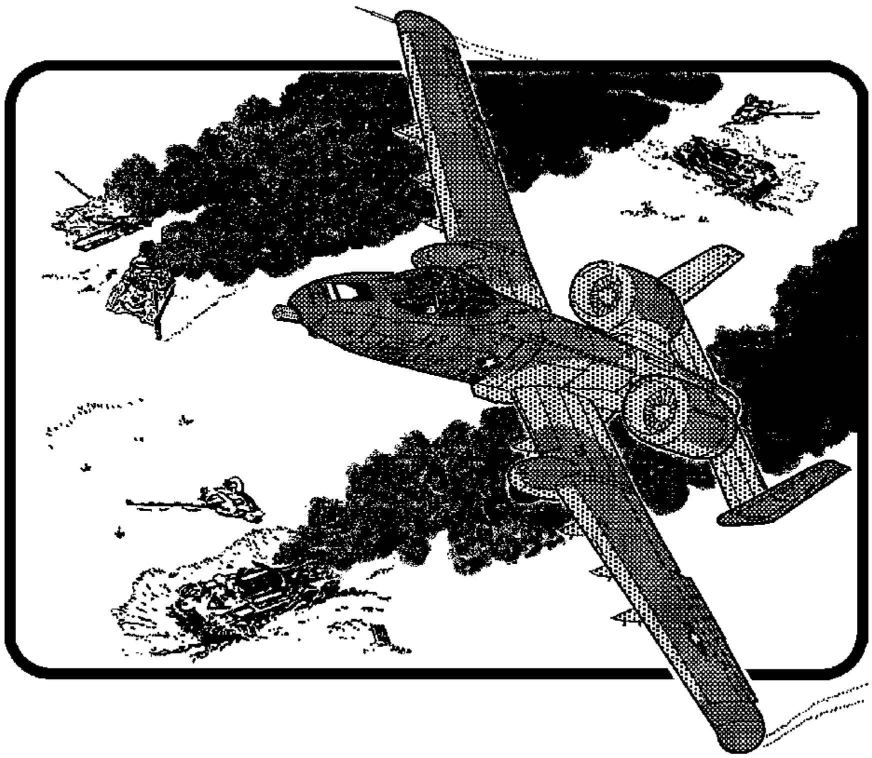
FLIGHT MANUAL

USAF SERIES A-10C AIRCRAFT



Prepared by Lockheed Martin
F04606-98-D-0002
Prepared by HEBCO, INC.
FA8202-09-A-0001

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10 NOVEMBER 2008 **CHANGE 10** **2 APRIL 2012**

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the change is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by shaded or screened areas, or by miniature pointing hands.

Dates of issue for original and changed pages are:

Original .... 0 ... 10 November 2008	Change .... 4 .... 1 January 2010	Change .... 8 .... 10 May 2011
Change .... 1 ...... 1 December 2008	Change .... 5 .... 1 May 2010	Change .... 9 ... 10 September 2011
Change .... 2 .... 10 May 2009	Change .... 6 ... 10 November 2010	Change .... 10 .... 2 April 2012
Change .... 3 .... 1 August 2009	Change .... 7 .... 15 March 2011	

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*Zero in this column indicates an original page.

STATUS PAGE

This page is published with each change package for Flight Manual Program publications. It contains a listing of the affected Flight Manual and its related Supplements and Checklists current on the date of this publication. However, formal Safety and Operational Supplements that are issued after the publication of this change, will contain a more current version of the status page. Changes or revisions that are in production are shown in parentheses.

AIRCREW FLIGHT MANUAL	BASIC DATE	CHANGE NO./	DATE
TO 1A-10C-1	10 November 2008	10	2 April 2012
TO 1A-10C-1-1 (Performance Data)	1 April 2007	3	10 November 2010

FLIGHT CREW CHECKLISTS	BASIC DATE	CHANGE NO./	DATE
TO 1A-10C-1CL-1	10 November 2008	9	10 September 2011

SAFETY AND OPERATIONAL SUPPLEMENTS	DATE	SHORT TITLE

INCORPORATED, RESCINDED, OR DELETED SUPPLEMENTS

TO 1A-10C-1SS-1	16 July 2007	Incorporated in this revision
TO 1A-10C-1S-2	13 August 2007	Not Used
TO 1A-10C-1SS-3	19 February 2008	Incorporated in this revision
TO 1A-10C-1S-4		Not Used
TO 1A-10C-1S-5	5 December 2008	Rescinded
TO 1A-10C-1S-6	5 December 2008	Rescinded
TO 1A-10C-1S-7	19 May 2009	Incorporated in Change 3
TO 1A-10C-1S-8	19 May 2009	Incorporated in Change 3
TO 1A-10C-1SS-9	17 December 2009	Rescinded
TO 1A-10C-1SS-10	8 February 2010	Rescinded
TO 1A-10C-1SS-11	10 March 2010	Incorporated in Change 5
TO 1A-10C-1SS-12	11 March 2011	Incorporated in Change 8

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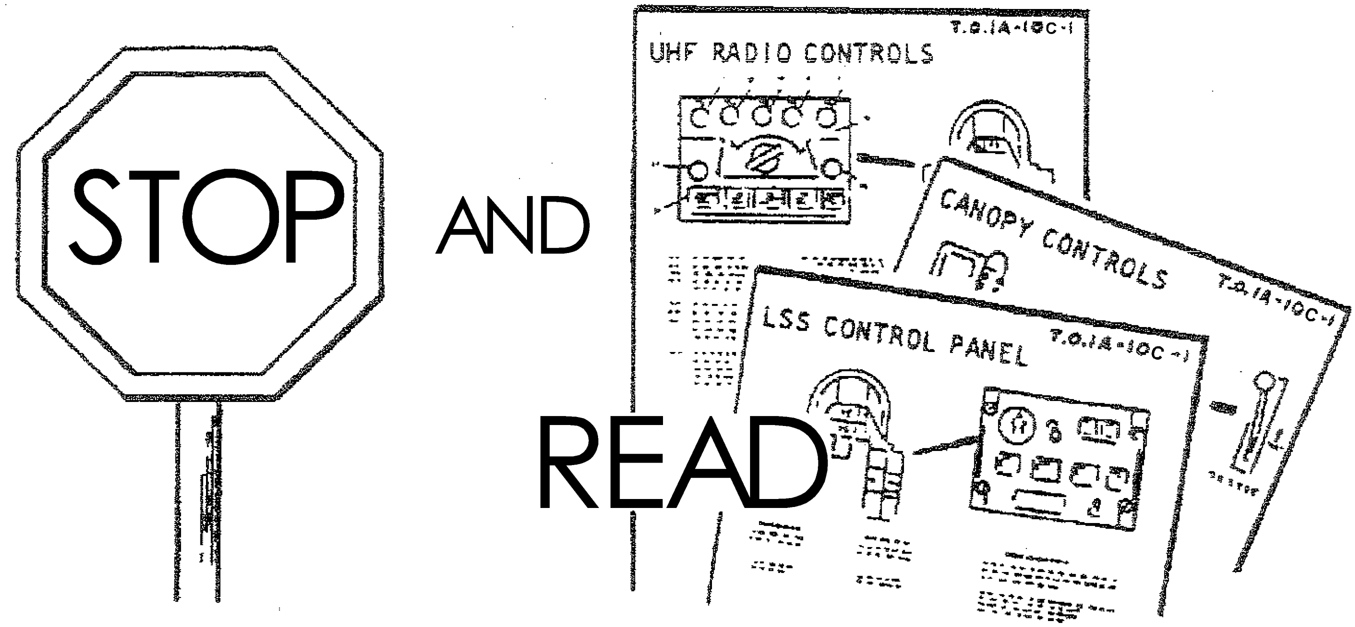
LIST OF ILLUSTRATIONS - Continued

LIST OF ILLUSTRATIONS - Continued

LIST OF ILLUSTRATIONS - Continued

INTRODUCTION



13467-2

Stop and Read

SCOPE.

This manual contains the necessary information for safe and efficient operation of your aircraft. These instructions provide you with a general knowledge of the aircraft and its characteristics and specific normal and emergency operating procedures. Your experience is recognized; therefore, basic flight principles are avoided. Instructions in this manual are for a pilot inexperienced in the operation of this aircraft. This manual provides the best possible operating instructions under most circumstances. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS.

The flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance must be obtained before any questionable operation, which is not specifically permitted in this manual, is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA.

Check the flight manual cover page, the title block of each safety and operational supplement, and all status pages contained in the flight manual or attached to formal safety and operational supplements, and checklists. Clear up all discrepancies before flight.

ARRANGEMENT.

The manual is divided into eight independent sections to simplify reading it straight through or using it as a reference manual.

SAFETY SUPPLEMENTS.

Information involving safety will be promptly forwarded to you in a safety supplement. Supplements covering loss of life will get to you within 48 hrs., and supplements covering serious damage to equipment within 10 days by mail. The cover page of the flight manual and the title block of each safety supplement should be checked to determine the effect they may have on existing supplements.

OPERATIONAL SUPPLEMENTS.

Information involving changes to operating procedures will be forwarded to you by operational supplements. The procedure for handling operational supplements is the same as for safety supplements.

CHECKLISTS.

The flight manual contains itemized procedures with necessary amplification. The checklist contains itemized procedures without the amplification. Primary line items in the flight manual and checklist are identical. If a formal safety or operational supplement affects your checklist, the affected checklist page will be attached to the supplement.

HOW TO GET PERSONAL COPIES.

Each pilot is entitled to personal copies of these flight manual, safety supplements, operational supplements, and checklists. The required quantities should be ordered before you need them to ensure their prompt receipt. Check with your publication distribution officer - it is his job to fulfill your TO requests. Basically, you must order the required quantities on the appropriate Numerical Index and Requirement Table (NIRT), TO 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crew immediately upon receipt.

FLIGHT MANUAL BINDERS.

Loose-leaf binders and sectionalized tabs are available for use with your manual. They are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Check with your supply personnel for assistance in procuring these items.

DEFINITION OF WORDS "SHALL," "WILL," "SHOULD," "MAY".

The words "shall" and "will" indicate a mandatory requirement. The word "should" indicates a non-mandatory desire or preferred method of accomplishment. The word "may" indicates an acceptable or suggested means of accomplishment.

WARNINGS, CAUTIONS, AND NOTES.

The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING

Operating procedures, techniques, etc., which will result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

NOTE

An operating procedure, technique, etc., which is considered essential to emphasize.

YOUR RESPONSIBILITY - TO LET US KNOW.

Every effort is made to keep the flight manual current. Review conferences with operation personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. We cannot correct an error unless we know of its existence.

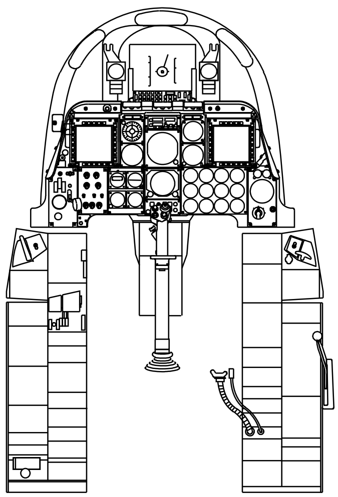
In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the flight manual program are welcomed. These should be forwarded through your command channels on AF Form 847 to: OO-ALC/GHAEJ, 6057 Box Elder Lane, Hill AFB, UT 84056.

COCKPIT CONFIGURATION LAYOUT.

Cockpit configurations as depicted within this book are TYPICAL layouts. For specific cockpit configuration layout based on aircraft modifications, refer to the following figures:

NOTE

Shadowed boxes indicate the changes from the previous configuration.



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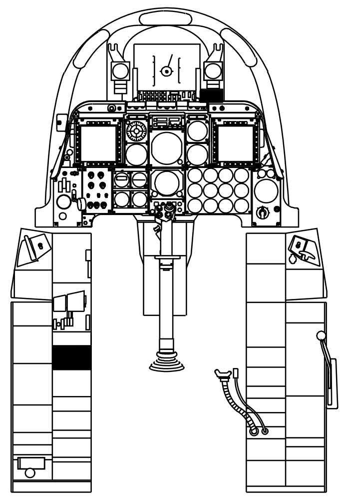

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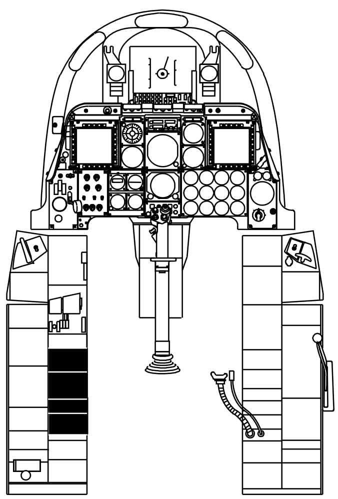

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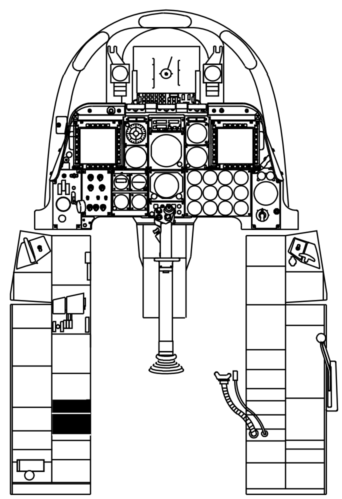

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ARC2102-059-C1

Cockpit Configurations

TIME COMPLIANCE TECHNICAL ORDERS

The following list of Time Compliance Technical Orders (TCTOs) affect the technical content of this manual. Only current TCTOs are listed. A TCTO is deleted from this list when rescinded, superseded, or fully incorporated.

TCTO NUMBER	TITLE	DATE
1A-10-1327	Lightweight Airborne Recovery System	24 Feb 93
1A-10-1460	Installation of AN/ARS-6, Light Weight Airborne Recovery System	1 Nov 2001
1A-10-1496	Installation of Precision Engagement Block Cycle Update, A-10C Aircraft	23 Oct 2006
1A-10-1503	Replacement of RT-1063C/APX-101V (154000), IFF Receiver/Transmitter with RT-1867B/APX-119 281A317-1 (4079100-0508) IFF Receiver/Transmitter in the A-10C Aircraft	16 Mar 2006
1A-10C-504	Installation of Turbine Engine Monitoring System/Airborne Data Recorder (TEMS/ADR) A-10C Aircraft	20 Dec 2007
1A-10C-509	Installation of Enhanced Position Location Reporting System (EPLRS)/Situation Awareness Data Link (SADL), AN/ARC-210 Secure Line of Sight (SLOS)/Beyond Line of Sight (BLOS) on A-10C Aircraft	10 Nov 08
1A-10C-510	Installation of 1553 Bus Connection to RT-1867B/APX-119 IFF Receiver/Transmitter on A-10C Aircraft	31 Aug 08
1A-10C-513	Installation of Integrated ARC-210 on A-10C Aircraft	1 May 09
1A-10C-514	Installation of the Mass Memory on A-10C Aircraft	1 May 09
1A-10C-515	Installation of Improved Data Modem (IDM) on A-10C Aircraft	1 May 09
1A-10C-516	Installation of Operational Flight Programs (OFP) for Suite 5 on A-10C Aircraft	1 May 09
1A-10C-517	Installation of AN/AAR-47 Missile Warning Set (MWS) A(V)2 A-10C Aircraft	1 Jun 09
1A-10C-518	Installation of Onboard Oxygen Generating System (OBOGS) on A-10C Aircraft	1 Aug 09
1A-10C-525	Installation of Suite 6 Software and Hardware, A-10C Aircraft	1 Jun 10
1A-10C-526	Installation of Second AN/ARC-210 (ARC-210-2) Radio System on A-10C Aircraft	31 Dec 10

TCTO NUMBER	TITLE	DATE
1A-10C-531	Installation of Suite 7A Software on A-10C Aircraft	1 Jun 11

EFFECTIVITY PAGE

Effectivity Number	Description
131	Aircraft modified by TO 1A-10-1327 and TO 1A-10-1327C, or 1A-10-1460, 1A-10-1460C, and 1A-10-1460D (LARS).
148	Aircraft modified by TCTO 1A-10-1509 (DVADR).
152	Aircraft modified by TO 1A-10C-504 (TEMS/ADR).
509	Aircraft modified by TO 1A-10C-509 (SADL/SLOS/BLOS).
510	Aircraft modified by TO 1A-10C-510 (CNS-ATM)
513	Aircraft modified by TO 1A-10C-513 (ARC-210 Integration)
514	Aircraft modified by TO 1A-10C-514 (Mass Memory Ethernet Kit)
515	Aircraft modified by TO 1A-10C-515 (Improved Data Modem)
517	Aircraft modified by TO 1A-10C-517 (AAR-47)
518	Aircraft modified by TO 1A-10C-518 (OBOGS)
526	Aircraft modified by TO 1A-10C-526 (ARC-210-2)
531	Aircraft modified by TO 1A-10C-531 (Suite 7A)

SECTION I

DESCRIPTION AND OPERATION

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THE AIRCRAFT.

The A-10C is a single-seat close air support aircraft (Figure 1-1 and Figure 1-2) manufactured by Fairchild Republic Company, Farmingdale, New York. The aircraft is a low wing, low tail configuration with two high bypass turbo fan engines installed in nacelles mounted on pylons extending from the aft fuselage. Twin vertical stabilizers are mounted on the outboard tips of the horizontal tail. The tricycle forward retracting landing gear is equipped with an anti-skid system and a steerable nose-wheel. The nose gear is installed to the right of the aircraft centerline to permit near-centerline gunfire. The nose gear retracts fully into the fuselage while the main gears partially retract into streamlined pods in the wings. A titanium armor installation surrounds the cockpit. The primary flight controls are equipped with artificial feel devices to simulate aerodynamic feel. The elevator and aileron controls split into redundant separate systems before leaving the armor protection. The controls are powered by two independent hydraulic systems, either of which has the capability of controlling the airplane. If both hydraulic systems fail, the airplane can be flown using a manual reversion system. The ailerons consist of an upper and lower panel that become speed brakes when opened. The windshield front panel is resistant to small arms fire and birds. The windshield side panels are resistant to spall spray caused by penetrations. The fuselage fuel cell sumps are self-sealing on the lower portion and tear resistant on the upper portion. The cells are filled with a flexible foam to prevent fuel tank explosion. Single point ground refueling and engine feed lines are self-sealing. The escape system provides a zero/zero capability (zero velocity and zero pitch and roll attitude) either with the canopy removed or through the canopy. The armament system includes a high fire rate 30mm seven-barrel gun with ammunition stored in a drum. A variety of stores is carried on 11 pylons, four on each wing and three on the fuselage.

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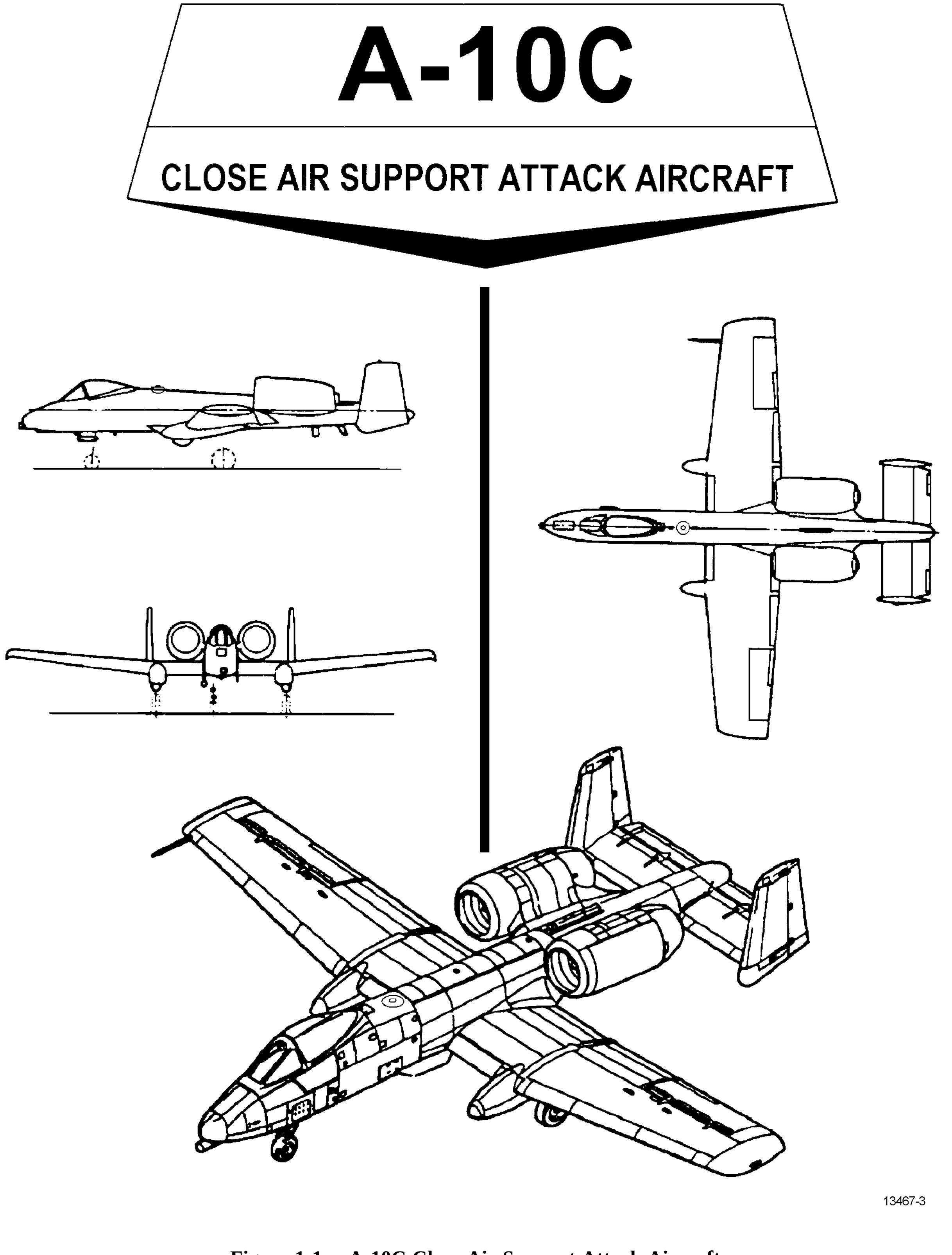

Figure 1-1.   A-10C Close Air Support Attack Aircraft

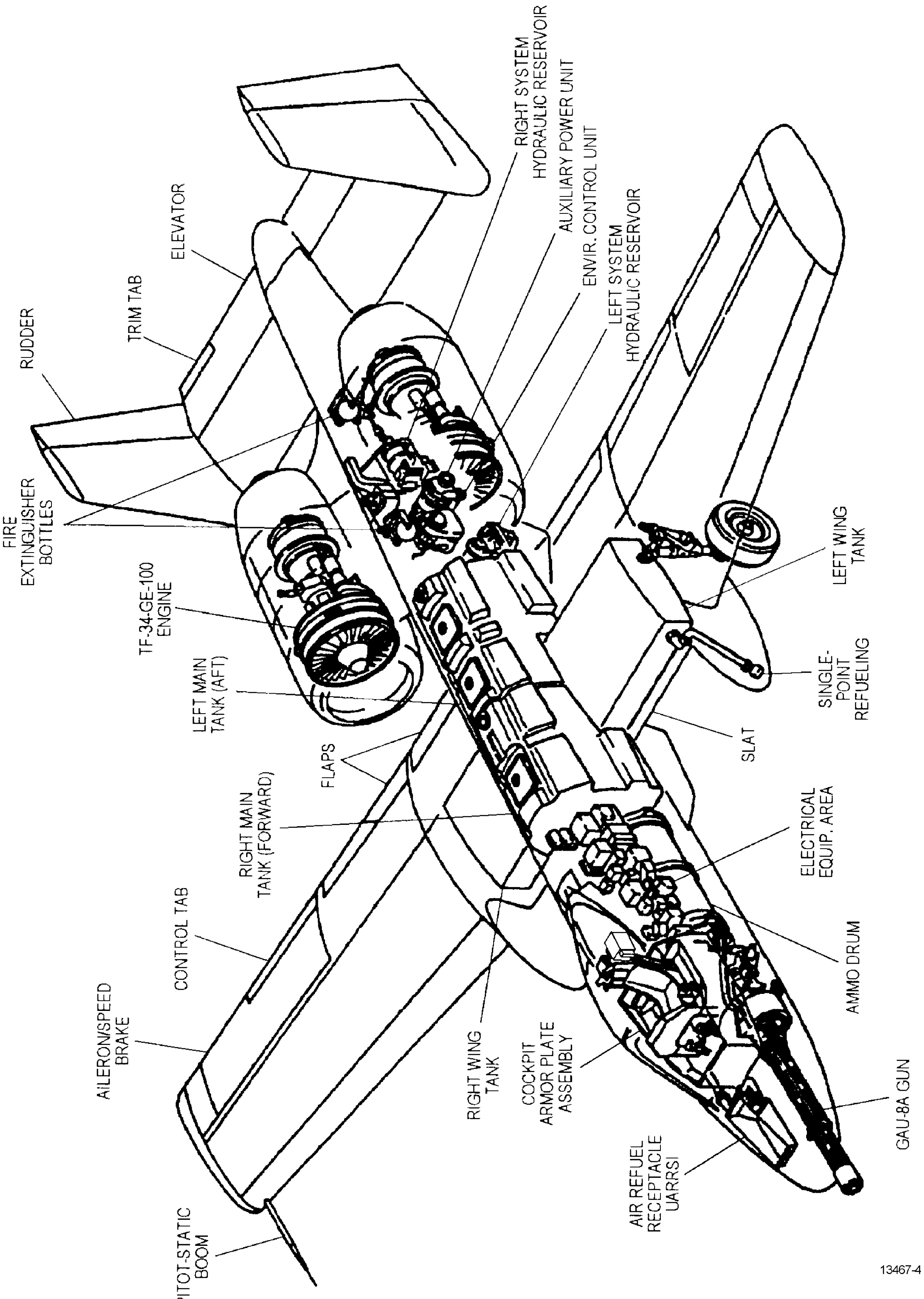

Figure 1-2. A-10C Aircraft Equipment Location

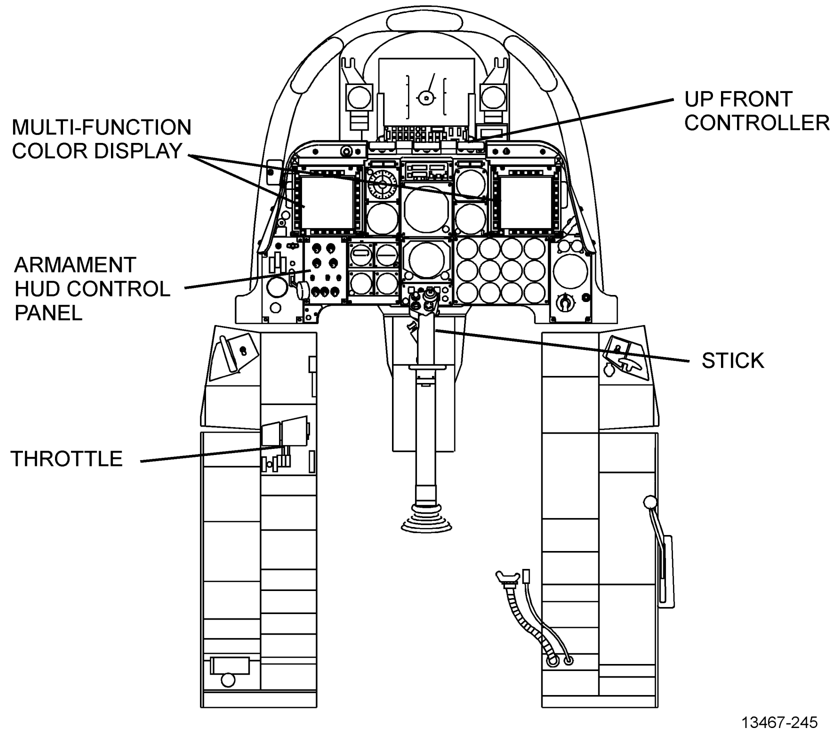

Figure 1-3. PE Cockpit

AIRCRAFT DIMENSIONS.

The overall dimensions of the aircraft under normal conditions of gross weight, tire and strut inflation are as follows:

Overall length	53 ft 4 in.
Wing span	57 ft 6 in.
Horizontal tail span	18 ft 10 in.
Height to top of fin	14 ft 8 in.
Wheel base	17 ft 9 in.
Wheel tread	17 ft 3 in.

Refer to Section II for minimum turning radius and ground clearance dimensions.

AIRCRAFT GROSS WEIGHT.

The aircraft operating weight is approximately 28,000 pounds. This weight includes pilot, gun (full of ammunition), 11 empty pylons, oil, windshield wash, and unusable fuel. Refer to Section V for gross weight limits. For specific aircraft weight, refer to Weight and Balance Data, TO 1-1B-40.

ENGINES.

The aircraft is powered by two General Electric TF34-GE-100A engines (Figure 1-4). Sea level, standard day, static thrust for an installed engine is approximately 8,900 pounds at maximum thrust. The engine incorporates a single-stage bypass fan and a 14-stage axial flow compressor. Bypass air produces over 85% of engine thrust. Therefore, engine fan speed is the best indication of thrust. Variable inlet guide vanes automatically modulate throughout the engine operating range. An accessory gearbox drives a hydraulic pump, fuel pump and fuel control, oil pump, and an electric generator. An air bleed for aircraft systems is provided. Engine acceleration time from IDLE to MAX thrust will be approximately 10 seconds at sea level. Engine thrust droop results from differential expansion of the engine turbines and casings during transients from low to high thrust operation. The duration and extent of the thrust droop is dependent upon the rate/range of throttle movement.

ENGINE THRUST DROOP.

During turbine engine operation, heat expands the rotating and stationary components to normal operating dimensions and clearances. Engine thrust droop results from differential expansion of the engine turbines and casings during transients from low to high thrust operation. The duration and extent of the thrust droop is dependent upon the rate/range of throttle movement. Thrust droop is decreased if the engines have been idling for a period of time. Thrust droop is further decreased if the engines have been run up before takeoff. An example of the worst condition would be a scramble takeoff where takeoff is accomplished shortly after engine start. Maximum droop occurs approximately 10 seconds after the throttle is advanced from IDLE to MAX. After approximately 4 minutes of operation at MAX thrust, power output returns to normal. Elimination of thrust droop can be observed on the engine fan speed indicator. Thrust will increase as fan speed increases.

ENGINE CORE LOCK.

Engine core lock results when an engine is shut down because its rotating and stationary components do not contract at the same rates due to differences in material properties and differing exposure to cooling air. Temporary losses of clearances occur until the temperatures of the components reach equilibrium. Because of this characteristic, turbine engine shutdown procedures include operation for several minutes at a lower power setting to permit internal temperatures and clearances to stabilize.

Flameouts at high power and/or high altitude conditions produce even greater thermal distress because internal temperatures are hottest at high power settings and the external air is colder at high altitudes. A sudden engine shutdown under these conditions will cause increased thermal shock exacerbating the loss of component clearance and alignment. Once core rotation stops, binding will prevent core rotation from resuming during subsequent APU assisted restart attempts.

CAUTION

Engine failure at high power and/or high altitude may result in engine core lock, preventing subsequent restart.

TURBINE ENGINE MONITORING SYSTEM (TEMS).

The TEMS provides a means for supporting the on-condition maintenance concept for the TF34-100A engine installed on the A-10C aircraft. Information is provided to the system Electronic Processor Unit (EPU) automatically whenever the engine is operated. If any engine operation limit is exceeded, or when the TEMS DATA switch is depressed, a frame of data is recorded. An overlimits event will be displayed on the umbilical display unit (UDU), located in the nosewheel well. This data is provided in code form in order to determine engine condition. The codes are provided in Figure 2-9.

152 The IEPU is a form, fit, function replacement on select A-10C aircraft for the existing EPU. The IEPU monitors engine and airframe mounted sensors and monitors, via the aircraft 1553 Avionics #1 data bus, aircraft performance parameters. The IEPU OFP determines and records aircraft structural events that are retrieved for later analysis. Engine related performance and event data is retrieved and processed by the Comprehensive Engine and Trending Acquisition Database (CETADS) system. The IEPU converts analog engine and airframe data into digital data and processes MIL-STD-1553B Inertial Navigation System data, compares the processed data with established software limits, identifies out-of-limit parameters, and records structural loads as software requirements dictate. Recent enhancements to the IEPU OFP provides MIL-STD-1553B Remote Terminal (RT) capabilities for uploading OFP releases from the Data Transfer Cartridge (DTC) and downloading ADR collected data to the Portable Automated Test Station (PATS) ground support equipment and software. PATS is a portable computer system that utilizes an Operational Test Program (OTP) that provides diagnostic and support software for the A10 Avionics and Weapons computer systems. In addition, the IEPU provides RS-232 Serial communication to a commercial off the shelf (COTS) laptop computer system operating in a Windows XP or newer operating system (OS). The OS operates an A-10 unique set of programs that provides operational and diagnostic support for the TEMS and ADR system.

152 The IEPU equipped aircraft displays IEPU status annunciations on the CDU ("IEPU FULL", "IEPU FAIL", and "IEPU NOT READY"). These annunciate the TEMS/ADR system status and the need to download TEMS and ADR data prior to next flight. IEPU system information is accessed from page 3 of the CDU SYS page. Access to MX Pages allows viewing of the 1553 communication, execute Built In Test (BIT), initiation of ADR data download, and viewing of the IEPU health status.

ENGINE OIL SYSTEM.

The engine oil system is self-contained and all the oil supplied is used for lubrication and cooling. Usable oil capacity is 5.6 quarts, and maximum oil consumption is 0.5 pint/hr. An oil pressure indicator and an independent light on the caution light panel monitor oil pressure of each engine. Oil grade and specification to be used are covered in the servicing diagram, Figure 1-204.

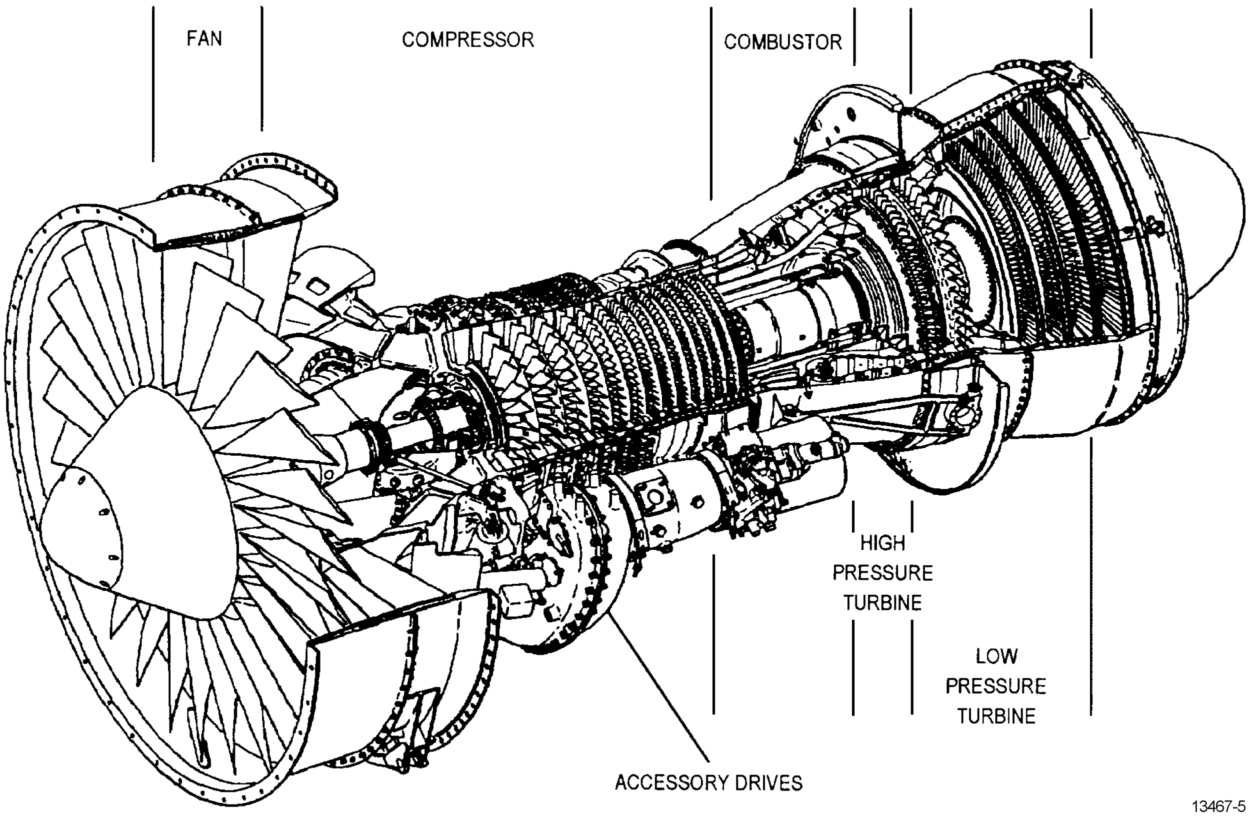

Figure 1-4. TF-34 Engine

Engine Oil Pressure Indicators.

An oil pressure indicator (41, Figure FO-1) is provided for each engine. They indicate oil pressure in psi, and are powered by the 26 V instrument transformer bus.

Engine Oil Pressure Caution Lights.

An engine oil pressure caution light (independent of the oil pressure indicators) (Figure 1-158), on the caution light panel, is provided for each engine. The lights are placarded L-ENG OIL PRESS and R-ENG OIL PRESS and will come on if the pressure is less than 34 to 39 psi.

ENGINE FUEL SYSTEM.

The engine fuel system (Figure FO-4) provides fuel required for combustion, controls engine variable geometry actuation, and provides engine oil cooling. Fuel is supplied to the engine fuel pumps, where it is pressurized and directed to the fuel control. From the fuel control, metered fuel passes through the engine oil cooler to the distribution valve.

Engine Fuel Control.

The engine fuel control (Figure FO-4) is a hydro-mechanical type which modulates fuel flow to maintain a constant core speed as called for by throttle position. An electrical control unit regulates fuel flow at maximum power to maintain Interstage Turbine Temperature (ITT) limits. In the event of an ITT control unit electrical failure, the system can be disabled with the engine fuel flow switch. In this mode, the engine will be speed-controlled throughout the entire range of operation, requiring monitoring to prevent engine over-temperature.

The fuel control also prevents compressor discharge pressure from exceeding structural limits of the compressor. At sea level static, this limit is normally encountered at maximum power when engine inlet temperature is 0°F or colder. The limit can also be encountered on a standard day at sea level above approximately 330 knots. In this case it will not be possible to obtain rated ITT. The fuel control automatically controls the position of the compressor inlet guide vanes and the first five stator stages to prevent compressor stall. The engine fuel control does not require electrical power, but the ITT control unit is powered by the auxiliary AC essential bus.

Engine Fuel Flow Indicators.

A fuel flow indicator (43, Figure FO-1) is provided for each engine. They show fuel flow in pounds per hour. The indicators are powered by the right AC bus.

Engine Fuel Flow Switches.

Two engine fuel flow switches (Figure 1-5), one for each engine, are located on the engine control panel. These switches are placarded ENG FUEL FLOW L and R and each switch has two positions, placarded NORM and OVERRIDE. With the switch in NORM, the engine fuel flow is scheduled on the basis of throttle position and limited to the maximum power trim setting by the ITT amplifier.

OVERRIDE will provide up to a 15% increase in thrust and an increase in SERC of up to 300 FPM. The amount of additional SERC is at a maximum between 15°C and 35°C for low takeoff speeds. If the engine core temperature is limited by the ITT amplifier limitation then the additional thrust will be available due to OVERRIDE beginning at an ambient temperature of about -10°C.

Takeoff Speed (KIAS)	Temperature (°C)					
	-10	0	10	20	30	40
130	0	90	140	225	280	250
140	0	90	135	215	265	235
150	0	105	150	230	275	240
160	5	100	150	220	265	230

Fuel Flow Override Increase in SERC (Feet per Minute) at 6,000 ft. MSL

Takeoff Speed (KIAS)	Temperature (°C)					
	-10	0	10	20	30	40
130	15	145	255	295	250	225
140	5	125	245	275	230	215
150	0	115	260	290	240	225
160	0	105	250	275	230	215

Fuel Flow Override Increase in SERC (Feet per Minute) at Sea Level

In the event of an ITT amplifier failure, the temperature control system can be deactivated by placing the appropriate switch in OVERRIDE. When this is done, the engine will be speed controlled by the throttle position alone. Selection of OVERRIDE when ITT is below the maximum power trim setting will produce no change in engine operation. The engine fuel flow switches are powered by the auxiliary AC essential bus.

THROTTLES.

A mechanical throttle (Figure 1-5) controls the operation of each engine. Each throttle has three positive stop positions placarded OFF, IDLE, and MAX. To move from OFF to IDLE, the throttle is raised and moved forward to the first stop position. To move to OFF the throttle is retarded to the IDLE stop, then raised and moved aft to OFF. The DC fuel pump is energized when either throttle is positioned to IDLE or above, and there is no pressure from the left main tank boost pump. When the throttle is at IDLE stop, the following actions take place provided engine core rpm is below 56%, and electrical power and an air source are available.

- ATS valve opens causing the ENG START CYCLE light to come on
- ECS shutoff valve closes
- Both engine bleed air shutoff valves open
- Ignition is supplied to the engine
- Fuel is supplied when engine rotation starts
- DC fuel pump is energized if there is no fuel pressure from the left main tank boost pump.

Engine speed is normally controlled by the throttle. Under certain flight conditions, the engine fuel control overrides the throttle to protect the engine from overtemperature, overpressure, and compressor stall.

Switches and controls located on the throttle are shown on Figure 1-5. The speed brake switch, along with engine throttles and the landing gear handle are coupled with logic in the Integrated Flight and Fire Control Computer (IFFCC) which enables the speed brake warning functions. The speed brake warning is a function of throttle position, not engine rpm. The Speed Brake Warning System logic is enabled based on the throttle at MAX.

Throttle Friction Control.

Throttle friction for both throttles is controlled by means of the friction control located on the throttle quadrant (Figure 1-5).

ENGINE IGNITION SYSTEM.

Ignition is supplied by two ignitors in each engine. The ignition ignitors are powered by the AC essential bus and actuated by DC powered relays. The ignitor circuits are protected by two ENG IGNITOR (L/R-1 and L/R-2) circuit breakers. Each circuit breaker protects an ignition circuit in each engine; therefore, to totally disable the ignition circuit to one engine, it is necessary to open both circuit breakers.

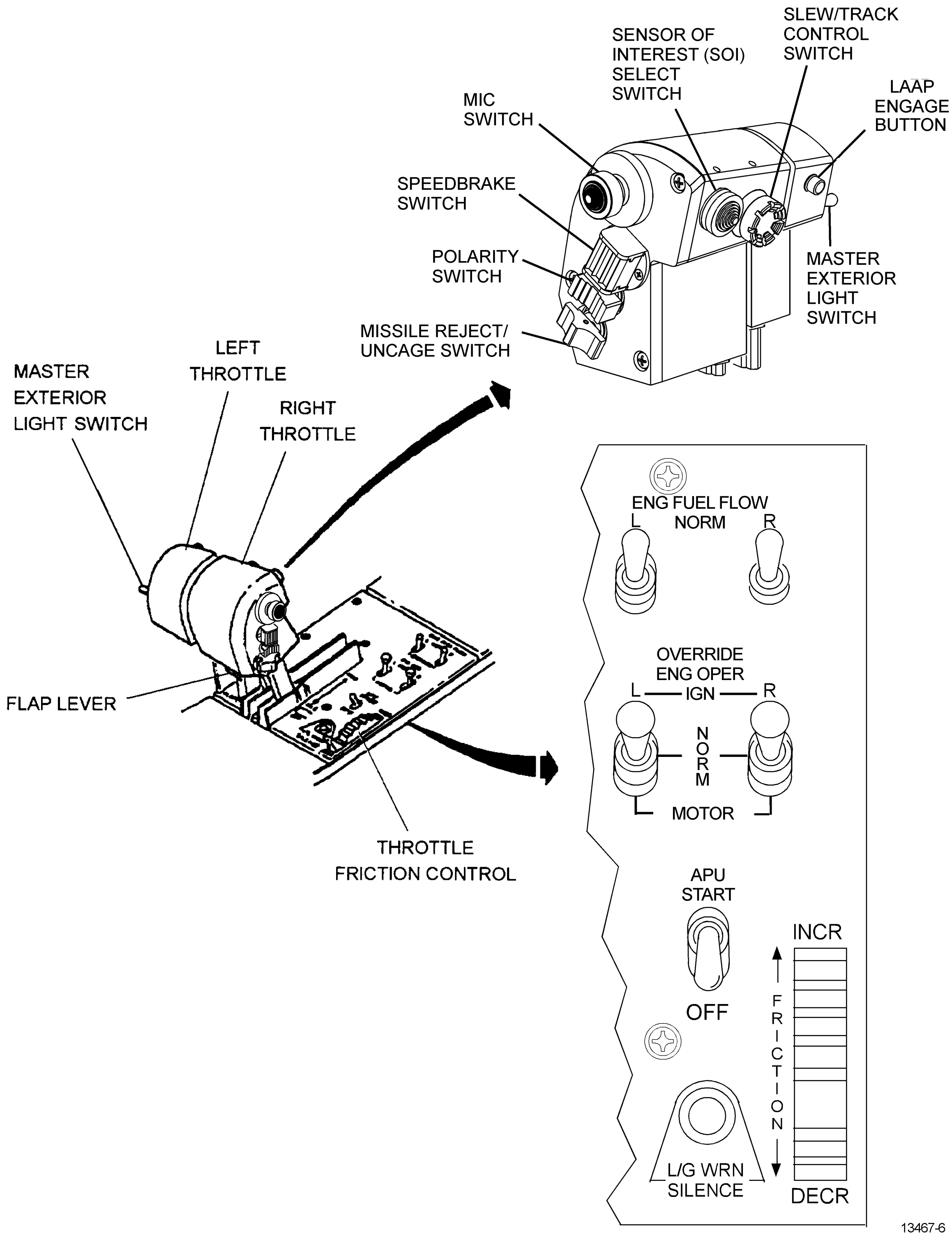

Figure 1-5. Throttle Quadrant Including Engine Control Panel

Engine Ignition Controls.

The ignition system is actuated through throttle position (IDLE, core rpm below 56%) or by the IGN function of the engine operate switch (Figure 1-5). Ignition is also provided to both engines while the gun trigger is depressed to the second detent or during activation of stall warning chopped tone, and continues for 1 second after gun trigger release or termination of stall warning.

BLEED AIR SYSTEM.

Bleed air from each engine, from the Auxiliary Power Unit (APU), and from a ground receptacle are routed to a common manifold (Figure 1-6). The bleed air supply system furnishes air for the following:

- Engine starter system
- Environment control system
- Windshield rain removal and wash system
- Canopy de-fog system
- Canopy seal
- Anti-g suit
- External tank pressurization.
- Onboard Oxygen Generating System (OBOGS) 518

Each of the above systems is described in detail under the respective sections. Bleed air supplied from the engine is controlled by a shutoff valve adjacent to each engine. Both valves are opened or closed simultaneously by the bleed air switch. Bleed air from the APU and/or external source is not controlled by the bleed air switch.

A temperature sensor is provided adjacent to the manifold for bleed air leak detection. The bleed air leak detection system is powered by the auxiliary AC essential bus.

Bleed Air Switch.

The bleed air switch (Figure 1-30), on the environment panel, is a two-position lever-locked switch, with positions placarded BLEED AIR and OFF. BLEED AIR opens both engine bleed air valves and will provide bleed air to any bleed air system selected by appropriate controls. OFF closes the valves except during engine start. The switch is powered by the DC essential bus.

WARNING

518 Turning BLEED AIR switch to OFF without the APU running will cause OBOGS to stop producing oxygen-enriched air. Depending on altitude, regulator setting, and breathing rate, OBOGS will provide 2 to 10 minutes of reserve (2 to 3 minutes if 100% is selected).

Fire Detect/Bleed Air Leak Test Button.

The fire detect/bleed air leak test button (Figure 1-158) is a push-to-test button, placarded FIRE DETECT BLEED AIR LEAK TEST. Depressing the switch checks the bleed air sensors, fire detection sensors, and associated warning lights. If the circuit is intact, the BLEED AIR LEAK caution light on the caution light panel and the MASTER CAUTION, FIRE (L ENG) PULL, FIRE (R ENG) PULL, FIRE (APU) PULL lights will come on. The test button is powered by the auxiliary DC essential bus.

Bleed Air Leak Caution Light.

The bleed air lines upstream from the precooler are monitored by a leak detection system. Upon sensing a temperature of 400°F or more, the system responds by activating the BLEED AIR LEAK caution light on the caution light panel (Figure 1-158).

ENGINE OPERATE SWITCHES.

Two engine operate switches (Figure 1-5), one for each engine, are located on the engine control panel. These switches are placarded ENG OPER L and R, with each switch having three positions placarded IGN, NORM, and MOTOR. The switches are springloaded from IGN to NORM positions. The switches must be raised when moving between NORM and MOTOR. Momentarily placing the engine operate switch to IGN will supply ignition to the corresponding engine for 30 seconds, regardless of the throttle position or engine core rpm. NORM is used during normal engine operation and for engine starting. MOTOR is used for air-purging of excessive fuel, cooling the engine, or manual starting. When the switch is moved to MOTOR, the following actions are accomplished, provided electrical power and an air source are available:

- ATS valve opens, causing the ENG START CYCLE light to come on
- ECS shutoff valve closes
- Both engine bleed air shutoff valves open.

NOTE

The throttle must be in OFF or IDLE in order to motor the engine.

The engine operate switches are powered by the DC essential bus.

ENGINE START SYSTEM.

Engine starts require low pressure air to power the ATS unit mounted on the engine. Air may be obtained from the following sources:

- APU
- Crossbleed air from an operating engine (85% core rpm minimum)
- External pneumatic power unit.

Air from any of these sources (Figure 1-6) is ducted through the bleed air shutoff valves to the ATS valves.

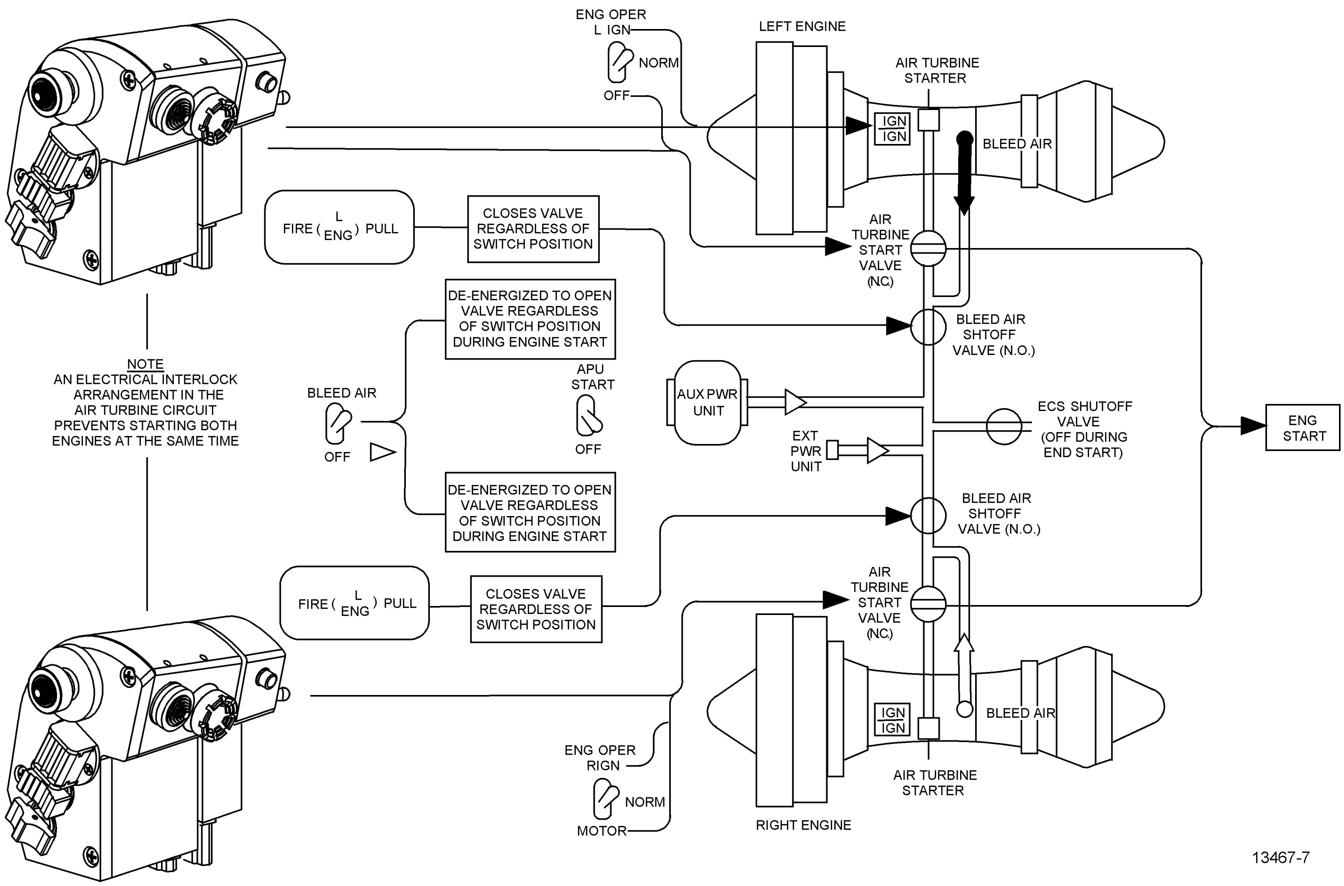

Figure 1-6. Engine Start System

The throttle must be in IDLE to obtain starter-assisted engine starts. If the throttle is moved above IDLE, the bleed air to the starter will be shut off. The electrical circuits controlling the two ATS valves are interlocked to prevent both valves being opened simultaneously. Insufficient air pressure is available to start both engines simultaneously. After the start is complete, the ATS valve is closed (automatically or manually) to prevent overspeeding of the ATS and the ENG START CYCLE light goes off. During the start, the ECS is shut off automatically to eliminate bleed air drain during the start cycle. Electrical power for starting the engines may be obtained from an external AC power unit, aircraft battery and inverter, or APU generator.

The aircraft contains an automatic engine starting system. Automatic engine starting will be initiated when the throttle is moved to IDLE, provided the engine core rpm is below 56%, electrical power and an air source are available. The following events occur:

- ATS valve opens, allowing engine to rotate
- ECS shutoff valve closes
- Both engine bleed air shutoff valves open
- Ignition is supplied for a minimum of 30 seconds
- Fuel is provided after engine starts to rotate
- ATS valve closes within 10 seconds after engine reaches 56% core rpm
- ECS valve opens within 10 seconds after engine reaches 56% core rpm
- Both engine bleed air shutoff valves close after engine reaches 56% core rpm.

Engine Start Cycle Caution Light.

The engine start cycle caution light (Figure 1-158), on the caution light panel, is placarded ENG START CYCLE and will come on whenever the ATS valve is opened.

Engine Core Speed Indicators.

An engine core speed indicator (40, Figure FO-1) is provided for each engine. The indicators display the speed of the compressor core in percent rpm. The system is independent of the aircraft electrical system except for instrument lighting purposes.

NOTE

Failure of the engine core speed indicator may cause activation of the start system when the associated throttle is brought to idle.

Engine Fan Speed Indicators.

A fan speed indicator (42, Figure FO-1) is provided for each engine. The indicators display the fan speed in percent rpm and are powered by the auxiliary AC essential bus.

Engine Interstage Turbine Temperature Indicators.

An ITT indicator (39, Figure FO-1) is provided for each engine. The indicators display the temperature between the high and low pressure turbine sections in degrees C. A warning flag placarded OFF will appear in a window to indicate power loss. The indicators are powered by the auxiliary AC essential bus.

Engine Overheat Caution Lights.

An engine overheat caution light (Figure 1-158), on the caution light panel, is provided for each engine. The lights are placarded L ENG HOT and R ENG HOT and will come on if the ITT indicator exceeds 880°C.

FIRE EXTINGUISHING SYSTEM.

The fire extinguishing system is available to both engines and to the APU compartment/area. It consists of fire extinguishing agent stored in two independently actuated pressurized bottles located in the fuselage. Either bottle may be discharged to either engine nacelle or the APU compartment area by pulling the appropriate fire handle and actuating the discharge switch. The system is de-armed by pushing the appropriate fire handle in. The fire extinguishing system operates on battery bus power. However, fire detection and fuel/bleed air shutoff functions require auxiliary DC essential and DC essential bus power.

NOTE

Extinguishing agent will not put out an engine core fire, as it does not discharge into the core.

Extinguishing agent should be used if the fire light comes on, indicating fire in the engine nacelle.

FIRE DETECTION SYSTEM.

Fire detection is provided for in both engine nacelles, and in the APU area by continuous temperature-sensitive elements. The fire warning light in the applicable left or right engine fire handle will come on when the entire sensor element detects fire/overheat condition. The APU fire and overheat system is similar to the engine fire system except that the warning light is in the APU fire handle. The APU fire detection includes coverage for the adjacent hydraulic, fuel, electrical, flight control and environmental control subsystems equipment installed in the fuselage between the fuel tank aft bulkhead and the frame aft of the APU. Both systems are powered by the auxiliary DC essential bus. The system is tested by depressing the FIRE DETECT BLEED AIR LEAK TEST button. Refer to Bleed Air System for test function description.

CAUTION

The fire detection system may not detect an engine nacelle or APU compartment fire/overheat condition of high intensity and short duration.

ENGINE AND APU FIRE HANDLES.

Three T-shaped handles (8, 9, 10, Figure FO-1) located in the glareshield on the instrument panel provide fire warning for the engine nacelles or the APU when illuminated. The handles are labeled FIRE (L ENG) PULL, FIRE (APU) PULL, and FIRE (R ENG) PULL.

NOTE

Night Vision Imaging System (NVIS) T-handle bulbs may not be noticed when illuminated under bright lighting conditions. If any indications of a fire exist under bright lighting conditions, depress the FIRE DETECT BLEED AIR LEAK TEST button to determine if the fire light is illuminated.

The lights are powered by the auxiliary DC essential bus.

Engine Fire.

By pulling the appropriate fire handle, the following actions are initiated:

- Arms the fire extinguishing system to respective engine nacelle (provided battery bus power is available)
- Cuts off fuel flow to the affected engine by closing the motorized main fuel shutoff valve (provided DC essential bus power is available)
- Closes the bleed air shutoff valve from the affected engine (provided DC essential bus power is available).

APU Fire.

By pulling the appropriate fire handle, the following actions are initiated:

- Arms fire extinguishing system to APU compartment (provided battery bus power is available)
- Cuts off fuel flow to the APU fuel control by closing the solenoid operated APU fuel shutoff valve (provided DC essential bus power is available).

CAUTION

With more than one fire handle pulled, the fire extinguishing agent will be discharged into all areas selected. The quantity then discharged into the areas selected may be insufficient to extinguish that fire.

FIRE EXTINGUISHING AGENT DISCHARGE SWITCH.

The fire extinguishing agent discharge switch (11, Figure FO-1), placarded FIRE EXTING DISCH, is located on the right side of the glareshield above the instrument panel. The switch has three unlabeled positions. When the switch is moved either left or right, an extinguisher bottle is discharged and agent is directed to the engine or APU compartment selected by the fire handle. The switch will remain in the selected position to indicate which extinguisher bottle was discharged. The fire extinguisher bottles can be armed and discharged if battery bus power is available.

AUXILIARY POWER UNIT.

The APU (Figure 1-2) supplies air for engine starting, drives a generator for aircraft electrical power, and can drive a hydraulic pump to pressurize the aircraft hydraulic system for ground maintenance functions. The unit is located in the aft fuselage between the two engines and is provided with safety devices that shut down the APU when certain operating limitations are exceeded. Fuel for APU starting is supplied by the DC fuel pump. APU controls are powered by the DC essential bus.

APU SWITCH.

The APU switch (Figure 1-5) is a two-position switch, placarded START and OFF. START supplies DC essential bus power to operate the DC fuel pump, open the APU fuel valve, enable APU compartment-cooling, energize the APU starter, and enable the APU Exhaust Gas Temperature (EGT) gauge and APU tachometer.

APU GENERATOR SWITCH.

The APU generator switch (Figure 1-10), placarded APU GEN, is a two-position lever-lock switch, placarded PWR and OFF/RESET. When in PWR, the APU generator powers an APU hydraulic pump cooling fan and electrical system busses, provided the busses are not powered by an engine generator or external power. If the APU generator drops off the line, the system may be reset by momentarily placing the APU generator switch in OFF/RESET and returning it to PWR.

APU GENERATOR CAUTION LIGHT.

The APU generator caution light (Figure 1-158) is placarded APU GEN. The light is inoperative when the APU generator switch is in OFF/RESET.

With the APU generator switch in PWR, light on indicates:

- Inoperable generator
- APU operating with generator switch in PWR but aircraft busses being powered by either external power or engine generator(s).

CAUTION

During this mode of operation, the caution light is on regardless of APU generator output. There is no indication that the APU hydraulic pump cooling fan is not receiving power. Overheating of the pump could result from extended operation with a failed APU generator either in the air or on the ground.

- APU not running and generator switch in PWR.

NOTE

> If the APU is operating with the APU generator switch in PWR, and the APU is shut down and restarted, confirmation should be made that the APU generator is operating. If not, the APU generator switch should be momentarily positioned to OFF/RESET, then back to PWR.

Light off indicates:

- APU powering aircraft busses.

APU TACHOMETER.

The APU tachometer (44, Figure FO-1) indicates the speed of the APU in percent rpm. DC essential bus power is required to enable the APU tachometer through the APU switch.

APU TEMPERATURE INDICATOR.

The APU temperature indicator (45, Figure FO-1) indicates the turbine discharge temperature in degrees C. The indicator is powered by the DC essential bus and is enabled by the APU switch.

APU OPERATION.

APU starting requires only DC essential bus power and a fuel supply. When the APU start switch is positioned to START, the DC essential bus power operates the DC fuel pump, opens the APU fuel valve (aft fuel tank mounted), and energizes the APU starter. The starter rotates the APU compressor and, at approximately 10% rpm, the APU fuel valve (APU mounted) opens; and fuel and ignition are supplied to the APU. Acceleration of the APU continues until at approximately 60% rpm the starter disengages. At approximately 95% rpm, ignition is terminated and the APU is self-sustaining. APU speed and turbine discharge temperature are automatically controlled. The APU will stabilize at 100 (±3)% rpm in approximately 60 seconds. APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet) and the APU output will be sufficient to start an engine up to an altitude of 10,000 feet (most cases up to 15,000 feet). The APU will operate during negative g conditions for approximately 10 seconds.

APU will automatically shut down during ground operation if the APU EGT is excessive, APU rpm is excessive, APU oil pressure is low, or the APU fire warning system is activated. APU over-temperature shutdown is disabled during ground engine start cycle plus 4 seconds. Once the weight is off the landing gear, the APU will automatically shut down only if the rpm is excessive or the oil pressure is low.

AIRCRAFT FUEL SYSTEM.

The aircraft fuel supply system (Figure FO-4) consists of two internal wing tanks (left and right wing), and two tandem-mounted fuselage tanks (left main-aft and right main-forward). Up to three external (pylon) tanks may be carried, one tank on each wing and one on the fuselage centerline. The fuel supply system operates as two independent subsystems, with the left wing and left main tank feeding the left engine and the APU, and the right wing and right main tank feeding the right engine. The two subsystems can be interconnected by opening cross feed valves (controlled by a single switch in the cockpit) to allow pressurized fuel flow to both engines and the APU from either subsystem. In addition, the two main tanks can be interconnected by opening a tank gate valve. The main tank sumps are self-sealing bladder cells. Each self-sealing sump contains approximately 900 pounds of fuel. The upper portion of the cells are tear-resistant bladders. The wing tanks are integral within the wing structure and do not have bladder cells. Foam is incorporated in each tank to prevent fuel tank explosion.

WARNING

External fuel tanks do not contain explosive suppression material. In the event of a weapons impact, there is a very high likelihood of tank explosion; therefore the use of the 600 gallon fuel tank is restricted to no threat environments.

Boost pressure is provided by boost pumps located in each main and wing tank. A DC boost pump, located in the left main tank is used during engine and APU starts if the left main boost pump is inoperative. For negative g flight, collector tanks will supply the engine with sufficient fuel for 10 seconds operation at MAX power.

CAUTION

In the event an engine is suction feeding due to a failed boost pump, the affected engine will suction-feed from the failed tank for all power settings above idle, up to 10,000 feet (most cases, 20,000 feet).

The wing tank boost pumps operate at a higher pressure and override the main tank boost pumps to automatically empty the wing tanks first.

The main fuel feed lines to each engine, and to the APU, contain shutoff valves that are controlled by the fire handles. These shutoff valves allow for isolation of the fuel feed system outside the tanks.

Fuel in the external tanks is transferred to the main or wing tanks by pressure from the bleed air system. Fuel tank sump drains are provided for each tank. Drain valves can be opened externally. Fuel cavity drains are provided in each main tank and protrude through the aircraft skin to give an indication of fuel cell leaks.

The wing tanks have a dual-level refueling shutoff valve. The valve closes when the tank is full and will not reopen unless the fuel level drops approximately 400 pounds or a time delay of approximately 10 minutes has elapsed.

Wing tanks cannot be topped off unless the fuel level is below approximately 1,590 pounds or the fuel manifold has been unpressurized for the time delay period. This assures even fuel transfer from the external tanks. Therefore, during fuel transfer from the external tanks, the wing tank fuel quantity will drop approximately 400 pounds, then will fill to capacity. This cycling repeats until external fuel is depleted. During air refueling the wing tanks will not accept fuel unless the fuel level in the tanks has dropped approximately 400 pounds or the time delay has elapsed. The total fuel on board after refueling could be approximately 800 pounds less than total capacity.

If total fuel capacity is required during air refueling, the external tanks can be turned off sufficiently prior to refueling so that the wing tank quantity drops approximately 400 pounds or the time delay has elapsed. A single-point ground refueling receptacle, located in the leading edge of the left landing gear nacelle permits refueling of each internal and external tank. A control panel, adjacent to the refueling receptacle, provides a means of ground checking the refueling valve shutoff. The panel also permits selective loading of any internal or external tank. Auxiliary DC essential bus power is required for refueling valve checks, selective tank filling, and to enable external tank filling. When the tanks are full, the refueling valves are closed by a float valve in each tank. Fuel tank capacities are shown in the usable fuel quantity data table, Figure 1-7. Fuel grade and specification to be used are covered in the servicing diagram, Figure 1-204.

Figure 1-7. Usable Fuel Quantity Data

		POUNDS		
FUEL TANK	GALLONS*	JP-4 (NOTE 1)	JP-5 (NOTE 2)	JP-8 (NOTE 3)
L. MAIN	507	3,244	3,446	3,396
R. MAIN	507	3,244	3,446	3,396
L. WING	308	1,974	2,097	2,066
R. WING	308	1,974	2,097	2,066
TOTAL INTERNAL	1,630	10,436	11,086	10,924
CENTERLINE	600	3,840	4,080	4,020
L. WING	600	3,840	4,080	4,020
R. WING	600	3,840	4,080	4,020
TOTAL EXTERNAL	1,800	11,520	12,240	12,060
TOTAL FUEL	3,430	21,956	23,326	22,984

NOTES:

1. FUEL WEIGHT BASED ON 6.4 LBS PER GALLON
2. FUEL WEIGHT BASED ON 6.8 LBS PER GALLON
3. FUEL WEIGHT BASED ON 6.7 LBS PER GALLON

* FUEL QUANTITIES BASED ON FUEL TEMPERATURE OF 60 (±40)°F (TO 42B1-1-14)

In addition to features previously mentioned, the following survivability features are built into the fuel system:

- Single-point ground refueling and engine feed lines outside the tanks are self-sealing to prevent leaks
- The fuel feed shutoff valves are inside the tanks to keep the engine feed lines dry after shutoff
- Fill disable switches are provided to close off damaged internal tank when air refueling.

FUEL QUANTITY INDICATOR AND SELECTOR.

The fuel quantity indicator (Figure 1-8) is provided to monitor the total fuel remaining, or fuel remaining in selected tanks. The digital readout is a continuous display of total fuel remaining including external, in pounds. The pointer display provides an indication of fuel in specific tanks as selected by the rotary selector switch. The left and right pointers indicate for the left and right fuel systems, respectively. The fuel indicator is powered by the auxiliary AC essential bus. Positions of the selector are as follows:

INT	-	Left and right pointers indicate total internal fuel for respective system
MAIN	-	Left and right pointers indicate fuel in the respective main tank
WING	-	Left and right pointers indicate fuel in the respective wing tank
EXT WING	-	Left and right pointers indicate fuel in the respective wing pylon tank
EXT CTR	-	Left pointer indicates fuel in the fuselage pylon tank. The right pointer will zero.
TEST IND	-	When the TEST IND button is depressed, the left and right pointers will read 3,000 (±300) pounds each and the digital readout will read 6,000 (±400) pounds. When the TEST IND switch is released, the pointers and digital readout will return to the normal positions.

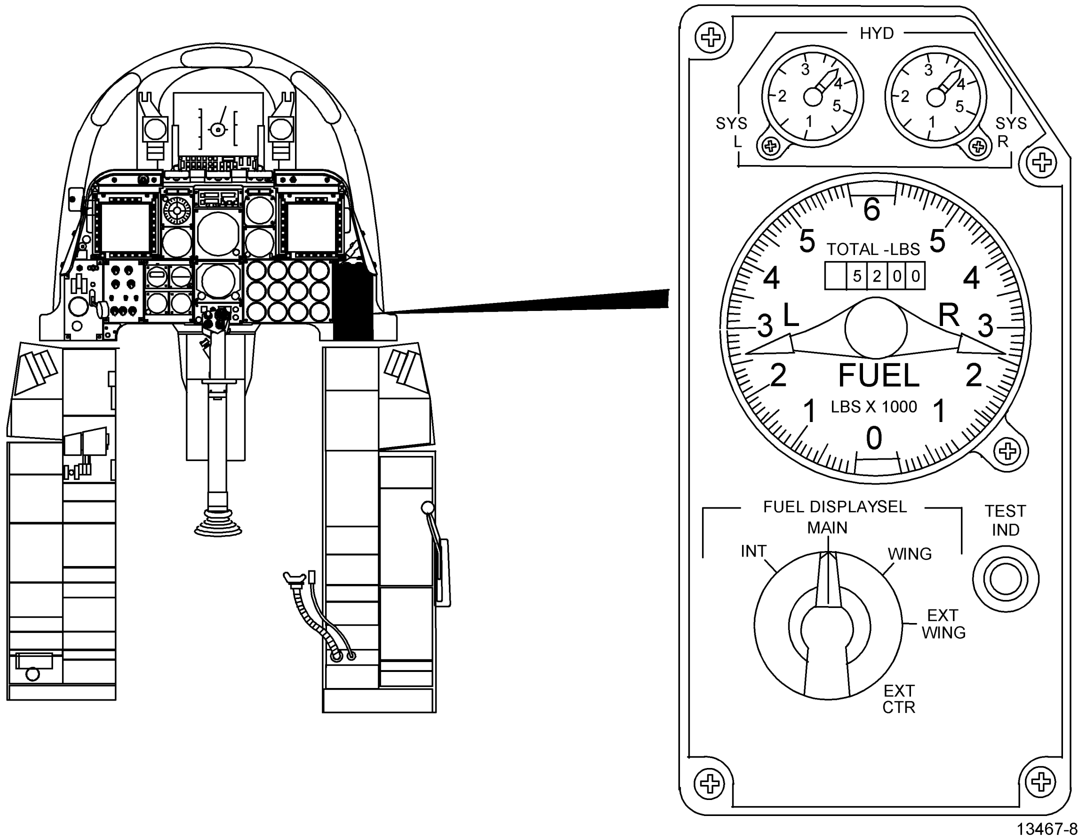

Figure 1-8. Fuel Quantity Indicator and Selector

NOTE

The fuel quantity totalizer and left wing tank will read high if the left main tank quantity is below approximately 500 pounds and a considerable quantity of fuel remains in the other tanks. The percent error will decrease as the fuel remaining decreases.

LEFT AND RIGHT MAIN FUEL LOW CAUTION LIGHTS.

The left and right main fuel low caution lights (Figure 1-158) are placarded L-MAIN FUEL LOW and R-MAIN FUEL LOW, respectively. When the L-MAIN FUEL LOW or the R-MAIN FUEL LOW caution light comes on, fuel quantity in the respective main tank is approximately 500 pounds. This condition can be verified at the fuel quantity indicator. The lights operate independently of the gauge.

LEFT AND RIGHT FUEL PRESSURE CAUTION LIGHTS.

The left and right fuel pressure caution lights (Figure 1-158), placarded L-FUEL PRESS and R-FUEL PRESS, respectively, come on to indicate low fuel pressure at the engine fuel feed lines.

FUEL TANK VENT SYSTEM.

Each main and wing tank (Figure FO-4) is vented independently to a vent collector tank located in the left main tank. Vent lines from the wing tanks also serve as return lines for any fuel collected in the vent tank. Fuel in the vent tank is vented to the wing tanks or overboard.

Foam is installed in the vent tank to provide fire and lightning protection for the fuel system.

MAIN TANK BOOST PUMP SWITCHES.

Two main tank boost pump switches (Figure 1-9) are placarded BOOST PUMPS, with positions L-MAIN-R and OFF. L and R supply left and right AC bus power to the respective main boost pump. OFF deactivates the respective boost pump.

LEFT AND RIGHT MAIN BOOST PUMP CAUTION LIGHTS.

The left and right main fuel tank boost pump caution lights (Figure 1-158), placarded L-MAIN PUMP and R-MAIN PUMP, respectively, come on when fuel pressure at the outlet of the indicated fuel boost pump is low.

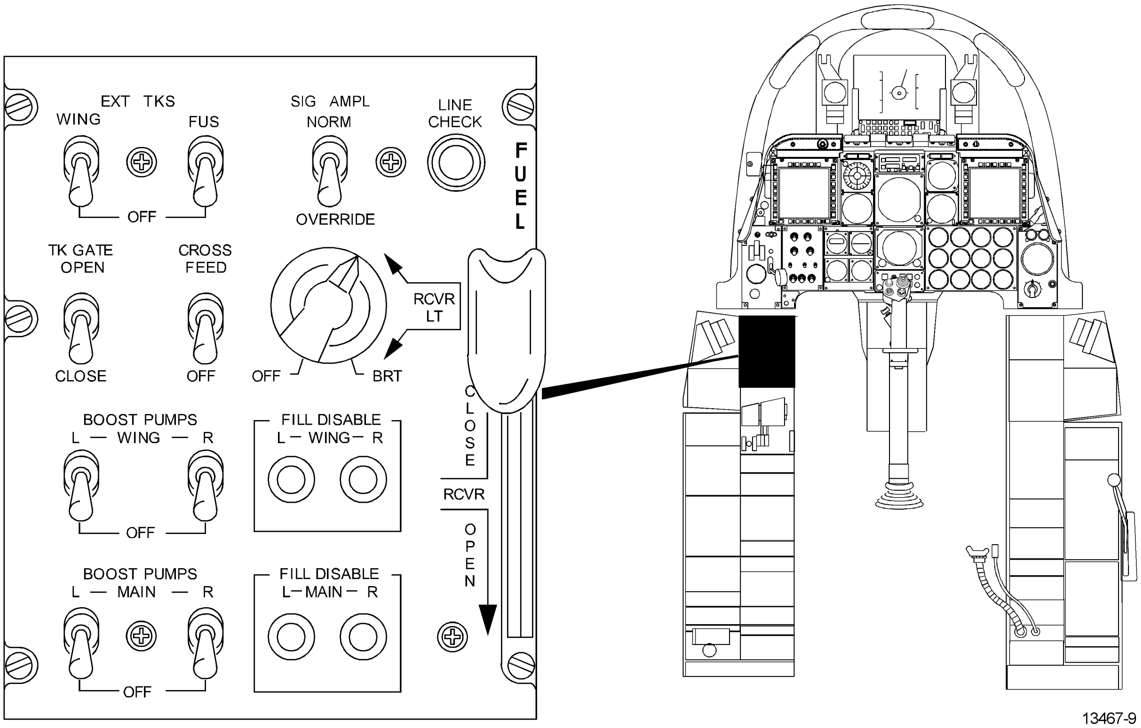

Figure 1-9. Fuel System Control Panel

WING TANK BOOST PUMP SWITCHES.

Two wing tank boost pump switches (Figure 1-9) are placarded BOOST PUMPS, with positions L-WING-R and OFF. L and R supply left and right AC bus power to the respective wing boost pump. The pumps will automatically stop when the tank float switch senses an empty tank. OFF deactivates the respective boost pump.

LEFT AND RIGHT WING BOOST PUMP CAUTION LIGHTS.

The left and right wing main fuel tank boost pump caution lights (Figure 1-158), placarded L-MAIN PUMP and R-MAIN PUMP, respectively, come on when fuel pressure at the outlet of the indicated fuel boost pump is low.

EXTERNAL TANK SWITCHES.

Two external tank switches (Figure 1-9), placarded EXT TKS, are located on the fuel system control panel. One switch is placarded WING and OFF, the other is placarded FUS and OFF. WING and FUS supply auxiliary DC essential bus power to pressurize the external tanks, using bleed air. The fuel is transferred to the main and wing tanks until external tanks are empty or not transferring fuel. However, if the left or right main tank low level switch is actuated due to low fuel, external fuel, if available, will automatically transfer to the main tanks even if the external tank switches are OFF.

CROSSFEED SWITCH.

The crossfeed switch (Figure 1-9) is a two-position switch, placarded CROSSFEED and OFF. In CROSSFEED, two auxiliary DC essential bus-powered valves open to allow any operating boost pump to feed both engines. When OFF, the valves close, isolating the two fuel systems.

TANK GATE SWITCH.

The tank gate switch (Figure 1-9) is a two-position switch placarded TK GATE, with positions placarded OPEN and CLOSE. OPEN supplies auxiliary DC essential bus power to open the gate valve linking the left and right main fuel tanks. Fuel in the main tanks will be below the tank gate valve and will not transfer in level flight when the fuel level is below 1,300 pounds in each main tank. The sump fuel will not flow between the tanks. CLOSE closes the gate valve.

If the tank gate is used in other than relatively level unaccelerated flight, monitor fuel quantity for excessively large cg shift due to fuel transfer. Fuel venting may be noted in this situation.

LEFT AND RIGHT TANKS UNEQUAL CAUTION LIGHT.

The left and right fuel tanks unequal caution light (Figure 1-158), placarded L-R TKS UNEQUAL, comes on when an imbalance of 750 (±250) pounds in fuel quantity is sensed between the two main fuselage tanks. This condition may be verified by checking the fuel quantity indicator.

FUEL SYSTEM OPERATION.

Normally, fuel system operation is automatic except for selecting external tanks. The main and wing tank boost pump switches are positioned to L and R. The tank gate switch is positioned to CLOSE. The crossfeed switch is positioned to OFF. With the battery switch in PWR, the DC boost pump is energized when the APU switch is positioned to START, or either throttle is forward of OFF, and the left main boost pump is inoperative. The DC boost pump supplies fuel to the APU and the left engine. When the left and right AC busses are energized, the left and right main and wing tank boost pumps will operate. External tank fuel will be transferred to the internal tanks as fuel is used, until the external tanks are empty. The wing boost pumps will then supply the respective engine with fuel until the wing tanks are empty, at which time the wing tank boost pumps will automatically shut off. The main boost pumps will then supply the respective engine with the remainder of the fuel in the airplane. In the event of a wing tank boost pump failure, wing tank fuel should gravity feed to its associated main tank, depending on aircraft attitude and fuel levels. Gravity feed of a full wing tank will not occur until the main tank fuel level is below approximately 600 pounds. Gravity feed of a partially full wing tank will occur at lower main tank fuel level. Dual check valve units in each wing tank gravity feed line prevent reverse fuel flow from the main tanks back into the wing tanks.

When carrying external tanks, fuel sequencing will be as follows:

- External wing tanks
- External fuselage tank
- Internal fuel.

WARNING

Feeding fuel simultaneously from external wing and fuselage tanks will cause cg shift that may exceed allowable limits.

AIR REFUELING SYSTEM.

The aircraft can be refueled in-flight from a boom-equipped tanker. The aircraft is equipped with a UARRSI (Figure 1-2), located forward of the cockpit. By positioning a lever on the fuel system control panel, a flush (slipway) door, powered by the right hydraulic system, folds down into the fuselage to expose the air refueling receptacle and to provide a slipway to guide the tanker boom. When the tanker boom is inserted in the receptacle, the nozzle latch rollers are actuated to the locked position, and refueling transfer commences. Fuel transfer through the receptacle is distributed to the main and wing tanks, and to external tanks if carried. Through use of the fill disable switches, located on the fuel system control panel, fuel can be prevented from entering any specific internal tank suspected of being damaged. As each tank is filled, float-operated fuel shutoff valves within each tank will close, preventing overfill. When refueling is completed, the disconnect of the boom nozzle will normally be accomplished by a signal from the tanker or by the receiver depressing the air refuel disconnect/reset button (Nosewheel Steering (NWS) button) on the control stick grip. An automatic disconnect will occur when both receiver and tanker systems are completely operational and one of the following occurs:

- Excessive fuel pressure occurs in the receiver fuel manifold
- Tanker boom limits are exceeded (see Section VIII).

Refer to Section VIII for air refueling procedures.

If the right hydraulic system fails, the spring loaded slipway door will open when the air refuel control is set to OPEN. The time for the door to open sufficiently to expose the receptacle is improved by reducing speed and will occur within approximately 3 minutes at 150 Knots Indicated Airspeed (KIAS).

Aerodynamic effect will open the door sufficiently to expose the receptacle lights and permit emergency "stiff boom" refueling with or without a READY light. Applying boom nozzle pressure on the slipway door should result in the slipway door downlock engaging and a READY light. The LATCHED and DISCONNECT light will not come on in this case.

Air Refuel Control.

The air refuel control (Figure 1-9) is placarded RCVR, with two positions OPEN and CLOSE. When OPEN, the left DC bus powers the signal amplifier and the hydraulic control valve. The slipway door opens and the READY light (6, Figure FO-1) comes on when the door is locked open. When the boom nozzle is inserted on the receptacle, the latches close, securing the nozzle, the LATCHED light comes on and the READY light goes off. After the nozzle is removed from the receptacle, the DISCONNECT light comes on. CLOSE directs the hydraulic pressure to close the slipway door and the DISCONNECT light goes off. In the event of loss of hydraulic pressure, OPEN releases a lock allowing the spring-loaded slipway door to open.

NOTE

Fuel in external tanks will not feed with the air refueling control in OPEN.

Fill Disable Switches.

The four fill disable switches (Figure 1-9) are similar to circuit breakers. Two switches are placarded L-MAIN-R and two are placarded L-WING-R. If a main or wing tank is damaged, pulling up the respective switch prevents that tank from being refueled. The switches are powered by the left DC bus.

Signal Amplifier Switch.

The signal amplifier switch (Figure 1-9) provides for emergency refueling. The switch is placarded SIG AMPL and has two positions placarded NORM and OVERRIDE. During the normal refueling cycle, the switch remains in NORM, and air refueling system power and actuating signals function automatically. If a failure occurs, fuel may not be transferred or the tanker boom may not stay latched. In this case, the override switch should be placed to OVERRIDE. In OVERRIDE no signals are passed to the tanker, and the tanker cannot actuate the disconnect cycle.

Disconnect is accomplished by depressing the air refuel disconnect/reset button on the control stick. The signal amplifier switch is powered by the left DC bus.

Air Refuel Disconnect/Reset.

An air refuel disconnect/reset function is provided via the NWS button on the control stick grip (Figure 1-13). Setting the air refuel control to OPEN activates this button. With the boom nozzle inserted in the receptacle and the LATCHED light on, a disconnect may be accomplished by depressing the NWS button. If the DISCONNECT light is on, depressing the air refuel NWS button recycles the air refueling system to the ready mode.

Air Refuel Line Check Button.

The air refuel line check button (Figure 1-9) is a pushbutton switch placarded LINE CHECK. Momentarily depressing this button checks the air refuel manifold integrity through a time delay relay. When the button is depressed before operating the air refuel door, the internal tank shutoff valves are closed and the air purge valve opens, allowing air to pressurize the air refueling manifold. One engine must be operating at 85% core rpm or the APU must be operating to supply sufficient air pressure for the READY light to come on if the manifold is intact. The READY light (6, Figure FO-1) comes on when the air pressure builds up in the manifold (approximately 1 to 3 minutes). The light will go off approximately 3 minutes after the line check button is depressed. However, the light will remain on as long as the wing tanks are above approximately 1625 pounds.

WARNING

- If the READY light does not come on within 3 minutes after the line check button is depressed, the refuel manifold is damaged. In this case, air refueling should not be attempted unless absolutely necessary.
- If the manifold is damaged, air refueling may cause inflowing fuel to be discharged overboard into the fuselage of the aircraft and result in fire and explosion.

Air Refuel Status Lights.

The air refueling status indication is provided by three lights (6, Figure FO-1) placarded READY, LATCHED, and DISCONNECT. When the slipway door is fully open and locked, the READY light comes on. Once the tanker boom nozzle and the refueling receptacle are connected, the READY light goes out and the LATCHED light comes on. When the boom nozzle and refueling receptacle are disconnected for any reason, the LATCHED light will go out and the DISCONNECT light will come on. The DISCONNECT light will remain on until the air refuel control is moved to CLOSE or the air refuel disconnect/reset button (NWS button) is depressed.

Air Refueling Exterior and Receptacle Lighting.

Aircraft lighting is provided for night refueling operations. These systems are described under Lighting System, Exterior Lights, in this section.

Air Refueling Intercommunications.

With some tankers, secure interphone is available between aircraft when the signal amplifier switch is in NORM and the LATCHED light is on. The intercom system is powered by the DC essential bus. Controls for this system are described under INTERCOM control panel in this section.

ELECTRICAL POWER SYSTEM.

The electrical power system (Figure FO-5) provides DC and AC power. The battery produces DC to power essential equipment which provides the aircraft with a limited instrument flight capability. The instrument inverter changes DC from the battery to AC to power essential equipment. DC produced by the battery is adequate to start the APU. When operational, the APU generator produces sufficient AC and DC (through the converters) to power all electrical busses indefinitely, provided electrical load is minimized. With engines running, two generators take over production of AC and DC (through the converters) to power all busses. External power can also be used to power all AC and DC (through the converters) busses. The cockpit battery switch is shown in Figure 1-10 and the cockpit circuit breaker panel is shown in Figure 1-11.

DC SYSTEM.

Battery.

The battery is a 24-volt nickel cadmium type, and supplies DC to the battery, DC essential, and auxiliary DC essential busses.

External Battery Switch.

The external battery switch (Figure 1-204, sheet 2) has two positions placarded ON and OFF. The switch is spring-loaded to ON, and is held in OFF by a safety pin. When ON, this switch allows the battery to supply DC to the battery bus.

Battery Bus.

The battery bus (Figure FO-5) provides DC so that certain equipment can be operated when the cockpit battery switch is off.

Cockpit Battery Switch.

The cockpit battery switch (Figure 1-10), placarded BATTERY, has two positions placarded PWR and OFF. The switch is located on the electrical power control panel. PWR allows the battery to supply the DC essential and auxiliary DC essential busses, and OFF disconnects the battery from the busses.

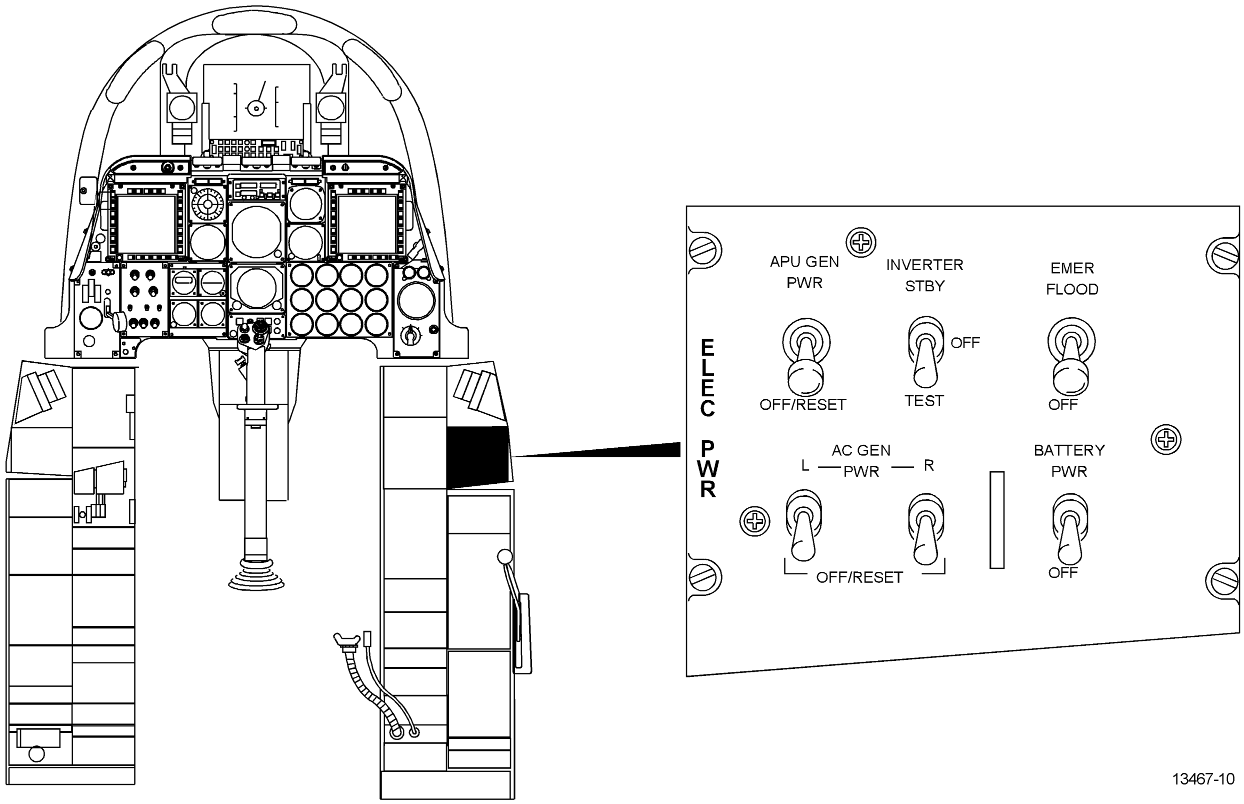

Figure 1-10. Electrical Power Control Panel

DC Essential Bus and Auxiliary DC Essential Bus.

The DC essential and auxiliary DC essential busses (Figure FO-5) provide DC to equipment deemed essential for flight.

Converter Caution Lights.

The left and right converter caution lights (Figure 1-158) are placarded L CONV and R CONV. These lights will come on to indicate failure of the associated converter. If either generator fails, the associated converter caution light should remain off, indicating automatic transfer to the operating system.

Left DC Bus, Right DC Bus and DC Armament Bus.

The left DC, right DC, and DC armament busses (Figure FO-5) provide DC to mission support equipment and those systems not deemed essential to flight.

AC SYSTEM.

Instrument Inverter.

The instrument inverter changes DC supplied by the battery to AC. AC from the inverter powers the AC essential, auxiliary AC essential, and AC instrument transformer busses, when the left and right AC busses are not energized or the instrument inverter switch is set to TEST.

AC Essential Bus, Auxiliary AC Essential Bus, and AC Instrument Transformer Bus.

The AC essential, auxiliary AC essential, and instrument transformer busses power equipment (Figure FO-5) needed for starting engines and operating engine instruments.

Instrument Inverter Switch.

The instrument inverter switch (Figure 1-10), placarded INVERTER, has three positions placarded STBY, OFF, and TEST (spring-loaded to OFF). STBY allows the APU generator, external source, inverter, or engine driven generators to supply AC to the busses to which they are connected. OFF shuts off AC from all sources to the AC essential bus, and causes the INST INV caution light to come on. TEST cuts off AC to the AC essential bus from all sources except the inverter, permitting a test of the inverter’s ability to operate properly. Proper inverter operation is indicated by the INST INV caution light remaining off or coming on momentarily. The INST INV light will remain on if the inverter fails to operate.

Instrument Inverter Caution Light.

The instrument inverter caution light (Figure 1-158), placarded INST INV, comes on to indicate that the AC essential, auxiliary AC essential, and AC instrument transformer busses are not receiving AC power.

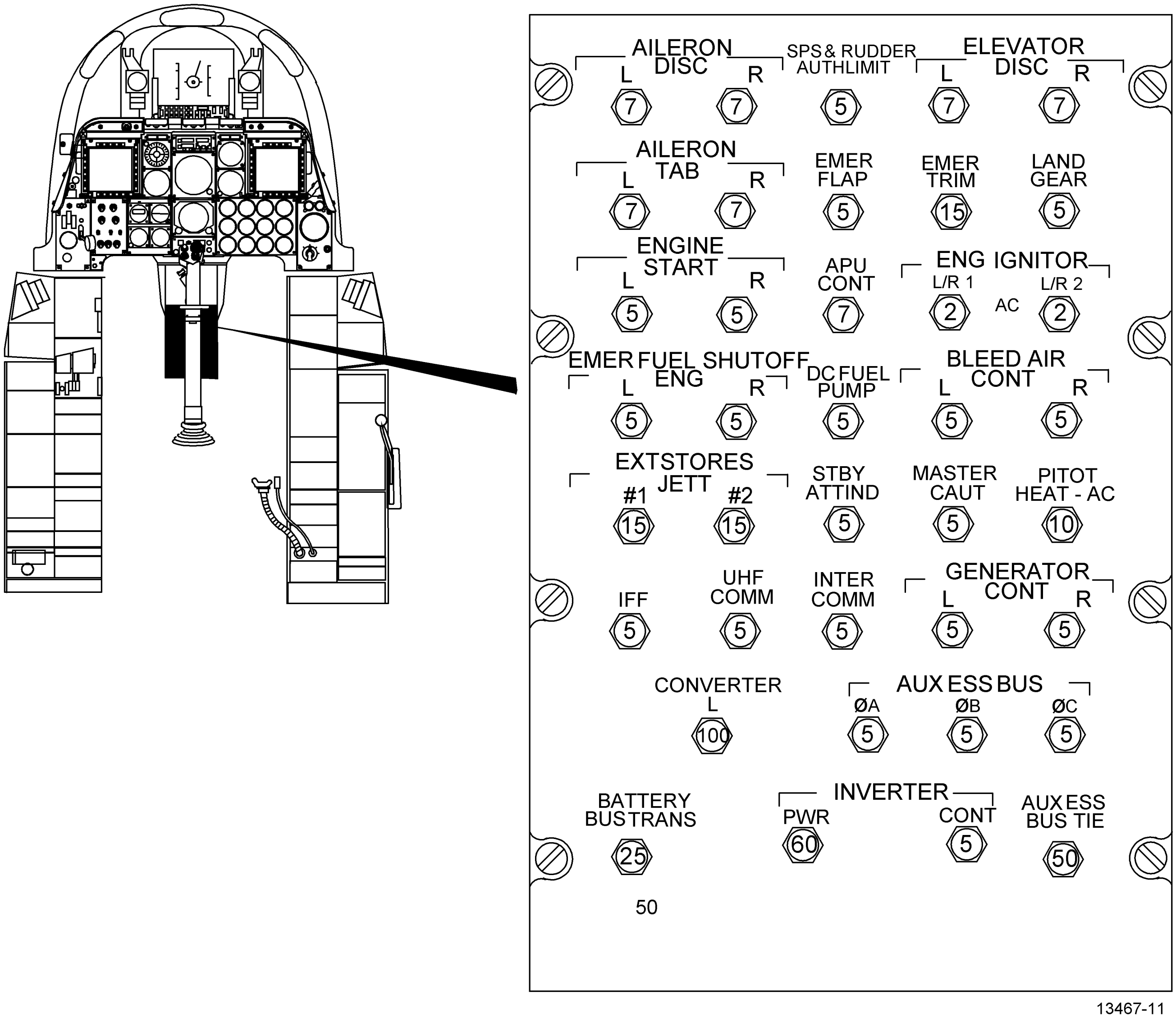

Figure 1-11. Circuit Breaker Panel (Sheet 1 of 2)

CB	RESULT OF POPPED CB	CB	RESULT OF POPPED CB	CB	RESULT OF POPPED CB
AILERON DISC L/R	DISCONNECTOR STAYS IN LAST POSITION.	SPS & RUDDER AUTH LIMIT	RUDDER TRAVEL REMAINS ± 25° ABOVE 240 KIAS.LIMITER INOP.SPS TONES INOP.	EMER TRIM	EMER TRIM INOP.
AILERON TAB L/R	ALL SHIFTER IN LAST POSITION. TAB LIGHT INOP. ASSOCIATED HYD SHUTOFF VALVE - OPEN.	EMER FLAP	EMER FLAP RETRACT INOP.	LAND GEAR	NORM LDG GEAR EXTEND/RETRACT, NORM WHEEL BRAKES, NOSEWHEEL STEERING, AND ANTI-SKID INOP.
ENGINE START L/R	ENG STARTERS AND IGN INOP. ASSOCIATED MAIN FUEL LOW AND MAIN PUMP LTS INOP. AUTO FEEDING OF EXT FUEL AT LOW FUEL INOP.	APU CONT	APU AND DC FUEL PUMP INOP.	ENG IGNITOR L/R-1/-2	A SET OF IGNITORS (ONE IN EACH ENG) INOP WITH EACH CB THAT IS OUT.
EMER FUEL SHUTOFF ENG L/R	FIRE HANDLE FUEL SHUTOFF - INOP.	DC FUEL PUMP	DC FUEL PUMP INOP.	BLEED AIR CONT L/R	ASSOCIATED BLEED AIR VALVE OPEN.
EXT STORES JETT #1/#2	ONE OF DUAL JETT SYSTEMS INOP WITH EACH CB THAT IS OUT.	STBY ATT IND	SAI AVAILABLE FOR 9 MINUTES MAXIMUM	MASTER CAUT	MASTER CAUTION AND CAUTION LIGHTS INOP.
IFF	IFF INOP - ALL MODES.	INTERCOMM	ALL INTERCOM PANEL AND RWR AUDIO INOP (LDG GEAR AND AOA TONES REMAIN).	PITOT HEAT AC	HTR IN PITOT TUBE ONLY INOP.
UHF COMM	UHF RADIO INOP.	INVERTER PWR	INVERTED DISCONNECTED FROM BUSSES. NO EFFECT IF GEN-ON LINE.	GENERATOR CONT L/R	IF GEN-ON LINE - NO EFFECT. IF GEN-OFF LINE - WILL NOT COME ON OR RESET.
CONVERTER L	BATTERY OR R CONVERTER MUST SUPPLY DC.	INVERTER CONT	INVERTER INOP. NO EFFECT IF GEN-ON LINE.	AUX ESS BUS	AUX AC ESSENTIAL AND 26V INST TRANSFORMER BUSSES INOP (LOSS OF ENG INSTRUMENTS).
BATTERY BUS TRANS	BATTERY ONLY DC SOURCE AVAILABLE TO BATTERY BUS.	ELEVATOR DISC L/R	DISCONNECTOR STAYS IN LAST POSITION.	AUX ESS BUS TIE	AUX DC ESSENTIAL BUS INOP.

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Figure 1-11. Circuit Breaker Panel (Sheet 2)

Integrated Drive Generators.

An IDG unit is mounted on each engine. Each unit consists of a drive system and an AC generator.

Generators.

Left and right generators produce AC power. Each generator is capable of supplying sufficient power for all AC busses, and either one will automatically pick up the load if the other fails. Cockpit control of the generators is provided by generator switches.

Generator Switches.

Two AC generator switches (Figure 1-10) are placarded AC GEN L and R. Each switch has two positions placarded PWR and OFF/RESET. In PWR, the associated generator is placed on the line, provided the corresponding generator control unit senses that the output is within limits.

If limits are exceeded, as indicated by an L or R GEN caution light coming on, the affected generator will go off the line. The system may be reset momentarily cycling the applicable generator switch to OFF/RESET and back to PWR. If the fault remains, the system will not reset. Placing an AC GEN switch in OFF/RESET removes the generator from the line.

Generator Caution Lights.

The left and right generator caution lights (Figure 1-158) are placarded L GEN and R GEN. If a generator caution light comes on, it indicates the associated generator has automatically shut down because AC output was out of limits.

Left AC Bus, Right AC Bus, and AC Armament Bus.

The left AC, right AC, and AC armament busses (Figure FO-5) provide AC power to mission support equipment and systems not deemed essential to flight.

External Power.

External power can be used to supply all AC busses directly, and all DC busses through the converters. A standard receptacle (Figure 1-204, sheet 2), on the forward underside of the fuselage, is provided for ground connection of external power. Inserting the plug of the external power unit depresses a contactor button and enables the system. When power is available from both the external source and APU generator, the first one selected automatically locks out the other. With external power supplied to the aircraft, the first engine driven generator to come on line will supply power to its associated bus, and the external source will continue to supply the opposite system. When the second engine driven generator comes on line, the external power is automatically locked out. During engine shutdown, when the generator drops off the line, the associated left/right busses will be supplied with power from the external source, if one is connected.

ELECTRICAL SYSTEM OPERATION.

With all cockpit electrical switches off and the external battery switch OFF, no electrical power is being supplied to any aircraft system. When the external battery switch is ON, power is supplied to the battery bus. When the cockpit battery switch is set to PWR, the DC essential and auxiliary DC essential busses are energized. Setting instrument inverter switch to STBY powers the AC essential, auxiliary AC essential, and instrument transformer busses. When the APU is started and the APU generator switch is set to PWR, the left and right AC busses and AC armament bus are energized, as well as the left and right converters. The left converter powers the left DC bus and the right converter powers the right DC bus and the DC armament bus.

In addition, when the APU generator comes on line, the inverter reverts to the standby mode and the APU generator picks up the load formerly carried by the inverter (AC essential, auxiliary AC essential, and instrument transformer busses). At this point, the entire electrical system is powered by the APU generator. After engine start, the first engine driven generator to come on the line powers the entire system and locks out the APU generator. When the second engine driven generator comes on the line, the two share the total load. The left generator powers the left AC, AC essential, auxiliary AC essential, and instrument transformer busses, and the left converter. The right generator powers the right AC and AC armament busses, and the right converter. Together, the left and right generators provide power, through the converters, to the DC essential, auxiliary DC essential, and battery busses. In the event of a failure of either engine driven generator, the load of the failed system will automatically transfer to the operating system. If both engine driven generators fail, the system can again be powered by the APU generator. Turn off nonessential electrical equipment. If the APU generator then fails, essential AC and DC power will be provided by the battery and the instrument inverter. If the converters fail, the battery will supply the DC essential, auxiliary DC essential, and battery busses.

HYDRAULIC POWER SUPPLY SYSTEM.

The hydraulic power supply system (Figure FO-6) consists of two fully independent hydraulic power systems, designated left hydraulic system and right hydraulic system. Both systems are pressurized by identical engine driven pumps. A small accumulator in each system stabilizes the pressure. In addition to the two system hydraulic pumps, an APU hydraulic pump can be selected for ground use only to provide hydraulic power to either hydraulic system, but not both simultaneously. The selector valve is accessible through the APU access door on the bottom of the aft fuselage.

The left hydraulic system powers the following systems:

Flight control	-	Left rudder, left elevator, left and right aileron, flaps
Landing gear	-	Landing gear extend and retract, wheel brakes, anti-skid, and NWS
Armament	-	One half of gun drive

The right hydraulic system powers the following systems:

Flight control	-	Right rudder, right elevator, left and right aileron, speed brakes, slats
Emergency		Auxiliary landing gear systems extend, emergency wheel braking and associated accumulators
Armament	-	One half of gun drive
Air refueling	-	Slipway door and receptacle lock

The hydraulic systems are designed for combat survivability. The left and right systems are physically separated as much as possible. The landing gear, gear uplock, wheel brake, and NWS lines are isolated from the left system pressure when the gear is up and locked. The landing gear and associated systems can also be isolated from the left hydraulic system by opening the LAND GEAR circuit breaker. The speed brakes are isolated from right system pressure when the speed brake switch is in hold or by selecting SPD BK EMR RETR on the emergency flight control panel. Flaps can be totally isolated from the left hydraulic system by selecting FLAP EMER RETR on the emergency flight control panel.

HYDRAULIC SYSTEMS PRESSURE GAUGES.

Two hydraulic pressure gauges (46, Figure FO-1) permit the monitoring of both hydraulic systems continuously. These gauges are placarded HYD SYS L and HYD SYS R and indicate pressure in psi. The gauges are powered by the instrument transformer bus.

HYDRAULIC PRESSURE CAUTION LIGHTS.

Two hydraulic pressure caution lights (Figure 1-158), on the caution light panel, are placarded L HYD PRESS and R HYD PRESS. The lights will come on if the pressure in the respective system drops below 900 (±100) psi. The light will go off when the pressure returns to a level above 1,000 psi.

HYDRAULIC RESERVOIR LOW LEVEL CAUTION LIGHTS.

Two hydraulic reservoir low level lights (Figure 1-158), on the caution light panel, are placarded L HYD RES and R HYD RES. The lights will come on whenever the respective reservoir fluid level falls below a preset level.

A windmilling engine will produce some hydraulic pressure. As the engine decelerates to windmilling, for a short period of time (less than 60 seconds), this pressure may be enough to provide normal hydraulic operations.

LANDING GEAR SYSTEM.

The landing gear system (Figure 1-12) is a tricycle configuration with the main gear retracting into pods suspended below the wing and the nose gear retracting into the fuselage. The nose gear is offset to the right of the aircraft centerline to accommodate the centerline location of the 30mm gun. All three landing gear struts retract forward to aid free-fall auxiliary extension. Landing gear extension and retraction is controlled by the landing gear handle and powered by the left hydraulic system. In the gear-retracted position, the system is depressurized and isolated. In the normal gear down position, the system is pressurized.

Auxiliary extension of the landing gear is available in the event left hydraulic system pressure is not present or if the landing gear handle or valve is jammed or failed. The system requires no electrical power. To actuate the auxiliary landing gear extension system, the landing gear auxiliary extension handle must be pulled to its stop. When the handle is pulled to its stop, right hydraulic system pressure releases the uplocks. If right hydraulic system pressure is not present, the landing gear emergency accumulator, located in the nose wheel well, automatically serves as the pressure source. This accumulator is pressurized by, but isolated from, the right hydraulic system. Upon release of the uplocks, all three gears will extend by gravity, aided by aerodynamic forces. Should left hydraulic system pressure be present, landing gear extension by the auxiliary system can be accomplished by first opening the LAND GEAR circuit breaker to deactivate the landing gear control circuit.

Pulling of auxiliary landing gear extension handle, in addition to releasing the uplocks, directs the same hydraulic pressure to a valve, which depressurizes the left hydraulic system reservoir and thereby minimizes the back pressure against which the gear must fall.

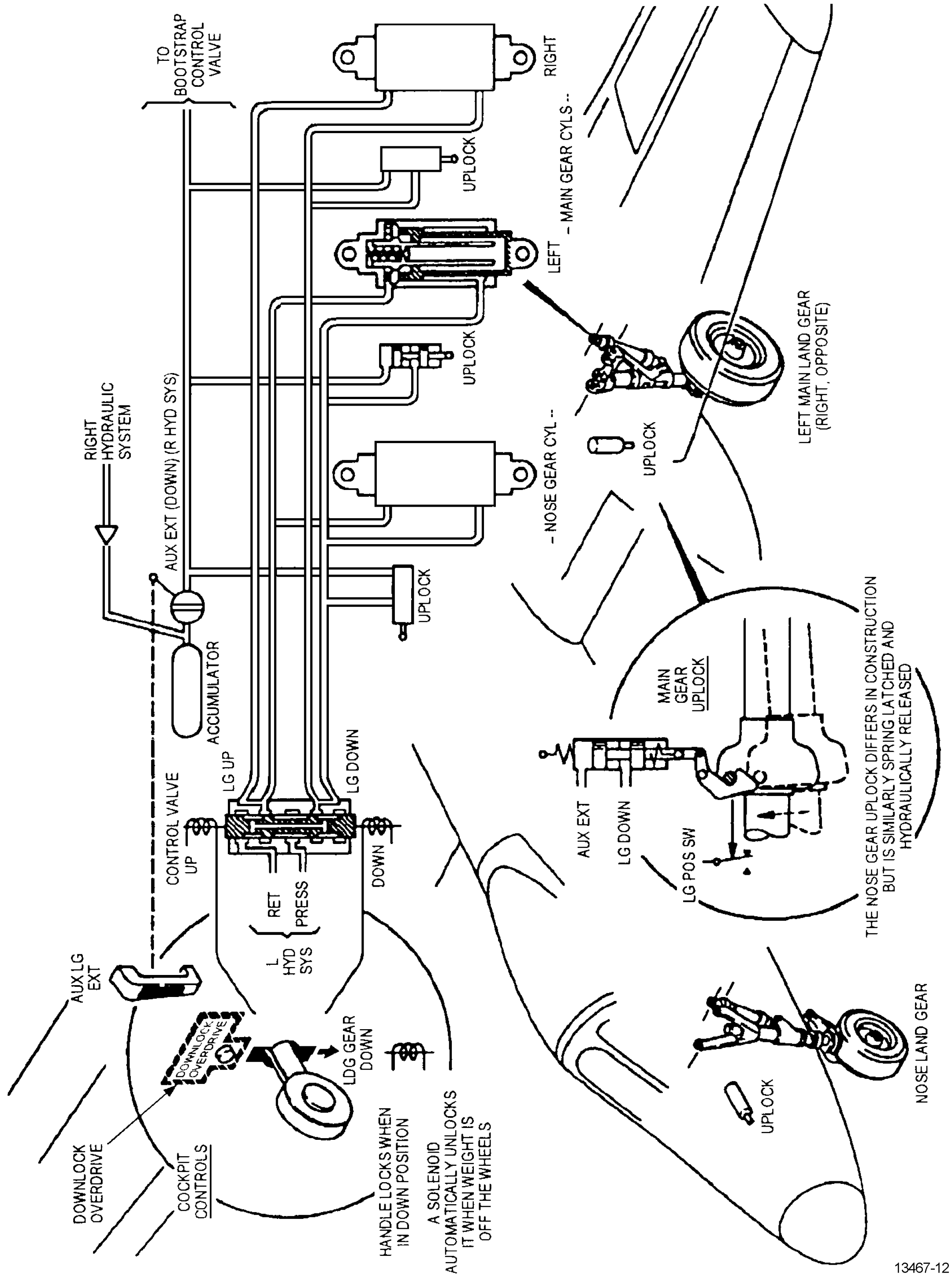


Figure 1-12. Landing Gear System Schematic

Should the auxiliary landing gear handle be pulled with the LAND GEAR circuit breaker closed, left hydraulic system pressure present, and the landing gear handle up, the landing gear will be powered to the up position as soon as the uplocks are released, and the landing gear will be held in the retracted position by hydraulic pressure. Auxiliary landing gear extension can be accomplished when in the manual reversion flight control mode without opening the LAND GEAR circuit breaker, as both the left and right hydraulic pressure systems are shut off in this mode.

Components of the landing gear system are the Main Landing Gear (MLG), Nose Landing Gear (NLG), wheel brake system, emergency brake system, anti-skid devices, and NWS system. In addition, the landing gear system includes a landing gear position and warning system, and a downlock override control. Switches sense gear and uplock position to provide cockpit indications and to depressurize/isolate the landing gear hydraulic system after retraction. The landing gear system also provides the IFFCC logic with two discrete signals, one for weight-on-wheels (WOW) and one for landing gear extended.

MLG.

The shock struts provide a rough field taxi capability. The landing gear retracting cylinder is also the drag brace. A spring-powered mechanical downlock automatically engages both for powered and free-fall gear extensions. Switches provide cockpit indication of downlock.

For gear retraction, hydraulic pressure unlocks the downlock and then extends the retracting cylinder piston to push (rotate) the gear forward and up. As the gear approaches the upstop, an uplock is engaged (see Figure 1-12). Also, gear up pressure automatically applies brake pressure to stop wheel rotation before the wheels retract into the gear pods.

For gear extension, hydraulic pressure disengages the uplock hooks and simultaneously retracts the cylinder piston to pull down the gear. Extend pressure is maintained with the gear handle in DOWN.

When retracted, a spring-loaded snubber contacts the tire to prevent air drag rotation of the wheels.

NLG.

The nose landing gear operates similar to the main gear. As the strut extends when weight comes off the tire, a cam centers the nosewheel. Two doors seal off the fuselage compartment after gear retraction.

LANDING GEAR HANDLE.

The landing gear handle (33, Figure FO-1) is wheelshaped and placarded LDG GEAR DOWN. The handle can only be moved from DOWN to up when DC essential power is available and the aircraft weight is off the wheels, or when the landing gear DOWNLOCK OVERRIDE button is depressed while moving the landing gear handle up.

The handle must be pulled aft before moving it to DOWN.

Normally the time for the gear to extend or retract is approximately 6 seconds.

The speed brake caution function of the IFFCC will transmit the voice message "Speed brakes, Speed brakes" over the intercom system when the following conditions are met for one-half second or longer:

- The landing gear handle is up and speed brakes are extended (open) more than 10%, and either throttle (not both) is set over 96% or both throttles are set over 96% and KIAS is less than 145; or

- The landing gear handle is down, speed brakes are extended (open) more than 10%, either or both throttles are set over 96% and airspeed is less than 145 KIAS.

DOWNLOCK SOLENOID OVERRIDE BUTTON.

The downlock solenoid override button (33, Figure FO-1) is located on the landing gear control panel and placarded DOWNLOCK OVERRIDE. Depressing the button allows the landing gear handle to be moved to UP even if aircraft weight is on the main gear. However, the nose and main gear will not retract until weight has been removed from the main gear and both struts have extended. The button is powered by the DC essential bus.

CAUTION

If the downlock override is used in flight with a broken scissors or uninflated strut, damage to the gear or aircraft could result.

AUXILIARY LANDING GEAR EXTENSION HANDLE.

An auxiliary landing gear extension handle (48, Figure FO-1), placarded AUX LG EXT, permits extension of the landing gear in the event of left hydraulic system failure or if the landing gear handle or valve is jammed or failed. A button at the top of the auxiliary landing gear extension handle must be depressed before the handle can be pulled out. Extension of the landing gear by the auxiliary system without left hydraulic system pressure should be accomplished by first placing the landing gear handle DOWN and then pulling out the auxiliary landing gear extension handle. The auxiliary landing gear extension handle should be returned to its stowed position as soon as the landing gear is down and locked.

Extension of the landing gear by the auxiliary system when left hydraulic system pressure is present should be accomplished by first opening the LAND GEAR circuit breaker, placing the landing gear handle DOWN and finally pulling out the auxiliary landing gear extension handle. The auxiliary landing gear extension handle should be returned to its stowed position as soon as the landing gear is down and locked to preclude left hydraulic system pump cavitation in the event a heavy demand is imposed upon the system.

Landing gear retraction after extension by the auxiliary system with left hydraulic system pressure present should be accomplished by first checking that the auxiliary landing gear extension handle is stowed, closing the LAND GEAR circuit breaker, and finally placing the landing gear handle up.

After extension by the auxiliary system during intentional manual reversion, the landing gear can be retracted, provided left hydraulic system pressure will be available. The retraction should be accomplished by first checking that the auxiliary landing gear extension handle is in its stowed position and that the LANDING GEAR circuit breaker is closed, then placing the flight control mode switch in NORM, and finally raising the landing gear handle.

CAUTION

Allow at least 15 seconds to elapse between returning the auxiliary landing gear extension handle to the stowed position and placing the flight control mode switch in NORM to avoid left hydraulic system pump cavitation.

LANDING GEAR POSITION INDICATING AND WARNING SYSTEM.

The landing gear position indicating and warning system consists of three separate green landing gear display lights (32, Figure FO-1), red warning lamps within the landing gear handle (33, Figure FO-1), and an audible warning signal (beeper).

The three landing gear display lights are placarded L SAFE, N SAFE, and R SAFE. Each display contains two bulbs and comes on green to indicate the respective gear is down and locked.

When the landing gear is up and locked, all display lights are off. When the gear handle is placed to DOWN, the warning light and beeper come on and remain on until all three gears are in their locked positions. When the handle is moved up, each safedown display light will go off, and the warning light and beeper will come on and remain on until all gears are in their up and locked positions. The beeper will sound and the warning light will come on if the following conditions occur simultaneously:

- Gear handle up
- Below approximately 10,000 feet Mean Sea Level (MSL)
- Below approximately 160 KIAS
- A throttle positioned below approximately halfway between IDLE and MAX.

The signal lights test button (Figure 1-158), placarded SIGNAL LIGHTS LAMP TEST, causes the landing gear display lights and the landing gear warning light to come on and tests the audible warning signal. The lights coming on tests the lamps only and not the complete circuit.

The landing gear position indicating and warning system is powered by the auxiliary DC essential bus.

LANDING GEAR HORN SILENCE BUTTON.

The landing gear horn silence button (Figure 1-5), on the throttle quadrant, is placarded L/G WRN SILENCE. Depressing the button will silence the beeper. If the beeper sounds due to an unsafe gear and is silenced, it will not sound again until the gear is recycled. If the beeper sounds due to aircraft configuration (gear not down and locked, altitude below approximately 10,000 feet MSL, air speed below approximately 160 KIAS and throttle retarded) and is silenced, it will sound again if the throttle is advanced and again retarded. The button is powered by auxiliary DC essential bus.

NOSEWHEEL STEERING (NWS) SYSTEM.

The NWS system is pressurized by the left hydraulic system. Damping is provided to prevent nosewheel shimmy in the steering and swivel modes.

NWS is available only when the landing gear handle is DOWN and weight is sensed on either main gear. Failure of the circuitry or loss of electrical power will revert the system to the swivel mode to prevent a hardover. A compensator on the steer/damp unit provides sufficient hydraulic fluid and pressure to retain the shimmy damping function in event of loss of hydraulic power. NWS must be engaged, at least momentarily, prior to each flight to insure damping.

NWS Button.

The NWS button is located on the control stick grip. (Refer to Figure 1-13.)

Auxiliary DC essential bus power arms the engage switch when weight is on either main gear. Subsequent depression and release of the button engages steering. When in steering mode, depression and release of the button disengages steering. A sustained depression of the button, regardless of sequence, engages steering.

Any interruption of electrical power disengages steering until the button is again depressed. After landing, NWS is not engaged until the button is depressed after main gear ground.

With Low Altitude Safety And Targeting Enhancement (LASTE) operating, and weight off wheels, this button is used to command TGP laser fires.

During air refueling, the NWS button is used to disconnect from air refueling if the boom nozzle is inserted and the LATCHED light is on. If the DISCONNECT light is on, the NWS button is used to recycle the air refueling system to the ready mode.

NWS Engaged Advisory Light.

The NWS engaged advisory light (14, Figure FO-1), placarded STEERING ENGAGED, will come on to indicate that NWS has been selected. The light does not necessarily indicate proper functioning of the system. The light is powered by auxiliary DC essential bus.

WHEEL BRAKE SYSTEM.

The normal wheel brake system is fully powered from the left hydraulic landing gear-down circuit (Figure FO-6, sheet 2). The brakes are independently activated by linkage from the rudder pedals.

During landing gear retraction, hydraulic pressure stops the main wheels prior to engagement of the snubbers. This brake pressure is released when the landing gear is unpressurized after reaching the up and locked position.

Optimum Braking.

For initial takeoffs and normal landings, the brake system, in conjunction with fully extended speed brakes, is capable of stopping the aircraft throughout the range of acceptable gross weights and configurations. Optimum braking ensures that maximum performance of the brake system is available when required. During normal landings, use all of the runway available to slow the aircraft to taxi speed. The greatest amount of aerodynamic braking and rolling friction are realized during the initial part of the landing roll. After touchdown, open speed brakes to 100% and apply wheel brakes as needed to attain a safe taxi speed. During normal operations, delaying the application of brakes until below 100 knots ground speed will normally prevent hot brakes.

EMERGENCY BRAKE SYSTEM.

With the left hydraulic system failed and the right hydraulic system operative, the emergency brake system has the same capabilities as the normal system without anti-skid. In event of a failure of both hydraulic systems, emergency braking power is provided by an accumulator serviced by, but isolated from, the right hydraulic system. In the event of loss of both hydraulic systems, sufficient accumulator fluid pressure is available for a minimum of five full brake applications.

The system is activated by pulling the emergency brake handle, and then actuating the brake pedals. Pulling the handle also actuates a switch which disables the anti-skid system.

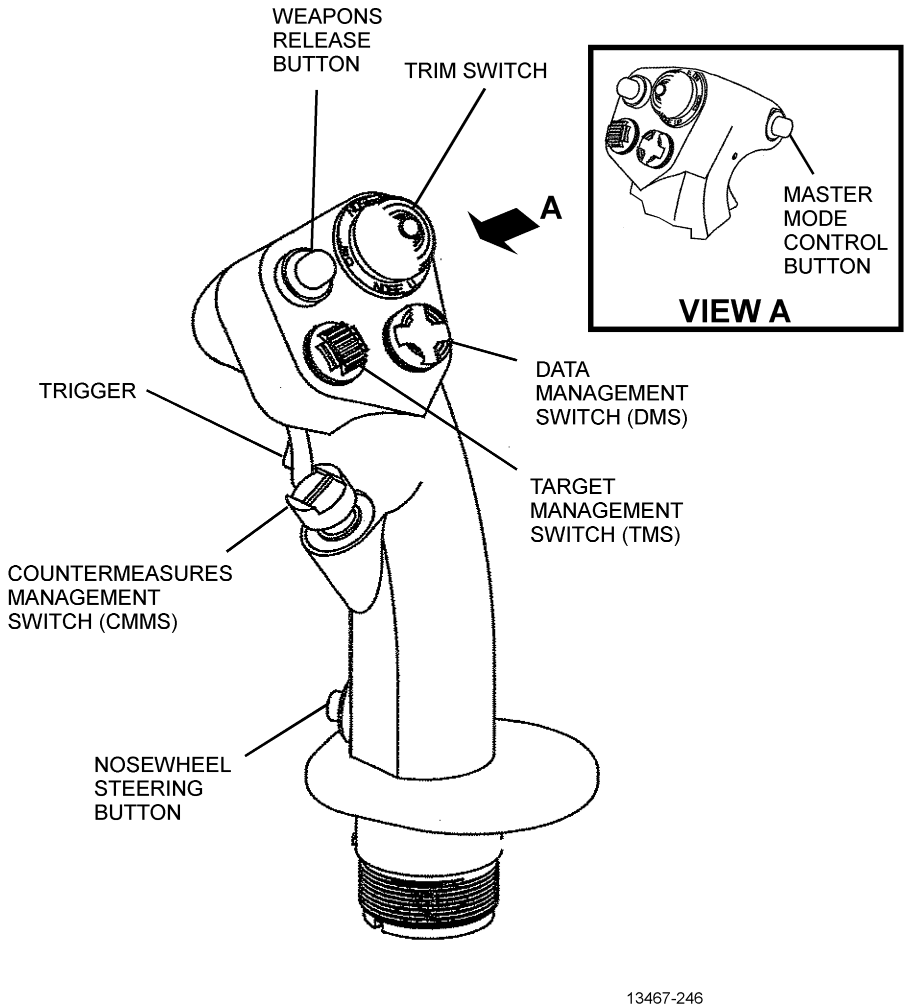


Figure 1-13. Control Stick Grip

The emergency braking system is fully independent of the normal system down to, but not including, the wheel brake cylinder. In the event left hydraulic pressure becomes available while emergency braking is selected, the emergency system retains control of the brakes.

Emergency Brake Handle.

The emergency brake handle (1, Figure FO-2) is placarded EMERG BRAKE. The emergency brake system is engaged by pulling the emergency brake handle aft which mechanically positions a valve, directing pressure from the right hydraulic system or accumulator to the brakes. If the right hydraulic system is intact, unlimited braking will be available. When the emergency brake handle is pulled, the anti-skid control system is deactivated.

CAUTION

Emergency brake handle must either be full in or full out to obtain braking.

ANTI-SKID CONTROL SYSTEM.

The anti-skid control system enables efficient maximum braking for all runway conditions. Cockpit controls and displays consist of an engage switch, an emergency disengage switch, and a caution light. On landing, either or both MLG WOW switches arm a locked wheel/touchdown protection circuit which prevents the application of any brake pressure until both wheels have spun up to 25 knots. During light and moderate braking, the system usually does not operate. During heavy braking, the anti-skid control system attempts to achieve a maximum deceleration rate. This maximum deceleration rate can be achieved from wheel brakes alone (if speed brakes are not open) or a combination of both wheel brakes and speed brakes. For example, when max braking at higher ground speeds where speed brakes are more effective, speed brakes provide a larger portion of the total deceleration leaving a smaller portion to the wheel brakes. As ground speed decreases, speed brake effectiveness decreases requiring the wheel brakes to provide a larger portion of the deceleration. Once the maximum deceleration limit is sensed by the anti-skid control system, brake pressure is automatically regulated to maintain this deceleration rate. If a difference in wheel speed is sensed, indicating a skid on one wheel, brake pressure is released to both wheels until wheel speeds are equal. The system continues to operate until it senses wheel rotation speed has decreased to 10 knots.

In the event that one of the WOW switches fails to activate after touchdown, normal skid control is available to approximately 15 knots.

Anti-Skid Switch.

The anti-skid switch (30, Figure FO-1) is placarded ANTI-SKID and OFF. The switch must be manually moved to ANTI-SKID, where it is electrically held. The switch can be manually moved to OFF and is electrically released to OFF whenever:

- Emergency disconnect lever is actuated
- Emergency brake handle is pulled
- The auxiliary DC essential bus is deenergized.

When the landing gear is raised, the anti-skid control elements are deenergized; however, the switch remains engaged. OFF deactivates the system and causes the ANTI-SKID caution light to come on if the landing gear handle is DOWN. The switch does not automatically disengage as a result of the anti-skid caution light coming on or system failure.

Anti-Skid Caution Light.

The anti-skid caution light (Figure 1-158) is placarded ANTI-SKID. The light serves two functions:

- Indicates the anti-skid system is not engaged when the landing gear handle is DOWN
- Indicates anti-skid system has automatically deactivated in response to a self-detected failure.

Maximum Performance Braking.

If maximum braking is required during an abort or after touchdown, minimum stopping distance can be achieved in a three-point attitude, throttles idle, speed brakes 100%, and wheel brakes applied with a firm continuous force sufficient to feel anti-skid cycling.

CAUTION

Maximum performance braking may cause hot brakes, depending upon aircraft speed and gross weight. If hot brakes are suspected, park aircraft in uncongested area until cooling is accomplished. (See Figure 5-3 for wheel brake energy limits.)

PRIMARY FLIGHT CONTROL SYSTEM (PFCS).

Commands are transmitted via nonredundant pushrods from the stick to the aft area of the armored cockpit (white area), through a set of control disconnectors, and then by redundant cables to the elevators and ailerons, and by a single cable to the rudders. Loss of one hydraulic system does not affect pitch and roll response, but does cause moderate increase in pedal force required for yaw inputs. Jams in the pitch or roll control systems, aft of the disconnect units in the white area, may be isolated to free the stick for control of the unjammed portions.

Redundant control circuits provide for trim controls in the pitch and roll axis, while yaw trim is through the yaw Stability Augmentation System (SAS). The dual channel SAS provides rate damping in both the pitch and yaw axis as well as automatic turn coordination.

PITCH CONTROL SYSTEM.

Pitch control (Figure 1-14) is provided by two elevators, which are connected by a shearable crossover shaft. The elevators are powered by independent actuators, which are also connected by a shearable crossover shaft and powered by independent hydraulic systems. Inputs to the actuators are made via independent, widely separated cable and linkage paths which connect directly to the disconnector units. A single system of pushrods within the white area connect the disconnector units to the stick. Since the elevators are connected, one actuator will power both elevators in the event of the loss of one hydraulic system. The actuators are connected, so that both actuators (and in turn both elevators) will be operated via a single mechanical control path in the event one control path is lost. Hence, loss of one hydraulic system and/or mechanical control path will have no discernible effect on stick/surface response.

If an elevator, elevator actuator, or control path aft of the disconnector is jammed, the jammed side of the system can be disconnected using the elevator emergency disengage switch. Stick inputs will then shear the actuator crossover shaft and the elevator crossover shaft. This will free the unjammed side of the system. If a jam occurs with appreciable elevator deflection, pitch authority in the opposite direction will be minimal; e.g., if an elevator is jammed with an upward deflection, pitch down authority will be reduced.

Artificial stick feel is provided by devices located close to the elevator actuators and a bobweight located in the white area. Trim is provided by two independent, electrical circuits: the normal pitch/roll trim control circuit and the emergency override pitch/roll trim circuit. These circuits lead to a trim motor which acts on the artificial feel device to reposition the actuators and move the entire elevator surface. If both hydraulic systems are lost, pitch trim inputs will automatically operate the two elevator trim tabs via two additional trim motors to provide pitch trim.

The geared/trimmable elevator tabs are mounted on the outboard trailing edges of both elevators. The tabs are trimmable in manual reversion, and geared in the powered flight control mode. This reduces elevator aerodynamic loads to levels satisfactory for instantaneous transfer from the powered mode to Manual Reversion Flight Control System (MRFCS). Refer to PITCH MRFCS section for additional description of pitch manual reversion operation.

Two identical and independent pitch SAS channels provide rate damping for enhanced tracking and pitch trim compensation for speed brake deployment.

A pitch transducer attached to a crank in the aft fuselage provides input data to the IFFCC for PAC.

ROLL CONTROL SYSTEM.

Each aileron is powered by a tandem hydraulic actuator which normally allows each aileron to be powered by both hydraulic systems (Figure 1-15). Inputs to the actuators are made through independent, widely separated cable and linkage paths which connect through aileron tab shift mechanisms to the disconnect units. A single system of pushrods within the white area connects the disconnect units to the control stick.

If one hydraulic system is lost, the operative system will continue to power both ailerons. Hence, the loss of one hydraulic system has no discernible effect on stick/surface response.

In the event one control path is lost, roll control will be provided by the connected aileron, and roll authority will be reduced by approximately one half. Normal stick force relative to roll rate will be experienced, but the stick will have to be moved twice as much for a given maneuver. If an aileron surface, aileron actuator, or a control path aft of the disconnectors becomes jammed, the aileron emergency disengage switch can be used to free the unjammed aileron. If a jam occurs with appreciable aileron deflection, roll control in the opposite direction will be minimal; e.g., if right aileron is jammed with an upward deflection, roll authority to the left will be reduced.

Artificial stick feel is provided by redundant devices located close to the aileron actuators. Trim is provided by two independent electrical circuits: the normal pitch/roll trim control circuit and the emergency override pitch/roll trim circuit. These circuits lead to a trim motor in each wing. The trim motor acts on the artificial feel device, which in turn repositions the actuator to move the entire aileron surface. Sufficient trim for normal operations can be obtained from one trim motor. However, trim rate and authority will be reduced. Disengagement of an aileron will not cause loss of roll trim. No roll trim will be available in the manual reversion operating mode. (See section on MRFCS.)

Aileron tabs are mounted on the inboard trailing edge of each aileron. During normal flight, the tabs are geared to reduce the aerodynamic loads on the ailerons, and are not directly controlled by lateral stick inputs. In manual reversion, lateral stick inputs are transmitted directly to the tabs, which in turn fly the ailerons.

A roll transducer attached to a crank in the forward fuselage provides input data to the IFFCC for PAC.

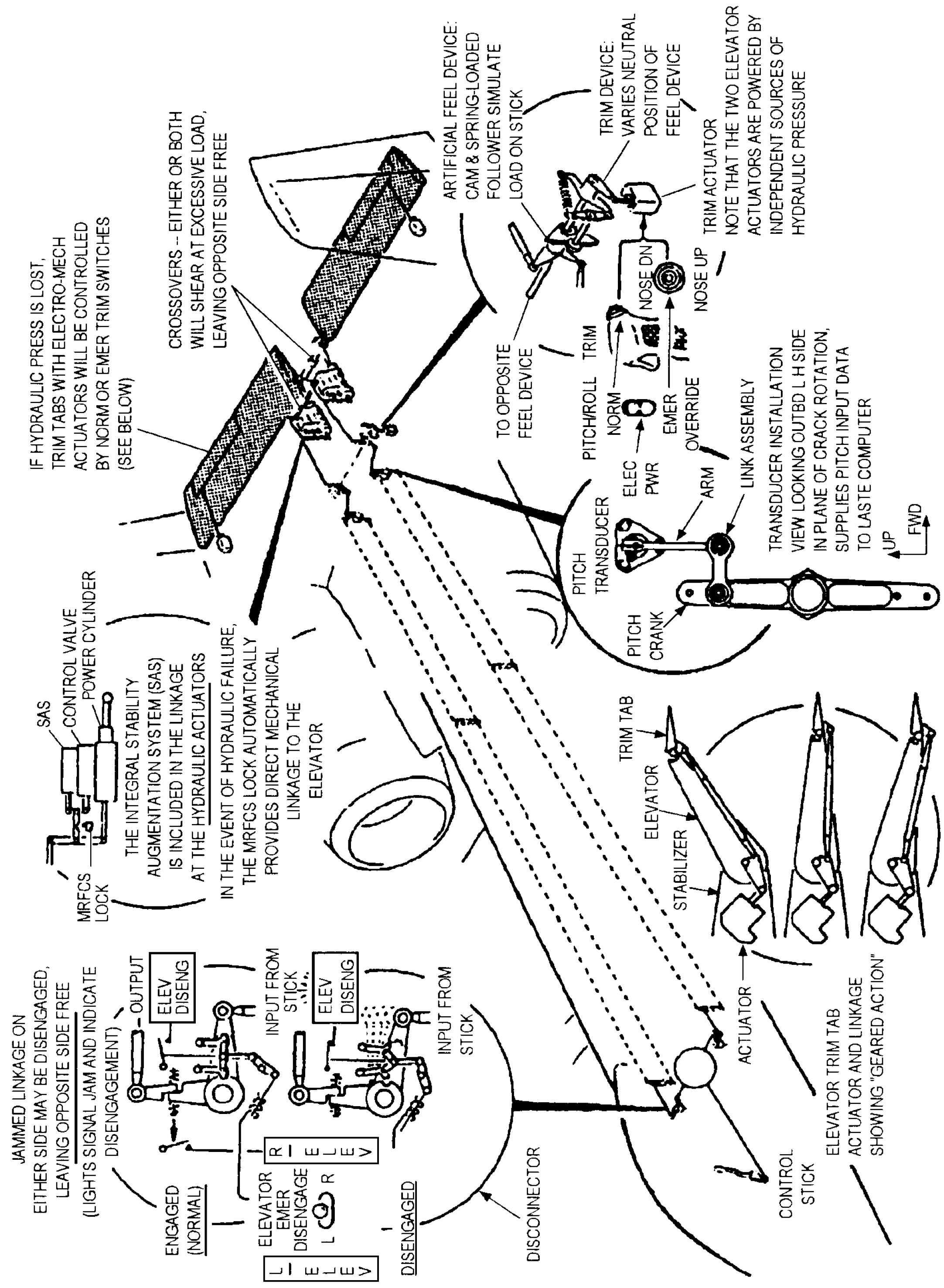


Figure 1-14. Pitch Control System Schematic

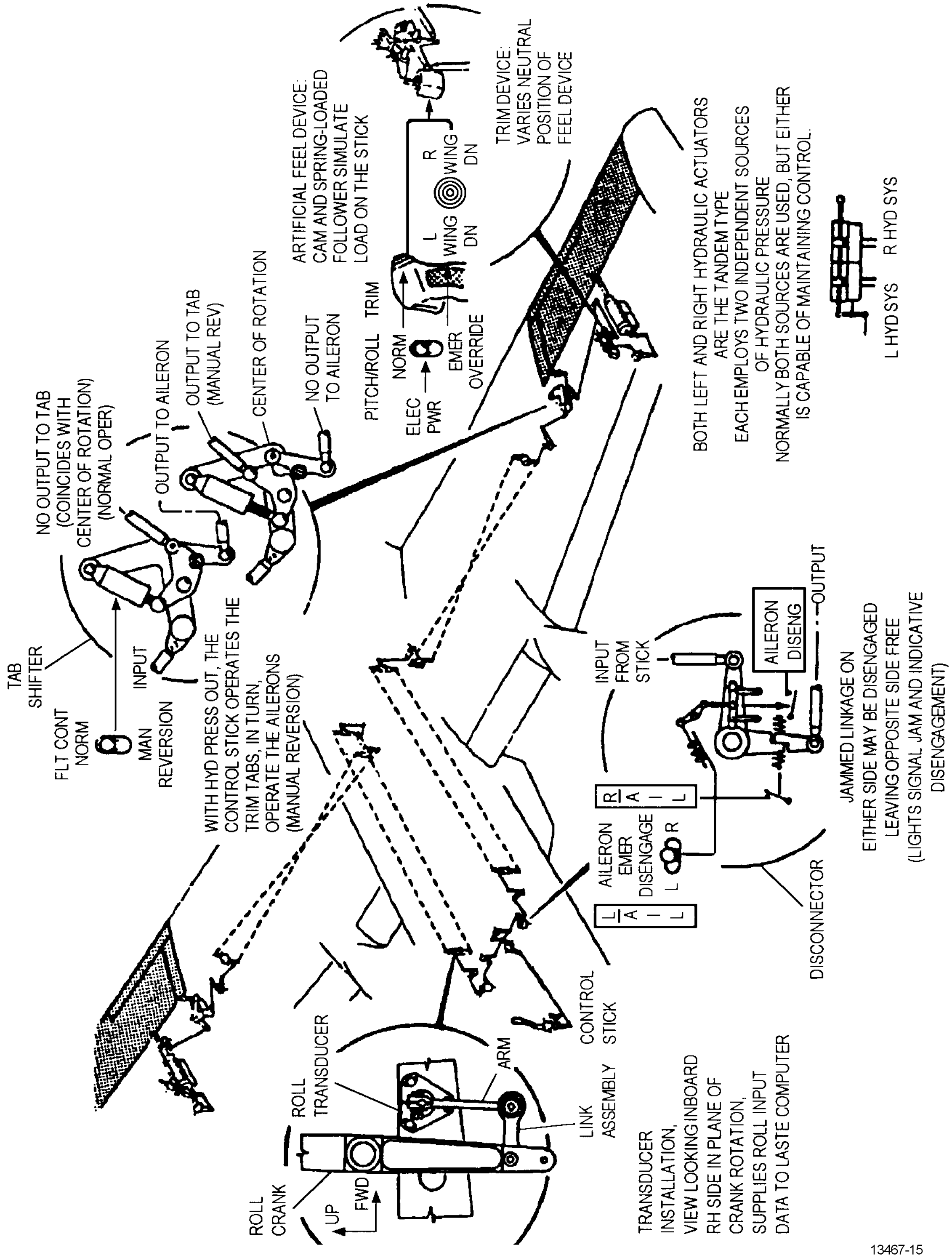


Figure 1-15. Roll Control System Schematic

Elevator/Aileron Emergency Disengage Switches.

Two three-position lever-locked switches (Figure 1-17), placarded ELEVATOR EMER DISENGAGE and AILERON EMER DISENGAGE, are mounted on the emergency flight control panel. The switches are normally centered. In the event of a jam of a control path aft of the disconnector units, or a jam in the actuator or control surface, a light adjacent to the appropriate switch will come on as abnormal stick force countering the jam is exerted. The stick is disconnected from the jammed side by moving the appropriate switch toward the light.

The stick becomes immediately free to control the unjammed control path. After disconnecting a jammed elevator, stick force will be momentarily higher than normal until the controllable elevator is displaced approximately 3° relative to the jammed surface, at which point the crossover shaft between the two elevator actuators will shear. The subsequent shearing of the elevator crossover shaft will be accomplished with hydraulic powered inputs.

For both elevator and aileron control jams, normal stick force per g relative to roll or pitch input is experienced, but the stick has to be moved or trimmed approximately twice as much for a given maneuver. When a control path is not fully engaged at the disconnect unit, the ELEV DISENG or AIL DISENG light on the caution light panel comes on. When the switch is subsequently moved to the center position or to disengage the opposite side, the surface will reconnect as soon as the stick is moved in alignment with the surface position. Though remotely possible, both elevators or ailerons can be disconnected, but one surface will automatically reconnect as soon as the stick is moved into alignment with the position of the control surface. The disengage circuits are powered by the DC essential bus.

Elevator/Aileron Disengaged Caution Lights.

The elevator and aileron disengaged caution lights (Figure 1-158), on the caution light panel, are placarded ELEV DISENG and AIL DISENG. The lights indicate that either or both elevator or aileron control paths are not connected at the disconnect units.

Elevator/Aileron Jam Indicator Lights.

The elevator and aileron jam indicator lights (Figure 1-17), on the emergency flight control panel, are placarded L ELEV/R ELEV, and L AIL/R AIL, respectively. These lights are controlled by load-sensing switches in the disconnector units and are powered from the auxiliary DC essential bus. In the event of an actual jam aft of the disconnect units, a light will come on to identify which side is jammed when 50 to 65 pounds of stick force against the jam is applied. The stick force must be maintained to keep the light on. The jam light will remain on for 3 to 5 seconds after the stick force required to turn the light on is reduced. Stick force should be reduced during disengagement to relieve loads on the disconnect units and also to reduce transients as the disconnector actuates. The lights may come on when there is no jam condition by the application of stick force and rate in excess of the capacity of the powered actuators to respond. The lights may also come on during manual reversion because of the high stick force gradients.

YAW CONTROL SYSTEM.

Yaw control (Figure 1-16) is provided by two rudders, which are individually driven by independent hydraulic actuators. The actuators are controlled in unison by a single cable and linkage transmission path which connects to the rudder pedals. Since there is a single control path, there is no disconnect capability in the event of a jam. However, if an actuator or rudder surface becomes jammed, some yaw control from the unjammed rudder may be available due to stretching of the connecting cables between the actuators. Required rudder pedal force will be significantly higher. Full trim authority will be available for the unjammed rudder if the yaw SAS channel on the jammed side is turned off. If one hydraulic system is lost, slightly degraded rudder authority will result. Initial rudder pedal inputs will move only the powered rudder. Then, increases in rudder pedal input will move both the powered and unpowered rudders and the unpowered rudder will trail the powered rudder. Hence, the rudder pedals have to be moved more than normal and there will be a moderate increase in the pedal force required. If both hydraulic power sources are lost, the actuators automatically shift modes to permit direct transfer of rudder pedal inputs to the rudder surfaces. Pedal forces in this mode are higher. Artificial rudder pedal feel and centering characteristics are integrated into both rudder actuators.

At aircraft speeds above 240 KIAS, available powered rudder travel is automatically reduced from ±25° to ±8°. If aircraft speed increases through approximately 240 KIAS with rudder inputs greater than ±8°, rudder pedal "kicks" or "thumps" may be felt as the rudder returns to 8°. Independent SAS signals are electrically transmitted to each rudder actuator to provide automatic turn coordination, yaw damping and yaw trim.

A yaw transducer attached to a crank in the aft fuselage provides input data to the IFFCC for PAC.

Rudder Pedal Adjustment Handle.

The rudder panels are individually adjustable with a single rudder adjustment handle (50, Figure FO-1), located on the upper side of the center pedestal. When the handle is rotated up, the pedal assemblies are spring-loaded against the pilot’s feet. After the rudders are moved to the desired positions, the handle is released and the pedals lock. The pedal positions are numerically identified on the pedal assemblies for visual reference.

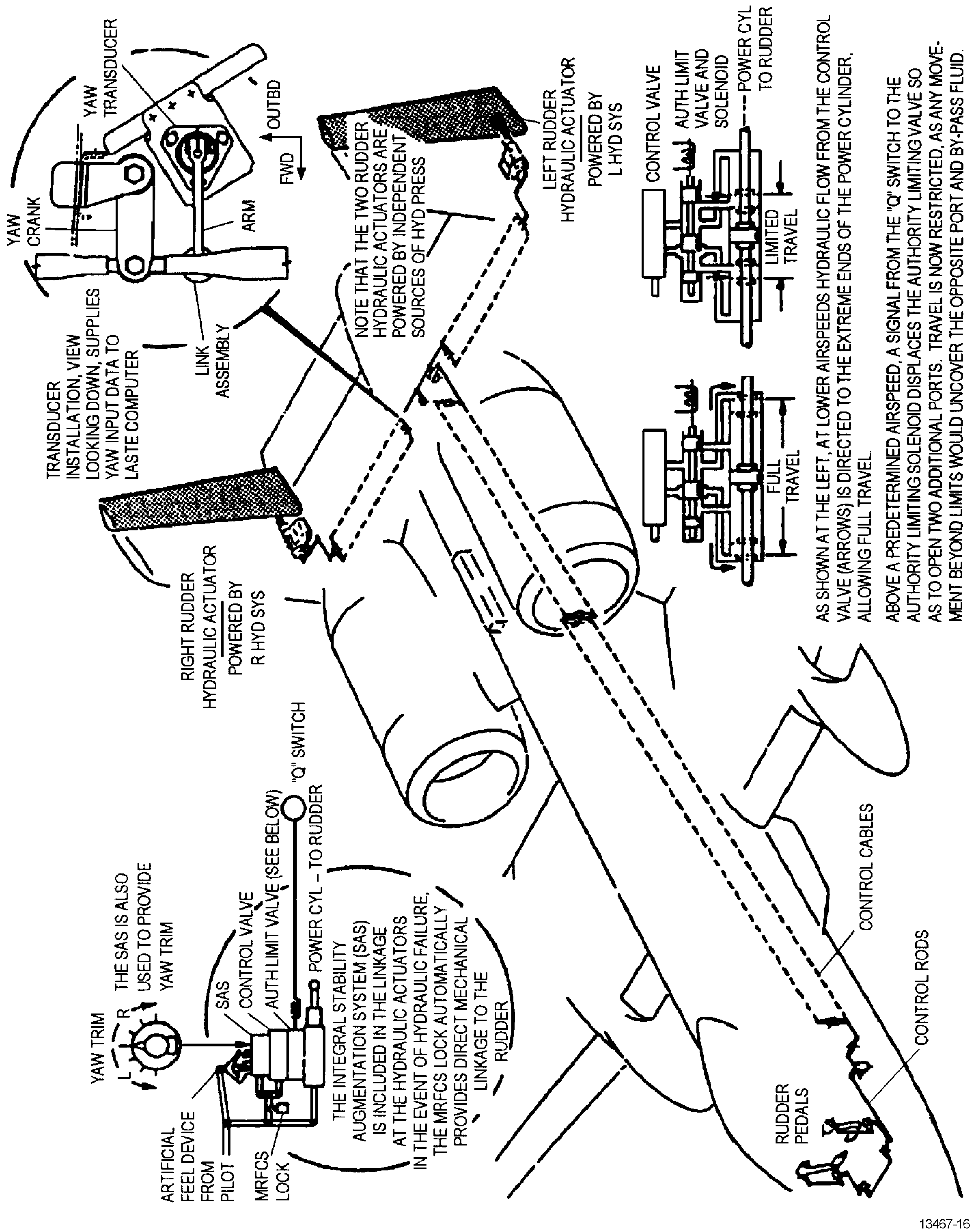


Figure 1-16. Yaw Control System Schematic

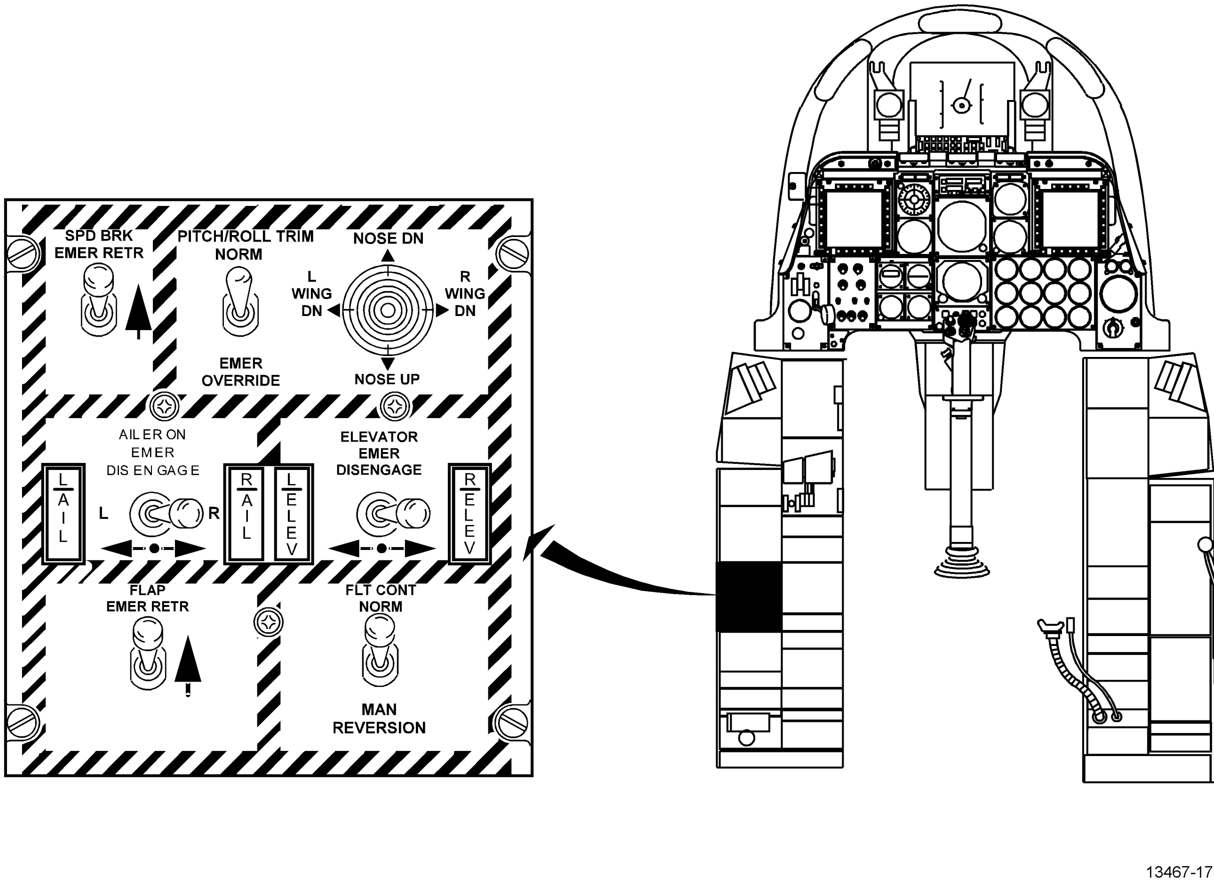


Figure 1-17. Emergency Flight Control Panel

PITCH AND ROLL TRIM CONTROL SYSTEMS.

The pitch and roll trim control systems are similar in function. Both systems act on the artificial feel devices to vary the zero load position of the stick and equivalent surface positions. A five-position switch, mounted at the top of the stick grip (Figure 1-13), is used for normal pitch/roll trim control. Trim change is proportional to the time the button is activated. Trim rates are essentially independent of stick loading conditions. In the event of a failure in either the pitch or roll trim circuit, control of both trim axes may be transferred to an identical five-position switch located on the emergency flight control panel (Figure 1-17) . The emergency pitch/roll trim circuitry is powered separately from the normal trim; however, both circuits operate the same trim motors. A roll trim controller transmits trim inputs to the two independent trim motors (one for each aileron) so that the roll trim motors are actuated equally. In the event of a failure on one side, roll trim with the other motor will be available, but the overall trim authority and trim rate will be reduced. In addition, there will be a noticeable difference in lateral stick feel near the center/neutral position and the stick may not return to a precise lateral center position if released (hands-off).

Normal Pitch and Roll Trim.

When the pitch/roll trim override switch (Figure 1-17) is in NORM, aircraft pitch and roll trim is controlled by a trim switch on the control stick grip (Figure 1-13). Normal trim switch control circuits are powered by the auxiliary DC essential bus.

Emergency Pitch and Roll Trim Switch.

When the pitch/roll trim override switch (Figure 1-17) is in EMER OVERRIDE, aircraft pitch and roll trim is controlled by an emergency pitch and roll trim switch (Figure 1-17), located on the emergency flight control panel , to the right of the pitch/roll trim override switch. The switch is identical to the Trim switch on the control stick grip (Figure 1-13). Emergency trim, hence aircraft pitch and roll trim, may be provided by the emergency pitch and roll trim system in the event of loss of the auxiliary DC essential bus power or a failure in the normal trim circuits.

Pitch/Roll Trim Override Switch.

The pitch/roll trim override switch (Figure 1-17), placarded PITCH/ROLL TRIM, is a two-position toggle switch located on the emergency flight control panel. When set to NORM, aircraft pitch and roll trim are controlled by the normal trim switch located on the control stick grip. When set to EMER OVERRIDE, aircraft pitch and roll trim are controlled by the emergency trim switch located on the emergency flight control panel. The pitch/roll trim override switch must be in NORM for TAKEOFF TRIM pushbutton switch (Figure 1-18) to operate.

Yaw Trim Control Knob.

Yaw trim control is effected with a knob placarded YAW TRIM (Figure 1-18), located on the SAS control panel on the left console. The single knob controls two independent circuits, each of which trims a rudder through the respective YAW SAS channel. Rudder pedals do not move in response to trim inputs. Rudder trim authority is limited to ±10° at speeds below 240 KIAS and ±8° above 240 KIAS. A detent is provided in the zero trim position. The yaw trim system is powered by the right DC and AC busses. In the event of loss of one SAS channel or one hydraulic power supply, 50% yaw trim authority is retained through the powered SAS channel.

TAKEOFF TRIM CONTROL SYSTEM.

When the T/O TRIM button (Figure 1-18) is depressed, the pitch and roll trim motors and the two elevator tab trim motors are driven to neutral. With the T/O TRIM button depressed, the yaw trim knob in neutral setting, and the five trim motors at neutral setting, the TAKEOFF TRIM light comes on. The T/O TRIM button does not operate when the pitch/roll trim override switch is in EMER OVERRIDE. The takeoff trim circuit is powered by the auxiliary DC essential bus.

Takeoff Trim Button.

The takeoff trim button (Figure 1-18), placarded T/O TRIM, is a pushbutton located on the SAS control panel. The button must be depressed until TAKEOFF TRIM light comes on, indicating that the surfaces have reached the desired position. When the T/O TRIM button is released, the TAKEOFF TRIM light will go off.

Takeoff Trim Light.

A green takeoff light (Figure 1-18), placarded TAKEOFF TRIM, is located on the SAS control panel. The TAKEOFF TRIM light indicates that all trim surfaces have achieved proper trim for takeoff. The TAKEOFF TRIM light is energized by the auxiliary DC essential bus.

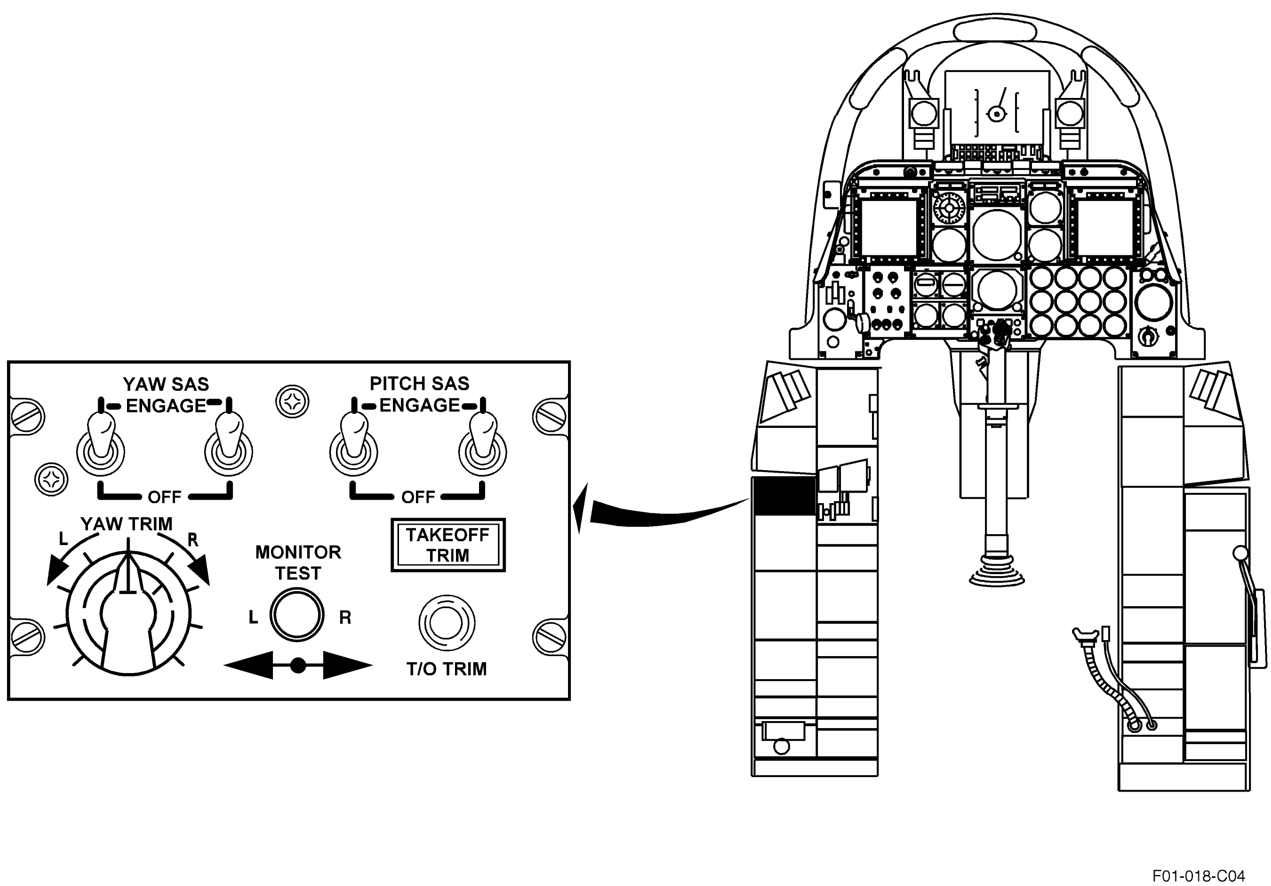


Figure 1-18. Stability Augmentation System Panel

SAS.

The SAS enhances flying qualities for target tracking, reduces workload, and provides yaw trim capability. Two SAS channels are provided in both the pitch and yaw axis. Each channel acts on the respective control surface actuator. The output of the two SAS channels is continuously compared and in the event of an excessive difference, a computer deactivates both channels in the affected axis, triggering a light on the caution light panel.

The pitch and yaw SAS failure monitor circuits can be tested by using the monitor test switch on the SAS panel.

An emergency disconnect lever, located immediately below the stick grip, disengages all SAS channels when momentarily depressed. Hydraulic power is required for the SAS to work. The SAS is powered by the right AC and DC busses.

Monitor Circuit Test Switch.

A test switch on the SAS control panel (Figure 1-18), placarded MONITOR TEST, is used to check both pitch and yaw SAS failure monitor circuits. The switch is three-positioned and spring-loaded at the mid position where it is lever-locked. When the switch is held to L or R, a simulated failure is introduced in the associated pitch and yaw channels and the monitor circuits disengage all SAS channels.

Emergency Disconnect Lever.

The emergency disconnect lever is located on the forward side of the control stick just below the grip. Momentary actuation of the lever immediately deactivates both the anti-skid and SAS systems and the switches go to OFF.

Pitch SAS.

The pitch SAS provides the control functions for the IFFCC pitch commands and the pitch trim function. Total SAS authority is limited to 5° elevator trailing edge up and 2° elevator trailing edge down. A monitor circuit senses differential between the left and right channels and shuts off pitch SAS when the differential is excessive. A hydraulic or engine failure will not automatically result in SAS disengagement. However, the affected axis will disengage when a differential between channels is sensed. Control stick authority is more than sufficient to override an SAS induced elevator displacement.

WARNING

The pitch SAS fail-safe monitoring feature does not function during single channel SAS operation. Single channel operation will also result in repetitive loading of the elevator interconnect shear bolts. If pitch SAS operation cannot be maintained with both channels engaged, pitch SAS must be left OFF.

Pitch SAS Engage Switches.

Two pitch SAS engage switches (Figure 1-18) are located on the SAS control panel. These are two-position solenoid-held switches placarded PITCH SAS ENGAGE and OFF with one switch placarded L, and the other placarded R. For normal engagement, both switches are actuated simultaneously and momentarily held. The switches are both electrically released to OFF if the monitor circuit signals a failure or if the SAS emergency disengage switch is actuated. The switches can also be manually moved to OFF. When either or both switches are OFF, the PITCH SAS caution light will come on. The switches are powered by the right DC bus.

Pitch SAS Caution Light.

The PITCH SAS caution light (Figure 1-158), on the caution light panel, will come on to indicate that one or both of the pitch SAS channels is disconnected.

Yaw SAS.

The yaw SAS performs three basic functions: yaw rate damping with ±7° rudder authority, turn coordination with ±7° rudder authority, and yaw trim with ±10° rudder authority.

The SAS authority is limited to ±10° below 240 KIAS and ±8° above 240 KIAS. The sideslip control is generated by the Inertial Navigation System (INS) or Heading Attitude Reference System (HARS) roll rate sensors, Angle-of-Attack (AOA) transmitter, and yaw rate sensors.

A monitor circuit senses differential between the left and right channels and shuts off yaw SAS when the differential is excessive. A hydraulic or engine failure will not automatically result in SAS disengagement. However, the affected axis will disengage when a differential between channels is sensed. Rudder pedal authority is more than sufficient to override an SAS induced rudder displacement. Below 240 KIAS, SAS can reduce the maximum obtainable rudder deflection from 25° to 15° in one direction. Above 240 KIAS, the full 8° of rudder deflection in either direction can always be obtained, regardless of SAS inputs. Flight with a single yaw SAS channel engaged can be safely pursued under most flight conditions once the malfunctioning channel is determined and deactivated. Such flight, however, should be pursued with caution when in formation or when at low altitude due to the possibility of a hardover type failure in the active channel. Such hardover failure will result in the respective rudder being driven a maximum of 10° right or left at speeds below 240 KIAS and 8° at speeds above 240 KIAS if not counteracted by appropriate rudder pedal displacement or SAS emergency disengagement. Single channel yaw SAS operation provides approximately 50% of the yaw trim, damping, and turn coordination available under two-channel operation.

Reengagement of yaw SAS, if desired, following a disengagement should be accomplished with caution, one channel at a time, in straight and level flight at a safe altitude and with sufficient clearance with other aircraft for recovery from possible yaw/roll transients during re-engagement. If yaw SAS operation cannot be maintained with both channels engaged, and single channel operation is desired for yaw damping, yaw trim, and partial turn coordination, the properly functioning channel can be determined by the trial and error method.

WARNING

- The yaw SAS fail-safe monitoring feature does not function during single channel SAS operation. Close formation or low altitude flight are not recommended during single channel SAS operation due to the possibility of an undesirable roll/yaw transient in the event of a yaw SAS hardover failure.

- Only one yaw SAS channel should be engaged when only one hydraulic power source or engine is available. The MASTER CAUTION will come on, should a disengagement occur, and this could result in distraction during a critical phase of flight. Additionally, a yaw transient may be experienced at time of disengagement with severity depending upon the amount of yaw SAS input into the rudder actuator.

If HARS is the operating attitude reference, an uncommanded disengagement will occur in the event of HARS roll or pitch servo failure. This is identified by noting the Attitude Direction Indicator (ADI) and Horizontal Situation Indicator (HSI) power off flags in view and the roll tabs missing from the HUD, or the HARS caution light coming on with disengagement of yaw SAS. Yaw trim and yaw rate damping can be reenabled by setting the HARS/SAS override switch to OVERRIDE and reengaging the SAS switches.

Yaw SAS Engage Switches.

Two yaw SAS engage switches (Figure 1-18) are located on the SAS control panel. These are two-position, solenoid-held switches, placarded YAW SAS ENGAGE and OFF, with one switch placarded L and the other placarded R. For normal engagement, both switches are actuated simultaneously and momentarily held. The switches are both electrically released to OFF if the monitor circuit signals a failure or if the SAS emergency disengage switch is actuated. The switches can also be manually moved to OFF. When either or both switches are OFF, the YAW SAS caution light will come on. The switches are powered by the right DC bus.

HARS/SAS Override Switch.

The HARS/SAS override switch (Figure 1-158) is located on the auxiliary lighting panel. The switch is a two-position toggle switch, placarded OVERRIDE and NORM. Setting the switch to OVERRIDE eliminates HARS roll error checking and provides for yaw SAS reengagement. The HAR/SAS override switch is powered by the right DC bus.

Yaw SAS Caution Light.

The YAW SAS caution light (Figure 1-158), on the caution light panel, will come on to indicate that one or both of the yaw SAS channels is disconnected.

MANUAL REVERSION FLIGHT CONTROL SYSTEM (MRFCS).

The MRFCS is an emergency system for use when dual hydraulic failure is impending or has occurred. The mode is adequate for executing moderate maneuvers. Landing should only be attempted under ideal conditions or when ejection is not possible, since any degradation beyond normal reversion may make landing impossible.

Emergency transitions to manual reversion are automatic and instantaneous in pitch and yaw, with stick and pedal commands transmitted directly to the elevator and rudder surfaces through the actuators, which are in the hydraulic bypass mode. Transitions in roll must be initiated. When MAN REVERSION (Figure 1-17) is selected, roll control is transferred from the ailerons to the aileron tabs. Selecting MAN REVERSION also closes hydraulic shutoff valves preventing unexpected return to hydraulic powered flight control. Manual reversion trim is provided only in pitch.

PITCH MRFCS.

Pitch transition to manual reversion occurs due to hydraulic pressure depletion. The same components are used for manual and hydraulic pitch control. As hydraulic pressure drops to 600 to 400 psi, elevator control automatically changes from hydraulic to mechanical. Electrical control of the two elevator trim tabs is automatically achieved when both hydraulic power sources have dropped below 1,000 to 800 psi. Artificial feel is retained.

Transition is reversible. Power control of the elevators is instantly restored as pressure at one (or both) of the actuators is increased above 700 to 900 psi. Both elevator trim tabs trim to neutral when either pressure switch senses 1,000 to 1,200 psi.

YAW MRFCS.

Yaw transition to manual reversion occurs due to hydraulic pressure depletion. The same mechanical elements are used for manual and hydraulic yaw control. As hydraulic pressure drops to 600 to 400 psi, rudder control automatically changes from hydraulic to mechanical. Transition is reversible. Power control is instantly restored as pressure is increased to 700 to 900 psi.

ROLL MRFCS.

To achieve roll control when hydraulic pressure is not present, the flight control mode switch must be set to MAN REVERSION. When MAN REVERSION is selected, stick commands are disconnected from the aileron actuators and connected to the aileron tabs. In this tab drive mode, the aileron tabs fly the aileron surface to the position commanded by the stick. Feel at the stick is proportional to air loads on the tabs.

Aileron Float-Up Transition.

After loss of hydraulic pressure, the trailing edges of the ailerons float up to a position that is higher than the powered neutral position. Aileron float up normally induces an aircraft pitch change which can be nose up or down depending on aircraft cg, elevator trim tab setting, power setting, and flap position. The pitch change intensity varies and is dependent on aileron float up rate, airspeed and altitude, and can range from minus 2.0 to plus 6.8 g's during transition.

To soften pitch onset, the aileron float-up rate is limited by damping in the actuators. The time for the ailerons to float-up after hydraulic pressure loss/bleed off is approximately 4 seconds. If the flight control mode switch has not been placed in MAN REVERSION after a dual hydraulic failure, the ailerons will float up, the stick will act directly on the actuator linkage and almost no roll control will be available. The stick feel will be the same as experienced on the ground before engine start.

Flight Control Mode Switch.

The flight control mode switch (Figure 1-17), located on the emergency flight control panel, is placarded FLT CONTR, with positions NORM and MAN REVERSION. The switch is lever-locked in both positions.

In MAN REVERSION both hydraulic systems are shut off. The switch simultaneously drives the aileron/tab shifters to tab drive. All other roll transfer logic is automatic. The switch controls two independent circuits, powered through the L & R AILERON TAB circuit breakers by the DC essential bus.

NOTE

All flight control mode switch functions are fully reversible at any time if hydraulic power is available.

Aileron/Tab Shifting Transition.

Selecting MAN REVERSION initiates aileron/tab shifting immediately. The shift cycle takes approximately 4 seconds to complete (in either direction). Tab shift action is progressive, providing increasing roll control.

As the shifters move from the normal position switches:

- Deactivate both normal and emergency roll trim
- Drive the roll trim actuators to neutral
- Cause the corresponding L or R AIL TAB caution light to come on.

Driving roll trim to neutral during MRFCS operation assures that the ailerons will go to neutral when power is restored.

Aileron Tab Caution Lights.

The aileron tab caution lights (Figure 1-158), placarded L AIL TAB and R AIL TAB, come on if the corresponding aileron/tab shifter is not at the full normal position.

Aileron/Tab Shifter Malfunctions.

Failure to shift to tab drive after the flight control mode switch is placed to MAN REVERSION is indicated by:

- Respective AIL TAB caution light off
- Very high lateral stick force - approaching locked stick feel
- Aileron jam light(s) may be on depending upon stick forces applied
- Stick moves toward the side of the nonfunctioning shifter.

If failure to shift is experienced after switching to MAN REVERSION and hydraulic power is available, return to NORM for the remainder of the flight. Should hydraulic power not be available, some roll control may be achieved by disengaging the aileron for the side with the nonfunctioning aileron/tab shifter.

WARNING

Flight in manual reversion with an aileron disconnected has not been tested and may be impossible.

Failure of a shifter to return to aileron drive after selecting NORM is indicated by:

- Stick movement toward the side of the malfunctioning shifter
- High lateral stick force required to keep wings level
- Respective AIL TAB caution light remains on when opposite side AIL TAB caution light goes
- Aileron tab on side with nonfunctioning shifter responds to stick movement with aileron remaining in neutral position
- Aileron trim inoperative.

If failure to shift is experienced after shifting to NORM, roll control can be increased, if necessary, by disengaging the aileron for the side with the nonfunctioning aileron/tab shifter as indicated by the AIL TAB caution light.

With one side disengaged, maximum roll capability will be reduced approximately 50%, and stick input for a given roll will be twice normal.

Roll trim can be restored by pulling the AIL TAB circuit breaker for the side with the nonfunctioning shifter. The corresponding AIL TAB caution light will go off when this circuit breaker is pulled and both ailerons will respond to roll trim.

Failure to complete the shift to tab or aileron drive degrades roll control for the mode selected. The degree of control available is based upon the amount of shift accomplished prior to failure. Hydraulic pressure and neutral aileron position will be normal for the mode selected. The aileron tab caution lights should provide an indication of which shifter has malfunctioned, unless an AIL TAB circuit breaker has opened. If an AIL TAB circuit breaker is open, the associated caution light is inoperative. The aileron tab circuit breaker should be checked whenever a shifter failure is suspected.

MRFCS OPERATION.

Shifting to MRFCS Mode (Hydraulic Power Available).

Most conversions to MRFCS will be intentionally initiated. If intentional transition is planned, the MRFCS should be ground checked prior to flight. Reasons to transfer to MRFCS, while hydraulic power is still available, include the following:

- Training in the MRFCS mode
- Check-out of the MRFCS mode
- Precautionary transfer to MRFCS mode; e.g., one hydraulic system failed and failure of the second system is imminent.

When accomplishing an intentional shift into manual reversion, comply with operating limitations in Section V. Selecting MAN REVERSION simulates a dual hydraulic failure, while simultaneously initiating roll transition to manual reversion. When the flight control mode switch is placed to MAN REVERSION, the following events occur:

- Hydraulic supply pressure is shut off and bleeds off to zero psi. This can take up to 10 seconds. Bleed off can be observed on the cockpit hydraulic pressure gauges and by noting the L/R HYD PRESS caution lights.
- The aileron tabs initiate (on switch actuation) shift to tab drive and this is indicated by the L/R AIL TAB caution lights coming on. Complete shift can take up to 4 seconds.

When hydraulic supply pressure bleed off is complete, aileron float up begins. Float up will take up to 4 seconds. Once the ailerons are floated up, the aileron actuators are in a bypass mode. Since supply pressure bleed off and aileron float up are sequential, the total time to regain roll control after selecting MAN REVERSION can be up to 14 seconds. If the stick is moved laterally prior to completion of aileron float up, the ailerons may float up abruptly and asymmetrically.

CAUTION

- Failure of one or both hydraulic systems to drop below 250 psi after switching to MAN REVERSION may result in locked ailerons after shift to aileron tab drive commences. Under these circumstances, control stick feel will be near normal for manual reversion; however, roll capability will be slight and in the opposite direction to stick displacement. Therefore, should one or both hydraulic pressure gauges fail to drop below 250 psi within approximately 10 seconds, and, if roll is in opposite direction to stick displacement, return the switch to NORM.
- If the stick is moved laterally prior to completion of aileron float up, the ailerons may float up abruptly and asymmetrically.

NOTE

The L/R AIL or L/R ELEV jam indicator lights may come on during manual reversion, due to airloads.

Shifting to MRFCS Mode (Hydraulic Power Not Available).

In a dual hydraulic failure the stick will essentially lock on roll. Stick feel will be the same as experienced on the ground before engine start. Pitch and yaw control will be available immediately, but MAN REVERSION must be selected to initiate tab shifting which will make it possible to regain roll control. Roll control will be available in approximately 4 seconds after selecting MAN REVERSION.

If hydraulic failure occurs, when operating single engine or with an asymmetric loading, the aircraft will begin a slow roll into the dead engine or heavy wing. The throttle should be retarded on the operating engine (to IDLE if conditions permit) after selecting MAN REVERSION. Coordinate rudder and aileron as thrust is increased after transition is complete. Asymmetric loadings can be corrected by selective jettison, as conditions permit.

Shifting Back to PFCS Mode.

Hydraulic power, if available, is immediately applied to flight control actuators when the flight control mode switch is returned to NORM. All logic functions are fully reversible and powered control of the elevators and rudders is immediate. Pitch trim change may be required. The ailerons drive down to neutral trim position, but roll control is not fully effective until aileron/tab shifting is complete. Roll trim control, both normal and emergency, is available at the completion of the shifting operation. Yaw trim control is regained after YAW SAS is reengaged.

SECONDARY FLIGHT CONTROL SYSTEM.

FLAP SYSTEM.

The aircraft is equipped with four wing trailing edge flaps (Figure 1-19). Flap positions are 0° (UP), 7° maneuver (MVR), and 20° (DN). The flaps are individually supported and each flap is positioned by one hydraulic actuator. The flaps are powered by the left hydraulic system. A cockpit control lever controls the flaps. When extended, flaps hold position in the event of loss of flap system electrical and/or hydraulic power until commanded up by the flap emergency retract switch. On loss of the left hydraulic system, the flaps will be inoperative. When fully extended, aerodynamic forces will cause unpowered flaps to retract to less than 15° and maneuvering flaps to retract to 0° if the emergency flap switch is activated. In full UP or DN, hydraulic pressure is retained in the selected position to eliminate flap creeping. During ground operations with the flap control set to MVR, the flaps may creep. The left outboard flap will cycle about the 7° position, and the other flap panels may assume varying positions. It may be necessary to recycle the flap lever to get all panels back to the 7° position.

Flaps will not extend and will automatically retract if the airspeed exceeds 185 to 210 KIAS. The flap control must be recycled through UP position, after the airspeed is below approximately 180 KIAS, in order to extend the flaps. When aircraft speed is reduced below approximately 190 KIAS (5 to 15 KIAS below auto retract speed), the flaps will automatically reextend if the flap lever is in MVR or DN. Emergency flap retract capability is provided by an emergency flap switch on the emergency flight control panel. When activated, the switch shuts off pressure and opens the down lines to return. Aerodynamic forces drive the flaps up to a minimum position.

Flap Lever.

The flap lever (Figure 1-5) is located on the throttle quadrant. It is placarded FLAPS with positions designated UP, MVR and DN. The lever electrically directs left hydraulic pressure to the flap actuators. The UP position fully retracts the flaps and retains hydraulic pressure to maintain flaps up. Selection of MVR positions the flaps to 7°. The DN position drives the flaps to full extended and retains hydraulic pressure to maintain flaps down. In the MVR position all but the left-hand outboard flap can creep but should retain symmetry under airloads. The flap lever has a lever lock which must be lifted when moving the lever from MVR to DN. The flap lever is powered by the right DC bus.

Flap Emergency Retract Switch.

The flap emergency retract switch (Figure 1-17) is a two-position lever-locked switch, located on the emergency flight control panel, placarded FLAP EMER RETR. The switch is powered by DC essential bus. The FLAP EMER RETR switch allows aerodynamic blow back of the flaps if flaps fail to retract due to failure of normal valving, control circuitry, or hydraulic system.

CAUTION

The overspeed protection circuit "Q switch sensor" is inoperative with the emergency flap switch in EMER RETR. Aerodynamic blow back may not fully retract the flaps in this position. Flap extension speeds are noted in Section V.

Flap Position Indicator.

The flap position indicator (34, Figure FO-1), on the instrument panel, is placarded FLAPS DEGREES. The indicator is powered by the auxiliary DC essential bus and receives its position signal from the position control unit attached to the left outboard flap.

SLAT SYSTEM.

The slat system (Figure 1-20) consists of movable two-position slat panels which are mounted on the inboard leading edge section of each wing. Slats are powered by the right hydraulic system. Electrical power for control is from the right DC bus.

The slats function automatically to improve high AOA air flow to the engines. The Emergency Stall Prevention System (ESPS) detects conditions that will lead to engine stall. Stall is determined in the ESPS system as a function of AOA and Mach. The AOA is measured by a lift transducer mounted on the lower side of the left wing leading edge. Mach is measured internally in the ESPS through the pitot static system. At a predetermined AOA and Mach, the slats extend. The ESPS is powered by the right AC bus.

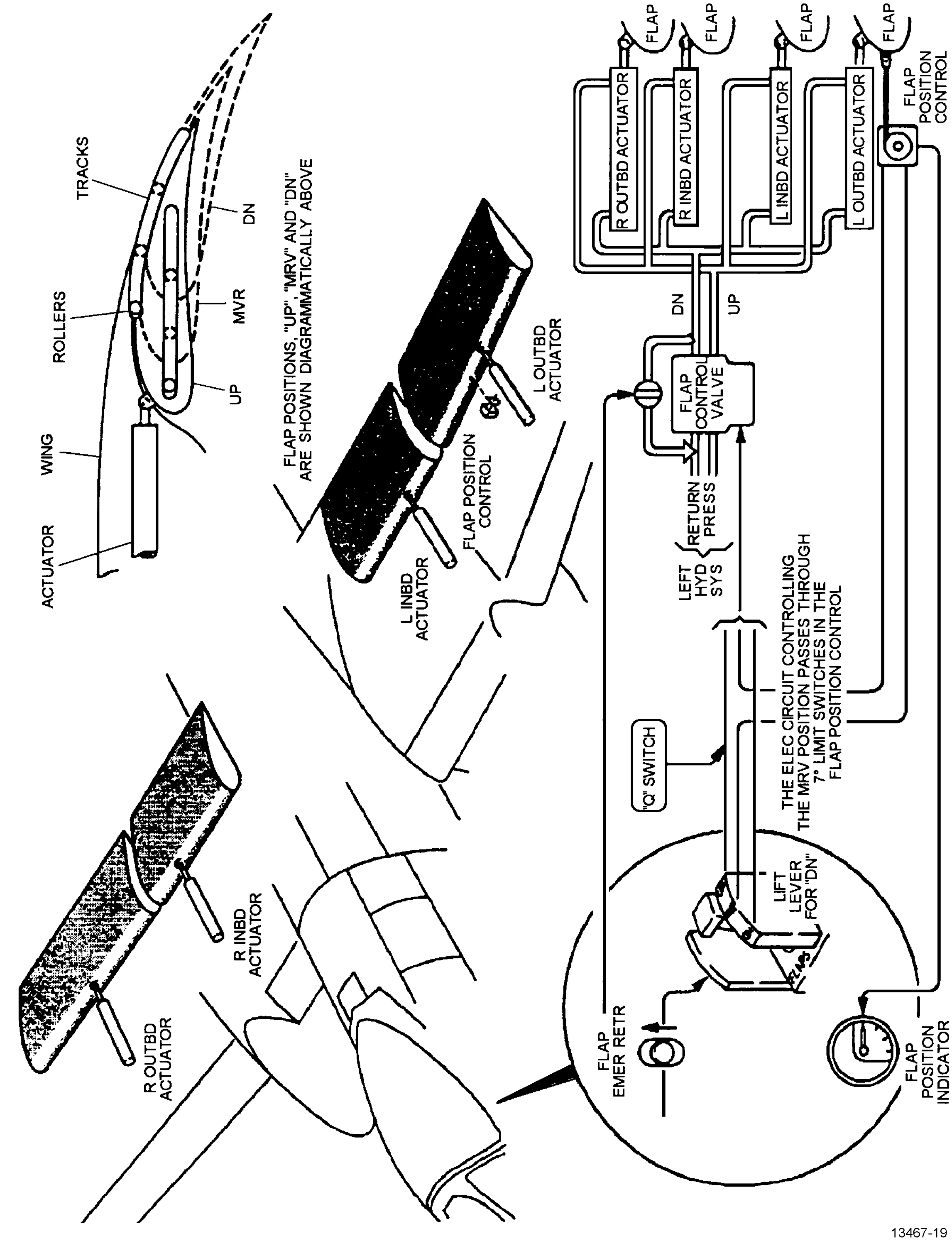


Figure 1-19.   Wing Flap System Schematic

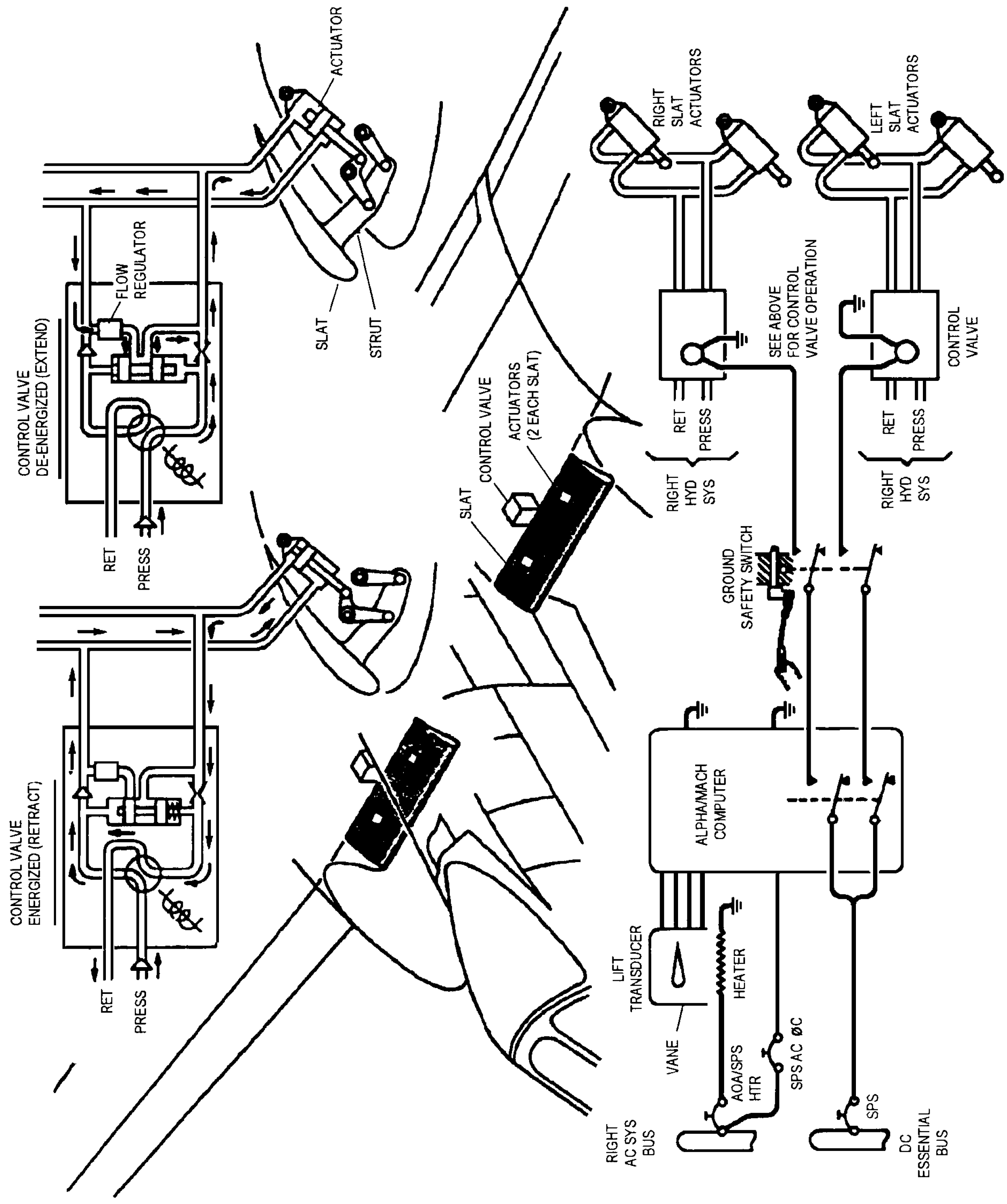


Figure 1-20. Wing Slat System Schematic

The lift transducer and its sensing vane are protected from icing by a heating element, which is energized when the pitot heat switch is set to HEAT. The heating element is powered by the right AC bus.

CAUTION

If the pitot heat switch is OFF, or fails during flight or the lift transducer vane heater fails, the slats may not extend when required.

On loss of either AC or DC electric power, the hydraulic system will extend the slats for fail-safe protection of the engines. On loss of hydraulic power, airloads will automatically extend the slats. With the slats extended, a drag index increase of 2.0 will result. Upon engine shutdown, slats may or may not extend.

WARNING

During ground operations, slats could cycle rapidly with application or removal of aircraft electrical power. Use caution to avoid injury to ground personnel.

SPEED BRAKE SYSTEM.

The speed brake surfaces (Figure 1-21) and actuating mechanisms are integrated in the ailerons. The upper and lower surfaces of both ailerons open to act as speed brakes.

The speed brakes fully open or close in approximately 3 seconds. On the ground, opening time is slightly less and closing time is slightly more. A limit switch limits the speed brakes to the 80% position during flight, and precludes holding positions of less than 10%. The WOW switch on the left MLG allows 100% deployment on the ground. If the aircraft becomes airborne with a speed brake position exceeding 80%, the speed brakes will not automatically retract to 80%. In this condition the speed brakes will only respond to retract commands initiated by the speed brake switch.

Automatic pitch trim compensation is provided by the IFFCC via pitch SAS for speed brake deployment. Automatic over-speed structural protection is provided by means of hydraulic relief action. The speed brakes blow back proportionally as air loads approach structural limits. Similarly, speed brake extend rate and travel is limited at high speed.

With total loss of hydraulic power (right engine not rotating), aerodynamic forces will slowly close speed brakes to trail position. With right engine windmilling, and if commanded prior to engine failure, speed brakes will be held in position. If commanded after engine failure and engine is windmilling, partial extension (degree dependent on airspeed) can be expected. Closing speed brake switch or selecting SPD BK EMER RETR will allow speed brakes to retract as hydraulic pressure is depleted.

With loss of electrical power, the speed brakes will retract to the closed position hydraulically.

NOTE

When right hydraulic pressure is 1000 psi or greater, the fastest way to close the speed brake is with the normal speed brake switch. When right hydraulic pressure is lower than 1000 psi, the fastest way to close the speed brake is with the speed brake emergency retract switch.

Speed Brake Switch.

The speed brake switch, located on the right throttle grip (Figure 1-5), has three positions. The aft position extends the speed brakes, and the switch is springloaded to the center or hold position. The forward position is detented and retracts the speed brakes. Moving or releasing the switch to the center position will hold the speed brakes in any position permitted by the system limits. The switch is powered by the auxiliary DC essential bus.

Speed Brake Emergency Retract Switch.

The speed brake emergency retract switch (Figure 1-17), placarded SPD BK EMER RETR, is located on the emergency flight control panel. It is a leverlocked, two-position switch. When the switch is in the normal (unmarked) position, the speed brakes are controlled by the speed brake control. When the switch is set to SPD BK EMER RETR, normal control circuits are deactivated and a direct emergency circuit blocks hydraulic pressure and vents speed brake extend lines to return. This action allows air loads to completely close the speed brakes in 2 to 10 seconds. As the system vents, a slight but distinct movement or "pop" of the open speed brakes indicates that the emergency valve has moved. The switch circuitry is independently powered by the auxiliary DC essential bus.

SPEED BRAKE WARNING SYSTEM.

Refer to the IFFCC in this section.

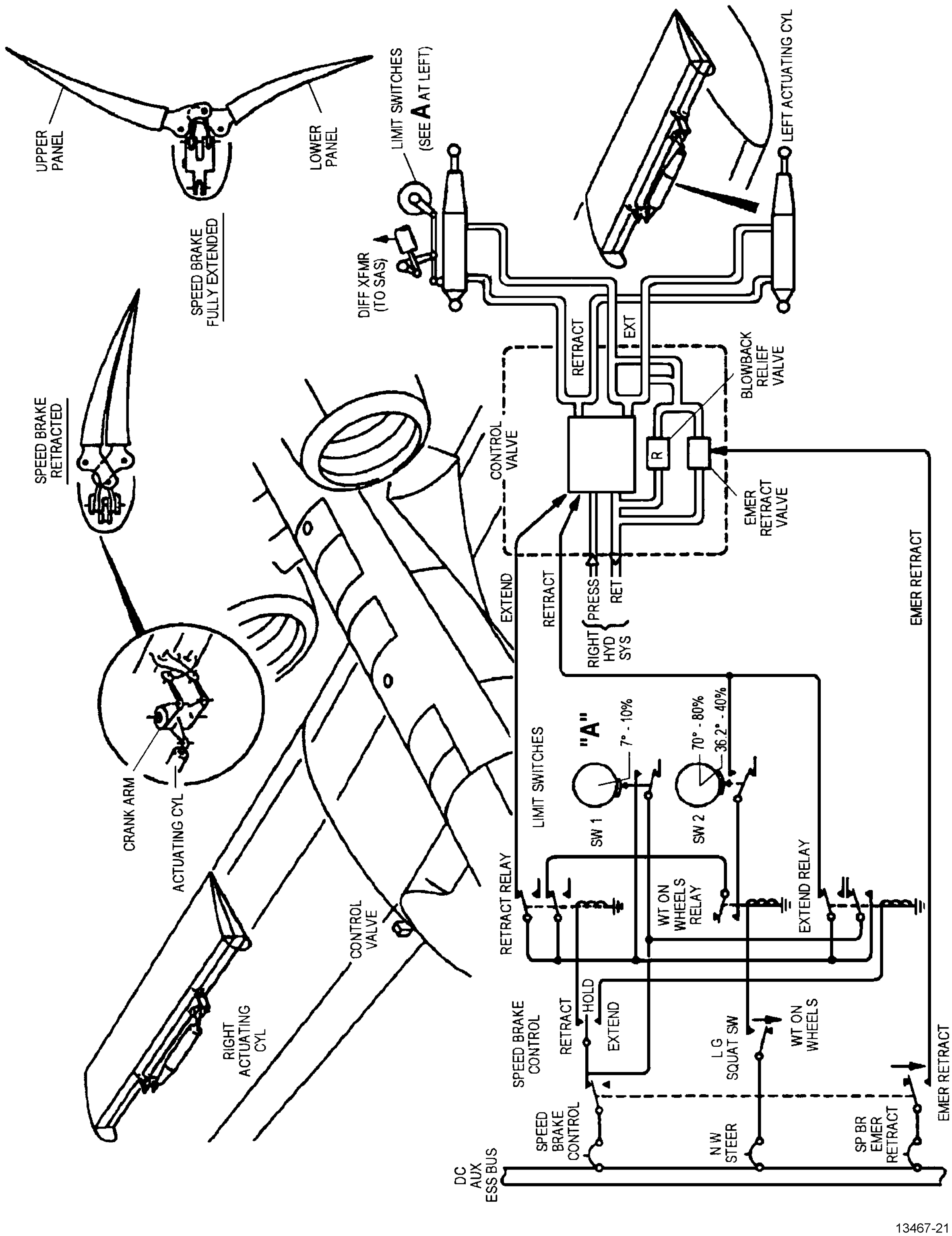


Figure 1-21. Speed Brake System Schematic

BOARDING LADDER.

The boarding ladder (Figure 1-22) is a telescoping ladder that stows in a compartment in the left forward fuselage, below the cockpit. The ladder compartment door is hinged on the forward edge and opens to rest flat against the fuselage. A permanent-type magnet holds the door in the open position. A battery bus-powered latch mechanism is located at the aft edge of the door. Both the compartment door and the ladder are spring-loaded to open, and the ladder telescopes open by gravity. From the cockpit, the ladder may be extended by depressing a pushbutton switch (4, Figure FO-3) located under a hinged cover guard placarded EXTEND BOARDING LADDER.

From the exterior of the aircraft, the ladder may be extended by depressing the ladder release button located aft of the door. For stowage, the ladder must be pushed up manually.

CANOPY.

The canopy is constructed of molded stretched acrylic plastic, with no supporting structural members.

Normal raising or lowering of the canopy is accomplished by control switches, from inside or outside the aircraft (Figure 1-23). The canopy is opened and closed by an actuator that operates on battery bus power.

WARNING

> A malfunction in the canopy control circuitry could cause the canopy to immediately begin closing after reaching the full up position. If this occurs, place CANOPY switch to HOLD and stay clear. Once the canopy is fully closed, exit from the aircraft can be accomplished by manually raising the canopy.

In the event of failure of the actuator or loss of battery bus power, provisions for mechanical disengagement of the canopy/actuator attachment are available. Disengagement is accomplished by three mechanical control devices enabling the canopy to be opened manually from the inside or outside (left or right side) of the aircraft.

The canopy may be jettisoned, either in flight or on the ground, independent of the seat ejection function, by pulling a control, placarded CANOPY JETTISON, located on the right console. The canopy may be jettisoned from the outside by a control on either side of the aircraft which is independent of the seat ejection function. The canopy jettison sequence is initiated by opening either rescue door, and pulling the handle approximately 6 feet.

COCKPIT CANOPY CONTROL SWITCH.

The cockpit canopy control switch (Figure 1-23), placarded CANOPY, is a three-position toggle switch located on the right console placarded OPEN, HOLD, and CLOSE. When the switch is lifted and set to OPEN, battery bus power unlocks the canopy and the actuator drives the canopy to full open. When in HOLD, the canopy will stop movement and remain at the desired position. When the switch is held in CLOSE, the actuator is electrically driven to the fully locked position. The switch is spring-loaded to return from CLOSE to HOLD when released. The switch will remain in OPEN.

NOTE

> After the canopy switch is positioned to OPEN, it may take up to 3 seconds for the canopy seal to depressurize and the canopy locks to open before the canopy starts to move.

CANOPY UNLOCKED LIGHT.

A red warning light (16, Figure FO-1), placarded CANOPY UNLOCKED, is located on the instrument panel. The light indicates the canopy is not closed and locked. The light is powered by the auxiliary DC essential bus.

EXTERNAL CANOPY CONTROL SWITCH.

The external canopy control switch (Figure 1-23) is located at the lower left side of the aircraft beneath the canopy behind access F71. The switch is placarded CANOPY with two momentary positions OPEN and CLOSE and spring-loaded to a center unmarked OFF position. To close the canopy with the external switch, insure the cockpit canopy control switch is in HOLD to preclude the canopy from opening when the external switch is released. The switch is powered by the battery bus.

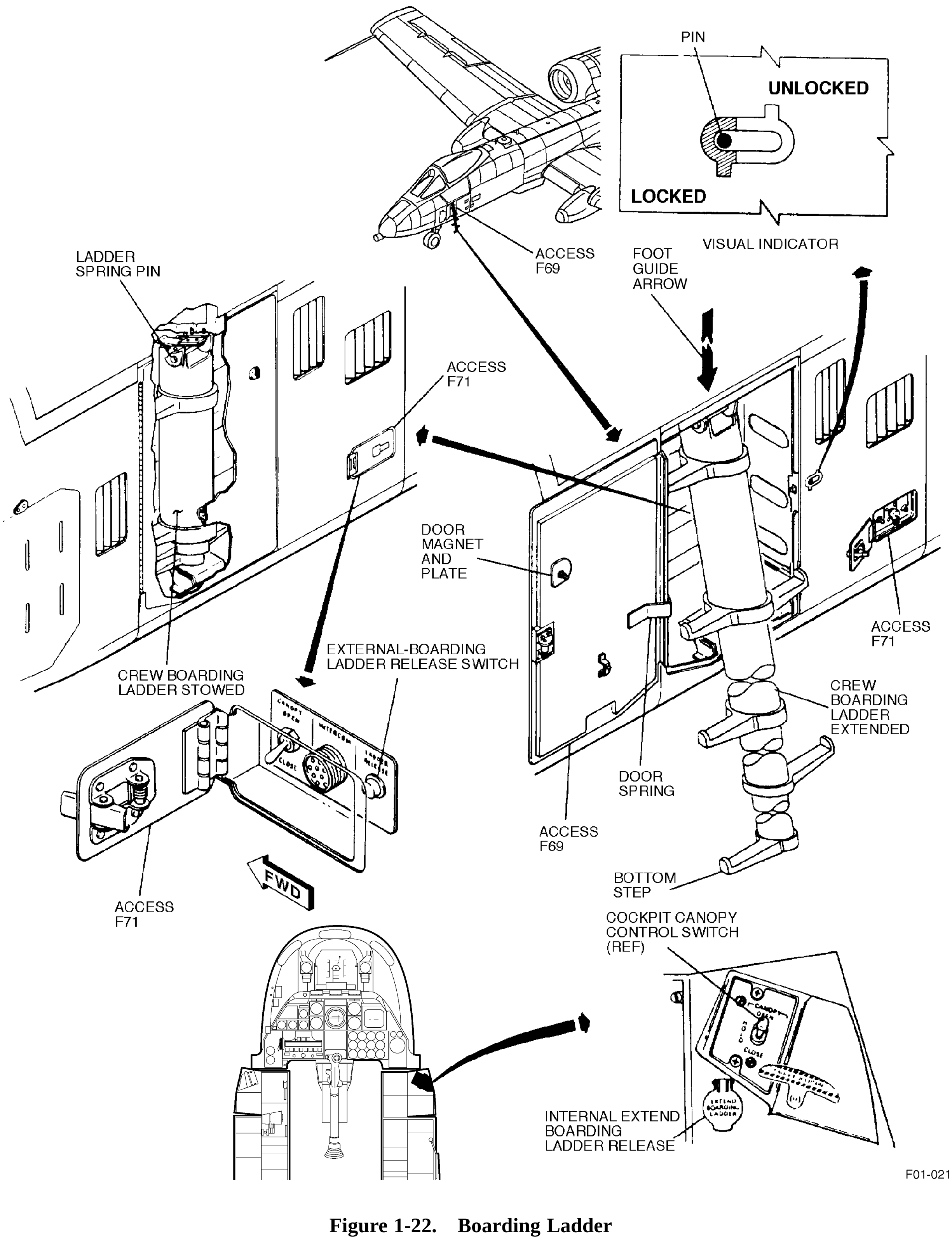


Figure 1-22. Boarding Ladder

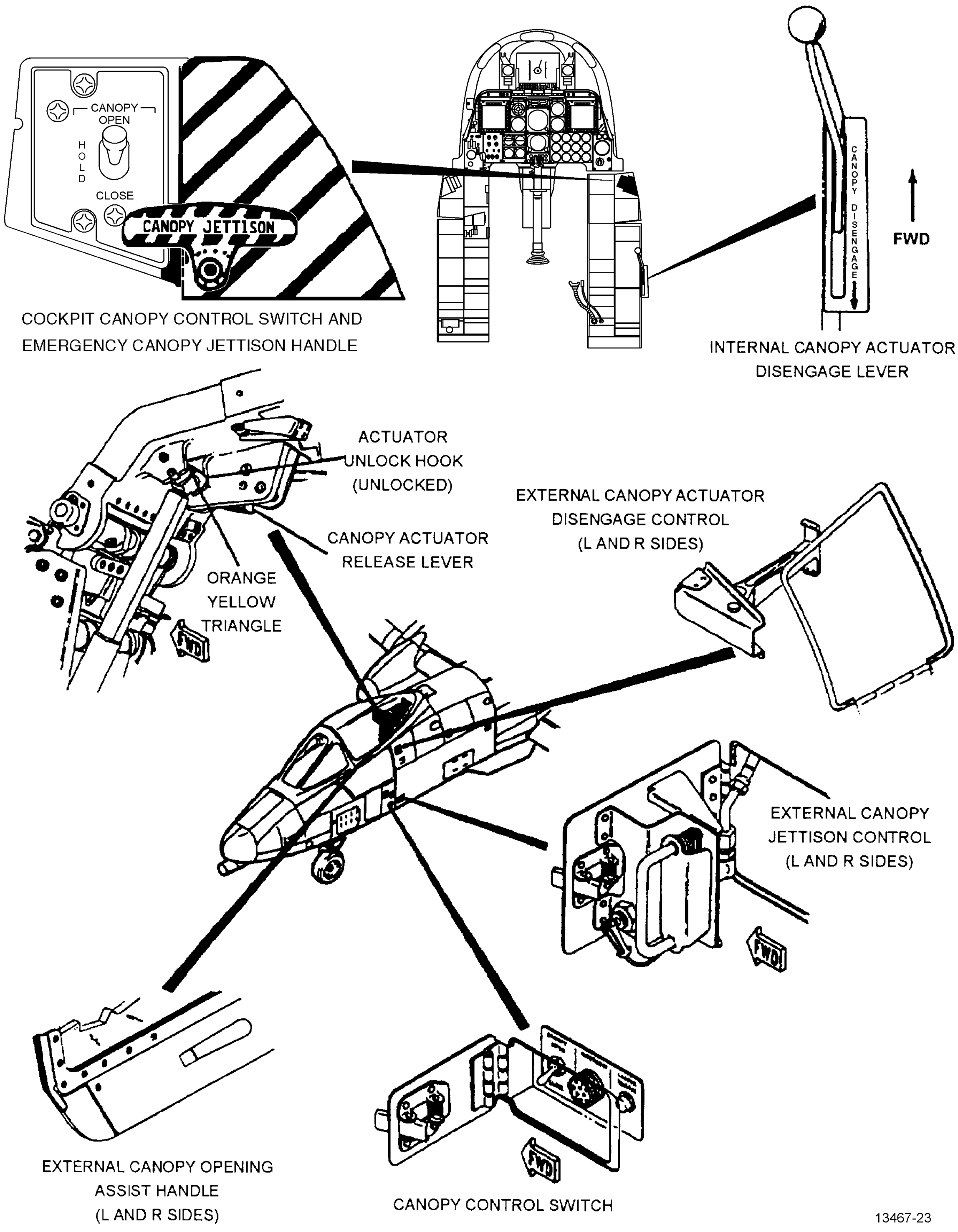


Figure 1-23. Canopy Controls (Sheet 1 of 2)

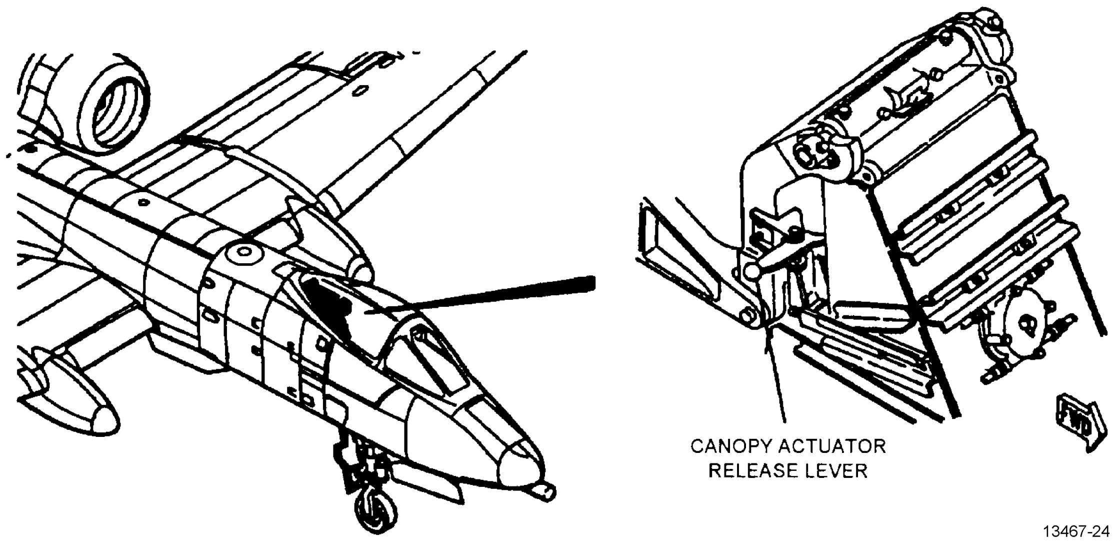


Figure 1-23. Canopy Controls (Sheet 2)

INTERNAL CANOPY ACTUATOR DISENGAGE LEVER.

The internal canopy actuator-disengage lever (Figure 1-23), placarded CANOPY DISENGAGE, is located on the outboard side of the right console. To disengage the canopy actuator, the canopy must be closed and the lever moved aft, as indicated by placarded arrow. Moving the lever aft releases the canopy downlock mechanism, unlocks the canopy, and disengages the canopy actuator. When it is unlocked and disengaged, the canopy is free to slide aft about one inch and open manually. The canopy is then held in the full-open position by a spring-loaded uplock pin. If the canopy is partially open and the actuator cannot be disengaged by use of the canopy actuator, disengage lever.

- The actuator can be disengaged by reaching behind the seat on the right side and actuating the canopy actuator release lever.

If the canopy must be opened manually while the engines or APU are running:

- The APU should be shut down and the MAIN AIR switch should be positioned to OFF prior to opening the canopy. Either action will depressurize the canopy seal and allow the actuator disengage lever to be moved aft with less effort.

INTERNAL EMERGENCY CANOPY ACTUATOR RELEASE LEVER.

The internal emergency canopy actuator release lever is located above and aft of the ejection seat (Figure 1-23). The emergency canopy actuator release lever, extending toward the right side of the fuselage, is pulled forward to displace the canopy downlock mechanism to unlock the canopy and disengage the canopy actuator. The handle is colored flat black with a yellow knob on the outboard end.

INTERNAL MANUAL CANOPY OPENING ASSIST HANDLES.

The internal manual canopy opening assist handles (4, Figure FO-2 and 10, Figure FO-3) are placarded MANUAL CANOPY OPENING ASSIST.

Each handle is retained in a stowed position by a spring-loaded pin. Each handle is manually rotated in an inward and upward direction to a horizontal position. Grasping the handles with both hands and sliding the canopy aft and up opens the canopy manually, after the canopy has been disengaged.

INTERNAL CANOPY JETTISON HANDLE.

The internal canopy jettison handle (Figure 1-23), placarded CANOPY JETTISON superimposed on a striped background, is located in the extreme forward panel of the right console. The handle is linked by a shaft directly to the canopy initiator. The jettison sequence is begun by pulling the canopy jettison handle. Pip button must be depressed before CANOPY JETTISON handle can be pulled.

CANOPY BREAKER TOOL.

The canopy breaker tool (13, Figure FO-3) is a special knife with a short blade, located on the right canopy rail.

EXTERNAL CANOPY ACTUATOR DISENGAGE CONTROLS.

The external canopy actuator disengage controls (Figure 1-23) are T-shaped handles installed on the left and right sides of the fuselage and accessible by opening an access door. When either T-handle is rotated with the canopy closed, the canopy is unlocked and the canopy actuator is disengaged.

EXTERNAL CANOPY OPENING ASSIST HANDLES.

The external canopy opening assist handles (Figure 1-23) are flush mounted foldout handles located at the left and right sides of the canopy frame approximately 6 inches aft of the bow. Rotating the handles upward and grasping facilities raises the canopy manually.

EXTERNAL CANOPY JETTISON CONTROLS.

The external canopy jettison controls (Figure 1-23) are located in compartments located on either side of the fuselage, behind access doors placarded RESCUE. Both left and right doors are accessible from the ground. Inside the compartments are handles that are linked by 6-foot long lanyards to canopy initiators.

EJECTION SEAT.

The ACES II ejection seat is a dual initiated, fully automatic, catapult rocket system (Figure 1-24). Three ejection modes are automatically selected. Mode 1 is a low-speed mode during which the parachute is deployed almost immediately after the seat departs the aircraft. Mode 2 is a high-speed mode during which a drogue chute is first deployed to slow the seat, followed by the deployment of the parachute. Mode 3 is a high altitude mode in which the sequence of events is the same as Mode 2, except that man-seat separation and deployment of the parachute is delayed until a safe altitude is reached. Controls are provided to adjust seat height and lock shoulder harness.

WARNING

Increased potential for injury, due to drogue parachute opening shock, exists for ejection above 340 knots. The risk of injury at higher airspeeds increases significantly for body-weights less than 140 pounds (below the ACES II ejection seat design range of 140 to 211 pounds).

BATTERY INDICATOR.

A battery indicator (Figure 1-24), a small circular hole on the right side of the seat forward of the seat rail, gives indication of the status of the seat sequencing system battery. White indicates a good battery; red indicates bad.

EMERGENCY OXYGEN.

An emergency oxygen supply is contained in a cylinder located on the left side of the seat. The hose is routed to a connector on the torso harness. The system is actuated automatically in an ejection by a lanyard anchored to the cockpit structure. A green ring is located on the left side of the seat bucket for in-cockpit use.

INERTIA REEL POWER HAUL-BACK.

The seat system incorporates a powered inertia reel retraction mechanism. The inertia lock reel mechanism automatically restrains the pilot against the seat backrest as a pre-ejection function.

MANUAL INERTIA REEL CONTROL.

The manual inertia reel control is placarded SHOULDER HARNESS with positions UNLOCKED (aft) and LOCKED (forward). The LOCKED position locks the inertia reel at any increment of shoulder harness extension. The UNLOCKED position unlocks the shoulder harness inertial reel. The reel automatically locks if subjected to an inertia load of more than 2.0 g's. If the inertia reel has automatically locked, the inertia reel control must be cycled to release the reel.

SEAT GROUND SAFETY LEVER.

A seat ground safety lever is located behind the left side ejection control handle. When the lever is in the SAFE position (forward), the ejection controls are locked. During flight, the seat ground safety lever must be in armed position (aft) to ensure that the handles are unlocked. A safety pin can be inserted to lock the controls.

SEAT NOT ARMED.

The SEAT NOT ARMED light on the caution light panel will illuminate with the seat ground safety lever in the SAFE (forward) position. The light will go out when the lever is in the ARMED (aft) position.

EJECTION HANDLES.

The ejection control handles, mounted on each side of the seat bucket, placarded PULL TO EJECT, are actuated by an upward and aft pull of approximately 45 pounds, and lock in the extended position. Measured from forward edge of control handles, handles need only be raised 2.05 inches or more (25 degrees) to initiate ejection. Handle over-center locks engage at close to 4 inches (45 degrees) of travel.

The handles are interconnected so that actuation of either handle initiates the ejection sequence. The hand opening in each handle is covered on the inboard side by a flexible safety guard.

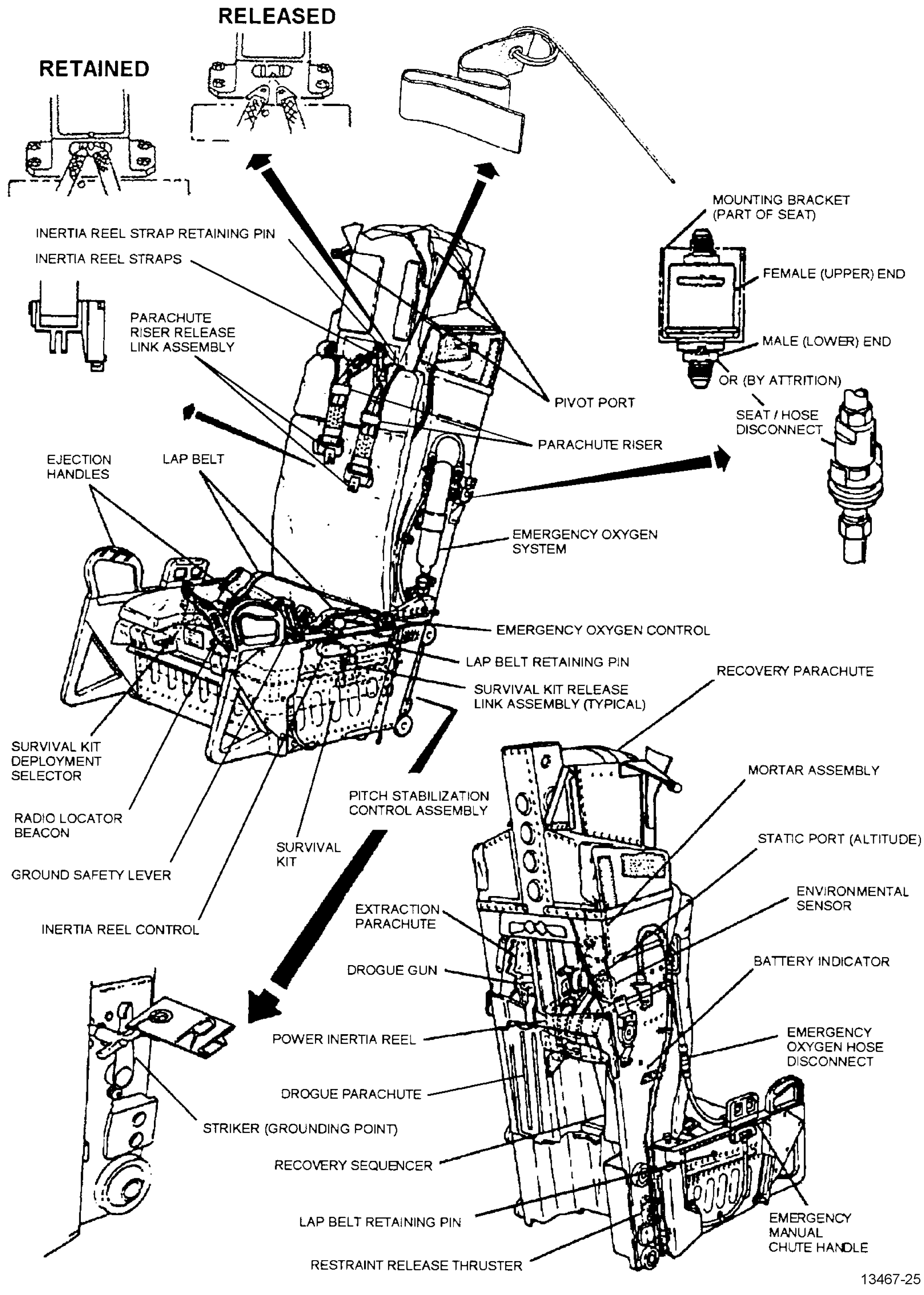


Figure 1-24. ACES II Ejection Seat

SEAT ADJUSTMENT SWITCH.

The seat adjustment switch is placarded SEAT and has three positions: UP, DOWN and HOLD. Seat height is selected by holding the switch in UP or DOWN until the desired height is obtained. The seat adjustment motor is protected by a thermal relay that will disconnect when overheated. After a 1-minute cooling period, the motor should operate normally. The switch, spring-loaded to return to the center HOLD position when released from either UP or DOWN positions, is powered by the left AC bus.

CAUTION

Seat adjustment with disconnected personal leads or strap-in connections lodged between the seat and console may result in damage to the seat, console, and/or leads/connections.

SEAWATER ACTIVATED RELEASE SYSTEM (SEAWARS).

The SEAWARS consists of two parachute harness sensing-release units (Figure 1-24), one fitted to each parachute riser. When the water sensor is immersed in seawater, the parachute riser is released from the canopy release, freeing the pilot from the parachute.

NOTE

Some aircraft may be modified with a Universal Water Activated Release System (UWARS). See below.

UNIVERSAL WATER ACTIVATED RELEASE SYSTEM (UWARS).

The UWARS consists of two parachute harness sensing-release units (Figure 1-25), one fitted to each parachute riser. The UWARS unit is designed to operate within 2.5 seconds after being immersed in seawater. The UWARS unit will remain inactive when exposed to humidity, rain, and salt spray. The UWARS consists of two independent self-contained activation devices that attach to the parachute risers and the left and right canopy releases. The UWARS is functionally independent from the manual release system. It does not affect the operation of the manual release, nor does it depend on the manual release for proper operation.

SURVIVAL KIT.

The ACES II ejection seat provides for stowage of a nonrigid equipment package in the seat bucket, covered by a rigid, contoured seat pan.

The survival kit (Figure 1-26) consists of a fabric case that houses the life raft, a rucksack, and a small inner container for the stowage of survival equipment. A radio locator beacon is installed on the outside of the kit. Two adjustable straps secure the kit to the torso harness by means of quick-release connectors.

SURVIVAL KIT DEPLOYMENT SELECTOR.

A kit deployment selector, located in the right side forward edge of the seat pan, allows automatic or manual deployment of the rucksack and life raft to be preselected. When automatic deployment is selected, the kit closures are released by a 4-second delay cutter that is armed at seat-pilot separation. This allows the rucksack and life raft to drop on a 25-foot lanyard. The rucksack and life raft can be manually deployed during descent by pulling the manual release ring. The inner container is secured to the kit case, and does not deploy.

RADIO LOCATOR BEACON.

The radio locator beacon is activated and its antenna is deployed automatically at seat/pilot separation. A control switch is provided in the left side, forward edge of the seat pan, to permit overriding the automatic operation of this beacon.

EMERGENCY MANUAL CHUTE HANDLE.

The emergency manual chute handle (Figure 1-24) is placarded EMERGENCY MANUAL CHUTE. The handle cannot be activated while the seat is in the aircraft. After ejection, if automatic recovery sequence is not completed, the handle may be pulled to ballistically deploy recovery chute and disconnect pilot from seat.

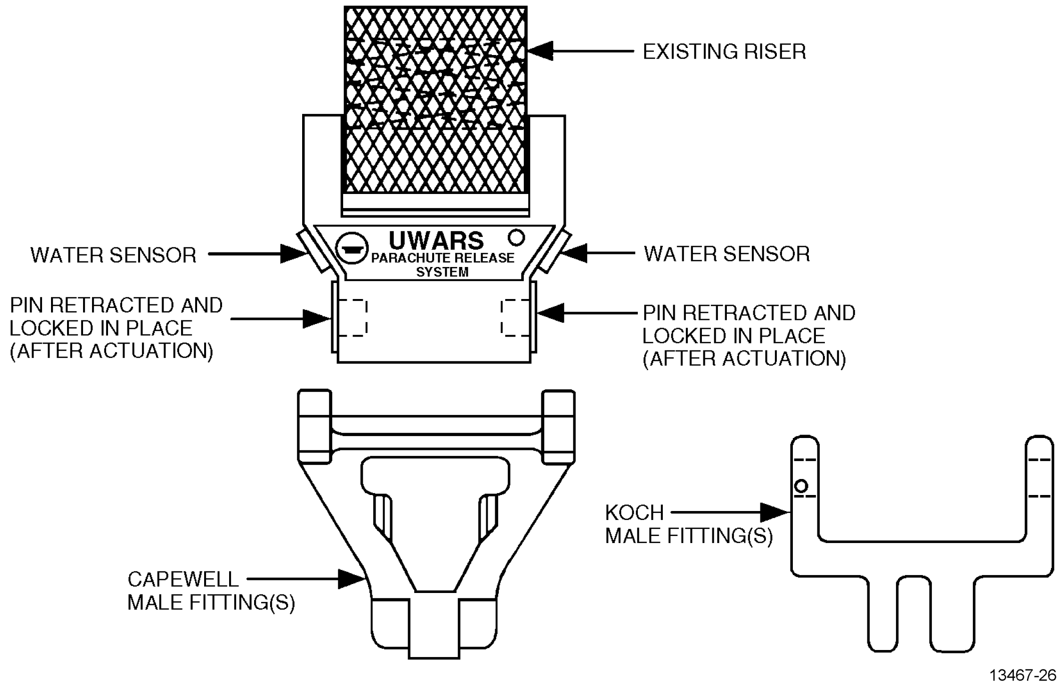


Figure 1-25. Universal Water Activated Release System (UWARS)

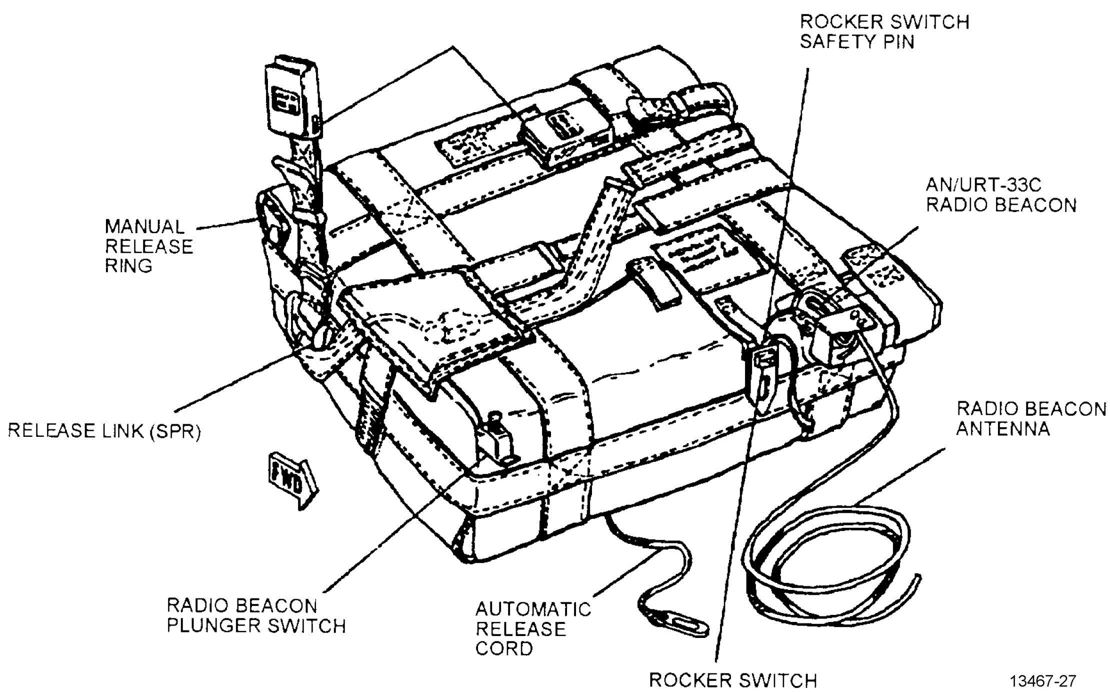


Figure 1-26. Survival Kit

SEAT OPERATION - EJECTION SEQUENCE.

a. Escape begins by grasping and pulling either or both ejection handles in an up and aftward direction. Actuation fires a cartridge, generating gas pressure that activates the haulback inertia reel and fires other cartridge actuated components for immediate jettisoning of the canopy and activation of an aircraft-mounted delay initiator. When Identification Friend or Foe (IFF) is in primary control mode, a signal will be sent from the Armament Logic Module (ALM) to the CICU when ejecting. When this signal is received, the IFF will be set into emergency mode. When the IFF is in backup control mode, the gas pressure also closes a switch activating the aircraft emergency IFF system.

WARNING

Do not attempt to eject with the canopy open, since the canopy will not jettison and the bow structure will obstruct the escape clearance envelope.

b. The forward structural bow of the canopy clears the ejection path in approximately 0.2 second.

NOTE

In the event the canopy fails to jettison, the canopy breaker at the top of the seat will shatter the canopy and an ejection can take place.

c. The delay initiator fires 0.3 second after activation, causing a cartridge in the rocket catapult to fire, projecting the seat upward. During the upward travel, the pilot's personal leads separate, the seat/airplane gas disconnect separates, and a lanyard actuates the emergency oxygen cylinder. Also, the acceleration forces cause the pilot's legs to be held within the sides of the seat bucket due to the raised ejection controls. Catapult pressure activates two thermal batteries, providing electrical power for the recovery sequencer.

d. As the seat moves up the guide rails, the pitot tubes at each side of the headrest (parachute container) are exposed to the airstream. Speed and altitude transducers determine the airspeed and altitude of the seat. The recovery sequencer selects the appropriate automatic sequence.

e. As the seat approaches the top of the guide rails:

(1) The rocket motor ignites.

(2) Recovery sequencer is initiated by a switch that closes on contact with a striker plate on the right guide rail.

(3) An electrical signal from the sequencer fires a cartridge, generating pressure to spin up a pitch rate gyro.

(4) Upon reaching its operating speed, the gyro is uncaged and the pitch stabilization vernier rocket motor ignites.

(5) As the seat leaves the guide rails, the rocket motor accelerates the seat away from the aircraft in a suitable trajectory.

(6) The gyro controlled vernier rocket motor stabilizes the seat in its trajectory. Leg flailing due to windblast is prevented by the high extended sides of the seat bucket with the raised ejection controls, which also aids in maintaining seat stability.

(7) The remainder of the recovery sequences depends upon the recovery mode. The envelopes relating to each mode of operation are shown in Figure 3-7. The recovery sequence for each mode is as follows:

Mode 1 Operation.

(Figure 3-5) In mode 1, the recovery parachute mortar is fired 0.2 second after rocket catapult ignition. As the mortar propels the parachute assembly away from the seat, 1.15-second delay reefing line cutters are activated and the pilot chute is released. The harness release thruster is actuated 0.25 second later and the deploying parachute separates the pilot from the seat. The parachute inflates to the reefed configuration until the reefing line cutters actuate to permit full inflation. The survival kit is automatically deployed approximately 4.0 seconds after seat/man separation (if automatic survival kit deployment is selected). In addition, if the locator beacon rocker switch is in the automatic position, the beacon will be activated at this time.

Mode 2 Operation.

(Figure 3-5) In Mode 2, the drogue gun is initiated as the seat approaches the top of the guide rails. Projection of the drogue gun slug deploys the extraction chute which in turn deploys the drogue chute. The drogue chute provides seat retardation and additional stabilization for high-speed ejections. The recovery parachute mortar is fired 0.82 second after rocket catapult ignition, and 0.15 second later the drogue chute is severed from the seat. Parachute operation, seat/man separation, etc., occur thereafter as in Mode 1.

Mode 3 Operation.

In Mode 3, the operation and sequence of events is identical to that for Mode 2 (Figure 3-5), except that after the drogue chute is deployed, the sequence is interrupted until the altitude and speed decrease to Mode 2 conditions (Figure 3-7).

BACK-UP RECOVERY MODE OPERATION.

The EMERGENCY MANUAL CHUTE handle (Figure 1-24) cannot be activated while the seat is in the aircraft. After ejection, pulling the handle will ballistically deploy chute and disconnect pilot from seat.

OXYGEN SYSTEM NON518.

The oxygen system is a liquid oxygen type consisting of a converter, a quantity gauge, external filler valve, and a regulator. A regulator supplies breathing oxygen. Oxygen duration at various altitudes is shown in Figure 1-27.

CAUTION

- Do not hold emergency control in EMERGENCY longer than ten seconds with a leaking mask or with the mask down.
- When placing the emergency lever in either EMERGENCY or TEST-MASK, the oxygen mask must be fitted to the face. Continuous delivery of oxygen at a positive pressure with a leaking or with the mask removed for extended time periods will deplete the oxygen supply rapidly. This will result in extremely cold oxygen and the possibility of liquid oxygen flowing into the regulator.

OXYGEN REGULATOR.

The oxygen regulator (Figure 1-28), installed on the right console, is an automatic diluter-demand type. In normal use, as the altitude increases, the amount of air in the mixture decreases until 100% oxygen is delivered to the mask at 30,000 feet cabin altitude. Pure oxygen (100%) can be delivered at all altitudes.

Supply Lever.

The supply lever (Figure 1-28), placarded SUPPLY, is a green colored two-position toggle control. The positions are placarded ON and OFF. In ON position, gaseous oxygen flows from the oxygen regulator. Setting the regulator to OFF shuts off oxygen flow at the regulator.

Diluter Lever.

The diluter lever (Figure 1-28), a white colored two-position toggle, is located on the oxygen regulator control panel. The two positions are placarded 100% OXYGEN and NORMAL OXYGEN. In NORMAL OXYGEN, the oxygen regulator provides the optimum air/oxygen mixture for a particular altitude, in the quantity demanded by the pilot. In 100% OXYGEN, pure oxygen is provided regardless of altitude.

Emergency Lever.

The emergency lever (Figure 1-28), a red colored three-position toggle, is located on the oxygen regulator panel. The three positions are placarded EMERGENCY, NORMAL, and TEST MASK. In EMERGENCY, a constant flow of oxygen is delivered to the oxygen mask under pressure. In NORMAL, the proper oxygen-ambient air mixture is available on demand. In TEST MASK, in which the toggle must be held, since it is spring-loaded to NORMAL, oxygen is delivered under pressure to test the oxygen mask for leaks and proper fit.

Oxygen Flow Indicator.

The oxygen flow indicator (Figure 1-28) is an oblong-shaped display located in the upper left corner of the oxygen regulator control panel, placarded FLOW. The indicator blinks alternately white and black with each inhalation/exhalation cycle to signify the flow of oxygen.

Oxygen Supply Pressure/Oxygen Quantity Indicator.

The oxygen supply pressure indicator (Figure 1-28), placarded OXYGEN SUPPLY PRESSURE or OXYGEN QTY, displays the gaseous oxygen pressure in the oxygen supply line.

OXYGEN INDICATOR TEST BUTTON.

The oxygen indicator test button (Figure 1-30), placarded OXY IND TEST, is a pushbutton switch located on the environment control panel. When the button is depressed and held, the liquid oxygen quantity indicator moves toward 0 and at the 0.5 liter indication triggers the oxygen low level caution light. When the button is released, the liquid oxygen indicator displays actual oxygen quantity.

OXYGEN QUANTITY INDICATOR.

The liquid oxygen quantity indicator (Figure 1-30), mounted on the environment control panel in the right console, is placarded LIQUID OXYGEN LITERS. The indicator scale ranges from 0 to 5 liters. The indicator shows the quantity of liquid oxygen in the converter. The indicator uses power from the auxiliary AC essential bus.

OXYGEN LOW-LEVEL CAUTION LIGHT.

The liquid oxygen low-level caution light (Figure 1-158), placarded OXY LOW, is located on the caution light panel. The OXY LOW light and the MASTER CAUTION light come on when the liquid oxygen quantity gauge indicates 0.5 liter or less.

OXYGEN DURATION - HOURS

with diluter lever “100%” *

with diluter lever “normal”

CABIN ALTITUDE FEET	INDICATED QUANTITY - LITERS 5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	BELOW 0.5
35,000 & above	30.94 - 30.94	27.84 - 27.84	24.75 - 24.75	21.65 - 21.65	18.56 - 18.56	15.47 - 15.47	12.37 - 12.37	9.28 - 9.28	6.19 - 6.19	3.09 - 3.09	DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
30,000	22.63 - 22.99	20.37 - 20.70	18.11 - 18.40	15.84 - 16.10	13.58 - 13.80	11.32 - 11.50	9.05 - 9.20	6.79 - 6.90	4.53 - 4.60	2.26 - 2.30	
25,000	17.48 - 21.72	15.73 - 19.55	13.98 - 17.37	12.24 - 15.20	10.49 - 13.03	8.74 - 10.86	6.99 - 8.69	5.24 - 6.52	3.50 - 4.34	1.75 - 2.17	
20,000	13.19 - 24.43	11.87 - 21.99	10.55 - 19.55	9.23 - 17.10	7.91 - 14.66	6.60 - 12.22	5.28 - 9.77	3.96 - 7.33	2.64 - 4.89	1.32 - 2.44	
15,000	10.62 - 29.86	9.56 - 26.88	8.49 - 23.89	7.43 - 20.90	6.37 - 17.92	5.31 - 14.93	4.25 - 11.94	3.19 - 8.96	2.12 - 5.97	1.06 - 2.99	
10,000	8.53 - 29.85	7.68 - 26.88	6.83 - 23.89	5.97 - 20.90	5.12 - 17.92	4.27 - 14.93	3.41 - 11.94	2.56 - 8.96	1.71 - 5.97	0.85 - 2.99	
5,000	6.75 - 29.86	6.08 - 26.88	5.40 - 23.89	4.73 - 20.90	4.05 - 17.92	3.38 - 14.93	2.70 - 11.94	2.03 - 8.96	1.35 - 5.97	0.68 - 2.99	
SL	5.46 - 29.86	4.92 - 26.88	4.37 - 23.89	3.82 - 20.90	3.28 - 17.92	2.73 - 14.93	2.19 - 11.94	1.64 - 8.96	1.08 - 5.97	0.55 - 2.99	

* Using CRU-73A Diluter-Demand Regulator

13467-28

Figure 1-27. Oxygen Duration NON518

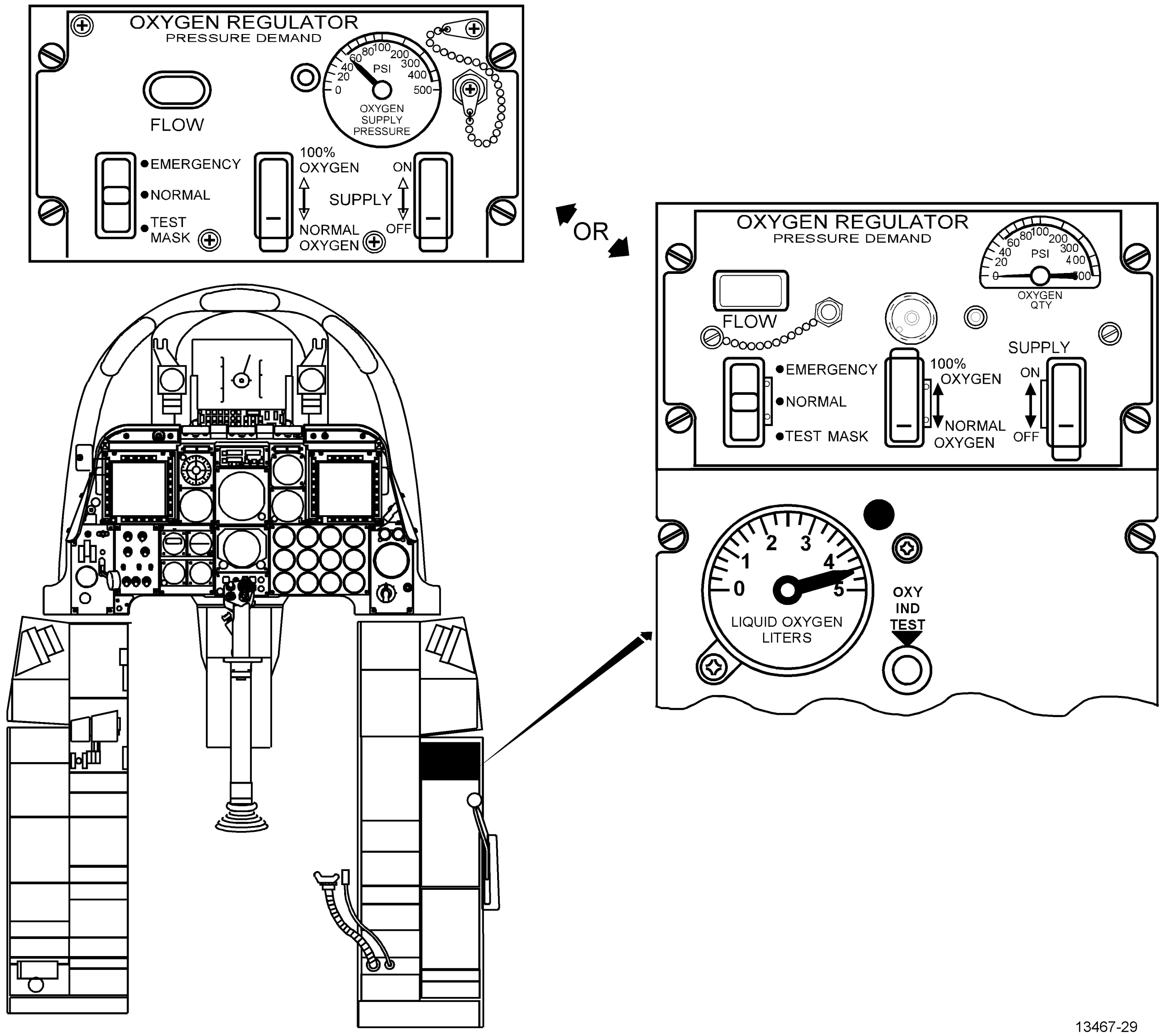


Figure 1-28. Oxygen System Regulator and Quantity Gauge NON518

OXYGEN HOSE CONNECTION.

The oxygen hose connection (16, Figure FO-3) provides the means to connect the oxygen mask to the oxygen system.

Deleted.

OXYGEN SYSTEM 518 .

The oxygen system consists of an Onboard Oxygen Generating System (OBOGS) and a 50 cubic inch Regulated Emergency Oxygen System (REOS) bottle.

ONBOARD OXYGEN GENERATING SYSTEM (OBOGS).

The core of OBOGS is a molecular sieve/concentrator that uses an adsorption filtering process to remove nitrogen from the ECS-supplied service air and provide oxygen-rich breathing gas. The system is capable of producing 95 percent oxygen with the balance being argon and other inert gases. For normal operation, the concentrator provides oxygen to a compatible diluter demand breathing regulator. The system pressure to the regulator can be read on a pressure gage located on the face of the regulator. The normal operating pressure range is 25-40 psi. However, actions that reduce service air pressure such as running engines at idle during ground operations or during idle descents will cause the OBOGS regulator pressure to drop. If this results in the OBOGS PRESS LOW caution light coming on, an increase in throttle setting or use of the APU will correct the problem.

OBOGS CONTROLS AND INDICATORS.

Refer to Figure 1-28.1 for a description of the OBOGS controls and indicators.

OXYGEN SYSTEM SCHEMATIC.

Refer to Figure 1-28.2.

OBOGS PLENUM.

If the OBOGS is not producing oxygen due to loss of input air to the concentrator, concentrator failure, or loss of power to the concentrator, the system will revert to stored oxygen in a 250 cu. in. sieve-filled plenum. Depending on altitude, regulator setting, and breathing rate, the OBOGS Plenum will provide 2 to 10 minutes of oxygen - enriched air or 2 to 3 minutes if 100% is selected. With service air operating normally, running the engines at 80% core speed can recharge a depleted plenum in about 20 seconds. After plenum contents have been expended and system pressure falls below 10 psi, the OBOGS PRESS LOW caution light (Figure 1-28.1) on the Caution Light Panel will come on flashing. If this occurs, immediate action should be taken to restore service air pressure, descend below 10,000 feet altitude, if practical, or activate the emergency oxygen supply (REOS).

NOTE

> Extended operation with engines at idle and the APU off may cause the OBOGS PRESS LOW caution light to come on. Increasing throttle setting, turning on the APU, or reducing the load on service air should restore adequate OBOGS pressure.

OBOGS MONITOR.

The OBOGS is monitored by an oxygen monitor with built-in-test (BIT) circuitry. The oxygen monitor samples oxygen-enriched air from the plenum for the correct oxygen concentration for a particular cabin altitude. The oxygen monitor provides a signal to turn on the OBOGS FAIL caution light (Figure 1-28.1) if the partial pressure of oxygen (PPO2) from the concentrator drops below a preset alarm range or if BIT detects an internal monitor fault. The oxygen monitor provides a low oxygen partial pressure warning at either of two thresholds based on the position of the diluter lever located on the oxygen regulator. Low PPO2 can be caused by a concentrator malfunction or a clogged input filter on the concentrator. It is possible to get an OBOGS FAIL indication for a few seconds under normal operating conditions if the plenum is depleted and then rapidly charged - such as soon after the engines are throttled up after a prolonged period at idle. If it has rapidly recharged and has low oxygen quantity, it is necessary to put a demand on the system by normal breathing or by using the Test Mask for a couple of seconds.

OBOGS BUILT-IN-TEST (BIT).

The OBOGS monitor has five BIT functions: Power-Up BIT, Periodic BIT, Maintenance BIT, Initiated BIT, and Pneumatic BIT. All BIT programs are for testing the monitor's circuitry only. Only Initiated BIT is can be controlled in the cockpit.

Power-Up BIT.

Power-Up BIT is performed automatically upon power-up. It includes a two minute warm-up period during which the OBOGS FAIL caution light is inhibited. The OBOGS FAIL warning light comes on at the end of the Power-Up BIT if a monitor failure is detected.

Periodic BIT.

Periodic BIT is performed automatically during normal operations. If a monitor fault is detected, the OBOGS FAIL caution light will come on.

Initiated BIT.

Initiated BIT is started by momentarily pressing the OBOGS MON TEST button on the Environment Control Panel (Figure 1-30.1). Initiated BIT should be performed prior to flight to ensure proper operation of the Monitor circuitry.

Maintenance and Pneumatic BIT.

Maintenance and Pneumatic BIT functions are available to maintenance personnel only.

REGULATED EMERGENCY OXYGEN SYSTEM (REOS).

The REOS consists of a high-pressure bottle mounted on the left side of the ejection seat. The REOS is a regulated oxygen supply that will last for 7 to 9 minutes at a constant flow rate. The output of the REOS connects to the regular oxygen supply through an adapter to the CRU-60 connector, which feeds oxygen to the oxygen mask. A gauge on the REOS indicates the stored oxygen pressure.

The REOS is activated:

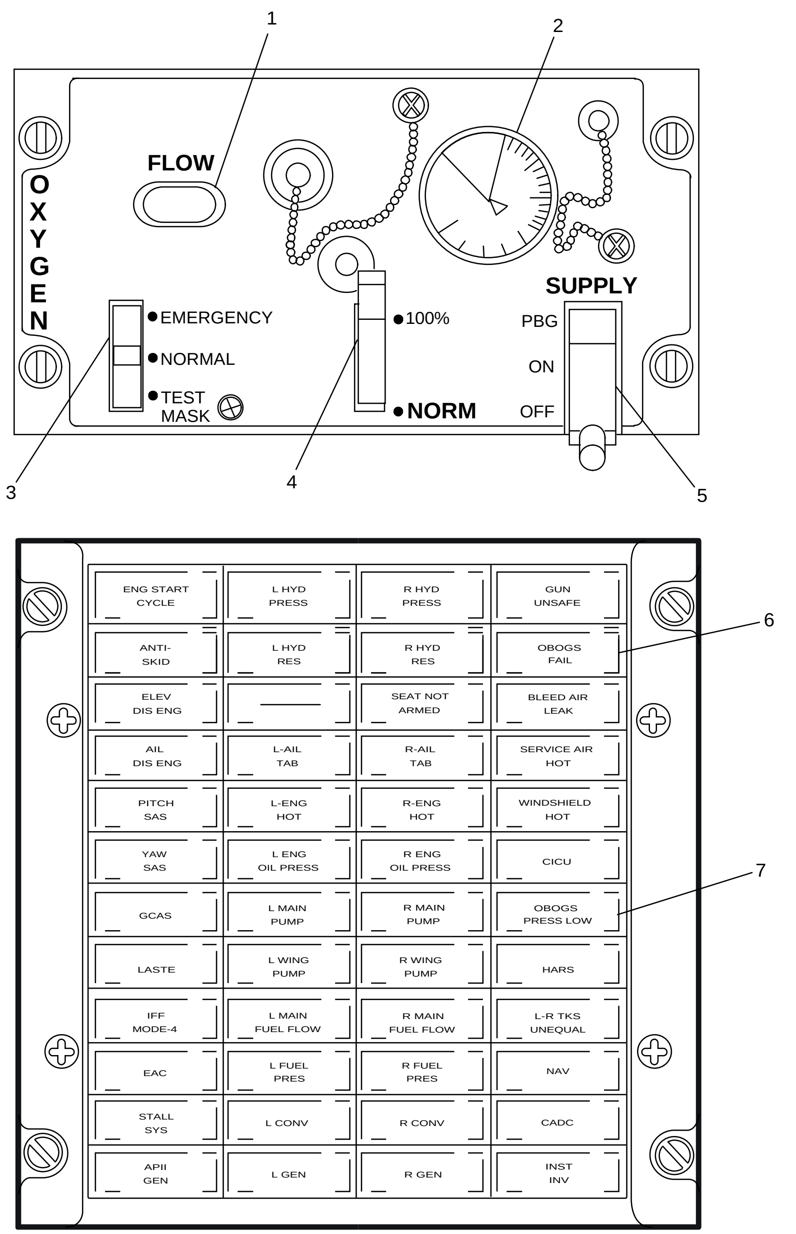
- Automatically upon ejection.
- Manually by pulling the emergency oxygen green ring located on the left aft side of the seat.

PRESSURE BREATHING FOR G (PBG).

The PBG mode of the oxygen regulator is not supported on the A-10 at this time. The regulator SUPPLY switch's PBG position operates identically to the ON position. The switch locks in the PBG position. If desired, the PBG position may be used to prevent the regulator supply lever from inadvertently being turned to OFF.

OXYGEN HOSE CONNECTION.

The oxygen hose connection (16, Figure FO-3) provides the means to connect the oxygen mask to the oxygen system.



CAUTION LIGHT PANEL

1. Oxygen Regulator Flow Indicator
2. Oxygen Regulator Supply Pressure Indicator
3. Oxygen Regulator Emergency Lever
4. Oxygen Regulator Diluter Lever
5. Oxygen Regulator Supply (Mode) Lever (PBG Lever Lock)
6. OBOGS FAIL caution light
7. OBOGS PRESS LOW caution light

BOG0165

Figure 1-28.1. OBOGS Controls and Indicators 518 (Sheet 1 of 2)

CONTROL/INDICATOR	POSITION/INDICATION	FUNCTION
1. OXYGEN Regulator FLOW Indicator	White	Indicates oxygen flow
	Black	Indicates no oxygen flow
2. OXYGEN Regulator Supply Indicator	Oxygen pressure (psi)	Indicates gaseous oxygen pressure at regulator input in psi
3. OXYGEN Regulator Emergency Lever	NORM	Provides normal operation. Positive pressure is provided if cockpit altitude exceeds 28,000-32,000 feet
	EMERGENCY	Provides maximum amount of oxygen under positive pressure.
	TEST MASK	Provides maximum amount of oxygen under positive pressure. This position is used for testing by life support maintenance.
4. OXYGEN Regulator Diluter Lever	NORM	Provides regulated mixture of cockpit air and oxygen-enriched air from OBOGS
	100%	Provides maximum amount of oxygen (undiluted OBOGS output)
5. OXYGEN Regulator SUPPLY (Mode) Lever	PBG (lever lock)	Provides oxygen supply to mask. (Pressure Breathing as a function of g is not supported.)
	ON	Provides oxygen supply to mask.
	OFF	Turns off oxygen supply
6. OBOGS FAIL Caution Light	On	Indicates that partial pressure of oxygen (PPO2) is low or the presence of a BIT detected Oxygen Monitor fault
7. OBOGS PRESS LOW Caution Light	On	Indicates that Plenum output pressure has fallen below 10 psi

Figure 1-28.1. OBOGS Controls and Indicators 518 **(Sheet 2)**

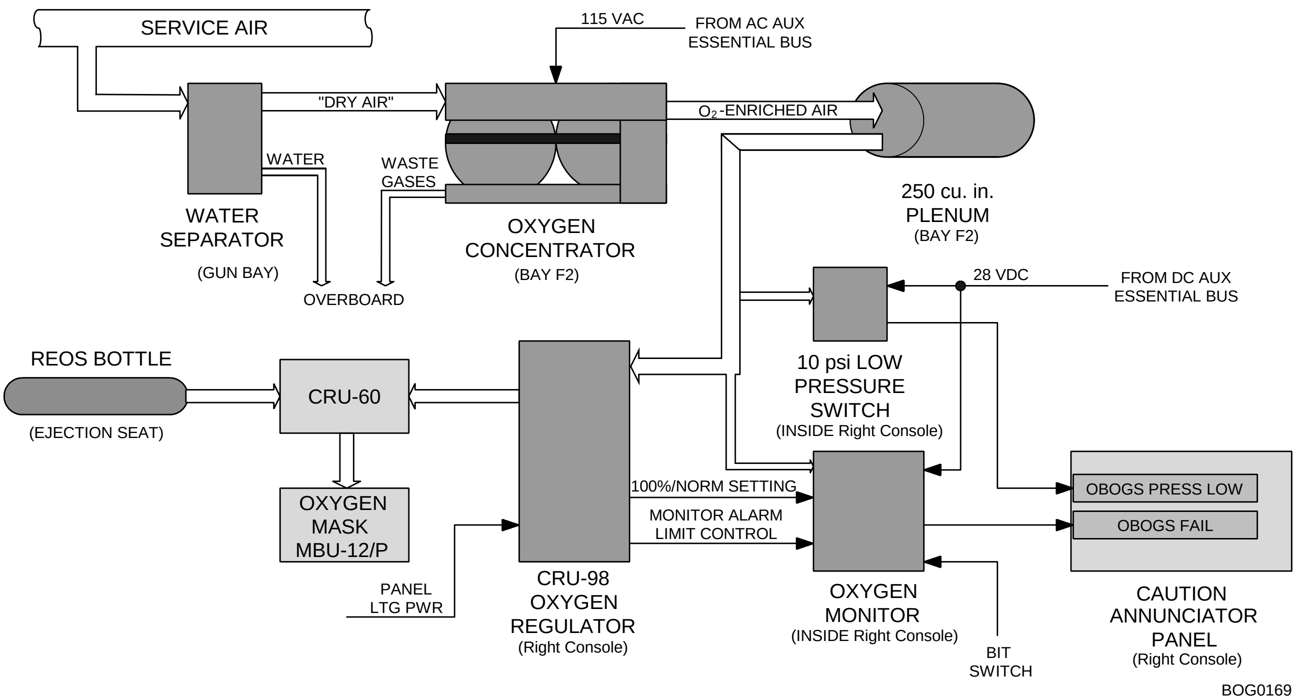


Figure 1-28.2. OBOGS Block Diagram 518

NVIS GOGGLES HOLDER.

The NVIS goggles holder is mounted to the right Console Anti-Spall Blanket Assembly. To secure the NVIS goggles, orient the goggles with the eyepiece facing down, insert the mounting barrel into the holder from the aft end, and close the holder door to prevent the NVIS goggles from sliding out.

ENVIRONMENT SYSTEM.

The environment system (Figure 1-29) supplies temperature-controlled air for cockpit air conditioning and pressurization. The system also provides service air for windshield and canopy defogging, windshield rain removal, canopy seal, anti-G suit pressurization, and external tank pressurization. The environment system receives bleed air from the APU, external source, or from the engines. The airflow rate to the cockpit is controlled by means of the flow level control on the environment control panel. The temperature controller automatically maintains the selected mixed airflow temperature level. If the environment system becomes inoperative, the cockpit can be ventilated by ram air.

Cockpit pressurization is ensured by use of a canopy seal system and a cockpit air pressure regulator. Cockpit pressurization (Figure 1-29) is automatically initiated at 10,000 feet and is controlled by the cockpit air pressure regulator. Regulator discharge air assists in cooling equipment in the electronic and avionics compartments. If the regulator fails, a cockpit air pressure safety valve automatically opens. The safety valve may also be operated manually by selecting DUMP on the TEMP/PRESS switch (Figure 1-30). Cockpit pressurization is powered by the auxiliary DC essential bus. Cockpit altitude is monitored by the cockpit pressure altimeter on the environment control panel.

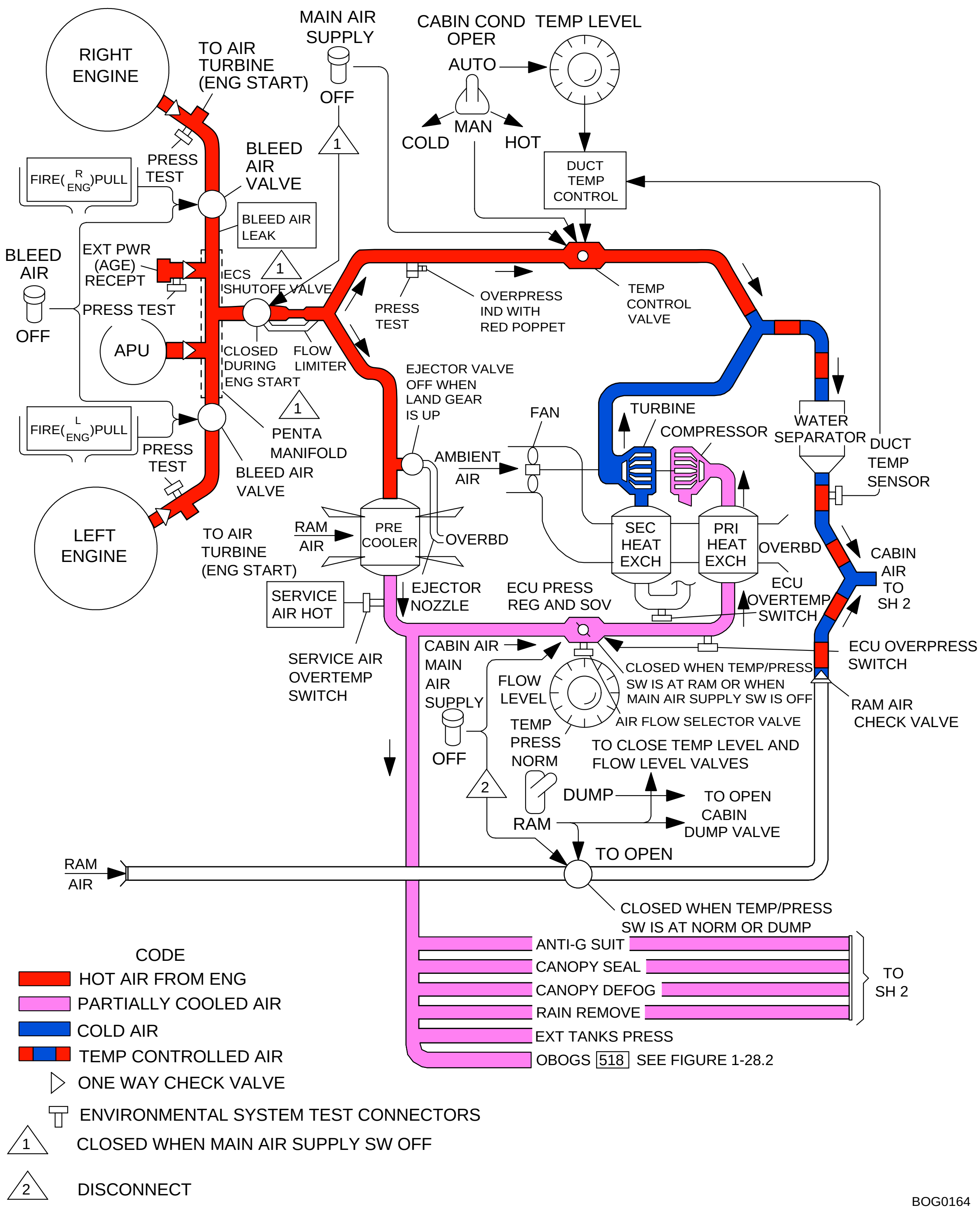


Figure 1-29. Environment System Schematic (Sheet 1 of 2)

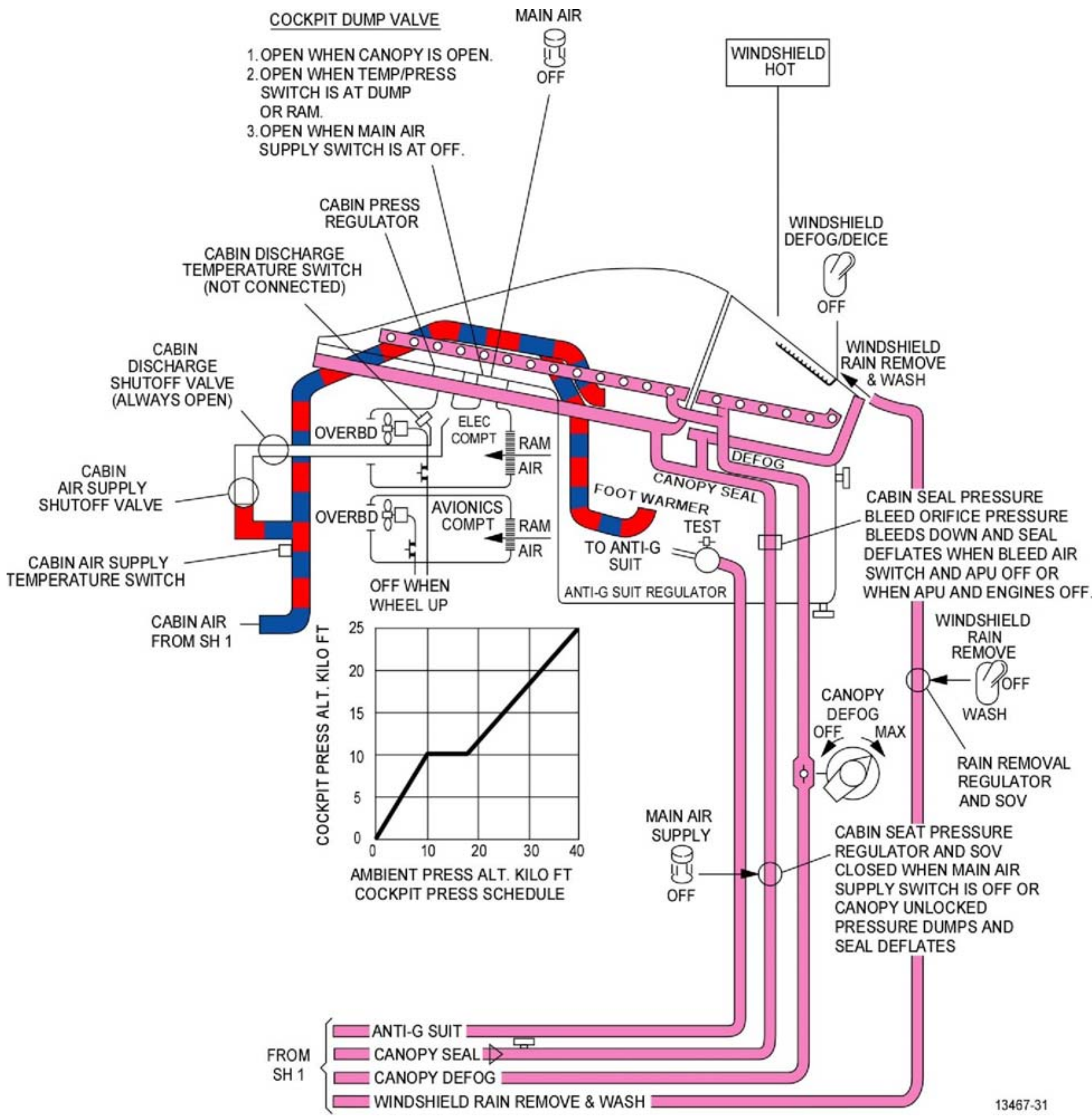


Figure 1-29. Environment System Schematic (Sheet 2)

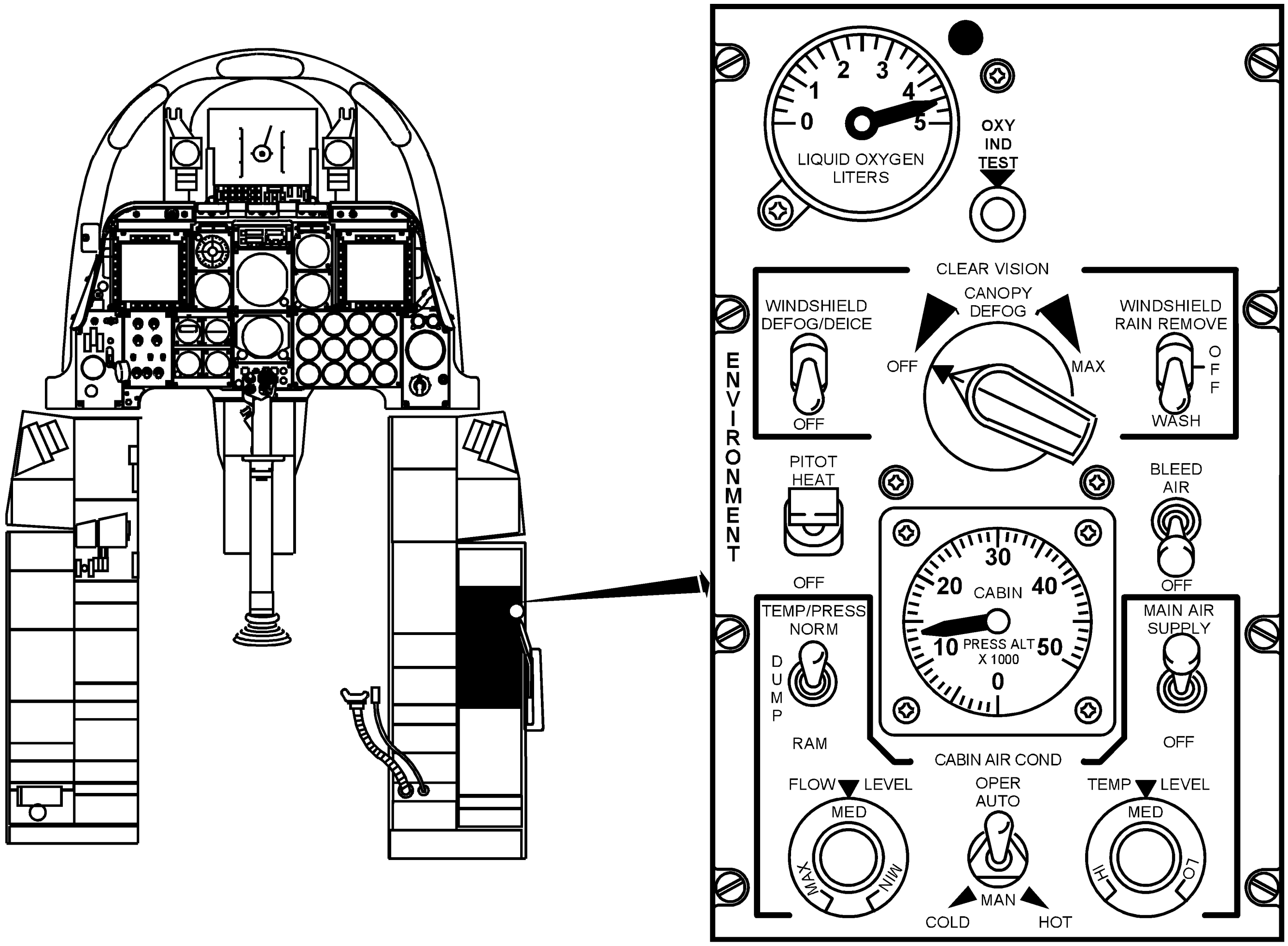


Figure 1-30. Environment Control Panel NON518

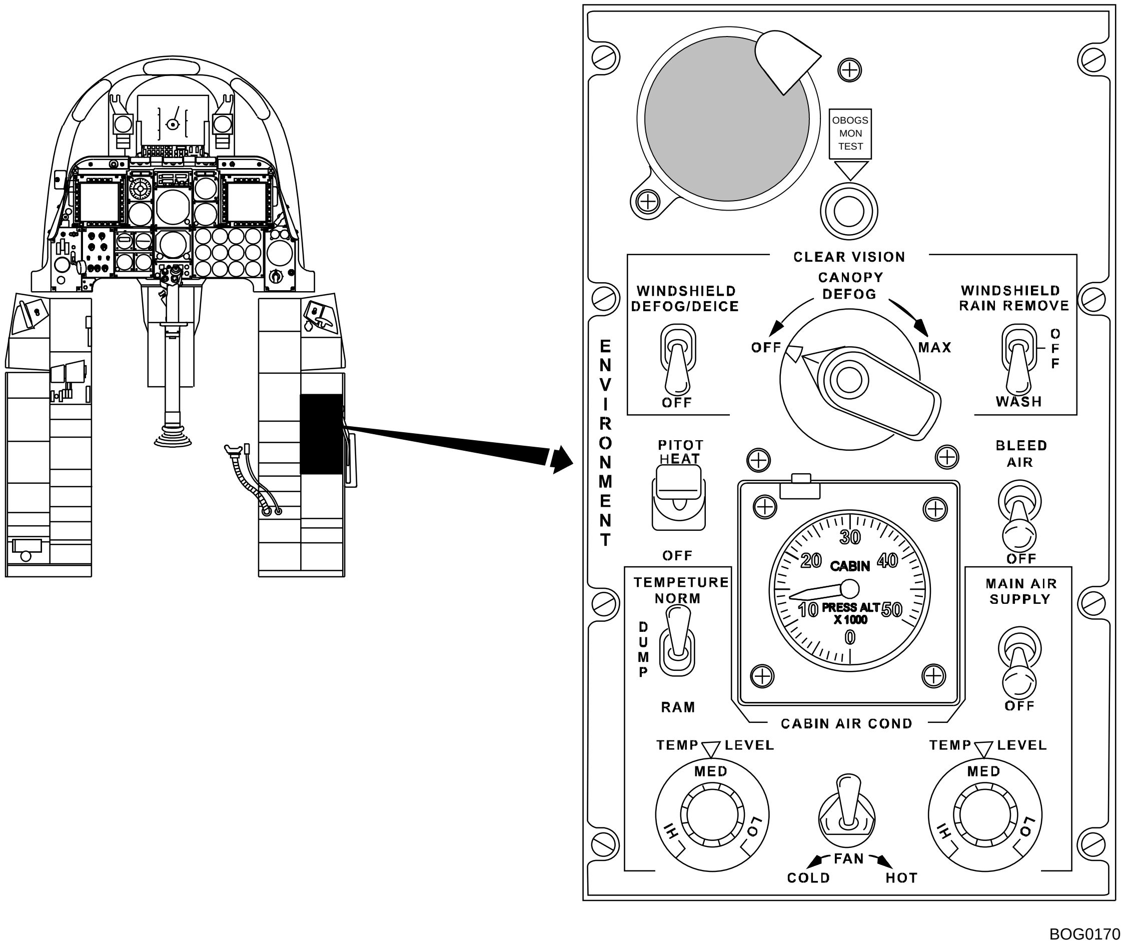


Figure 1-30.1. Environment Control Panel 518

Cooling air is always supplied to the Embedded GPSI/INU (EGI) from cabin discharge air. The cabin discharge shutoff valve is always open. The cabin air supply shutoff valve is always closed. This routes cabin discharge air to the EGI. The cabin discharge shutoff valve and cabin air supply shutoff valve are powered by the right auxiliary DC bus.

MAIN AIR SUPPLY SWITCH.

The main air supply switch (Figure 1-30), placarded MAIN AIR, located on the environment control panel, is a two-position toggle switch used to provide alternate closure of ECS valve which shuts off engine bleed air to Environment Control System but does not shut off ram air. The placarded positions are SUPPLY and OFF. The switch must be raised to move it from the SUPPLY position. The switch is powered by the battery bus. See Figure 1-31 for main air supply switch positions versus temperature/pressure control switch position.

WARNING

- The main air supply switch is for emergency use only. The temperature pressure control should be positioned to RAM when normal shutoff of air conditioning is desired.

- Whenever the main air supply or bleed air controls (APU and bleed air switch) are OFF, 100% oxygen should be selected because air may not be entering cockpit.

- 518 Whenever the main air supply or bleed air controls (APU and bleed air switch) are OFF, OBOGS will cease production of oxygen-enriched air. Depending on altitude, regulator setting, and breathing rate, OBOGS will provide 2 to 10 minutes of reserve (2 to 3 minutes if 100% is selected).

NOTE

When MAIN AIR switch is OFF, the 6t5 PSI valve (ECS shutoff valve) is closed and all bleed air to environment system is cut off.

Figure 1-31. Temperature/Pressure Control Position Versus Main Air Supply Switch Position

TEMP/PRESS (POSITION)	MAIN AIR SUPPLY - SUPPLY	MAIN AIR SUPPLY - OFF
NORM	Air cond - On Cabin press - On Canopy seal - Inflated Cabin ram air - Off	Air cond - Off Cabin press - Dump Canopy seal - Deflated Ram air - Off
DUMP	Air cond - On Cabin press - Dump Canopy seal - Inflated Cabin ram air - Off	Air cond - Off Cabin press - Dump Canopy seal - Deflated Ram air - Off
RAM	Air cond - Off Cabin press - Dump Canopy seal - Inflated Cabin ram air - On	Air cond - Off Cabin press - Dump Canopy seal - Deflated Ram air - On

NOTE

The above operation holds true whether the air conditioner switch is in AUTO or MAN, assuming bleed air is available to ECS, and canopy closed.

SERVICE AIR HOT CAUTION LIGHT.

The SERVICE AIR HOT caution light (Figure 1-158) is located on the caution light panel, and works in conjunction with an over-temperature switch that continuously monitors precooler air output temperature. If the precooler output air temperature is excessive, the SERVICE AIR HOT caution light will come on. Any obstruction of the ram air duct, ejector nozzle, or precooler will cause an over-temperature condition.

TEMPERATURE/PRESSURE CONTROL SWITCH.

The temperature/pressure control switch (Figure 1-30), placarded TEMP/PRESS, is a three-position toggle switch, located on the environment control panel. The switch positions are placarded NORM, DUMP, and RAM. NORM and DUMP are powered by the auxiliary DC essential bus; the RAM position is powered by the battery bus. See Figure 1-31 for temperature/pressure control switch positions versus main air supply switch positions.

COCKPIT PRESSURE ALTIMETER.

The cockpit pressure altitude indicator (Figure 1-30), placarded CABIN PRESS ALT X 1000, is located in the center of the environment control panel. The altimeter operates on a self-contained aneroid mechanism.

AIR CONDITIONER CONTROL SWITCH.

The air conditioner control switch (Figure 1-30), placarded CABIN AIR COND OPER, is located on the environment control panel. The control switch provides a selection of either automatic or manual control of the air conditioning system. In AUTO, air conditioning temperature is automatically regulated by the temperature level rotary switch. In MAN, the conditioned air temperature is selected by holding the switch in COLD or HOT. It will take approximately 13 seconds for the temperature valve to cycle from full COLD to full HOT or vice versa. The switch is powered by the auxiliary DC essential bus.

NOTE

- When operating in MAN, the temperature and airflow to the cockpit will increase if engine throttle setting is increased. Reestablish desired temperature by holding switch toward COLD. Select MAN only if automatic control is inoperative.
- To prevent overshooting the desired temperature level in the cockpit, when operating the air conditioner control in MAN, it is recommended that a short pulse (~2 seconds) be used followed by a waiting period (~10 seconds) to determine the amount of temperature increase or decrease.

FLOW LEVEL CONTROL.

The flow level control (Figure 1-30), placarded FLOW LEVEL, is a manually operated rotary control, located on the environment control panel. The flow level control is used to control the amount of conditioned air flowing into the cockpit. The rotary portion of the control is placarded MIN, MED, and MAX, but any desired intermediate flow may be selected.

TEMPERATURE LEVEL CONTROL.

The temperature level control (Figure 1-30), placarded TEMP LEVEL, is a rotary switch located on the environment control panel that is active when the cabin air control switch is in AUTO. The temperature level control permits selection of any desired conditioned air temperature setting. The rotary portion of the control is placarded LO, MED, and HI, but any desired intermediate temperature may be selected. The switch is powered by the auxiliary DC essential bus.

CANOPY DEFOG SYSTEM.

Defogging of the canopy and windshield panels is accomplished by defog tubes, which discharge precooled engine bleed air.

Canopy Defog Control.

The canopy defog control (Figure 1-30), placarded CANOPY DEFOG, is a rotary control located on the environment control panel. It is used to manually control the amount of precooled engine bleed air flowing through the defog tubes along the base of the canopy. The control positions are placarded OFF and MAX, with arrows indicating direction of rotation. The control should be used during descents to provide maximum windshield antifog protection.

WINDSHIELD DEFOG/DEICE SYSTEM.

The center windshield panel interior surface is deiced and defogged by heat from an element embedded near the outer surface of the windshield center panel. The windshield heater is controlled by the windshield defog/deice switch.

Windshield Defog/Deice Switch.

The windshield defog/deice switch (Figure 1-30), placarded WINDSHIELD DEFOG/DEICE, located on the environment control panel, is a two-position toggle switch used to control the electrically heated deicing circuit in the windshield. In DEFOG/DEICE, left AC system bus power energizes the element embedded in the windshield. Placing the switch in OFF deactivates the system. The DEFOG/DEICE position shall be selected anytime windshield fogging or icing conditions are suspected during flight.

Windshield Hot Caution Light.

The WINDSHIELD HOT caution light (Figure 1-158), located on the caution light panel, is actuated by a temperature sensor on the windshield center panel. The light will come on when the windshield temperature is in excess of 150°F, whether caused internally by system malfunction or externally by leaving the rain removal system on for an extended period. The light will also come on to indicate a malfunction in the windshield deicing circuit, a system power failure, or if the battery is the sole source of electrical power. If the cause is due to an over-temperature condition, continued use can result in windshield cracking.

WINDSHIELD RAIN REMOVAL SYSTEM.

For ground operation and to aid in-flight rain removal when flying at low speed, an air jet blast, utilizing precooled bleed air, provides rain removal over the windshield center panel. The electrically-operated shutoff valve is controlled by the rain removal switch.

WINDSHIELD WASH SYSTEM.

A wash system for removing gun gas residue from the windshield and side panels is provided. A three-gallon wash solution tank is located in the forward portion of the nose wheelwell. Approximately one half gallon of solution is used during each wash cycle. The rain removal nozzle includes a wash solution nozzle. The system is controlled by the rain removal/windshield wash switch.

WARNING

The windshield wash system should not be used anytime forward vision is essential, since forward vision is obscured during the wash cycle.

Rain Removal/Windshield Wash Switch.

The rain removal/windshield wash switch (Figure 1-30), a three-position switch, is placarded RAIN REMOVE, OFF, and WASH. When positioned to RAIN REMOVE, an airjet blast of engine bleed air from the precooler is directed to facilitate rain removal from the windshield. The switch is springloaded from WASH to OFF. Momentarily positioning the switch to WASH activates the circuit for 30 seconds (wash 6 seconds and purge 24 seconds). The switch is powered by the left DC bus.

AIRCREW EYE/RESPIRATORY PROTECTION (AERP) SYSTEM.

The AERP system (Figure 1-32) is designed for the protection from toxic chemical exposure to the head, neck, face, eyes, and respiratory tract. The equipment is designed to provide protection without degrading mission capability or combat effectiveness. The AERP equipment consists of a hood assembly which integrates a pressure-demand oxygen mask, hood, oxygen regulator, a chemical-biological filter and pigtail adapter hose assembly, blower assembly, and a ground intercommunication unit. The hood assembly is worn with the aircrew helmet using standard offset bayonet connectors, or worn without a helmet using a detachable harness assembly. The shoulder cowl is worn under the flight suit and over the standard chemical defense inner coverall.

ANTI-G GARMENT SYSTEM.

The anti-g garment system (Figure 1-29) consists of a pressure regulating valve which supplies air to the garment upon accelerations of 2.5 g or greater. A test button is provided to simulate operation under g loading.

FLIGHT INSTRUMENTS.

PITOT-STATIC SYSTEM.

The pitot-static system consists of a pitot-static probe, located in a boom on the leading edge of the right wing. The probe supplies impact air pressure to the airspeed indicator, "Q" sensors, and the Central Air Data Computer (CADC). Static pressure is supplied to the airspeed indicator, "Q" sensors, CADC, and the Vertical Velocity Inidicator (VVI).

The pitot-static system functions automatically. However, the pitot-static probe contains a heating device controlled by a switch in the cockpit.

Pitot Heater Switch.

The pitot heater switch (Figure 1-30), placarded PITOT HEAT and OFF, is located on the environment control panel. HEAT supplies power from the left AC bus to the pitot heater and total temperature probe and power from the right AC bus to the AOA vane heater and the lift transducer vane.

CADC.

The CADC receives inputs of static and pitot pressure from the pitot-static system, total temperature from the total temperature probe, and barometric pressure setting from the altimeter (see Figure 1-33). The inputs are used by the CADC to provide electrical outputs to aircraft systems. Equipment receiving CADC outputs include the EGI, altimeter, IFF, caution light panel, IFFCC and CDU. The CADC operates in two modes, normal and self-test. The normal mode is automatic. Inputs are processed and converted, as appropriate, to analog or digital data.

During normal (in the air) operation, the CADC continuously monitors its own performance as well as the validity of input data. In the air, data validity and CADC performance are considered when determining a CADC failure. On the ground, a CADC failure indication is based only on CADC operation. If a malfunction occurs, the CADC caution light on the caution light panel comes on, airspeed and altitude are not displayed on the HUD, and the CADC FAIL and INS DEGRADED annunciations will appear on the CDU display. The annunciation on the CDU is turned off when the fault acknowledge (FA) function key is depressed. On the ground, the CADC outputs arbitrary 70 TAS and 50 Indicated Airspeed (IAS) values. The self-test mode is activated by placing the PAGE select switch to OTHER and depressing SYS function key on the CDU to display System (SYS) Page 1/3, and then using the P/G rocker switch to display System (SYS) Page 2/3. This allows the selection of the LRUTEST Page by depressing the LRUTEST Page Line Select Key (LSK). When the LRUTEST Page appears, depressing CADC LSK allows CADC self-test to start. IP on the CDU display indicates Line Replaceable Unit (LRU) test is in progress; if a GO appears, the CADC has passed the self-test; if an NG appears, the CADC has failed.

WARNING

Certain failures of the CADC could cause erroneous data to be displayed with no warning indication.

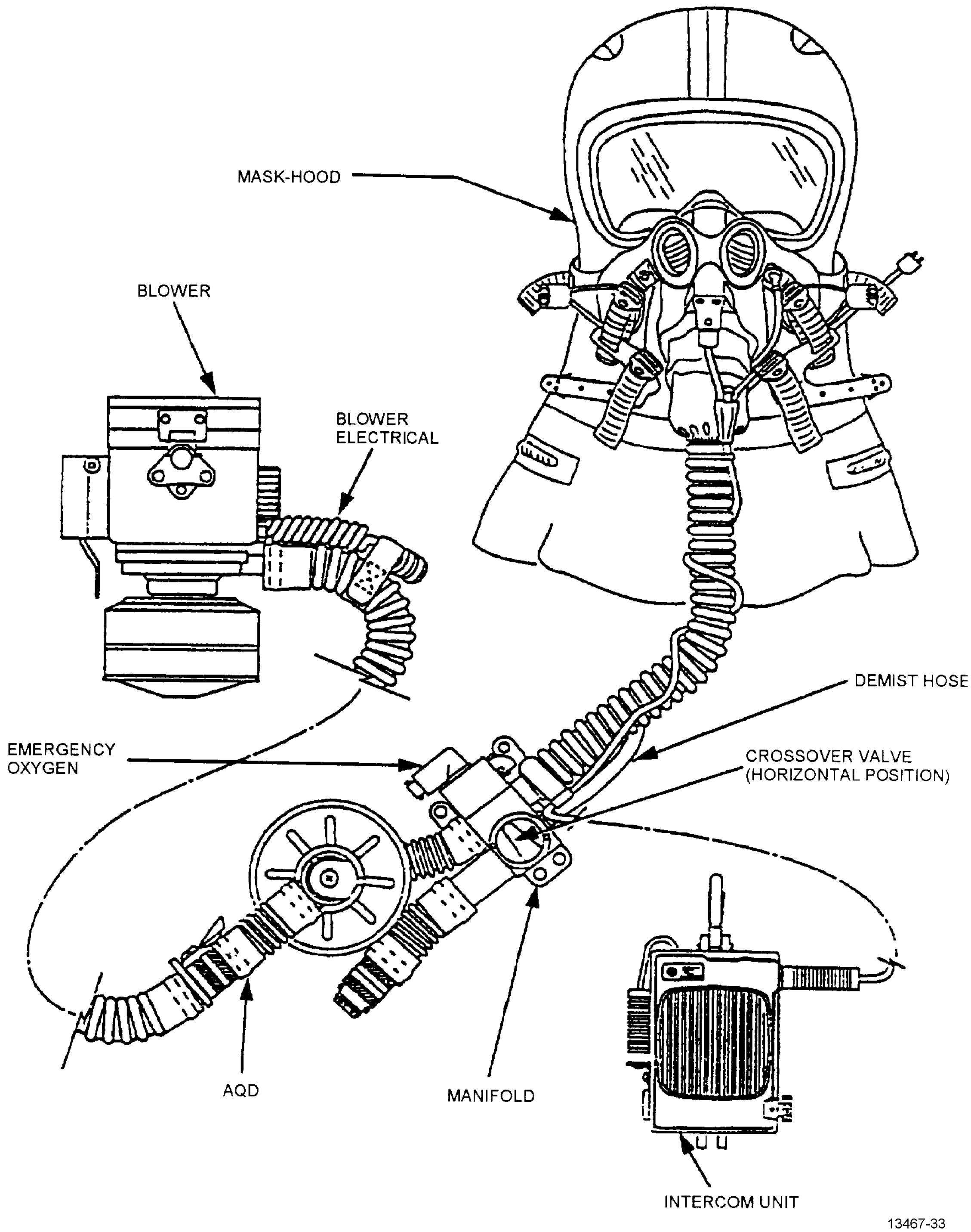


Figure 1-32. Aircrew Eye/Respiratory Protection (AERP) System

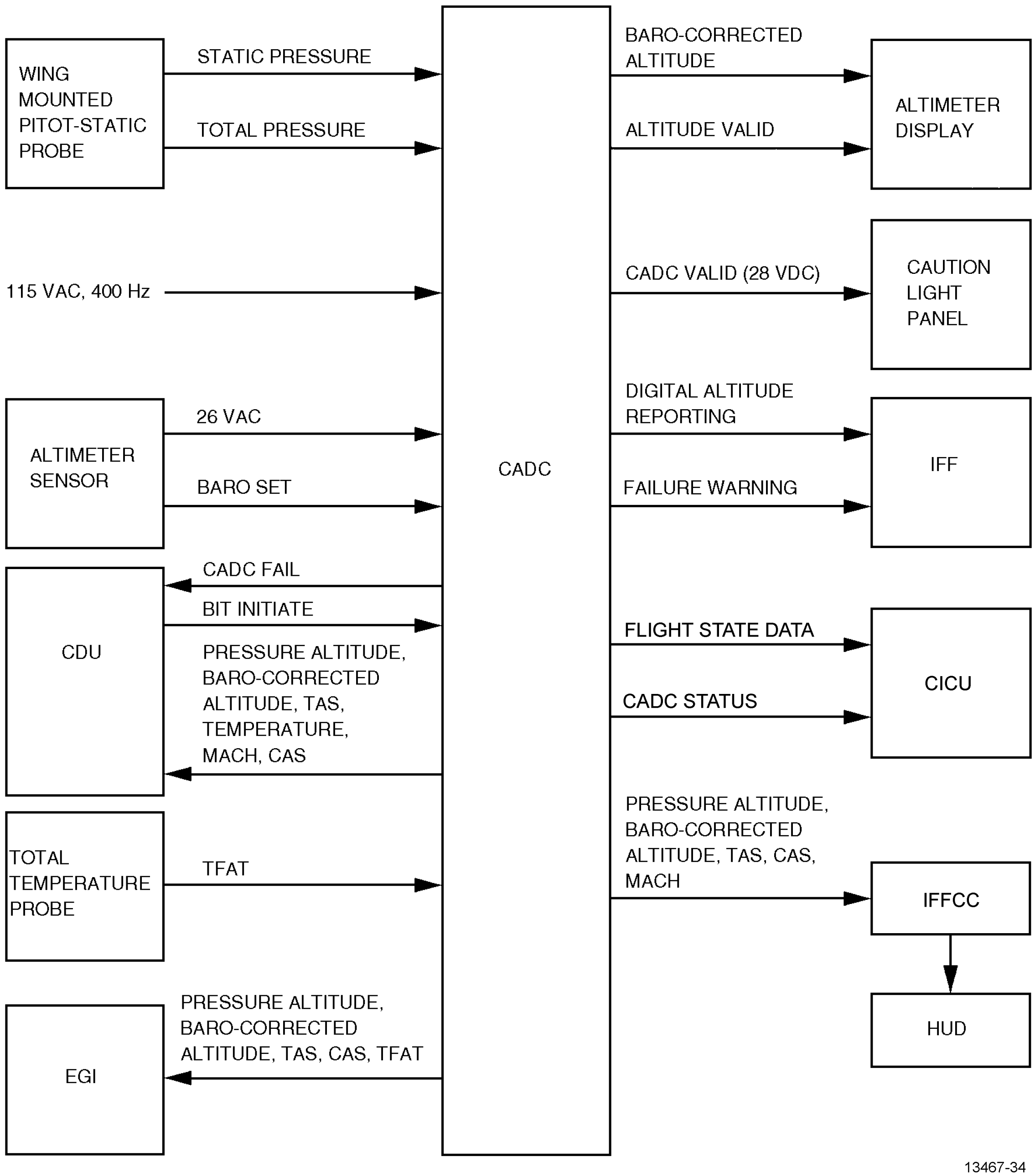


Figure 1-33. Central Air Data Computer Interfaces

CADC Caution Light.

The CADC caution light (Figure 1-158), located on the caution light panel, will come on when CADC data is unreliable, or the CADC has failed.

Altimeter.

The altimeter (Figure 1-34) is a combined pneumatic altimeter and servo repeater indicator. The pneumatic mode operates in a normal barometric manner. The normal mode of operation is the servoed mode, which is obtained by placing the function switch on the lower right corner of the instrument case in RESET or ELECT, when normal aircraft power is available. During pneumatic operation, a STBY or PNEU flag appears on the instrument face to indicate pneumatic operation.

When transferring modes, hold the function switch momentarily in the selected mode to allow system transfer.

During pneumatic operations, an internal vibrator operates to minimize friction to allow a smoother display during altitude changes. A quivering pointer and counter-drum may be noticeable due to vibrations set up by the vibrator. This is an indication that the vibrator is operating and normal, provided excursions of the pointer are not excessive. Should vibrator failure occur, the altimeter continues to function pneumatically, but the quivering will not be present and a less-smooth movement of the instrument display is evident with changes in altitude.

WARNING

- During pneumatic operation, if the altimeter's internal vibrator is inoperative due to either internal failure or DC power failure, the 100-foot pointer may momentarily hang up when passing through 0 (12 o'clock position). If the vibrator has failed, the 100-foot pointer hangup can be minimized by tapping the case of the altimeter.

- During normal use of the barometric pressure set system, momentary locking of barocounters may be experienced. If this occurs, do not force the setting. Application of force may cause internal gear disengagement, thereby resulting in excessive altitude errors in both the standby and servo modes. If locking occurs, the required setting may be established by rotating the knobs a full turn in the opposite direction and approaching the setting carefully.

- If altimeter setting knob can be moved in or out and the pointer moves without corresponding change of the barometric setting when the knob is rotated, the altimeter is unacceptable for flight.

Radar Altimeter System.

The radar altimeter system is part of the LASTE system. The radar altimeter system provides altitude Above Ground Level (AGL) data to the Ground Collision Avoidance System (GCAS) and the computed weapon delivery functions of the IFFCC. The radar altimeter system consists of a Receiver/Transmitter (R/T) and wide-angle antenna system composed of a solid-state antenna switching unit (ASU) and three pairs of antennas.

The antennas (Figure 1-43) are located on the vertical stabilizers and the horizontal tail. The antenna system provides coverage below 5,000 feet AGL with coverage being a function of pitch and roll angles.

Above 3,000 feet:

Pitch angles between ±35°, roll angle coverage is ±120°.

Pitch angles between ±35° to ±50°, roll angle coverage is reduced to ±15°.

WARNING

At steeper dive angles, radar altitude may not register and GCAS warnings will not be available.

Below 3,000 feet:

Pitch angles between ±45°, roll angle coverage is ±120°.

Pitch angles between ±45° to ±60°, roll angle coverage is reduced to ±15°.

The radar altimeter provides altitude AGL data up to at least 5,000 feet AGL. The radar altimeter system is controlled by the radar altimeter switch on the LASTE Control Panel (LCP) (Figure 1-185). Radar altitude is displayed on the HUD in all modes. If the radar altimeter goes out of coverage, the system will go into an extended coverage mode. In this mode, the system will "coast" for a variable length of time depending on aircraft altitude. Unless valid radar information is regained within this time limit, extended coverage is considered invalid and XXXXR is displayed.

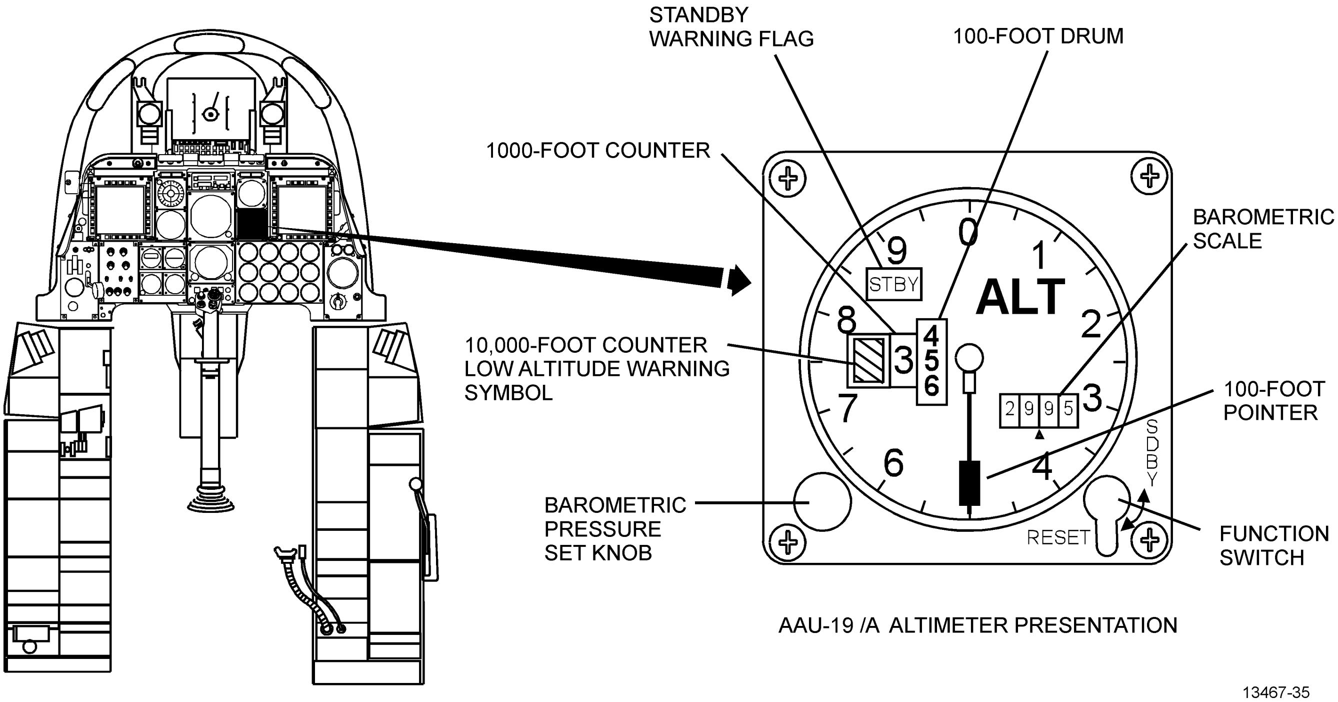


Figure 1-34. Altimeter

Airspeed Indicator.

The airspeed indicator (25, Figure FO-1), on the instrument panel, is graduated CW from a 50-knot minimum indication in increments of 10 knots to a maximum indication of 550 knots. A barrel in the top center of the dial displays a scale from 0 to 100 knots, in 2-knot increments. The striped pointer, which is altitude compensated, moves to indicate the limiting structural airspeed or the airspeed representing the limiting Mach number. A yellow mark indicates the limiting airspeed for use of full wing flaps and gear extension. The airspeed indicator operates from inputs of impact and static pressures.

VVI.

The VVI (27, Figure FO-1), on the instrument panel, is a static pressure instrument receiving inputs directly from the pitot-static probe. The VVI provides rate of climb, or descent, in feet per minute. The indicator is calibrated in thousands of feet per minute. From 0 to 1,000 feet, up or down, the scale is in increments of 100 feet.

HARS.

The HARS consists of a gyro platform, an amplifier, and a control panel (Figure 1-35). The HARS is a back-up heading and attitude system. HARS will automatically supply heading and attitude information when aircraft power is initially applied, the EGI is off, the EGI is in an alignment mode, or the EGI attitude fails. HARS attitude information is interfaced to the CDU and can be displayed on the HARS page. HARS information (roll, pitch and magnetic heading) can be selected for display on the flight instruments, but not deselected, by depressing the HARS switch-indicator on the Navigation Mode Select Panel (NMSP). HARS can be deselected (operative EGI INS function) by depressing the EGI switch indicator on the nav mode select panel. If the HARS heading or attitude is invalid, the HARS caution light on the caution light panel comes on. Certain conditions such as loss of attitude reference or attitude rate exceeding 570 deg/sec for one second will cause the CDU to annunciate HARS FAIL. The annunciation is removed from the CDU display when the fault acknowledge (FA) pushbutton on the CDU is depressed. The HARS is powered by the right AC bus.

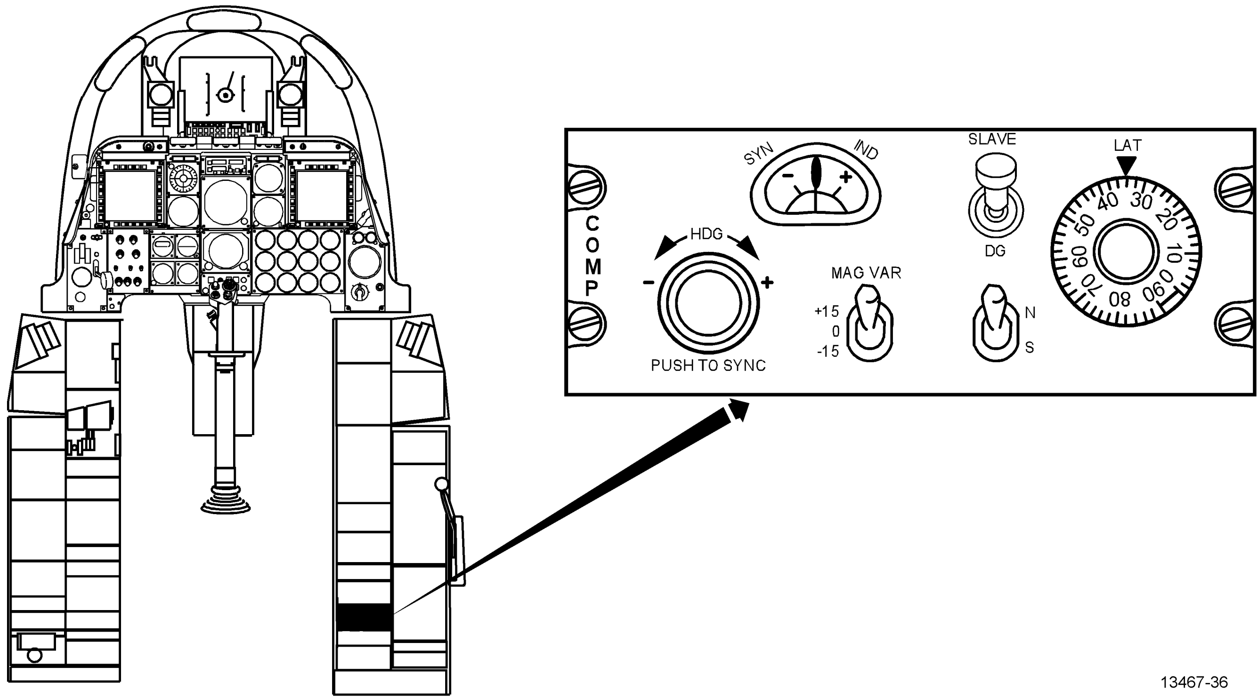


Figure 1-35. Heading Attitude Reference System Control Panel (Sheet 1 of 2)

Control Indicator	Position or Display	Function
SYN-IND (ANNUNCIATOR)		Indicates synchronization between HARS output and the remote compass transmitter when in SLAVE mode. When the system is not synchronized, the SYN-IND annunciator indicates in which direction the system must be corrected.
MODE SELECTOR SWITCH		Selects HARS mode of operation.
	SLAVE	The system aligns with the remote compass transmitter, causing the system to operate as a gyro-stabilized magnetic compass. SLAVE is the normal operating mode.
	DG	The remote compass transmitter is disconnected from the system, reverting operation to that of a basic directional gyroscope.
LAT CORRECTION CONTROL		Corrects the system for the apparent drift of the directional and vertical gyros caused by the earth's rotation. The direction of correction for the northern or southern hemisphere is selected by the N-S hemisphere selector switch. The latitude correction is applied in both SLAVE and DG modes of operation.
N-S HEMISPHERE SELECTOR SWITCH		Determines polarity of DG earth rate correction.
MAG VAR SWITCH		Compensates for magnetic variation. The MAG VAR switch is position which provides the closest representation of the magnetic variation at the aircraft's position, providing improving earth rate correction.
HDG PUSH-TO-SYNC CONTROL		Provides fast synchronization of heading.
	PUSHED IN	In SLAVE mode, synchronizes the system to 1° within 6 seconds.
		In DG mode, turning the control changes heading output at a rate proportional to knob displacement to a maximum of 30° per second.

Figure 1-35. Heading Attitude Reference System Control Panel (Sheet 2)

HARS Caution Light.

The HARS caution light (Figure 1-158), located on the caution light panel, comes on when the HARS heading or attitude is invalid, irrespective of whether EGI or HARS is selected as the operating attitude reference system.

HARS Fast Erect Switch.

The HARS FAST ERECT switch (Figure 1-36) is located on the left side of the main instrument panel and is independent of the NWS. The fast erect switch is used to eliminate errors in HARS attitude displays. To prevent erection to a false vertical, the fast erect switch should be depressed only during straight and level, unaccelerated flight. The fast erect function will operate on the ground or in the air. When HARS is the operating attitude reference, depressing the HARS FAST ERECT switch will cause the ADI and HSI power off flags to come into view, and will remove pitch angle and roll bar displays from the HUD.

Slaved Mode Operation.

The slaved mode of operation is the normal mode of heading reference. The controls and indicators involved are the SLAVE-DG mode selector, the PUSH-TO-SYNC control, and the SYN-IND annunciator. The slaved mode is initiated by placing the SLAVE-DG mode selector switch in SLAVE, the N-S toggle switch to the appropriate northern (N) or southern (S) hemisphere position, and the LAT control to the correct latitude.

In slaved mode, the heading signal inputs are slaved so that heading output agrees with the magnetic heading sensed by the remote compass transmitter. The SYN-IND annunciator on the HARS control panel displays the magnitude and polarity of slaved heading error. The system can be synchronized manually (much faster than by the normal slaving rate) by use of the PUSH-TO-SYNC control on the HARS control panel. Depressing the PUSH-TO-SYNC control causes the system to synchronize, and the pointer on the SYN-IND annunciator will center. In normal flight operation, slight movement of the SYN-IND annunciator pointer about the center mark indicates proper slaving action. Automatic synchronization takes place on power application and whenever the SLAVE-DG mode selector is switched from DG to SLAVE mode.

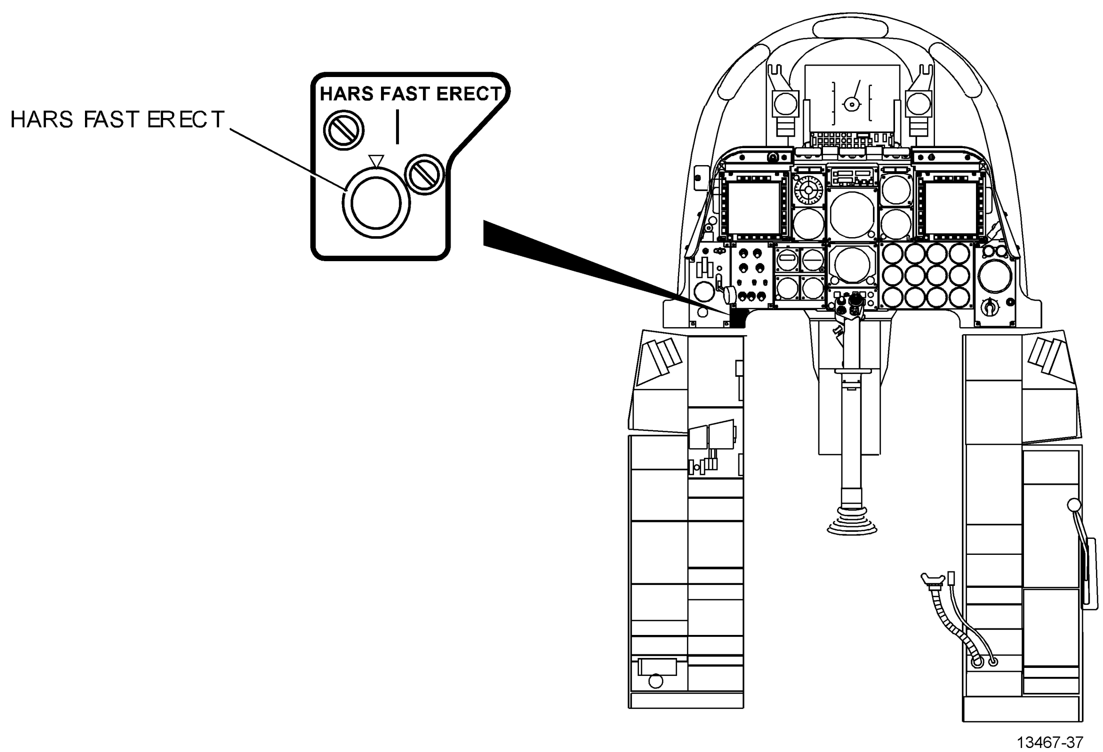


Figure 1-36. HARS Fast Erect Switch

Vertical Gyro Operation.

The vertical gyro provides pitch and roll information to aircraft systems and vertical information to the DG. The vertical gyro is erected to local gravity.

DG Mode Operation.

The DG mode of operation is a back-up mode of heading reference in the event of a malfunction in the slave mode.

The heading indicator can be aligned by placing the mode selector switch in DG and pushing in and rotating the HDG PUSH-TO-SYNC control until HSI heading agrees with the standby compass.

In the DG mode, no heading information is received from the remote compass transmitter.

AOA SYSTEM.

The AOA system consists of a vane-transmitter, a cockpit indicator, and indexer lights. The vane-transmitter is located on the left side of the forward fuselage.

The AOA system measures the angle between the longitudinal axis of the aircraft and the relative wind. This information is presented in the cockpit on the AOA indicator and AOA indexer. The vane transmitter is provided with a heater which is controlled by the pitot heater switch.

AOA Indicator.

The AOA indicator (24, Figure FO-1) is placarded ANGLE OF ATTACK. The scale is calibrated from 0 to 30 arbitrary units, in single unit increments, increasing in a CCW direction. Reference marks are provided as follows: At 15.6 scale units a rectangular maximum range index; at 17.5 scale units a triangular maximum endurance index; at 20.0 scale units a T-shaped approach index; from 23.1 to 24.1 scale units a striped stall warning index. The red (OFF) flag will appear at the 3 o'clock position when the unit experiences a loss of power.

AOA Indexer.

The AOA indexer (3, Figure FO-1) presents AOA information during a landing approach by displaying illuminated green symbols; low-speed symbol "\ /", on-speed symbol "circle", and high-speed symbol "/ \". Slightly low/high speed is indicated by the on-speed and low/high speed symbols coming on simultaneously.

The AOA indexer lights operate only when the nose gear is down. The lighting control is located on the auxiliary lighting control panel (Figure 1-158) and is powered by the right DC bus.

STALL WARNING SYSTEM.

Stall Warning Stick Shaker.

Stick shaker operation is a function of AOA vane, AOA indicator and interlocks with landing gear position and flaps switch. The mechanical stick shaker is mounted on the control stick just above the protective boot. Stick shaker operation is triggered by an electronic switch located in the AOA indicator at 22.6 units. Stick shaker operation requires NLG down or flap switch in full down position and weight off wheels. The stick shaker provides mild agitation of the control stick 4 to 12 knots prior to wing stall in unaccelerated (1g) flight. The stick shaker is powered by the auxiliary DC essential bus. Note that stick shaker is active only during landing approach configuration (landing gear down or flap switch in full down position).

Stall Warning Aural Tones.

The system consists of the Alpha Mach Computer, Wing Lift Transducer, two Tone Generators, and a caution annunciator light (STALL SYS). The Alpha Mach Computer computes discrete triggers for the steady peak-performance and chopped stall warning 600 Hz tones. Both engine igniters initiate on the same discrete triggers as the stall chopped tone and continue 1 second after termination of stall warning. Tone activation is initiated by the Alpha Mach computer as a function of the wing lift transducer signal and mach computed from the pitot/static pneumatic inputs. The lift transducer is mounted on the front lower quadrant of the left wing. Note that the aural stall warning is independent of the AOA system. A steady peak-performance tone is generated approximately two AOA units prior to stall and a chopped stall warning tone is generated approximately one AOA unit before stall. The chopped stall warning tone does not change in volume or frequency as AOA increases. Thus, actual wing stall or its depth is not indicated by this system. The two headset tones are controlled by separate volume knobs on the stall warning control panel. The audio stall warning system is powered by the DC essential bus and active as long as power is available. The leading edge slats are also controlled by the Alpha Mach Computer.

CAUTION

Inoperable stall tones or STALL SYS light on the caution annunciator panel will present the risk of dual engine stall at high AOA maneuvering. Visually confirm that Leading Edge (LE) Slats extend with illumination of the Caution Annunciator STALL SYS light. With the STALL SYS light illuminated, automatic engine ignition at wing stall will not function; avoid high AOA flight. Loss of pitot heat in icing conditions may result in stall warning tones and auto-engine ignition.

Stall Warning Control Panel.

The stall warning control panel (Figure 1-37) has two volume controls, placarded STALL and PEAK PRFM. The STALL volume control sets the volume of the chopped tone and has a minimum level equal to the landing gear warning volume. The PEAK PRFM volume control sets the volume of the steady tone and can be reduced to zero.

Stall System Caution Light.

The stall system caution light (Figure 1-158), on the caution light panel, is placarded STALL SYS. The light coming on indicates a power failure in the Alpha/Mach computer.

ACCELEROMETER.

The accelerometer (2, Figure FO-1) is suspended from the left side of the windshield bow.

NOTE

When the GAU/8A gun is being fired, air-frame vibration will cause the accelerometer needles to oscillate wildly, giving false maximum positive and negative readings which may exceed aircraft limits. The accelerometer should be zeroed after gunfiring to record subsequent g levels.

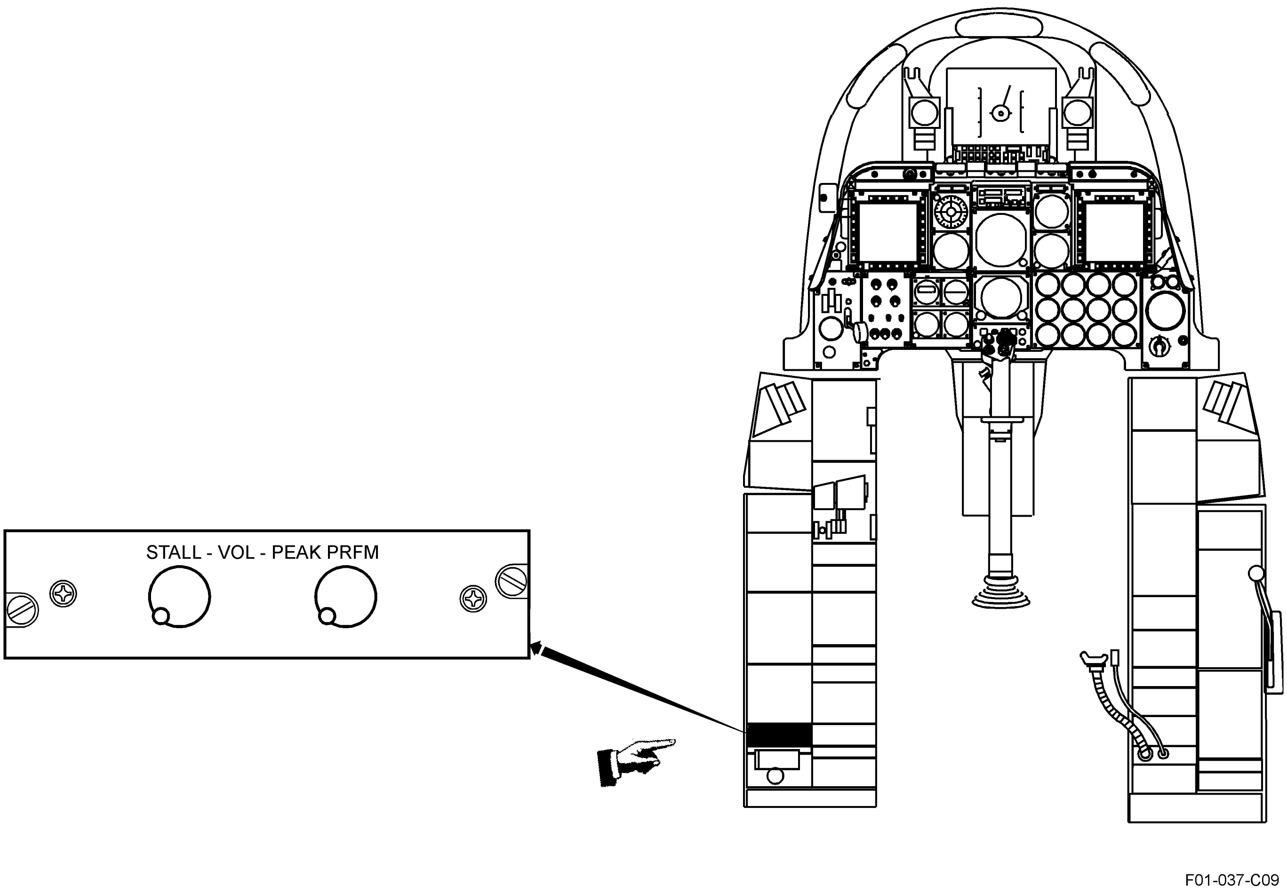


Figure 1-37. Stall Warning Control Panel

DIGITAL ELECTRONIC CLOCK.

The Digital Electronic Clock (Figure 1-38) has three modes of operation:

- CLOCK MODE - This mode accumulates and displays time in hours, minutes, seconds, and indicates clock mode is in effect by a "C" showing on display below the seconds digital indication.

- ELAPSED TIME MODE - This mode accumulates and displays time counting upward in hours, minutes, and seconds, displays an illuminated sweep second hand, and indicates elapsed time mode is in effect by an "ET" showing on display below seconds digital indication.

- TIME SET MODE - This mode is used to set time for clock mode and indicates time set mode is in effect by a flashing digit.

Two pushbuttons on front face of clock are used to select desired operating mode. The buttons are labeled "SEL" for select and "CTRL" for control. These buttons have various functions, depending on which operating mode the clock is in (Figure 1-38).

The clock is powered by 28 VDC for the Standby Attitude Indicator (SAI) and 5 VAC background lighting from the auxiliary AC essential bus.

ADI.

The ADI (Figure 1-39), located on the instrument panel, provides a display of aircraft pitch and bank attitude relative to the horizon. The ADI consists of a two-tone attitude sphere with graduated pitch references, fixed miniature aircraft, turn and slip indicator, pitch trim knob, pitch and bank steering bars, ADI off flag, glide slope deviation indicator and warning flag, and course warning flag. The ADI receives attitude information from either the HARS or EGI, as well as steering information from the EGI, TACAN, ILS, TISL, or FM homing, and displays it. The turn and slip indicator receives information only from the HARS, no matter which attitude reference system is selected. The EGI unit provides two- and three-dimensional navigation information used to drive the ADI steering bars and Glide Slope Indicator (GSI). See Figure FO-7 for additional information on navigation interfaces with the ADI. The ADI is powered by the right AC bus.

WARNING

- Certain EGI failures may cause incorrect information to be displayed on the ADI bank steering bar without causing the ADI course warning flag to come into view when STR PT or ANCHR is selected on the NMSP. However, these failures will cause the HSI bearing validity flag to come into view. Therefore, when STR PT or ANCHR is selected on the NMSP and the HSI bearing validity flag is in view, disregard the ADI bank steering bar indications. The ADI bank steering bar and course warning flag operate normally when TACAN, Instrument Landing System (ILS), Target Identification Set Laser (TISL), or FM HOMING is the selected source of the bank steering bar indications.

- Transitioning to instruments while flying with Night Vision Goggles (NVGs) may result in increased time required to discern aircraft altitude from the ADL.

HSI.

The HSI (Figure 1-40), located on the instrument panel, displays a plan view of navigation and positioning information. The HSI presents magnetic heading from the EGI or HARS, and relative bearing information from the EGI unit, TACAN and/or Automatic Direction Finder (ADF), command heading information, course information, Distance Measuring Equipment (DME) and TO-FROM indication relative to selected TACAN station or EGI steerpoint. The HSI also presents displacement of aircraft from selected course as computed by EGI unit, TACAN, or ILS. See Figure FO-7 for additional information on navigation interfaces with the HSI. The HSI compass card, bearing pointer, and course deviation indicator are powered by the right AC bus.

ADI and HSI Power Off Warning Flags.

During normal operation, the ADI and HSI power OFF flags will be in view under any of the following conditions:

- During the initial start cycle for approximately 90 seconds when HARS Δ indicator is lit on NMSP
- Whenever the HARS FAST ERECT switch is depressed when HARS Δ indicator is lit on NMSP
- During heading synchronization in the SLAVE mode when HARS Δ indicator is lit on NMSP.

A power OFF flag in view in either or both instruments, other than those listed above, indicates a malfunction. See Figure FO-7 for additional information on the ADI and HSI power OFF flags.

WARNING

Failure of certain components can result in erroneous or complete loss of attitude and heading presentations without a visible OFF flag. It is imperative that the ADI and HSI be cross-checked with other flight instruments when under actual or simulated instrument conditions.

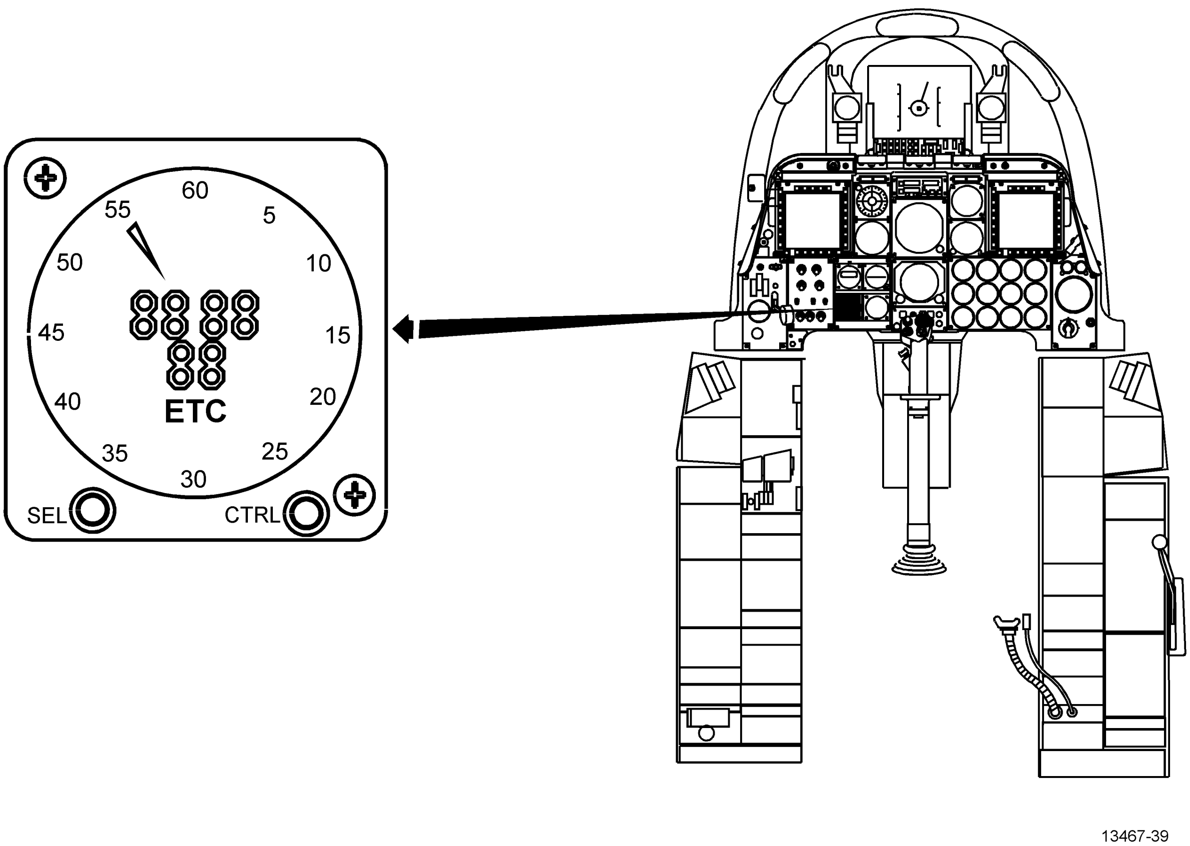


Figure 1-38. Digital Electronic Clock (Sheet 1 of 3)

MODE	Control or Indicator	Position or Display	Function
Clock	Sel	Depress	Changes Operating Mode From Clock To Elapsed Time.
	Ctrl	Depress	No Function In Clock Mode.
	SEL & CTRL	Depress simultaneously	Changes operating mode from clock to time set. **NOTE** While in clock mode, elapsed time continues to function.
ELAPSED TIME	SEL	Depress	Changes operating mode from elapsed time to clock.
	CTRL	Depress	Controls elapsed time function by starting, stopping, or resetting to zero. Consecutively depressing and releasing "CTRL" will cycle elapsed time as follows: "start-stop-zero-start" **NOTE** While in elapsed time mode, elapsed time continues to function.
TIME SET	SEL	Depress	Changes which digit is flashing, awaiting setting.
	CTRL	Depress	Increments by one, the digit which is flashing. **NOTE** While in time set mode, clock time is stopped and elapsed time continues to function.

Operational Procedure

Self-Test

The clock during the first 5 seconds of operation, illuminates all of the segments. Check to see if all segments are illuminated. The clock will then start up in formal time mode.

Time Set Sequence

Enter set time mode: Depress SEL & CTRL simultaneously during clock mode (Hrs digits flash)

Depress CTRL:	Hours will increment
Depress SEL:	Minutes will flash
Depress CTRL:	Minutes will increment
Depress SEL:	Seconds will flash
Depress CTRL:	Seconds will increment
Depress SEL:	Returns to normal clock mode

Figure 1-38. Digital Electronic Clock (Sheet 2)

Selecting Elapsed Time (ET) & Clock Modes (C)	
Depress SEL:	Clock changes to elapsed mode (ET)
Depress SEL:	Clock changes to clock mode (C)
Elapsed Time Operation	
Depressing CTRL in Elapsed Time Mode (ET)	
	1st - Starts Elapsed Timer
	2nd - Stops Elapsed Timer
	3rd - Resets Elapsed Timer
	4th - Repeats cycle (Starts)

Figure 1-38. Digital Electronic Clock (Sheet 3)

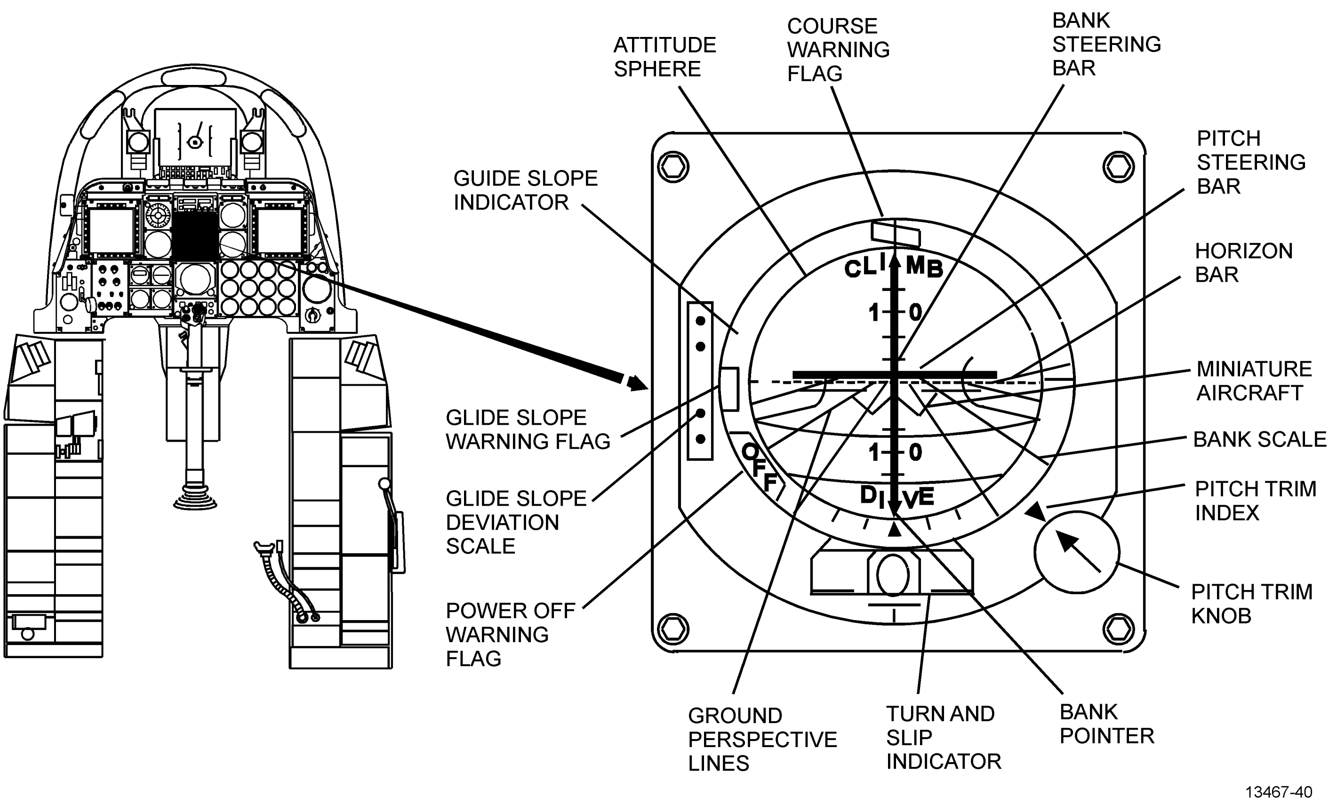


Figure 1-39. Attitude Directional Indicator (ADI)

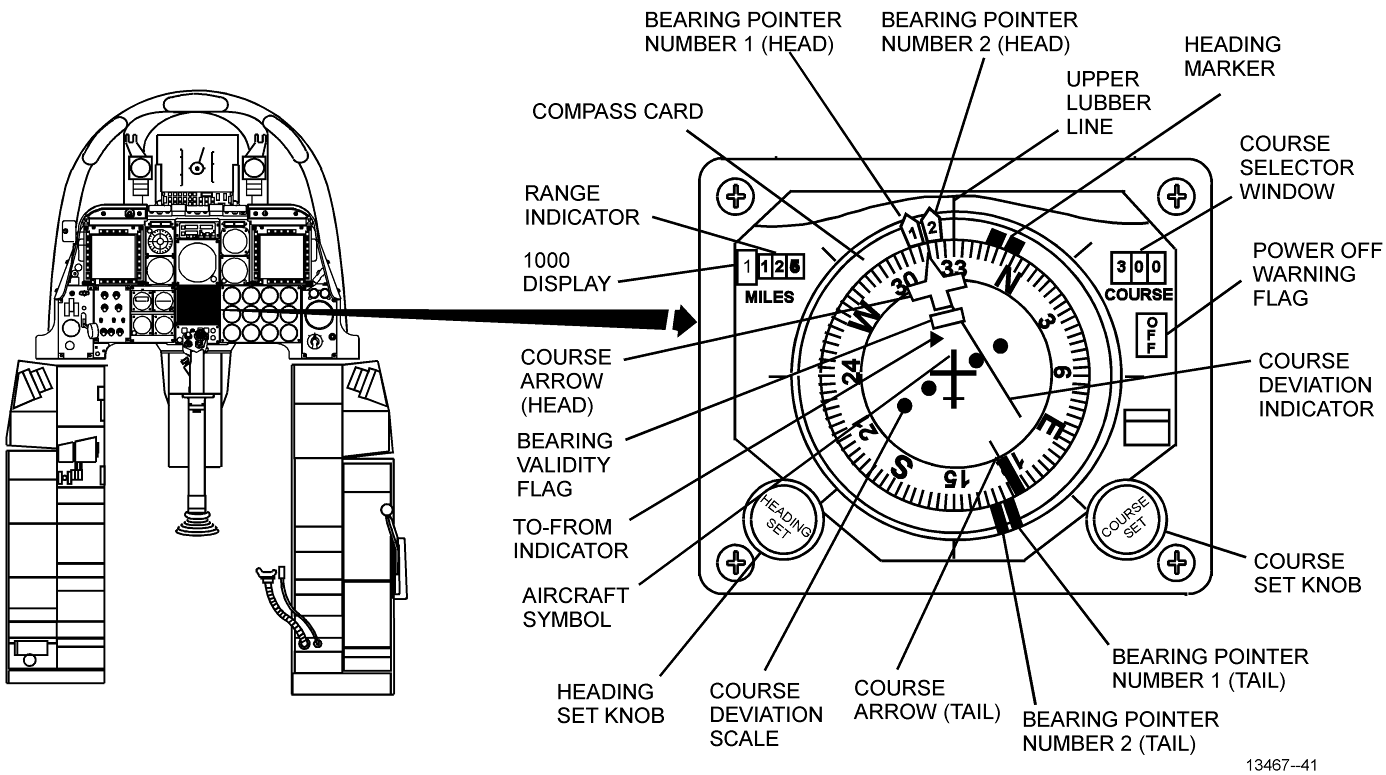


Figure 1-40. Horizontal Situation Indicator

STANDBY FLIGHT INSTRUMENTS.

STANDBY COMPASS.

The standby compass (5, Figure FO-1) is a conventional liquid filled magnetic compass.

SAI.

The SAI (20, Figure FO-1) provides an independent attitude indicating system in the event of failure of the ADI. The SAI receives its pitch and roll information from a self-contained gyro, powered by the DC essential bus, and will provide usable roll and pitch information within 6° for a minimum of 9 minutes after loss of electrical power. A red warning flag will come into view whenever the indicator is caged or when electrical power is interrupted.

A pull-to-cage knob, located on the right side of the instrument face, provides for pitch trim adjustment. With the knob fully extended and rotated to the extreme CW position, the gyro will remain caged and the knob will remain locked in the extended position. Avoid snap release when uncaging.

At high AOA it may not always be possible to superimpose the miniature aircraft on the horizon bar in level flight.

DATA TRANSFER SYSTEM (DTS).

The DTS (Figure 1-41) consists of an Upgraded Data Transfer Unit (UDTU) and a Data Transfer Cartridge (DTC). On some aircraft, the UDTU is housed in an enclosure. The UDTU is located behind the seat on the left-hand side of the canopy sill.

NOTE

Failure to properly close and latch UDTU enclosure door may cause excessive electromagnetic interference (EMI) noise levels on some VHF and UHF radio frequencies.

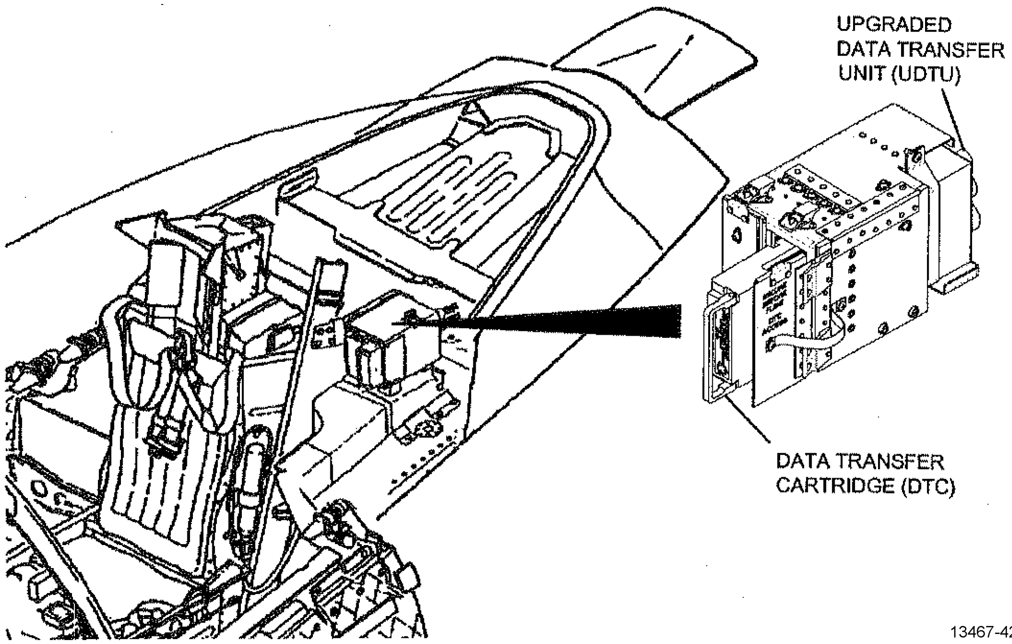


Figure 1-41. Data Transfer System (DTS)

The DTC is a memory cartridge that is inserted into and removed from the UDTU. A ground-based mission support system is used to create and process information files to be loaded into and read from the DTC. The DTS provides the ability to input mission data that was previously recorded on the DTC into the CICU, EGI, CDU and LASTE equipment of the aircraft. This data includes waypoints, flight plans, GEM OFP, EGI OFP, SYMGEN, VMU files, GPS almanac, GPS Cryptographic Key (JDAM), CDU initialization file, ARC-210 configuration data, TAD display settings, TAD map overlays, HMCS Profiles, Threat data, IFF OFP, LASTE pilot preferences, weapons inventory and profiles data, launch region coefficients, datalink (SADL/VMF) configuration data and message upload, Targeting Pod configuration data, Data and Settings Upload, TAD profiles, and CICU Data Pump definitions. (Refer to TO 1A-10C-34-1-1 for a description of the LASTE pilot preferences and weapons inventory and profile data.) The DTS also provides the means to record mission data such as mark points, avionics equipment Built-in Test (BIT) results (from the CDU, GPS, INS, and CADC), weapon delivery data, SADL/VMF received/sent messages, GCAS messages on the DTC and IFFCC maintenance data. This mission data can then be read from the DTC by the mission support system. Whenever a DTS upload or download is in progress, a flashing asterisk (*) will appear in the upper left corner of the CDU display.

NOTE

If a GCAS call is issued during a weapons event, the weapons event data being written to the DTC will be interrupted with some possible information loss due to the GCAS event having priority over the weapons event for DTC storage.

The DTC can also contain the Digital Terrain System Application Software (DTSAS) which is executed using the processor in the DTC. This software, in conjunction with the EGI navigation system, LASTE system, and the DTS, provides Predictive Ground Collision Avoidance system (PGCAS) warnings, Obstacle Warning Cues (OWC), and Target Ranging (TR) information on the HUD. The DTSAS function is turned on and off from the DTSAS Page (Figure 1-93).

The DTS also provides maintenance personnel with the means to upload UDTU, CDU, EGI, global positioning system embedded module (GEM) (part of EGI unit), IEPU $\boxed{152}$, and IFFCC Operational Flight Programs (OFPs).

The DTS also provides maintenance personnel with the means of downloading ADR recorded data to the DTC. $\boxed{152}$

NOTE

Although the DTC is capable of storing data downloaded from several sorties, it is recommended that a DTC be created prior to each flight. This is to ensure that there will be adequate memory space available in the DTC to contain the various data to be downloaded.

DTC INSERTION.

The DTC should be inserted and locked into the UDTU before the CDU is powered on (refer to EGI NAVIGATION SYSTEM). After the DTC is inserted and CDU is powered on, the data uploading function automatically takes place upon the completion of the CDU startup BIT test. The DTC must be inserted and locked into the UDTU prior to the completion of the CDU startup BIT test. If the DTC is not inserted and locked into the UDTU prior to the completion of the CDU startup BIT test, all data may not be uploaded and an upload error annunciation may be displayed on the CDU. If the DTC is not inserted and locked into the UDTU prior to the completion of the CDU startup BIT test, all data must be uploaded either manually or automatically. Data can be uploaded manually using the DTS Upload (DTSUPLD) Page (Figure 1-77) and the ALL ORIG DATA LSK, or automatically by cycling power to the CDU using the Avionics Auxiliary Panel (AAP) CDU toggle switch.

NOTE

When cycling power to the CDU, power must be removed from the CDU for at least 4 seconds to ensure that a cold start will occur.

AUTOMATIC INITIALIZATION.

To the greatest possible extent, the initialization of the CDU, EGI, and LASTE are automated. The CDU controls the digital data transfer of the IFF configuration data from the DTS while it is being loaded into the CICU. Waypoint data (including initial position) and flight plans from the DTC are loaded into the CDU via the UDTU. A ground (normal gyrocompass) alignment of the INS section of the EGI is started upon the completion of the CDU startup BIT test. GPS almanacs from the DTS are loaded into the Global Positioning System (GPS) section of the EGI. When present on the DTC, the CDU preferences (wind model data, DTSAS settings, local time adjust, and/or data pump setting) are uploaded directly to the CDU. LASTE pilot preferences and weapons inventory and profile data are loaded directly from the DTS to LASTE under control of the CDU. The alignment status of the EGI INS is displayed on the CDU ALIGN Page (Figure 1-73).

When degraded navigation capability is available, a steady INS NAV RDY is annunciated on the CDU. When full navigation accuracy is available, a flashing INS NAV RDY is annunciated on the CDU.

DTS UPLOAD.

Upload of data stored on the DTC to the CDU and other LRUs is normally accomplished automatically at power on. Upload can also be accomplished manually using the DTS Upload (DTSUPLD) Page (Figure 1-77).

a. To upload all of the original waypoints and almanac data, flight plans, CDU preferences and LASTE pilot preferences and weapons inventory and profile data, depress ALL ORIG DATA LSK. This original data consists of waypoints and almanac data, flight plans, CDU preferences, and LASTE pilot preferences and weapons inventory and profile data uploaded from DTS prior to any modifications or additions to the mission waypoints or flight plans, or creation of any mark points.

NOTE

Depressing the ALL ORIG DATA LSK after making any modifications or additions to the mission waypoints or flight plans, CDU preferences, or LASTE pilot preferences and weapons inventory and profile data, or creation of any mark points causes the modified, added, or created data to be lost.

b. To upload all of the original navigation data, depress the ORIG NAV DATA LSK. This original navigation data consists of waypoints and flight plans uploaded from DTS prior to any modifications or additions to the mission waypoints or flight plans, or creation of any mark points.

NOTE

Depressing the ORIG NAV DATA LSK after making any modifications or additions to the mission waypoints or flight plans, causes the modified or added waypoints and/or flight plan data, or created mark point data to be lost.

c. To upload all of the recent navigation data, depress the RECENT NAV DATA LSK. This recent navigation data consists of the original waypoints and flight plans databases and includes any modifications or additions to the mission waypoints or flight plans, or created mark points.

NOTE

Depressing the RECENT NAV DATA LSK after depressing the ALL ORIG DATA or ORIG NAV DATA LSK(s) will not restore any modified or created data since depressing either of these LSKs causes all modified or created data to be lost.

d. To upload all of the original CDU preferences and LASTE pilot preferences and weapons inventory and profile data, depress the CDU/LASTE PREFERENCES LSK.

NOTE

Depressing the CDU/LASTE PREFERENCES LSK after making any modifications to the CDU preferences and/or LASTE pilot preferences and weapons inventory and profile data causes all modified data to be lost.

Upload Failure/Error.

When an attempt has been made to upload data to the CDU, EGI, and LASTE, the CDU displays the DTC UPLOAD COMPLETE annunciation. If an error occurs during an auto or ALL ORIG DATA upload, the CDU displays the annunciation that corresponds to the error that occurred; WP UPLOAD ERROR, FP UPLOAD ERROR, LASTE UPLOAD FAIL, or GPS ALM LOAD ERR. If an error occurs during an ORIG or RECENT NAV DATA upload, the CDU displays the annunciation that corresponds to the error that occurred; WP UPLOAD ERROR or FP UPLOAD ERROR. If an error occurs when the waypoints database is being uploaded, the WP UPLOAD ERROR annunciation is displayed. If an error occurs when the flight plans database is being uploaded, the FP UPLOAD ERROR annunciation is displayed. If an error occurs during a CDU/LASTE preferences upload, the LASTE UPLOAD FAIL annunciation is displayed when the error occurs during the LASTE preferences upload. No annunciation is provided if the error occurs during the CDU preferences upload. If an error occurs during the GPS almanac upload, the GPS ALM LOAD ERR annunciation is displayed.

NOTE

If an upload failure/error occurs it is recommended to reseat the DTC in the UDTU and reattempt upload procedures.

DTS DOWNLOAD.

LASTE weapons events and GCAS messages and training events are automatically downloaded to the DTC as they occur. CDU events are automatically downloaded to the DTC every fourth CDU event. CDU events include: keystrokes, LRU status changes, bus transitions, and radial error rate (RER) and cumulative error probable (CEP) data (if calculated upon landing). Download of data (not including LASTE weapons events, GCAS messages, and CDU events) to the DTC is normally accomplished automatically upon landing when weight is on wheels and the airspeed has fallen below 75 knots. At this time, the waypoints (including created and modified waypoints, and mark points), flight plans, SADL/VMF received/sent text, MA, BDA, DIP, APTD, and AOS messages, and present position are downloaded to the DTC.

NOTE

When a flight plan or waypoint parameter is changed for the first time, it may take up to 3 minutes to write the temp file to the DTC.

Approximately 30 seconds later the CDU begins to calculate the RER and CEP if the EGI GPS expected horizontal error (EHE) is less than 300 feet. When the EGI GPS EHE is 300 feet or more, the RER and CEP are not calculated (steerpoint will not change) and the RER and CEP fields on the MXRER Page will display asterisks. This causes the CDU to create a new mission waypoint at the next available mission waypoint number with the waypoint identifier RERCALC if the mission waypoint (MS 0 through MS 50) database is not full. If the mission waypoint database is full, the CDU will overwrite the position information in waypoint MS 50 (waypoint number will not be changed and identifier will change to RERCALC). If the aircraft takes off and lands a second time without realigning the EGI INS, the RER and CEP will be calculated a second time as described above; except, if the first RER and CEP that was calculated created a waypoint with the identifier RERCALC; the second waypoint created will overwrite the waypoint with the identifier RERCALC and the identifier will not change. The CDU then selects this position as the steerpoint and calculates the RER and CEP (steerpoint data on CDU changes to this RER steerpoint, and HSI, ADI, and HUD steering cues are to this steerpoint). The RER and CEP will only be calculated if the entire mission has been flown after a full ground EGI INS alignment was performed. (EGI INS placed in NAV mode after flashing INS NAV RDY annunciation was displayed on CDU; and no other degraded alignment or update was performed during the mission. Under these conditions, it will appear that the RER and CEP are being calculated (steerpoint will change); however, the RER and CEP fields on the MXRER Page will display N/A (not available)). The CDU then places the EGI GPS in the INIT mode and downloads the GPS almanac to the DTS. Upon completion of the GPS almanac download, the CDU returns the EGI GPS to the NAV mode. The CDU then causes a maintenance log to be written. This causes a warm start of the CDU and a WARM START annunciation to be displayed on the CDU. When the aircraft is on the ground and the IAS is less than 75 knots, manual downloads can be initiated using the DTS Download (DTSDNLD) Page (Figure 1-99) as follows:

a. To download all data that are normally downloaded during landing, depress the ALL LSK. When the GPS almanacs are downloaded, the EGI GPS is automatically placed in the INIT mode.

b. To download only the GPS almanacs, depress the GPS ALMANACS LSK. When the GPS almanacs are downloaded, the EGI GPS is automatically placed in the INIT mode.

c. To download only the LRU BIT results, depress the LRU BIT LOG LSK.

NOTE

When the aircraft is in the air (weight off wheels and IAS is 75 knots or above), the ALL, GPS ALMANACS, and LRU BIT LOG LSKs are inactive.

NAVIGATION SYSTEMS.

See Figure 1-42 for a listing of navigation aids installed in the aircraft.

ANTENNA LOCATIONS.

Antennas used with the navigation and communications equipment installed in the aircraft are illustrated in Figure 1-43.

NMSP.

The NMSP (Figure 1-44) is located on the instrument panel, and provides the means to select and/or indicate which navigation information is being displayed on the HSI and ADI. The NMSP contains seven pushbutton type switch-indicators, a two-position toggle switch, and two HOMING (UHF and FM) indicator lights.

NOTE

The FM HOMING indicator light is deactivated on aircraft with ARC-210-2. 526

A triangle symbol in the lower half of each switch-indicator will come on to signify selected display. The NMSP interface chart (Figure FO-7) indicates which data is displayed by the HSI and ADI for the various configurations of the switch-indicators.

Figure 1-42. Navigation Aids

TYPE	DESIGNATION	FUNCTION	RANGE	CONTROL LOCATION
TACAN System	AN/ARN-118(V)	Provides navigational information in conjunction with a surface navigation beacon or with another airplane equipped with similar TACAN system.	Line of sight	Right console
Instrument Landing System (ILS)	AN/ARN-108	Provides vertical and horizontal guidance information for instrument landings.		Right console
Automatic Direction Finder (ADF)	AN/ARC-164(V)	Provides bearing information to selected station transmitting on UHF.	Line of sight	Left console (thru UHF radio)
Automatic Direction Finder (ADF)	AN/ARC-186(V) NON526	Provides bearing information to selected station transmitting on VHF/FM.	Line of sight	Left console (thru VHF/FM radio)
Embedded GPS Receiver/INU (EGI)	CN-1689(V) 5/ASN	Provides position, velocity, steering data, acceleration, attitude, and time for world-wide navigation capability.	Line of sight to GPS satellites for EGI GPS solution. Anywhere, any attitude for EGI INS solution	Right console thru CDU

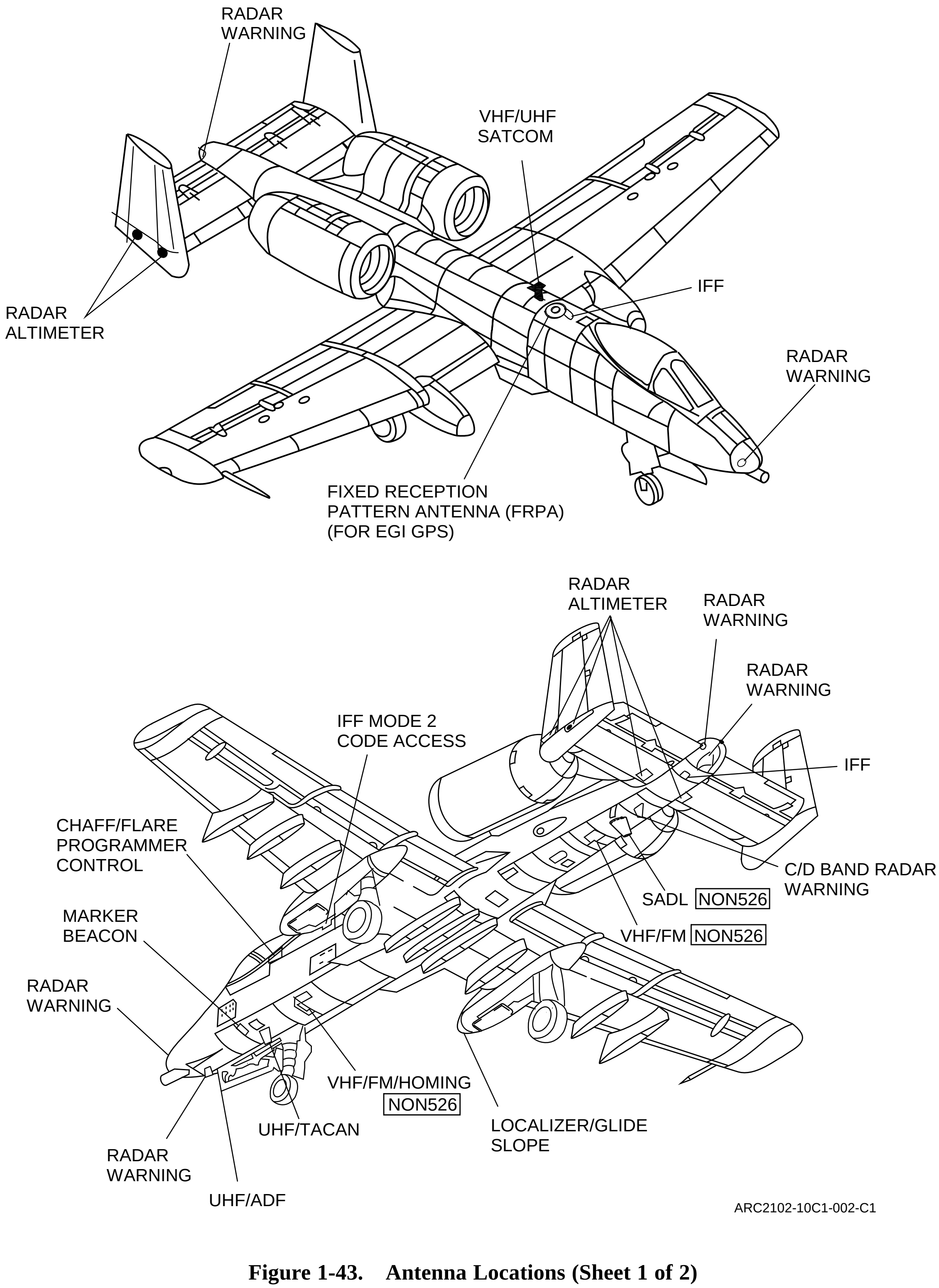


Figure 1-43. Antenna Locations (Sheet 1 of 2)

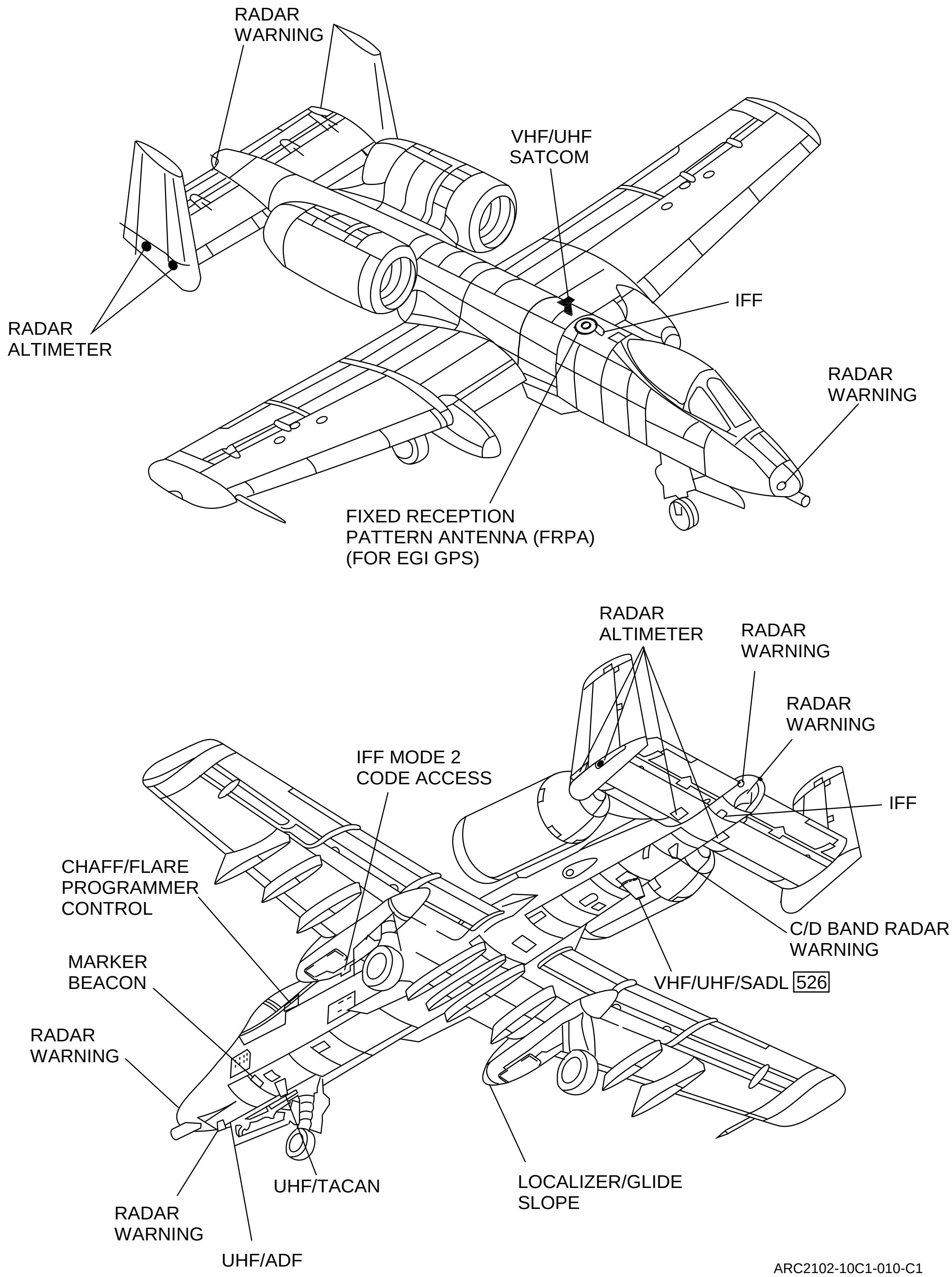


Figure 1-43. Antenna Locations (Sheet 2)

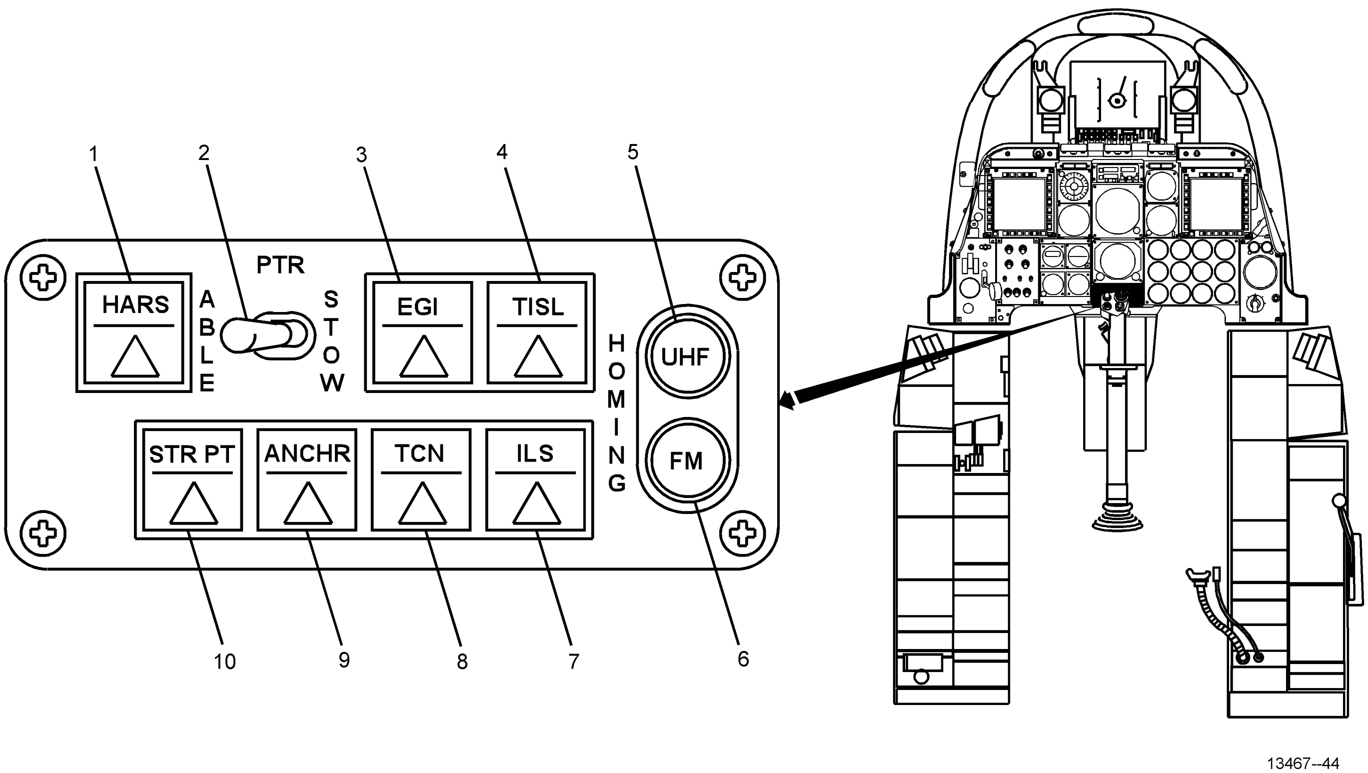


Figure 1-44. Nav Mode Select Panel (NMSP) (Sheet 1 of 2)

Index No.	Control or Indicator	Position or Display	Function
1	HARS switch-indicator	Depress	Selects HARS as the operating heading and attitude system providing this data to the ADI, HSI, and HUD (see Figure FO-7).
2	PTR switch	ABLE	Enables the pitch/bank steering bars and the course warning flag on the ADI.
		STOW	Stows the pitch/bank steering bars and the course warning flag, except when TISL or FM homing is selected.
3	EGI switch-indicator	Depress	Selects EGI as the operating heading and attitude system and provides this data to the ADI, HSI, and HUD (see Figure FO-7).
4	TISL switch-indicator	Depress	TISL (laser spot seeker) raw azimuth and elevation pointing data is displayed on the ADI. The TISL switch-indicator has priority over the FM light and when depressed, the FM light will not come on.
5	HOMING UHF light	-	Comes on amber when ADF mode is selected on the UHF control panel.
6	HOMING FM light **NON526**	-	Comes on amber when homing mode (DF) is selected on VHF/FM radio control panel and the TISL mode has not been selected. When the homing mode is selected, course deviation and relative signal strength will be displayed on the ADI via the pitch/bank steering bars. TISL takes precedence over VHF/FM when selected. The FM HOMING function and indicator light is deactivated on aircraft with ARC-210-2 526.
7	ILS switch-indicator	Depress	ILS steering and raw glide slope information are displayed on the ADI. Raw localizer information is displayed on the HSI (see Figure FO-7).
8	TCN switch-indicator	Depress	See Figure FO-7.
9	ANCHR switch-indicator	Depress	See Figure FO-7.
	NOTE When the ANCHR switch is depressed, the Anchor Point will be displayed on the HUD and steering information to the Anchor Point will be indicated on the HSI.		
10	STR PT switch-indicator	Depress	See Figure FO-7.

Figure 1-44. Nav Mode Select Panel (NMSP) (Sheet 2)

TACAN (AN/ARN-118 (V)).

The TACAN set (Figure 1-45) provides a continuous line-of-sight range and bearing to a ground TACAN station, or to a suitably equipped cooperating aircraft. The A-10 can provide Air-to-Air range information to another A-10 or suitably equipped aircraft, but cannot provide Air-to-Air bearing information. The TACAN set displays navigation data on the HSI.

TACAN-HSI Display.

The TACAN information displayed on the HSI is in accordance with the mode selected at the NMSP (see Figure FO-7).

When the TCN mode has been selected (Δ light is on) and homing UHF mode (ADF) is not selected, bearing information will be displayed at all times by bearing pointer 1. When bearing lock-on occurs, the bearing validity flag will be out of view. When range lock-on occurs, the range shutter will uncover the MILES indicator which displays the TACAN station range. If the course pointer is more than ±90° displaced from the bearing pointer, the To/From indicator will indicate From.

The TACAN, operating in conjunction with the HSI, provides a course deviation function. A desired TACAN radial or course is selected using the COURSE SET knob. The course deviation bar will deflect either to the right or left of the course pointer. This indicates the aircraft is either to the right or left of the selected course. Within approximately ±10° of the selected course, the course deviation bar will indicate the relative position of the aircraft from the selected course. When the course deviation bar is aligned with the course pointer, the aircraft is on the selected course or radial.

TACAN-ADI Display.

The TACAN information displayed on the ADI is in accordance with the mode selected at the NMSP (see Figure FO-7).

TACAN Controls.

The TACAN control panel (Figure 1-45) contains all controls necessary for channel selection, operating mode selection, pulse mode selection (X or Y), volume control, and self-test.

TACAN Antenna.

The TACAN antenna system consists of a lower blade type antenna which is shared with the UHF radio.

TACAN Modes of Operation.

The TACAN set has four modes of operation: receive, transmit-receive, air-to-air receive, and air-to-air transmit-receive. Refer to Figure 1-45 for a description of each mode of operation.

The TACAN set has two self-test modes. The manual self-test mode is initiated by setting the mode switch to T/R and depressing the TEST pushbutton. If the TEST indicator is still on at the end of the self-test cycle, a malfunction or failure has occurred. The test should then be repeated in the REC mode. If the TEST indicator is not on at the end of the self-test cycle in the REC mode, the malfunction is probably in the transmitter and the bearing information is valid. If the TEST indicator is on at the end of the self-test cycle in the REC mode, all information received should be considered invalid. Self-test mode can be terminated at any time by rotating either a channel knob or the mode selector. The automatic self-test mode occurs automatically whenever the received signal becomes unreliable or is lost (memory time elapsed). If the TEST indicator is found to be on in flight, a manual self-test should be initiated to confirm the malfunction and to determine limitations.

TACAN Operation.

When operating in either of the Air-to-Air modes, the frequency of the master aircraft and all receiver aircraft must be in the same X/Y mode and spaced 63 channels apart; i.e., MASTER: Y mode channel 10, Receivers: Y mode channel 73. Additionally, when multiple flights are using Air-to-Air mode in close geographical proximity, paired channels should be spaced at least two channels apart.

To operate the TACAN, proceed as follows:

a. Set operating mode (OFF-REC-T/R-A/A REC - A/A T/R) selector switch to desired mode. Allow a 90-second warm-up period.

NOTE

T/R and A/A T/R modes should not be used when radio silence conditions are imposed. Do not use channels 1 - 9, 64 - 72, and 126 in Air-to-Air modes, due to IFF interference.

b. Rotate two channel switches to desired channel, as displayed in CHANNEL indicator window.

c. Set X/Y switch to the desired X or Y mode. The X mode should be selected unless otherwise required by the appropriate flight publications.

d. Pull out the TCN monitor switch on intercom control panel and adjust VOL control on TACAN panel for desired audio level. Audio may also be controlled by the TCN monitor volume control on the intercom control panel.

e. At the NMSP, depress TCN switch-indicator (Δ is on) to provide TACAN data for presentation on the HSI.

f. At the HSI, rotate COURSE SET knob to set course arrow (and course indication) to desired radial or course.

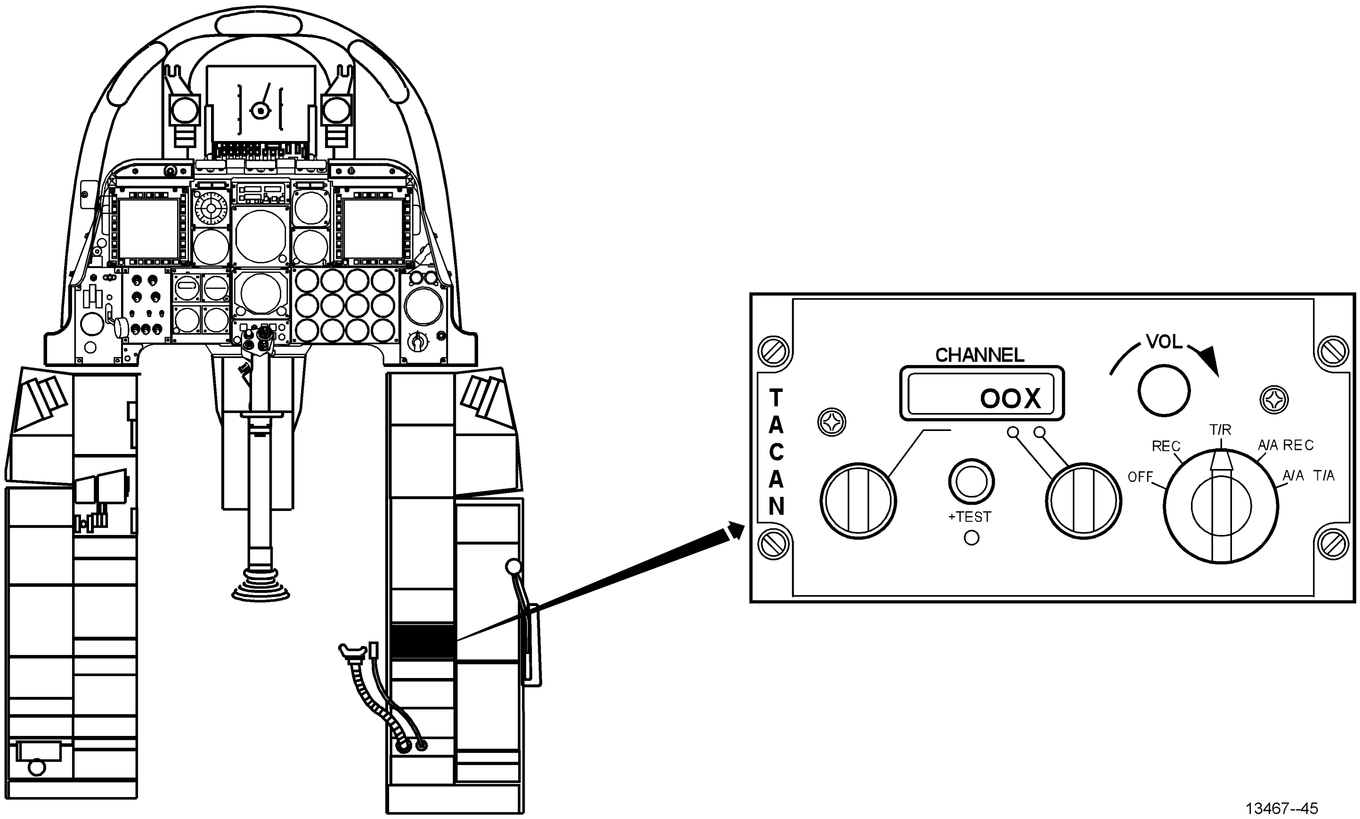


Figure 1-45. TACAN Control Panel - AN/ARN-118(V) (Sheet 1 of 2)

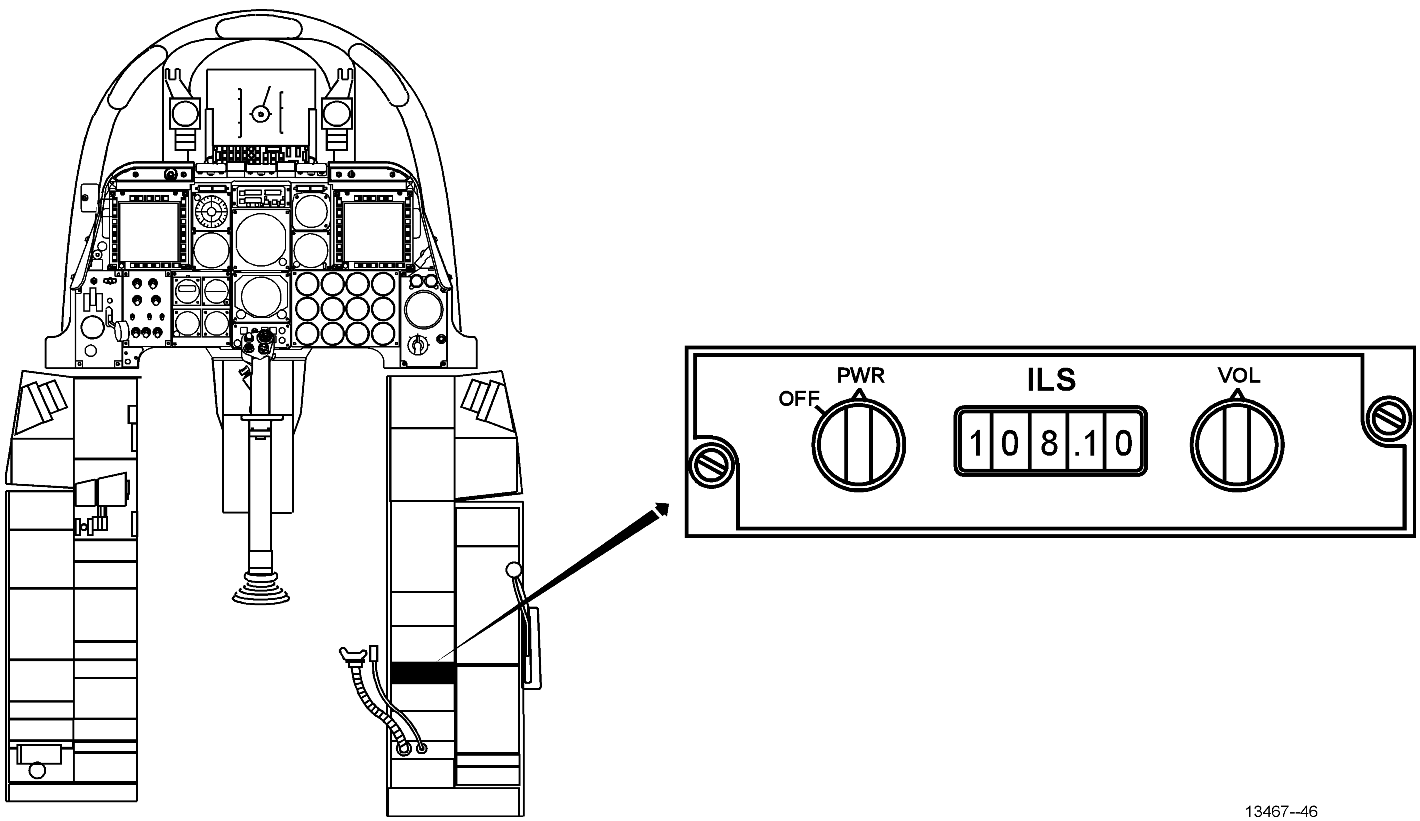
Control or Indicator	Position or Display	Function
CHANNEL digital display		Displays TACAN channel selected by the two channel selector switches.
X/Y pulse mode selector switch (outer ring CHANNEL units selector switch)		Permits selection of either X or Y pulse mode of operation.
VOL control		Controls the volume of the station identification.
Operating mode selector switch	OFF	Disconnects power to TACAN set.
	REC	TACAN set operates in receive mode only and provides bearing information, course deviation, and station identification.
	TR	TACAN set operates in both transmit and receive modes, providing bearing, range, deviation, and station identification information.
	A/A REC	TACAN set provides air-to-air bearing information when operating with a suitably equipped reference aircraft.
Operating mode selector switch	A/A T/A	TACAN system provides range and relative bearing to a suitably equipped, cooperating aircraft. If the reference aircraft is not equipped with bearing producing equipment, only slant-range is provided. The A-10 is not equipped with bearing producing equipment. In this mode, the TACAN system provides distance replies to other aircraft when interrogated.
Channel selector control		Selects the desired TACAN channel.
TEST pushbutton	Depressed	Initiates TACAN self-test mode. In self-test mode, HSI indications are: distance shutter in view, course deviation flag in view, bearing pointers slew to 270° for nominal 7 seconds. After 7 seconds, distance shutter and course deviation flag go out of view, distance indicator indicates 000 miles, bearing pointers lock onto 180°. After nominal 15 seconds, distance and bearing flags come into view and bearing pointers rotate CCW.
TEST indicator		Lights when malfunction occurs during manual or automatic system self-test. Flashes at start of test cycle to check indicator lamp.

Figure 1-45. TACAN Control Panel - AN/ARN-118(V) (Sheet 2)

ILS.

The ILS consists of a receiver (AN/ARN-108), ILS control panel (Figure 1-46), and three antennas for the reception of localizer, glide slope, and marker beacon signals. Localizer deviations are presented on the HSI and glide slope deviations on the ADI. Both the ADI and HSI have warning flags which come into view to indicate that the glide slope or localizer signals are unreliable. In addition to these visual signals, a localizer audio is available. The localizer receiver operates on 40 channels at a frequency range of 108.1 to 111.95 MHz. The radio receiver also provides audible and visual signals to indicate passage over a marker beacon. When this occurs, the MARKER BEACON signal light (15, Figure FO-1) will come on and an audio tone will be heard in the headset. Localizer and marker beacon audio is enabled through the use of the ILS monitor switch on the INTERCOM control panel (Figure 1-112). The VOL control on the ILS control panel varies the volume of the localizer audio only. The ILS monitor switch and VOL control on the INTERCOM control panel varies beacon and localizer audio signals.

The ILS control panel, on the right console, is described and illustrated in Figure 1-46. The ILS is powered from the right AC and DC busses.



Control or Indicator	Position or Display	Function
PWR control switch	OFF	Removes power from ILS.
	PWR	Applies power to ILS.
Frequency control switches	-	Used to select the desired localizer frequency.
Frequency dial	-	Indicates the localizer frequency selected.
VOL control switch		Controls the volume of the localizer identifier audio signal.

Figure 1-46. ILS Control Panel

ILS ADI/HSI Display.

To obtain ILS indications, the ILS switch-indicator on the NMSP (Figure 1-44) is depressed. ILS localizer deviation signals are supplied to the course deviation indicator (CDI) on the HSI (Figure 1-40) and ILS glide slope deviation signals to the GSI on the ADI (Figure 1-39). The To/From indicator will be stowed out of view and the bearing validity flag will reflect localizer receiver status. After ILS selection and prior to localizer capture, the bank steering bar on the ADI will be out of view. Bank steering will not be available until the CDI is within an equivalent displacement of 2.6 dots. The CDI will move off the stops and begin displaying valid displacement information. If steering commands are satisfied, the aircraft will intercept the localizer inbound course. Maximum bank command during localizer intercept is limited to 30°. Prior to glide slope capture, the pitch steering bar on the ADI is out of view. Glide slope capture occurs automatically when the aircraft is within 1/2 dot GSI deviation. Upon capture, the pitch steering bar comes into view at an initial 2° pitch down command position to facilitate glide slope capture, and then commands interception of the glide path. Maximum bank command after glide slope capture is 15°.

NOTE

- During back course localizer approaches, the ADI steering command bars and glide slope deviation indicator present incorrect information. Stow the bank and pitch steering bars on the ADI by setting PTR switch to STOW on the NMSP, and disregard glide slope deviation indications.

- If localizer and glide slope capture occur at the same time, the commanded bank angle will be limited to 15° which may cause a significant localizer overshoot. In this case, disregard command steering, and fly the aircraft as required to intercept the localizer.

ILS Operation.

To operate the ILS, proceed as follows:

a. At the INTERCOM control panel:

   (1) Set VOL control knob to midposition.

   (2) Pull out ILS monitor switch and place in midposition.

b. At the ILS control panel:

   (1) Set frequency dial to selected localizer frequency.

   (2) Set VOL control knob to midposition.

   (3) Set PWR switch to PWR.

c. Set HSI course selector window (course arrow) to published inbound localizer course.

d. At the NMSP: Depress ILS switch-indicator. Check that ILS Δ light comes on.

EGI.

The EGI navigation system (Figure 1-47) is the aircraft's primary navigation system, and provides an accurate, world-wide, navigation capability. The EGI Navigation (ENAV) system improves navigation accuracy by use of the EGI. This system provides attitude, navigation, and vertical and horizontal steering information.

Degraded back-up operating modes are provided, using the HARS in combination with the EGI GPS receiver when the EGI INU fails, and using the EGI INU when the EGI GPS receiver fails. The available navigation modes are described in Figure 1-48.

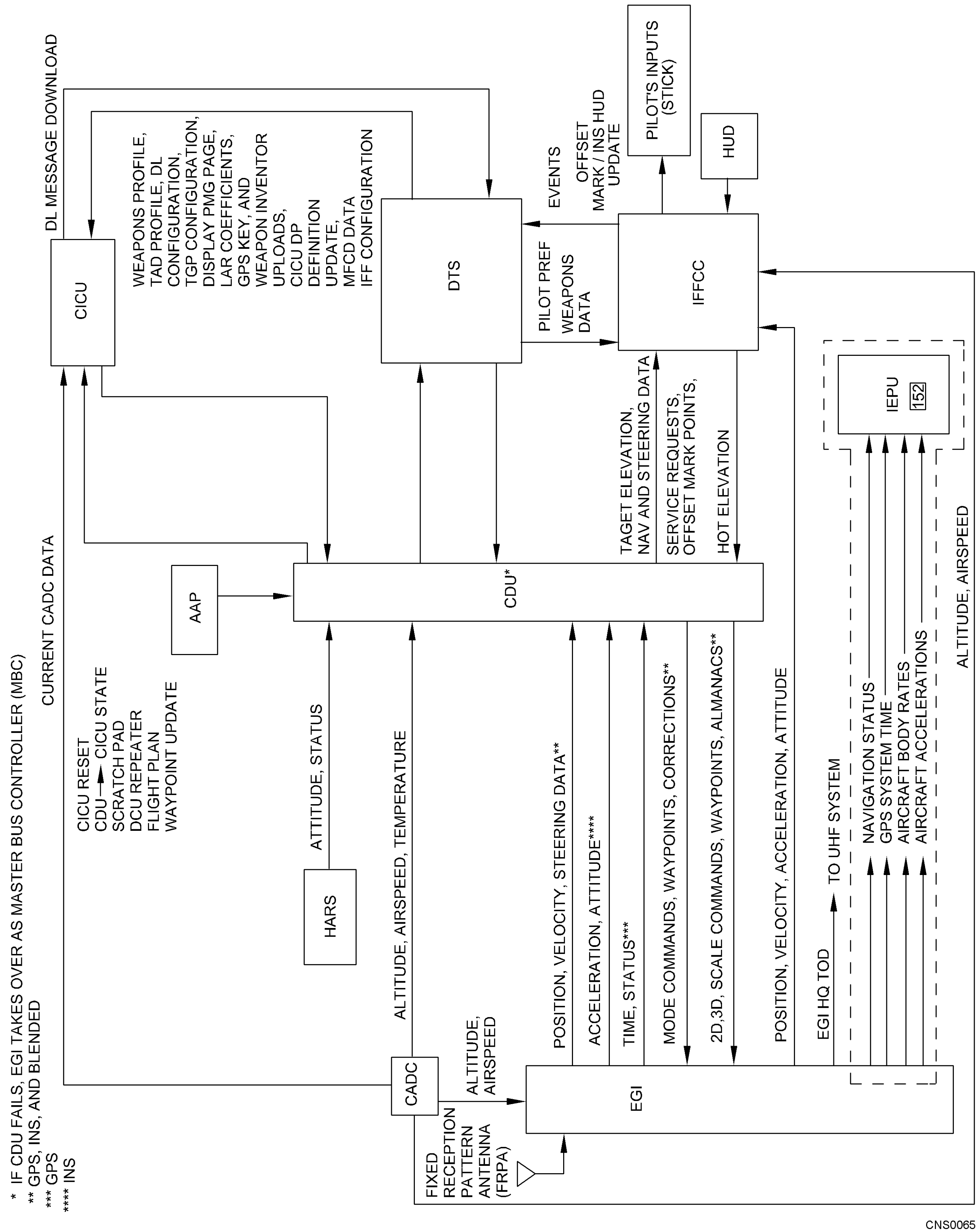


Figure 1-47. EGI Navigation (ENAV) System

Figure 1-48. Navigation Modes

Navigation Modes	Attitude Source	Position Source	Velocity Source	Characteristics
BLENDED	EGI INS	EGI	EGI	No long-term drift. Position error = 50 feet. Velocity error < 0.1 fps.
INS - only	EGI INS	EGI INS	EGI INS	Long-term drift = 0.8 nm/hr. Velocity error 2 fps.
GPS - only	If INS is valid, INS; otherwise HARS	EGI GPS	EGI GPS	No long-term drift. Navigation data is updated once per second.

The CDU is the primary central processor which provides an interface via the CDU pages, which are displayed on the CDU or MFCD, if weapons video is not present. These pages provide position, navigation, steerpoint, waypoint, and various other information. The pages also describe the state of the ENAV system and its LRUs. The ENAV system consists of an AAP, NMSP, EGI, fixed reception pattern antenna (FRPA), CDU, HARS, and CADC; and interfaces with the HSI, ADI, and HUD (via LASTE) when one of the EGI modes is selected on the NMSP.

CAUTION

Although the EGI provides the A-10 with RNAV capability, the key difference between EGI and TACAN navigation must be understood. The TACAN uses a programmed magnetic variation at the station, and the variation may not be current or accurate. The EGI corrects for magnetic variation based on its position and internal computations. The difference between these two methods may be several miles, especially at longer ranges from the station. When the direction by ATC is to navigate via Navaid radial/fixes, EGI/TCN should be selected. Navigating in EGI/STR PT (with the TACAN coordinates entered in as the steerpoint) may cause significant errors. If TACAN guidance is unavailable, point-to-point navigation or radar vectors should be insisted on.

Waypoints.

The ENAV system provides point-to-point navigation with a maximum of 2077 waypoints. These waypoints are stored in the waypoint database. The waypoint database is divided into four subsets (Figure 1-49): mission waypoints, navigation waypoints, and mark points databases, and the LASTE weapons event mark point. The mission waypoints are assigned waypoint numbers 0 through 50. Mission waypoint 0 is normally the initial position. The navigation waypoints are assigned waypoint numbers 51 through 2050. The mark points are assigned waypoint letter A through Y. The LASTE weapons event mark point is assigned waypoint letter Z.

Figure 1-49. Waypoint Database

WAYPOINT DATABASE	
Waypoint Number	Type & Comments
0	• Initial Position
1 - 50	• Mission Waypoints • Can be modified or entered manually using the CDU
51 - 2050	• Navigation Waypoints • Cannot be modified or entered manually using the CDU
A - Y	• Mark points • Cannot be modified or entered manually using the CDU. • Can be deleted using the DELETE MARKPOINT button on the CDU.
Z	• Reserved for LASTE weapons event mark points. Succeeding LASTE weapons events cause the previously stored mark point Z data to be overwritten. Cannot be modified or entered manually using the CDU.

The mission waypoints (0 through 50) can be loaded automatically before or during flight from the DTS, or manually entered before or during the flight using the CDU. Mission waypoints can be assigned a tactical attribute (Navigation, Friendly, Target, or Named Area of Interest (NAI)) in mission planning using A/W/E or by hooking a mission point and selecting the attribute via OSB 10 on the MFCD. The symbol selected displays on the TAD Page in the appropriate color. A mission point that is also a steerpoint keeps the same symbol, but displays in yellow.

The navigation waypoints (51 through 2050) can only be loaded automatically before or during flight from the DTS. The navigation waypoints are reserved for navigation fixes (e.g., airfields, TACANs, airway intersections, AOR points, etc.), and cannot be manually entered or modified using the CDU. Up to 25 mark points (A through Y) can be created during the flight. There are two types of mark points: an overhead mark and an offset mark. An overhead mark records the current aircraft position. An offset mark records the position of a landmark or object identified by LASTE. The overhead or offset mark is stored in the next mark point memory location. If all 25 mark point memory locations (A through Y) are used, the next overhead or offset mark will overwrite the position stored at Mark point A. The next mark will overwrite the Mark point B position, etc. Mark point Z is reserved for LASTE weapons event mark points, which are created each time a LASTE weapons event occurs. Succeeding LASTE weapons events cause the previously stored mark point Z data to be overwritten. Mark points cannot be modified during the flight. Navigation waypoints and mark points can be modified by copying them to the mission waypoint database using Waypoint (WAYPT) Pages (Figure 1-63); and then modifying this new mission waypoint.

Flight Plans.

The CDU can store up to 20 flight plans of 40 waypoints each. The flight plans are comprised of waypoints from the waypoint database. The active flight plan is selected via the Flight Plan Menu (FPMENU) Page (Figure 1-67), but is active only if the STEER PT rotary switch on the AAP is in the FLT PLAN position or selected from the Up Front Controller. When a flight plan is active, the flight plan number is displayed on line 1 of every CDU page excluding the maintenance pages. Flight plans may be generated before flight using a mission support system and uploaded via the DTS. Flight plans may also be created and edited using the CDU Flight Plan Build (FPBUILD) Page (Figure 1-68). When flight plans have been created or uploaded via the DTS and the STEER PT rotary switch is set to the FLT PLAN position, the CDU will display F1 (after completion of CDU startup BIT test) on line 1 until another flight plan is selected using the FPMENU Page. F1 is the default flight plan. When flight plans have not been uploaded via the DTS, no flight plans have been created using the FPMENU and FPBUILD Pages, and the STEER PT rotary switch is set to the FLT PLAN position, the CDU will display F0 (no flight plans available) on line 1. When flight plans have not been uploaded via the DTS but have been created using the FPMENU and FPBUILD Pages and the STEER PT rotary switch is set to the FLT PLAN position, the CDU will display F0 on line 1 until a flight plan is selected using the FPMENU Page.

ENAV System Description.

The EGI processes GPS receiver and INU information to produce three navigation solutions: BLENDED, INS-only, and GPS-only. The BLENDED navigation solution is typically the most accurate; and is the default navigation solution if the EGI INS is aligned and the EGI GPS has not failed. The selected solution is used to drive the flight instruments and provide data to the CDU and the IFFCC. The EGI also computes the accuracy of each navigation solution which is represented by the Figure of Merit (FOM) and the Expected Horizontal Error (EHE) and Expected Vertical Error (EVE) which are based on the GPS-only solution. If the EGI INS attitude is not valid, the HARS automatically becomes the operating attitude reference system. The EGI and CDU are powered by the 28 VDC left system bus.

NAV CAUTION LIGHT.

The NAV caution light (Figure 1-158), located on the caution light panel, comes on when:

- The EGI is in an alignment mode and goes off when the EGI INS is placed in NAV mode either manually or automatically (see INSSTAT Page, Figure 1-92).

- The CDU displays the INS FAIL, GPS FAIL, EGI FAIL, or EGI FLT INST FAIL annunciation which remains on until the CDU FA pushbutton is depressed.

- The navigation solution mode has automatically down-moded from the commanded mode.

- The CDU displays the EGI NOT RDY annunciation which remains on until the CDU FA pushbutton is depressed or the EGI is ready.

EGI.

The EGI consists of an inertial navigation unit (INU, hereinafter called INS) a global positioning system receiver (GPS), system processor, and a missionization section. The EGI INS measures aircraft acceleration and attitude, and provides inertial navigation data to the system processor. The EGI GPS measures aircraft position and velocity, and provides global positioning data to the system processor. The system processor processes the inertial navigation and global positioning data to produce the BLENDED, INS-only and GPS-only data used by the EGI navigation system. The selected data are applied to the missionization section and discrete input/output (I/O) interface which produces the various signals required by the flight instruments. These signals provide attitude, navigation, and vertical and horizontal steering information.

AAP.

The AAP (Figure 1-50) provides the power switching for the EGI; and power and functional switching for the CDU. The PAGE select rotary knob determines which CDU page is displayed. The STEER PT select rotary knob determines from which portion of the waypoint database the steerpoint is selected. The STEER toggle switch permits incrementing or decrementing of the steerpoint within the selected portion of the waypoint database or flight plan. The CDU will allow the Steerpoint to cycle through Mission, Last Mark, Mark Z, and Nav points, in that order, while the AAP is set to Mission. Selecting the CDU pages via the UFC overrides the AAP settings.

CDU.

The CDU (Figure 1-51) along with the UFCP, provides the control and information interface to the EGI navigation system. The CDU controls the automatic initialization of EGI, LASTE pilot preferences and weapons inventory and profile data, and flight plan information. The CDU also indicates and records the operational status of various LRUs, equipment failures, LASTE events, and CDU events. A Master Bus Controller (MBC), which is part of the CDU, initiates, monitors, and controls data transfers over the digital data bus. When a failure occurs in the CDU, the EGI assumes control of the digital data bus. When power is applied, the CDU clears, resets, and performs a start-up BIT before assuming control of the digital data bus. A BIT test can also be manually initiated via the CDU test page. If a fault is detected, an error message is displayed on the CDU.

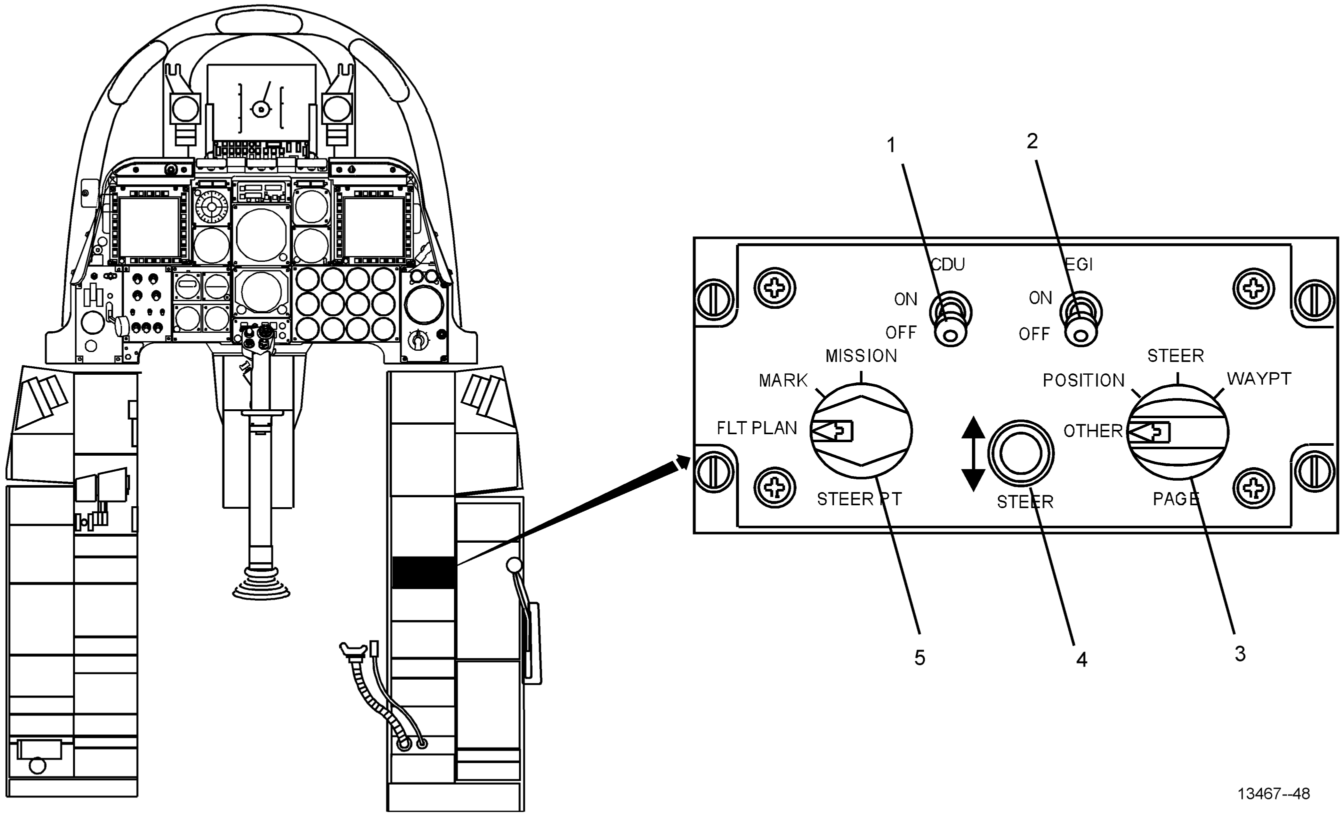


Figure 1-50. Avionics Auxiliary Panel (Sheet 1 of 2)

Index No.	Control or Indicator	Position or Display	Function
1	CDU power switch	ON	Applies power to CDU.
		OFF	Removes power from CDU.
2	EGI power switch	ON	Applies power to EGI.
		OFF	Removes power from EGI.
3	PAGE select switch	OTHER	Allows function select keys on CDU to select page to be displayed.
		POSITION	Causes Position Information (POSINFO) Page (Figure 1-59) to be displayed on CDU.
		STEER	Causes Steerpoint Information (STRINFO) Page (Figure 1-60) to be displayed on CDU.
		WAYPT	Causes Waypoint Information (WP INFO) Page (Figure 1-61) to be displayed on CDU.
4	STEER toggle switch		Selects active steerpoint by scrolling through portion of waypoint database selected by STEER PT select switch (flight plan, mark, or mission).
5	STEER PT select switch	FLT PLAN	Provides steerpoint access from active flight plan.
		MARK	Provides steerpoint access from mark point portion of waypoint database. When moved to this position, the steerpoint is the most recently created mark point.
		MISSION	Provides steerpoint access from mission and navigation portions of waypoint database.

Figure 1-50. Avionics Auxiliary Panel (Sheet 2)

ENAV CDU DISPLAY PAGES.

NOTE

At CDU and EGI turn-on, many fields of the CDU display pages may display asterisks, zeros, or invalid information, or be blank until valid data is entered manually via the scratchpad, or automatically via the DTS, or produced by EGI when EGI computes a valid navigation solution.

The ENAV CDU display pages menu tree (Figure 1-57) illustrates the flow between the CDU operational pages for the various ENAV functions. Figure 1-59 through Figure 1-108 provide a description of each operational page by label and LSK. Each page consists of 10 lines of 24 characters. Eight LSKs are located adjacent to the left and right edges of the display at lines 3, 5, 7, and 9. Line 1 is used to display the page label, active flight plan, and steerpoint on all CDU display pages excluding maintenance pages. When data is uploaded or downloaded from the DTC, a flashing asterisk will appear on the left side of line 1. Line 2 is used for annunciations, and displays the CDU navigation mode if other than blended, as well as the FOM for the selected solution on all CDU display pages. If the EGI is not communicating, failed, or powered down, the FOM will be an N and an asterisk (*). Line 10 contains a scratchpad for data entry on the left end. If there are multiple display pages for the function in view, the page is identified in the right end of line 10 with the symbol P1/X, where X is the total number of pages. When the function in view consists of only one page, the symbol P1/X is not displayed. Some pages are dynamic pages that may consist of one or more pages. A dynamic page that consists of only one page will display the symbol P1/1. Each page description includes notes on access to that page.

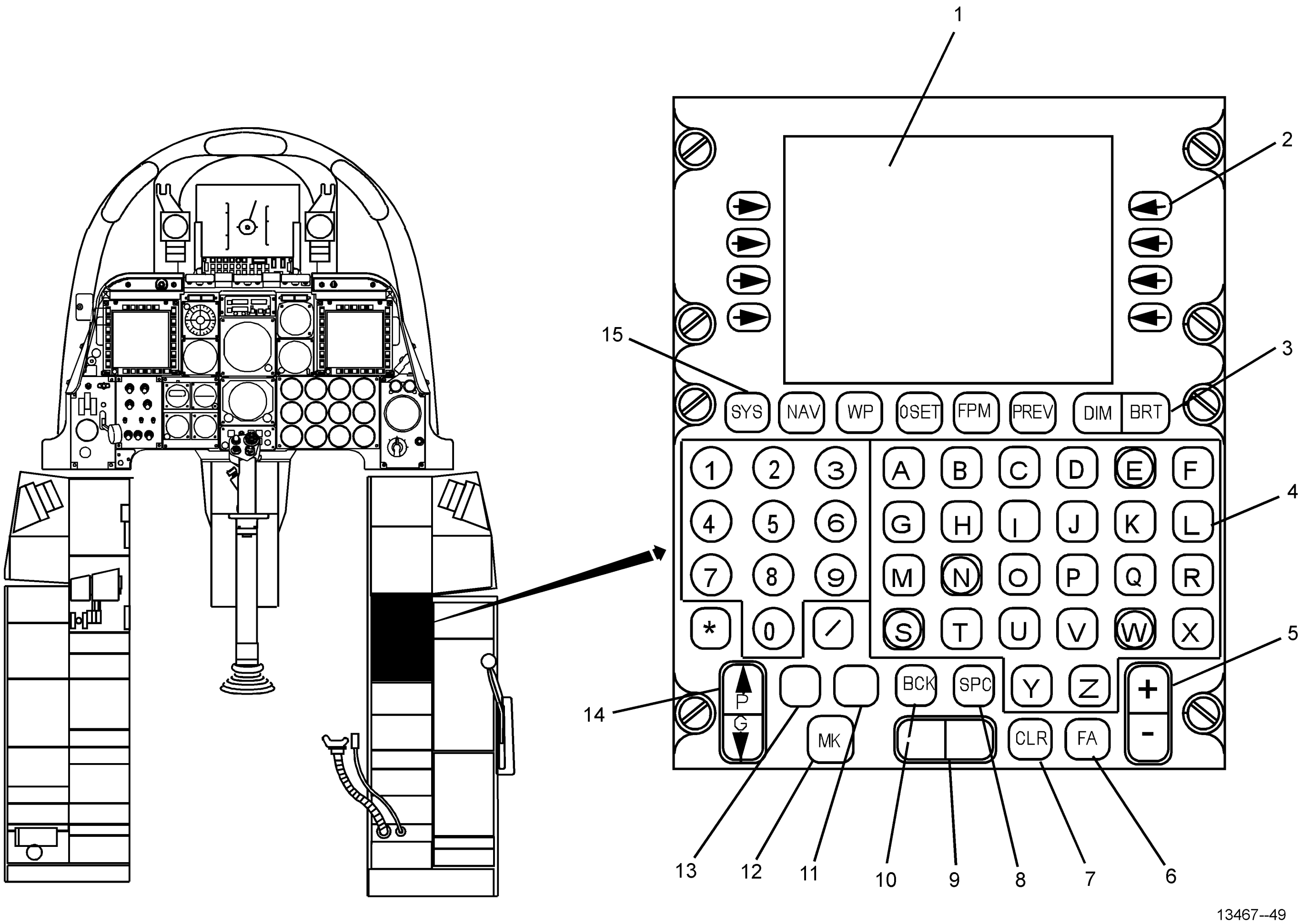


Figure 1-51. Control Display Unit (Sheet 1 of 4)

Index No.	Control or Indicator	Position or Display	Function
1	Display	-	Displays CDU START-UP BIT TEST page for approximately 45 seconds after CDU is turned on, and then displays the ALIGN Page (Figure 1-73) when PAGE switch on AAP is set to OTHER, or to page selected by PAGE switch. These ENAV CDU display pages provide for display of ENAV data on 10 data lines with up to 24 characters per line. A scratchpad, with up to 15 enterable characters, occupies part of the 10th line.
2	LSKs	-	Eight keys, four on each side of display, when depressed, control data entry on page selection. Active LSKs are indicated by one of the five following symbols being displayed next to the LSK.
			LSKs that do not have a symbol displayed next to them are inactive.
		← →	Depressing the LSK next to this symbol (arrow) causes the page indicated in the display next to the symbol to be displayed.
		±	When this symbol (plus and minus) is displayed, the ± rocker switch can be used to step through the data or to enter data into the scratchpad using the keyboard pushbuttons, and then entering the displayed data by depressing the LSK next to this symbol.
		↕	When this symbol (up and down arrow) is displayed, depressing the associated LSK causes the data field display to step through the possible choices associated with that data field.
		[ ]	When this symbol (brackets) is displayed, data is entered into the scratchpad using the keyboard pushbuttons and then depressing the LSK to enter the scratchpad data in the corresponding data field.
		⊙	When this symbol (target) is displayed, depressing the associated LSK initiates the indicated operation, function, or action.
3	DIM/BRT rocker switch	-	Provides dimming and brightness adjustment of Cathode Ray Tube (CRT) display. (Disabled during start-up BIT.)
4	Keyboard pushbuttons	-	Used to insert data.
5	± rocker switch	-	Allows stepping through waypoints or flight plans.
6	FA pushbutton	-	Causes certain displayed fault or status annunciations (see CDU Annunciations) to disappear and signals system that the fault has been acknowledged, also clears DTS FAIL and OFFMAP annunciations on the HUD.
7	CLR pushbutton	-	Erases entire scratchpad and clears INPUT ERROR.
8	SPC pushbutton	-	Provides capability for inserting space.

Figure 1-51. Control Display Unit (Sheet 2)

Index No.	Control or Indicator	Position or Display	Function
9	Blank rocker switch	-	Provides the means to step through the identifiers using the Waypoint Search Procedure - Using Waypoint Identifier procedure contained in this section. Disabled by INPUT ERROR caused by incorrect entry; re-enable when error cleared on scratchpad using CLR button.
10	BCK pushbutton	-	Erases character to left of cursor. Holding pushbutton depressed will cause characters to disappear in a manner similar to repeated depressing of pushbutton.
11	Delete Mark Point button	-	Commands deletion of the mark point currently displayed on the WAYPT page.
12	MK pushbutton	-	Commands creation of an overhead mark if the UPDATE Page (Figure 1-75) is not displayed on the CDU. Commands generation of an INS overhead update if the UPDATE Page is displayed on the CDU.
13	Data Capture button	-	Initiates LASTE system (IFFCC) manual data capture.
14	P/G rocker switch	-	Commands stepping of pages backward or forward.
15	Function select keys	-	Selects page one display for each page hierarchy when AAP page select switch is in OTHER position.
	SYS		Commands display of System (SYS) Page 1/3 (Figure 1-80).
	NAV		Commands display of Navigation (NAV) Page (Figure 1-70).
	WP		Commands display of Waypoint Menu (WP MENU) Page (Figure 1-62).
	OSET		Commands display of OFFSET Page (Figure 1-66). When selected, this page initially displays the offset information between steerpoints MS 0 and MS 1. If the steerpoint MS 1 is not in the waypoint database, this page displays only steerpoint MS 0 information. When the Offset Page is displayed and the offset point is undefined, if MS 1 is in the waypoint database, waypoint management computes and displays the offset information between steerpoint MS 0 and steerpoint MS 1. If MS 1 is not in the waypoint database, waypoint management displays information for steerpoint MS 0.
	FPM		Commands display of Flight Plan Menu (FPMENU) Page 1/1 (Figure 1-67). The FPMENU Page is a dynamic page; that is, it will display P1/1 when it consists of only one page or P1/X when it consists of more than one page where X will be the actual total number of pages.
	PREV		The operation of this key is determined by the position of the AAP PAGE select rotary knob as described below: a. With the AAP PAGE select rotary knob set to OTHER, depressing this key allows for sequentially stepping back through the previously displayed pages (up to five) that were displayed while the AAP PAGE select rotary knob was set to OTHER. This key does not provide the means to step back through previously displayed page numbers of the same page. b. With the AAP PAGE select rotary knob is set to POSITION, depressing this key has no effect. The CDU will continue to display the POSINFO Page.

Figure 1-51. Control Display Unit (Sheet 3)

Index No.	Control or Indicator	Position or Display	Function
			c. With the AAP PAGE select rotary knob set to STEER: (1) When the STRINFO Page is displayed, this key has no effect. The CDU will continue to display the STRINFO Page. (2). When the WAYPT Page is displayed, depressing this key allows return to the STRINFO Page. (3) When the FLDINFO Page is displayed, depressing this key allows return to the WAYPT Page and then the STRINFO Page. d. With the AAP PAGE select rotary knob set to WAYPT: (1) When the WP INFO Page is displayed, this key has no effect. The CDU will continue to display the WP INFO Page. (2) When the WAYPT Page or ANCHOR Page is displayed, depressing this key allows return to the WP INFO Page. **NOTE** When the ACC/REJ Page is displayed, this key will have no effect.

Figure 1-51. Control Display Unit (Sheet 4)

CDU DATA ENTRY.

The following paragraphs describe general procedures for entering data into the CDU.

KEYBOARD.

Data can be entered from the keyboard when the plus or minus (±) or bracket ([ ]) symbol is displayed next to a LSK. This data entered from the keyboard appears first in the scratchpad line of the CDU display. If an error is made during number or letter entry, depressing BCK clears the last entry. Depressing CLR clears the entire scratchpad line.

DATA ENTRY.

When the desired data is displayed in the scratchpad line, it is entered by depressing the associated LSK.

A ± or [ ] symbol next to the LSK indicates that the LSK is active. Absence of a symbol indicates that the corresponding LSK is inactive. When the LSK is depressed, the scratchpad line contents are checked by the CDU for proper range and format. If the entry is valid, it is accepted and displayed adjacent to the associated LSK.

ERROR CHECKING.

Several checks are performed on entered data before they appear on the data field and the scratchpad is cleared. Failure to pass these checks causes the message INPUT ERROR to be displayed on the bottom line of the CDU. The message is cleared by depressing the CLR pushbutton located on the CDU.

GENERAL RULES FOR ERROR CHECKING.

Although error messages are an essential part of the CDU operation, certain errors are not noted. Some general rules of operation are as follows:

- If a LSK is depressed that performs no operation (no symbol displayed next to LSK), no error message is given.
- Leading and trailing zeros and decimal points are not required, unless the value is ambiguous without them.

CDU ANNUNCIATIONS.

The CDU is capable of annunciating the following conditions on line 2 of any CDU display page (excluding maintenance pages) so that immediate action can be taken if required. These annunciations are divided into four priority groups.

Group 1 has the highest priority, group 4 has the lowest priority. Active annunciations in the highest priority group are displayed first. Active annunciations in any one priority group are displayed in reverse chronological order; that is, the last annunciation detected is displayed first. Many annunciations are turned off only when the fault acknowledge (FA) pushbutton is depressed. There are several exceptions. The first exception is INS NAV RDY. The steady or flashing INS NAV RDY annunciation is turned off when the NAV mode from the INS Page is selected (Figure 1-89), or when the aircraft moves, which automatically transitions the ENAV system to the NAV mode.

The remaining exceptions are: CADC NOT RDY, DTS NOT RDY, EGI NOT RDY, GPS NEEDS KEYS, INIT POS, IFFCC NOT RDY, SCALE ERROR, IEPU NOT READY 152, IEPU FULL 152, IEPU FAIL 152, and VERT MODE INPUT ERROR which are removed from the display when the cause of the annunciation is removed or the FA pushbutton is depressed; and annunciations DOWNLOAD COMPLETE, DTC UPLOAD COMPLETE, and MARK A through MARK Z, which are automatically cleared 10 seconds after they are annunciated or FA pushbutton is depressed. Except for the INS NAV RDY annunciation, all other annunciations may be cleared by depressing the FA pushbutton before the annunciation times out.

If more than one annunciation occurs, or an annunciation occurs before prior annunciations have timed out or been cleared, the number of annunciations hidden by the currently displayed annunciation appears at the left end of line 2 of the CDU page being displayed. Hidden annunciations are displayed in priority sequence. If more than one annunciation is hidden with the same priority, the last annunciation detected is displayed first.

GROUP 1.

CADC FAIL

When the CADC fails, an annunciation CADC FAIL is displayed and the CADC caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed. This annunciation will also be displayed when the CADC data received by the CDU does not pass the CDU CADC data reasonableness test (CADC data is not within operating limits). If this annunciation is displayed and the CADC caution light is illuminated, or only this annunciation is displayed, refer to the CADC Caution Light Analysis information contained in Section III for corrective action.

DTS FAIL

When the DTS fails, an annunciation DTS FAIL is displayed. This annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed prior to flight, ensure DTC is properly installed in UDTU, on RESET Page (Figure 1-87) depress DTS LSK, replace DTC, or manually enter initialization data using CDU and LASTE, as required. If this annunciation is displayed during or after flight, ensure DTC is properly installed in UDTU and attempt to manually download data to DTC.

CICU FAIL

When the CICU fails, an annunciation CICU FAIL is displayed and the CICU caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed. The CDU then sets CICU Status to "Not Communicating" and "CICU availability" to unavailable (shown on System Status Page). This mode is entered because of critical hardware or software failures in the CICU processors. The CICU transitions to the Failure Mode and reports the CICU Mode as FAIL.

INTERNAL SUPPRESSION ASSEMBLY (ISA) FAIL

NOTE

No HOTAS functions, including Weapons Systems, are available until the ISA is reset.

When the ISA detects a failure and activates the failsafe circuits, a 28VDC ISA FAIL or ISA EMERGENCY JETT FAIL message is displayed on the MFCD. Reset the ISA by going to the STAT page and scrolling down to the ALM SRU. The ISA RESET legend will appear next to OSB 6. Pressing OSB 6 will reset the ISA.

EGI FAIL

When the EGI fails, an annunciation EGI FAIL is displayed and the NAV caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed. Refer to the NAV Caution Light Analysis information contained in Section III for corrective action.

EGI FLT INST FAIL

When EGI is unable to drive flight instruments (HSI and ADI), an annunciation EGI FLT INST FAIL is displayed and the NAV caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed. Refer to the NAV Caution Light Analysis information contained in Section III for corrective action.

GPS FAIL

When the EGI GPS fails, an annunciation GPS FAIL is displayed and the NAV caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed. Refer to the NAV Caution Light Analysis information contained in Section III for corrective action.

HARS FAIL

When the HARS fails, an annunciation HARS FAIL is displayed and the HARS caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed. Refer to the HARS Caution Light Analysis information contained in Section III for corrective action.

INS FAIL

When the EGI INS fails, an annunciation INS FAIL is displayed and the NAV caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed. Refer to the NAV Caution Light Analysis information contained in Section III for corrective action.

INS FLT INST FAIL

When the EGI missionization circuit fails, an annunciation INS FLT INST FAIL is displayed. This annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, the HSI and ADI indications may be incorrect; select an alternate navigation source.

GROUP 2.

BUS A FAIL or BUS B FAIL

If the CDU determines that a transmission has failed three consecutive times on the 1553 A bus or B bus, a BUS A FAIL or BUS B FAIL is displayed. The annunciation is turned off when acknowledged by depressing the FA pushbutton or communication is re-established. Once acknowledged, the annunciation will not be displayed again until a CDU cold start or warm start occurs. If the condition clears then returns, the failure is logged with no annunciation.

NOTE

If a CDU power cycle or warm start occurs, BUS A FAIL will re-annunciate.

BLENDED GPS DIFFER

When the Blended and GPS positions differ by more then 3000 feet, the annunciation BLENDED GPS DIFFER is displayed. This is a warning that EGI may have failed and an alternate source is required to confirm position. The annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, ensure that correct initial position was entered as displayed on the ALIGN Page (Figure 1-73) or Alternate Align (ALTALGN) Page (Figure 1-90). If incorrect initial position was entered and on the ground, enter correct initial position and repeat desired alignment procedure. If in the air, perform an in-flight alignment. If correct initial position was entered, either a partial EGI GPS or EGI INS failure may have occurred. EGI navigation may be unreliable; select an alternate navigation source.

CADC NOT RDY

When the CADC is not communicating on the 1553 bus, an annunciation CADC NOT RDY is displayed. The annunciation is turned off when the FA pushbutton is depressed, or automatically when the CADC begins communicating on the 1553 bus. If this annunciation is displayed, refer to CADC Caution Light Analysis procedure contained in Section III.

CDU UPLOAD FAIL

When there is no CDU initialization file on the DTC, or an error is encountered while reading the file from the DTC, the CDU will annunciate "CDU UPLOAD FAIL."

CICU NOT RDY

If the CICU status transitions to Not Communicating, the CDU displays the "CICU NOT RDY" annunciation. This annunciation is turned off when the FA pushbutton is depressed.

DOWNLOAD COMPLETE

When download of data to the DTC is completed, an annunciation DOWNLOAD COMPLETE is displayed. The annunciation is turned off when the FA is depressed, or automatically after 10 seconds.

DOWNLOAD FAILED

When an error occurs during download of data to DTC, an annunciation DOWNLOAD FAILED is displayed. Some or all of the downloaded data may be missing or unusable. The annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, attempt to manually download data. Ensure DTC is installed in UDTU.

DTC FULL

When the DTC memory is full, an annunciation DTC FULL is displayed. This annunciation is turned off when the FA pushbutton is depressed.

DTC UPLOAD COMPLETE

When the DTC upload is complete, an annunciation DTC UPLOAD COMPLETE is displayed. This annunciation is turned off when the FA pushbutton is depressed, or automatically after 10 seconds.

DTSAS FAIL

When DTSAS fails, an annunciation DTSAS FAIL is displayed. This annunciation is turned off when the FA pushbutton or UFC ENT pushbutton is depressed. This will also cause the accompanying DTS FAIL or OFFMAP annunciation in the HUD to change to NODTS.

DTS NOT RDY

When the DTS is not communicating on the 1553 bus, an annunciation DTS NOT RDY is displayed. This annunciation is turned off when the FA pushbutton is depressed, or automatically when the DTS begins communicating on the 1553 bus. If this annunciation is displayed, ensure DTC is properly installed in UDTU. If this corrects the problem, manually upload and/or download data, as required. If this does not correct the problem, the DTS (DTC or UDTU) is inoperable.

EGI NOT RDY

When the EGI is not communicating on the 1553 bus, an annunciation EGI NOT RDY is displayed and the NAV caution light is illuminated. This annunciation is turned off when the FA pushbutton is depressed, or when the EGI begins communicating on the 1553 bus. Refer to NAV Caution Light Analysis contained in Section III for corrective action.

FP UPLOAD ERROR

When an error occurs during the upload of flight plans, FP UPLOAD ERROR is displayed. The flight plan database on the DTC may be empty. The annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, attempt to manually upload the flight plans from the DTC using DTS Upload (DTSUPLD) Page, attempt upload with another DTC, or manually enter flight plans using CDU.

IEPU FAIL 152

If the IEPU is not communicating, the CDU annunciates IEPU NOT READY.

IEPU NOT RDY 152

If the IEPU status/command response message indicates the IEPU has failed, annunciation IEPU FAIL is displayed.

INIT POS

When the initial position needs to be entered, the annunciation INIT POS is displayed. This annunciation is turned off when the FA pushbutton is depressed, or automatically when the initial position is entered. If this annunciation is displayed, enter the initial position using the ALIGN Page (Figure 1-73) or Alternate Align (ALTALGN) Page (Figure 1-90). The initial position must be entered within 2 minutes of the CDU completing the CDU startup BIT test, or within 2.5 minutes after EGI is turned on.

INS DEGRADED

When EGI is not receiving CADC data, an annunciation INS DEGRADED is displayed.

The annunciation is turned off when the FA pushbutton is depressed, or automatically when EGI receives CADC data. If this annunciation is displayed, refer to CADC Caution Light Analysis procedure contained in Section III.

IFFCC NOT RDY

When the IFFCC is not communicating on the 1553 bus, an annunciation IFFCC NOT RDY is displayed. This annunciation is turned off when the FA pushbutton is depressed, or automatically when IFFCC begins communicating on the 1553 bus. If this annunciation is displayed, ensure IFFCC is turned on and operational, cross check HUD and check IFFCC Page (Figure 1-82).

LASTE UPLOAD FAIL

When an error occurs during the upload of LASTE pilot preferences and weapons data, the LASTE UPLOAD FAIL annunciation is displayed. The annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, attempt manual upload of LASTE data using DTS Upload (DTSUPLD) Page (Figure 1-77) or attempt upload with another DTC. If unsuccessful, manually load data using LASTE. If the CDU preferences fail to upload properly, this or no other annunciation will be displayed.

MARK A, (B, C...Z)

When a mark point is generated and stored, an annunciation MARK A, B...Z is displayed. This annunciation is turned off when the FA pushbutton is depressed, or automatically after 10 seconds.

OFP LOAD FAIL

When the OFP loading process fails, an annunciation OFP LOAD FAIL is displayed. This annunciation is turned off when the FA pushbutton is depressed. This annunciation is provided for maintenance personnel when an OFP is being loaded.

OFP VERIFY FAIL

When contents of the loaded OFP cannot be verified, an annunciation OFP VERIFY FAIL is displayed. This annunciation is turned off when the FA pushbutton is depressed. This annunciation is provided for maintenance personnel when an OFP is being loaded.

POWER EGI OFF

When the EGI is to be turned off during the OFP loading process, an annunciation POWER EGI OFF is displayed. This annunciation is turned off when the FA pushbutton is depressed. This annunciation is provided for maintenance personnel when an OFP is being loaded.

SCALE ERROR

When the selected SCALE (sensitivity) mode and the actual SCALE mode are different 5 seconds after the mode was selected, an annunciation SCALE ERROR is displayed. This annunciation is turned off when the FA pushbutton is depressed, or automatically when the selected and actual deviation modes are the same. If this annunciation is displayed, EGI may not be qualified for selected SCALE mode (see Figure FO-7), or either a partial EGI GPS or EGI INS failure may have occurred; select an alternate navigation source.

VERT MODE INPUT ERR

When the selected vertical NAV mode (2D/3D) and the actual vertical NAV mode are different 5 seconds after the vertical mode was selected, an annunciation VERT MODE INPUT ERR is displayed. This annunciation is turned off when the FA pushbutton is depressed, or automatically when the selected and actual vertical modes are the same. If this annunciation is displayed, EGI has not acquired four satellites. When EGI acquires four satellites, select desired vertical mode.

WP UPLOAD ERROR

When an error occurs during the upload of waypoints, an annunciation WP UPLOAD ERROR is displayed. The mission and/or navigation waypoint databases may be empty. WP upload errors may occur due to errors in waypoint data, or an attempt to load more than 50 mission points. The annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, attempt to manually upload waypoint data from the DTC using DTS Upload (DTSUPLD) Page (Figure 1-77), attempt upload with another DTC, or manually enter waypoint data using CDU.

GROUP 3.

DTC ERASED

When there is no data on the DTC, an annunciation DTC ERASED is displayed. The annunciation is turned off when the FA pushbutton is depressed.

DTSAS OFF MAP

When the aircraft position is off the digital map stored in DTSAS, an annunciation DTSAS OFF MAP is displayed. This annunciation is turned off when the CDU FA or UFC ENT pushbutton is depressed. This acknowledgement will also cause the accompanying DTS FAIL or OFFMAP annunciation to the HUD to change to NODTS.

GPS ALM LOAD ERR

When the GPS almanacs upload fails, an annunciation GPS ALM LOAD ERR is displayed. This annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, attempt manual upload of all data using DTS Upload (DTSUPLD) Page (Figure 1-77), attempt upload with another DTC, or wait for EGI to acquire an almanac which may take from 10 minutes to up to 2 hours.

GPS KEY ERASE FAIL **NOT509**

When the commanded zeroize of GPS key fails, an annunciation GPS KEY ERASE FAIL is displayed. The annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, after landing have maintenance personnel zeroize GPS keys using ZEROIZE switch on GPS fill panel.

GPS KEY ERASE FAIL 509

When the commanded zeroize of GPS key fails, an annunciation GPS KEY ERASE FAIL is displayed. The annunciation is turned off when the FA pushbutton is pressed. If this annunciation is displayed, after landing have maintenance personnel zeroize GPS keys using ZEROIZE switch on GPS/EPLRS fill panel.

GPS KEY LOAD FAILED

When a GPS key is rejected by the EGI, an annunciation GPS KEY LOAD FAILED is displayed. The annunciation is turned off when the FA pushbutton is depressed. This annunciation is provided for maintenance personnel when a GPS key is being loaded.

GPS KEY 2HR WARNING

When the GPS keys will be invalid within 2 hours, an annunciation GPS KEY 2HR WARNING is displayed. This annunciation is turned off when the FA pushbutton is depressed.

GPS KEYS ERASED

When GPS keys are erased, an annunciation GPS KEYS ERASED is displayed. The annunciation is turned off when the FA pushbutton is depressed.

GPS NEEDS ALMS

When GPS does not have almanacs available, an annunciation GPS NEEDS ALMS is displayed. The annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, almanacs can be uploaded from a DTC that contains almanacs.

If a DTC that contains almanacs is not available, EGI can still acquire satellites, but the acquisition will take up to 2 hours rather than the approximately 2 minutes required if almanacs are available.

GPS NEEDS KEYS

When GPS has no keys, it will not have full accuracy. In this event, an annunciation GPS NEEDS KEYS is displayed. This annunciation is turned off when the FA pushbutton is depressed. If this annunciation is displayed, have maintenance personnel load EGI GPS keys if possible. EGI can be operated without keys; however, with no keys, EGI accuracy is approximately 300 feet. With keys, EGI GPS accuracy is approximately 50 feet.

NOTE

If GPS is keyed with EGI Operating, EGI will require power cycled to read new key.

IEPU FULL 152

If IEPU status word indicates ADR data storage is full, annunciation IEPU FULL is displayed. ADR data download is required prior to next flight to ensure continued collection of TEMS Engine data. The annunciation is turned off when the FA pushbutton is pressed or when the ADR data has been downloaded to the DTC or PATS.

WARM START

A warm start occurs if CDU power is interrupted for less than 2 seconds, OR upon aircraft landing, OR if a maintenance log is written. 152 ADR data download is required prior to next flight to ensure continued collection of TEMS Engine data. This annunciation is turned off when the FA pushbutton is pressed. When a warm start occurs, the following information is not saved:

a. After a warm start, depressing the PREV function select key will not cause the previous page to be displayed. The previous (or another) page must be reselected (or selected) to return the PREV function select key to normal operation.

b. If a hot elevation had been entered prior to the warm start, the hot elevation will be lost and the elevation will revert to the previously stored steerpoint elevation. Reenter hot elevation using LASTE.

c. If a magnetic variation (MV) had been entered using the OPTIONS Page (Figure 1-79) prior to the warm start, the system will revert to the computed MV. Reenter MV, if necessary.

d. If a maintenance (MX) page other than the MXLOG Page is being displayed when the warm start occurs, the CDU will display SYS Page 1/ 3.

e. After a warm start, as the CDU reestablishes communications with LRUs that are turned on, the status of the LRU(s) may briefly transition to N, and the associated LRU NOT RDY annunciation may be displayed.

f. If a MISC address was being read using the INS Page (Figure 1-89) when the warm start occurred, the desired MISC address will have to be reentered.

g. If the CDUTEST Page (Figure 1-103) was being displayed when the warm start occurred, the TWO MIN AVG field will display 0.0 for 2 minutes.

GROUP 4.
INS NAV RDY

When degraded EGI INS navigation is available, a steady INS NAV RDY annunciation is displayed. The INS NAV RDY annunciation automatically changes to a flashing INS NAV RDY annunciation when full EGI INS navigation capability is available. The steady or flashing INS NAV RDY annunciation is turned off when the NAV mode is selected from the ALIGN Page (Figure 1-73) or Alternate Align (ALTALGN) Page (Figure 1-90), or when the aircraft moves, which automatically transitions the ENAV system to the NAV mode. The INS NAV RDY annunciation is the lowest priority annunciation. The annunciation field must be cleared of any previous annunciations that are visible for the INS NAV RDY annunciation to be visible.

ENAV Initialization.

The following paragraphs describe the initialization of the ENAV and its components.

EGI GPS Keying NOT509.

Normally, the EGI GPS is keyed from a fill device, via the GPS J2 connector on the fill panel located in access bay F99. Aircraft power is not required to load the key. Following entry of the key, the GPS Status light located on the fill panel illuminates for approximately half a second.

EGI GPS Keying 509.

Normally, the EGI GPS is keyed from a fill device, via the GPS J3 connector on the GPS-EPLRS fill panel located in access bay F99. Aircraft power is not required to load the key. Following entry of the key, the GPS Status light located on the GPS/EPLRS fill panel illuminates for approximately half a second.

DTC INSERTION.

NOTE

- If a DTC is not available, the initial position, waypoint data, flight plan data, and LASTE pilot preferences and weapons data must be manually entered using the CDU and Up Front Controller (UFC).

- Other than initial position, do not attempt to enter data using the CDU scratchpad until after the DTC is inserted and locked into the UDTU and the flashing asterisk in the upper left corner of the CDU (indicating DTS activity) disappears. Data entered while the DTS activity asterisk is flashing may be overwritten or erased. If a DTC is not available, data can be entered any time after the completion of the CDU start up test.

The DTC should be inserted and locked in the UDTU before the CDU is powered on. The UDTU is located behind the seat on the left-hand side of the cockpit (Figure 1-41). After the DTC is inserted and CDU is powered on, the data uploading function automatically takes place, which allows system initialization. A DTC can be inserted and locked into the UDTU prior to the completion of the CDU startup BIT test. If the DTC is not inserted and locked into the UDTU prior to the completion of the CDU startup BIT test, all data must be uploaded either manually or automatically. Data can be uploaded automatically by cycling power to the CDU using the AAP CDU toggle switch. Power must be removed from the CDU for at least 4 seconds to ensure that a cold start will occur. Data can be uploaded manually using the DTS Upload (DTSUPLD) Page (Figure 1-77) and the ALL ORIG DATA LSK. The systems receiving this upload data via the CDU are: EGI and LASTE. The data received from the DTS are as follows:

- Waypoint database to the CDU
- CDU preferences
- Flight plan(s) to CDU
- Initial latitude/longitude to CDU and EGI
- Satellite almanac to EGI
- LASTE pilot preferences and weapons data
- CDU, EGI, GEM, and LASTE OFPs may also be loaded from the DTS. This is a maintenance function.

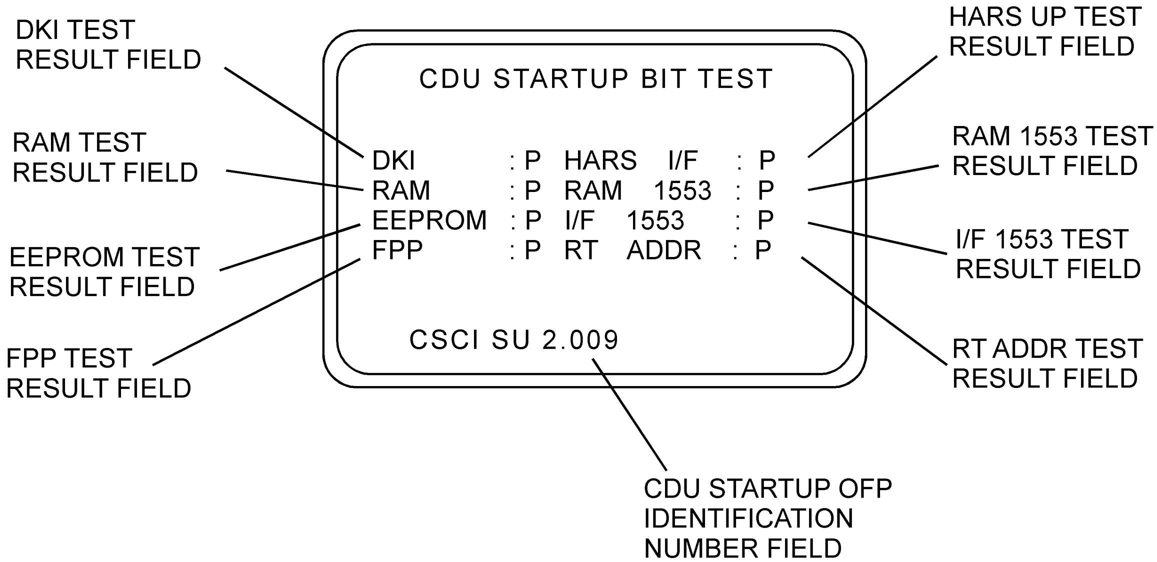
CDU/EGI POWER ON.

The CDU and EGI are powered on using the switches on the AAP. Normally, the CDU and EGI are powered up at the same time. The order of power up is insignificant if they are turned on at the same time. The CDU performs a BIT at power on and briefly displays the results on the CDU Startup BIT Test display (Figure 1-52). This page displays the results of the CDU startup BIT test and the CDU startup OFP identification number across the bottom of the display. As each segment of the CDU startup BIT test is successfully completed, a P is displayed next to the segment name (an F is displayed if test failed). If all tests are successfully completed, this page will be displayed for approximately 45 seconds after the CDU is turned on. If any one or more of the tests fails, the CDU will display DISPLAY FAILURE, MBC FAIL, ADA FAIL, or HARDWARE FAIL.

If power has been removed from the CDU for more than 3 seconds, the CDU will undergo a cold start. All data previously stored in the CDU (e.g., waypoints and events) are erased. The CDU conducts a self-test, showing the results on the display. If this test fails, DISPLAY FAILURE will appear on the scratchpad line. If the test passes, the CDU monitors the status of the other LRUs, and begins to upload data from the DTS. Completion of the upload (e.g., waypoint, flight plan, etc.) is indicated by the annunciation DTC UPLOAD COMPLETE. Following BIT, the page displayed on the CDU is determined by the PAGE select switch on the AAP. If the switch is in the OTHER position, the ALIGN Page (Figure 1-73) is displayed. If the System (SYS) Page (Figure 1-80) is selected for display upon the completion of the CDU startup BIT test using the SYS function select key, the SYS Page in the initialization mode is displayed. The SYS Page in the initialization mode is displayed until 2 minutes have elapsed since the completion of the CDU startup BIT test and no LRU is in an initialization mode. When no LRU is in an initialization mode and 2 minutes have elapsed since the completion of the CDU startup BIT test, the SYS Page in the operational mode is displayed.

If power has been removed from the CDU 3 seconds or less, either manually, or by an electrical transient, the CDU will perform a warm start. The WARM START annunciation will appear on the CDU, and the CDU will continue operation as though it was uninterrupted. Data are preserved in memory, and no specific action is required.

CDU STARTUP BIT TEST DISPLAY



Field	Display
DKI test result field	Displays result of CDU Display Keyboard Interface (DKI) test; (in progress), P (pass) or F (fail).
RAM test result field	Displays result of CDU Random Access Memory (RAM) test; W (in progress), P (pass) or F (fail).
EEPROM test result field	Displays result of CDU Electronically Erasable Programmable Read Only Memory (EEPROM) test; (in progress), P (pass) or F (fail).
FPP test result field	Displays result of CDU Floating Point Processor (FPP) test; (in progress), P (pass) or F (fail).
HARS I/F test result field	Displays result of Heading Attitude Reference System (HARS) interface (I/F) test; (in progress), P (pass) or F (fail).
RAM 1553 test result field	Displays result of CDU 1553 Random Access Memory (RAM) test; (in progress), P (pass) or F (fail).
I/F 1553 test result field	Displays result of CDU 1553 Interface (I/F) test; (in progress), P (pass) or F (fail).
RT test result field	Displays result of CDU serial data Receiver Transmitter (RT) test; (in progress) P (pass) or F (fail).
CDU startup (SU) OFP identification number field	Displays identification number of the CDU startup (SU) Operational Flight Program (OFP) that is loaded in CDU. (This OFP is a different OFP than the CDU OFP.)

Figure 1-52. CDU Startup BIT Test Display

AUTOMATIC INITIALIZATION.

To the greatest possible extent, the initialization of the CDU, EGI, and LASTE are automated. The CDU controls the digital data transfer of the IFF configuration data from the DTS while it is being loaded into the CICU. Waypoint data (including initial position) and flight plans from the DTC are loaded into the CDU via the UDTU. A ground (normal gyrocompass) alignment of the EGI INS is started upon the completion of the CDU startup BIT test. Almanacs from the DTC are loaded into the EGI GPS and the EGI GPS is placed in initialization (INIT) mode for approximately 2.5 minutes after the completion of the CDU startup BIT test. The EGI GPS is then automatically placed in the operational mode by the CDU. CDU preferences are loaded directly from the DTS to the CDU. LASTE pilot preferences and weapons inventory and profile data are loaded directly from the DTS to LASTE under control of the CDU. If the initial position (waypoint 0) in the DTC is not the aircraft's current position, enter the aircraft's current position using the ALIGN Page (Figure 1-73) when the INIT POS annunciation is displayed on the CDU. To manually override the auto alignment mode position and use the last position stored in the EGI, press LAST POS LSK on the ALIGN page. The alignment status of the EGI INS is displayed on the ALIGN Page. When degraded EGI INS navigation capability is available, a steady INS NAV RDY is annunciated on the CDU. The INS NAV RDY annunciation will automatically change to a flashing INS NAV RDY annunciation when full EGI INS navigation capability is available. When a flashing INS NAV RDY annunciation is displayed, the NAV mode can be selected from the ALIGN Page or by moving the aircraft. When the NAV mode is selected, the INS NAV RDY annunciation disappears from the CDU and an * appears next to NAV on the ALIGN Page and the Alternate Align (ALTALGN) Page (Figure 1-90). It should be noted that the NAV mode can be selected when degraded EGI INS navigation capability is available (steady INS NAV RDY annunciation). If the NAV mode is selected before full EGI INS navigation capability is available, the ENAV system will operate normally; however, the EGI INS-only navigation solution may have a considerable error and Enhanced Attitude Control (EAC) may not initially engage. If the aircraft is not moving, the GROUND (normal gyro compass) alignment mode can be selected on the ALIGN Page to complete the ground alignment. If the aircraft is moving, the in-flight (IN-FLT) alignment mode can be selected on the ALIGN Page.

NOTE

- When GPS-only is the selected navigation solution, EAC will not engage; or will disengage if it was engaged prior to selecting the GPS-only solution.
- When INS-only is the selected navigation solution, EAC will not engage if the NAV mode was selected on the ALIGN Page or ALTALGN Page when a steady INS NAV RDY (degraded NAV) annunciation was displayed on the CDU; or will disengage if it was engaged prior to selecting the INS-only navigation solution when the degraded NAV mode was selected.
- When BLENDED is the selected navigation solution, EAC will not engage (if a degraded NAV mode was selected on the ALIGN Page or ALTALGN Page) until the quality of the BLENDED navigation solution has reached an accuracy that corresponds to a full INS alignment. That is, when degraded NAV is selected, the EAC cannot be engaged until the GPS-only solution corrects the BLENDED solution to an accuracy that corresponds to a full INS alignment.
- When EGI is not selected on the NMSP, EAC will not engage; or will disengage if EGI is deselected (either manually or automatically).

MANUAL INITIALIZATION.

If a DTC is not available, or the DTS is not functioning, the ENAV system and LASTE may be manually initialized. To manually initialize the system after the CDU and EGI have been turned on, and the CDU has completed its startup BIT test, proceed as follows:

a. When the CDU displays the INIT POS annunciation, enter the initial position (present aircraft position or last position stored in EGI) using the ALIGN Page or select LAST POS LSK (Figure 1-73).

b. Enter mission waypoints 1 through 50 (Waypoint 0 is initial position waypoint) data, as required, using the WAYPT Pages (Figure 1-63) or the OFFSET Page (Figure 1-66).

c. On aircraft, enter the CDU preferences, as required, as described below:

(1) Enter wind model data using WIND Page (Figure 1-83) and WNDEDIT Page (Figure 1-84).

(2) Set DTSAS to ON or OFF, select CR, and enter OWC height, as required, using DTSAS Page (Figure 1-93).

(3) Enter local time adjust, if necessary, using TIME Page (Figure 1-74).

(4) Ensure data pump is OFF using CDUTEST Page (Figure 1-103).

d. After LASTE is turned on using the IFFCC switch on the AHCP, LASTE pilot preferences and weapons inventory and profile data are automatically entered from the DTS.

TRANSITION TO NAV MODE.

Under normal circumstances, the only action that must be taken is to either command the NAV mode from the ALIGN Page (Figure 1-73) or ALTALGN Page (Figure 1-90) before the first motion of the aircraft, or move the aircraft. The recommended method for selecting the NAV mode is to command the NAV mode from the ALIGN or ALTALGN Page. With the CDU displaying the ALIGN or ALTALGN Page, depress the NAV LSK. An asterisk (*) will appear next to the NAV display when the ENAV system is in the NAV mode. Moving the aircraft when a steady or flashing INS NAV RDY annunciation display causes the system to automatically transition to the NAV mode.

It is recommended that the NAV mode be commanded from the ALIGN or ALTALGN Page as soon as possible after the CDU begins to display the flashing INS NAV RDY annunciation. This allows the system to automatically enter the navigation alignment refinement (NARF) mode anytime the aircraft is stopped if the airspeed has not exceeded 85 knots up to this point. In the NARF mode, the BLENDED solution is updated by the EGI GPS-only solution to provide a more accurate BLENDED solution. Therefore, the sooner the NAV mode is selected, the greater the time the system may be in the NARF mode to produce a more accurate BLENDED solution. It should be noted that each time the aircraft stops, prior to the airspeed exceeding 85 knots, the system returns to the NARF mode. When in the NARF mode, NARF is displayed in the MODE field of the INS Status (INSSTAT) Page (Figure 1-92). When the aircraft moves after being stopped, the system automatically transitions to the NAV mode.

If the aircraft is moved within 125 seconds after the CDU and EGI are turned on or within 80 seconds after the EGI is turned on (CDU already on), whichever is later, and before a steady INS NAV RDY annunciation is displayed, the EGI INS may not automatically transition to an INFLT alignment. If the aircraft is moved within this time period and before a steady INS NAV RDY annunciation, a steady or flashing asterisk displayed next to INFLT on the ALIGN Page should be verified. If a steady or flashing asterisk is not present next to INFLT, depress the INFLT LSK if the aircraft is moving. If the aircraft has been stopped, depress the GROUND LSK.

INITIAL POSITION ENTRY.

a. The initial position must be entered if:

(1) A DTC is available, but the initial position on the DTC is not the aircraft's current position.

(2) The aircraft has been moved since EGI was last shut down and a DTC is not available.

NOTE

It is always preferable to align the EGI INS with the most accurate coordinates available. However, the EGI INS is capable of adequate performance when the initial position is up to 1 NM in error with no degradation to the blended solution.

b. Initial position must be entered on the ALIGN Page (Figure 1-73) in either latitude/longitude or Military Grid Reference System (MGRS) format. To display the ALIGN Page, if not being displayed, proceed as follows:

(1) AAP - Page select rotary knob - Select OTHER.

(2) CDU - Depress SYS function select key. Observe SYS Page 1/ 3 (Figure 1-80) is displayed.

(3) CDU - SYS Page 1/3 - Depress INS page LSK. Observe INS Page (Figure 1-89) is displayed.

(4) CDU - INS Page - Depress ALIGN page LSK. Observe ALIGN Page (Figure 1-73) is displayed.

NOTE

The ALIGN Page can also be selected from the NAV Page (Figure 1-70).

c. An initial position must be entered or modified within 2 minutes after the completion of the CDU startup BIT test, or within 2.5 minutes after EGI is turned on.

d. If the CDU and EGI are turned on at the same time, or the CDU is turned on and then the EGI is turned on within 2 minutes of the completion of the CDU startup BIT test, the priority (from highest to lowest) of these initial positions is as follows:

(1) **Manually Entered Position**: The manually entered initial position using the ALIGN Page which must be entered within 2 minutes after completion of the CDU startup BIT test.

(2) **Last Position**: Select align at last position using the ALIGN Page that must be entered within 2 minutes after completion of the CDU startup BIT test.

(3) **DTC Initial Position**: If an initial position is not entered using the ALIGN Page, the initial position from the DTC is used, if available.

NOTE

Other than initial position, do not attempt to enter data using the CDU scratchpad until after the DTC is inserted and locked into the UDTU and the flashing asterisk in the upper left corner of the CDU (indicating DTS activity) disappears. Data entered while the DTS activity asterisk is flashing may be overwritten or erased. If a DTC is not available, data can be entered any time after the completion of the CDU start up test.

(4) **Waypoint 0 Coordinates**: If EGI is turned on after the CDU has completed the CDU startup BIT test, an initial position has not been manually entered using the ALIGN Page, and a DTC is not available; the position entered on WAYPT Page 1/2 for waypoint 0 if this position is not latitude 00°00.0000’ and longitude 000°00.0000’.

(5) **Last Known Position (Blended)**: If an initial position has not been manually entered, a DTC is not available, and the position on WAYPT Page 1/2 for waypoint 0 is latitude 00°00.0000’ and longitude 000°00.0000’, the blended position stored in EGI when EGI was turned off last and this position is not latitude 00°00.0000’ and longitude 000°00.0000’.

(6) **Last Known Position (GPS)**: If an initial position has not been manually entered, a DTC is not available, the position on WAYPT Page 1/2 for waypoint 0 is not latitude 00°00.0000’ and longitude 000°00.0000’, and the blended position stored in the EGI is latitude 00°00.0000’ and longitude 000°00.0000’, the GPS-only position stored in EGI when EGI was turned off last. (Latitude 00°00.0000’ and longitude 000°00.0000’ is a valid position for this initial position.)

e. If the CDU is on and the EGI is turned on more than 2 minutes after the completion of the CDU startup BIT test, the priority (from highest to lowest) of the initial positions is the same as above; except the manually entered initial position must be entered within 2.5 minutes after EGI is turned on.

WAYPOINT ENTRY.

Existing mission waypoints (0 through 50) can be modified and new mission waypoints created using the WAYPT Pages (Figure 1-63). To display the WAYPT Pages, proceed as follows:

a. AAP - Page select rotary knob - Select OTHER.

b. CDU - Depress WP function select key. Observe WP MENU Page (Figure 1-62) is displayed.

c. CDU WP MENU Page - Select WAYPT Pages using appropriate page LSKs.

NOTE

The WAYPT Pages can also be selected from the STRINFO Page (Figure 1-60) or WP INFO Page (Figure 1-61).

d. CDU - Use the waypoint or waypoint identifier LSK on WAYPT Page 1/2 or the ± rocker switch to display the desired waypoint.

NOTE

Navigation waypoints (the waypoints with numbers above 50) cannot be modified. However, navigation waypoints can be copied to the next available mission number and then modified. For a detailed description of waypoint entry, refer to Geographical Data Entry paragraph.

ENAV Operations.

STATUS CHECKING.

During initialization, the status of all LRUs with which the CDU communicates is displayed on the System (SYS) Page (Figure 1-80), providing the following indications:

- N - indicates that communication has not been established with the LRU.
- I - indicates that initialization of the LRU is in progress.
- V - indicates that the LRU operation is valid.
- F - indicates that the LRU has failed.
- T - indicates that the LRU is performing a self-test (used only for maintenance).

NAVIGATION MODES.

Four navigation modes, distinguished by navigation source, are available through the CDU. Transitions between navigation modes are illustrated in Figure 1-53. The four navigation modes are:

BLENDED - This is the ENAV navigation mode that is automatically selected upon initialization (default mode). In this mode, the letter B will be present on the right side of line 1 and to the left of the FOM. In this mode, the EGI combines the EGI GPS and EGI INS navigation data to provide the blended position, velocity, and attitude data. The EGI INS position, velocity, tilts, and gyro bias are corrected at regular intervals using the EGI GPS data to produce the EGI BLENDED navigation data. In this mode, the CDU estimates and stores HARS attitude errors for use in the event of an EGI INS failure. In the event of an EGI GPS failure, the ENAV remains in the BLENDED mode. The BLENDED solution will initially be the same as before the EGI GPS failed or lost satellites; however, the BLENDED solution will drift based on the EGI INS until EGI GPS is reacquired.

INS-ONLY - This mode is selected manually. In this mode, the letter I will appear on the right side of line 1 and to the left of the FOM on the CDU. In this mode, the system position, velocity, and attitude data are equal to the EGI INS position, velocity, and attitude. EGI GPS position and velocity corrections are not utilized in this mode.

GPS-ONLY - This mode is selected manually or automatically (in the event of an EGI INS failure). In this mode, the letter G will appear on the right side of line 1 and to the left of the FOM on the CDU. In this mode, the system position and velocity are equal to the EGI GPS position and velocity. If the EGI INS attitude data are valid, the system attitude is equal to the EGI INS attitude. If the EGI INS attitude data are not valid, the system attitude is equal to the HARS attitude.

NAV IDLE - This mode is selected automatically when both the EGI GPS and EGI INS data are invalid. This mode cannot be selected manually. In this mode, the letter N will appear on the right side of line 1 and to the left of the FOM, which will be an asterisk, on the CDU. The system position and velocity are frozen in this mode.

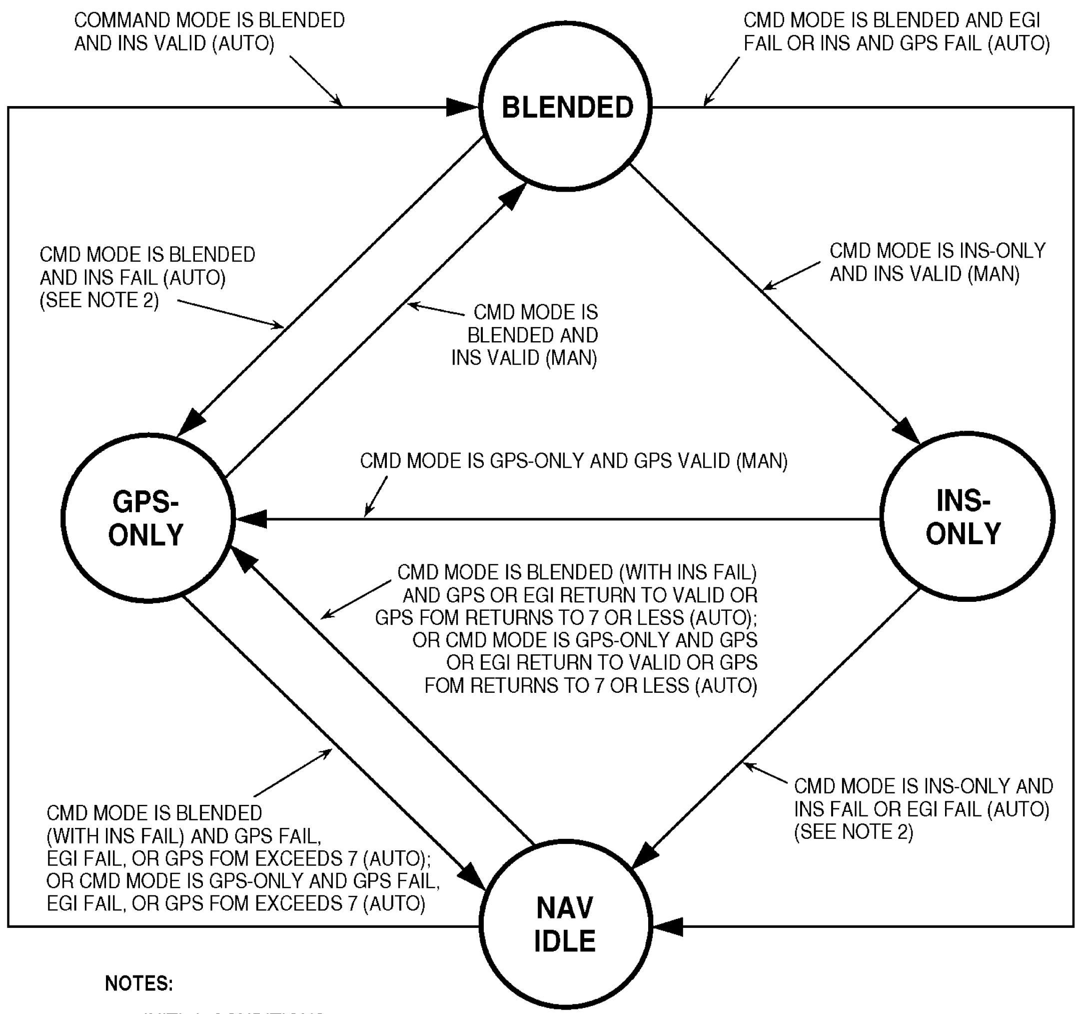
EGI GPS INITIALIZATION.

Under normal circumstances a DTC is available and the EGI GPS batteries are working. The GPS key has been loaded from a fill device; EGI GPS initialization is entirely automatic. With no key entered, EGI GPS navigates with an accuracy of about 300 feet. With a key, EGI GPS accuracy is 50 feet.

If the EGI GPS batteries have failed, or if the batteries have been changed, the EGI GPS loses track of the current time. Under these circumstances, the EGI GPS requires up to 2 hours to acquire satellites and provide accurate navigation. However, if the EGI GPS loses track of current time, the time can be entered manually using the GPS Time (TIME) Page (Figure 1-74) to reduce the time required to acquire satellites.

EGI GPS ALMANAC ENTRY.

Normally, EGI GPS almanacs are loaded from the DTC only if the almanacs to be uploaded from the DTC are more recent than the almanac already stored in EGI. The EGI GPS stores almanacs in its battery-backed memory. When a DTC is not available and the battery has failed or has been removed, the EGI GPS loses its almanac. It can still acquire satellites, but the acquisition may take up to 2 hours rather than the approximately 2 minutes required if almanacs are available.



NOTES:

1. INITIAL CONDITIONS:
   A. EGI, INS, AND GPS STATUS ARE VALID (V).
   B. SYSTEM IS IN NAV MODE (BLENDED SOLUTION IS AUTOMATICALLY SELECTED).

2. SYSTEM MAY ALSO AUTOMATICALLY DOWN MODE TO THE NEXT LOWER NAVIGATION SOLUTION OR NAV IDLE IF CDU DETECTS THAT THE COMMANDED NAVIGATION SOLUTION DATA IS NOT BEING RECEIVED IN A TIMELY MANNER. IF THIS AUTOMATIC DOWN MODE OCCURS, THE ONLY VISIBLE INDICATION IS THAT THE NAV MODE INDICATION ON THE RIGHT SIDE OF LINE 2 OF THE CDU WILL CHANGE TO REFLECT THE NAVIGATION SOLUTION OR NAV IDLE MODE THAT THE SYSTEM HAS DOWN MODED TO. THE INS AND GPS STATUS WILL REMAIN VALID (V).

3. (AUTO) INDICATES AN AUTOMATIC DOWN MODE CONDITION.

4. (MAN) INDICATES PILOT INITIATED MANUAL MODE CHANGE.

5. IF AN EGI GPS OR EGI INS FAILURE OCCURS AND AN ATTEMPT IS MADE TO REINITIALIZE THE EGI GPS OR EGI INS; THIS DIAGRAM IS INVALID UNTIL THE REINITIALIZATION IS COMPLETED (SUCCESSFULLY OR UNSUCCESSFULLY).

13467-51

Figure 1-53. Navigation Mode Transition Diagram

EGI GPS KEY ENTRY AND ZEROIZING.

EGI GPS key entry is normally accomplished by maintenance personnel using a fill device via the GPS J2 connector on the fill panel. Normally, a yearly key (GUK) is entered into the EGI GPS. To interpret the key, the EGI GPS must combine it with data transmitted by the satellites. The process of combining the yearly key with the data from the satellites may take about 12 minutes; and consequently, after entry of a new key, full EGI GPS accuracy is not available until about 12 minutes after the first satellite is acquired. When the yearly key is combined with the satellite data, the EGI GPS calculates and stores daily keys. The EGI GPS can be commanded to store any number of days of daily keys for up to 180 days. Key entry can be accomplished at any time whether EGI is turned on or off.

Keys in the EGI GPS can be zeroized (erased) using the GPS ZEROIZE switch on the fill panel or CDU GPS Keys (GPSKEYS) Page (Figure 1-97). The zeroization must be confirmed using the GPS Status (GPSSTAT) Page 2 (Figure 1-95) on the CDU. It may take up to 2 minutes to receive this confirmation.

EGI GPS TIME ENTRY.

Normally, if the EGI GPS battery has not failed or been removed, it is not necessary to initialize EGI GPS time. To manually initialize EGI GPS time or enter the local adjustment (LCL ADJUST) or desired time on target adjustment (DTOT ADJUST), use the GPS Time (TIME) Page (Figure 1-74). If EGI does not have current GPS time and the EGI GPS time is not entered, EGI GPS will reset its own time within approximately 2 hours.

NOTE

> Prior to creating a mission DTC, especially if desired times on target (DTOT) are to be assigned to waypoints, it should be determined whether the mission will be flown using GMT or local time. All time entries on the mission DTC must be made in the selected time; and all DTOT entries made using the CDU must be made in this selected time.

EGI INS Alignment.

NOTE

> Whenever the EGI INS alignment time is less than 2 minutes as indicated on the ALIGN Page (Figure 1-73), the aircraft initial position can be entered via the ALIGN Page. The EGI INS alignment time will reset to zero whenever EGI power is cycled. If EGI power is cycled, leave AAP EGI switch in OFF position for at least 10 seconds.

Ground, In-flight, and Fast are the alignment modes available for the EGI INS. A ground alignment is a stationary, full gyrocompass alignment. An in-flight alignment is accomplished while the aircraft is moving (on ground or in the air). A fast alignment (Stored Heading and Best Available True Heading (BATH)) is a degraded alignment mode requiring significantly less time than a full gyrocompass alignment. Time to align depends on ambient temperature and the type of alignment.

Full gyrocompass alignment is complete as indicated by a flashing INS NAV RDY annunciation on the CDU. A degraded alignment is indicated by a steady INS NAV RDY annunciation.

If an alignment is terminated by the EGI switch on the AAP being turned off, wait at least 10 seconds prior to setting the EGI switch to ON.

GROUND ALIGNMENT.

A ground (normal gyrocompass) alignment of the EGI INS is initiated automatically at power up. A ground alignment requires approximately 4 minutes when the initial position is south of 45°N and north of 45°S latitudes. When the initial position is north of 45°N or south of 45°S latitudes, the alignment time is determined using the following formula:

$$\text{Time (minutes)} = 2.83 \text{ x } \frac{1}{\text{cosine L}}$$

where L is the initial position latitude.

For example, at a latitude of 65° (north or south), the alignment time may be as much as 6.7 minutes.

A ground alignment provides a more accurately aligned EGI INS than does an in-flight or fast alignment. A ground alignment of the EGI INS is initiated automatically when the EGI and CDU are turned on, and the aircraft is on the ground and not moving. The ground alignment mode can also be selected manually when the ENAV system is in the NAV, INFLT, or FAST mode. When the system attains a degraded INS navigation ready status, a steady INS NAV RDY annunciation is displayed on the CDU. When the system attains the full INS navigation ready status, a flashing INS NAV RDY annunciation is displayed on the CDU. At this time, the NAV mode can be selected from the ALIGN Page (Figure 1-73) or Alternate Align (ALTALGN) Page (Figure 1-90). Moving the aircraft automatically transitions to the NAV mode. Refer to the EGI INS alignment procedures contained in Section II for the procedures to perform the automatically initiated ground alignment, the ground alignment from the NAV mode or FAST mode, and the ground alignment from the INFLT mode.

NOTE

If the aircraft has been moved since EGI was last shut down, waypoint 0 on DTC is not aircraft's present position, or no DTC is available, the aircraft's initial position must be entered. The initial position can be entered or modified within 2 minutes of the CDU completing the CDU startup BIT test using the ALIGN Page (Figure 1-73), or anytime before the EGI is turned on using the WAYPT Page (Figure 1-63) in waypoint 0. The initial position can also be entered within 2.5 minutes after turning on the EGI using the ALIGN Page.

FAST ALIGNMENT.

Stored heading and BATH are two modes of fast alignment. Either mode provides rapid alignment of the EGI INS; however, these are degraded alignment modes when the EGI GPS is not available. The stored heading alignment provides a more accurate alignment than the BATH alignment. Refer to the EGI INS alignment procedures contained in Section II for the procedures to perform the stored heading and BATH alignments.

IN-FLIGHT ALIGNMENT.

During an in-flight alignment, the EGI uses position and velocity measurements from the EGI GPS to align the EGI INS. An in-flight alignment of the EGI INS is initiated when the INFLT LSK on the ALIGN Page (Figure 1-73) is depressed, when power is cycled to the EGI when the aircraft is moving, or when the aircraft moves before a degraded nav ready (steady) annunciation is displayed on the CDU. Prior to initiating an in-flight alignment, deselect EGI (or select HARS) and STR PT or ANCHR on the NMSP, if selected. When the INFLT LSK is depressed, if EGI GPS is qualified to do an in-flight alignment, a flashing asterisk will be displayed for 5 to 10 seconds, and then a steady asterisk will be displayed. When the INFLT LSK is depressed, if EGI GPS is not qualified to do an in-flight alignment, a flashing asterisk will be displayed next to INFLT until EGI GPS is qualified; and a steady asterisk will be displayed. The EGI GPS is qualified to do an in-flight alignment when the expected horizontal error (EHE) and expected vertical error (EVE) are both less than 100 feet if the EGI is keyed, or both are less than 400 feet if EGI is not keyed. An in-flight alignment generally requires 5 to 10 minutes to complete (until flashing INS NAV RDY annunciation is displayed on CDU). EGI and STR PT or ANCHR can be selected on the NMSP when the steady INS NAV RDY annunciation appears. This provides usable steering information for the HSI, ADI, and HUD.

An in-flight alignment can be performed on the ground or in the air. Refer to the EGI INS alignment procedures contained in Section II for the procedures to perform an in-flight alignment on the ground and in the air.

NAVIGATION ALIGNMENT REFINEMENT (NARF).

The NARF mode uses the EGI GPS-only solution to update the BLENDED solution. The ENAV system automatically enters the NARF mode when the system is in the NAV mode, anytime the aircraft is stopped if the airspeed has not exceeded 85 knots up to this point. That is, after the NAV mode is selected, each time the aircraft stops prior to the airspeed exceeding 85 knots, the BLENDED solution is updated while the aircraft is not moving. When in the NARF mode, NARF is displayed in the MODE field of the INS Status (INSSTAT) Page (Figure 1-92). When the aircraft moves, the system automatically transitions from NARF mode to NAV mode.

Attributes.

Attributes define the steering modes selected for the steerpoint. These steering modes are; scale, steer, vertical navigation (2D/3D), vertical angle (when in 3D mode only), and selected vertical angle (when in 3D mode only).

There are two classes of attributes: waypoint specific and flight plan specific. Waypoint specific attributes are used when the AAP STEER PT rotary select knob is set to MISSION or MARK. Flight plan specific attributes are used when the AAP STEER PT rotary select knob is set to FLT PLAN. Waypoint specific attributes can be uploaded from the DTS, entered using the Attributes (ATTRIB) Page (Figure 1-78) (if none have been uploaded from the DTS or entered using the Waypoint (WAYPT) Pages) or entered/modified using the WAYPT Page 2/2 (Figure 1-63). Flight plan specific attributes can be uploaded from the DTS, entered using the Attributes (ATTRIB) Page (if none have been uploaded from the DTS), and/or entered/modified using the Waypoint Attributes (WPTATT) Page (Figure 1-69).

The ATTRIB Page provides the means to assign waypoint specific attributes to any waypoint (mission waypoints 0 through 50, navigation waypoints 51 through 2050, and mark points A through Z). These attributes are; scale mode, steer mode (not including SCS mode), vertical navigation mode, vertical angle, and selected vertical angle. If, no attributes have been entered on this page or uploaded from the DTS, this page defaults to; SCALE: ENROUTE, STEER: TO FROM, and vertical Nav mode 2D. When the vertical NAV mode is changed to 3D, vertical angle (VANGLE) defaults to ENTERED and selected vertical angle defaults to 0.0.

The attributes selected on the ATTRIB Page are applied to a waypoint or when:

- The AAP STEER PT rotary select knob is set to MISSION or MARK and waypoint specific attributes have not been uploaded from the DTS or have not been assigned using WAYPT Page 2/2.
- The AAP STEER PT rotary select knob is set to FLT PLAN and flight plan specific attributes have not been uploaded from the DTS or have not been assigned using WPTATT Page.
- A waypoint is inserted into a flight plan using the FPBUILD Page (Figure 1-68).
- A mark point is created.

The WAYPT Pages provide the means to assign waypoint specific attributes to any waypoint (mission waypoints 0 through 50, navigation waypoints 51 through 2050, and mark points A through Z). If no attributes have been uploaded from the DTS or entered on this page, this page defaults to the attributes indicated on the ATTRIB Page.

The WPTATT Page allows flight plan specific attributes to be entered. These attributes are: scale mode, steer mode (not including Selected Course Steering (SCS) mode), vertical navigation mode, vertical angle, and selected vertical angle. This allows a single waypoint to be used in more than one flight plan or multiple times in a single flight plan with each usage of the waypoint having unique attributes. Flight plan specific attributes can be changed or modified on any waypoint (mission waypoints 0 through 50, navigation waypoints 51 through 2050, and mark points A through Z). If flight plan specific attributes have not been uploaded from the DTS or entered using the WPTATT Page, the flight plan specific attributes default to those defined on the ATTRIB Page.

Steer/Scale Modes.

The CDU provides four steer modes (Figure 1-54); TO FROM, DIRECT, TO TO, and SCS. These steer modes are described below:

- TO FROM - the commanded course is the great circle path along the course entered via the HSI COURSE SET knob to/from the selected steerpoint.
- DIRECT - the commanded course is the great circle path from the aircraft position at the time the DIRECT mode is selected to the selected steerpoint. Subsequently, each time a new steerpoint is selected, a course is computed from the aircraft's position at that instant to the new steerpoint.
- TO TO - the commanded course is the great circle path from the designated From point, displayed on the CDU FROM Page (Figure 1-65), to the selected steerpoint.
- SCS - the commanded course is manually selected course away from the point where the aircraft was located at the time SCS is selected.

NOTE

- When ANCHR is selected, the SCS steer mode can not be selected on the ATTRIB Page (SCS LSK is inactive).
- If the SCS steer mode has been selected and then ANCHR is selected on the NMSP, the SCS mode is automatically deselected and steering cues are provided to the anchor point. These steering cues are determined by the attributes of the waypoint that is the anchor point.
- The SCS steer mode is not an attribute and can only be selected or deselected on the ATTRIB Page.
- When the SCS steer mode is selected, SCALE and 2D or 3D can be selected to provide the desired steering cues.

The CDU provides four scale modes (Figure 1-54); ENROUTE, TERMINAL, high accuracy (HIGH ACC), and APPROACH. The ENROUTE, TERMINAL, high accuracy (HIGH ACC), and APPROACH scales determine the sensitivity of the HSI course deviation indicator and ADI GSI (when 3D vertical steering mode is selected) as described in Figure 1-54.

STEER Mode Selection.

There are four steer (STEER) modes: TO FROM, DIRECT, TO TO, and SCS. The TO FROM, DIRECT, and TO TO steer modes are waypoint and/or flight plan specific attributes. The steer attribute displayed on the Attributes (ATTRIB) Page (Figure 1-78) or Waypoint (WAYPT) Page 2/2 (Figure 1-63) is waypoint specific. The steer attribute displayed on the Waypoint Attributes (WPTATT) Page (Figure 1-69) is flight plan specific. The SCS mode is not an attribute, and can only be selected/deselected on the ATTRIB Page (Figure 1-78). The waypoint specific steer attribute is entered/changed using the ATTRIB Page or WAYPT Page 2/2 (Figure 1-63) as explained in the Attributes paragraph. The flight plan specific steer attribute is entered/changed using the WPTATT Page (Figure 1-69) as explained in the Attributes paragraph.

The TO FROM and SCS steer modes require that a selected course be entered using the COURSE SET knob on the HSI if you want consistent HSI course deviation indicator, ADI bank steering bar, and CDU Position (POS) Page (Figure 1-91) cross track deviation (CROSS TRK DEV) indications. In the DIRECT and TO TO steer modes, the course arrow on the HSI should be set to the course indicated on the ATTRIB Page, using the COURSE SET knob on the HSI, for a consistent HSI course deviation indicator, ADI bank steering bar, and CDU POS Page (Figure 1-91) cross track deviation (CROSS TRK DEV) indications. In the TO FROM, DIRECT, and TO TO modes, the TO steerpoint is shown in the upper right corner of the CDU as the waypoint (e.g., 1). In the SCS mode, this is replaced by SCS.

NOTE

- When ANCHR is selected, the SCS steer mode can not be selected on the ATTRIB Page (SCS LSK is inactive).
- If the SCS steer mode has been selected and then ANCHR is selected on the NMSP, the SCS mode is automatically deselected and steering cues are provided to the anchor point. These steering cues are determined by the attributes of the waypoint that is the anchor point.

Vertical Nav (2D/3D) Mode Selection.

The EGI provides both two- and three-dimensional (2D and 3D) vertical navigation modes for driving the HSI (Figure 1-55) and the ADI (Figure 1-56). When the 3D mode is selected, a manually entered or computed vertical angle can be selected. The 2D/3D vertical navigation (VNAV MODE) and vertical angle (VANGLE) modes are waypoint and/or flight plan specific attributes. The VNAV MODE and VANGLE attributes displayed on the Attributes (ATTRIB) Page (Figure 1-78) or Waypoint (WAYPT) Page 2/2 are waypoint specific. The VNAV MODE and VANGLE attributes displayed on the Waypoint Attributes (WPTATT) Page are flight plan specific. The waypoint specific VNAV MODE and VANGLE attributes are entered/changed using the ATTRIB Page or WAYPT Page 2/2 as explained in the Attributes paragraph. The flight plan specific VNAV MODE and VANGLE attributes are entered/changed using the WPTATT Page (Figure 1-69) as explained in the Attributes paragraph.

In the TO FROM and 2D mode (Figure 1-55, sheet 1), horizontal guidance is provided to a line passing through the steerpoint at the magnetic heading selected using the HSI course set knob and as indicated by the HSI course arrow and course selector window and the HSI SET AT CRS: field on the CDU ATTRIB Page.

<table>
<tr><th colspan="4">Steering Modes</th></tr>
<tr><th>TO FROM</th><th>DIRECT</th><th>TO TO</th><th>SCS</th></tr>
<tr>
<td>HSI course deviation indicator indicates deviation from the course passing through the steerpoint at the heading selected using HSI COURSE SET knob. When 3D mode is selected, ADI glide slope indicator indicates vertical deviation from a line passing through the selected steerpoint at a computed or manually entered vertical angle.</td>
<td>HSI course deviation indicator indicates deviation from course computed by CDU from the aircraft position at the moment DIRECT was selected to the selected steerpoint; or, when DIRECT is the selected steer mode, the course from the aircraft position when a new steerpoint is selected to the new steerpoint. When 3D mode is selected, ADI glide slope indicator indicates vertical deviation from a line connecting the aircraft position at the moment DIRECT was selected, or a new steerpoint is selected, to the selected steerpoint (computed vertical angle) or manually entered vertical angle.</td>
<td>HSI course deviation indicator indicates deviation from course from the From point to present steerpoint (computed by CDU). When 3D mode is selected, ADI glide slope indicator indicates vertical deviation from a line connecting the From point to the current steerpoint (computed vertical angle) or manually entered vertical angle.</td>
<td>HSI course deviation indicator indicates deviation from the course selected using HSI COURSE SET knob. When 3D mode is selected, ADI glide slope indicator indicates vertical deviation from a line passing through the position at the moment SCS was selected at a computed or manually entered vertical angle. If a vertical angle is not entered, the vertical angle defaults to 0 degrees.

NOTE

• When ANCHR is selected, the SCS steer mode can not be selected on the ATTRIB Page (SCS LSK is inactive).

• If the SCS steer mode has been selected and then ANCHR is selected on the NMSP, the SCS mode is automatically deselected and steering cues are provided to the anchor point. These steering cues are determined by the attributes of the waypoint that is the anchor point.</td>
</tr>
</table>

<table>
<tr><th colspan="5">Scale Modes</th></tr>
<tr><th rowspan="2">SCALE</th><th colspan="2">HSI Course Deviation Indicator Sensitivity</th><th colspan="2">ADI Glide Slope Sensitivity</th></tr>
<tr><th>1 DOT</th><th>2 DOTS</th><th>1 DOT</th><th>2 DOTS</th></tr>
<tr><td>ENROUTE</td><td>2.00 NM</td><td>4.00 NM</td><td>500 FT</td><td>1000 FT</td></tr>
<tr><td>TERMINAL</td><td>0.50 NM</td><td>1.00 NM</td><td>250 FT</td><td>500 FT</td></tr>
<tr><td>APPROACH</td><td>1.5 DEG</td><td>3.0 DEG*</td><td>0.35 DEG</td><td>0.70 DEG</td></tr>
<tr><td>HIGH ACC</td><td>0.05 NM</td><td>0.10 NM</td><td>100 FT</td><td>200 FT</td></tr>
<tr><td colspan="5">* Never less than 350 ft</td></tr>
</table>

Figure 1-54. Steer/Scale Modes

In the DIRECT and 2D mode (Figure 1-55, sheet 2), horizontal guidance is provided to a line passing through the aircraft location at which DIRECT was selected to the current steerpoint; or if DIRECT was selected and a new steerpoint is selected, to the line passing through the point at which the new steerpoint was selected to the new steerpoint.

In the TO TO and 2D mode (Figure 1-55, sheet 3), horizontal guidance is provided to a line passing through the From point to the current (TO) steerpoint.

In the SCS and 2D mode (Figure 1-55, sheet 4), horizontal guidance is provided to a line passing through the aircraft location at which SCS was selected along a magnetic heading selected using the HSI COURSE SET knob and as indicated by the HSI course arrow and course selector window and the HSI SET AT CRS: field on the CDU ATTRIB Page.

NOTE

- When ANCHR is selected, the SCS steer mode can not be selected on the ATTRIB Page (SCS LSK is inactive).
- If the SCS steer mode has been selected and then ANCHR is selected on the NMSP, the SCS mode is automatically deselected and steering cues are provided to the anchor point. These steering cues are determined by the attributes of the waypoint that is the anchor point.

In the TO FROM, 3D, and COMPUTED mode (Figure 1-56, sheet 1), vertical guidance is provided to a line at the vertical angle determined by the line passing through the steerpoint (at selected magnetic heading) to the altitude of the aircraft when the TO FROM mode was selected. In the TO FROM, 3D, and ENTERED mode, vertical guidance is provided to a line passing through the steerpoint at the manually entered vertical angle.

In the DIRECT, 3D, and COMPUTED mode (Figure 1-56, sheet 2), vertical guidance is provided to a line at the vertical angle determined by the line passing through the aircraft location at which DIRECT was selected to the current steerpoint; or if DIRECT was selected and a new steerpoint is selected, by the line passing through the aircraft location at which the new steerpoint was selected to the new steerpoint. In the DIRECT, 3D, and ENTERED mode, vertical guidance is provided to a line passing through the current steerpoint at the manually entered angle.

In the TO TO, 3D, and COMPUTED mode (Figure 1-56, sheet 3), vertical guidance is provided to a line passing through the From point to the current (TO) steerpoint. In the TO TO, 3D, and ENTERED mode, vertical guidance is provided to a line passing through the current steerpoint at the manually entered vertical angle.

In the SCS, 3D, and COMPUTED mode (Figure 1-56, sheet 4), vertical guidance is provided to a line at the vertical angle determined by the line passing through the aircraft location at which SCS was selected to the latitude and longitude of the aircraft location at which SCS was selected at the elevation of the last selected steerpoint (if this steerpoint had a valid elevation), or 0 MSL (if there was no previous steerpoint selected or the last selected steerpoint did not have a valid elevation). Therefore, the computed vertical angle will be either 0.0°, +90.0° or -90.0°. In the SCS, 3D, and ENTERED mode, vertical guidance is provided to a line passing through the latitude and longitude of the aircraft location at which SCS was selected at the manually entered angle at the elevation of the last selected steerpoint (if this steerpoint had a valid elevation, or 0 MSL (if there was no previous steerpoint selected or the steerpoint did not have a valid elevation).

NOTE

- When ANCHR is selected, the SCS steer mode can not be selected on the ATTRIB Page (SCS LSK is inactive).
- If the SCS steer mode has been selected and then ANCHR is selected on the NMSP, the SCS mode is automatically deselected and steering cues are provided to the anchor point. These steering cues are determined by the attributes of the waypoint that is the anchor point.

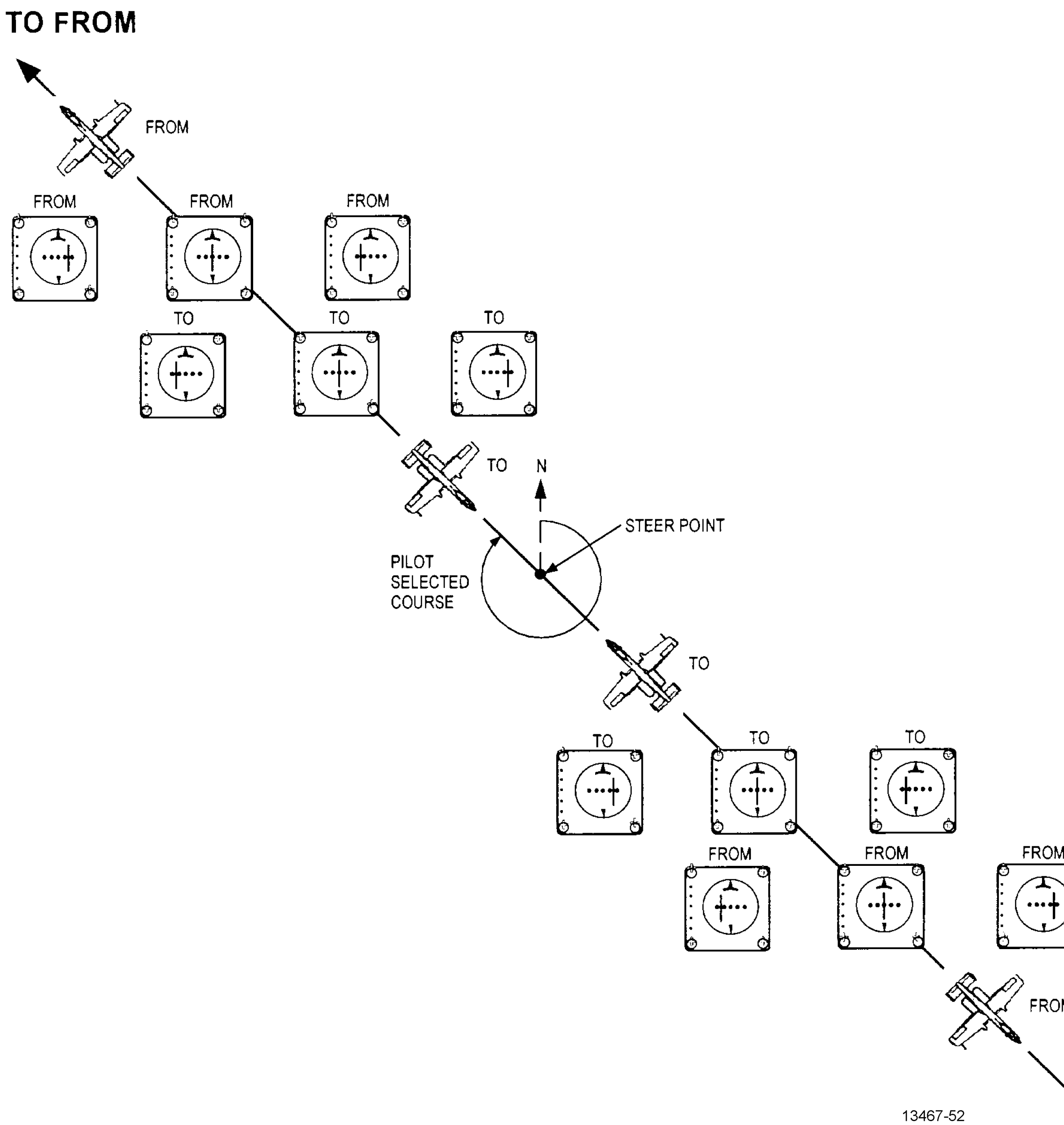


Figure 1-55. Horizontal Steering (2D or 3D Mode) (Sheet 1 of 4)

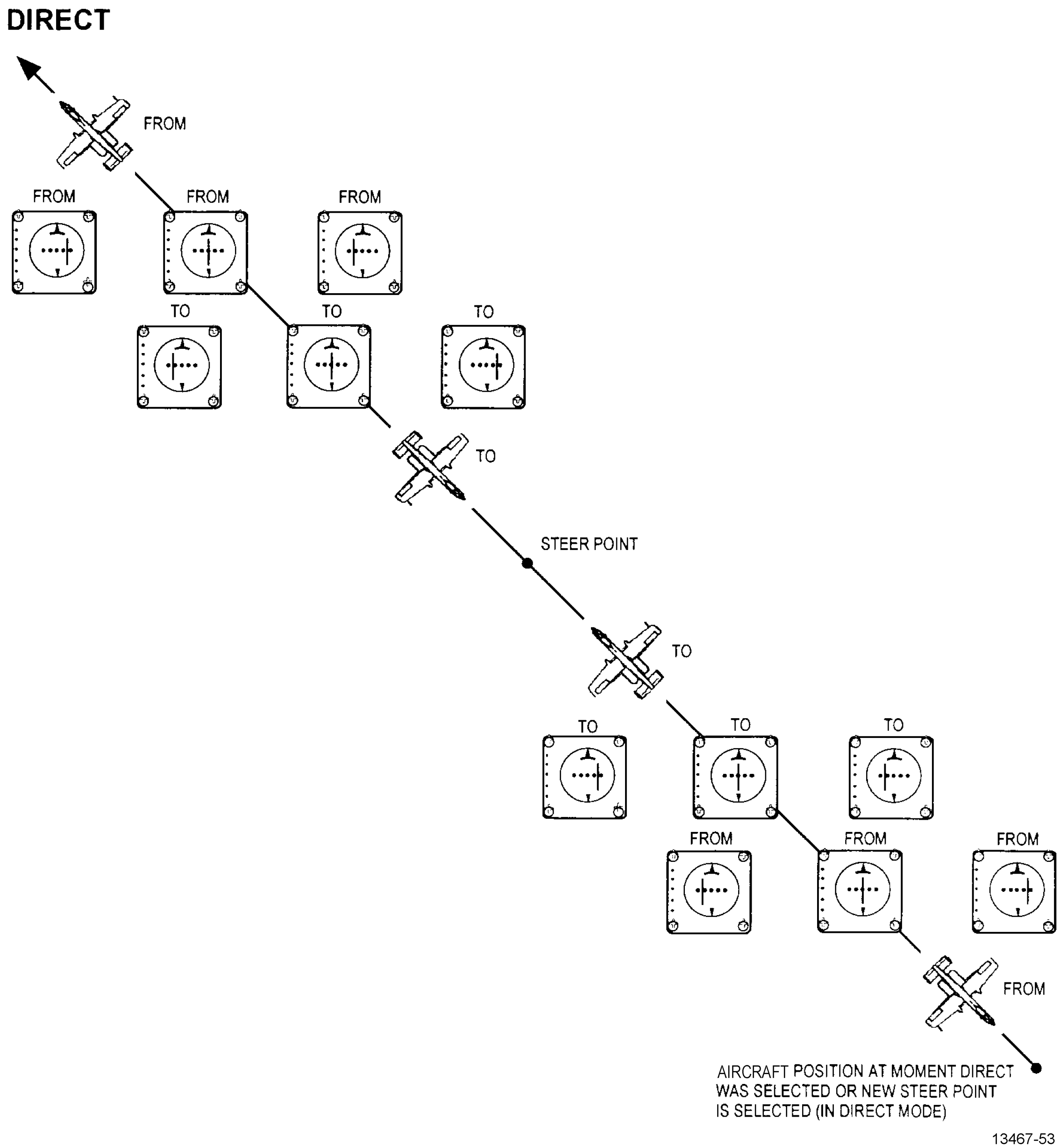


Figure 1-55. Horizontal Steering (2D or 3D Mode) (Sheet 2)

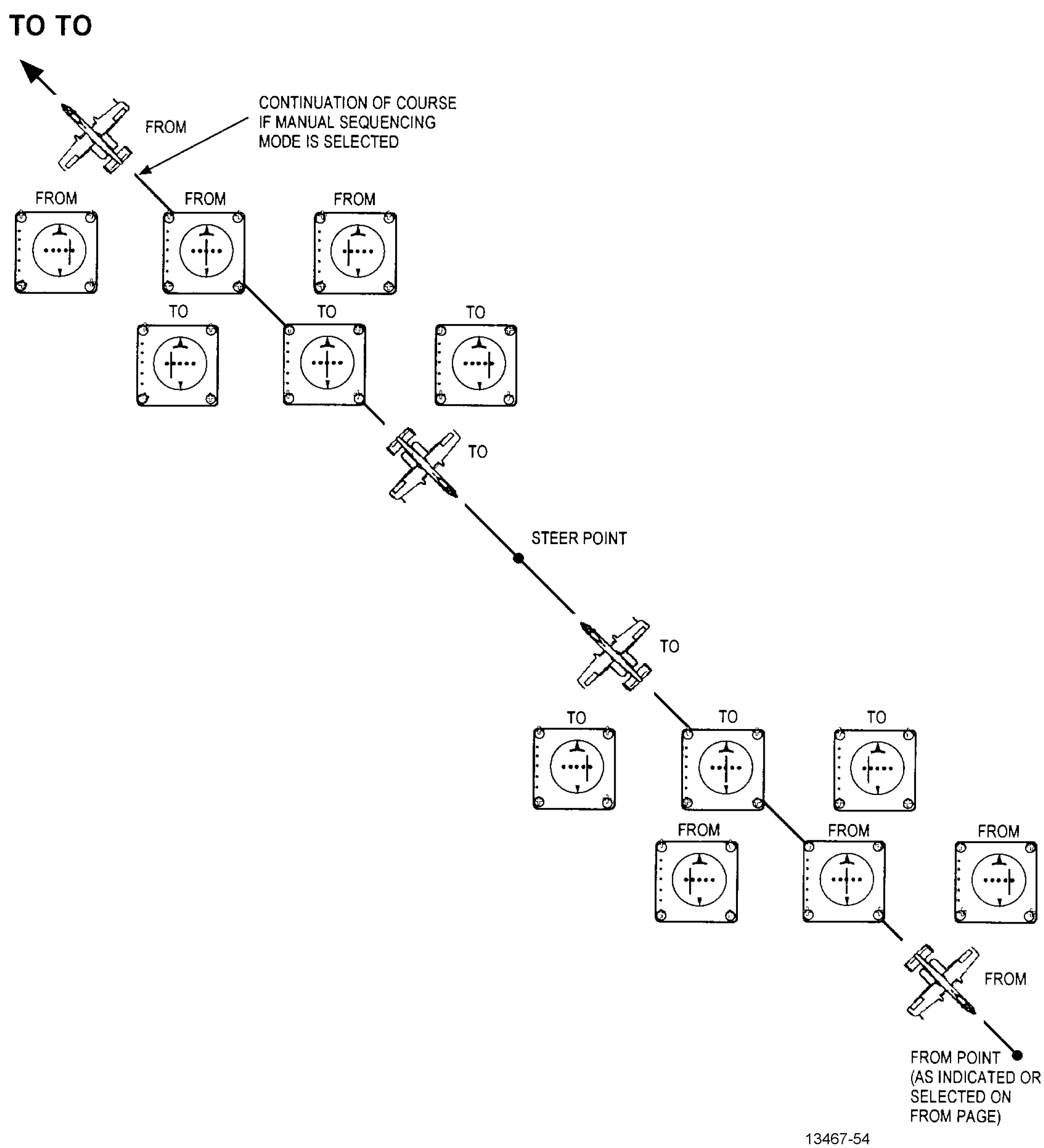


Figure 1-55. Horizontal Steering (2D or 3D Mode) (Sheet 3)

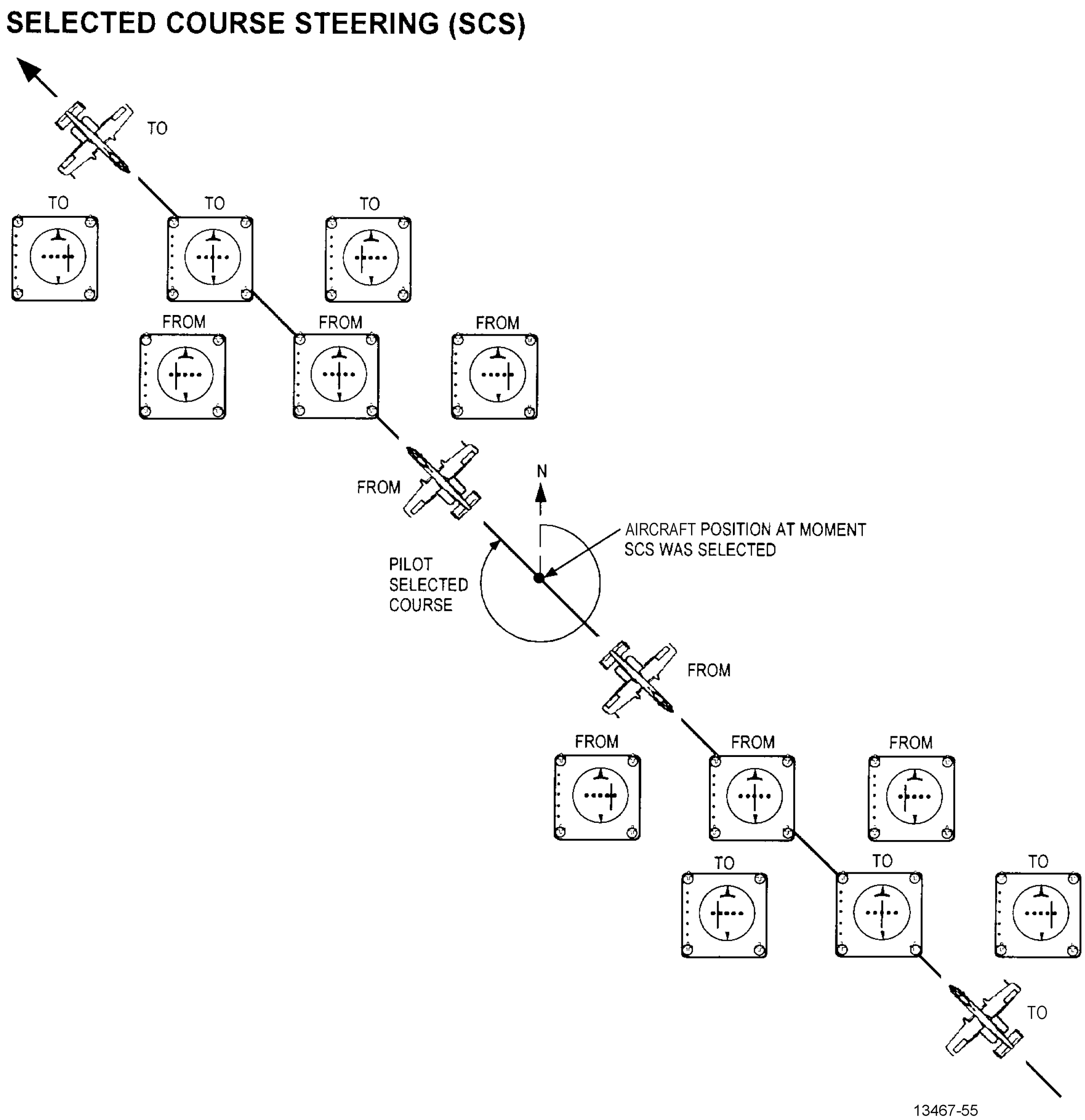


Figure 1-55. Horizontal Steering (2D or 3D Mode) (Sheet 4)

TO FROM

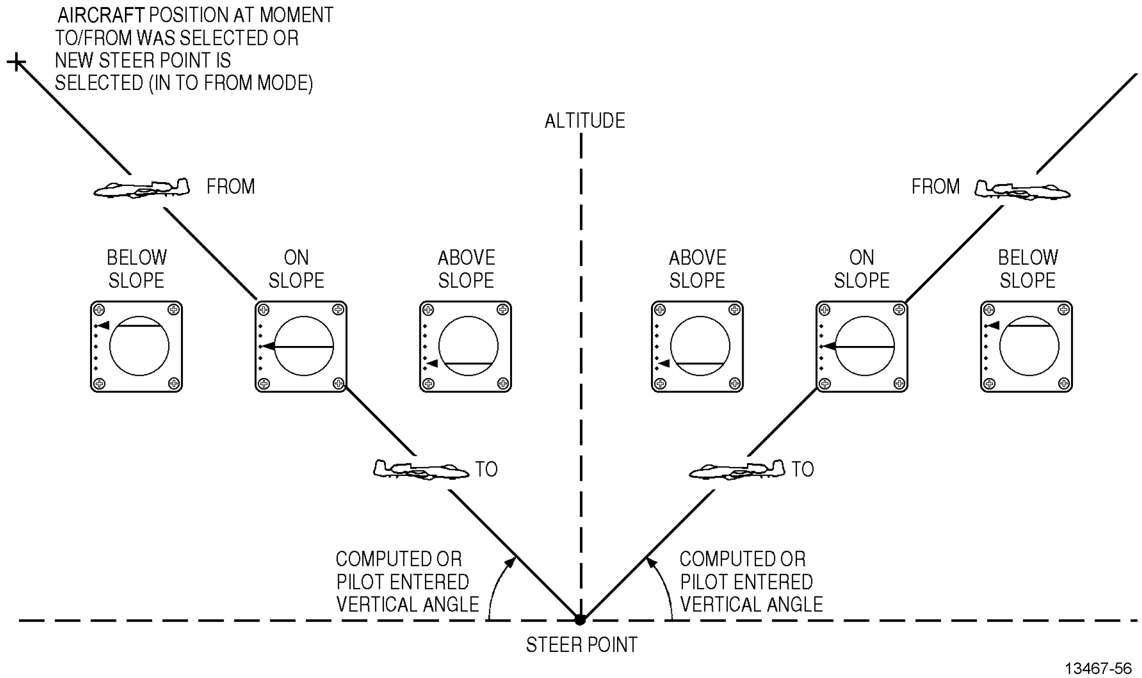


Figure 1-56. Vertical Steering (3D Mode Selected) (Sheet 1 of 4)

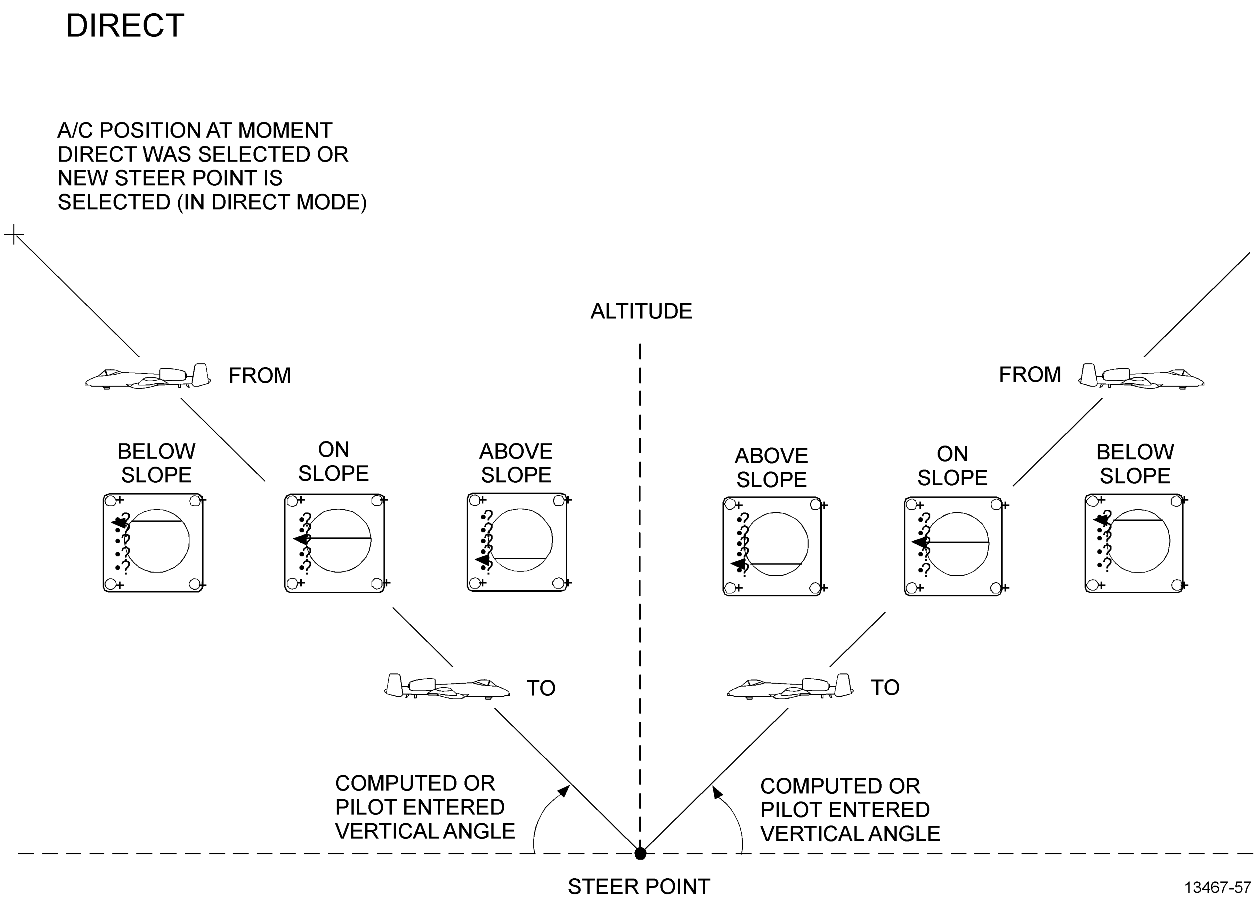


Figure 1-56. Vertical Steering (3D Mode Selected) (Sheet 2)

TO TO

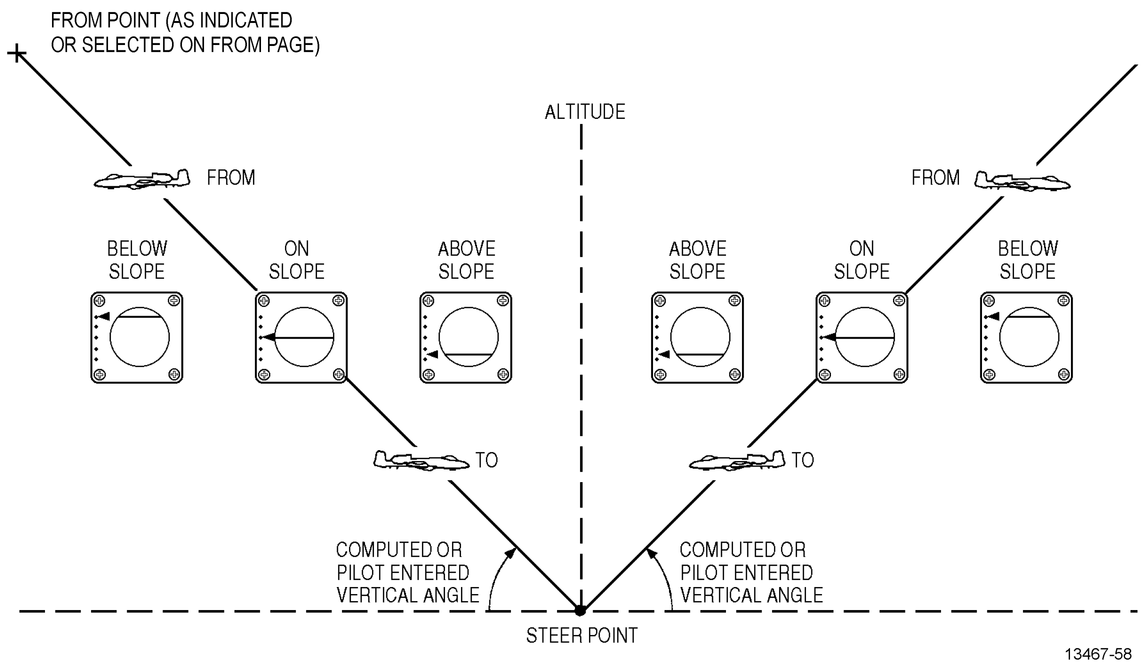


Figure 1-56. Vertical Steering (3D Mode Selected) (Sheet 3)

SELECTED COURSE STEERING (SCS)

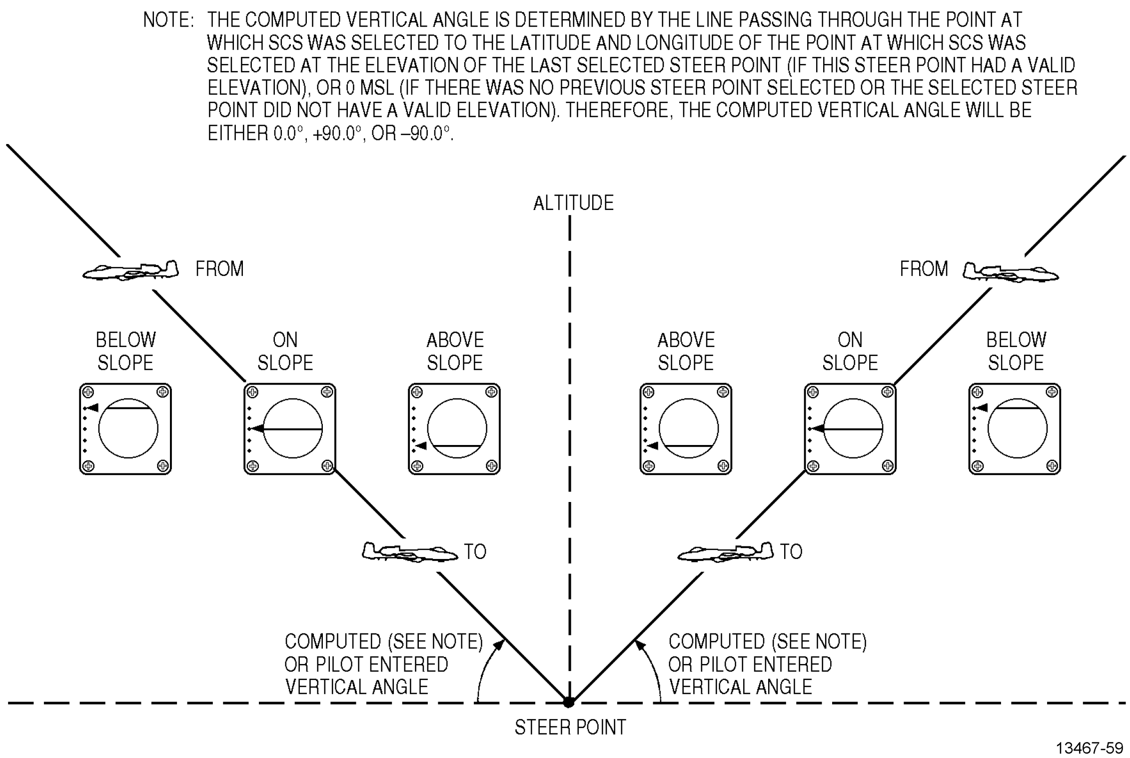


Figure 1-56. Vertical Steering (3D Mode Selected) (Sheet 4)

SCALE Mode Selection.

There are four scale modes; ENROUTE, TERMINAL, APPROACH, and high accuracy (HIGH ACC). These scale modes determine the sensitivity of the HSI Course Deviation Indicator (CDI) and the ADI GSI. The HIGH ACC is the most sensitive mode, and the ENROUTE mode is the least sensitive mode (Figure 1-54). The scale attribute displayed on the Attributes (ATTRIB) Page (Figure 1-78) or Waypoint (WAYPT) Page 2/2 (Figure 1-63) is waypoint specific. The scale attribute displayed on the Waypoint Attributes (WPTATT) Page (Figure 1-69) is flight plan specific. The waypoint specific scale attribute is entered/changed using the ATTRIB Page or WAYPT Page 2/2 as explained in the Attributes paragraph. The flight plan specific scale attribute is entered/changed using the WPTATT Page as explained in the Attributes paragraph.

NOTE

If FOM of selected navigation solution is 3 or greater, HIGH ACC and APPROACH scale modes will be unavailable. If FOM of selected navigation solution is 6 or greater, TERMINAL scale mode will be unavailable. If FOM of selected navigation solution is 7 or greater, ENROUTE scale will be unavailable and system will down mode to Navigation Idle (NI) mode. See Figure FO-7 for the effects of FOM on SCALE and 2D/3D modes on the HSI and ADI indications.

Steerpoint Selection.

There are three different ways to select steerpoints. Regardless of which method is used, the STEER PT select rotary knob on the AAP (Figure 1-50) is used to select the applicable portion of the waypoint database from which the steerpoint is selected.

- In the FLT PLAN position, the steerpoint comes from the active flight plan.
- In the MARK position, the steerpoint is one of the mark points created during the flight and comes from the mark point portion of the waypoint database.
- In the MISSION position, the steerpoint comes from the mission and navigation portions of the waypoint database.

The STEER toggle switch on the AAP is used to increment or decrement the steerpoint within the selected portion of the waypoint database.

The steerpoint can also be selected on the Steerpoint Information (STRINFO) Page (Figure 1-60). When the STRINFO Page is displayed, the steerpoint can be selected by waypoint number or waypoint identifier and the associated LSK, or by incrementing or decrementing through selected portion of the waypoint database using the CDU ± rocker switch. When the STRINFO Page is used, only waypoints from the portion of the database selected by the STEER PT select rotary knob can be accessed.

If a non-existent steerpoint is selected, the annunciation INPUT ERROR is displayed on the scratchpad line. This annunciation can be cleared by depressing the CLR key.

NOTE

L/R rocker switch will be disabled until INPUT ERROR is cleared.

In SCS mode, the steerpoint is the position of the aircraft at the time SCS was commanded. Any manual steerpoint selection is ineffective in this mode. The steerpoint data will appear as SCS. The steerpoint identifier will appear as **** in SCS.

When a flight plan is active, the AAP STEER toggle switch can be used to select steerpoints within the active flight plan by stepping up and down through the steerpoints of the active flight plan. When auto sequencing is selected using the flight leg sequencing mode LSK on the FPBUILD Pages (Figure 1-68), new steerpoints are selected by automatically incrementing to the next steerpoint when the current steerpoint is achieved. When the auto sequencing mode is selected, steerpoint achieved is indicated by the steerpoint data displayed on current CDU page automatically changing to the next steerpoint. Steerpoint achieved in the auto sequencing mode occurs when the aircraft passes abeam the current (TO) steerpoint and is within 1 nautical mile of the steerpoint. The AAP STEER toggle switch can also be used to select a steerpoint when the auto sequencing mode is selected. If the manual (MAN) mode is selected, steerpoint achieved is indicated by the flight instruments indications (i.e., flying past the steerpoint).

Flight Plan Selection.

The Flight Plan Menu (FPMENU) Page(s) (Figure 1-67) is used to select the active flight plan. The ± rocker switch of the CDU keyboard is used to increment and decrement the flight plan number. The active flight plan can also be selected using the scratchpad and active flight plan LSK on the FPMENU Page(s) (Figure 1-67).

An asterisk is displayed next to the selected flight plan. The selected flight plan becomes the active flight plan when the STEER PT select switch on the AAP is put in the FLT PLAN position. A flight plan can be selected and displayed (but not activated) when the STEER PT select switch is not in the FLT PLAN position.

Flight plans can be manually created or modified using the Flight Plan Menu (FPMENU) Page(s) (Figure 1-67), Flight Plan Build (FPBUILD) Page (Figure 1-68), and Waypoint Attributes (WPTATT) Page (Figure 1-69). For detailed procedures to manually build/modify flight plans, refer to the Build/Modify Flight Plans Procedures, (this section). When a new flight plan is created or an existing flight plan is modified, the created/modified flight plan is automatically written to the DTS when another CDU display page other than FPMENU, FPBUILD, or WPTATT page is selected.

NOTE

Other than initial position, do not attempt to enter data using the CDU scratchpad until after the DTC is inserted and locked into the UDTU and the flashing asterisk in the upper left corner of the CDU (indicating DTS activity) disappears. Data entered while the DTS activity asterisk is flashing may be overwritten or erased. If a DTC is not available, data can be entered any time after the completion of the CDU start up test.

Geographical Data Entry.

a. To enter geographical data into the CDU in L/L format, proceed as follows:

   (1) The L/L format can be selected and geographical data entered on the Pages listed below:

      (a) ALIGN Page (Figure 1-73)

      (b) ALTALGN Page (Figure 1-90)

      (c) WAYPT Page 1/2 (Figure 1-63)

      (d) OFFSET Page (Figure 1-66).

   (2) Using AAP and/or CDU, select desired Page (see Figure 1-57).

   (3) CDU - Desired Page alternate coordinate format LSK - to display L/L.

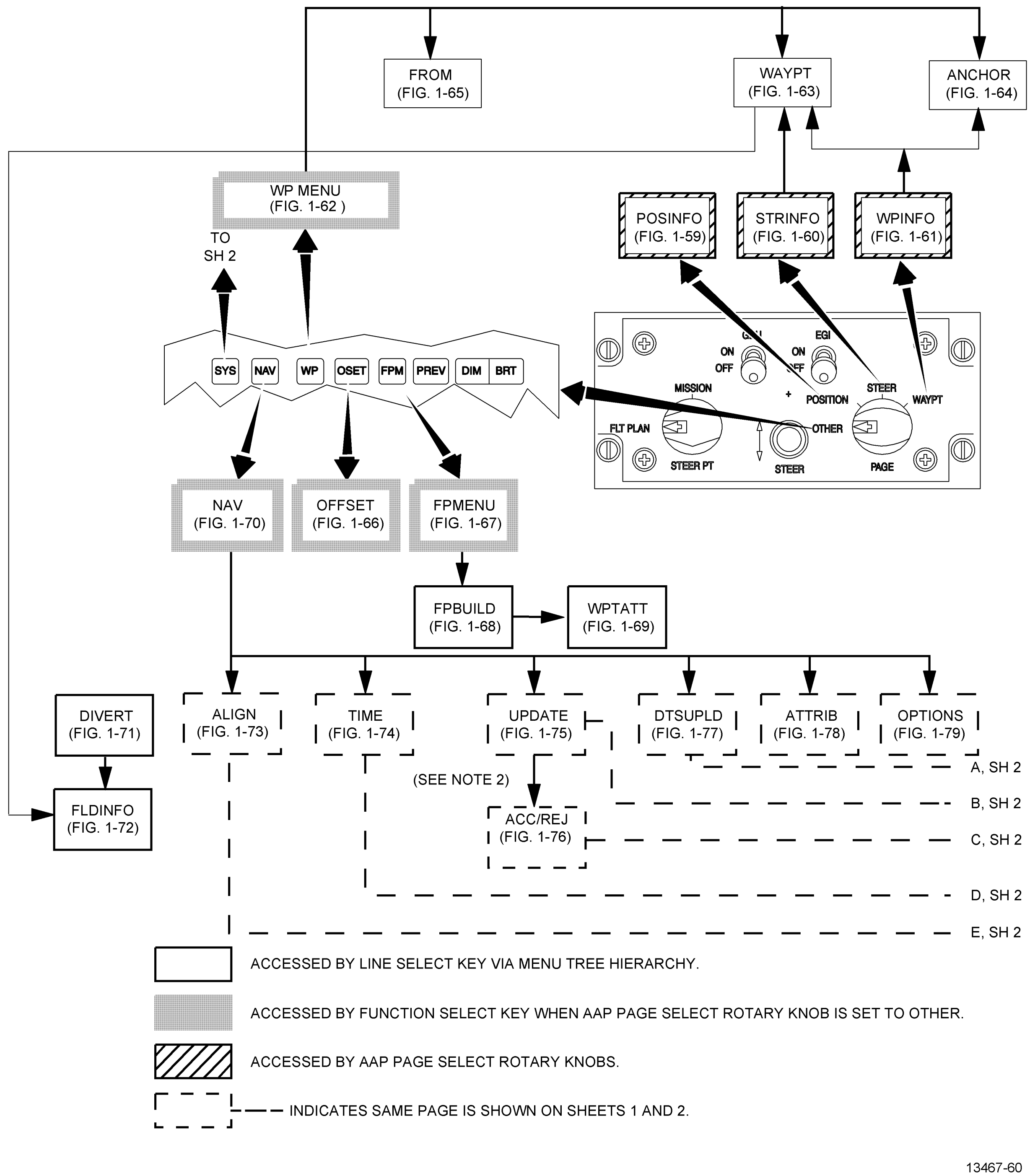
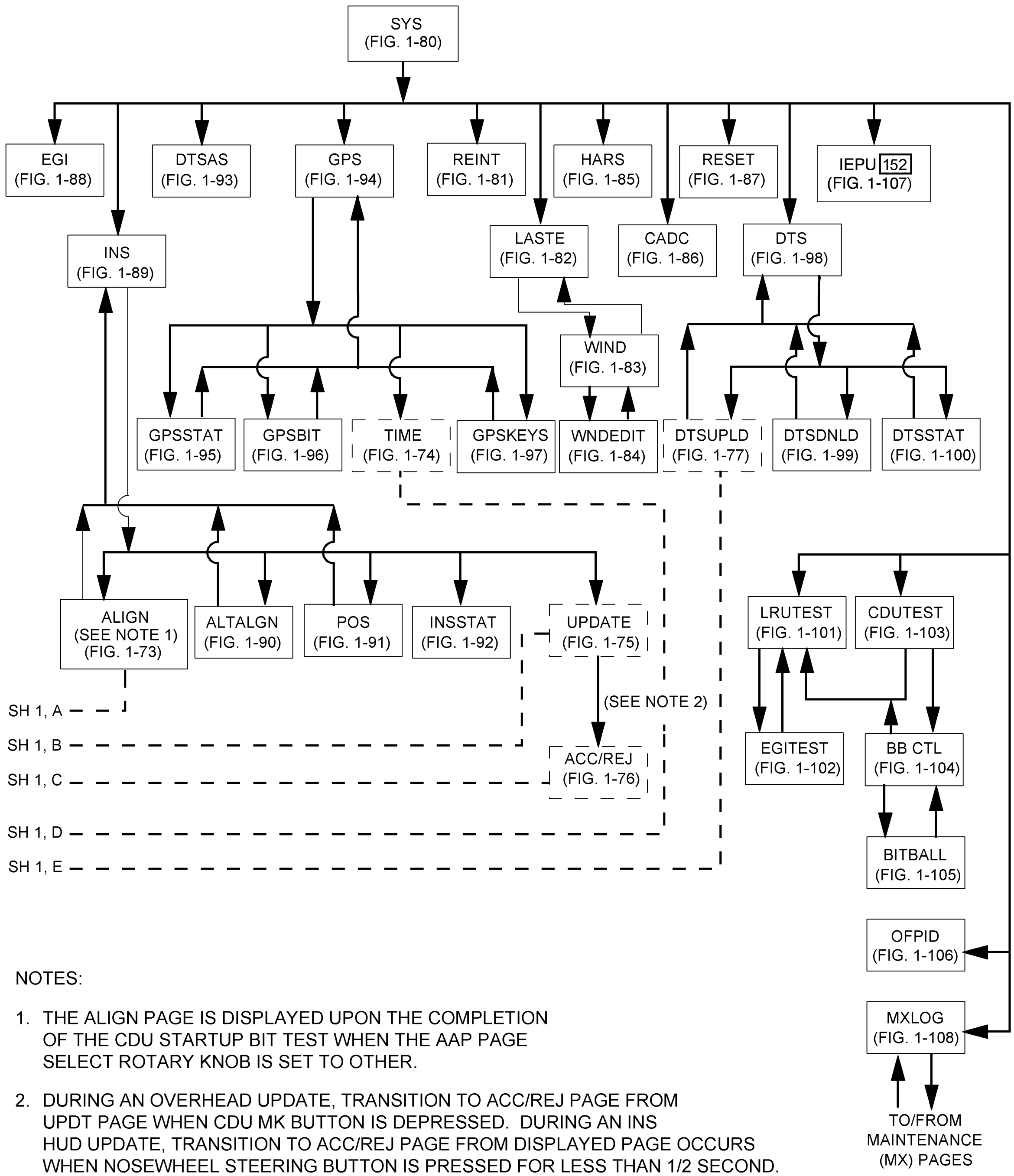


Figure 1-57. ENAV CDU Display Pages Menu Tree (Sheet 1 of 2)



NOTES:

1. THE ALIGN PAGE IS DISPLAYED UPON THE COMPLETION OF THE CDU STARTUP BIT TEST WHEN THE AAP PAGE SELECT ROTARY KNOB IS SET TO OTHER.
2. DURING AN OVERHEAD UPDATE, TRANSITION TO ACC/REJ PAGE FROM UPDT PAGE WHEN CDU MK BUTTON IS DEPRESSED. DURING AN INS HUD UPDATE, TRANSITION TO ACC/REJ PAGE FROM DISPLAYED PAGE OCCURS WHEN NOSEWHEEL STEERING BUTTON IS PRESSED FOR LESS THAN 1/2 SECOND.

Figure 1-57. ENAV CDU Display Pages Menu Tree (Sheet 2)

(4) CDU - Keyboard pushbuttons - Depress for desired alphanumeric latitude readout in scratchpad.

NOTE

- Keyboard entry format for latitude is HLLMM.XXXX, where:
  H is hemisphere (N or S)
  LL is latitude in whole degrees (00 to 90)
  MM is minutes of latitude (00 to 59)
  XXXX is ten-thousandths of minutes (0000 to 9999). Entry of decimal point (.) is optional.

- If previous entry was for same hemisphere (N or S), that letter need not be entered into scratchpad.

- If displayed numeric latitude is correct and only the hemisphere is incorrect, only N or S needs to be entered into scratchpad.

- Latitude data are entered in degrees, minutes, and ten-thousandths of minutes. If between 0°00.0000 and 9°59.9999, a leading zero must be entered.

- Leading zeroes must be used for minutes values of 9.9999 or less. Trailing zeroes may be omitted. For example:
  North 8 degrees 21.8760 minutes would be N0821876.
  South 71 degrees 5.4321 minutes would be S71054321.

(5) CDU - Desired Page latitude LSK - Depress to enter.

(6) CDU - Keyboard pushbuttons - Depress for desired alphanumeric longitude readout in scratchpad.

NOTE

- Keyboard entry format for longitude is HLLLMM.XXXX, where:
  H is hemisphere (E or W)
  LLL is longitude in whole degrees (000 to 180)
  MM is minutes of longitude (00 to 59)
  XXXX is ten-thousandths of minutes (0000 to 9999). Entry of decimal point (.) is optional.

- If previous entry was for same hemisphere (E or W), that letter need not be entered into scratchpad.

- If displayed numeric longitude is correct and only the hemisphere is incorrect, only E or W needs to be entered into the scratchpad.

- Longitude data are entered in degrees, minutes, and ten-thousandths of minutes. If between 0°00.0000 and 99°59.9999, one or two leading zeroes must be entered. Similarly, a leading zero must be used for minutes values of 9.9999 or less. Trailing zeroes may be omitted. For example:
  East 175 degrees 21.8760 minutes would be entered as E17521876, E175218760 is also acceptable;
  West 71 degrees 5.4321 minutes would be entered as W071054321;
  West 8 degrees 5.0002 minutes would be entered as W008050002.

(7) CDU - Desired Page longitude LSK - Depress to enter.

b. To enter geographical data into the CDU in MGRS format, proceed as follows:

(1) The MGRS format can be selected and geographical data entered on the Pages listed below:

(a) ALIGN Page (Figure 1-73)

(b) ALTALGN Page (Figure 1-90)

(c) WAYPT Page 1/2 (Figure 1-63)

(d) OFFSET Page (Figure 1-66).

(2) Using AAP and/or CDU, select desired Page (see Figure 1-57).

(3) CDU - Desired Page alternate coordinate format LSK - Depress to display MGRS.

(4) To enter grid and/or spheroid data, proceed as follows:

NOTE

- Entry of grid data by itself causes the area near the center of the new grid and eastings and northings of 0000000000 to be displayed.
- Entry of spheroid data by itself causes area, eastings, and northings data to be transformed from one spheroid to another.
- Keyboard entry format is ZZZSSS or ZZZSSSS, where:
  ZZZ is the grid zone consisting of a one-or two-digit number (1 to 60) and one letter (C to X)
  SSS or SSSS is the three- or four-character alphanumeric spheroid code from the list of acronyms.

(a) CDU - keyboard pushbuttons - Depress for desired alphanumeric grid acronym (see following list of acronyms) and/or spheroid readout in scratchpad.

List of Spheroid Models

CODE	SPHEROID MODEL ELLIPSOID
AC50	ARC 1950 (Clarke 1880)
ADIN	ADINDAN (Clarke 1880)
AU66	AUSTRALIAN GEODETIC 1984 (Australian)
BRIM	BUKIT RIMPAH (Bessel)
CAST	CAMP AREA ASTRO (International)
DIAK	DJAKARTA (Bessel)
EU50	EUROPEAN 1950 (International)
GB36	ORD SURVEY GREAT BRITAIN 1936 (Airy)
GD49	GEODETIC DATUM 1949 (International)
GHAN	GHANA (WGS 84)
GU63	GUAM 1963 (Clarke 1866)
HERA	HERAT NORTH (International)

List of Spheroid Models

CODE	SPHEROID MODEL ELLIPSOID
HJOR	HJORSEY 1955 (International)
INDI	INDIAN (Everest)
IR65	IRELAND 1965 (Modified Airy)
KAUA	OLD HAWAIIAN KAUAI (International)
KERT	KERTAU (Modified Everest)
LI64	LIBERIA 1964 (Clarke 1880)
LOWE	MONTJONG LOWE (WGS 84)
LUZO	LUZON (Clarke 1866)
MAUI	OLD HAWAIIAN MAUI (International)
MERC	MERCHICH (Clarke 1880)
NIGE	NIGERIA (Clarke 1880)
N27A	NORTH AMERICAN 1927 (ALASKA AND CANADA) (Clarke 1866)
N27C	NORTH AMERICAN 1927 (CONUS) (Clarke 1866)
OAHU	OLD HAWAIIAN OAHU (International)
QORN	QORNOQ (International)
SACA	SOUTH AMERICAN CORREGO ALEGRE (International)
SAP	SOUTH AMERICAN PROV 1956 (International)
SACH	SOUTH AMERICAN ASTRO (International)
SACI	SOUTH AMERICAN INCHAUSPE (International)
SAY	SOUTH AMERICAN YACARE (International)
SDIN	SD INDIAN SPECIAL (Everest)
SDLU	SD LUZON SPECIAL (Clarke 1866)
SDTO	SD TOKYO SPECIAL (Bessel)
SD84	SD WGS 84 SPECIAL (WGS 84)

List of Spheroid Models

CODE	SPHEROID MODEL ELLIPSOID
SEGA	G SEGARA (Bessel)
SERI	G SERINDUNG (WGS 84)
SHAN	HU-TZU-SHAN (International)
SL60	SIERRA LEONE 1960 (WGS 84)
TIMB	TIMBALAI (Bessel)
TO25	TANANARIVE OBS 1925 (International)
TOKY	TOKYO (Bessel)
USER	USER ENTERED
VOIR	VOIROL (WGS 84)
WG72	WGS 72 (WGS 72)
WG84	WGS 84 (WGS 84)

(b) CDU - Desired Page grid and spheroid LSK - Depress to enter. If the grid is not changed, the spheroid will change to the new value. The area, eastings, and northings, are recomputed for the new spheroid, and will most likely change as a result.

(5) To enter area and/or eastings and northings, proceed as follows:

(a) CDU - Keyboard pushbuttons - Depress for desired alphanumeric area and/or numeric eastings and northings readout in scratchpad.

NOTE

- Area only, or combined eastings and northings (without area), may be entered separately.
- Keyboard entry format is AAEEEEENNNNN, where AA is a two-letter alpha code representing MGRS map coordinates. The first letter represents area column, the second, area row:
  EEEEE is eastings in whole meters (00000 to 99999)
  NNNNN is northings in whole meters (00000 to 99999).
- Eastings and northings data comprise a 10-digit number representing meters. If all 10 digits are entered, the first five represent the eastings measurement and the second five, the northings measurement. For example:
  0052388650 represents 523 meters eastings, 88650 meters northings.
- Any even number of digits is also acceptable. The first half represents the most significant portion of the eastings and the second half the most significant portion of the northings. For example:
  11708030 represents 11700 meters eastings, 80300 meters northings
  004566 represents 400 meters eastings, 56600 meters northings.
- For measurements between 0 and 9999 meters, leading zeroes must be entered.
- Some eastings and northing values of all zeroes may not be accepted by the CDU, and the CDU will display INPUT ERROR in the scratchpad. If this occurs, enter an eastings or northing value of 1 meter. This value will be accepted by the CDU and will cause a 1-meter error in the entered geographical position.

(b) CDU - Desired Page area, eastings, and northings LSK. Depress to enter.

NOTE

Certain checks are performed on entered data. Should an entered value fail to pass such a check, INPUT ERROR will appear in the scratchpad and the data will not be entered. If this occurs, depress the CDU CLR key and re-enter data.

WAYPOINT SEARCH PROCEDURES.

The following paragraphs contain the waypoint search procedures listed below:

- Using Waypoint Number or Mark Point Letter
- Using Waypoint Identifier

NOTE

The waypoint search function is automatically available on the CDU display pages listed below:
STRINFO Page (Figure 1-60)
WPINFO Page (Figure 1-61)
WAYPT Page (Figure 1-63)
ANCHOR Page (Figure 1-64)
FROM Page (Figure 1-65)
OFFSET Page (Figure 1-66)
FPBUILD Page (Figure 1-68)

Using Waypoint Number or Mark Point Letter.

To search for a waypoint using a waypoint number or a mark point letter, proceed as follows:

a. CDU - With a CDU display page listed above displayed, enter waypoint number (0 to 2050) or mark point letter (A to Z) in scratchpad.

b. CDU - Depress LSK that is associated with the CDU display page as listed below:

CDU Display Page	Line Select Key
STRINFO	Steerpoint
WPINFO	Waypoint
WAYPT	Waypoint
ANCHOR	Anchor point
FROM	From point
OFFSET	Initial waypoint or offset waypoint number
FPBUILD	Waypoint

c. On displayed CDU Page, observe information pertaining to selected waypoint is displayed.

NOTE

- When AAP STEER PT select switch is set to MISSION or MARK, the ± rocker switch on the CDU or the STEER toggle switch on the AAP can be used to select the waypoint from within the selected waypoint database.
- When AAP STEER PT select switch is set to FLT PLAN, the steerpoint can only be changed by using the STEER toggle switch on the AAP.
- If the entered number or letter is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad when this LSK is depressed. Clear error by pressing CLR pushbutton on CDU.

Using Waypoint Identifier.

To search for a waypoint using a waypoint identifier, proceed as follows:

NOTE

- When using the waypoint identifier search procedure to select a steerpoint, the STEER PT select switch must be set to MISSION or MARK.
- When AAP STEER PT select switch is set to FLT PLAN, the steerpoint can only be changed by using the STEER toggle switch on the AAP.

a. CDU - With a CDU display page listed above displayed, enter the first alphabetical character of the desired waypoint identifier in scratchpad.

b. CDU - Enter the second alphabetical or numeric (alphanumeric) character of the identifier in scratchpad.

NOTE

The entering of an alphabetical character and then an alphanumeric character automatically initiates the waypoint search.

c. Observe that cursor is removed from scratchpad while the search is in progress.

d. When the search is complete, observe that cursor returns to the scratchpad and:

(1) If there is no identifier with the entered characters (identifier) or there are no identifiers beginning with the entered characters, the scratchpad displays the entered characters with the cursor in the third (blank) position.

(2) If an identifier exists consisting of the two entered characters, the two character identifier is displayed in the scratchpad with the cursor overlaying the third blank character. If the displayed identifier is the identifier of the desired waypoint, proceed to Step e.

(3) If an identifier exists, beginning with the entered characters, the entire identifier is displayed in the scratchpad with the cursor overlaying the third character. If the displayed identifier is the identifier of the desired waypoint, proceed to Step e.

(4) If identifiers exist, beginning with the entered characters, the entire identifier of the first identifier (in alphanumeric order) is displayed in the scratchpad with the cursor overlaying the third character. If the displayed identifier is the identifier of the desired waypoint, proceed to Step e. If the displayed identifier is not the identifier of the desired waypoint, perform either or both of the following steps , as desired:

(a) Use the left/right (unmarked) rocker switch (9, Figure 1-51) on the bottom of the CDU to step up/down through the identifiers beginning with the entered characters.

NOTE

When INPUT ERROR is displayed on the scratch pad, the left/right rocker switch (unmarked) will be disabled until error is cleared by pressing CDU CLR pushbutton.

(b) Enter a new third character in the scratchpad by depressing the desired keyboard pushbutton. Observe that cursor disappears while search is in progress, and, when search is complete, first identifier beginning with the three entered characters is displayed in the scratchpad with the cursor overlaying the fourth character. If the displayed identifier is the identifier of the desired waypoint, proceed to Step e. If the displayed identifier is not the identifier of the desired waypoint, repeat this step for the fourth through 12th characters, as required.

e. When the displayed identifier is the identifier of the desired waypoint, on CDU, depress LSK that is associated with the CDU display page as listed below:

CDU Display Page	Line Select Key
STRINFO	Steerpoint identifier
WPINFO	Waypoint identifier
WAYPT	Waypoint identifier
ANCHOR	Anchor point identifier or steerpoint identifier
FROM	From point identifier
OFFSET	Initial waypoint identifier
FPBUILD	Waypoint

NOTE

- When AAP STEER PT select switch is set to MISSION or MARK, the ± rocker switch on the CDU can be used to select the waypoint from within the selected waypoint database

- On the WAYPT Pages only, if the displayed waypoint is a mission waypoint (0 to 50) or mark point (A to Z) and the entered waypoint identifier is not present in the waypoint database, the displayed waypoint will be renamed with identifier displayed in the scratchpad when this LSK is depressed.

- On the WAYPT Pages only, if the displayed waypoint is a navigation waypoint (51 to 2050) and the entered waypoint identifier is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad when this LSK is depressed. Error is cleared by pressing the CDU CLR pushbutton.

- On the STRINFO, WPINFO, ANCHOR, FROM, OFFSET, and FPBUILD Pages, if the entered waypoint identifier is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad when this LSK is depressed. Error is cleared by pressing CLR pushbutton on CDU.

f. On displayed CDU Page, observe information pertaining to selected waypoint is displayed.

BUILD/MODIFY FLIGHT PLANS PROCEDURES.

The following paragraphs contain the build/modify flight plans procedures listed below:

- Waypoint entry rules
- Build new flight plan
- Change flight plan name
- Delete waypoint from flight plan
- Replace waypoint in flight plan
- Insert waypoint in flight plan

Waypoint Entry Rules.

When building or modifying a flight plan, waypoints can be selected by using one of the following Waypoint Search Procedures described above:

a. Using Waypoint Number or Mark Point Letter procedure or,

b. Using Waypoint Identifier procedure.

Build New Flight Plan.

To build a new flight plan, proceed as follows:

a. CDU - Depress FPM function select key. Observe FPMENU Page(s) (Figure 1-67) is displayed.

b. CDU - Enter name of new flight plan in scratchpad.

c. CDU - FPMENU Page - Depress name new flight plan LSK. [This is the LSK next to the brackets symbol and the (NEW FP) field.] Observe the following:

(1) FPBUILD Page (Figure 1-68) for building new flight plan is displayed. Brackets symbol, 01, and NEXT displayed in fields associated with second LSKs.

(2) Scratchpad is cleared.

NOTE

Upon return to the FPMENU Page, the following are displayed.

(3) New flight plan name is displayed in flight plan name field associated with the LSK that was depressed.

(4) (NEW FP) is displayed to the right of the next available flight plan number which will have the brackets symbol to the left.

NOTE

- If the flight plan database is full, the flight plan name field on the top of Page 6/6 will display (FULL), and the flight plan number and brackets will not be displayed.
- If the name new flight plan LSK is depressed with no name entered in the scratchpad, INPUT ERROR will be displayed in the scratch until the CLR pushbutton on the CDU is depressed.

d. To enter waypoints into the new flight plan, on FPBUILD Page, proceed as follows:

(1) Using Waypoint Search Procedures (Using Waypoint Number or Mark Point Letter or Using Waypoint Identifier) enter, in the scratchpad, the waypoint information for first waypoint in the flight plan.

(2) Depress waypoint LSK to the left 01. Observe the following:

(a) Entered waypoint identifier is displayed to the right of 01.

(b) An arrow symbol is displayed to the left of the branch to waypoint attributes (WPTATT) LSK.

(c) Brackets symbol, 02, and NEXT are displayed in next available waypoint fields.

(3) Repeat Step d.(1) and Step d.(2) above until desired flight plan is completely entered.

NOTE

- To assign or modify flight plan specific attributes to a waypoint, depress the WPTATT LSK associated with the desired waypoint. Use WPTATT Page (Figure 1-69) to change/modify flight plan specific attributes.
- The new flight plan is automatically written to the DTS, when another CDU display page other than the FPMENU, FPBUILD, or WPTATT Page is selected.

Change Flight Plan Name.

To change a flight plan name, proceed as follows:

a. CDU - Depress FPM function select key. Observe FP-MENU Page (Figure 1-67) is displayed.

b. CDU - Use P/G rocker switch, if necessary, to page down (or up) until desired flight plan number and name are visible on page.

c. CDU - FPMENU Page - Depress branch to FPBUILD Page LSK associated with flight plan whose name is to be changed. Observe desired FPBUILD Page (Figure 1-68) is displayed.

d. CDU - Ensure scratchpad is cleared. Depress CLR pushbutton, if necessary.

NOTE

The flight plan name LSK will be inactive (no target symbol displayed) if data is displayed in the scratchpad at this time.

e. CDU - FPBUILD Page - Depress flight plan name (NM:) LSK. Observe the following:

(1) Flight plan name field next NM: is cleared.

(2) Flight plan name is displayed in the scratchpad.

(3) Target symbol next NM: changes to brackets symbol.

NOTE

Waypoint search function is disabled at this time.

f. CDU - Edit/change flight plan name in scratchpad.

g. CDU - FPBUILD Page - Depress flight plan name (NM:) LSK. Observe the following:

(1) Scratchpad is cleared.

(2) Edited/changed flight name appears in the flight plan name field next NM.

(3) Brackets symbol next to NM: changes to target symbol.

NOTE

- Waypoint search function is enabled at this time.
- The updated flight plan is automatically written to the DTS, when another CDU display page other than the FPMENU, FPBUILD, or WPTATT Page is selected.

Delete Waypoint From Flight Plan.

To delete a waypoint from a flight plan, proceed as follows:

NOTE

A flight plan with only one waypoint (leg), or the last waypoint of any flight plan **cannot** be deleted.

a. CDU - Depress FPM function select key. Observe FP-MENU Page (Figure 1-67) is displayed.

b. CDU - Use P/G rocker switch, if necessary, to page down (or up) until desired flight plan number and name are visible.

c. CDU - FPMENU Page - Depress branch to FPBUILD Page LSK associated with flight plan that is to be changed. Observe desired FPBUILD Page (Figure 1-68) is displayed.

d. CDU - Use P/G rocker switch, if necessary, to page down (or up) until waypoint to be deleted is visible on page.

e. CDU - FPBUILD Page - Depress waypoint LSK next to waypoint sequence number of waypoint to be deleted. Observe the selected waypoint number appears in the scratchpad. CDU - Depress CLR pushbutton. UFC - Depress CLR pushbutton and hold. Observe the following:

(1) Selected waypoint is removed from flight plan.

(2) All subsequent waypoints move up by one and their waypoint sequence numbers are decremented by one.

(3) Scratchpad is cleared.

NOTE

The updated flight plan is automatically written to the DTS, when another CDU display page other than the FPMENU, FPBUILD, or WPTATT Page is selected.

Replace Waypoint In Flight Plan.

To replace a waypoint in a flight plan, proceed as follows:

a. CDU - Depress FPM function select key. Observe FP-MENU Page (Figure 1-67) is displayed.

b. CDU - Use P/G rocker switch, if necessary, to page down (or up) until desired flight plan number and name are visible on page.

c. CDU - FPMENU Page - Depress branch to FPBUILD Page LSK associated with flight plan that is to be changed. Observe desired FPBUILD Page (Figure 1-68) is displayed.

d. CDU - Use P/G rocker switch, if necessary, to page down (or up) until waypoint to be replaced is visible on page.

e. CDU - FPBUILD Page - Using Waypoint Search Procedures (Using Waypoint Number or Mark Point Letter or Using Waypoint Identifier) enter, in the scratchpad, the waypoint information for the replacement waypoint in the flight plan.

f. CDU - FPBUILD Page - Depress the waypoint LSK to the left of the waypoint to be replaced. Observe that waypoint selected in above step replaces the waypoint associated with the LSK that was depressed.

NOTE

- To assign or modify flight plan specific attributes to the replacement waypoint, depress the WPTATT LSK associated with the desired waypoint. Use WPTATT Page (Figure 1-69) to change/modify flight plan specific attributes.

- The updated flight plan is automatically written to the DTS, when another CDU display page other than the FPMENU, FPBUILD, or WPTATT Page is selected.

Insert Waypoint In Flight Plan.

To insert a waypoint into a flight plan, proceed as follows:

a. CDU - Depress FPM function select key. Observe FP-MENU Page (Figure 1-67) is displayed.

b. CDU - Use P/G rocker switch, if necessary, to page down (or up) until desired flight plan number and name are visible on page.

c. CDU - FPMENU Page - Depress branch to FPBUILD Page LSK associated with flight plan that is to be changed. Observe desired FPBUILD Page (Figure 1-68) is displayed.

d. CDU - FPBUILD Page - Depress INSERT LSK. Observe the following:

   (1) All waypoints move down one line so that they are positioned between LSKs.

   (2) The branch to waypoint attributes (WPTATT) Page header is removed and the branch to waypoint attributes (WPTATT) Page LSKs are inactive (arrow symbols removed).

e. CDU - Use P/G rocker switch, if necessary, to page down (or up) until waypoint below the point where the new waypoint is to be inserted is visible on page.

f. Using Waypoint Search Procedures (Using Waypoint Number or Mark Point Letter or Using Waypoint Identifier) enter, in the scratchpad, the waypoint information for the waypoint to be inserted in the flight plan.

g. CDU - FPBUILD Page - Depress the waypoint LSK to the left of the where the new waypoint is to be inserted. Observe the following:

   (1) Observe that waypoint selected in above Step g is inserted in the desired position.

   (2) The waypoint sequence numbers of all waypoints following the inserted waypoint are incremented by one.

   (3) The waypoints are all properly aligned with their LSKs.

(4) The branch to waypoint attributes (WPTATT) Page header reappears and the branch to waypoint attributes (WPTATT) Page LSKs are active (arrow symbols displayed).

NOTE

- To assign or modify flight plan specific attributes to a waypoint, depress the WPTATT LSK associated with the desired waypoint. Use WPTATT Page (Figure 1-69) to change/modify flight plan specific attributes.

- The updated flight plan is automatically written to the DTS, when another CDU display page other than the FPMENU, FPBUILD, or WPTATT Page is selected.

MARK FUNCTION.

Together the CDU and LASTE can create two different kinds of mark points: overhead mark points (directly below aircraft) and offset mark points (an object offset from aircraft position).

Creating Overhead Mark Points.

To create an overhead mark point:

NOTE

- CDU cannot be displaying NI mode.

- EGI INS must be in NAV mode.

- IFFCC must be turned on and functioning to obtain valid mark point elevation data.

a. LCP - RDR ALTM switch - NRM.

b. Stick Grip - Master Mode Control Button - Depress to select - GUNS, CCIP, CCRP, or NAV.

c. CDU - Verify UPDATE Page not displayed.

d. CDU - MK button - or UFC MK pushbutton Depress at flyover. The position of the point overflown is stored in the mark point portion of the waypoint database in location A, B, C,....etc. MARK A (B, C,....) will be annunciated on the CDU for 10 seconds or until the FA pushbutton is depressed; and, on the HUD, the steerpoint identifier, number, and distance fields will flash for approximately 5 seconds, and the mark point elevation (or XXXX if above 5000 feet AGL) is displayed and flashes for approximately 10 seconds. Depressing the MK pushbutton on the CDU will result in an overfly mark regardless of the HUD format.

NOTE

- There are 25 mark points available (A thru Y). The 26th mark point (Z) is reserved for LASTE weapons event mark points. The 26th mark point will overwrite the data in the A position. The 27th mark point will overwrite the B position, etc. Each succeeding LASTE weapons event mark point will overwrite the data in the Z position.

- All mark points are initially displayed using the last spheroid model selected.

- If marks are taken less than one second apart, the elevation may not be accurate and "*****" will be displayed for elevation.

Creating HUD Offset Mark Points.

To designate points as mark points without flying directly overhead, proceed as follows:

NOTE

- Offset mark accuracy is maximized when accomplished in a non-maneuvering state with the target or steerpoint near the Total Velocity Vector (TVV).

- When an offset mark point is to be created, the altitude of the mark point must be at least 1 foot below the LASTE system current altitude, the mark point must be less than 14.8 NM slant range (for Hot Target elevation) and 10 NM ground range (for DTS mode) from the aircraft, and the mark point must be at least 5 mils below the horizon.

- LASTE must be turned on and functioning and the aircraft must be in the air to create offset mark points.

- The Maverick symbol, when outside the HUD Field of View (FOV), can be used to create an offset mark. However, the mark point is only as accurate as the look-angle received by LASTE from the Maverick.

a. LCP - RDR ALTM switch - to NRM.

b. Stick Grip - Master Mode Control Button - Depress to select - GUNS, CCIP, CCRP, or NAV.

NOTE

Although the system will create an offset mark point in the LASTE NAV mode, EGI will use the aircraft's barometric altitude for the computation. This will, in most cases, produce a mark point that is significantly less accurate than one taken from GUNS, CCIP, or CCRP mode.

c. AHCP - ALTITUDE switch - Select desired altitude source.

NOTE

When the RADAR mode (aircraft below 5000' AGL) is selected, the system will create an accurate offset mark point only when the mark point elevation is the same as the terrain elevation underneath the aircraft.

d. Set LASTE elevation to elevation of intended mark point or select DTS.

e. Use Slew Enable Switch to move the Target Designation Cue (TDC) - As required.

f. Slew TDC over the intended mark point. If the TDC is not slewed from the TVV, the TDC must be flown to the intended mark point and ground stabilized using TMS-FWD/SHORT.

g. Stick-TMS-RIGHT/SHORT to send offset markpoint position to the CDU. The position of the offset mark point is stored in the mark point portion of the waypoint database in location A, B, C,…, etc. MARK A (B, C,....) will be annunciated on the CDU.

NOTE

- The CDU MK button or UFC MK button cannot be used for creating offset mark points. It will create an overfly mark regardless of the HUD mode.
- There are 25 mark points available (A thru Y). The 26th mark point (Z) is reserved for LASTE weapons event mark points. The 26th mark point will overwrite the data in the A position. The 27th mark point will overwrite the B position, etc. Each succeeding LASTE weapons event mark point will overwrite the data in the Z position.
- All mark points are initially displayed using the last spheroid model selected.

Selecting Mark Points.

To select a mark point as the steerpoint:

a. AAP - STEER PT select rotary knob - MARK.

b. To change the steerpoint, either:

(1) Go to the Steerpoint Information (STRINFO) Page (Figure 1-60) and enter the letter corresponding to the mark point to be used, and depress the steerpoint LSK, or

(2) Use the STEER toggle switch on the AAP to change the steerpoint to the desired mark point.

c. To display mark point coordinates, go to the Waypoint (WAYPT) Pages (Figure 1-63) and either:

(1) Enter mark point letter in scratchpad and depress waypoint LSK.

(2) Use the ± rocker switch on the CDU or the FUNC mode of the SELECT switch on the UFC to display the desired mark point, or

(3) Use the Waypoint Search Procedure and the waypoint identifier LSK to display the desired mark point.

Offset Displacements.

The OFFSET Page (Figure 1-66) can be used to compute displacements between waypoints, between a waypoint and entered geographic data, and to generate a new waypoint at a specified offset from an existing waypoint.

a. To compute offset between waypoints:

(1) Select the initial waypoint using the initial waypoint database and number or identifier LSK.

(2) Select the second waypoint as the offset waypoint using the offset waypoint database and number LSK.

(3) The offset will appear as the magnetic heading/distance below MH/DIS:

b. To compute the offset between a waypoint and entered geographic data:

(1) Select initial waypoint using the initial waypoint database and number or identifier LSK.

(2) Enter the desired geographic data using the offset waypoint latitude and longitude LSKs, or the offset waypoint MGRS grid and spheroid and area, eastings, and northings LSKs.

(3) The offset will appear as the magnetic heading/distance below MH/DIS:

c. To generate a new waypoint at a specified offset from an existing waypoint:

(1) Select initial waypoint using the initial waypoint database and number or identifier LSK.

(2) Enter the offset heading and distance as HHHDDDDT and depress the magnetic heading/distance (MH/DIS) LSK.

NOTE

- Entry procedure for MH/DIS is identical for L/L or MGRS coordinate format.

- Keyboard entry format for MH/DIS is HHHDDDD.T, where:
  HHH is magnetic heading in whole degrees, enter one leading zero if less than 100°, two if less than 10°.
  DDDD is distance in nautical miles (NM), between 0000 and 9999.
  T is fractional NM in tenths; use the decimal point (.) to enter tenths. Tenths of a NM may always be entered, but will only be displayed when distance is less than 100 NM. Although tenths of a NM will not be displayed when entered distances are greater than 99.9 NM, the tenths will be used in the computation of the geographic data.

(3) Geographic data for the offset waypoint will appear in the geographical data fields. This data can be copied into a new waypoint by depressing the copy (?XX) LSK where XX is the number of the next available mission waypoint, or overwriting an existing mission waypoint by entering 1-50 or a waypoint identifier (up to 12 alphanumeric characters) on the scratchpad and pressing the Copy LSK. If an identifier is entered that does not match an existing identifier, the new mission point's identifier will be assigned the entered identifier. If the mission point does exist, the identifier will not be overwritten. If an identifier is not entered into the scratchpad, and the mission point being copied to does not currently exist, the identifier MSNOXX (where XX is the next unused mission number) will be assigned the new waypoint when the copy LSK is depressed. The created waypoint will contain steering attributes on WAYPT Page 2/2 (Figure 1-63) that are the current steering attributes (the attributes the system is using at the time the waypoint is created).

NOTE

As the waypoint identifier is entered in the scratchpad, the waypoint search function will be initiated after the first two characters are entered and after each succeeding character is entered. For details, refer to the Waypoint Search Procedures paragraph.

Overhead Update.

A manual overhead update of the EGI INS can be accomplished as follows:

NOTE

- If overhead update is accepted, only the INS-only solution is updated, the blended solution is not changed.

- If overhead update is accepted, RER and CEP will not be computed upon landing.

- LASTE must be turned on and functioning to obtain valid update point elevation data.

a. LCP - RDR ALTM switch - to NRM.

b. AHCP - IFFCC Switch - to ON.

c. AAP - PAGE select rotary knob - Select OTHER.

d. CDU - Depress SYS function select key, if necessary. Observe System (SYS) Page (Figure 1-80) is displayed.

e. CDU - SYS Page - Depress INS Page LSK. Observe INS Page (Figure 1-89) is displayed.

f. CDU - INS Page - Depress UPDATE page LSK. Observe UPDATE Page (Figure 1-75) is displayed.

NOTE

The UPDATE Page can also be selected from the NAV Page (Figure 1-70).

g. CDU - UPDATE Page - Depress PROCEED LSK (if PROCEED and its target symbol are present). Observe that PROCEED and its target symbol disappear, and the system downmodes to INS-only mode (I displayed next to FOM line 1).

NOTE

If system is already in INS-only mode, PROCEED and its target symbol will not be present; proceed to Step i.

h. CDU - Depress MK pushbutton when directly over selected (current) steerpoint. Observe Accept/Reject (ACC/REJ) Page (Figure 1-76) is displayed.

i. CDU - ACC/REJ Page - Accept or reject update using ACCEPT or REJECT LSK.

NOTE

- If the update is neither accepted nor rejected within 30 seconds, or a different page is selected within 30 seconds, the update will be automatically rejected. Depressing REJECT LSK causes update to be rejected and UPDATE Page to be redisplayed.

- Once the INS-only mode is entered and with the UPDATE Page displayed, any number of overhead updates can be performed. Any page other than the UPDATE Page must be displayed to prevent overhead updates from being initiated when the CDU MK button is depressed.

j. To return to the original blended solution, proceed as follows:

    (1) AAP - PAGE select rotary knob - Select OTHER, if necessary.

    (2) CDU - Depress NAV function select key. Observe NAV Page (Figure 1-70) is displayed.

    (3) CDU - NAV Page - Use commanded mode LSK to select BLENDED.

INS HUD Update (Offset Update).

An INS HUD update of the EGI INS can be accomplished as follows:

NOTE

- INS HUD update accuracy is maximized when accomplished in a non-maneuvering state with the target or steerpoint near the TVV.

- If INS HUD update is accepted, only the INS-only solution is updated, the blended solution is not changed.

- If INS HUD update is accepted, RER and CEP will not be computed upon landing.

- When an INS HUD update of the EGI INS is to be performed; the altitude of the update point must be at least 1 foot below the LASTE system current altitude, the update point must be less than 14.8 NM slant range (for Hot Target elevation) and 10 NM ground range (for DTS mode) from the aircraft, and the update point must be at least 5 mils below the horizon.

- LASTE must be turned on and functioning and the aircraft must be in the air to perform an INS HUD update.

a. LCP - RDR ALTM switch - Select NRM.

b. AHCP - IFFCC Switch - to ON.

NOTE

Although the system will update the EGI INS in the LASTE NAV mode, EGI will use the aircraft's barometric altitude for the computation. This will, in most cases, produce an offset update that is significantly less accurate than one taken from GUNS, CCIP, or CCRP mode.

c. AHCP - ALTITUDE switch - Select desired altitude source.

NOTE

When the RADAR mode (aircraft below 5000’ AGL) is selected, the system will perform an accurate INS HUD update only when the steerpoint elevation is the same as the terrain elevation underneath the aircraft.

d. AAP - PAGE select rotary knob - Select OTHER.

e. UFC - FUNC/MK {UPDT} - Depress once and observe HUD displays HUD UPDATE, and on CDU, system downmodes to INS-only mode (I next to FOM on line 1).

f. Use Slew Enable Switch to move TDC - As required.

g. Slew TDC symbol on selected (current) steerpoint and depress UFC ENT. Observe Accept/Reject (ACC/REJ) Page (Figure 1-76) is displayed on CDU, and on HUD, HUD UPDATE message flashes for 2 seconds and then disappears, and target designation (TD) box moves to selected (current) steerpoint.

h. CDU - ACC/REJ Page - Accept or reject update using ACCEPT or REJECT LSK.

NOTE

If the update is neither accepted nor rejected or a different page selected within 30 seconds, the update will be automatically rejected. Depressing REJECT LSK causes update to be rejected and page that was displayed prior to ACC/REJ Page to be redisplayed.

i. To return to the original blended solution, proceed as follows:

(1) CDU - Depress NAV function select key. Observe NAV Page (Figure 1-70) is displayed.

(2) CDU - NAV Page - Use commanded mode LSK to select BLENDED.

INS TGP Update.

An INS TGP update of the EGI INS can be accomplished as follows:

NOTE

- INS TGP update accuracy is maximized by lasing the groundpoint of the current steerpoint.
- INS will only be displayed on the TGP A-G Page (OSB 10) when the EGI is in an INS-only navigation mode.

a. CDU - select update point as current steerpoint

b. MFCD - TGP A-G Page - Track ground position of the current steerpoint.

c. MFCD - Press INS (OSB 10).

d. MFCD - Press INS (OSB 10) again within 3 seconds to acknowledge the INS update and send the TGP position information to the CDU.

e. CDU - Accept/Reject page is shown with the calculated offset.

f. CDU - ACC/REJ Page - Accept or reject update using ACCEPT or REJECT LSK.

NOTE

If the update is neither accepted nor rejected or a different page selected within 30 seconds, the update will be automatically rejected. Depressing REJECT LSK causes update to be rejected and page that was displayed prior to ACC/REJ Page to be redisplayed.

LRU Reset.

If the CDU has determined that an LRU (EGI, LASTE, CADC, HARS, or DTS) has failed (F) or not communicating (N), the CDU will not use data from that LRU in forming the ENAV solution. Attempt to reset the failed LRU as follows:

a. Reset the CDU’s failure determination by depressing the failed LRU LSK on the RESET Page (Figure 1-87).

b. The CDU resumes monitoring the LRU indicators that it uses in determining LRU status. If the cause of the original failure no longer exists, the LRU status will continue to indicate V. If the cause of the original failure is still present, the LRU indicators will once again result in a failure (F or N) status for that LRU.

LRU Reinitialization.

Reinitialization of the INS, GPS, or LASTE can be performed by depressing the corresponding LSK on the Reinitialization (REINIT) Page (Figure 1-81).

NOTE

If the aircraft is on the ground, reinitialization is identical to the original power up initialization. For GPS, in-flight reinitialization is identical to the original power up initialization. If INS reinitialization is performed in the air, an IN-FLT alignment is performed instead of a normal alignment. LASTE cannot be reinitialized via the REINIT Page when airborne.

LRU and CDU Tests.

The LRU and CDU tests are selected and controlled by the LRU Test (LRUTEST) Page (Figure 1-101), EGI Test (EGITEST) Page (Figure 1-102), CDU Test (CDUTEST) Pages (Figure 1-103), Bitball Control (BB CTL) Page (Figure 1-104), and BITBALL Page (Figure 1-105), which are provided for reference only. These pages are active only on the ground. Do not use any of these pages prior to flight; the only way to exit these pages, if a test has been selected, is to cycle CDU power. These pages contain maintenance information for use by maintenance personnel. For information pertaining to these pages, refer to Troubleshooting Avionics Integrated Systems - Navigation Systems, TO 1A-10C-2-40TS-3.

WARNING

Do not select any of the LRU or CDU test(s) prior to flight. Some of these tests can cause the rudder to move prior to takeoff.

CDU Bitballs.

When a failure occurs within the CDU, the CDU display could freeze, go blank, or a DISPLAY FAILURE, MBC FAIL, ADA FAIL, or HARDWARE FAIL message could appear on the screen. If this failure occurs during flight, power to the CDU can be cycled. If the CDU powers on again, a bitball (Δ) will appear in the top right-hand corner of all pages. The bitball alerts ground crew personnel that a failure occurred in the CDU. Maintenance personnel then can examine the last five BITBALLs via the Bitball Control (BB CTL) Page (Figure 1-104) and BITBALL Page (Figure 1-105).

Access To Miscellaneous EGI INS Data.

EGI INS miscellaneous data can be accessed on the INS Page (Figure 1-89). To read the data at a particular address, enter the address in the scratchpad and depress the MISC LSK. The data appears next to the bottom right LSK. To write data to a particular address, first select the address using the scratchpad and the MISC LSK. Then enter the data in the scratchpad and depress the bottom right LSK. The data is written to the selected address. This LSK is for use by maintenance personnel only.

FOM.

The FOM for the selected navigation solution is displayed on the right side of line 1 on all CDU operation display pages. The EGI Page 1/4 (Figure 1-88) displays the INS-only, GPS-only, and blended (BLD) navigation solutions FOMs. The FOM for the BLENDED and GPS-only solutions is a number that represents the 3-dimensional estimated position error (spherical error probable (SEP)) as listed below:

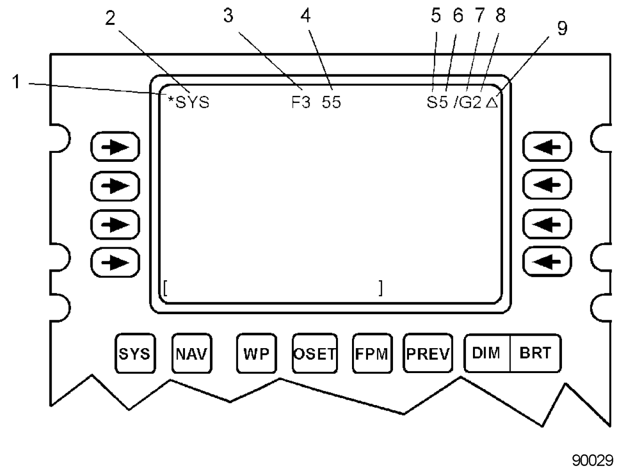
FOM	Estimated Position Error
1	Less than 85.3 feet (26m).
2	Greater than 85.3 feet (26m) to 164.1 feet (50 m).
3	Greater than 164.1 feet (50 m) to 246.1 feet (75 m).
4	Greater than 246.1 feet (75 m) to 328.1 feet (100 m).
5	Greater than 328.1 feet (100 m) to 656.2 feet (200 m).
6	Greater than 656.2 feet (200 m) to 1640.5 feet (500 m).
7	Greater than 1640.5 feet (500 m) to 3281.0 feet (1000 m).
8	Greater than 3281.0 feet (1000 m) to 16405 feet (5000 m).
9	Greater than 16405 feet (5000 m).

NOTE

The FOM for the INS-only solution is a time dependent number which gradually increases with time.

List Of ENAV CDU Display Pages.

Figure 1-57 illustrates the ENAV CDU display pages menu tree. The following is a list of figures of the ENAV system CDU display pages that can be used.



INDEX NO.	LABEL	FUNCTION
1	Flashing asterisk	Indicates DTS upload and download activity in progress.
2	Page Label field	Identifies page currently displayed.
3	Active flight plan field	Identifies active flight plan. Is blank if no active flight plan is selected. Is replaced by "TST" when the CDU is in test mode.
4	Steerpoint field*	Identifies current steerpoint. If steerpoint is undefined, displays "****". During RER processing, displays temporary active steerpoint number.
5	DTSAS mode field*	Identifies current DTSAS mode: "D" = Track mode "S" = Search mode "**" = DTSAS failure or aircraft is off map Blank = DTSAS selected off
6	DTSAS Figure of Merit (FOM) field*	Identifies current DTSAS Figure of Merit (FOM).
7	EGI Mode Field*	Identifies current EGI mode: "B" = Blended mode "G" = GPS only mode "I"= INS only mode "N" = NAV idle mode
8	GPS Figure of Merit*	Identifies GPS FOM.
9	BITBALL indicator	Indicates a failure has occurred in the CDU for which data is contained in a BITBALL page. As many as five BITBALL pages can be retained in memory. This field is blank when there are no BITBALL events.

NOTE

- Header line format is applicable to all CDU pages except for the BITBALL page and all maintenance pages accessible via the MXOPT LSK on the MXLOG page.
- *Not displayed when the CDU is in test mode.

Figure 1-58. CDU Header Line Display

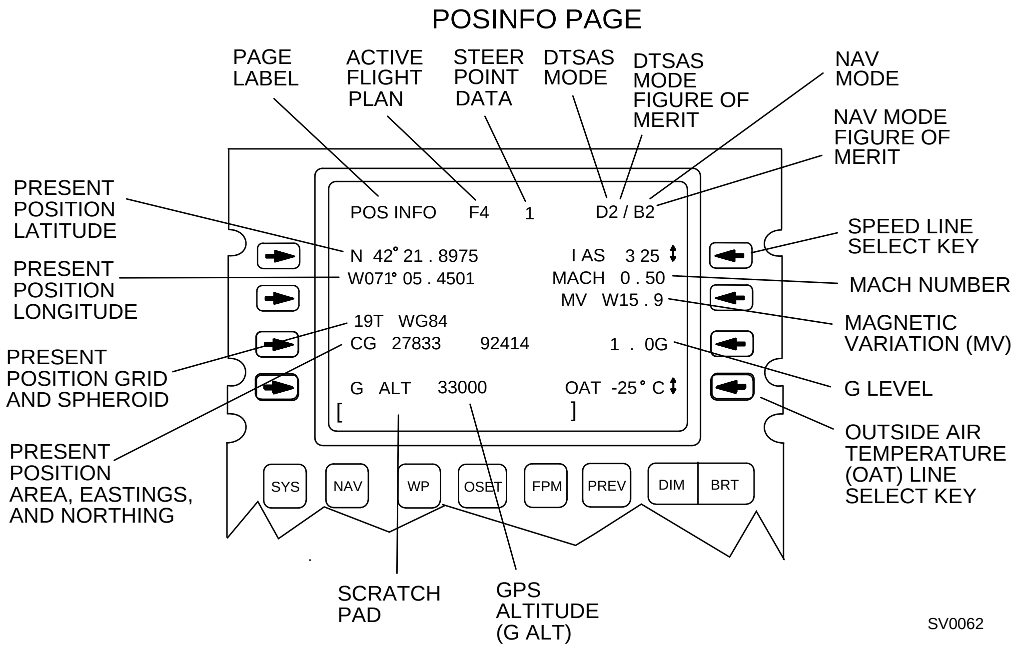


Figure 1-59. Position Information (POSINFO) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Present position latitude	Displays present position latitude based on the indicated NAV mode. When the NAV mode field displays N, this field will display 11 asterisks.
Present position longitude	Displays present position longitude based on the indicated NAV mode. When the NAV mode field displays N, this field will display 11 asterisks.
Present position grid and spheroid	Displays present position grid and spheroid based on the indicated NAV mode. When the NAV mode field displays N, this field will display 9 asterisks.
Present position area, eastings, and northings	Displays present position area, eastings, and northings based on the indicated NAV mode. When the NAV mode field displays N, this field will display 14 asterisks.
Speed LSK	Allows stepping through and displaying indicated airspeed (IAS) from CADC, or ground speed (GS) from EGI. If the NAV mode field is displaying N when GS is selected, this field will display three asterisks.
MACH number	This field displays the aircraft's MACH from CADC.
Magnetic variation (MV) LSK	Normally, this field displays the magnetic variation provided by EGI with no equal sign between MV and the magnetic variation. When the NAV mode field displays N, this field will display eight asterisks. When a magnetic variation is entered using the OPTIONS Page (Figure 1-79), this field displays the entered magnetic variation with an equal (=) sign between MV and the entered magnetic variation. The magnetic variation displayed in this field is the magnetic variation used in the computation of the navigation solutions and steering information. **NOTE** When the grid heading mode is selected using the OPTIONS Page (Figure 1-79), this field does not display the convergence (C) value that is being used to compute the navigation solutions and steering information. Therefore, when the grid heading mode is selected, and if the convergence value has not been properly entered, there may be significant errors in the navigation solutions and steering information.
G level	This field displays the G level experienced by the pilot, from -9.9 to +9.9 Gs through the Z axis of the aircraft. When the NAV mode field indicates N, I, or G, this field will display four asterisks.
Outside air temperature (OAT) LSK	This LSK allows selection of either OAT in °C or °F. At turn-on, this field defaults to °C. This field displays the OAT from CADC.
GPS altitude (G ALT)	This field displays the present altitude in feet, as calculated by the EGI GPS. When the NAV mode field indicates N or the expected vertical error (EVE) (see GPS Page, Figure 1-94) is greater than 50 feet, this field will display five asterisks.

Figure 1-59. Position Information (POSINFO) Page (Sheet 2)

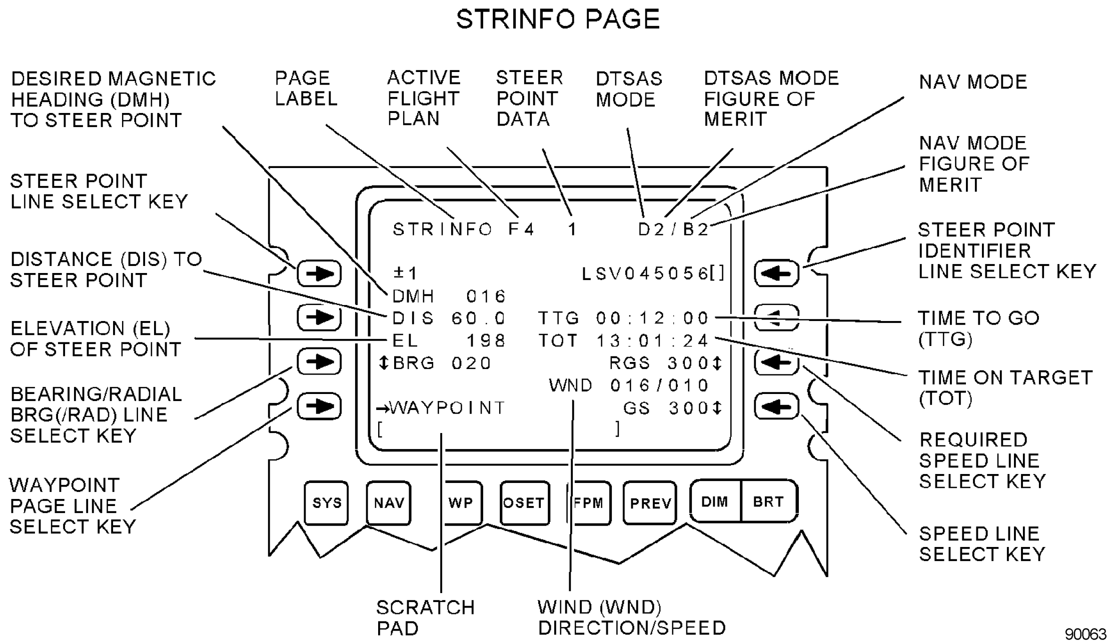


Figure 1-60. Steerpoint Information (STRINFO) Page (Sheet 1 of 4)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Steerpoint LSK	Allows selection of the steerpoint database and number/letter in one of three ways: 1. When the AAP STEER PT switch is set to MISSION and a numeric string (from 0 to 2050) is entered into scratchpad, then a specific MSN or NAV waypoint is assumed. Pressing the Steerpoint LSK selects that waypoint. 2. When the AAP STEER PT switch is set to MARK and a single alpha character is entered into scratchpad, then a specific markpoint is assumed. Pressing the Steerpoint LSK selects that markpoint. 3. The ± rocker switch can be used to change the number/letter within the displayed waypoint database without using the LSK. When AAP STEER PT switch is set to FLT PLAN, this LSK is inactive (no ± symbol displayed) and the field displays the number/letter of the active steerpoint displayed on the Flight Plan Build (FPBUILD) Page. When SCS is the selected steering mode, this LSK is inactive (no ± symbol displayed) and the field displays SXXX.X, where XXX.X is the course selected by the HSI COURSE SET knob.
Steerpoint identifier LSK	When AAP STEER PT switch is set to MISSION or MARK, allows entry from scratchpad of steerpoint identifier, up to 12 alphanumeric characters. If two or more characters are entered (with the first an alpha character), a search through the Waypoint ID database search is assumed. The Waypoint ID database search engine operates as follows: 1. The cursor is removed from scratchpad while the search is in progress. If there are no Waypoint IDs found that start with those characters, nothing else is displayed in scratchpad, and the cursor returns when the search through the Waypoint ID database is complete. 2. If Waypoint ID(s) are found starting with those characters, the first applicable Waypoint ID (in alphanumeric order) is displayed in scratchpad (with the cursor overlaying the third character). If this is the desired anchor point, it is selected by depressing the Anchor Point ID LSK. 3. If the Waypoint ID displayed in scratchpad is not the desired waypoint, there are two options available: (1) Enter a third character into scratchpad and perform another search, or (2) utilize the "←/→" rocker switch to toggle alphanumerically in either direction through the Waypoint ID database until the desired anchor point is found.

Figure 1-60. Steerpoint Information (STRINFO) Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
	Pressing this LSK when the scratchpad contains a Waypoint ID which is not present in the Waypoint ID database, will result in "INPUT ERROR" being displayed in the scratchpad.
	When AAP STEER PT switch is set to FLT PLAN, this LSK is inactive (no ± symbol displayed) and the field displays the identifier of the active steerpoint displayed on the Flight Plan Build (FPBUILD) Page.
	When SCS is the selected steering mode, this LSK is inactive (no bracket symbols displayed) and the field displays 12 asterisks.
Desired magnetic heading (DMH)	Displays wind corrected magnetic heading to steerpoint in degrees. When SCS is the selected steering mode, displays magnetic heading in degrees to the point at which the SCS steering mode was selected.
Distance (DIS) to steerpoint	Displays distance to steerpoint in nautical miles. When the distance is less than 100 miles, tenths of a nautical mile are displayed. When the distance is equal to or greater than 100 nautical miles, only whole nautical miles are displayed which are rounded off to the nearest nautical mile. When the distance exceeds 9998.5 nautical miles, the distance field will display 9999. When SCS is the selected steering mode, displays the distance from the point at which the SCS steering mode was selected.
Elevation (EL) of steerpoint	Displays elevation of steerpoint if an elevation has been uploaded from the DTC or assigned on WAYPT Page P1/2 (Figure 1-63). When SCS is the selected steering mode, displays altitude at the point at which SCS steering mode was selected.
Bearing/radial LSK	Allows selection of bearing (BRG) to steerpoint or radial (RAD) from steerpoint for display. When SCS is the selected steering mode, allows selection of BRG to or RAD from the aircraft location at which the SCS steering mode was selected.
WAYPOINT LSK	Allows selection of WAYPT Page P1/2 (Figure 1-63). When the WAYPT Page is selected from this page, the WAYPT Page will display the information for the steerpoint. When SCS is the selected steering mode and the WAYPT Page is selected from this page, the WAYPT Page will display the information for the last waypoint that was displayed.
Time to go (TTG)	Displays time to steerpoint at current ground speed: shown in hours, minutes, and seconds. When ground speed is less than 3 knots, TTG will display eight asterisks. When SCS is the selected steering mode, displays time in hours, minutes, and seconds at current airspeed from the aircraft location at which SCS steering mode was selected.
Time on target (TOT)	Displays time of arrival at steerpoint at current ground speed in hours, minutes and seconds (in selected time mode, GMT or local). When ground speed is less than 3 knots, TOT will display eight asterisks. When SCS is the selected steering mode, displays time from the point at which the SCS steering mode was selected at the current air speed in hours, minutes and seconds.

Figure 1-60. Steerpoint Information (STRINFO) Page (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
Required speed LSK	This LSK is only active (up and down arrow display) when a desired time on target (DTOT) has been uploaded from the DTC or entered using WAYPT Page, P1/2 or P2/2 (Figure 1-63) or a desired time to go (DTTG) has been entered using WAYPT Page, P2/2. This LSK, when active, allows selection of either the required indicated airspeed (RIAS), required ground speed (RGS), or required true airspeed (RTAS) in knots. This field indicates the selected speed required to arrive at the steerpoint at the desired time. When a DTOT or DTTG has not been assigned or the SCS steering mode has been selected, this field will be blank. **NOTE** ● The required speed display will indicate zero (0) and then remain at zero (0) when the current time exceeds the entered hack, DTTG, or DTOT time for the selected steerpoint. (Aircraft will arrive late at the steerpoint.) ● If the aircraft arrives early at the steerpoint, the required speed display will decrease to zero (0) then increase as the aircraft moves away from the steerpoint.
Speed LSK	This LSK allows stepping through and display ground speed (GS) from EGI, indicated airspeed (IAS) from CADC, or true airspeed (TAS) from CADC. This field indicates the selected speed in knots. If the NAV mode field is displaying N when GS is selected, this field will display three asterisks.
Wind (WND) direction/speed	Displays current wind direction in degrees (magnetic) and speed in knots as calculated by the LASTE system.

Figure 1-60. Steerpoint Information (STRINFO) Page (Sheet 4)

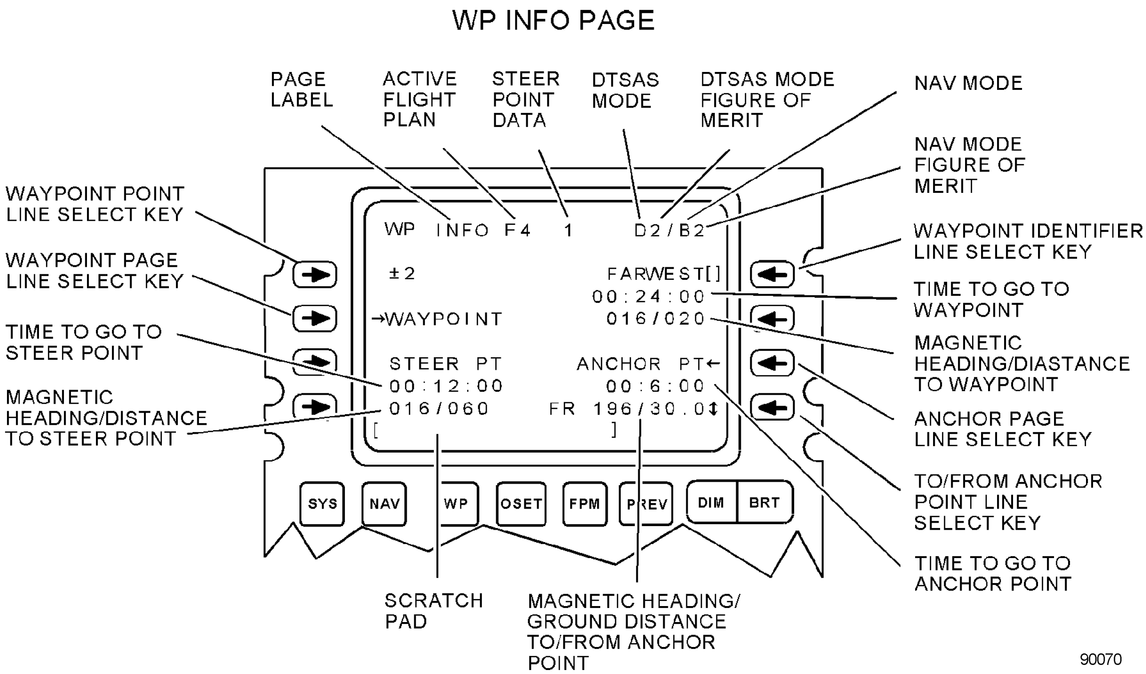


Figure 1-61. Waypoint Information (WP INFO) Page (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Waypoint LSK	Allows selection of a mission or navigation waypoint, or a mark point for display as follows: a. If a number from 0 to 2050 is entered in the scratchpad (a mission or navigation waypoint is assumed) and then this LSK depressed, the waypoint with the number displayed in the scratchpad becomes the displayed waypoint. b. If an alphabetical character is entered in the scratchpad (a mark point is assumed) and then this LSK is depressed, the mark point with the alphabetical character displayed in the scratchpad becomes the displayed waypoint. **NOTE** Use the ± rocker switch on the CDU or the FUNC mode of the SELECT switch on the UFC to display the desired mark point.
Waypoint identifier LSK	Allows operator to select a waypoint by using the scratchpad (Waypoint Search Procedure, (this section) and then pressing this LSK. If the entered waypoint identifier is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad when this LSK is depressed.
Magnetic heading/distance to selected waypoint	Displays magnetic heading in degrees and distance in nautical miles to selected waypoint. When the distance is less than 100 miles, tenths of a nautical miles are displayed. When the distance is equal to or greater than 100 miles, only whole nautical miles are displayed which are rounded off to the nearest nautical mile. When the distance exceeds 9998.5 nautical miles, the distance field will display 9999.
Time to go to waypoint	Displays time to go to selected waypoint at current ground speed, shown in hours, minutes, and seconds. When ground speed is less than 3 knots, this field will display eight asterisks.
WAYPT Page LSK	Allows selection of WAYPT Page P1/2 (Figure 1-63). When the WAYPT Page is selected from this page, the WAYPT Page will display the information for the last waypoint that was displayed.
Magnetic heading/distance to steerpoint	Displays magnetic heading in degrees and distance in nautical miles to steerpoint. When the distance is less than 100 nautical miles, tenths of a nautical mile are displayed. When the distance is equal to or greater than 100 nautical miles, only whole nautical miles are displayed which are rounded off to the nearest nautical mile. When the distance exceeds 9998.5 nautical miles, the distance field will display 9999.

Figure 1-61. Waypoint Information (WP INFO) Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Time to go to steerpoint	Displays time to go to steerpoint at current ground speed, shown in hours, minutes, and seconds. When ground speed is less than 3 knots, this field will display eight asterisks.
ANCHOR Page (ANCHOR PT) LSK	Allows selection of ANCHOR Page (Figure 1-64).
Anchor point to (TO)/from (FR) LSK	Allows toggling between a display of magnetic heading/distance to (TO) or from (FR) the anchor point.
Magnetic heading/distance to anchor point	Displays magnetic heading in degrees (1 to 360) and ground distance in nautical miles (0 to 999) to or from the anchor point as selected by the (TO)/from (FR) anchor point LSK. When the distance is less than 100 nautical miles, tenths of a nautical mile are displayed. When the distance is equal to or greater than 100 nautical miles, only whole nautical miles are displayed which are rounded off to the nearest nautical mile. When an anchor has not been selected using the ANCHOR Page (Figure 1-64), this field will display eight asterisks. When the distance exceeds 998.5 nautical miles, the distance field will display 999.
Time to go to anchor point	Displays time to go to anchor point at current ground speed, shown in hours, minutes, and seconds. When ground speed is less than 3 knots, this field will display eight asterisks. When an anchor has not been selected using the ANCHOR Page (Figure 1-64), this field will display eight asterisks.

Figure 1-61. Waypoint Information (WP INFO) Page (Sheet 3)

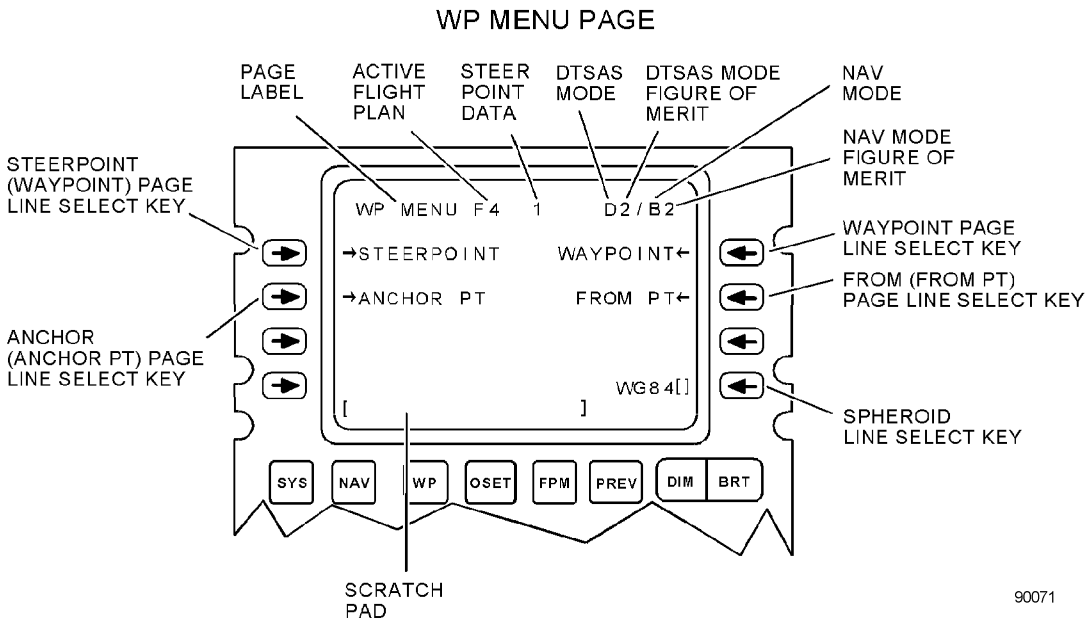


Figure 1-62. Waypoint Menu (WP MENU) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
STEERPOINT (Waypoint) Page LSK	Allows selection of WAYPT Pages (Figure 1-63) for the current steerpoint.
Anchor (ANCHOR PT) Page LSK	Allows selection of ANCHOR Page (Figure 1-64).
WAYPOINT Page LSK	Allows selection of WAYPT Pages (Figure 1-63) for the last waypoint displayed.
From (FROM PT) Page LSK	Allows selection of FROM Page (Figure 1-65).
Spheroid LSK	Allows entry of spheroid model in three or four alphanumeric characters (as listed in List of Spheroid Models) using the scratchpad. This spheroid model is the model used in all navigation computations. Upon completion of the CDU startup BIT test, this field displays WG84. When MGRS format is selected and/or displayed, the spheroid model displayed in this field will be displayed in the spheroid field of the Pages listed below: ALIGN Page (Figure 1-73) ALTALGN Page (Figure 1-90) POS Page (Figure 1-91) UPDATE Page (Figure 1-75) ACC/REJ Page (Figure 1-76) POSINFO Page (Figure 1-59) WAYPT Pages (Figure 1-63) FROM Page (Figure 1-65) OFFSET Page (Figure 1-66)

Figure 1-62. Waypoint Menu (WP MENU) Page (Sheet 2)

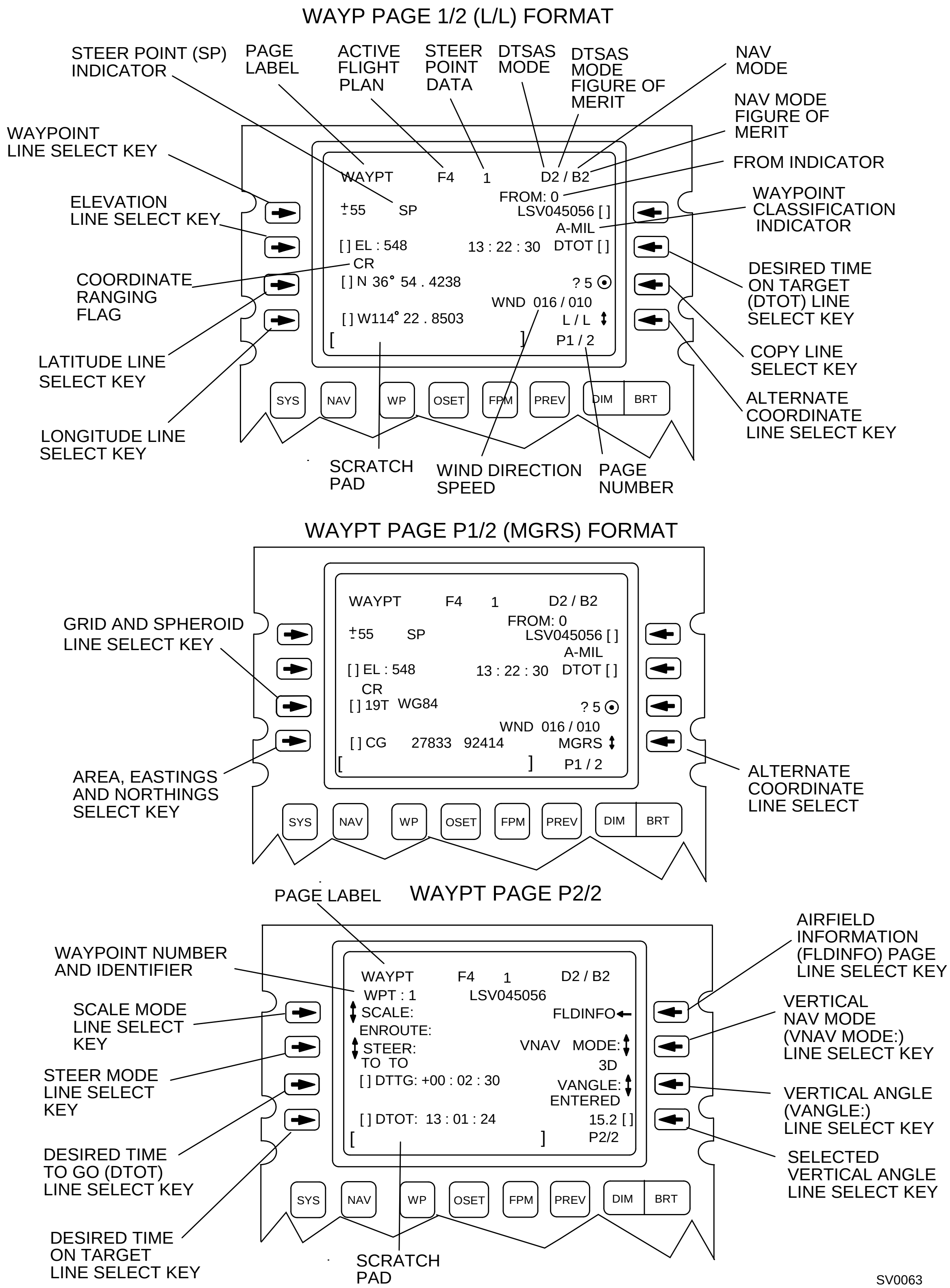


Figure 1-63. Waypoint (WAYPT) Pages (Sheet 1 of 8)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
FROM: indicator	This field is displayed only when the TO TO steering mode is selected. This field indicates the waypoint number or mark point letter of the From point. Any CDU annunciation will overwrite this field until the annunciation is cleared or acknowledged. If the FROM Waypoint is undefined the FROM indicator will not be displayed.
Waypoint LSK	Allows selection of a mission or navigation waypoint, or a mark point for display as follows: a. If a number from 0 to 2050 is entered in the scratchpad (a mission or navigation waypoint is assumed) and then this LSK is depressed, the waypoint with the number displayed in the scratchpad becomes the displayed waypoint. b. If an alphabetical character from A to Z is entered in the scratchpad (a mark point is assumed) and then this LSK is depressed, the mark point with the alphabetical character displayed in the scratchpad becomes the displayed waypoint. **NOTE** When the AAP STEER PT rotary select knob is set to MISSION or MARK, the ± rocker switch on the CDU can be used to select the waypoint within the displayed waypoint database without using the LSK.
Waypoint identifier LSK	Allows selection of a waypoint by using the scratchpad (Waypoint Search Procedure, this section) and then depressing this LSK. Depressing this LSK, when a mission waypoint (0 through 50) or a mark point (A through Z) is displayed and the identifier entered in the scratchpad is not present in the waypoint database, will rename the displayed waypoint with the identifier displayed in the scratchpad. Depressing this LSK, when a navigation waypoint (51 through 2050) is displayed and the entered waypoint identifier is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad.

Figure 1-63. Waypoint (WAYPT) Pages (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Waypoint classification indicator	Indicates the waypoint type as listed below: AIMP, LOCAL, VORDME, WAY-R A-CIV, NDB, VORTAC, WAY-T A-JNT, NDBDME, WAY-B, W-IAP A-MIL, TACAN, WAY-H, W-SID A-OTH, VOR, WAY-L, W-STAR **NOTE** Waypoints with the classification, A-CIV, A-JNT, A-MIL, or A-OTH, are the diversion airfields displayed on the Diversion (DIVERT) Page (Figure 1-71) and the Airfield Information (FLDINFO) Page (Figure 1-72).
Elevation (EL) LSK	Allows entry of elevation [in feet above mean sea level (MSL)] of mission waypoints from scratchpad. The range of elevation that can be entered is from -1000 feet to +32767 feet. Entering an elevation value and depressing the LSK enters a positive value. Depressing the LSK a second time changes the sign of elevation. If Coordinate Ranging is enabled on the DTSAS page (Figure 1-93), the CDU will request the DTSAS function to determine the elevation of a manually modified (i.e., a change to the waypoint position) mission waypoint. This is indicated by the Coordinate Ranging (CR) flag being displayed immediately below the waypoint elevation. However, the waypoint elevation determined by the DTSAS Coordinate Ranging function may be overridden by entering the desired waypoint elevation in scratchpad and depressing the Elevation LSK. This will remove the CR flag from the display. **NOTE** When DTSAS automatic elevation mode is selected in CCRP for use against a designated target, LAR is used to determine target elevation. The elevation of NAV waypoints and Mark points may not be modified. This is indicated by no brackets being displayed, rendering the Elevation LSK inactive.
Coordinate ranging (CR) flag	This field displays: 1. CR - when CR is set to ON on the DTSAS Page (Figure 1-93) and the displayed mission waypoint elevation has been determined by DTSAS coordinate ranging. 2. NO CR - when: CR is set to ON on the DTSAS Page (Figure 1-93) and the elevation for the entered waypoint position (i.e., latitude and longitude) could not be determined by the DTSAS Coordinate Ranging function. 3. CR is set to OFF on the DTSAS Page (Figure 1-93). **NOTE** This flag is only displayed when a Mission waypoint position is modified. The flag is not displayed (i.e., blank) for Navigation and Markpoint waypoints.

Figure 1-63. Waypoint (WAYPT) Pages (Sheet 3)

<table>
<tr><th>LABEL/LINE SELECT KEY</th><th>FUNCTION</th></tr>
<tr><td>Desired time on target (DTOT) LSK</td><td>Allows desired time of arrival at selected waypoint to be entered from scratchpad in hours, minutes and seconds (in the selected time mode, GMT or local). The allowable DTOT entry range is from 1 to 240000. Leading zeroes do not have to be entered. When the DTOT is entered, the desired time to go (DTTG) is automatically updated to reflect the new DTOT. When a DTOT or DTTG has not been entered or assigned (uploaded from DTS) to the waypoint, this field and the DTOT and DTTG fields on Page 2/2 will display eight asterisks.

Clearing DTOT by depressing this LSK when the scratchpad is empty will cause this field and the DTOT and DTTG fields on Page 2/2 to display eight asterisks.

NOTE

• Entering or changing the DTOT or DTTG value, when IFFCC is in the HACK time mode, will not cause a corresponding change to the HACK time fields displayed on the HUD. However, when IFFCC is in the HACK time mode, using IFFCC to enter or change a HACK time will cause a corresponding change to the DTOT and DTTG values displayed on this page when the displayed waypoint is the steerpoint.

• All DTOT entries must be made in the selected time mode, GMT or local.

• If the IFFCC HACK time is allowed to decrement past -60:00, the CDU will display a positive (early) DTTG value, whereas the delta time displayed in the HUD will be negative (late).

• When a DTOT is assigned to a waypoint that was created after a DTOT ADJUST value was entered, using the TIME Page (Figure 1-74). The DTOT ADJUST value is not automatically added to the DTOT.

• When a DTOT is entered that is up to an hour earlier than the current time, the resulting DTTG will be negative. Otherwise the DTOT is assumed to be in the future and the resulting DTTG will be a positive value.</td></tr>
<tr><td>Copy LSK</td><td>Allows waypoint data to be copied to the next available mission waypoint or allows an existing waypoint to be overwritten when LSK is depressed; next available location is displayed next to target symbol.

If a waypoint identifier, up to 12 alphanumeric characters, is entered into the scratchpad before this LSK is depressed and the entered waypoint identifier does not match the waypoint identifier of an existing waypoint, the entered waypoint identifier will be assigned to the new mission waypoint.

NOTE

Since the waypoint identifier search engine is active on this page, the CDU BCK and SPC pushbuttons can be used to edit the waypoint identifier displayed in the scratchpad. Depressing this LSK at this time causes the edited waypoint identifier to be assigned to the new mission waypoint.</td></tr>
</table>

Figure 1-63. Waypoint (WAYPT) Pages (Sheet 4)

LABEL/LINE SELECT KEY	FUNCTION
	If a waypoint identifier is not entered into the scratchpad before this LSK is depressed, the waypoint identifier MSNOXX (where XX = the next available mission waypoint number) will automatically be assigned to the new mission waypoint. When the mission waypoint database is full (0 through 50 used), the copy field will display ?-1 and depressing this LSK will cause INPUT ERROR to be displayed in the scratchpad.
Alternate coordinate format LSK	Allows selection of either L/L or MGRS coordinates. Depressing this key when L/L is displayed results in MGRS display format.
L/L FORMAT	
*Waypoint latitude LSK	Allows entry of waypoint latitude in degrees, minutes and ten-thousandths of a minute. This LSK is inactive (no brackets symbol displayed) for navigation waypoints (51 through 2050) and mark points (A through Z).
*Waypoint longitude LSK	Allows entry of waypoint longitude in degrees, minutes and ten-thousandths of a minute. This LSK is inactive (no brackets symbol displayed) for navigation waypoints (51 through 2050) and mark points (A through Z).
MGRS FORMAT	
**Grid and spheroid LSK	Allows entry of waypoint MGRS zone of up to two numeric characters and one alpha character, and spheroid model in three or four alphanumeric characters (as listed in List of Spheroid Models).
**Area, eastings and northings LSK	Allows entry of area in two alpha characters and eastings and northings in ten digits. This LSK is inactive (no brackets symbol displayed) for navigation waypoints (51 through 2050) and mark points (A through Z).
Wind direction/speed	Displays real time, current wind calculated by IFFCC. Any CDU annunciations will overwrite this field until the annunciation is cleared or acknowledged. **NOTE** If the IFFCC status is N or I these fields will display three asterisks/three asterisks.

*Only mission waypoints 0 to 50 may be modified. Waypoint coordinates LSK brackets [ ] will not be displayed for navigation waypoints (51 through 2050) or mark points (A through Z).

**For mission waypoints 0 to 50, MGRS grid, spheroid, area easting and northings may be modified. For all other waypoints, only spheroid may be modified.

Figure 1-63. Waypoint (WAYPT) Pages (Sheet 5)

LABEL/LINE SELECT KEY	FUNCTION
	NOTE The purpose of WAYPT Page, P2/2 is to provide the capability to enter waypoint specific attributes. Waypoint specific attributes can also be assigned using the ATTRIB Page (Figure 1-78). This is in contrast to the Waypoint Attributes (WPTATT) Page (Figure 1-69), which provides the ability to enter specific attributes for the Waypoint associated with the flight plan. The attributes are: scale mode, steering mode (not including SCS mode), desired time to go, desired time on target, vertical navigation mode, vertical angle, and selected vertical angle.
Waypoint number and identifier	Displays waypoint (WPT:) number and identifier of selected waypoint. **NOTE** Any CDU annunciations will overwrite this display until the annunciation is cleared or acknowledged.
SCALE mode LSK	Allows selection of one of four different levels of sensitivity with which EGI can drive the CDI and glideslope indicator. The four sensitivity levels are: ENROUTE, TERMINAL, HIGH ACC, and APPROACH (see Figure 1-54). Depressing the LSK allows stepping through the possible choices. If a scale has not been entered or uploaded from the DTS, this field displays eight asterisks.
Steering mode (STEER) LSK	Allows selection of one of three different steering modes. These steering modes are: TO FROM, DIRECT, and TO TO. Depressing the LSK allows stepping through the possible choices. If a steering mode has not been entered or uploaded from the DTS, this field displays seven asterisks.
Desired time to go (DTTG) LSK	Allows desired time to go to selected waypoint to be entered from scratchpad in hours, minutes, and seconds (1 to 235959). When the DTTG is entered, the DTOT is automatically updated to reflect the new DTTG. Clearing DTTG (scratchpad empty and depressing this LSK) will cause both DTOT and DTTG fields to display eight asterisks.

Figure 1-63. Waypoint (WAYPT) Pages (Sheet 6)

LABEL/LINE SELECT KEY	FUNCTION
	When a DTOT or DTTG has not been entered or uploaded from DTS, this field and the DTOT field will display eight asterisks. **NOTE** ● Entering or changing the DTOT or DTTG value, when IFFCC is in the HACK time mode, will not cause a corresponding change to the HACK time fields displayed on the HUD. However, when IFFCC is in the HACK time mode, using IFFCC to enter or change a HACK time will cause a corresponding change to the DTOT and DTTG values displayed on this page when the displayed waypoint is the steerpoint. ● If the IFFCC Hack time is allowed to decrement past -60:00, the CDU will display a positive (early) DTTG value, whereas the delta time displayed in the HUD will be negative (later). ● A negative DTTG indicates that the aircraft is late arriving at the Waypoint by the corresponding amount of time, up to one hour.
Desired time on target (DTOT) LSK	Allows desired time of arrival at selected waypoint to be entered from scratchpad in hours, minutes, and seconds (1 to 225959) in the selected time mode, GMT or local. When the DTOT is entered, the DTTG is automatically updated to reflect the new DTOT. Clearing DTOT (scratchpad empty and depressing this LSK) will cause both DTTG and DTOT fields to display eight asterisks. When a DTOT or DTTG has not been entered or uploaded from DTS, this field and the DTTG field will display eight asterisks. **NOTE** ● Entering or changing the DTOT or DTTG value, when IFFCC is in the HACK time mode, will not cause a corresponding change to the HACK time fields displayed on the HUD. However, when IFFCC is in the HACK time mode, using IFFCC to enter or change a HACK time will cause a corresponding change to the DTOT and DTTG values displayed on this page when the displayed waypoint is the steerpoint. ● All DTOT entries must be made in the selected time mode, GMT or local. ● When a DTOT is assigned to a waypoint after a DTOT ADJUST value was entered, using the TIME Page (Figure 1-74). The DTOT ADJUST value is not automatically added to the DTOT. ● If the IFFCC Hack time is allowed to decrement past -60:00, the CDU will display a positive (early) DTTG value, whereas the delta time displayed in the HUD will be negative (later). ● When a DTOT is entered that is up to an hour earlier than the current time, the resulting DTTG will be negative. Otherwise the DTOT is assumed to be in the future and the resulting DTTG will be a positive value.

Figure 1-63. Waypoint (WAYPT) Pages (Sheet 7)

LABEL/LINE SELECT KEY	FUNCTION
Airfield information (FLDINFO) Page LSK	Allows selection of FLDINFO Page (Figure 1-72). FLDINFO and the arrow symbol are displayed only if selected waypoint is an airfield. **NOTE** Waypoints with the classification, A-CIV, A-JNT, A-MIL, or A-OTH, are the diversion airfields displayed on the Diversion (DIVERT) Page (Figure 1-71) and the Airfield Information (FLDINFO) Page (Figure 1-72).
Vertical navigation mode (VNAV MODE:) LSK	Allows selection of either two- or three-dimensional mode (2D or 3D). If a VNAV MODE has not been entered or uploaded from the DTS, this field displays two asterisks. **NOTE** IF 3D is selected as the Vertical Navigation mode, the 3D will flash until the EGI GPS enters Nav mode and has acquired 4 satellites.
Vertical angle (VANGLE:) LSK	Allows selection of either ENTERED or COMPUTED vertical angle. This LSK is active only when "3D" is the selected Vertical Navigation mode. This field is blank when 2D is the selected VNAV MODE.
Selected vertical angle LSK	Allows entry of ENTERED vertical angle in degrees and tenths (0.0 to 89.9) when ENTERED is selected using VANGLE: LSK. Displays ENTERED vertical angle in degrees and tenths. Brackets appear next to this LSK only when ENTERED is selected using VANGLE: LSK. Entering a desired vertical angle of up to 89.9 degrees using the scratchpad and depressing this LSK once enters a positive vertical angle. Depressing this LSK a second time changes the sign of the entered vertical angle. This field is blank and the LSK is inactive when "2D" is the selected Vertical Navigation mode; or when "3D" is the selected Vertical Navigation mode, the vertical angle is COMPUTED, and the displayed waypoint is not the current steerpoint, or the displayed waypoint is not the current anchor point while the Anchor switch is depressed on the NMSP. When the displayed waypoint is the current steerpoint, the Anchor switch is not depressed on the NMSP, and the vertical angle is COMPUTED, this LSK is inactive (no brackets symbol displayed) and this field displays the computed vertical angle. When the displayed waypoint is the current anchor point while the Anchor switch is depressed on the NMSP and the vertical angle is COMPUTED, this LSK is inactive (no brackets symbol displayed) and this field displays the computed vertical angle for the anchor point.

Figure 1-63. Waypoint (WAYPT) Pages (Sheet 8)

ANCHOR PAGE

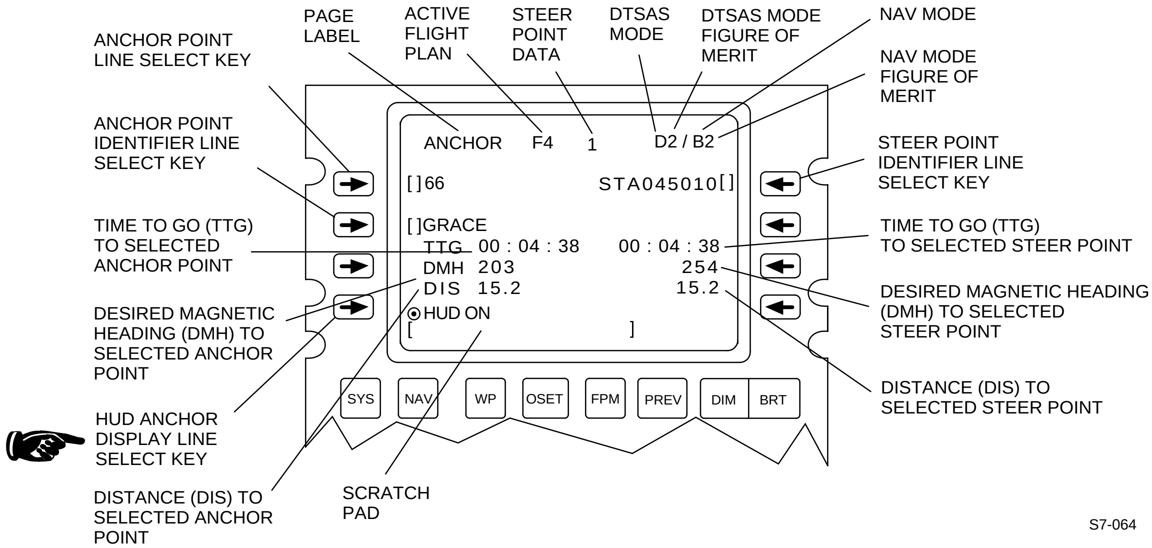


Figure 1-64. ANCHOR Page (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section). **NOTE** Upon completion of the CDU startup BIT test and system initialization, all fields on this page listed below, except steerpoint identifier, the desired magnetic heading (DMH) and the distance (DIS) to the steerpoint, will display asterisks until an anchor point is manually selected using the anchor point or anchor point identifier LSK.
Anchor point LSK	Allows selecting and entering an anchor point from the scratchpad as follows: a. If a number from 0 to 2050 is entered in the scratchpad (a mission or navigation waypoint is assumed) and then this LSK is depressed, the waypoint with the number displayed in the scratchpad becomes the anchor point. b. If an alphabetical character is entered in the scratchpad (a mark point is assumed) and then this LSK is depressed, the mark point with the alphabetical character displayed in the scratchpad becomes the anchor point. **NOTE** • The ± rocker switch on the CDU can also be used to select the anchor point within the displayed waypoint database without using the LSK. • When AAP STEER PT switch is set to FLT PLAN, the steerpoint can only be changed by using the STEER toggle switch on the AAP. After completion of the CDU startup BIT test and system initialization, if no waypoint has been defined as the anchor point in the waypoint database, this field will display four asterisks.
Anchor point identifier LSK	Allows selection of an anchor point by using the scratchpad (Waypoint Search Procedure, (this section) and then depressing this LSK. Upon completion of the CDU startup BIT test and system initialization, this field will display 12 asterisks.
Time to go (TTG) to anchor point	Displays time to anchor point at current ground speed in hours, minutes, and seconds. When ground speed is less than 3 knots, TTG to anchor point will display eight asterisks.
Desired magnetic heading (DMH) to anchor point	Displays wind corrected magnetic heading to anchor point in degrees.

Figure 1-64. ANCHOR Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Distance (DIS) to anchor point	Displays ground distance to anchor point in nautical miles (0 to 999). When the distance is less than 100 nautical miles, tenths of a nautical mile are displayed. When the distance is equal to or greater than 100 nautical miles, only whole nautical miles are displayed which are rounded off to the nearest nautical mile. When the distance exceeds 998.5 nautical miles, the distance field will display 999. When an anchor point has not been selected using this page, this field displays three asterisks.
HUD Anchor Point display LSK (HUD ON)	When HUD ON is selected, the CDU commands IFFCC to activate the HUD Anchor Point display. This will allow activation of the display without selecting the ANCHR button on the NMSP. Data displayed still depends on selection of a valid anchor point, via CDU ANCHOR page and sufficient HUD write time. Function defaults to HUD ON.
Steerpoint identifier LSK	When AAP STEER PT switch is set to MISSION or MARK, allows selection of a steerpoint by using the scratchpad (Waypoint Search Procedure, (this section) and then depressing this LSK. When AAP STEER PT switch is set to FLT PLAN, this LSK is inactive (no brackets symbol displayed) and the field displays the identifier of the selected steerpoint. When SCS is the selected steering mode, this LSK is inactive (no bracket symbols displayed) and the field displays 12 asterisks.
Time to go (TTG) to steerpoint	Displays time to steerpoint at current ground speed, shown in hours, minutes, and seconds. When ground speed is less than 3 knots, TTG to steerpoint will display eight asterisks. When SCS is the selected steering mode, displays time in hours, minutes, and seconds at current airspeed from aircraft location at which the SCS steering mode was selected.
Desired magnetic heading (DMH) to steerpoint	Displays wind corrected magnetic heading to steerpoint in degrees. When SCS is the selected steering mode, displays magnetic heading in degrees to the point at which the SCS steering mode was selected.
Distance (DIS) to steerpoint	Displays ground distance to steerpoint in nautical miles. When the distance is less than 100 nautical miles, tenths of a nautical mile are displayed. When the distance is equal to or greater than 100 nautical miles, only whole nautical miles are displayed which are rounded off to the nearest nautical mile. When the distance exceeds 9998.5 nautical miles, the distance field will display 9999. When SCS is the selected steering mode, displays the distance from the point at which the SCS steering mode was selected.

Figure 1-64. ANCHOR Page (Sheet 3)

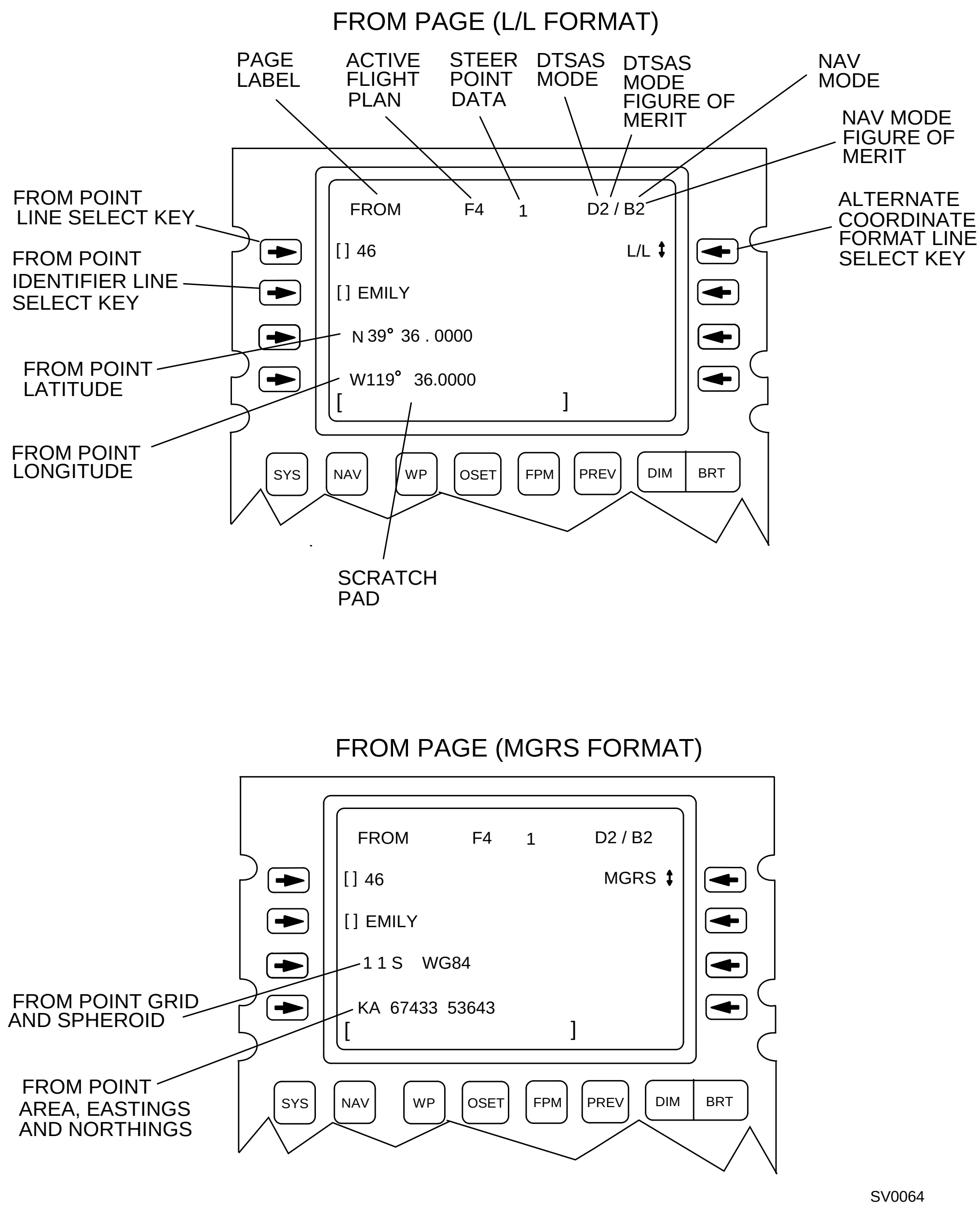


Figure 1-65. FROM Page (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section). **NOTE** After the completion of the CDU startup BIT test and system initialization, the FROM Page defaults to the initial position, waypoint 0. When a new steerpoint is selected, the From point is the previous steerpoint. The FROM Page provides the means to change the From point without changing the steerpoint.
From point LSK	Allows selecting and entering a From point from the scratchpad as follows: a. If a number from 0 to 2050 is entered in the scratchpad (a mission or navigation waypoint is assumed) and then this LSK is depressed, the waypoint with the number displayed in the scratchpad becomes the displayed From point. b. If an alphabetical character is entered in the scratchpad (a mark point is assumed) and then this LSK is depressed, the mark point with the alphabetical character displayed in the scratchpad becomes the displayed From point. This LSK is active (bracket symbols are displayed) only when the selected steering mode is TO TO. When the steerpoint is changed, the previous steerpoint becomes the From point. When TO FROM, DIRECT, or SCS is the selected steering mode, this LSK is inactive (no bracket symbols displayed) and the field displays four asterisks.

Figure 1-65. FROM Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
From point identifier LSK	Allows selection of a From point by using the scratchpad (Waypoint Search Procedure, (this section) and then depressing this LSK. This LSK is active (bracket symbols are displayed) only when the selected steering mode is TO TO. When TO FROM, DIRECT or SCS is the selected steering mode, this LSK is inactive (no bracket symbols displayed) and the field displays 12 asterisks. If the entered waypoint identifier is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad when this LSK is depressed.
Alternate coordinate format LSK	Allows selection of L/L or MGRS coordinates. Depressing this key when L/L is displayed results in MGRS display format.
L/L FORMAT	
From point latitude	When TO TO is the selected steering mode, this field displays from point latitude in degrees, minutes, and thousandths of a minute. When TO FROM, DIRECT, or SCS is the selected steering mode, this field displays 11 asterisks.
From point longitude	When TO TO is the selected steering mode, this field displays from point longitude in degrees, minutes, and thousandths of a minute. When TO FROM, DIRECT, or SCS is the selected steering mode, this field displays 12 asterisks.
MGRS FORMAT	
From point grid and spheroid	When TO TO is the selected steering mode, this field displays from point grid of up to two numeric characters and one alpha character, and spheroid model in three or four alphanumeric characters. When TO FROM, DIRECT, or SCS is the selected steering mode, this field displays seven asterisks.
From point area, eastings, and northings	When TO TO is the selected steering mode, this field displays area in two alpha characters, and eastings and northings in ten digits. When TO FROM, DIRECT, or SCS is the selected steering mode, this field displays 14 asterisks.

Figure 1-65. FROM Page (Sheet 3)

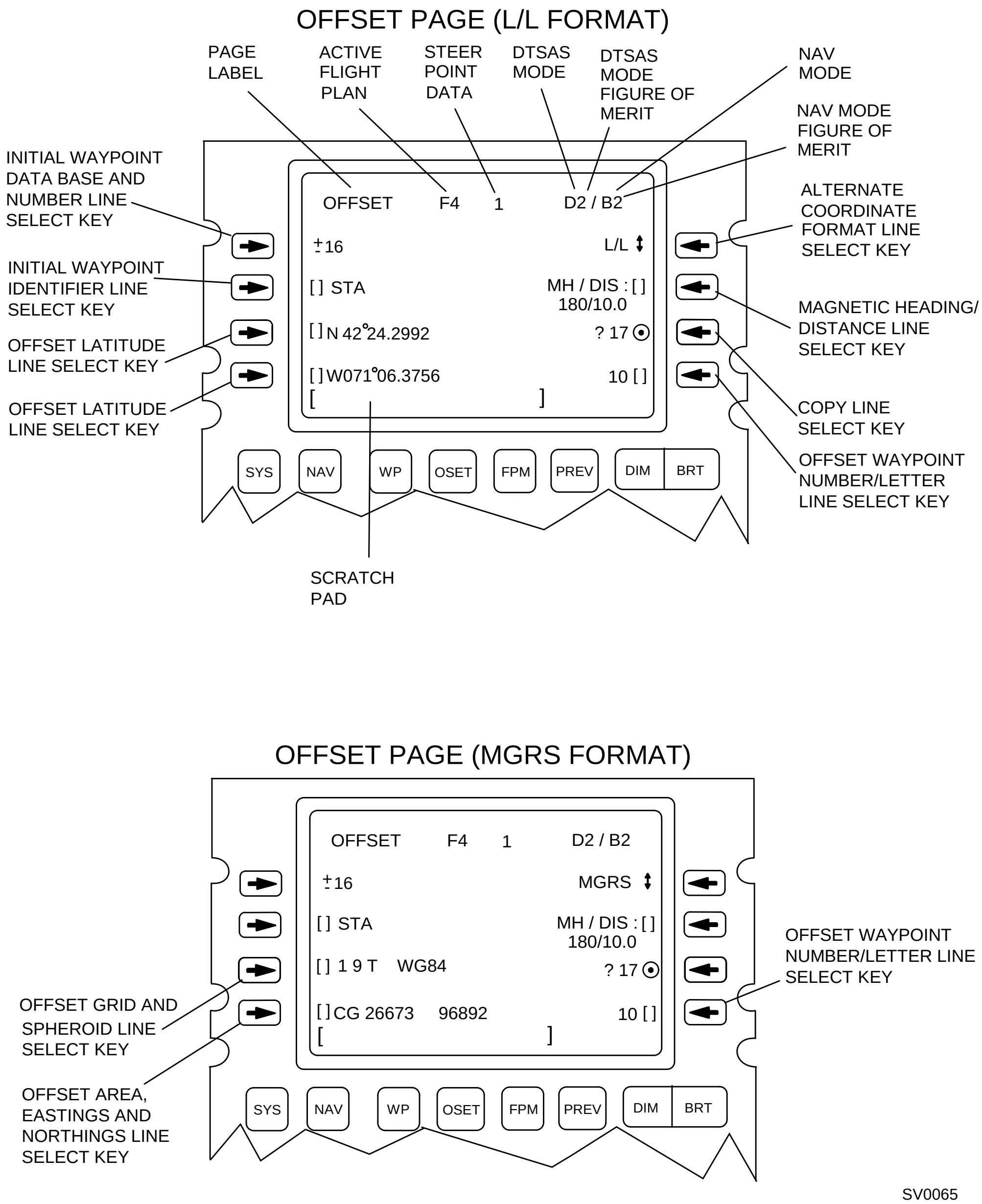


Figure 1-66. OFFSET Page (Sheet 1 of 4)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Initial waypoint LSK	Allows selecting and entering an initial waypoint from the scratchpad as follows: a. If a number from 0 to 2050 is entered in the scratchpad (a mission or navigation waypoint is assumed) and then this LSK is depressed, the waypoint with the number displayed in the scratchpad becomes the displayed waypoint. b. If an alphabetical character is entered in the scratchpad (a mark point is assumed) and then this LSK is depressed, the mark point with the alphabetical character displayed in the scratchpad becomes the displayed waypoint. **NOTE** The ± rocker switch on the CDU can also be used to select the waypoint within the displayed waypoint database without using the LSK.
Initial waypoint identifier LSK.	Allows selection of an initial waypoint by using the scratchpad (Waypoint Search Procedure, (this section) and then depressing this LSK. If the entered waypoint identifier is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad when this LSK is depressed.
Alternate coordinate format LSK	Allows selection of either L/L or MGRS coordinates. Pressing this key when L/L is displayed results in MGRS display format.
Magnetic heading/distance (MH/DIS) LSK	Allows addition of an offset to the initial waypoint. Magnetic heading and distance are entered as HHHDDDDT into the scratchpad and LSK is depressed. When a new waypoint is to be created at a specified offset from an existing waypoint, this LSK allows addition of an offset (at a specified magnetic heading and distance) from the initial waypoint. Magnetic heading and distance are entered as HHHDD.T when the distance is less than 100 NM, HHHDDD.T when the distance is 100 NM or more but less than 1000 NM, and HHHDDDD.T when the distance is 1000 NM or more and equal to or less than 9999.9 NM. The magnetic heading and distance are entered when this LSK is depressed. When the entered distance is less than 100 NM, this field will display NM and tenths of an NM. When the entered distance is equal to or more than 100 NM, this field will display only NM (no tenths); however, if tenths of an NM were entered, this value will be used in calculating the offset position. The created offset waypoint coordinates are displayed at lower left, and offset waypoint database and number field will be asterisks. This field also displays the magnetic heading and distance (up to 9999 NM) for a computed offset between waypoints and a computed offset between a waypoint and entered geographical coordinates. When the computed offset distance is less than 100 NM, this field will display NM and tenths of an NM. When the computed offset distance is equal to or more than 100 NM, this field will display NM (no tenths). If the computed offset distance is greater than 9998.5 NM, this field will display 9999. Offset waypoint coordinates are displayed at lower left, and the offset waypoint number display will be asterisks.

Figure 1-66. OFFSET Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Copy LSK	Allows storage of offset coordinates as a mission waypoint. Depressing Copy LSK stores the offset waypoint data at next available mission number or allows an existing waypoint to be overwritten. If a waypoint identifier, up to 12 alphanumeric characters, is entered into the scratchpad before this LSK is depressed, and the entered waypoint identifier does not match the waypoint identifier of an existing waypoint, the entered waypoint identifier will be assigned to the new mission waypoint. If a waypoint identifier is not entered into the scratchpad before this LSK is depressed, the waypoint identifier MSNOXX (where XX = the next available mission waypoint number) will automatically be assigned to the new mission waypoint. When the mission waypoint database is full (waypoint 50 used), the Copy field will display ?-1, and depressing this LSK will cause INPUT ERROR to be displayed in the scratchpad. The created waypoint will contain steering attributes on WAYPT P2/2 (Figure 1-63) that are the current steering attributes (the attributes defined on the ATTRIB page at the time the waypoint is created). **CAUTION** Do not create offset waypoints when a magnetic variation or convergence factor has been entered (or the grid heading format has been selected) on the OPTIONS Page (Figure 1-79). Offset waypoints are created using the computed magnetic variation that is stored in EGI. Therefore, when an offset waypoint is created when a magnetic variation or convergence factor has been entered (or grid heading format has been selected), significant errors may exist in the position of the offset waypoint.
Offset waypoint number LSK	Allows calculatation of the offset between the initial waypoint and an offset waypoint by entering offset waypoint from the scratchpad as follows: a. If a number from 0 to 2050 is entered in the scratchpad (an offset Waypoint is assumed) and then this LSK is depressed, the offset magnetic heading/distance is computed and displayed below the MH/DIS field. It also causes offset waypoint coordinates to be displayed at the lower left. b. If an alphabetical character is entered in the scratchpad (an offset waypoint is assumed) and then this LSK is depressed, the offset magnetic heading/distance is computed and displayed below the MH/DIS field. It also causes waypoint coordinates to be displayed at the lower left.

Figure 1-66. OFFSET Page (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
L/L FORMAT	
Offset latitude LSK*	Allows entering offset waypoint latitude in degrees, minutes, and ten-thousandths of a minute. When a latitude and/or longitude has not been entered, this field displays the latitude of the point determined by the position displayed in the initial waypoint number or letter and identifier fields, and the magnetic heading and distance are displayed in the MH/DIS field.
Offset longitude LSK*	Allows entering offset waypoint longitude in degrees, minutes, and ten-thousandths of a minute. When a latitude and/or longitude has not been entered, this field displays the longitude of the point determined by the position displayed in the initial waypoint number or letter and identifier fields, and the magnetic heading and distance are displayed in the MH/DIS field.
MGRS FORMAT	
Offset grid and spheroid LSK*	Allows entering offset waypoint in MGRS grid and spheroid. When an offset grid and spheroid and/or offset area, eastings, and northings have not been entered, this field displays the offset grid and spheroid of the point determined by the position displayed in the initial waypoint number or letter and identifier fields, and the magnetic heading and distance are displayed in the MH/DIS field.
Offset area, eastings and northings LSK*	Allows entering offset area waypoints in two alpha characters, and eastings and northings in up to ten digits. When an offset grid and spheroid and/or offset area, eastings, and northings have not been entered, this field displays the offset area, eastings, and northings of the point determined by the position displayed in the initial waypoint number or letter and identifier fields, and the magnetic heading and distance are displayed in the MH/DIS field.

*If new latitude/longitude or MGRS coordinates are entered from scratchpad, the offset waypoint number changes to asterisks; and the MH/DIS field displays the magnetic heading and distance to the entered coordinates.

Figure 1-66. OFFSET Page (Sheet 4)

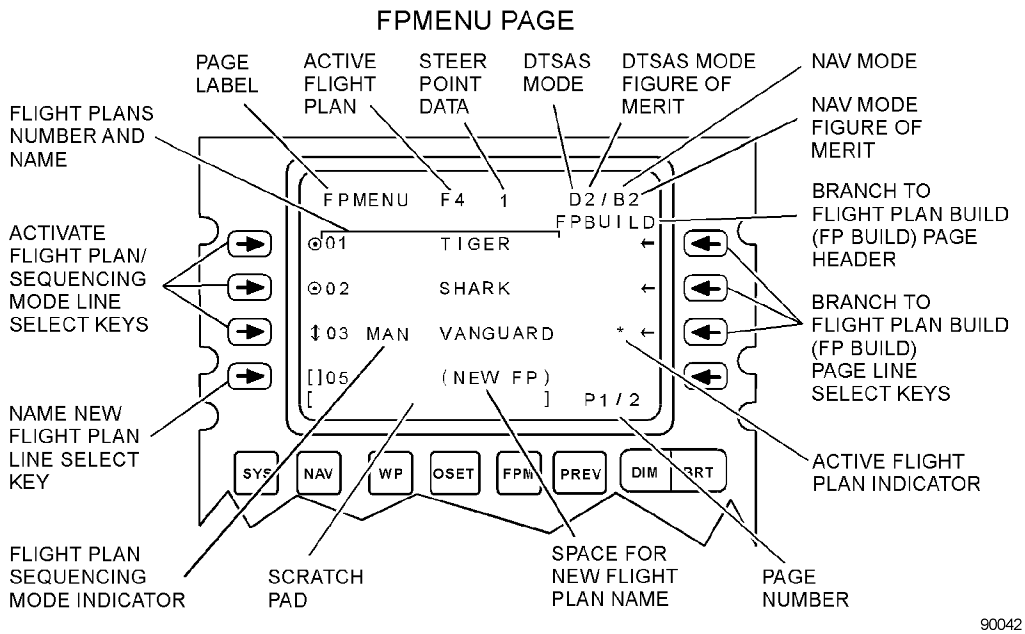


Figure 1-67. Flight Plan Menu (FPMENU) Page(s) (Sheet 1 of 3)

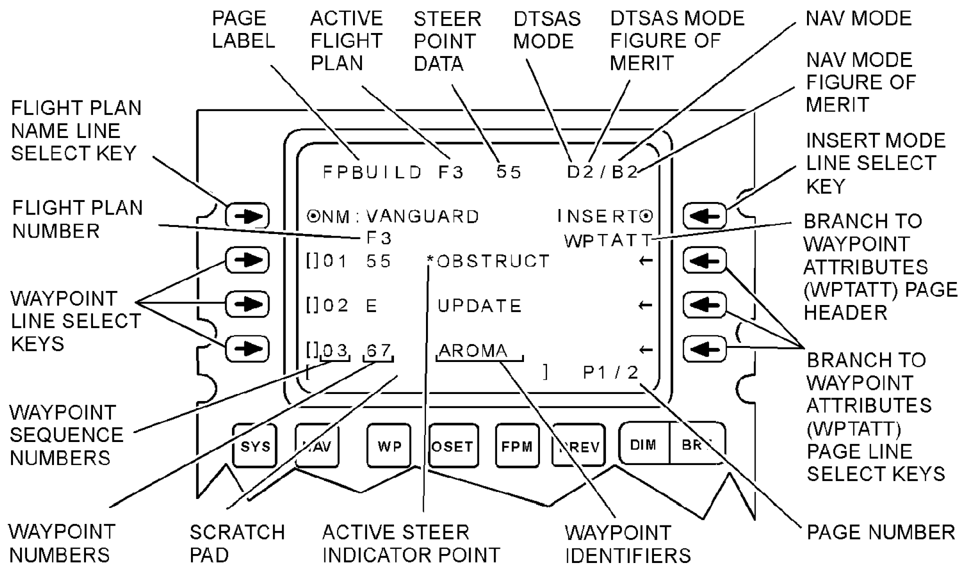
LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Activate flight plan (target symbol)/sequencing mode (up and down arrow) LSKs	Depressing the activate flight plan (target symbol) LSK next to a flight number and name: a. Deactivates the flight plan that was active. b. Activates the flight plan that was selected. c. Causes the active flight plan indicator (*) to be displayed to the right of the selected flight plan. d. Causes the flight plan sequencing mode indicator to indicate the selected sequencing mode. Default mode is manual (MAN). e. Causes the target symbol of the flight plan that was selected to change to the sequencing mode (up and down arrow) symbol. With the up and down arrow symbol displayed, the sequencing mode can be selected using the LSK. The sequencing mode is toggled between automatic (AUTO) and manual (MAN) sequencing.
Active flight plan indicator	An asterisk (*) is displayed to the right of the flight plan name that is active. **NOTE** For the active flight plan to provide steering cues, the STEER PT switch on the AAP must be set to FLT PLAN.
Flight plan sequencing mode indicator	Indicates the selected flight plan sequencing mode for the active flight plan (MAN or AUTO). Manual (MAN) is the default flight plan sequencing mode. The LSK next to the up and down arrow symbol of the active flight plan is used to toggle between the MAN and AUTO modes.
Branch to Flight Plan Build (FPBUILD) Page header	This header informs that the LSKs below the header with an arrow symbol next to them, when depressed, will cause the associated Flight Plan Build (FPBUILD) Page (Figure 1-68) to be displayed. Any CDU annunciations will overwrite this header until the annunciation is cleared or acknowledged.
Branch to Flight Plan Build (FPBUILD) Page	When depressed, causes the Flight Plan Build (FPBUILD) Page (Figure 1-68) associated with the flight plan whose number and name appear to the left of the LSK that was depressed to be displayed. For the detailed procedures to modify an existing flight plan, refer to the Build/Modify Flight Plans Procedures, (this section).

Figure 1-67. Flight Plan Menu (FPMENU) Page(s) (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Name new flight plan LSK	The fields associated with this LSK display the number to be assigned to the flight plan to be created; and (NEW FP) which is constant and informs that this is the LSK used to create new flight plans. These fields are displayed in the second line up from the bottom of the CDU display on all FPMENU Pages. When a new flight plan name is entered in the scratchpad and then this LSK is depressed, the Flight Plan Build (FPBUILD) Page (Figure 1-68) for the new flight plan is displayed. For the detailed procedures to build (create) a flight plan, refer to the Build/Modify Flight Plans Procedures, (this section). **NOTE** ● If the flight plan database is full (maximum of 20 flight plans), (NEW FP) field will display (FULL) and this LSK will be inactive (brackets symbol and flight plan number will be blank). ● If this LSK is depressed with the scratchpad empty, input error will be displayed in the scratchpad.

Figure 1-67. Flight Plan Menu (FPMENU) Page(s) (Sheet 3)

FPBUILD PAGE(S) (WITH EXISTING FLIGHT PLANS)



FPBUILD PAGE(S) (FOR BUILDING NEW FLIGHT PLAN)

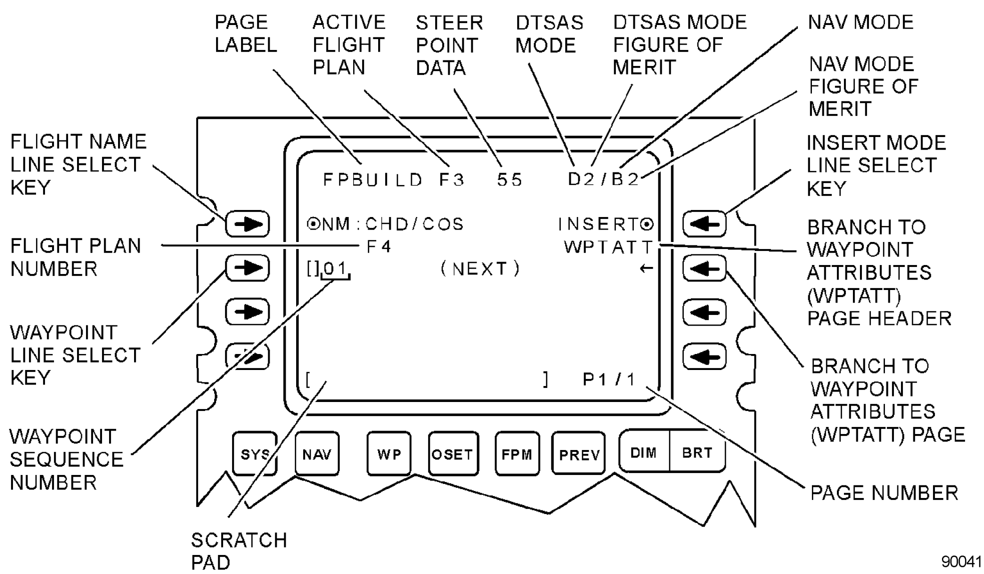


Figure 1-68. Flight Plan Build (FPBUILD) Page(s) (Sheet 1 of 4)

NOTE

For detailed procedures to build, modify, and/or change flight plans, refer to Build/Modify Flight Plans Procedures, (this section).

LABEL/LINE SELECT KEY	FUNCTION
Page number	Displays current/total page numbers. This page may have multiple pages. Use P/G rocker switch on the CDU to step through these pages. A flight plan may contain up to 40 legs that can be displayed and/or created using this page.
Scratchpad	Provides display of characters entered via the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Flight plan name (NM:) LSK	When target symbol is displayed and this LSK is depressed, the flight plan name field next to NM: is cleared, the flight plan name is placed in the scratchpad, and the target symbol changes to the brackets symbol which allows the flight plan name to be changed. For the detailed procedures to change the flight plan name, refer to the Build/Modify Flight Plans Procedures, (this section).
Flight plan number	Displays F and the number of the flight plan being displayed.
INSERT mode LSK	**NOTE** Inserting a waypoint into a flight plan automatically exits to insert mode. When depressed, places system in insert mode. This mode allows insertion of waypoints in a flight plan. If the flight plan is full (contains 40 waypoints), this LSK is inactive (no target symbol displayed) and INSERT is replaced with FULL. For the detailed procedure to insert waypoints in a flight plan, refer to the Build/Modify Flight Plans Procedures, (this section). In the insert mode, paging up and down, using the P/G rocker switch on the CDU, is allowed. Depressing this LSK a second time takes the system out of the insert mode.

Figure 1-68. Flight Plan Build (FPBUILD) Page(s) (Sheet 2)

<table>
<tr><th><u>LABEL/LINE SELECT KEY</u></th><th><u>FUNCTION</u></th></tr>
<tr><td>Waypoint LSKs</td><td>These LSKs perform the following functions:

a. When the scratchpad is empty and a LSK is depressed, the waypoint sequence number adjacent to the LSK that was depressed is copied to the scratchpad. Depressing the CLR pushbutton on the CDU at this time deletes the selected waypoint from the flight plan and clears the scratchpad.

NOTE

A flight plan with only one waypoint (leg), or the last waypoint of any flight plan cannot be deleted.

b. When the scratchpad contains a waypoint number or identifier and the system is not in the insert mode, the waypoint adjacent to the LSK that was depressed is replaced with the waypoint defined by data in the scratchpad.

c. When the scratchpad contains a waypoint number or identifier and the system is in the insert mode, the waypoint defined by data in the scratchpad is inserted in the flight plan adjacent to the LSK that was depressed.

NOTE

If the entered number, letter, or waypoint identifier is not present in the waypoint database, INPUT ERROR will be displayed in the scratchpad when this LSK is depressed.</td></tr>
<tr><td>Waypoint sequence numbers</td><td>Indicates the sequence of the associated waypoint in the displayed flight plan. A maximum of 40 waypoints are permitted in a flight plan.

If there are less than 40 waypoints in the displayed flight plan, the waypoint sequence number of the next waypoint is displayed in the waypoint sequence number column.</td></tr>
<tr><td>Waypoint numbers</td><td>Displays the number or letter of the waypoint. A maximum of 40 waypoints are permitted in a flight plan.</td></tr>
<tr><td>Waypoint identifiers</td><td>Displays name of the waypoint. If there are less than 40 waypoints in the displayed flight plan, (NEXT) is in the waypoint identifier column adjacent to the last waypoint sequence number. If the flight plan contains 40 or more waypoints (full). Is displayed in the waypoint identifier column.</td></tr>
</table>

Figure 1-68. Flight Plan Build (FPBUILD) Page(s) (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
Active steerpoint indicator	An asterisk (*) is displayed to the right of the waypoint identifier that is (would be) active when (if) the displayed flight plan is active. **NOTE** • For the active flight plan to provide steering cues, the STEER PT switch on the AAP must be set to FLT PLAN. • When AAP STEER PT switch is set to FLT PLAN, the steerpoint can only be changed by using the STEER toggle switch on the AAP.
Branch to Waypoint Attributes (WPTATT) Page header	Indicates that the LSKs below the header with an arrow symbol next to them, when depressed, will cause the associated Waypoint Attributes (WPTATT) Page (Figure 1-69) to be displayed.
Branch to Waypoint Attributes (WPTATT) Page	When depressed, causes the Waypoint Attributes (WPTATT) Page (Figure 1-69) associated with the waypoint whose number and identifier are displayed to the left of the LSK that was depressed to be displayed.

Figure 1-68. Flight Plan Build (FPBUILD) Page(s) (Sheet 4)

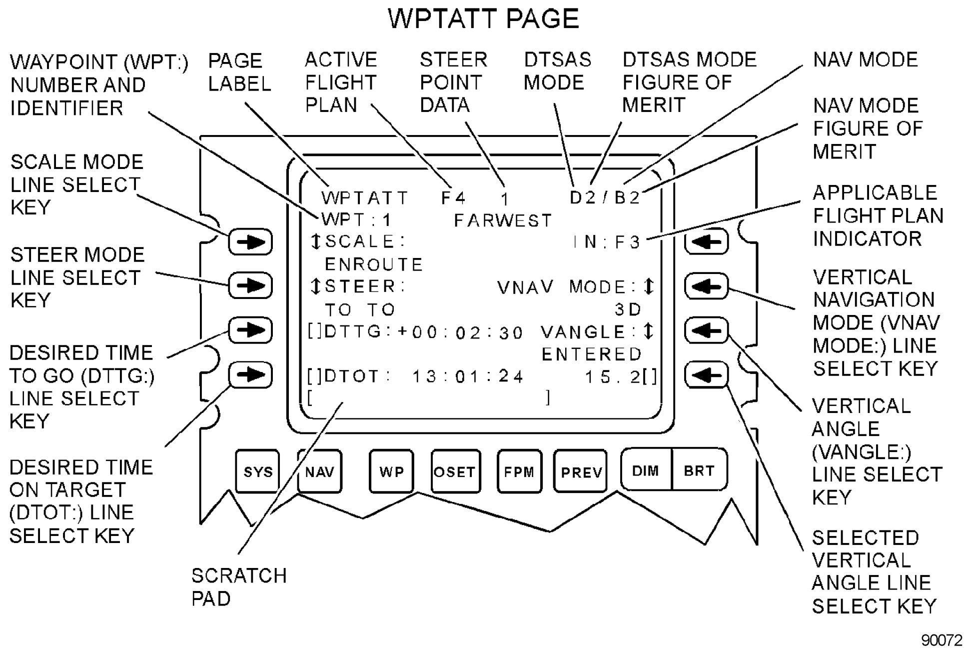


Figure 1-69. Waypoint Attributes (WPTATT) Page (Sheet 1 of 5)

NOTE

The purpose of this page is to allow the entering of flight plan specific attributes to be entered. These attributes are: scale mode, steer mode (not including SCS mode), desired time to go, desired time on target, vertical navigation mode, vertical angle, and selected vertical angle. This allows a single waypoint to be used in more that one flight plan or multiple times in a single flight plan with each usage of the waypoint having unique attributes. Flight plan specific attributes can be changed or modified for any waypoint within a given flight plan (mission waypoints 0 through 50, navigation waypoints 51 through 2050, and mark points A through Z).

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Waypoint (WPT:) number and identifier indicator	Indicates waypoint number and identifier whose attributes are being displayed on this page for the flight plan indicated in the flight plan indicator.
Applicable flight plan indicator	Indicates the flight plan that contains the waypoint whose attributes are being displayed on this page.
SCALE: mode LSK	Allows selection of one of four different levels of sensitivity with which EGI can drive CDI and glide slope indicator. The four levels are ENROUTE, TERMINAL, HIGH ACC, and APPROACH (see Figure 1-54). Depressing this LSK allows stepping through the possible choices. If a scale mode has not been defined or has not been entered using the WAYPT Page, P2/2 (Figure 1-63) or the ATTRIB Page (Figure 1-78), this field will display eight asterisks.
STEER: mode LSK	Allows selection of one of three different steering modes. These steering modes are TO FROM, DIRECT, and TO TO. If a steering mode has not been defined or entered using the WAYPT Page, P2/2 (Figure 1-63) or the ATTRIB Page (Figure 1-78), this field will display seven asterisks.
Desired time to go (DTTG) LSK	Allows DTTG to be entered from scratchpad in hours, minutes, and seconds for the selected waypoint in the selected flight plan. When the DTTG is entered, the DTOT is automatically updated to reflect the new DTTG. When a DTOT or DTTG has not been defined or entered using the WAYPT Page, P2/2 (Figure 1-63) or the ATTRIB Page (Figure 1-78), this field and the DTTG field will display eight asterisks. Clearing DTTG (nothing in scratchpad and depressing this LSK). Displays asterisk in the DTTG and DTOT fields. If current time passes the entered/calculated DTOT for the selected waypoint, DTTG will display negative (-) time, up to one hour.

Figure 1-69. Waypoint Attributes (WPTATT) Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
	Allowable DTTG entry range is 1 to 225959. **NOTE** • Entering or changing the DTOT or DTTG value, when LASTE is in the HACK time mode, will not cause a corresponding change to the HACK time fields displayed on the HUD. However, when LASTE is in the HACK time mode, using LASTE to enter or change a HACK time will cause a corresponding change to the DTOT and DTTG values displayed on this page when the displayed waypoint is the steerpoint. • When GMT is the selected time mode and a DTTG is entered, the DTOT ADJUST value, if entered on the TIME Page (Figure 1-74), is added to the DTTG and DTOT. • When LCL time is the selected time mode and a DTTG is entered, the DTOT ADJUST and LCL ADJUST values, if entered on the TIME Page, are added to the DTTG and DTOT. If current time passes the entered/calculated DTOT for the selected waypoint, DTTG will display negative (-) time. Allowable DTTG entry range is 1 to 235959. **NOTE** • Entering or changing the DTOT or DTTG value, when LASTE is in the HACK time mode, will not cause a corresponding change to the HACK time fields displayed on the HUD. However, when LASTE is in the HACK time mode, using LASTE to enter or change a HACK time will cause a corresponding change to the DTOT and DTTG values displayed on this page when the displayed waypoint is the steerpoint. • When GMT is the selected time mode and a DTTG is entered, the DTOT ADJUST value, if entered on the TIME Page (Figure 1-74), is added to the DTTG and DTOT. • When LCL time is the selected time mode and a DTTG is entered, the DTOT ADJUST and LCL ADJUST values, if entered on the TIME Page, are added to the DTTG and DTOT.

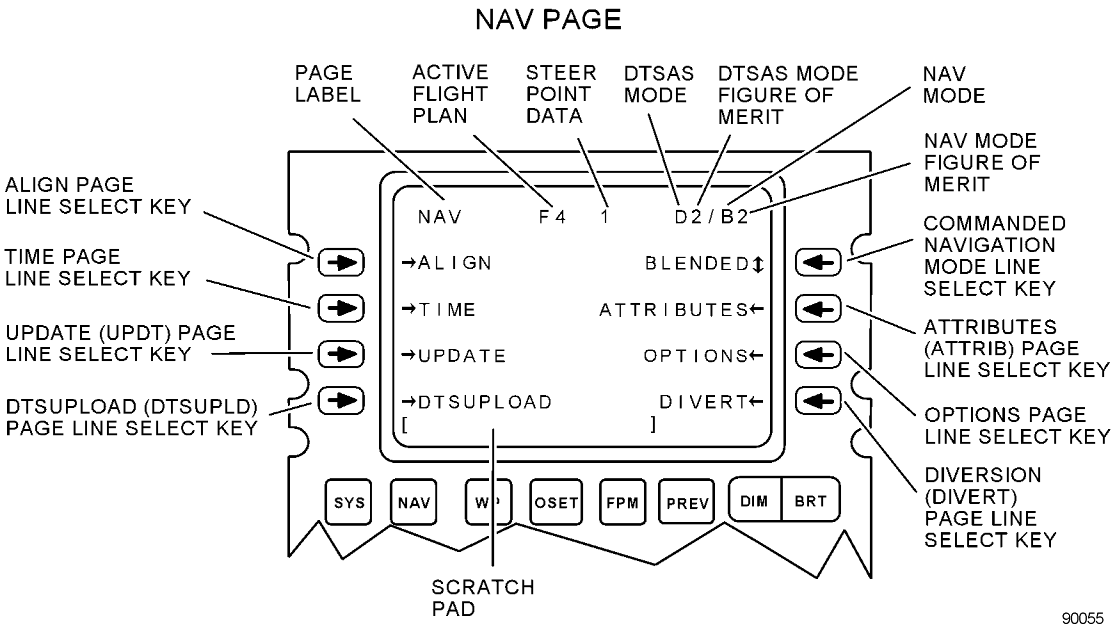
Figure 1-69. Waypoint Attributes (WPTATT) Page (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
Desired time on target (DTOT) LSK	Allows DTOT at selected waypoint to be entered from scratchpad in hours, minutes, and seconds for the selected waypoint in the selected flight plan. When the DTOT is entered, the DTTG is automatically updated to reflect the new DTOT. When a DTOT or DTTG has not been defined or entered using the WAYPT Page, P2/2 (Figure 1-63) or the ATTRIB Page (Figure 1-78), this field and the DTTG field will display eight asterisks. Clearing DTOT (with nothing in scratchpad and depressing this LSK) will cause the DTTG and DTOT fields to display eight asterisks. If current time passes the entered/calculated DTOT for the selected waypoint, DTTG will display negative (-) time, up to one hour. Allowable DTOT entry range is 1 to 240000. **NOTE** • Entering or changing the DTOT or DTTG value, when LASTE is in the HACK time mode, will not cause a corresponding change to the HACK time fields displayed on the HUD. However, when LASTE is in the HACK time mode, using LASTE to enter or change a HACK time will cause a corresponding change to the DTOT and DTTG values displayed on this page when the displayed waypoint is the steerpoint. • When GMT is the selected time mode and a DTTG is entered, the DTOT ADJUST value, if entered on the TIME Page (Figure 1-74), is added to the DTTG and DTOT. • When LCL time is the selected time mode and a DTTG is entered, the DTOT ADJUST and LCL ADJUST values, if entered on the TIME Page, are added to the DTTG and DTOT.
Vertical navigation mode (VNAV MODE:) LSK	Allows the selection of either two- or three-dimensional vertical navigation mode (2D or 3D). When EGI GPS is in the INIT mode or EGI GPS does not have four satellites and this LSK is depressed, a flashing 3D indication will be displayed. When EGI is not qualified for 3D mode, refer to Figure FO-7 for the effects on the HSI and ADI indications. When a VNAV MODE has not been defined or entered using the WAYPT Page, P2/2 (Figure 1-63) or the ATTRIB Page (Figure 1-78), this field will display two asterisks. If 3D is selected as the Vertical Navigation mode, the 3D will flash until the EGI GPS enters Nav mode and has acquired 4 satellites.
Vertical angle (VANGLE:) LSK	When the selected VNAV MODE is 3D, allows selection of either ENTERED or COMPUTED vertical angle. This LSK is active only when "3D" is the selected Vertical Navigation mode. This field is blank when 2D is the selected VNAV MODE.

Figure 1-69. Waypoint Attributes (WPTATT) Page (Sheet 4)

LABEL/LINE SELECT KEY	FUNCTION
Selected vertical angle LSK	Allows the entry of a vertical angle in degrees and tenths when "ENTERED" is the selected option in the Vertical Angle field. Allowable entries: ±0.0 to 89.9. This field is blank and this LSK is inactive when "2D" is the selected Vertical Navigation mode; or when "3D" is the selected Vertical Navigation mode, the vertical angle is COMPUTED, and the displayed waypoint is not the current steerpoint. When "3D" is the selected Vertical Navigation mode, the displayed waypoint is the current steerpoint, and the vertical angle is COMPUTED, this LSK is inactive (no brackets symbol displayed) and this field displays the computed vertical angle.

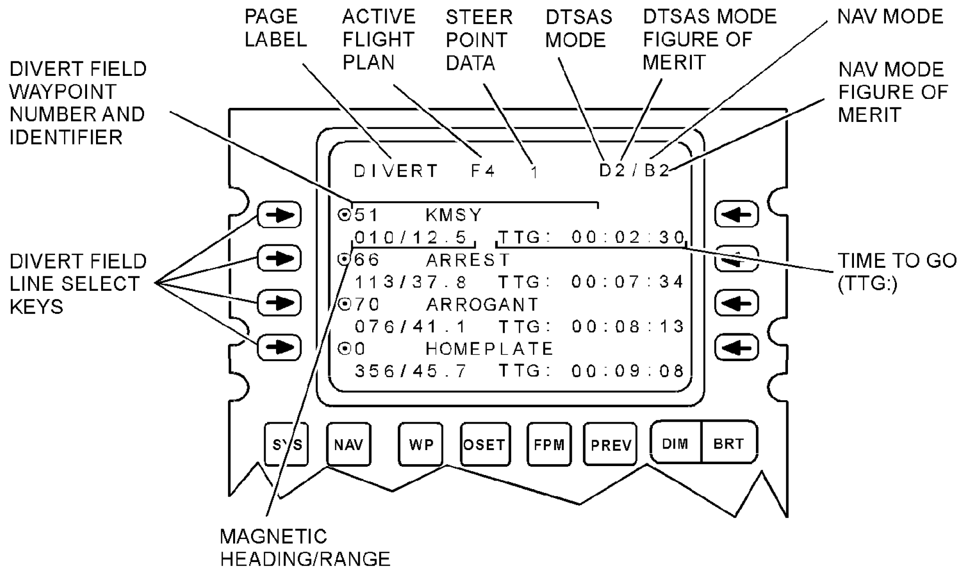
Figure 1-69. Waypoint Attributes (WPTATT) Page (Sheet 5)



LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered via the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
ALIGN Page LSK	Allows selection and display of ALIGN Page (Figure 1-73).
TIME Page LSK	Allows selection and display of TIME Page (Figure 1-74).
UPDATE Page LSK	Allows selection and display of UPDATE Page (Figure 1-75).
DTSUPLOAD (DTSUPLD) Page LSK	Allows selection and display of DTSUPLD Page (Figure 1-77).
Commanded navigation mode LSK	Allows one of three NAV modes to be commanded. The NAV modes are: BLENDED, INS-only (INS), and GPS-only (GPS). Depressing the LSK allows one to step through the possible choices. When this LSK is depressed, this field steps immediately to the next NAV mode; the NAV mode field (on line 1) will change to the selected NAV mode approximately 2 seconds after the LSK was last depressed.
Attributes (ATTRIB) Page LSK	Allows selection and display of ATTRIB Page (Figure 1-78).
OPTIONS Page LSK	Allows selection and display of OPTIONS Page (Figure 1-79).
Diversion (DIVERT) Page LSK	Allows selection and display of DIVERT Page (Figure 1-71).

Figure 1-70. Navigation (NAV) Page

DIVERT PAGE (WITH NO DIVERSION AIRFIELD SELECTED)



DIVERT PAGE (WITH DIVERSION AIRFIELD SELECTED)

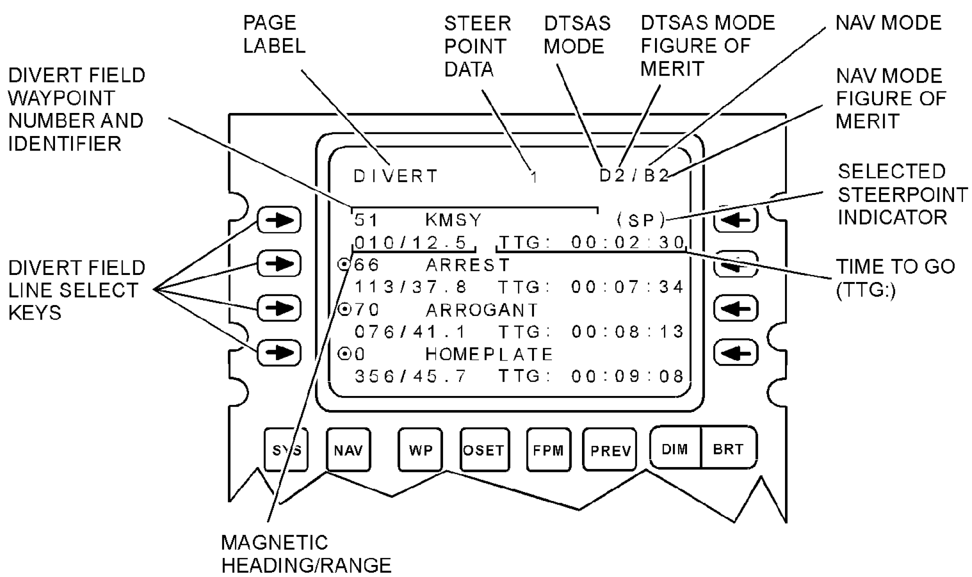


Figure 1-71. Diversion (DIVERT) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
	NOTE • This Page displays the waypoint number, waypoint identifier, magnetic heading and range, and time to go (TTG) for the four closest diversion airfields. These diversion airfields are listed in descending order, with the closest diversion airfield (with respect to TTG at present speed) listed first. The information pertaining to these airfields is obtained from the or navigation waypoint database. • If a DTC is not available or the navigation waypoint (51 through 2050) database on the DTC did not contain diversion airfields, this page will be blank except for the information displayed in line 1 and the annunciator field (line 2) of the CDU display.
Divert field LSKs	Allows selection of the diversion airfield identified in the fields to the right of the depressed LSK as the steerpoint regardless of the position of the AAP STEER PT switch. Depressing this LSK, regardless of the selection of the AAP steer switch causes the selected diversion airfield to become the current steerpoint, the Airfield Information (FLDINFO) Page (Figure 1-72) to be displayed, and the DIRECT steering mode to be automatically selected. If this Page is returned to, via the NAV Page (Figure 1-70), after a diversion airfield is selected, the target symbol to the right of the LSK of the selected diversion airfield will not be visible (LSK inactive). In addition, the steerpoint indicator (SP) will be visible to the right of the waypoint identifier of the selected diversion airfield. **NOTE** Once a diversion field has been selected as a steerpoint, changing the selection of the AAP steerpoint switch will deselect the diversion airfield as the steerpoint and set the appropriate point from the selected database (mission, mark, or flight plan) as the steerpoint.
Divert field waypoint number and identifier	Displays waypoint number and identifier of associated diversion airfield. **NOTE** The four closest diversion airfields are listed in descending order, with the closest airfield listed at the top.
Magnetic heading range	Displays magnetic heading (1 to 360 degrees) and range (0 to 999.9 NM) to the diversion airfield identified in line above this field.
Time to go (TTG)	Displays TTG (hours:minutes:seconds) at current speed to the diversion airfield identified in line above this field.
Selected Steerpoint (SP) Indicator	Indicates that the diversion airfield to the immediate left is the selected steerpoint.

Figure 1-71. Diversion (DIVERT) Page (Sheet 2)

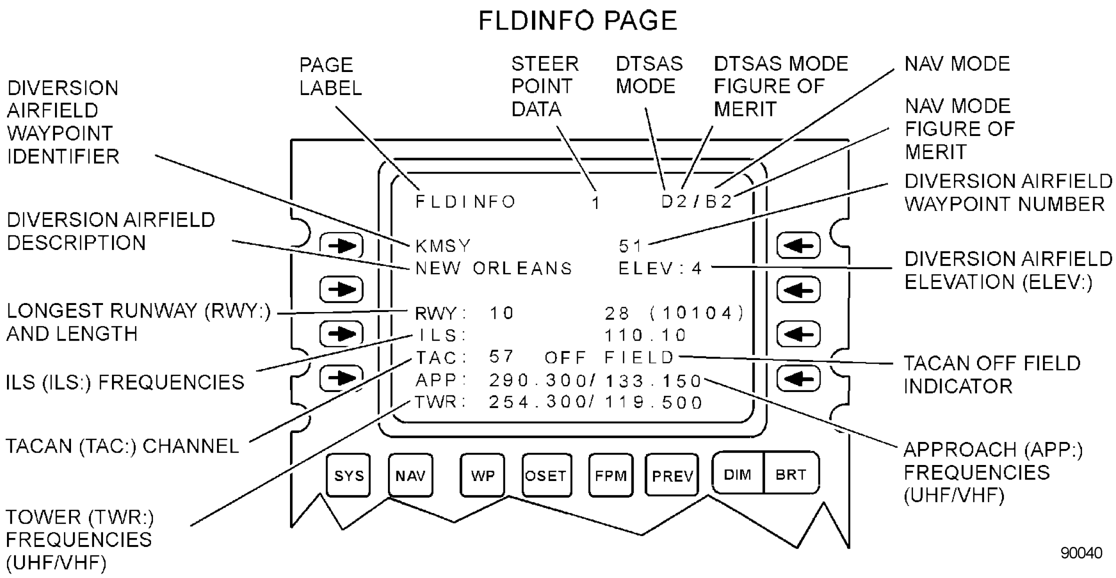
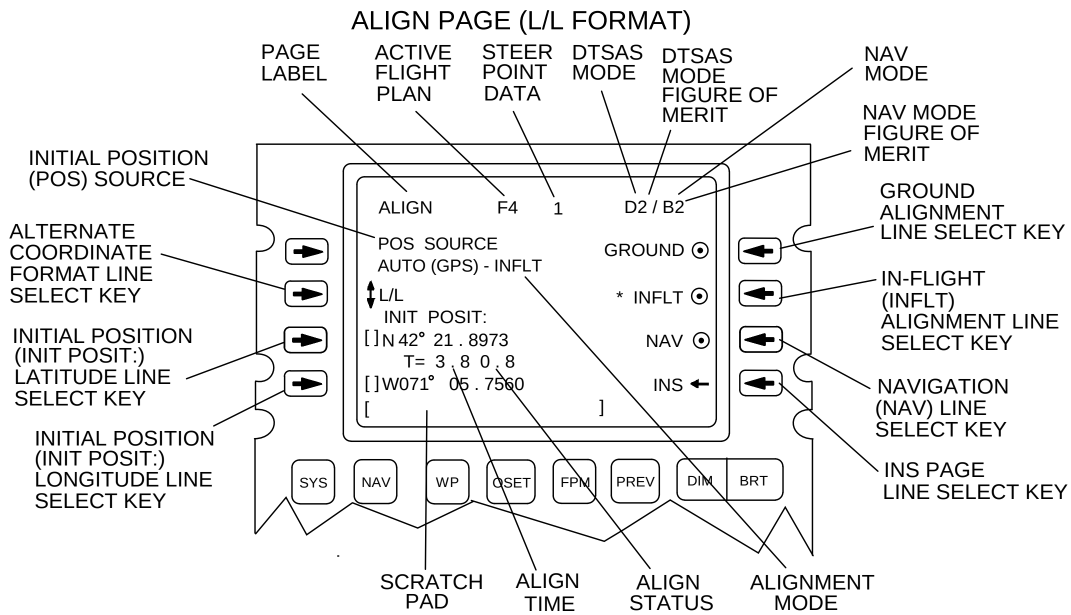


Figure 1-72. Airfield Information (FLDINFO) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
	WARNING
	Information provided is for reference only and is only as accurate as the data uploaded to the DTC.
Diversion airfield waypoint identifier	Displays waypoint identifier of associated diversion airfield.
Diversion airfield waypoint number	Displays waypoint number of associated diversion airfield.
TACAN OFF FIELD indicator	If the TACAN station is co-located at the selected diversion airfield, this field will be blank. If the TACAN station is not co-located at the selected diversion airfield, this field will display OFF FIELD.
Approach (APP) frequencies (UHF/VHF)	Displays the UHF and/or VHF frequencies of the approach control facility serving the selected diversion airfield.
	If there is no approach control facility serving the selected diversion airfield, or approach control frequency information is not available, the applicable UHF and/or VHF field(s) will display seven asterisks.
Tower (TWR) frequencies (UHF/VHF)	Displays the UHF and/or VHF frequencies of the control tower serving the selected diversion airfield.
	If there is no control tower serving the selected diversion airfield, or control tower frequency information is not available, the applicable UHF and/or VHF field(s) will display seven asterisks.
Diversion airfield description	Displays description (up to 12 characters) of selected diversion airfield.
Diversion airfield elevation (ELEV)	Displays MSL elevation (in feet) of selected diversion airfield.
Longest runway (RWY) and length (in parentheses)	Displays runway number of longest runway at selected diversion airfield and its length in feet in parentheses.
ILS (ILS) frequencies	Displays ILS frequencies that apply to the runway listed in the RWY: fields in the line above this line.
	If there is no ILS for the runway, or the ILS frequency information is not available, this field will display six asterisks.
TACAN (TAC) channel	Displays channel number of the TACAN station at the selected diversion airfield.
	If there is no TACAN station at the selected diversion airfield, or the TACAN information is not available, this field will display three asterisks.

Figure 1-72. Airfield Information (FLDINFO) Page (Sheet 2)



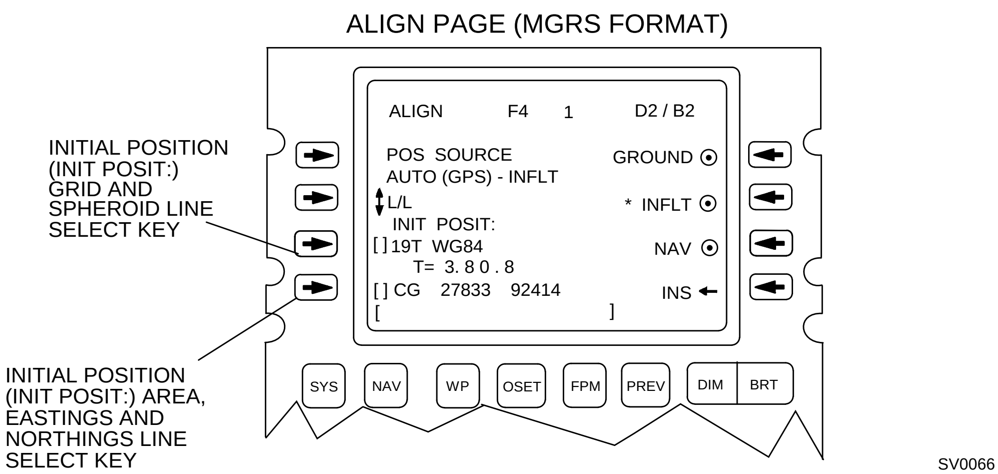


Figure 1-73. ALIGN Page (Sheet 1 of 5)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Initial position (LAST POS) source	This field displays the source of the initial position used during an alignment as described below: MAN(PILOT) - This indicates that the initial position was manually entered. MAN(LAST POS) - This indicates that the last initial position stored when EGI was turned off was manually selected. AUTO(DTC) - This indicates that the initial position was provided from the DTC. AUTO(LAST POS) - This indicates that the initial position was the last position stored in EGI when EGI was turned off. AUTO(GPS) - This indicates that an in-flight alignment is being or was performed. During and after an in-flight alignment, the initial position (INIT POSIT:) latitude (or grid and spheroid) and longitude (or area, eastings, and northings) field will be blank, and the LSKs will be inactive (no brackets displayed). STANDBY - Displayed until CDU detects the first valid initial position. NOT AVAILABLE - This indicates that the CDU has been turned off (for more than 3 seconds) and then turned on while the EGI INS was in the NAV mode. When NOT AVAILABLE is displayed, the initial position (INIT POSIT:) LSKs will be inactive (no brackets displayed) and the associated fields will be blank.
GROUND alignment LSK	Allows the initiation of a ground (normal gyrocompass) alignment. This LSK is active (target symbol displayed) when the aircraft is on the ground and not moving. Approximately 45 seconds after the completion of the CDU startup BIT test and 30 seconds after EGI is turned on, GROUND can be selected and a steady asterisk will be displayed next to GROUND. The steady asterisk indicates that the normal alignment is in progress. If GROUND is not manually selected during this 30 seconds, GROUND is automatically selected after this 30 seconds (if FAST or INFLT not selected), and a steady asterisk is displayed next to GROUND. **NOTE** ● Prior to selecting any alignment on the ALIGN Page, ensure that the EGI and/or STR PT or ANCHR switch-indicators on the nav mode select panel are deselected (Δ indicators not lit). ● Do not select EGI and/or STR PT or ANCHR on the nav mode select panel until after NAV has been manually selected on the ALIGN Page or the system has automatically transitioned to NAV mode.

Figure 1-73. ALIGN Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
In-flight (INFLT) alignment LSK	Allows an in-flight alignment to be selected. When this LSK is depressed and EGI GPS is qualified to do an in-flight alignment, a flashing asterisk will be displayed next to INFLT for 5 to 10 seconds, and then a steady asterisk will be displayed. When this LSK is depressed and EGI GPS is not qualified to do an in-flight alignment, a flashing asterisk will be displayed next to INFLT until EGI GPS is qualified, and then a steady asterisk will be displayed. The EGI GPS is qualified to do an in-flight alignment when both the expected horizontal error (EHE) and the expected vertical error (EVE) are less than 100 feet if EGI is keyed, or both are less than 400 feet if EGI is not keyed. The system will automatically transition to an in-flight alignment if the aircraft is moved before the steady INS NAV RDY annunciation is displayed. If the aircraft is moved before a steady INS NAV RDY annunciation is displayed and EGI GPS is not qualified, a flashing asterisk will automatically be displayed next to INFLT. When EGI GPS becomes qualified, a steady asterisk will be displayed, indicating that the in-flight alignment has begun. If the aircraft is moved before a steady INS NAV RDY annunciation is displayed and EGI GPS is qualified, a steady asterisk will automatically be displayed next to INFLT, indicating that the in-flight alignment has begun. **NOTE** If the aircraft is moved within 125 seconds after the CDU and EGI are turned on or within 80 seconds after the EGI is turned on (CDU already on), whichever is later, and before a steady INS NAV RDY annunciation is displayed, the EGI INS may not automatically transition to an INFLT alignment. If the aircraft is moved within this time period, verify that a steady or flashing asterisk is displayed next to INFLT. If a steady or flashing asterisk is not present next to INFLT, depress the INFLT LSK, if the aircraft is moving; or depress the GROUND LSK if the aircraft is stopped to select a ground (gyrocompass) alignment.
Navigation (NAV) LSK	Allows NAV mode to be entered. This LSK becomes active (target symbol displayed) when EGI INS attains a degraded navigation ready status which is indicated by a steady INS NAV RDY annunciation on the CDU. When EGI attains full navigation ready status, the flashing INS NAV RDY annunciation is displayed, and this LSK remains active. To enter the NAV mode during a normal or fast alignment, depress this LSK or move the aircraft when a steady or flashing INS NAV RDY annunciation is displayed. The asterisk next to GROUND will disappear, and an asterisk will appear next to NAV. To obtain a more accurate normal or fast alignment, it is recommended that you wait until a flashing INS NAV RDY annunciation is displayed before depressing this LSK or moving the aircraft.

Figure 1-73. ALIGN Page (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
	To enter the NAV mode during an in-flight alignment, depress this LSK when a steady or flashing INS NAV RDY annunciation is displayed, or wait 30 seconds after the flashing INS NAV RDY annunciation is displayed and the system will automatically transition to the NAV mode. When the NAV mode is selected or the system automatically transitions to the NAV mode, the asterisk next to INFLT will disappear, and an asterisk will appear next to NAV. It is recommended to wait until a flashing INS NAV RDY annunciation is displayed before depressing this LSK, or allow the system to automatically transition to the NAV mode.
INS Page LSK	Allows return to (or go to) INS Page (Figure 1-89).
Alignment mode	This field identifies the alignment that is in progress or was completed prior to selecting NAV mode as described below: Blank = Ground alignment INFLT = In-flight alignment SH = Fast (stored heading) alignment BATH = Fast (best available true heading) alignment
Alternate coordinate format LSK	Allows selection of either L/L or MGRS coordinates. Depressing this key when L/L is displayed results in MGRS display format. Depressing this key when MGRS is displayed results in L/L display format.
Align status	Displays alignment status. Displays INIT when in initialization mode. Displays ATTD when attitude information is available. Displays ATTD + HDG when attitude and heading information are available. When the estimated drift calculated by EGI is 8.0 nm/hr, this field displays 8.0 and slowly decreases to 0.8 or until NAV mode is selected.
Align time	Displays time INS has been in alignment mode (FAST, NORM, or INFLT).
L/L FORMAT	
Initial position (INIT POSIT:) latitude LSK	This field displays the latitude of the initial position indicated in the LAST POS field. This LSK allows latitude entry in degrees, minutes, and ten-thousandths of a minute (with or without a decimal point) from the scratchpad during the first 2 minutes of a GROUND alignment (as indicated by presence of brackets). When an initial position latitude or longitude is entered, the LAST POS field will display MAN(PILOT). When the initial position source (LAST POS) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed).
Initial position (INIT POSIT:) longitude LSK	This field displays the longitude of the initial position indicated in the LAST POS field. This LSK allows longitude entry in degrees, minutes, and ten-thousandths of a minute (with or without a decimal point) from the scratchpad during the first 2 minutes of a GROUND alignment (as indicated by presence of brackets). When an initial position latitude or longitude is entered, the LAST POS field will display MAN(PILOT). When the initial position source (LAST POS) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed).

Figure 1-73. ALIGN Page (Sheet 4)

LABEL/LINE SELECT KEY	FUNCTION
MGRS FORMAT	
Initial position (INIT POSIT:) grid and spheroid LSK	This field displays the grid and spheroid of the initial position indicated in the LAST POS field. This LSK allows MGRS grid and spheroid entry from the scratchpad during the first 2 minutes of EGI GROUND alignment (as indicated by presence of brackets). When initial position grid and/or spheroid area, eastings, and northings are entered, the LAST POS field will display MAN(PILOT). When the initial position source (LAST POS) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed). When the NAV mode is selected on this page, this LSK becomes active again (as indicated by presence of brackets). This allows the spheroid model to be changed by entering the three or four alphanumeric spheroid code into the scratchpad and then depressing this LSK.
Initial position (INIT POSIT:) area, eastings, and northings LSK	This field displays the area, eastings, and northings of the initial position indicated in the LAST POS field. This LSK allows MGRS area, eastings, and northings entry from the scratchpad during the first 2 minutes of EGI GROUND alignment (as indicated by presence of brackets). When an initial position grid and/or spheroid or area, eastings, and northings are entered, the LAST POS will display MAN(PILOT). When the initial position source (LAST POS) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed).

Figure 1-73. ALIGN Page (Sheet 5)

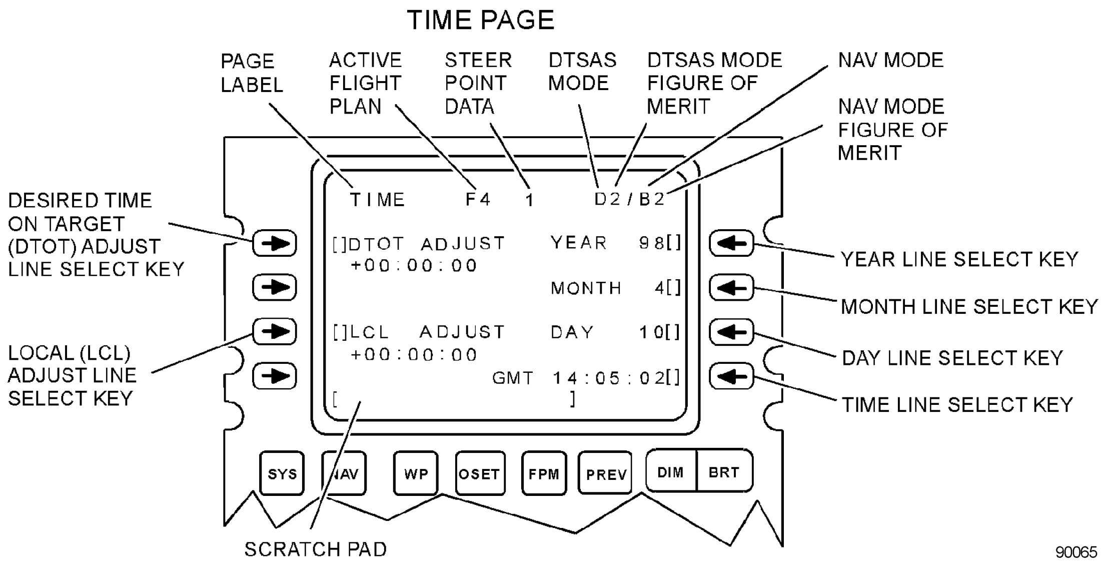


Figure 1-74. TIME Page (Sheet 1 of 6)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Desired time on target (DTOT) ADJUST LSK	Allows a mission adjustment time to be entered as HHMMSS where: HH = hours MM = minutes SS = seconds Leading zeroes do not need to be entered. Trailing zeroes must be entered. When a mission adjustment time is entered using the keyboard to enter hours, minutes, and seconds (plus sign is not entered), depressing this LSK will enter the mission adjustment time. The mission adjustment time will be displayed with a plus (+) sign before the hours, indicating DTOT is later. Depressing this LSK a second time causes a minus (-) sign to be displayed before the hours, indicating DTOT is earlier. This mission adjustment time is added to, or subtracted from, the DTOT for each waypoint that has a DTOT assigned. This causes the DTTG for each waypoint that has a DTOT assigned to be changed to reflect this mission adjustment time.

Figure 1-74. TIME Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
	NOTE Entering or changing the DTOT ADJUST value, when LASTE is in the HACK time mode, will not cause a corresponding change to the HACK time field displayed on the HUD.
Local (LCL) ADJUST LSK	Allows local time adjustment (+1200 to -1200 hours) to be entered as HHMM where: HH = hours MM = minutes Leading zeroes need not be entered. Trailing zeroes must be entered. When a local adjust time is entered using the keyboard to enter hours and minutes (plus sign is not entered), depressing this LSK will enter the local adjust time. The local adjust time will be displayed with a plus (+) sign before the hours, indicating that local adjust time is later. Depressing this LSK a second time causes a minus (-) sign to be displayed before the hours, indicating that local adjust time is earlier. If the time field is displaying GMT time (and date: YEAR, MONTH, and DAY) when a local adjust time is entered, the GMT time (and date) will change to local (LCL) time (and date). If the time field is displaying CDU time (and date, YEAR, MONTH, and DAY, are asterisks) and a local adjust time has been entered the local year, month, day, and time must be entered. This will cause LCL time (and date) to be displayed. **NOTE** ● If the DTC contains waypoints that have desired times on target (DTOT) in local time, the local adjust (LCL ADJUST) that corresponds to the local time on the DTC must be entered. ● If UTC time is not valid, GMT time should be entered using the YEAR, MONTH, DAY and time LSKs. ● If the EGI has been operated recently, it should contain accurate time and date. If EGI does not have accurate time and date, it could take EGI several minutes to acquire satellites for EGI GPS navigation. If EGI does not have accurate time and date, acquisition of satellites can be hastened by manually entering GMT date and time.
YEAR LSK	This LSK is inactive (no brackets displayed) when EGI GPS is in NAV mode (as indicated on GPS Page, Figure 1-94), the UTC status is V (as indicated on GPSSTAT Page P1/2, Figure 1-95), and the GPS FOM is 5 or less (as indicated on GPS page). This LSK is active (brackets displayed), when EGI GPS is not in NAV mode or EGI GPS is in NAV mode, the UTC status is F, and the GPS FOM is greater than 5. When active, this LSK allows the year to be entered from the scratchpad as two numbers. If UTC time is not available from EGI (UTC status F) or GPS FOM is greater than 5 and year has not been previously entered, this field displays two asterisks.

Figure 1-74. TIME Page (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
	NOTE ● If an incorrect year is entered and then the month, day, and time are entered, EGI GPS may create an incorrect almanac. This will cause EGI GPS to require an excessive amount of time to acquire satellites. If this occurs, place EGI GPS in INIT mode using the GPS Page (Figure 1-94) and then enter the correct year, month, day, and time. Then place EGI GPS in NAV mode (using GPS Page), and allow EGI GPS to acquire satellites and UTC on the GPSSTAT Page (Figure 1-95) to go to V to correct the problem. (It will still take EGI GPS an excessive amount of time to acquire satellites the first time the correct year, month, day and time are entered.) The incorrect almanac can also be erased by turning EGI off and having maintenance personnel remove the battery from EGI for several seconds. ● If this incorrect almanac has been downloaded to a DTC, (1) erase the DTC and (2) ensure that the DTC has not been read by the mission support system, ensure that the mission support system contains the current almanac and not the incorrect almanac that was downloaded to the DTC.
MONTH LSK	This LSK is inactive (no brackets displayed) when EGI GPS is in NAV mode (as indicated on GPS Page, Figure 1-94), the UTC status is V (as indicated on GPSSTAT Page P1/2, Figure 1-95), and the GPS FOM is 5 or less (as indicated on GPS page). This LSK is active (brackets displayed), when EGI GPS is not in NAV mode or EGI GPS is in NAV mode, the UTC status is F, and the GPS FOM is greater than 5. When active, this LSK allows the month to be entered from the scratchpad as up to two numbers. If UTC time is not available from EGI (UTC status F) or GPS FOM is greater than 5 and month has not been previously entered, this field displays two asterisks.
DAY LSK	This LSK is inactive (no brackets displayed) when EGI GPS is in NAV mode (as indicated on GPS Page, Figure 1-94), the UTC status is V (as indicated on GPSSTAT Page P1/2, Figure 1-95, and the GPS FOM is 5 or less (as indicated on GPS page). This LSK is active (brackets displayed), when EGI GPS is not in NAV mode or EGI GPS is in NAV mode, the UTC status is F, and the GPS FOM is greater than 5. When active, this LSK allows the day to be entered from the scratchpad as two numbers. If UTC time is not available from EGI (UTC status F) or GPS FOM is greater than 5 and day has not been previously entered, this field displays two asterisks.

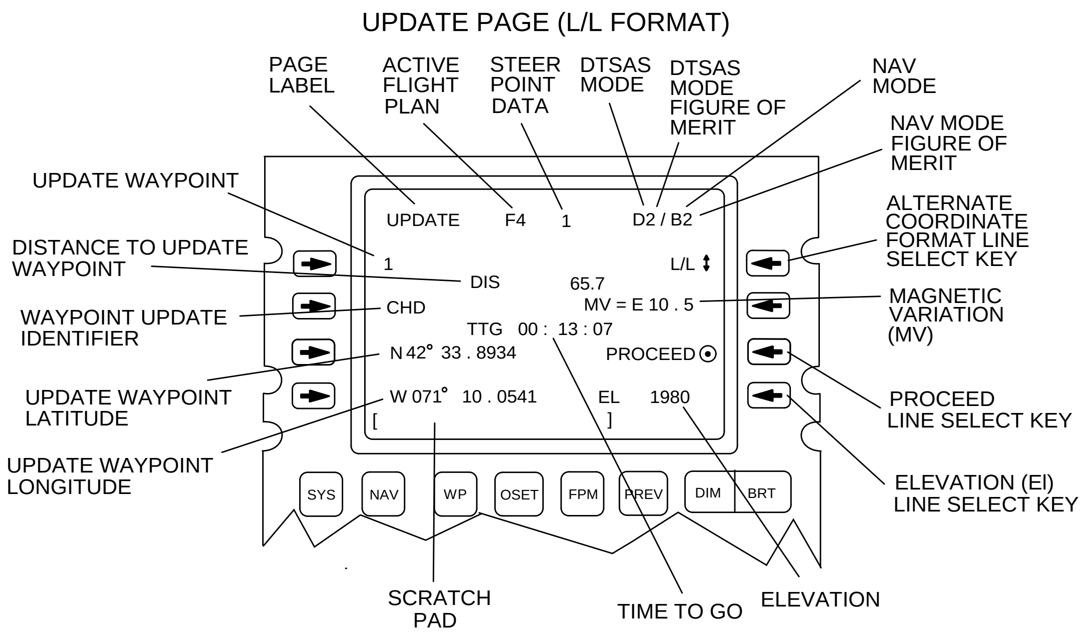
Figure 1-74. TIME Page (Sheet 4)

LABEL/LINE SELECT KEY	FUNCTION
Time LSK	This LSK is inactive (no brackets displayed), when EGI GPS is in NAV mode (as indicated on GPS Page, Figure 1-94), the UTC status is V (as indicated on GPSSTAT Page P1/2, Figure 1-95) and the GPS FOM is 5 or less (as indicated on GPS Page). This LSK is active (brackets displayed), when EGI GPS is not in NAV mode or EGI GPS is in the NAV mode, the UTC status is F, and the GPS FOM is greater than 5 when active. When active, this LSK allows GMT or local time to be entered from the scratchpad if YEAR, MONTH, and DAY have been previously entered (these fields are not displaying asterisks). GMT or local time is entered as HHMMSS, where: HH = hours MM = minutes SS = seconds Leading zeroes do not need to be entered. Allowable entries are from 1 to 240000. If UTC time is not available from EGI (UTC status F) or GPS FOM is greater than 5 and time has not been previously entered, this field displays CDU time. If the LCL ADJUST field displays + or - 00:00, this field displays GMT time. If the LCL ADJUST field displays any value other than + or -00:00, this field displays local (LCL) time. **CAUTION** When entering or changing the time, ensure that YEAR, MONTH, and DAY are entered each time prior to entering the time. Failure to enter YEAR, MONTH, and DAY each time, may cause a CDU software failure. CDU will display ADA FAIL, which will require cycling power to the CDU to clear the failure and the loss of all current mission data.

Figure 1-74. TIME Page (Sheet 5)

LABEL/LINE SELECT KEY	FUNCTION
	NOTE • To enter time, YEAR, MONTH, and DAY must have been previously entered. • If LCL ADJUST is + or - 00:00, GMT time must be entered. • If LCL ADJUST is not + or - 00:00, local time must be entered. • If GMT time is selected, all Desired Times On Target (DTOT)/Other Alerts must be entered in GMT time. If local (LCL) time is selected, all DTOT/Other Alerts must be entered in the selected local time. The selected time mode, GMT or local, should not be changed during the mission if DTOTs have been assigned to any waypoints. • When initially entering date and time, the values must be entered in the following order: Year Month Day Time • The year, month, and day will be updated once the time is entered.

Figure 1-74. TIME Page (Sheet 6)



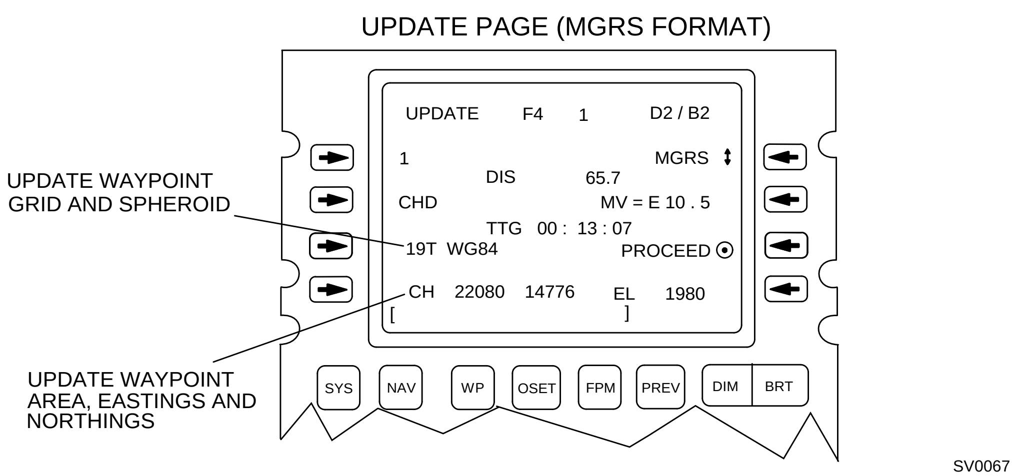
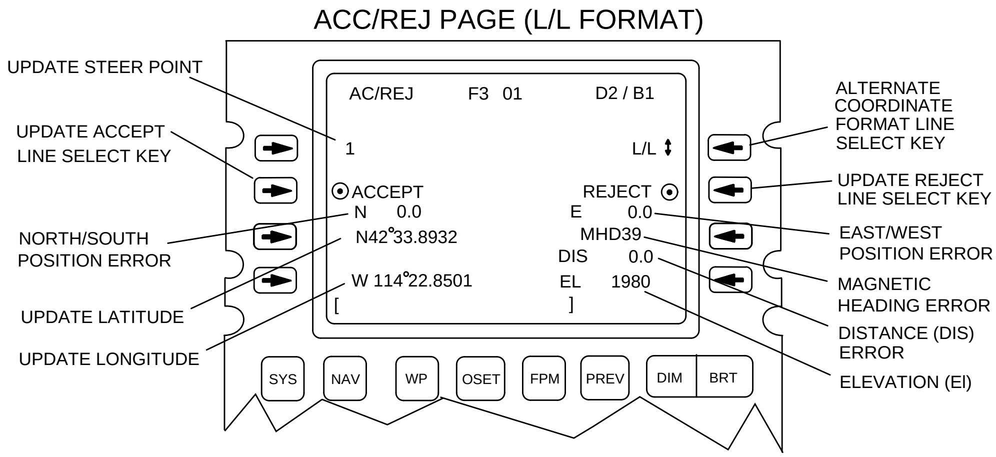


Figure 1-75. UPDATE Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Update waypoint	Identifies update waypoint (current steerpoint) by number or letter.
Distance (DIS) to update waypoint	Provides distance to update waypoint (current steerpoint) in nautical miles (resolution 0.1 NM when distance is equal to or less than 99.9 NM). When the distance exceeds 9998.5 nautical miles, the distance field will display 9999.
Steerpoint identifier	Displays update waypoint (current steerpoint) identifier.
Alternate coordinate format LSK	Allows selection of either L/L or MGRS coordinates. Depressing this key when L/L is displayed results in MGRS display format.
Magnetic variation (MV)	Displays magnetic variation associated with the update waypoint (current steerpoint) in degrees and tenths. Equal sign indicates entered magnetic variation; no equal sign indicates magnetic variation provided by EGI.
PROCEED LSK	When depressed, allows overhead update to be commanded by depressing the CDU MK pushbutton. When PROCEED LSK is depressed, PROCEED and its associated target symbol disappear until the BLENDED or GPS-only NAV mode is selected using the commanded navigation (NAV) mode LSK on the NAV Page (Figure 1-70). Depressing the PROCEED LSK automatically selects the INS-only solution as the NAV mode. If the INS-only solution is already the selected NAV mode, this field will be blank, and the target symbol will not be displayed.
Elevation (EL)	Displays update waypoint (current steerpoint) elevation.
Time to go (TTG)	Time to update waypoint (current steerpoint) at current ground speed. Shown in hours, minutes, and seconds. When ground speed is less than 3 knots, TTG will display eight asterisks.
L/L FORMAT	
Update waypoint latitude	Displays update waypoint (current steerpoint) latitude in degrees, minutes, and ten-thousandths of a minute.
Update waypoint longitude	Displays update waypoint (current steerpoint) longitude in degrees, minutes, and ten-thousandths of a minute.
MGRS FORMAT	
Update waypoint grid and spheroid	Displays update waypoint (current steerpoint) grid of up to two numeric characters and one alpha character, and spheroid model in three or four alphanumeric characters.
Update waypoint area, eastings and northings	Displays update waypoint (current steerpoint) area in two alpha characters and eastings and northings in ten digits.

Depressing the CDU MK button will capture the aircraft position and command the Accept/Reject (ACC/REJ) Page (Figure 1-76) to be displayed.

Figure 1-75. UPDATE Page (Sheet 2)



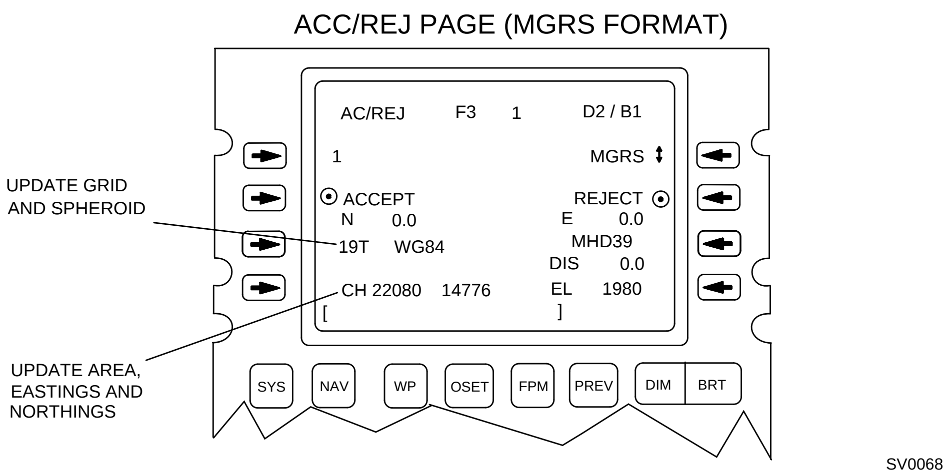


Figure 1-76. Accept/Reject (ACC/REJ) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Update steerpoint	Identifies update (current) steerpoint by waypoint number or letter.
Update ACCEPT LSK	Accepts TGP INS, overhead or HUD INS update and returns CDU display to UPDATE Page (Figure 1-75) if an overhead update was performed, or to page that was previously displayed, if a HUD INS update was performed. If not depressed within 30 seconds, update is automatically rejected.
North/South (N/S) position error	Provides North or South component of EGI INS position error in nautical miles and tenths.
Alternate coordinate format LSK	Allows selection of either L/L or MGRS coordinates. Pressing this key when L/L is displayed results in MGRS display format.
Update REJECT LSK	If depressed within 30 seconds, rejectsTGP INS, overhead or HUD INS update and returns CDU display to UPDATE Page (Figure 1-75) if an overhead update was performed, or to page that was previously displayed, if a TGP INS or HUD INS update was performed. If not depressed within 30 seconds, update is automatically rejected.
East/West (E/W) position error	Provides East or West component of position error in nautical miles and tenths.
Magnetic heading (MHD) and distance (DIS) error	Provides EGI INS position update error in magnetic heading in degrees and distance in nautical miles (resolution 0.1 NM when distance error is equal to or less than 99.9 NM). When the distance exceeds 9998.5 nautical miles, the distance field will display 9999.
Elevation (EL)	Displays update (current) steerpoint elevation.
L/L FORMAT	
Update latitude	Displays update (current) steerpoint latitude in degrees, minutes, and ten-thousandths of a minute.
Update longitude	Displays update (current) steerpoint longitude in degrees, minutes, and ten-thousandths of a minute.
MGRS FORMAT	
Update grid and spheroid	Displays update (current) steerpoint grid of up to two numeric and one alpha character and spheroid model in three or four alphanumeric characters.
Update area, eastings, and northings	Displays update (current) steerpoint area in two alpha characters and eastings and northings in ten digits.

Figure 1-76. Accept/Reject (ACC/REJ) Page (Sheet 2)

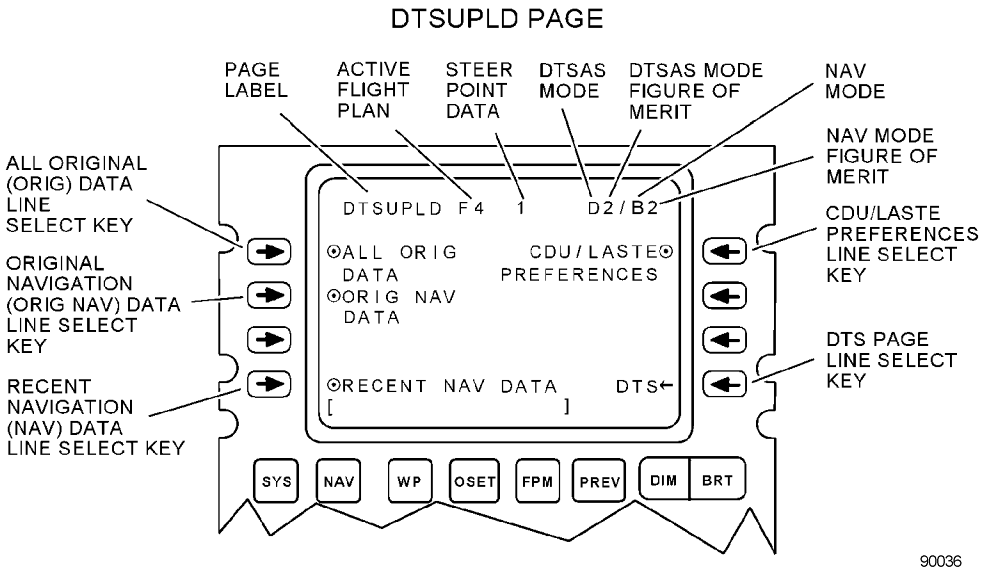


Figure 1-77. DTS Upload (DTSUPLD) Page (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. **NOTE** When the DTS status on the DTS Page (Figure 1-98) is I, do not perform any manual uploads of data. Uploading when the DTS status is I may cause any previously uploaded, manually entered, and modified data that corresponds to the upload requested to be erased. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. When an asterisk is seen flashing in the upper left corner of the screen do not attempt to enter or modify any flight plan, waypoint, or CDU preferences until the asterisk stops flashing or the entered data may be overwritten by data from the DTC.
ALL ORIG DATA LSK	Allows the uploading of all of the original waypoints and almanac data, flight plans, CDU preferences (wind model data, DTSAS settings, local time adjust, and data pump setting), and LASTE pilot preferences and weapons data from the DTS. This original data consists of waypoints and almanac data, flight plans, CDU preferences, and LASTE pilot preferences and weapons data uploaded from DTS prior to any modifications or additions to the mission waypoints or flight plans, or creation of any mark points. Flashing asterisk is displayed in upper left corner while upload is in progress. Depressing this LSK when the DTS status on the DTS Page (Figure 1-98) is N, does not cause an upload to occur; and will cause the DTS NOT RDY annunciation to be displayed on the CDU. Depressing this LSK when the DTS status on the DTS Page is F, does not cause an upload to occur; and will cause the DTS FAIL annunciation to be displayed on the CDU. **NOTE** Depressing this LSK after making any modifications or additions to the mission waypoints or flight plans, CDU preferences, or LASTE pilot preferences and weapons data, or creation of any mark points causes the modified, added, or created data to be lost.

Figure 1-77. DTS Upload (DTSUPLD) Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
ORIG NAV DATA LSK	Allows the uploading of all of the original navigation data from the DTS. This original navigation data consists of waypoints and flight plans uploaded from DTS prior to any modifications or additions to the mission waypoints or flight plans, or creation of any mark points. Flashing asterisk is displayed in upper left corner while upload is in progress. Depressing this LSK when the DTS status on the DTS Page (Figure 1-98) is N, does not cause an upload to occur; and will cause the DTS NOT RDY annunciation to be displayed on the CDU. Depressing this LSK when the DTS status on the DTS Page is F, does not cause an upload to occur; and will cause the DTS FAIL annunciation to be displayed on the CDU. **NOTE** Depressing this LSK after making any modifications or additions to the mission waypoints or flight plans, causes the modified or added waypoints and/or flight plan data, or created mark point data to be lost.
RECENT NAV DATA LSK	Allows the uploading of all of the recent navigation data from the DTS. This recent navigation data consists of the original waypoints and flight plans databases and includes any modifications or additions to the mission waypoints or flight plans, or created mark points. Flashing asterisk is displayed in upper left corner while upload is in progress. Depressing this LSK when the DTS status on the DTS Page (Figure 1-98) is N, does not cause an upload to occur; and will cause the DTS NOT RDY annunciation to be displayed on the CDU. Depressing this LSK when the DTS status on the DTS Page is F, does not cause an upload to occur; and will cause the DTS FAIL annunciation to be displayed on the CDU. **NOTE** Depressing this LSK after depressing the ALL ORIG DATA or ORIG NAV DATA LSK(s) will not restore any modified or created data since depressing either of these LSKs causes all modified or created data to be lost.
CDU/LASTE PREFERENCES LSK	Allows the uploading of all of the original CDU preferences and LASTE pilot preferences and weapons data. Flashing asterisk is displayed in upper left corner while upload is in progress. Depressing this LSK when the DTS status on the DTS Page (Figure 1-98) is N, does not cause an upload to occur; and will cause the DTS NOT RDY annunciation to be displayed on the CDU. Depressing this LSK when the DTS status on the DTS Page is F, does not cause an upload to occur; and will cause the DTS FAIL annunciation to be displayed on the CDU. **WARNING** Depressing this LSK after making any modifications to the CDU preferences and/or LASTE pilot preferences and weapons data causes all modified data to be lost.
Data Transfer System (DTS) Page LSK	Returns to DTS Page (Figure 1-98).

Figure 1-77. DTS Upload (DTSUPLD) Page (Sheet 3)

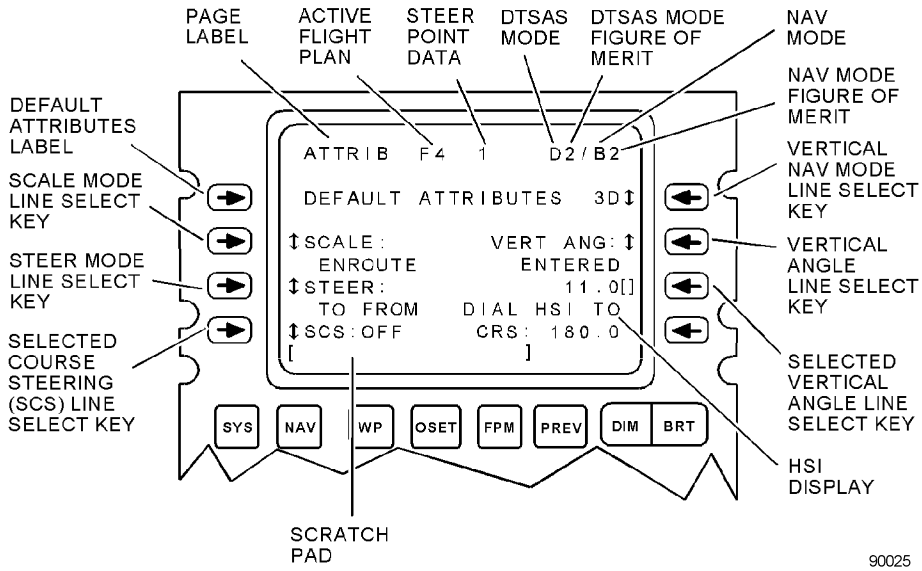


Figure 1-78. Attributes (ATTRIB) Page (Sheet 1 of 4)

NOTE

- This page provides the means to assign waypoint specific attributes to mission waypoints (0 through 50), navigation waypoints (51 through 2050), or mark points (A through Z).
- If no attributes have been entered on this page or uploaded from the DTS, this page defaults to: SCALE: ENROUTE, STEER: TO FROM, and vertical Nav mode 2D. When the vertical NAV mode is changed to 3D, VANGLE defaults to ENTERED and selected vertical angle defaults to 0.0.
- The attributes selected on this page are applied to a mission waypoint or waypoints when:
  A waypoint is inserted into a flight plan using the FPBUILD Page (Figure 1-68).
  A mark point is created.
  When the AAP STEER PT rotary select knob is set to MISSION or MARK and waypoint specific attributes have not been assigned using WAYPT Page 2/2 (Figure 1-63) or have not been uploaded from the DTS.
  When the AAP STEER PT rotary select knob is set to FLT PLAN and flight plan specific attributes have not been assigned using WPTATT Page (Figure 1-69) or have not been uploaded from the DTS.
  A waypoint is copied from another waypoint.

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
DEFAULT ATTRIBUTES label	Provides the information that this page displays the default attributes.
SCALE mode LSK	Allows selection of one of four different levels of sensitivity with which EGI can drive the CDI and glide slope indicator. The four levels are: ENROUTE, TERMINAL, HIGH ACC, and APPROACH (see Figure 1-54). Depressing the LSK allows stepping through the possible choices.
STEER mode LSK	Allows selection of one of three different steering mode Attributes. These steering modes are: TO FROM, DIRECT, and TO TO. Depressing the LSK allows stepping through the possible choices.

Figure 1-78. Attributes (ATTRIB) Page (Sheet 2)

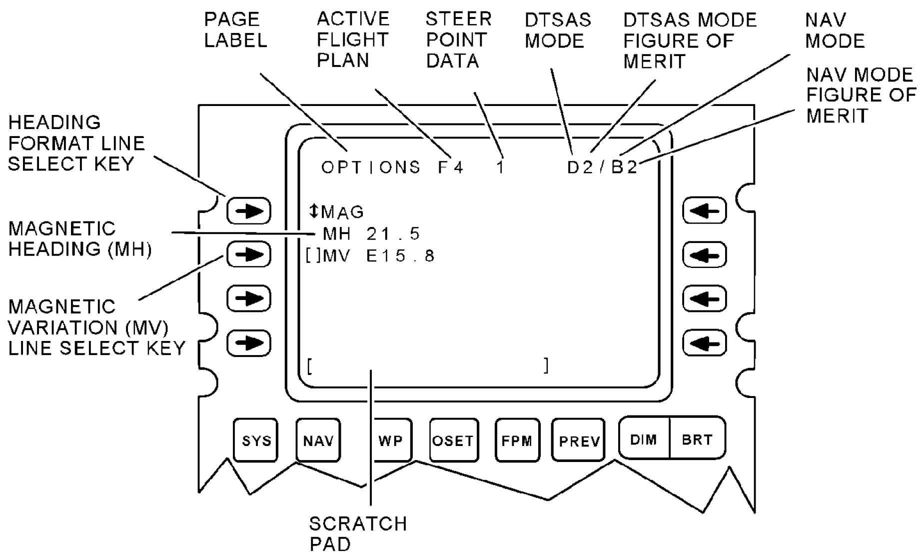
LABEL/LINE SELECT KEY	FUNCTION
Selected course steering (SCS) mode LSK	Allows selection of SCS mode (ON or OFF). This mode is not an attribute and can not be assigned to a waypoint. The SCS mode can ony be selected and deselected on this page. **NOTE** • This key is inactive (and SCS mode is disabled) while the Anchor switch is depressed on the NMSP. • When SCS is the selected steer mode, SCALE and 2D or 3D can be selected, as desired, to provide the desired steering cues. • If the SCS steer mode has been selected and then ANCHR is selected on the NMSP, the SCS mode is automatically deselected and steering cues are provided to the anchor point. These steering cues are determined by the attributes of the waypoint that is the anchor point.
Vertical NAV mode LSK	Allows the selection of either two- or three-dimensional (2D or 3D) vertical Nav mode (VNAV MODE). When this LSK is depressed to select the 3D vertical navigation mode, the 3D indication will flash until the EGI GPS enters Nav mode and has acquired four satellites. When EGI is not qualified for 3D mode, refer to Figure FO-7 for the effects on the HSI and ADI indications.
Vertical angle (VERT ANG:) LSK	This LSK is active (up and down arrow symbol displayed) when 3D is selected using the vertical NAV mode LSK. This allows selection of either ENTERED or COMPUTED vertical angle. This LSK is inactive and the field is blank when 2D is the selected vertical NAV mode.
Selected vertical angle LSK	When 3D is selected using the vertical Nav mode LSK and ENTERED is selected using the vertical angle LSK, this LSK is active (brackets symbol displayed) and this field displays 0.0 degrees. This allows entry of a desired vertical angle of from 0.0 to 89.9 degrees using the scratchpad. After entering the desired vertical angle, pressing this LSK once enters a positive (+) vertical angle. Depressing this LSK a second time changes the sign of the entered vertical angle to negative (-). This LSK is inactive (no brackets symbol displayed) when "2D" is the selected Vertical Navigation mode, or when Vertical Angle is "COMPUTED." This field is blank when 2D is the selected vertical Nav mode, or when the Vertical Angle is "COMPUTED" and SCS mode is disabled (OFF).

Figure 1-78. Attributes (ATTRIB) Page (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
	When 3D is selected using the vertical NAV mode LSK and COMPUTED is selected using the vertical angle (VERT ANG:) LSK, this LSK is inactive (no brackets symbol displayed) and this field is blank. To view the value of the computed vertical angle, refer to the Waypoint (WAYPT) Pages (Figure 1-63) or Waypoint Attributes (WPTATT) Page (Figure 1-69) and select COMPUTED using the VERT ANG: LSK, if necessary. The waypoint displayed on the WAYPT or WPTATT Page must be the steerpoint for the computed vertical angle to be displayed.
HSI display	When the active steering mode is DIRECT or TO TO, this field displays DIAL HSI TO CRS: XXX.X, where XXX.X is the heading to which the course should be set using the HSI COURSE SET knob. When the active steering mode is TO FROM or while in SCS mode, this field displays HSI SET AT CRS: XXXX, where XXXX is the heading the course arrow was set to using the HSI COURSE SET knob. If the HSI selected magnetic course is undefined, this field displays "****".

Figure 1-78. Attributes (ATTRIB) Page (Sheet 4)

OPTIONS PAGE (MAG HDG FORMAT)



OPTIONS PAGE (GRID HDG FORMAT)

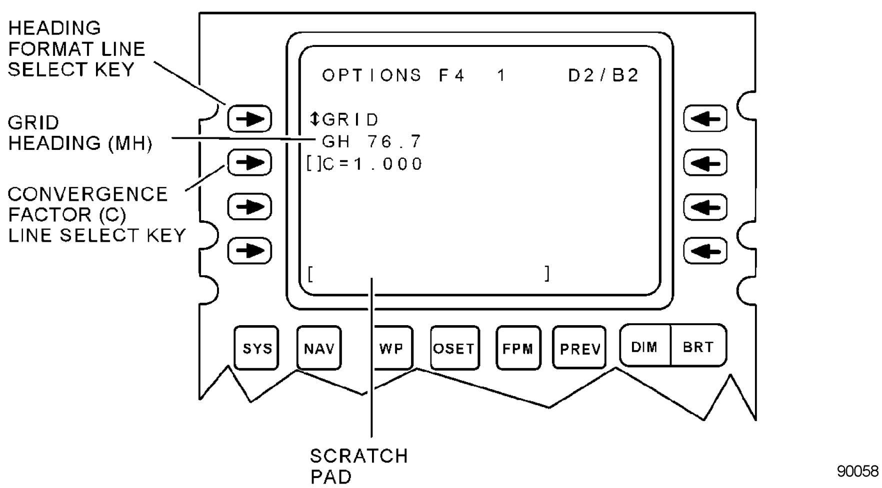


Figure 1-79. OPTIONS Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Heading format LSK	Allows toggling between heading formats; magnetic or grid.
MAG HDG FORMAT	
Magnetic heading (MH)	Displayed when MAG heading format is selected and displayed. Displays aircraft's magnetic heading in degrees and tenths.
Magnetic variation (MV) LSK	Displayed when MAG heading format is selected and displayed. Normally, this field displays the magnetic variation provided by EGI with no equal sign between MV and the magnetic variation. If magnetic variation is entered into the scratchpad in degrees and tenths and this LSK is depressed, this field displays the entered magnetic variation with an equal sign between MV and the magnetic variation. If the scratchpad is empty and this LSK is depressed, this field returns to the magnetic variation provided by EGI with no equal sign. The magnetic variation displayed in this field is the magnetic variation used in the computation of the navigation solutions and steering information. When entering a magnetic variation, the entry must be between E99.9 and W99.9 with the decimal point entered if tenths of a degree are being entered.
GRID HDG FORMAT	
Grid heading (GH)	Displayed when GRID heading format is selected and displayed. Displays aircraft's grid heading in degrees and tenths. **CAUTION** When grid heading is selected on this Page, the convergence factor (C) that corresponds to the aircraft's present position must be manually entered using the convergence factor LSK. Failure to enter this convergence factor, as required by the changing aircraft position, may cause the HSI, ADI, and HUD to provide incorrect steering information; especially with regard to the HSI compass card and course deviation indicator and the ADI bank steering bar.
Convergence factor (C) LSK	Allows convergence (C) factor (the number 1 or a number up to 4 digits preceded by a decimal point) to be entered from the scratchpad. At turn-on, the convergence factor defaults to 1, and is displayed as 1.0000. To enter a convergence factor other than 1, enter decimal point (.) XXXX, where XXXX is the desired convergence factor into scratchpad, and depress the convergence factor (C) LSK. To enter a convergence factor of 1, only the number 1 needs to be entered into scratchpad, and when convergence factor (C) LSK is depressed, field will display 1.0000. If this LSK is depressed with the scratchpad cleared, this field will display 1.0000.

Figure 1-79. OPTIONS Page (Sheet 2)

SYSTEM PAGE 1/3 (OPERATIONAL MODE)

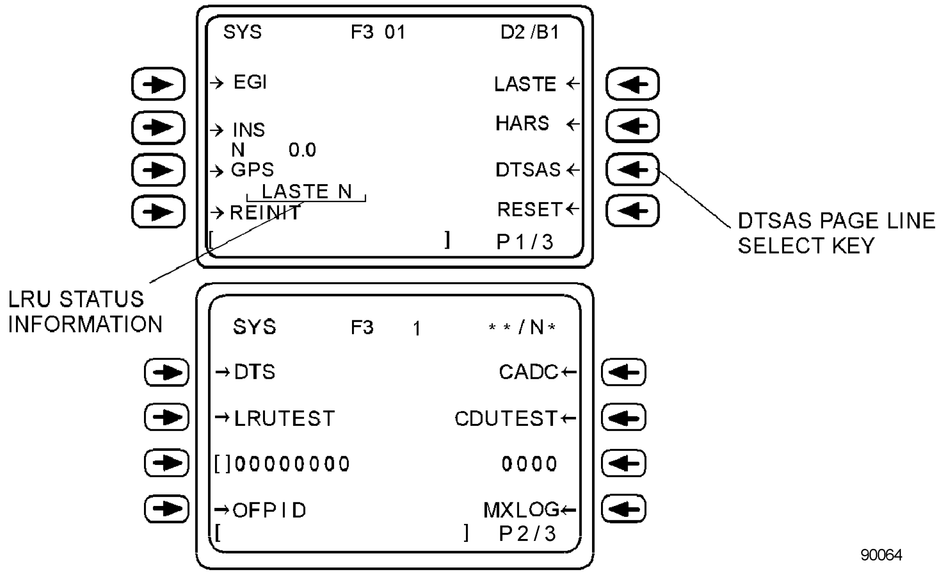


Figure 1-80. System (SYS) Pages (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Page number	Displays current/total page numbers.
PAGE 1/3*	
EGI Page LSK	Allows the selection and display of the EGI Pages (Figure 1-88).
INS Page LSK	Allows the selection and display of the INS Page (Figure 1-89).
GPS Page LSK	Allows the selection and display of the GPS Page (Figure 1-94).
REINIT Page LSK	Allows the selection and display of the REINIT Page (Figure 1-81).
LASTE Page LSK	Allows the selection and display of the LASTE Page (Figure 1-82).
HARS Page LSK	Allows the selection and display of the HARS Page (Figure 1-85).
DTSAS Page LSK	Allows the selection and display of the DTSAS Page (Figure 1-93).
RESET Page LSK	Allows the selection and display of the RESET Page (Figure 1-87).
LRU status information	Provides status for each system/subsystem as described below:
	INS - Displays current status of INS using the codes listed below**.
	GPS - Displays current status of GPS using the codes listed below**.
	Missionization (MSN) - Displays current status of EGI missionization section using the codes listed below (does not display I) **.
	CADC - Displays current status of CADC using the codes listed below (does not display I) **.
	HARS - Displays current status of HARS using the codes listed below (does not display N, I, or T) **.
	LASTE - Displays current status of LASTE using the codes listed below (does not display T or F) **.
	CDU - Displays current status of CDU using the codes listed below (does not display N or I)**.
	Master bus controller (MBC) (part of CDU) - Displays current status of CDU MBC using the codes listed below (does not display N, I, or T)**.

Figure 1-80. System (SYS) Pages (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
DTS	Displays current status of DTS using the codes listed below (does not display T)**.
DTSAS	Displays current status of DTSAS using the codes listed below (does not display N or T)**.
IEPU 152	Displays current status of IEPU using the codes listed below (does not display I)**.

* Initialization mode is displayed until 2 minutes have elapsed since the completion of the CDU startup BIT and no LRU is in an initialization mode; then operational mode is entered.

** N = not communicating

I = initializing

V = valid

F = failed

T = test

X = IEPU not installed 152

PAGE 2/3	
DTS Page LSK	Allows the selection and display of the DTS Page (Figure 1-98).
LRUTEST Page LSK	Allows the selection and display of the LRUTEST Page (Figure 1-101).
CADC Page LSK	Allows the selection and display of the CADC Page (Figure 1-86).
CDUTEST Page LSK	Allows the selection and display of the CDUTEST Page (Figure 1-103).
Operational flight program identification numbers (OFPID) LSK	Allows the selection and display of the OFPID Page (Figure 1-106).
Maintenance Log (MXLOG) LSK	Allows the selection and display of the MXLOG Page (Figure 1-108).
Diagnostic CDU Address LSK	Allows maintenance personnel to enter a diagnostic CDU address using the scratchpad. This LSK is for use by maintenance personnel only.
Diagnostic CDU Data	Displays data from CDU address selected using CDU Address LSK.
PAGE 3/3	
IEPU Page LSK 152	Allows selection and display of IEPU Page.

Figure 1-80. System (SYS) Pages (Sheet 3)

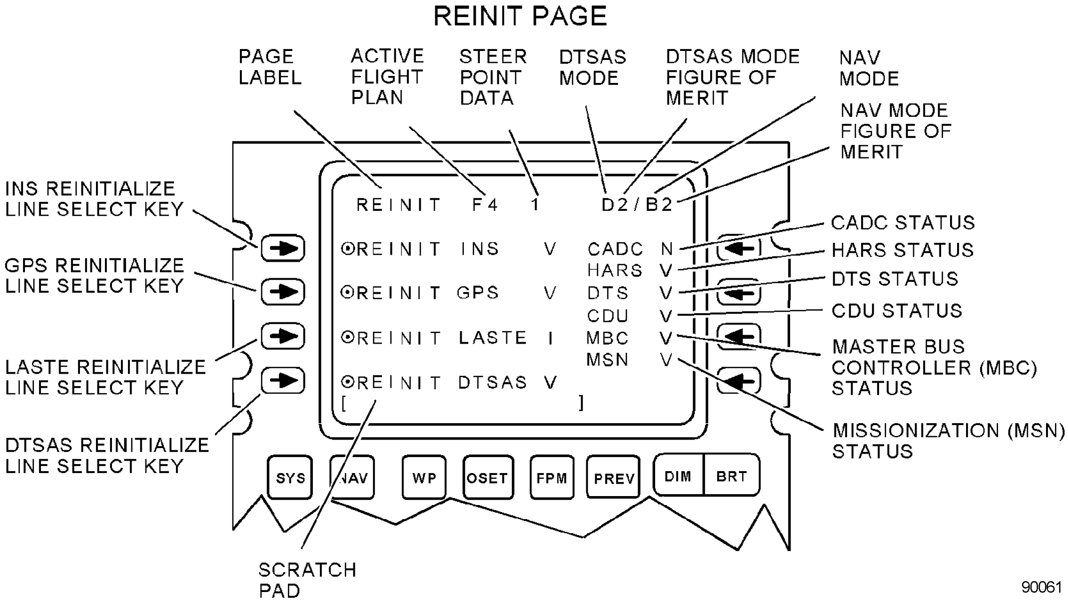


Figure 1-81. Reinitialization (REINIT) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Reinitialize INS (REINIT INS) LSK	Allows EGI INS to be reinitialized. The current status of INS is displayed using codes listed below*. Depressing this LSK, when the aircraft is on the ground and not moving, and EGI INS is in NARF mode, causes the EGI INS to return to and continue the EGI INS alignment from the point at which NAV was selected on the ALIGN Page (Figure 1-73). Depressing this LSK, when the aircraft is on the ground and moving, does not cause the EGI INS to be reinitialized. Depressing this LSK, when the aircraft is in the air, causes the EGI INS to do an in-flight alignment.
Reinitialize GPS (REINIT GPS) LSK	Allows EGI GPS to be reinitialized. The current status of GPS is displayed using codes listed below*. EGI GPS initialization requires approximately 2 minutes.
Reinitialize LASTE (REINIT LASTE) LSK**	Allows LASTE to be reinitialized. The current status of LASTE is displayed using codes listed below (does not display T or F)*. Reinitialization of LASTE consists of uploading pilot preferences and weapons data from the DTS if this data has not been uploaded previously. Reinitialization of LASTE does not erase pilot preferences and weapons data uploaded to the LASTE either during turn-on or when manually entered. **NOTE** The REINIT LASTE LSK is inactive (no target symbol displayed) when the aircraft is airborne.
Reinitialize DTSAS (REINIT DTSAS) LSK	Allows DTSAS to be reinitialized. The current status of DTSAS is displayed using codes listed below (does not display N or T)*. Reinitialization of DTSAS consists of reinitializing the Kalman filters within the DTSAS.
CADC status	Displays current status of CADC using the codes listed below (does not display I)*.
HARS status	Displays current status of HARS using the codes listed below (does not display N, I, T)*.
DTS status	Displays current status of DTS using the codes listed below (does not display T)*.
CDU status	Displays current status of CDU using the codes listed below (does not display N, I)*.
Master bus controller (MBC) status	Displays current status of CDU MBC using the codes listed below (does not display N, I, T)*.
Missionization (MSN) status	Displays current status of EGI missionization section using the codes listed below (does not display I)*.

* N = not communicating
I = initializing
V = valid
F = failed
T = test

** Not available when airborne (no target symbol), displays status only.

Figure 1-81. Reinitialization (REINIT) Page (Sheet 2)

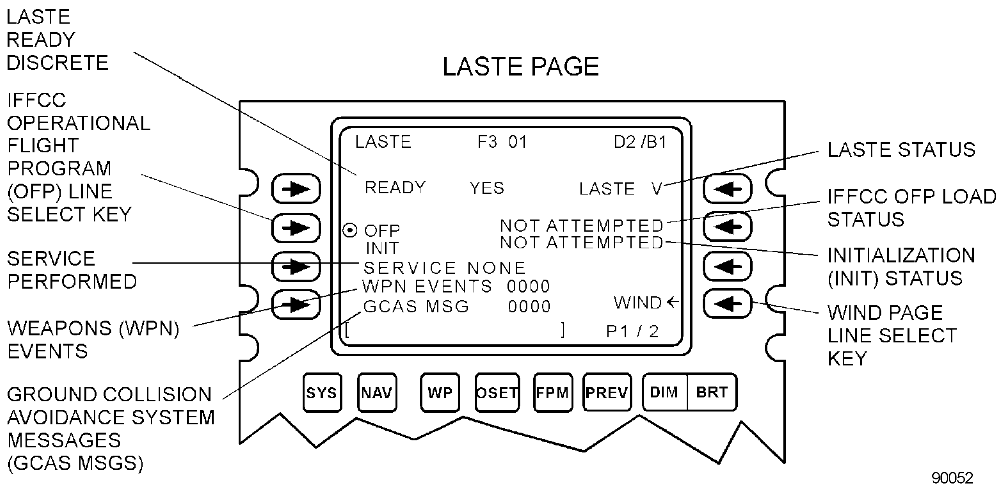


Figure 1-82. LASTE Page (Sheet 1 of 3)

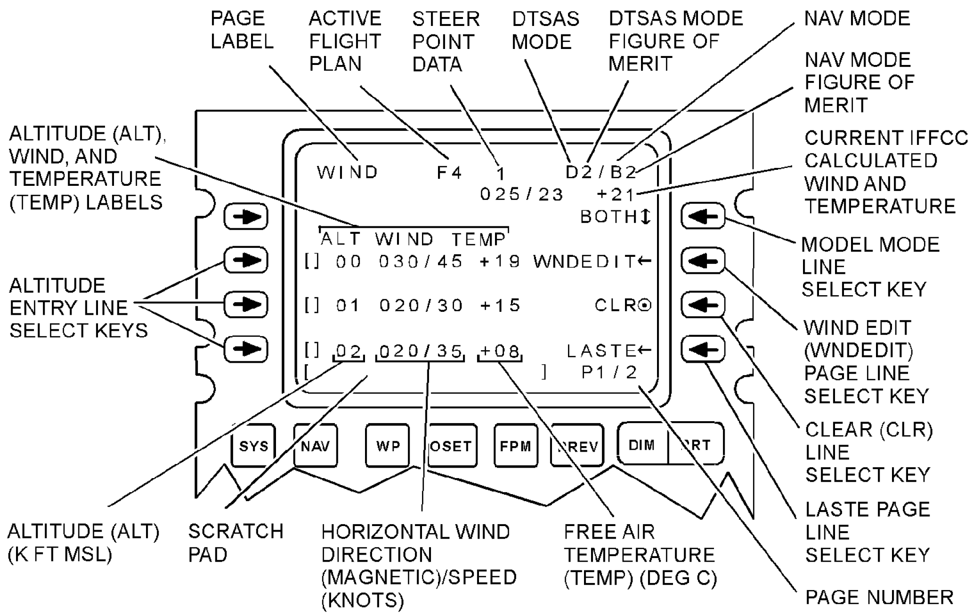
LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
LASTE READY discrete	Identifies if LASTE is ready: YES or NO.
	YES = LASTE present
	NO = LASTE not present
IFFCC operational flight program (OFP) load LSK	This LSK is active (target symbol displayed) only when the test (TST) mode is selected using the LRUTEST Page and LASTE status is "V" . When depressed, it initiates the loading of the IFFCC, VMU, and SYMGEN OFPs from the DTS.
IFFCC OFP load status	Display status of IFFCC OFP load (NOT ATTEMPTED, LOADING XXX% where XXX is percentage of OFP load completed, SUCCESSFUL when OFP load is successfully completed, FAILED X where X is a number that identifies the cause of the failed OFP load, or FAILED UNKN when cause of failed OFP load is unknown).
Initialization (INIT) status	Displays status of initialization: NOT ATTEMPTED, IN PROGRESS, SUCCESSFUL and FAILED.
SERVICE performed	Displays the service currently being requested by LASTE System. These include:
	NONE
	OFFSET MARK
	LASTE EVENT
	GCAS EVENTS
	RDY FOR OFP
	RDY FOR INIT
	PREP OFF UPDT
	INS OFF UPDT
	HOT ELEVATION
	LOAD PASS
	LOAD FAIL
	HACK TIME

Figure 1-82. LASTE Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Weapons (WPN) EVENTS	Displays total number of weapons events that have occurred and been transferred to the DTS.
LASTE status	Displays status of LASTE through the following codes:
	N = not communicating
	I = initializing
	V = valid
Ground Collision Avoidance System messages (GCAS MSG)	Displays total number of GCAS (DTSAS and IFFCC) messages that have occurred and been transferred to the DTS.
WIND Page LSK	Allows the selection and display of the WIND Page (Figure 1-83).

Figure 1-82. LASTE Page (Sheet 3)

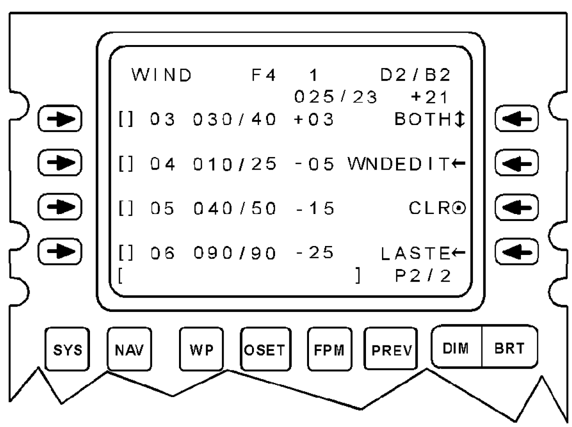
WIND PAGE 1/2



WIND PAGE 2/2

NOTE

WIND PAGE P2/2 IS IDENTICAL TO WIND PAGE 1/2 EXCEPT, IT DOES NOT DISPLAY THE ALT, WIND, AND TEMP LABELS AND IT DISPLAYS FOUR ROWS OF ALT, WIND AND TEMP DATA RATHER THAN THREE ROWS.



90068

Figure 1-83. Wind/Temperature Profile (WIND) Pages (Sheet 1 of 4)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Page number	Displays current/total page numbers
Page 1/2	
Altitude (ALT), WIND, and Temperature (TEMP) labels	These labels provide information on the data that is displayed below the label. **NOTE** These labels are only displayed on WIND Page P1/2.
Altitude (K FT MSL)	Up to seven altitude fields are available on the two WIND Pages. Altitude data is entered and displayed using the altitude entry LSKs. **NOTE** If no altitudes have been entered or uploaded from the DTS, these field or fields will be blank.
Altitude entry LSKs	These keys allow the entry of an altitude profile. The altitude information is first entered into the scratchpad (valid range 0 to 99), in thousands of feet MSL. a. Altitude is inserted into the profile by depressing the corresponding LSK (one of 7 choices). b. If an altitude LSK is depressed while the scratchpad is blank then the associated altitude profile record (including wind and temperature data) will be cleared. c. If the altitude profile table is filled then entering a new altitude causes the currently selected altitude to be deleted (including the associated wind and temperature data) and the new altitude will be entered in its place. **NOTE** • The CDU automatically sorts the altitude entries from highest to lowest MSL altitude. • Entry of duplicate altitude will result in "input error" being displayed in the scratchpad.

Figure 1-83. Wind/Temperature Profile (WIND) Pages (Sheet 2)

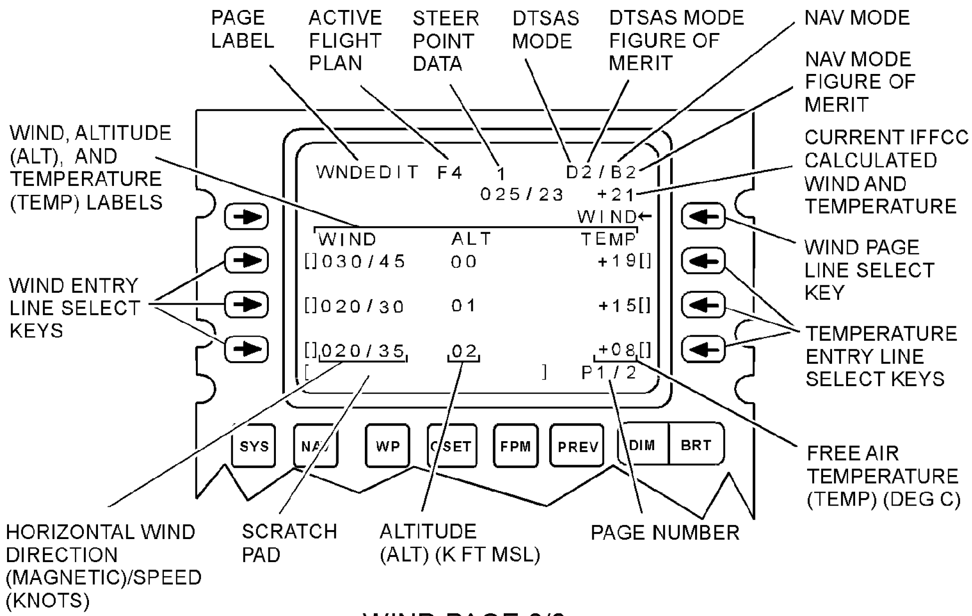
LABEL/LINE SELECT KEY	FUNCTION
Horizontal WIND direction (magnetic)/speed (knots)	Up to seven WIND direction/speed fields are available. Wind direction is displayed as a magnetic heading. Wind speed is displayed in knots. WIND direction/speed is entered using the WNDEDIT Pages (Figure 1-84) or uploaded from the DTS. **NOTE** If no WIND directions/speeds have been entered or uploaded from the DTS for a particular altitude, these fields will display six asterisks.
Free air temperature (TEMP) (°C)	Up to seven TEMP fields are available. TEMP is displayed in degrees centigrade (°C). TEMP is entered using the WNDEDIT Pages (Figure 1-84) or uploaded from the DTS. **NOTE** If no TEMPs have been entered or uploaded from the DTS, for a particular altitude the associated fields will display three asterisks.
Current IFFCC calculated wind and temperature	Displays real time, current wind and temperature calculated by IFFCC. Any CDU annunciations will overwrite this field until the annunciation is cleared or acknowledged. **NOTE** If the LASTE status is N or I these fields will display three asterisks/three asterisks.
Model mode LSK	Allows the selection of the wind and temperature model mode that will be used by IFFCC in its ballistic calculations. There are four possible model modes. Depressing this LSK steps through the model modes described below: 1. BOTH - Indicates that both the wind and temperature values displayed on this page will be used by IFFCC. 2. WIND - Indicates that only the wind values displayed on this page will be used by IFFCC. 3. TEMP - Indicates that only the temperature values displayed on this page will be used by IFFCC. 4. NONE - Indicates that neither the wind or temperatures values displayed on this page will be used by IFFCC. **NOTE** If no profile has been entered or uploaded from the DTS, none is the default model selection.

Figure 1-83. Wind/Temperature Profile (WIND) Pages (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
Wind edit (WNDEDIT) Pages LSK	Allows the selection and display of the WNDEDIT Pages (Figure 1-84).
Clear (CLR) LSK	Depressing this LSK twice clears the WIND Pages as follows: 1. When depressed the first time, CLR is replaced with a flashing CONFIRM for 5 seconds. 2. When depressed a second time with the flashing CONFIRM displayed, the WIND profile is cleared. 3. If not depressed within the 5 second time period, the flashing CONFIRM is replaced with CLR. **NOTE** When the WIND page is cleared using this LSK, all ALT, WIND, and TEMP fields are cleared (become blank).
LASTE Page LSK	Allows the return to the LASTE Page (Figure 1-82).
Page 2/2	**NOTE** WIND Page P2/2 is identical to WIND Page 1/2 except; it does not display the ALT, WIND, and TEMP labels and it displays four rows of ALT, WIND, and TEMP data rather than three rows.

Figure 1-83. Wind/Temperature Profile (WIND) Pages (Sheet 4)

WNDEDIT PAGE 1/2



WIND PAGE 2/2

NOTE

WNDEDIT PAGE P2/2 IS IDENTICAL TO WNDEDIT PAGE 1/2 EXCEPT; IT DOES NOT DISPLAY THE ALT, WIND, AND TEMP LABELS, AND IT DISPLAYS FOUR ROWS OF WIND, ALT, AND TEMP DATA RATHER THAN THREE ROWS, AND IT DOES NOT ALLOW THE OPERATOR TO RETURN TO THE WIND PAGE.

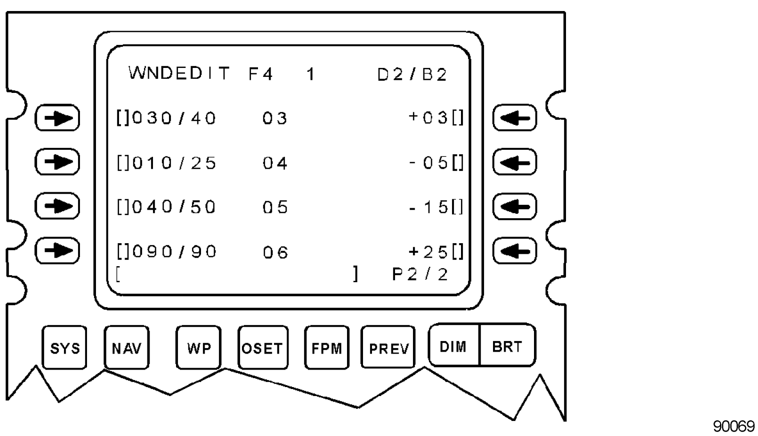


Figure 1-84. Wind/Temperature Profile Edit (WNDEDIT) Pages (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Page number	Displays current/total page numbers
Page 1/2	
WIND, altitude (ALT), and temperature (TEMP) labels	These labels provide information on the data that is displayed below the label. **NOTE** These labels are only displayed on WNDEDIT Page P1/2.
WIND entry LSKs	There are a total of seven WIND fields on the WNDEDIT Pages, three on Page 1/2 and four on Page 2/2. Each of these fields is associated with a LSK. After entering the desired horizontal wind direction (magnetic, 1 to 360) and speed (knots, 0 to 99) in the scratchpad, depressing one of these LSKs causes the scratchpad entry to be placed in the WIND field associated with the LSK that was depressed. This data is displayed to the left of the associated ALT field. **NOTE** • If wind direction/speed have not been entered or uploaded from the DTS, the fields that have not had data entered or uploaded will display six asterisks. • The WIND field for an individual altitude (ALT) can not be cleared. The ALT, WIND and TEMP fields can be cleared using the WIND Pages (Figure 1-83).
Altitude (K FT MSL)	Up to seven altitude fields are available. Altitude data is displayed in thousands of feet (K FT MSL) and entered using the WIND Pages (Figure 1-83). **NOTE** If altitudes have not been entered or uploaded from the DTS, the fields that have not had data entered or uploaded will be blank.

Figure 1-84. Wind/Temperature Profile Edit (WNDEDIT) Pages (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Temperature (TEMP) entry LSKs	There are a total of seven TEMP fields on the WNDEDIT Pages, three on P1/2 and four on P2/2. Each of these fields is associated with a LSK. After entering the desired temperature (0 to 99, °C) in the scratchpad, depressing one of these LSKs causes the scratchpad entry to be placed in the TEMP field associated with the LSK that was depressed as a positive (+) value. Depressing the same LSK a second time changes the sign of the entered value to negative (-). This data is displayed to the right of the associated ALT field. **NOTE** ● If temperatures have not been entered or uploaded from the DTS, the fields that have not had data entered or uploaded will display three asterisks. ● The TEMP field for an individual altitude (ALT) can not be cleared. The ALT, WIND and TEMP fields can be cleared using the WIND Pages (Figure 1-83).
Current IFFCC calculated wind and temperature	Displays real time, current wind and temperature calculated by IFFCC. Any CDU annunciations will overwrite this field until the annunciation is cleared or acknowledged. **NOTE** If the LASTE status is N or I these fields will display six asterisks and three asterisks.
WIND Page LSK	Allows the return to the WIND Pages (Figure 1-83).
Page 2/2	**NOTE** WNDEDIT Page, P2/2 is identical to WNDEDIT Page, P1/2 except: it does not display the WIND, ALT, and TEMP labels; it displays four rows of WIND, ALT, and TEMP data rather than three rows; and it does not allow the return to the WIND Pages (Figure 1-83).

Figure 1-84. Wind/Temperature Profile Edit (WNDEDIT) Pages (Sheet 3)

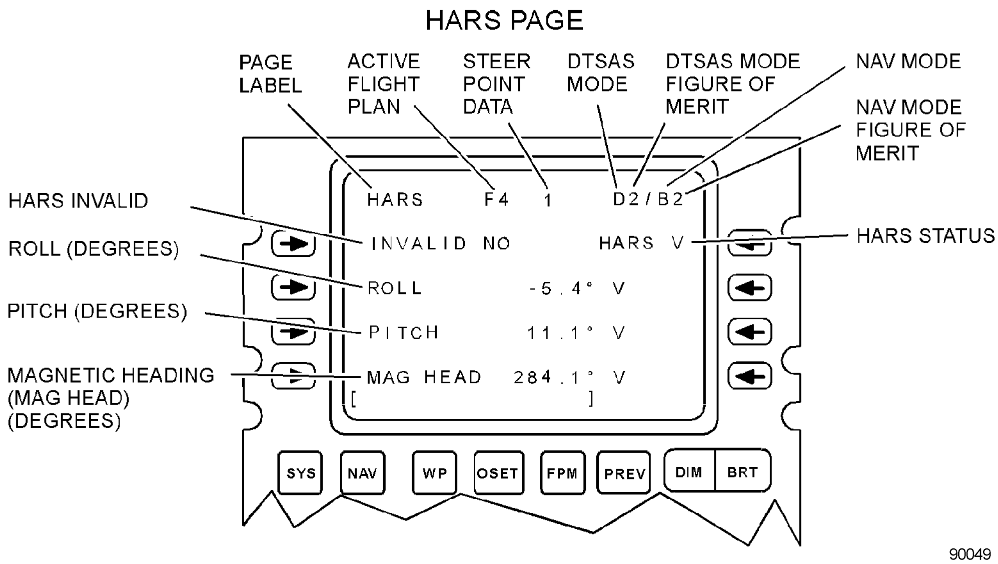


Figure 1-85. HARS Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
INVALID	Indicates validity of HARS data - YES (Invalid) or NO (Valid).
HARS status	Displays status of HARS with two different codes: V = valid F = failed
ROLL*	Displays HARS roll in degrees and status of roll with two different codes: V = valid F = failed
PITCH*	Displays HARS pitch in degrees and status of pitch with two different codes: V = valid F = failed
Magnetic heading (MAG HEAD)*	Displays HARS heading in degrees and status of magnetic heading with two different codes: V = valid F = failed

* ROLL, PITCH, or MAG HEAD status display is V when:

a. Associated signal is present

b. Associated signal changes at least once every 5 seconds, and

c. Range of associated signal is between 0° and 360°

Figure 1-85. HARS Page (Sheet 2)

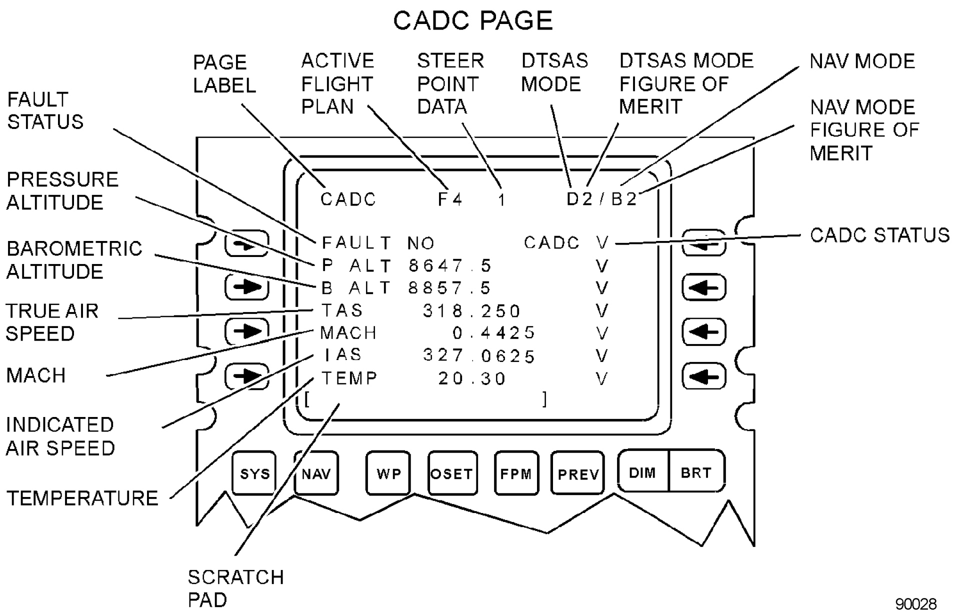
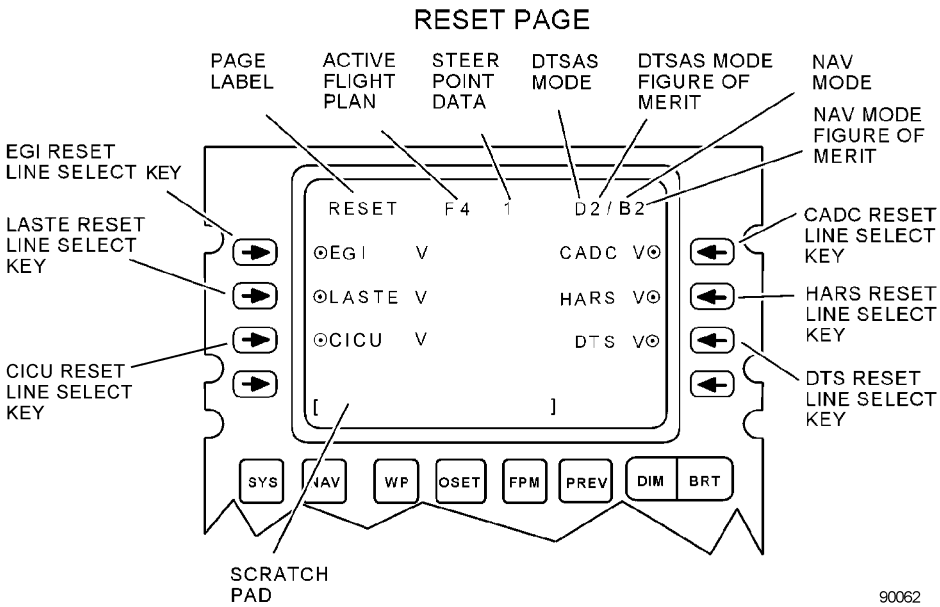


Figure 1-86. CADC Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
FAULT status	Displays fault status of CADC with two different codes:
	NO = no fault
	YES = fault present
Pressure altitude (P ALT)	Displays pressure altitude in feet and status with two different codes:
	V = valid (between -1,000 and 45,000 feet)
	F = not valid
Barometric altitude (B ALT)	Displays barometric altitude in feet and status with two different codes:
	V = valid (between -1,000 and 45,000 feet)
	F = not valid
True air speed (TAS)	Displays true air speed in knots and status with two different codes:
	V = valid (between 70 and 600 knots)
	F = not valid
MACH	Displays mach number and status with two different codes:
	V = valid (between 0.09 and 0.8 MACH)
	F = not valid
Indicated air speed (IAS)	Displays indicated air speed in knots and status with two different codes:
	V = valid (between 49 and 600 knots)
	F = not valid
Temperature (TEMP)	Displays outside air temperature (OAT) in degrees Celsius (°C) and status with two different codes:
	V = valid (between -100°C and 50°C)
	F = not valid
CADC status	Displays status of CADC through the following codes:
	N = not communicating
	V = valid
	F = failed
	T = test

Figure 1-86. CADC Page (Sheet 2)



LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
EGI reset LSK	Allows EGI to be reset and current status displayed through the codes listed below.*
LASTE reset LSK	Allows LASTE to be reset and current status displayed through the codes listed below (does not display T or F).*
CICU reset LSK	Allows CICU to be reset and current status displayed through the codes listed below (does not display T or I).*
CADC reset LSK	Allows CADC to be reset and current status displayed through the codes listed below (does not display I).*
HARS reset LSK	Allows HARS to be reset and current status displayed through the codes listed below (does not display N, I, or T).*
DTS reset LSK	Allows DTS to be reset and current status displayed through the codes listed below (does not display T).*

*If LRU status is an F (FAILED), depressing the LSK will reset the LRU to determine its status code:

N = not communicating

I = initializing

V = valid

F = failed

T = test

Figure 1-87. RESET Page

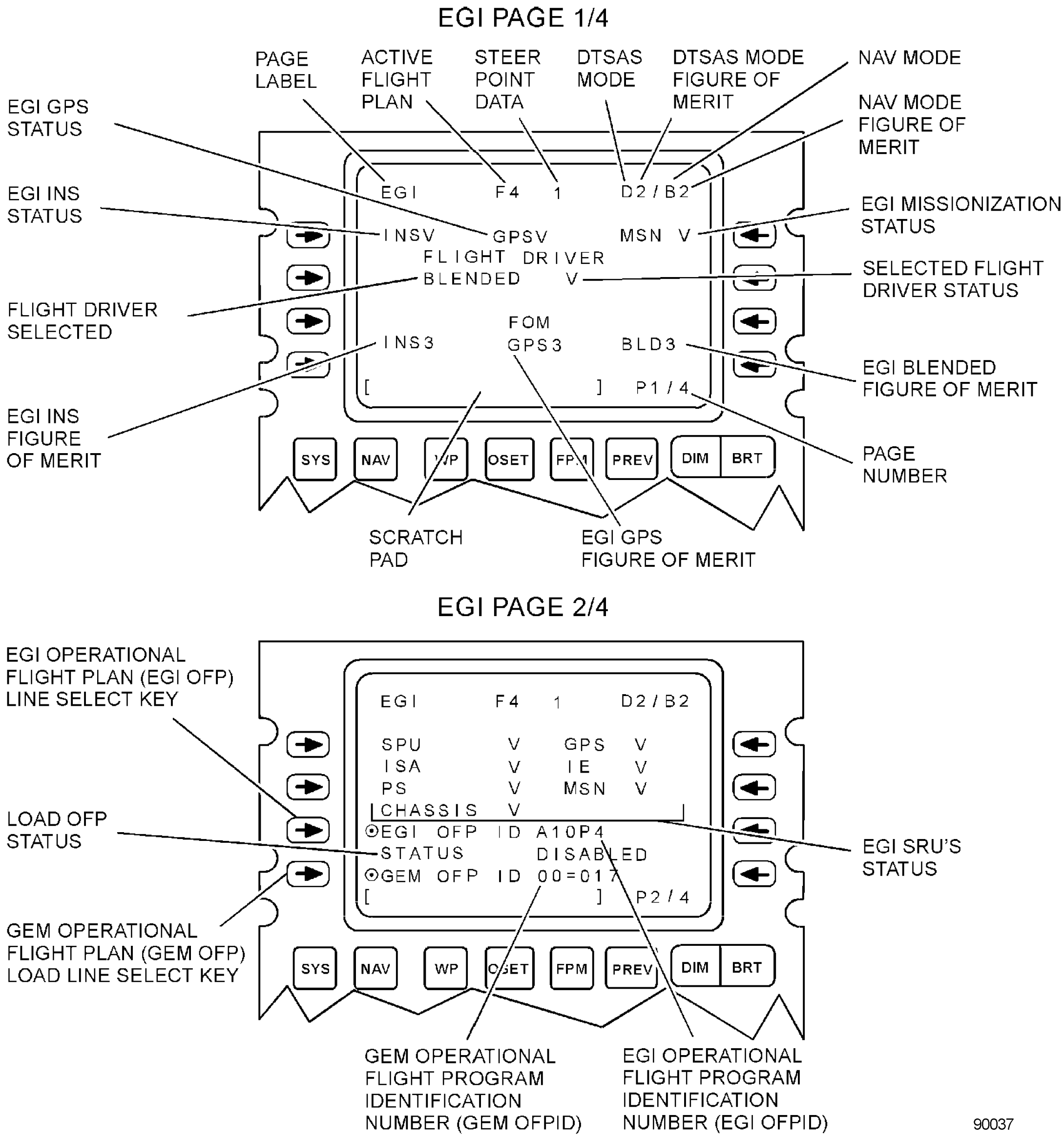
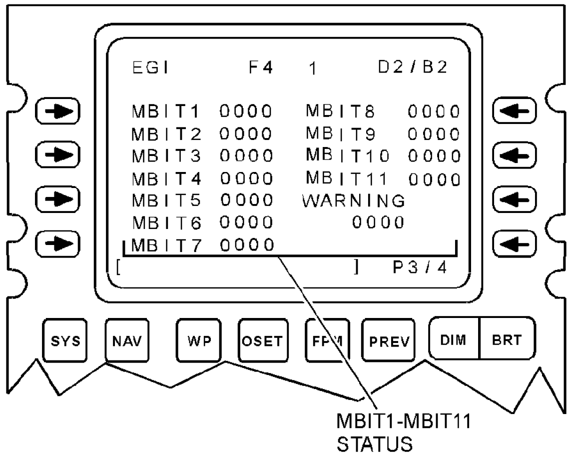


Figure 1-88. EGI Pages (Sheet 1 of 4)

EGI PAGE 3/4



EGI PAGE 4/4

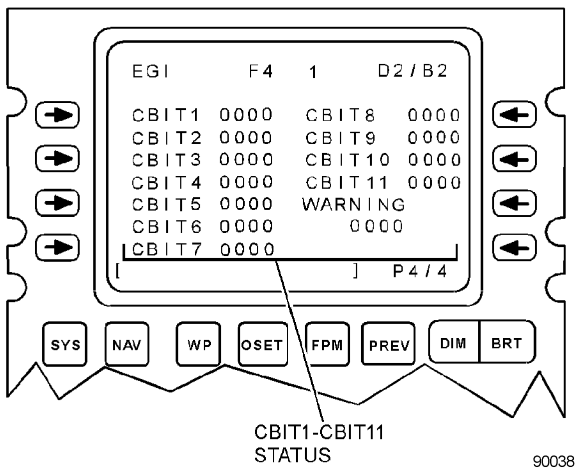


Figure 1-88. EGI Pages (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Page number	Displays current/total page numbers.
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
PAGE 1/4	
EGI INS status	Provides status of EGI INS through the following codes:
	N = not communicating
	I = initializing
	V = valid
	F = failed
	T = test
EGI GPS status	Provides status of EGI GPS using the N, I, V, F and T codes described above.
EGI missionization section (MSN) status	Provides status of EGI missionization section using the N, V, F and T codes described above (does not display I).
FLIGHT DRIVER selected	Displays selected NAV mode (BLENDED, GPS, INS).
Selected FLIGHT DRIVER status	Displays status of selected NAV mode (V = valid, F failed).
EGI blended (BLD) figure of merit (FOM)	Identifies current EGI BLENDED figure of merit.
EGI GPS figure of merit (FOM)	Identifies current EGI GPS figure of merit.
EGI INS figure of merit (FOM)	Identifies current EGI INS figure of merit.
PAGE 2/4	
EGI SRU status	Provides status of each EGI SRU through the following codes:
	N = not communicating
	I = initializing
	V = valid
	F = failed
	T = test

Figure 1-88. EGI Pages (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
	where:
	SPU = EGI system processor
	ISA = EGI inertial sensor assembly
	PS = EGI power supply
	CHASSIS = EGI chassis
	GPS = EGI global positioning system (GPS) receiver
	IE = EGI inertial electronics
	MSN = EGI configurable avionics interface card
EGI operational flight program (EGI OFP) load LSK	This LSK is active (target symbol displayed) only when the test (TST) mode is selected using the LRUTEST Page (Figure 1-101) and an OFP load is not in progress. When depressed, this LSK initiates the loading of the EGI OFP from the DTS. This LSK is for use by maintenance personnel only when installing a new OFP.
EGI operational flight program identification number (EGI OFPID)	Provides identification number of EGI operational flight program.
Load OFP status	Displays status of EGI or GEM OFP load (DISABLED, LOAD XX % where XX is percentage of OFP load completed, VERIFY XX% where XX is percentage of OFP load verification completed, and FAILED).
GEM operational flight program (GEM OFP) load LSK	This LSK is active (target symbol displayed) only when the test (TST) mode is selected using the LRUTEST Page (Figure 1-101) and an OFP load is not in progress. When depressed, this LSK initiates the loading of the GEM OFP from the DTS. This LSK is for use by maintenance personnel only when installing a new OFP.
GEM operational flight program identification number (GEM OFP ID)	Provides identification number of EGI GEM (GPS Receiver) operational flight program.
PAGE 3/4	
MBIT1 - MBIT11 and WARNING status	Displays EGI BIT result words for use by maintenance personnel only.
PAGE 4/4	
CBIT1 - CBIT11 and WARNING status	Displays EGI BIT history words for use by maintenance personnel only.

Figure 1-88. EGI Pages (Sheet 4)

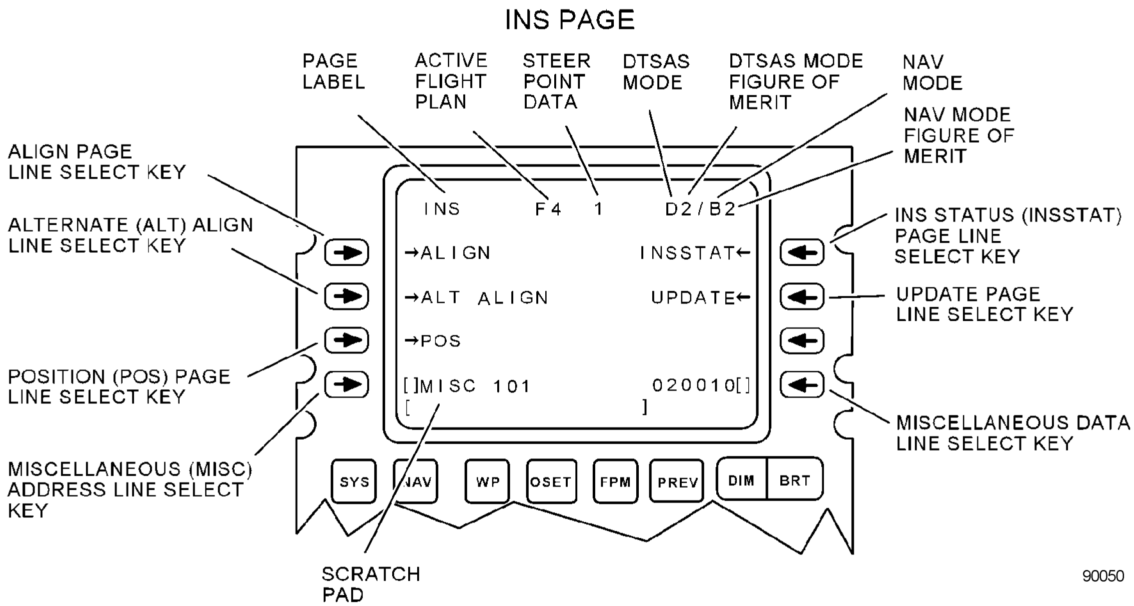
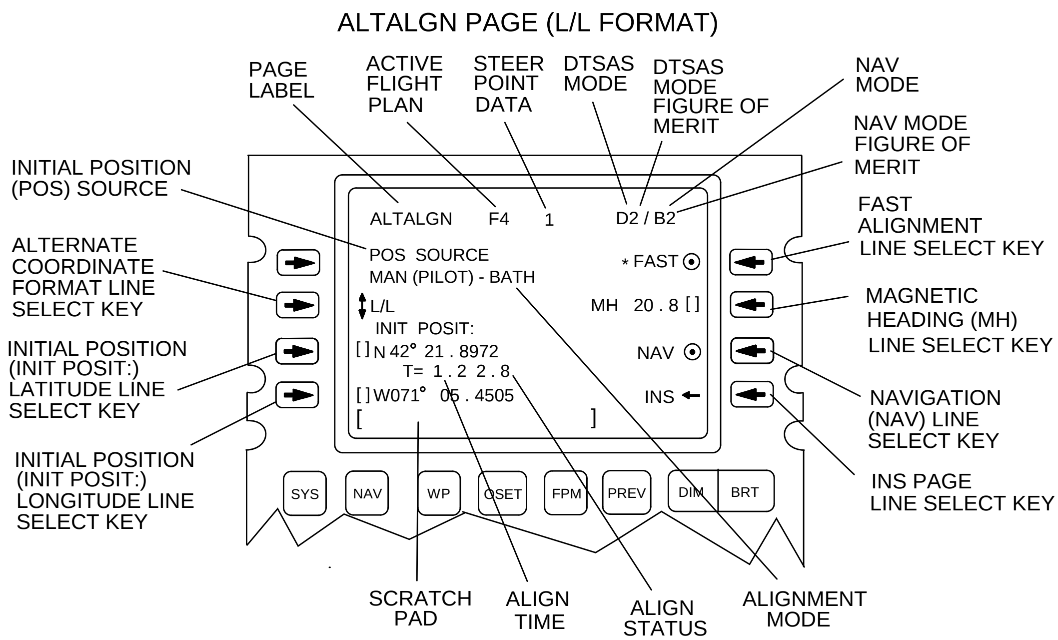


Figure 1-89. INS Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
ALIGN Page LSK	Allows the selection and display of the ALIGN Page (Figure 1-73).
Alternate Align (ALTALGN) Page LSK	Allows the selection and display of the ALTALGN Page (Figure 1-90).
Position (POS) Page LSK	Allows the selection and display of the POS Page (Figure 1-91).
Miscellaneous (MISC) address LSK	Allows the address of miscellaneous data of the EGI to be entered. To access miscellaneous data, enter address in scratchpad using keyboard and then depress MISC LSK. EGI parameters are displayed in miscellaneous data field. To enter miscellaneous data, enter address using miscellaneous address LSK and then enter data using miscellaneous data LSK. This LSK is active (brackets symbol displayed) 30 seconds after EGI is turned on. This LSK is for use by maintenance personnel only. **CAUTION** Do not enter miscellaneous data. Entering miscellaneous data may affect the calibration of the EGI or cause faulty operation of the EGI.
INS Status (INSSTAT) Page LSK	Allows the selection and display of the INS status (INSSTAT) Page (Figure 1-92). This LSK is active (arrow symbol displayed) when EGI is on.
UPDATE Page LSK	Allows the selection and display of the UPDATE Page (Figure 1-75).
Miscellaneous Data LSK	Allows miscellaneous data to be selected and displayed or to be entered to/from EGI. [See miscellaneous (MISC) Address LSK.]

Figure 1-89. INS Page (Sheet 2)



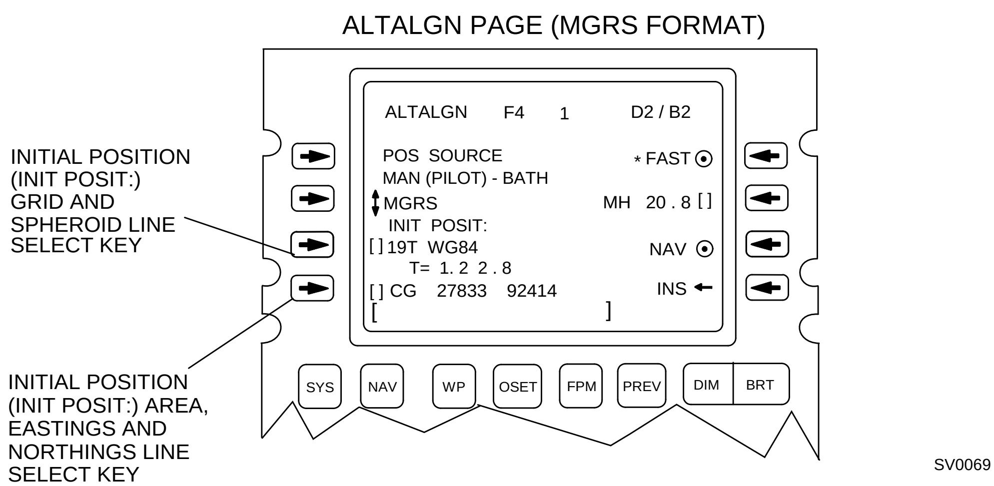


Figure 1-90. Alternate Align (ALTALGN) (Sheet 1 of 5)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Initial position source (POS SOURCE)	This field displays the source of the initial position used during an alignment as described below: MAN (PILOT) - This indicates that the initial position was entered manually. AUTO(DTC) - This indicates that the initial position was provided from the DTC. AUTO(LAST POS) - This indicates that the initial position was the last position stored in EGI when EGI was turned off. AUTO(GPS) - This indicates that an in-flight alignment is being or was performed. During and after an in-flight alignment, the initial position (INIT POSIT:) latitude (on grid and spheroid) and longitude (or area, eastings, and northings) field will be blank, and the LSKs will be inactive (no brackets displayed). STANDBY - Displayed until CDU detects the first valid initial position. NOT AVAILABLE - This indicates that the CDU has been turned off (for more than 2 seconds) and then turned on while EGI was in the NAV mode. When NOT AVAILABLE is displayed, the initial position (INIT POSIT:) LSKs will be inactive (no brackets displayed) and the fields will be blank.
FAST alignment LSK	Allows one to select a degraded EGI INS alignment (stored heading or BATH). This LSK becomes active (target symbol displayed), if the aircraft is not moving, 5 seconds after the completion of the CDU startup BIT test if EGI is on, or 5 seconds after EGI is turned on if CDU had completed the CDU startup BIT test, remains active for 25 seconds, and then becomes inactive (target symbol disappears). When this LSK is depressed, the fast alignment mode is selected, and an asterisk is displayed next to FAST. If the aircraft had been cocked prior to the previous shutdown and, if after this LSK is depressed, a magnetic heading (MH) and an initial position (INIT POS) are not entered, a stored heading alignment will be performed. (POS SOURCE field will display AUTO(LAST POS) and alignment mode field will display -SH.) If a magnetic heading (MH) and/or an initial position is entered after this LSK is depressed, a best available true heading (BATH) alignment will be performed. (POS SOURCE field will display initial position source MAN (PILOT) if initial position has been entered), and alignment mode field will display -BATH.)

Figure 1-90. Alternate Align (ALTALGN) (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
	NOTE When the alignment field indicates SH, an SH alignment may not be performed if the aircraft had been cocked and then moved. The only indications that an SH alignment has not been performed are: 1. A steady INS NAV RDY annunciation will continue to be displayed 24 seconds after the FAST line was depressed. 2. The MODE: field on the INSSTAT Page (Figure 1-92) will display BATH if the INS has not been placed in NAV mode either by using the NAV LSK on this Page or by moving the aircraft.
Magnetic heading (MH) LSK	When the FAST LSK is depressed, this LSK will be active (as indicated by presence of brackets) for 2 minutes after the asterisk appears next to FAST. When active, this LSK allows magnetic heading entry in degrees from the scratchpad. If the aircraft has been moved since EGI was last shut down, the aircraft's present position (initial position (INIT POS) must also be entered to obtain the most accurate BATH alignment possible. When an initial position is entered, the POS SOURCE field will display MAN (PILOT). If an initial position is not entered, the POS SOURCE field will display the position source of the initial position being used for the alignment.
Alternate coordinate format LSK	Allows selection of L/L or MGRS coordinates. Depressing this LSK when L/L is displayed results in MGRS display format.
Align Status	Displays alignment status. Displays INIT when in initialization mode. Displays ATTD when attitude information is available. Displays ATTD + HDG when attitude and heading information are available. When estimated drift is 8.0 nm/hr, displays estimated drift which will decrease to 0.8 or until NAV mode is selected.

Figure 1-90. Alternate Align (ALTALGN) (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
Align time	Displays time INS has been in alignment mode (FAST, NORM, or INFLT).
Navigation (NAV) LSK	Allows one to enter NAV mode. This LSK becomes active (target symbol displayed) when EGI INS attains a degraded navigation ready status which is indicated by a steady INS NAV RDY annunciation on the CDU. When EGI attains the navigation ready status, the flashing INS NAV RDY annunciation is displayed, and this LSK remains active. To enter the NAV mode during a normal or fast alignment, depress this LSK or move the aircraft when a steady or flashing INS NAV RDY annunciation is displayed. The asterisk next to GROUND will disappear, and an asterisk will appear next to NAV. To obtain a more accurate normal or fast alignment, it is recommended to wait until a flashing INS NAV RDY annunciation is displayed before depressing this LSK or moving the aircraft. To enter the NAV mode during an in-flight alignment, depress this LSK when a steady or flashing INS NAV RDY annunciation is displayed, or wait 30 seconds after the flashing INS NAV RDY annunciation is displayed and the system will automatically transition to the NAV mode. When the NAV mode is selected or automatically transitioned to, the asterisk next to INFLT will disappear, and an asterisk will appear next to NAV. It is recommended to wait until a flashing INS NAV RDY annunciation is displayed before depressing this LSK, or allow the system to automatically transition to the NAV mode.
INS Page LSK	Allows return to INS Page (Figure 1-89).
Alignment mode	This field identifies the alignment that is in progress or was completed prior to selecting NAV mode as described below: Blank = Ground alignment INFLT = In-flight alignment SH = Fast (stored heading) alignment BATH = Fast (best available true heading) alignment
L/L FORMAT	
Initial Position (INIT POSIT) latitude LSK	This field displays the latitude of the initial position indicated in the POS SOURCE field. When the FAST LSK is depressed, this LSK will be active (as indicated by presence of brackets) for 2 minutes after the asterisk appears next to FAST. When active, this LSK allows latitude entry in degrees, minutes, and ten-thousandths of minutes (with or without a decimal point) from the scratchpad. When an initial position latitude and/or longitude is entered, the POS SOURCE field will display MAN(PILOT), the alignment mode field will display BATH, and a BATH alignment will be initiated. When the initial position source (POS SOURCE) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed).

Figure 1-90. Alternate Align (ALTALGN) (Sheet 4)

LABEL/LINE SELECT KEY	FUNCTION
Initial Position (INIT POSIT) longitude LSK	This field displays the longitude of the initial position indicated in the POS SOURCE field. When the FAST LSK is depressed, this LSK will be active (as indicated by presence of brackets) for 2 minutes after the asterisk appears next to FAST. When active, this LSK allows longitude entry in degrees, minutes, and ten-thousandths of minutes (with or without a decimal point) from the scratchpad. When an initial position latitude and/or longitude is entered, the POS SOURCE field will display MAN(PILOT), the alignment mode field will display BATH, and a BATH alignment will be initiated. When the initial position source (POS SOURCE) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed).
MGRS FORMAT	
Initial position (INIT POSIT) grid and spheroid LSK	This field displays the grid and spheroid of the initial position indicated in the POS SOURCE field. When the FAST LSK is depressed, this LSK will be active (as indicated by presence of brackets) for 2 minutes after the asterisk appears next to FAST. When active, this LSK allows grid and spheroid entry from the scratchpad. When an initial position grid and/or spheroid and/or area, eastings, and northings is entered, the POS SOURCE field will display MAN(PILOT), the alignment mode field will display BATH, and a BATH alignment will be initiated. When the initial position source (POS SOURCE) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed).
Initial position (INIT POSIT) areas, eastings, and northings LSK	This field displays the areas, eastings, and northings of the initial position indicated in the POS SOURCE field. When the FAST LSK is depressed, this LSK will be active (as indicated by presence of brackets) for 2 minutes after the asterisk appears next to FAST. When active, this LSK allows areas, eastings, and northings entry from the scratchpad. When an initial position grid and/or spheroid and/or area, eastings, and northings is entered, the POS SOURCE field will display MAN(PILOT), the alignment mode field will display BATH, and a BATH alignment will be initiated. When the initial position source (POS SOURCE) field displays NOT AVAILABLE, this field will be blank, and the LSK will be inactive (no brackets displayed).

Figure 1-90. Alternate Align (ALTALGN) (Sheet 5)

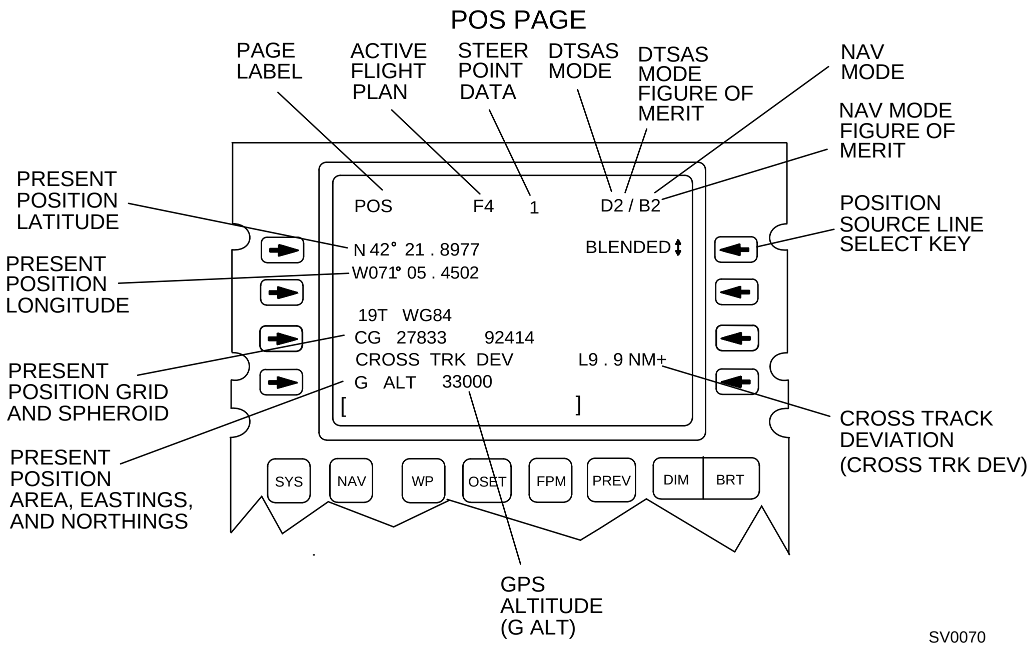


Figure 1-91. Position (POS) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section). **CAUTION** Disregard position information displayed on this page when the FOM for the selected position source (see EGI Page P1/4, Figure 1-88) is 9 or blank.
Position source LSK	Allows selection of BLENDED, GPS-only (GPS), or INS-only (INS) navigation solution to be used as the basis of the position information displayed on this page. Changing the position source does not change the commanded navigation (NAV) mode that was selected on the NAV Page (Figure 1-70).
Present position latitude	Displays present position latitude based on selected position source. When the selected position source navigation solution is not available, this field will display 11 asterisks.
Present position longitude	Displays present position longitude based on selected position source. When the selected position source navigation solution is not available, this field will display 11 asterisks.
Present position grid and spheroid	Displays present position grid and spheroid based on selected position source. When the selected position source navigation solution is not available, this field will display 9 asterisks.
Present position area, eastings, and northings	Displays present position area, eastings, and northings based on the selected position source. When the selected position navigation solution is not available, this field will display 14 asterisks.
GPS altitude (G ALT)	Displays the MSL altitude in feet as calculated by the EGI GPS. When the NAV mode field displays NI, this field will display eight asterisks.
Cross track deviation (CROSS TRK DEV)	Displays cross track deviation as a direction, left (L) or right (R), and distance in nautical miles (NM) aircraft is off of selected course. L indicates aircraft is left of selected course (HSI course deviation indicator deflected to right). R indicates aircraft is right of selected course (HSI course deviation indicator deflected to left). When the actual navigation (NAV) mode is BLENDED or INS, the cross track deviation pegs at 9.9 NM at which time a plus (+) sign appears after NM. When the actual NAV mode is GPS, the cross track deviation pegs at 5.4 NM at which time a plus (+) sign appears after NM.

Figure 1-91. Position (POS) Page (Sheet 2)

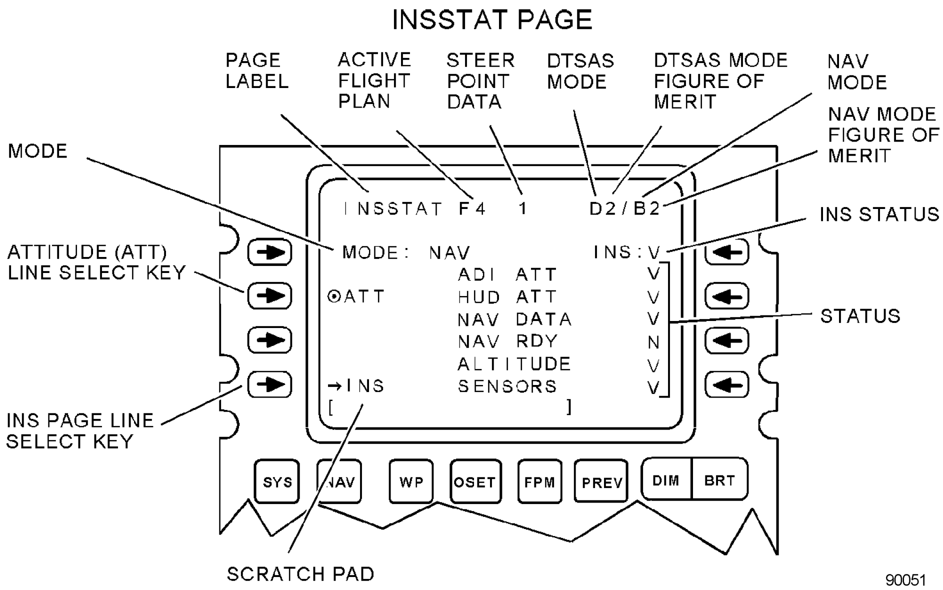


Figure 1-92. INS Status (INSSTAT) Page (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
MODE	Displays mode of EGI INS. The displayed modes are: OFF - Indicates EGI is turned off. STBY - Indicates EGI INS is in standby mode. EGI INS is in the standby mode when EGI is turned on and remains in this mode until an alignment mode is selected (either automatically or manually) or the attitude mode is selected. AA - Indicates an in-flight alignment of EGI INS is being performed. SH - Indicates stored heading alignment of EGI INS is being performed. GC - Indicates gyrocompass (normal) alignment of EGI INS is being performed. NAV - Indicates EGI INS is in navigation mode. BATH - Indicates best available true heading alignment of EGI INS is being performed. ATT - Indicates EGI INS is in attitude mode. TEST - Indicates EGI INS is performing INS initiated BIT. NARF - Indicates EGI INS is in navigation alignment refinement mode.
ATTITUDE (ATT) LSK	Allows the selection of the attitude mode. This LSK is active (target symbol displayed) whenever the EGI is on. When this LSK is depressed, the attitude mode is selected and a steady asterisk is displayed to the right of ATT. **NOTE** If the attitude mode is selected when EGI is selected on the NMSP and if EAC is engaged, EGI will be deselected (HARS will be automatically selected) and EAC will disengage.
INS Page LSK	Allows return to the INS page (Figure 1-89).
INS status	Displays status of EGI INS through the following codes: N = not communicating I = initializing V = valid F = failed T = test

Figure 1-92. INS Status (INSSTAT) Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION	
Status	Displays status of the following functions:	
	ADI ATT	V = valid
		F = failed
	HUD ATT	V = valid
		F = failed
	NAV DATA	V = valid
		F = failed
	NAV RDY	D = degraded navigation ready
		N = no navigation ready
		Y = full navigation ready
	ALTITUDE	V = valid
		F = failed
	SENSORS	V = valid
		F = failed

Figure 1-92. INS Status (INSSTAT) Page (Sheet 3)

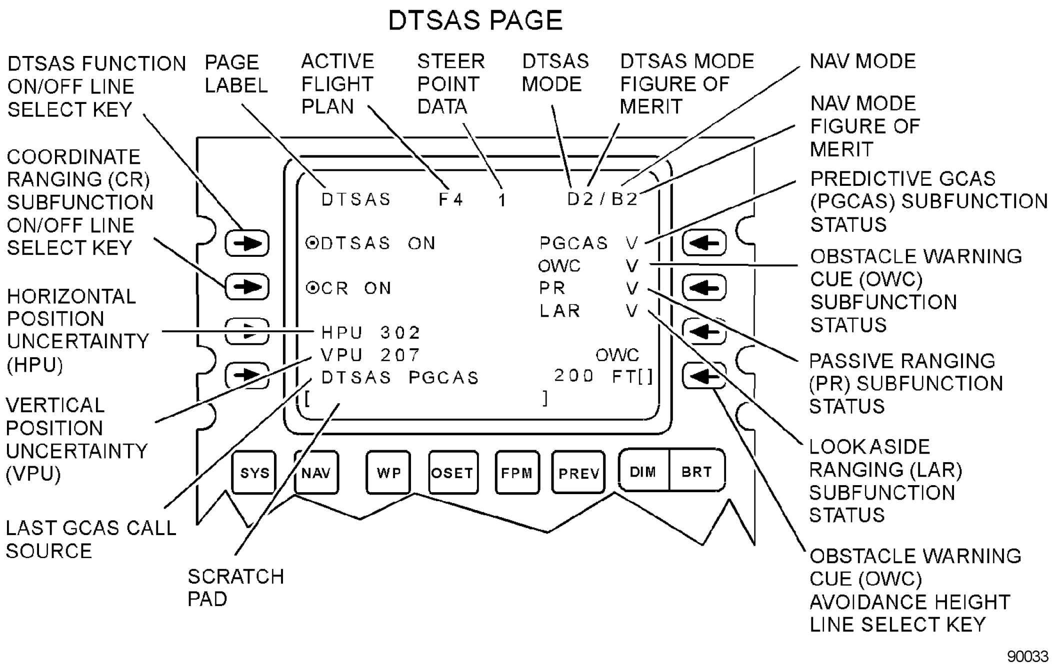


Figure 1-93. Digital Terrain System Application Software (DTSAS) Page (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
DTSAS function ON/OFF LSK	Allows the DTSAS function to be enabled/disabled. Depressing this LSK alternately toggles the DTSAS function between ON and OFF. When this field indicates OFF, the DTSAS function is disabled. When MDTC is not installed, DTSAS function display will default to DTSAS OFF.
Coordinate ranging (CR) subfunction ON/OFF LSK	Enables or disables the Coordinate Ranging subfunction. Indicates "off" when CR subfunction is disabled.
Horizontal position uncertainty (HPU)	Displays DTSAS calculated HPU (0 to 3346 feet)
	If DTSAS is OFF or failed, this field will display three asterisks.
Vertical position uncertainty (VPU)	Displays DTSAS calculated VPU (0 to 207 feet)
	If DTSAS is OFF or failed, this field will display asterisks.
Predictive GCAS (PGCAS) subfunction status	Indicates validity of PGCAS subfunction:
	V = Valid
	F = Failed
	* = Status Unknown
Obstacle warning cue (OWC) subfunction status	Indicates validity of OWC subfunction:
	V = Valid
	F = Failed
	* = Status Unknown
Passive ranging (PR) subfunction status	Indicates validity of PR subfunction:
	V = Valid
	F = Failed
	* = Status Unknown

Figure 1-93. Digital Terrain System Application Software (DTSAS) Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Look aside ranging (LAR) subfunction status	Indicates validity of LAR subfunction: V = Valid F = Failed * = Status Unknown
Obstacle warning cue (OWC) avoidance height LSK	Allows OWC avoidance height (0 to 9999 feet) to be entered by entering desired height in scratchpad and then depressing this LSK. If an OWC avoidance height is not entered, this field defaults to 100 feet.
Last GCAS call source	Displays source of last GCAS call. The three possibilities are: DTSAS PGCAS — DTSAS PGCAS subfunction was source of last call. IFFCC PGCAS — Integrated Flight and Fire Control Computer (IFFCC) PGCAS subfunction was source of last call. IFFCC 90 - FT — IFFCC 90 foot hard call was source of last call. **NOTE** This field will be blank until a GCAS message is received from the IFFCC.

Figure 1-93. Digital Terrain System Application Software (DTSAS) Page (Sheet 3)

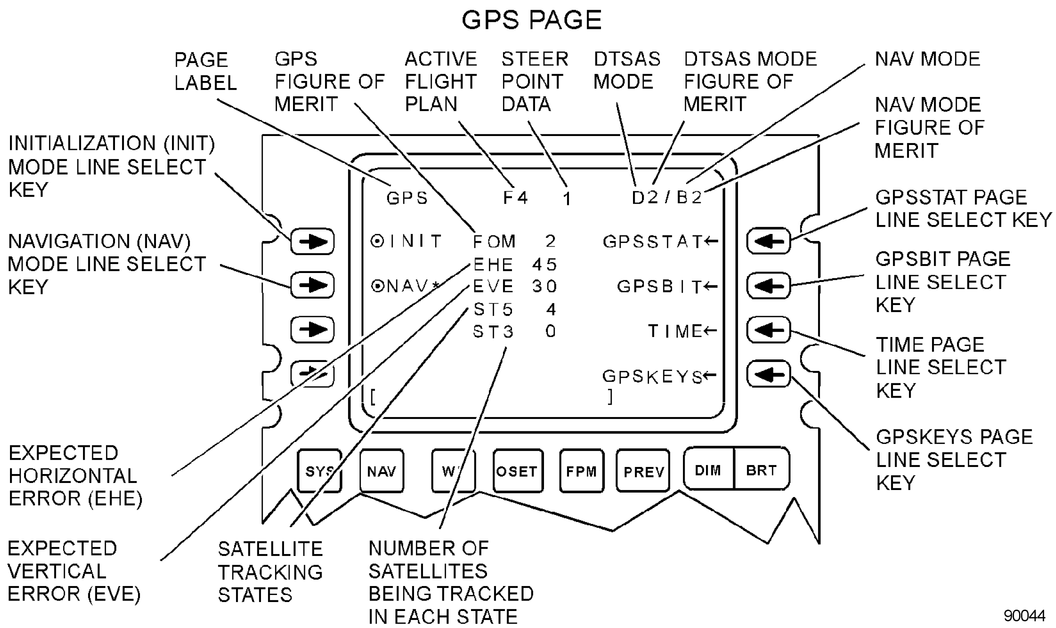


Figure 1-94. GPS Page (Sheet 1 of 3)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Initialization (INIT) mode LSK	Allows the selection of GPS INIT mode. Asterisk indicates GPS is in INIT mode.
Navigation (NAV) mode LSK	Allows the selection of GPS NAV mode. Asterisk indicates GPS is in NAV mode.
GPS FOM (figure of merit)	Displays GPS figure of merit (FOM) number between 1 and 9. Disregard the information in this field when GPS is in the INIT mode. The following lists GPS FOM and associated GPS accuracy: FOM — Spherical Error Probable (ft) 1 — Less than 85.3 feet (26 m). 2 — 85.3 feet (26 m) to 164.1 feet (50 m). 3 — Greater than 164.1 feet (50 m) to 246.1 feet (75 m). 4 — Greater than 246.1 feet (75 m) to 328.1 feet (100 m). 5 — Greater than 328.1 feet (100 m) to 656.2 feet (200 m). 6 — Greater than 656.2 feet (200 m) to 1640.5 feet (500 m). 7 — Greater than 1640.5 feet (500 m) to 3281.0 feet (1000 m). 8 — Greater than 3281.0 feet (1000 m) to 16405 feet (5000 m). 9 — Greater than 16405 feet (5000 m).
EHE (Expected horizontal error)	Displays GPS expected horizontal error (EHE) in feet. Disregard the information in this field when GPS is in the INIT mode and/or the GPS FOM is 9.
EVE (Expected vertical error)	Displays GPS expected vertical error (EVE) in feet. Disregard the information in this field when GPS is in the INIT mode and/or the GPS FOM is 9.
STs (Satellite tracking states)	Displays number of satellites (0 to 4) being used to calculate the navigation solution in state 5 (ST5) and in state 3 (ST3). The sum of the ST5 and ST3 fields will be a number from 0 to 4. State 5 is preferable and provides the best GPS FOMs. When the EGI GPS is receiving both position and velocity information from a satellite, this satellite is in state 5. When the EGI GPS is receiving only position information from a satellite, this satellite is in state 3. Usually state 3 occurs only briefly during initial satellite acquisition or during periods of jamming or noise. Disregard the information in this field when GPS is in the INIT mode and/or the GPS FOM is 9.
GPSSTAT Page LSK	Allows selection and display of GPS status (GPSSTAT) Page (Figure 1-95).

Figure 1-94. GPS Page (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
GPSBIT Page LSK	Allows the selection and display of the GPSBIT Page (Figure 1-96). This LSK is inactive (no arrow displayed) if GPS BIT data is unavailable.
TIME Page LSK	Allows the selection and display of the GPS time (TIME) Page (Figure 1-74).
GPSKEYS Page LSK	Allows the selection and display of the GPS keys (GPSKEYS) Page (Figure 1-97).

Figure 1-94. GPS Page (Sheet 3)

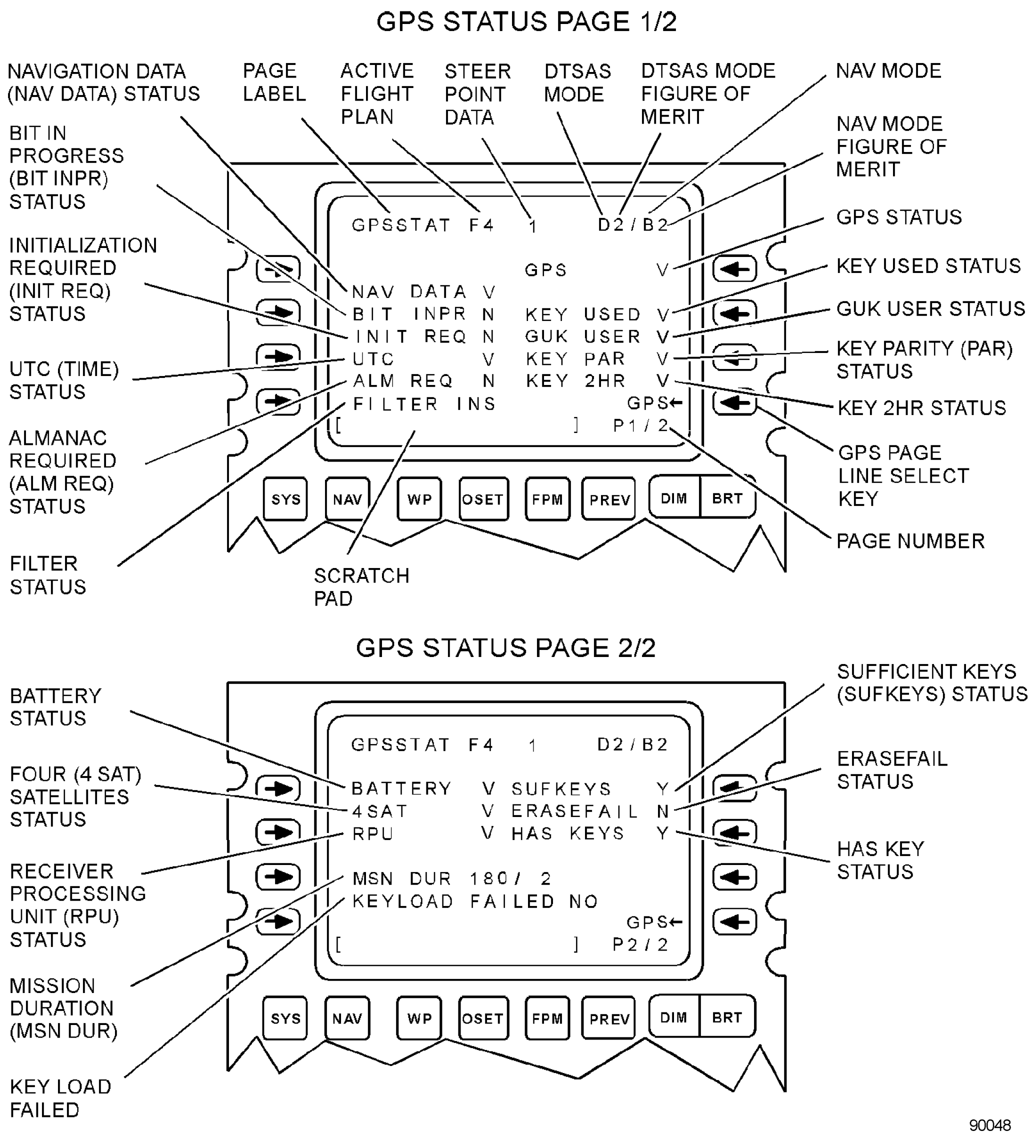


Figure 1-95. GPS Status (GPSSTAT) Pages (Sheet 1 of 4)

LABEL/LINE SELECT KEY	FUNCTION
Page number	Displays current/total page numbers.
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
PAGE 1/2	
Navigation data (NAV DATA) status	Displays status of GPS navigation data.
	V = valid
	F = failed
BIT In progress (BIT INPR) status	Displays status of GPS BIT in progress.
	N = not in progress
	Y = in progress
Initialization required (INIT REQ) status	Identifies if GPS requires time, position, or almanacs.
	N = initialization not required
	Y = initialization required
UTC (Time) status	Identifies status of GPS time.
	V = UTC valid
	F = UTC not valid
Almanac required (ALM REQ) status	Identifies if almanac required by the GPS.
	N = almanac not required
	Y = almanac required
FILTER status	Identifies which Kalman filter mode is being used in the internal GPS filter.
	INS = Inertial navigation system mode
	PVA = Position velocity acceleration mode
GPS status	Identifies status of GPS.
	N = not communicating
	V = valid
	F = failed
	I = initializing
	T = test

Figure 1-95. GPS Status (GPSSTAT) Pages (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
KEY USED status	Identifies status of key using the codes below. If a weekly key is loaded, this field will display only V or N. N = no key in use U = key in use unverified I = key in use incorrect V = key in use verified **NOTE** • If a new key has just been loaded, it may take as long as 12 minutes after the EGI GPS acquires satellites for this field to display the status of the key in use. • If the KEY USED field displays N or I, disregard the indications in the GUK USER, PAR and KEY 2HR fields.
GUK USER status	Identifies status of yearly key (GUK USER). Y = key is a yearly key N = key is not a yearly key
Key Parity (PAR) status	Identifies parity status of loaded key. V = valid F = not valid
KEY 2HR status	Identifies status of key over the next two hours. V = good for 2 hours F = expires within 2 hours
GPS Page LSK	Allows return to the GPS page (Figure 1-94).
PAGE 2/2	
BATTERY status	Identifies status of GPS receiver batteries. V = working F = failed
Four Satellites (4 SAT) status	Identifies whether four or more satellites being tracked. V = at least 4 satellites being tracked F = fewer than 4 satellites being tracked
Receiver processing unit (RPU) status	Identifies status of EGI GPS receiver processing unit (RPU). V = working F = failed

Figure 1-95. GPS Status (GPSSTAT) Pages (Sheet 3)

LABEL/LINE SELECT KEY	FUNCTION
Mission duration (MSN DUR)	Number left of slash identifies number of days EGI GPS is set up to store keys. Number right of slash identifies number of days remaining before EGI GPS must be rekeyed. When the EGI GPS is loaded with yearly (GUK) keys, the field right of the slash will never be more than 1. When EGI GPS does not have keys, this field displays 0/0. The duration (DUR) LSK on the GPS KEYS Page (Figure 1-97) allows the modification of the number of days (up to 180) that the keys are to be valid.
Sufficient keys (SUFKEYS) status	Identifies whether loaded keys (weekly keys only) are sufficient for requested mission duration. When no keys are loaded or a GUK (yearly) key is loaded, this field will display U. When weekly keys are loaded, this field will display Y or N. N = insufficient Y = sufficient U = undefined **NOTE** If a new weekly key has just been loaded, it may take as long as 12 minutes after the EGI GPS acquires satellites for this field to display the sufficient keys status.
ERASEFAIL status	Identifies if key erase was completed on last command. Y = erase failed N = erase accomplished
HAS KEYS status	Identifies if EGI GPS contains keys. Y = contains keys N = does not contain keys
KEY LOAD FAILED status	Identifies status of key loading. YES = keys were not loaded NO = keys were loaded or no key load has been attempted

Figure 1-95. GPS Status (GPSSTAT) Pages (Sheet 4)

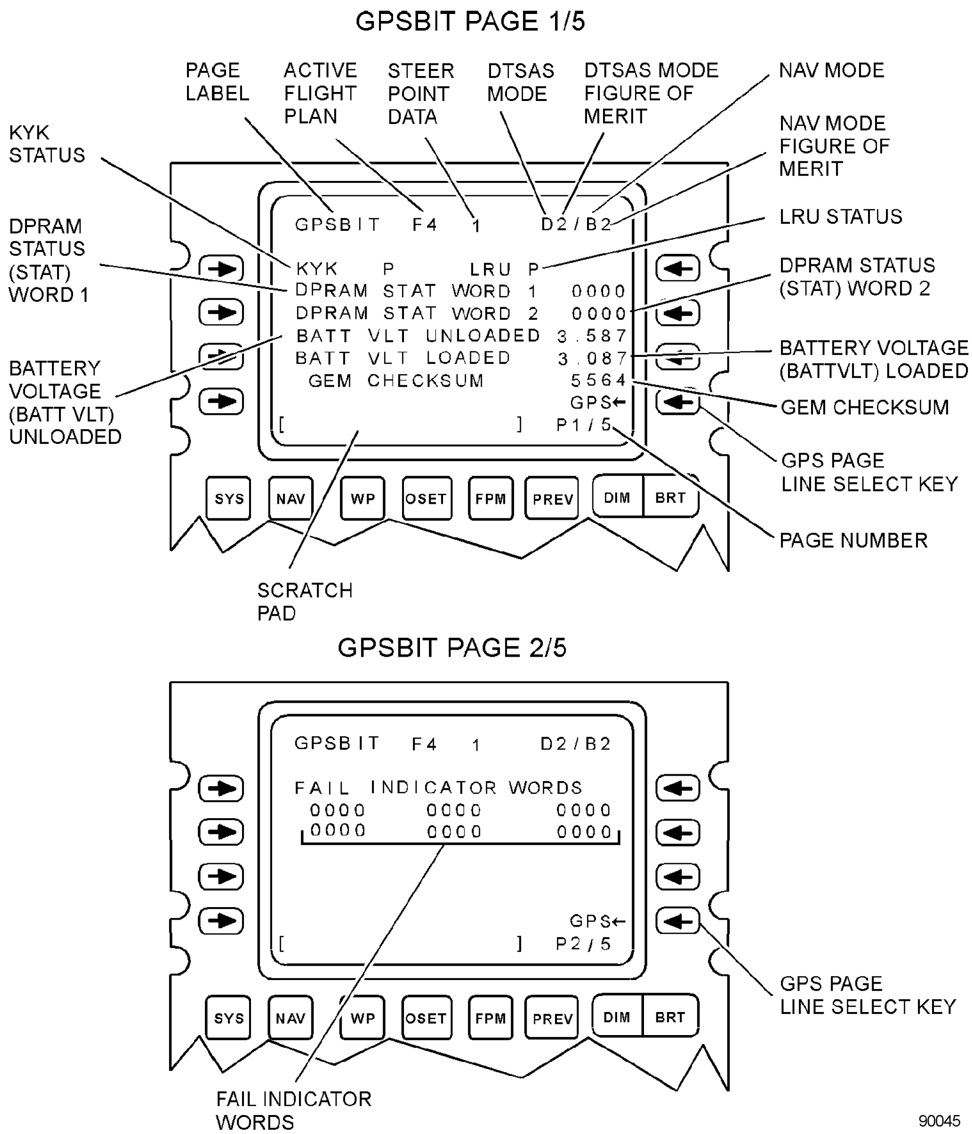


Figure 1-96. GPS BIT (GPSBIT) Pages (Sheet 1 of 4)

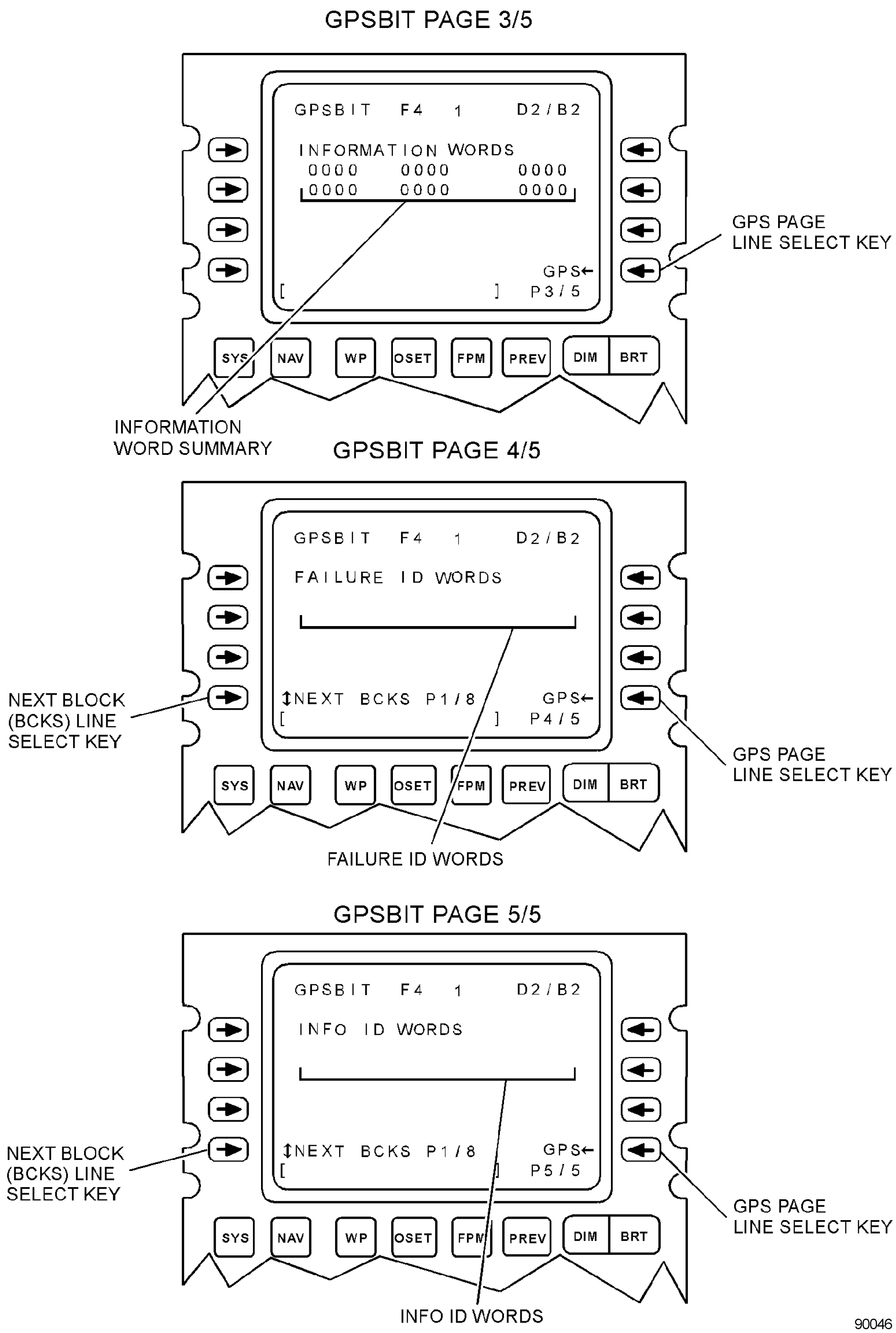


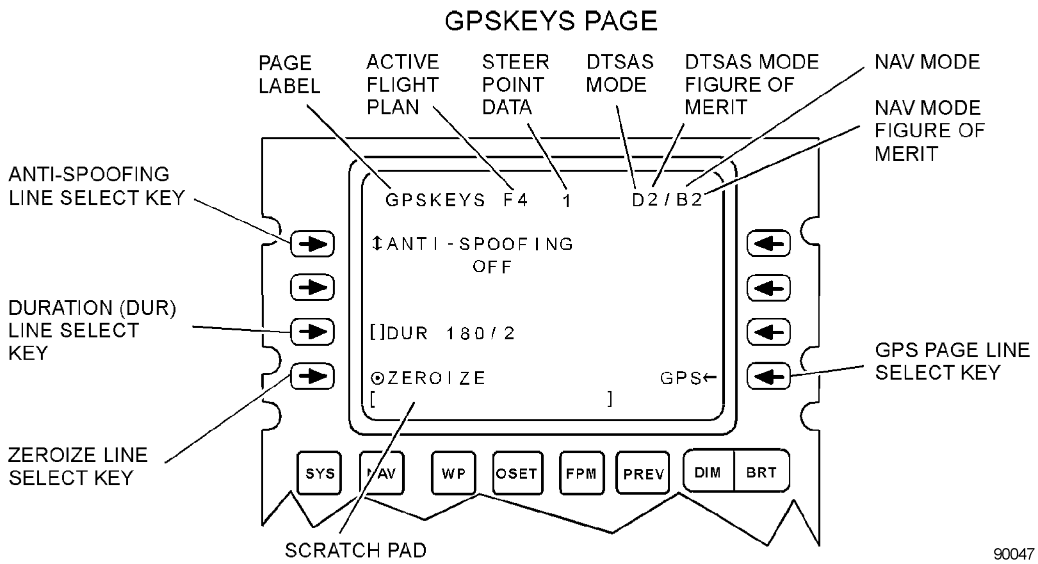
Figure 1-96. GPS BIT (GPSBIT) Pages (Sheet 2)

LABEL/LINE SELECT KEY	FUNCTION
Page number	Displays current/total page numbers.
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
PAGE 1/5	
KYK status	Indicates status of periodic and initiated BIT of EGI GPS key circuitry where: P = Pass F = Fail
LRU status	Indicates status of periodic and initiated BIT of EGI GPS circuitry where: P = Pass F = Fail
DPRAM status (STAT) WORD 1 and WORD 2	Displays status words associated with the memory shared by the EGI and EGI GPS circuitry.
Battery Voltage (BATT VLT) UNLOADED	Displays EGI GPS unloaded battery voltage.
Battery Voltage (BATT VLT) LOADED	Displays EGI GPS loaded battery voltage.
GEM CHECKSUM	Displays EGI GEM OFP checksum.
GPS Page LSK	Allows return to the GPS Page (Figure 1-94).
PAGE 2/5	
FAIL INDICATOR WORDS	Displays EGI GPS BIT fail indicator words; for use by maintenance personnel only.
GPS Page LSK	Allows return to the GPS Page (Figure 1-94).
PAGE 3/5	
INFORMATION WORD SUMMARY	Displays EGI GPS BIT information words; for use by maintenance personnel only.
GPS Page LSK	Allows return to the GPS Page (Figure 1-94).
PAGE 4/5	
FAILURE ID WORDS	Displays EGI GPS BIT failure identifiers and words; for use by maintenance personnel only.
NEXT Block (BCKS) LSK	Allows selection of the next block of failure, identifiers and words data. The number to the left of the slash indicates the number of the block being displayed. The number to the right of the slash indicates the total number of blocks; for use by maintenance personnel only.

Figure 1-96. GPS BIT (GPSBIT) Pages (Sheet 3)

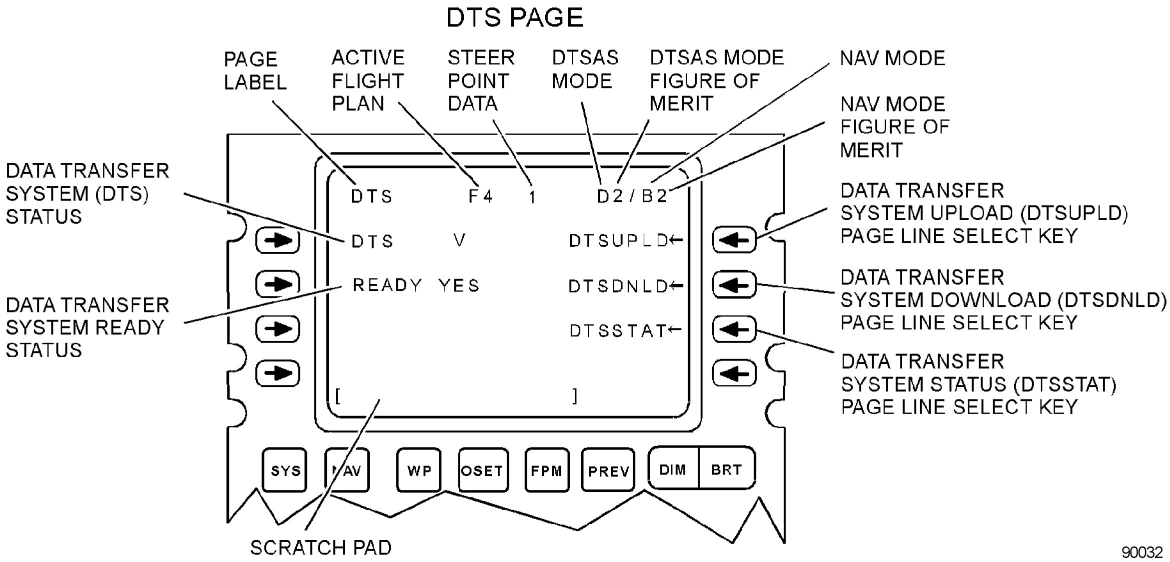
LABEL/LINE SELECT KEY	FUNCTION
GPS Page LSK	Allows return to the GPS Page (Figure 1-94).
PAGE 5/5	
Information (INFO) ID WORDS	Displays EGI GPS BIT information identifiers and words; for use by maintenance personnel only.
NEXT Block (BCKS) LSK	Allows selection of the next block of INFO ID words. The number to the left of the slash indicates the number of the block being displayed. The number to the right of the slash indicates the total number of blocks; for use by maintenance personnel only.
GPS Page LSK	Allows return to the GPS Page (Figure 1-94).

Figure 1-96. GPS BIT (GPSBIT) Pages (Sheet 4)



LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
ANTI-SPOOFING LSK	Allows anti-spoofing mode to be turned ON and OFF. When anti-spoofing is set to ON, the EGI uses only the encrypted military GPS signals when computing navigation data. This may decrease the number of satellites that can be detected by EGI. When EGI is off, this field displays three asterisks.
Duration (DUR) LSK	This LSK allows the modification of the number of days (up to 180) that the keys are to be valid. Number left of slash identifies number of days EGI GPS is set up to store keys. Number right of slash identifies number of days remaining before EGI GPS must be rekeyed. When the EGI GPS is loaded with yearly (GUK) keys, the field right of the slash will never be more than 1. When EGI GPS does not have keys, this field displays 0/0.
ZEROIZE LSK	Allows EGI GPS keys to be zeroized. Success or failure of zeroization is annunciated on CDU as GPS KEYS ERASED or GPS KEY ERASE FAIL. The GPS status (GPSSTAT) Page 2/2 (Figure 1-95) must also be checked to confirm that "HAS KEY" is N. **NOTE** To zeroize EGI GPS keys using the ZEROIZE LSK, EGI GPS must be in the NAV mode as indicated by the asterisk next to NAV on the GPS Page (Figure 1-94).
GPS Page LSK	Allows return to the GPS Page (Figure 1-94).

Figure 1-97. GPS Keys (GPSKEYS) Page



LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Data transfer system (DTS) status	Displays status of DTS with the following codes: N = not communicating I = initializing V = valid F = failed
DTS READY status	Identifies if DTS is ready: YES or NO. Displays NO if no DTC is installed in UDTU or DTS status is N or F.
DTS Upload (DTSUPLD) Page LSK	Allows the selection and display of the DTSUPLD Page (Figure 1-77).
DTS Download (DTSDNLD) Page LSK	Allows the selection and display of the DTSDNLD Page (Figure 1-99).
DTS Status (DTSSTAT) Page LSK	Allows the selection and display of the DTSSTAT Page (Figure 1-100).

Figure 1-98. DTS Page

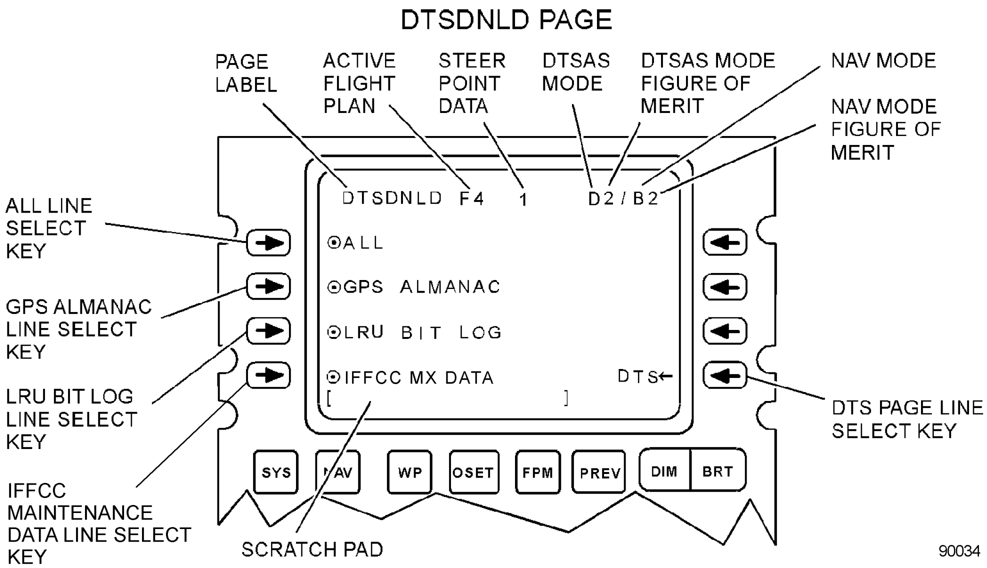


Figure 1-99. DTS Download (DTSDNLD) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
ALL Maintenance	Allows the downloading of data to DTS, including waypoint, markpoints, flight plans, HUD LASTE events, almanac, BIT log and IFFCC Maintenance data. ADR data is not downloaded. Flashing asterisk displayed in upper left corner while download is in progress. Depressing this LSK when the DTS status on the DTS Page (Figure 1-98) is N, I, T, or F, causes a flashing asterisk to be displayed in the upper left corner of the CDU; and then causes the DOWNLOAD FAILED annunciation to be displayed on the CDU. This LSK is only active (target symbol displayed) when the aircraft is on the ground (weight on wheels) and the indicated airspeed is less than 75 knots. 152 Does not include IEPU data.
GPS ALMANAC	Allows the downloading of GPS almanac to DTS. Flashing asterisk is displayed in upper left corner while download is in progress. Depressing this LSK when the DTS status on the DTS Page (Figure 1-98) is N, I, T, or F, causes a flashing asterisk to be displayed in the upper left corner of the CDU; and then causes the DOWNLOAD FAILED annunciation to be displayed on the CDU. This LSK is only active (target symbol displayed) when the aircraft is on the ground (weight on wheels) and the indicated airspeed is less than 75 knots.
LRU BIT LOG	Allows the downloading of LRU BIT log data to DTS. Flashing asterisk displayed in upper left corner while download is in progress. Depressing this LSK when the DTS status on the DTS Page (Figure 1-98) is N, I, T, or F, causes a DOWNLOAD FAILED annunciation to be displayed on the CDU. This LSK is only active (target symbol displayed) when the aircraft is on the ground (weight on wheels) and the indicated airspeed is less than 75 knots.
IFFCC MX DATA line select key	Allows the downloading of all IFFCC maintenance data and fault codes to DTS. Flashing asterisk displays in upper left corner of CDU during download. Pressing this LSK when the DTS status is N, I, T, or F on DTS Page, causes a flashing asterisk in upper left corner and DOWNLOAD FAILED annunciation on CDU. LSK is active (target symbol displayed) only when aircraft is on ground (weight on wheels) and airspeed is less than 75 knots.
IEPU LSK 152	Allows downloading of all ADR data to DTS.
Data Transfer System (DTS) Page LSK	Allows return to the DTS Page (Figure 1-98).

Figure 1-99. DTS Download (DTSDNLD) Page (Sheet 2)

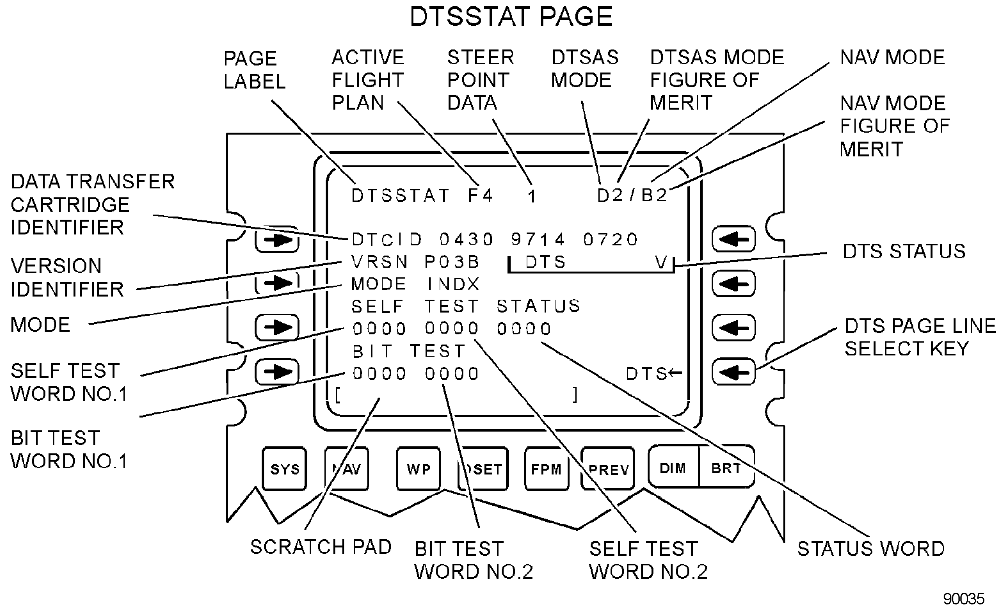


Figure 1-100. DTS Status (DTSSTAT) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Data transfer cartridge identifier (DTCID)	Displays data transfer cartridge (DTC) identification number. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after the CDU is turned on, disregard any information displayed in this field.
Version identifier (VRSN)	Displays DTS OFP version number. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after the CDU is turned on, disregard any information displayed in this field.
MODE	Displays DTS mode. During normal operation, this field will display INDX. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after the CDU is turned on, disregard any information displayed in this field.
SELF TEST word no. 1	Displays SELF TEST word no. 1 data with 4-bit hexadecimal code. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after the CDU is turned on, disregard any information displayed in this field. This field is for use by maintenance personnel only.
SELF TEST word no. 2	Displays SELF TEST word no. 2 data with 4-bit hexadecimal code. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after the CDU is turned on, disregard any information displayed in this field. This field is for use by maintenance personnel only.
STATUS word	Displays DTS status with 4-bit hexadecimal code. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after the CDU is turned on, disregard any information displayed in this field. This field is for use by maintenance personnel only.
DTS status	Displays status of DTS with the following codes: V = valid F = failed N = not communicating I = initializing T = test
BIT TEST word no. 1	Displays BIT TEST word no. 1 data with 4-bit hexadecimal code. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after the CDU is turned on, disregard any information displayed in this field. This field is for use by maintenance personnel only.
BIT TEST word no. 2	Displays BIT TEST word no. 2 data with 4-bit hexadecimal code. If a DTC has not been inserted and locked into the UDTU (DTS status field will display N) either before or after CDU is turned on, disregard any information displayed in this field. This field is for use by maintenance personnel only.
DTS Page LSK	Allows return to the DTS Page (Figure 1-98).

Figure 1-100. DTS Status (DTSSTAT) Page (Sheet 2)

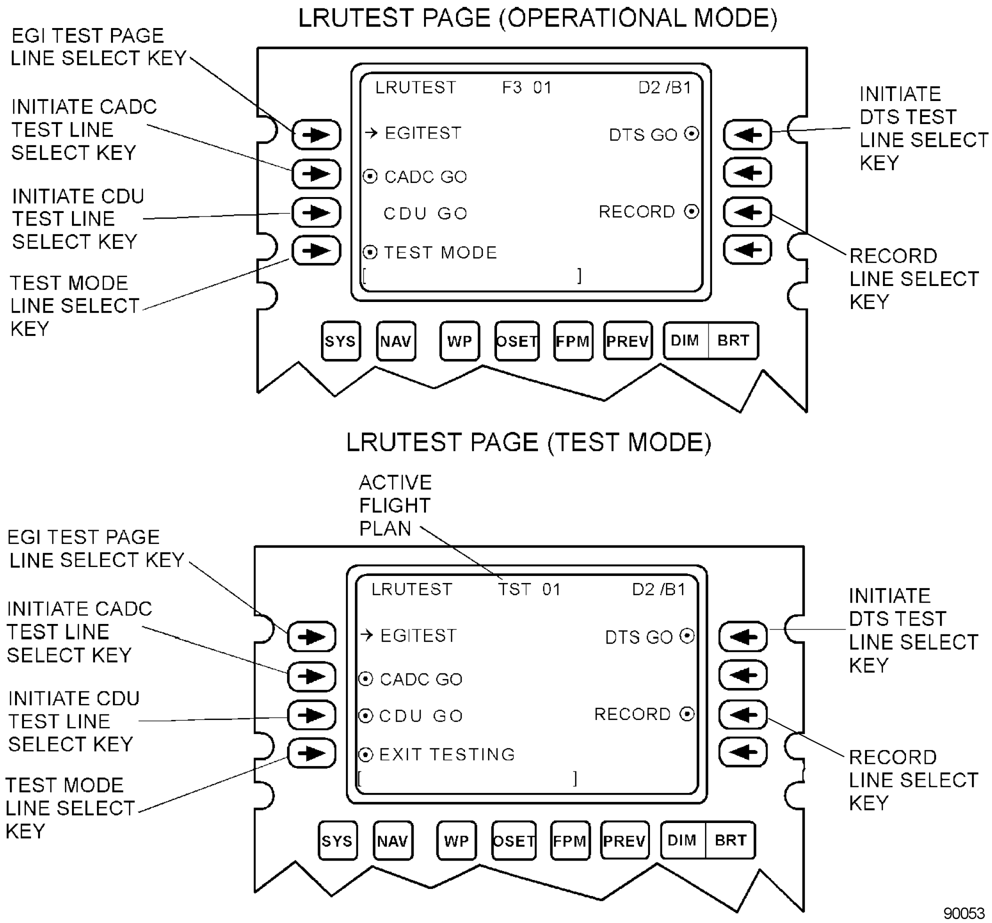


Figure 1-101. LRU Test (LRUTEST) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
EGITEST Page LSK	Allows the selection and display of the EGITEST Page (Figure 1-102).
Initiate CDU test LSK	Allows initiation of CDU BIT and displays CDU test status. This LSK is inactive (no target symbol displayed) in CDU operational mode. Once the CDU is in test mode, depressing this LSK initiates the CDU self test. IP indicates that the test is in progress. GO indicates that the test has passed, NG indicates a system failure, and UN indicates that the CDU is untested.
Initiate CADC test LSK	Allows the placement of CADC into self-test mode and displays CADC test status. If a test is in progress, an IP will be displayed. GO indicates that the system test has passed, an NG indicates a system failure, and a UN indicates that the CADC is untested. This LSK is inactive (no target symbol displayed) when the CADC status on the SYS Page 1/3 (Figure 1-80) or CADC Page (Figure 1-86) is N, or the aircraft is in the air.
TEST MODE LSK	Allows the placement of CDU into test mode. To place CDU in test mode, first depress TEST MODE LSK. The CDU will display CONFIRM Y/N? To enter test mode, type Y. Depressing any other key will erase display and leave CDU in operational mode. This LSK is inactive (no target symbol displayed) when the aircraft is in the air. When CDU is in TEST MODE, the active flight plan field in the top line displays TST and the field associated with this LSK changes to EXIT TESTING. To exit the TEST MODE, first depress this LSK (to the left of EXIT TESTING). The CDU will display CONFIRM Y/N? To exit TEST MODE, type Y. EXIT TESTING will flash until the CDU returns to the operational mode, a warm start will occur, and WARM START will be displayed in the annunciator field for 10 seconds or until FA key is depressed. Depressing any other key will erase display and leave CDU in operational mode. **NOTE** While EXIT TESTING is flashing, all LSK, function select key, and keyboard keys on the CDU are inactive.
Initiate DTS test LSK	Allows the placement of DTS into self-test mode and displays DTS test status. Depressing this LSK initiates the DTS self test. IP indicates the test is in progress. GO indicates that the test has passed, an NG indicates a system failure, and a UN indicates that the DTS is untested. This LSK is inactive (no target symbol displayed) when DTS status is not communicating.
IEPU GO 152	Allows operator to place IEPU in self-test mode and displays IEPU status: IP = test in progress, GO = test has passed or UN = not tested. Key is inactive with no IEPU installed.
RECORD LSK	Records BIT results on the DTC when LSK is depressed.
IEPU installed/not installed LSK 152	Allows operator to indicate an IEPU is installed. Key is active in test mode only. YES = installed, NO = not installed. Saved to NUM during CDU warm start upon exit of test mode. In operational mode, key is inactive (no up/down arrow) but setting is shown.

Figure 1-101. LRU Test (LRUTEST) Page (Sheet 2)

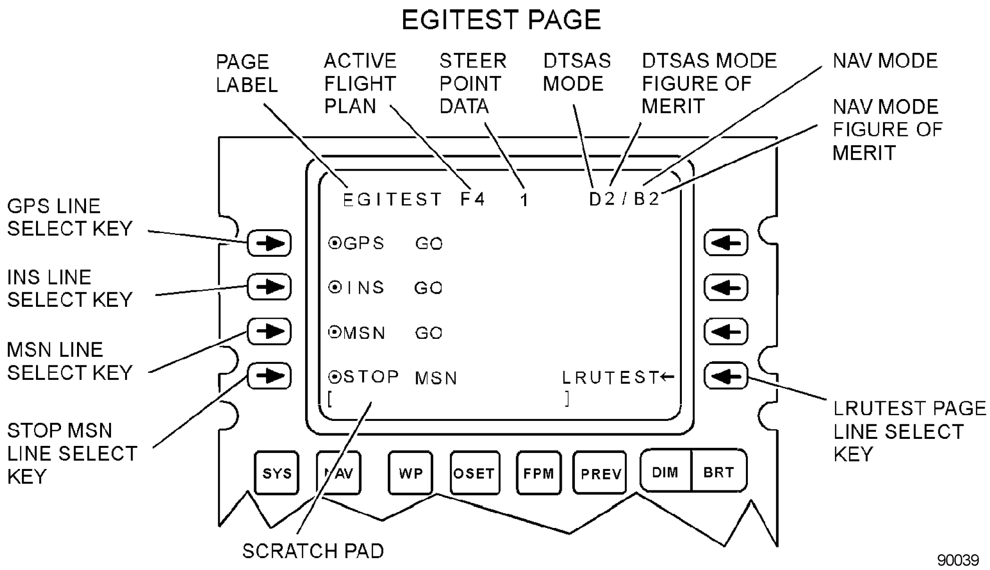


Figure 1-102. EGI Test (EGITEST) Page (Sheet 1 of 2)

WARNING

This page is for use by maintenance personnel only and is provided for reference only. Selecting MSN test from this page could result in movement of the rudder while the aircraft is on the ground and below 75 knots.

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
GPS LSK	Allows the placement of EGI GPS into self-test mode and displays EGI GPS test status. If a test is in progress, IP will be displayed. GO indicates that the EGI GPS self-test has passed, an NG indicates an EGI GPS failure, and UN indicates that the EGI GPS is untested. This LSK is inactive (no target symbol displayed) when the aircraft is in the air or when the EGI GPS status is N or I. If selected, this test requires approximately 2 minutes.
INS LSK	Allows the placement of EGI INS into self-test mode and displays EGI INS test status. If a test is in progress, an IP will be displayed. GO indicates that the EGI INS self-test has passed, an NG indicates an EGI INS failure, and UN indicates that the EGI INS is untested. This LSK is inactive (no target symbol displayed) when the aircraft is in the air or is in motion on the ground, the EGI missionization section (MSN) status is T, the EGI INS status is N, or EGI INS is in NAV or attitude (ATT) mode. If selected, this test requires approximately 12 minutes.
MSN LSK	Allows the placement of EGI missionization (MSN) section into self-test mode and displays EGI missionization section test status. If a test is in progress, IP will be displayed. GO indicates that the EGI missionization section self-test has passed, an NG indicates an EGI missionization section failure, and UN indicates that the EGI missionization section is untested. This LSK is inactive (no target symbol displayed) when the aircraft is in the air, the EGI INS status is T, or the EGI missionization section (MSN) status is N. If selected, this test requires approximately 3.5 minutes.
STOP MSN LSK	Allows EGI missionization section self-test to be stopped. This LSK is inactive (no target symbol displayed) when the aircraft is in the air, the EGI INS status is T, or the EGI missionization section (MSN) status is N.
LRUTEST Page LSK	Allows return to the LRUTEST Page (Figure 1-101).

Figure 1-102. EGI Test (EGITEST) Page (Sheet 2)

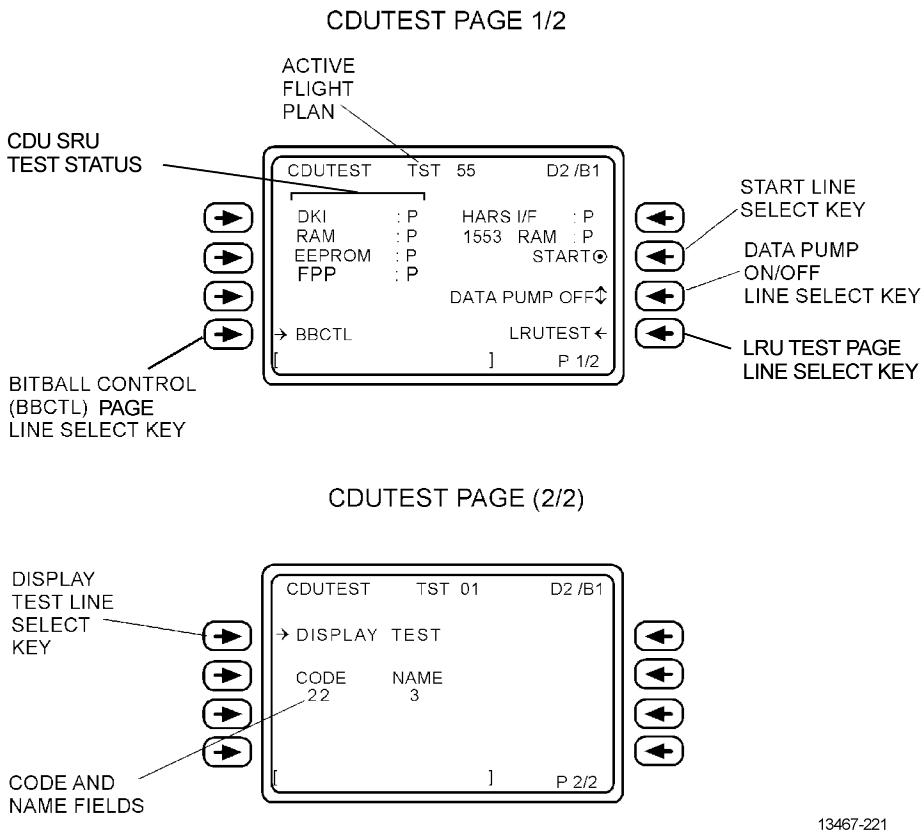


Figure 1-103. CDU Test (CDUTEST) Pages (Sheet 1 of 2)

NOTE

This page is for use by maintenance personnel only and is provided for reference only.

LABEL/LINE SELECT KEY	FUNCTION
Page number	Displays current/total page numbers.
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
PAGE 1/2	
START LSK	Allows CDU self-test to be started when CDU is in test mode. (This LSK is active (target symbol displayed) only when CDU is in test mode.) The functions tested are CDU shop replaceable units (SRUs). CDU SRUs are: DKI (keyboard) RAM (random access memory) EEPROM (programmable memory) FPP (floating point processor) HARS I/F (interface with HARS) 1553 RAM (1553 bus random access memory)
CDU SRU test status	Indicates current status of each CDU SRU self test. Note that a P = passed, an F = failed, and a W = in progress.
DATA PUMP ON/OFF LSK	Allows data pump to be turned on and off. (Provided for test purposes only. Should normally be set to off.)
LRUTEST Page LSK	Allows return to the LRUTEST Page (Figure 1-101).
Bitball Control (BB CTL) Page LSK	Allows the selection and display of the BB CTL Page (Figure 1-104).
PAGE 2/2	
DISPLAY TEST LSK	First depression displays moving test pattern across complete screen. Second depression returns CDU screen to original CDUTEST Page P2/2.
CODE and NAME fields	Displays the code and name of each key of the CDU keyboard when the key is depressed.

Figure 1-103. CDU Test (CDUTEST) Pages (Sheet 2)

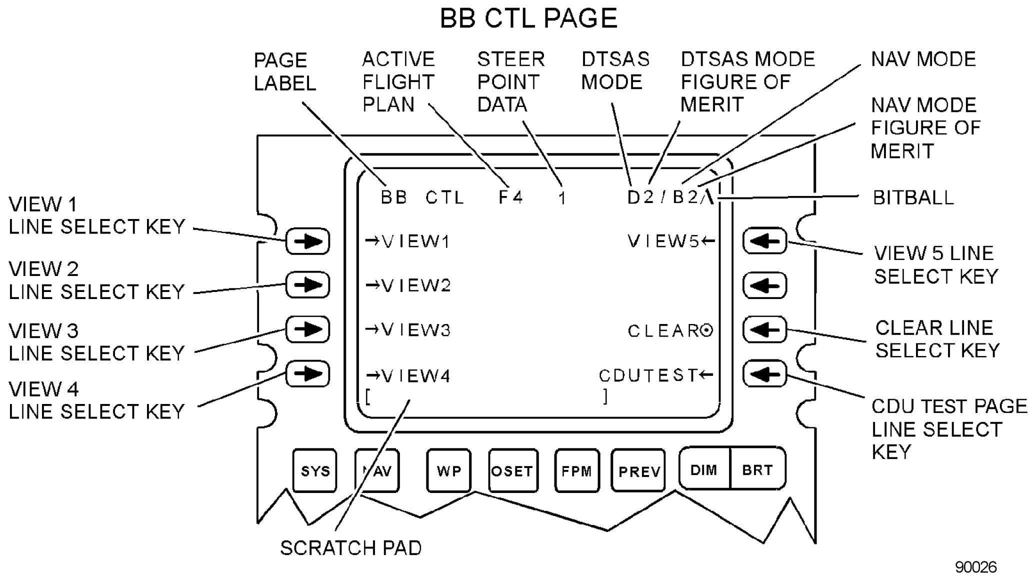


Figure 1-104. Bitball Control (BB CTL) Page (Sheet 1 of 2)

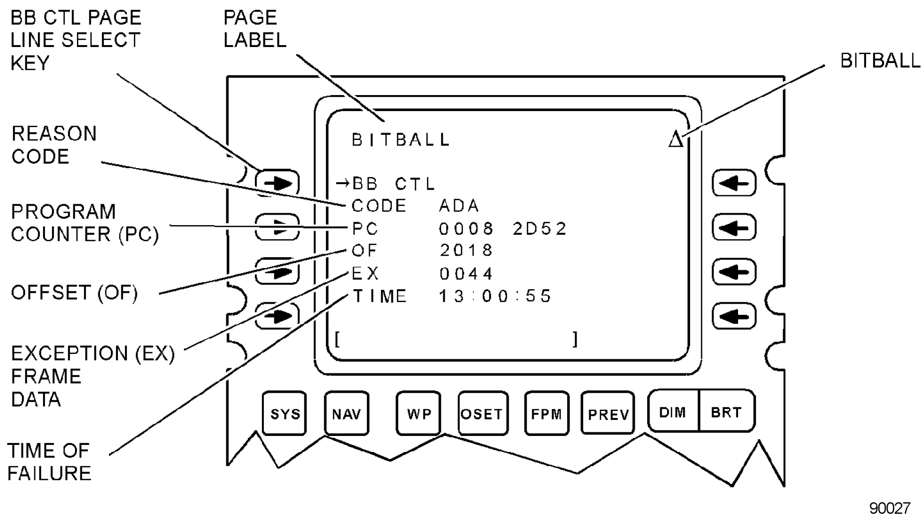
NOTE

This page is for use by maintenance personnel only and is provided for reference only.

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Bitball	Displayed on all CDU pages when valid information is contained in BITBALL Page (e.g., a CDU failure has occurred, and has not been cleared by maintenance personnel).
VIEW1 LSK	Displays BITBALL Page (Figure 1-105), which contains information on first CDU bitball in memory. When present, an arrow symbol indicates a bitball is present, and LSK is active.
VIEW2 LSK	Displays BITBALL Page (Figure 1-105), which contains information on second CDU bitball in memory. When present, an arrow symbol indicates a second bitball is present, and LSK is active.
VIEW3 LSK	Displays BITBALL Page (Figure 1-105), which contains information on third CDU bitball in memory. When present, an arrow symbol indicates a third bitball is present, and LSK is active.
VIEW4 LSK	Displays BITBALL Page (Figure 1-105), which contains information on fourth CDU bitball in memory. When present, an arrow symbol indicates a fourth bitball is present, and LSK is active.
VIEW5 LSK	Displays BITBALL Page (Figure 1-105), which contains information on fifth CDU bitball in memory. When present, an arrow symbol indicates a fifth bitball is present, and LSK is active.
CLEAR LSK	Clears all CDU bitballs from memory. This LSK is active (target symbol displayed) only when TEST MODE is selected on the LRUTEST Page.
CDUTEST Page LSK	Allows return to the CDUTEST Page (Figure 1-103).

Figure 1-104. Bitball Control (BB CTL) Page (Sheet 2)

BITBALL PAGE



NOTE

This page is for use by maintenance personnel only and is provided for reference only.

LABEL/LINE SELECT KEY	FUNCTION
Bitball	Displayed on all CDU pages, when valid information is contained in BITBALL Page (e.g., a CDU failure has occurred, and has not been cleared by maintenance personnel).
BB CTL Page LSK	Allows return to the BB CTL Page (Figure 1-104).
Reason Code	Translates exception (EX) frame data into high level codes.
Program Counter (PC)	Displays program counter contents at time of failure.
Offset (OF)	Displays offset register contents at time of failure.
Exception (EX) Frame Data	Displays exception frame data register contents at time of failure.
Time of Failure (TIME)	Displays time of failure in selected time mode (GMT or local).

Figure 1-105. BITBALL Page

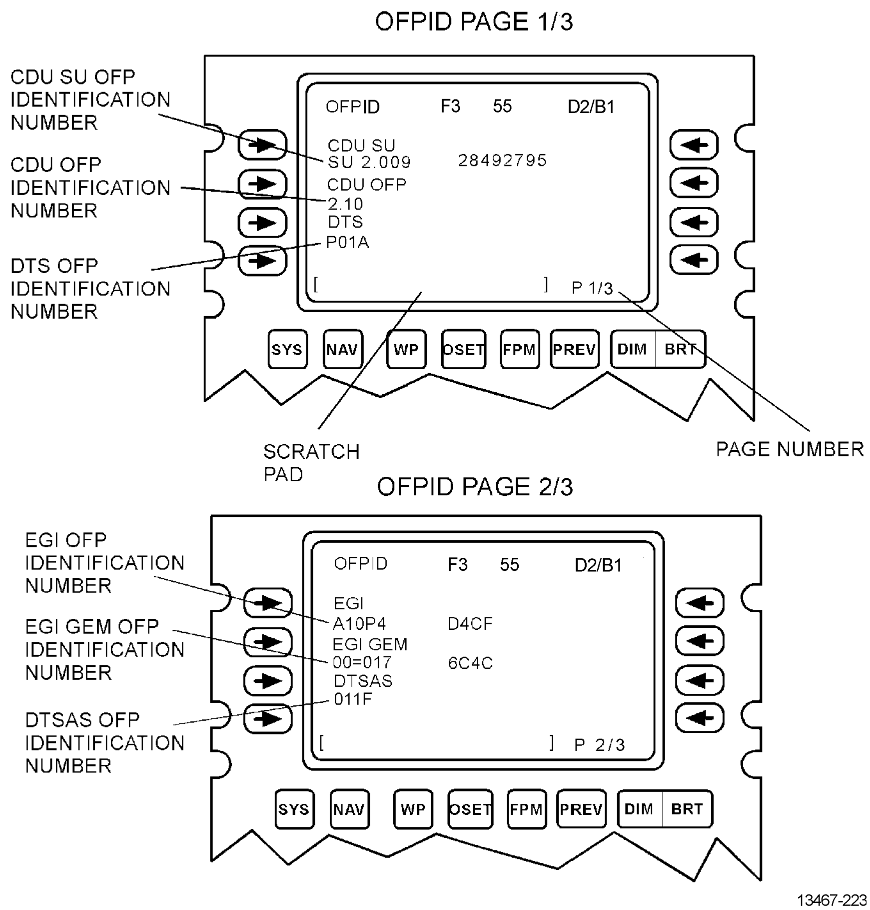


Figure 1-106. Operational Flight Programs Identification (OFPID) Page (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
Page number	Displays current/total page numbers.
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
PAGE 1/3	
CDU SU OFP identification number	Displays CDU startup OFP identification number and its checksum.
CDU OFP identification number	Displays CDU OFP identification number and its checksum.
DTS OFP identification number	Displays DTS OFP identification number and its checksum. If a DTC has not been inserted and locked into the UDTU either before or after the CDU is turned on, disregard any indications in this field.
PAGE 2/3	
EGI OFP identification number	Displays EGI OFP identification number and its checksum. When EGI is off, this field is blank.
EGI GEM OFP identification number	Displays EGI GEM OFP identification number and its checksum. When EGI is off, this field is blank.
DTSAS OFP identification number	Displays DTSAS OFP identification number. If a DTC has not been inserted and locked into the UDTU either before or after the CDU is turned on, disregard any indications in this field.
PAGE 3/3	
IEPU OFP identification number	Displays IEPU OFP identification number and its checksum.

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Figure 1-106. Operational Flight Programs Identification (OFPID) Page (Sheet 2)

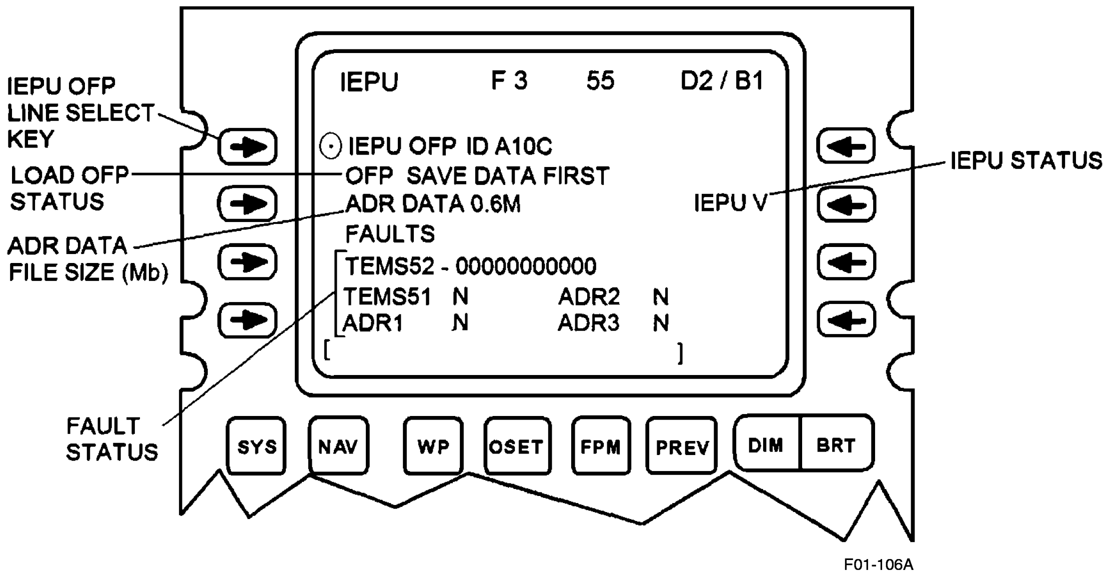

Figure 1-107. IEPU Page 152 (Sheet 1 of 2)

LABEL/LINE SELECT KEY	FUNCTION
IEPU operational flight program (IEPU OFP) load line select key	This line select key is active (target symbol displayed) only when the TEST mode is selected using the LRUTEST Page, and when pressed, initiates the loading of the IEPU OFP from the DTS. This line select key is for use by maintenance personnel only when installing a new OFP.
IEPU operational flight program identification number (IEPU OFP ID)	Provides identification number of IEPU operational flight program.
OFP status Displays status of IEPU load:	SAVE DATA FIRST: Indicates ADR data is saved. OFP can be uploaded, but data will be lost if not saved first. If IEPU Status/Command response word does not indicate ADR data "Empty", this will be displayed if OFP load is not being attempted.
	NOT ATTEMPTED: Upload has not been attempted, and ADR data file is empty.
	PENDING: Upload has been requested.
	LOADING XXX%: Upload in progress, XXX is percentage of OFP load completed.
	FAILED: Upload failed.
	PASSED: Upload completed successfully, and ADR data file is empty.
ADR Data File Size	Displays size of ADR data file in Megabytes as reported from IEPU.
IEPU status	Displays status of IEPU through the following codes: N = not communicating, V = valid, F = failed, T = test.
Fault Status	Displays faults as reported from IEPU.
	TEMS 52- 00000000000: Any value set to 1 is a detected failure.
	TEMS 51: N = no fault, Y = Battery Failure
	ADR1: N = no fault, Y = 1553 Data bus failure.
	ADR2: N = no fault, Y = .
	ADR3: N = no fault Y =

Figure 1-107. IEPU Page 152 (Sheet 2)

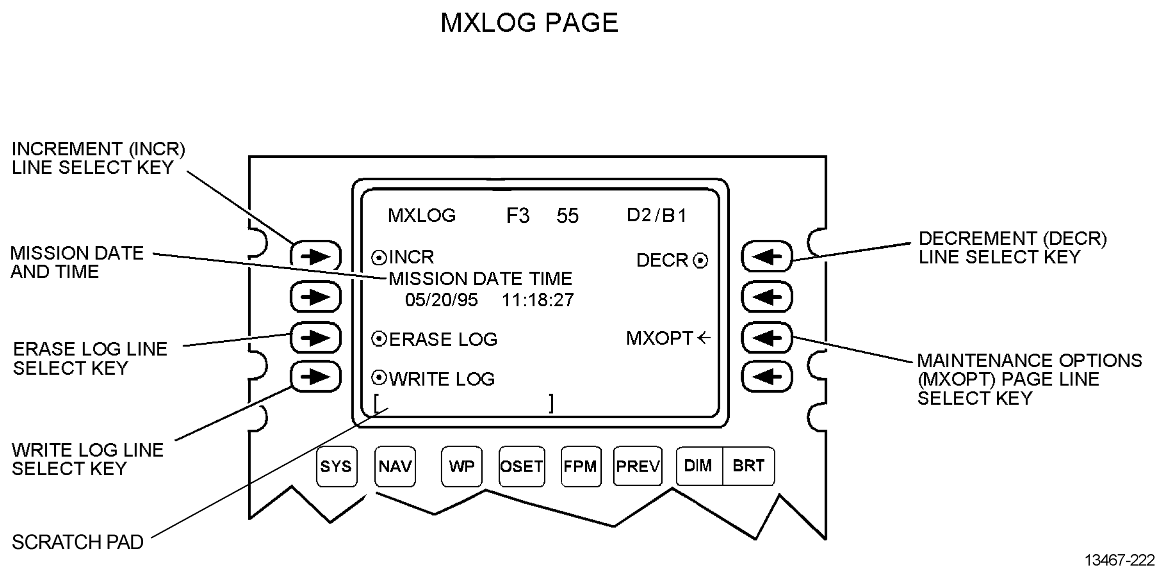

Figure 1-108. Maintenance Log (MXLOG) Page (Sheet 1 of 2)

NOTE

This page is for use by maintenance personnel only and is provided for reference only.

LABEL/LINE SELECT KEY	FUNCTION
Scratchpad	Provides display of characters entered using the keyboard. On this Page, entering an alphabetical character (A to Z) and then entering an alphanumeric character (A to Z or 0 to 9) in the scratchpad initiates a search of the waypoint database for waypoint(s) whose identifier begins with these characters. For the detailed procedures to perform a waypoint search refer to the Waypoint Search Procedure, (this section).
Increment (INCR) LSK	This LSK is active (target symbol displayed) only when more than one maintenance log has been created. When depressed, this LSK increments through the maintenance logs which are displayed under MISSION DATE TIME.
MISSION DATE and TIME field	Displays mission date and time of selected maintenance log. The mission date and time is the date and time that the maintenance log was created. If no maintenance log(s) have been created, EMPTY MX LOG is displayed below MISSION DATE TIME.
ERASE LOG LSK	This LSK is active (target symbol displayed) only when a maintenance log has been created and TEST MODE has been selected using the LRUTEST Page (Figure 1-101). When depressed, this LSK erases all maintenance logs.
WRITE LOG LSK	This LSK is active (target symbol displayed) only when the aircraft is on the ground and its speed is less then 75 knots. When depressed, this LSK causes a maintenance log associated with the test date and time to be created. When a maintenance log is created, the CDU performs a warm start, and the WARM START annunciation is displayed on the CDU.
Decrement (DECR) LSK	This LSK is active (target symbol displayed) only when more than one maintenance log has been created. When depressed, this LSK decrements through the maintenance logs which are displayed under MISSION DATE TIME.
Maintenance Options (MXOPT) LSK	This LSK is active (arrow symbol displayed) only when one or more maintenance logs have been created. When depressed, this LSK causes the maintenance option (MXOPT) Page to be displayed which allows maintenance personnel to observe various maintenance data stored in the selected maintenance log.

Figure 1-108. Maintenance Log (MXLOG) Page (Sheet 2)

COMMUNICATION SYSTEMS.

See Figure 1-109 for a listing of communications equipment installed in the aircraft.

ANTENNA LOCATIONS.

Antennas used with the communications equipment installed in the aircraft are illustrated in Figure 1-43.

IDENTIFICATION SYSTEM - IFF (AN/APX-101 or AN/APX-119).

The identification system enables the aircraft to identify itself when interrogated by proper signals from appropriate radar. Modes 1, 2, and 4 are used for tracking and identification purposes. Modes 3/A, C and S (AN/APX-119 only) are used for tracking and altitude reporting, respectively.

Mode 4 operation is provided by the transponder in conjunction with the transponder computer, KIT-1C. The KIT-1C is classified equipment and must be protected at all times in accordance with applicable security regulations.

The R/T contains BIT module which can monitor transponder responses to operational interrogations, or internally simulate any mode of interrogation by pressing the TEST OSB on System Status Page 2 (Figure 1-167.1) when in primary control or by using the test positions of the switches available at the Identification Friend or Foe/Selective Identification Feature (IFF/SIF) control panel (Figure 1-111).

AN/APX-119 option only - Mode S establishes selective and addressed interrogations with aircraft within its coverage. Selective interrogation improves the quality and integrity of the detection and altitude reporting.

IFF Antenna Switch.

The IFF antenna switch (Figure 1-110) is a three-position toggle switch, located on the antenna select panel on the left console. The switch is placarded IFF ANT, with positions UPPER, LOWER, and BOTH. UPPER and LOWER positions receive and transmit on the respective antenna. BOTH receives and transmits on the antenna receiving the strongest signal and is the normal position for this switch. The switch must be raised to move out of BOTH. When Mode S is enabled, antenna select function is disabled and the switch defaults to BOTH. The IFF antenna switch is only used in backup control. In primary control, the ANTENNA OSB on IFF CONTROLS Page (Figure 1-109.2) is used. The transponder defaults to BOTH after 60 seconds when set to UPPER or LOWER.

Mode 4 Caution Light.

An IFF MODE-4 caution light (Figure 1-158), located on the caution light panel, comes on whenever the IFF caution light circuitry detects an inoperative Mode 4 capability, provided that:

- KIT-1C computer is installed.
- Aircraft power is on.
- IFF MASTER switch is not OFF.

Specific discrepancies monitored by the IFF caution light circuitry are:

- Mode 4 codes zeroed,
- Transponder failure to reply to proper interrogation, and
- Failure of automatic self-test.

NOTE

> If the IFF Mode 4 caution light comes on, the equipment will not respond to Mode 4 interrogations, and operation in a known Mode 4 interrogating environment should be avoided, or if already in one, appropriate corrective or emergency action should be taken.

IFF Operation.

The IFF system receives pulse-coded UHF radio signals. The radio signals are captured by antennas and processed. The encoded reply is routed to the antenna that received the strongest signal.

The system includes an IDENT function which is activated by momentarily placing the IDENT/OUT/MIC switch on the IFF/Mode S control panel to IDENT, or placing the switch to MIC initiating a response each time the UHF radio is keyed, or pressing the upper right blank key (IFF) on the UFC with the scratch pad empty. The response will continue for 17 to 19 seconds after initiation.

The emergency mode of operation is initiated by setting the EMER OSB to ON on one of the IFF CONTROLS Page and IFF PROFILES Page when in primary control or by placing the MASTER switch to EMER while in Mode 1, 2, or 3A. During the ejection sequence a switch automatically enables Modes 1, 2, 3/A, plus emergency. In addition, the Mode 4 code is automatically zeroed.

The two system modes of operation, primary and backup, are described as follows.

Type	Designation	Function	Range	Control Location
Airborne Transponder (IFF) NOT510	AN/APX-101 or AN/APX-119	Provides automatic radar identification to suitably equipped challenging aircraft, surface ships, and ground facilities within range.	Line of sight	Left console
Airborne Transponder (IFF) 510	AN/APX-119	Provides automatic radar identification to suitably equipped challenging aircraft, surface ships, and ground facilities within range.	Dependent on function selected	MFCD
Intercommunications System	AIC-18	Aircraft communications center; permits audio monitoring and transmits audio monitoring and transmitter selection. All audio signals and landing gear warning signals are routed through the AIC-18. During ground operations, permits interphone communication between aircraft and ground crew.	Dependent on function selected	Left console
UHF Radio	AN/ARC-164(V)	Provides UHF communications and ADF in the 225.000 to 399.975 MHz frequency range. Twenty preset channels may be stored.	Line of sight	Left console
Deleted				
VHF/FM Radio NON526	AN/ARC-186(V)	Provides two-way communications in the frequency modulation band of 30.000 to 76.000 MHz. Twenty preset channels may be stored.	Line of sight	Left console
Deleted				

Figure 1-109. Communications Equipment (Sheet 1 of 2)

Type	Designation	Function	Range	Control Location
VHF/UHF Radio	AN/ARC-210(V) (ARC-210-1	Provides simplex or half-duplex two-way communication of normal and secure voice AM or FM signals in the 30 through 512 MHz (VHF/UHF) frequency range. AM, FM, embedded COMSEC, Maritime, 8.33 kHz channel spacing, HAVEQUICK (HQ), HAVEQUICK II, Single Channel Ground and Airborne Radio System (SINCGARS), and Satellite Communication (SATCOM) modes are provided. 25 Simplex, 10 half-duplex DAMA/SATCOM, 25 Electronic Counter Counter-Measures (ECCM), 5 half-duplex or wide band satellite communication, and 57 Maritime presets may be stored.	Line of sight/Beyond Line of sight	Left console, UFC, MFCDs
VHF/UHF Radio 526	AN/ARC-210(V) (ARC-210-2)	Provides simplex two-way communication of normal and secure voice AM or FM signals in the 30 through 512 MHz (VHF/UHF) frequency range. AM, FM, embedded COMSEC, Maritime, 8.33 kHz channel spacing, HAVEQUICK (HQ), HAVEQUICK II, and SINCGARS modes are provided. 25 Simplex, 25 ECCM, and 57 Maritime presets may be stored. **NOTE** ARC-210-2 will tune to SATCOM/Satellite presets; however the system is not designed for this operation (i.e. no High Power Amplifier or SATCOM antenna).	Line of sight	Left console, UFC, MFCDs
Secure voice system	KY-58	Provides either plain or cipher communications using the UHF and VHF/ **NON526** radios.		Left console
Improved Data Modem 515	IDM	Provides means for secure or clear digital data communications using the AN/ARC-164 (secure only) and AN/ARC-210-1. ARC-210-2 is not an option for data transmission.		
Light Airborne Recovery System (LARS) 131	AN/ARS-6(V)	Provides means to quickly and precisely locate and communicate with survivors equipped with the survival radio set AN/PRC-112.	Line of sight	Left console

Figure 1-109. Communications Equipment (Sheet 2)

IFF Primary Control.

The IFF is in primary control mode when it is able to communicate with the CICU over 1553. When in primary control mode, the IFF/SIF control panel switches, with the exception of the MASTER switch OFF position, the CODE switch, the Mode 4 switch, and the Audio Light switch, are ignored and the IFF CONTROLS Page and IFF PROFILES Page on the MFCDs act as primary data entry interface. The IFF IDENT/MIC function control is divided between the IFF Control Panel and CICU. The IFF CONTROLS and PROFILES can be reached by selecting the IFF branch OSB on the COMM Page (Figure 1-109.2).

In addition to the mode and code controls found on the IFF/SIF control panel, the IFF COMM Page, IFF CONTROLS Page, and PROFILES Page incorporate the ability to set the MODE S Address and Flight ID and the option to manage mode and code settings by setting up profiles. The profile configuration data includes the mode code data, whether the mode is enabled or disabled, the trigger condition for the profile (None, Position, or Time), and the Time or Position parameters. The IFF PROFILES Page also allows enabling or disabling the automatic loading of profiles and for manual loading of a selected profile. To provide feedback for ongoing edits to a profile, the selected profile will be highlighted in yellow reverse video if a profile change is detected. The profile information will be saved once a different profile is selected or a MFCD page transition occurs. The IFF PROFILES Page also allows the configuration of a profile such that the mode information used for the profile can be designated in the profile or be the existing IFF mode information. For example, if OSB 18 is activated while Mode 1 is selected, Mode 1 will be marked as IFF CUR (highlighted violet reverse). When the profile is loaded, whatever the current Mode 1 settings are, will remain after the profile load. The IFF profiles controls are on the IFF PROFILES Page and contain the ability to select modes within the current profile, only displaying OSBs when they are relevant (based on the Trigger Type). A multifunction OSB allows the selecting of the mode code and enable setting for the selected mode. IFF Mode C does not have an associated code with it. To avoid a CICU INPUT ERR when the Mode Update OSB is pressed on the IFF Profiles page, the data entry function is disabled. A note will be displayed when a profile is triggered and will remain displayed until acknowledged. The IFF functions (Mode 1, Mode 3/A and Mode C enable, Mode 1 and Mode 3/A updates, or Identification of Position) can be triggered by the IFF IDENT/MIC switch on the IFF Control Panel or by the CICU via the MFCD OSBs or IFF key on the UFC. When the CICU is requesting IFF IDENT, the IDENT/MIC switch on the IFF Control Panel is disabled.

The Mode 4 function provides a secure IFF capability. Mode 4 is activated by placing the MODE 4 switch to ON with the MASTER OSB 6 set on the COMM Page to NORM. The desired code is selected by setting the CODE switch to A or B. The A and B codes are set on the ground. Both codes are zeroized when power is removed from the system after the aircraft has landed, unless holding has been executed. Holding is accomplished by momentarily placing the CODE switch to HOLD after landing, but prior to removal of power from the system. System power should be maintained for at least 15 seconds after the CODE switch is placed in HOLD. The receiver-transmitter will respond to Mode 4 interrogations only if the interrogations are coded the same as the code selected on the CODE switch. Placing the AUDIO-LIGHT switch at AUDIO enables an audio signal in the pilot's headset when valid Mode 4 interrogations are being received. The Mode 4 REPLY light (green) coming on indicates when replies are transmitted. Placing the AUDIO-LIGHT switch at LIGHT causes the Mode 4 REPLY light to come on when Mode 4 replies are transmitted. The level of the Mode 4 audio is adjustable on the INTERCOM control panel by rotating the IFF volume control (Figure 1-110). Placing the AUDIO-LIGHT switch at OUT disables both light and audio indications. The REPLY light will not depress-to-test when the switch is in OUT.

If the IFF MODE-4 caution light comes on, the MASTER OSB 6 should be set to NORM, the MODE 4 ON-OUT toggle switch should be checked to see that it is ON, and the CODE switch should be checked to see that the proper code (A or B) has been selected for the current code time period. If the IFF MODE-4 caution light stays on, the applicable flight procedures that are operationally directed for inoperative Mode 4 should then be employed or the Mode 4 environment avoided.

In addition to the operational modes, the system has a BIT capability for confidence testing on a go/no-go basis. The BIT can monitor transponder responses to operational interrogations, or internally stimulate any mode of interrogation. The BIT is initiated by setting the MODE 4 switch to ON and then pressing the TEST OSB 18 on System Status Page 2. A correct reply to the interrogation will result in PASS being displayed in the TEST column for IFF on the System Status Page 2 table. If a no-go response is made with the ANTENNA OSB 19 set to BOTH, the test shall be repeated in UPPER and LOWER. A go response in either UPPER or LOWER indicates an operational IFF system on that antenna.

IFF Backup Control.

If the 1553 communication between the CICU and the IFF is interrupted, or TCTO 1A-10C-510 is not installed, the IFF begins operating in backup control mode. When this occurs, the IFF OSB 6 on the COMM Page is deactivated, No Comm (NC) is displayed, access to the IFF CONTROLS and IFF PROFILES Page are disabled, and the IFF/SIF control panel becomes fully active.

After transitioning into backup control mode, the IFF uses the settings that were in use while in primary mode for each input. If one of the IFF settings has not changed since transitioning in backup control mode, and its respective switch is changed on the IFF/SIF control panel, the IFF will update the setting to look at the IFF/SIF control panel setting rather than the setting that was defined while in primary control mode.

The Mode 4 functions the same in backup mode as in primary. Mode 4 is activated by placing the Mode 4 ON/OUT switch to ON, with the MASTER switch in any position except OFF or STBY.

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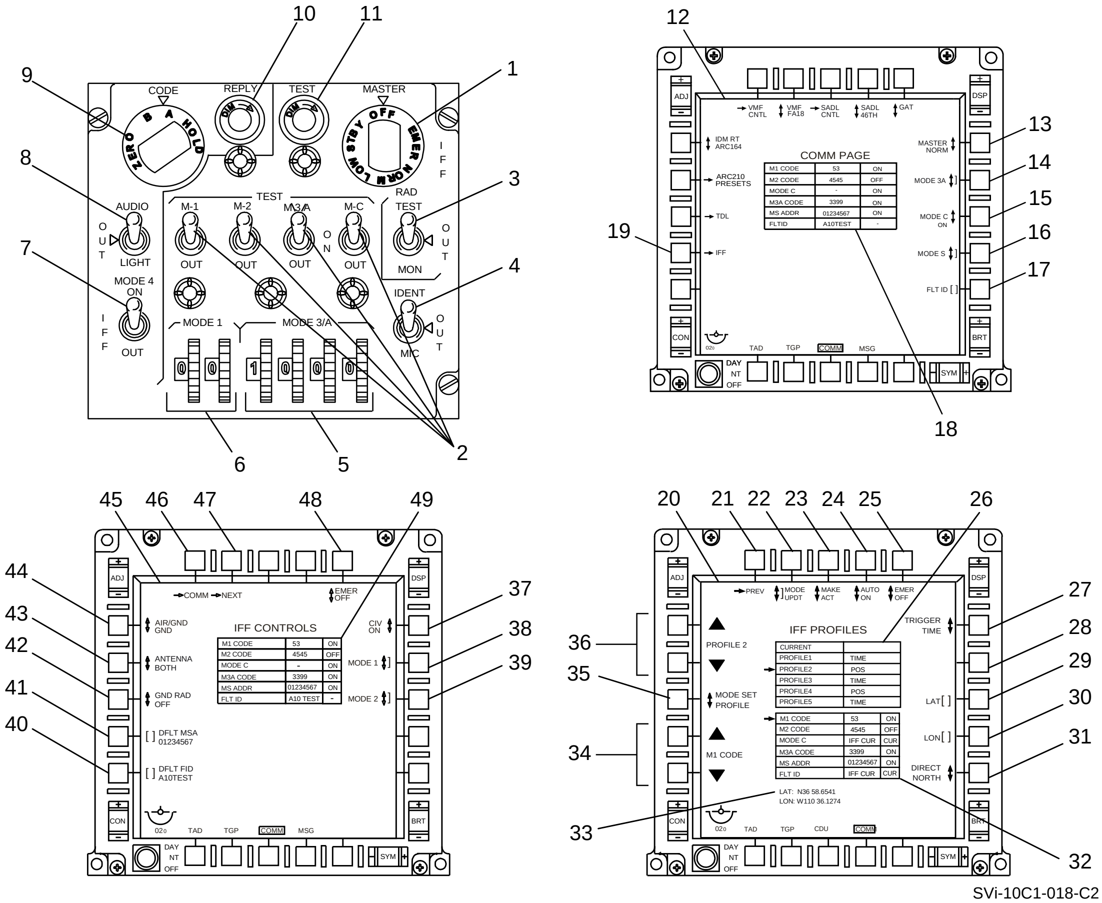

Figure 1-109.2. IFF/SIF Control (Sheet 1 of 6)

Index	Control or OSB	Position	Function
1	MASTER switch	OFF	IFF system de-energized. The switch must be pulled out to rotate it from STBY to OFF. When the IFF is in primary control mode, any setting other than OFF transfers control to the MFCDs.
		STBY	System in warm-up (standby) condition.
		LOW	Disabled per AIMS.
		NORM	System operative at normal receiver sensitivity.
		EMER	System operative and will respond to interrogations in Modes 1, 2, 3/A and S. The reply for Modes 1 and 2 is the code selected on the applicable dials, while Mode 3/A transmits mode 7700. The switch must be pulled out to rotate it from NORM to EMER.
2	M-1 switch	ON	Selects Mode 1 transponder operation.
		TEST	Initiates BIT of Mode 1 capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables reply to Mode 1 interrogations.
	M-2 switch	ON	Selects Mode 2 transponder operation.
		TEST	Initiates BIT of Mode 2 capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables reply to Mode 2 interrogations. **NOTE** Mode 2 four-digit reply code is selected on front panel of the receiver/transmitter unit located behind panel F103 (see Figure 1-43).
	M-3/A switch	ON	Selects Mode 3/A/S transponder operation.
		TEST	Initiates BIT of Mode 3/A/S capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables reply to Mode 3/A/S interrogations.
	M-C switch	ON	Selects Mode C altitude data operation.
		TEST	Initiates BIT of Mode C capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables altitude data in Mode 3/A replies.
3	Radiation test monitor switch	RAD TEST	Sets M4 Ver Bit No. 1 in Mode 4 replies. Allows verification of Mode 4 when requested by air traffic control. Air traffic control looks for Bit to be set.
		MON	Not used.
		OUT	Normal operating mode.

Figure 1-109.2. IFF/SIF Control (Sheet 2)

Index	Control or OSB	Position	Function
4	Identification of position switch Not functional while CICU is requesting IDENT)	IDENT	When momentarily actuated (switch has spring-loaded return), enables identification of position reply for approximately 18 (±1) seconds.
		OUT	Prevents triggering of identification of position reply.
		MIC	Initiates identification of position reply simultaneously with the keying of the UHF radio.
5	MODE 3/A code select switches		Provides coding selection of the Mode 3 reply. Each digit may be set from 0 to 7.
6	MODE 1 code select switches		Provides coding selection of the Mode 1 reply. The first digit may be set 0 to 7 and the second digit may be set 0 to 3.
7	MODE 4 switch	ON	Selects Mode 4 transponder operation.
		OUT	Disables reply to Mode 4 interrogations.
8	Audio light switch	AUDIO	Enables Mode 4 audio operation even when MASTER switch is set to STBY or when Mode 4 switch is set to OUT. Permits audio tone when Mode 4 interrogations are received. Operation of the REPLY light is identical to that described for the LIGHT position. AUDIO is the preferred operating position, since an audio tone indicates the presence of Mode 4 interrogations. IFF audio level is adjustable on the INTERCOM panel by rotating the IFF volume control, but the on-off function of this control is non-functional.
		LIGHT	When Mode 4 replies are satisfactorily transmitted, the REPLY light will come on. If no replies are being generated to Mode 4 interrogations, the REPLY light will not come on; however, the IFF MODE-4 Caution Light/MASTER CAUTION will come on. No audio is obtained in this switch position.
		OUT	Disables AUDIO and REPLY light monitoring of Mode 4 interrogations and replies.
9	CODE switch (primary control)	ZERO	Permits zeroing of Mode 4 code. The switch must be pulled out to rotate it from Code B to zero.
		A/B	Code provided by KIT 1C computer.
		HOLD	Locks in Mode 4 code setting after landing and before power is turned off. **NOTE** The switch is spring-loaded in HOLD and will return to Code A after release. Code B must be reselected if necessary.

Figure 1-109.2. IFF/SIF Control (Sheet 3)

Index	Control or OSB	Position	Function
10	REPLY light	ON	Indicates presence of Mode 4 replies.
11	TEST light	ON	Indicates transponder responding properly to a Mode 1, 2, 3/A, and C test. Light will also come on when depressed.
12	COMM Page	N/A	Provides common location to view and modify the settings of the aircraft emitters.
13	IFF Master (OSB 6)	STBY	Sets IFF to standby.
		NORM	Sets IFF to operate normally.
14	IFF Mode 3A (OSB 7)	MODE 3A, MODE 3A CODE, MODE 3A STATUS	Sets a new Mode 3A Code or toggle the Mode 3/A On/Off.
15	IFF Mode C (OSB 8)	ON, OFF	Toggles IFF Mode C On/Off.
16	IFF Mode S (OSB 9)	MODE S, MODE S ADDRESS, MODE S STATUS	Sets a new Mode S address or toggle the Mode S On/Off.
17	IFF FLT ID (OSB 10)	FLT ID	Sets a new Mode S Flight ID.
18	IFF Status Table		Displays quick view of IFF transponder configuration. Provides status and code information for each mode. Active modes shown in green reverse and inactive modes in white reverse. An IFF state change that can not be executed or IFF transponder transitions to a new mode not matching the CICU requesting mode, are shown in yellow reverse with an annunciation.
19	IFF (OSB 17)	IFF	Access to the IFF Controls Page.
20	IFF PROFILES Page	N/A	Controls IFF profile enabling and configuration data.
21	IFF PREV (OSB 1)	PREV	Returns to IFF Control Page.
22	IFF MODE UPDATE (OSB 2)	MODE UPDT, MODE CODE, MODE STAT	Allows input of data from scratchpad to or the toggle of the currently selected profile mode. **NOTE** IFF Mode C does not have an associated code with it. To avoid a CICU INPUT ERR when the Mode Update OSB is pressed on the IFF Profiles page, the data entry function is disabled.
23	IFF MAKE ACTIVE (OSB 3)	MAKE ACT	Loads the mode enable and code settings from the currently selected profile.
24	IFF AUTO (OSB 4)	AUTO ON, AUTO OFF	Sets whether IFF should automatically change profiles when trigger conditions are met.

Figure 1-109.2. IFF/SIF Control (Sheet 4)

Index	Control or OSB	Position	Function
25	IFF EMER (OSB 5)	EMER ON, EMER OFF	Sets the Emergency mode. When enabled, all modes are turned on and cannot be turned off.
26	IFF PROFILE SELECTION TABLE		Table provides feedback for ongoing edits to a profile. A profile change to selected profile will be highlighted in yellow reverse.
27	IFF TRIGGER (OSB 6)	TRIGGER NONE, TRIGGER TIME, TRIGGER POS	Sets the type of trigger that will load the currently selected profile.
28	IFF COORDINATE FORMAT (OSB 7)	COORD L/L, COORD MGRS	Selects whether coordinates are displayed in LAT/LON format or MGRS format.
	IFF TIME (OSB 7)	TIME	Sets the time that will be used to trigger the currently selected profile. The time is the same format as the time on the HUD.
29	IFF LAT (OSB 8)	LAT	Sets the latitude to use as a boundary for triggering a profile changeover.
30	IFF LON (OSB 9)	LON	Sets the longitude to use as a boundary for triggering a profile changeover.
31	IFF DIRECT (OSB 10)	DIRECT NORTH, DIRECT SOUTH, DIRECT EAST, DIRECT WEST	Sets whether aircraft position must be North, South, East or West of a latitude or longitude to trigger a profile changeover.
32	IFF PROFILES SETTINGS TABLE		Displays IFF Mode Profile settings. Rows with "IFF CUR" are not updated when profile triggers and are displayed in violet reverse. Any other value replaces the corresponding mode setting in the IFF control values when the profile triggers or activation of the Make Active OSB 3. For an enable mode, the row is displayed in green reverse. All other rows are in white reverse. Upon initial display of the IFF Profiles page or if a different profile is selected, the selection arrow will reset to the first row in the table.
33	IFF LST/MGRS Trigger Position, IFF LON Trigger Position		Displays GPS position when trigger type is POS. Position data is displayed as latitude/longitude or MGRS depending on IFF coordinate format.
34	IFF Mode Selection Down/Up (OSB 16 and OSB 17)	M1 CODE, M2 CODE, MODE C, M3A CODE, MS ADDR, FLT ID	Moves arrow up or down to select Mode in IFF Profiles Settings Table.
35	IFF MODE SET (OSB 18)	MODE SET XXXX	Sets whether profile will leave IFF Mode setting unchanged or load new profile based setting when selected profile is triggered.
36	IFF Profile Selection Down/Up (OSB 19 and OSB 20)		Moves arrow up or down to select Profile in Profile Selection Table.

Figure 1-109.2. IFF/SIF Control (Sheet 5)

Index	Control or OSB	Position	Function
37	IFF CIV (OSB 6)	CIV OFF, CIV MIX, CIV ON	Turns on or off modes (Mode 3/A, Mode C, or Mode S).
38	IFF Mode 1 (OSB 7)	MODE 1, MODE 1 CODE, MODE 1 STATUS	Sets new IFF Mode 1 Code or toggle the Mode 1 enable setting. First digit may be set 0 to 7 and the second digit may be set 0 to 3.
39	IFF Mode 2 (OSB 8)	MODE 2, MODE 2 CODE, MODE 2 STATUS	Sets a new IFF Mode 2 Code or toggle the Mode 2 enable setting. Valid input range is between 0000-7777 (octal digits only).
40	IFF DEFAULT FLT ID	DFLT FID XXXXXXXX	Sets a new default Mode S Flight ID. If input is less than eight (8) characters, it is padded with spaces on right to create an eight character input string.
41	IFF DEFAULT MS ADDR	DFLT MSA XXXXXXXX	Sets a new default Mode S Address. Valid input range is between 00000001-77777776 (octal digits only). **NOTE** Address must be configured correctly to ensure Mode S Address is available even if transponder is rebooted.
42	IFF GND RAD	GND RAD ON, GND RAD OFF	Sets whether or not transponder replies to interrogations while on the ground.
43	IFF ANTENNA	ANTENNA BOTH, ANTENNA UPPER, ANTENNA LOWER	Selects antenna to use for radiation testing.
44	IFF AIR/GND	AIR/GND GND, AIR/GND AIR	Sets whether or not the Mode S ground communication should be inhibited.
45	IFF CONTROLS Page	N/A	Provides mode code, antenna selection, air ground and ground radiate controls.
46	IFF COMM	COMM	Access to COMM Page.
47	IFF NEXT	NEXT	Access to IFF PROFILES Page.
48	IFF EMER	EMER ON, EMER OFF	Used to set the Emergency Mode.
49	IFF CONTROLS Profiles Status Table		Displays IFF Mode Profile settings status. Rows with “IFF CUR” are not updated when profile triggers and are displayed in violet reverse. Any other value replaces the corresponding mode setting in the IFF control values when the profile triggers or activation of the Make Active OSB. For an enable mode, the row is displayed in green reverse. All other rows are in white reverse.

Figure 1-109.2. IFF/SIF Control (Sheet 6)

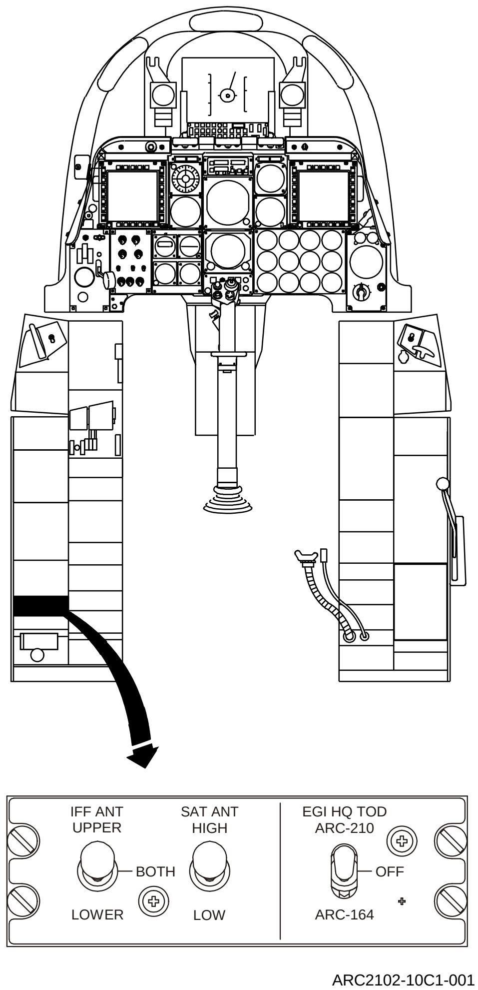

Figure 1-110. Antenna Select Panel

If the IFF MODE-4 caution light comes on, the IFF MASTER control switch should be set to NORM, the MODE 4 ON-OUT toggle switch should be checked to see that it is ON, and the CODE switch should be checked to see that the proper code (A or B), has been selected for the current code time period. If the IFF MODE-4 caution light stays on, the applicable flight procedures that are operationally directed for inoperative Mode 4 should then be employed or the Mode 4 environment avoided.

In addition to the operational modes, the system has a BIT capability for confidence testing on a go/no-go basis. The BIT can monitor transponder responses to operational interrogations, or internally stimulate any mode of interrogation by placing the M-1, M-2, M-3A, or M-C switch on the control panel to TEST. A correct reply to the interrogation will cause the TEST light on the IFF/SIF control panel to come on indicating a go condition. If a no-go response is made with the IFF ANT switch in BOTH, the test shall be repeated in UPPER and LOWER. A go response in either UPPER or LOWER indicates an operational IFF system on that antenna.

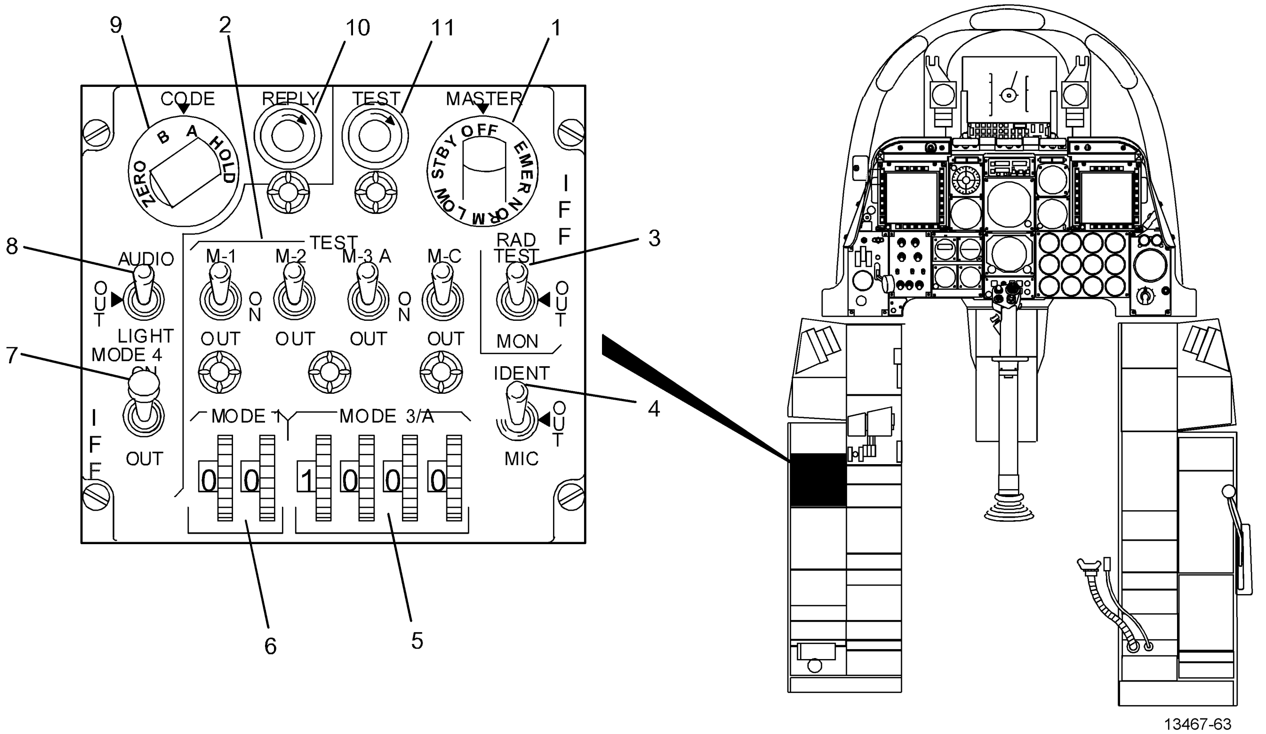

Figure 1-111. IFF/SIF Control Panel (Sheet 1 of 3)

Index No.	Switch	Position	Function
1	MASTER switch	OFF	IFF system de-energized. The switch must be pulled out to rotate it from STBY to OFF.
		STBY	System in warm-up (standby) condition.
		LOW	System operative but at reduced receiver sensitivity.
		NORM	System operative at normal receiver sensitivity.
		EMER	System operative and will respond to interrogations in Modes 1, 2, 3/A and S. The reply for Modes 1 and 2 is the code selected on the applicable dials, while Mode 3/A transmits mode 7700. The switch must be pulled out to rotate it from NORM to EMER.
2	M-1 switch	ON	Selects Mode 1 transponder operation.
		TEST	Initiates BIT of Mode 1 capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables reply to Mode 1 interrogations.
	M-2 switch	ON	Selects Mode 2 transponder operation.
		TEST	Initiates BIT of Mode 2 capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables reply to Mode 2 interrogations. **NOTE** Mode 2 four-digit reply code is selected on front panel of the receiver/transmitter unit located behind panel F103 (see Figure 1-43).
	M-3/A switch	ON	Selects Mode 3/A/S transponder operation.
		TEST	Initiates BIT of Mode 3/A/S capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables reply to Mode 3/A/S interrogations.
	M-C switch	ON	Selects Mode C altitude data operation.
		TEST	Initiates BIT of Mode C capability. Go condition indicated by the green TEST lamp coming on.
		OUT	Disables altitude data in Mode 3/A replies.
3	Radiation test monitor switch	RAD TEST	Sets M4 Ver Bit No. 1 in Mode 4 replies. Allows pilot to verify Mode 4 when requested by air traffic control. Air traffic control looks for Bit to be set.
		MON	Not used.
		OUT	Normal operating mode.

Figure 1-111. IFF/SIF Control Panel (Sheet 2)

Index No.	Switch	Position	Function
4	Identification of position switch (Not functional while CICU is requesting IDENT)	IDENT	When momentarily actuated (switch has spring-loaded return), enables identification of position reply for approximately 18 (+/- 1) seconds.
		OUT	Prevents triggering of identification of position reply.
		MIC	Initiates identification of position reply simultaneously with the keying of the UHF radio.
5	MODE 3/A code select switches		Provides coding selection of the Mode 3 reply. Each digit may be set from 0 to 7.
6	MODE 1 code select switches		Provides coding selection of the Mode 1 reply. The first digit may be set 0 to 7 and the second digit may be set 0 to 3.
7	MODE 4 switch	ON	Selects Mode 4 transponder operation.
		OUT	Disables reply to Mode 4 interrogations.
8	Audio light switch	AUDIO	Enables Mode 4 audio operation even when MASTER switch is set to STBY or when Mode 4 switch is set to OUT. Permits audio tone when Mode 4 interrogations are received. Operation of the REPLY light is identical to that described for the LIGHT position. AUDIO is the preferred operating position, since an audio tone indicates the presence of Mode 4 interrogations. IFF audio level is adjustable on the INTERCOM panel by rotating the IFF volume control, but the on-off function of this control is non-functional.
		LIGHT	When Mode 4 replies are satisfactorily transmitted, the REPLY light will come on. If no replies are being generated to Mode 4 interrogations, the REPLY light will not come on; however, the IFF MODE-4 Caution Light/MASTER CAUTION will come on. No audio is obtained in this switch position.
		OUT	Disables AUDIO and REPLY light monitoring of Mode 4 interrogations and replies.
9	CODE switch	ZERO	Permits zeroing of Mode 4 code. The switch must be pulled out to rotate it from Code B to zero.
		A/B	Code provided by KIT 1C computer.
		HOLD	Locks in Mode 4 code setting after landing and before power is turned off. **NOTE** The switch is spring-loaded in HOLD and will return to Code A after release. Code B must be reselected if necessary.
10	REPLY light	ON	Indicates presence of Mode 4 replies.
11	TEST light	ON	Indicates transponder responding properly to a Mode 1, 2, 3/A, and C test. Light will also come on when depressed.

Figure 1-111. IFF/SIF Control Panel (Sheet 3)

INTERCOM SYSTEM.

The intercommunications system provides the audio interface between the pilot and the onboard communication and radio navigation equipment. The intercom system also interfaces with the in-flight refueling system to provide for direct communications with the tanker aircraft. The LASTE system uses the intercom system to provide for audio warnings from the LASTE computer. The system consists of an intercommunication set control located on the left console and the pilot's headset/microphone assembly. An external interphone station enables communication with the ground crew.

The intercommunications set control (Figure 1-112) includes both headset and microphone amplifiers. Each audio input has a separate switch and volume control. A master volume control adjusts the volume level of all audio inputs simultaneously. The landing gear warning signal bypasses the electronics of the control set and is coupled directly to the pilot's headset. LASTE voice warnings cannot be turned off except by pulling the intercom circuit breaker. All LASTE messages are the same loudness except "Pull-Up, Pull-up" message which is twice as loud as the other messages.

In addition to the audio monitoring capability, a rotary selector switch on the intercommunications control panel permits the selection of the interphone or transmitter keying circuits for up to four R/Ts.

Electrical power is supplied by the DC essential bus.

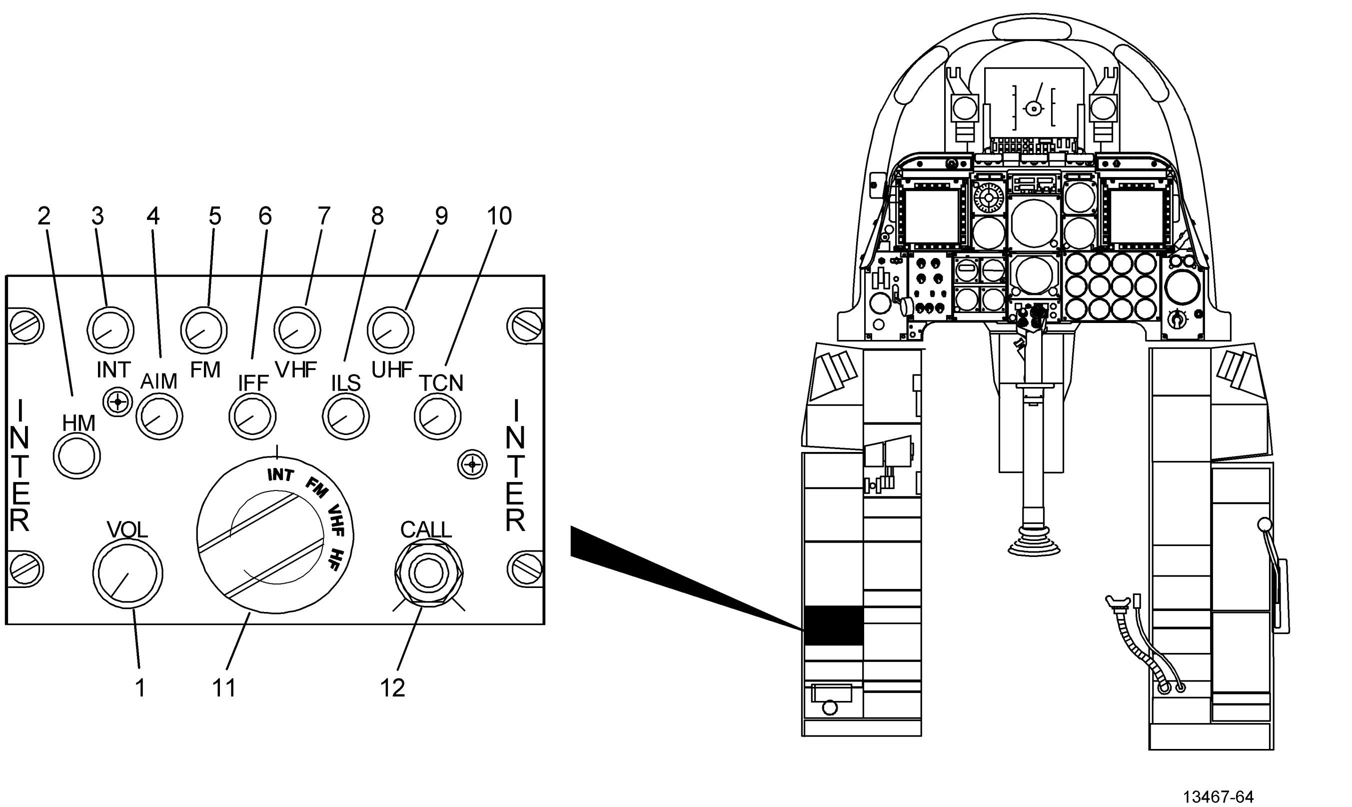

Figure 1-112. Intercom Control Panel (Sheet 1 of 3)

Index No.	Control or Indicator	Position or Display	Function
1	VOL control		Adjusts volume level of all audio inputs simultaneously.
2	HM switch	Out	Enables hot mic interphone operation, allowing communication with the tanker during air refueling or with ground crew without using the MIC switch. Rotary selector switch (11) must be set to INT, or INT monitor switch (3) must be in the pulled-out (enable) position for hot mic operation.
		In	Disables hot mic operation.
3	INT monitor switch	Out	Enables interphone operation allowing communication with the tanker during air refueling or with the ground crew when HM switch is also in the pulled-out position: (Allows interphone audio to be monitored from the tanker during air refueling or from the ground crew regardless of the position of the rotary selector switch (11).) An integral volume control permits individual control of the interphone audio level.
		In	Disables the interphone audio from being monitored unless it is selected via the rotary selector switch (11).
4	AIM monitor switch	Out	Enables AIM-9 audio tone to be monitored. (An audio tone is provided to the headset through the intercom control panel when the AIM-9 Mode switch is in the SELECT position.) The audio level is controlled by rotating the switch to the desired level.
		In	Disables AIM-9 audio tone from being monitored.
5	FM monitor switch	Out	Enables VHF/FM NON526 or ARC-210-2 526 receiver audio to be monitored regardless of the positions of the rotary selector switch (11). An integral volume control permits individual control of the VHF/FM NON526 or ARC-210-2 526 receiver audio level.
		In	Disables the VHF/FM NON526 or ARC-210-2 526 receiver audio from being monitored unless it is selected via the rotary selector switch (11).
6	IFF monitor switch		Nonfunctional as an on-off control. VOL control permits individual control of the IFF receiver audio level.
7	VHF monitor switch		Same as item 5 except controls ARC-210-1 receiver audio.
8	ILS monitor switch	Out	Switch in the pulled-out position enables localizer and marker beacon identifier audio to be monitored in the headset.
		In	Disables localizer and marker beacon audio from being monitored.
9	UHF monitor switch		Same as item 5 except controls UHF receiver audio.

Figure 1-112. Intercom Control Panel (Sheet 2)

Index No.	Control or Indicator	Position or Display	Function
10	TCN monitor switch	Out	Enables TACAN receiver audio to be monitored regardless of the position of the rotary selector switch (11). An integral volume control permits individual control of the TACAN receiver audio level.
		In	Disables TACAN receiver audio from being monitored unless the rotary selector switch (11) is rotated to the extreme CCW (unplacarded) position.
11	Rotary selector switch		Controls which radio is enabled for transmission by MIC-FWD. Applies only to the front radio or intercom.
		INT	Provides intercommunications with ground crew or boom operator. If HM (2) is disabled, the MIC switch on the throttle must be depressed to talk to the ground crew or boom operator. If the INT monitor switch (3) is in the enable position, the ground crew or boom operator may call regardless of the position of the rotary selector switch. To answer the ground crew or boom operator, the selector switch must be INT or the HM switch must be in the enable position.
		FM	Not used for MIC-FWD. Enables aft radio (ARC-210-2 or VHF/FM) receiver audio to be monitored regardless of FM monitor switch (5) position.
		VHF	Provides microphone input to the VHF/UHF/SATCOM transmitter and permits keying of the transmitter when the mic switch on throttle lever is used.
		HF	Not used.
		Unplacarded (full CCW position)	Not used for MIC-FWD. Enables TACAN receiver audio to be monitored regardless of TCN monitor switch (10) position.
12	CALL switch		Not used.

Figure 1-112. Intercom Control Panel (Sheet 3)

MIC Switch.

A four-position MIC switch is located on the right throttle grip (Figure 1-5). Depending on the rotary switch (11, Figure 1-112) position on the intercom control panel, the MIC switch functions are as follows:

MIC Switch (momentary)	Rotary Switch	Result
FWD	INT	Transmit interphone
	VHF	Transmit front radio (ARC-210-1)
	Any other	No transmit
AFT	Any	Transmit aft radio (ARC-210-2 or VHF/FM)
DOWN	Any	Transmit UHF
UP	Any	Not used.

UHF RADIO SYSTEM.

The UHF radio system consists of a panel-mounted UHF radio, Have Quick II (HQ II) UHF Radio RT-1505A/C /ARC-164(V), and an associated antenna system. The HQ II UHF radio (Figure 1-113) is located in the left console.

The HQ II UHF radios have a jam-resistant frequency hopping capability when operating in the antijamming (ECCM) frequency hopping mode.

The HQ II UHF radio is capable of maintaining two-way line-of-sight communications over a normal operational range of 220 nm depending on the frequency and aircraft altitude. Communications may be conducted in one of 20 preset channels, or in any one of 7,000 manually selected frequencies spaced 25 kHz apart throughout the 225.000 to 399.975 MHz frequency range.

In addition, the HQ II UHF radio is capable of simultaneously monitoring the UHF guard channel (243.0 MHz) through a separate receiver. Both guard and working channels or only the working channel can be monitored.

NOTE

- Failure to properly close and latch UDTU enclosure door may cause excessive electromagnetic interference (EMI) noise levels on some VHF and UHF radio frequencies.

For transmitting purposes, guard channel may be selected by placing the MANUAL-PRESET-GUARD switch on the control panel to GUARD. This automatically shifts the main receiver and transmitter to the guard channel. The HQ II UHF radio is powered by the DC essential bus.

The HQ II UHF radio is fully compatible with secure communications equipment KY-58.

UHF Automatic Direction Finding.

The ADF capability is activated by placing the HQ II UHF radio function selector in ADF. The ADF provides relative bearing to any steady signal received on the UHF main receiver. This information is displayed on the HSI bearing pointer number 1. The guard receiver is disabled when ADF is selected on the UHF radio. In the ECCM mode, ADF will function, but accuracy will be degraded. Voice reception may be degraded in ADF. Selecting ADF also causes the NMSP UHF HOMING light to come on. The UHF/ADF is powered by the right DC bus.

UHF Radio Antenna System.

The UHF radio system has a single blade type antenna, shared with the TACAN navigation system. The UHF antenna is located on the underside of the forward fuselage.

Deleted.

Deleted.

Deleted.

EGI HAVEQUICK Time-of-Day (EGI HQ TOD) Select Switch.

The EGI HQ TOD Select Switch, located on the Antenna Select panel, (Figure 1-110), is a three-position switch labeled ARC-210, OFF, and ARC-164. In the ARC-210 position, the time of day signal from the EGI is provided to ARC-210-1 and ARC-210-2 $\boxed{526}$ if the signal is available. While in the ARC-210 position, the signal to the ARC-164 UHF radio is blocked. In the OFF position the time of day signal from the EGI is blocked from the ARC-164 and ARC-210 radios. In the ARC-164 position, the time of day signal from the EGI is provided to the ARC-164 radio if the signal is available. While in the ARC-164 position, the signal to the ARC-210 radios is blocked.

UHF Radio Operation (Normal Mode).

Frequency selection can be accomplished in one of three modes: PRESET, MANUAL, and GUARD.

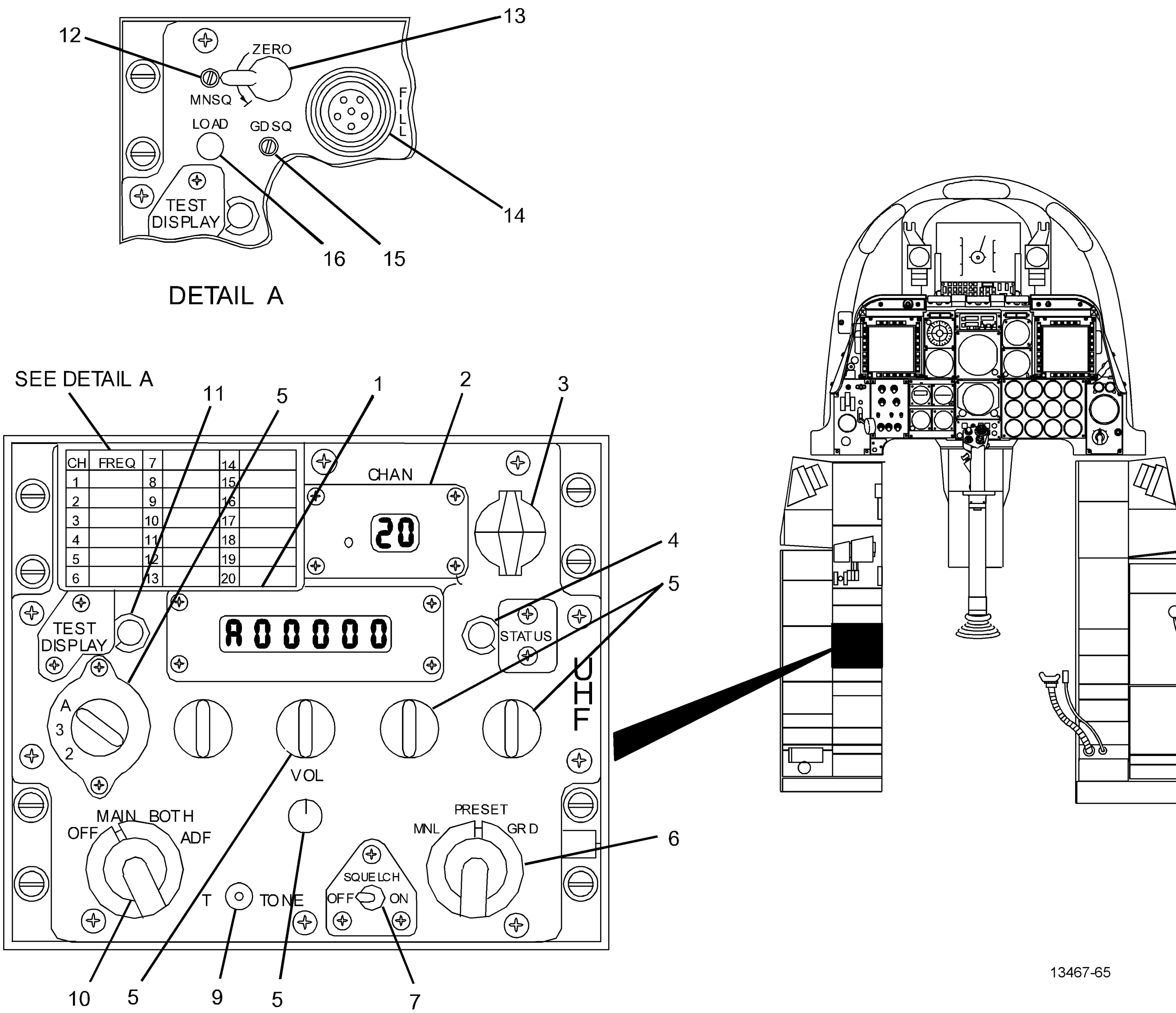

Figure 1-113. Have Quick II (HQII) UHF Radio RT-1505A/C/ARC-164(V) (Sheet 1 of 4)

Index No.	Nomenclature	Function
1	Frequency/Status (F/S) indicator	Displays individual frequency switch settings or any of the following prompts.
		REMOTE - Indicates remote control (for dual control installations).
		VER/OP - Indicates normal operating mode.
		M-LOAD - Indicates multiple word-of-day (MWOD) load mode.
		ERASE - Indicates MWOD erase mode.
		FMT.CNG - Indicates Frequency Management Training (FMT) Change mode.
		FILL - Indicates keyfill device is connected.
		WOD OK - Indicates valid word-of-day (WOD) successfully received from keyfill device.
		BAD - Indicates no WOD or a bad parity WOD received from keyfill device.
2	CHAN indicator	Displays selected channel when MPG switch is PRESET or displays selected memory location when in MWOD load or FMT change modes.
3	CHAN switch	Selects desired preset channel (1 to 20) during preset operation. Also selects desired memory locations in MWOD load mode (20 to 14, 1) or FMT change mode (20 to 5).
4	STATUS button	When depressed, initiates alternate display on F/S and CHAN indicators for 5 seconds.
5	23A/Frequency switches	Switches select corresponding hundreds, tens, units, tenths, and thousandths digits (as shown on F/S indicator) for desired frequency in normal mode, and desired WOD elements or net number for antijamming (AJ) mode. In addition, the A position puts radio set into AJ frequency-hopping mode of operation when selected.
6	MNL-PRESET-GRD (MPG) switch	Determines method of frequency selection:
		MNL - Frequency manually selected using five frequency switches.
		PRESET - Frequency selected using CHAN switch. Along with switch, LOAD also used when programming 20 preset channels.
		GRD - Automatically tunes radio set main receiver and transmitter to guard frequency (243.000 MHz) and disables guard receiver.
7	SQUELCH ON-OFF switch	Enables and disables squelch (noise quieting) of radio set main receiver. On the RT-1505C only, the SQUELCH switch also determines the receive TOD processing method utilized with the radio. The SQUELCH ON position enhances the ability of the RT-1505C to receive TOD from an on-aircraft hardwire TOD source such as GEM III OR IV contained within the EGI. The SQUELCH OFF position can be selected whenever it is desired to maximize the probability of reception of TOD signals from an RF TOD source, such as an AN/TRC-187A Time Signal Set. For aircraft utilizing the RT-1505C, it is recommended that the SQUELCH switch be left in the ON position.
8	VOL control	Adjusts audio level.

Figure 1-113. Have Quick II (HQII) UHF Radio RT-1505A/C/ARC-164(V) (Sheet 2)

Index No.	Nomenclature	Function
9 NON513	T-TONE switch	Three-position toggle switch (middle position normally off) with two positions spring-loaded. When placed in TONE, transmits a 1020 Hz DF tone on selected frequency and will stop when switch is released. If TOD clock is started, TONE position transmits TOD message data followed by DF tone. When placed in T, enables reception of TOD message for 1 minute, if the EGI HQ TOD switch on the antenna select panel (Figure 1-110) is set to DISABLE. If the EGI HQ TOD switch is set to ENABLE when the T-TONE switch is set to T, the HQ II radio receives the time of day (TOD) with date appended from the EGI if the EGI GPS FOM is 8 or less (see EGI Page 1/4 (Figure 1-88)) and the EGI UTC is valid (see GPSSTAT Page 1/2 (Figure 1-95)). If the EGI time is not available, the EGI TOD will not be received from the EGI, and the pilot will have to request a MICKEY or manually enter the day of month (DOM) and self-start the radio's clock. T-TONE switch used in conjunction with TEST DISPLAY also initiates emergency TOD clock start, loads MWOD elements, erases MWOD elements and loads FMT-net operating frequencies when in respective MWOD operating mode.
9 513	T-TONE switch	Three-position toggle switch (middle position normally off) with two positions spring-loaded. When placed in TONE, transmits a 1020 Hz DF tone on selected frequency and will stop when switch is released. If TOD clock is started, TONE position transmits TOD message data followed by DF tone. When placed in T, enables reception of TOD message for 1 minute, if the EGI HQ TOD switch on the antenna select panel (Figure 1-109) is set to OFF. If the EGI HQ TOD switch is set to ARC-164 when the T-TONE switch is set to T, the HQ II radio receives the time of day (TOD) with date appended from the EGI if the EGI GPS FOM is 8 or less (see EGI Page 1/4 (Figure 1-95)) and the EGI UTC is valid (see GPSSTAT Page 1/2 (Figure 1-95)). If the EGI time is not available, the EGI TOD will not be received from the EGI, and the pilot will have to request a MICKEY or manually enter the day of month (DOM) and self-start the radio's clock. T-TONE switch used in conjunction with TEST DISPLAY also initiates emergency TOD clock start, loads MWOD elements, erases MWOD elements and loads FMT-net operating frequencies when in respective MWOD operating mode. **NOTE** If communication problems occur in the ECCM mode after selecting the EGI TOD, set the EGI HQ TOD switch to OFF and request a MICKEY.
10 NON513	Function selector switch	Selects operating function: OFF - Shuts down equipment. If EGI HQ TOD switch is set to ENABLE and EGI is on and UTC is valid when this switch is rotated out of OFF, the HQII radio receives the TOD with date appended from EGI. MAIN - Enables main receiver and transmitter. BOTH - Enables main receiver, transmitter and guard receiver. ADF - Enables aircraft ADF or homing system (if installed) and main receiver. Disables guard receiver and transmitter.

Figure 1-113. Have Quick II (HQII) UHF Radio RT-1505A/C/ARC-164(V) (Sheet 3)

Index No.	Nomenclature	Function
10 513	Function selector switch	If EGI HQ TOD switch is set to ARC-164, EGI is on and UTC is valid when this switch is rotated out of OFF, the HQII radio receives the TOD with date appended from EGI.
11	TEST DISPLAY button	Lights all segments of F/S and CHAN indicators when pressed. Also used with T-TONE switch for emergency clock start.
12	MN SQ (main squelch)	Adjusts level of squelch (noise quieting) for main receiver.
13	ZERO switch	Erases all MWOD elements when pressed down to ZERO.
14	FILL connector	Interconnects a KYK-13/TSEC keyfill device to radio set for automatic loading of MWOD.
15	GD SQ (guard squelch)	Adjusts level of squelch (noise quieting) for guard receiver.
16	LOAD button	Loads frequency data displayed on F/S indicator into preset channels 1 to 19 as selected by CHAN switch. Preset channel 20 is reserved for loading MWOD operating mode data (220.0XX).

Figure 1-113. Have Quick II (HQII) UHF Radio RT-1505A/C/ARC-164(V) (Sheet 4)

OPERATION IN PRESET MODE NON513.

a. To receive the EGI TOD at UHF radio turn-on, proceed as follows:

(1) Ensure EGI GPS FOM is 8 or less (see EGI Page 1/4 (Figure 1-88).

(2) Ensure EGI UTC is valid (see GPSSTAT Page 1/2 (Figure 1-95)).

(3) On antenna select panel, set EGI HQ TOD switch (Figure 1-110) to ENABLE.

NOTE

If communication problems occur in the HQ mode after selecting the EGI TOD, set the EGI HQ TOD switch to DISABLE and request a MICKEY.

b. Set function selector switch (Figure 1-113) to MAIN or BOTH.

c. Set MPG switch to PRESET.

d. Select desired channel using CHAN switch.

OPERATION IN PRESET MODE 513.

a. To receive the EGI TOD at UHF radio turn-on, proceed as follows:

(1) Ensure EGI GPS FOM is 8 or less (see EGI Page 1/4 (Figure 1-88).

(2) Ensure EGI UTC is valid (see GPSSTAT Page 1/2 (Figure 1-95)).

(3) On antenna select panel, set EGI HQ TOD switch (Figure 1-110) to ARC-164.

NOTE

If communication problems occur in the ECCM mode after selecting the EGI TOD, set the EGI HQ TOD switch to OFF and request a MICKEY.

b. Set function selector switch (Figure 1-113) to MAIN or BOTH.

c. Set MPG switch to PRESET.

d. Select desired channel using CHAN switch.

OPERATION IN MANUAL MODE.

a. Set function selector switch to MAIN or BOTH.

b. Set MPG switch to MNL.

c. Select desired frequency using 23A/frequency switches.

OPERATION IN GUARD MODE.

a. Set function selector switch to MAIN or BOTH.

b. Set MPG switch to GRD.

NOTE

When operating in the GUARD mode, the main receiver and transmitter are tuned to the guard frequency automatically. The guard receiver is disabled.

ENTERING PRESET FREQUENCIES.

a. Set MPG switch to PRESET.

b. Set manual frequency using 23A/frequency switches.

c. Set CHAN switch to desired channel.

d. Depress LOAD button.

UHF Radio HQ II Operation.

There are four separate COMMAND CODE functions associated with the activation of an HQ II operation. These command codes are used to access memory locations and process instructions without unnecessarily consuming preset storage or necessitate switch modifications. A six-digit command code is entered into PRESET channel 20 to begin the unique initialization procedure. Thereafter, all other switch actions are performed with the radio in the manual mode, but using switch actions normally associated with loading preset channels.

HQII COMMAND CODES	
COMMAND CODE	FUNCTION
220.000	VERIFY/OPERATE
220.025	MWOD LOAD
220.050	MWOD ERASE
220.075	FMT-NET FREQUENCY LOAD

CONFERENCE CAPABILITY.

In the anti-jamming (AJ) mode, the radio has the ability to receive and process two simultaneous transmissions on the same net. The receiver will read both transmissions without the interference normally associated with two radios transmitting on the same frequency simultaneously. Three simultaneous transmissions will result in garbled reception. Conferencing is disabled when the net number is followed by 25.

FREQUENCY MANAGED A-NETS (FMA-NETS).

The geographical area of operation will determine which net number is to be selected from the available frequency tables or hopsets. These active nets are identified as FMA-Nets. One large hopset has been coordinated for use in NATO-Europe and another large hopset for employment in non-NATO countries. The frequency table to be employed is determined by the last two digits of the net numbers A00.0XX to A99.9XX. Active nets are selected in accordance with ABB.BCC where:

A	=	A (Active)
BB.B	=	Desired net
CC	=	00 for Basic HAVE QUICK, 25 for NATO Europe, 50 for Non-NATO, 75 Non-operational

FREQUENCY MANAGEMENT TRAINING (FMT) NETS.

To expand the number of training nets available to HQ users, HQ II provides 16 FMT-nets including the 5 T-nets already in the HQ system. To use the FMT-nets, 16 training frequencies must be loaded into the radio. Ideally, a 4-MHz frequency separation is maintained to reduce interference between collocated radios. Unlike basic HQ, these frequencies are not part of the training Word-of-Day (WOD). The procedure for loading FMT-net frequencies need only be repeated if the authorized training frequencies change. Sixteen frequencies that maintain 4 MHz minimum separation have been approved for CONUS training.

To use FMT-nets, a basic training WOD must first be entered. The frequencies loaded into presets 19 through 15 during training WOD entry will have no effect on the FMT-nets but will determine the frequencies used when a basic HQ T-net is selected. The 6-digit training WOD loaded into preset 20, as with basic HQ, cause the radio, when active, to operate in the training mode. The hop rate (same as basic HQ) is determined by the last two digits loaded into preset 20.

The 16 FMT-nets are selected the same as other active nets. They are numbered A00.025 through A01.525 and they do not repeat. All six characters in the net designator must be selected and the last two digits must be 25. Selection of an FMT-net greater than A01.525 or ending in 50 or 75 will result in an audio alarm (interrupted tone).

BASIC T-NETS.

Basic T-nets are selected the same as in basic HQ except that all six digits are now read and the last two must have 00. The T-nets are numbered A00.000 through A00.400 and they do not repeat. All six characters in the net designator must be selected. Selection of a T-net greater than A00.400 or ending in 50 or 75 will result in an audio alarm (uninterrupted tone). Selection of a T-net ending in 25 will result in HQ II FMT-net operation. The conversion of the Basic T-Net to a HQ II net is indicated below.

T-NET CONVERSION	
BASIC T-NET	HQII T-NET
A00-0 (SAME NET AS A00.5)	A00.000
A00.1	A00.100
A00.2	A00.200
A00.3	A00.300
A00.4	A00.400

ENABLING HQ II MODES.

The following are step-by-step instructions on enabling HQ II modes:

a. Verify/Operate. To conserve radio presets, the MWOD load, erase and FMT-Net frequency load switch actions are performed using switch actions very similar to those used to load channel presets, but with the radio in the manual mode. The verify/operate command alerts the radio that the above MWOD/FMT-NET functions have been completed and restores the radio to the normal operating condition where channels are related to PRESET switch actions. This mode is also used to verify that current MWODs are loaded. The radio will not transmit (not even normal UHF) until radio is returned to the verify/operate mode.

(1) Set CHAN switch to 20.

(2) Set MPG switch to PRESET.

(3) Set 23A/frequency switches to 220.000 (VERIFY/OPERATE).

(4) Depress and release LOAD button. (Listen for single beep.)

NOTE

- High pitched continuous tone indicates WOD or TOD not loaded. An interrupted tone indicates invalid net selected.
- When active mode is selected, an HQ II radio must be in the verify/operate mode to transmit. Enter the verify/operate command (220.000) after all MWOD loads/erases and FMT-NET frequency loads. The radio will power up in the same mode it was in when powered down. If the radio does not function as expected at power up, enter the verify/operate command.

b. Multiple WOD Loading.

(1) Set CHAN switch to 20.

(2) Set MPG switch to PRESET.

(3) Set 23A/frequency switches to 220.025 (MWOD Load).

(4) Depress and release LOAD button. (Listen for single beep.)

(5) Set MPG switch to MNL.

(6) Set 23A/frequency switches to element 20 of the WOD.

(7) Set T-TONE switch to TONE and release. (Listen for single beep.)

(8) Set CHAN switch to 19.

(9) Set 23A/frequency switches to element 19 of the WOD.

(10) Set T-TONE switch to TONE and release. (Listen for single beep.)

(11) Repeat Step b.(8) through Step b.(10), decreasing the channel and WOD element numbers by one for each WOD element through 15.

(12) Set CHAN switch to 14.

(13) Set 23A/frequency switches to element 14 (Day-of-Month Tag) of the WOD.

NOTE

Multiple WODs must be linked with an associated day-of-month (DOM). This "date tag" element has been added to every operational and training segment in basic HQ and need only be loaded when MWOD is used.

(14) Set T-TONE switch to TONE and release. (Listen for double beep.)

(15) To load additional MWODs, set CHAN switch to 20 and repeat Step b.(6) through Step b.(14) above. The six most recently entered MWODs will be stored in the radio.

(16) Set CHAN switch to 01.

(17) Set frequency selector switches to current day-of-month. The format is 3AB.000, where A is the 10's digit and B is the 1's digit of the current day-of-month. For example, if today were 26 June, then select 326.000.

(18) Set T-TONE switch to TONE and release. (Listen for single beep.)

(19) Set MPG switch to PRESET.

(20) Set CHAN switch to 20.

(21) Set 23A/frequency switches to 220.000 (VERIFY/OPERATE).

(22) Depress and release LOAD button. Listen for single beep. The radio is now ready to receive TOD and then operate in the AJ mode.

WARNING

HQ II radios are designed to transmit and receive date information in the TOD signal (MICKEY). A future modification to the Reference Signal Generator (RSG) will result in date information being transmitted in all MICKEYS. This will alleviate the need to perform sStep b.(16) through Step b.(18) above. In the meantime, HQ II radios can append date information to their MICKEY if they are manually loaded with DOM (Step b.(16) through Step b.(18) above), are self-started, and then receive a basic MICKEY. This expanded MICKEY may then be passed to other HQ II radios using MWODs. The appended date information is transparent (not usable) to basic HQ radios.

NOTE

If the EGI HQ TOD switch on the antenna select panel is set to ENABLE **NON513** or ARC-164 513 and EGI is on and the UTC is valid when the HQ II radio is turned on, the HQ radio receives the EGI TOD (GMT time, day, month and year). This alleviates the need to perform Step b.(16) through Step b.(22) above.

c. Verifying an MWOD is Loaded. With the radio in the verify/operate mode (220.000 entered into preset channel 20), the storage of a particular day's WOD may be verified as follows:

WARNING

When MWOD procedures (radio in verify/operate mode) are used, the current date must be loaded into the radio prior to receiving TOD or receiving a TOD with a date append. Without date information, the radio cannot select the current WOD from memory. This results in an alarm (steady tone) when the active mode is selected.

(1) Set MPG switch to MNL.

(2) Set CHAN switch to 20.

(3) Set 23A/frequency switches to Day-of-Month (DOM) to be verified. The format is 3AB.000, where A is the 10's digit and B is the 1's digit of the Day-of-Month (5 May would be 305.000).

(4) Momentarily set CHAN switch to 19 and return to 20. A single beep indicates WOD for that day is loaded. No beep indicates WOD for that day is not loaded. Repeat for each day to be verified.

d. MWOD Operation. Once the loading of current MWOD (Step c.(1) through Step c.(4) above) has been verified, the radio must be provided the current DOM so that radio can transfer the correct MWOD segment from memory into the radio's processor. There are three ways to enter DOM information into an HQ II radio, by receiving TOD with date appended from EGI, by receiving a MICKEY from an HQ II radio loaded with current DOM or by entering it manually.

e. Receiving an EGI TOD or an HQ II MICKEY is the preferred method of initializing a radio loaded with MWODs. An EGI TOD consists of GMT, day, month, and year information received from the GPS satellites. An HQ II MICKEY consists of date information DOM and Day-of-Year (DOY) appended to TOD and will originate from an AN/TRC-187 HQ II Time Signal Set which will append manually supplied data information to TOD supplied by the TRANSIT satellite system. Date information will be supplied to the Time Signal Set once and need only be reinitialized following a power interruption. Upon receipt of an HQ II MICKEY or EGI TOD, an HQ II radio will set its clock to the correct TOD and DOM (derived from the data information) and transfer the correct MWOD segment into its processor. With these actions completed, the radio is ready for active net selection. If a mission should run into the next zulu day, the radio's clock will update to the next day and, if it has been loaded, the correct WOD will be transferred into the radio's processor. If the next day's WOD has not been loaded, the current day's WOD will be repeated.

NOTE

Because HQ II radios do not experience midnight madness, they cannot communicate with a basic HQ radio that has passed through 2400Z until the basic HQ radio is reinitialized.

f. Manual Entry. If an EGI TOD or HQ II MICKEY (date information appended to TOD) is not available, the current DOM with a manually loaded DOM will have to be manually entered; the radio is ready for active net selection as if date information were received from an HQ II MICKEY. An HQ II radio can append date information to its MICKEY, but this requires DOM to be entered manually, and then the radio's clock self-started. When this procedure is completed, the radio appends the DOM into the DOY slot of the MICKEY and sets the year of the MICKEY to 80. Since the clock has been self-started (arbitrary time), the radio should further receive a true MICKEY (zulu time) in order to correctly align its TOD. Because manual entry of DOM requires many switch actions, consider using this procedure to load a master TOD source (an HQ II equipped RSG) and then using the procedure described previously to initialize all other radios. Once loaded, the master radio need only be reinitialized following a power interruption or at the beginning of the next month. The steps for manual entry of DOM are as follows:

(1) Set MPG switch to PRESET.

(2) Set CHAN switch to 20.

(3) Set 23A/frequency switches to 220.025 (MWOD LOAD).

(4) Depress and release LOAD button. (Listen for single beep.)

(5) Set MPG switch to MNL.

(6) Set CHAN switch to 01.

(7) Set 23A/frequency switches to current DOM. The format is 3AB.000, where A is the 10's digit and B is the 1's digit of the current DOM. For example, 23 July would be 323.000.

(8) Set T-TONE switch to TONE and release. (Listen for single beep.)

(9) Set MPG switch to PRESET.

(10) Set CHAN switch to 20.

(11) Set 23A/frequency selector switches to 220.000 (VERIFY/OPERATE).

(12) Set T-TONE switch to TONE and release. (Listen for single beep.)

(13) Set MPG switch to MNL.

(14) Self-start the radio's clock.

NOTE

If using a RF TOD source (other than EGI system), to maximize source reception, place the SQUELCH switch in the OFF position. Once TOD is established, return SQUELCH switch to the ON position.

(15) At this point, the radio is ready to receive a normal MICKEY (request MICKEY, momentarily set T-TONE switch to T, tune to MICKEY frequency and wait for TOD signal). When the radio receives the MICKEY, it will load the MWOD segment matching the DOM entered into the radio. The radio is also now capable of passing HQ II MICKEYs to other radios.

g. MWOD Erase.

(1) Set MPG switch to PRESET.

(2) Set CHAN switch to 20.

(3) Set 23A/frequency switches to 220.050 (MWOD Erase).

(4) Depress and release LOAD button. (Listen for single beep.)

(5) Set MPG switch to MNL.

(6) Set T-TONE switch to TONE and release. (Listen for single beep.)

(7) At this point, all MWODs have been erased and transmit is disabled. To enable transmit or, in non-emergency situations, to return the radio to its normal configuration, continue as follows:

(a) Set MPG switch to PRESET (channel 20 is still selected).

(b) Set 23A/frequency selector switches to 220.000 (VERIFY/OPERATE).

(c) Depress and release LOAD button. (Listen for single beep.) The UHF radio will now operate in the normal mode.

h. FMT-NET Frequency Loading. The following are general instructions for loading FMT-NET frequencies.

(1) Set MPG switch to PRESET.

(2) Set CHAN switch to 20.

(3) Set 23A/frequency switches to 220.075 (FMT-Net Freq. Load).

(4) Depress and release LOAD button. (Listen for single beep.)

(5) Set MPG switch to MNL.

(6) Set 23A/frequency switches to training frequency #1.

(7) Set T-TONE switch to TONE and release. (Listen for single beep.)

(8) Set CHAN switch to 19.

(9) Set 23A/frequency switches to training frequency #2.

(10) Set T-TONE switch to TONE and release. (Listen for single beep.)

(11) Repeat Step h.(8) through Step h.(10), decreasing the channel number by one for each training frequency until all 16 frequencies are loaded.

(12) Set MPG switch to PRESET.

(13) Set 23A/frequency switches to 220.000 (VERIFY/OPERATE).

(14) Depress and release LOAD button. (Listen for single beep.) The FMT-net frequencies are now loaded and need not be reloaded until the approved training frequencies change.

NOTE

When selecting FMT-Net frequencies, a 4 MHz minimum frequency separation should be maintained. Additionally, the radio will accept the frequencies in any order, but they must be loaded in the same order in all radios to maintain interoperability.

i. CONUS FMT-Net Training Frequencies. With an understanding of the above paragraph, the following can be used as a checklist for loading CONUS FMT-net training frequencies. The frequencies are in the order suggested for use throughout the CONUS. Using the FMT-NET Frequency Loading procedure (step h) as a guide, load the CONUS FMT-net training as follows:

(1) Perform steps h.(1) through h.(5).

(2) Observe the following frequency/channel assignments when performing remainder of procedure:

(a) Load 235.050 into channel 20.

(b) Load 225.150 into channel 19.

(c) Load 252.925 into channel 18.

(d) Load 239.950 into channel 17.

(e) Load 271.950 into channel 16.

(f) Load 267.850 into channel 15.

(g) Load 262.450 into channel 14.

(h) Load 257.250 into channel 13.

(i) Load 314.450 into channel 12.

(j) Load 308.750 into channel 11.

(k) Load 303.275 into channel 10.

(l) Load 298.650 into channel 09.

(m) Load 293.550 into channel 08.

(n) Load 289.050 into channel 07.

(o) Load 284.150 into channel 06.

(p) Load 279.750 into channel 05.

(3) Load frequencies as follows:

(a) Set 23A/frequency switches to desired frequency.

(b) Set CHAN switch to appropriate channel.

(c) Set T-TONE switch to TONE and release. (Listen for single beep.)

(d) Repeat steps i(3)(a) through i(3)(c) until all frequencies have been loaded into their respective channels.

(4) Perform steps h.(12) through h.(14).

j. Expanded Memory Board. To verify that the radio is Expanded Memory Board (EMB) modified, the following operational checks may be performed. The first procedure (Step j.(1)) is preferred because the second procedure (Step j.(2)) removes any WOD element stored in preset channel 20.

(1) If the radio is already successfully operating in the AJ mode, select any active net ending in 75 (i.e., A52.275). If a fault tone (interrupted tone) is heard, the radio is EMB modified. Nets ending in 75 have been reserved for a future faster hopping modification (HQ IIA) and are not used with HQ II.

(2) If the radio is powered but has not been initialized for AJ operation, the following procedure may be used to verify that the radio is EMB modified:

(a) Set MPG switch to PRESET

(b) Set CHAN switch to 20.

(c) Set 23A/frequency switches to 220.000 (VERIFY/OPERATE).

(d) Press and release the LOAD button. A single beep may be heard (indicating the EMB radio was not in the VERIFY/OPERATE mode or the non-EMB radio has accepted 220.000 as a WOD element) or there may be no beep (indicating the radio is EMB modified and was already in the VERIFY/OPERATE mode).

(e) If a beep was heard at Step j.(2)(d), set the channel selector switch to 19. If there is no beep, the radio is EMB modified. A basic HQ radio will beep once (if the first digit of the number stored in preset 19 is a 2) or twice (if the first digit of the number stored in preset 19 is a 3).

OPERATING HQ II RADIOS IN THE BASIC HQ MODE.

When a basic HQ net (except T-Net) is selected on an HQ II radio, the WOD will determine which algorithm is used. Because basic HQ radios are not programmed with the improved algorithm, operational and training WOD material is designed to select the original algorithm in HQ II radios to maintain interoperability with basic HQ radios.

NOTE

When using an HQ II radio to communicate on basic HQ nets, the hundredths/thousandths frequency selector switch must be set to double zero. The conferencing option previously controlled by this switch is determined by the Word-of-Day element loaded into preset 19.

The following checklist should be sufficient to provide guidance through the necessary switch actions to operate an HQ II radio.

Abbreviated HQ II Checklist

NOTE

If using a RF TOD source (other than EGI system), in order to maximize source reception, place SQUELCH switch in the OFF position. Once TOD is established, return SQUELCH switch to the ON position.

a. Receive TOD if EGI TOD Not Being Used.

(1) Select TOD frequency - Request TOD.

(2) T-TONE switch - Momentarily to T.

(3) Listen for one or two step tone within 60 seconds.

b. Send TOD.

(1) Radio contact - ESTABLISH.

(2) T-TONE switch - Momentarily to TONE.

c. Verification of MWOD Loading (Combat Mode).

(1) Verify/operate (radio in combat mode).

(a) MPG switch - PRESET.

(b) CHAN switch - 20.

(c) 23A/frequency switches - 220.000.

(d) LOAD button - Depress and release.

(2) Check Day.

(a) MPG switch - MNL.

(b) 23A/frequency switches - 3XX.000 (where XX = day to verify).

(c) CHAN switch - momentarily to 19 then return to 20. (A beep upon returning to channel 20 indicates an MWOD is loaded for date checked.)

d. Training Mode Operations. Radio Setup: FMT-Net or training WOD frequencies not previously entered.

(1) Activate FMT-Net frequency load or change.

(a) MPG switch - PRESET.

(b) CHAN switch - 20.

(c) 23A/frequency switches - 220.075.

(d) LOAD button - Depress and release (hear beep).

(2) LOAD FMT-Net Frequencies (channels 20 - 5).

(a) MPG switch - MNL.

(b) CHAN switch - PRESET to be loaded (20, 19...).

(c) 23A/frequency switches - Select frequency for selected PRESET.

(d) T-TONE switch - Momentarily to TONE (hear beep).

(e) Repeat Step d.(2)(b) through Step d.(2)(d) as necessary.

(3) Load basic HQ training WOD (channels 20 to 15).

(a) MPG switch - PRESET.

(b) CHAN switch - PRESET to be loaded (20, 19, ...).

(c) 23A/frequency switches - Set WOD segment for PRESET selected.

(d) LOAD button - Depress and release.

(e) Repeat Step d.(3)(b) through Step d.(3)(d) as necessary to complete frequencies and enter training WOD in memory.

(4) WOD - Load.

(a) MPG switch - PRESET.

(b) CHAN switch - PRESET to be loaded (20 to 15) (hear single beep after each channel 20 through 16 and double beep at 15).

(5) Receive TOD (dated TOD not required with single WOD).

(6) MPG switch - MNL.

(7) Select Net - ABB.BCC where:

A	=	A (Active)
BB.B	=	Desired Net
		(000-004 for Basic HQ,
		000-015 for HQ II,
		Other numbers invalid -
		Hear interrupted tone)
CC	=	00 for Basic HQ
		25 for HQ II NATO
		50 for HQ II Non-NATO
		75 invalid (hear interrupted tone)

e. Combat Operations Mode (MWODs Not Used).

(1) WOD/TOD - Same switch actions as Basic HQ.

(2) Select Net - ABB.BCC where:

A	=	A (Active)
BB.B	=	Desired Net
CC	=	00 for Basic HQ
		25 for HQ II NATO
		50 for HQ II Non-NATO
		75 invalid (hear interrupted tone)

f. Combat Operations Mode (MWODs Not In Memory).

(1) MWOD function - ACTIVATE.

(a) MPG switch - PRESET.

(b) CHAN switch - 20.

(c) 23A/frequency switches - 220.025.

(d) LOAD button - Depress and release (hear beep).

(2) MWODs - Enter.

(a) MPG switch - MNL.

(b) 23A/frequency switches - Enter elements starting with channel 20.

(c) T-TONE switch - Momentarily to TONE (hear beep).

(d) Repeat Step f.(2)(b) and Step f.(2)(c) for WOD elements 19-15.

(e) CHAN switch - 14.

(f) 23A/frequency switches - Set date tag for WOD.

(g) T-TONE switch - Momentarily to TONE (hear double beep).

(h) Repeat Step f.(2)(b) through Step f.(2)(g) for each additional WOD (up to six total).

(3) Verify/operate.

(a) MPG switch - PRESET.

(b) CHAN switch - 20.

(c) 23A/frequency switches - 220.000.

(d) LOAD button -Depress and release (hear beep).

(4) MWOD Loading - completed.

g. WOD/TOD Update (WOD In Memory and Date Is Part of TOD).

(1) Receive EGI TOD if not previously received or request MICKEY - Same switch actions as Basic HQ.

(2) Current WOD and TOD are now loaded if radio was in VERIFY/OPERATE mode (220.000 in PRESET 20). An alarm (steady tone) upon going active could indicate the TOD did not have date tag as required or WOD is not current.

h. WOD/TOD Update (Date Not Part of TOD).

(1) Activate MWOD - Load mode.

(a) MPG switch - PRESET.

(b) CHAN switch - 20.

(c) 23A/frequency switches - 220.025.

(d) LOAD button - Depress and release (hear beep).

(2) Current date - Set.

(a) MPG switch - MNL.

(b) CHAN switches - 01.

(c) 23A/frequency switches - 3XX.000.

(d) T-TONE switch - Momentarily to TONE (hear beep).

(3) Verify/operate.

(a) MPG switch - PRESET.

(b) CHAN switch - 20.

(c) 23A/frequency switches - 220.000.

(d) LOAD button - Depress and release (hear beep).

(4) Self-start the radio's clock.

(a) MPG switch - MNL.

(b) TEST DISPLAY switch - Depress and hold.

(c) T-TONE switch - Momentarily to TONE.

(d) TEST DISPLAY switch - RELEASE.

NOTE

If using a RF TOD source (other than EGI system), in order to maximize source reception, place SQUELCH switch in the OFF position. Once TOD is established, return SQUELCH switch to the ON position.

(5) Receive EGI TOD if not previously received or request MICKEY - Same switch actions as Basic HQ.

i. Combat Operations Net Selection.

(1) MPG switch - MNL.

(2) Select Net - ABB.BCC where:

A	=	A (Active).
BB.B	=	Desired Net.
CC	=	00 for Basic HQ
		25 for HQ II NATO
		50 for HQ II Non-NATO
		75 invalid (hear interrupted tone)

NORMAL MODE (NON-HQ/ECCM).

a. Turn-On.

(1) To receive EGI TOD at turn-on, proceed as follows:

(a) Ensure EGI GPS FOM is 8 or less (see EGI Page 1/4 (Figure 1-88)).

(b) Ensure EGI UTC is valid (see GPSSTAT Page 1/2 (Figure 1-95)).

(c) On antenna select panel (Figure 1-110) EGI HQ TOD switch - ENABLE NON513 or ARC-164 513.

NOTE

- NON513 If communication problems occur in the HQ mode after selecting the EGI TOD, set the EGI HQ TOD switch to DISABLE and request a MICKEY. While receiving MICKEY, ensure that SQUELCH switch is OFF.
- 513 If communication problems occur in the ECCM mode after selecting the EGI TOD, set the EGI HQ TOD switch to OFF and request a MICKEY. While receiving MICKEY, ensure that SQUELCH switch is OFF.

(2) Function switch - MAIN. All segments of both displays will light momentarily on power-up and series of beeps may be heard. After power-up, if F/S indicator displays a frequency, proceed to Step a.(3). If M-LOAD, FMT.CNG, or ERASE is displayed:

(a) CHAN switch - Channel 20.

(b) 23A/frequency switches - 220.000 on F/S indicator.

(c) MPG switch - PRESET.

(d) LOAD button - Depress and release.

(e) MPG switch - MNL.

(3) SQUELCH switch - OFF (rushing noise).

(4) SQUELCH switch - ON (rushing noise stops).

(5) Transmit (verify sidetone).

b. Manual Frequency Selection.

(1) MPG switch - MNL.

(2) 23A/frequency switches - frequency shown on F/S indicator.

c. Preset Channel Selection.

(1) MPG switch - PRESET.

(2) CHAN switch - Desired operating channel.

NOTE

Channel 20 is reserved for loading single WODs and MWOD operating mode data. To see what frequency is loaded in selected channel, depress STATUS switch. The frequency is displayed on F/S indicator for 5 seconds.

d. Preset Channel Loading.

(1) MPG switch - PRESET.

(2) 23A/Frequency switches - Desired operating frequency.

(3) CHAN switch - Desired channel number 1 to 19.

(4) LOAD button - Depress/release.

(5) Record selected frequency.

(6) Repeat Step d.(1) to Step d.(5) to load additional preset channels.

(7) Access cover - Close.

e. Guard Channel Monitoring. To monitor guard frequency (243.000 MHz) in addition to operating frequency: function switch - BOTH.

f. Guard Frequency Selection. To operate on guard frequency only: MPG switch - GRD. Main receiver and transmitter are now tuned to 243.000 MHz.

g. Automatic Direction Finding (ADF) Operation. The ADF function provides relative bearing information to any signal received on main receiver. Normal radio transmissions are not possible with function switch in ADF. For ADF capability:

(1) Function switch - ADF.

(2) Refer to applicable technical manuals for operation of ADF equipment.

h. ADF Tone Transmission.

(1) Frequency/Channel - Select.

(2) T-TONE switch - TONE (1020-Hz tone will transmit - Transmission will stop when switch is released.)

SECURE VOICE OPERATION.

Obtain proper COMSEC equipment and variables from COM-SEC custodian. After following turn-on procedures, refer to applicable technical manual for operation of associated COMSEC equipment.

HAVE QUICK/ELECTRONIC COUNTER COUNTERMEASURES (HQ/ECCM) MODE.

The HQ/ECCM mode programs a frequency-hopping pattern and rate to provide capability for jam-resistant communications. Three inputs are needed for entering HQ/ECCM mode: time-of-day (TOD), word-of-day (WOD) and net number.

a. Turn-On.

(1) Radio - ON (per turn-on procedures).

(2) Load WOD. Can be loaded manually using MWOD loading method or single WOD loading method. WOD can also be loaded electronically using a KYK-13/TSEC keyfill device.

NOTE

If using a RF TOD source (other than EGI system), in order to maximize source reception, place SQUELCH switch in the OFF position. Once TOD is established, return SQUELCH switch to the ON position.

(3) Receive TOD. If TOD is not available from the EGI system, a coordinated time source (Time Signal Set AN/TRC-177 or AN/TRC-187) or from any other source within your operating network, perform a TOD emergency clock start.

(4) Enter net number.

NOTE

A steady warning tone is heard in headphone when AJ mode is selected and TOD or a valid WOD have not been entered. A pulsating warning tone is heard in headphone when an invalid operating net is selected.

b. TOD Receive. If using a RF TOD source (other than EGI system), in order to maximize source reception, place SQUELCH switch in the OFF position. Once TOD is established, return SQUELCH switch to the ON position.

NOTE

On initial power-up, first TOD message is accepted. Subsequent TOD transmissions are ignored.

(1) Frequency switches or CHAN switch - Predesignated frequency for TOD transmission.

(2) Request TOD from another station in network or:

(a) Ensure EGI GPS FOM is 8 or less (see EGI Page 1/4 (Figure 1-88)).

(b) Ensure EGI UTC is valid (see GPSSTAT Page 1/2 (Figure 1-95)).

(c) Antenna select panel-EGI HQ TOD switch - ENABLE **NON513** or ARC-164 513.

NOTE

If time is being automatically beaconed, the first TOD message received within 1 minute of selecting T position will be accepted.

(3) T-TONE switch - T (1 second, then release).

NOTE

- **NON513** If communication problems occur in the HQ mode after selecting the EGI TOD, set the EGI HQ TOD switch to DISABLE and request a MICKEY. While receiving MICKEY, ensure that SQUELCH switch is OFF.
- 513 If communication problems occur in the ECCM mode after selecting the EGI TOD, set the EGI HQ TOD switch to OFF and request a MICKEY. While receiving MICKEY, ensure that SQUELCH switch is OFF.

c. TOD Update. Slightly garbled but otherwise acceptable communications during AJ operation is an indication of drift in TOD synchronization. To resynchronize radio sets, a TOD update can be performed while still in AJ mode as follows:

(1) Request TOD from another station on operating network or:

(a) Ensure EGI GPS FOM is 8 or less (see EGI Page 1/4 (Figure 1-88)).

(b) Ensure EGI UTC is valid (see GPSSTAT Page 1/2 (Figure 1-95)).

(c) Antenna select panel-EGI HQ TOD switch - ENABLE **NON513** or ARC-164 513.

(2) T-TONE switch - T (1 second, then release).

NOTE

- **NON513** If communication problems occur in the HQ mode after selecting the EGI TOD, set the EGI HQ TOD switch to DISABLE and request a MICKEY. While receiving MICKEY, ensure that SQUELCH switch is OFF.
- 513 If communication problems occur in the ECCM mode after selecting the EGI TOD, set the EGI HQ TOD switch to OFF and request a MICKEY. While receiving MICKEY, ensure that SQUELCH switch is OFF.

d. TOD Send.

(1) 23A/frequency switches or CHAN switch - Predesignated frequency (normal mode) or net number (AJ mode for a TOD update).

(2) T-TONE switch - TONE momentarily.

e. TOD Emergency Clock Start.

NOTE

If the WOD you intend to operate on was loaded using single WOD method (presets 20 to 15), it is not necessary to load an operational date; proceed to Step e.(2).

(1) Load operational date:

NOTE

The operational date is the current (GMT) day-of-month and must be entered so the radio set can select one of the MWODs for code generator initialization.

(a) Enter MWOD loading mode.

(b) CHAN switch - 1.

(c) 23A/frequency switches - Select operational date in format XAB.XXX, where AB equals day-of-month (01-31) and X equals don't care.

(d) T-TONE switch - TONE then release. Note audible tone. Operational date is now entered.

(e) Enter verify/operate mode.

(2) T-TONE switch - T simultaneously depress TEST DISPLAY switch, then release.

NOTE

This new TOD is arbitrary and will not be synchronized to coordinated time. The radio set will not communicate with any other ECCM-equipped radio sets in AJ mode unless this new TOD is transmitted to other radio sets.

f. MWOD Operating Modes Selection. Four operating modes are used within the radio set to initiate various MWOD programming functions. The following table lists the four modes and the displays applicable to each mode. After radio set has been turned on, proceed as follows to enter any of these modes.

Code No.	Display	Function
220.000	VER/OP	VERIFY/OPERATE
220.025	M-LOAD	MWOD LOAD
220.050	ERASE	MWOD ERASE
220.075	FMT.CNG	FREQUENCY MANAGEMENT TRAINING CHANGE

(1) CHAN switch - 20.

(2) MPG switch - PRESET.

(3) Frequency switches - Applicable code number (220.OXX) from the list above for desired operating mode.

(4) LOAD pushbutton - Depress/release.

(5) The radio set is now in selected mode. For MWOD load, MWOD erase or FMT-change modes, the operating mode is displayed on the F/S indicator. For verify/operate mode, depress STATUS switch and VER/OP is displayed on F/S indicator for 5 seconds.

(6) MPG switch - MNL.

g. MWOD Loading Using Manual Method. MWOD capability allows for up to six WODs to be loaded at one time. Each WOD contains a unique date code which is entered in memory location 14. When the current operational date is updated in the radio set at midnight transitions (GMT), the code generator automatically reinitializes with a new WOD having the same date. Proceed as follows to perform manual MWOD loading:

NOTE

In the following steps, if the frequency switches are not used within 5 seconds, the F/S indicator reverts to the M-LOAD display. To review the frequency switch settings, depress the STATUS switch.

(1) Enter M-LOAD mode. MPG switch - MNL.

(2) CHAN switch - 20. Set 23A/frequency switches to first WOD element.

(3) T-TONE switch - TONE then release. Note audible tone. First WOD element is entered.

(4) CHAN switch - Select next lower memory location.

NOTE

All remaining WOD elements may be loaded in memory locations 19 - 15 by repeating Step g.(2) through Step g.(4).

(5) CHAN switch - 14.

NOTE

If two or more WODs loaded have the same code, the radio recognizes only the latest one entered.

(6) Select applicable date code using 23A/frequency switches.

NOTE

Date code entry for the WOD is represented by the format XAB.XXX, where AB equals the day-of-month (01 to 31) and X equals don't care.

(7) T-TONE switch - TONE and release. Note double beep. One complete WOD is now entered. To load more WODs, reselect location 20 and repeat Step g.(2) through Step g.(7).

NOTE

If the radio set is switched off or power is lost after entry of MWODs, the data is not lost. All MWOD data remains in force until erased.

h. MWOD Loading Using KYK-13/TSEC Keyfill Device. The KYK-13/TSEC keyfill device is used to load MWOD electronically. MWOD keying material is supplied through cryptically channels. Load as follows:

(1) Radio - ON (per turn on procedures).

(2) Lift front panel access cover to reveal FILL connector.

NOTE

The fill cable for the KYK-13 may be used while loading MWOD information into the RT, but is not required.

(3) KYK-13 mode switch - OFF/CHECK.

(4) KYK-13 fill device - Install.

(5) KYK-13 mode switch - ON. F/S indicator displays FILL.

(6) KYK-13 address switch - Applicable channel (1-6).

(7) LOAD switch - Depress. Note series of beeps and F/S indicator displays WOD OK.

NOTE

- The CHAN indicator steps down from memory location 20 to 14, then displays memory location one while the KYK-13 is connected and turned on. This allows entry of operational date information, if required. The operational date must match date code of one of the WODs being loaded with KYK-13 fill device.

- If F/S indicator displays BAD, KYK-13 must be reloaded and Step h.(3) through Step h.(7) repeated.

(8) KYK-13 address switch - Next applicable channel and repeat Step h.(7). Observe that WOD OK is displayed on F/S indicator after each WOD is loaded.

(9) If desired, load operational date by depressing the STATUS switch, then select date on 23A/frequency switches in the format XAB.XXX (where AB-01 to 31 for day-of-month and X - don't care). Momentarily set T-TONE switch to TONE position then release.

(10) KYK-13 mode switch - OFF/CHECK.

(11) Unplug fill device and close access cover. Radio returns to previous mode and both displays return to previous settings.

i. MWOD Erase. The erase mode is used to clear the memory of all MWOD elements.

(1) Enter ERASE mode (per Enabling HQ II Modes, step g).

(2) T-TONE switch - TONE momentarily. All MWODS now erased.

(3) Enter verify/operate mode.

j. MWOD Erase - Alternate Method. An alternate and quicker method of erasing MWODs is as follows:

(1) Lift front panel access cover to reveal ZERO switch.

(2) Depress ZERO switch down, then release to normal position. ERASE is displayed. All MWODs are erased.

(3) Close front panel access cover.

AN/ARC-186(V) VHF/FM Radio NON526.

The AN/ARC-186(V) radio installed in the aircraft provides VHF/FM capability. The radio has been preset to provide dedicated VHF/FM operation. If the wrong frequency band is selected on the control panel, a tone will be heard.

NOTE

- Failure to properly close and latch UDTU enclosure door may cause excessive electromagnetic interference (EMI) noise levels on some VHF and UHF radio frequencies.

Deleted.

AN/ARC-186(V) VHF/FM Radio System NON526.

The AN/ARC-186(V) VHF/FM radio system provides two-way voice communications between air-to-air and air-to-ground VHF/FM radio stations, and an emergency (guard) channel provision with an automatic switchover from FM CIPHER to FM PLAIN communications whenever the VHF/FM emergency mode is selected. The system also provides homing data relative to the selected station in the form of visual displays on the ADI. The system can be tuned to within the tactical FM band of 30 to 76 MHz. Operation above 76 MHz may be possible, but should not be attempted due to the design limits of the VHF/FM antenna. The VHF/FM radio system consists of an AN/ARC-186(V) R/T, a control panel having a 20-channel preset capability, and two antennas, one for communications and the other for homing. Power is supplied by the right DC bus.

VHF/FM Antenna.

The VHF/FM radio system uses a single blade type antenna mounted on the underside of the rear fuselage. The KY-58 secure voice system can be used to transmit on the VHF/FM band.

VHF/FM Radio Control Panel.

The VHF/FM radio control panel is located on the left console, and contains all controls necessary for frequency selection, channel selection, operating mode selection, and volume control.

VHF/FM Radio Operation.

MANUAL FREQUENCY SELECTION.

Manual frequency selection is accomplished as follows:

a. Mode selector knob - TR.

b. Frequency control/emergency select knob - MAN.

c. Frequency selector knobs - Set desired frequency.

LOADING PRESET CHANNELS.

Frequencies can be preset for 20 channels. Loading of a set channel is accomplished as follows:

a. Mode selector knob - TR.

b. Frequency control/emergency select knob - MAN.

c. Frequency selector knobs - Rotate until desired frequency is obtained.

d. Preset channel selector - Rotate until the desired channel number is obtained.

e. Load pushbutton - Depress.

PRESET CHANNEL SELECTION.

Selection of a preset channel is accomplished as follows:

a. Mode selector knob - TR.

b. Frequency control emergency select knob - PRE.

c. Preset channel selector - Rotate until the desired channel number is obtained.

EMERGENCY GUARD OPERATION.

a. Mode selector knob - TR.

b. Frequency control emergency select knob - EMER AM (121.5 MHz) or EMER FM (40.5 MHz).

VHF/FM RADIO TURN-ON PROCEDURE.

a. Mode selector knob - TR.

b. On intercom control panel, set rotary selector switch to VHF or FM, as desired. Adjust VOL control and appropriate monitor volume control to a desired level.

c. Frequency control/emergency select knob - MAN. Manually select a frequency. Check for warning tone in the headset. Adjust VOL control for a desired level.

d. Squelch disable/tone select switch - SQ DIS. Noise will be received in headset.

e. Squelch disable/tone select switch - Center position (receiver noise in headset disappears). Squelch will open only when a carrier signal is received in the R/T.

f. Load preset channels as required - Manually set in required frequency.

g. After a 2-second warm-up, slide the MIC switch to UP and talk into the microphone; sidetone is heard in the headset. Adjust VOL control for comfortable volume level.

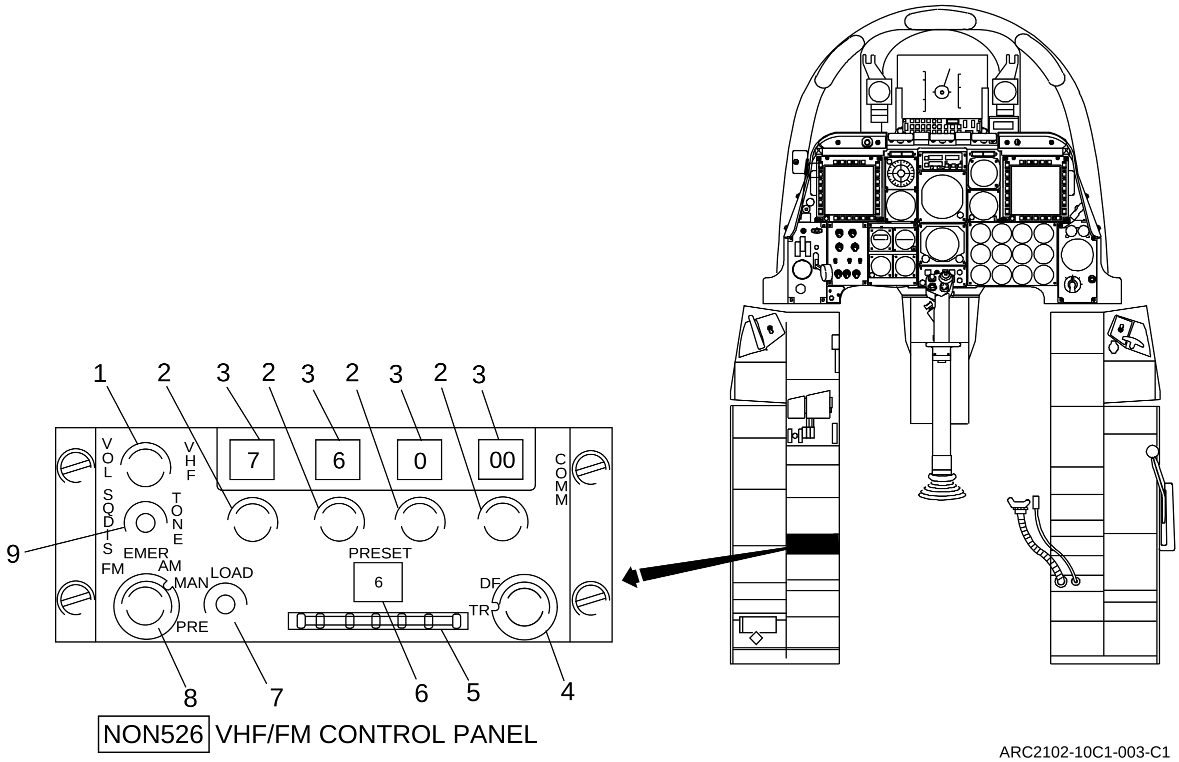

Figure 1-114. AN/ARC-186(V) VHF/FM Control Panel NON526 (Sheet 1 of 2)

Index No.	Control or Indicator	Position or Display	Function
1	VOL control knob	-	Adjusts the audio output.
2	Manual frequency selector switches	-	Manually select R/T frequency. Frequency control/emergency select switch must be at MAN.
3	Frequency indicator	-	Indicates frequency selected by the frequency selector knobs.
4	Mode selector knob	OFF	Disables the R/T.
		TR	Enables the transmitter/receive modes.
		DF	Enables FM homing.
5	Preset channel selector switch	-	Selects preset channel from 1 to 20.
6	Preset channel indicator	-	Indicates preset channel selected by preset channel selector switch.
7	LOAD pushbutton	Depress	Inserts manually selected frequency into selected preset channel.
8	Frequency control/emergency select switch	EMER FM	Selects a prestored channel.
9	Squelch disable/tone select switch	SQ DIS	Disables squelch.
		Center	Enables squelch.
		TONE	Transmits a 1000 Hz tone for audio checking or homing. Spring-loaded to center position.

Figure 1-114. AN/ARC-186(V) VHF/FM Control Panel NON526 (Sheet 2)

FM Homing Capability (VHF/FM Radio) NON526.

When the mode selector knob on the VHF/FM control panel is in DF, the R/T switches to the home mode, and the FM HOMING light on the NMSP (Figure 1-44) comes on if the ILS or TISL modes on the NMSP have not been selected. The ILS or TISL modes override the FM homing mode because they use the same display on the ADI. If the received signals are insufficient to open the squelch circuit, the course warning flag on the ADI will remain in view. When the received signals are adequate to open the squelch, the course warning flag is driven from view. When the squelch disable/tone select switch on the VHF/FM control panel is in SQ DIS, the course warning flag is always in view.

FM Homing ADI Display NON526.

The bank steering bar of the ADI will indicate course deviation to the left or right of the centerline, relative to the selected station. Turning the aircraft toward the bank steering bar will correct the deviation. Initially, the pitch steering bar will line up (approximately) with the second dot below the centerline as marked on the left side of the ADI. As the aircraft approaches the station, the pitch steering bar will move up toward the centerline in accordance with the increasing strength of the received signal. If the station is in the opposite direction (aircraft flying away from station), the pitch steering bar will move down from the centerline towards the second dot. When not in the DF mode, the ADI bank and pitch steering bars and course warning flag are stowed out of view.

Secure Voice Communications System.

The KY-58 secure voice system (Figure 1-115) provides for either plain or cipher communications on the UHF and the VHF/FM NON526 radios. The KY-58 can be used either in the active mode or the inactive (non HQ) mode of the HQ UHF radio system. The KY-58 will switch over from cipher to plain communications whenever GUARD is selected on the UHF radio or whenever EMER is selected on the VHF/FM NON526 radio.

NOTE

If unsecure radio operation is desired, ensure C/RAD is set to PLAIN prior to turning power OFF. Failure to do so will prevent normal communications.

OPERATION OF THE KY-58 SYSTEM.

a. KY-58 daily key - Set.

b. UHF and FM NON526 radios - Set.

c. Interphone panel - Set.

(1) FM monitor switch - Pull out.

(2) UHF monitor switch - Pull out.

d. KY-58 panel - Set.

(1) Power switch - ON.

(2) C/RAD switch - PLAIN (indicator light on).

(3) Delay switch - OFF.

e. Make test transmissions.

f. C/RAD switch - C/RAD 2-(FM) NON526 or C/RAD 1-(UHF) (corresponding light will come on).

- When the C/RAD switch is set to C/RAD 2 or C/RAD 1, an automatic alarm procedure is initiated. A constant tone is heard in the headset, and after approximately 2 seconds, the constant tone will change to an interrupted tone.
- 526 Aircraft equipped with ARC-210-2 do not require use of the KY-58 secure voice system as the radio has an internal COMSEC processor. Inadvertent selection of the C/RAD 2 switch position is prevented by use of a mechanical stop.

g. MIC switch - FWD or AFT as required, then release.

- The interrupted tone will no longer be heard. The system is now in standby condition ready to transmit and receive.

h. To transmit - MIC switch FWD or AFT as required.

- Do not talk for approximately 1/2 second. At that time a beep will be heard which indicates the receiving station is capable of receiving.

i. C/RAD switch - PLAIN.

j. Power switch - OFF.

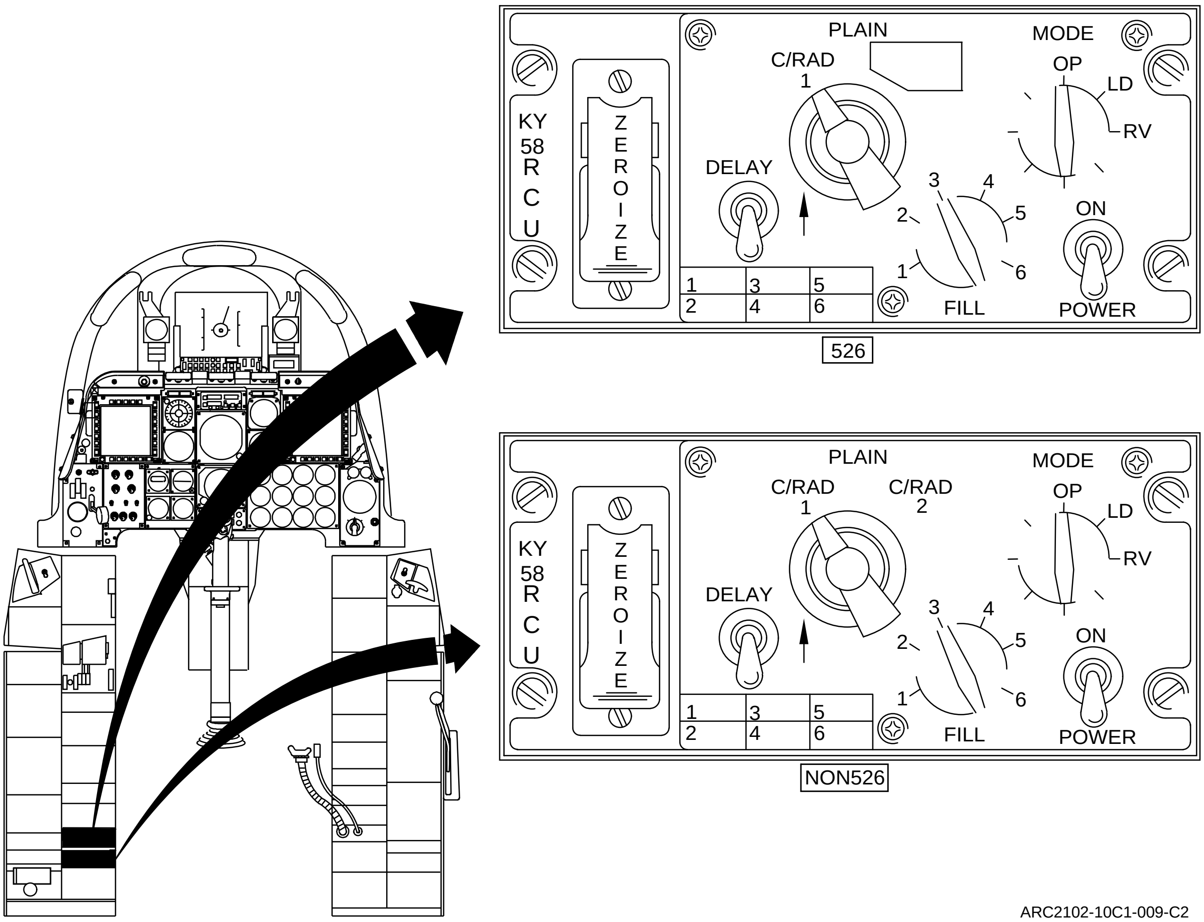

Figure 1-115. Secure Voice Control Panel

AN/ARC-210(V) VHF/UHF RADIO SYSTEM(S).

The AN/ARC-210(V) Radio System(s) provides simplex or half-duplex two-way communication of normal and secure voice AM or FM signals in the 30 through 512 MHz (VHF/UHF) frequency range. AM, FM, embedded COMSEC, Maritime, 8.33 kHz channel spacing, HAVE QUICK (HQ), HAVE QUICK II, Single Channel Ground and Airborne Radio System (SINCGARS), and Satellite Communication (SATCOM) modes are provided.

The AN/ARC-210(V) Radio System-1 (ARC-210-1) consists of an RT-1851A(C)/ARC Receiver Transmitter (RT), RT-Mount Assembly, Radio Set Control (RSC), High Power Amplifier (HPA Mount Assembly, and VHF/UHF/SATCOM Antennas.

The AN/ARC-210(V) Radio System-2 (ARC-210-2) replaces the VHF/FM radio system and consists of an RT-1851A(C)/ARC Receiver Transmitter (RT), a SADL/ARC-210-2 Diplexer, and a shared VHF/UHF/SADL Antenna 526.

The RSC provides operational control of the selected ARC-210 RT. Volume is controlled via menu option on the RSC and intercom knob.

The Up Front Controller (UFC) provides a means to operate the most frequently used radio operations.

NOTE

In rare situations, when controlling an ARC-210 radio from the UFC, the RSC display will not match the actual configuration of the radio. To prevent this problem, the CICU will wait a maximum of 3 seconds until the radio has finished loading data before starting to extract data. The HUD display will also provide correct indication of the radio configuration.

GPS Time-of-Day (TOD) is provided by the EGI. Upon CICU initialization, with a valid TOD and ARC-210(s) powered on, the TOD is automatically loaded to each ARC-210. If a TOD load is manually commanded via the RSC, the TOD signal is loaded to the RT as selected by the RSC.

The DTC provides a means to perform a black fill for either RT, as determined by Mission Planning.

The MFCDs provide a means to view/edit preset data, command BIT, view radio status and recorded faults, and configure the ARC-210-1 RT for data. ARC-210-2 is not an option for data transmission.

NOTE

The A-10 is currently not authorized to operate in the 400-512 MHz frequency range for voice operation. The 400-512 MHz is used for Land-Mobile applications.

Radio Set Control.

The RSC is located on the left side console aft of the throttles. When out of OFF, the RSC power is enabled for both RSC and the RT(s). Manual selection of frequencies is done through the RSC. Twenty-five Simplex, ten half-duplex DAMA/SATCOM, and five half-duplex or wide band satellite communication can be preset for quick selection by means of the RSC when in preset (PRST) Frequency Mode, fifty-seven Maritime channels when in the Maritime (MAR) Frequency Mode, and twenty-five channels when in the Electronic Counter-Counter Measures (ECCM) or ECCM MASTER Frequency Mode. Five frequency select knobs are provided on the RSC in order to select a frequency other than a preset channel.

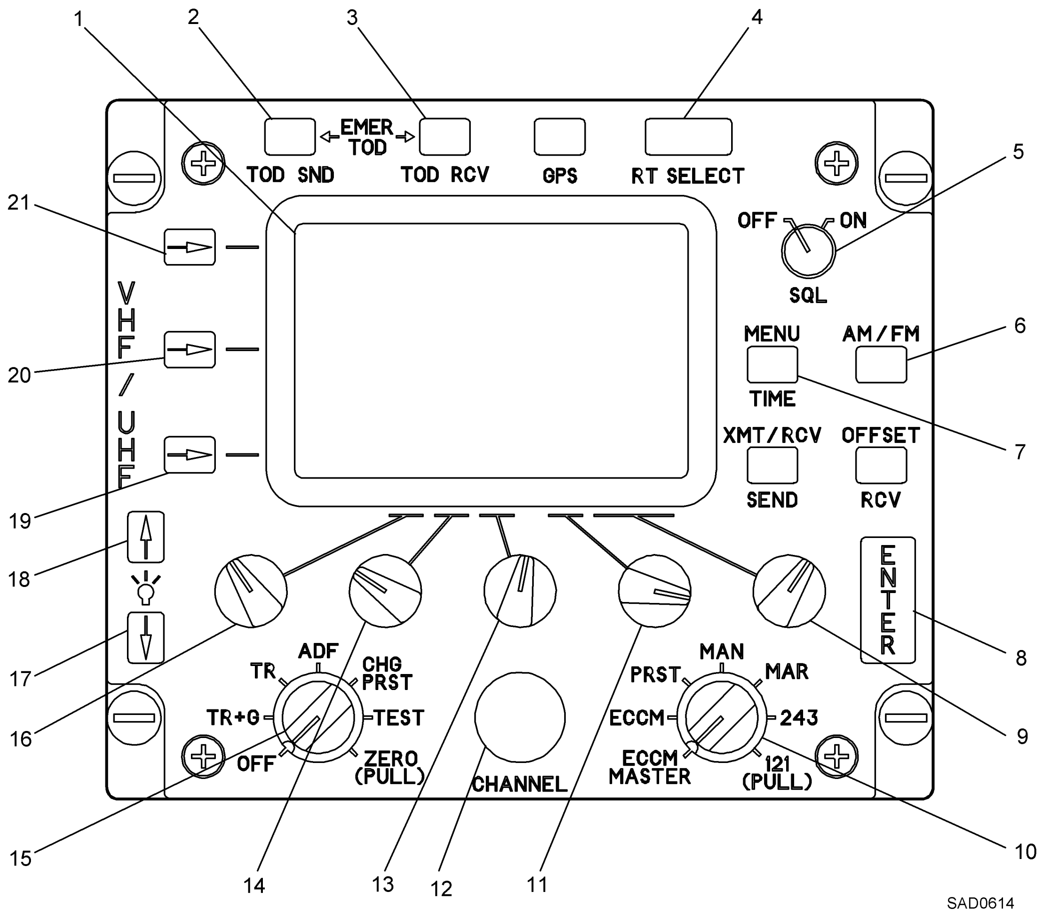

Figure 1-116. Radio Set Control

Figure 1-117. RSC Control and Indicators

Item	Control/Indicator	Function
1	Display	Provides a visual display of radio control and status information based on the control and menu selections that have been activated.
2	TOD SND	Time-Of-Day (TOD) Send (SND) key. When pressed, commands the selected RT to transmit the TOD (not used for SATCOM).
2, 3	EMER TOD	Pressing TOD SND and TOD RCV (receive) keys simultaneously for at least one second with the following: • The radio set control set to any frequency • The operational mode switch in the TR+G (transmit and receive plus guard), TR, or ADF (automatic direction finding) position • The frequency mode switch in the ECCM MASTER (electronic counter-countermeasure), ECCM, MAN (manual), PRST (preset), or MAR (maritime) modes commands the RT to reset the HAVE QUICK master clock (not used for SATCOM).
3	TOD RCV	TOD RCV key. When pressed, commands the selected RT to receive TOD from another transmitter.
Deleted		
*	GPS	When pressed provides the display to select HQ time only or HQ and SG time.
4	RT SELECT	**NON526** Not used for A-10. 526 Selects RT1 for control of the Front radio (ARC-210-1) or RT2 for control of the AFT radio (ARC-210-2). The default setting at power up is RT1.
5	SQ OFF/ON	Squelch (SQL) OFF/ON rotary switch. RT squelch circuits are disabled in the OFF position and enabled in the ON position.
6	AM/FM	AM/FM key. When pressed, toggles RT modulation between AM; FM; BLT selections B1, B2, B3, or B4 (if enabled); or CTCSS (if BLT is enabled and Plain Text (PT) voice is selected). Refer to Table C-3 for details about the available RT modulation types in each frequency band. Selected mode is shown on display. **NOTE** BEAM Line Of Sight Technology (BLT) and Continuous Tone Controlled Squelch System (CTCSS) features are disabled and not used on the A-10.
7	MENU/TIME	MENU/TIME key. When pressed provides for the selection of display pages used to perform various auxiliary functions or displays current time. In Single Channel Ground Airborne Radio System (SINCGARS) mode, the time is displayed. In HAVE QUICK mode, the options include HQ MENUS, COMSEC, SYSTEM SETTINGS (if BLT modulation is disabled) or LAND MOBILE, COMSEC, and MORE (if BLT modulation is enabled). If the volume control menu is enabled, headset volume level can be selected.

Figure 1-117. RSC Control and Indicators - Continued

Item	Control/Indicator	Function
*	OFFSET/RCV	OFFSET/RCV key. Provides for the selection of offsets from 5 to 20 kHz from the selected frequency over the range of 30 to 511.975 MHz except for the Air Traffic Control (ATC) frequency range. Press the OFFSET/RCV key to increment the displayed frequency in 5 kHz steps. The RT software translates the frequency from the radio set control to provide the appropriate frequency. In the ATC frequencies, provides for offsets of 8.33 to 16.66 kHz, which result in an 8.33 kHz bandwidth mode for European ATC.

Figure 1-117. RSC Control and Indicators - Continued

Item	Control/Indicator	Function
		When CTCSS is selected, press the OFFSET RCV key for frequency offsets of 6.25 to 18.75 kHz.
*	XMT/RCV	Transmit (XMT)/RCV/SND key. When pressed, toggles between the XMT/RCV and SND functions. XMT/RCV provides for the exchange of location of transmit and receive frequency display when programming preset SATCOM or half-duplex channels (Not used on A-10).
8	ENTER (disabled)	Not used for A-10.
9, 11, 13, 14, 16	Frequency Selector Switches	Continuous rotary switches used to select the desired frequency for the RT. Only valid frequencies (standard military frequency bands) are allowed. Refer to Table C-3.
10	Frequency Mode	Isolated position rotary switch (knob must be pulled out to enter or exit positions marked PULL) selects one of the following seven frequency modes for the selected RT. **NOTE** Attempts to select invalid frequencies are indicated on the display by blanking the two least significant digits of the frequency (e.g. 100.9_ _).
	ECCM MASTER	ECCM MASTER selects operation in the Electronic Protection (EP) frequency mode with the added functions associated with SINCGARS Master Net Controller.
	ECCM	ECCM selects operation in Have Quick, Have Quick II, or SINCGARS mode. The operator can select up to 25 ECCM nets.
	PRST	In PRST mode, selects operation in the preset frequency mode.
	MAN	Manual (MAN) selects operation in the manual frequency mode. When in this mode, frequency selection switches (items 12, 14, 16, 17, 19) can be used to tune to any valid frequency. The bottom (→) pushbutton (item 19) selects an extended frequency range feature when +EX or -EX is displayed adjacent to key.
	MAR	Maritime (MAR) selects operation in the maritime frequency mode. When in this mode, channel select switch (item 15) can be used to select one of 57 maritime channels.
	243	243 select operation in the 243 MHz guard precedence frequency mode. When in this mode, the main receiver is tuned to the 243.000 MHz guard frequency. All Communications Secure (COMSEC) functions are disabled while in this mode.
	121 (PULL)	121 (PULL) selects operation in the 121.5 MHz guard precedence frequency mode. When in this mode, the main receiver is tuned to the 121.500 MHz guard frequency. All COMSEC functions are disabled in this mode.

Figure 1-117. RSC Control and Indicators - Continued

Item	Control/Indicator	Function
12	CHANNEL (VOLUME)	CHANNEL rotary switch is used to select desired channel or action depending on selected frequency mode:
		Selects one of 41 preset channels when in PRST or CHG PRST frequency mode.
		Selects one of 27 preset channels when in ECCM MASTER or ECCM frequency mode.
		Selects one of 57 maritime channels when in MAR frequency mode.
		Selects the day for HAVE QUICK auxiliary information when in the ECCM MASTER or ECCM frequency mode (not used for SATCOM).
		Selects the day when using SINCGARS in ECCM MASTER or ECCM frequency mode.
		Selects HOPSETS and LOCKSETS when using SINCGARS in ECCM MASTER or ECCM frequency mode.
		Selects volume level, when Volume is enabled, also used to send stored Maintenance Fill MIC and Side Tone levels to RT.
15	Operational Mode	The operational mode switch, marked OFF, Transmitter-Receiver + Guard receiver (TR+G), TR, ADF (Automatic Direction Finder), CHG PRST (Change Preset), TEST, and ZERO, on the RSC turns the equipment on and off and selects the type of operation.
	OFF	OFF removes power applied to radio set control, and RT. When in the OFF position, however, radio set control may still be powered on if an appropriate hard-wired input is received on the guard precedence input or on the system on/off input. When the operational mode switch is moved out of the OFF position, electrical power is applied to the radio set control and the RT.
	TR+G	Transmit Receive + Guard (TR+G) selects RT operations in both transmit and receive modes for both the main receiver and the guard receiver. If the radio set control receives a hard-wire input on the guard precedence line, however, the radio set control commands the RT to tune to 243.000 MHz.
	TR	TR selects RT operations in both transmit and receive modes for the main receiver. The guard receiver is turned off.
	ADF	ADF selects RT operation in the ADF mode (not used for A-10).
	CHG PRST	CHG PRST (change preset) selects RT operation that allows information for the currently selected preset channel to be defined and loaded into that channel location. Also puts RT into the TR mode of operation.
	TEST	TEST mode, the RT and RSC perform Built-In Test (BIT). BIT will not function or will cease to function if the radio set control receives a guard precedence command (hardwire input), the frequency mode switch is placed in the 243 position, or the operational mode switch is placed in the ZERO (PULL) position.
	ZERO (PULL)	ZERO (PULL) mode, Electronic Protection (EP) frequency parameters, and Secure Communication (COMSEC) keys are zeroized. Zeroizing is not complete until a ZEROIZE COMPLETE message is displayed. When controlling two receiver-transmitters, each RT must be zeroized individually.
17	↓	↓ Pushbutton. When pressed, display brightness is decreased.
18	↑	↑ Pushbutton. When pressed, display brightness is increased.

Figure 1-117. RSC Control and Indicators - Continued

Item	Control/Indicator	Function
19	→ (bottom) pushbutton	Bottom (→) pushbutton. Pushbutton function depends on menu displayed when pushbutton is pressed. Pushbutton is active only when the operational mode switch is in the TR+G, TR, or ADF mode position and the frequency mode switch is in the ECCM MASTER, ECCM, PRST, or MAN mode position. If not in a menu and the RT is in a cipher mode, this pushbutton cycles through encryption key numbers (can be in CHG PRST mode).
20	→ (middle) pushbutton	Middle (→) pushbutton. Pushbutton function depends on menu displayed when pushbutton is pressed. Pushbutton is active only when the operational mode switch is in the TR+G, TR, or ADF mode position and the frequency mode switch is in the ECCM MASTER, ECCM, PRST, or MAN mode position. If not in a menu, this pushbutton cycle through text operations plain/cipher (can be in CHG PRST mode).
21	→ (top) pushbutton	Top (→) pushbutton. Pushbutton function depends on menu displayed when pushbutton is pressed. Pushbutton is active only when the operational mode switch is in the TR+G, TR, or ADF mode position and the frequency mode switch is in the PRST, or MAN mode position. If not in a menu, function of this pushbutton depends on frequency mode: In SINCGARS mode performs LATE NET ENTRY (LE) function. In MAR mode, toggles between ship/shore frequencies. In MAN mode, returns RT to previous frequency. In CHG PRST mode, loads new frequency/modulation pair. In ECCM MASTER or ECCM mode, loads new net number.

8.33 KHZ CHANNEL SPACING.

NOTE

> The 8.33 kHz channel spacing is used to alleviate Air Traffic Control (ATC) band congestion in the VHF band.

The designated ATC channel is set on the RSC. The RT receives the channel command from the RSC and performs all necessary conversions automatically to translate from an ATC channel to an ATC frequency with the appropriate receiver bandwidth necessary.

For example, if directed to go to Channel 118.040, set the RSC to that channel, the radio automatically interprets that, and outputs in a bandwidth of 8.33 kHz at a frequency of 118.0417 MHz.

ARC 210(V) RT.

RT Provided Embedded COMSEC Functionality.

The RT provides embedded COMSEC functionality for one voice port. The voice port is used in either the wideband or the narrowband modes of operation. The wideband voice processing is interoperable with the Continuous Variable Slope Delta (CVSD) voice-processing algorithm used by the VINSON (KY-58), IAW CSESD-14. The narrowband voice COMSEC is interoperable with the Advanced Narrowband Digital Voice Terminal (ANDVT) waveform. The narrowband voice processing is interoperable with the Linear Predictive Coding (LPC) voice processing algorithm used by the ANDVT, IAW MIL-C-28883.

Figure 1-118. 8.33-kHz Channel Spacing

Channel (MHz) (User Entered)	Bandwidth (kHz)	Receiver-Transmitter Interpreted Frequency (MHz)
118.000	25	118.0000
118.005	8.33	118.0000
118.010	8.33	118.0083
118.015	8.33	118.0167
118.020	25	118.0250
118.025	25	118.0250
118.030	8.33	118.0250
118.035	8.33	118.0333
118.040	8.33	118.0417
118.045	25	118.0450
118.050	25	118.0500
118.055	8.33	118.0500
118.060	8.33	118.0583
118.065	8.33	118.0667
118.070	25	118.0750
118.075	25	118.0750
118.080	8.33	118.0750
118.085	8.33	118.0833
118.090	8.33	118.0917
118.095	25	118.0950

ECCM TOD Receive Functions.

The ECCM TOD receive functions are not allowed while the RT is operating in a cipher text mode. Complete COMSEC status, including alarm status, are available to the RSC. The RT provides COMSEC functionality for the operational modes. COMSEC functionality is available for only one port, either voice or data, at a time.

SINCGARS.

SINCGARS General Information.

The ARC-210 Radio has the capability of electronic counter-countermeasures (ECCM) operation using the SINCGARS waveform. The RT automatically produces the SINCGARS waveform when the operator selects the mode. ECCM operation using the SINCGARS waveform is described in this section.

NOTE

SINCGARS operation can only be activated if the RT is loaded or filled with the proper ECCM data. Fill data can be transferred into the RT utilizing a data transfer device (DTD).

SINCGARS Operations.

The radio provides SINCGARS preset channel capability for ECCM operation under normal operational conditions. Up to 25 SINCGARS ECCM preset channels can be stored and accessed for use during all phases of flight that VHF radio communication is allowed. Channels 1 through 25 in the ECCM MASTER or ECCM position of the Frequency Mode selector can contain the regular SINCGARS presets. Each SINCGARS preset channel identifies net data stored in the radio containing the net identifier (ID), hop set, and the TRANSEC variable. This net data is stored in NVM and is retained in the event of power loss. In addition, SINCGARS operation requires SINCGARS base time to synchronize the frequency hopping operations.

SINCGARS base time (including the mission day) can be loaded by Over-the-Air transfer or by placing the EGI HQ TOD switch on the Antenna Select Panel to ARC-210, pressing the GPS button then either the "HQ TIME ONLY" or the "HQ AND SG TIME" button on the RSC. The SINCGARS base time is equal to the received time, and the SINCGARS mission day is equal to the least significant two digits of the 3-digit day-of-year. SINCGARS base time can be viewed when a SINCGARS channel is selected. The time is viewed in the form of days, hours, and minutes (DD:HH:MM). If the SINCGARS base time is updated manually, all SINCGARS net time offsets are zero.

NOTE

If the ARC-210 radio(s) is/are powered on, Antenna Select Panel HQ TOD switch is set to ARC-210, and the EGI has acquired time from GPS, GPS TOD will automatically be loaded into the ARC-210 radio(s) when the CICU is initially powered on.

MARITIME OPERATION.

This mode is enabled by selecting the maritime mode (MAR) on the frequency mode selector of the radio set control. In this mode, any of the 57 preset maritime channels permanently stored in the RT can be selected (1 through 28, and 60 through 88) using the CHANNEL selector. The RT defaults to the shore station frequency for transmit and the ship station frequency for receive. The RSC displays the selected channel and the transmit frequency. Press the top (→) pushbutton (SHIP/SHORE) to toggle the radio between the two ship/shore frequencies assigned to the channel.

513 The selected preset channel is displayed in the HUD with an indication that the preset is a maritime preset (see TO 1A-10C-34-1-1 for HUD Symbology details).

Figure 1-119. Maritime Channel Assignments and Transmit Frequencies

Channel	Frequency (MHz)	
	Ship Station	Shore Station
1	156.050	160.650
2	156.100	160.700
3	156.150	160.750
4	156.200	160.800
5	156.250	160.850
6	156.300	*
7	156.350	160.950
8	156.400	*
9	156.450	156.450
10	156.500	156.500
11	156.550	156.550
12	156.600	156.600
13	156.650	156.650
14	156.700	156.700
15	156.750	156.750
16**	156.800	156.800
17	156.850	156.850
18	156.900	161.500
19	156.950	161.550
20	157.000	161.600
21	157.050	161.650
22	157.100	161.700

Figure 1-119. Maritime Channel Assignments and Transmit Frequencies - Continued

Channel	Frequency (MHz)	
	Ship Station	Shore Station
23	157.150	161.750
24	157.200	161.800
25	157.250	161.850
26	157.300	161.900
27	157.350	161.950
28	157.400	162.000
60	156.025	160.625
61	156.075	160.675
62	156.125	160.725
63	156.175	160.775
64	156.225	160.825
65	156.275	160.875
66	156.325	160.925
67	156.375	156.375
68	156.425	156.425
69	156.475	156.475
70	156.525	156.525
71	156.575	156.575
72	156.625	*
73	156.675	156.675
74	156.725	156.725
75	156.775	156.775
76	156.825	156.825
77	156.875	*
78	156.925	161.525
79	156.975	161.575
80	157.025	161.625
81	157.075	161.675
82	157.125	161.725
83	157.175	161.775
84	157.225	161.825
85	157.275	161.875

Figure 1-119. Maritime Channel Assignments and Transmit Frequencies - Continued

Channel	Frequency (MHz)	
	Ship Station	Shore Station
86	157.325	161.925
87	157.375	161.975
88	157.425	162.025
* Not defined as shore (coast) station. These are ship-to-shore or ship-to-ship channels.		
**Maritime Guard Channel		

ECCM CAPABILITY.

The ECCM mode of operation provides jam-resistant capability by taking advantage of rapid tuning ability of the RSC. Automatically changing the frequency many times for each second is a technique called frequency hopping. To permit frequency hopping, three special entries are required. These entries are Word-Of-Day (WOD), TOD, and net number.

Word-Of-Day.

WOD programs the frequency-hopping rate and frequency-hopping pattern. The radio cannot function in ECCM mode without a valid WOD. A separate set of preset channels (1-25) is reserved for WOD storage. WOD length may vary and may require anywhere from one to six channel locations. At midnight Greenwich Mean Time (GMT) transitions, the radio automatically generates a new frequency pattern based on the new days WOD. Up to six WOD may be entered at one time, allowing for multi-day use of the radio without installing another WOD. The RSC has the capability to erase all stored WODs and Multiple WOD's (MWODs).

Figure 1-120 Deleted

Time-Of-Day.

NOTE

- TOD Over-The-Air Transfer can be done from the ARC-164 to the ARC-210. The ARC-164 radio gets TOD from satellites and a discrete line from the EGI. This TOD can be sent to either ARC-210.
- TOD can be sent directly from the EGI to the ARC-210 or ARC-164 by using the EGI HAVEQUICK Time-of-Day Select switch on the Antenna Select panel (Figure 1-110).

TOD synchronization is necessary for communicating in the ECCM mode to allow frequency hopping at the same instant in time. TOD is initialized via TOD Emergency Start, TOD Over-the-Air Transfer. TOD contained in the radio may be sent to other radios similarly equipped. In HAVE QUICK II radio, operational date information is part of the TOD message. This information is necessary for the radio to select the WOD with the same date. The time signal set maintains and disseminates UTC as TOD, allowing all users to receive TOD at the start of every mission.

Net Numbers.

The net numbers are used in ECCM mode in the same fashion as a non-ECCM mode frequency. The net number enables multiple station pairs to operate simultaneously on a non-interference basis in ECCM mode while sharing a common WOD and TOD. The net number begins with an A and is followed by three digits 000 to 999. The last two digits of the display (00, 25, 50, and 75) designate the frequency table being used. Net numbers ending 00 select original A-net and B-net frequency tables. Net numbers ending in 25 select NATO/Europe frequency table and net numbers ending in 50 select non-NATO/Europe frequency table. Net numbers ending in 75 are reserved for future use and will generate an invalid net alarm. TRAINING MODE net (T-net) numbers are A00.000 through A00.400 for five T-net numbers and A00.025 through A01525 for sixteen Frequency Management Training (FMT) net numbers. Selecting any other net number while operating on a TRAINING MODE WOD also generates the invalid net alarm.

HAVE QUICK AND HAVE QUICK II.

By selecting ECCM MASTER or ECCM on the frequency mode selector, up to 25 ECCM preset channels containing HAVE QUICK (HQ), HAVE QUICK II (HQII) , or SINCGARS (SG) data may be selected.

NOTE

- ECCM operation can only be activated if the radio is loaded or filled with the proper data. HQ data can be transferred utilizing a DTD. WOD/MWOD can be loaded manually. WOD/MWOD can be loaded along with radio presets and other radio parameters from the DTC using the DTS UPLOAD Page (Figure 1-159).
- Utilizing a DTD to program HQ operational data into the RT normally negates the need to access most of the ancillary functions. It should be noted, however, the DTD does not program TOD information into the RT.

A HQ preset channel is represented by the symbols HQI or HQII centered at the top of the RSC display. The RT can store up to 25 HQ preset channels. One WOD and six MWOD can be stored in the RT. The selection of WOD or MWOD mode is determined by the fill. The ARC-210 load automatically determines the mode. If loaded manually, then select day 01 to 31 for MWOD or day 00 for WOD. 513 The selected preset channel is displayed in the HUD with an indication that the preset is an ECCM preset (see TO 1A-10C-34-1-1 for HUD Symbology details).

NOTE

HQ and HQ II were developed for use in the military UHF AM band. Since the original HQ development, military communications systems have incorporated FM operation in the same UHF band. The RT allows for the use of HQ in AM or FM. However, many HQ radios in the military inventory do not have FM capability.

ZEROIZE.

The radio provides a zeroize utility for use under normal or emergency operational conditions. The zeroize utility erases ECCM fill data from RT memory.

NOTE

In the event the zeroization fails to delete secure data, the message ZEROIZE FAILURE is displayed.

NORMAL OPERATING PROCEDURES.

a. Operational Mode Selector - TR or TR+G.

WARNING

The system RT contains a RF transmitter which, when operated into an antenna, can produce electromagnetic fields in close proximity (152.4 mm (6 in)) to the antenna that are in excess of OSHA recommended maximum limits.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - MAN or PRST, as required.

(1) MAN (Frequency Selector Switches) - Set desired frequency

NOTE

If an invalid frequency is entered, the radio set control remains tuned to the last valid operating frequency used and the last two frequency digits of the display are blanked.

(2) AM/FM - Select, as required

(3) OFFSET/RCV - Press, if required

NOTE

If frequency offset is required, press the OFFSET RCV pushbutton. Frequency display indicates a new frequency offset by 5 kHz. If an offset of 10 kHz is required, press OFFSET RCV display indicates a new frequency offset by 5 kHz. If an offset of 10 kHz is required, press OFFSET RCV pushbutton a second time, a third time for an offset of 15 kHz, and a fourth time if an offset of 20 kHz is required. Press the OFFSET RCV pushbutton a fifth time to return the frequency to the original value.

(4) PRST (CHANNEL Selector) - Select desired preset channel

NOTE

Only previously, programmed channels are shown.

d. COMSEC - Set, if required

(1) Select PT, CT, or CT-TD (middle (→) pushbutton)

NOTE

- PT plain text, CT secure, CT-TD secure with time delay based on KY-58, CT ONLY based on KY-58 voice and KY-58 data, or CTO-TD based on KY-58 voice and KY-58 data with time delay based on KY-58.
- Preset channels, manual frequencies and COMSEC mode can be commanded via the UFC (See section on AN/ARC-210 Control via UFC). The selected preset channel, manual frequency is displayed in the HUD along with the COMSEC mode (see TO 1A-10C-34-1-1 for HUD Symbology details).

(2) Select cipher key # 1 - 6 (bottom (→) pushbutton)

LOADING PRESET CHANNELS.

a. Operational Mode Selector - CHNG PRST

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - PRST

d. CHANNEL Selector - Select desired channel

e. Frequency Selector Switches - Set desired frequency

f. AM/FM Selector - Select, as required

g. COMSEC - Select, as required (middle (→) pushbutton)

NOTE

Valid fill is required to select CT or CT- TD.

h. Load, select top (→) pushbutton - Press

i. Operational Mode Selector - TR or TR+G

NOTE

513 Preset channels can be loaded from the DTC using the DTS UPLOAD Page (Figure 1-159) and modified using the ARC-210 Preset Pages accessible through the COMM PAGE (Figure 1-173.15 COMM PAGE).

SCAN OPERATION.

Before using the scan function, preset channels 22-25 must be preset with desired frequencies to be scanned. If transmission is attempted during scanning operations then transmission goes out on the command channel (22) unless RT is keyed within three seconds of receiving a transmission, then it is the last channel scanned. If while receiving on a channel the radio is double keyed, the radio transmits on the command channel (preset channel 22). Scanning resumes after approximately three seconds of inactivity. The channel and frequency are displayed when a signal is detected on a scanned channel. To transmit on an active channel while scanning, press top (→) pushbutton to return the RT to channel 22 (scanning ceases). The RT is ready to communicate on the selected frequency. Press the top (→) pushbutton a second, third, and/or fourth time to tune the RT to channels 23, 24, and 25, respectively. Press top (→) pushbutton a fifth time to cause the RT to resume scanning.

NOTE

In scan mode, preset channel 22 is the command channel and preset channels 23 through 25 are secondary scanned channels.

a. Operational Mode Selector - TR or TR+G

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - PRST

d. CHANNEL - 31

e. COMSEC - Set, if required

NOTE

SCAN mode can be commanded via the UFC. (See section on AN/ARC-210 Control via UFC). An indication that the radio is in SCAN is displayed in the HUD (see TO 1A-10C-34-1-1 for HUD Symbology details).

MARITIME OPERATION.

a. Operational Mode Selector - TR or TR+G

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - MAR

d. Channel - Set, as required (Available channels are 1 - 28, 60 - 88)

e. Top (→) pushbutton - Toggle, as required (Select appropriate SHIP/SHORE setting)

f. COMSEC - Set, if required

HAVE QUICK OPERATION.

INITIALIZE TIME.

Operational use of HQ and HQ II require a TOD (i.e. TOD Emergency Start or over-the-air transfer or GPS TOD).

For GPS TOD:

a. Ensure EGI is on and a valid UTC time is available.

b. RSC, Operational Mode Selector - TR, TR+G.

c. RT Select pushbutton - RT1 or RT2, as required.

d. RSC, Frequency Mode Selector - Verify not in 243 or 121.

e. Antenna Select Control Panel EGI HAVEQUICK Time-of-Day Select Switch - ARC-210.

f. RSC - Press GPS key to receive GPS TOD.

g. RSC - Press the lower (→) button for HQ AND SG TIME or the middle (→) button for HQ TIME ONLY.

h. VERIFY RSC display - "ATTEMPTING TO LOAD GPS TIME".

i. VERIFY RSC display - "GPS TIME RECEIVED".

NOTE

- Must receive GPS TOD within 60 seconds of pressing "HQ and SG TIME" or "HQ TIME ONLY".
- If the ARC-210 radio is powered on, Antenna Select Panel HQ TOD switch is set to ARC-210, and the EGI has acquired time from GPS, GPS TOD will automatically be loaded into the selected ARC-210 radio when the CICU is initially powered on.
- Operational Day must be loaded following this procedure.

For TOD Emergency Start:

a. Operational Mode Selector - TR, TR+G, or CHNG PRST.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - Verify not in 243 or 121.

d. EMER TOD - Press TOD SND and TOD RCV keys at the same time for at least 1 second.

For TOD Over Air Transfer:

NOTE

If the transfer is accomplished in MAN or PRST positions of the frequency mode selector, the entire time is passed (day, hour, seconds, and fractions of seconds). In ECCM MASTER or ECCM positions, it is presumed TOD already exists; therefore, only fractions of seconds are passed for exact synchronization.

a. Operational Mode Selector - TR, TR+G, or CHNG PRST.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - MAN or PRST.

d. Frequency Selector Switches - Enter frequency to transmit or receive TOD.

e. Send/Receive TOD.

(1) To send press TOD SND key.

(2) To receive press TOD RCV key.

NOTE

Must receive TOD within 60 seconds of pressing TOD RCV key.

LOAD OPERATIONAL DAY.

Load operational day if operation is in HQ II MWOD mode. This procedure is necessary if the TOD established via a TOD Emergency Start.

a. Operational Mode Selector - TR, TR+G, or CHNG PRST

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - ECCM or ECCM MASTER

d. CHANNEL Selector - 1 - 25

e. MENU/TIME - Press

f. HQ MENUS - Press (top (→) pushbutton)

g. OPER. DATE LOAD - Press (middle (→) pushbutton)

h. CHANNEL - Set Rotate channel knob to enter day (MWOD = 01 - 31)

i. LOAD OPER. DATE - Press (middle (→) pushbutton)

j. EXIT - Press (top (→) pushbutton)

LOAD WOD/MWOD.

The following procedure allows manual entry WOD/MWOD without the use of a DTD. Each WOD/MWOD consists of one to six segments.

a. Operational Mode Selector - TR, TR+G

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - ECCM or ECCM MASTER

d. CHANNEL Selector - Set channel 1 - 25

e. MENU/TIME Key - Press

f. HQ MENUS - Select (top (→) pushbutton)

g. MORE - Select (bottom (→) pushbutton twice)

h. WOD LOAD - Select (middle (→) pushbutton)

i. Frequency Selector - Enter first segment of WOD/MWOD

NOTE

The display signifies the first segment of the WOD/MWOD by displaying a 20. The segment takes the form of a 6-digit frequency. A WOD/MWOD is complete whenever a 3 is loaded in the hundred MHz position (e.g., 3XX.XXX). For a multiple segment WOD/MWOD, the hundred MHz position contains a 2. The last two digits determine the hop rate (00 for the slowest rate, 75 for the fastest).

j. LOAD WOD - Select (middle (→) pushbutton)

NOTE

The RT acknowledges by producing a headset beep and directs the RSC display to decrement to 19 to signify the next segment to be loaded, if multiple segments are to be used.

k. Repeat Step i and Step j to enter next segment of WOD/MWOD until "14" is displayed.

l. Operational Date - LOAD WOD (middle (→) pushbutton) Rotate CHANNEL selector to desired date (MWOD = 01 - 31, WOD = 00)

NOTE

For HQ I, select CHANNEL 00 and select LOAD WOD.

m. Repeat Step i thru Step l for MWOD operations.

n. EXIT - Select (top (→) pushbutton)

LOAD NET ID NUMBER.

a. Operational Mode Selector - CHG PRST

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - ECCM or ECCM MASTER

d. Select Channel to Load Net - CHANNEL Select 1-25

e. Select Net ID - Set frequency

f. LOAD - Select (top (→) pushbutton)

NORMAL OPERATION (ACTIVE).

a. Operational Mode Selector - TR or TR+G

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - ECCM or ECCM MASTER

d. Channel Selector - Select authorized net

e. AM/FM - Select, as required

f. COMSEC - Set, if required FAULT MESSAGES

NOTE

Proper HQ net display with no communication could be caused by the wrong TOD, WOD, or MWOD.

NO OPER DAY - indicates the operational date was not loaded or wrong day was received during over-the-air transmission.

NO FILL - can indicate one of the following: WOD or MWOD not loaded, invalid HQ net ID loaded (combat net ID loaded with training WOD or MWOD), or no HQ II FMT frequencies.

NO TIME - indicates time has not been initialized or received.

NO WOD - indicates no WOD has been loaded.

NO MWOD - indicates no MWOD has been loaded.

NO FM - indicates FMT frequencies have not been loaded.

INVALID NET ID - indicates a valid net ID has not been loaded into the channel.

VERIFY WOD/MWOD DATE TAG.

a. Operational Mode Selector - TR, TR+G

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - ECCM or ECCM MASTER

d. CHANNEL Selector - 1 - 25

e. MENU/TIME Key - Press

f. HQ MENUS - Select (top (→) pushbutton)

g. MORE - Select (bottom (→) pushbutton)

h. VERIFY WOD/MWOD - Select (middle (→) pushbutton)

i. CHANNEL - Select day of the month that is to be verified (01-31)

j. VERIFY WOD/MWOD - Select (middle (→) pushbutton) (a beep verifies the WOD/MWOD is loaded for that date)

k. EXIT - Select (top (→) pushbutton)

ERASE WOD/MWOD.

a. Operational Mode Selector - TR, TR+G

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - ECCM or ECCM MASTER

d. CHANNEL Selector - 1 - 25

e. MENU/TIME Key - Press

f. HQ MENUS - Select (top (→) pushbutton)

g. MORE - Select (bottom (→) pushbutton three times)

h. WOD ERASE - Select (middle (→) pushbutton)

i. YES or EXIT/NO - Select (top/bottom (→) pushbutton, as required)

FMT TRAINING NET LOAD.

NOTE

- Because HQ training frequencies are contained in the WOD, the capability exists to load up to seven sets of HQ training nets. The seven sets would be contained in the set of six MWOD and the single WOD.
- FMT Training nets can be built in mission planning and loaded from the DTC using the DTS Upload Page (Figure 1-159).

a. Operational Mode Selector - TR, TR+G

b. RT Select pushbutton - RT1 or RT2, as required.

c. Frequency Mode Selector - ECCM or ECCM MASTER

d. CHANNEL Selector - 20

e. MENU/TIME Key - Press

f. HQ MENUS - Select (top (→) pushbutton)

g. MORE - Select (bottom (→) pushbutton four times)

h. HQ II FMT - Select (middle (→) pushbutton)

i. Frequency Selector - Enter segment of training net

j. HQ II FMT - Select (middle (→) pushbutton)

k. Repeat Step i and Step j to enter next segment of HQ II FMT 19 to 05 of the training net. After the last segment is loaded, the display returns to segment 20.

l. HQ II FMT - Select (middle (→) pushbutton). This loads the training net into the RT

m. EXIT - Select (top (→) pushbutton)

SINCGARS OPERATIONS SET UP.

NOTE

The internal clock is referenced to the Have Quick time-of-day (TOD). Internal clock timing is retained for a minimum of seven seconds during a power loss. If a power loss lasts beyond seven seconds, the internal clock needs to be reloaded, unless battery backup power is present.

a. Ensure radio set control SQL OFF/ON switch is set to ON.

b. Initialize time by one of the following methods.

- TOD Emergency Start.
- TOD Over-The-Air transfer.
- EGI TOD.

SINCGARS OPERATIONS PROCEDURES.

a. Set Operational Mode selector to TR or TR+G.

b. Set Frequency Mode selector to ECCM MASTER or ECCM.

c. Rotate CHANNEL selector to obtain desired SINCGARS net.

d. COMSEC - Set, if required

NOTE

SINCGARS presets can be selected via the UFC (See section on AN/ARC-210 Control via UFC). The selected SINCGARS preset is displayed in the HUD (see TO 1A-10C-34-1-1 for HUD Symbology details).

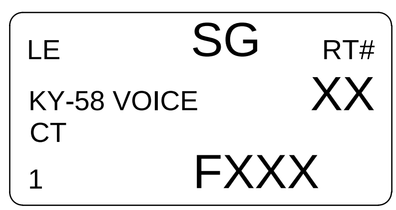

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Figure 1-121. SINCGARS Operations Typical RSC Screen

SINCGARS NET TIME VIEWING/BASE TIME EDITING.

NOTE

- The RT must already have TOD previously established by Receive TOD Emergency Start or TOD Over-The-Air or direct connection with EGI.
- Perform SINCGARS Net Time Viewing/Base Time Editing procedure to load operational day if time is loaded from EGI.

a. Set Operational Mode selector to TR or TR+G.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Set Frequency Mode selector to ECCM MASTER or ECCM.

d. Rotate CHANNEL selector to obtain desired SINCGARS net.

NOTE

The specific SINCGARS channel selected is not important since this procedure changes the SINCGARS base time for all SINCGARS channels.

e. Press MENU TIME key.

f. Rotate CHANNEL selector to select desired two-digit operational day to be loaded.

g. If time is to be loaded, use Frequency Selector switches to enter desired time.

h. Press middle (→) pushbutton to select LOAD TIME.

i. Press top (→) pushbutton to exit the display page and end the time editing procedure.

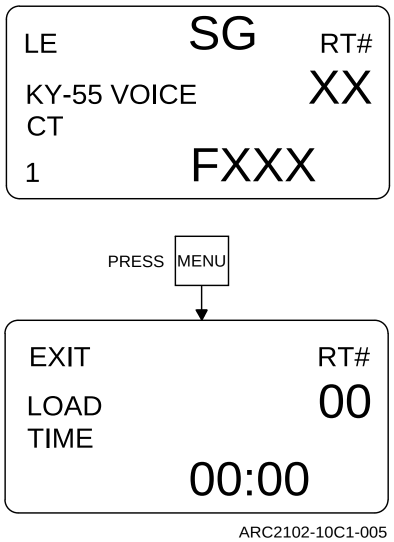

Figure 1-122. SINCGARS Time Edit Procedure RSC Screen

SINCGARS COLD START PROCEDURE.

The following procedure allows sending or receiving of SINCGARS frequency hop data by RF transfer over the COLD START channel. This cooperative method can be used to initially open a SINCGARS net. The radio must have a compatible TRANSEC variable loaded.

The radio has ECCM preset channel 26 allocated as the COLD START channel. The COLD START preset channel is loaded with a predetermined VHF FM frequency (30 to 88 MHz). With the preset channel selected in the ECCM MASTER or ECCM Frequency Mode selector position, the SINCGARS algorithm causes the RT to hop on that single frequency. This allows the radio to transmit or receive an ERF.

NOTE

SINCGARS COLD START is a cooperative effort and both the transmitting and the receiving radios must be set up with compatible communication conditions. They must share a common TRANSEC variable and SINCGARS net time.

a. Set Operational Mode selector to TR or TR+G.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Set Frequency Mode selector to ECCM MASTER or ECCM.

d. Rotate CHANNEL selector to obtain SINCGARS channel 26.

NOTE

The SINCGARS COLD START preset channel can be selected via the UFC (See section on AN/ARC-210 Control via UFC). The SINCGARS preset channel is displayed in the HUD with an indication that the preset is an ECCM preset (see TO 1A-10C-34-1-1 for HUD Symbology details).

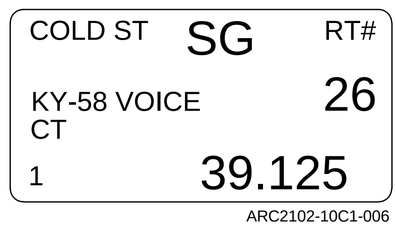

Figure 1-123. SINCGARS Cold Start RSC Screen

ELECTRONIC PROTECTION REMOTE FILL PROCEDURE.

The following procedure allows for sending or receiving of SINCGARS ERF frequency hop data by RF transfer. ERF data can be transferred over a SINCGARS channel (including the COLD START channel) in the ECCM MASTER or ECCM Frequency Mode selector position.

NOTE

SINCGARS ERF is a cooperative effort and both the transmitting and the receiving radios must be set up with compatible communication conditions. They must share a common TRANSEC variable and SINCGARS net time.

a. Set Operational Mode selector to TR or TR+G.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Set Frequency Mode selector to ECCM MASTER or ECCM.

d. Rotate CHANNEL selector to obtain desired SINCGARS net.

NOTE

The specific SINCGARS channel selected is not important since this procedure changes the SINCGARS base time for all SINCGARS channels.

To transmit ERF, perform the following:

a. Press XMT/RCV SEND key to access HOPSET or LOCKOUT menu.

b. Press middle (→) pushbutton to toggle between HOPSET and LOCKOUT.

c. Rotate CHANNEL selector to select desired hop-set or lockout preset to be transferred.

d. Press top (→) pushbutton to transmit hop-set or lockout preset and to exit the display page.

To receive ERF, perform the following:

a. Press OFFSET RCV key to access HOPSET or LOCKOUT menu.

b. Press middle (→) pushbutton to toggle between HOPSET and LOCKOUT.

c. Press top (→) pushbutton to initiate receive ERF function and to exit the display page. The RT continues normal operation and accepts ERF when it arrives. If ERF is received without errors and is successfully stored in RT NVM, a short beep is heard in the headset.

LATE NET ENTRY PROCEDURE.

The following procedure allows entry into a SINCGARS net without prior precise time synchronization. This procedure assumes that SINCGARS data such as hop-set, lockout set, and TRANSEC variable have previously been loaded.

NOTE

- The SINCGARS base time must be loaded prior to late net entry.
- SINCGARS base time must be within one minute of SINCGARS net time.

a. Set Operational Mode selector to TR or TR+G.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Set Frequency Mode selector to ECCM MASTER or ECCM.

d. Rotate CHANNEL selector to obtain desired SINCGARS net.

NOTE

The specific SINCGARS channel selected is not important since this procedure changes the SINCGARS base time for all SINCGARS channels.

e. Perform the SINCGARS Net Time Viewing/Base Time Editing procedure in this section to load SINCGARS base time, if necessary.

f. Push top (→) pushbutton to select Late Entry (LE). The net number (LXXXX) replaces LE on the display.

NOTE

SINCGARS base time updates automatically when a transmission from a net-synchronized radio occurs. LE mode exits automatically when the radio becomes synchronized. Normal SINCGARS communications are then possible on the SINCGARS channel or net.

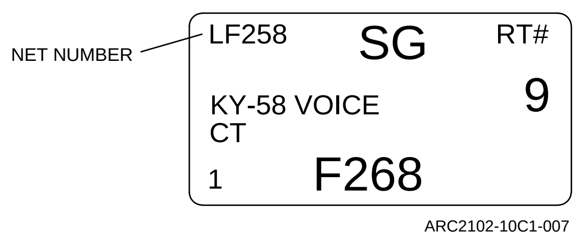

Figure 1-124. Late Net Entry Typical RSC Screen

SINCGARS CUE PROCEDURE.

The following procedure allows for receiving a SINCGARS CUE transmission from a radio that is not an active member of that net. CUE takes the form of a predetermined contact frequency that, if programmed into a SINCGARS radio, is periodically scanned for activity during the SINCGARS frequency hopping operation. The CUE frequency is loaded into SINCGARS CUE preset channel 27.

NOTE

SINCGARS CUE operation is a cooperative effort and both the transmitting and the receiving radios must be set up with compatible communication conditions.

To initiate a CUE transmission, perform the following:

a. Set Operational Mode selector to TR or TR+G.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Set Frequency Mode selector to ECCM MASTER or ECCM.

d. Rotate CHANNEL selector to select SINCGARS channel 27.

e. Key radio to establish two-way communications on the CUE frequency.

NOTE

The SINCGARS CUE preset channel can be selected via the UFC (See section on AN/ARC-210 Control via UFC). The SINCGARS channel selected is displayed in the HUD (see TO 1A-10C-34-1-1 for HUD Symbology details).

To receive a CUE transmission, perform the following:

a. Set Operational Mode selector to TR or TR+G.

b. RT Select pushbutton - RT1 or RT2, as required.

c. Set Frequency Mode selector to ECCM MASTER or ECCM.

d. Push top (→) pushbutton to select CUE ON, on SINCGARS channel 27, if necessary.

NOTE

A valid frequency must be loaded into the SINCGARS CUE channel to turn on the CUE function. The CHG PRST Operational Mode selector position, with the Frequency Mode selector in the ECCM MASTER or ECCM position, can be used to load a frequency into the SINCGARS CUE channel. Refer to Loading Preset Channels 1 through 25 procedure in the Normal Operation section.

e. Rotate CHANNEL selector to obtain desired SINCGARS net.

NOTE

When a signal is received on the SINCGARS CUE frequency while operating on any SINCGARS channel, a short tone is heard in the headset and CUE is displayed.

f. Key radio to establish two-way communications with the station transmitting the CUE.

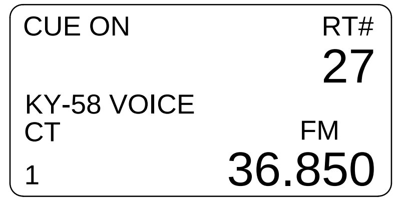

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Figure 1-125. SINCGARS CUE Channel Selected RSC Screen

ZEROIZE PROCEDURE.

NOTE

Performing the zeroization deletes ECCM parameters from the selected RT memory. Refilling RT memory using a DTD may be required prior to resumption of ECCM operations.

a. Set Operational Mode selector to ZERO (PULL).

NOTE

- The message ZEROIZE IN PROCESS is displayed while the zeroization is in progress. The message ZEROIZE COMPLETE is displayed upon completion of the zeroization.
- In the event the zeroization fails to delete secure data, the message ZEROIZE FAILURE is displayed. Continuous beeping is heard until zeroize is completed. The message ZEROIZE COMPLETE is displayed for two seconds when the data is zeroized.

b. Set Operational Mode selector to a position other than ZERO (PULL).

AN/ARC-210(V) SATCOM RADIO SYSTEM.

The ARC-210 VHF/UHF Multimode Radio has the capability of non-ECCM dedicated channel SATCOM in the UHF band. The radio also has the capability of Demand Assigned Multiple Access (DAMA) SATCOM in the UHF band.

WARNING

- Minimum safe distance from the active antenna is five feet, when operating in SATCOM mode.
- ARC-210-2 system is not set-up for BLOS operation. (i.e. no High Power Amplifier or SATCOM antenna) 526.

GENERAL DEDICATED CHANNEL INFORMATION.

The ARC-210-1 RT can store up to five half-duplex wide-band SATCOM channels for use during all phases of flight that UHF radio communication is allowed. Preset channels 26 through 30 have been designated for half-duplex or dedicated channel SATCOM (non-DAMA) operation.

GENERAL DAMA INFORMATION.

The ARC-210-1 RT can store up to 10 half-duplex DAMA SATCOM channels for use during all phases of flight that UHF radio communications is allowed. Preset channels 31 through 40 (or 41 through 50) have been designated for DAMA SATCOM operations.

SATCOM ADDITIONAL FUNCTIONS.

Operation in SATCOM mode requires setup of certain system parameters. SATCOM operational parameters can be manually set up during all phases of flight that UHF radio communication is allowed.

CONFIGURING DAMA/SATCOM COMSEC OPERATION.

The RT is capable of operation in five modes of COMSEC during DAMA/SATCOM communications. The five COMSEC modes are ANDVT VOICE, ANDVT DATA, KG-84 DATA, KY-58 DATA, or KY-58 VOICE. However ANDVT VOICE and KY-58 VOICE are the only modes used by the A-10. COMSEC modes are used for all SATCOM operations.

The COMSEC mode chosen is displayed on the radio set control display at the middle (→) pushbutton position. The steps in the following procedures are basic procedures for use during all phases of flight that VHF or UHF radio communication is allowed.

LOADING PRESET CHANNELS 26 THROUGH 30.

The RT can store up to 30 user-selectable preset channel frequencies for use during all phases of flight that VHF or UHF radio communication is allowed. Channels 26 through 30 are for half-duplex or wideband SATCOM operation. To configure channels 26 through 30 for half-duplex operation, refer to Configuring Preset Channels 26 Through 30.

ELECTRONIC DATA LOADING GENERAL INFORMATION.

The RT requires loading of encryption keys prior to COMSEC operation.

AN/ARC-210(V) SATCOM RADIO SYSTEM CONTROLS AND INDICATORS.

Deleted.

HI/LO SATCOM ANTENNA SELECTOR FUNCTION.

The SAT ANT upper/lower selector switch will be used to select between the HIGH or LO angle antenna section of the antenna. Set to HIGH for high angle (>30 degree satellite look angle) satellite communications. Set to LO for low angle (<30 degree satellite look angle) satellite communications. The selection of either the high or low angle antenna for satellite communications will be determined based on the operational location in the world and available satellite locations.

DEDICATED CHANNEL SATCOM SETUP.

Ensure radio set control SQL OFF/ON switch is set to ON.

NOTE

- For dedicated channel UHF SATCOM (non-DAMA) operation, channels 26 through 30 must be programmed with separate transmit and receive FM frequencies in the UHF band. Encryption keys must be loaded into the radio before cipher text (CT) operation.
- The RSC ENTER key should be disabled.
- ARC-210-2 is not set-up for BLOS operation. (i.e. no High Power Amplifier or SATCOM antenna) 526.

DEDICATED CHANNEL SATCOM OPERATIONS.

a. Operational Mode selector - TR or TR+G.

b. Frequency Mode selector - PRST.

c. CHANNEL selector - Select desired SATCOM channel (26 to 30) (indication on display).

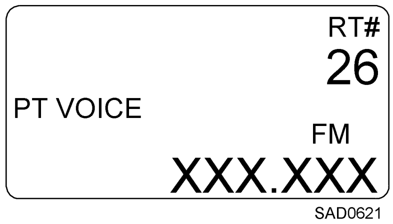

Figure 1-126. SATCOM Channel Typical Display Page

d. COMSEC - Set.

NOTE

Desired SATCOM channel (26 to 30) and COMSEC mode can be selected via the UFC (See section on AN/ARC-210 Control via UFC). The selected channel and COMSEC are displayed in the HUD (see TO 1A-10C-34-1-1 for HUD Symbology details).

DAMA UHF SATCOM OPERATION.

The radio provides DAMA UHF SATCOM capability for operation under normal operational conditions.

DAMA UHF SATCOM OPERATIONS.

For DAMA UHF SATCOM operation, channels 31 through 40 (or 41 through 50) must be programmed with separate transmit and receive FM frequencies in the UHF band. Encryption keys must be loaded into the radio prior to CT operation.

a. Operational Mode selector - TR or TR+G.

b. Frequency Mode selector - PRST.

c. CHANNEL selector - Select desired channel (31 through 40 or 41 through 50).

NOTE

- DAMA SATCOM channels can be 5K, 25K, dedicated (DED), Demand Assigned Single Access (DASA), DAMA, or Officer in Tactical Command Information Exchange Subsystem (OTCIXS) channels.
- Log in is only applicable to 5K and 25K DAMA channels. There can be transmission delays of several minutes due to satellite operation.
- Half-duplex preset channels 31 through 40 or 41 through 50 contain both transmit and receive frequencies. IDLE is displayed if the DAMA SATCOM preset channel is not filled with preset data.

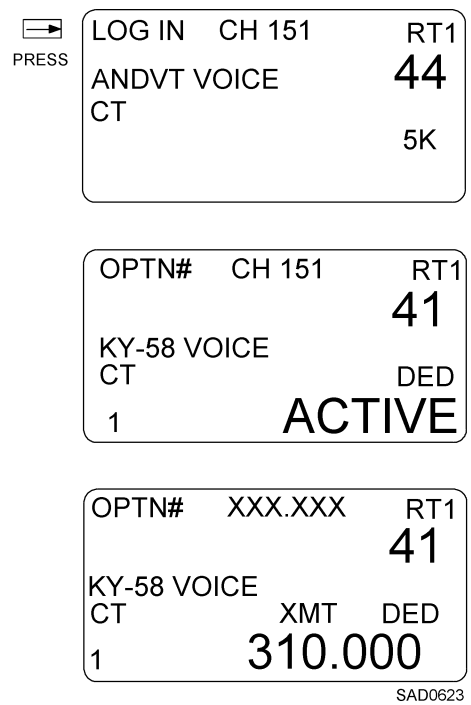

Figure 1-127. Typical DAMA Displays

NOTE

- Once a downlink (DNLNK) signal is received on a DED or OTCIXS DAMA SATCOM channel, the downlink option (OPTN) number is displayed.

- The DED and OTCIXS DAMA SATCOM channel option numbers or uplink/downlink frequencies can be temporarily changed.

d. Top (→) pushbutton - Press to begin DAMA log in with the network controller.

Deleted.

Deleted.

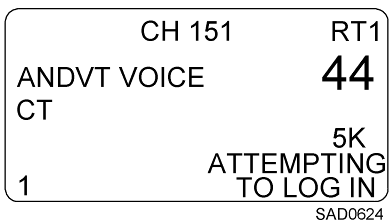

Figure 1-128. Typical DAMA Displays

Once log in is completed, CONNECT or ACTIVE is displayed. When a call is received, or when the transmitter is keyed, the network controller notifies the user by showing a display indicating the link is complete and how much time is remaining (XX:XX:XX) for the call (if implemented).

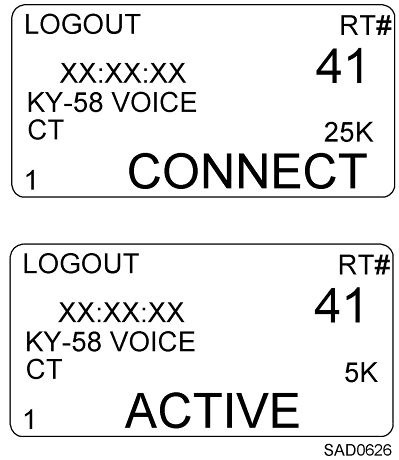

Figure 1-129. Typical DAMA Displays

a. COMSEC - Set.

b. To enable or disable emissions control (EMCON) operation, perform the following:

(1) MENU TIME key - Press

(2) Top (→) pushbutton - Press to select EMCON.

(3) Middle (→) pushbutton - Press to toggle between EMCON: ON and EMCON: OFF.

(4) Top (→) pushbutton - Press to initiate desired option.

(5) MENU TIME key - Press to exit the display page.

NOTE

When EMCON is on, no transmissions are sent.

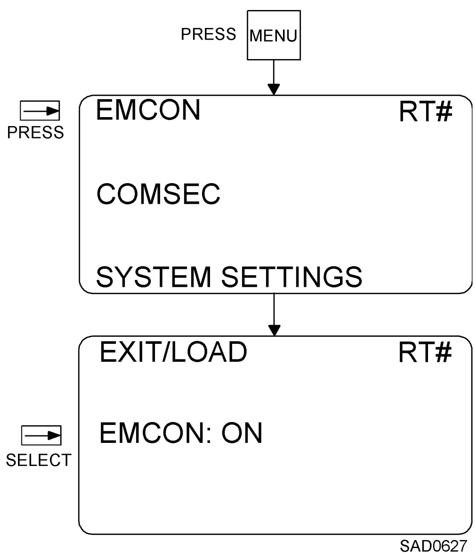

Figure 1-130. Typical DAMA Displays

c. Top (→) pushbutton - Press to log out, while a preset DAMA channel is selected. LOGGING OUT..., then IDLE is displayed.

EDITING DAMA SATCOM PRESETS OPERATION.
Only DED and OTCIXS DAMA SATCOM presets can be edited. The new values are temporary, and the values return to the default (data filled) values when a new channel is selected.

a. Operational Mode selector - TR or TR+G.

b. Frequency Mode selector - PRST.

c. CHANNEL selector - Select desired DED or OTCIXS DAMA SATCOM channel (31 through 40 or 41 through 50) indication on display.

NOTE

Half-duplex preset channels 31 through 40 or 41 through 50 contain both transmit and receive frequencies.

d. To temporarily change the option number at which to operate in the selected channel and perform the following:

(1) Top (→) pushbutton - Press to select OPTN#.

(2) Bottom (→) pushbutton - Press as necessary, to select desired uplink option number.

(3) Middle (→) pushbutton - Press to load selected uplink option number.

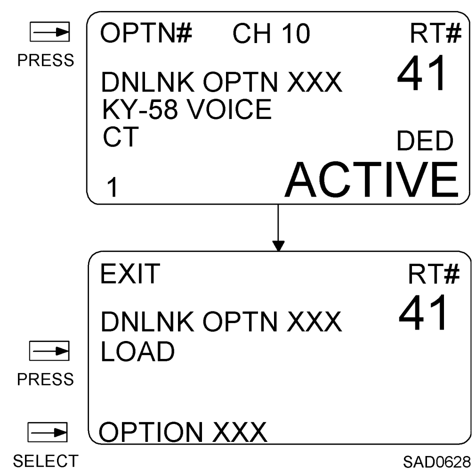

Figure 1-131. Typical DAMA Displays

e. To temporarily load a new transmit (uplink) and receive (downlink) frequency into the selected channel, refer to Loading Preset Channels 26 through 30.

NOTE

Step c and Step e in the Loading preset channels 26 through 30 operations procedure; do not apply to this uplink/downlink frequency loading procedure.

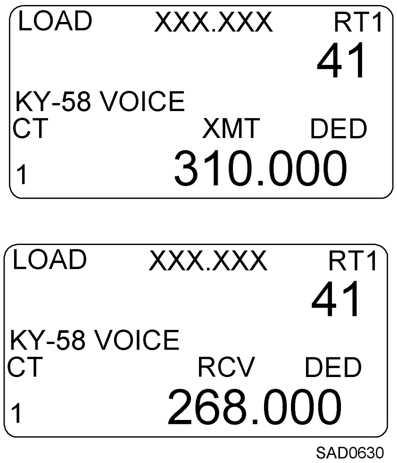

Figure 1-132. Typical DAMA Displays

CONFIGURING PRESETS CHANNELS 26 THRU 30 OPERATION.

a. Operational Mode selector - TR or TR+G.

b. Frequency Mode selector - PRST.

c. CHANNEL selector - Select desired operating channel (channels 26 through 30) until operating channel is displayed.

d. MENU TIME key - Press.

e. Bottom (→) pushbutton - Press to select MORE until PRESET CH. 26-30 is available on the middle pushbutton.

f. Middle (→) pushbutton - Press.

g. Middle (→) pushbutton - Press to toggle between HALF DUPLEX and SATCOM ONLY.

h. Top (→) pushbutton - Press to load the configuration selected for the preset channels and to exit the display page.

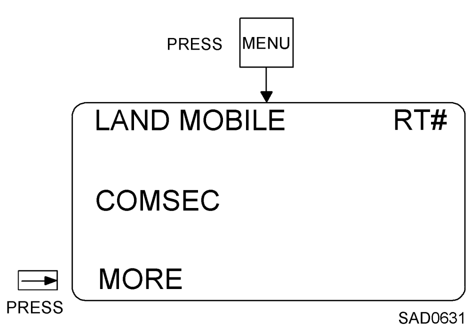

Figure 1-133. Typical DAMA Displays

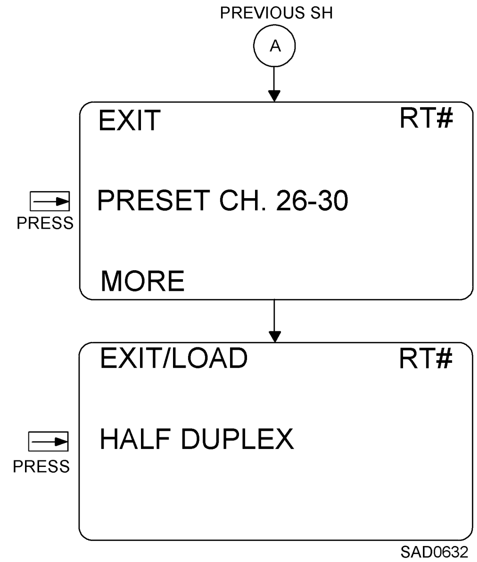

Figure 1-134. Typical DAMA Displays

DAMA SATCOM CHANNEL NUMBER SELECTION OPERATION.

a. Operational Mode selector - TR, TR+G, or CHG PRST.

b. Frequency Mode selector - PRST, MAN, or MAR.

c. CHANNEL selector - Select desired operating channel is displayed or select desired operating frequency (MAN mode) with the Frequency Selector switches.

d. MENU TIME key - Press.

e. Bottom (→) pushbutton - Press to select MORE until DAMA CHANNELS is available on the middle pushbutton.

f. Middle (→) pushbutton - Press to select DAMA CHANNELS.

g. Middle (→) pushbutton - Press to toggle between DAMA CH. 31-40 and DAMA CH. 41-50.

h. Top (→) pushbutton - Press to load the preset DAMA channel number selection and to exit the display page.

NOTE

The DAMA SATCOM channels are numbered accordingly.

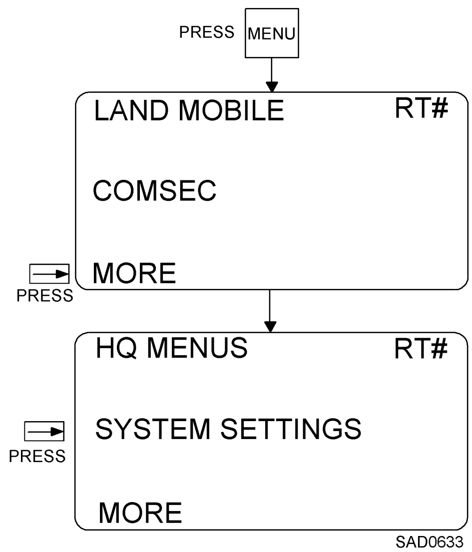

Figure 1-135. Typical DAMA Displays

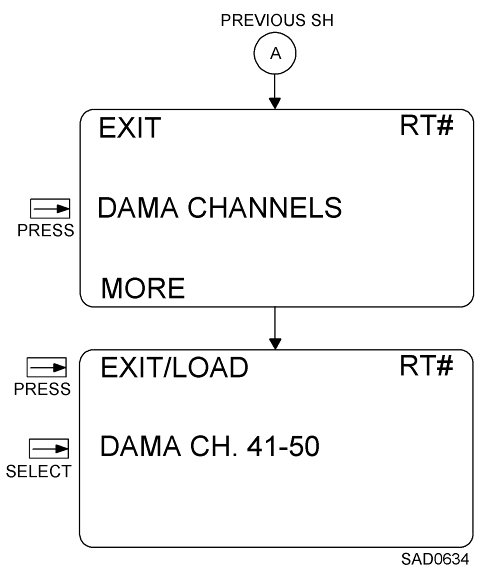

Figure 1-136. Typical DAMA Displays

CONFIGURING DAMA/SATCOM COMSEC OPERATION PROCEDURES.

a. Operational Mode selector - TR+G or TR.

b. Frequency Mode selector - PRST, MAN, or MAR.

c. CHANNEL selector - Select desired operating channel is displayed or select desired operating frequency (MAN mode) with the Frequency Selector switches.

d. MENU TIME key - Press.

e. Bottom (→) pushbutton - Press to select MORE until COMSEC is available on the middle pushbutton.

f. Middle (→) pushbutton - Press to select COMSEC.

g. Middle (→) pushbutton - Press to toggle and select DAMA/SATCOM COMSEC if necessary.

h. Bottom (→) pushbutton - Press to select MORE.

i. Middle (→) pushbutton - Press to select ANDVT VOICE, ANDVT DATA, KG-84 DATA, KY-58 DATA, or KY-58 VOICE.

j. Bottom (→) pushbutton - Press to select MORE if ANDVT VOICE was selected.

(1) Middle (→) pushbutton - Press to toggle between Linear Predictive Coding (LPC-10) or Mixed Excitation Linear Predictive (MELP).

(2) Top (→) pushbutton - Press to load the selection and to exit the display page.

k. If KY-58 VOICE was selected perform the following:

(1) Bottom (→) pushbutton - Press to select MORE.

(2) Middle (→) pushbutton - Press to toggle between BASEBAND or DIPHASE.

(3) Bottom (→) pushbutton - Press to select MORE.

(4) Middle (→) pushbutton - Press to toggle between CVSD 16K and CVSD 12K.

(5) Top (→) pushbutton - Press to load the selection and to exit the display page.

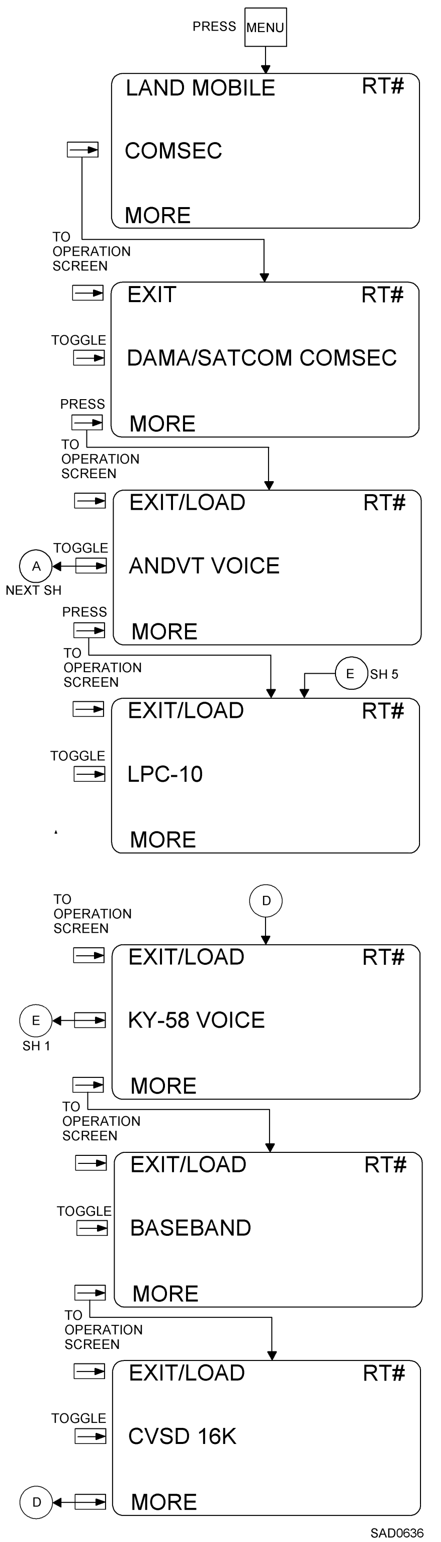

Figure 1-137. Typical DAMA Displays

NOTE

- The radio set control displays DAMA COMSEC PARAMETERS UPDATED when the COMSEC configuration is loaded into the radio.

AN/ARC-210 CONTROL VIA UFC.

The UFC (Figure 1-145) provides control of the most frequently used features of the ARC-210 radios. The ARC-210 features available through the UFC consist of:

- Commanding ARC-210-1 or ARC-210-2 to a manual frequency.
- Commanding ARC-210-1 or ARC-210-2 to a simplex preset, half duplex-wideband SATCOM preset, or SATCOM/DAMA preset.
- Commanding ARC-210-1 or ARC-210-2 to an ECCM (SINCGARS, HAVEQUICK I, HAVEQUICK II) preset including SINCGARS Cold Start and SINCGARS Cue.
- Commanding ARC-210-1 or ARC-210-2 into SCAN mode.
- Designating an ARC-210 as the selected radio for COMSEC mode changes and radio status display toggle on the HUD.
- Commanding the selected ARC-210 to change COMSEC mode.
- Commanding the selected ARC-210 to toggle between a simplex preset and an ECCM preset of the same number.
- Commanding ARC-210-1 or ARC-210-2 to the last valid manual frequency when radio is not already tuned to a manual frequency.
- Turning on/off display of status from the selected ARC-210 on the HUD.

COMMANDING A MANUAL FREQUENCY.

To command ARC-210-1 or ARC-210-2 to a manual frequency, proceed as follows:

a. RSC Operational Mode Selector - TR or TR+G.

b. RT Select pushbutton - RT1 or RT2.

c. RSC Frequency Mode Selector - Not in 243 or 121.

d. Enter frequency into scratchpad.

NOTE

- Entered frequency must be 3 to 6 digits. Digits 1-3 are in MHz. Digits 4-6 are in KHz. Trailing zeros are filled in automatically. Frequencies within 30 to 87.990 MHz must be entered using a leading zero (i.e. 30 MHz is entered as 030).

- Entered frequency must be within the following frequency ranges and entered in increments of 5KHz:

  030000-087990
  108000-117990
  118000-173990
  225000-399990

e. Depress COM1 key on UFC to command ARC-210-1 or COM2 key on UFC to command ARC-210-2.

COMMANDING A SIMPLEX, HALF DUPLEX-WIDEBAND SATCOM, OR SATCOM-DAMA PRESET.

To command ARC-210-1 or ARC-210-2 to a simplex preset, half duplex-wideband SATCOM preset or SATCOM/DAMA preset, proceed as follows:

a. RSC Operational Mode Selector - TR or TR+G.

b. RT Select pushbutton - RT1 or RT2.

c. RSC Frequency Mode Selector - Not in 243 or 121.

d. Enter preset into scratchpad.

NOTE

- Entered preset must be 1 to 2 digits. Simplex presets range from 1 to 25. Half duplex-wideband SATCOM presets range from 26 to 30. SATCOM/DAMA presets range from 41 to 50.

- ARC-210-2 is not set-up for BLOS operation. (i.e. no High Power Amplifier or SATCOM antenna) 526.

e. Depress COM1 key on UFC to command ARC-210-1 or COM2 key on UFC to command ARC-210-2.

COMMANDING SCAN MODE.

To command ARC-210-1 or ARC-210-2 to SCAN mode, proceed as follows:

a. RSC Operational Mode Selector - TR or TR+G.

b. RT Select pushbutton - RT1 or RT2.

c. RSC Frequency Mode Selector - Not in 243 or 121.

d. Enter 31 into scratchpad.

e. Depress COM1 key on UFC to command ARC-210-1 or COM2 key on UFC to command ARC-210 (2).

COMMANDING AN ECCM PRESET (SINCGARS, HAVEQUICK I, HAVEQUICK II).

To command ARC-210-1 or ARC-210-2 to an ECCM (SINCGARS, HAVEQUICK I, HAVEQUICK II) preset, proceed as follows:

a. RSC Operational Mode Selector - TR or TR+G.

b. RT Select pushbutton - RT1 or RT2.

c. RSC Frequency Mode Selector - Not in 243 or 121.

d. Enter preset into scratchpad.

NOTE

Entered preset must be 1 to 2 digits. ECCM presets range from 1 to 25. For SINCGARS Cold Start enter 30. For SINCGARS CUE enter 31.

e. Depress ECCM key.

NOTE

When entering an ECCM preset,wait until the scratchpad cursor moves to the right of the "E" displayed in the scratchpad before pressing the COM1 or COM2 key to send the command to the corresponding radio. Pressing the COM1 or COM2 key before the cursor moves to the right of the "E", the scratchpad will not clear and the command will not be sent to the radio.

f. Depress COM1 key on UFC to command ARC-210-1 or COM2 key on UFC to command ARC-210-2.

RADIO SELECTION.

To designate a radio as the selected radio for COMSEC mode or HUD status display toggle, depress COM1 key to designate ARC-210-1 as the selected radio or depress COM 2 key to designate ARC-210-2 as the selected radio.

COMMANDING A COMSEC MODE TOGGLE.

To command the selected ARC-210 radio to change COMSEC mode, proceed as follows:

a. RSC Operational Mode Selector - TR or TR+G.

b. RT Select pushbutton - RT1 or RT2.

c. RSC Frequency Mode Selector - Not in 243 or 121.

d. Depress COMSEC key.

NOTE

Depressing the COMSEC key will toggle between Plain Text, Cipher Text/Plain Text Override, and Cipher Text Only. Cipher Text/Plain Text Override Time Delay and Cipher Text Only Time Delay are only available through RSC control in Non-ECCM modes.

COMMANDING AN ECCM TOGGLE.

To command the selected ARC-210 radio to toggle between a simplex presets and ECCM presets of the same number, proceed as follows:

a. RSC Operational Mode Selector - TR or TR+G.

b. RT Select pushbutton - RT1 or RT2.

c. RSC Frequency Mode Selector - Not in 243 or 121.

d. Depress ECCM key.

COMMANDING LAST VALID MANUAL FREQUENCY.

To command ARC-210-1 or ARC-210-2 to revert to the last valid manual frequency when the radio is not already tuned to a manual frequency, proceed as follows:

a. RSC Operational Mode Selector - TR or TR+G.

b. RT Select pushbutton - RT1 or RT2.

c. RSC Frequency Mode Selector - Not in 243 or 121.

d. Enter 0 into scratchpad.

e. Depress COM1 key on UFC to command ARC-210-1 or COM2 key on UFC to command ARC-210-2.

TURNING ON/OFF HUD STATUS.

To toggle on/off the display of the selected ARC-210 radio status on the HUD, depress and hold COM1 key for more than 1 second to turn on/off ARC-210-1 status in the HUD or depress and hold COM2 key for more than 1 second to turn on/off ARC-210-2 status in the HUD.

TACTICAL DATA NETWORK (TDN)/TACTICAL DATA LINK (TDL).

TACTICAL DATA NETWORK (TDN)/VARIABLE MESSAGE FORMAT (VMF) SYSTEM.

The purpose of Tactical Data Network (TDN) is to improve situational awareness and communication. The TDN enhances situational awareness and command and control capabilities. In addition, the TDN provides for bi-directional digital transfer of targeting data and imagery. The TDN supplies critical, time-sensitive information related to friendly and enemy positions.

The major components of the TDN are an Improved Data Modem (IDM) which interfaces with either the SLOS/BLOS ARC-210-1 RT or the ARC-164 RT (secure using the KY-58 encryption device) to receive and transmit digital Variable Message Format (VMF) data on the TDN. When the ARC-164 radio is selected as the RT for use with IDM, the Time Delay switch on the Secure COMM (KY-58) Control Panel should be set to DELAY to improve the KY-58s ability to synchronize and process secure VMF data. In addition, by interfacing with the Central Interface Control Unit (CICU), the IDM exchanges this digital information for processing and display by the operational flight program (OFP) on the Multi-Functional Color Displays (MFCDs). Refer to the IDM section for detailed TDN/VMF information.

TACTICAL DATA LINK (TDL)/SITUATION AWARENESS DATA LINK (SADL) SYSTEM.

The purpose of Tactical Data Link (TDL) is to improve situational awareness and communication. The TDL provides situation awareness data, target information, and command and control capabilities.

The major components of the TDL are an EPLRS RT-1720G Radio with EPLRS Power Adapter (EPA) and an Antenna Selector. The TDL provides the capability to display situation awareness information and perform command and control through the EPLRS/SADL network.

TDL KEY ENTRY AND ZEROIZING.

EGI GPS Key Entry and Zeroizing EGI GPS key entry is normally accomplished by maintenance personnel using a fill device via the EPLRS J3 connector on the GPS-EPLRS fill panel. Normally, a monthly key is entered into the EPLRS. Key entry must be accomplished with the EPLRS turned on. Keys in the EGI GPS can be zeroized (erased) using the EPLRS ZEROIZE switch on the GPS-EPLRS fill panel. The zeroization must be confirmed by a steady ALARM light on the GPS-EPLRS fill panel. It may take up to 2 minutes to receive this confirmation.

TACTICAL DATA LINK (TDL).

The hardware used to support the TDL is the Enhanced Position Location Reporting System (EPLRS). EPLRS loaded with SADL software provides the capability to display situational awareness information and perform command and control through the TDL network. In addition, through the use of a gateway, the A-10 is capable of communicating on the Link 16 network.

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TDL CONFIGURATION.

The TDL Configuration Pages (See Figure 1-156.5) provide the ability to initialize and modify the SADL and VMF Participants lists. The SADL Profile Settings Page (see Figure 1-156.8), accessed by selecting OSB 3 from the COMM Page, provides the ability to create, modify, delete or activate SADL profiles as well as modify EPLRS settings.

All available profiles can be activated directly from the COMM Page by selecting SADL Active Profile Selection OSB 4. The VMF Profile Settings Page, accessed by selecting OSB 1 from the COMM Page, provides the capability to create, modify, delete and activate VMF profiles. For both the VMF and SADL Profile Settings Pages, up to nine editable profiles and one static default profile can exist. Profiles can also be created in the A/W/E and loaded through the DTC. Refer to the IDM section for detail on the VMF Profile Settings Page.

While most of these items are set to their proper values using the A/W/E, there could be a need to modify these during flight.

NOTE

If the SADL Settings (Air, Ground, etc.) change, the radio will be reinitialized.

TDL CONFIGURATION PAGE OPTIONS.

The TDL Configuration Pages (see Figure 1-156.5) are available by selecting OSB 18 from the COMM Page.

TDL Configuration Pages provide the ability to define the flight members, SPI/target donor aircraft along with entries related to ownship Precise Participant Location and Identification (PPLI) transmission. Variable Message Format (VMF) participants that have a defined Track Number will also be considered as SPI/target donor aircraft for SADL TDL Configuration Page 1 provides for entry of Flight Member and Donor information. TDL Configuration Page 2 provides for entry of VMF Participant information. Each entry contains the following:

- Call Sign (CS) (up to 17 characters)
- Track Number (TN)
- Unit Reference Number (URN)
- Internet Protocol (IP) Address
- Data Link Address

If the IPv4 or DL address in the Flight Member, Donor, or VMF Participants Lists is set to broadcast (i.e. 255.255.255.255, 127), the address will be updated with the unique received address.

Each list will display the Call Sign as the unique identifier for each entry. All other data will be shown below the list when an entry is selected. If the Call Sign is not defined for a list entry then the list entry will be displayed as follows:

- For the Flight Member and Donor lists the TN will be displayed (if a TN is not defined but a URN is defined then the URN will be displayed).
- For the VMF Participant list, the URN will be displayed (if a URN is not defined but a TN is defined then the TN will be displayed).
- All data for each entry on TDL Configuration Page 1 and 2 must be unique. If the data entered is not unique then a WCN will be provided.
- In addition, if each entry does not contain required information then the row in the table and the OSB(s) for the selected row in the table that is missing data will be highlighted in yellow.

NOTE

- Flight Member list entries are required to have a Track Number, URN, and Call Sign entered.
- Donor list entries are required to have a Track Number and Call Sign entered.
- VMF Participant list entries are required to have a URN and Call Sign entered.

The flight location (1-4) selected on OSB 6 is displayed as "OWN" to the right of the entry in the flight member table. The information in the selected ownship entry will be used in SADL and VMF communication.

NOTE

Since the entered Call Sign is up to 17 characters and the TDL PPLI is limited to 4 characters, the system will transmit the first literal character, the last literal character and the last two numbers as the call sign. Example, if the entered Call Sign is BOAR01, the system will transmit BR01 as the call sign in the TDL PPLI. In addition, this 4 character Call Sign can be used to address messages on the message page.

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TDL SITUATIONAL AWARENESS.

The TDL provides enhanced situational awareness capabilities by processing the following data link information:

- Precise Participant Location and Identification (PPLI) reports
- Command and Control (C2) Surveillance Track reports
- Emergency Point reports
- Local and Primary Donor Sensor Point of Interest (SPI) Target reports
- Received and Transmitted TDL Mark Points

Figure 1-140. J-Series Message Processing

MSG	TITLE/DESCRIPTION	TRANS/REC
J2.0	INDIRECT INTERFACE UNIT PPLI	R
J2.2	AIR PPLI	T/R
J2.3	SURFACE PPLI	R
J2.5	LAND POINT PPLI	R
J2.6	LAND TRACK PPLI	R
J3.0	REFERENCE POINT/LINE/AREA	R
J3.1	EMERGENCY POINT	R
J3.2	AIR TRACK	R
J3.3	SURFACE TRACK	R
J3.5	LAND POINT TRACK	R
J7.0	TRACK MANAGEMENT (DROP TRACK ONLY)	R

Figure 1-140. J-Series Message Processing - Continued

MSG	TITLE/DESCRIPTION	TRANS/REC
J12.0	MISSION ASSIGNMENT (TRANSMIT ATTACK ONLY AS PART OF CAS MESSAGE)	T/R
J12.4	CONTROLLING UNIT CHANGE REQUEST	R
J12.6	TARGET SORTING MESSAGE	T/R
J13.2	A/C STATUS, (FUEL, STORES, TYPE)	T/R
J16.0	IMAGE TRANSFER MESSAGE	T/R
J28.2	FREE TEXT	T/R

The CICU reports Identification Friend or Foe (IFF) system data over the TDL (Mode 1, Mode 2 Code, and Mode 3 Code) via J2 message and IFF/SIF Transponder Status via J13 series message.

The CICU reports IFF/SIF Transponder status via the System Status page LRUs. The IFF Transponder Status is operational when the LRU current status is VALID and non-operational when the current LRU status is CRITICAL FAIL, DEGRADE, or TEST. When LRU current status is NO COMM, the IFF Transponder status is set to no statement which signifies there is no communication between the CICU and IFF Transponder.

In addition, using the EPLRS/SADL network provides ground friendly position reports when communicating in the Ground networks.

The main means for providing enhanced situational awareness is through the display of PPLI reports, track reports, emergency points, target reports, and EPLRS friendly position reports on the TAD.

In addition to the TAD, EPLRS friendly position reports will also be displayed on the TGP and the HUD.

TDL COMMAND AND CONTROL.

The TDL provides digital command and control by processing the following data link information:

- Reception of Text Messages addressed to own flight and the collective address
- Transmission of Text Messages to own flight, other flights, and the collective address
- Reception of Mission Assignment (MA) Messages addressed to own flight
- Transmission of Mission Assignment (MA) Messages as part of the Attack 9-Line format
- Reception of Image (IMG) Messages addressed to own flight and the collective address.
- Transmission of Image (IMG) Messages to own flight, other air or ground network participants, and the collective address.

TDL INTERFACE WITH HUD.

The HUD provides additional situational awareness with the ability to display up to five friendly ground positions, flight members and their corresponding SPI, and a TDL DL Message indication (Figure 1-140.1 and Figure 1-140.2). HUD TDL symbology is defined as follows:

- Ground PPLIs/VMFs: A total of up to five friendly tracks/points (based on position reports on the EPLRS/SADL net, VMF friendly position reports from IDM, or closest friendly from a MA) nearest to the Sensor Point of Interest (SPI) will be displayed on the HUD when within the HUD FOV (Figure 1-140.2). A green "X" is displayed for a ground PPLI and a green chevron is displayed for ground track/point. The closest friendly ground track from a VMF MA is also displayed as a green chevron.
- Flight members and their corresponding SPI: Flight members and their corresponding SPI (when broadcast) will be displayed in the HUD when within the HUD FOV (Figure 1-140.2) or clamped to the HUD FOV when outside the HUD FOV and less than 60 degrees bearing off the nose of the aircraft.
- Message indication: "MESSAGE" will be displayed in the scratchpad area, without square brackets, when received message records have not been acknowledged and the HUD Scratchpad is not in use. If received message records have not been acknowledged and the HUD Scratchpad is in use, an "M" will be displayed to the left of the Scratchpad. The "MESSAGE" and "M" indications flash and will be removed when the related message is acknowledged.

TDL INTERFACE WITH TGP.

The TDL functionality interfaces with the targeting pod in the TGP Air-to-Ground display page. When TGP is in A-G mode, the Targeting Pod video overlays the 5 closest SADL or VMF friendly positions based on the TGP Line-of-Sight (LOS). OSB 9 can be used to create or delete TDL mark points.

NOTE

For more detailed information on TGP TDL mark points, see TO 1A-10C-34-1-1.

TDL symbology which could be displayed are friendly ground and surface PPLIs, VMF friendly position reports (displayed as a green "X"), friendly ground and surface tracks (displayed as a green chevron "^"), the closest friendly from the mission assignment (displayed as a green "^"), the Flight Member SPI, and TDL mark points. All data link symbology displayed on the TGP except for the Flight Member's SPI will be clamped to the side of the TGP page when it is outside the FOV but less than a FOV away from the center FOV.

Upon startup, the CICU will send the SPI to the EPLRS radio to sort and return the closest 64 positions. The TGP LOS sort will not be sent to the EPLRS radio until a Friendly DL symbol near the SPI is returned (TGP is the SPI).

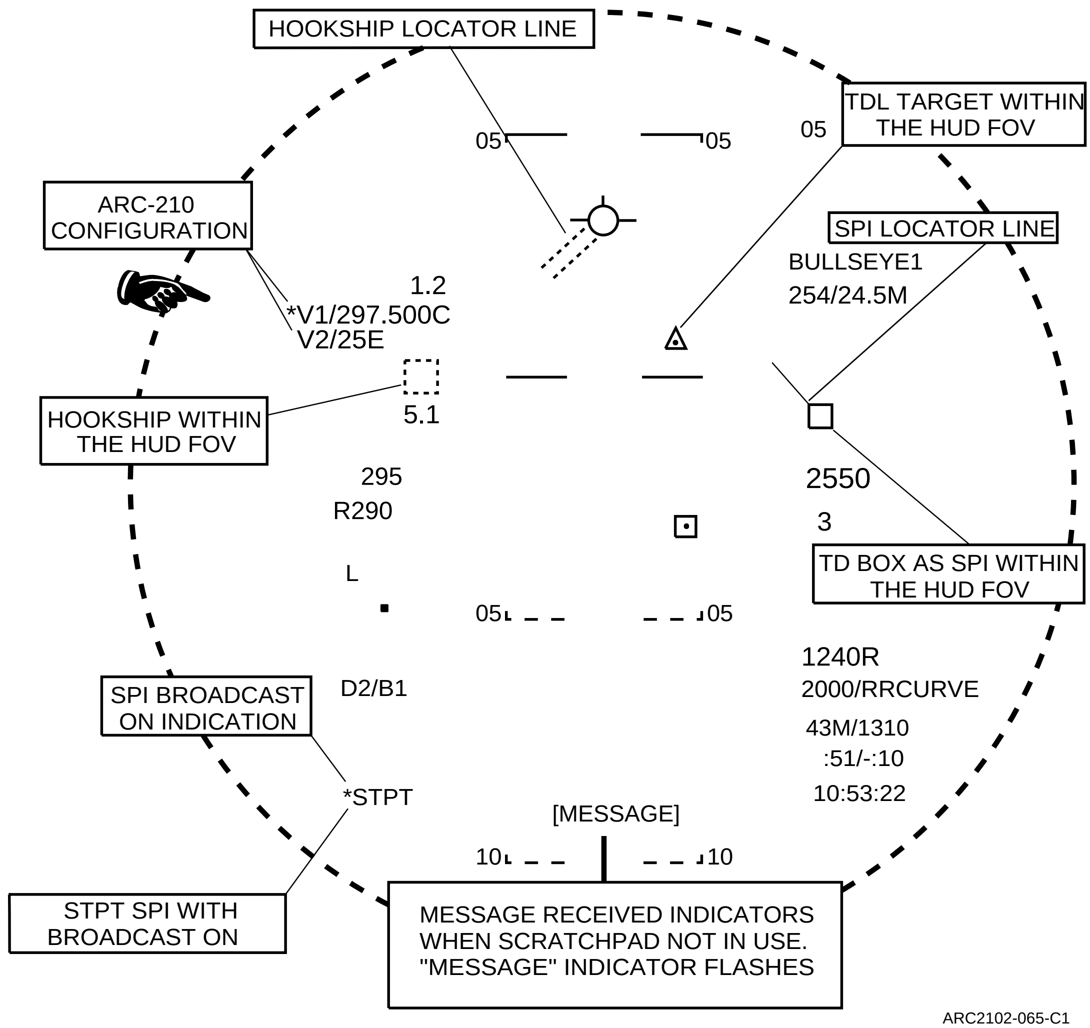

Figure 1-140.1. HUD Display (Message Indication, No Data Link Symbols in FOV)

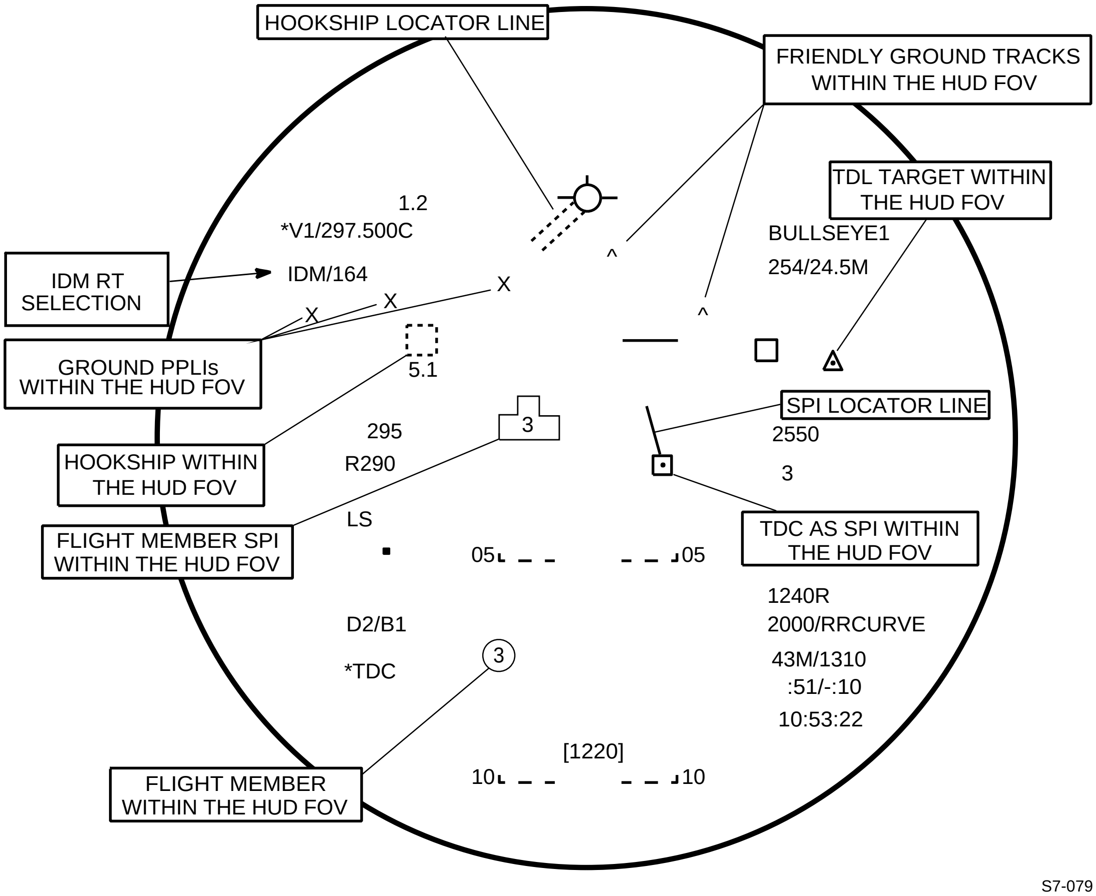

Figure 1-140.2. HUD Display (Data Link Symbols in FOV)

MESSAGE PAGE USAGE.

The message (MSG) page allows viewing received and transmitted text messages, image messages, and Mission Assignment (MA) messages. In addition, the MSG page provides an interface to manage and edit these received and transmitted messages or create draft (pending) messages that can be transmitted to other flights of aircraft or Data Link/network members. Message record formats include formatted plain text (TEXT), image (IMG), and a digital Mission Assignment (MA) message variant.

NOTE

90% and 100% full alerts do not apply to Pre-canned (PRE) messages.

Figure 1-140.3 describes the storage capacity for message records. When capacity reaches 90% full, an alert is displayed. An additional alert is provided if the database transitions to being 100% full. If the Text/Image (IMG) message database is filled, the oldest message of the same message type will automatically be discarded. If there is not a previous message of the same type, the oldest Text/IMG message will be automatically discarded. MAs will not be automatically deleted.

Message records are sorted by Type and Format, and placed in order by transmit/receive time, with message #1 being the most recent. Pending message records are sorted in order of creation, with lower numbers for the most recently created Pending messages. If a text message must be automatically deleted to make room for an incoming message, the oldest message (of the same Message Type and Format) will be deleted.

Whenever a text message (to include text portions of MA messages) is received, a "MESSAGE" advisory is displayed on the MFCDs and in the HUD scratchpad. When the MSG page is selected, the display defaults in the following order to:

- The most recently viewed message.
- The most recently Transmitted message record if no Received message records exist.
- The latest Pending (draft) message record if no Received or Transmitted message records exist.
- The Pre-canned message record if no Received, Transmitted, or Pending message records exist.

If there are no message records at all when the MSG page is selected, the text "NO MESSAGE" appears in large font near the center of the display. Figure 1-140.6 describes Message Page OSB functions.

For Sent VMF text messages, TX FAIL displays in the Status line of the transmitted (SENT) message page when transmission fails. TX COMPLETE displays when the receiver acknowledges reception. For sent SADL text messages, TX COMPLETE displays when the sending aircraft has completed the transmission.

Pre-canned images from the RMMD can be displayed on the MSG page. Pre-canned images can be annotated, compressed, and sent using the Data Link or VMF. Supported image types are bitmap (.bmp), JPEG (.jpg, .jpeg, etc), Portable Network Graphics (.png), and Tagged Image File Format (.tiff, .tif). Only a single image is ever displayed on the MFCD. The first Pre-planned image automatically uploads and displays on the IMG Message Page. A second image load request (from the CICU to the RMMD) removes the previously loaded image from the display. The MFCD TO field displays the filename and extension of the currently selected Pre-canned image file. Once the Pre-canned image is loaded to the MFCD, OSBs become available for modification, compression, and destination.

Over SADL or VMF, a receiver will attempt to display an image that was not completely received if enough data was received in the beginning of the image to define it. DEGR displays above the FR: line to indicate that a partial (degraded) image message has been received (Figure 1-140.4), and the Note IMG PART displays instead of IMG.

Sent images, either over SADL or VMF, will display progress while they are being transmitted. SADL, due to the large number of packets in the transfer, will show progress as a percentage (e.g., PENDING 75%). VMF will display the number of packets transmitted out of the total (e.g., PENDING 4/9). Progress is incremented as soon as the data is transferred to the radio. The final status will be TX COMPLETE, TX FAIL, or TX DEGRADED.

- TX COMPLETE: Shown for VMF and SADL Two-Way transfers when all image packets are acknowledged or at the conclusion of a SADL One-Way transfer.
- TX FAIL: Shown for VMF and SADL Two-Way transfers when no image packets are acknowledged or when a SADL One-Way transmission is aborted using BREAK (OSB 6).
- TX DEGRADED: Shown for VMF and SADL Two-Way transfers when the transfer ends or is aborted using BREAK (OSB 6) without all packets acknowledged.

Pre-canned MAs from the MDTC are made available by selecting PRE (OSB 3) and MA (OSB 4) on the MA Message Page (Figure 1-140.7). The Pre-canned MA includes an indication of the MA type selected during mission planning (SADL or VMF), which is displayed in the upper left hand corner of the page. Pre-canned MAs can be sent over VMF or SADL, regardless of type. For all Pre-canned MAs, the Destination Group defaults to Call Sign (CS) and Destination (Call Sign, URN, or TN) is not defined. Pre-canned MAs cannot be changed or deleted, but any modification made (including changing the Destination Group or defining a Destination) will result in the MA becoming a Pending MA, which can then be saved or sent. When a Call Sign is entered in the Destination OSB, the destination network of the new Pending MA is set to the Pre-canned MA type, regardless of whether the Call Sign is in the FM/Donor/Participant list.

Figure 1-140.3. Message Storage Capacities

Message Type	Message Format		
	TEXT	MA	IMG
SENT or RCVD	160	80[1]	10
PEND	40	20	10
PRE	40		20

[1] If a total of 80 SENT/RCVD MAs are saved in the system and a PEND MA is selected, the SEND OSB is disabled until an MA is manually deleted.

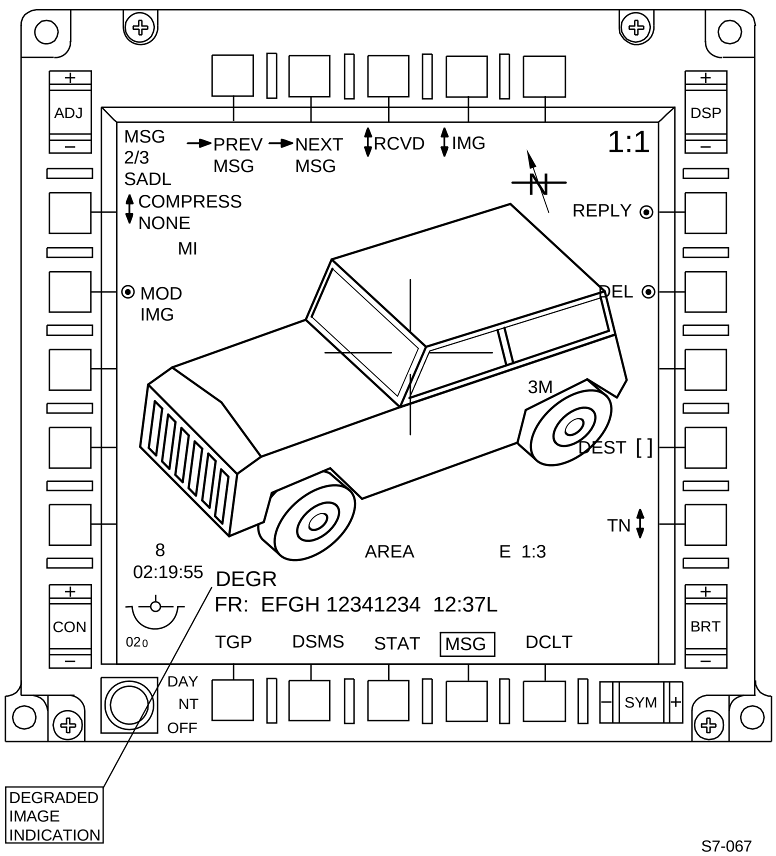

Figure 1-140.4. Degraded Image Message Page (Sample Received SADL IMG)

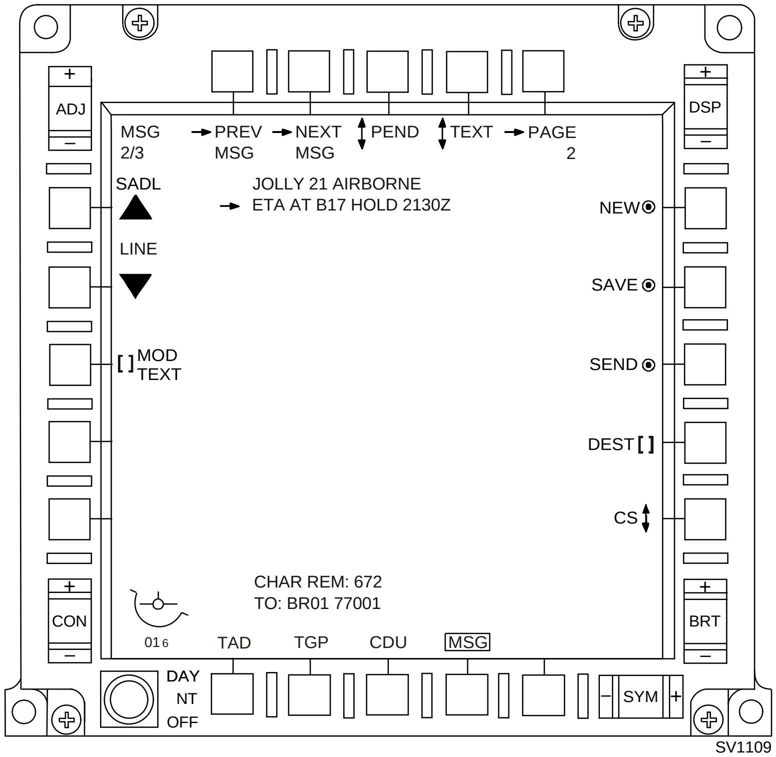

Figure 1-140.5. Message Page (Sample Pending Text Message)

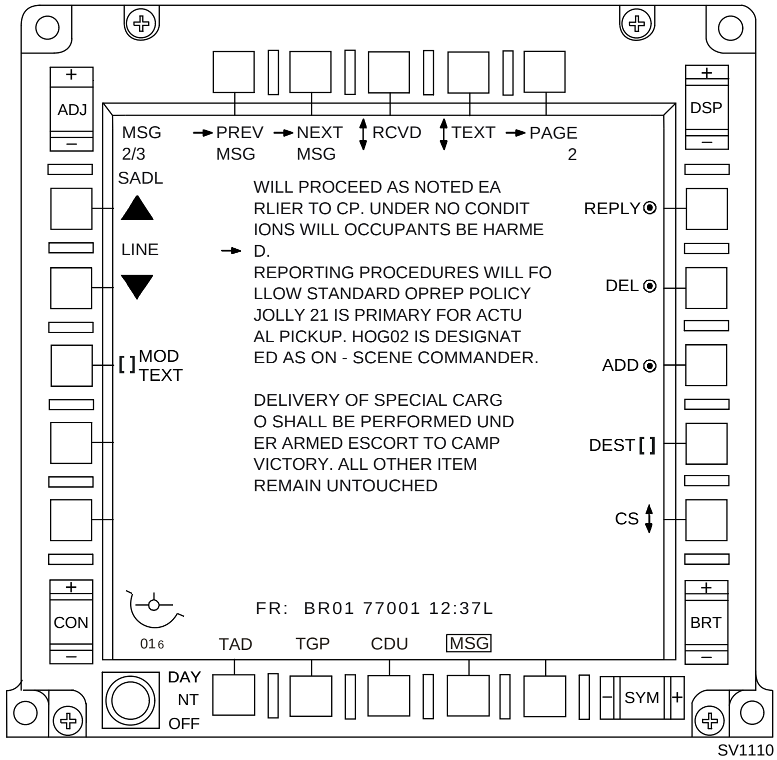

Figure 1-140.6. Message Page (Sample Text Receipt) (Sheet 1 of 4)

Message Navigation (OSB 1 and 2)	OSBs 1 & 2 are page branch OSBs that navigate through the stored messages, as limited by Message Type (OSB 3) and Format (OSB 4). OSB 1 changes the display to the previous message and OSB 2 changes the display to the next message.
Message Type (OSB 3)	Rotary key selects one of the following: • Pending (PEND) for draft messages pending future transmission • Pre-canned (PRE) for uploaded text, MA, or image message that may be edited • Transmitted (SENT) • Received (RCVD) message types for display. Along with Format (OSB 4), OSB 3 limits the message records selectable for display using the Message Select keys.
Format (OSB 4)	Rotary key selects TEXT, MA, or IMG formats for display. Along with Message Type (OSB 3), limits the message records selectable for display using the Message Select keys. Upon initial selection of the MSG Page for display (either due to selection of the MSG Page OSB, or MSG Quick-Look via HOTAS), always set to the most recent message format of the selected Message Type (per OSB 3).
Page Select (OSB 5)	Selection will toggle between Page 1 and Page 2 of a message. Resets to the first page upon opening the Message Page, and whenever a different message record is displayed.
Reply (OSB 6)	Creates a new unsaved Pending blank plain text message record. Sets the destination OSB 9 to the source TN of the displayed message (if received on the TDL (SADL) network). Sets the destination OSB 9 to the source URN of the displayed message (if received on the TDN (VMF) network). Only displayed for Received text message records (not Pending or Transmitted message records).
Cancel (OSB 6)	Cancels the MA associated with the target after confirmation. Only displayed for MA format Transmitted message records.
New (OSB 6)	Creates a new blank unsaved Pending message record with format as selected on OSB 4. Only displayed when Message Type (OSB 3) is PEND. Not available when Message Format (OSB 4) is IMG.
Save Record (OSB 7)	Only available on a Pending message record. Even on a Pending message record, not available unless the message record is unsaved or changes have been made since last saved.
Delete Record (OSB 7)	Deletes the displayed message record. DEL (OSB 7) is unavailable when: • No messages of the selected type are in the system. • The displayed message has been modified and SAVE (OSB 7) is available. • The displayed message is a Pre-canned text, image, or MA message. • The displayed message is a received MA that is the basis of a pending copy for forwarding.
Send (OSB 8)	Transmits the displayed message (all pages) to the destination group/destination selected on OSB 9/10, along with any required target/objective/IP locations and mission assignment messages. A new Transmitted message record is created and displayed, and Message Type (OSB 3) is changed to SENT in order to automatically display this new record. Not available on MA format messages unless a valid target location is selected. Not available on a MA, TEXT, or IMG message if a previously sent message in any of the MA, TEXT, or IMG formats is still in the process of being transmitted to the same addressee.

Figure 1-140.6. Message Page (Sample Text Receipt) (Sheet 2)

Add (OSB 8)	Selection of this OSB will add the originator's addressing information (either Track Number for SADL messages or Unit Reference Number, IPv4, and DL Address for VMF messages) to the donor or VMF participant list. Only displayed and enabled on the RCVD Text Message page and the RCVD MA Message page.
Destination (OSB 9)	Provides for entry of destination TN (5 digit number with each digit having a range of 0-7), URN (8 digit number in the range of 00000000-16777215), or Call Sign (4 digit alphanumeric with each digit having a range of A-Z, 0-9, or space). The CICU software will search the Flight Member, Donor, or VMF Participant lists for the remaining destination information (TN, URN, or Call Sign) that corresponds to the entered destination and will store this information as part of the destination. In addition, if a match is not found in these lists, the CICU software will use the PPLI database to find and store the remaining destination information (TN or Call Sign only) if the corresponding TN or Call Sign is entered as the destination. **NOTE** • The selections on OSB 9 and OSB 10 determine which network a pending message will be sent. If a TN and URN are both available, the default is the TN. • The following are not allowable destination values: 1) Track Number: 00077, 07777, 00000, 00177 (MA Only), and Ownship Track Number; 2) Unit Reference Number: 16777213, 16777215 (MA and IMG Only), and Ownship Unit Reference Number; 3) Call Sign: four spaces and Ownship Call Sign. In addition to manual entry of TN, URN, or Call Sign; the default TN can be changed by hooking a PPLI, and then selecting OSB 9 with nothing entered in the scratchpad. The CICU software will search the Flight Member, Donor, or VMF Participant lists for the associated URN and Call Sign that corresponds to the default TN and will store this information as part of the destination. Defaults as follows based on a hooked PPLI with an empty scratchpad: • Flight Leader CS/TN of the hooked PPLI • Otherwise, the source CS/TN of the hooked PPLI Creates a new unsaved Pending message record if changed on a Received or Transmitted message record.
Destination Group (OSB 10)	Rotary key selects between TN (individual TN), SADL (collective TN for TEXT and IMG messages only), URN (individual URN), VMF (collective URN for TEXT messages only), or CS (individual voice call sign). For use in conjunction with the Destination key (OSB 9). Automatically changed based on the manually entered destination using OSB 9. **NOTE** The selections on OSB 9 and OSB 10 determine which network a pending message will be sent. Creates a new unsaved Pending message record if changed on a Received or Transmitted message record.

Figure 1-140.6. Message Page (Sample Text Receipt) (Sheet 3)

Modify (OSB 18)	For TEXT messages: OSB is used to enter new alphanumeric text for the line selected on OSBs 19 & 20. Selection of this key will overwrite the entire line selected on plain text format messages. For MA messages: OSB is used to transition the page to modify mode for the selected line where digital data is entered for the selected line. Only available when the MA Type is ATTACK. (See Figure 1-149.2 for a description of each line and available data entry) Creates a new unsaved Pending message record if on a Received or Transmitted message record.
Digital MA Data Entry (OSB 17, OSB 19-20)	After a transition to modify mode for MA messages, OSB 17, OSB 19-20 are transitioned for digital data entry depending on the line selected. (See Figure 1-149.2 for a description of each line and available data entry)
Line Select (OSBs 19 and 20)	Allows for selection of the line desired for text or value modification, using the arrow to the left of the field. For TEXT messages: Only selects lines where text is already entered, and the first available line below that text (arrow automatically resets to top line if out of that range). For MA messages: Selects any available line for ATTACK messages only. Line Select arrow resets to top line upon opening the Message Page, and upon selection of a new page using OSB 6.

Figure 1-140.6. Message Page (Sample Text Receipt) (Sheet 4)

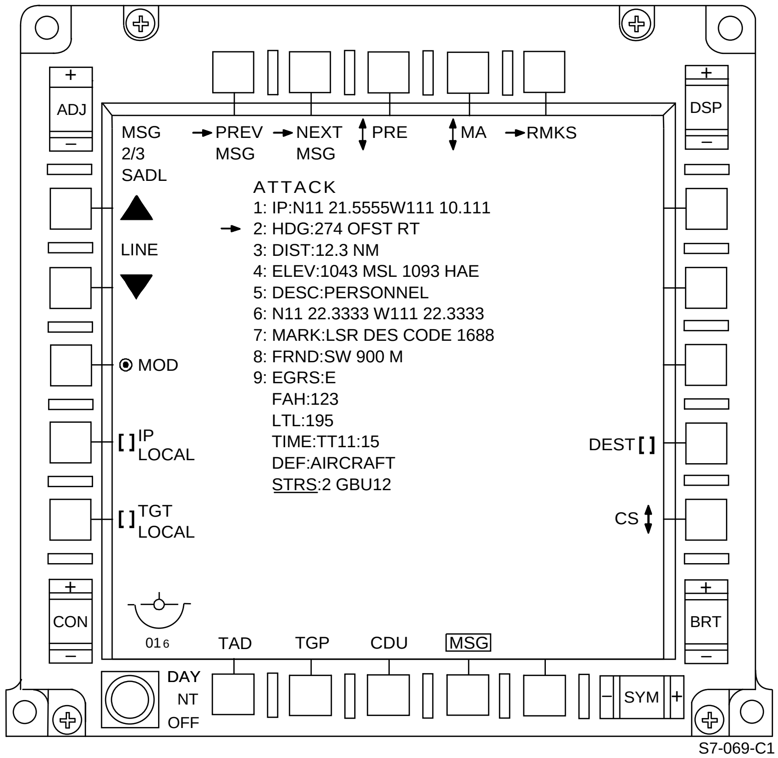

Figure 1-140.7. MA Message Page (Sample Pre-canned MA)

At the bottom of each Received message record is text " FR:" followed by the source Call Sign (if available), TN and time that the message was received.

At the bottom of each Transmitted message record is text "TO:" followed by the destination Call Sign (if available), TN, and time that the message was transmitted.

At the bottom of each Pending TEXT format message record is a count of the number of characters remaining (prior to reaching the 840 character limit).

At the bottom of each Pending MA message record is an indication of the destination TN Type/Description, along with a summary of the stores being carried by the destination s flight. The "GUN" is displayed if any aircraft in the flight is reporting" Gun Capable" (≥50 rounds). The remaining stores fields are populated based on up to 8 different store types reported by members of that flight. Number of Stores values of >9 for a given Type of Stores value are displayed simply as a "+" sign.

MSG QUICK-LOOK.

The Quick-Look function allows for a quick display of the most recently received message via HOTAS control SOI Select-Up/LONG). NO MESSAGE is displayed if there are no Received messages. While MSG Quick-Look is active, the MSG Page is automatically selected for display on the MFCD with the MSG Page programmed (on OSB 12-15). However, the MSG Page does not have to be one of the page selections programmed for OSBs 12-15 on either MFCD in order for the MSG Quick Look to function. The message is automatically selected for display on the Right MFCD if neither of the MFCDs have MSG Page programmed or both of the MFCDs have MSG Page programmed. While MSG Quick- Look is active, all OSBs on both the Left and Right MFCD are displayed but are inoperative, and the MFCD display relinquishes the SOI if necessary only while MSG Quick-Look is active.

In addition to clearing a message related WCN through a HOTAS Acknowledge WCN (TMS-LEFT/SHORT) or ACK OSB at OSB 11, HOTAS MSG Quick-Look could clear a WCN associated with the displayed message. It also clears all the displayed message related WCN(s).

EDITING AND TRANSMITTING MESSAGES.

To create or edit a message, select the NEW key when OSB 3 is set to PEND if a clean slate is desired, or select the REPLY key when OSB 3 is set to RCVD to automatically default the response back to the originator of that received message. To forward a message, enter a new destination on OSB 9 and select "SEND" to resend a previously received or transmitted message record. In addition, any changes to an existing Pre-canned (text, image, or MA), Received or Transmitted message record will result in creation of a new Pending message record which can then be saved/sent.

A pending message must be saved before leaving that page. If not, the Pending message record (or any changes made since the last SAVE to that record) will be deleted. The plain text message provides for display of up to 28 characters per row, with up to 15 rows per page, and a maximum of 2 pages. When received by another A-10 this will produce a received message formatted just as it was displayed on the transmitting A-10.

If communicating with other systems, and it is desired to force a new line (carriage return), this can be indicated by entering two virgules (often called slashes) (//) or by bracketed virgules (<//>) where the carriage return is desired. The virgules themselves will not be displayed on the Received message record (but will be shown on the Pending or Transmitted message record). Note that the use of this carriage return feature limits each line to 28 other characters max.

When the system observes the two virgules together, it will not allow entry of any additional text on that line, and will erase any text already entered to the right of this point on the line. Note: If the message is received by a system which allows fewer than 28 characters per line, this still may not result in the desired formatting. In addition, not all system designs may recognize this convention, in which case the virgules themselves would presumably show up as text within the displayed message.

The MA format message page 1 (see Figure 1-151) contains all-digital data entry for mission assignments to be sent on the TDL (SADL) or TDN (VMF). To modify an available line, select the line and select the MOD key (OSB 18). In the modify mode, OSBs 16 - 20 are used to modify the digital data from the selected line (see Figure 1-152.1). Figure 1-152.2 shows the available selections in modify mode depending on the selected line and interface (VMF or SADL) of the destination address. Select ENTR (OSB 18) to exit from modify mode with the changes made, and return to the MA Message View Page 1. Select RSET (OSB 16) to exit from modify mode with no change made and return to the MA Message View Page 1. In modify mode, selection of the ENTR OSB will finalize the modification of the selected line, the display will be updated on the MA Message View Page, and advance the line select arrow to the next modifiable line of the MA Message View Page. If the line being modified is the last modifiable line, upon selection of the ENTR OSB, the line select arrow will advance to the first modifiable line.

MISSION ASSIGNMENTS AND TEXT MESSAGING

RECEIVING TDL MISSION ASSIGNMENTS.

Mission Assignments (MA) are used to assign aircraft to specific missions and objectives. The system allows for multiple MAs to be assigned to a single aircraft or flight, and by definition any MA assigned to any member of a flight applies to all members of that flight. When a new (pending) MA is assigned, one member of the flight, normally the flight lead, is the addressed recipient of the MA and is prompted to respond with WILCO (will comply) or CNTCO (cannot comply). Other flight members can monitor this exchange, but do not directly respond. If conditions do not allow the recipient to respond within a designated time period (120 seconds for all MA types), the system will automatically transmit a CANTPRO (can't process) response, and the WILCO or CNTCO OSBs are removed.

When a SENT MA is pending, the TAD MA Page displays the PROXY WILCO (OSB 7) in green and PROXY CNTCO (OSB 8) in red when the MA is selected (see Figure 1-156.14). Provides the capability to manually enter a Will Comply (WILCO) acknowledgement for the Addressee TN at any time after the mission assignment is transmitted until such time that an acknowledgement is actually received from the addressee. This permits the originator to act as a proxy for an addressee who chooses to respond by voice or other means.

ORGANIZATION AND DISPLAY OF MA INFORMATION.

In order to maintain an organized structure for handling multiple MAs, the system provides for four classifications; current (receive only), pending, active, and inactive as shown in Figure 1-141 Mission Assignment Classifications.

Upon receipt of a pending MA, the pending MA line is displayed graphically along with the associated top center (MA Type) text field for the addressed flight member, and only the addressed recipient (normally the Flight Leader) can provide the response.

Detailed information for the selected MA is displayed on the bottom of the Mission Assignment Page. See Figure 1-156.11. The field data includes the magnetic bearing and range to objective, elevation/altitude of the objective, and EISN/target source and CS or URN (VMF) or TN (SADL) on the right hand side of the display. Bottom display fields contain the message originator information for a RCVD MA, and the addressee information for a SENT MA in the upper row. The bottom middle row displays final attack heading or FAH cone, target ID, egress heading and BDA status or Disengage (for an INACTIVE MA only); for a SADL MA this field can also display Required Stores or the Engagement status (for a CURRENT, ACTIVE, or PENDING MA). The bottom lower row displays the Lat/Lon of the objective. Along the left hand side the time stamp for the selected MA and the Identity (Friend/Hostile/etc) (SADL only). An MA will also display the ownship Mission Number.

Figure 1-141. Mission Assignment Classifications

MA Classification		Description	Max #
Received	Current	The received MA currently being executed.	10
	Pending	A recently received MA awaiting WILCO or CNTCO response.	
	Active	Received MAs accepted through a WILCO response.	
Sent	Pending	A recently sent pending MA WILCO or CNTCO response.	10
	Active	Sent MAs accepted through a received WILCO response.	
Received or Sent	Inactive	MAs (received and sent) either cancelled or completed.	80

NOTE

- Received MAs in excess of the maximum value will be automatically discarded regardless of MA priority, with a CANTPRO response sent to the CU.
- The current MA is considered as one of the active MAs.
- Received MAs are considered Inactive upon transmission of BDA by own unit or member of own flight or upon disengagement by the addressed recipient, usually the flight leader (SADL only).
- A total of 10 combined received Pending and Active MAs allowed.
- A total of 10 combined sent Pending and Active MAs are allowed.
- A total of 80 combined received and sent MAs are allowed.
- Maximum amounts are for both VMF and SADL mission assignments combined.

MA TRANSMISSION.

The sender of the MA has the PROXY WILCO and PROXY CNTCO OSBs displayed on the TAD Mission Assignment page. The PROXY WILCO (OSB 7) is displayed in green and the PROXY CNTCO (OSB 8) is displayed in red for the selected sent MA. The sender can select PROXY WILCO or PROXY CNTCO on behalf of the recipient, or pending MA will default to active after 120 seconds.

MA RECEPTION.

The addressed recipient of the MA has the WILCO and CNTCO OSBs displayed. The CNTCO (OSB 7) is displayed in red, while the WILCO (OSB 19) is always displayed in green, whenever there is a pending MA.

The recipient can select WILCO or CNTCO, or a CANTPRO will be automatically transmitted after 120 seconds.

After responding with WILCO or CNTCO, or if the system generates a CANTPRO, not only are the WILCO and CNTCO OSBs removed but the pending MA becomes either active (if WILCO) or inactive (if CNTCO or CANTPRO). If WILCO'd the new MA may supercede the previous MA, in which case the older MA automatically becomes inactive.

If the new MA supercedes or is higher priority than the previous current MA, the new MA will be selected as the current MA automatically. Otherwise it is added to the queue of active MAs awaiting action.

The current MA can also be selected directly from the TAD page by hooking that MA objective if the following conditions are met: (1) there is no current MA already defined; and (2) there is no higher-priority active MA. The current MA selected is used to determine current MA symbology displayed on the TAD, including the current MA line and MA Type mnemonic at the top-center of the TAD. The current MA Type mnemonic is replaced with a flashing pending MA Type mnemonic when there is a pending MA. The MA Type mnemonic is always displayed in the same color as the objective of that MA based on identity (white if no objective is specified), and is blank if there is no current or pending MA.

MISSION ASSIGNMENT PAGE.

The active MA information may be viewed, or disengaged from an active MA on the Mission Assignment Page (see Figure 1-156.11). The Mission Assignment Page is available by selecting OSB 3 from the base TAD Page.

MISSION ASSIGNMENT PAGE OPTIONS.

MAs are sorted in order by time of receipt (most recent at top), but with the inactive MAs grouped below all of the active and pending MAs. In addition to the time (HH:MM) field which determines the sort order, the MA Type is also shown, along with the range from the ownship position to the objective (range value not computed or displayed for inactive MAs). OSBs 19 and 20 are used to select any one of the MAs (defaults to the current MA upon initial display of the page). That MA can then be selected as the current MA using OSB 18.

Active MAs are shown in green (exception: an active MA where the objective is based upon stale data is shown in yellow), a pending MA is shown in white, and inactive MAs are shown in red. The current MA is always shown in reverse video. If the CU has sent a cancellation of an active MA, but has not been accepted via WILCO, or been declined via CNTCO, then the MA is still considered as active. Disengaging the MA can be done by selecting the desired MA using OSBs 19 or 20, and then selecting the Disengage (OSB 7) (2nd depression required to confirm). Above OSB 20 is an indication of the interface (SADL or VMF) where the selected MA was sent or received. This interface indication is also displayed next to the MA Type ("S-" for SADL or "V-" for VMF).

The TAD MA Page (see Figure 1-156.11) can display BDA status (PTR 19-531) or Disengage (INACTIVE MAs only) and display Required Stores (for a SADL MA) or Engagement status (for a CURRENT, ACTIVE, or PENDING MA).

NOTE

When the MA Status is Current, Active, or Pending, the BDA, Engagement Status, or Required Stores will be displayed. When the MA Status is Inactive, the BDA Status, Disengage, or Required Stores will be displayed (SADL only).

For VMF, the TAD MA Page also displays DIP transmission status indications (see Figure 1-156.11). If a DIP was sent when a received VMF 9-Line is selected, "DIP SENT" displays. If a DIP was received from the recipient of the VMF 9-Line when a sent VMF 9-Line is selected, "DIP RCVD"displays. If a BDA is sent or received for the selected VMF 9-Line, the BDA status will override the DIP status.

The Final Attack Heading (FAH) or FAH Cone displays on the bottom of the TAD MA Page. Both MSL and HAE elevation will display if available; if only HAE elevation is available, the display will reflect the elevation followed by the letter H (e.g. 12345 H). If both MSL and HAE elevation are present, the MSL elevation followed by an "*" (asterisk) display to indicate HAE elevation is available.

Page 1-351 deleted.

TRANSMISSION OF VMF/SADL CAS MESSAGES. Depart Initial Point (DIP), Aircraft On-Station (AOS), Aircraft Position and Target Designation (APTD), Aircraft Position and Target Designation Request (APTD RQST), and Battle Damage Assessment (BDA) reports (both SADL and VMF) can be transmitted directly from the TAD Page. The ARC-164 or ARC-210-1 must be configured for data transmission in order to transmit a VMF BDA, DIP, APTD, APTD RQST, or AOS from the TAD Page. VMF BDA, DIP, APTD, APTD RQST, and AOS messages can also be sent from the VMF Mission Page (Figure 1-156.13) (accessed via OSB 5 on the TAD MA Page). Refer to the VMF Mission Page section for detail on sending a DIP, AOS, APTD, APTD RQST, or BDA from the VMF Mission Page.

From the TAD Page, if a 9-Line is hooked, DIP messages are sent to the originator of the hooked 9-Line; if a 9-Line is not hooked the DIP is sent to the originator of the current VMF 9-Line. A DIP message cannot be sent when a transmitted VMF 9-Line is hooked. AOS messages sent from the TAD Page are always broadcasted. An AOS sent from the TAD Page will not contain the optional Abort Code, and will indicate the default Time On Station time of 90 minutes. To supply an Abort Code or a Time On Station time other than 90 minutes the AOS message must be sent from the VMF Mission Page.

To send a DIP message, select DIP at OSB 19 and press OSB 7 (DIP is the default option for OSB 19). To send an AOS message, select AOS at OSB 19 and press OSB 7. When a DIP or AOS is sent from the TAD Page, the data is automatically logged to the applicable DIP or AOS report table on the VMF Mission Page.

To send an unsolicited APTD message from the TAD Page, select APTD (OSB 19), and press SEND APTD (OSB 7). When an APTD is sent from the TAD Page, the data is automatically logged to the APTD report table on the VMF Mission Page. APTD messages sent from the TAD Page are always broadcast.

While in manual response mode action is required to comply with or reject the received request. Refer to VMF Mission Page -APTD RQST section for more information on manual and auto response modes. To send a response to an APTD RQST for single or multiple APTD reports, select SEND APTD (OSB 19) or REJECT (OSB 7). Use Quick look to view the details of the APTD RQST on the APTD RQST VMF Mission Page while OSB 19 and OSB 7 are active. If OSB 19 is selected, the CICU will begin responding to the request as defined by the start criteria and stop criteria of the received message.

When broadcasting an APTD message, APTD YYY displays at OSB 16 on the TAD page (where YYY is equal to the Entity ID Serial Number sent in the APTD) to indicate that APTD message(s) are being transmitted. APTD YYY will display:

- For 5 seconds for a single APTD response
- Once the start criteria has been met for a multiple APTD response and will remain visible until the APTD stop criteria has been met.

To send an APTD RQST message from the TAD Page, hook the desired 9-Line, select APTD RQST (OSB 19) and press SEND RQST (OSB 7). When an APTD RQST is sent from the TAD Page, the data is automatically logged to the APTD RQST report table on the VMF Mission Page. The VMF Mission Page determines if the APTD RQST is for single or multiple APTDs when transmitted from the TAD. This is configurable on the VMF Mission Page (APTD RQST) by using OSB 4 and 5.

APTD RQST can be sent from the VMF Mission Page to a unique URN with or without a 9-Line. The VMF Mission Page determines if the APTD RQST is sent to addressee of the MA or the addressee's entire flight. If an AOS record is provided for the flight (contains the destination URN for addressing). Selecting FLT (OSB 10) on the VMF Mission Page (APTD RQST) uses the latest AOS record for addressing the APTD RQST. If an APTD RQST is sent to a flight, then a separate APTD RQST record is created for each flight member so that the requests can be managed from the VMF Mission Page as if the request were sent separately. Once FLT is selected on OSB 10, it will remain as the default option until changed and all APTD RQSTs sent from the TAD will be sent to the entire flight.

After an APTD RQST is transmitted for multiple APTDs and responses are being received, a request can be cancelled by hooking the target and selecting CANX RQST (OSB 19) and pressing SEND CANX (OSB 7).

The system automatically transmits periodic engagement status reports on all active MAs addressed to own unit, including the current MA. For MAs categorized as destruction orders (Priority Kill, Engage, Clear To Drop, and Attack), there are two ways to terminate an active MA and cease related engagement status reporting: 1) a flight member (typically the Flight Leader) must supply a Battle Damage Assessment (BDA) on the associated MA objective or 2) the addressed flight member chooses to disengage from the associated assignment.

To supply a SADL or VMF Battle Damage Assessment (BDA) report and close out an associated mission assignment, hook the MA objective, select the BDA type from OSB 19 and then select SEND BDA on OSB 7.

Figure 1-144.1. TAD Page OSB 7/19 Priorities

Relative Priority	Text - OSB 19	Text - OSB 7	Condition
1	WILCO	CNTCO	Pending MA/Controlling Unit Change received and WILCO/CNTCO not yet selected.
2	AOS	SEND AOS	AOS can be sent from the TAD when either ARC-164 or ARC-210-1 is configured for data and one of these conditions are met: • No symbol is hooked. • Hooked symbol is not a SADL MA.
	DIP	SEND DIP	DIP can be sent from the TAD when either ARC-164 or ARC-210-1 is configured for data, there is a current VMF 9-Line and one of these conditions are met: • No symbol is hooked. • Hooked symbol is not a SADL MA.
	APTD	SEND APTD	APTD can be sent from the TAD if either ARC-164 or ARC-210-1 configured for data. **NOTE** The current SPI will be transmitted in the APTD message.
	APTD RQST	SEND RQST	APTD RQST can be sent from the TAD if either ARC-164 or ARC-210-1 configured for data and a VMF 9-Line is hooked. Single or multiple APTD RQSTs are configured on the VMF Mission Page. APTD RQST can be sent from the VMF Mission Page to a unique URN with or without a 9-Line.
	CANX RQST	SEND CANX	Cancels the selected APTD RQST in progress. For a sent APTD RQST where reports are being received, selecting CANX RQST will transmit a stop request message.
	BDA UNK TGT DSTR NO EFCT PART DSTR	SEND BDA	VMF BDA can be sent from TAD if either ARC-164 or ARC-210-1 configured for data and a VMF 9-Line is hooked.
	TGT DSTR PART DSTR (Air Environment)	SEND BDA	SADL BDA can be sent from TAD if a symbol other than a VMF 9-Line is hooked and not in data mode.
	TGT DSTR PART DSTR BDA UNK RE-ATCK (other than Air Environment)	SEND BDA	SADL BDA (other than Air Environment) can be sent from TAD if a symbol other than a VMF 9-Line is hooked.
3	OSB 19 is blank	OSB 7 is blank	Any condition except those listed above.

The definition of the various types of BDAs are shown in Figure 1-145.

WILCO and CNTCO have priority over BDA functions of OSBs 7 & 19.

RECEPTION OF STATUS/BDA FOR TRANSMITTED SADL MA MESSAGES.

When the A-10 transmits a MA message, a status response is received from the tasked jet(s). This status is updated at least every 24 seconds and is displayed one line below the "TO:" line at the bottom center of the display as shown in Figure 1-153. Valid status indications for the STAT: line are shown in Figure 1-152.

Receipt of BDA (TGT DSTR, PART DSTR, BDA UNK, RE-ATCK) or DISENG indicates that the attacking aircraft is no longer prosecuting the attack described by this CAS message/mission assignment.

Figure 1-145. BDA Descriptions

BDA ANNUNCIATION	Long Name - Description	Environment
TGT DSTR	Track/Target Destroyed - Indicates the referenced object was destroyed. For VMF, defaults the re-attack indicator to NO.	Any
PART DSTR	Target Partially Destroyed - Indicates the referenced object was only partially destroyed. For VMF, defaults to a percent destroyed value of 50% and sets the re-attack indicator to YES re-attack. To modify these settings, the BDA must be sent from the VMF Mission Page.	Any
BDA UNK	BDA Unknown - Indicates the condition of the referenced object could not be assessed. For units that are not capable of determining BDA, it indicates that weapons were released against the object. For VMF, default the re-attack indicator to No. To modify this setting, the BDA must be sent from the VMF Mission Page.	Not Air Target
RE-ATCK	Recommend Reattack - Indicates that the referenced object was not destroyed. For units that are not capable of determining BDA, it indicates that weapons were not released against the object.	Not Air Target
NO EFCT	No effect on target. For VMF, defaults the re-attack indicator to YES re-attack. To modify this setting, the BDA must be sent from the VMF Mission Page.	Any

Deleted.

Deleted.

Pages 1-354.1 - 1-356.2 deleted.

PLAIN TEXT (TEXT) MESSAGE FORMAT.

The plain text message provides for display of up to 28 characters per row, with up to 15 rows per page and a maximum of 2 pages for a total of 840 characters. If the system recognizes that part of a SADL Received message record was not received, it will fill in each unknown character with a tilde (~). If unreadable, a text reply or voice communication may be necessary to resolve any questions.

MISSION ASSIGNMENT (MA) MESSAGE FORMAT.

An example of a sent MA message is shown in Figure 1-149. For compatible objectives for each MA with the appropriate target/reference type and the description of each MA Text Field on the MSG Page, see Figure 1-149.1. MA Text Fields for text only data are underlined on the MSG Page. Regardless of the message type received, each MA will be formatted for display with the information shown in Figure 1-149.2.

DOWNLOAD VMF/SADL MESSAGES.

When the weight on wheels switch is activated during landing, the CICU automatically downloads sent/received VMF/SADL messages for the current flight to the DTC. The following VMF/SADL messages are available for post flight analysis:

- Mission Assignment (MA) - SADL/VMF
- Text - SADL/VMF
- Aircraft On Station (AOS) - VMF Only
- Depart Initial Point (DIP) - VMF Only
- Aircraft Position and Target Designation (APTD) - VMF Only
- Battle Damage Assessment (BDA) - VMF Only

Downloaded VMF/SADL messages (excluding AOS and Text) can either be stand alone or correlated to a MA. AOS and Text messages can not be correlated. A CICU cycle will delete all VMF/SADL messages and only the messages that are sent/received prior to landing will be downloaded.

IMAGE (IMG) MESSAGE TRANSFER FORMAT.

Image (IMG) Messages are scaled to fit the MFCDs. The MFCD size is 600 x 600 pixels. Refer to Figure 1-148.1 for an example of an Image Message.

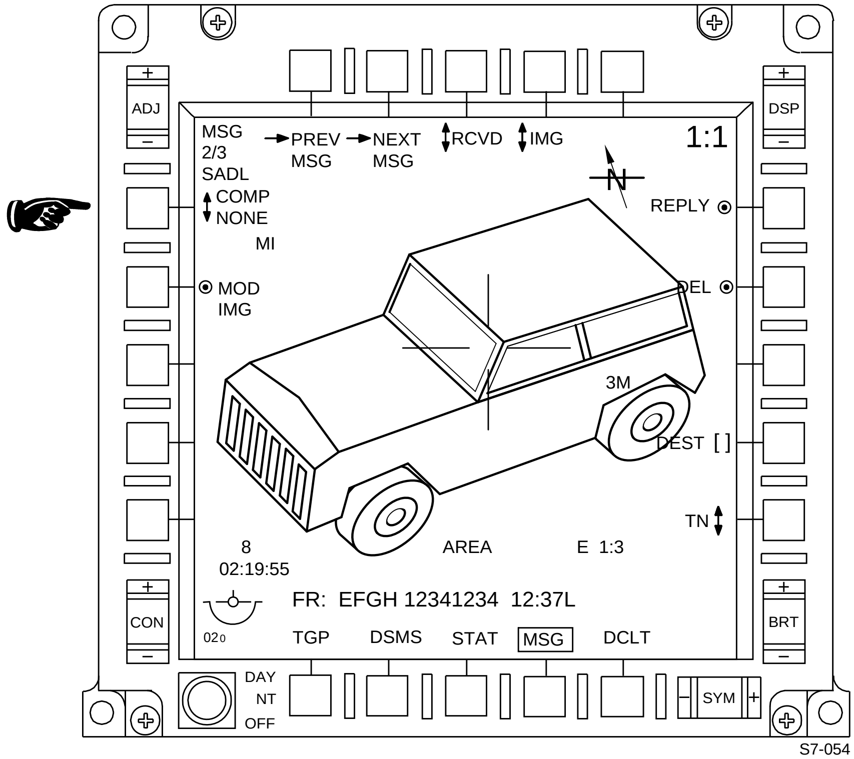

Figure 1-148.1. Image (Received) Message Page (Sheet 1 of 3)

Message Select (OSBs 1 and 2)	OSBs 1 & 2 are page branch OSBs that allow navigation through the stored messages, as limited by Message Type (OSB 3) and Format (OSB 4). OSB 1 changes the display to the previous message and OSB 2 changes the display to the next message. Selecting OSB 1 when already on message #1 will select the last (oldest) message, or be ignored if less than 2 message records are stored. Selecting OSB 2 when on the last message will select the first (newest) message, or be ignored if less than 2 message records are stored. In a display field to the left of OSB 1 is the text "XXX/YYY", where XXX is the currently displayed message and YYY is the total number of stored messages as limited by Message Type (OSB 3) and Format (OSB 4). Note that XXX is set to "P" if on a Pending Message Record that has never been saved. Resets to the most recent Received message record upon opening the Message Page, or to the most recent Transmitted message record if there are no Received message records (may not be message #1).
Message Type (OSB 3)	Rotary key selects one of the following: • Pending (PEND) for draft messages pending future transmission • Pre-canned (PRE) for uploaded text, MA, or image messages that may be edited • Transmitted (SENT) • Received (RCVD) message types for display. Upon initial selection of the MSG Page for display (either due to selection of the MSG Page OSB, or MSG Quick-Look via HOTAS), OSB is set to the last viewed message.
Format (OSB 4)	Rotary OSB selects TEXT, MA, or IMG formats for display. Upon initial selection of the MSG Page for display (either due to selection of the MSG Page OSB, or MSG Quick-Look via HOTAS), always set to the most recent message format of the selected Message Type (per OSB 3).
Break (OSB 6)	Ends the transmission of an image message. • TX FAIL displays in the Status line for a SADL One-Way transmission or for VMF and SADL Two-Way transmission if pressed before the first packet is acknowledged. • TX DEGRADED displays in the Status line for VMF and SADL Two-Way transmission when pressed after at least one packet is acknowledged. Only available when Message Type (OSB 3) is SENT.
Reply (OSB 6)	Creates a new unsaved Pending message record with the received Image.
Delete Record (OSB 7)	Deletes the displayed message record, regardless of type. OSB is available if and only if the Save Record OSB is not available. OSB is not available on a Received MA Message record unless that MA is inactive.

Figure 1-148.1. Image (Received) Message Page (Sheet 2)

Destination (OSB 9)	Provides for entry of destination TN (5 digit number with each digit having a range of 0-7), URN (8 digit number in the range of 00000000-16777215), or Call Sign (CS) (4 digit alphanumeric with each digit having a range of A-Z, 0-9, or Space). **NOTE** The selections on OSB 9 and OSB 10 determine which network a pending message will be sent. Defaults as follows based on a hooked PPLI with an empty scratchpad: • Flight Leader CS/TN of the hooked PPLI • Otherwise, the source CS/TN of the hooked PPLI Creates a new unsaved Pending message record if changed on a Received or Transmitted message record.
Destination Group (OSB 10)	Rotary OSB selects between TN (individual TN), SADL (collective TN for TEXT and IMG messages only), URN (individual URN), VMF (collective URN for TEXT messages only), or CS. For use in conjunction with the Destination OSB (OSB 9). Automatically changed based on the manually entered destination using OSB 9. **NOTE** The selections on OSB 9 and OSB 10 determine which network a pending message will be sent.
Modify (OSB 19)	Select this OSB to activate modify mode on this page. The OSB Shape, Annotation, Undo and MSG Cursor will be displayed for image annotation. Selection of this OSB again will turn off the modify mode. (See Image (IMG) Message Format) Creates a new unsaved Pending message record if on a Received or Transmitted message record.
Compress (OSB 20)	Rotary OSB selects the compression of NONE, LOW, MEDIUM, or HIGH. **NOTE** FWD is also used as an option when forwarding messages. This option appears when a destination has been modified for a received message. It will be removed when any other change has been made or if the received image was transmitted uncompressed (not possible from another A-10C).

Figure 1-148.1. Image (Received) Message Page (Sheet 3)

The image message page contains an Image Scaling display field (1:1) in the upper right hand corner of the display to indicate if the image has been scaled to fit the MFCD. Absence of 1:1 indicates that the image has been scaled to fit the MFCD in a manner that preserves the aspect ratio. The larger dimension fills the screen and the shorter dimension is centered in the display. When the OSB Modify Image (OSB 19) is selected, the respective image will be shown without any scaling (1:1), see Figure 1-148.2.

Images that are larger than the available MFCD will require the use of the annotation cursor to update the display. For example, when the cursor scrolls to the right of the MFCD edge, the image will be updated to the right respectively. In addition, due to the display fields on the Image Message Page, sections of the base image may be obstructed from view. To clear the display fields, select OSB Declutter (OSB 11). Refer to Figure 1-148.2 for an example of an Image message page with Declutter on.

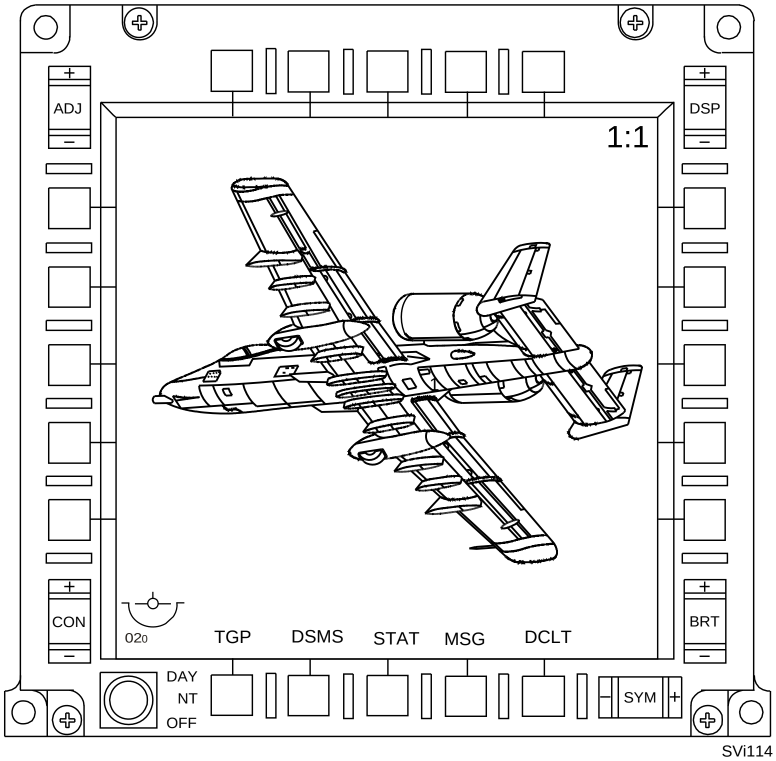

Figure 1-148.2. Image Message Page with Declutter On

To create or capture an image, select the HOTAS Left Throttle Button/LONG. The right MFCD image is selected for capture by default, unless the left MFCD is displaying the SOI. During the capture, the respective MFCD will have a status field displaying the completion percentage (CAP:XX%). Selection of HOTAS Left Throttle Button/LONG during the capture process will cancel the capture. Upon completion of Image Capture, the image is automatically saved into the Image Message Database.

Images in the Image Message Database may be annotated. Upon selection of OSB Modify Image (OSB 19), the annotation cursor will be displayed as shown in Figure 1-148.3.

The cursor assumes the annotation shape to assist in graphics placement. After placement of an annotation symbol, a number will appear under the image to assist in identification (see Figure 1-148.4).

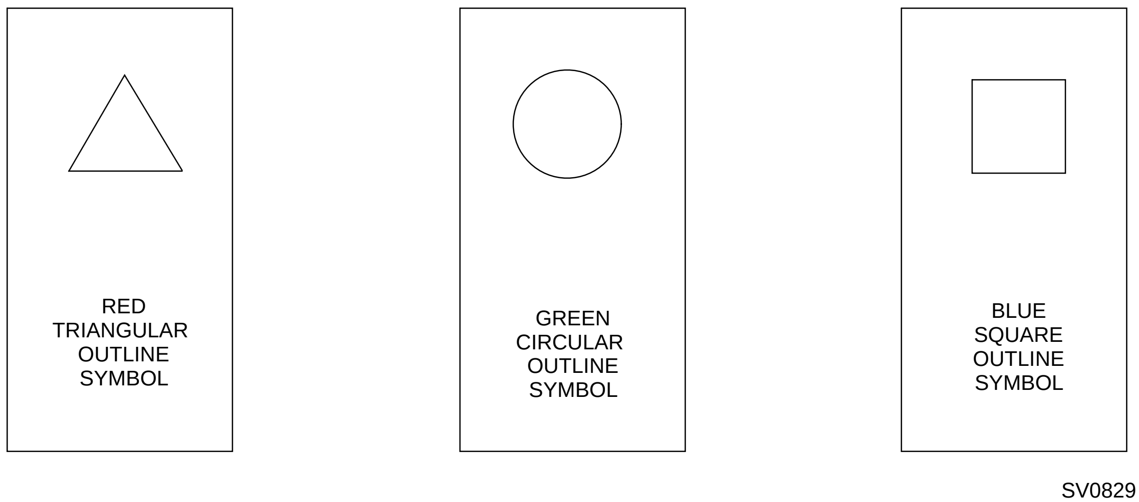

Figure 1-148.3. Annotation Symbols

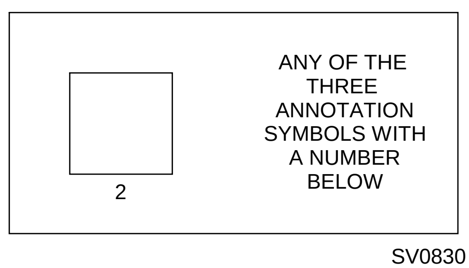

Figure 1-148.4. Annotation Symbols Displayed with Numerical Label

From the image message page, an image may be cropped to reduce transmit time. The CROP rotary (OSB 17) is used to crop an image. CROP is only available for a pending image when the compression is set to NONE. Once the image is compressed, the cropped areas are deleted and the remaining image is scaled to fit the display.

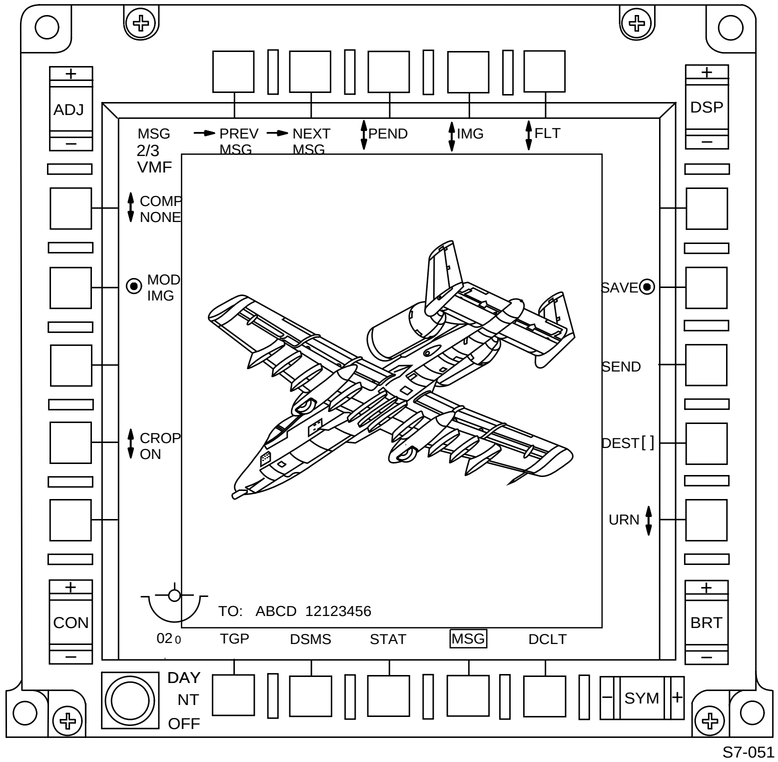

Figure 1-148.5. Image Message Page with Cropped Image

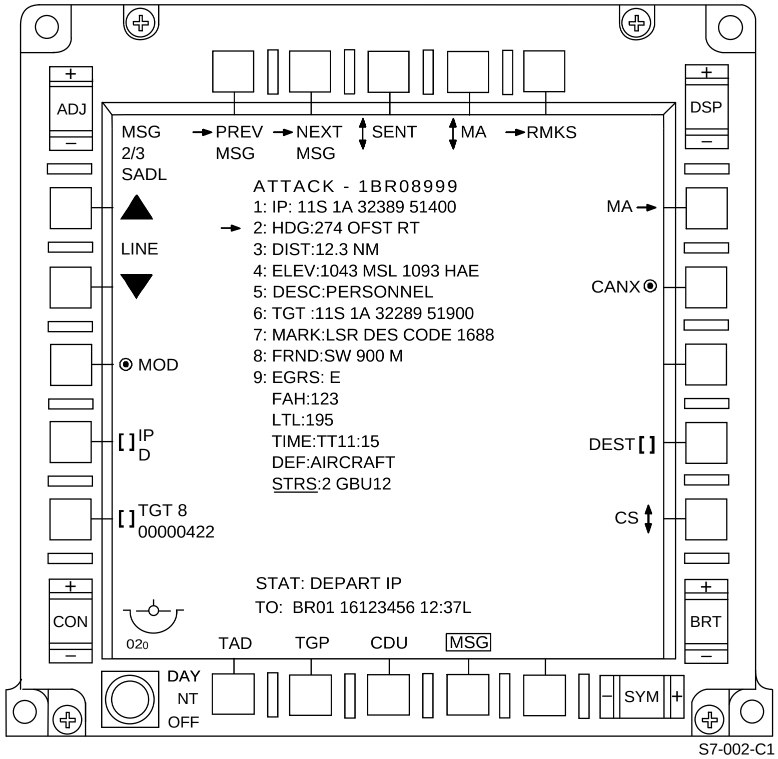

Figure 1-149. MA Message View Page (Sample Sent MA Message)

Figure 1-149.1. MA Message Page View Line Descriptors

Line	Header	Description	SADL MA	VMF MA
		Mission Type and Identifier	MA Type and Objective TN or IN	MA Type and Mission Number
1	IP:	Latitude/Longitude of the IP.	Latitude/Longitude	Latitude/Longitude
		IP Coordinates	MGRS	MGRS
2	HDG:	Heading from TGT to IP.	(0-359 degrees) (Auto Calculated)	(0-359 degrees), plus offset L/R/none (Auto Calculated)
3	DIST:	Distance between the IP and TGT.	N/A (receiving system will calculate for display)	Received distance if available, ownship calculated if distance not sent in the MA.
4	ELEV:	Elevation (relative to MSL) of the TGT/Objective.	~3 foot resolution	1 foot resolution
5	DESC:	Target Description.	Target Type or Specific Type	Target Generic Type
6	N/A	Target Latitude/Longitude.	Latitude/Longitude	Latitude/Longitude
	TGT:	Target Coordinates	MGRS	MGRS
7	MARK:	Mark type. If a laser designator, will also provide the laser code.	Laser code (only if Laser Designation MA). Target Position Marking, plus laser code (text only)	Target Position Marking, plus laser code
8	FRND:	Closest Friendly position.	Latitude/Longitude in message converted to semi-cardinal directions and distance in meters betwen the target and closest Friendly position (text only)	Latitude/Longitude in message converted to semi-cardinal directions and distance in meters between the target and closest Friendly position
9	EGRS:	Egress Heading.	000-359 degrees in message converted to semi-cardinal directions for display/data entry	Semi-cardinal directions (8 choices)
	FAH:	Final Attack Heading. (FAH) or FAH Cone	(000-359 degrees) FAH only. SADL does not support FAH Cone	(000-359 degrees) One azimuth displayed for FAH, two azimuth angles for FAH Cone
	LTL:	Laser/Target Line.	(000-359 degrees)	(000-359 degrees)
	TIME:	Time Discrete.	Hours, minutes	Day, hours, minutes, seconds converted to HH:MM for display/data entry
	DEF:	Target Defenses.	Target Defenses	Target Air Defenses
	STRS:	Required Stores.	Required Stores	Required Stores (text only)

Figure 1-149.2. Message Page (MA Type and Display Format)

Type	Compatible Objectives	Description	Format
Priority Kill	Air Track (TN); Air Target (IN)	(Blank) (Blank) (Blank) Altitude/Elevation Description OBJ Location (Blank) (Blank) (Blank) (Blank) (Blank) (Blank) (Blank) (Blank)	 4: ELEV: 5: DESC: 6: (Lat/Long) or TGT: (MGRS)
Engage	(same as Priority Kill)	(same as Priority Kill)	(same as Priority Kill)
Attack (TDL (SADL) network)	Surface/Land Track (TN); Land Point (TN);Surface/Land Target (IN); for transmitted message can also be a local target defined by CDU waypoint number (0-2050) or CDU mark point (A-Z), TGP symbol or SPI symbol	IP Location Run-in Heading Distance Altitude/Elevation Description TGT Location Mark Type Friendly Location Egress Heading Final Attack Heading Laser/Target Line Time Discrete Target Defenses Required Stores	1: IP: 2: HDG: 3: DIST: 4: ELEV: 5: DESC: 6: (Lat/Long) or TGT: (MGRS) 7: MARK: 8: FRND: 9: EGRS: FAH: LTL: TIME: DEF: STRS:

Figure 1-149.2. Message Page (MA Type and Display Format) - Continued

Type	Compatible Objectives	Description	Format
Attack (TDN (VMF) network)	Surface/Land Track (TN); Land Point (TN);Surface/Land Target (IN); for transmitted message can also be a local target defined by CDU waypoint number (0-2050) or CDU mark point (A-Z), TGP symbol or SPI symbol	IP Location Run-in Heading Distance Altitude/Elevation Description TGT Location Mark Type Friendly Location Egress Heading Final Attack Heading Laser/Target Line Time Discrete Target Defenses Required Stores	1: IP: 2: HDG: 3: DIST: 4: ELEV: 5: DESC: 6: (Lat/Long) or TGT: (MGRS) 7: MARK: 8: FRND: 9: EGRS: FAH: LTL: TIME: DEF: STRS:
Close Air Support	No Statement; Land Track (TN); Land Point (TN); Land Target (IN)	IP Location Run-in Heading Distance Altitude/Elevation Description TGT Location (Blank) Friendly Location Egress Heading (Blank) (Blank) Time Discrete	1: IP: 2: HDG: 3: DIST: 4: ELEV: 5: DESC: 6: (Lat/Long) or TGT: (MGRS) 8: FRND: 9: EGRS: TIME:
Suppression of Enemy Air Defenses	(same as Attack)	(same as Close Air Support)	(same as Close Air Support)
Aerial Reconnaissance	(same as Attack)	(same as Priority Kill)	(same as Priority Kill)
Armed Reconnaissance	(same as Attack)	(same as Priority Kill)	(same as Priority Kill)
Laser Designation Bombing	Surface/Land Track (TN); Land Point (TN)	(same as Attack)	(same as Attack)
Investigate/ Interrogate	Air/Surface/Land Track (TN); Land Point (TN); Air/Surface/Land Target (IN)	(same as Priority Kill)	(same as Priority Kill)
Shadow	(same as Investigate)	(same as Priority Kill)	(same as Priority Kill)
Cover	(same as Investigate)	(same as Priority Kill)	(same as Priority Kill)

Figure 1-149.2. Message Page (MA Type and Display Format) - Continued

Type	Compatible Objectives	Description	Format
Intervene	(same as Investigate)	(same as Priority Kill)	(same as Priority Kill)
Fighter Sweep	No Statement	(no text fields)	(all lines blank)
Visual ID	(same as Investigate)	(same as Priority Kill)	(same as Priority Kill)
Escort	Air/Surface/Land Track (TN); Air/Surface/Land Target (IN)	(same as Priority Kill)	(same as Priority Kill)
Divert	No Statement; Air/Surface/Land Track (TN); Land Point (TN); Air/Surface/Land Target (IN)	(same as Priority Kill)	(same as Priority Kill)
Recall	(same as Divert)	(same as Priority Kill)	(same as Priority Kill)
Orbit	(same as Investigate)	(Blank) (Blank) (Blank) Orbit Altitude Description OBJ Location (Blank) (Blank) (Blank) (Blank) (Blank) (Blank) (Blank) (Blank)	 4: ELEV: 5: DESC: 6: (Lat/Long) or TGT: (MGRS)
Refuel	(same as Investigate)	(same as Priority Kill)	(same as Priority Kill)
Search and Rescue	(same as Investigate)	(same as Priority Kill)	(same as Priority Kill)
Combat Air Patrol	(same as Investigate)	(Blank) (Blank) (Blank) CAP Altitude Description OBJ Location (Blank) (Blank) (Blank) (Blank)	 4: ELEV: 5: DESC: 6: (Lat/Long) or TGT: (MGRS)

Figure 1-149.2. Message Page (MA Type and Display Format) - Continued

Type	Compatible Objectives	Description	Format
		(Blank) (Blank) (Blank) (Blank)	
Clear to Drop	Surface/Land Track (TN); Land Point (TN);	(same as Close Air Support)	(same as Close Air Support)
Return to Base	No Statement; Surface/Land Track (TN); Land Point (TN)	(same as Priority Kill)	(same as Priority Kill)
Salvo/Clear Aircraft	No Statement; Surface/Land Track (TN); Land Point (TN)	(same as Priority Kill)	(same as Priority Kill)

NOTE

ATTACK is the only MA message that can be sent. All others are receive only.

Page 1-359 deleted.

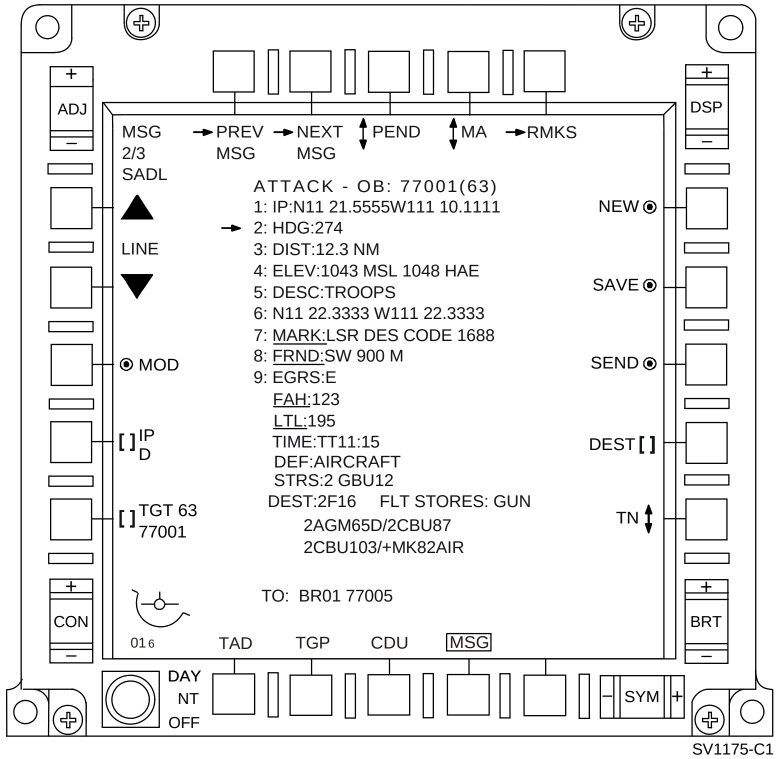

Figure 1-151. Message Page (Sample Pending MA Message View Page 1)

Figure 1-152. SADL Mission Assignment Status

SADL Priority	Type/Annunciation	Comments
1	BDA (TGT DSTR, PART DSTR, BDA UNK, RE-ATCK)	When BDA is reported by assigned aircraft.
2	DISENG	If assigned aircraft reports Disengaging.
3	CANC WILCO, CANC CNTCO, CANC CANTPRO	If associated response to MA cancellation provided.
4	PROXY CANC WILCO, PROXY CANC CNTCO	If proxy response to MA cancellation provided.
5	Targeting status (SHOOTING)	Automatic response from assigned aircraft.
6	Engagement Status (ATTACKING, ENGAGING, INVES if Investigating, or COVERING)	Automatic response from assigned aircraft.
7	WILCO, CNTCO, CANTPRO	If associated response to original order provided.
8	PROXY WILCO, PROXY CNTCO	If proxy response to original order provided.
9	MA NO OPR	No operator response received to a transmitted MA.
10	PENDING	Awaiting response from assigned aircraft.

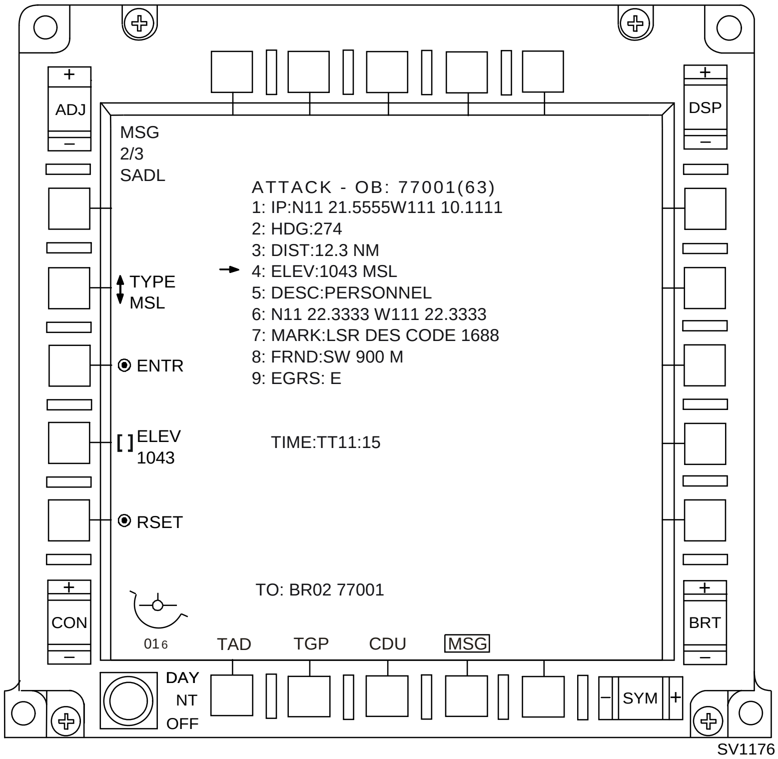

Figure 1-152.1. Message Page (Sample Pending MA Message Modify Mode)

Figure 1-152.2. MA Message Modify Mode OSB Selections

Line	Header	Description	OSB 17	OSB 19	OSB 20
		Mission Type and Identifier.	N/A (not modifiable)	N/A (not modifiable)	N/A (not modifiable)
1	IP:	Latitude/Longitude of the IP.	N/A (not modifiable)	N/A (not modifiable)	N/A (not modifiable)
2	HDG:	Heading from IP to TGT.	N/A (not modifiable)	Offset Rotary (OFST LT/RT/NONE) (VMF ONLY)	N/A
3	DIST:	Distance between the IP and TGT.	N/A (not modifiable)	N/A (not modifiable)	N/A (not modifiable)
4	ELEV:	Elevation of the TGT.	Elevation Data Entry (ELEV -1320 - 65535, 1FT resolution)	N/A	N/A
5	DESC:	Target Description.	N/A	Description Navigation Down (scrolls through list, see Figure 1-152.3 and Figure 1-152.4)	(scrolls through list, see Figure 1-152.3 and Figure 1-152.4)
6	(Blank)	Target Latitude/Longitude.	N/A (not modifiable)	N/A (not modifiable)	N/A (not modifiable)
	TGT:	Target Coordinates in MGRS	N/A (not modifiable)	N/A (not modifiable)	N/A (not modifiable)
7	MARK:	Mark type. If a laser designator, will also provide the laser code. (sent out as text in SADL Attack MA)	Laser Code Data Entry (YZZ or 1YZZ for VMF or XZZZ for SADL; where Z = 1-8, Y=1-7, and Z=1-2)	Mark Type Rotary (scrolls through list, see Figure 1-152.5)	N/A
8	FRND	Closest Friendly position. (sent out as text in SADL Attack MA)	Distance to Friendly Data Entry (0-16383 meters)	Heading Rotary (HDG NONE / N / NE / E / SE / S / SW / W / NW)	N/A
9	EGRS	Egress heading.	N/A	Heading Rotary (HDG NONE / N / NE / E / SE / S / SW / W / NW)	N/A
	FAH	Final Attack Heading. (FAH) or FAH Cone	Final Attack Heading (FAH) Data Entry (YYYZZ where YYY is 0 - 359 degrees final attack heading, ZZ is 1-99 ± offset degrees [for cone])	N/A	N/A
	LTL	Laser Target Line. (sent out as text in SADL Attack MA)	Laser Target Line (LTL) Data Entry (0 - 359 degrees)	N/A	N/A

Figure 1-152.2. MA Message Modify Mode OSB Selections - Continued

Line	Header	Description	OSB 17	OSB 19	OSB 20
	TIME	Time Discrete.	Time Data Entry (HHMM)	Time Discrete Rotary (TT/IP/IL) (SADL ONLY)	N/A
	DEF	Target Defenses.	N/A	Target Defenses Rotary (scrolls through list, see Figure 1-152.6 and Figure 1-152.7)	N/A
	STRS	Required Stores. (based on flight available stores if defined for destination; otherwise tailored list as detailed in Figure 1-152.8 - sent out as text in VMF MA)	Num of Stores Data Entry (1 - 63)	Required Stores Navigation Down (scrolls through list, see Figure 1-152.8)	Required Stores Navigation Up (scrolls through list, see Figure 1-152.8)

NOTE

- Mission Type and Identifier: For TDL (SADL), the Track Number or Index Number automatically defined for the target will be assigned as the identifier. For TDN (VMF), the Mission Number entered will be assigned as the identifier.
- Line 2 (HDG:): Transmit MA and Receive MA will show the calculated heading, unless modified. Offset is only available for TDN (VMF) network.
- Line 3 (DIST:): Transmit MA and Receive MA will show the calculated distance for SADL.
- Line 5 (DESC:): Different options for TDL (SADL) and TDN (VMF) networks. When changing between SADL and VMF the description format will automatically change to the appropriate value.
- (TIME:): TDL (SADL) supports Illumination On (IL)/Initial Point Time (IP)/Time On Target (TT) while TDN (VMF) only supports TT. If forwarding to the TDN (VMF), will be blanked if the original message is not TT.
- (DEF:): Different options for TDL (SADL) and TDN (VMF) networks. When forwarding or changing the destination interface, will map the values accordingly.
- Line 7 (MARK), Line 8 (FRND:), (FAH:), (LTL:): Digitally selected, but is transmitted as text over TDL (SADL) network.
- (STRS:): Digitally selected, but is transmitted and received as text over TDN (VMF) network. The selectable stores for this list is based on the Flight Stores defined for the destination of the message. If Flight Stores are not defined then a default stores list can be used.

Figure 1-152.3. MA Message Line 5 SADL Target Types

TDL Target Type	Annunciation
AIR DEFENSES, AIRCRAFT	A/C
ANTI AIRCRAFT ARTILLERY	AAA
AIRBASE	AIRBASE
AIRPORT FACILITIES	AIRPORT
ARMORED VEHICLES	ARMRDVEH
ARTILLERY/MORTARS	ARTILERY
BRIDGE	BRIDGE
COMMUNICATIONS	COMMS
CONVOY	CONVOY
DAM	DAM
DOCK AREA	DOCKAREA
FORTIFICATION	FORT
GUN EMPLACEMENT	GUNPLMNT
INDUSTRIAL SITE	IND STE
OTHER SURFACE VESSELS	OTHRVESS
PILL BOX/BUNKER	PILLBOX
PETROLEUM, OIL, AND LUBRICANTS (POL)	FUEL
POWER PLANT	PWRPLNT
RAIL	RAIL
ROAD	ROAD
SURFACE-TO-AIR MISSILE (SAM)	SAM
SHIPPING	SHIPPING
SUPPLY DEPOT	SUPPLY
TROOPS	TROOPS
TUNNEL	TUNNEL
VEHICLES	VEHICLE
WARSHIP (LARGE)	WARSHP L
WARSHIP (MEDIUM)	WARSHP M
WARSHIP (SMALL)	WARSHP S
NO STATEMENT	NO STMT

Figure 1-152.4. MA Message Line 5 VMF Target Types

TDN Target Description	Annunciation
AIRCRAFT	A/C
AIR DEFENSE ARTILLERY	AAA
ARMOR, COMBAT	ARMRCMBT
ARTILLERY	ARTILERY
ASSEMBLY AREA	ASSEMBLY
BRIDGE	BRIDGE
BUILDINGS	BUILDING
COMMAND CENTER	C2 CNTR
DAM	DAM
EQUIPMENT	EQUIPMNT
FORMATION	FORMATN
FIELD FORTIFICATIONS	FLD FORT
ROCKET/MISSILES	MISSLES
MORTAR	MORTAR
MULTIPLE ROCKET LAUNCHER	MRLAUNCH
PERSONNEL	PERSONEL
SHIP/BOAT	SHIP
SUPPLY DUMP	SPLYDMP
TERRAIN FEATURE	TERRAIN
VEHICLES	VEHICLES
WEAPONS	WEAPONS
UNDEFINED	NO STMT

Figure 1-152.5. MA Message Line 7 VMF Target Marking

TDN Target Marking	Annunciation
SMOKE	SMOKE
FLARES	FLARES
LIGHT	LIGHT
FIRE	FIRE
LASER DESIGNATOR	LSR DES
COLORED SMOKE	C SMOKE
WHITE PHOSPHORUS	WHT PHOS
INFRARED	INFRARED
ILLUMINATION	ILLUM

Figure 1-152.6. MA Message Line 13 VMF Target Defenses

TDN Target Defenses	Annunciation
UNKNOWN	UNKNOWN
ANTIAIRCRAFT ARTILLERY	AAA
SURFACE-TO-AIR MISSILE	SAM
COMBAT AIR PATROL	AIRCRAFT

Figure 1-152.7. MA Message Line 13 SADL Target Defenses

TDN Target Defenses	Annunciation
AIRCRAFT	AIRCRAFT
SURFACE-TO-AIR MISSILE (SAM)	SAM
NO KNOWN DEFENSE	NO KNOWN DEF
ANTI-AIRCRAFT ARTILLERY	AAA
SMALL ARMS	SMALL ARM

Figure 1-152.8. MA Message Line 14 Required Stores List

Required Stores	Annunciation	SADL MSG Digital/Text
30MM	30MM	Text
MK-82 LD	MK82LD	Digital
MK-82 AIR	MK82AIR	Digital
MK-84 LD	MK84LD	Digital
GBU-31 JDAM (MK-84)	GBU31	Digital
GBU-38 JDAM (MK-82)	GBU38	Digital
AGM-65B MAVERICK (TV)	AGM65B	Digital
AGM-65D MAVERICK (IR)	AGM65D	Digital
AGM-65E MAVERICK (LASER MAW)	AGM65E	Digital
AGM-65F MAVERICK (IR MAW)	AGM65F	Digital
AGM-65G MAVERICK (IR MAW)	AGM65G	Digital
AGM-65H MAVERICK	AGM65H	Digital
AGM-65K MAVERICK	AGM65K	Digital
GBU-10 PAVEWAY (MK84)	GBU10	Digital
GBU-12 PAVEWAY (MK82)	GBU12	Digital
CBU-87 CEM	CBU87	Digital
CBU-103 WCMD-CEM	CBU103	Digital
ROCKET	ROCKETS	Digital
BDU-33 (PRACTICE BOMB)	BDU33	Digital

Figure 1-152.8. MA Message Line 14 Required Stores List - Continued

Required Stores	Annunciation	SADL MSG Digital/Text
BDU-50 (PRACTICE BOMB)	BDU50	Digital
LUU-2	LUU2	Digital
MK-83 GP	MK83GP	Digital
GBU 32 JDAM (MK-83)	GBU32	Digital
GBU-38(V)4/B (BLU-126)	GBU38V	Text
GBU-39	GBU39	Text
GBU-53	GBU53	Text
GBU-24 (MK 84)	GBU24	Digital
EGBU-27	EGBU27	Digital
GBU-28 (LG BLU-113)	GBU28BL	Digital
GBU-51 Low collateral LGB	GBU51	Text
CBU-89 GATOR	CBU89	Digital
CBU-97 SFW	CBU97	Digital
CBU-104 WCMD-GATOR	CBU104	Digital
CBU-105 WCMD-SFW	CBU105	Digital
AGM-88 HARM	AGM88	Digital

NOTE

If a destination is defined on the MA Message Page and is reporting flight stores, the reported flight stores will be used as the scrollable list to choose the MA Required Stores.

VMF MISSION ASSIGNMENT STATUS.

When an A-10C sends a mission assignment, a status response is received from the tasked aircraft. Valid VMF status indications for the MA MSG Page are shown in Figure 1-152.9. MA MSG Page status is displayed one line above the "TO:" line at the bottom center of the display as shown in Figure 1-152.10.

Valid VMF status indications for the TAD Page, TAD MA Page, and VMF Mission Page (9-Line) are shown in Figure 1-152.11. For the TAD Page (Figure 1-152.12), TAD MA Page (Figure 1-152.13), and VMF Mission Page (Figure 1-152.14) the VMF MA status annunciations are displayed below the Call Sign or URN on the lower right side of the display.

Receipt of BDA (TGT DSTR, PART DSTR, BDA UNK, RE-ATCK) or DISENG indicates that the attacking aircraft is no longer prosecuting the attack described by this mission assignment. If a BDA is sent or received for the selected VMF 9-Line, the BDA status will override the DIP status.

Figure 1-152.9. VMF Mission Assignment Status for MA MSG Page

Priority	Type/Annunciation	Comments
1	BDA (PART DSTR-RE-ATCK, PART DSTR, TGT DSTR, NO EFCT-RE-ATCK, NO EFCT, BDA UNK-RE-ATCK, BDA UNK)	BDA Status of Partially Destroyed with re-attack required, Partially Destroyed, Target Destroyed, No Effect with re-attack required, No Effect, BDA Unknown with re-attack required, or BDA Unknown.
2	DEPART IP	If status of Disengaging provided (SADL only)
3	WILCO, CNTCO, CANTPRO, PROXY WILCO, PROXY CNTCO	If associated (or proxy) response to original order provided.
4	MA NO OPR	No operator response received to transmitted VMF 9-Line.
5	PENDING	No operator response received, and no response from another flight member being monitored, and two minutes have not elapsed since message was sent.
6	TRANSMIT FAIL	Machine ackowledge was not received for a sent message.

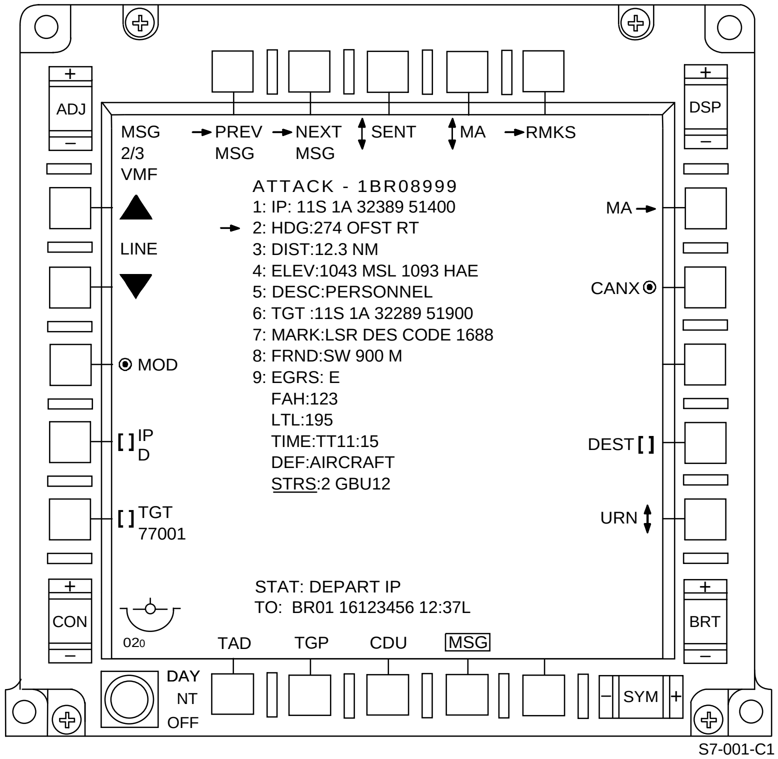

Figure 1-152.10. MA Message View Page (Sample Transmitted VMF MA Message)

Figure 1-152.11. VMF Mission Assignment Status for TAD Page, TAD MA Page, and VMF Mission Page

VMF Priority	Type/Annunciation	Comments
1	BDA (PART DSTR, TGT DSTR, NO EFCT, BDA UNK) (Transmitted or Received MAs)	BDA Status of Partially Destroyed, Target Destroyed, No Effect, or BDA Unknown. **NOTE** BDA display is only applicable for the TAD MA Page and VMF Mission Page.
2	DIP RCVD (Transmitted MA)	9-Line recipient has departed the initial point in the 9-Line report.
	DIP SENT (Received MA)	

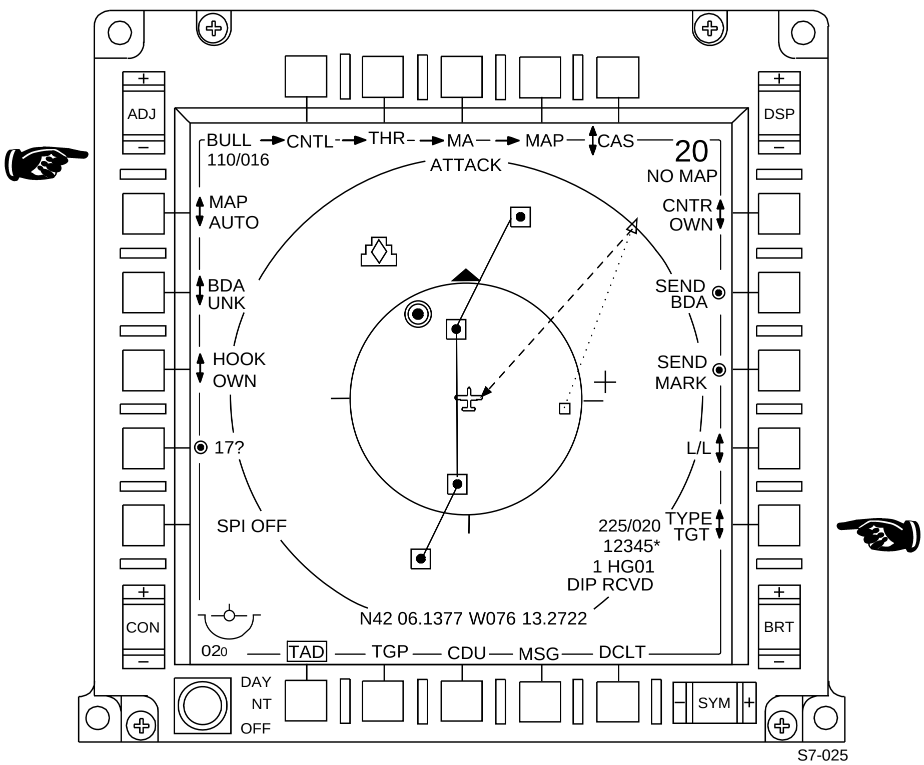

Figure 1-152.12. VMF Mission Assignment Status Displayed on TAD Page

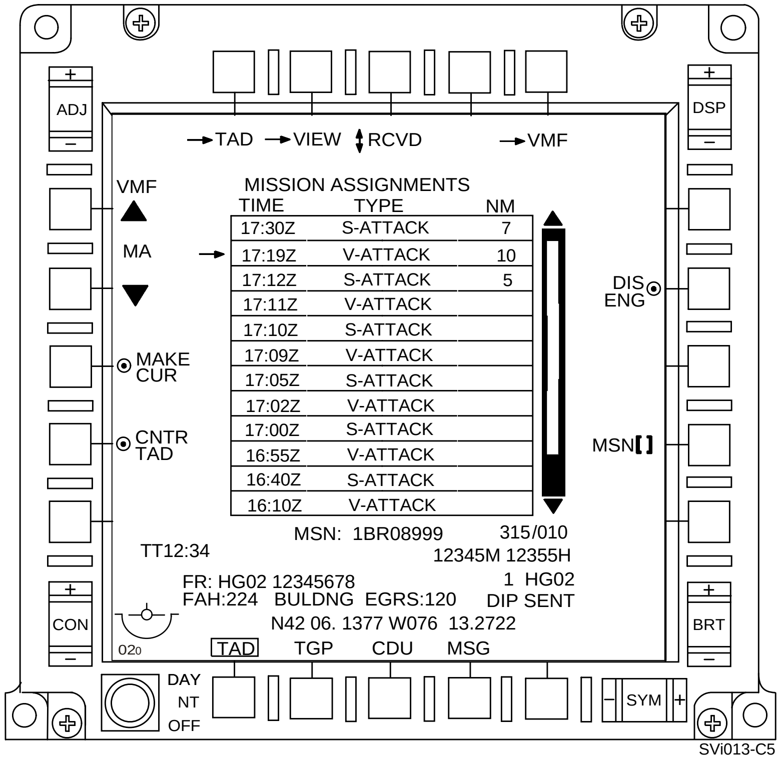

Figure 1-152.13. VMF Mission Assignment Status Displayed on TAD MA Page

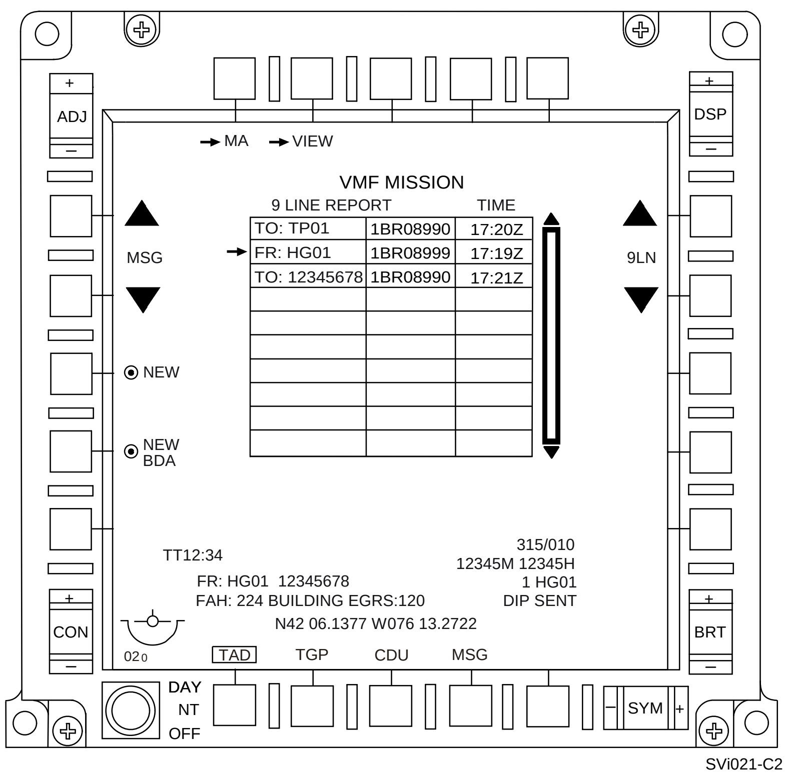

Figure 1-152.14. VMF Mission Assignment Status Displayed on VMF Mission Page

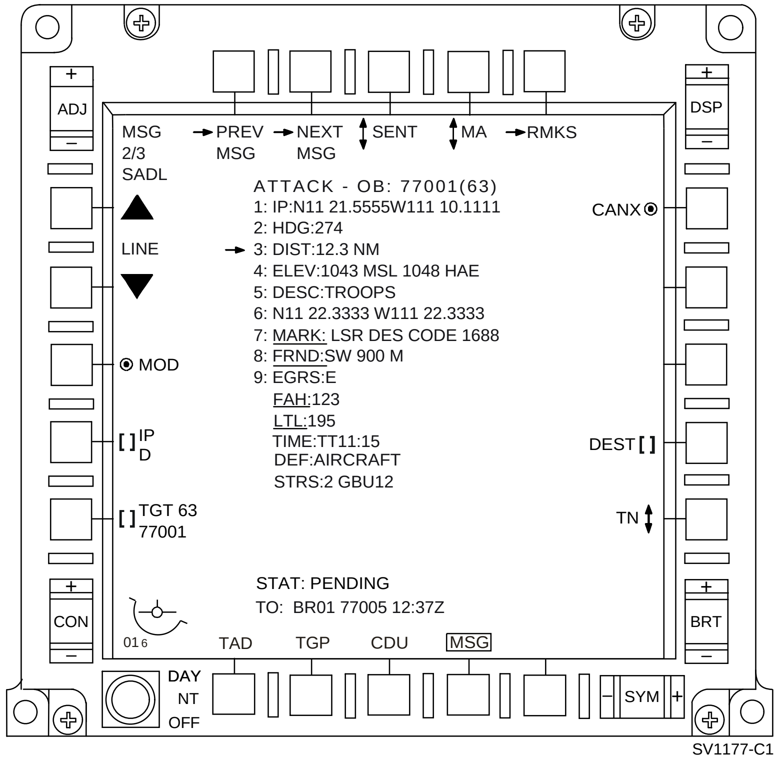

Figure 1-153. MA Message View Page (Sample Transmitted MA Message)

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Deleted.

Pages 1-363 - 1-364 deleted.

Figure 1-156. TAD TDL/TDN SYMBOLOGY

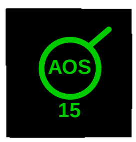
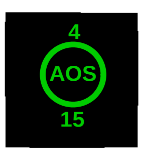
Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
Air PPLI (J2.2/K02.34 Messages)					
Own Flight	Circle with velocity vector; Wingman ID in center; Altitude (K ft) below*		Blue	Varies (2-3 sec for fighters)	60 sec
Donor	Dot replaces Wingman ID		Green	Same	Same
Other PPLI	Center is blank		Green	Same	Same
Emergency Indicator	Red "E" in center (replaces Wingman ID or dot if applicable)		Green; red "E"	Same	Same
Aircraft On-Station (AOS) (correlated to a PPLI; Emergency Indicator and Controlling Unit have priority over AOS)	Green “AOS” in center (replaces Wingman ID or dot if applicable); Altitude (K ft) below of aircraft that transmitted the PPLI		Green	Same	60 sec
Aircraft On-Station (not correlated to an Air PPLI) (K02.34 Message)					
Controlling Unit Indicator	Green "C" in center (replaces Wingman ID or dot if applicable)		Base symbol no change; green "E"	Same	Same
Aircraft On Station (not correlated to a PPLI) (K02.34 Message)					
Aircraft On-Station (AOS) (not correlated to an Air PPLI)	Circle w/out velocity vector; number of aircraft in the flight above (a "+" is displayed if greater than 14 aircraft are in the flight and the exact number of aircraft is unknown); "AOS" in center; Altitude (K ft) below of aircraft that reported the AOS		Green	Not Updated	15 Seconds

Figure 1-156. TAD TDL/TDN SYMBOLOGY - Continued

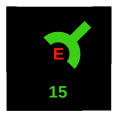
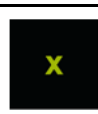
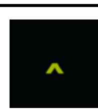
Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
Air Track (Friendly) (J3.2 Message)					
Friendly	Semicircle with velocity vector; Altitude (K ft) below*		Green	12-48 sec	30-120 sec (Depends on Track Quality)
Air Track (Emergency Indicator) (J3.2 Message)					
Emergency Indicator	Red "E" in center (friendly track shown just as an example)*		Green; red "E"	Same	Same
Air Track (Neutral/Suspect/Unknown) (J3.2 Message)					
Neutral	Square with velocity vector; Altitude (K ft) below*		Blue	12-48 sec	30-120 sec (Depends on Track Quality)
Suspect	Same		Yellow	Same	Same
Other Unknown (Assumed Friend, Pending or Undefined)	Same		White	Same	Same
Air Track (Hostile) (J3.2 Message)					
Hostile	Triangle with velocity vector; Altitude (K ft) below*		Red	12-48 sec	30-120 sec
Surface/Land PPLI (J2.3/J2.5/J2.6 Messages)					
PPLI (includes EPLRS/SADL and VMF)	"X"		Green	12 sec for SADL, Undeterminable for VMF	60 sec for SADL, None for VMF
Controlling Unit Indicator	Green "C" replaces "X"		Green	12 sec	60 sec
Surface/Land Point/Track (Friendly) (J3.3/J3.5 Messages)					
Friendly point/track or Closest Friendly in MA	Lower half of "X"		Green	Land Track: 48; Land Point: 96; Surface Track: 12-48	30 - 240 sec (Depends on Track Quality, or Track/Point Indicator)

Figure 1-156. TAD TDL/TDN SYMBOLOGY - Continued

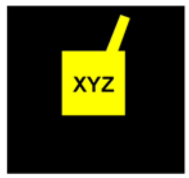
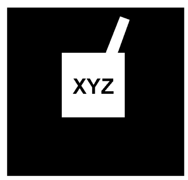
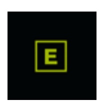
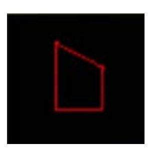
Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
Surface/Land Point/Track (Neutral/Suspect/Unknown) (J3.3/J3.5 Messages)					
Neutral	Square with velocity vector shown in Reverse video*		Blue	Same	Tracks 30 - 120 sec. Land points only deleted if stale (>240 sec old)
Suspect	Same		Yellow	Same	Same
Other Unknown (Assumed Friend, Pending or Undefined)	Same		White	Same	Same
Surface/Land Point/Track (Hostile) (J3.3/J3.5 Messages)					
Hostile	Diamond with velocity vector shown in reverse video*		Red	Same	Same
Reference Points (J3.1 Message)					
Emergency Point	Boxed "E"		Green	12 sec	60 sec
Reference Point/Lines/Areas (J3.0 Message)					
Hostile Boundary or Kill Zone	Line encompassing area, or marking boundary. Area could be multipoint area (shown), or could be a rectangle or ellipse centered on a single point.		Red	96 sec	5 min if 3 points or less; 38.4 min if >3 points
Hazards, Buffer Zone Boundary	Point, line, or area		Yellow	Same	Same
Corridor or Low Level Transit Route	Single Line (double in thickness, no connection at ends to form area)		Yellow	Same	Same

Figure 1-156. TAD TDL/TDN SYMBOLOGY - Continued

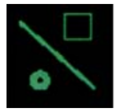
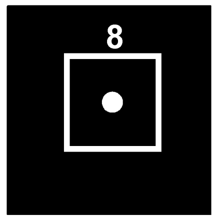
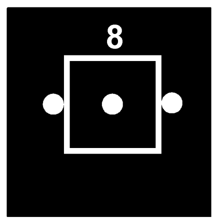
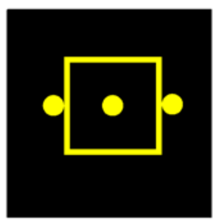
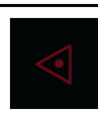
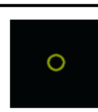
Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
Other Reference Points, Lines, or Areas	Point, line, or area		Green	Same	Same
TDL Mark Points (J12.6 Message)					
TDL Mark Points	Square centered over a filled circle with index number above		White	N/A - Not updated	N/A No timeout
Transmitted TDL Mark Points	Two small circles on either side of a TDL Mark point with index number above		White	N/A - Not updated	N/A No timeout
Temporary TDL Mark Points (will become a Transmitted Mark point when elevation request returns)	Two small circles on either side of a TDL Mark point		Yellow (if DTSAS elevation request in progress) Red (if no elevation)	N/A - Not updated	N/A No timeout
Objective, IP, or CP Overlay for an Active Mission Assignment (MA) (J12.0/K02.33 Messages)					
Objective of MA (Attack)	Equilateral triangle centered on objective with base perpendicular to attack azimuth		Red	Same as objective	N/A - No timeout
Objective of MA (other than Attack)	Circle centered on objective		Green	Same as objective	N/A - No timeout
Objective of MA with Env = Air	No overlay (just original air PPLI or air track symbol)	N/A	N/A	N/A	N/A

Figure 1-156. TAD TDL/TDN SYMBOLOGY - Continued

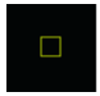
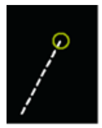
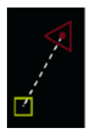
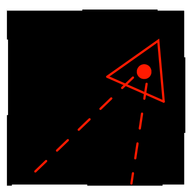
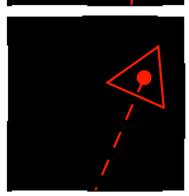
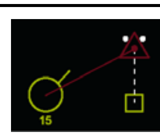
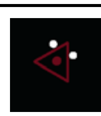
Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
Air PPLI					
MA Initial Point (IP) or Contact Point (CP)	Square centered on IP or CP coordinates		Green	N/A - Not updated	N/A - No timeout
Target to IP Line	Dashed line between current or oldest pending Mission Assignment objective and IP. If no IP specified and no FAH or FAH Cone is specified, the system will draw the line 10 NM in length from the objective toward ownship. Flashes @ 1Hz interval if pending. Displayed only when hooked for Transmitted MA.	  	White	N/A - Not updated	N/A - No timeout
FAH Line or Cone	Dashed line 10 NM from current or oldest pending Mission Assignment objective along Final Attack Heading. FAH Cone is displayed as two dashed lines. Flashes @ 1Hz interval if pending. Displayed only when hooked for Transmitted MA.	 	Red	N/A - Not updated	N/A - No timeout
Transmitted MA Line (while hooked) with assigned aircraft	Transmit MA Line displayed between Transmitted MA and assigned aircraft symbol.		Red	N/A - Not updated	N/A - No timeout
Transmitted MA Circles (while not hooked)	Circles on both sides of objective. IP (if specified).		White	N/A - Not updated	N/A - No timeout

Figure 1-156. TAD TDL/TDN SYMBOLOGY - Continued

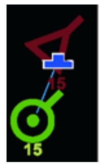
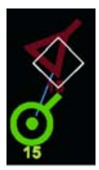
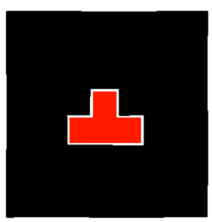
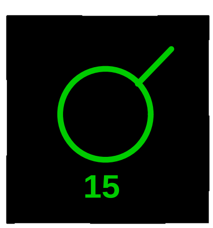
Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
Donated SPI/Target and "Lock Line"					
Primary Donor Target/SPI	Two-tiered version of ownship SPI symbol; Solid line from donor aircraft location (donor could be a flight member)		See notes; Blue line	3 sec (air); 6 sec (not air)	13 sec (air); 25 sec (not air)
Target from Donor - Weapon Released	Same, except line flashes @ 1Hz interval during weapons release and through weapon Time of Fall (Weapon Release button, Gun Trigger Second Detent)	Same	Same	Same	Same
Local Target, BDA, or Engagement Status Report from Donor	Diamond; Solid line from donor aircraft location ONLY if target diamond is hooked symbol		Same	Same	Same
Aircraft Position/Target and "Lock Line"					
APTD Target	Two-tiered version of ownship SPI symbol; A red lock line displays from the aircraft symbol (APTD Aircraft or SADL PPLI symbol) to the target symbol if both locations are known.		Red with white outline	APTD will be a burst if the APTD is unsolicited, an APTD in response to an APTD RQST will update at the rate specified in the request.	5 minutes
APTD Aircraft (Only displayed if the originator does not already have a SADL PPLI on the TAD.)	Circle with a blank center and the aircraft's Velocity Vector* and Altitude (K ft); lock line can be drawn if the originator of the APTD Target.		Green	APTD will be a burst if the APTD is unsolicited, an APTD in response to an APTD RQST will update at the rate specified in the request.	30 seconds
General Notes * No velocity vector if the course is unknown or invalid.					

Figure 1-156.1. TAD Threat Symbology

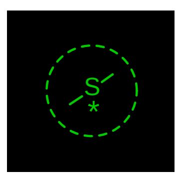
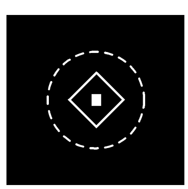
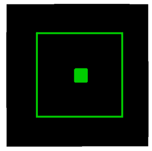
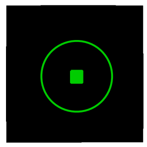
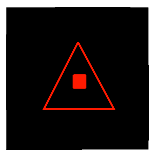
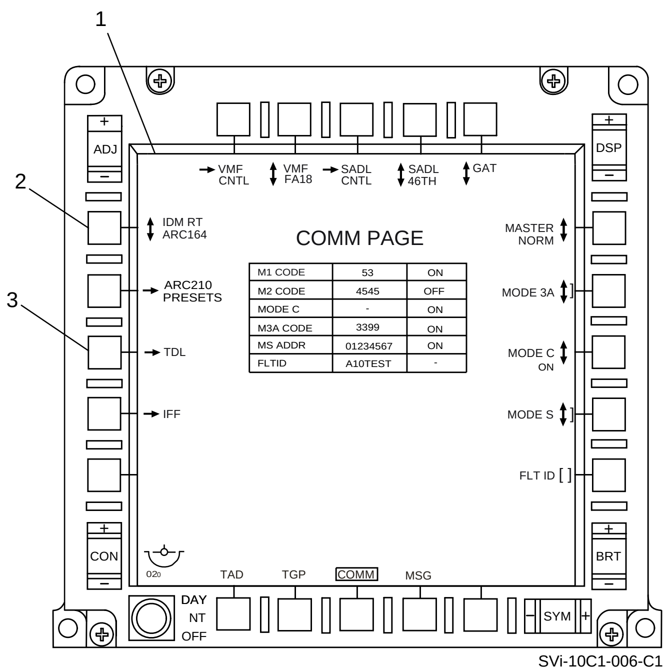
Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
ALQ-213 Threat	1-3 Character Threat Code. Solid Range Ring based on Lethal Range. Character threat code flashes at 2 Hz rate.		Red = Hostile Green = Friendly Yellow = Suspect White = Unknown	Varies	Tied to RWR display
Azimuth Threat	1-3 Character Threat Code, no Range Ring. Located at edge of TAD display along bearing to threat.		Red = Hostile	Varies	Tied to RWR display
Donor Threat	Slash across a 1-3 Character Threat Code. Solid Range Ring based on Lethal Range. Threat symbol, but not range ring flashes at 2 Hz rate		Red = Hostile Green = Friendly Yellow = Suspect White = Unknown	Varies	60 sec after last update (becomes Memory Threat)
Data Link	Slash across a 1-3 Character Threat Code. Dashed Range Ring based on Lethal Range.		Red = Hostile Green = Friendly Yellow = Suspect White = Unknown	Varies	240 sec after last update (becomes Memory Threat)
Memory Threat	Bracket above a 1-3 Character Threat Code. Dashed Range Ring based on Lethal Range.		Red = Hostile Green = Friendly Yellow = Suspect White = Unknown	N/A - No Update	N/A - No timeout
Pre-Planned Threats	Chevron above a 1-3 Character Threat Code. Dashed Range Ring based on Lethal Range.		Red = Hostile Green = Friendly Yellow = Suspect White = Unknown	N/A - No Update	N/A - No timeout
Unknown Threat Code	Diamond with a filled center square. Dashed Range Ring based on Lethal Range (if available)		Red = Hostile Green = Friendly Yellow = Suspect White = Unknown	N/A - No Update	N/A - No timeout
Asterisk under Threat Symbol indicates collocated threats (within three miles) with the same threat code or correlation code.					
Pre-planned threats of the same type will always be displayed, even when they are within three miles.					

Figure 1-156.2. TAD Mission Points/Waypoint Symbology

Description/Notes		Symbol	Color	Expected Update Interval	Timeout Period
Navigation (NAV)	Square frame centered on filled square. Centered on waypoint.		Green, Yellow	Waypoint Type is updated on demand.	N/A - No Timeout
Friendly (FRND)	Circle frame centered on filled square. Centered on waypoint.		Green, Yellow	Same	N/A - No Timeout
Target (TGT)	Equilateral triangle frame centered on filled square. Centered on waypoint with base parallel to bottom of MFCD.		Red, Yellow	Same	N/A - No Timeout
Named Area of Interest (NAI)	Square centered on exclamation point. Centered on waypoint.		Blue, Yellow	Same	N/A - No Timeout

NOTE

- If a Mission Point is designated a steerpoint, the symbol color is yellow.
- The Waypoint Type cannot be changed if the CDU is not available.
- The default Waypoint Type is NAV.



M1 CODE	53	ON
M2 CODE	4545	OFF
MODE C	-	ON
M3A CODE	3399	ON
MS ADDR	01234567	ON
FLTID	A10TEST	-

Figure 1-156.3. COMM Page

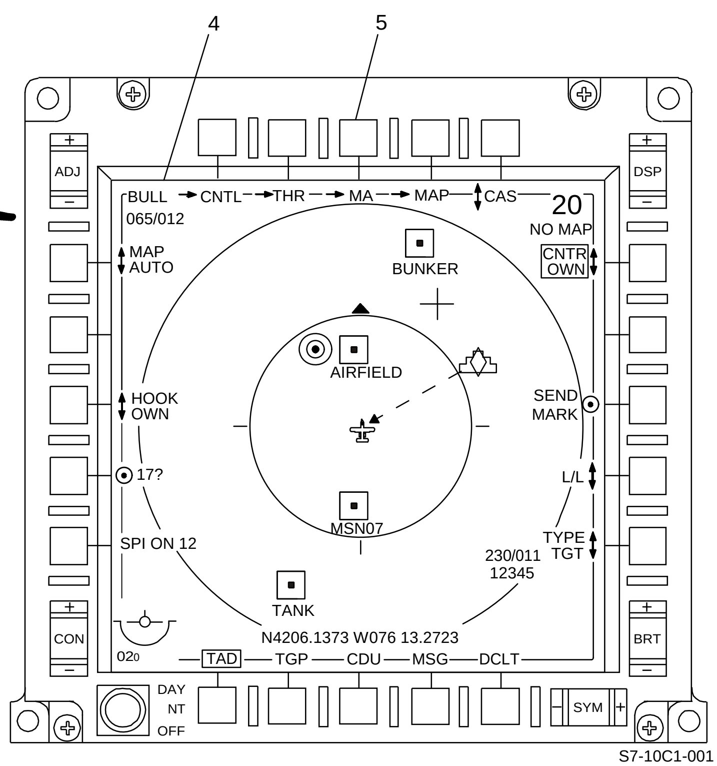


Figure 1-156.4. TAD Page

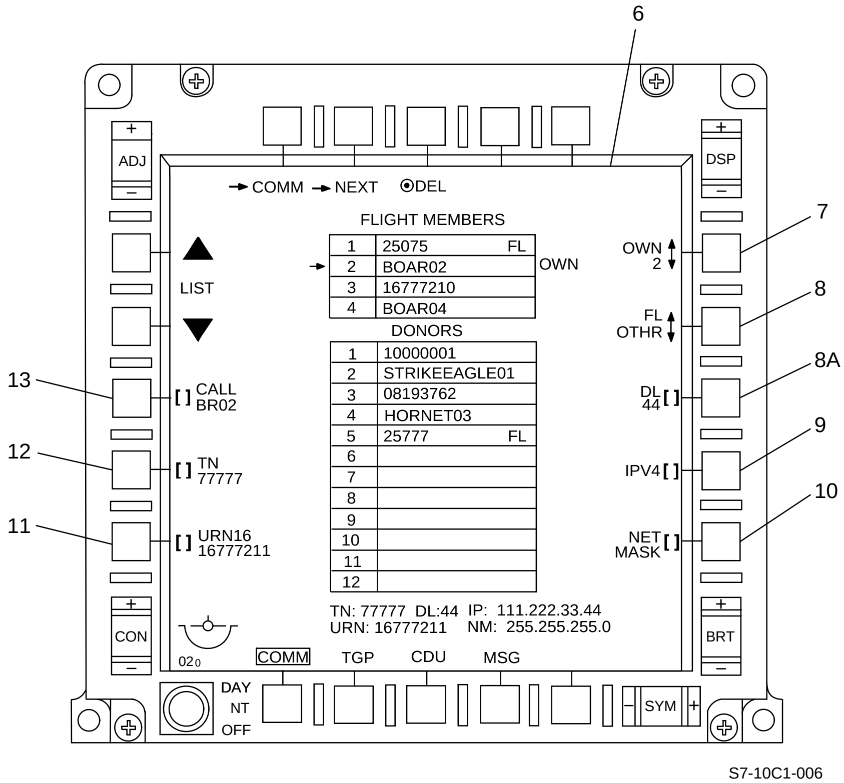


Figure 1-156.5. TDL Configuration Page 1

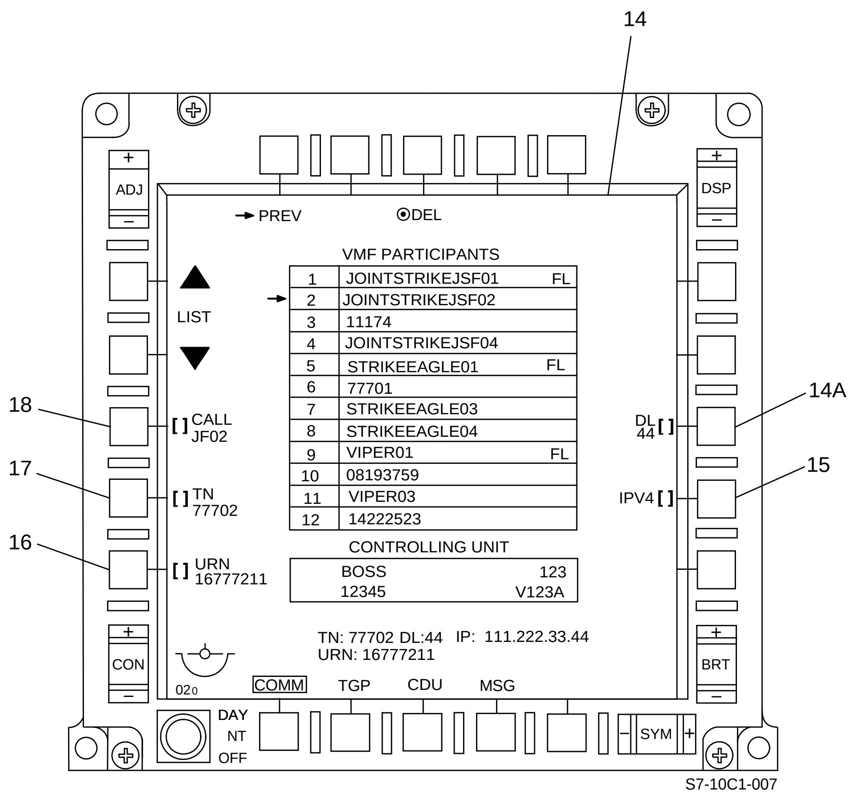
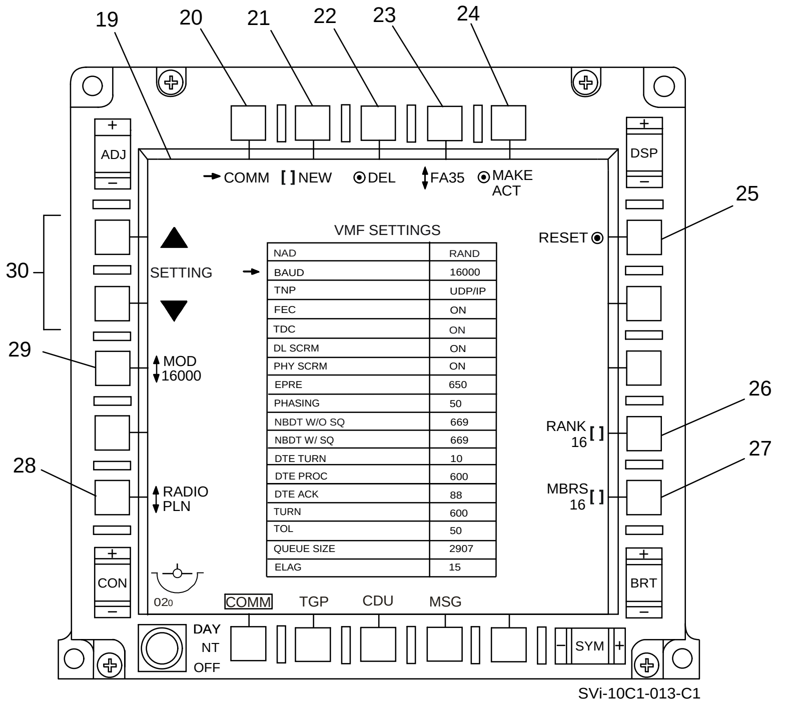
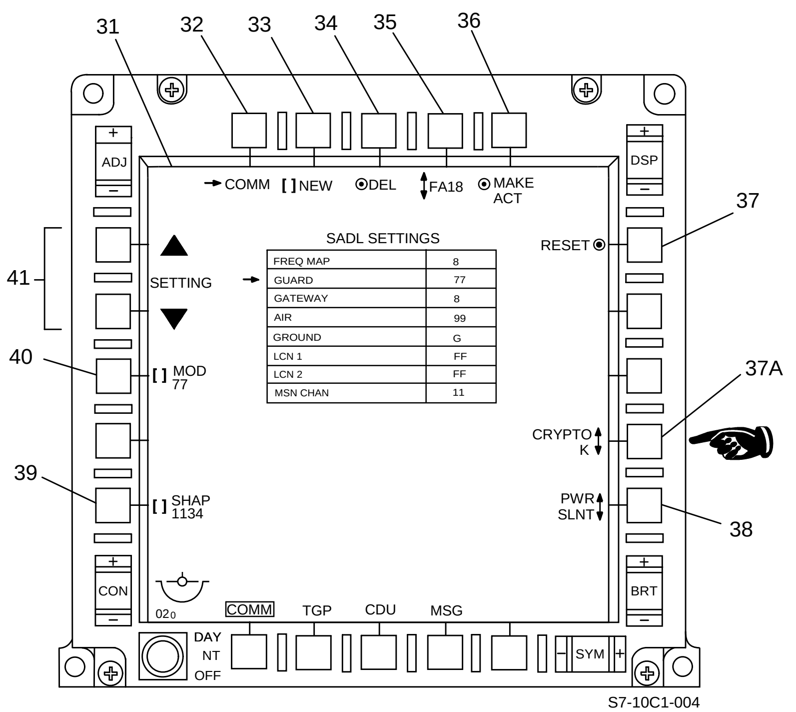


Figure 1-156.6. TDL Configuration Page 2



NAD	RAND
BAUD	16000
TNP	UDP/IP
FEC	ON
TDC	ON
DL SCRM	ON
PHY SCRM	ON
EPRE	650
PHASING	50
NBDT W/O SQ	669
NBDT W/ SQ	669
DTE TURN	10
DTE PROC	600
DTE ACK	88
TURN	600
TOL	50
QUEUE SIZE	2907
ELAG	15

Figure 1-156.7. VMF Profile Settings Page



FREQ MAP	8
GUARD	77
GATEWAY	8
AIR	99
GROUND	G
LCN 1	FF
LCN 2	FF
MSN CHAN	11

Figure 1-156.8. SADL Profile Settings Page

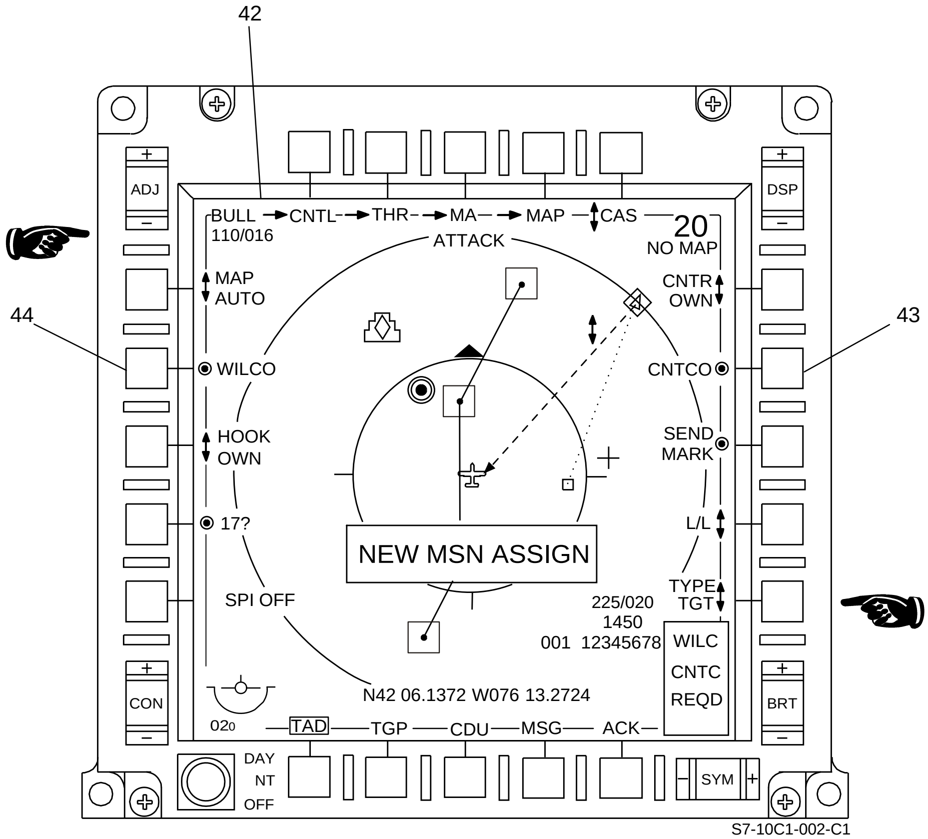


Figure 1-156.9. TAD Page with Pending Mission Assignment

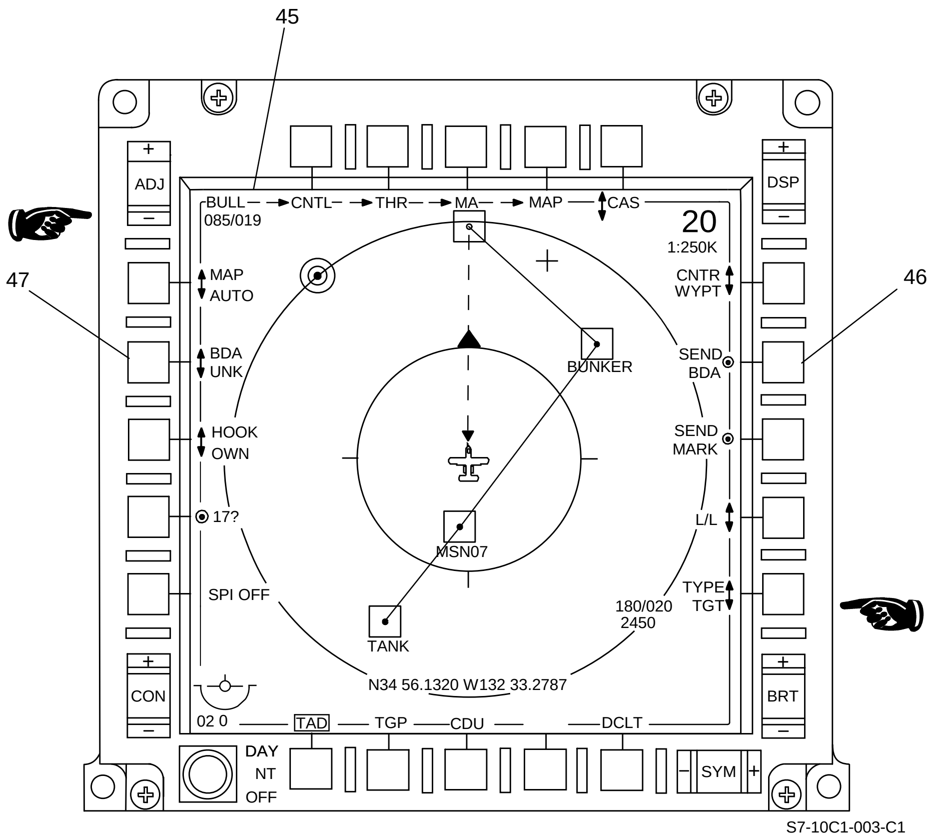


Figure 1-156.10. TAD Page with Message Type Keys

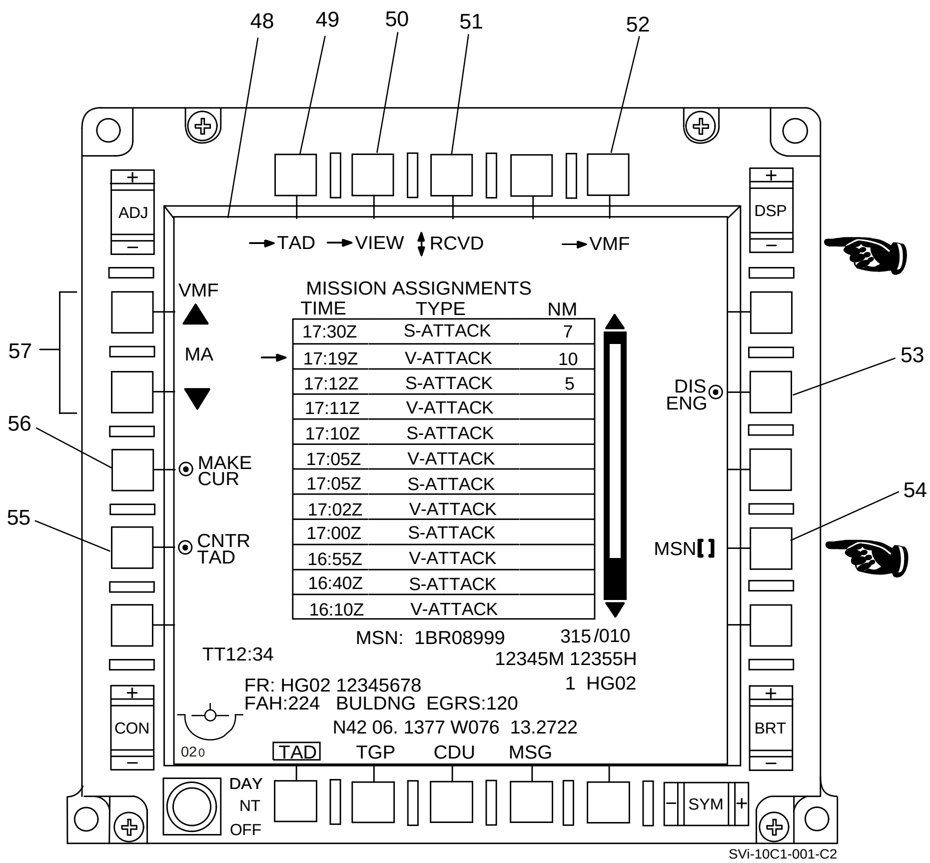


Figure 1-156.11. Mission Assignment Page

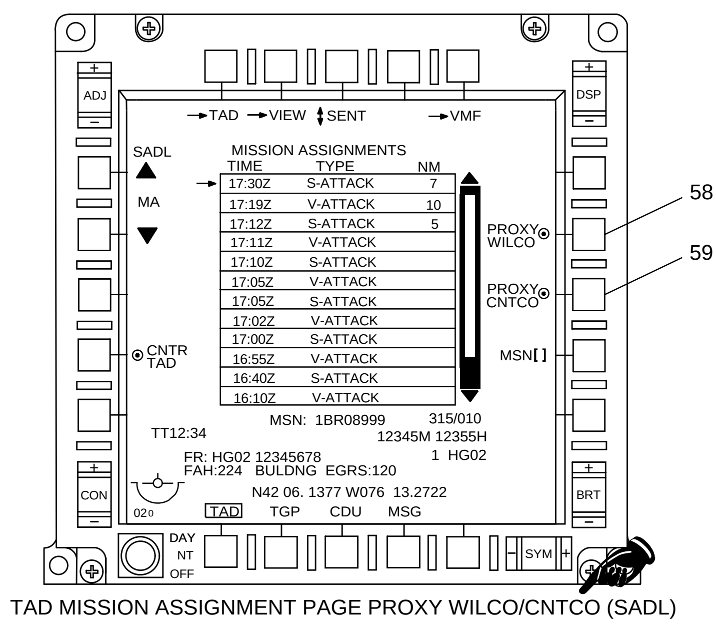


Figure 1-156.12. Mission Assignment Page PROXY WILCO and PROXY CNTCO

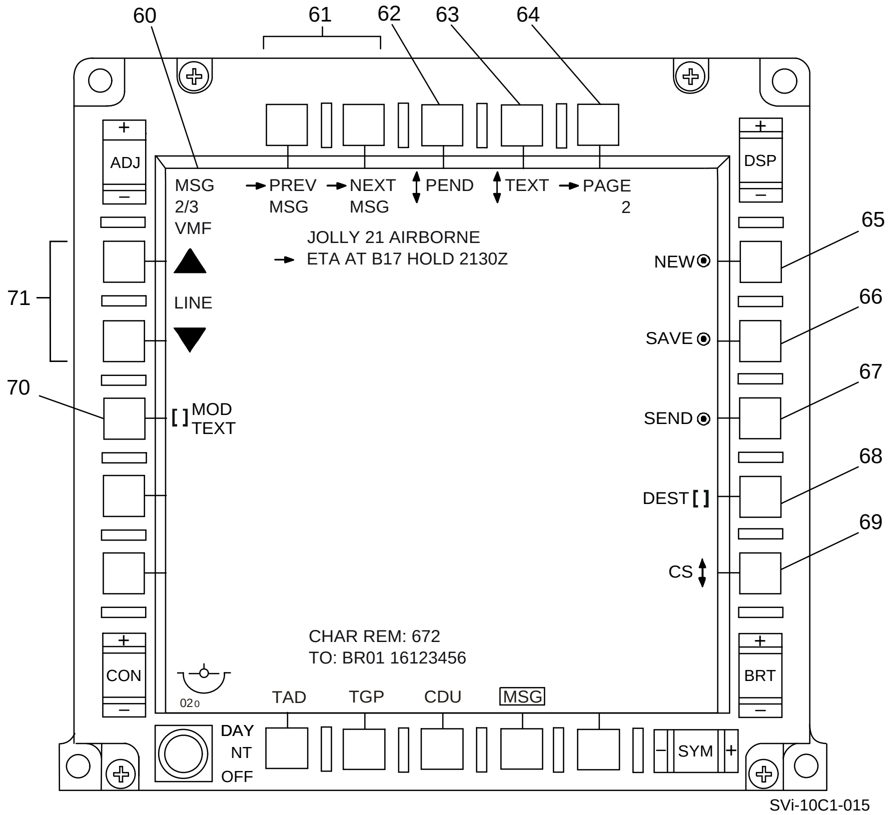


Figure 1-156.13. Message Page (Sample Pending Text Message)

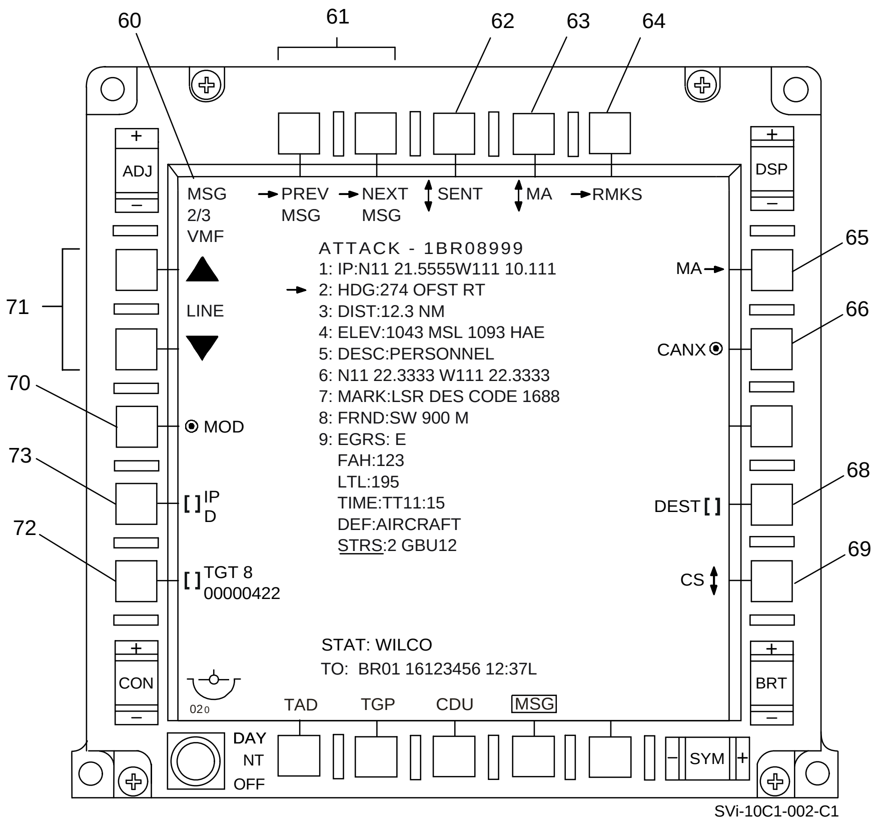


Figure 1-156.14. MA Message View Page (Sample Sent MA Message)

NOTE

- Refer to Figure 1-152.2 for description of VMF MA Message Modify Mode OSB Selections.
- Refer to Figure 1-152.4 and Figure 1-152.6 for description of VMF target types and defenses.
- Refer to Figure 1-152.3 and Figure 1-152.7 for SADL Target Types and Defenses.
- Refer to Figure 1-152.5 for SADL/VMF Target Markings.
- Refer to Figure 1-152.8 for SADL/VMF Required Stores.
- Refer to Figure 1-152.9 and Figure 1-152.10 for VMF Mission Assignment Status priorities.

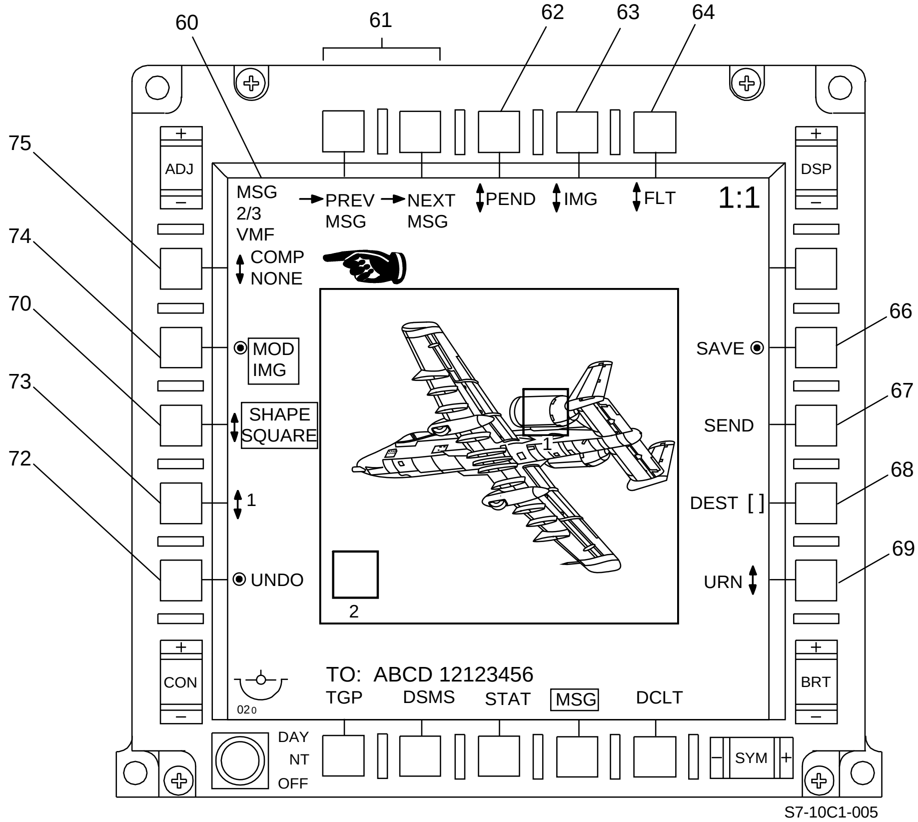


Figure 1-156.15. Message Page (Sample Pending IMG Message)

Index Number	Control or OSB	Function
1	COMM Page	Communication Page.
2	IDM Radio Selection (OSB 20)	Selects radio for data transmission over the IDM (NONE, ARC210, ARC164). Selecting ARC210 will configure ARC-210-1. ARC-210-2 is not an option. Selecting NONE disables IDM data transmission. If ARC-210 is selected and the radio is placed into guard mode (243 or 121.5 MHz) or set to Not Present, or the LRU status becomes NC, the selection will automatically be set to None. If ARC-210 is not selected and the radio is tuned to 243 or 121.5 MHz, not present, the LRU status becomes NC, or running BIT (TEST), ARC-210 is removed as an option.
3	→ TDL (OSB 18)	Access to the TDL Configuration Page 1.
4	TAD Page	Provides a plan-view representation of the current tactical situation.
5	→ MA (OSB 3)	Access to the Mission Assignment page.
6	TDL Configuration Page 1	Provides for entry of Flight Member and Donor information.
7	Ownship Flight Position (OSB 6)	Selects ownship position within flight (1-4). This selection will automatically update the SADL network shape on the SADL Profile Settings Page. **NOTE** OSB disabled for the FLIGHT MEMBERS list if MA is pending, current, or active.
8	Flight Leader Indicator (OSB 7)	Rotary key selects Flight Leader (FL) as either Ownship (OWN) or Other (OTHR).When set to OWN, the Flight Leader Indicator is set to active and the Flight Leader TN is set to ownship TN in the ownship TDL PPLI. When set to OTHR, the Flight Leader Indicator is set to inactive and the Flight Leader TN is set to the lowest-numbered TN within the list of flight members who has the Flight Leader Indicator set in their TDL PPLI. **NOTE** Multiple Flight Members should not have their Flight Leader Indicator set to active. A multiple flight leader note will be displayed if this occurs.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 1 of 16)

Index Number	Control or OSB	Function
8A, 14A	[ ] Data Link Address (OSB 8)	Provides for entry of the TDN DL Address (4-95, and if not ownship, 127), which is used to address VMF messages. Entry of a non-unique DL address is not allowed, except when using 127. **NOTE** OSB disabled for the FLIGHT MEMBERS list if MA is pending, current, or active.
9, 15	[ ] IP Address (OSB 9)	Provides for entry of the TDN Internet Protocol (IP) version 4 Address for the selected member in the list. The IP address is a (maximum) 12-character value aaa.bbb.ccc.ddd, where each group (octet) of characters separated by a period is in the range 0-255. Entry of a non-unique IP address is not allowed, except when using the combination 255.255.255.255/127. **NOTE** OSB disabled for the FLIGHT MEMBERS list if MA is pending, current, or active.
10	[ ] TDN Network Mask (OSB 10)	Provides for entry of the TDN Network Mask. Must be a 12 character value aaabbbcccddd where each group of three characters (octet) is in the range of 0-255. Only available for flight members. **NOTE** OSB disabled for the FLIGHT MEMBERS list if MA is pending, current, or active.
11, 16	[ ] VMF Unit Reference Number (OSB 16)	Provides for entry of the VMF Unit Reference Number (URN) (0-16,777,214), which is used to uniquely identify participants on the VMF and EPLRS ground networks. Entry of value 16777213 is not allowed. Entry of a new URN that currently exists in the flight member, VMF participant, or donor lists is not allowed. **NOTE** • Selection of this OSB with no data in the scratchpad will insert the URN (if defined) from the actively hooked K05.1 friendly symbol to be entered in the selected row. • OSB disabled for the FLIGHT MEMBERS list if MA is pending, current, or active.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 2)

Index Number	Control or OSB	Function
12, 17	[ ] Track Number (OSB 17)	Allows for manual entry of a TN (5 octal digits). If arrow is positioned next to an existing entry, the new TN replaces the previous TN entry on that row. Entry of values 00077, 00177, or 07777 is not allowed. Entry of a new TN that currently exists in the flight member, VMF participant, or donor lists is not allowed. **NOTE** • Selection of this OSB with no data in the scratchpad will insert the Track Number and 4-character Call Sign (if defined) from the actively hooked symbol to be entered in the selected row. • OSB disabled for the FLIGHT MEMBERS list if MA is pending, current, or active.
13, 18	[ ] Voice Call Sign (OSB 18)	Allows for manual entry of the voice call sign (17 alphanumeric characters) for transmission in the PPLI message. Will display the converted 4-character voice call sign on the OSB. Entry of a new 17-character VCS that currently exists in the flight member, VMF participant, or donor lists is not allowed. **NOTE** • Selection of this OSB with no data in the scratchpad will insert the Track Number and 4-character Call Sign (if defined) from the actively hooked symbol to be entered in the selected row. • OSB disabled for the FLIGHT MEMBERS list if MA is pending, current, or active.
14	TDL Configuration Page 2	Provides for entry of VMF Participant information
19	VMF Profile Settings Page	Provides the ability to create, modify, activate, or delete VMF profiles.
20	→ COMM	Returns to the COMM Page.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 3)

Index Number	Control or OSB	Function
21	[ ] VMF Profile New (OSB 2)	Creates a new profile or renames the current profile based on the scratchpad entry. Profile names are up to four characters, and can be a combination of both letters and numbers. If the default (DFLT) profile is selected and up to four characters are entered into the scratchpad, pressing NEW will create a new profile with the entered name. If a profile other than DFLT is selected, entering up to four characters in the scratchpad and pressing NEW will change the name of that profile.
22	VMF Profile Delete/Save (OSB 3)	Deletes the current profile or saves the current profile if changes have been made. SAVE is available after modifying a name or setting on an existing non-DFLT profile, otherwise DEL is displayed. If any change has been entered, SAVE will flash in green reverse video indicating that the profile needs to be saved. Exiting the VMF Profile Settings Page prior to pressing SAVE will cause any changes made to be lost. The default profile cannot be modified, if a parameter is changed for the DFLT profile without creating a new profile the SAVE OSB will flash in yellow reverse video indicating a new profile must be created first. When DEL is pressed, the message "PRESS DEL AGAIN TO CONFIRM DELETION" is displayed in reverse video on the bottom center of the screen. DEL must be pressed a second time within 3 seconds to perform the deletion. The default profile cannot be deleted.
23	↕ VMF Profile Select (OSB 4)	Selects the current profile to be displayed in the VMF Settings Table. **NOTE** If the Make Active OSB (OSB 5) is enabled, the displayed profile is not currently active.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 4)

Index Number	Control or OSB	Function
24	VMF Make Active (OSB 5)	Makes the current profile the active profile and loads the settings into the IDM. **NOTE** • If there is a mismatch between a setting and what is loaded into IDM that setting will be displayed in yellow reverse video, a note (CHCK TDL CNFG) is displayed on the TAD and an IDM fault is logged. • OSB is disabled if the active profile settings are displayed in the settings table.
25	VMF Profile Reset (OSB 6)	Resets the current profile to the settings in the default (DFLT) profile. When RESET is pressed, the message "PRESS RESET AGAIN TO CONFIRM RESET" is displayed in reverse video on the bottom center of the screen. RESET must be pressed a second time within 3 seconds to perform the reset.
26	[ ] TDN Station Rank (OSB 9)	Provides for entry of the ownship station rank (1-16) in the TDN.
27	[ ] Number of TDN Members (OSB 10)	Provides for entry of the number of members (2-16) in the TDN.
28	↕ Radio Mode (OSB 16)	Toggles the settings displayed in the VMF Settings Table between plain and cipher and is used to view or modify plain or cipher portions of the profile.
29	↕ or [ ] VMF Profile Modify (OSB 18)	Modifies the selected setting in the current profile. May be rotary or data entry OSB, depending on the selected setting. Modified settings are displayed in yellow reverse video if there is a mismatch between the setting the CICU set the IDM to versus the actual IDM setting.
30	Setting Selection (OSBs 19 and 20)	Navigation OSBs used to move the selection arrow up or down the VMF Settings Table.
31	SADL Profile Settings Page	Provides the ability to create, modify, activate, or delete SADL profiles.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 5)

Index Number	Control or OSB	Function
32	→ COMM	Returns to the COMM Page
33	[ ] SADL Profile New (OSB 2)	Creates a new profile or renames the current profile based on the CDU scratchpad entry
34	SADL Profile Delete/Save (OSB 3)	Deletes the current profile or save the current profile if changes have been made.
35	↕ SADL Profile Select (OSB 4)	Selects the current profile to be displayed in the SADL Settings Table.
36	SADL Make Active (OSB 5)	Makes the current profile the active profile.
37	SADL Profile Reset (OSB 6)	Resets the current profile to the settings in the default profile.
37A	Crypto Setting (OSB 9)	SADL Firmware version 11Z allows selection of cryptographic algorithm. Rotary options are limited to the algorithm(s) loaded in the radio. **NOTE** ● This OSB will be removed if the radio is pre-11Z, or if no algorithms are loaded. ● This OSB will not be selectable if only one algorithm is loaded. ● This rotary selects a type of algorithm, not a particular key. The selection of the even and odd keys (if both are loaded) is performed automatically by the radio when joining the network. ● An algorithm may take a few minutes to load. During loading, the radio will not transmit or receive data, and System Status Page 3 will report the EPLRS LRU as being in INIT mode.
38	Power Level (OSB 10)	Selects EPLRS/SADL power level. Choices are 0.4, 3, 20, 100, and SLNT (Silent/Passive Mode) (numeric values are in watts). SLNT is the default selection.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 6)

Index Number	Control or OSB	Function
39	Network Shape (OSB 16)	Provides for entry of aircraft position within own flight/network (2-digit value 11-14, 21-24, 31-34, or 41-43) followed by overall network shape (12-14, 21-24, 31-34, or 41-44). Aircraft Position: Digit 1 (Flight Number): The current ownship flight number 1-4 in a maximum group of 16. Digit 2 (Flight Position): The current ownship position 1-4 within the current flight. Network Shape: Digit 3 (Number of Flights): Number of flights 1-4 (with up to 4 members each) in the network. Digit 4 (Number of Aircraft per Flight): Number of aircraft 1-4 in each flight of the network. Restrictions: Digit 3 (Number of Flights) must be greater than or equal to Digit 1 (Flight Number). Digit 4 (Number of Aircraft per Flight) must be greater than or equal to Digit 2 (Flight Position). Digit 3 and Digit 4 cannot both be 1.
40	SADL Profile Modify (OSB 18)	Depending on parameter selected either a data entry or rotary OSB to enter configuration data or select a configuration parameter. Modified settings are displayed in yellow reverse video until saved (OSB 3).
41	Setting Selection (OSBs 19 and 20)	Navigation OSBs used to move the selection arrow up or down the SADL Settings Table.
42	TAD Page with Pending Mission Assignment	When a new (pending) MA is assigned, the addressed recipient of the MA (normally the flight lead) is prompted to respond with WILCO or CNTCO to the controlling unit (CU).
43	CNTCO (OSB 7)	Provides selection of Cannot Comply (CNTCO) for the oldest pending received Mission Assignment.
44	WILCO (OSB 19)	Provides selection of Will Comply (WILCO) for the oldest pending received Mission Assignment.
45	TAD Page with Battle Damage Assessment (BDA) keys	Provides option to send BDA for hooked symbol over TDL.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 7)

Index Number	Control or OSB	Function
46	Send Message (OSB 7)	Provides option to send SADL or VMF Battle Damage Assessment (BDA) for the hooked symbol. Transmits the BDA type selected on OSB 19. Provides option to send DIP report for a hooked received VMF 9-Line. Selecting DIP at OSB 19 enables operator to SEND DIP to the VMF 9-Line originator. Selecting BDA at OSB 19 enables operator to send BDA to the SADL or VMF 9-Line originator/destination. **NOTE** If there is a pending MA that requires receipt compliance, this OSB will display CNTCO.
47	Message Type (OSB 19)	SADL: provides for selection of BDA type (TGT DSTR/PART DSTR for airborne targets or BDA UNK/TGT DSTR/PART DSTR/RE-ATCK for ground targets) for transmission for the hooked symbol. VMF: provides for selection of BDA type (TGT DSTR / PART DSTR/NO EFCT/BDA UNK) for transmission for a hooked VMF 9-Line. VMF: provides for selection of DIP for transmission for a hooked received VMF 9-Line. System defaults to DIP when a received VMF 9-Line is hooked. **NOTE** If there is a pending MA that requires receipt compliance, this OSB will display WILCO.
48	Mission Assignment Page	Provides a view of active MA information and the ability to disengage from an active MA.
49	→ TAD (OSB 1)	Returns to the TAD page.
50	→ View (OSB 2)	Display the associated Received or Transmitted message record on the message page.
51	↕ Message Type (OSB 3)	Rotary key selects either Transmitted (SENT), or Received (RCVD) message types for display. Defaults to RCVD on first display. When re-displayed, will default to the last known selection.
52	VMF (OSB 5)	Access to the VMF Mission page

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 8)

Index Number	Control or OSB	Function
53	⊙ Disengage/Cancel (OSB 7)	Only available if the selected MA is active. For RCVD MA: OSB is set to DIS ENG. Removes the MA from the list of active MAs, after confirmation (If selected by the addressed recipient of the MA disengagement status will be transmitted). For SENT MA: OSB is set to CANX. Transmits the appropriate "cancellation" order for the selected MA. Removes the MA from the list of active MAs, after a WILCO for the sent cancellation is received. **NOTE** No disengaging or cancellation message will be sent for MA orders received on the TDN. To communicate a disengage or cancel for a TDN MA order, use voice communication.
54	[ ] Mission Number (OSB 9)	Data entry for TDN Mission Number. This entry will populate the mission number field in VMF mission assignments that are originated by ownship. Valid Mission Number includes at least 1 to up to 8 characters of the following character set: A-Z 0-9 -? ( ) , .
55	⊙ Center TAD (OSB 17)	Centers TAD display onto MA objective location. Only available if the selected MA is active or pending.
56	⊙ Make Current (OSB 18)	Makes the MA selected using OSBs 19 and 20 the current MA. Only available if the selected MA is active. Only available for received MAs.
57	▲ ▼MA Select (OSBs 19 and 20)	Allows selection of any of the displayed MAs.
58	PROXY WILCO (OSB 7)	Only available for pending (transmitted) MAs. Allows sender of an MA to select Will Comply (WILCO) for the addressee at any time until a response is received by addressee. Allows sender to act as a proxy for an addressee that chooses to respond by voice or other means.
59	PROXY CNTCO (OSB 8)	Only available for pending (transmitted) MAs. Allows sender of an MA to select Can Not Comply (CNTCO) for the addressee at any time until a response is received by addressee. Allows the sender to act as a proxy for an addressee that chooses to respond by voice or other means.
60	Message Page	The message (MSG) page allows viewing of received and transmitted, text messages, image messages, and Mission Assignment (MA) messages. In addition, the MSG page provides an interface to manage and edit received and transmitted messages or create draft (pending) messages that can be transmitted to other flights of aircraft or Data Link/network members.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 9)

Index Number	Control or OSB	Function
61	→ Message Select (OSBs 1 and 2)	OSBs 1 & 2 are page branch OSBs that allow the pilot to navigate through the stored messages, as limited by Message Type (OSB 3) and Format (OSB 4). OSB 1 changes the display to the previous message and OSB 2 changes the display to the next message. Selecting OSB 1 when already on message #1 will select the last (oldest) message, or be ignored if less than 2 message records are stored. Selecting OSB 2 when on the last message will select the first (newest) message, or be ignored if less than 2 message records are stored. In a display field to the left of OSB 1 is the text "MSG XXX/YYY", where XXX is the currently displayed message and YYY is the total number of stored messages as limited by Message Type (OSB 3) and Format (OSB 4). Note that XXX is set to "P" if on a Pending Message Record that has never been saved. Resets to the most recent Received message record upon opening the Message Page, or to the most recent Transmitted message record if there are no Received message records (may not be message #1).
62	↕ Message Type (OSB 3)	Rotary key selects one of the following: • Pending (PEND) for draft messages pending future transmission • Pre-canned (PRE) for uploaded text, MA, or image messages that may be edited • Transmitted (SENT) • Received (RCVD) message types for display. Upon initial selection of the MSG Page for display (either due to selection of the MSG Page OSB, or MSG Quick-Look via HOTAS), OSB is set to the last viewed message.
63	↕ Format (OSB 4)	Rotary key selects TEXT, MA, or IMG formats for display. Along with Message Type (OSB 3), limits the message records selectable for display using the Message Select keys. Upon initial selection of the MSG Page for display (either due to selection of the MSG Page OSB, or MSG Quick-Look via HOTAS), always set to the most recent message format of the selected Message Type (per OSB 3).

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 10)

Index Number	Control or OSB	Function
64	→ Page Select (OSB 5) (VMF)	Selection will toggle between Page 1 and Page 2 of a message. Resets to the first page upon opening the Message Page, and whenever a different message record is displayed.
	↕ Image Packet Size (OSB 5) (VMF)	Rotary key selects FLT (default) or GND formats for display. If FLT is selected the image data is 3072 Bytes per K04.17 transmission. If GND is selected the image data is 1280 Bytes per K04.17 transmission. Only available if Format (OSB 4) is IMG and Message Type (OSB 3) is PEND or SENT.
	Image Transfer Protocol (OSB 5) (SADL)	Rotary OSB selects either ONE WAY or TWO WAY protocol for image transfer. With One-Way protocol the receiving radio is silent - there is no acknowledgement of message receipt or message status. One-Way protocol can be used for broadcast (address 00177). With Two-Way protocol the receiving radio acknowledges receipt of all message packets. Missed packets are automatically re-sent without operator action to assure the entire image was transferred. Two-Way protocol can transfer to one receiver only. **NOTE** Two-way protocol SADL Image file transfer will be terminated if the Image Receiver does not receive the message from the Image Sender within 12 seconds. File packets received from an incomplete message will be discarded. Only available if Format (OSB 4) is IMG and Message Type (OSB 3) is PEND or SENT.
65	⊙ NEW (OSB 6) [SCR 1608]	Creates a new blank unsaved Pending message record with format as selected on OSB 4. Only displayed when Message Type OSB 3 is PEND. Not available when Message Format OSB 4 is IMG.
	→ MA (OSB 6) [SCR 1608]	Access the Mission Assignment Page. Only available if Format OSB 4 is MA. Only displayed when Message Type OSB 3 is RCVD/SENT.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 11)

Index Number	Control or OSB	Function
66	Disengage/Cancel (OSB 7)	Only available if the selected MA is active. For RCVD MA: OSB displays DIS ENG. Transmits the appropriate "disengaging" status for the selected MA. Makes MA inactive after confirmation. For SENT MA: OSB displays CANX. Transmits the appropriate "cancellation" order for the selected MA. Makes MA inactive after a WILCO for the sent cancellation is received. **NOTE** No disengaging or cancellation message will be sent for MA orders received on the TDN. To communicate a disengage or cancel for a TDN MA order, use voice communication.
	Save Record (OSB 7)	Only available on a Pending message record. Even on a Pending message record, not available unless the message record is unsaved or changes have been made since last saved.
	Delete Record (OSB 7)	Deletes the displayed message record, regardless of type after pilot confirmation. OSB is available if and only if the Save Record key is not available. Key is also not available on a Received MA Message record unless that MA is inactive.
67	SEND (OSB 8)	Transmits the displayed message (all pages) to the destination group/destination selected on OSB 9/10, along with any required target/objective/IP locations and mission assignment messages. A new Transmitted message record is created and displayed, and Message Type (OSB 3) is changed to SENT in order to automatically display this new record. Not available on MA format messages unless a valid target location is selected. Not available on a MA, TEXT, or IMG message if a previously sent message in any of the MA, TEXT, or IMG formats is still in the process of being transmitted to the same addressee.
	ADD (OSB 8)	Selection of this OSB will add the originators addressing information (either Track Number for SADL messages or Unit Reference Number, IPv4, and DL Address for VMF messages) to the donor or VMF participant list if already present. Only displayed and enabled on the RCVD Text Message page and the RCVD MA Message page.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 12)

Index Number	Control or OSB	Function
68	[ ] Destination (OSB 9)	Provides for entry of destination TN (5 digit number with each digit having a range of 0-7), URN (8 digit number in the range of 00000000-16777215), or Call Sign (4 digit alphanumeric with each digit having a range of A-Z, 0-9, or Space). The CICU software will search the Flight Member, Donor, or VMF Participant lists for the remaining destination information (TN, URN, or Call Sign) that corresponds to the entered destination and will store this information as part of the destination. In addition, if a match is not found in these lists, the CICU software will use the PPLI database to find and store the remaining destination information (TN or Call Sign only) if the corresponding TN or Call Sign is entered as the destination. **NOTE** ● The selections on OSB 9 and OSB 10 determine which network a pending message will be sent. See Figure 1-156.18 for a description of the destination based on the selections at OSB 9 and OSB 10. ● The following are not allowable destination values: 1) Track Number: 00077, 07777, 00000, 00177 (MA Only), and Ownship Track Number; 2) Unit Reference Number: 16777213, 16777215 (MA and IMG Only), and Ownship Unit Reference Number; 3) Call Sign: Four Spaces and Ownship Call Sign. In addition to manual entry of TN, URN, or Call Sign; the default TN can be changed by hooking a PPLI, and then selecting OSB 9 with nothing entered in the scratchpad. The CICU software will search the Flight Member, Donor, or VMF Participant lists for the associated URN and Call Sign that corresponds to the default TN and will store this information as part of the destination. Defaults as follows based on a hooked PPLI with an empty scratchpad: • Flight Leader CS/TN of the hooked PPLI • Otherwise, the source CS/TN of the hooked PPLI creates a new unsaved Pending message record if changed on a Received or Transmitted message record.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 13)

Index Number	Control or OSB	Function
69	↕ Destination Group (OSB 10)	Rotary key selects between TN, SADL (collective TN for TEXT and Image messages), URN (individual URN), VMF (collective URN for TEXT messages only), or CS (individual voice call sign). For use in conjunction with the Destination key (OSB 9). Automatically changed based on the manually entered destination using OSB 9. **NOTE** The selections on OSB 9 and OSB 10 determine which network a pending message will be sent.
70	↕ Shape (OSB 18)	Rotary OSB selects between Square, Circle, and Triangle. Not available unless Modify state is ON. Only available if Format (OSB 4) is IMG.
	[ ] Modify (OSB 18)	For TEXT messages: OSB is used to enter new alphanumeric text for the line selected on OSBs 19 & 20. Selection of this key will overwrite the entire line selected on plain text format messages. Modify (OSB 18)
	⊙ Modify (OSB 18)	For MA messages: OSB is used to transition the page to modify mode for the selected line where digital data is entered for the selected line. Only available when the MA Type is ATTACK. Creates a new unsaved Pending message record if on a Received or Transmitted message record.
71	▲▼ Line Select (OSBs 19 and 20)	Allows for selection of the line desired for text or value modification, using the arrow to the left of the field. For TEXT messages: Only selects lines where text is already entered, and the first available line below that text (arrow automatically resets to top line if out of that range).

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 14)

Index Number	Control or OSB	Function
72	[ ] TGT Location (OSB 16)	Provides for entry of the target location in terms of a 5 digit TN (for a Surface/Land Track, Land Point) (must include any leading zeroes), CDU waypoint number (0-2050), or CDU mark point (A-Z). Only available if Format (OSB 4) is MA. The entered value is displayed below the letters "TGT" in green once verified as valid (valid Surface/Land Track, Land Point, or CDU location with Index Number available/assigned), in red if confirmed as invalid. In addition to manual entry of location, the pilot can select a target location by hooking a Surface/Land Track (TN), Land Point (TN), SPI symbol, TGP symbol, CDU mark or steer point (IN) symbol, or TDN MA symbol (EISN/URN) and then selecting OSB 16 with nothing entered in the scratchpad. Blank until entry made. Creates an unsaved Pending message record with existing format and text retained if selected on a Received or Transmitted message record.
	[ ] UNDO (OSB 16)	Removes the annotation specified by OSB Annotation. Not available unless Modify state is ON. Only available if Format (OSB 4) is IMG.
73	↕ Annotation (OSB 17)	Rotary OSB selects between 1-10 (limited to the number of actual shapes dropped) and ALL. Upon selection of OSB Undo, the respective annotation(s) will be removed for the image. Not available unless Modify state is ON. Only available if Format (OSB 4) is IMG.
	↕ CROP (OSB 17)	Rotary OSB controls the crop mode of the image. Only available for PEND images when compression is set to NONE.
	[ ] IP Location (OSB 17)	Provides for entry of Initial Point (IP) location in terms of a 5 digit TN (must include any leading zeroes) for a Land Point, CDU waypoint number (0 2050), or CDU mark point (A Z). Only available if Format (OSB 4) is MA. The entered value is displayed below the letters "IP" in green once verified as valid (valid Land Point TN or CDU location, and not same location as TGT Location), or in red if confirmed as invalid. In addition to manual entry of location, the pilot can select an IP location by hooking a Land Point (TN), or CDU mark or steer point (IN) symbol and then selecting OSB 17 with nothing entered in the scratchpad. Blank until entry made. Creates an unsaved Pending message record with existing format and text retained if selected on a Received or Transmitted message record.

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 15)

Index Number	Control or OSB	Function
N/A	[ ] Digital MA Data Entry (OSB 17, OSB 19-20)	After a transition to modify mode for MA messages, OSB 17, OSB 19-20 are transitioned for digital data entry depending on the line selected.
74	⊙ Modify (OSB 19)	For IMG messages: OSB is used to transition the page to modify mode. The OSB Shape, Annotation, Undo and MSG Cursor will be displayed for image annotation. Selection of this OSB again will turn off the modify mode. (See Image (IMG) Message Format) Creates a new unsaved Pending message record if on a Received or Transmitted message record.
75	↕ Compress (OSB 20)	Rotary OSB selects the EagleEye™ compression of Low, Medium, or High.
	FWD (OSB 20)	FWD is only an option when forwarding messages. This option will appear when a destination has been modified for a received message. It will be removed when any other change has been made or if the received image was transmitted uncompressed (not possible from another A-10C).

Figure 1-156.16. TDL/TDN MFCD Controls and Indicators (Sheet 16)

IMPROVED DATA MODEM (IDM) DIGITAL DATA COMMUNICATIONS 515 .

The IDM interfaces with the front ARC-210 in secure and plain modes and with the ARC-164 via the KY-58 encryption device in secure mode. When the ARC-164 radio is selected as the RT for use with IDM, the Time Delay switch on the Secure COMM (KY-58) Control Panel should be set to DELAY to improve the KY-58s ability to synchronize and process secure VMF data. The IDM converts VMF digital data to RF data in order to be transmitted on the Tactical Data Network via the two RT Radios. Additionally, the IDM converts received RF data from the Tactical Data Network into VMF digital data and sends to the CICU to be processed.

By powering on the CICU, the IDM will be powered on as well. Additional power control of the IDM is provided on the System Status Page 3, as displayed on the Multi-Function Color Displays (MFCDs).

The Avionics Relay Box provides a monitoring signal (KEYMON) to the IDM indicating activation of the voice MIC switch for the UHF radio or selection of CRAD2 on the Secure COMM Control Panel. This provides an interface to allow the modem to recognize the presence of voice transmission and to cease output until voice activity is completed.

Control of the IDM is facilitated through the UFC and the MFCDs. The RT selected for data transmission is controlled by either the UFC IDM RT selection button or by OSB 20 on the COMM Page. When the IDM RT is selected by the UFC the selection is displayed in the upper left corner of the HUD below the ARC-210 Configuration data and displays the RT selected for IDM data transmission. Possible displays are IDM/210 for ARC-210-1, IDM/164 for ARC-164, or IDM/NONE if neither RT is configured for data transmission. Display is temporary (5 seconds duration) after pressing the IDM RT selection button unless the IDM RT selection button is held on the UFC for greater than 1 second.

The TDL Configuration Page provides the ability to add and modify addressing information for each VMF Participant on the network. An important factor affecting IDM system performance is VMF interoperability between all communicating platforms on a network. To ensure reliable data communication; it is critical that each platform is configured with the same network parameters. These parameters are dependent on other participating in the network and may require configuration. VMF profiles provide the capability to define and modify these network parameters. The VMF Profile Settings Page (see Figure 1-156.7), accessed by selecting OSB 1 from the COMM Page, provides the capability to create, modify, delete and activate VMF profiles. All available profiles can be activated directly from the COMM Page by selecting VMF Active Profile Selection OSB 2. Profiles can also be created in the A/W/E and loaded through the MDTC. Up to nine editable profiles and one static default profile can exist.

If a new profile is created when nine profiles exist, a VMF PROF FULL note will be displayed on the TAD. A profile would need to be deleted before a new profile can be created.

The VMF Profiles Settings Page also provides the ability to change the IDM station rank and number of participants via OSBs 9 and 10 respectively. Every VMF configuration parameter exists twice within each VMF profile - one setting for a radio configured for plain text and one setting for a radio configured for cipher text. The settings used to configure the radio are automatically selected based on the radio mode (plain or cipher). When ARC-210 is the RT selected for data transmission and is in cipher mode, secure settings are automatically loaded into IDM. If ARC-210 is the selected RT for data transmission and is in plain mode, plain settings are automatically loaded into IDM. Whenever the ARC- 164 is selected for data transmission, secure settings are automatically loaded into the IDM. OSB 16 on the VMF Profile Settings Page provides the capability to view or modify the plain or cipher portions of the profile.

The TDL Configuration can be modified from the TDL Configuration Pages (OSB 18 on the COMM Page). Though most of these items are set to their proper values by the A/W/E, there could be a need to modify these during flight.

TDN COMMAND AND CONTROL.

The TDN (VMF) systems provide enhanced command and control capabilities by processing the following information:

- Reception of Text Messages addressed to own flight and the collective address
- Transmission of Text Messages to own flight, other flights, and the collective address
- Reception of Mission Assignment (MA) Messages addressed to own flight
- Transmission of Mission Assignment (MA) Messages as part of the Attack 9-Line format
- Reception of Image (IMG) Messages addressed to own flight and the collective address.
- Transmission of Image (IMG) Messages to own flight, other air or ground network participants, and the collective address.

Figure 1-156.17. K-Series Message Processing

MSG	TITLE/DESCRIPTION	TRANS/REC
K011	FREE TEXT	T/R
K02.28	BDA	T/R
K02.33	CAS	T/R
K02.34	AOS	T/R
K02.35	DIP	T/R
K02.57	APTD	T/R
K02.59	APTD RQST	T/R
K04.17	IMAGE	T/R
K05.1	FRIENDLY POSITION REPORT	R

The TDN (VMF) enhances Mission Assignment and Text Message capabilities provided by the TDL (SADL) by allowing these messages to be sent and received on the TDN using the IDM. Where possible, processing and displays for messages sent and received on either network will be processed identically to avoid confusion and reduce workload.

Figure 1-156.18 describes the destination and network for a pending message based on the MSG page OSB 9 and OSB 10 entries.

Figure 1-156.18. Message Destination Descriptions

Format (OSB 4)	Group (OSB 10)	Data Entered for Destination (OSB 9)	Network	Description
TEXT MA	TN	12345	SADL	Direct Track Number Addressing. Must be 5 characters of a valid TN.
TEXT	SADL	00177	SADL	Collective TDL Addressing.
TEXT MA IMG	URN	01234567	VMF	Direct Unit Reference Number Addressing. Must be 8 numbers of a valid URN.
TEXT	VMF	16777215	VMF	Collective URN Addressing.
TEXT MA IMG	CS	AB01	VMF SADL	Direct Call Sign Addressing. Must be 4 characters that maps to a call sign in the Flight Member, Donor, VMF Participant lists, or the PPLI database. If the associated Call Sign has a valid URN and TN, then the default interface will be SADL.

NOTE

- The Destination OSB (OSB 9) is a data entry OSB for operator entry of addressing data. Data entered must be in the format and character length specified in this table. All associated destination information will be displayed on the "TO:" line at the bottom of the message page.
- The Call Sign entered in the Flight Member, Donor, and VMF Participant lists can be up to 17 characters. Every Call Sign with more than 4 characters is converted into a 4 character Call Sign and displayed on TDL Configuration Page (1-2). Only 4 character Call Signs are allowed for entry.
- If a Call Sign is entered for the destination, the matching entry in the Flight Member, Donor, VMF Participant list, or PPLI database, should have a valid TN or URN; 1) If a Call Sign is entered but the values for both associated TN and URN are not defined, the Send OSB (OSB 8) will be disabled.; 2) If a Call Sign is entered that has an associated TN and URN equivalent to Ownship information, the Destination OSB (OSB 9) will be highlighted in red, the Ownship URN/ TN displayed on the "TO" line will be highlighted in red, and the Send OSB (OSB 8) will be disabled.
- For both TEXT and MA messages: If a Call Sign is entered for the destination, and the matching entry in the Flight Member, Donor, or VMF Participant list has both a URN and TN, the network will indicate SADL.

TAD VMF MISSION PAGE.

The TAD VMF Mission Page (accessed via OSB 5 from the TAD MA Page) tabulates transmitted and received digital VMF Close Air Support (CAS) messages based on the selected message type.

Message types displayed on the VMF Mission Page are:

- Aircrew Briefing (9-Line) - broadcast from the controlling agency to the flight containing mission assignments.
- Depart Initial Point (DIP) - indicates to the controlling agency that the flight is departing the initial point.
- Aircraft On Station (AOS) - indicates to the controlling agency that the flight has arrived on station.
- Aircraft Position and Target Designation (APTD) - Indicates current aircraft position, SPI, ground speed/track, and selected ordnance; can be unsolicited or in response to an APTD RQST.
- Aircraft Position and Target Designation Request (APTD RQST) - requests single or multiple close air support aircraft attack position and target designation reporting messages.
- Battle Damage Assessment (BDA) - is broadcast to report a battle damage assessment

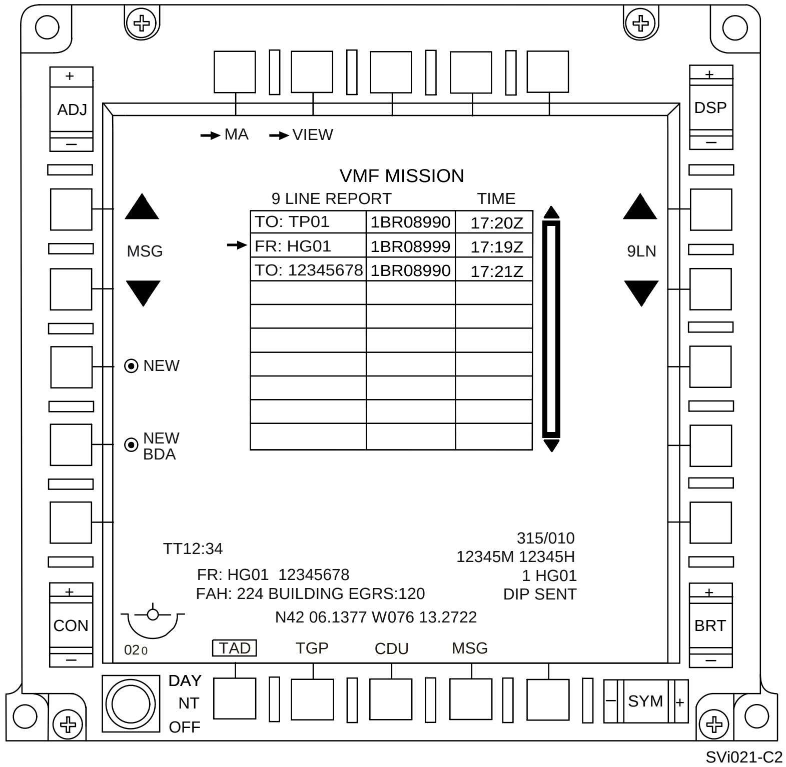
Message type (9-Line, AOS, DIP, APTD, APTD RQST, or BDA) are selected via OSBs 6 and 7. Once the message type is selected, specific messages for that message type can be selected via OSBs 19 and 20.

Information includes the originator for received reports or destination/addressee for transmitted reports, mission number, and message time stamp. APTD RQST messages do not contain mission number information. A database is created for each of the message types with a maximum capacity of 50 received/sent DIP, AOS, APTD, APTD RQST, and BDA messages. A combined total of 80 SENT/RCVD VMF and SADL MAs (9-Line reports) can be maintained in the database along with an additional 20 Pending (newly created) VMF and SADL MAs. DIP, AOS, APTD, and BDA messages display in chronological order with the latest received message at the top. APTD RQST messages display sorted by color-coded status and then by chronological order with the latest received message at the top (Refer to the VMF MISSION PAGE - APTD RQST section for more information.) Once full, the oldest received/sent message is deleted upon receipt of a new message. OSBs displayed (available) on the TAD VMF Mission Page are dependent on the message type selected. Amplification field data displayed is also dependent on the message type selected. If the Call Sign is available, the originator/destination field displays the Call Sign; if unavailable, the originator/destination field will display the URN.

VMF MISSION PAGE - 9-LINE.

The 9-Line is displayed as shown in Figure 1-156.15. Data shown in the display field is based on the selected 9-Line. The display fields on the 9-Line match the display fields from the TAD MA Page. Color-coding within the 9-Line table is also consistent with the TAD MA Page; reverse green video indicates the current 9-Line, green text is active and red text is inactive.

When a received VMF 9-Line is selected on the VMF Mission Page, if a DIP has been sent "DIP SENT" is displayed in the BDA status field on the VMF Mission Page. Color coding is consistent with displays on the TAD Page; a successful transmission is displayed in green, an unsuccessful transmission is displayed in red. When a sent VMF 9-Line is selected on the VMF Mission Page, if a DIP has been received from the recipient of the VMF 9-Line, "DIP RCVD" is displayed in the BDA status field on the VMF Mission Page. If a BDA is sent or received for the selected VMF 9-Line, the BDA status will override the DIP status.



MA (OSB 1)	Returns to the TAD MA Page.
VIEW (OSB 2)	View the currently selected 9-Line.
Message Type Selection (OSBs 6/7)	Navigation OSBs used to select the VMF Message Type (AOS, 9LN, DIP, APTD, APTD RQST, BDA).
NEW BDA (OSB 17)	Access to VMF BDA Pending (PEND) Page (creates new BDA for selected VMF 9- Line, disabled if 9-Line is inactive).
NEW (OSB 18)	Access to Pending MA Message View Page (creates new 9-Line report).
Message Selection (OSB 19/20)	Navigation OSBs used to select a specific 9-Line report.

Figure 1-156.19. VMF Mission Page (9-Line)

VMF MISSION PAGE - AOS.

The Aircraft On-Station (AOS) report is displayed on the TAD VMF Mission Page as shown in Figure 1-156.20. The AOS can be broadcasted from the TAD Page, or broadcast or sent to a specific destination from the TAD VMF Mission Page and is used to notify the controlling agency (e.g. JTAC, FAC(A), or TACP) that the flight has arrived at the prescribed control station or contact point. The AOS report also provides the aircraft's position, ordnance, VMF addressing information, Time On Station (TOS), and the Abort Code. The AOS can be sent as a single aircraft report, or as a multi-aircraft report dependant on flight members. Ordnance data for a multiaircraft report is obtained via a SADL J13.2 message from each Flight Member if a J13.2 is not available from each Flight Member, a multi-aircraft report is transmitted without ordnance information for the undefined aircraft. The AOS View Page provides the ability to view detailed Stores information for each aircraft reported in a received AOS report.

The AOS View Page provides reception of Fuze and Laser Code information as well as the Mission Number and Abort Code (if provided).

NOTE

Fuze and Laser Code data is not transmitted in an AOS message from the A-10C.

The Abort Code and Time on Station data fields for an AOS message can be modified via the VMF Mission Page. The Abort Code is an optional one or two character field; if an Abort Code is not entered, one will not be transmitted.

Time on Station is a mandatory data field to transmit an AOS message; if Time on Station data is not entered, the system enters a default time of 90 minutes.

A received AOS will also display the following amplification data:

- Aircraft position ((Lat/Long or MGRS)/altitude)
- Aircraft Time On Station (TOS)
- Number of aircraft and type
- Summary of flight stores (maximum of 4 stores)
- Abort Code (blank if not provided)

A Note will be displayed on the TAD for a received AOS message(s) indicating how many messages are awaiting acknowledgement, "AOS (x)" with "x" being the number of received AOS messages. A "+" sign will be displayed if greater than nine AOS messages are received. Acknowledgement of the Note will clear all received AOS messages.

Upon reception of an AOS message, a Note and originator call sign is displayed. Upon acknowledgement of the Note, the TAD status is removed. If multiple messages of the same type are received, the reception status on TAD is displayed for the latest message. To view status use the VMF Mission Page.

When AOS is selected on the VMF Mission Page, AOS transmission status is displayed with consistent color coding to the TAD Page. For the selected AOS message, a successful transmission is displayed in green, an unsuccessful transmission is displayed in red, and display in white indicates the message transmission is in progress. These indications are for AOS messages addressed to a specific recipient, for an AOS that is broadcasted transmission status is not provided.

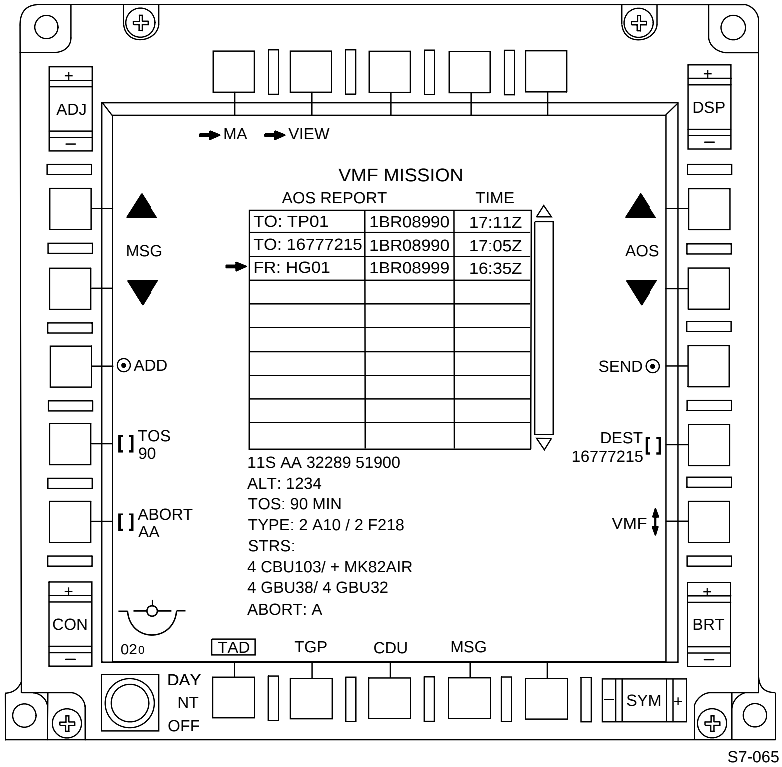


Figure 1-156.20. VMF Mission Page (AOS) (Sheet 1 of 2)

MA (OSB 1)	Returns to the TAD MA Page
VIEW (OSB 2)	Access to the AOS View Page (OSB only displayed on a received AOS message)
Message Type Selection (OSBs 6/7)	Navigation OSBs used to select the VMF Message Type (AOS, 9LN, DIP, APTD, APTD RQST, BDA)
SEND (OSB 8)	Sends the AOS report to the destination specified at OSB 9 (Default is the Broadcast address (16777215)). OSB is disabled if IDM status on System Status Page 3 is NC, OFF, INIT, or FAIL; or if IDM RT selection OSB (OSB 20) on the COMM Page is set to NONE. OSB 8 is also disabled if the destination entry displayed at OSB 9 is displayed in red reverse video.
DEST (OSB 9)	Provides for entry of destination URN (8 digit number in the range of 00000000-16777215), or Call Sign (4 digit alphanumeric with each digit having a range of A-Z, 0-9, or Space). If a Call Sign is entered, the CICU software will search the Flight Member, Donor, or VMF Participant lists for a URN that corresponds to the entered destination. If entered call sign does not correspond to a URN, destination is displayed in red reverse video. Additionally, if entered call sign corresponds to ownship URN, destination is displayed in red reverse video. **NOTE** The following are not allowable destination values: 1. Unit Reference Number: 16777213 and Ownship Unit Reference Number 2. Call Sign: Four spaces or Ownship Call Sign
Destination Group (OSB 10)	Used to select the Destination Group (either VMF, URN or CS, with VMF being the default setting)
ABORT (OSB 16)	Abort code entry for message transmission, consists of one or two alphabetic characters. If OSB 16 is pressed with nothing in the scratchpad, a previously entered abort code will be cleared. **NOTE** Abort code entry is not required for transmission of an AOS report. If abort code is not entered, the AOS report is transmitted without it.
TOS (OSB 17)	Time on Station entry for message transmission. Mandatory field, system defaults to 90 minutes if entry not provided. Data entry can range from 1 to 999 minutes. An entry of greater than 127 minutes is shown as greater than 127+ minutes)
ADD (OSB 18)	Allows the message originator to be added to the VMF Participant List (OSB only displayed on a received AOS message; removed if the URN is already in the Flight Member, Donor, or VMF Participants Lists)
Message Selection (OSB 19/20)	Navigation OSBs used to select a specific AOS report

Figure 1-156.20. VMF Mission Page (AOS) (Sheet 2)

AOS symbology displayed on the TAD will be correlated to PPLI symbols whenever possible by comparing URNs in the AOS message to air PPLIs with the same URN in the SADL donor or VMF Participant Lists.

AOS PPLI correlated symbology is displayed on the TAD for 1 minute, uncorrelated symbology is displayed for 15 seconds (the display of AOS symbology can be turned ON/OFF from TAD via the TAD Profile Settings Page). Refer to Figure 1-156 for specific detail on AOS symbology.

Selection of View (OSB 2) on a received AOS message displays the AOS View Page. The AOS View Page (Figure 1-156.21) provides additional data for each aircraft identified in an AOS report including call signs and aircraft type(s) and the type and quantity of stores (up to 16 different store types for the selected flight member) available for the selected aircraft. A "+" in the stores table indicates a quantity greater than 9 for that specific store.

Fuze types (up to two for each ordnance type); Laser Codes, Mission Number and Abort Codes are displayed at the bottom of the page. Laser Codes and Fuze types are receive only.

Aircraft that are On-Station and not already in the Flight Member, Donor, or VMF Participant Lists can be added individually or as a group by selection of OSBs 18 or 6 respectively provided the VMF Participant List is not already full and the Flight Member(s) URN is provided in the AOS message. Flight Member(s) information (Call Sign, URN, Data Link Address, and IPv4 Address (if provided) already in the VMF Participant List will not be overridden when ADD ALL is selected. The ADD ALL OSB is only displayed if there are multiple aircraft in the AOS report, for a single aircraft report the ADD OSB must be used and the ADD ALL OSB is removed from display. Additionally, the ADD ALL OSB is removed from display if there is not enough room in the VMF Participant List to add all aircraft not already in the Flight Member, Donor, or VMF Participants Lists; e.g. if four aircraft are reported but there are only two available slots in the VMF Participants List then the aircraft would need to be added individually.

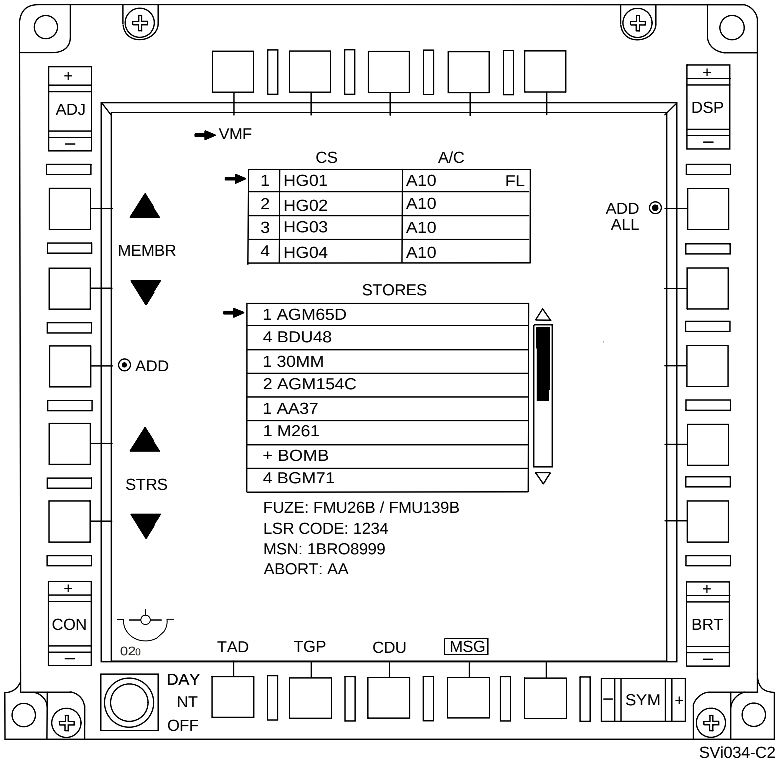


Figure 1-156.21. AOS View Page (Sheet 1 of 2)

VMF (OSB 1)	Returns to the VMF Mission Page.
ADD ALL (OSB 6)	Adds all Flight Members from the AOS View Page to the VMF Participant List. **NOTE** • OSB removed if all Flight Members, Donors, or VMF Participants currently not included in the VMF Participant List cannot be added due to lack of available slots or if a URN is not provided in the AOS message for each Flight Member, Donor, or VMF Participant not already in the VMF Participant List. • If a Flight Member, Donor, or VMF Participant on the AOS View Page is already included in the VMF Participant List, that information will not be overridden when ADD ALL is selected. • Pressing the ADD ALL OSB ensures all Flight Members, Donors, and VMF Participants from the AOS View Page are present in the TDL Configuration List. • OSB removed for a single aircraft AOS report.
STRS (OSBs 16/17)	Selects Stores type to view corresponding fuze type and laser code.
ADD (OSB 18)	Adds the selected Flight Member from the AOS View Page to the VMF Participant List. **NOTE** OSB removed if the VMF Participant List is full, the selected Flight Member, Donor, or VMF Participant has already been added to the VMF Participant List, or the AOS message did not provide a URN for the selected Flight Member.
MEMBR (OSBs 19/20)	Flight Member selection for display of corresponding stores information.

Figure 1-156.21. AOS View Page (Sheet 2)

VMF MISSION PAGE - DIP.
The Depart Initial Point (DIP) report displays on the TAD VMF Mission Page as shown in Figure 1-156.22. The DIP report provides the ability to notify the controlling agency (e.g. JTAC, FAC(A), or TACP) that the flight is departing the initial point of a VMF 9-Line to complete the CAS mission assignment. The DIP can be sent from the TAD, or can be broadcast or sent to a specific destination from the TAD VMF Mission Page. Data fields for a DIP message cannot be modified, with the Mission Number being the only mandatory field in the message. The Abort Code can display as part of a received DIP message, but will only be transmitted as part of an AOS message.

A Note will display on the TAD for a received DIP message(s) indicating how many messages are awaiting acknowledgement; "DIP (x)" with "x" being the number of received DIP messages. A "+" sign will be displayed if greater than nine messages are received. Acknowledgement of the Note will clear all received DIP messages.

Upon reception of a DIP message, a Note, and originator's call sign is displayed. If call sign is not available, URN displays. Upon acknowledgement of the NOTE, the TAD status is removed from display. If multiple messages of the same type are received, the reception status on TAD is displayed for the latest message. To view status of the other received messages of the same type, use the VMF Mission Page.

Reception of a DIP message that can be correlated to a transmitted VMF 9-Line report (same Mission Number and URN) will update the status line on a VMF MA (9-Line) Message to "Depart IP" (see Figure 1-152.10).

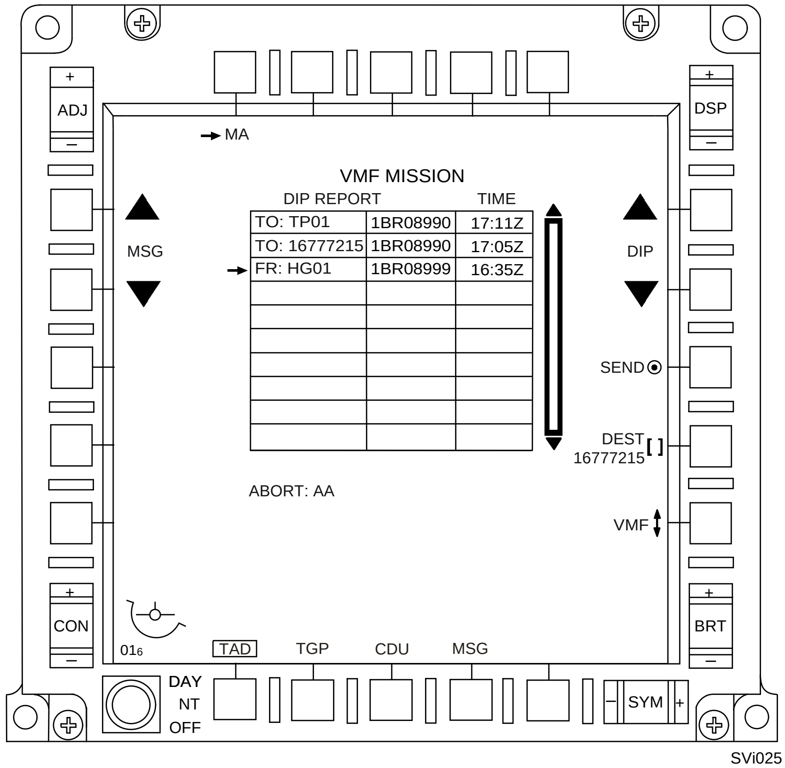
Status displays on the TAD Page indicate if DIP message transmission is in progress, successful or has failed. Once SEND DIP (OSB 7) has been pressed, the OSB 7 "bullseye" is replaced by an asterisk "*" to indicate DIP message transmission is in progress. If the DIP transmit is successful, "DIP SENT" appears in green in the BDA status field and OSB 7 is re-enabled (the bullseye returns). If the DIP transmission is unsuccessful, "DIP SENT" appears in red in the BDA status field and OSB 7 is re-enabled. When a DIP message is received from the recipient of a sent VMF 9-Line, "DIP RCVD" is displayed in green in the BDA status field on the TAD Page when the 9-Line is hooked.

NOTE

Transmission status indications are only displayed on the TAD if the VMF 9-Line is hooked. If a DIP is sent without hooking a 9-Line, the 9-Line would need to be hooked in order to view the transmission status.

When DIP is the selected message type on the VMF Mission Page, DIP transmission status is displayed with consistent color coding to the TAD Page. For the selected DIP message, a successful transmission is displayed in green, an unsuccessful transmission is displayed in red, and display in white indicates the message transmission is in progress. These indications are for DIP messages addressed to a specific recipient, for a DIP that is broadcasted transmission status is not provided. Transmit status for a BDA is not displayed on the VMF Mission Page as all BDA transmissions are broadcasted.

When a received VMF 9-Line is selected on the TAD MA Page, if a DIP was sent "DIP SENT" is displayed in the BDA status field, with consistent color coding to the TAD Page. When a sent VMF 9-Line is selected on the TAD MA Page, if a DIP was received from the recipient of the VMF 9-Line "DIP RCVD" is displayed in the BDA status field. If a BDA is sent or received for the selected VMF 9-Line, the BDA status will override the DIP status.



MA (OSB 1)	Returns to the TAD MA Page.
Message Type Selection (OSBs 6/7)	Navigation OSBs used to select the VMF Message Type (AOS, 9LN, DIP, APTD, APTD RQST, BDA).
SEND (OSB 8)	Sends the DIP to the destination specified at OSB 9 (default is the Broadcast address (16777215)). OSB is disabled if IDM status on System Status Page 3 is NC, OFF, INIT, or FAIL; or if IDM RT selection OSB (OSB 20) on the COMM Page is set to NONE. OSB 8 is also disabled if the destination entry displayed at OSB 9 is displayed in red reverse video.
DEST (OSB 9)	Provides for entry of destination URN (8 digit number in the range of 00000000-16777215), or Call Sign (4 digit alphanumeric with each digit having a range of A-Z, 0-9, or space). If a Call Sign is entered, the CICU software will search the Flight Member, Donor, or VMF Participant lists for a URN that corresponds to the entered destination. If entered call sign does not correspond to a URN, destination is displayed in red reverse video. Additionally, if entered call sign corresponds to ownship URN, destination is displayed in red reverse video. **NOTE** • The following are not allowable destination values: • Unit Reference Number: 16777213 and Ownship Unit Reference Number. • Call Sign: Four spaces or Ownship Call Sign.
Destination Group (OSB 10)	Rotary OSB to select the Destination Group (VMF, URN or CS, with VMF setting as the default).
Message Selection (OSB 19/20)	Navigation OSBs used to select a specific DIP.

Figure 1-156.22. VMF Mission Page (DIP)

VMF MISSION PAGE - APTD.

The Aircraft Position and Target Designation (APTD) report is displayed on the VMF Mission Page as shown in Figure 1-156.23. The APTD report can be broadcast from the TAD Page, or broadcast or sent to a specific destination from the TAD VMF Mission Page and is used to transmit current aircraft position, SPI, ground speed/track, and selected ordnance. APTD reports can be sent as an unsolicited message or in response to a received APTD Request (APTD RQST) message sent from the designated air or ground control unit. (Refer to VMF Mission Page - APTD RQST for more information.)

When APTD is selected on the VMF Mission Page, APTD transmission status is displayed with the following color status:

- Green text indicates a successful message broadcast or transmission to the indicated destination.
- Red text indicates a failed transmission.
- White text indicates message transmission in progress.

An APTD report will display the following data:

- SPI Entity ID Serial Number (EISN) and Originator URN/Call Sign
- SPI Coordinates (Lat/Long or MGRS)
- SPI elevation (MSL/HAE)
- Selected ordnance type - Transmits Ordnance Type displays 30MM when HUD mode is GUNS or no profile is selected; otherwise, it displays store type of selected profile.
- Fuze option of selected ordnance - Transmits Fuze Type (Off, Impact, Proximity, Proximity Delay Short, Impact Delay Short, and Impact Delay Long). Transmits OFF when ordnance is 30MM or the weapon has no fuzes. Fuze Type displays to Profile JPF Function (Long Impact Delay (> 1 sec), Short Impact Delay (≤ 1 second), Impact, Prox (JPF delay = 0 sec), Proximity Delay Short (JPF delay > 0 sec) when ordnance is JDAM and Fuze Type is JPF; otherwise, it displays Impact.

To send a response to an APTD RQST for single or multiple APTD reports, select SEND APTD (OSB 19) or REJECT (OSB 7) on the TAD page. Use Quick look to view the details of the APTD RQST on the APTD RQST VMF Mission Page while OSB 19 and OSB 7 are active. If OSB 19 is selected, the CICU will begin responding to the request as defined by the start criteria and stop criteria (see Figure 1-156.24) of the received message.

In addition to responding to APTD RQSTs and sending unsoliticited APTDs from the TAD, unsolicited APTDs can be sent from the VMF Mission Page. When an APTD is sent the data is automatically logged to the APTD report table.

Upon reception of an APTD report, a Note displays on the TAD indicating that an APTD has been received and the call sign of the message originator will display followed by the message type of APTD. To view the status of the APTD, use the VMF Mission Page.

NOTE

> When periodic APTDs are received from the same Originator URN, a Note is only displayed for the first APTD. The Note will re-display if an APTD is received with a different target (Target Originator URN or EISN).

Upon acknowledgement of the Note, the originator Call Sign/message type field is removed from display. If multiple reports of the same type are received, the reception status on TAD is displayed for the latest received reports. Acknowledgement of the Note will acknowledge all APTD reports in the buffer.

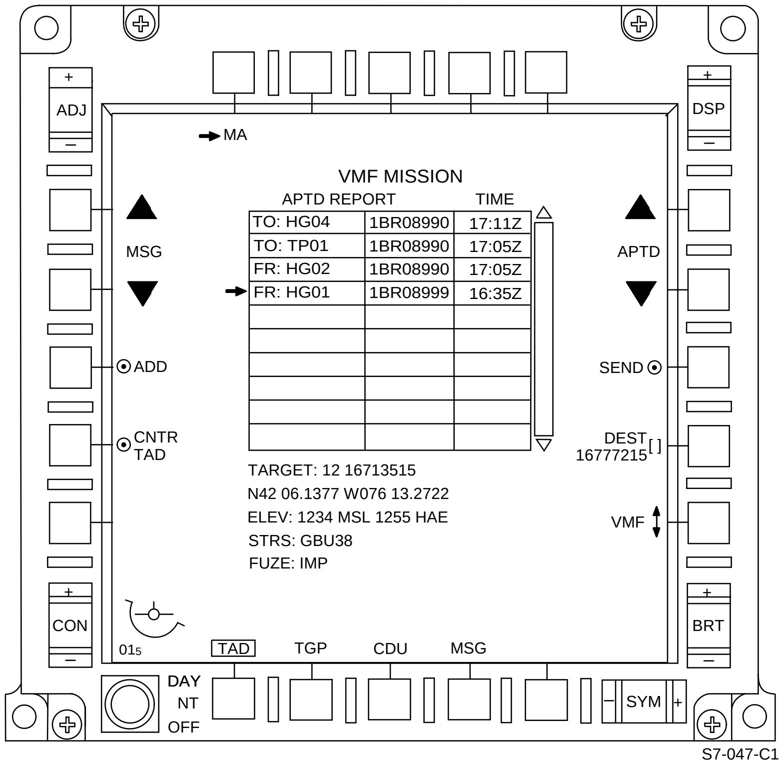


Figure 1-156.23. VMF Mission Page - APTD (Sheet 1 of 2)

MA (OSB 1)	Returns to the TAD MA Page.
Message Type Selection (OSBs 6/7)	Navigation OSBs used to select the VMF Message Type (AOS, 9LN, DIP, APTD, APTD RQST, and BDA).
SEND (OSB 8)	Transmits an APTD message to the specified address in defined in OSB 9. **NOTE** ● This OSB is disabled when: ● An active multiple APTD RQST is in progress. The current request must be cancelled prior to sending a new request. ● The IDM Radio Selection is set to NONE or the TDN is currently unavailable (IDM Off, Not Communicating, or Failed).
DEST (OSB 9)	Selects the destination address for the selected APTD report (defaults to broadcast address.)
Destination Group (OSB 10)	Selects the destination group for the selected APTD RQST message (CS, URN, FLT)
CNTR TAD (OSB 17)	Centers the TAD display: • On the active APTD target symbol. • On the last known location of the selected timed-out APTD target symbol for the APTD record received in response to an APTD RQST. Resets the display of the APTD target symbol for 5 minutes. **NOTE** This OSB is available if the received APTD is the latest APTD from originator URN that contains a Target.
ADD (OSB 18)	Adds the originator of a received APTD report to the VMF Participant List. **NOTE** OSB 18 disabled if originator URN already exists in the Flight Member List, Donor List, or VMF Participant List, or if the VMF Participant List is full.
Message Selection (OSBs 19/20)	Navigation OSBs used to select a specific APTD report.

Figure 1-156.23. VMF Mission Page - APTD (Sheet 2)

VMF MISSION PAGE - APTD RQST.

The Aircraft Position and Target Designation Request (APTD RQST) is displayed on the VMF Mission Page as shown in Figure 1-156.25. An APTD RQST is used to request aircraft position, SPI, selected ordnance, and weapon data. A single report or multiple reports can be requested. APTD RQSTs can be sent to a specific destination or a destination flight.

The TAD VMF Mission Page report table displays all transmitted and received APTD RQST reports including:

- Destination/ Originator (TO:/FR:)
- Report Type (SINGLE/MULTIPLE)
- Time Stamp (Sent/Received)
- Status of the request

On the VMF Mission Page, APTD transmission status is displayed with the following color scheme:

For transmitted APTD RQSTs:

- White text indicates that the CICU is awaiting receipt acknowledgment from the request destination.
- Green text indicates a reciept acknowledgement has been received.
- Red text indicates a CANTPRO was received, a cancel APTD RQST was sent (OSB 18), or no reciept acknowledgement was received from destination.

For received APTD RQSTs:

- White text indicates that the request is awaiting response.
- Green text indicates that a single response was sent successfully or a multiple response is complete.
- Red text indicates that the Start or Stop Criteria of the request was not satisfied or a newer request was complied with when an existing request was in progress or an APTD RQST is cancelled from the VMF Mission page.
- Green reverse text indicates that APTDs are currently in progress of being transmitted in response to a multiple APTD RQST.

Upon reception of an APTD RQST a Note displays on the TAD indicating that an APTD RQST has been received. The Note indicates if a single or multiple reports are requested. Upon reception of an APTD RQST, the originator's call sign is displayed followed by APTD RQST below the new hostile TN notification on TAD. If call sign is not available, URN displays. To view the status of the APTD RQST, use the VMF Mission Page.

NOTE

MSG Quick-Look via HOTAS provides a view of the details of the APTD RQST on the VMF Mission Page.

If multiple reports of the same type are received, the reception status on TAD is displayed for the latest received reports. Acknowledgement of the Note will acknowledge all APTD reports in the buffer.

Each received APTD RQST requires either an automatic (AUTO) or manual (MAN) response.

- In MAN mode, REJECT (OSB 7) and SEND APTD (OSB 19) will be activated on the TAD page to comply or reject the request. Upon acknowledgement of the Note, the originator/message type field remains until OSB 7 or 19 are activated.
- In AUTO mode, if the originator URN is in the Flight Member, Donor, or VMF Participant list, the CICU will automatically respond to the request. Upon acknowledgement of the Note, the originator/message type field is removed from display.

NOTE

While in AUTO mode, if the request originator URN is not in the Flight Member, Donor, or VMF Participant list, or if an APTD RQST is in progress and a new APTD RQST is received, SEND APTD (OSB 19) and REJECT (OSB 7) are activated on TAD to comply with or reject the new request.

Compliance with an APTD RQST in either mode instructs the CICU to begin responding to the request as defined by the start criteria and stop criteria (see Figure 1-156.24) of the received APTD RQST.

NOTE

If a new APTD RQST is received while an APTD report cycle is in progress, the current APTD report cycle must be completed or cancelled. Accepting a new APTD RQST will stop response to an in progress APTD RQST and will begin responding to new APTD RQST.

APTD RQSTs for multiple reports require that the Number (OSB 4) and the Interval (OSB 5) of APTD report be defined.

APTD RQSTs can be sent to an entire flight if an AOS record is provided for the flight (contains the destination URN for addressing). If FLT is selected on OSB 10, the latest AOS record that contains the destination URN will be used for addressing the APTD RQST. If OSB 10 displays FLT in yellow reverse video then no flight information could be obtained for the entered destination and sending the APTD RQST will only go to the destination entered on OSB 9.

If an APTD RQST is sent to a flight, then a separate APTD record is created for each flight member so that the requests can be managed as if the request were sent separately.

NOTE

If a multiple APTD RQST is transmitted and the response is in progress, the ability to send a new request will be disabled until the current request completes or is canceled.

Selecting CANX (OSB 18) cancels the current APTD RQST in progress. For a sent APTD RQST, selecting CANX will transmit a stop request message. After the APTD RQST is cancelled the record is displayed in red on the report table.

If an APTD cancel request is received for the current APTD RQST, a "CANX APTD RQST" WCN NOTE will be displayed on the TAD and the APTD RQST will be terminated.

APTD RQSTs (single and multiple) display the following criteria:

Figure 1-156.24. APTD RQST Criteria

Destination Group	CS	Call Sign
	URN	Unit Reference Number
	FLT	Flight
Start Criteria	IMMEDIATELY	Send APTD immediately
	DEPART IP	Send APTD after DIP is sent
	HH:MM:SS (Z or L)	Send APTD at specified time (Zulu and Local)
	TT + N SEC or TT - N SEC	(N = delta start time) - Send APTD at delta time from time on target (TT)
Stop Criteria	1 REPORT (if single APTD RQST)	Stop after 1 APTD is sent successfully
	WPN IMPACT	Stop after weapons impact
	WPN RELEASE	Stop after weapons release
	N REPORTS	Stop after N number of reports (N = number of APTDs requested)
	HH:MM:SS (Z or L)	Stop APTD at specified time (Zulu or Local)
	TT + N SEC or TT - N SEC	Stop APTD at delta time from time on target (TT) (N = delta start time)
	WHEN DIRECTED	Stop upon reception of an APTD RQST with a request set to Stop. **NOTE** A Cleared Hot/Abort is not supported. If a Cleared Hot/Abort is received, an automatic CANTPRO will be generated for the request.
Report Interval	N SEC	N = received time between reports
	Blank	Blank for single APTD RQSTs
Response Type	Manual	Manual Response required
	Automatic	CICU will automatically respond to the request.

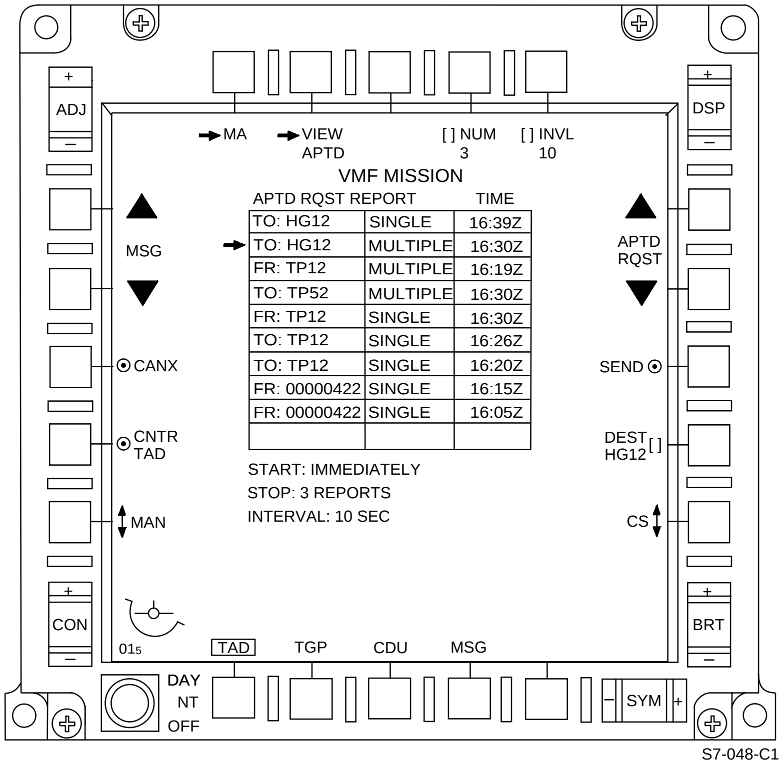


Figure 1-156.25. VMF Mission Page - APTD RQST (Sheet 1 of 3)

MA (OSB 1)	Returns to the TAD MA Page.
VIEW APTD (OSB 2)	Displays the corresponding received or sent APTD on VMF Mission APTD page.
NUM (OSB 4)	Selects number of reports when sending a request. Defaults to 1. Range 1 to 127.
INVL (OSB 5)	Selects report interval in seconds when sending a request. Only enabled if OSB 4 is greater than 1. Defaults to 5 seconds. Range 5 to 255.
Message Type Selection (OSBs 6/7)	Navigation OSBs used to select the VMF Message Type (AOS, 9LN, DIP, APTD, APTD RQST, and BDA).
SEND (OSB 8)	Transmits an APTD RQST message to the specified address to the destinations specified by OSB 9. Transmits to all members of a flight if OSB 10 is set to FLT. **NOTE** • This OSB is disabled when: • An active multiple APTD RQST in process. The current request must be cancelled prior to sending a new request. • The IDM Radio Selection is set to NONE or the TDN is currently unavailable (IDM Off, Not Communicating, or Failed).
DEST (OSB 9)	Selects the destination address for the selected APTD RQST message. Provides for entry of destination URN (8 digit number in the range of 00000000-16777215), or Call Sign (4 digit alphanumeric with each digit having a range of A-Z, 0-9, or Space). If a Call Sign is entered, the CICU software will search the Flight Member, Donor, or VMF Participant lists for a URN that corresponds to the entered destination. If entered call sign does not correspond to a URN, destination is displayed in red reverse video. Additionally, if entered call sign corresponds to ownship URN, destination is displayed in red reverse video. **NOTE** The following are not allowable destination values: 1. Unit Reference Number: 16777213 and Ownship Unit Reference Number 2. Call Sign: Four spaces or Ownship Call Sign
Destination Group (OSB 10)	Selects the destination group for the selected APTD RQST message (CS, URN, FLT) **NOTE** VMF is not an available selection as APTD RQST can not be broadcasted.

Figure 1-156.25. VMF Mission Page - APTD RQST (Sheet 2)

Response Configuration (OSB 16)	Selects the response mode for received APTD RQST; automatic (AUTO) or manual (MAN). Defaults to MAN. While MAN is selected, all APTD responses must be approved manually. While AUTO, APTD responses are automatically sent if the originator of the request exists in the Flight Member, Donor, or VMF Participant List.
CNTR TAD (OSB 17)	Centers the TAD display: • On the APTD target symbol for the APTD record received in response to an APTD RQST. • On the last known location the selected timed-out APTD target symbol and redisplays the symbol on the TAD. Resets the display of the APTD target symbol for 5 minutes. **NOTE** This OSB is available if the received APTD is the latest APTD from originator URN that contains a Target.
CANX (OSB 18)	Provides capability to either stop responding to the selected request (received request) or send an APTD RQST for the selected APTD RQST (sent request). Only available for multiple request types.
Message Selection (OSBs 19/20)	Navigation OSBs used to select a specific APTD RQST.

Figure 1-156.25. VMF Mission Page - APTD RQST (Sheet 3)

VMF MISSION PAGE - BDA.

The Battle Damage Assessment (BDA) report is displayed on the VMF Mission Page as shown in Figure 1-156.26. A BDA can be sent from the VMF Mission Page (based on the current active 9-Line or a hooked 9-Line) or sent directly from the TAD page if a VMF 9-Line is hooked. The BDA is always broadcast when transmitted to ensure all VMF 9-Line records are closed. When a BDA is sent or received, the applicable 9-Line is set to INACTIVE.

While BDA is selected as the message type, information can be viewed for all transmitted and received VMF BDAs. When received BDAs are selected, the following amplification data is also displayed (amplification data is not displayed when sent BDAs are selected):

- Target Entity ID Reference Number (EIRN) (target ID (last 3 digits of the Entity ID Serial Number (EISN)) followed by originator URN)
- Target location ((Lat/Long or MGRS) and elevation)
- BDA status
- Target percent destroyed
- Stores used on target
- Re-attack indicator

An OSB is provided to create a new BDA for either the current VMF 9-Line (displays the VMF BDA PEND PAGE) or a VMF 9-Line that has been hooked on TAD.

Transmission of BDA from VMF Mission Page can be on a hooked or current 9-Line. To transmit a BDA for the current VMF 9-Line ensures that a VMF 9-Line is not hooked on TAD or the current 9-Line is hooked on the TAD.

NOTE

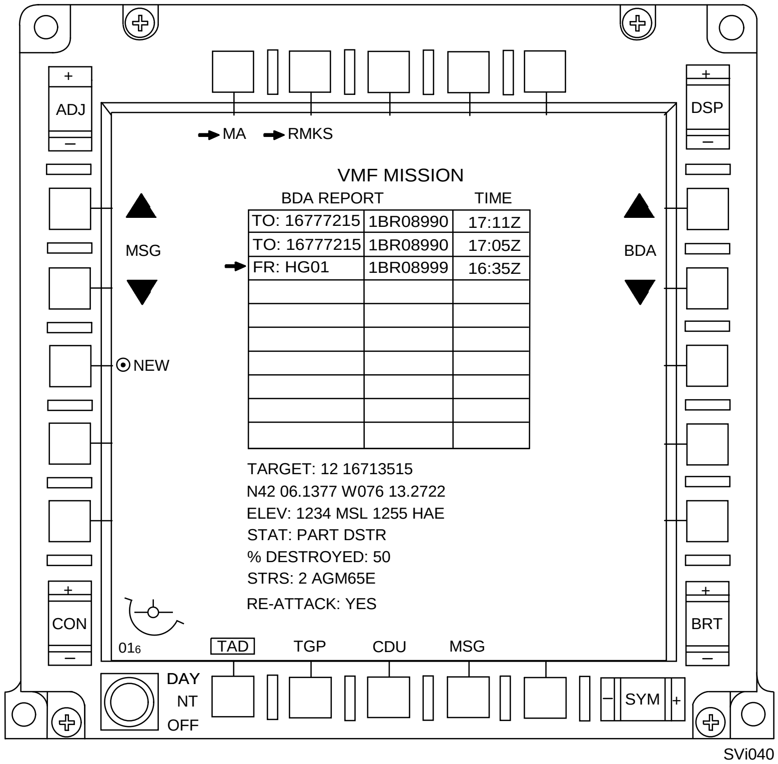
If a VMF 9-Line is not hooked on TAD and a VMF 9-Line is not the current MA, the OSB to create a new BDA is disabled.

A note will be displayed on the MFCD to indicate that an active or current MA has transitioned to inactive due to BDA reception.

- If the BDA is received from a Flight Member, "FLT MBR BDA" is displayed.
- If the BDA is received from the MA originator, "MA ORIG BDA" is displayed.
- If the BDA received correlates to a transmitted MA, "BDA RSPS RCVD" is displayed.

Reception of a BDA that can be correlated to a sent VMF 9-Line report (same Mission Number and EIRN) will update the status line on a VMF MA (9-Line) Message to reflect the BDA status (BDA UNK, TGT DSTR, PART DSTR, NO EFCT, PART DSTR-RE-ATCK, NO EFCT- RE-ATCK, BDA UNK-RE-ATCK).

When BDA is selected on the VMF Mission Page, BDA transmission status is not displayed on the VMF Mission Page via color coding as is done for DIP and AOS (non-broadcast) transmissions. Transmission status is not displayed for a BDA as all BDA messages are broadcasted.

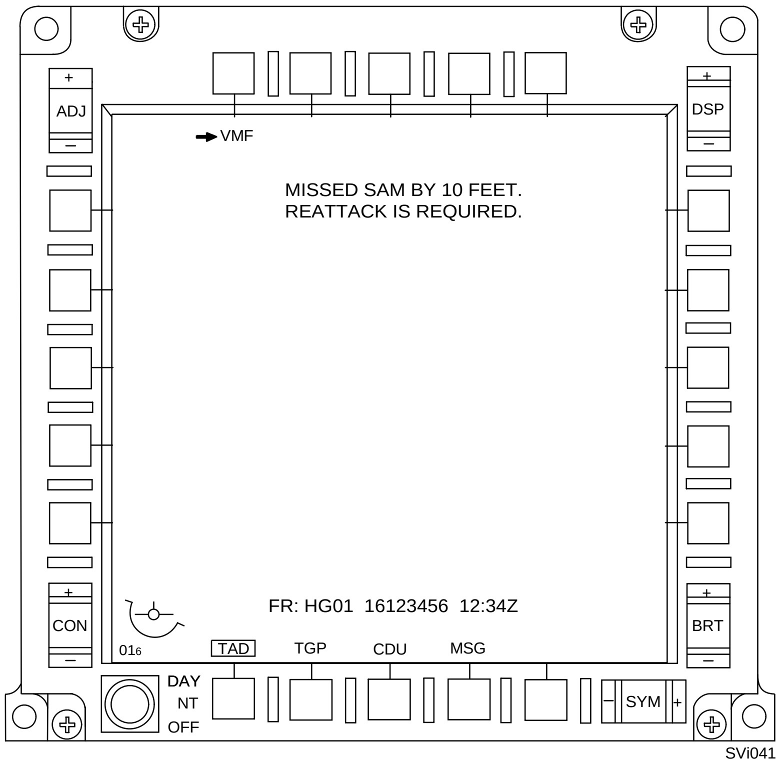


MA (OSB 1)	Returns to the TAD MA Page.
RMKS (OSB 2)	Access to the Remarks Page (OSB only displayed on a received BDA and is disabled if no remarks were received). **NOTE** OSB disabled if remarks were not received with a BDA or if SEND BDA is selected.
Message Type Selection (OSB 6/7)	Navigation OSBs used to select the VMF Message Type (AOS, 9LN, DIP, APTD, APTD RQST, BDA).
NEW (OSB 18)	Access to VMF Pending (PEND) Page to create a new BDA report on either the current VMF 9-Line or a hooked VMF 9-Line (sent or received). **NOTE** OSB is disabled if either the current 9-Line is a SADL MA and a VMF 9-Line is not hooked on the TAD, or if no MA is selected as current.
Message Selection (OSB 19/20)	Navigation OSBs used to select a specific BDA.

Figure 1-156.26. TAD VMF Mission Page (BDA)

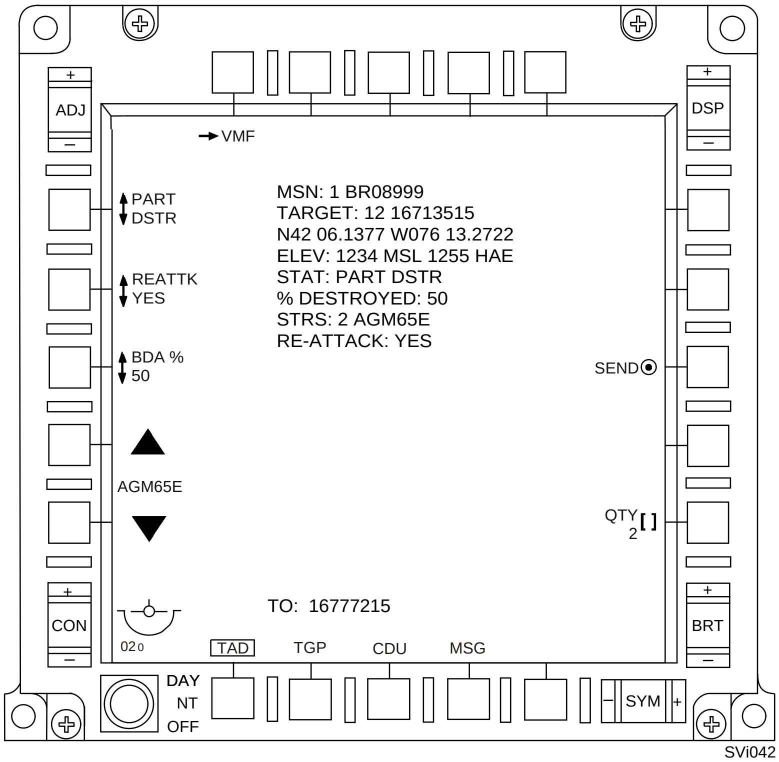
The BDA Remarks Page (Figure 1-156.27) provides the ability to view up to 200 characters of text. The originator call sign, URN and message time of reception displays at the bottom of the page. Select OSB 1 to return to the VMF Mission page. BDA text is receive only.

The VMF BDA Pending (PEND) Page (Figure 1-156.28) provides the ability to create a BDA for either the current VMF 9-Line or a hooked VMF 9-Line. Display fields include the current Mission Number, target EIRN, and target location (latitude, longitude, elevation) contained in either the current or hooked report. BDA status, percent destroyed, stores used (type and quantity), and re-attack indicator display fields show the current settings of each field in the pending BDA and can be modified through OSBs.



VMF (OSB 1)	Returns to the TAD VMF Mission Page.

Figure 1-156.27. BDA Remarks Page



VMF (OSB 1)	Returns to the VMF Mission Page
SEND (OSB 8)	Send the BDA report to the Broadcast address (16777215). OSB is disabled if IDM status on System Status Page 3 is NC, OFF, INIT or FAIL, or if IDM RT selection OSB (OSB 20) on the COMM Page is set to NONE.
QTY (OSB 10)	Selects the quantity of the store type (selected by OSB 16/17) used on the target, defaults to the number of ordnance last fired if a weapon was released. OSB removed from display if store selection is set to NONE.
Ordnance Type (OSBs 16/17)	Selects stores used on the target, defaults to the last weapon used, or NONE if no weapon was released.
BDA % Damaged (OSB 18)	Selects the percent of the target that has been destroyed or damaged. Options are 25, 50, or 75 percent. Default is 50 percent. OSB removed from display if BDA Status (OSB 20) is set to TGT DSTR, NO EFCT, or BDA UNK.
BDA Re-attack Indicator (OSB 19)	Selects whether a re-attack on the target is required. Options are YES or NO. If BDA Status (OSB 20) is set to PART DSTR, or NO EFCT the default is YES. If BDA Status (OSB 20) is set to BDA UNK, the default is NO. If BDA Status (OSB 20) is set to TGT DSTR, the re-attack is set to NO and the OSB is disabled and removed from display.
BDA Status (OSB 20)	Selects the BDA of the target. Options are target destroyed (TGT DSTR), target partially destroyed (PART DSTR), no effect on target (NO EFCT), or unknown (BDA UNK). Default is PART DSTR.

Figure 1-156.28. BDA PEND Page

VMF FRIENDLY POSITIONS.

VMF Friendly Positions are displayed on the TAD Page (Figure 1-156.29) as SURFACE/LAND PPLIs consistent with display of SADL Land and Surface PPLIs (VMF Friendly Position reports can be received from either IDM or the EPLRS radio). Each Friendly Position report can contain up to 64 individual friendly units. VMF does not specify a required transmission rate; therefore, position reports received via IDM will not time out. The CICU can store 400 VMF Friends received from IDM and 64 VMF Friends received from EPLRS. The closest 64 VMF friendly unit symbols to SPI are displayed based on friendly unit symbols received from EPLRS and IDM. Each friendly will have a unique URN, correlation between EPLRS and IDM is performed using the URN to remove duplicate display of the same unit. Report time (time the report was transmitted) will be used to ensure that the latest received data from IDM is used to display the friendly unit's position (report time is an optional field, therefore if report time is not provided; time of reception will be used); EPLRS always uses time of reception. In addition to display on TAD Page, the five closest friendly units can display on the TGP and HUD.

A Note displays on the TAD for a received friendly position report indicating how many reports are awaiting acknowledgement, with the annunciation displaying as "NEW FRND RPT (x)" with "x" being the number of received friendly position reports. A "+" sign will be displayed if greater than nine friendly position reports are received. Acknowledgement of the Note will clear all received friendly position report notes.

NOTE

When a VMF 9-Line is received DTSAS elevation processing is performed to display an approximate elevation on the HUD and TGP when elevation is not provided.

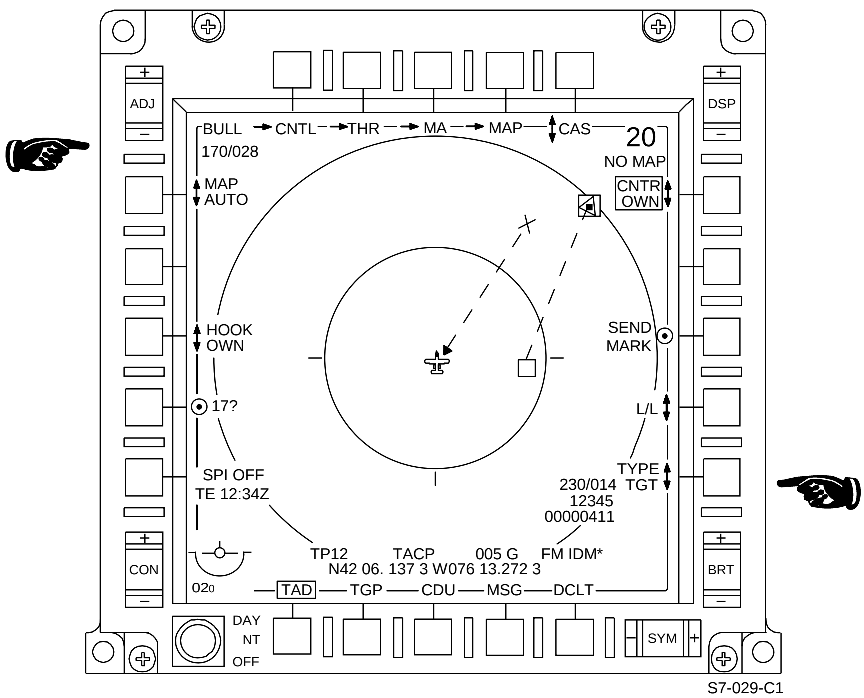


Figure 1-156.29. Hooked Friendly on TAD Page

When a friendly "X" symbol is actively or passively hooked the following data is displayed on the TAD Page:

Figure 1-156.30. TAD Page Data

Field	Description
Bearing/Range	Magnetic bearing (0° - 359°) of the hooked symbol (Reference point to-from for bearing display based on selection of OSB 18) followed by the range cursor of OWN-HOOK (default), HOOK-OWN, BULL-HOOK, HOOK-BULL, CURS-HOOK, HOOK-CURS, or CURS-BULL. The TAD cursor range value in the hooked point bearing and range display field is displayed to the following resolutions: • >10 NM: When the cursor range is greater than 10 NM, the range is displayed to the nearest NM. • 1-10 NM: When the cursor range is in between 1 and 10 NM, the range is displayed to the nearest tenth of an NM (e.g., 8.3). • <1 NM MGRS: When the cursor range is less than 1 NM and the coordinate mode OSB is set to MGRS, the cursor range is displayed in meters rounded to the nearest 5 meters followed by "m". • <1 NM L/L: When the cursor range is less than 1 NM and the coordinate mode OSB is set to L/L [158] (Lat/Long), the cursor range is displayed in feet rounded to the nearest 10 feet followed by "f".
Elevation	Elevation (0 - 99999 ft MSL) of the hooked symbol.
Unit URN	URN of the selected unit.
Time Function	Report Time as TE HH:MMZ TE = Time Report was established/transmitted, HH = Hours, MM = Minutes If Transmission Time is not available, display Reception Time as RT HH:MMZ. For time established (TE) or receive time (RT), either "Z" or "L" will be displayed after the time dependent on whether a local adjust has been applied. If local adjust has been applied "L" will display after the time. If local adjust is set to 0, "Z" will display after the time.
Call Sign	Call Sign displayed if URN matches to a URN in the TDL Config List with a call sign.
Unit Type	Displays the unit type if specific type is provided.
Speed	Ground Speed (0 - 999 knots) followed by "G".
Source	Displays whether the source is from IDM or EPLRS. IDM Friendly: FM IDM EPLRS Friendly: FM EPLRS An asterisk (*) indicates that friendly is correlated between IDM/EPLRS.
Coordinates	Coordinates of the hooked symbol. Default setting for OSB 9 is MGRS, will display. Latitude/Longitude if OSB 9 is set to L/L. MGRS if OSB 9 is set to MGRS. Affects the coordinate format displayed on TAD, Message, Threat, and TGP pages.

LIGHTING SYSTEM.

EXTERIOR LIGHTS.

The exterior lighting system is comprised of the lights used for navigation (formation, position and NVIS lights), landing, taxi, and air refueling. Controls are provided for mode of operation and intensity of the lights.

Master Exterior Light Switch.

The master exterior light switch is a three-position switch mounted on the left engine throttle grip (Figure 1-5). The forward position of the master exterior light switch controls the following:

- Retention of illumination level set on panel for formation lights, nose floodlights and nacelle floodlights
- Changes position lights from bright to dim steady
- Removes power from the anti-collision solenoid switch so that the switch automatically returns to OFF.

The centered position of the master exterior light switch turns off position lights, formation lights, nose floodlights, nacelle floodlights, and anti-collision lights regardless of control panel settings. To reactivate the anti-collision lights following turnoff by the master exterior light switch, the master exterior light switch must be moved aft and the anti-collision switch on the lighting control panel must be reset. The aft position of the master exterior light switch allows for operations of the lights as set on the lighting control panel (Figure 1-157).

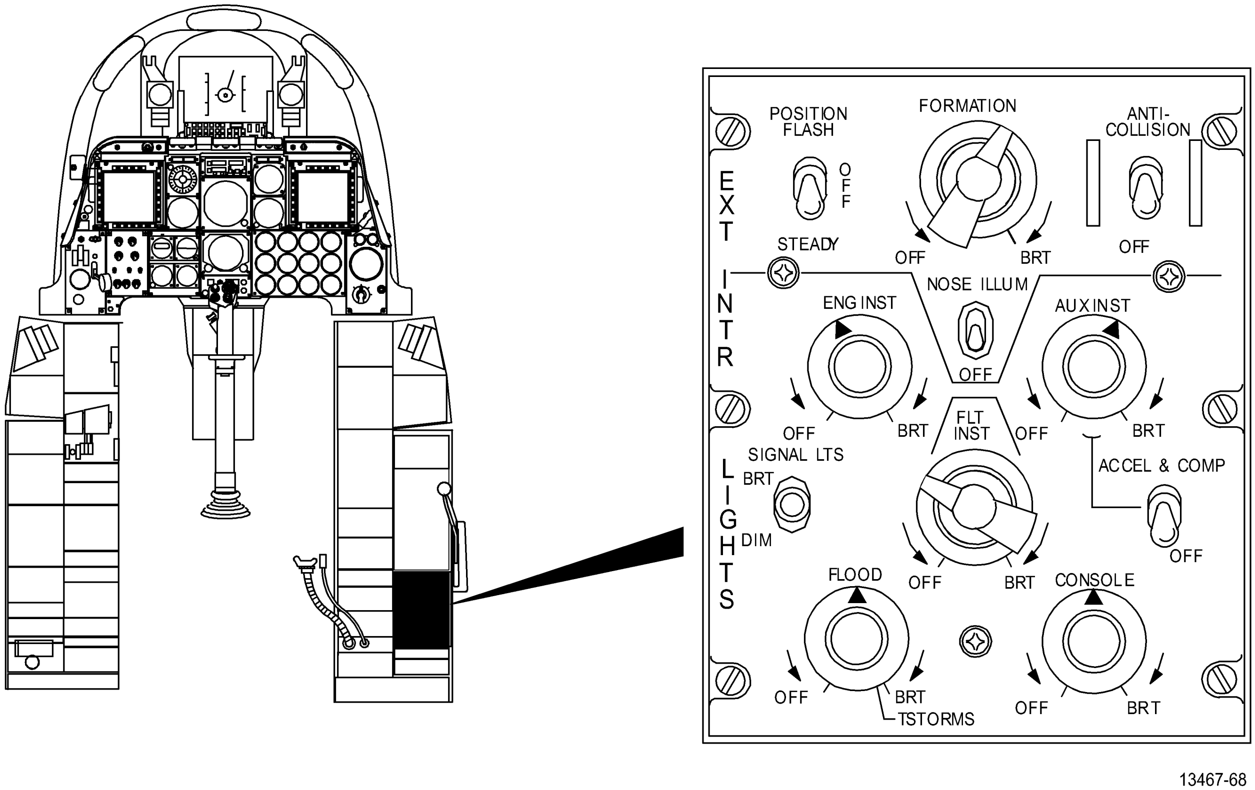


Figure 1-157. Lighting Control Panel

Landing and Taxi Lights.

The landing and taxi lights consist of two separately powered lights located on the nose gear strut. The landing light is mounted on the upper, non-rotating section of the strut. The taxi light is mounted on the steerable section of the strut to provide directional lighting for taxiing. Electrical circuits to the lights are interlocked to insure operation only when the nose gear is down and locked. Both lights are used as landing lights, but on the ground only the taxi light is necessary. The lights are controlled by the landing/taxi light switch on the instrument panel, above the landing gear handle. The landing light is powered by the left AC bus. A NVIS compatible filter may be installed on the taxi light as mission requirements dictate.

Landing/Taxi Lights Switch.

The landing/taxi lights switch (31, Figure FO-1) is a three-position toggle switch, located on the instrument panel, and placarded LIGHTS, with positions TAXI, LAND, and OFF. Placing the switch in TAXI causes the lower light on the nosewheel strut to come on. In LAND position, both lights come on. The OFF position removes power from both lights.

Position Lights.

The position lights consist of red (left side) and green (right side) lights in the wing tips, and a white light at the fuselage tail. A dimmer control and a steady/flash/off control switch are provided to activate and control the position lights. In addition, the position lights may be overridden by the master exterior light switch on the left throttle grip (Figure 1-5). The position lights are powered by the right DC bus.

Position Lights Switch.

The position lights switch, placarded POSITION (Figure 1-157), is located on the lighting control panel on the right console. The switch has three positions, placarded FLASH, STEADY, and OFF. The position lights may be turned off with either the position light switch or by the master exterior light switch. In addition, the position lights may be dimmed with the master exterior light switch .

Strobe Anti-Collision Lights.

The strobe anti-collision lights are white, high intensity lights, mounted at each wing tip and on the fuselage tail. The strobe lights are powered by the left DC bus and are synchronized to flash simultaneously.

Strobe Anti-Collision Lights Switch.

The wing tip and tail strobe anti-collision lights are controlled by a two-position toggle switch on the lighting control panel. The switch is placarded ANTI-COLLISION and OFF (Figure 1-157). The switch is solenoidal in ANTI-COLLISION. In ANTI-COLLISION, left DC bus power operates the strobe lights.

Formation Lights.

White formation lights are installed on the lower outside of each vertical fin and at the top and bottom of the fuselage aft of the cockpit. Green electroluminescent formation lights are installed on the outside of each vertical fin, at top and bottom of aft fuselage between vertical fins, behind and below both sides of the cockpit on the fuselage and wing tips. These lights serve as a reference for formation flying. The formation lights are powered by the left AC bus.

Formation Lights Switch.

The formation lights are controlled by a rotary dimmer control, placarded FORMATION (Figure 1-157), located on the lighting control panel. The formation switch has two placarded range positions, with OFF position at the extreme CCW position, and BRT in extreme CW position. The switch is powered by the left AC bus.

Nose Floodlights.

A lighting fixture is installed in each aileron actuator fairing to illuminate both sides of the fuselage nose section. These lights are used as formation lights and during air refueling, and are controlled by the formation lights switch. A separate switch is provided for turning off the nose floodlights only.

Nose Floodlights Switch.

The nose floodlights switch (Figure 1-157) is a two-position switch, placarded NOSE ILLUM and OFF. The nose floodlights come on when the formation lights switch is out of OFF and the nose floodlights switch is in NOSE ILLUM. OFF position is used when reflective light may be disturbing. The switch is powered by the left DC bus.

Nacelle Floodlight.

A nacelle floodlight is incorporated with the top fuselage formation light. This light floodlights the engine nacelle area during air refueling. The nacelle floodlight is controlled and dimmable by the air refueling light switch. So that the light will also be available during formation flying, it is not interlocked with the air refuel control. The second lamp functions as the formation light and is controlled by the formation lights switch.

Nacelle Floodlight Control.

The nacelle floodlight on-off capability and lighting intensity are controlled by the rotary selector switch, placarded RCVR LT, located on the fuel system control panel (Figure 1-9) on the left console. The switch is powered by the left DC bus.

Air Refueling Lights.

Air refueling (slipway) lights, consisting of two flush lamp assemblies, are located on each side of the UARRSI slipway to illuminate the slipway and receptacle. The slipway lights are powered by the left DC bus.

Air Refueling Lights Switch.

The air refueling (slipway) and nacelle floodlights are controlled by a rotary selector switch, placarded RCVR LT, located on the fuel system control panel (Figure 1-9) on the left console. Any desired level of illumination, from OFF to BRT, may be selected by using the RCVR LT switch. The switch is powered on the left DC bus.

NVIS LIGHTS.

The NVIS lights are installed on the top of the fuselage, on the wing tips, and on the tail cone. The NVIS lights provide a reference for tactical and enroute maneuvering when NVISs systems are in use.

NVIS Lights Switch.

The NVIS lights are controlled by a three-position lever-locked toggle switch, placarded NVIS LTS (Figure 1-158), located on the auxiliary lighting control panel. The switch has three placarded positions, OFF, ALL, and TOP. The OFF position is used to select all NVIS lights off when normal position lights are in use. The ALL position is used to select all NVIS lights on (all other position lights are powered off). The TOP position is used to select only the top fuselage NVIS lights (all other NVIS/position lights are powered off).

NOTE

The strobe anti-collision lights are not affected by the NVIS LTS switch. In addition, steady/flash control is provided by the position light switch. The engine nacelle flood lights are controlled by the air refueling RCVR LT switch, and is independent of the NVIS LTS switch.

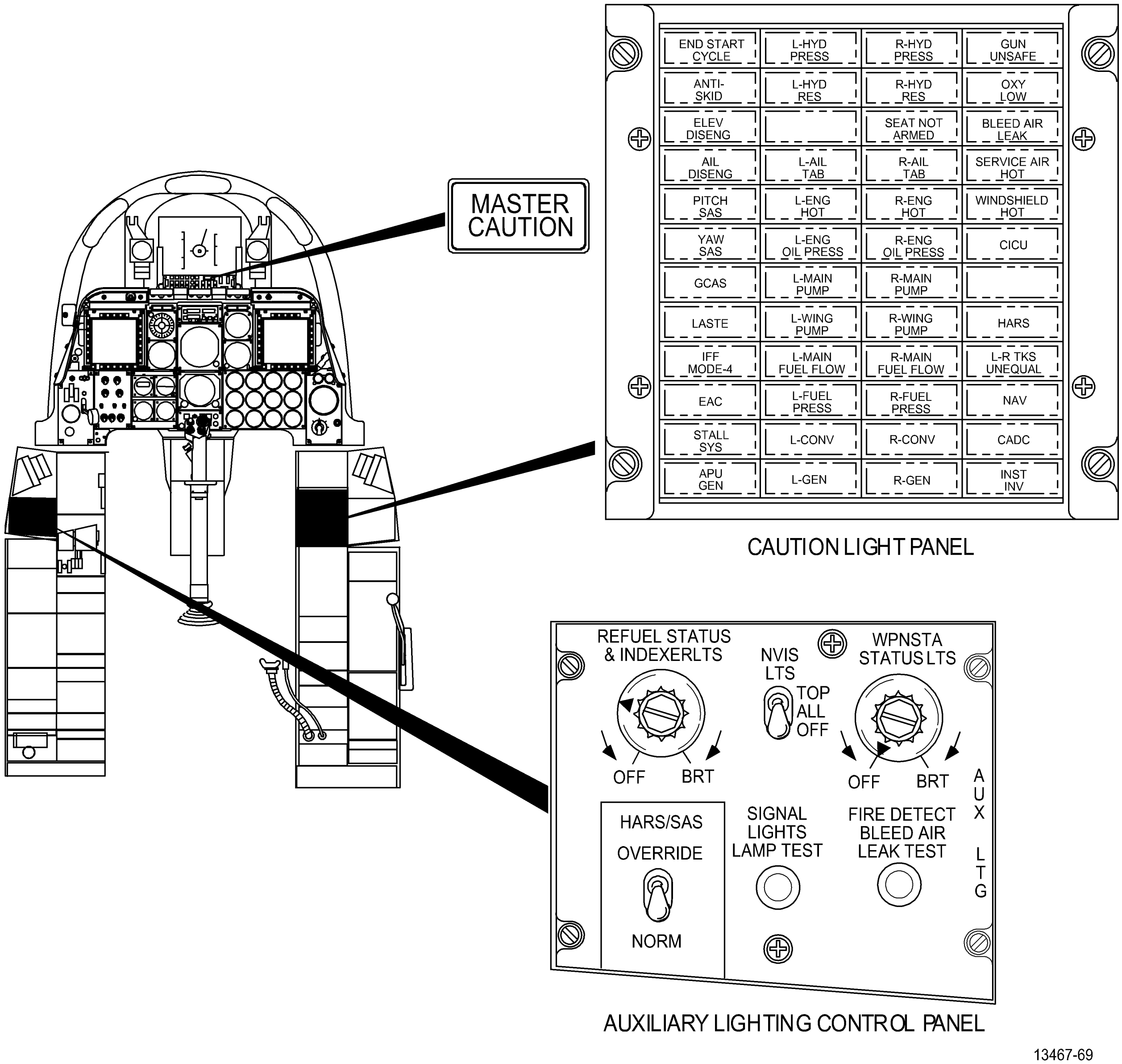


Figure 1-158. Caution Light Panel and Auxiliary Lighting Control Panel

INTERIOR LIGHTING.

Primary interior lighting is provided for instruments, control panels, and information placards. Secondary interior lighting is provided by low-intensity floodlights for the instrument panel, left and right consoles and controls. A utility light fixture (20, Figure FO-2), with a plug-in attachment, is installed at the aft portion of the left console for general utility purposes. Thunderstorm lights are provided to illuminate the instrument panel and consoles.

Separate cockpit controls are provided for variable control of illumination levels by area. These controls are located on the lighting control panel (Figure 1-157). The standby compass and accelerometer lights are controlled with the auxiliary instruments through a separate switch.

A bright-dim switch is provided for the warning/caution/advisory signal lights with automatic return to dim. A SIGNAL LIGHTS LAMP TEST button is provided to test certain warning/caution/advisory signal lights.

To achieve balanced illumination levels between adjacent instruments, control panels, etc., screwdriver adjustable controls are provided. These controls are located in the left electrical system load center.

Engine Instrument Lights Control.

The ENG INST lights control (Figure 1-157), powered by the auxiliary AC essential bus, controls the intensity level of the panel lights for the following:

- Left and right ITT indicators
- Left and right engine oil pressure indicators
- Left and right engine fuel flow indicators
- Left and right engine core speed indicators
- Left and right engine fan speed indicators
- APU tachometer
- APU temperature indicator

Flight Instruments Light Control.

The FLT INST light control (Figure 1-157), powered by the auxiliary AC essential bus, controls the intensity level of the panel lights for the following:

- ADI
- HSI
- Airspeed indicator
- VVI
- AOA indicator
- Clock
- NMSP switch identifiers
- Altimeter

The FLT INST light control must be rotated CW of the 9 o'clock position for the signal light switch to function.

Auxiliary Instrument Lights Control.

The AUX INST lights control (Figure 1-157), powered by the left AC bus, controls the intensity level of the panel lights for the following:

- Hydraulic pressure indicators
- Flap position indicator
- Fire extinguisher panel
- Fuel quantity panel and indicator
- Emergency jettison, lighting plate
- Radio call number
- Standby compass
- SAI
- Accelerometer
- Landing gear control panel
- LCP
- MFCD (L/R) OSBs
- AHCP
- TISL control panel

Accelerometer and Compass Lights Switch.

The accelerometer and compass lights are controlled by a two-position toggle switch, placarded ACCEL & COMP and OFF (Figure 1-157). The switch is powered by the left AC bus.

Floodlights Control.

The floodlights control, placarded FLOOD (Figure 1-157), provides variable intensity level to the low-intensity floodlights. These lights are powered by the auxiliary DC essential bus when the emergency floodlight switch is in OFF. There are low-intensity floodlights arranged along each side of the cockpit. The intensity level of each floodlight increases when the floodlights control is turned CW. In addition to the low-intensity floodlights, thunderstorm lights are provided. The thunderstorm lights come on when the floodlights control is turned beyond the maximum BRT detent to TSTORM. The thunderstorm lights are powered by the auxiliary DC essential bus. All low-intensity and thunderstorm floodlights are shaded to glare.

Emergency Floodlights Switch.

The emergency floodlights switch (Figure 1-10), a two-position switch, placarded EMER FLOOD and OFF, is located on the electrical power control panel. EMER FLOOD causes the cockpit floodlights to come on full bright using power from the battery bus. In this position the floodlights control is inoperative. In OFF, the floodlight intensity is controlled by the floodlights control.

Console Lights Control.

The console lights control, placarded CONSOLE (Figure 1-157), powered by the left AC bus, controls the intensity level of the panel lights for the following:

- Emergency flight control panel
- Throttle quadrant panel
- SAS panel
- Fuel system control panel
- Canopy control switch lighting plate
- UHF radio panel
- VHF/AM radio panel
- VHF/FM radio panel
- Antenna select control panel
- Intercom control panel
- IFF control panel
- Circuit breaker panel
- Electrical power control panel
- Chaff/flare control panel
- ILS control panel
- TACAN control panel
- HARS control panel
- Oxygen control panel
- Environment control panel
- Lighting control panel
- AAP
- CDU
- Color Cockpit Television Sensor (CCTVS)/DVADR control panels

Signal Lights Switch.

The signal lights switch (Figure 1-157), placarded SIGNAL LTS, is a two-position spring-loaded toggle switch, powered by the auxiliary DC essential bus that provides for either of two illumination levels, BRT and DIM, for warning, caution, and advisory signal lights, except for approach indexer and air refuel status lights. The warning, caution, and advisory signal lights are reset to bright automatically when the FLT INST lighting control is initially turned on. As the control is turned, the lights will return to dim. All signal lights are reset to bright automatically when the thunderstorm lights circuit is energized, or the signal lights bus power is lost.

Signal Lights Lamp Test Button.

The signal lights lamp test button (Figure 1-158), placarded SIGNAL LIGHTS LAMP TEST on the auxiliary lighting control panel, is a depress-to-test button. The signal lights lamp test button is powered by the auxiliary DC essential bus. Only those test circuits with the appropriate electrical power available will be activated when the button is depressed. In the following list, items marked with an asterick operate when only battery power is available; all others require power from the generators, converters, or some external source. Depressing the SIGNAL LIGHTS LAMP TEST tests the landing gear audio warning and lights the lamps in the following signal lights:

Instrument panel:

- GUN READY
- *STEERING ENGAGED
- *MARKER BEACON
- *CANOPY UNLOCKED
- *MASTER CAUTION
- *Landing gear condition (L-SAFE, N-SAFE, R-SAFE)
- *Landing gear handle (LDG GEAR DOWN)

NMSP:

- HARS, EGI, TISL, STR PT, ANCHR, TCN, ILS, UHF HOMING, and FM HOMING

Windshield bow:

- Approach indexers - test bright only, regardless of signal light switch position.
- Air refuel READY, LATCHED, DISCONNECT - test bright only, regardless of signal light test switch position.

Pedestal:

- TISL (TISL/AUX, OVERTEMP, DET/ACD, TRACK) (if pod installed and on).

Left console:

- *Emergency control panel (L-AIL, R-AIL, L-ELEV, R-ELEV)
- *SAS control panel (TAKEOFF TRIM)

Right console:

- *Caution light panel
- *Chaff/flare control panel ready lights

When the SIGNAL LIGHTS LAMP TEST button is released, all signal lights not already activated through normal system operation will go off. The SIGNAL LIGHTS LAMP TEST button does not test the fire warning lights.

Cockpit Utility Light.

The cockpit utility light (20, Figure FO-2) is a standard light fixture with self-contained brightness control installed at the aft portion on the left console. It functions as a general utility light and as an emergency lighting source. The plug-in type attachment and extensible cord permits removal and movement of the fixture in order to direct light to any desired area within the cockpit. An additional plug-in retainer base is affixed to the left canopy bow to permit directing light to any desired area without needing to hold the utility light. The cockpit utility light is powered by the auxiliary DC essential bus.

Right-Hand Map Light.

On affected aircraft, the right-hand map light (54, Figure FO-1) is a standard light fixture with self-contained brightness control installed under the right-hand corner of the glare shield. It functions as a general utility light, and as an emergency lighting source. To turn on the light, pull lamp fixture down and out, lamp will automatically illuminate. The right-hand map light is powered by the battery bus.

APPROACH INDEXER AND AIR REFUELING STATUS LIGHTS CONTROL.

A lighting control, on the auxiliary lighting control panel (Figure 1-158), placarded REFUEL STATUS & INDEXER LTS, is provided for controlling the intensity level of the AOA indexer, and air refuel status lights (3 and 6, Figure FO-1) located in the windshield area. The AOA indexer lights are powered by the right DC bus, and the air refuel lights are powered by the left DC bus. The control does not turn the lights off; it is only possible to achieve a dim level.

MASTER CAUTION AND CAUTION LIGHT PANEL LIGHTS.

The caution light panel (Figure 1-158), on the right console, consists of a series of green fault identification display lights. The master caution light on the UFC, is placarded MASTER CAUTION. The first indication of malfunction will be a light on the caution light panel flashing simultaneously with the MASTER CAUTION light.

The flashing light on the caution light panel will change from flashing to steady illumination when the MASTER CAUTION light is depressed, at which time the MASTER CAUTION light will go off. The caution light will remain on until the fault has been corrected. Each of the caution light panel lights is described in the applicable system description. The MASTER CAUTION and the caution light panel lights are powered by the DC essential bus, except the GUN UNSAFE light, which is powered by the DC armament bus.

CAUTION

Removing caution panel legend caps with power applied may cause a power surge that will damage the annunciator panel. When this happens, all caution lights will be inoperative. The MASTER CAUTION light should still function.

NOTE

- Upon initial application of power, all faults present at the time will come on steady and the MASTER CAUTION light will not come on. Any new fault(s) thereafter will come on flashing and the MASTER CAUTION light will come on flashing. After acknowledging the new fault(s) by depressing the MASTER CAUTION light, the legend(s) will become steady and the MASTER CAUTION light will go off.

- Intermittent faults will cause caution panel lights to flash and the MASTER CAUTION light will come on flashing. When the fault disappears, the panel light and the MASTER CAUTION light go off automatically.

- To change bulbs, depress individual light fixture and allow to release. The fixture will extend 1/16-inch. Using the finger grips on either side of the legend cap, carefully pull the light assembly housing to the fully extended position. Rotate the fixture to expose the lamp bases and remove and replace lamps as required. Reset fixture in panel and, using one continuous motion, fully depress assembly until flush with panel.

CENTRAL INTERFACE CONTROL UNIT (CICU).

The A-10 avionics system consists of hardware and software integrated on the aircraft, enabling safe and reliable accomplishment of tasks such as navigation, weapons delivery, and observation. The CICU portion of the system provides bus controller functionality for multiple MIL-STD 1553 buses, discrete interfaces to the weapons system, and MIL-STD-1760 interface.

The CICU system consists of the CICU computer and the two MFCDs. The system provides display of navigation waypoint data on a Tactical Awareness Display (TAD) and an alternate display for viewing and controlling CDU pages via the MFCDs. The system also provides HOTAS capability and control and display capability for the TGP, data link, ARC-210 radio(s) and the DSMS.

The purpose of the CICU is to perform data processing related to the control of the weapon systems and TGP and to provide a user interface to these systems. The CICU interfaces directly to the 11 weapon stations via various analog and discrete interfaces, allowing for total control of weapon initialization, launch, and jettison.

The following equipment interfaces directly or indirectly with the CICU: 1760 Relay Box, CADC, DVADR, CDU, IDM, SADL/EPLRS, DTS, EGI, IFFCC, ISA JDAM, MFCDs, ARC-210-1 and ARC-210-2, CMSP, control stick, TGP, Throttle, Wind Corrected Munitions Dispenser, and weapon stations 1-11.

CICU SYSTEM CONFIGURATION/INITIALIZATION.

When the CICU is powered on from the AHCP, various self tests are performed, signals are commanded to safe values, and mission data parameters are loaded for use in the current mission. During initialization, parameters may be loaded from Non-Volatile Memory (NVM) saved from the previous mission, or parameters can be selected to load from the DTC.

NOTE

Mission data parameters are never automatically uploaded from the DTC. Interaction is required in order to avoid inadvertent replacement of data that may need to be retained from a previous mission.

Various mission data parameters, used during a mission for system configuration, are saved to the system's NVM. This is so the system parameters may be used in either a future mission or be used to recover quickly from system failures or power-transients that may occur during a mission. For example, if a mission is performed, the aircraft is landed and refueled at a secondary airfield, and plans are to return to the home airbase, all parameters for the previous mission would be restored upon initialization. This prevents spending extra time re-entering configuration parameters that may have changed since an initial load of mission data parameters (SCL, etc.). Another example is a system failure or power transient during a mission. Upon re-initialization, the mission data parameters saved to NVM are restored to their values prior to the failure, also saving valuable time during the mission that would otherwise be used to recover from the failure.

Configuration parameters that are saved to NVM for initialization typically include all data that is pre-planned from the Aircraft/Weapons/Electronics (A/W/E) and loaded from the DTC, such as DSMS Inventory or Profile information. Other non-safety critical parameters that may be modified during a mission may also be saved to NVM.

Mission data parameters that are not saved to NVM for initialization typically include data that is used in a mission but may need to be set to a safe value upon initialization. In this case, the parameters used for initialization are always set to safe, default values. Classified parameters, such as GPS cryptographic keys, are never saved to NVM.

During initialization, the system always loads and uses the mission data parameters stored in NVM for use in the active mission. The alternative to using the parameters from NVM is to load the mission data parameters from the DTC. The Data Transfer System (DTS) Upload page is always displayed at the end of initialization, on both MFCDs, to give the option to load new mission data parameters from the DTC. If an upload is selected from the DTS Upload page, then the configuration parameters stored in NVM are automatically replaced by the data uploaded from the DTS. If an upload is not selected from the DTS Upload page and the pilot selects a different page (other than the DTS upload page) on either MFCD the configuration parameters loaded from NVM are used for the active mission.

DTS UPLOAD PAGE.

The DTS Upload page provides the ability to upload mission data parameters from the DTC. The DTS Upload page (see Figure 1-159) is the first page displayed, on both MFCDs, after initialization. The DTS Upload page may also be displayed by selecting the LOAD page select OSB on the appropriate MFCD if displayed via the page select function choices.

If the DTS Upload page is being displayed for the first time after initialization, configuration errors associated with the mission data parameters are suppressed since errors may be detected when the previous mission data is loaded from NVM. Once the DTS Upload page is exited, by selecting another page using a Page Select OSB (OSBs 12-15), or an upload is performed, any detected errors with the mission data parameters are displayed. For example, upon initialization, DSMS Inventory data is loaded from NVM. Since this data may be from the previous mission, it may be inaccurate, and therefore have errors. However, these errors are ignored, while the DTS Upload page is still displayed on both MFCDs, in order to reduce nuisance errors and allow a choice to load applicable data from the cartridge. When LOAD DSMS or LOAD ALL is selected, the DSMS data loaded from the DTC replaces the NVM data and any errors associated with the new parameters (e.g. loaded inventory mismatch) are displayed.

The DTS Upload page provides selections to perform upload of all page select configuration parameters (including TDL, TAD, DSMS, TGP, MFCD, ARC-210, OSBs and LOAD ALL, but not IFFCC or CDU).

Once an upload option is selected, the DTS Upload page shows that the selected upload is in progress and shows all other OSBs as disabled. If the upload fails, all OSBs are re-enabled and an appropriate annunciation of the failed upload is displayed (e.g. UPLOAD DSMS FAIL if a DSMS upload failed). Since both the CDU and the DTS are needed to perform any DTS upload, every upload OSB on the DTS Upload page is disabled if either the CDU or DTS is not available.

Any time an upload option is selected on the DTS Upload page, the system prevents further uploads or changes in the system until the upload is complete by performing the following:

- Display the DTS Upload page on both MFCDs
- Disable all OSBs on the DTS Upload page while the upload is in progress
- Disable HOTAS functions while the upload is in progress.

NOTE

Since both the CDU and the CICU need data from the DTC and only one can be performing an upload at any given time, there may be a delay in uploading data from the DTS Upload page if the CDU is currently uploading or downloading data from the DTC (especially waypoint or flight plan information).

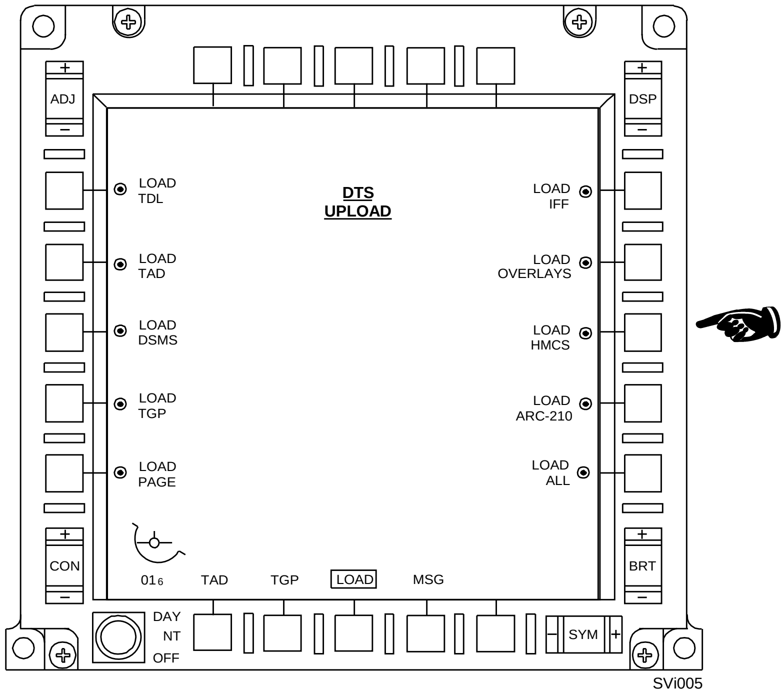


Figure 1-159. DTS Upload Page

DTS Upload Page Options.

LOAD IFF (OSB 6) OSB selection initiates an upload of IFF data from the DTS.

LOAD OVERLAYS (OSB 7) OSB selection initiates an upload of TAD Map Overlays from the DTC.

LOAD HMCS (OSB 8) OSB selection initiates an upload of HMCS profile data from the DTC.

LOAD ARC-210 (OSB 9) OSB selection initiates upload of ARC-210 configuration parameters for both ARC-210 radios from the DTC. The CICU may briefly tune the radio off the current channel during the FILL, but will return to that channel upon completion.

LOAD ALL (OSB 10) OSB selection initiates an upload of all configuration data from the DTC, except ARC-210 configuration data.

LOAD PAGE (OSB 16) OSB selection initiates an upload of MFCD page selection options (Page options for OSBs 12 - 15) from the DTC.

LOAD TGP (OSB 17) OSB selection initiates an upload of TGP configuration data from the DTC.

LOAD DSMS (OSB 18) OSB selection initiates an upload of DSMS configuration data from the DTC.

LOAD TAD (OSB 19) OSB selection initiates an upload of TAD profiles from the DTC.

LOAD TDL (OSB 20) OSB selection initiates an upload of TDL (SADL) and TDN (VMF) configuration data (including Pre-canned Text and MA messages) from the MDTC.

HOTAS AND SENSOR-OF-INTEREST (SOI).

The A-10C has 14 switches and buttons on the throttle and stick, not including the trigger and Weapons Release button. Many of these switches have four directions of movement; the Countermeasures Management Switch (CMMS) on the stick also has a Z-axis (push in) function. Many are also sensitive to how long they are held - a short duration (less than 1/2 second) and long duration (1/2 second or more). This gives the A-10C improved HOTAS Pilot-to-Vehicle Interface (PVI). However, there are still not enough combined switches and movements to dedicate to all of the capability integrated into the A-10C. The solution is to share switches using the design concept of SOI.

The SOI design concept allows the controlled allocation of the HOTAS system by multi-tasking certain HOTAS switches and buttons in an orderly manner. The SOI can be selected as the HUD (the slewable TDC and the AIM-9, when the HUD is in A/A Mode), the TAD, the TGP, and the Maverick missile. Because this design concept allows the system to have only one SOI at a time, the multi-tasked HOTAS switches can be dedicated to that SOI. For example, when the TGP is the SOI, the Target Management Switch (TMS) on the stick controls TGP functions; but when the Maverick is the SOI, the TMS controls Maverick functions. Additional information on the SOI concept is presented below.

Control Stick.

The A-10C stick is depicted in Figure 1-160. The function of each control mechanism is described in Figure 1-161.

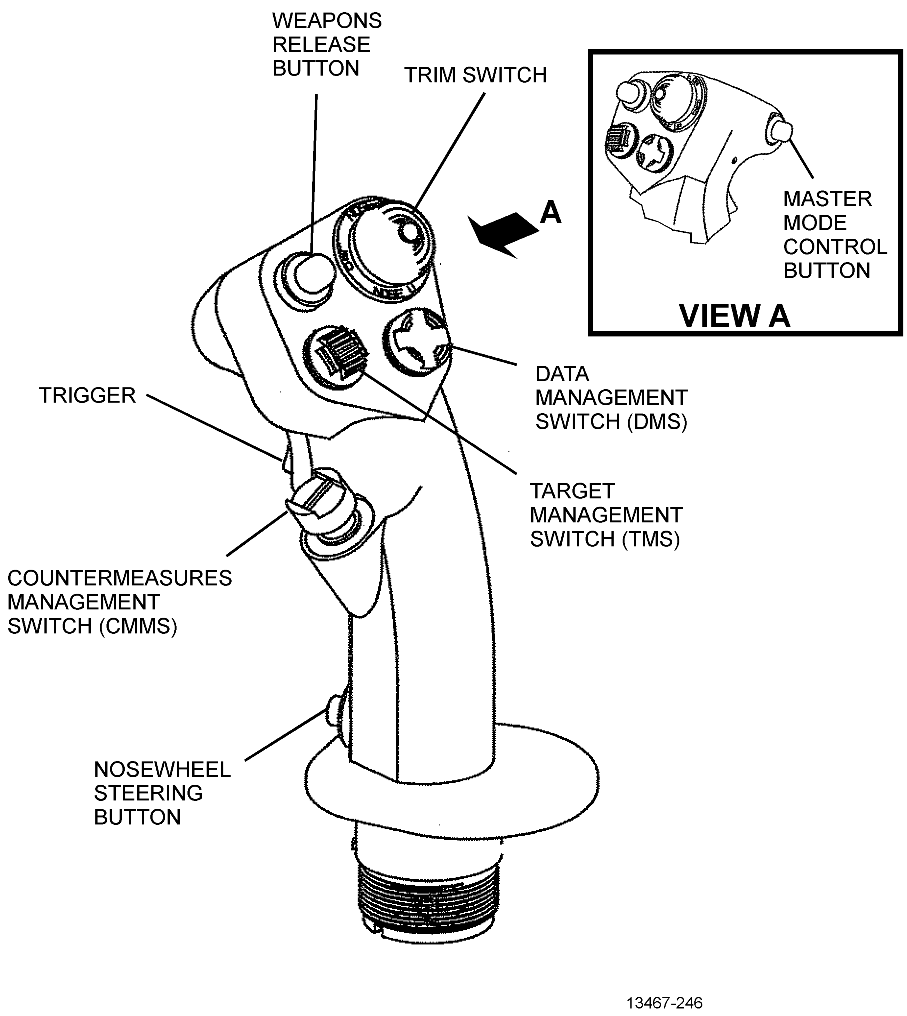


Figure 1-160. A-10C Stick

Figure 1-161. A-10C Stick Controls Functional Definitions

<table>
<tr><th rowspan="2">Stick</th><th rowspan="2" colspan="2">Action</th><th colspan="8">Selected Sensor of Interest</th></tr>
<tr><th>TAD</th><th>TGP</th><th>HUD A-G</th><th>HUD A-A</th><th>MAV</th><th>HMCS</th><th>HMCS Boresight</th><th>MSG</th></tr>
<tr><td rowspan="2">Master Mode Control (MMCB)</td><td rowspan="2">De-press</td><td>Short</td><td colspan="8">Toggle HUD (GUNS/CCIP/CCRP/NAV/Exit Air-to-Air)</td></tr>
<tr><td>Long</td><td colspan="8">Enter Air-to-Air Mode</td></tr>
<tr><td rowspan="8">Data Management Switch (DMS)</td><td rowspan="2">For-ward</td><td>Short</td><td>TAD Scale Decrease</td><td rowspan="2">Zoom Increase Focus Increase</td><td>Steerpoint Increment</td><td>Steerpoint Increment</td><td>Mav BS Reticle Up (MBS Only)</td><td rowspan="2">Brightness Increase</td><td rowspan="2">Text Rotate CCW</td><td>Change Shape</td></tr>
<tr><td>Long</td><td>Quick Map Toggle</td><td>Steerpoint Increment Cycle</td><td>Steerpoint Increment Cycle</td><td>Mav BS Reticle Up (MBS Only)/ Gyro Stabilize (when held)</td><td>Drop Shape</td></tr>
<tr><td rowspan="2">Aft</td><td>Short</td><td>TAD Scale Increase</td><td rowspan="2">Zoom Decrease Focus Decrease</td><td>Steerpoint Decrement</td><td>Steerpoint Decrement</td><td rowspan="2">Mav BS Reticle Down (MBS Only)</td><td rowspan="2">Brightness Decrease</td><td rowspan="2">Text Rotate CW</td><td rowspan="2"></td></tr>
<tr><td>Long</td><td>Select TAD Center Option</td><td>Steerpoint Decrement Cycle</td><td>Steerpoint Decrement Cycle</td></tr>
<tr><td rowspan="2">Left</td><td>Short</td><td>CEN/DEP Mode return to CTRN OWN</td><td>Right MFCD Video on the HMD On/Off</td><td>Gunsight Toggle Profile Toggle</td><td>Profile Toggle</td><td>Mav BS Reticle Left (MBS Only)</td><td>Right MFCD Video on the HMD On/Off</td><td rowspan="2">Boresight Roll CCW</td><td></td></tr>
<tr><td>Long</td><td colspan="6">HMD On/Off</td><td>HMD On/Off</td></tr>
<tr><td rowspan="2">Right</td><td>Short</td><td>Cycle TAD Center Option</td><td>Laser/IR Pointer Toggle</td><td>Gunsight Toggle Profile Toggle</td><td>Profile Toggle</td><td>Mav BS Reticle Right (MBS Only)</td><td>Cycle HMCS Profiles (Right MFCD Only)</td><td rowspan="2">Boresight Roll CW</td><td></td></tr>
<tr><td>Long</td><td colspan="4">Slave TGP to HMCS LOS</td><td>Slave MAV to HMCS LOS</td><td>Slave TGP to HMCS LOS</td><td>Slave TGP to HMCS LOS</td></tr>
</table>

Figure 1-161. A-10C Stick Controls Functional Definitions - Continued

Stick	Action		Selected Sensor of Interest							
			TAD	TGP	HUD A-G	HUD A-A	MAV	HMCS	HMCS Boresight	MSG
Target Management Switch (TMS)	Fwd	Short	HOOK Symbol Under Cursor/ Cycle through Symbols	Track Toggle (Area/ Point/INR)	TDC Ground Stabilize	Conical Scan/Con-sent to Self Track	Track	Hook Symbol Under Crosshair	Complete Boresight/Set Occlusion Point	
		Long	Make SPI					Make Hooked Object or HDC SPI	Complete Occlusion Zone	
	Aft	Short	Un-Hook Symbol	FLIR Autofocus	IFFCC Weapon Solution SPI	Breaklock/ Return to Boresight	Ground Stabilize	Un-Hook Symbol	Remove Occlusion Point	
		Long	Reset SPI to Current Steerpoint							
	Left	Short	Acknowledge W/C/N (Includes Message Receipt Acknowledge)							
		Long	Sensor Point of Interest (SPI) Broadcast							
	Right	Short	Create Mark at TAD Cursor	Create Mark at TGP LOS	Create Mark at TDC	Create Mark at TDC	Create Mark at Mav LOS	Create Mark at HDC		
		Long	Make Last Markpoint SPI							
Nosewheel Steering Button (NWS)	Ground		NWS Button Engage/Disengage							
	Air		Laser/IR Pointer HOT Fire or Toggle Fire							
		AR	AR Disconnect/Reset							
Countermea-sures Manage-ment Switch (CMMS)	Fwd		CMS Forward Program							
	Aft		CMS Aft Program							
	Left		CMS Left Program							
	Right		CMS Right Program							
	Depress		Consent							
Weapons Release Button	Depress		Release Selected Weapon (Master Armament - ARM)							

Figure 1-161. A-10C Stick Controls Functional Definitions - Continued

Stick	Action	Selected Sensor of Interest							
		TAD	TGP	HUD A-G	HUD A-A	MAV	HMCS	HMCS Boresight	MSG
Trim	Up/Down	Trim Pitch Up/Down							
	Left/Right	Trim Roll Left/Right							
Trigger	1st Detent	PAC-1, CAVTR Record (CAVTR in STBY)							
	2nd Detent	Gun Fire, PAC-2, CAVTR Record (CAVTR in STBY)							

NOTE

- LONG refers to >1/2 second and SHORT refers to <1/2 second of depression.

Throttle.

The A-10 Throttle is depicted in Figure 1-162. The function of each control mechanism is detailed in Figure 1-163.

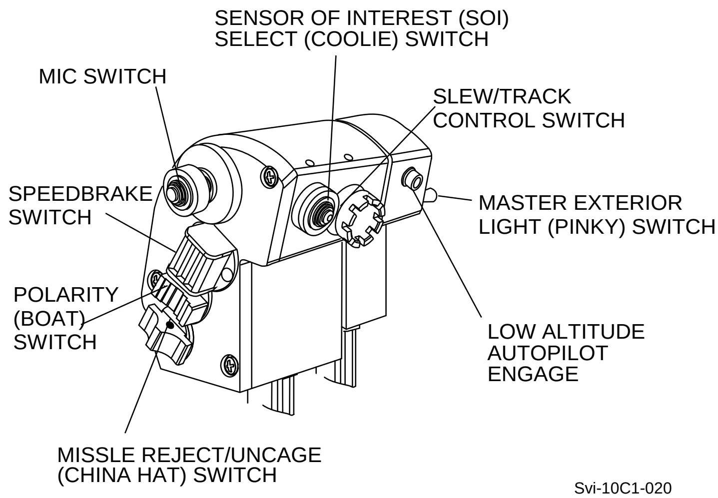


Figure 1-162. A-10C Throttles

Figure 1-163. A-10C Throttle Controls Functional Definitions

<table>
<tr><th rowspan="2">Stick</th><th rowspan="2" colspan="2">Action</th><th colspan="8">Selected Sensor of Interest</th></tr>
<tr><th>TAD</th><th>TGP</th><th>HUD A-G</th><th>HUD A-A</th><th>MAV</th><th>HMCS</th><th>HMCS Boresight</th><th>MSG</th></tr>
<tr><td rowspan="4">MIC Switch</td><td colspan="2">Fwd</td><td colspan="8">Transmit Front Radio (Rotary = VHF)</td></tr>
<tr><td colspan="2">Aft</td><td colspan="8">Transmit Aft Radio (Rotary = Anything)</td></tr>
<tr><td colspan="2">Up</td><td colspan="8">No Transmit (Rotary = Anything)</td></tr>
<tr><td colspan="2">Down</td><td colspan="8">UHF</td></tr>
<tr><td rowspan="3">Speed Brake</td><td colspan="2">Fwd</td><td colspan="8">Retract Speed brakes</td></tr>
<tr><td colspan="2">Aft</td><td colspan="8">Extend Speed brakes</td></tr>
<tr><td colspan="2">Center</td><td colspan="8">Hold Speed brakes Position</td></tr>
<tr><td rowspan="3">Polarity Switch</td><td colspan="2">Fwd</td><td colspan="4">TGP FLIR Black Hot</td><td>MAV
Dark/Cold on
Light/Hot</td><td colspan="3">TGP FLIR Black Hot</td></tr>
<tr><td colspan="2">Aft</td><td colspan="4">TGP FLIR White Hot</td><td>MAV
Light/Hot on
Dark/Cold</td><td colspan="3">TGP FLIR White Hot</td></tr>
<tr><td colspan="2">Center</td><td colspan="4">TGP CCD</td><td>MAV
Boresight
-Forced
Correlate
-Auto</td><td colspan="3">TGP CCD</td></tr>
<tr><td rowspan="4">Missile Reject Uncage (China Hat) Switch</td><td rowspan="2">Fwd</td><td>Short</td><td>FOV Toggle</td><td>-FOV Change
-LSS FOV Change</td><td>Select Mav Video / Make Mav Sensor of Interest (SOI) if Mav Profile Selected</td><td>Uncage/ Consent to Self Track</td><td>FOV Change</td><td>-TGP FOV Change
-LSS FOV Change</td><td></td><td></td></tr>
<tr><td>Long</td><td colspan="8">Slave All to SPI</td></tr>
<tr><td rowspan="2">Aft</td><td>Short</td><td>Reset Cursor</td><td>LSS Toggle</td><td>Reset/Cage TDC to TVV</td><td>-Recage
-Manual
Sequence</td><td>-Recage
-Manual
Sequence</td><td>Reset/Cage HDC to Crosshair</td><td></td><td></td></tr>
<tr><td>Long</td><td colspan="8">Slave TGP to Steerpoint</td></tr>
</table>

Figure 1-163. A-10C Throttle Controls Functional Definitions - Continued

<table>
<tr><th rowspan="2">Stick</th><th rowspan="2" colspan="2">Action</th><th colspan="8">Selected Sensor of Interest</th></tr>
<tr><th>TAD</th><th>TGP</th><th>HUD A-G</th><th>HUD A-A</th><th>MAV</th><th>HMCS</th><th>HMCS Boresight</th><th>MSG</th></tr>
<tr><td rowspan="3">Master Exterior Light Switch</td><td colspan="2">Fwd</td><td colspan="8">Position lights to dim steady/Strobes off</td></tr>
<tr><td colspan="2">Aft</td><td colspan="8">Exterior lights per lighting panel</td></tr>
<tr><td colspan="2">Center</td><td colspan="8">Black out all exterior lights</td></tr>
<tr><td rowspan="2">LAAP Engage (Left Throttle Button)</td><td rowspan="2">De-press</td><td>Short</td><td colspan="8">LAAP</td></tr>
<tr><td>Long</td><td colspan="8">Image Capture</td></tr>
<tr><td rowspan="2">Slew/Track</td><td colspan="2">Slew</td><td>Slew TAD Cursor</td><td>Slew TGP</td><td>Slew TDC</td><td>Slew AIM-9/ Consent to Self Track</td><td>Slew Mav</td><td>Slew HDC</td><td>Slew Bore-sight/Occult Point</td><td>Slew IMG Cursor</td></tr>
<tr><td colspan="2">Z Axis</td><td colspan="8">(RESERVED FOR FUTURE USE)</td></tr>
<tr><td rowspan="8">SOI Select (Coolie) Switch</td><td rowspan="2">Up</td><td>Short</td><td colspan="2">HUD as SOI</td><td colspan="2">HMCS as SOI</td><td colspan="4">HUD as SOI</td></tr>
<tr><td>Long</td><td colspan="8">Message Quick Look</td></tr>
<tr><td rowspan="2">Down</td><td>Short</td><td colspan="8">Swap Left MFCD and Right MFCD</td></tr>
<tr><td>Long</td><td colspan="8">DSMS Quicklook (Display DSMS Weapon Status Page & Selected Profile)</td></tr>
<tr><td rowspan="2">Left</td><td>Short</td><td colspan="8">Cycle Left MFCD Page</td></tr>
<tr><td>Long</td><td colspan="8">Left MFCD as SOI</td></tr>
<tr><td rowspan="2">Right</td><td>Short</td><td colspan="8">Cycle Right MFCD Page</td></tr>
<tr><td>Long</td><td colspan="8">Right MFCD as SOI</td></tr>
</table>

NOTE

LONG refers to >1/2 second and SHORT refers to <1/2 second of depression.

MFCDs.

The PE-modified A-10C aircraft includes two identical MFCDs as part of the pilot-vehicle interface. Each MFCD (Figure 1-164) is a 5-in. by 5-in. color active matrix liquid crystal display that operates as both a monitor and input/output device. The MFCD displays video outputs generated by the CICU and translates inputs, entered via MFCD panel switches, to the CICU for processing. Switches are also provided for control of the display mode and appearance.

Option Select Buttons (OSBs).

For data entry and display format changes, the MFCD provides 20 bezel-mounted, momentary, single-action pushbutton switches called OSBs. The OSBs, arranged five along each side of the MFCD screen, are numbered (but not labeled) from 1 to 20, beginning with the upper leftmost key and proceeding in a clockwise direction. The keys are individually programmable and perform different functions depending on the display format selected. The OSB legends are displayed on the display screen, directly adjacent to the OSBs.

OSB Symbols.

Most of the OSB legends contain a symbol indicating the function of the OSB. These are the same symbols used by the CDU (refer to Figure 1-50, sheet 2).These symbols and their functions are:

Symbol	Type	Description
↕	Rotary	Cycle through values
⨀	System Action	Perform displayed action
[ ]	Data Entry	Direct data entry allowed
±	Incre-ment/Decre-ment	Data changed by CDU ± rocker switch, UFC, ± rocker switch, or direct entry
→	Branch	Branch to displayed page
▲▼	Navigation	Multidirectional Cycling of data

NOTE

Navigation symbols are unique to the MFCD; they are not used by the CDU. The navigation symbols allow cycling through data in both up and down directions. Navigation OSBs are used in pairs, with the upward-pointing symbol next to the upper OSB and the downward-pointing symbol next to the lower OSB. The current data associated with the OSB symbol pair is displayed between the symbols. When a navigation OSB is depressed, the data displayed changes value at a 3-Hz rate while the OSB is held depressed. Releasing the OSB selects the displayed data.

Disabled OSB Indication.

When an OSB has been disabled, but still needs to be present to display pertinent information, the symbol is removed from the associated OSB legend to indicate that the OSB is nonfunctional. If an OSB function is disabled, the OSB legend, with symbol, is removed from the display screen.

In-Progress Indication.

To indicate that a commanded action or state change cannot be immediately accomplished and/or verified, the OSB legend symbol is replaced by an asterisk, indicating the OSB is "in progress", but the operation has not been completed.

OSB Depression Indication.

In addition to the tactile or physical sensation of an OSB being depressed, each OSB contains an indicator that turns on when the OSB is depressed. This indication has two meanings: First, it provides visual feedback that the OSB has been depressed. Second, if the indication remains when another OSB is actuated, it indicates that the OSB is stuck. In the latter situation, because the system cannot indicate which OSB is stuck, the indication is removed from the stuck OSB while the other OSB is depressed.

Page Select OSBs.

OSBs 12 through 15 provide a page selection function for all MFCD pages. The page selections available from the displayed page are indicated in the legends for OSBs 12 through 15. To change the displayed page, depress the OSB below the legend for the desired page. When a page select OSB is depressed, the OSB legend is highlighted and the desired page is displayed on the MFCD. The display options available via the page select OSBs are listed below, by OSB legend:

a. TAD - Allows display and control of the Tactical Awareness Display.

b. TGP - Displays Targeting Pod video.

c. DSMS - Allows display and entry of DSMS information.

d. MSG - Displays the Message Page (Data Link only).

e. CDU - Provides a repeat of the CDU display.

f. COMM - Displays the COMM Page.

g. STAT - Allows display of system status and BIT results (System Status Page).

h. LOAD - Allows access to DTC control for CICU information.

i. MAV - Displays Maverick video.

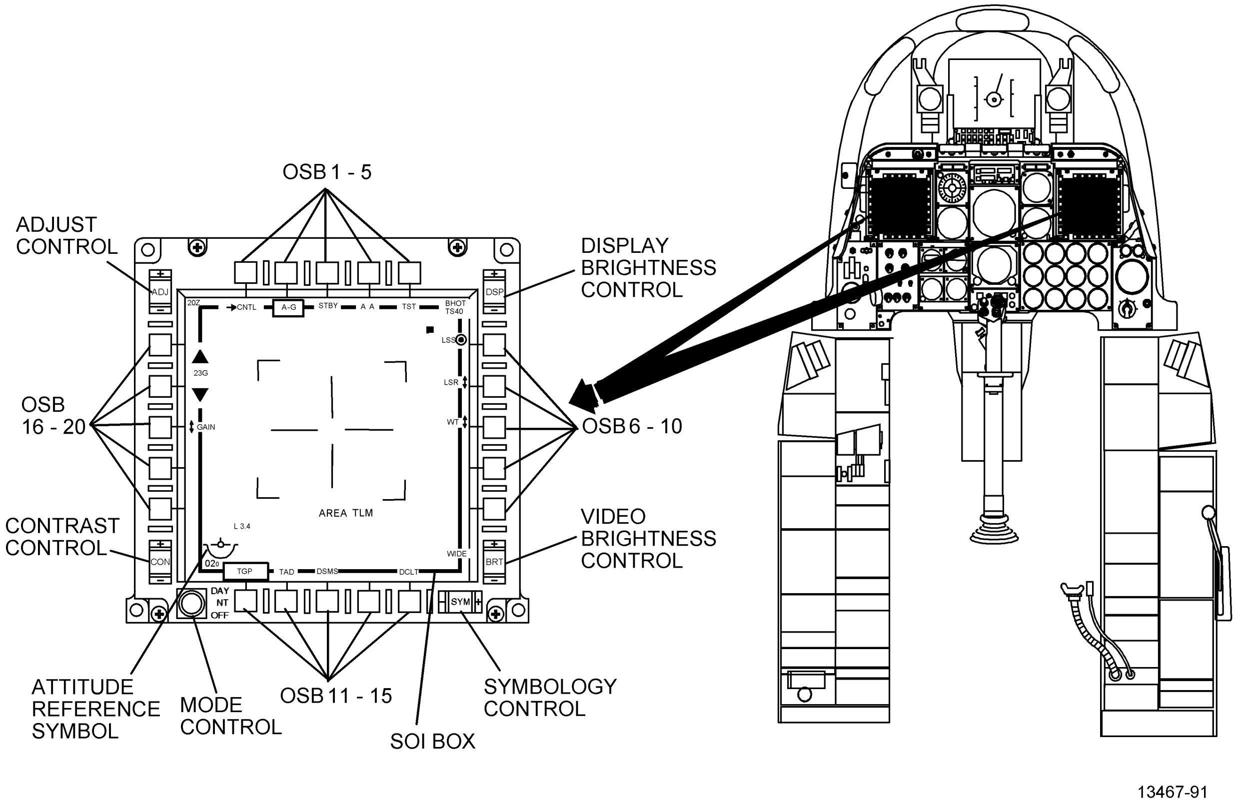


Figure 1-164. Multifunction Color Displays (MFCDs)

The displays available for selection from the page select OSBs are normally pre-selected via the A/W/E and loaded to the aircraft via A/W/E. The availability and/or order of the pages displayed can be changed, in flight, by depressing any of OSBs 12 through 15 for longer than 1 second. The Display Program Page will be displayed, providing the means to remap the page select OSBs.

Rocker Switch Controls.

Five labeled rocker switches, located at the corners of the MFCD display screen, are provided to allow control of MFCD display contrast and brightness as follows:

a. DSP - Display brightness control, located beside upper right corner of the display screen, allows display backlight to be varied, increasing or decreasing the brightness of all displayed colors.

b. BRT - Video brightness control, located beside bottom right corner of the display screen, allows the brightness of the external video to be varied.

c. SYM - Symbology control, located under bottom right corner of display screen, allows brightness of CICU-supplied symbols to be varied.

d. CON - Contrast control, located beside bottom left corner of display screen, allows contrast of external video to be varied.

e. ADJ - Adjust (+/-) control, located beside upper left corner of display screen, allows TAD map scale to be increased or decreased in manual mode.

Mode Control.

A three-position rotary switch, located below the bottom left corner of the MFCD display screen, allows selection of the MFCD display mode to support day (DAY), night (NT), or power-off (OFF) MFCD operation.

Attitude Reference Symbol (ARS).

In the lower left corner of every MFCD page display is an ARS, indicating the aircraft's current pitch and roll. (Refer to Figure 1-164). The ARS is derived from the basic attitude indicator and consists of three components:

a. Ownship reference - Aircraft symbol at opening of ground reference arc.

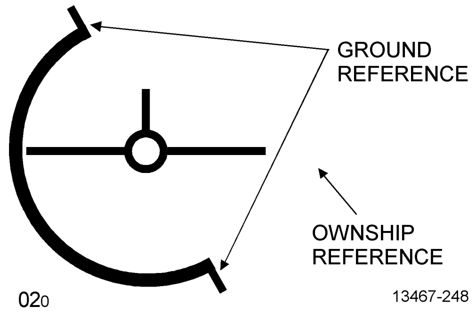


Figure 1-165. ARS Components (Displayed in Straight Flight With 45° Left Bank)

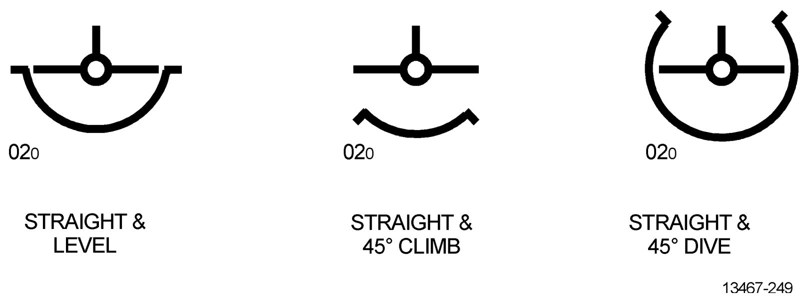


Figure 1-166. ARS Displayed in Various Attitudes

b. Ground reference -Arc terminated by the ground ticks. During straight and level flight, with equal amounts of ground and sky viewable, the arc displays 180°. During a bank, a 180° arc is displayed, but is rotated to correspond with the degrees of banking. During a dive, the arc displays increasingly more than 180° as the dive angle increases, making a greater amount of ground viewable. During a climb (nose up), the arc displays increasingly less than 180° as the nose-up angle increases, making a lesser amount of ground viewable.

c. Ground ticks - Ticks extending outward at ends of ground reference arc.

The arc portion of the symbol is the "ground" portion of the traditional attitude indicator. (See Figure 1-165.) During straight and level flight, equal amounts of ground and sky are viewable; therefore, the arc displays a full 180 degrees and the ground reference is aligned with the ownship reference "wingtips". (Refer to Figure 1-166.) During a level 45 degree left bank, a full 180 degree arc is still seen but is rotated clockwise 45 degrees (Refer to Figure 1-165.) During dive maneuvers, the attitude indicator displays increasingly more ground as the dive increases; therefore, the arc increases in size to represent increasing dive angles. During nose-up attitudes, the attitude indicator presents less ground; therefore, the arc decreases in size to correspond to the current pitch attitude. (Refer to Figure 1-166.)

Barometric Altitude Display.

The Barometric Altitude is displayed below the ARS symbol. The Barometric Altitude display is based on Ownship, with the first two digits representing thousands of feet and the third (smaller sized) digit representing hundreds of feet.

SOI Box.

The SOI Box is an MFCD-size box that indicates when an MFCD is the current SOI.

MFCD Operations.

The MFCD operations described in the following paragraphs facilitate the use of the MFCD in aircraft operations. Other information on MFCD use is included within other operation descriptions in this manual, as applicable.

Display System Status.

The MFCD provides a system status display to show system operational status and provide a means to troubleshoot system faults. The System Status Pages, accessible by selecting the STAT OSB found on most MFCD screens, provides an overview of avionics subsystem LRU status, various maintenance functions for testing the avionics systems controlled by the CICU, and control of power application for selected LRUs. The System Status Pages consist of three parts, System Status Page 1 (Figure 1-167), System Status Page 2 (Figure 1-167.1), and System Status Page 3 (Figure 1-167.2). System Status Pages provide for selecting an LRU for display of fault information or for controlling functions associated with the selected LRU. LRUs are selected via the LRU Select OSBs (OSBs 19 and 20). The current LRU selection is displayed between OSBs 19 and 20 and is indicated by an arrow adjacent to the LRU name in the LRU list. Depending on the LRU selected, functions available include performing BIT (via TEST, OSB 18), viewing fault information (via MFL Flight Selection, OSB10 and MFL Navigation, OSBs 16 and 17), controlling power to the LRU (Power Control, OSB 7), and resetting failures (via RESET, OSB 6 and MFL CLEAR, OSB 9). The WS CHK OSB (OSB 5) is used to initiate the Bomb Release and Selective Jettison Check mode. The LRU Link system action OSB (OSB 8) displayed on System Status Page 2 when DVADR is selected is used to start the eject or mount process of the RMMD. If the DVADR does not detect the RMMD the MOUNT will be displayed, otherwise EJECT will be displayed. If the DVADR LRU status is NO COMM or the DVADR test or reset is in progress, OSB 8 is disabled. The LRU Present rotary OSB (OSB 8) displayed on System Status Page 3 when either ARC-210-1 or ARC-210-2 is selected is used to indicate whether the selected ARC-210 radio is present on the aircraft. By default ARC-210-1 will be present and ARC-210-2 will not be present. To change this configuration, the LRU Present rotary OSB is used. The ARC-210 present/not present configuration is stored in NVM; therefore, the latest present/not present configuration for ARC-210-1 and ARC-210-2 is retained until the configuration is changed. When either ARC-210-1 or ARC-210-2 is selected on System Status Page 3, the OFP ID and Boot Code for the selected radio are displayed. The MAINT FAULT LOG DISPLAY lists (below the LRU list) the faults for the selected LRU and MFL Flight, two faults at a time.

To simplify determination of LRU health, each line in the LRU list is highlighted in color as follows:

- Green - LRU is ready. (Green reverse video if STAT field is VALID.)
- Yellow - LRU is in marginal or degraded condition. LRU reports at least one non-critical failure but no critical failures. (Yellow reverse video if STAT field is DEGR.)
- White - LRU is in unknown state (e.g., off, initialization, or test). (White reverse video if STAT field is TEST, INIT, or OFF.)
- Red - LRU has at least one critical failure. (Red reverse video if STAT field is NC or FAIL.)

The following LRUs/SRUs in the LRU list can be selected individually for Initiated BIT (IBIT) via the System Status Page, using OSBs 19 and 20 to navigate up/down the list.

- CICU and its SRUs: Weapon Processor (WP), Mission Processor (MP), Datalink Processor (DLP), Graphics Video Module (GVM), Armament Logic Module (ALM).
- Weapon Stations 3, 4, 5, 7, 8, and 9 (depending on store type, each of these stations may be displayed on the LRU list as JDAM, WCMD, or 1760, e.g., JDAM4).
- TGP.
- Left and Right MFCD (LTMFCD, RTMFCD).
- HOTAS and its SRUs: Stick, Throttle (THROT), AHCP.
- EGI.
- IFFCC.
- CDU.
- EPLRS.
- IFF.
- 515 IDM.
- 514 DVADR.
- 513 ARC-210-1.
- 513 ARC-210-2.

The status (STAT) displayed for each LRU/SRU in the list may be one of the following (not all status indications are available for each LRU):

- INIT - LRU is in power-up or initialization phase.
- FAIL - Critical failure in LRU.
- DEGR - Non-critical or degraded failure in LRU.
- NC - LRU not communicating with CICU.
- TEST - LRU is in an IBIT.
- VALID - LRU is communicating properly and shows all passing conditions.
- OFF - Power has been removed from LRU.

Test (TEST) status displayed for an LRU in the list is from the most recent initiated BIT for LRUs having a BIT capability (not available for individual SRUs in the list):

- UN - IBIT has not been performed or has been aborted before completion.
- IP - IBIT is in progress.
- PASS - LRU passed most recent IBIT.
- FAIL - LRU failed most recent IBIT.

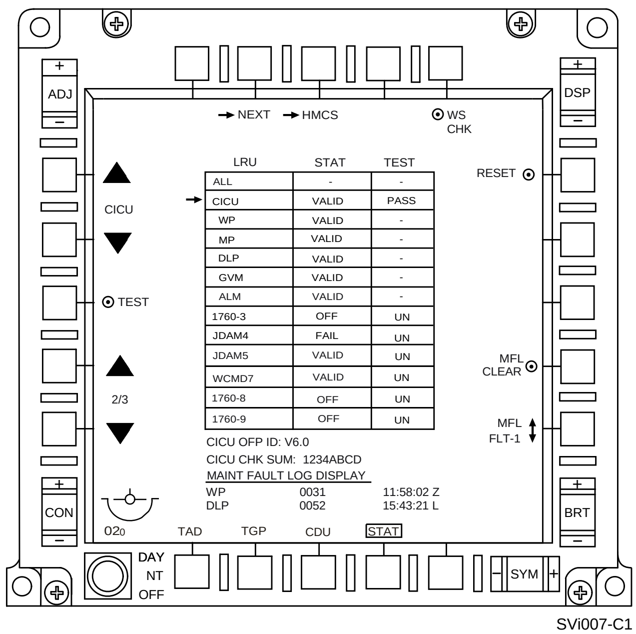


Figure 1-167. System Status Page 1

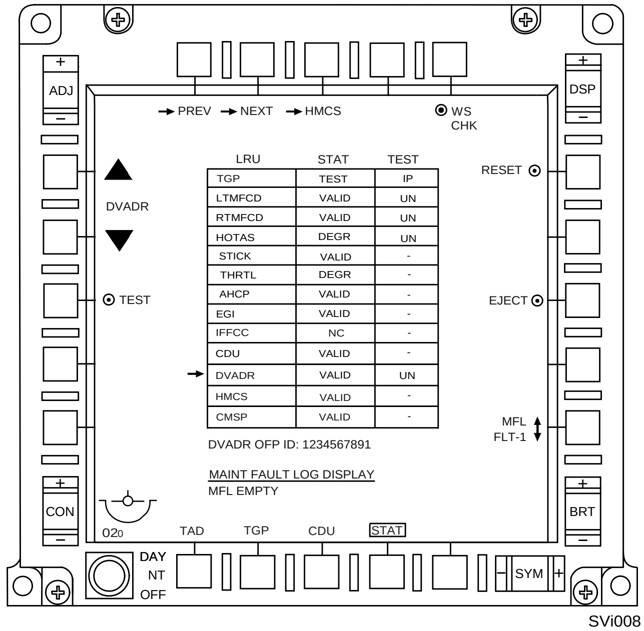


Figure 1-167.1. System Status Page 2

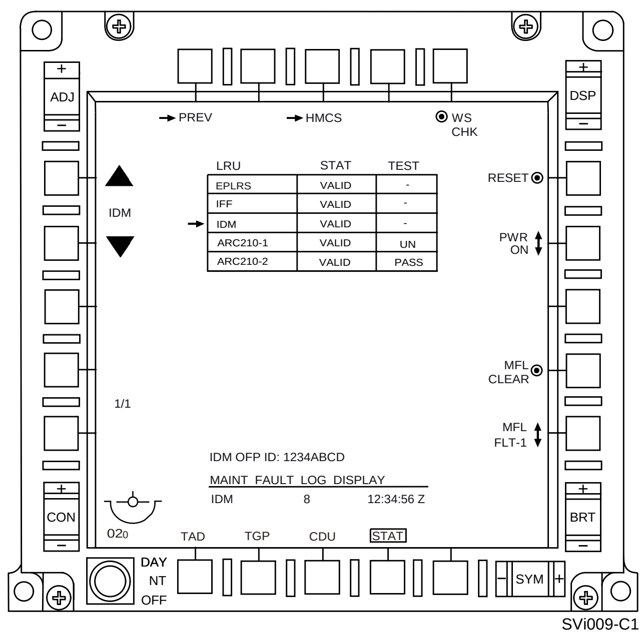


Figure 1-167.2. System Status Page 3

INITIATE LRU BIT.

The Test function on the System Status Page provides a means to initiate BIT in those LRUs having the BIT capability. If system conditions are satisfied for IBIT on a selected LRU, the TEST OSB (OSB 18) on the System Status Page will be enabled when the LRU is selected. Selecting the TEST OSB will cause IBIT to be run on the selected LRU, with test results to be displayed in the STAT and TEST columns of the LRU list on the System Status Page.

CAUTION

Do not command a DVADR BIT within 30 seconds of a previous DVADR BIT, CICU failure may result.

RESET LRU.

The Reset function on the System Status Page provides a means to correct a failed or noncommunicating system during a mission. When a reset is initiated via depression of the RESET OSB (OSB 6), the CICU will attempt to reset the desired system to attempt to reestablish communications or to correct faults. Since failures reported by the LRUs are latched by the CICU on the System Status Page, the reset function will reset the FAIL or DEGR status indication on the System Status Page for the selected LRU.

CONTROL 1760 WEAPON STATION POWER.

The System Status Page provides a means to control power to 1760 weapons stations when the weapons stations are loaded. The PWR OSB (OSB 7) on the System Status Page allows power to be applied or removed when the selected LRU is a 1760 weapon station. The power control function can be used to reset a power interruption to a 1760 weapon station. When the PWR OSB is depressed, the CICU commands the 1760 store to erase its classified data. When the classified data has been erased, the CICU removes DC power from the weapon station.

Slew Sensitivity.

The slew sensitivity is adjustable via OSB 8 when the throttle is the selected LRU. The slew setting selects the sensitivity of the slew switch for all sensors except the maverick. Slew settings range from 1.0 (most sensitive) to 7.9 (least sensitive) with 2.0 being the default. Sensitivity sets the dead band of the slew switch to prevent undesired slew and jitter. The slew setting is saved in the Nonvolatile Memory (NVM).

Declutter MFCD Display.

The MFCD declutter function is used to remove OSB legends from the MFCD display screen when TGP, TAD (with the exception of the TAD Map Settings Page), and Maverick video pages are displaying so that the underlying video can be better viewed. Declutter is activated by selecting DCLT (OSB 11). Declutter removes the legends for OSBs 1 through 10 and 16 through 20, leaving only the page select and declutter OSB legends (OSBs 11 through 15) at the bottom of the display screen. (OSB legends and functions remain active, even though they are hidden.) OSB legend DCLT is displayed in reverse video. If the TAD Map Settings Page is displayed, OSB 11 only removes the TAD Map Overlays Table. (Declutter is activated only for the displayed page.) Depressing OSB 11 a second time deactivates the declutter function and restores the OSB legends and the TAD Map Overlay Table on the TAD Map Settings Page. Declutter is not available on non-sensor pages (i.e., Message Read Pages, DSMS Pages, DTS Upload Page, CDU Repeater Page, System Status Pages, and Data Link Configuration Page).

Swap MFCDs.

The MFCD swap function is used to swap the contents of the left and right MFCDs. This function may be used to overcome a failed MFCD, to optimize the location of information for the current mission, or to adjust the displays according to the ambient light. All information, legends, and page select OSB order are transferred with the display. The swap function does not change the previously selected SOI. The swap function is controlled by SOI Select-DOWN/SHORT.

Select Display Pages.

Selecting a layer (page) for display on the MFCD is accomplished via the page selection OSBs or HOTAS. The page selections available from the displayed page are indicated in the legends for the page selection OSBs (OSBs 12 through 15). To change the displayed page, depress the OSB below the legend for the desired page. Page selection via HOTAS is accomplished through the throttle SOI Select switch. Selecting SOI Select-LEFT/SHORT cycles through the display layers on the left MFCD, from OSB 12 through 15, wrapping back to OSB 12. Selecting SOI Select-RIGHT/SHORT cycles through the display layers on the right MFCD, from OSB 15 through 12, wrapping back to OSB 15. When a page is selected, the OSB legend for that page is highlighted and the desired page is displayed on the MFCD.

Page Selection OSBs.

The pages available for selection via the page selection OSBs are normally pre-selected via A/W/E and loaded to the aircraft via the DTC. These OSB assignments can be remapped in flight, providing a means to change the availability/order of the pages displayed. This remapping capability is provided via the Display Program Page (Figure 1-168), which can be displayed by depressing any of OSBs 12 through 15 for longer than 1 second. To reprogram the page selection OSBs from the Display Program Page, depress the OSB for the desired page (OSB 6 through 10 or 16 through 20). Then depress the page selection OSB (OSB 12 through 15) where the selected page should be assigned. The legend for the page selection OSB should change to reflect the new assignment. If a page selection option is being remapped for a page that is already assigned to one of OSBs 12 through 15, the option will be reassigned to the new OSB and will be removed from its previously assigned OSB. To delete an existing page selection OSB assignment, depress CLR (OSB 10) and then depress the OSB whose page selection assignment is being deleted.

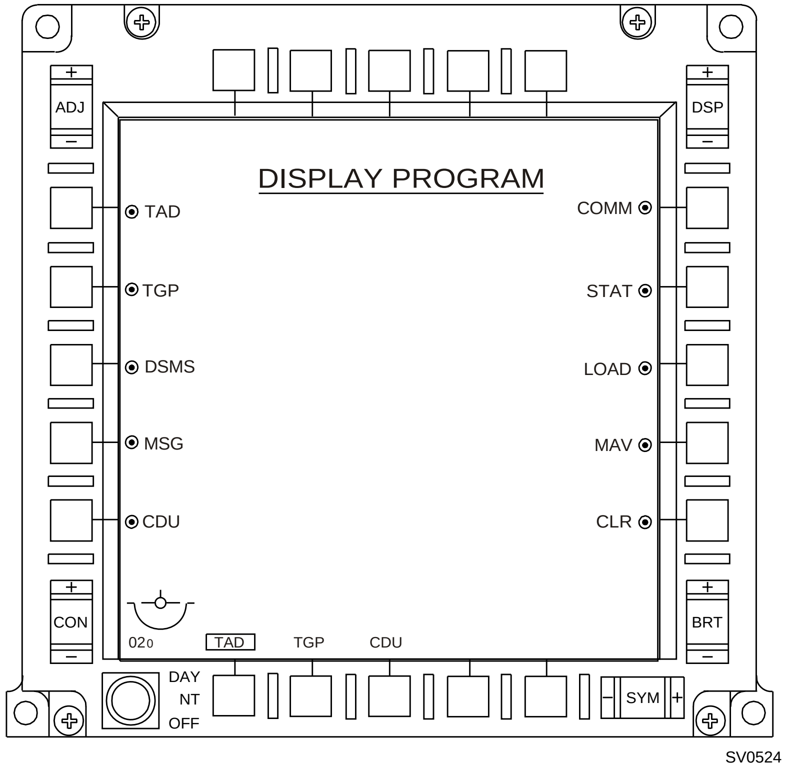


Figure 1-168. Display Program Page

Display Warnings, Cautions, and Notes.

Warnings, Cautions, and Notes (WCNs) are displayed on the MFCD screen. Warnings that cannot be acknowledged, indicating there is immediate concern, are displayed in the middle of both MFCD screens in red reverse video. Warnings that can be acknowledged are displayed in the lower center of the screens in red reverse video. This same area is where cautions are displayed, except that cautions are displayed in yellow reverse video. Notes are displayed in the lower right corner of the MFCD screens, in white reverse video. WCNs are displayed in order of priority, with higher priority WCNs overwriting lower priority WCNs of the same type. Lower priority WCNs are buffered. When a WCN is buffered, the DCLT OSB (OSB 11) becomes the WCN Acknowledge OSB (ACK). Control stick grip TMS-LEFT/SHORT or the ACK OSB can be used to acknowledge (clear) those WCNs that can be acknowledged. As WCNs are acknowledged, the lower priority WCNs are displayed. A WCN indication on the MFCD screen is accompanied by a "WARNING", "CAUTION", or "NOTE" message in the HUD scratchpad. (If there is data in the HUD scratchpad, a "W", "C", or "N" will be displayed to the left of the scratchpad.)

NOTE

- A WCN is displayed the first time a fault record is reported in the Maintenance Fault Log (MFL). Additional occurrences of the same fault record do not display the WCN unless the WCN for the previous occurrence has been acknowledged. The WCN is then redisplayed to show that another fault has occurred.

- WCNs are displayed on the MFCD screen. Warnings that cannot be acknowledged, indicating there is immediate concern, are displayed in the middle of both MFCD screens in red reverse video.Warnings that can be acknowledged are displayed in the lower center of the screens in red reverse video. This same area is where cautions are displayed, except that cautions are displayed in yellow reverse video. Notes are displayed in the lower right corner of the MFCD screens, in white reverse video. WCNs are displayed in order of priority, with higher priority WCNs overwriting lower priority WCNs of the same type. Lower priority WCNs are buffered. A WCN indication on the MFCD screen is accompanied by a WARNING, CAUTION, or NOTE message in the HUD scratchpad. (If there is data in the HUD scratchpad, a W, C, or N will be displayed to the left of the scratchpad.)

- All WCNs except Warnings 1 and the WILCO/CNTCO required WCN (while it is the highest prioritized displayed WCN) are buffered. Buffered WCNs cause a WCN Acknowledge OSB on all MFCD pages. The WCN Acknowledge OSB replaces the Declutter OSB (OSB 11) when a WCN is buffered. Each selection of the WCN Acknowledge OSB will clear the highest priority WCN from the buffer (identical to HOTAS WCN Acknowledge).

- While there are buffered WCNs, the CICU will activate the WCN Acknowledge OSB. Otherwise, the CICU removes and disables the WCN Acknowledge OSB, allowing the OSB to be used as the Declutter OSB.

- A "CHCK MFL" WCN indicates a failure was identified that requires maintainer action after a flight. CHCK MFL is displayed when the aircraft is on the ground (Weight On Wheels), either after landing or before takeoff, until the failure is resolved.

Repeat CDU Display.

The system allows the CDU display to be repeated on either of the MFCDs to reduce the head-down time required to observe the CDU display. When the CDU display is repeated on the MFCD, the MFCD OSBs operate as if they were the CDU LSKs. For the MFCD to act as CDU repeater, the page selection OSB (one of OSBs 12 through 15) assigned to the CDU repeater function is depressed. When the CDU repeater page Figure 1-169 is displayed, OSBs 7 through 10 and 16 through 19 act as CDU LSKs, with the same functionality as their associated LSKs. An action can then be performed by selecting either an LSK on the CDU or the corresponding OSB on the MFCD.

SOI AND SENSOR POINT OF INTEREST (SPI).

The SOI and SPI concepts allow unique control of each of the major PE systems.

SOI.

The SOI is defined as the sensor that is currently being controlled. With only one sensor allowed to be SOI at a time, multitasked controls (specifically, HOTAS) are uniquely allocated to that SOI-capable sensor. SOI-capable sensors are the HUD, Maverick, TGP, and TAD.

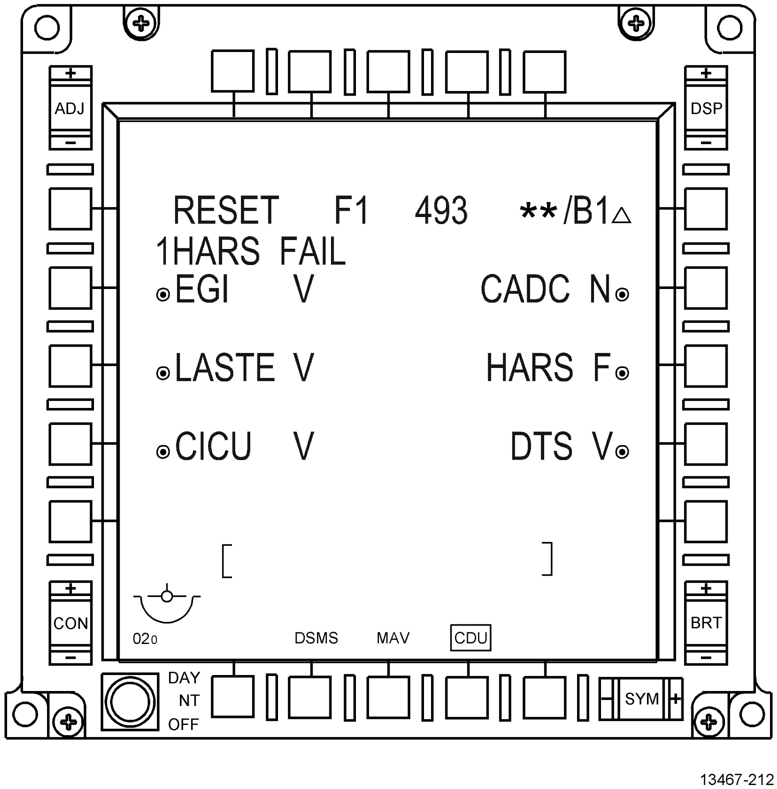


Figure 1-169. CDU Repeater Page

SPI.

The SPI is defined as the point in three-dimensional space that the system uses as a unique reference for other functions, such as weapons delivery, off-board transmission, and sensor slaving. A sensor can define the SPI only when it is the SOI, but once defined, the SPI is not necessarily confined to the SOI. For example, a change in SOI does not necessarily mean that the SPI changes. A SPI is always present unless there is an error condition such as a failed CDU. Incorporation of Datalink allows transmission of the SPI off-board. For a detailed description of SOI, and SPI, refer to TO 1A-10C-34-1-1.

TAD.

The TAD provides a plan-view representation of the current tactical situation to aid Situational Awareness (SA). This includes:

a. Current aircraft position

b. SPI

c. Anchor Point/Bullseye

d. Current Steerpoint

e. Active Flight Plan

f. Range rings/arcs

g. Digital Map

h. TGP Diamond.

i. Ownship Waypoint (mark or mission).

j. Weapon release mark point (Z).

k. TDL/TDN Symbology

l. Threat Symbology

The TAD is selected via the appropriate Page Select OSB or via SOI Select (Coolie)-LEFT/LONG or SOI Select (Coolie)-RIGHT/LONG. The TAD also utilizes a cursor (maneuvered by the Slew/Track Control switch when TAD is the SOI) to select symbols and "Hook" them (TMS-FWD/SHORT) to obtain relevant information associated with them. Subsequent commands of TMS-FWD/SHORT are used to cycle through TAD symbols. If the hooked TAD symbol does not have a defined Flight Lead TN, use TMS-FWD/SHORT to cycle through symbols of the same environment as long as the symbols are within a 40 pixel cycle radius of the initial hook point and the cursor stays within the 40 pixel cycle radius. If the hooked TAD symbol has a defined Flight Lead TN, use TMS-FWD/SHORT to cycle through all symbols reporting the same Flight Lead TN. The cursor can be reset to the middle of the TAD at any time by Missile Reject Uncage (China Hat)-AFT/SHORT. When a symbol is not actively or passively hooked on the TAD Page, TAD profile CURSOR COORD is ON, and the cursor is not within 10 pixels of the ownship, the cursor coordinates are displayed in the same location as the hooked symbol coordinates. Once the cursor stops moving for one second, and it is not within 10 pixels of the ownship, an elevation is requested from the DTED map data uploaded from the RMMD. If the elevation is not returned after three seconds, a request is made to the IFFCC for a DSTAS elevation. Elevation lookup is not performed when cursor is centered on the ownship.

TAD Format.

The basic TAD format is shown in Figure 1-170. If centered on OWN, the ownship symbol will be located at the center of the display with range rings positioned at half- and full-scale range. Located along the inside range ring are cardinal heading ticks that rotate as the aircraft heading changes. The triangular tick references magnetic North. The current TAD range scale is displayed in the upper right corner of the display, indicating the radius of the outer ring in nautical miles (NM). The scale may be decreased (zoom in) to the next value by DMS-FWD. The scale may be increased (zoom out) by DMS-AFT. For valid range scales, see Figure 1-173.1.

The current bearing and range from the bullseye to the cursor is displayed in the upper left corner of the display. The range value in the TAD Bull Bearing and Range display field will be displayed to the nearest tenth of a nautical mile (NM) (e.g., 8.3) when the range is between 1 and 10 NM, or to the nearest whole nautical mile when the range is greater than 10 NM. If the range is less than 1 NM, the range is rounded to the nearest NM (0 or 1).

The current bearing and range in relation to the hook is shown on the lower right side of the display in a format corresponding to OSB 18. The first line indicates FROM, the second line is TO (i.e., HOOK OWN is from the hook to the ownship). The TAD cursor range value in the hooked point bearing and range display field is displayed to the following resolutions:

- >10 NM: When the cursor range is greater than 10 NM, the range is displayed to the nearest NM.
- 1-10 NM: When the cursor range is in between 1 and 10 NM, the range is displayed to the nearest tenth of an NM (e.g., 8.3).
- <1 NM MGRS: When the cursor range is less than 1 NM and the coordinate mode OSB is set to MGRS, the cursor range is displayed in meters rounded to the nearest 5 meters followed by "m".
- <1 NM L/L: When the cursor range is less than 1 NM and the coordinate mode OSB is set to L/L [158] (Lat/Long), the cursor range is displayed in feet rounded to the nearest 10 feet followed by "f".

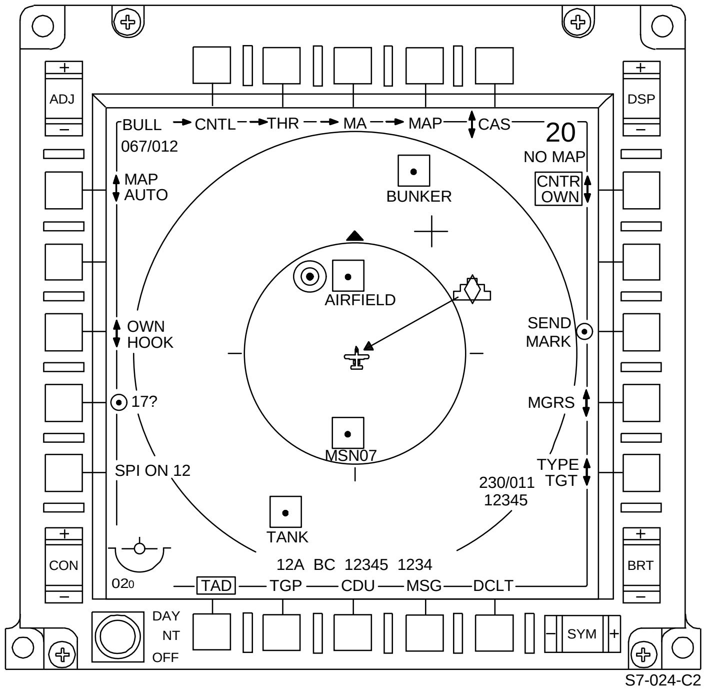


Figure 1-170. TAD Page

TAD Status Fields.

Status fields at the top of TAD display (see Figure 1-170.1) provide the following information:

- Mission Assignment Status (top-center display field): Mission Assignment status for the current or pending MA is displayed regardless of the hooked symbol. The MA selected as "current" is used to determine the current MA line. The current MA Type annunciation is replaced with a flashing pending MA Type annunciation when there is a pending MA Change. The MA Type annunciation is always displayed in the same color as the objective of that MA (white if no objective is specified), and is blank if there is no current or pending MA.

- Hostile (red)/Suspect (yellow)/Emergency Point (green) TN notification (top-middle display field): A flashing 'TN #####' will display on the TAD for 10 seconds when a new hostile, suspect, or emergency point TN is received. If two or more new Hostile/Suspect/Emergency Point TNs are received at the same time or one is received while the other is flashing, a '*' will display around the currently flashing TN, seen as *TN 12345*, and the other TN will be displayed when the current one has flashed for 10 seconds. Hostile and Suspect TN notification will only occur when the TN is inside of the range set on the TAD Profile Settings Page. The range from ownship to a Hostile or Suspect TN on the TAD can be modified from the TAD Profile Settings Page by selecting "NEW TN RANGE" in the Display Settings table, entering desired range (in NM) into the scratchpad and then pressing MOD ACT OSB 18. Emergency Points (J3.1) TN notification will be displayed at any range. This function will not display TN # for PPLI emergency indicators.

- VMF message reception (top-lower display field): Call Sign or URN followed by message type (DIP, AOS, APTD, or VMF FRND (friendly)). If multiple messages are received the latest received message is displayed.

Status remains on the TAD until WCN is acknowledged.

NOTE

A note and status on the TAD Page is only displayed for new friendly position reports. The note and status are not displayed for updates to friendly units.

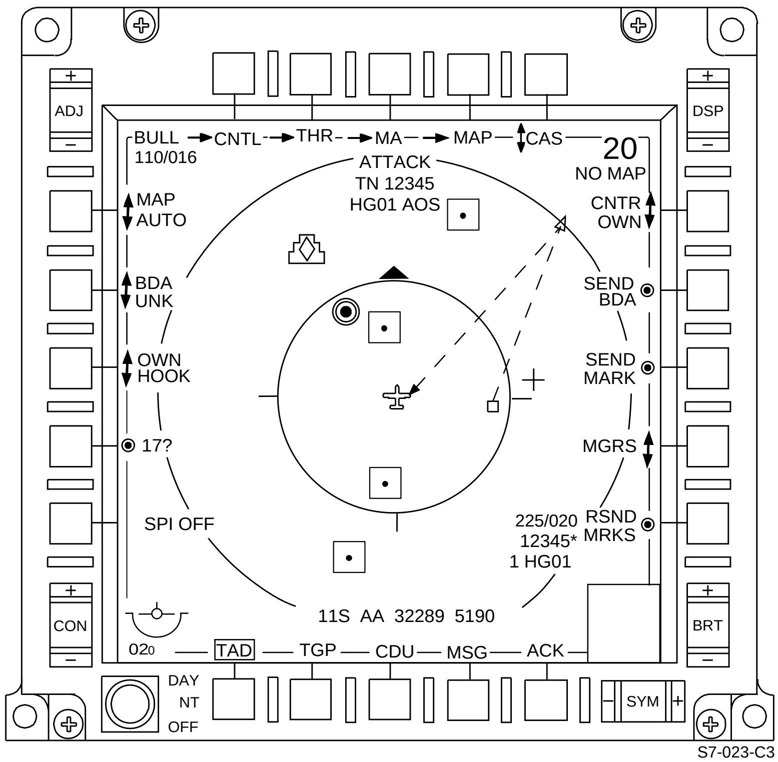


Figure 1-170.1. TAD Page with Status Displays

TAD Symbology.
The symbols utilized on the TAD are illustrated, in priority order, in Figure 1-171.

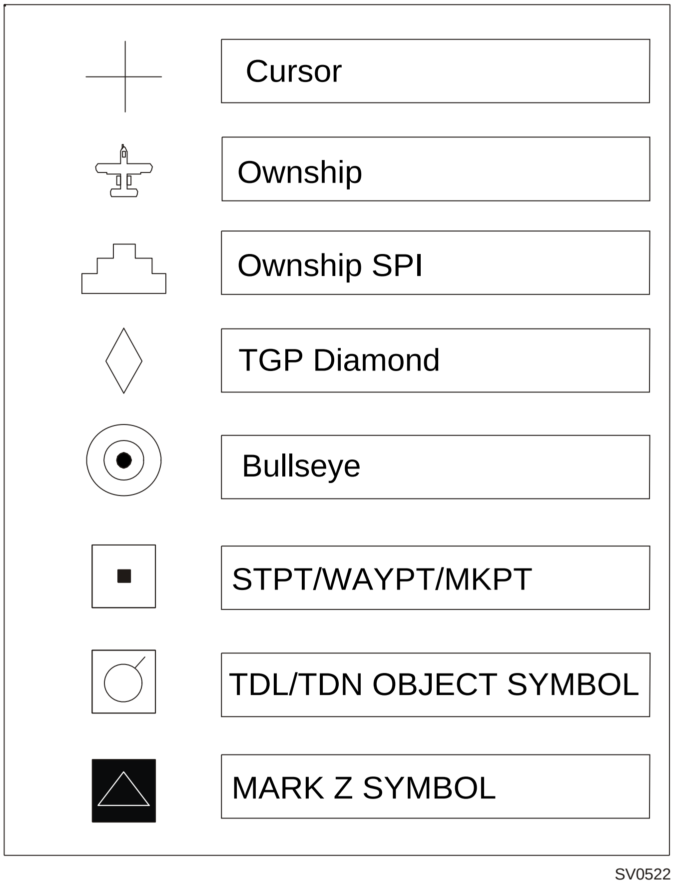


Figure 1-171. TAD Symbology Displayed in Priority Order

NOTE

- See Figure 1-156 for a complete list of TAD TDL Symbology.
- The TGP Diamond will not be displayed on the TAD display when the TGP is in Boresight mode.
- See Figure 1-156.1 for a complete list of TAD Threat Symbology.

The priority order for TAD Symbology and Hooked Symbols are:

TAD Symbology Display Priority

1. Fixed Displays (Equal Priority - ARS, Barometric Altitude, MFCD, WCNs)
2. Fixed Displays (Equal priority - Sensor Status, Message Window, Hooked Ground Location Coordinates, Hookship (Altitude, Aspect Angle, Bearing, Closure Rate, Ground Track Angle, Groundspeed, Range))
3. Fixed Displays (Equal priority - NOT SOI, OSB 1-20, SOI box, Bull Brg/Rng)
4. TAD Cursor
5. Ownship Reference
6. Primary Donor Target/SPI (Shown simultaneously on TAD, HUD, and TGP Page)
7. Ownship SPI
8. TGP Seeker Head Position
9. Emergency Point Symbol
10. ALQ-213 Threat
11. Donor Threat
12. Data Link Threat
13. Pre-Planned Threat
14. Memory Threat
15. Unknown Threat
16. Azimuth Threat
17. Surface/Land Point/Track PPLI
18. Surface/Land Point/Track (Friendly)
19. MA Objective Overlay (Attack)
20. MA Objective Overlay (Other than Attack)
21. Transmitted MA
22. MA IP/CP Overlay
23. Local Target Report
24. Waypoint (Target) (Symbol is Steerpoint)
25. Waypoint (NAI) (Symbol is Steerpoint)
26. Waypoint (Friendly) (Symbol is Steerpoint)
27. Waypoint (Navigation) (Symbol is Steerpoint)
28. Bullseye (Anchor Point)
29. Ownflight PPLI
30. Donor PPLI
31. Other PPLI
32. Surface/Land Point/Track (Neutral)
33. Surface/Land Point/ Track (Unknown)

34. Surface/Land Point/Track (Suspect)
35. Surface/Land Point/Track (Hostile)
36. AOS
37. Air Track (Friendly)
38. Air Track (Neutral)
39. Air Track (Unknown)
40. Air Track (Suspect)
41. Air Track (Hostile)
42. TDL Mark Point
43. Transmitted Mark Point
44. Waypoint (Target) (Symbol is Not Steerpoint)
45. Waypoint (NAI) (Symbol is Not Steerpoint)
46. Waypoint (Friendly) (Symbol is Not Steerpoint)
47. Waypoint (Navigation) (Symbol is Not Steerpoint)
48. TDL Mark Point
49. Transmitted Mark Point
50. Line Reference Point
51. Square/Rectangular Reference Point
52. Circular/Elliptical Reference Point
53. Corridor Reference Point
54. Reference Point
55. MA Line, Flight Plan Line
56. Lock Line
57. Transmit MA Line
58. APTD Lock Line
59. Hook Line
60. SCS Line
61. Range Rings/Arcs (DEP/CEN Modes)
62. Temporary Mark Point

TAD Hooked Symbology Priority

1. Primary Donor Target/SPI
2. APTD Target
3. Local Target Report
4. Emergency Point
5. Surface/Land Point/Track PPLI
6. Surface/Land Point/Track (Friendly)
7. Ownflight PPLI
8. Donor PPLI
9. Other PPLI
10 ALQ-213 Threat
11. Donor Threat
12. Data Link Threat
13. Pre-Planned Threat
14. Memory Threat
15. Unknown Threat
16. APTD Aircraft
17. VMF MA Objective Overlay Attack
18. Transmitted VMF MA
19. Surface/Land Point/Track (Neutral)
20. Surface/Land Point/Track (Unknown)
21. Surface/Land Point/Track (Suspect)
22. Surface/Land Point/Track (Hostile)
23. Air Track (Friendly)
24. Air Track (Neutral)
25. Air Track (Unknown)
26. Air Track (Suspect)
27. Air Track (Hostile)
28. Ownship SPI
29. TGP Seeker Head Position
30. MA Objective Overlay Attack
31. SADL MA Objective Overlay Other than Attack
32. Transmitted SADL MA
33. Ownship Reference
34. Bullseye (Anchor Point)
35. Ownship Steerpoint
36. Markpoint Z
37. TDL Mark Point
38. Transmitted Mark Point
39. Waypoint (Navigation)
40. Waypoint (Friendly)
41. Waypoint (Target)
42. Waypoint (NAI)
43. TDL Mark Point
44. Transmitted Mark Point

45. Reference Point
46. MA Line
47. MA FAH Line
48. MA FAH Cone
49. Lock Line
50. APTD Lock Line
51. MA IP/CP Overlay

NOTE

For more detailed information on the TAD, see TO 1A-10C-34-1-1.

TAD Map Display.

The TAD map display feature allows Falcon View maps to be overlaid on the original TAD background. See Figure 1-172. The possible maps available, along with their corresponding default map scales, are listed in Figure 1-173. In order to access any given map, it must first be loaded from the PATS or DVADR RMMD map partition into the CICU. The MAP branch function on OSB 4 selects a MAP Settings page.

TAD Quick Map.

The TAD Quick Map feature switches the view on the TAD map display from the current map scale, range scale, and centered mode to a custom defined map/range scale and centered mode via DMS-FWD/LONG. Quick Map settings can be defined using A/W/E and defined/modified using the TAD Map Settings Page. Once activated OSBs 6 and 20 are highlighted in yellow reverse video to indicate that Quick Map is active. The display will remain in the quick map mode until DMS-FWD/LONG is commanded again, and then return to the TAD map settings prior to activating Quick Map. OSBs 6 and 20 will no longer be highlighted in yellow reverse video.

TAD Map Settings.

The TAD Map Settings Page provides a central location for Map and Overlay control functions and information (refer to Figure 1-172.1). The page includes a table listing all available overlays from the selected overlay source. Each source can hold up to 20 overlays. OSB 1 returns to the TAD Map Page. OSBs 2, 3, and 4 are used to adjust TAD Quick Map settings (range scale, map scale, and center selection respectively). OSBs 6 and 7 are used to vary the map intensity. OSB 8 designates the selected overlay as a default (DFLT) overlay. When an overlay is set as default, the DFLT column displays YES. Default overlays are set to ON when the Overlay setting in a TAD profile transitions to DFLT. The overlays will set to ON or OFF based on the TAD Overlay profile setting. OSBs 9 and 10 are used to vary the overlay intensity. OSB 16 is used to select the preferred overlay source (RMMD or MDTC). OSB 17 is used to select the preferred map source (RMMD or CICU) for CADRG maps. The TAD IMG Source display area below OSB 17 indicates status for RMMD IMG maps. OSBs 16 and 17, and TAD IMG Source text are displayed in green reverse video when the preferred source is available. OSBs 16 and 17 are displayed in yellow reverse video when a non-preferred source is used. OSBs 16, 17, and TAD IMG text are displayed in red reverse video when no data is available. When an overlay is ON, the overlay is displayed in green reverse video. If an overlay file can not load, it is displayed in red reverse video. OSB 18 turns the selected overlay on or off. OSBs 19 and 20 are used to scroll up and down the overlay table to select the desired overlay. A transition of source using OSBs 16 or 17 will result in a source change confirmation prompt (displayed for 3 seconds) that must be selected to change preferred source. The Map ID Field is at the top center of the display. It shows the first 16 characters of the map name. If no map is located in memory or the map does not have an ID, the Map ID Field will display "NONE". HOTAS commands for TAD Center Select and TAD Center Command are disabled on the TAD Map Settings Page.

TAD ECHUM Symbology.

Data from Digital Vertical Obstruction Files (DVOF) displays on the TAD Map Settings Page (Figure 1-172.1) as an Electronic Chart Update Manual (ECHUM) overlay when available. DVOF resides only on the map partition of the RMMD. Vertical obstruction data in the ECHUM overlay provides obstruction symbology such as towers and power lines. On the TAD Map Settings Page, ECHUM is the first overlay in the table, in addition to the other 20 allowed overlays. It remains as the first overlay, even if the Overlay Source is changed to MDTC. The ECHUM row displays as follows:

- In red reverse video if the RMMD is unavailable or DVOF is not present on the RMMD.
- In yellow reverse video if ECHUM is enabled but only partial data can load.
- In green reverse video if ECHUM is enabled with no loading issues.

ECHUM symbols are described in Figure 1-172.2. The ECHUM setting on the TAD Profile Settings Page allows display of ALL data, all data above 200 ft Above Ground Level (AGL), or all data above 400 ft AGL.

NOTE

The power lines do not have altitude data, so they cannot be filtered off.

The AGL altitude value is displayed by each tower. Power line symbols and Xs (deleted map symbols) do not display altitudes. ECHUM is not displayed on GNC or JNC map scales. If no maps are available or if they are turned off, no ECHUM data is displayed for TAD range scales of 40 NM, 80 NM, and 160 NM and their associated depressed mode scales.

CAUTION

RMMD ECHUM data is separate from IFFCC obstacle warning and will not trigger VMU alerts.

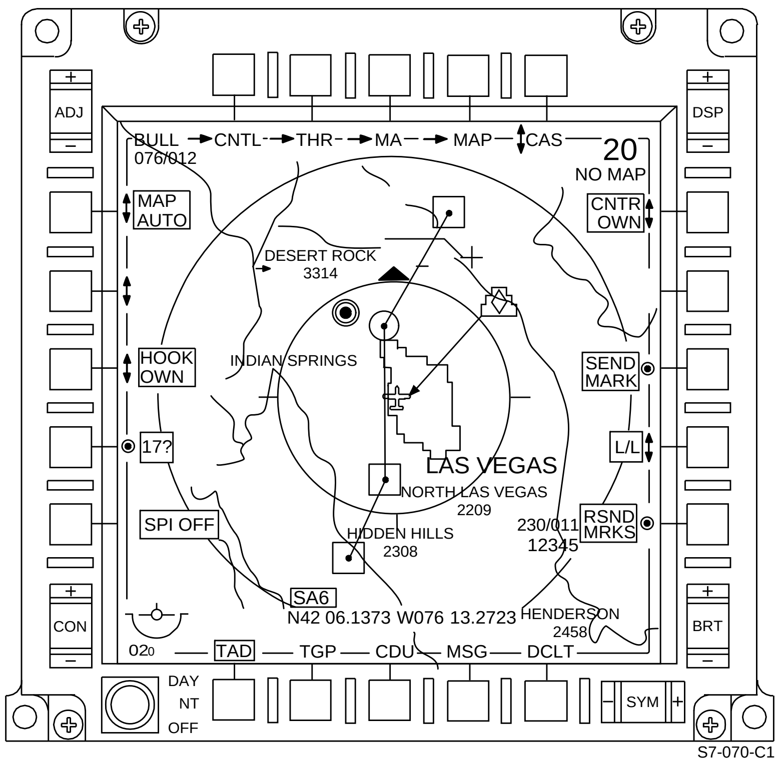


Figure 1-172. TAD Map Display

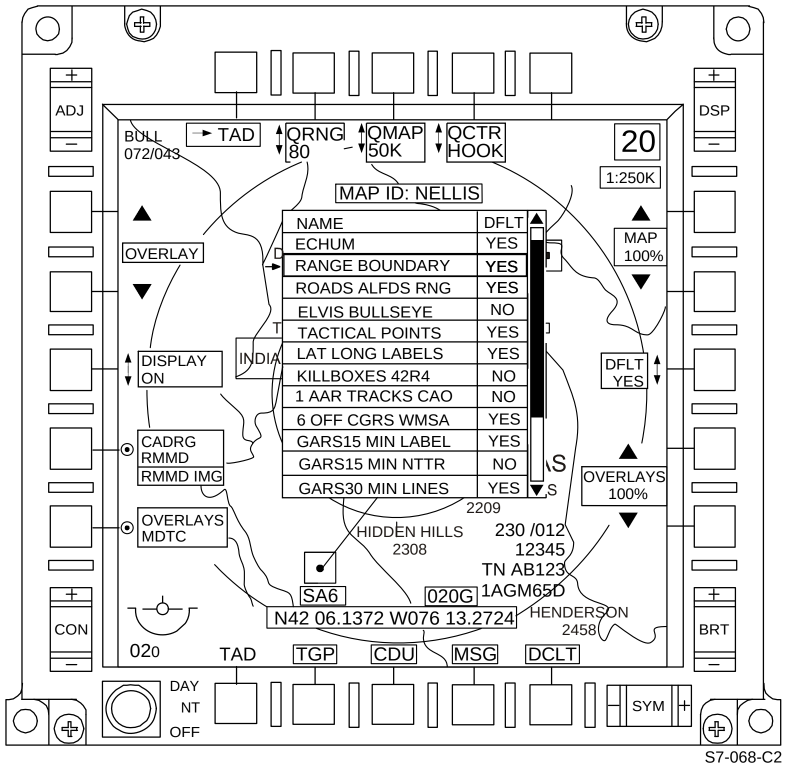


Figure 1-172.1. TAD Map Settings Page

Figure 1-172.2. TAD ECHUM Symbology

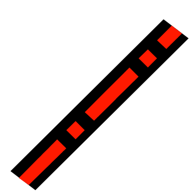
Description/Notes	Sym	Color
Tower and AGL number		Red
X = deleted map symbol (usually shown over tower)		Red
Power lines (dashes) with pylons (dots)		Red

Figure 1-173. Map Format

Map Format		Default Map Scale	
Global Navigation Chart	(GNC)	1:5M	(1:5,000,000)
Jet Navigation Chart	(JNC)	1:2M	(1:2,000,000)
Operational Navigation Chart	(ONC)	1:1M	(1:1,000,000)
Tactical Pilotage Chart	(TPC)	1:500K	(1:500,000)
Joint Operations Graphic	(JOG)	1:250K	(1:250,000)
Topographic Line Map 100K	(TLM100)	1:100K	(1:100,000)
Topographic Line Map 50K	(TLM50)	1:50K	(1:50,000)

TAD Range Scale.

The TAD Range Scale will be displayed in feet or meters for the lower range scales based upon the TAD Coordinate Mode as defined by OSB 9 on the TAD Page. The TAD Range Scale shall be displayed in TAD Cursor (CSR) Range Scale display field as defined in Figure 1-173.1.

TAD Map/Range Scale Displays.

Certain map/range scale combinations have been determined to cause excessive system processing time and will not be shown on the TAD in order to avoid processing delays (see Figure 1-173.2). If these map/range scale combinations are selected, the map will not display and map scale on TAD will be displayed in white reverse video.

Figure 1-173.1. TAD Range Scale Display in L/L and MGRS

TAD Coordinate Mode MGRS	TAD Coordinate Mode L/L
115m/175m	380f/570f
230m/350m	760f/1.1K
465m/695m	1.5K/2.3K
925m/1.4Km	3.0K/4.6K
1/1.5	1/1.5
2/3	2/3
5/7.5	5/7.5
10/15	10/15
20/30	20/30
40/60	40/60
80/120	80/120
160/240	160/240

Figure 1-173.1. TAD Range Scale Display in L/L and MGRS - Continued

Figure 1-173.2. TAD Map/Range Scale Displays

Map Scales	Range Scales X designates a map/range scale combination that will not be displayed on the TAD. If combination is selected, Map Scale will be displayed in white reverse video.											
Display Field	380f/ 115m	760f/ 230m	1.5K/ 465m	3.0K/ 925m	1 NM	2 NM	5 NM	10 NM	20 NM	40 NM	80 NM	160 NM
1:5M												
1:2M												
1:1M												X
1:500K											X	X
1:250K										X	X	X
1:100K									X	X	X	X
10m									X	X	X	X
1:50K								X	X	X	X	X
5m								X	X	X	X	X
1m						X	X	X	X	X	X	X

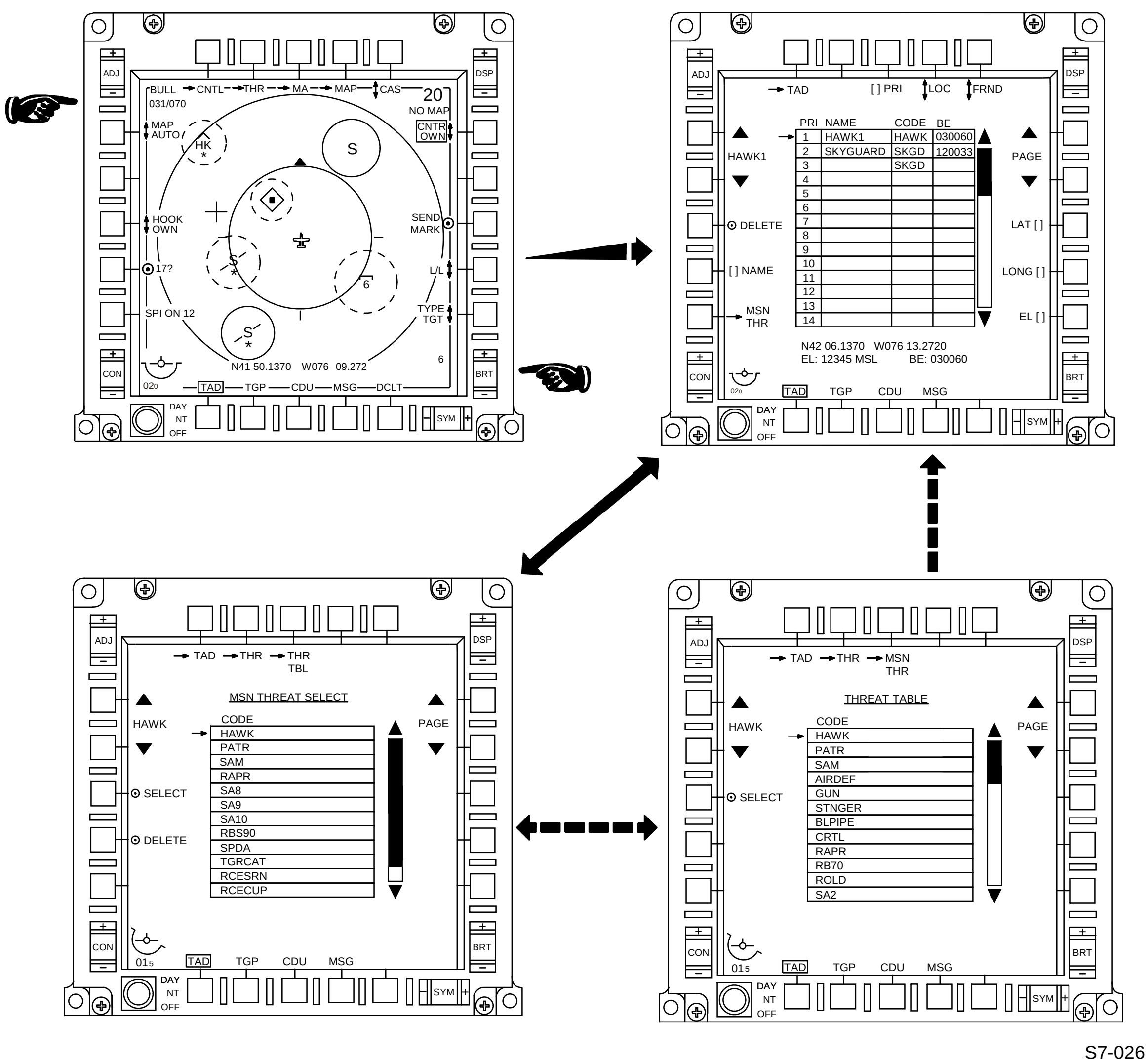


Figure 1-173.3. Display TAD Mission Threats

Display TAD Mission Threats.

The TAD Page displays mission threats defined in the Mission Threat page. To define a new mission threat, select the first empty row in the Mission Threat page and select the MSN THR (OSB 16). Selecting a threat code from the MSN THREAT SELECT table on the Mission Threat Select Page adds the threat to the selected line in the Mission Threat page. If the desired threat code is not listed in the MSN THREAT SELECT table, it can be selected from the Threat Table page. Selecting a threat code from the Threat Table page adds the Threat Code to the Mission Threat Select page, and displays the Mission Threat Page. Use the available OSB functions in the Mission Threat page to define the remaining parameters of the selected mission threat. Refer to the following sections for more information.

Mission Threat Page.

The Mission Threat Page (Figure 1-173.4) can be accessed from TAD using the THR OSB 2. The Mission Threat Page contains a centered list of up to 40 Pre-planned threats listed in priority order. Each row of the list consists of Priority, Name, Threat Code and Bullseye (BE) offset. Row text color represents Identity (Hostile - Red, Suspect - Yellow, Friendly - Green, and Unknown - White). PAGE navigation OSBs are provided when the list of threats is longer than the display page limit. Paging up/down displays the previous or next page of threats. Navigation OSBs 19 and 20 scroll through individual threats. When a threat is selected, fields at the bottom of the page display the latitude, longitude, elevation (EL) and BE offset for that threat. The elevation color will be based on elevation source (Green - DTSAS or hand entered, Yellow Reverse - Steerpoint, Red Reverse "NO EL" - no stated elevation).

NOTE

- In Lat/Long format, MFCD OSB entry format for latitude is
  HLLMM.XXXX, where:
  H is hemisphere (N or S)
  LL is whole degrees (00 to 90)
  MM is minutes of latitude (00 to 59)
  XXXX is ten-thousandths of minutes (0000 to 9999). Entry of decimal point (.) is optional.

- In Lat/Long format, MFCD OSB entry format for longitude is
  HLLLMM.XXXX, where:
  H is hemisphere (E or W)
  LLL is whole degrees (000 to 180) MM is minutes of longitude (00 to 59)
  XXXX is ten-thousandths of minutes (0000 to 9999). Entry of decimal point (.) is optional.

- If TAD is set to display MGRS format, threat coordinates will be displayed in MGRS.

The pre-planned threats can be uploaded from a DTC. They can also be created, modified, or deleted on the aircraft using the Mission Threat Page.

New threats are created by selecting the first empty row. Only the first of the empty rows can be selected. If latitude or longitude are missing, the row is displayed in red reverse video. Two methods are provided to define the location of the threat.

- In LOC mode, enter a lat/long for the location.

- In BULL mode, enter a bearing and range from the current BE which will be translated into a lat/long.

- In LOC and BULL modes, if latitude and longitude are populated or modified without an elevation, a request will be sent to DTSAS for elevation.

NOTE

OSB 4 defaults to BULL the first time the Mission Threat page is entered from the TAD. On subsequent accesses to the Mission Threat page, OSB 4 displays the last selected mode.

The latitude and longitude are populated when the BE OSB 4 is pressed. In LOC and BULL modes, identity and threat code default to Hostile and Unknown, respectively. Threats can be deleted by selecting a threat and pressing the Delete OSB 18. A confirmation note appears after selecting delete. Once deleted, the selected row is blanked and the remaining rows are re-prioritized.

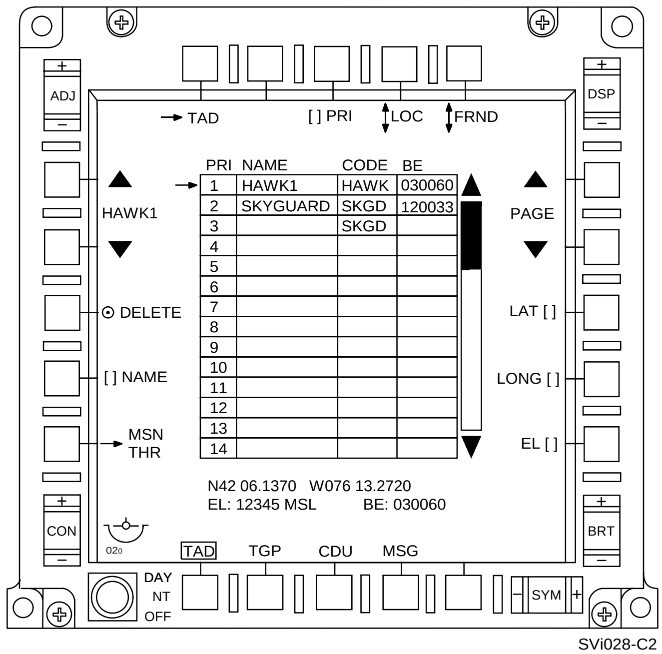


Figure 1-173.4. Mission Threat Page in LOC Mode

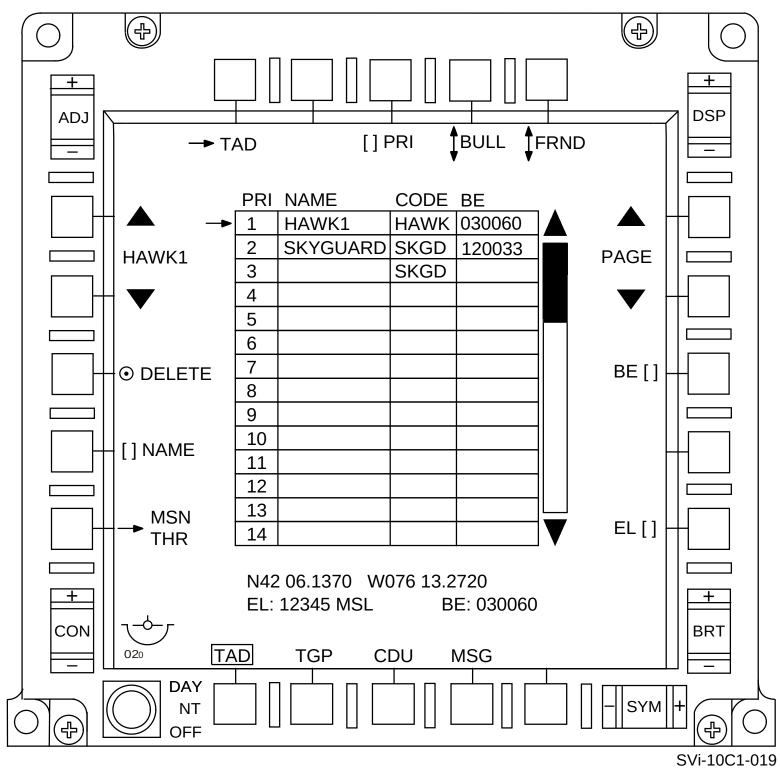


Figure 1-173.5. Mission Threat Page in BULL Mode

TAD (OSB 1)	Returns to the TAD page.
PRI (OSB 3)	Sets the priority of selected threat.
LOC/BULL (OSB 4)	Defines the mode for modifying the threat.
Identity (OSB 5)	Sets the identity of the selected threat (HOS/SUS/UNK/FRND)
PAGE (OSB 6/7)	Displays previous or next page of threats, when applicable.
BE (OSB 8)	Displayed when modification mode is BULL. Set or modify the bearing and range from the current bullseye. This will be converted to lat/long for the selected threat. BE Format XXXYYY where XXX = bearing and YYY = Range.
LAT (OSB 8)	Displayed when modification mode is LOC. Set or modify the latitude of the selected threat.
LONG (OSB 9)	Displayed when modification mode is LOC. Set or modify the longitude of the selected threat.
EL (OSB 10)	Sets the elevation of the selected threat.
MSN THR (OSB 16)	Accesses the Mission Threat Select page.
NAME (OSB 17)	Allows entry/modification of the threat name for the selected threat.
DELETE (OSB 18)	Deletes the currently selected threat.
Threat Select (OSB 19/20)	Moves up and down the list of threat codes.

Figure 1-173.6. Mission Threat Page Options

Mission Threat Select Page.

The Mission Threat Select Page (Figure 1-173.7) is accessed from the MSN THR OSB on the Mission Threat Page. The Mission Threat Select Page provides a subset of the Threat Table and allows the selection of one of those codes for the Pre-planned threat currently being edited. The codes displayed are uploaded from A/W/E or selected on the Threat Table Page.

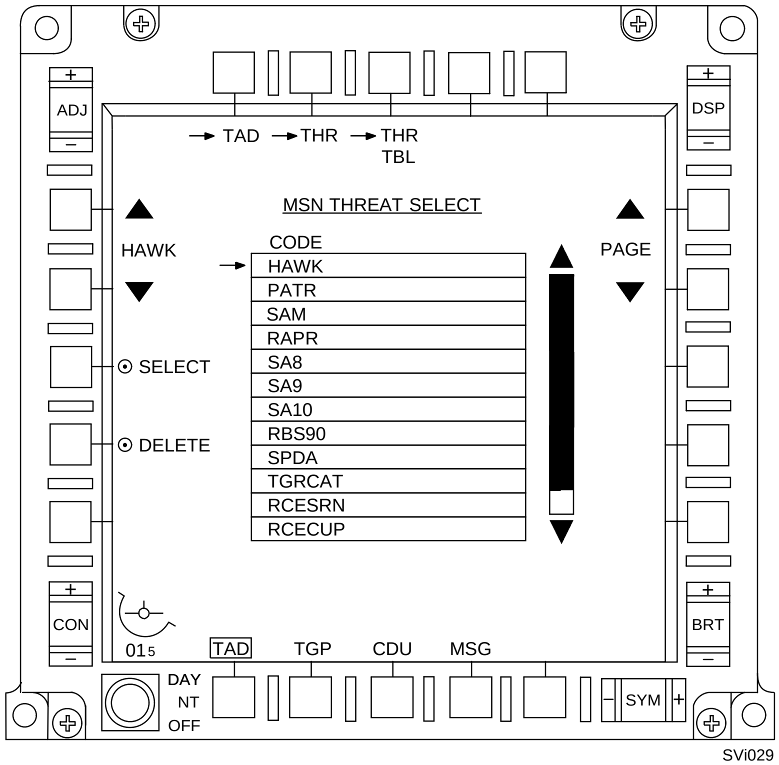


Figure 1-173.7. Mission Threat Select Page

TAD (OSB 1)	Returns to the TAD page.
THR (OSB 2)	Returns to the Mission Threat Page.
THR TBL (OSB 3)	Accesses the Threat Table Page.
PAGE (OSBs 6/7)	Displays previous or next page of threat codes, when applicable.
DELETE (OSB 17)	Removes the selected threat code from this page.
SELECT (OSB 18)	Applies selected code to the threat being edited and displays Mission Threat Page.
Threat Select (OSBs 19/20)	Moves up and down the list of threat codes.

Figure 1-173.8. Mission Threat Select Page Options

Threat Table Page.

The Threat Table Page (Figure 1-173.9) is accessed from the Mission Threat Select page. It provides the ability to select a threat code from the threat table for addition to the Mission Threat Select Page and for application to the threat currently being edited. The threat table contains the complete list of threat codes loaded from the DTC via PATS or A/W/E. If threats are not uploaded from a DTC, the MSN THREAT SELECT Page and THREAT TABLE Page are initialized to a default set of threats from NVM (Figure 1-173.11). Information for each threat includes: code, symbol, threat range, ID, and name. Threat Codes displayed in white reverse are currently selected for display on the Mission Threat Select Page. The different threat types are described in Figure 1-173.12.

NOTE

Threat information is only loaded from the DTC by pressing LOAD ALL (OSB 10) on the DTS UPLOAD Page.

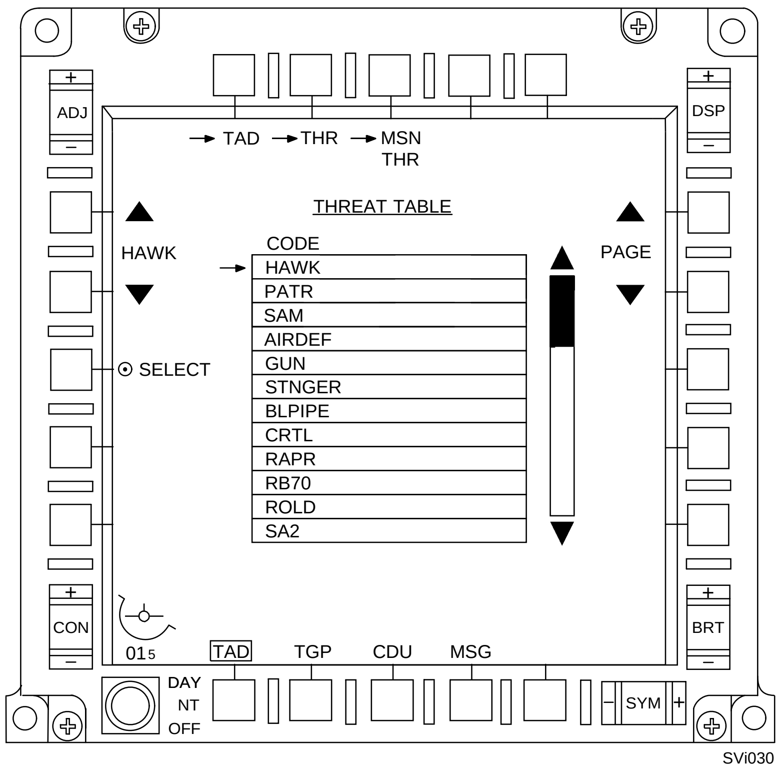


Figure 1-173.9. Threat Table Page

TAD (OSB 1)	Returns to the TAD page.
THR (OSB 2)	Returns to the Mission Threat page.
MSN THR (OSB 3)	Returns to the Mission Threat Select page.
PAGE (OSBs 6/7)	Displays the previous or next page of threat codes.
SELECT (OSB 18)	Adds the selected code to the Mission Threat Select Page, applies it to the threat being edited and displays the Mission Threat Page.
Threat Select (OSBs 19/20)	Moves up and down the list of threat codes.

Figure 1-173.10. Threat Table Page Options

Figure 1-173.11. Default Threat Table

Threat Code	Correlation Code	Symbol	Mnemonic	Lethal Range
0	0	UNK	UNK	0
28	28	HK	HAWK	25
198	253	RL	ROLD	5
199	199	2	SA2	28
200	200	3	SA3	16
205	205	6	SA6	14
208	208	8	SA8	6.2
210	210	10	SA10	47
211	211	11	SA11	22
238	239	A12	SA12A	47
239	239	12	SA12B	63
241	241	15	SA15	7.5
253	253	R2	ROL2	5
281	281	T2	SA2TS	34
282	282	2NK	SA2NK	34
444	444	20	SA20	84

Figure 1-173.12. TAD Threats

Threat Type	Source	Description
Pre-Planned	DTC	Threats entered at the Mission Planning System or updated using the Mission Threat Page.
Data Link	TDL	Land tracks (J3.5) that match a threat code in the threat table.
Donor Threat	TDL	Target Sorting Message reports (J12.6) that match a threat code in the threat table, only from network participants defined on the TDL Configuration pages (Flight Members, Donors, or VMF Participants).
Memory	TDL	Active Data Link threats that have not been updated within 60 seconds or Data Link TDL sourced threats that have not been updated within 240 seconds.
Azimuth	ALQ-213	Uncorrelated EW threats reported from the ALQ-213 with a bearing from the aircraft.
ALQ-213	ALQ-213 TDL DTC	Threats reported by the ALQ-213 and correlated with threats sourced by TDL or the DTC. Position (latitude/longitude) is known.
Unknown	ALQ-213 TDL DTC	Any threat that lacks a specific threat code, displayed with the Unknown threat symbol.

Threat Database.

TAD threats are maintained in a threat database in the CICU. In addition to pre-planned threats, the database includes threats from the TDL and ALQ-213. TDL threats are either data link threats from TDL land tracks (J3.5) or donor threats from TDL target sorting message (J12.6). Threats reported from the ALQ-213 are either azimuth with a known bearing from the aircraft, are correlated to geo-located threats from the CICU, or are uncorrelated threats. All threats returned from the ALQ-213 will have an updated lethal range. Correlated threats reported by the ALQ-213 are automatically transmitted over the TDL in the target sorting message (J12.6). Figure 1-173.13 shows the maximum threat capacity for each section of the threat database.

Figure 1-173.13. Threat Database Capacities

TAD Threats	Source	Capacity
ALQ-213 Threats and Azimuth Threats	ALQ-213	14
Donor Threats, or Memory Threats	TDL	150
Data Link Threats, or Memory Threats	TDL	100
Pre-Planned Threats (from the Mission Threat Page)	DTC	40
Total Threat Capacity		304

NOTE

Any threats with an Unknown threat code are displayed as Unknown Threats.

Threat Display.

(See Figure 1-156.1 and Figure 1-173.14) Azimuth threats are placed on the edge of the TAD screen at the appropriate bearing from the aircraft. The display of azimuth threats is independent of TAD centering options and map orientation. All other threats are displayed at their known position (latitude and longitude). Geo-located threats include a range ring centered on the symbol. The radius of the range ring is based on the threat range from the threat table or ALQ-213. Pre-planned, data link, and memory threats have a dashed range ring. ALQ-213 and donor threats have a solid range ring. The threat symbol and range ring color is based on the identity element in the threat database. Hostiles are displayed in red, suspects are yellow, friendlies are green, and unknowns are white.

Threats received from several sources may be the same physical threat. For instance, the same threat may be reported as a data link threat, a donor threat, and be a pre-planned threat. Threats may have the same threat code or the same correlation code - data that maps the selected threat code to another threat code. When there are multiple threats that are within three nautical miles and have the same threat code or correlation code, only the highest priority threat will be displayed. The symbol will be annotated with an asterisk per the following priority:

1. ALQ-213 Threat (no asterisk)
2. Donor Threat
3. Data Link Threat
4. Pre-Planned Threat
5. Memory Threat

Pre-planned threats will not be grouped if a Pre-planned threat is the highest priority threat within that group.

When threat symbols of the same threat type overlap on the display, lower priority threat symbols are occulted by higher priority threat symbols per the following priority:

- ALQ-213 Threat priority, if correlated, will be based on the correlated threat type (Donor, then Data Link, then Pre-Planned).
- Pre-planned Threat priority will be based on priority as displayed on the Mission Threat page.
- Unknown threat symbols that are Donor threats will take priority over unknown threat symbols that are Pre-planned Threats.
- In all other cases, a threat symbol of the same threat type with the newest time received will have the higher priority.

Threat Hookpoint Information Display.

Geo-located threats can be actively or passively hooked. Actively hooked threat symbols can be made SPI using the currently established functions for TAD symbols. When a threat symbol is hooked, the TAD Hookpoint Information Display shows the threat location, name (for pre-planned threats or threats grouped with Pre-planned threats) or mnemonic (for all other threats), ground speed (for data link threats), identity, track number (for data link threats), or source track number (for Donor threats) lethal range, and own/hook bearing and range. The threat location format matches the format specified for all TAD location displays (Lat/Long or MGRS). The elevation text color is displayed the same as other Mission Threat Page elevations.

When a symbol with an asterisk is hooked and the source of the highest priority symbol is removed, the hook will switch to the next highest priority symbol with the same threat code. For instance, when a donor threat is not updated and marked as a memory threat, the next highest priority threat within three miles would be displayed.

Threat System Status Display.

The following notes will be displayed on the MFCDs upon indication of a failure by the ALQ-213:

- CMSP FLT
- CMDS FLT
- RWR FLT
- MWS FLT
- ECM POD FLT

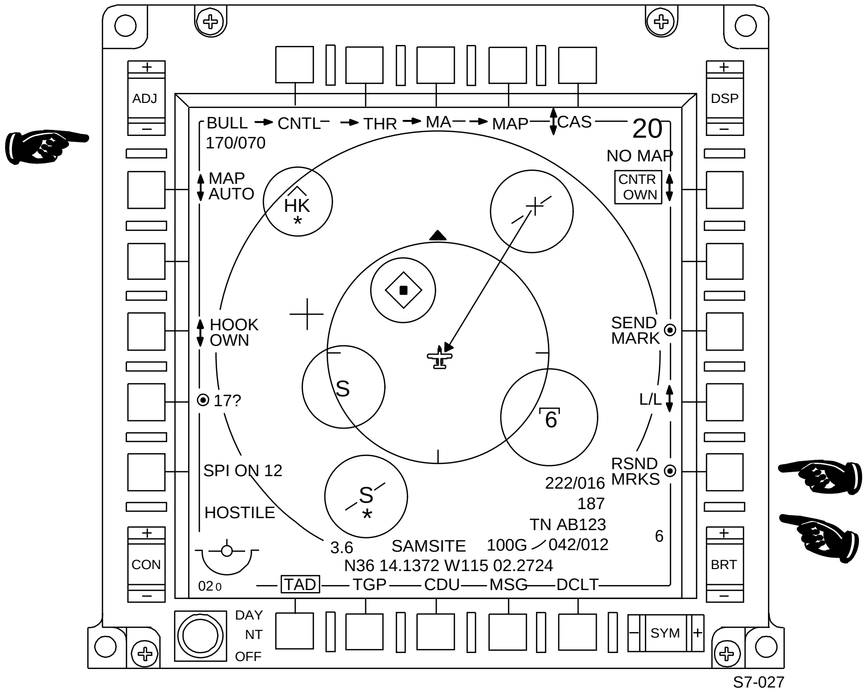


Figure 1-173.14. TAD Page with Threat Symbols

COMM Page.

The COMM Page (see Figure 1-173.15) provides a central location for controlling EPLRS (SADL), IDM (VMF), ARC-210, and IFF RTs. COMM Page OSBs branch to Profile Settings pages that allow capability to change and activate SADL and VMF profiles and provide the ability to select the radio to be configured for data reception/transmission in conjunction with the IDM (options are ARC-210, ARC-164, or NONE). Selection of NONE disables the IDM data communications for either the ARC-164 or ARC-210-1, enabling normal voice operations for each radio. If the LRU Present OSB on System Stat Page 3 indicates ARC-210-1 is not present or if ARC-210-1 status is No Comm (NC), or ARC-210-1 is in Guard or Test, then ARC-210 will be removed as an option for data transmission.

Depressing ARC-210 PRESETS OSB (OSB 19) on the COMM Page will display Simplex Preset Page 1 for ARC-210-1 (See Figure 1-173.15). The COMM Page also allows limited control of IFF Modes, and provides a branch to the IFF CONTROLS Page and provides a table displaying current IFF status information.

The COMM PAGE IFF Status table provides a quick view of the current configuration of the IFF transponder by highlighting the mode status in reverse video. Active modes are shown in green reverse with ON displayed in the third column. Non-active modes are shown in white reverse video with OFF in the third column (e.g. IFF set to Standby). When an IFF state change is requested, but can not be executed, the related mode row is highlighted in yellow reverse video with a Timeout Annunciation. If the IFF transponder transitions to a new mode that does not match the CICU requesting mode, a yellow reverse video is also shown with a Mismatch Annunciation.

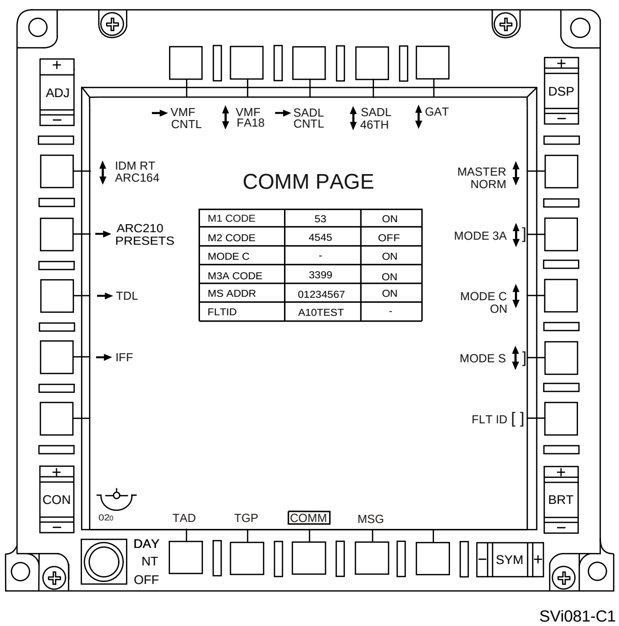


Figure 1-173.15. COMM Page

ARC-210 Preset Pages.

The ARC-210 Preset Pages accessible through the ARC210 PRESETS branch OSB on the COMM Page consist of four preset pages for each ARC-210 radio. The four pages are Simplex Preset Page 1, Simplex Preset Page 2, ECCM Preset Page 1, and ECCM Preset Page 2. Simplex Preset Page 1 (see Figure 1-173.16) displays the name, frequency and modulation associated with simplex preset channels 1-18 for the selected ARC-210 radio. Simplex Preset page 2 (see Figure 1-173.17) displays the name, frequency and modulation of simplex preset channels 19-30 for the selected ARC-210 radio which includes Tx/Rx preset channels 26-30. Both Simplex Preset Page 1 and Simplex Preset Page 2 provide options to modify the name, frequency and modulation of the ARC-210 radio simplex preset channels. ECCM Preset Page 1 (see Figure 1-173.18) displays the name and net number of ECCM (SINCGARS, HAVEQUICK I, HAVEQUICK II) preset channels 1-18 for the selected ARC-210 radio. ECCM Preset Page 2 (see Figure 1-173.19) displays the name and net number of ECCM (SINCGARS, HAVEQUICK I, HAVEQUICK II) preset channels 19-25 for the selected ARC-210 radio. Both ECCM Preset Page 1 and ECCM Preset Page 2 provide options to change the name of the selected ARC-210 radio ECCM preset channels. All four ARC-210 preset pages provide options for loading alternate loadsets to replace the A/W/E-assigned default loadsets. A loadset consists of a group of radio frequency presets, including frequency hopping and multiple WOD data.

The ARC-210 preset pages are always available even if the radio is not installed on the aircraft, not communicating with the CICU or performing IBIT. If Simplex Preset Page 1 or Simplex Preset Page 2 is accessed while the selected radio is not present, not communicating or performing IBIT, the FREQ and MOD columns for the preset page will consist of dashes and the NAME column will be blank. In addition, the options to change preset name, frequency and modulation will be removed from the preset page. If ECCM Preset Page 1 or ECCM Preset Page 2 is accessed while the selected radio is not present, not communicating or in IBIT, the NET column for the preset page will consist of dashes and the NAME column will be blank. In addition, the option to change the name of a preset will be removed from the preset page.

ARC-210 Preset Page Navigation.

Depressing the RT Selection rotary OSB (OSB 18) on any of the ARC-210 preset pages will display the corresponding preset page for the other ARC-210. This OSB provides the ability to toggle between display of ARC-210-1 and ARC-210-2 preset pages. For example if ECCM Preset Page 1 for ARC-210-1 is currently displayed and the RT Selection rotary OSB is depressed, then ECCM Preset Page 1 for ARC-210-2 will be displayed. If the RT Selection rotary OSB is depressed again, then ECCM Preset Page 1 for ARC-210-1 will be displayed. This behavior is consistent for all preset pages.

Depressing the COMM branch OSB (OSB 1) on Simplex Preset Page 1 will display the COMM Page. The COMM branch is only available on Simplex Preset Page 1.

Depressing the NEXT branch OSB (OSB 2) on Simplex Preset Page 1 will display Simplex Preset Page 2 for the selected ARC-210 radio. Depressing the PREV branch OSB (OSB 1) on Simplex Preset Page 2 will display Simplex Preset Page 1 for the selected ARC-210 radio. Depressing the Next branch OSB (OSB 2) on Simplex Preset Page 2 will display ECCM Preset Page 1 for the selected ARC-210 radio. Depressing the PREV branch OSB (OSB 1) on ECCM Preset Page 1 will display Simplex Preset Page 2 for the selected ARC-210 radio. Depressing the NEXT branch OSB (OSB 2) on ECCM Preset Page 1 will display ECCM Preset Page 2 for the selected ARC-210 radio. Depressing the PREV branch OSB (OSB 1) on ECCM Preset Page 2 will display ECCM Preset Page 1 for the selected ARC-210 radio. Navigation up and down through preset channels is performed by depressing the up and down navigation OSBs (OSB 20 and OSB 19).

ARC-210 Preset Page Options.

Depressing the NAME data entry OSB (OSB 16) on any preset page will take the contents of the scratchpad, up to 8 characters, and modify the NAME of the currently selected preset channel. Entries on the scratchpad longer than 8 characters will be truncated. If NAME data entry OSB (OSB 16) is depressed when there is no content in the scratchpad then the NAME of the currently selected preset channel will be blank. If the currently selected radio has been filled using a loadset, the modified channel names are updated in the CICU NVM.

Depressing FREQ data entry OSB (OSB 17) on Simplex Preset Page 1 and Simplex Preset Page 2 will take the contents of the scratchpad, between 3 and 6 digits, and modify the frequency of the currently selected preset channel. An in progress indicator is displayed while the change is made to the ARC-210. A valid frequency data entry must be 3-5 digits, in increments of 5kHz and within one of the following frequency ranges:

1) 030000 - 087990 MHz
2) 108000 - 117990 MHz
3) 118000 - 173990 MHz
4) 225000 - 399990 MHz

If the scratchpad content is 3-5 digits and the FREQ data entry OSB is depressed, then the trailing digits will be automatically filled with zeros. For example, if the scratchpad contents is 030 when FREQ data entry OSB is depressed, then the frequency for the selected preset will be modified to 30 MHz.

The modulation rotary OSB (OSB 5) on Simplex Preset Page 1 and Simplex Preset Page 2 is only enabled when the frequency of the preset selected is within one of following two frequency ranges that support both AM and FM modulation:

1) 136.000 - 155.990 MHz
2) 225.000 - 399.990 MHz

Depressing the modulation rotary OSB (OSB 5) on Simplex Preset Page 1 and Simplex Preset Page 2 when the selected preset frequency supports both AM and FM modulation will toggle the modulation of the selected preset between AM and FM. An in progress indicator is displayed while the change is made to the ARC-210.

For example, if preset 2 on Simplex Preset Page 2 is AM and the frequency of preset 2 supports both AM and FM modulation and the modulation rotary OSB is depressed, the modulation for preset 2 is changed to FM. When depressed again, the modulation changes back to AM.

If ARC-210 presets are updated using the RSC, the MFCD Preset pages will be updated.

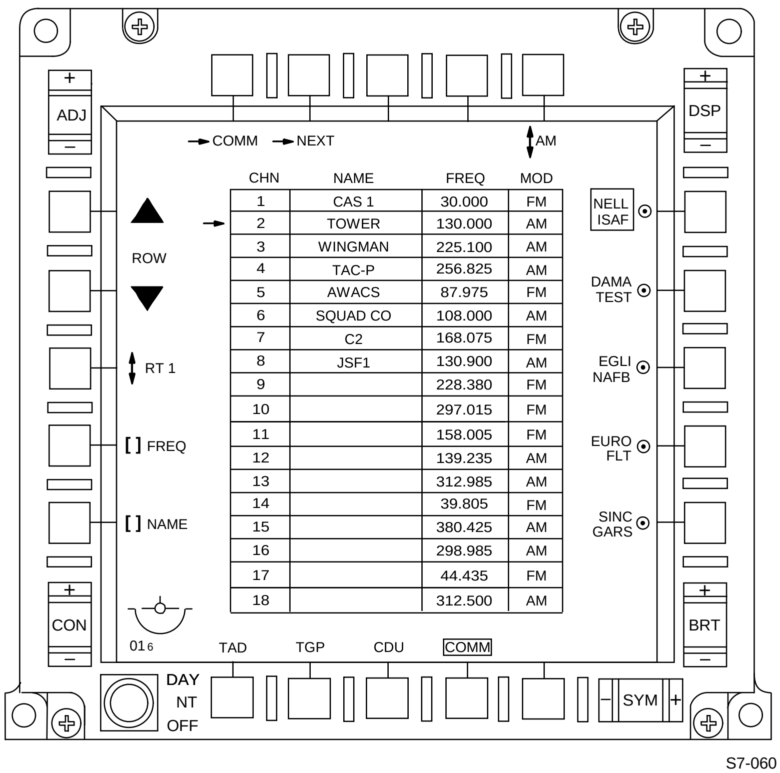


Figure 1-173.16. Simplex Preset Page 1

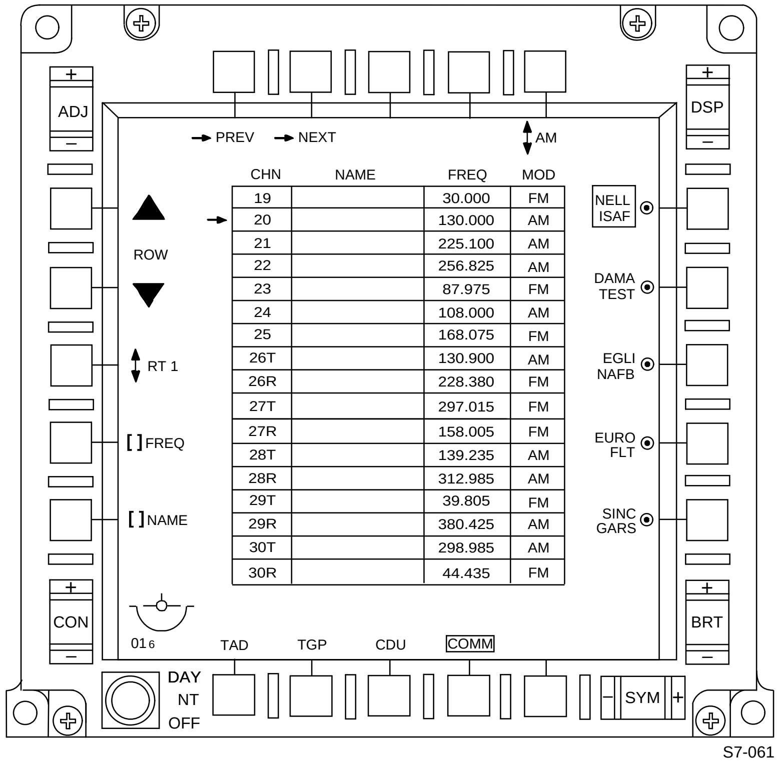


Figure 1-173.17. Simplex Preset Page 2

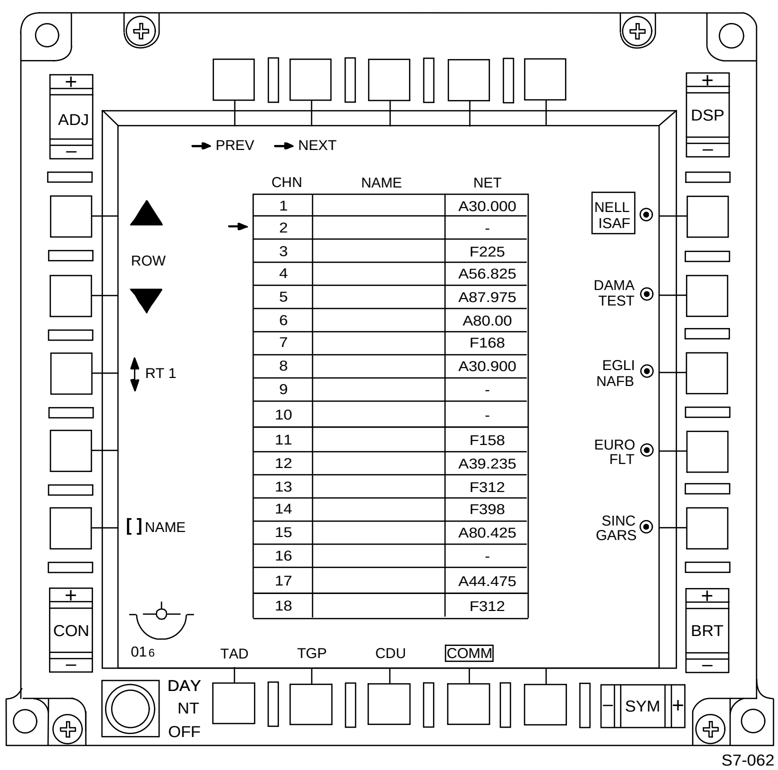


Figure 1-173.18. ECCM Preset Page 1

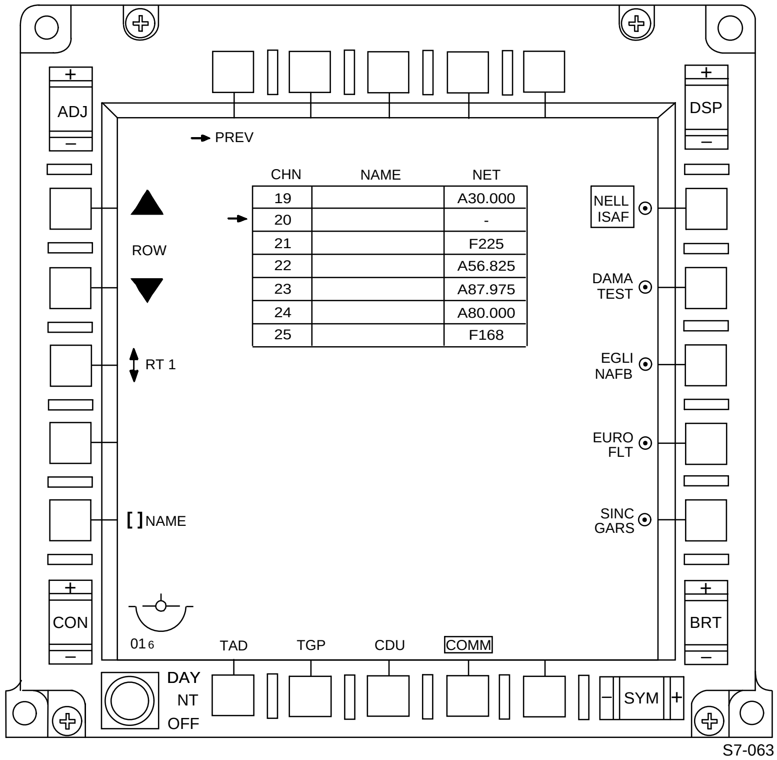


Figure 1-173.19. ECCM Preset Page 2

Loading ARC-210 Loadsets.

Up to five ARC-210 radio loadsets can be saved to the operational DTC during mission planning and uploaded to the CICU. Each loadset can then be downloaded to either radio. The ARC-210 radios are initially filled with two A/W/E assigned loadsets (one for each radio). The radios are filled upon installation of the DTC and pressing LOAD ARC-210 (OSB 9) on the DTS Upload Page. Pressing OSB 9 also loads up to three unassigned loadsets. The unassigned loadsets can then be manually selected from any of the four ARC-210 preset pages to fill either radio during mission operations.

Fill OSBs 6-10 on the ARC-210 preset pages (Figure 1-173.16 through Figure 1-173.19) fill the ARC-210 radio with the corresponding loadset. The Fill OSBs display the name of the loadset selected in A/W/E (up to eight characters on two separate lines). If the loadset name is greater than eight characters, the additional characters are truncated. OSB 18 selects the radio to be filled. The applied OSB loadset text is displayed in green reverse video. Loadset OSBs 6-10 are displayed for all uploaded loadsets. ARC-210 presets can be modified either via the MFCD or the RSC. MFCD-modified presets are saved to the selected radio loadset. Presets modified by the RSC appear on the display, but are not saved to the loadsets. When a radio fill is in progress, OSBs 6-10 are disabled and the loadset table is blanked. When the fill is complete, the table displays presets from the selected radio with names from the loadset.

ARMAMENT SYSTEM.

The Armament System includes those elements used to control the storage and delivery of armaments, including weapons, chaff, and flares. The A-10 provides the weapons stations for carrying armaments under the aircraft wings and fuselage. The aircraft also includes a 30 mm gun system mounted in the aircraft nose. The armament system controls are shown in Figure 1-174. The AHCP provides power switches to enable/disable various elements of the Armament System. The DSMS provides for management and control of the weapons stores carried by the aircraft. Cockpit interface with DSMS is provided via HOTAS switches and the MFCDs. For detailed information on the Armament System, refer to TO 1A-10C-34-1-1.

AHCP.

The AHCP provides four switches for armament control.

a. MASTER armament switch - In ARM, controls power to the gun arm, mechanical fusing, selective jettison, store release, and trigger controls (provided the landing gear handle is up or the ARMAMENT GND SAFETY switch is set to OVERRIDE). In TRAIN, puts DSMS in training mode. In SAFE, disables all function enabled by the ARM or TRAIN setting.

b. GUN/PAC armament switch - In ARM, enables the 30 mm gun to fire and enables the PAC function of the EAC. In GUNARM, enables the 30 mm gun to fire without PAC. In SAFE, disables all functions enabled by the ARM or GUNARM setting. With MASTER armament switch in TRAIN and GUN/PAC switch in SAFE, PAC is enabled for training purposes.

c. LASER armament switch - In ARM, selects the combat laser and enables the combat laser and/or IR pointer to fire. In TRAIN, selects training laser and enables laser and/or IR pointer to fire.

d. TGP switch - In ON, enables the TGP; in OFF, disables the TGP.

NOTE

The TGP ON/OFF switch should never be used to turn off the LITENING TGP during Initiated IBIT, during Forward Looking Infra-Red (FLIR) calibration (either short or long), or when the TGP is unstowed.

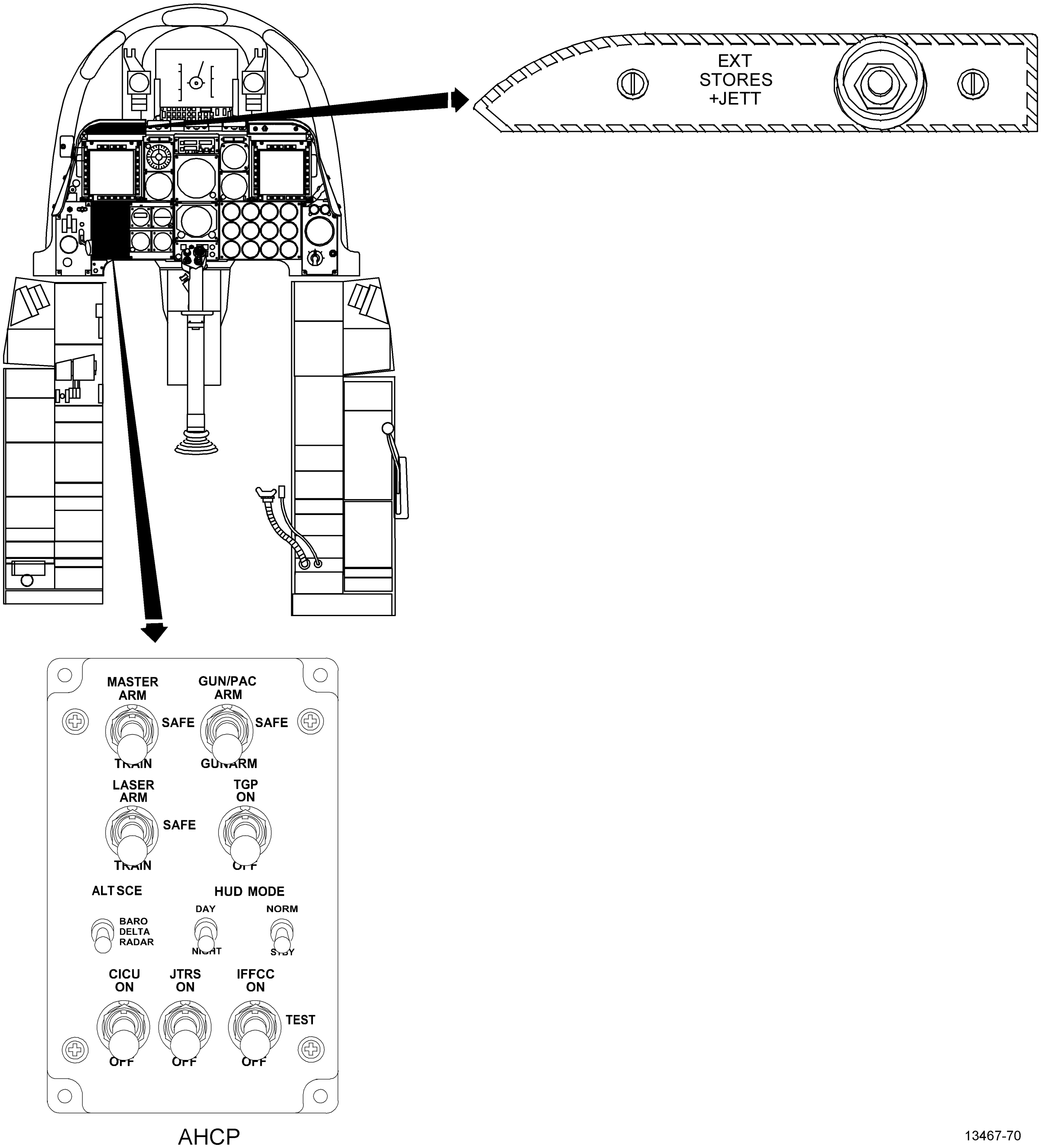


Figure 1-174. Armament System Controls (Sheet 1 of 2)

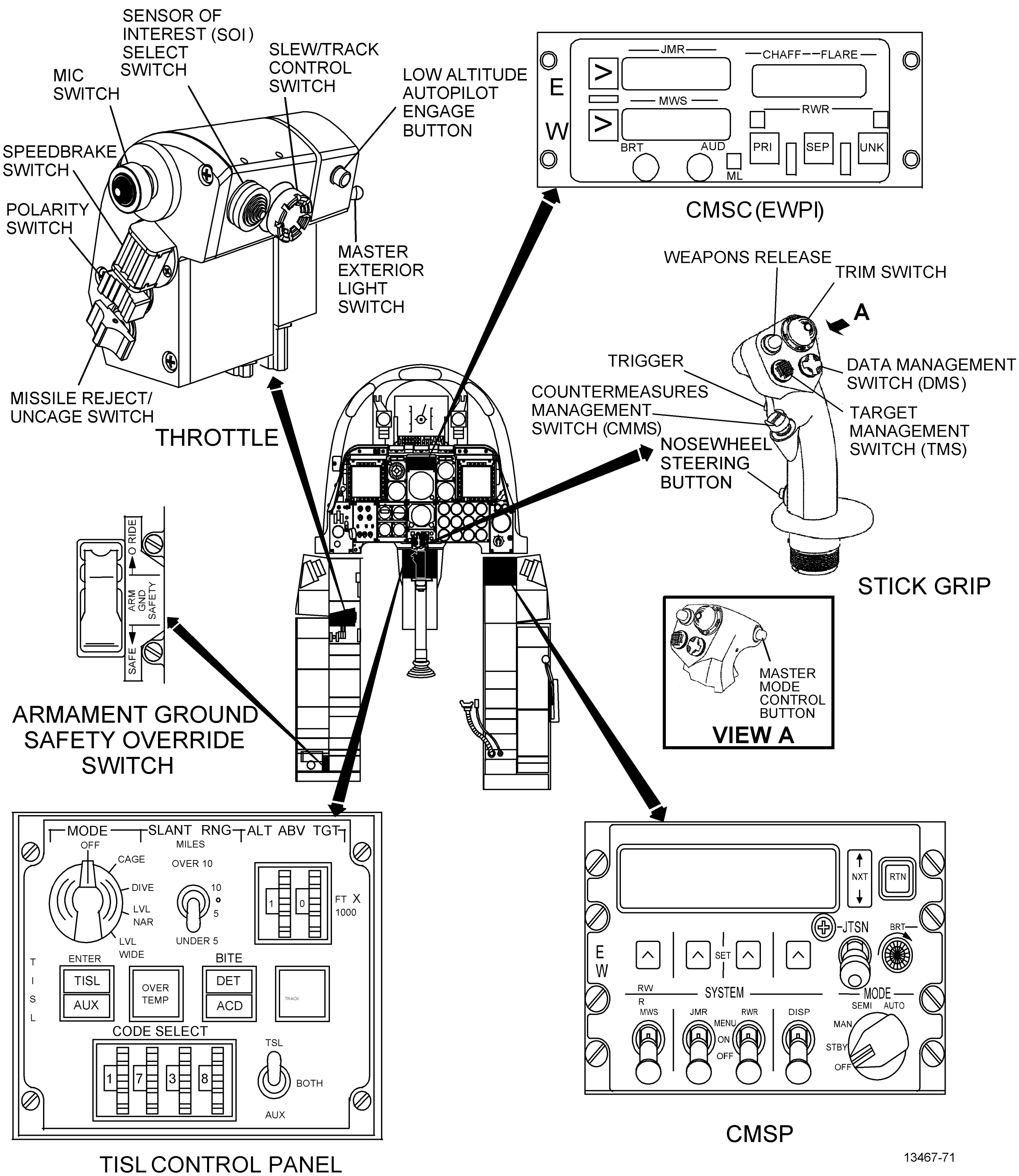


Figure 1-174. Armament System Controls (Sheet 2)

STORES CARRIAGE CAPABILITY.

The aircraft has eleven non-jettisonable external pylon stations, three of which have the capability of carrying external fuel tanks. Forward firing ordnance may be carried on pylon stations 2 through 10. AIM-9 missiles may be carried on stations 1 and/or 11. Conventional munitions may be carried on all pylons. Seven of the pylons house a bomb rack, which has both 14- and 30-inch suspension hooks. The two most outboard wing pylons on each wing contain a bomb rack which has 14-inch suspension hooks. Each ejection rack assembly has provisions for bomb arming, release, and a forced ejection mechanism. This provides for carriage of multiple bomb loads at those stations which are structurally capable of the load requirements. On four chaff/flare dispensers are installed in each MLG pod and each wing tip such that the payloads are dispensed in a downward direction.

30MM GUN SYSTEM.

The gun subsystem consists of a seven-barrel GAU-8/A 30mm Gatling gun and a double-ended linkless feed system with a capacity up to 1,174 rounds of percussion primed ammunition. The gun system retains all spent cases or dud rounds. The gun system is electrically controlled and hydraulically driven. The gun-drive motors normally provide a single firing rate and are pressurized from the two independent hydraulic systems. If one aircraft hydraulic system fails or one hydraulic drive motor is inoperable, the gun will operate at a reduced rate.

The system is safed by a single safing pin which prevents the firing pins from striking the round of ammunition.

CAUTION

Flight testing has shown that engine disturbances can be caused by gun gas ingestion during gun firing. If an engine disturbance does occur during gun firing, the only cockpit indication may be a momentary drop in fan speed. When firing, it may be possible for multiple engine disturbances to occur causing an engine stall/over-temperature. In this condition, refer to Engine Malfunction emergency procedures in Section III.

Gun Ready and Gun Unsafe Lights.

The gun ready light, placarded GUN READY (13, Figure FO-1), is a green light located on the instrument panel. Refer to TO 1A-10C-34-1-1 for operation of the GUN READY light.

The gun unsafe light, placarded GUN UNSAFE (Figure 1-158), is located on the caution light panel. This light will come on approximately 2.5 seconds after release of trigger if the clearing cycle is not completed. The GUN UNSAFE light coming on indicates the possibility that the gun could inadvertently fire. The GUN UNSAFE light is powered by the DC armament bus.

CAUTION

The trigger should not be depressed when the GUN UNSAFE light is on. Doing so may cause serious damage to the system and aircraft.

ARMAMENT GROUND SAFETY OVERRIDE SWITCH.

The armament Ground Safety Override (GSO) switch (23, Figure FO-2) is a guarded two-position switch, placarded ARM GND SAFETY, with positions SAFE and ORIDE. The ORIDE position overrides the ground safety circuit for maintenance purposes.

The ground safety circuit, activated by the DOWN position of the landing gear handle, prevents normal release or arming of ordnance and gun firing circuits.

EMERGENCY JETTISON BUTTON.

The emergency jettison button (Figure 1-174), placarded EXT STORES JETT, is located on the glare shield. Emergency jettison is dual-powered from the DC essential bus with automatic back-up from the battery bus. When the EXT STORES JETT button is depressed, external stores on pylon stations 1 to 11 are released in the following sequence:

- Simultaneous with switch actuation - stations 1, 2, 10, and 11
- 0.5 second after switch actuation - stations 3, 4, 8, and 9
- 1.0 second after switch actuation - stations 5, 6, and 7.

NOTE

- The emergency jettison button, once powered, will function with weight-on-wheels regardless of the position of the armament ground safety override switch.
- Chaff/flare payloads may be installed in each MLG pod and each wing tip. Flare payloads are jettisoned through the use of the FLARE JETTISON switch on the chaff/flare control panel. Chaff payloads cannot be jettisoned.

Refer to TO 1A-10C-34-1-1 for selective jettison procedures.

TRIGGER.

The trigger (Figure 1-174), is mounted on the forward upper surface of the control stick grip. The trigger works in conjunction with the MASTER armament switch on the AHCP. Ignition is provided to both engines while the trigger is depressed to the second detent and for 1 second after gun trigger release. The gun will not operate unless the landing gear handle is UP or the armament ground safety override switch is in ORIDE (guard up).

WEAPONS RELEASE BUTTON.

The weapons release button (Figure 1-174) is located on the control stick grip. Depressing the button will release stores from selected pylons.

DIGITAL STORES MANAGEMENT SYSTEM.

The DSMS page on the MFCD controls all weapons settings, release logic, and armament control interfaces.

The design of DSMS is based on the concept of a combination of weapons and associated weapons profiles. DSMS uses weapon information provided by the pilot via A/W/E and DTC load or manually entered via the DSMS page on the MFCD. This weapons information includes the weapons type (MK-82, MK-84, etc.), weapon configuration (LDGP, HDGP), and weapons fuzes (M904, M905, FMU-139A/B, DSU-33A/B or B/B, etc.). The weapons profile includes weapons release mode, fuzing, ripple quantity, release interval, HUD mode, safe escape maneuver, minimum altitude, desired/minimum time of fall, HUD adjustment options, ejection delay option, and rack delay option. Access to weapons and profiles is via a series of DSMS pages presented on the MFCDs. The DSMS is capable of storing a maximum of 20 live profiles and 20 training profiles. Pre-planned profiles are normally constructed via A/W/E and transferred into the CICU via the DTC. Profiles can also be retrieved from the previous DTC load via non-volatile memory or profiles can be built in the cockpit via the DSMS options. The manual profiles provide a quick response to select a weapon and generate the desired profile. For detailed descriptions, refer to TO 1A-10C-34-1-1.

NOTE

DSMS QTY display may not be an accurate indication of actual stores expended. Expenditures should be confirmed visually.

HEAD-UP DISPLAY SYSTEM.

The HUD system provides primary and standby weapon delivery capability, and a simplified data display mode as a visual aid for normal light operation. The HUD system is controlled from the AHCP (Figure 1-174) on the instrument panel.

All HUD displays are presented on the optical combiner above the instrument panel. The optical combiner is an optical reflecting surface that reflects HUD symbols projected from a remote CRT into the line of sight.

WARNING

The HUD is not a primary flight instrument, and should not be used as a substitute for the airspeed indicator and altimeter for takeoff and landing.

HUD FORMAT.

The HUD displays the INS format when the EGI Δ light on the NMSP is lit and Blended or INS-only is the selected navigation mode. The HUD displays the HARS format when the EGI Δ light is lit and GPS-only is the selected navigation mode, or the HARS Δ light is lit. For more information on the HUD format, refer to TO 1A-10C-34-1-1.

LOW ALTITUDE SAFETY AND TARGETING ENHANCEMENTS (LASTE) SYSTEM.

NOTE

- The LASTE system is a major integrated avionic subsystem of the A-10C. It consists of electronic components that work in conjunction with the HUD Projection Unit (PU) to provide electronically generated symbolic displays of aircraft flight and weapon delivery information. The LASTE system includes an EAC capability which works in conjunction with the SAS to provide autopilot functions in the Low Altitude Autopilot (LAAP) mode and weapon stabilization in the PAC mode. A GCAS is provided, which works in conjunction with the communications/intercom system to provide audio warnings of potentially dangerous flight conditions.

- The IFFCC is a combined GCAS, weapons delivery/flight control computer and display processor/symbol generator. The IFFCC contains the symbol generator and stroker circuitry that drive the deflection and bright-up circuits in the projection unit for display of system symbology.

- The IFFCC receives discrete, analog, and digital signals from the EGI, SAS, CADC, and armament systems to compute the navigation and weapon delivery symbology positions for display on the HUD. Rudder and elevator commands are computed by the EAC functions and are sent to the SAS computer.

- The IFFCC contains automatic and manual IBIT functions. The BIT provides in-flight and on-ground failure detection, determines operational readiness of the LASTE system, and assists maintenance personnel by isolating detected faults to failed LRUs. The faults found by BIT are logged in memory, and are displayed on the HUD, that can be retrieved by maintenance personnel.

GENERAL.

The LASTE system provides GCAS, Continuously Computed Impact Point (CCIP), Continuously Computed Release Point (CCRP), EAC, air-to-air gunsight capabilities, extended and improved HUD symbology, and DTSAS. DTSAS includes PGCAS, OWC, DTSAS Status Message, and DTSAS Error Message capabilities. The IFFCC is powered when the AHCP IFFCC OFF/TEST/ON switch is in any position other than the OFF position. If a DTC is inserted and locked into the UDTU when the IFFCC is turned on and the DTC contains pilot preferences and weapons data, this data will be automatically uploaded to the IFFCC. (Refer to TO 1A-10C-34-1-1 for a description of the pilot preferences and weapons data that can be uploaded from the Data Transfer System.)

NOTE

- If IFFCC is turned off and then on without cycling power to the CDU, then the pilot preferences and weapons data located on the DTC will not be automatically uploaded to IFFCC. Weapons data and some pilot preference data are stored in NVM and will be retained when IFFCC power is restored. However, pilot preference data that is lost may be restored by using the DTS Upload (DTSUPLD) Page (Figure 1-77) or by manually re-entering the desired data using IFFCC.

- After an IFFCC power cycle, the automatic upload of changes to the IFFCC data from the MDTC will not immediately show on the IFFCC Main Menu Page. The changes can be viewed by cycling off from the main menu page and returning.

GCAS.

GCAS is a warning system, not a collision prevention system. GCAS uses data from the radar altimeter system, EGI, CADC, and the IFFCC to provide warnings of potential ground impact. GCAS is normally operational whenever the radar altimeter is in Normal (NRM) position and within coverage of the antennas, the landing gear handle is up, and the aircraft has initially attained 115 feet AGL. Warnings are provided on the HUD with a Break-X symbol, which flashes for 2 seconds for each warning, and a female voice that announces "Pull-Up, Pull-Up" over the intercom system. The "Pull-Up, Pull-Up" voice message takes priority over all other intercom traffic, cannot be turned off using the intercom volume control, and is twice as loud as any other message. These warnings are provided under two conditions. The first is when the aircraft descends below 90 feet AGL. The second condition is based on a radar altitude flight path prediction. The warning is issued when a maximum performance roll to wings level and maximum performance pull-out initiated immediately will just clear the ground. In addition, with DTSAS PGCAS capability, the system warns of an impending collision with rising terrain that cannot be detected by the LASTE system. The DTSAS PGCAS calls are inhibited below 450 feet AGL. Safe recovery from a GCAS "Pull-Up, Pull-Up" warning and/or "Break X" in the HUD requires that the aircraft be flown at maximum performance. To attain maximum performance, the aircraft must be flown to the chopped tone, periodically (2 to 3 seconds) backing off to the steady tone. Flying between the steady and chopped tones provides performance as close to maximum performance as possible without going into the stall regime, but should only be used to actually recover from the GCAS warning of potential ground collision.

WARNING

- The following does not apply to DTSAS PGCAS:
- If no aircraft recovery is initiated after first GCAS call, subsequent calls are inhibited for 8 seconds including the 90-foot hard call.
- GCAS is not a maneuvering aid, and will not be relied on to provide safe ground clearance.
- IFFCC GCAS will not be available if the radar altimeter is disabled or the HUD displays XXXXR.
- Expect reduced coverage at dive angles of greater than 45 degrees.
- The 90-foot hard call will not be available if the ASU or Radar Altimeter is invalid, or if both the Navigation and HARS data are invalid.

NOTE

Radar returns from other aircraft can cause false GCAS warnings.

GCAS Training Mode.

The GCAS TRAINING mode allows the selection and storage of a false ground plane for GCAS training and allows entry into the CAPTURE DATA submenus. Selection of a false ground plane is enabled when the cursor is placed opposite the GND PLANE. The UFC DATA switch is used to toggle between the following false ground plane options: OFF, 2000, or 3000 ft AGL.

The CAPTURE DATA submenu can be selected by placing the cursor opposite AUTO SCROLL and depressing the UFC ENT button. Depressing the UFC ENT key with the cursor next to STORE causes the selected false ground plane to be stored in Random Access Memory (RAM) and allows return to the MAIN MENU. Selecting CANCEL and depressing UFC ENT button will reset the false ground plane to OFF. The HUD message "GCAS" is displayed while in GCAS training mode.

In modes other than TEST, when the false ground plane is set to 2000 or 3000 ft via the GCAS TRAINING submenu "GCAS" is displayed in 6- to 8-mil letters in the HUD Priority Message Window. The message is horizontally centered on the HUD, vertically above HUD center (Figure 1-175).

NOTE

In GCAS training mode, the IFFCC inhibits 90-foot hard calls when the flight path angle exceeds zero degrees.

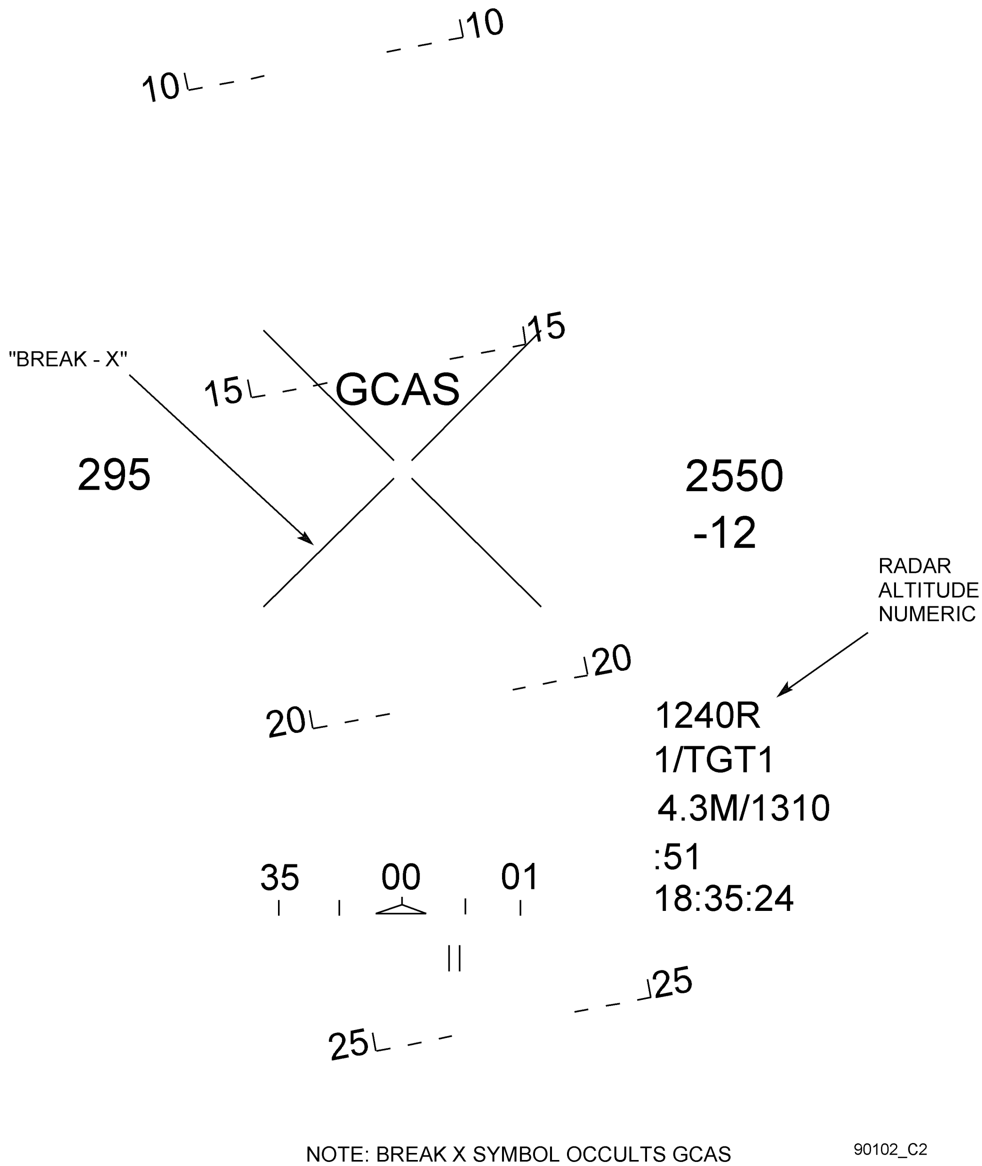


Figure 1-175. GCAS Training Message

GCAS Events Download.

When a GCAS message is generated, data representing the generated GCAS message is automatically downloaded to the DTS and written into the DTC. In addition, this generated GCAS message causes the count displayed in the GCAS MSGS field on the LASTE Page (Figure 1-82) to be incremented by the number of GCAS messages that actually occurred.

Altitude Alert.

GCAS provides the voice altitude alert message "Altitude, Altitude" when the aircraft descends through a preset AGL or MSL altitude. Whenever the aircraft ascends through the MSL ceiling altitude, "Ceiling" is announced over the Voice Message Unit (VMU). The ceiling altitude alert is disabled by setting it to zero.

Both MSL and AGL altitude alerts are active at the same time. Altitude alerts can be uploaded from the DTS, or are selectable from 0 to 5,000 feet AGL, and 0 to 45,000 feet MSL. The MSL alert is initially set to 0 feet on power up. The AGL altitude alert is initially set to 500 feet on power up. The altitude is entered using the ALT ALERT key and DATA switch on the UFC panel or by entering an elevation into the scratchpad and depressing ENT on the UFC. Altitude alert setting is displayed in the center of the HUD for 1/2 second when the ALT ALERT key is activated and will remain displayed for 4 seconds after the switch is released. The DATA switch increments the altitude setting in 10-foot increments up to 500 feet and then in 100-foot increments above 500 feet. Altitude alerts are set by depressing the ALT ALERT switch, altitude alerts cycle through MSL FLOOR, AGL FLOOR, and MSL CEILING. MSL altitudes are displayed with MSL displayed after the numerics, and are based on uncorrected barometric altitude. If the radar altitude scale is being displayed on the HUD, and the altitude alert is set below 1,500 feet AGL, a T-bar is continuously displayed on the left side of the radar altitude scale. If no entry is selected, or altitude alert is set to zero, that altitude alert is disabled.

NOTE

All altitude alert settings may also be preset via the A/W/E.

Speed Brake Warning.

The voice message "Speed Brakes, Speed Brakes" will be transmitted over the intercom system with the speed brakes open under the following conditions:

<u>CONDITION 1</u>: Landing gear handle up and either:

- Only one throttle at max at any airspeed, or
- Both throttles at max and airspeed < 145 KIAS

<u>CONDITION 2:</u> Landing gear handle down and:

- One or both throttles at max, and
- Airspeed < 145 KIAS

Logic has been added to reduce nuisance warnings:

- The speed brake warning conditions must be continuously present for 0.5 sec.
- Once a speed brake warning has been issued, no further warnings are issued until the condition that caused the warning is corrected (i.e., closing speed brakes, throttle movement).
- If a warning was issued as the aircraft decelerated through an airspeed of 145 KIAS, no other warning is issued until the airspeed is increased to above 150 KIAS and again falls to 145 KIAS (assuming all other conditions that caused the warning are still present). If a condition that caused the warning is corrected (i.e., closing speed brakes), the 145 KIAS threshold is again enabled.

WARNING

The speed brake extended warning will not be transmitted in all potentially hazardous conditions.

NOTE

- It is possible to be in situations where the Speed Brake Warning System will not issue a warning.
- With the landing gear handle up, both throttles at MAX (regardless of actual engine operation), speed brakes open, and airspeed above 145 KIAS.
- With the landing gear handle down, one or both throttles at MAX (regardless of engine operation), speed brakes open, and airspeed above 145 KIAS.

VMU.

The VMU alert message priority order is as follows:

- "Pull-Up, Pull-Up" (GCAS warning message)
- "Missile, Missile" (Missile warning message)
- "Warning, Autopilot" (autopilot disconnect warning)
- "Speedbrakes, Speedbrakes" (speedbrake warning message)
- "Altitude, Altitude" (altitude alert warning message)
- "Chaff-Flare, Chaff-Flare" (countermeasures dispense message)
- "Obstacle" (obstacle warning message)
- "Ceiling" (ceiling alert message)
- "Counter, Counter" (countermeasures consent required message)
- Autopilot Engagement Tone

NOTE

Only the "Pull-Up, Pull-Up" VMU message can interrupt the other VMU messages.

The "Pull-Up, Pull-Up"; "Altitude, Altitude"; and "Speed brakes, Speed brakes" alert messages are described earlier in this section. The "Warning, Autopilot" message is described in the EAC section.

The following paragraphs describe the other VMU messages.

Missile, Missile" Warning Message.

When the CMSP reports a missile launch, a "Missile, Missile" message is announced via the VMU.

"Chaff-Flare, Chaff-Flare" Warning Message.

When the CMSP is dispensing chaff or flare countermeasures, a "Chaff-Flare, Chaff-Flare" message is announced via the VMU.

"Obstacle" Warning Message.

Whenever the DTSAS generates a valid OWC, an "Obstacle" message is announced via the VMU.

If VMU warnings for multiple obstacles become stacked (with no OWC being displayed), the unnecessary VMU message is removed from the stack and will not be announced. This avoids potentially confusing situations when VMU warnings are being announced while no OWC is displayed in the HUD.

Deleted.

Deleted.

"Ceiling" Advisory Message.

Whenever the aircraft ascends through the preset MSL Ceiling altitude (set through the IFFCC altitude alert capability), a "Ceiling" message is announced via the VMU.

"Counter, Counter" Warning Message.

When the CMSP requires consent to counter a threat, a "Counter, Counter" message is announced via the VMU.

Autopilot Engagement Tone.

Whenever the LAAP is engaged through the left throttle LAAP Engage button or LCP AUTOPILOT ENGAGE/DISENGAGE button, an aural tone is provided by the VMU.

DTSAS.

DTSAS has a number of capabilities along with its specific HUD symbols and messages. These are the following:

- PGCAS
- OWC
- DTSAS Status Message
- DTSAS Error Messages.

DTSAS PGCAS Capability.

The DTSAS function provides an additional PGCAS capability, above 450 ft AGL, that is integrated with the current IFFCC GCAS capability. As in IFFCC GCAS, the DTSAS function provides warning of an impending collision with the ground. In addition, it warns of an impending collision with rising terrain or obstacles that cannot be detected by the LASTE system.

NOTE

The DTSAS PGCAS capability is available in all IFFCC flight modes.

The DTSAS PGCAS capability is enabled through the CDU DTSAS page when the DTSAS function is activated. DTSAS PGCAS warnings are then enabled when the aircraft initially exceeds 450 feet AGL with the landing gear retracted and the previous call is cleared (as in IFFCC GCAS capability).

The DTSAS PGCAS capability is integrated with the IFFCC GCAS as follows:

- The DTSAS PGCAS warning can be issued in lieu of the IFFCC PGCAS and 90-foot hard call depending on flight and terrain conditions.
- The "Pull-Up, Pull-Up" VMU message and HUD "Break-X" symbol are used for warning against ground and obstacles.
- Warnings are issued on the leading edge of the first occurrence. Other warnings are inhibited until the first warning is cleared.
- A DTSAS PGCAS warning is considered "cleared" when either (1) the warning flag has been de-activated by DTSAS and aircraft flight path angle exceeds terrain slope or (2) an 8-second timeout period has elapsed.
- DTSAS terrain elevation data is used to inhibit nuisance IFFCC GCAS calls.

The source of the GCAS call is indicated on page 2 of the GCAS Data Capture pages. It is also displayed at the bottom left of the CDU DTSAS page.

WARNING

- DTSAS PGCAS warnings are inhibited when:
- The DTSAS is commanded OFF through the CDU DTSAS page.
- The DTSAS function is invalid (as indicated on the CDU DTSAS page).
- The landing gear is extended, and airspeed is less than 200 KIAS.
- Below 450ft AGL

NOTE

- With the radar altimeter turned off or invalid, the estimated AGL height from DTSAS is used to determine when the aircraft is above 450 ft AGL. This height is used to determine if DTSAS PGCAS is inhibited.
- When in GCAS Training Mode, the DTSAS-generated PGCAS warning is based on the manually-entered ground plane. If the aircraft descends below this ground plane value, the actual ground plane is used for DTSAS PGCAS warnings.
- With the radar altimeter turned off or invalid, the estimated AGL height from DTSAS is used to determine whether the aircraft is above or below the false ground plane (FGP). This height is used to determine what to reference the GCAS calls to. If the DTSAS AGL height is greater than the FGP, then the GCAS call is referenced against to FGP. If the DTSAS AGL height is below the FGP, then the GCAS calls are referenced against the actual terrain.

OWC Capability.

The OWC provides real-time warning of obstacles ahead, to the left, or to the right of the aircraft (with respect to a preset obstacle/terrain avoidance height) out to a distance of 4000 meters. This obstacle/terrain avoidance height is entered on the CDU DTSAS page or through the A/W/E.

WARNING

DTSAS PGCAS "Pull-Up, Pull-Up" calls and Break-X messages based off obstacles may not ensure safe clearance from the obstacle.

NOTE

- If zero is entered as the obstacle warning height, the OWC capability is disabled.
- The OWC is displayed in all IFFCC flight modes.

When DTSAS detects an obstacle, an "OBSTACLE" text message is displayed in the HUD, accompanied by a caret pointing in the direction of the obstacle (Figure 1-176). The text is centered horizontally in the HUD 43 milliradians (mils) above HUD center (above the HUD Priority Message Window), and does not occult any other HUD symbology. The directional caret flashes at 4 Hz for a maximum of five seconds or until the UFC ENT or CDU FA button is depressed. The caret flashes for a minimum of one second, however, regardless of when the UFC ENT is depressed.

NOTE

If there are contentions with Hack Time, Delta Update, "Hot" Target Altitude, Overhead Mark, or IFF Advisories/Other Alerts , the first UFC ENT depression completes the process in progress. The second UFC ENT depression clears the flashing of the directional caret.

Upon receipt of every obstacle warning, the "Obstacle" VMU message is announced. This message is also annunciated in TEST mode but no visual warning is provided). The visual OWC and aural VMU messages are disabled when the landing gear handle is down and airspeed is below 200 KIAS.

DTSAS Status Message.

The DTSAS Status Message provides vital DTSAS and EGI operational mode and associated FOM information. It is displayed in the lower left corner of the HUD (in the DTSAS Status Window), immediately below the Altitude Source (Figure 1-177). The DTSAS mode and FOM are displayed first if no DTSAS errors are present, followed by the EGI mode and FOM. A slash separates the DTSAS and EGI information. If all DTSAS functionality is commanded OFF via the CDU DTSAS page, the DTSAS mode and FOM, including the slash, are removed from the HUD.

NOTE

The DTSAS Status Message is displayed in all IFFCC flight modes.

DTSAS mode information will be indicated by one of two characters:

- "D" represents Track mode.
- "S" represents Search mode.

EGI mode information will be indicated by one of four characters:

- "B" represents Blended mode.
- "G" represents GPS Only mode.
- "I" represents INS Only mode.
- "N" represents NAV Idle mode.

NOTE

- The FOM for both the DTSAS and EGI ranges from one to nine. The estimated position error associated with each FOM value is shown in Figure 1-178. The DTSAS FOM is calculated by the same formula used by the EGI to calculate its estimated position error.
- If the EGI is in a failed state or cannot calculate a FOM, a "*" will be displayed in place of the EGI FOM.

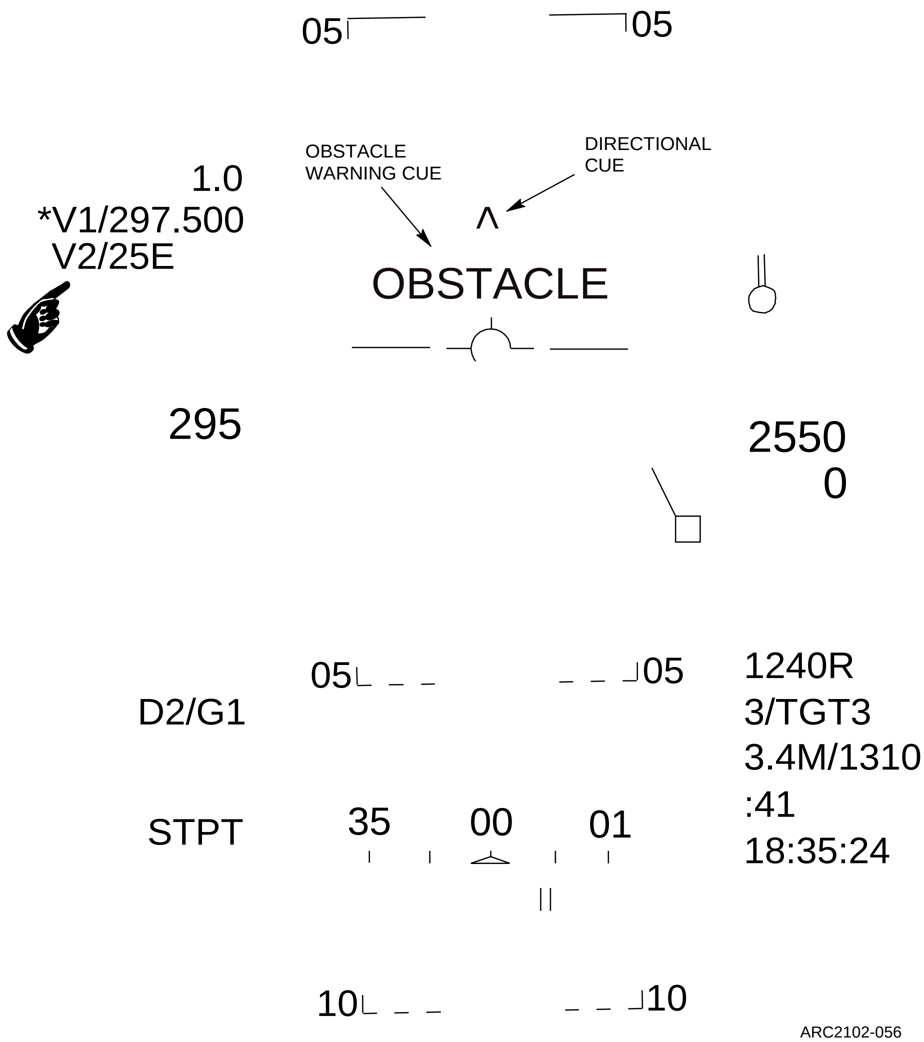


Figure 1-176. Obstacle Warning Cue

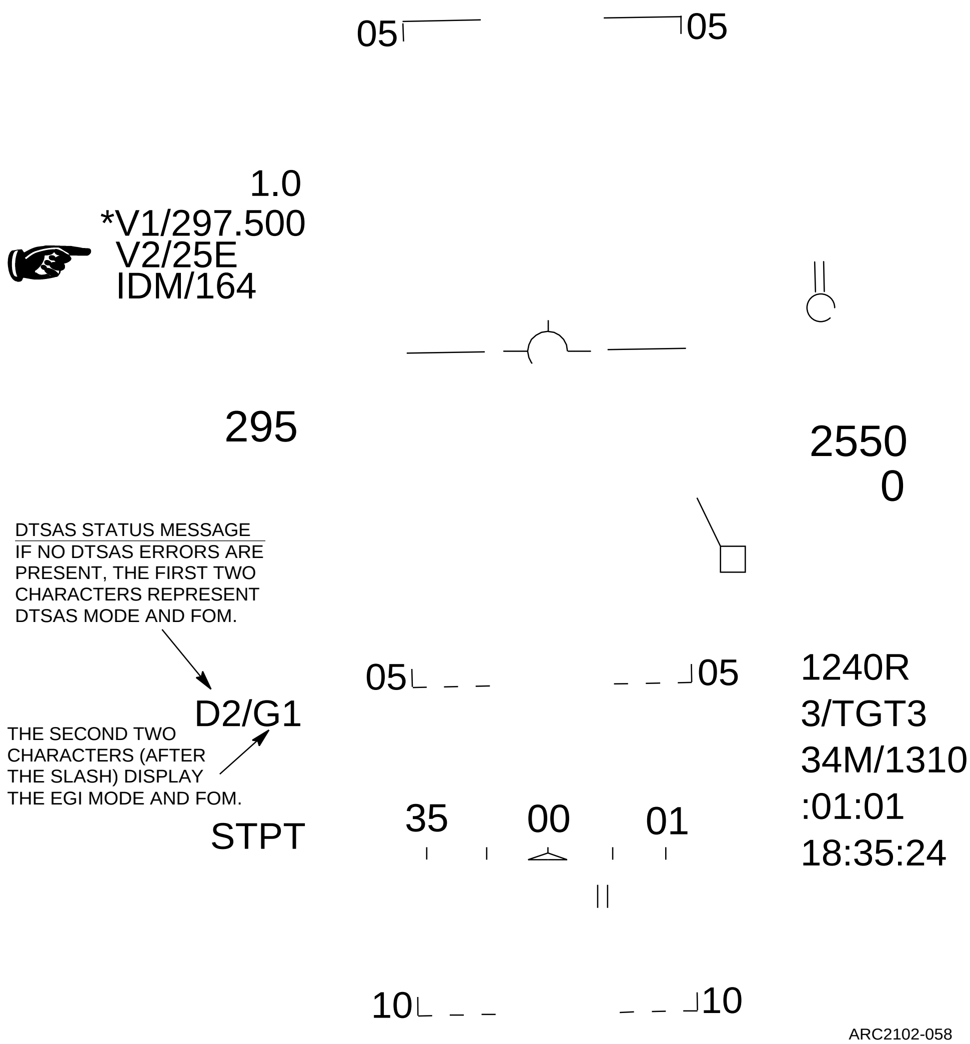


Figure 1-177. DTSAS Status Message

Figure 1-178. FOM Values and Associated Estimated Position Error

FOM	Estimated Position Error (in meters)
1	<26
2	26 - 50
3	51 - 75
4	76 - 100
5	101 - 200
6	201 - 500
7	501 - 1000
8	1001 - 5000
9	>5000

When the DTSAS Status Message displays "Sx" (where "x" is the DTSAS FOM), this indicates that the DTSAS is in Search mode. The Search mode annunciates that the DTSAS is trying to obtain a position fix of relative confidence. All DTSAS functionality is disabled if this message is displayed. This message will flash at 4 Hz in the HUD. Depressing the UFC ENT key clears the flashing, and causes the "Sx" to be replaced by "NODTS" (Figure 1-179). When the DTSAS enters Track mode, the "NODTS" is replaced by "Dx" (where "x" is the DTSAS FOM).

NOTE

If there are contentions with Hack Time, Delta Update, "Hot" Target Altitude, Overhead Mark, or IFF Advisories/Other Alerts , then the first UFC ENT depression completes the process in progress. The second UFC ENT depression clears the flashing "Sx" annunciation.

DTSAS Error Messages.

The two DTSAS error messages annunciated on the CDU DTSAS page are also displayed in the DTSAS portion of the DTSAS Status Window in the HUD. These error messages are:

- "DTSFAIL"
- "OFFMAP"

NOTE

DTSAS Error Messages may be displayed in all IFFCC flight modes.

If the DTSAS is commanded OFF, both error messages will be removed.

The "DTSFAIL" message has the highest priority of all the DTSAS Status Window messages. It indicates that all DTSAS functionality has failed. Specifically, this means that the IFFCC is no longer receiving DTSAS 1553 traffic or that the DTSAS has stopped running. The "DTSFAIL" message flashes at 4 Hz in the HUD. Depressing the UFC ENT key or CDU FA button clears the flashing, and causes the "DTSFAIL" to be replaced by "NODTS" (Figure 1-180). This error message is also displayed if DTSAS is not loaded on the Mega Data Transfer Cartridge (MDTC) and DTSAS is commanded on. If no MDTC is installed the DTSAS defaults to off.

NOTE

If there are contentions with Hack Time, Delta Update, "Hot" Target Altitude, Overhead Mark, or IFF Advisories/Other Alerts , then the first UFC ENT depression completes the process in progress. The second UFC ENT depression clears the flashing "DTSFAIL" annunciation.

The "OFFMAP" message has the second highest priority of all the DTSAS Status Window messages. It indicates that the aircraft has flown off the digital database. The "OFFMAP" message flashes at 4 Hz in the HUD. Depressing the UFC ENT key or CDU FA button clears the flashing, and causes the "OFFMAP" to be replaced by "NODTS" (Figure 1-181). The message is removed by the DTSAS when the aircraft flies back onto the digital database.

NOTE

If there are contentions with Hack Time, Delta Update, "Hot" Target Altitude, Overhead Mark, or IFF Advisories/Other Alerts , the first UFC ENT depression completes the process in progress. The second UFC ENT depression clears the flashing "OFFMAP" annunciation.

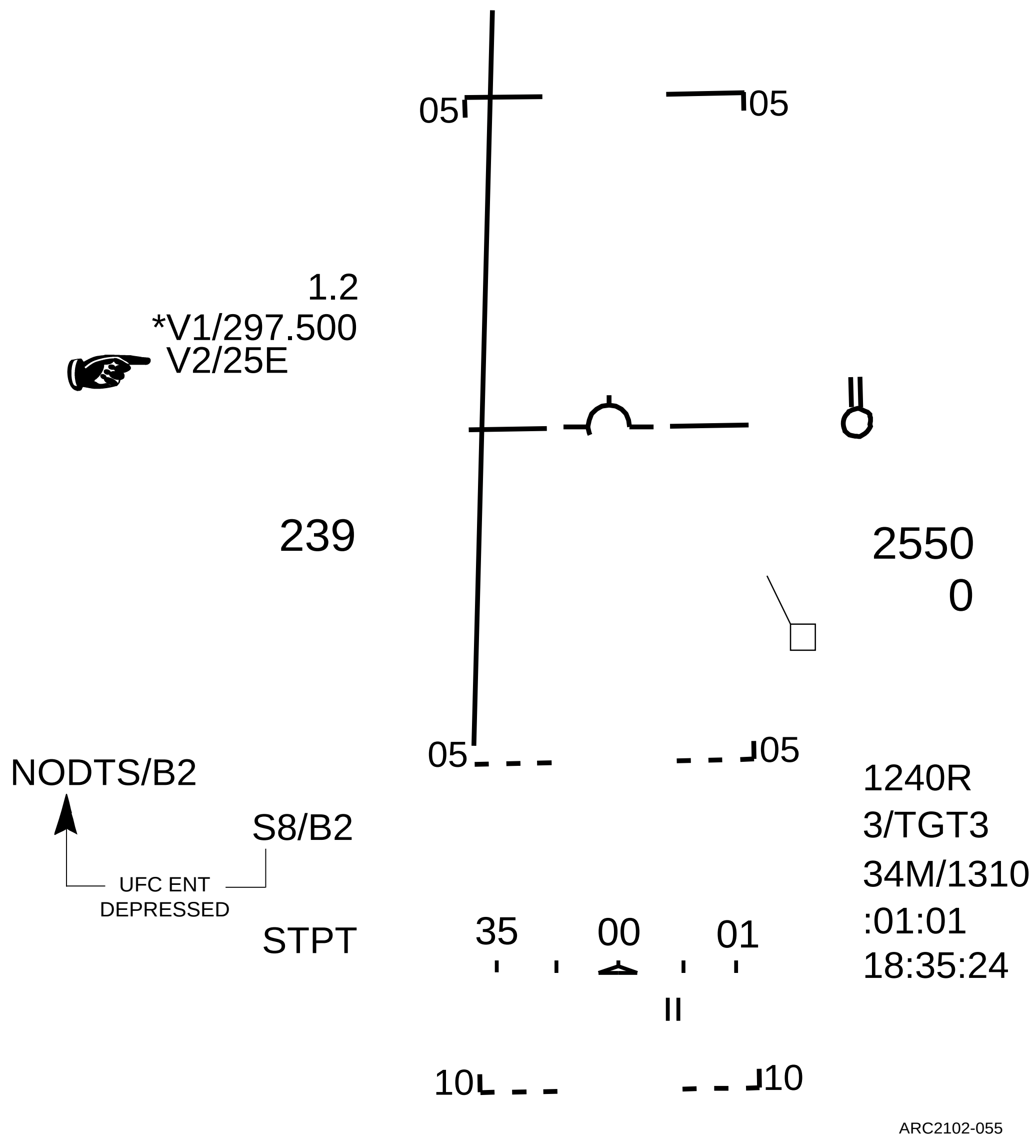


Figure 1-179. DTSAS Search Mode Annunciation

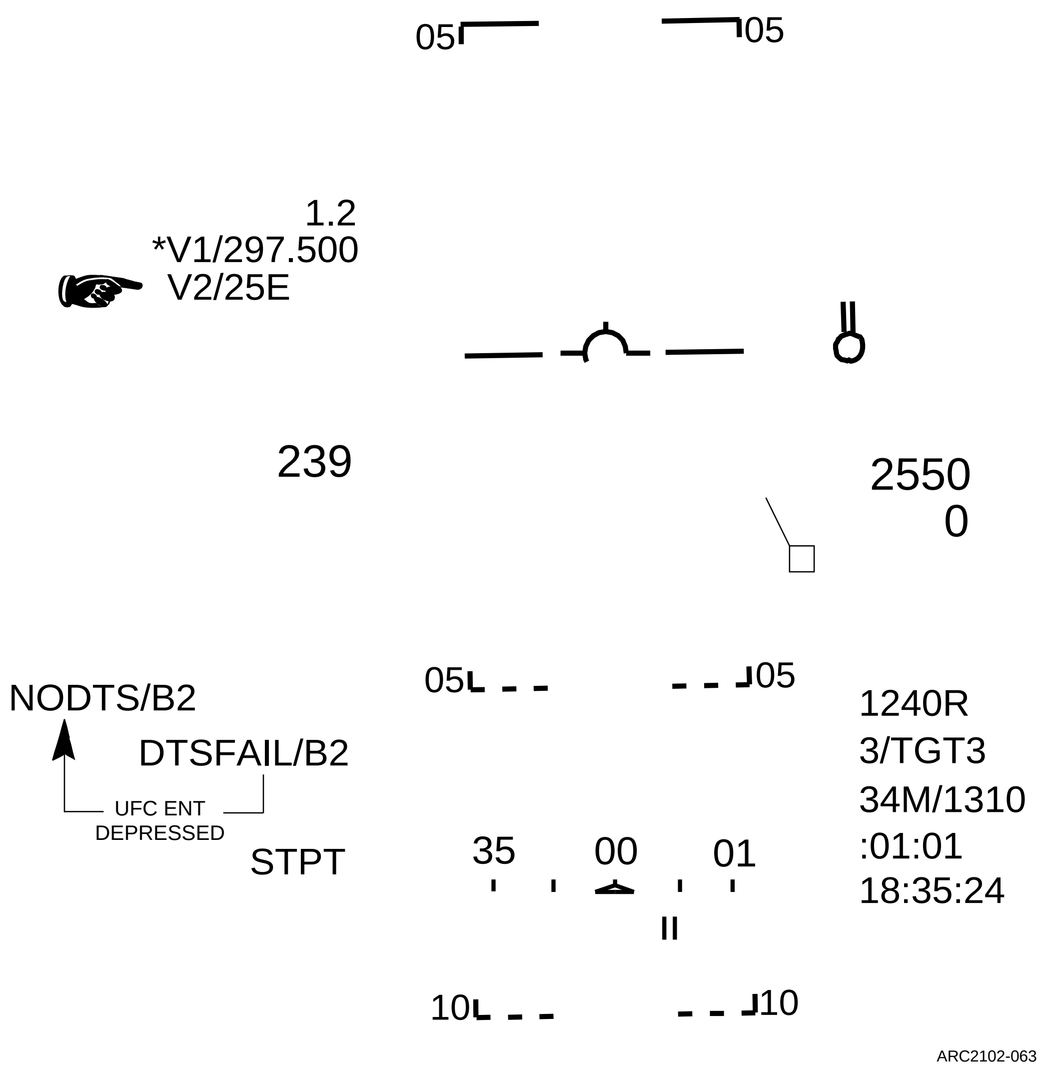


Figure 1-180. "DTSFAIL" Error Message

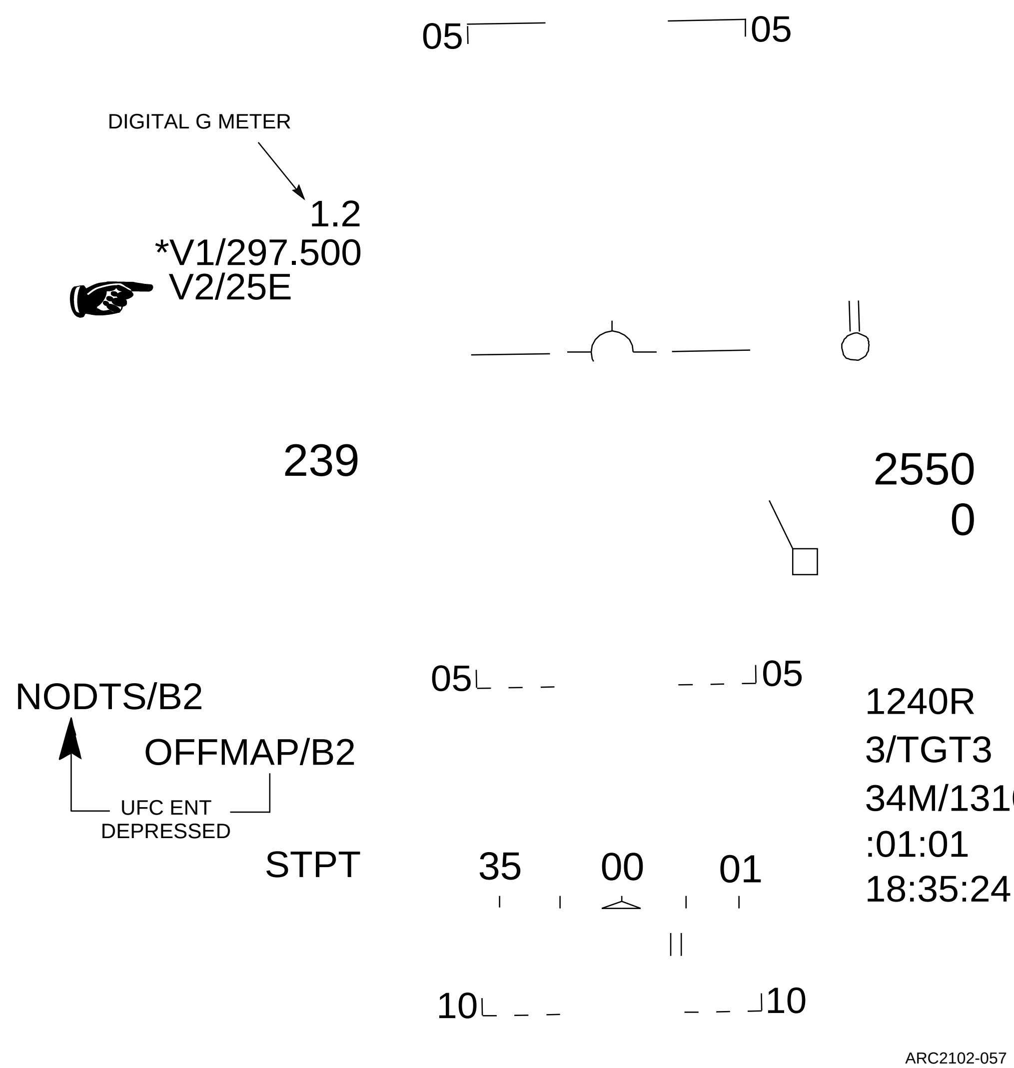


Figure 1-181. "OFFMAP" Error Message and Digital G Meter

EAC SYSTEM.

The EAC system is an autopilot capability provided by the LASTE system. EAC is implemented in the IFFCC using sensor data from the EGI, CADC, and SAS. Outputs from the computer are sent to the SAS to drive the elevator and rudder actuators. Figure 1-182 illustrates the EAC system tie-in to other aircraft components. The EAC system includes PAC mode and LAAP mode. LAAP modes are altitude/bank hold, altitude/heading hold, and path hold modes. The EAC system is armed by the EAC switch, which is located on the LASTE control panel. The EAC switch is solenoid-held in the ARM position. If the LASTE system detects a fault which jeopardizes safe EAC operation, the EAC switch de-energizes, and thus disengages or prevents engagement of any EAC mode. EAC will disarm when invalid data is received from the LASTE sensors (CADC, EGI, and SAS), when any of the SAS Engage switches on the SAS Control Panel are disengaged, or when EGI is deselected either automatically (by an EGI failure) or manually via the switch on the NMSP. Any disarming of EAC will cause the EAC light on the caution light panel and the MASTER CAUTION light to illuminate. If autopilot mode was engaged, the audio warning "Warning, Autopilot", is announced over the intercom. Engagement of the EAC autopilot or PAC modes is possible only if the EAC switch is set to ARM, SAS is engaged, HUD mode selector switch is not off, EGI is selected, BLENDED or INS-only NAV solution is selected after full EGI INS alignment, and air refueling door lever is in the closed position. EAC disconnects associated with a rudder kick may occur when pitch angles exceed 70° either in pitch up or pitch down attitude. If the EAC switch reengages without incident and no LASTE fault codes are present, no further maintenance action is required. This anomaly is most common at northern latitudes.

NOTE

- EAC disconnect may be an indication of IFFCC master bus failure. Check LASTE fault codes for IFFCC status.
- EAC disconnects associated with a rudder kick may occur when pitch angles exceed 70° either in pitch up or pitch down attitude. This anomaly is more common at northern latitudes.
- If the EAC switch reengages without incident and no LASTE fault codes are present, no further maintenance action is required.
- When auto-download of system data is initiated and a CDU warm start occurs (aircraft landing and airspeed falls below 75 knots), automatic disengagement of the LASTE EAC switch may occur. This is normal system operation.

Sufficient SAS control actuator authority for the PAC mode to counteract pitching moments produced during gunfire is provided by a 2° nose-down elevator trim change through the IFFCC. The trim change occurs when the aircraft is in flight, EAC is armed, PAC switch is on, air refueling door is closed, AHCP IFFCC switch is in any position except off, and the MASTER armament switch is in ARM. When the Air-to-Air mode is selected, PAC is still armed (2° nose-down trim), but will not function when the gun trigger is pulled to the first or second detent. The trim change input should be compensated for by retrimming using the manual trim switch on the control stick and not by applying an appropriate amount of aft stick pressure.

NOTE

- If the control stick inputs are greater than 0.5 inch from takeoff trim, aircraft transients may occur during the PAC 1 and PAC 2 phases of gunfire.
- If EAC disarms in this situation, a 2° nose up elevator trim change occurs. Rearming the EAC in the same configuration causes a 2° nose-down elevator trim change.

PAC.

PAC assists in target acquisition and provides aircraft stabilization during Air-to-Ground gunnery. The PAC target acquisition submode and the PAC target hold submode process aircraft pitch, roll, and yaw rates, airspeed, direction cosines, height above target, dynamic pressure, inertial velocity vector, control stick position, rudder pedal position, elevator series servo position, and aiming reference data to calculate the pitch and yaw output signals that drive the SAS to control the aircraft orientation. PAC applies elevator and rudder control signals through the SAS to stabilize the aircraft during gunfire.

PAC is enabled when the following conditions are satisfied:

- Air-to-air refueling door closed.
- IFFCC is in GUNS or CCIP mode.
- Air-to-Air GUNS not selected (AIM-9 not selected).
- EAC is engaged.
- AHCP GUN/PAC armament switch is in the ARM position.
- LAAP is not engaged.
- Aircraft is in flight.
- A valid CCIP or fixed range gun solution exists.

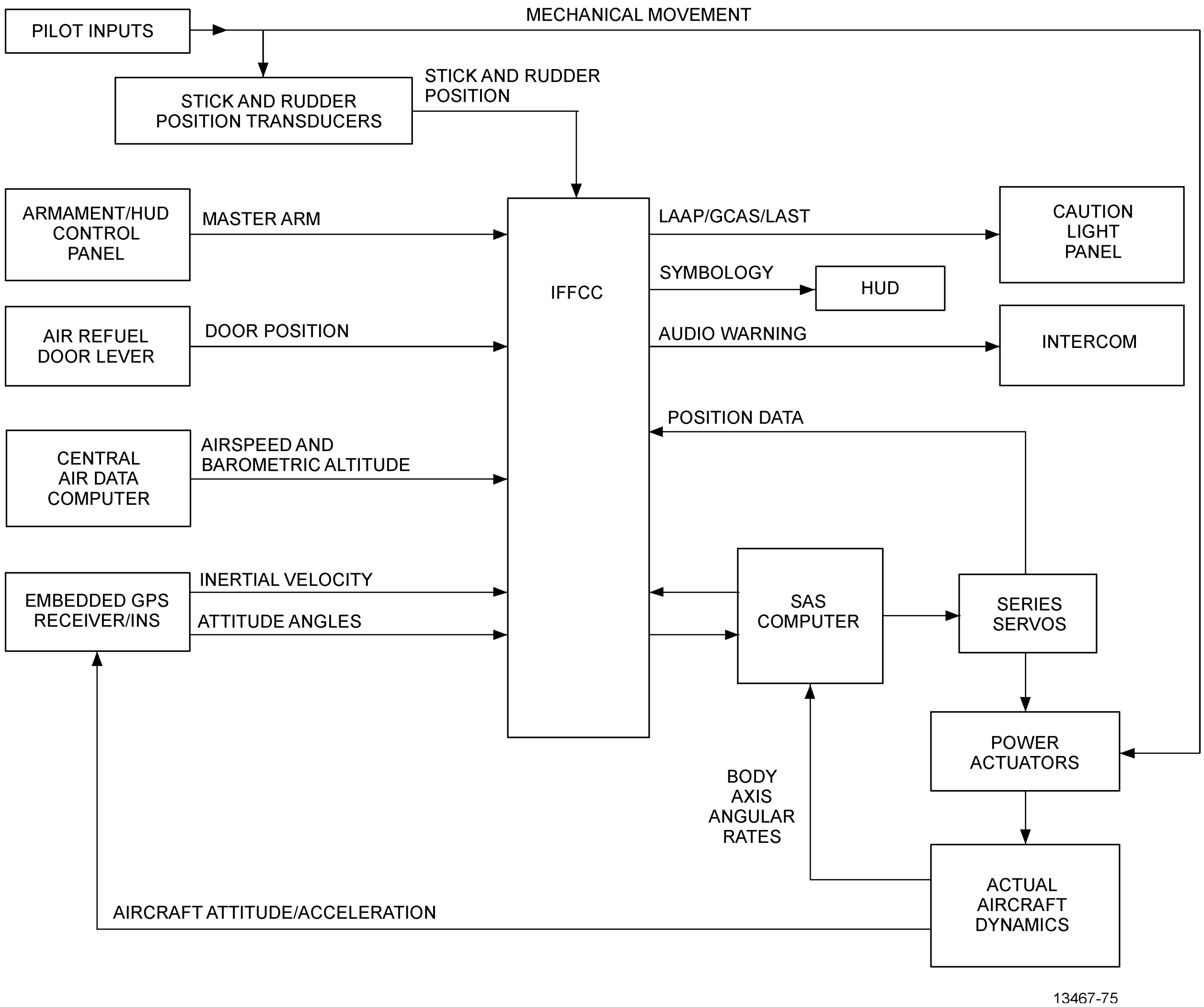


Figure 1-182. Enhanced Attitude Control (EAC) System Tie-In

PAC is disengaged by releasing the control stick trigger.

For a detailed description of PAC mode, refer to TO 1A-10C-34-1-1.

LAAP.

The LAAP modes are selected by means of the lever-lock AUTOPILOT switch located on the LCP. The AUTOPILOT switch positions are PATH (Path Hold), ALT/HDG (Altitude/Heading Hold), and ALT (Altitude/Bank Hold). The selected mode is engaged/disengaged by depressing the AUTOPILOT ENGAGE/DISENGAGE switch on the LASTE panel or by depressing the LAAP Engage button on the left throttle. Whenever the LAAP is engaged through the LCP AUTOPILOT pushbutton, an aural tone is annunciated by the VMU. If the autopilot disengages for any reason other than the intentional use of the LCP AUTOPILOT pushbutton or the LAAP Engage button, an audio warning is provided by the VMU through the intercom system. The voice message provided is "Warning, Autopilot," and is not repeated.

NOTE

- When GPS-only is the selected navigation solution, EAC will not engage or will disengage if it was engaged prior to selecting the GPS-only solution.

- When INS-only is the selected navigation solution, EAC will not engage if the NAV mode was selected on the INS Page when a steady INS NAV RDY (degraded NAV) annunciation was displayed on the CDU; or will disengage if it was engaged prior to selecting the INS-only navigation solution when the degraded NAV mode was selected.

- When BLENDED is the selected navigation solution, EAC will not engage (if a degraded NAV mode was selected on the INS Page) until the quality of the BLENDED navigation solution has reached an accuracy that corresponds to a full INS alignment. That is, when degraded NAV is selected, the EAC cannot be engaged until the GPS-only solution corrects the BLENDED solution to an accuracy that corresponds to a full INS alignment.

- When EGI is not selected on the NMSP, EAC will not engage or will disengage if EGI is deselected (either manually or automatically).

- The pilot is responsible for maintaining airspeed when autopilot is engaged.

- LAAP engagement on the HUD should be visually confirmed.

- If either altitude/heading hold or altitude/bank hold mode is engaged in a climb or descent, an overshoot will occur. Altitude stabilization occurs within 30 seconds.

- Heading and bank are controlled by the rudders; significant side forces may be felt during heavy turbulence.

- If turbulence precludes maintaining LAAP limits or airspeed declines to a point where SAS authority is not sufficient to maintain parameters, the autopilot disengages.

- Interaction between the LAAP and the radar altimeter has occasionally resulted in small, continuous pitch and yaw movements in IFFCC-controlled aircraft. Cycling the radar altimeter switch off and on should correct the problem with no further action required.

PATH HOLD MODE.

The path hold mode holds the aircraft on the path established at mode engagement, as determined by the position of the TVV as seen on the HUD. The selected path can be a climb, a descent, or level flight. Path hold mode will not engage with bank angles greater than 10°. LAAP maintains the selected path within 50 feet vertically and horizontally (200 feet for the first 30 seconds of engagement). Path hold mode disengages upon stick or rudder inputs.

ALTITUDE/HEADING HOLD MODE.

The altitude/heading hold mode of the EAC system captures and holds heading and barometric altitude at the moment of engagement. Altitude and heading capture is possible for climb and dive rates of 2,000 feet/minute or less, and bank angles of 10° or less. The altitude/heading hold mode holds altitude within 50 feet (500 feet for the first 30 seconds of engagement), and heading within 5°. Altitude/heading hold mode disengages upon stick or rudder inputs.

ALTITUDE/BANK HOLD MODE.

The altitude/bank hold mode of the EAC system captures and holds barometric altitude and bank angle at the moment of engagement and maintains a constant altitude while allowing bank angle changes. Altitude/bank capture is possible for climb and dive rates of 2,000 feet per minute or less. The altitude/bank hold mode maintains altitude within 50 feet (500 feet for the first 30 seconds of engagement). Figure 1-183 illustrates typical bank angle limits for various cases of altitude/bank hold engagement. Altitude/bank hold mode disengages upon pitch or rudder inputs. Lateral stick inputs allow changes in bank angle without disengaging LAAP.

EAC Malfunctions.

Most EAC malfunctions result in LAAP disengagement or disarming of the solenoid-held EAC switch. LAAP disengagement or disarming of the EAC switch can be caused by faults in LASTE equipment or interfacing equipment or by a procedural error. Faults are logged in IFFCC non-volatile memory for maintenance action. Disarming or disengagement does not necessarily mean a hard fault exists, and rearming EAC or reengaging any EAC mode can be attempted. SAS, EGI, CDU, CADC failures, or invalid data result in EAC disengagement. The EAC system can always be overridden by control inputs, disengaged by the engage/disengage switches, or disarmed by the EAC switch or the SAS emergency disconnect switch on the control stick. A LASTE system reset can be performed by depressing the FUNC key (on the UPC) and then depressing the MALF button on the UHC. This will clear the internal LASTE fault flags while retaining the fault codes in non-volatile memory. The reset will also re-initialize the control algorithms to reset any faults that may be latched.

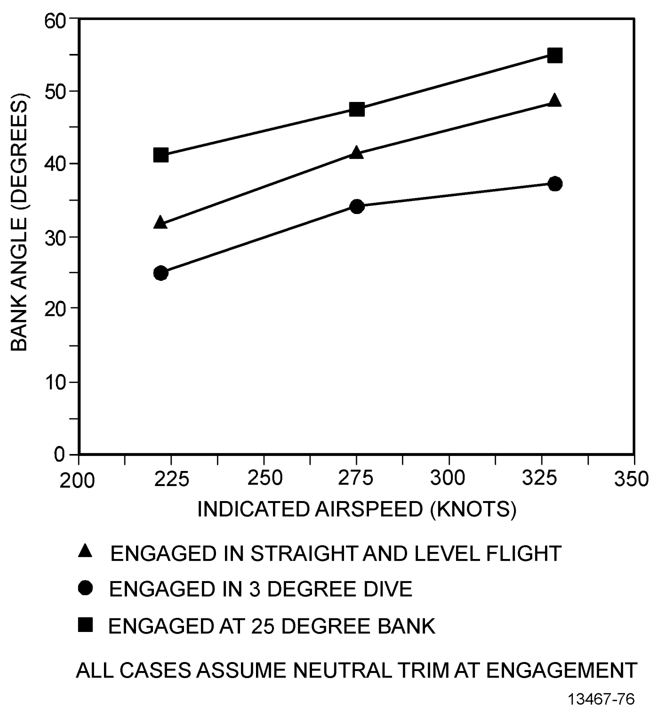


Figure 1-183. Typical Altitude/Bank Hold Envelope for 5000 Feet

LASTE COCKPIT INTERFACES.

LASTE cockpit interfaces (Figure 1-184) are described in the following paragraphs. Figure 1-185 describes the LCP.

LASTE System Caution Lights.

The LASTE system caution lights (Figure 1-184) are placarded LASTE, GCAS, and EAC. The LASTE caution light comes on when a fault is detected in the LASTE system. The GCAS caution light comes on when a fault is detected in the LASTE system that affects GCAS operation. The EAC caution light comes on when the EAC switch has disarmed. The three LASTE caution lights (GCAS, LASTE, and EAC) also come on during BIT check operations.

AHCP.

The AHCP (Figure 1-186) is located on the left side of the cockpit instrument panel. The AHCP provides switches for IFFCC power, HUD mode, altitude source, CICU power, JTRS power, and TGP power. It also contains switches for MASTER armament, GUN/PAC armament, and LASER armament. (The armament switches are described in ARMAMENT SYSTEM.)

Deleted.

UFC.

The UFC (Figure 1-187) is located in the cockpit on top of the instrument panel. It is a multipurpose alphanumeric keypad and function select device that is used to control the HUD, IDM RT Select, ARC-210-1, ARC-210-2, CDU, IFF functions (Mode 1, Mode 3/A, Mode C enable, Mode 1 or 3/A code updates or Identification of Position (IDENT)), and MFCD data entry. The primary purpose of the UFC is to provide a head-up data entry capability as well as acting as a remote CDU controller.

Throttle Controls.

The throttle controls (Figure 1-184) include the MIC switch, Speed Brake switch, Polarity switch, Missile Reject/Uncage Switch, LAAP Engage button, Slew/Track Control switch, and SOI switch. For more information on the throttle control functions, see TO 1A-10C-34-1-1.

Control Stick Grip Controls.

The control stick grip, illustrated in Figure 1-184, includes the Master Mode Control button, Data Management Switch, TMS, NWS button, Countermeasures Management Switch, Weapons Release button, Trim Switch, and Trigger. For more information on the control stick functions, see TO 1A-10C-34-1-1.

TRIGGER.

The Trigger is located on the forward upper surface of the control stick grip. The Trigger works in conjunction with the MASTER armament switch on the AHCP. The 30mm gun cannot be fired unless the MASTER armament switch is in the ARM position. Depressing the trigger to the first detent activates PAC-1. Depressing the trigger to the second detent will display a weapon release cue on the DVADR, a release cue and weapons event marker (letter W) on the HUD, and a gun trigger event is written to the Personal Computer Debrief System (PCDS) file on the DVADR RMMD.

WEAPONS RELEASE BUTTON.

The Weapons Release button is located on the control stick grip. Depressing the button will release stores from selected pylons that are highlighted in green on each respective MFCD. Depressing the Weapons Release button with the MASTER armament switch in ARM will display a weapon release cue on the DVADR, a release cue and weapons event marker (letter W) on the HUD, and a weapon release (pickle) event is written to the PCDS file on the DVADR RMMD. The Weapons Release button is also used to designate a target in CCIP consent release mode or to enable a CCIP or CCRP consent release. Weapons release data is captured when the MASTER armament switch is in the ARM or TRAIN position.

MASTER MODE CONTROL BUTTON.

The Master Mode Control button is used to select the HUD mode of operation. Depressing the Master Mode Control button for less than 1/2 second causes the HUD to cycle to the next mode of operation as follows: NAV, GUNS, CCIP, CCRP. The respective modes are used as follows:

a. NAV Mode - Used during normal point-to-point flight. On the HUD, the flight path ladder rotates around the TVV to display aircraft roll in all modes. The two NAV mode HUD displays (EGI INS and HARS) contain navigation information, but no weapon delivery symbology.

b. GUNS Mode - In conjunction with the LASTE system, is used to display symbology for Air-to Ground gun and Maverick delivery. There are two GUNS mode HUD display types: normal and HARS. GUNS HARS mode provides the same HUD symbology as NAV HARS mode with the addition of the depressible pipper/reticle, depression readout, fixed gun cross, weapons event marker, and Bullets At Target Altitude (BATA).

c. CCIP Mode - Is the primary mode for bomb and rocket delivery. There are two CCIP mode displays: normal and HARS. CCIP HARS mode provides the same HUD symbology as GUNS HARS mode, with the addition of reticle eyebrows. A roll-stabilized, wind-corrected depressible pipper is available in both CCIP and CCRP modes.

d. CCRP Mode - Provides capability to employ on a target outside the HUD FOV. There are two CCRP mode displays: normal and HARS. In HARS mode, the depression readout is multiplied by a factor of 3, effectively compressing the depressible pipper/reticle by a factor of 3.

Depressing the Master Mode Control button for 1/2 second or more selects the Air-to-Air mode. The Air-to-Air mode provides the same HUD symbology as the NAV mode with the addition of the funnel, Multiple Reference Gun Sight (MRGS), AIM-9 seeker, Air Mass Impact Line (AMIL), and Firing Evaluation Display System (FEDS).

LCP.

The LCP is located on the left console just aft of the throttle quadrant. The LCP controls the EAC function, LAAP function, and radar altimeter system. The controls and indicators for the LCP are shown and described in Figure 1-185.

LASTE Weapons Event Download.

When a LASTE weapons event occurs, a code representing the weapons event that occurred is automatically downloaded to the DTS and written into the DTC. Additionally, every time the trigger is pulled or the Weapons Release button is depressed, a markpoint is created. This markpoint is captured in Mark Z, which is exclusively reserved for the storage of the most recent weapon delivery aimpoint. Refer to TO 1A-10C-34-1-1 for further information on Mark Z. A weapons event causes the count displayed in the WPN EVENTS field on the LASTE Page (Figure 1-82) to be incremented by one.

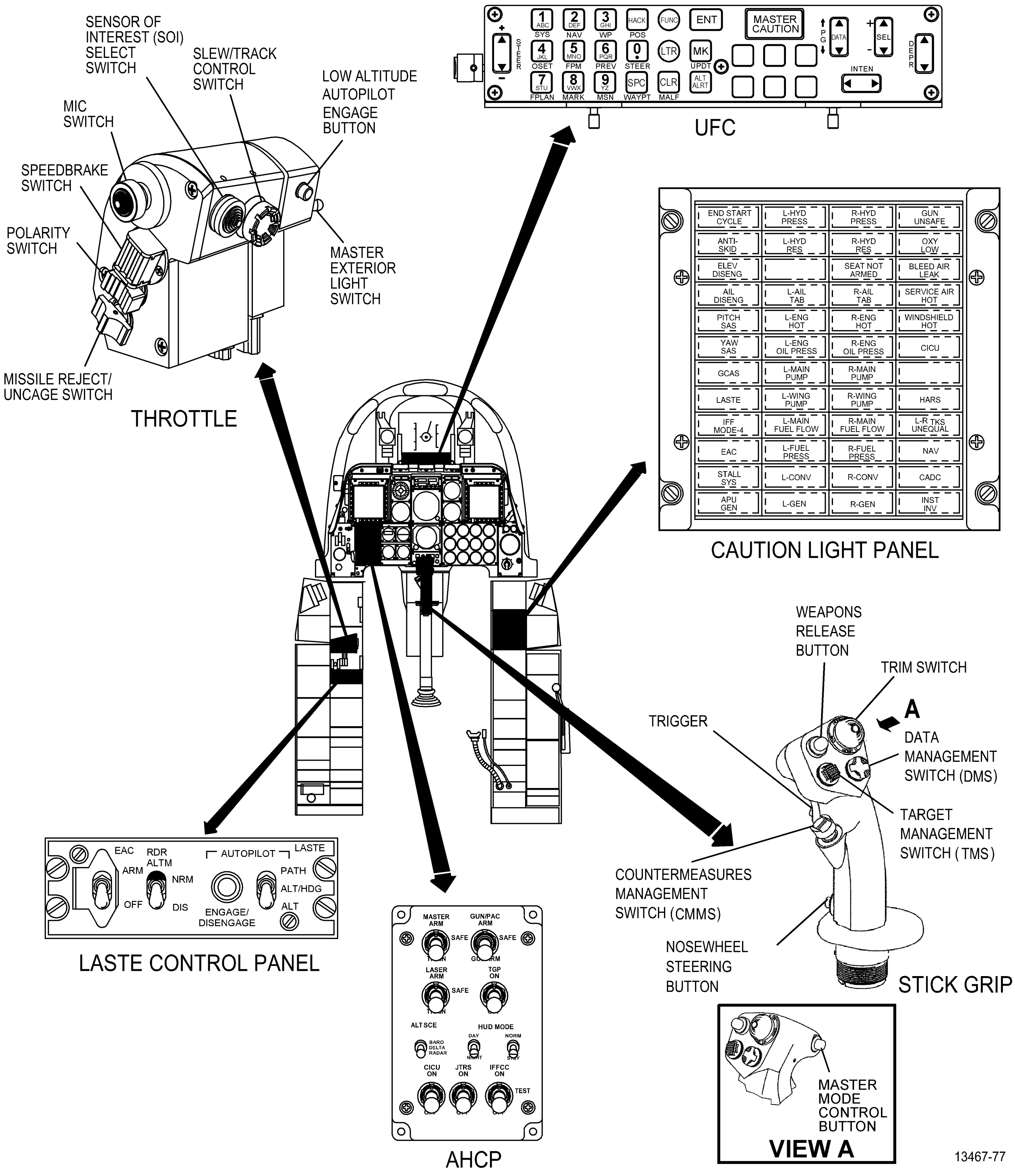


Figure 1-184. LASTE Cockpit Interfaces

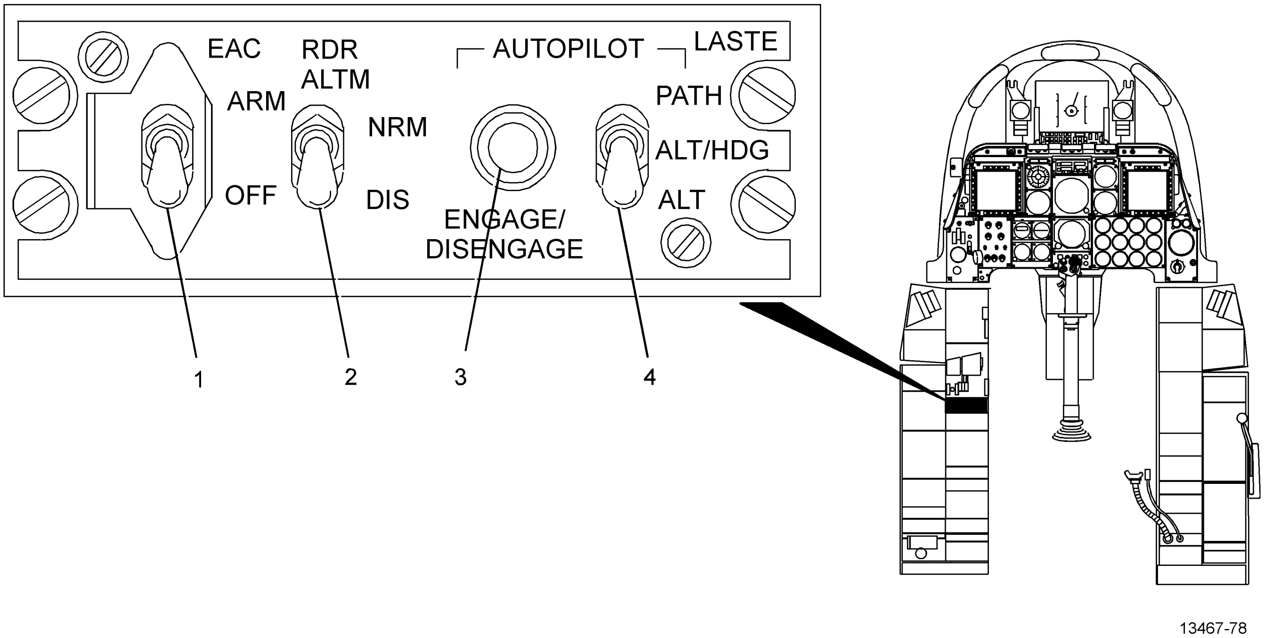


Figure 1-185. LASTE Control Panel (Sheet 1 of 2)

Index No.	Control or Indicator	Position or Display	Function
1	EAC switch	OFF	Disables EAC function of LASTE system and causes the EAC caution light on the caution light panel to be illuminated.
		ARM	Enables EAC function of LASTE system. The switch is held in ARM position by a latching coil. The switch will revert to OFF when an invalid signal is received by the IFFCC from the CADC, EGI, or SAS; pitch and yaw SAS switches disengage; an internal LASTE BIT fails; or the emergency disconnect switch on the control stick is engaged. For the EAC switch to engage (latch in ARM position), EGI must be selected on the NMSP, the INS NAV mode must have been selected after a full INS alignment (flashing INS NAV RDY annunciation on CDU), and the BLENDED or INS-only solution must be selected.
2	RDR ALTM switch	DIS	Disables radar altimeter and GCAS.
		NRM	Enables radar altimeter to provide altitude signals to the IFFCC.
3	AUTOPILOT pushbutton switch	ENGAGE/DISEN-GAGE	Turns on/off selected autopilot function in the IFFCC.
4	AUTOPILOT three-position switch	PATH	Selects Path Hold mode to fly the aircraft along a straight path without manual control inputs.
		ALT/HDG	Selects Altitude/Heading Hold mode to fly the aircraft at constant altitude and heading without manual control inputs.
		ALT	Selects Altitude/Bank Hold mode to fly the aircraft at a constant altitude and bank angle. Lateral control stick inputs allow the bank angle to be changed manually.

Figure 1-185. LASTE Control Panel (Sheet 2)

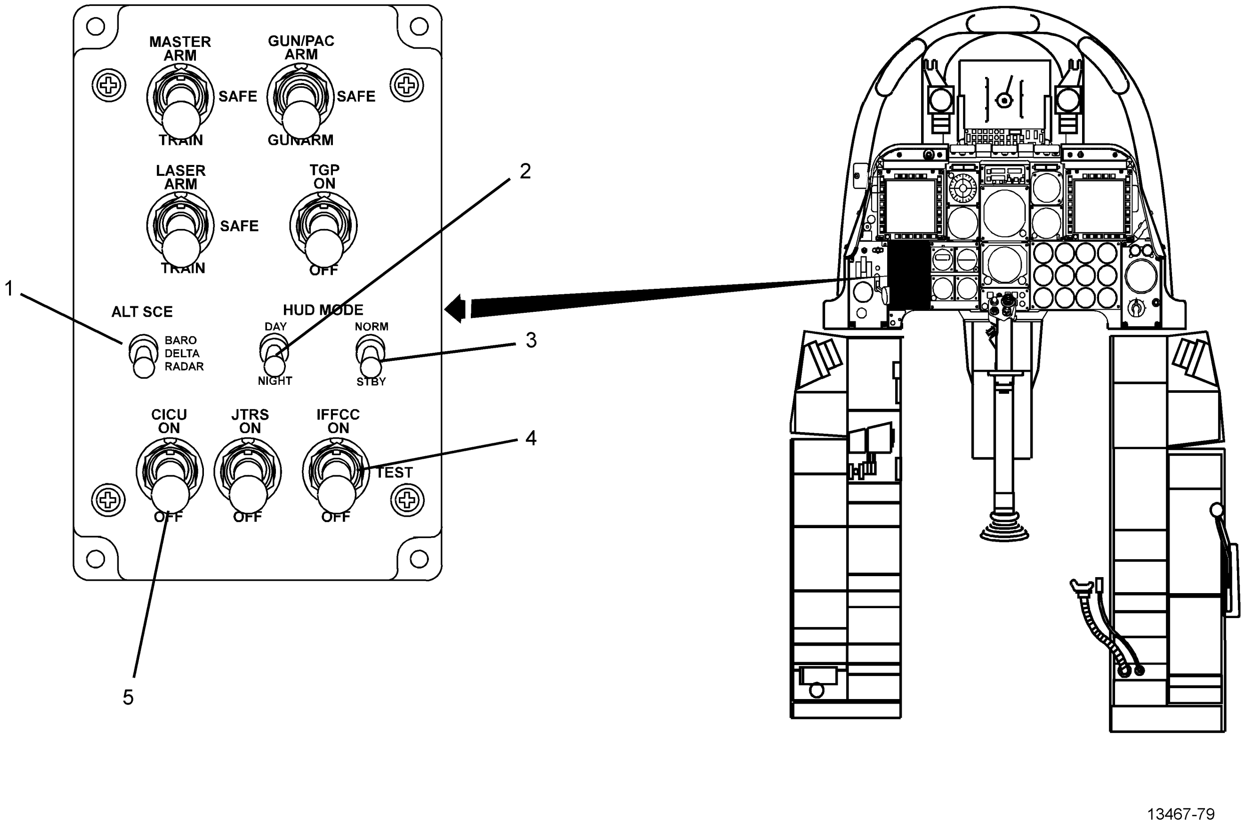


Figure 1-186. Armament HUD Control Panel (AHCP) (Sheet 1 of 2)

Index No.	Control or Indicator	Position or Display	Function
1	ALT SCE switch		Selects altitude source to be used for CCIP/CCRP TDC generation, INS HUD and overhead updates, offset, and overhead marks elevation computations.
		BARO	Selects barometric altitude as altitude source.
		DELTA	Selects pressure altitude referenced from a radar or GPS update.
		RADAR	Selects radar altimeter as altitude source.
2	HUD MODE Day/Night switch	NIGHT	Energizes a motor-driven roller mechanism that draws a red plastic film across the lens of the projection unit to serve as a filter during night operation.
		DAY	Energizes a motor-driven roller mechanism that withdraws the red plastic film across the lens of the projection unit for daylight operation.
3	HUD MODE Normal/ Standby switch	NORM	Used for all normal operations.
		STBY	Used as a back-up or emergency mode in the event of a cathode ray tube (CRT) or associated electronics malfunction. When STBY is selected, a separately generated, manually depressible reticle and mil depression readout are provided. The standby mode will show a pipper depressed 14 to 20 mils more than the setting selected by LASTE. This reticle is depressible over the same range as that available in the primary weapon delivery mode. STBY receives power from the dc armament bus. Standby mode becomes active 6 seconds after selection.
4	IFFCC switch	ON	Powers up and enables the IFFCC.
		TEST	In conjunction with the UFC, displays IFFCC system Main Menu and submenus on the HUD and provides for data entry into the IFFCC (normal).
		OFF	Removes power from, and disables, the IFFCC.
5	CICU switch	ON	Powers up and enables the CICU.
		OFF	Removes power from, and disables, the CICU.

Figure 1-186. Armament HUD Control Panel (AHCP) (Sheet 2)

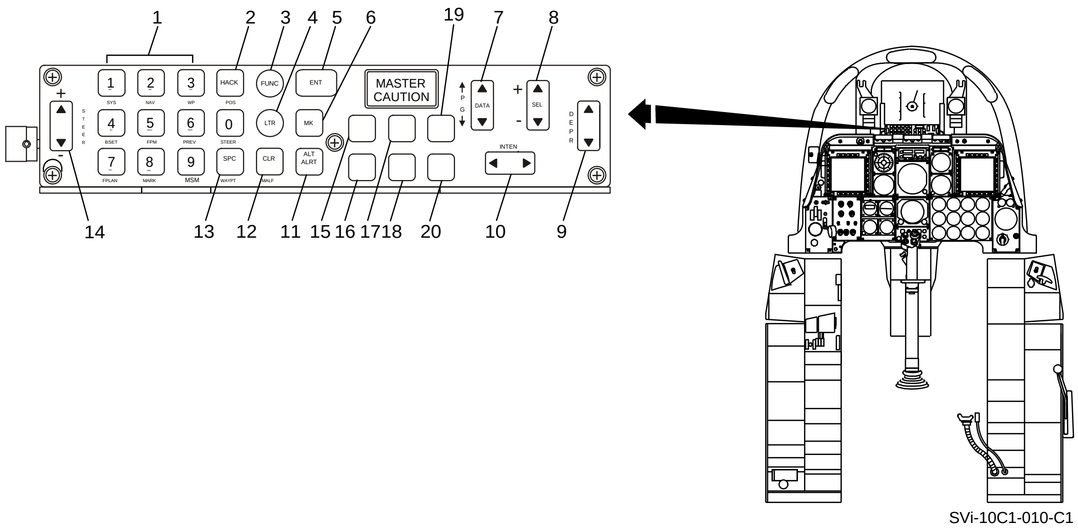


Figure 1-187. Up Front Controller (UFC) (Sheet 1 of 9)

Index No.	Control or Indicator	Position or Display	Function
1	Alpha-numeric keypad		Used to enter alphanumeric data into the CDU and HUD scratchpads or to select CDU functions.
		Numeric mode	Depress key to enter that numeric character into scratchpad area. Numeric mode is active upon UFC power up, whenever the UFC is not in letter mode or function mode, and whenever the IFFCC is in Test mode.
		Letter mode	In letter mode, depress desired key once to enter the first alphabetic character for that key into scratchpad area, twice to enter next character, etc. After reaching desired character, pause for 1 second to move to next space in scratchpad. Letter mode is controlled via the LTR key: one LTR key depression allows one character to be entered; two consecutive depressions activates letter mode indefinitely.
		Function mode	In function mode, depress key associated with desired CDU function (listed below the alphanumeric keys and other UFC buttons/switches). Function mode is controlled via the FUNC key: one FUNC key depression allows one function to be performed; two consecutive depressions activates function mode indefinitely. In function mode, the alphanumeric keys have the following functions, identified below the keys: • 0 (STEER) - Display CDU Steerpoint Information Page • 1 (SYS) - Display CDU System Page 1/3 • 2 (NAV) - Display CDU NAV Page • 3 (WP) - Display CDU Waypoint Menu Page • 4 (OSET) - Display CDU OFFSET Page • 5 (FPM) - Display CDU Flight Plan Menu Page 1/X • 6 (PREV) - Display previously displayed CDU Page (up to five previous pages) • 7 (FPLAN) - Select current flightplan waypoint • 8 (MARK) - Select current mark point waypoint • 9 (MSN) - Select current mission waypoint database
2	HACK/POS key	Depressed	Depress key once to enter Hack mode and display previous Hack time-on-target value (boxed on right side of HUD) below actual time-to-go value and delta time-on-target. Depress key again to return to normal mode. In function mode, depress key (POS) to display CDU Position Information (POSINFO) page.

Figure 1-187. Up Front Controller (UFC) (Sheet 2)

Index No.	Control or Indicator	Position or Display	Function
3	FUNC key	Depressed	When depressed, engages function mode, allowing CDU functions (below alphanumeric keys and other UFC buttons/switches) to be selected. Depressing FUNC key once allows one function to be performed; two consecutive depressions activates function mode indefinitely.
4	LTR key	Depressed	When depressed, engages letter mode, allowing letters on alphanumeric switches to be selected for entry into CDU and HUD scratchpads. Depressing LTR key once allows one character to be entered into the scratchpads; two consecutive depressions activates letter mode indefinitely.
5	ENT key	Depressed	Used in conjunction with HUD submenus and displays as follows (when depressed): • Performs actions in menus and submenus and re-calibrates the non-standard day corrected barometric altitude (DELTA Altitude). • Selects the menu/submenu indicated by the HUD cursor position in HUD SOI mode. • Enters a "hot" target elevation update for the current steerpoint. • Accepts the values flashing in the HUD in the Hot Target Elevation mode when the HUD is the SOI and the elevation for the current steerpoint was changed using the DATA rocker switch. • In Hack mode, accepts the time to target selected by the DATA rocker switch. • Stores a markpoint calculated elevation. • Acknowledges DTSAS warning and error messages. • Accepts hack length. • In Maverick HUD Boresight mode, accepts boresight adjustments.

Figure 1-187. Up Front Controller (UFC) (Sheet 3)

Index No.	Control or Indicator	Position or Display	Function
6	MK/UPDT switch	Depressed	Functions as repeater of CDU Mark switch (overhead mark). In function mode, UPDT is used to perform an INS HUD update. With switch depressed, an INS HUD update is performed by depressing ENT. With switch depressed, pressing UPDT again enters/exits the INS HUD update mode.
7	DATA/PG rocker switch	Up/ Down	Used in conjunction with HUD submenus and displays to change hot target elevation. Only means available to set a negative target elevation. Test Mode- Used to alter data to be subsequently entered from submenus and displayed on HUD. NAV, GUNS, CCIP, CCRP, and Air-toAir Modes - Used to select target elevation (flashing) and increment/decrement target elevation displayed on HUD. Hack Mode - Used to increment/decrement hack time value. **NOTE** When used to alter altitude values, toggling DATA switch changes the altitude value in 10-ft increments (from 0 to 500 ft) and from 100-ft increments (from 500 to maximum setting). In function mode, functions as CDU page (PG) up/down rocker switch, allowing scrolling forward/backward through displayed pages.
8	SEL/+/- rocker switch	Up/ Down	Used to navigate menus and to change weapon profiles, gun reticles, and air-to-air selected threats when HUD is SOI. Can also be used to change hot target elevation. Test Mode - Scrolls cursor up/down through Main Menu and submenus. NAV Mode - Not applicable. GUNS Mode - Toggles gunsight display. CCIP and CCRP Modes - Cycles through selected weapon profiles. NAV, GUNS, CCIP, and CCRP Modes - (If DTSAS is loaded to DTC and target elevation displayed on HUD is selected - flashing) Switches between hot target, auto and TGP elevation. Air-to-Air Mode - Toggles through Air-to-Air threats.
		+/-	In function mode, functions as CDU +/- rocker switch, allowing stepping through waypoints or flight plans.

Figure 1-187. Up Front Controller (UFC) (Sheet 4)

Index No.	Control or Indicator	Position or Display	Function
9	DEPR rocker switch	Up/ Down	Enables depressible pipper/reticle and standby arming reticles to be manually depressed over a range of +10 to -300 mils referenced to ZSL. Individual depressions of switch move applicable pipper up/down 1 mil.
10	INTEN rocker switch	Left/ Right	Permits discrete control of brightness for both primary and secondary HUD symbology.
11	ALT ALRT switch	Depressed	Selects altitude alert (audio warning) options. When depressed, displays an altitude alert value on the HUD. (First depression displays MSL altitude alert value; second depression displays AGL altitude alert value; third depression displays MSL ceiling value; fourth depression exits the function.) When an altitude alert value is displayed, it can be adjusted using the DATA rocker switch. The displayed data remains displayed for 4 seconds, after which the altitude alert function times out, provided there are no characters in the UFC's scratchpad. If an altitude alert is being displayed and the ENT key is depressed while the scratchpad contains a value between 0 and 45000, the currently displayed altitude alert value will be set to that value (if the value is within the alert's operational range).
12	CLR/ MALF key	Depressed	Each individual depression causes one character to be removed from the scratchpad (back spaces). Holding depressed for more than 1/2 second causes entire scratchpad to be cleared. In function mode, MALF is used with IFFCC to reset detected fault flags without clearing stored BIT fault codes.
13	SPC/ WAYPT key	Depressed	Each depression causes one blank space to be inserted into scratchpad. In function mode, depress WAYPT key to display CDU Waypoint Information (WP INFO) page.
14	STEER/+/- rocker switch	Up/ Down	Functions as repeater of STEER toggle switch on AAP.
		+/-	In function mode, functions as repeater of CDU left/right rocker switch. Allows stepping through identifiers waypoint database in conjunction with waypoint search function on CDU pages.

Figure 1-187. Up Front Controller (UFC) (Sheet 5)

Index No.	Control or Indicator	Position or Display	Function
15 513	COM1 key	Depressed	Used to send valid commands entered into the scratchpad to ARC-210-1, designate ARC-210-1 as the selected radio, and toggle on and off display of ARC-210-1 status in the HUD. Key depression for less than 1 second: • Entry between 1 and 25 into the scratchpad, commands ARC-210-1 to the simplex preset entered into the scratchpad. • Entry between 26 and 30 into the scratchpad, commands ARC-210-1 to the Half Duplex/Wideband SATCOM preset entered into the scratchpad. • Entry between 41 and 50 into the scratchpad, commands ARC-210-1 to the SATCOM/DAMA preset entered into the scratchpad. • Entry of 0 into the scratchpad, commands ARC-210-1 to the last valid manual frequency commanded to ARC-210-1 when ARC-210-1 is not already tuned to a manual frequency. • Entry of 3 to 6 digits into the scratchpad, commands ARC-210-1 to the manual frequency entered into the scratchpad. • Entry of 31 into the scratchpad commands ARC-210-1 into SCAN mode. • Entry between 1 and 25 into the scratchpad and depression of the ECCM key, commands ARC-210-1 to the ECCM preset entered into the scratchpad. • Entry of 26 into the scratchpad and depression of the ECCM key, commands ARC-210-1 to SINCGARS Cold Start. • Entry of 27 into the scratchpad and depression of the ECCM key, commands ARC-210-1 to SINCGARS Cue. • When the scratchpad is empty designates ARC-210-1 as the selected radio. • Key depression for more than 1 second toggles on and off the display of ARC-210-1 status in the HUD.

Figure 1-187. Up Front Controller (UFC) (Sheet 6)

Index No.	Control or Indicator	Position or Display	Function
16 $\boxed{526}$	COM2 key	Depressed	Same as COM1 for ARC-210-2.

Figure 1-187. Up Front Controller (UFC) (Sheet 7)

Index No.	Control or Indicator	Position or Display	Function
17 513	COMSEC key	Depressed	Used to toggle the COMSEC mode of the selected ARC-210 radio. • Key depression toggles the COMSEC mode of the selected ARC-210 radio between Plain Text, Cipher Text/Plain Text Only, and Cipher Text Only.
18 513	ECCM key	Depressed	• Used to designate an ECCM preset entry into the scratchpad and perform an ECCM preset toggle. • Key depression following numerical entry between 1 and 25 is used to enter a valid ECCM preset entry into the scratchpad. The ECCM preset is not sent to the radio until the COM1 or COM2 key is depressed. An "E" is displayed in the scratchpad following the entered preset number. • Key depression when the scratchpad is empty and the selected ARC-210 radio is set to a simplex preset, toggles to the corresponding ECCM preset. For example if ARC-210-1 is set to simplex preset 12, depressing the ECCM key when the scratchpad is empty will command ARC-210-1 to ECCM preset 12. • Key depression when the scratchpad is empty and the selected ARC210 radio is set to an ECCM preset toggles to the corresponding simplex preset. For example if ARC-210-1 is set to ECCM preset 12, depressing the ECCM key when the scratchpad is empty will command ARC-210-1 to simplex preset 12.

Figure 1-187. Up Front Controller (UFC) (Sheet 8)

Index No.	Control or Indicator	Position or Display	Function
19	IFF Select Key	Depressed	Key depression triggers IFF functions: enable/disable Mode 1, Mode 3/A, or Mode C, Mode 1 or 3/A code updates, or Identification of Position (IDENT). • Pressing right upper blank right key with scratchpad empty sends IDENT to the IFF. • Entering a two digit Mode 1 code on UFC and pressing right upper blank key sends new Mode 1 code to IFF. • Entering four digit Mode 3/A code on UFC and pressing right upper blank key sends new Mode 3/A code to the IFF. **NOTE** If the CICU can not validate the Mode enable (1, 3, or 6), the CICU INPUT ERR message will display in scratchpad. • Entering “1” on UFC and pressing right upper blank key toggles Mode 1 On/Off. • Entering “3” on UFC and pressing right upper blank key toggles Mode 3/A On/Off. • Entering “6” on UFC and pressing right upper blank key toggles the Mode C On/Off. When a Mode C enable is activated by the UFC, the OSB is set to In Progress. If the OSB is already In Progress, the new enable is ignored.
20	IDM RT Select key	Depresses	Used to modify selection of radio for IDM data transmission, consistent with IDM Radio Selection OSB on COMM page (OSB 20). • Pressing key for less than one second, with no IDM/RT symbol on HUD (below ARC-210-2 radio status), displays the current selection for 5 seconds. • Pressing key for less than one second, with an IDM/RT symbol on HUD, cycles to the next selection (IDM/NONE, IDM/210 or IDM/164), displays the updated selection for 5 seconds. • The new IDM Radio selection also changes the rotaries on the COMM Page (OSB 20). **NOTE** If key is held longer than 1 second, the symbology is permanently displayed on the HUD until key is held again for longer than 1 second.

Figure 1-187. Up Front Controller (UFC) (Sheet 9)

LASTE SYSTEM OPERATION.

The LASTE system operates in the following HUD modes: NAV, GUNS, CCIP, CCRP, Air-to-Air, and TEST. Manually initiated testing and data entry are performed with HUD in TEST mode by using the MAIN MENU (Figure 1-188) and appropriate submenus.

Main Menu.

At the MAIN MENU (Figure 1-188), the SEL key on the UFC is used to position the cursor on the HUD next to the appropriate submenu. The ENT key on the UFC is depressed to display the selected submenu. For more information on usage of submenus, see TO 1A-10C-34-1-1. To test the system, refer to LASTE System Testing in this section.

CCIP Consent OPT.

CCIP Consent Release mode selectable from MAIN MENU. For more information on usage of CCIP Consent Release Option, see TO 1A-10C-34-1-1.

	MAIN MENU	V7.00
	CCIP CONSENT OPT	OFF
>	BIT	
	AAS	
	WEAPONS	
	WPN REL DATA	
	DISPLAY MODES	
	MAINTENANCE	
	DELTA CAL	
	GCAS TRAINING	OFF
	CMS ALERTS	ON

S7-080

Figure 1-188. Main Menu

BIT Submenus.

LASTE system testing is performed via the GROUND BIT or IN-FLIGHT BIT submenus. For more information on LASTE system testing, refer to LASTE System Testing in this TO.

AAS Submenu.

The Air-to-Air Submenu (AAS) (Figure 1-189) permits the selection of up to 10 specific and two manual threat aircraft. Each aircraft is identified by an up-to 8-character text name, wingspan, length, and corner airspeed. The A/W/E maintains the threat aircraft database used to create download data for the IFFCC. Up to 10 specific aircraft can be selected, along with two manual threat aircraft. For more information on the AAS submenu, refer to TO 1A-10C-34-1-1.

		AAS
	•	MIG-21
		F-7
		F-8
	•	MIR-2000
		MIG-29
		SU-24
>	•	SU-27
		JAS-39
		MIG-24
	•	YAK-9
		MAN-FXD
		MAN-RDY
		EXIT

Figure 1-189. AAS Submenu

WEAPONS Submenu.

The Weapons submenu page is shown in Figure 1-190. For more information on the WEAPONS submenu, refer to TO 1A-10C-34-1-1.

	WEAPONS	
>	30MM	HEI
	OFFSET ADJUST	
	VAR TGT ELEV	
	EXIT	10

Figure 1-190. Weapons Submenu

WPN REL DATA Submenu.

The WPN REL DATA submenu allows the option to automatically scroll through all the weapon delivery parameter pages or manually scroll through each bomb and gun data page. For more information on the WPN REL DATA submenu and weapon delivery parameter pages, refer to TO 1A-10C-34-1-1.

HUD 30 MM Submenu.

The 30 MM Submenu (Figure 1-191) provides a real-time count of rounds remaining and the capability to perform an on-ground reset-to-full of the rounds counter (1150 rounds). In addition, the rounds remaining can be incremented or decremented while on the ground. These gun settings are contained in the IFFCC 30 MM Submenu, which is selected from the modified IFFCC Weapons Submenu. For more information on the 30 MM submenu, refer to TO 1A-10C-34-1-1.

	30 MM	
>	AMMO TYPE	TP
	AMMO MFG	OLIN
	PAC1 POS MODE	Y
	MIN ALT	5000
	RNDS	1150
	RNDS RESET	
	STORE	

Figure 1-191. HUD 30 MM Gun Submenu

DISPLAY MODES Submenu.

For more information on the DISPLAY MODES submenu (Figure 1-192), refer to TO 1A-10C-34-1-1.

	DISPLAY MODES	
>	AUTO DATA DISP	2
	GUNS OCCULT TD BOX	Y
	CCIP GUN CROSS OCCULT	Y
	TAPES	N
	METRIC	N
	RDRALT	N
	AIRSPEED	IAS
	VERT VEL	N
	FLIGHT MEMBERS	N
	ALERTS	Y
	EXIT	

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Figure 1-192. Display Modes Submenu

ALERTS Submenu.

The ALERTS submenu (Figure 1-193) is used to set and/or modify the start and interval times that drive the audio and visual IFF alerts. These alerts notify the need for an IFF Mode 1 or Mode 4 code change, as well as, up to nine other preset alerts (OTHER ALERTS). The IFF alerts and Other alerts are displayed in the same location on the HUD with the IFF alerts having priority over the Other alerts. The IFF alerts display as solid text and the Other alerts display as flashing text.

Mode 1 and Mode 4 alerts are enabled/disabled via the mode line items with N disabling the mode (default). The selected mode is enabled with Y and allows setting the desired start time (START) and interval (INTRVL).

The type of time being used by the IFFCC is displayed to the right of the ALERTS title. The letter Z indicates Zulu time, L indicates local time and F indicates IFFCC Internal time. Alert times set in the OTHER ALERTS submenu are enabled and by placing the cursor next to OTHER ALERTS on the ALERTS submenu and toggling UFC DATA to set the value to ON or OFF.

	ALERTS	L
>	MODE 1	Y
	START	24:00
	INTRVL	00:30
	MODE 4	Y
	START	24:00
	INTRVL	00:30
	OTHER ALERTS	OFF
	EXIT	

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Figure 1-193. ALERTS Submenu

OTHER ALERTS Submenu.

The OTHER ALERTS submenu (Figure 1-194) is accessed from the ALERTS submenu and allows individually setting or clearing up to nine alerts, in addition to the Mode 1 and Mode 4 alerts. The alert times are set in hours/minutes and notify when the set time is reached by an ALERT. annunciation. One or all nine alerts can be cleared or EXIT to return to the ALERTS submenu. If you do a time adjust, it will not affect the menu.

	OTHER ALERTS	L
	1	01 : 00
	2	03 : 30
	3	05 : 27
	4	07 : 30
	5	10 : 05
	6	14 : 00
	7	16 : 30
	8	18 : 27
	9	XX : XX
>	CLEAR ALL	
	EXIT	

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Figure 1-194. OTHER ALERTS Submenu

MAINTENANCE Submenu.

The MAINTENANCE submenu (Figure 1-195) is used to verify software version, verify software integrity with a software checksum reset the data capture list, and allow ±15 mils maintenance boresight adjustments to align all dynamic symbols on the HUD. Maintenance adjustments must be done on the ground.

WARNING

It is possible to adjust aircraft boresight to such an extent that use of aiming references may result in significant and in some cases dangerous errors during weapons employment.

	MAINTENANCE	
	SW VERSION	V3.01
	CHK SUM	FDC4 5222
	VMU VERSION	V4.00
	VMU CHK SUM	39B8
	SG/S VERSION	V3.10
	SG/S CHK SUM	08DB E22F
	CAPTURE LIST	CUSTOM
>	BORESIGHT	N
	RT BORESIGHT	0
	UP BORESIGHT	0
	EXIT	

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Figure 1-195. Maintenance Submenu

The CAPTURE LIST in the Maintenance submenu is used by maintenance and pilot. If a custom data capture list has been loaded into the IFFCC, the CAPTURE LIST line item will display CUSTOM (Figure 1-195). To switch from the custom list to the default list, move the cursor next to CAPTURE LIST, and use UFC DATA switch to toggle from CUSTOM to DEFAULT. DEFAULT will flash. Press OSP ENTR to accept the change (DEFAULT stops flashing). The IFFCC reverts to the default list and the custom list is removed and no longer available (see note below). The custom data capture list is not removed if the cursor is moved from the CAPTURE LIST line item or the MAINTENANCE menu is exited with DEFAULT still flashing.

NOTE

When maintenance loads a custom data capture list into the IFFCC (causing any data previously captured in flash memory to be erased), the new CAPTURE LIST line item will display CUSTOM. To switch from the custom data capture list to the default data capture list, move the cursor next to CAPTURE LIST and use UFC DATA switch to toggle from CUSTOM to DEFAULT. DEFAULT will flash; depress the UFC ENT button to accept the change (which causes DEFAULT to stop flashing). This causes IFFCC to revert to its default data capture list. When this occurs, the custom data capture list is no longer available and must be reloaded.

DELTA CAL Submenu.

The DELTA CAL submenu (Figure 1-196) allows verification of and adjustments to the delta calibration data. For more information on the DELTA CAL submenu, refer to TO 1A-10C-34-1-1.

NOTE

If manually inserting a delta value, LASTE will only accept the delta value after STORE is entered.

	DELTA CAL	
>	RDR DELTA ALT	-36
	RDR MSL CAL	5764
	GPS DELTA ALT	140
	GPS MSL CAL	7490
	SELECTED MODE	GPS
	STORE	
	CANCEL	

Figure 1-196. Delta CAL Submenu

GCAS TRAINING Submenu.

The GCAS TRAINING submenu (Figure 1-197) allows the selection and storage of a false ground plane for GCAS training and also allows entry into the CAPTURE DATA submenus. Selection of a false ground plane is enabled when the cursor is placed opposite GND PLANE. The UFC DATA key is used to toggle between the following false ground plane options: OFF, 2000, or 3000 ft AGL. For more information on the GCAS Training Submenu, refer to TO 1A-10C-34-1-1.

Figure 1-197. GCAS Training Submenu

	GCAS TRAINING	
	GND PLANE	2000
	AUTO SCROLL	YES
>	STORE	
	CANCEL	

CMS ALERTS.

CMS ALERTS allows the selection CMS audio alerts to be ON or OFF.

Altitude Source.

LASTE processes HUD attitude information from either the EGI or HARS, as determined by the NMSP and three fault flags: EGI INS Fail, Digital Attitude Fail, and no 1553 bus message received from CADC for more than 1 second. Selected HUD symbology is displayed and updated by EGI attitude data when EGI is selected on the NMSP and all three fault flag states are FALSE. HARS symbology is displayed and updated by HARS attitude data when HARS is selected on the NMSP.

An automatic reversion to HARS symbology occurs when any of the three fault flags is set to TRUE. With an automatic reversion to HARS symbology, EGI INS attitude data is still used to update the HUD symbology unless the EGI INS Fail flag is set to TRUE. If the EGI INS Fail flag state is TRUE, HUD symbology is updated via HARS attitude data.

In NAV mode and the Air-to-Air sight, LASTE repeats the altitude displayed on the cockpit altimeter within normal tolerances. The altitude can be adjusted along with the cockpit altimeter using the Kollsman settings. In the weapons delivery modes, the LASTE system provides three other options of altitude source selection via the AHCP ALT SCE switch. The selected altitude source is used in CCIP/CCRP, Maverick, and TDC ranging.

The first option is Baro Mode. When Baro Mode is selected, the system computes a true MSL altitude from the CADC barometric reference altitude that is adjusted by the Kollsman altimeter setting. The geometric altitude is corrected for static port installation errors, dynamic lag, and nonstandard air temperatures. The geometric altitude also contains a bias correction based upon the EGI GPS altitude. The system captures the field elevation on takeoff roll from the Baro altimeter - not the steerpoint elevation, and uses this as the calibration point to formulate the corrections. This calibration point is stored in non-volatile memory such that in the event of an in-flight power interruption, the calibration point will be recalled.

NOTE

- In BARO mode, the calibration point is valid only for the altimeter setting and air mass which exists at takeoff. Changing the Kollsman altimeter setting may cause a bias error as great as 250 feet in the geometric altitude displayed on the HUD.
- This should not be confused with the Delta Update generated on takeoff roll. This is a barometric calibration that applies to the BARO altitude source only.
- The Estimated Vertical Error (EVE) in the GPS is continually provided by the EGI. In order to calculate the most accurate weapon solution, the IFFCC needs to be in the mode that uses the most accurate altitude data. When the EVE is greater than 50 feet for 10 consecutive minutes a notification displays on the MFCD. A second notification displays when the EVE is less than 50 feet for 60 consecutive seconds.

The second option is the Delta Mode. When Delta Mode is selected, the system computes the geometric MSL altitude from the CADC pressure altitude, which is not affected by the Kollsman altimeter setting. The geometric MSL altitude in Delta Mode is also corrected for static port installation errors, dynamic lag, and nonstandard air temperatures. The calibration reference point for Delta Mode is derived from two parameters: the Radar MSL value (Radar altitude plus target elevation) and EGI GPS MSL value. This calibration point is first automatically captured on takeoff roll using the displayed barometric altitude. An in-flight Delta update can be accomplished at any altitude by first depressing the ENT key on the UFC and using the UFC SEL button to choose either the Radar or EGI GPS modes displayed in the center of the HUD screen (the Radar mode will be valid only if the AGL is less than 5000 ft and RAD ALT is valid); the EGI GPS mode will be valid if EVE is less than 50 ft. Invalid modes will be displayed as XXXs. If both modes are invalid, the Delta calibration will revert to the last valid calibration. These values can also be manually entered into the DELTA CAL submenu if obtained from other aircraft. The altitude corrections will then start from the new reference point when either a delta update has been accepted or new data is entered in the DELTA CAL submenu and the menu is exited via the STORE option.

NOTE

- The Delta Calibration reference values will be reset to zero feet in the event of LASTE power interruption.
- Delta Mode can be used prior to taking an airborne update because it performs an automatic Delta update on takeoff.
- Delta altitudes are not affected by Kollsman altimeter settings.
- LASTE will use only one delta altitude. If a new delta altitude is entered, the previous delta altitude value is lost.

The third option is the Radar Mode. When Radar Mode is selected, the system uses the radar altimeter altitude. The radar altitude is valid up to approximately 5,000 feet. Beyond 5,000 feet, the system estimates AGL altitude for a period of time after which the radar altitude is declared invalid. This is a GCAS function and should not be used for performing a Delta update. The altitude source defaults to the Delta altitude mode. An invalid radar altitude is displayed as XXXXR.

The altitude source used for ranging is displayed on the HUD in the EAC Messages window. Either BARO, RDR, DELR, DELG, DTS, or XXXX is displayed in GUNS, CCIP, and CCRP modes. The HUD option display will overwrite these modes and DELR will be displayed if Radar Mode is selected and radar altitude is valid. An XXXX is displayed if no altitude source is valid. DELG will be displayed if the EGI GPS mode is selected and the Radar altitude is invalid. Three automatic target ranging methods are available through the DTSAS capability: Passive Ranging (PR), Look-Aside Ranging (LAR), and Coordinate Ranging (CR). For information on these methods, refer to TO 1A-10C-34-1-1.

NOTE

- The barometric altitude displayed on the HUD (tapes or numerics) is the geometric MSL altitude in GUNS, CCIP, and CCRP modes, and is the raw CADC barometric altitude in NAV Mode, Air-to-Air Mode, and whenever the aircraft is on the ground.

- The altitude displayed in GUNS, CCIP, and CCRP modes is corrected for static port installation, dynamic lag, and non-standard air temperatures with BARO selected on the AHCP ALT SCE switch. True MSL altitude is referenced from field elevation on takeoff and computed from CADC barometric reference altitude, which is a function of the Kollsman altimeter setting. With Delta Mode selected, the true MSL altitude is referenced from a radar altitude update after the delta has been accepted and computed from CADC pressure altitude, which is independent of the Kollsman setting. The altitude displayed in the NAV and Air-to-Air mode is the uncorrected CADC barometric altitude.

LASTE Modes.

The LASTE system provides functions in the following HUD modes:

NAVIGATION (NAV) MODE.

The NAV Mode provides data presented on the HUD pertaining to aircraft state, including airspeed, altitude, heading, and velocity vector information. The NAV Mode also provides steering information to selected steerpoints.

GUNS MODE.

The GUNS Mode is primarily an air-to-ground gun mode that uses the EGI, CADC, radar altimeter, SAS, and HUD systems to compute and display the appropriate CCIP gun solution. An option for PAC is also provided. When the gun trigger is depressed to the second detent, the positions of the bullet impacts on the ground (BATA) are generated by the simulated bullet function, and are displayed at the computed time of ground impact on the HUD. The CCIP Gun Reticle, TDC, TDC Numeric, Relative Bearing Numeric (RBN), and BATA symbology are displayed in addition to the navigation displays. The GUNS Mode provides a depressible pipper for use in bore sighting Maverick missiles.

CCIP MODE.

The CCIP Mode is primarily an air-to-ground bomb/rocket mode. A simultaneous air-to-ground gunnery solution is also provided. Selection of a particular set of bomb ballistics data is made using the DSMS menu. The data is channeled to the ballistics algorithm, which determines the bomb impact point. The CCIP solution is displayed on the HUD. The CCIP Mode allows the elevation and azimuth angles of the TISL, TDC, TDC Numeric, and RBN. CCIP inhibits minimum range and BATA with LAAP engaged; it also inhibits minimum range with PAC-1 or PAC-2 engaged. Safe Escape Cues are also inhibited with PAC-1, PAC-2, or LAAP engaged.

The CCIP Mode uses EGI, CADC, target elevation, and stored weapons information to compute the impact point for forward firing and free-fall ordnance. It allows selection of various modes, weapons, target elevations, and fuze times. A pipper and reticle continuously display the impact point for selected ordnance. The information is displayed on the HUD, and includes symbology for CCIP guns, moving target indicator, BATA display, CCIP bombs, Minimum Range Staple (MRS), Desired Release Cue (DRC), and Projected Bomb Impact Line (PBIL). Other information displayed on the HUD includes symbology for Consent Release, Time of Fall/Flight, DTSAS Target Ranging (TR) modes, Pre-designate Time-to-Release Numeric, and Occultation Windows. The CCIP function is not available when the navigation mode displayed on line 1 of the CDU is GPS-only (G). Refer to TO 1A-10C-34-1-1 for a detailed description of CCIP operations.

CCRP MODE.

The CCRP Mode adds the capability for weapons deliveries outside the HUD FOV by using SPI. The CCRP Mode adds a CCRP, which allows a delivery of rockets and bombs over larger envelope of release conditions than with the CCIP and also allows the use of flares. The CCRP Mode display includes a Projected Bomb Release Line (PBRL), Solution Cue, Time-To-Release Numeric, Release Angle Numeric, Azimuth Steering Line (ASL), and Rocket Steering Line.

The CCRP function is not available when the navigation mode displayed on line 1 of the CDU is GPS-only (G). Refer to TO 1A-10C-34-1-1 for detailed description of CCRP operations.

AIR-TO-AIR MODE.

LASTE provides an Air-to-Air mode capability for use against fixed and rotary wing airborne targets. It is a passive system and provides an all-aspect gunnery capability. The air-to-air gunsight is provided when Air-to-Air mode is selected. The gunsight is composed of three separate sighting references. These are the funnel, the Multiple Reference Gun Sight (MRGS), and the AMIL. LASTE computes lead angle solutions for targets at ranges up to 2 seconds bullet time of flight. Target dimensions are entered in the computer by means of the Air-to-Air Sight (AAS) submenu. Up to ten specific threat aircraft and two manual threat aircraft (fixed and rotary) loaded from A/W/E can be selected. The selected threat aircraft are downloaded to the IFFCC through the DTC. To select or deselect an aircraft as "active," the SEL switch on the UFC is used to move the cursor next to the desired aircraft, and the UFC ENT toggles the threat as active or inactive. Active threat aircraft are indicated by a "donut." A FEDS is available when the MASTER armament switch is in TRAIN or ARM and the gun trigger is depressed to the second detent. Refer to TO 1A-10C-34-1-1 for a detailed description of Air-to-Air Gunsight operations. In this mode, low-aspect lead angles are defined by the Funnel, and high-aspect lead angles are defined by the MRGS. Both gunsights use stadiametric (target size) ranging. The mode also incorporates FEDS for dry-fire training and post-flight evaluation of air-to-air gunnery performance.

TEST MODE.

The Test Mode displays the MAIN MENU, which allows for the selection of submenus, entering data on the submenu, running initiated self-tests of the LASTE system, or displaying BIT faults on the HUD.

STANDBY MODE.

The Standby Reticle is a manually depressed aiming reticle ring and pipper, generated independently of the IFFCC in the HUD projection unit by means of a lamp and optics. The Standby Reticle is provided as a mechanical back-up in the event of a computer failure. If the failure does not cause an invalid GCAS solution, the GCAS remains operational in the Standby Mode. Autopilot function remains available in the Standby Mode.

HUD SYMBOLOGY DISPLAY.

For a detailed description of HUD symbology, refer to TO 1A-10C-34-1-1.

LASTE SYSTEM TESTING.

LASTE system testing is performed via the GROUND BIT or IN-FLIGHT BIT submenus (Figure 1-198), which are accessed through the MAIN MENU.

```
        GROUND BIT

        GCAS BIT
        VMU BIT
  >     PREFLIGHT BIT
        MAINT BIT-WARNING NVM INFO WILL BE
        LOST
        MANUAL RADAR ALTIMETER SWITCH
        BIT FAULT DISPLAY

        EXIT
```

```
        IN-FLIGHT BIT


  >     GCAS BIT
        VMU BIT
        BIT FAULT DISPLAY


        EXIT
```

Figure 1-198. Ground and In-Flight BIT Submenus

Initiated LASTE BIT Checks.

The LASTE system performs four manually initiated BITs and two automatic BITs. The IBITs are Preflight, GCAS, VMU, and Maintenance BIT. When a Preflight BIT is initiated, the GCAS BIT is automatically performed. GCAS and VMU BITs can be run independently on the ground or in flight. The automatic BITs are power-on (POBIT) and periodic (PBIT). Execution of the automatic BITs is transparent. PBIT runs as the IFFCC background traffic allows. A BIT fault display can be called up anytime during system operation to observe faults logged during BIT checks.

NOTE

- If BIT does not respond to prompted actions, this indicates a fault. Acknowledge fault by depressing ENT button on UFC. This allows the fault BIT to continue.
- During POBIT if a Consent Release failure is detected, a CONSENT RELEASE FAILURE FOUND prompt is displayed on the HUD. To bypass this prompt, depress the UFC ENT button. Consent Release mode will be disabled until failure is repaired and a clean Consent Release PBIT is performed by maintenance.

GCAS BIT.

The GCAS BIT performs a test of the GCAS function of the LASTE system. The BIT includes the IFFCC, radar altimeter, antennas, ASU, and activation of the predictive warning and altitude alert messages over the intercom system. The entire GCAS BIT can be performed independently in flight or on the ground. GCAS BIT is accessed through the GROUND BIT or IN-FLIGHT BIT submenus. If failures are found during GCAS BIT, fault codes can be displayed on the HUD. Typical fault code displays for LASTE BIT are shown in Figure 1-199.

VMU BIT.

The voice message unit BIT performs a test of the voice message functions of the LASTE and intercom systems. The VMU BIT can be performed independently in flight or on the ground. VMU BIT is accessed through GROUND BIT or IN-FLIGHT BIT submenus. If failures are found during VMU BIT, fault codes can be displayed on the HUD. Typical fault code displays for LASTE BIT are shown in Figure 1-199.

NOTE

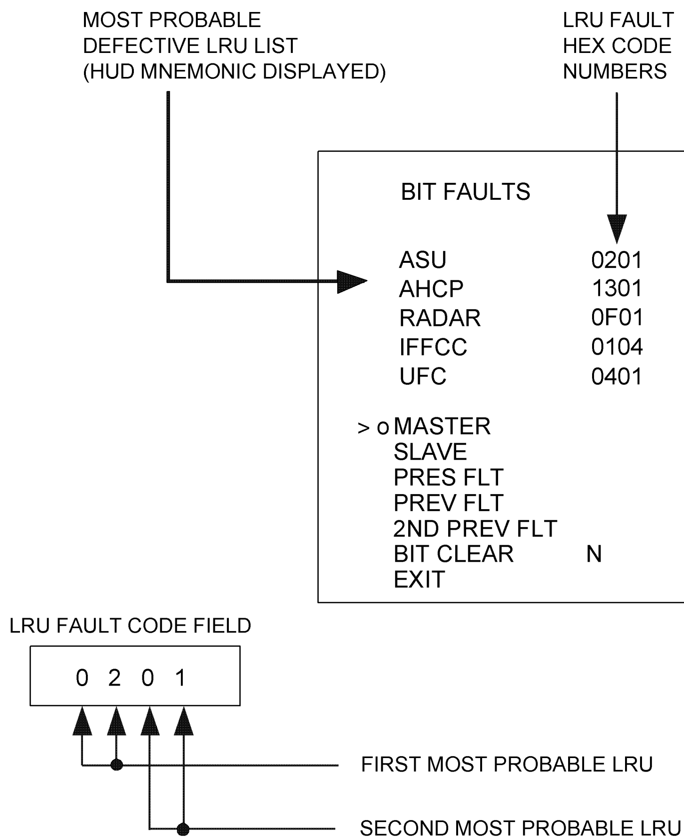
If VMU BIT or GCAS BIT is performed in flight, the GCAS function of the LASTE system will be inoperative, and the GCAS caution light will come on during the test.

LASTE PREFLIGHT BIT.

The LASTE Preflight BIT performs a set of tests to ensure safety critical functions of the LASTE system are operational. The BIT is performed before takeoff, with engines running and radar altimeter on. Preflight BIT can only be performed on the ground. If failures are found during BIT, fault codes can be displayed on the HUD. Typical fault code displays for LASTE BIT are shown in Figure 1-199.

NOTE

- PRESENT FLT, PREV FLT, and 2ND PREV FLT have a capacity of five fault codes each.
- For fault logging purposes, transition from PRESENT FLT to PREV FLT occurs just after takeoff.



HEX CODE NO.	FAILED LRU	HUD MNEMONIC
00	NO LRU IDENTIFIED	NO LRU
01	IFFCC (COMPUTER)	IFFCC
02	ANTENNA SWITCHING UNIT	ASU
03	LASTE CONTROL PANEL	LCPNL
04	UP FRONT CONTROLLER	UFC
05	SPARE	
06	PILOT'S STICK (PITCH RVDT)	PITXDCR
07	PILOT'S STICK (ROLL RVDT)	ROLXDCR
08	YAW PEDAL RVDT	RUDXDCR
0A	CAUTION ANNUNCIATOR PANEL	CAPNL
0B	SPARE	
0D	PROJECTION DISPLAY UNIT	PDU
0E	DIGITAL DATA PROCESSING UNIT (FOR TISL/AIM-9)	DDPU
0F	RADAR ALTIMETER	RADAR

HEX CODE NO.	FAILED LRU	HUD MNEMONIC
10	SAS	SAS
11	LANDING GEAR CONTROL SYSTEM	LDG GR
12	CONTROL STICK GRIP	STK GRP
13	ARMAMENT/HUD CONTROL PANEL	AHCP
14	AGM-65 MAVERICK INTERFACE	AGM65D
15	INTERPHONE/INTERCOM I/F	INTERCOM
16	MISCELLANEOUS RELAY BOX (INTERIOR LIGHTING CONTROL PANEL)	INTLTPNL
17	MISCELLANEOUS RELAY BOX (AUXILIARY LIGHTING CONTROL PANEL)	AUXLTPNL
18	1553A	1553
19	NAVIGATION MODE RELAY BOX	NAVRLYBX
1A	THROTTLE QUADRANT	QUAD
1B	SPEEDBRAKE	SPD BK
1C	DIRECTIONAL GYRO	DG
1D	ELEVATOR LVDT	ELEV LVDT
1E	RUDDER LVDT	RUD LVDT
1F	SPARE	

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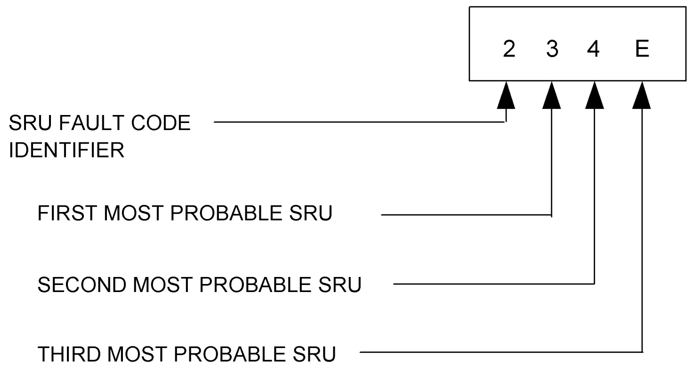
Figure 1-199. LASTE BIT Fault Code Displays (Sheet 1 of 2)

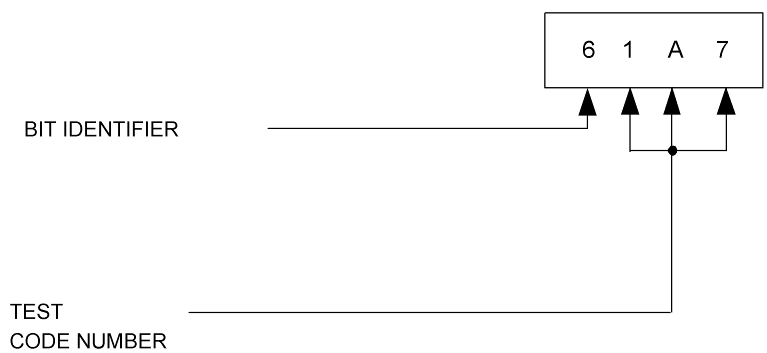
SRU FAULT CODE



HEX CODE	FAILED SRU	HEX CODE	FAILED SRU
0	CHASSIS	8	DISCRETE I/F 2 CCA (A3)
1	CPU A CCA (A13)*	9	HUD POWER SUPPLY MODULE (CHASSIS, FRONT)
2	CPU B CCA (A14)	A	IFFCC POWER SUPPLY MODULE (CHASSIS, REAR)
3	COMMAND A CCA (A6)	B	VMU CCA (A9)
4	COMMAND B CCA (A5)	C	SPARE
5	HEADING CCA (A4)	D	STROKER/SYMBOL GENERATOR (A11)
6	RT 1553/DDC CCA (A8)	E	A/D-D/A CCA (A7)
7	DISCRETE I/F #1 CCA (A2)	F	SPARE/NO SRU IDENTIFIED

*(AXX) REFERS TO THE CIRCUIT CARD OR MODULE POSITION IN THE BOX CHASSIS (A1 FRONT, A14 REAR).

TEST CODE



BIT IDENTIFIER	
3	GCAS IBIT
4	SPARE
5	POWER-ON KERNEL ABIT
6	POWER-ON INIT STATE ABIT
7	PERIODIC ABIT
8	VMU IBIT
9	O-LEVEL IBIT
A	PREFLIGHT IBIT
C	SYSTEM SERVICES

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Figure 1-199. LASTE BIT Fault Code Displays (Sheet 2)

BIT FAULT DISPLAY.

The BIT FAULT DISPLAY (Figure 1-199) allows the option of displaying separate BIT FAULT DISPLAY pages for the Master and the Slave CPUs such that present flight faults, previous flight faults, and second previous flight faults are annunciated.

The PRES/FLT, PREV FLT, AND 2ND PREV FLT selections allow movement through the display of each CPU. The clearing of all faults is allowed only while the plane is on the ground. The power-on default for clearing all failures is an "N". An "EXIT" selection allows return to the BIT menu.

NOTE

> All BIT faults will be cleared when the BIT CLEAR entry is selected and toggled to Y and the ENT is depressed.

BIT FAULT DATA CAPTURE DISPLAY.

The BIT FAULT DATA CAPTURE (Figure 1-200) displays the aircraft state at the time the BIT Fault was generated and up to four (32-bit) parameters associated with the BIT Fault displayed on the BIT Fault page.

Aircraft state data displayed:

- DATE - Date fault was generated (MM/DD/YY).
- TIME - Time fault was generated (hrs: min: secs), suffixed by either Z, L or F (Zulu, Local, or IFFCC Internal time)
- MSL ALT - Mean Sea Level Altitude (feet)
- KCAS - Calibrated Airspeed (knots)
- AOA - Angle of Attack (degrees)
- PITCHRATE - Pitch Rate (degrees/seconds)
- GAMMA - Flight Path Angle (degrees)

Below the aircraft state data, the parameters (A, B, C and D) are displayed with data specific to the displayed fault code. To return to the BIT FAULT display, place cursor next to EXIT and press OSP ENTR (the cursor is locked next to EXIT).

BIT FAULT DATA CAPTURE

	SAS	7114
	DATE	08/04/03
	TIME	17:54:22Z
	ALT MSL	14943
	KCAS	238
	AOA	2.56
	PITCHRATE	1.2
	GAMMA	0.00
	A	1.24
	B	7.5
	C	0.104
	D	
>	EXIT	

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Figure 1-200. BIT FAULT DATA CAPTURE Display

LASTE MALFUNCTIONS.

LASTE malfunctions can be caused by hard or transient faults in LASTE, by interfacing equipment, or by a procedural error. If the fault causing the EAC, LASTE, or GCAS caution light to come on is transient, the caution light will go off. Faults may occur which do not cause a caution light to come on, but cause abnormal behavior of the system. Abnormal system behavior will most likely be indicated by an erratic HUD or unusual movement of one or more of the HUD symbols. The EAC system can always be overridden, disengaged by the engage/disengage switches, or disarmed by the EAC switch or the EAC/SAS/anti-skid emergency disconnect lever on the control stick below the stick grip. A LASTE system reset can be performed by pushing the MALF key on the UFC. This will clear the internal LASTE fault flags while retaining the fault codes in NVM. The reset will also reinitialize the control algorithms to reset any faults that may be latched.

NOTE

- When any LASTE BIT fault occurs, the LASTE system performs an automatic data capture of a default or pre-initialized set of signals to the IFFCC volatile memory.
- If a maintenance download of the data capture signals is required, the LASTE system must remain ON without power interrupt until the maintainer connects the Portable Automatic Test Station (PATS) and downloads via the cockpit data port. If LASTE is turned off, or a power interrupt occurs, all data is lost.
- A manually initiated data capture is also possible by depressing the Data Capture button on the CDU (Figure 1-51, 13).

Malfunctions of LASTE Interfacing Systems and Components.

The following systems and components interface with the IFFCC:

- Radar Altimeter and ASU
- SAS
- Intercom System
- Control Stick
- Projection Display Unit (PDU)
- EGI
- CADC
- HARS
- TISL
- Digital Data Processing Unit (DDPU)
- ACS
- Landing Gear Control System
- AGM/TGM-65 Launchers
- Air Refueling Door
- Throttle Quadrant
- Speed Brake Interface
- UDTU
- DTC
- UFC
- LCP
- AIM-9 Missile Control System
- CICU
- CMSP

Failures in these systems or components cause loss of certain functions of the LASTE system, described as follows:

RADAR ALTIMETER AND ASU.

The radar altimeter, ASU, and antennas provide the AGL altitude data used in GCAS and in CCIP/CCRP radar and delta modes. Failure of the radar altimeter, ASU, or any of the antennas causes loss of these functions.

SAS.

The SAS provides the interface between the IFFCC and the control surface actuators during EAC functions and provides angular rate data for CCIP, GCAS, and EAC functions. Loss or disconnect of either pitch or roll SAS functions disarms EAC. Some SAS failures interfere with CCIP/CCRP and GCAS functions.

INTERCOM SYSTEM.

The LASTE voice warnings are issued over the intercom system. Failure of the intercom system prevents the voice warnings from being issued.

CONTROL STICK.

The control stick switches control PAC mode engage/disengage. The EAC/SAS/anti-skid emergency disconnect lever on the control stick below the stick grip disarms EAC. The EAC can be disarmed by several other means if the EAC/SAS/anti-skid emergency disconnect lever fails. Failure of the trigger on the stick grip prevents the use of PAC.

PDU.

Failure of the PDU prevents the use of all LASTE CCIP/CCRP and air-to-air sight functions. If the PDU fails, GCAS and autopilot functions remain available.

EGI.

The EGI controls the digital data transfer from the EGI to LASTE and CADC to LASTE. Failure of the EGI disables all CCIP/CCRP, air-to-air sight, and EAC functions of the LASTE. The GCAS predictive warnings are not available, but the 90-foot warning remains operational. The EGI also provides velocity and attitude data to LASTE. Failure of the velocity and attitude data disables GCAS (except for 90-foot warning), CCIP/CCRP, air-to-air sight, and autopilot functions.

CADC.

The CADC provides airspeed and barometric altitude to the LASTE system. Loss of CADC causes loss of GCAS (except for the 90-foot warning), CCIP/CCRP, air-to-air sight, autopilot functions, and Speed Brake Warning System with landing gear down.

HARS.

The HARS provides back-up attitude data to LASTE. Loss of HARS does not affect LASTE unless the EGI also fails.

TISL.

The TISL seeker pointing angles are provided to LASTE for display on the HUD. Loss of the TISL prevents the display.

DDPU.

The DDPU provides TISL and AIM-9 pointing data to LASTE for display on the HUD. Loss of the DDPU prevents the AIM-9 display, but TISL will still be displayed.

ACS.

The ACS provides arming status, bomb release status, AIM-9 select status, trigger, bomb release, and Maverick switching to LASTE. Failure of these various functions interferes with proper CCIP/CCRP guns and bombs, air-to-air mode selection, and AGM/TGM/CATM-65D, G, G2, H, or K seeker position display.

LANDING GEAR CONTROL SYSTEM.

LASTE receives information on landing gear handle position and weight-on wheels for mode switching use. Failure of these switches can interfere with airborne behavior of the system since some LASTE functions are not operational on the ground.

AGM/TGM/CATM-65D, G, G2, H, or K LAUNCHERS.

The AGM/TGM/CATM-65D, G, G2, H, or K launcher provides seeker head position and missile present status to LASTE. Loss of launcher signals prevents display of the seeker position.

AIR REFUELING DOOR.

The air refueling door is interlocked with the availability of EAC functions. Failure of the door or interlock switch in the open position prevents the use of the EAC functions.

THROTTLE QUADRANT.

Switches inside the throttle quadrant sense throttle lever position. Ninety-six percent of throttle lever travel is in the position where Speed Brake Warning System logic, in conjunction with other factors, determines whether or not a warning is issued. Failure of these switches may cause a failure of the Speed Brake Warning System. An autopilot engage/disengage switch on the LCP allows autopilot engagement if the LAAP Engage button on the left throttle fails.

SPEED BRAKE INTERFACE.

The speed brake interface serves the position of the speed brakes. When the speed brakes are open more than 10 percent, a speed brake signal is generated. The Speed Brake Warning System uses this signal in conjunction with other factors to determine whether or not to issue a warning.

UDTU.

The UDTU provides an interface from the DTC and IFFCC, and the DTC and EGI. If the UDTU fails, any data loaded on or being loaded to the DTC is unaccessable.

DTC.

The DTC contains preloaded mission and weapons data and any post mission data that is written to it. If the DTC fails, all data will be lost.

UFC.

The UFC is a multipurpose alphanumeric keypad and function select device that is used to control the HUD, CDU, IDM RT Select (NONE, ARC-210-1 or ARC-164), CDU, IFF functions (Mode 1, 3/A, C enable, Mode 1 or 3/A code updates or Identification of Position (IDENT)), and MFCD data entry. The primary purpose of the UFC is to provide a head-up data entry capability, as well as acting as a remote CDU controller.

The UFC is located on top of the glareshield. The UFC provides a number of keys and rocker switches that allow manual interface with the LASTE System, CDU, and CICU. The UFC has 10 keys that are a combination digit/alphanumeric/function. The UFC has four keys that have a dual interpretation: MK, CLR, HACK, and SPC. The interpretation of these keys is determined by the mode of the UFC, which is determined by depressing the FUNC or LTR keys. The six blank keys below the Master Caution indicator (COM1, COM2, COMSEC, ECCM, IFF and IDM RT) control ARC-210 radio(s), IDM RT selection, and IFF settings. The controls for the UFC are described in Figure 1-187.

LCP.

The LCP is located on the left console in the cockpit. The panel controls the EAC function, LAAP function, and radar altimeter portion of the LASTE system. The panel is powered by +15 VDC from the IFFCC.

THE AIM-9 MISSILE CONTROL SYSTEM.

The AIM-9 Missile Control System provides means for selection, arming, and launch of AIM-9 missiles in an automatically controlled repetitive series. The system is configured to accommodate a Dual Rail Adapter (DRA) with LAU-105 launchers loaded with missiles on station 1 and/or station 11. Mixed loading of AIM-9 type missiles is permitted. The AIM-9 Missile Control System consists of four LRUs: DDPU, Electrical Test Panel (ETP), Guided Missile Interface Unit (GMIU), and DRA assembly.

Present ACS safety interlocks are maintained on the A-10 aircraft. Selective jettison and emergency jettison of missiles and racks are provided by existent ACS circuitry. Only a complete missile station (DRA, launchers, and missiles present) can be jettisoned when the pylon is carted.

CMSP.

The CMSP is located in the right console. The CMSP provides integrated management and control of the electronic warfare systems. The CMSP and IFFCC communicate via AV Bus-3. When appropriate, the CMSP requests that the IFFCC generate one of three VMU messages - "MISSILE, MISSILE", "CHAFF/FLARE, CHAFF/FLARE", or "COUNTER, COUNTER". The IFFCC acknowledges to the CMSP when a requested VMU message has been generated. The IFFCC also provides the CMSP with radar altitude and airspeed.

COLOR COCKPIT TELEVISION VIDEO SENSOR/DIGITAL VIDEO AIRBORNE DATA RECORDER (CCTVS/DVADR).

The CCTVS/DVADR system provides simultaneous digital video recording of the left and right MFCDs, the CDU display, the HUD with the HUD symbology and TV monitor video, as well as associated headset audio. The CCTVS/DVADR consists of these components:

- DVADR installed in the aft-most position in the cockpit right console.
- CCTVS installed in front of the HUD.
- DVADR Remote Control Panel installed on the left canopy bow.

The DVADR has no operating controls. The DVADR Remote Control Panel operates as the system master control: Record on the REC position, Stop on the STDBY position. Two NVIS-compatible LED indicators on the DVADR light when the system is powered on or when the Removable Mass Memory Device (RMMD) is fully recorded. This RMMD loads through an upward-facing access door in the DVADR. Closing and locking this access door secures the RMMD inside the DVADR. DVADR system power (DC for the DVADR and DVADR Remote Control Panel, AC for the CCTVS) comes from the Armament Relay Box.

Mass Memory, enables the DVADR to communicate with the CICU through an Ethernet interface. The CICU reads data from and writes data to the RMMD data partitions. The MFCD System Status page provides the interface for the DVADR status display.

The CICU processes aircraft Time-Space-Position Information (TSPI) during flight operations for recording on the DVADR RMMD. The recorded TSPI data is used for mission debriefing and post-flight training. The CICU writes the TSPI data to the RMMD in compressed Mission Data Files (MDFs) that support the debrief file format for mission playback.

The TSPI data contains only basic aircraft parameters and weapon loadout information. It does not include targeting or electronic warfare event information. Recording of the TSPI data begins as soon as range, mission, ownship, and weapon definition information is available with partial information upon weight-off-wheels.

AIRBORNE DATA RECORDING SYSTEM (ADR) 152.

The ADR Improved Electronic Processor Unit (IEPU) is an improved sub-system consolidation of the Turbine Engine Monitoring System (TEMS) and Flight Load Data Recorder (FLDR)/Individual Aircraft Tracking Program (IATP). The TEMS/ADR IEPU enables long-term support for the weapons system by combining engine monitoring and structural data collection into one Line Replaceable Unit (LRU) supported by modern software tools. The TEMS detects and gathers engine malfunction and general health information for engine maintenance at the organizational level. The ADR records various aircraft state parameters and weapon events related to aircraft structural loads. Its purpose is to provide structural load data to support management of aircraft structural integrity.

CCTVS.

The CCTVS is a self-contained color television camera system that supplies a Y-C video signal of the HUD flight data display and the pilot's view through the windscreen. The CCTVS video output goes to the DVADR where the DVADR switches between it and the TVM video. Setting the DVADR to STBY powers on the CCTVS. The FOV through the HUD is a minimum of -305mr to +5mr° vertically and a maximum of -330mr to +20mr° horizontally.

DIGITAL VIDEO AIRBORNE DATA RECORDER.

The DVADR houses the system electronics (except for the camera electronics) and RMMD. The DVADR simultaneously records the HUD, left and right MFCDs, and CDU display. The DVADR also records the voice signal from the aircraft audio intercom system.

NOTE

For 2-channel recording, the DVADR will record the MFCD display with highest priority. The CICU determines which MFCD has higher priority based on SOI status and page displayed on the MFCD. The MFCD displayed pages recording priority, as determined by the CICU, from the highest to lowest is TGP, MAV, TAD, DSMS, CDU, STAT, MSG, and LOAD.

DVADR REMOTE CONTROL PANEL.

The DVADR Remote Control Panel (Figure 1-201) has two 3-position toggle switches and two visual indicators. The upper toggle switch has positions that include OFF, STBY (non functional), and REC. The lower toggle switch has positions that include HUD, AUTO, and TVM, but is nonfunctional with the DVADR modification. Indicators on the DVADR Remote Control Panel light green to indicate when the DVADR is in record mode and amber when the RMMD is 100% full.

REMOVABLE MASS MEMORY DEVICE.

The RMMD contains multiple partitions that are utilized by different functions of the DVADR. The primary partition contains data recorded from the audio and video sources. The secondary partitions are utilized by the CICU to read and write mission data to the RMMD, including time-space-position information for post-flight training and debrief activity.

TARGET IDENTIFICATION SET LASER.

The TISL is a forward-looking laser seeker and tracker system. The system consists of a laser-illuminated detector, an Adapter Control Detector (ACD), and a control panel. The detector is attached to the lower right fuselage on an adapter pylon. The ACD connects the pod with the aircraft systems. The TISL control panel is mounted on the instrument pedestal. The TISL system functions are to search for coded laser energy reflected from a target being illuminated by a coded laser designator, to lock on and track, and to provide target location information to the aircraft avionics systems. Target location information is presented on the HUD and the ADI to aid ordnance delivery. The TISL is powered by the AC and DC armament busses. For further information, refer to TO 1A-10C-34-1-1.

COUNTERMEASURES SET/ELECTRONIC WARFARE MANAGEMENT SYSTEM (CMS/EWMS).

The CMS provides consolidated controls and indicators for the Electronic Warfare (EW) subsystems. The EW subsystems consist of the Chaff/Flare dispensing system, AN/ALR-69 Radar Warning Receiver (RWR), and AN/ALQ-131 or AN/ALQ-184 Electronic Countermeasures (ECM) jammer. The CMS includes two control panels, the Countermeasures Set Processor (CMSP) Electronic Warfare Management Unit (EWMU) and the Countermeasures Set Control (CMSC) Electronic Warfare Prime Indicator (EWPI) (Figure 1-174). The CMSP (EWMU) is located on the right console and provides control of the EW subsystems. The CMSC (EWPI) is located on the main instrument panel and provides status indications for the EW subsystems. For additional information and operating procedures, refer to TO 1A-10C-34-1-1.

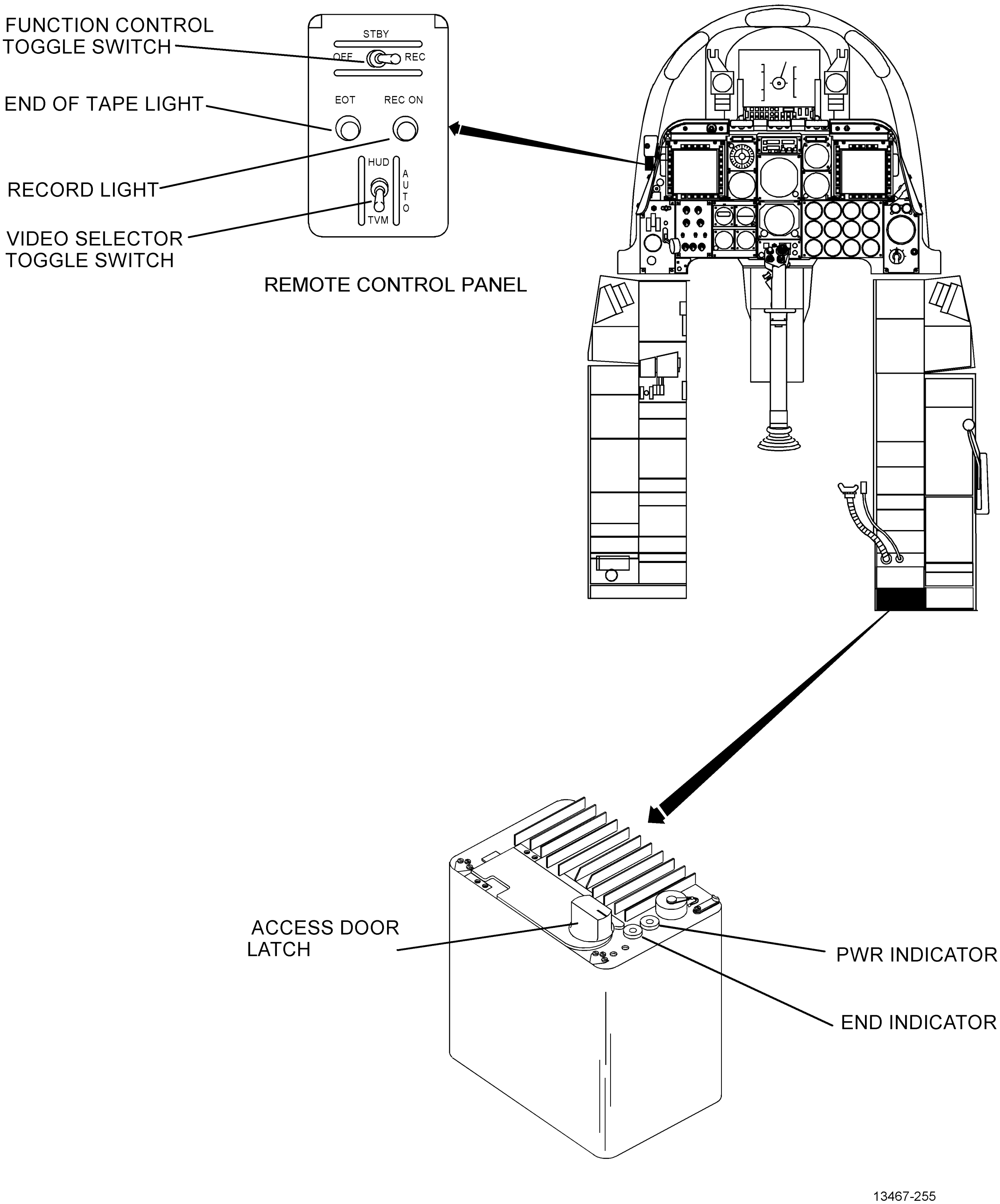


Figure 1-201. Color Cockpit Television Sensor (CCTVS)/Digital Video Airborne Data Recorder (DVADR) (Sheet 1 of 2)

Control or Indicator	Condition or Position	Function
PWR indicator*	On (green)	Lights green when DVADR is powered on.
END indicator*	Off (amber)	Lights amber when RMMD is 100% full or DVADR fault is detected.
Access door latch*	OPEN	Turn latch to release, then flip door open.
Function control toggle switch	OFF	Turns DVADR off.
	STBY	Puts DVADR in STOP mode.
	REC	Puts DVADR in RECORD mode.
EOT indicator	OFF	Lights amber when RMMD is 100% full.
REC ON indicator	ON	Lights green when DVADR is recording video.
Video selector toggle switch	HUD	Not used with DVADR.
	AUTO	Not used with DVADR.
	TVM	Not used with DVADR.
NOTE * Control/indicator on DVADR.		

Figure 1-201. Color Cockpit Television Sensor (CCTVS)/Digital Video Airborne Data Recorder (DVADR) (Sheet 2)

RADAR WARNING SYSTEMS.

A radar warning system may be installed in the aircraft. The system detects the presence of radar signals and provides visual and aural indications. This information is displayed on the standby azimuth indicator (21, Figure FO-1) and RWR control indicator (17, Figure FO-1) located on the main instrument panel. For further information on the radar warning systems, refer to TO 1A-10C-34-1-1.

NOTE

The radar warning system performs the same functions and provides the same azimuth indicator displays, but the control indicator functions are performed by the Countermeasures Set (CMS/EWMS). Refer to the Countermeasures Set for control functions and operation.

LIGHTWEIGHT AIRBORNE RECOVERY SYSTEM (LARS) 131.

The LARS (AN/ARS-6(V)) provides airborne electronic equipment which will quickly and precisely locate survivors equipped with the survival radio set AN/PRC-112. The LARS can also steer to any source of continuous wave UHF signals (such as the AN/PRC-90) and provide two-way UHF voice communications.

The LARS operates in the UHF band between 225 and 300 MHz, tunable in 25-kHz increments. To locate a survivor, the LARS transmits short coded messages. The radio set receives the coded message and its internal transponder, which responds only to its ID code, transmits a coded message back to LARS. The received message from the survival radio is decoded. Range and steering to the survivor is calculated. The LARS Remote Display Unit (RDU) indicates the range and left/right steering data to the survivor. The LARS can store nine survivor radio ID codes simultaneously. The LARS provides steering commands to any AM, FM, or CW source operating in the 225- to 300-MHz band.

LARS CDU 131.

All LARS data entries and control functions are accessed using the LARS CDU (Figure 1-202). Modes include BIT, Frequency programming (FREQ), and entry of survivor ID codes (CODE). Survivor interrogations can be either single burst (BRST) or continuous (CONT). Homing to any AM, FM, or CW signal source in the LARS frequency band is enabled by selecting the HOME mode. Voice communications on the designated UHF channel is accessed in BRST, CONT, or HOME modes by actuating the MIC switch DOWN on the right throttle grip (Figure 1-5).

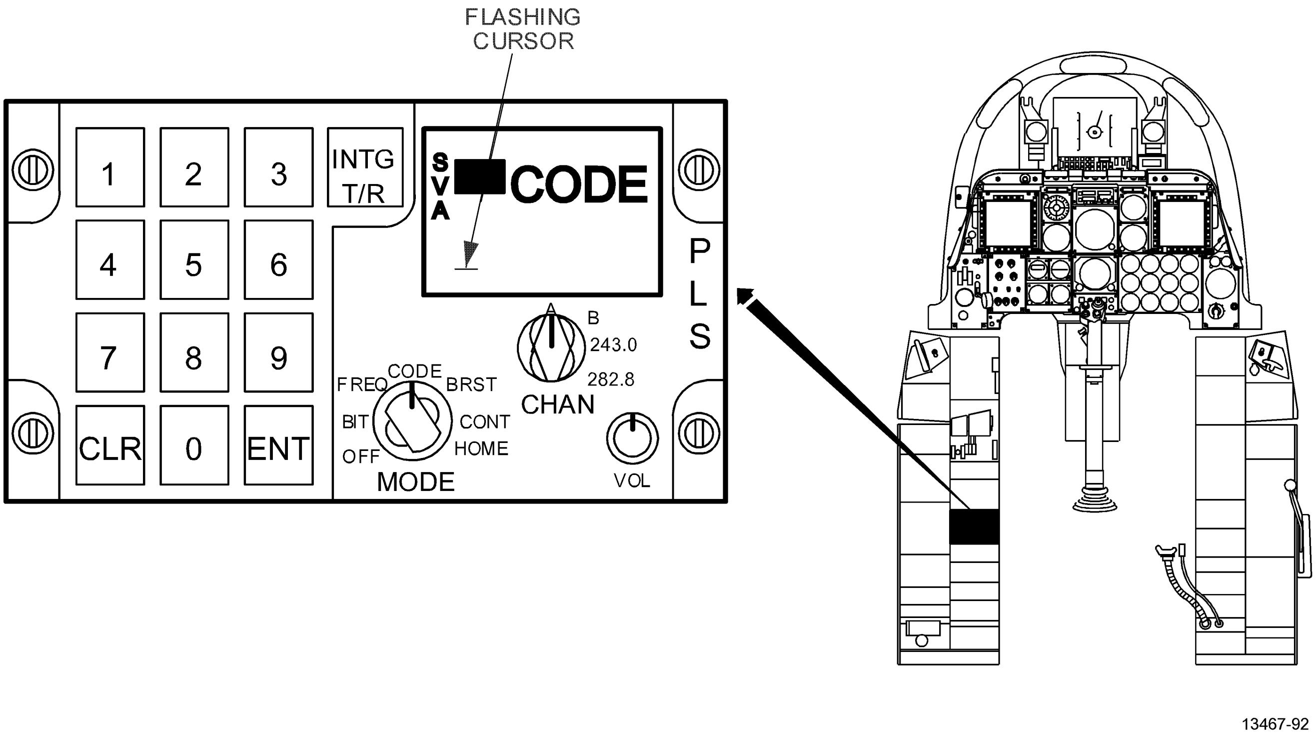


Figure 1-202. LARS Control Display Unit (CDU) $\boxed{131}$ (Sheet 1 of 2)

Control/Indicator	Condition or Position	Function
Number keys 0 through 9	-	When depressed, numerical values for frequency, code or survivor number are selected. If incorrect number is depressed, depress CLR and start over.
		CLR must always be depressed before the keyswitch selection of frequency or code.
CLR (clear) key	-	When depressed, clears frequency or survivor code and initiates a flashing cursor on the display.
ENT (enter) key	-	When depressed, enters the displayed frequency or survivor code into memory.
INTG - T/R (interrogate - transmit/receive key)		When depressed, alternately selects transmit-receive or interrogate mode of operation.
Display	-	Indicates survivor code, operating frequency, survivor numbers, mode and BIT results.
CHAN switch	A	Selects channel A for frequency programming or operation.
	B	Selects channel B for frequency programming or operation.
	243.0	Selects the preset international emergency frequency of 243.0 MHz.
	282.8	Selects the preset frequency of 282.8 MHz.
MODE switch	OFF	Removes electrical power for the AN/ARS-6. When another position is selected, power is applied to the AN/ARS-6.
	BIT	Initiates the AN/ARS-6 self-test.
	FREQ	Enables keyswitch programming of frequencies for channels A and B.
	CODE	Enables keyswitch programming of survivor number and survivor identification number.
	BRST	In conjunction with the INTG-T/R key, enables single interrogation of a survivor.
	CONT	In conjunction with the INTG-T/R key, enables multiple interrogation of a survivor.
		NOTE The INTG-T/R key needs to be depressed in order to re-initiate interrogations.
	HOME	Enables the system to display steering data on the RDU to the selected beacon.
VOL control	-	Varies the received audio level to the aircraft intercom system.

Figure 1-202. LARS Control Display Unit (CDU) 131 (Sheet 2)

LARS REMOTE DISPLAY UNIT (RDU) 131 .

The LARS RDU (Figure 1-203) diachronic liquid crystal display provides day and night readability and the electroluminescent backlighting makes viewing compatible with night vision goggles. The RDU displays range in nautical miles (nm) or in feet (for ranges of 9999 feet or less). Steering commands are presented as a bargraph to command left or right turns, or a solid sphere (bullseye) signifying the survivor is dead ahead (or directly aft) of the aircraft. In addition, a no update (NO UPDT) annunciator on the RDU indicates whether survivor data are current.

LARS INITIALIZATION 131 .

NOTE

LARS initialization must be performed prior to performing LARS operational check.

a. VOL control - Fully counterclockwise (OFF).

b. MODE switch - BIT.

  (1) Segments on both CDU and RDU displays activate for 3 to 5 seconds.

  (2) CDU - Displays BIT PASS or the failed LRU name and FAIL.

NOTE

BIT failure may occur on power up. Therefore, rerun BIT at least three times. If BIT fails three times, do not proceed.

c. MODE switch - FREQ and CHAN switch - A. (Display reads FREQ with six dashes).

d. CLR key - Depress to clear six dashes (a flashing cursor display indicates ready for frequency selection).

e. To enter desired Channel A frequency - Depress required numbered keys (Display reads selected frequency).

NOTE

Software trailing zeros for even number channels such as 268.000 need to be entered.

f. ENT key - Depress (selected frequency entered into memory).

NOTE

Kilohertz frequency must be entered in increments of 25 kHz. If a wrong value is entered, the number will not be displayed. Depress CLR and then enter correct value.

g. CHAN switch - B, repeat Step d, Step e, and Step f.

h. MODE SWITCH - CODE (SVR display shows 1 code and six dashes).

i. Survivor (SVR) No. 1 ID code entry:

  (1) CLR key - Depress (clears 6 dashes on display and cursor will flash).

  (2) Numbered keys - Depress for 6-digit survivor ID code (display will read code value).

  (3) ENT key - Depress (enters ID code into memory).

j. SVR No. 2 ID code entry:

  (1) Key No. 2 - Depress (SVR will read 2 code and six dashes).

  (2) CLR key - Depress (display clears, cursor will flash).

  (3) Numbered keys - Depress for 6-digit survivor ID code (display will read code value).

  (4) ENT key - Depress (enters ID code into memory).

k. Repeat Step j for each additional survivor code to be entered up to a maximum of 9.

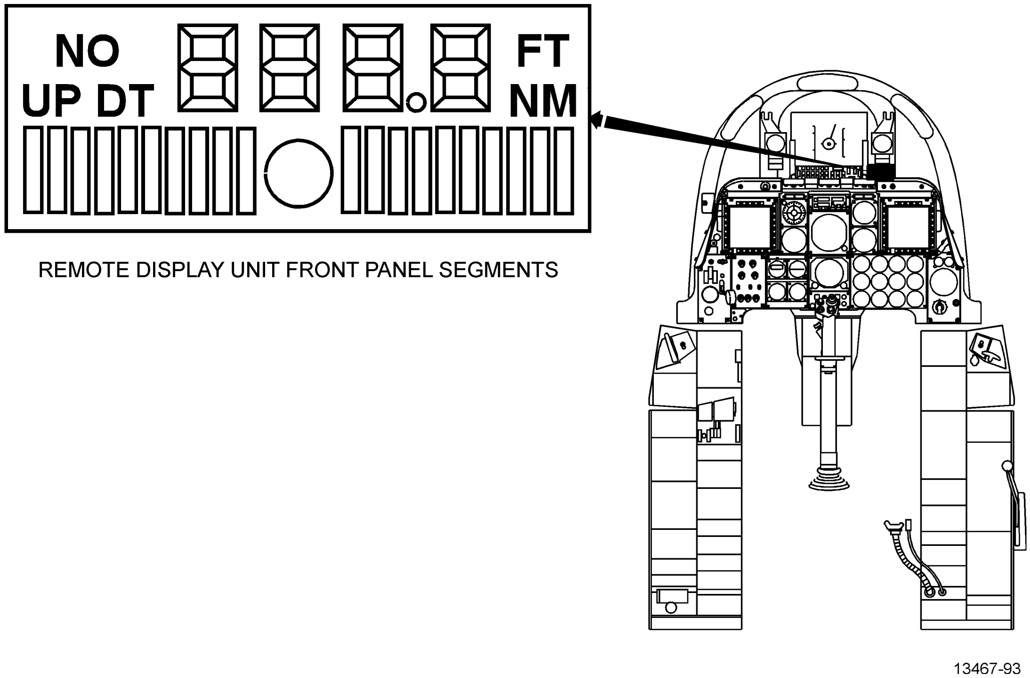
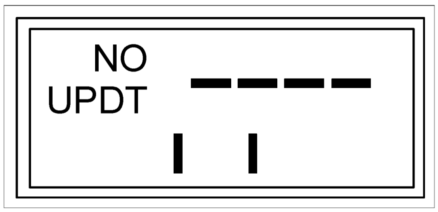
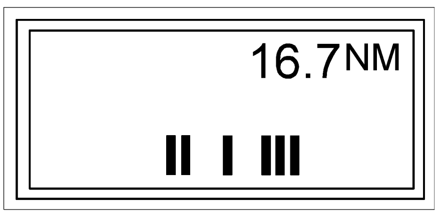
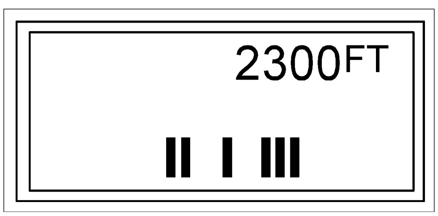


Figure 1-203. LARS Remote Display Unit (RDU) 131 (Sheet 1 of 3)

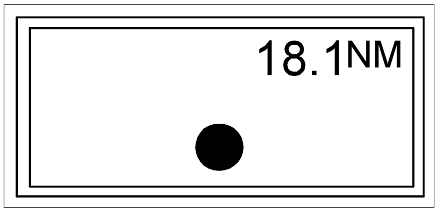
Control/Indicator	Function
	NOTE Bars “left” or “right” do not correlate to any specific number of degrees.
Four dashes in range readout, two bars in steering bargraph.	
	No steering or range data inputs to the display, or data entry mode (i.e., FREQ, CODE) selected on the CDU.
RANGE  	Range to survivor displayed in nautical miles to the nearest 0.1 mile until within 9999 feet, then range is displayed in feet (100's of feet from 9900 to 1000, 10's of feet from 990 to 0). If four dashes are displayed, no range value has been received.

13467-119

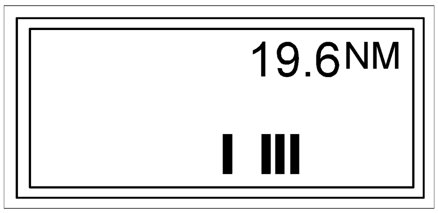
Figure 1-203. LARS Remote Display Unit (RDU) 131 (Sheet 2)

Control/Indicator	Function

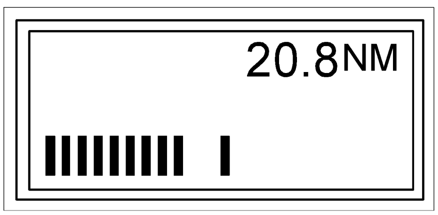
STEERING



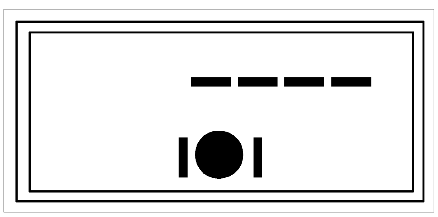
BORESIGHT: Indicates the aircraft is headed directly towards or away from the survivor.



VERTICAL BARS RIGHT (maximum of 10): Commands the aircraft to turn right to place the survivor on the nose of the aircraft.

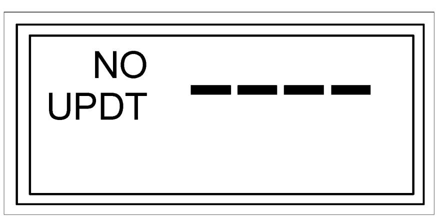


VERTICAL BARS LEFT (maximum of 10): Commands the aircraft to turn left to place the survivor on the nose of the aircraft.



Steering data from beacon has not been received.

NO UPDT



Indicates that all additional displayed data is not current, or that the initial response has been received.

13467-94

Figure 1-203. LARS Remote Display Unit (RDU) 131 (Sheet 3)

LARS OPERATIONAL CHECK $\boxed{131}$.

NOTE

LARS initialization required prior to performing operational check.

a. MODE switch - BRST (display should read T/R).

b. CHAN switch - A (display should read channel A frequency).

c. Key No. 1 - Depress (SVR should display 1).

d. INTG - T/R key - Depress.

(1) CDU display reads INTG until completion of interrogate/respond cycle (about 0.5 sec), then reverts to T/R.

(2) RDU display shows NO UPDT, four dashes in range readout, and two parallel bars (Figure 1-203, sheet 2).

e. MODE switch - CONT (display reads SVR 1, T/R, and selected channel frequency).

f. INTG - T/R key - Depress.

(1) Display reads SVR 1, INTG, and selected channel frequency.

(2) Display will continue to read INTG until INTG - T/R key or UHF MIC switch is actuated.

(3) RDU display shows NO UPDT, four dashes in range readout, and two parallel bars.

g. MODE switch - HOME.

(1) CDU display reads HOME and selected channel frequency.

(2) CDU will read HOME and selected channel until UHF MIC switch is actuated, which will interrupt homing functions, causing T/R display. When UHF MIC is released, homing resumes.

(3) If no beacon is present on selected channel, RDU will display NO UPDT, four dashes in range readout, and two parallel bars.

(4) If beacon is present on selected channel, RDU displays four dashes and steering command to beacon.

SERVICING DIAGRAM.

Figure 1-204 is the servicing diagram for the A-10. The diagram shows service points and includes information on fluids and gases used in servicing the aircraft.

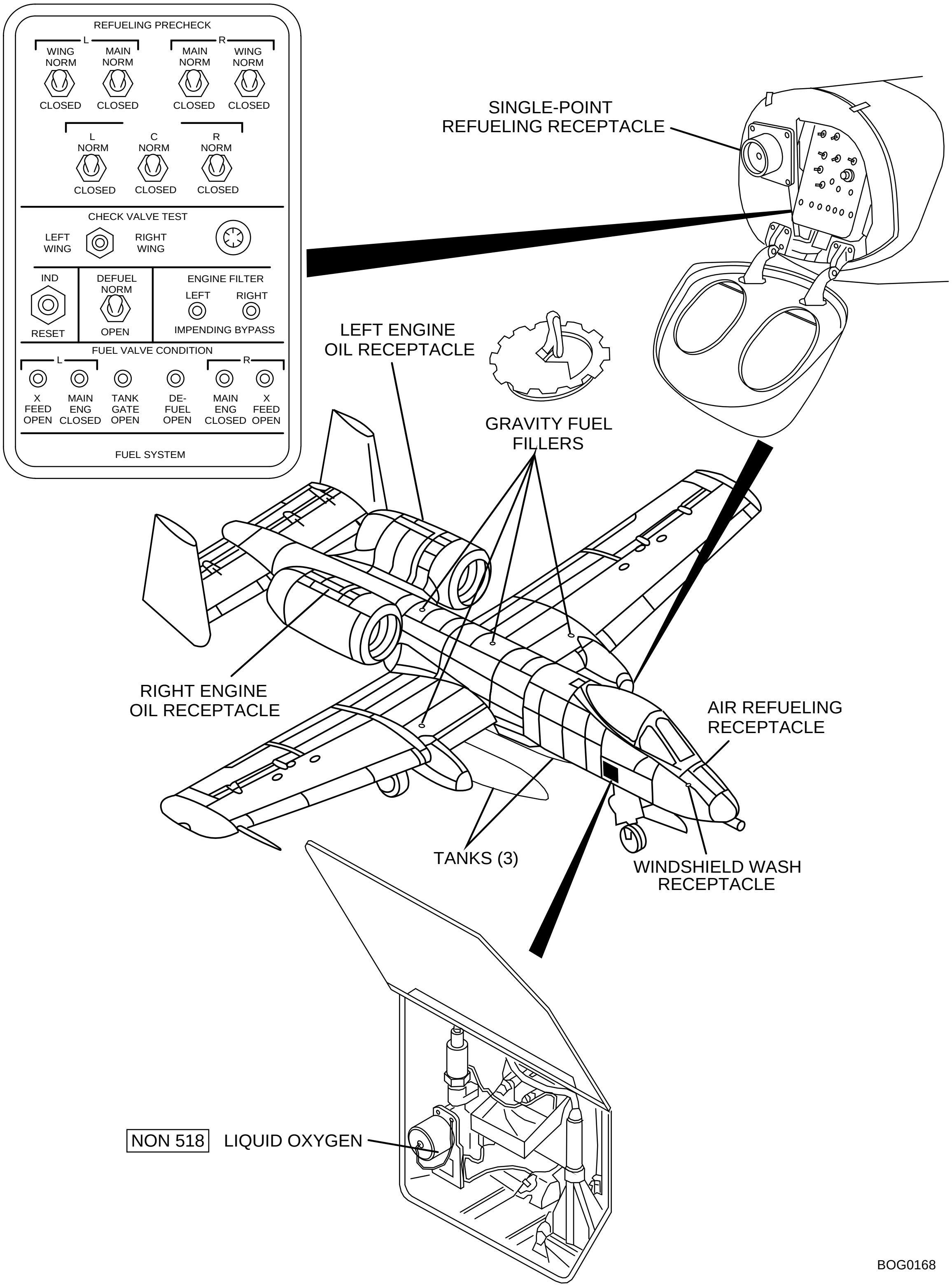


Figure 1-204. Servicing Diagram (Sheet 1 of 5)

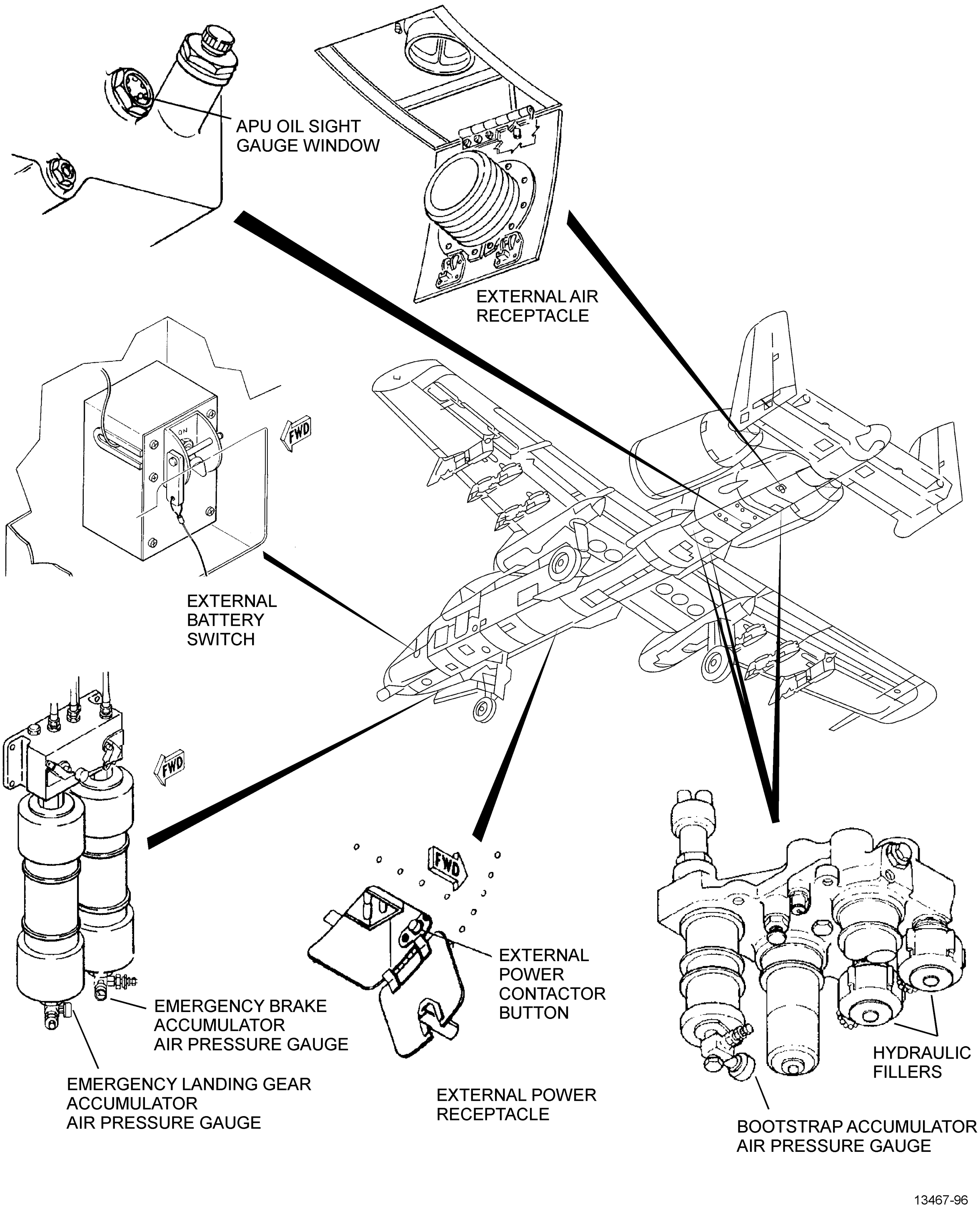


Figure 1-204. Servicing Diagram (Sheet 2)

SERVICEABLE ITEM		USAF SYMBOL	MILITARY SPECIFICATION	NATO SYMBOL	COMMERCIAL DESIGNATION (NOTE 3)
FUEL (NOTES 1 AND 2)	PRIMARY	JP-4	MIL-T-5624	F-40	JET B
		JP-5	MIL-T-5624	F-44	JET A AND JET A-1
		JP-8	MIL-T-83133	F-34	NONE
		JP-8/SPK (NOTE 6)			
		JP-8+100 (NOTE 4)			
	ALTERNATE	JET A, A-1 AND JET B WITHOUT TWO ADDITIVES. OBSERVE NOTE 3 RESTRICTIONS. TS-1 OR RT WITH US MILITARY ADDITIVE PACKAGE. OBSERVE NOTE 5 RESTRICTIONS.			
	EMERGENCY	NONE AUTHORIZED			
ENGINE OIL			MIL-L-7808	0-148 0-149	
APU OIL			MIL-L-7808	0-148 0-149	
HYDRAULIC FLUID			MIL-H-83282		
OXYGEN NON518			MIL-O-27210		
WINDSHIELD WASH SOLUTION DISTILLED WATER/METHANOL (METHYL ALCOHOL) (40/60)			MIL-O-M-232F		
TIRE SERVICING (NITROGEN PN C-2666-5)	AIRCRAFT GROSS WT (LB)	MLG TIRE INFLATION PRESSURE (PSI)		NLG TIRE INFLATION PRESSURE (PSI)	
	ALL GROSS WTS	185 (±5)		140 (±5)	

Figure 1-204. Servicing Diagram (Sheet 3)

NOTES:

1. IF POSSIBLE, THE AIRCRAFT SHOULD BE REFUELED IMMEDIATELY AFTER FLIGHT, TO MINIMIZE WATER CONDENSATION IN THE FUEL TANKS.

2. JP-4, JP-5, JP-8, JP-8+100, AND JP-8/SPK MAY BE COMBINED TO FORM A MIXTURE. THE MIXTURE MAY CONTAIN ANY QUANTITY OF THESE FUELS; HOWEVER, TEMPERATURE LIMITS FOR JP-5 OR JP-8 SHALL BE OBSERVED. IF THESE FUELS ARE USED IN THE MIXTURE, ENGINE OPERATIONS ARE RESTRICTED TO THE FOLLOWING TEMPERATURE RANGES (REF TO 2J-TF34-116-1):

JP-4, JET B NATO F-40:	-54 DEGREES C {-65 DEGREES F} TO 57 DEGREES C {135 DEGREES F}
JP-5, JET A/A-1, NATO F-44:	-29 DEGREES C {-20 DEGREES F} TO 57 DEGREES C {135 DEGREES F}
JP-8, JP-8+100, NATO F-34:	-29 DEGREES C {-20 DEGREES F} TO 57 DEGREES C {135 DEGREES F}

3. a. WITH ICING AND CORROSION INHIBITORS - NO RESTRICTIONS.

   b. WITHOUT ICING INHIBITOR - ENSURE FUEL TEMPERATURE IS MAINTAINED ABOVE 0 DEGREES C (32 DEGREES F). EXPOSURE OF AN HOUR OR TWO TO LOW TEMPERATURE WILL NOT SIGNIFICANTLY CHANGE THE TEMPERATURE OF FUEL IN THE AIRCRAFT FUEL TANKS.

   c. WITHOUT CORROSION INHIBITOR - ENGINE OPERATIONS SHALL BE RESTRICTED TO 10 CONSECUTIVE HOURS.

4. JP-8+100 INCLUDES A THERMAL STABILITY ADDITIVE. IF AIRCRAFT IS SERVICED WITH JP-8+100, COMPLETE AFTO FORM 148 AND ANNOTATE AIRCRAFT RECORDS.

5. USE RUSSIAN TS-1 OR RT FUEL ONLY IF NO OTHER ALTERNATE FUELS ARE AVAILABLE. TS-1 OR RT MUST CONTAIN US MILITARY ADDITIVE PACKAGE. TS-1 OR RT MAY BE CONSIDERED TO HAVE THE SAME DENSITY AND TEMPERATURE RANGE AS JP-8.

6. JP-8/SPK IS A MIXTURE OF JP-8 AND UP TO 50% OF SYNTHETIC PARAFFINIC KEROSENE (SPK) IAW MIL-T-83133.

Figure 1-204. Servicing Diagram (Sheet 4)

NITROGEN PRECHARGE (CLEAN-DRY) PRESSURE TOLERANCE ±50 PSI		
	TEMP (°F)	PSI
BOOTSTRAP ACCUMULATORS (NITROGEN PN C-2666-5)	-40	1200
	-20	1280
	0	1360
	20	1430
	40	1500
	60	1570
	70	1600
	80	1640
	100	1710
	120	1800
	130	1900
EMERGENCY BRAKE AND EMERGENCY LANDING GEAR ACCUMULATORS (NITROGEN PN C-2666-5)	-40	900
	-20	950
	0	1010
	20	1065
	40	1120
	60	1175
	70	1200
	80	1230
	100	1285
	120	1340
	140	1395

Figure 1-204. Servicing Diagram (Sheet 5)

HELMET MOUNTED CUEING SYSTEM (HMCS).

The HMCS provides the capability to command a sensor to the user line of sight and provides situational awareness via a Helmet Mounted Display (HMD). The following paragraphs describe the HMCS system.

Hooking on Helmet Mounted Display (HMD).

Located at the center of the HMD display as crosshair symbol which provides the LOS cue. The HMCS will hook an object within 5 mils of the center of the crosshair when selecting TMS-FWD/SHORT. The A hooked object can be made SPI with TMS-FWD/LONG or unhooked with TMS-AFT/SHORT. When the hooked object is made SPI, HMCS displays on the HUD, and *HMCS displays if SPI is being transmitted. The hookship symbol on the HUD is based on the most recent active tag; be it on the TAD or HMD.

Helmet Designation Cue (HDC).

The HMD utilizes a Helmet Designation Cue (maneuvered by the Slew/Track Control switch when HMD is the SOI). If the HDC position has not been previously determined, the HDC symbol is caged within the Crosshair. The Slew/Track Control switch slews the HDC to any location within the HMD FOV. While slewing, the HDC VALID symbol displays. When the Slew/Track Control Switch is released, the HDC attempts to establish a position on the ground (defined by a lat/long/elevation). If successful, the HDC becomes ground stabilized at that point. The HDC can then be made SPI either by hooking it and commanding TMS-FWD/LONG or by commanding a TMS-FWD/LONG when nothing is currently hooked. If the HDC is slewed to a position where a ground position cannot be calculated, an INVALID HDC symbol is drawn and the HDC is Helmet stabilized (to the position it was last commanded to) to indicate an invalid designation. The HDC will stay Helmet stabilized until the Slew/Track Control Switch is bumped or moved onto a valid ground position at which point the HDC becomes ground stabilized. If HDC is VALID, TMS-RIGHT creates a Markpoint at the HDC position.

SPI Indicator.

The HMD provides a cue to the SPI when the SPI is located outside the HMD Field of View (FOV). The cue consists of a partially dashed line drawn from the center of the fixed crosshair to the edge of the display in the direction of the SPI. The "solid" part of the line will grow as the SPI moves farther from the edge of the display.

Horizon Line.

The HMD displays a solid Horizon Line to provide a horizon indicator. When the Horizon Line moves outside of a centered 18 degree wide FOV the Horizon Line will become the Ghost Horizon Line. The Ghost Horizon Line is dashed and will be clamped to the edge of the centered 18 degree wide FOV.

Mark Points.

The HDC is used to create a mark point. If TMS-RIGHT/SHORT is commanded while a valid HDC symbol is displayed on the HMD (i.e. the DTED data is valid for the HDC position) a mark point will be created at that position.

HMCS LOS Cueing.

The Maverick and TGP can cue to the helmet LOS. When Maverick is the SOI, DMS-RIGHT/LONG cues the Maverick to the HMCS LOS. If anything other than Maverick is the SOI, DMS-RIGHT/LONG cues the TGP to the HMCS LOS.

HMCS HOTAS Control.

The HOTAS controls for selection and operation of HMCS as SOI and HMCS Boresight are shown in Figure 1-161 and Figure 1-163.

HMCS Control Pages.

HMCS Control Page 1 and HMCS Control Page 2 control and communicate with the HMCS. HMCS Control Page 1, Figure 1-204.2 is accessed via OSB 3 on System Status Pages 1, 2, or 3. Once HMCS Control Page 1 displays, selecting PREV (OSB 1) transitions back to System Status Page 1, 2, or 3. Selecting NEXT (OSB 2) transitions to HMCS Profile Control Page 2.

Day/Night Mode.

The HMCS has two separate brightness levels designated as DAY mode and NIGHT mode. Use OSBs 9 (DAY) and 10 (NIGHT) on the HMCS Page to select between the two modes. Each mode can be adjusted when selected and will retain the final value input before it is switched.

Brightness Control.

The HMD brightness be adjusted using the DMS-FWD and AFT with the HMCS as SOI. The brightness adjustment is applied to the currently selected mode (DAY or NIGHT). The current brightness level displays on center of the HMD for three seconds whenever it is modified.

Targeting Pod Track Mode.

The HMCS can be set to cue the targeting pod (TGP) in different tracking modes regardless of the current TGP tracking mode. When a TMS-LEFT/LONG is used to slave the TGP to the HMCS LOS, it will jump into the TGP Track Mode (Area Track, Point Track, or Inertial Rates (INR)) selected via the TRK OSB (OSB 8).

HMCS Profile Editing.

The HMCS Page contains three preloaded profiles. Initially all symbol states are set to OCLD and the range is set to 50 (where applicable). Edit each profile by first selecting a profile (OSBs 3 through 5). This displays the selected profile on the HMD along with the profile name (i.e. PRO1) for 2 seconds. Using the Symbol Navigation buttons (OSBs 6 and 7, or 19 and 20) select the symbol to be edited. Once selected, the Symbol State button (OSB 18) toggles the symbol ON, OFF, or OCLD (symbol is ON and occludable) for that profile (Note: The HORIZON LINE is an exception and can be set to OFF, NORM, and GHST). Certain symbols can also have a defined maximum range for display. The range can be set on the scratchpad with a value of 1 - 999.

A selection with a " - " in the range column can not have a defined range for display. RANGE (OSB 17) sets the display range for a symbol. Some symbols have special Symbol State options that are listed in Figure 1-204.1. Each profile will be automatically saved in the state it is left in.

Figure 1-204.1. HMCS Profile Symbols

Displayed Text (20 Characters)	Description	Symbol State Options	Range
Crosshair	Gives an indication of LOS.	OFF, ON, OCLD	-
OWN SPI	Ownship SPI	OFF, ON, OCLD	-
SPI INDICATOR	Line connecting center of crosshair to Ownship SPI when SPI in not in HMD FOV.	OFF, OCLD	-
HORIZON LINE	Solid or Dashed (Ghost) line indicating the horizon.	OFF, NORM, GHST	-
HDC	HMCS HDC Symbol	OFF, ON, OCLD	-
Hookship	HMCS Hookship symbol	OFF, ON, OCLD	
TGP DIAMOND	Indicates TGP LOS	OFF, ON, OCLD	-
TGP FOV	Dashed box indicating the TGP FOV	OFF, ON, OCLD	-
Flight Members	Own Flight Members	OFF, ON, OCLD	#
FLIGHT MEMBER SPI	A flight member SPI	OFF, ON, OCLD	#
DONOR AIR PPLI	Donor Air PPLIs	OFF, ON, OCLD	#
DONOR SPI	Non flight member SPIs	OFF, ON, OCLD	#
AIR ENVIR	All Air Objects (except FM and donors)	OFF, ON, OCLD	-
AIR VMF FRIEND	All Air VMFs	OFF, ON, OCLD	#
AIR PPLI (NON-DONR)	Air PPLIs except Flight Members and Donors	OFF, ON, OCLD	#
AIR TRK FRIEND	Air Tracks with Identity of Friend	OFF, ON, OCLD	#
AIR NEUTRAL	Air Tracks with Identity of Neutral	OFF, ON, OCLD	#
AIR SUSPECT	Air Tracks with Identity of Suspect	OFF, ON, OCLD	#
AIR HOSTILE	Air Tracks with Identity of Hostile	OFF, ON, OCLD	#
AIR OTHER	Air Tracks with Identity Assumed Friend, Pending, or Unknown	OFF, ON, OCLD	#
GND ENVIR	All Land & Surface Objects	OFF, ON, OCLD	-
GND VMF FRIEND	All GND VMFs	OFF, ON, OCLD	#
GND PPLI	J2.5 grouped with J2.6 Land PPLIs	OFF, ON, OCLD	#

Figure 1-204.1. HMCS Profile Symbols - Continued

Displayed Text (20 Characters)	Description	Symbol State Options	Range
GND TRK FRIEND	Land or Surface Tracks with Identity of Friend	OFF, ON, OCLD	#
GND NEUTRAL	Land or Surface Tracks with Identity of Neutral	OFF, ON, OCLD	#
GND SUSPECT	Land or Surface Tracks with Identity of Suspect	OFF, ON, OCLD	#
GND HOSTILE	Land or Surface Tracks with Identity of Hostile	OFF, ON, OCLD	#
GND OTHER	Land or Surface Tracks with Identity Assumed Friend, Pending, or Unknown	OFF, ON, OCLD	#
EMER POINT	Emergency Points and AIR symbols with Emergency Indicator set to TRUE	OFF, ON, OCLD	#
STEERPOINT	Current Steerpoint selected	OFF, ON, OCLD	#
MSN/MARKPOINTS	Missionpoints or Markpoints depending on Steerpoint switch setting	OFF, ON, OCLD	#
MSN/MARK LABELS	Missionpoint and Markpoint text labels (ignored for MARKPOINTS or MISSIONPOINTS if set to OFF)	OFF, ON, OCLD	-
AIRSPEED	Indicated Airspeed (IAS)	OFF, ON, OCLD	-
RADAR ALTITUDE	Altitude (AGL)	OFF, ON, OCLD	-
BARO ALTITUDE	Barometric Altitude (MSL)	OFF, ON, OCLD	-
A/C HEADING	Heading of Aircraft	OFF, ON, OCLD	-
HELMET HEADING	Heading of Helmet LOS	OFF, ON, OCLD	-

HMCS Control Page 2.

HMCS Control Page 2 is accessed via the HMCS Control Page 1 button (OSB 2). Once HMCS Control Page 2 is displayed selecting PREV (OSB 1) accepts all currently displayed settings and returns to HMCS control page 1. HMCS Control Page 2 provides control and displays to support boresighting the HMCS. Boresighting is a three step process requiring a coarse and fine boresight along with a text leveling procedure (if necessary). HMCS Control Page 2 also provides the ability to define an occlusion zone.

HMCS Boresighting.

The HMCS can be boresighted on the ground or in flight. During Boresight, the HMD displays the Boresight Crosshair symbol (BCS) and a box that outlines the HMD FOV. Also, the HUD displays a boresight crosshair symbol and two long horizontal lines on each side of the symbol to assist in boresighting. Once boresighted, the HMCS will not require re-boresighting until the HMCS power is cycled.

Coarse Boresight.

An initial or coarse boresight is commanded via OSB 20 on HMCS Control Page 2. In coarse boresight mode the Crosshair symbol on the HMD will change to the Boresight Crosshair Symbol (BCS). This BCS is centered on the HMD and be helmet stabilized. The HMCS boresight symbol displays automatically on the HUD during boresighting. Align the center of the BCS with the HMCS Boresight Symbol on the HUD by adjusting head position. When the BCS is in position, use TMS-FWD/SHORT to aircraft stabilize the BCS. This completes the coarse boresight and enters the system into fine boresight mode.

Fine Boresight.

A fine boresight is performed immediately after a coarse boresight or via OSB 19 on HMCS Control Page 2 after an initial boresight has completed. In fine boresight mode the BCS becomes aircraft stabilized and two long horizontal lines appear on each side of it. This allows for helmet movement and keeps the BCS centered on the HUD. Fine boresighting is done using the HOTAS switches. The BCS can be adjusted up, down, left, right and rotationally. The goal is to align the center of the BCS to the HMCS Boresight Symbol on the HUD and have the long horizontal bars on the HUD and HMCS overlap. Changes to fine boresight settings are saved as they are made and displayed on the HMCS Boresight Page as AZ, EL, and ROLL. Use TMS-FWD/SHORT or the FINE BORE OSB (OSB 19 on the HMCS Control Page 2) to complete fine boresight and exit boresight mode.

Text Leveling.

The text string "MAKE THIS TEXT LEVEL" displaying above the horizontal bar while in the boresight mode needs to remain level to properly align the helmet fixed symbols and text. Using the DMS FWD and AFT, the text can be rotated CCW and CW respectively. These changes are saved as they are made and displayed on the HMCS Boresight Page as MOUNT.

Occlusion Zone.

The HMCS can also define an occlusion zone using HMCS Control Page 2 by selecting the NEW OCCL ZONE (OSB 17). This will display a helmet stabilized crosshair which will be used to mark the borders of the occlusion zone. The BCS along with the roll bars will remain aircraft stabilized. Use TMS-FWD/SHORT to mark a point while looking at the lower left most point of the occlusion zone. After a point is marked a diamond will overlay it and the mark position can be moved using the slew switch. As each sequential point is marked, a red line appears between the previous point and the new point. This indicates the border of the occlusion zone. TMS-AFT/SHORT can be used to remove a marked point and "step-back" in the process. Use TMS-FWD/LONG or pressing the NEW OCCL ZONE OSB completes the occlusion zone and draws a line between the last point and the first point. The NEW OCCL ZONE OSB text will change from reverse video to normal video indicating the new occlusion zone has been stored. The new occlusion zone can be undone by hitting the UNDO OCCL OSB (OSB 9 on the HMCS Control Page 2) which reverts to the previously saved occlusion zone.

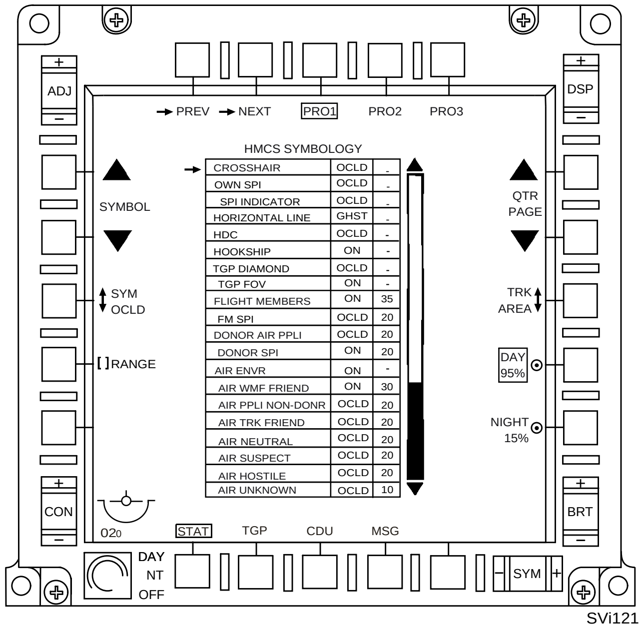


Figure 1-204.2. HMCS CONTROL PAGE 1

Figure 1-204.3. HMCS CONTROL PAGE 1 Option Select Button Definitions

CONTROL/INDICATOR	FUNCTION
PREV (OSB 1)	Transitions to System Status Page 1, 2, or 3.
NEXT (OSB 2)	Transitions to HMCS Profile Control Page 2.
PRO# (OSBs 3 through 5)	Selects one of three possible profiles. Profiles can be edited and automatically saved. Selecting a new profile will display that profiles name (i.e. PRO1) in the HMD for 2 seconds.
QTR PAGE (OSBs 6 and 7)	Scrolls quickly through symbol list for HMD.
TRK (OSB 8)	Cycles through the targeting pod track modes: INR, AREA, or POINT.
DAY (OSB 9)	Selects DAY mode for the HMD. DAY mode sets the brightness of the HMD to the current DAY mode value.
NIGHT (OSB 10)	Selects NIGHT mode for the HMD. NIGHT mode sets the brightness of the HMD to the current NIGHT mode value.
RANGE (OSB 17)	Sets the display range for a symbol.
Symbol State (OSB 18)	Cycles through symbol state options: ON, OFF, or OCLD (OCLD means symbol is on and occludable). Current value is displayed. (Note: The HORIZION LINE is an exception and can be set to OFF, NORM, and GHST).
Symbol Navigation (OSBs 19 and 20)	Scrolls through symbol list for HMD. Not displayed if at top (bottom) of list.

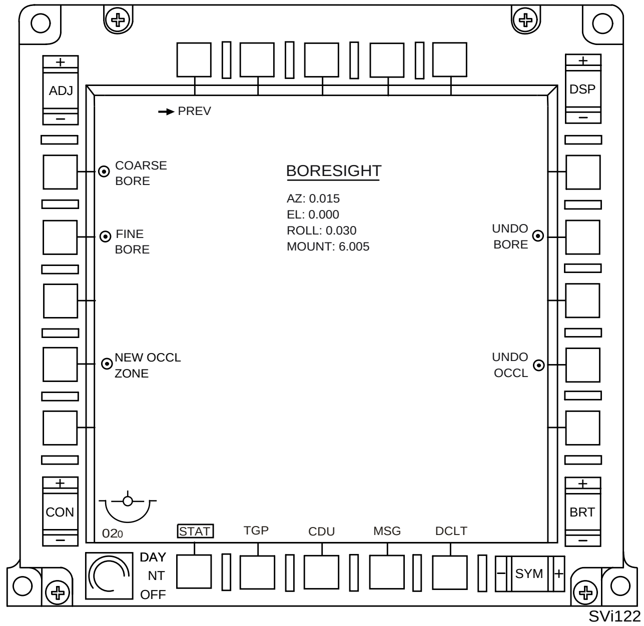


Figure 1-204.4. HMCS CONTROL PAGE 2

Figure 1-204.5. HMCS CONTROL PAGE 2 Option Select Button Definitions

CONTROL/INDICATOR	FUNCTION
PREV (OSB 1)	Accepts all currently displayed settings and returns to HMCS control page 1.
UNDO BORE (OSB 7)	Resets boresight values to values stored when Boresight Page was entered.Only enabled after an initial boresight.
UNDO OCCL (OSB 9)	Reverts to the previous zone or the default zone. Only enabled if default zone is not currently set.
NEW OCCL ZONE (OSB 17)	Creates a new occlusion zone.
FINE BORE(OSB 19)	Commands a Fine Boresight. Only enabled after an initial/coarse boresight.
COARSE BORE (OSB 20)	Commands an initial/coarse Boresight.

SECTION II

NORMAL PROCEDURES

TABLE OF CONTENTS

PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

Refer to Section V for all Operating Limitations.

Authorized Speeds Below 10,000 Feet Mean Sea Level (MSL) (Outside Special Use Airspace)

If FAA and/or Host Nation rules require aircrew to fly the aircraft at safe maneuvering airspeeds below 10,000 feet MSL (outside Special Use Airspace), use the following:

- Formation Rejoins on Departure: 200-250 knots.
- Point-to-Point Navigation/Formation Rejoins that do not occur on departure: 250 - 300 knots.
- Non-TFR Descents into an Military Training Route (MTR): 250 - 300 knots; accelerate to airspeeds authorized in Flight Information Publication (FLIP) when the aircraft is established inside the confines of the MTR.
- If a route abort or unplanned climb causes the aircraft to exit the MTR, slow to safe maneuvering airspeed (250 - 300 knots) after terrain/obstacle clearance is assured.
- Non-Instrument Approach Procedures (IAP) Descents into the Terminal Area: 250 - 300 knots.
- Initial Entry Airspeed for G-Awareness Exercises: 285 - 325 knots.

FLIGHT PLANNING.

Preflight planning data, such as takeoff performance, fuel required, cruise data, and other performance information to complete the proposed mission, will be determined using the performance data contained in TO 1A-10C-1-1.

WEIGHT AND BALANCE.

Refer to Handbook of Weight and Balance Data, TO 1-1B-40, for the aircraft to be flown.

CHECKLIST.

This section contains the amplified checklist. The abbreviated checklist is published separately as TO 1A-10C-1CL-1.

BEFORE EXTERIOR INSPECTION.

1. AFTO Form 781 - Check.

COLD WEATHER PROCEDURE.

See Section VII, Adverse Weather Conditions.

EXTERIOR INSPECTION.

Perform the exterior inspection as outlined in Figure 2-1.

BEFORE ENTERING COCKPIT.

1. Canopy actuator - Check locked.

NOTE

If the canopy actuator is disengaged by use of the internal or external canopy actuator disengage lever, the locking system must be reset by maintenance personnel. Canopy disengagement is indicated by a small orange-yellow triangle on the actuator unlock hook, which is located at the top end of the canopy actuator and visible from the left side of the aircraft.

2. Canopy uplock pin - Check.
3. Canopy controls - Check.
   a. Canopy actuator disengage lever - Full forward.
   b. Canopy jettison handle - Full forward, safety pin removed.
4. Ejection seat - Check.
   a. Seat ground safety lever - SAFE (UP).
   b. Ejection handles - Secured.
   c. Ejection handles safety pin (left handgrip) - Removed.
   d. Survival kit - AUTO.
   e. Radio locator beacon - A (AUTO) or M (MANUAL) (as required).
   f. Survival kit and lap belt connections - Check secure.

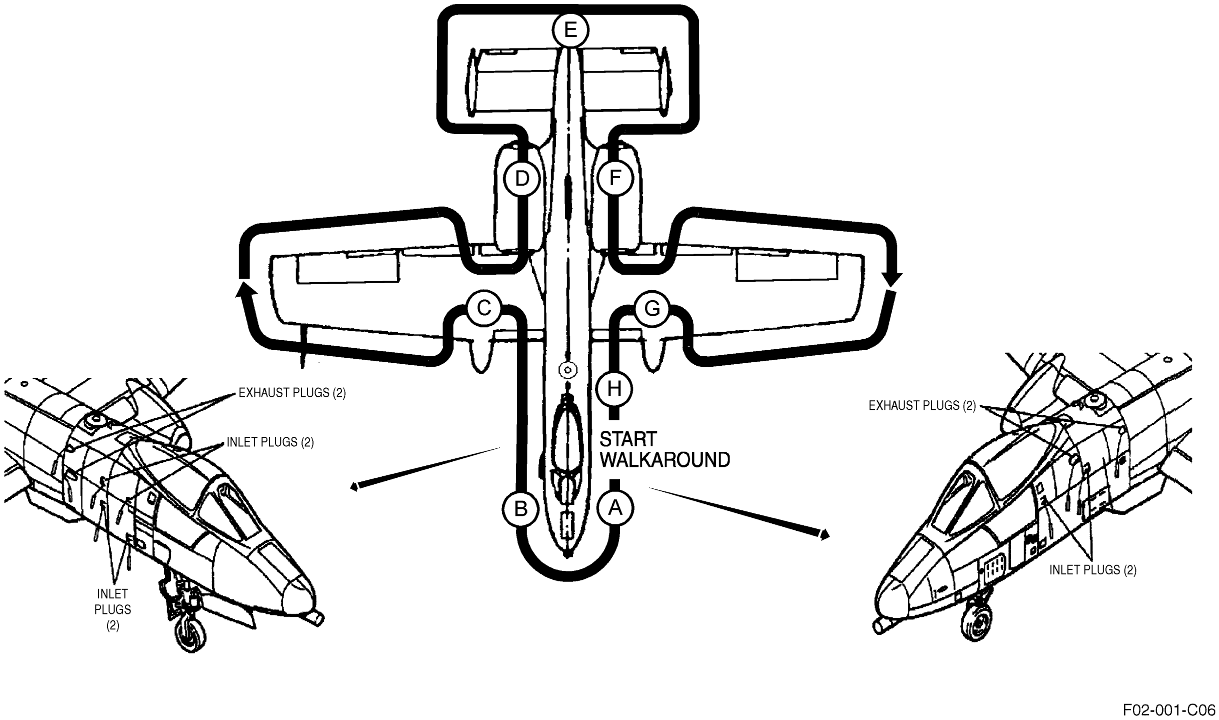


Figure 2-1. Exterior Inspection (Sheet 1 of 3)

CAUTION

It is physically possible for a water intrusion plug to wedge into an aft-facing avionics duct without external streamers or lanyards. A direct visual inspection from aft of each of the 4 duct shrouds is required to confirm the absence of plugs. Failure to remove all plugs before flight could lead to significant foreign object damage.

NOTE

During the Exterior Inspection, the aircraft should be checked for general condition, covers and plugs removed, wheels chocked, access doors and filler caps secured, and for hydraulic fluid, oil, and leaks, as well as for the following specific items.

A LEFT FORWARD SECTION

1. ANGLE OF ATTACK VANE - CHECK.
2. EXTERNAL BATTERY SWITCH - ON.

NOTE

NO BATTERY POWER IS AVAILABLE IF EXTERNAL BATTERY SWITCH IS OFF.

3. AN/ALR-69 ANTENNA - CHECK.

B RIGHT FORWARD SECTION

1. GAU-8 SAFETY PIN - CHECK.
2. NOSEWHEEL - CONDITION.
3. NOSE GEAR STEERING LOCK CAP - SAFETY PIN REMOVED AND CAP SAFETIED.
4. BATHTUB DRAIN - CHECK.
5. SLAT SAFETY PIN - REMOVED.
6. BALLASTS - CHECK.
7. EMERGENCY ACCUMULATORS - CHECK PRECHARGE (PLACARD).
8. WINDSHIELD WASH QUANTITY - CHECK.
9. GEAR SAFETY PIN - REMOVED.
10. UMBILICAL DISPLAY UNIT CHECK TEMS STATUS.
11. AN/ALR-69 ANTENNA - CHECK.
12. INTRUSION PLUGS (6) - CHECK REMOVED.

CAUTION

DO NOT TAXI WITH A FULLY COMPRESSED STRUT.

C RIGHT CENTER SECTION

1. AVIONICS INLET VENTS (4) - CLEAR.
2. AVIONICS EXHAUST VENTS (2) - CLEAR.
3. FUSELAGE FENCE - INSPECT FOR IMPACT DAMAGE.
4. MAIN LANDING GEAR STRUT CENTER DOOR - CHECK SAFETY PIN INSTALLED AND DOOR SECURE.
5. GEAR SAFETY PIN - REMOVED.
6. WHEEL WELL - CONDITION.
7. SPEED BRAKE SAFETY PIN - REMOVED.
8. MAINTENANCE RECORD STOWAGE CONTAINER IN WHEEL WELL - CLOSED AND SECURE.
9. PITOT TUBE STATIC PORTS - CLEAR.

D RIGHT AFT SECTION

1. SPEED BRAKE - CONDITION.
2. FLAPS - CONDITION (NOTE POSITION).
3. ENGINE NACELLE - CONDITION.
4. RIGHT RUDDER/ELEVATOR - CONDITION.

E TAIL CONE

1. AN/ALR-69 ANTENNA CHECK.

Figure 2-1. Exterior Inspection (Sheet 2)

F LEFT AFT SECTION

1. LEFT RUDDER/ELEVATOR - CONDITION.
2. ENGINE NACELLE - CONDITION.
3. APU HYD VALVE DOOR - CLOSED.
4. FLAPS - CONDITION (NOTE POSITION).
5. SPEED BRAKE - CONDITION.

G LEFT CENTER SECTION

1. AVIONICS INLET VENTS (2) - CLEAR.
2. AVIONICS EXHAUST VENTS (2) - CLEAR.
3. LIFT TRANSDUCER VALVE - CONDITION.
4. MAIN LANDING GEAR STRUT CENTER DOOR - CHECK SAFETY PIN INSTALLED AND DOOR SECURE.
5. GEAR SAFETY PIN - REMOVED.
6. WHEEL WELL - CONDITION.
7. SAFETY PIN POUCH - CHECK SECURE.
8. DEFUEL SWITCH - NORMAL.
9. GROUND REFUELING DOOR - CLOSED.
10. FUSELAGE FENCE - INSPECT FOR IMPACT DAMAGE.

H FROM BOARDING LADDER

1. UPPER SURFACES - CHECK.
2. INTRUSION PLUGS (4) - CHECK REMOVED.

Figure 2-1. Exterior Inspection (Sheet 3)

g. Emergency oxygen bottle supply and connections - Check.

NOTE

Emergency oxygen bottle supply pressure may be below normal limits for cold weather operation. If below normal limits, consult crew chief for proper limits.

h. Seat hose disconnects - Right and left sides engaged.

i. Parachute and harness connection - Check. Make sure threaded retaining pins are:

(1) (FLUSH SCREW) Flush or below surface.

(2) (SLOTTED SCREW) Head underside seated against link assembly.

(3) (SEAWARS/UWARS) Check security of fittings and (SEAWARS only) integrity of tamper dots.

(4) (INERTIAL REEL STRAP PIN) Is visible and protrudes through inertial reel straps.

WARNING

If lap belt and inertia reel strap retaining pins do not protrude, the recovery chute is not properly installed and is unsafe for flight.

j. Pitot tubes - Check clear and undamaged.

k. Recovery sequencer battery indicator - Check.

NOTE

If the indicator is shown it should be white. Red protrusion indicates expended sequencer battery. If indicator is black or covered, ejection seat has been modified with the Digital Recovery Sequencer and is safe to use.

l. EMERGENCY MANUAL CHUTE handle - Secure, safety pin removed.

5. Data Transfer System (DTS) - If Data Transfer Cartridge (DTC) available:

Insert and lock DTC in Upgraded Data Transfer Unit (UDTU).

a. Unlatch and open UDTU enclosure door.

b. Insert and lock DTC in UDTU.

c. Close and latch UDTU enclosure door.

NOTE

Failure to properly close and latch UDTU enclosure door may cause excessive electromagnetic interference (EMI) noise levels on some VHF and UHF radio frequencies.

6. Flight publications - Check (as required).

7. Night Vision Goggles (NVGs) - Stow (as required).

8. DVADR RMMD - Load. $\boxed{148}$

To load the RMMD:

a. Open the RMMD access door by pressing the "PUSH TO OPEN" latch, then flip open the door.

b. Insert the RMMD with the labels (top side) facing aft and the two arrows on the "insert label" oriented downward.

c. Push the RMMD until the red "PUSH TO EJECT" lever pops out. Only a limited mechanical effort is necessary to obtain positive locking.

d. Close and latch the access door.

AIRCREW EYE/RESPIRATORY PROTECTION (AERP) INGRESS.

Prior to strap-in:

1. Boarding ladder switch - Activate.

NOTE

- Activating boarding ladder switch confirms 28 VDC will be available to AERP blower.
- Make sure demist hose does not crimp, as ventilation will be reduced and visor may fog up.

2. Blower strap assy - Remove and stow.

3. Blower - Install in bracket.

4. Blower electrical connector - Connect; stow dust cap.

5. Blower hose upper restraint straps - Connect.

Strap-in:

6. Aircraft Oxygen Regulator - Emergency.
7. Blower hose - Remove from AQD.
8. Oxygen hose - Connect to AQD.
9. Blower hose - Thread thru lower restraint loop.
10. Blower hose - Connect to manifold.
11. Eyes - Close.
12. Crossover valve - Rotate to vertical.
13. Emergency oxygen hose - Connect to manifold.
14. Intercom unit - Disconnect and stow.

COCKPIT INTERIOR CHECK.

1. Loose or foreign objects - Check.
2. Strap-in connections - Check.
   a. Anti-g hose - Connect.
   b. Survival kit - Connect and adjust.

WARNING

Failure to adjust kit straps to achieve snug fit between pilot and kit may result in injury during ejection.

CAUTION

Verify that the "D" ring and buckle are securely connected. Accomplish this by inserting the "D" ring into the buckle until it snaps audibly in place. Then firmly pull on the harness while holding the buckle strap, to insure a proper connection.

   c. Lap belt - Connect and adjust.
   d. Shoulder/parachute straps - Connect.

NOTE

The shoulder/parachute straps shall be pulled from the inertia reel simultaneously. Pulling straps out individually during strap-in may cause the inertia reel to jam.

   e. Aircraft oxygen hose - Connect.
   f. Emergency oxygen hose - Connect.
   g. Communications lead - Connect.
3. Rudder pedals - Adjust.

WARNING

If the rudder pedal adjust handle does not fully retract to the stowed position, the rudder pedals may come loose. This would significantly degrade aircraft control.

LEFT CONSOLE.

1. Armament/ground safety override switch - SAFE (guard down).
2. Utility light - Stowed.
3. IFF antenna - BOTH.
4. SATCOM antenna - As required.
5. EGI HQ TOD switch - As required.
6. CCTVS/DVADR remote control panel (left canopy bow) - OFF.
7. KY-58 - OFF/set.
8. Intercom controls - Set.
9. VHF/FM controls - OFF/set. NON526
10. UHF controls - ON/set.
11. VHF/UHF controls - OFF/set.
12. Radar altimeter - NRM.

13. Emergency flight controls - Set.

    a. Flap emergency retract switch - Unmarked, aft position.

    b. Ensure flight control mode switch - NORM.

    c. Ensure aileron emergency disengage switch - Center position.

    d. Ensure elevator emergency disengage switch - Center position.

    e. Ensure speed brake emergency retract switch - Unmarked, aft position.

    f. Ensure pitch/roll trim override switch - NORM.

14. IFF - OFF/set.

15. HARS/SAS override switch - NORM.

16. Refuel status and indexer light control - Set.

17. NVIS lights switch - OFF.

18. Throttle Master Exterior Light switch - AFT.

19. Throttles - OFF.

20. Flap lever - Set to flap position.

21. Throttle friction control - Set.

22. Speed brake control - Set to center (HOLD) position if speed brakes open; set to closed position if speed brakes are closed.

23. APU switch - OFF.

24. Engine operate switches - NORM.

25. Engine fuel flow switches - NORM.

26. Fuel system controls - Set.

    a. Main boost pump switches (L and R) - MAIN.

    b. Wing boost pump switches (L and R) - WING.

    c. Main fill disable switches (L and R) - Depress.

    d. Wing fill disable switches (L and R) - Depress.

    e. Air refuel control - CLOSE.

    f. Tank gate switch - CLOSE.

    g. Crossfeed switch - OFF.

    h. External tank switches (WING and FUS) - OFF.

    i. Signal amplifier switch - NORM.

27. Emergency brake handle - Push IN (if starting left engine first); pull OUT (if starting right engine first).

INSTRUMENT PANEL.

1. Landing gear handle - DOWN.

2. Landing/taxi light switch - OFF.

3. Armament HUD Control Panel (AHCP) - Set:

    a. MASTER armament - SAFE.

    b. GUN/PAC armament - SAFE.

    c. LASER armament - SAFE.

    d. TGP - OFF.

    e. ALT SCE - As desired.

    f. HUD MODE - As desired.

    g. CICU - OFF.

    h. JTRS - OFF.

    i. IFFCC - OFF.

4. Multifunction Color Display (MFCD) (L/R) - OFF.

5. Standby Attitude Indicator (SAI) - CAGE.

6. Accelerometer - Reset.

7. Fire handles - In.

8. Fire extinguisher discharge switch - Center position.

9. Standby compass - Check.

10. Auxiliary landing gear extension handle - In.

11. Circuit breakers - Check closed.

RIGHT CONSOLE.

1. Electrical power controls - Set.

   a. APU generator switch - OFF/RESET.

   b. Inverter switch - OFF.

   c. AC generator switches - PWR (L and R).

   d. Battery switch - OFF.

   e. Emergency flood light switch - As required.

2. Countermeasures Set Processor (CMSP) Electronic Warfare Management Unit (EWMU):

   a. MODE switch - OFF.

   b. SYSTEM switches - OFF.

3. ILS controls - OFF/set.

4. Avionics Auxiliary Panel (AAP):

   a. CDU switch - OFF.

   b. EGI switch - OFF.

   c. PAGE select rotary knob - OTHER.

   d. STEER PT select rotary knob - MISSION.

5. Oxygen system - Check. (PRICE) Perform PRICE check. NON518

   a. Pressure (P) - Check 55 to 145 psi.

   b. Regulator (R) - Check condition.

      (1) Emergency level - Normal.

      (2) Diluter lever - Normal.

      (3) Supply lever - OFF (unless safety wired ON). Check that you cannot inhale through the oxygen system.

WARNING

If it is possible to inhale through the oxygen system with the supply lever OFF, the regulator is malfunctioning and may not be safe for flight.

      (4) Supply lever - ON. Check for normal breathing.

NOTE

The CRU-73/A diluter-demand regulator will automatically (internally or by switch interlocking) switch from NORMAL OXYGEN to 100% OXYGEN when the SUPPLY lever is shut OFF, blocking airflow as a warning that the regulator is OFF.

   c. Indicator (I) - Check for flow indication (white) on inhalation and no flow indication (black) on exhalation.

   d. Connectors (C) - Check. Check condition and security of connector (10 to 20 pound pull required to separate the aircraft hose from the crew connector).

      (1) Diluter lever - 100%.

      (2) Emergency lever - EMER. Check for leaks. Positive pressure should be supplied to the mask. Hold breath and check for a no flow (black) indication. Leaks will be detected by a flow indication (white) and must be corrected before flight.

CAUTION

- Do not hold the emergency control lever in EMER longer than ten seconds with a leaking mask or with the mask down.

- When placing the emergency lever in either EMER or TEST-MASK, the oxygen mask must be fitted to the face. Continuous delivery of oxygen at a positive pressure with a leaking mask or with the mask removed for extended time periods will deplete the oxygen supply rapidly. This will result in extremely cold oxygen and the possibility of liquid oxygen flowing into the regulator.

   e. Emergency (E) - Check.

      (1) Emergency bottle connections.

      (2) Emergency lever - Hold to test mask and check for positive pressure and leaks at the mask.

NOTE

518 The OBOGS PRICE check cannot be performed until at least 2 minutes after APU start.

6. Environment controls - Set.
   a. Windshield defog/deice switch - OFF.
   b. Canopy defog control - OFF.
   c. Rain removal switch - OFF.
   d. Head switch - OFF.
   e. Bleed air switch - BLEED AIR.
   f. Main air switch - SUPPLY.
   g. Temperature/pressure control - NORM.
   h. Flow level control - As required.
   i. Air conditioner control - OPER AUTO.
   j. Temperature level control - As required.
7. TACAN controls - OFF/set.
8. Lighting controls - Set.
9. Heading Attitude Reference System (HARS) controls - Set.
10. Color Cockpit Television Sensor (CCTVS)/DVADR remote control panel - OFF.
11. DVADR off - Verify PWR indicator off.

PRIOR TO ENGINE START.

Before starting the engine, make sure that danger areas (Figure 2-2) fore and aft of the aircraft are clear. Refer to Section V for starting exhaust gas temperatures.

1. Battery switch - PWR.
2. Inverter switch - STBY.

NOTE

The following caution lights should go out: INST INV, L/R ENG HOT.

3. Engine instruments - Check. ITT indicator reads below 150°C, OFF flag not visible.
4. Fire detect/bleed air leak test button - Depress. Lights in the fire handles and the BLEED AIR LEAK caution lights should come on.
5. Gear lights - Check. (three green, no red)
6. Signal lights - Test.
7. Clock - Set.
8. Fuel quantity - Check.
   a. Test indicator button - Depress. L and R pointers will read 3,000 (±300) pounds, totalizer will read 6,000 (±400) pounds.
   b. Fuel display selector - Verify total by checking in each position and reset to MAIN.

NOTE

Fuel gauge indicator tolerance is ±600 pounds of actual fuel loaded on the aircraft. Regardless of indications given during the fuel quantity indicator test, the fuel quantity indicated by the needles and gauge totalizer may be higher or lower than actual fuel available by ±150 pounds per system L/R Wing and L/R Main.

9. Oxygen quantity - Check. **NON518**
   a. OXY LOW caution light - OFF.
   b. OXY IND TEST button - Depress. (OXY LOW caution light comes on at 0.5 liter.)
10. OBOGS PRESS LOW caution light - Check on. 518

If OBOGS PRESS LOW light is not on:

   a. Regulator gauge - check pressure less than 10 psi.

If pressure greater than 10 psi -

   b. Regulator SUPPLY lever - ON.
   c. Regulator Emergency lever - TEST MASK until pressure on gauge below 10 psi.
   d. OBOGS PRESS LOW caution light - Check on.
   e. Regulator SUPPLY lever - OFF.

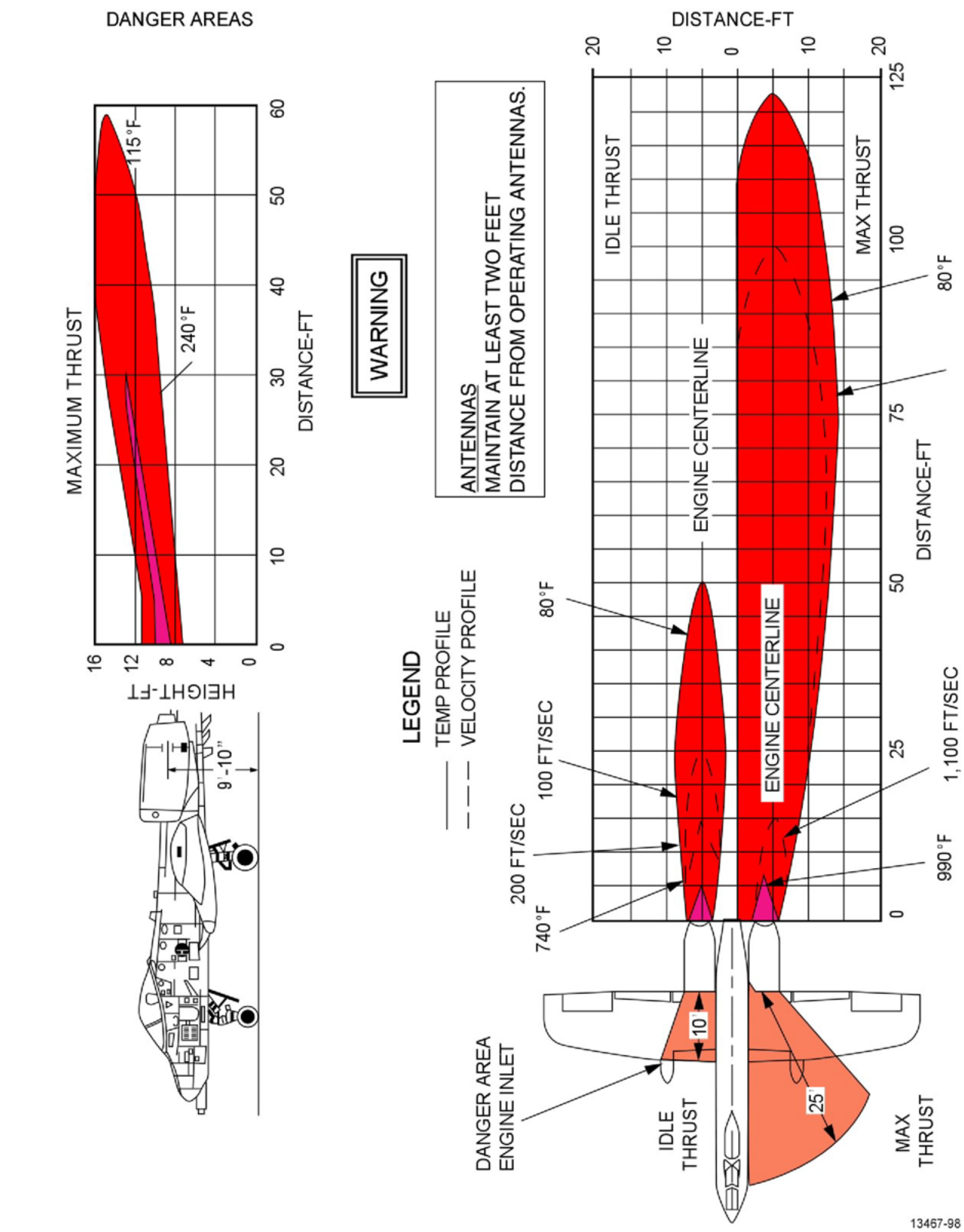


Figure 2-2. Danger Areas

11. APU switch - START (or signal for external air).

WARNING

If external electrical power is required to start APU because of a weak or dead battery, the battery may not recharge enough to start the APU in the event of a dual engine flame-out/dual generator failure.

12. L-FUEL PRESS light - Check off.

NOTE

The L-FUEL PRESS light being off confirms operation of DC fuel boost pump only if AC electrical power is not operating the main and wing fuel boost pumps. If L-FUEL PRESS light is on and the DC FUEL PUMP circuit breaker is closed, abort the aircraft for an inoperative DC fuel boost pump.

13. Auxiliary Power Unit (APU) generator switch - PWR. Confirm APU generator caution light is off. If light remains on, recycle generator switch to OFF/RESET, then to PWR.

CAUTION

The APU generator is the only source of power for electric fan cooling of the APU hydraulic pump. Therefore, do not operate the APU for more than 5 minutes with the APU generator OFF.

NOTE

Having WING and MAIN fuel boost pumps on during extended use of the APU with fuel internal tanks may cause fuel to vent overboard.

14. AAP:

    a. CDU - ON.

    b. EGI - ON.

15. CDU - Set for desired alignment, if necessary, upon completion of CDU startup BIT test.

16. Seat - Adjust.

STARTING ENGINES.

NOTE

- Normal brakes will be available if the left engine is started first. Should the right engine be started first, pull the emergency brake handle.
- If the right engine must be started first, without AC power available, select CROSSFEED to provide positive fuel pressure. Pull out EMER BRAKE handle.

1. Left engine - Start.

   Prior to engine start, it will be necessary to motor the engine if the Interstage Turbine Temperature (ITT) is above 150°C.

NOTE

- An engine being motored by APU should reach 26% to 28% core RPM. Less than 26% to 28% core RPM may indicate an impending APU failure or insufficient power for a proper engine start, leading to a tail pipe fire.
- Motoring engine at a temperature less than 150°C is appropriate if a potential hot start is suspected.
- Starter is capable of motoring engine to approximately 24 - 28% core RPM.

   a. Left throttle - IDLE (ENG START CYCLE light on and core rpm increasing).

   b. Left Engine Operate switch NORMAL (if used for motoring).

CAUTION

Failure to ensure Engine Operate switch is in NORMAL, if used to motor engines during start can result in damage to the starter control valve.

   c. ITT - Check.

      If ITT does not rise within 20 seconds, retard throttle OFF, dry motor engine for 30 seconds, wait 1 minute, and reattempt start.

   d. Oil pressure - Check rising.

   e. Hydraulic pressure - Check full pressure at approximately 40% core rpm.

f. L-GEN light - Check off at approximately 52% core rpm.

g. ENG START CYCLE light - OFF (will close 10 seconds after 56% core rpm).

CAUTION

Failure of ENG START CYCLE light to go off within 30 seconds after 56% core rpm may damage ATS.

2. Engine Operate Switch - NORMAL (If used for motoring).

CAUTION

Failure to ensure Engine Operate Switch is in NORMAL, if used to motor engine during start can result in damage to the Starter Control Valve.

3. Left engine instruments - Check.

a. Idle RPM - Check.

Engine should accelerate to at least minimum idle speed core rpm limits within 60 seconds after ITT RISE (light - OFF). Recheck rpm after 2 minutes stabilization.

CAUTION

- For the idle speed check to be valid, the throttle must be firmly against idle stop until after the check is complete.
- Shut down engine if it does not idle at or above the minimum core rpm limit to reduce the possibility of stage one compressor blade damage.

NOTE

A slow start may occur on the first start of the day due to combustion energy loss from heating a cold engine. If a slow start occurs on the first start of the day, a second start may be attempted. If the second start is not within limits, abort the aircraft.

b. Left engine caution lights - OFF.

4. Flight controls - Check.

Check full travel response and feel of the ailerons, elevators, and left rudder.

5. Right engine - Start.

Repeat Step 1 through Step 4 using right engine controls and indicators.

6. AC generators - Check.

L generator switch - OFF/RESET (L GEN light is on). R generator has load (APU GEN light is on). L generator switch - PWR (L GEN light out).

7. Instrument inverter - Check.

a. Inverter switch - OFF.

Observe that INST INV, L/R ENG HOT and MASTER CAUTION lights come on. The following instruments are not powered: L/R oil pressure, fan speed, ITT, oxygen quantity **NON518**, fuel quantity, on AOA.

b. Inverter switch - TEST and hold.

Observe that INST INV, L/R ENG HOT and MASTER CAUTION lights go off, and the above instruments are powered.

c. Inverter switch - STBY.

BEFORE TAXIING.

1. Oxygen system (OBOGS) - Check. (PRICE) 518 Perform PRICE check at least 2 minutes after APU start.

a. Pressure (P) - Check.

(1) OBOGS PRESS LOW caution light - Off.

(2) Regulator pressure - Check 25 to 40 psi.

b. Regulator (R) - Check.

(1) Emergency Lever - NORMAL.

(2) Diluter Lever - NORMAL.

(3) Supply lever - OFF.

Check that you cannot inhale through the oxygen system.

WARNING

If it is possible to inhale through the oxygen system with the supply lever OFF, the regulator is malfunctioning and may not be safe for flight.

NOTE

The diluter-demand regulator will automatically switch from NORMAL OXYGEN to 100% OXYGEN when the SUPPLY lever is shut OFF, blocking airflow as a warning that the regulator is OFF.

(4) SUPPLY lever - ON.

Check for normal breathing.

c. Indicator (I) - Check flow indications.

White (flow) on inhalation and black (no flow) on exhalation.

d. Connectors (C) - Check.

Check condition and security of aircraft hose and emergency bottle connectors (A 10 to 20 pound pull is required to separate the aircraft hose from the crew connector).

(1) Diluter lever - 100%.

(2) Emergency lever - EMERGENCY.

Check for leaks. Positive pressure should be supplied to the mask. Hold breath and check for a black no flow indication. Leaks will be detected by a white flow indication and must be corrected before flight.

CAUTION

- Do not hold the emergency control lever in EMER longer than ten seconds with a leaking mask or with the mask down.
- When placing the emergency lever in either EMER or TEST-MASK, the oxygen mask must be fitted to the face. Continuous delivery of oxygen at a positive pressure with a leaking mask or with the mask removed for extended time periods will deplete the oxygen supply.

e. Emergency (E) - Check.

(1) Emergency lever - TEST MASK.

Hold to check for positive pressure and leaks at the mask.

(2) Emergency lever - NORMAL.

(3) Diluter lever - NORMAL.

f. OBOGS MON TEST button - Press and release.

Ensure OBOGS FAIL caution and Master Caution lights come on flashing for 10 seconds and then go off.

2. Anti-g suit - TEST.

3. Radios - As required.

4. IFF - STBY.

5. Air refueling door - Check (if required).

CAUTION

Fuel may momentarily vent approximately 3 minutes after either pushing the line check button or cycling the Receiver Control Handle.

6. EXT TKS switch(es) - WING/FUS, pressure check, then OFF (with EXT TKS switch(es) ON, crew chief will check pressure relief valve (if equipped)).

7. Crossfeed - OFF.

8. Emergency brake handle - Full forward.

9. CMSP (EWMU) - Set.

   a. Jettison switch - Aft (off).

   b. Subsystems switches - As required.

10. DVADR function control toggle switch - As required.

NOTE

- To turn on DVADR, place switch in STBY (STANDBY mode), allow one minute for DVADR initialization, then place switch to REC (RECORD mode). Verify REC ON light is illuminated.

- The EOT light does not always go out after an RMM has been inserted into the DVADR. The EOT light should go out 10-15 seconds after the RMM has been inserted. If the light does not go out, turn the DVADR Record switch to "OFF", remove RMM, wait 10 seconds, insert RMM, wait 10-15 seconds, turn the DVADR Record switch to "RECORD".

11. Target Identification Set, Laser (TISL) - CAGE (as required).

12. ILS PWR control knob - PWR.

13. TACAN mode selector switch - T/R.

14. Windshield defog/deice switch - DEFOG/DEICE (if required).

15. Signal lights - Test.

16. Flaps - Cycle.

17. Speed brakes - Check.

    Open speed brakes, and while speed brakes are opening, set the speed brake emergency retract switch to EMER RETR. Speed brakes should stop moving and hold. Move speed brake switch to full close, then full open while checking that speed brakes do not move. Return speed brake emergency retract switch to the unmarked position. Close speed brakes slightly, then to full open. Speed brakes should go from hold to full open (100%). Slight speed brake reversal may occur during this step. With speed brakes open, check aileron movement, check for binding. Move speed brake switch to full close; speed brakes should fully close.

NOTE

Speed brakes may not close simultaneously due to lack of airloads.

18. Flight controls - Check.

    a. Free and correct movement of control surfaces.

    b. Hydraulic pressure - Check.

    c. Manual Reversion Flight Control System (MRFCS) check - If applicable.

19. Stability Augmentation System (SAS) - Check.

    a. Anti-skid switch - ANTI-SKID.

    b. SAS switches - ENGAGE.

NOTE

If the L-R YAW SAS switches do not remain engaged, use the takeoff trim button to center stick and flight controls. Reattempt to engage SAS switches.

    c. Monitor test switch - L (hold). Check all SAS switches disengage.

    d. SAS switches - ENGAGE.

    e. Monitor test switch - R (hold). Check all SAS switches disengage.

NOTE

After each operation of monitor test switch, wait 15 seconds before activating switch in same direction.

    f. SAS switches - ENGAGE.

    g. Emergency disconnect lever - Depress. Check SAS, anti-skid switches - OFF.

    h. SAS switches - ENGAGE.

i. Pitch trim compensator - Check.

Open speed brakes to 40%. Crew chief verifies elevator trailing edge moves down approximately 1 inch. Close speed brakes and note elevator moves up.

20. Trim - Check.

Check travel of pitch, roll and yaw in both directions. Check for positive left/right stop of yaw trim knob. Check emergency trim in pitch and roll.

NOTE

The yaw SAS must be engaged to obtain operation of the yaw trim function.

21. Takeoff trim button - Depress. Check T/O TRIM light comes on.

NOTE

- Yaw trim must be neutral and the pitch/roll trim override switch in NORM before the takeoff trim light will come on.
- The TAKEOFF trim indicator lights with visual confirmation by the crew chief is the only positive check that the elevator tab trim motors are neutrally positioned.

22. Brakes - Check.

Crew chief checks for proper operation.

a. Anti-skid switch - ANTI-SKID.

b. Anti-skid switch - OFF.

23. Slat operation, peak performance tone, and stall warning tone - Check (ensure pitot heat switch - OFF).

Crew chief will actuate the lift transducer until slats extend. Crew chief will check left slat operation while pilot checks right slat operation. Steady peak performance and chopped stall warning tones should be heard in the headset. With the DC SPS circuit breaker pulled, the slats will remain extended.

24. Pitot heat - Check.

25. Control Display Unit (CDU) data - Verify/Enter.

a. Waypoint data - Verify/Enter (if DTC is unavailable).

b. Flight plan data - Verify/Enter (if DTC is unavailable).

c. Wind data - Verify/Enter (if DTC is unavailable).

d. Digital Terrain System Application Software (DTSAS) data - Verify.

WARNING

Ensure that TESTMODE has not been selected on LRUTEST Page and that a test is not in progress. The MSN test may cause rudder movement while the true airspeed is less than 80 knots.

NOTE

If DTSAS DTED files are not loaded to DTC and DTSAS is commanded ON via CDU, a DTSAS fault code may be logged in IFFCC.

After EGI INS alignment is complete:

26. CDU - ALIGN Page - Depress NAV LSK.

27. NAV Mode Select Panel (NMSP) - EGI and STR PT, ANCHR, or TACAN, as desired.

28. NMSP - HARS.

Observe HSI and ADI for proper indications and Head Up Display (HUD) reverts to HARS mode.

29. NMSP - As desired.

30. AHCP IFFCC switch - TEST.

31. AHCP JTRS switch - ON - As required.

32. AHCP CICU switch - ON.

33. MFCD (L/R) - As required.

34. MFCD (LOAD Page displayed) - Load data (as required).

35. MFCD - Select STAT Page - Check/Record/Clear MFLs.

36. TGP SWITCH - ON - As required.

37. IFF - Check. 509

    a. MFCD IFF page - Set MASTER to NORM.

    b. MFCD STAT page - Select IFF and Test.

    c. MFCD IFF page - Set MASTER to STBY.

    After 1-minute warm-up, test each mode. Go condition indicated by the TEST lamp coming on.

38. DVADR remote control panel - STBY.

NOTE

The EOT light does not always go out after an RMM has been inserted into the DVADR; the EOT light should go out 10-15 seconds after the RMM has been inserted. If the EOT light does not go out, turn the DVADR Record switch to "OFF", remove RMM, wait 10 seconds, insert RMM, wait 10-15 seconds, then turn the DVADR Record switch to "RECORD".

39. CMSP - Perform CMS BIT and subsystem BIT.

NOTE

Countermeasures Set (CMS) Electronic Warfare Management System (EWMS) system Built-In Test (BIT) and subsystem BIT and operating procedures are described in TO 1A-10C-34-1-1.

40. CMSP - MODE switch - STBY.

41. Radar warning system - test and set - As required.

42. TACAN - Test.

43. Flight instruments - Check.

    a. ADI - Check movement.

    Pitch trim arrow aligned with reference mark.

    b. HARS - SYNC (if sync indicator indicates it is necessary).

    c. SAI - UNCAGE.

    d. Verticle Velocity Indicator (VVI) - Zero.

    e. Airspeed indicator - Check.

44. Integrated Flight and Fire Control Computer (IFFCC) preflight BIT - Check (3 minutes minimum after starting ENAV alignment).

45. IFFCC - BIT FAULTS - CLEAR.

NOTE

If the IFFCC is started prior to full EGI alignment and selection of NAV mode on the CDU, the following fault codes may be generated: 7222, 7206, 716C, 718B, 7160, 71DE, and 71DF. These codes are due to the lack of 1553 data.

46. SAS - Engage.

47. AHCP IFFCC Switch - ON.

48. Stick Master Mode Control button - As required.

49. Integrated Flight and Fire Control Computer (IFFCC) data - Verify/Enter.

    a. IFFCC Display modes submenu data - Verify/Enter (if DTC is unavailable).

    b. Weapon data - Verify/Enter (if DTC is unavailable).

50. Altimeter - Set/Check.

    Set local barometric pressure setting. Check altimeter agrees within ±75 feet of field elevation in both ELECT (RESET) and PNEU (STBY) modes. The ELECT (RESET) and PNEU (STBY) modes should agree within 75 feet.

51. TISL - Check (if required).

    a. Mode switch - CAGE.

       (Allow 30 seconds for gyro spin-up before depressing BITE switch.)

    b. BITE switch - Depress.

       The DET and ACD lights will come on during the BITE sequence. Equipment failure is indicated if one or both lights remain on longer than 20 seconds.

52. APU generator switch - OFF/RESET (prior to APU shutdown).

53. APU switch - As required.

CAUTION

Allow at least 2 minutes after ENG START CYCLE light goes off, before APU shutdown.

54. Ladder - Stowed.

55. Idle core RPM - Check.

a. Rapidly move throttle from IDLE to MAX, then with hard chop motion back to IDLE (IDLE-MAX-IDLE in 2 seconds or less).

CAUTION

If CIT sensor has failed, stage 1 compressor blades may be damaged if engine is operated above 70% RPM. Aircraft should be aborted.

NOTE

When throttle is moved from IDLE-MAX-IDLE in 2 seconds or less, core RPM will not exceed 70%.

b. Stabilize at IDLE for 10 seconds with throttle against IDLE stop.

c. Check core RPM versus ambient temperature (Minimum Idle Speed Chart, Section V).

If core RPM is below minimum computed:

d. ABORT.

CAUTION

If idle core RPM exceeds 70% or idle core RPM is below computed, aircraft should be aborted as this is an indication of a CIT failure.

56. EAC switch - ENGAGE.

57. Chocks - Removed.

TAXI.

See Figure 2-3 for minimum turning radius and ground clearance.

CAUTION

- Do not adjust rudder pedals during taxi.
- Maximum gross weight for taxiing is 46,000 lb.
- During turns when taxiing near 46,000 lbs. gross weight, reduce taxi speed and widen turn radius to avoid damage to the nose wheel and/or strut assembly. Use approximately five knots or a fast walking pace as a guide for speed during wide turns. If a sharp turn is required, further reduce taxi speed to minimum practical, approximately three knots or normal walking pace.
- Do not TAXI with a fully compressed strut.

1. Nosewheel steering - Engage.

NOTE

Nosewheel steering must be engaged, at least momentarily, prior to each flight to ensure full charge within the damping mode compensator.

2. Throttles - As required.

3. Brakes - Check.

CAUTION

A power interruption to the landing gear control valve can cause simultaneous loss of nosewheel steering and normal brakes. Use the emergency brake system to stop the aircraft. Use extreme caution when taxiing in the vicinity of obstructions.

4. Turn needle - Check.

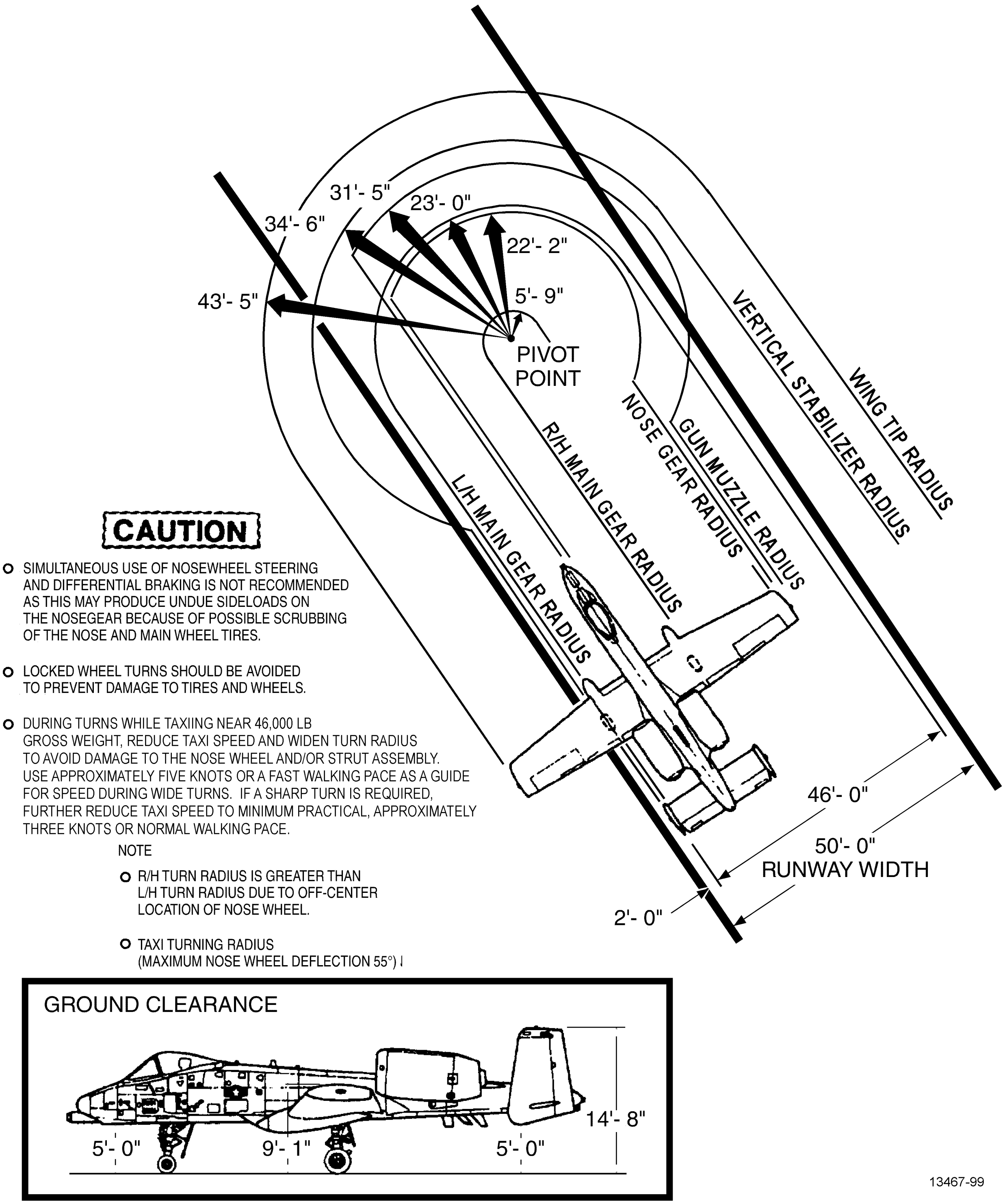


Figure 2-3. Turning Radius and Ground Clearance

BEFORE TAKEOFF.

1. Engine instruments - Check.

CAUTION

- Idle RPM below computed minimum indicates possible CIT sensor failure; abort.
- Stabilized idle ITT above 675°C could indicate a failing outer transition linear; abort.

2. Flaps - Set for takeoff.
3. Speed brakes - CLOSED.
4. IFF - As required.
5. MFCD - Select IFF Page - As required.
6. Takeoff trim - Check.
7. CMS - As required.
8. TACAN - Set.
   a. NMSP - Select EGI and TCN and verify EGI and TCN Δ lights on and all other Δ lights off.
   b. Course selector window - Dial in mag bearing of bearing pointer number 1.
   c. CDI - ±2° of center.
   d. Rotate the course set knob until the CDI is deflected ±10°. Check that the course select window correctly displays the change.
9. NMSP - As desired.
10. Oxygen regulator - As required.
11. Canopy defog control - As required.
12. Windshield defog/deice switch - As required.
13. Harness connections - Check.

    Ensure all buckles, straps, and fittings are secure and properly adjusted.
14. Canopy - Closed and locked (light off).
15. Ejection seat ground safety lever - ARMED.
16. Exterior lights - As required.
17. HUD - Indicated airspeed display.
18. NVGs - Adjust and (if applicable) stow.

LINEUP CHECK.

1. Flight instruments - Check.
2. Anti-skid switch - ANTI-SKID.

CAUTION

At the instant the Anti-skid switch is placed to ANTI-SKID, brake pressure is dumped momentarily (1-2 seconds). Normal braking may not be available during this time. This indicates normal ANTI-SKID operation.

3. Pitot heat switch - PITOT HEAT.
4. APU generator switch - OFF/RESET.
5. APU switch - OFF.
6. Throttles - 90% core rpm.
7. Engine instruments - Check.
8. Warning and caution lights - OFF.

TAKEOFF.

1. Nosewheel steering - As desired.
2. Brakes - Release.
3. Throttles - MAX.

4. Engine instruments - Check.

WARNING

Fan speeds less than the predicted fan speed will result in reduced single-engine rate of climb, and will adversely affect other takeoff parameters. Under critical operating conditions (short runway, high gross weight, high temperature, pressure altitude, etc.), an abort may be the appropriate action if predicted fan speed cannot be achieved.

NOTE

- For rolling takeoffs add 200 feet to takeoff roll. Rolling takeoffs are based on stopping at the end of the runway and releasing brakes as the throttles are advanced to takeoff power.
- Fan speed should be checked after approximately 1,000 feet on takeoff roll.
- During high pressure altitude or high gross weight operations, the minimum fan speed required for single-engine rate of climb may exceed 3% below prediction fan speed. Under these conditions, if the minimum fan speed required for single-engine rate of climb cannot be obtained, the takeoff should be aborted.
- During takeoff, maintain directional control using nosewheel steering until the flight controls become effective. At approximately 10 knots below computed takeoff speed, apply back pressure to the stick to begin establishing a takeoff attitude by increasing the pitch attitude to 10°.

WARNING

For proper clearance, when carrying external fuel tanks, assure all gear are in ground contact, when crossing the arresting gear cables.

CROSSWIND TAKEOFF.

Crosswind produces a tendency to weather-vane (turn into the wind), and will tend to raise the upwind wing. Slight aileron into the wind will keep wings level, and moderate rudder inputs will be required to maintain track on runway centerline. The normal takeoff procedure should be used, except that the nosewheel steering should be left engaged to 70 Knots Indicated Airspeed (KIAS) for crosswind components in excess of 20 knots. If the nosewheel steering is left engaged higher than 70 KIAS, the transient with nosewheel steering disengagement will be more severe but easily controllable. After nosewheel steering disengagement, rudder pedal force will be fairly high to maintain track on the runway. During rotation, rudder input should be slowly blended out to establish proper crab angle into the wind, so that when the aircraft becomes airborne, the flight path will be aligned with runway centerline.

AFTER TAKEOFF.

1. Landing Gear - UP. (When safely airborne)
2. Flaps - UP. (10 Knots above takeoff speed)
3. Pitch attitude - Maintain as necessary to accelerate to climb speed.

NOTE

- To ensure proper cabin pressurization/oxygen system operation, cabin pressure/oxygen should be checked passing approximately 13,000 feet MSL.
- If the light in the landing gear handle flashes and/or the warning horn sounds as the landing gear reaches the full up position, this may indicate impending gear up-lock switch failure.

FLIGHT.

There is no requirement to refer to the checklist during normal flight in the A-10. During climbout, after level off and at frequent intervals, engine instruments should be checked, as well as fuel, cabin pressurization, and oxygen status.

NOTE

To ensure proper cabin pressurization/oxygen system operation, cabin pressure/oxygen should be checked passing approximately 13,000 feet MSL.

The correct altimeter setting should be used for each phase of the flight. The canopy defog and rain removal systems should be used as required to ensure visibility out of the aircraft.

WARNING

- During low altitude maneuvering, closely monitor the aircraft's flight path and attitude to prevent development of a hazardous flight path from which recovery is impossible.

- Do not exceed stall Angle of Attack (AOA). As AOA is increased above stall:

CAUTION

Prior to descent, canopy and windshield should be preheated using canopy defog and windshield DEFOG/DEICE to minimize fogging.

NOTE

- The canopy provides unrestricted visibility to the sides and overhead. However, windshield front panel frame, HUD combining glass frame, and attached equipment cause blind spots which degrade visual lookout and flight path deconfliction.

- Also, visual cues to changes in flight path are degraded when the canopy bow/sloping rail are not included in the field of view. This situation may readily occur during high bank angle maneuvering. Subtle undetected changes in flight path vector generally will not present a problem unless the aircraft is operating in a low altitude environment.

1. Engine stall susceptibility is greatly increased.

2. Aircraft drag is dramatically increased.

3. Aileron effectiveness is significantly decreased, especially when sideslip is present.

WARNING

If a stall is entered, relax aft stick to break the stall prior to attempting large roll inputs. Large aileron inputs beyond stall AOA will create sideslip, which increases engine stall susceptibility, and greatly reduces aileron effectiveness.

DESCENT/BEFORE LANDING.

CAUTION

Prior to descent, canopy and windshield should be preheated using canopy defog and windshield DEFOG/DEICE to minimize fogging.

1. Altimeter - Check.

2. EGI/HARS - Compare.

   If a disparity exists between the HARS attitude and/or heading and EGI attitude and/or heading, the disparity should be corrected prior to entering instrument conditions. If the disparity cannot be corrected, select the most accurate/reliable system.

WARNING

If the HARS has processed significantly and the EGI subsequently fails - uncommanded yaw inputs and/or unreliable attitude reference may cause extreme spatial disorientation.

3. Canopy defog control - As required.

4. Windshield DEFOG/DEICE - As required.

5. Speed brakes - As required.

6. Anti-skid switch - ANTI-SKID.

7. NVIS lights switch - As required.

8. Landing lights - As required.

9. Fuel quantity - Check.

10. HUD - Indicated airspeed.

11. NVGs - Remove and stow (as required).

INSTRUMENT APPROACHES.

TACAN APPROACH.

A typical TACAN approach is outlined in Figure 2-4.

INSTRUMENT LANDING SYSTEM (ILS) APPROACH.

A typical ILS approach is outlined in Figure 2-5.

WARNING

It is essential that raw ILS data be monitored at all times during an ILS approach. Disagreement between raw data and command (computed) steering must be taken as an indication that the command steering indications are unreliable, even with all warning flags out of view, and if the approach is continued, use only raw data. Raw data is indicated on the CDI on the HSI, and on the GSI on the ADI. Command steering is given on the bank steering and pitch steering in bars on the ADI.

RADAR APPROACH.

A typical radar approach is outlined in Figure 2-6.

STRAIGHT-IN APPROACH.

Establish a final approach configuration and airspeed and descent as required to reach a point 1 mile from the desired touchdown point at 300 feet above the ground. CAP final approach from this point is the same as for a normal pattern.

CIRCLING APPROACH.

A circling approach is accomplished using final turn airspeed with landing gear down, full flaps, and speed brakes 40%. For final turn airspeed at 30,000 lbs total aircraft weight, use 145 KIAS plus 2 knots per additional 1000 pounds of fuel. Circling approach is flown at a lower altitude than Visual Flight Rules (VFR) patterns; therefore, the perception of the runway at this lower altitude may cause the aircraft to be too close to the runway for a safe approach. Allow sufficient room for the larger turn radius required. Once established on final, slow to final approach airspeed. For final approach airspeed at 30,000 lbs total aircraft weight, use 130 KIAS plus 2 knots per additional 1000 lbs of fuel for full flaps. For exact approach speeds, see TO 1A-10C-1-1.

BEFORE LANDING.

Refer to Section V for landing gross weight; e.g., and crosswind limitations. Determine minimum final turn/base leg and final approach speed based on intended configuration, gross weight, and crosswind/gust conditions. See Figure 2-4 through Figure 2-7 for pattern and approach airspeeds. After configuring, check cockpit indicators to ensure intended configuration and check that the anti-skid and landing light are on. Ensure rudder pedal carriages are locked.

In the final turn and on final approach, fly on-speed AOA, but no slower than computed airspeed. This will provide a safeguard against a malfunction in either the AOA system or airspeed indicator. An excessive discrepancy between computed airspeed and AOA indication indicates that the flaps are not in the intended position.

WARNING

- Total reliance on either the AOA system or airspeed computation may result in a reduced stall margin.
- Sideslip will cause erroneous AOA indications and the stick shaker will not provide accurate stall warning.
- Engine acceleration from IDLE to MAX thrust requires approximately 10 seconds. This delay should be anticipated when planning thrust requirements in the landing pattern.

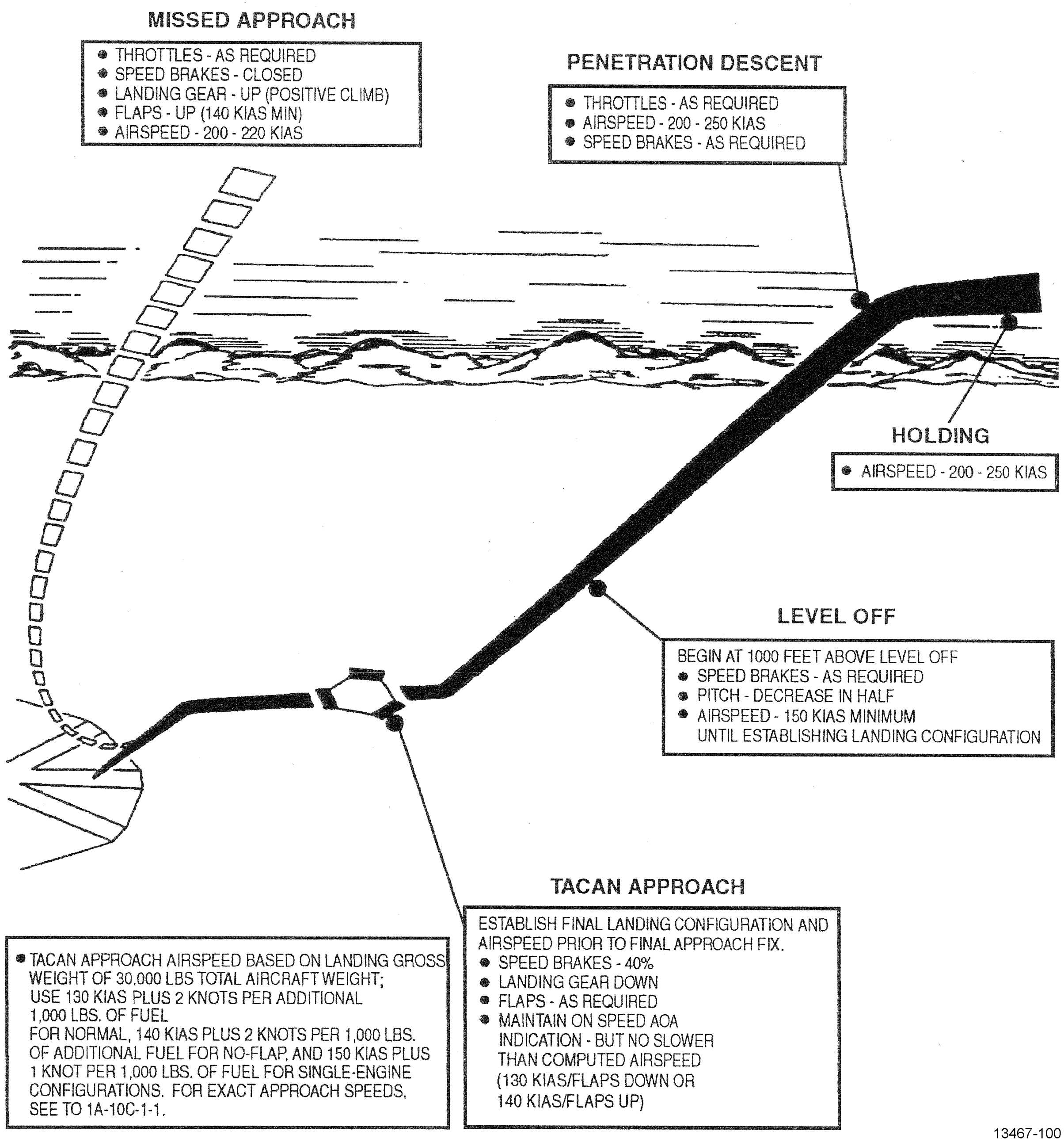


Figure 2-4. TACAN Penetration and Approach - Typical

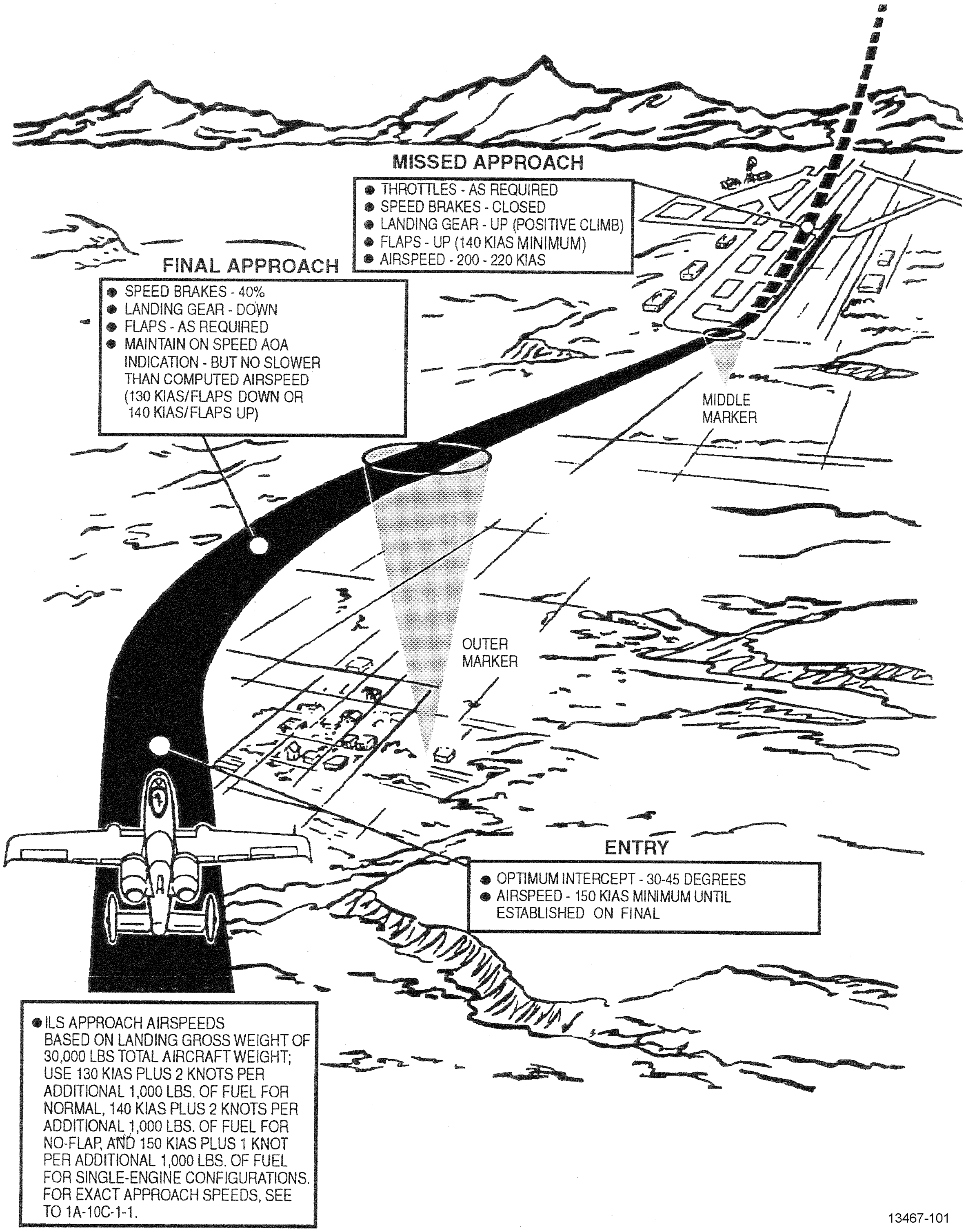


Figure 2-5.   Typical ILS Approach

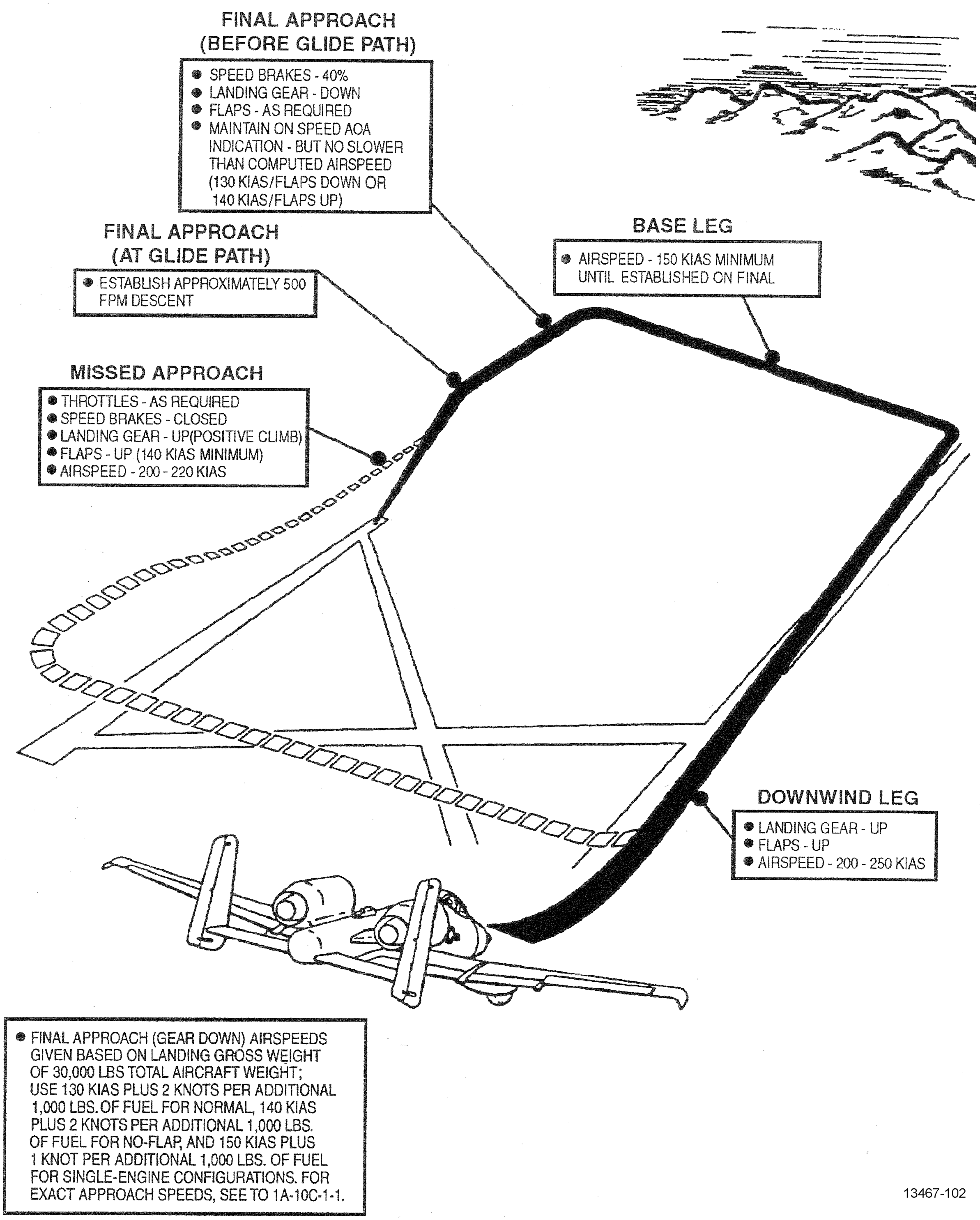


Figure 2-6. Typical Radar Approach - GCA

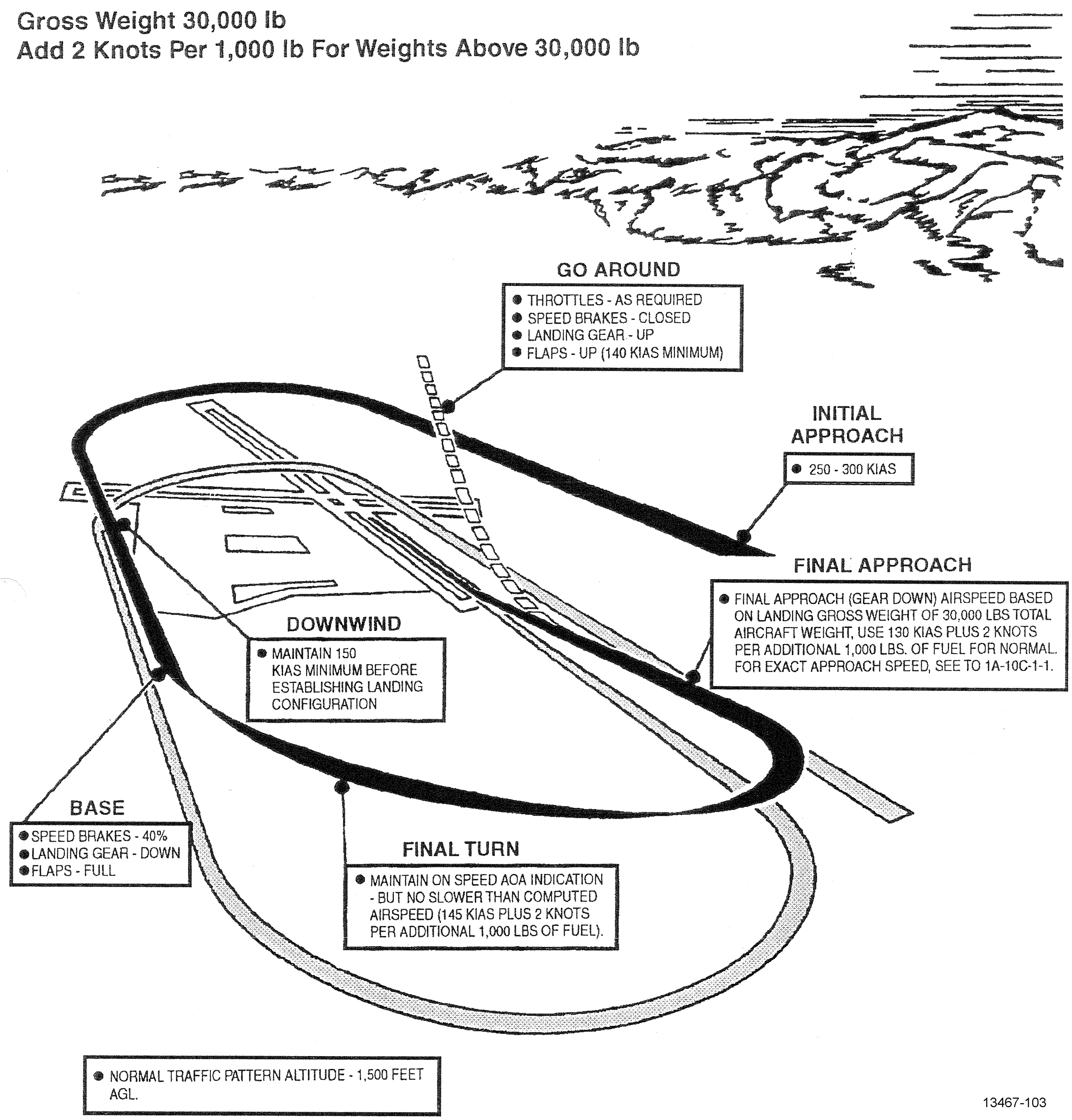


Figure 2-7. Typical Overhead Landing Pattern

LANDING.

At extreme forward cg's, near maximum aft stick is required for landing at the nominal flight manual speeds. Also at forward cg's, the aircraft will respond less to pitch inputs and stick forces will be higher than at mid cg loadings. At extreme aft cg conditions, the aircraft will respond more to pitch inputs and stick forces will be lighter than at mid cg loadings.

CAUTION

- If an unusually high attitude exists upon touchdown, the tail of the aircraft may contact the landing surface. Incorrect flap position, fuel imbalance, heavy weight conditions, too slow final approach airspeed, high sink rates and excessive flare will aggravate this condition but are not sufficient for damage to occur.

- Plan final approach to avoid touching down on arresting gear cables.

When landing is assured, retard throttle slowly to IDLE. Touchdown speed for normal landing is 10 knots less than final approach airspeed. Landing distances are given in TO 1A-10C-1-1.

CAUTION

For proper clearance, when carrying fuel tanks, plan touchdown to assure that all gear are in ground contact when crossing an arresting gear cable.

LANDING IN GUSTS.

Landing in gusts procedure is the same as for normal landing, except add one half of gust factor to final approach and touchdown speeds. The gust factor is the difference between the average wind and gust wind speeds. If the average wind is 20 knots with gusts to 30 knots, the gust factor would be 10 knots; add 5 knots to the final approach and touchdown speeds.

MINIMUM RUN LANDING.

For a minimum run landing, the final approach speed (gear and flaps down and speed brakes 40%) should be reduced by 10 knots from the on-speed AOA indication or computed minimum, whichever is faster. The airspeed indicator should be used to fly a minimum run landing since the AOA indexer may indicate slow "\ /" only, and will not provide sufficient guidance for a safe approach. Power should be sufficient to maintain the final approach speed and sink rate until touchdown. Select speed brakes 100% immediately after touchdown. If maximum performance braking is required, immediately achieve a three point attitude, place the throttles to idle, and apply wheel brakes with a firm continuous force, sufficient to feel anti-skid cycling.

CAUTION

- Do not exceed sink rate limitations in Section V.

- The 10-knot lower approach speed results in an increase in AOA which, for the same flight path angle (rate of sink) as a normal approach, results in the aircraft being closer to the tail scrape angle. Attempting to flare before touchdown will increase the likelihood of tail scrape, particularly with aft cg loadings.

- A minimum run landing may require near maximum elevator deflection due to lower airspeed.

- Maximum performance braking may cause hot brakes, depending on aircraft speed and gross weight. If hot brakes are suspected, park aircraft in uncongested area until cooling is accomplished. (See Figure 5-3 for wheel brake energy limits.)

- Minimum run landing practice is prohibited when aircraft is configured with AGM/TGM-65 missiles mounted on bottom rail of LAU-88A/A launchers. Restriction is pending determination of an improved missile restraint.

CROSSWIND LANDING.

Normal landing procedures should be used in addition to the following techniques. The recommended final approach technique is to establish a combination of crab into the wind and wing low. A full crab final approach will lessen workload on the rudder pedals but will degrade runway visibility for high crosswind components. Prior to flare, rudder input should be gradually increased to align the fuselage with the runway and bank angle increased into the wind to maintain flight path towards the runway. Care should be exercised to maintain track down runway centerline. Touching down in a slight crab is acceptable, provided that a positive rudder correction is made to align the fuselage with the runway after touchdown. The aircraft track may diverge into the wind if a crab angle is maintained after touchdown. Crab angle at touchdown should be limited to 10° (runway visible through center windscreen) to prevent excessive gear loads.

After touchdown, the cross wind produces a tendency to weathervane (turn into the wind), and must be corrected with rudder. Extending the speed brakes to 100% after nose gear lowering will cause the nose of the aircraft to cock slightly into the wind, and can be easily corrected with rudder. Maintain directional control by use of rudder, nosewheel steering and differential braking as necessary. Nosewheel steering engagement will produce a transient dependent on the amount of rudder deflection. Severe transients can be avoided by momentarily neutralizing rudders prior to nosewheel steering engagement, and using nosewheel steering only as rudder effectiveness becomes degraded below 70 KIAS.

Refer to the table in Section V for cross wind component limitations. The effect of adding external stores is to destabilize the aircraft directionally, particularly in the flaps-up configuration, resulting in lower crosswind components limits.

For crosswind components above 20 knots, high sideslip angles are required to align the fuselage with the runway, and produce a significant error in airspeed and AOA indications.

CAUTION

For crosswind components in excess of 20 knots, add 10 knots to recommended final approach and landing speeds (except single-engine approach speed) to compensate for airspeed indicator errors at high sideslip angles. The AOA system is unreliable at high sideslip angles and should not be used as a reference to final approach speed.

NOTE

- The use of large aileron deflections after touchdown is not required because of the wide track of the main gear.
- Workload increases with SAS off and large wind gust velocities.
- The aircraft characteristics while carrying external fuel tank(s) also result in a further increased workload.
- The SAS will counter attempt to kick out crab angle with rapid rudder movement. SAS effects can be minimized by using gradual rudder inputs to align fuselage with the runway.

TOUCH AND GO.

After touchdown, smoothly advance both throttles and retract the speed brakes. The nosewheel may or may not contact the runway, depending on aircraft speed.

Close attention to directional control is required after touchdown, due to possible uneven engine acceleration and crosswinds. The rotation attitude for takeoff should be similar to a normal takeoff. Landing and takeoff speed should be computed prior to landing.

MISSED APPROACH.

Should conditions dictate the execution of a missed approach, set throttles as required, close speed brakes, raise gear and flaps, and establish an instrument takeoff attitude. If subsequent instrument approaches are to be flown, set power to maintain 200 to 220 KIAS and a rate of climb not less than 1,000 feet/minute. When the desired missed approach altitude is reached, level off and maintain 200 to 250 KIAS.

AFTER LANDING.

Maintain directional control using aileron and rudder as long as they remain effective, then transition to differential braking. Delay nosewheel steering until slowing to a normal taxi speed unless required to maintain directional control. If available runway does not require maximum braking, speed can be reduced by aerodynamic braking or by extending speed brakes. Following aerodynamic braking, smoothly lower the nose to the runway prior to loss of elevator effectiveness. When the nosewheel touches down, do not attempt to raise it again. Speed brake effectiveness decreases rapidly with airspeed reduction.

CAUTION

Brake heating is a function of aircraft configuration, groundspeed when brakes are applied, gross weight, ambient temperature, and pressure altitude. Operations within the danger and caution zones shown on the Wheel Brake Energy Limits Chart (Figure 5-3) should be avoided when possible. If anti-skid is not used, be alert to tire skidding and release brake pedal pressure, as necessary.

After touchdown:

1. Throttles - As required.
2. Speed brakes - As required.
3. Wheel brakes - As required.
4. Nosewheel steering - As required.

WARNING

Nosewheel steering malfunctions at any speed may cause an abrupt turn tire skidding or blowout, aircraft tipping, and/or departure from prepared runway surface.

CAUTION

- Minimize taxi with a suspected compressed strut.
- Nosewheel steering malfunctions at any speed may cause an abrupt turn tire skidding or blowout, aircraft tipping, and/or departure from prepared runway surface.
- Rubber deposits and paint on last 2,000 feet of a wet runway make directional control/hydroplaning a problem even at very low speeds. Start braking early so only minimal braking is required on last part of runway. Maintain runway centerline until slowed to taxi speed. Turning on slippery runway can cause rotational skids; almost stop before attempting to turn.

NOTE

- During anti-skid maximum braking with speed brakes extended, speed brakes may start an oscillatory motion that is self-sustaining. The resulting aircraft vibration can be felt. Maintain braking as required and stop the oscillations by moving the control stick hard over to left or right after speed is reduced to a point where full aileron inputs will not create a directional problem or by closing the speed brakes after a safe stopping distance is assured.
- With weight on wheels, and when the airspeed decreases below 75 knots, a download of data to the DTC is automatically initiated.
- This download causes the waypoints, flight plans, and present position to be downloaded; approximately 30 seconds later, the CDU calculates the Radial Error Rate (RER) and Cumulative Error Probable (CEP) (displayed steerpoint will change to next available mission waypoint number or overwrite MS 50 position with steerpoint identifier of RERCALC) if the EGI GPS EHE is less than 300 feet; the EGI GPS is placed in the INIT mode and the INIT mode and the GPS almanac is downloaded; and the EGI GPS is placed in the NAV mode and then a maintenance log is written which causes a warm start of the CDU. When a warm start of the CDU occurs, this display will go blank for several seconds, then the page that was displayed prior to the warm start will be redisplayed, and the WARM START annunciation will be displayed on CDU for 10 seconds or until the FA pushbutton is depressed. Download of data other than Almanacs, BIT data, and IFFCC maintenance will be performed automatically on the ground after touchdown.

NOTE

- When auto-download of system data is initiated and a CDU warm start occurs (aircraft landing and airspeed falls below 75 knots), automatic disengagement of the IFFCC EAC switch (if engaged) may occur. This is normal system operation.

After clearing runway:

CAUTION

Do not taxi with a confirmed fully compressed strut.

5. Anti-skid switch - OFF.
6. Ejection seat ground safety lever - SAFE.
7. Canopy - As desired.
8. CCTVS/DVADR remote control panel - OFF.
9. TACAN/ILS equipment - OFF.
10. IFF - code switch - HOLD (momentarily) and MFCD - Select IFF Page - Set MASTER to STBY.
11. IFFCC BIT fault display - Record.
12. MFCD - Select STAT Page - Check/record MFLs.
13. HUD night/day filter - DAY.

CAUTION

Failure to place the night/day filter to DAY prior to engine shutdown may cause damage to the night filter due to prolonged exposure to sunlight.

14. Landing/taxi lights - As required.
15. CMSP MODE switch - STBY.
16. Record fault record from ERROR CATALOG.
17. CMSP system switches - OFF.
18. CMSP - OFF.
19. Windshield DEFOG/DEICE - OFF.
20. Pitot heat - OFF.
21. Position lights - Bright/Flash.
22. Anti-collision lights - OFF.
23. Flaps - As required.

ENGINE SHUTDOWN.

1. Brakes - Hold, until chocks are installed.
2. IFF - OFF.
3. SAI - CAGE.
4. AHCP - Set:
   a. MASTER armament - SAFE.
   b. GUN/PAC armament - SAFE.
   c. LASER armament - SAFE.
   d. TGP - OFF.
   e. ALT SCE - As desired.
   f. HUD MODE - As desired.
   g. CICU - OFF.
   h. JTRS - OFF.
   i. IFFCC - OFF.
5. MFCD (L/R) - OFF.
6. CDU - If DOWNLOAD COMPLETE annunciation was not displayed or DTS FAIL or DOWNLOAD FAILED annunciation was displayed, attempt manual download using DTSDNLD Page and depressing ALL LSK, if desired; or write maintenance log using CDU MXLOG Page and depressing WRITE LOG LSK.
7. CDU - Depress any CDU key, pushbutton, or switch three times. (This is to ensure that RER and CEP, if calculated, is downloaded to the DTC.)

8. AAP:

    a. EGI - OFF.

    b. CDU - OFF.

9. TISL - OFF.

10. Seat - Full up.

NOTE

All personnel should be clear of aircraft prior to engine shutdown.

11. Left throttle - OFF after 5 minutes at IDLE. Taxi time may be included if core rpm does not exceed 80%.

    Hold throttle against aft OFF stop until it can be confirmed that engine fuel has drained or engine rpm reaches 5% core rpm and ITT has decreased below 200°C. ITT should not increase past 540°C during heat soakback.

CAUTION

- Do not shut down the left engine if the APU is running, except in an emergency. The temperature of the APU exhaust gases is high enough to ignite the unused fuel being vented out of the left engine when it is shut down.

- If left engine is to be motored by using crossbleed air from right engine, normal brakes will not be available. Emergency brake handle should be pulled prior to advancing right throttle.

NOTE

Shut down left engine first so that if motoring should be required, the right engine can be used to motor the left engine.

12. Flight Controls.

    After left hydraulic pressure bleedoff, check full travel response and feel of the ailerons, elevators, and right rudder.

13. Right throttle - OFF.

    Hold throttle against aft OFF stop until it can be confirmed that engine fuel has drained or engine rpm reaches 5% core rpm and ITT has decreased below 200°C. ITT should not increase past 540°C during heat soakback.

CAUTION

- Right engine should not be shut down until left engine fuel has drained or left engine core rpm is below 5% and ITT has decreased below 200°C.

- If a rapid shutdown on the ground is necessary, the engine should be motored as soon as possible using APU, an operating engine if applicable, or external air. This action will prevent freeze-up due to uneven cooling.

14. Inverter switch - OFF.

15. Battery switch - OFF.

16. Communications equipment - OFF.

17. Oxygen regulator (OBOGS) - Set: 518

    a. Diluter lever - 100%.

    b. Emergency lever - Hold to TEST MASK until pressure on gauge drops below 10 psi.

    c. Emergency lever - NORMAL.

    d. SUPPLY lever - OFF.

BEFORE LEAVING THE AIRPLANE.

1. Canopy control switch - HOLD.

CAUTION

Exercise extreme care when releasing lap belt and oxygen connections and laying them across the console to prevent damage to glass faceplates and control knobs on control panels.

2. Stow CRU-60 on bracket.

3. Boarding ladder - As required.

WARNING

Ensure no ground personnel are in proximity to door and ladder before extending.

CAUTION

Do not hold boarding ladder switch depressed for more than 4 seconds, as the latch relay may be damaged.

4. Emergency flood lights switch - OFF.

5. DTS - If DTC inserted:

   a. Unlatch and open UDTU enclosure door.

   b. Unlock and remove DTC from UDTU.

   c. Close and latch UDTU enclosure door.

6. DVADR RMMD - Remove. 148

   To remove the RMMD:

   a. Open the RMMD access door by pressing the "PUSH TO OPEN" latch, then flip open the door.

   b. Push red "PUSH TO EJECT" lever to remove the RMMD.

   c. Close and latch the access door.

7. Turbine Engine Monitoring System (TEMS) Status - Check.

AIRCREW EYE/RESPIRATORY PROTECTION (AERP) EGRESS.

1. Seat - Safe.

2. Attachments - Release:

   a. Shoulder harness

   b. Lap belt

   c. Survival kit straps

3. Emergency oxygen hose - Disconnect.

4. Blower hose - Disconnect; disconnect from all straps.

5. Oxygen hose - Disconnect and stow (CRU/60).

6. Blower hose - Connect to AQD.

7. Crossover valve - Rotate to horizontal.

8. Anti-G hose - Disconnect.

9. Comm cord - Disconnect.

10. Intercom unit - Connect.

11. Blower electrical connection - Disconnect: install dust cover.

12. Blower - Remove from bracket.

13. Blower strap assembly - Reconnect.

14. Exit aircraft.

ALERT/COCKING.

Perform the following prior to assuming alert status:

1. BEFORE EXTERIOR INSPECTION - Complete.

2. EXTERIOR INSPECTION - Complete.

3. Interior Inspections - Complete.

4. PRIOR TO ENGINE START - Complete.

5. STARTING ENGINES - Complete.

6. BEFORE TAXIING - Complete. (Do not select NAV on CDU INS Page if engines and APU are to be shut down.)

If engines and APU are to be shut down:

7. IFF Code switch - HOLD (momentarily).

8. When EGI INS alignment is complete (as indicated by a flashing INS NAV READY annunciation on CDU), on AAP:

   a. EGI switch - OFF.

   b. CDU switch - OFF.

9. Standby attitude indicator - CAGE.

10. IFF - OFF (15 seconds minimum after IFF code switch hold).

11. ECM, RWR - OFF.

12. AHCP IFFCC switch - OFF.

13. AHCP JTRS - OFF.

14. AHCP CICU switch - OFF.

15. MFCD (L/R) - OFF

16. APU GEN and APU - OFF.

17. Engines - Shut down.

If assuming out of cockpit alert status:

18. Battery switch - OFF.

NOTE

- If the above actions have not been completed prior to scramble, normal procedures should be used.
- The pilot and aircraft are placed on alert status IAW local policies and directives (i.e., with the pilot out of the cockpit, in the cockpit, in the cockpit with the APU running, and/or in the cockpit with the engines running).

SCRAMBLE (BEFORE TAXIING).

1. Strap-in connections - Check.

2. Battery switch - PWR (ensure inverter operation).

3. APU switch - START.

4. APU generator switch - PWR.

5. AAP:

   a. CDU - ON.

   b. EGI - ON.

   c. PAGE - OTHER.

   d. STEER PT - As desired.

6. Engines - Start.

7. CDU - Align.

If aircraft has not been cocked:

8. CDU - ALIGN Page or ALTALIGN Page - Select desired alignment mode (GROUND, INFLT, or FAST (BATH)).

NOTE

If time does not permit a GROUND alignment (approximately 4 minutes), it is recommended that INFLT alignment be selected.

If aircraft has been cocked:

9. CDU - ALTALGN Page - Depress FAST line select key within 30 seconds after completion of CDU startup BIT test. Observe asterisk is displayed next to FAST.

NOTE

Do not enter magnetic heading or initial position. Entering magnetic heading and/or initial position will initiate a BATH alignment.

   a. CDU - ALTALIGN Page - When a flashing INS NAV RDY annunciation is present, depress NAV LSK on CDU ALTALIGN Page (or more aircraft to automatically transition to the NAV mode). Observe asterisk appears next to NAV.

10. NMSP - As required.

11. AHCP IFFCC switch - ON.

12. AHCP JTRS switch - ON As required.

13. AHCP CICU switch - ON.

14. MFCD (L/R) - As required.

15. TGP - ON.

16. Strobe lights - As required.

17. Altimeter/HUD - Set.

SCRAMBLE (BEFORE TAKEOFF).

1. Flaps - Recheck and set for takeoff.
2. Speed brakes - CLOSED.
3. IFF - As required.
4. MFCD - Select IFF Page - As required.
5. SAS/Trim - ENGAGE/Check takeoff trim.
6. SAI - UNCAGE.
7. NMSP - As required.
8. Canopy - Closed and locked (light off).
9. Ejection seat ground safety lever - ARMED.
10. Pitot heat switch - PITOT HEAT.
11. Exterior lights - As required.
12. Anti-skid switch - ANTI-SKID.
13. APU generator or APU - As required.
14. Warning and caution lights - OFF.

HOT REFUELING.

De-arming will be accomplished prior to entering the hot refueling pit. If suspected hot brakes or other unsafe conditions exist, do not enter the refueling area. Follow ground crew directions into the refueling area and establish intercom with the ground crew. If any malfunction is suspected, stop refueling.

Hot refueling will not be conducted with any hung ordnance. External stores and the GAU-8 must be pinned and weapon switches OFF/SAFE. Hot refueling will not be conducted if any problems with in-flight air refueling, fuel transfer or fuel venting have occurred. In the refueling area, minimum power will be used for taxi and canopy repositioning are prohibited except in an emergency.

PRIOR TO HOT PIT ENTRY.

1. AFTER LANDING - Complete.
2. De-arming - Complete (if required).
3. APU generator or APU - OFF.
4. TGP - OFF.

PRIOR TO REFUELING.

1. Canopy - As desired.

NOTE

Canopy position is a pilot option. A closed canopy may provide fire protection; however, ground egress time will be increased and high ambient temperature may preclude this option. If an ejection capability is desired, canopy must be down and locked and pilot completely strapped in.

2. Strap-in connections - As desired (leave oxygen and communications leads connected).

NOTE

Emergency ground egress time can be saved by disconnecting lap belt, shoulder harness, and survival kit attachments before refueling.

3. Fuel display selector - MAIN.

4. Brake and tire inspection - Complete.

5. Intercom with refueling supervisor - Establish.

6. Tank gate switch - Closed. Verify with refueling supervisor.

7. Fuel system operation - Verify with refueling supervisor.

DURING REFUELING.

1. Monitor intercom and appropriate emergency response frequency.

NOTE

Terminate refueling with a visual signal if intercom is lost.

2. Hands - In sight of ground crew.

WARNING

In the event of a fire or fuel leak in the immediate vicinity of the aircraft while connected to the hydrant, shut down and ground egress. If a fire occurs outside the immediate vicinity of the aircraft, terminate refueling and taxi and clear as directed by the ground crew.

AFTER REFUELING.

1. Fuel quantity - Check.

2. Strap-in connections - As required.

3. Taxi clear of refueling area and configure aircraft as required by mission plan.

FORWARD AREA REFUELING PROCEDURES (FARP).

Forward area refueling is a specific set of refueling procedures accomplished in austere locations. Normally, fuel is provided by another aircraft and personnel specifically trained for FARP operations. Operational requirements dictate that a number of items normally accomplished in hot refueling will not be accomplished. Compliance with the procedures, FARP survey instructions, and mission specific instructions is imperative to ensure safety.

CAUTION

- If any unsafe conditions exist, do not enter the refueling area.
- Forward area refueling will not be conducted with any hung ordnance.
- Do not conduct hot refueling if any problems with in-flight refueling, fuel transfer, or fuel venting have occurred.
- Use minimum power in the refueling area.
- Canopy reposition during refueling is prohibited except in an emergency.

PRIOR TO FARP ENTRY.

1. AFTER LANDING - Complete.

2. APU generator switch - OFF/RESET (prior to APU shutdown).

3. APU switch - OFF.

4. Armament HUD control panel - Set:

   a. MASTER armament switch - SAFE.

   b. GUN/PAC switch - SAFE.

   c. LASER armament switch - SAFE.

   d. TGP - OFF.

5. Digital Stores Management System - Set:

   a. Weapons Status Page - DESELECT all stations.

   b. Missile Page - EO PWR - OFF.

6. Armament/ground safety override switch - SAFE (guard down).

7. AHCP - LASER armament switch - OFF.

8. MFCD - DSMS Weapon Status Page - DESELECT all applicable stations.

9. Armament/ground safety override switch - SAFE (guard down).

PRIOR TO REFUELING.

1. Fuel Display selector - MAIN.

2. Tank gate switch - Closed.

3. Communications frequency - Set.

4. Canopy - As required.

DURING REFUELING.

1. Monitor communications frequency and refueling personnel.

2. Hands - In sight of ground crew.

WARNING

In the event of a fire in the immediate vicinity of the aircraft while connected to refueling hose, shut down and ground egress. If a fire or fuel leak occurs outside the immediate vicinity of the aircraft, terminate refueling, taxi, and clear the area as directed by the FARP survey.

AFTER REFUELING.

1. Fuel quantity - Check.

2. Taxi clear of refueling area and configure aircraft as required by mission plan.

MRFCS GROUND CHECK.

(Performed when intentional transition into MRFCS is expected.)

1. Emergency brake handle - Pull out.

CAUTION

Ensure that wheel chocks are in place, since wheel brakes will not be available if the accumulator depletes or malfunctions.

2. Trim ailerons full left or right.

3. Flight controls - MAN REVERSION.

   a. L and R AIL TAB Lights - ON.

   b. L and R HYD PRESS Lights - ON.

   c. L and R hydraulic pressure below 100 psi (corrected for gauge error) within 10 seconds.

4. Elevators - Check for full stick travel, with higher than normal stick force required, while crew chief verifies elevator movement.

5. Rudders - Move one pedal forward, with higher than normal force required, while crew chief verifies rudder movement. When released, pedal should return close to neutral. Repeat for other rudder pedal.

6. Aileron tabs - Check for free travel, opposite normal aileron movement.

7. Normal trim - Check. Hold control stick in neutral to maintain neutral elevator while actuating trim. Crew chief shall verify that elevator tabs move properly, from stop to stop, within 9-11 seconds. During this check, stick pressure should be felt and is an indication that the pitch trim actuator is functioning.

8. Emergency trim - Check, same as normal in Step 7.

9. Emergency brakes - Check.

   Apply brakes a minimum of five times. Crew chief verifies brake applications and accumulator pressure has not depleted to precharge level before fifth brake application.

10. Flight controls - NORM.

   Verify emergency brake accumulator charges to normal and L and R hydraulic pressures return to normal. L and R PRESS and L and R AIL TAB lights go off. Check ailerons return to neutral with hands off stick indicating aileron trim was automatically neutralized during transition MRFCS.

11. Emergency brake handle - Push in.

12. Flight controls - Check.

TEMS STATUS CHECK.

(Figure 2-8 and Figure 2-9)

1. External aircraft battery switch - ON.

2. Umbilical Display Unit (UDU) status switch - Depress and hold.

NOTE

152 Depress and hold for greater than 30 seconds or until UDU alphanumeric display is illuminated.

   a. UDU AIRCRAFT STATUS indicators - ON.

   b. UDU POWER INDICATOR - ON.

   c. UDU alphanumeric display - Four-dot matrix segment goes on one at a time in sequence. Display continues until UDU status switch is released.

3. UDU status switch - Release.

   a. UDU aircraft status indicators - One will remain on for approximately 5 seconds. Other than GREEN, note code in alphanumeric display and depress UDU status switch again to check for other codes until the word DONE appears.

   b. UDU power indicator - Remains on for approximately 5 seconds after DONE appears.

4. External aircraft battery switch - OFF.

5. See Figure 2-9 for definition of alphanumeric codes.

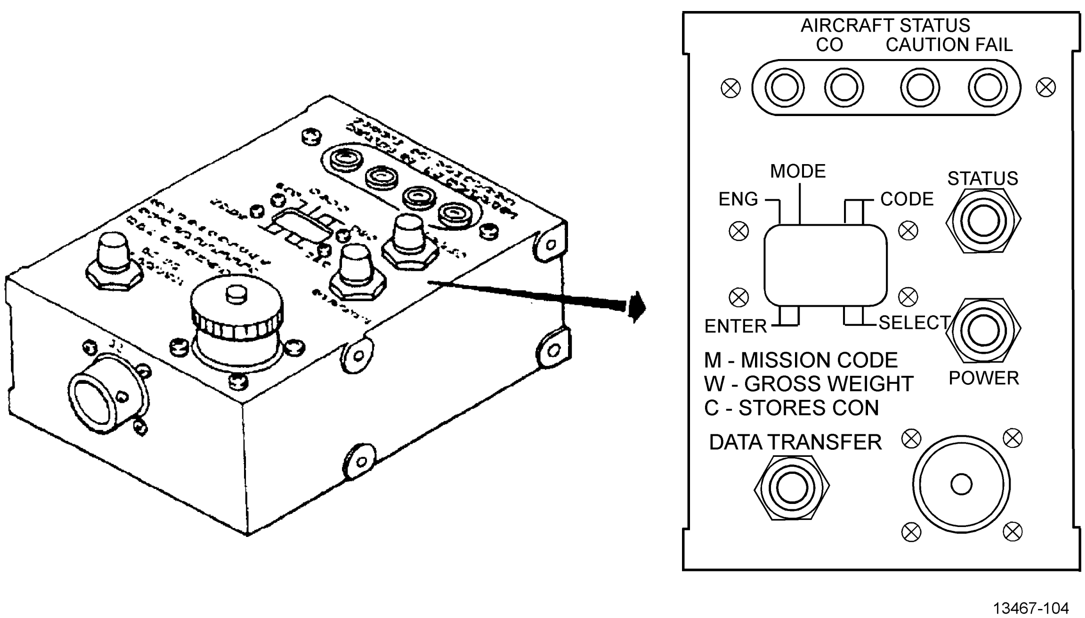


Figure 2-8. Umbilical Display Unit (UDU)

EGI INS ALIGNMENT.

The following paragraphs contain the EGI INS alignment procedures listed below:

- Automatically Initiated Ground Alignment
- Ground Alignment from NAV Mode, INFLT mode, or FAST Mode
- Stored Heading Alignment
- BATH Alignment
- In-Flight Alignment on Ground
- In-Flight Alignment in Air

Also included is a list of CDU non-emergency status messages and action to be taken if they occur.

AUTOMATICALLY INITIATED GROUND ALIGNMENT.

To perform the automatically initiated ground alignment, proceed as follows:

NOTE

To perform a ground alignment, the aircraft must be on the ground and not moving.

1. AAP - Ensure controls are set as listed below:
   a. CDU switch - OFF.
      Verify NAV caution light on caution light panel is on.
   b. EGI switch - OFF.
   c. PAGE select rotary knob - OTHER.
   d. STEER PT select rotary knob - As desired.

Figure 2-9. TEMS Alphanumeric Codes

ENGINE CONDITIONS CODES CRITICAL TO SAFETY OF FLIGHT.	
01	ITT over 945°C or over 1000°C; fuel flow override normal
02	ITT over 945°C or over 1000°C; fuel flow in override
03	ITT over 900°C, 945°C or 1000°C during START cycle
04	Core speed over 102%
05	Fan speed over 99.7%
06	More than one engine parameter fluctuating
07	Low oil pressure
08	Oil pressure fluctuating
09	Core speed vibration on more than one pickup
10	Fan speed vibration on more than one pickup
11	Inlet guide vanes OPEN off schedule
12	Flameout
13	Rollback
14	Low power
36	Core speed vibration on one pickup
37	Fan speed vibration on one pickup
39	Idle speed low
51	EPU battery voltage low NON152
52	EPU/IEPU failure
73	IEPU CALMEM Fault 152
74	IEPU File System Failure 152
FULL	IEPU memory full
OVG1	Over G case 1
OVG2	Over G case 2
OVG3	Over G case 3
OVG4	Over G case 4
HDL5	Hard landing - Aircraft/LG
HDL6	Hard landing - LAU-88 Maverick shear pins

Figure 2-9. TEMS Alphanumeric Codes - Continued

ENGINE CONDITIONS CODES NOT CRITICAL TO SAFETY OF FLIGHT.	
26	ITT 890°C; fuel flow override normal
27	ITT 890°C; fuel flow in override
28	Core speed over 99.4%
29	Fan speed over 98%
30	Fan speed over 94.5% on GROUND
31	ITT fluctuating
32	Core speed fluctuating
33	Fan speed fluctuating
34	Fuel flow fluctuating
35	High oil pressure
38	Inlet guide vanes CLOSED off schedule
40	ITT shift from normal
41	Stall
42	Stall (out of envelope)
43	Slow start
44	Fuel Filter differential pressure high
51	IEPU battery voltage low 152
72	IEPU OFP Checksum Fault 152
TEMS SYSTEM STATUS CODES.	
53	T2C data invalid
54	PLA data invalid
55	VG data invalid
56	PS3 data invalid
57	PT5 data invalid
58	Gearbox vibration data invalid
59	Front frame vibration data invalid
60	Exhaust frame vibration data invalid
61	ITT data invalid
62	Fuel flow data invalid
63	Core speed data invalid
64	Fan speed data invalid
65	Oil pressure data invalid
66	Vert G data invalid
67	PTO data invalid

Figure 2-9. TEMS Alphanumeric Codes - Continued

TEMS SYSTEM STATUS CODES.	
68	PAMB data invalid
69	AOA data invalid
70	TT2 data invalid
71	PT5 vs PS3 data invalid
72	IEPU OFP checksum fault 152
80	PLA Synchro Leg Voltage Low
81	AOA Synchro Leg Voltage Low
82	Variable Geometry Synchro Leg Voltage Low
83	Oil Pressure Synchro Leg Voltage Low
ADR CODES. 152	
ADR 1	IEPU Internal 1553 Card Failure
ADR 3	EGI Acceleration data has become Invalid in Flight
OVG1	Over-G Case 1 Inspection
OVG2	Over-G Case 2 Inspection
OVG3	Over-G Case 3 Inspection
OVG4	Over-G Case 4 Inspection
HDL5	Hard Landing Gear Inspection
HDL6	Hard Landing LAU-88 Inspection

2. AAP - CDU switch - ON.

3. AAP - EGI switch - ON

4. Observe the following:

NOTE

The MFCD display unit will display the CDU displays. The CDU and MFCD display unit displays will be identical.

a. CDU STARTUP BIT TEST Page (Figure 1-52) is shown on CDU and MFCD.

b. NAV caution light on caution light panel and MASTER CAUTION light are off for the duration of the CDU startup BIT test.

c. Approximately 45 seconds after CDU is turned on and successful completion of CDU startup BIT test, ALIGN Page (Figure 1-73), is displayed.

d. NAV caution light on caution light panel and MASTER CAUTION light are flashing upon completion of the CDU startup BIT test.

NOTE

- If a DTC is not available and the aircraft has been moved since EGI was last shut down (after an INS alignment), or the initial position on the DTC is incorrect, the initial position must be entered within 2.0 minutes of the CDU completing the CDU startup BIT test, or within 2.0 minutes after EGI is turned on.

- If the DTC has a different initial position from when the EGI was last shut down, the LAST POS LSK may be selected to align EGI to the last position stored in NVM.

5. AAP EGI switch - ON.

6. MASTER CAUTION light - Depress when more than 10 seconds has elapsed since the completion of the CDU startup BIT test. Observe that MASTER CAUTION light goes off and NAV caution light on caution light panel stays on.

7. CDU - ALIGN Page - Depress GROUND LSK or wait approximately 30 seconds after completion of CDU startup BIT test, observe that an asterisk is displayed next to GROUND indicating that a ground (normal gyrocompass) alignment is in progress. Observe that LAST POS displays desired initial position source and INIT POSIT displays aircraft's present position. Enter aircraft's present position, if necessary.

8. CDU - ALIGN Page - Approximately 2 minutes after completion of CDU startup BIT test, observe that CDU displays a steady INS NAV RDY annunciation, and a target symbol is displayed next to the NAV LSK. To select a degraded NAV mode, proceed to Step 10.

NOTE

- The INS NAV RDY annunciation is the lowest priority annunciation. The CDU annunciation field must be cleared of any previous annunciations that are visible, using the FA pushbutton on the CDU, for the INS NAV RDY annunciation to be visible.

- When GPS-only is the selected navigation solution, Enhanced Attitude Control (EAC) will not engage or will disengage if it was engaged prior to selecting the GPS-only solution.

- When INS-only is the selected navigation solution, EAC will not engage if the NAV mode was selected on the ALIGN Page when a steady INS NAV RDY (degraded NAV) annunciation was displayed on the CDU; or will disengage if it was engaged prior to selecting the INS-only navigation solution when the degraded NAV mode was selected.

- When BLENDED is the selected navigation solution, EAC will not engage (if a degraded NAV mode was selected on the ALIGN Page) until the quality of the BLENDED navigation solution has reached an accuracy that corresponds to a full INS alignment. That is, when degraded NAV is selected, the EAC cannot be engaged until the GPS-only solution corrects the BLENDED solution to an accuracy that corresponds to a full INS alignment.

- When EGI is not selected on the NMSP, EAC will not engage or will disengage if EGI is deselected (either manually or automatically).

- When a degraded NAV mode is selected, RER and CEP will not be calculated upon landing.

9. CDU - ALIGN Page - Approximately 4 minutes after completion of CDU startup BIT test, observe that CDU displays a flashing INS NAV RDY annunciation.

10. CDU - ALIGN Page - Depress NAV LSK to select NAV mode. When NAV mode is selected, observe that an asterisk is displayed next to NAV, asterisk next to GROUND disappears, INS NAV RDY annunciation is cleared, and NAV caution light on caution light panel goes out.

MAINTENANCE FAULT LOG.

When a problem, malfunction or unexpected event occurs, a fault is logged in the CICU when detected. When a fault is stored, additional information is stored with that code at the time the fault was detected. This additional information is as follows:

1. Minor Frame Count value (counter restarts every power-up cycle and counts time in 20 millisecond intervals). (Exception: For DTSAS fault codes 7224 and 7225, minor frame count is replaced with the DTSAS diagnostic code.)

2. Current Airspeed.

3. Current Barometric Reference.

4. Angle of Attack value.

5. Pitch Rate.

6. Flight Path Angle.

NOTE

The above additional information stored in NVM with the detected fault code is not displayed on the HUD. This data is available for retrieval only when maintenance uses the PATS unit for examination of fault code data.

A Critical Failure means the Unit/System identified has completely failed, is being shown as red on the STAT page, and is no longer available.Figure 2-10 lists Critical MFLs, MFCD Annunciation, Condition (system(s) affected), and corrective action.

Figure 2-10. Critical Faults

Critical Fault	Annunciation	Condition	Corrective Action
Armament Logic Module (ALM) Faults			
ALM 8-10, 17-20, 25, 27-30, 215-217, 228-240, 242-244, 246-250, 262-274	ALM FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 12	ALM WEAPONS FAILURE	Loss of weapon station release capability and HOTAS controls.	Reset CICU from the systems status page or cycle CICU power.
ALM 15, 23, 182	ALM FAILURE	Loss of weapon station release capability and HOTAS controls.	Reset CICU from the systems status page or cycle CICU power.
ALM 21	ALM POWER FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 78	ALM WEAPONS FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 110-120	ALM WEAPONS FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 121	ALM ODD WEAPONS FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 128-133	ALM WEAPONS FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 152	ALM EVEN WEAPONS FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 157-162	ALM WEAPONS FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 220, 222	MASTER ARM FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
ALM 223	GUN ARM FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
ALM 225	ALM FAILURE	Loss of weapon station release capability.	Reset CICU from the systems status page or cycle CICU power.
CICU Faults			
CICU 648-665, 667-668, 687, 689	CICU FAILURE	Loss of weapon station release capability, HOTAS controls, MAV video, TGP video, and TAD (all CICU functions).	Reset CICU from the systems status page or cycle CICU power.
CICU Graphics Video Module (GVM) Faults			

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
CICU GVM 40-45, 59		MFCDs freeze up or go blank.	Reset MFCDs from the system status page or cycle CICU power; use IFFCC profiles for weapons release.
Armament HUD Control Panel (AHCP) Fault			
AHCP 16	MASTER ARM SWITCH FAIL	Gun can not be fired.	Clear with CLEAR MFL OSB, will return if detected again.
Enhanced Position Location Reporting System (EPLRS) Faults			
EPLRS 15	EPLRS KEY FAIL	Complete loss of SADL.	Unable to clear fault in-flight.
EPLRS 19-21, 32-37	EPLRS WAVEFORM INOPERATIVE	EPLRS radio failure. Complete loss of SADL.	Restart radio, if remains inoperative.
Wind Corrected Munitions Dispenser (WCMD) Faults			
WCMD 23, 25-27, 29	WCMDX FAIL	WCMD can not be released	Reset or power cycle JDAM/WCMD from the system status page.
JDAM/WCMD 39-40		IAM can not be released	Reset or power cycle JDAM/WCMD from the system status page.
Joint Direct Attack Munitions (JDAM) Faults			
JDAM 7	JDAMX FAIL	JDAM can not be released.	Reset or power cycle JDAM/WCMD from the system status page.
JDAM 9-11, 13	JDAMX FAIL	JDAM can not be released.	Reset or power cycle JDAM/WCMD from the system status page.
NOTE The "X" in the JDAM and WCMD annunciations will be populated by the WS number of the store with the reported failure.			
Multi-Function Color Dirplays (MFCD) Faults			
MFCD 7, 10	XMFCD FAIL	Loss of MFCD video.	Reset MFCD from the system status page or cycle CICU power.
MFCD 13	XMFCD FAIL	Loss of CICU control of MFCD and all bezel and rocker keys.	Reset MFCD from the system status page or cycle CICU power.
NOTE The "X" in the annunciations will be populated by LT or RT for the MFCD that reported failure.			
Targeting Pod (TGP) Faults			
TGP 11	TGP FAIL	Inaccurate pointing and/or LOS drift. Total loss of POD function.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
TGP 12	TGP Video FAIL	Loss of video Synchronization. Total loss of POD function.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 13	TGP Video FAIL	Loss of one or both CCD FOV's video.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 14	TGP FLIR FAIL	Loss of FLIR video.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 15	TGP Laser FAIL	No laser designator. Total loss of POD function.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 16	TGP Laser FAIL	Loss of PIM codes designation.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 18	TGP Spot Detector FAIL	No Laser Spot Detection capability.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 19	TGP Laser Range FAIL	No Laser Range finding capability. Total loss of POD function.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 21	TGP ECU FAIL	Loss of ECS control or loss of one ECS element.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 24, 39	TGP Laser Marker FAIL	Loss Laser marker capability.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 43	TGP Video FAIL	Loss of TGP video. Total loss of POD function.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 45	TGP CID FAIL	CID Failure.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 56	TGP FAIL	Possible Condition: Servo/LOS Control Degradation, Servo/LOS, Control FAIL, Loss of acceptable FLIR video, Negligible FLIR video degradation, No Laser Capability, Degraded Laser, No Laser Ranging, Boresight Fail, Loss of at least one power module, Total Loss of TV Video, Degraded TV Video, Total Loss of Laser Marker, Total Loss of LST.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 57	TGP FAIL	Total loss of POD function.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
TGP 58	TGP FAIL	Possible Condition: Loss of acceptable FLIR video, overheating of POD Laser (potential shutdown).	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 59	TGP FAIL	Possible Condition: No Laser capability, overheating of POD Laser (potential shutdown).	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 60	TGP FAIL	Possible Condition: Loss of acceptable FLIR video, Negligible FLIR video degradation, overheating of POD Laser (potential shutdown), degraded TGP video.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 61	TGP FAIL	Possible Condition: Boresight Fail, Overheating of Pod/Laser (potential Shutdown), Total Loss of TV Video, Degraded TV Video, Total Loss of Laser Marker, Total Loss of LST, Degraded TGP Video.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 62	TGP FAIL	Laser Range Receiver Failed.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 63	TGP FAIL	Total loss of CID	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 64	TGP FAIL	Possible Condition: No Laser capability, Boresight fail, overheating of POD Laser (potential shutdown), Total loss of TV video, Total loss of Laser marker, Total loss of CID.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power
TGP 66	TGP FAIL	Possible Condition: Servo/LOS Control fail, Loss of acceptable FLIR video, Negligible FLIR video degradation, No Laser capability, No Laser Ranging, Loss of at least one power module, Total loss of TV video, Total loss of LST, Gimbal controller fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power
TGP 68	TGP FAIL	Forward Power A Supply Failure. Possible Condition: Loss of acceptable FLIR video, Negligible FLIR video degradation, overheating of POD Laser (potential shutdown), Loss of at least one power module.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 69	TGP FAIL	Forward Power B Supply Failure. Possible Condition: Loss of at least one power module. Total loss of Laser Marker, Total loss of LST, Servo/LOS Control fail, overheating of POD/ Laser (potential shutdown).	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
TGP 70	TGP FAIL	Roll Servo ECA Fail. Possible Condition: Servo/LOS Control fail, Gimbal controller fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 71	TGP FAIL	Pitch Servo ECA Failure. Possible Condition: Servo/LOS Control fail, overheating of POD/ Laser (potential shutdown).	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 72	TGP FAIL	YAW Interface ECA Failure. Possible Condition: Servo/LOS Control fail, overheating of POD/ Laser (potential shutdown), Total loss of Laser Marker, Total loss of LST.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 74	TGP FAIL	Dual Focus SW and ECA Failure. Possible Condition: Loss of acceptable FLIR video, No Laser Capability, Overheating of Pod/Laser (potential Shutdown), Servo/LOS Control Fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 75	TGP FAIL	Laser Risley and WP Failure. Possible Condition: No Laser Capability, Overheating of Pod/Laser (potential Shutdown), Total Loss of TV Video, Total Loss of Laser Marker, Servo/LOS Control Fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 76	TGP FAIL	Dual Focus SW and ECA Failure. Possible Condition: No Laser Capability, No Laser Ranging, Boresight Fail, Overheating of Pod/Laser (potential Shutdown), Total Loss of TV Video, Servo/LOS Control Degradation.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 78	TGP FAIL	LOS Controller ECA (LC) Failure. Possible Condition: No Laser Capability, Boresight Fail, Overheating of Pod/Laser (potential Shutdown), Loss of at least one power module, Total Loss of TV Video, Degraded TV Video, Total Loss of Laser Marker, Total Loss of LST.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 80	TGP FAIL	Laser Assembly Fail. Possible Condition: No Laser Capability, Degraded Laser, Total Loss of Laser Marker, Degraded LST.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 81	TGP FAIL	Roll Actuator Assembly Fail. Possible Condition, servo/LOS Control Fail, Overheating of Pod/Laser (potential Shutdown).	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
TGP 82	TGP FAIL	Roll Interface Assembly Fail. Possible Condition: Servo/LOS Control Fail, Loss of acceptable FLIR video, Negligible FLIR video degradation, No Laser Capability, Degraded Laser, Loss of at least one power module, System Controller Fail, Total Loss of TV Video, Degraded TV Video, Total Loss of Laser Marker.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 83	TGP FAIL	Aft Electronics Access Panel Fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 84	TGP FAIL	Aft Structure Assembly Fail Possible Condition: Servo/LOS Control Fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 85	TGP FAIL	Aircraft Adapter Assembly Fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 86	TGP FAIL	Desiccant Assembly Fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 87	TGP FAIL	Aft Chassis/ Motherboard Assembly Fail: Possible Condition: Servo/LOS Control Fail, Loss of acceptable FLIR video, Negligible FLIR video degradation, No Laser Capability, Degraded Laser, Loss or all or part of ECU Capability, Loss of at least one power module, System Controller Fail, ECU Degraded, Total Loss of TV Video, Degraded TV Video, Total Loss of Laser Marker, Total Loss of TGP Video, No Tracker Capability.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 88	TGP FAIL	System Controller Processor ECA (SC) Fail: Possible Condition: Servo/LOS Control Fail, No Laser Capability, Overheating of Pod/Laser (potential Shutdown), Loss or all or part of ECU Capability, Loss of at least one power module, System Controller Fail, ECU Degraded, Total Loss of Laser Marker, Total Loss of TGP Video, Degraded TGP Video.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
TGP 89	TGP FAIL	Track Controller Processor ECA (TC) Fail: Possible Condition: Overheating of Pod/Laser (potential Shutdown), System Controller Fail, Total Loss of TGP Video, Degraded TGP Video, No Tracker Capability.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 91	TGP FAIL	Multi Sensor Interface ECA (MSI) Fail: Possible Condition: No Tracker Capability, Loss of acceptable FLIR video, Negligible FLIR video degradation, Overheating of Pod/Laser (potential Shutdown), System Controller Fail, Total Loss of TV Video, Degraded TV Video, Total Loss of TGP Video, Degraded TGP Video.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 93	TGP FAIL	Aft Power Supply ECA Fail: Possible Condition: No Tracker Capability, Servo/LOS Control Fail, No Laser Capability, Degraded Laser, Overheating of Pod/Laser (potential Shutdown), Loss or all or part of ECU Capability, Loss of at least one power module, System Controller Fail, ECU Degraded, Total Loss of TGP Video.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 94	TGP FAIL	Motor Power Supply Fail: Possible Condition: Servo/LOS Control Fail, Overheating of Pod/Laser (potential Shutdown), Loss of at least one power module.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 95	TGP FAIL	Rectifier ECA Fail: Possible Condition: Servo/LOS Control Fail, No Laser Capability, Degraded Laser, Overheating of Pod/Laser (potential Shutdown), Loss or all or part of ECU Capability, Loss of at least one power module, System Controller Fail, ECU Degraded.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 96	TGP FAIL	EMI Filter / ECU Controller Fail: Possible Condition: Servo/LOS Control Fail, Overheating of Pod/Laser (potential Shutdown), Loss or all or part of ECU Capability, System Controller Fail, ECU Degraded.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 97	TGP FAIL	Aircraft Interface Assembly Fail: Possible Condition: Loss or all or part of ECU Capability, Loss of at least one power module, System Controller Fail.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
TGP 98	TGP FAIL	ECU Fail: Possible Condition: Overheating of Pod/Laser (potential Shutdown), Loss or all or part of ECU Capability, ECU Degraded.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 99	TGP FAIL	ECU Pod Fan Assembly Fail: Possible Condition: Loss or all or part of ECU Capability.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 100	TGP FAIL	ECU Ground Fan Assembly Fail: Possible Condition: Loss or all or part of ECU Capability.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 101	TGP FAIL	Assembly Group 500 Fail: TGP FAIL.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
TGP 158	TGP FAIL	TGP on WS10 not communicating on 1553 BUS. Total loss of POD function.	Run IBIT via STAT page to determine if fault is intermittent. Cycle TGP power.
Digital Video Airborne Data Recorder (DVADR) Faults			
1 $\boxed{514}$	DVADR FAIL	DVADR Recorder feature is reporting BIT Failure.	1. Use MFCD Status Page OSB to reset DVADR 2. Replace DVADR
2 $\boxed{514}$	DVADR CONFIG FAIL	DVADR Time Code feature is reporting Setup Failure.	1. Use MFCD Status Page OSB to reset DVADR 2. Upload correct TMATS configuration on the ground 3. Replace DVADR
3 $\boxed{514}$	DVADR FAIL	DVADR Recorder feature is reporting Operation Failure.	1. Use MFCD Status Page OSB to reset DVADR 2. Replace DVADR
4 $\boxed{514}$	DVADR FAIL	DVADR Recorder feature is reporting Media I/O Failure.	1. Remove and reinsert RMMD 2. Use MFCD Status Page OSB to reset DVADR 3. Replace DVADR
5 $\boxed{514}$	DVADR FAIL	DVADR Time Code feature is reporting BIT Failure.	1. Use MFCD Status Page OSB to reset DVADR 2. Replace DVADR
6 $\boxed{514}$	DVADR CONFIG FAIL	DVADR Time Code feature is reporting Setup Failure.	1. Use MFCD Status Page OSB to reset DVADR 2. Upload correct TMATS configuration on the ground 3. Replace DVADR

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
NOTE The "X" in the annunciations will be populated by 1 if ARC-210-1 reported the critical failure. If ARC-210-2 reported the critical failure the "X" will be populated by 2.			
ARC-210 Critical Faults			
0A, 0B, 0C, 0D, 0E, 0F, 01, 02, 03, 04, 05, 06, 07, 08, 09,10, 11, 12, 13, 14, 16, 17, 18, 1A, 1B, 1E, 1F, 22, 24, 26, 27, 28, 29, 2A, 2B, 2C, 2D, 2E, 2F, 30, 31, 32, 33, 35, 36, 37, 3E, 3F, 40, 41, 44, 45, 47, 48, 49, 4A, 4B, 4D, 4E, 4F, 51, 52, 53, 54, 56, 57, 58, 59, 5A, 5B, 5C, 5E, 5F, 60, 61, 63, 64, 65, 67, 68, 69, 6A, 6B, 6D, 6F, 72, 75, 77, 79, 7A, 7B, 7C, 7D, 7E, 7F, 80, 84, 86, 87, 88, 89, 8A, A8 513	ARC-210 (X) FAIL	Critical fault reported during ARC-210 CBIT or IBIT.	Reset radio and initiate BIT from system status page to determine if fault is intermittent. If fault returns, cycle radio power from RSC and initiate ARC-210 BIT from system status page.
A5 513	ARC-210 (X) 1553 FAIL	ARC-210 1553 data may not be valid.	Reset radio and initiate BIT from system status page to determine if fault is intermittent. If fault returns, cycle radio power from RSC and initiate ARC-210 BIT from system status page. If fault returns, reset or cycle CICU power.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
Identification Friend or Foe (IFF) Faults			
IFF 6	IFF FAIL	IFF not receiving altitude data from CADC.	If fault clears, functionality returns. Cycle IFF power.
IFF 7	IFF FAIL	Upper Antenna functionality may be degraded or nonfunctional.	Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
IFF 8	IFF FAIL	Lower Antenna functionality may be degraded or nonfunctional.	Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
IFF 9	IFF FAIL	KIT-1C not fully functional, Mode 4 codes are not loaded, or theMode 4 switch on IFF control panel is not set to ON. Mode 4 functionality may be degraded or nonfunctional.	Set the Mode 4 switch on the IFF control panel to ON. Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
IFF 12	IFF FAIL	Mode 3/A functionality may be degraded or nonfunctional.	Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
IFF 13	IFF FAIL	Mode C functionality may be degraded or nonfunctional.	Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
1FF 14	IFF FAIL	Mode 4 functionality may be degraded or nonfunctional.	Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
1FF 15	IFF FAIL	Mode S functionality may be degraded or nonfunctional.	Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
1FF 17	IFF FAIL	IFF not connected to the KIT-1C computer, and therefore Mode 4 is non functional.	Unable to manually clear fault in-flight.
1FF 18	IFF FAIL	The IFF has detected that its functionality is degraded.	Run IBIT via STAT page to determine if fault is intermittent. Cycle IFF power.
1FF 19	IFF FAIL	The IFF indicates that it is not correctly configured for the A-10.	Unable to manually clear fault in-flight.

Figure 2-10. Critical Faults - Continued

Critical Fault	Annunciation	Condition	Corrective Action
Improved Data Modem (IDM) Faults			
IDM 001 515	IDM INOP	The IDM failed DRAM test.	Cycle IDM power via STAT page 3.
IDM 002 515	IDM INOP	The IDM failed Protocol Application Flash Checksum test.	Cycle IDM power via STAT page 3.
IDM 003 515	IDM INOP	The IDM failed Waveform Application Flash Checksum test.	Cycle IDM power via STAT page 3.
IDM 004 515	IDM INOP	The IDM failed DSP #1 RAM test.	Cycle IDM power via STAT page 3.
IDM 005 515	IDM INOP	The IDM failed DSP Message Loopback test.	Cycle IDM power via STAT page 3.
IDM 006 515	IDM INOP	The IDM failed External UART Clock Detect test.	Cycle IDM power via STAT page 3.
IDM 007 515	IDM INOP	The IDM failed other startup built in test.	Cycle IDM power via STAT page 3.
IDM 008 515	IDM INOP	The CICU has failed to receive start-up built-in test (SBIT) results from the IDM.	Cycle IDM power via STAT page 3. Cycle CICU power.
IDM 012 515	IDM INOP	The CICU has failed to transmit data to the IDM or CICU has failed to receive expected data from the IDM during initial configuration process.	Cycle IDM power via STAT page 3. Cycle CICU power.
IDM 013 515	IDM INOP	The CICU has encountered failure during data verification, where data transmitted to the IDM does not match data received during initial configuration process.	Cycle IDM power via STAT page 3. Cycle CICU power.

Normal Alignment From NAV, In-Flight (INFLT), or FAST Mode.

To perform the normal alignment from the NAV, In-flight (INFLT), or FAST mode, proceed as follows:

NOTE

- To perform a ground alignment, the aircraft must be on the ground and not moving.
- The following procedures assume that the aircraft initial position has been entered if the aircraft has been moved since the last EGI shutdown.

1. NMSP - Deselect EGI (or select HARS) and/or STR PT or ANCHR, if selected.
2. AAP - PAGE select rotary knob to OTHER.
3. If ALIGN Page (Figure 1-73) is displayed on CDU, proceed to Step 7. If ALIGN Page is not displayed, proceed to Step 4.
4. CDU - Depress SYS function select key. Observe that CDU displays SYS Page 1/3 (Figure 1-80).
5. CDU - SYS Page 1/3 - Depress INS Page LSK. Observe that CDU displays INS Page (Figure 1-89).
6. CDU - INS Page - Depress ALIGN page LSK. Observe that CDU displays ALIGN Page (Figure 1-73).
7. If the present NAV mode was selected from NARF mode as indicated on INSSTAT Page (Figure 1-92), to continue the original ground alignment, proceed to Step 13; to restart a ground alignment, proceed to Step 8. If the present NAV mode was selected from the ground alignment and the aircraft's airspeed has exceeded 75 knots, or from an in-flight or fast alignment, proceed to Step 13.

8. CDU - ALIGN Page - Depress INS page LSK. Observe that CDU displays INS Page (Figure 1-89).

9. CDU - INS Page - Depress INSSTAT page LSK. Observe that CDU displays INSSTAT Page (Figure 1-92) and MODE field displays NARF.

10. CDU - INSSTAT Page - Depress ATT LSK. Observe that asterisk appears next to ATT and MODE field displays ATT.

11. CDU - INSSTAT Page - Depress INS page LSK. Observe that CDU displays INS Page (Figure 1-89).

12. CDU - INS Page - Depress ALIGN page LSK. Observe that CDU displays ALIGN Page (Figure 1-73).

13. CDU - ALIGN Page - Depress GROUND LSK. Observe that an asterisk is displayed next to GROUND, LAST POS displays initial position source, INIT POSIT displays aircraft's initial position, LSKs are active (bracket symbols are displayed), and NAV caution light on caution light panel and MASTER CAUTION light are flashing.

NOTE

If ground alignment is a continuation of the previous ground alignment, then the align time (T =) and status fields will start at the time and status that existed when the NAV mode was selected. For the start of any other ground alignment, these fields will start at zero.

14. CDU - ALIGN Page - Enter initial position, if displayed initial position (INIT POSIT) is not aircraft's current position or depress LAST POS LSK.

15. MASTER CAUTION light - Depress. Observe that MASTER CAUTION light goes out and NAV caution light on caution light panel stays on.

16. CDU - ALIGN Page - Within 3 seconds to 2 minutes after GROUND was selected (as determined by the mode that was selected prior to selecting GROUND), observe that CDU displays a steady INS NAV RDY annunciation. To select a degraded NAV mode, proceed to Step 18.

NOTE

- The INS NAV RDY annunciation is the lowest priority annunciation. The CDU annunciation field must be cleared of any previous annunciations that are visible, using the FA pushbutton on the CDU, for the INS NAV RDY annunciation to be visible.

- When GPS-only is the selected navigation solution, Enhanced Attitude Control (EAC) will not engage; or will disengage if it was engaged prior to selecting the GPS-only solution.

- When INS-only is the selected navigation solution, EAC will not engage if the NAV mode was selected on the ALIGN Page when a steady INS NAV RDY (degraded NAV) annunciation was displayed on the CDU; or will disengage if it was engaged prior to selecting the INS-only navigation solution when the degraded NAV mode was selected.

- When BLENDED is the selected navigation solution, EAC will not engage (if a degraded NAV mode was selected on the ALIGN Page) until the quality of the BLENDED navigation solution has reached an accuracy that corresponds to a full INS alignment. That is, when degraded NAV is selected, the EAC cannot be engaged until the GPS-only solution corrects the BLENDED solution to an accuracy that corresponds to a full INS alignment.

- When EGI is not selected on the NMSP, EAC will not engage; or will disengage if EGI is deselected (either manually or automatically).

- If a stored heading alignment procedure is performed, RER and CEP will not be calculated upon landing.

17. CDU - ALIGN Page - Approximately 4 minutes after GROUND was selected, observe that CDU displays a flashing INS NAV RDY annunciation.

18. CDU - ALIGN Page - Depress NAV LSK to select NAV mode. When the NAV mode is selected, observe that an asterisk is displayed next to NAV, the asterisk next to GROUND disappears, the INS NAV RDY annunciation is cleared, and NAV caution light on caution light panel goes out.

NOTE

Override the AUTO (DTC) alignment mode, by pressing LAST POS LSK on ALIGN page. This selection aligns EGI to last position stored when EGI was turned off, instead of parking spot of MDTC. The two minute window (like manually entering coordinates) applies.

Stored Heading Alignment.

NOTE

- Before a stored heading alignment is performed, the EGI should have been powered up with a full ground (gyrocompass) alignment and the EGI powered down without transitioning the EGI INS to NAV mode, and the aircraft should not have been moved.
- If a stored heading alignment procedure is performed, RER and CEP will not be calculated upon landing.

A stored heading alignment, which uses the magnetic heading stored in the EGI, takes only 24 seconds but provides a less accurate EGI INS alignment than ground (gyrocompass) alignment. To initiate stored heading alignment, proceed as follows:

1. AAP - Ensure controls are set as listed below:

   a. CDU switch - OFF.

      Verify NAV caution light on caution light panel is on.

   b. EGI switch - OFF.

   c. PAGE select rotary knob - OTHER.

   d. STEER PT select rotary knob - As desired.

2. AAP:

   a. CDU switch - ON.

   b. EGI switch - ON.

3. After approximately 45 seconds, observe that CDU has successfully completed the CDU startup BIT test and ALIGN Page (Figure 1-73) is displayed. Observe NAV caution light on caution light panel and MASTER CAUTION light are flashing.

4. CDU - ALIGN Page - Depress INS page LSK. Observe that INS Page (Figure 1-89) is displayed.

5. CDU - INS Page - Depress ALT ALIGN Page LSK. Observe that ALTALGN Page (Figure 1-90) is displayed.

NOTE

To select the stored heading alignment, the FAST LSK must be depressed within 30 seconds after the completion of the CDU startup BIT test, if the CDU and EGI were turned on at the same time; the FAST LSK will be active (target symbol displayed) for approximately 30 seconds after the completion of the CDU startup BIT test. If the EGI is turned on after the completion of the CDU startup BIT test, the FAST LSK must be depressed within 30 seconds after EGI was turned on; the FAST LSK will be inactive (no target symbol displayed) for approximately 5 seconds after EGI is turned on, then become active for approximately 25 seconds, and then become inactive again.

6. CDU - ALTALGN Page - Depress FAST LSK. Observe that asterisk is displayed next to FAST and brackets symbol appears next to magnetic heading (MH) and initial position (INIT POSIT) LSKs. Observe that POS SOURCE indicates AUTO (LAST POS) - SH, INIT POSIT indicates aircraft's present position, and MH indicates aircraft's present magnetic heading.

NOTE

The stored heading alignment mode is automatically selected when the aircraft has been cocked, and magnetic heading and/or initial position are not entered. Do not enter magnetic heading or initial position.

7. MASTER CAUTION light - Depress when more than 10 seconds has elapsed since the completion of the CDU startup BIT test. Observe that MASTER CAUTION light goes out and NAV caution light on caution light panel stays on.

8. CDU - ALTALGN Page - Approximately 24 seconds after the FAST LSK was depressed, observe that CDU displays a flashing INS NAV RDY annunciation.

NOTE

The INS NAV RDY annunciation is the lowest priority annunciation. The CDU annunciation field must be cleared of any previous annunciations that are visible, using the FA pushbutton on the CDU, for the INS NAV RDY annunciation to be visible.

9. CDU - ALTALGN Page - Depress NAV mode LSK to select NAV mode. When the NAV mode is selected, observe that an asterisk is displayed next to NAV, the asterisk next to FAST disappears, flashing INS NAV RDY annunciation is cleared, and NAV caution light on caution light panel goes out.

NOTE

The NAV mode LSK must be depressed to select the NAV mode within approximately 1 minute after the CDU displays the flashing INS NAV RDY annunciation. If the NAV mode is not manually (or automatically) selected within this 1-minute period, the INS will automatically enter a BATH alignment when the EGI GPS acquires satellites and calculates the aircraft's position.

BATH Alignment.

A BATH alignment requires only 30 seconds and does not require that the aircraft be cocked, but provides a less accurate EGI INS alignment than stored heading or ground (gyrocompass) alignment. To initiate BATH alignment, proceed as follows:

WARNING

To perform a BATH alignment, the aircraft's magnetic heading must be known to an accuracy of ±1.0 degree, or its position known to an accuracy of ±1.0 Nautical Miles (NM). If a magnetic heading or position is not known to these accuracies, do not perform a BATH alignment. If a magnetic heading or position is entered that exceeds these tolerances, HSI and ADI indications will be incorrect and eventually the CDU will display the BLENDED GPS DIFFER annunciation.

NOTE

If a BATH alignment procedure is performed, RER and CEP will not be calculated upon landing.

1. AAP:

   a. CDU switch - OFF.

      Verify NAV caution light on caution light panel is on.

   b. EGI switch - OFF.

   c. PAGE select rotary knob - OTHER.

   d. STEER PT select rotary knob - As desired.

2. AAP:

   a. CDU switch - ON.

   b. EGI switch - ON.

3. After approximately 45 seconds, observe that CDU has successfully completed the CDU startup BIT test and ALIGN Page (Figure 1-73) is displayed. Observe NAV caution light on caution light panel and MASTER CAUTION light are flashing.

4. CDU - ALIGN Page - Depress INS page LSK. Observe that INS Page (Figure 1-89) is displayed.

5. CDU - INS Page - Depress ALT ALIGN page LSK. Observe that ALTALGN Page (Figure 1-90) is displayed.

NOTE

To select the BATH alignment, the FAST line select key must be pressed within 30 seconds after the completion of the CDU startup BIT test, if the CDU and EGI were turned on at the same time; the FAST line select key will be active (target symbol displayed) for approximately 30 seconds after the completion of the CDU startup BIT test. If the EGI is turned on after the completion of the CDU startup BIT test, the FAST line select key must be pressed within 30 seconds after EGI was turned on; the FAST line select key will be inactive (no target symbol displayed) for approximately 5 seconds after EGI is turned on, then become active for approximately 25 seconds, and then become inactive again.

6. CDU - ALTALGN Page - Depress FAST LSK. Observe that asterisk appears next to FAST. Observe the following:

   a. When DTC is inserted and locked into UDTU:

      (1) Brackets symbol appears next to magnetic heading (MH) and initial position (INIT POSIT) LSKs.

      (2) POS SOURCE field indicates AUTO (DTC) - BATH.

      (3) INIT POSIT fields indicate waypoint 0 (from DTC) position. If displayed INIT POSIT position is not aircraft's present position, enter aircraft's present position within 30 seconds after FAST LSK was depressed via scratchpad and INIT POSIT LSKs.

      (4) MH field indicates aircraft's present magnetic heading. If displayed MH is not aircraft's present magnetic heading, enter aircraft's present magnetic heading within 30 seconds after the FAST LSK was depressed or the initial position was entered (whichever is later). Enter aircraft's present magnetic heading via scratchpad and MH LSK.

b. When a DTC is not available:

(1) Brackets symbol appears next to magnetic heading (MH) and initial position (INIT POSIT) LSKs.

(2) POS SOURCE field indicates AUTO (LAST POS) - BATH.

(3) INIT POSIT fields indicate last position (from EGI). If displayed INIT POSIT position is not aircraft's present position, enter aircraft's present position within 30 seconds after FAST LSK was depressed via scratchpad and INIT POSIT LSKs. POS SOURCE field will indicate MAN(PILOT) - BATH.

(4) MH field indicates aircraft's present magnetic heading. If displayed MH is not aircraft's present magnetic heading, enter aircraft's present magnetic heading within 30 seconds after the FAST LSK was depressed or the initial position was entered (whichever is later). Enter aircraft's present magnetic heading via scratchpad and MH LSK. POS SOURCE field will indicate MAN(PILOT) - BATH.

7. MASTER CAUTION light - Depress when more than 10 seconds has elapsed since the completion of the CDU startup BIT test. Observe that MASTER CAUTION light goes out and NAV caution light on caution light panel stays on.

8. CDU - ALTALGN Page - Within 30 seconds after the FAST LSK was depressed, an initial position was entered, or a magnetic heading was entered (whichever was later), observe that CDU displays a steady INS NAV RDY annunciation, and a target symbol is displayed next to the NAV LSK.

NOTE

- The INS NAV RDY annunciation is the lowest priority annunciation. The CDU annunciation field must be cleared of any previous annunciations that are visible, using the FA pushbutton on the CDU, for the INS NAV RDY annunciation to be visible.
- In the BATH alignment mode, the steady INS NAV RDY annunciation on the CDU will never change to a flashing annunciation.
- When GPS-only is the selected navigation solution, EAC will not engage or will disengage if it was engaged prior to selecting the GPS-only solution.
- When INS-only is the selected navigation solution, EAC will not engage if the NAV mode was selected on the INS Page when a steady INS NAV RDY (degraded NAV) annunciation was displayed on the CDU; or will disengage if it was engaged prior to selecting the INS-only navigation solution when the degraded NAV mode was selected.
- When BLENDED is the selected navigation solution, EAC will not engage (if a degraded NAV mode was selected on the INS Page) until the quality of the BLENDED navigation solution has reached an accuracy that corresponds to a full INS alignment. That is, when degraded NAV is selected, the EAC cannot be engaged until the GPS-only solution corrects the BLENDED solution to an accuracy that corresponds to a full INS alignment.
- When EGI is not selected on the NMSP, EAC will not engage or will disengage if EGI is deselected (either manually or automatically).

9. CDU - ALTALGN Page - Depress NAV mode LSK to select NAV mode. When the NAV mode is selected, observe that an asterisk is displayed next to NAV, asterisk next to FAST disappears, steady INS NAV RDY annunciation is cleared, and NAV caution light on caution light panel goes out.

In-Flight Alignment on Ground.

To perform an in-flight alignment on the ground, proceed as follows:

NOTE

- An in-flight alignment on the ground can be terminated by selecting the normal alignment mode from the in-flight alignment mode, or by turning the EGI off for at least 10 seconds.
- The following procedure assumes that the CDU and EGI have been turned on and are functioning properly, and CDU is displaying System (SYS) Page 1/3 (Figure 1-80).
- If an in-flight alignment procedure is performed, RER and CEP will not be calculated upon landing.

1. NMSP - Deselect EGI (or select HARS) and STR PT or ANCHR, if selected.

2. CDU - SYS Page 1/3 - Depress INS Page LSK. Observe that INS Page (Figure 1-89) is displayed.

NOTE

If the aircraft is moved within 125 seconds after the CDU and EGI are turned on or within 80 seconds after the EGI is turned on (CDU already on), whichever is later, and before a steady INS NAV RDY annunciation is displayed, the EGI INS may not automatically transition to an INFLT alignment. If the aircraft is moved within this time period, verify that a steady or flashing asterisk is displayed next to INFLT on the ALIGN Page (Figure 1-73). If a steady or flashing asterisk is not displayed next to INFLT, depress the INFLT LSK if the aircraft is moving or in the air; or depress the NORM LSK if the aircraft is on the ground and stopped.

3. CDU - INS Page - Depress ALIGN page LSK. Observe that ALIGN Page (Figure 1-73) is displayed.

4. CDU - ALIGN Page - Depress INFLT LSK. When this LSK is depressed and EGI GPS is qualified to do an in-flight alignment, a flashing asterisk will be displayed next to INFLT for 5 to 10 seconds, and then a steady asterisk will be displayed. When this LSK is depressed and EGI GPS is not qualified to do an in-flight alignment, a flashing asterisk will be displayed next to INFLT until EGI GPS is qualified, and then a steady asterisk will be displayed.

NOTE

The EGI GPS is qualified to do an in-flight alignment when both the Expected Horizontal Error (EHE) and Expected Vertical Error (EVE) are less than 100 feet if EGI is keyed; or both are less than 400 feet if EGI is not keyed.

5. Observe that NAV caution light on caution light panel and MASTER CAUTION light are flashing.

6. MASTER CAUTION light - Depress. Observe that MASTER CAUTION light goes out and NAV caution light on caution light panel stays on.

7. CDU - ALIGN Page - Within 2 to 4 minutes after a steady asterisk is displayed next to INFLT, observe that steady INS NAV RDY annunciation is displayed, the NAV mode (displayed on line 1) automatically transitions to blended (B), a target symbol is displayed next to the NAV LSK, and the NAV caution light on the caution light panel goes out. To select a degraded NAV mode, proceed to Step 9.

NOTE

- The INS NAV RDY annunciation is the lowest priority annunciation. The CDU annunciation field must be cleared of any previous annunciations that are visible, using the FA pushbutton on the CDU, for the INS NAV RDY annunciation to be visible.
- When the NAV mode indication (on line 1 of CDU) automatically transitions to blended, EGI and STR PT or ANCHR can be selected on the NMSP. This provides usable steering information for the HSI, ADI, and HUD.
- When INS-only is the selected navigation solution, EAC will not engage if the NAV mode was selected on the ALIGN Page when a steady INS NAV RDY (degraded NAV) annunciation was displayed on the CDU; or will disengage if it was engaged prior to selecting the INS-only navigation solution when the degraded NAV mode was selected.
- When BLENDED is the selected navigation solution, EAC will not engage (if a degraded NAV mode was selected on the INS Page) until the quality of the BLENDED navigation solution has reached an accuracy that corresponds to a full INS alignment. That is, when degraded NAV is selected, the EAC cannot be engaged until the GPS-only solution corrects the BLENDED solution to an accuracy that corresponds to a full INS alignment.
- When EGI is not selected on the NMSP, EAC will not engage or will disengage if EGI is deselected (either manually or automatically).

8. CDU - ALIGN Page - Between 2 and 12 minutes after a steady asterisk is displayed next to the INFLT LSK, observe that a flashing INS NAV RDY annunciation is displayed.

9. CDU - ALIGN Page - Depress NAV mode LSK to select NAV mode or wait 30 seconds after INS NAV RDY annunciation begins to flash (for automatic transition to NAV mode). Observe that an asterisk is displayed next to NAV, the asterisk next to INFLT disappears, and INS NAV RDY annunciation is cleared.

In-Flight Alignment in Air.

To perform an in-flight alignment in the air, proceed as follows:

NOTE

- The following procedure assumes that the CDU and EGI are turned on and functioning properly, and the CDU is displaying System (SYS) Page 1/3 (Figure 1-80).
- If an in-flight alignment procedure is performed, RER and CEP will not be calculated upon landing.

1. NMSP - Deselect EGI (or Select HARS) and STR PT or ANCHR, if selected.

2. Fly aircraft straight and level in unaccelerated flight prior to selecting in-flight alignment.

3. CDU - SYS Page 1/3 - Depress INS page LSK. Observe that INS Page (Figure 1-89) is displayed.

4. CDU - INS Page - Depress ALIGN page LSK. Observe that ALIGN Page (Figure 1-73) is displayed.

5. CDU - ALIGN Page - Depress INFLT LSK. When this LSK is depressed and EGI GPS is qualified to do an in-flight alignment, a flashing asterisk will be displayed next to INFLT for 5 to 10 seconds, and then a steady asterisk will be displayed. When this LSK is depressed and EGI GPS is not qualified to do an in-flight alignment, a flashing asterisk will be displayed next to INFLT until EGI GPS is qualified, and then a steady asterisk will be displayed.

NOTE

The EGI GPS is qualified to do an in-flight alignment when both the EHE and EVE are less than 100 feet if EGI is keyed; or both are less than 400 feet if EGI is not keyed.

6. Observe that NAV caution light on caution light panel and MASTER CAUTION light are flashing.

7. MASTER CAUTION light - Depress. Observe that MASTER CAUTION light goes out and NAV caution light on caution light panel stays on.

8. Continue to fly aircraft straight and level in unaccelerated flight until a steady asterisk is displayed next to INFLT.

9. After a steady asterisk is displayed next to INFLT, the in-flight alignment can be hastened by flying gentle S-turns with approximately 30° of bank angle. Losing satellites during this maneuvering will increase the duration of the in-flight alignment.

10. CDU - ALIGN Page - Within 2 to 4 minutes after a steady asterisk is displayed next to INFLT, observe that steady INS NAV RDY annunciation is displayed, the NAV mode (displayed on line 1 of CDU) automatically transitions to blended (B), target symbol is displayed next to NAV, and the NAV caution light on the caution light panel goes out. To select a degraded NAV mode, proceed to Step 12.

NOTE

- The INS NAV RDY annunciation is the lowest priority annunciation. The CDU annunciation field must be cleared of any previous annunciations that are visible, using the FA pushbutton on the CDU, for the INS NAV RDY annunciation to be visible.

- When the NAV mode (on line 1 of CDU) automatically transitions to blended, EGI and STR PT or ANCHR can be selected on the NMSP. This provides usable steering information for the HSI, ADI, and HUD.

- When GPS-only is the selected navigation solution, EAC will not engage or will disengage if it was engaged prior to selecting the GPS-only solution.

- When INS-only is the selected navigation solution, EAC will not engage if the NAV mode was selected on the ALIGN Page when a steady INS NAV RDY (degraded NAV) annunciation was displayed on the CDU; or will disengage if it was engaged prior to selecting the INS-only navigation solution when the degraded NAV mode was selected.

- When BLENDED is the selected navigation solution, EAC will not engage (if a degraded NAV mode was selected on the INS Page) until the quality of the BLENDED navigation solution has reached an accuracy that corresponds to a full INS alignment. That is, when degraded NAV is selected, the EAC cannot be engaged until the GPS-only solution corrects the BLENDED solution to an accuracy that corresponds to a full INS alignment.

- When EGI is not selected on the NMSP, EAC will not engage or will disengage if EGI is deselected (either manually or automatically).

11. CDU - ALIGN Page - Between 2 and 12 minutes after a steady asterisk is displayed next to INFLT, observe that a flashing INS NAV RDY annunciation is displayed.

12. CDU - ALIGN Page - Depress NAV mode LSK to select NAV mode or wait 30 seconds after INS NAV RDY annunciation began flashing and system will automatically transition to NAV mode. When the NAV mode is selected, an asterisk will appear next to NAV, the asterisk next to INFLT will disappear, and the INS NAV RDY annunciation will be cleared.

    a. Approximately 45 seconds after CDU and EGI are turned on and successful completion of CDU startup BIT test, ALIGN Page (Figure 1-69), is displayed.

CDU NON-EMERGENCY STATUS MESSAGES.

Figure 2-11 lists CDU non-emergency status messages that may occur while performing the procedures in this section. Included is a description of the condition that causes the status message to be displayed and any corrective action to be taken.

Figure 2-11. CDU System Non-Emergency Status Messages

MESSAGE	CONDITION	CORRECTIVE ACTION
BLENDED GPS DIFFER	EGI Blended and GPS positions differ by more than 3000 feet.	Ensure correct initial position was entered.
DOWNLOAD COMPLETE	Download to DTS is complete.	None or depress FA pushbutton.
CDU UPLOAD FAIL	Error during CDU upload.	Attempt upload again or replace DTC.
BUS A FAIL BUS B FAIL	Either A or B AV BUS-1 has failed.	None, or Press FA.
DOWNLOAD FAILED	Error during download to DTS.	Attempt manual download; change DTC and attempt manual download. **NOTE** If download fails, mission data can be retrieved from CDU maintenance pages and LASTE pages.
DTC ERASED	No data on DTC.	Replace with good DTC.
DTC FULL	DTC cannot record more data.	Change DTC and attempt manual download. **NOTE** If download fails, mission data can be retrieved from CDI maintenance pages and LASTE pages.
DTC UPLOAD COMPLETE	Upload from DTS is complete.	None or depress FA pushbutton.
DTS FAIL	DTS hardware failure.	Verify DTC locked in UDTU. CDU-RESET Page-depress DTS LSK. **NOTE** If DTS fails, mission data can be retrieved from CDU maintenance pages and LASTE pages.
DTS NOT RDY	DTS not functioning.	Check DTC. Verify DTC locked in DTU.
DTSAS FAIL	DTSAS not functioning.	Attempt reinitialization of DTSAS. Depress FA or UFC ENT pushbutton.
DTSAS OFF MAP	Aircraft off of DTSAS digital map.	Attempt reinitialization of DTSAS. Incorrect digital map in DTSAS. Aircraft position off map in DTSAS. Depress FA or UFC ENT pushbutton..
FP UPLOAD ERROR	Error during upload of flight plan.	Attempt manual upload or replace DTC.
GPS ALM LOAD ERROR	No almanacs on DTC or error in reading almanacs.	Attempt manual upload or replace DTC.
GPS KEY 2HR WARNING	GPS keys will be invalid in 2 hours, after which EGI accuracy will degrade.	None or depress FA pushbutton.

Figure 2-11. CDU System Non-Emergency Status Messages - Continued

MESSAGE	CONDITION	CORRECTIVE ACTION
GPS KEY ERASE FAIL	Attempt to erase GPS keys has failed.	Retry.
GPS KEY LOAD FAILED	GPS key rejected by EGI.	Request maintenance personnel to reload keys.
GPS KEYS ERASED	GPS keys have been erased.	Depress FA pushbutton.
GPS NEEDS ALMS	No almanacs in EGI memory.	Load almanacs from DTC or wait for up to 2 hours for almanacs to be loaded from GPS satellites.
GPS NEEDS KEYS	EGI needs GPS keys. EGI will operate with degraded accuracy without keys.	Request maintenance personnel to load keys if high accuracy is required.
IEPU FAIL 152	IEPU internal failure.	Replace IEPU (MX).
IEPU FULL 152	IEPU memory full.	Download data.
IEPU NOT READY 152	IEPU not communicating.	Reset IEPU.
INIT POS	Initial position entry required.	Enter initial position.
INS DEGRADED	EGI not receiving CADC data.	Refer to CADC CAUTION LIGHT ANALYSIS (Figure 3-2)
INS NAV RDY	Steady annunciation indicates degraded EGI INS navigation capability is available. Flashing annunciation indicates full EGI INS navigation capability is available.	None.
LASTE NOT RDY	LASTE not functioning.	Cross check HUD and check LASTE page.
LASTE UPLOAD FAIL	Error during upload of LASTE data.	Attempt manual upload or replace DTC.
MARK A (B, C, ...)	Indicates a mark point has been generated and stored.	None or depress FA pushbutton.
OFP LOAD FAIL	Operational flight program load failure.	Displayed only during loading OFP procedure (performed by maintenance personnel only).
OFP VERIFY FAIL	Verification of operational flight program failure.	Displayed only during loading OFP procedure (performed by maintenance personnel only).
POWER EGI OFF	Indicates when EGI is to be turned off during OFP loading process.	Displayed only during loading OFP procedure (performed by maintenance personnel only).
SCALE ERROR	Indicates deviation mode selected and actual deviation mode are different 5 seconds after deviation mode was selected.	may not be qualified for selected SCALE, or either a partial EGI GPS or EGI INS failure may have occurred; select an alternate navigation source.

Figure 2-11. CDU System Non-Emergency Status Messages - Continued

MESSAGE	CONDITION	CORRECTIVE ACTION
VERT MODE INPUT ERROR	Indicates vertical mode selected and actual mode are different 5 seconds after vertical mode was selected.	has not acquired four satellites. When EGI acquires four satellites, select desired vertical (3D) mode. If EGI does not acquire four satellites, the vertical (3D) mode will not be available.
WARM START	Indicates a power transient of 3 seconds or less, a maintenance log was written to the DTC, or CDU was turned off for 3 seconds or less, and a warm start process has begun.	None.
WP UPLOAD ERROR	Error druing upload of waypoints.	Attempt manual upload or replace DTC.

MFCD WARNINGS, CAUTIONS AND NOTES (WCN).

The warnings, cautions, and notes that can be displayed on the MFCD during system operation are listed, in priority order, in Figure 2-12 through Figure 2-15.2.

Figure 2-12. WCN Warnings 1 - Highest Priority

Priority	Annunciation	Description
1	GCAS Break X	GCAS Break X Warning Displayed on Both MFCDs
2	OBSTACLE	Obstacle warning from IFFCC

Figure 2-13. WCN Warnings 2- Second Highest Priority

Priority	Annunciation	Description
1	CHECK ATTITUDE	TGP Attitude Alert Function Message
2	IAM LAUNCH ABORT	IAM Failed to meet launch criteria
3	EMERGENCY JETT FAIL	Failure of Emergency Jettison logic detected
4	HUNG STORE STATION XX	Hung Store detected on a weapon station (XX=1-11)
5	HVI UNSAFE	Quick Disconnect (QDC) on the HMCS Harness Vehicle Interlock (HVI) cabling is not properly fastened

Pages 2-57 - 2-65 deleted.

Figure 2-15.1. WCN Cautions

Priority	Annunciation	Description
1	CICU FAIL	Critical CICU or CICU Processor Failure.
2	TGP LASER/INV CONFLICT	An inventory condition exists that indicates it is dangerous to fire the laser.
3	ALM FAIL	Critical Failure Reported from the ALM.
4	28VDC ISA FAIL	Main 28VDC power voltage suppression circuitry failure.
5	ISA EMERGENCY JETT FAIL	Essential power voltage suppression circuitry failure.
6	ALL WEAPONS FAIL	All Weapon Stations failed and all armament outputs disabled.
7	ODD STATIONS FAIL	Odd Weapon Stations failed and odd armament outputs disabled.
8	EVEN STATIONS FAIL	Even Weapon Stations failed and even armament outputs disabled.
9	RELEASE ABORTED	Weapons release aborted during ripple release.
10 510	IFF FAILURE	Critical Failure Reported from the IFF.
11	CHECK MASTER ARM	Switch in inappropriate position at system power on.
12	CHECK GND SAFETY ORIDE	Switch in inappropriate position at system power on.
13	CHECK GUN ARM	Switch in inappropriate position at system power on.
14	CHECK PICKLE	Switch in inappropriate position at system power on.
15	CHECK LASER ARM	Laser arm switch and TGP laser arm state do not agree.
16	MASTER ARM FAIL	Failure of the Master Arm logic detected.
17	LASER CODE MISMATCH	TGP LASER code does not match LGB profile LASER code.
18	GUN ARM FAIL	Failure of the Gun Arm logic detected.
19 510	IFF NOT READY	IFF Not Communicating on the 1553.
20	IFFCC AV3 NOT READY	IFFCC Failure of 1553 Communication on Avionics Bus 3.
21	EGI AV3 NOT READY	EGI Failure of 1553 Communication on Avionics Bus 3.
22	CDU NOT READY	CDU Not Communicating on the 1553.
23	CADC NOT READY	CADC Not Communicating on the 1553.
24	LEFT MFCD NOT READY	Left MFCD Not Communicating on the RS-422.
25	RIGHT MFCD NOT READY	Right MFCD Not Communicating on the RS-422.
26	TGP NOT READY	Targeting Pod Not Communicating on the 1553.
27	HMCS NOT READY	HMCS Not communicating with CICU on the Ethernet.
28	EPLRS NOT READY	EPLRS LRU current status is Not Communicating on the Ethernet.
29 515	IDM NOT READY	IDM Not Communicating on the RS-422.
30 513	ARC-210 (X) NOT READY	The associated ARC-210 is not communicating on the 1553.
31 514	DVADR NOT READY	DVADR is not communicating on the Ethernet.
32	CMSP NOT READY	CMSP is Not Communicating on the 1553.
33	JDAM NOT READY STATION 3	JDAM on WS3 Not Communicating on the 1553.

Figure 2-15.1. WCN Cautions - Continued

Priority	Annunciation	Description
34	JDAM NOT READY STATION 4	JDAM on WS4 Not Communicating on the 1553.
35	JDAM NOT READY STATION 5	JDAM on WS5 Not Communicating on the 1553.
36	JDAM NOT READY STATION 7	JDAM on WS7 Not Communicating on the 1553.
37	JDAM NOT READY STATION 8	JDAM on WS8 Not Communicating on the 1553.
38	JDAM NOT READY STATION 9	JDAM on WS9 Not Communicating on the 1553.
39	WCMD NOT READY STATION 3	WCMD on WS3 Not Communicating on the 1553.
40	WCMD NOT READY STATION 4	WCMD on WS4 Not Communicating on the 1553.
41	WCMD NOT READY STATION 5	WCMD on WS5 Not Communicating on the 1553.
42	WCMD NOT READY STATION 7	WCMD on WS7 Not Communicating on the 1553.
43	WCMD NOT READY STATION 8	WCMD on WS8 Not Communicating on the 1553.
44	WCMD NOT READY STATION 9	WCMD on WS9 Not Communicating on the 1553.
45	1760 NOT READY STATION 3	1760 on WS3 Not Communicating on the 1553.
46	1760 NOT READY STATION 4	1760 on WS4 Not Communicating on the 1553.
47	1760 NOT READY STATION 5	1760 on WS5 Not Communicating on the 1553.
48	1760 NOT READY STATION 7	1760 on WS7 Not Communicating on the 1553.
49	1760 NOT READY STATION 8	1760 on WS8 Not Communicating on the 1553.
50	1760 NOT READY STATION 9	1760 on WS9 Not Communicating on the 1553.
51 513	ARC-210 (X) FAIL	The associated ARC-210 is reporting a Critical Failure.
52 513	ARC-210 TAKE CTRL FAIL	The ALM is reporting a Take Control failure.
53 513	ARC-210 (X) 1553 FAIL	The associated ARC-210 1553 data cannot be trusted.
54 514	DVADR FAIL	DVADR Recorder or Time Code feature is reporting a Critical Failure.
55 514	DVADR CONFIG FAIL	DVADR Recorder or Time Code feature is reporting a Critical Failure associated with the loaded DVADR configuration or setup.
56	LEFT MFCD FAIL	Critical Failure Reported in Left MFCD Status.
57	RIGHT MFCD FAIL	Critical Failure Reported in Right MFCD Status.
58	TGP FAIL	Critical Failure Reported in TGP Status.
59	EPLRS INOP	Critical Failure Reported in EPLRS Status.
60 515	IDM INOP	IDM is inoperable.
61	MASTER ARM SWTCH FAIL	Master Arm Switch detected in invalid state.
62	GUN TRIGGER FAIL	Gun Trigger detected in invalid state.
63	WEAPON RELEASE STUCK KEY	Weapon Release Button Stuck Key detected.
64	LASER ARM SWITCH FAIL	Laser Arm Switch detected in invalid state.
65	ALM POWER FAIL	Internal ALM Power Supplies are out of tolerance.
66	TMS SWITCH FAIL	TMS Switch detected in invalid state.

Figure 2-15.1. WCN Cautions - Continued

Priority	Annunciation	Description
67	DMS SWITCH FAIL	DMS Switch detected in invalid state.
68	SLEW FAIL	Slew input commands from the Throttle are out of tolerance or unreliable.
69	COOLIE SWITCH FAIL	Coolie Switch detected in invalid state.
70	BOAT SWITCH FAIL	Boat Switch detected in invalid state.
71	CHINA HAT SWITCH FAIL	China Hat Switch detected in invalid state.
72 513	ARC-210 (X) COMSEC FAIL	The associated ARC-210 has had the crypto keys zeroized.
73	JDAM FAIL STATION 3	Critical Failure Reported in JDAM Status on Station 3.
74	JDAM FAIL STATION 4	Critical Failure Reported in JDAM Status on Station 4.
75	JDAM FAIL STATION 5	Critical Failure Reported in JDAM Status on Station 5.
76	JDAM FAIL STATION 7	Critical Failure Reported in JDAM Status on Station 7.
77	JDAM FAIL STATION 8	Critical Failure Reported in JDAM Status on Station 8.
78	JDAM FAIL STATION 9	Critical Failure Reported in JDAM Status on Station 9.
79	WCMD FAIL STATION 3	Critical Failure Reported in WCMD Status on Station 3.
80	WCMD FAIL STATION 4	Critical Failure Reported in WCMD Status on Station 4.
81	WCMD FAIL STATION 5	Critical Failure Reported in WCMD Status on Station 5.
82	WCMD FAIL STATION 7	Critical Failure Reported in WCMD Status on Station 7.
83	WCMD FAIL STATION 8	Critical Failure Reported in WCMD Status on Station 8.
84	WCMD FAIL STATION 9	Critical Failure Reported in WCMD Status on Station 9.

Figure 2-15.1. WCN Cautions - Continued

Priority	Name	Annunciation	Description
85	JDAM 3 JPF Fail	JDAM JPF FAIL STATION 3	JPF Failure Reported from JDAM on Station 3.
86	JDAM 4 JPF Fail	JDAM JPF FAIL STATION 4	JPF Failure Reported from JDAM on Station 4.
87	JDAM 5 JPF Fail	JDAM JPF FAIL STATION 5	JPF Failure Reported from JDAM on Station 5.
88	JDAM 7 JPF Fail	JDAM JPF FAIL STATION 7	JPF Failure Reported from JDAM on Station 7.
89	JDAM 8 JPF Fail	JDAM JPF FAIL STATION 8	JPF Failure Reported from JDAM on Station 8.
90	JDAM 9 JPF Fail	JDAM JPF FAIL STATION 9	JPF Failure Reported from JDAM on Station 9.
91	ARC-210 (X) SATCOM Fail	ARC-210 (X) SATCOM FAIL	The associated ARC-210 is reporting a HPA failure. **NOTE** Fault only applicable to ARC-210-1.
92	ARC-210 (X) Degraded	ARC-210 (X) DEGRADED	The associated ARC-210 is reporting a Non-Critical Failure.
93	TRIG 1ST Stuck Key	TRIGGER 1ST STUCK KEY	TRIG 1ST Detent Stuck Key detected.
94	TRIG 2ND Stuck Key	TRIGGER 2ND STUCK KEY	TRIG 2ND Detent Stuck Key detected.
95	TMS Stuck Key	TMS SWITCH STUCK KEY	TMS Switch Stuck Key detected.
96	DMS Stuck Key	DMS SWITCH STUCK KEY	DMS Switch Stuck Key detected.
97	Slew Stuck Key	SLEW SWITCH STUCK KEY	Slew Switch Stuck Key detected.
98	Coolie Stuck Key	COOLIE SWITCH STUCK KEY	Coolie Switch Stuck Key detected.
99	China Hat Stuck Key	CHINA HAT SWITCH STUCK KEY	China Hat Switch Stuck Key detected.

Figure 2-15.1. WCN Cautions - Continued

Priority	Annunciation	Description
100	LEFT MFCD STUCK KEY	Left MFCD Stuck Key.
101	RIGHT MFCD STUCK KEY	Right MFCD Stuck Key.
102	AV2 FAIL	Failure of the AV2 Bus.
103	AV3 FAIL	Failure of the AV3 Bus.
104	1760 FAIL	Failure of the 1760 Bus.
105	CICU DEGRADED	Non-Critical CICU or CICU Processor Failure.
106	ALM DEGRADED	Degraded ALM Condition detected.
107	GVM VIDEO FAIL	Error in GVM input, output, or channel A, B, and or C detected.
108 $\boxed{510}$	IFF DEGRADED	Degraded IFF Condition detected.
109	CICU OVER TEMP	CICU Over Temperature indication detected.
110	LEFT MFCD OVER TEMP	Left MFCD Over Temperature.
111	RIGHT MFCD OVER TEMP	Right MFCD Over Temperature.
112	JDAM GPS FAIL STATION 3	GPS Failure reported from the JDAM on WS3.
113	JDAM GPS FAIL STATION 4	GPS Failure reported from the JDAM on WS4.
114	JDAM GPS FAIL STATION 5	GPS Failure reported from the JDAM on WS5.
115	JDAM GPS FAIL STATION 7	GPS Failure reported from the JDAM on WS7.
116	JDAM GPS FAIL STATION 8	GPS Failure reported from the JDAM on WS8.
117	JDAM GPS FAIL STATION 9	GPS Failure reported from the JDAM on WS9.
118	JDAM TM FAIL STATION 3	Telemetry Failure reported from the JDAM on WS3.
119	JDAM TM FAIL STATION 4	Telemetry Failure reported from the JDAM on WS4.
120	JDAM TM FAIL STATION 5	Telemetry Failure reported from the JDAM on WS5.
121	JDAM TM FAIL STATION 7	Telemetry Failure reported from the JDAM on WS7.
122	JDAM TM FAIL STATION 8	Telemetry Failure reported from the JDAM on WS8.
123	JDAM TM FAIL STATION 9	Telemetry Failure reported from the JDAM on WS9.
124	WCMD TM FAIL STATION 3	Telemetry Failure reported from the WCMD on WS3.
125	WCMD TM FAIL STATION 4	Telemetry Failure reported from the WCMD on WS4.
126	WCMD TM FAIL STATION 5	Telemetry Failure reported from the WCMD on WS5.
127	WCMD TM FAIL STATION 7	Telemetry Failure reported from the WCMD on WS7.
128	WCMD TM FAIL STATION 8	Telemetry Failure reported from the WCMD on WS8.
129	WCMD TM FAIL STATION 9	Telemetry Failure reported from the WCMD on WS9.
130	ANALOG INPUT FAIL	Analog Inputs failed and ignored.
131	ANALOG OUTPUT FAIL	Analog Outputs failed and disabled.
132	FUEL QUANTITY FAIL	Fuel Quantity signal out of tolerance.
133	AIM9 SEEKER FAIL	AIM9 seeker values out of tolerance.
134	MAV GIMBAL FAIL	Maverick gimbal values out of tolerance.

Figure 2-15.1. WCN Cautions - Continued

Priority	Annunciation	Description
135	TGP TRACKER FAIL	Targeting Pod Tracker Failure.
136	TGP VIDEO FAIL	Targeting Pod Video Failure.
137	TGP FLIR FAIL	Targeting Pod FLIR Failure.
138	TGP LASER FAIL	Targeting Pod Laser Failure.
139	TGP LASER DES FAIL	Targeting Pod Laser Designator Failure.
140	TGP LASER SPOT FAIL	Targeting Pod Laser Spot Detector Failure.
141	TGP LASER RANGER FAIL	Targeting Pod Laser Range Detector Failure.
142	TGP BORESIGHT FAIL	Targeting Pod Laser Boresight Failure.
143	TGP ECU FAIL	Targeting Pod ECU Failure.
144	TGP OVER TEMP	Targeting Pod Temperature Overheating.
145	TGP HIGH PRESSUR FAIL	Targeting Pod High Pressure.
146	TGP LASER MARKER FAIL	Targeting Pod Laser Marker Failure.
147	TGP CID FAIL	Targeting Pod CID Failure.
148	TGP DEGRADED	Targeting Pod Degraded.
149	HMCS DEGRADED	HMCS Degraded
150	EPLRS DEGRADED	EPLRS Radio Degraded.
151	RMMD EJECT FAIL	RMMD failed to unmount properly.
152	TGP BUS A FAIL	Error in the Transmit Status Mode Code occurred on Channel A only for 3 consecutive message transmissions.
153	TGP BUS B FAIL	Error in the Transmit Status Mode Code occurred on Channel B only for 3 consecutive message transmissions.
154	TGP AUTOLASE FAIL	Interlocks not set for TGP Autolase mode to function.
155	TGP HOME FAIL	TGP failed to return to the Home Position within specified time.
156	LASER DES CODE INVALID	Invalid designator code entered.
157	LASER TRACK CODE INVALID	Invalid track code entered.
158	IFF UPDATE TIMEOUT	An IFF OSB not associated with Mode 4 failed to update with the current control message.
159	IFF MISMATCH	The status message being sent from the IFF updated a signal not associated with Mode 4 unexpectedly.
160	IFF WOW UPDATE FAIL	The IFF has failed to transition its internal Weight on Wheels state to match that indicated by the CICU.
161	IFF DEFAULT MS INVALID	The Default Mode S Address or the Default Flight ID stored on the CICU is invalid.
162	IFF GND RAD FAIL	The IFF ground radiation function failed to transition to OFF within 60 ±5 seconds.
163	IFF BUS A FAIL	1553 Channel A Failure for the IFF.
164	IFF BUS B FAIL	1553 Channel B Failure for the IFF.
165	ARC-210 (X) BUS A FAIL	1553 Channel A failure for the associated ARC-210.

Figure 2-15.1. WCN Cautions - Continued

Priority	Annunciation	Description
166	ARC-210 (X) BUS B FAIL	1553 Channel B failure for the associated ARC-210.
167	CMSP BUS A FAIL	1553 Channel A failure for the CMSP.
168	CMSP BUS B FAIL	1553 Channel B failure for the CMSP.
169	WS3 BUS A FAIL	Error in the Transmit Status Mode Code occurred on Channel A only for 3 consecutive message transmissions.
170	WS4 BUS A FAIL	Error in the Transmit Status Mode Code occurred on Channel A only for 3 consecutive message transmissions.
171	WS5 BUS A FAIL	Error in the Transmit Status Mode Code occurred on Channel A only for 3 consecutive message transmissions.
172	WS7 BUS A FAIL	Error in the Transmit Status Mode Code occurred on Channel A only for 3 consecutive message transmissions.
173	WS8 BUS A FAIL	Error in the Transmit Status Mode Code occurred on Channel A only for 3 consecutive message transmissions.
174	WS9 BUS A FAIL	Error in the Transmit Status Mode Code occurred on Channel A only for 3 consecutive message transmissions.
175	WS3 BUS B FAIL	Error in the Transmit Status Mode Code occurred on Channel B only for 3 consecutive message transmissions.
176	WS4 BUS B FAIL	Error in the Transmit Status Mode Code occurred on Channel B only for 3 consecutive message transmissions.
177	WS5 BUS B FAIL	Error in the Transmit Status Mode Code occurred on Channel B only for 3 consecutive message transmissions.
178	WS7 BUS B FAIL	Error in the Transmit Status Mode Code occurred on Channel B only for 3 consecutive message transmissions.
179	WS8 BUS B FAIL	Error in the Transmit Status Mode Code occurred on Channel B only for 3 consecutive message transmissions.
180	WS9 BUS B FAIL	Error in the Transmit Status Mode Code occurred on Channel B only for 3 consecutive message transmissions.
181	EGI BUS A FAIL	1553 Channel A Failure for the EGI.
182	EGI BUS B FAIL	1553 Channel B Failure for the EGI.
183	IFFCC BUS A FAIL	1553 Channel A Failure for the IFFCC.
184	IFFCC BUS B FAIL	1553 Channel B Failure for the IFFCC.
185	TGP LASER NOT FIRING	Laser is not firing with only Ranging Laser selected or "both" selected.
186	TGP MARKER NOT FIRING	Marker is not firing with only IR Pointer selected or "both" selected.
187	CU TERMINATE	Controlling Unit Change Termination.
188	CU CHANGE	Controlling Unit Change.
189	SALVO/CLEAR A/C	Salvo/Clear Aircraft Order - WILCO/CNTCO keys provided only if addressed to own unit (can be broadcast).
190	MSN CANCELLED	Mission Assignment (MA) Cancellation (if Current MA).
191	NEW MSN ASSIGN	New MA - WILCO/CNTCO keys provided.

Figure 2-15.1. WCN Cautions - Continued

Priority	Annunciation	Description
192	CANCEL ACT MS	MA Cancellation (if active, but not Current MA).
193	GO TO VOICE	Go To Voice Order, Addressed to Own Flight -WILCO/CNTCO keys provided.
194	NEW APTD RQST (XXXXXXXX)	New APTD RQST received.
195	LAR TIME OUT	LAR Algorithm execution exceeded allotted time.

Figure 2-15.2. WCN Notes

Priority	Annunciation	Description
1	WILC CNTC REQD	WILCO/CNTCO Required - Generated if WILCO/CNTCO keys are displayed but related "Warnings 2" WCN has not been acknowledged. Cannot be acknowledged in order to meet APIS requirement for Alert Category 1 response. Removed only if condition no longer true.
2	STL DATA	Mission Assignment Objective Stale Data.
3	NEW EMER PT	New Emergency Point.
4	FLT WILC	Flight Member WILCO Response to Pending MA, MA Cancellation, Go To Voice Order, or Salvo/Clear Aircraft Order.
5	FLT CNTC	Flight Member CNTCO Response to Pending MA, MA Cancellation, Go To Voice Order, or Salvo/Clear Aircraft Order.
6	FLT CNTP	Flight Member CANTPRO Response to Pending MA, MA Cancellation, Go To Voice Order, or Salvo/Clear Aircraft Order.
7	FLT MBR DSNG	Flight Member Disengagement.
8	MA ORIG BDA	BDA received from the originator of an active received MA.
9	FLT MBR BDA	Flight Member BDA.
10	FLT MBR ASGN	Flight Member Assignment. MA Record is added to the DB based on a received engagement status message from a Flight Member whose objective and MA type were not previously contained in DB.
11	TGT IDNT CHNG	Identity Difference (when to/from hostile when current MA objective - see related Cat 3 alert).
12	SALV CLR AC	Salvo/Clear Aircraft Order, Addressed to All Parties. Received on the Collective Address, i.e. the Addressee TN =00177.
13	GO TO VO	Go To Voice Order, Addressed to All Parties. Received on the Collective Address, i.e. the Addressee TN =00177.
14	DSNG RSPS RCVD	Disengage Received for Transmitted MA.
15	BDA RSPS RCVD	TDL BDA received from the MA addressee (or a MA addressee flight member) of an active sent TDL MA or TDN BDA received for an active or current TDN MA excluding BDA received from the originator of the MA.
16	MA WILC RCVD	Operator Response WILCO Received to Transmitted MA.
17	MA CNTC RCVD	Operator Response CNTCO Received to Transmitted MA.
18	MA CNTP RCVD	Operator Response CANTPRO Received to Transmitted MA.

Figure 2-15.2. WCN Notes - Continued

Priority	Annunciation	Description
19	CANC WILC RCVD	Operator Response WILCO Received to Transmitted MA Cancellation.
20	CANC CNTC RCVD	Operator Response CNTCO Received to Transmitted MA Cancellation.
21	CANC CNTP RCVD	Operator Response CANTPRO Received to Transmitted MA Cancellation.
22	IDNT DIFF	Identity Difference (unless to/from hostile when current MA objective - see related Cat 2 alert).
23	MA NO OPR	No Operator Response Received to Transmitted MA.
24	CANC NO OPR	No Operator Response Received to Transmitted MA Cancellation.
25	ADDL MSN DATA	Additional Mission Data Received for a MA.
26	EMER PT CANC	Emergency Point Deactivated.
27	APTD (X)	Aircraft Position and Target Designation Message Received.
28	CANX APTD RQST	Aircraft Position and Target Designation Message Received with request set to STOP.
29	MSG (x)	Text Message(s) Received that have not been previously acknowledged.
30	IMG	Image Message Received.
31	IMG PART	Partial Image Message Received.
32	DIP (X)	Depart Initial Point Message Received
33	AOS (X)	Aircraft On-Station Message Received
34	NEW FRND RPT (X)	VMF Friendly Report Received
35	CHNG LSR SW	Cannot Fire combat Laser in A-A with XR.
36	TGP MARK DEGR	Targeting Pod Laser Marker Degraded.
37	TGP LSD DEGR	Targeting Pod Spot Detector Degraded.
38	TGP VID DEGR	Targeting Pod Video Degraded.
39	TGP CID DEGR	Targeting Pod CID Degraded.
40	LMFD DEGR	Left MFCD Degraded.
41	RMFD DEGR	Right MFCD Degraded.
42	EPLR BATT LOW	EPLRS Battery Low.
43	EPLR KEY FAIL	EPLRS Cryptographic or TRANSEC Key Invalid.
44	NVM FAIL	Data retrieval from NVM Failed.
45	RMMD EJCT COMP	The RMMD was successfully unmounted by the CICU and the DVADR.
46	IFF PROF (X) LOAD	IFF Profile (X) has been automatically triggered.
47	NO SPI	No SPI is available for current SOI or CDU.
48	TGP TRCK ERR	TGP has not changed to selected submode.
49	TGP TRCK POL ERR	Track polarity does not match the selected track polarity.
50	TGP GAIN ERR	Gain does not match selected gain.
51	TGP FLIR POL ERR	FLIR display polarity does not match selected FLIR polarity.
52	TGP SNSR ERR	TGP sensor does not match the selected sensor.

Figure 2-15.2. WCN Notes - Continued

Priority	Annunciation	Description
53	TGP FOV ERR	Field-of-view does not match selected field-of-view.
54	FLIR CAL NO STRT	FLIR calibration does not match selected FLIR calibration.
55	SRVC MODE NO STRT	TGP has not entered Service submode.
56	TGP INT TIME OUT	TGP has not changed to requested Integration time.
57	TGP CAL TIME OUT	TGP FLIR calibration has taken too long.
58	TGP BRST TIMEOUT	TGP has not changed to requested Autoboresight.
59	TGP CUE TIME OUT	Cue TGP to helmet LOS has taken too long.
60	COPY FAIL	Waypoint copy request failed.
61	CHCK EO TIME	Advisory to pilot indicating that the Mavericks have been powered on for greater than 60 minutes.
62	CHCK EO WYPT	Valid data for the entered EO Waypoint was not found in the CDU.
63	CHCK TGP MODE	TGP has not changed to selected mode.
64	CHCK LSR TYPE	TGP has not changed to selected designator type.
65	CHCK TGP STN	Error in detecting TGP mounting location.
66	AIM9 MODE	AIM-9 Mode does not match the selected mode.
67	DSMS STAT	Weapon status or failure detected in DSMS.
68	DSMSINVT ____ CMBT	Combat inventory mismatch or failure detected in the DSMS.
69	DSMSINVT TRN	Training inventory mismatch or failure detected in the DSMS.
70	DSMS PROF ____ CMBT	Combat profile mismatch or failure detected in the DSMS.
71	DSMS PROF ____ TRN	Training profile mismatch or failure detected in the DSMS.
72	CHCK TDL CNFG	The DL Parameters loaded from NVM or DTS are invalid.
73	IAM3 KEY CHK- SUM	The IAM on WS3 reported a crypto key checksum failure.
74	IAM4 KEY CHK- SUM	The IAM on WS4 reported a crypto key checksum failure.
75	IAM5 KEY CHK- SUM	The IAM on WS5 reported a crypto key checksum failure.
76	IAM7 KEY CHK- SUM	The IAM on WS7 reported a crypto key checksum failure.
77	IAM8 KEY CHK- SUM	The IAM on WS8 reported a crypto key checksum failure.
78	IAM9 KEY CHK- SUM	The IAM on WS9 reported a crypto key checksum failure.
79	UP LOAD PAGE FAIL	Failure occurred during the MFCD Page Selections DTS Upload.
80	UP LOAD TAD FAIL	Failure occurred during the TAD Profiles DTS Upload.
81	UP LOAD DSMS FAIL	Failure occurred during the DSMS Data DTS Upload.
82	UP LOAD TGP FAIL	Failure occurred during the TGP Configuration DTS Upload.
83	UP LOAD GPS FAIL	Failure occurred during the GPS Keys DTS Upload.
84	UP LOAD DP FAIL	Failure occurred during the Data Pump Initialization DTS Upload.
85	UP LOAD TDL FAIL	Failure occurred during the Data Link Configuration DTS Upload.
86	UP LOAD IFF FAIL	Failure occurred during the IFF Configuration DTS Upload.
87	UP LOAD OVER FAIL	Failure occurred during the TAD Map Overlays DTS Upload.

Figure 2-15.2. WCN Notes - Continued

Priority	Annunciation	Description
88	DOWN LOAD MSG FAIL	Failure occurred during the DL Message Download (excludes MDTC Full).
89	DOWN LOAD MSG FULL	Failure occurred during the DL Message Download (MDTC Full).
90	RAD LOAD FAIL	Failure occurred during the ARC-210 Configuration Upload.
91	RAD X FILL FAIL	Failure occurred during ARC-210-1 (1) or ARC-210-2 (2) Black Fill.
92	UP LOAD THRT FAIL	Failure occurred during the Threat Data Upload.
93	UP LOAD HMCS FAIL	Failure occurred during the HMCS Profiles DTS Upload.
94	UP LOAD HMCS ERR	Invalid parameter defined in HMCS Profiles DTS Upload.
95	UP LOAD IMG FAIL	Failure occurred during the Pre-canned image upload.
96	IAM3 KEY LOAD FAIL	IAM on WS3 indicated that it did not successfully receive crypto keys.
97	IAM4 KEY LOAD FAIL	IAM on WS4 indicated that it did not successfully receive crypto keys.
98	IAM5 KEY LOAD FAIL	IAM on WS5 indicated that it did not successfully receive crypto keys.
99	IAM7 KEY LOAD FAIL	IAM on WS7 indicated that it did not successfully receive crypto keys.
100	IAM8 KEY LOAD FAIL	IAM on WS8 indicated that it did not successfully receive crypto keys.
101	IAM9 KEY LOAD FAIL	IAM on WS9 indicated that it did not successfully receive crypto keys.
102	IAM3 ERSE FAIL	IAM on WS3 indicated that it did not successfully complete the commanded erase.
103	IAM4 ERSE FAIL	IAM on WS4 indicated that it did not successfully complete the commanded erase.
104	IAM5 ERSE FAIL	IAM on WS5 indicated that it did not successfully complete the commanded erase.
105	IAM7 ERSE FAIL	IAM on WS7 indicated that it did not successfully complete the commanded erase.
106	IAM8 ERSE FAIL	IAM on WS8 indicated that it did not successfully complete the commanded erase.
107	IAM9 ERSE FAIL	IAM on WS9 indicated that it did not successfully complete the commanded erase.
108	TDL CON FIG FAIL	Failure occurred during the data link configuration process.
109	DSMSPROF ERR	IFFCC Profile Checksum Echo did not match the Profile Checksum sent to IFFCC.
110	SEL JETT CHK-SUM	IFFCC Selective Jettison Checksum Echo did not match the Selective Jettison Checksum sent to IFFCC.
111	DSMSPROF FULL	The DSMS profile database is full.
112	DSMSDUP PROFNAME	A profile name was entered that already existed in the database.
113	DSMS DFLT PROF INVL	An invalid parameter from a DTS load of default profiles has been replaced with a valid value.
114	TAD PROF FULL	The TAD profile database is full.
115	SADL PROF FULL	The SADL profile database is full.

Figure 2-15.2. WCN Notes - Continued

Priority	Annunciation	Description
116	VMF PROF FULL	The VMF profile database is full.
117	TGP XR ERR	TGP XR state does not match the selected state.
118	TGP SLV STPT INV	The Targeting pod was commanded to slave to a steerpoint that is not valid. Can occur if the STPT is not defined, the STPT is defined with and invalid elevation, or the CDU is not communicating.
119	TGP IO FAIL	A failure was identified in the TGP Weapon Station Interface.
120	CHCK MFL	A failure was identified that requires maintainer action post-flight.
121	TGP LMZ ERR	Laser Mask Zone does not match commanded setting.
122	TGP YRD STK ERR	A failure was detected in TGP Yardstick ON/OFF or Units setting.
123	WS3 IO FAIL	An I/O failure was identified in the Weapon Station Interface.
124	WS4 IO FAIL	An I/O failure was identified in the Weapon Station Interface.
125	WS5 IO FAIL	An I/O failure was identified in the Weapon Station Interface.
126	WS7 IO FAIL	An I/O failure was identified in the Weapon Station Interface.
127	WS8 IO FAIL	An I/O failure was identified in the Weapon Station Interface.
128	WS9 IO FAIL	An I/O failure was identified in the Weapon Station Interface.
129	EVE >50	Estimated Vertical Position Error is greater than 50 ft for 10 consecutive minutes.
130	EVE <50	Estimated Vertical Position Error is less than 50 ft for 60 consecutive seconds.
131	IFF M3AC NOT UPDT	The Mode 3/A and Mode C enable settings are not updated when the profile or cartridge was loaded because the AIR/GND OSB was set to AIR.
132	IFF MS NOT UPDT	The Mode S Enable settings are not updated when the profile or cartridge was loaded because the Default Mode S Address was INVALID.
133	PPLI OVFL	Precise Participant Location and Identification (PPLI) Database Full (Discarding Data).
134	IMG FILE ID ERR	An error occurred during the processing of the image.id file on the mass memory device.
135	RMMD MSN FULL	RMMD mission data partition is at capacity and no new data can be written.
136	RMMD VID FULL	RMMD video recording partition is at capacity and no new data can be written.
137	PPLI 90% FULL	PPLI Database 90% Full.
138	TEXT FULL	Text Message Database 100% Full.
139	MA FULL	MA Message Database 100% Full.
140	IMG FULL	IMG Message Database 100% Full.
141	PEND MA FULL	Pending (Draft) MA Message Database Full.
142	PEND TEXT FULL	Pending (Draft) Text Message Database Full.
143	PEND IMG FULL	Pending (Draft) IMG Message Database Full.

Figure 2-15.2. WCN Notes - Continued

Priority	Annunciation	Description
144	ACT RCVD MA FULL	Maximum number of Active received Mission Assignments reached. Operator cannot receive any new Mission Assignments until others are closed out.
145	ACT SENT MA FULL	Maximum number of Active sent Mission Assignments reached. Operator cannot transmit any new Mission Assignments until others are closed out.
146	RMMD MSN 90% FULL	RMMD mission data partition is at 90% of capacity.
147	RMMD VID NEAR FULL	RMMD video recording partition is almost (95%) full.
148	TEXT 90% FULL	Text Message Database 90% Full.
149	MA 90% FULL	MA Message Database 90% Full.
150	IMG 90% FULL	IMG Message Database 90% Full.
151	TGT DB FULL	TDL Target Sorting Database Full.
152	MULT FLT LEAD	Multiple Flight Leader Indicators Active in Flight.
153	DUP LIST ENTR	Duplicate Track Number / Call Sign / URN Entry (flight member, donor, VMF Participant lists).
154	IFF MS ADDR DFLT	The IFF Mode S Address value has been reset to the Default Mode S Address.
155	IFF RAD TIME OUT	The IFF has failed to enter into Radiation Test mode.
156	LAR EXCP	LAR Algorithm exited due to a software exception.
157	TGP MENU FLT	The TGP is reporting a fault condition or error related to a function accessed via the TGP Menu structure.
158	JPF INVT ERR	JDAM manual profile selected with DSMS JPF = ON and inventory does not have a JDAM with tail fuze of FMU-152.
159	TGP MENU TIME OUT	When the communication between the TGP and the CICU exceeds the limit for the command and response, then this NOTE will be displayed.
160	TGP MENU ENTR ERR	When the TGP abnormally enters the TGP Menu State, then this NOTE will be displayed.
161	TGP MENU EXIT ERR	When the TGP abnormally exits the TGP Menu State, then this NOTE will be displayed.
162	OVER LAY LOAD COMP	Map Overlay Upload Complete.
163	CMSP FLT	The CMSP is reporting a fault condition.
164	CMDS FLT	The CMDS is reporting a fault condition.
165	RWR FLT	The RWR is reporting a fault condition.
166	MWS FLT	The MWS is reporting a fault condition.
167	ECM POD FLT	An ECM POD is reporting a fault condition.
168	TSPI FILE LIMT	The last TSPI recording file index was the largest possible (99).

Figure 2-15.3. MFCD Priority Notes

Priority	Text	Description
(These priority notes are acknowledgeable and located in the lower center of both MFCDs in white reverse video)		
1	PRESS EJECT AGAIN FOR RMMD UNMOUNT	Used to confirm a RMMD eject when the system detects that the DVADR is in recording mode.
2	PRESS RESET AGAIN FOR DVADR RESET	Used to confirm a DVADR reset when the system detects that the DVADR is in recording mode.
3	PRESS SRC AGAIN TO SWAP MAP SOURCE	Used to confirm a map source switch selection from FLASH to RMMD or from RMMD to FLASH.

AIR REFUELING PROCEDURES.

The tanker boom is controlled by the boom operator while the fuel transfer (pressure, flow, quantity, etc.) is controlled by the tanker crew from the pilot's compartment. In Instrument Meteorological Conditions (IMC), when visibility is such that Lost Wingman Procedures may be necessary, receiver formations and the refueling sequence will be structured so that no more than three aircraft are on each wing of the tanker.

FINGERTIP FORMATION.

Normally, the leader will proceed to the precontact position. Number 2 will proceed to the lead element's observation position. The second element will proceed to an observation position on the tanker's opposite wing. Each subsequent receiver will visually clear and move from the observation position to the precontact position. The refueling sequence will be designated by the receiver leader. Each receiver, after refueling is completed, will rejoin to an outside wing position of his original element. When all receivers have completed refueling, the receiver force will rejoin to the left or right, as briefed, and slightly below the tanker.

ECHELON FORMATION VISUAL METEOROLOGICAL CONDITIONS (VMC ONLY).

Normally, the leader will proceed to the precontact position. Number 2 will proceed to the observation position with the remainder of the flight. Refueling sequence will be as directed by receiver leader. Each receiver will visually clear and move from the observation position to the precontact position. The receivers, after refueling is completed, will rejoin in echelon formation on the tanker's opposite wing.

FUEL MANAGEMENT.

Precautions to insure adequate internal fuel available to complete the refueling operation will be taken prior to attempting contact with the tanker. The fuel system operation is automatic, fuel being distributed to the main and wing tanks. The tank gate switch is positioned to CLOSE to preclude an imbalance. Through the use of fill disable switches, fuel can be prevented from entering any internal tank suspected of being damaged.

During the air refuel line check or the purge cycle after refueling, air pressure is directed into the air refuel manifold. In order to supply sufficient air pressure one engine must be operating above 85% core RPM or the APU must be in operation.

PRECONTACT.

All precontact air refueling checks will be completed in the observation position or prior to reaching 1 NM in trail, except for final exterior light adjustment. After stabilizing in the precontact position, move to the contact position.

WARNING

- The receiver will stabilize in the precontact position and attain a zero rate of closure. If the receiver fails to attain stabilized position, or it becomes apparent that a closure overrun will occur, a breakaway will be initiated. Failure to initiate a breakaway under closure overrun conditions can result in a mid-air collision.
- Upwash and downwash effects may occur drawing the aircraft together. Low pressure areas created by an overrunning receiver flying under the tanker will affect static ports causing possible erroneous airspeed and altitude indication to both aircraft. On KC-135 airplanes, the autopilot altitude hold function may sense the low pressure as a climbing indication and initiate a descent into the lower aircraft.

BOOM AND RECEPTACLE PROCEDURES.

NOTE

For night operations prior to closing for contact with the tanker, coordinate with the boom operator on lighting brilliance to avoid impairing night vision.

When cleared, move forward to the contact position and the boom operator will make contact. The receiver may request assistance from the boom operator in obtaining and maintaining position. Upon contact, check the air refuel lights for illuminated LATCHED light; intercommunication system is now enabled (KC-135Q only). The receiver pilot will then state, "(Receiver call sign) contact", and the boom operator will state, "(Tanker call sign) contact", and air refueling will commence. Contact and disconnect will be acknowledged by both the boom operator and receiver pilot.

1. Approaching the boom from the precontact position, the receiver moves slowly forward with a 2-3 knot closure until reaching the contact position. Azimuth alignment is a simple matter of aligning the receptacle with the boom tip. When closing on the boom, constant cross reference between the boom and the tanker fuselage will alleviate any tendency to "chase" variations of boom trail position due to turbulence.

   The boom operator will make contact after the receptacle door is stabilized just below the boom tip.

CAUTION

Attempts to effect a contact during loss of any air refueling lighting that results in less than desired illumination will be at the discretion of the boom operator.

NOTE

Receivers may be reluctant to close with the boom, due to its close proximity to the canopy. The reaction must be anticipated and overcome.

2. If for any reason fuel is not transferring or is transferring at less than normal rate, the receiver pilot will disconnect and approach for another contact.

NOTE

For successive contacts, the pilot must recycle the air refuel system by actuating the air refuel disconnect/reset button (Nosewheel Steering button) on the control stick after each disconnect or closing and opening the slipway door.

DISCONNECT.

When the receiver's tanks are near full, the fuel flow rate will decrease. When the tanks are filled, line pressure will build up and cause a pressure disconnect. Note the illumination of the DISCONNECT light of the Air Refuel Signal, and the extinguishing of the LATCHED light as the boom operator or receiver pilot disconnects. In the event of failure to obtain a contact and after each disconnect, the receiver will move aft and stabilize in a position in trail of the boom or in precontact position reset air refueling system and await clearance from the boom operator to return to the contact position. Upon disconnect, slowly reduce power and drop down and aft. Caution must be exercised in clearing the boom from the receiver to avoid touching the aircraft or surface with the nozzle. After refueling disconnect and when the slipway door is closed, the air refueling manifold forward of the main tank is automatically purged of fuel by air pressure. The READY light will illuminate for up to three minutes during the purge cycle. The fuel in the line is forced into the R-MAIN tank.

CAUTION

- During normal air refueling should an inadvertent disconnect occur when 90% full the receiver pilot will not attempt further contact. It is possible to build up excessive pressure in the air refueling manifold thru further contact attempts. Normal air refueling to 100% capacity is not affected.

- Remain stabilized in the contact position until visually confirming a disconnect has been made. This will prevent damage to the boom and/or receptacle through a brute force disconnect.

- Brute force disconnects can occur unintentionally as the result of rapidly exceeding boom limits or failure of the receptacle toggles to release when a disconnect is initiated.

QUICK FLOW AIR REFUELING PROCEDURES.

Fighter type receivers may use Quick Flow procedures to expedite air refueling operations. Quick Flow allows receivers to minimize refueling time with maximum fuel transfer. Quick Flow may be used during day or night operations, in VMC conditions only. If it appears that the flight may encounter adverse weather conditions, standard IMC procedures will be used. Coordination between tanker(s) and receivers prior to initiation of Quick Flow procedures is required. Air tasking guidance, direct communication with the tanker unit, or adding the term "Quick Flow" to the initial radio call will satisfy coordination requirements. Tanker lead is the final authority for Quick Flow operations. Right echelon formation is normally used for Quick Flow, however, variations are authorized with flight lead coordination and tanker lead approval.

Normally, the receiver flight will join on tanker with the flight lead moving to the pre-contact position. Remaining aircraft will proceed to the right observation position. Once the flight lead commences refueling, the second aircraft in the air refueling sequence will move to the On-Deck Position (Figure 2-16). When the flight lead completes refueling, that aircraft moves to an observation position on the tanker's left wing. The second receiver moves from the On-Deck Position to the pre-contact and contact position. With three or more receivers, the third receiver moves to the On-Deck position. The right-to-left flow continues until all fighters have refueled. When the air refueling operation is complete, the flight may depart the tanker or, if additional refueling is required, remain in echelon formation on the tanker's left wing and reverse the Quick Flow procedures, with a left to right flow. The second receiver will assume a left On-Deck Position and Quick Flow will continue in order. Additional receivers arriving prior to the first flight completing refueling operations, will remain in trail position until they are cleared by the tanker to the observation and/or pre-contact position.

In the event of a breakaway, the On-Deck receiver follows the receiver that was on the boom. Any receivers on the wing will remain with the tanker. In the event a breakaway is initiated while a receiver is transitioning from the observation position to the On-Deck position, that receiver will follow the receiver that was on the boom.

TOBOGGAN.

When altitude and atmospheric conditions result in thrust requirements that exceed the receiver's available thrust, a toboggan will be necessary. The toboggan technique is a coordinated effort between the tanker pilot and the receiver pilot.

1. The receiver pilot must signal for a toboggan before reaching full military thrust.

2. The tanker pilot will very gently reduce thrust and initiate a rate of descent of approximately 300 Feet per Minute (FPM) while maintaining the air refueling airspeed throughout the toboggan maneuver.

3. If the receiver's thrust requirements continue to exceed the thrust capability, an increased rate of descent must be requested.

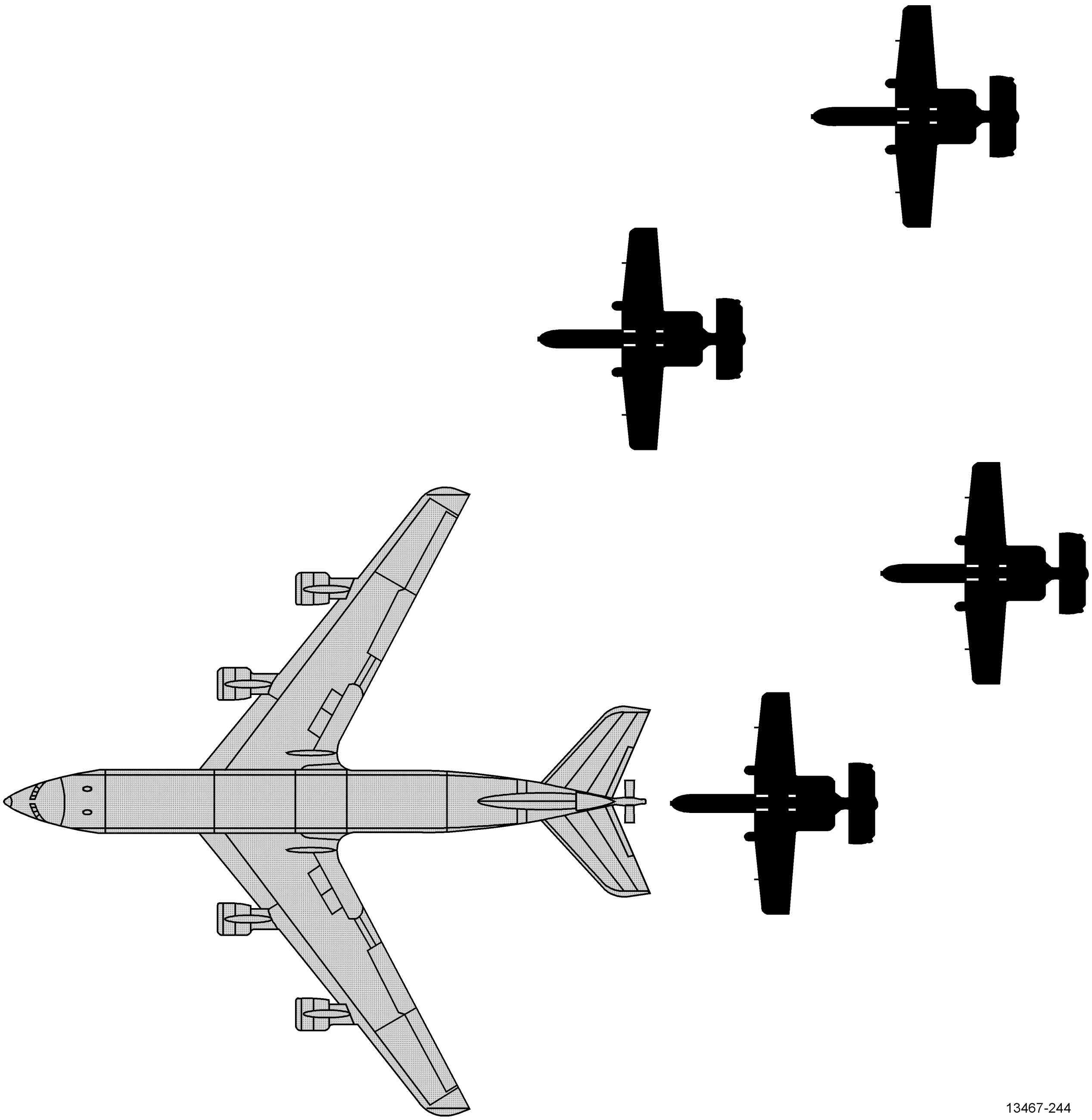


Figure 2-16. Quick Flow Air Refueling

NOTE

One engine must be operating above 85% core RPM or the APU operating to supply sufficient air pressure for the air refuel line check or the automatic purge cycle after air refuel.

REFORM 148.

Receivers will leave the air refueling envelope by dropping aft and down until well clear before moving to their pre-briefed enroute position.

HOT ARMAMENT SAFETY CHECK (IN FLIGHT).

Prior to closing within the armament maximum LAUNCH or FIRING range of the tankers, complete the following checks:

1. AHCP-MASTER armament switch - SAFE.
2. AHCP-GUN/PAC armament switch - SAFE.
3. MFCD - DSMS Missile Page - EO PWR - OFF.
4. AHCP - LASER armament switch - SAFE.
5. MFCD - DSMS Weapon Status Page - DESELECT all applicable stations.

LINE CHECK.

NOTE

At least 3 minutes prior to the first air refueling of each sortie, a Line Check will be accomplished at approximately the air refueling altitude.

1. Air Refueling Door - Check Closed.
2. Engine RPM - At least one engine core RPM minimum 85%.
3. Air Refueling Line Check Button - Depress.

   NOTE

   Fuel may vent momentarily. If venting persists, abort the mission.

4. Ready Light - On (approximately 1-3 minutes).

   Ready light should come on 1-3 minutes after Line Check Button is depressed.

   WARNING

   If ready light does not come on the refuel manifold is damaged, do not refuel unless absolutely necessary.

PRECONTACT CHECKS.

Prior to air refueling, the following checks will be completed:

1. Internal fuel quantity - CHECK.

   Assure sufficient fuel remains internally to complete the refueling attempt with an adequate reserve.

2. IFF - STBY.
3. MFCD - Select IFF page - Set MASTER to STBY.
4. TACAN - REC (A/A with KC-135).
5. ECM - STBY.
6. Refueling light rheostats - ON.

   For night hookups, coordinate lighting intensity with the boom operator. When cleared by the boom operator, move to the precontact position.

7. Exterior lights - AS REQUIRED.
8. INT monitor switch - AS REQUIRED.
9. HM switch - AS REQUIRED.
10. Signal amplifier switch - NORM.
11. Fill disable switches - AS REQUIRED.
12. Air refuel control - OPEN.

13. READY light - ON.

WARNING

If ready light does not come on the refuel manifold is damaged, do not refuel unless absolutely necessary.

NOTE

Should the receiver receptacle light become inoperative during night refueling, receiver pilots will turn on the lights as requested by the boom operator.

CONTACT.

1. READY light - OFF.

2. LATCHED light - ON.

   When the ready light goes out, and latched light illuminates, the boom is locked into the receptacle.

NOTE

Fuel from the tanker is now being transferred. Check the refueling progress by observing the fuel quantity gage.

DISCONNECT.

1. Air refuel disconnect/reset (Nosewheel Steering button) - DEPRESS AND HOLD.

   When the required amount of fuel has been transferred, the boom operator or receiver pilot will initiate electrical disconnect.

CAUTION

If making an outer limit disconnect, high separation rates should be avoided to prevent damage to the boom or receptacle.

2. DISCONNECT light - ON.

CAUTION

Illumination of the disconnect light does not necessarily indicate the boom and receptacle have separated. Friction and/or binding may retain the boom in the receptacle. Do not move refueling position until positive visual confirmation of boom separation is received.

POST AIR REFUELING.

1. Air refuel control - CLOSED.

   The disconnect light will go out when the air refuel control is moved to the CLOSE position, the air refuel disconnect/reset button (Nosewheel Steering button) is depressed, and the slipway door closes.

NOTE

- The air refuel control must be returned to the CLOSED position to reinstate the continuity of the fuel control panel and restore fuel management.

- If the disconnect light illuminates before refueling is completed, ensure the boom is clear of the receptacle and then reset the system by depressing air refuel disconnect/reset button (Nosewheel Steering button) or by actuating the air refuel control. Closing and reopening the slipway door will recycle the system. Ready light will illuminate.

- If the air refueling control cannot be moved from the open position, fuel in any external tank(s) will be unusable.

2. READY light - ON (approx. 3 minutes) then extinguished.

   During the automatic purge cycle, the READY light will illuminate for up to three minutes.

3. Fuel quantity - CHECK.

4. INT monitor switch - AS REQUIRED.

5. HM switch - AS REQUIRED.

6. TACAN - AS REQUIRED.

7. IFF - AS REQUIRED.

8. MFCD - Select IFF page - AS REQUIRED.

9. Exterior Lights - AS REQUIRED.

SECTION III

EMERGENCY PROCEDURES

TABLE OF CONTENTS

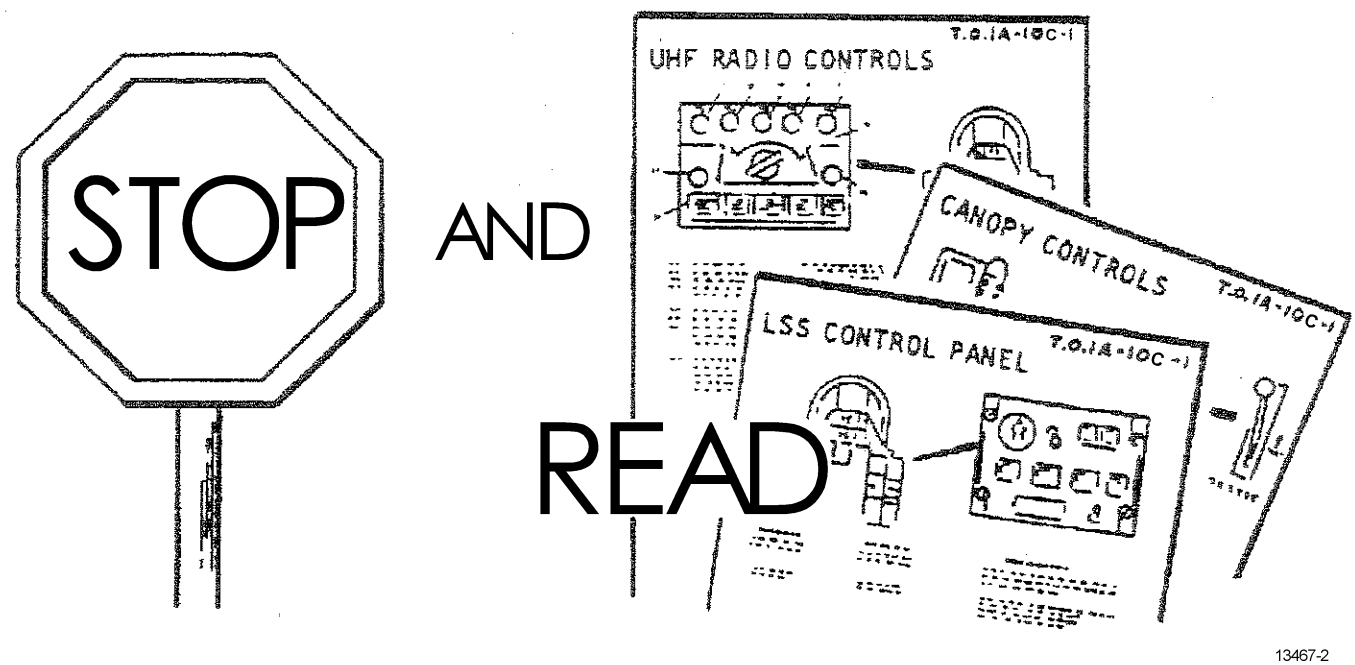


Figure 3-1. Stop and Read

INTRODUCTION.

This section covers the operation of the aircraft during emergency/abnormal conditions. It includes discussions of problem indications and corrective actions, as well as procedural steps when applicable. Adherence to these guidelines will ensure maximum safety for the pilot and/or aircraft.

The situations covered represent the most probable malfunctions. However, multiple emergencies, weather, or other factors may require modification of the recommended procedures. Accomplish only those steps required to correct or manage the problem.

When dealing with emergency/abnormal conditions, pilots must determine the most correct action using SOUND JUDGMENT, COMMON SENSE, and FULL UNDERSTANDING OF APPLICABLE SYSTEMS.

Critical emergency procedures are presented in BOLDFACE capital letters. Pilots shall be able to immediately accomplish these procedures in the published sequence without reference to the checklist.

Three basic rules apply to all emergency situations. These basic rules are not repeated in each of the procedures listed. However, in ALL EMERGENCIES, THE OVERRIDING CONSIDERATION SHALL BE TO:

- Maintain aircraft control.
- Analyze the situation.
- Take proper action.

NOTE

- The ground, takeoff, and landing emergency procedures are sequenced as outlined in the Table of Contents.
- The in-flight emergency procedures follow the HEFOE sequence with an additional listing of general in-flight emergencies.
- Decision factors are provided as a guide in selecting certain procedures.

TERMS.

The terms "Land as soon as possible" and "Land as soon as practical" are used throughout this section. These terms are defined as follows:

Land as soon as possible - An emergency will be declared. A landing should be accomplished at the nearest suitable airfield, considering the severity of the emergency, weather conditions, field facilities, ambient lighting, aircraft gross weight, and command guidance.

Land as soon as practical - Emergency conditions are less urgent, and although the mission is to be terminated, the degree of the emergency is such that an immediate landing at the nearest adequate airfield may not be necessary.

LIGHT*	CONDITION	CORRECTIVE ACTION
AIL, L/R	Respective Aileron jammed.	Position aileron emergency disengage switch toward affected jam indicator light and monitor AIL DISENG caution light. Refer to AILERON/ELEVATOR CONTROL JAMS.
AIL DISENG	Either aileron is disengaged from the control stick at the disconnect unit.	Placing the aileron emergency disengage switch to the center position will rearm the disconnected control to reengage the control stick. If necessary, move stick in roll to achieve alignment of disconnector elements so that reengagement can occur.
AIL TAB, L/R	Advises when the roll servo tab shift actuator has extended.	Advisory only in MRFCS. In powered flight control system, refer to FAILURE TO SHIFT OUT OF MANUAL REVERSION.
ANTI-SKID	Indicates: • Anti-skid switch OFF and landing gear handle in down position, or • When switch is ANTI-SKID, failure in anti-skid circuit	• If anti-skid switch is OFF, reengage. • Ensure emergency brake handle is fully stowed. If anti-skid switch is ANTI-SKID or will not reengage, refer to NORMAL BRAKE/ANTI-SKID FAILURE.
APU GEN	APU generator off-line with APU generator switch set in PWR.	Reduce electrical load and attempt to reset the generator by momentarily placing the APU GEN switch in OFF/RESET, then returning to PWR. If malfunction was transitory, the APU GEN caution light will go out.
BLEED AIR LEAK	Temperature-sensitive conductor adjacent to bleed manifold senses a bleed air leak.	Turn bleed air switch OFF. Refer to BLEED AIR LEAK/SERVICE AIR OVERHEAT.

Figure 3-2. Caution Light Analysis (Sheet 1 of 5)

LIGHT*	CONDITION	CORRECTIVE ACTION
CADC	CADC failure	Monitor pitot-static airspeed indicator and select STBY or PNEU on altimeter. Deselect mode C on IFF. The HUD will continuously display the last airspeed and altitude data received from the CADC. The CDU will display the CADC FAIL and INS DEGRADED annunciations. **WARNING** Certain failures of the CADC could cause erroneous data to be displayed with no warning indications.
CICU	CICU Failure	• Check CDU for CICU NOT READY annunciation, and check CDU System (SYS) Page for CICU status of N. • Refer to CICU FAILURE.
CONV, L/R	Failure of indicated converter	Check L CONVERTER and AUX ESS BUS TIE circuit breakers closed. Refer to CONVERTER FAILURE.
EAC	IFFCC EAC switch has disarmed or has failed.	Attempt to rearm EAC. If it fails to rearm, depress the HUD malfunction button (MALF) on the UFC. (To access the HUD malfunction button, depress FUNC button, then CLR button.) Check that CADC, SAS, and EGI are selected; EGI INS was placed in NAV mode from a full EGI INS alignment (flashing INS NAV RDY annunciation displayed on CDU); and the GPS-only is not the selected navigation (commanded) mode. If these conditions are met and EAC will not rearm, EAC has failed.
ELEV, L/R	Respective elevator jammed.	Position elevator emergency disengage switch toward affected jam indicator light and monitor ELEV DISENG caution light. Refer to AILERON/ELEVATOR CONTROL JAMS.
ELEV DISENG	Either elevator is disengaged from the control stick at the disconnect unit.	Placing the elevator emergency disengage switch to the center position will rearm the disconnected control to reengage the control stick. If necessary, move stick in pitch to achieve alignment of disconnector elements so that reengagement can occur.

Figure 3-2. Caution Light Analysis (Sheet 2)

LIGHT*	CONDITION	CORRECTIVE ACTION
ENG HOT, L/R	ITT indicator is exceeding 880°C.	Retard throttle to setting at which ITT decreases to within normal limits. If necessary, shut down engine. Refer to ENGINE FAILURE/OVERTEMP.
ENG OIL PRESS, L/R	Oil pressure less than 34 to 39 psi.	Refer to ENGINE OIL SYSTEM MALFUNCTION.
ENG START CYCLE	• Light remains on after starting cycle.	• On ground: Refer to ENGINE START CYCLE CONTINUES AFTER START (GROUND). • In Air: REFER TO ENGINE START CYCLE LIGHT ON (IN FLIGHT).
	• Air turbine start solenoid valve is open due to throttle positioned at IDLE (engine speed below 56%), or the engine operate switch is in MOTOR.	• Advisory.
FUEL PRESS, L/R	Fuel differential pressure is low. Indicates possible boost pump failure, or if boost pump caution light is not on, a failure or clog in the engine feed line.	Refer to FUEL PRESSURE LOW.
GCAS	GCAS may be inoperative.	Advisory only. Ensure radar altimeter switch is set to NRM. Reset MASTER CAUTION light. If GCAS light goes off, GCAS is functional. If GCAS light does not go off, GCAS is inoperative.
GEN, L/R	Indicated AC generator off-line, or AC generator in OFF/RESET.	Refer to GENERATOR FAILURE.
GUN UNSAFE	Comes on when gun trigger is released if clearing cycle is not completed within 2.5 seconds. Live rounds are in the barrel and the gun could fire.	If GUN UNSAFE light comes on and remains on, proceed as follows: • GUN/PAC armament switch - SAFE • MASTER armament switch - SAFE • Do not attempt to fire the gun (if cause cannot be isolated and corrected). Refer to TO 1A-10C-34-1-1.
HARS	Loss of HARS	Refer to HARS MALFUNCTION procedure.
HYD PRESS, L/R	• Indicated hydraulic system pressure is below 900 (±100) psi.	• Monitor hydraulic pressure gauge and equipment operated by the affected hydraulic system. Refer to LEFT/RIGHT HYDRAULIC SYSTEM FAILURE.
	• Flight control mode switch - MAN REVERSION.	• Advisory only.
HYD RES, L/R	Quantity of hydraulic fluid is low.	Monitor hydraulic pressure. Refer to L/R HYDRAULIC SYSTEM FAILURE.
IFF MODE-4	Inoperative Mode-4 capability, such as Mode-4 codes zeroized, transponder failure, faulty computer.	Avoid operation in a known Mode-4 interrogating environment. If already in one, take appropriate emergency or corrective action.

Figure 3-2. Caution Light Analysis (Sheet 3)

LIGHT*	CONDITION	CORRECTIVE ACTION
INST INV	AC essential and auxiliary AC essential busses are not receiving AC power. Possible failure of instrument inverter.	Refer to INVERTER FAILURE procedure.
L-R TKS UNEQUAL	Imbalance of 750 (±250) pounds of fuel is sensed between two main fuselage tanks.	Refer to L-R TANKS UNEQUAL procedure.
LASTE	LASTE system may be inoperative.	Advisory only. Cycle the IFFCC switch on AHCP to OFF, then to the desired function. If LASTE light remains on, the LASTE system is inoperative.
MAIN FUEL LOW, L/R	Fuel quantity indicated is approximately 500 pounds.	Refer to FUEL QUANTITY INDICATOR MALFUNCTION.
MAIN PUMP, L/R	Fuel pressure differential at outlet of indicated main fuel boost pump is low, indicating possible pump failure.	Refer to MAIN BOOST PUMP FAILURE.
NAV	EGI failure and auto down mode from blended, INS-only, or GPS-only to NI.	• Check CDU for EGI FAIL annunciation, and check CDU system (SYS) Page for INS, GPS and MSN status of N of F. • Refer to ENAV FAILURES-EGI Failure.
	EGI flight instrument failure.	• Check CDU for EGI FLT INST FAIL annunciation, and check CDU system (SYS) Page for MSN status not V. • Refer to ENAV FAILURES-EGI Flight Instrument Failure.
	EGI not ready failure.	• Ensure AAP EGI switch set to ON. Check CDU for EGI NOT RDY annunciation, and check CDU System (SYS) Page for INS, GPS, and MSN status of N. • Refer to ENAV FAILURES-EGI Not Ready Failure.
	EGI GPS failure or auto down mode from GPS-only to NI.	• Check CDU for GPS FAIL annunciation, and check CDU System (SYS) Page for GPS status not V. • Refer to ENAV FAILURES-EGI GPS Failure.
	EGI INS failure or auto down mode from blended to GPS- or INS-only to NI.	• Check CDU for INS FAIL annunciation, and check CDU system (SYS) Page for INS status not V. • Refer to ENAV FAILURES-EGI INS Failure.

Figure 3-2. Caution Light Analysis (Sheet 4)

LIGHT*	CONDITION	CORRECTIVE ACTION
NAV - Continued	CDU failure. Display screen may freeze, become blank, show a flashing DISPLAY FAILURE across bottom of screen; MBC FAIL, ADA FAIL, or HARDWARE FAIL message across middle of screen; or cause a bitball (Δ) to be displayed in upper right corner of screen.	• Ensure AAP CDU switch is set to ON. • Refer to ENAV FAILURES CDU Failure.
OBOGS FAIL 518	• Low partial pressure of oxygen at regulator input • Oxygen Monitor BIT detected fault	• Refer to OBOGS FAIL procedure.
OBOGS PRESS LOW 518	OBOGS regulator input pressure has fallen below 10 psi.	• Refer to OBOGS PRESSURE LOW procedure.
OXY LOW **NON518**	0.5 liter or less liquid oxygen remains in oxygen converter.	• Descend to 10,000 feet MSL or below if possible. • Activate emergency oxygen supply (if required). • Land as soon as practical.
PITCH SAS	One or both pitch SAS channels disengaged.	Refer to PITCH/YAW SAS DISENGAGEMENT.
SEAT NOT ARMED	Seat ground safety lever in SAFE (fwd) position.	Move lever to ARMED (aft) position.
SERVICE AIR HOT	Indicates precooler output air temperature is excessive.	Bleed air switch OFF. Refer to BLEED AIR LEAK/SERVICE AIR OVERHEAT.
STALL SYS	Power failure in Alpha/Mach computer. Peak performance/stall warning tones inoperative. Slats will extend automatically.	• AOA 20.0 units or less until landing. • If stall or peak performance tones on continuously: • SPS & RUDDER AUTH LIMIT circuit breaker - Open.
WINDSHIELD HOT	Windshield anti-icing electrical circuit temperature is in excess of 150°F, or aircraft is on battery power only.	Windshield defog/deice switch OFF. Rain removal switch OFF.
WING PUMP, L/R	Fuel pressure differential at outlet of indicated wing fuel boost pump is low, indicating possible pump failure.	Refer to WING BOOST PUMP FAILURE.
YAW SAS	One or both yaw SAS channels disengaged.	Refer to PITCH/YAW SAS DISENGAGEMENT.
* All caution lights are on caution light panel except AIL, L/R and ELEV, L/R. These are on emergency flight control panel.		

Figure 3-2. Caution Light Analysis (Sheet 5)

- GENERAL EMERGENCIES -.

CANOPY MALFUNCTIONS.

If canopy will not open:

1. Canopy actuator disengage lever - Pull aft.
2. Cockpit canopy control switch - Open.

If canopy still does not open:

3. Canopy - Raise manually.

If canopy is jammed partially open:

3. Emergency canopy actuator release lever - Actuate (located behind seat on aircraft right side).

CAUTION

Emergency canopy actuator release lever may be unreachable without unstrapping if the aircraft is fitted with the AERP system blower bracket and the seat is not in the full up position.

4. Canopy - Raise manually.

NOTE

Ground personnel can mechanically disengage the canopy by using the external release mechanism located below the canopy rail on both left and right side, refer to Figure 1-23.

CANOPY UNLOCKED LIGHT ON.

If the CANOPY UNLOCKED light comes on during flight, slow the aircraft to the lowest practical speed:

1. Oxygen - 100%.
2. Descend to 25,000 feet MSL or below.
3. MAIN AIR SUPPLY switch - OFF.

WARNING

518 Turning MAIN AIR SUPPLY switch to OFF will cause OBOGS to stop producing oxygen-enriched air. At 100% oxygen setting, the OBOGS Plenum will provide 2 to 3 minutes of reserve. If OBOGS PRESS LOW caution light comes on, refer to OBOGS PRESSURE LOW procedure.

NOTE

This will depressurize the canopy seal. The light may then go off when the canopy control switch is momentarily held in CLOSE.

4. Canopy control switch - CLOSE momentarily.

If light goes off:

5. MAIN AIR SUPPLY switch - SUPPLY.

If light remains on:

5. Stow loose items.
6. Land as soon as practical.

CANOPY/WINDSHIELD CRACK.

1. Oxygen - 100%.
2. Descend to 25,000 feet MSL or below.
3. TEMP/PRESS control - DUMP.

If center windshield is cracked:

4. WINDSHIELD DEFOG/DEICE switch - OFF.
5. RAIN REMOVE switch - OFF.
6. Land as soon as practical.

CANOPY - LOSS OF.

1. Slow the aircraft, bend forward, and lower the seat simultaneously.
2. Check condition of the engines and aircraft tail.
3. Stow all remaining loose equipment.

NOTE

Flight tests have shown that no major problem exists up to at least 350 knots; however, 200 knots or less will greatly aid pilot comfort.

CREW ENVIRONMENT EMERGENCIES.

COCKPIT - LOSS OF PRESSURIZATION.

Loss of cockpit pressurization will be indicated on the cockpit pressure altitude indicator by an increase of normal cabin altitude.

1. Oxygen - 100%.
2. Descend to 25,000 feet MSL or below.
3. TEMP/PRESS control - NORM.
4. MAIN AIR SUPPLY switch - SUPPLY.
5. BLEED AIR switch - BLEED AIR.
6. CANOPY DEFOG control - MAX.

If no service air entering cockpit inlets:

7. Perform BLEED AIR LEAK/SERVICE AIR OVERHEAT procedure.

COCKPIT OVERPRESSURIZATION.

Cockpit overpressurization, due to a failure of the cockpit air pressure regulator, will be indicated on the cockpit pressure altitude indicator by a decrease in normal cabin altitude.

1. Descend to 25,000 feet MSL or below.
2. TEMP/PRESS control - DUMP.

COCKPIT OVERTEMPERATURE.

NOTE

No cockpit overtemperature warning is provided.

If cockpit temp cannot be controlled by the TEMP LEVEL and FLOW LEVEL controls and heat is excessive:

1. **MAIN AIR SUPPLY - OFF.**

WARNING

518 Turning MAIN AIR SUPPLY switch to OFF will cause OBOGS to stop producing oxygen-enriched air. At 100% oxygen setting, the OBOGS Plenum will provide 2 to 3 minutes of reserve. If OBOGS PRESS LOW caution light comes on, refer to OBOGS PRESSURE LOW procedure.

NOTE

With MAIN AIR switch OFF, the following will not be available; External tank pressurization, Canopy defog, Canopy seal, Cabin pressurization, Rain removal, Anti G suit.

2. BLEED AIR switch - OFF.
3. APU - OFF.
4. Oxygen - 100%.
5. Descend to 25,000 feet MSL or below.
6. TEMP/PRESS control - RAM.

If heat cannot be tolerated:

7. Canopy - Jettison.

If hot airflow stops and bleed air is required:

7. MAIN AIR SUPPLY switch - SUPPLY.
8. TEMP/PRESS control - NORM.
9. CABIN AIR COND control - MAN and hold in COLD for approximately 30 seconds.
10. BLEED AIR switch - BLEED AIR.
11. CABIN AIR COND control - As required.

EMERGENCY GROUND EGRESS.

The method used to exit the aircraft will be determined by the circumstances of the emergency. A closed cockpit will provide a layer of protection from external fires or toxic fumes. When possible, do not open the cockpit until free of all restraints.

WARNING

Operating canopy electrical or canopy explosive jettison system when fuel fumes are present is not recommended.

1. Throttles, APU, and battery - OFF.
2. Seat - Safe.
3. Attachments - Release.
   a. Shoulder harness - Release.
   b. Lap belt - Release.
   c. Survival kit straps - Release.

If time is critical:

4. Canopy - Open.
   a. Canopy jettison handle - Pull.

WARNING

- The canopy may not jettison unless down and full forward.
- Pip button must be depressed before CANOPY JETTISON handle can be pulled.

If time is not critical:

4. Canopy - Open.

a. Canopy actuator disengage lever - Pull aft.

WARNING

To avoid the possibility of being trapped in the cockpit during an emergency, the canopy actuator disengage lever should be pulled prior to attempting to open the canopy. This action allows the canopy to be opened manually if the actuator fails during the opening cycle.

b. Canopy control switch - Open.

c. Canopy - Raise manually.

WARNING

If the canopy is disengaged and partially lifted manually, the canopy must not be opened electrically. Opening the canopy electrically after unseating the canopy actuator may cause damage, and the canopy may not be held up securely.

d. Canopy breaker tool - Break hole in canopy. Grasp the breaker tool in both hands with the sharp curved edge toward you. Strike perpendicular to the canopy surface with hard blows using blade alignment to set direction of cracks. Three or four blows will normally open an adequate escape hole.

e. Aircraft - Abandon. (Extend boarding ladder if desired.) Standing up in the aircraft will normally disconnect the remaining pilot service leads (communications, oxygen, and anti-g suit leads). Be sure all leads are disconnected before exiting the cockpit. Depress boarding ladder extension button, if desired.

RUDDER PEDAL FAILURE TO LOCK.

1. Rudder adjust handle - Reset.

If rudder pedals come loose in flight:

2. Rudder adjust handle - Check stowed.

WARNING

- Previous mishaps have shown that rudder control may only be regained by hooking toes under the rudder pedals and pulling them back to a normal position.
- Check to make sure the rudder adjust handle is fully retracted. If the handle will not fully retract, pushing on the white tabs located on/near the rudder adjustment index may assist in locking the rudder pedals.

TAKEOFF EMERGENCIES.

ABORT.

During an abort, the speed brakes can be open to 100% and will remain fully open down to zero air speed after losing the right engine. The loss of speed brakes in this instance would be a second order failure of the hydraulic system, due to either a rapid fluid loss or catastrophic engine failure (seized engine). Speed brake failure during an abort can be considered to have an extremely remote probability of occurrence.

If maximum braking is required during an abort, minimum stopping distance can be achieved in a three-point attitude, throttles idle, speed brakes full open, and wheel brakes applied with a firm continuous force sufficient to feel anti-skid cycling.

1. **THROTTLES - IDLE.**

2. **SPEED BRAKES - OPEN.**

WARNING

Once the decision to abort has been made, immediately retard the throttles to idle and open the speed brakes. Any delay in accomplishing these steps will result in either an increase in stopping distance, a significant increase in wheel brake energy needed to stop, or both.

3. **WHEEL BRAKES - AS REQUIRED.**

If an engine failure, fire, or overtemp is indicated:

4. Throttle(s) {malfunctioning engine(s)} - OFF.

CAUTION

If the throttle is left in IDLE, ignition will be initiated when core rpm decreases below 56%. This could cause engine core overtemp.

5. Emergency brake handle - Pull {if left/both engine(s) shut down}.

CAUTION

- If the left engine is inoperative, nosewheel steering, normal braking, and anti-skid are not available. In this case, the emergency brake handle must be pulled to obtain brakes. If both engines are shut down or failed, at least five full brake applications should be available.

- Maximum performance braking may cause hot brakes, depending upon aircraft speed and gross weight. If hot brakes are suspected, park aircraft in uncongested area until cooling is accomplished. (See Figure 5-3 for wheel brake energy limits.)

NOTE

- Using down lock override with weight on struts will not cause gear to retract and cannot be used as alternate method of stopping.

- If it is apparent that the aircraft is going to run off the runway, it may be desirable to jettison stores.

- Aircraft damage from MA-1 barrier engagements has been minimal compared to departing a prepared surface. If an MA-1 is the only thing between stopping or running off a prepared surface, taking the barrier would be the best alternative.

6. Perform ground ENGINE FIRE procedure, if applicable.

IN-FLIGHT EMERGENCIES.

IN-FLIGHT STRUCTURAL FIRE.

The A-10 has been shown to be susceptible to in-flight structural fire. This type of fire may begin with chafed wires arcing to a hydraulic line. Once the fire starts, it can spread rapidly in the area around the leak and could propagate to other areas of the aircraft. Indications for this fire usually begin in the cockpit. There may initially be fuel gauge problems or loss of a hydraulic system. The hydraulic pressure or reservoir lights may illuminate with the associated pressure gauge remaining in the 2800 to 3350 range. As the fire intensifies and adjacent wire harnesses are burned, numerous caution lights will illuminate in the cockpit. The hydraulic gauge will begin dropping to zero. The engine instruments may be erratic.

Numerous other electrical problems will occur, and the loss of airspeed indications is likely. Flight control malfunctions may also occur due to the fire damaging aircraft structure. Once a structural fire starts, it will quickly become self-sustaining with no way to extinguish it. Visual indications of the fire will be the aircraft trailing flames or smoke, which may appear as vapor or fluid.

The above indications will occur rapidly. The illumination of so many caution lights in such a short period of time will be task saturating. Actions must be prioritized, taking factors such as degradation of flight controls, extent of the fire, and location of the nearest suitable airfield into account. Ejection should be considered.

SPIN RECOVERY.

Refer to Out of Control procedures. Refer to Section VI for an explanation of spin characteristics.

OUT-OF-CONTROL RECOVERY.

Control neutralization will recover all out-of-control situations. Throttles should be immediately positioned to IDLE to reduce the possibility of engine compressor stalls.

Recoveries from uncommanded roll reversals or incipient spins are rapid with few oscillations. Uncommanded roll accelerations may continue for several rolls after neutralizing controls with pitch and AOA oscillations possibly occurring during recovery. Neutral controls must be maintained until oscillations have ceased. Rushing recovery may result in secondary stalls and excessive loss of altitude. Since PSGs and spin recoveries normally result in a steep, nose down attitude, the dive recovery technique is critical in minimizing altitude lost. Use back stick pressure short of stall AOA to optimize recovery. PSG recoveries require from less than 1,000 to as much as 8,000 feet altitude. Spin recoveries required from 4,000 to 6,000 feet altitude for incipient, half-turn spins, and 10,000 feet altitude for three-turn developed spins. The following procedure is recommended for all departures from controlled flight:

1. **THROTTLES - IDLE**.

2. **CONTROLS - NEUTRAL**.

WARNING

Power reduction in Manual Reversion mode will cause an aircraft pitch down, rapidly becoming severe at higher airspeeds. Make full use of available aft stick, nose up pitch trim, and return to normal flight mode (if available) before reducing power during recovery from high-speed dives.

If spin is confirmed:

3. Rudder - Abruptly full opposite turn needle.

   An erect spin can be confirmed with turn needle pegged with airspeed at or below 120 KIAS and an AOA consistently above 25 unit and usually pegged. The turn needle will be inoperative and centered and AOA may not be available, if both engines are flamed out.

   If an engine flameout or overtemperature occurs, perform the appropriate engine malfunction procedures after recovering to normal controlled flight.

LANDING EMERGENCIES.

EMERGENCY LANDING PATTERNS.

The emergency landing pattern is a pattern to be flown when an emergency exists or there is a malfunction that could result in an emergency. The primary objective of the pattern is to land the aircraft safely on the first attempt with the least amount of risk. Because of the many variables involved, such as type of emergency, position and altitude in relation to the field, gross weight, fuel remaining, weather, populated areas, runway length, etc., a standard pattern could not be prescribed. Depending on the circumstances, it might be desirable to utilize GCA, make a straight-in approach, enter the pattern from downwind or base leg, or make a circling pattern. Because of the various circumstances, many factors must be evaluated to determine the type of landing pattern to be flown. However, there are some general guidelines that are applicable regardless of the approach selected. Reduce gross weight to minimum practical. Prior to establishing the landing configuration, maintain a minimum maneuvering airspeed of 200 knots and, when possible, 2000 feet AGL until beginning descent on final approach. This will allow the aircraft to remain at controlled ejection altitude longer. The pattern should be planned to avoid abrupt, steep, or hard turns, and large or abrupt power changes, especially with a flight control malfunction, structural damage, or single-engine condition. Under these circumstances, the minimum practical bank angle required should be used. Circumstances permitting, a long, straight-in final should be planned and the landing configuration established on final. Should the nature of the emergency or other factors dictate establishing the landing configuration prior to final, 180 knots should be maintained until established on final (unless a higher airspeed is required due to structural damage). This airspeed will provide a margin of safety for maneuvering flight. If the pattern must be entered on downwind, base, or from an overhead pattern, the pattern should be expanded, the landing configuration established prior to final, and roll-out on final should be at least 2 to 3 miles out. A normal 2° to 3° glide slope, unless otherwise directed, should be flown. For most emergencies, final approach airspeeds are increased and AOA decreased to provide adequate aircraft handling characteristics. Maximum performance braking may cause hot brakes and eventual total braking loss, depending on aircraft speed and gross weight.

EJECTION PROCEDURES.

BEFORE EJECTION.

Escape from the airplane must be made with the ejection seat. After ejection, all seat/man separation and recovery parachute functions are automatically accomplished. Under level flight conditions, eject above 2,000 feet AGL whenever possible.

WARNING

Do not delay ejection below 2,000 feet AGL for any reason. Accident statistics emphatically show a progressive decrease in successful ejection as altitude decreases below 2,000 feet AGL.

During uncontrolled conditions, minimum Out-of-Control ejection altitude is 4,000 feet AGL.

WARNING

This is the minimum altitude to initiate ejection with minimal risk of injury under the most adverse conditions. This altitude does not include the time required for making the ejection decision. The decision to eject must be made above this altitude. Delaying ejection below this altitude may result in serious injury or death.

The aircraft parameters used to determine this altitude are 450 KIAS and 90 degrees nose low. These parameters result in a 760.5 feet/second descent rate.

Given these parameters, the Out-of-Control ejection altitude equals the sum of 1) time to move the hands from the throttles/stick to the ejection handles of 1.5 seconds (1,141 feet), 2) altitude loss from ejection initiation to a full parachute (762 feet), and 3) parachute descent (2,097 feet).

The Life Sciences Directorate of the Air Force Safety Agency estimates that reaction time is anywhere from 2.05 to 4.9 seconds. This reaction time equates to 1,559 to 3,726 feet of altitude loss at 450 KIAS and 90 degrees of dive. Other sources state that this decision process may require 4 to 8 seconds, with a corresponding increase in the required altitude.

When the aircraft is out-of-control and the ground is a factor, ejection should be immediate and automatic, no matter what the altitude. The design of the minimum out-of-control ejection altitude helps in determining when the ground is a factor. Altitude variables must be considered (changes in terrain, MSL altitudes versus AGL altitudes, etc.) when using this ejection altitude to determine whether the ground is a factor. While the minimum Out-of-Control ejection altitude design uses worst case parameters, do not second guess this minimum Out-of-Control ejection altitude for parameters that differ.

At low altitude, the chances for successful ejection can be greatly increased by pulling up to exchange airspeed for altitude. Ejection should be accomplished while in a positive rate of climb with the aircraft approximately 20°; nose-up, and before the start of any sink rate. The ejection system design provides a capability for a safe ejection at ground level if the sink rate and attitude limits of Figure 3-3 and Figure 3-4 are satisfied. This capability must not be used as a basis for delaying ejection when above 2,000 feet AGL. See Figure 3-3 for minimum ejection altitude versus sink rate. See Figure 3-4 for minimum ejection altitude versus airspeed and dive angle. See Figure 3-5 for ejection seat operation. See Figure 3-6 for parachute drift distance versus altitude. See Figure 3-7 for ejection system operating mode envelope. SeeFigure 3-8 for the ejection injury risk for the ACES II seat.

WARNING

Increased potential for injury, due to drogue parachute opening shock, exists for ejection above 340 knots. The risk of injury at higher airspeeds increases significantly for body weights less than 140 pounds (below the ACES II ejection seat design range of 140 to 211 pounds).

If time and conditions permit:

1. Turn IFF to EMER, Mode 3/A, Code 7700.
2. MFCD - Select IFF page - Set EMER to ON.
3. Transmit "May Day" call on UHF guard channel.
4. Stow loose equipment.
   a. NVGs - Remove (if applicable).
5. Tighten oxygen mask, lower helmet visor, tighten chin strap.
6. Turn aircraft toward uninhabited area.
7. Trim aircraft for lowest practical speed with wings level prior to ejection.
8. Leave feet on rudder pedals and sit erect with spine straight and head firmly against headrest.

WARNING

If the inertial reel straps bind and cannot be freed, the preceding step will minimize the risk of injury during ejection.

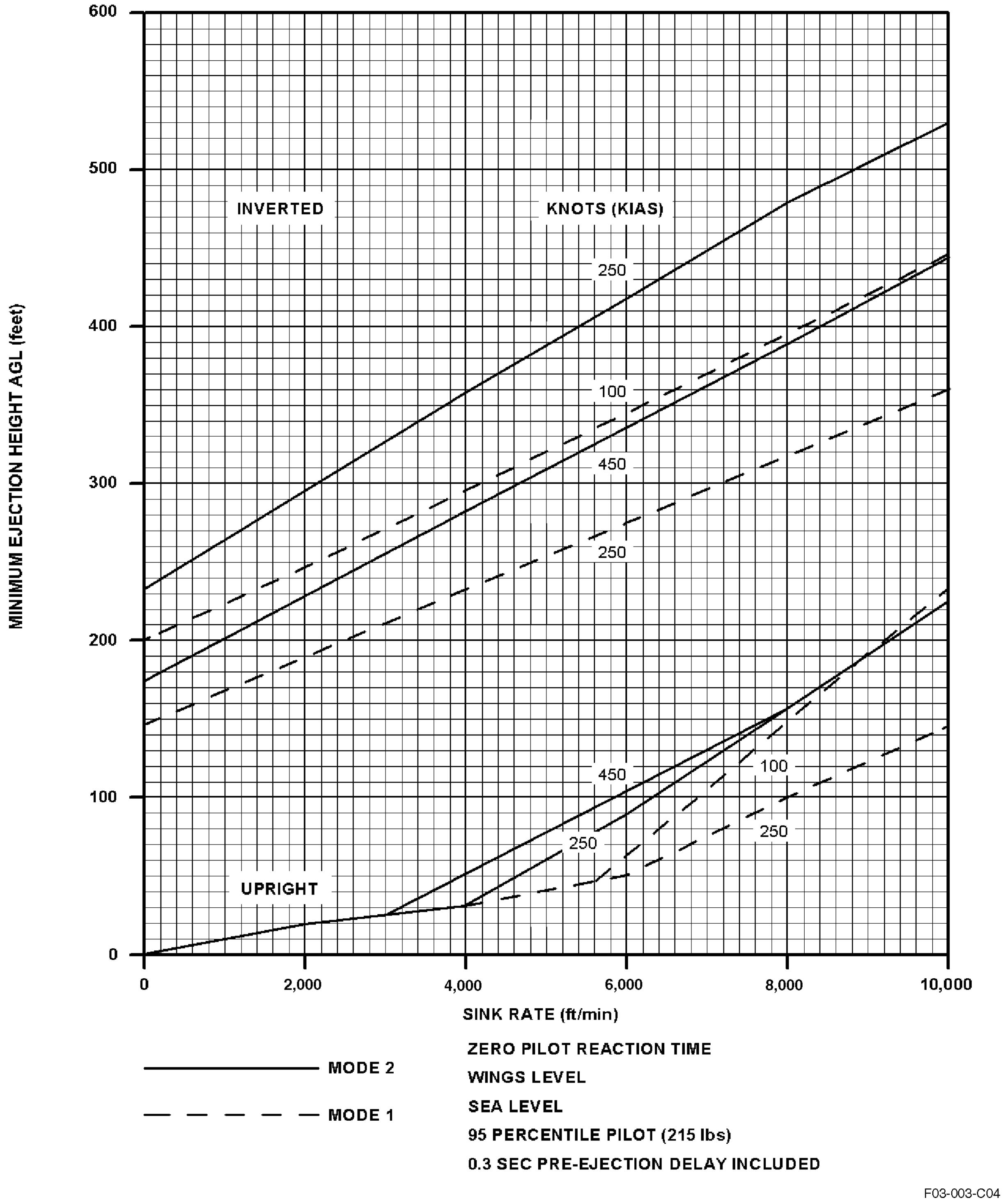


Figure 3-3. Minimum Ejection Altitude vs Sink Rate and Speed

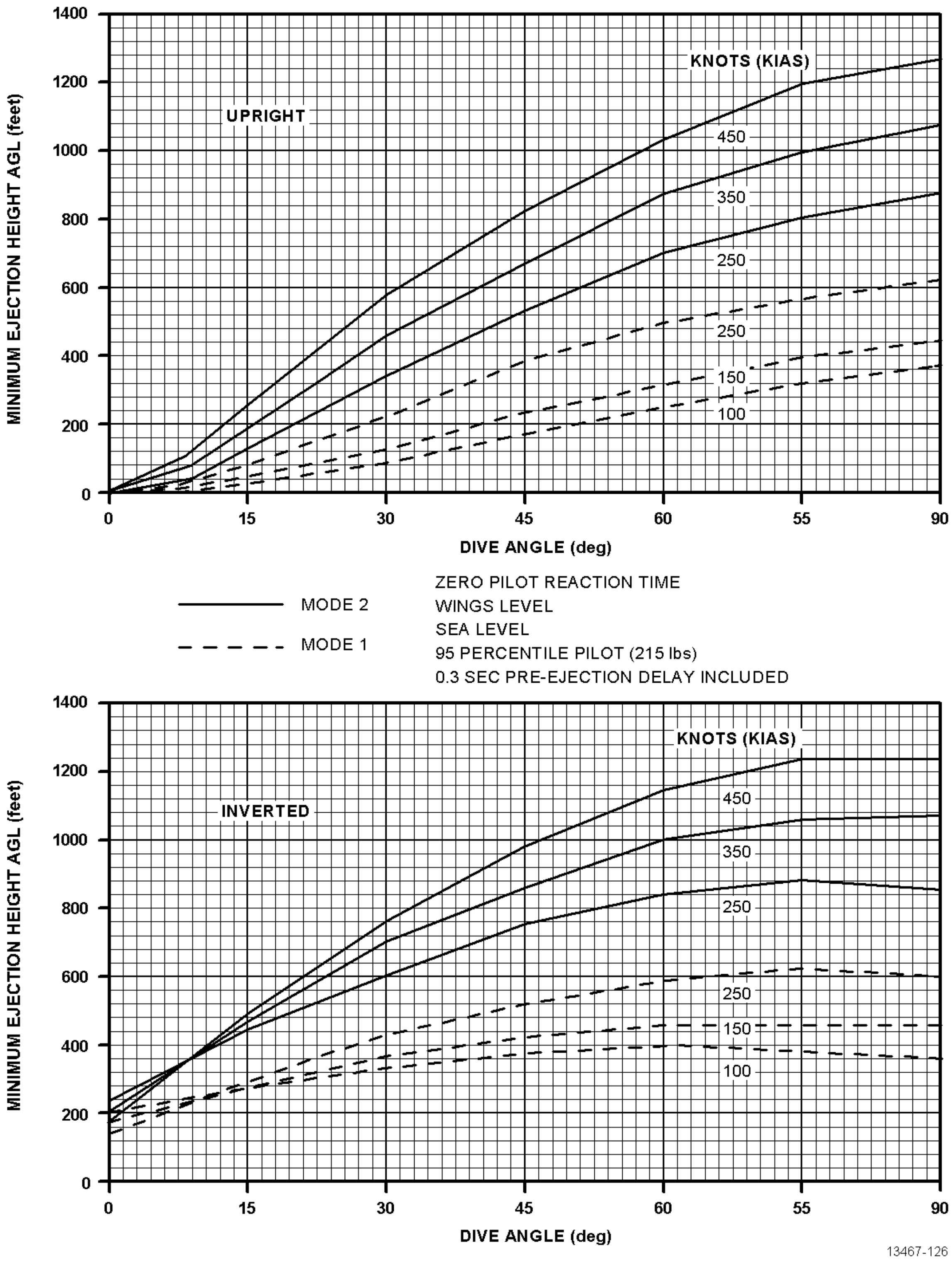


Figure 3-4. Minimum Ejection Altitude vs Dive Angle and Speed

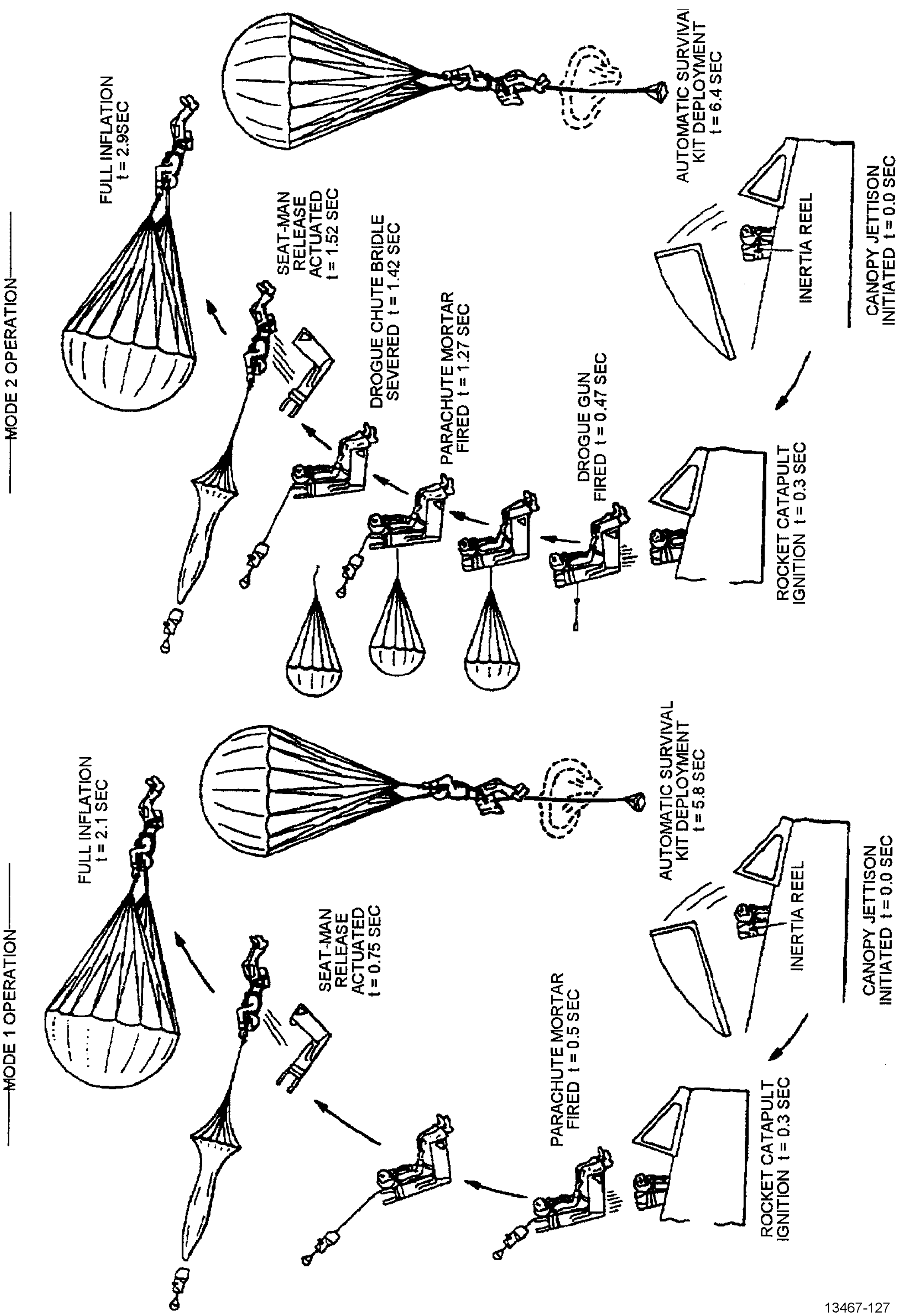


Figure 3-5. Ejection Seat Operation

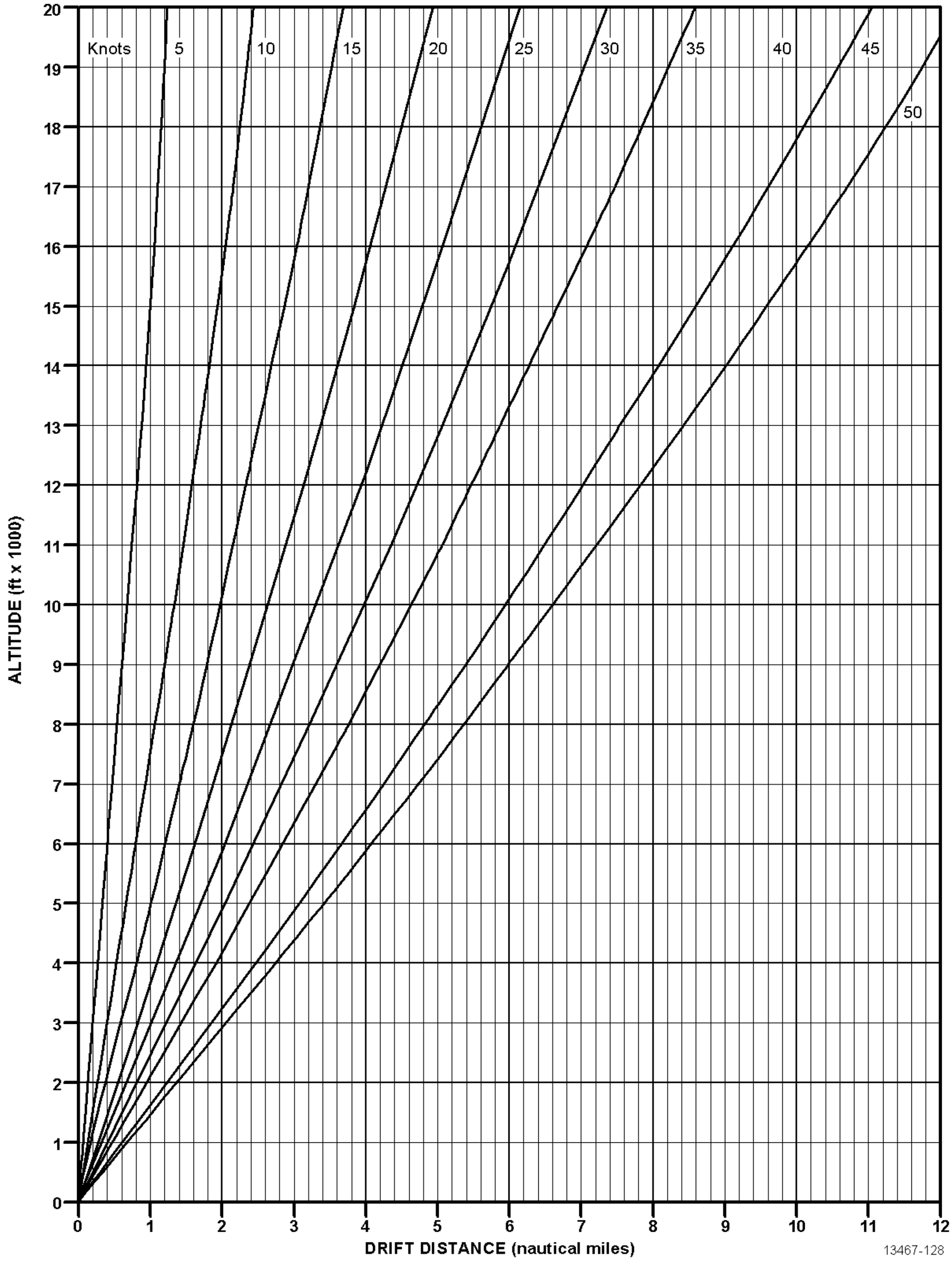


Figure 3-6. Parachute Drift Distance vs Altitude

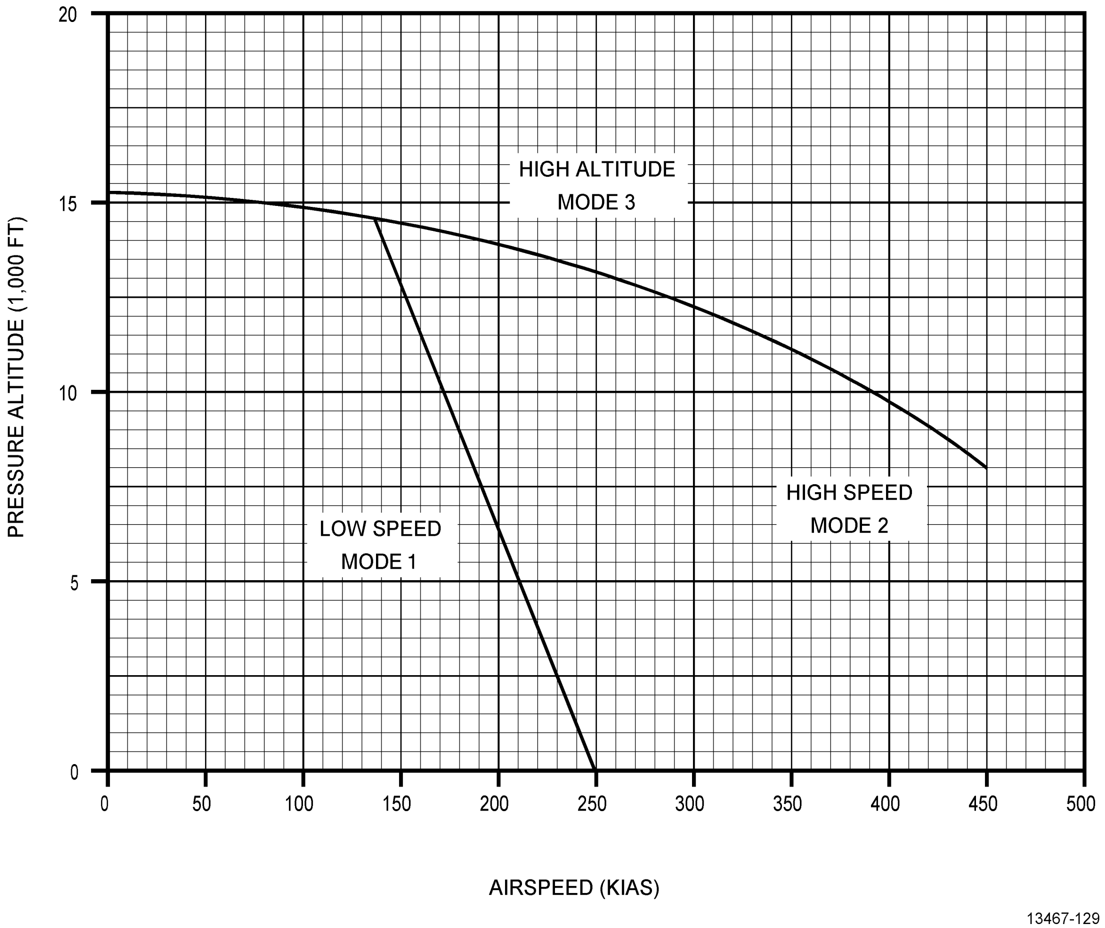


Figure 3-7. Ejection System Operating Mode Envelope

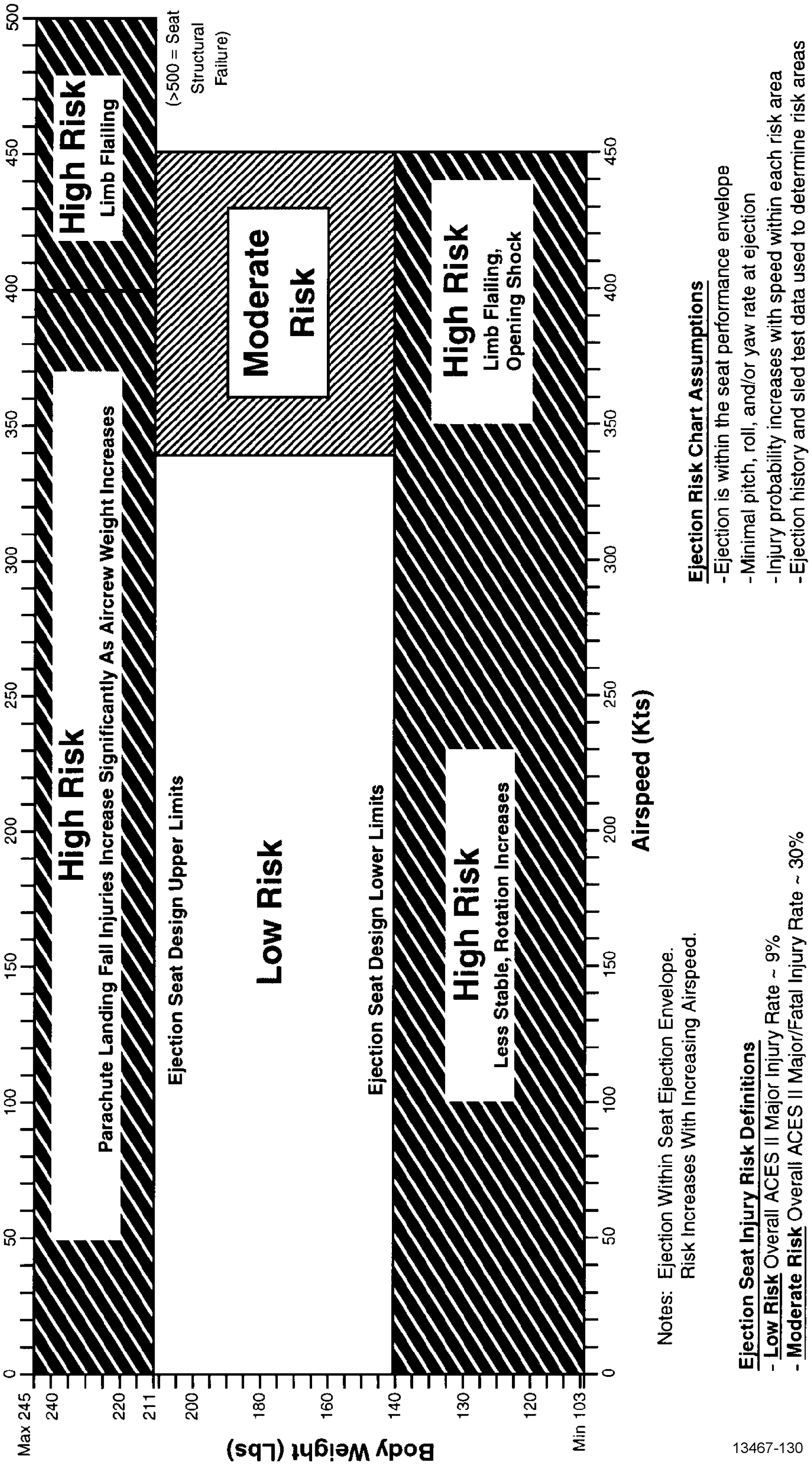


Figure 3-8. A-10C ACES II Ejection Injury Risk

EJECTION.

1. Ejection handles (both, if possible) - PULL.

WARNING

- Ejection initiation will occur if handle is raised 2.05 inches or more (25 degrees).
- Initiating ejection with both hands will reduce the possibility of sustaining flailing injuries.

No other action should be required unless a malfunction occurs.

If automatic man/seat separation does not occur below 15,000 feet MSL:

2. EMERGENCY MANUAL CHUTE handle - PULL (ballistically deploys recovery chute).

WARNING

- The emergency manual chute handle must be pulled to its full travel to assure restraint release.
- If parachute does not separate you from the seat, do not release the lap belt. Ensure the emergency manual chute handle was pulled full travel. Releasing the lap belt will cause a partial separation from the seat. The inertia straps will remain attached to the parachute risers.
- Do not attempt to push up on Left/Right pitot supports.

NOTE

Initial travel of the emergency manual chute handle deploys the personnel parachute (at 2 inches of travel). Additional travel of the handle is required to release the lap belt, inertia reel and seat pan. Full travel of the handle is approximately 7 inches.

3. Kick free of seat.

If parachute assembly fails to separate from the seat:

4. Parachute risers - Jerk.

If, after parachute opening, the survival kit does not automatically deploy:

5. Survival kit - Deploy manually.

WARNING

If the survival kit has not deployed automatically, pull the manual release ring. If the survival kit still has not deployed, shake or strike the sides of the kit to free the kit closures and allow the contents to drop on the 25-foot lanyard.

DITCHING.

Ditching is not recommended; however, if necessary:

1. Gear - UP.
2. Stores - Jettison (if necessary).
3. Flaps - DOWN.
4. Speed brakes - Close.
5. Shoulder harness - LOCK.
6. Canopy - Jettison.
7. Oxygen - 100%.
8. Touch down with minimum sink rate.

- HYDRAULIC EMERGENCIES -.

Adequate flight control system response will be available with either the left or right hydraulic system operating.

NOTE

With one hydraulic system out, rudder forces will be higher than normal and total rudder authority will be reduced. Crosswind landing will require a higher pilot workload.

LEFT/RIGHT HYDRAULIC SYSTEM FAILURE.

If the left hydraulic system fails, the following systems will be inoperative: flaps, nosewheel steering, normal landing gear operation, normal wheel brakes, and anti-skid. Additionally, the left elevator and rudder actuators will be inoperable hydraulically and dual channel pitch and yaw SAS will be nonfunctional.

If the right hydraulic system fails, the following systems will be inoperative: slats, slipway door (normal operation), air refueling nozzle hatch rollers, and speed brakes. The auxiliary landing gear accumulator will not be recharged. The slats will extend and the drag index will increase. Additionally, the right elevator and rudder actuators will be inoperable hydraulically and dual channel pitch and yaw will be nonfunctional.

The L/R-HYD RES caution light comes on to indicate loss of hydraulic fluid. If hydraulic fluid continues to leak, the L/R-HYD PRESS caution light will come on, at which time left/right system hydraulic pressure will be lost.

If a leak in the flap or speed brake hydraulic line is suspected, selecting EMER RETR for the affected system may prevent depletion of the associated hydraulic fluid supply.

If left system fails:

1. FLAP EMER RETR - EMER RETR.

WARNING

With flaps full down, maintaining level flight following transition to manual reversion may require aft stick forces that exceed the physical capability of the pilot. If transition to MRFCS occurs with flaps full down, it is imperative that the flap emergency retract switch be activated immediately.

2. If landing gear is down, LAND GEAR circuit breaker - Pull.

NOTE

Since the landing gear are pressurized while down, depletion of left hydraulic pressure due to a leak in the landing gear (or associated systems) hydraulic lines can be prevented by pulling the LAND GEAR circuit breaker (2nd row down, far right).

If right system fails:

1. SP BK EMER RETR - EMER RETR.

2. Deleted

If pressure decreases:

3. SAS/Anti-skid - Paddle OFF.

4. Pitch SAS - Leave OFF.

5. Yaw SAS switch (operable channel only) - Engage (if desired).

6. Anti-skid switch - ANTI-SKID (if left hydraulic system is operable).

7. Monitor hydraulic pressure of operable hydraulic system and land as soon as practical. If damage is confirmed or suspected, accomplish STRUCTURAL DAMAGE CHECK.

Prior to landing:

If left hydraulic system has failed, or LAND GEAR circuit breaker was pulled:

8. Speed brakes - As required.

9. Landing gear handle - DOWN.

10. AUX LG EXT handle - Pull.

11. AUX LG EXT handle - Push in (when landing gear indicates safe).

12. Emergency brake handle - Pull.

13. Fly a no-flap approach at 140 KIAS plus 2 knots for each 1,000 pounds of aircraft gross weight over 30,000 pounds until landing is assured.

If right hydraulic system has failed:

8. Landing gear handle - DOWN.

9. Flaps - As required.

If both hydraulic systems fail: refer to DUAL HYDRAULIC SYSTEM FAILURE procedure.

DUAL HYDRAULIC SYSTEM FAILURE.

WARNING

- With flaps full down, maintaining level flight following transition to manual reversion may require aft stick forces that exceed the physical capability of the pilot. If transition to MRFCS occurs with flaps full down, it is imperative that the flap emergency retract switch be activated immediately.

- Waiting to transition to MRFCS until total failure of the hydraulic system may place the aircraft in a situation where recovery is impossible, even after completion of aileron tab shifting.

- With dual hydraulic loss, failure to select MRFCS will result in jam indications in the roll axis when sufficient stick forces are applied. In addition, abrupt stick forces applied in both axis may also result in elevator jam indications when in MRFCS.

On indication of impending failure:

1. Attain 1g level flight at moderate speed: 180 - 210 KIAS if able.

2. Flaps - UP (EMER RETR if necessary).

3. Stores - Jettison as appropriate to produce symmetrical store configuration.

4. Flight controls - MAN REVERSION.

WARNING

- Aileron float up normally induces an aircraft pitch change which can be nose up or nose down, depending on aircraft cg, elevator trim tab setting, power setting, and flap position. The pitch change intensity varies and is dependent on aileron float up rate, airspeed and altitude, and can range from minus 2.0 to plus 6.8 g’s during transition.

- The cumulative effects of failure to use pitch trim, maneuvering flight/dives, and rapid throttle movements when in Manual Reversion, could require stick forces beyond a pilot’s physical capability to recover the aircraft. Slow, smooth power adjustments are essential.

CAUTION

Restrain stick lateral neutral while actuating flight control mode switch. If the stick is moved laterally prior to completion of Aileron float up, the ailerons may float up abruptly and asymmetrically.

Four seconds after hydraulic pressure supply bleed off, the aircraft should be in full manual reversion mode.

Prior to landing:

5. Refer to MRFCS APPROACH/LANDING.

MRFCS APPROACH/LANDING.

A manual reversion (MRFCS) approach and landing should be attempted only under ideal conditions.

WARNING

- Any degradation of flight controls beyond manual reversion may make landing impossible. Ejection is recommended.
- Do not use pitch trim for flaring the aircraft due to possibility of overcontrolling pitch attitude.
- Maximum cross wind limit - 20 knots.
- Weather conditions of less than day VMC may task pilot beyond capabilities.
- MRFCS landing with an ECM pod on station 1 or 11, or any equivalent asymmetric load, is not recommended in gusty wind conditions due to marginal roll authority/capability.
- Flight tests have shown that manual reversion landings are characterized by heavy control forces, which, when combined with controllability problems, high final approach speed, lack of speed brakes, antiskid, nosewheel steering, and limited brake application, may result in rollout exceeding 5,000 feet with limited directional control once on the runway.

1. External fuel tank(s) - Jettison.
2. STRUCTURAL DAMAGE CHECK and/or CONTROLLABILITY CHECK - Perform.
3. Extend landing gear:
   a. Gear handle - Down.
   b. AUX LG EXT handle - Pull.
   c. AUX LG EXT handle - Push in (when gear indicates safe).
4. EMER BRAKE handle - Pull.
5. Fly straight-in approach.

NOTE

Fly shallow approach (1 1/2° to 2°), and fly aircraft onto runway, observing sink rate limitations. Pitch response becomes extremely degraded in ground effect below 50 feet AGL. Aircraft will touch down firmly and nose gear will drop rapidly to runway.

6. Hold minimum airspeed of 140 KIAS (Both Engines) at 30,000 pounds total aircraft weight, plus 2 knots per 1,000 pounds of additional fuel for no-flap, or 150 KIAS (Single-engine) plus 1 knot per 1,000 pounds of fuel until landing is assured. For exact approach speeds, see TO 1A-10C-1-1.

SINGLE-ENGINE MRFCS LANDING.

WARNING

- A single engine MRFCS landing should only be attempted if ejection is not possible, as the approach and landing will leave little room for error.
- Single-engine MRFCS minimum control speed is 130 KIAS, unless a higher speed has been determined during controllability check.
- Single-engine MRFCS landing with an asymmetry equivalent to an ECM pod on the same side as dead engine is not recommended. Selectively jettison other ordnance to regain symmetry or to get asymmetry (weapons load) to favor side of good engine. In any case, perform controllability check prior to attempting to land.
- Max cross-wind limit: 10 knots, clean configuration.

WARNING

- A successful single-engine MRFCS go-around is extremely difficult to accomplish and an early decision must be made.

When a single-engine MRFCS landing is the only option, the approach and landing will leave little room for error. A relatively steep approach should be made (3° to 3 1/2°) with minimum power on good engine. Use applicable techniques as described in SINGLE-ENGINE LANDING procedure. Start flare at 200 feet AGL to arrest sink rate and place aircraft onto shallow flight path for landing. Follow steps listed under MRFCS APPROACH/LANDING.

- ELECTRICAL EMERGENCIES -.

See Figure 3-9 for busses and systems lost due to electrical power supply system failure.

BATTERY FAILURE.

Caution light panel legends on: None.

In the event of battery failure caused by "thermal runaway", or an internal short as differentiated from a depleted battery, the overloads placed upon the converters cause the converter circuit breakers to open. This results in complete loss of DC power recognizable by loss of all warning lights and communications. It is assumed that the main generators are operational. Use the following procedure to restore DC power:

1. Battery switch - OFF.

2. CONVERTER L circuit breaker - Close. (Left side - 2nd up from bottom)

   The left converter will now power the entire DC system. Leave battery switch in OFF.

3. Land as soon as practical.

CONVERTER FAILURE.

Caution light panel legends on: L-CONV and/or R-CONV.

If only one converter is failed, the operational converter will assume the DC load.

1. CONVERTER L and AUX ESS BUS TIE circuit breakers - Check closed.

If both converters have failed:

   With both converters failed, the battery is the remaining source of DC, and will automatically power the DC essential and auxiliary DC essential busses.

2. Land as soon as possible.

NOTE

- Battery life is approximately 30 minutes.
- NON518 This time may be extended indefinitely by switching the battery off until absolutely essential to use.
- 518 This time may be extended by switching systems off until absolutely essential to use. OBOGS will not operate with battery off.
- 518 If the battery must be switched off to extend battery life, OBOGS can be completely recharged, when required, by turning the battery back on for about 3 seconds with the APU on or one or both engines at full power (slightly longer with engine(s) at reduced power).

INVERTER FAILURE (NO POWER AVAILABLE TO AC ESSENTIAL BUSSES).

In the event of loss of both generators and the instrument inverter fails to automatically come on line or fails subsequently, the INST INV and L and R ENG HOT caution lights will come on.

1. Throttle(s) - Retard. (Maintain core speeds below 90% when at or below 25,000 feet MSL, or below 85% if above 25,000 feet MSL.)

CAUTION

Severe engine overtemp is possible due to loss of ITT amplifiers.

2. Circuit breakers - Check closed.

3. Inverter switch - Recycle STBY to TEST and back to STBY several cycles. Leave in STBY.

4. APU - START (below 15,000 feet MSL).

NOTE

APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet).

5. APU generator switch - PWR.

6. Land as soon as practical.

GENERATOR FAILURE.

Caution light panel legends on: L-GEN and/or R-GEN.

In addition, with both generators failed: L and R CONV, L and R MAIN PUMP, L and R WING PUMP, R FUEL PRESS, PITCH SAS, YAW SAS, WINDSHIELD HOT.

With one generator failed, the remaining generator should automatically assume and support the AC power requirements.

CAUTION

If left generator fails and bus power fails to transfer, temporary loss of ITT amplifiers may result in double engine overtemp with both throttles in MAX.

NOTE

- Battery life is a function of its condition and state-of-charge, and should last for approximately 30 minutes.
- NON518 If the generators are not supplying AC, the battery life will be reduced to 18 minutes unless the inverter is turned off.
- 518 If the generators are not supplying AC, the battery life will be reduced to 18 minutes unless some systems running on essential AC are turned off.
- 518 If the battery must be switched off to extend battery life, OBOGS can be completely recharged, when required, by turning the battery back on for about 3 seconds with the APU on or one or both engines at full power (slightly longer with engine(s) at reduced power).

1. GENERATOR CONT circuit breaker(s) - Check closed.

2. If above 10,000 feet, crossfeed - CROSSFEED

CAUTION

If above 10,000 feet, turn CROSSFEED on prior to resetting generators to prevent possible fuel pressure loss and subsequent flameout.

3. Failed generator switch(es) - OFF/RESET momentarily, then to PWR.

If light goes out within 3 attempts, and electrical system operation is normal, continue normal operations. If L and/or R GEN light remains on after 3 attempts:

4. Generator switch(es) - OFF/RESET.

5. APU - START (below 15,000 feet MSL).

NOTE

APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet).

6. APU generator switch - PWR.

NOTE

In an emergency, the APU generator can be used to supply essential equipment indefinitely.

7. Crossfeed - As required.

8. Land as soon as practical.

ELECTRICAL FAILURE - TOTAL.

WARNING

518 A total electrical failure will cause the OBOGS to cease production of oxygen-enriched air and there will be no caution lights to indicate depletion of the Plenum supply.

Caution light panel legends on: None.

Total electrical failure is defined as loss of generators and failure or complete discharge of the battery. Electrical failure is indicated by loss of all electrical instruments except core rpm, off flags in electrically powered instruments, loss of communications/side tones, and loss of all electrically controlled and actuated systems. Engine start, APU, normal landing gear extension and its indication, flaps, speed brakes, normal brakes, trim, SAS, and the ability to transition to or from MRFCS will not be available.

The following systems should be available following complete electrical failure:

- Accelerometer
- Anti-g system
- Auxiliary gear extension
- Canopy jettison
- Core rpm indication
- ECS (fails to NORM or RAM, as set before failure)
- Ejection seat
- Emergency braking
- Gravity fuel feed
- Manual canopy opening
- Normal flight controls (without SAS or trim)
- Nosewheel shimmy damping
- Oxygen (normal and emergency) NON518
- Oxygen (normal for 2-3 minutes) 518
- Oxygen (emergency 7-9 minutes) 518
- Pitot-static instruments (No error correction or de-icing)
- SAI (±6° for 9 minutes following electrical failure)
- Slip indicator
- Standby compass
- Throttles (Control by mechanical position only, no ITT or fuel flow indicators)

The following procedure applies to flight and landing following total electrical failure:

1. Throttles - Retard (maintain core speeds below 90% when at or below 25,000 feet MSL or below 85% if above 25,000 feet MSL).

CAUTION

In the event an engine is suction-feeding due to a failed boost pump, the affected engine will suction-feed from the failed tank for all power settings above idle up to 10,000 feet (most cases, 20,000 feet).

NOTE

SAI is reliable within ±6° for a minimum of 9 minutes after the battery switch is OFF.

2. Descend to 10,000 feet MSL or below, if possible. If not possible, maintain altitude below 20,000 feet MSL.

WARNING

Cockpit indication of fuel status will not be available. Timing and estimated fuel flow must be used to determine quantity remaining. Fuel in external tanks will not feed, and the tanks cannot be jettisoned.

3. Regulated Emergency Oxygen Supply (REOS) - Activate, if necessary. 518

Prior to landing:

4. Plan no flap/no speed brake approach.
5. Extend landing gear.
   a. Landing gear handle - DOWN.
   b. AUX LG EXT handle - Pull.

NOTE

There will be no cockpit indication of landing gear down and locked. Rely on sound and feel or visual checks to determine gear position. It may take up to 30 seconds or longer for the gear to extend and lock.

   c. AUX LG EXT handle - Push in.

6. Emergency brake handle - Pull.

CAUTION

Anti-skid will not be available. If locked wheel(s) and/or skidding are detected, release brake and reapply cautiously.

NOTE

Electrical canopy actuation and boarding ladder extension will be inoperative. Use the canopy actuator disengage lever and manually raise the canopy. If time is critical, emergency canopy jettison can be used.

ELECTRICAL FIRE - COCKPIT.

Smoke or odors from burning insulation in the cockpit may be indicative of electrical or an engine/air conditioning system malfunction. Therefore, this procedure should be used only when there is evidence that the cause is an electrical fault or malfunction.

1. Oxygen - 100%.

2. Descend below 25,000 feet MSL (if practical).

3. Temperature pressure control - RAM.

4. Crossfeed switch - CROSSFEED.

5. Generator switches (L & R) - OFF/RESET.

WARNING

Placing the L and R generator switches to OFF/RESET will result in shutoff of all fuel pumps except the DC fuel pump in the left main tank. Placing the battery switch to OFF will shut off the DC fuel pump. The maximum altitude for suction-feed is affected by engine power setting, throttle movements, fuel temperature, and aircraft maneuvers. Although engines have operated successfully under ideal conditions at altitudes above 20,000 feet, consideration should be given to maintaining a lower altitude. Below 10,000 feet, suction-feed will be adequate for all operating conditions.

6. APU - OFF.

7. Emergency floodlights switch - EMER FLOOD (if required).

8. Throttles - Retard until engine core speed starts to decrease.

NOTE

Retarding the throttles should prevent engine overtemperature, unless a climb is made to a significantly higher altitude. Turning off the inverter will result in engine fuel flow override operation (no ITT limiter) and loss of engine temperature indication. The engine core speed indicator is independent of the aircraft electrical system except for lighting.

9. Inverter switch - OFF. (Maintain core speeds below 90% when at or below 25,000 feet MSL, or below 85% if above 25,000 feet MSL.)

WARNING

- 518 Turning off all electrical power will cause the OBOGS to cease production of oxygen-enriched air and there will be no caution lights to indicate depletion of the Plenum supply.
- 518 OBOGS will supply 2-3 minutes of reserve with 100% selected. If supply becomes depleted, activate REOS and descend below 10,000 feet MSL.

10. Battery switch - OFF.

NOTE

SAI is reliable within ±6° for a minimum of 9 minutes after battery is OFF.

11. All electrical equipment - OFF.

In the following steps, restore power sources one at a time after the fire is out only to the extent necessary to restore minimum essential electrical equipment to continue to a safe landing. If the fire recurs when the battery switch is turned on, it may be possible to isolate the malfunctioning component using cockpit circuit breakers.

12. Battery switch - PWR.

If power can be restored:

13. Inverter switch - STBY.

14. Respective generator switches - PWR.

15. Turn on essential electrical equipment, one at a time.

16. Crossfeed switch - As required.

If power cannot be restored:

13. Refer to ELECTRICAL FAILURE - TOTAL.

ELECTRICAL SYSTEMS LOST	BUSSES LOST	ELECTRICAL SYSTEMS OPERATIONAL	BUSSES OPERATIONAL
BOTH ENGINE GENERATORS AND APU GENERATOR	L/R AC BUSSES	BATTERY	BATTERY BUS
	L/R DC BUSSES	INVERTER	DC ESSEN BUS
	AC ARMAMENT BUS		AUX DC ESSEN BUS
			AC ESSEN BUS
			AUX AC ESSEN BUS
			INST TRANSFORMER
BOTH CONVERTERS	L/R DC BUSSES	BATTERY	BATTERY BUS
	DC ARMAMENT BUS	L/R AC SYSTEM	DC ESSEN BUS
			AUX DC ESSEN BUS
			L/R AC BUSSES
			AC ESSEN BUS
			AUX AC ESSEN BUS
			26V INST XFORMER

BUSSES LOST	COCKPIT INDICATIONS	BASIC SYS LOST	WEAPONS SYS LOST
LEFT AC, POSSIBLE LEFT DC (NOTE 1)	LGEN	L BOOST PUMPS	RWR
	L MAIN PUMP	DEFOG/DEICE	STA 1 (NOTE 2)
	L WING PUMP	CONSOLE LTS	STA 3 (NOTE 3)
	L CONV	AUX INST LTS	
	L FUEL PRESS	TAXI LT	
	NO L MFCD	CICU INOP	STA 4 & 5
	NO R MFCD (NOTE 8&9)	EPLRS INOP (NOTE 8&9)	STA 2 (NOTE 7) STA 7, 8 & 9 (NOTE 8 & 9) STA 10 (NOTE 7, 8 & 9)

Figure 3-9. Electrical Power Supply System Failure Chart (Sheet 1 of 4)

BUSSES LOST	COCKPIT INDICATIONS	BASIC SYS LOST	WEAPONS SYS LOST
RIGHT AC, POSSIBLE RIGHT DC (NOTE 4)	R GEN	R BOOST PUMPS	HUD
	R MAIN PUMP	DEFOG/DEICE	STA 1 (NOTE 2)
	R WING PUMP	CONSOLE LTS	STA 3 (NOTE 3)
	R FUEL PRESS	HARS (ADI/HSI)	LASTE
	RCONV	SAS	PAVE PENNY
	NO HUD	IFF	STA 11 (NOTE 2)
	NO L/R FUEL FLOW INDICATION	STALL WARNING	STA 9 (NOTE 3)
		AOA HEAT	TV
	ADI/ HSI OFF FLAGS		DVADR
	NO R MFCD (NOTE 8)		STA 7 & 8 (NOTE 8) STA 10 (NOTE 7 & 8)
LEFT DC	ANTI-COLLISION LTS INOP	CDU EGI THUNDERSTORM LTS INOP	STA 1 (NOTE 2)
	FLOOD LTS INOP (CONSOLE)		STA 3 (NOTE 3)
	CDU LOST	AIR REFUEL	STA 5 & 6 (NOTE 5)
	NO L-MFCD	ANTI-COLL LTS	STA 4
	NO R-MFCD (NOTE 8)	EPLRS INOP (NOTE 8)	STA 2 (NOTE 7)
	SATCOM (BLOS) INOP	CICU INOP (NOTE 8)	STA 7, 8 & 9 (NOTE 8)
	VHF/UHF SYS 2 INOP	SATCOM VHF/UHF SYS 2	STA 10 (NOTE 7 & 8)
RIGHT DC	NO HUD	VHF/UHF SYS 1 OR LARS 131	GAU-8
	VHF/UHF SYS 1 (LOS) INOP		PAVE PENNY
	SLATS EXTEND	TACAN	ARMAMENT CONTR
	EXT LTS FAIL	FLAP CONTROL	LASTE
	VHF/UHF RSC INOP	ALL EXT LTS	DVADR
		SAS	
AC ESSENTIAL,	L/R ITT-OFF FLAGS	FUEL GAUGES	NONE
AUX AC ESS (NOTE 6)	L/R FAN GAUGES INOP	ITT AMPLIFIERS	
	L/R OIL PRESS GAUGES FAIL	ITT/FAN/OBOGS 518 / OIL/HYD GAUGES	
		ENG IGNITORS	
		INSTRUMENT LTS	

Figure 3-9. Electrical Power Supply System Failure Chart (Sheet 2)

DEGRADED ELECTRICAL SYSTEMS		
POWER PROVIDED	OPERATIVE SYSTEMS	
EXT BATTERY	CORE RPM INDICATORS AUX GEAR EXT GRAVITY FEED FUEL (LESS THAN 10,0000')	EMERG FLOOD LTS STBY ADI (9 MIN) MAG COMPASS FIRE EXTINGUISHERS
EXT BATTERY INT BATTERY SW - ON	APU START UHF RADIO CAUTION LT PANEL NORM SPD BRK AND LND GEAR/INDICATOR FIRE DETECT SYSTEM	DC FUEL PUMP AND CROSS FEED CONTR STANDBY ADI (INDEF) NWS AND ANTI-SKID COCKPIT UTILITY LT/EMERG FLOOD LTS NORM/EMERG TRIM
EXT BATTERY INT BATTERY SW - ON INVERTER - ON	FUEL QUANTITY GAUGES ENG INST (EXCEPT F/F) ITT AMPLIFIERS	INSTRUMENT LTS ENGINE IGNITERS (RESTART)
NOTE: WITH EXTERNAL BATTERY ONLY, THE FOLLOWING CRITICAL EQUIPMENT IS NOT AVAILABLE: LND GEAR LTS — ALL BOOST PUMPS FLAPS/SPEED BRKS — ALL RADIOS FIRE DETECT — EMERG FUEL SHUTOFF (T-HANDLES) ITT AMPS: CORE RPM LESS THAN 85% WHEN ALT IS GREATER THAN 25,000 FEET, AND CORE RPM LESS THAN 90% WHEN ALT IS LESS THAN 25,000 FEET. ALTHOUGH ALL ESSENTIAL EQUIPMENT IS NOW OPERATIVE, FLIGHT IN INSTRUMENT CONDITIONS SHOULD BE AVOIDED DUE TO INOPERATIVE PITOT HEAT, TACAN, AND HARS.		

Figure 3-9. Electrical Power Supply System Failure Chart (Sheet 3)

NOTES

1. TO SEE IF LEFT DC BUS IS ON LINE, TURN ON FLOODLIGHTS WITH CONSOLE RHEOSTAT AND CHECK ANTI-COLLISION LT OPERATION. IF THESE SYSTEMS ARE INOP, THE LEFT DC BUS IS INOP.
2. ECM CAPABILITY IS LOST, BUT FREE-FALL ORD MAY STILL BE RELEASED.
3. MAV CAPABILITY LOST, BUT FREE-FALL ORD MAY STILL BE RELEASED.
4. TO SEE IF RIGHT DC BUS IS ON LINE, CHECK VHF AM/FM COMM OR TACAN OPERATION. IF THESE SYSTEMS ARE INOP, THE RIGHT DC BUS IS INOP.
5. EMERGENCY AND SELECTIVE JETTISON ARE STILL AVAILABLE.
6. LOSS OF AC/AUX ESSENTIAL BUSSES IS AN INDICATION OF INVERTER FAILURE FOLLOWING DUAL GEN FAILURE. **CHECK INVERTER SWITCH - STBY**.

7 TGP CAPABILITY LOST.

8 CAPABILITY LOST VIA THE ARMAMENT CB PANEL.

9 LEFT DC POWER LOST.

IMPORTANT: IF THE CROSSOVER TIE FAILS DURING GEN FAILURE, STARTING THE APU AND APU GENERATOR MAY REGAIN SOME OR ALL OF THE LOST SYSTEMS.

Figure 3-9. Electrical Power Supply System Failure Chart (Sheet 4)

- FUEL EMERGENCIES -.

FUEL PRESSURE LOW/FUEL LEAK.

Indicated by the L-FUEL PRESS or R-FUEL PRESS caution lights coming on.

1. Crossfeed switch - CROSSFEED.

If L/R FUEL PRESS light goes out, indicating a boost pump failure:

2. Refer to BOOST PUMP FAILURE.

If L/R-FUEL PRESS light stays on, indicating possible leak or pressure sensor malfunction:

3. Crossfeed switch - OFF.
4. Monitor fuel status to determine if leak exists.

NOTE

If pressure sensor malfunction is suspected, recommend land as soon as possible.

If an external fuel leak exists, indicated by excessive fuel quantity drop, vapor trail and/or verification by other aircraft:

5. Throttle (affected engine) - OFF.
6. Fire handle (affected engine) - PULL.

If leak stops, go to Step 8.

If leak continues, left system:

7. Left boost pump switches - OFF; DC FUEL PUMP circuit breaker - OPEN.

If leak continues, right system:

7. Right boost pump switches - OFF.
8. SAS switches - OFF.
9. YAW SAS switch (operable channel only) - Engage (if desired).

10. Crossfeed switch - CROSSFEED (if fuel leak has definitely stopped).

11. Perform SINGLE-ENGINE LANDING procedure.

WARNING

Due to the possibility of explosion, do not start the APU following engine shutdown for a fuel leak.

FUEL QUANTITY INDICATOR MALFUNCTION/MAIN FUEL LOW L/R.

In the event of fuel quantity indicator malfunctions, monitor fuel flow and flight time and land when practical. The L and R MAIN FUEL LOW caution lights are independent of the quantity measuring system, and should not be affected by a malfunction of the quantity indicating system.

1. Crossfeed switch - CROSSFEED (unless fuel leak is suspected).

NOTE

The fuel remaining after either MAIN FUEL LOW caution light comes on is sufficient to fly 20 minutes at maximum range cruise power and altitude, plus fuel for a normal descent and landing, plus one missed approach. When operating with the L or R MAIN FUEL LOW light on, maintain a cruise altitude and avoid abrupt maneuvers that will cause fuel sloshing in the tanks.

If rapid fuel transfer from feeding to all other tanks occurs:

2. All FILL DISABLE switches - PULL.

WARNING

- If the defuel valve fails to open, and crossfeed is selected, fuel will rapidly transfer from boost pump fed tanks into all tanks.

- Dual engine flameout may occur during crossfeed operations if the tank with the operative boost pump runs dry.

NOTE

If in-flight refueling is required, FILL DISABLE switches must be enable.

If fuel state becomes critical:

3. All boost pumps - Check ON.

WARNING

If fuel state becomes critical, maximum usable fuel can be obtained with the crossfeed on and all boost pumps on.

MAIN BOOST PUMP FAILURE.

Failure of either main fuselage boost pumps, indicated by the applicable L or R MAIN PUMP caution light coming on, will have no effect on engine operation while fuel is being pressure fed from the wing tanks. When the wing tank boost pumps are not operating, fuel will suction-feed from the main tanks to an altitude of approximately 10,000 feet. Above this altitude, engine operation could become erratic; however, placing the crossfeed switch to CROSSFEED will supply the engines with fuel under pressure from any operating boost pump and allow continued operation above 10,000 feet.

WARNING

Dual engine flameout may occur during negative g flight after approximately 5 seconds with one main boost pump inoperative, or off.

CAUTION

In the event an engine is suction-feeding due to a failed boost pump, the affected engine will suction-feed from the failed tank for all power settings above idle up to 10,000 feet (most cases, 20,000 feet).

Fuel quantity must be monitored to maintain cg within limits and to preclude fuel exhaustion.

1. Crossfeed switch - CROSSFEED.

If rapid fuel transfer from feeding tanks to all other tanks occurs:

2. All FILL DISABLE switches - PULL.

WARNING

- If the defuel valve fails to open, and crossfeed is selected, fuel will rapidly transfer from boost pump fed tanks into all tanks.
- Dual engine flameout may occur during crossfeed operation if the tank with the operative boost pump runs dry.

NOTE

If in-flight refueling is required, FILL DISABLE switches must be enabled.

If fuel state becomes critical:

3. All boost pumps - Check ON.

WARNING

If fuel state becomes critical, maximum usable fuel can be obtained with the crossfeed on and all boost pumps on.

NOTE

The tank gate switch will equalize the main tanks in straight and level flight and may be used to accomplish transfer if desired. Fuel transfer from the left (aft) tank to the right (forward) tank may be expedited by lowering the nose and allowing the tank fuel to gravity flow to the forward tank. Climbing with the tank gate switch in open position will expedite gravity fuel flow to the aft tank. To ensure that the aircraft cg remains within established limits, the aft fuel tank should not exceed the forward tank by more than 1,000 pounds.

4. Tank gate switch - As required.

NOTE

Fuel in main tanks will be below tank gate valve and will not transfer in level flight when fuel level is below 1,300 pounds in each main tank. The sump fuel will not transfer flow between tanks.

WING BOOST PUMP FAILURE.

If the L or R WING PUMP caution light comes on, the remaining fuel in the affected tank will not gravity transfer until the fuel level in that fuselage is below 600 pounds. If no action is taken, a maximum difference of approximately 2,000 pounds JP-8 (total left or right wing tank fuel) could exist between main tanks. If the right wing boost pump fails, this will place the aircraft in the aft cg condition that is at or beyond limits, and impose air speed limits on operations (for Flight Restrictions with Fuel Imbalance refer to Section V, OPERATING LIMITATIONS). Failure of the left wing boost pump will cause the left (aft) fuselage tank to feed while the right (forward) tank remains full (during pressurized feed of the right wing tank). CG will shift forward within allowable limits.

If either L or R WING PUMP caution light comes on, the pilot will be required to take the following actions to minimize CG travel.

1. Crossfeed switch - CROSSFEED.

   The higher pressure (+5 psi minimum) of the wing boost pump overrides the main fuselage boost pump pressure, and will cause wing fuel tank to empty. If the demand of both engines lowers the operating wing boost pump pressure, the added fuel required will be supplied by the main boost pumps.

If rapid fuel transfer from feeding tanks to all other tanks occurs:

2. All FILL DISABLE switches - PULL.

WARNING

- If the defuel valve fails to open, and crossfeed is selected, fuel will rapidly transfer from boost pump fed tanks into all tanks.
- Dual engine flameout may occur during crossfeed operation if the tank with the operative boost pump runs dry.

NOTE

If in-flight refueling is required, FILL DISABLE switches must be enabled.

If fuel state becomes critical:

3. All boost pumps - Check ON.

WARNING

If fuel state becomes critical, maximum usable fuel can be obtained with the crossfeed on and all boost pumps on.

If wing fuel stops feeding, as evidenced by fuel gauge readings:

4. Crossfeed switch - OFF.

   Fuel will then feed from each fuel tank to its respective engine in the normal manner.

CAUTION

Applicable wing fuel may not be recoverable with a failed boost pump.

NOTE

Straight and level flight with a minimum of abrupt maneuvers will maximize the amount of wing fuel available by gravity to the main tanks.

EXTERNAL FUEL FAILS TO TRANSFER.

If fuel transfer from the external tank(s) fails to start after 15 to 30 minutes of flight:

1. EXT TKS switch (WING/FUS) - Check On.
2. FILL DISABLE switches - Ensure fully depressed.
3. RCVR lever - Cycle OPEN to CLOSE.

If fuel still fails to transfer:

4. Descend below 18,000 feet MSL.
5. APU - START.

NOTE

APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet).

6. APU GEN switch - PWR.

If fuel still fails to transfer:

7. MAIN AIR switch - Cycle OFF to SUPPLY.

If the preceding steps do not start the external fuel tanks feeding, the aircraft tanks have a failure which cannot be resolved through pilot action. It may be necessary to jettison the external tank(s) if range becomes critical. Continue to monitor for signs of feeding.

LEFT/RIGHT TANKS UNEQUAL.

The L-R TKS UNEQUAL caution light comes on at a 750 (±250) pound differential between the main fuel tanks.

CAUTION

If tank gate switch is unintentionally left open, large shifts in fuel between forward and aft main tanks can result in significant aft CG shift may occur, depending on aircraft altitude.

NOTE

- Determine the cause of the fuel imbalance and use differential throttles, boost pump switches, or the tank gate switch as necessary to maintain internal fuel at the desired level.
- Aircraft cg will remain within limits if left main (aft) tank level is not allowed to exceed right main (forward) tank level by more than 1,000 pounds.
- With less than 300 rounds of ammunition or without ammunition but with ballast and L-R TKS UNEQUAL caution light on with a left (aft) tank heavy imbalance, the following airspeeds should not be exceeded until imbalance is corrected:

Altitude (feet)	Maximum Speed (KIAS)
Sea Level	315
15,000	240
35,000	156

If the L-R TKS UNEQUAL caution light comes on or fuel imbalance is noted, equalize the main fuel tank levels as follows:

NOTE

Fuel in main tanks will be below tank gate valve and will not transfer in level flight when fuel level is below 1,300 pounds in each main tank. The sump fuel will not transfer flow between tanks.

1. Crossfeed switch - CROSSFEED.
2. Wing boost pump switches - OFF.

IF the left system has less fuel:

3. Left main boost pump switch - OFF.
4. DC FUEL PUMP circuit breaker - Open.

WARNING

Dual engine flameout may occur during negative g flight after approximately 5 seconds with one main boost pump inoperative, or off.

If the right system has less fuel:

3. Right main boost pump switch - OFF.

WARNING

Dual engine flameout may occur during negative g flight after approximately 5 seconds with one main boost pump inoperative, or off.

IF fuel transfers rapidly from feeding tanks to all other tanks, if not, go to step 6:

5. All FILL DISABLE switches - PULL.

WARNING

- If the defuel valve fails to open position, and crossfeed is selected, fuel will rapidly transfer from the boost pump fed tanks into all tanks.
- Dual engine flameout may occur during crossfeed operations if the tank with the operative boost pump runs dry.

NOTE

If in-flight refueling is required, FILL DISABLE switches must be enabled.

IF fuel imbalance is corrected, OR fuel state becomes critical and imbalance cannot be corrected, OR gauge malfunction is suspected:

6. Left and Right main boost pump switch - ON.

7. Left and Right wing boost pump switches - ON.

8. DC FUEL PUMP circuit breaker - Close.

WARNING

If fuel state becomes critical, maximum usable fuel can be obtained with the crossfeed on and all boost pumps on.

IF fuel state is not critical:

9. Crossfeed switch - OFF.

WARNING

- Returning the crossfeed switch to OFF prior to turning the main boost pump on may result in an engine flameout.
- If the tank gate switch has been activated, do not hot refuel until it can be verified by ground test that the tank gate valve is closed. Hot Refueling Job Guide provides ground crew/pilot verification procedures.

NOTE

Conditions permitting, the tank gate switch may be used; however, the fuel imbalance must be closely monitored.

EXTERNAL TANK JETTISON.

If it becomes necessary to selectively jettison external tanks because of one tank being damaged, the following procedure is recommended:

1. Landing gear handle - UP.
2. Flap lever - UP.
3. MFCD - Select DSMS Page.
4. MFCD (DSMS Page) - Select SJET.
5. MFCD (Selective Jettison Page) - Select STR (Figure 3-10).
6. MFCD - Fuel tank station - Select.

NOTE

Selected station inventory will be displayed in flashing green reverse video.

7. MFCD - Fuzing - Select SAFE.
8. AHCP - MASTER Armament switch - ARM.
9. Weapons Release Button - Depress.

NOTE

EXTERNAL TANK JETTISON LIMITS 1.0g LEVEL FLIGHT

1 OR 2 TANKS	275 KIAS maximum
3 TANKS	250 KIAS maximum

10. AHCP - MASTER Armament switch - SAFE.

AIR REFUELING EMERGENCIES.

BREAKAWAY PROCEDURES.

Relative position of both airplanes must be closely monitored by all crewmembers during all phases of air refueling. When either a tanker or receiver crewmember determines that an abnormal condition exists which requires an immediate separation of the airplanes, that crewmember will transmit the breakaway call on air refueling frequency. Abnormal conditions include excessive rate of closure, closure overrun, and engine failure. The airplanes do not have to be in contact-mode to call a breakaway.

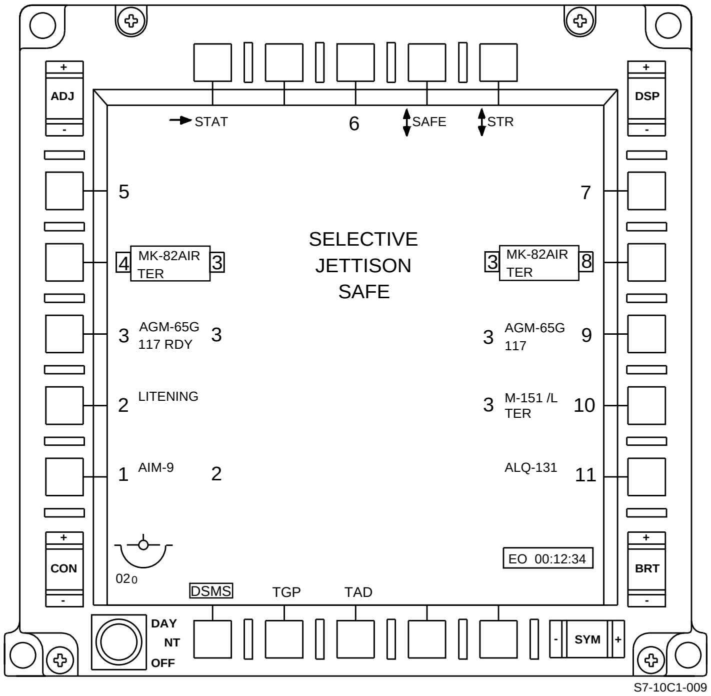


Figure 3-10. Selective Jettison Safe

For all breakaways, transmit the tanker's call sign and the word "breakaway" three times (Example: "Chevy 2, breakaway, breakaway, breakaway") and simultaneously take the following actions indicated.

- Tanker Pilot - The pilot will increase power to obtain forward separation. Unless lateral separation cannot be assured, the tanker will accelerate in level flight and will not climb. When the receiver is well clear, the breakaway may be terminated. The receiver pilot will be notified of and will acknowledge any reduction in power by the tanker to resume air refueling speed. If a climb is required, the tanker pilot will disengage the autopilot and climb straight ahead. If in a turn, the tanker will maintain the established bank angle until the receiver is well clear. The lower rotating beacon will be turned on, the pilot director lights will be flashed, and the Radar/Rendezvous Beacon will be turned to operate, if appropriate.

- Receiver Pilot - Actuate disconnect switches as applicable. Retard throttles and establish a definite rate of descent, using speed brakes if necessary. If possible, drop aft of tanker until entire tanker is in sight and monitor flight instruments.

NOTE

- If a breakaway is called prior to any receiver reaching the observation position, the entire receiver flight will execute the breakaway procedure. If a breakaway is called after receiver(s) have reached the observation position, only the receiver in the contact or precontact position will execute the breakaway procedure. The receiver(s) in the observation position will maintain formation on the tanker.

- With certain gross weights and aircraft configurations, the tanker rate of acceleration on a breakaway may exceed the rate of acceleration for the receiver aircraft in the observation position. If this occurs, follow the procedures for a receiver in the contact or precontact positions if in VMC, or applicable lost wingman procedures if in IMC.

AIR REFUELING SYSTEMS MALFUNCTIONS.

When any system malfunction or condition exists which could jeopardize safety, air refueling will not be accomplished except during fuel emergencies or when continuance of refueling is dictated by operational necessity.

Signal Amplifier Switch Override Operation.

If the signal amplifier fails, the READY light may not illuminate or may not go out after contact is made. When this occurs, the signal amplifier switch should be placed in the OVERRIDE position. In OVERRIDE, when the nozzle contact switch has actuated the latch control valve, there is no light action, no signals are passed to the tanker, and the tanker cannot actuate the disconnect cycle.

Inoperative Boom/Receptacle Latching.

When all other recognized means of fuel transfer have failed, and a bona fide fuel shortage emergency aboard the receiver aircraft exists, fuel can be transferred by maintaining boom/receptacle contact using a slight extend pressure on the boom telescope lever.

WARNING

The receiver pilot must inform the tanker he is ready to receive fuel and coordinate the disconnect cycle at the conclusion of refueling.

CAUTION

- Prior to attempting this method of transferring fuel, the boom operator will brief the receiver pilot and thoroughly coordinate the procedures to be used. Both tanker and receiver crews will monitor the refueling with extreme caution.
- Air refueling will be terminated intentionally at 90% full to prevent a buildup of pressure in the manifold.

Unusual and varying trim changes may be required of both tanker and receiver aircraft.

HYDRAULIC FAILURE, BOOM RECEPTACLE.

In the event of loss of hydraulic fluid (return pressure loss) the OPEN position of the Air Refuel control releases a lock allowing the spring loaded slipway door to open.

WARNING

- The nozzle latch rollers will not lock without hydraulic pressure; however transfer may be completed, in an emergency, by using INOPERATIVE BOOM/RECEPTACLE LATCHING procedures described above.
- Considerable fuel spraying will occur during transfer, causing no visibility problem.
- The air refuel control must be returned to CLOSE position after fuel transfer.

The normal refueling checklist for the boom and receptacle system will apply.

BRUTE FORCE DISCONNECTS.

There are two types of brute force disconnects; inadvertent and controlled-tension.

CAUTION

Following a brute-force disconnect emergency, air refueling may be continued when dictated by operational necessity or fuel emergencies.

NOTE

Any brute-force disconnect emergency must be entered in the AFTO Form 781 and should specify whether the brute-force disconnect was inadvertent or controlled tension.

Inadvertent Brute-force Disconnect.

An inadvertent disconnect is defined as any unplanned, mechanical, tanker/receiver separation resulting from the receiver exceeding the aft limit or boom envelope (automatic disconnect) limits.

Controlled-tension Brute-force Disconnect.

A controlled-tension disconnect is defined as an intentional, coordinated disconnect accomplished by a gradual movement aft to the boom's aft limit (maximum extension) resulting in a smooth-tension boom pullout. When all normal methods of disconnect fail, the following procedure will be accomplished.

1. Altitude - Maintain.
2. Power - Gradually reduce to establish a positive rate of separation.

CAUTION

- A controlled-tension brute-force disconnect is a last resort.
- A tension force of approximately 4,800 pounds in the nozzle will effect a disconnect.
- Do not jerk the boom out with idle power and speed brakes. This method can cause serious structural damage to the tanker or receiver.

DAMAGED TANK PROCEDURE.

CAUTION

- In the event of a damaged internal tank, as evidenced by a Fuel Low light or abnormal drop in fuel quantity, the damaged tank must be prevented from receiving fuel during air refueling. Pull the FILL DISABLE switch for the subject tank.
- In the event an external tank is damaged, as reported by a wingman, this individual tank shall be jettisoned using the following selective jettison procedure.

1. Landing gear handle - UP.
2. Flap lever - UP.
3. MFCD - Select DSMS Page.
4. MFCD (DSMS Page) - Select SJET.
5. MFCD (Selective Jettison Page) - Select STR.
6. MFCD - Fuel tank station - Select.

NOTE

Selected station inventory will be displayed in flashing green reverse video.

7. AHCP - MASTER armament switch - ARM.
8. MFCD - Fuzing - Select SAFE.
9. Weapons Release button - Depress.

NOTE

EXTERNAL TANK JETTISON LIMITS 1.0g LEVEL FLIGHT

1 OR 2 TANKS	275 KIAS maximum
3 TANKS	250 KIAS maximum

10. AHCP - MASTER armament switch - SAFE.

FUEL LEAK DURING AIR REFUELING TRANSFER.

A fuel leak may not be associated with any fuel pressure lights. Fuel spray during disconnect is normal and is not considered an emergency during fuel transfer.

WARNING

- If an automatic disconnect occurs while in the normal air refueling limits, this may be due to excessive manifold pressure. Damage may have occurred. Do not continue to air refuel.
- If fuel spray is observed from the nozzle and/or receptacle during fuel transfer, the fuel transfer will be terminated, non-essential electrical equipment should be turned off, radio transmissions minimized, and the mission terminated as soon as practical to allow investigation of fuel in interior areas. Further refueling will not be conducted except in an emergency fuel situation.
- If an automatic disconnect occurs while in the normal air refueling limits, this may be due to excessive manifold pressure. Damage may have occurred. Do not continue to air refuel.

NOTE

During or after air refueling, if fuel is draining from the gun bay or nosewheel well, or fuel fumes are entering the cockpit, a fuel leak in the aircraft air refueling system may exist. Fuel leaks can be verified by confirmation of fuel flow from the tanker with no fuel quantity increase or by visual indications outside the aircraft verified by the tanker or wingman.

If a fuel leak is suspected, perform DISCONNECT checklist:

1. Air Refueling door - Close.
2. Visually inspect for fuel leaks.
3. Perform LINE CHECK.

If fuel is leaking:

4. Oxygen - 100%.
5. Check for a fire. (If a fire exists, refer to ELECTRICAL FIRE - COCKPIT)
6. Landing/Taxi Lights - OFF.

NOTE

Fuel leak drainage may be improved by lowering the landing gear.

If practical, to aid fuel leak drainage:

7. Airspeed - <200 KIAS.
8. Landing Gear handle - Down.

After approximately 2 to 5 minutes:

9. Landing Gear - Up. (If needed for fuel considerations)

   Delaying lowering the landing gear will slow the fuel draining process and could cause the fuel to remain inside the nose and avionics bay.

10. Land as soon as practical.
11. Manually open the canopy if any fuel fumes are present after landing.
12. Shutdown all aircraft systems as soon as possible.

TOWING.

When air refueling with the boom, it may be desirable to be towed. After notification from the pilot of his desire to be towed, and acknowledgement received from the tanker pilot and boom operator, the receiver pilot will hook-up then extend boom to the outer boom limit at a slow rate to prevent a brute force pullout. Disconnect can be accomplished by either the boom operator or the receiver pilot.

WARNING

Disconnect with aircraft in 0 azimuth so that boom will not bind in receptacle.

CRASH LANDING, DITCHING, OR BAILOUT.

If an emergency occurs which necessitates a crash landing, ditching, or bailout, an aircraft designated by the leader will accompany the disabled aircraft or will cover personnel at a safe distance above the surface. The designated aircraft will render all assistance possible, orbiting the area until aid arrives or until fuel supply requires leaving the area.

- OXYGEN EMERGENCIES -.

SMOKE, FUMES, OR ODORS.

Smoke/Fumes/Odors can cause some measure of pilot incapacitation that can degrade a pilot's ability to exercise proper judgment.

1. Oxygen - 100%.
2. Check for fire. (If electrical fire exists, refer to ELECTRICAL FIRE - COCKPIT.)
3. APU switch - OFF.
4. (CONDITIONS PERMITTING) Descend to 25,000 feet MSL or below.
5. TEMP/PRESS control - RAM.
6. CANOPY DEFOG control - OFF.

If smoke, fumes, or odors continue:

WARNING

518 Turning BLEED AIR switch to OFF with APU off or turning MAIN AIR SUPPLY switch to OFF will cause OBOGS to stop producing oxygen-enriched air. At 100% oxygen setting, the OBOGS Plenum will provide 2 to 3 minutes of reserve. If OBOGS PRESS LOW caution light comes on, refer to OBOGS PRESSURE LOW procedure.

7. BLEED AIR switch - OFF.

If smoke is still entering from air conditioning system:

8. MAIN AIR SUPPLY switch - OFF.

If smoke becomes severe:

9. Canopy - Jettison.

HYPOXIA.

If hypoxia is suspected:

1. Oxygen supply lever - ON.
2. Oxygen - 100%.
3. Oxygen emergency lever - EMERGENCY.
4. Oxygen flow indicator - Check blinking.
5. Oxygen supply pressure - Check.
   a. Above 55 psi NON518
   b. Above 10 psi 518

If malfunction confirmed:

6. Activate emergency oxygen supply.
7. Descend to 10,000 feet MSL or below, if possible.

OBOGS FAIL 518.

The OBOGS FAIL caution light on indicates either that the percentage of oxygen in the OBOGS product has fallen below physiological requirements or an oxygen monitor failure has been detected.

1. Regulator diluter lever - 100%
2. Breathe normally for 5 seconds.

If light goes off:

3. Diluter lever - Set as desired

If light remains on:

3. Descend to 10,000 feet MSL or below, if practical.
4. Regulated Emergency Oxygen Supply (REOS) - Activate, if necessary.
5. Land as soon as practical.

OBOGS PRESSURE LOW 518.

1. ENVIRONMENT Control Panel - Check.

   a. MAIN AIR SUPPLY - ON

   b. BLEED AIR - ON

2. ECS air pressure - Increase

   Increase engine rpm, increase airspeed, decrease altitude, reducing/shutting off air conditioning, or reducing/shutting off canopy defog.

If light remains on:

3. Descend to 10,000 feet MSL or below, if practical.

4. Regulated Emergency Oxygen Supply (REOS) - Activate, if necessary.

5. Land as soon as practical.

- ENGINE EMERGENCIES -.

WARNING

Flight tests show a significantly higher rudder force is required to maintain controlled flight following the failure of a right engine as opposed to the failure of a left engine. The additional force required varies but has been measured to be as high as 100 pounds. The onset rate is rapid and occurs when the right hydraulic system depressurizes, about the same time that the slats extend. Failure to apply sufficient and timely rudder inputs may result in yaw rates so high that there is insufficient rudder available to correct it, and the aircraft will depart controlled flight. Use of rudder trim may be necessary to relieve excessive rudder pressure.

BLEED AIR LEAK/SERVICE AIR OVERHEAT.

A bleed air leak or overheat in the environment system precooler may be indicated by one of the following:

- BLEED AIR LEAK caution light on.
- Unexplained loss of environment system air.
- SERVICE AIR HOT caution light on.

CAUTION

If BLEED AIR LEAK light goes off, a successful FIRE DETECT BLEED AIR LEAK TEST indicates that the circuit is reliable. An unsuccessful test means that the light may have gone off due to fire damage, and other indicators must be closely monitored.

If any of the above occurs:

1. BLEED AIR switch - OFF.

WARNING

518 Turning BLEED AIR switch to OFF with APU off or turning MAIN AIR SUPPLY switch to OFF will cause OBOGS to stop producing oxygen-enriched air. At 100% oxygen setting, the OBOGS Plenum will provide 2 to 3 minutes of reserve. If OBOGS PRESS LOW caution light comes on, refer to OBOGS PRESSURE LOW procedure.

2. MAIN AIR SUPPLY switch - OFF.

3. APU - OFF.

4. Oxygen - 100%.

5. TEMP/PRESS control - RAM (if required).

NOTE

Cockpit ventilation and limited defogging can be obtained by placing the temp/press control to RAM.

6. Land as soon as practical.

ENGINE/APU FIRE.

An engine/APU fire is indicated by the engine/APU fire light coming on and/or visual indications of fire in the engine nacelle or APU area.

CAUTION

If possible, one engine should remain running during braking to provide unlimited hydraulic power to either the normal or emergency brake system.

NOTE

The design configuration of the A-10, with the engines mounted in nacelles external to the aft fuselage, is less subject to rapid spread of a catastrophic fire than internally mounted engines. The fire extinguishing system offers a high probability of controlling fire in the nacelle. Propagation of engine fire to the fuselage proper is restricted by a stainless steel firewall in the engine mount pylon. Differential pressure between the nacelle and the fuselage could allow heat or fire to transfer to the fuselage if the pylon firewall fails. The initial instrument indication to the pilot that the firewall has failed will probably be a BLEED AIR LEAK light. The canopy design allows the pilot to monitor the engine and nacelle section visually if fire indications persist.

ENGINE FIRE.

A possible engine fire is indicated when the engine fire light comes on. A malfunction of the indicating circuit also is possible, and the presence of an actual fire should be confirmed. If an actual engine fire exists, there will normally be visual indications of fire in the engine nacelle area. Engine fires also are usually accompanied by erratic or abnormal engine instrument readings, loss of thrust, or mechanical failure indications such as engine vibration. If an engine fire light comes on, retard the throttle (if practical) and check for other fire indications.

Reducing power on the affected engine may cause the fire light to go off. If the fire light goes off, check the fire detection circuit by pressing the FIRE DETECT BLEED AIR LEAK TEST button. If the fire light tests good, this indicates that the circuit is reliable. If the fire light does not test good, this indicates a failure of the test or detection system, warranting increased attention to visual or other fire indications. Experience has shown that engine fires can occur without causing the engine fire light to come on immediately. Therefore, absence of the light provides no assurances when there are other positive fire indications.

APU FIRE.

If the APU fire light comes on, it indicates a possible fire in the APU area.

The BLEED AIR LEAK light should not come on unless the hot condition exists outside the firebox. In either case, illumination of the APU fire and BLEED AIR LEAK lights at the same time indicates that hydraulic, fuel, electrical, flight control, and ECS equipment are being exposed to heat or fire. Wiring for instruments and electrical equipment is more susceptible to damage than flight controls and fluid lines. Erratic instrument indications or equipment malfunctions tend to confirm a fire. If the APU fire and/or BLEED AIR LEAK lights go off, a successful FIRE DETECT BLEED AIR LEAK TEST indicates that the circuits are reliable. An unsuccessful test means that the light(s) may have gone off due to fire damage, and other indicators must be closely monitored. If the APU fire light comes on, prompt action is necessary to preclude the spread of fire within the fuselage.

At first indication of engine or APU fire (ground), or confirmed engine fire (in flight), or first indication of APU fire (in flight):

1. **THROTTLE/APU - OFF.**

2. **FIRE HANDLE - PULL.**

3. **AGENT - DISCHARGE.**

WARNING

- If an in-flight fire in the APU compartment occurs, land as soon as possible while continually checking for fire. If it continues to burn out of control, ejection is recommended.

- If an engine fire can not be confirmed from other indications (fluctuating fuel flows, excessive ITT, flames, or smoke) and/or a malfunction in the fire indicator circuit is suspected, closely monitor the aircraft for an actual fire and land as soon as possible.

NOTE

If fire light goes off, check fire detection circuit by pressing the FIRE DETECT BLEED AIR LEAK TEST button.

If an engine/APU is shut down on the ground:

4. Perform EMERGENCY GROUND EGRESS, as required.

CAUTION

If possible, one engine should remain running during braking to provide unlimited hydraulic power to either normal or emergency brake system.

If an engine is shut down and safe airspeed and altitude can be maintained, go to step 8:

5. Speed brakes and flaps - RETRACT.

6. Stores - JETTISON (If required).

7. Fuel Flows - OVERRIDE (If required).

CAUTION

- During emergency situations, operation of the engine with the ENG FUEL FLOW switches in OVERRIDE will provide 0 - 15% more engine thrust (approximately 0 - 300 FPM). Operation of the engine in above normal temperature range should only be accomplished for the minimum time to achieve safe operating conditions. Throttle should be retarded to maintain ITT below 865°C as soon as minimum safe altitude and rate of climb are achieved (estimate 1 to 3 minutes).

- Additional rudder input and bank will be required to control yaw when selecting OVERRIDE. Anticipate an ENG HOT light illuminated and high ITT on the properly functioning engine.

- Operation for several minutes in above normal temperature range will not precipitate an immediate engine failure. However, ITT can reach 980°C and some engine durability degradation will occur. Operation in above normal temperature range for more than 15 minutes is not recommended

- Engineering analysis determined that the aircraft will be controllable during single-engine operations with T5 override. With an ECM pod on the same side as the non-operating engine, approximately 40% rudder travel is still available for maneuvering the aircraft.

NOTE

Best single-engine climb speed is a function of temperature, pressure altitude, gross weight, and configuration/drag index. Under normal single-engine approach conditions (gear down, flaps up, stores previously jettisoned or of minimal consequence in regard to drag/gross weight) best single-engine climb speed is approximately 10 KIAS less than single engine approach speed. From this baseline, best single-engine climb speed increased 10 KIAS when the gear is retracted. Due to high rudder force requirements and increased yaw departure potential at low airspeeds, the pilot should attempt to maintain a climb speed in excess of 150 KIAS if possible. If a best single-engine climb speed below 150 KIAS must be maintained, it is essential that yaw rate be controlled through proper use of rudder and bank into the good engine. This will increase climb potential, as well as reduce the possibility of a yaw departure.

8. SAS switches - OFF

9. Yaw SAS switch (operable channel only) - Engage - (if desired).

10. APU - START.

NOTE

APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet).

11. APU generator switch - PWR.

12. Crossfeed switch - CROSSFEED.

13. Land as soon as possible using SINGLE-ENGINE LANDING procedure.

ENGINE CORE OVERTEMP/FUEL FAILS TO DRAIN/LOSS OF PNEUMATIC POWER DURING ENGINE START.

An Engine core overtemp exists whenever the ITT limitations in Section V are exceeded.

Fuel normally drains from engine within 5 seconds after shutdown. A post-shutdown overtemp is likely to occur if fuel fails to drain. An ITT indication above 540°C with the core rpm below 5% indicates an engine post-shutdown overtemp.

If loss of pneumatic power (APU, ground cart, or an operating engine) occurs during engine start, an engine overtemp may result, depending on engine rpm.

1. Throttle - OFF against AFT stop.

If ITT is not decreasing:

2. Establish an air source from:

   a. APU.

   b. Other engine (85% core rpm minimum) (pull emergency brake handle if required).

   c. External ground cart.

3. Engine operate switch - MOTOR (until ITT below 150°C).

If ITT does not go below 200°C in 2 minutes:

4. Fire handle - PULL.

NOTE

Engine core overtemp or tail pipe fire (reported by outside observer) will not normally cause the engine fire warning light to come on. Extinguishing agent will not put out an engine core fire, as it does not discharge into the core. Extinguishing agent should be used if the fire light comes on or if there are visual indications of an engine fire.

5. Perform EMERGENCY GROUND EGRESS.

ENGINE START CYCLE CONTINUES AFTER START.

If the ENG START CYCLE caution light remains on, or APU fails to unload within designated limits:

1. APU or external air source - OFF.

2. Throttles - OFF.

ENGINE FAILS TO SHUT DOWN.

If core RPM and ITT are maintained with throttle in OFF:

1. Fire handle (affected engine) - PULL.

NOTE

Engine cannot be motored unless fire handle is pushed in or the appropriate BLEED AIR CONT circuit breaker is open.

SINGLE-ENGINE FAILURE OR FIRE DURING TAKEOFF (TOO LATE TO ABORT).

If an engine failure or fire occurs during takeoff, immediately decide whether to continue the takeoff or abort. Below 70 KIAS, flight control inputs may be inadequate to maintain control of the aircraft with one engine at MAX and the other engine failed. In this case, an abort is the only option. Above continuation speed (minimum go-speed) but below refusal speed, it is possible to continue the takeoff. However, an abort is normally the preferable option. If an abort is not possible, both throttles should remain at MAX until a safe altitude is attained. Gear retraction should be accomplished promptly once safely airborne in order to enhance performance and to take advantage of any residual hydraulic pressure. If the aircraft does not have a positive gear down, single-engine, rate-of-climb potential, it may be possible to retract the landing gear by residual hydraulic pressure if the gear handle is raised within 5 seconds after left engine failure.

WARNING

Continuation of the takeoff with an engine failure must include consideration of the gear down single-engine rate of climb at takeoff speed and configuration. A positive gear down single-engine rate of climb must be available for a valid Continuation Speed. In the absence of a valid Continuation Speed, abort may be the only option.

A catastrophic engine failure (seized engine), or a rapid loss of left hydraulic fluid could preclude raising the gear, but this has a remote probability of occurrence. Jettison of heavyweight stores will significantly improve climb performance. Fully retracting the flaps will increase single-engine climb performance, but will also decrease stall margin at low air speed. Therefore, if climb performance allows, full retraction should be delayed until above 150 KIAS. A near level attitude should be maintained while accelerating to a minimum of best single-engine climb speed. Accelerate and climb straight ahead if terrain permits. If turns are necessary, they should be made into the good engine, if possible, and at a minimum practical bank angle.

WARNING

- During single-engine operation, failure to use sufficient rudder can result in large sideslip angles and yaw rates, producing excessive drag, sink rates and loss of airspeed. Use coordinated flight and slight bank into the good engine to prevent sideslip buildup and avoid large yaw rates. Power reduction on the good engine may be required to arrest yaw buildup. Failure to arrest an excessive yaw rate may create a condition where there is insufficient rudder to correct the sideslip and cause the aircraft to depart controlled flight. Increased power must be led by coordinated rudder. Significantly higher forces will be required with a right engine failure (as high as 100 lbs). Use rudder trim to relieve excessive rudder pressure.

NOTE

- Following engine failure, the associated rudder will revert to manual control when hydraulic pressure bleeds off. Total rudder effectiveness is slightly degraded and pedal force requirements are noticeably higher.
- In visual meteorological conditions, yaw control is best accomplished by using rudder to stop any nose excursions relative to outside visual cues. In instrument meteorological conditions, use cockpit instruments (turn needs - centered and heading-stabilized) to determine when sufficient rudder is being applied.

1. **THROTTLES - MAX.**

WARNING

If the throttle of the bad engine is retarded to IDLE, crossbleed air from the good engine will be initiated when core rpm decreases below 56%, resulting in a 4% thrust loss.

2. **GEAR - UP.**

NOTE

Single-engine rate of climb at takeoff is increased 400 FPM if the gear is retracted.

3. **STORES - JETTISON IF REQUIRED.**

WARNING

- The external 600 gallon fuel tanks are directionally destabilizing. Close attention is required to avoid rapid increases in sideslip. External tank jettison is highly recommended for both performance and handling considerations.

- Engine failure after takeoff prior to gear retraction with high runway temperature/pressure altitude may result in the aircraft being unable to accelerate to single-engine climb speed. With gear up, minimal acceleration rate, low altitude, and terrain features may not allow for sufficient time of flight to safely recover the aircraft.

- Nonjettisonable ECM pods on outboard stations will contribute to directional control problems if a counter balancing store on the opposite wing is jettisoned. This will be particularly evident if the ECM pod is in the same side as the failed engine. The overriding consideration must be aircraft performance. If single-engine climb capability is questionable, jettison is the only alternative.

NOTE

Best single-engine performance is achieved with a slight bank (up to 5°) into the good engine and rudder, as required, to maintain constant heading. The ball will be displaced toward the good engine, proportional to the amount of bank used.

4. **FUEL FLOWS - OVERRIDE.**

CAUTION

- During emergency situations, operation of the engine with the ENG FUEL FLOW switches in OVERRIDE will provide 0 - 15% more engine thrust (approximately 0 - 300 FPM). Operation of the engine in above normal temperature range should only be accomplished for the minimum time to achieve safe operating conditions. Throttle should be retarded to maintain ITT below 865°C as soon as minimum safe altitude and rate of climb are achieved (estimate 1 to 3 minutes).

- Additional rudder input and bank will be required to control yaw when selecting OVERRIDE. Anticipate an ENG HOT light illuminated and high ITT on the properly functioning engine.

- Engineering analysis determined that the aircraft will be controllable during single-engine operations with T5 override. With an ECM pod on the same side as the nonoperating engine, approximately 40% rudder travel is still available for maneuvering the aircraft.

At safe altitude and with airspeed above 150 KIAS (if possible):

5. Flaps - UP (EMER RETR if necessary).

WARNING

If left hydraulic pressure is not available, the pilot must select EMER RETR. Use extreme caution to ensure the manual reversion switch is not inadvertently activated.

NOTE

Best single-engine climb speed is a function of temperature, pressure altitude, gross weight, and configuration/drag index. Due to high rudder force requirements and increased yaw departure potential at low airspeeds, attempt to maintain a climb speed in excess of 150 KIAS, if possible. If a best single-engine climb speed below 150 KIAS must be maintained, it is essential that yaw rate be controlled through proper use of rudder and bank into the good engine. This will increase climb potential, as well as reduce the possibility of a departure.

6. FUEL FLOWS - NORM, if desired.

CAUTION

Operation for several minutes in above normal temperature range will not precipitate an immediate engine failure. However, ITT can reach 980°C and some engine durability degradation will occur.

7. Accomplish **ENGINE FAILURES/OVERTEMP or ENGINE FIRE** procedure, as required.

ENGINE FAILURES/OVERTEMP/COMPRESSOR STALL.

WARNING

- Flameouts, characterized by a decrease in ITT, RPM (both fan and core), and fuel flow, are usually associated with fuel starvation or fuel interruption, but may be associated with operation outside the normal flight envelope.
- A compressor stall is characterized by an increase in ITT along with a hang-up or rollback in core and fan RPM. Experience has shown that a non-recoverable compressor stall will result in rising ITT (which may exceed limits and peg the ITT gauge) and a decrease in fan and core RPM. Compressor stalls are usually associated with aircraft AOAs above wing stall AOA.
- A mechanical failure is usually characterized by unusual engine noise and/or vibration.
- An engine overtemp is indicated by ITT gauge or the L- or R-ENG HOT caution light coming on.

CAUTION

Engine fan and core speed fluctuations beyond limits may indicate impending engine failure. Land as soon as possible.

If any of the above occurs:

1. Control stick - Unload to ensure operation within flight envelope.

2. Throttle - Retard to minimum practical. (Do not select IDLE.)

CAUTION

- Retarding the throttle to IDLE following a flameout will result in a hot start condition, since fuel and ignition will be available.
- A nonrecoverable compressor stall must be cleared by shutting down the engine and restarting.

If engine is flamed out, does not recover within RPM and/or ITT limits, or mechanically failed:

3. Throttle - OFF.

NOTE

If rapid cooldown is not observed within 5 seconds of shutdown, ensure that the affected throttle is positioned against the aft/OFF stop to shut off all fuel flow and permit engine cooling.

If safe airspeed and altitude can be maintained, go to step 7.

4. Speed brakes and Flaps - RETRACT.

5. Stores - JETTISON (if required).

6. Fuel Flows - OVERRIDE (if required).

CAUTION

- During emergency situations, operation of the engine with the fuel flow switches in override may provide additional thrust. The engine should be operated in above normal temperature range only for the minimum time to achieve safe operating conditions. Throttle should be retarded to maintain ITT below 865°C as soon as minimum safe altitude and rate of climb are achieved (estimate 1 to 3 minutes).

- Additional rudder input and bank will be required to control yaw when selecting override. The pilot should also anticipate ENG HOT light illuminated and high ITT on the properly functioning engine.

- Operation for several minutes in above normal temperature range will not precipitate an immediate engine failure. However, ITT can reach 980°C and some engine durability degradation will occur. Operation in above normal temperature range for more than 15 minutes is not recommended.

- Engineering analysis determined that the aircraft will be controllable during single-engine operations with T5 override. With an ECM pod on the same side as the non-operating engine, approximately 40% rudder travel is still available for maneuvering aircraft.

7. SAS switches - OFF.

8. Yaw SAS switch (operable channel only) - Engage (if desired).

9. APU - START (below 15,000 feet MSL).

WARNING

Due to possibility of explosion, do not start APU if fuel leak is suspected.

NOTE

APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet).

10. APU generator switch - PWR.

11. Crossfeed switch - CROSSFEED (unless fuel leak suspected).

12. Refer to SINGLE-ENGINE RESTART or SINGLE-ENGINE LANDING procedure, as appropriate.

CAUTION

- An engine restart after a compressor stall, rollback, or flameout should be attempted only if required to safely land the aircraft. Engine damage may have occurred and not be apparent from inside the aircraft.

- If ITT limits are exceeded or internal damage is suspected, do not restart unless a critical thrust requirement exists.

ENGINE OIL SYSTEM MALFUNCTION.

If oil pressure is not within operating limits:

1. Throttle - Minimum practical (do not select IDLE).

CAUTION

Selecting idle with simultaneous loss of core speed will activate engine start cycle. Operation of ATS at high power will cause severe aircraft damage and probable fire.

If oil pressure and core speed indicate zero or 30 psi minimum oil pressure cannot be maintained:

2. Throttle - OFF.

CAUTION

- Abnormal oil pressure gauge indication not accompanied by loss of core RPM and/or the illumination of the L/R ENG OIL PRESS caution light may indicate oil pressure gauge failure.

- Total loss of oil pressure and core speed indication is a positive sign of oil pump driveshaft failure and engine failure can occur in 1 to 3 minutes.

If 30 psi minimum oil pressure can be maintained and core speed is in the normal range:

2. Throttle - IDLE.

If an engine is shut down and safe airspeed and altitude can be maintained, go to step 6:

3. Speed brakes and Flaps - RETRACT.

4. Stores - JETTISON (if required).

5. Fuel Flows - OVERRIDE (if required).

CAUTION

- During emergency situations, operation of the engine with the fuel flow switches in override may provide additional thrust. The engine should be operated in above normal temperature range only for the minimum time to achieve safe operating conditions. Throttle should be retarded to maintain ITT below 865°C as soon as minimum safe altitude and rate of climb are achieved (estimate 1 to 3 minutes).

- Additional rudder input and bank will be required to control yaw when selecting override. The pilot should also anticipate ENG HOT light illuminated and high ITT on the properly functioning engine.

- Operation for several minutes in above normal temperature range will not precipitate an immediate engine failure. However, ITT can reach 980°C and some engine durability degradation will occur. Operation in above normal temperature range for more than 15 minutes is not recommended.

- Engineering analysis determined that the aircraft will be controllable during single-engine operations with T5 override. With an ECM pod on the same side as the non-operating engine, approximately 40% rudder travel is still available for maneuvering aircraft.

6. SAS switches - OFF.

7. Yaw SAS switch (operable channel only) - ENGAGE (if desired).

8. APU - START.

NOTE

APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet).

9. APU generator switch - PWR.

10. Crossfeed switch - CROSSFEED.

NOTE

If single-engine flight must be continued for an extended period, it will be necessary to place the crossfeed switch to CROSSFEED and manage furl to ensure the cg remains within limits.

11. Refer to SINGLE-ENGINE LANDING procedure.

ITT CONTROL SYSTEM FAILURE/LOW CORE RPM AT MAX POWER.

Failure of the ITT control system is indicated by:

- Exceeding maximum ITT
- Fluctuating engine parameters when operating at core speeds above 80%
- The inability to attain core speeds above 80%.

CAUTION

With the engine fuel flow switch in OVERRIDE, close monitoring of ITT is required to prevent possible overtemperature. Since ITT may rise significantly upon selection of OVERRIDE, the throttle should be retarded until core speed starts to decrease prior to this action to prevent an overtemperature condition.

1. Throttle (affected engine) - Retard (until core speed starts to decrease).
2. Engine fuel flow switch (affected engine) - OVERRIDE.
3. Throttle - Adjust slowly and monitor ITT to maintain within limits.
4. Cross-check engine instruments on both engines to confirm proper operation of the ITT gauges by comparison of fan speed levels at same ITT.

ENGINE START CYCLE LIGHT ON/CORE RPM INDICATOR MALFUNCTION.

Malfunction of the core RPM indicator is indicated by an abnormally low or zero reading of the core RPM gauge without the corresponding loss of thrust or change in other associated engine performance indications. Malfunction of this gauge may cause initiation of start cycle whenever associated throttle is restarted to idle. This will cause a reduction of thrust, a loss of bleed air/cabin pressurization, and possible burn-out of ATS.

If the ENG START CYCLE light comes on during flight:

1. L and R ENG START circuit breakers - Open (third row down, first and second from left).

NOTE

If subsequent airstart becomes necessary, ensure appropriate circuit breaker is closed.

Core RPM Indicator Malfunction.

1. Throttle (affected engine) - Maintain above IDLE.

CAUTION

Selecting idle with core speed loss will activate engine start cycle. Operation of ATS at high power will cause severe engine damage and probable fire.

2. ENG START circuit breakers (affected engine) - OPEN (third row down, left side).

NOTE

If subsequent airstart becomes necessary, ensure appropriate circuit breaker is closed.

APU FLUCTUATIONS/OVERTEMPERATURE/OVERSPEED.

If the APU experiences fluctuations, overtemperature, or overspeed condition, shut down the APU.

1. APU - OFF.

    If the APU is needed for engine start or electrical power, restart and monitor. If either or both engines are running at or above approximately 80% core RPM during APU operation, failure of the bleed air check valve in the bleed air system will cause unstable operation of the APU and possibly serious damage. Core speeds above 80% RPM allow high pressure bleed air from the engine to override low pressure APU air when this check valve fails. The resulting back pressure on the APU causes fluctuating APU RPM and EGT, surging, etc., and could result in an overtemp and possible fire if immediate action is not taken. If either engine is operating above 80% core RPM and the APU shows the above signs of unstable operation, the problem may be resolved by placing the bleed air switch to OFF. If the APU stabilizes, a failed check valve is likely. If this problem is discovered on the ground, retard the throttle(s) to idle and abort the mission. If airborne and the APU is required, leave the bleed air switch OFF and land as soon as practical.

BROKEN THROTTLE CABLE/STUCK THROTTLE(S).

The A-10 fuselage throttle cable is prone to fatigue failure, and may fail at any time. There may be no prior indication of throttle cable failure, such as stuck throttle, binding, etc. After cable failure, engine power may be increased but not reduced. Flight may continue for some time before the realization that the engine is not responding to throttle reductions. Indications of throttle cable failure include abnormal yaw, greater than expected airspeed for a given throttle position, or inability to slow down. With a stuck throttle, close monitoring of fuel balance is required. Landing may be accomplished with one or both engines operating, as necessary to control airspeed. Consideration should be given to shutting down an engine stuck at a high power setting in flight, rather than pulling the fire handle after landing, when directional control and braking difficulties will be encountered. Engine shutdown time, using the corresponding fire handle, varies between 2 (from Max) and 23 (from idle) seconds. With the stuck throttle engine operating, rudder will be required to control yaw induced by differential thrust, which will increase as the throttles are reduced in an attempt to slow down.

1. Control airspeed through configuration changes and/or engine shutdown.

NOTE

- If throttle(s) is/are stuck at a high power setting, the option of landing with one or both engines operating, as needed to control airspeed, is available.
- An engine shutdown accomplished with the fire handle will take from 2 to 23 seconds, depending on power setting. If one engine is stuck at a high power setting, consideration should be given to shutting down that engine prior to recovering the aircraft.

If engine is shut down in flight:

2. Throttle(s) - OFF (if possible).
3. Fire handle - Pull (if required).
4. Refer to SINGLE-ENGINE LANDING.

If engine is not shut down in flight:

2. Establish a landing configuration.

NOTE

During and after landing, consideration must be given to increased yaw induced by the difference in thrust.

If left engine will be shut down after landing:

5. Emergency brake handle - Pull.

After touchdown:

6. Speed brakes - OPEN.
7. Throttle(s) - OFF.
8. Fire handle(s) - PULL.

CAUTION

- If fire handle is used to shut down an engine that is operating above IDLE power, a post-shutdown overtemperature and/or tailpipe fire is possible and fire department should be notified. Refer to ENGINE START/SHUTDOWN - CORE OVERTEMP/FUEL FAILS TO DRAIN/LOSS OF PNEU POWER DURING ENGINE START.
- With left engine shut down, nosewheel steering, normal braking, and anti-skid are not available. If right engine is operating, emergency brake system will provide unlimited brake applications.

9. Emergency brake handle - Pull (if left engine is shutdown prior to stopping).

CAUTION

- If a post-shutdown overtemperature develops, the appropriate Fire Handle must be pushed back in or BLEED AIR CONT circuit breaker pulled to allow engine motoring. Refer to ENGINE START/SHUTDOWN - CORE OVERTEMP/FUEL FAILS TO DRAIN/LOSS OF PNEU POWER DURING ENGINE START.
- If the Fire Handle is pushed back in to allow motoring, the main fuel shutoff valve will open potentially resulting in a fire in the engine.

NOTE

- Engine core overtemperature or tailpipe fire (reported by outside observer) will not normally cause the engine fire warning light to come on. Extinguishing agent will not put out an engine core fire, as it does not discharge into the core. Extinguishing agent should be used if the fire light comes on or there are visual indications of an engine fire.
- Engine cannot be motored unless fire handle is pushed in or the appropriate BLEED AIR CONT circuit breaker is open.

SINGLE-ENGINE RESTART.

1. Throttle (affected engine) - OFF.

NOTE

- If rapid cooldown is not observed within 5 seconds of shutdown, ensure that the affected throttle is positioned against the aft/OFF stop to shut off all fuel flow and permit engine cooling.
- If possible, descend below 20,000 feet MSL and increase airspeed to improve starting characteristics.

2. APU - START.

NOTE

APU starts can be made up to an altitude of 15,000 feet (most cases up to 20,000 feet).

3. APU generator switch - PWR.

4. Throttle (operating engine) - MAX.

WARNING

- 518 The bleed air supply to OBOGS is cut off during engine motoring and during the engine start cycle. Depending on altitude, regulator setting, and breathing rate, OBOGS will provide 2 to 10 minutes of reserve (2 to 3 minutes if 100% is selected).
- 518 If OBOGS PRESS LOW caution light illuminates while motoring engine, set engine operate switch to NORM and allow OBOGS pressure to increase to 35-40 psi before starting engine.
- 518 If OBOGS PRESS LOW caution light illuminates during the engine start cycle, no action should be necessary due to its short duration. However, if OBOGS becomes completely depleted, immediately abort the engine start cycle. Activate REOS if needed.

NOTE

If start is attempted above 10,000 feet, loss of cabin pressure will occur, when the throttle is moved to IDLE for start, the ECS shutoff valve closes and all bleed air to the environmental system is lost.

5. Engine operate switch (affected engine) - MOTOR.

WARNING

A 4% thrust loss will be experienced even with the APU running since above approximately 80% core RPM, engine bleed air is at a higher pressure than the APU can supply. This 4% thrust loss may be sufficient to preclude sustained level flight or seriously degrade single-engine climb performance in a critical thrust situation.

NOTE

- Starter is capable of motoring engine to approximately 24-28% core RPM.
- Placing the engine operate switch to MOTOR will provide rapid cooling of the engine. Cool engine until ITT below 150°C (100°C above 15,000 feet MSL).

6. Inoperative engine - Start.

7. Engine operate switch (affected engine) - NORM.

If restart was unsuccessful:

8. Throttle (affected engine) - OFF.

9. Crossfeed - As required.

10. Refer to SINGLE-ENGINE LANDING.

If restart is successful:

8. SAS switches - ENGAGE.

9. Crossfeed - As required.

10. Anti-skid - ENGAGE.

NOTE

There is a possibility for engine failure after successful engine restart.

WINDMILL AIRSTART.

It takes between 6,000 and 8,000 feet in a steep dive (at least 30° dive angle) with power off to gain windmill airstart speed from normal cruise speeds. Additional altitude will be lost during engine start and dive recovery. This may preclude safe accomplishment of a windmill start (see Figure 3-11 for the windmill start envelope). If an assisted start is unsuccessful, then a windmill start may be attempted, provided the inoperative engine shows no signs of seizure or other damage. ITT will rapidly fall to 150°C or below as airspeed increases.

Windmill airstart is not recommended. However, if necessary:

1. Place aircraft in a dive to obtain and/or maintain sufficient windmill start airspeed.

WARNING

Accomplishing a windmill airstart following a dual engine flameout will require a high-speed dive in manual reversion. If engine start is unsuccessful, high control forces will be necessary to recover from the dive. If pitch trim is inoperative, ejection may be the only option.

2. BLEED AIR switch - OFF.

WARNING

518 Turning BLEED AIR switch to OFF with APU off or turning MAIN AIR SUPPLY switch to OFF will cause OBOGS to stop producing oxygen-enriched air. Depending on altitude, regulator setting, and breathing rate, OBOGS will provide 2 to 10 minutes of reserve (2 to 3 minutes if 100% is selected). If OBOGS PRESS LOW caution light comes on, refer to OBOGS PRESSURE LOW procedure.

3. CROSSFEED switch - CROSSFEED.

ITT below 150° C and inside the windmill start envelope:

4. Throttle(s) - MAX.

5. Engine operate switch(es) affected engine(s) - IGN.

CAUTION

If both engines are inoperative and windmilling, selection of IDLE will open both bleed valves and the ATS valve on one engine, to bleed into the open starter. This will lead to slow acceleration or prevent a successful start.

NOTE

Both engines may be windmill-started simultaneously. Placing the crossfeed switch in CROSSFEED allows either engine an equal chance of starting first during a double-engine flameout; otherwise, the left engine has the best chance of starting first due to positive fuel pressure from the DC fuel pump.

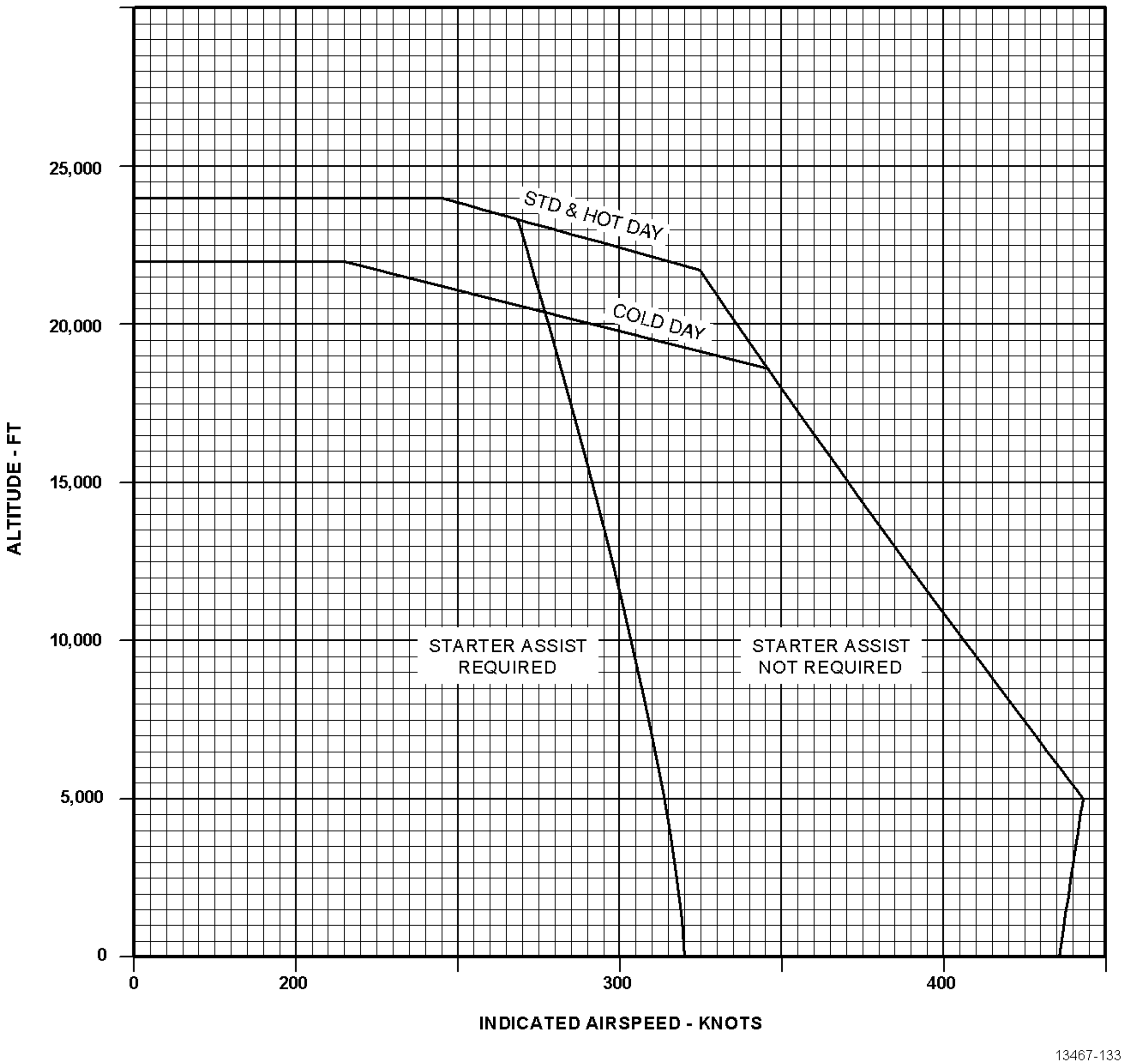


Figure 3-11. Windmill Start Envelope

SINGLE-ENGINE FAILURE OR FIRE WHILE CONFIGURED FOR LANDING.

The following procedure applies when an engine malfunction occurs after landing configuration is established.

When engine failure or fire occurs or is suspected while configured, use rudder as required to control yaw, advance throttles to MAX, retract speed brakes, and if flaps are full down, select MVR. This is critical to preclude airspeed bleedoff and to accelerate to single-engine approach or safe go-around airspeed. As the throttles are advanced, the primary method of controlling yaw is to apply rudder into the good engine. Banking into the good engine will reduce the amount of rudder required and enhance single-engine airspeed above 150 KIAS (climb capability permitting). If altitude permits, maintaining a descent will allow more rapid acceleration.

If the pilot elects to go-around, the throttles should remain at MAX until at a safe altitude and airspeed. Gear retraction should be accomplished promptly once committed to the go-around, to enhance performance and to take advantage of any residual hydraulic pressure. Jettison of heavyweight stores will significantly improve climb performance. Fully retracting the flaps will increase single-engine climb performance, but will also decrease stall margin at low airspeed. Therefore, if climb performance allows, full retraction should be delayed until above 150 KIAS. Accelerate and climb straight ahead if terrain permits. If turns are necessary, they should be made into the good engine, if possible, and at minimum practical bank angle.

If landing is assured at the time of an engine failure or fire indication, apply power as required, retract the speed brakes, and devote full attention to completing the landing. After touchdown, primary attention should be on restoring braking (if necessary), maintaining directional control, and safely stopping the aircraft. As time and circumstances permit, engine fire or shutdown procedures should be accomplished.

WARNING

- During single-engine operation, failure to use sufficient rudder can result in large sideslip angles and yaw rates, producing excessive drag, sink rates and loss of airspeed. Use coordinated flight and slight bank into the good engine to prevent sideslip buildup and avoid large yaw rates. Power reduction on the good engine may be required to arrest yaw buildup. Failure to arrest an excessive yaw rate may create a condition where there is insufficient rudder to correct the sideslip and cause the aircraft to depart controlled flight. Increased power must be led by coordinated rudder. Significantly higher forces will be required with a right engine failure (as high as 100 lbs). Use rudder trim to relieve excessive rudder pressure.

NOTE

- Following engine failure, the associated rudder will revert to manual control when hydraulic pressure bleeds off. Total rudder effectiveness is slightly degraded and pedal force requirements are noticeably higher.

- In visual meteorological conditions, yaw control is best accomplished by using rudder to stop any nose excursions relative to outside visual cues. In instrument meteorological conditions, use cockpit instruments (turn needle - centered, and heading - stabilized) to determine when sufficient rudder is being applied.

1. **THROTTLES - MAX.**

WARNING

If the throttle of the bad engine is retarded to IDLE, crossbleed air from the good engine will be initiated when core RPM decreases below 56%, resulting in a 4% thrust loss.

2. **SPEED BRAKES - Close.**

3. **FLAPS - MVR.**

NOTE

- The intent is to decrease drag. If the flaps are already up, do not put the flaps down to MVR.

- Going from full flaps to MVR provides a significant decrease in drag without imposing a severe penalty in stall margin or available left/climb potential. If MVR is selected promptly following left engine failure, residual hydraulic pressure will drive the flaps to the 7° position, which will allow subsequent full retraction using EMER RETR. If complete left hydraulic pressure depletion has occurred prior to selecting MVR, select EMER RETR to obtain flap aerodynamic retraction to less than 15°.

If go-around is necessary go to step 4, if not, go to step 9:

4. Gear - UP (if possible).

5. Stores - Jettison (if required).

WARNING

- The external 600 gallon fuel tanks are directionally destabilizing. Close attention will be required to avoid rapid increases in sideslip. External tank jettison is highly recommended for both performance and handling considerations.

- Nonjettisonable ECM pods on outboard station will contribute to directional control problems if a counterbalancing store on the opposite wing is jettisoned. This will be particularly evident if the ECM pod is on the same side as the failed engine. The overriding consideration must be aircraft performance. If single-engine climb capability is questionable, jettison is the only alternative.

NOTE

Best single-engine performance is achieved with a slight bank (up to 5°) into the good engine and rudder, as required, to maintain a constant heading. The ball will be displaced toward the good engine, proportional to the amount of bank used.

6. FUEL FLOWS - OVERRIDE (if required).

CAUTION

- During emergency situations, operation of the engine with the ENG FUEL FLOW switches on OVERRIDE will provide 0 - 15% more engine thrust (approximately 0 - 300 FPM). Operation of the engine in above normal temperature range should only be accomplished for the minimum time to achieve safe operating conditions. Throttle should be retarded to maintain ITT below 865° as soon as minimum safe altitude and rate of climb are achieved (estimate 1 to 3 minutes).
- Additional rudder input and bank will be required to control yaw when selecting OVERRIDE. Anticipate an ENG HOT caution light and high ITT on the properly functioning engine.
- Operation for several minutes in above normal temperature range will not precipitate an immediate engine failure. However, ITT can reach 980°C and some engine durability degradation will occur. Operation in above normal temperature range for more than 15 minutes is not recommended.
- Engineering analysis determined that the aircraft will be controllable during single-engine operations with T5 override. With an ECM pod on the same side as the nonoperating engine, approximately 40% rudder travel is still available for maneuvering the aircraft.

At safe altitude and with airspeed above 150 KIAS (if possible):

7. Flaps - UP (EMER RETR if necessary).

WARNING

If the left hydraulic pressure is not available EMER RETR must be selected. Use extreme caution to ensure the manual reversion switch is not inadvertently activated.

NOTE

Best single-engine climb speed is a function of temperature, pressure altitude, gross weight, and configuration/drag index. The worst case occurs when a left engine failure precludes gear retraction and flaps can only be partially retracted (to less than 15° following emergency retraction). Due to high rudder force requirements and increased yaw departure potential at low airspeeds, attempt to maintain a climb speed in excess of 150 KIAS if possible. If needed for obstacle clearance, best single-engine rate of climb is approximately 10 knots below single-engine approach speed. Below 150 KIAS, it is essential that yaw rate be controlled through proper use of rudder and bank into the good engine. This will increase climb potential, as well as reduce the possibility of a yaw departure.

8. Accomplish **ENGINE FAILURES/OVERTEMP/ COMPRESSOR STALL** or **ENGINE FIRE** procedure, as required.

If approach is continued:

9. Airspeed - Maintain 150 KIAS plus 1 knot for each 1,000 pounds of aircraft gross weight over 30,000 pounds.

10. Perform SINGLE-ENGINE LANDING procedure, and appropriate ENGINE FAILURE/OVERTEMP or ENGINE FIRE procedure as time and circumstances permit.

SINGLE-ENGINE LANDING.

WARNING

- During single-engine operation, failure to use sufficient rudder can result in large sideslip angles and yaw rates, producing excessive drag, sink rates and loss of airspeed. Use coordinated flight and slight bank into the good engine to prevent sideslip buildup and avoid large yaw rates. Power reduction on the good engine may be required to arrest yaw buildup. Failure to arrest an excessive yaw rate may create a condition where there is insufficient rudder to correct the sideslip and cause the aircraft to depart controlled flight. Increased power must be led by coordinated rudder. Significantly higher forces will be required with a right engine failure (as high as 100 lbs). Use rudder trim to relieve excessive rudder pressure.

- The yaw SAS fail-safe monitoring feature does not function during single-channel SAS operation. Close formation or low altitude flight is not recommended during single-channel SAS operation. Close formation or low altitude flight is not recommended during single-channel SAS operation due to the probability of an undesirable roll/yaw transient in the event of a yaw SAS hardover failure.

- If an undesirable aircraft transient is experienced as a yaw SAS switch is engaged, leave yaw SAS off, select the other attitude reference system, either HARS or NAVCRS, and then reattempt yaw SAS engagement.

- If an undesirable aircraft transient is experienced as a yaw SAS switch is engaged after selecting the other attitude reference system, leave yaw SAS off.

When faced with a single-engine landing, consideration must be given to aircraft gross weight, asymmetry, pressure altitude, and temperature. Checklist performance data is available to determine best single-engine climb speed. If level flight cannot be maintained at maximum power with stores on board, an early decision must be made as to which stores to jettison and where. The aircraft configuration should be cleaned up as much as possible. Use flap emergency retract or speed brake emergency retract, as required. A single-engine landing should be flown from a straight-in approach, with all maneuvering accomplished by a minimum of 2 to 3 nm from the touchdown point. A no-flap approach should be flown to ensure having go-around capability.

Lowering the gear will result in an increase in drag, and must be compensated for by increasing power and increasing rudder opposing the failed engine. At 1 to 2 nm from the touchdown point, the fuselage should be aligned with the runway. Power reduction during the flare should be made slowly, and coordinated with a steady decrease in rudder to maintain nose alignment with the runway.

WARNING

- A combination of high gross weight, high pressure altitude, and high temperature may create a condition in which level flight is not possible with gear extended. In this case, delay lowering gear until ready for descent on final, and, if possible, reduce weight prior to starting approach.

- During single-engine operation, failure to use sufficient rudder can result in large sideslip angles and yaw rates, producing excessive drag, sink rates and loss of airspeed. Use coordinated flight and slight bank into the good engine to prevent sideslip buildup and avoid large yaw rates. Power reduction on the good engine may be required to arrest yaw buildup. Failure to arrest an excessive yaw rate may create a condition where there is insufficient rudder to correct the sideslip and cause the aircraft to depart controlled flight. Increased power must be led by coordinated rudder.

WARNING

- Nonjettisonable ECM pods on outboard stations will contribute to directional control problems if a counterbalancing store on the opposite wing is jettisoned. This will be particularly evident if the ECM pod is in the same side as the failed engine. The overriding consideration must be aircraft performance. If single-engine climb capability is questionable, jettison is the only alternative.

- The external 600 gallon fuel tanks are directionally destabilizing. Close attention will be required to avoid rapid increases in sideslip. External tank jettison is highly recommended for both performance and handling considerations.

With the loss of a hydraulic system, rudder forces will be higher than normal and total rudder authority will be degraded. Rudder forces required to align the fuselage with the runway can be extreme under conditions of high power setting and high crosswind into the dead engine. The following procedures may be used to minimize fatigue:

NOTE

- Flying a constant heading with a slight (up to 5°) bank angle into the good engine and sideslip toward the good engine (aircraft nose toward the dead engine) will reduce rudder force. The ball will be displaced toward the good engine, proportional to bank angle.

- Fly the approach with the crosswind from the operating engine side, if possible. In this case, crab angle (due to crosswind) and sideslip angle (due to asymmetric thrust) cancel each other out and require minimum rudder effort. The differences in technique between approach and landing with a crosswind from the dead-engine side versus operating-engine side are significant, and preplanning is essential.

- Fly a relatively steep approach (3°) to minimize power on the operating engine. Rudder deflection to align the fuselage with the runway should be coordinated with power reduction during the flare.

- If the left engine is inoperative and auxiliary landing gear extension handle is used, nosewheel steering, normal wheel brakes, flaps, and anti-skid will not be available.

- If the right engine is inoperative, speed brakes will not be available and the slats will extend, producing an increase in drag.

- Final approach airspeed above minimum will enhance aircraft single-engine flight characteristics transition to computed final approach airspeed when practical. When landing is assured, begin a flare so as to touch down at the speeds recommended in TO 1A-10C-1-1, and use available drag devices. Gust factor and crosswind corrections should be applied to touchdown airspeed, but are not applied to single-engine approach speed.

1. Speed brakes - Close.

2. Flaps - Retract.

3. External stores - Jettison (if required).

NOTE

Selective jettison of stores on the same side as the dead engine will reduce rudder requirement.

4. Yaw trim control knob - Neutral.

5. SAS/Anti-skid Paddle - OFF.

6. Yaw SAS - Engage operable channel if hydraulic pressure for operable hydraulic system is normal, and yaw damping, trim and turn coordination is desired. (Do not engage pitch SAS.)

7. Landing gear handle - DOWN. (If left hydraulic system is inoperative: AUX LG EXT handle - Pull; when gear indicates safe: AUX LG EXT handle - Push in.)

NOTE

It may take up to 30 seconds or longer for the gear to extend and lock.

8. Emergency brake handle - Pull (if left hydraulic system is inoperative).

9. Anti-skid switch - ANTI-SKID (if left hydraulic system is operative).

10. Review SINGLE-ENGINE GO-AROUND procedure.

11. Fly no flap approach at a minimum of 150 KIAS plus 1 knot for each 1,000 pounds of aircraft gross weight over 30,000 pounds until landing is assured.

After landing is assured:

12. Flaps - As required (if left hydraulic system is operative).

13. Speed brakes - As required (if right hydraulic system is operative).

SINGLE-ENGINE GO-AROUND.

WARNING

- During single-engine operation, failure to use sufficient rudder can result in large sideslip angles and yaw rates. Large sideslip angles will produce excessive drag, loss of airspeed, and excessive sink rates. It is critical to maintain coordinated flight using the rudders and slight bank into the good engine to prevent sideslip buildup during single-engine situations. If altitude and the situation permit, power reduction on the good engine may be required to arrest excessive yaw buildup. If sideslip is not arrested, it is possible to create a condition where the yaw rate becomes so large that there is insufficient rudder available to correct the sideslip, and the aircraft can depart controlled flight. Increased power settings must be led by timely and coordinated rudder inputs.

- Flight tests show a significantly higher rudder force is required to maintain controlled flight following the failure of a right engine as opposed to a failure of a left engine. The additional force required varies but has been measured to be as high as 100 pounds. The onset rate is rapid and occurs when the right hydraulic system depressurizes, about the same time the slats extend. Failure to apply sufficient and timely rudder inputs may result in yaw rates so high that there is insufficient rudder available to correct it, and the aircraft will depart controlled flight. Use of rudder trim may be necessary to relieve excessive rudder pressure.

The following procedures should be used when required to execute a go-around from a single-engine approach.

1. Throttle - MAX.

2. Landing gear - UP (if left hydraulic system available).

NOTE

Best single-engine climb speed is a function of temperature, pressure altitude, gross weight, and configuration/drag index. Under normal single-engine approach conditions (gear down, flaps up, stores previously jettisoned or of minimal consequence in regard to drag/gross weight) best single-engine climb speed is approximately 10 KIAS less than single engine approach speed. From this baseline, best single-engine climb speed increases 10 KIAS when the gear is retracted. Due to high rudder force requirements and increased yaw departure potential at low airspeeds, a climb speed in excess of 150 KIAS should be maintained if possible. If a best single-engine climb speed below 150 KIAS must be maintained, it is essential that yaw rate be controlled through proper use of rudder and bank into the good engine. This will increase climb potential, as well as reduce the possibility of a yaw departure.

3. External Stores - Jettison (if required).

4. FUEL FLOWS - OVERRIDE (if required).

CAUTION

- During emergency situations, operation of the engine with the WNG FUEL FLOW switches in OVERRIDE will provide 0 - 15% more engine thrust (approximately 0 - 300 FPM). Operation of the engine in above normal temperature range should only be accomplished for the minimum time to achieve safe operating conditions. Throttle should be retarded to maintain ITT below 865°C as soon as minimum safe altitude and rate of climb are achieved (estimate 1 to 3 minutes).

- Additional rudder input and bank will be required to control yaw when selecting OVERRIDE. Anticipate an ENG HOT caution light and high ITT on the properly functioning engine.

- Operation for several minutes in above normal temperature range will not precipitate an immediate engine failure. However, ITT can reach 980° C and some engine durability degradation will occur. Operation in above normal temperature range for more than 15 minutes is not recommended.

- Engineering analysis determined that the aircraft will be controllable during single-engine operations with T5 override. With an ECM pod on the same side as the nonoperating engine, approximately 40% rudder travel is still available for maneuvering the aircraft.

DOUBLE-ENGINE FAILURE.

NOTE

- It may take up to 110 seconds to regain usable engine power after initiation of the APU start and subsequent engine start. At low altitude, a 30,000 pound A-10 flown at best glide speed will descend approximately 3,700 feet in 110 seconds. Consequently, during takeoff, landing, and certain low airspeed/low altitude cruise situations, it is impossible to accomplish an engine start prior to ground impact. An early decision to eject is imperative. If possible, ejection should be accomplished in a wings level climb. However, in some cases it will not be possible to attempt a climb without risking a stall. In some cruise situations, even at low altitude, there will be potential for an engine restart. The aircraft will either already be at an adequate starting altitude or can be zoomed to exchange airspeed for altitude. The situation must be evaluated to determine whether a restart or ejection is the proper course of action. (See Figure 3-12 for determining maximum glide distance with both engines windmilling.) If the APU is running when engine failure occurs, restart time will be reduced by 30 to 40 seconds. If both engines fail during flight at high altitude (above 20,000 feet MSL), the decision must be made whether to trade altitude for airspeed to try a windmill start using the WINDMILL AIR-START procedure, and/or to glide down to a lower altitude to start the APU for an assisted start. If attempts to start the APU fail, a windmill start is the only option for an engine start.

- Jettisoning external ordnance will reduce gross weight and may increase glide distance.

1. **THROTTLES - OFF**.

WARNING

In certain situations, flight into the engine disturbance area (see Figure 6-2), with the throttles in idle, may cause the engines to stagnate at idle core RPM without engine overtemp. This condition will not cause a MASTER CAUTION light and the best course of action may be to leave one engine running, shut down other engine to clear stall/stagnation, and perform single engine restart using APU. If engine is stalled/stagnated at idle, there will be hydraulics available to power flight controls.

NOTE

If rapid cool down is not observed within 5 seconds of shutdown, ensure that the affected throttles are positioned against the aft/OFF stop to shut off all fuel flow and permit engine cooling.

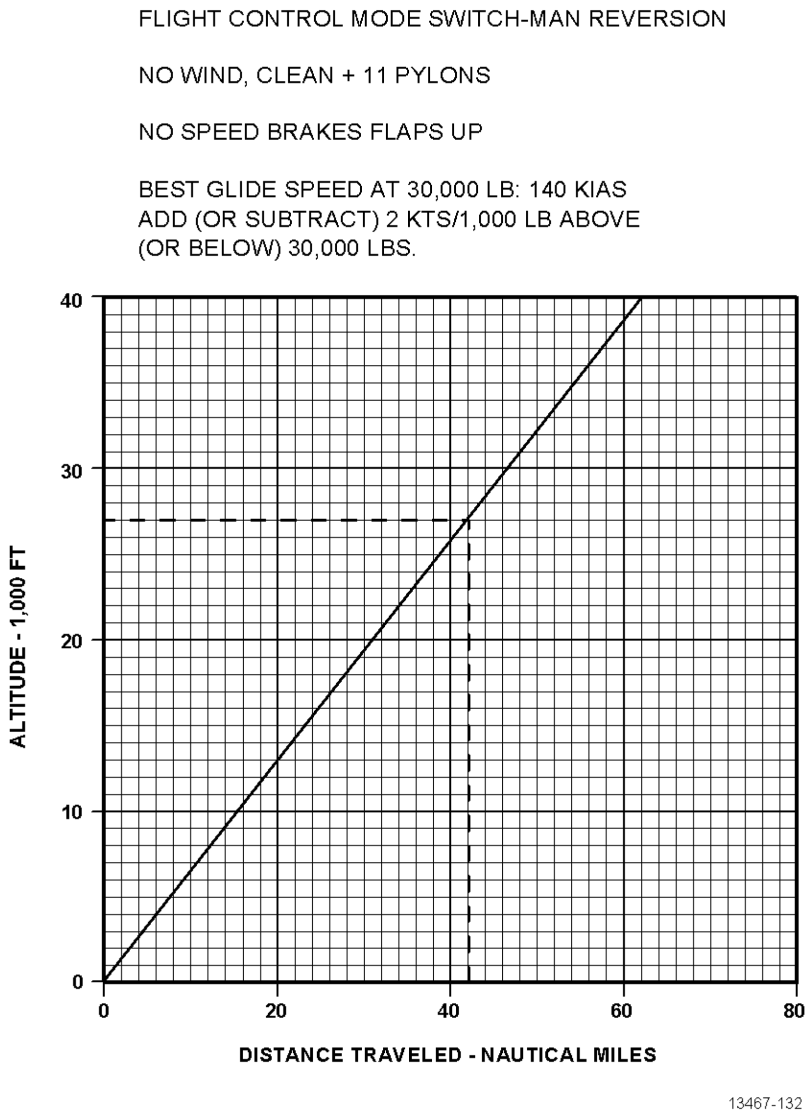


Figure 3-12. Best Glide - Both Engines Windmilling

2. **APU - START**.

NOTE

- The APU is designed to start at altitudes up to 15,000 feet. However, the APU has been started at altitudes up to 20,000 feet.

- APU generator should be turned on after the APU comes up to speed to provide electrical power for hydraulic pump cooling.

3. **FLIGHT CONTROLS - MAN REVERSION**.

WARNING

Aileron float up normally induces an aircraft pitch change which can be nose up or nose down depending on aircraft cg, elevator trim tab setting, power setting, and flap position. The pitch change intensity varies and is dependent on aileron float up rate, airspeed, and altitude, and can range from minus 2.0 to plus 6.8 g's during transition.

NOTE

It will normally take 4 seconds after the flight control mode switch is set to MAN REVERSION before the aircraft is in full manual reversion mode. Expect a pitch transient at transition. During this time, only rudder is available for roll control (rudder and elevator are available immediately).

4. **LEFT ENGINE - MOTOR.**

CAUTION

Cool engine until the ITT is below 150° C. Attempting restart with ITT above 150° C will result in overtemp and may damage the engine to the extent that usable power will not be available.

5. **LEFT ENGINE - START (ITT will rise within 20 seconds).**

WARNING

Actuation of the ignition sequence between the time the APU switch is moved to START and the APU RPM reaches 60% may preclude ignition signals from reaching the engine. If ignition does not occur, stop the ignition attempt and reinitiate the ignition sequence after the APU RPM has reached 60% or greater.

CAUTION

The throttle must be positioned against IDLE stop in order to obtain APU-assisted engine starts. If the throttle is moved forward of IDLE, the ATS control valve will close and ignition is terminated after 30 seconds.

NOTE

The APU is designed to provide adequate air pressure and flow for engine starting at altitudes up to 10,000 feet. Starts, however, have been accomplished at altitudes up to 15,000 feet.

If left engine start is successful:

6. Flight controls - NORM.

7. Left engine operate switch - NORM.

8. Left throttle - MAX.

9. APU generator - PWR.

NOTE

APU generator should be turned on after APU comes up to speed to provide electrical power for hydraulic pump cooling.

10. Refer to SINGLE-ENGINE RESTART procedure.

If left engine start is unsuccessful:

6. Left throttle - OFF.

7. Left engine operate switch - NORM.

8. Crossfeed switch - CROSSFEED.

9. Right engine operate switch - MOTOR.

10. Right engine - START.

11. Flight controls - NORM.

12. Right engine operate switch - NORM.

13. Right throttle - MAX.

14. APU generator switch - PWR.

NOTE

APU generator should be turned on after APU comes up to speed to provide electrical power for hydraulic pump cooling.

15. Refer to SINGLE-ENGINE RESTART or SINGLE-ENGINE LANDING procedures as appropriate.

FLAMEOUT LANDING.

A flameout landing may be possible if any of the three key positions (Figure 3-13) can be reached. The flameout pattern is a very steep, almost circular, approach with low key displaced almost 8,000 feet from the runway. Bank angle in the flameout pattern should be limited to 30° if possible, and rollout on final must be initiated early due to the slow roll response of the aircraft in manual reversion. Maintain the airspeed at a minimum of 150 KIAS until flaring the aircraft. The flare should be initiated at 200 to 300 feet AGL to arrest the high sink rate and place the aircraft onto a shallow flight path (1-1/2° to 2°) by 50 feet AGL. The aircraft will touch down firmly and the nose gear will drop rapidly to the runway. The use of pitch trim is not recommended during the flare since large, uncontrollable changes in pitch attitude may result.

WARNING

Attempt only if ejection is not possible.

CAUTION

Pitch response becomes extremely degraded as the aircraft enters ground effect below 50 feet AGL. The flare must be initiated prior to passing 200 feet AGL to arrest the sink rate before entering ground effect.

Actual touchdown should be planned for approximately 1/3 down the runway at about 120 KIAS. Emergency brakes must be used to stop the aircraft straight ahead on the runway. No anti-skid protection, flaps, or speed brakes will be available to help slow the aircraft. Time from high key to touchdown will be approximately 2 minutes. Wind effects must be considered early in the pattern; for example, a 10-knot headwind will cause the touchdown point to move approximately 2,000 feet short of the no-wind touchdown point.

1. Landing gear handle - Down.

2. AUX LG EXT handle - Pull. (Gear may take up to 30 seconds or longer to extend and lock.)

3. Emergency brake handle - Pull.

4. High key - Gear down 160 KIAS minimum (approximately 6,500 to 7,000 feet AGL).

5. Low key - 160 KIAS minimum (approximately 3,500 to 4,000 feet AGL).

6. Base key - 160 KIAS minimum (approximately 2,000 to 2,500 feet AGL). Plan final turn to touchdown at 1/3 point on runway.

7. Final approach - 150 KIAS minimum (wings level at or above 500 feet AGL).

NOTE

Speeds shown are for aircraft gross weight of 30,000 lbs. Increase all speeds 2 KIAS for each 1,000 lbs over 30,000 lbs in gross weight.

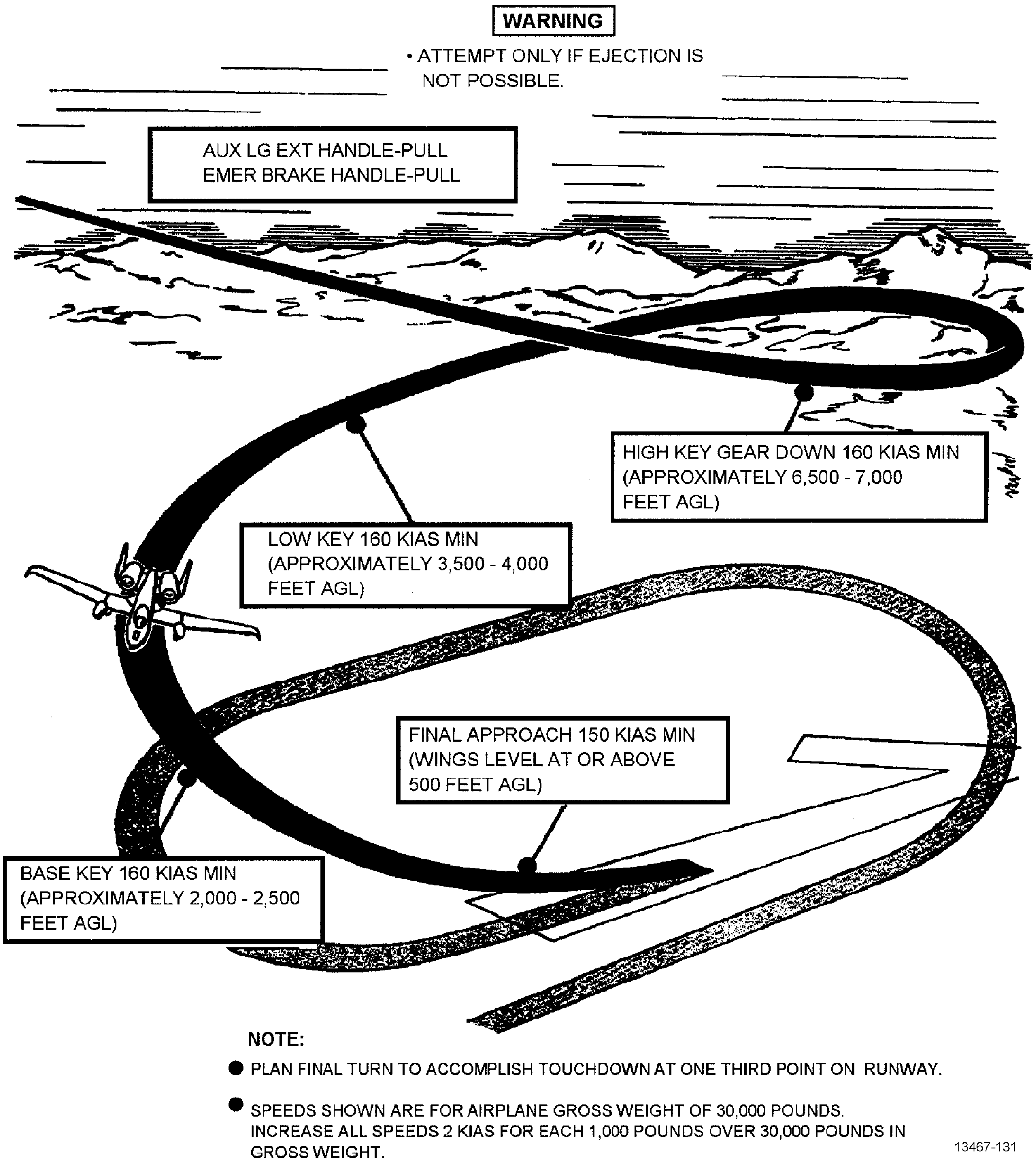


Figure 3-13. Flameout Landing Pattern

- FLIGHT CONTROL EMERGENCIES -.

FLAP ASYMMETRY.

In the event of wing flap asymmetry:

1. Flap lever - Select position used before asymmetry occurred.

If flaps remain asymmetrical:

2. Flap lever - MVR at safe speed and altitude in attempt to equalize flaps.

If flaps still remain asymmetrical:

3. Flap emergency retract switch - EMER RETR.

WARNING

If the flap asymmetry cannot be corrected, the AOA system will be unreliable and landing approach should be made at no-flap airspeeds.

4. Refer to CONTROLLABILITY/STRUCTURAL DAMAGE procedure.

SPEED BRAKE ASYMMETRY OR FAIL TO CLOSE.

1. Speed brake emergency retract switch - EMER RETR.

If speed brakes fail to close:

2. AUX ESS BUS TIE circuit breaker (bottom right) - Check closed.
3. Speed brake emergency retract switch - Cycle.
4. FUEL FLOWS - OVERRIDE (if required).

CAUTION

- During emergency situations, operation of the engine with the fuel flow switches in override may provide additional thrust. The engine should be operated in above normal temperature range only for the minimum time to achieve safe operating conditions. Throttle should be retarded to maintain ITT below 865°C as soon as minimum safe altitude and rate of climb are achieved (estimate 1 to 3 minutes). Anticipate ENG HOT lights illuminated and high ITT on the engines.

- Operation for several minutes in above normal temperature range will not precipitate an immediate engine failure. However, ITT can reach 980°C and some engine durability degradation will occur. Operation in above normal temperature range for more than 15 minutes is not recommended.

If right system hydraulic pressure remains:

5. Attempt normal closure.

AILERON/ELEVATOR CONTROL JAMS.

WARNING

- Control jams that cannot be identified by a jam indicator light cannot be overcome by disengaging a flight control path.
- The jam indicator lights must be used to determine the jammed surface. Stick movement in either direction can exert the force required to cause the light to come on.

If control response is inadequate for flight and landing:

1. Apply pressure against the jam and check jam indicator lights.

If a jam indicator light comes on:

2. Displace emergency disengage switch toward the affected jam indicator light.

If no jam indicator light comes on:

2. Apply rapid stick motion away from the jam or maximum force against the jam.

WARNING

- MRFCS should not be selected, as it will not assist in alleviating the jam, and will make control of the aircraft more difficult.
- With dual hydraulic loss, failure to select MRFCS will result in jam indications in the roll axis when sufficient stick forces are applied. In addition, abrupt stick forces applied in both axis may also result in elevator jam indications when in MRFCS.

Prior to Landing:

3. Refer to CONTROLLABILITY CHECK and STRUCTURAL DAMAGE procedure.

NOTE

A small amount of roll control may be achieved following an unresolved white area jam by disengaging an aileron and using roll trim.

FAILURE TO SHIFT INTO MANUAL REVERSION.

Aileron/Tab Shifter Malfunctions.

Failure to shift to tab drive after the flight control mode switch is placed to MAN REVERSION is indicated by:

- Respective AIL TAB caution light off
- Very high lateral stick force - approaching locked stick feel
- Aileron jam light(s) may be on depending on stick forces applied
- Stick moves toward the side of the nonfunctioning shifter.

WARNING

- If failure to shift is experienced after switching to MAN REVERSION and hydraulic power is available, return to NORM for the remainder of the flight.
- Should hydraulic power not be available, some roll control may be achieved by disconnecting the aileron from the side with the nonfunctioning aileron/tab shifter.
- If roll control cannot be achieved and/or maintained, then ejection is recommended.

WARNING

- Flight in manual reversion with one aileron disconnected has not been tested and may be impossible.

Failure of a shifter to return to aileron drive after selecting NORM is indicated by:

- Stick movement toward the side of the malfunctioning shifter
- High lateral stick force required to keep wings level
- Respective AIL TAB caution light remains on when opposite side AIL TAB caution light goes off
- Aileron tab on side with nonfunctioning shifter responds to stick movement with aileron remaining in neutral position
- Aileron trim inoperative.

If failure to shift is experienced after shifting to NORM, roll control can be increased, if necessary, by disconnecting the aileron from the side with the nonfunctioning aileron/tab shifter as indicated by the AIL TAB caution light.

With one side disengaged, maximum roll capability will be reduced approximately 50%, and stick input for a given roll will be twice normal.

Roll trim can be restored by pulling the AIL TAB circuit breaker for the side with the nonfunctioning shifter. The corresponding AIL TAB caution light will go off when this circuit breaker is pulled and both ailerons will respond to roll trim.

Failure to complete the shift to tab or aileron drive degrades roll control for the mode selected. The degree of control available is based upon the amount of shift accomplished prior to failure. Hydraulic pressure and neutral aileron position will be normal for the mode selected. The aileron tab caution lights should provide an indication of which shifter has malfunctioned unless an AIL TAB circuit breaker has opened. If an AIL TAB circuit breaker is open, the associated caution light is inoperative. The aileron tab circuit breaker should be checked whenever a shifter failure is suspected.

If hydraulic power is available:

1. Flight controls - NORM.

If hydraulic power is not available:

1. AIL TAB circuit breaker - Check in.

WARNING

Very high lateral stick forces, approaching locked stick feel, will occur. This aircraft may roll off, usually toward the side of the nonfunctioning shifter.

As a last resort, if roll control is not available:

2. AIL DISENG switch - Move toward aileron jam indicator light.

WARNING

Flight in MRFCS with one aileron disconnected has not been tested. Ejection is recommended.

3. AIL TAB circuit breaker - Open, for disengaged aileron, to prevent tab shift after disengagement.

NOTE

STRUCTURAL DAMAGE CHECK and/or CONTROLLABILITY CHECK recommended prior to attempting a landing.

FAILURE OF AN AILERON TAB TO SHIFT OUT OF MANUAL REVERSION.

1. AIL TAB circuit breakers - Check in. (Circuit breakers - second row, first two on left)

If satisfactory roll control is not available:

2. Identify the nonfunctioning aileron/tab shifter by:
    a. AIL TAB caution light remains on.
    b. AIL TAB circuit breaker open.
    c. Aileron tab moves without aileron movement.
    d. Stick movement toward the side of the malfunctioning shifter.
3. AIL TAB circuit breaker (for side with the nonfunctioning aileron tab) - Pull and reset.

If aileron operation returns to normal, do NOT return to Manual Reversion.

If aileron operation does not return to normal:

4. Aileron emergency disengage switch - Disengage the malfunctioning aileron.

5. Pull AIL TAB circuit breaker for side with nonfunctioning shifter, to provide roll trim and prevent subsequent shifting.

6. Speed brake Emergency Retract Switch - Retract.

WARNING

Activation of speed brakes after disengaging an aileron could produce an uncommanded roll. To prevent this roll, the speed brakes should be isolated by placing the Speed brake Emergency Retract switch to the Retract Position. If the speed brakes are needed for stopping distance constraints, do not employ them until below 100 knots.

NOTE

- It is possible to have an intermittent TAB shifter which could function when the appropriate AIL TAB circuit breaker is cycled. If after cycling the circuit breaker the aileron operation returns to normal, land as soon as possible. Do not attempt to return to Manual Reversion Flight unless required for a dual hydraulic malfunction.

- Roll trim can be restored by pulling the AIL TAB circuit breaker for the side with the nonfunctioning shifter. The corresponding AIL TAB caution light will go off when this circuit breaker is pulled and both ailerons will respond to roll trim.

- With one aileron disengaged, maximum roll capability is reduced almost 50% and stick input for a given roll is twice normal. Roll capability is also increased when rolling away from disengaged aileron.

- Maximum crosswind limit is 20 knots including gusts. Crosswind landings should be performed with crosswind on same side as operable aileron to take advantage of roll rate away from disengaged aileron.

7. Refer to CONTROLLABILITY CHECK and STRUCTURAL DAMAGE procedure.

PITCH/YAW SAS DISENGAGEMENT.

Pitch and/or yaw SAS disengagement in flight is indicated by the respective caution light(s) coming on.

If pitch SAS is disengaged:

1. Pitch SAS - Reengage one channel at a time. If two-channel engagement cannot be maintained, leave pitch SAS OFF.

WARNING

- The pitch SAS fail-safe monitoring feature does not function during single-channel SAS operation. If pitch SAS operation cannot be maintained with both channels engaged, pitch SAS should be turned OFF.

- If an undesirable aircraft transient is experienced as the pitch SAS switches are engaged, leave pitch SAS OFF.

CAUTION

Single-channel operation will result in repetitive loading of the elevator interconnect shear bolts.

NOTE

A nose up trim change occurs when pitch SAS fails while speed brakes are extended.

If yaw SAS is disengaged:

1. Yaw SAS - Reengage one channel at a time. If two-channel engagement cannot be maintained, engage operable channel if yaw damping and yaw trim are desired.

2. NMSP - Select the other attitude reference system, either HARS or EGI, then attempt to reengage both channels. If two-channel engagement cannot be maintained, engage operable channel if yaw damping and yaw trim are desired.

WARNING

- The yaw SAS fail-safe monitoring feature does not function during single-channel SAS operation. Close formation or low altitude flight is not recommended during single-channel SAS operation due to the possibility of an undesirable roll/yaw transient in the event of a yaw SAS hardover failure.
- If an undesirable aircraft transient is experienced as a yaw SAS switch is engaged, leave that switch OFF.

UNCOMMANDED PITCH/YAW INPUT.

1. Attain coordinated flight and recover wings level.

WARNING

Aileron input without rudder may result in a post stall gyration (PSG). The PSG will manifest itself as a roll acceleration or roll reversal. Application of back stick without controlling yaw input may result in a sideslip departure. If altitude permits, do not apply back stick until coordinated flight is obtained.

2. SAS/Anti-skid - Paddle OFF.
3. Anti-skid switch - ANTI-SKID.

NOTE

The malfunctioning SAS axis should remain off. If malfunctioning axis cannot be determined, the entire SAS should remain off.

4. Land as soon as practical.

TRIM FAILURE.

1. Pitch/roll trim override switch - EMER OVERRIDE.
2. Trim as necessary by use of the emergency pitch and roll trim switch.

STRUCTURAL DAMAGE CHECK.

If there is damage, confirmed or suspected, to hydraulic lines or wing structure due to battle damage, bird strike, mid-air collision, etc., utilize all available resources (battle damage check, chase aircraft, tower fly-by, etc.) to determine type and extent of damage. Perform the following structural damage procedure:

WARNING

- With aircraft structural damage, artificial stall warning devices, AOA, and pitot static system may not be reliable.
- With aircraft structural damage, flight characteristics may be altered. It is important to determine the actual flight characteristics and amount of control authority available before attempting to recover the aircraft.
- If the rudder pedals become loose in flight, refer to RUDDER PEDAL FAILURE TO LOCK.

CAUTION

If air refueling is required, depress Line Check Button. If the READY light does not come on within 3 minutes after the Line Check Button is depressed, the refuel manifold is damaged and air refueling should not be attempted unless absolutely necessary.

NOTE

- If there is damage to the landing gear, flaps, or speed brake hydraulic lines, normal actuation of the system may cause the respective hydraulic system to vent overboard.
- The leading edge of wings, wingtips, and leading edge of right elevator contain right hydraulic system lines. The trailing edge of wings and leading edge of left elevator contain left hydraulic system lines.

1. Minimize g loading and attain a safe altitude.
2. Flap emergency retract switch - EMER RETR.

3. Speed brake emergency retract switch - EMER RETR.

4. LAND GEAR circuit breaker - Pull (second row down, far right).

NOTE

With landing gear circuit breaker open, normal brakes, anti-skid, and nosewheel steering will be inoperative.

5. Perform appropriate selective or emergency jettison procedures, as required.

If both hydraulic systems fail:

6. Accomplish DUAL HYDRAULIC SYSTEM FAILURE.

If one hydraulic system fails:

7. SAS/Anti-Skid Paddle - Off.

8. Pitch SAS - Leave OFF.

9. Yaw SAS switch (operable channel) - Engage (if desired).

10. Perform a CONTROLLABILITY CHECK.

If NO damage to the hydraulic system(s) or wing structure is confirmed:

7. Flap emergency retract switch - AFT.

8. Speed brake emergency retract switch - AFT.

9. LAND GEAR circuit breaker - Reset (second row down, far right).

10. Perform a CONTROLLABILITY CHECK.

CONTROLLABILITY CHECK.

If handling characteristics for recovery are suspect, for whatever reason, perform controllability check to determine if recovery is possible, and if so, under what conditions.

1. Attain a safe altitude (minimum of 5,000 feet AGL, if possible).

2. Reduce gross weight, if practical.

3. While slowing to less than 185 KIAS, check roll, pitch, and yaw authority:

   a. Perform a series of turns not to exceed 30° bank using normal rudder inputs.

   b. Check pitch response up to ±10°.

   c. Check yaw response up to ±5°.

WARNING

- If aircraft has structural damage, artificial stall warning devices, AOA, and pitot static system may not be reliable.
- If aircraft has structural damage, flight characteristics may be altered. It is important to determine the actual flight characteristics and amount of control authority available before attempting to recover the aircraft.
- If the rudder pedals become loose in flight, refer to RUDDER PEDAL FAILURE TO LOCK.

4. Prior to commencing recovery while still at safe altitude, maintain level flight, and make a series of turns duplicating the pattern and control inputs that will be used to recover the aircraft.

5. Decide on landing configuration. If landing gear down desired:

CAUTION

- If a usable landing configuration is unlikely, consideration should be given to landing all gear up (see LANDING GEAR EMERGENCIES).
- If structural damage is suspected or confirmed in the nosewheel well (e.g. catastrophic gun malfunction), consideration should be given to the possibility of nose gear extension malfunction or engine damage due to FOD.

If damage to the hydraulic lines or wing structure is confirmed or suspected:

6. LAND GEAR circuit breaker - Pull, if not previously accomplished (second row down, far right).

7. Landing gear handle - DOWN.

8. AUX LG EXT handle - Pull.

9. AUX LG EXT handle - Push in (when landing gear indicates safe).

10. Emergency Brake Handle - Pull.

NOTE

- With the LANDING GEAR circuit breaker open, normal brakes, anti-skid, and nosewheel steering will be inoperative. Pulling the emergency brake handle will provide braking capability.

- If damage resulted in right hydraulic system failure, pulling the emergency brake handle will provide a minimum of five brake applications.

If damage is away from the main landing gear or rear wing area AND left hydraulics is available:

6. LAND GEAR circuit breaker - Reset, if not previously accomplished (second row down, far right).

7. Landing gear handle - DOWN.

8. Flaps - As required.

9. Anti-Skid - ANTI-SKID. (Proceed to Step 11.)

NOTE

With the LANDING GEAR circuit breaker reset, normal braking, anti-skid, and nosewheel steering are regained for landing.

11. Gradually slow aircraft to desired touchdown airspeed, or to minimum airspeed at which approximately one-half the available control in an axis is required to maintain altitude in wing level flight. If the aircraft can be controlled at speeds below the gear and flap limit speed, recovery is possible.

NOTE

Touchdown speed is ten knots below computed final approach speed for normal and no-flap configurations. For single-engine landings, single-engine final approach speed is maintained until landing is assured, then use normal/no-flap touchdown speed, as appropriate.

- Add 2 knots to 130 KIAS for a normal.
- Add 2 knots to 140 KIAS for a no-flap.
- Add 1 knot to 150 KIAS for a single-engine.
- For exact approach speeds, see TO 1A-10C-1-1.

12. Maintain landing configuration and fly at 20 KIAS above the minimum control or desired touchdown speed (whichever is higher) on final approach until landing is assured.

CAUTION

Main wheel tire ground speed rating 165 knots. If landing is attempted with touchdown speed higher than 165 knots, tire failure may occur.

13. Land as soon as practical.

If landing is not possible, refer to BEFORE EJECTION.

- LANDING GEAR EMERGENCIES -.

NOSEWHEEL STEERING MALFUNCTION.

If nosewheel vibration, shimmy, or control problems are experienced:

1. Stop the aircraft.

CAUTION

Nosewheel steering loss may be an indication of normal brake failure.

NOTE

Shimmy may be reduced by increasing weight on the nosewheel and reducing speed.

NORMAL BRAKE FAILURE.

Use of emergency brake will restore braking capability. If the right hydraulic system is pressurized, unlimited emergency braking is available. Otherwise, a minimum of five full emergency brake applications can be expected from the emergency accumulator, if pressurized.

1. Emergency brake handle - PULL (full aft).

CAUTION

- Release brake pedal pressure prior to selecting emergency brakes. Failure to release brake pedal pressure may cause wheels to lock.

- Loss of braking can result from an electrical malfunction in the landing gear circuitry. If this occurs, there will be no caution light or gauge indication, and normal brakes, anti-skid, and nosewheel steering will be inoperative.

- If either or both weight-on-wheels squat switches do not arm (i.e. compress due to weight-on-wheels) or malfunction, brake pedal pressure may feel normal, even though brake pressure is not supplied to the wheels. The Emergency Brake handle must be pulled to obtain braking action.

ANTI-SKID FAILURE.

CAUTION

Some anti-skid failures are not indicated by the anti-skid caution light.

1. Anti-skid - OFF

2. Anti-skid - Engage.

IF Anti-skid does not engage or Anti-skid Caution light remains illuminated:

3. Anti-skid - OFF.

CAUTION

Landing distances may increase without anti-skid.

TIRE FAILURE DURING TAKEOFF.

If takeoff aborted:

1. EAC/SAS/Anti-skid emergency disconnect lever - Depress (blown main).

2. Use rudder, nosewheel steering, and brakes to maintain directional control.

If takeoff continued:

1. Do not retract gear or flaps.

CAUTION

Airspeed - Maintain below 185 KIAS to prevent inadvertent retraction of flaps from the Q sensor.

2. Refer to BLOWN TIRE procedure.

BLOWN TIRE.

1. Anti-skid - OFF (blown main).

2. Land on the side of the runway away from the malfunction.

3. Use rudder, nosewheel steering, and brakes to maintain directional control.

CAUTION

Emergency braking may be required depending on the failure mode. Nosewheel steering is available with the EMER BRAKE handle pulled unless the LAND GEAR circuit breaker has been pulled.

NOSEWHEEL COCKED.

If the nosewheel cocks, it will probably caster straight ahead after nosewheel touchdown.

1. Pull g's to extend nosewheel strut.

2. After touchdown, lower nosewheel slowly to runway.

NOTE

Engaging nosewheel steering immediately after main gear touchdown may center the nosewheel. However, this method is not recommended when large rudder inputs are required due to strong crosswind conditions.

LANDING GEAR RETRACTION FAILURE.

If the warning light in the landing gear handle remains on after the handle has been moved to UP or if there is other indication of gear retraction failure:

NOTE

If the light in the landing gear handle flashes and/or the warning horn sounds as the landing gear reaches the full up position, this may indicate impending gear up up-lock switch failure.

1. Airspeed - Maintain below 200 KIAS.

2. Landing gear handle - DOWN.

NOTE

If the landing gear cannot be raised, it could indicate an electrical malfunction in the landing gear control valve circuitry. If this is the case, the landing gear circuit breaker may or may not be open. The landing gear circuit breaker should be reset, if possible. Use caution on landing, as normal brakes, antiskid, and nosewheel steering may not be available. Emergency braking can be obtained by pulling the emergency brake handle.

3. LAND GEAR circuit breaker - Check closed.

4. AUX LG EXT handle - Check closed.

UNSAFE GEAR DOWN INDICATION.

Maintain airspeed below 200 KIAS.

1. Signal lights switch - BRT.

2. Signal lights lamp test button - Depress.

NOTE

- Each indicator has two bulbs. If test indicated that both bulbs are inoperative, the bulbs from less essential indicators such as the TAKE-OFF TRIM, MARKER BEACON, or GUN READY can be used as replacements.

- If all three indicators show safe, but the horn and red light in the handle are on, the gear is down and locked.

3. LAND GEAR circuit breaker - Recycle, open to close.

4. Left hydraulic pressure - Check.

5. Check for damage and gear position. Use any means possible (visual, wingman, tower, etc.).

If hydraulic pressure is normal and there is no damage:

6. Gear handle - Recycle UP, then DOWN.

NOTE

- The only positive in-flight indication that the nose gear is down and locked is an operational landing/taxi light and/or nose gear indicator light illuminated.

- Reference marks on the landing gear are not reliable indications that the gear are down and locked.

- Landing gear warning light will come on and beeper will sound if the gear handle is up, the aircraft is below approximately 10,000 feet MSL and below approximately 160 KIAS, and a throttle is positioned below approximately halfway between idle and max.

- If landing gear handle cannot be raised, it may be necessary to use the DOWNLOCK OVERRIDE button to raise the handle to the UP position.

7. Airspeed - Increase to 200 KIAS and induce positive/negative g's and/or roll/yaw moments. If landing gear remains unsafe, perform LANDING GEAR ALTERNATE EXTENSION.

LANDING GEAR ALTERNATE EXTENSION.

1. Airspeed - 200 KIAS or below.

2. GEAR handle - Up (if left hydraulic system pressure is available and there is no structural damage).

NOTE

- To optimize the Landing Gear Alternate Extension, start the procedure with the gear up.

- If landing gear handle cannot be raised, it may be necessary to use the DOWNLOCK OVERRIDE button to raise the handle to the UP position.

3. LAND GEAR circuit breaker - Open (if left hydraulic system pressure is available).

4. Gear handle - Down (if possible).

5. AUX LG EXT handle - Pull.

CAUTION

Minimize use of flight controls and flaps whenever the auxiliary landing gear extension handle is in the out position and left hydraulic system pressure is present to avoid left hydraulic system pump cavitation.

NOTE

It may take 30 seconds or longer for the gear to extend and lock.

If Gear is Safe:

6. If gear is safe, refer to GEAR SAFE (AFTER LANDING GEAR ALTERNATE EXTENSION).

If Gear is Unsafe:

6. If gear is unsafe, refer to GEAR UNSAFE (AFTER LANDING GEAR ALTERNATE EXTENSION).

GEAR SAFE (AFTER LANDING GEAR ALTERNATE EXTENSION).

If all gear indicate down and locked:

1. AUX LG EXT handle - Push in.

2. EMER BRAKE handle - Pull (nosewheel steering, anti-skid, and normal braking will not be available).

CAUTION

If gear failed to extend normally with left hydraulic system pressure available, and the alternate extension is successful, the gear control valve may be stuck in the neutral position or receiving an improper up signal. Leave LAND GEAR circuit breaker open. Normal brakes, nosewheel steering, and antiskid will not be available, and emergency brakes must be used. There is no indication if the valve has failed.

3. Monitor right hydraulic system pressure, and land.

GEAR UNSAFE (AFTER LANDING GEAR ALTERNATE EXTENSION).

If visual indication verifies that gear is not full down:

1. AUX LG EXT handle - Push in (If ALL gear have dropped from the well).

NOTE

With the gear still in the wheel well, having the handle pulled will keep the gear uplocks open, allowing the gear to more likely fall during g-loading.

2. Sequentially increase airspeed to 200/250/300 KIAS, and aggressively induce positive and negative g's and/or yaw/roll moments.

CAUTION

Avoid overflight of populated areas in order to minimize potential collateral damage due to dropped objects.

CONSIDERATIONS

- If gear indicates safe, perform GEAR SAFE procedure.
- If all gear remain up, perform ALL GEAR REMAIN UP procedure.
- If all gear are down, but indicate unsafe, perform GEAR DOWN, BUT INDICATE UNSAFE procedure.
- If any gear does not visually appear full down, perform LANDING WITH GEAR NOT DOWN procedure.

ALL GEAR REMAIN UP (AFTER LDG GEAR ALT EXT).

If all gear remain full up:

1. AUX LG EXT handle - Push in.

CAUTION

Allow at least 15 seconds between stowing AUX LG EXT handle and closing breaker, to avoid hydraulic pump cavitation.

After 15 seconds:

2. LAND GEAR circuit breaker - Close.
3. GEAR handle - Up. (If handle will not go up, use downlock override.)
4. Cycle LAND GEAR circuit breaker - Open, then close.
5. Gear handle - Down. (It may be necessary to repeat step 3 thru step 5.)

If gear still does not appear fully down:

6. Perform LANDING WITH GEAR NOT DOWN.

If ALL gear are down but any indicate unsafe:

6. Perform GEAR DOWN, BUT INDICATE UNSAFE procedure.

ALL GEAR DOWN, BUT INDICATE UNSAFE (AFTER LDG GEAR ALT EXT).

If all gear visually appear down, but indicate unsafe:

NOTE

This checklist assumes squat switch/electrical malfunction. The only positive indication of the nose gear down and locked is an operational landing/taxi light and/or nose gear indicator light illuminated.

1. Gear handle - Check down.
2. AUX LG EXT handle - Push in.

After 15 seconds:

3. LAND GEAR circuit breaker - Close.

CAUTION

Allow at least 15 seconds between stowing the auxiliary landing gear extension handle and closing the LAND GEAR circuit breaker, to avoid hydraulic pump cavitation.

4. EMER BRAKE handle - Push in (if left hydraulic system pressure is available).
5. Anti-skid switch - ANTI-SKID (if left hydraulic system pressure is available).
6. If no damage is apparent and left hydraulics are normal, recycle gear as a last resort.

CAUTION

- Have arresting gear cables removed from landing area.
- Consider jettison of armament and self-protection flares (retain racks and inert stores).

7. Reduce gross weight to lowest practical.

NOTE

- External stores should be jettisoned to reduce gross weight, except for those that would afford the aircraft protection: e.g., empty fuel tanks, inert stores, TERs, etc.
- Burn off excess fuel.
- Land at lightest practical gross weight, with an airspeed that provides good control and a minimum sink rate touchdown.

8. Review procedures for potential configuration after touchdown.

NOTE

Refer to appropriate checklist for configuration:
ALL GEAR UP NOSE SAFE,
BOTH MAINS UNSAFE NOSE SAFE,
ONE MAIN SAFE NOSE UNSAFE,
BOTH MAINS SAFE NOSE UNSAFE,
ONE MAIN SAFE NOSE UNSAFE,
ONE MAIN SAFE WITH OUTBOARD STORE

9. Flaps - 20 degrees (if possible).

10. Speed brakes - 40% (if possible).

11. Lower visor, lock shoulder harness, and stow loose items.

12. Fly straight-in approach.

13. After landing, stop straight ahead.

14. Maintain idle power on left engine while gear pins are installed. Ensure ground personnel are clear before left engine shutdown.

WARNING

Gear pins can be installed when the gear is not locked down. If ground crew determines that the drag strut actuator inner piston shows more than 1/4 inch, then gear is not locked down and jacks must be installed prior to left engine shutdown.

LANDING WITH GEAR NOT DOWN.

With any confirmed gear malfunction or gear damage, the decision to land or eject should be based on numerous factors unique to any landing gear emergency. The first goal is to obtain all gear down through an ALTERNATE GEAR EXTENSION. With the exception of a few ALL GEAR UP LANDINGS, data regarding malfunctions has been obtained from computer simulations under controlled situations. There are many considerations which must be analyzed, including, but not limited to: pilot proficiency, crosswinds, runway length and width, firefighting capabilities, condition of the ground to the sides of the runway, obstructions to the sides of the runway, aircraft center of gravity, aircraft condition (hydraulic failure, structural/battle damage, etc.), environmental conditions, runway composition (concrete, asphalt, or both), external stores, and ejection survivability.

Depending on the analysis of these factors, the proper decision may be to eject. No flight test data exists to determine the results of landing in a partial gear down configuration. Some computer simulation has been done, which tends to indicate that certain conditions may be more favorable to maintaining directional control than others. The validity of modeling characteristics, and reliability of this data must be considered.

Results of actual experience and computer simulation trends indicate that, if the decision is made not to eject, landing with all gear up is the most desirable means of recovering the aircraft, rather than landing with an abnormal gear configuration.

If any gear does not appear fully down after performing the UNSAFE GEAR DOWN INDICATION and LANDING GEAR ALTERNATE EXTENSION procedures:

1. Have arresting gear cables removed from the landing area.

2. If possible, retract landing gear as follows:

    a. AUX LG EXT handle - Push in.

CAUTION

Allow at least 15 seconds between stowing AUX LG EXT handle and closing breaker to avoid hydraulic pump cavitation.

After 15 seconds:

b. LAND GEAR circuit breaker - Close.

c. Landing gear handle - Up.

3. Jettison armament and self-protection flares (retain racks and inert stores).
4. Burn off excess fuel.
5. EMER BRAKE handle - Pull.
6. Speed brakes - 40 percent (if available).
7. Flaps - 20 degrees (if possible).
8. Lower visor, lock shoulder harness, and stow loose items.
9. Fly shallow approach (2 degrees) at normal airspeed.
10. Touch down at minimum sink rate.

If all gear are up:

11. Perform ALL GEAR UP procedure.

If all gear are not up:

11. Gear handle - Down, perform procedure for applicable configuration.

NOTE

Refer to appropriate checklist for configuration:
NOSE SAFE, BOTH MAINS UNSAFE
NOSE SAFE, ONE MAIN SAFE
NOSE UNSAFE, BOTH MAINS SAFE
NOSE UNSAFE, ONE MAIN SAFE
NOSE UNSAFE, ONE MAIN SAFE WITH OUTBOARD STORE

ALL GEAR UP.

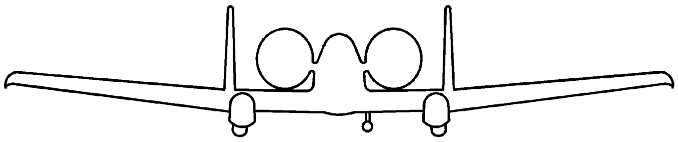


Figure 3-14. All Gear Up

CAUTION

Results of actual experience and computer simulation indicate, if the decision is made not to eject, landing with all gear up is the most desirable means of recovering rather than landing with abnormal gear configurations.

CONSIDERATIONS

- POINTS OF CONTACT: Both retracted main gears and vertical stabilizers.
- Touch down on runway centerline.

NOTE

Vertical stabilizers will probably touch first.

After touchdown:

1. Speed brakes - Full Open.

NOTE

- Only 80 percent speed brakes available.
- Speed brakes and flaps will not contact runway.
- Landing roll is increased significantly without speed brakes.

2. Throttles - Idle.

NOTE

Although the thrust of each engine at idle is approximately 500 lbs, this is offset by brake availability and increased rudder control with engines operating.

3. Stick - Full aft.

4. Wheel brakes - Light to moderate pressure, to ensure aircraft stays on prepared surface.

NOTE

- For wheels-up maximum braking speeds and stopping distances, see TO 1A-10C-1-1.
- Use light pressure for directional control, moderate pressure to slow aircraft.
- Anti-skid is not available.

5. Throttles - OFF (if required).

CAUTION

- Throttles should be cut off if runway departure is imminent.
- A minimum of five full brake applications are available after engine shutdown.

NOTE

More rudder pedal pressure is required to maintain directional control after engine shutdown.

After stopping:

6. Perform EMERGENCY GROUND EGRESS.

NOSE SAFE, BOTH MAINS UNSAFE.

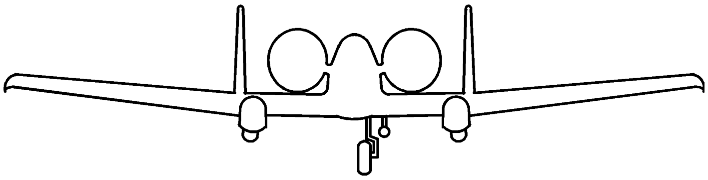


Figure 3-15. Nose Safe, Both Mains Unsafe

WARNING

If nose-wheel steering is not available, rudder effectiveness will provide limited directional output. Departing prepared surface is probable.

CAUTION

Results of actual experience and computer simulation indicate, if the decision is made not to eject, landing with all gear up is the most desirable means of recovering rather than landing with abnormal gear configurations.

CONSIDERATIONS

- POINTS OF CONTACT: Nose gear and vertical stabilizer (nonjettisonable stores will not contact runway).
- Fly a shallow approach controlling aircraft to the runway allowing tail to settle on ground slowly.
- Touchdown on upwind side of runway.
- After touchdown, aircraft will drift downwind.
- Nose wheel steering may be available after touchdown if engaged with left hydraulic pressure.

After touchdown:

1. Throttles - Off.

After stopping:

2. Perform EMERGENCY GROUND EGRESS.

NOSE SAFE, ONE MAIN SAFE.

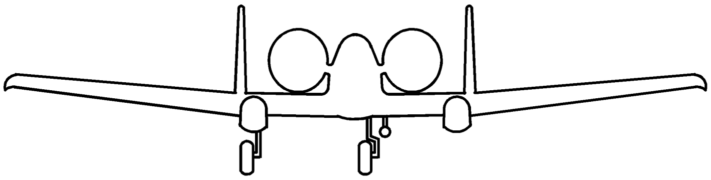


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Figure 3-16. Nose Safe, One Main Safe

CAUTION

- Results of actual experience and computer simulation indicate, if the decision is made not to eject, landing with all gear up is the most desirable means of recovering rather than landing with abnormal gear configurations.

- At touchdown, the wing with unsafe main gear will drop almost immediately.

CONSIDERATIONS

- POINTS OF CONTACT: Nose gear, extended main gear, vertical stabilizer, and outboard pylon on gear up side.

- Weather vaning into the wind is not a significant factor in maintaining directional control. Aircraft tends to be blown downwind; therefore, if runway selection is an option, crosswind should be from the side of the unsafe main gear.

- Drag from wingtip and vertical stabilizer is significant. Plan landing on side of runway corresponding to safe main gear.

After touchdown:

1. Throttles - Idle.

CAUTION

Throttles should be cut off if runway departure is imminent.

2. Wheel brake - As required to maintain directional control.

CAUTION

A minimum of five full brake applications are available after engine shutdown.

3. Throttles - OFF.

4. Perform EMERGENCY GROUND EGRESS.

NOSE UNSAFE, BOTH MAINS SAFE.

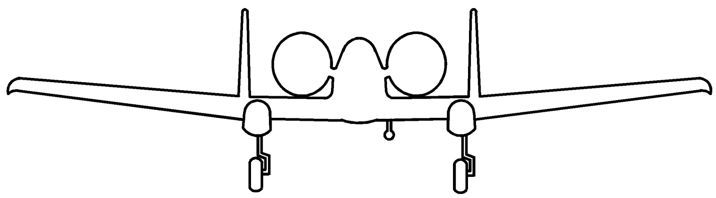

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Figure 3-17. Nose Unsafe, Both Mains Safe

CAUTION

Results of actual experience and computer simulation indicate, if the decision is made not to eject, landing with all gear up is the most desirable means of recovering rather than landing with abnormal gear configurations.

CONSIDERATIONS

- POINTS OF CONTACT: Both main gears and gun barrel.

- Touch down on runway centerline.

- If possible, reduce weight below 30,000 pounds, induce aft cg by crossfeed and expending ammo and stores.

NOTE

- With less than 375 pounds of ammo/casings, fuel can be evenly distributed.
- With more than 375 pounds of ammo/casings, aft fuel must exceed forward fuel by 1,000 pounds. Gross weight should be at an absolute minimum.
- Use the following weight figures to compute the ammo/casing weight:
  Live rounds - 1.5 pounds each
  Empty casings - 0.5 pound each.

After touchdown:

1. Throttles - Idle.

CAUTION

Throttles should be cut off if runway departure is imminent.

2. Following touchdown, slowly lower nose to runway prior to loss of elevator effectiveness.
3. Wheel brakes - light application, as required, to maintain directional control.

CAUTION

Directional control may be difficult using differential brakes. Pilot-induced oscillations may occur.

After stopping:

4. Throttles - Off.
5. Perform EMERGENCY GROUND EGRESS.

NOSE UNSAFE, ONE MAIN SAFE.

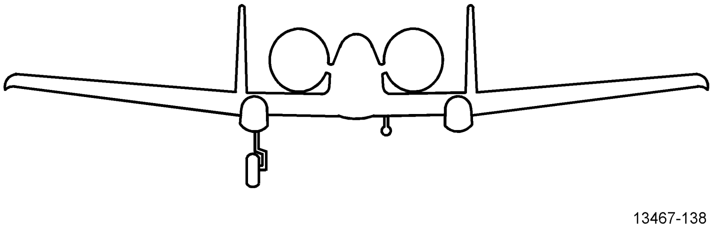

Figure 3-18. Nose Unsafe, One Main Safe

CAUTION

- Results of actual experience and computer simulation indicate, if the decision is made not to eject, landing with all gear up is the most desirable means of recovering rather than landing with abnormal gear configurations.
- At touchdown, wing with unsafe main gear and the nose will drop almost immediately.

CONSIDERATIONS

- POINTS OF CONTACT: Extended main gear, unsafe main gear, and vertical stabilizer.
- Land on side of runway with extended main gear and crosswind from side with unsafe main gear.
- If possible, reduce weight and induce aft CG by crossfeed, expending ammo, and stores jettison. An aft CG should be more directionally stable by induced drag on vertical stabilizer contacting the runway.

After touchdown:

1. Throttles - Idle.

CAUTION

Throttles should be cut off if runway departure is imminent.

2. Wheel brake - As required for directional control.

CAUTION

Wheel brake will be sensitive due to vertical stabilizer dragging. Pilot-induced oscillations may occur. Directional control should be sufficient to keep the aircraft on the runway.

After stopping:

3. Throttles - Off.

4. Perform EMERGENCY GROUND EGRESS.

NOSE UNSAFE, ONE MAIN SAFE WITH OUTBOARD STORE.

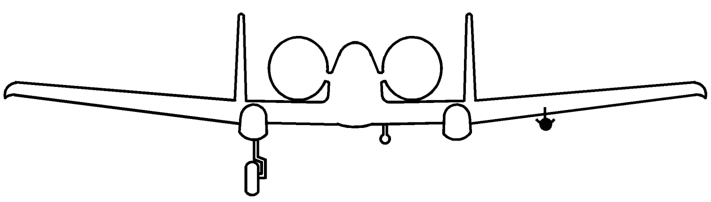

Figure 3-19. Nose Unsafe, One Main Safe With Outboard Store

CAUTION

- Results of actual experience and computer simulation indicate, if the decision is made not to eject, landing with all gear up is the most desirable means of recovering rather than landing with abnormal gear configurations.
- At touchdown, wing with unsafe main gear and the nose will drop almost immediately.

CONSIDERATIONS

- POINTS OF CONTACT: Extended main gear, vertical stabilizer, and outboard store on main gear up side (station 1 or 11).
- Land on side of runway with extended main gear and crosswind from side with unsafe gear.
- If possible, reduce weight and induce aft cg by crossfeed, expending ammo, and stores jettison. An aft CG should be more directionally stable by induced drag on vertical stabilizer contacting the runway.

After touchdown:

1. Throttles - Idle.

CAUTION

Throttles should be cut off if runway departure is imminent.

2. Wheel brake - As required for directional control.

CAUTION

Wheel brake will be sensitive due to vertical stabilizer dragging. Pilot-induced oscillations may occur. Directional control should be sufficient to keep the aircraft on the runway.

After stopping:

3. Throttles - Off.

4. Perform EMERGENCY GROUND EGRESS.

- MISCELLANEOUS EMERGENCIES -.

HARS MALFUNCTION.

If HARS is the operating attitude reference and the HARS caution light comes on, with one or both hydraulic power sources available, yaw damping and trim can be restored.

If EGI is operating:

1. NMSP - Select EGI.
2. YAW SAS - Reengage applicable channel(s).

If EGI is not operating:

1. AAP - CDU switch - OFF.
2. AAP - EGI switch - OFF.
3. HARS/SAS - OVERRIDE.
4. YAW SAS - Reengage applicable channel(s).

ENAV FAILURES.

CAUTION

Certain EGI failures may cause incorrect information to be displayed on the ADI bank steering bar without causing the ADI course warning flag to come into view when STR PT or ANCHR is selected on the NMSP. However, these failures will cause the HSI bearing validity flag to come into view. Therefore, when STR PT or ANCHR is selected on the NMSP and the HSI bearing validity flag is in view, disregard the ADI bank steering bar indications. The ADI bank steering bar and course warning flag operate normally when TACAN, ILS, TISL, or FM HOMING is the selected source of the bank steering bar indications.

If the NAV caution light comes on, one or more of the following failures has occurred:

EGI Failure.

NOTE

- When the EGI fails or is turned off, disregard the steerpoint ID, steerpoint database and number, distance to steerpoint, actual TTG, and delta time displayed on the HUD.
- If EGI fails, the EGI Δ light on the NMSP if selected, will go out and the HARS Δ light will light (indicating HARS is attitude source) if HARS is available; and STR PT or ANCHR, if selected, will disengage.
- When the EGI fails or is turned off (with the CDU operational), the HUD displays the HARS magnetic heading.
- If HARS is available, HSI and ADI steering can be driven by ILS, ADF, TCN, or TISL.

1. NMSP - Verify HARS Δ light is on.
2. CDU - Verify EGI FAIL annunciation is displayed, or on SYS Page, verify EGI status is not V.
3. CDU - RESET.
   a. Select SYS FSK
   b. Select RESET LSK
   c. If EGI status is N or F, press EGI LSK. (If this corrects the problem, reselect EGI and configure NMSP as desired.)

If EGI status remains N or F:

4. AAP - EGI switch to OFF for at least 10 seconds, then set EGI switch to ON. If this corrects the problem, when the alignment is complete, select EGI and/or STR PT or ANCHR, as desired, on the NMSP.

NOTE

- When the EGI is turned off, disregard the steerpoint ID, steerpoint database and number, distance to steerpoint, actual TTG, and delta time displayed on the HUD.
- When the EGI is turned off (with the CDU operational), the HUD displays the HARS magnetic heading.
- This action will cause an in-flight alignment to be initiated if the aircraft is in the air or on the ground and moving. If the aircraft is on the ground and not moving, this action will cause a ground alignment to be initiated.
- An in-flight alignment requires that the aircraft be flown straight and level in unaccelerated flight prior to the initiation of an in-flight alignment, and until a steady asterisk is displayed next to INFLT on the ALIGN Page.
- If aircraft cannot be flown straight and level in unaccelerated flight prior to and during the in-flight alignment until a steady asterisk is displayed next to INFLT, it is recommended that another in-flight alignment be initiated using the INFLT LSK on the ALIGN Page when the aircraft can be flown straight and level in unaccelerated flight.
- Override the automatic alignment by depressing the LAST POS LSK on the ALIGN page. The EGI aligns to the last position stored in the EGI.

EGI Flight Instrument Failure.

NOTE

- An EGI flight instrument failure will result in the inability of EGI to drive the HSI and ADI. The Nav Mode Select Panel will automatically transition from EGI to HARS if EGI was selected.
- Full ENAV capability is retained on the CDU and HUD.
- If performing an instrument approach using EGI for attitude source, it is recommended that a missed approach be executed followed by an approach using HARS.

1. NMSP - Select HARS.
2. CDU - Verify EGI FLT INST FAIL annunciation is displayed, or on SYS Page, verify MSN status is not V.
3. CDU - RESET.
   a. Select SYS FSK
   b. Select RESET LSK
   c. If EGI status is N or F, press EGI LSK. (If this corrects the problem, reselect EGI and configure NMSP as desired.)

If EGI status remains N or F:

4. AAP - EGI switch to OFF for at least 10 seconds, then set EGI switch to ON.

NOTE

- When the EGI is turned off, disregard the steerpoint ID, steerpoint database and number, distance to steerpoint, actual TTG, and delta time displayed on the HUD.
- When the EGI is turned off (with the CDU operational), the HUD displays the HARS magnetic heading.
- This action will cause an in-flight alignment to be initiated if the aircraft is in the air or on the ground and moving. If the aircraft is on the ground and not moving, this action will cause a ground alignment to be initiated.
- An in-flight alignment requires that the aircraft be flown straight and level in unaccelerated flight prior to the initiation of an in-flight alignment, and until a steady asterisk is displayed next to INFLT on the ALIGN Page.
- If aircraft cannot be flown straight and level in unaccelerated flight prior to and during the in-flight alignment until a steady asterisk is displayed next to INFLT, it is recommended that another in-flight alignment be initiated using the INFLT LSK on the ALIGN Page when the aircraft can be flown straight and level in unaccelerated flight.
- Override the automatic alignment by depressing the LAST POS LSK on the ALIGN page. The EGI aligns to the last position stored in the EGI.

5. If this corrects the problem, when the alignment is complete, select EGI and/or STR PT or ANCHR, as desired, or the NMSP.

EGI Not Ready Failure.

1. AAP - Verify EGI switch is set to ON.

2. AAP - Set EGI switch to OFF for at least 10 seconds.

NOTE

- When the EGI fails or is turned off, disregard the steerpoint ID, steerpoint database and number, distance to steerpoint, actual TTG, and delta time displayed on the HUD.
- When the EGI is turned off (with the CDU operational), the HUD displays the HARS magnetic heading.
- Override the automatic alignment by depressing the LAST POS LSK on the ALIGN page. The EGI aligns to the last position stored in the EGI.

3. AAP - Set EGI switch to ON. If this corrects the problem, when the alignment is complete, select EGI and/or STR PT or ANCHR, as desired, on the NMSP.

NOTE

- This action will cause an in-flight alignment to be initiated, if the aircraft is in the air or on the ground and moving. If the aircraft is on the ground and not moving, this action will cause a ground alignment to be initiated. (The aircraft's present (initial) position may have to be entered.)
- An in-flight alignment requires that the aircraft be flown straight and level in unaccelerated flight prior to the initiation of an in-flight alignment, and until a steady asterisk is displayed next to INFLT on the ALIGN Page.
- If aircraft cannot be flown straight and level in unaccelerated flight prior to and during the in-flight alignment until a steady asterisk is displayed next to INFLT, it is recommended that another in-flight alignment be initiated using the INFLT LSK on the ALIGN Page when the aircraft can be flown straight and level in unaccelerated flight.

EGI GPS Failure.

NOTE

- GPS-only navigation mode will be unavailable.
- If EGI INS and HARS remain available, full navigation and steering are retained; however, EGI INS may drift. If EGI INS also fails, HARS will be automatically selected, and HSI steering can be driven by selection of ILS, ADF, TCN, or TISL.

1. NMSP - Confirm EGI Δ light on. Select EGI, if required.
2. CDU - Verify GPS FAIL annunciation is displayed.
3. CDU - RESET.
   a. Select SYS FSK
   b. Select RESET LSK
   c. If EGI status is N or F, press EGI LSK. (If this corrects the problem, reselect EGI and configure NMSP as desired.)

If EGI status remains N or F:

4. NMSP - Select HARS, if necessary, and deselect STR PT or ANCHR, if selected.
5. CDU - REINIT.
   a. Select SYS FSK
   b. Select REINIT LSK
   c. If REINIT GPS status is N or F, press REINIT GPS LSK. (If this corrects the problem, reselect EGI and configure NMSP as desired.)

EGI INS Failure.

NOTE

- Blended and INS-only navigation modes will be unavailable.
- If EGI/GPS and HARS remain available, full navigation and steering are retained.
- If the EGI INS failure results in the inability of EGI to drive the HSI and ADI, the Nav Mode Select Panel will automatically transition from EGI to HARS if EGI was selected.

1. NMSP - Confirm EGI Δ light on. Select EGI, if required.
2. CDU - Verify INS FAIL annunciation is displayed.
3. CDU - RESET.
   a. Select SYS FSK
   b. Select RESET LSK
   c. If EGI status is N or F, press EGI LSK. (If this corrects the problem, reselect EGI and configure NMSP as desired.)

If EGI status remains N or F:

4. NMSP - Select HARS, if necessary, and deselect STR PT or ANCHR, if selected.

5. CDU - REINIT.

   a. Select SYS FSK

   b. Select REINIT LSK

   c. If REINIT GPS status is N or F, press REINIT GPS LSK. (If this corrects the problem, reselect EGI and configure NMSP as desired.)

NOTE

- This action will cause an in-flight alignment to be initiated if the aircraft is in the air. If the aircraft is on the ground and not moving, and EGI INS is in NARF mode, this action will cause the EGI INS to return to and continue the EGI INS ground alignment. If the aircraft is on the ground and moving, this action will not cause the EGI INS to be reinitialized. If the aircraft is on the ground, not moving, and has taken off and landed, this action will cause the EGI INS to be reinitialized (ground alignment to be started, aircraft's present (initial) position may have to be entered).

- An in-flight alignment requires that the aircraft be flown straight and level in unaccelerated flight prior to the initiation of an in-flight alignment, and until a steady asterisk is displayed next to INFLT on the ALIGN Page.

- If aircraft cannot be flown straight and level in unaccelerated flight prior to and during the in-flight alignment until a steady asterisk is displayed next to INFLT, it is recommended that another in-flight alignment be initiated using the INFLT line select key on the ALIGN Page when the aircraft can be flown straight and level in unaccelerated flight.

- The pilot can override the automatic alignment by depressing the LAST POS LSK on the ALIGN Page. The EGI aligns to the last position stored in EGI.

INS Flight Instrument Failure.

NOTE

- An INS flight instrument failure will result in the inability of EGI to drive the HSI and ADI. The Nav Mode Select Panel will automatically transition from EGI to HARS if EGI was selected.

- Full ENAV capability is retained on the CDU and HUD.

1. NMSP - Confirm HARS Δ light on.

2. CDU - Verify INS FLT INST FAIL annunciation is displayed.

3. CDU - RESET

   a. Select SYS FSK

   b. Select RESET LSK

   c. If EGI status is N or F, press EGI LSK. (If this corrects the problem, reselect EGI and configure NMSP as desired.)

If EGI status remains N or F:

4. AAP - EGI switch to OFF for at least 10 seconds, then set EGI switch to ON. (If this corrects the problem, when the alignment is complete, select EGI and/or STR PT or ANCHR, as desired, or the NMSP.)

NOTE

- When the EGI is turned off, disregard the steer point ID, steer point database and number, distance to steer point, actual TTG, and delta time displayed on the HUD.
- When the EGI is turned off (with the CDU operational), the HUD displays the HARS magnetic heading.
- This action will cause an in-flight alignment to be initiated if the aircraft is in the air or on the ground and moving. If the aircraft is on the ground and not moving, this action will cause a ground alignment to be initiated.
- An in-flight alignment requires that the aircraft be flown straight and level in unaccelerated flight prior to the initiation of an in-flight alignment, and until a steady asterisk is displayed next to INFLT on the ALIGN Page.
- If aircraft cannot be flown straight and level in unaccelerated flight prior to and during the in-flight alignment until a steady asterisk is displayed next to INFLT, it is recommended that another in-flight alignment be initiated using the INFLT line select key on the ALIGN Page when the aircraft can be flown straight and level in unaccelerated flight.

CDU Failure.

NOTE

- When the CDU fails or is turned off, disregard the steerpoint ID, steerpoint database and number, distance to steerpoint, actual TTG, delta time, attitude, airspeed, and magnetic heading displayed on the HUD.
- When the CDU fails, STR PT or ANCHR on the NMSP, if selected, will disengage. The HSI mag heading, ADI pitch and roll, and HUD pitch and roll, will continue to be provided by HARS or EGI as previously selected. All EGI steering information presented on the HSI, ADI, and HUD will be lost or invalid.
- HSI and ADI steering can be driven by ILS, ADF, TCN, or TISL as selected by NMSP.
- When the CDU fails, the CDU screen will freeze, become blank, show a flashing DISPLAY FAILURE across bottom of the screen; MBC FAIL, ADA FAIL, or HARDWARE FAIL message across middle of the screen. The CDU will display a bitball (Δ) (if not cleared after a previous CDU failure) in the upper right corner.

1. AAP - Set CDU switch to OFF for at least 4 seconds.
2. AAP - Set CDU switch to ON.

NOTE

- Cycling power to the CDU for more than 3 seconds will cause any modified or created waypoints, flight plans, or LASTE pilot preferences and weapons data to be lost.
- This action will not initiate an EGI INS alignment if the EGI INS is in NAV or NARF mode.
- HUD altitude and airspeed will not be available until the completion of the CDU startup BIT test.

3. If this corrects the problem, upon completion of CDU startup BIT test and DTC upload (if DTC inserted and locked), CDU will be configured to original turn-on defaults. Reconfigure CDU for mission requirements (select next steerpoint, steering modes, etc., as required). If no DTC, reenter mission initialization parameters.
4. Select desired operating modes on NMSP when alignment is complete.

CICU FAILURE.

If CICU caution light is on:

1. CDU - check for CICU NOT READY annunciation.

2. AAP - Set PAGE switch to OTHER.

3. CDU - Depress SYS key.

4. CDU (System Page) - Check for CICU Status - N.

5. MFCD - Select System Status Page (STAT).

6. MFCD (System Status Page) - Toggle OSBs 19/20 until CICU legend is displayed between OSBs 19 and 20.

7. MFCD - Depress OSB 6 (RESET) to reset CICU.

If CICU caution light stays on:

8. AHCP - Set TGP to OFF.

9. AHCP - Set CICU to OFF for at least 5 seconds.

10. AHCP - Set CICU to ON.

If CICU caution light still on:

11. CICU Failure.

If CICU caution light goes out:

12. CICU will perform BIT and initialization from DTC if DTC inserted and locked). Reconfigure CICU for mission as necessary.

Check ISA Failure:

13. MFCD - Select system status page (STAT).

14. MFCD (system status page) - Toggle OSB 19/20 until ALM legend is displayed between OSBs 19 and 20.

For ALM 05-07 ISA modified aircraft, if ISA reset bullseye is displayed:

15. Press ISA reset (OSB 6).

If ISA reset bullseye is still displayed:

16. CICU Failure

If ISA reset bullseye is no longer displayed:

17. CICU will perform BIT and initialization (from DTC if DTC inserted and locked).

18. Reconfigure CICU for mission as necessary.

Message	Condition	Corrective Action
CADC FAIL	Air data is invalid.	Cross check Caution Light Panel, refer to CADC CAUTION LIGHT ANALYSIS (Figure 3-2).
CADC NOT RDY	CADC not functioning.	Cross check Caution Light Panel, refer to CADC CAUTION LIGHT ANALYSIS (Figure 3-2).
CICU FAIL	CICU Status transitioned to FAILED	Cross check Caution Light Panel, refer to CICU CAUTION LIGHT ANALYSIS (Figure 3-2)
CICU NOT READY	CICU Status transitioned to Not Communicating	Cross check Caution Light Panel, refer to CICU CAUTION LIGHT ANALYSIS (Figure 3-2)
EGI FAIL	EGI hardware failure.	Refer to ENAV FAILURES-EGI Failure.
EGI FLT INST FAIL	EGI hardware failure.	Refer to ENAV FAILURES-EGI Flight Instrument Failure.
EGI NOT RDY	EGI not functioning.	Refer to ENAV FAILURES-EGI Not Ready Failure.
GPS FAIL	EGI GPS hardware failure.	Refer to ENAV FAILURES-EGI GPS Failure.
IFFCC NOT RDY	IFFCC not communicating.	Reset IFFCC.
INS FAIL	EGI INS hardware failure.	Refer to ENAV FAILURES-EGI INS Failure.
INS FLT INST FAIL	INS input to FLT INST failed.	Select HARS for FLT INST.
HARS FAIL	HARS hardware failure.	Refer to HARS MALFUNCTION.

Figure 3-20. CDU System Emergency Status Messages

SECTION IV

CREW DUTIES

NOT APPLICABLE

SECTION V

OPERATING LIMITATIONS

TABLE OF CONTENTS

OPERATING LIMITATIONS.

This section specifies aircraft and engine limitations to be observed during normal operation of the aircraft. They are derived from actual flight tests and demonstrations. The most restrictive limitation applies to any given condition. Limitations that are merely associated with a certain technique or specialized phase of operation are discussed appropriately in other sections of the manual.

INSTRUMENT MARKINGS.

The limitations that must be observed for safe and efficient operation of the aircraft and engine are shown in Figure 5-1, Instrument Markings. When necessary, further explanation of the instrument markings is covered in the text of this section under the appropriate heading.

GENERAL RESTRICTIONS.

a. Do not deploy the speed brakes while rolling the airplane at speeds above 350 KIAS.

b. Do not operate pitot heat system for more than 6 minutes while on the ground.

c. Practice elevator and aileron emergency disengagements are not authorized during flight.

d. Canopy restrictions while taxiing:

(1) Canopy must be closed and locked if the total effective headwind velocity/force against the canopy while taxiing is in excess of 50 knots.

(2) Canopy must not be actuated while turning.

e. ECM pod operations/check-outs should be kept to a minimum time on the ground. Operation of the ECM pods on the ground should not be accomplished if only one engine generator is functioning.

BASED ON JP-4/5/8 FUEL

INTERSTAGE TURBINE TEMPERATURE

LINE 865 °C
- STABILIZED TEMP ABOVE 865° C INDICATES AN ENGINE MALFUNCTION. DAMAGE TO ENGINE MAY HAVE OCCURRED.
- TRANSIENT OPERATION UP TO 900°C FOR NO MORE THAN 12 SECONDS DURING STARTING OR DURING ACCELERATION IS ACCEPTABLE.

BAND 275 - 865 °C
- NORMAL RANGE

CAUTION

STABILIZED ITT ABOVE 675°C AT IDLE POWER COULD INDICATE A FAILING OUTER TRANSITION LINER: ABORT.

CORE SPEED

LINE 102%
- NO OPERATION ABOVE LINE

BAND 100 - 102%
- MAXIMUM 3 SEC WITHIN BAND

BAND 56 - 100%
- NORMAL RANGE

CAUTION

IDLE RPM BELOW COMPUTED MINIMUM INDICATES POSSIBLE CIT FAILURE: ABORT.

OIL PRESSURE STEADY STATE LIMITS

LINE 95 PSI
- MAXIMUM ALLOWABLE

BAND 55 - 95 PSI
- NORMAL RANGE - CORE RPM IDLE TO MAX

BAND 40 - 55 PSI
- ACCEPTABLE RANGE CORE RPM IDLE - 85%

BAND 40 PSI
- MINIMUM FOR NORMAL IDLE OPERATION

30 PSI
- DO NOT OPERATE BELOW

FLUCTUATION LIMITS

± 5 PSI WITHIN STEADY STATE LIMITS WITH INTERMITTENT FLUCTUATIONS ALLOWABLE TO ±10 PSI FOR A MAXIMUM OF 2 SECONDS

NOTES:

- ENGINE OIL PRESSURE MAY BE ERRATIC DURING AIRCRAFT MANEUVERS. DURING ZERO "G" AND NEGATIVE "G" FLIGHT OIL PRESSURE WILL DROP TO ZERO. DURING POSITIVE "G" FLIGHT OIL PRESSURE MAY INCREASE. DURING YAWING MANEUVERS OIL PRESSURE MAY MOMENTARILY DROP BELOW THE GREEN BAND (55 - 95 PSI). THESE TRANSIENT CONDITIONS ARE ACCEPTABLE PROVIDED PRESSURE RETURNS TO WITHIN THE GREEN BAND (55 - 95 PSI) WITHIN 1 MINUTE AFTER RETURN TO STEADY-STATE, STRAIGHT AND LEVEL FLIGHT.
- OIL PRESSURE MAY PEG AT 100 PSI AFTER GROUND OR AIR START. IF PRESSURE DOES NOT DECREASE TOWARD NORMAL AFTER A MAXIMUM OF 2.5 MINUTES, SHUT DOWN THE ENGINE.
- WHEN OAT IS -30 °C OR BELOW, MAXIMUM OIL PRESSURE IS INCREASED TO 100 PSI. IF OIL PRESSURE EXCEEDS 100 PSI FOR MORE THAN TWO MINUTES WHEN OAT IS -30°C OR BELOW, SHUT DOWN THE ENGINE.

F05-001S01-C04

Figure 5-1. Instrument Markings (Sheet 1 of 4)

FAN SPEED

LINE 100%	• OPERATION ABOVE THIS SPEED COULD RESULT IN ENGINE DAMAGE. OVER SPEED INSPECTION REQUIRED.
BAND 98 - 100%	• STEADY STATE SPEEDS IN THIS BAND INDICATED AN ENGINE MALFUNCTION.
BAND 22 - 98%	• NORMAL RANGE: IDLE — MAXIMUM

NOTE

- REFER TO T.O. 1A-10C-1-1 FOR PREDICATED TAKEOFF FAN SPEED.
- FAN SPEED SHOULD BE CHECKED DURING MAXIMUM POWER TAKEOFFS AT APPROXIMATELY 1,000 FEET ON THE TAKEOFF ROLL.
- THE 1% BELOW MINIMUM TRIM AUTHORIZED FOR SELECTED TF34-GE-100 ENGINES, SHALL NOT BE A FACTOR WHEN COMPUTING TAKEOFF FAN SPEED.

2% REDUCTION BELOW PREDICTED TAKEOFF FAN SPEED AT MAX POWER, WRITE UP ON AFTO FORM 781.
3% REDUCTION BELOW PREDICTED TAKEOFF FAN SPEED AT MAX POWER IS INDICATIVE OF MECHANICAL MALFUNCTION AND ABORT IS REQUIRED.

EXAMPLE:
80% PREDICTED TAKEOFF FAN SPEED
78% WRITE UP FAN SPEED
77% MECHANICAL MALFUNCTION INDICATED, ABORT

WARNING

- FAN SPEEDS LESS THAN PREDICTED WILL RESULT IN REDUCED SINGLE-ENGINE RATE OF CLIMB, AND WILL ADVERSELY AFFECT OTHER TAKEOFF PARAMETERS. UNDER CRITICAL OPERATING CONDITIONS (SHORT RUNWAY, HIGH GROSS WEIGHT, HIGH TEMPERATURE, PRESSURE ALTITUDE, ETC.) AN ABORT MAY BE APPROPRIATE ACTION IF PREDICTED FAN SPEED CANNOT BE ACHIEVED.
- DURING HIGH PRESSURE ALTITUDE, HIGH GROSS WEIGHT OPERATIONS, OR WHEN A HIGHER RATE OF CLIMB IS REQUIRED FOR OBSTACLE CLEARANCE, THE MINIMUM FAN SPEED REQUIRED FOR SINGLE-ENGINE RATE OF CLIMB MAY EXCEED 3% BELOW PREDICTED FAN SPEED.

F05-001S02-C04

Figure 5-1. Instrument Markings (Sheet 2)

FUEL FLOW

BAND 150 - 4100	• NORMAL RANGE
LINE 150	• DO NOT OPERATE BELOW

APU

OPERATION

LINE 110 (±3)% RPM	• AUTOMATIC SHUTDOWN
100 (±3)% RPM	• NORMAL
LINE 760°C	• MAXIMUM CONTINUOUS OPERATION
BAND 715 - 760°C	• LIMIT TO TWO SECONDS DURING ENGINE START
BAND 200 - 715°C	• NO LIMIT

STARTING LIMITS (UNDER 60% RPM)

LINE 980°C	• LIMIT TO TWO SECONDS DURING APU START

HYDRAULIC PRESSURE

LINE 3350 PSI	• MAX PRESSURE
BAND 2800 - 3350 PSI	• NORMAL PRESSURE

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Figure 5-1. Instrument Markings (Sheet 3)

ACCELEROMETER

WEIGHT (APPROX.)	BASIC AIRCRAFT LOAD FACTOR LIMITATIONS	
	SYM	ASYM
30,000 LB	+7.33	+5.86
	-3.00	-1.00
46,000 LB	+5.00	+4.00
	-2.00	-1.00

NOTE

SEE FIGURE 5-5 (SHEET 3) FOR LOAD FACTOR LIMITATIONS VS GROSS WEIGHT.

SEE FIGURE 5-6 FOR LIMITATIONS APPLICABLE TO SPECIFIC STORE CONFIGURATIONS: HOWEVER, IN NO CASE SHALL THE ALLOWABLE ASYMMETRIC LOAD FACTORS BE EXCEEDED.

AIRSPEED

LINE 200 KNOTS LIMIT GEAR DOWN & FLAP DOWN SPEED.
STRIPED POINTER WILL MOVE TO INDICATE LIMITING STRUCTURAL AIRSPEED.

FLAP POSITION

LINE AT 7 DEGREES (MVR) POSITION

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Figure 5-1. Instrument Markings (Sheet 4)

FLIGHT RESTRICTIONS.

FUEL IMBALANCE.

With less than 300 rounds of ammunition remaining or for configurations without ammunition but with ballast for the most aft cg limit, and an L-R TANKS UNEQUAL caution light on:

Verify unequal fuel quantity utilizing fuel quantity gauge.

If imbalance is caused by more fuel remaining in the left (aft) tank, the aircraft should not exceed the airspeeds indicated below.

Altitude (feet)	Maximum Speed (KIAS)
Sea Level	315
15,000	240
35,000	156

CROSSWIND LANDING RECOMMENDATIONS.

Figure 5-2 lists the recommended limits of crosswind component velocities. The limits have been verified by flight test except as noted.

NOTE

Asymmetric store landings, high gust conditions, and any adverse runway conditions must be evaluated when attempting a crosswind landing.

The aircraft has less directional stability with external tanks, especially with the flaps up, and, therefore, the crosswind limits are lower. Other external stores loadings may exhibit a slight loss in directional stability, but the ferry configuration is considered the worst case. Full flap landings are recommended with external stores or fuel tanks. SAS off approaches and large wind gust velocities increase the pilot workload, but adequate control exists within specified limitations.

INSTRUMENT METEOROLOGICAL CONDITIONS.

Flight into areas of known moderate or severe icing is not recommended.

BRAKE LIMITATIONS.

The maximum design wheel brake energy limit is 20 million ft/lbs, as shown in Figure 5-3. The brake cooling time required between landing and takeoff can be determined from this chart by using aircraft speed, gross weight, and ambient air temperature. If hot brakes are suspected, do not attempt subsequent takeoff or park in congested area until brake housings have cooled and been inspected for brake damage.

ENGINE LIMITATIONS.

Normal engine operating limitations are shown in Figure 5-4. In the event of an over-temperature condition, note the maximum temperature reached and the duration of the overtemp.

NOTE

- Engine operation should be conducted at the lowest power setting consistent with mission accomplishment to extend engine life.
- If an engine problem is suspected or a frame of flight data is desired, depress TEMS DATA switch (below and left of the landing gear handle). Switch must be depressed for at least 1 second. Note the time and indications of related cockpit instruments for ground comparison. Perform TEMS Status Check after flight for code(s).

ENGINE STARTING LIMITATIONS.

The starter is capable of making any number of consecutive start cycles with 60 seconds between cycles. In addition, the starter is limited to motoring the engine for a maximum of 2 minutes followed by a 5-minute rest period. If light off does not occur after 20 seconds, retard throttle to OFF, dry-motor engine for 30 seconds, wait 1 minute, and reattempt start. The engine should accelerate to at least minimum idle speed core RPM limits within 60 seconds after light-off (ITT RISE).

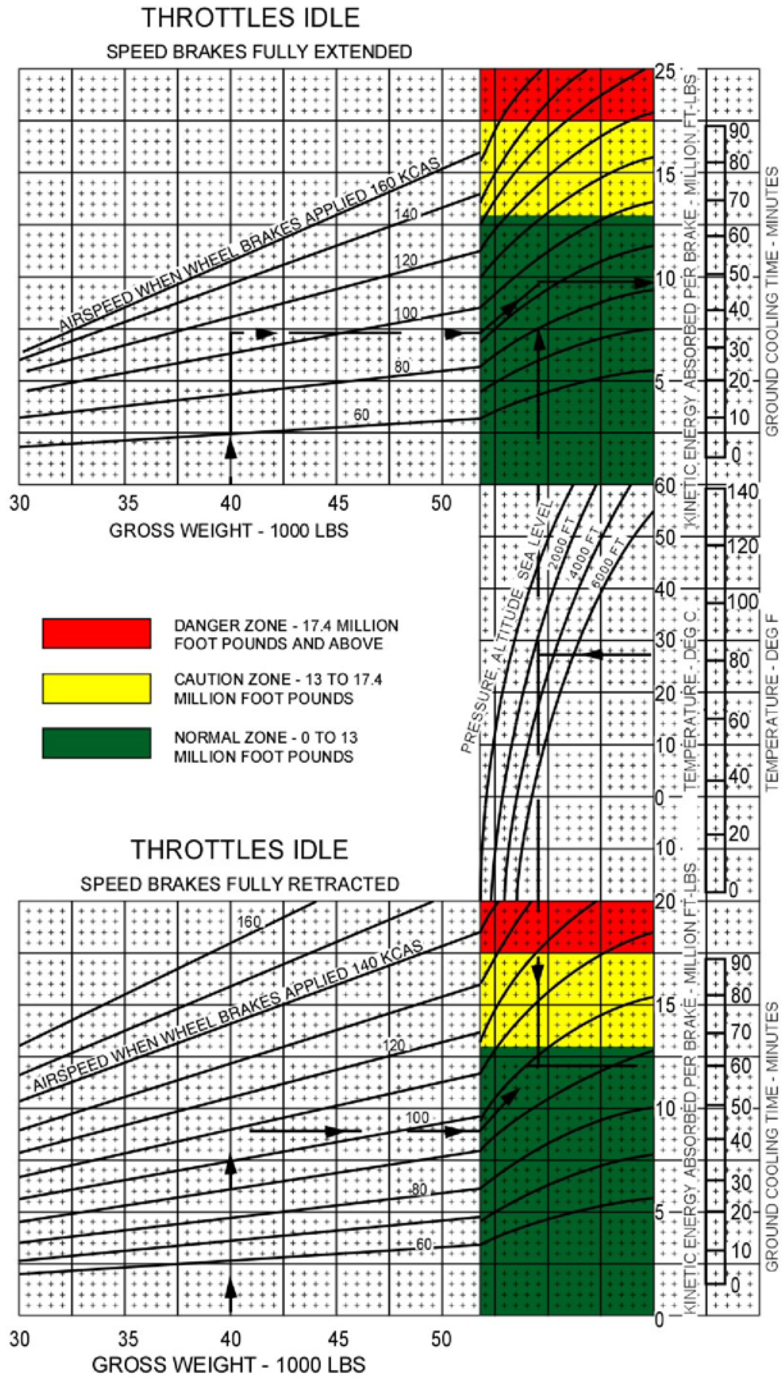
	Operable Engine(s)	Operable Hydraulic Systems	Flaps	Configuration	
				No External Tanks	1, 2, or 3 External Tanks
		Normal			
	2	2	20°	35KTS	30KTS
	2	2	0°	35KTS	25KTS
		Single System		30KTS	25 KTS
	2/1	1	20°/0°	20KTS	N/A (jettison)
		Manual/Reversion			
	2	0	0°	10KTS	N/A (jettison)
△1	1	0	0°		
		One Aileron Disengaged		20KTS	N/A (jettison)
	2	2/1	20/0°		
△2	2/1	0	- - - -	- - - -	- - - -

WARNINGS:

△1 Single-engine MRFCS landing should be attempted only if ejection is not possible.

△2 Landing in MRFCS with one aileron disconnected has not been tested. Ejection recommended.

Figure 5-2. Crosswind Landing Recommendations



THE FOLLOWING INFORMATION EXPLAINS ACTION TO BE TAKEN WHEN A STOP IN THE DANGER, CAUTION, OR NORMAL ZONE IS PERFORMED.

DANGER ZONE

1. Proceed to the nearest designated hot brake area on the ramp without stopping and as quickly as possible.
2. Request fire fighting equipment.
3. After engine shut-down, evacuate aircraft as soon as possible and leave immediate vicinity.

CAUTION ZONE

1. Clear active runway as tires may deflate.
2. Do not attempt subsequent takeoff or park in a congested area until brake housings have cooled and been inspected for brake damage.

NORMAL ZONE

Delay subsequent takeoff for times indicated on chart.

WARNING

- Loss of wheel braking will occur when the designated brake energy limit of 20 million FT/LBS is exceeded.

NOTE

- AIRSPEED SHOULD BE CORRECTED FOR GROUND WIND COMPONENT.
- ALLOWANCE SHOULD BE MADE FOR LOW SPEED TAXI ENERGY AT A RATE OF 1 MILLION FOOT POUNDS PER MILE FOR WEIGHTS BELOW 40,000 LBS AND 1/2 MILLION FOOT POUNDS PER MILE FOR WEIGHTS GREATER THAN 40,000 LBS.

EXAMPLES: FULL STOP LANDING
GIVEN:
GROSS WEIGHT = 40,000 LBS
AIRSPEED WHEN BRAKES ARE APPLIED = 115 KCAS
TOWER REPORTED WIND VELOCITY = 5 KNOT HEADWIND
PRESSURE ALTITUDE = 3000 FEET
OUTSIDE AIR TEMP 80 °F
FIND:
BRAKE ENERGY ABSORBED AND COOLING TIME REQUIRED

SOLUTION:
FOLLOWING EXAMPLE LINES THE ENERGY ABSORBED IS 12 MILLION FOOT POUNDS PER BRAKE WHEN SPEED BRAKES ARE RETRACTED AND IS 9.8 MILLION FOOT POUNDS WHEN SPEED BRAKES ARE EXTENDED COOLING TIME IS 60 MINUTES AND 48 MINUTES, RESPECTIVELY.

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Figure 5-3. Wheel Brake Energy Limits (One Continuous Brake Application)

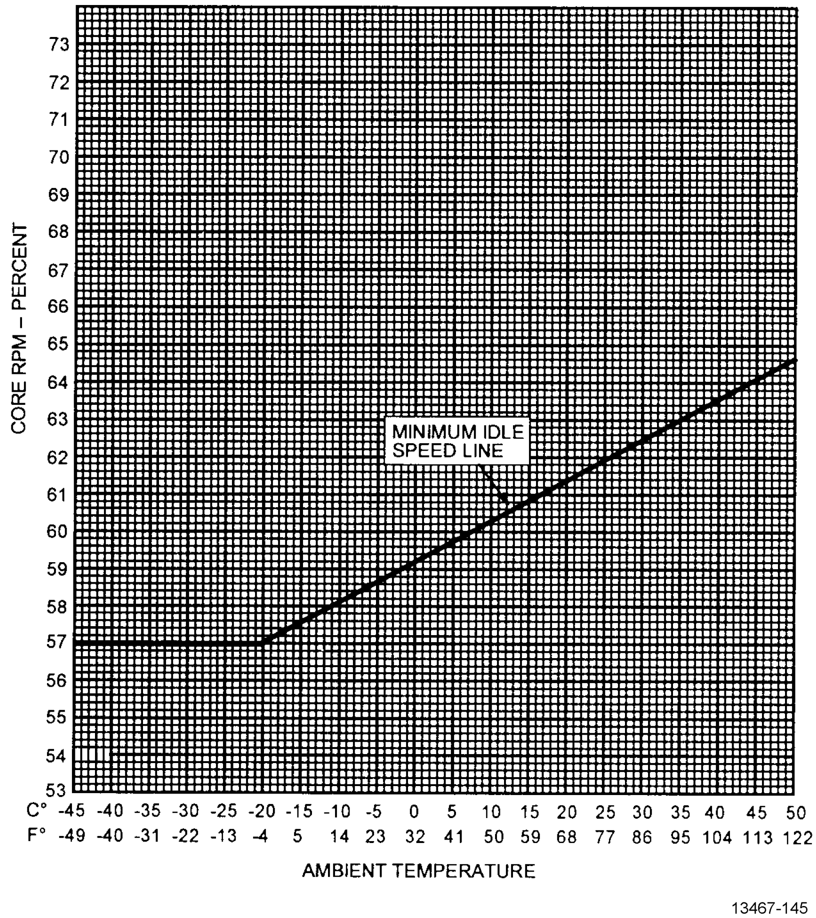


Figure 5-4. Minimum Idle Speed Core Percent RPM Limits

APU LIMITATIONS.

UNSUCCESSFUL APU STARTS.

Unsuccessful starts should be aborted by placing the APU switch in OFF. An unsuccessful APU start is defined as follows:

a. APU does not exceed 60% rpm within 30 seconds.

b. EGT does not decrease toward continuous operating range as rpm increases above 60% (hung start).

APU AIR OR GROUND STARTING.

a. While on the ground, do not start the APU if there is visible fuel collected on the left engine nacelle.

b. During ground operation, 10 minutes must elapse between initiation of successful start cycles.

c. During flight, a second start may be made 2 minutes after APU shutdown.

d. After an unsuccessful start, wait 1 minute for the APU to stop rotating and drain fuel before attempting another start.

e. Three unsuccessful attempts may be made followed by a 20-minute cool-down period prior to attempting another APU start.

APU OPERATION.

Either on the ground or in the air, do not operate the APU for more than 5 minutes with the APU generator OFF. The APU generator is the only source of power for electric fan cooling of the APU hydraulic pump. Wait at least 2 minutes after ENG START CYCLE caution light off before APU shutdown.

NOTE

An engine being motored by APU should reach 26% to 28% fan speed. Less than 26% to 28% fan speed may indicate impending APU failure or insufficient power for a proper engine start, leading to a tail pipe fire.

PROHIBITED AND RESTRICTED MANEUVERS.

a. Zero or negative g maneuvers for more than 10 seconds are prohibited.

b. Intentional spins are prohibited.

c. If the pitch and/or yaw SAS is OFF, 360° rolls are restricted as follows:

(1) Clean aircraft - 1g.

(2) With external stores - not recommended.

d. Intentional transition and flight in MRFCS operating mode are limited to the following situations:

(1) Response to emergency.

(2) Acceptance flights.

(3) Functional check flights (FCF) and other flights while observing the following restrictions:

	TRANSITION	FLIGHT
Airspeed	180 to 210 KIAS	140 to 280 KIAS
	180 to 250 KIAS (FCF only)	140 to 300 KIAS (FCF only)
Altitude	10,000 FT AGL minimum	5,000 FT AGL minimum
G load	1g	0 to + 4g
Attitude	Level flight	±30° bank
		±10° pitch
cg	25 to 29.6% MAC	
Configuration	Flaps up	Flaps up
External Stores	Symmetrical stores only	Symmetrical stores only

WARNING

- Trim malfunctions during transition to and in manual reversion mode, especially at higher air speeds, can result in control forces which exceed physical capability to counteract. Immediately before transition, trim for level flight. Immediately after transition, check pitch trim operates in both directions before exceeding manual reversion transition speed limits. If pitch trim is inoperative/malfunctions, immediately return to normal flight mode.
- If either hydraulic pressure fails to drop during transition to manual reversion, immediately return to normal flight mode and do not attempt another transition.
- Aileron tab shifter malfunctions may result in unsatisfactory roll control for flight mode selected. If a tab fails to shift on selection of manual reversion mode, return to normal flight mode. If a tab fails to shift when returning to normal flight mode, the associated tab light will remain on. Refer to FAILURE OF AN AILERON TO SHIFT OUT OF MANUAL REVERSION procedure, Section III.
- Power reductions at high speed in manual reversion mode will cause severe pitch down. Make full use of available aft stick, nose up pitch trim, and return to normal flight mode before reducing power during recovery from high-speed dives.

AIRSPEED LIMITATIONS.

Refer to instrument markings illustration (Figure 5-1).

a. With or without stores:

(1) One or both hydraulic systems operative - 450 KIAS or Mach 0.75, whichever is lower.

(2) Both hydraulic systems inoperative (manual reversion - 390 KIAS or Mach 0.75, whichever is lower).

b. Maximum airspeed with landing gear and/or flaps extended is 200 KIAS.

TIRE GROUND-SPEED LIMITATIONS.
NOSE WHEEL TIRE: The maximum NLG tire ground speed rating is 217 knots.

MAIN WHEEL TIRE: The maximum MLG tire ground speed rating is 165 knots.

ACCELERATION LIMITATIONS.

The flight strength diagram (Figure 5-5) shows the acceptable limits to which the airplane can be flown without exceeding design limit load on any primary structural components. The curved portion of the flight strength diagrams indicates the number of g's that can be obtained before the airplane stalls. At the higher airspeeds and gross weights, the number of g's that can be obtained without stalling exceeds the load factors shown in the diagrams. See Figure 5-5 for variation of normal load factor with gross weight.

Load factor encounters (g-overshoot) due to wing-tip vortices/wake turbulence should be considered as an asymmetrical load factor in computing maximum acceleration limits.

CAUTION

During rapid pitch rate maneuvers, the cockpit accelerometer may read as much as 1g less than the absolute value experienced by the aircraft. This is due to the location of the cockpit accelerometer forward of the aircraft cg.

TEMS/ADR OVG1, OVG2, and OVG3 are a result of maneuvers exceeding case inspection regions 1, 2 and 3, respectively, as depicted in Figure 5-4.1. These OVG codes result in increasing maintenance effort.

WEIGHT LIMITATIONS.

The maximum in-flight gross weight is 51,000 pounds.

The maximum gross weight for towing, taxiing, takeoff, and landing is 46,000 pounds.

CAUTION

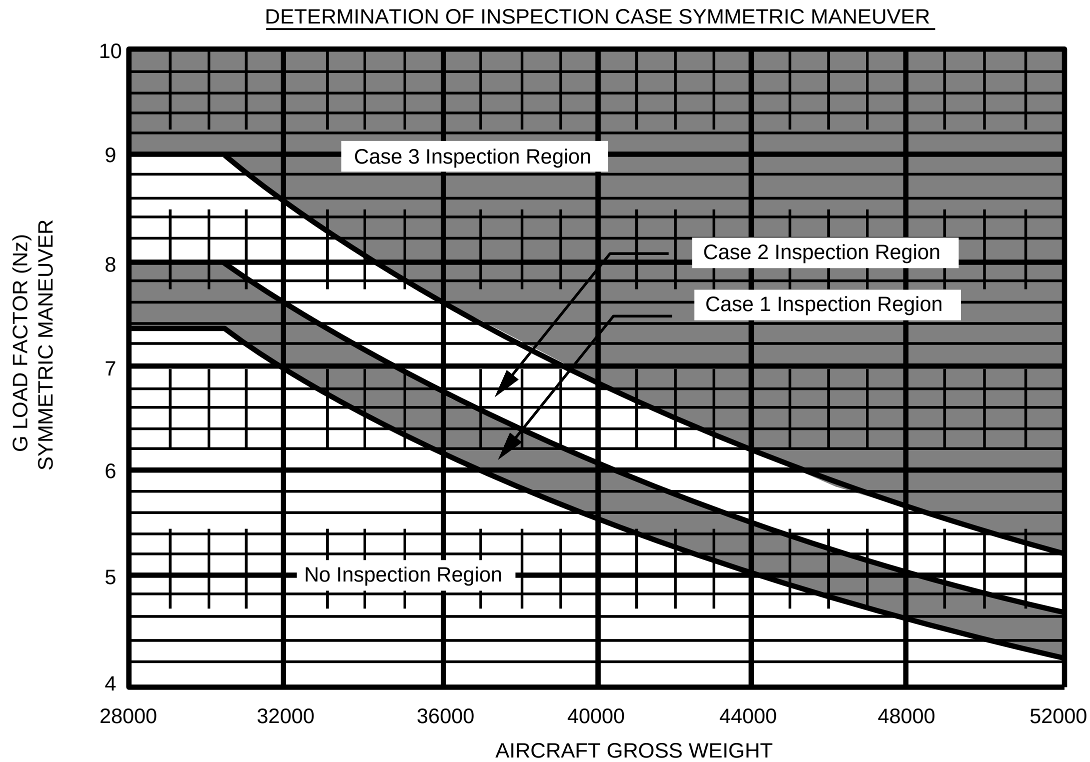
During turns when taxiing near 46,000 pounds gross weight, reduce taxi speed and widen turn radius to avoid damage to the nose wheel and/or strut assembly. Use approximately five knots or a fast walking pace as a guide for speed during wide turns. If a sharp turn is required, further reduce taxi speed to minimum practical, approximately three knots or normal walking pace.

SINK RATE LIMITATIONS.

The maximum allowable sink rate for landing is 600 feet/minute for gross weights up to 33,200 pounds; the rate decreases linearly (approximately 14 feet/minute/1,000 pounds) to 354 feet/minute at 51,000 pounds.

CENTER-OF-GRAVITY.

Refer to aircraft Weight and Balance Data, (TO 1-1B-50), and Basic Weight Checklist and Loading Data, (TO 1A-10C-5).



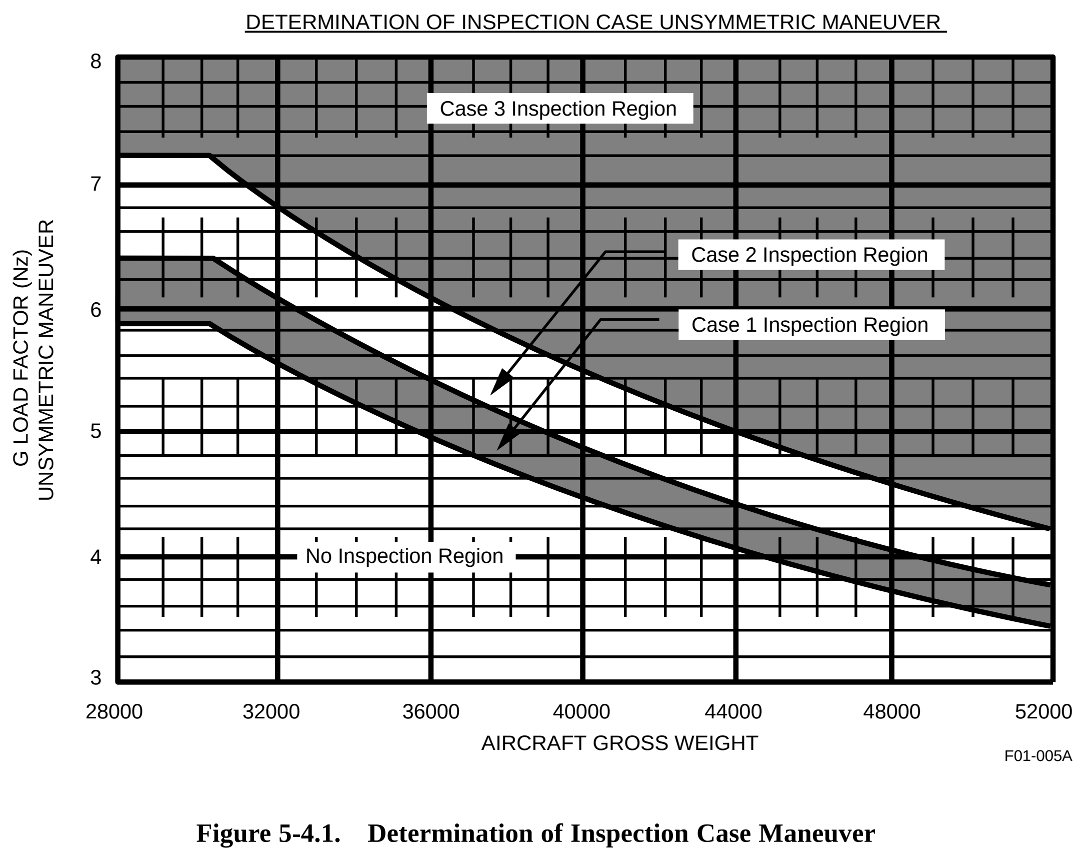


Figure 5-4.1. Determination of Inspection Case Maneuver

WEIGHT 30,000 POUNDS, SPEED BRAKES CLOSED

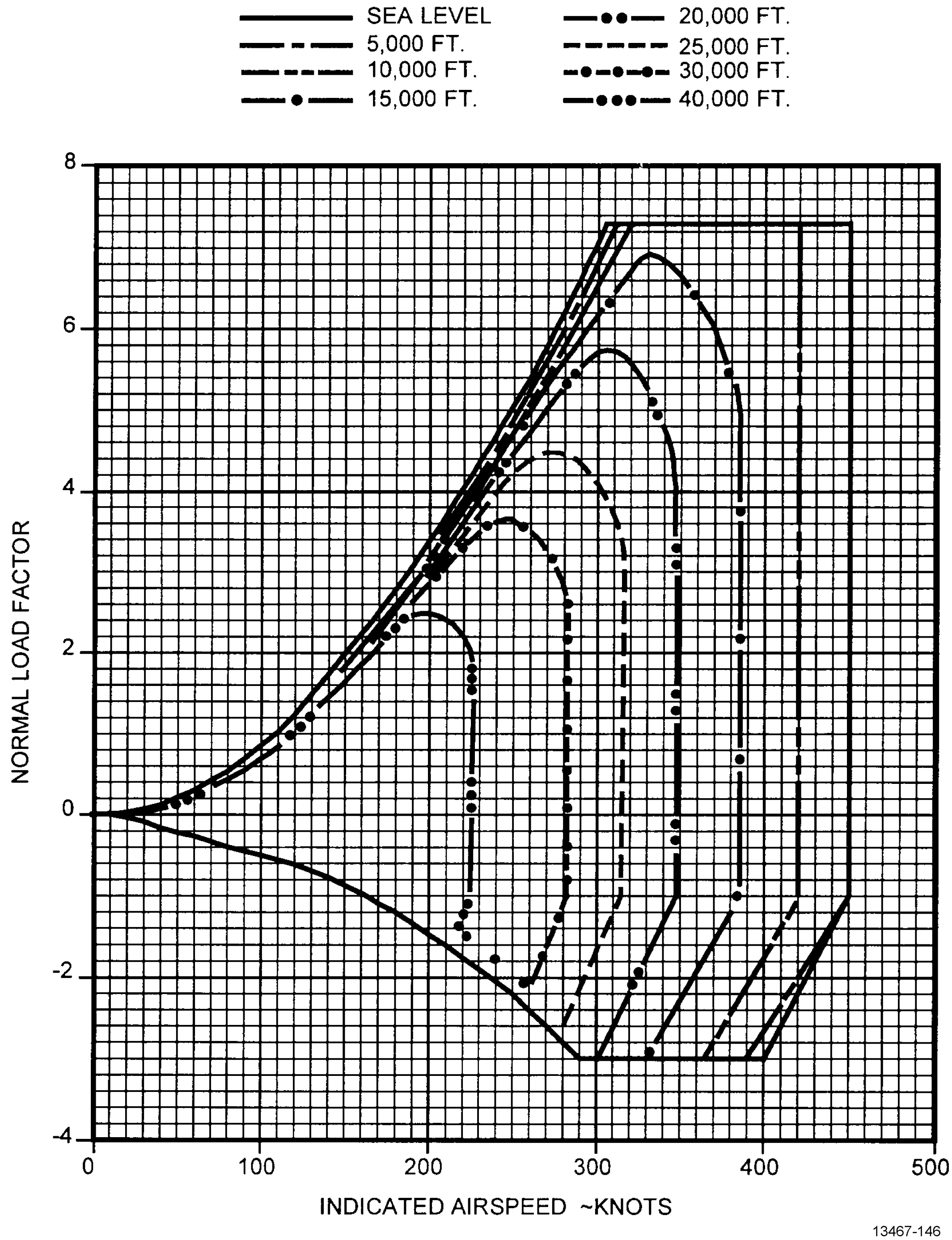


Figure 5-5. Flight Strength Diagram (Sheet 1 of 3)

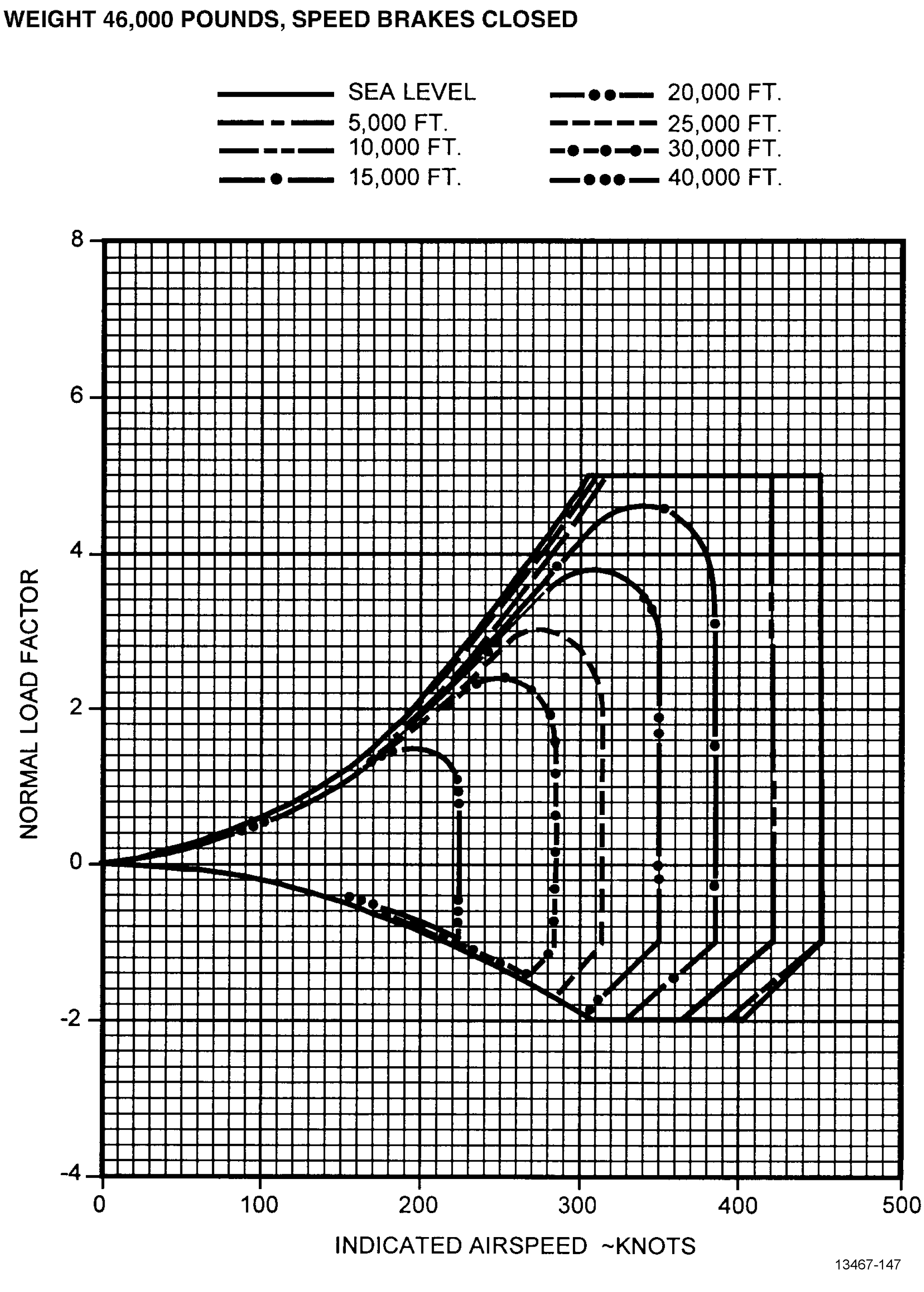


Figure 5-5. Flight Strength Diagram (Sheet 2)

(SUBJECT TO EXTERNAL STORES STRENGTH LIMITATIONS)

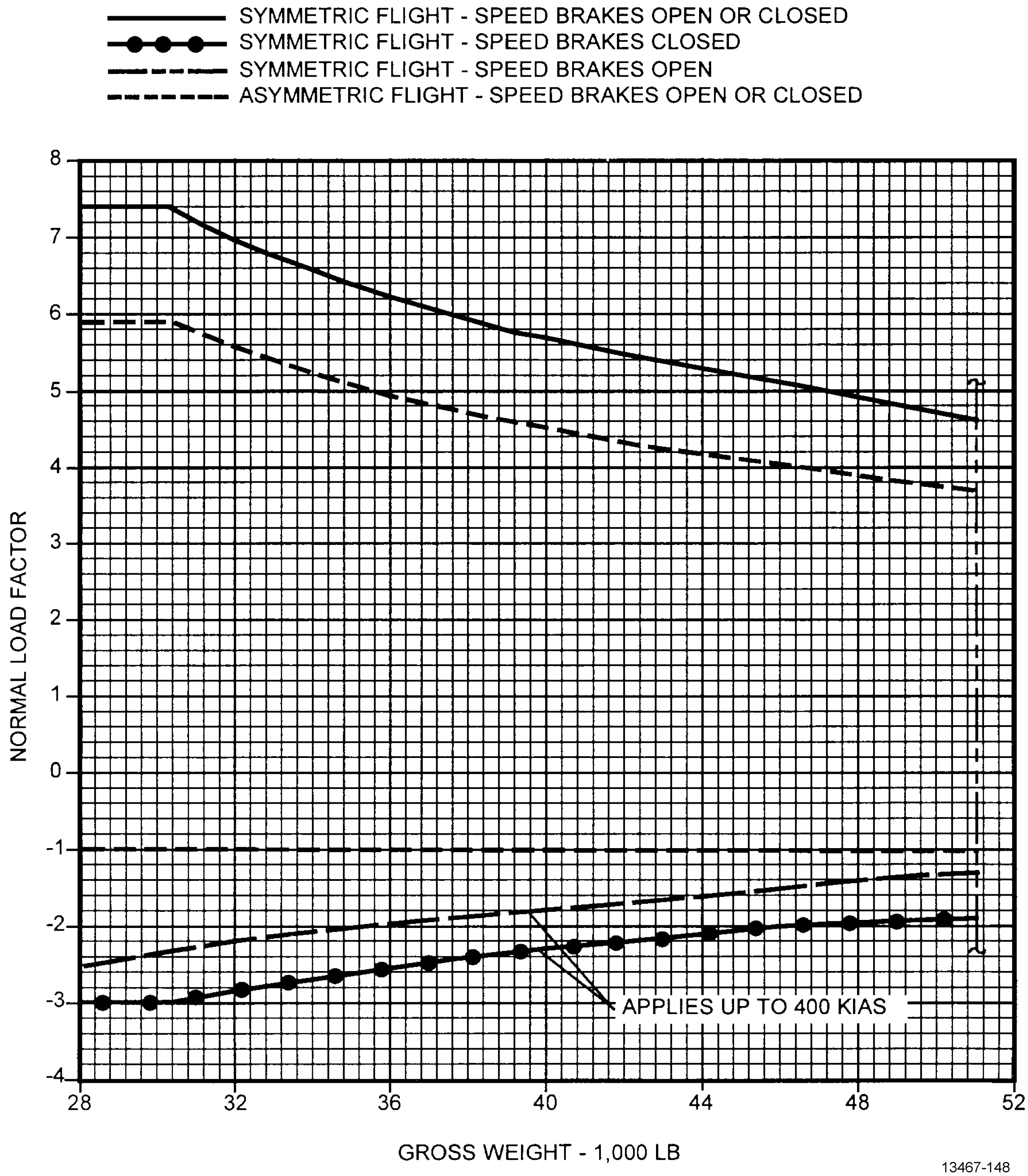


Figure 5-5. Flight Strength Diagram (Sheet 3)

ASYMMETRICAL LOAD MOMENT LIMITATIONS.

Maximum asymmetrical load moment is 27,168 foot-pounds. Distance in feet from fuselage center-line to pylon stations is as follows:

STATION	DISTANCE/FT
1 & 11	19.1
2 & 10	15.6
3 & 9	12.0
4 & 8	5.5
5 & 7	1.9

EXTERNAL STORES LIMITATIONS.

The external stores limitations charts (Figure 5-9.1) depict the authorized types of suspension and store loadings. The symbols shown in Figure 5-8 are used to indicate the type of suspension and the rack stations upon which stores are authorized carriage and release. These symbols are also used in the example configurations shown in Figure 5-8 and Figure 5-6. Release sequence for stores on a single rack is also shown in Figure 5-6. Release sequence shown for LAU-88/A sequences from outboard to inboard. Four chaff/flare dispensers are installed in each main landing gear pod and each wing tip

Figure 5-9.1 covers carriage of like stores. Each configuration is illustrated to show the pylon station on which the store is certified, the approved rack loading, and the carriage, release, and jettison limits pertinent to each store making up the configuration. Unless otherwise noted, all 11 pylons with the basic parent racks are installed on the configurations listed.

WARNING

Only the configuration shown in Figure 5-9.1 or mixed configurations properly obtained from those shown, may be carried, released, or jettisoned. Unauthorized loads may result in flutter, overstress, cg travel aft of the approved limit during carriage, and unpredictable ordnance separation characteristics during release of jettison.

General Restrictions and Definitions..

The following paragraphs present restrictions applying to carriage, employment, release, and jettison of the configurations shown in Figure 5-9.1 and to their mixed configurations. Definitions are included for all the terms used in the columns of Figure 5-9.1.

For mixed type store configurations, the carriage, release, and jettison limits are given for each store type. The limits of the most restricted store apply as long as that store is retained.

The limits shown represent maximum safe performance limits for the specific aircraft/store combinations depicted.

BASIC AIRCRAFT - An aircraft with 11 pylons, including pylon bomb racks, without stores or suspension equipment (TERs, etc.) up loaded.

SYMMETRIC FLIGHT - Symmetric flight is flight involving no roll or sideslip.

LIKE STORE CONFIGURATION - A configuration that consists of only one store type.

MIXED STORE CONFIGURATION - The simultaneous carriage or loading of two or more unlike store types on a given aircraft.

EMPLOYMENT - The use of a store for the purpose and in the manner for which it was designed, such as releasing a bomb, launching a missile, firing a gun, or dispensing a sub munition

RIPPLE - The separation of two or more stores, submunitions, etc., one after the other in a given sequence at a specified interval.

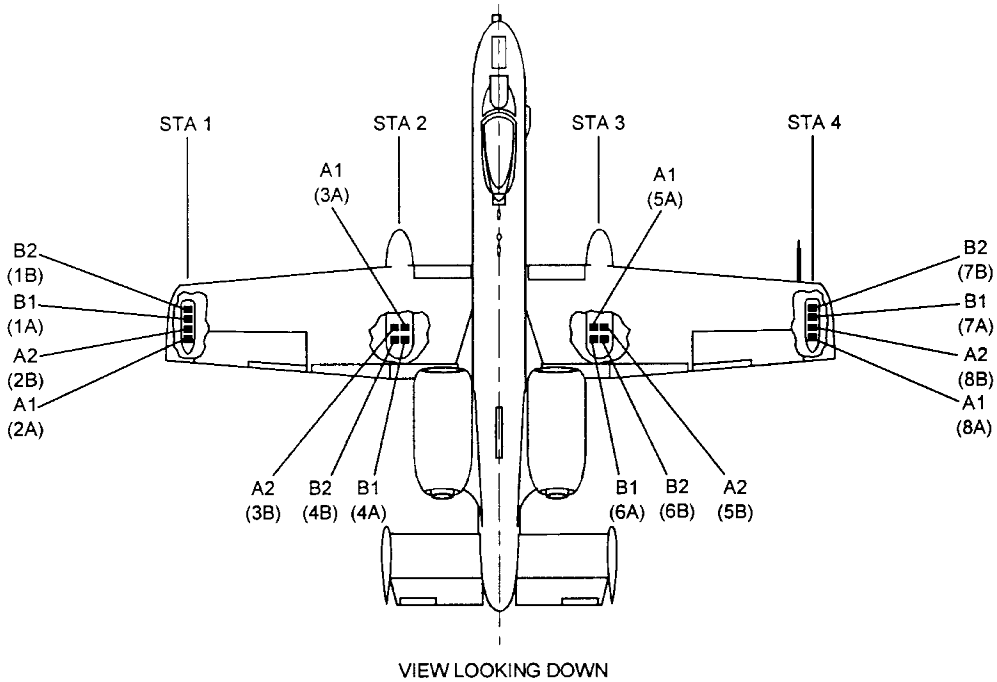
Stores Carriage.

The symbols used in Figure 5-9.1 for the station loading and suspension columns define the specific rack locations for the carriage of the stores. These locations must be adhered to in each particular configuration.

Carriage airspeed limits for each configuration are listed in KIAS and TMN. Carriage is restricted to whichever of the two airspeed values is less.

Empty LAU-88A/A, LAU-117A(V)3/A, and TER airspeed and acceleration limits are to the limits of the basic aircraft.

Figure 5-5 (sheet 3) presents symmetrical acceleration limits as a function of aircraft gross weight. Asymmetric acceleration limits are 80% of the symmetric limits. Acceleration limits in Figure 5-9.1 cover essentially typical conditions of symmetrical and asymmetrical pullouts, and do not consider gross weight variations. For any set of conditions, both figures should be consulted and the more restrictive load factor limit observed.



NOTE

NUMBERS IN PARENTHESES REPRESENT THE STATION IDENTIFICATION USED BY THE EWMS/CMS.

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Figure 5-6. Chaff/Flare Dispensing System Release Sequence

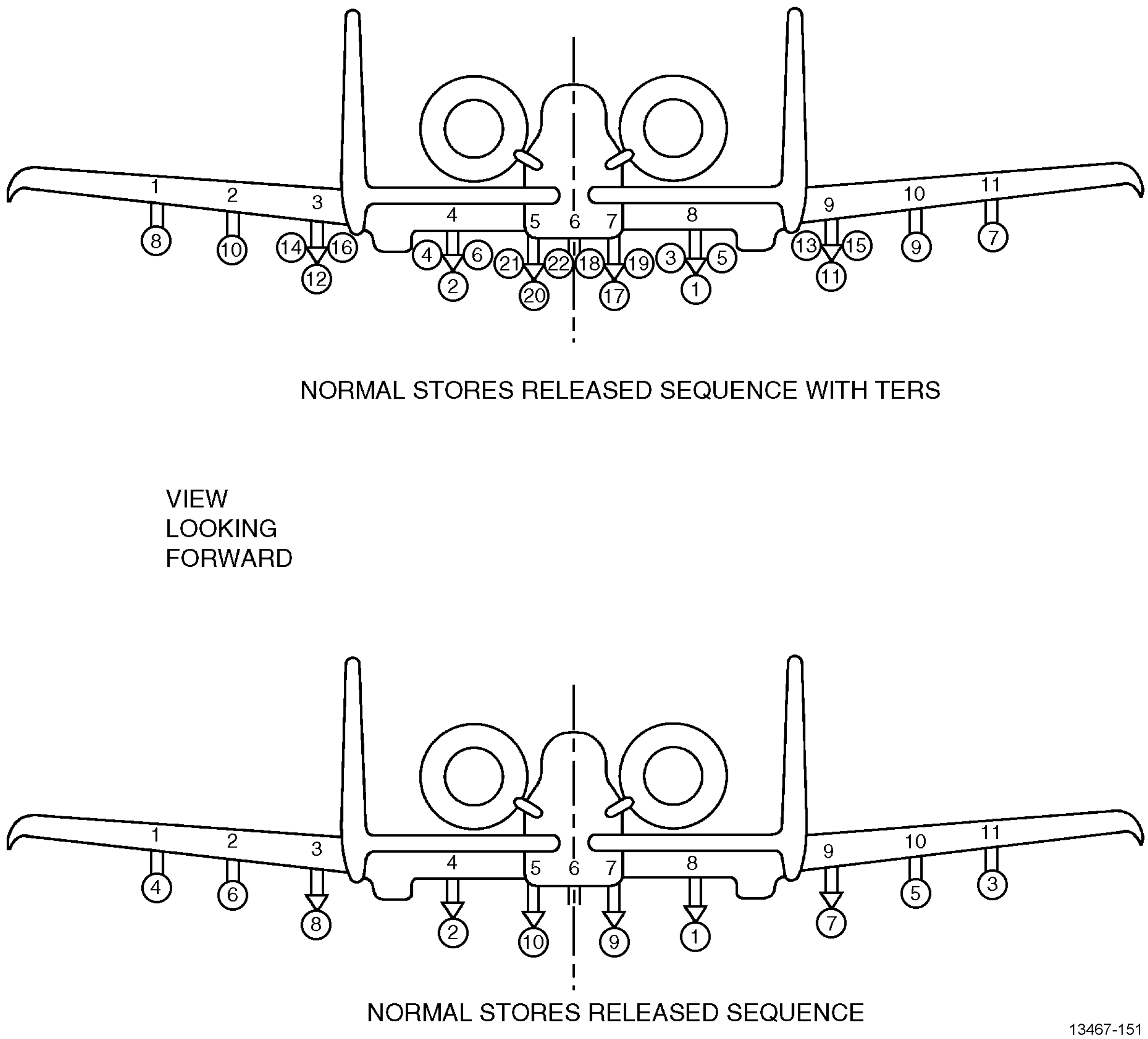

Figure 5-7. Like Store Partial Configurations

Store Configurations.

Mixed and like store configurations are obtained from the existing certified station/store configurations illustrated in Figure 5-9.1 using the following rules:

Pylon stations 3 through 9: Certified stores may be loaded in any combination to obtain mixed or like store configurations on the certified stations.

NOTE

The configurations displayed in this section on pylon stations 5 and 7 are authorized on station 6, provided stations 5 and 7 are not loaded.

Pylon stations 1, 2, 10, and 11:

Certified stores may be combined with any Station 3 through 9 mixed/like store configurations.

Pylon stations 1 through 11:

Mixing of stores on individual TER-9/A loaded stations is not authorized.

Authorized release sequence is optimal/mission determined except from individual TER-9A and LAU-88A/A loaded station, which require normal release sequence.

Employment.

Airspeed and acceleration (g’s) limits listed under the Employment column of Figure 5-9.1 are applicable to releasing stores from suspension equipment, TERs, or pylon bomb racks, the launching of rockets and missiles, and the dispensing of flares and practice bombs, etc.

When carrying stores of mixed types, any one store type may be selected for release on any given bomb run. A store may be selectively jettisoned in any release sequence.

All configurations shown in Figure 5-9.1 are assumed to consist of like store types unless otherwise noted in the Station Loading and Suspension column. When a general type such as BLU, SUU, etc., is listed, the same assumption applies. Therefore, when various specific versions of a specific store type (i.e., A/B, B/B, C/B) are mixed in a like or mixed store configuration, these specific series should be considered as a single store type.

Minimum Release Interval.

To prevent bomb-to-bomb collisions during ripple release of multiple carried stores, minimum release intervals have been established for applicable store configurations. These minimum release intervals are noted in Rel Modes column of Figure 5-9.1 for the applicable configurations and must be adhered to. Release mode abbreviations are defined in Figure 5-8.

Jettisoning.

Airspeed (KIAS) and acceleration (g’s) limits in the selective Jettison column are applicable as follows:

Store - - Jettison of stores from the pylon rack or from suspension equipment (TER) attached to the pylon bomb rack.

Missile - - Jettison of AGM-65 from LAU-88. An AGM-65 missile is launched in an unarmed/unguided mode with each depression of the button.

Rack - - Jettison of suspension equipment (TER) from the pylon rack (suspension equipment may be loaded with other stores or empty).

WARNING

- Stores should be jettisoned above the maximum fragmentation clearance altitude when possible, even if jettisoned in a safe condition.
- Limitations for emergency jettisoning of stores and/or suspension equipment (with or without stores) are presented in Note C of Figure 5-9.1.

NOTE

Selective jettison should be accomplished with the landing gear retracted, if possible.

Stick Throw.

Stick throw values provided in the Carriage column of Figure 5-9.1 are drawn from and correspond to roll rate and roll acceleration limitations imposed upon the particular store configuration.

Maximum Dive for Employment.

The dive angle listed in the Deliv Angle column is the maximum dive angle currently certified from flight test results for tactical employment of a particular store or configuration. The maximum dive angle may in some cases be lower than those shown in delivery envelopes or ballistic tables contained in the weapons delivery manual, since these do not take into consideration flight certification results. Maximum dive angles listed opposite dispensers, such as the SUU-25, are dive angles for employment of the submunition loaded within the dispensers.

Aircraft/Bomb Collision.

When making single or ripple bomb releases, care must be taken to avoid pushover at release. Since the normal acceleration is less than 1g when in a dive, any further reduction by pushover can cause aircraft/bomb collision. Various weapons have minimum g restrictions even for ejected releases.

Refer to the External Stores Limitations, Figure 5-9.1, for release g limitations.

Total Drag Index.

The drag index of stores and racks and gross weight of each are presented in TO 1A-10C-1-1, Figure A1-1.

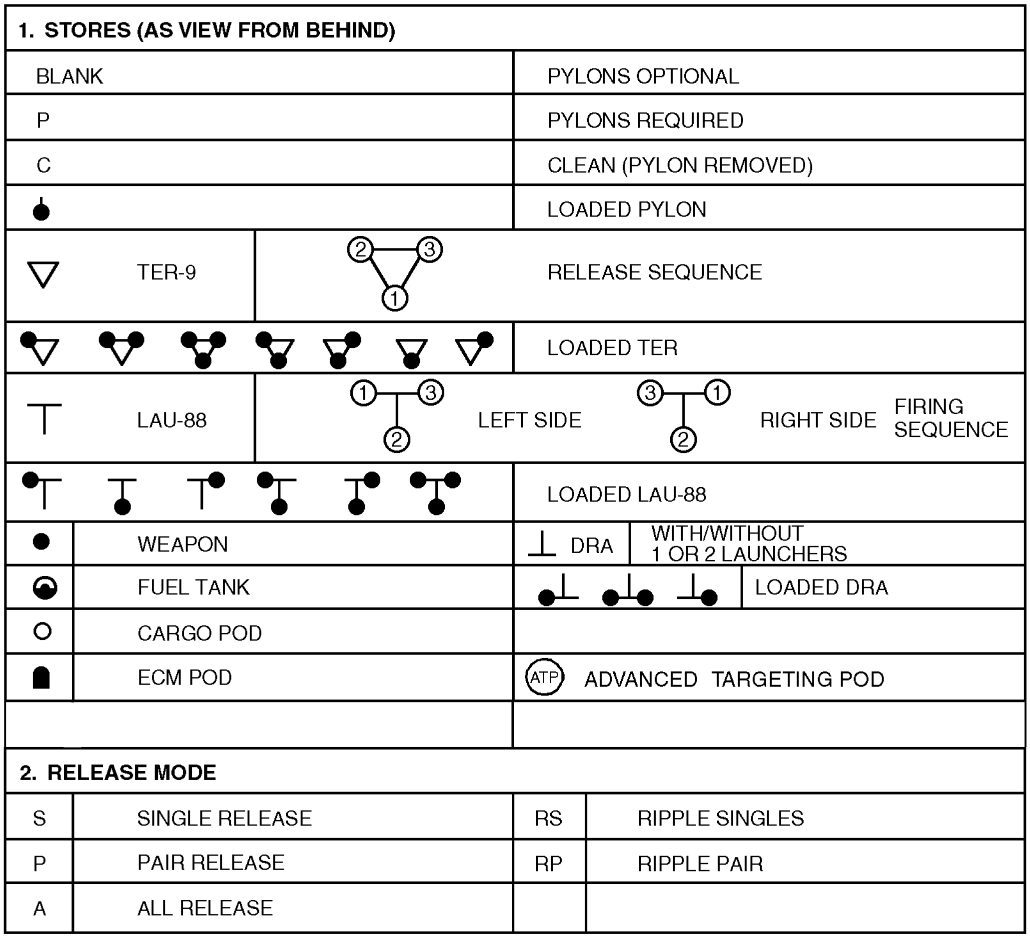

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Figure 5-8. Symbols Used in Stores Limitations Charts

Pages 5-22 - 5-24 deleted.

Figure 5-9.1. Index to External Stores Limitations Charts

Basic Generic Store Types	Authorized Nomenclature Series	Chart
AGM-65 Maverick Missile	AGM-65A, B, D, E, G, G2, H, K; TGM-65A, B, D, E, G, G2, H; and CATM-65K	12
AIM-9 Sidewinder Missile	AIM-9M; CATM-9M	11
Instrumentation Pod (AIS)	AN/ASQ, AN/ASQ-T50(V)1, -52B(V)-2 (GPS-ARDS), -T35A (P4NS) (NACTS) GRDCS II, -T38C (P4R1) (P4R1)	11
Instrumentation Pod (GPS)	AN/ASQ-T50(V)2 (TCTS)	11
CMS Dispenser	RR-170A/AL, RR-180A/AL, RR-188/AL Chaff Cartridges; MJU-7/B, MJU-47/B, MJU-50/B, MJU-64/B, M-206 and M-211 Flare Cartridges	
ECM Pods (Group 1)	AN/ALQ-184(V)-12	20
ECM Pods (Group 2)	AN/ALQ-131(V)-14, AN/ALQ-184(V)-11	20
GBU-10	GBU-10C/B, D/B, E/B; BDU-56 with LGB kits	3
GBU-12	GBU-12B/B, C/B, D/B, (BDU-50/B, A/B, W/LGB Kits)	4
GBU-31	GBU-31(V)1/B, B(V)1/B, C(V)1/B (DSU-33 with Block 8 OFP)	5
GBU-38	GBU-38/(V)1/B, (V)4/B, B(V)1/B, B(V)4/B, C(V)1/B, C(V)4/B, DSU-33A/B, B/B, D/B	6
GBU-51	GBU-51/B (GBU-12 with BLU-126 Warhead)	4
LAU-131 Rocket Launcher	LAU-131/A; Motors 2.75 MK40 (FFAR), MK66 (WAFAR); Warheads MK1(HE), MK5(HEAT), M151(PMI), M156(WP), M61(TP), WTU-1/B(TP), M274 (Smoke), M257 (Flare), M278 (IR Illumination), WDU-4A/A and WDU-13/A (Flechette)	9
Triple Ejector Rack (TER)	TER-9/A, MOD TER-9/A (High Speed)	
MK-82 LDGP	WARHEADS MK-82 LIVE, MK-82 INERT, BDU-50/B, A/B; TAIL KIT MAU-93/B, BSU-33B/B; FUZES M904, M905, FMU-139A/B, FMU-152/B, A/B, DSU-33A/B, B/B, D/B	1
MK-82 AIR	WARHEAD MK-82 LIVE, MK-82 INERT, BDU-50/B, A/B, TAIL KIT BSU-49/B, FUZES M904, FMU-139A/B, FMU-152/B, A/B, DSU-33A/B, B/B, D/B	1
MK-84 LDGP	WARHEAD MK-84 LIVE, MK-84 INERT, BDU-56/B, TAIL KIT BSU-50/B, FUZES M904, M905, FMU-139A/B, FMU-152/B, A/B, DSU-33A/B, B/B, D/B	2
Cargo Pod	MXU-648A/A, C/A Sargent Fletcher MXU	22
Special Munitions	M129E2 Leaflet Bomb	25

Figure 5-9.1. Index to External Stores Limitations Charts - Continued

Basic Generic Store Types	Authorized Nomenclature Series	Chart
BDU-33	BDU-33B/B, D/B	13
SUU-25 Flare Dispenser	SUU-25 C/A, SUU-25E/A; Flares LUU-2/B, LUU-2A/B, LUU-2C/B; LUU-1/B Target Markers; LUU-19/B IR Flares SUU-25F/A; Flares LUU-2/B, LUU-2A/B, LUU-2B/B; LUU-19/B IR Flare	10
CBU-87	CBU-87/B, A/B, B/B, C/B Combined Effects Munitions (CEM), Tactical Munitions Dispenser (TMD)	7
CBU-89 (Gator)	CBU-89/B, A/B Cluster Bomb (Gator), Tactical Munitions Dispenser (TMD)	7
CBU-97	CBU-97/B, A/B, B/B Sensor Fuzed Weapon (SFW), Tactical Munitions Dispenser (TMD)	7
CBU-103/CBU-104	CBU-103A/B and B/B Cluster Bomb Combined Effects Munition. Wind Corrected Munitions Dispenser	8
600 gallon Tank	Royal Industries or Sargent Fletcher	14
Combat Loads with Centerline Tanks	Royal Industries or Sargent Fletcher	15, 17, 18
Advanced Targeting Pod	AN/AAQ-28 LITENING ATP, AN/AAQ-28A(V)3 (Config 2) LITENING ATP with VDL, AN/AAQ-28A(V)3 Block I LITENING AT Plug & Play II; AN/AAQ-28A(V)3 Block I LITENING PnP II with CMDL Targeting Pod, AN/AAQ-33(V) Sniper with CMDL Targeting Pod, AN/AAQ-33(V)1 Sniper ATP, AN/AAQ-33(V)2 Sniper ATP with VDL	24

GENERAL NOTES RELATING TO EXTERNAL STORE LIMITATION CHARTS

A. Any authorized ECM pod or DRA/AIM-9 configuration may be substituted for a store on Aircraft Station(s) 1 and/or 11 for any pure load or mixed configuration. If no store is portrayed on Aircraft Stations 1 and 11, then any authorized ECM pod or DRA/AIM-9 configuration may be added to one or both stations.

B. Flight limitations are generated for mixed store configurations by using the most restrictive flight limitations of the store types being carried. If the most restrictive store type is released or jettisoned, then the restrictions associated with the next most critical store will be the limits. If stores are being carried singly and multiply on the same configuration, the multiple store limitations will always be the most restrictive and shall limit until all the stores being carried multiply are released or jettisoned.

C. Recommended emergency jettison airspeed is 250 KIAS or less.

D. Pylons which are not being utilized to carry stores may be removed. Caution should be exercised to ensure that all store configurations are obtained by following the authorized mixed and like store configuration rules. However, symmetry should be maintained when possible. The only restriction is that the total number of pylons outboard of the gear pod on one side of the aircraft must be within one of the total number outboard of the gear pod on the other side of the aircraft.

E. Basic Generic Store Type is used in the STORE TYPE column of the External Stores Limitations Charts. Consult the Authorized Nomenclature Series column in for specific store versions/variants authorized for flight.

F. The PAVE PENNY pod and/or pylon are optional for carriage with all configurations in this section, unless specified otherwise.

G. The configurations displayed in this section are authorized for carriage with all approved chaff/flare payloads, unless specified otherwise.

Figure 5-9.1. Index to External Stores Limitations Charts - Continued

H. Wind Corrected Munition Dispenser and Joint Direct Attack Munition variants are not authorized on station 6 as it is not MIL-STD-1760 compatible. All other stores displayed on stations 5 and 7 are authorized on station 6 with no change in limits, only if stations 5 and 7 are empty or clean.

I. Minor flap damage can be expected from 2.75 rockets when fired from launchers mounted on parent pylons. Damage can be avoided by mounting launchers on station 1 (bottom) of TER-9. MK-40 motors cause more damage than MK-66 motors.

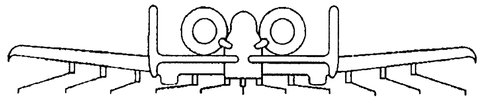
SPECIFIC NOTES REFERENCED FROM EXTERNAL STORE LIMITATION CHARTS

1. The TAIL or N/T fuzing selection in the weapon profile should be used when employing high drag bombs for this configuration. Minimum weapon release interval may effect actual release spacing. Refer to TO 1A-10C-34-1-1.
2. Launching Maverick missiles from the inboard rail of a LAU-88A/A should be avoided to minimize paint and rain erosion coating deterioration.

CAUTION

If operationally feasible, avoid a firm landing (with greater than 450 FPM sink rate) while carrying a loaded LAU-88A/A. If firm landing is encountered, indicated by UDU code HDL6, write-up in AFTO 781 and notify maintenance due to possible damage to LAU-88A/A shear pin(s).

3. LAU-131 rocket pods, Advanced Targeting Pods, and SUU-25 flare dispensers may be carried in mixed loads on stations 2 and 10.
4. Do not load LAU-88 with live AGM-65s next to a targeting pod.



STORE	LINE NO	STATION LOADING 1	2	3	4	5	6	7	8	9	10	11	CARRIAGE MAX KIAS TMN	MAX ACCEL (g) SYM	MAX ACCEL (g) ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	EMPLOYMENT MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	SELECTIVE JETTISON STORE KIAS	STORE ACCEL (g)	RACK WITH OR WITHOUT EXT STORES KIAS	RACK WITH OR WITHOUT EXT STORES ACCEL (g)
MK-82 LDGP MK-82 AIR BDU-50	1	●	●	●	●	●		●	●	●	●	●	450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL	420	+3.0 +0.5 Low Drag	0 -60 Low Drag	S P RS RP Low Drag 70 min	420	+3.0 +0.5 Low Drag	N/A	N/A
	2			▽	▽				▽	▽				+5.0 -2.0	+4.0 -1.0	FULL (1/2)		+3.0 +0.8 High Drag	0 -35 High Drag	High Drag See RMKS		+3.0 +0.8 High Drag	250	1.0 Level Flight

REMARKS:

1. See Note 1 for High Drag Ripple Release.

Figure 5-10. External Stores Limitations (Sheet 1 of 28)

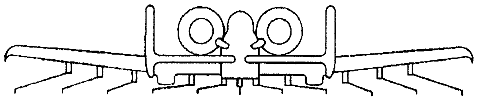
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)							STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	ACCEL (g)	KIAS	ACCEL (g)
MK-84 LDGP BDU-56	1			●	●				●	●			450 0.75M	+7.3 -3.0	+5.8 -1.0	3/4 (1/2)	420	+3.0 +0.5	0 -60	S P RS RP	420	+3.0 +0.5	N/A	N/A
	2					●		●								FULL				70 MIN				
	REMARKS:																							

Figure 5-10. External Stores Limitations (Sheet 2)

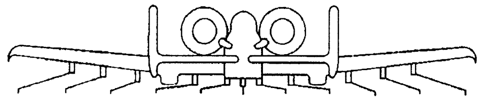
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)							STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
GBU-10 BDU-56	1					●		●					450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL (1/2)	420	+1.5 +0.5	0 -60	S P RS RP 70 MIN	420	+1.5 +0.5	N/A	N/A
	2			●		●		●		●						3/4 (1/2)								
	3			●	●	●		●	●	●							390				390			
	REMARKS:																							

Figure 5-10. External Stores Limitations (Sheet 3)

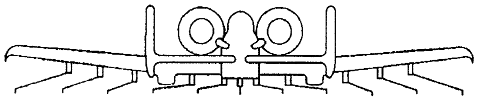
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
STORE	LINE NO	 1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	MAX ACCEL (g) SYM	MAX ACCEL (g) ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	STORE KIAS	STORE ACCEL (g)	RACK WITH OR WITHOUT EXT STORES KIAS	RACK WITH OR WITHOUT EXT STORES ACCEL (g)
GBU-12 GBU-51 BDU-50	1	●	●	●	●				●	●	●	●	450 0.75M	+7.3 -3.0	+5.8 -1.0	3/4 (1/2)	420	+1.5 +0.5	0.0 -60	S P RS RP 70 MIN	420	+1.5 +0.5	N/A	N/A
	2					●		●								FULL								
	3			▽	▽				▽	▽				+5.0 -2.0	+4.0 -1.0	3/4 (1/2)				120 min for RS 250 min for RP			250	+1.0 Level Flight
	REMARKS:																							

Figure 5-10. External Stores Limitations (Sheet 4)

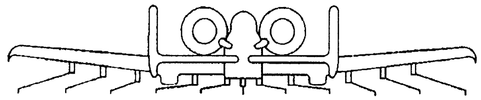
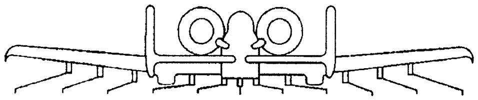
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)							STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	ACCEL (g)	KIAS	ACCEL (g)
GBU-31	1			●	●				●	●			450 0.75M	+6.0 -2.0	+4.8 -1.0	3/4 (1/2)	450 0.75M	+3.0 +0.5	+5 -60	S P RS RP (250 Min)	450	+3.0 +0.5	N/A	N/A
	2					●		●								FULL (1/2)								
	REMARKS: 1. The GBU-31 cannot be employed from station 6.																							

Figure 5-10. External Stores Limitations (Sheet 5)



		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)					STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
GBU-38	1			●	●	●		●	●	●			450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL	450 0.75M	+3.0 +0.5	+5 -60	S P RS RP (250 Min)	450	+3.0 +0.5	N/A	N/A
	REMARKS: 1. The GBU-38 cannot be employed from station 6.																							

Figure 5-10. External Stores Limitations (Sheet 6)

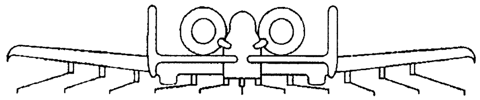
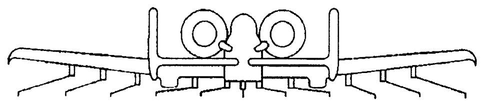
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
STORE	LINE NO												MAX KIAS TMN	MAX ACCEL (g) SYM	MAX ACCEL (g) ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	STORE KIAS	STORE ACCEL (g)	RACK WITH OR WITHOUT EXT STORES KIAS	RACK WITH OR WITHOUT EXT STORES ACCEL (g)
		1	2	3	4	5	6	7	8	9	10	11												
CBU-87 CBU-97	1			●	●	●		●	●	●			450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL (3/4)	420	+3.0 +0.6	0 -60	S P RS RP 70 min	420	+3.0 +0.5	N/A	N/A
	2	●	●								●	●		+5.0 -2.0	+4.0 -1.0	3/4 (1/4)								
CBU-89	3			●	●	●		●	●	●				+7.3 -3.0	+5.8 -1.0	FULL								
	4	●	●								●	●		+6.0 -2.0	+4.8 -1.0	FULL 3/4								
	REMARKS:																							

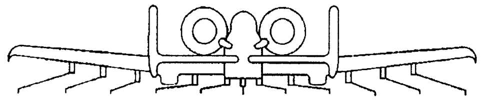
Figure 5-10. External Stores Limitations (Sheet 7)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)					STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
CBU-103	1			●	●	●		●	●	●			450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL (3/4)	450 0.75M	+3.0 +0.5	+5 -60	S P RS RP (250 min)	450	+3.0 +0.5	N/A	N/A
CBU-104	2			●	●	●		●	●	●						FULL								

REMARKS:

1. The CBU-103 and CBU-104 cannot be employed on station 6.

Figure 5-10. External Stores Limitations (Sheet 8)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)			DEL IV ANGLE (deg)	REL MODES	STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	+climb -dive	intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
LAU-131	1		●	●	●				●	●	●		450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL	420	+4.0 +0.5	+60 -60	S P RS RP 220 MIN	325	+1.0 Level Flight	N/A	N/A
	2			▽	▽				▽	▽				+5.0 -2.0	+4.0 -1.0								250	+1.0 Level Flight

REMARKS:

1. Carriage of LAU-131 launchers with nose fairings is authorized for ferry purposes only.
2. Rockets are not to be loaded into launchers with nose fairings fitted.
3. Launcher umbilical cables are not to be fitted to LAU-131 launchers with nose fairings.
4. Employment of launchers fitted with nose fairings is not authorized.

Figure 5-10. External Stores Limitations (Sheet 9)

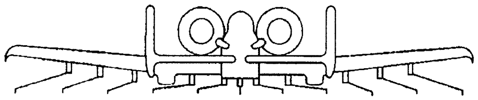
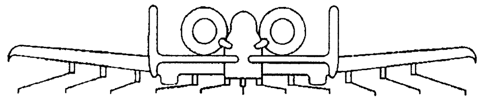
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)							STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	ACCEL (g)	KIAS	ACCEL (g)
SUU-25	1		●	●						●	●		450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL	420	+1.1 +0.9	0.0 -10	S P 150 min	325	+1.0 Level Flight	N/A	N/A
	2			▽						▽				+5.0 -2.0	+4.0 -1.0	FULL (1/2)					250		250	+1.0 Level Flight
	REMARKS:																							

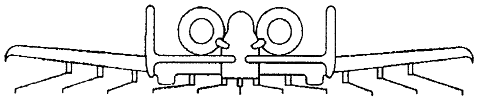
Figure 5-10. External Stores Limitations (Sheet 10)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)		MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN				KIAS	ACCEL (g)	KIAS	ACCEL (g)
AIM-9 CATM-9 AIS or GPS Pod	1	•|•										•|•	450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL	450 0.75M	+7.3 -3.0	AC Limits	N/A	N/A	N/A	N/A	N/A

REMARKS:

1. AIS Pod or CATM-9 will not be loaded on DRA with live AIM-9.
2. AIS or GPS Pod may be loaded on DRA with CATM-9.
3. DRAs in all authorized configurations are non-jettisonable.

Figure 5-10. External Stores Limitations (Sheet 11)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
STORE	LINE NO	 1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	MAX ACCEL (g) SYM	MAX ACCEL (g) ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DEL IV ANGLE (deg) +climb -dive	REL MODES intevl msec	MISSILE KIAS	MISSILE ACCEL (g)	RACK WITH OR WITHOUT EXT STORES KIAS	RACK WITH OR WITHOUT EXT STORES ACCEL (g)
AGM-65 TGM-65 on LAU-88	1												450 0.75M	+5.0 -2.0	+4.0 -1.0	FULL (3/4)	420	+3.0 +0.5	0.0 -60.0	S P	420	+3.0 +0.5	250	+1.0 Level Flight
AGM-65 TGM-65 or CATM-65 on LAU-117	2													+7.3 -3.0	+5.8 -1.0									

CAUTION

If operationally feasible, avoid a firm landing (with greater than 450 FPM sink rate) while carrying a loaded LAU-88A/A. If firm landing is encountered, indicated by UDU code HLD6, write-up in AFTO 781 and notify maintenance due to possible damage to LAU-88A/A shear pin(s).

REMARKS:

1. LAU-88 selective jettison of a missile is accomplished by launching an unarmed unguided missile.
2. Live or training missiles will not be combined on a single LAU-88A/A.
3. Up to three missiles, live or training, may be loaded on a LAU-88A/A.
4. The AGM/TGM/CATM-65E, G, G2 or K is not authorized for use on the LAU-88A/A launcher.
5. Do not load LAU-88 with live AGM-65s next to a targeting pod.

Figure 5-10. External Stores Limitations (Sheet 12)

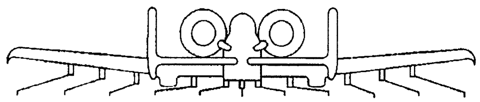
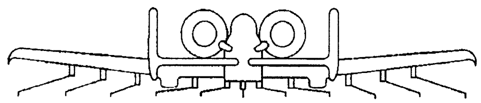
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)							STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
BDU-33 on TER-9	1												450 0.75M	+7.3 -2.0	+5.8 -1.0	FULL	420	+3.0 +0.5	0 -60	S P RS RP 70 min	420	+3.0 +0.5	250	+1.0 Level Flight
	REMARKS:																							

Figure 5-10.   External Stores Limitations (Sheet 13)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
	LINE NO													MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)					STORE		RACK WITH OR WITHOUT EXT STORES	
STORE		1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
600 Gallon Fuel Tank(s) Only	1						◒						275	+2.5 -1.9	+2.0 0.0	1/4	N/A	N/A	N/A	N/A	275	+1.0 Level Flight	N/A	N/A
	2				◒				◒															
	3				◒		◒		◒				250								250			

REMARKS:

1. Maximum KIAS with 600 gallon tanks are:

   (1) or (2) tanks - 275 KIAS/(3) tanks - 250 KIAS: sea level to 15,000 feet

   (1) or (2) tanks - 265 KIAS/(3) tanks - 240 KIAS: 15,000 to 20,000 feet

   (1) or (2) tanks - 240 KIAS/(3) tanks - 215 KIAS: 20,000 to 25,000 feet

   (1) or (2) tanks - 195 KIAS/(3) tanks - 170 KIAS: 25,000 to 35,000 feet

   (1) or (2) tanks - 180 KIAS/(3) tanks - 155 KIAS: 35,000 to 40,000 feet

2. Aerial refueling is authorized.
3. Mixed load rules do not apply to these configurations. No other stores are authorized.
4. Aft center of gravity limited to 29.6% MAC (landing gear raised).

WARNING

- The most aft cg condition does not occur with full or empty tanks, but with partially filled external tanks. This condition results in increased sensitivity in pitch control and decreased lateral directional control at low speeds.
- Do not takeoff with partially filled external tanks.
- Extension of the landing gear will aggravate the aft cg condition. Extreme caution should be used if landing is required with any partially filled external fuel tanks.
- Mixed loads of different model external fuel tanks are not authorized.

Figure 5-10. External Stores Limitations (Sheet 14)

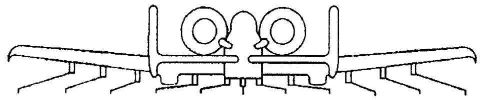
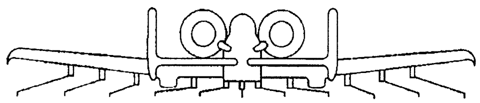
STORE	LINE NO	STATION LOADING  1	2	3	4	5	6	7	8	9	10	11	CARRIAGE MAX KIAS TMN	MAX ACCEL (g) SYM	MAX ACCEL (g) ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	EMPLOYMENT MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	SELECTIVE JETTISON STORE KIAS	STORE AC-CEL (g)	RACK WITH OR WITHOUT EXT STORES KIAS	RACK WITH OR WITHOUT EXT STORES AC-CEL (g)
Sargent Fletcher 600 gallon External Fuel Tank	1												375 0.58M	+3.75 to -2.0	+2.75 to 0.0	3/4 (1/2)	N/A	N/A	N/A	N/A	275	Level +1.0	N/A	N/A
Royal Industries 600 gallon External Fuel Tank	2												275 0.58M	+2.5 to -1.9	+2.0 to -0.0	1/4								
Sargent Fletcher Or Royal Industries 600 gallon External Fuel Tank	3																							

Figure 5-10. External Stores Limitations (Sheet 15)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)							STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)

REMARKS:

1. Mirror image is authorized.
2. All downloads are authorized as long as Remark 5 is satisfied.
3. Mixed and like store rulings" do not apply to these configurations with the following exceptions:
   a. Lines 1, 2, and 3: MXU-648 and Targeting Pods can be substituted for LAU-117 on stations 3 and/or 9.
   b. Lines 1 and 2: Carriage of MXU-648 on Parent Pylon is authorized on stations 4 and/or 8.
4. Reduced lateral asymmetry limits apply. See Section 5, Asymmetric Load Moment Limitations for lateral moment arm data.
   a. Lines 1 and 2 - Lateral asymmetry can not exceed 20,376 ft-lbs.
   b. Line 3 - Lateral asymmetry can not exceed 13,584 ft-lbs.
5. Aircraft center of gravity must not move aft of:
   a. Line 1 - 29.6% MAC
   b. Lines 2 and 3 – 31% MAC
6. Do not take off with partially filled external fuel tanks.
7. See Figure 5-2 for crosswind limits with external fuel tank(s).
8. Refer to Section VI, Flight with Centerline Sargent Fletcher Fuel Tank Configurations.
9. Rudder pedal inputs limited to 3/4 input during sideslip maneuvers at airspeeds less than 240 KIAS.
10. DRA, ECM Pods, Targeting Pods, MXU-648, and TER-9 with MXU-648 are non-jettisonable.

CAUTION

Table 1 - Carriage KIAS Limits

Alt.	Line 1	Line 2 & 3
<1.5k	375	275
5k	350	
10k	320	
15k	290	
20k	265	265
25k	240	240
30k	215	215
35k	190	195
40k	170	180

Figure 5-10. External Stores Limitations (Sheet 16)

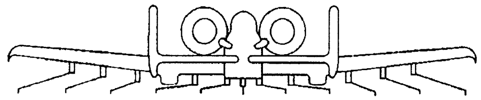
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)					STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
	11. Line 3: Selective jettison of LAU-117 is not authorized with adjacent fuel tank present. See Section V for applicable jettison limits after the adjacent fuel tank is jettisoned. 12. Rocket Pods must be empty. 13. To ensure correct external fuel quantity indications, ECM Pods, ATPs with Video Down Link, and AIS pods are not to be used in modes that enable RF transmissions from the Pods.																							

Figure 5-10. External Stores Limitations (Sheet 17)

Pages 5-42 - 5-43 deleted.

STORE	LINE NO	STATION LOADING 1	2	3	4	5	6	7	8	9	10	11	CARRIAGE MAX KIAS TMN	MAX ACCEL (g) SYM	MAX ACCEL (g) ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	EMPLOYMENT MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	SELECTIVE JETTISON STORE KIAS	STORE ACCEL (g)	RACK WITH OR WITHOUT EXT STORES KIAS	RACK ACCEL (g)
Centerline Sargent Fletcher 600 gallon External Fuel Tank Part No. 32-600-48270	1												375 0.58M	2400 lb or more external fuel			N/A	N/A	N/A	N/A	600 Gallon Fuel Tank			
	2													+3.75 to -2.0	+2.75 to 0.0	3/4 (1/2)					275	Level +1.0	N/A	N/A
														less than 2400 lb external fuel										
														+5.0 to -2.0	+4.0 to -1.0	Full (1/2)								
														zero external fuel										
														+5.0 to -2.0	+4.0 to -1.0	Full (3/4)								

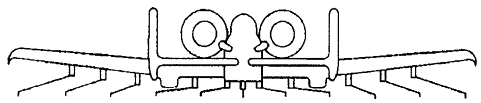
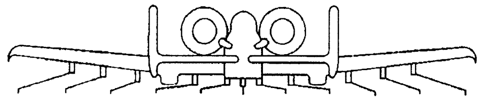


Figure 5-10. External Stores Limitations (Sheet 20)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)							STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL	MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	ACCEL (g)	KIAS	ACCEL (g)

REMARKS:

1. Aft center of gravity limited to 29.6% MAC (landing gear raised).

2. Carriage Speed is limited to the appropriate KIAS or 0.58 Mach, whichever is less. Above 1,500 ft. MISL, 0.58 Mach becomes the more restrictive of the two limits. Table 1 at right provides KIAS limits at given altitudes above 1,500 ft. MSL. Aircrew should interpolate between these figures to determine KIAS limits for intermediate altitudes. If more detailed limits are required, consult a Mach Altitude chart. Refer to TO 1A-10C-1-1, Figure A1-5.

3. Loaded Rolls are limited to 180 degrees bank angle change. Perform 360 degree rolls only with SAS On.

4. See Figure 5-2 for crosswind limits with external fuel tank(s).

5. Rudder pedal inputs limited to 3/4 input during side-slip maneuvers at airspeeds less than 240 KIAS.

6. Inertial cross coupling may occur during high roll rate maneuvers. There is a tendency for the g load to increase by up to 0.5 with large/rapid roll inputs.

7. Directional stability will be reduced by the Pave Penny pod and external fuel tank.

8. Aircraft may experience speed instability at high speeds.

9. Mixed and like store rulings are not applicable to these configurations. Partial Downloads of the above configurations are authorized.

10. Unlike stores are not authorized on stations 2 and 10 or 4 and 8.

11. Do not take off with partially filled fuel tank.

12. Employment/Jettison of stores from stations 4 to 8 is NOT AUTHORIZED with 600 gallon tank present.

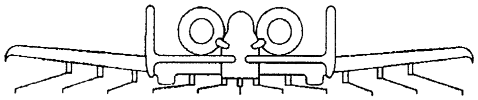
13. Employment and Selective Jettison limits applies to 600 gallon external tank. For applicable Employment Selective Jettison limits for mixed store loads, see Figure 5-9.1, Note B.

CAUTION

Table 1 - KIAS LIMITS

Alt.	KIAS
<1.5k	375
5k	350
10k	320
15k	290
20k	265
25k	240
30k	215
40k	170

Figure 5-10. External Stores Limitations (Sheet 21)

STORE	LINE NO	STATION LOADING											CARRIAGE MAX KIAS TMN	CARRIAGE MAX ACCEL (g) SYM	CARRIAGE MAX ACCEL (g) ROLL	CARRIAGE MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)	EMPLOYMENT MAX KIAS TMN	EMPLOYMENT MAX ACCEL SYM (g)	EMPLOYMENT DEL IV ANGLE (deg) +climb -dive	EMPLOYMENT REL MODES intevl msec	SELECTIVE JETTISON STORE KIAS	SELECTIVE JETTISON STORE ACCEL (g)	SELECTIVE JETTISON RACK WITH OR WITHOUT EXT STORES KIAS	SELECTIVE JETTISON RACK WITH OR WITHOUT EXT STORES ACCEL (g)
																								
		1	2	3	4	5	6	7	8	9	10	11												
	14. Refer to Section VI, Flight with Centerline Sargent Fletcher Fuel Tank Configurations.																							

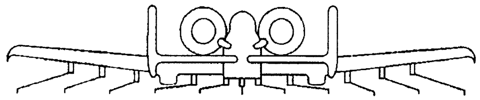
WARNING

External fuel tanks do not contain explosive suppression material. In the event of an incendiary impact, there is a high likelihood of tank explosion and possible loss of aircraft.

CAUTION

Care needs to be exercised during dives for weapons deliveries from medium and high altitudes to avoid exceeding 0.58M limit. Early use of power reduction, speed brakes, and/or decrease of dive angle is required.

Figure 5-10. External Stores Limitations (Sheet 22)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)					STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
ECM Pods (Grp 1)	1	■										■	450 0.75M	+7.3 -3.0	+5.8 -1.0	FULL (3/4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ECM Pods (Grp 2)	2	■										■		+5.0 -2.0	+4.0 -1.0									

REMARKS:

1. ECM pods are not jettisonable.
2. No actively RF-emitting pods (AN/AAQ-33(V)2, Sniper with VDL and AN/AAQ-28A(V)3 Config 2 LITENING with VDL) may be carried immediately next to the AN/ALQ-184(V)-11 or -12 ECM pods. AN/AAQ-33(V)1, Sniper ATP (without VDL) and AN/AAQ-28 LITENING II, ER, and AT (all without VDL) can be carried adjacent to the AN/ALQ-184.
3. No telemetry should be used while carrying CBU-87(D-4)/B, CBU-103(D-4)/B or CBU-104(D-4)/B munitions.

Figure 5-10. External Stores Limitations (Sheet 23)

[redacted]

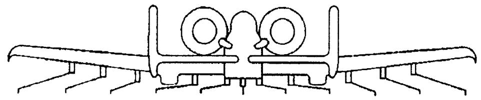
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)		MAX ACCEL	DELIV ANGLE (deg)	REL MODES	STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	SYM (g)	+climb -dive	intevl msec	KIAS	ACCEL (g)	KIAS	ACCEL (g)
Deleted																								
	REMARKS:																							

Figure 5-10. External Stores Limitations (Sheet 24)

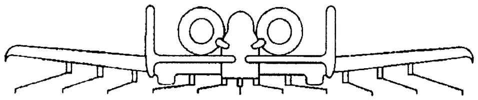
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)		MAX ACCEL SYM (g)	DEL IV ANGLE (deg) +climb -dive	REL MODES intevl msec	STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN				KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
MXU-648 Cargo Pod, Sargent Fletcher MXU	1			○	○	○		○	○	○			450 0.75M	+5.0 -1.0	+3.0 0.0	FULL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MXU-648 Cargo Pod on TER-9A Chin Station	2			▽	▽				▽	▽														
	3					▽		▽					250											
	REMARKS: 1. The MXU-648 is not jettisonable. 2. The MXU-648 C/A Cargo Pod is limited to +4.0/0.0 Rolling Acceleration.																							

Figure 5-10. External Stores Limitations (Sheet 25)

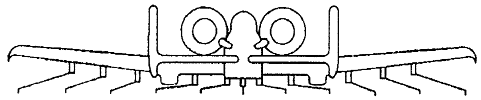
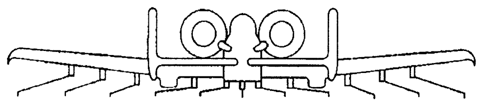
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)					STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
Deleted																								
	REMARKS:																							

Figure 5-10. External Stores Limitations (Sheet 26)

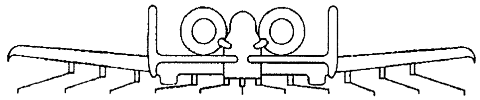
		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)					STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN	MAX ACCEL SYM (g)	DEL IV ANGLE (deg) +climb -dive	REL MODES intevl msec	KIAS	AC-CEL (g)	KIAS	AC-CEL (g)
Sniper ATP	1		ATP								ATP		450 0.75M	+6.0 -2.0	+5.0 -1.0	FULL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LITEN-ING ATP	2		ATP								ATP					FULL (3/4)								

Remarks

1. Targeting Pods are non-jettisonable.

2. Do not load LAU-88 with live AGM-65s next to targeting pod.

Figure 5-10. External Stores Limitations (Sheet 27)

		STATION LOADING											CARRIAGE				EMPLOYMENT				SELECTIVE JETTISON			
														MAX ACCEL (g)		MAX ROLL RATE STICK THROW (W/ SPEED BRAKES DFLCT)		MAX ACCEL SYM (g)	DELIV ANGLE (deg) +climb -dive	REL MODES intevl msec	STORE		RACK WITH OR WITHOUT EXT STORES	
STORE	LINE NO	1	2	3	4	5	6	7	8	9	10	11	MAX KIAS TMN	SYM	ROLL		MAX KIAS TMN				KIAS	ACCEL (g)	KIAS	ACCEL (g)
M129 Leaflet Bomb	1		●	●	●	●		●	●	●	●		450 0.75M	+3.0 -1.0	+2.4 0.0	1/3 (1/4)	400	+3.0 +0.8	0 -30	S P RS	400	+3.0 -0.8	N/A	N/A

Remarks

1. Configure the MAU-40 and MAU-50 with an ARD-446/ARD863 cartridge combination. Install a -10 (0.063 inch) FWD and a -10 (0.063 inch) AFT orifice combination unless noted otherwise.

Figure 5-10. External Stores Limitations (Sheet 28)

Figure 5-11. Load Configuration

STORE	PYLON STATION										
	1	2	3	4	5	6	7	8	9	10	11
600 gallon Fuel Tank				1		1		1			
AGM-65, TGM-65 on LAU-88			3						3		
AGM-65, TGM-65 on LAU-117			1						1		
AIM-9, CATM-9, AIS or GPS Pod	2										2
BDU-33 on TER-9			3	3	3	*	3	3	3		
Deleted											
CBU-87, CBU-97	1	1	1	1	1	*	1	1	1	1	1
CBU-89	1	1	1	1	1	*	1	1	1	1	1
CBU-103			1	1	1	*	1	1	1		
CBU-104			1	1	1	*	1	1	1		
Deleted											
ECM Pods (Grp 1) and (Grp 2)	1										1
GBU-10, BDU-56			1	1	1	*	1	1	1		
GBU-12, GBU-51, BDU-50	1	1	3	3	1	*	1	3	3	1	1
GBU-31			1	1	1	*	1	1	1		
GBU-38			1	1	1	*	1	1	1		
Deleted											
LAU-131		1	3	3				3	3	1	
LITENING ATP		1								1	
M129 Leaflet Bomb		1	1	1	1	*	1	1	1	1	
MK-82 LDGP, MK-82 AIR, BDU-50	1	1	3	3	1	*	1	3	3	1	1
MK-84 LDGP, BDU-56			1	1	1	*	1	1	1		
MXU-648 or Sargent Fletcher MXU Cargo Pod			1	1	1	*	1	1	1		
MXU-648 or Sargent Fletcher MXU Cargo Pod on TER-9A Chin Station			1	1	1	*	1	1	1		
TER-9 Triple Ejector Rack			1	1	1	*	1	1	1		
Sniper ATP		1								1	
SUU-25 Flare Dispenser		1	3						3	1	
* STORES LOADED ON STATIONS 5 AND 7 ARE AUTHORIZED ON STATION 6, PROVIDED STATIONS 5 AND 7 ARE NOT LOADED.											

Pages 5-50 - 5-52 deleted.

SECTION VI

FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

GENERAL FLIGHT CHARACTERISTICS.

Satisfactory levels of stability and control exist throughout the airspeed and altitude flight envelope of the A-10C. Stability is further improved by the use of Stability Augmentation System (SAS) in the pitch and yaw axis.

FLIGHT CONTROL EFFECTIVENESS.

Either hydraulic system is capable of providing sufficient power for control at any speed or altitude within the flight envelope with one or both engines running.

Roll Control.

The ailerons provide satisfactory roll control throughout the flight envelope. Roll response increases with increasing speed brake settings up to approximately 20%, is relatively flat between 20% and 40%, then begins to fall off again until roll response at 80% again equals response at 0% deflection. Roll rates up to 130° per second can be expected with 0% speed brakes at 300 KIAS, and up to 200° per second with 40% speed brakes at 300 KIAS. Roll control and forces are the same with one or both hydraulic systems operating. SAS provides turn coordination as long as the yaw SAS is engaged.

Pitch Control.

The aircraft is free of any unusual pitch change tendencies and has effective pitch control throughout the flight envelope. Pitch control and forces are the same with one or both hydraulic systems operating.

The A-10C is resistant to Pilot Induced Oscillations (PIO) (SAS-ON) throughout the flight envelope. With three fuel tanks (SAS-OFF) and aft cg, the A-10C has a definite susceptibility to PIO at higher Mach numbers. The most positive method to stop PIO is to release the stick if flight conditions permit. If flight conditions do not permit releasing the stick, then holding the stick aft or center will stop the PIO.

Yaw Control.

The rudder becomes effective at approximately 50 KIAS. Rudder inputs produce yaw with little rolling motion. Yaw SAS provides yaw damping, rudder trim, and turn coordination. Rudder authority is 25° below 240 KIAS but is reduced to 8° by a Q-switch above 240 KIAS. Although the A-10 is not a centerline thrust aircraft, the relatively close proximity of the engines to the centerline of the aircraft allows adequate directional control under asymmetric thrust conditions by use of moderate rudder deflection.

SAS reduces sideslip rate through automatic application of rudder. With a hydraulic supply failure or engine-out condition, the corresponding rudder will revert to manual control. This causes higher rudder forces, but will not reduce the authority of the powered side. The manually powered rudder will trail the powered rudder by as much as 10°. Total rudder available is still sufficient to maintain straight, steady heading flight down to stall speed while operating on a single engine (assuming symmetric loading).

SAS rudder transients will occur when the attitude indicator passes through ±90° pitch attitude. These transients are due to the roll attitude flipping 180° on the ADI in the vertical positions. The Heading Attitude Reference System (HARS) or Embedded Gps/Inu (EGI) passes this 180° roll input to the SAS. Rudder transients will also occur when the HARS or EGI supplies a bank angle to the SAS (as indicated by a bank on the ADI) and the SAS gains are changed when passing through 180° or 255 KIAS. Transients will also occur any time the ADI is indicating a bank angle and a HARS or EGI failure occurs, resulting in a zero bank angle input to the SAS. This also occurs when switching from DG to slaved mode, or when the sync button is depressed while operating in HARS. This is indicated by the appearance of both HSI and ADI off flags. When the HARS FAST ERECT button is depressed, the HARS supplies a zero bank angle signal to the SAS and will cause rudder transients if the ADI is indicating a bank. Any time a double failure of HARS and EGI occurs, the yaw SAS will be disconnected. Yaw SAS may be reengaged by switching into override and reengaging the yaw SAS switches. Mild transients will occur if in a steep bank.

WARNING

> When the ADI is indicating a bank, certain HARS or EGI failure modes may cause the SAS to give a full SAS authority rudder input. If any HARS malfunctions occur or are suspected, establish a wings level attitude and disengage yaw SAS. Any EGI malfunction causing loss of attitude validity will automatically transfer attitude and heading inputs to HARS. In the event of a failure where transfer does not occur or a failure of the HARS affecting roll servo validity, the HARS/SAS validity assembly will automatically disengage yaw SAS, possibly producing a rudder response. A HARS or EGI induced rudder hardover during constant altitude, steep back maneuvers is normally recovered in less than 50 feet. In a descending steep bank, additional altitude will be required. After a wings level attitude has been established, yaw SAS may be reengaged, using the HARS/SAS override switch for yaw damping and trim; however, turn coordination will not be provided.

Flaps.

The flaps increase lift, which decreases aircraft stall speed and increases g available at low speeds. Extension of the flaps results in a slight nose down pitch change. The 7° flap position is used for takeoff since it increases lift on the wing but does not introduce a great deal of drag or nose down pitch moment. The 20° flap position is used for landing since it greatly increases lift and drag, which allows slower landing speeds and higher power settings. Takeoff ground runs with flaps at 20° are longer than those with flaps at 7°.

Speed Brakes.

The speed brakes are very effective at creating high drag. They are limited to 80% deflection in flight, but can extend 100% with weight on the main gear. Speed brake deflection will increase the aircraft pitch attitude at a given speed requiring a nose down trim correction. This trim correction is automatically applied when the pitch SAS is engaged.

When the EAC mode is armed, WD-1 is selected, and MASTER armament switch is in ARM, EAC uses some of the SAS servo capability. This reduces the capability of the SAS to provide pitch damping when speed brakes are extended.

LEVEL FLIGHT CHARACTERISTICS.

The A-10C possesses good low-speed stability characteristics and handling qualities, especially at low altitudes. However, neutral or even negative stability will be encountered at high speed and at high altitude. Hence, the A-10C is difficult to trim and keep trimmed. Three external fuel tanks decrease stability, especially at higher speeds and aft cg’s.

NOTE

> Air refueling with three external fuel tanks and SAS ON requires no more than normal pilot workload under most conditions. With SAS OFF, the pilot workload for successful refueling is increased.

MANEUVERING FLIGHT CHARACTERISTICS.

The A-10C is highly maneuverable with excellent instantaneous g available and relatively high roll rate capability throughout its flight envelope. Stick force and stick position per g for a given airspeed are essentially linear throughout the flight envelope. Increasing force and aft stick are required for increased g.

WARNING

Aircraft stability is decreased at altitudes above 15,000 feet.

NOTE

- The carriage of two or three external fuel tanks, full or empty, decreases directional stability. Rolling maneuvers in this configuration may cause large sideslip angles, particularly without the yaw SAS engaged, and are not recommended. During landing with two or three external fuel tanks, a straight-in approach or a wide, conservative traffic pattern is recommended so that large sideslip angles can be avoided.

- Rudder vibration may be experienced during maneuvering at high angles of attack. Sustained vibration should be avoided. If rudder vibration is experienced, relaxation of the g load or disengagement of the SAS will terminate the vibration.

While instantaneous capability is excellent, the relatively low thrust-to-weight ratio of the aircraft adversely affects sustained turn performance. Charts provided in TO 1A-10C-1-1, Figure A6-2 and TO 1A-10C-1-1, Figure A6-3 can be used to determine sustained and instantaneous g available. The limited sustainable g of the aircraft dictates that extreme caution be exercised when sustained high AOA and high bank angle maneuvering is conducted at low altitude. Low altitude flight at bank angles in excess of 90° (inverted or semi-inverted) demands caution due to high turn rate and instantaneous g capability. At normal operational speeds, turn rates in excess of 15° per second can be generated with as little as four radial g's on the aircraft. With the lift vector pointed down, this results in a rapidly developing negative flight path angle. The rate at which this occurs allows little time for inattention to aircraft attitude.

The hazards associated with the high bank, high Angle of Attack (AOA), and high g flight at low altitude are compounded by the lack of visual cues available. The canopy/cockpit design allows subtle flight path and attitude changes to go unnoticed unless attitude and flight path are being monitored in conjunction with a horizon reference.

During low altitude maneuvering, situational awareness must be maintained and the energy state and attitude of the aircraft must not be allowed to deteriorate to a condition where recovery is impossible. The aural peak performance/stall warning system of the aircraft can be used effectively to enhance maneuvering performance and to avoid wing stall.

WARNING

Failure to monitor flight path and aircraft altitude during low altitude maneuvering may result in ground impact.

The Ground Collision Avoidance System (GCAS) function of the Low Altitude Safety and Targeting Enhancement (LASTE) system is designed to assist in maintaining situational awareness. As such, it will attempt to provide a warning when imminent terrain impact is probable. However, system specifications were designed to minimize false warnings. This may cause a warning to be issued too late to effect successful recovery.

WARNING

GCAS is not a maneuvering aid. The system will not provide warning for safe ground clearance under all flight path conditions.

Maximum instantaneous g available occurs just prior to wing stall. Maneuvering at the steady tone provides sufficient performance for most maneuvers and provides some margin for error. When recovering from a GCAS "pull up" warning and/or "break X" in the HUD, maximum performance is required and should include the following steps. Begin an aggressive and immediate roll (including aggressive top rudder) towards an upright wings-level attitude and determine if the aircraft attitude is less than or more than 90 degrees of bank. If less than 90 degrees of bank, aggressively and immediately apply positive stick forces (including aggressive top rudder) in a loaded rolling maneuver towards an upright wings-level attitude using the maximum performance (steady) with occasional stall warning (chopped) tones as a guide. Continue the loaded roll at maximum available g until wings level and then continue a maximum available g pull up until clear of all obstacles. If greater than 90 degrees of bank, use the same aggressive roll technique as above, except delay the g onset until reaching 90 degrees of bank. At that point, continue the recovery using the loaded roll and pull up technique described above.

NOTE

Top rudder is used to reduce the adverse yaw associated with high angles of attack (AOA) rolling maneuvers, and to increase roll rate. While aggressive rudder use is recommended, full rudder forces should be reduced once the aircraft has established a significant roll rate.

In this case, the aircraft should be flown to the chopped tone, periodically (2 to 3 seconds) backing off to the steady tone. Flying between the steady and chopped tones provides performance as close to maximum as possible without going into the stall regime, but should only be used to actually recover from GCAS warning of potential ground collision.

The peak performance/stall warning system is not compensated for rapid AOA rates. Rapid stick motion can produce AOA overshoots into the region where wing stall and engine disturbance can occur. To avoid these conditions, be alert to the approach of the steady, peak performance tone and reduce the pitch rate accordingly. At high pitch rates, the steady and chopped tones will appear to occur simultaneously. At this point, it is necessary to immediately check the maneuver and adjust the g loading accordingly. Maneuver checking may require forward stick movement equal and opposite to that used to produce the initial pitch rate.

WARNING

Engine(s) disturbances during high pitch rate maneuvering, including those resulting from excessive or rapid throttle movements, may result in engine(s) overtemp stall, or stagnation, requiring engine(s) shutdown and restart.

CAUTION

- At high pitch rates, AOA overshoots and subsequent engine disturbances can occur despite checking the maneuver at the steady tone. To avoid AOA overshoots at high pitch rates, anticipate the approach of the steady tone.
- Aggressive application of backpressure when operating at or near the steady tone will cause an AOA overshoot. If this occurs or the aircraft buffet is experienced in maneuvering flight, the engine disturbance area may have been reached.
- If either of the above occurs, immediately reduce AOA and check engine instruments for evidence of compressor stall.
- The cockpit AOA indicator may lag true aircraft AOA by as much as eight units during a high rate maneuver. Caution must be exercised during rapid maneuvering at high AOA to avoid inadvertently exceeding the aircraft AOA where engine disturbances may occur (Figure 6-2).

NOTE

Aircraft load factor limits must be observed during maneuvers when using the aural tones as aids since it is possible to overstress the aircraft while maneuvering at peak performance in certain flight regimes.

ADVERSE YAW.

The A-10C produces adverse yaw during rolling maneuvers. Adverse yaw is the tendency for the nose of the aircraft to move in the opposite direction of roll. The amount of adverse yaw produced increases as roll rate, AOA, or g level increases. When the ailerons are deflected, the rudder is automatically deflected in the direction of roll to help reduce the adverse yaw. A damping system reduces sideslip for low to moderate roll rates. With either SAS, additional rudder is required to coordinate turns. For large, rapid roll inputs above the rudder Q-limit speed (240 KIAS), there will not be enough rudder available to completely coordinate high rate rolls, since rudder is limited to 8°. This is especially evident under high g conditions. When performing rapid roll reversals, the aircraft can experience large sideslip angles when the AOA is also high. This greatly increases the likelihood of wing stall and engine disturbances, particularly when attempting to maintain or increase the load factor throughout the roll reversal. The likelihood of stall and engine disturbance can be greatly minimized by decreasing the back stick pressure during the roll. Yaw can be reduced and roll rate increased by leading high g rolling turns with rudder. However, once a significant roll rate is established, rudder should be reduced to coordinate the turn. Full rudder should not be sustained in combined pitch and roll maneuvers while at high AOA (above the peak performance tone level). This will avoid large proverse sideslip angles (nose inside the turning flight path) of magnitudes comparable to the adverse yaw angles in uncoordinated rolling turns. Either adverse yaw or proverse yaw sideslip, while stalled, will place the aircraft in the engine disturbance area (Figure 6-2).

CAUTION

Do not sustain full rudder inputs when rolling the aircraft at high AOA.

NOTE

- Proverse yaw does not tend to produce noticeable sensations of uncoordinated flight as does adverse yaw.
- Rudder authority is increased from 8 to 25 degrees by a Q-Switch when airspeed decreases below 240 KIAS which can increase the likelihood of wing stall and engine disturbances during roll reversals when the rudder is applied.

Adverse yaw is much more apparent when the yaw SAS is disengaged and turn coordination must be supplied totally by the pilot. Fuel tanks or other destabilizing store configurations also increase adverse yaw.

FLIGHT WITH CENTERLINE SARGENT FLETCHER FUEL TANK CONFIGURATIONS.

Flight test results up to 375 KIAS/0.58M show that the flying qualities of the A-10C with the centerline Sargent Fletcher fuel tank are not significantly different from those without the fuel tank. Flight test data indicates a slight reduction in directional stability with the fuel tank, but with the SAS on, there is little noticeable change in aircraft handling. With fuel in the centerline tank, there is a tendency for the "g" load to increase by up to 0.5g with large or rapid roll inputs.

SAS-off flying qualities are similar to those of an A-10 C without a centerline fuel tank. With the Yaw SAS-OFF configuration, a combined yaw-roll motion (Dutch roll) is easily excited by any abrupt aileron or rudder inputs. This is very noticeable while executing operational maneuvers such as a roll in for weapons delivery. This behavior makes it very difficult to achieve a suitable weapons delivery solution with the SAS off. Sideslip can build up rapidly during uncoordinated rolling maneuvers. Increased roll rates, "g" loading, or AOA increases the amount of sideslip build-up.

Based on flight test results, any bank angle change should be limited to a maximum of 180° with the yaw SAS off to reduce departure susceptibility. In the power approach configuration, the Dutch roll mode is easily excited, and large sideslip angles are possible if flight control inputs are not smooth or turns are not properly coordinated with rudder inputs.

CAUTION

- With the centerline Sargent Fletcher fuel tank loaded, loaded rolls beyond a total of 180° of bank are prohibited.
- With the centerline Sargent Fletcher fuel tank loaded and yaw SAS off, bank angle changes beyond a total of 180° are prohibited.
- Takeoff with a partially filled tank may result in fuel tank damage and potential trapped fuel.

Carriage of Two or Three External Fuel Tanks.

NOTE

The carriage of two or three external fuel tanks, full or empty, decreases directional stability. Rolling maneuvers in this configuration may cause large sideslip angles, particularly without the yaw SAS engaged, and are not recommended. During landing with two or three external fuel tanks, a straight-in approach or a wide, conservative traffic pattern is recommended so that large sideslip angles can be avoided.

DIVES/COMPRESSIBILITY EFFECTS.

The A-10C displays good lateral/directional control characteristics throughout all dive conditions. As the aircraft approaches limiting Mach, the aircraft tends to "tuck under" or increase its nose down pitch attitude. This is easy to control with light aft stick pressure and aft trim. As the aircraft approaches redline airspeeds (0.75M/450 KCAS), compressibility effects cause shock waves to form on the wing. This condition does not result in any adverse changes in the flight characteristics of the A-10. The shock waves increase drag and cause increased flow separation along the trailing edge of the wing. This separated flow buffets the trailing edge of the wing, causing a slight aileron vibration. This condition may be encountered within 25 knots of the redline. It is more noticeable in bunting (below 1g) maneuvers and reduces as the g is increased. The effects are a mild vibratory buffet of the airframe and shaking of the pitot boom. The tabs and/or ailerons may be observed to vibrate slightly as they respond to the buffeting airflow. The handling characteristics of the aircraft are not affected, and the slight vibratory response is not of concern structurally. The buffet onset is an indication of approach to redline airspeeds and should be used accordingly.

As Mach increases above 0.6, the g available decreases somewhat. Wing stall and buffet onset will occur simultaneously and at a lower AOA than at low Mach. Engine disturbance (without sideslip) will occur shortly after wing stall and buffet onset.

FLIGHT WITH ASYMMETRIC LOAD.

Asymmetric stores loadings may exhibit a slight loss in directional stability. Adequate control exists within specified limitations.

NOTE

Asymmetric stores landings must be evaluated by the pilot.

ABNORMAL FLIGHT CHARACTERISTICS.

ROLL ACCELERATIONS.

Roll accelerations are characterized by a sudden, often violent increase in roll rate. Roll rates may exceed 200° per second. Negative load factors of up to -2g may be experienced. Neutralizing controls will recover the aircraft, but the rolling motion may continue for several turns after neutralization. AOA and load factor oscillations may occur during recovery. Neutral controls must be maintained until all oscillations have ceased. Rushing the recovery may produce an AOA transient above stall AOA and a possible secondary departure. Roll accelerations are normally produced by sustained crossed controls with the aircraft stalled.

SIDESLIP DEPARTURES.

Rudder control is sufficient to exceed 25° of sideslip and depart the aircraft at any airspeed below 240 KIAS. Warning cues associated with sideslip departures include very large sideslip angles, high lateral accelerations, and very light airframe buffet. Immediately prior to departure, the yaw rate will suddenly increase with little or no increase in rudder input. If the warning cues are ignored, a rapid roll will occur in the direction of rudder application. The departure may be avoided or recovered at any time by neutralizing controls. Sideslip departures occur only below stall AOA. At stall AOA or greater, sustained full rudder applications will produce spins.

WARNING

Flight tests indicate that, at airspeeds below 240 KIAS, the aircraft will depart controlled flight with steady-state, uncoordinated, rudder inputs short of full rudder deflection.

STALLS.

The A-10C has little natural (aerodynamic) stall warning, regardless of flap position. Unaccelerated and accelerated stalls below Mach 0.6 are characterized by a slight g-break and post stall buffet. In accelerated stalls above Mach 0.6, buffet occurs with no g-break and masks the actual stall. The airframe buffet with large (60% or greater) speed brake deflections totally masks the stall indications. See Figure 6-1 for stall speeds.

Stalls with the gear down have a pronounced nose right yawing tendency due to the location of the nose gear door. The indications of stall with large speed brake deflections are full aft stick, a high rate of descent, or a wing rolloff. Although rolloffs are usually mild, they are more abrupt with flaps down. Power setting or SAS do not significantly affect stall characteristics.

Aileron and rudder control can be maintained throughout the stall, provided there is not a large amount of sideslip. Aileron is more effective than rudder in controlling roll. Control effectiveness decreases steadily as AOA increases above stall, and aileron effectiveness also decreases as sideslip increases. In some cases, aileron effectiveness can be reduced to near zero when the aircraft is stalled with sideslip present. Yaw can easily be controlled with rudder. In all cases, drag increases dramatically as AOA increases above stall.

CAUTION

Maintain AOA below stall warning or buffet. If AOA is increased above buffet or stall warning, engine disturbances are likely to occur, particularly at high Mach numbers.

ARTIFICIAL STALL WARNING.

Artificial stall warning is provided by a stick shaker operated off the AOA probe, when the gear is down and/or the flap lever is in DN. The stick shaker is activated at 1 to 2 units AOA below the stall AOA. It provides mild agitation of the control stick 4 to 12 knots prior to wing stall (1g condition).

When the gear is up and the flap lever is in other than DN, the stick shaker is disconnected and a two-tone aural peak performance/stall warning system is activated. The peak performance/stall warning system generates audible signals which allow maneuvering at high performance, and also provide an alert that the aircraft is approaching the stall. The aural peak performance signal is a continuous tone and the aural stall warning signal is a chopped tone.

The steady peak performance tone occurs approximately two AOA units before the stall. The chopped stall warning tone is activated approximately one AOA unit prior to the stall. The margin between the onset of stall warning tone and wing stall varies with Mach number and AOA as shown in Figure 6-2. The chopped stall warning tone does not change in volume or frequency as AOA increases. Thus, actual wing stall or depth of stall indications are not provided by this system.

WARNING

Flight near the engine disturbance area may result in an engine flameout. If one engine flames out, the aircraft will experience a yawing motion which may induce a subsequent flameout of the second engine.

Aural tone stall warning system is also available with gear down and/or flaps MVR/DN. During accelerated stalls, aural tones occur 6 to 10 KIAS prior to stall regardless of aircraft configuration and gross weight. The steady tone typically comes on 8 to 10 KIAS ahead of stall with chopped tone occurring 6 to 8 KIAS ahead of stall.

SINGLE-ENGINE STALLS.

Single-engine stall characteristics are generally the same as dual-engine stall characteristics except rudder is required to counter asymmetric thrust. However, if a stall is not immediately recovered, a rolloff is produced into the dead engine. This is caused by the operative engine drawing air over the wing and increasing the lift relative to the other wing.

STALLS WITH ASYMMETRIC STORES.

Stalls with the equivalent of three AGM-65s and an ALQ-119 on the same wing have been tested. Over 50% of aileron authority is required to avoid a rolloff during unaccelerated stalls. If AOA is increased, full aileron may not control the rolloff. The increased aircraft response to aileron and rudder inputs at higher speeds reduces the control inputs required to avoid rolloff during accelerated stalls.

STALL RECOVERY.

Reducing AOA to below stall warning by relaxing aft stick pressure will produce an immediate recovery. Retracting speed brakes and applying maximum power will decrease altitude loss; which for idle, unaccelerated stalls is largely dependent upon engine acceleration time. Altitude loss during an unaccelerated landing configuration stall recovery is less than 1,000 feet.

WARNING

> If a post stall gyration is entered, recovery may require from less than 1,000 feet to as much as 8,000 feet altitude.

During recovery to level flight the lack of natural stall warning may result in secondary stalls unless the stick shaker, AOA indexer, AOA indicator, or aural tones (depending on configuration) are used as references. Accelerated stall recoveries are immediate with relaxation of aft stick pressure.

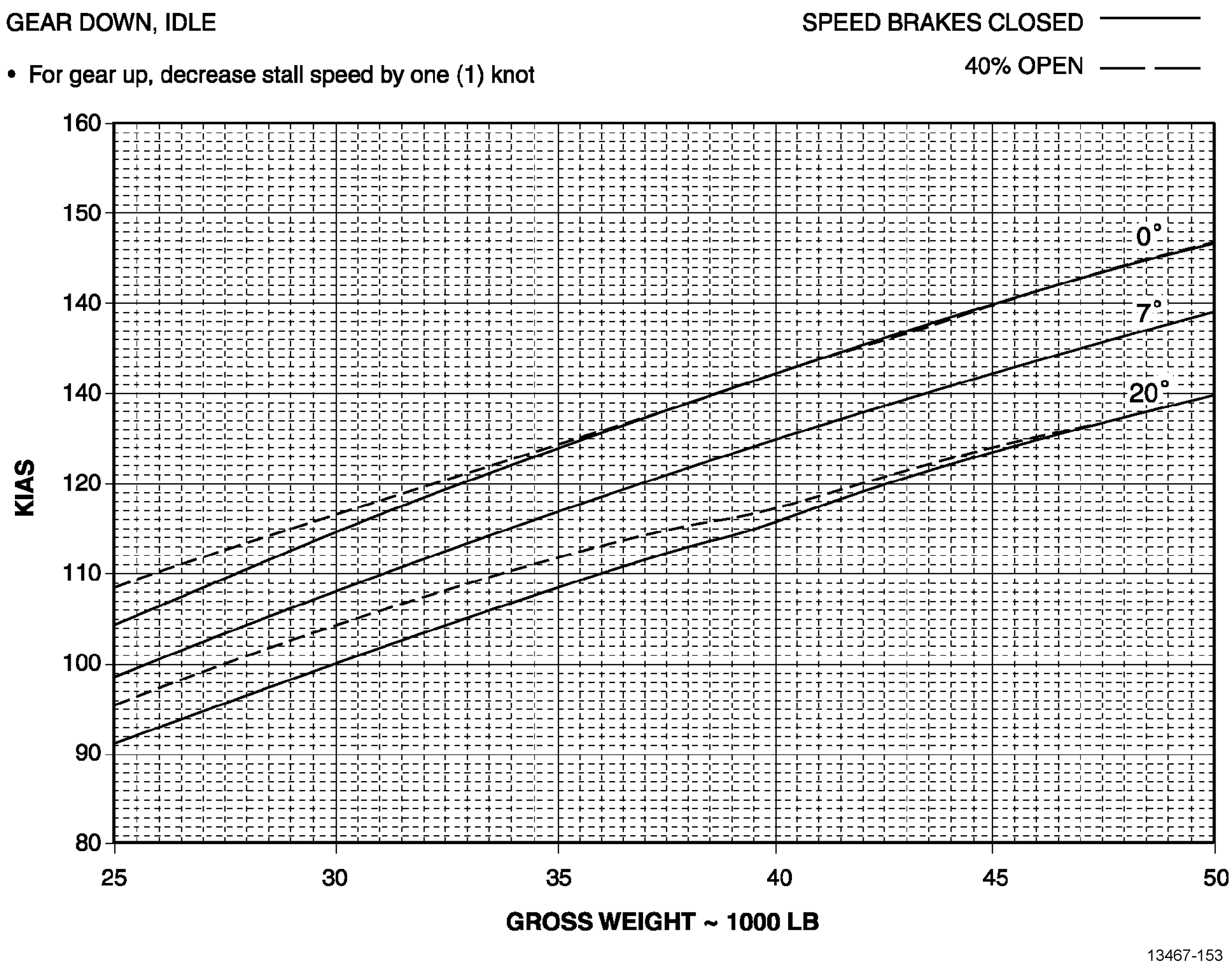


Figure 6-1. In-Flight Stall Speeds

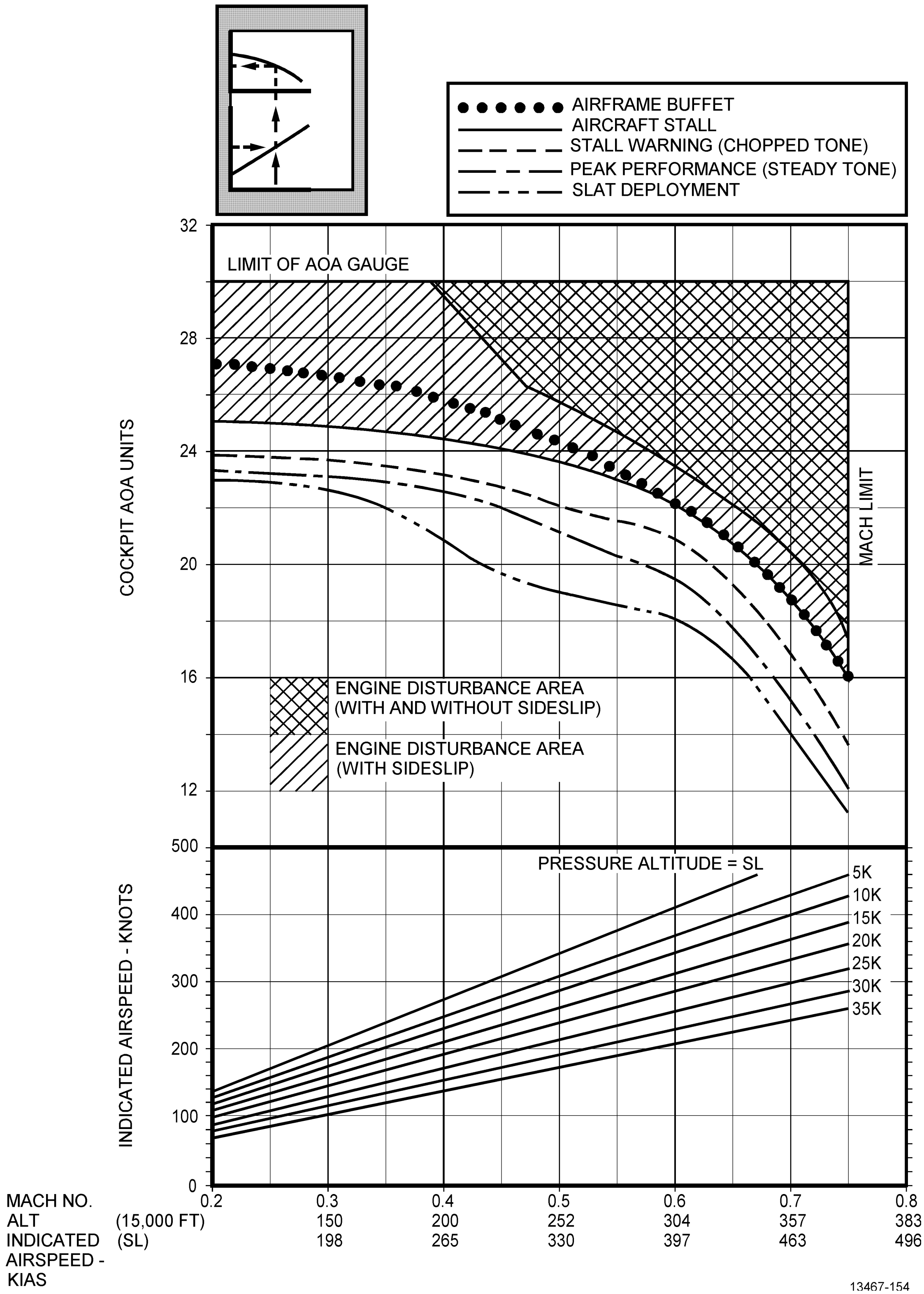


Figure 6-2. Stall Warning and Engine/Airframe Compatibility

DEPARTURES.

The A-10C aircraft possesses excellent flying qualities for a designed mission. Adequate stall warning and departure avoidance are essential in this environment and have been the subject of test and emphasis since the initial flights of the aircraft. With the exception of inadequate natural stall warning, which was somewhat resolved by using a dual-stall warning tone system, the A-10C has excellent stall/post-stall/spin characteristics. Directional and pitch stability is positive for all angles of attack. The aircraft is resistant to departure and requires sideslip angles in excess of 20° to precipitate an out-of-control condition or post-stall gyration (PSG). The aircraft can be flown into the PSG condition, however, with large sideslip angles or if large roll rates are demanded when the AOA is high. The natural resistance of the aircraft to enter this out-of-control regime decreases as altitude increases and/or if the yaw damper system is off or malfunctioning. The altitude effect is caused by the less effective vertical fin with normal indicated airspeeds at the higher altitudes as well as the increased propensity for higher AOAs at the higher altitudes. At higher altitudes (15,000 feet and above), aircraft maneuvering is normally accomplished at lower indicated airspeeds and higher AOAs, but with the capability to still generate high yaw and roll rates. These are the ingredients for yaw-roll coupling. Yaw-roll coupling is a rapid exchange of AOA for sideslip.

WARNING

> AOAs of more than 25 units are easily generated at the higher altitudes. If this AOA is then converted (through a rapid roll) to sideslip, a departure will result. Also, full aileron or crossed controls maintained for at least 2 seconds or cross controls maintained for at least 2 seconds after stall, will produce the sideslip necessary for a PSG.

The flying technique to prevent this sideslip during maneuvers is simply to release back stick (reduce g or AOA) prior to large roll inputs. The roll response using this technique is better and a crisp, concise maneuver results. The g can be immediately reapplied after the roll is completed.

If the aircraft enters the out-of-control arena (either through this yaw-roll coupling, through excessive sideslip, or from a classic cross control situation), two distinct post-stall gyrations may result. These are characterized by either a roll reversal or a roll acceleration.

POST-STALL GYRATIONS.

PSGs are large, uncommanded, random motions about one or more aircraft axis. All A-10 PSGs are uncommanded roll reversals or roll accelerations produced at sideslip angles in excess of 20°. Departure warning cues prior to PSGs are large sideslip angle and moderate lateral acceleration.

Roll Reversals.

Roll reversals are uncommanded rolls opposite to the direction of large aileron input. Excessive sideslip, high lateral acceleration, and a hesitation in commanded roll rate normally precede the reversal and serve as warning cues. Abruptly reversing uncommanded roll rates of up to 155 degrees/second, sideslip angles of up to 85°, and angles of attack as high as 75° have been recorded during tests where roll reversals were encountered. Maximum load factors during tests ranged from +2.3g to -1.0g; however, larger positive and negative g excursions are theoretically possible upon neutralizing controls with roll rate rapidly decreasing as sideslip angle returns to zero.

STALL/DEPARTURE/SPIN AVOIDANCE.

All out-of-control situations may be avoided by stall/sideslip recognition and immediate control relaxation. Stalls must be severely aggravated to force a spin or PSG. In addition, the following will aid in avoiding inadvertent stalls, departures, PSGs, or spins:

a. Rudder rolls are not recommended. Aileron control is excellent at all AOAs and produces much better roll performance.

b. Avoid full rudder sideslips and abrupt rudder reversals.

c. Leading large aileron inputs at high AOA with rudder will augment the SAS to reduce sideslip holdup from adverse yaw and will improve rolling performance.

d. Natural stall warning is inadequate. Monitoring AOA and stall warning devices will aid in avoiding stalls.

SPINS.

The A-10C is extremely resistant to spins. Aft stick producing AOA above stall and full rudder are required to both enter and maintain a spin. Although numerous attempts were made, inverted spins could not be obtained during flight testing and are considered extremely unlikely.

Spin characteristics are not significantly affected by aircraft configuration, store loading, cg position, or SAS operation. Spins with the equivalent of three AGM-65s and one ALQ-119 on the same wing have been tested. During the first turn of unaccelerated entries, the aircraft slowly rolls 180° as the nose slices to approximately 70° nose low. This attitude may appear vertical. Slow roll and nose slice continue until the aircraft is in an upright, nose low attitude after one turn. Accelerated entries are faster and appear primarily as a rolling motion during the first turn. Subsequent turns have an upright, turning motion with one oscillation in both pitch and bank attitude during each turn. These oscillations are greatest with asymmetric store loadings, and least with either 20° of flaps or 80% speed brakes. One turn requires about 5 seconds. If aileron is applied against the spin, the spin will become flat and faster with about 4 seconds per turn. Recovery will then be delayed from 1 to 2 1/4 turns. Full forward stick, during recovery, will result in violent pitch oscillations and is not recommended.

OUT-OF-CONTROL RECOVERY CHARACTERISTICS.

The out-of-control recovery procedure of throttles IDLE and controls - neutral will recover the A-10C from all out-of-control situations, including spins.

The optimum spin recovery technique includes full rudder opposite the spin direction. Recoveries from PSGs may require as many as two roll revolutions followed by a rapid reduction in yaw rate, roll rate and load factors during return to controlled flight. Elevator must be maintained neutral until oscillation stops to avoid secondary stalls during PSG recoveries. Spin recoveries are characterized by an immediate decrease in yaw rate. The last portion of recovery may resemble a slow roll in a steep, nose-down attitude. Motion will stop with either neutral controls or opposite rudder with no tendency to reverse directions.

Ailerons with the spin or during spins or spin recovery are unacceptable because of a rapid transition to a roll acceleration PSG. Recoveries are not affected by flap or speed brake position, with or without the SAS engaged. The effect of the landing gear during spins is unknown; retraction is recommended if recovery is not immediate.

Since PSG and spin recoveries normally result in a steep, nose-down attitude, the dive recovery technique is critical in minimizing altitude lost. Use of AOA to optimize recovery is recommended. PSG recoveries require from less than 1,000 to as much as 8,000 feet altitude. Spin recoveries require from 4,000 to 6,000 feet altitude, for incipient, half-turn spins, and 10,000 feet altitude for three-turn developed spins.

WARNING

> Engine disturbances during PSG are common, and will normally result in engine(s) overtemperature or engine(s) stall stagnation following the maneuver, requiring engine(s) shutdown and restart.

SINGLE-ENGINE FLIGHT CHARACTERISTICS.

The A-10C single-engine flight characteristics differ from dual-engine flight characteristics in three basic areas. First, single-engine operation results in asymmetric thrust requiring application of rudder opposite the dead engine to maintain coordinated flight. Second, the loss of one hydraulic system reduces total rudder authority and results in a 50% reduction in the yaw trim authority. Third, the yaw SAS will disengage when a difference in rudder displacement is exceeded. This results in loss of automatic turn coordination, rudder trim, and yaw damping. The operative yaw SAS channel may be reengaged to regain 50% of these losses.

WARNING

> Flight tests have shown a significantly higher rudder force is required to maintain controlled flight following the failure of a right engine as opposed to the failure of a left engine. The additional force required varies, but has been measured to be as high as 100 pounds. The onset rate is rapid and occurs when the right hydraulic system depressurizes, about the same time that the slats extend. Failure to apply sufficient and timely rudder inputs may result in yaw rates so high that there is insufficient rudder available to correct it, and the aircraft will depart controlled flight. Use of rudder trim may be necessary to relieve excessive rudder pressure.

TAKEOFF.

If an engine failure or fire occurs during takeoff, the decision must be made immediately whether to continue the takeoff or to abort. Below 70 KIAS, flight control inputs may be inadequate to maintain control of the aircraft with one engine at MAX and the other engine failed. In this case, an abort is the only option. Above continuation speed (minimum go-speed) but below refusal speed, it is possible to continue the takeoff. However, an abort is normally the preferable option. If an abort is not possible, both throttles should remain at MAX until a safe altitude is attained. If an engine failure is experienced, gear retraction should be accomplished promptly once safely airborne in order to enhance acceleration and climb performance and to take advantage of any residual hydraulic pressure. Single-engine rate of climb at takeoff is increased 400 FPM (500 FPM at best rate of climb speed) if the gear is retracted. If experiencing an engine failure after takeoff with the gear down and below best single-engine climb speed, it may be impossible to accelerate to best single-engine climb speed. The loss of approximately 10 knots of airspeed can be anticipated when an engine fails on takeoff. Fully retracting the flaps will increase single-engine climb rate by 100 FPM (150 FPM at best rate of climb speed) but will also decrease stall margin at low airspeed. Therefore, if climb performance allows, full retraction should be delayed until above 150 KIAS. The retention of external stores located opposite the failed engine may help to control asymmetric thrust. However, the drag and weight associated with external stores may, under certain circumstances, make it impossible to accelerate to single-engine climb speed if an engine fails immediately after takeoff. Thus, jettison of external stores is critical.

During the initial takeoff roll, fan speed should be checked after approximately 1,000 feet. Since fan speed is a direct indication of thrust, obtaining the correct minimum acceptable fan speed is necessary to obtain the performance shown in this technical order for maximum power takeoff. Fan speeds less than the predicted fan speed will result in reduced single-engine acceleration to best single-engine climb speed and will adversely affect other takeoff parameters. Under critical operating conditions (short runway, high gross weight, high temperature/pressure altitude, etc.), an abort may be the appropriate action if predicted fan speed cannot be achieved.

If an engine failure is experienced shortly after takeoff, the thrust required to accelerate to best single-engine climb speed may be greater than thrust available. As a result, it may be necessary to lower the nose of the aircraft in an attempt to exchange altitude for airspeed. An engine failure at extremely low altitudes (just after lift-off) may preclude this option. If electing to trade altitude for airspeed in an attempt to achieve best single-engine climb airspeed, be conscious of the terrain in front of the aircraft. Single-engine acceleration rates under certain conditions (high temperatures/pressure altitudes and heavy gross weights) are very slow with a corresponding small vertical climb potential. A near level attitude should be maintained while accelerating to a minimum of best single-engine climb speed. Accelerate and climb straight ahead if terrain permits. If turns are necessary, they should be made into the good engine, if possible, and a minimum practical bank angle (any turns will degrade aircraft performance). Best single-engine performance is achieved with a slight bank (up to 5°) into the good engine and rudder, as required, to maintain a constant heading. The ball will be displayed toward the good engine, proportional to the amount of bank used. It is essential that yaw rates be controlled through proper use of rudder and bank into the good engine (center the turn needle). This will increase climb potential, as well as reduce the possibility of a yaw departure. Failure of the number two engine with a corresponding loss of right hydraulic pressure will result in a further degraded climb/acceleration potential as a result of the slats extending (2.02 units of drag). A further increase in drag could result due to pitch and yaw transients as the SAS disengages. Also, a "wallowing" effect can be encountered while overcorrecting for asymmetric thrust as hydraulic pressure and engine thrust are lost. Yaw in excess of 8° to 10° will increase drag adversely affecting airspeed and acceleration. All these factors can combine to prevent acceleration while in a climb or, in certain conditions, level flight.

IN-FLIGHT.

Control can be maintained while flying on one engine throughout the flight envelope. Moderate rudder must be held opposing the failed engine to reduce sideslip, because the engines are significantly offset from the aircraft centerline. A slight bank angle into the good engine will reduce the amount of rudder required to hold a constant heading, and will reduce pilot workload for prolonged single-engine flight. Yaw trim is available as long as the yaw SAS channel corresponding to the operating engine is engaged. Single channel yaw damping and automatic turn coordination will also be provided. However, single channel rudder authority for turn coordination for sideslip control is not sufficient and pilot rudder inputs opposite the failed engine will be required. Under steady-state flight conditions, the flight controls provide adequate response to maintain aircraft control down to stall speed, even with maximum power on the good engine. However, under maneuvering flight conditions of high sideslip angles, adverse yaw rates, and high bank angles, adequate flight control response may not be available to effect an immediate recovery. With symmetric store loads, gear down and flaps up, the maximum amount of powered rudder required to maintain a steady heading down to stall speed is approximately half the available rudder. Full rudder may be required to maintain heading at stall speed if the gear is down and flaps are down 20° at light gross weights. Asymmetric store loadings and/or crosswinds on the side of the good engine will help reduce the amount of rudder required. Performance considerations should override handling qualities when making the decision to selectively jettison stores.

WARNING

A combination of high gross weight, high pressure altitude, and high temperature may create a condition in which level flight is not possible with gear extended. Increases in AOA result in decreases in rudder effectiveness, decreases in airspeed, and increases in sideslip angle. This produces an increase in yawing moment that must be compensated for by increasing rudder into the good engine. If the additional rudder is not applied, the aircraft will rotate to a higher sideslip angle, further decreasing the airspeed. The problem is compounded by the fact that to maintain airspeed, thrust on the good engine must be increased, further increasing the sideslip angle. Therefore, airspeed and aircraft attitude should be closely monitored and rudder opposing the failed engine should be maintained to reduce the sideslip angle.

During single-engine approaches, avoid abrupt control inputs. This is particularly important when the SAS is off, since additional amounts of sideslip will be generated during banking maneuvers unless the turn is coordinated with rudder. All maneuvering turns should be made into the good engine, if possible. Bank angle should not exceed 30°, and g loading should be minimized. If it is necessary to turn the aircraft into the failed engine, relaxation of opposite rudder will be required to coordinate the turn. The amount of rudder required to control the yawing moment due to engine thrust, plus the additional rudder required to coordinate turns into the operating engine, may be substantial and will require close attention to ensure that decreases in airspeed and increases in sideslip are not excessive.

WARNING

During single-engine approaches, failure to use sufficient rudder during maneuvering turns can result in large sideslip angles and yaw rates. It is possible to create a condition where the yaw rate becomes so high that there is insufficient rudder available to correct it, and the aircraft will depart controlled flight. Under correcting with rudder can lead to aircraft rolloff requiring excess altitude to recover. All flight control inputs should be made with constant attention to turn coordination and maintaining approach airspeed.

ENGINE OPERATION.

Engine compressor stalls may be encountered due to ingestion of turbulent airflow during operation where the aircraft stall AOA has been exceeded. The following types of compressor stalls may be encountered:

a. Minor compressor stall - Characterized by a momentary decrease in compressor discharge pressure accompanied by a slight Interstage Turbine Temperature (ITT) increase which in most cases is undetectable by the pilot and is self-recoverable without pilot action.

b. Unrecoverable compressor stall - Characterized by a rapid increase in ITT, requiring immediate action to prevent an overtemperature condition.

c. Flameout - Leading edge slats have been incorporated to delay the onset of engine disturbances to a higher AOA. However, if the aircraft is flown into a stall, the engine will ingest turbulent flow which may cause a compressor stall in one of the above categories. Two warning signals (aural tones) are incorporated to assist in checking any maneuver prior to wing stall AOA. The first (steady) tone signifies that the maximum usable lift of the wing (peak performance) is approaching. The second (chopped) tone indicates the top of the regime of peak performance, and that if AOA is allowed to increase still further, a wing stall will occur. If these warnings are ignored, and the AOA is permitted to rise above the wing stall, an engine compressor stall may also result, depending on the degree of severity of the maneuver.

d. As shown in Figure 6-2, the engine is less tolerant to post-stall inlet disturbance as Mach number is increased. Compressor stalls are less likely below approximately 0.5 Mach due to the increased disturbance margin. High Mach number buffet masks the stall characteristics making it easier to enter the engine disturbance regime inadvertently. The engine becomes more tolerant to aircraft post-stall inlet disturbances as altitude decreases. Maneuvering with high sideslip will significantly decrease the engine operating envelope.

NOTE

Certain engines may exhibit a characteristic of slow or limited acceleration from low power at high altitude (usually above 25,000 feet). The condition can result in either a long time period elapsing (over 1 minute) to accelerate an engine(s) to maximum power parameters from a low power setting or of not reaching maximum power parameters unless a descent to lower altitude is made. Overtemperature should not occur nor should any engine damage be sustained.

MANUAL REVERSION FLIGHT CONTROL SYSTEM (MRFCS).

The MRFCS is an emergency system for use when dual hydraulic failure is impending or has occurred.

WARNING

This mode is intended to allow recovery of the aircraft to a safe area to eject or land. (However, landings should only be attempted under ideal conditions or when ejection is not possible, since any degradation beyond normal reversion may make landing impossible.)

AILERON/TAB SHIFTING TRANSITION.

Selecting MAN REVERSION initiates aileron/tab shifting immediately. The shift cycle takes approximately 4 seconds to complete (in either direction). Tab shift action is progressive, providing increasing roll control. As the shifters move from the normal position, switches:

- Deactivate both normal and emergency roll trim
- Drive the roll trim actuators to neutral
- Cause the corresponding L and R AIL TAB caution lights to come on.

Driving roll trim to neutral during MRFCS operation assures that the ailerons will go to neutral when hydraulic power is restored.

AILERON TAB CAUTION LIGHTS.

The aileron tab caution lights (Figure 1-68), placarded L AIL TAB and R AIL TAB, come on if the corresponding aileron/tab shifter is not at the full normal position.

MRFCS FLIGHT CHARACTERISTICS.

During flight test, the aircraft has been flown in the manual reversion mode to dive angles of 90 degrees, airspeeds up to 390 KIAS, to stall, and in spins. Dive recoveries of up to 4 g’s have been accomplished.

WARNING

MRFCS is designed for only moderate maneuvering.

Prior to switching to manual reversion, the stick feel in the roll axis will be the same as experienced on the ground before engine start. After switching to manual reversion mode, roll response is fair and stick forces are moderate to high. Reducing airspeed will reduce the lateral stick forces required for roll response.

Pitch stick forces are high, requiring to frequent trim out of the forces. Pitch trimming while in the manual reversion mode is best accomplished by holding in the stick force for the desired trim change and then trimming out the force by utilizing the trim button. If the stick is trimmed without holding in the correction (i.e., flying the aircraft by trim), the resultant trim rate will be quite rapid with the possibility of trim overshoots.

WARNING

Failure to use pitch trim with caution while in manual reversion, particularly during maneuvering/high airspeed dives, can result in loss of control due to excessive pitch stick forces.

Power effects are very noticeable in manual reversion and are characterized by a nose-up pitch moment when power is applied, and a nose-down pitch moment when power is reduced. Therefore, slow, smooth power adjustments are recommended.

WARNING

The cumulative effects of failure to use pitch trim, rapid throttle movements, and highspeed maneuvering/dives, when in manual reversion, could require stick forces beyond a pilot's physical capability to recover the aircraft.

Transition into manual reversion has been successfully accomplished at forward, mid, and aft cg conditions and at varying airspeeds from 140 to 390 KIAS. The transition into manual reversion may be accompanied by pitch transients, The magnitude and direction of these transients are primarily dependent upon the elevator tab setting, the cg position, airspeed, and power setting and can range from -2.0 g to +6.8 g's. With flaps extended 20°, a large nose-down pitch moment will occur during and after transition to MRFCS. Full aft stick trim and maximum power may not hold level flight under these conditions.

WARNING

With flaps full down, maintaining level flight following transition to manual reversion may require aft stick forces which exceed the pilot's physical capability. If transition to MRFCS occurs with flaps full down, it is imperative that the flap emergency retract switch be activated immediately.

With the aircraft in a mid cg configuration, the transition into manual reversion (within the range of airspeeds from 150 to 200 KIAS, power for level flight) is characterized by a small nose-up excursion. If the transition is performed above this airspeed, the magnitude of the transient will increase reaching an approximate 2.7 g nose-up transient at 300 KIAS. Transitions performed with the aircraft in a forward cg configuration will minimize the magnitude of the pitch excursion, while transitions accomplished with the aircraft in an aft cg configuration will tend to increase the excursion. Engine power setting during the transition will also affect the magnitude and direction of the pitch excursion. With throttles at IDLE, the nose-up pitch tendency will be reduced. At some cg conditions (forward cg) and speeds, the power reduction will actually produce a nose-down excursion during the transition.

The incremental g experienced during the transition is not additive to the maneuvering load factors. If, for example, a 4 g recovery from a dive is being performed while simultaneously reverting to manual reversion, and aircraft cg configuration and speed are such that they would produce a 4 g transient (incremental 3 g) during the transition, no pitch transient would be experienced. The magnitude of pitch excursions can be reduced significantly by manual correction.

Most A-10 aircraft tend to roll off to some extent in manual reversion. This is due to manufacturing tolerances, and the fact that there is no lateral trim in manual reversion. The direction and magnitude of rolloff vary from aircraft to aircraft. This rolloff characteristic is speed-dependent and tends to increase as airspeed increases. Stick forces to maintain level flight can be as high as 25 pounds at 300 KIAS. To reduce workload and fatigue on long duration flights, reduce airspeed and/or use asymmetric thrust to keep wings level and reduce lateral control forces.

MRFCS OPERATION.

Shifting to MRFCS Mode (Hydraulic Power Available).

Most conversions to MRFCS will be intentionally initiated. If intentional transition is planned, the MRFCS should be ground checked prior to flight. Reasons to transfer to MRFCS, while hydraulic power is still available, include the following:

- Training in the MRFCS mode
- Checkout of the MRFCS mode
- Precautionary transfer to MRFCS mode; e.g., one hydraulic system failed and failure of the second system is imminent.

When accomplishing an intentional shift into manual reversion, comply with operating limitations in Section V. Selecting MAN REVERSION simulates a dual hydraulic failure, while simultaneously initiating roll transition to manual reversion. When the flight control mode switch is placed to MAN REVERSION, the following events occur:

- Hydraulic supply pressure is shut off and bleeds off to zero psi. This can take up to 10 seconds. Bleed off can be observed on the cockpit hydraulic pressure gauges and by noting the L/R HYD PRESS caution lights.
- The aileron tabs begin (on switch actuation) shifting to tab drive. This is indicated by the L/R AIL TAB caution lights coming on. Complete shift can take up to 4 seconds.

When hydraulic supply pressure bleed off is complete, the aileron actuators go into bypass mode and aileron float up begins. Float up will take up to 4 seconds. Since supply pressure bleed off and aileron float up are sequential, the total time to regain roll control after selecting MAN REVERSION can be up to 14 seconds. If the stick is moved laterally prior to completion of aileron float up, the ailerons may float up abruptly and asymmetrically.

CAUTION

Failure of one or both hydraulic systems to drop below 250 psi after switching to MAN REVERSION may result in locked ailerons after shift to aileron tab drive commences. Under these circumstances, control stick feel will be near normal for manual reversion; however, roll capability will be slight and in the opposite direction to stick displacement. Therefore, should one or both hydraulic pressure gauges fail to drop below 250 psi within approximately 10 seconds and, if roll is in opposite direction to stick displacement, return the switch to NORM.

NOTE

The L/R AIL or L/R ELEV jam indicator lights may come on during manual reversion due to air loads.

MANUAL REVERSION STICK FORCE.

As the plots indicate (Figure 6-3), aft stick forces even to maintain level flight can quickly become excessive when flying above 300 KIAS. Each of these curves is a representation of a specific test condition. Actual stick forces required will vary with aircraft cg, gross weight, altitude and atmospheric conditions. The important thing to remember is the potential for an MRFCS dive to become unrecoverable unless proper throttle and pitch trim techniques are used.

NOTE

The L/R AIL or L/R ELEV jam indicator lights on the emergency flight control panel may come on during manual reversion due to air loads.

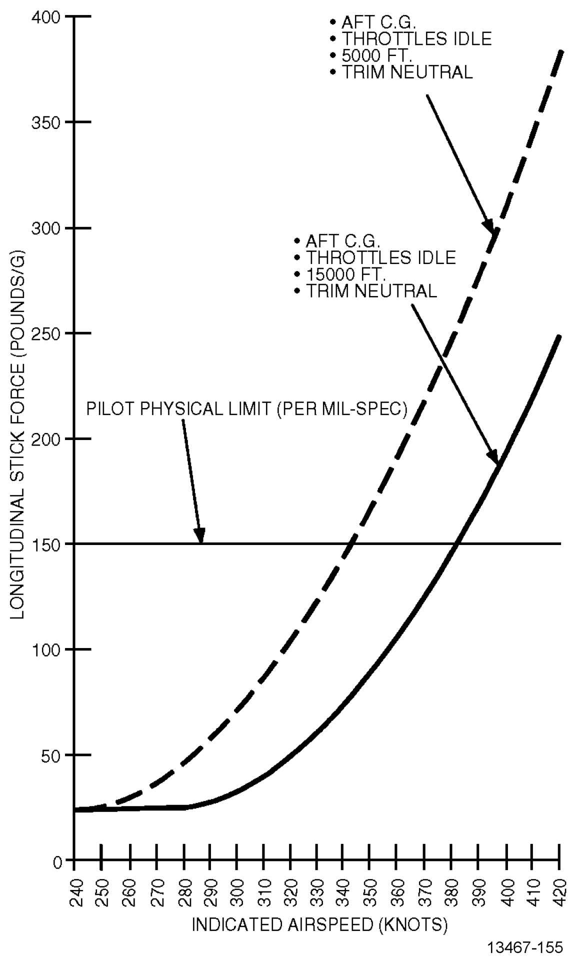


Figure 6-3. A-10 Manual Reversion Stick Force per "G"

Even in a relatively shallow (20-30°) dive, increasing airspeed can rapidly build up airloads on the elevator, which would hinder pullout attempts and, if left unchecked, cause the dive to steepen. This leads to a rapidly deteriorating situation with higher airspeeds leading to increasing dive angles, etc. If this occurs, a return to powered flight, if possible, or ejection may be warranted.

To avoid this situation, the use of pitch trim to reduce MRFCS stick forces is essential. Of equal importance is the prudent use of the throttles. Due to the upward cant of the engine nacelle exhaust, high throttle settings actually increase the nose-up tendency of the A-10. In a 300 KIAS dive with throttles at idle, the application of full power will reduce the aft stick force necessary to recover from the dive by 80-90 pounds.

Shifting to MRFCS Mode (Hydraulic Power Not Available).

In a dual hydraulic failure, the stick will essentially lock in roll. Pitch and yaw control will be available immediately, but MAN REVERSION must be selected to initiate tab shifting, which will make it possible to regain roll control. Partial roll control will be available approximately 4 seconds after selecting MAN REVERSION.

If hydraulic failure occurs, when operating single engine or with an asymmetric loading, the aircraft will begin a slow roll into the dead engine or heavy wing. The throttle on the operating engine should be retarded (to IDLE if conditions permit) after selecting MAN REVERSION. Coordinate rudder and aileron as thrust is increased after transition is complete. Asymmetric loadings can be corrected by selective jettison, as conditions permit.

Shifting Back to Primary Flight Control System (PFCS) Mode.

Hydraulic power, if available, is immediately applied to flight control actuators when the flight control mode switch is returned to NORM. All logic functions are fully reversible and powered control of the elevators and rudders is immediate. Pitch trim change may be required.

The ailerons drive down to neutral trim position, but roll control is not fully effective until aileron/tab shifting is complete. Roll trim control, both normal and emergency, is available at the completion of the shifting operation. Yaw trim is regained after YAW SAS is reengaged.

MRFCS SINGLE-ENGINE FLIGHT CHARACTERISTICS.

Manual reversion single-engine flight is a very demanding task. The limited aileron and rudder authority in manual reversion make countering the roll moment due to asymmetric thrust difficult. If manual reversion flight becomes necessary when operating with a single-engine, thrust should be reduced as low as possible prior to transition. Rudder and aileron into the good engine should precede addition of thrust. High rudder forces will be required, as will moderate to high aileron forces, to maintain steady heading flight. Some sideslip will have to be maintained in cruise flight. Maneuvers should be planned to avoid turns into the dead engine. Some bank into the good engine will reduce rudder required to maintain heading. Single-engine manual reversion landings have not been tested due to safety considerations.

Simulated single-engine manual reversion landings have been accomplished with one engine at IDLE. Actual single-engine manual reversion go-arounds have been tested at altitude and are very difficult to perform. Power has to be applied very slowly as rudder and ailerons are blended in. A light asymmetric store loading on the side of the good engine may help reduce control forces, while stores on the side of the dead engine will increase control forces and should be jettisoned. Five degrees of bank into the good engine will reduce rudder forces, but will also reduce available roll rate into the good engine. An ECM pod or similar asymmetric load on the dead engine side will decrease the full aileron roll rate into the good engine to less than 5° per second, which may be inadequate to retain control of the aircraft for landing in gusty conditions. Minimum single-engine control speed in manual reversion is 130 KIAS. This was determined as the physical limit of the pilot. Individual aircraft and pilot differences may require higher speeds.

FAILURE MODE FLIGHT CHARACTERISTICS.

The many redundant features of the A-10C flight control system made testing of all failures impossible. In case of multiple failures, a controllability check in the landing configuration should be performed prior to attempting a landing.

LOSS OF ONE PITCH MECHANICAL COMMAND PATH.

In the case of a severed control cable, the pitch response and feel is no different than with both mechanical paths operating.

SINGLE OPERABLE ELEVATOR.

With the exception of a full-up jammed elevator, which has been disconnected, the aircraft can be mildly maneuvered and landed with a single operable elevator. With a full-down jammed elevator, a controllability check should be made to determine the minimum control speed.

Elevator stick forces will appear lighter than normal; however, twice the stick displacement is required to achieve a given pitch rate or g. Trim rates in the single elevator mode appear to be cut in half.

SINGLE OPERABLE AILERON.

With one aileron disconnected or control path severed, the remaining operable aileron has sufficient authority to control the aircraft, provided hydraulic power is available.

NOTE

With one aileron disengaged, maximum roll capability will be reduced approximately 50% and stick input for a given roll will be twice normal. Roll capability is increased with speed brakes 40%, flaps 20 degrees. Roll capability is also increased when rolling away from the disengaged aileron. Maximum crosswind limit is 20 knots including gusts. Crosswind landings should be performed with the crosswind on the same side of the aircraft as the operable aileron to take advantage of the roll rate away from the disengaged aileron.

Sufficient control is available to land the aircraft with moderate workload. If one aileron is inoperative due to a severed control path, it may still be trimmable, as long as the electrical circuits remain intact.

WARNING

Landing in manual reversion with one aileron disconnected has not been tested. Ejection is recommended.

LOSS OF MECHANICAL COMMAND PATHS TO RUDDERS.

Loss of rudder command is of little consequence in the A-10 C as long as symmetric flight is maintained. If the SAS is still engaged, the rudders can be controlled by means of rudder trim as long as the electrical path remains intact. The yaw SAS will continue to function normally with a functioning electrical path.

LOSS OF ALL MECHANICAL COMMAND PATHS AND HYDRAULICS ON ONE SIDE.

The aircraft in this condition handles just like an A-10 C with a single operable aileron. Turn coordination is provided by the SAS through the operable rudder if the corresponding yaw SAS channel is engaged. If SAS is off, the aircraft will tend to dutch roll whenever aileron inputs are made and this condition is aggravated with gear and flaps DN. If yaw SAS cannot be maintained, then slow, shallow turns should be made while avoiding rapid power changes.

RUNAWAY TRIM.

Runaway pitch trim is easily controlled throughout the powered control flight regime. Maximum forces required can be expected to be on the order of 10 to 15 pounds aft force for full forward runaway trim and about 25 pounds forward force for full aft runaway trim.

Full runaway roll trim requires about 10 to 15 pounds of side stick force to counteract. If either pitch or roll runaway trim is encountered, the pitch/roll trim override switch, on the emergency flight control panel, should be placed in EMER OVERRIDE and the emergency pitch and roll trim switch should be used to trim out the forces.

Runaway rudder trim is easily controlled with opposite rudder. Disengaging the yaw SAS will cut out rudder trim completely.

Runaway pitch trim in manual reversion has been tested. At all but the lowest speeds attainable, runaway trim would be uncontrollable in this flight mode if control is not regained using emergency override.

FLAP ASYMMETRY.

Tests have been conducted with both right flap sections locked up and left flaps extended to MVR, full DN, and emergency retract positions. With gear DN the aircraft is trimmable to a hands-off condition. In the case of 20° flaps, however, it was not possible to reduce sideslip to zero with trim alone.

SECTION VII

ADVERSE WEATHER CONDITIONS

TABLE OF CONTENTS

INTRODUCTION.

This section consists of procedures and information which differ from, or are supplementary to, the normal operating and instrument flight procedures in Section II. Except for some repetition necessary for emphasis or clarity, only those procedures required for all-weather operation are discussed.

TURBULENCE AND THUNDERSTORMS.

The key to proper flight technique through severe thunderstorm activity and turbulence is attitude. Both pitch and bank should be controlled by reference to the attitude indicator.

WARNING

Intentional flight through thunderstorms, hail, or known severe turbulence is not recommended. Flights into these areas increase the danger of engine flameout and aircraft damage.

If flight through severe turbulence or thunderstorms is unavoidable, establish and maintain a power setting and pitch attitude that will hold the aircraft in level flight at 200 KIAS or cruise airspeed, whichever is lower. Trim the aircraft at this speed. Throttle setting and pitch attitude, if maintained throughout the severe activity, will normally result in constant airspeed regardless of any false readings of the airspeed indicator. Do not chase the airspeed.

NOTE

Be alert for possible instrument failures. Maintain a constant cross check between the main attitude indicator and the standby.

Do not change trim after the proper attitude has been established. Extreme gusts will cause large attitude changes. Use smooth and moderate aileron and elevator control inputs to reestablish the desired aircraft attitude.

Severe vertical gust may cause appreciable altitude deviations. Allow the altitude to vary. Continue to maintain desired attitude and do not chase the altimeter and VVI.

Concentrate on maintaining a constant heading. Do not make any turns unless absolutely necessary.

Should flight through an area of severe turbulence or thunderstorm activity become necessary, the following procedure is recommended:

a. Turn on pitot heat, tighten safety belt, lock shoulder harness, and stow loose items.

b. Recheck windshield anti-ice - ON.

c. Rain removal - ON (if required).

d. Thunderstorm lights - ON (if required).

ICE AND RAIN.

The airplane is equipped with a windshield and canopy defogging system, windshield rain removal system, pitot heater, AOA vane heater, and a lift transducer heater. Engine inlet icing and anti-icing or deicing system for the wings and empennage are not provided. Sustained flight through areas of known icing should be avoided when possible. However, short duration icing (approximately 1/4 inch) can be tolerated without significant damage to fan blades due to shedding. When icing is encountered, a change in altitude or course should be made to prevent ice from accumulating on the airframe and engine inlets. If circumstances preclude sublimation at altitude, avoid rapid (penetration type) descent rates if possible. Rapid descent rates will cause accumulated ice to break off in large chunks.

WARNING

Flight into areas of known moderate or severe icing is not recommended.

Experience has shown that shedding of ice from the airframe or engine inlet can result in damage to fan blades, and replacement of damaged fan blades may be required. If flight through icing occurs, appropriate entry in AFTO Form 781 is required, and the engine must be inspected after landing for possible damage.

Accumulations of up to 3/4 inch of ice do not significantly increase stall speed, but the stall break will be masked in the clean configuration as a result of ice on the stall strips. Power on approach stall characteristics do not change. However, heavy icing may result in improper leading edge slat operation, change of stall speed, or engine disturbances in the stall/post stall regime. Windshield anti-ice and the pitot heat system are very effective even in severe icing conditions, if they are on prior to encountering ice.

If operational requirements dictate flying in icing conditions:

a. Recheck pitot heat and windshield defog/deice are on.

b. Adjust cockpit temperature and canopy defog flow to maximum consistent with pilot comfort to aid in quarter panel and canopy anti-icing and deicing.

c. Minimize exposure time to prevent larger buildup of ice on aircraft structure and engine intakes.

d. Avoid rapid descent rates with accumulated airframe or engine intake ice.

HYDROPLANING.

Dynamic hydroplaning is a condition where the tires of the airplane are separated from the runway surface by a fluid. Under conditions of total dynamic hydroplaning, the hydrodynamic pressures between the tires and runway lift the tires off the runway to the extent that wheel rotation slows or actually stops. When an airplane is subjected to hydroplaning to any degree, directional control becomes difficult. Under total dynamic hydroplaning conditions, nosewheel steering is ineffective and wheel braking is nonexistent. The major factors in determining when an airplane will hydroplane are groundspeed, tire pressure, and depth of water on the surface. To a lesser degree, the surface texture, type of tire, and tire tread depth influence the speed for the onset of hydroplaning. Total dynamic hydroplaning of the nosewheel with 0.1 inch or more of water or slush on the runway can be expected at approximately 91 knots groundspeed based on a tire pressure of 140 psi and nonrotation at touchdown. Main landing gear tires are inflated for the heaviest weight mission to be flown for the day. The speed for total dynamic hydroplaning of the main wheels, therefore, depends on this weight. Main wheel hydroplaning speed is given in the following chart for takeoff weight and corresponding tire pressure (nonrotation at touchdown).

Aircraft Gross Weight	MLG Tire Inflation Pressure	Total Dynamic Hydroplaning Speed
Pounds	psi	Knots
31,500	155(±5)	81
41,500	185(±5)	95
48,000	185(±5)	104

Partial dynamic hydroplaning occurs to varying degrees below these speeds. Once dynamic hydroplaning has been established, it can continue at speeds below the onset speed and in water shallower than onset depth.

In addition to dynamic, two other types of hydroplaning can occur:

Viscous hydroplaning is caused by a thin film of water mixed with contaminants such as oil, JP-4, rubber deposits, and/or dust, and can occur down to slow taxi speeds. Tire pressure and wheel loading have little effect on viscous hydroplaning.

Reverted rubber hydroplaning is caused by a locked-wheel skid on a wet surface which lasts long enough to heat the rubber sufficiently to revert it to its natural state and seal the tire grooves, delaying water dispersal. Once rubber reversion is well established, the combination of water film and uncured tire will sustain a skid down to approximately 10 knots.

When possible hydroplaning conditions exist, be aware of the following:

a. Smooth tires tend to hydroplane with as little as 0.08 inch of water. New tires tend to release hydroplaning pressures and will require in excess of 0.2 inch of water depth to hydroplane.

b. Takeoffs with crosswinds on water-covered runways should be made with caution. An aborted takeoff on a wet runway, initiated at or near hydroplaning speed, will require considerably more runway than a dry runway abort. Directional control of the aircraft will be critical until the speed has decreased below hydroplaning velocity.

c. In the absence of accurately measured runway water depths, use the following information to determine the possibility of hydroplaning when landing must be accomplished on a wet runway that does not have a porous surface or is not grooved:

   (1) Rain reports as LIGHT - Dynamic hydroplaning unlikely, viscous and reverted rubber hydroplaning are possible.

   (2) Rain reported as MODERATE - All types of hydroplaning are possible. Smooth tires will likely hydroplane; however, new tires are less likely to hydroplane.

   (3) Rain reports as HEAVY - Hydroplaning will occur.

d. When faced with a possible hydroplaning situation, use speeds for a minimum run landing with upward adjustments if gusts are expected. Land on the centerline where the runway crown will provide the least standing water. Plan a firm touchdown near the start of the runway. After touchdown, immediately reduce power to IDLE and extend speed brakes 100%. Maximum aerodynamic braking should be used throughout the landing roll. When directional control is firmly established, apply brakes as required. Utilize maximum anti-skid braking if stopping distance is critical on roll out, minimize nosewheel steering and differential braking to preclude loss of directional control and continue roll out straight ahead down to slow taxi speed (about 10 knots).

CAUTION

Rubber deposits and paint on last 2,000 feet of a wet runway make directional control/hydroplaning a problem even at very low speeds. Start braking early so only minimal braking is required on last part of runway. Maintain runway center-line until slowed to taxi speed. Turning on slippery runway causes rotational skids; almost stop before attempting to turn.

NIGHT FLYING.

Night flight necessitates a high degree of instrument proficiency and more reliance on flight instruments than would be experienced for normal day VFR operation. Otherwise, techniques used in night flying do not differ appreciably from those used in daylight operation.

WARNING

Transitioning to instruments while flying with Night Vision Goggles may result in increased time required to discern aircraft attitude from the ADI.

NOTE

Reflections from the Head-Up Display (HUD) combining glass may cause a false image of ground lights on the windshield during night flight. These false images can be distracting and should be anticipated, especially in the runway environment.

COLD WEATHER OPERATION.

Most cold weather operating difficulties are encountered while on the ground.

NOTE

- Snow, ice, or frost that accumulates on parked aircraft has different characteristics than in-flight ice, which accumulates on surfaces normal to airflow. Therefore, do not confuse this discussion with the paragraphs on inflight ice and rain.

- Liquids may enter the gun compartment through drains in ram air cooled avionics bays during rain and during the removal of snow, ice, and slush. Should this occur when the temperature is subfreezing, ice may form on the gun system and ammunition. If there is a possibility this could have occurred:
  (1) an inspection should be conducted,
  (2) visible ice should be removed, and
  (3) the gun system should be operated manually prior to flight.

EXTERIOR INSPECTION.

Snow and ice shall be removed from all surfaces prior to flight. Frost shall be removed from the aircraft prior to flight IAW AFI 11-202, Volume 3, General Flight Rules.

WARNING

- Ensure that all vent lines, pitot tube, Angle of Attack (AOA) vane, and static ports are free from obstruction. Check that all ice and slush are removed from landing gears, actuating pistons, and limit switches. Inspect aircraft carefully for fuel and hydraulic leaks caused by contraction of fittings or shrinkage of packing.

- The effects of snow, ice, and frost on A-10C performance has not been tested. Experience on other types of aircraft indicates these phenomena could vary stall speeds significantly.

COLD WEATHER PROCEDURE.

In extreme cold weather (-10°F or below), the following steps may be taken prior to completing the walk-around to ensure the Air Turbine Start (ATS) valve is not frozen and to allow cockpit components to warm adequately:

a. Check Auxiliary Power Unit (APU) exhaust pipe - Clear.

b. Check Environment Control System (ECS) and engine covers - Removed.

c. Battery switch - PWR.

d. Fire lights and caution panel - Check.

e. APU - START.

f. APU generator switch - PWR.

g. Inverter switch - STBY.

h. Left engine operate switch - MOTOR until fan turns.

i. Left engine operate switch - NORM.

j. Right engine operate switch - MOTOR until fan turns.

k. Right engine operate switch - NORM.

l. TEMP/PRESS control switch - DUMP.

m. TEMP level - HI.

n. ENAV system - Align (as desired).

o. Complete the exterior inspection.

WARNING

Avoid the APU exhaust pipe during the exterior inspection, since it will be hot with the APU running.

NOTE

If the engine core rpm does not indicate rotation, external heat should be applied to the ATS valve. If the engine core rpm begins to rise but fan rotation does not begin by 30% core rpm, inspect the fans for freedom of rotation.

PRIOR TO ENGINE START.

To conserve the battery, use external power if available. If APU/battery start must be made in extremely cold weather, use a warm battery. If a warm battery is not available, attempt APU start. If start is unsuccessful, wait 5 minutes and attempt a restart. The initial battery current drain can warm the battery sufficiently to accomplish a successful start. APU starting characteristics may be improved by starting the APU prior to placing the inverter switch to STBY.

CAUTION

Without external power, bleed air leak detection will not be available, subsequent to APU start, until the APU generator switch is placed to PWR or the inverter switch is placed to STBY.

STARTING ENGINES.

Engine starts made under low ambient temperature conditions will result in maximum gauge oil pressure (100 psi). The time required for oil pressure to return to normal depends on throttle setting. There are no restrictions on high power settings following low temperature starts. Shut down engine if oil pressure does not decrease toward normal limits within 2.5 minutes. Before starting, use ground heater units to remove any ice from fan inlet. During extremely cold weather the generators may not automatically come on line upon reaching idle speed. If this occurs, reset the generator and allow at least 30 seconds for warmup before advancing the throttle above IDLE.

CAUTION

When starting the engines in temperatures below 10°F, allow 5 minutes to elapse prior to turning on engine generator(s) to allow for warmup.

BEFORE TAXIING.

Check flight controls, flaps, speed brakes, and trim for proper operation. Flight controls, flaps, and speed brakes should be cycled until normal operation is observed. At low engine power settings, the APU is required to provide enough airflow to keep cockpit temperature comfortable and provide proper defogging. Use of MAN HOT may be required.

WARNING

- Return temperature control to AUTO prior to advancing engines for takeoff; otherwise very high temperature air will enter the cockpit through the ECS.
- Make sure all instruments have warmed up sufficiently to ensure normal operation. Check for sluggish instruments during taxiing.

CAUTION

At cold temperatures the canopy may not close fully. Check the canopy seal for accumulated ice and recycle, if necessary.

NOTE

- To maintain speed brake actuator warming, place speed brake control to CLOSE.
- To maintain flap actuator warming, place flap lever UP.

TAXI.

The aircraft displays good handling characteristics on hard-packed snow and icy surfaces, if speed is kept at a minimum.

CAUTION

It may be necessary to bring the aircraft to a complete stop before initiating turns.

Avoid taxiing in slush or deep snow before flight. Frozen squat switches may later result in false gear warning indications. Increase the normal interval between aircraft to ensure safe stopping distance and prevent icing of aircraft surfaces with moisture blown by the jet blast of the preceding aircraft. If bare spots exist through the snow, skidding the tires onto them should be avoided.

TAKEOFF.

Refused takeoff data should reflect braking capability due to ice and snow on the runway in event of an abort. Make normal takeoff.

NOTE

- For rolling takeoffs add 200 feet to takeoff roll. Rolling takeoffs are based on stopping at the end of the runway and releasing brakes as the throttles are advanced to takeoff power.
- At cold temperatures, it may not be possible to perform engine runup during the line up check without skidding. Caution should be exercised during runup.
- At temperature below -20°F, performing of a static engine runup may bottom out the nose strut and cause damage to strut seals.
- At temperature below 0°F, engine will not reach maximum ITT on engine runup. At -40°F, engine ITT will be approximately 750°C and will increase linearly to approximately 865°C.
- Takeoff with ice on main gear or takeoffs from slush-covered runways may result in a red light in gear handle and gear warning horn after retraction. Recycling gear should break off accumulated ice and result in a good up and locked indication. Recycle the gear only if it can be visually determined the gear is not damaged.
- If aircraft has been exposed to subfreezing temperatures, up to 20 seconds may be required for landing gear retraction.
- After takeoff from slush-covered runways, the landing gear should be recycled several times to prevent the possibility of the landing gear freezing in the gear wells during later portions of the flight.

IN-FLIGHT.

Procedures are as follows:

WARNING

At extremely cold temperatures, with increased aircraft performance, use caution to avoid flight into the engine disturbance area (see Figure 6-2) during high airspeed, high G operations.

LANDING.

Make normal approach and landing. Speed brakes should be opened fully after touchdown. If the aircraft starts to skid sideways, the brakes should be released until the aircraft straightens. On slippery runways nosewheel steering is of little use until slow speeds are reached.

When landing on an ice covered runway, make a normal approach and touchdown. Consideration should be given to flying a minimum run approach and landing based on available runway and RCR. Use aerodynamic braking (flaps, speed brakes, and high AOA) during the high-speed portion of the rollout. Aerodynamic braking is ineffective below approximately 60 KIAS. Apply wheel brakes as necessary after nosewheel touches down on runway. When RCR is 10 or less, leave the speed brakes extended until aircraft has slowed to turnoff speed.

HOT WEATHER AND DESERT OPERATION.

Hot weather and desert procedures differ from normal procedures, mainly in that additional precautions must be taken to protect the aircraft from damage caused by high temperatures and dust. Particular care should be taken to prevent the entrance of sand into the various aircraft parts and systems (engine, fuel system, pitot-static systems, etc.). Units with plastic or rubber parts should be protected as much as possible from windblown sand and excessive temperatures. Tires should be checked frequently for signs of blistering or cord separation. Canopy covers should be left off, to prevent sand between the cover and the canopy acting as an abrasive on the plastic.

EXTERIOR INSPECTION.

Check exposed portions of shock strut pistons for dust and sand, and have them cleaned if necessary.

Check inflation of shock struts and hydraulic accumulators that may have become overinflated because of temperature increases. Check tires carefully for blistering or cord separation, and be sure all protective covers are removed from aircraft.

Check engine nacelle intake for accumulations of dust or sand.

Inspect area behind aircraft to make sure sand or dust will not be blown onto personnel, or equipment, during starting operations.

INTERIOR INSPECTION.

Check cockpit for accumulation of dust or sand and have cleaned if necessary.

BEFORE TAKEOFF.

Limit use of brakes as much as possible, because brake cooling is reduced when outside air temperatures are high.

CAUTION

Extended ground operation during hot weather with windshield defogging/deicing system energized may overheat windshield. DEFOG/DEICE should be selected during BEFORE TAKEOFF checks.

NOTE

- At temperatures above 85°F, with the engines at IDLE, the APU must be used on the ground (canopy closed) to provide sufficient cooling to make the cockpit comfortable. Sufficient cold airflow will not be provided until the engine core rpm is above 80%.
- Above 95°F, the CANOPY UNLOCKED light may not go out. Close the canopy and cool the cockpit with APU running at maximum flow. Recycle canopy with the canopy control switch after cooling.

TAKEOFF.

A noticeable decrease in thrust occurs at all power settings; therefore, more acceleration time and greater runway distance are required during hot weather operations.

Maximum power engine runs may be required prior to takeoff to minimize engine fan droop and maximize fan speed to ensure single-engine rate of climb.

NOTE

Approximately four minutes operation at or near maximum power prior to takeoff will minimize thrust droop. Thrust can be increased up to 4% (1.6% fan speed increase by minimizing droop).

During extreme temperature conditions, predicted fan speeds infringe upon the minimum fan speeds required to meet desired single engine rates of climb. Rotating 10 kias prior to takeoff speed requires a higher fanspeed to sustain a desired climb rate than rotating at best single-engine rate of climb speed. Rotation may be delayed to use best single-engine rate of climb speed as takeoff speed to ensure single-engine rate of climb is attainable.

CAUTION

At high gross weights, takeoffs using single-engine rate of climb speed as takeoff speed may approach maximum main tire ground speed.

LANDING.

Anticipate a longer landing roll resulting from increased touchdown speed.

SECTION VIII

AIR REFUELING

TABLE OF CONTENTS

AIR REFUELING DESCRIPTION AND OPERATION.

MISSION PLANNING.

General.

This section reflects Emission Option 2 procedures unless noted within the text.

Inflight situations and sound judgement may dictate discontinuing communications procedures outlined for Emission Option 2.

Both tanker and receiver crew must be thoroughly familiar with all aspects of the refueling in order to adequately plan the mission. Planners will coordinate and crews will be thoroughly familiar with mission requirements as prescribed in the appropriate command directives.

The air refueling operation requires precise and detailed planning to insure success. Each receiver unit will maintain a file of TO 1-1C-1.

Control of Tanker/Receiver Forces.

An airborne tanker force commander and alternate commanders, as required by the mission, will be designated for each air refueling area. During operational missions, the tanker commander is in command of the air refueling operation from the period after positive radio contact between the tanker cell leader and the receiver leader during rendezvous until the end of refueling or termination of route cell formation, as applicable. The airborne tanker force commander will coordinate with the receiver force commander to insure successful mission completion.

Wingman/Receiver Responsibilities.

To assist the cell leader in insuring the safety and integrity of the flight, the wingman/receiver will:

a. Keep the leader in visual or electronic contact at all times.

b. Maintain briefed position at all times.

c. Anticipate corrections/changes and plan accordingly.

d. Monitor all aspects of formation operations and advise the cell leader if an unsafe condition is noted.

Airspeeds and Altitudes.

With KC-135 tankers, Air Refueling Airspeed is 220 KCAS at a base planning altitude of 15,000 feet. The tanker gross weight will be the prime consideration when determining the refueling airspeed and altitude. The use of speed brakes on the A-10C is not recommended.

NOTE

For planning purposes, ENROUTE speed with KC-135 tankers will be approximately 10 KCAS below A-10 maximum continuous power speed with three tanks and 41,000 pounds average gross weight or 242 KCAS at 15,000 feet.

Lower altitudes may be required for abnormally high free temperatures. The controlling agency directing the mission will be responsible for obtaining enroute and air refueling altitude clearance for training and operational mission.

Fuel Reserve Requirements.

For deployment operations, the last receiver in the cell will depart the penetration fix at the abort or destination base with a minimum of 30 minutes of fuel remaining, computed in accordance with appropriate AFIs as supplemented by the MAJCOM.

Weather.

Weather minimums are prescribed by AFI 11-202 Vol 3, GENERAL FLIGHT RULES (as supplemented by major commands). Buddy departure minimums are 1500 feet and 3 NM for day and 2500 feet and 3 NM for night takeoffs.

Rendezvous and air refueling will not be attempted when inflight visibility is deemed insufficient for safe air refueling operations. Minimum visibility for rendezvous is 1 NM. The A-10C TACAN may be used for DME information, and the UHF/ADF equipment provides bearing information for rendezvous.

COMMUNICATIONS.

Emission Option 2 will be used as the normal rendezvous and air refueling procedures. Emission Option 2, 3, or 4 procedures do not preclude verbal communications for safety of flight situations or to insure mission success. Boom Interphone should be used when compatible.

Communications procedures and plans for rendezvous and air refueling as outlined in pertinent command directives will apply. Deviations must be specifically authorized by the appropriate command headquarters.

Unless directed otherwise, communication capability between tankers and receivers will be maintained during all normal rendezvous and air refueling operations. Voice transmissions, however, will be held to an absolute minimum during rendezvous and air refueling to be in accordance with the Emission Option being used.

CAUTION

Except during an emergency fuel situation, air refueling operations will not be conducted when radio communications capability is lost between the tanker and receiver. If radio communications are lost, or unreadable between the boom operator and receiver pilot, contacts will not be attempted.

NOTE

During enroute rendezvous, all Air Refueling (A/R) equipment operations, interplane communications, and timing should be based on the Rendezvous (RZ) time. For example, the A/A TACAN should be turned to the appropriate channel 15 minutes prior to the Rendezvous Initial Point (RZIP) unless it is required for navigational purposes.

All crewmembers must be thoroughly familiar with all required oral, visual, and electronic means of communications. Strict radio discipline must be adhered to at all times. All calls will be prefaced with individual call signs. Tankers will begin monitoring designated frequencies and will have the Radar/Rendezvous Beacon operating at least 30 minutes prior to the rendezvous control time. The A/A Tacan will be turned to the appropriate channel 15 minutes prior to the rendezvous control time unless it is required for navigational purposes. Receivers will call 15 minutes prior to the air refueling control time, advising the tanker(s) of call signs, any changes in ETA (minutes early or late), and altitude and hot armament check (if required).

NOTE

If tankers and receivers are in contact with a common facility providing rendezvous assistance, then radio contact between the tankers/receivers may be delayed to accomplish the rendezvous.

The tanker will advise the receiver(s) of their call sign, air refueling altitude, and, if applicable, any change in tanker timing that would affect the rendezvous (in minutes early or late).

Tanker(s) and/or receiver(s) will make an additional radio call confirming level at the proper rendezvous altitude if they are not at the proper rendezvous altitude when the 15 minute prior to the rendezvous control time call is made.

NOTE

Tankers and receivers will include altimeter setting with appropriate altitude calls if other than 29.92 is used. For example, "RENO 01, one two thousand feet, altimeter setting three zero zero four, on time". If EMCON 3 or 4, altimeter setting must be prebriefed.

For all rendezvous and air refueling operations, tankers and receivers will normally use their individual flight call signs unless directed otherwise in operational plans.

When assured no other co-unit formation will be in range of or using the frequency, and/or a discrete tactical frequency has been assigned to the formation, flight call signs may be abbreviated for clarity and brevity purposes, for example, "RENO FLIGHT....GO ECHELON" (acknowledge) "TWO" "THREE".

Mandatory call for the receivers is as follows:

a. Initial radio call 15 minutes prior to the rendezvous control time.

b. Notify the tanker when established on the proper rendezvous altitude, if not at the proper rendezvous altitude at the 15 minutes prior to the Air Refueling Control Time (ARCT) call.

c. Precontact call (Required by Flight Leader only).

d. Report hot armament check complete for the night, if applicable.

Oral Communications.

NOTE

- With the exception of the breakaway calls, crew members may shorten individual flight call signs using only the number. Example: Tank 11 would be 11.

- Normally the receiver leader will proceed to the precontact position. When the leader has completed refueling, subsequent receivers will move from the observation position as precoordinated.

Normally boom visual signals will be used exclusively; however, if required or requested by the receiver, the boom operator will begin communications when the receiver reaches approximately 50 feet from the contact position. Direction, if required, will precede distance for receiver to move and will be given until the receiver reaches the contact position. Example: "Forward 50", "Up 4", "Back 2". When contact is established, the tanker will state, "(Tanker call sign) contact".

a. The communications requirements should be established prior to the flight.

b. For Emission Option 1 and 2, the boom operator will make a precontact radio check with the receiver(s) and the receiver(s) will acknowledge. Example: Tanker will say "25/57", the receiver will reply "25".

c. During receiver pilot demonstration of air refueling envelope limits, the boom operator will state boom limit and give the boom position for the limit being demonstrated in increments of 2.

d. When the tanker is required to use manual operation without disconnect capability, the boom operator will state, "(Receiver call sign), the following contacts will be made in tanker manual operation. Receiver air refueling system will remain in normal and receiver pilot must initiate all disconnects. (Tanker call sign), ready". Receiver pilot acknowledges by stating, "(Receiver call sign), ready".

e. The tanker must be notified prior to using the OVERRIDE position of the signal amplifier override switch. If mission requirements dictate the boom operator will switch to manual operation and will state "(Receiver call sign), the following contacts will be made in manual boom latching and receiver pilot must initiate all disconnects". "(Tanker call sign), ready". Acknowledge by stating "(Receiver call sign), ready". After the tanker is in manual operation, the receiver director lights should operate normally.

VISUAL SIGNALS.

Radio silent air refueling can be conducted by use of visual signals provided the following precautions and procedures are observed:

The method, time, and place of rendezvous and amount of fuel to be transferred must be covered in the briefing of each crew. The tanker will use the receiver director lights (red only) to aid in positioning the receiver. A steady red light indicates a large correction and a flashing red light indicates a small correction in the direction indicated. If the need for an emergency breakaway occurs during radio silent air refueling, oral breakaway procedures will be used along with the visual signals in Figure 8-1.

a. If the need for an emergency breakaway occurs during planned radio silence air refueling, oral breakaway procedures will be initiated unless security will be compromised.

b. If an emergency air refueling is required without two-way radio communication or during practice radio silence air refueling, the visual signals (Figure 8-1) will be used.

Figure 8-1. Visual Signals

SIGNAL	INDICATION
1. Boom in Trail	
(a) extended 10 feet	*Ready for Contact
(b) fully extended	1. Tanker Manual Operation without Tanker Disconnect Capability 2. Acknowledge Receiver's Manual Boom Launch (MBL) signal
(c) fully retracted	Offload Complete
2. Boom Stowed	
(a) fully retracted	Tanker Air Refueling System Inoperative
(b) extended 5 feet	System Malfunction, Tanker and Receiver Check Air Refueling Systems
3. Flashing Receiver Director Lights/Tanker Lower Rotating Beacon ON	BREAKAWAY
4. ***Receiver Director Lights Going OUT During Contact	Tanker Request for Disconnect, Receiver return to Pre-contact Position
5. Receiver Closing and Opening Receptacle Door when in Pre-contact Position	1. MBL 2. Acknowledge Tanker's Manual Operation without Tanker Disconnect Capability Signal
6. **Steady Light from Receiver or rock wings	Emergency Fuel Shortage Exists
7. Flashing light from receiver cockpit area	Initiate toboggan maneuver
8. Same receiver returns to pre-contact with receptacle door open (DAY); Pilot signals closed fist, thumb to mouth plus hand signaling number. ****(NIGHT): Same receiver returns to pre-contact with receptacle door open, ready for contact.	Additional Fuel required - EMCON 2-4.

Figure 8-1. Visual Signals - Continued

SIGNAL	INDICATION
(a) Same receiver returns to pre-contact - Ready for contact. Pilot signals closed fist plus hand signaling number (DAY). ****(NIGHT): Same receiver returns pre-contact - Ready for contact.	
* Receiver(s) in the observation position will move to the pre-contact position in their briefed sequence only after insuring that the boom is in the ready for contact position and the preceding receiver has cleared the tanker. The receiver will stabilize in the pre-contact position, then move to the contact position. The boom operator will not give the ready for contact signal until the preceding receiver has cleared the tanker. ** If fuel shortage occurs at times other than scheduled air refueling, the receiver should be positioned so the signal may be seen from the tanker cockpit. *** The receivers will advise the tanker of any pilot director light malfunctions/deficiencies. **** Additional fuel offloaded will be 5M for large receiver aircraft, 2M for small receiver aircraft, on each subsequent contact.	

HOT ARMAMENT PROCEDURES.

Prior to rendezvous with the tanker for air refueling, receiver aircraft carrying forward firing ordnance will conduct a hot armament safety check in accordance with Section II. When radio silence is mandatory, the receiver leader will conduct a visual challenge with each member of his flight by pointing his index finger straight forward and thumb upward (simulating a pistol). Each member of the flight will complete the safety check and respond to the leader by raising his hand and showing circle formed by his index finger and thumb. To reduce the possibility of inadvertent firing, receivers will not reposition any electrical switches while behind a tanker unless those switch changes are required for air refueling operations or aircraft control.

LIGHTING.

While approaching the precontact/contact position, the receiver pilot can adjust lighting as required by the boom operator.

Single KC-135 tankers will display red and white (without TCTO 1339). (With TCTO 1339) both upper and lower strobes will display red.

NOTE

- Visual contact for night air refueling can be aided by requesting the tanker to flash his landing lights prior to and/or during the tanker turn.
- If the spare is used during the air refueling, the appropriate color code will be displayed until the receiver is in the precontact position. To further aid in identification, tanker position lights will be placed on BRIGHT and FLASHING for number 1, 3, and 5. Position lights for numbers 2 and 4 will be BRIGHT and STEADY. Position lights will be set prior to takeoff. After the receiver has established visual contact and has closed to 1/2 NM in trail, tankers will turn position lights to STEADY and DIM and turn lower rotating beacon (without TCTO 1339) strobe (with TCTO 1339) light OFF. When any aircraft will be flying visual wing formation on the tanker, the tanker will also turn off the upper rotating beacon (without TCTO 1339) strobe (with TCTO 1339). In this case, the last (outside) receiver aircraft with each tanker will have anticollision lights ON. When receivers reach the observation position, tankers will turn underwing, under body, and nacelle illuminating lights to DIM. Exterior lights will then be adjusted as required by the receiver pilot.

KC-135 identification lighting is as follows:

TANKER NUMBER	LIGHT COLOR UPPER	LOWER
1	RED	RED
2	WHITE	WHITE
3	RED-WHITE	RED-WHITE
	WITH TCTO 1339	
	RED	WHITE
4	WHITE	RED

Receiver Director Lights.

The director lights do not give true vertical and horizontal information. The up-and-down lights change because of angular movement of the boom and the fore-and-aft lights change because of in-and-out movements of the boom. The axis of the director lights system is inclined at a 30-degree angle to the fuselage. This angle causes an interaction in both lights when a true vertical or horizontal movement is made by the receiver. For example, flying straight forward while in contact will cause the boom to compress and also increase its angle with the tanker fuselage. The lights will show that the aircraft is flying forward and down. If a true up movement is made, the boom will compress and also lessen its angle with the tanker fuselage giving a combined up-and-forward indication from the lights. Small fore-and-aft corrections can be made with little or no power change by moving vertically.

KC-135.

Receiver director lights are on the bottom of the fuselage directly aft of the nose landing gear. (Refer to Figure 8-2.) They consist of two rows of lights; the left row for elevation and the right row for telescoping. The elevation lights consist of five colored panels with a green stripe, green and red colors, and two illuminated letters, D and U, for down and up respectively. (Refer to Figure 8-3.) The colored panels are illuminated by lights that are controlled by boom elevation during contact made. There is an illuminated white panel between each panel to serve as a reference. The letters, A for aft and F for forward, augment the colored panels on the telescope side. The receiver pilot director lights will remain illuminated and follow boom movements in both the contact made and disconnect conditions. There are no lights for azimuth position. A fluorescent yellow stripe on the bottom center of the tanker fuselage may be used as a centerline reference by the pilot. The triangular-shaped panels are for elevation and the rectangular-shaped panels are for forward-and-back movement.

NOTE

The forward centerline location of the A-10 receptacle and the pilot also being in a centerline position, places the boom where it may obscure the director lights when the receiver is "in the green" during contact. Using standard closure procedures from the observation, to Precontact, to the Contact position should minimize any problems by non-observance of the director lights. Boom operator assistance should be utilized if in doubt.

BOOM ENVELOPE LIMITS.

The refueling envelope (Figure 8-4) is limited by the refueling receptacle location. As long as the receiver is positioned within these limits, contact can be maintained despite rolling, yawing, or pitching.

CAUTION

Approaching boom upper, lower, and side limits at a relatively high velocity can cause structural damage as a result of an inability to disconnect due to binding action of the boom nozzle.

NOTE

The boom operator will disconnect at automatic disconnect limits if automatic disconnect does not occur.

NAVIGATION AND POSITION REPORTING.

When the rendezvous is complete, tankers will be responsible for all navigation, weather avoidance, and position reporting. The tanker pilot will, once each hour, advise the receiver pilots of the cell geographic position, heading, distance, and ETE to the next checkpoint or destination, as applicable. If the receiver pilot has not completed his onload upon reaching his geographic air refueling abort point, the tanker pilot will so advise.

NOTE

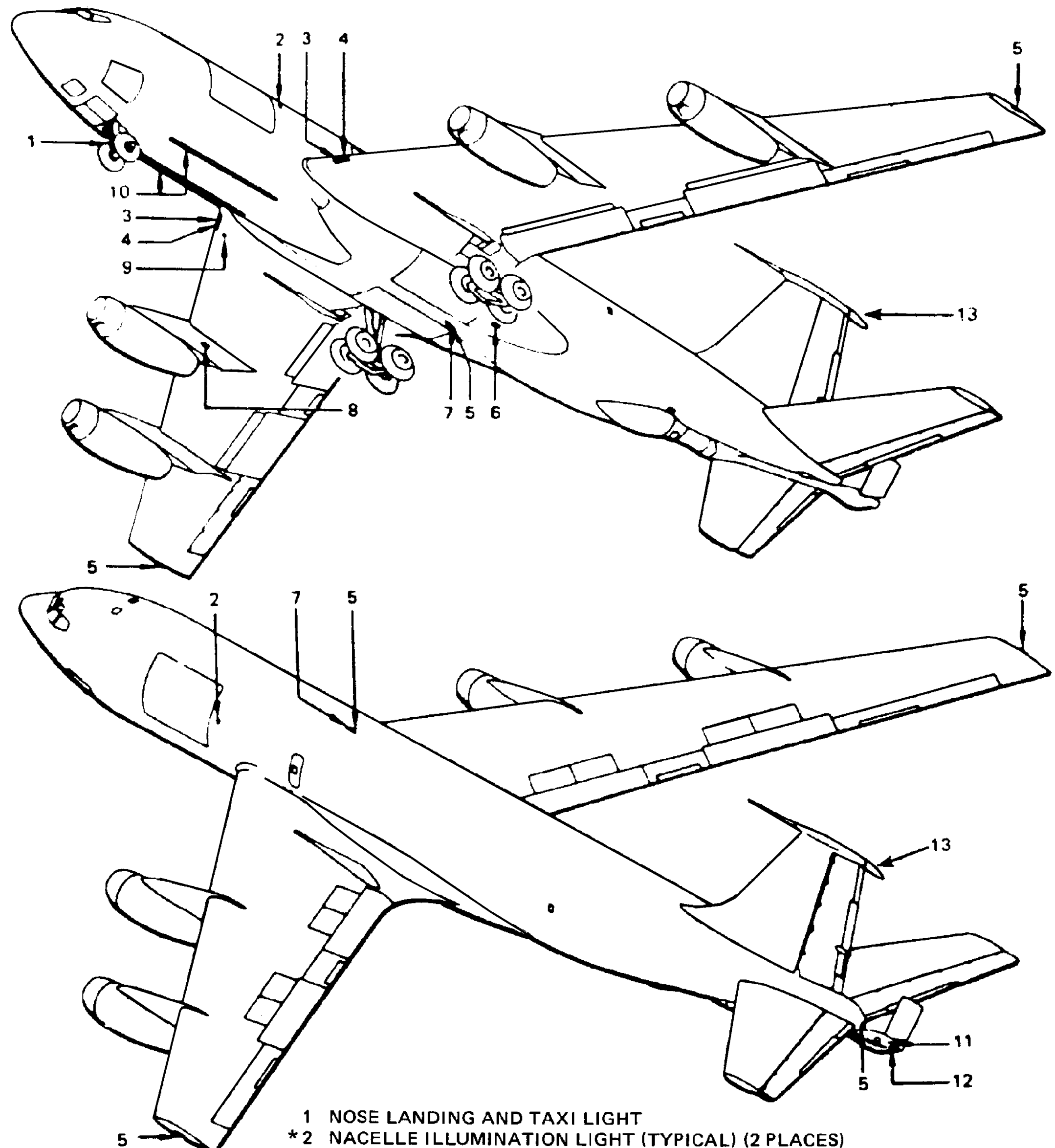
During refueling operations conducted within a preplanned orbit pattern, the tanker is not required to provide the above information unless requested by the receiver leader.

POST AIR REFUELING.

Upon completion of air refueling the tanker will normally climb to the top and the receiver(s) will descend to the bottom of the air refueling block. The receivers should maneuver to the prescribed formation position while awaiting the post air refueling report and further ARCT clearance. The tanker will give post air refueling information to the receiver as required. The receiver will advise the tanker of any pilot director light malfunctions/deficiencies, e.g., lights intermittent, inoperative, dim, dirty, etc. Upon termination of air refueling, all exterior lights will be as directed.

WARNING

Receivers will insure a safe clearance from the tanker(s) as they proceed on their assigned missions. Receiver(s) required to accelerate past the tanker(s) and climb on the refueling heading will maneuver either left or right (a minimum of 1 NM) of track to preclude climbing directly in front of the tanker(s)/remaining receiver(s). Tanker(s)/remaining receiver(s) flying through departing receivers’ jet wash may experience damage to the aircraft and injury to personnel.



1 NOSE LANDING AND TAXI LIGHT
*2 NACELLE ILLUMINATION LIGHT (TYPICAL) (2 PLACES)
3 TAXI LIGHT (2 PLACES)
4 LANDING LIGHT (FIXED) (2 PLACES)
*5 NAVIGATION/POSITION LIGHTS (7 PLACES)
*6 UNDERWING ILLUMINATION LIGHT (TYPICAL)
7 ROTATING/RENDEZVOUS BEACON LIGHTS (WITHOUT TCTO 1339) STROBE LIGHTS (WITH TCTO 1339) (2 PLACES)
*8 UNDERBODY ILLUMINATION LIGHT (TYPICAL)
9 TERRAIN LIGHT (RETRACTABLE)
*10 RECEIVER PILOT DIRECTOR LIGHTS
11 BOOM MARKER LIGHTS (FLUORESCENT)
*12 BOOM NOZZLE LIGHT
*13 A/R FLOOD LIGHTS

*DESIGNATES ADJUSTABLE LIGHTING

13467-238

Figure 8-2. KC-135 Exterior Lighting

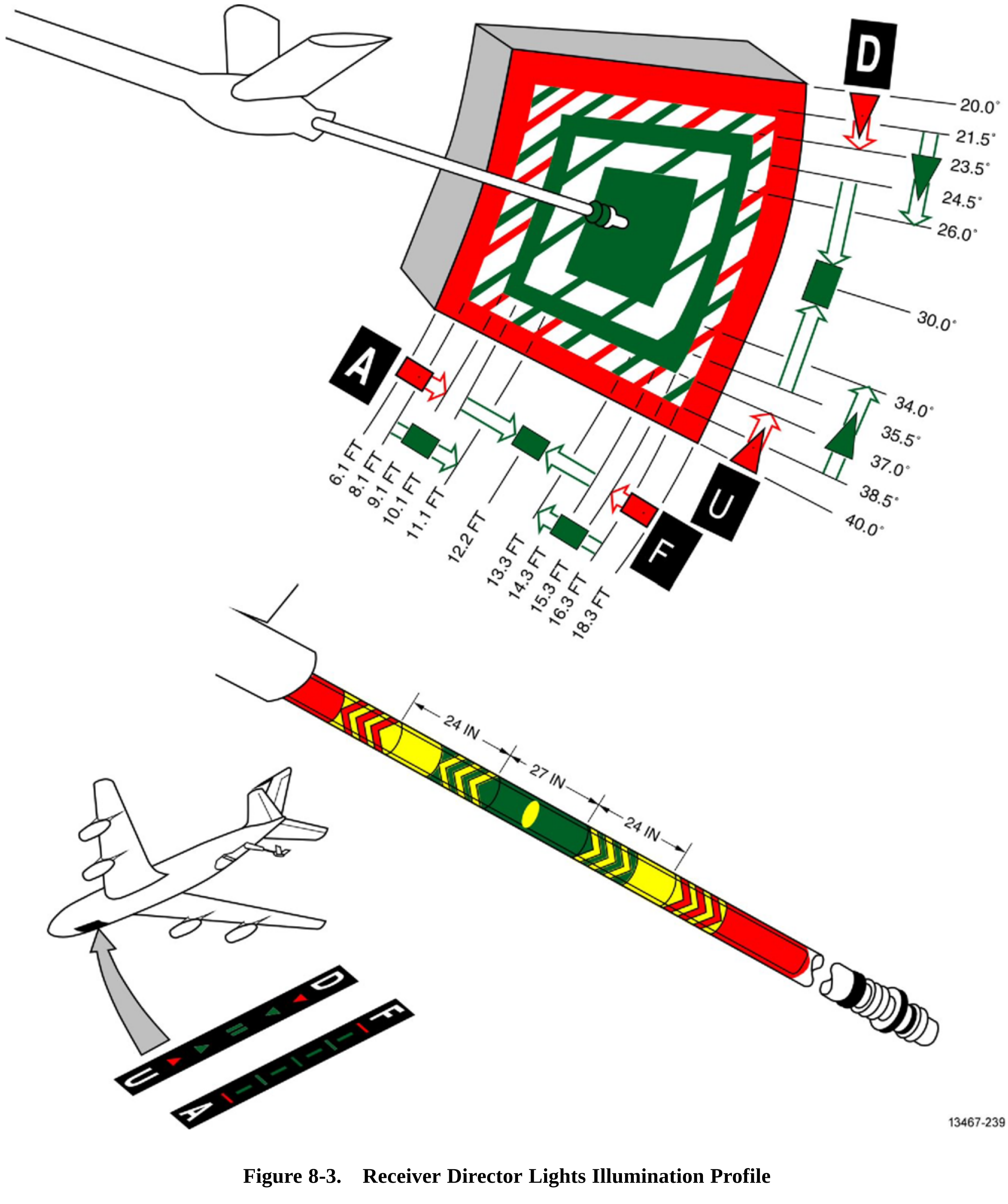


Figure 8-3. Receiver Director Lights Illumination Profile

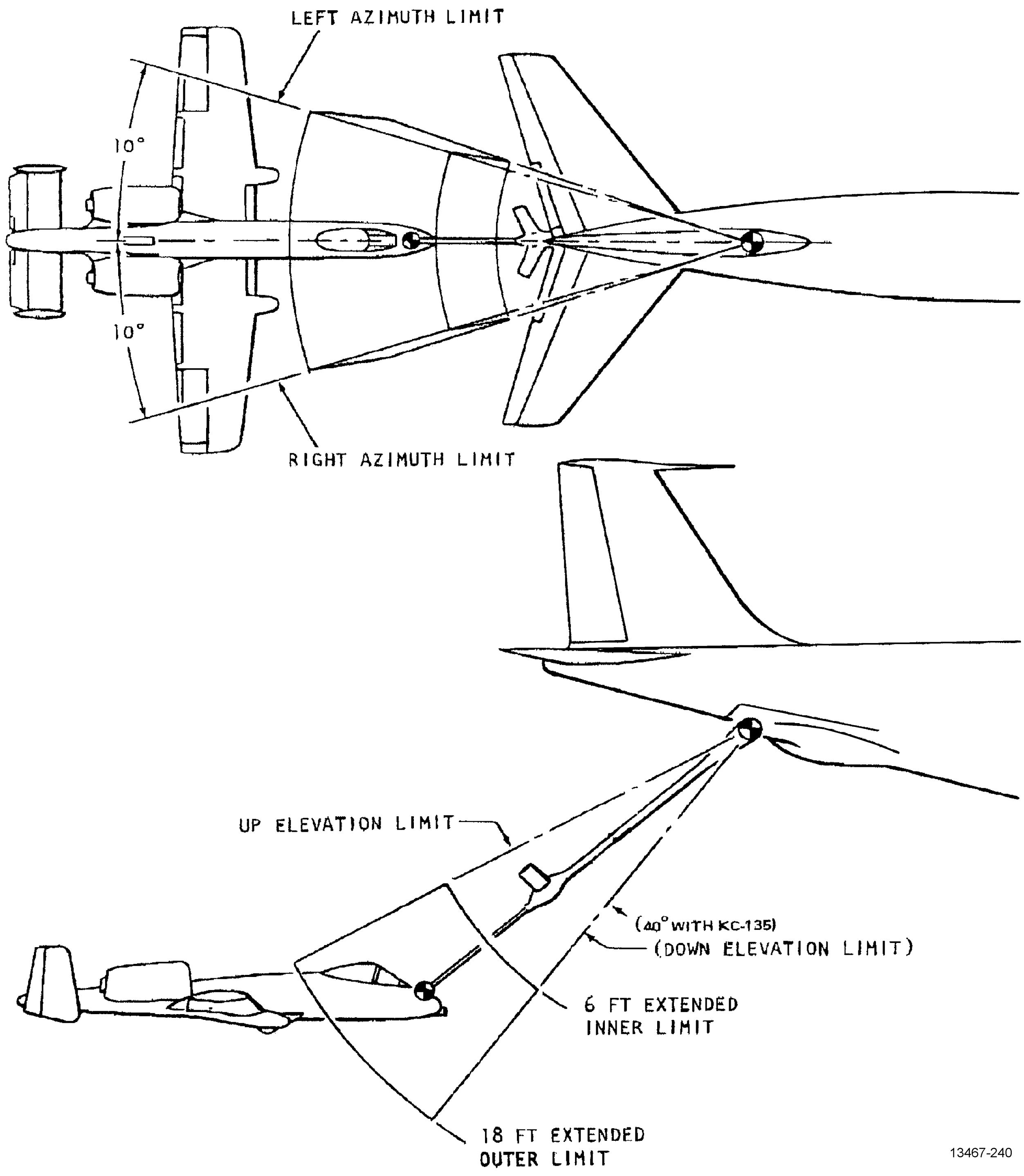


Figure 8-4. Boom Envelope Limits

Figure 8-5. Emission Option Communications

Item	Action	Emission Option 1	2	3	4
1	Radios set 30 minutes prior to ARCT (if dual radio capable)	X	X	*	**
2	15 minute call	X	X		
3	A/A Tacan set 15 minutes prior to ARCT	X	X	X***	
4	Beacon positive identification (if applicable)	X			
5	ADF check (if applicable)	X			
6	1/2 way thru turn call (tanker)	X			
7	Mandatory Boom Operator Calls				
	a. Precontact Call	X	X		
	b. Clear Receiver to Contact	X			
	c. Acknowledge Contact/Disconnect	X			
	d. Verbal Corrections	X			
	e. Advise Receiver(s) to Return to Precontact for checklist or equipment considerations	X			
8	Mandatory Receiver Calls After 15 Minute Call				
	a. Visual Contact Established/Lost to Include Overrun	X			
	b. Precontact Call	X	X		
	c. When Contact or Disconnect is made	X			
	d. Verbally notify boom operator prior to Manual/Emergency Boom latching procedures	X	X		
9	Post Air Refueling Report	X	X		
10	1 mile closure call (receiver)	X			

NOTE

Variations may be indicated by "EMCON 2. Item 7a./8b. COMM N/A.". This would mean normal Emission Option 2 procedures except the Precontact call would be deleted.

* Radio silent. Use of other emitters is authorized unless prohibited by Supported Operations Plans.

** No emissions (radios, doppler, navigation transmitters, radar, IFF, exterior lighting, etc.) unless authorized by Air Tasking Order, Rules of Engagement, Operations Plans, Safe Passage Procedures, or other mission directives.

*** Point Parallel only.

Figure 8-6. Emission Option Emitters (EMCON)

Item	Equipment	Emission Option			
		1	2	3	4
1	RADAR	On	On	As Required	Off
2	DOPPLER	On	On	As Required	Off
3	RADIO ALTIMETER	On	On	As Required	Off
4	TACAN/DME	On	On	As Required	Off
5	IFF	On	On	As Required	Off
6	UHF/VHF	On	On	Monitor	Monitor
7	HF	On	On	Monitor	Monitor
8	LIGHTING	On	On	As Required	Off

NOTE

Variations may be indicated by "EMCON 3. Item 1 Emitters Off.". This would mean normal Emission Option 3 procedures except the radar would be off.

NORMAL PROCEDURES.

CELL LEADER RESPONSIBILITY.

The tanker cell leader or specified commander is responsible for the command and control of the formation and the air refueling operation. The cell leader or specified commander will coordinate with the receiver force commander to ensure successful mission completion. Formation integrity and discipline begin with the formation briefing. The cell leader must insure that all aspects of the mission are clarified and understood.

Normally, lead responsibilities pass from number one to number two to number three; however, all pilots must be prepared to assume full responsibility for the formation at any time. When it is necessary to transfer lead responsibilities, all airplanes in the affected formation will be notified when the new leader assumes responsibility for the formation.

The tanker cell leader/specified commander must take every feasible action to enhance the possibility of completing air refueling.

BUDDY DEPARTURE.

A buddy departure is effected when the tanker(s) and receiver(s) take off from the same base and visual contact is maintained. Buddy departure procedures may not provide the most expeditious/fuel efficient rejoin with A-10 aircraft due to a large (35 knots) difference in climb speed. An Enroute Overtaking Rendezvous at a predetermined rendezvous point may provide for a more expeditious/efficient rejoin.

Taxi.

After engine start, receivers will check in with the tanker on the predetermined frequency. When ready to taxi, each tanker will call, "(Tanker call sign) -Taxiing". A distance of 300 feet will be maintained between tankers and receivers.

Line-Up.

On runways at least 300 feet wide, the tanker will line up on the downwind side of the runway. The receivers will be positioned on the upwind side of the runway, maintaining wing tip clearance.

NOTE

On runways less than 300 feet wide, the receiver will remain in the number 1 position until the tanker rolls.

Takeoff.

Tankers and receivers will take off in elements of one tanker plus one or more receivers. The tanker will roll first followed in 45 seconds by the first receiver in his element. Each element will be individually cleared for takeoff by the tower after the last aircraft in the preceding element has passed the end of the runway. Takeoff interval may be varied when weather, terrain, airfield conditions or other considerations dictate.

WARNING

Wake turbulence generated by preceding aircraft may create a hazard during buddy takeoffs and join-ups.

Aborts During Takeoff.

An aborting aircraft will make abort call on the pre-briefed common frequency as soon as possible. Frequency changes will not be made by tanker/receivers until all aircraft in the same clement are airborne.

Rendezvous Altitude Block.

Four consecutive altitudes shall be requested by the tanker for rendezvous and refueling. When four altitudes are available, the rendezvous will be effected with the tanker at the second altitude and the fighter at the third. For example, when the refueling altitudes available are FL290, 300, 310, 320, the tanker will be at FL310 and the fighters at FL300 for rendezvous, thus providing 1000 feet above the tankers and 1000 feet below the fighters. When tankers are in cell they will stack up from FL310, in this specific case.

When only three altitudes are available, the tanker shall be at the top altitude with the fighters at the mid altitude providing 1000 feet below the fighters.

When only three altitudes are available and the refueling involves tanker cell formation, the highest tanker within the cell should be at the top of the block. To accomplish this, the tanker leader shall place himself at an altitude that will permit the highest tanker in his cell to be at the top of the block. For example, when there are two tankers and available block is FL270-290, tanker leader would be at FL285 and number two tanker is at FL290. The fighters would rendezvous at FL275 (1000 feet below the lowest tanker).

The above procedures do not apply when aircraft are operating on an Altitude Reservation (ALTRV) or when clearance has been granted for aircraft to operate as an enroute cell. In these cases, the altitude block will provide airspace necessary to accommodate the type of formations being used (standard or non-standard), with at least 1000 feet between the highest receiver and lowest tanker during rendezvous, and at least 1000 feet below the air refueling formation once the rendezvous is complete.

TANKER RENDEZVOUS EQUIPMENT.

Tanker rendezvous equipment consists of the following:

a. KC-135.

(1) A/A TACAN - DME only.

(2) Radar beacon AN/APN-69 (all aircraft) and AN/APN-134 (some aircraft).

(3) Automatic Direction Finder -AN/ARA-25.

b. KC-10 - see KC-10/KDC-10 AIR REFUELING PROCEDURES.

RECEIVER FORMATION DURING RENDEZVOUS.

Formation procedures after level off or from the Air Refueling Initial Point (ARIP) until join-up with the tankers will be as follows:

NOTE

Formation lead changes and join-ups will normally be completed prior to departure from the ARIP. Should such maneuvers be required subsequent to departure and prior to join-up on the tanker(s), the rendezvous will not be continued unless the flight leader is positive of his position in relation to the tanker(s) and the published A/R tracks.

Day VMC (visibility five miles or better). Flights will be in trail, offset to the right of the preceding flight. When all aircraft are in visual contact with the tankers, each aircraft/flight will join with his respective tanker as briefed.

IMC or night. Flights of four aircraft will be in the briefed formation with succeeding flights positioned in a like formation.

KC-10/KDC-10 AIR REFUELING PROCEDURES.

INTRODUCTION.

NOTE

The following information is provided to amplify only the differences to KC-135 tanker procedures contained herein.

PILOT DIRECTOR LIGHTS - KC-10.

The pilot director lights consist of two rows of lights located forward of the wing root. (Refer to Figure 8-7.) Relative elevation position is provided by the left row; the right row provides telescoping position. (Refer to Figure 8-8.) The elevation row contains one striped green, two amber, and two red triangular panels and two white letters: "U" at the forward end for UP, and "D" at the aft end for DOWN. The colored panels and letters are dimly illuminated by background lights. The telescoping row contains one striped green, two amber, two red, and four white rectangular panels and two white letters: "A" at the forward end for AFT, and "F" at the aft end for FORWARD. The colored panels are not background lighted; however, the letter at each end of the row is dimly illuminated. Separation is provided by the white panels. The pilot director lights are adjusted by the boom operator to the size air refueling envelope for each receiver and provide guidance during contact.

To provide more response time, the appropriate panel and letter are illuminated in anticipation of receiver movement. The director lights provide commands based on both receiver position and rate of movement. Figure 8-8 shows the lights with no receiver motion. With rapid motions of the receiver, the lights can show a correction required even though the receiver is in the center of the envelope.

The red panel and letter at the ends of each row can be illuminated by the boom operator to aid the receiver in attaining the contact position.

RENDEZVOUS EQUIPMENT - KC-10.

Search Radar, UHF/DF, TACAN A/A (Range and Bearing) and INS.

COMMUNICATIONS - KC-10.

UHF, HF, VHF and BOOM INTERPHONE.

DISCONNECT - KC-10.

The KC-10 aerial refueling boom is controlled by a digital fly-by-wire system. Certain failure conditions of this system may cause one or more axes of the boom control system to become inoperative. Should this occur, the boom operator may not be able to maneuver the boom to avoid striking the receiver airplane. In this situation, the boom operator will issue instruction to direct the receiver to a position where a safe disconnect can be effected. The envelope limits of the boom are shown in Figure 8-9. The receiver disconnect limits are shown in Figure 8-10.

WARNING

- When notified that a KC-10 boom flight control system failure has occurred, do not initiate a disconnect unless directed by the boom operator.

- Follow the boom operator's instruction explicitly. To reduce the probability of boom strike after disconnect, it may be necessary to remain in a stabilized position to allow for aerodynamic fairing of the boom control surfaces.

Another feature of the KC-10 is the Independent Disconnect System. This system allows the KC-10 boom operator to obtain a disconnect even when the receiver's toggles remain in the latched position. This system should be used in lieu of a Brute Force Disconnect.

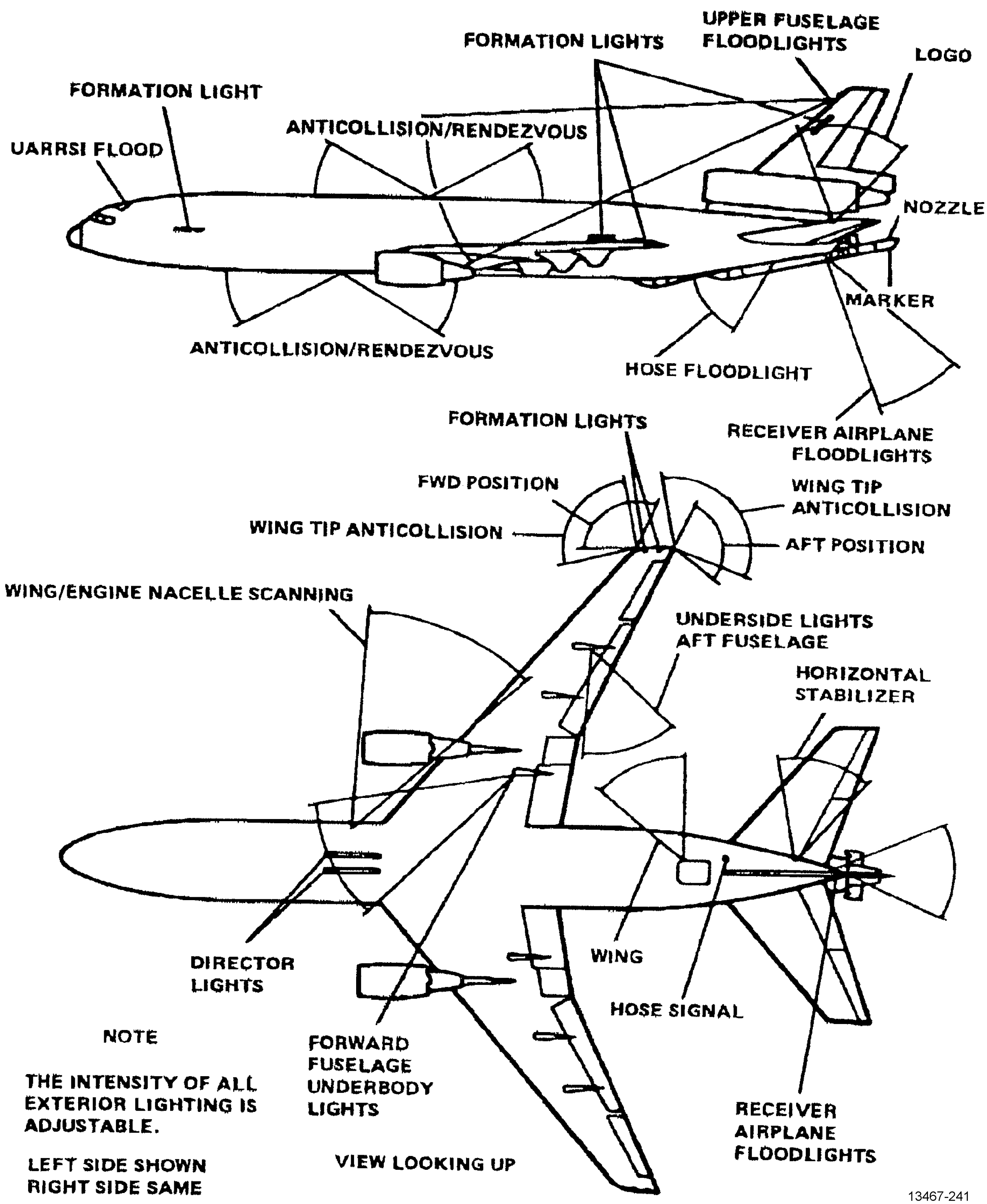


Figure 8-7. Position of KC-10 Lights

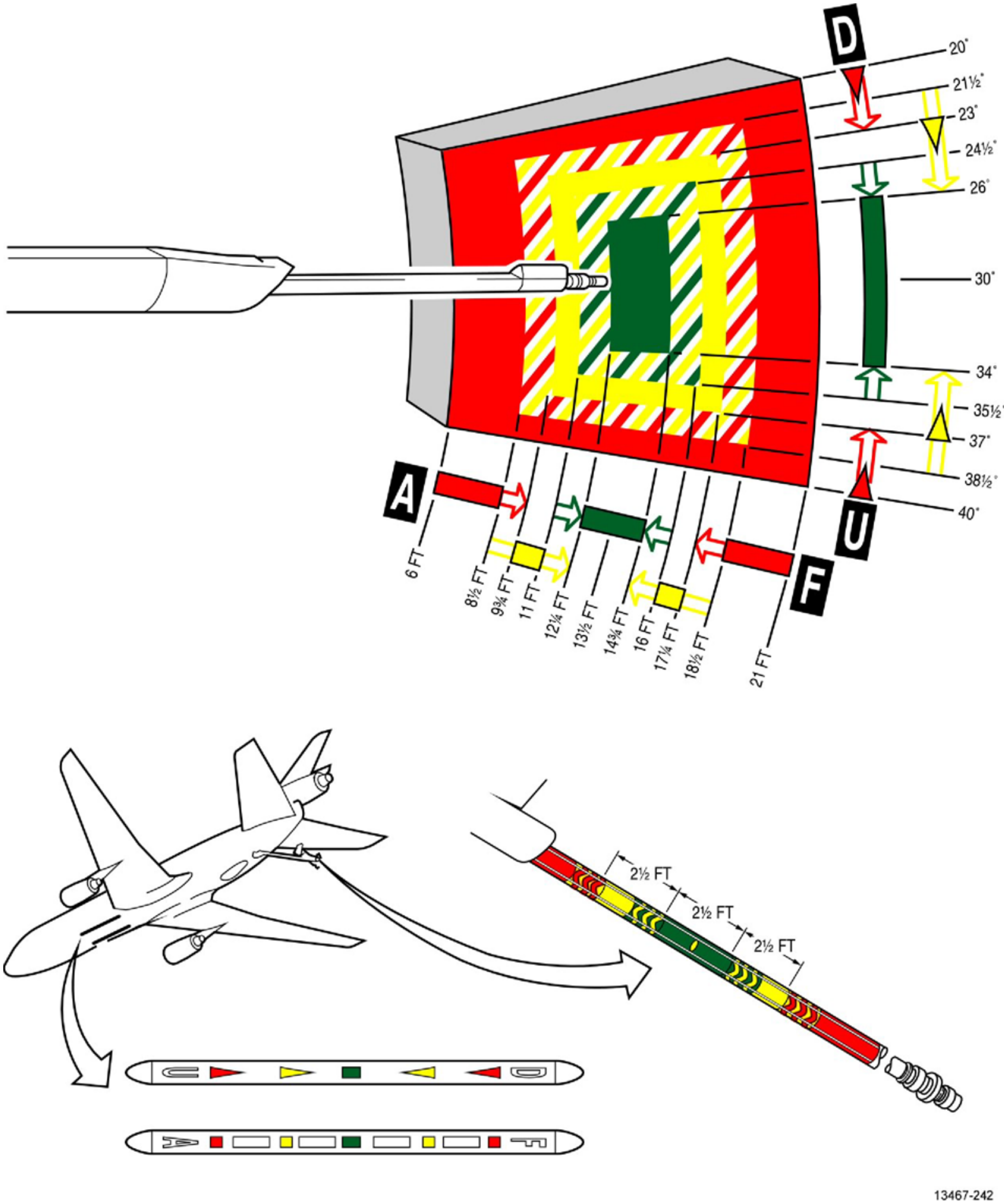


Figure 8-8. Pilot Director Lights

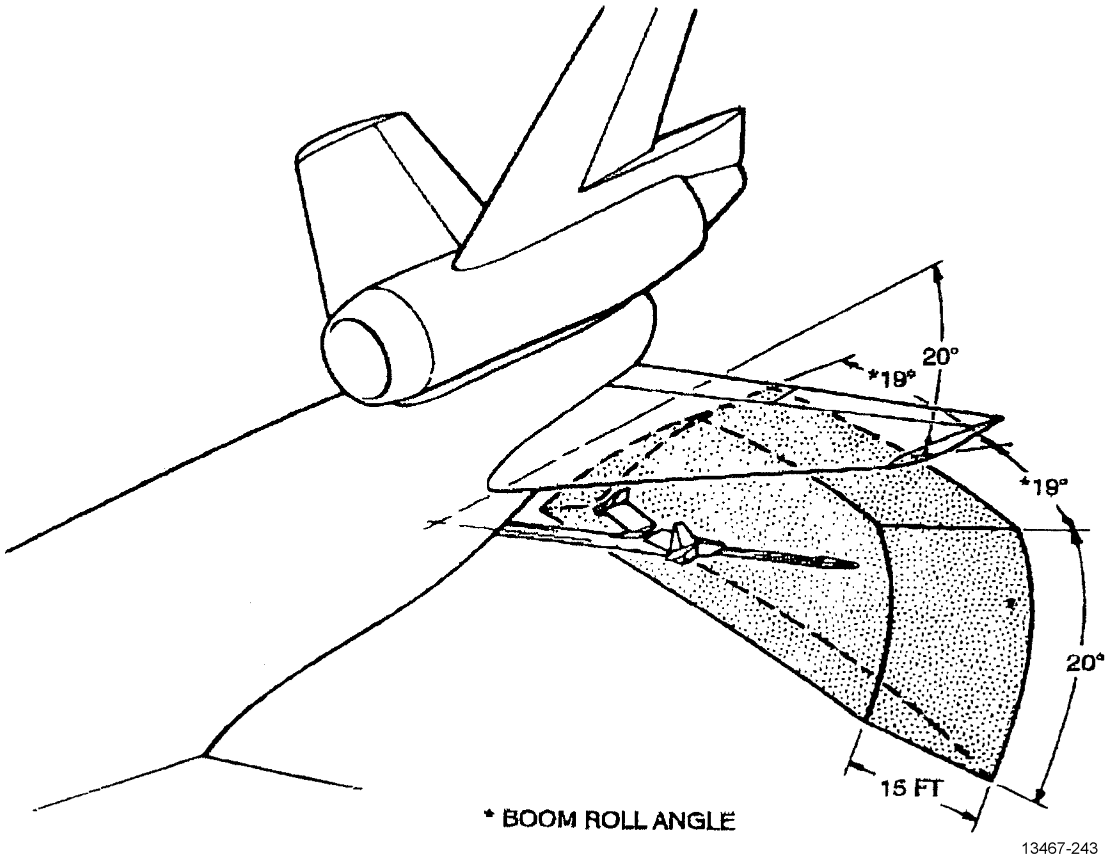


Figure 8-9. Boom Envelope Limits (KC-10)

AIR REFUELING OF DEPLOYMENT CONFIGURED A-10s.

For air refueling of deployment configured A-10s (two external tanks and two ECM pods) use the following guidelines:

Air refueling altitude:	15,000 MSL (Max).
Buddy cruise altitude:	20,000 MSL (Max).
Air refueling airspeed:	210 KIAS (Min).
Buddy cruise airspeed:	230 KIAS (Max).
Max KC-10A start air refueling weight:	540,000 pounds.

The KC-10A will require slats extended until the gross weight reaches approximately 420,000 pounds, standard day conditions. This gross weight and below will allow the KC-10A to maintain clean the 210 KIAS air refueling speed at 15,000 MSL and 230 KIAS at 20,000 MSL during cruise. The 540,000 pounds KC-10A maximum gross weight is limiting only so far as the A-10 is power limited and unable to break through the KC-10A down wash under these conditions. The only way possible for the A-10 to effect a hook-up above 540,000 pounds KC-10A gross weight would be for the KC-10A to tobbogan for each receiver. This should be done as a last resort. Figure 8-11 shows mission planning and in-flight data for air refueling.

RCVR TYPE	UPPER LIMIT	LOWER LIMIT	LEFT LIMIT	RIGHT LIMIT	INNER LIMIT	OUTER LIMIT
A-10C	20°	40°	19°	19°	6 ft	21 ft
NOTE: The tanker’s lower automatic disconnect limit is set for 40° but the receiver pilot should stay at a high enough elevation to maintain tanker perspective through the windscreen.						

Figure 8-10. Receiver Disconnect Limits

TYPE TANKER	CRUISE A/R ALTITUDE	BUDDY CRUISE TANKER KCAS	A/R TANKER KCAS	OVERRUN TANKER KIAS	TRANSFER RATE
KC-10	19,000	210	210	250	3,000 PPM

Figure 8-11. Air Refueling Mission Planning and Inflight Data Chart

GLOSSARY

1

1553 RAM - 1553 Bus Random Access Memory

A

A-A - Air-to-Air
A/C - Aircraft
A-G - Air-to-Ground
A/R - Air Refueling
A/S - Air Speed
A/W/E - Aircraft/Weapons/Electronics
AAP - Avionics Auxiliary Panel
ACC - Accuracy
ACC/REJ - Accept/Reject (Page)
ACCEL - Accelerometer
ACD - Adapter Control Detector
ACP - Armament Control Panel
ACS - Armament Control System
ADF - Automatic Direction Finder
ADI - Attitude Director Indicator
ADJ - Adjust
AERP - Aircrew Eye/Respiratory Protection
AFSEO - Air Force Seek Eagle Office
AGC - Automatic Gain Control
AGL - Above Ground Level
AGM - Air-To-Ground Missile
AHCP - Armament HUD Control Panel
AIL - Aileron
AIR - Air Inflatable Retarder
AIS - Aircraft Instrumentation System
AJ - Anti-Jamming
ALM - Almanac; Armament Logic Module
ALT - Altitude
ALTALGN - Alternate Align (Page)
ALTRV - Altitude Reservation
AMIL - Air Mass Impact Line
ANT - Antenna
AOA - Angle of Attack
AOS - Aircraft On-Station
API - Armor Piercing Incendiary
APTD - Aircraft Position and Target Designation
APTD RQST - Aircraft Position and Target Designation Request
APU - Auxiliary Power Unit
AQD - Automatic Quick Disconnect
ARCT - Air Refueling Control Time
ARIP - Air Refueling Initial Point
ARS - Attitude Reference Symbol
AS/ALT - Airspeed and Altitude
ASL - Azimuth Steering Line
ASU - Antenna Switching Unit
ATS - Air Turbine Start
ATT - Attitude
ATTD - Attitude
ATTRIB - Attribute
AUX - Auxiliary
AV Bus 3 - MIL-STD-1553 Avionics Bus 3

B

B ALT - Barometric Altitude
BARO - Barometric
BATA - Bullets at Target Altitude
BATH - Best Available True Heading
BB CTL - Bitball Control (Page)
BDA - Battle Damage Assessment
BDU - Bomb Dummy Unit
BE - Bullseye
BIT - Built-in Test
BITE - Built-in Test Equipment
BLU - Bomb Live Unit
BRT - Bright
BT - Black Track

C

C - Convergence Factor
CADC - Central Air Data Computer
CAS - Calibrated Air Speed
CAS - Close Air Support
CBIT - Cumulative BIT
CBU - Cluster Bomb Unit
CCD - Charge Coupled Device
CCIP - Continuously Computed Impact Point
CCRP - Continuously Computed Release Point
CCTVS - Color Cockpit Television Sensor
CCW - Counterclockwise
CDI - Course Deviation Indicator
CDU - Control Display Unit
CEP - Cumulative Error Probable
CG, cg - Center of Gravity
CHAN - Channel
CICU - Central Interface Control Unit
CM - Combat Mix
CMS - Countermeasures Set or System
CMMS - Countermeasures Management Switch
CMSC - Countermeasures Set Control
CMSP - Countermeasures Set Processor
COMP - Compass
CONV - Converter
CORE RPM - Speed of shaft connecting the high pressure turbine and the engine compressor
CR - Coordinate Ranging
CRS - Course
CRSDEV - Course Deviation
CRT - Cathode Ray Tube
CSR - Cursor

CTR - Center
CTU - Cargo Transport Unit
CW - Clockwise; Continuous Wave

D

DDPU - Digital Data Processing Unit
DECR - Decrement
DEPR - Depression
DIP - Depart Initial Point
DIS - Distance
DISENG - Disengage
DKI - Display and Keyboard Interface
DLZ - Dynamic Launch Zone
DME - Distance Measuring Equipment
DMH - Desired Magnetic Heading
DMS - Data Management Switch
DN - Down
DNLD - Download
DOM - Day Of Month
DOY - Day Of Year
DPRAM - Dual Purpose Read Only Memory
DRA - Dual Rail Adapter
DRC - Desired Release Cue
DSMS - Digital Stores Management System
DTC - Data Transfer Cartridge
DTOT - Desired Time-on-Target
DTS - Data Transfer System
DTSAS - Digital Terrain System Application Software (DTSAS)
DTTG - Desired Time-to-Go
DUR - Duration
DVADR - Digital Video Airborne Data Recorder
DVOF - Digital vertical Obstruction File(s)

E

EAC - Enhanced Attitude Control
ECHUM - Electronic Chart Update Manual
ECM - Electronic Countermeasures
ECS - Environment Control System
ECU - Environment Control Unit
EEPROM - Electronically Erasable Programmable Read Only Memory
EGI - Embedded GPS/INU
EGT - Exhaust Gas Temperature
EHE - Expected Horizontal Error
EL - Elevation
ELEV - Elevator
EMB - Expanded Memory Board
EMER - Emergency
EMI - Electromagnetic Interference
ENAV - Embedded GPS/INU Navigation
ENG - Engine
EO - Electro-Optical
EOT - End Of Tape
EPU - Electronic Processor Unit
ESPS - Engine Stall Prevention System
ETE - Estimated Time Enroute
ETP - Electrical Test Panel
EVE - Expected Vertical Error
EW - Electronic Warfare
EWMS - Electronic Warfare Management System
EWMU - Electronic Warfare Management Unit
EWPI - Electronic Warfare Prime Indicator
EXT - External, Extension

F

FA - Fault Acknowledge
FAC(A) - Forward Air Controller (Airborne)
FAN RPM - Speed of shaft connecting the low pressure turbine and the fan
FCF - Functional Check Flight
FCS - Flight Control System
FDC - Flight Director Computer
FEDS - Firing Evaluation Display System
FGP - False Ground Plane
FLIP - Flight Information Publication
FLT CONT - Flight Control
FLT INST - Flight Instrument
FMT - Frequency Management Training
FOM - Figure of Merit
FOV - Field of View
FP - Flight Plan
FPM - Feet Per Minute
FPM - Flight Plan Menu
FPP - Floating Point Processor
FRND - Friend
FRPA - Fixed Reception Pattern Antenna

G

G, g - Gravity
G ALT - GPS Altitude
GBL - Gun Bore Line
GBU - Guided Bomb Unit
GCAS - Ground Collision Avoidance System
GEM - GPS Embedded Module
GEN - Generator
GH - Grid Heading
GMIU - Guided Missile Interface Unit
GMT - Greenwich Mean Time
GPS - Global Positioning System
GS - Ground Speed
GSI - Glide Slope Indicator
GSO - Ground Safety Override
GTK - Ground Tracking
GUK - Government User Keys
GVM - Graphics Video Module

H

HARS - Heading Attitude Reference System
HD - High Drag
HDC - Helmet Designation Cue
HDG - Heading
HDGP - High Drag General Purpose
HEI - High Explosive Incendiary
HI - High
HM - Hot Mic
HMCS - Helmet Mounted Cueing System
HMD - Helmet Mounted Display
HOTAS - Hands On Throttle And Stick
HPU - Horizontal Position Uncertainty
HQ - Have Quick
HSI - Horizontal Situation Indicator
HUD - Head-Up Display
HVI - Helmet Vehicle Interface
HYD - Hydraulic

I

I - Inertial Solution FOM
I/F - Interface
I/O - Input/Output
IAM - Inertially Aided Munition
IAP - Instrument Approach Procedure
IAS - Indicated Airspeed
IBIT - Initiated BIT
ID - Identification
IDG - Integrated Drive Generator
IDM - Improved Data Modem
IE - Inertial Electronics
IEPU - Improved Electronic Processor Unit 152
IFF - Identification Friend or Foe
IFFCC - Integrated Flight and Fire Control Computer
ILS - Instrument Landing System
IMC - Instrument Meteorological Conditions
IMU - Inertial Measurement Unit
INCR - Increment
IND - Indicator
INDX - Index
INFLT - In-Flight
INIT - Initialization; Initial
INIT POS - Initial Position
INIT POSIT - Initial Position
INPR - In Progress
INS - Inertial Navigation System
INST - Instrument
INT - Internal
INU - Inertial Navigation Unit
INV - Inverter
IP - Internet Protocol
IP - Initial Point
IR - Infra-Red
ISA - Inertial Sensor Assembly; Internal Suppression Assembly
ITT - Interstage Turbine Temperature

J

JDAM - Joint Direct Attack Munition
JTAC - Joint Terminal Attack Controller

K

KCAS - Knots Calibrated Air Speed
KHZ - Kilohertz
KIAS - Knots Indicated Air Speed
KTAS - Knots True Air Speed

L

L-R - Left or Right
L/L - Latitude/Longitude
L/R - Left and/or Right
LAAP - Low Altitude Autopilot
LAR - Look Aside Ranging; Launch Acceptability Region
LARS - Light Airborne Recovery System
LASTE - Low Altitude Safety and Targeting Enhancement
LAT - Low Altitude Toss
LAU - Launcher Armament Unit
LCL - Local
LCP - LASTE Control Panel
LD - Low Drag
LDGP - Low Drag General Purpose
LE - Leading Edge
LG - Landing Gear
LGB - Laser Guided Bomb
LO - Low
LOS - Line-of-Sight
LRU - Line Replaceable Unit
LSK - Line Select Key
LSS - Laser Spot Seeker (PAVE-PENNY)
LST - Laser Spot Track
LTS - Lights
LVDT - Linear Variable Differential Transducer
LUU - Illumination Unit

M

MAC - Mean Aerodynamic Chord
MAG - Magnetic
MAN - Manual
MAT - Medium Altitude Toss
MAV - Maverick
MBC - Master Bus Controller
MBIT - Maintenance BIT
MBL - Manual Boom Launch
MDTC - Mega Data Transfer Cartridge
MER - Multiple Ejector Rack
MFCD - Multifunction Color Display
MFL - Maintenance Fault Log
MGC - Manual Gain Control
MGRS - Military Grid Reference System
MH - Magnetic Heading
MHD - Magnetic Heading
MHZ - Megahertz

MIL - An angular measurement (17.78 mils in 1 degree)
MISC - Miscellaneous
MK - Mark
MLG - Main Landing Gear
MRC - Minimum Range Caret
MRFCS - Manual Reversion Flight Control System
MRGS - Multiple Reference Gun Sight
MRS - Minimum Range Staple
MS - Mission
MSL - Mean Sea Level
MSN - Missionization; Mission
MSN THR - Mission Threat Select (Page)
MTR - Military Training Route
MV - Magnetic Variation
MVR - Maneuver
MWOD - Multiple Word-of-Day
MX - Mark; Maintenance
MXLOG - Maintenance Log (Page)
MXOPT - Maintenance Options (Page)

N

N/T - Nose/Tail
NAI - Named Area of Interest
NARF - Navigation Alignment Refinement
NAV - Navigation
NLG - Nose Landing Gear
NM - Nautical Miles
NMSP - Nav Mode Select Panel
NORM - Normal
NSCH - Narrow Search
NT - Neutral Track
NVG - Night Vision Goggles
NVIS - Night Vision Imaging System
NVM - Nonvolatile Memory
NWS - Nosewheel Steering

O

OAT - Outside Air Temperature
OFP - Operational Flight Program
OFPID - Operational Flight Program Identification
ORIDE - Override
OSB - Option Select Button
OSET - Offset
OTS - Operational Test System
OWC - Obstacle Warning Cue

P

P ALT - Pressure Altitude
PAC - Precision Attitude Control
PATS - Portable Automatic Test Station
PBIL - Projected Bomb Impact Line
PBIT - Periodic BIT
PBRL - Projected Bomb Release Line
PCDS - Personal Computer Debrief System
PDU - Projection Display Unit
PFCS - Primary Flight Control System
PFL - Pilot Fault List
PGCAS - Predictive Ground Collision Avoidance System
PIO - Pilot Induced Oscillation
PNL LTS - Panel Lights
POBIT - Power-On BIT
POS - Position
POSIT - Position
PPM - Pounds Per Minute
PPOS - Present Position
PR - Passive Ranging
PRESS - Pressure
PREV - Previous
PRF - Pulse Repetition Frequency
PRICE - Pressure, Regulator, Indicator, Connectors, Emergency
PS - Power Supply
PSG - Post Stall Gyration
PTAM - Periodic Transfer Alignment Message
PTR - Pointer
PU - Projection Unit
P/V/T - Position/Velocity/Time
PWR - Power

Q

QDC - Quick Disconnect

R

R/T - Receiver/Transmitter
RAM - Random Access Memory
RAN - Release Angle Numeric
RBN - Relative Bearing Numeric
RCR - Runway Condition Reading
RDR - Radar
RDU - Remote Display Unit
RDY - Ready
REC - Receiver
REINIT - Reinitialize; Reinitialization
REQ - Request
RER - Radial Error Rate
RETR - Retract
RGS - Required Ground Speed
RHAW - Radar Homing and Warning
RIAS - Required Indicated Airspeed
RMMD - Removable Mass Memory Device
RPU - Receiver Processing Unit
RSG - Reference Signal Generator
RT - Receiver Transmitter
RT ADDR - Receiver Transmitter Address
RTAM - Reset Transfer Alignment Message
RVDT - Rotary Variable Differential Transducer
RWR - Radar Warning Receiver
RZ - Rendezvous
RZIP - Rendezvous Initial Point

S

SA - Situational Awareness
SAI - Standby Attitude Indicator
SAS - Stability Augmentation System
SAT - Satellites
SCL - Standard Conventional Load
SCS - Selected Course Steering
SEAWARS - Seawater Activated Release System
SEP - Spherical Error Probable
SFCS - Secondary Flight Control System
SFO - Simulated Flameout
SFW - Sensor Fused Weapon
SH - Stored Heading
SIF - Selective Identification Feature
SLANT RANGE - Line-of-sight distance from aircraft to target
SOI - Sensor Of Interest
SP - Steerpoint
SPD BK - Speed Brake
SPI - System Point Of Interest
SPS - Stall Prevention System
SPU - System Processor
SRU - Shop Replaceable Unit
ST - Satellite Tracking
STAT - Status
STR - Steer
SU - Start Up
SUFKEYS - Sufficient Keys
SUU - Suspension Utility Unit
SYMGEN - Symbol Generator
SYS - System

T

T/O - Takeoff
TAAF - TGP Attitude Advisory Function
TACAN - Tactical Air Navigation
TACP - Tactical Air Control Party
TAD - Tactical Awareness Display
TAS - True Airspeed
TCN - TACAN
TD - Target Designation
TDC - Target Designation Cue
TDL - Tactical Data Link
TDN - Tactical Data Network
TEMP - Temperature
TEMS - Turbine Engine Monitoring System
TER - Triple Ejector Rack
TFAT - Total Free Air Temperature
TFR - Terrain Following Radar
TGM - Training Guided Missile
TGP - Targeting Pod
TGT - Target
TH - True Heading
THR - Threat
THR TBL - Threat Table
TISL - Target Identification Set, Laser
TK - Tank
TMN - True Mach Number
TMS - Target Management Switch
TOD - Time-Of-Day
TOLD - Takeoff and Landing Data
TOT - Time-On-Target
TR - Target Ranging
TSPI - Time-Space-Position Information
TSTORM - Thunderstorm
TTG - Time-to-Go
TTRN - Time-To-Release Numeric
TVV - Total Velocity Vector

U

UARRSI - Universal Aerial Refueling Receptacle Slipway Installation
UDTU - Upgraded Data Transfer Unit
UDU - Umbilical Display Unit
UFC - Up Front Controller
UPDT - Update
UPLD - Upload
UTC - Universal Time Coordinate
UTM - Universal Transverse Mercator
UWARS - Universal Water Activated Release System

V

VAC - Voltage Alternating Current
VANGLE - Vertical Angle
VDC - Voltage Direct Current
VERT ANG - Vertical Angle
VFR - Visual Flight Rules
VG - Vertical Gyro
VLT - Voltage
VMC - Visual Meteorological Conditions
VMF - Variable Message Format
VMU - Voice Message Unit
VNAV - Vertical Navigation
VPU - Vertical Position Uncertainty
VRSN - Version
VVI - Vertical Velocity Indicator

W

WCMD - Wind Corrected Munitions Dispenser
WCN - Warnings, Cautions, and Notes
W/D - Weapon Delivery
WD - Wind Direction
WOD - Word Of Day
WOW - Weight On Wheels
WP - Waypoint; Weapon Processor
WPN - Weapon
WPT - Waypoint
WSCH - Wide Search
WT - Weight; White Track

X

XR - Extended Range

Z

ZSL - Zero Sight Line

INDEX

Subject Page

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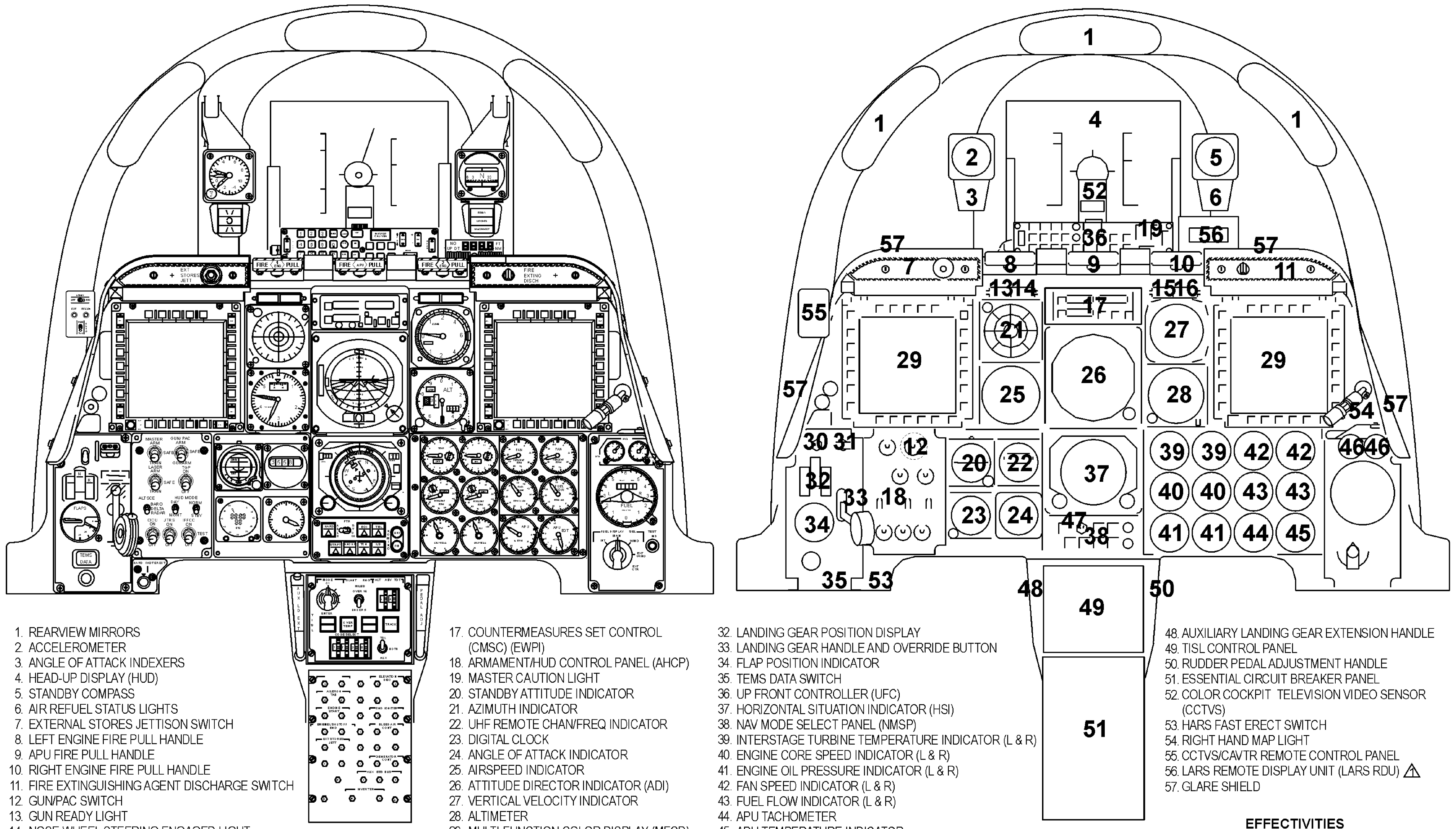
B

H

I



1. REARVIEW MIRRORS
2. ACCELEROMETER
3. ANGLE OF ATTACK INDEXERS
4. HEAD-UP DISPLAY (HUD)
5. STANDBY COMPASS
6. AIR REFUEL STATUS LIGHTS
7. EXTERNAL STORES JETTISON SWITCH
8. LEFT ENGINE FIRE PULL HANDLE
9. APU FIRE PULL HANDLE
10. RIGHT ENGINE FIRE PULL HANDLE
11. FIRE EXTINGUISHING AGENT DISCHARGE SWITCH
12. GUN/PAC SWITCH
13. GUN READY LIGHT
14. NOSE WHEEL STEERING ENGAGED LIGHT
15. MARKER BEACON LIGHT
16. CANOPY UNLOCKED LIGHT
17. COUNTERMEASURES SET CONTROL (CMSC) (EWPI)
18. ARMAMENT/HUD CONTROL PANEL (AHCP)
19. MASTER CAUTION LIGHT
20. STANDBY ATTITUDE INDICATOR
21. AZIMUTH INDICATOR
22. UHF REMOTE CHAN/FREQ INDICATOR
23. DIGITAL CLOCK
24. ANGLE OF ATTACK INDICATOR
25. AIRSPEED INDICATOR
26. ATTITUDE DIRECTOR INDICATOR (ADI)
27. VERTICAL VELOCITY INDICATOR
28. ALTIMETER
29. MULTI-FUNCTION COLOR DISPLAY (MFCD)
30. ANTI-SKID SWITCH
31. LANDING/TAXI LIGHTS SWITCH
32. LANDING GEAR POSITION DISPLAY
33. LANDING GEAR HANDLE AND OVERRIDE BUTTON
34. FLAP POSITION INDICATOR
35. TEMS DATA SWITCH
36. UP FRONT CONTROLLER (UFC)
37. HORIZONTAL SITUATION INDICATOR (HSI)
38. NAV MODE SELECT PANEL (NMSP)
39. INTERSTAGE TURBINE TEMPERATURE INDICATOR (L & R)
40. ENGINE CORE SPEED INDICATOR (L & R)
41. ENGINE OIL PRESSURE INDICATOR (L & R)
42. FAN SPEED INDICATOR (L & R)
43. FUEL FLOW INDICATOR (L & R)
44. APU TACHOMETER
45. APU TEMPERATURE INDICATOR
46. HYDRAULIC PRESSURE GAGE (LEFT SYS & RIGHT SYS)
47. FUEL QUANTITY INDICATOR
48. AUXILIARY LANDING GEAR EXTENSION HANDLE
49. TISL CONTROL PANEL
50. RUDDER PEDAL ADJUSTMENT HANDLE
51. ESSENTIAL CIRCUIT BREAKER PANEL
52. COLOR COCKPIT TELEVISION VIDEO SENSOR (CCTVS)
53. HARS FAST ERECT SWITCH
54. RIGHT HAND MAP LIGHT
55. CCTVS/CAVTR REMOTE CONTROL PANEL
56. LARS REMOTE DISPLAY UNIT (LARS RDU) △
57. GLARE SHIELD

EFFECTIVITIES

△ AIRCRAFT MODIFIED BY TO 1A-10-1327 AND/OR 1A-10-1460

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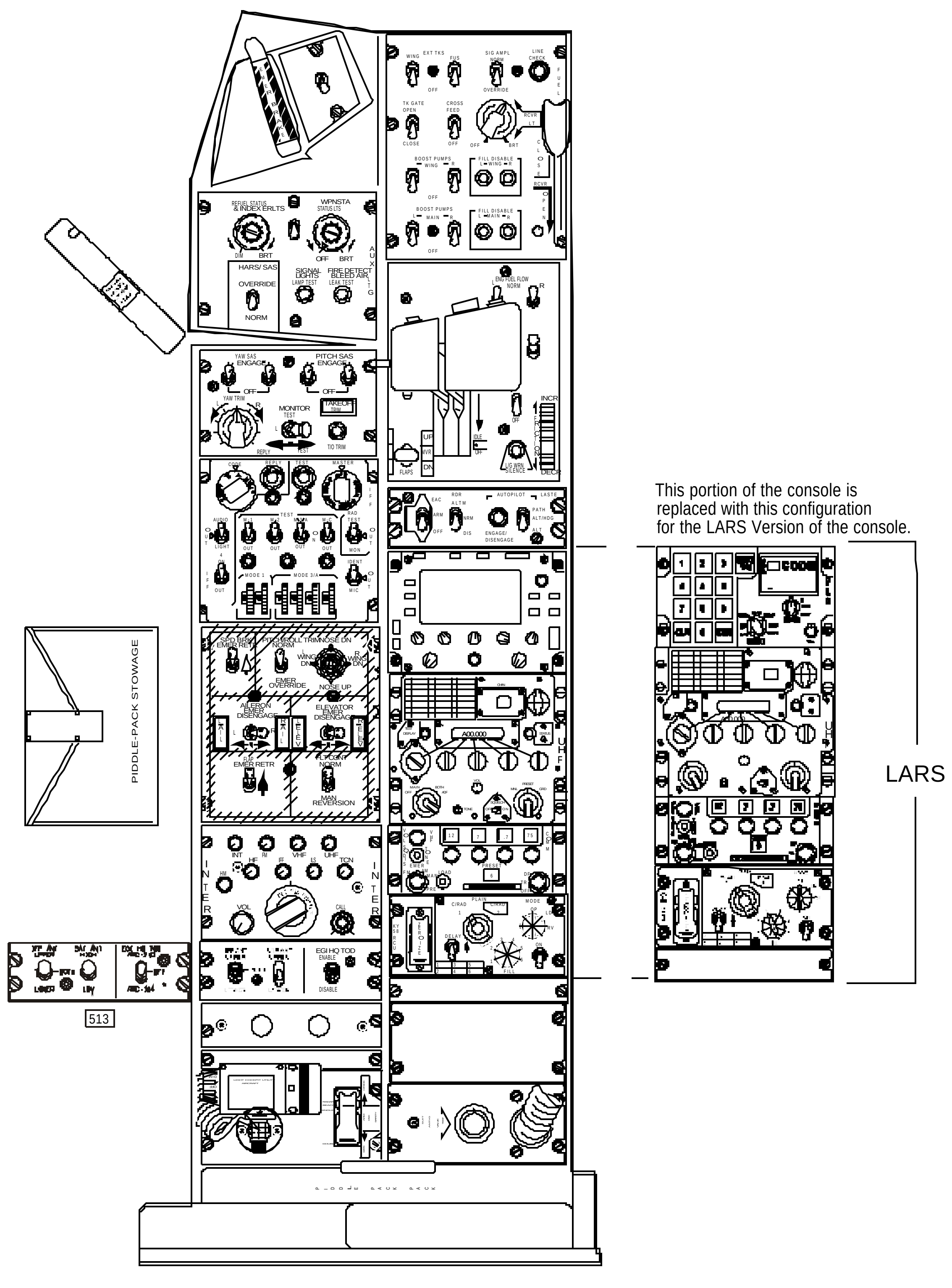
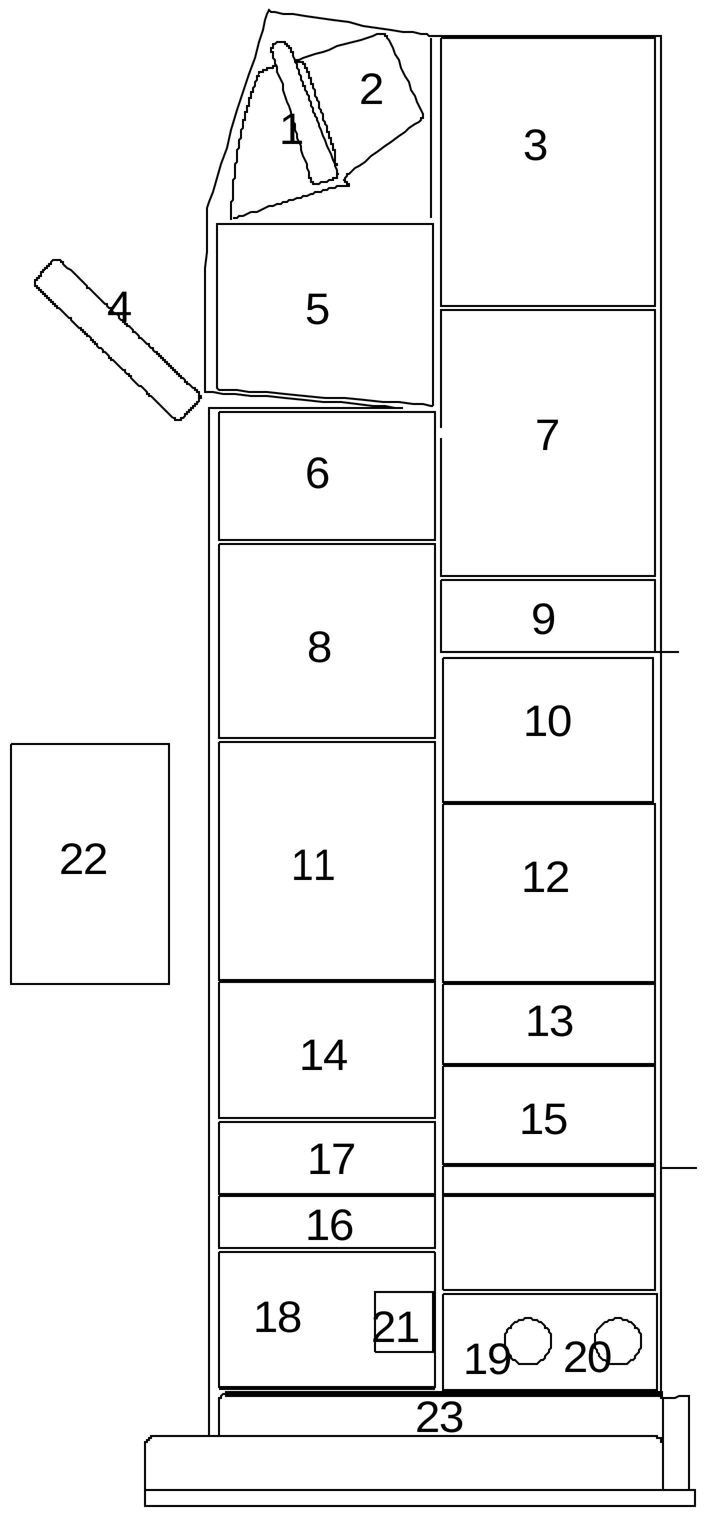
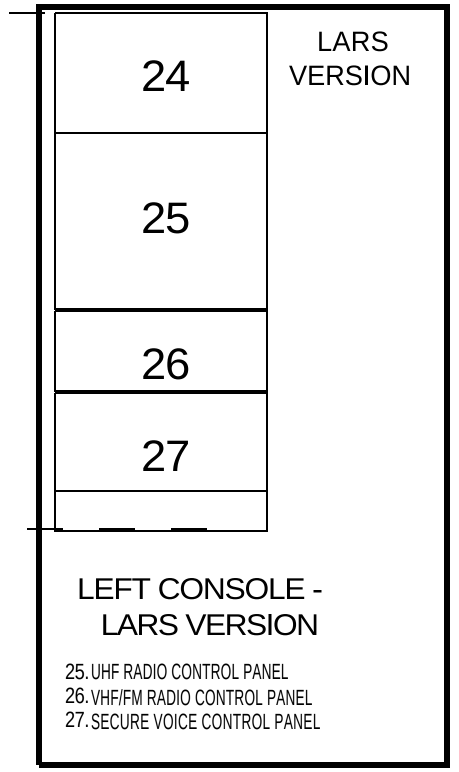
Figure FO-1. Instrument Panel





LEFT CONSOLE

1. EMERGENCY BRAKE HANDLE
2. SEAT HEIGHT ADJUSTMENT SWITCH
3. FUEL SYSTEM CONTROL PANEL
4. MANUAL CANOPY OPENING ASSIST HANDLE
5. AUXILIARY LIGHTING CONTROL PANEL
6. STABILITY AUGMENTATION SYSTEM (SAS) PANEL
7. THROTTLE QUADRANT
8. IFF CONTROL PANEL
9. LASTE CONTROL PANEL
10. ARC-210 RADIO SET CONTROL (RSC)
11. EMERGENCY FLIGHT CONTROL PANEL
12. UHF RADIO CONTROL PANEL
13. VHF/FM RADIO CONTROL PANEL
14. INTERCOM CONTROL PANEL
15. SECURE VOICE CONTROL PANEL
16. STALL WARNING CONTROL PANEL
17. ANTENNA SELECT PANEL
18. UTILITY LIGHT
19. ANTI-G SUIT VALVE TEST BUTTON
20. ANTI-G SUIT HOSE
21. ARMAMENT GROUND SAFETY SWITCH
22. PIDDLE PACK STOWAGE
23. PIDDLE PACK DISPOSAL
24. LARS CONTROL DISPLAY UNIT (LARS CDU)

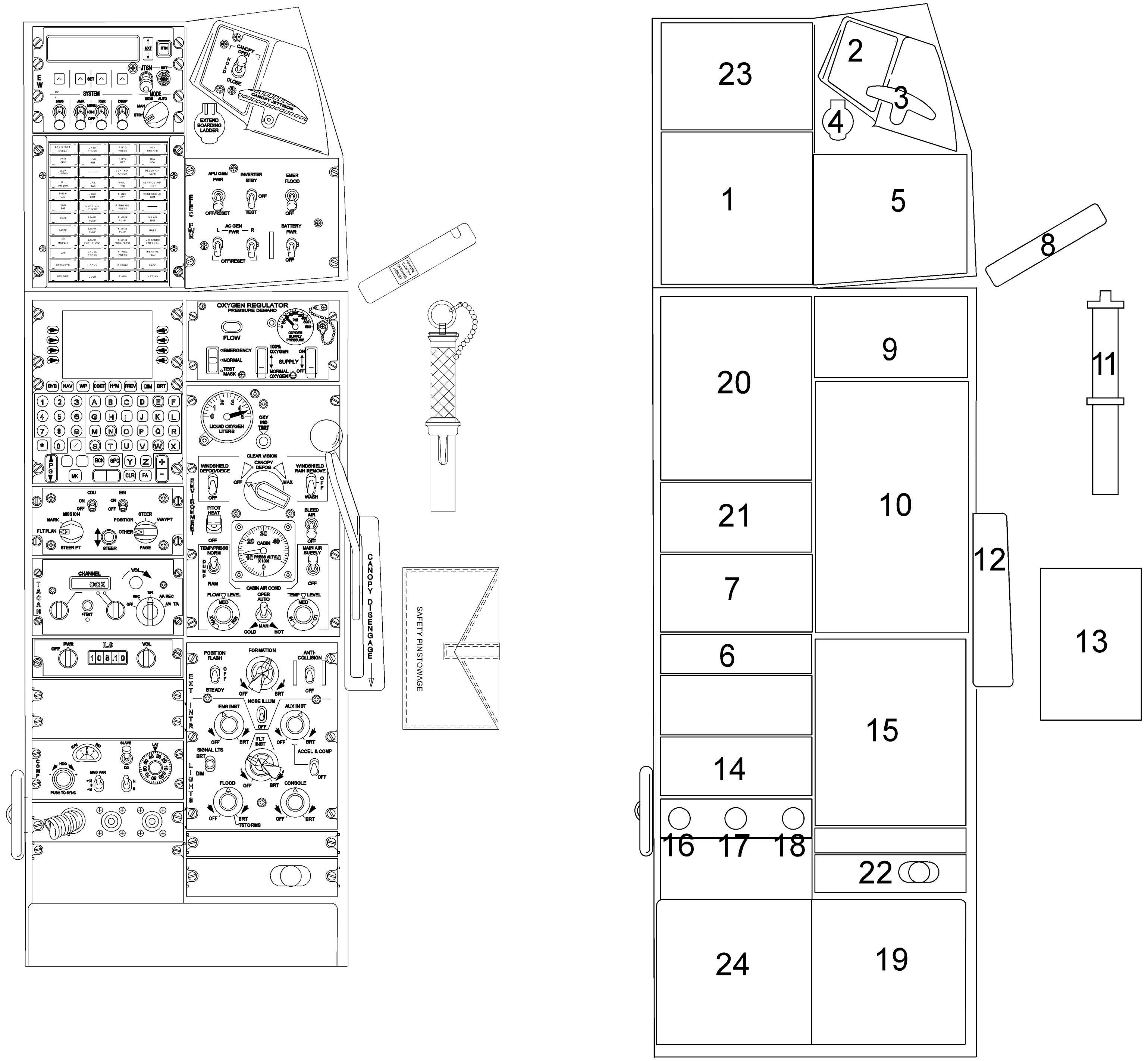


LEFT CONSOLE -
LARS VERSION

25. UHF RADIO CONTROL PANEL
26. VHF/FM RADIO CONTROL PANEL
27. SECURE VOICE CONTROL PANEL

SV1014

Figure FO-2. Left Console



RIGHT CONSOLE

1. CAUTION ANNUNCIATION PANEL
2. CANOPY CONTROL SWITCH
3. CANOPY JETTISON HANDLE
4. EXTEND BOARDING LADDER PUSH BUTTON SWITCH
5. ELECTRICAL POWER PANEL
6. ILS CONTROL PANEL
7. TACAN CONTROL PANEL
8. MANUAL CANOPY OPENING ASSIST HANDLE
9. OXYGEN CONTROL PANEL
10. ENVIRONMENT CONTROL PANEL
11. CANOPY BREAKER TOOL
12. CANOPY ACTUATOR DISENGAGE LEVER
13. SAFETY PIN STOWAGE
14. HARS CONTROL PANEL
15. LIGHTING CONTROL PANEL
16. OXYGEN HOSE CONNECTION
17. INTERCOM CONNECTION
18. SYSTEM SOFTWARE LOADING RECEPTACLE
19. FLIGHT DATA STOWAGE (NOT SHOWN)
20. CONTROL DISPLAY UNIT (CDU)
21. AVIONICS AUXILIARY PANEL (AMP)
22. BREATHING OXYGEN QUICK DISCONNECT (CRU- 60)
23. COUNTERMEASURES SET SIGNAL PROCESSOR (CMSP (EWMU)
24. CAVTR RECORDER (NOT SHOWN)

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Figure FO-3. Right Console

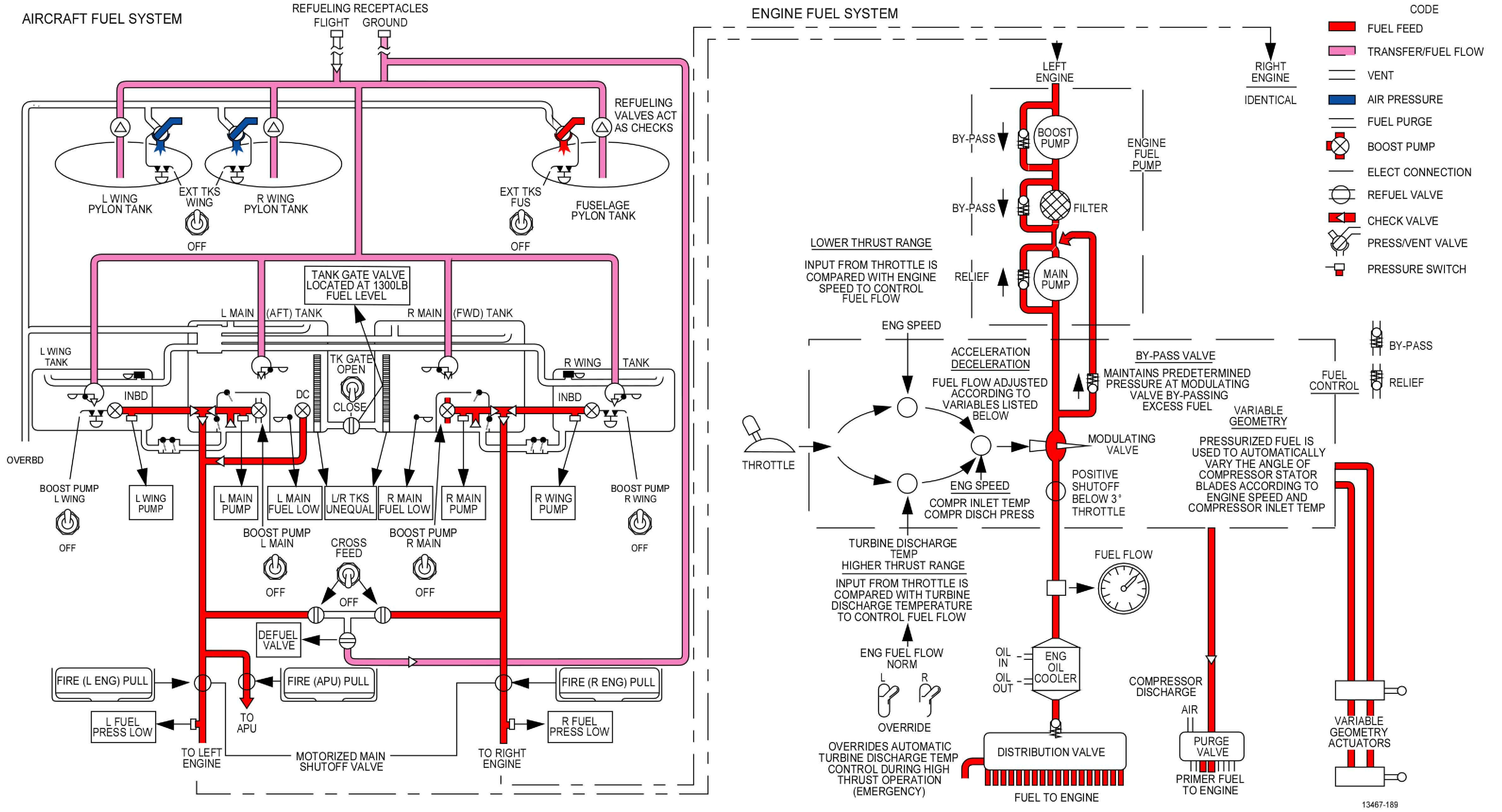


Figure FO-4. Fuel System (Sheet 1 of 2)

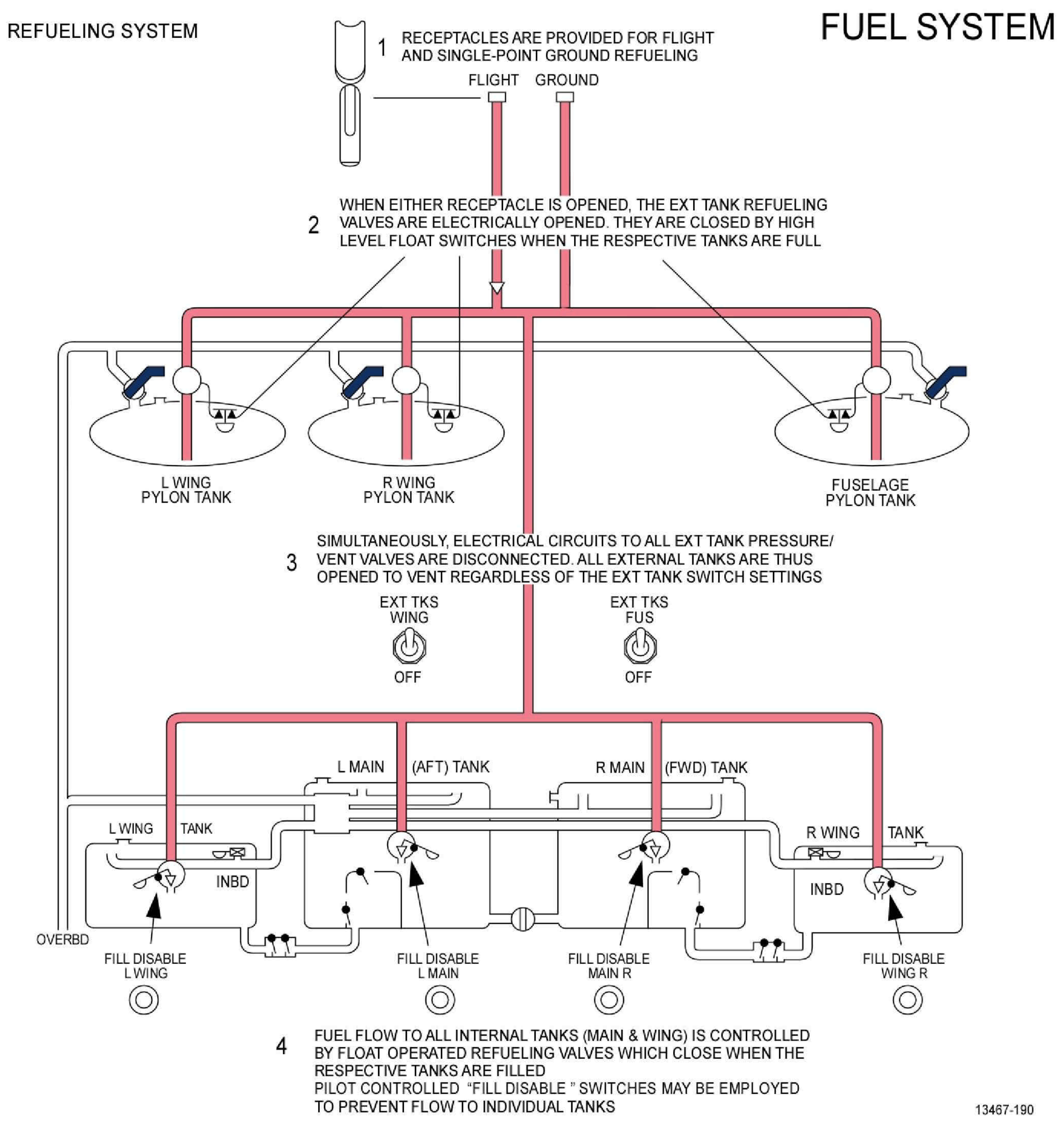


Figure FO-4. Fuel System (Sheet 2)

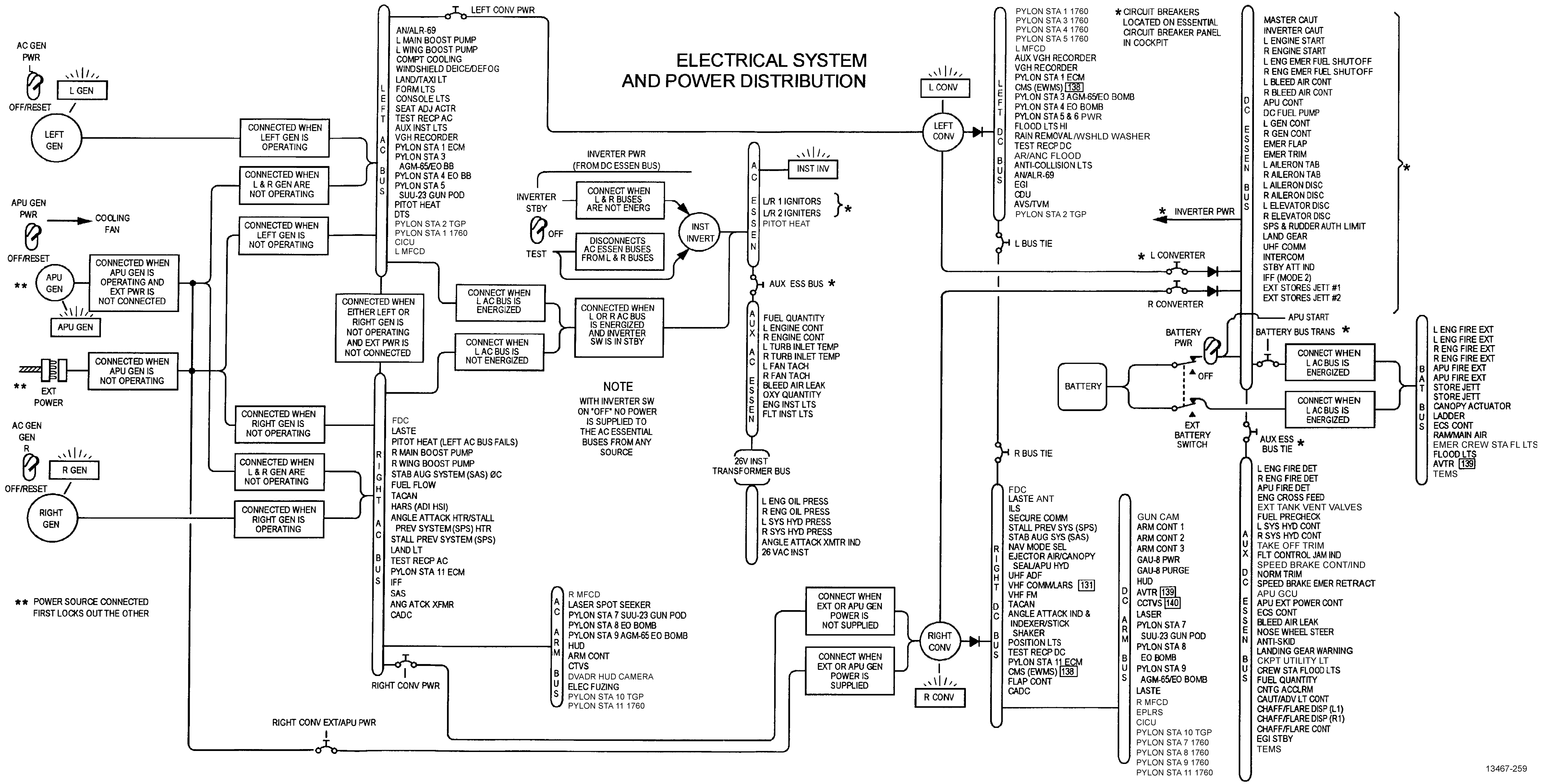
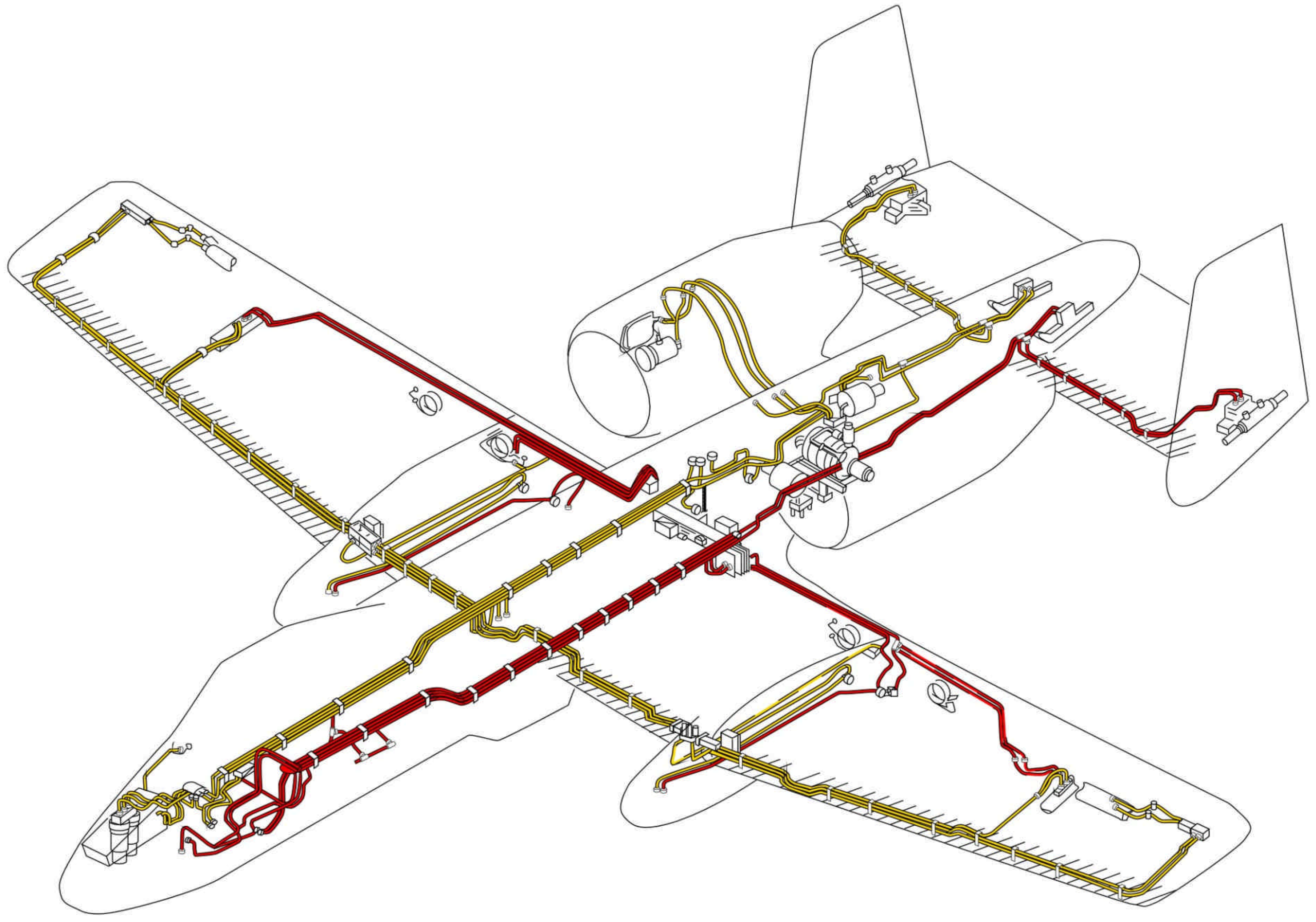


Figure FO-5. Electrical System and Power Distribution

HYDRAULIC SYSTEM INSTALLATION



HYDRAULIC POWER SUPPLY

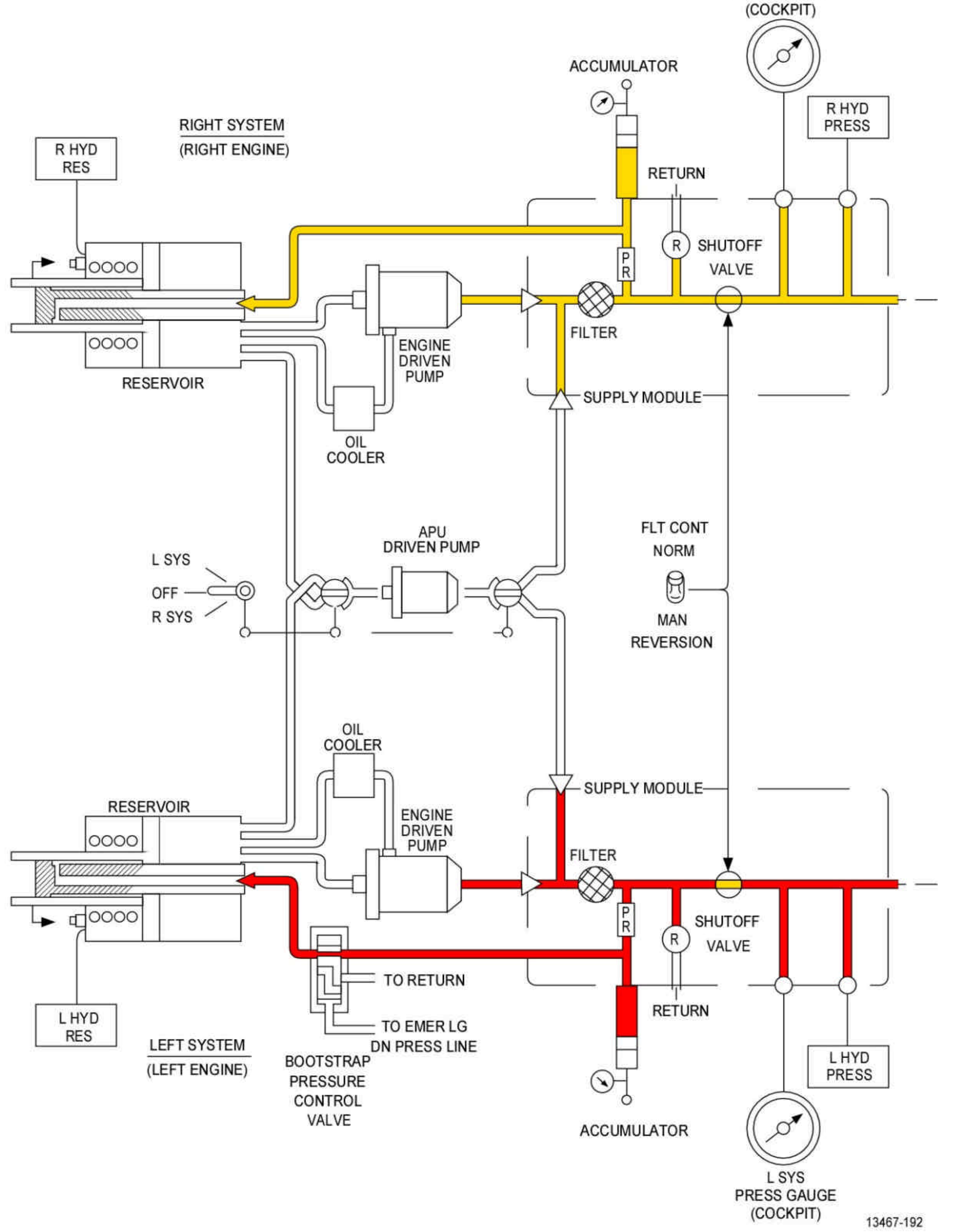


Figure FO-6. Hydraulic System (Sheet 1 of 2)

HYDRAULIC SYSTEM

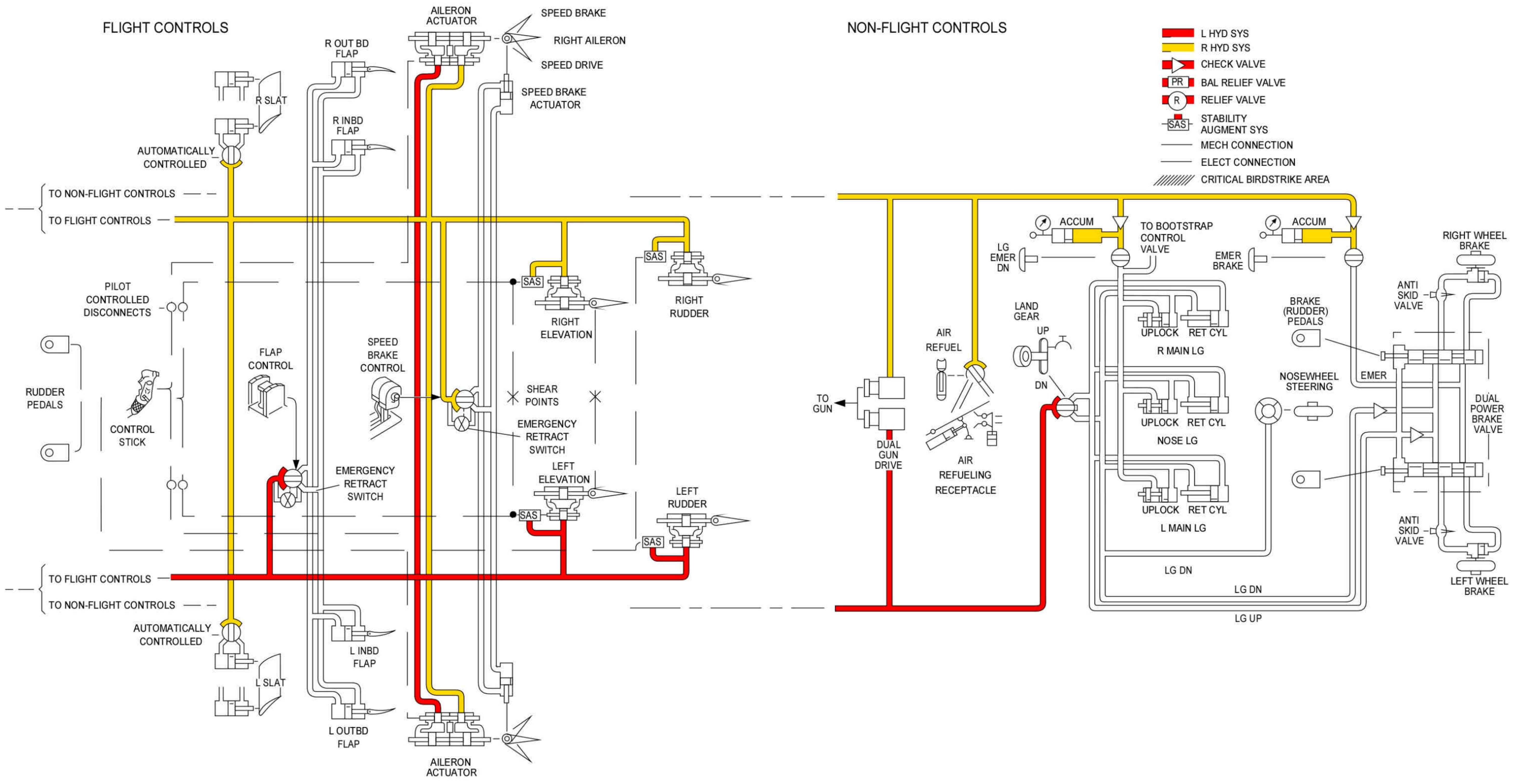


Figure FO-6. Hydraulic System (Sheet 2)

NAV MODE SELECT PANEL (NMSP) INTERFACE CHART (CONT.) (ADI INDICATIONS)

Notes:

1. If UHF lit, HSI bearing pointers nos. 1 and 2 indicate bearing to UHF radio station.
2. If UHF lit, HSI bearing pointer no. 1 indicates bearing to UHF radio station.
3. HSI bearing pointer no. 1 spins if no anchor point defined on CDU ANCHOR Page; and HSI bearing pointer no. 2, course deviation indicator, to/from indicator, and range indicator indications will be to the steerpoint. If the steerpoint is changed when bearing pointer no. 1 is opening; the HSI bearing no. 2, course deviation indicator, to/from indicator, and range indicator indications will be to the steerpoint that was selected when ANCHR was selected (even if the steerpoint is changed while bearing pointer no. 1 is spinning). If this occurs, either define an anchor point using the CDU ANCHOR Page or deselect ANCHR (or select STR PT) on the nav mode select panel.
4. If ILS lit, HSI bearing validity flag and course deviation indicator and ADI course warning flag, pitch steering bar, bank steering bar, glide slope warning flag, and glide slope indicator operate as described in ILS column.
5. If TISL lit, ADI course warning flag, pitch steering bar, and bank steering bar operate as described in TISL column. The TISL mode overrides the FM mode.
6. If FM lit, ADI course warning flag, pitch steering bar, and bank steering bar operate as described in FM column. The FM mode overrides the ILS mode.
7. Determined by HARS or EGI and STR FT, ANCHR, or TCN pushbutton switches.
8. If UHF not lit, indicates bearing determined by HARS or EGI and STR PT, ANCHR, or TCN pushbutton switches.
9. Range indicator displays 000 to 999 NM. 1000 display (1) prefixes range indication when range exceeds 1000 NM. Range indicator flag covers only range indicator. If the distance to the steerpoint exceeds 1999 NM, the range indicator flag will not be in view. For the correct distance to the steerpoint for distances up to 9998 NM, refer to the STR INFO page.
10. If FM not lit, determined by HARS or EGI and STR PT, ANCHR, or TCN pushbutton switches; if FM lit, refer to FM column.
11. The HUD displays the INS format when the EGI Δ light on the NMSP is lit and Blended or INS-only is the selected navigation mode. The HUD displays the HARS format when the EGI Δ light is lit and GPS only is the selected navigation mode, or the HARS Δ light is lit For more information on the HUD format, refer to TO 1A-10C-34-1-1.
12. TISL and ILS modes are mutually exclusive. That is, TISL pushbutton switch will select and deselect TISL mode, and ILS pushbutton switch will select and deselect ILS mode. However, if ILS mode is selected and TISL pushbutton switch is pressed, ILS mode will be deselected and TISL mode will be selected. If TISL mode is selected and ILS pushbutton switch is pressed, TISL mode will be deselected and ILS mode will be selected.
13. When SCS mode is selected, steerpoint is defined as aircraft's position when SCS mode was selected.

    When ANCHR is selected, the SCS steer mode can not be selected on the ATTRIB Page (SCS LSK is inactive).

    If the SCS steer mode has been selected and then ANCHR is selected on the NMSP, the SCS mode is automatically deselected and steering cues are provided to the anchor point. These steering cues are determined by the attributes of the waypoint that is the anchor point.
14. See Sheet 5 for effects of BLENDED FOM, selected scale, and 2D or 3D mode on ADI indications when STR PT or ANCHR is selected on nav mode select panel and BLENDED is the selected navigation solution.
15. See Sheet 6 for effects of GPS-only FOM, selected scale, and 2D or 3D mode on HSI and ADI indications when STR PT or ANCHR is selected on nav mode select panel and GPS-only is the selected navigation solution.
16. Certain EGI failures may cause incorrect information to be displayed on the ADI bank steering bar without causing the ADI course warning flag to come into view when STR FT or ANCHR is selected on the nav mode select panel. However, these failures will cause the HSI bearing validity flag to come into view. Therefore, when STR PT or ANCHR is selected on the nav mode select panel and the HSI bearing validity flag is in view, disregard the ADI bank steering bar indications. The ADI bank steering bar and course warning flag operate normally when TACAN, ILS, TISL, or FM HOMING is the selected source of the bank steering bar indications.

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 1 of 9)

Pushbutton(s) selected (lit)/Indicators HSI/ADI Indicators/Controls	HARS only (with EGI turned off)	HARS only (with EGI turned on and functioning in background)	HARS and STR PT	HARS and ANCHR	HARS and TCN	EGI only	EGI and STR PT	EGI and ANCHR	EGI and TCN	TISL (See note 12)	UHF	FM (See note 10)	ILS (See note 12)
HSI Compass Card	Indicates aircraft magnetic heading (HARS) under upper lubber line.	Indicates aircraft magnetic heading (HARS) under upper lubber line.	Indicates aircraft magnetic heading (HARS) under upper lubber line.	Indicates aircraft magnetic heading (HARS) under upper lubber line.	Indicates aircraft magnetic heading (HARS) under upper lubber line.	Indicates aircraft magnetic heading (EGI) under upper lubber line.	Indicates aircraft magnetic heading (EGI) under upper lubber line.	Indicates aircraft magnetic heading (EGI) under upper lubber line.	Indicates aircraft magnetic heading (EGI) under upper lubber line.	See note 7.	See note 7.	See note 7.	See note 7.
HSI Bearing Pointer No. 1	Stowed at 3 o'clock. (See note 1.)	Stowed at 3 o'clock. (See note 1.)	Indicates bearing (EGI) to steerpoint. (See notes 2 and 13.)	In TO FROM, DIRECT, and TO TO modes, indicates bearing (EGI) to anchor point. In SCS mode, indicates bearing (EGI) to position when SCS mode was selected. (See notes 2 and 3.)	Indicates bearing to TACAN station. Spins if no TACAN signal received. Stowed at 3 o'clock TACAN off. (See note 2.)	Stowed at 3 o'clock. (See note 1.)	Indicates bearing (EGI) to steerpoint. (See notes 2 and 13.)	In TO FROM, DIRECT, and TO TO, and SCS modes, indicates bearing (EGI) to anchor point. (See notes 2 and 3.)	Indicates bearing to TACAN station. Spins if no TACAN signal received. Stowed at 3 o'clock TACAN off. (See note 2.)	See notes 2 and 8.	Indicates heading to UHF radio station.	See notes 2 and 8.	See notes 2 and 8.
HSI Bearing Pointer No. 2	Stowed at 3 o'clock. (See note 1.)	Stowed at 3 o'clock. (See note 1.)	Indicates bearing (EGI) to steerpoint. (See note 13.)	Indicates bearing (EGI) to steerpoint. (See note 13.)	Indicates bearing (EGI) to steerpoint. (See note 13.)	Stowed at 3 o'clock. (See note 1.)	Indicates bearing (EGI) to steerpoint. (See note 13.)	Indicates bearing (EGI) to steerpoint. (See note 13.)	Indicates bearing (EGI) to steerpoint. (See note 13.)	See note 7.	See note 7.	See note 7.	See note 7.
HSI Bearing Validity Flag	In view. (See note 4.)	In view. (See note 4.)	Stowed; in view when EGI bearing invalid. (See notes 4 and 15.)	Stowed; in view when EGI bearing invalid. (See notes 4 and 15.)	Stowed; in view when TACAN bearing invalid. (See note 4.)	In view. (See note 4.)	Stowed; in view when EGI bearing invalid. (See notes 4 and 15.)	Stowed; in view when EGI bearing invalid. (See notes 4 and 15.)	Stowed; in view when TACAN bearing invalid. (See note 4.)	See note 7.	See notes 4 and 7.	See notes 4 and 7.	Out of view. If in view, indicates weak, unreliable, or non-existent localizer signals.
HSI Heading Marker	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	Indicates heading selected by HEADING SET control.	See note 7.	See note 7.	See note 7.	See note 7.
HSI Course Selector Window	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	See note 7.	See note 7.	See note 7.	See note 7.

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 2)

Pushbutton(s) selected (lit)/Indicators HSI/ADI Indicators/Controls	HARS only (with EGI turned off)	HARS only (with EGI turned on and functioning in background)	HARS and STR PT	HARS and ANCHR	HARS and TCN	EGI only	EGI and STR PT	EGI and ANCHR	EGI and TCN	TISL (See note 12)	UHF	FM (See note 10)	ILS (See note 12)
HSI Power OFF Warning Flag	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when EGI magnetic heading invalid.	Stowed; in view when EGI magnetic heading invalid.	Stowed; in view when EGI magnetic heading invalid.	Stowed; in view when EGI magnetic heading invalid.	See note 7.	See note 7.	See note 7.	See note 7.
HSI Course Deviation Indicator	Centered. (See note 4.)	Centered. (See note 4.)	In TO FROM, DIRECT, and TO TO modes, indicates deviation from course to/ from steerpoint. In SCS mode, indicates deviation from selected course. (See note 4.)	In TO FROM, DIRECT, and TO TO modes, indicates deviation from course to/ from anchor point. In SCS mode, indicates deviation from selected course. (See note 4.)	Indicates deviation from course to/ from TACAN station. Alternates from left to right of course as bearing pointer no. 1 spins if no TACAN signal received. (See note 4.)	Centered. (See note 4.)	In TO FROM, DIRECT, and TO TO modes, indicates deviation from course to/ from steerpoint. In SCS mode, indicates deviation from selected course. (See note 4.)	In TO FROM, DIRECT, and TO TO, and SCS modes, indicates deviation from course to/from anchor point. (See notes 3 and 4.)	Indicates deviation from course to/ from TACAN station. Alternates from left to right of course as bearing pointer no. 1 spins if no TACAN signal received. (See note 4.)	See note 7.	See notes 4 and 7.	See notes 4 and 7.	Indicates localizer deviation from selected course.
HSI To/From Indicator	Stowed. (See note 4.)	Stowed.	In TO FROM, DIRECT, and TO TO, indicates TO if bearing to steerpoint <90° from bearing indicated by course arrow; FROM if bearing to steerpoint Š 90° from bearing indicated by course arrow. In SCS mode, indicates TO or FROM aircraft's position when SCS mode was selected.	In TO FROM, DIRECT, and TO TO, indicates TO if bearing to anchor point <90° from bearing indicated by course arrow; FROM if bearing to anchor point Š 90° from bearing indicated by course arrow. In SCS mode, indicates TO or FROM aircraft's position when SCS mode was selected.	TO if bearing to TACAN station <90° from bearing indicated by course arrow; FROM if bearing to TACAN station Š 90° from bearing indicated by course arrow. Alternates between TO and FROM as bearing pointer no. 1 spins if no TACAN signal received.	Stowed.	In TO FROM, DIRECT, and TO TO, indicates TO if bearing to steerpoint <90° from bearing indicated by course arrow; FROM if bearing to steerpoint Š 90° from bearing indicated by course arrow. In SCS mode, indicates TO or FROM aircraft's position when SCS mode was selected.	In TO FROM, DIRECT, and TO TO, and SCS modes, indicates TO if bearing to anchor point <90° from bearing indicated by course arrow; FROM if bearing to anchor point Š 90° from bearing indicated by course arrow. (See note 3.)	TO if bearing to TACAN station <90° from bearing indicated by course arrow; FROM if bearing to TACAN station Š 90° from bearing indicated by course arrow. Alternates between TO and FROM as bearing pointer no. 1 spins if no TACAN signal received.	See note 7.	See note 7 See note 7.	See note 7.	
HSI COURSE SET Control	Used to select desired course. (Not used.)	Used to select desired course. (Not used.)	Used to select desired course.	Used to select desired course.	Used to select desired course.	Used to select desired course. (Not used.)	Used to select desired course.	Used to select desired course.	Used to select desired course.	See note 7.	See note 7 See note 7.	See note 7.	
HSI HEADING SET Control	Used to select desired heading.	Used to select desired heading.	Used to select desired heading.	Used to select desired heading.	Used to select desired heading.	Used to select desired heading.	Used to select desired heading.	Used to select desired heading.	Used to select desired heading.	See note 7.	See note 7 See note 7.	See note 7.	

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 3)

Pushbutton(s) selected (lit)/Indicators HSI/ADI Indicators/Controls	HARS only (with EGI turned off)	HARS only (with EGI turned on and functioning in background)	HARS and STR PT	HARS and ANCHR	HARS and TCN	EGI only	EGI and STR PT	EGI and ANCHR	EGI and TCN	TISL (See note 12)	UHF	FM (See note 10)	ILS (See note 12)
HSI Course Arrow	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	Indicates course selected by COURSE SET control.	See note 7.	See note 7 See note 7.	See note 7.	
HSI Range Indicator	Covered by range indicator flag.	Covered by range indicator flag.	In TO FROM, DIRECT, and TO TO, indicates distance from steerpoint, 0 to 1999 NM. In SCS mode, indicates distance from position when SCS mode was selected. (See note 9.)	In TO FROM, DIRECT, and TO TO, indicates distance from anchor point, 0 to 1999 NM. In SCS mode, indicates distance from position when SCS mode was selected. (See note 9.)	Indicates distance to/from TACAN station, 0 to 999 NM. (See note 9.)	Covered by range indicator flag.	In TO FROM, DIRECT, and TO TO, indicates distance from steerpoint, 0 to 1999 NM. In SCS mode, indicates distance from position when SCS mode was selected. (See note 9.)	In TO FROM, DIRECT, and TO TO, and SCS modes, indicates distance from anchor point, 0 to 1999 NM. (See notes 3 and 9.)	Indicates distance to/from TACAN station, 0 to 999 NM. (See note 9.)	See note 7.	See note 7 See note 7.	See note 7.	
HSI 1000 Display	Out of view.	Out of view.	In view when distance exceeds 999 NM. (See note 9.)	In view when distance exceeds 999 NM. (See note 9.)	Out of view.	Out of view.	In view when distance exceeds 999 NM. (See note 9.)	In view when distance exceeds 999 NM. (See note 9.)	Out of view.	See note 7.	See note 7 See note 7.	See note 7.	
HSI Range Indicator Flag	In view.	In view.	Covers range indicator when EGI distance is invalid. (See note 15.)	Covers range indicator when EGI distance is invalid. (See note 15.)	Covers range indicator when TACAN distance is invalid.	In view.	Covers range indicator when EGI distance is invalid. (See note 15.)	Covers range indicator when EGI distance is invalid. (See note 15.)	Covers range indicator when TACAN distance is invalid.	See note 7.	See note 7 See note 7.	See note 7.	
ADI Course Warning Flag	Stowed. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, 6, 14, 15, and 16.)	Stowed. (See notes 4, 5, 6, 14, 15, and 16.)	Stowed. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, 6, 14, 15, and 16.)	Stowed. (See notes 4, 5, 6, 14, 15, and 16.)	Stowed. (See notes 4, 5, and 6.)	Stowed. When in view, indicates TISL is not tracking target.	See note 7 Out of view. If in view, indicates weak, unreliable, or non-existent course signals. If TISL lit, see TISL column.	Out of view. If in view, indicates weak, unreliable, or nonexistent course signals. If FM lit, see FM column.	

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 4)

Pushbutton(s) selected (lit)/Indicators HSI/ADI Indicators/Controls	HARS only (with EGI turned off)	HARS only (with EGI turned on and functioning in background)	HARS and STR PT	HARS and ANCHR	HARS and TCN	EGI only	EGI and STR PT	EGI and ANCHR	EGI and TCN	TISL (See note 12)	UHF	FM (See note 10)	ILS (See note 12)
ADI Pitch Steering Bar	Stowed. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, and 6.)	If 2D mode or 3D and not approach mode, stowed. If TO TO or DIRECT and 3D and approach mode, indicates vertical deviation from path to steerpoint or vertical angle entered by pilot. If TO FROM or SCS and 3D and approach mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 5, 6, 14 and 15.)	If 2D mode or 3D and not approach mode, stowed. If TO TO or DIRECT and 3D and approach mode, indicates vertical deviation from path to anchor point or vertical angle entered by pilot. If TO FROM or SCS and 3D and approach mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 5, 6, 14 and 15.)	Stowed. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, and 6.)	If 2D mode or 3D and not approach mode, stowed. If TO TO or DIRECT and 3D and approach mode, indicates vertical deviation from path to steerpoint or vertical angle entered by pilot. If TO FROM or SCS and 3D and approach mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 5, 6, 14 and 15.)	If 2D mode or 3D and not approach mode, stowed. If TO TO, DIRECT, or SCS with 3D and approach mode, indicates vertical deviation from path to anchor point or vertical angle entered by pilot. If TO FROM and 3D and approach mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 5, 6, 14 and 15.)	Stowed. (See notes 4, 5, and 6.)	Indicates target error relative to A/C vertical axis.	See note 7.	Indicates relative signal strength of received FM radio signal (rises toward centerline when approaching station, falls from centerline when flying away from station). If TISL lit, see TISL column.	Indicates aircraft attitude for intercepting center of glide slope; if centered, A/C is on glide slope. If FM lit, see FM column.
ADI Bank Steering Bar	Stowed. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, and 6.)	Indicates relative amount A/C is off course to/from steerpoint (in TO FROM, DIRECT, and TO TO modes) or selected course (in SCS mode). (See notes 4, 5, 6, 14, 15, and 16.)	Indicates relative amount A/C is off course to/from anchor point (in TO FROM, DIRECT, and TO TO modes) or selected course (in SCS mode). (See notes 4, 5, 6, 14, 15 and 16.)	Indicates relative amount A/C is off course to/from TACAN station. (See notes 4, 5, and 6.)	Stowed. (See notes 4, 5, and 6.)	Indicates relative amount A/C is off course to/from steerpoint (in TO FROM, DIRECT, and TO TO modes) or selected course (in SCS mode). (See notes 4, 5, 6, 14, 15, and 16.)	Indicates relative amount A/C is off course to/from anchor point (in TO FROM, DIRECT, and TO TO, and SCS modes). (See notes 4, 5, 6, 14, 15, and 16.)	Indicates relative amount A/C is off course to/from TACAN station. (See notes 4, 5, and 6.)	Indicates target error relative to A/C horizontal axis.	See note 7.	Indicates direction to FM radio station in relation to A/C. If TISL lit, see TISL column.	Indicates position of localizer in relation to A/C. If FM lit, see FM column.
ADI Power OFF Warning Flag	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when HARS invalid.	Stowed; in view when EGI invalid.	Stowed; in view when EGI attitude invalid.	Stowed; in view when EGI attitude invalid.	Stowed; in view when EGI attitude invalid.	See note 7.	See note 7.	See note 7.	See note 7.

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 5)

Pushbutton(s) selected (lit)/Indicators HSI/ADI Indicators/Controls	HARS only (with EGI turned off)	HARS only (with EGI turned on and functioning in background)	HARS and STR PT	HARS and ANCHR	HARS and TCN	EGI only	EGI and STR PT	EGI and ANCHR	EGI and TCN	TISL (See note 12)	UHF	FM (See note 10)	ILS (See note 12)
ADI Glide Slope Warning Flag	Stowed. (See note 4.)	Stowed. (See note 4.)	If 2D mode, stowed. If 3D mode, controlled by EGI. (See notes 4, 14 and 15.)	If 2D mode, stowed. If 3D mode, controlled by EGI. (See notes 4, 14 and 15.)	Stowed. (See note 4.)	Stowed. (See note 4.)	If 2D mode, stowed. If 3D mode, controlled by EGI. (See notes 4, 14 and 15.)	If 2D mode, stowed. If 3D mode, controlled by EGI. (See notes 4, 14 and 15.)	Stowed. (See note 4.)	See note 7.	See notes 4 and 7.	See notes 4 and 7.	Out of view. If in view, indicates weak, unreliable, or nonexistent glide slope signals.
ADI Glide Slope Indicator	Stowed. (See note 4.)	Stowed. (See note 4.)	If 2D mode, stowed. If TO TO or DIRECT and 3D mode, indicates vertical deviation from path to steerpoint or vertical angle entered by pilot. If TO FROM or SCS and 3D mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 14 and 15.)	If 2D mode, stowed. If TO TO or DIRECT and 3D mode, indicates vertical deviation from path to anchor point or vertical angle entered by pilot. If TO FROM or SCS and 3D mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 14 and 15.)	Stowed. (See note 4.)	Stowed. (See note 4.)	If 2D mode, stowed. If TO TO or DIRECT and 3D mode, indicates vertical deviation from path to steerpoint or vertical angle entered by pilot. If TO FROM or SCS and 3D mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 14 and 15.)	If 2D mode, stowed. If TO TO, DIRECT, or SCS with 3D mode, indicates vertical deviation from path to anchor point or vertical angle entered by pilot. If TO FROM and 3D mode, indicates vertical deviation from vertical angle entered by pilot. (See notes 4, 14 and 15.)	Stowed. (See note 4.)	See note 7.	See notes 4 and 7.	See notes 4 and 7.	Indicates position of glide slope in relation to A/C.
HUD Format	HARS	HARS	HARS	HARS	HARS	INS	INS	INS	INS	See note 11.	See note 11.	See note 11.	See note 11.
HUD Steering	Not available.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.	Steerpoint indicated on CDU.

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 6)

SCALE, 2D/3D, AND BLENDED FOM EFFECTS ON ADI INDICATIONS (WHEN STR PT OR ANCHR IS SELECTED ON NAV MODE SELECT PANEL AND BLENDED IS SELECTED NAVIGATION SOLUTION)						
		ADI				
Scale	2D/3D	Bank Steering Bar	Pitch Steering Bar	Glide Slope Indicator	Glide Slope Warning Flag	Course Warning Flag
Approach	2D	Operational.	Stowed.	Stowed.	Stowed.	Operational.
Approach	3D	Operational.	FOM = 1 or 2, operational; FOM = 3 or more, stowed.	Operational.	FOM = 1 or 2, operational; FOM = 3 or more, in view.	Operational.
Hi Accuracy	2D	Operational. (See note 16.)	Stowed.	Stowed.	Stowed.	Stowed. (See note 16.)
Hi Accuracy	3D	Operational. (See note 16.)	Stowed.	Operational.	FOM = 1 or 2, operational; FOM = 3 or more, in view.	Stowed. (See note 16.)
Terminal	2D	Operational. (See note 16.)	Stowed.	Stowed.	Stowed.	Stowed. (See note 16.)
Terminal	3D	Operational. (See note 16.)	Stowed.	Operational.	FOM = 1 to 2, operational; FOM = 3 or more, in view.	Stowed. (See note 16.)
Enroute	2D	Operational. (See note 16.)	Stowed.	Stowed.	Stowed.	Stowed. (See note 16.)
Enroute	3D	Operational. (See note 16.)	Stowed.	Operational.	FOM = 1 to 2, operational; FOM = 3 or more, in view.	Stowed. (See note 16.)

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 7)

SCALE, 2D/3D, AND BLENDED FOM EFFECTS ON ADI INDICATIONS (WHEN STR PT OR ANCHR IS SELECTED ON NAV MODE SELECT PANEL AND BLENDED IS SELECTED NAVIGATION SOLUTION)								
		HSI		ADI				
Scale	2D/3D	Bearing Validity Flag	Range Indicator Flag	Bank Steering Bar	Pitch Steering Bar	Glide Slop Indicator	Glide Slope Warning Flag	Course Warning Flag
Approach	2D	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	Operational.	Stowed.	Stowed.	Stowed.	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.
Approach	3D	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	Operational.	Operational.	FOM = 1 or 2 and EVE = 50 meters or less, operational; FOM = 3 or more or EVE = more than 50 meters, in view.	FOM = 1 or 2 and EVE = 50 meters or less, operational; FOM = 3 or more or EVE = more than 50 meters, in view.	Stowed. (See note 16.)
Hi Accuracy	2D	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	Operational. (See note 16.)	Stowed.	Stowed.	Stowed.	Stowed. (See note 16.)
Hi Accuracy	3D	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	FOM = 1 or 2 and EHE = 50 meters or less, operational; FOM = 3 or more or EHE more than 50 meters, in view.	Operational. (See note 16.)	Stowed.	Operational.	FOM = 1 or 2 and EVE = 50 meters or less, operational; FOM = 3 or more or EVE = more than 50 meters, in view.	Stowed. (See note 16.)
Terminal	2D	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	Operational. (See note 16.)	Stowed.	Stowed.	Stowed.	Stowed. (See note 16.)
Terminal	3D	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	Operational. (See note 16.)	Stowed.	Operational.	FOM = 1 or 2 and EVE = 50 meters or less, operational; FOM = 3 or more or EVE = more than 115 meters, in view.	Stowed. (See note 16.)

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 8)

SCALE, 2D/3D, AND BLENDED FOM EFFECTS ON ADI INDICATIONS (WHEN STR PT OR ANCHR IS SELECTED ON NAV MODE SELECT PANEL AND BLENDED IS SELECTED NAVIGATION SOLUTION)								
		HSI		ADI				
Scale	2D/3D	Bearing Validity Flag	Range Indicator Flag	Bank Steering Bar	Pitch Steering Bar	Glide Slop Indicator	Glide Slope Warning Flag	Course Warning Flag
Enroute	2D	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	Operational. (See note 16.)	Stowed.	Stowed.	Stowed.	Stowed. (See note 16.)
Enroute	3D	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	EHE= 115 meters or less, operational; EHE = more than 115 meters, in view.	Operational. (See note 16.)	Stowed.	Operational.	FOM = 1 or 2 and EVE = 50 meters or less, operational; FOM = 3 or more or EVE = more than 115 meters, in view.	Stowed. (See note 16.)

Figure FO-7. Nav Mode Select Panel (NMSP) Interface Chart (Sheet 9)