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UNITED STATES ARMY AVIATION CENTER

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MAY 2008

STUDENT HANDOUT

(LOT 11)

TITLE: AH-64D DATA MANAGEMENT SYSTEM

FILE NUMBER: 11-6248

This Package Has Been Developed For Use By:	**AH-64D Maintenance Test Pilot Course**
Proponent For This Tsp Is:	**United States Army Aviation School** **Fort Rucker, AL 36362**

FOREIGN DISCLOSURE STATEMENT: This product/publication has been reviewed by the product developers in coordination with the Ft. Rucker foreign disclosure authority. This product is releasable to students from foreign countries on a case-by-case basis.

TERMINAL LEARNING OBJECTIVE:

At the completion of this lesson you (the student) will:

ACTION:	Troubleshoot the AH-64D Data Management System.
CONDITIONS:	Given an AH-64D helicopter, a Maintenance Support Device (MSD), with TM 1-1520-Longbow/Apache Interactive Electronic Technical Manual (IETM) software, TM 1-1520-251-10, TM 1-1520-251-CL, and TM 1-1520-251-MTF.
STANDARD:	In accordance with TM 1-1520-Longbow/Apache IETM, TM 1-1520-251-10, TM 1-1520-251-CL, and TM 1-1520-251-MTF.

A. Enabling Learning Objective 1

After this lesson you will:

ACTION: Describe the operation of the MUX bus systems.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM 1-1520-251-10 and TM 1-1520-Longbow/Apache IETM.

1. Learning Step/Activity 1:

Identify the purpose and components of the MUX bus system.

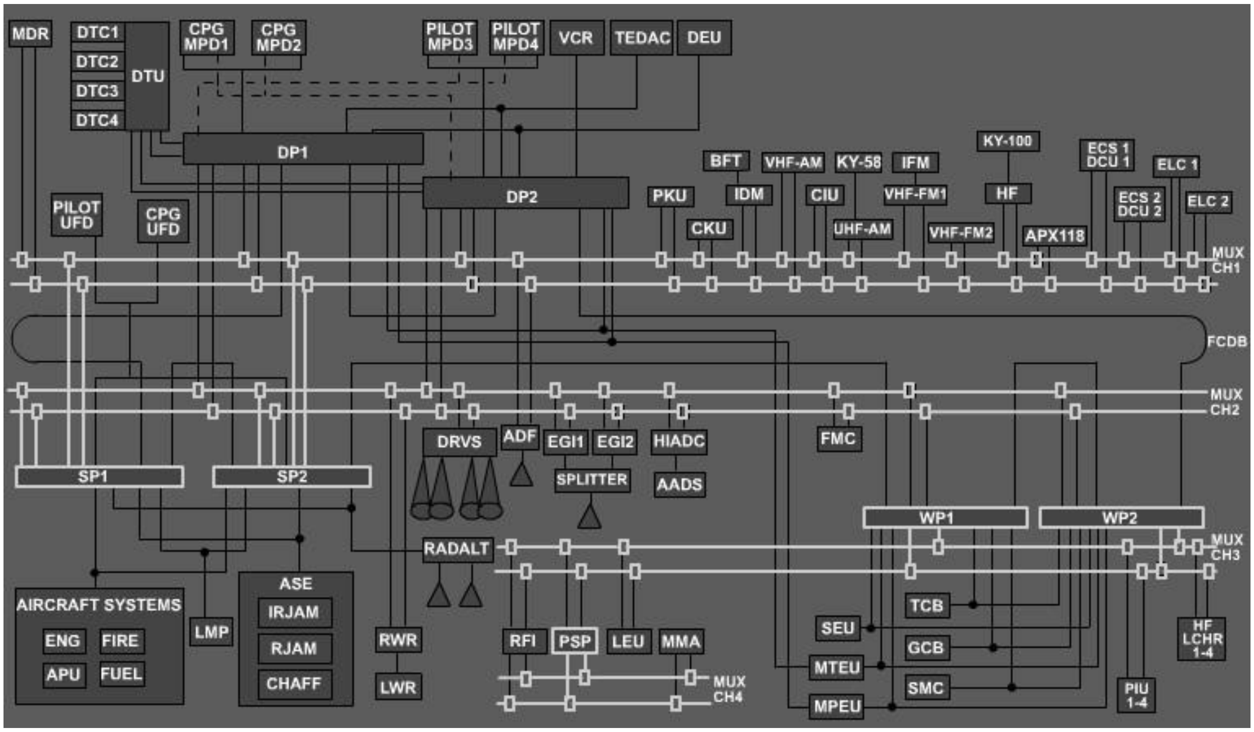


Figure 1. Data Bus Systems.

a. The Multiplex (MUX) bus system provides communications between the aircraft systems and components connected to the data transfer system. It consists of:

(1) 4 MUX channels with 2 MUX buses per channel

(2) 5 Bus Controllers (BC)/monitors

(3) Remote Terminals (RT) (either stand-alone or embedded in a using component)

(4) Data Link Terminal Units (DLTU)

(5) Data Bus Terminators (DBT)

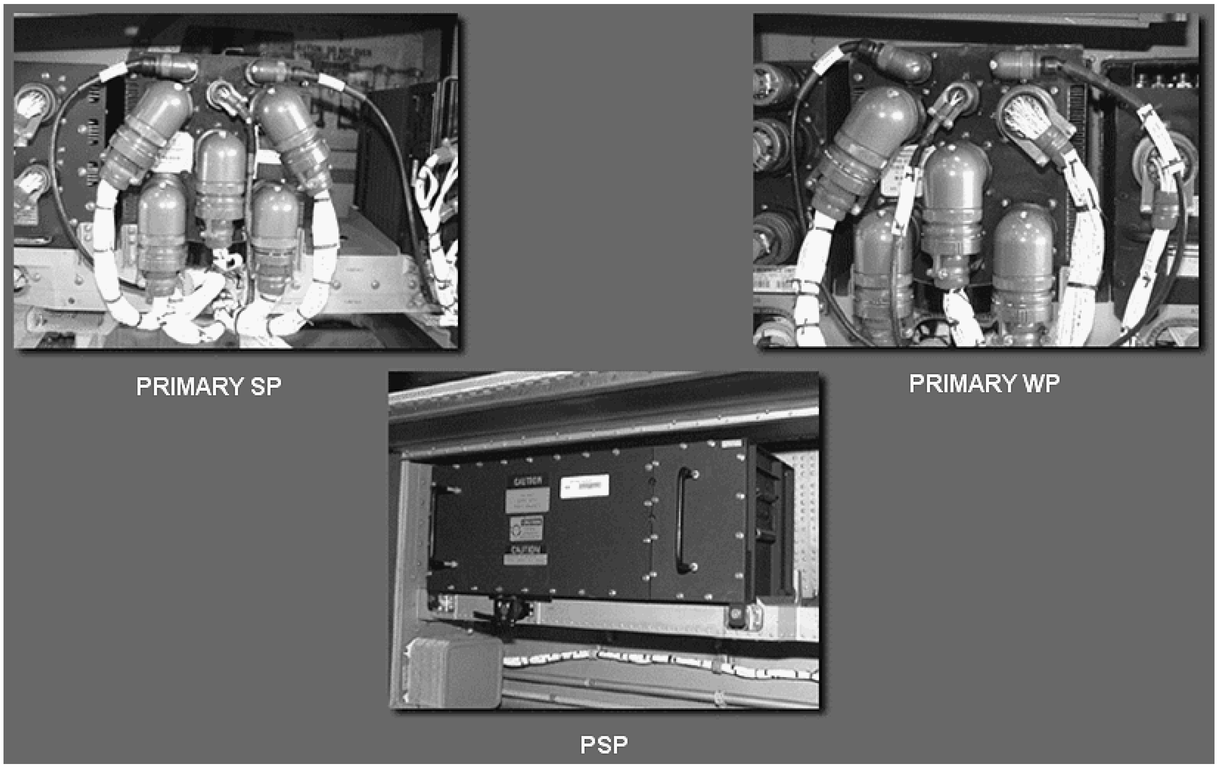


Figure 2. Data Bus Controllers.

(6) BC

(a) Based on internal software, the BC is responsible to command each system/component to perform a particular function and then verify that the system/component performs as commanded.

(b) These commands can be a result of many different types of initiators, such as a previous command, reaction to a system or component action, a manual input, or reaction to a set of preprogrammed parameters that have been met.

(c) There are three active BCs:

1) Primary System Processor (SP)

2) Primary Weapons Processor (WP)

3) Programmable Signal Processor (PSP).

(7) Bus Monitor (BM)

(a) The BM is usually identical to the BC but is in a passive or back-up mode of operation, monitoring bus traffic and continuously updating itself.

(b) In the event the active BC fails, the BM will instantly assume bus control and continue bus operation without interruption.

(c) There are two BMs: the non-primary SP and non-primary WP.

Figure 3. Remote Terminals.

(8) Remote Terminal (RT)

(a) An RT is a device that connects components to the MUX buses.

(b) An RT may be of several types:

1) A stand-alone unit that connects one or more non-multiplex bus compatible components/systems to the MUX bus

2) A resident unit in a component, connecting that component and other non-multiplex bus compatible components to the MUX bus

3) A unit built into and dedicated to connecting a component to the MUX bus (most common on the Longbow)

(c) Each RT has a unique MUX bus address. The RT will monitor all messages on the bus but will respond only to messages with its unique address.

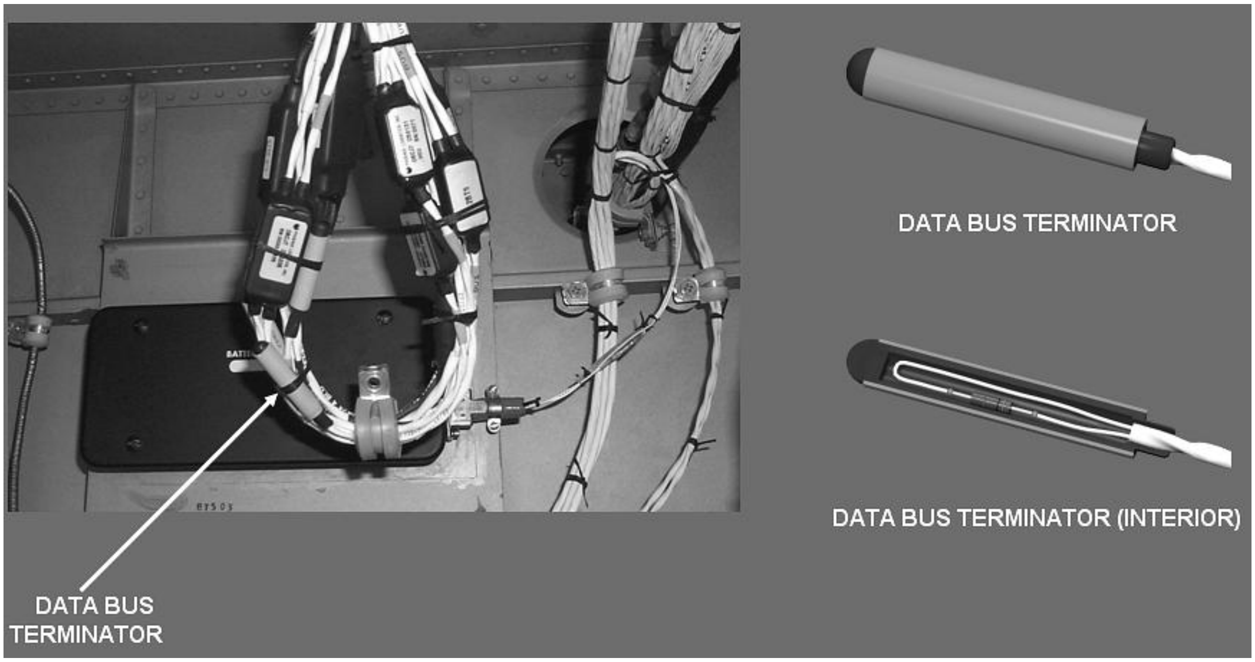


Figure 4. Data Bus Terminator.

(9) DBT

(a) A DBT is a resistor used to electrically terminate the ends of a MUX bus.

(b) The DBT serves two purposes:

1) Establishing proper line impedance

2) Optimizing signal characteristics

(c) Both ends of the bus must have a DBT installed to allow the bus to appear as though it is an infinite line electrically.

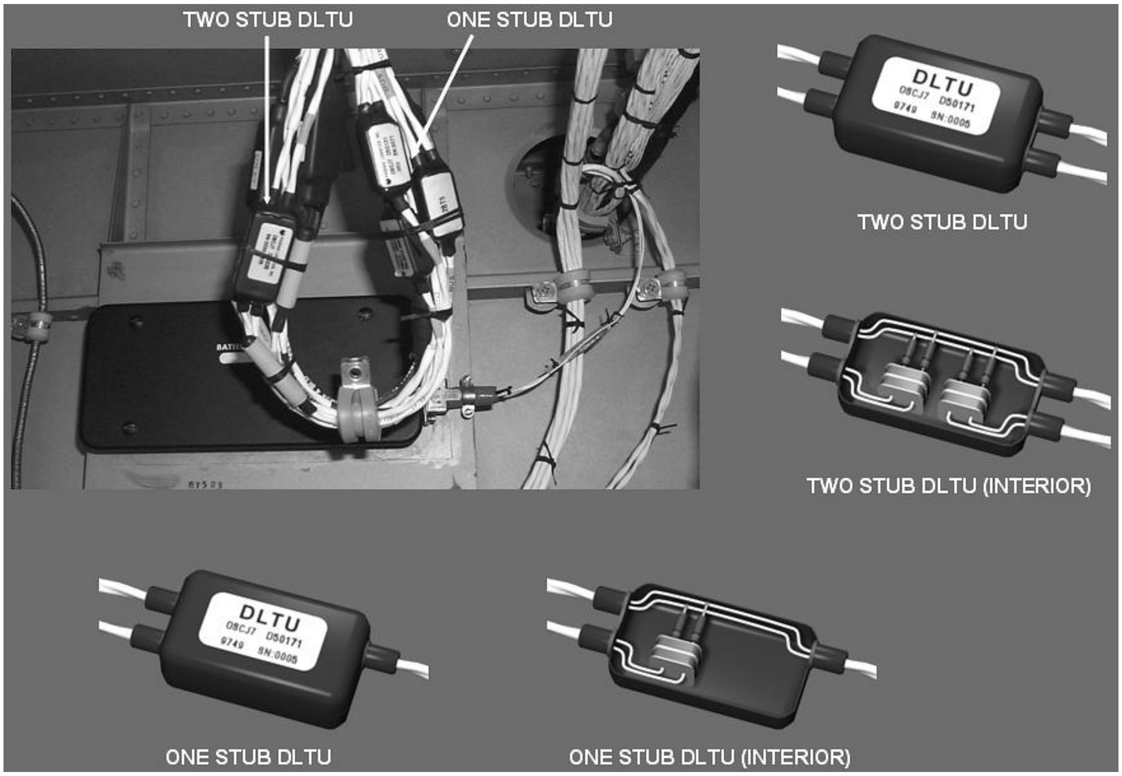


Figure 5. Data Link Terminal Units.

(10) DLTU

(a) The DLTUs provide the connections from the remote terminals to the MUX buses.

(b) They provide high-impedance coupling of the signals while preventing a short-circuit within either the RT, or in the wiring from the DLTU to the RT from disabling the entire bus.

(c) They may be of two types with either one or two stubs.

(d) A stub is simply a length of two-conductor shielded wire that is used to connect the DLTU to the remote terminal.

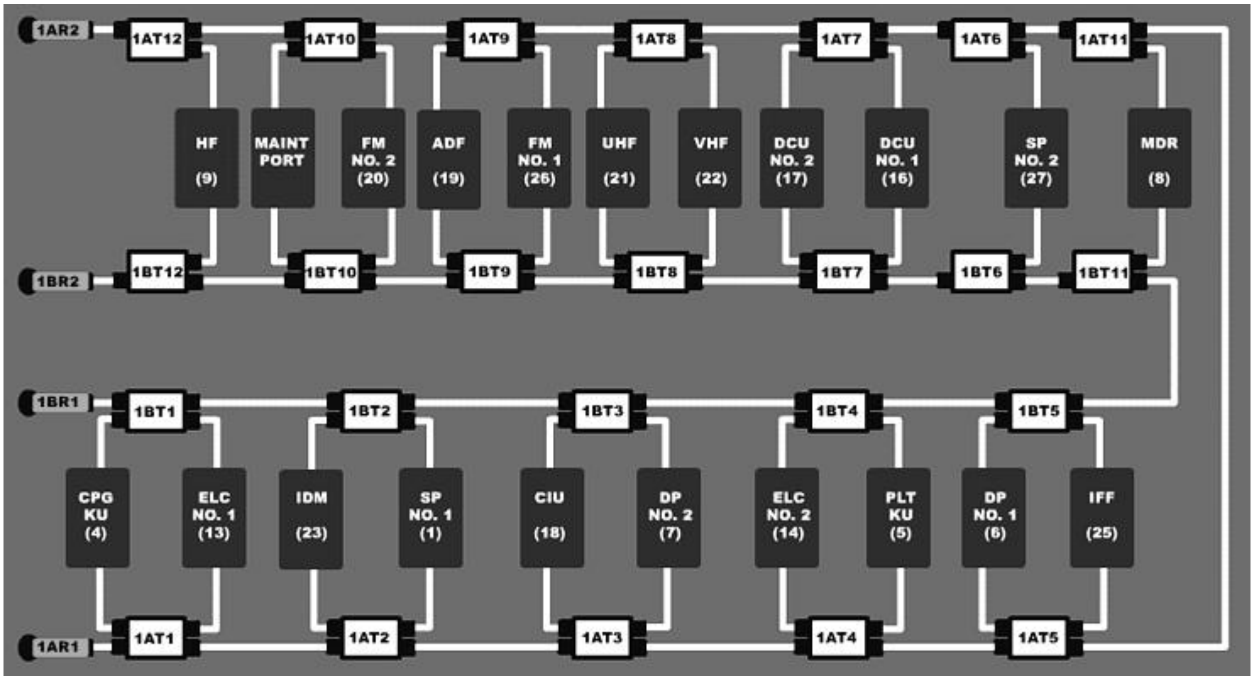


Figure 6. MUX Data Bus.

(11) MUX data buses

(a) Each MUX channel consists of two data buses designated as BUS A and BUS B.

(b) Each MUX bus is a shielded, twisted, jacketed pair of wires that connect all the DLTUs on that MUX bus. The data bus, DLTUs, and DLTU stubs are shielded to prevent electromagnetic interference from affecting bus traffic.

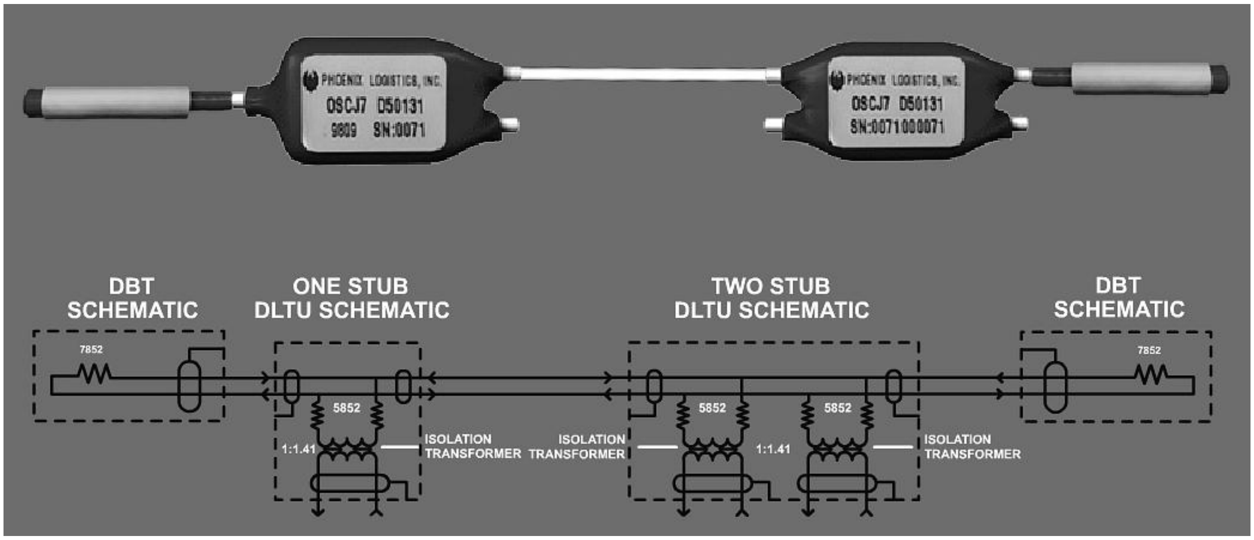


Figure 7. MUX Bus Harness.

(c) Each bus is manufactured as a harness that includes the bus wire between each DLTU, the DLTU with stub wire(s), and the data bus terminators.

1) The number of DLTUs and length of the DLTU stub wire are dependent on how many remote terminals are on the bus and their physical distance from the bus.

2) Connectors are attached to the stubs prior to installing the harness.

2. Learning Step/Activity 2

Identify the operation of the MUX bus system.

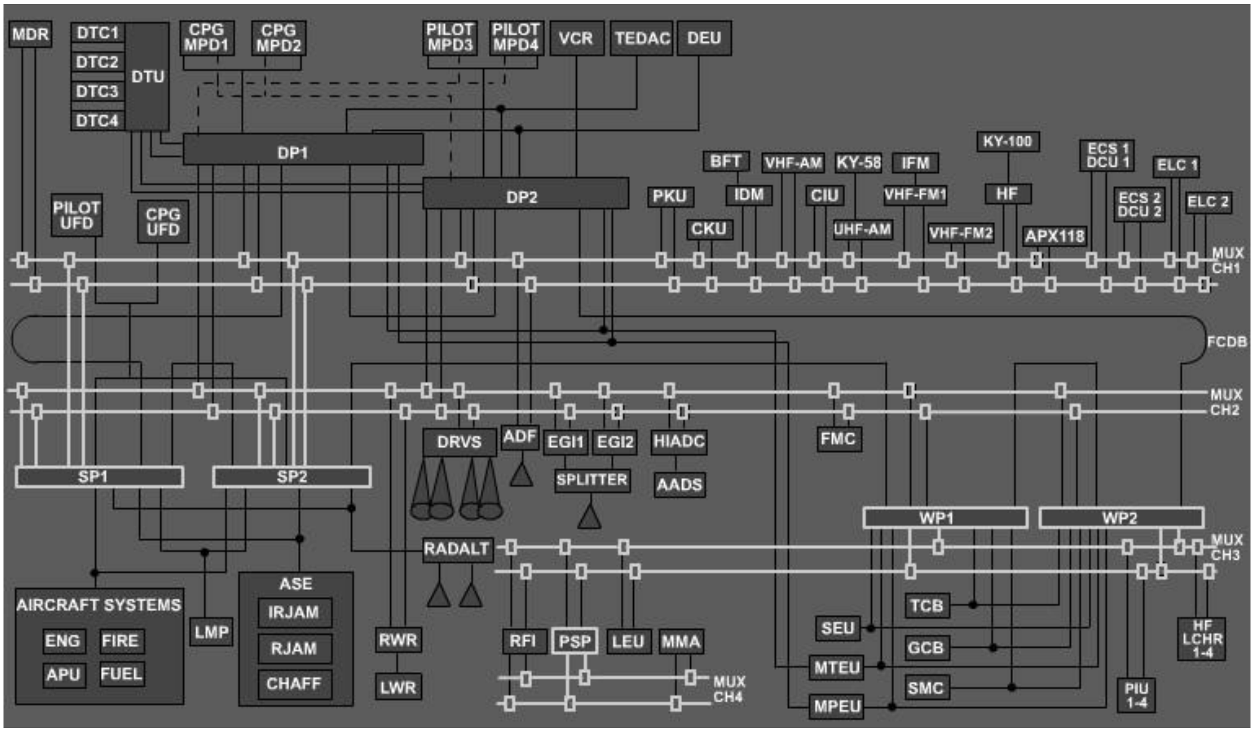


Figure 8. MUX Channels.

a. The MUX bus system consists of four MUX bus channels, five BCs/monitors, and the required number of DLTUs to connect the buses to the RTs.

(1) MUX bus channels are designated as MUX bus channels 1 through 4.

(2) Each channel has two buses: Bus A and Bus B.

(a) MUX bus channel 1 integrates the display, communications, radio navigation, electrical, environmental control systems; the maintenance data recorder; and the keyboard units.

(b) MUX bus channel 2 integrates the navigation and flight control equipment and the radar warning receiver.

(c) MUX bus channel 3 integrates the Weapons and Sighting Systems.

(d) MUX bus channel 4 is dedicated to the Fire Control Radar (FCR) and Radar Frequency Interferometer (RFI).

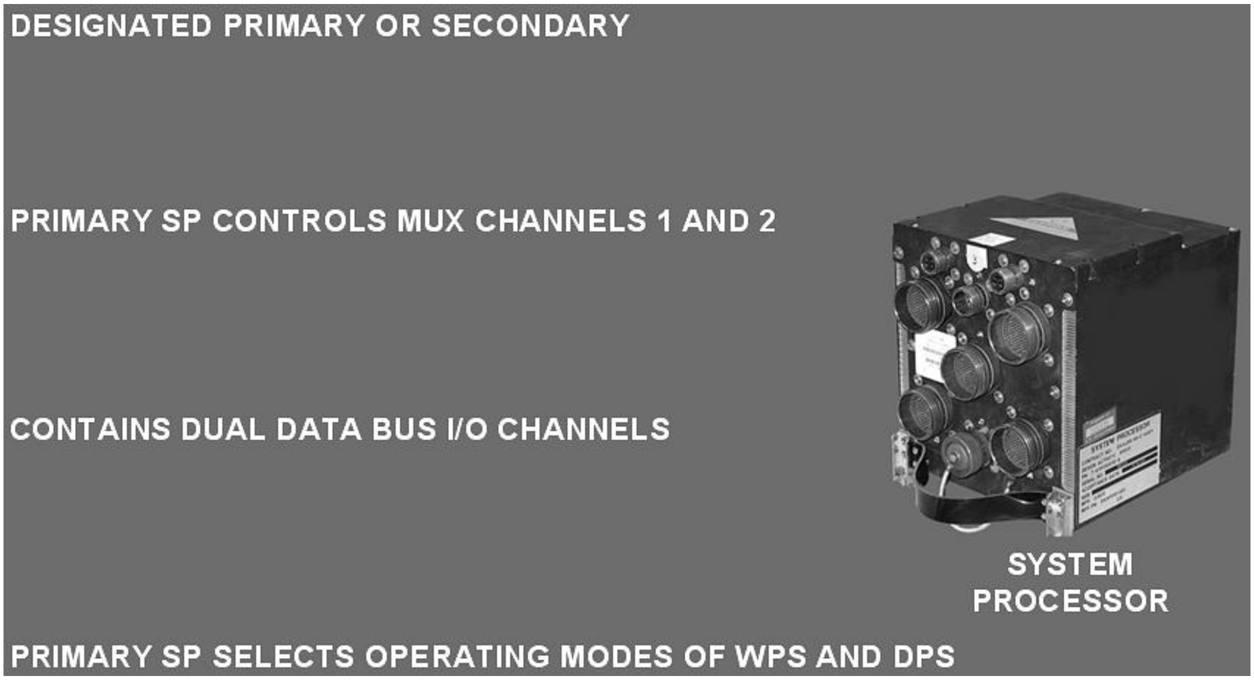


Figure 9. System Processor.

(3) Functional control and management of the MUX system is contained in embedded software, which is distributed among three major processing centers: the SPs, WPs, and the PSP.

(a) SP operation

1) When the MUX system is in operation, the SPs are designated as primary and secondary.

2) SP2 startup is delayed to allow SP1 to normally be selected as the primary.

3) The primary SP controls the MUX system channels 1 and 2, whereas the secondary SP monitors the data on the buses.

a) The secondary SP will remain inactive until it is commanded to assume bus control via the PROCESSOR SELECT panel switch or the primary SP fails.

b) At this point, it will become the primary SP and control the MUX system.

c) Either SP can perform as primary SP with no MUX system degradation.

4) Each SP contains two dual data bus Input/Output (I/O) channels that connect the SPs to MUX bus channels 1 and 2.

5) While serving as the BC, the primary SP schedules all data bus traffic between remote terminals on MUX bus channels 1 and 2.

6) In addition, the primary SP selects the operating modes of the WPs and DPs based on the Built-In-Test (BIT) status reported by these units.

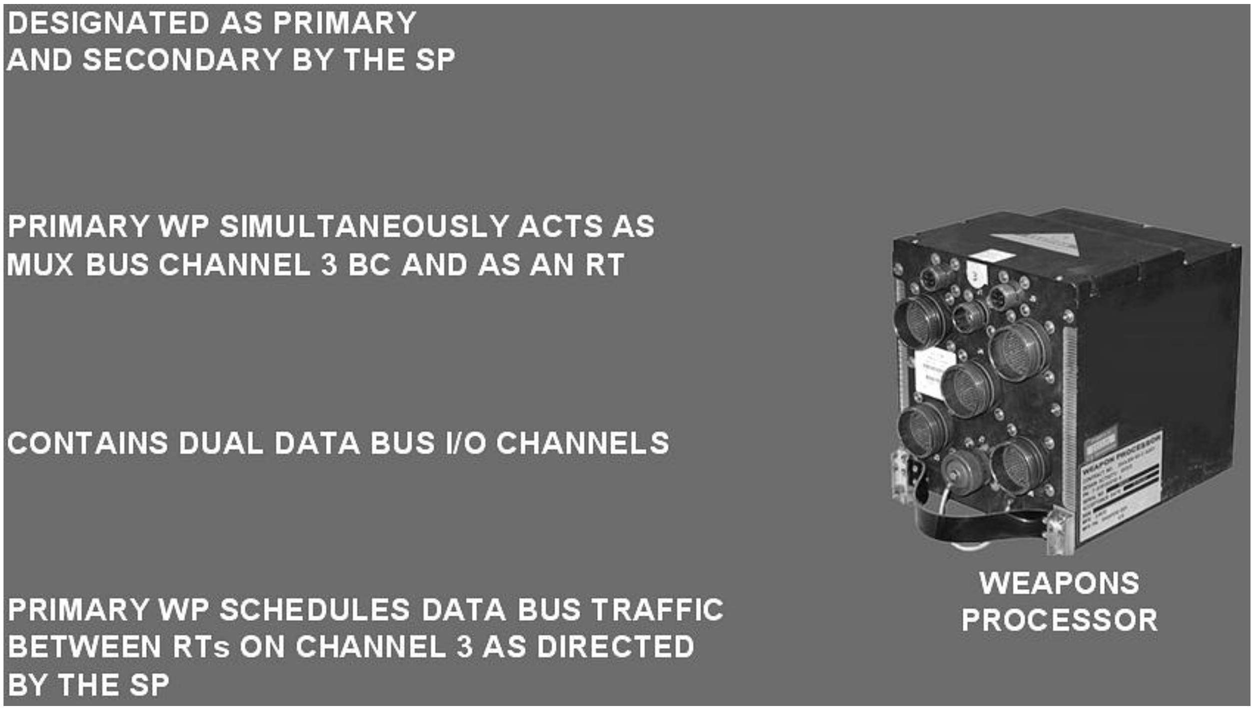


Figure 10. Weapons Processor.

(b) Weapons Processor operation

1) When the MUX system is in operation, the WPs are designated as primary and secondary by the SP, based on WP BIT status.

2) The primary WP simultaneously acts as the MUX bus channel 3 BC and as an RT to pass MUX data between the primary SP (on MUX bus channel 2) and other remote terminals on MUX bus channel 3.

   a) The secondary WP will remain inactive until the primary WP fails.

   b) In that case, it will become the primary WP and perform the bus control and RT functions.

   c) Either WP can perform as primary WP with no MUX system degradation.

3) Each WP contains two dual data bus I/O channels that connect the WPs to MUX bus channels 2 and 3.

4) While serving as the BC, the primary WP schedules all data bus traffic between remote terminals on MUX bus channel 3 as directed by the primary SP.

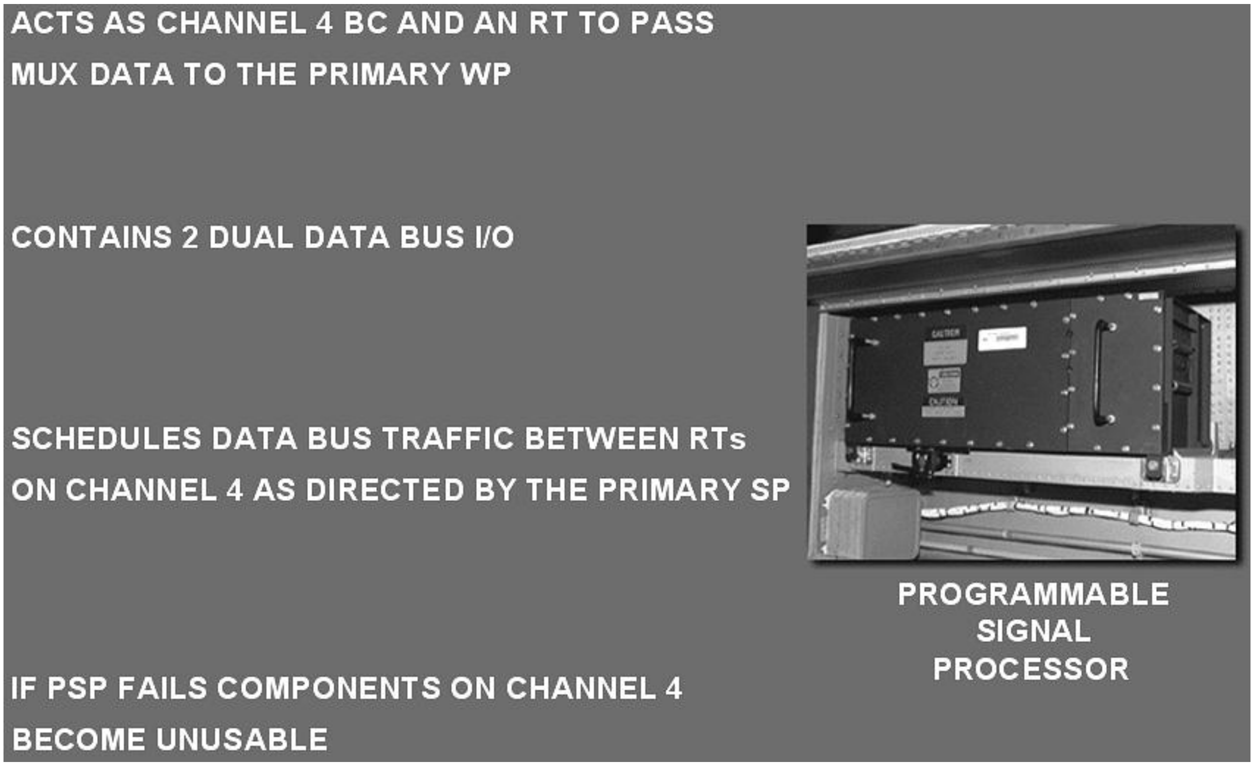


Figure 11. Programmable Signal Processor.

(c) PSP operation

1) The PSP acts as the MUX bus channel 4 BC and as an RT to pass MUX data between the primary WP (on MUX bus channel 3) and other remote terminals on MUX bus channel 4.

2) The PSP contains two dual data bus I/O channels that connect it to MUX bus channels 3 and 4.

3) While serving as the BC, the PSP schedules all data bus traffic between remote terminals on MUX bus channel 4 as directed by the primary SP.

4) There is no backup for the PSP.

5) In the event the PSP fails, components on MUX bus channel 4 become unusable.

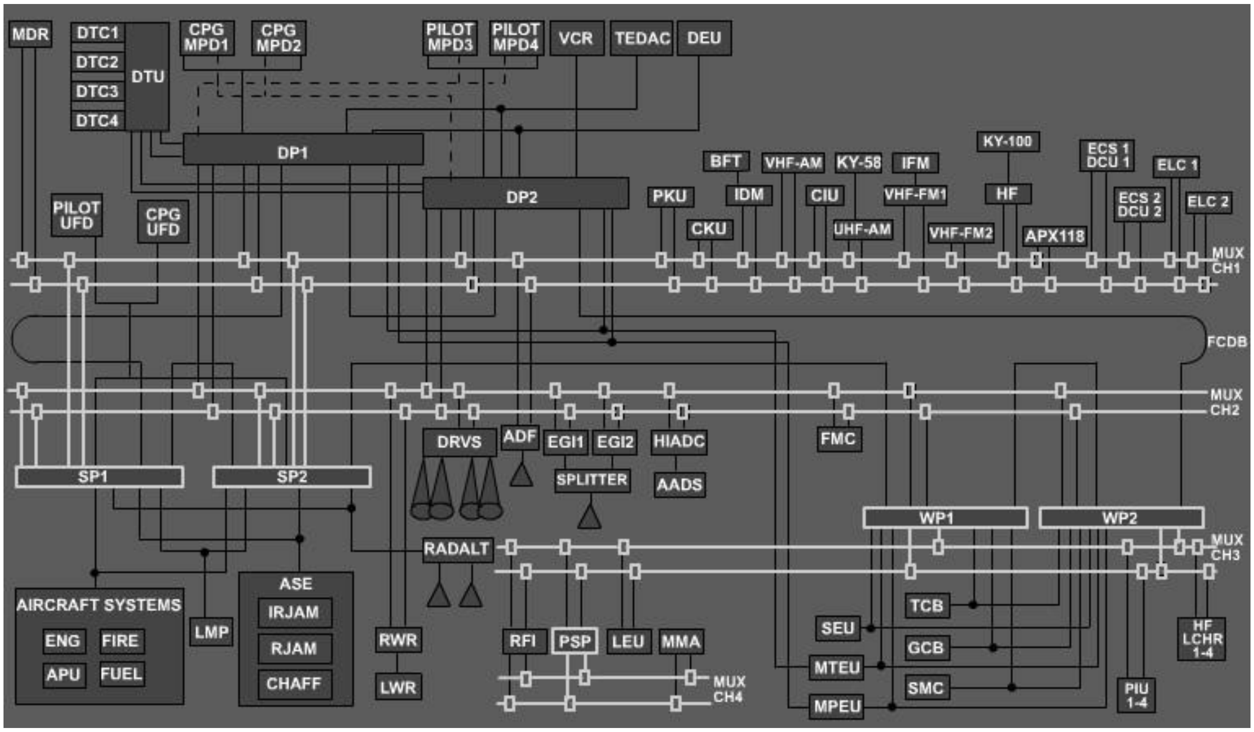


Figure 12. Data Transfer.

b. Data transfer

(1) The primary SP controls data transfer.

(2) The transfer of fault data, software versions, time and date, boresight, and zeroize functions occur mainly on the MUX system; however, the primary SP and WP also transfer data to/from non-multiplexed components directly via hard wiring.

(3) When power is applied to the aircraft and the primary SP initializes, the transfer of data (data bus words) begins.

CHECK ON LEARNING

1. Which MUX system component is responsible for bus operation?

2. The primary weapons processor serves as the BC for which bus channel?

B. Enabling Learning Objective 2

After this lesson, you (the student) will:

ACTION: Describe the operation of the Fibre Channel Data Bus system.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM 1-1520-251-10 and TM 1-1520-Longbow/Apache IETM.

1. Learning Step/Activity 1

Identify the purpose and components of the Fibre Channel Data Bus system.

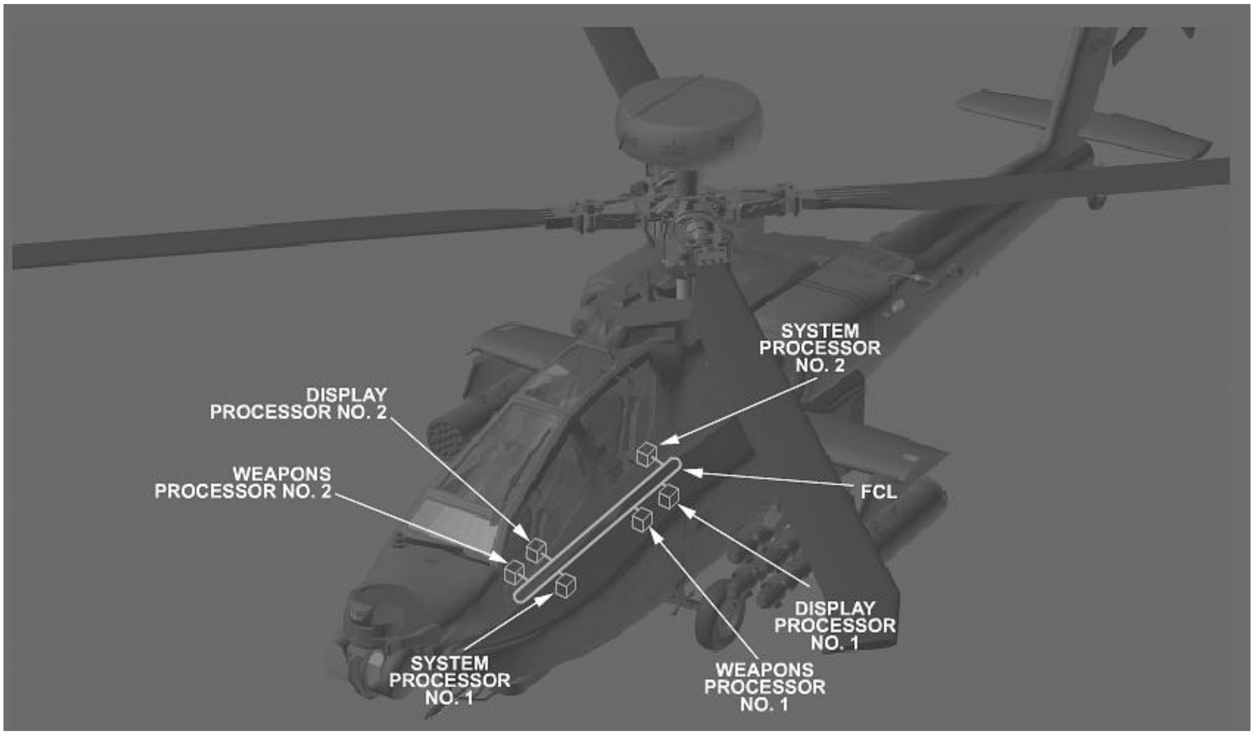


Figure 13. Fibre Channel Data Bus.

a. The Fibre Channel Data Bus (FCDB) bus system consists of an interprocessor fibre channel data bus loop (arbitrated loop), two dedicated Fibre Channel (FC) data buses (point-to-point), the Data Transfer Unit (DTU), both SPs, both WPs, and both Display Processors (DPs).

b. The DTU is used for mission and map data transfer on the FCDB.

(1) The DTU communicates with the DPs over dedicated fibre channel interfaces (point-to-point) using Internet Protocol (IP).

(2) The DPs use Network File System (NFS) procedures for all file operations with the Data Transfer Cartridges (DTCs) installed in the DTU.

(3) Both DPs have full access to the DTU and can read from and write data to the DTU.

c. The DPs provide a central hub for the FCDB network with each DP containing ports to:

(1) DTU (point-to-point)

(2) SP1 (arbitrated loop)

(3) SP2 (arbitrated loop)

(4) WP1 (arbitrated loop)

(5) WP2 (arbitrated loop)

(6) Spare (growth)

d. The SP provides functional control and acts as data controller for the FCDB system.

2. Learning Step/Activity 2

Identify the operation of the FCDB System.

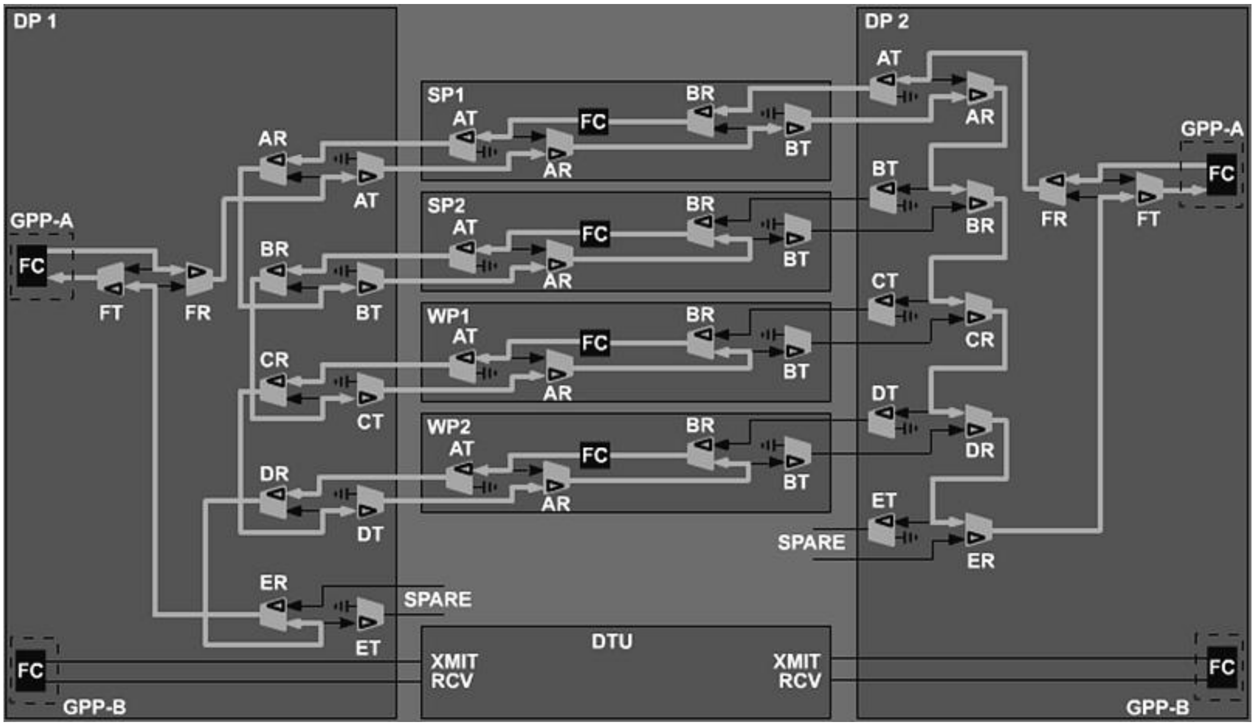


Figure 14. Fibre Channel Data Bus System.

a. The FCDB provides a network for high-speed transfer of data between the main components of the Data Management System (DMS) using point-to-point communication and arbitrated loop architecture.

(1) The primary purpose of the point-to-point FCDB is to initialize subsystems via the DPs with mission data at power-up, with most uploads initiated by the operator via the Multipurpose Display (MPD).

(2) The FCDB is a redundant, high-speed (1.025 Gigabits per second), arbitrated loop network that performs the following functions:

(a) Decreases data bus loading of the MIL-STD-1553B data bus

(b) Provides for multiple Line Replaceable Unit (LRU) and cable failures with no significant degradation of overall system performance

(c) Provides additional bandwidth for Embedded Battle Command (EBC) functionality

(3) The DP provides a central hub for the FCDB network with each DP containing a hub with six FC ports. The switched hubs provide rerouting of network traffic around failed LRUs and or cables.

(4) The primary SP controls the FCDB system. Once the primary SP establishes a loop connection with one of the DPs, it begins bus controller operation of the fibre channel.

(5) Each SP contains two external FC ports.

(6) Each FC port contains two FC switches.

(a) One side of the port functions as the transmitter.

(b) The other side functions as the receiver.

(7) Each WP contains two external FC ports.

(8) Each FC port contains two FC switches.

(a) One side of the port functions as the transmitter.

(b) The other side functions as the receiver.

CHECK ON LEARNING

1. Which FCDB system component functions as data controller of the FCDB system?

2. The DTU communicates with the DPs over dedicated fibre channel interfaces (point-to-point) using what type of protocol?

C. Enabling Learning Objective 3

After this lesson, you (the student) will:

ACTION: Describe the operation of the Data Management System.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM 1-1520-251-10 and TM 1-1520-Longbow/Apache IETM.

1. Learning Step/Activity 1

Identify DMS operation.

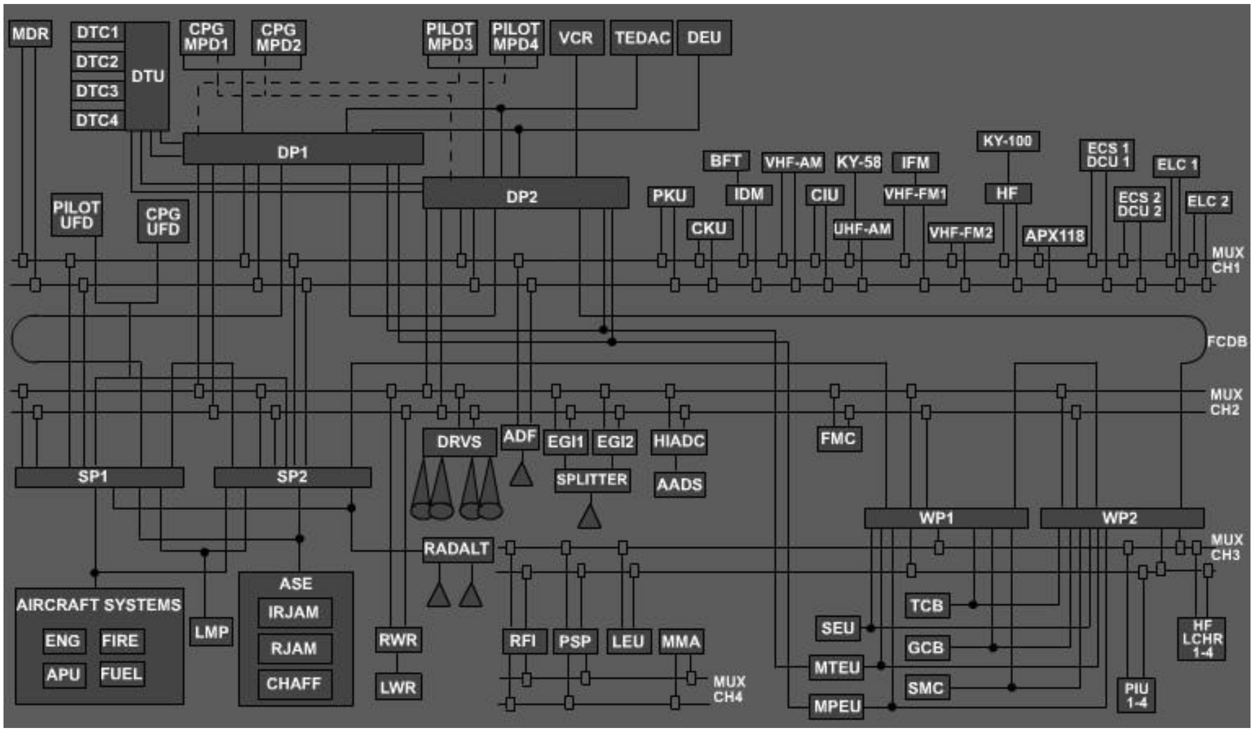


Figure 15. DMS Software Routines.

a. The DMS software routines reside in the SPs and provide three functions:

(1) Data transfer

(2) Fault detection/isolation

(3) Warning, caution, and advisory indications

b. Data transfer

Data transfer is the movement of data from one location to another for use by a system, subsystem, and/or component. The FCDB and the 1553B MUX bus systems are the primary media for transferring data within the AH-64D Data Management System. Non-multiplex compatible components are hardwire-linked to the BCs directly or through remote terminals.

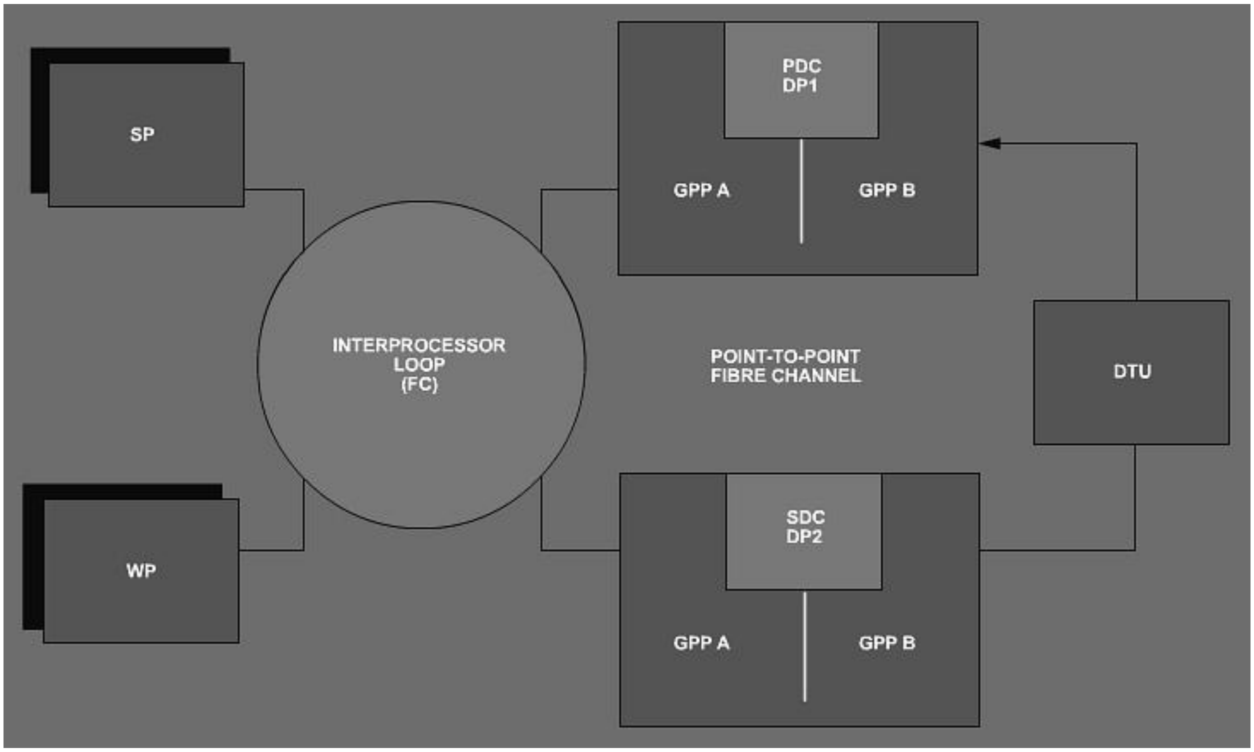


Figure 16. Mission Data.

(1) Mission data

(a) Initial mission and map data can be compiled on the Aviation Mission Planning Station (AMPS) and loaded into a DTC.

1) The DTC is then inserted into the Data Transfer Receptacle (DTR) and uploaded by the FCDB via the DPs.

2) Using the FCDB and the 1553B MUX bus, the DMS transfers the data to the appropriate system, subsystem, and/or component where the data will be stored and/or used.

(b) Selected data collected during the flight is transferred via the primary DP to the DTC for post-mission analysis/debriefing using the AMPS.

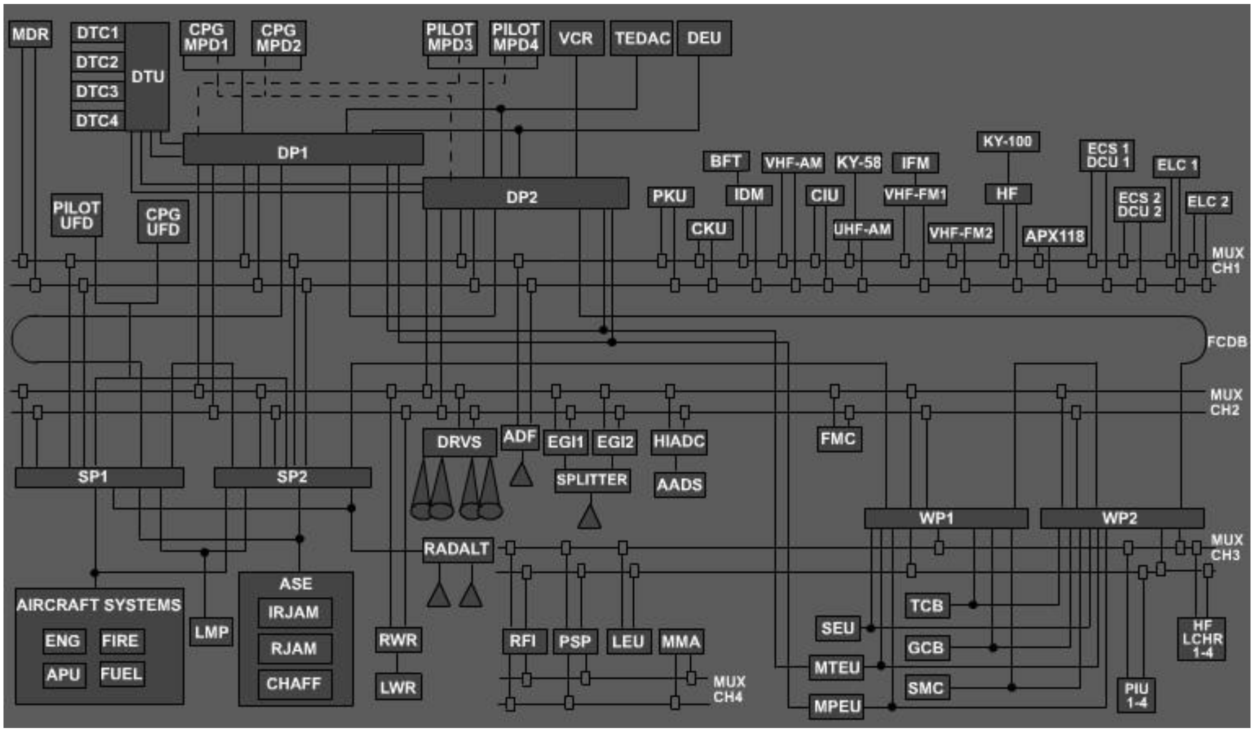


Figure 17. Data Management System.

(2) Flight, safety, maintenance data, and crewstation voice audio are processed by the DMS and transferred to the Maintenance Data Recorder (MDR) for storage.

(a) When the flight/mission is complete, the maintenance and safety data can be downloaded via the Maintenance Support Device (MSD), and used for fault identification and correction, maintenance planning, etc.

(b) Flight data, crewstation voice audio, and operating parameters are also collected and stored in the MDR.

(c) This data is useful in post-accident analysis activities.

(3) Communications data loaded via the load maintenance panel and/or multi-select fill panel is transferred to the using component/system by the DMS.

(4) Commands, data, and BIT status are transferred by the DMS, based on software, operator inputs, system operation, detected conditions, etc.

c. Fault detection/isolation

(1) System and component status is available to the DMS as a result of the MUX bus protocol.

POWER-ON BUILT-IN-TEST (PBIT)
- AUTOMATIC UPON APPLICATION OF PRIMARY POWER
- VERIFIES OPERATIONAL STATUS OF UUT
- MAY AFFECT OPERATIONAL STATUS OF UUT
- NO SP, WP, OR DP PBIT IF TESTING AFFECTS CREW SAFETY
- FAULTS DISPLAYED UPON DETECTION

CONTINUOUS BUILT-IN-TEST (CBIT)
- AUTOMATIC UPON COMPLETION OF PBIT
- DETECTS RUN-TIME FAULTS FOR UUT
- RUNS IN BACKGROUND (NON-INTERFERING)
- TIME FILTER BETWEEN FAULT DETECTION AND DISPLAY
- (TYPICALLY 10 SECONDS)

INITIATED BUILT-IN-TEST (IBIT)
- INITIATED BY EITHER CREWMEMBER
- INITIAL CONDITIONS MUST BE SATISFIED TO RUN IBIT
- INTERRUPTIVE TEST – MAY AFFECT OPERATIONAL STATUS OF UUT
- MAY REQUIRE OPERATOR INTERACTION
- FAULTS DISPLAYED UPON DETECTION

Figure 18. DMS Built-In-Tests.

(2) DMS Built-In Testing (BIT)

DMS Fault Detection and Isolation (FDI) is dependent on the three different types of BIT conducted by each system. These tests are Power-On BIT (PBIT), Continuous BIT (CBIT), and Initiated BIT (IBIT).

(a) PBIT

1) This test verifies the operational readiness of the Unit Under Test (UUT).

2) The test is automatically started upon application of primary power and may interfere with the normal operation of the equipment.

3) No PBIT for the SPs, WPs, or DPs will be allowed if it threatens flight/ground crew safety.

4) PBIT results are immediately sent to the primary SP upon completion.

5) When PBIT is complete, CBIT is enabled.

(b) CBIT

1) Continuous BIT is responsible for detecting run-time faults for the system under test.

2) The tests run as a set of non-interfering background checks and start running at the completion of PBIT.

3) CBIT continues to run until the system is turned off or IBIT is enabled.

4) All faults detected from CBIT are displayed after they pass a predetermined time delay filter (typically 10 seconds).

5) The purpose of the time delay is to limit the display of ambiguous faults.

(c) IBIT

1) IBIT operations are initiated by the operator via the DMS IBIT pages and represent an interruptive mode of operation.

2) IBIT is designed to interrupt CBIT because, for most systems, IBIT is a deeper level of testing.

3) IBIT may be identical to the tests conducted during PBIT.

4) These tests may require operator interaction, depending on the complexity of the equipment under test. This interaction may include the following:

a) Selecting a specific switch position or pushbutton state

1 In some cases, the IBIT will continue when the SP detects that the prompt was carried out.

2 In other cases, the operator must inform the SP that the prompt has been completed via an Acknowledge (ACK) input.

b) Positioning a control. Again, this action may or may not require the ACK input.

c) Evaluating a condition when presented. This is normally a visual evaluation and requires an “ACK” input to confirm the condition is acceptable.

d) Entering alphanumeric data via the Keyboard Unit (KU).

5) To enable IBIT, a set of initial conditions must be satisfied.

6) If the conditions are not satisfied, the IBIT selection will be barriered.

7) Test results are not subject to any time filter.

8) They are displayed as soon as the test is completed.

9) Results include subsystem specific fault information associated with the system selected as well as fault information of ancillary systems that could adversely affect the operation of the system under test.

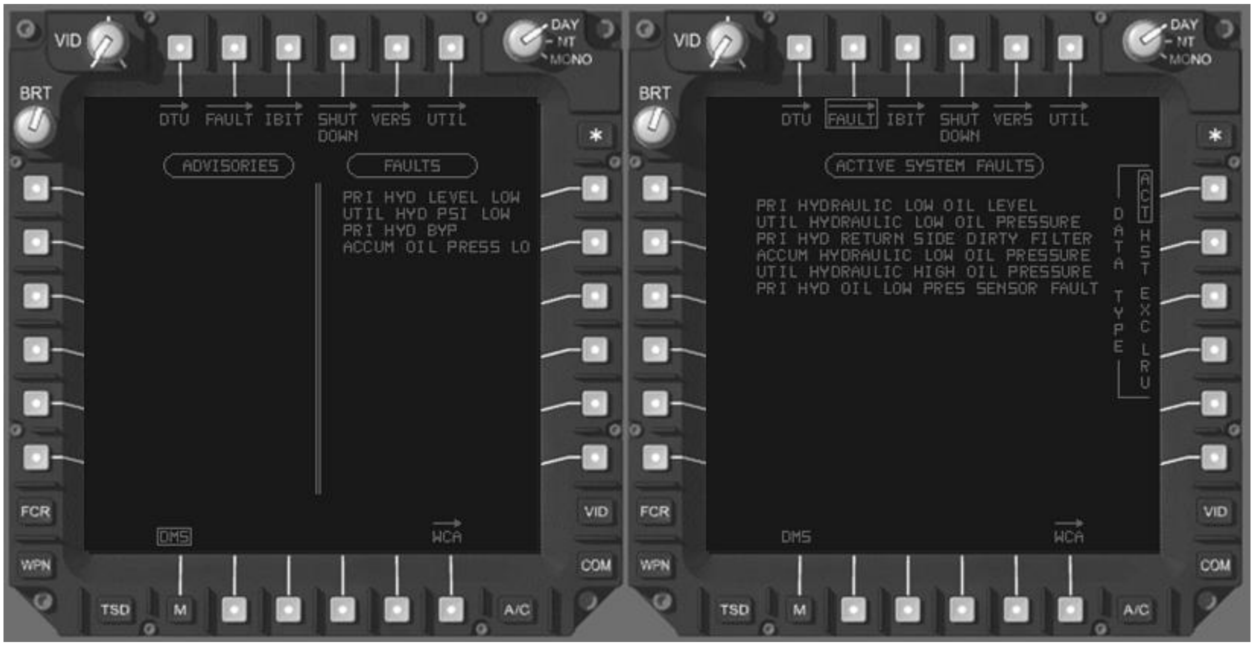


Figure 19. BIT Result Displays.

(3) The DMS can display BIT results via one or more media, depending on the fault detected, as follows:

(a) On the DMS and FAULT pages in the fault listing areas for PBIT and CBIT (faults, fails, and degradations)

(b) In the high action display on the Helmet Display Unit (HDU) and Target Acquisition and Designation Sight (TADS) Electronic Display and Control (TEDAC) (weapon and sight status)

(c) On the DMS IBIT page from which IBIT was initiated

(d) IBIT-detected faults will also be displayed on the DMS and FAULT pages once detected.

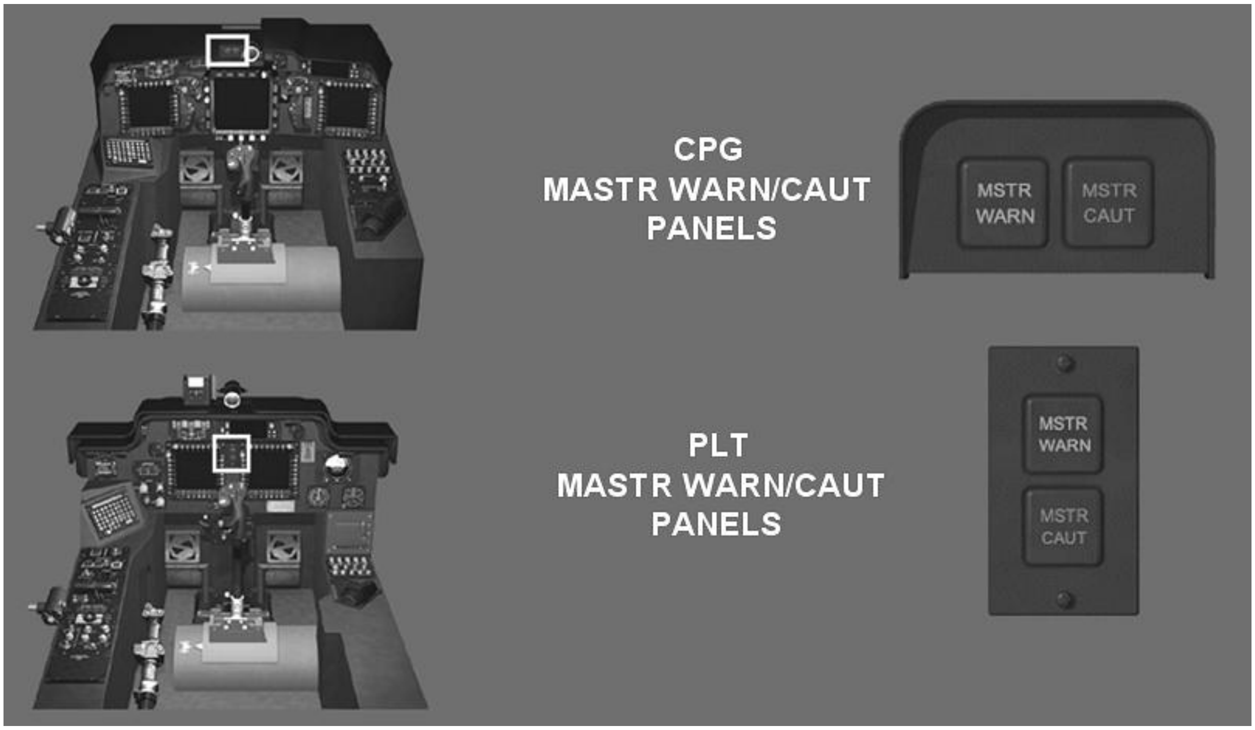


Figure 20. Master Warning/Caution Panels.

(4) Master Warning/Caution Panels

(a) The Master Warning and Master Caution (MSTR WARN and MSTR CAUT) pushbuttons alert the crewmembers that a warning or caution condition exists.

1) The MSTR WARN is an Night Vision Imaging System (NVIS) yellow lamp. It flashes at a 4 Hz rate when a fault is detected.

2) The MSTR CAUT is an NVIS green lamp. It illuminates steadily when a caution is detected.

3) Both lamps are also pushbutton switches. When selected, an acknowledgment signal is sent to the SPs.

a) Connected to the Lighting System Controller (LSC) for light illumination

b) Connected to the SPs for button acknowledgment

(b) Warning, Caution, and Advisory (WCA) indications

1) WCA conditions are detected through system monitoring and PBIT and CBIT in the same manner as system faults, failures, and degradations.

2) WCA conditions are automatically displayed when detected.

3) The annunciation and display media are dependent on the severity of the condition detected.

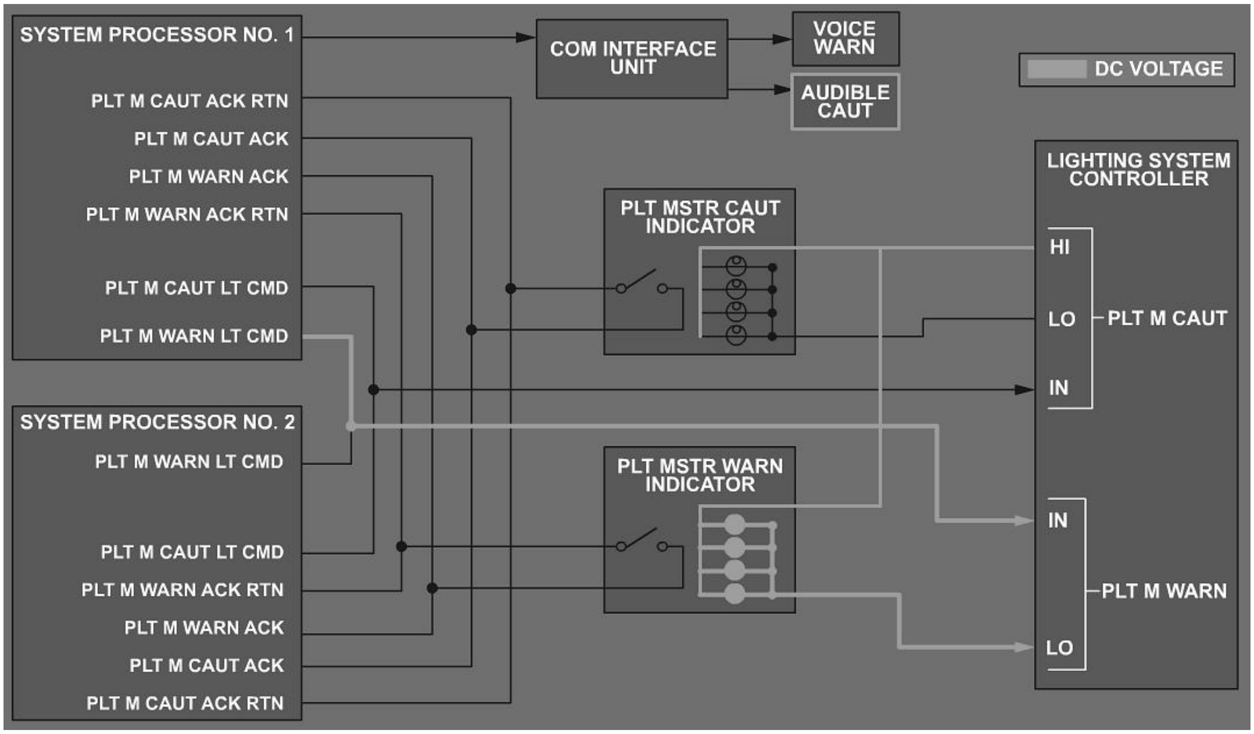


Figure 21. Warning/Caution/Advisory Audio.

(c) Warnings

1) A voice message is presented through the Intercommunications System (ICS) describing the warning condition.

2) MSTR WARN annunciator pushbuttons will illuminate.

3) Pressing the illuminated pushbutton in either crewstation will:

a) Extinguish the MSTR WARN indicator in that crewstation only

b) Reset (silence) the voice warning in both crewstations

4) Warnings will be displayed on the Engine (ENG) and WCA pages and will be recorded in the MDR.

(d) Cautions

1) Caution tones are presented through the ICS.

2) MSTR CAUT annunciator pushbuttons will illuminate.

3) Pressing the illuminated pushbutton in either crewstation will:

a) Extinguish the MSTR CAUT indicator in that crewstation only

b) Reset (silence) the caution tone in both crewstations

4) Cautions are displayed on the ENG and WCA pages and will be recorded in the MDR.

(e) Advisories

1) Advisories are a single tone presented through the ICS for messages related to flight control or Improved Data Modem (IDM) conditions (MSG SEND) only.

2) If the aircraft is equipped with the Tactical Engagement Simulation System (TESS), voice messages will be given to alert the crew to various hostile engagement situations.

3) Advisories are displayed on the DMS and WCA pages and recorded in the MDR.

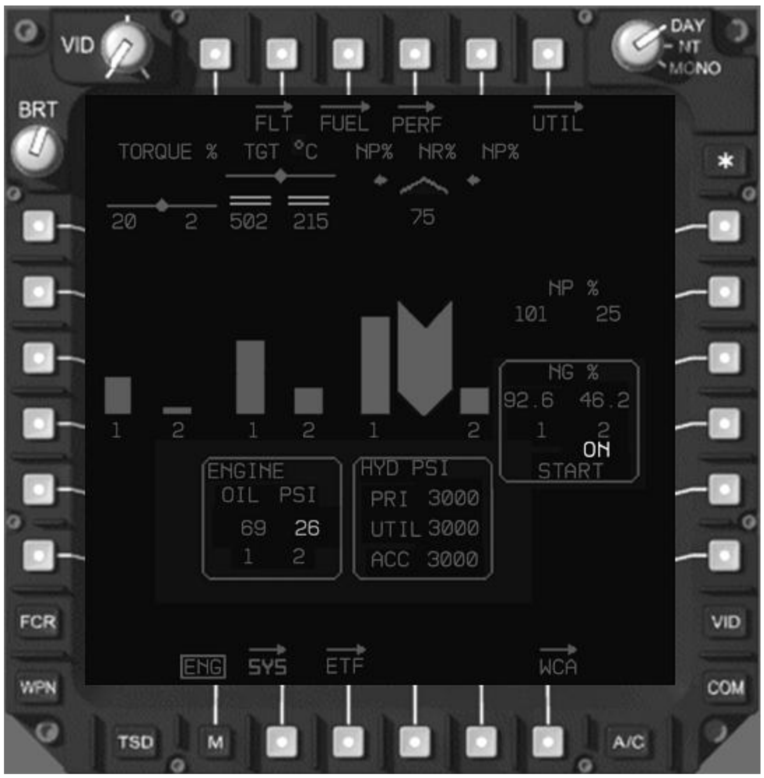


Figure 22. Engine Page Formats.

4) DMS autopage

The autopage function will cause the ENG page to be displayed when any warning condition is detected as outlined below.

a) The ENG page autopage format depends on the format of the ENG page at the time the warning condition is detected.

<u>1</u> Ground format – The emergency format is not available; however, the system will autopage to the ENG page ground format.

<u>2</u> Flight format – the system will autopage to the ENG page emergency format.

b) The ENG autopage format will be displayed as follows in the pilot crewstation:

1 If the Flight (FLT) page is selected on the left MPD, the autopage format will replace the display selected on the right MPD.

2 If the FLT page is **not** selected on the left MPD, the autopage format will replace the display selected on the left MPD.

c) The ENG autopage format will be displayed as follows in the CPG crewstation:

1 If the CPG has the DMS autopage function enabled (DMS Utility page) the ENG autopage format will also be automatically displayed in the CPG crewstation as outlined above for the pilot.

2 If the CPG has the DMS autopage function disabled, the autopage function will not affect his displays.

3 If the display system is operating on one DP (single DP fail), the autopage disable function is not available and the ENG autopage format will be displayed in the CPG crewstation as outlined above for the pilot.

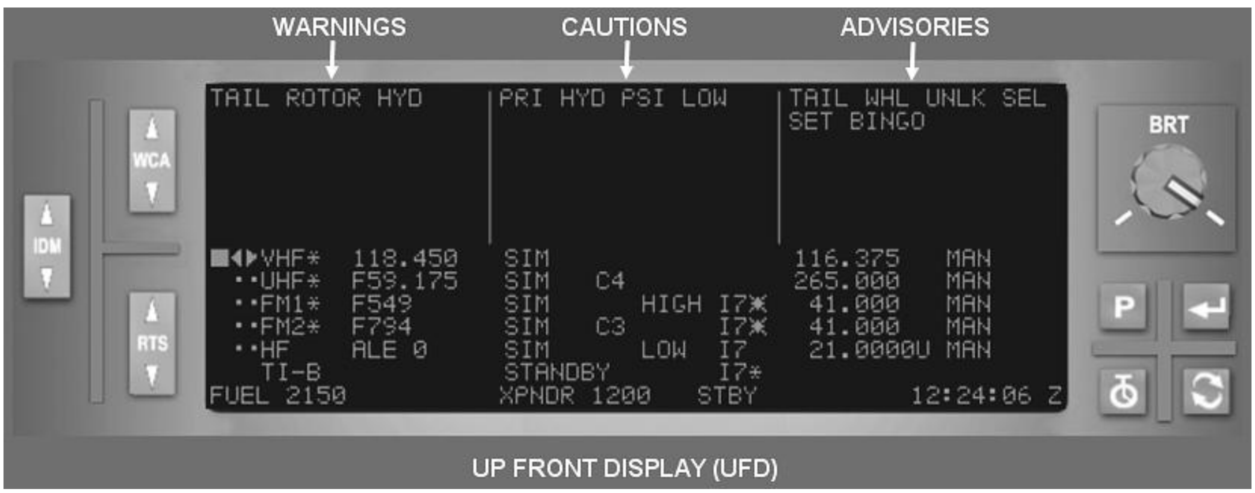


Figure 23. Up-Front Display.

5) Up-Front Display (UFD) indications

a) Warnings

All warnings, with the exception of engine and Auxiliary Power Unit (APU) fires, will be presented in the Warning section of the UFD in both crewstations.

b) Cautions

All cautions will be presented in the Caution section of the UFD in both crewstations.

c) Advisories

All advisories will be presented in the Advisory section of the UFD in both crewstations.

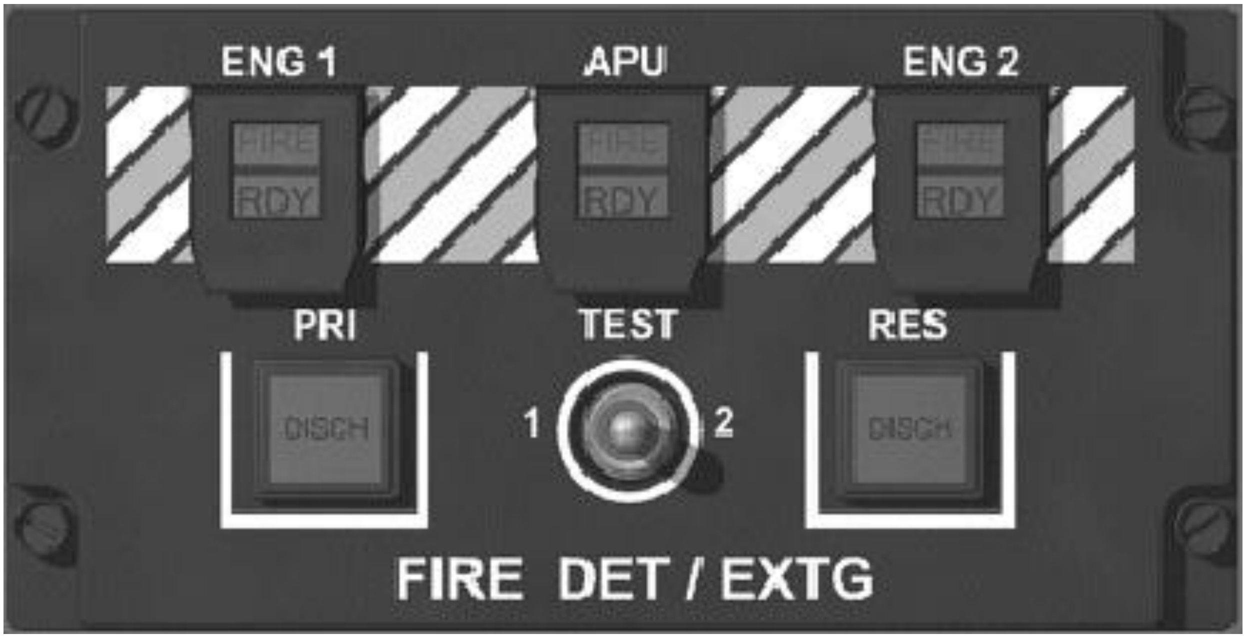


Figure 24. FIRE DET/EXTG Panels.

6) Fire Detection/Extinguishing panel

a) FIRE warning lights will illuminate for ENG 1, ENG 2, and APU fires.

b) Pressing the illuminated FIRE pushbutton in either crewstation will:

1 Arm the Fire Detection/Extinguishing System and illuminate the Ready (RDY) light

2 Shut off fuel to the indicated engine or APU

3 Shut off bleed air from the indicated engine or APU

4 Close the cooling louver to the indicated engine

5 Shut down the Environmental Control System (ECS) to the crewstations

6 Extinguish the MSTR WARN indicator in both crewstations

7 Reset (silence) the voice warning in both crewstations

c) The Fire Detection/Extinguishing System can only be activated in the crewstation in which it was armed.

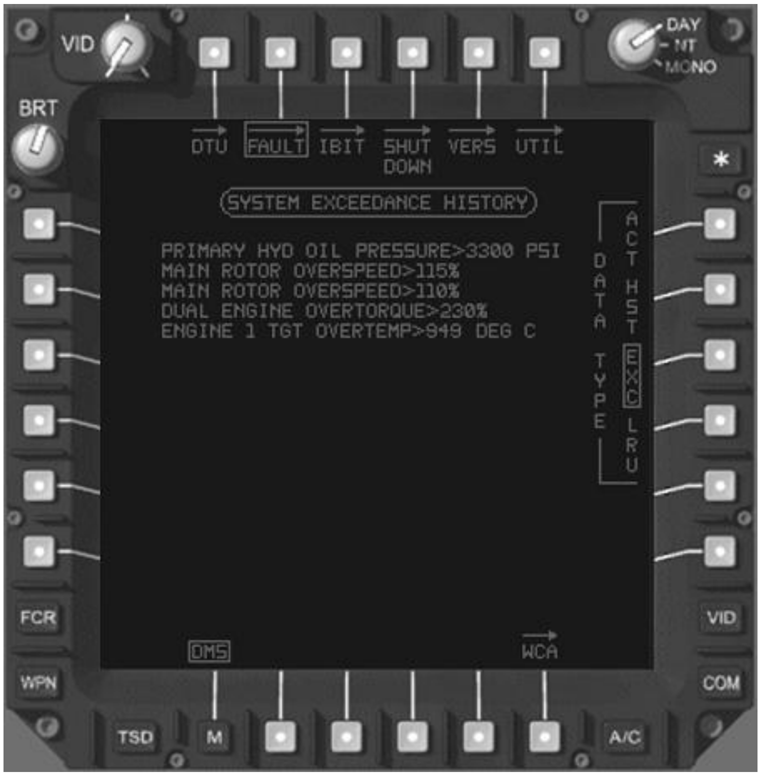


Figure 25. Exceedance Page.

d. Exceedances

Exceedances are defined as operation above the operational limit of an aircraft component.

(1) The DMS monitors, displays, and records data related to exceedances of main rotor speed, hydraulic system pressure, engine torque, and Turbine Gas Temperature (TGT) operating limits.

(a) The DMS records the exceedance parameters to the MDR.

(b) Exceedances are available for display on the FAULT page when the Exceedance (EXC) DATA TYPE is selected.

NOTE: When power is removed from the aircraft, all exceedance data is cleared from the SP memory and cannot be recovered for display. Because exceedance data is recorded only to the MDR, it is extremely important that pilots accurately record all exceedances in the aircraft logbook, especially if a mid-mission crew change takes place.

NOTE: Because exceedance data from previous flights is not maintained in the SP NVM after power-down, exceedance data must be checked and recorded by the aircrew as required in the -10 CL prior to shutdown of aircraft power.

NOTE: Data in the MDR is not available to the aircrew and must be downloaded by maintenance personnel using a MSD computer. Once downloaded, it can be compared to the aircraft logbook, and, if required, additional or corrected data may be added to the logbook.

(2) Main rotor speed

(a) The rate of main rotor rotation is expressed in percent. The Number of Rotations (NR) maximum speed is 110%.

(b) At 106%, the high rotor warning is annunciated and ENG autopage occurs to display NR speed.

(c) As long as operation is within these parameters, there is no exceedance.

(d) When NR is greater than 110%, an exceedance has occurred.

(e) Five NR exceedance messages are available, and more than one message may be displayed at the same time.

(f) Once displayed, they are recorded to the MDR and can only be cleared by maintenance personnel.

1) MAIN ROTOR OVERSPEED > 110%

Displayed when N_R speed is greater than 110%

2) MAIN ROTOR OVERSPEED > 115%

Displayed when N_R speed is greater than 115%

3) MAIN ROTOR OVERSPEED > 125%

Displayed when N_R speed is greater than 125%

4) MAIN ROTOR UNDERSPEED < 90%

A main rotor underspeed condition of less than 90% with the squat switch indicating the aircraft is in the air has occurred.

5) LOW ROTOR RPM

NR < 93% and the aircraft is in the air.

(3) Hydraulic systems pressure

(a) The maximum operating pressure for the primary and utility hydraulic systems is 3400 psi with a 5-minute transient between 3310 and 3400 psi and a 5-second transient above 3400 psi.

(b) When pressure exceeds the time or pressure limits, an exceedance has occurred.

(c) When primary or utility hydraulic pressure is below 1260 psi or above 3400 psi for more than 5 seconds, or between 3310 and 3400 for more than 5 minutes, the red HYD PSI status window will be displayed in the upper right portion of the ENG page flight format.

(d) Four hydraulic pressure exceedance messages are available, and all four messages may be displayed at the same time.

(e) Once displayed, they are recorded to the MDR and can only be cleared by maintenance personnel.

1) PRIMARY/UTILITY HYD OIL PRESSURE > 3300PSI

Displayed when steady-state pressure greater than 3300 psi exists for 5 minutes

2) PRIMARY/UTILITY HYD OIL PRESSURE > 3400PSI

Displayed when steady-state pressure greater than 3400 psi exists for 5 seconds

3) ACCUM HYD OIL PRESSURE > 3300 PSI

Displayed when steady-state pressure greater than 3300 psi exists for more than 5 minutes

4) ACCUM HYD OIL PRESSURE > 3400 PSI

Displayed when steady-state pressure greater than 3400 psi exists for more than 5 seconds

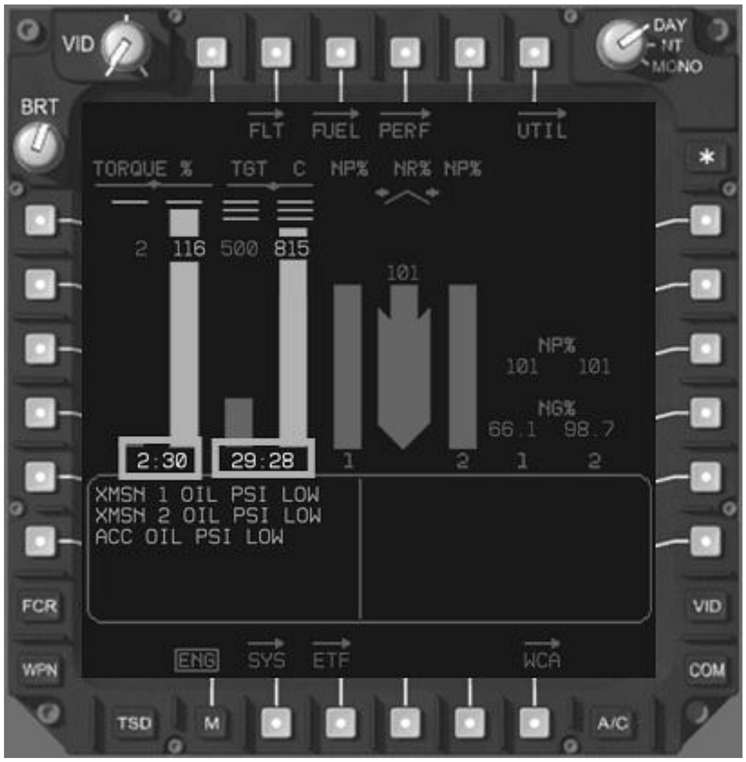


Figure 26. Engine Page with Countdown Timer.

(4) Engine torque and TGT

To aid the pilot in observing torque and TGT transient time and exceedance limits, countdown timers are employed on the ENG page flight format.

(a) Countdown timers are displayed in white on the ENG page and count down in decrements based on parameters listed in TM 1-1520-251-10; Table 2-4.

(b) When time-limited indications are entered, such as TORQUE or TGT, a countdown timer is displayed in place of the engine numbers under that parameter tape to alert the crewmembers of the time remaining before exceeding a limitation.

(c) Multiple timer operations

When more than one limit of an engine parameter is exceeded, the timer of the highest priority limit will be displayed. For example:

1) When single engine torque exceeds 110% (but does not exceed 122%), a timer (timer 1) initializes at 2:30 and starts to count down.

a) As long as torque remains greater than 110% and less than 123%, timer 1 will count down to 0.

b) Once the timer reaches 0:0, the 0:0 displays will remain until torque is reduced below 100% and then reset (blank), and the engine numbers will be displayed.

2) If timer 1 is counting down and torque increases to greater than 122%, timer 1 would be replaced with a second timer (timer 2) that initializes at 6 seconds.

a) Now, timer 2 starts to count down and will remain at 0:0 until torque is reduced below 122%.

b) While timer 2 is being displayed, timer 1 continues to count down.

3) When torque is reduced below 123%, timer 2 will blank and timer 1 will be displayed, still counting down from the original 2:30 initialization point.

4) This process can involve up to four timers when exceeding -701C engine TGT limitations.

5) Engine TGT is displayed on the FLT page and Helmet Mounted Display (HMD) during the last 2 minutes of the TGT 10 and 30-minute countdown timers.

(d) When the timer reaches 0:0 and the parameter is not reduced, an exceedance occurs.

FAULT Page Text	Description
DUAL ENGINE OVERTORQUE > 230%	An overtorque condition occurred in dual engine mode with the torque from both engines measuring greater than 230% has occurred.
DUAL ENGINE OVERTORQUE > 260%	An overtorque condition occurred in dual engine mode with the torque from both engines measuring greater than 260% has occurred.
SINGLE ENGINE 1/2 OVERTORQUE > 125%	An engine overtorque condition greater than 125% has occurred.
SINGLE ENGINE 1/2 OVERTORQUE > 130%	An engine overtorque condition greater than 130% has occurred.
ENGINE 1/2 TGT OVERTEMP > 807 DEG C	A 701 engine TGT overtemperature condition of greater than 807 deg C for greater than 30 minutes has occurred.
ENGINE 1/2 TGT OVERTEMP > 864 DEG C	A 701 engine TGT overtemperature condition of greater than 864 deg C for greater than 2.5 minutes has occurred.
ENG 1/2 START TGT OVERTEMP > 869 DEG C	A 701 engine TGT overtemperature condition of greater than 852 deg C has occurred within 1.5 minutes from selecting engine start or before putting the throttle in the FLY position.
ENGINE 1/2 TGT OVERTEMP > 919 DEG C	A 701 engine TGT overtemperature condition of greater than 919 deg C for greater than 12 seconds has occurred.
ENGINE 1/2 TGT OVERTEMP > 965 DEG C	A 701 engine TGT overtemperature condition of greater than 965 deg C has occurred.
ENGINE 1/2 TGT OVERTEMP > 810 DEG C	A 701C engine TGT overtemperature condition of greater than 810 deg C for greater than 30 minutes has occurred.
ENG 1/2 START TGT OVERTEMP > 851 DEG C	A 701C engine TGT overtemperature condition of greater than 851 deg C has occurred within 1.5 minutes from selecting engine start or before putting the throttle in the FLY position.
ENGINE 1/2 TGT OVERTEMP > 870 DEG C	A 701C engine TGT overtemperature condition of greater than 870 deg C for greater than 10 minutes has occurred.
ENGINE 1/2 TGT OVERTEMP > 878 DEG C	A 701C engine TGT overtemperature condition of greater than 878 deg C for greater than 2.5 minutes has occurred.
ENGINE 1/2 TGT OVERTEMP > 896 DEG C	A 701C engine TGT overtemperature condition of greater than 896 deg C for greater than 12 seconds has occurred.
ENGINE 1/2 TGT OVERTEMP > 949 DEG C	A 701C engine TGT overtemperature condition of greater than 949 deg C has occurred.

Table 1 Engine Torque and TGT Exceedances

NOTE: When referencing Exceedances for your specific aircraft refer to the current operators manual for the aircraft.

(e) Engine torque and TGT exceedance messages are displayed on the FAULT page and more than one message can be displayed at a time.

(f) Once displayed, the messages are recorded to the MDR and can only be cleared by maintenance personnel.

e. The SP provides a means of informing the DMS of the configuration of the aircraft.

(1) When equipment/systems are added or removed, the use of wiring terminators, end caps, microswitches, logic circuits, and other devices allow the SP to automatically configure the aircraft for proper display/utilization of installed systems.

(2) Some examples are:

(a) Auxiliary fuel tanks

(b) Avionics equipment not installed or type installed—for example, Have Quick 1 (HQ1) vs. HQ2

(c) Type of engine (-701 vs. -701C)

(d) Armament and ammunition load

(3) The configuration data is used for weight and balance, fuel consumption, engine parameters, weapons moding and inventory, and so forth.

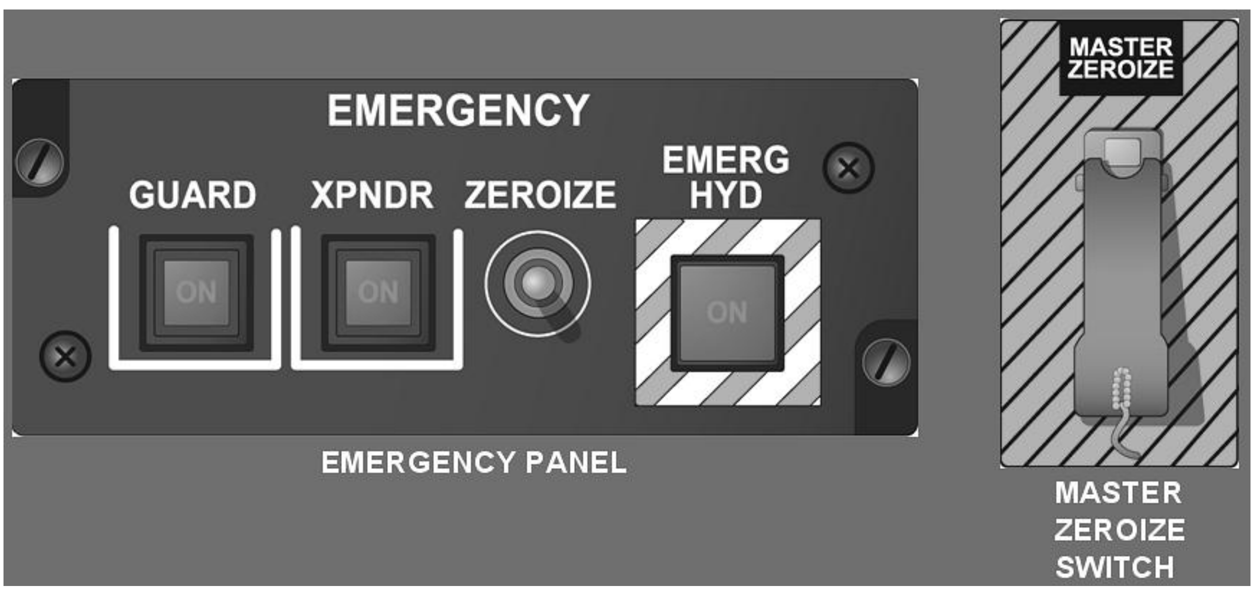


Figure 27. Zeroize and Master Zeroize Switches.

f. Zeroize functions

(1) The DMS has the capability to erase, or zeroize, classified data resident in the aircraft.

(a) Three levels of data zeroizing are available:

1) Emergency Zeroize (manual activation of Emergency ZEROIZE switch)

2) Master Zeroize (manual activation of MASTER ZEROIZE switch)

3) 5 G impact (Master Zeroize activation by 5 G impact)

(b) Aircraft power is required for all three functions.

(2) ZEROIZE switch

The ZEROIZE switch, one located on each Emergency panel, provides the capability for either crewmember to erase specific classified data in the aircraft.

DEVICE	MASTER ZEROIZE	EMERGENCY ZEROIZE	5G ZEROIZE	ZEROIZED ACTION
UHF	YES	YES	YES	MWODS cleared and tunes to 243.000 MHz
FM1	YES	YES	YES	Man and CUE freqs, date/time, Hopsets, Lockouts, CNVs cleared Tunes to 30.00 or 40.50 MHz
FM2	YES	YES	YES	Man and CUE freqs, date/time, Hopsets, Lockouts, CNVs cleared Tunes to 30.00 or 40.50 MHz
HF	YES	YES	YES	Datafill and keyfill cleared, tuned to 29.999 MHz for recieve and transmit
IDM	YES	YES	YES	Network, channel, subscriber, and ATHS parameters and MSG REC buffer cleared
APX-118 (MODE 4)	YES	YES	YES	CNVs cleared
UHF KY-58	YES	YES	YES	CNVs cleared
UHF KY-100	YES	YES	YES	CNVs cleared
EGI1	YES	YES	YES	CNVs and satellite almanac cleared
EGI2	YES	YES	YES	CNVs and satellite cleared
DTU	YES	NO	YES	Zeros written to all locations DTCs rendered unusable (destructive)
FCR PSP	YES	NO	YES	Program data cleared FCR rendered unusable until reprogrammed
SP	YES	YES	YES	Classified data in NVM and RAM (Ground Only) Except for 5 G zeroize
DP	YES	YES	YES	Classified data in NVM (1) and RAM (Ground Only) Except for 5 G zeroize

Figure 28. Zeroize Table.

(3) Emergency Zeroize

The data erased varies with the aircraft lot number. The following is applicable to Lot 8 aircraft only:

(a) UHF

1) Multiple Word Of Day (MWODs) cleared

2) Radio tunes to 243.00 MHz

(b) FM1

1) Man and Cue frequencies cleared

2) Date and Time cleared

3) Hopsets and Lockouts cleared

4) Crypto Net Variables (CNVs) cleared

5) Radio tunes to 30.00 or 40.50 MHz

(c) FM2

1) Man and Cue frequencies cleared

2) Date and Time cleared

3) Hopsets and Lockouts cleared

4) CNVs cleared

5) Radio tunes to 30.00 or 40.50 MHz

(d) HF

1) Datafill and keyfill cleared

2) Radio tunes to 29.999 MHz for receive and transmit

(e) IDM

1) Network, channel, and subscriber cleared

2) Air Target Handover System (ATHS) parameters cleared

3) MSG REC (Received) buffer cleared

(f) IFF AN/APX-118 (Mode 4) – CNVs cleared

(g) KY-58 – CNVs cleared

(h) KY-100 – CNVs cleared

(i) Embedded Global Inertial (EGI) 1 – CNVs and satellite almanac cleared

(j) EGI 2 – CNVs and satellite almanac cleared

(k) SP 1 and 2 – In Emergency Zeroize, classified data in the Non-Volatile Memory (NVM) and Random Access Memory (RAM) is cleared only when the aircraft reaches a weight-on-wheels condition.

(l) DP 1 and 2 – In Emergency Zeroize, classified data in the NVM and RAM is cleared only when the aircraft reaches a weight-on-wheels condition.

(4) Master Zeroize

(a) The MASTER ZEROIZE switch, protected by a safety-wired guard, is located on the right-side instrument panel in both crewstations.

(b) It performs all of the functions of the ZEROIZE switch, plus zeroizes the following:

1) DTU

a) Writes zeros to all data storage locations

b) Performs a destructive zeroize on all DTCs (they will no longer be useable and cannot be reprogrammed)

(c) FCR/PSP

a) Non-volatile memory is cleared.

b) Program data is cleared from the PSP.

<u>1</u> This is a zeroize function

<u>2</u> The PSP can be removed from the aircraft and returned to the manufacturer to be reprogrammed.

3 The Contractor Field Service Representative (CFSR) also has the capability to reprogram the PSP on the airframe.

(5) 5 G impact zeroize

This function performs the same function as the Master Zeroize switch— the only exception is that for the SPs and DPs to zeroize, the aircraft must have no weight on wheels.

(6) Installed Aircraft Survivability Equipment (ASE) User Data Modules (UDM) will **not** be zeroized by any of the above functions.

CHECK ON LEARNING

1. Which type of BIT has a time delay between fault detection and display?

2. The DMS autopage has priority over all other page displays except the ______ page.

3. When is CBIT enabled?

SITUATION: On the first leg of a mission, the aircraft experienced an overtorque event that resulted in an exceedance. The Exceedance page message displayed is DUAL ENGINE OVERTORQUE > 230%. The aircraft is then shut down and serviced.

4. When the aircraft is started for the second leg of the flight, the exceedance data ____ (will / will **not**) be available for display.

5. The Master Zeroize switch was activated. What, if any, classified data was **not** zeroized?

D. Enabling Learning Objective 4

After this lesson, you (the student) will:

ACTION: Identify the purpose and components of the DMS.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM 1-1520-251-10 and TM 1-1520-Longbow/Apache IETM.

1. Learning Step/Activity 1

Identify the purpose and components of the DMS.

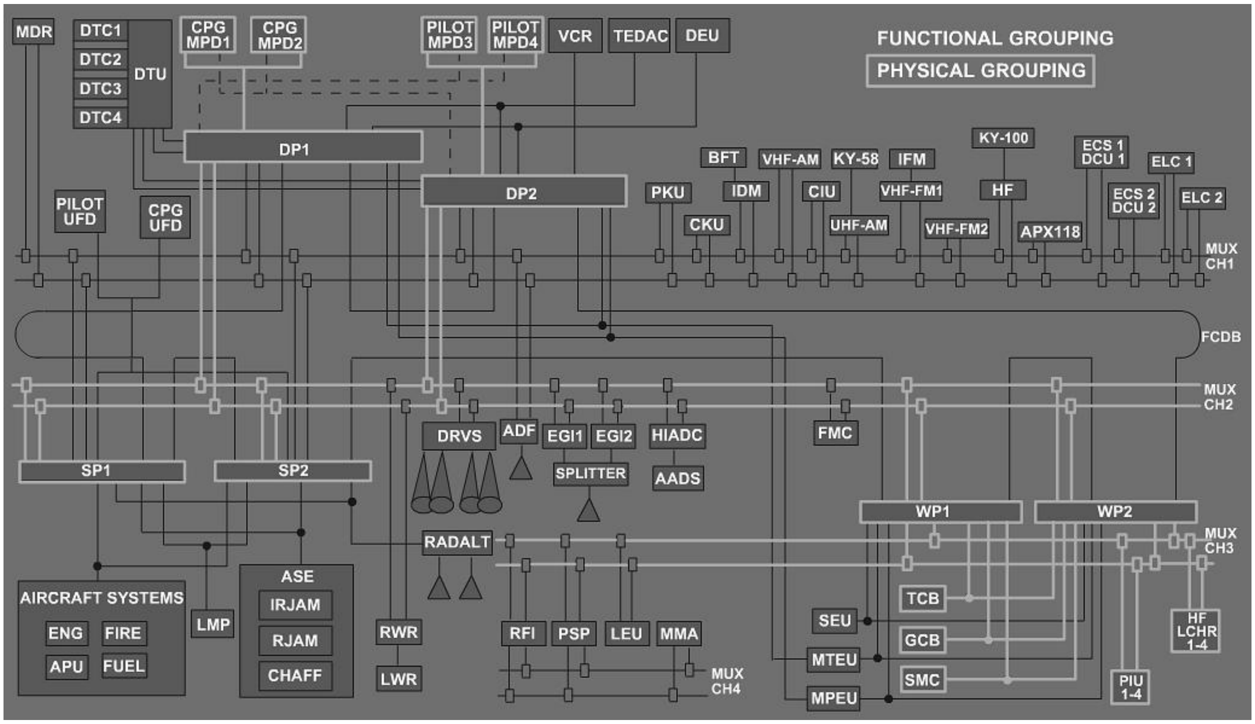


Figure 29. DMS Grouping.

a. 1553B MUX bus components

(1) The DMS integrates the Communications, Navigation, Flight Control, Sighting, Weapons, and Aircraft Survivability Equipment Systems, Controls and Displays, and aircraft management systems into one big, overall avionics/weapons system.

(2) The Avionics and Weapons Systems consist of three MIL-STD-1553B data buses.

(a) The FCR System also uses a MIL-STD-1553B data bus.

(b) Each of the systems is redundant.

(3) The AH-64D integrates all avionics and aircraft subsystem functions into the Mission Equipment Package (MEP).

(a) The MEP consists of functionally and physically grouped subsystems.

(b) This functional grouping enables merging of information and improves crewmember and aircraft performance.

(4) Functional grouping is achieved with the use of data buses to communicate information to system processing centers and presenting all tasks relative to an operation on MPDs.

(5) Examples of an MEP functional group would be the Weapons System or the Navigation System.

(6) Physical grouping increases efficiency through shared assets, such as data buses or processing centers, and increases reliability through redundant or reconfigurable assets—for example, dual processors and software.

(7) MIL-STD-1553B data buses are used to communicate system commands to the functionally grouped subsystems.

(a) The primary SP controls the communication on data bus channels 1 and 2.

(b) The primary WP controls communication on channel 3.

(c) The FCR PSP controls communication channel 4.

(8) DPs are used to receive and transmit data to and from the SP and WP.

(9) This integrates the crewmember with the MEP.

b. 1553B bus Components

(1) 1553B data buses

(2) SP

(3) DP

(4) WP

(5) KU

(6) MDR

c. Associated 1553B non-bus components

(1) PSP

(2) UFD

(3) MPD

(4) Video Cassette Recorder (VCR)

(5) Load/Maintenance Panel (LMP)

(6) Master Warning/Caution pushbuttons

d. 1553B data buses

(1) The data buses electronically integrate the Communications, Navigation, Flight Control, Sighting, Weapons, and Aircraft Survivability Equipment Systems, Controls and Displays, and aircraft management systems.

(2) The data buses are located throughout the aircraft, interconnecting the BCs (primary SP and primary WP) with the RT.

(3) The MUX data buses consist of the following:

(a) Twisted shielded-pair cables conforming to MIL-STD-1553

(b) DLTU

(c) DBT

e. FCDB components

(1) The aircraft MUX bus system also contains two FC point-to-point buses and a Fibre Channel Loop (FCL), also known as an arbitrated loop FCDB.

(2) Fibre channel data buses are used to communicate massive amounts of data, such as mission and map data, between the aircraft's primary processors.

f. FC components

(1) Point-to-point data bus cables

(a) There are two unique dedicated cables, one each between each DP and the DTU.

(b) Each cable is considered an LRU and has a unique part number.

(c) The fibre channel cables consist of four unique stranded copper fibre channel inserts that provide two balanced pairs of conductors to support the transmit and receive interfaces for each cable.

(2) Arbitrated loop data bus cables

(a) There are eight unique cables on each aircraft for the arbitrated loop, with each cable being considered an LRU with a unique part number.

(b) There is a dedicated cable between each DP port and the SP and WP ports.

(c) The fibre channel cables consist of four unique stranded copper fibre channel inserts that provide two balanced pairs of conductors to support the transmit and receive interfaces for each cable.

(3) SP

Each SP contains a fibre channel port with two fibre channel switches and is connected to each DP with a unique cable.

(4) DTU

(a) There is a dedicated point-to-point fibre channel link between the DTU and each DP.

(b) The fibre channel bus can transfer data from the DTU at a rate of 1024 megabits per second, with actual transfer rates controlled by the DTC involved in the process. Each DP provides a central hub with six fibre channel ports for the FCDB network.

(d) Each of the fibre channel ports contains two fibre channel switches.

(5) WP

Each WP contains a fibre channel port with two fibre channel switches and is connected to each DP with a unique cable.

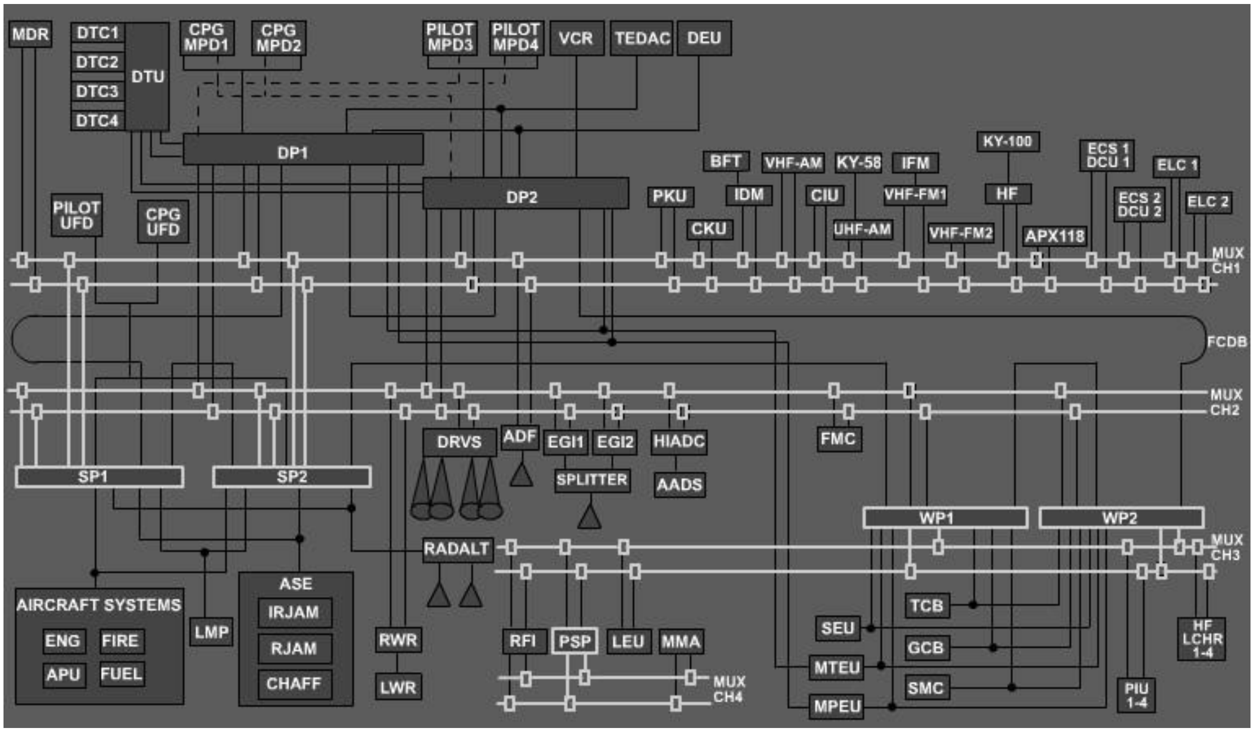


Figure 30. MUX Bus Interface.

(6) 1553B MUX bus interface

(a) Channel 1 provides an interface between the SPs and the following:

1) DPs

2) KUs

3) Electrical Load Centers (ELC1 and ELC2)

4) ECS Digital Control Units (DCUs)

5) Communication Interface Unit (CIU)

6) All radios

7) Identification Friend or Foe (IFF) transponder

8) Automatic Direction Finder (ADF)

(b) Channel 2 provides interface between the SPs and the following:

1) DPs

2) WPs

3) EGI

4) Doppler

5) Helicopter Air Data System (HADS)

6) Radar Laser Warning Receiver (RLWR)

7) Flight Management Computer (FMC)

(c) Channel 3 provides interface between the WPs and the following:

1) All four Pylon Interface Units (PIUs)

2) RFI

3) FCR

4) All four M299 launchers

(d) Channel 4 provides interface within the FCR System.

1) FCR PSP

a) BM for channel 3

b) BC for channel 4

2) Mast-Mounted Assembly (MMA)

3) RFI

(7) Interface circuit protection

The RTs, BCs, and BMs have adequate protection to prevent their input and output signal circuits from being damaged due to a reversal of the input leads and short circuits.

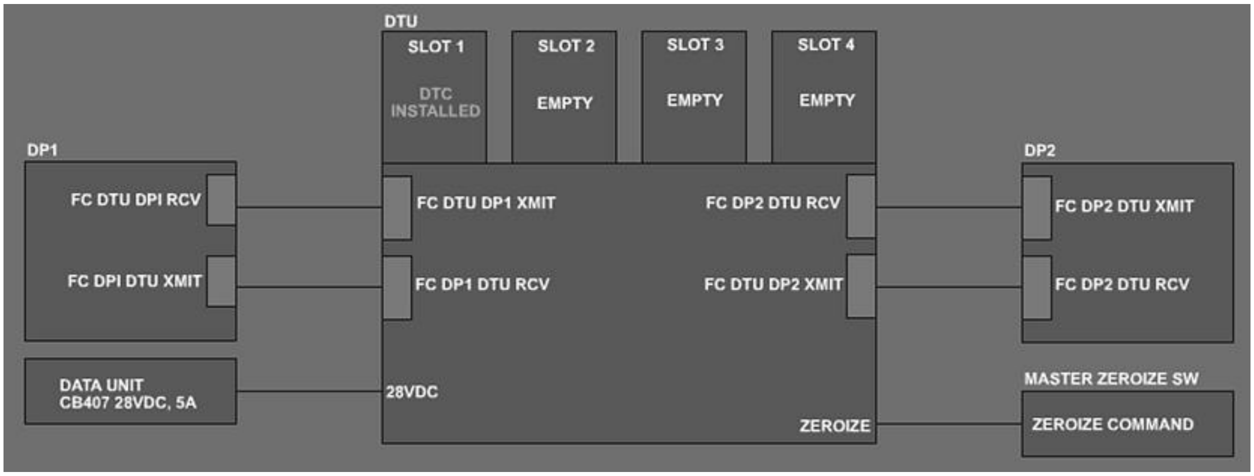


Figure 31. FCDB Point-to-Point Interface.

(8) FCDB point-to-point interface

(a) The FCDB point-to-point interfaces provide an interface between the DTU and the DPs.

(b) The FCDB point-to-point interfaces are high-speed data buses over which massive amounts of data are passed independently between the DTCs (via the DTU) and each of the DPs.

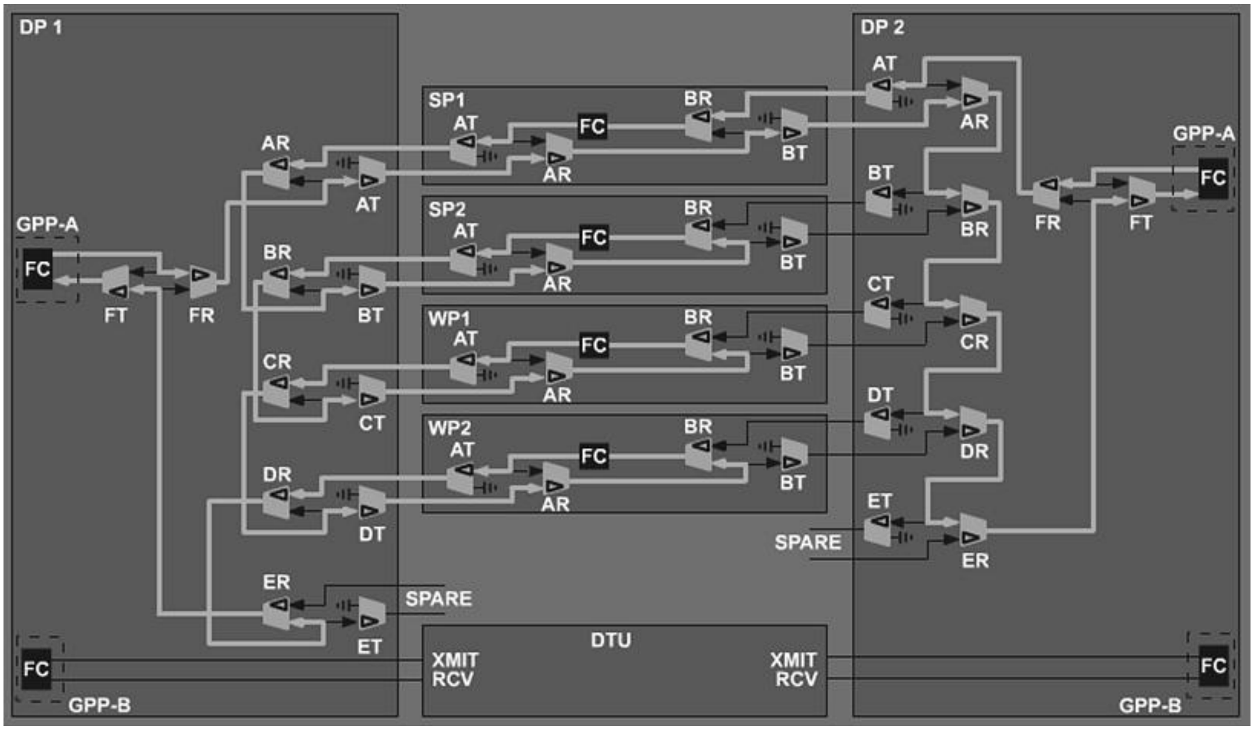


Figure 32. FCDB Interface.

(c) The FCL provides an interface between the DPs and the following:

1) SPs

2) WPs

The FCL provides a high-speed fully redundant data bus to pass information between the aircraft's primary processors.

CHECK ON LEARNING

1. A DBT is attached to each end of each _____?

2. The primary SP controls the communication on data bus channels ____and ____.

3. The ____act as the hub for the FCL.

4. There are ____ unique cables on each aircraft for the arbitrated loop.

E. Enabling Learning Objective 5

After this lesson you will:

ACTION: Identify the purpose, location, and function of the System Processors (SPs), and their interface with aircraft and avionics subsystem components.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose, location, and function of the System Processors (SPs), and their interface with aircraft and avionics subsystem components.

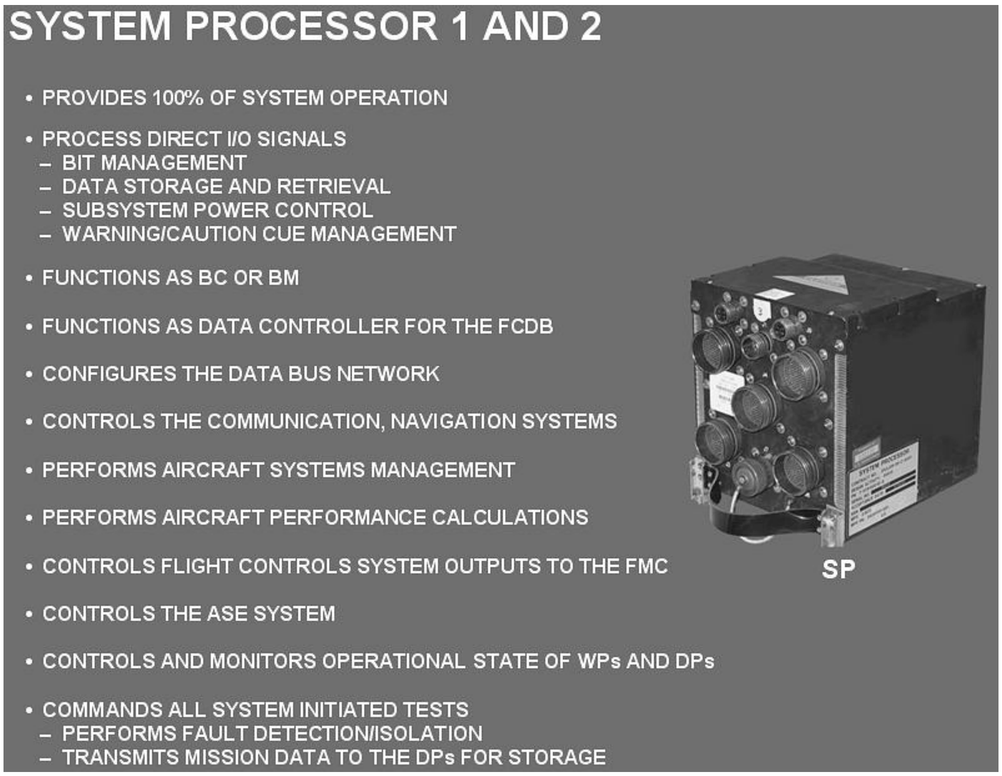


Figure 33. System Processor.

a. System Processors

(1) Each aircraft contains two SPs.

(2) Either SP can provide 100% of system operation.

(3) The SPs process direct I/O signals from several aircraft systems. This centralized architecture permits the SPs to perform numerous aircraft management functions, which include:

(a) BIT management

(b) Data storage and retrieval

(c) System and subsystem power control

(d) WCA cue management

(4) Primary SP

(a) The primary SP functions as the BC for the MUX bus channels 1 and 2 and as a part-time BM for data bus channels 1 and 2.

(b) In addition to performing as bus controller for the 1553B MUX channels 1 and 2, the primary SP performs as the data controller for the FCDB.

(c) The primary SP acts as a pass-through between the two DPs to allow for data flow between the components that act as the central hubs for data in the arbitrated loop.

(d) The primary SP is responsible for configuring the data bus network according to remote terminal availability and status, scheduling bus messages according to system status, and processing data bus message errors.

(e) The primary SP manages data for the following systems:

1) Controls the Communications (COM) System, performing status monitoring, failure reporting, radio control, Anti-Jam (AJ) control, and mode control

2) Performs the control and status logic for the Navigation (NAV) System, along with executing earth-to-aircraft referenced coordinate conversions, waypoint and target data file management, and navigation data validation

3) Performs navigation calculations such as time, distance, and bearing to a waypoint

4) Performs Aircraft Systems Management (ASM) to include control of the aircraft utility systems

5) Provides both automatic and manual control of these systems, monitors the status of the systems, and notifies the crew of any abnormal conditions

6) Executes aircraft performance calculations for the following:

a) Torque available

b) In Ground Effect (IGE) margins

c) Out of Ground Effect (OGE) torque required

d) IGE and OGE hover ceilings

e) IGE and OGE torque margins

f) True airspeed for maximum range and endurance

g) Velocity Never to Exceed (V_{NE})

7) Monitors the Flight Control System, outputs mode commands to the FMC, and monitors system status for display to the crew

8) Controls the ASE System

a) The primary SP outputs commands to the systems and processes threat information received from the system's sensors.

b) The primary SP controls the threat display to the crew.

9) Controls and monitors the operational state of the WPs and DPs

10) Commands all system-initiated tests, monitors system status and fault information, and processes the information for display

11) Processes aircraft status information by:

a) Performing fault detection/isolation operations to control redundancy and back-up modes

b) Transmitting mission data to the DPs for storage on the DTC and prioritizing failures for display to the crewmembers

(5) Secondary SP

(a) The secondary SP monitors the FCDB and data bus channels 1 and 2 to determine if it should assume responsibility as the primary SP.

(b) The secondary SP performs as a RT and as a part-time BM on the same data bus channels.

(c) The secondary SP serves as a "hot" spare for the primary.

(d) It remains in synchronization with the primary and processes the same data in order to be ready to assume control of the data buses, if required.

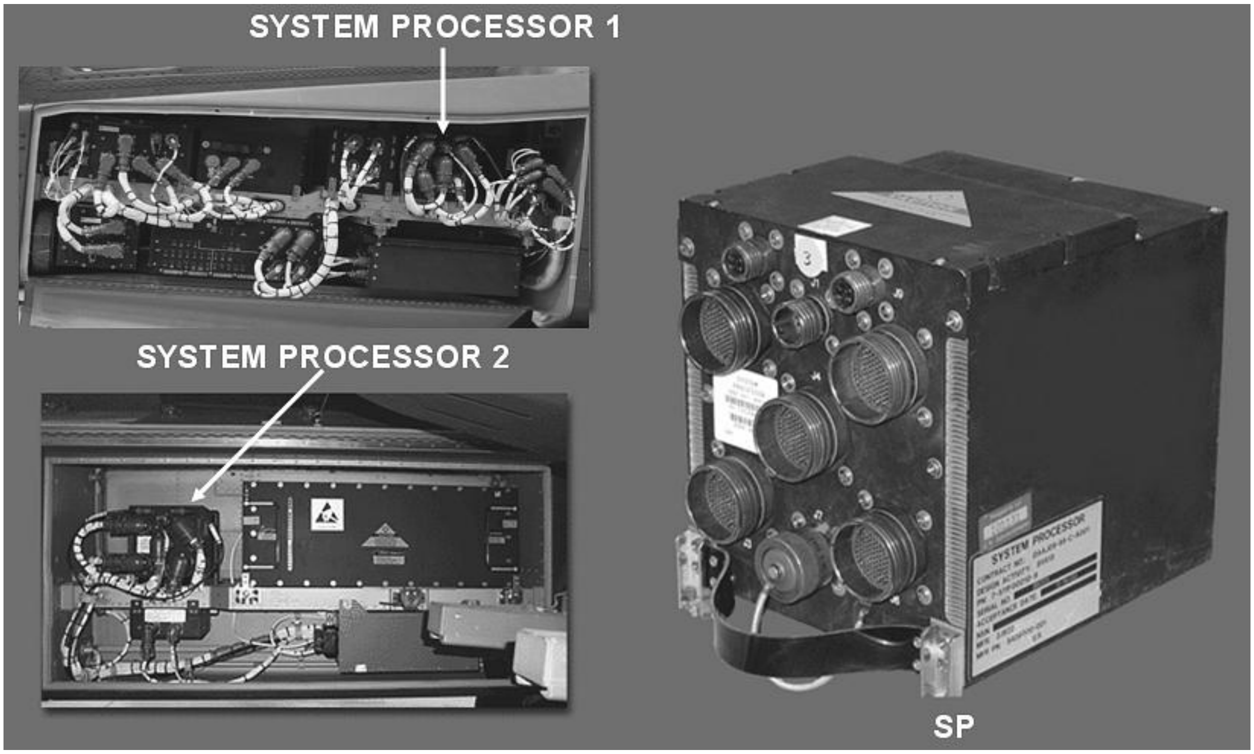


Figure 34. System Processor Locator Diagram.

(6) SP1 is located in the forward portion of the Left-Hand (LH) Extended Forward Avionics Bay (EFAB), behind panel 5L86.

(7) SP1 is the fourth LRU from the front, mounted on the top shelf.

(8) SP2 is located in the aft portion of the Right-Hand (RH) EFAB below the wing, behind panel 5R224.

(9) It is the aft LRU, mounted on the top shelf.

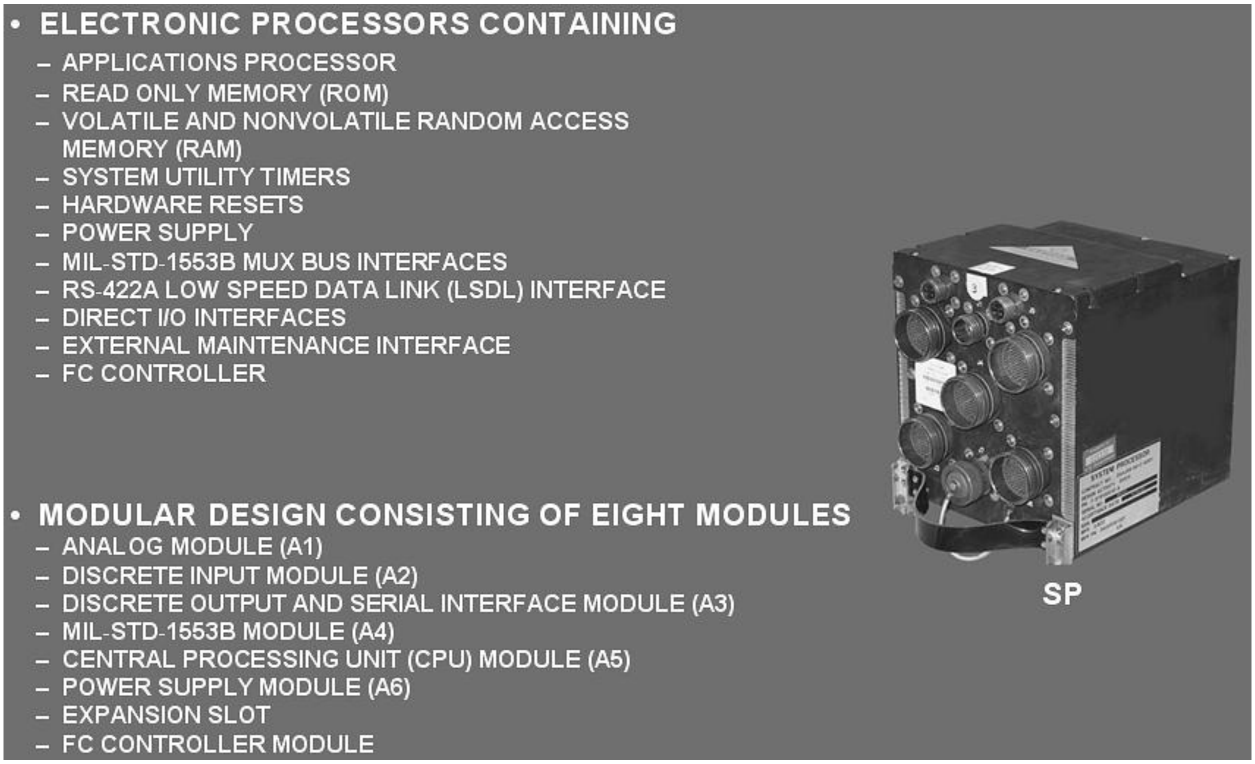


Figure 35. System Processor.

(10) The SPs are highly integrated input/output centers for non-multiplex data.

(11) The SPs are electronic processors containing the following:

(a) Applications processor

(b) Read Only Memory (ROM)

(c) Volatile and nonvolatile RAM

(d) System utility timers

(e) Hardware resets

(f) Power supply

(g) MIL-STD-1553B MUX bus interfaces

(h) RS-422A Low Speed Data Link (LSDL) interfaces

(i) Direct I/O interfaces

(j) External maintenance interface

(k) FC controller with port bypass circuitry

(12) The SPs are of a modular design and consist of eight modules.

(a) Analog Module (A1)

1) Accommodates 48 analog signals of eight different types

2) Contains 2k of 16-bit words of Static RAM (SRAM)

(b) Discrete Input Module (A2)

1) Handles 193 discrete inputs of seven different types

2) Contains 1k of 8-bit words of SRAM

(c) Discrete Output and Serial Interface Module (A3)

1) The discrete output portion of the module handles 61 discrete outputs of eight different types.

2) It contains 2k of 8-bit dual port SRAM.

3) The serial interface portion of the module provides eight RS-422A LSDL serial channels, of which only six are currently utilized.

(d) MIL-STD-1553B Module (A4)

1) The 1553 module contains two independent MIL-STD-1553B MUX bus channels.

2) Each channel has dual standby redundant buses that support all three terminal modes of operation: BC, RT, and BM.

3) The module also contains 32k of 16-bit words of SRAM per data bus channel.

(e) Central Processing Unit (CPU) Module (A5)

1) The CPU module consists of two Circuit Card Assemblies (CCAs), one R3000 CCA, and one memory CCA.

2) The CPU employs a Power PC 755 32-bit processor, 240 MHz applications processor.

3) The CPU contains 1.0M of level II cache.

4) The expected through-put of the CPU is approximately 21 Million Instructions Per Second (MIPS).

5) The CPU module contains both volatile and non-volatile memory to include 32 MB of SDRAM, 16 MB of flash memory, and 128 KB of nonvolatile memory.

(f) Power Supply Module (A6)

1) The power supply module can handle an 18 to 40 Vdc steady-state input.

2) It employs a 4 ms holdup for the LRU for input power dropouts down to 0 Vdc.

3) The Electrical Power Management System (EPMS) provides the SP with three sources of input power.

4) This eliminates SP resets for most aircraft power transients.

a) The SP normally draws power from the battery bus.

b) On aircraft power, the SP draws power from the direct battery bus.

c) On ground power, the SP draws power from the external power monitor.

5) The SPs employ Direct Memory Access (DMA) to decrease memory access times, optimizing overall computational (through-put) capabilities.

6) The programming languages utilized for all of the Computer Software Configuration Items (CSCIs) are either Ada or assembly language.

NOTE: Ada is not an acronym—it is a Department of Defense (DOD) Standard Computer Software Language named after Lady Ada Augusta Byron.

(g) Expansion slot

(h) Block 2 SPs also contain an FC controller module that provides two redundant FCDB interfaces.

1) The FCDB interface contains two external fibre channel ports.

2) Each fibre channel port contains two fibre channel switches.

a) One is designated as the transmitter.

b) The other is designated as the receiver.

3) The SP software controls each port's receiver and transmitter output.

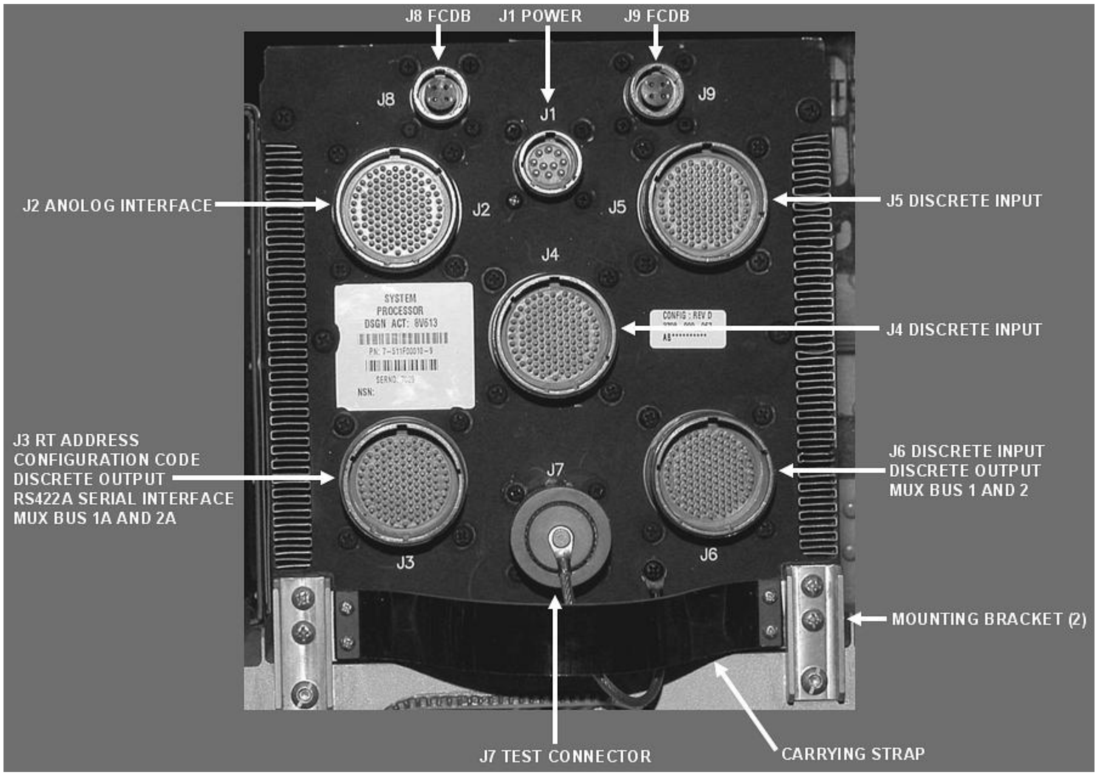


Figure 36. System Processor Connectors.

4) The SP has two mounting brackets, a plastic carrying strap, and nine electrical connectors accessible on the face of the unit.

5) The signals routed to/from the SP are segregated so that each of the connectors interfaces a certain type or types of signals.

6) The signal-to-connector partitioning is as follows:

a) J1 – Power interface

b) J2 – Analog interface

c) J3 – Miscellaneous

1 RT address

2 Configuration code

3 Discrete outputs

4 RS-422A LSDL serial interfaces

5 MIL-STD-1553B MUX buses 1A and 2A

d) J4 – Discrete input interface

e) J5 – Discrete input interface

f) J6 – Miscellaneous

1 Discrete input interface

2 Discrete output interface

3 MIL-STD-1553B MUX buses 1B and 2B

g) J7 – Test connector (with dust cap)

h) J8 – FCDB

i) J9 – FCDB

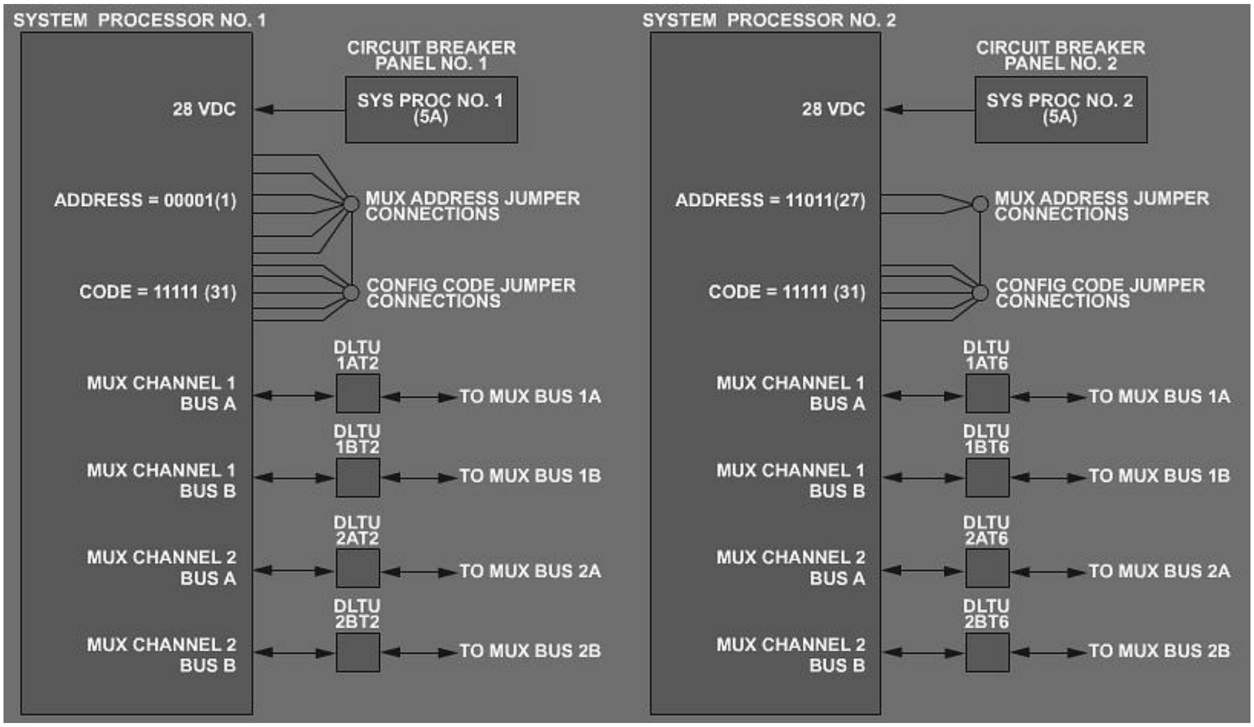


Figure 37. System Processor Interface Diagram 1.

b. SP power and MIL-STD-1553B MUX bus interface

The SPs interface with numerous aircraft components and systems via the MIL-STD-1553B MUX bus. They also interface via direct I/O discrete, AC and DC analog signals, and other serial data buses.

(1) SP1 receives 28 Vdc operating power from a 5-ampere circuit breaker labeled SYS PROC #1, located in the BATT (battery) zone, of Circuit Breaker Panel (CBP) 1.

(2) SP2 receives 28 Vdc operating power from a 5-ampere circuit breaker labeled SYS PROC #2, located in the BATT zone of CBP 2.

(3) Jumper connections are provided at the J3 connector for MUX bus terminal address selection and configuration code.

(a) The SP1 MUX bus address is 00001 binary (1 decimal) and requires six jumper connections to configure its address.

(b) SP2 has a MUX bus address of 11011 binary (27 decimal) and only requires two jumper connections to configure its address.

(c) Both SPs have the same configuration code of 11111 binary (31 decimal) and require five jumper connections to configure. Although the wiring is installed in the aircraft, this code is currently not used and is provided for future development considerations.

(4) SP1 is connected to the MUX bus channel 1 Bus A and Bus B through DLTU 1AT2 and 1BT2, respectively.

(5) SP2 utilizes DLTU 1AT6 and 1BT6 for MUX bus channel 1 Bus A and Bus B connections, respectively.

(6) SP1 is connected to the MUX bus channel 2 Bus A and Bus B through DLTU 2AT2 and 2BT2, respectively.

(7) SP2 utilizes DLTU 2AT6 and 2BT6 for MUX bus channel 2 Bus A and Bus B connections, respectively.

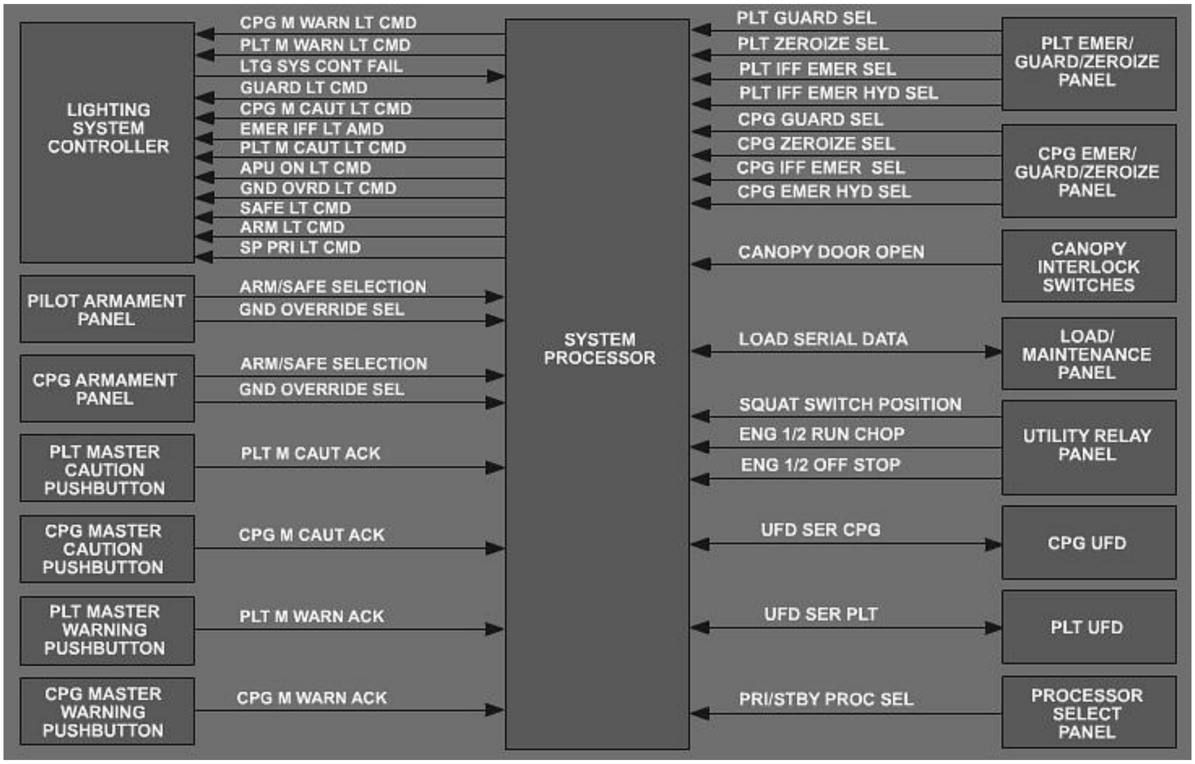


Figure 38. System Processor Interface Diagram 2.

c. Direct analog and discrete interface

(1) The SPs interface with numerous switches and indicators to provide switch position data and cockpit indications.

(a) The SPs interface with the Lighting System Controller (LSC) for control of dedicated warning, caution, and annunciator lights within each crewstation.

(b) The SPs also monitor the status of the LSC for a failure condition.

(c) The SPs accept inputs from the pilot and CPG armament panels for arm/safe selection and ground override selection.

(d) The pilot and CPG Master Caution and Master Warning lighted pushbuttons provide “acknowledge” signals to the SPs to extinguish the lights and terminate associated voice warnings/caution tones.

(e) The SPs monitor the pilot and CPG EMERGENCY panels for four signals that provide:

1) Guard-select to tune the UHF radio to the emergency frequency (243.000 MHz)

2) Zeroize-select to erase the following:

a) Frequencies in the UHF radio

b) CNVs in the UHF KY58/TSEC

c) Hopsets, lockout sets, frequencies, Time-Of-Day (TOD), and CNVs in the FM1 and FM2 radios

d) Network parameters to include network, channel, subscriber, and ATHS parameters in the IDM

e) IFF Mode 4 CNVs in the AN/APX-118

f) Global Positioning System (GPS) classified data to include CNVs and almanac data in the EGIs

3) IFF emergency-select to set the IFF to Emergency mode of operation

a) Sets the master mode to Normal (NORM)

b) Sets the mode 3/A code to 7700

4) Emergency hydraulic-select to enable emergency hydraulic power in case of complete primary and utility hydraulic system failures.

(f) The SPs monitor the Canopy Interlock switches for Door Locked indications.

(g) The SPs interface with the LMP via an RS-422A bidirectional serial data link for reception and transmission of the following information:

1) Rocket zone inventory

2) Squat override control and indication

3) Pylon position control

4) FM1 and FM2 Transmission Security (TRANSEC) and Communication Security (COMSEC) variable loading control and indication

5) Gun rounds count

6) ASE chaff count

(h) The utility relay panel provides the SPs with Squat switch position, engine run/chop status, and engine OFF STOP throttle position.

(i) The SPs interface with the CPG and pilot UFD via an RS-422A bidirectional serial data link for the display of Avionics System status, aircraft status, and Communications System status.

(j) The PSP sends the primary and secondary SP discrete commands based on the SP1/AUTO/SP2 switch position.

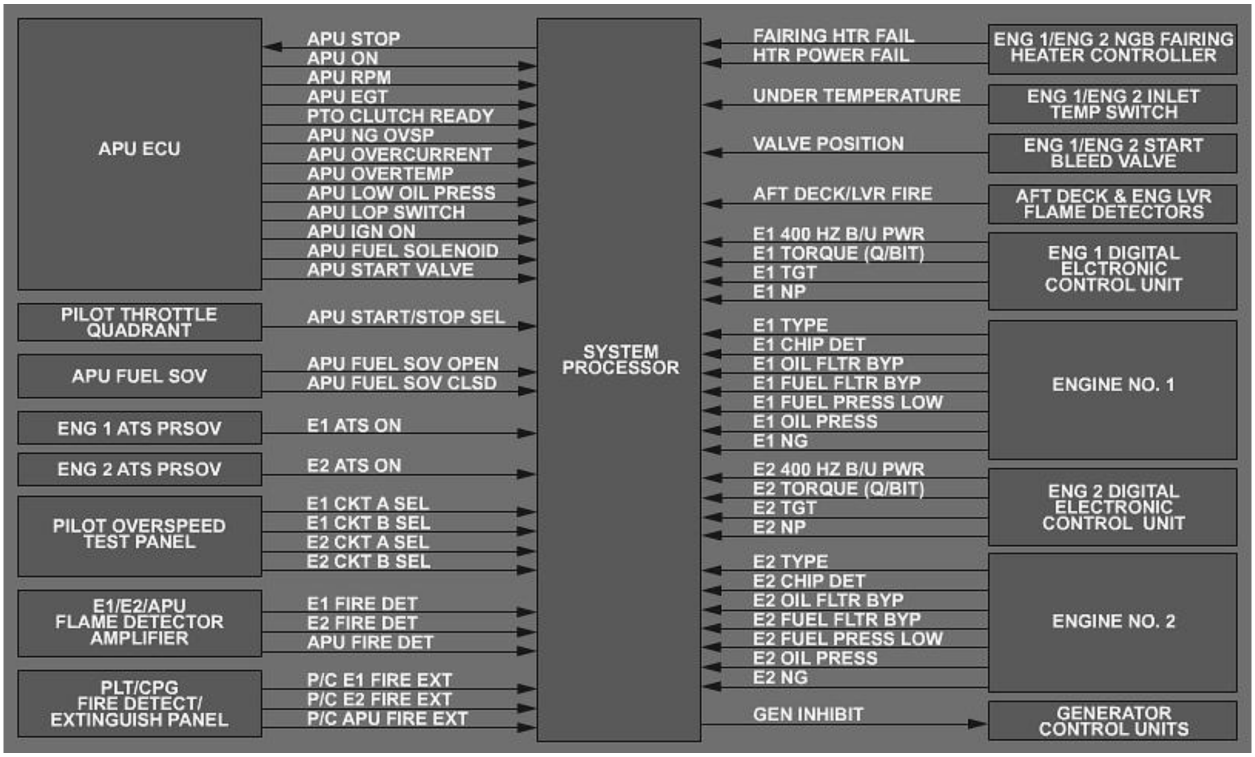


Figure 39. System Processor Interface Diagram 3.

(2) As part of the ASM functionality, the SPs supply and monitor numerous direct I/O signals to/from aircraft powertrain-related systems.

(a) The SPs monitor the APU Electronic Control Unit (ECU) for the following signals:

1) APU ON

2) APU RPM

3) APU Exhaust Gas Temperature (EGT)

4) Power Take-Off (PTO) clutch ready

5) APU Gas generator speed (N_G) overspeed

6) APU overcurrent

7) APU overtemperature

8) APU Low Oil Pressure (LOP)

9) APU LOP switch

10) APU ignition ON

11) APU fuel solenoid

12) APU start valve

(b) The SPs supply an APU stop signal to the APU ECU to terminate APU operation when commanded.

(c) The APU Start/Stop select command is received from the pilot throttle quadrant and the APU fuel shutoff valve position is provided to the SPs.

(d) The SPs perform ENG1 and ENG2 air turbine starter shutoff valve monitoring and monitor the pilot overspeed test panel for ENG1 and ENG2 overspeed circuit protection testing.

(e) The ENG1, ENG2, and APU flame detector amplifiers are monitored for fire detection signals.

(f) The Fire Detection/Extinguishing panels in each crewstation are monitored for ENG1, ENG2, and APU fire extinguish signals.

(g) The ENG1 and ENG2 nose gearbox fairing heater controllers are monitored for heater power and fairing heater failures.

(h) The SPs check the undertemperature signals from the ENG1 and ENG2 inlet temperature switches, and monitor the ENG1 and ENG2 start bleed valve positions.

(i) The aft deck and engine louver flame detectors also supply signals to the SPs for fire detection monitoring.

(j) The ENG1 and ENG2 Digital Electronic Control Units (DECUs) supply the following signals to the SPs for monitoring of engine operation:

1) 400 Hz backup power

2) Torque (Q/BIT)

3) TGT

4) Power Turbine Speed (N_P)

(k) The SPs also monitor ENG1 and ENG2 for the following:

1) Engine type (-701/-701C)

2) Chip detector

3) Oil filter bypass

4) Fuel filter bypass

5) Fuel filter pressure low

6) Oil pressure

7) N_G

(l) The SPs provide a generator inhibit control signal to the Generator Control Units (GCU), preventing the generator from connecting to the aircraft system until the APU reaches 95%.

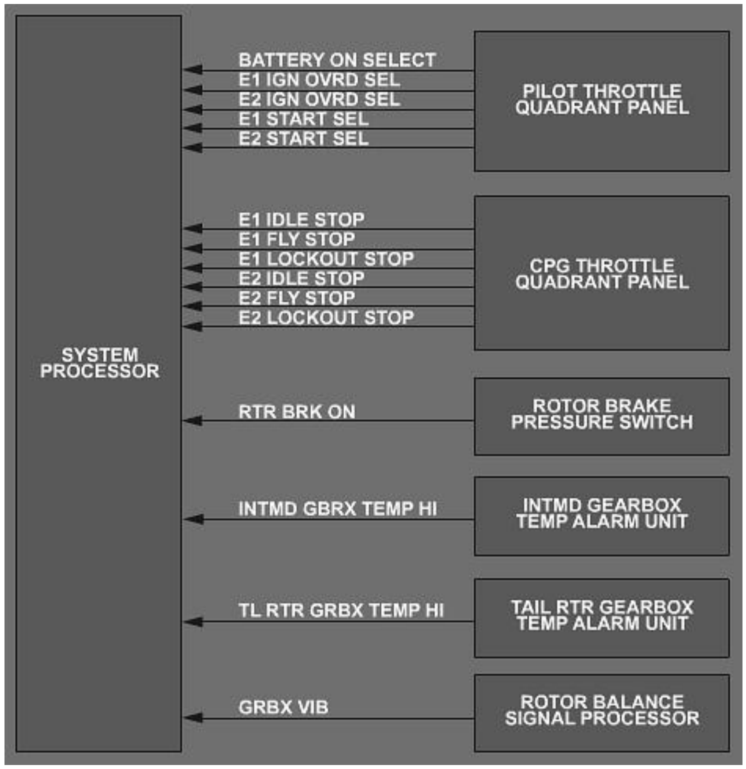


Figure 40. System Processor Interface Diagram 4.

(3) The SPs monitor the flight controls, transmissions, and hydraulic systems for operation and status.

(a) The SPs are supplied with switch status signals from the pilot throttle quadrant panel that include the following:

1) Battery On select

2) ENG1 Ignition Override select

3) ENG2 Ignition Override select

4) ENG1 Start select

5) ENG2 Start select

(b) The CPG POWER quadrant panel supplies the SPs with ENG1 and ENG2 throttle position signals that include:

1) Engine IDLE stop

2) Engine LOCKOUT stop

3) Engine FLY stop

(c) The rotor brake pressure switch is monitored for a rotor brake-applied condition.

(d) The intermediate and tail rotor gearbox temperature alarm units provide over-temperature signals to the SPs.

(e) The rotor balance signal processor supplies a gearbox vibration signal when either the intermediate or tail rotor gearbox is experiencing excessive movement.

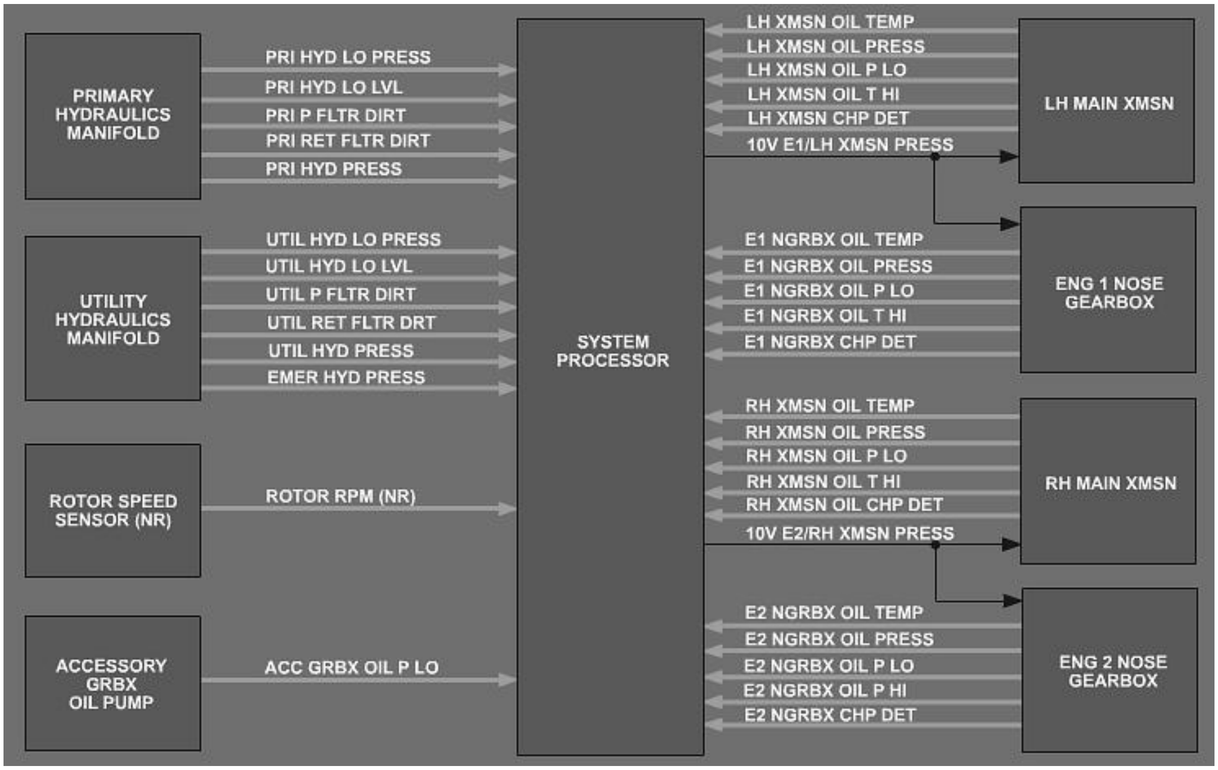


Figure 41. System Processor Interface Diagram 5.

(f) The primary and utility hydraulic manifolds are monitored by the SPs for the following primary and utility hydraulic system parameters:

1) Hydraulic low pressure

2) Hydraulic low level

3) Pressure filter dirty status

4) Return filter dirty status

5) Hydraulic pressure indication

6) Emergency hydraulic pressure indication (utility hydraulics manifold only)

(g) The main transmission rotor speed sensor provides a N_R signal to the SPs.

(h) An accessory gearbox oil pressure low discrete is supplied by the main transmission accessory gearbox oil pump.

(i) The SPs provide 10 Vdc excitation for the operation of the ENG1 and ENG2 nose gearbox and main transmission oil pressure transducers. The SPs monitor the left and right sides of the main transmission and both engine nose gearboxes for the following:

1) Oil temperature indication

2) Oil pressure indication

3) Low oil pressure discrete

4) High oil temperature discrete

5) Chip detector discrete

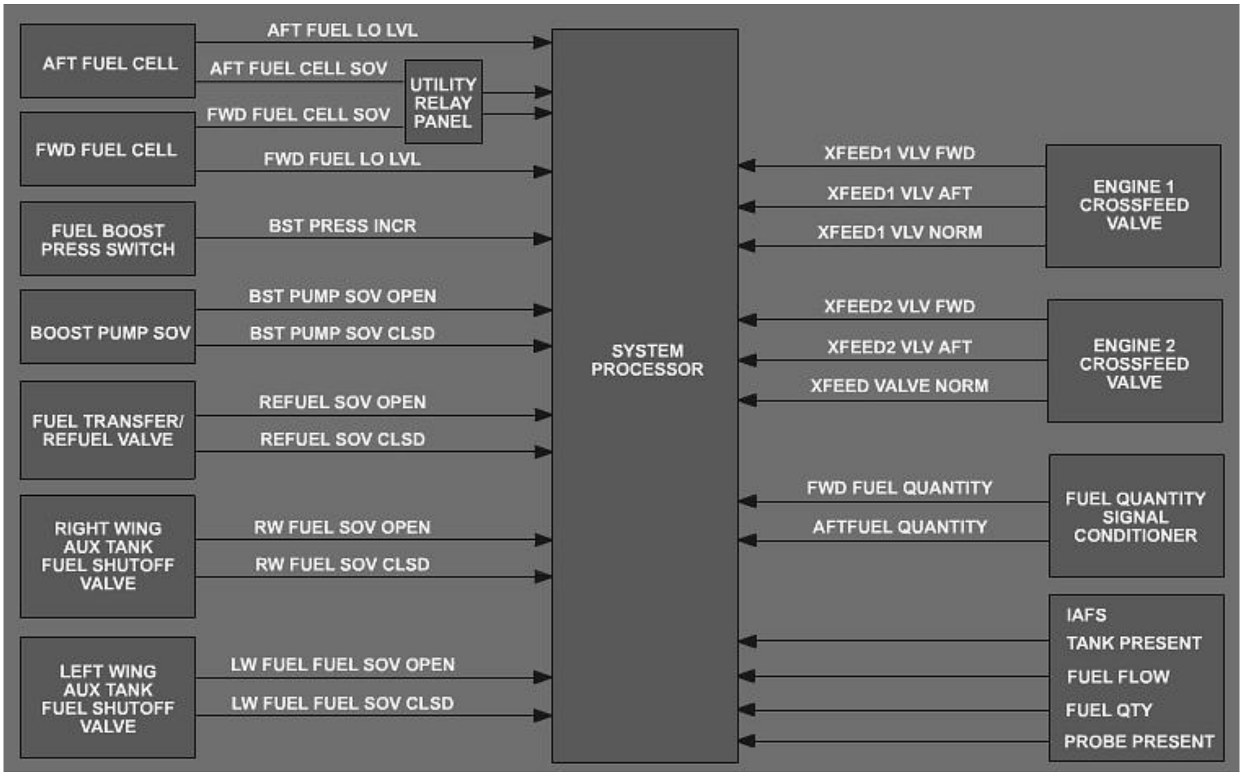


Figure 42. System Processor Interface Diagram 6.

(4) The SPs perform extensive Fuel System monitoring as indicated by the numerous discrete and analog signals provided between the Fuel System components and the SPs.

(a) The forward and aft fuel cells supply fuel low level signals when:

1) More than 240 pounds of fuel remain in the forward tank

2) More than 260 pounds of fuel remain in the aft tank

(b) The fuel cells also provide fuel Shutoff Valve (SOV) status (open/closed) to the SPs via the utility relay panel.

(c) The fuel boost pressure switch is monitored for increasing pressure (switch opens at 8-10 psi).

(d) The fuel boost pump SOV is checked for position (open/closed).

(e) The SPs also monitor the fuel transfer/refuel SOV and the left and right wing auxiliary tank, fuel SOVs for their position (open/closed).

(f) The ENG1 and ENG2 crossfeed valve positions are monitored.

(g) The fuel quantity signal conditioner provides an analog fuel-quantity signal to the SPs.

(h) Depending on type, if an internal tank is installed, the SPs will also monitor the following signals from the Internal Auxiliary Fuel System (IAFS).

1) Tank present

2) Fuel flow

3) Fuel quantity

4) Probe present

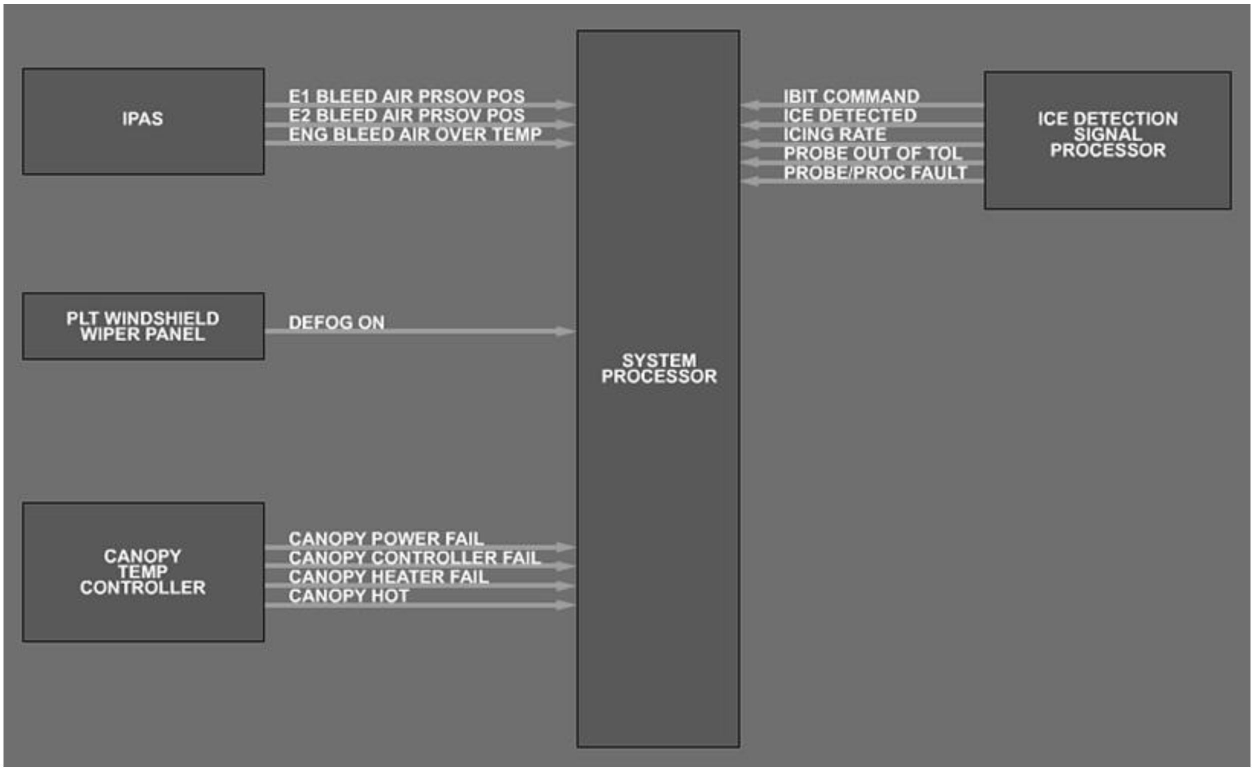


Figure 43. System Processor Interface Diagram 7.

(5) The direct I/O interface of the SPs with environmental and utility systems include signals to/from the:

(a) Integrated Pressurized Air System (IPAS)

(b) Pilot windshield wiper panel

(c) Canopy temperature controller

(d) Ice detection signal processor.

(6) The IPAS is monitored for ENG1 and ENG2 bleed air Pressure Relief Shutoff Valve (PRSOV) position and bleed air overtemperature.

(7) The pilot windshield wiper panel supplies a canopy defog on status signal to the SPs.

(8) The canopy temperature controller is sampled for the following signals indicating its health and status.

(a) Canopy power fail

(b) Canopy temperature controller fail

(c) Canopy heater fail

(d) Canopy hot indication

(9) The ice detection signal processor is provided an IBIT command from the SPs and is monitored for the following conditions:

(a) Ice detected

(b) Icing rate

(c) Ice detection probe out-of-tolerance

(d) Ice detection probe/processor fault

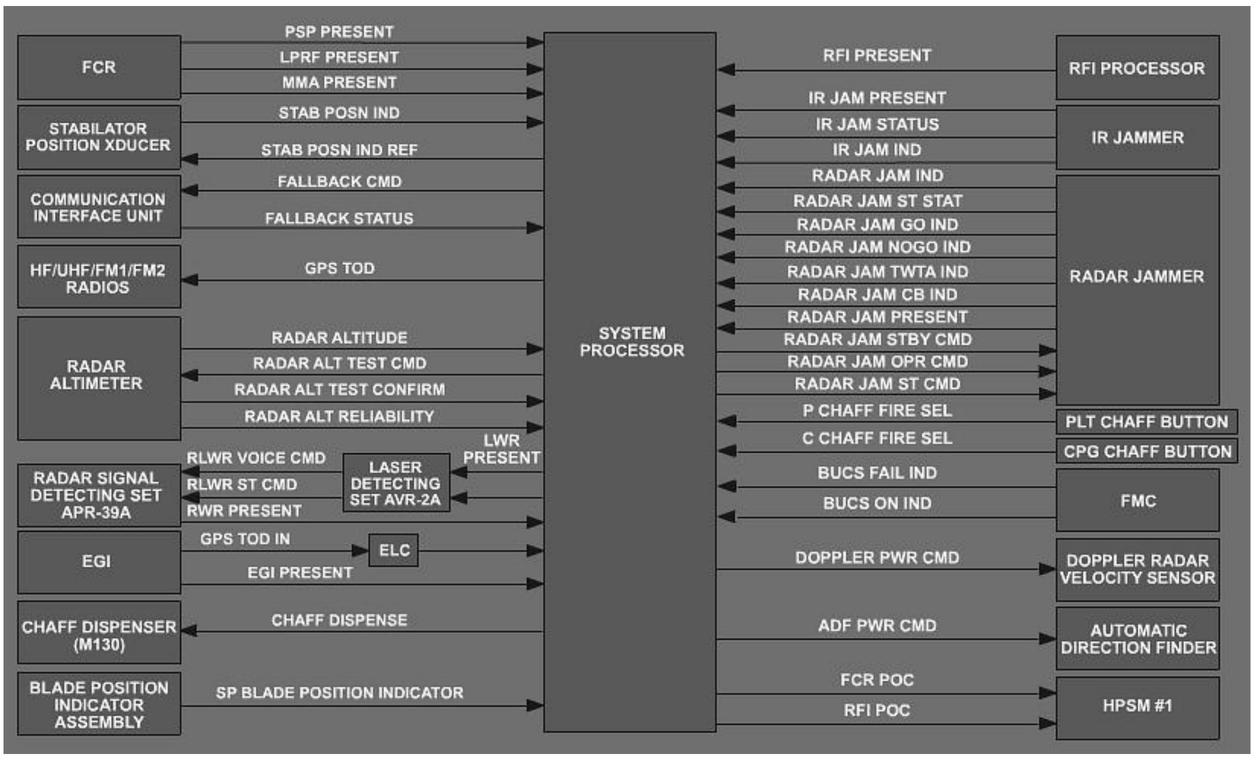


Figure 44. System Processor Interface Diagram 8.

(10) Although the majority of the SP interface with the aircraft Avionics System is via the MIL-STD-1553B MUX bus, a number of systems require direct I/O interface with the SPs to complete the overall system integration.

(a) The FCR major components provide the SPs with present discretes when they are physically installed in the aircraft.

(b) The SPs supply a stabilator position indication reference voltage to the stabilator position transducer. The transducer, in turn, provides an analog stabilator position indication for display on the MPDs.

(c) The CIU provides a FALLBACK status signal to the SPs when a catastrophic failure is detected by the CIU. Upon selection of the FALLBACK mode of the

CIU, the SPs provide a FALLBACK command signal to the CIU to provide limited backup communications capability.

(d) When commanded, the SPs supply Global Positioning System (GPS) Universal Time Coordinated (UTC) formatted TOD to the UHF, FM1, and FM2 radios for frequency hopping time synchronization.

(e) The radar altimeter is not MUX bus compatible and interfaces with the SPs via direct I/O only. The interface that is provided includes the following signals:

1) Radar Altitude, Above Ground Level (AGL)

2) Radar Altimeter (RAD ALT) Test Command

3) RAD ALT Test Confirmation

4) RAD ALT Reliability

(f) The AN/APR-39A Radar Signal Detecting Set (RSDS) digital processor and the AN/AVR-2A Laser Detecting Set (LDS) interface unit comparator both provide present discretes to the SPs to indicate that they are installed. The digital processor is provided an RLWR voice command and an RLWR self-test command via the interface unit comparator (if installed) when selected by the operator.

(g) Both of the EGIs provide a present discrete and a GPS TOD serial interface to the SPs. The GPS TOD interfaces are routed through the ELCs for switching purposes prior to being applied to the SPs.

(h) The SPs replace the electronics module for the M130 chaff dispenser, providing all of the necessary functionality and interface for the system. The SPs receive chaff fire select command signals from both the pilot and CPG cyclic grip chaff buttons, and issue chaff dispense command signals to the chaff dispenser assembly.

(i) The SPs monitor main rotor blade position via the blade position indication signal from the blade position indicator assembly.

(j) The RFI processor applies a present signal to the SPs when it is installed in the aircraft.

(k) The Infrared Jammer (IRJAM) is monitored by the SPs for an IRJAM present discrete, an IRJAM status discrete, and an IRJAM indication discrete signal.

(l) The SPs control the operation of the Radar Jammer (RJAM) via three discrete signals:

1) The RJAM Standby (STBY) command

2) The RJAM Operate (OPR) command

3) The RJAM Self-Test (ST) command

(m) The RJAM provides the following signals to the SPs for operation and status monitoring:

1) RJAM jam indication

2) RJAM self-test status

3) RJAM GO indication

4) RJAM NOGO indication

5) RJAM Traveling Wave Tube Assembly (TWTA) indication (transmitter status)

6) RJAM circuit breaker status indication

7) RJAM present discrete

(n) The FMC provides the Back Up Control System (BUCS) ON and BUCS Fail indications to the SPs.

(o) The SPs control the on/off state of the Doppler Radar Velocity Sensor (DRVS).

(p) The SPs control the ADF system via power command discrete.

(q) If the LH ECS (ECS1) experiences a critical failure, the SPs provide FCR and RFI Power On Command (POC) discrete signals to High Power Switching Module No. 1 (HPSM1). This permits continued operation of the FCR and RFI even if an ELC 1 critical failure occurs due to an overtemperature condition.

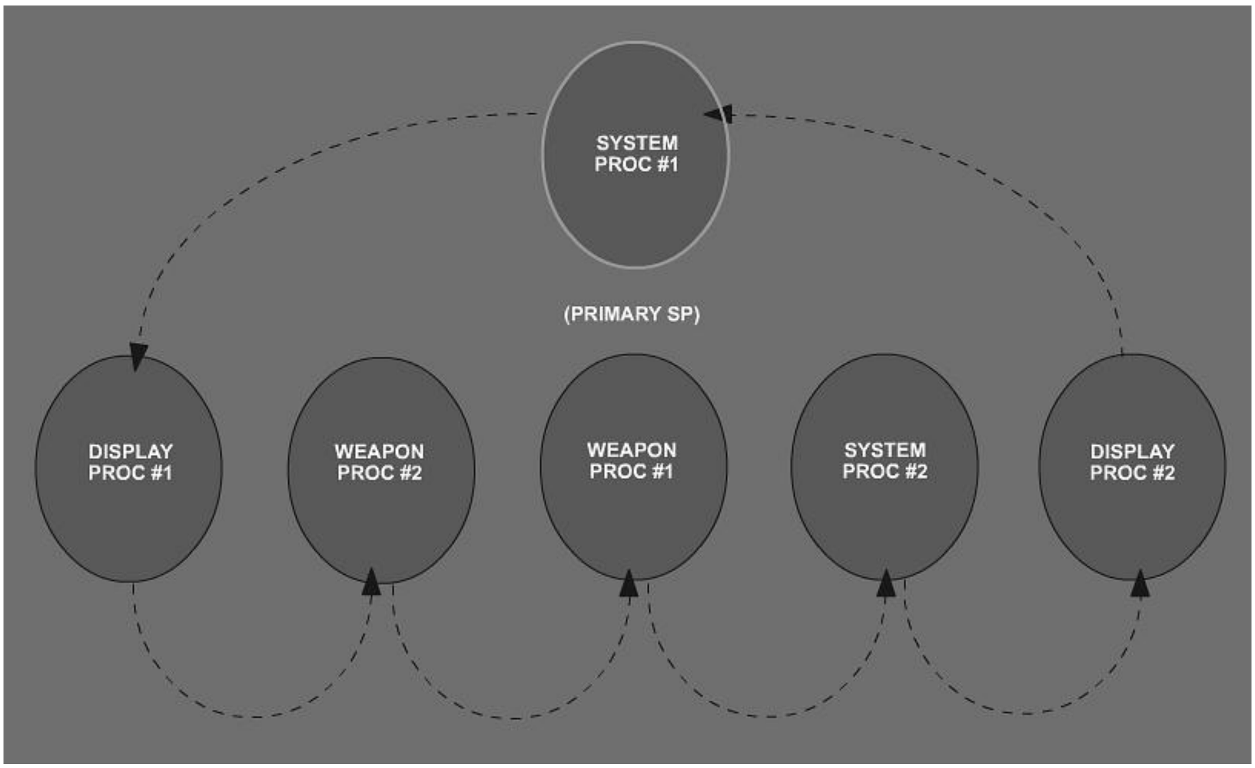


Figure 45. SP FCDB Interface.

d. SP FCDB interface

(1) The SPs are also interfaced with the DPs and WPs via the FCL and control the operation of the FCL, which is used to manage mission and communication data.

(2) The bus controller function begins once the primary SP has established a loop connection with a DP. Bus controller functions include the following:

(a) Operation of the fiber channel in 20-millisecond frames. Each frame provides all six processors a time slot in which to broadcast new messages on the fiber channel.

(b) Transmission of a NODE TRANSMIT CMD at the beginning of the bus controller’s time slot in order to reset the “watchdog” timers in the other nodes (processors).

(c) Coordination of each processor’s time slot by broadcasting one exchange with NODE TRANSMIT CMD = SET.

(d) Broadcast one spare exchange with RINGIN CMD = SET at 18 milliseconds from the start of the frame.

CHECK ON LEARNING

1. Each aircraft contains two SPs. Each SP can provide ____ of system operation.

2. The primary ____ functions as the BC and as a part-time BM for data bus channels 1 and 2.

F. Enabling Learning Objective 6

After this lesson, you (the student) will:

ACTION: Explain the operation of the System Processors (SPs) and their interface with aircraft and Avionics System components.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the operation of the System Processors (SPs) and their interface with aircraft and Avionics System components.

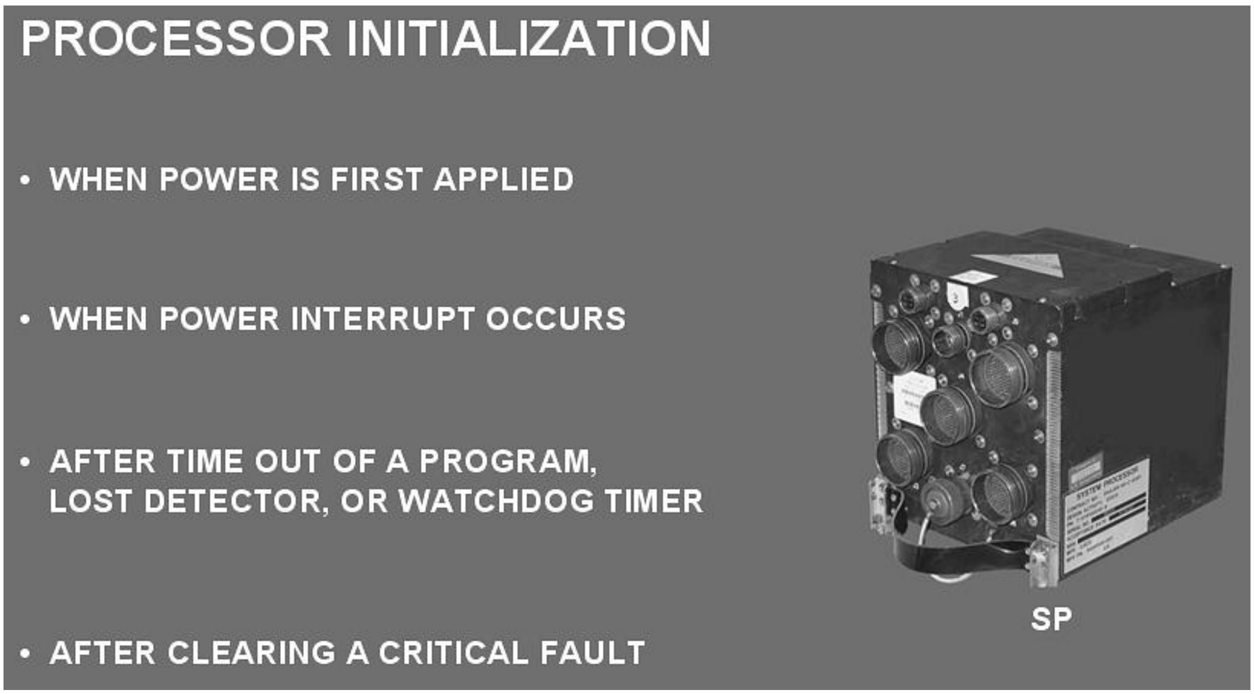


Figure 46. Processor Initialization.

a. Processor operation

(1) Processor operation is similar for the SP, DP, and WP. Functions that are peculiar to a specific processor will be explained in the appropriate block of instruction.

(2) Processor initialization or power-up is accomplished during the following:

(a) When power is first applied

(b) When power interrupt occurs

(c) After a time-out of a program-lost detector or watchdog timer

(d) After clearing a critical fault

(3) Initialization does not permit the following:

(a) Transmission of data via MUX bus or serial interfaces

(b) Enabling of discrete or analog outputs

(c) Transmission of erroneous BIT status information

(4) Initialization may be either ground or air

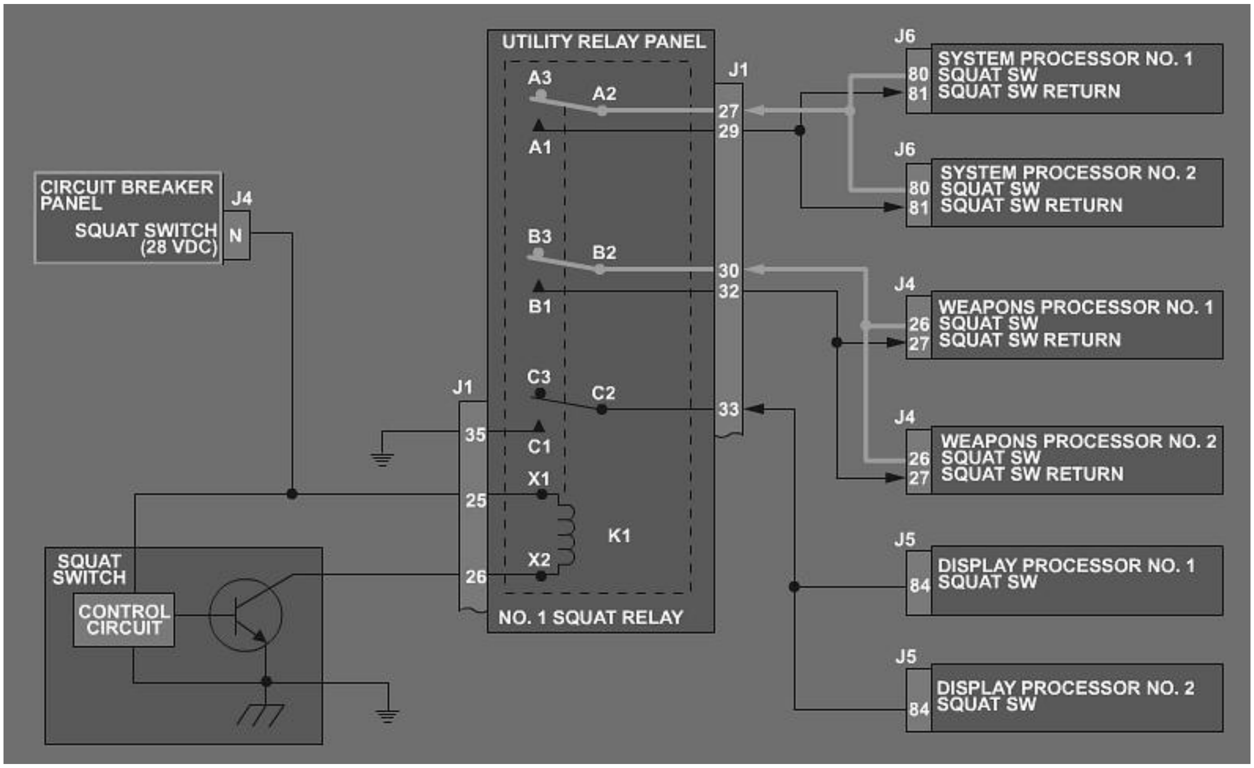


Figure 47. Processor/Squat Switch Interface Diagram.

(5) The processors determine if the aircraft is on the ground or in the air by reading the state of the landing gear squat relay and throttle position.

(a) Squat Switch position

1) 28 Vdc operating power is provided to the No. 1 and No. 2 squat relays (K2 and K10) in the utility relay panel and the Squat switch control circuit. 28 Vdc power originates from the No. 1 battery bus and is supplied via CBP 1 and a 5-ampere circuit breaker labeled SQUAT SWITCH, located in the BATT (battery) zone.

2) The processor Squat switch inputs and outputs are connected to the utility relay panel No. 1 squat relay contacts.

a) The SP Squat switch outputs and Squat switch RETURN inputs are connected to the “A” contacts of the relay.

b) The WP Squat switch outputs and Squat switch RETURN inputs are connected to the “B” contacts of the relay.

c) The DPs Squat switch inputs are connected to the “C” contacts of the relay.

3) With the aircraft sitting on the ground, the Squat switch control circuit provides an open to the base of the Squat switch transistor that places the transistor in the non-conducting (open) state. In this state, the Squat switch does not provide a ground for the, utility relay panel, squat relays.

4) The deenergized relay contacts open the path between the SP and WP Squat switch signal (10–29 Vdc) and signal return contacts, and opens the path between the DP Squat switch signal contact and signal ground. The open is read as logic 1 by the processors, indicating that the aircraft is on the ground.

5) With the aircraft in the air, the Squat switch control circuit supplies voltage to the transistor base, which places the transistor in the conducting (closed) state. The conducting transistor provides a ground to the utility relay panel squat relays.

6) The squat relays energize and close the relay contacts. The paths are closed between the SP and WP Squat switch signal and signal return contacts. The path is also closed between the DP Squat switch signal contact and signal ground. The closed path is read as logic 0 by the processors, indicating that the aircraft is in the air.

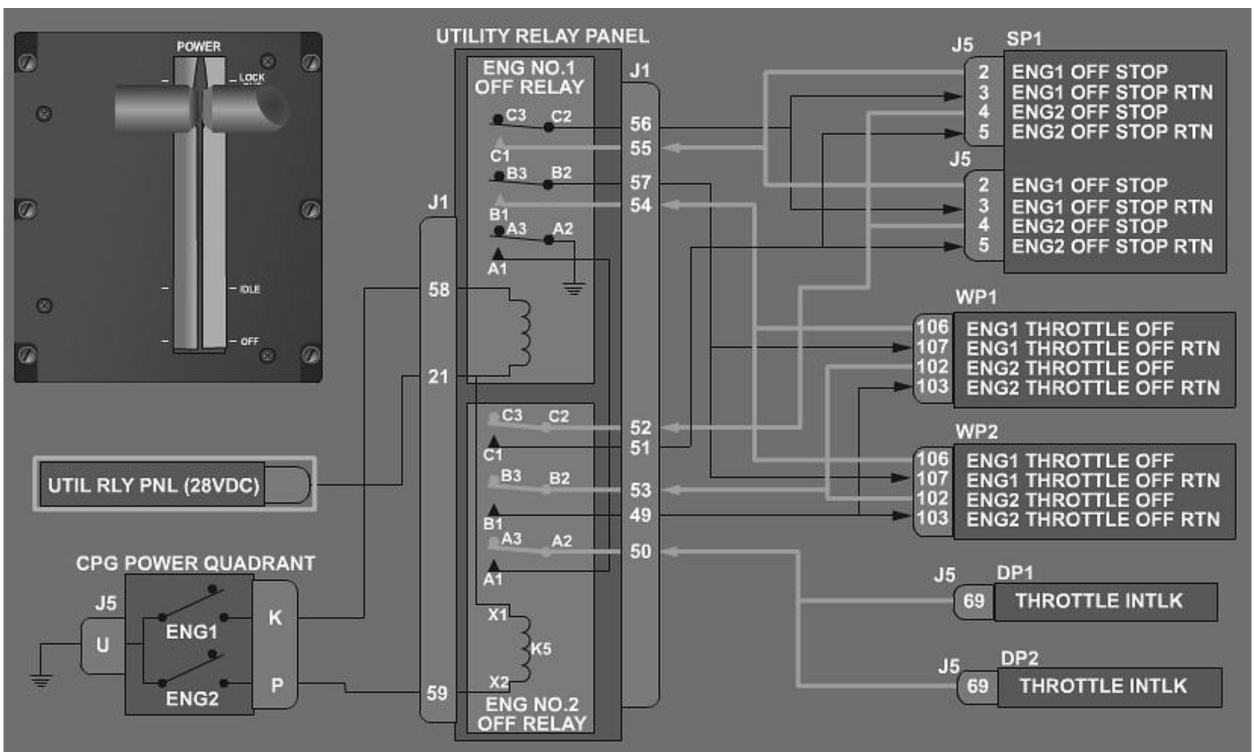


Figure 48. Processor/Throttle Position Interface Diagram

(b) Processor/throttle position

The SPs read the state of both engine throttle position switches in the following manner:

1) 28 Vdc operating power is provided to both the No. 1 (K4) and No. 2 (K5) engine off relay coils in the utility relay panel. 28 Vdc power originates from the battery bus and is supplied via CBP2 and a 5-ampere circuit breaker labeled UTIL RLY PNL (Utility Relay Panel), located in the BATT (battery) zone.

2) The ground for the engine-off relay coils is provided via the closed ENG1 and ENG2 throttle position switches in the CPG POWER quadrant. The throttle position switches are closed when the throttles are in the OFF position. This completes the energizing circuit to the utility relay panel engine-off relays.

3) The processor engine-off throttle position inputs and outputs are connected to the utility relay panel ENG1 and ENG2 off relay contacts.

   a) SP – ENG1 and ENG2 OFF STOP outputs and ENG1 and ENG2 OFF STOP RTN inputs are connected to the “C” contacts of the relays.

   b) WP – ENG1 and ENG2 OFF STOP outputs and ENG1 and ENG2 OFF STOP RTN inputs are connected to the “B” contacts of the relays.

   c) DP – THROTTLE INTLK (Interlock) inputs are connected to the “A” contacts of both relays.

4) When the ENG1 throttle is in the OFF position, the utility relay panel engine No. 1 off relay is energized and connects the SP1, SP2, WP1, and WP2 ENG1 OFF STOP signals (10–29 Vdc) and their signal returns. The closed path is read as logic 0 by the SPs and WPs.

5) When the ENG2 throttle is in the OFF position, the utility relay panel engine No. 2 off relay is energized and connects the SP1, SP2, WP1, and WP2 ENG2 OFF STOP signals (10–29 Vdc) and their signal returns. The closed path is read logic 0 by the SPs and WPs.

6) With both ENG1 and ENG2 throttles in the OFF position, the energized contacts of both relays provide a path to ground for the DP1 and DP2 THROTTLE INTLK signal inputs. The closed path is read as logic 0 by the DPs.

7) When either engine throttle is not in the OFF position, the throttle position switch for that engine is opened and the ground is removed from the affected utility relay panel engine off relay. The deenergized relay opens the path between the affected processor contacts and opens the path to ground for the DPs. The open is read as logic 1 by the processors.

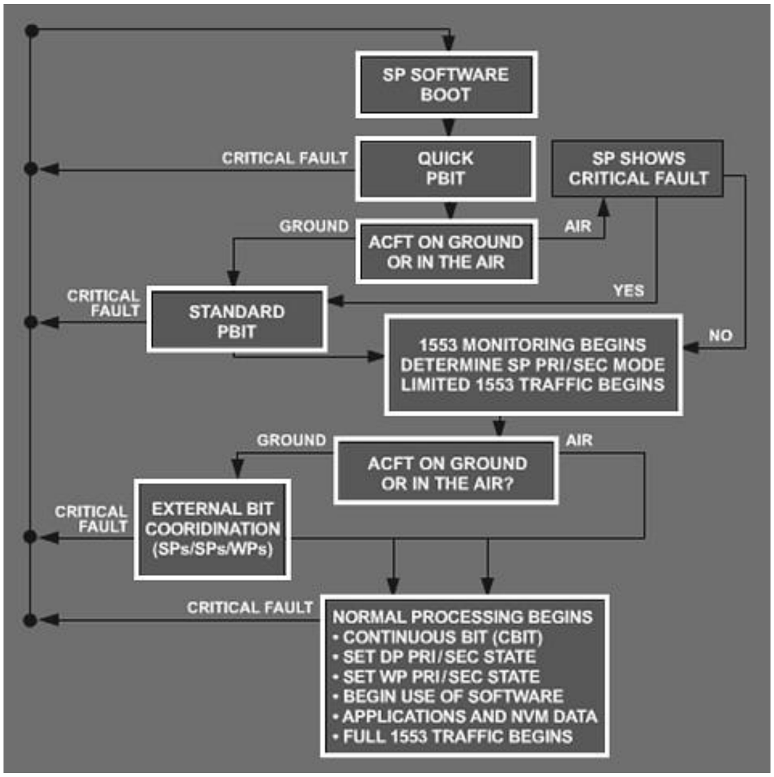


Figure 49. Ground initialization.

(6) Initialization

(a) The ground initialization and testing requires less than 7.5 seconds.

(b) The SP first performs a software boot.

(c) The SP then performs a PBIT.

1) The SP determines if it is the Primary (PRI) or Secondary (SEC) processor.

2) During PBIT, the SP determines if this is a ground or air initialization.

(d) The PBIT is followed by a Kernel and then the Operational Flight Program (OFP).

(7) Ground initialization

(a) The SP looks for critical bits present at shutdown.

1) If none exist, a standard PBIT is performed

2) If faults were present, an extended PBIT is performed.

(b) If a processor detects a critical failure, it initiates a shut-down

(c) If no critical failures are present, the SP performs the following:

1) Sets BIT status

2) Recalls subsystem selection

3) Reads terminal address

4) Determines SP PRI/SEC state

(d) The primary SP sets both DP to No operate state.

(e) The primary SP then sets both the WP to Norm Secondary.

(f) The primary SP then begins normal processing.

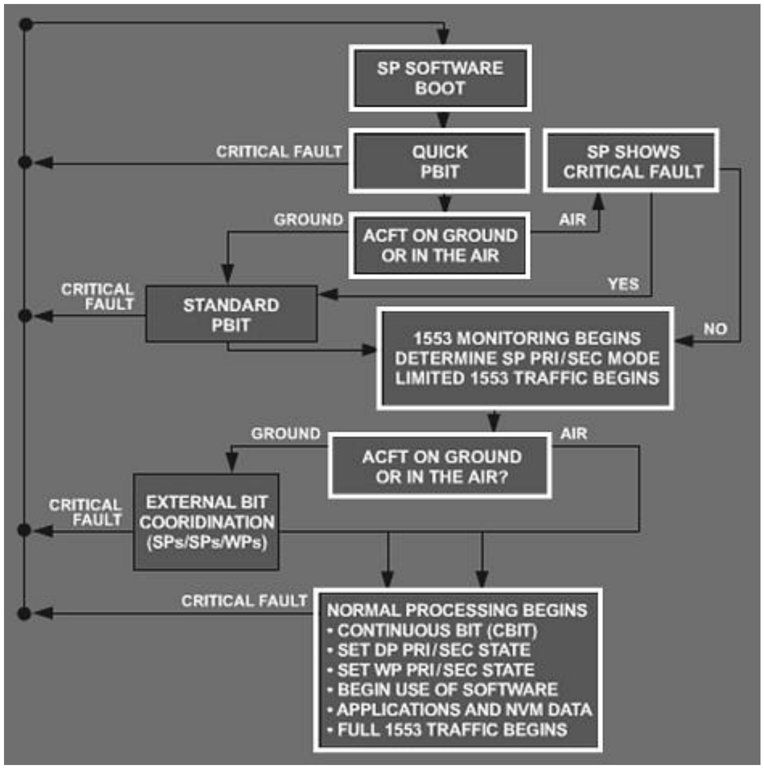


Figure 50. Air Initialization.

(8) Air initialization

(a) The SP determines if there are any critical faults at shutdown.

1) If there were faults, an extended PBIT is performed.

2) If critical faults are detected, the SP performs shutdown.

(b) If no faults were present, the SP performs a Quick BIT.

(c) The SP then performs the following:

1) Recalls direct output values

2) Recalls subsystem modes

3) Reads terminal address

(d) The SP sets the mode and discrete circuits as recalled.

(e) The WP is set to last state (PRI/SEC).

(f) The DP state is determined by the operation of the DP.

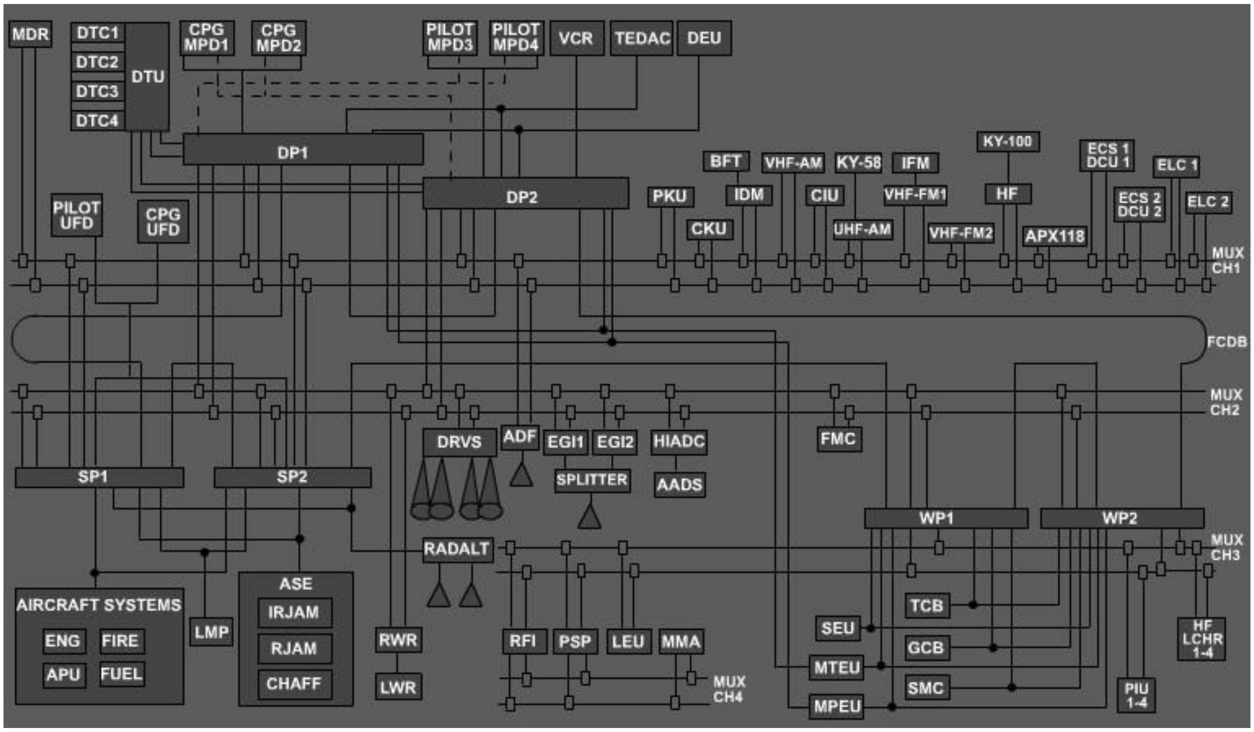


Figure 51. Display Processor Selection.

(9) Primary/secondary DP selection

(a) If both DPs are valid, the primary SP commands DP1 to Normal Primary and DP2 to Normal Secondary.

(b) If only 1 DP is valid, the primary SP commands the operational DP to Single DP and the invalid processor to No Operation.

(c) If both DPs are invalid, the primary SP commands both DPs to No Operation.

(d) If one DP is operating as Single DP and the invalid DP transitions to valid for 10 seconds, the primary SP commands the transitioning DP to Normal Secondary and the Single DP to Normal Primary.

(e) Whenever DP IBIT is being performed, the DP not performing the IBIT is commanded to Normal Primary.

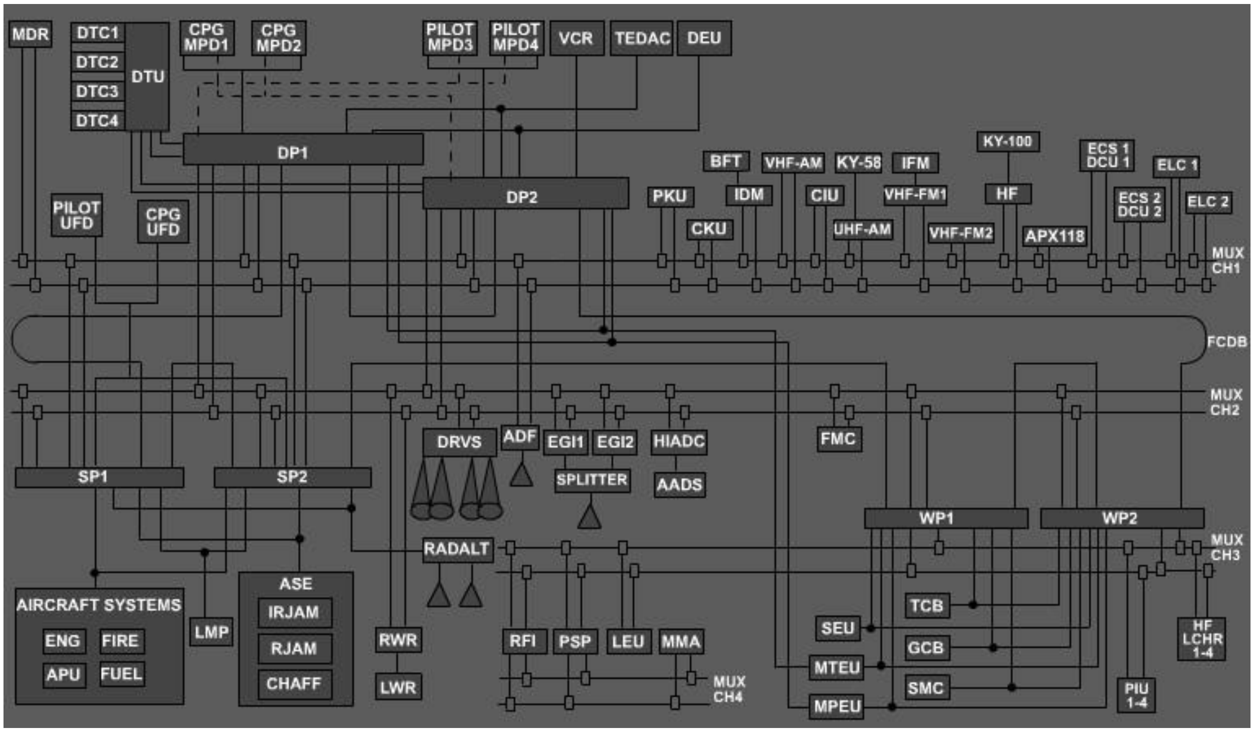


Figure 52. Weapons Processor Selection.

(10) Primary/secondary WP selection

(a) If both WPs are valid, the primary SP commands WP1 to Normal Primary and WP2 to Normal Secondary.

(b) If only 1 WP is valid, the primary SP commands the operational WP to Normal Primary and the invalid processor to Normal Secondary.

(c) If both WPs are invalid, the primary SP commands both WPs to Normal Secondary.

(d) If one WP is operating as primary WP and the invalid WP transitions to valid, the primary SP keeps the operating WP as Normal Primary and commands the transitioning WP to Normal Secondary.

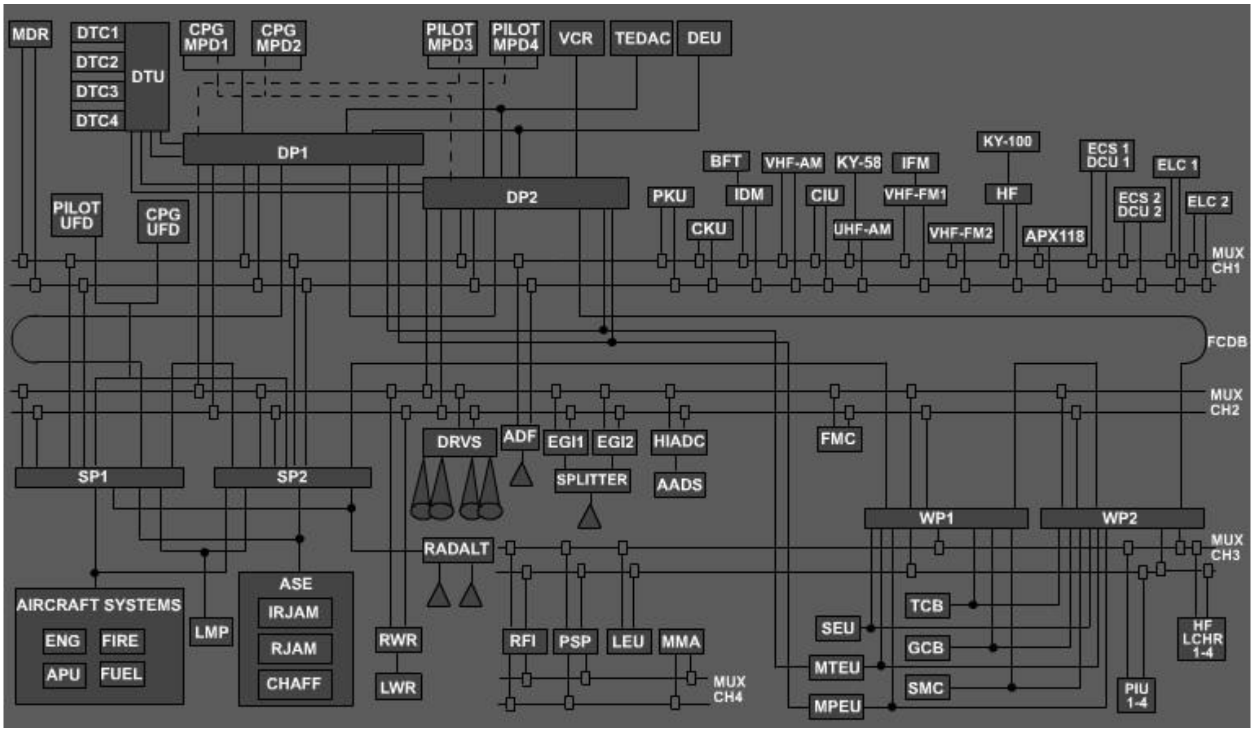


Figure 53. SP and WP Shutdown.

(11) Processor shutdown

(a) SP and WP

1) If the secondary SP (or WP) is valid and not in a degraded state, the primary SP (or WP) initiates the shutdown routine when any of the following conditions exist:

a) A critical or a noncritical fault is detected within the processor.

b) The processor input power is not within the limits specified.

2) If the secondary processor is valid but in a degraded state, the primary processor initiates the shutdown routine when any of the following conditions exist:

a) A critical fault is detected within the processor.

b) The processor input power is not within 19 to 32 Vdc.

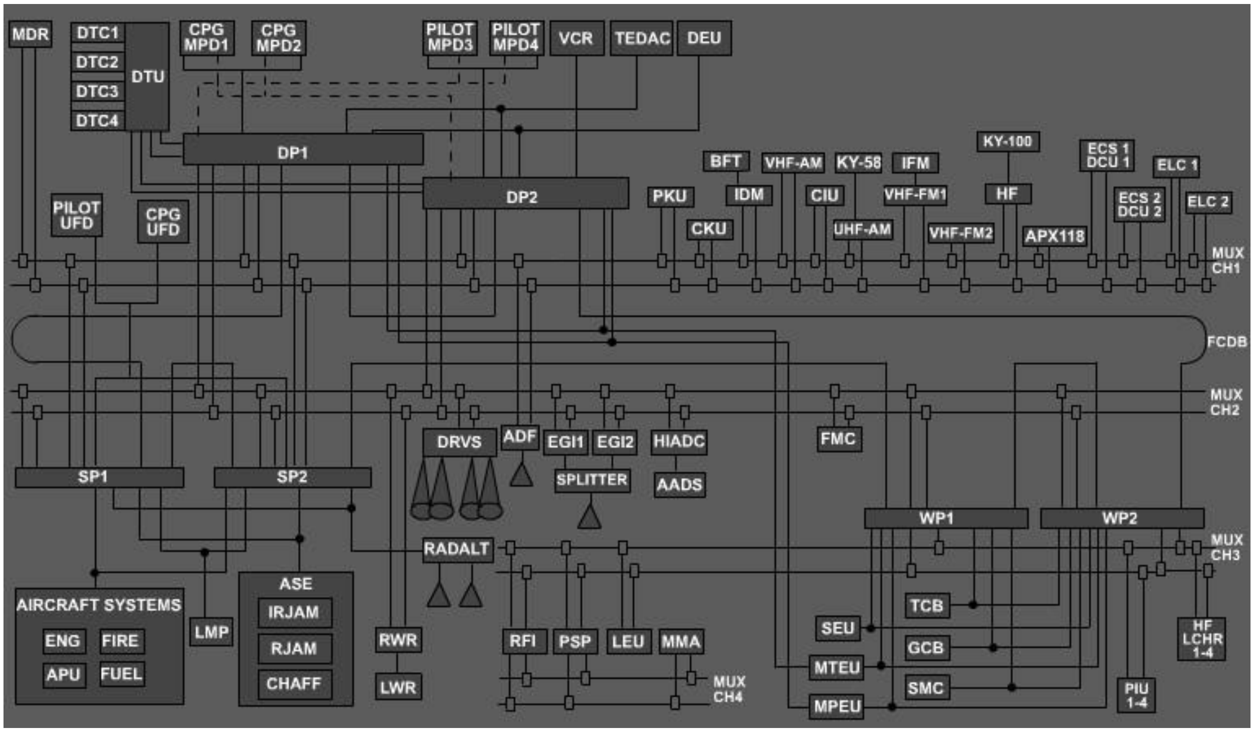


Figure 54. DP Shutdown.

(b) DP

If the DP is valid, the DP initiates the shutdown routine when any of the following conditions exist:

1) A critical fault is detected within the DP

2) The DP input power is not within 19 to 32 Vdc

(c) Processor shutdown routine provides for the following:

1) Prohibiting any data transmission on MUX or serial buses

2) Disabling all direct output drivers

3) Retaining

a) The current value of all direct outputs, except MUX bus channels and serial buses

b) The mode of all subsystem selections that the processor is responsible for managing. The SPs also store the WP operational modes.

4) Completion of the shutdown routine within 15 milliseconds after initiation.

(d) After completion, the processor continues to execute BITs to verify that the shutdown condition still exists.

(e) If the shutdown condition has been cleared, the processor will reinitialize.

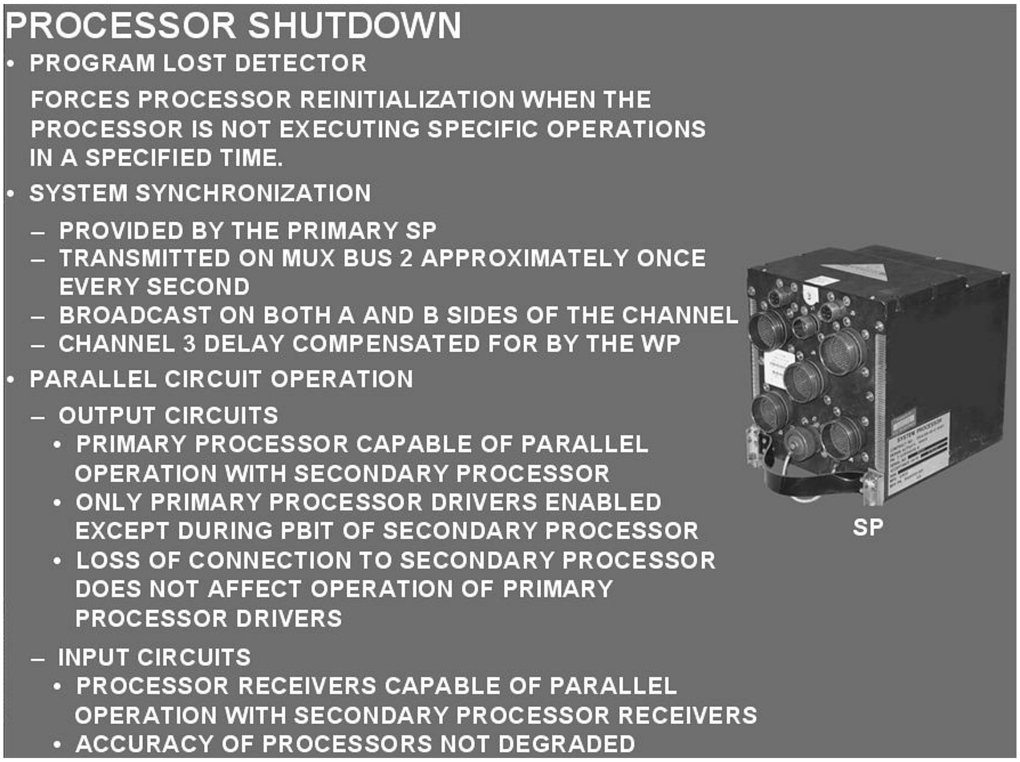


Figure 55. Processor Shutdown.

(12) Program-lost detector

(a) The detector forces the processor to reinitialize whenever it detects that the processor is not executing a specific operation in the specified time.

(b) When a lost condition is detected, the detector sets a program lost indication in nonvolatile memory to LOST.

(c) The program lost indication can be set to NOT LOST via the external maintenance interface.

(13) System synchronization

(a) System synchronization is provided by the primary SP so that data latency can be determined as required.

(b) The, synchronize, command is transmitted via the Synchronize With Data Word mode code message to all units on MUX bus channel No. 2. This occurs approximately once every second.

(c) The synchronize command is broadcast on the A side of a channel followed by the B side of the channel to ensure all units receive the data.

(d) The primary WP transmits a Synchronize With Data Word mode code message on MUX bus channel 3.

(e) The MUX bus channel 3 synchronize time associated with a synchronize command is the MUX bus channel 2 time. Transport delay time is compensated for within the WP.

(14) Parallel circuit operation

(a) Parallel output circuits

1) The primary processor drivers are capable of parallel operation with the secondary processor drivers.

2) Only the primary processor drivers are enabled at any 1 time, except during PBIT of the secondary processor. The primary processor drivers are disabled during secondary processor IBIT.

3) The secondary processor drivers are disabled, except during PBIT, and do not affect the operation or degrade the accuracy of the primary processor drivers.

4) Removal or loss of the connection to the secondary processor drivers does not affect the operation or degrade the accuracy of the primary processor drivers.

(b) Parallel input circuits

The primary processor receivers are capable of parallel operation with the secondary processor receivers. Receiver accuracy of both processors is not degraded by loss of power or connection to either processor.

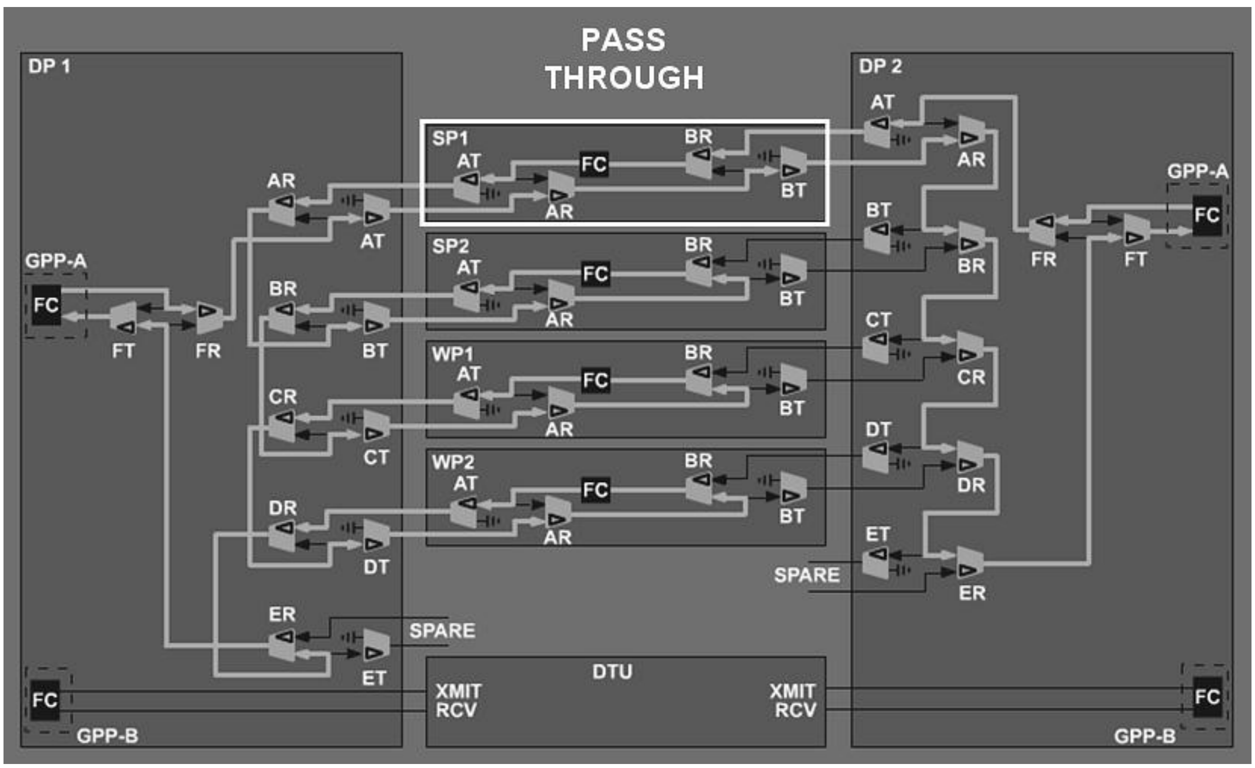


Figure 56. FCDB Initialization.

(15) FCDB initialization

(a) The data bus topology connects all LRUs in an arbitrated loop fashion. Each port connected in the loop sees all messages passed to it and passes and ignores those not addressed to that port.

1) The primary SP coordinates all message traffic for the fibre channel loop by issuing node transmit commands (one command per LRU every 20 milliseconds) to each LRU within the loop, including itself.

2) The primary SP also provides pass-through connection on the loop for the hub in DP1 and the hub in DP2.

3) Each LRU will respond when commanded by the bus controller by broadcasting a minimum of one exchange.

4) DP Ring-in service operation will be completed.

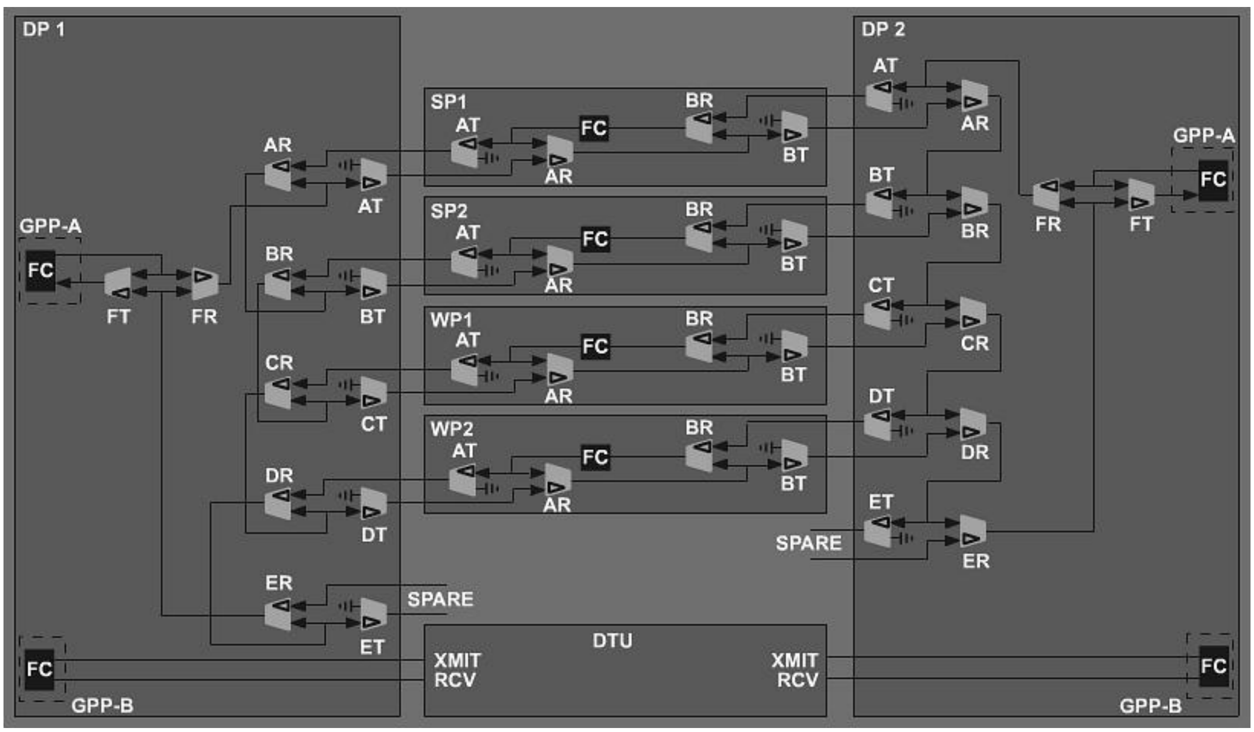


Figure 57. System Processor Ring-In.

(b) Primary SP ring-in request operation

1) After the primary SP completes a fibre channel reset, the SP will monitor 1553 data to determine which DPs are online.

2) The SP will attempt to ring-in to both DPs (if both are online).

3) Once connected to one of the DPs, a fibre channel loop is created and the SP begins scheduling node transmit commands at regular intervals.

4) The node transmit commands provide a time slot for each LRU to transmit a message exchange if connected in the loop.

5) If an LRU is not connected to the loop the loop will remain idle and provide a time slot for the LRU to ring-in to either of the DPs.

6) If a DP is communicating on the 1553 bus and the primary SP is unsuccessful in connecting to that DP on the fibre channel, a switchover to the other SP will be performed, provided the other SP is available as a primary SP.

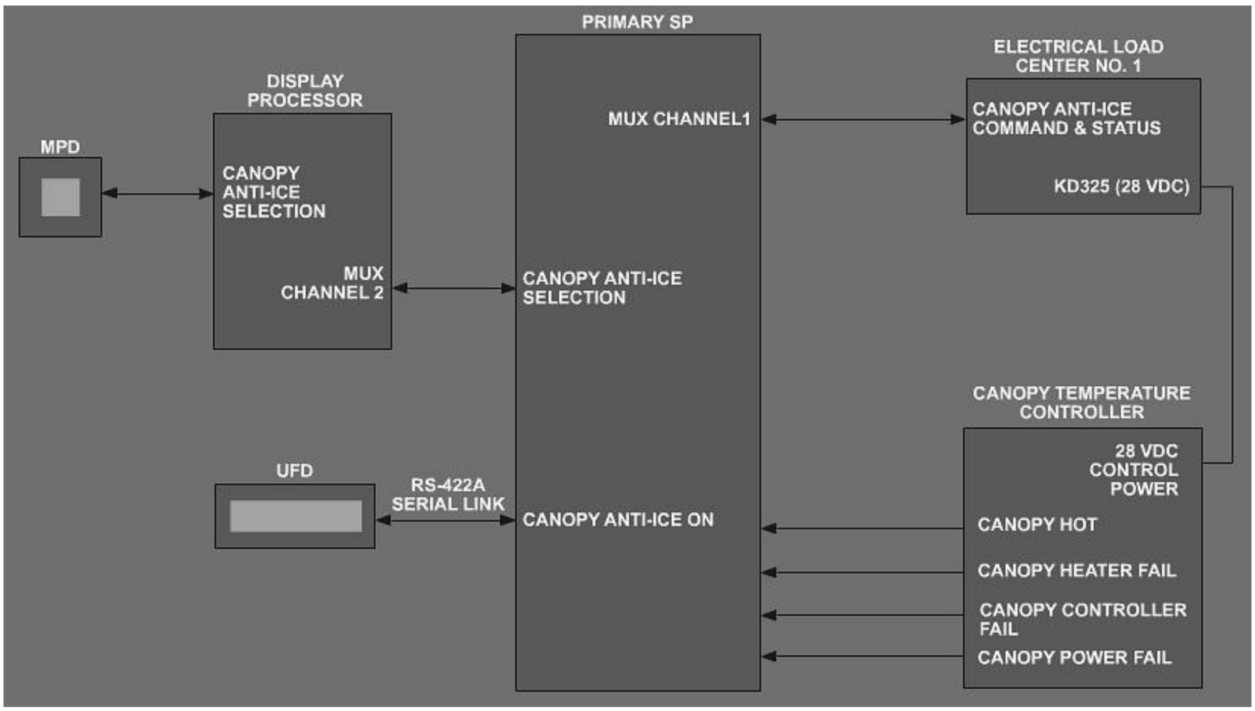


Figure 58. System Processor Operation.

(16) After initialization is complete, the primary SP performs the following functions:

(a) Monitors the secondary SP operational status to ensure a smooth transition of bus control if the primary SP fails

(b) Transmits and receives data and selections to and from the primary DP. An example of this type of operation would be a manual canopy anti-ice operation.

1) The SP monitors the canopy anti-ice selection from the DP.

2) When a crewmember activates the anti-ice subsystem via the MPD, the selection is sent over the serial data bus to the DP.

3) The DP transmits the selection to the SP over the MUX bus.

4) The SP commands ELC1 to provide the operating power to the canopy anti-ice system and informs the DP that the operation is in progress.

5) The SP monitors the canopy heater and heater controller for failures, controller power failure, and the status of the anti-ice power from ELC1.

6) If all of the above report no failures, the SP reports to the DP that the operation is completed and commands the DP to set the canopy anti-ice mode to on.

7) The DP sends a command to the MPD to display the canopy anti-ice subsystem as on (filled dot next to the canopy anti-ice selection).

8) Additionally, the SP will issue a command to the UFD via serial data link to display to the crewmember that the canopy anti-ice subsystem is on.

9) The SP will continue to monitor the heater, heater controller, and ELC1 statuses for any failure.

10) If a failure occurs, it will command ELC1 to remove power from the canopy anti-ice subsystem and inform the DP of the failure over the MUX bus.

11) The SP will also issue a command to the UFD to display to the crewmember that the system has failed.

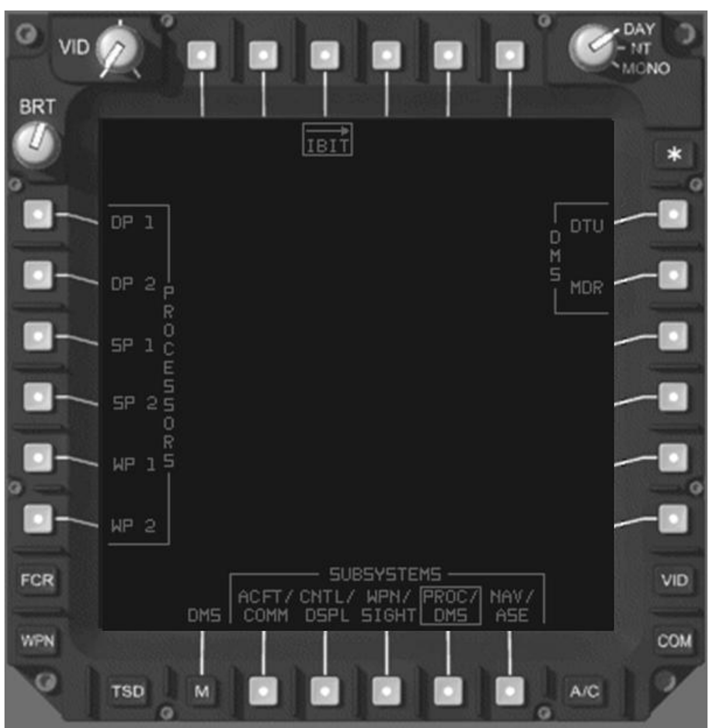
(c) Transmits and receives information and updates to and from the primary WP. Examples of this type of operation include the following:

1) Weapons load and power selections

2) Navigation and flight data

3) IBIT commands

(d) Issues commands to and receives statuses from the subsystems connected to MUX bus channels 1 and 2. EPMS statuses from the ELCs, inertial data from the Inertial Navigation Unit (INU), and velocities from the Doppler navigation system are examples of this type of data.



SYSTEM PROCESSOR IBIT PAGES

Figure 59. System Processor IBIT Initialization.

(17) CBIT

(a) CBIT provides for continuous monitoring of the SP internal operation.

(b) Both SPs perform a CBIT, except for toggling the direct outputs. The primary SP performs a limited CBIT on its direct outputs to verify they are in the commanded state. The secondary SP does not test its direct outputs.

(18) IBIT

(a) The operator selects either SP1 or SP2 IBIT button on the MPD DISPLAY/ PROCESSORS IBIT page to initiate the IBIT.

(b) The DP transmits the SP test selection to the SP.

(c) The primary SP sets the CREW IBIT PROMPT and an IBIT advisory screen is displayed to inform the crewmember that the processor select panel Select switch should not be in the position for the processor selected for IBIT.

(d) After crew acknowledgement to begin testing has been made, the SP begins IBIT testing.

(e) If the selected processor is the primary SP, the processor performs an IBIT, including testing of the direct outputs without altering the state of the outputs.

(f) If the selected processor is the secondary SP, the primary SP commands the secondary SP to perform IBIT. Testing of the direct outputs is not performed.

(g) Detected faults are displayed on the SP IBIT screen.

(h) The IBIT may be terminated at any time by selecting ABORT.

CHECK ON LEARNING

1. During PBIT the _________ determines if this is a ground or air initialization.

2. The SPs determine if the aircraft is on the ground or in the air by reading the state of the __________ and ___________.

G. Enabling Learning Objective 7

After this lesson, you (the student) will:

ACTION: Identify the characteristics of the Processor Select Panel (PSP).

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the characteristics of the Processor Select Panel (PSP).

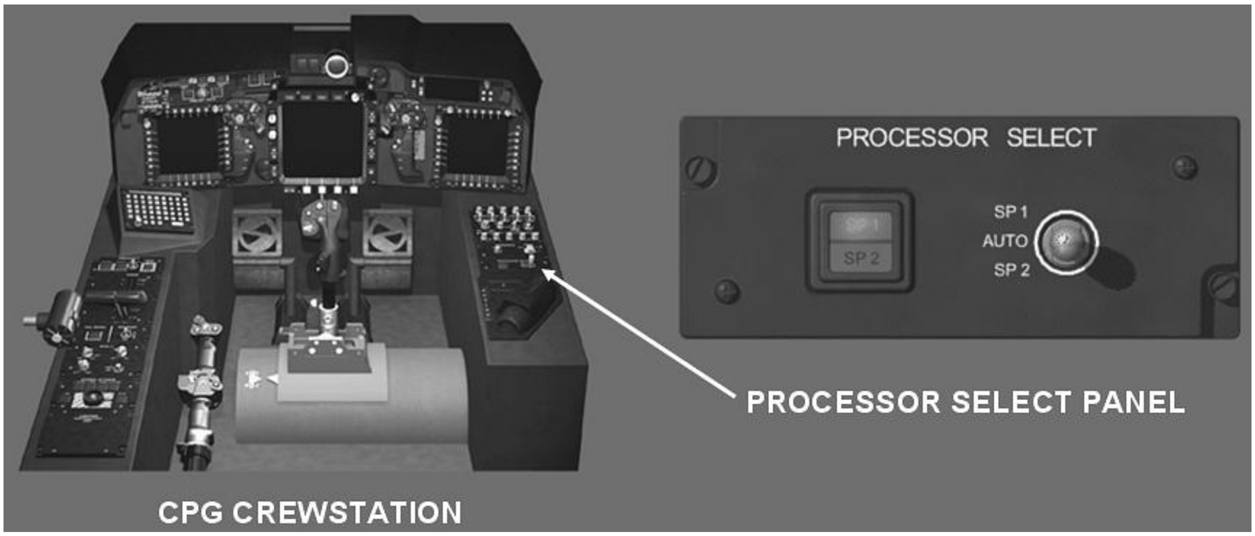


Figure 60. Processor Select Panel Location Diagram.

a. Processor Select Panel (PSP)

(1) The PSP provides for manual or automatic selection of the primary and secondary SP.

(2) The PSP also provides an indication as to which SP is currently acting as the primary processor and performing as the BC for the system. The PSP is located in the right console in the CPG station.

(3) The PSP is a Dzus-mounted panel containing the following:

(a) A split light indicator

(b) A three-position, lever-locked toggle switch

1) The AUTO position allows the SPs to decide which will be the primary SP.

2) The SP1 position selects SP1 as primary.

3) The SP2 position selects SP2 as primary.

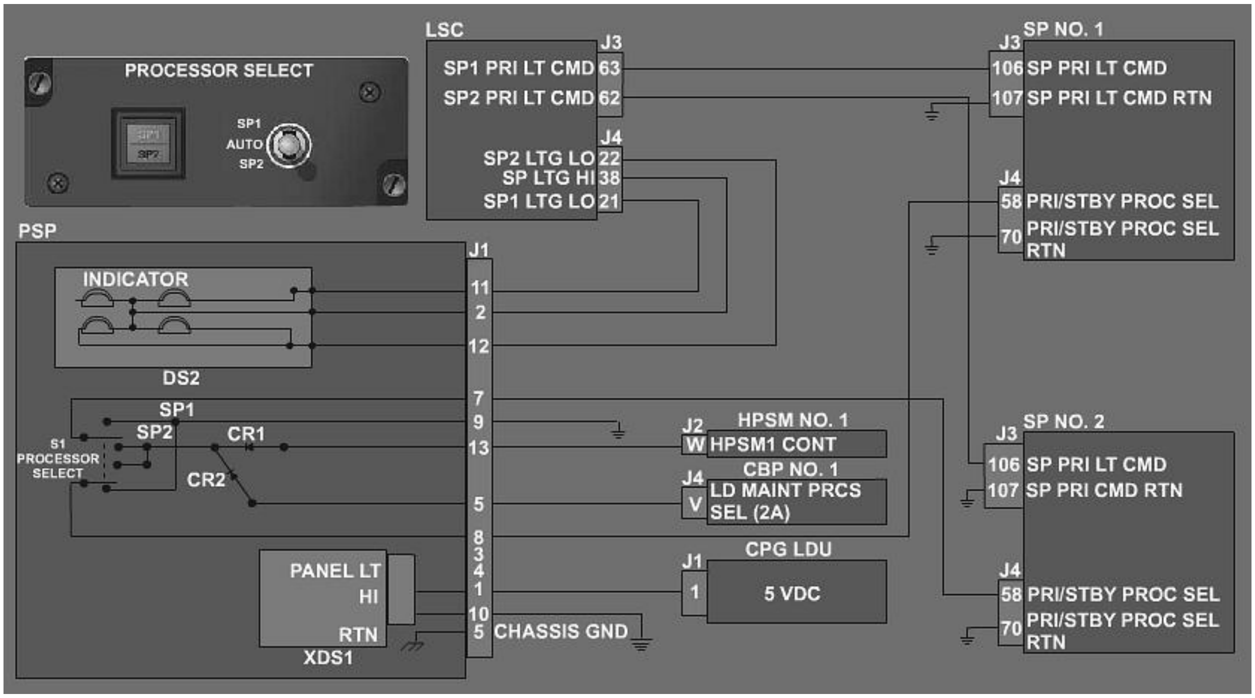


Figure 61. Processor Select Panel Interface Diagram.

b. PSP operation

(1) 28 Vdc primary select power for the PSP is provided from the battery bus via a 5-ampere circuit breaker labeled LD MAINT PRCS SEL (Load Maintenance Processor Select) on CBP1. 28 Vdc hold-up (back-up) select power is supplied from a 5-amp circuit breaker labeled SYS PROC SEL HOLDUP on HPSM 1.

(a) AUTO – Neither a ground nor 28 Vdc are applied to either SP.

(b) SP1

1) 28 Vdc is applied to the PRI/STBY PROC SEL input to SP1.

2) A ground is applied to the PRI/STBY PROC SEL input to SP2.

(c) SP2

1) 28 Vdc is applied to the PRI/STBY PROC SEL input to SP2.

2) A ground is applied to the PRI/STBY PROC SEL input to SP1.

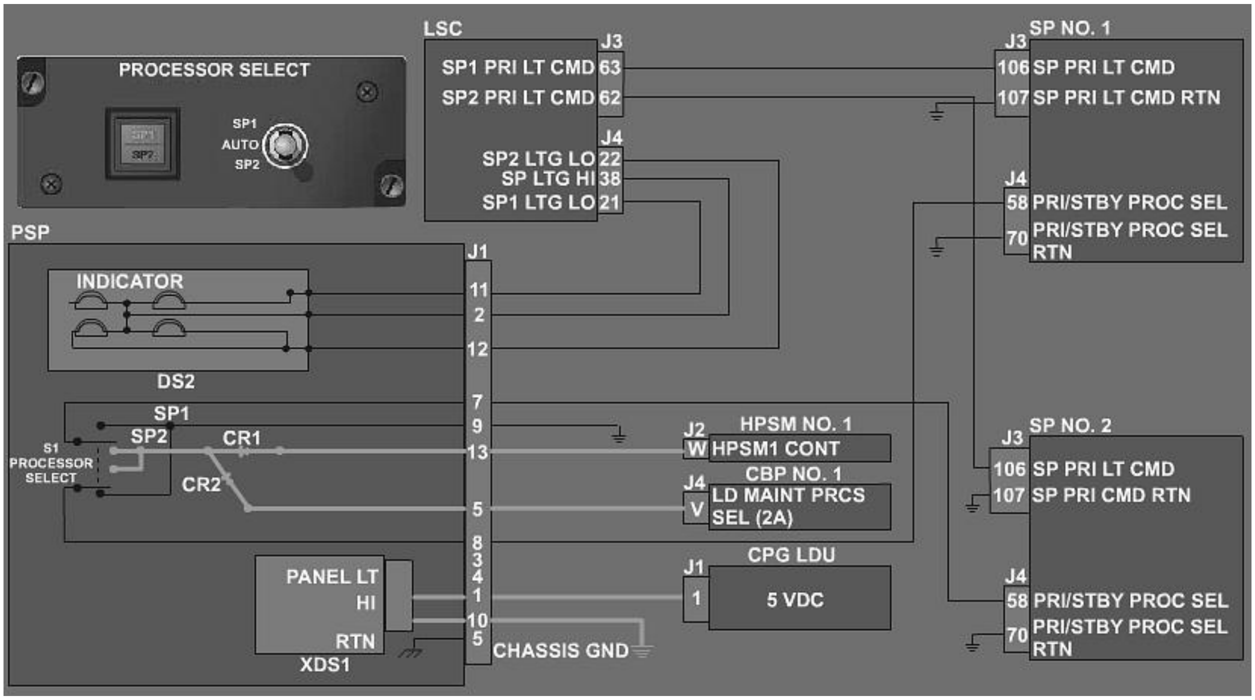


Figure 62. Automatic SP Selection.

(2) Automatic primary/secondary SP selection function

(a) If the Processor Select switch is in the AUTO position, the SPs initially configure their MUX bus interfaces to the monitor/remote terminal mode. They then monitor both MUX bus channels for receipt of an SP status message.

1) SP1 has a RT address of 01 decimal (00001 binary) and employs a 0.5- to 1-second monitor period for receipt of an SP2 status message.

2) SP2 has a RT address of 27 decimal (11011 binary) and employs a 1.5- to 2-second monitor period for receipt of an SP1 status message.

(b) If SP1 receives an SP2 status message on either MUX bus channel within the 0.5- to 1-second monitor period, then SP2 has already become the primary SP. SP1 immediately assumes the role as the secondary SP.

(c) If SP1 does not receive an SP2 status message on either MUX bus channel within the 0.5- to 1-second monitor period, it executes the following steps to become the primary SP:

1) The SP configures its MUX bus terminal interface as a BC.

2) SP1 transmits status messages on both MUX bus channels, indicating SP1 is the primary SP.

(d) If SP2 receives an SP1 status message on either MUX bus channel within the 1 - to 2-second monitor period, SP2 immediately assumes the role as the secondary SP.

1) If SP2 does not receive an SP1 status message on either MUX bus channel within the 1.5- to 2 -second period, it executes the following steps to become the primary SP.

2) It configures its MUX bus terminal interface as a BC.

3) SP2 transmits status messages on both MUX bus channels, indicating SP2 is the primary SP.

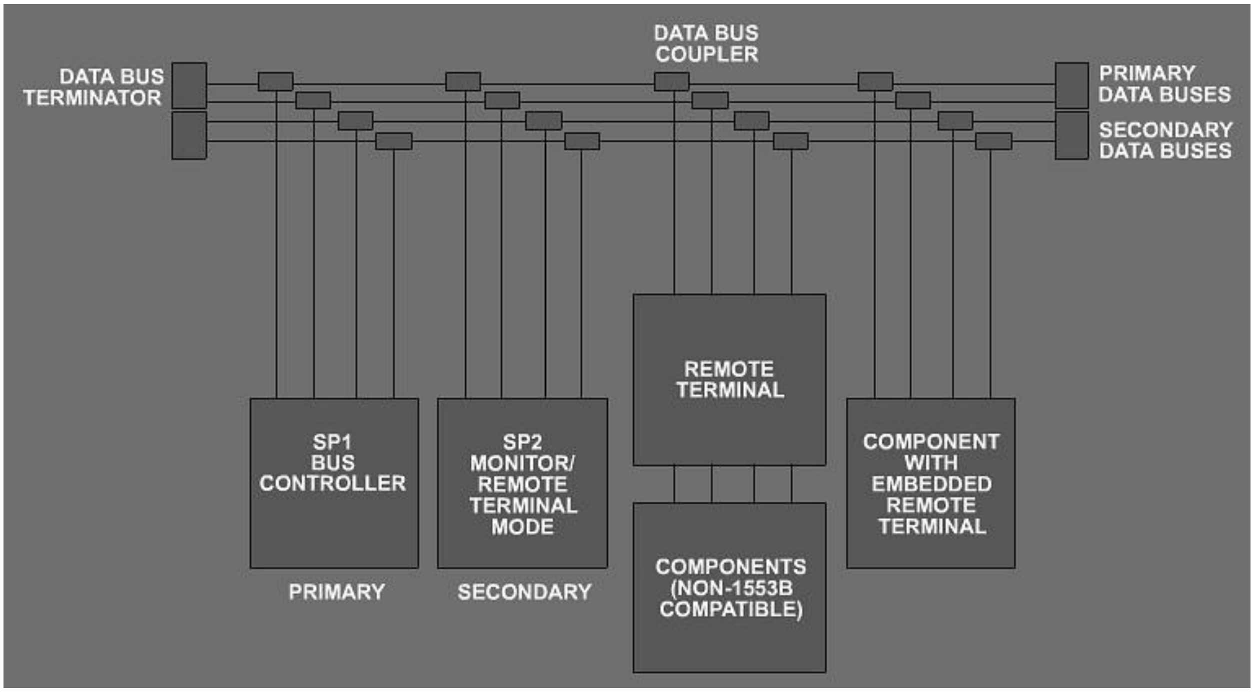


Figure 63. Manual Switchover.

(3) Manual primary/secondary SP switchover function

(a) The CPG can manually control the switchover of SPs via the processor select switch on the PSP. Examples of reasons to manually switch processors are:

1) Symbology/displays blank.

2) Symbology/displays freeze (fail to update).

3) Symbology/displays respond erratically.

(b) If any of the above listed conditions occur, the CPG can attempt to recover by placing the Processor Select switch to the SP position that is currently indicated as the secondary SP.

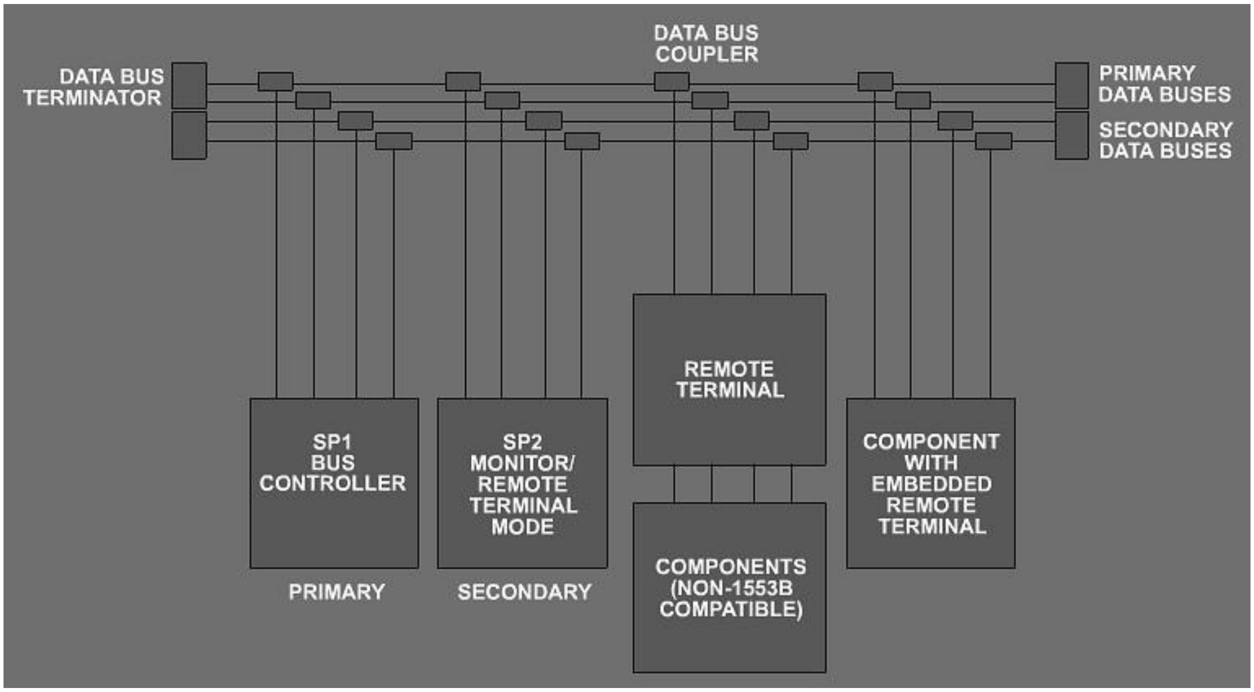


Figure 64. Automatic Switchover.

(4) Automatic primary/secondary SP switchover function

(a) After the system has been initialized and a primary SP established, the primary SP monitors the health of both SPs, the FCDB and MUX bus channels 1 and 2 for bus collisions. When appropriate, the primary SP automatically reverts to secondary mode, allowing the secondary SP to take over as the primary and assume control.

1) The primary SP continuously monitors for bus collisions on MUX bus channels 1 and 2. If the SP determines that the responding message error rate is greater than 10%, the primary SP assumes that bus collisions are occurring and transitions to secondary mode.

a) Upon transitioning into secondary, the SP waits 16 minor frames for SP1 or 50 minor frames for SP2.

b) After the delay, the SP begins normal processing as the secondary SP.

2) The primary SP continuously monitors for module failures in both SPs. If the primary SP has a module failure and the secondary SP does not, the primary SP initiates a coordinated switchover. A coordinated switchover is as follows:

a) The primary SP sends a “Become Primary” command to the secondary SP and waits for acknowledgement from the secondary SP.

b) The secondary SP acknowledges the current “Become Primary” command and wraps it back to the primary SP.

c) One of three things occurs:

1 If the primary SP determines that a switchover is no longer necessary before it receives an acknowledgement from the secondary SP, the coordinated switchover is aborted.

2 If the primary SP is issuing the command and receives an acknowledgment from the secondary SP, the primary SP transitions to secondary mode

3 If it is necessary for the primary SP to resume operation within two minor frames, the primary SP sets an internal flag, preventing it from going into secondary mode. This internal flag can only be cleared during SP initialization.

d) Upon transitioning into secondary mode due to a module failure, the SP waits for 250 milliseconds before beginning normal processing.

(b) The secondary SP continually monitors MUX bus channels 1 and 2. If the secondary SP does not detect an SP status message on both bus channels for two consecutive minor frames, the secondary SP assumes the role as primary SP by configuring its MUX bus terminal as BC and issuing SP status messages to the other SP.

(c) The automatic switchover of the primary/secondary SP can be affected by the following critical failures of the forward ECS.

1) ECS 1 LH EFAB BLOWER FAIL

2) ECS 1 LH EFAB BLOWER RELAY FAIL

3) ECS 1 CNDNSR BLOWER 1 FAIL

4) ECS 1 CNDNSR BLOWER 1 RELAY FAIL

5) ECS 1 COMPRESSOR MOTOR OVRTMP

6) ECS 1 COMPR LOW SPEED RELAY FAIL

7) ECS 1 DCU CPU SRU FAIL

8) ECS 1 DCU POWER SUPPLY SRU FAIL

9) ECS 1 ON/OFF CMD FAIL

10) ECS 1 COMPRESSOR LOW SPEED FAIL

(d) If SP1 is primary and SP2 does not have any critical failures and one or more of the aforementioned ECS critical failures exists, the following actions take place:

1) SP1 goes into secondary mode, permitting SP2 to become primary.

2) Upon becoming primary, SP2 sends the FCR/Low Power Radio Frequency (LPRF)/PSP and RFI ON command discretes to HPSM1.

3) This processing is accomplished because:

a) SP1 is located in the same EFAB area as ELC1. If the temperature in the EFAB is rapidly rising as a result of one or more of the critical ECS failures, the probability of an SP1 failure is very high.

b) SP2 becomes primary to extend the time that the FCR/RFI can continue to be powered.

4) If SP2 has critical failures, SP1 remains the primary since this multiple-failure situation would not be improved by switching SPs.

5) If SP1 is primary and SP2 is secondary and does have critical failures, SP1 sends the FCR/LPRF/PSP and RFI ON command discretes to HPSM1.

6) If SP2 is primary from initialization, it sends the FCR/LPRF/PSP and RFI ON command discretes to HPSM1.

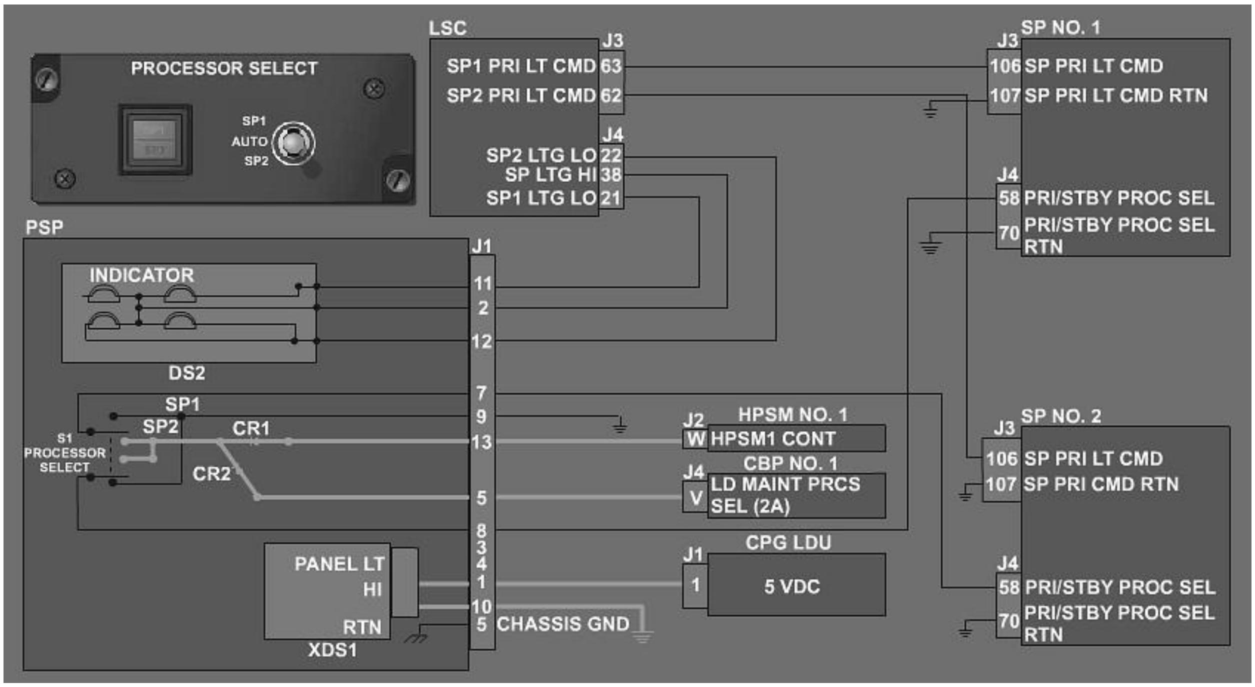


Figure 65. SP Primary Light Command.

(5) The primary SP provides an SP PRI LT CMD signal voltage to the LSC. Depending on crewmember interior lighting selection, the LSC provides a 6-14 Vdc adjustable (night) or 28 Vdc (day) signal to the appropriate SP1 or SP2 annunciator. The illuminated section of the split light indicator shows which SP is functioning as the primary.

CHECK ON LEARNING

1. The PSP provides for manual or automatic selection of the ____.

2. The SP switchover process can only occur if the switch on the PSP is in the ____ position.

H. Enabling Learning Objective 8

After this lesson, you (the student) will:

ACTION: Identify the characteristics of the Up-Front Display (UFD).

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the characteristics of the Up-Front Display (UFD).

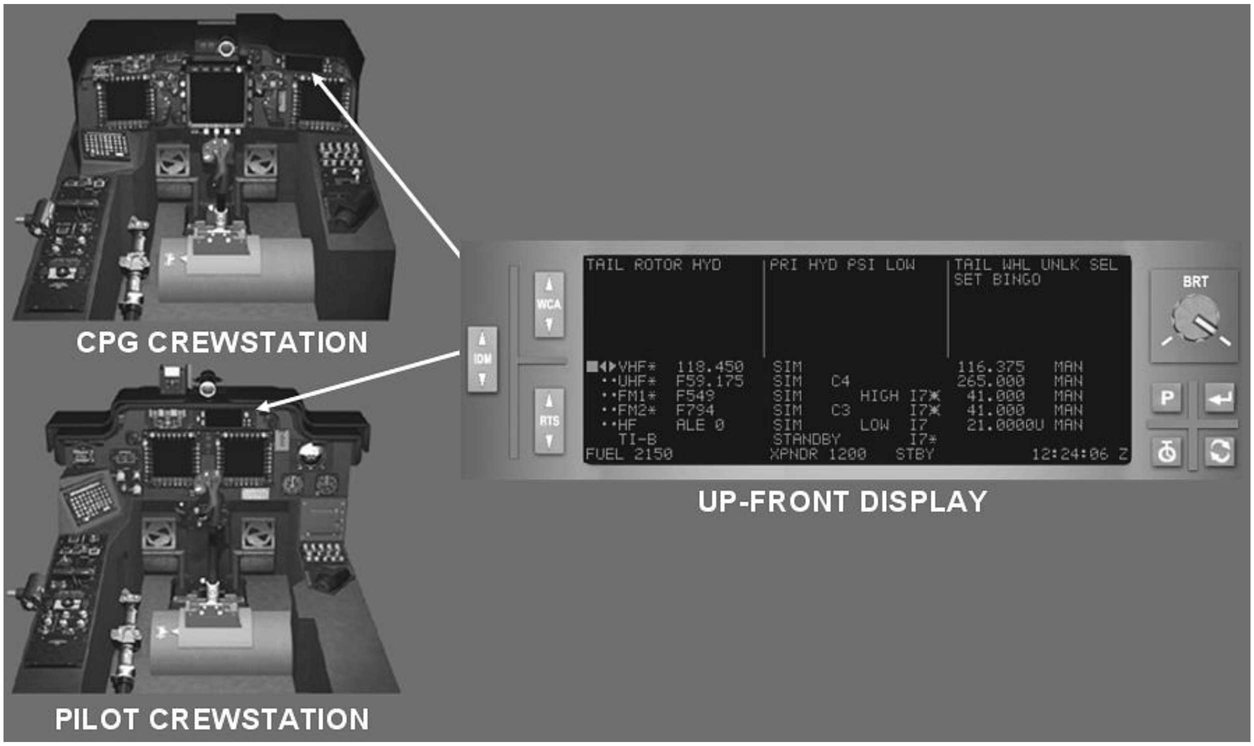


Figure 66. Up-Front Display.

a. UFD

(1) The UFD provides the crewmember with the following:

(a) Full-time display of communication information

(b) Local or Zulu time

(c) WCA information

(2) The UFD is located above the right MPD in each crewstation.

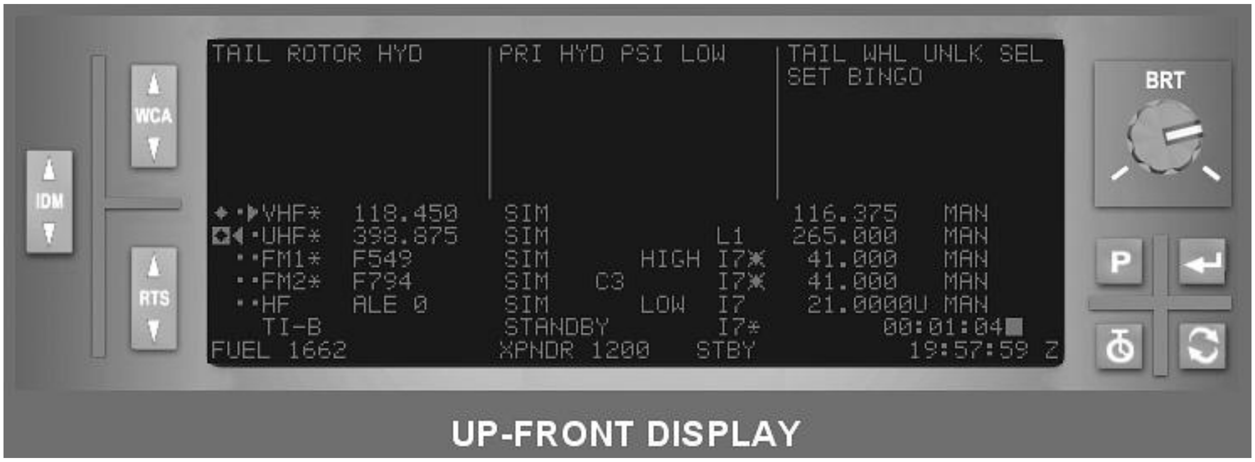


Figure 67. Up-Front Display Layout.

(3) UFD layout

(a) Displays in NVIS compatible yellow-green LEDs

(b) Displays 14 lines of 56 characters each

1) The WCA rocker switch allows the operator to scroll up/down through the caution/advisory section.

a) When any list is more than five lines in length, the vertical line separating the warning, caution, and advisory lists is augmented by double arrows.

b) When a WCA list contains information not currently on the display, arrows are presented indicating the direction in which to action the WCA rocker switch to view this information.

2) The BRT knob controls the brightness of the LED display only. The bezel brightness is controlled by the primary knob on the lighting panel.

3) Radio Transmit Select (RTS) switch selects the next radio as the transmitter, regardless of whether the up or down function is selected on the control. This is redundant to the RTS switch provided on the cyclic grip.

4) The Swap Control (circling arrows) button tunes the radio to the previous frequency.

5) The IDM Select switch allows cycling up or down through the available IDM radio selections for message transmit.

6) The Preset (P) Tune pushbutton is used to open a preset tune UHF window.

7) The Enter pushbutton is used to enter (activate) a selection.

8) The Stopwatch pushbutton is used to time an event.

a) Pressing the Stopwatch pushbutton will start the timer.

b) Pressing the Stopwatch pushbutton again will stop the timer.

c) To continue from the point the timer was stopped, press the Stopwatch pushbutton again.

d) To reset the timer, press and hold the Stopwatch pushbutton for at least 2 seconds. Once the timer is reset, it will be removed from the display.

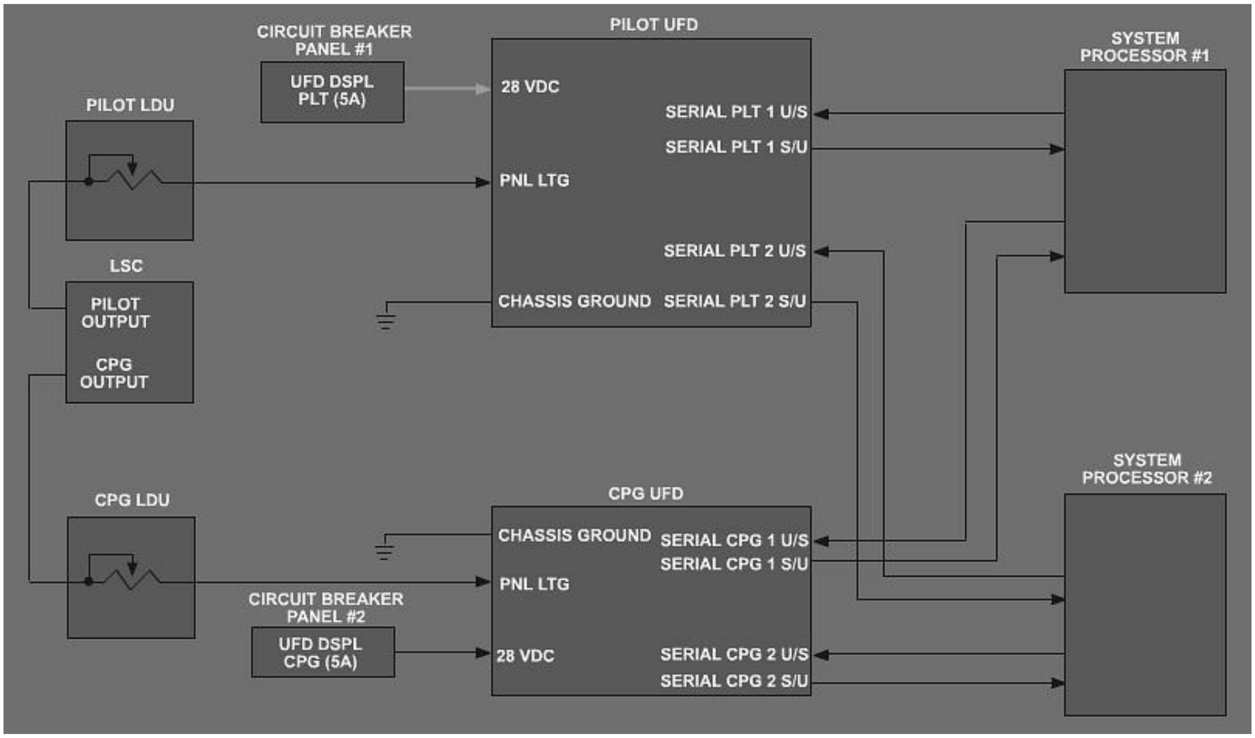


Figure 68. Up-Front Display Operation.

(4) UFD operation

(a) Power

1) 28 Vdc power to the pilot UFD is provided by ELC1 (KB320).

2) 28 Vdc power to the CPG UFD is provided by ELC2 (KB420).

(b) UFD panel lighting

1) The pilot UFD receives 5 Vdc panel lighting power from the pilot Lighting Distribution Unit (LDU). The pilot LDU receives its source power from the LSC.

2) The CPG UFD receives 5 Vdc panel lighting power from the CPG LDU. The CPG LDU receives its source power from the LSC.

(c) Data transfer

1) Each SP provides two bidirectional RS422 serial data link interfaces, one for the pilot UFD and one for the CPG UFD.

2) The interface uses non-return-to-zero logic, requiring no clock to reset message strings.

3) The interface operates at 38.4 kbaud (kilo bits per second).

4) The SP transmits character display data to each UFD using a 10-message data string with control words indicating the string is either a response message or an initiating message.

a) A response message is a message from the SP checking for a UFD pushbutton being activated.

b) An initiating message is a message from the SP initiating display changes or updates.

c) The SP requests UFD pushbutton selections from the UFD using a single message with a single control word.

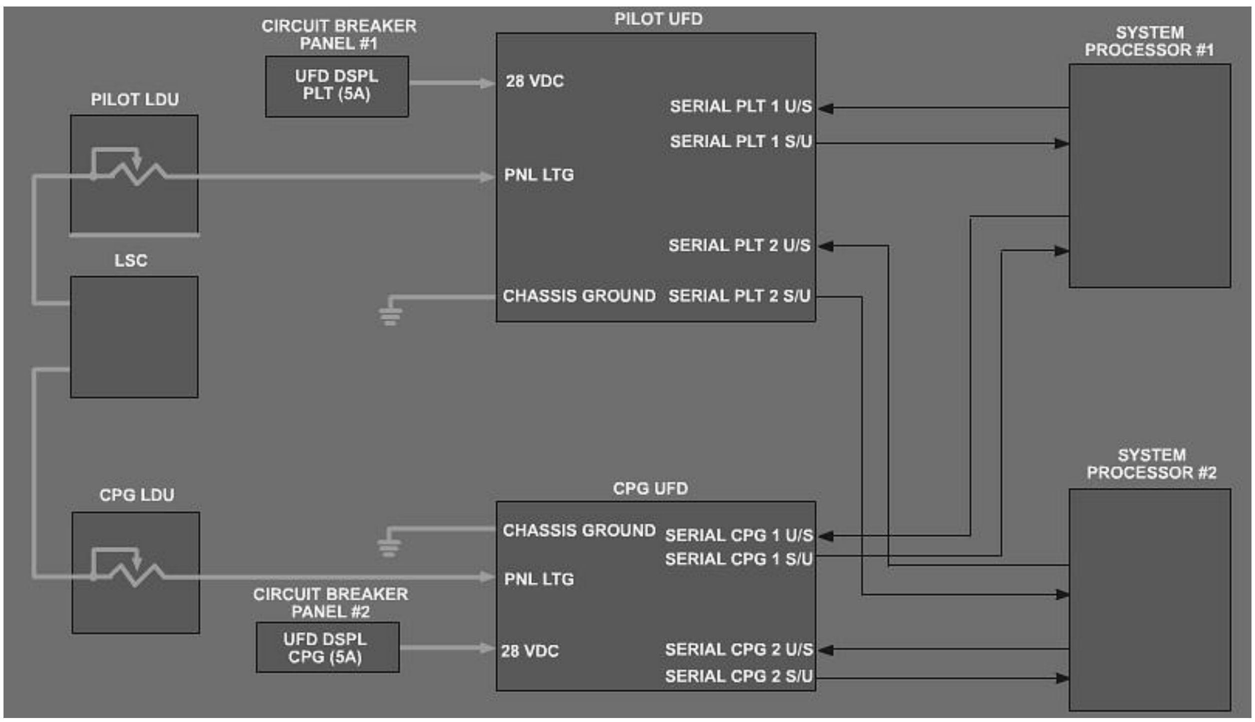


Figure 69. Up-Front Display Operation 2.

(d) BITs

1) Each UFD reports the following BIT errors to the SP:

a) Memory errors

b) RS422 interface errors

c) UFD display errors

2) Errors detected by the UFD during a BIT test are reported to the SP. The SP sends a UFD “No Go” status message to the MDR. The MDR writes a “UFD Failure” message to memory for data storage.

3) PBIT

The SP initializes and determines if the aircraft is on the ground or in the air.

a) If on the ground, the SP directs UFDs to perform PBIT.

b) If in the air, the SP inhibits UFDs from performing PBIT.

4) IBIT

a) If the crew initiates IBIT from the MPD:

1 The SP enables the UFD to perform an IBIT.

2 The UFD can be commanded to perform IBIT while the aircraft is either in-flight or on the ground. The UFD reports its test results for further processing.

3 During the MPD-initiated IBIT, an interactive test can also be initiated via the buttons on the UFD. Directions for completion of the interactive test are contained in the IETM as part of the UFD MOC.

4 The crew may discontinue the IBIT prior to completion of the test. When testing is stopped via MPD selection, the SP commands the appropriate UFD to stop BIT testing.

b) If the crew initiates IBIT from the UFD:

1 Selecting the RTS and Swap buttons simultaneously for 3–5 seconds causes the UFD to self-test the LEDs and display circuitry.

2 During self-test, a scrolling bar test pattern will be displayed. When the buttons are released, the normal display will return after the test bar scrolls off the right-hand side of the display.

5) CBIT

a) The UFD performs CBIT testing and reports any errors to the SP.

b) When a UFD has not responded to the SP after a period exceeding 750 milliseconds, the SP reports to the DTU and the MPDs that the UFD is in a "No Response" state.

CHECK ON LEARNING

1. The swap button on the UFD provides for ____.

2. The RTS switch will ____.

I. Enabling Learning Objective 9

After this lesson, you (the student) will:

ACTION: Identify the characteristics of the Load Maintenance Panel (LMP).

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the characteristics of the Load Maintenance Panel (LMP).

Figure 70. Load Maintenance Panel.

a. LMP

(1) The LMP provides the ground crew with the ability to determine and enter weapons load data, override the Squat switch, manually position weapons pylons, and to load-secure communication variables. The LMP is mounted in the right aft avionics bay behind access door R295.

(2) The LMP consists of a display, keyboard, rocket-select thumbwheels and inventory decal, SQUAT ORIDE switch, PYLON POS (Position) switch, COMSEC REMOTE ORIDE (Override) switch and PTT (Push-To-Talk) buttons, and brightness control knobs.

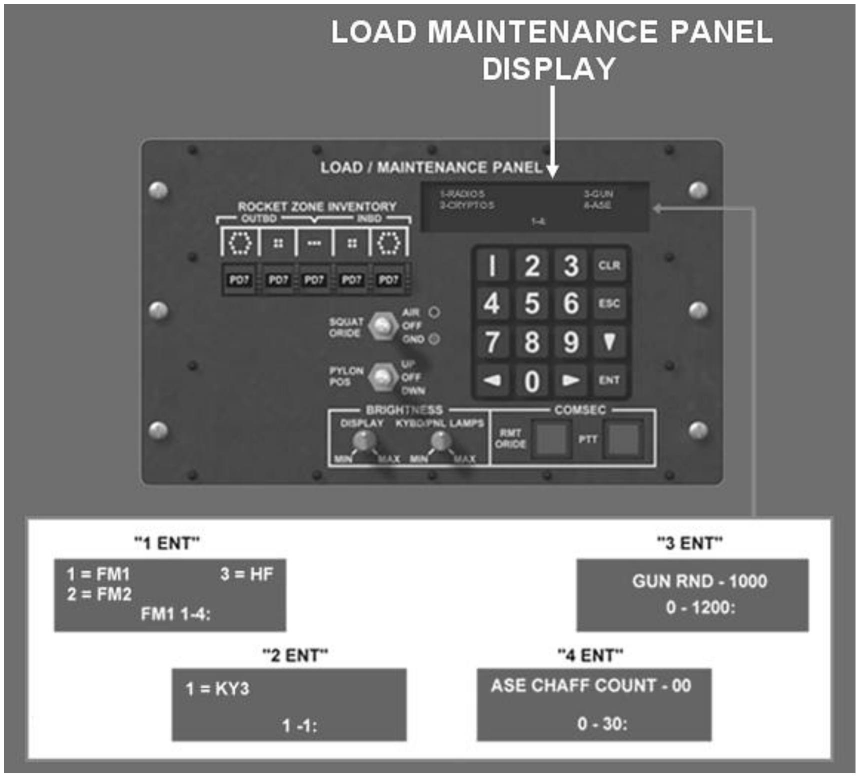


Figure 71. Load Maintenance Panel Display.

(a) The LMP provides a display for radios, CNVs, gun (rounds loaded), and ASE loads.

(b) The LMP provides a 3-line-by-24-character LED display.

The top two lines contain the following menu information:

1) The top-level page displays the menu:

   a) 1 = Radios for Radio Selection page

   b) 2 = Cryptos for KY-100 Fill page

   c) 3 = GUN to view/enter rounds loaded

   d) 4 = ASE to view/enter chaff cartridges

2) The next-level page allows view/entry of selected data. For example:

   a) Radios = FM1, FM2, HF (for radio key and datafill)

   b) Cryptos = KY3 (for KY-100 CNVs)

   c) GUN RND = 1200 rounds count information stored in WP

   d) ASE CHAFF COUNT = 30

3) The bottom line is divided into two sections.

   a) The label section (first 10 characters) shows the type of data to be entered via the keyboard.

b) The data entry field displays what was entered into the keyboard.

Figure 72. Load Maintenance Panel Layout.

(c) The Keyboard provides for data entry to the SP. Keys 0–9 are used to enter data to the screen data field. Pressing the 1 and 0 keys simultaneously will perform a self-test.

1) CLR (Clear) key clears all data in the data field.

2) ESC (Escape) key steps to the next higher screen.

3) ENT (Enter) key enters data.

(d) The Rocket Zone Inventory thumbwheel is for loading rocket and warhead type data with a rocket zone decal indicating the rocket zones.

(e) SQUAT ORIDE switch allows the ground crew to override the Squat switch relay to simulate an “in the air” condition. The switch is a spring-loaded, three-position switch (AIR/OFF/GND). NVIS-compatible green LED lamps indicate squat status.

(f) The PYLON POS switch repositions the pylons between flight stow and ground stow.

(g) Brightness control DISPLAY knob dims only the LED display. The Keyboard/ Panel (KYBD/PNL) LAMPS knob dims everything else.

(h) COMSEC buttons

1) RMT (Remote) ORIDE provides for encoding communication secure codes.

2) PTT provides for encoding communication secure codes.

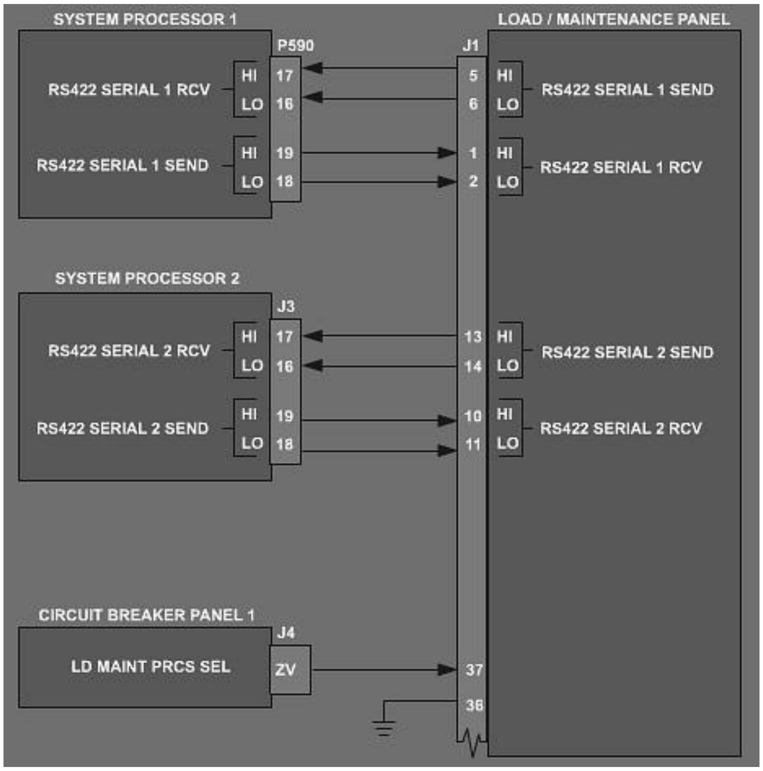


Figure 73. Load Maintenance Panel Interface.

(3) Interface

(a) 28 Vdc power is provided by LD MAINT PRCS SEL circuit breaker on the CBP1.

(b) Jumper connections for MUX bus terminal provide address selection and configuration code.

(c) Both SPs, via the RS422 serial data bus, provide a bidirectional communication link.

1) Serial outputs to the SPs include the following:

a) Rocket thumbwheel selections

b) Keyboard entries

c) Squat switch override

d) Manual pylon positioning

e) COMSEC variable functions

1 PTT

2 Remote (RMT) override

2) Serial inputs from the SPs include:

a) Screen displays

b) Squat override status

(d) The UHF KY-58 provides remote operate functions to itself, the UHF AM radio, and the IDM for PTT functions.

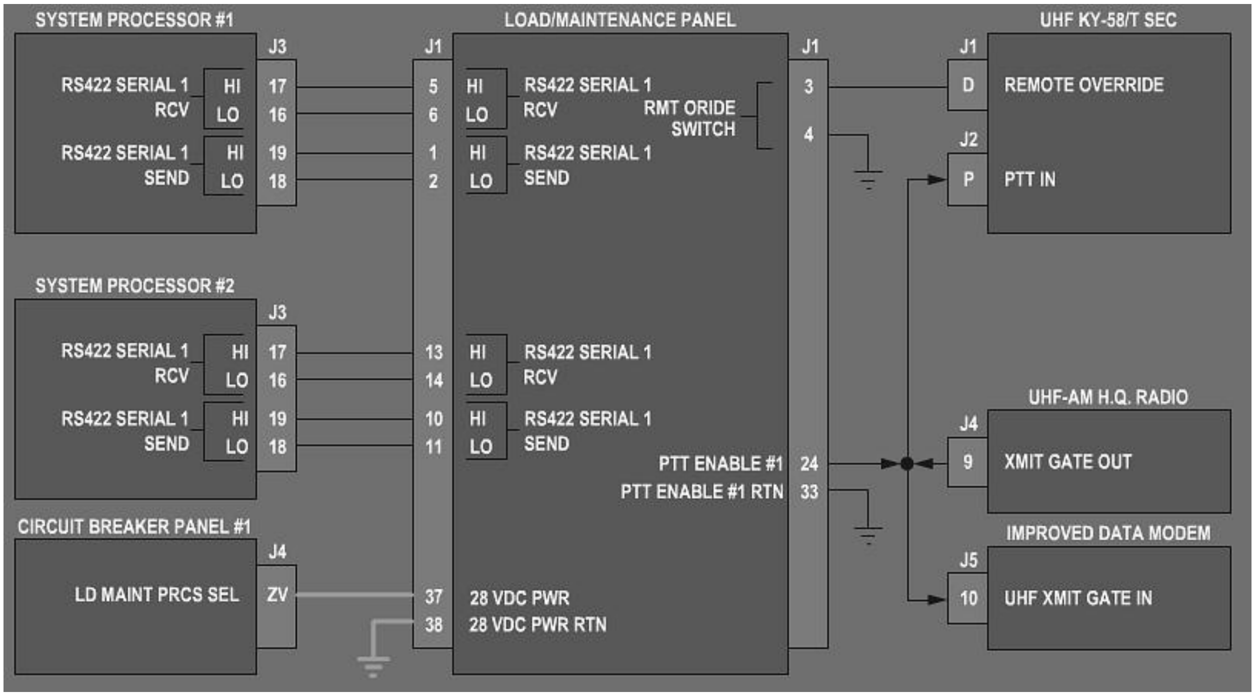


Figure 74. Load Maintenance Panel Operation.

(4) LMP operation

(a) The primary SP controls the LMP display power.

1) The SP sets the LMP power to on when the aircraft is on the ground.

2) The SP sets the power to off when the aircraft is in the air and keeps it off after landing until manually actuated by ground personnel.

a) After landing, activation of any keypad pushbutton shall reactivate the LMP displays and status lights.

b) Keypad pushbutton activation shall not be interpreted for data entry.

(b) LMP ground initialization

1) Pylon position shall be off.

2) Squat ORIDE shall not be selected.

3) RMT ORIDE shall be disabled.

4) The gun shall revert to its last setting.

(c) LMP power-interrupt initialization

1) The last settings shall be retained.

2) If this is not possible, the settings revert to those for LMP ground initialization.

(d) The ground crew enters the type of rockets loaded, and the number of 30mm rounds loaded, then positions the pylons for loading and simulates “in air” conditions.

CHECK ON LEARNING

1. The LMP is mounted in the ____.

2. Pressing the LMP keys ____ and ____ simultaneously will perform a self-test.

J. Enabling Learning Objective 10

After this lesson, you (the student) will:

ACTION: Identify the characteristics of the Master Warning/Caution pushbuttons.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the characteristics of the Master Warning/Caution pushbuttons.

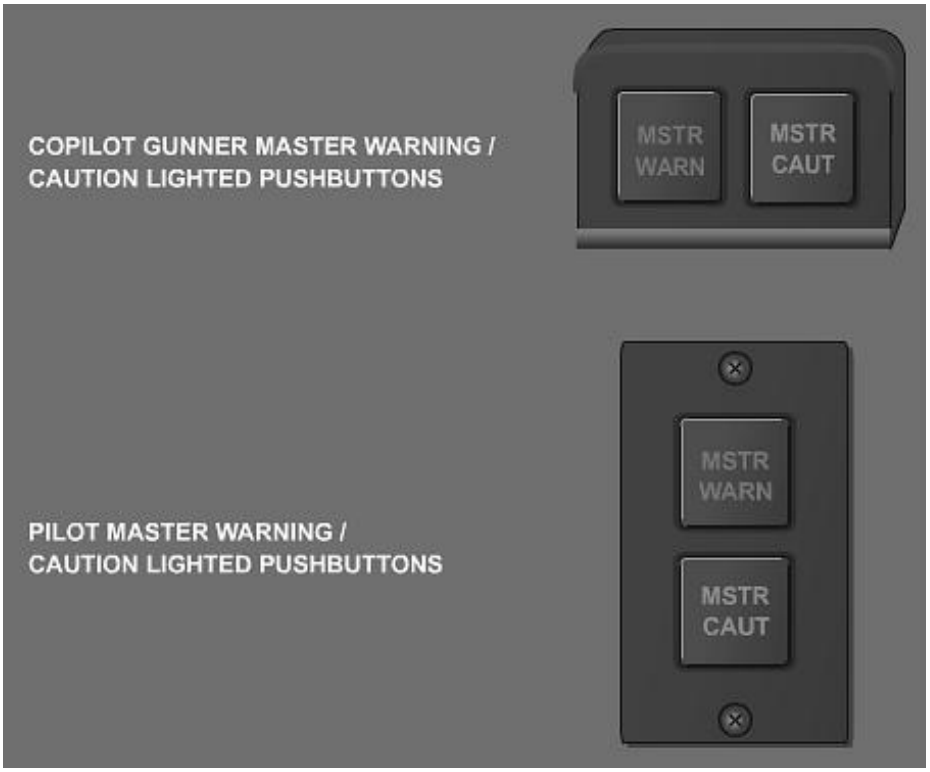


Figure 75. Master Warning/Caution Pushbuttons.

a. Master Warning/Caution pushbuttons

(1) The Master Warning/Caution (MSTR WARN/CAUT) pushbuttons alert the crewmembers that a "warning" or "caution" condition exists in the aircraft.

(2) The CPG MSTR WARN/CAUT pushbutton is located at the top of the LH instrument panel.

(3) The pilot MSTR WARN/CAUT pushbutton is located between the MPDs.

(4) The MSTR WARN is an NVIS-yellow lamp. It flashes at a 4 Hz rate when a fault is detected.

(5) The MSTR CAUT is an NVIS-green lamp. It illuminates steadily when a caution is detected.

(6) Both lamps are also pushbutton switches. When selected, an acknowledgment signal is sent to the SPs.

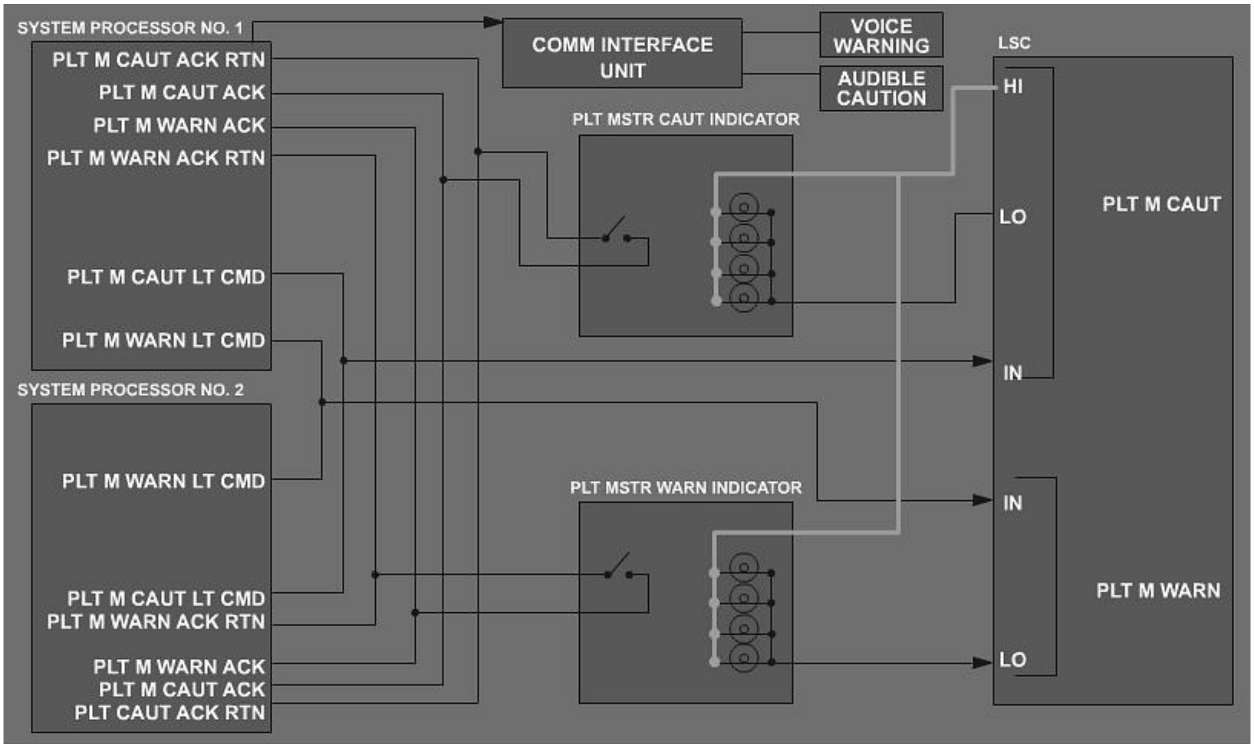


Figure 76. Master Warning/Caution Annunciator Interface 1.

(7) Interface

(a) Connected to the LSC for light illumination

(b) Connected to the SPs for button acknowledgment

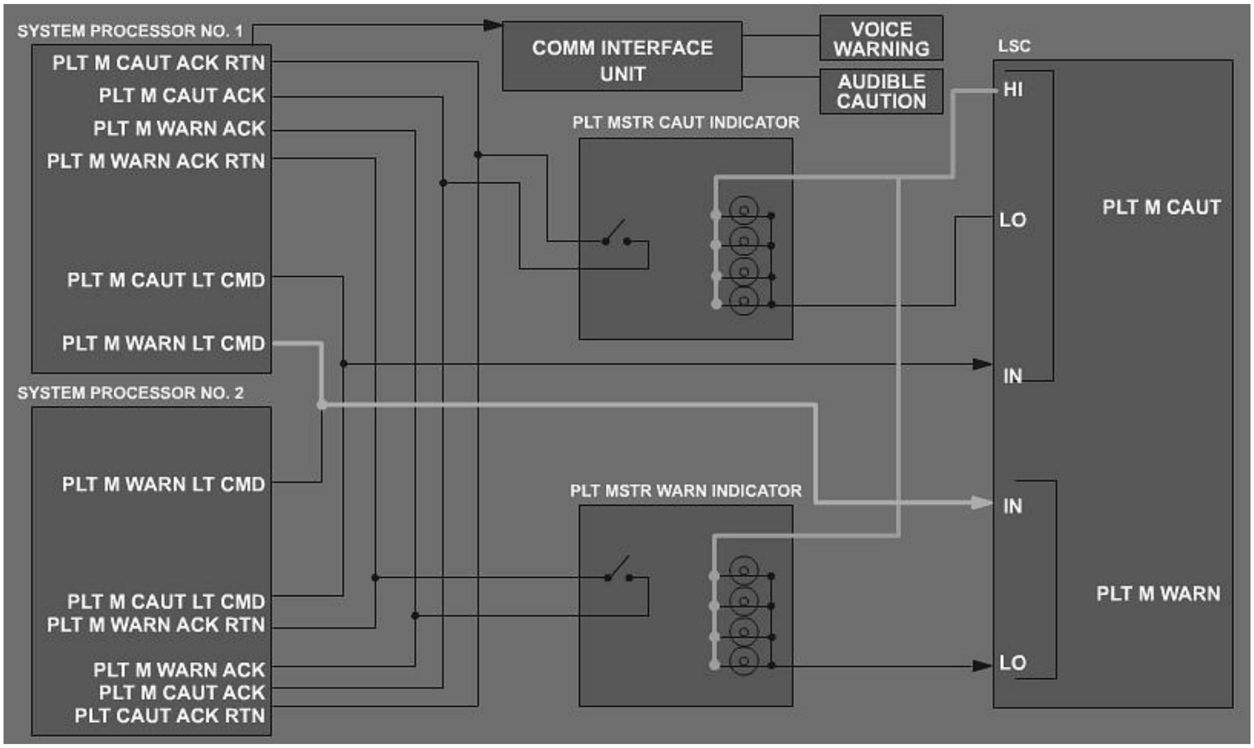


Figure 77. Master Warning/Caution Annunciator Interface 2.

(8) Operation

(a) Master Warning pushbutton

1) Whenever the primary SP detects a “warning” condition, it issues a command (5–29 Vdc) to the LSC.

2) The LSC provides a 14 Vdc (night) or 28 Vdc (day) output to both crewmember MSTR WARN lights.

3) The MSTR WARN annunciator flashes at a 4 Hz rate.

4) The SP also issues a command via the MUX bus to the CIU to provide the appropriate voice message for the warning condition.

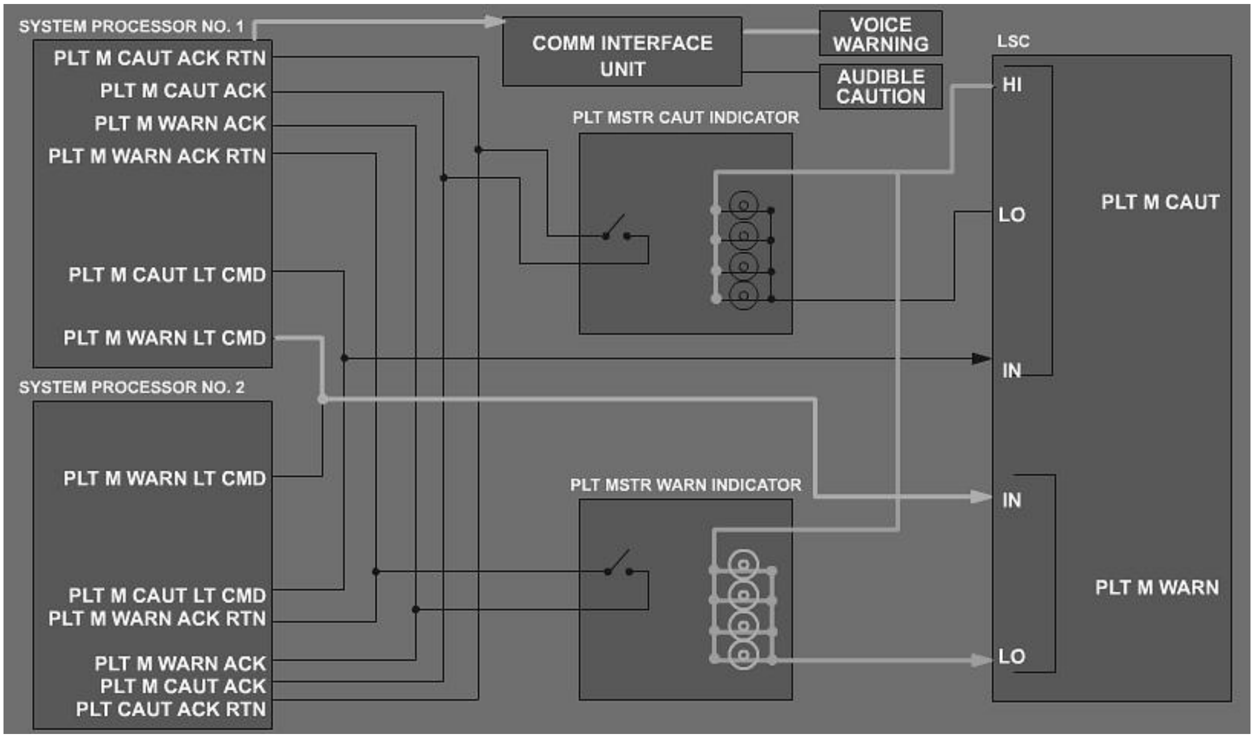


Figure 78. Master Warning/Caution Annunciator Interface 3.

5) Pressing the MSTR WARN pushbutton extinguishes the light in that station only.

6) Pressing the MSTR WARN pushbutton disables the audio in both stations.

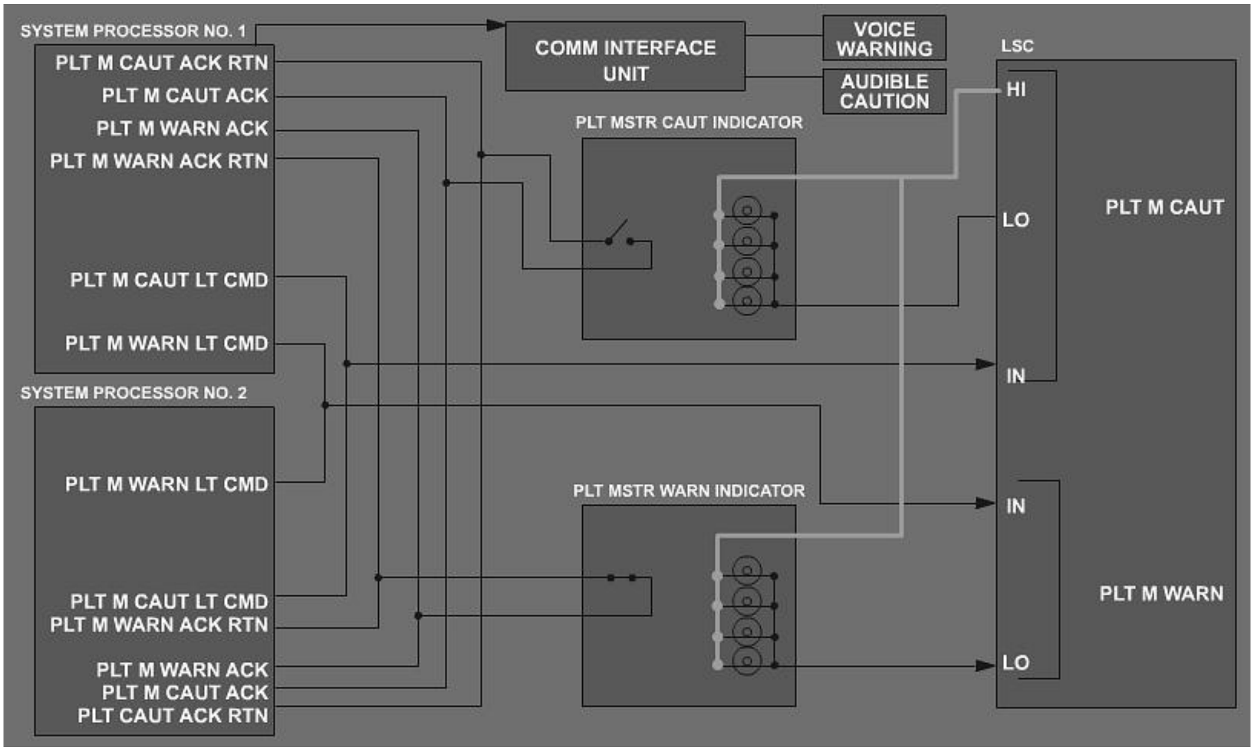


Figure 79. Master Warning/Caution Annunciator Interface 4.

(b) Master Caution pushbutton

1) When the primary SP detects a "caution" condition, it issues a command (5–29 Vdc) to the LSC.

2) The LSC provides a 14 Vdc (night) or 28 Vdc (day) output to both crewmember MSTR CAUT lights.

3) The MSTR CAUT annunciator illuminates steadily.

4) The SP issues a command via the MUX bus to the CIU to provide an alternating tone for the caution condition.

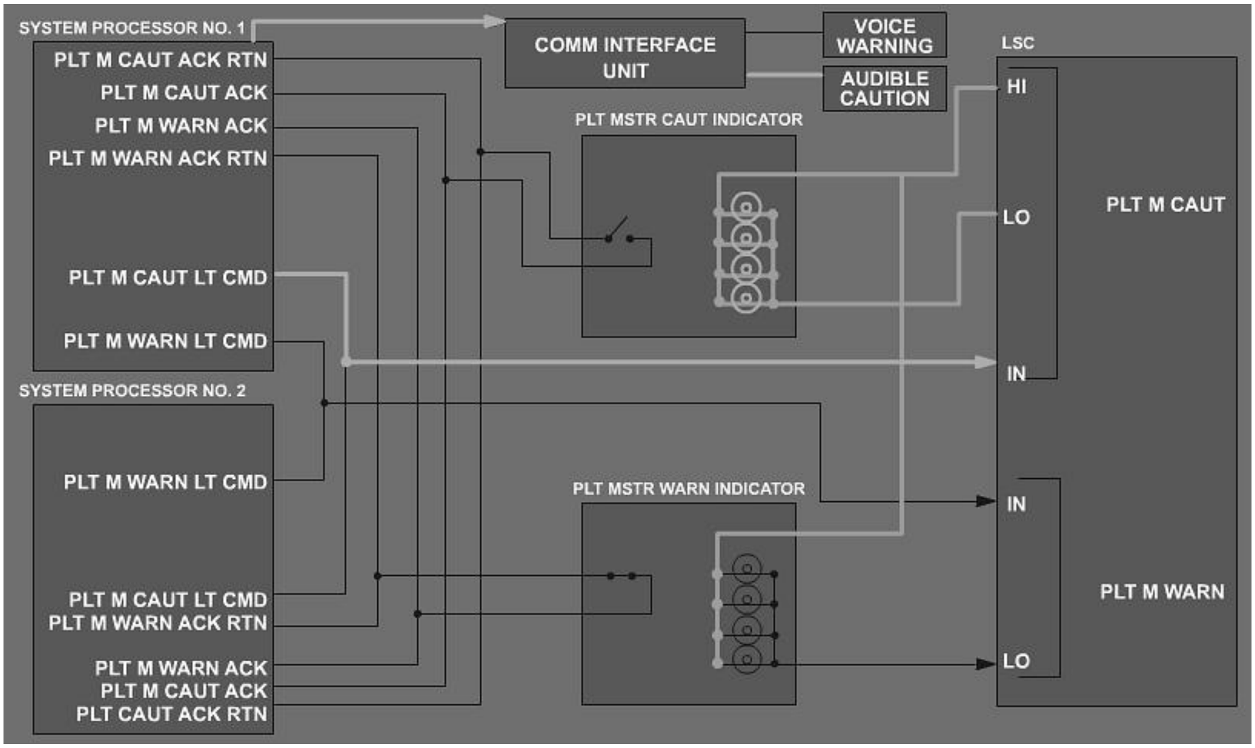


Figure 80. Master Warning/Caution Annunciator Interface 5.

5) Selecting the MSTR CAUT pushbutton extinguishes the light in that crewstation only.

6) The alternating tone plays every 10 seconds until the MSTR CAUT is acknowledged by selecting the pushbutton.

7) Selecting the MSTR CAUT pushbutton disables the audio in both stations.

CHECK ON LEARNING

1. Pressing the MSTR WARN pushbutton extinguishes the light in ____.

2. Pressing the MSTR CAUT pushbutton disables the audio in ____.

K. Enabling Learning Objective 11

After this lesson, you (the student) will:

ACTION: Identify the purpose, location, description and operation, of the Display Processor (DP) and its interface with system and subsystem components.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose, location, description, and operation of the Display Processor (DP) and its interface with system and subsystem components.

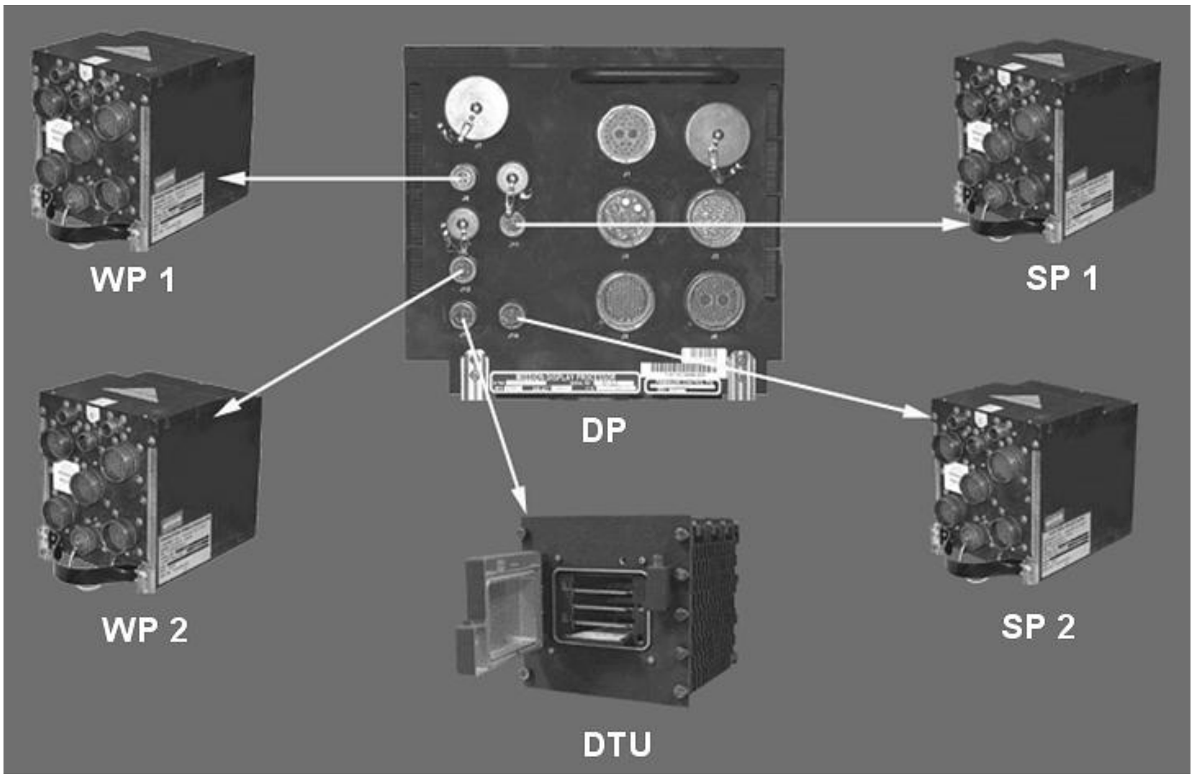


Figure 81. Display Processor Interconnect 1.

a. DP

(1) The DP provides the interconnect circuitry (Hub) for the FCDB used to connect the aircraft's primary processors in the arbitrated loop. The loop is actually being created inside the DP and controlled by General Purpose Processor (GPP) A.

(2) The DPs also provide a point-to-point fibre channel link with the DTU. The point-to-point fibre channel links are independent to each DP from the DTU and are controlled by GPP B.

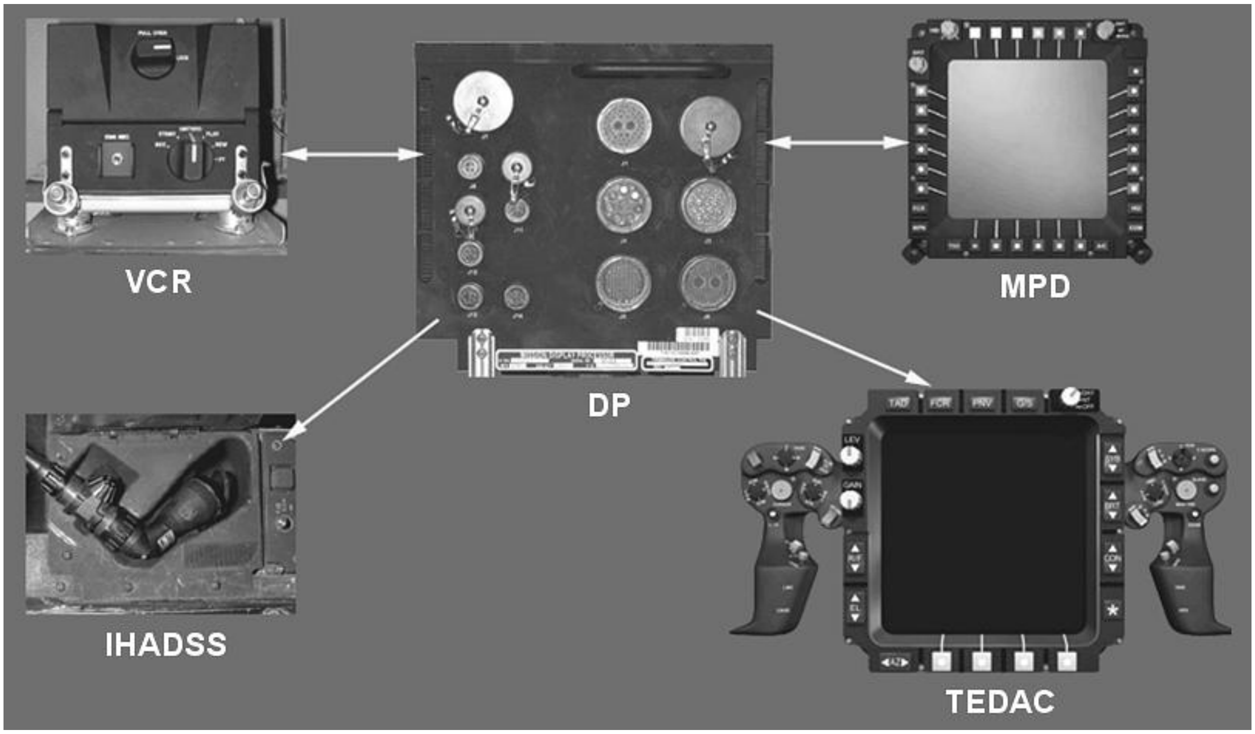


Figure 82. Display Processor Interconnect 2.

(3) The DP processes and distributes symbology and video to the MPDs, TEDAC, and Integrated Helmet And Display Sight System (IHADSS).

(4) The DP also receives and transmits video, symbology, and control signals to and from the VCR for VCR operation.

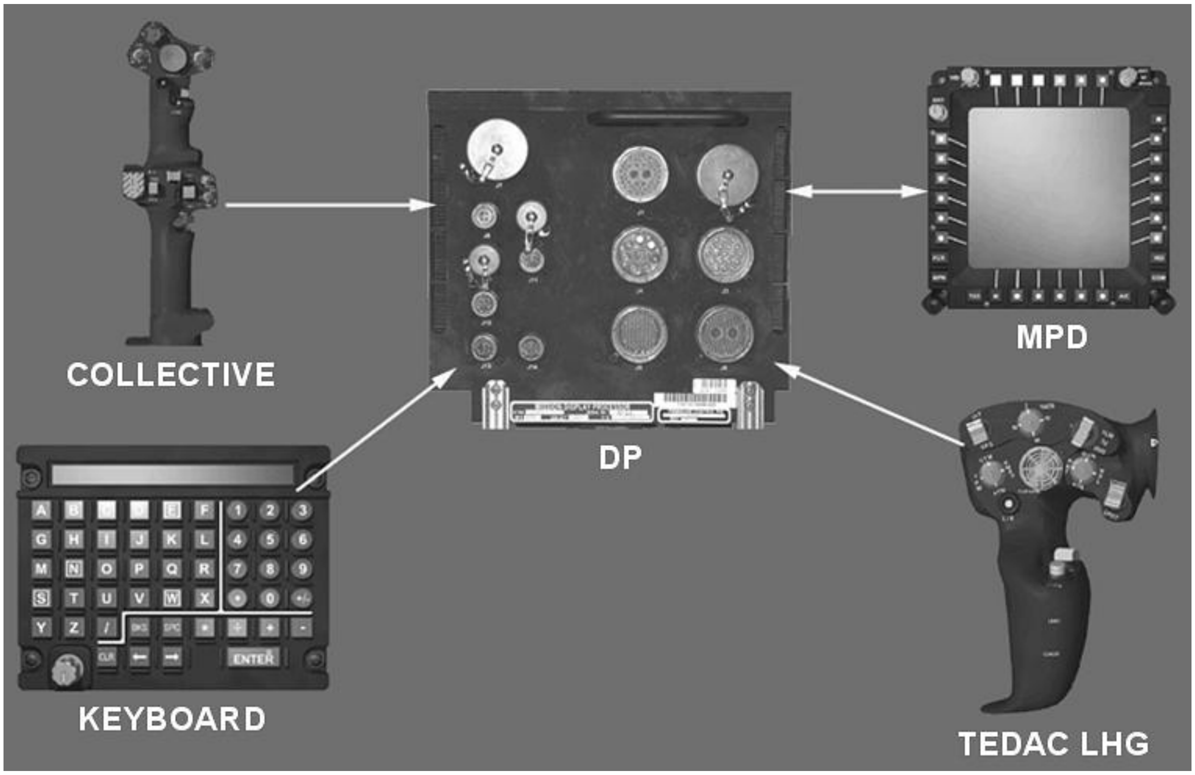


Figure 83. Display Processor Interconnect 3.

(5) The DP receives and processes inputs from the KUs, MPD bezel buttons, and cursor thumb controllers on the collective and TEDAC left-hand grip.

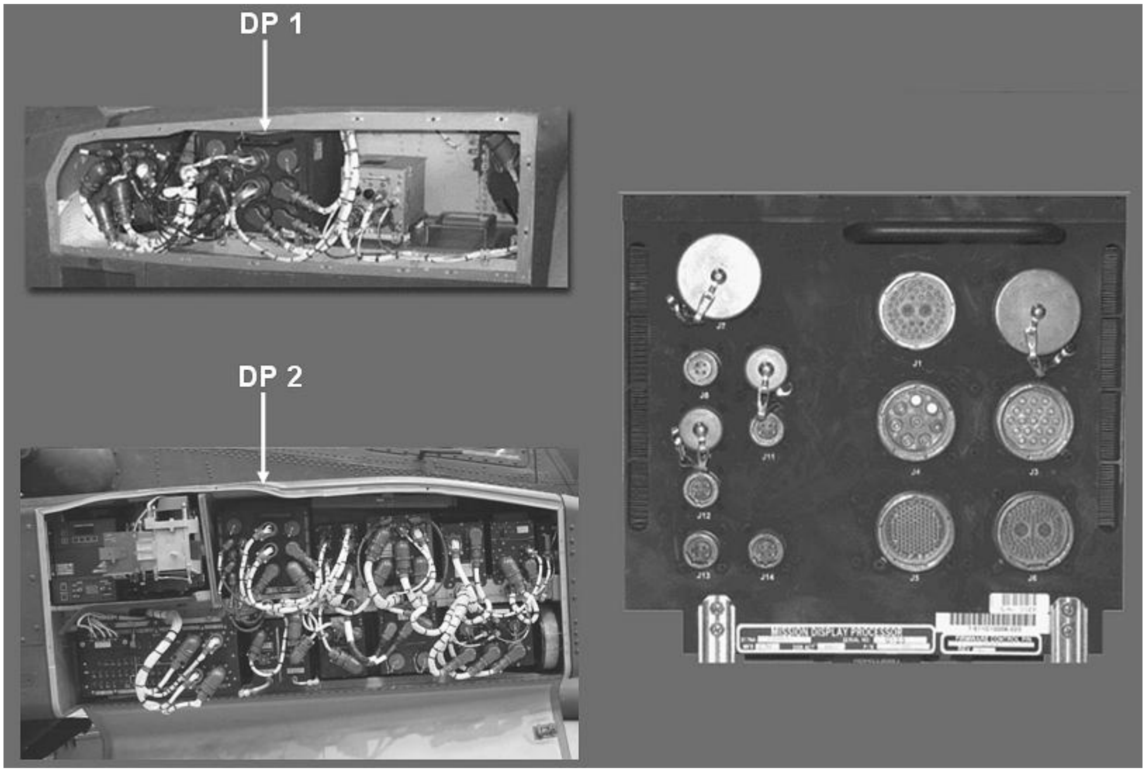


Figure 84. Display Processor.

(a) DP1 is in the LH EFAB behind door 5L86.

(b) DP2 is in the RH EFAB behind door 5R86.

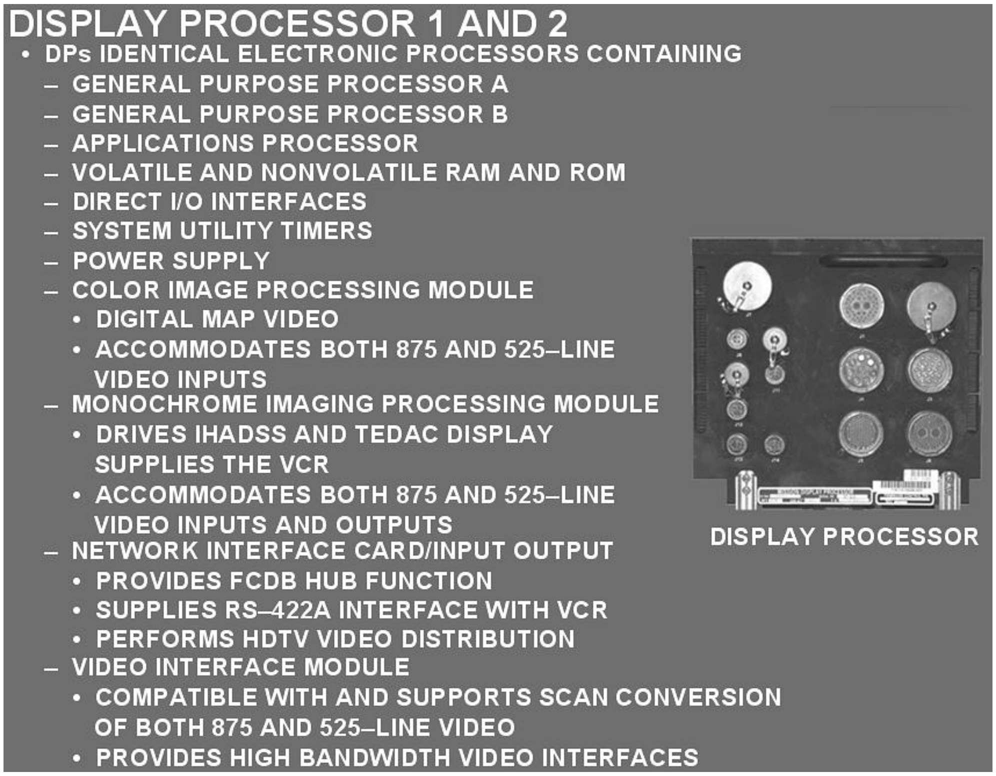


Figure 85. Display Processor Description.

(c) The DP is an electronic processor containing:

1) Applications processor

2) Volatile and nonvolatile RAM and ROM

3) Direct I/O interfaces

4) System utility timers

5) Power supply

6) General Purpose Processors (provides MUX bus and FC interfaces)

7) Color Image Processing Module (CIPM)

a) Generates digital map video for presentation on the MPDs

b) Accommodates the legacy analog RS-343A 875-line video inputs and the new RS-170A 525-line video inputs Monochrome Imaging Processing Module (MIPM)

c) Drives the IHADSS displays, TEDAC display, and supplies the VCR video

d) Handles the legacy RS-343A 875-line video inputs and outputs as well as the new RS-170A 525-line video inputs and outputs

8) Network Interface Card/Input Output (NICIO) module

a) Provides the FCDB hub function for the DP that includes five inter-processor network ports (four utilized, one spare) and one dedicated point-to-point interface port with the DTU

b) Supplies an additional RS-422A interface with the V-80 VCR for remote control and status monitoring

c) Performs the High Definition Television (HDTV) video distribution to all of the Imaging Processing Modules (IPM)

9) Video Interface Module (VIM)

a) Compatible with both 875-line and 525-line video for presentation on the MPDs

b) Supports scan conversion of both 875-line video to 525-line video for VCR recording

c) Supports scan conversion from 525-line video to 875-line video for presentation of VCR playback video on the TEDAC

d) Provides MIL-STD-1760A high bandwidth wing-tip, pylon, and Unmanned Aerial Vehicle (UAV) video interfaces

(d) Both DPs are identical units.

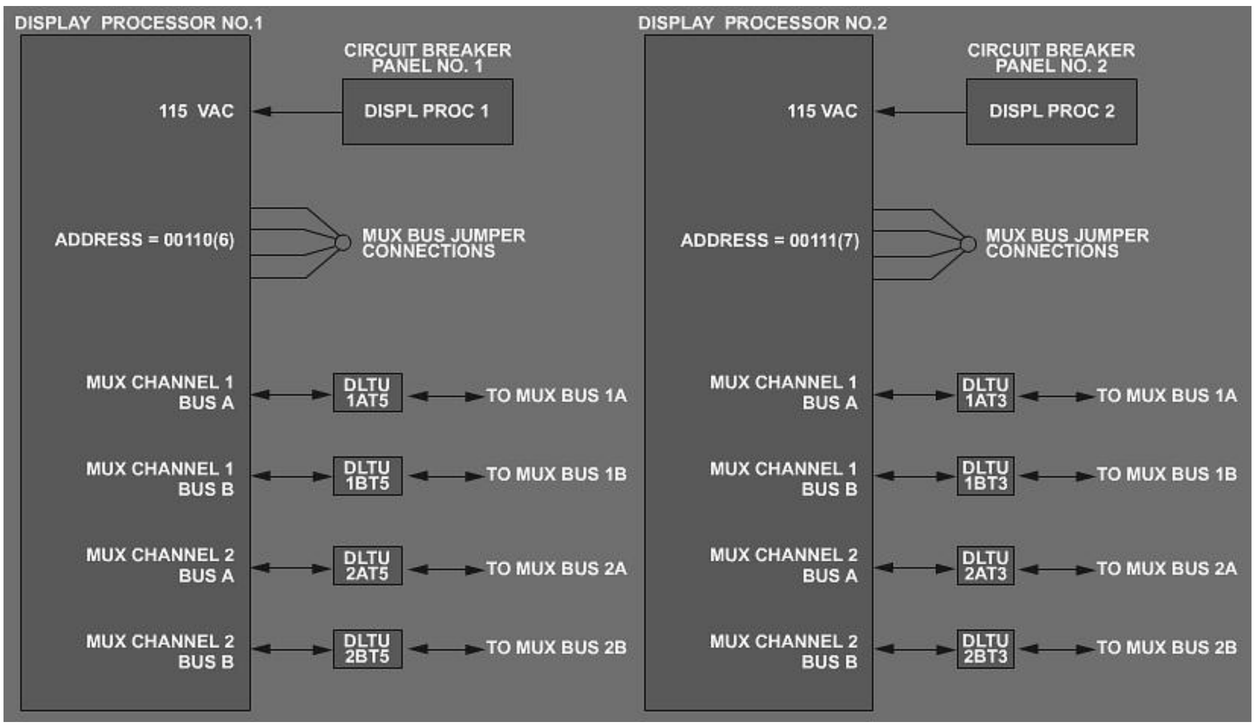


Figure 86. Display Processor Interface 1.

b. DP power and MUX bus interface

(1) 115 Vac three-phase power to DP1 is provided by DISPL PROC 1 circuit breaker on CBP1.

(2) 115 Vac three-phase power to DP2 is provided by DISPL PROC 2 circuit breaker on CBP2.

(3) Jumper connections for MUX bus terminal address selection and configuration code

(4) DP1 is connected to the MUX bus through the following:

(a) Channel 1

1) Bus A via DLTU 1AT5

2) Bus B via DLTU 1BT5

(b) Channel 2

1) Bus A via DLTU 2AT5

2) Bus B via DLTU 2BT5

(5) DP2 is connected to the MUX bus through the following:

(a) Channel 1

1) Bus A via DLTU 1AT3

2) Bus B via DLTU 1BT3

(b) Channel 2

1) Bus A via DLTU 2AT3

2) Bus B via DLTU 2BT3

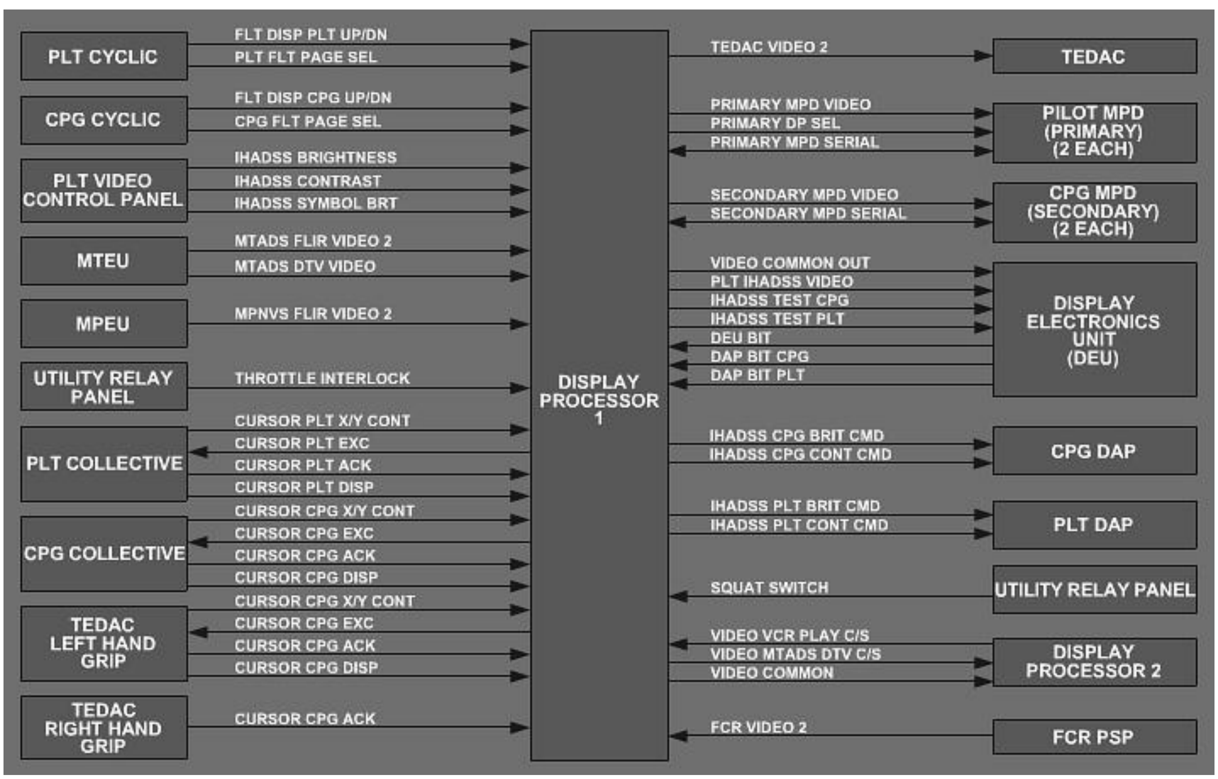


Figure 87. Display Processor Interface 2.

(6) DP1 interfaces with

(a) Pilot and CPG cyclic grips for flight symbology selection

(b) Pilot Video Control Panel (VCP) for the following:

1) IHADSS brightness

2) IHADSS contrast

(c) IHADSS symbol brightness Modernized TADS Electronic Unit (MTEU) for the following:

1) Modernized Target Acquisition and Designation Sight (MTADS) Forward Looking Infrared (FLIR) video

2) TADS TV video

(d) Modernized Pilot Night Vision System (MPNVS) Modernized PNVS Electronic Unit (MPEU) for PNVS FLIR video

(e) POWER quadrant for throttle off/stop position

(f) Pilot and CPG collective mission control grip for:

1) 10 Vdc excitation for the cursor thumb controller

2) Cursor thumb controller X and Y position signals

3) Cursor acknowledgement

4) Cursor left/right display selection

(g) TEDAC left-hand grip for the following:

1) 10 Vdc excitation for the cursor thumb controller

2) Cursor thumb controller X and Y position signals

3) Cursor CPG acknowledgement

4) Cursor CPG left/right display selection

(h) TEDAC right-hand grip for cursor acknowledgement

(i) CPG TEDAC for TEDAC video output

(j) CPG MPD for the following:

1) Primary MPD video

2) Primary MPD selection

3) RS422 serial data

(k) Pilot MPD for the following:

1) Secondary MPD video

2) RS422 serial data

(l) Display Electronics Unit (DEU) for the following:

1) CPG IHADSS video

2) Pilot and CPG test commands to provide grayscale test patterns on the HDUs

3) Common video select command

4) BIT monitoring for the following:

a) DEU

b) CPG Display Adjust Panel (DAP)

c) Pilot DAP

(m) Pilot and CPG DAP for the following:

1) IHADSS brightness command

2) IHADSS contrast command

(n) Utility Relay Panel for Squat switch position

(o) DP2 for the following:

1) VCR video input (Play)

2) TADS TV video output

3) Video common (for IHADSS single DP operation)

(p) FCR PSP for video input

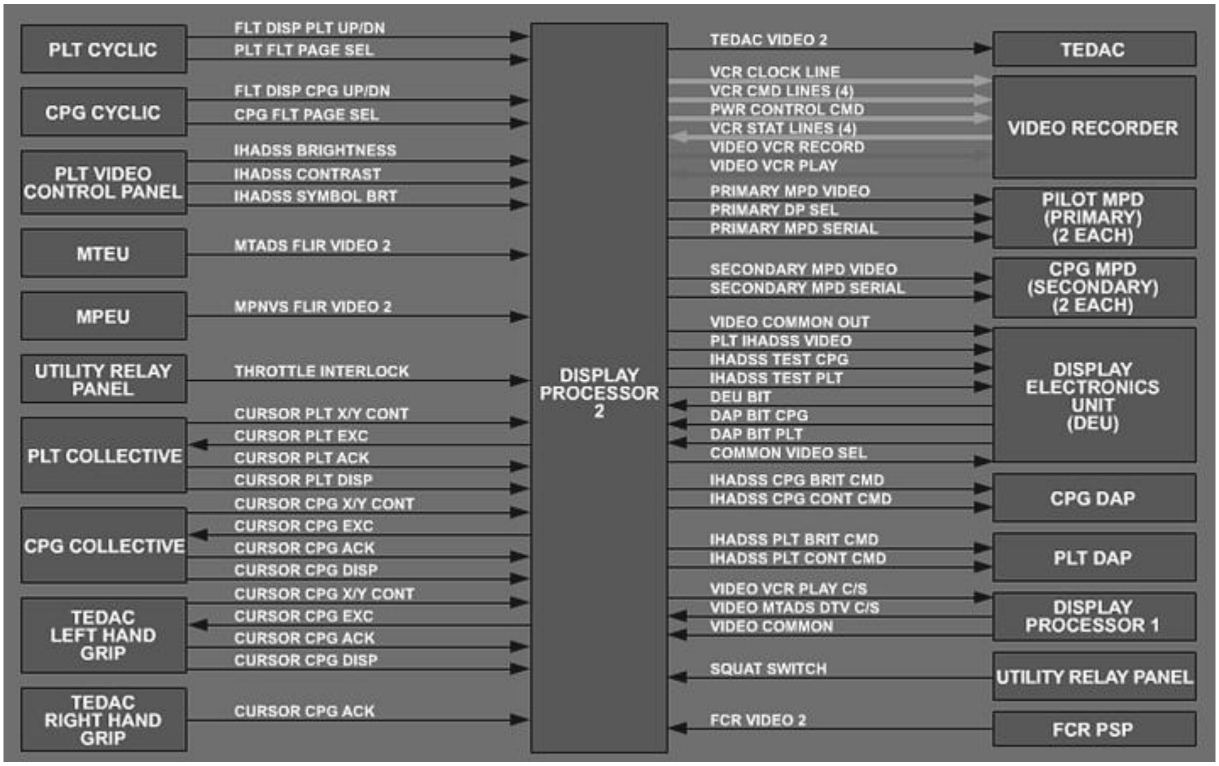


Figure 88. Display Processor Interface 3.

(7) DP2 interfaces with the following:

(a) Pilot and CPG cyclic grips for flight symbology selection

(b) VCP for:

1) IHADSS brightness

2) IHADSS contrast

3) IHADSS symbol brightness

(c) TEU for TADS FLIR video

(d) PEU for PNVS FLIR video

(e) POWER quadrant for throttle off/stop position

(f) Pilot and CPG collective mission control grip for the following:

1) 10 Vdc excitation for the cursor thumb controller

2) Cursor thumb controller X and Y position signals

3) Cursor acknowledgement

4) Cursor left/right display selection

(g) TEDAC left-hand grip for the following:

1) 10 Vdc excitation for the cursor thumb controller

2) Cursor thumb controller X and Y position signals

3) Cursor CPG acknowledgement

4) Cursor CPG left/right display selection

(h) TEDAC right-hand grip for cursor acknowledgement

(i) CPG TEDAC for TEDAC video output

(j) VCR for the following:

1) VCR power control

2) Video command/status line for:

a) Monitoring VCR status

b) Setting VCR commands

3) Video out (Record)

4) Video in (Play)

(k) Pilot MPD for the following:

1) Primary MPD video

2) Primary MPD selection

3) RS422 serial data

(l) CPG MPD for the following:

1) Secondary MPD video

2) RS422 serial data

(m) DEU for the following:

1) Common video output

2) Pilot IHADSS video

3) Pilot and CPG test commands to provide gray scale test patterns on the HDUs

4) BIT monitoring for:

a) DEU

b) CPG DAP

c) Pilot DAP

5) Common video select command

(n) Pilot and CPG DAP for the following:

1) IHADSS brightness command

2) IHADSS contrast command

(o) DP1 for the following:

1) VCR video output (Play)

2) TADS TV video input

3) IHADSS common video input (Single DP operation only)

(p) Utility Relay Panel for Squat switch position

(q) FCR PSP for video input

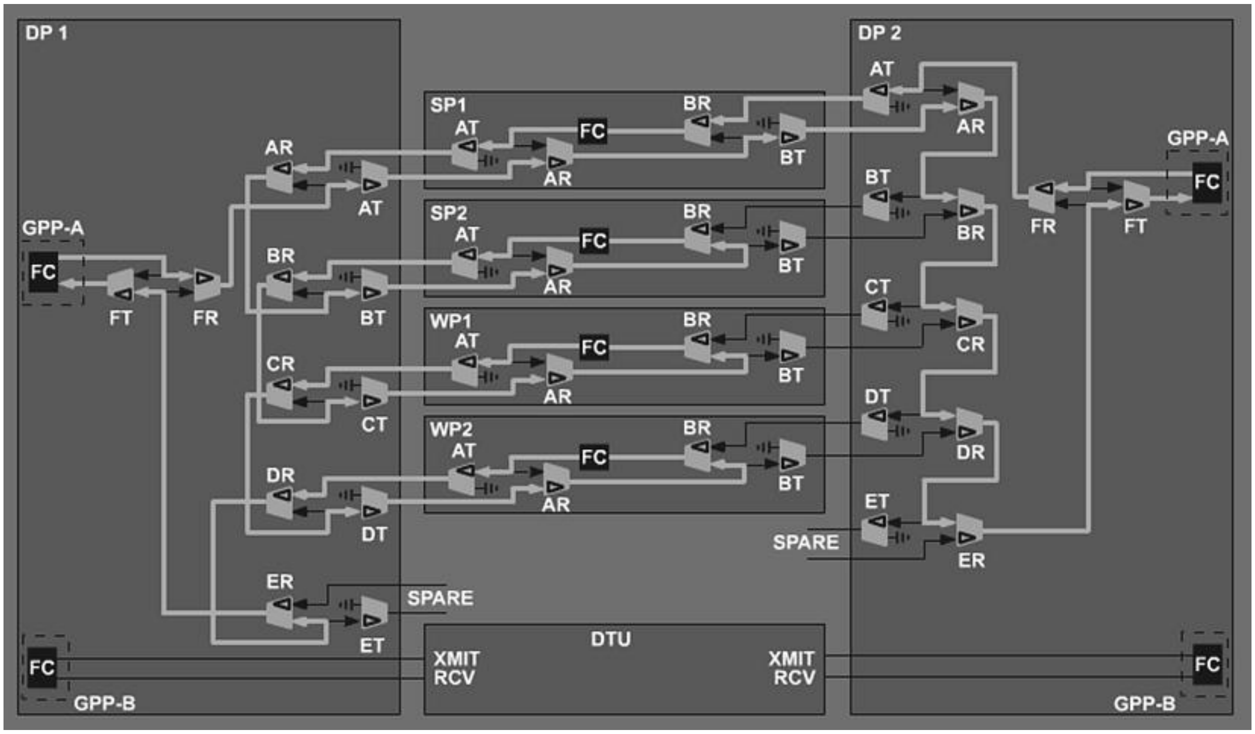


Figure 89. Display Processor FCDB Interface.

c. DP FCDB interface

(1) The DPs provide an interface for the FCL, independently connecting each of the processors in the loop directly to the DP internal hub. The following connections on the DP are used to interface with the other components on the FCL:

(a) J8 provides the FCL interface with WP1.

(b) J11 provides the FCL interface with SP1.

(c) J12 provides the FCL interface with WP2.

(d) J14 provides the FCL interface with SP2.

(2) The DP J13 connector also provides the point-to-point FC interface with the DTU.

(3) The FCDB connection between the DPs, and the SPs and WPs is used to transfer mission and map data.

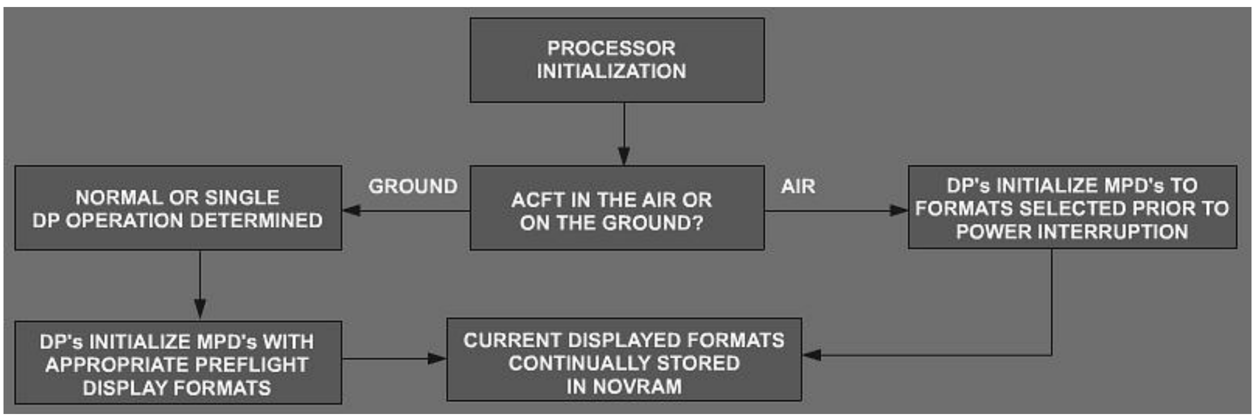


Figure 90. Display Processor Operation 1.

d. DP operation

(1) Display selection

Displays may be selected manually by the crew or automatically by the DP and SP, based on power-up initialization, failures, etc. The following display selections are dependent on Squat switch position (ACFT on the ground or ACFT in the air):

(a) On-ground power-up video display selection:

1) DP determines if it is under Normal DP operation or under Single DP operation.

2) The DPs initialize the MPDs with preflight display formats configured for the mode of operation (Normal or Single DP operation).

(b) In-air power-up video display selection:

1) If power is interrupted during in-flight operations, the DPs initialize the displays to the formats selected prior to the interrupt.

2) The DPs continually update the current display selections for each display in Non-Volatile Randomly Accessed Memory (NOVRAM).

3) When power is restored and the DP determines the aircraft is in the air, the DP uses the stored display information to initialize the displays.

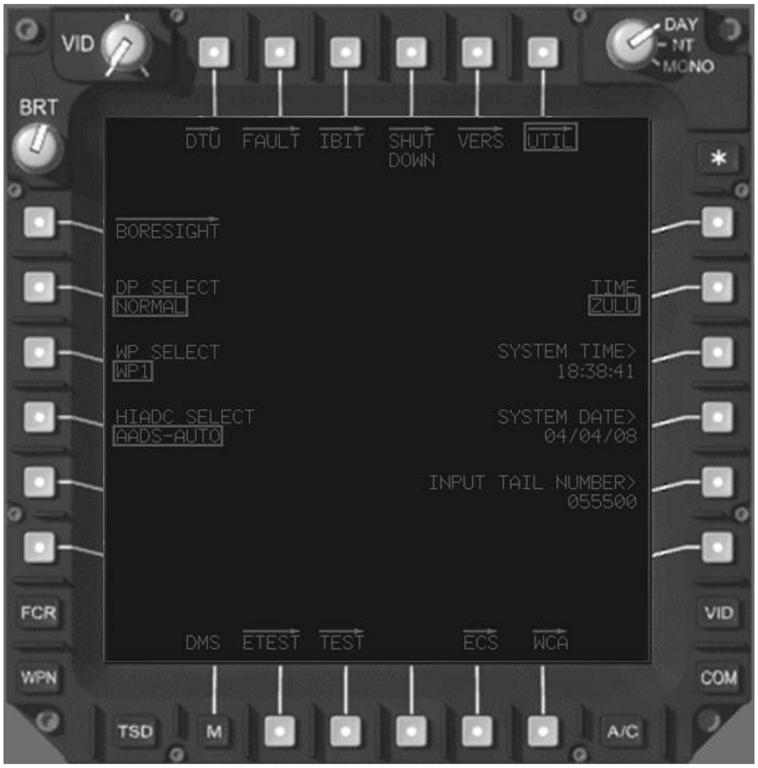


Figure 91. Format Selection 1.

(2) Format selection

Format selection can be automatically accomplished by the SP or operator-controlled by the crewmember.

(a) System-automated format selection

1) In critical situations (warning conditions, caution advisories, etc.), the controls and displays subsystems can automatically select the display format for the operator.

2) Changes in the DP operational state (Normal operation to Single DP operation) initiate an automatic change in display format to the MPD. These display changes are discussed in the following MPD section.

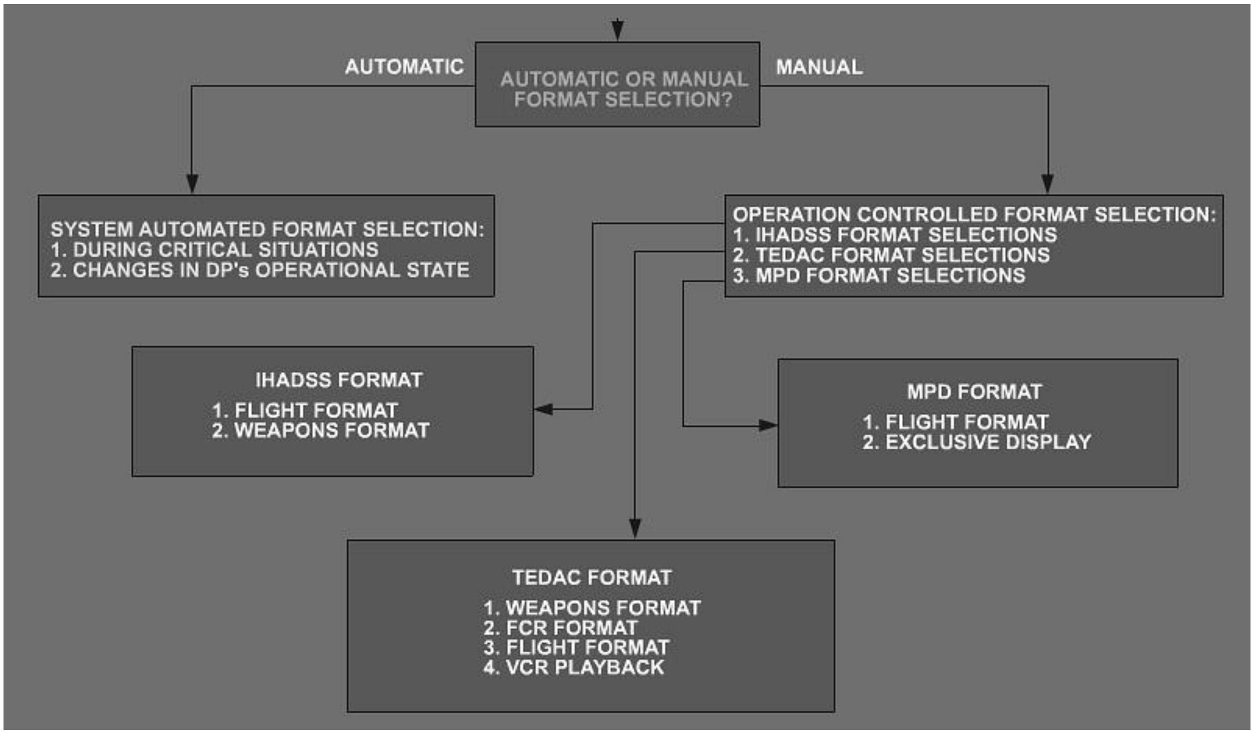


Figure 92. Format Selection 2.

(b) Operator-controlled format selection

The crewmember can control the format presented on each IHADSS, TEDAC, and MPD.

1) IHADSS format selection

a) Flight format

b) Weapons format

2) TEDAC format selection

a) Weapons format

b) FCR format

c) Flight formats

d) No format (during VCR playback to the TEDAC)

3) MPD format selection

a) Flight (FLT) format provides selections that are controlled between the two DPs.

b) Exclusive display selections viewed by both crewmembers but controlled by either crewmember:

1 Waypoint display

2 Route display

3 Update display

4 Target/threat display

5 Comm preset display

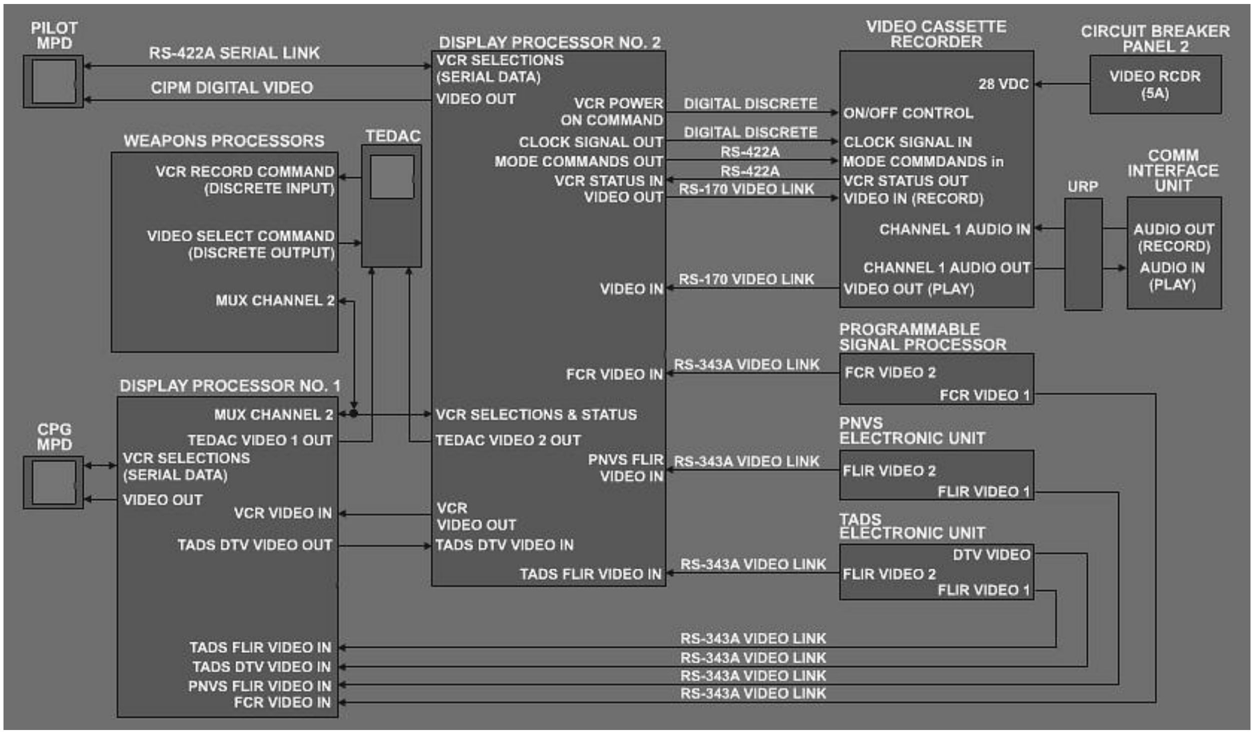


Figure 93. Display Processor Operation 2.

(3) After processor and display initialization is completed, the DP performs the following operations:

(a) Transmits and receives requests and data via RS-422 serial data, RS-343 video data links, and RS-170 video data links. VCR operational and mode commands are an example of this type of data transfer. The following is a typical operation involving recording TADS video to the VCR.

1) After initialization of the DPs, DP2 commands the VCR to power-on (VCR defaults on) via the VCR power control digital discrete and issues a record standby command via serial data link.

2) Selections for recording video are selected on the VCR page of the MPD or via the TEDAC. All CPG selections are sent from DP1 to DP2 via MUX bus channel 2.

3) VCR RECORD and TADS RECORD selections are transmitted from the MPD to the DP via serial data link.

4) Upon receipt of the command, DP2 commands the VCR to the record mode via serial data link. DP2 reports the recorder status to DP1 via MUX bus message.

5) The TADS video input to the DP is the video of the selected sensor (DTV or FLIR) from the TEU via video link.

6) DP2 routes the TADS video to the VCR via video link.

7) DP2 will continuously report to DP1 the operational state of the recorder. When RECORD is deselected on the MPD, DP2 will command the VCR to stop recording and report the status to DP1.

8) All status information reported to DP1 is transmitted to the CPG MPD via serial link for display on the VCR page.

(b) Issues and receives data and commands to/from the primary SP and WP via the MUX bus. Examples of this type of operation would be Navigation and Communications System selections and weapons inventory information.

(c) Receives, if the primary DP, selections, data, and status from the secondary DP for transmittal to the SP

(d) Transmits and receives data from subsystems connected to MUX bus channels 1 and 2. Inertial data from the INU and receiver tracking file information from the Radar Warning Receiver (RWR) are examples of this type of message communication via the MUX bus.

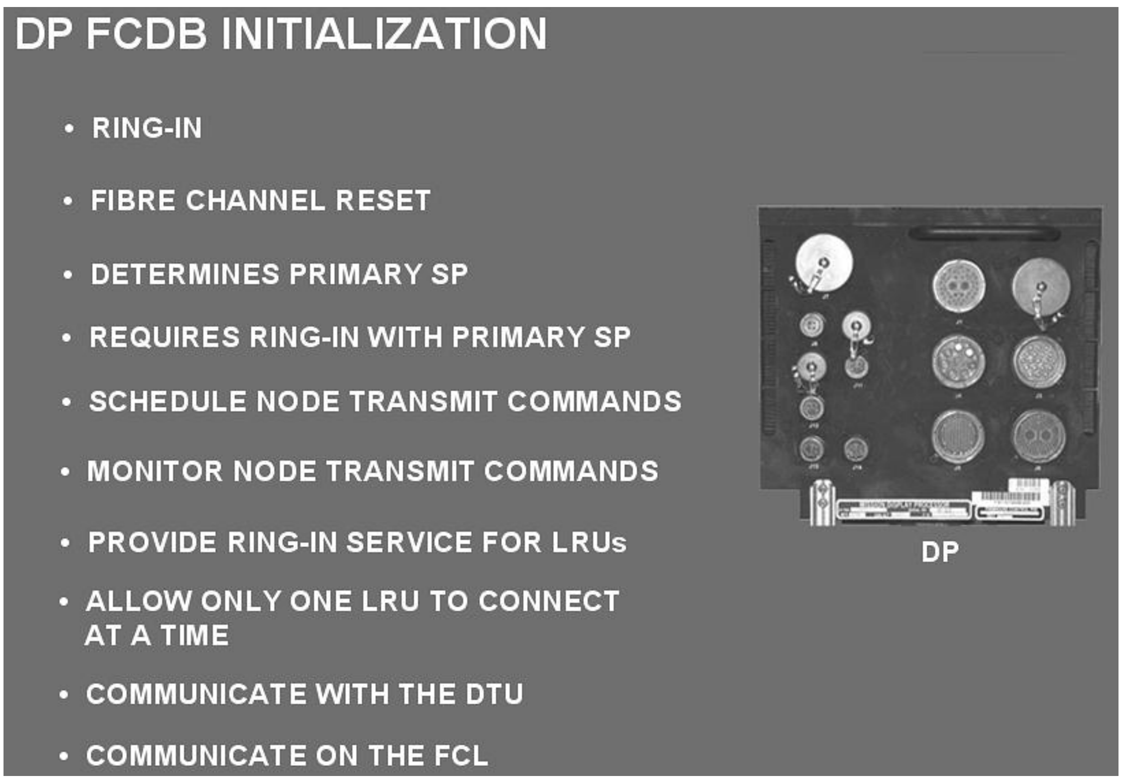


Figure 94. Display Processor FCDB Operation.

(4) DP FCDB operation

(a) DP ring-in service operation

The DP will:

1) Complete a fibre channel reset

2) Monitor 1553 MUX bus to determine primary SP

3) Require ring-in with the primary SP

4) Monitor node transmit commands sent by primary SP

5) Provide ring-in service for LRUs associated with each node transmit command

6) Allow only one LRU to connect to the loop at any one time

7) Connect and communicate with the DTU

8) Assume communication on the FCL

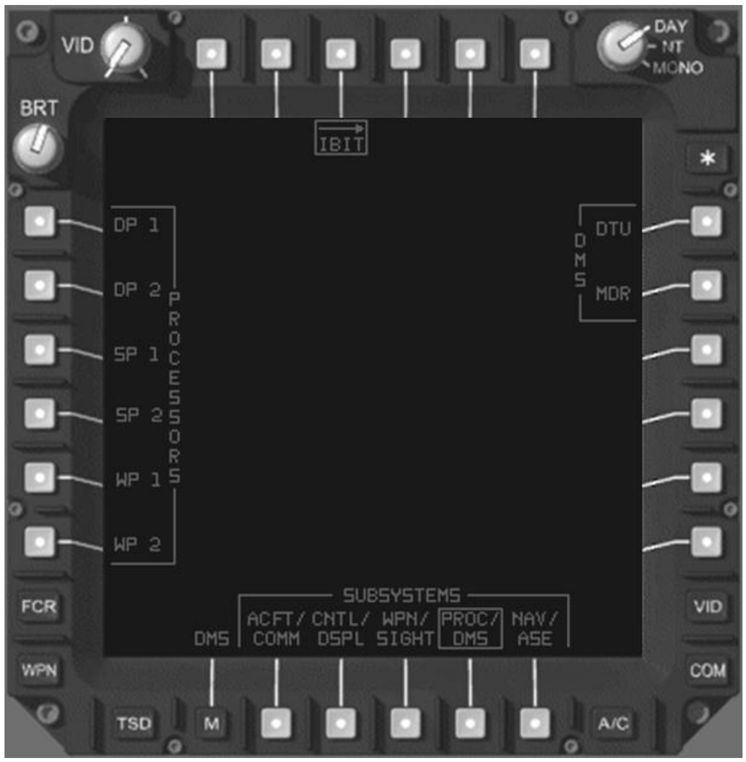


Figure 95. Display Processor IBIT Initialization.

(5) CBIT

(a) CBIT provides for continuous monitoring of the DP internal operation.

(b) Both DPs perform a CBIT, except for direct output testing.

(6) IBIT

(a) The crewmember selects either the DP1 (L1) or DP2 (L2) IBIT button on the MPD DISPLAYS/PROCESSORS IBIT page to initiate the IBIT.

(b) The SP commands the selected DP to perform an IBIT.

(c) Normal DP operation

1) Primary SP commands the DP that is not performing IBIT to Normal Primary, and the DP that is performing the IBIT to Normal Secondary.

2) When testing is complete, the SP leaves the DPs in the normal and secondary states, as tested, until a failure or another test occurs.

(d) Single DP operation

The SP commands the DP to perform an IBIT but does not change its operational state until testing is completed.

(e) Detected faults are displayed on the DP IBIT screen.

(f) The crewmember may abort the IBIT at any time by selecting ABORT. If the test is aborted, faults detected are not displayed.

CHECK ON LEARNING

1. The DP processes and distributes symbology and video to the MPDs, TEDAC, and ____.

2. To perform an IBIT on the DPs, the operator must select the IBIT button from the ____ page.

L. Enabling Learning Objective 12

After this lesson, you (the student) will:

ACTION: State the purpose and location of the Weapons Processor (WP) and its interface with system and subsystem components.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose and location of the Weapons Processor (WP) and its interface with system and subsystem components.

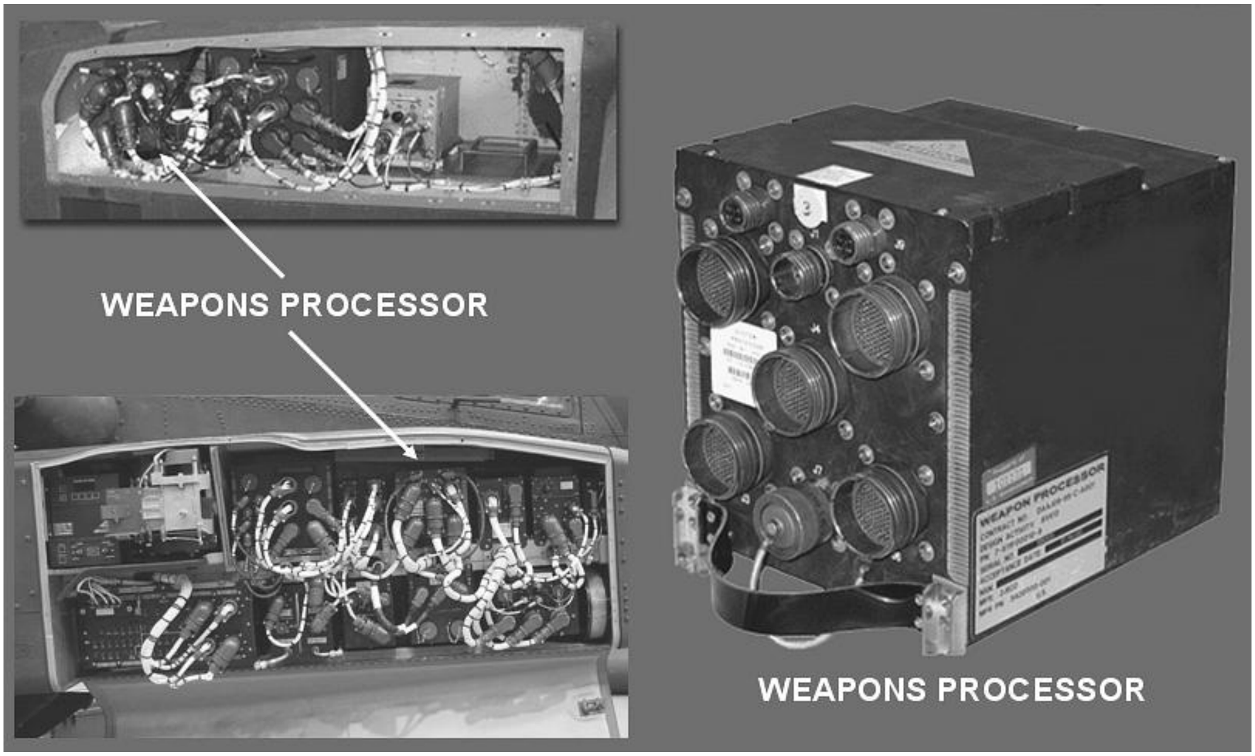


Figure 96. Weapons Processor.

a. WP

(1) WP1 is located in the LH EFAB.

(2) WP2 is located in the RH EFAB.

Figure 97. Weapons Processor Description 1.

(3) When functioning as the primary WP, WP1:

(a) Manages the Weapons and Sighting Systems

(b) Functions as the BC for MUX bus channel No. 3

(c) Performs as an RT and monitor for MUX bus channel 2

Figure 98. Weapons Processor Description 2.

(4) The primary WP will receive and process all DTU data from the processor fibre channel bus.

(5) The primary WP provides control of the following DMS functions:

(a) Receives DTU data from the display processors on the FCDB.

(b) Commands all system/subsystem IBIT on MUX bus channel 3.

(c) Receives all MUX channel 3 BIT results.

(d) Commands all system/subsystem IBIT connected to the WP I/O.

(e) Transmits all MUX channel 3 BIT results to the system processor over MUX bus channel 2.

(f) Receives all MUX channel 3 subsystem mode selections from the system processor over MUX bus channel 2.

(g) Retransmits selected data from MUX channel 3 to channel 2 for MDR storage.

(h) Performs weapon initialization, selection, inventory, moding, positioning, and firing for all aircraft weapons.

(i) Processes Sighting System sight selections, acquisition selections, sensor slaving, and calculations in support of fire control solutions.

(j) When not functioning as the primary WP

1) Performs as an RT and monitor for MUX bus channels 2 and 3.

2) Monitors primary WP functions and, when commanded by the SP, performs as the primary WP

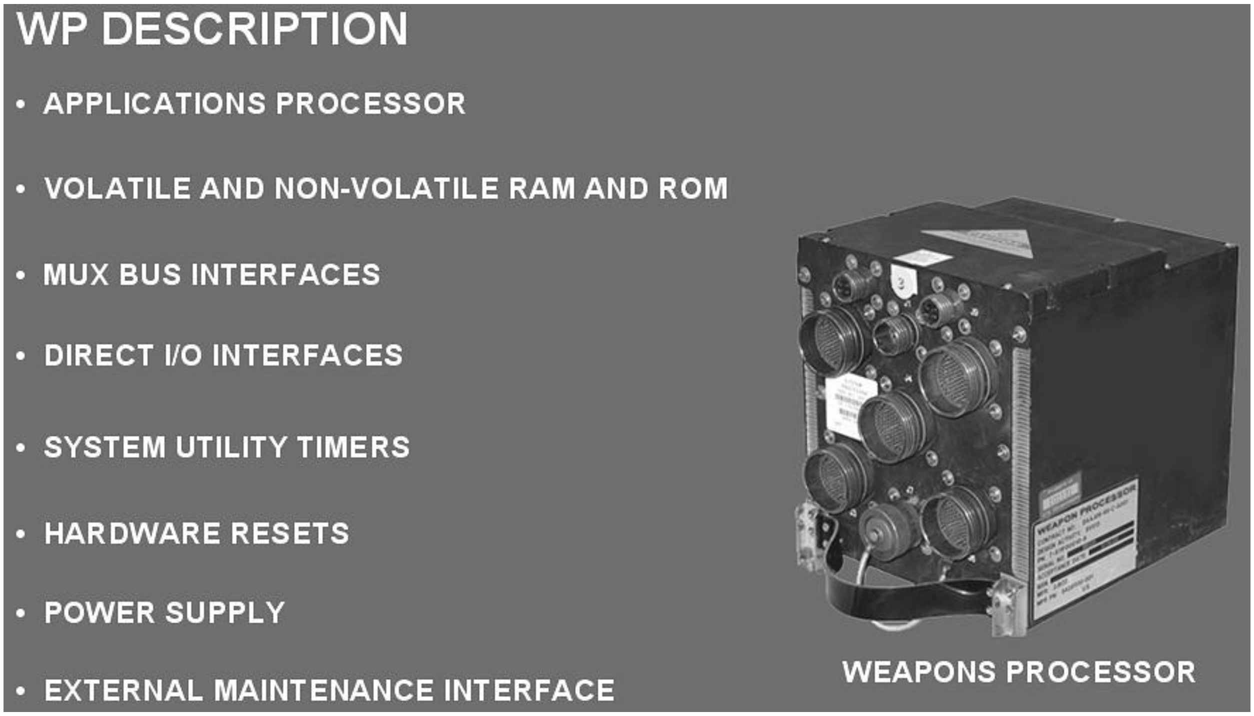


Figure 99. Weapons Processor Description 3.

(6) The WP contains:

(a) Applications processor

(b) Volatile and nonvolatile RAM and ROM

(c) MUX bus interfaces

(d) Direct I/O interfaces

(e) System utility timers

(f) Hardware resets

(g) Power supply

(h) External maintenance interface

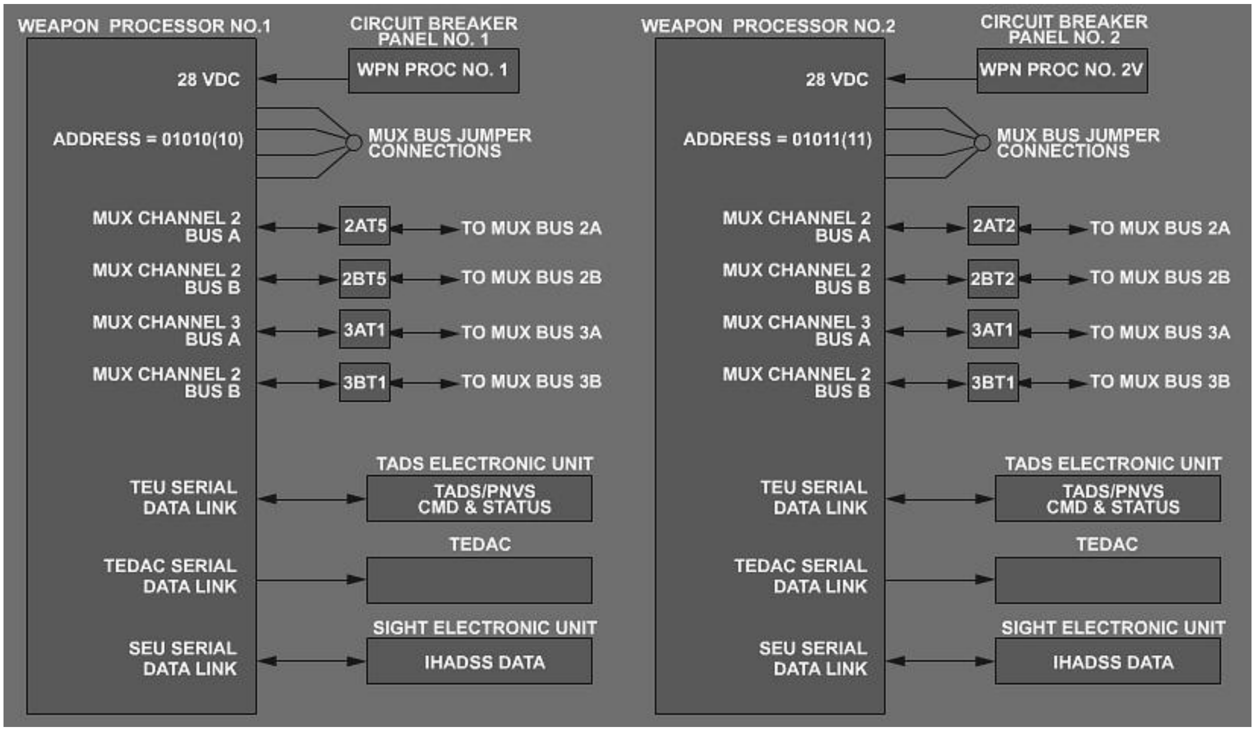


Figure 100. Weapons Processor Interface.

b. WP interface

(1) 28 Vdc power to WP1 is provided by CBP1 WPN PROC #1 circuit breaker.

(2) 28 Vdc power to WP2 is provided by CBP2 WPN PROC #2 circuit breaker.

(3) Jumper connections for MUX bus terminal address selection and configuration code.

(a) WP1 address is 01010 (10)

(b) WP2 address is 01011 (11)

(4) WP1 is connected to the MUX bus as follows:

(a) Channel 2

1) Bus A via DLTU 2A5T

2) Bus B via DLTU 2B5T

(b) Channel 3

1) Bus A via DLTU 3AT1

2) Bus B via DLTU 3BT1

(5) WP2 is connected to the MUX bus as follows:

(a) Channel 2

1) Bus A via DLTU 2AT2

2) Bus B via DLTU 2BT2

(b) Channel 3

1) Bus A via DLTU 3AT1

2) Bus B via DLTU 3BT1

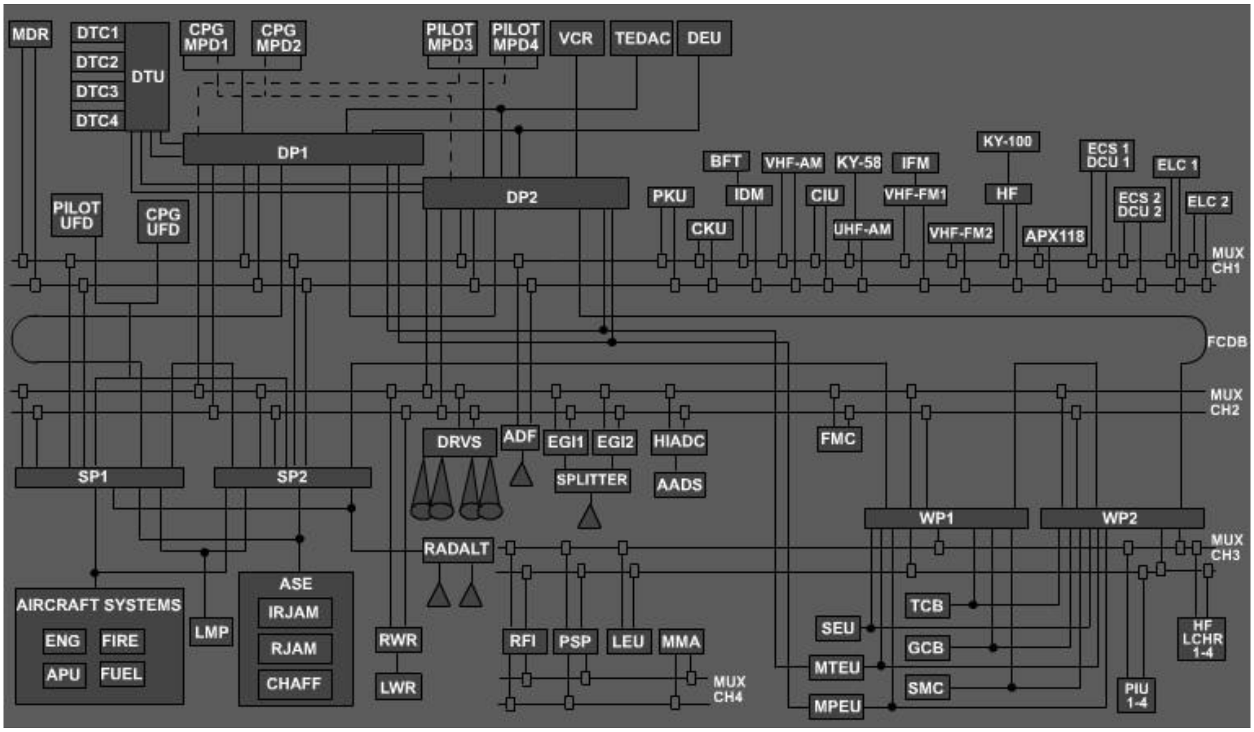


Figure 101. Weapons Processor Interface 1.

(6) The MUX bus system provides the primary interface between the WP and:

(a) DP interface

1) Interpretation of crew selections via the MPD, KU, and crewstation cursor controls

2) Transmittal of crew selections to the WP via RT to RT MUX bus transfers

3) Display of Weapons and Sighting System status received from the WP

(b) SP interface

1) Crew selections and Squat switch indications.

2) Controlling of weapon primary and arm power based on crewmember arm/safe status and weapon power requests from the WP.

3) Performing fault detection/isolation operations to control redundancy and back-up modes

4) Receiving LMP data consisting of weapon load selections

5) Transferring rounds count data from the WP to the LMP

(c) PIUs 1 through 4 for:

1) Providing the means of interfacing the Weapons System to the weapons launchers

2) Monitoring and transmitting pylon actuator position signals

(d) M299 launcher (Hellfire)

Each pylon contains one CLASS II interface, which operates as an RT to the WP.

(e) FMC

1) Provides aircraft position, attitude, rates, and accelerations to the WP for use in ballistic and weapons constraint calculations

2) Provides air temperature, pressure, speed, and direction to the WP for use in ballistic and weapons constraint (air-to-air only) calculations

(f) FCR

1) PSP – Combines information received from the LPRF and the RFI to detect, classify and prioritize targets. This target information is sent to the WP.

2) RFI – When the FCR is failed, the RFI sends emitter information to and receives control signals from the WP.

3) The secondary WP continuously receives primary WP status information to be used in the event the primary WP fails.

(g) There are RS-422 serial link interfaces between the WP and:

1) TEU

The TEU is a bidirectional serial interface used for communicating TADS/PNVS status and commands to and from the WP.

2) TEDAC

TEDAC is a unidirectional serial interface for communicating sight status and weapon status information from the WP.

3) Sight Electronic Unit (SEU)

SEU is a bidirectional serial interface for communicating IHADSS statuses and Line Of Sight (LOS) to/from the WP.

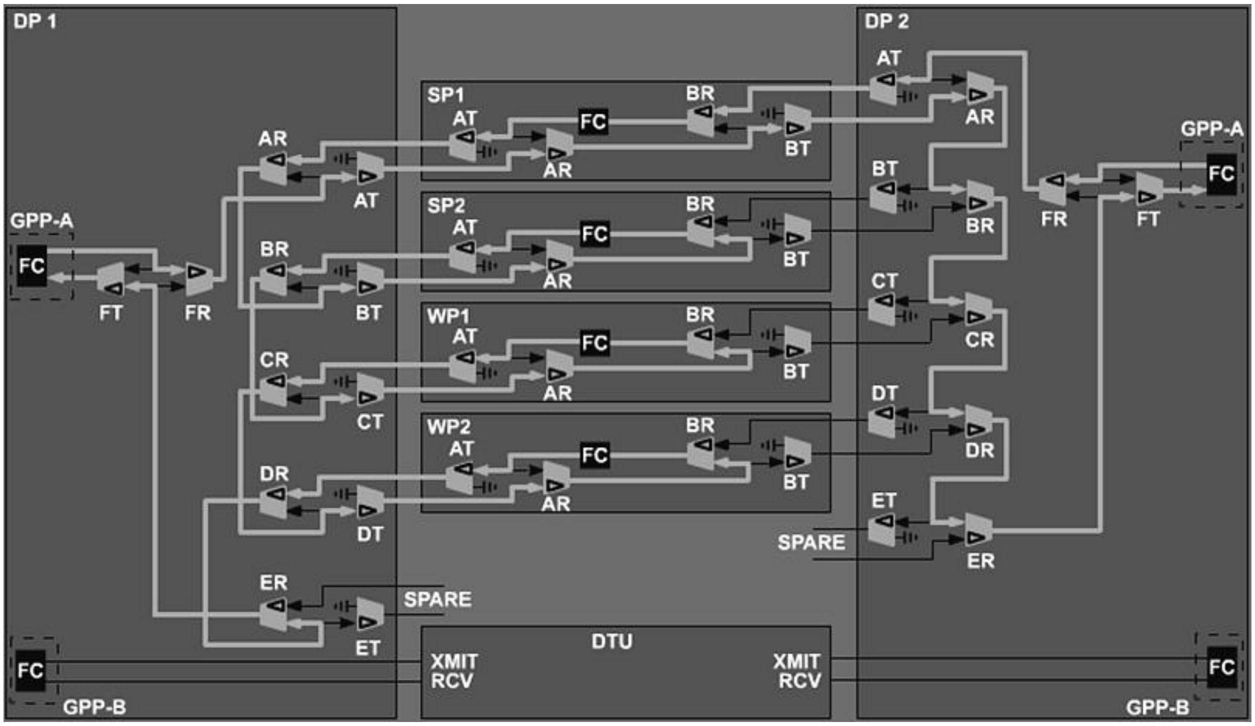


Figure 102. Weapons Processor FCDB Interface.

c. WP FCDB interface

(1) The WPs are also interfaced with the DPs and SPs via the FCL that is used to manage mission and communication data.

(2) The FCDB provides the primary interface between the WP and:

(a) DPs for display of weapon constraints symbology and sight cuing data based on status information received from the WP

(b) SPs providing waypoint target position information to the WP for weapons pointing

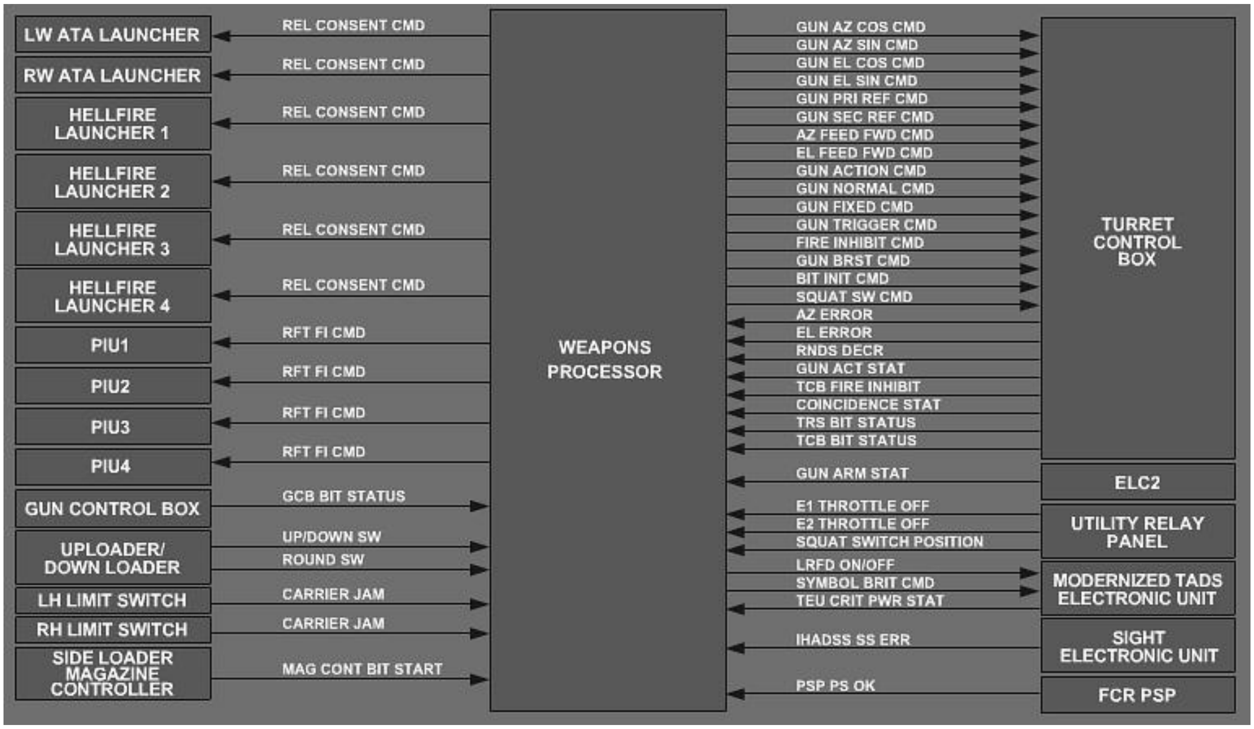


Figure 103. Weapons Processor Interface 2.

(c) There are discrete I/O interfaces between the WP and the following:

1) M299 Hellfire launchers 1 through 4 for REL (Release) CONSENT Command (CMD)

2) PIUs 1 through 4 for:

a) P1 through P4 RKT FI (Fire Interlock) CMD

b) P2 and P3 A-A (Air-to-Air) FI CMD

3) Gun Control Box (GCB) for GCB BIT STATUS

4) Uploader/downloader for:

a) LOADER UP/DOWN Switch (SW)

b) LOADER ROUNDS SW

5) Carrier tensioner assemblies limit switches for CARRIER JAM

6) Side-loader/Magazine Controller (SMC) for Magazine (MAG) CONT BIT Status STAT

7) URP for Squat switch relay position

8) Turret Control Box (TCB) for the following:

a) GUN AZ (Azimuth) COS CMD

b) GUN AZ SIN CMD

c) GUN EL (Elevation) COS CMD

d) GUN EL SIN CMD

e) GUN PRI REF CMD

f) GUN SEC REF CMD

g) AZ FEED Forward (FWD) CMD

h) EL FEED FWD CMD

i) GUN ACTION CMD

j) GUN NORMAL CMD

k) GUN FIXED CMD

l) GUN TRIGGER CMD

m) FIRE INHIBIT CMD

n) GUN BRST (Boresight) CMD

o) BIT INITIATE CMD

p) SQUAT SWITCH CMD

q) AZ ERROR

r) EL ERROR

s) RNDS DECREMENT

t) GUN ACTION STATUS

u) TCB FIRE INHIBIT

v) COINCIDENCE STAT

w) TRS (Train Rate Sensor) BIT STATUS

x) TCB BIT STATUS

9) ELC2 for GUN ARM STAT

10) Throttle quadrant for:

a) E1 (Engine No. 1) THROTTLE OFF

b) E2 (Engine No. 2) THROTTLE OFF

11) TEU for:

a) LRFD ON/OFF CMD

b) SYMBOL BRT CMD

c) TEU CRIT PWR STAT

d) SEU for IHADSS Sensor Surveying (SS) Error

e) PSP for Power Supply (PS) OK status

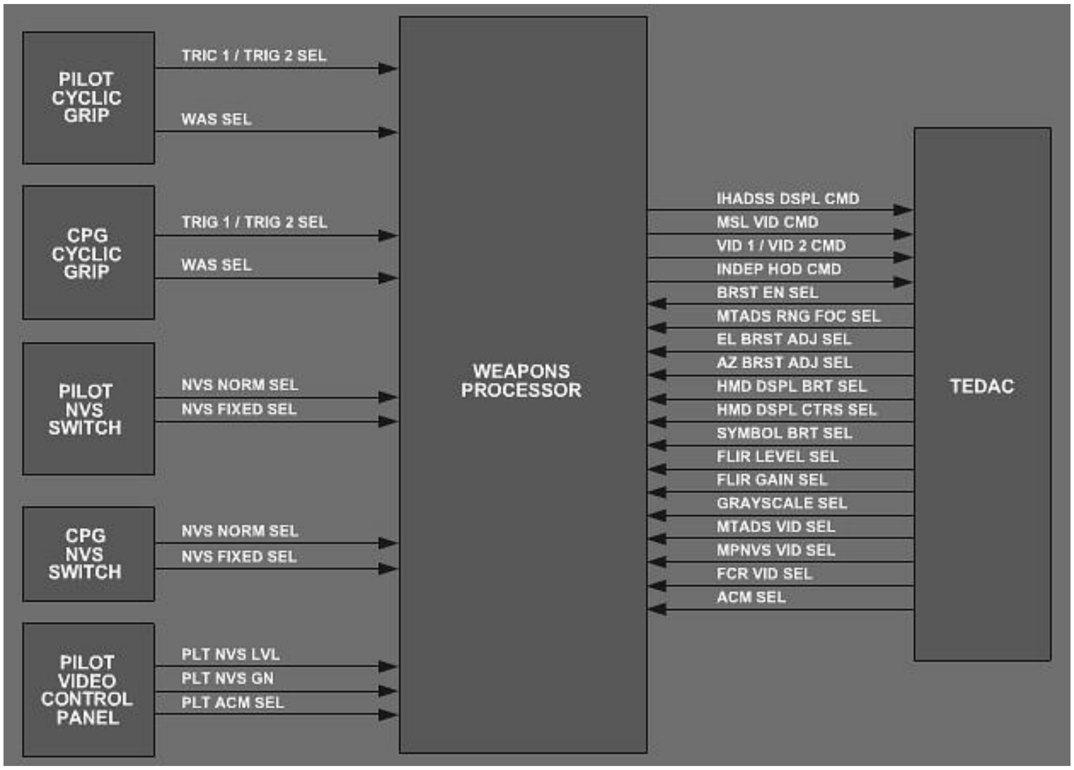


Figure 104. Weapons Processor Interface 3.

12) Pilot and CPG cyclic grips for the following:
   a) TRIG1/TRIG2 selection
   b) HF (Hellfire) Weapon Action Switch (WAS) selection
   c) GUN WAS selection
   d) RKT (Rocket) WAS selection
   e) ATA (Air-To-Air) WAS selection (Growth)
13) Pilot and CPG NVS switches for the following:
   a) NVS NORM selection
   b) NVS FIXED selection
14) Pilot VCP for the following:
   a) MPNVS LVL (Level)
   b) Pilot NVS GN (Gain)
   c) Pilot Automatic Control Mode (ACM) selection
15) TEDAC for the following:
   a) IHADSS Display (DSPL) CMD
   b) MSL VID (Missile Video) CMD
   c) VID1/VID2 CMD

d) INDEP (Independent) HOD (Head Out Display) CMD

e) BRST ENABLE SEL

f) MTADS RNG (Range) FOC (Focus) SEL

g) EL BRST ADJ (Adjust) SEL

h) HMD DSPL BRT SEL

i) HMD DSPL CTRS (Contrast) SEL

j) SYMBOL BRT SEL

k) FLIR LEVEL SEL

l) FLIR GAIN SEL

m) GRAYSCALE SEL

n) MTADS VID SEL

o) MPNVS VID SEL

p) FCR VID SEL

q) ACM SEL

16) TEDAC left-hand grip for the following:

a) TEDAC WPN (Weapon) TRIG1 SEL (1st Detent)

b) TEDAC WPN TRIG2 SEL (2nd Detent)

c) TEDAC HF WAS SEL

d) TEDAC GUN WAS SEL

e) TEDAC RKT WAS SEL

f) TEDAC A-A WAS SEL

g) FLIR SNSR (Sensor) SEL

h) DTV (Day TV) SNSR SEL

i) Image Auto Track (IAT)/MAN SEL

j) IAT OFFSET SEL

k) MTADS WFOV (Wide Field Of View) SEL

l) MTADS MFOV (Medium Field Of View) SEL

m) MTADS NFOV (Narrow Field Of View) SEL

n) MTADS ZFOV (Zoom Field Of View) SEL

o) Store (ST) Target (TGT) SEL

p) UPDATE TGT SEL

q) LMC (Linear Motion Compensation) ON/OFF SEL

r) Recorder (RCDR) ON/OFF SEL

s) C FCR 1SCAN (1 Scan) SEL

t) C FCR CSCAN (Continuous Scan) SEL

u) FCR Ground Target Mode (GTM) SEL

v) FCR Air Target Mode (ATM) SEL

w) FCR Terrain Profile Mode (TPM) SEL

x) FCR Radar Map (RMAP) SEL

y) FCR CUED SEL

17) TEDAC right-hand grip for the following:

a) CPG MSL STEP SEL (wired in parallel with CPG collective switch)

b) LRFD TRIG1 SEL

c) LRFD TRIG2 SEL

d) SLAVE SEL

e) IAT Black On White (BOW) SEL

f) IAT White On Black (WOB) SEL

g) FLIR PLRTY SEL

h) Laser Tracking (LT) AUTO SRCH SEL

i) LT MAN SRCH SEL

j) MTADS AZ MN RT (Manual Rate) SEL

k) MTADS EL MN RT SEL

l) TEDAC Continuous Scope (CSCOPE) SEL

m) C HMD SIGHT SEL

n) C FCR SIGHT SEL

o) C MTADS SIGHT SEL

p) C LINK SEL

q) FCR WIDE SEL

r) FCR MED SEL

s) FCR NAR SEL

t) FCR ZOOM SEL

u) DISPL ZOOM SEL

18) Switch position monitoring of the pilot collective for the following:

a) PLT (Pilot) MSL STEP SEL

b) PLT NVS MPNVS SEL

c) PLT NVS MTADS SEL

d) PLT BRST STORE SEL

e) PLT FLIR PLRT SEL

f) P FCR 1SCAN SEL

g) P FCR CSCAN SEL

h) P HMD SIGHT SEL

i) P FCR SIGHT SEL

j) P LINK SEL

k) FCR GTM SEL

l) FCR ATM SEL

m) FCR TPM SEL

n) FCR RMAP SEL

o) FCR WIDE SEL

p) FCR MED SEL

q) FCR NAR SEL

r) FCR ZOOM SEL

s) FCR CUED SEL

19) Switch position monitoring of the CPG collective for the following:

a) CPG MSL STEP SEL (wire in parallel with TEDAC right-hand grip step switch)

b) CPG NVS MPNVS SEL

c) CPG NVS MTADS SEL

d) CPG BRST STORE SEL

e) CPG FLIR PLRT SEL

f) C FCR 1SCAN SEL

g) C FCR CSCAN SEL

h) C HMD SIGHT SEL

i) C FCR SIGHT SEL

j) C LINK SEL

k) C MTADS SIGHT SEL

l) FCR GTM SEL

m) FCR ATM SEL

n) FCR TPM SEL

o) FCR RMAP SEL

p) FCR WIDE SEL

q) FCR MED SEL

r) FCR NAR SEL

s) FCR ZOOM SEL

t) FCR CUED SEL

20) MTADS turret for the following:

a) MTADS FLIR GN CMD

b) MTADS FLIR LVL CMD

c) DTV RNG FOC CMD

d) FLIR RNG FOC CMD

e) DTV ZOOM

f) MTADS FLIR PLR CMD

g) MTADS FLIR ACM CMD

h) NIGHT S (Sensor) ZOOM CMD

i) MTADS YAW RATE

j) MTADS PITCH RATE

k) MTADS ROLL RATE

l) MTADS FLIR COOL

m) MTADS TURRET RDY

21) MTADS Power Supply (TPS) for:

a) MTADS STBY CMD

b) MPNVS STBY CMD

c) MTADS FLIR STY CMD

d) MTADS OPER CMD

e) MPNVS OPER CMD

f) MTADS ANTI-ICE CMD

g) MTPS Critical (CRIT) BIT STAT

22) MPEU for the following:

a) MPNVS DIR (Direct video) CMD

b) HSZ (Headset Z axis) LOS EL CMD

c) HSY (Headset Y axis) LOS AZ CMD

d) MPNVS STBY (Standby) CMD

e) MPNVS OPR (Operate) CMD

f) MPNVS ANTI-ICE CMD

23) MPNVS turret for the following:

a) MPNVS FLIR PLR CMD

b) MPNVS ACM CMD

c) MPNVS FLIR LVL CMD

d) MPNVS FLIR GN CMD

e) MPNVS FLIR COOL

24) Laser Electronics Unit (LEU) for the following:

a) LRFD CCM (Counter-Counter Measures) CMD

b) LRFD ENERGY LOW

c) LRFD HI TEMP

d) LRFD COOLANT LOW

CHECK ON LEARNING

1. The ____ performs weapons initialization, selection, inventory, moding, positioning, and firing for all aircraft weapons.

2. The WP performs as an RT and monitor for MUX bus channels ____ and ____.

M. Enabling Learning Objective 13

After this lesson, you (the student) will:

ACTION: State the operation of the Weapon Processor (WP).

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the operation of the Weapons Processor (WP).

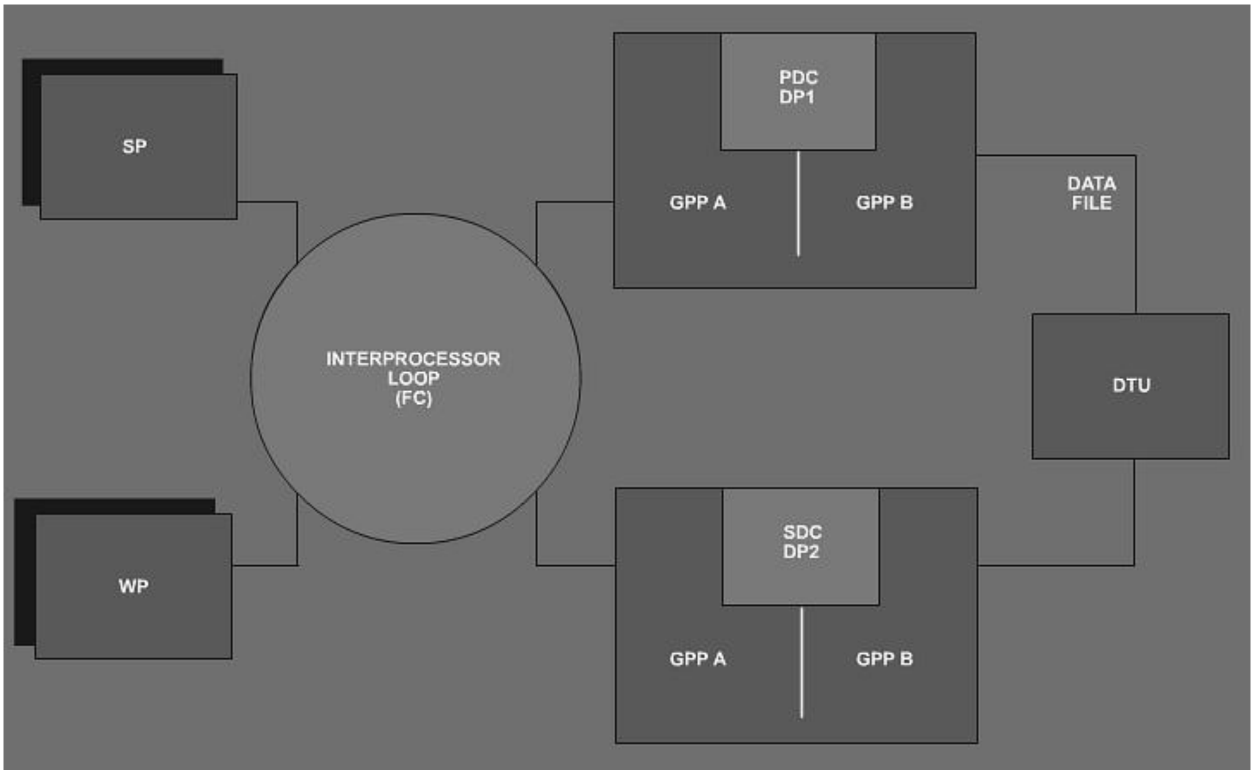


Figure 105. Weapons Processor FCDB Operation.

a. WP operation

After processor initialization is completed, the WP performs the following:

(1) FCDB Weapons System operations

(a) The PDC transfers all DTU data files on the FCDB that are required by the WP.

(b) DTU data transferred from the PDC to the WP includes:

1) Weapons data

2) Sights data

3) FCR data

(c) As the mission progresses, the WP will transfer data to the DTC for post-mission analysis.

(d) The primary WP is responsible for transferring DTU data to the DP for storage on the Mission DTC.

(e) The type of WP data transferred to the DTC includes Sights data.

(f) The primary WP will write all current DTU files to the mission DTC when the DTU write status becomes ready.

(g) The primary WP will also write all current DTU files if the WP resets on the ground and the DTU is ready.

(h) These conditions ensure that the current DTU files on the mission DTC will be initialized to the current data in the WP.

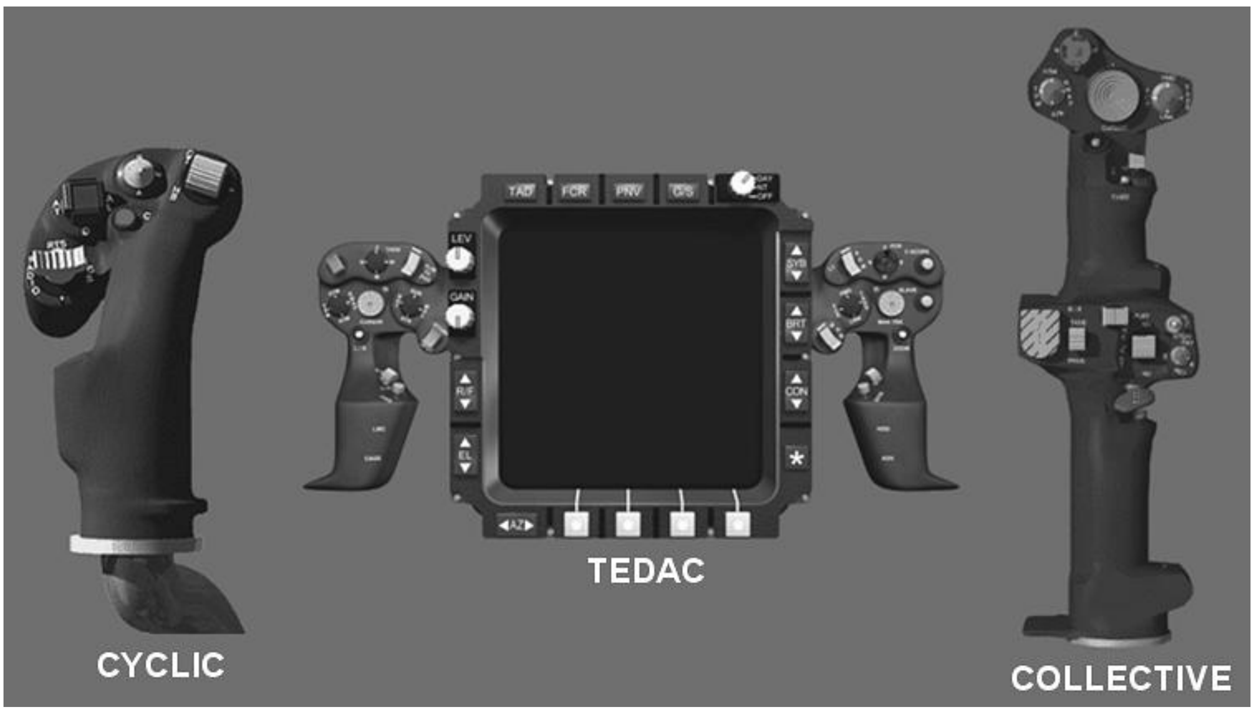


Figure 106. Weapons Processor Operation.

(2) MUX bus Weapons System operations

(a) Receives weapons moding selections from:

1) The primary DP via MUX bus messages

2) The cyclic grips, collective grips, and TEDAC controls via direct line discretes

(b) Transmits current weapons inventory and status over the MUX bus to the DP. For example, reporting 2.75-inch rocket inventory and launcher status to the DP for display on the MPD

(c) Controls weapons firing based on weapons moding and constraint information from the DP and SP via MUX bus messages

Figure 107. Weapons Processor Operation 1.

(d) Receives LMP selections from the SP and sends rounds count data to the SP, which is passed on to the LMP.

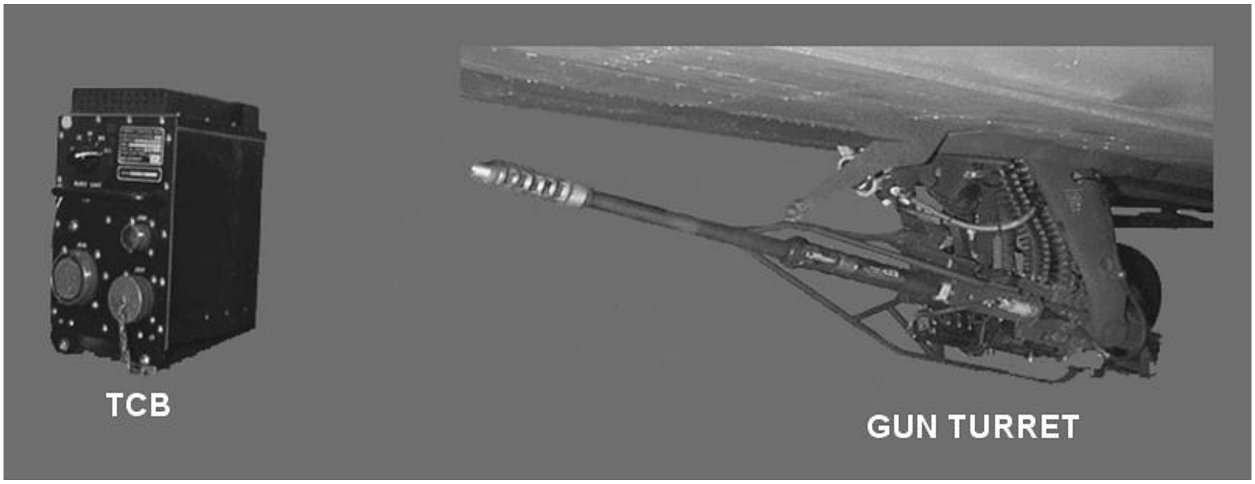


Figure 108. Weapons Processor Operation 2.

(e) Sends gun turret positioning and moding information to the TCB based on weapon moding and constraints calculations.

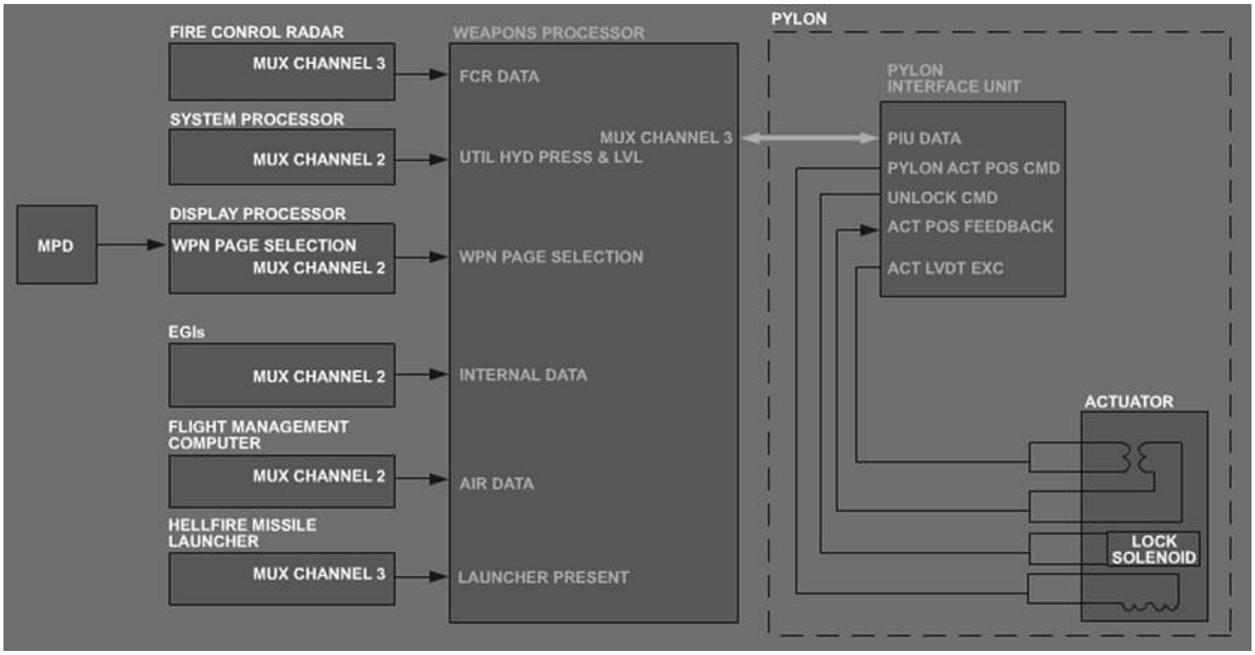


Figure 109. Pylon Positioning.

(f) Positions pylons according to weapons moding and pointing requirements. An example of this type of operation would be positioning the pylon for a missile launch. The following steps are accomplished to position the pylon:

1) The WP receives pylon actuator position from the PIU via the pylon position MUX bus message and issues positioning commands via the elevation command MUX bus message.

2) The WP uses the following information to determine if it is possible to position the pylon:

   a) Utility hydraulic pressure and level MUX bus information from the SP. The pressure and level cannot be LOW.

   b) The PIU is not performing an interruptive BIT. This will be reported to the WP via MUX bus channel 3.

3) The crewmember selects the missile via the WPN page on the MPD and this command is sent via serial link to the DP.

4) The DP reports the action to the WP.

5) The WP receives the command and checks these parameters:

   a) The selected sight is valid and not failed (internal to the WP).

   b) A rocket launcher is present (reported by the PIU).

   c) Pylon articulation and pylon position data are valid from the PIU.

   d) There is no external tank present (reported by the PIU).

6) If the above parameters are true, the WP will issue the UNLOCK command to the PIU for the PIU to unlock the pylon for positioning. This

MUX bus message is sent to the PIU and the PIU will energize its unlock driver interface to the Pylon Actuator.

7) The WP issues elevation commands to the PIU to position the pylon for missile firing. The command is a composite rate and position command.

8) The WP derives elevation commands based on calculations of the rate compensation correctors and rocket pylon position drive calculations of the fire control solution. Inertial data and air data from the FMC, parallax error between the selected sight and weapon, gravitational acceleration, and targeting data are used in the fire control solution calculation.

9) The PIU sends the actual elevation angle of the pylon to the WP.

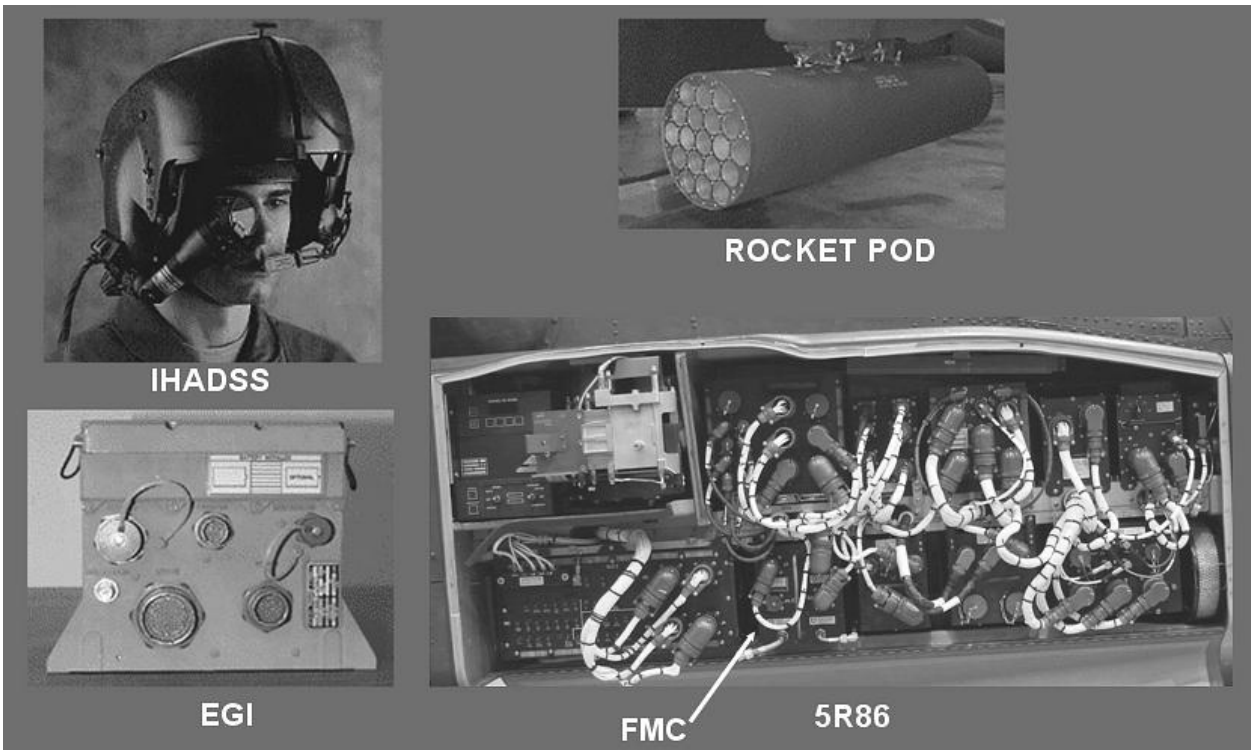


Figure 110. Weapons Processor Operation 3.

(g) Performs ballistics calculations based on data received from the EGI via the MUX Bus, along with sight and weapon data.

(h) Performs Hellfire missile computations consisting of selections, moding, inventory, seeker positioning, seeker coding, and launch processing.

(i) Performs rocket control computations consisting of selections, fusing, positioning, inventory, inhibits, and launch processing.

(j) Performs ATA missile computations consisting of missile selection, inventory, seeker pointing, inhibit and launch processing, and engagement management.

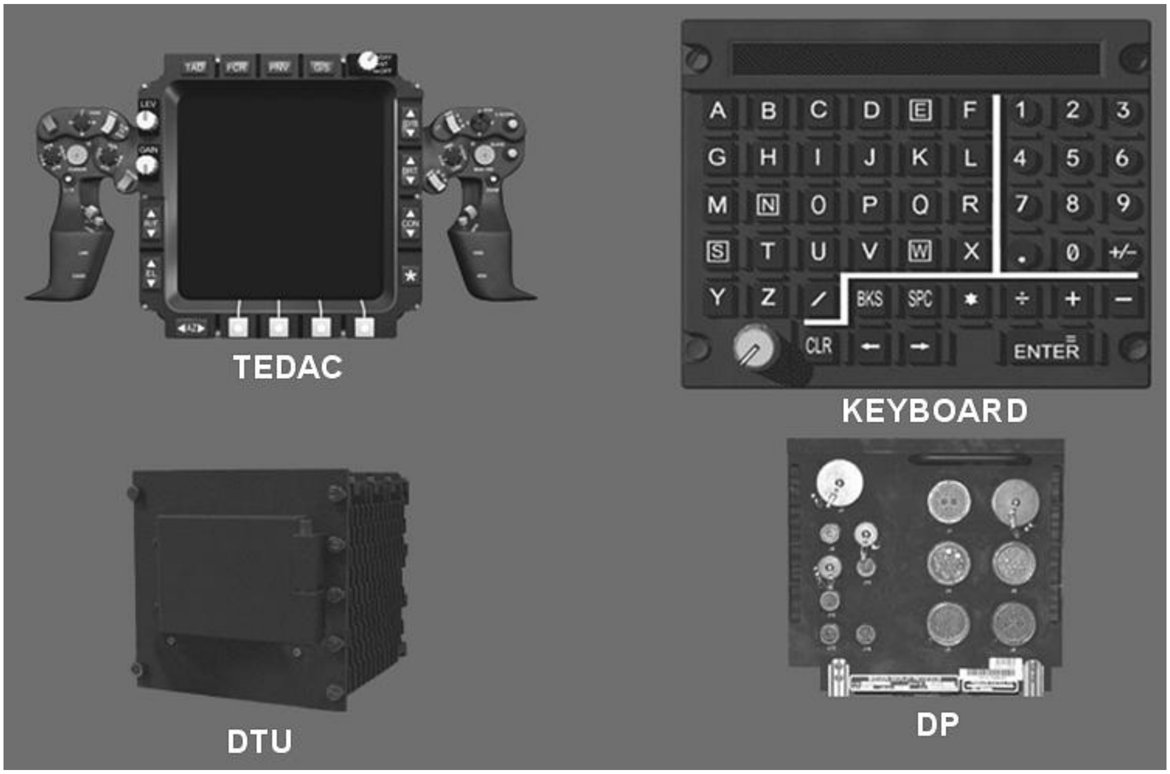


Figure 111. Weapons Processor Operation 4.

(3) Sighting System operations

(a) Determines sight and acquisition selections from system status, DP, DTU, TEDAC selections, and KU selections. Reports the actual sight selection and cueing information to the DP for display on the MPD.

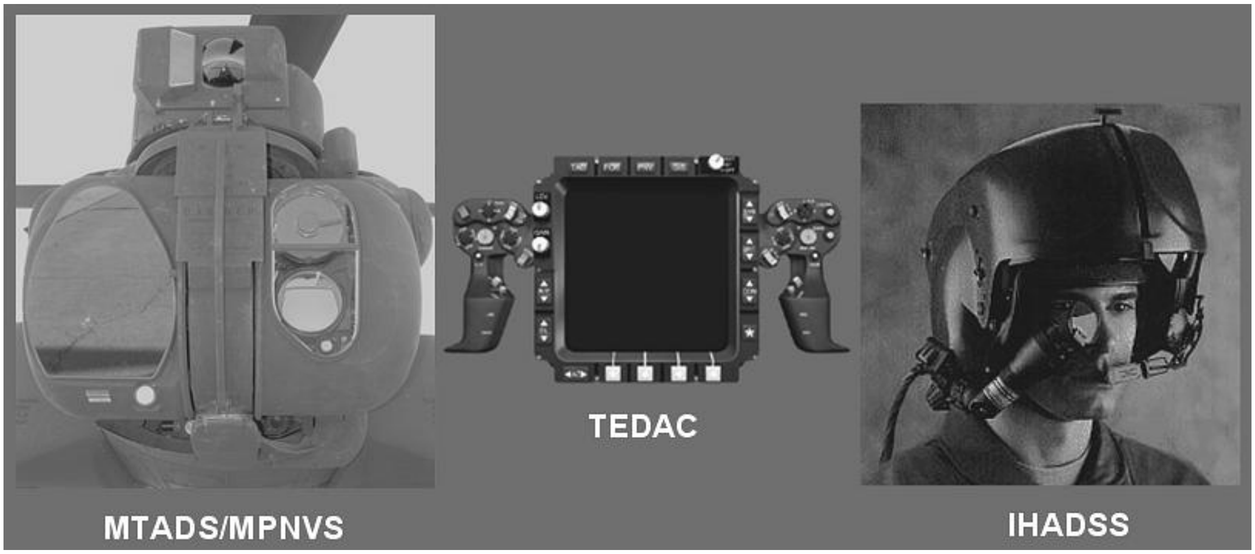


Figure 112. Weapons Processor Operation 5.

(b) Performs sight-select processing, LOS source select processing, and range processing as a function of the ballistics solution

(c) Determines subsystem LOS based on aircrew selections, subsystem status, and target location

(d) Determines and maintains target range and range rates based on range source selections, system status, and aircraft motion

(e) Provides filtered target range to the MTEU, DP, and SP

(f) Controls NVS processing for both crewmembers

(g) Commands sensors to the LOS based on sight select and acquisition select

(h) Transmits and receives LOS and component status to/from the MPEU via direct line discretes

(i) Transmits and receives LOS, component status, and control commands to/from the SEU via direct line discretes

(j) Processes selections and provides data to and from the FCR via the MUX bus. Data includes INU inertial data, RFI commands and statuses, and target data

(k) Determines manual or automatic track modes from TEDAC direct input lines for FLIR, and DTV and issues the appropriate tracking commands to the MTEU via direct discrete lines

(l) Enables boresight modes based on system constraints and aircrew selections from the TEDAC and DP and calculates corrections for the MTADS and IHADSS

(m) Performs coordinate system conversions to/from ADL referenced and earth-referenced systems

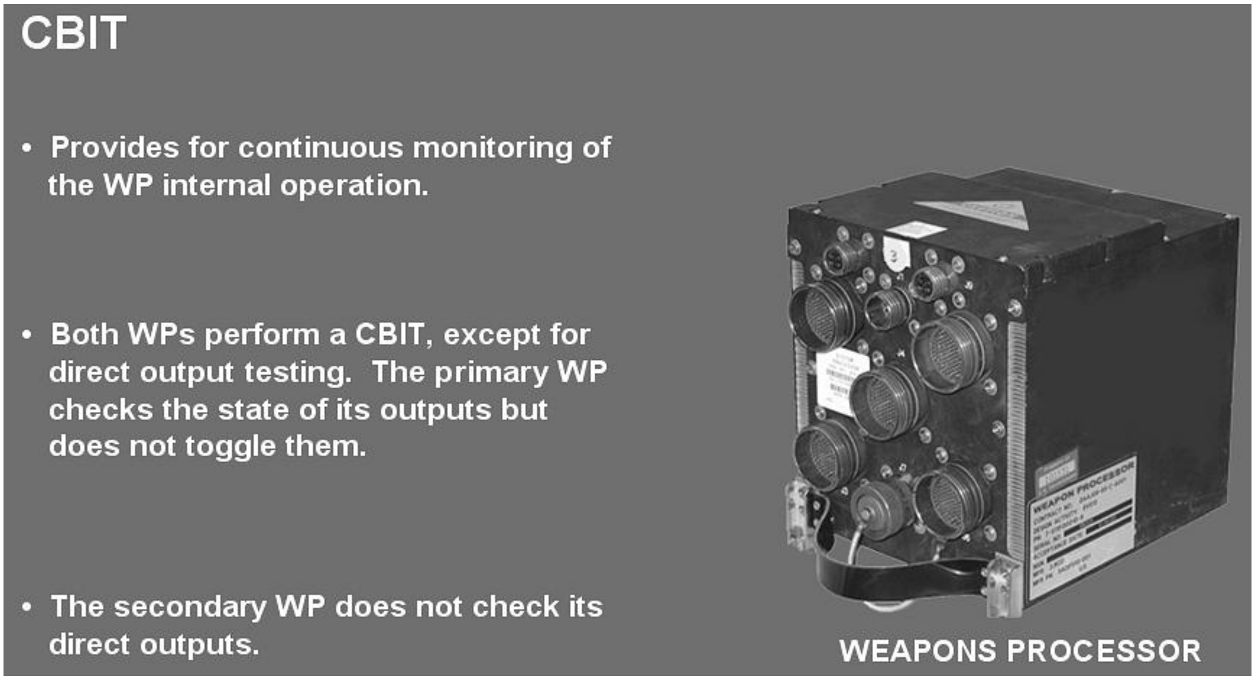


Figure 113. Weapons Processor CBIT.

(4) CBIT

(a) Provides for continuous monitoring of the WP internal operation

(b) Both WPs perform a CBIT, except for direct output testing.

1) The primary WP checks the state of its outputs but does not toggle them.

2) The secondary WP does not check its direct outputs.

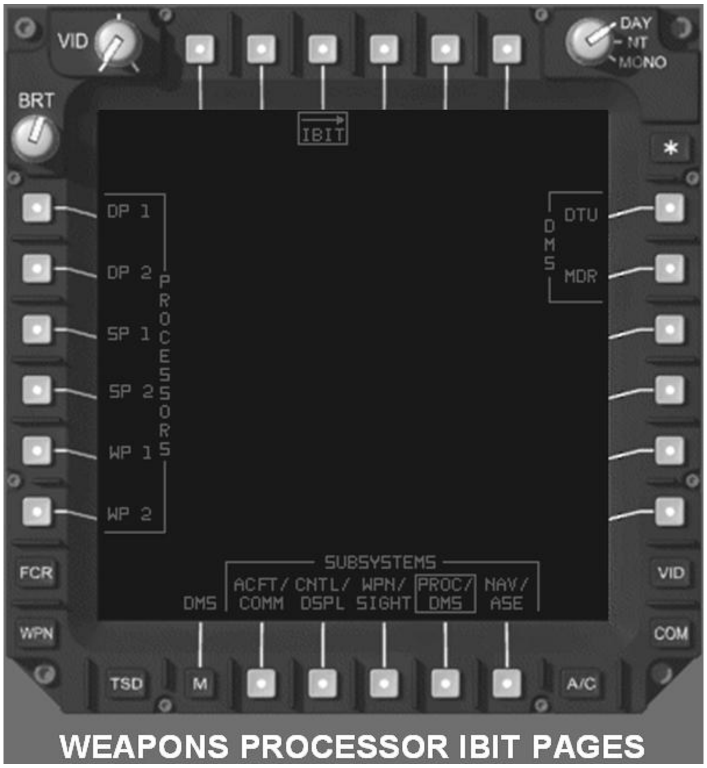


Figure 114. Weapons Processor IBIT.

(5) IBIT

(a) Only one WP can be tested at a time.

(b) The crewmember selects either WP1 or WP2 IBIT button on the MPD DISPLAYS/PROCESSORS IBIT page to initiate the IBIT.

(c) The DP transmits the WP test selection to the primary SP.

(d) Faults are displayed on the WP IBIT screen and are sent to the primary SP.

(e) The crewmember may abort the IBIT at any time by selecting ABORT.

CHECK ON LEARNING

1. The ____ reports to the WP that no external tanks are present.

2. The ____ controls NVS processing in both crewstations.

N. Enabling Learning Objective 14

After this lesson, you (the student) will:

ACTION: State the purpose, location, and operation of the Multipurpose Display (MPD).

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose, location, and operation of the Multipurpose Display (MPD).

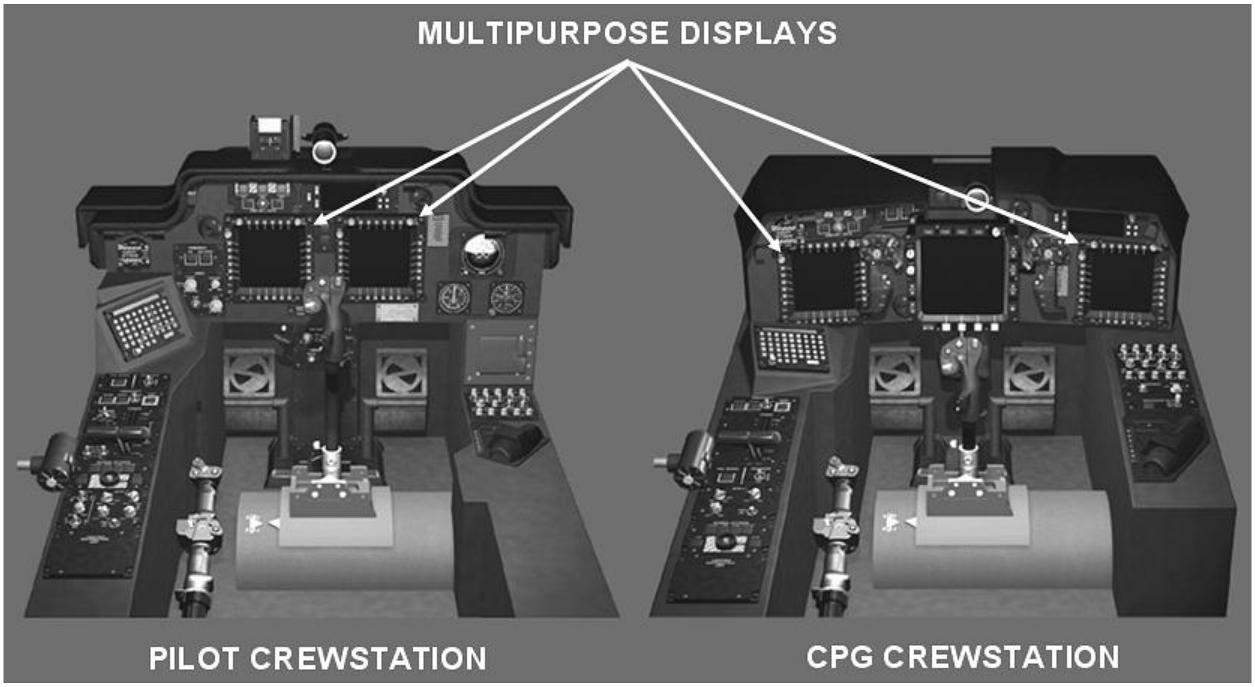


Figure 115. Multipurpose Display Locations.

a. MPD

(1) The MPDs provide the crewmember with the following:

(a) Control of systems and subsystems

(b) Visual indications of aircraft engine and flight conditions

(c) Display of sensor video imagery and symbology in a format designed to improve mission effectiveness while reducing cognitive and physical demand on the operator

(2) The MPDs are located on the pilot and CPG instrument panels. There are two MPDs in each crewstation.

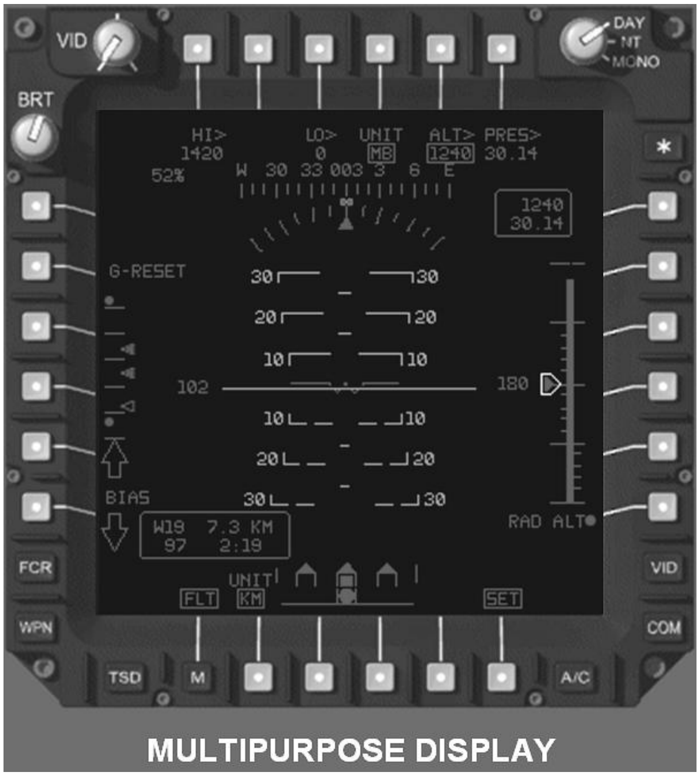


Figure 116. Multipurpose Display.

b. MPD description

(1) Chassis

(a) 8.5” wide by 8.5” high and 7.5” long

(b) Weight is 12.8 pounds

(c) Each MPD has an internal fan to circulate cabin air through the unit.

(2) Display

(a) 6.25” by 6.25” viewing area

(b) 512 by 512 color, Quad Pixel Active Matrix Liquid Crystal Display (AMLCD).

(3) Controls

Control knobs control display image quality of the MPD.

(a) Day/Night/Mono knob – This is a three-position rotary knob.

1) The DAY position provides a seven-color, plus black, display. The video and symbology intensity ranges from imperceptible in bright outdoor lighting to a level providing readable symbology in overcast conditions or direct sunlight.

2) The NT (night) position provides a full-color display at reduced intensity. The brightness ranges from imperceptible to a level sufficiently bright for early morning, late evening, or overcast conditions. This position is compatible with NVIS Class B.

3) The MONO position provides a green display. This position is compatible with NVIS Class A.

(b) VID (Video) knob – The rotary knob controls the image contrast.

(c) BRT (Brightness) knob – The rotary knob controls the display brightness.

(4) Bezel pushbuttons provide fixed-action, dual-action, and variable-action functions for selecting various displays and actions on the MPD. Thirty-one bezel pushbuttons surround the display area.

(a) The Menu button (M) functions as a variable- and fixed-action button.

1) Selecting the Menu button from any MPD subsystem page will retrieve the Main Menu page.

2) Selecting the Menu button from the MENU page will access the DMS page.

3) The label over the Menu button (on MPD) changes to reflect the subsystem currently selected.

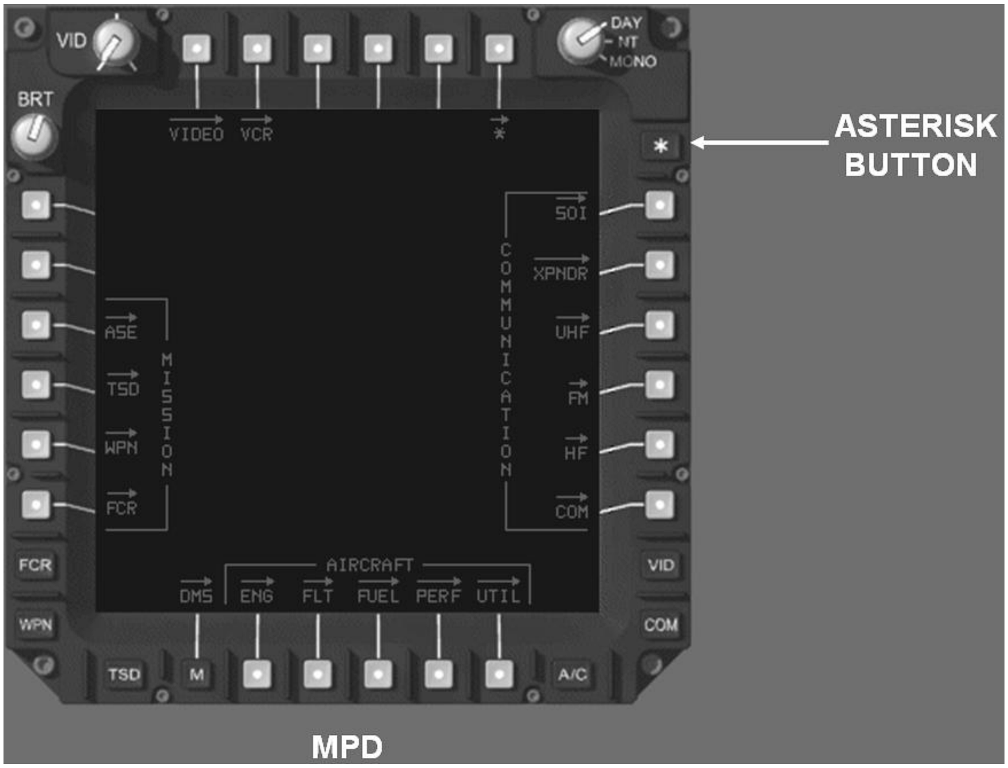


Figure 117. Asterisk (Star) Button.

(5) Asterisk (*) button

(a) The Menu page has been modified to incorporate the addition of the Asterisk (*) page. The Asterisk (*) page is only accessible from the Menu page unless no selections have been made on the * page. If no selections have been made on the * page, selecting the * bezel button will select the * page on that MPD. The * button is a MPD effect button, and each MPD * page must be set for the crewmember's desired selections.

(b) The Asterisk (*) page was added, providing crewmembers with a single button capability to cycle through up to three pages as set by that crewmember for that MPD. When the * page is selected, the following options are displayed NONE button, Queue (*) buttons (T3–T5), and the Page buttons that include MISSION buttons (L2–L6), AIRCRAFT buttons (B2–B4), COM button (B5), and VIDEO buttons (R3–R6). The * status window is also displayed.

(c) The Queue (*) Grouped Option buttons are used to set which of the three locations in the queue to store a page. When a position—for example, position 1—is selected, a corresponding arrow is displayed in the queue status window pointing to the selection. The crewmember does not need to select each queue button but can just select the page that goes into that position, and the page is selected. The selected queue then goes to the next position—for example, position 2 is selected after a page is loaded into position 1.

(d) The queue status window displays what page is stored in each queue location (1 through 3). An arrow indicates current queue selection corresponding to the Queue buttons at T3–T5. If a page is not stored in a queue position, then NONE will be displayed indicating that the position is open. All queue positions do not have to be filled for the * Fixed Action Button to work. If a crewmember wishes to toggle between one or two pages, the remaining slot or slots can remain empty. Currently, there are only 12 pages available for storing into a queue location.

(e) Selecting the Asterisk fixed action button will display the stored pages in the order selected by the crewmember and indicated in the queue status window as 1–3. If a page other than one of the pages in the queue is selected, that page will be displayed. The next selection of the * button will start the crewmember at the beginning of the queue.

(f) Page selection/changing can also be accomplished by placing the cursor over the asterisk symbol and cursor selecting through the stored pages.

(g) When the cursor is placed in the * area, it will remain there unless moved by the crewmember. The cursor will not return to the home position on the MPD screen.

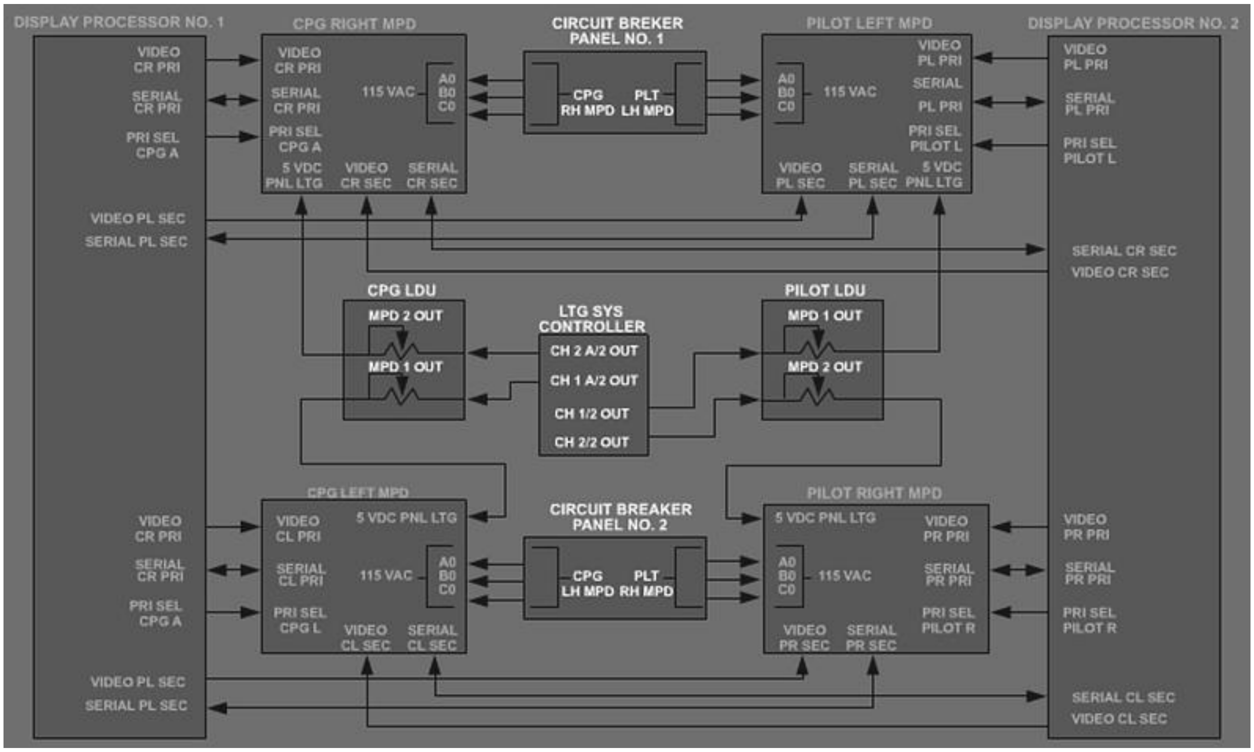


Figure 118. Multipurpose Display Operation.

c. MPD operation

(1) Power

(a) 115 Vac three-phase power is provided by CBP1 to:

1) The pilot left MPD from circuit breaker labeled PLT LH MPD

2) The CPG right MPD from circuit breaker labeled CPG RH MPD

(b) 115 Vac three-phase power is provided by CBP2 to:

1) The pilot right MPD from circuit breaker labeled PLT RH MPD

2) The CPG left MPD from circuit breaker labeled CPG LH MPD

(2) MPD control

(a) Normal DP operation

1) DP1 controls the CPG MPDs for cursor display and movement and monitors the interface for bezel button selections.

2) DP2 controls the pilot MPDs for cursor display and movement and monitors the interface for bezel button selections.

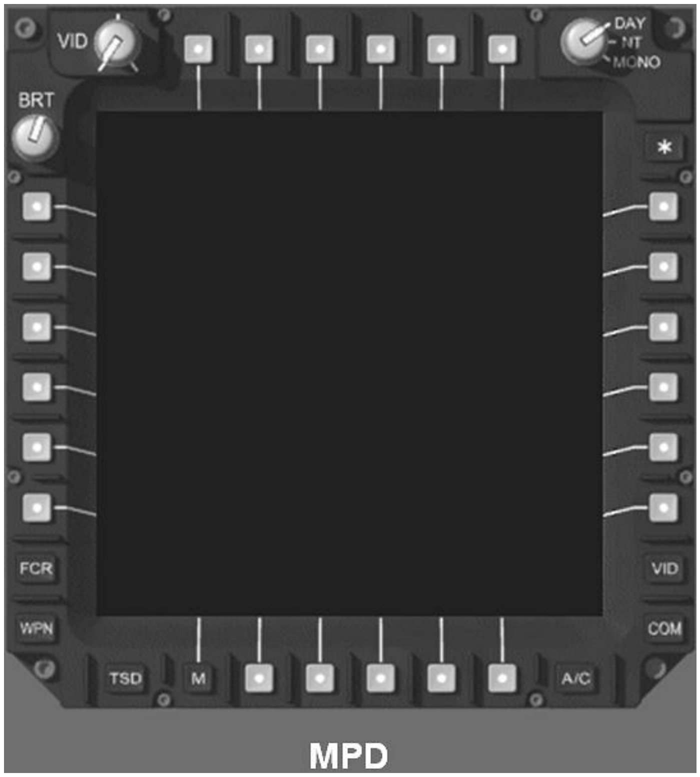


Figure 119. Multipurpose Display Screen Saver.

(b) Screen Saver mode

1) In Screen saver mode, the display will appear black.

2) Screen Saver mode is enabled when all the following conditions exist:

a) Aircraft is on the ground

b) External power is in use

c) Both throttles are off

d) No cursor or bezel button input for 5 minutes.

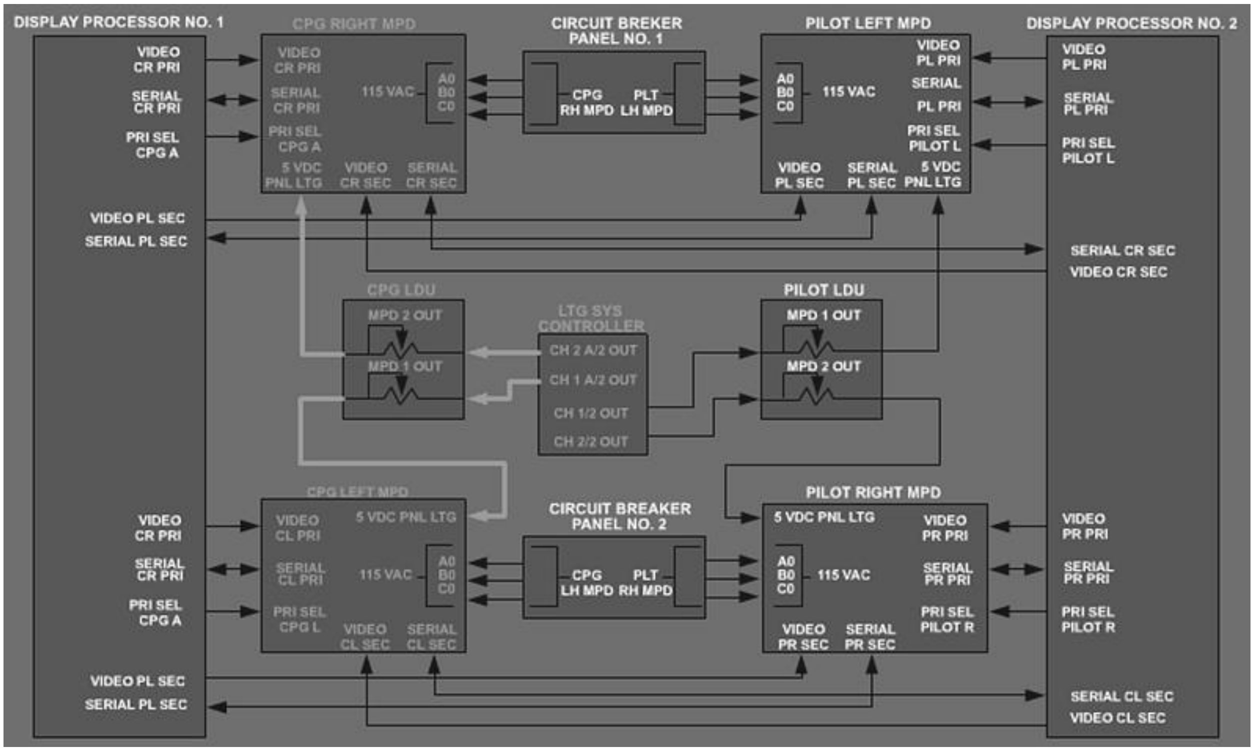


Figure 120. Multipurpose Display Operation 1.

(c) Single DP operation

The operational DP controls and monitors all four MPDs.

(3) Data transfer

(a) Each DP provides four RS422 serial data link interfaces, one for each MPD.

(b) Interface uses non-return-to-zero logic, requiring no clock to reset message strings.

(c) Interface operates at 62.5 kbaud.

(d) Each DP initiates one bidirectional message transfer for each MPD.

(e) The DP issues commands to the MPD and the MPD returns information on:

1) Symbol brightness

2) Bezel button inputs

3) BIT status

(f) MPD lighting

1) Pilot MPDs

a) Both pilot MPDs receive 5 Vdc panel lighting power from the pilot LDU. The pilot LDU receives its source power from the LSC.

b) Both pilot MPDs receive 0 to 5 Vdc bezel button power from the pilot LDU.

2) CPG MPDs

a) Both CPG MPDs receive 5 Vdc panel lighting power from the CPG LDU. The CPG LDU receives its source power from the LSC.

b) Both CPG MPDs receive 0 to 5 Vdc bezel button power from the CPG LDU.

(4) BIT

(a) Each MPD reports the following BIT errors to the DP controlling its operation:

1) Low voltage and high voltage power supply errors

2) Memory errors

3) Display control errors

4) RS422 interface errors

(b) Any errors reported to the DP are processed and reported to the SP as a "NO GO" indication for the faulty MPD.

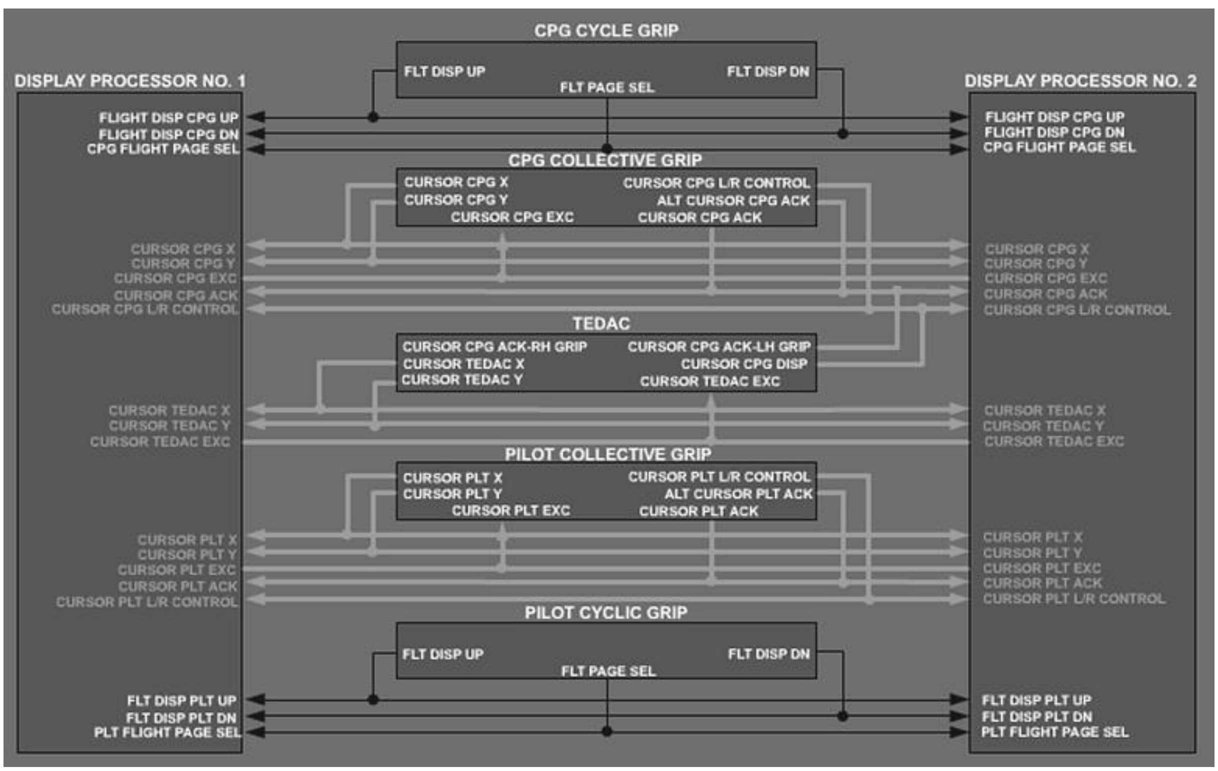


Figure 121. Cursor Operation.

d. MPD cursor operation

(1) The DPs interface with the pilot and CPG cyclic grips for the remote MPD flight page selection and IHADSS flight symbology mode selection.

(2) They both supply 10 Vdc excitation for cursor controller operation to both the pilot and CPG collective grips and the TEDAC left-hand grip.

(3) The DPs accept cursor controller X and Y position signals, cursor left/right display selection, and cursor acknowledgment from the pilot and CPG collective grips and the TEDAC left-hand grip.

(4) They also monitor the cursor acknowledgment signal coming from the TEDAC right-hand grip.

CHECK ON LEARNING

1. The MONO knob on the MPDs provides a ____ display and is NVIS class A compatible.

2. The MPD Screen Saver mode is enabled when no cursor or bezel button input has occurred for ____ minutes.

O. Enabling Learning Objective 15

After this lesson, you (the student) will:

ACTION: State the purpose, location, and operation of the Keyboard Unit (KU).

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose, location, and operation of the Keyboard Unit (KU).

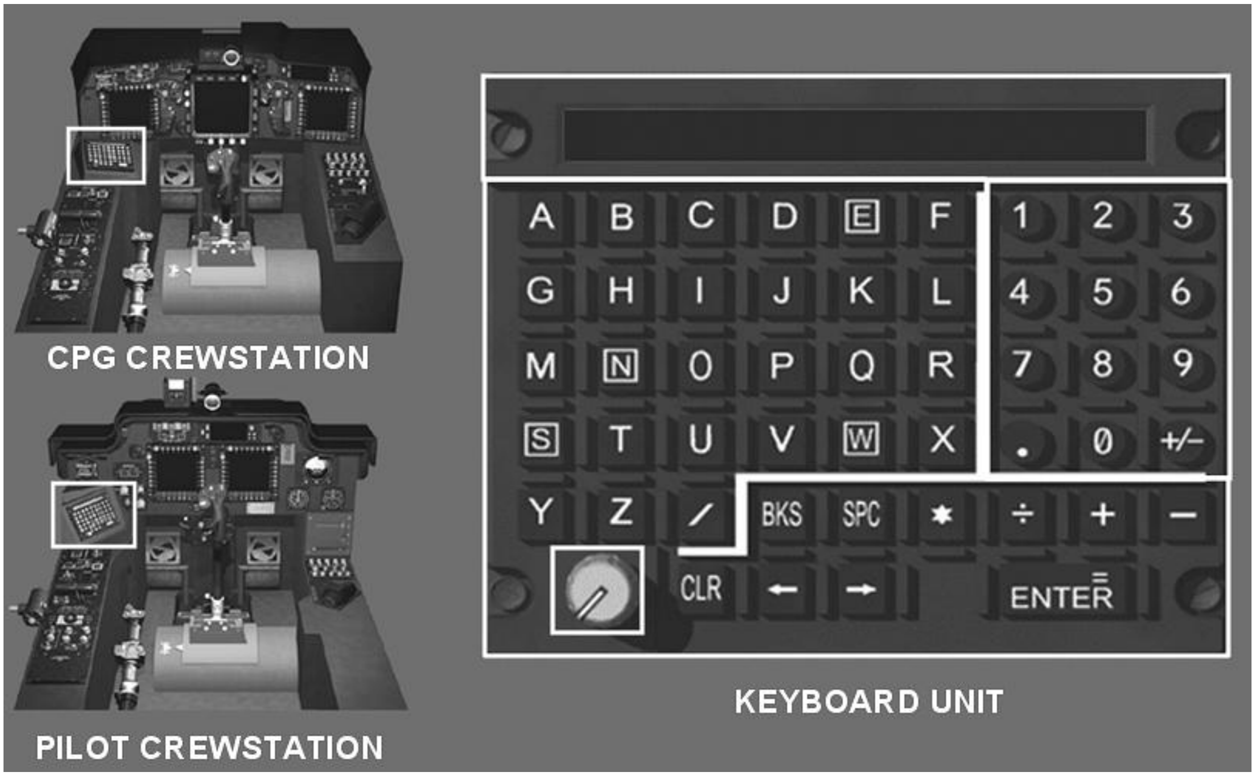


Figure 122. Keyboard Unit.

a. Keyboard Unit (KU)

(1) The KU provides the crewmembers with the ability to enter and retrieve data from the MUX bus system. The KU is located forward of the LH console in each crewstation.

(2) KU displays

(a) The display section is a single row of LEDs with 22 characters. This section contains 44 characters in the Scratchpad area.

(b) The Brightness (BRT) knob is used to control only the display section.

(c) The Alphabetic pad is used to enter alphabetic characters.

(d) The Numeric pad is used to enter numeric characters and also contains editing/calculator functions.

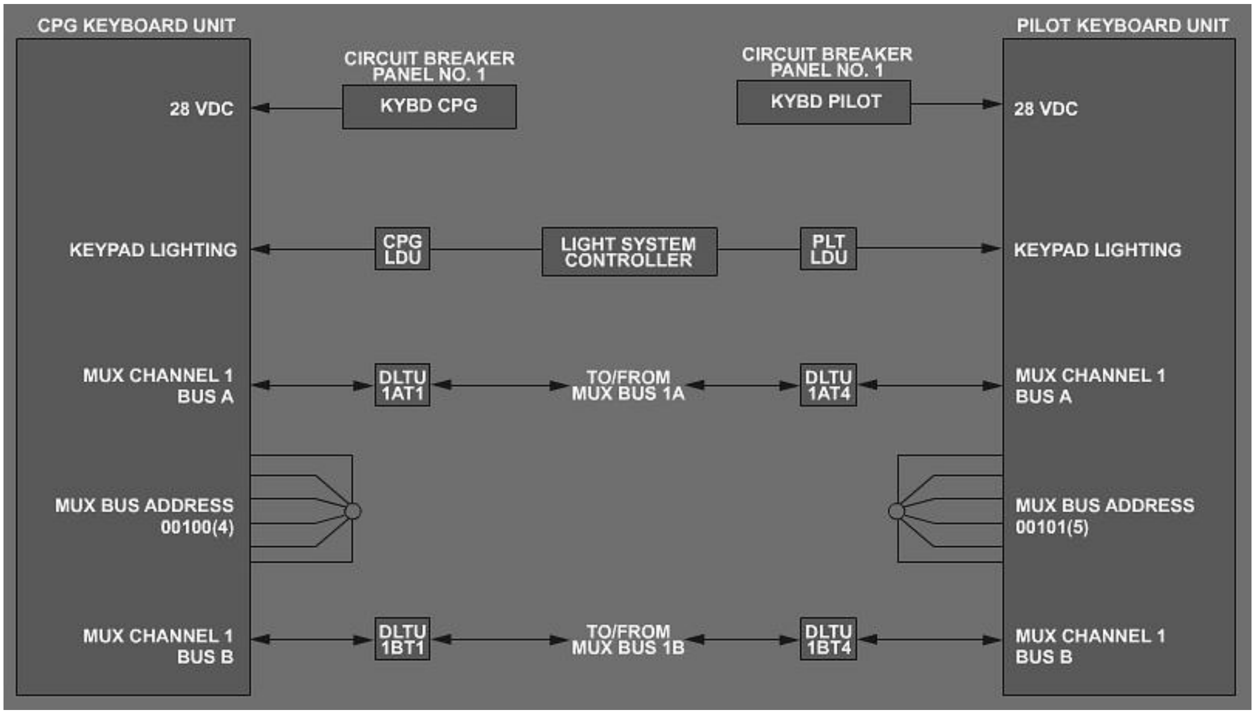


Figure 123. Keyboard Unit Interface.

b. KU interface

(1) Pilot

(a) 28 Vdc power is provided by KYBD PLT circuit breaker on CBP1.

(b) MUX bus terminal provides address jumper connection selection and configuration code.

(c) KU is connected to MUX bus channel No. 1 via DLTUs 1AT4 AND 1BT4.

(d) KU is connected to the pilot LDU for five Vdc panel lighting power. The pilot LDU receives its source power from the LSC.

(2) CPG

(a) 28 Vdc power is provided by KYBD CPG circuit breaker on CBP2.

(b) MUX bus terminal provides address jumper connection selection and configuration code.

(c) KU is connected to MUX bus channel 1 via DLTUs 1AT1 AND 1BT1.

(d) KU is connected to the CPG LDU for 5 Vdc panel lighting power. The CPG LDU receives its source power from the LSC.

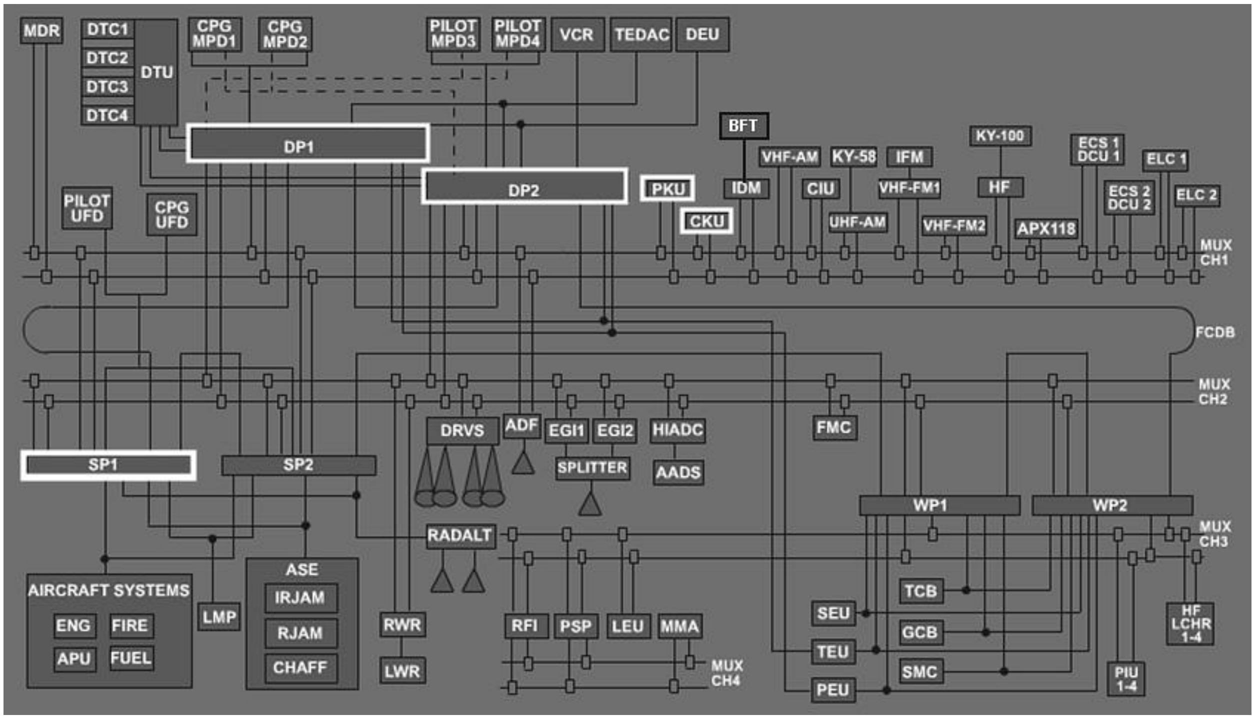


Figure 124. Keyboard Unit Operation.

c. KU operation

(1) The KUs are initialized when electrical power is applied to the aircraft.

(2) The CPG KU is controlled by DP1 via RT to RT data transfer under control of the primary SP.

(3) The pilot KU is controlled by DP2 via RT to RT data transfer under control of the primary SP.

(4) If a KU key has not been pressed or a command from the DP has not been received by the KU in 30 seconds, the KU display blanks.

(5) When the KU display is blank, if a KU key is pressed or a command is received from the DP, the display illuminates. The cursor flashes at a 4 Hz rate.

(6) Depressing the “A” and the “+”causes the KU to begin a self-test.

CHECK ON LEARNING

1. The KU is located on the ____ side of each crewstation.

2. Depressing the ____ and the ____ causes the KU to begin a self-test.

P. Enabling Learning Objective 16

After this lesson, you (the student) will:

ACTION: State the purpose, location, and operation of the Data Transfer Unit (DTU).

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose, location, and operation of the Data Transfer Unit (DTU).

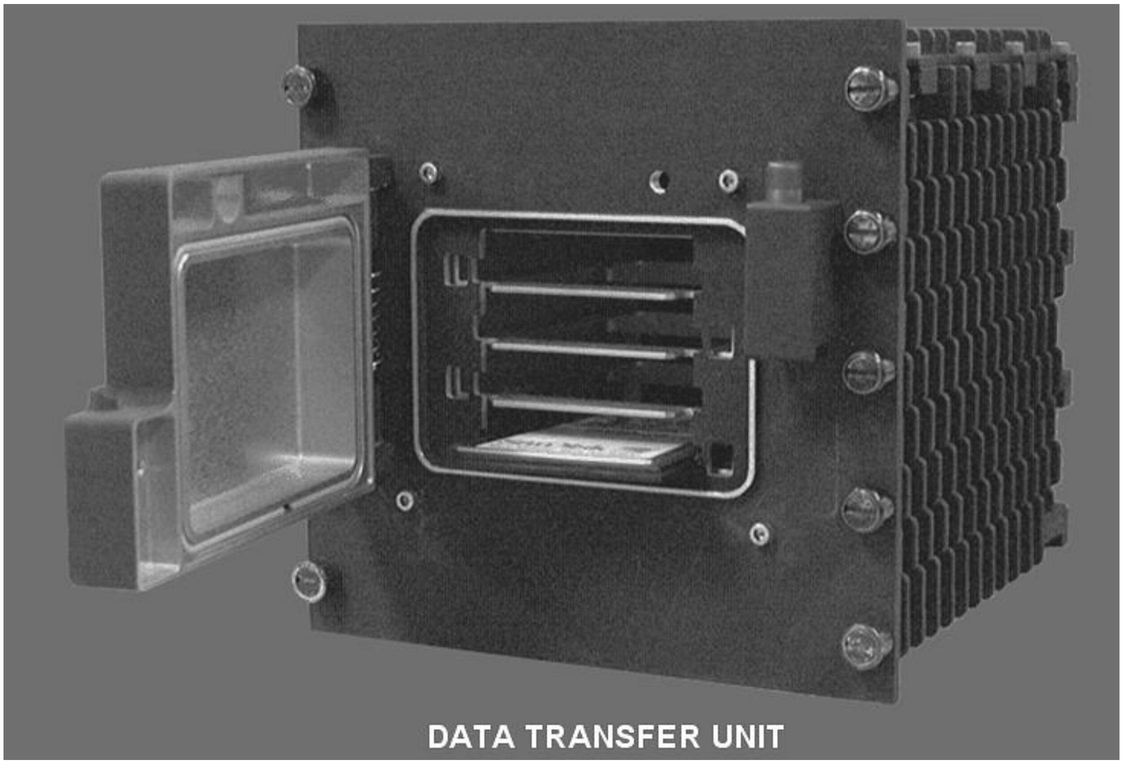


Figure 125. Data Transfer Unit.

a. DTU

(1) The DTU provides the ability to store, upload, and download mission and map data. It is mounted in the pilot right forward console.

(2) The DTU consists of the following components:

(a) DTR

1) The DTR is the RT section of the DTU.

2) The DTR has four Data Transfer Cartridge (DTC) slots available to support required mission and map data.

3) The DTR connects the DTC to DPs via the FCDB.

4) The DTR contains a microcontroller that writes data to and reads data from the DTC.

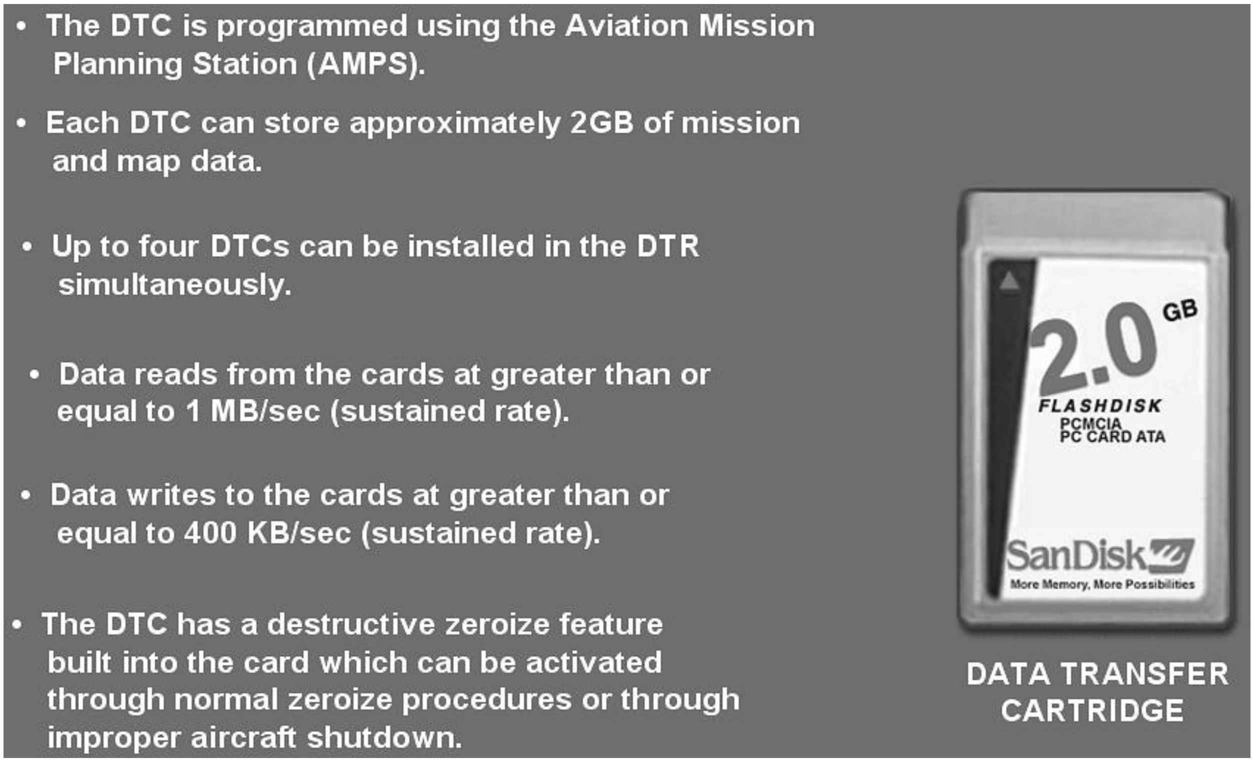


Figure 126. Data Transfer Cartridge.

(b) DTC

1) The DTC is a Personal Computer Memory Card International Association (PCMCIA) flash memory card used for data storage on the aircraft.

2) Each DTC can store approximately 2 GB of mission and map data.

3) Up to four DTCs can be installed in the DTR simultaneously.

4) Data reads from the cards at greater than or equal to 1 MB/sec (sustained rate)

5) Data writes to the cards at greater than or equal to 400 KB/sec (sustained rate)

6) The DTC has a destructive zeroize feature built into the card which can be activated through normal zeroize procedures or through improper aircraft shutdown.

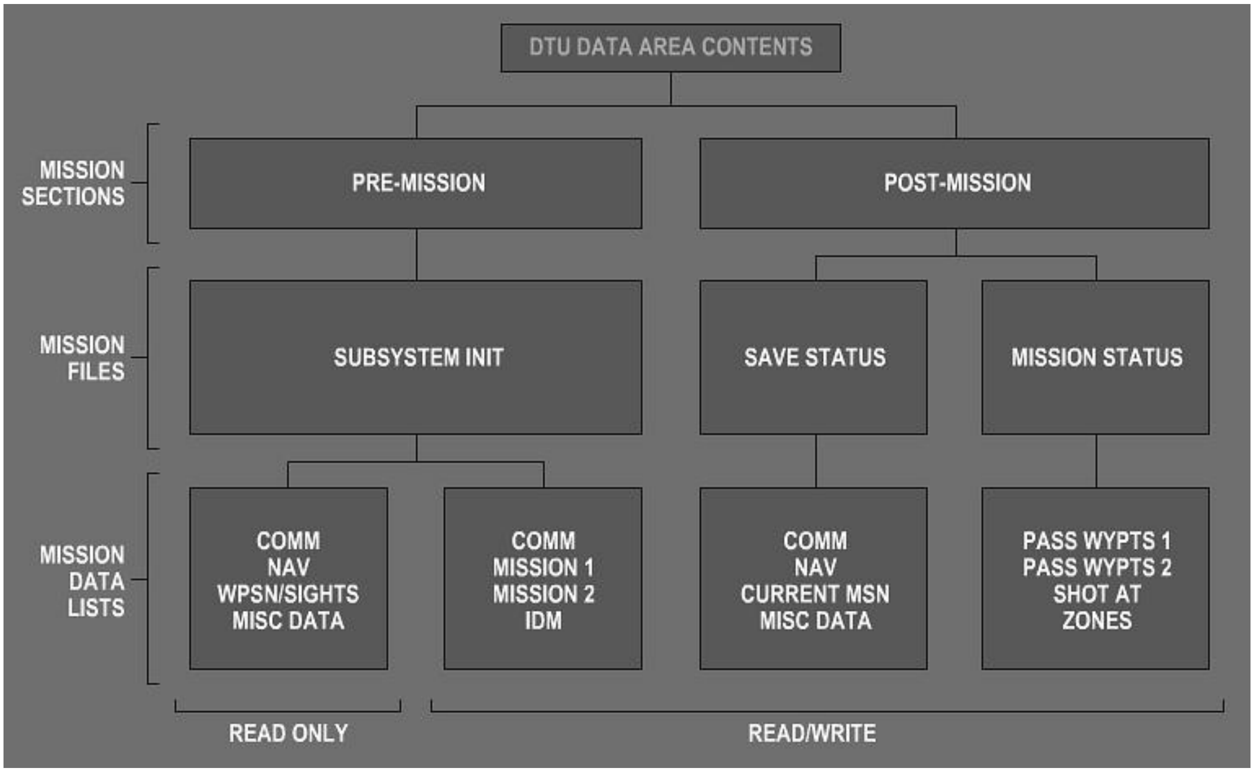


Figure 127. DTU Data Area Contents.

b. The DTU is programmed with two types of mission data:

(1) Pre-mission data is used to initialize the aircraft systems. These files consist of:

(a) Read-only data

1) Communication files

2) Navigation files

a) Navigation files consist of Navigation mode (LAND or SEA) and present position Latitude/Longitude (Lat/Long) with associated data.

b) Uploading this data as part of a MASTER LOAD forces the EGIs to reset, causing a significantly longer alignment than if the EGIs used their stored present position.

c) The navigation data block should only have to be uploaded if the aircraft has been moved a significant distance since shutdown.

3) Weapons files

4) Sight files

5) Miscellaneous files

(b) Read-and-write data

1) Communication files

2) Mission 1 and 2 files

3) IDM files

(2) Post-mission data is read/write data used to analyze post-flight status. This data consists of:

(a) Save status

1) Communication files

2) Navigation files

3) Current mission data files

4) Miscellaneous data files

(b) Mission status files

1) Passed waypoint 1 files

2) Passed waypoint 2 files

3) Shot-at files

4) Zone data

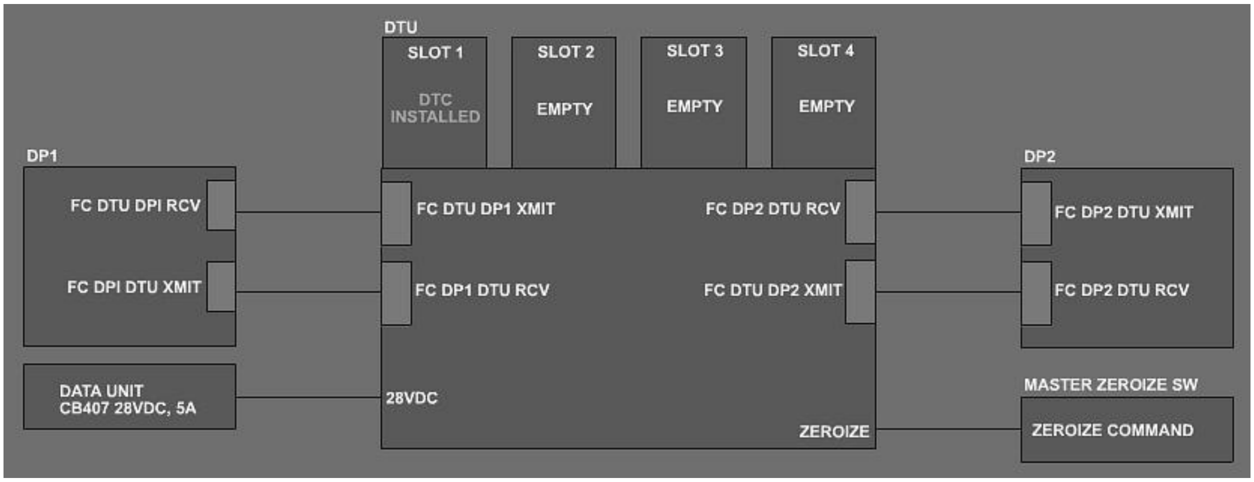


Figure 128. Data Transfer Unit Interface.

c. DTU interface

(1) Battery bus 28 Vdc power is provided by CBP2 DATA XFR UNIT circuit breaker.

(a) However, the primary DTU controller will not be operational until the aircraft is operating on AC power.

(b) Because of this, the DTU cannot be accessed until the aircraft is operating on AC power.

(2) The DTU is connected to both of the DPs with dedicated fibre channel interfaces.

(a) Only one DP controls the DTU at any given time.

(b) That DP is called the Primary DTU Controller (PDC).

(3) Pilot and CPG Emergency panels for ZEROIZE command

d. DTU operation

(1) Upon aircraft power-up on the AC bus, the DPs attempt to connect to the DTU via the FCDB.

(a) If DP1 cannot connect to the DTU, the message (DTU CHANNEL A FAIL) is displayed on the MPD.

(b) If DP2 cannot connect to the DTU, the message (DTU CHANNEL B FAIL) is displayed.

(c) If neither DP can connect to the DTU, the message (DTU FAIL) is displayed in lieu of the individual channel A and B messages.

(2) The primary SP uses the DP status information to select one of the DPs as the PDC.

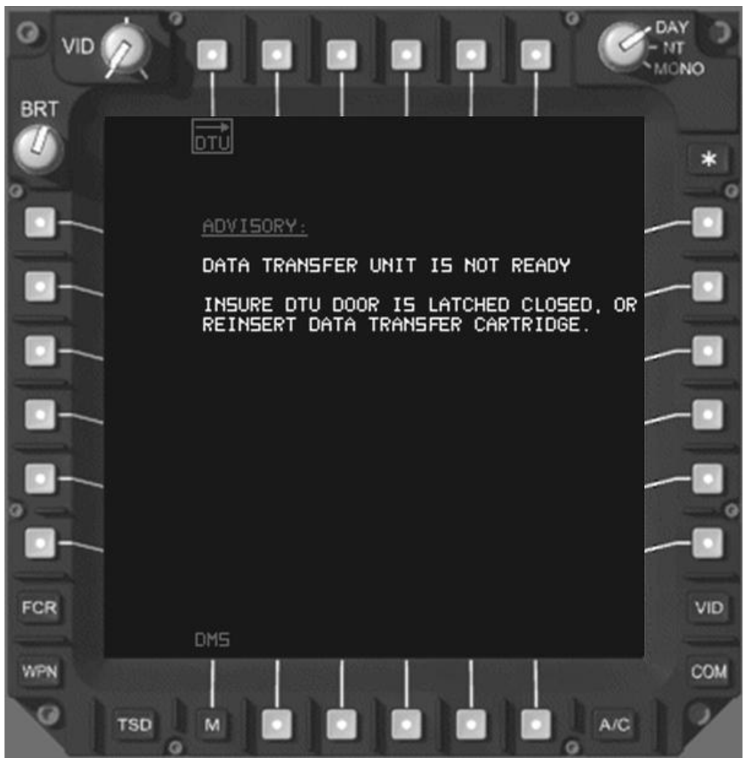


Figure 129. DTU Advisory Page.

(3) If it is determined that the DTU has successfully connected to a PDC, then both DPs begin monitoring the DTU door open/closed status.

(4) When the DTU door is closed, both DPs will check the DTU card slots for valid DTCs.

(5) If valid DTCs are found, then the mission and map DTCs closest to DTU card slot 1 (top slot) will be designated as the active DTCs.

(6) At the end of the process, the DTU selection page should be presented if no errors are present and there is a valid date at the top of the page.

(7) If the door is open during the process or a valid card is not loaded, the following messages may appear on the MPD.

(a) Cartridge not installed – No further processing takes place. "DTC NOT ON BOARD" is displayed on the MPD.

(b) DTU not ready – No further processing takes place. "INSURE DTU DOOR IS LATCHED CLOSED, OR REINSERT DATA TRANSFER CARTRIDGE" is displayed on the MPD.

(8) Any DTU card slots that do not contain valid DTCs will be denoted by a '**?**' next to the slot number designation.

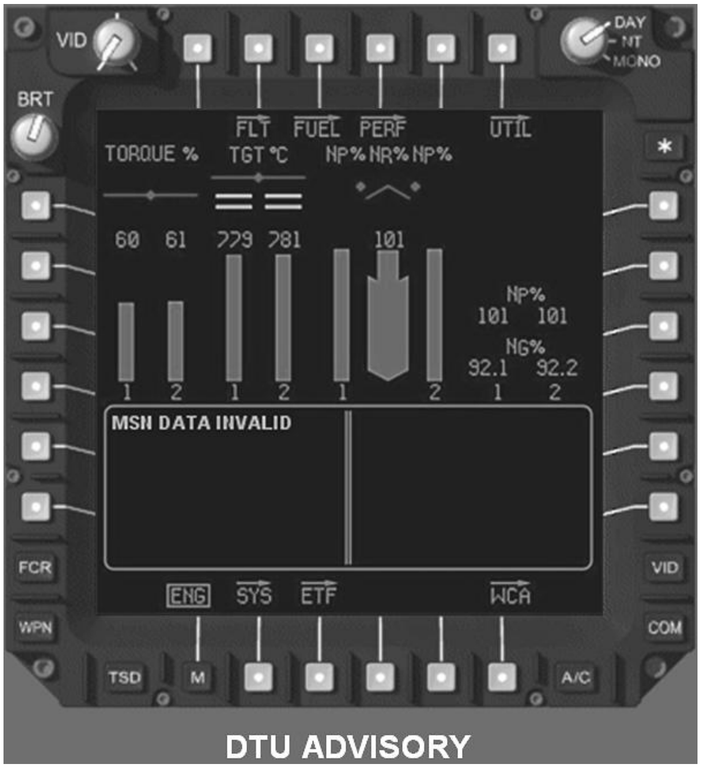


Figure 130. DTU Advisory.

(9) If there is a problem with the DTC connection the following caution can be displayed on the UFD and MPD.

(a) MSN DATA INVALID – There is no connection to the Fibre Channel link and mission data is invalid.

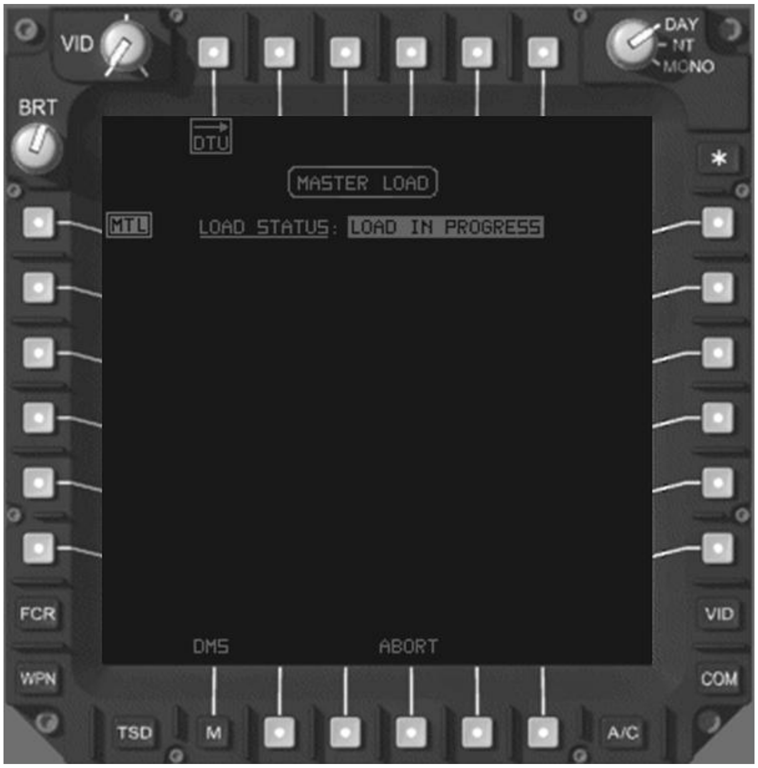


Figure 131. DTU Upload.

(10) The DTU uploads information over the FCDB to the PDC, which then packages the information and sends it to the SPs, the other DP, and the WPs.

(a) The information is transferred from the PDC to the SP and the other DP over the FCDB and the 1553 MUX bus channel 1.

(b) The information is transferred from the PDC to the WPs over the FCDB and the 1553 MUX bus channel 2.

(c) The system automatically uploads saved status files to the aircraft. Selecting an upload function commands the system to retrieve and upload specific data files from the DTC for system or mission operations. Selecting the MASTER LOAD option will sequentially upload multiple initialization files from the DTC.

(d) Once the upload is complete, the SP will send a LOAD COMPLETED status message to the DP for display on the MPD.

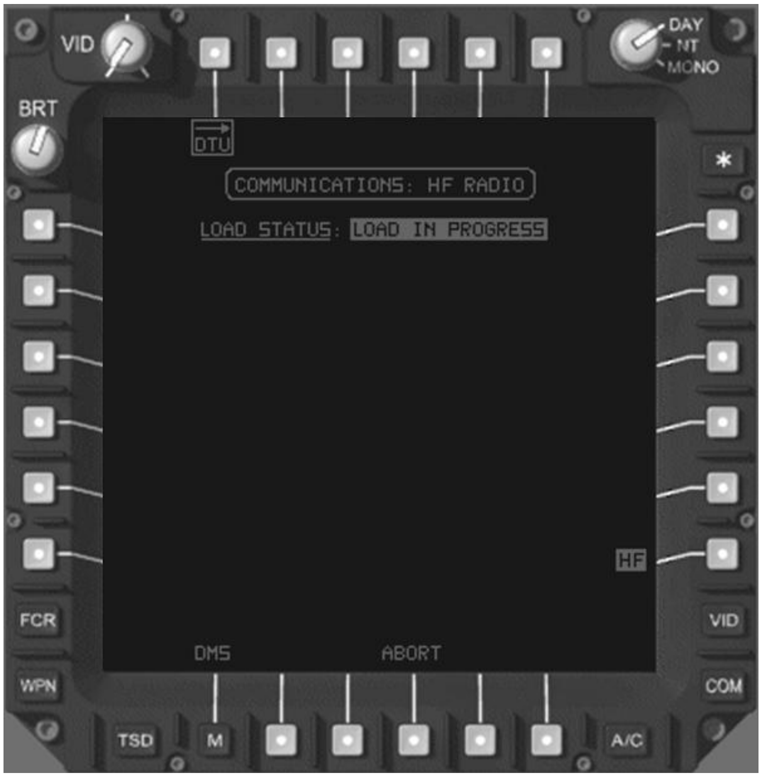


Figure 132. DTU HF Load Pages.

(11) DTU HF load

(a) If selecting MASTER LOAD to transfer data, the HF radio data will not be transferred; and it will become necessary to do the HF transfer independently.

(b) Selecting the current mission will provide access to the COMMUNICATION selection.

(c) Selecting COMMUNICATION will provide access to COM DATA where the HF radio upload can be selected.

(d) Selecting HF will begin the upload process to the HF radio. The SP will send a load status to the DP for display on the MPD.

(e) Once the upload is complete, a LOAD COMPLETED status message is displayed.

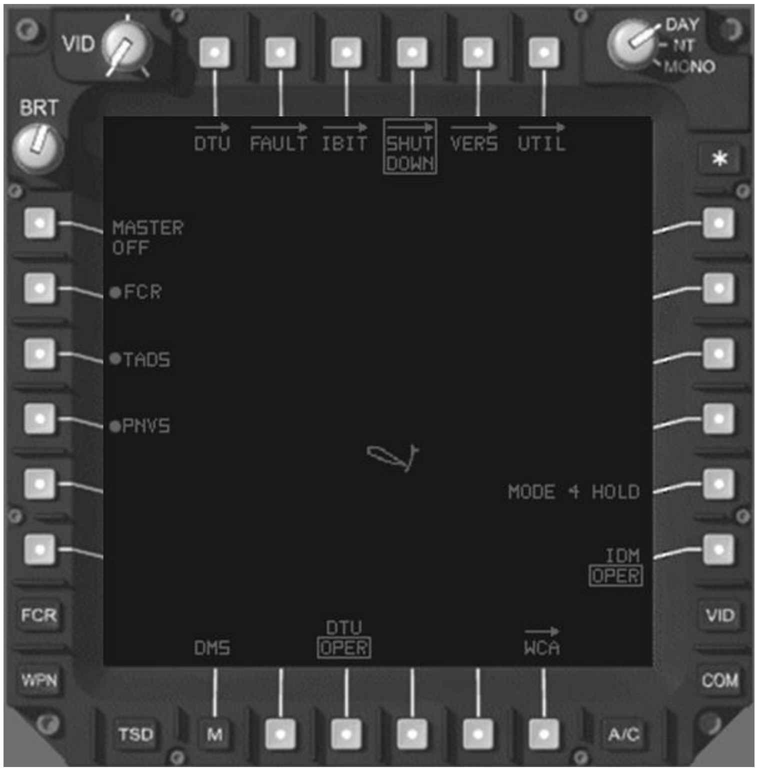


Figure 133. DTU Shutdown.

(12) DTU Shutdown

(a) During aircraft shutdown, care must be taken to ensure that the DTU is powered down correctly. Improper shutdown can result in the possible loss or corruption of post-mission data being written to the DTC, or result in a destructive zeroize being performed on the DTC. To prevent corruption of data or destructive zeroize during aircraft shutdown, the following procedures must be followed.

(b) Select the SHUTDOWN page.

(c) On the SHUTDOWN page, select MASTER OFF, DTU OPER, or IDM OPER.

(d) When SHUTDOWN appears, selecting YES will allow the previous selection to write data back to the DTC and complete the shutdown process. Either MASTER OFF or DTU OPER must be selected to power-down the DTU.

(e) Once the shutdown process has been successfully completed, STBY will be presented under the selections on the MPD. This process can take several seconds to complete, depending on the amount of data to be written to the DTC.

CHECK ON LEARNING

1. The DTU provides the ability to store, upload, and download ____ data.

2. The DTC can store approximately ____ of mission and map data.

Q. Enabling Learning Objective 17

After this lesson, you (the student) will:

ACTION: State the purpose and location of the Maintenance Data Recorder (MDR) and its interface with the MUX system.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose and location of the Maintenance Data Recorder (MDR) and its interface with the MUX system.

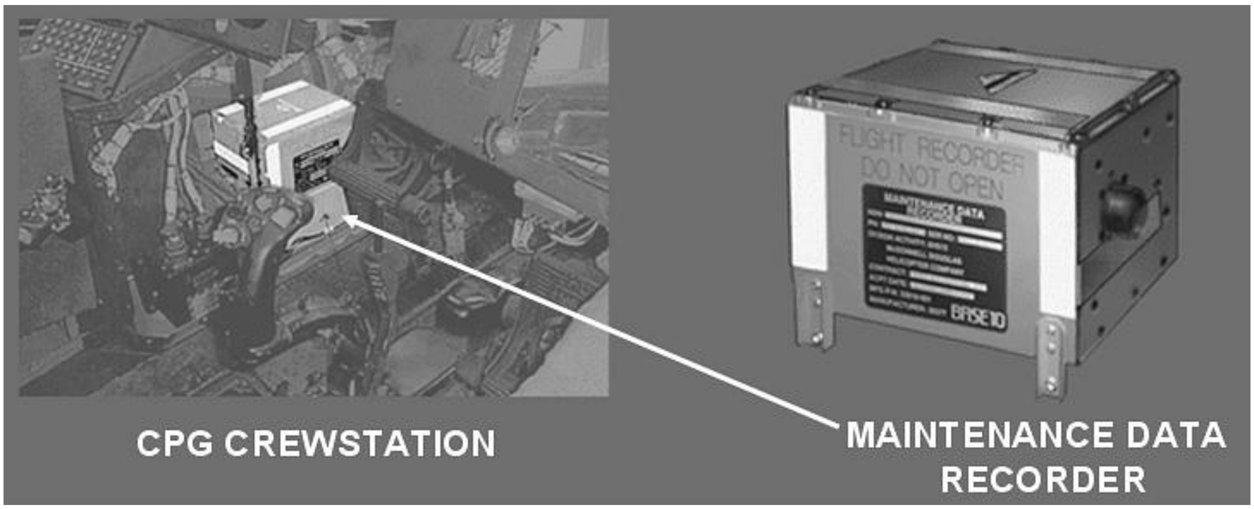


Figure 134. Maintenance Data Recorder.

a. MDR

(1) The MDR is mounted behind a panel next to the CPG's left foot.

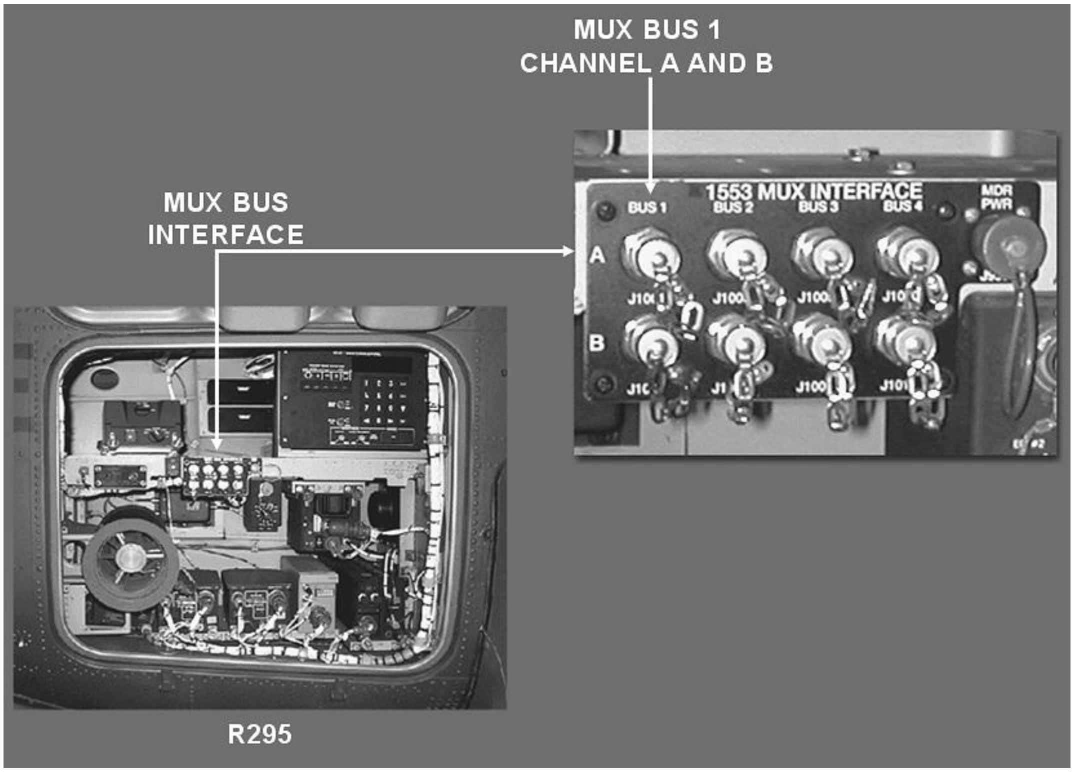


Figure 135. MUX Bus Connections.

(2) The MDR is downloaded using the MUX Bus interface located inside panel R295.

(3) When downloading data from the MDR, Bus 1 channel A or B must always be used to complete the transfer.

Figure 136. MDR Operation.

(4) The MDR provides a crash-survivable data storage medium for aircraft mishap investigation. The MDR consists of a processor connected to the 1553B channel 1 bus and a block of flash programmable Non-Volatile Memory (NVM).

(5) SP access to this NVM is through a set of commands that give the SP control over reading, writing, relative addressing, and MDR modes.

(6) The MDR enhances aircraft maintenance by storing up to 128 faults and 32 exceedances per flight.

(7) The MDR records the following types of data:

(a) Warnings, cautions, and advisories

(b) Flight data, such as:

1) Engine Health Indicator Test (HIT) results

2) Flight hours

3) Landings

(c) Electronic Logbook data such as:

1) Rounds fired

2) Equipment operating times for 18 systems

3) Software versions

4) Equipment installed

5) Aircraft weight

6) Aircraft Center of Gravity (CG)

(d) Aircraft drive train sensor data, such as:

1) Oil and hydraulic temperature and pressures

2) Torques

3) TGT

4) N_G

5) N_R

6) N_P

(e) Safety data, such as:

1) Flight control positions

2) Altitude

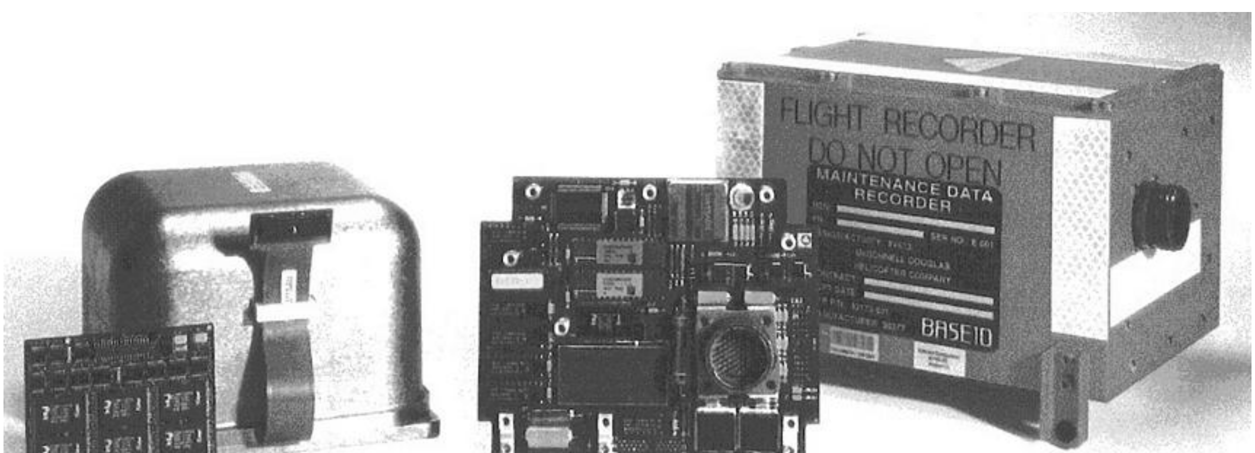
3) Attitude

(8) The MDR also records voice from two separate audio channels—one for the pilot and one for the CPG.

(a) Each voice channel records up to 30 minutes of digitized crewmember audio.

(b) Voice is recorded in a separate area of the NVM in a continuous loop with the oldest voice replaced first when the memory becomes full.

(c) Although voice is downloadable using the MSD computer if the situation requires, the software to allow listening to the voice audio is currently restricted. Accident investigation teams and other units requiring access to the information for evaluation purposes generally maintain software for voice.



MAINTENANCE DATA RECORDER

Figure 137. MDR (Internal).

b. The MDR is an electronic processor containing an applications processor, volatile and nonvolatile RAM and ROM, MUX bus interfaces, system utility timers, hardware resets, and a power supply.

c. MDR major components

(1) NVM

(2) Crash housing

(3) Processor

(4) Chassis

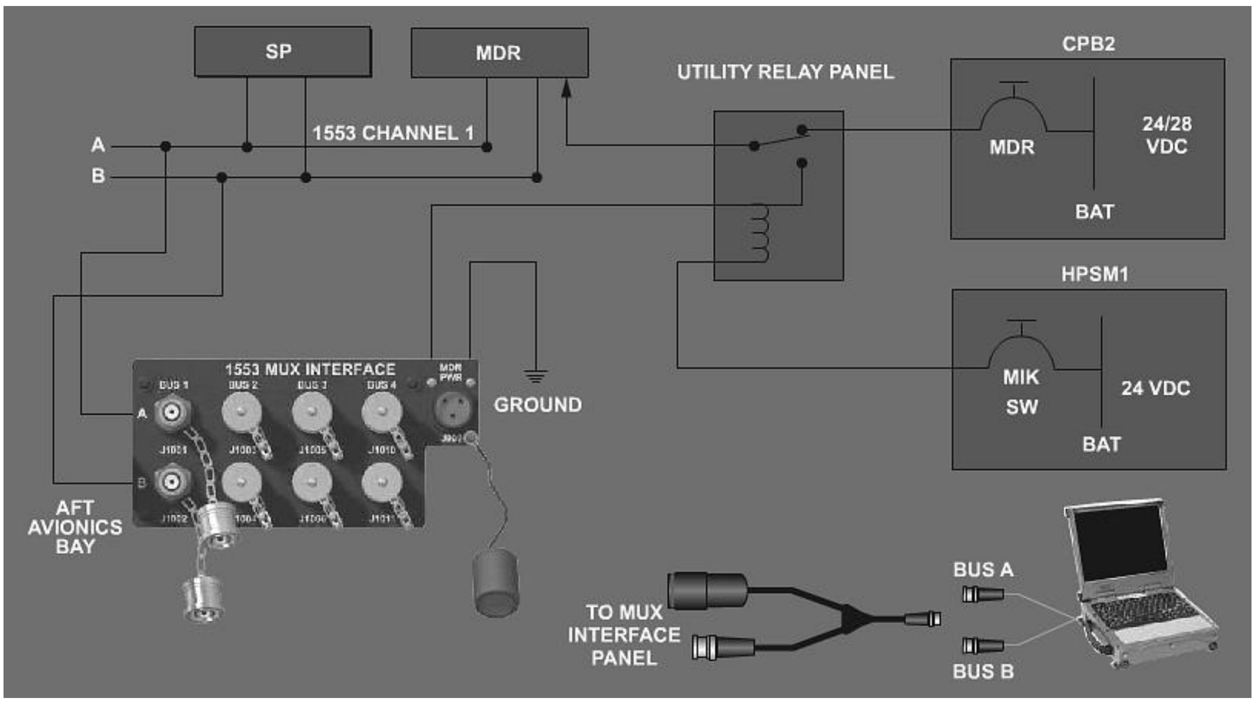


Figure 138. MDR Interface.

d. MDR interface

(1) 24/28 Vdc power is provided by one of two sources, depending on mode of operation.

(a) Normal operation

28 Vdc power is provided by the MDR circuit breaker in the battery section of CBP2.

(b) During downloading of data

24 Vdc power is provided by the Master Ignition Key Switch (MIK SW) circuit breaker on HPSM1 through a relay in the Utility Relay Panel (URP). A jumper attached to the download cable used with the MSD energizes the relay.

(2) Jumper connections for MUX bus terminal address selection. The address is 01000 (8)

(3) MDR is connected to the MUX bus through channel No. 1:

(a) Bus A via DLTU 1AT11

(b) Bus B via DLTU 1BT11

(4) The MSD computer Longbow Integrated Maintenance Support System (LIMSS) Ground Analysis Software (GAS) provides the maintainer with the capability to download recorded flight, maintenance, and safety data from the MDR, view flight data, and test the MDR 1553 interface.

(5) The MDR power connector provides a jumper to energize the URP relay.

(6) MUX bus connections provide connection for the MSD computer 1553 MUX Bus card. Only one bus of channel 1 is usable at a time. If Bus A does not respond, try connecting to Bus B.

CHECK ON LEARNING

1. The MDR can store up to ____ faults and ____ exceedances per mission

2. The ____ provides the maintainers the capability to download data from the MDR.

R. Enabling Learning Objective 18

After this lesson, you (the student) will:

ACTION: Identify the purpose and operation of the DMS warnings, cautions, advisories, and faults.

CONDITIONS: Given a written test utilizing the IETM without the use of student notes or references.

STANDARD: In accordance with TM1-1520-251-10 and TM 1-1520-LONGBOW/APACHE IETM.

1. Learning Step/Activity 1

Identify the purpose and operation of the DMS warnings, cautions, advisories, and faults.

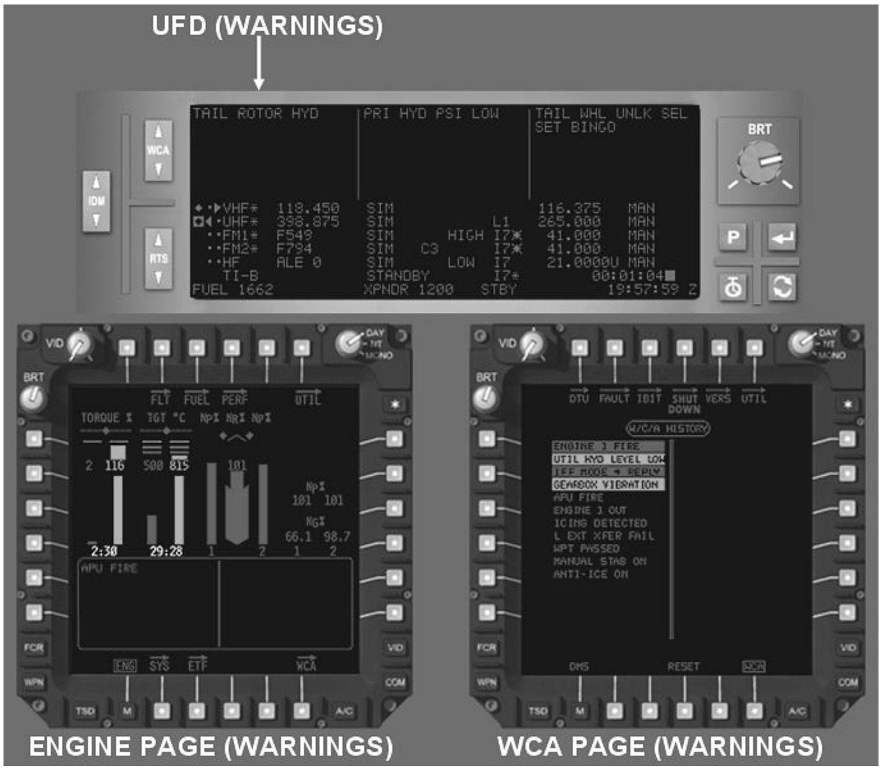


Figure 139. UFD, Engine Page, and WCA Page (Warnings).

a. Warning messages

DMS warning messages inform the operator of conditions that require immediate attention. Warning messages appear on the UFD and on the MPD Engine and WCA pages.

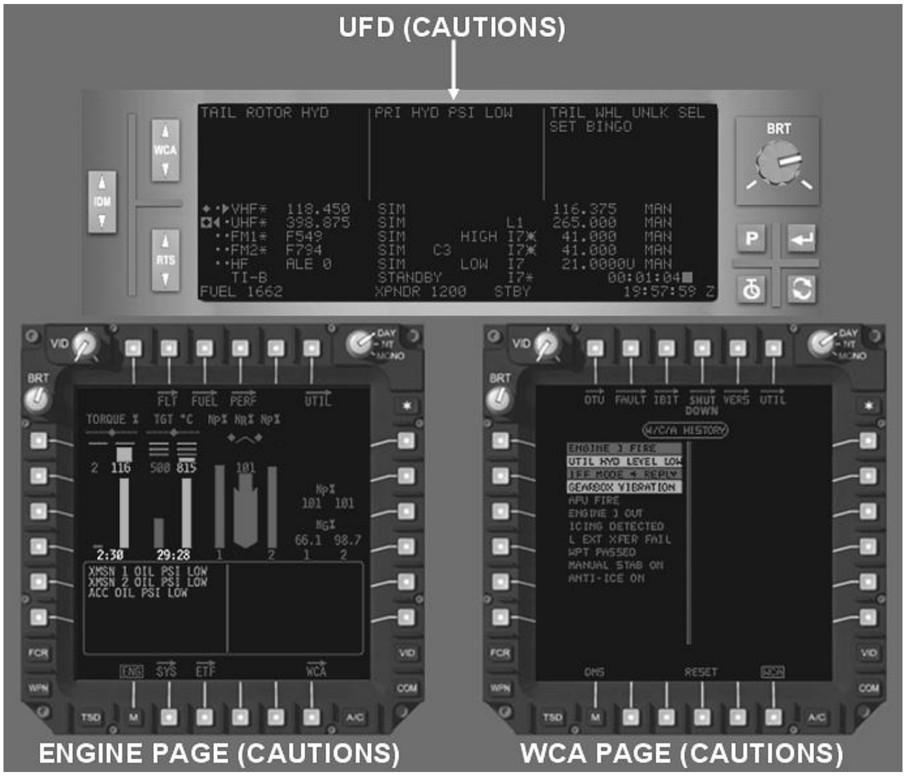


Figure 140. UFD, Engine Page, and WCA Page (Cautions).

b. Caution messages

DMS caution messages inform the operator of conditions that require operator attention, but not immediate action. Caution messages are shown on the UFD and on the MPD Engine and WCA History pages.

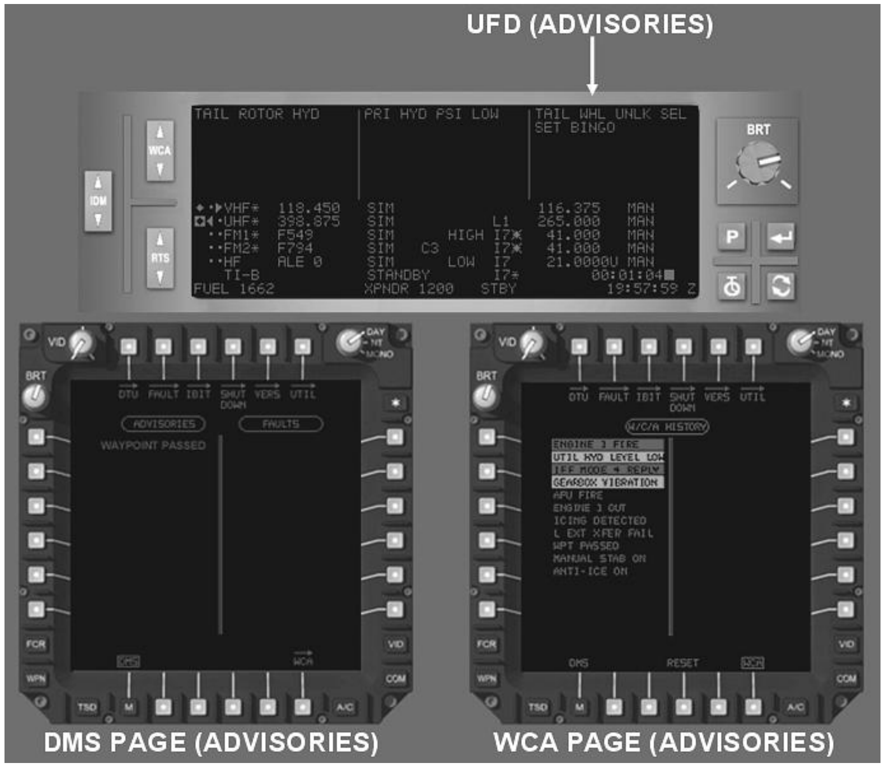


Figure 141. UFD, DMS Page, and WCA Page (Advisories).

c. Advisory Messages

Advisory messages may be viewed on the UFD, DMS page, or DMS WCA page. Advisory messages are not displayed on the in-flight Engine page.

d. The DMS WCA page list buttons will be presented when the listing area contains more than 15 WCAs, allowing the operator to select the next page of the list. The last line of text on page 1 will be the first line of text on page 2.

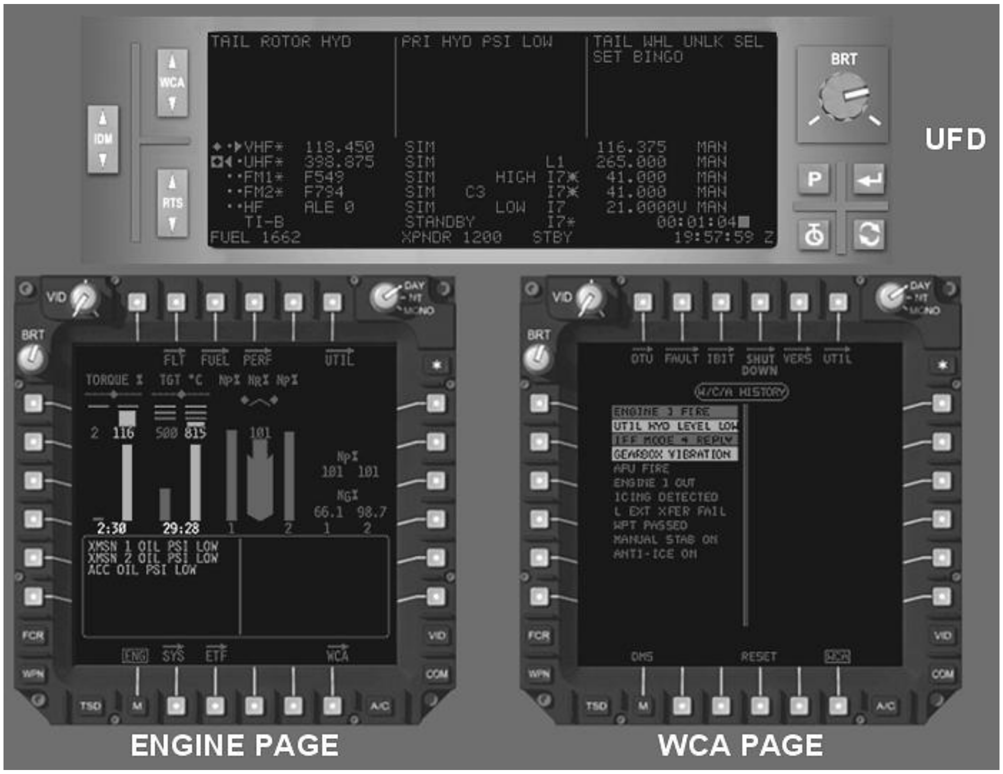


Figure 142. UFD, Engine Page, and WCA Page.

e. WCA page

(1) The WCA page is selectable from the DMS page by pressing the WCA button at the bottom of the page. The WCA page displays warnings, cautions, and advisories in 2 formats:

(a) WCAs that have occurred since the RESET button was selected will be displayed in inverse video (highlighted).

(b) Pressing the RESET button on the bottom of the screen can clear inverse video. The inverse video is cleared to ensure new faults are readily identified.

(c) Any new WCAs detected will be displayed and stored in the MDR.

(2) WCA are displayed in the order of occurrence with the last indication on top of the list

(3) The WCA page displays 2 columns of text with 15 lines per column. Each line contains a maximum of 18 characters per line. If more than 30 lines are needed, a paging function is provided to show all 128 indications.

f. Engine page with WC listing block

(1) The ENG (Engine) page has two display modes: ground and flight mode.

(2) Warnings and cautions are displayed in the flight mode only.

(3) The flight mode of the ENG page can be displayed on the ground if the engine power levers are moved to the FLY position.

(4) The flight mode ENG page has a window under the engine data digital readout in which active engine-related warnings and cautions can be displayed. The window will not be displayed if no warnings or cautions exist.

(5) The WC listing area shows two columns of text with six lines per column.

(6) Each line contains a maximum of 18 characters.

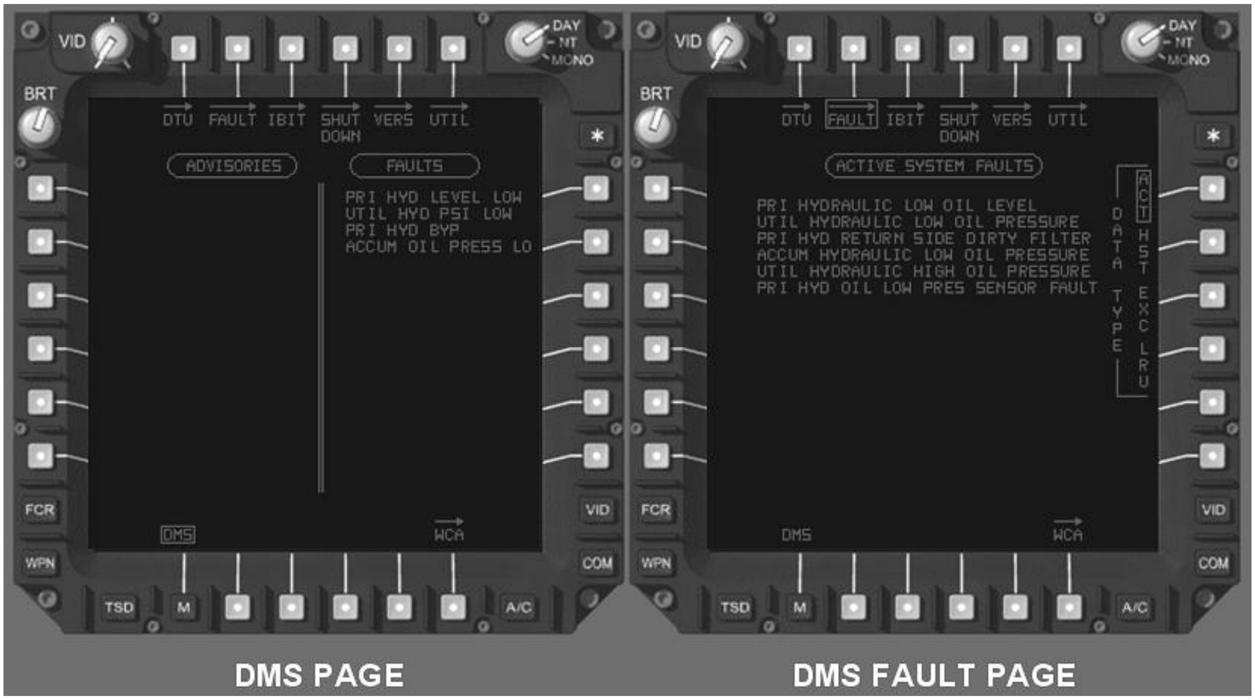


Figure 143. DMS and Fault Pages.

g. DMS and Fault Pages

(1) The MPD Fault page is the primary fault display. No faults are presented on the UFD. The MPD fault page displays fault information designed for use by the maintainer. The page is accessible from the DMS page by selecting the FAULT variable action button at the top of the display.

(2) The DMS Fault page has four selectable modes:

(a) ACT (Active) mode shows active subsystem faults.

(b) HST (History) mode shows a history of subsystem faults.

(c) EXC (Exceedance) mode shows a history of the exceedance indications.

(d) LRU (Line Replaceble Units) mode shows LRU and sub-LRU failure information.

(3) All four modes are selectable on the ground or in the air. Paging and mode selections are managed by the DP, which controls the MPD.

(4) All fault information is stored in the SP. The DP is continuously updated by the SP. The SP receives fault indications via direct wires or the MUX Bus.

(5) The SP filters the fault data such that the fault must be present for 10 consecutive seconds before it is displayed.

(6) The SP sends the filtered fault information to the DP over the MUX bus.

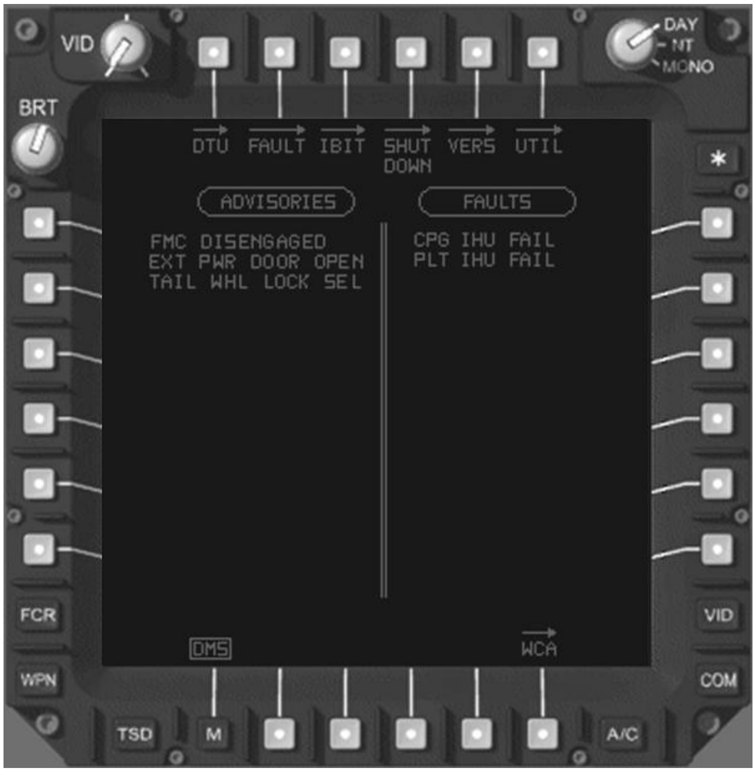


Figure 144. Fault Page Active Mode.

h. Fault page ACT (Active) mode

(1) The FAULT page in the ACT mode lists the subsystem fault messages presently being processed by the primary SP. The Active mode is the Fault page default mode after power is applied to the aircraft. The Active mode is selectable by pressing the ACT button on the right side of the display.

(2) When the Fault page is in the Active mode, two pages of text with a maximum of 15 lines of text per page may be presented. Each text line has a maximum of 35 characters.

(3) The text indicates which subsystem or LRU, Shop Replaceable Unit (SRU), and subsystem function or BIT test has failed.

(4) Each line of text maps to a unique fault isolation procedure or maintenance action available to the user in the IETM.

(5) When a fault no longer exists, it will be removed.

i. Fault page HST mode

(1) The FAULT page in the History mode displays fault messages that are stored on the MDR or are resident in the SP if power has not been removed from the aircraft.

(2) The History mode is selectable by pressing the HST button.

(3) The History mode does not delete faults from the display when they no longer exist. HST faults are stored in the MDR for the duration of the mission.

(4) The History page displays up to 9 pages of text at 15 lines per page.

j. Fault page EXC mode

(1) The FAULT page in the Exceedance mode displays text messages of aircraft exceedances.

(2) An exceedance is indicated when an aircraft performance parameter has reached an operating value that requires a maintenance procedure to be performed.

(3) Exceedance text messages name the aircraft subsystem being monitored along with the exceedance value and time.

(4) The EXC mode is selectable by pressing the EXC variable action button. EXC messages are stored in the MDR for the duration of the mission.

(5) The EXC page displays up to 9 pages of text at 15 lines per page.

k. Fault page LRU mode

(1) The FAULT page LRU mode displays component failure information of selected LRUs.

(2) The mode is selected from the fault page by pressing the LRU variable action button. Once the mode is selected, the operator needs to select an LRU for testing.

(3) Selecting an LRU does not put the LRU in an “off-line mode.”

(4) The test is nonobtrusive to the operational state of the LRU.

(5) LRU selections are displayed on the right- and left-hand sides of the MPD and include the DPs, SPs, WPs, and CIU.

(6) The LRU test display is a matrix of ones and zeros (bits) which represent the state of a particular test being monitored.

(7) The IETM must be used to understand which test is being monitored.

(8) 512 test results are shown as bits on the LRU page.

(9) Each bit position can be referred to by word number (1 or 2), and line (vertical axis).

(10) Each line position is defined by a line number (1–16) on the left-hand side of the page.

(11) The words are divided into columns 1 and 2. Each column is divided into 16 bits (read from left to right).

(12) Normally, zeros indicate a successful test, and ones indicate a test failure. Unused spaces are occupied with zeros.

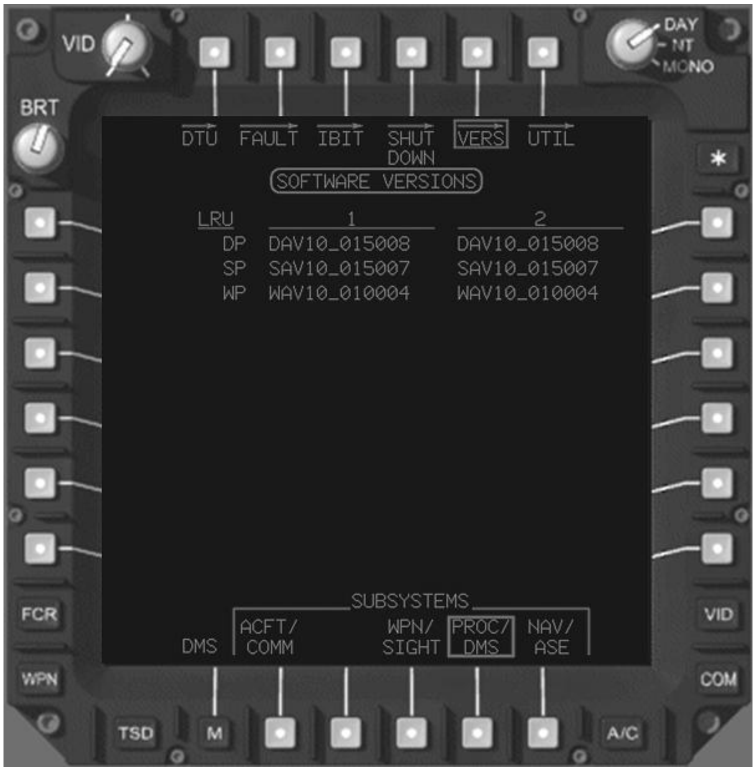


Figure 145. Software Version Pages.

l. Software VERS (Versions) page

(1) The VERS page allows the operator to determine the software version of the programmable equipment installed on the aircraft.

(2) Mismatched software versions will be denoted by the version numbers appearing side by side with the text in white.

CHECK ON LEARNING

1. DMS warning messages appear on the UFD, MPD, and ____ pages.

2. The FAULT page has ____ selectable modes.