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SECTION 4. PRINCIPLES OF OPERATION

4.1. GENERAL

This section describes the principles of operation of all major systems of the FTDs. Reference to FSI drawings will be required on some systems for explanations. A list of all vendor-related publications is provided at the end of Section 1.

4.2. POWER DISTRIBUTION SYSTEM

The power distribution system consists of both AC and DC power. The following paragraphs explain the principles of operation for both AC and DC distribution.

4.2.1. Facility Power

The power required from the site source is 12,000VA (240V x 50A). The designed load limit for the FTD is 9,600VA (12,000VA x 80%). The predicted load is 8,170VA. The allowable input voltage range is 230 VAC ±10%. This allows the use of two phases of the three-phase 208 VAC source.

The facility site power is supplied separately to six major areas on the OFT, four on the IFT, and three on the UTD. See Figure 4-1, Sheets 1 and 2. See Figure 4-2 for power distribution to the Sound Computer and Audio Processing System (APS).

AC Power Controller Assembly (9A1A1)

Digital Servo Remote Power Controller (9A2A5)

Fire Detection Master Control Panel (9A7A1)

Visual Projector Remote Power Controller (10A0A1) – OFT Only

Image Generator Equipment (IGE)1 PD1 (10A1) – OFT and IFT Only

IGE1 PD2 (10A2) – OFT Only

All receive 3-phase power with neutral bus and ground bus, except for the Fire Detection Panel, which receives single phase.

Detailed power distribution drawings for the OFT are 6520A00130 and 130E, Facility Electric Power and 6520ABA151, Simulator Power Control.

Detailed power distribution drawings for the IFT are 6520A00530 and 530E, Facility Electric Power and 6520ABA251, Simulator Power Control.

Detailed power distribution drawings for the UTD are 6520A00330 and 330E, Facility Electric Power and 6520ABA351, Simulator Power Control.

The circuit breaker schedules for the three devices and the fire detection system are in 6520A0001E.

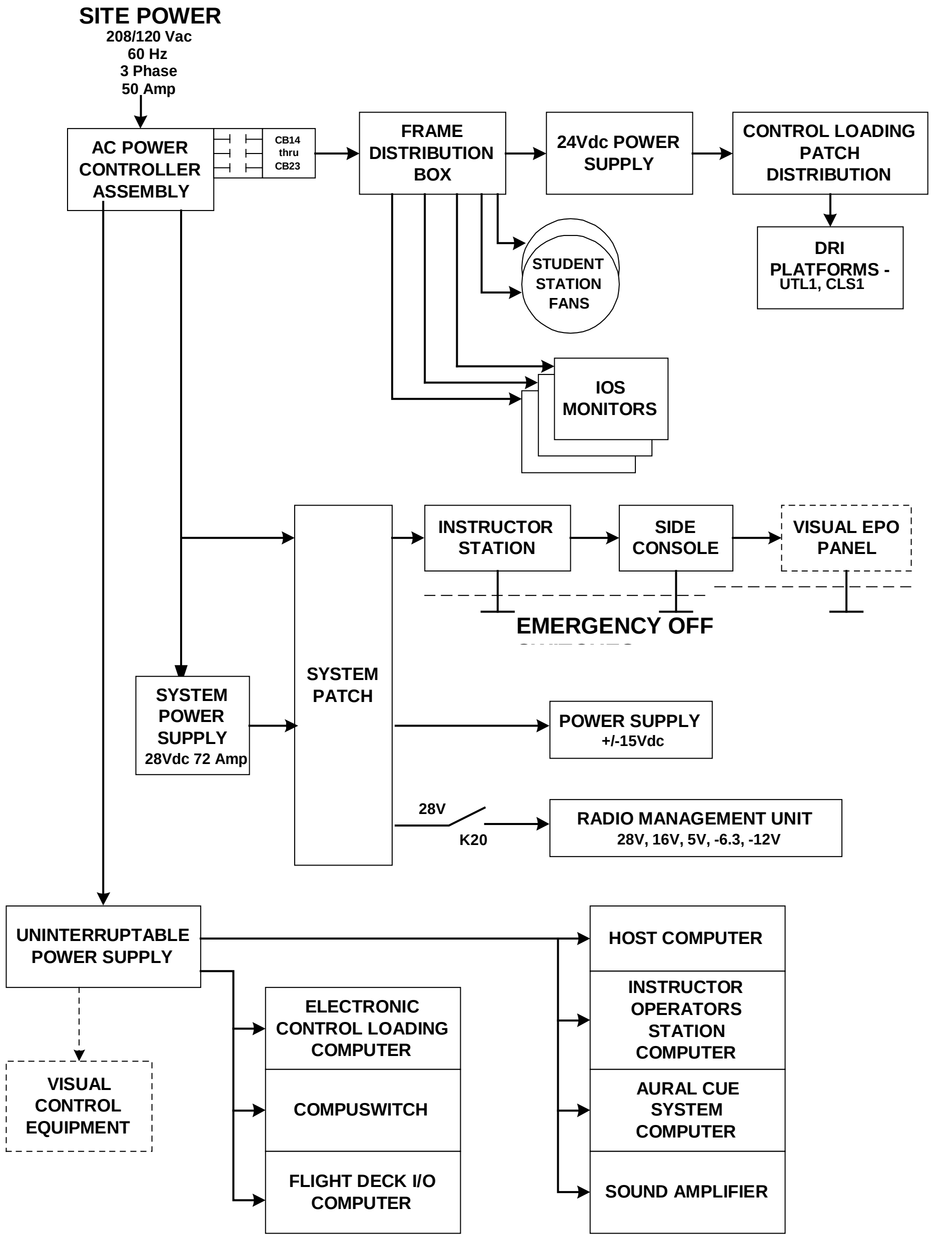

Figure 4-1. Power Distribution (Sheet 1 of 2)

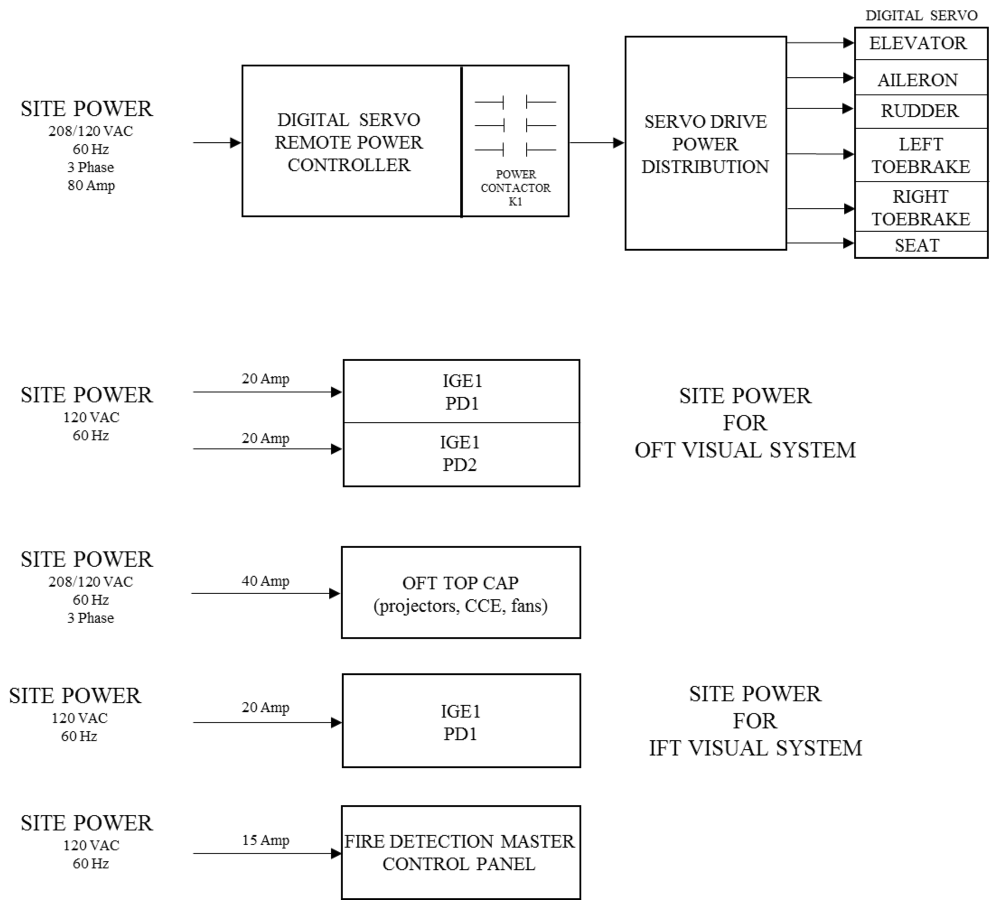

Figure 4-1 Power Distribution (Sheet 2 of 2)

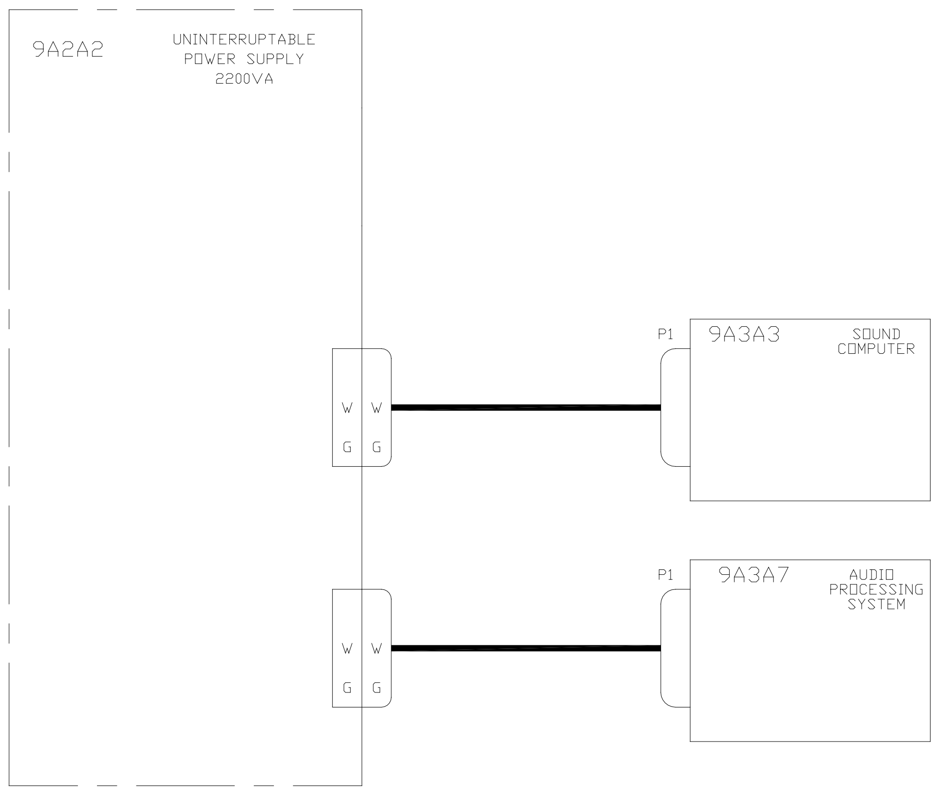

Figure 4-2. AC Power Distribution for APS

4.2.1.1. Ground Cabling

The ground cabling system is shown in Figure 4-3. Ground cabling to the Visual Cabinet 10A1 is not used on the UTD. Ground cabling to the Visual Support Ring, 6A3, and the Top Cap, 10A0, is not used on the IFT and the UTD.

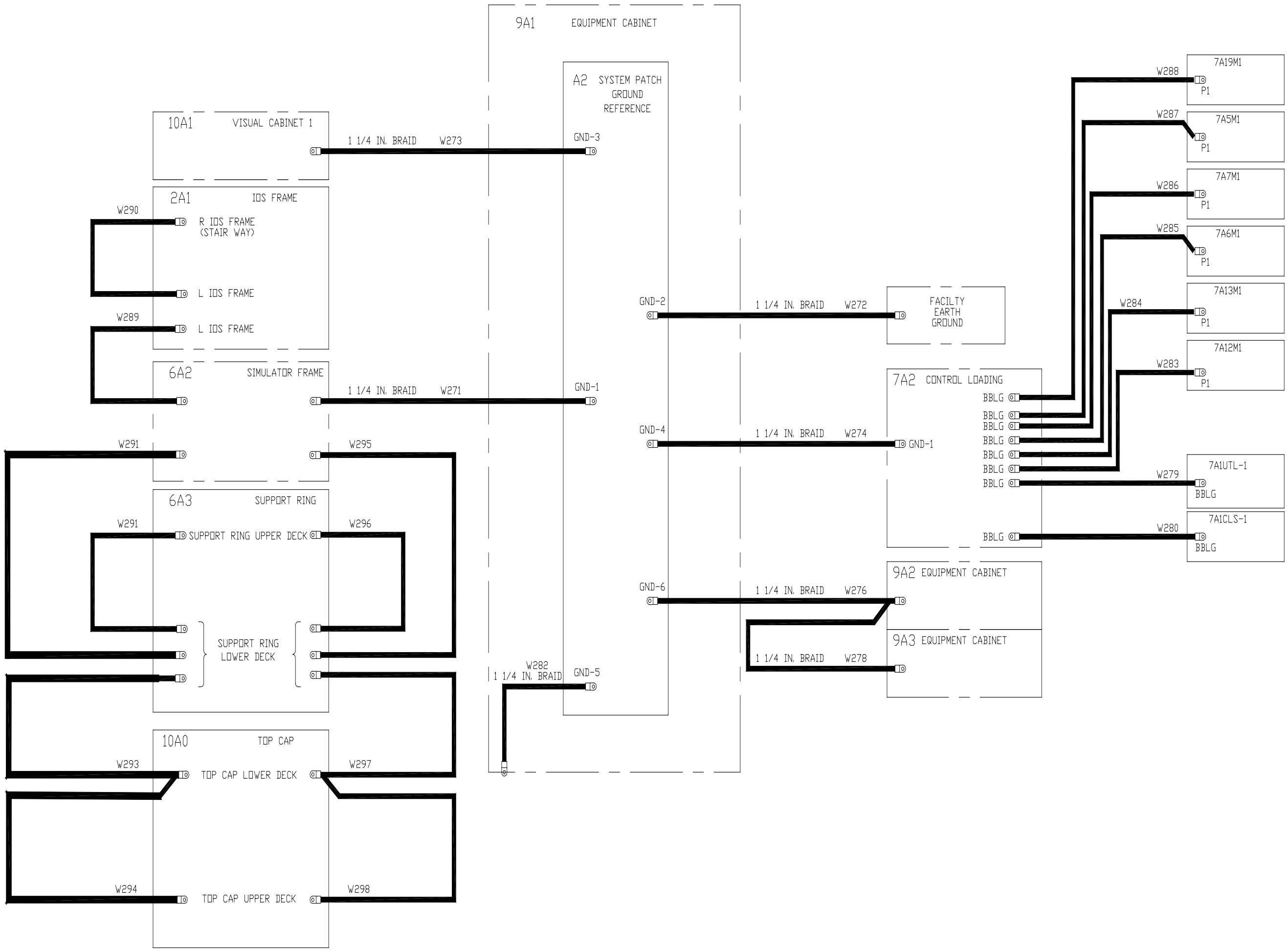

Figure 4-3. Ground Cabling System Diagram

4.3. AC POWER DISTRIBUTION

The facility site provides 208/120 VAC, 3-phase, 60 Hz power (See wiring diagrams 6520A00130E, 230E/530E, and 330E) to the AC Power Controller Assembly in the Equipment Cabinet (9A1A1) for further distribution to the Uninterruptible Power Supply (UPS) (6A2A1) in the Equipment Cabinet. The UPS provides power to the Electric Control Loading (ECL) Computer, the Compuswitch, the Flight Deck I/O Computer (FDK I/O), the Host Computer, the Instructor Operators Station (IOS) Computer, the Sound Computer and Audio Processing System (APS), the Sound Amplifier, and the Visual Control Equipment. The UPS will maintain power to these systems during a power failure long enough to manually shut down each system with the IOS PC.

The AC Power Controller Assembly also provides 208 VAC which is used to supply the 24VAC Emergency Off loop circuit. The Emergency Off switches are located at the IOS, on the left side of the student station console, and the Visual EPO panel.

The AC Power Controller Assembly also provides 208VAC to the 28VDC System Power Supply (SPS). The SPS provides 28 VDC to the ±15 VDC Power Supply (9A2A6PS2) in the Equipment Cabinet. The SPS provides 28 VDC through the K20 relay to the Radio Management Unit (RMU).

IGE1 PD1, IGE1 PD2, and the Projector Remote Power Controller for the OFT receive site power of 208/120 VAC, 3-phase, 60 Hz. The IFT has one IGE only. The UTD has no visual display.

Site power of 208/120 VAC, 3-phase, 80 amps is provided to the Digital Servo Remote Controller. Distribution of the 120VAC, 2-phase is through the K1 (9A2A5) contactor, then to the six Digital Servo Drives (Elevation, Aileron, Rudder, Left Toe Brake, Right Toe Brake, and Seat). See Figure 4-4.

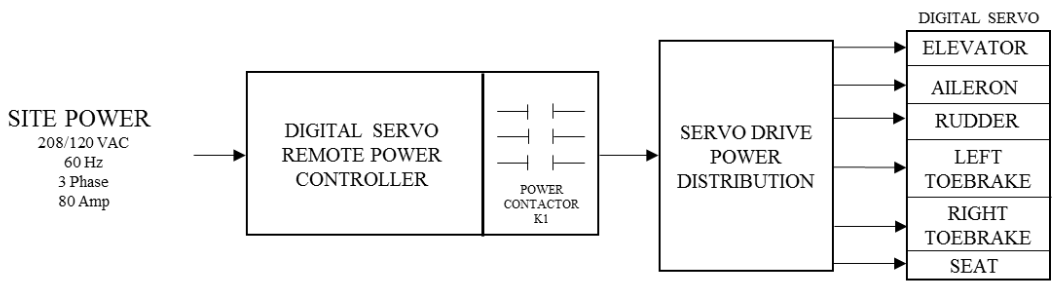

Figure 4-4. Power Distribution

4.3.1. AC Power Controller Assembly (9A1A1)

The AC Power Controller Assembly in the Equipment Cabinet (9A1A1) requires three-phase, 208/120 VAC, 50-amp source. The power buses are identified as phase A, phase B, and phase C on wiring diagrams and schematics. All outlets have a ground connection and all connectors have the metal shells grounded. Ground cables are run from ground reference to each major piece of equipment; the student station, instructor station, equipment cabinets, and visual system. Refer to Figure 4-3.

The AC Power Controller contains the circuitry to accomplish an orderly startup and shutdown of simulator power. CB1 controls the essential power to the simulator. However, visual channels 1 and 2, projector controller, digital servo remote power controller, and fire detection receive site power separately. The 60Hz phase indicators A, B, and C show if each of the AC power phases is being supplied. All three phases pass through K1 (9A1A1) contactor. The start, stop, and emergency off switches control K1 (9A1A1) contactor. Each of the three phases, the neutral bus, and the safety ground are distributed to terminal blocks in the patch system of the equipment cabinet (9A1A2).

Each power phase has the following circuit breakers.

Phase A power is applied to CB3, CB6, CB11, CB13, CB14, CB17, CB20, CB21, and CB23.

Phase B power is applied to CB4, CB7, CB12, CB13, CB15, CB18, CB20, CB22, and CB23.

Phase C power is applied to CB5, CB8, CB11, CB12, CB16, CB19, CB21, and CB22.

Circuit breakers CB11, CB12, CB13, CB20, CB21, CB22, and CB23 provide two-phase power to their respective subsystems. See Table 4-1.

CB2 circuit breaker supplies power to the T1 transformer. T1 converts single-phase, 60Hz to 24VAC power to the AC Loop Control circuit.

Table 4-1. AC Power Controller Circuit Breakers

Circuit Breaker	Component/System
AC Power Controller Assembly 9A1A1	
CB1	Main Power Circuit 208VAC, 3-Phase, 60 Hz, 50 Amp 9A1A1
CB2	24VAC Power Circuit 9A1A1
CB3	Blower Assembly 9A2B1
CB4	AC Power Distribution Box 9A2
CB5	Blower Assembly 9A3B1
CB6	AC Power Distribution Box 9A3
CB7	Spare
CB8	Spare
CB9	Uninterruptible Power Supply 9A2A2
CB10	Emergency Lighting 9A2A2 – OFT and IFT only
CB11	Spare
CB12	28VDC Power Supply 9A2A6PS1
CB13	Spare
CB14	Compartment Light Utility Box 9A9A3
CB15	IOS Monitors 2A1A1,A2,A3
CB16	Seat Motor Controller 1A9A1A1/AFT Fan 6A2
CB17	Visual – IFT / Top Cap Fans – OFT / Spare - UTD
CB18	Nose and AFT Fans 6A2
CB19	Maintenance Outlets 6A2A1
CB20	Spare
CB21	24VDC Power Supply 7A2PS1
CB22	Spare
CB23	Spare

The FTD site main power input to the AC Power Controller (9A1A1) is through the J1 connector and is routed to CB1. CB1 power is applied to the three interlocks on the contactor K1. When the Start switch is placed in the ON position, contactor K1 closes, and AC power is applied to each of the power bus phases A, B, and C in the power controller. A 24VAC, low-voltage Loop Control circuit through CB1 provides 24VAC out of transformer T1 for the 24VAC controls of contactor K1. There are four EPO switches in the EPO loop circuit. These are located in the AC Power Controller Assembly of the equipment cabinet (9A1A1), the Instructor Station Panel (2A2A4), the Student

Station right side console (1A6A8) and the Visual Area EPO Panel (10A0). Also in series are two relays: Smoke Detection relay (K02), and Hi Temperature Sensor relay (K01), one stop switch SDS2 (9A1A1) and the Start switch SDS1 (9A1A1). See Figure 4-5.

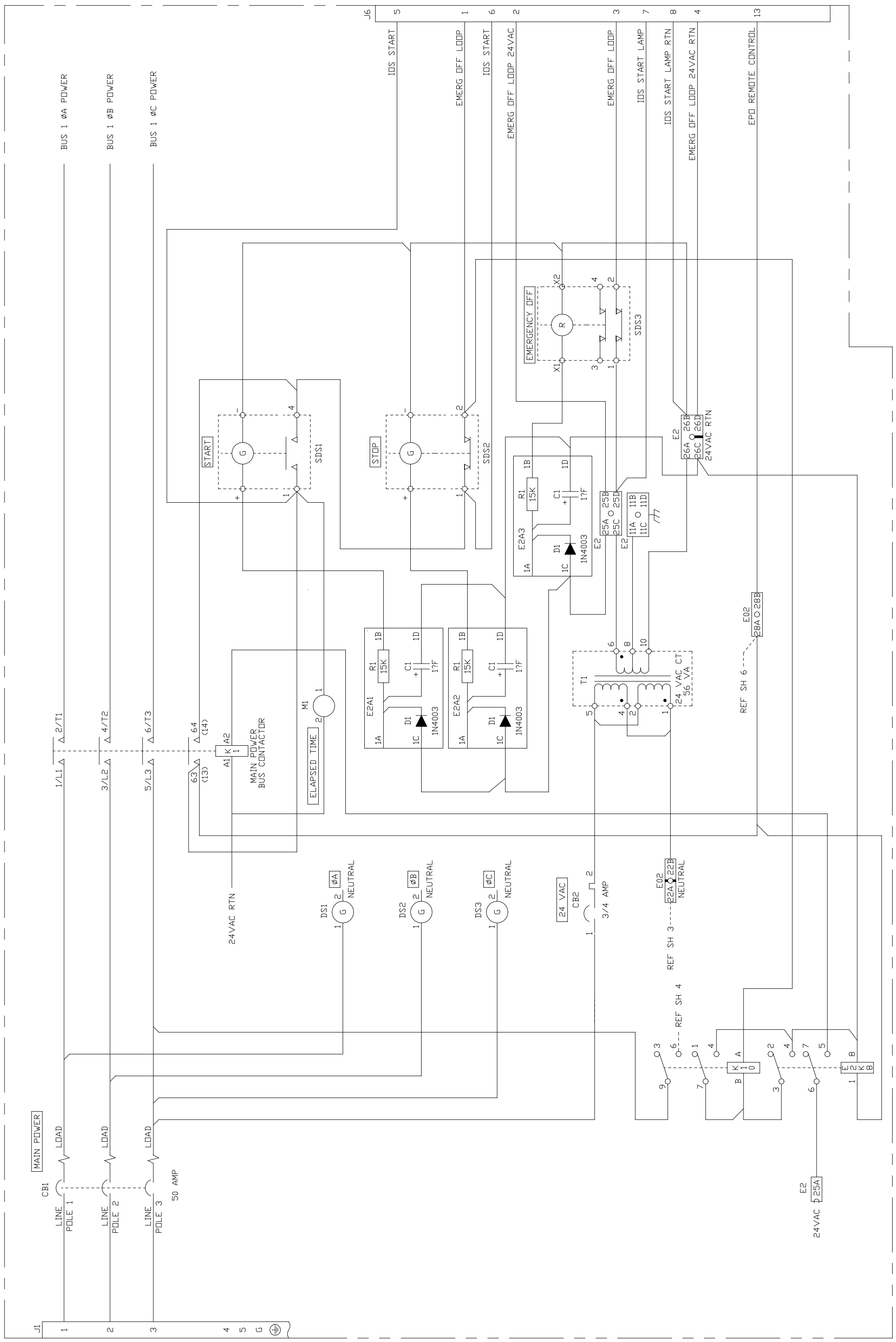

Figure 4-5. AC Power Controller Diagram

4.3.1.1. AC Loop Control Circuit

The AC Loop Control circuit is a series circuit that is designed to control the main power contactor K1 (9A1A1) for shutting off all power to the FTD. The K1 power contactor can open the 3-phase AC power circuit to the FTD in an emergency power off, overheat detection, smoke detection, or stop condition. If there is an emergency power off, the UPS will maintain power to the computers long enough to accomplish an orderly shutdown of each system. See Figure 4-6.

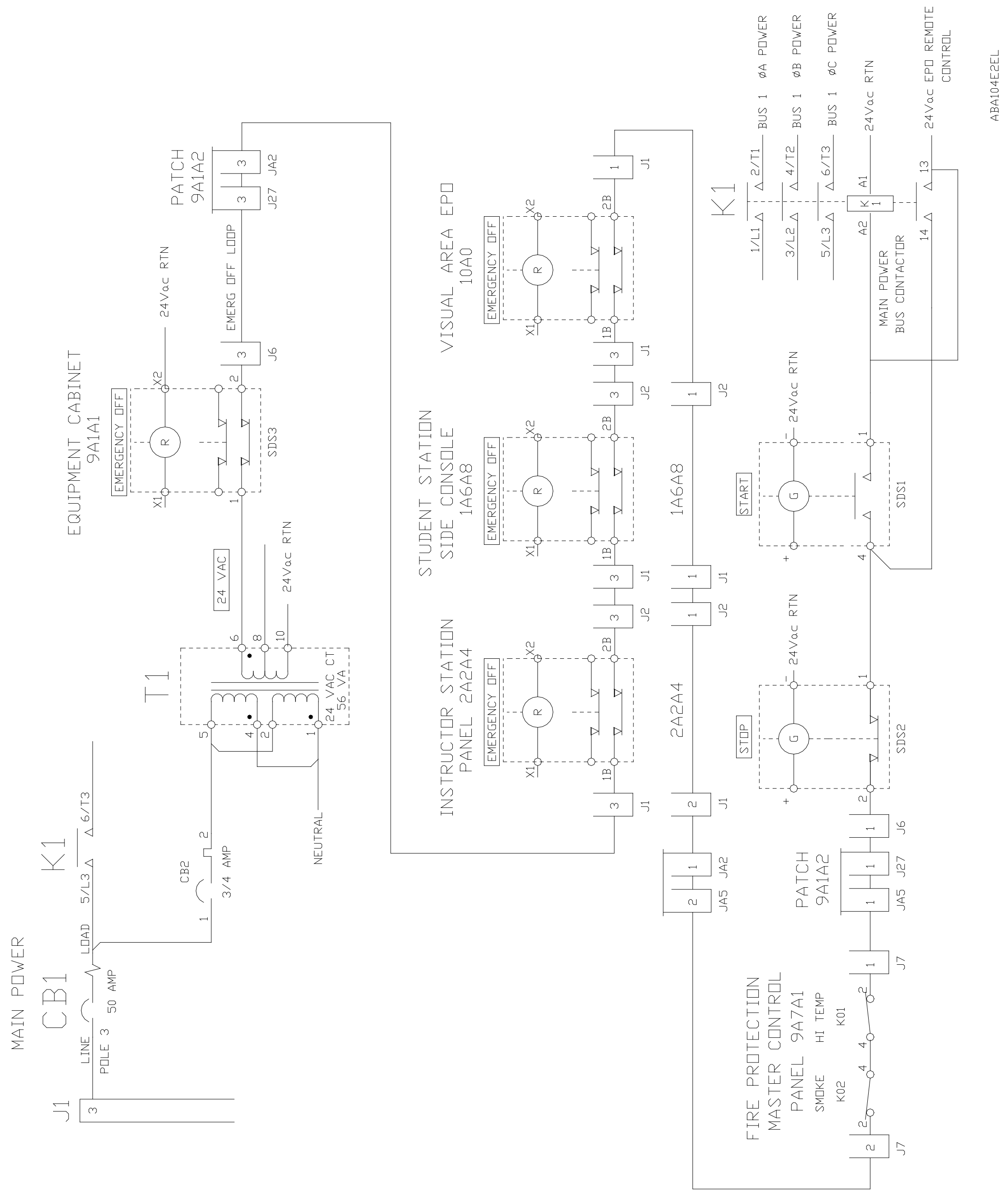

Figure 4-6. Emergency Power Off Loop

4.3.1.2. Emergency Power Off

Manual Emergency power-off switches are in the AC Power Controller Assembly (9A1A1), the IOS panel (2A2A4), the Student Station side console (1A6A8), and the Visual Area EPO Panel (10A0). The smoke detector at the Fire Protection Master Control Panel (9A7A1) opens the K1 contactor when it detects smoke. The overheat detector at the Fire Protection Master Control Panel (9A7A1) opens the K1 contactor when both temperature sensors reach their trip points, 140°F lower trip point and 170°F upper trip point.

4.3.1.3. Equipment Cabinet Cooling

The AC Power Controller provides power through CB3 and CB5 to the AC Power Distribution Boxes (9A2 upper right corner of cabinet for the cabinet blower and 9A3 upper right corner of cabinet for the cabinet blower). See Figure 4-7 and Figure 4-8.

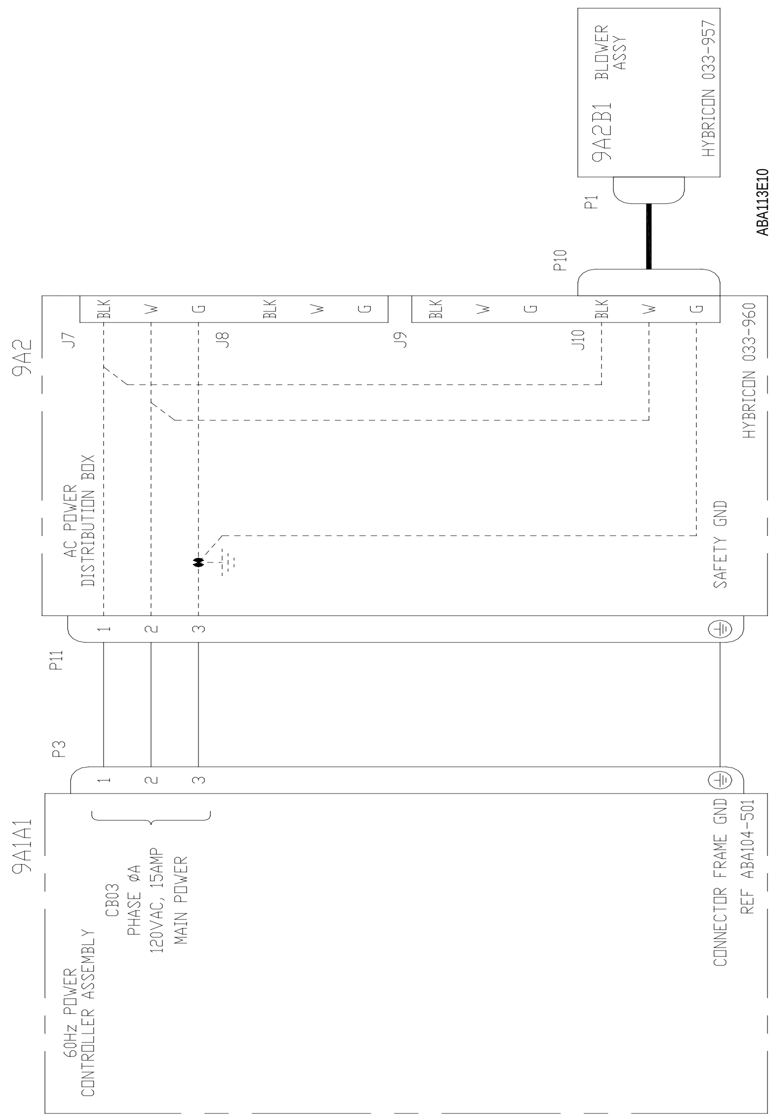

Figure 4-7. Cooling Fan 9A2B1 Diagram

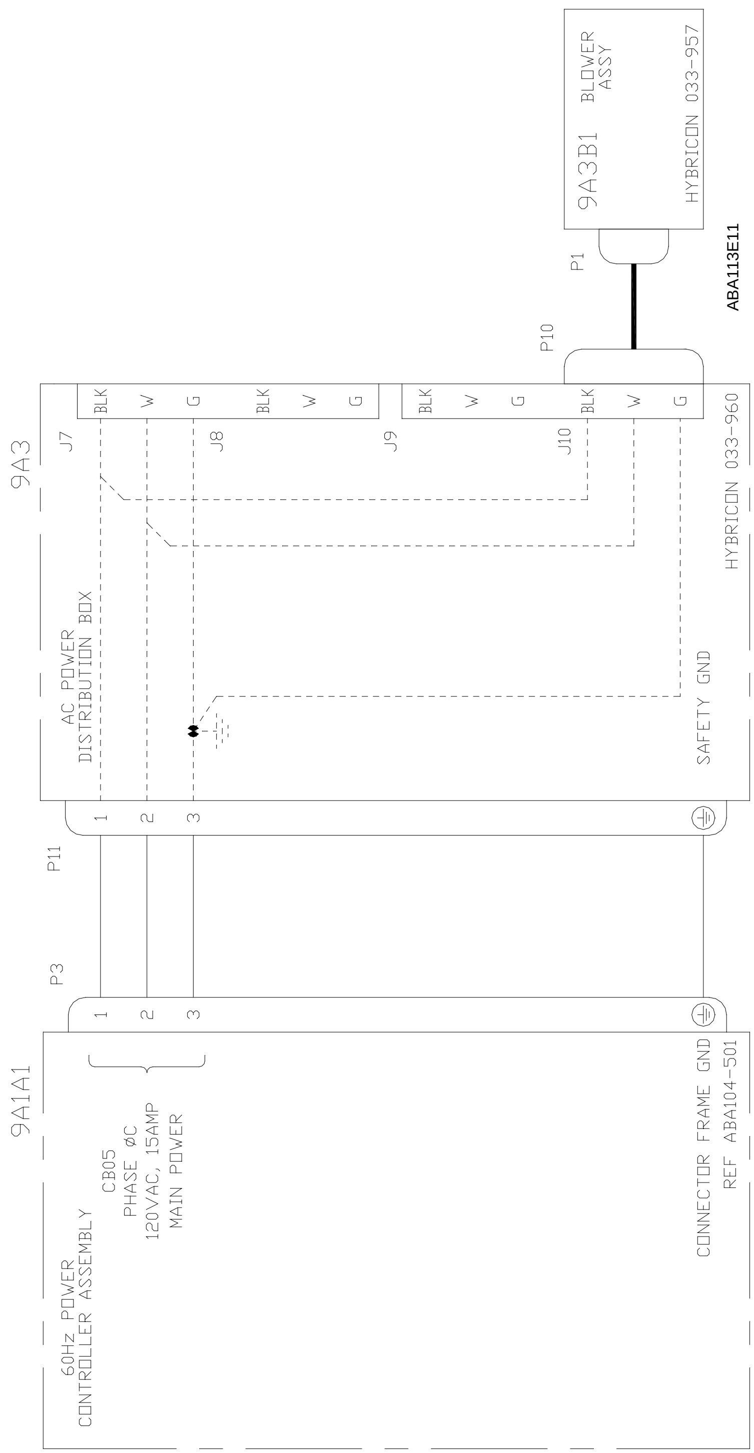

Figure 4-8. Cooling Fan 9A3B1 Diagram

4.3.1.4. Uninterruptible Power Supply (9A2A2)

The Uninterruptible Power Supply (UPS) receives power through CB9. In case of a power failure the UPS will maintain power to the systems for data retrieval of the computer systems. See Figure 4-9.

- Host Computer (9A3A1)
- IOS Computer (9A3A2)
- Aural Cue System (9A3A3)
- Sound Amplifier (9A3A4)
- DAS/DAS II (9A3A6)
- ECL Computer (9A2A1)
- FDKIO Computer (9A2A3)
- Compuswitch (9A2A4)
- Visual Control Equipment (10A3)
- Mic Pre-Amp (1A6A6A1 and 2A2A5A1)

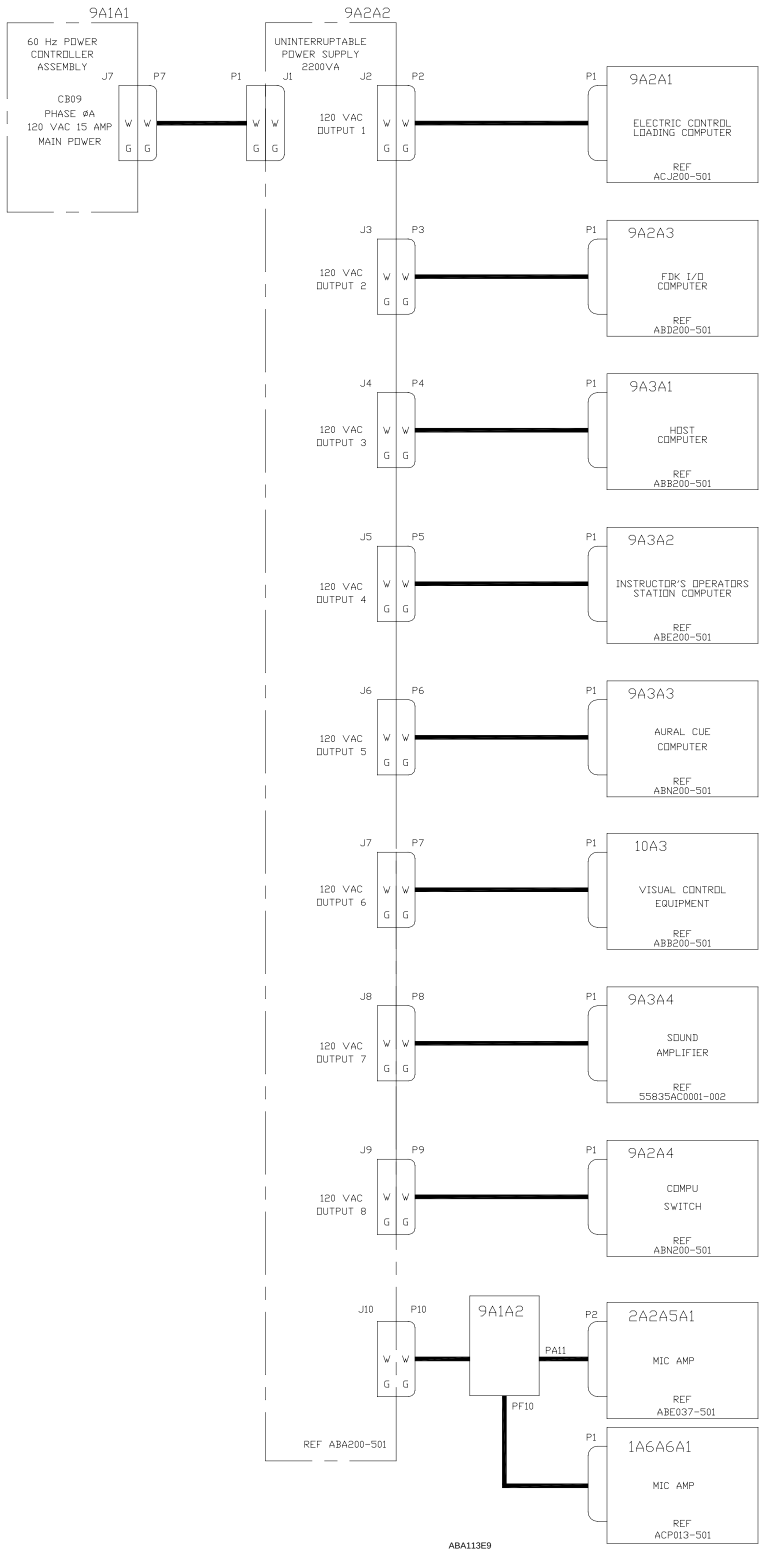

Figure 4-9. Uninterruptible Power Supply Diagram

4.3.1.5. Seat

4.3.1.5.1. Seat Stature Adjust (1A9A1A1)

The Seat Stature Adjust Controller is on the left side of the seat as shown in Figure 4-10. Power is supplied by CB16 from the AC Power Controller through the Frame Distribution Box. See Figure 4-11. The Seat actuator, in the backside of the seat, provides stature adjustment within the range of the limit switches.

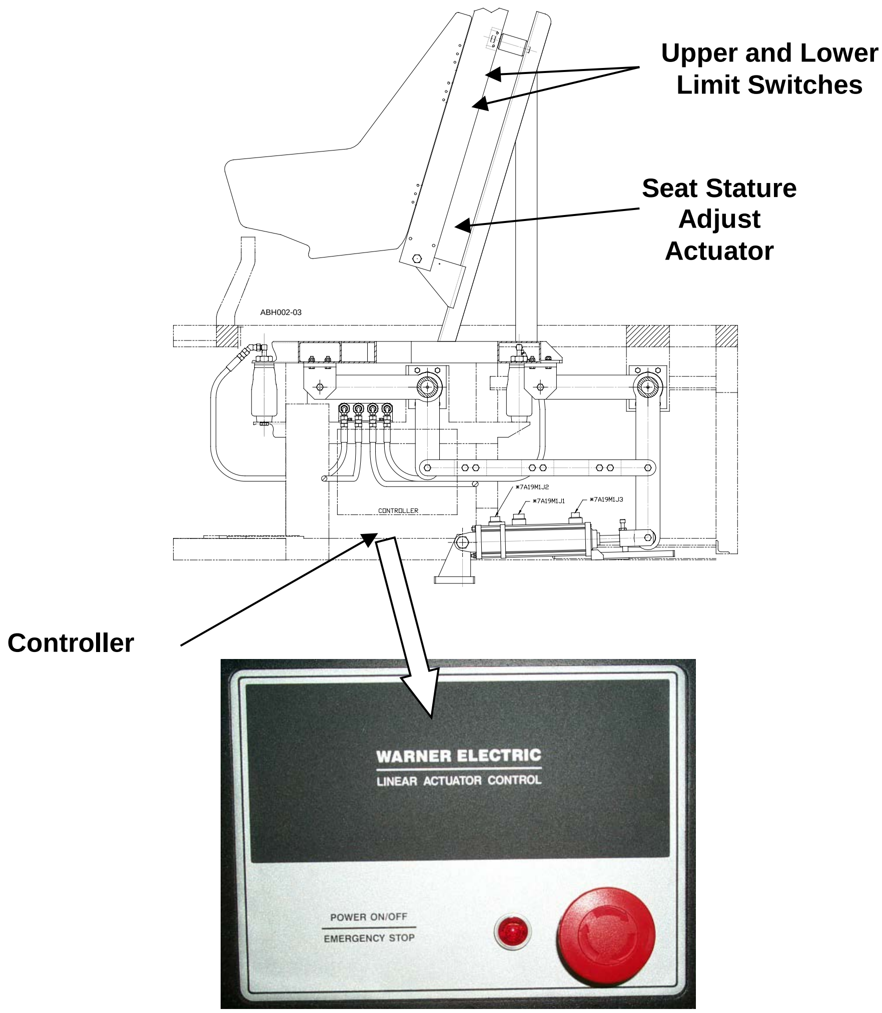

Figure 4-10. Seat Stature Adjust Controller

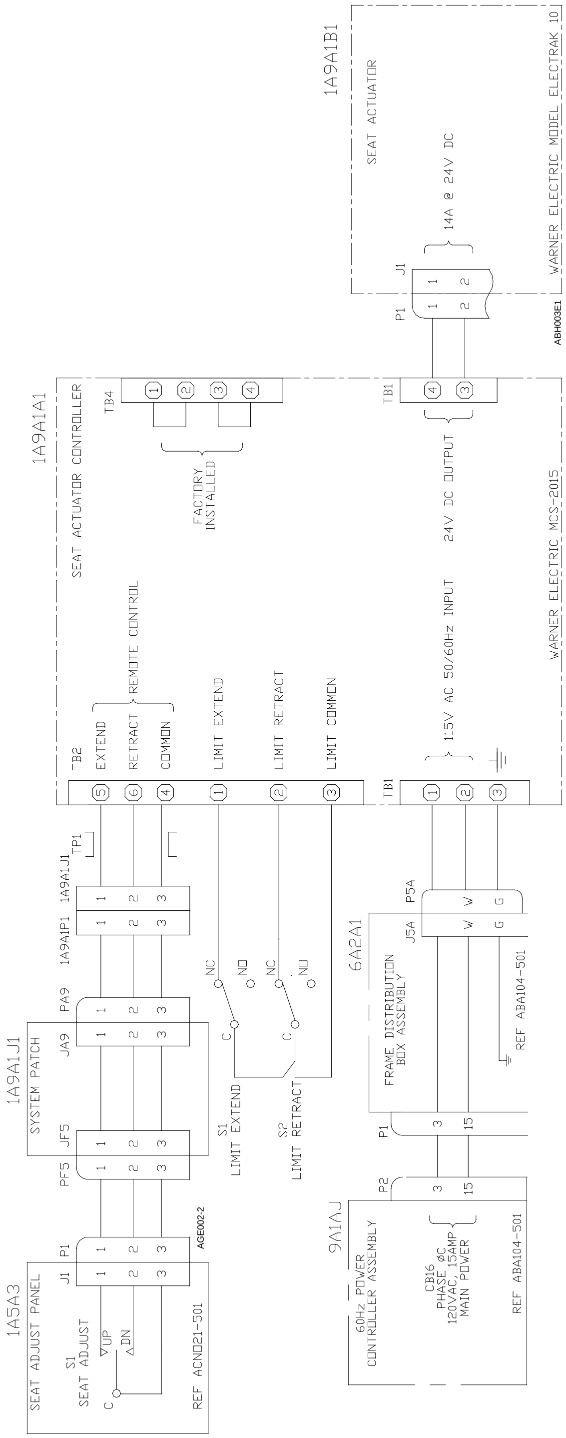

Figure 4-11. Seat Controller Diagram

4.3.1.5.2. Dynamic Seat Actuator

The Seat actuator operated by the DRI Electric Control Loading System (or Data Acquisition System (DAS) or DAS II) is shown in Figure 4-12. See Digital Remote Interface System in paragraph 4.7.2.1 for AC power requirements and paragraph 4.7.2.2 for DC power requirements. The Control Loading DRI interface is described in paragraph 4.7.2.

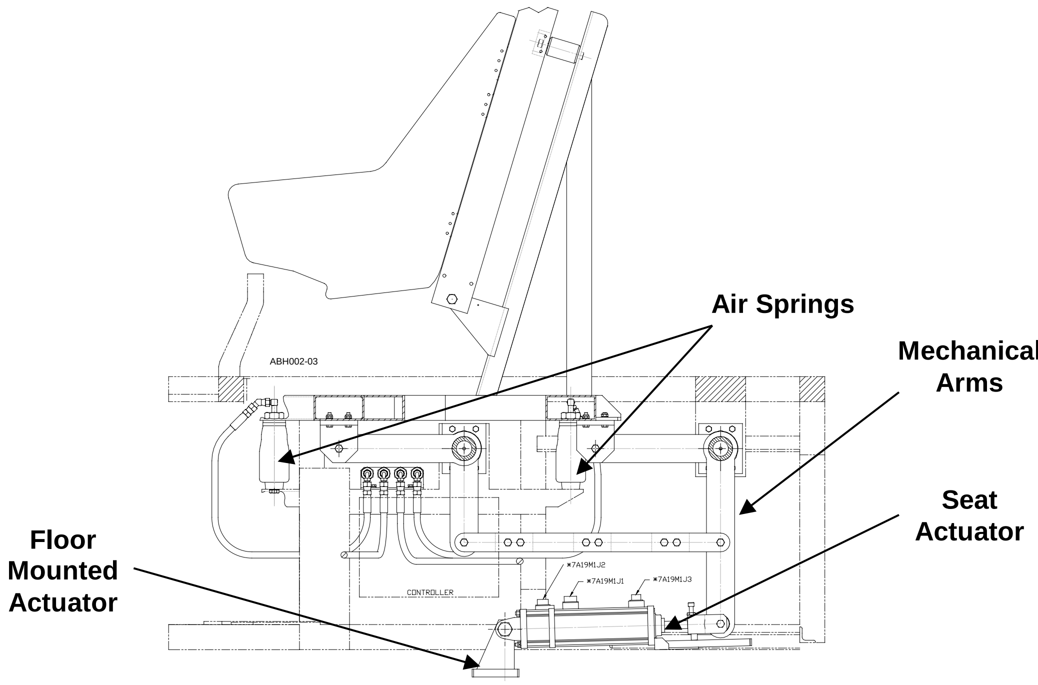

Figure 4-12. Seat-Secondary Motion

4.3.1.6. <u>Monitors</u>

The Monitors in the IOS receive their power from AC Power Controller CB15 then through the Frame Distribution Box. See Figure 4-13. The UTD does not have the third IOS Monitor #3 (2A1A3). See Figure 4-14.

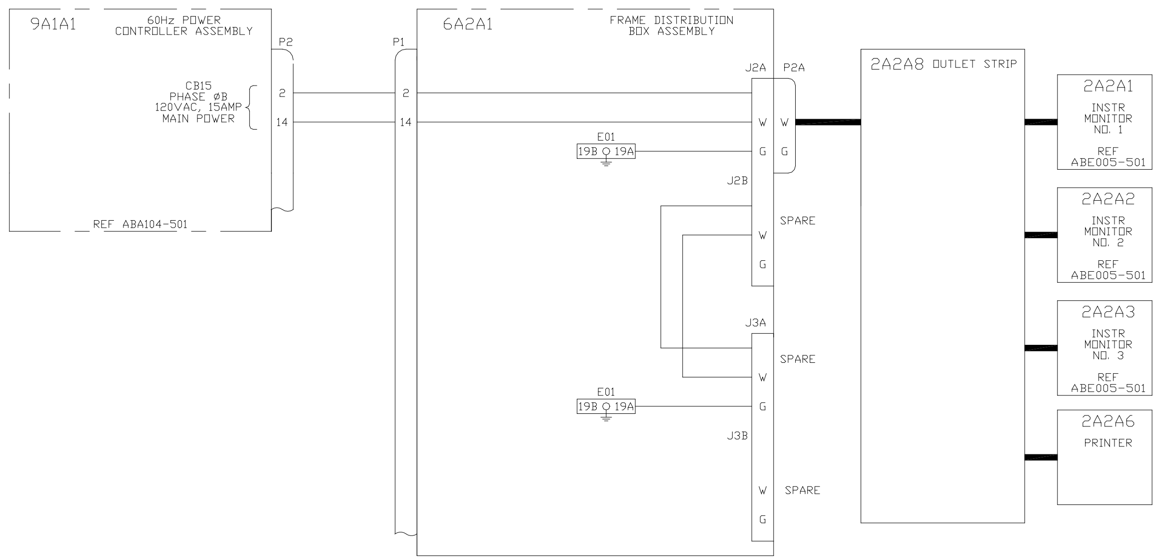

Figure 4-13. Instructor Operator Station Monitors OFT and IFT

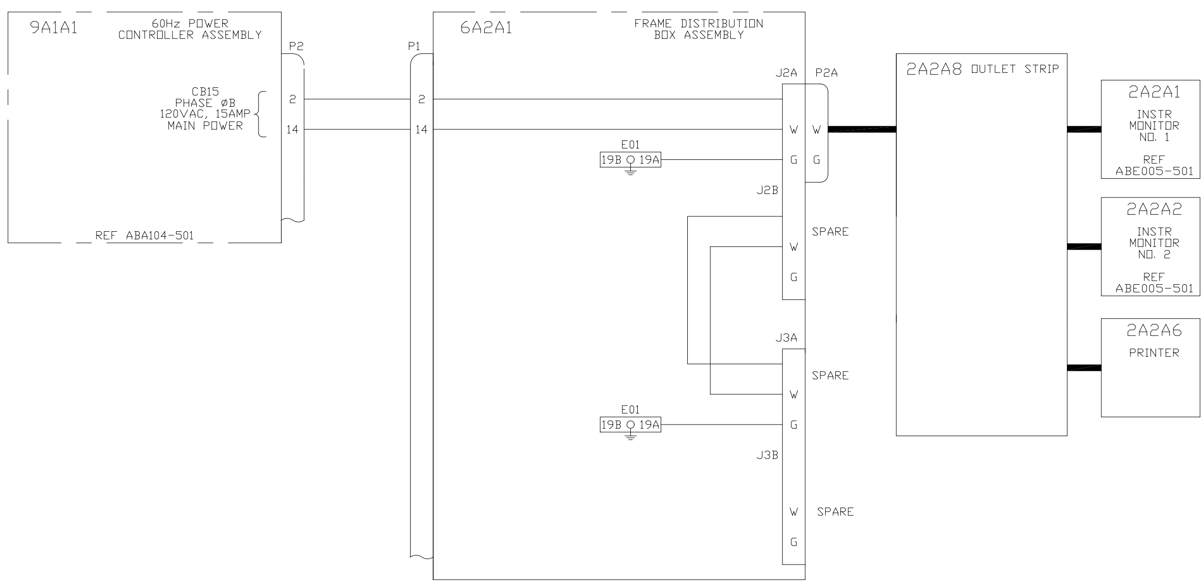

Figure 4-14. Instructor Operator Station Monitors UTD

4.3.1.7. Student Station Fans

Two fans at the student station (6A2 Nose) and the (6A2 Right side behind seat) receive power from the AC Power Controller CB18 through the Frame Distribution Box. One fan (6A2 Left side behind seat) receives power from AC Power Controller CB16 through the Frame Distribution Box. See Figure 4-15.

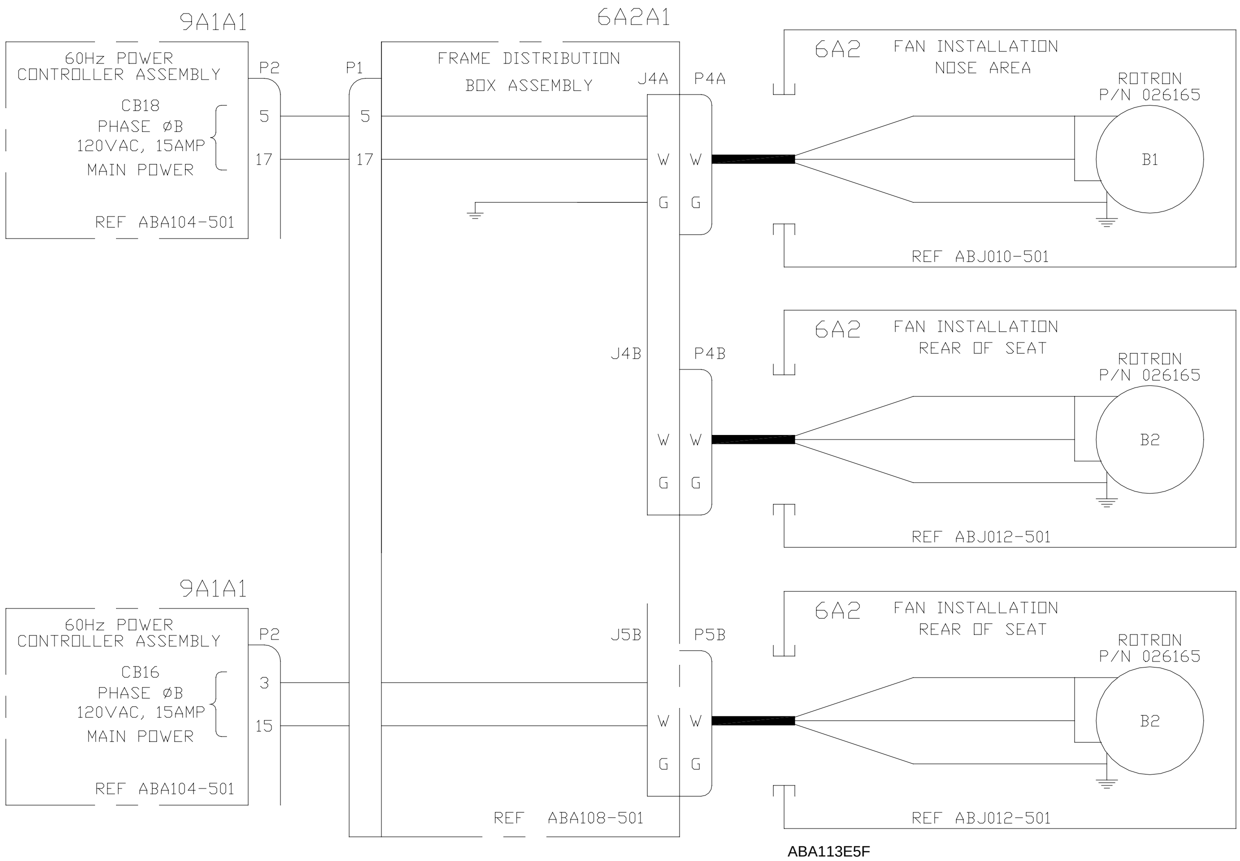

Figure 4-15. Fan Power Diagram

4.3.1.8. Visual Cooling Fans

The four fans on the OFT visual top cap dome are for cooling the FTD. These fans receive power from the AC Power Controller CB17 through the Frame Distribution Box. See Figure 4-16.

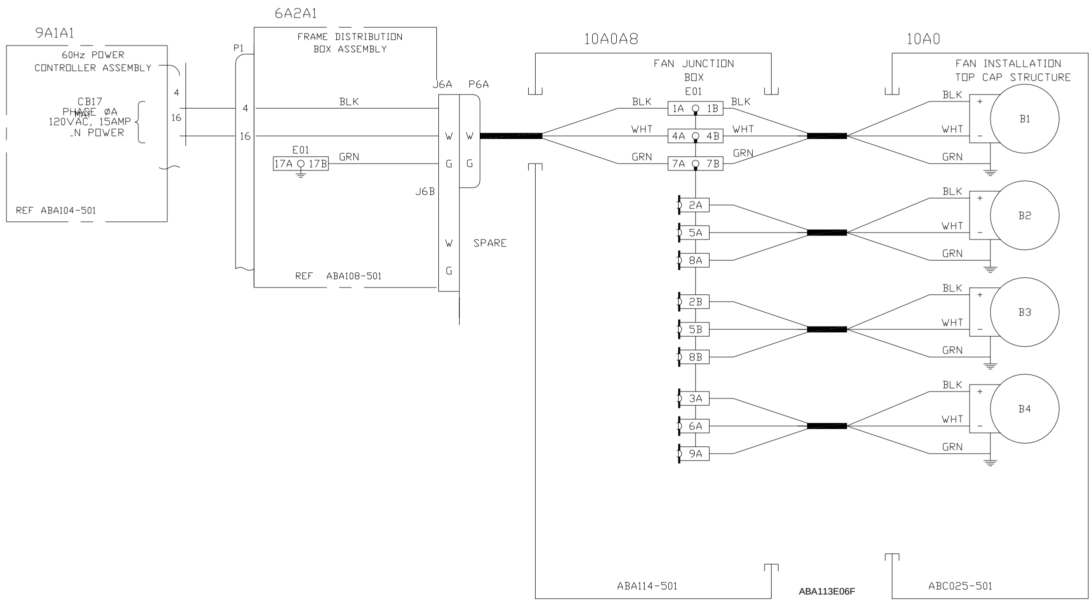

Figure 4-16. OFT Projector Cooling Fans

The three fans on the IFT visual structure cool the entire student station, IOS and the projector. These three fans receive power from the AC Power Controller CB17 through the Frame Distribution Box. See Figure 4-17.

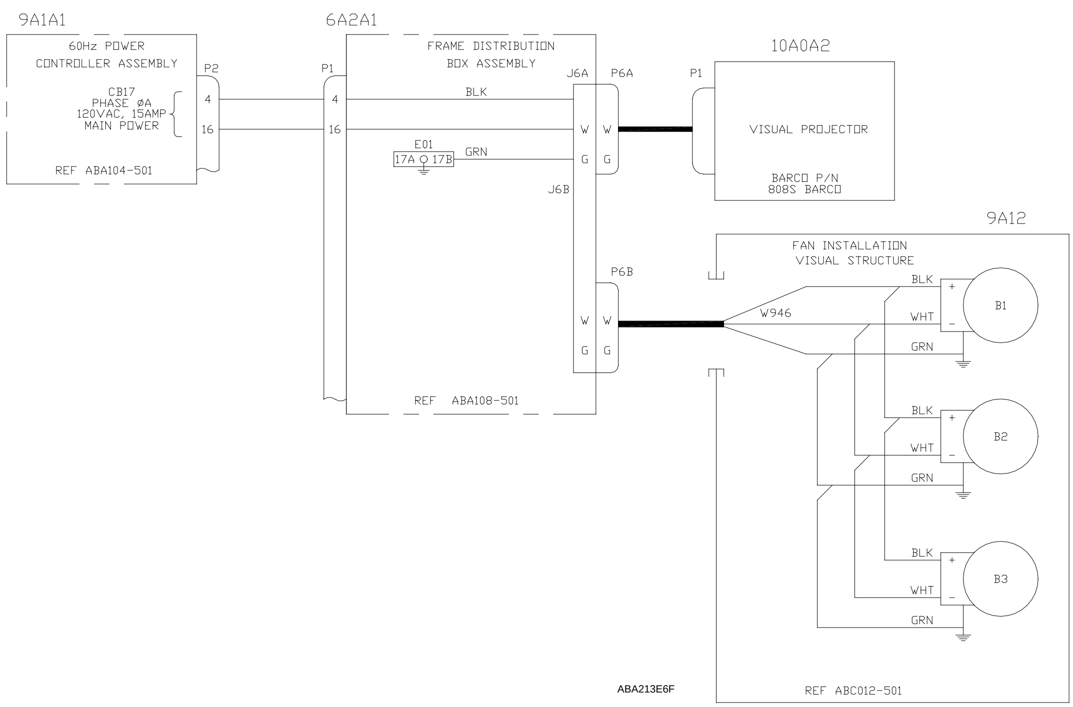

Figure 4-17. IFT Visual Structure Cooling Fans

4.3.2. Digital Servo Remote Power Controller (9A2A5)

The Digital Servo Remote Power Controller provides 208VAC, 80-amp, 3-phase power to the Digital Servos for Secondary Control System through the K1 (9A2A5) contactor, circuit breakers CB1-CB6. The K1 contactor is controlled by K02 relay in a 24VAC remote control circuit through connector J11 from the AC Power Controller Assembly (9A1A1). When the main power switch (SDS1) on the AC Power Controller Assembly is placed in the ON position, this activates the K02 relay, which in turn activates the K1 power contactor. The three-phase power will then pass on to the Digital Servos through designated circuit breakers and power distribution box. These 20-amp circuit breakers protect each digital servo drive system. F1 is a 1-amp fuse, which protects the power to the K1 contactor. S1 switch is for testing the K1 contactor and circuitry to the secondary function digital servos. See Figure 4-18. S1 needs to be in the open position for normal trainer operations.

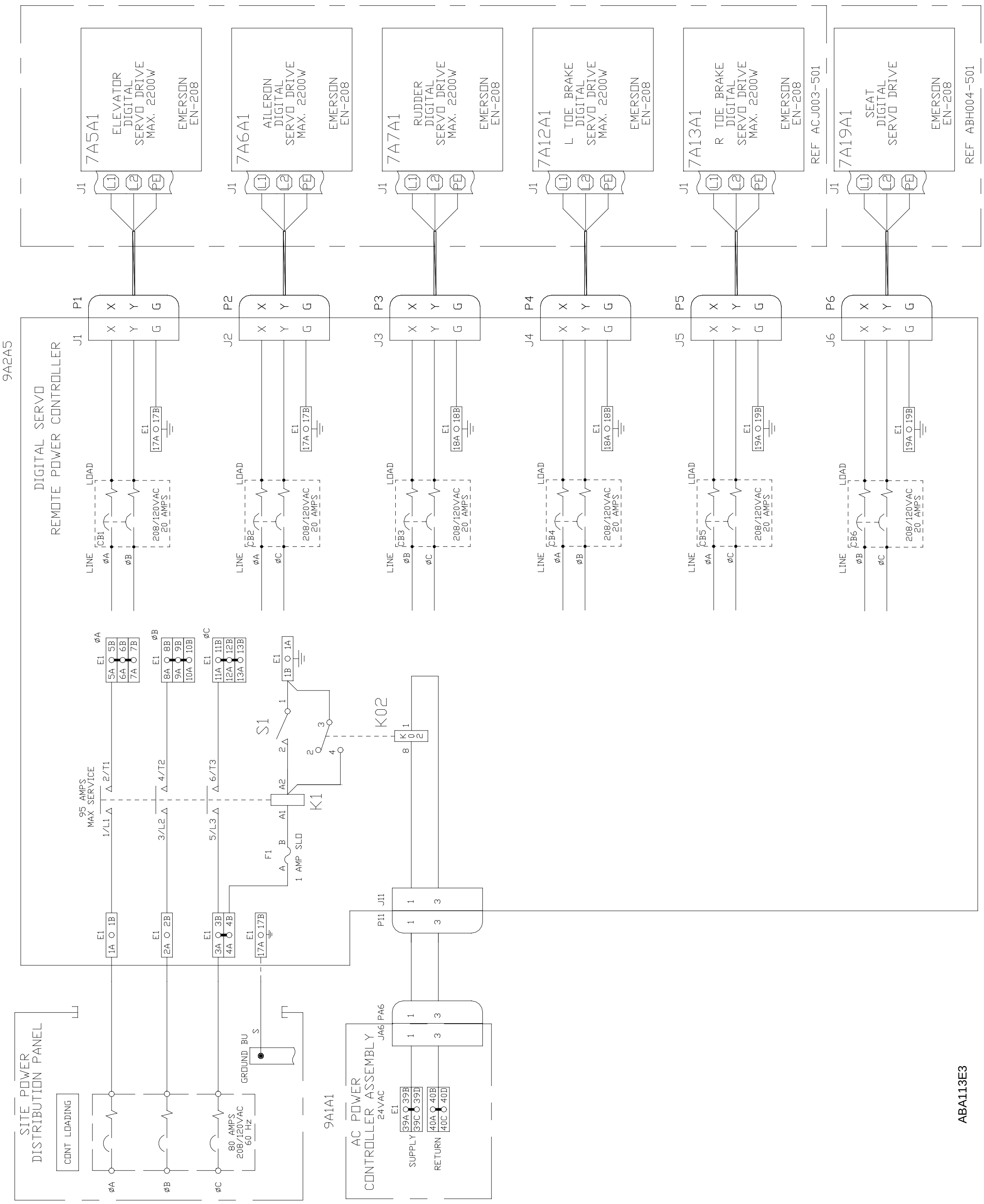

Figure 4-18. Digital Servo Remote Power Controller Diagram

4.3.2.1. Digital Servo Remote Power Controller Circuit Breakers

• Elevators	(7A5A1)	CB1-20 amp
• Ailerons	(7A6A1)	CB2-20 amp
• Rudders	(7A7A1)	CB3-20 amp
• Left Toe Brake	(7A12A1)	CB4- 20 amp
• Right Toe Brake	(7A13A1)	CB5-20 amp
• Seat	(7A19A1)	CB6-20 amp

4.3.3. Visual Projector Remote Power Controller (10A0A1)

The Visual System requires three-phase, 208/120 VAC.

20 amps for the IGE1 PD1

20 amps for the IGE1 PD2

40 amp for the OFT top cap

The Simulator Power Control supplies both IGE1 PD1 (10A1) and IGE1 PD2 as shown in Figure 4-19. Only the IGE1 PD1 (10A1) is visual in the IFT. The UTD has no visual component.

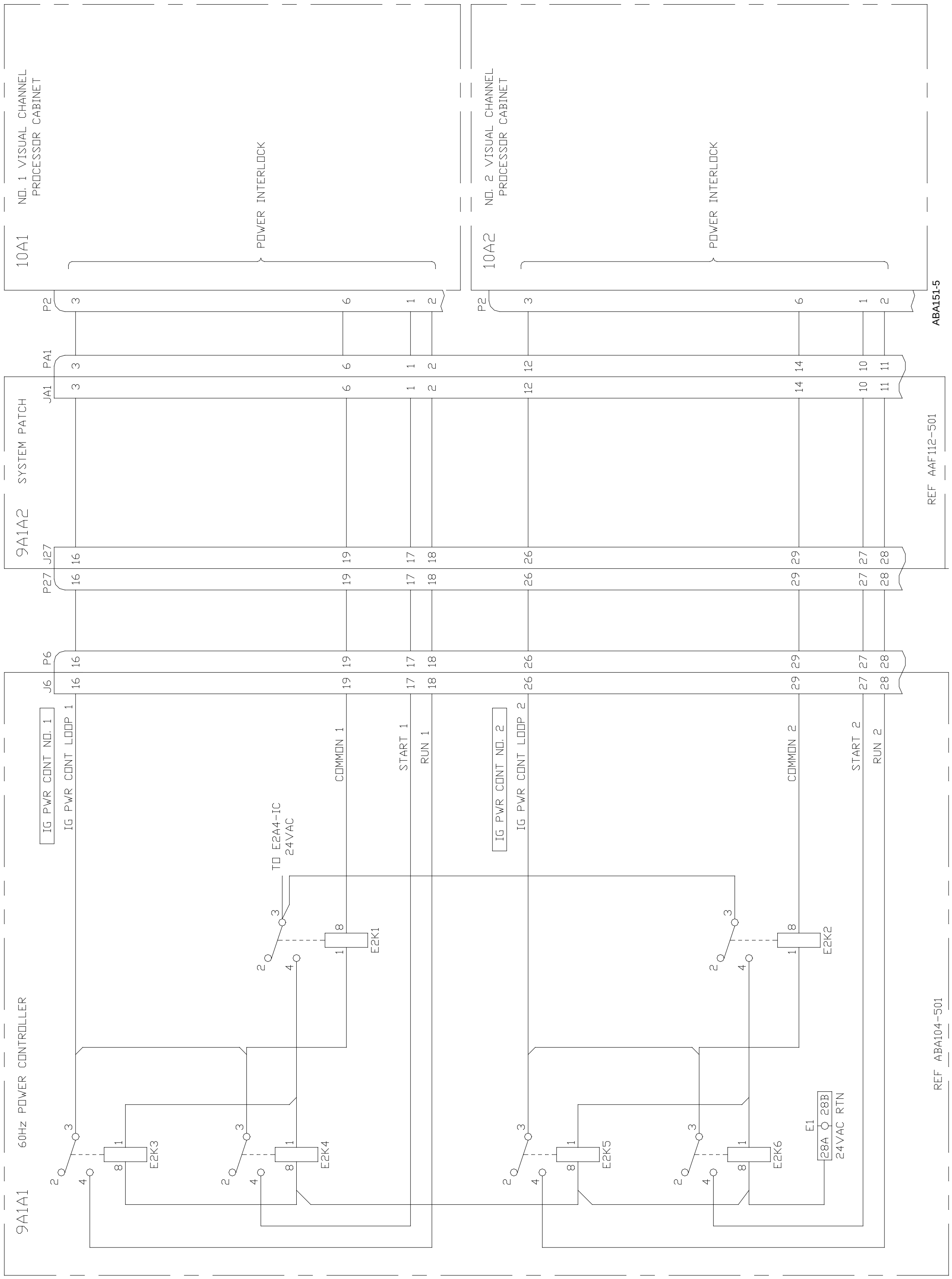

Figure 4-19. Simulator Power Control

4.4. DC DISTRIBUTION

4.4.1. 24VDC System Power Supply (7A2PS1)

The 24VDC power supply receives 2-phase AC power from CB21 in the AC Power Controller Assembly via the Frame Distribution Box Assembly (6A2A). Conversion from AC to 24VDC is then provided to Control Load Patch (7A2) for distribution to DRI Controls, Utility, and CLS-1. See Figure 4-20. There are various manufacturers for the 24VDC Power supply. Refer to Section 5.8 for further information.

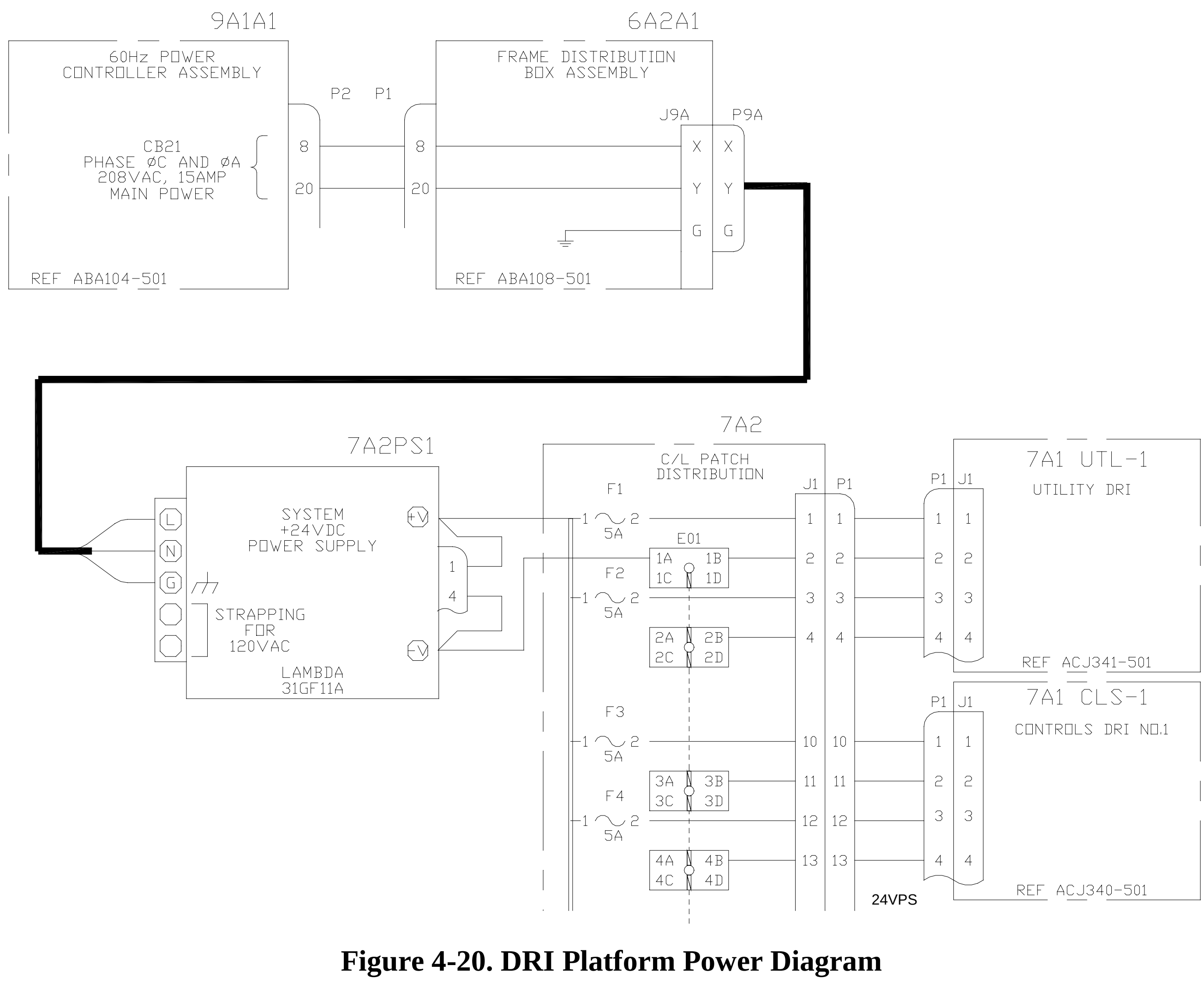

Figure 4-20. DRI Platform Power Diagram

4.4.2. 28VDC System Power Supply (9A2A6PS1)

The 28VDC-power supply receives 2-phase, 208VAC, 15-amp power from CB12 in the AC Power Controller Assembly direct from the controller. The 28VDC is then provided to the following systems. See Figure 4-21.

- System Patch
- Instrument Reference Supply (10.000VDC)
- DC-DC Converter (28VDC to ±15VDC)
- Radio Management Unit (28VDC to 16VDC, 5VDC, -6.3VDC, -12VDC)
- UHF DC-DC Converter (28VDC to 185VDC, 10VDC, -26VDC)

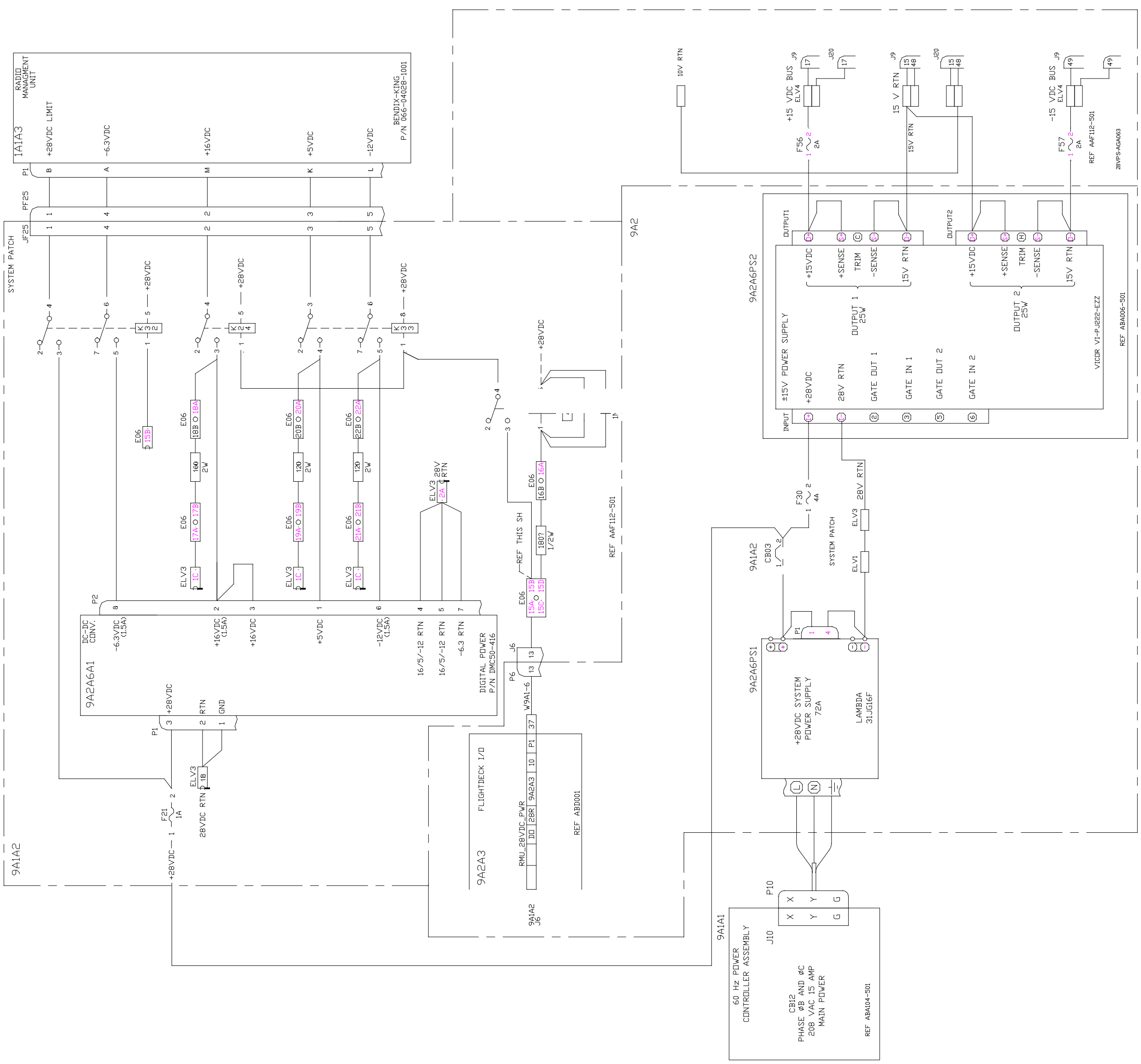

Figure 4-21. 28V Power Supply Diagram

4.4.2.1. Instrument Reference Supply (10.000VDC) (9A1A2PS1)

The 10.000VDC Instrument Reference Supply receives 28VDC through System Patch F27 Fuse. The 10.000VDC power is distributed from the System Patch (9A1A2) to the Student Station Instruments and serves as a reference voltage for them.

4.4.2.2. DC-DC Converter (28VDC to ±15VDC (9A2A6PS2)

The 15VDC power supply receives 28VDC through System Patch F30 fuse. This 15VDC power supply is distributed from the System Patch (9A1A2) to FDKIO analog input board 9A2A3XA12P2 and the Forward Right Hand Switch Control Panel 9A2A3XA12P1, the MIC Pre-Amps 2A2A5A1(IOS) and 1A6A6A1(Pilot Right Side O2 Panel). 15VDC power is also provided to the Conversion Module RS-332 (the Navy T-6A uses an RS-232) to RS-422 for the Power Control Lever Control Assembly (6A5AB1). Reference Figure 4-21.

4.4.2.3. MIC Pre-Amp Power Supply (9A2A6PS3)

The MIC Pre-Amps for the intercom system receive power from the 24VDC Power Supply. The power supply receives power from the UPS. This circuit keeps the intercom circuit active during a power failure.

4.4.2.4. Radio Management Unit (RMU) (9A2A6A1)

The DC-DC Converter supplies 16VDC, -6.3VDC, -12VDC to the Radio Management Unit (1A1A3) controlled by the K20 relay in the 9A1A2 System Patch. The RMU 28 VDC is applied directly from the 28VDC Power supply through the K32 relay and is fused by 9A1A2F21. The K32 relay applies the 28VDC and the –6.3VDC. The K33 relay, which applies the 5VDC and –12VDC, and the K24 relay which applies the 16VDC, are both controlled by the K20 relay. See Figure 4-22.

The Navy T-6A does not have an RMU but instead uses a UHF unit.

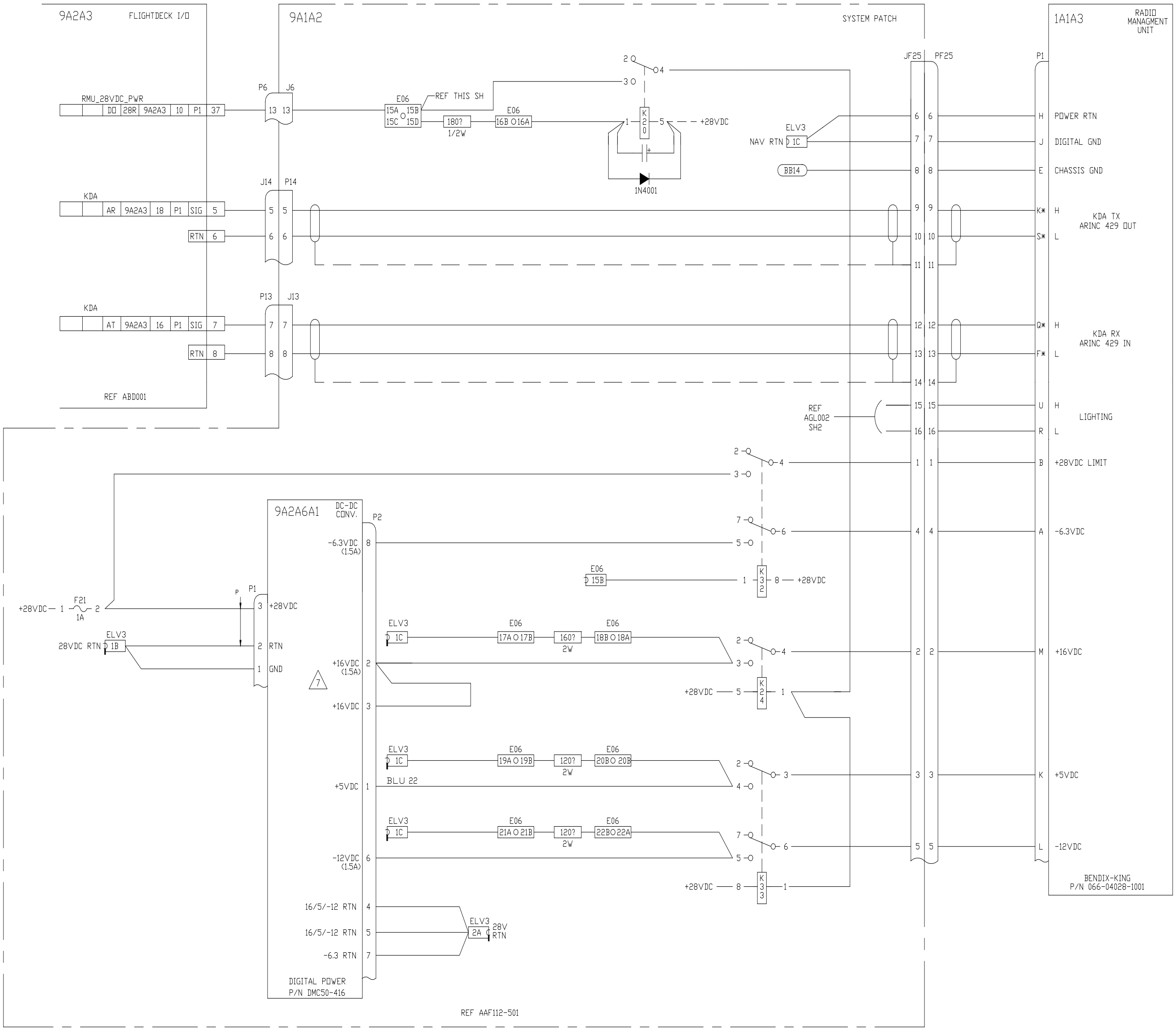

Figure 4-22. RMU System Diagram

4.4.2.5. Ultra High Frequency (UHF) DC-DC Converter (9A1A2A7)

The UHF power supply receives 28VDC via K21 switch in the System Patch. Conversion from 28VDC to 185VDC, 10VDC, -26VDC, is provided to the UHF (1A1A10M1). See Figure 4-23.

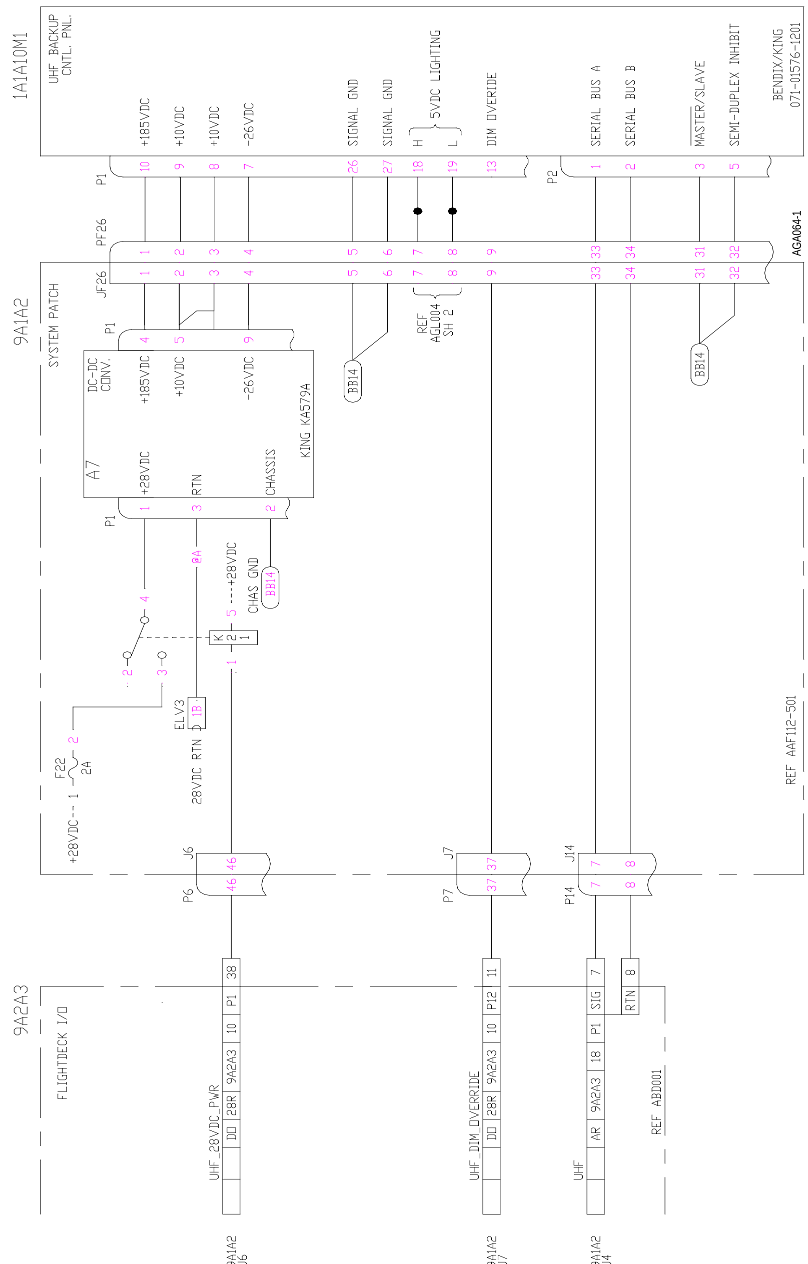

Figure 4-23. UHF System Diagram

4.5. HOST COMPUTER

The Host Computer is a PCI bus-based system, which communicates with the other Subsystems over a 100BaseT-dedicated network using TCP/IP socket interface protocol and User Datagram Protocol (UDP). The six Ethernet cables interface the host computer with the IOS, the ACS , the ECLS, the FDKIO System, the Visual Image Generator System and the on-site computer network. See Figure 4-24.

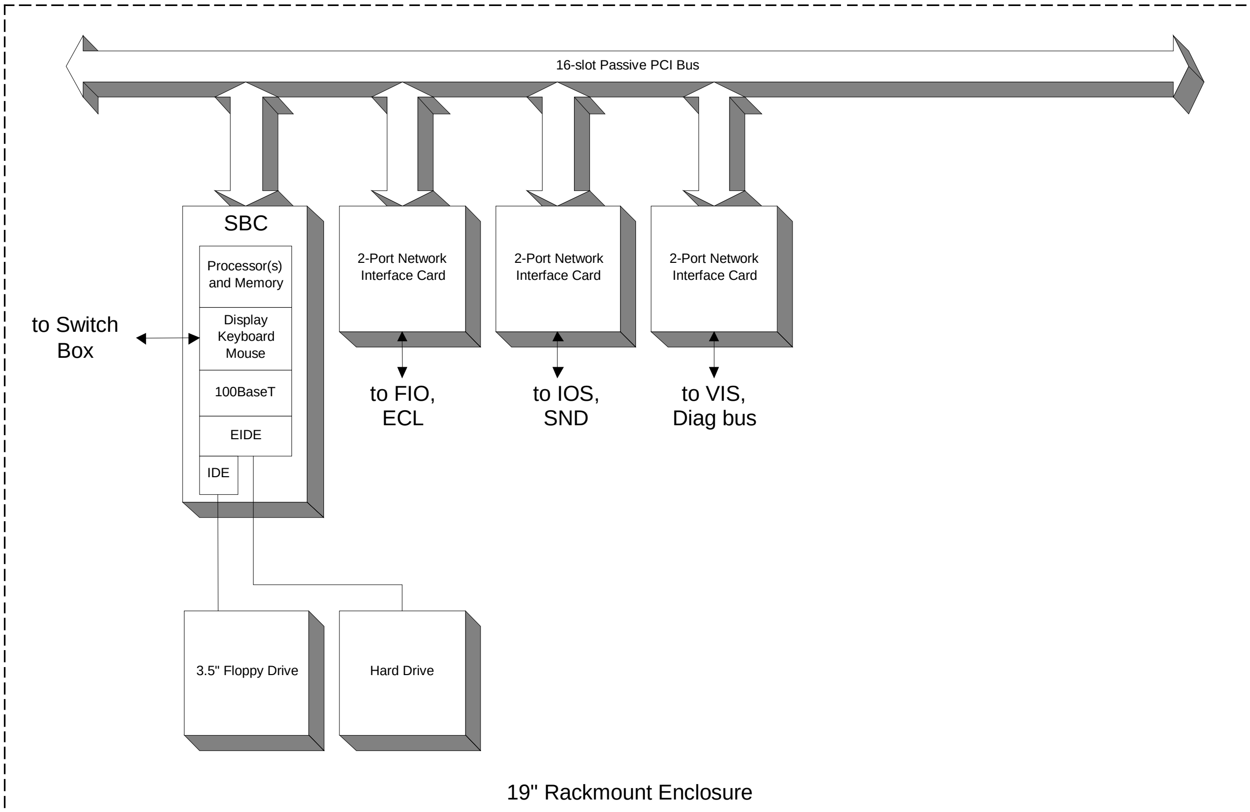

Figure 4-24. Host Computer Diagram

The Host Computer receives AC power from the UPS J4 connector (9A2A2). Refer to Figure 4-9.

4.5.1. Chassis (9A3A1)

The Host Computer chassis contains several components to execute real-time math models associated with flight, navigation, engine, and communication systems. The chassis components include:

- 20 slot PCI/ISA Backplane
- Dual Power Supplies, hot-swappable, dual-redundant
- Single-Board Computer
- 3 Network Interface PCI Bus Boards (dual-port cards)

- Hard Disk Drive
- Floppy Disk Drive

The 20-slot PCI/ISA backplane has 16 passive PCI slots. Six drive bays are provided; however, only two are used for the Hard Drive and the Floppy Drive. Three 90cfm cooling fans provide filtered air to the chassis components.

4.5.2. Single-Board Computer

The Single-Board Computer (SBC) (XA3, XA4) is Intel processor based and has a minimum of 800 MHz Pentium III microprocessor, 1024 Mbytes of RAM, two serial ports, one parallel port and 100BaseT-Ethernet port. The Intel 440X/GX AGP set supports the system and memory buses at both 66MHz and 100MHz speeds.

The BIOS (Flash) is a Hi-Flex AMIBIOS with built-in advanced CMOS setup for system parameters, peripheral management for configuring on-board peripherals, PCI-to-PCI bridge support and PCI interrupt steering. The BIOS chip is a boot-block Flash device.

The CACHE memory is a non-blocking, second level (L2), 512K unified for fast memory access and recently used instructions and data. The speed of the L2 cache is half the CPU core frequency.

The DRAM memory is a two, dual in-line memory module (DIMM) socket and supports auto detection of memory up to 512MB of Synchronous DRAM for the 440BX or up to 1GB of SDRAM for the 440GX. The System BIOS automatically detects memory type, size, and speed.

The PCI Local Bus interfaces to the on-board PCI Ultra Wide SCSI controller, to the PCI 100BaseT-Ethernet controller and to the 3 Network Interface PCI Bus Boards (9A3A1XA6, XA7, XA8).

The AGP VGA Interface is a Cirrus Logic GD5465 video interface device with both 3D and 2D capabilities. AGP will off-load the PCI Bus by allowing graphics data to move directly from system memory. The interface supports pixel resolutions up to 1600 x 1200 non-interlaced. The SBC provides 2MB of on-board Rambus Memory, which provides a high-bandwidth solution.

The System Hardware Monitor is based on the National Semiconductor LM80 / LM75 and monitors system voltages, temperature, and fan speeds. The LM80 interfaces with the associated programmable watchdog limits. When any of these programmed limits are exceeded, the monitor software can notify the SBC. Refer to Vendor documentation for more information on the System Hardware Monitor.

The onboard interface is not used.

The SBC supports two floppy disk drives. The Drives can be 360K to 2.88MB, in any combination.

The SBC is compatible with a PS/2-type mouse. A self-resetting fuse protects the mouse.

The SBC is compatible with an AT-type keyboard. A self-resetting fuse protects the keyboard.

The SBC Watchdog timer is not used.

4.5.3. CompuSwitch (9A2A4) Connections

The only rear panel wiring at XA3 and XA4 is the computer switch connections to the CompuSwitch.

4.5.4. Network Interface PCI Bus Boards

The Network Interface PCI bus boards (XA6, XA7, XA8) are used for real-time communication. The Ethernet port has a real-time communication with the subsystem computers. The rear panel wiring at XA6 is the connections to the LAN (top) and the FDKIO Computer (bottom). Wiring at XA7 is to the IOS Computer (top) and the Aural Cue Computer (or APS) (bottom). Wiring at XA8 is to the ECLS Computer (top) and to the Visual System Hub (bottom).

4.5.5. Hard Disk Drive

The Hard Disk drive stores the operating system and simulation software. When the computer turns ON, the CPU looks for the operating system program VxWorks. Once the operating system is loaded into memory of the CPU then it looks for the application program.

4.5.6. Floppy Disk Drive

The Floppy Disk drive is used to maintain or rebuild the hard drive if there is a failure of the hard-drive system. The Floppy Disk drive uses 3.5-inch floppy disks with 1.44MB capacity.

4.6. AURAL CUE SYSTEM

The Aural Cue System (ACS) is a vendor-supplied system that provides all the aural, ambient, and environmental sounds necessary of a flight simulator. This system also provides the digital communications system for the simulator.

4.6.1. Sound System Computer

The Sound System Computer performs all of the sound system modeling. It runs the FlightSafety program SimSound.exe. This program communicates over the Ethernet to both the Host computer, which runs aircraft simulation, and the APS unit. SimSound.exe performs all of the APS unit initialization. It takes inputs from the host such as engine RPM, airspeed, flap position, etc., and determines the required waveforms, playback volume, and playback frequency. It contains two separate Ethernet interfaces: one dedicated to communication with the host, and one dedicated to communication with the APS unit.

Refer to the vendor documentation for additional information.

4.6.2. Audio Processing System (APS)

The APS unit performs all audio input and output to the Sound System Computer. It is initialized with waveform data (up to 256MB) at run-time and performs mixing, frequency shifting, and volume scaling under command of the Sound System Computer. The output of the APS unit is routed to the Sound (Power) Amplifier.

The APS unit contains one Power PC CPU chip identified as the Control Processor (CP). It runs the VxWorks embedded real-time operating system. The CP provides the Sound System Computer Ethernet interface, memory management, front panel IO, and high level waveform data manipulation. The CP communicates with a second processor identified as the Audio Processor (AP) over a PCI interface. The AP performs the memory manipulation required to produce the desired audio signals. See Figure 4-25.

This manipulation includes amplitude and pitch shifting calculations needed to meet the Sound System computer’s volume and frequency control values. The audio processor routs the resulting samples to/from four DSP chips identified as audio stream processors (SP). The actual audio conversion to/from digital is done by eight stereo CODECS operating from a master sample frequency of 44.1KHz.

The APS processes standard Windows .wav files. It has 250MB of internal ram that is loaded with audio samples at initialization. The APS then mixes the stored samples for playback under external control. The APS control interface is performed through a standard RJ45 Ethernet connection to the Sound System Computer.

Refer to the vendor documentation for additional information.

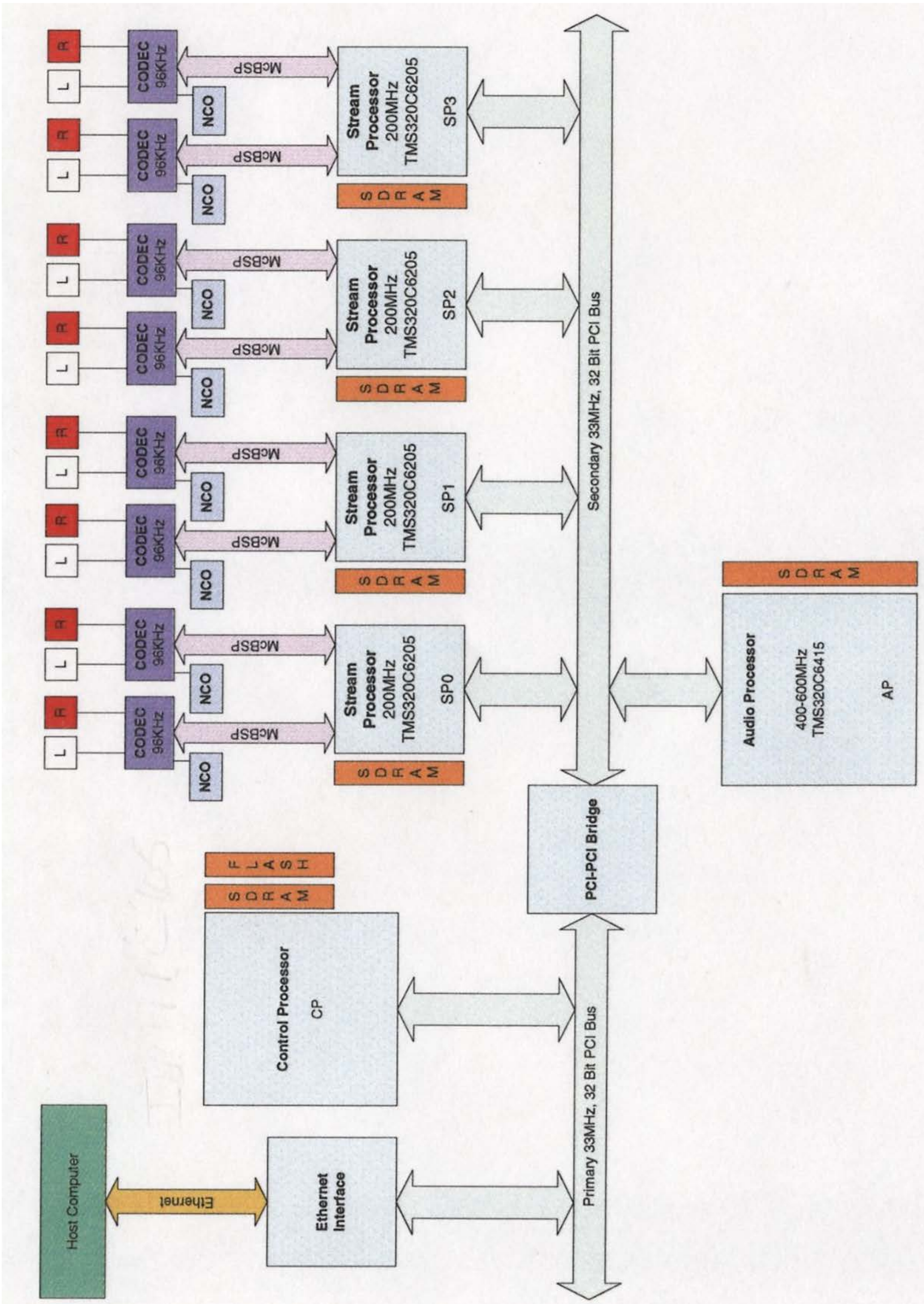

Figure 4-25. APS Unit Block Diagram

4.6.3. Overall System Operation

The APS Sound System provides all the aural, ambient, and environmental sounds necessary for the Flight Training Device.

Figure 4-26 shows a block diagram of the APS Sound System.

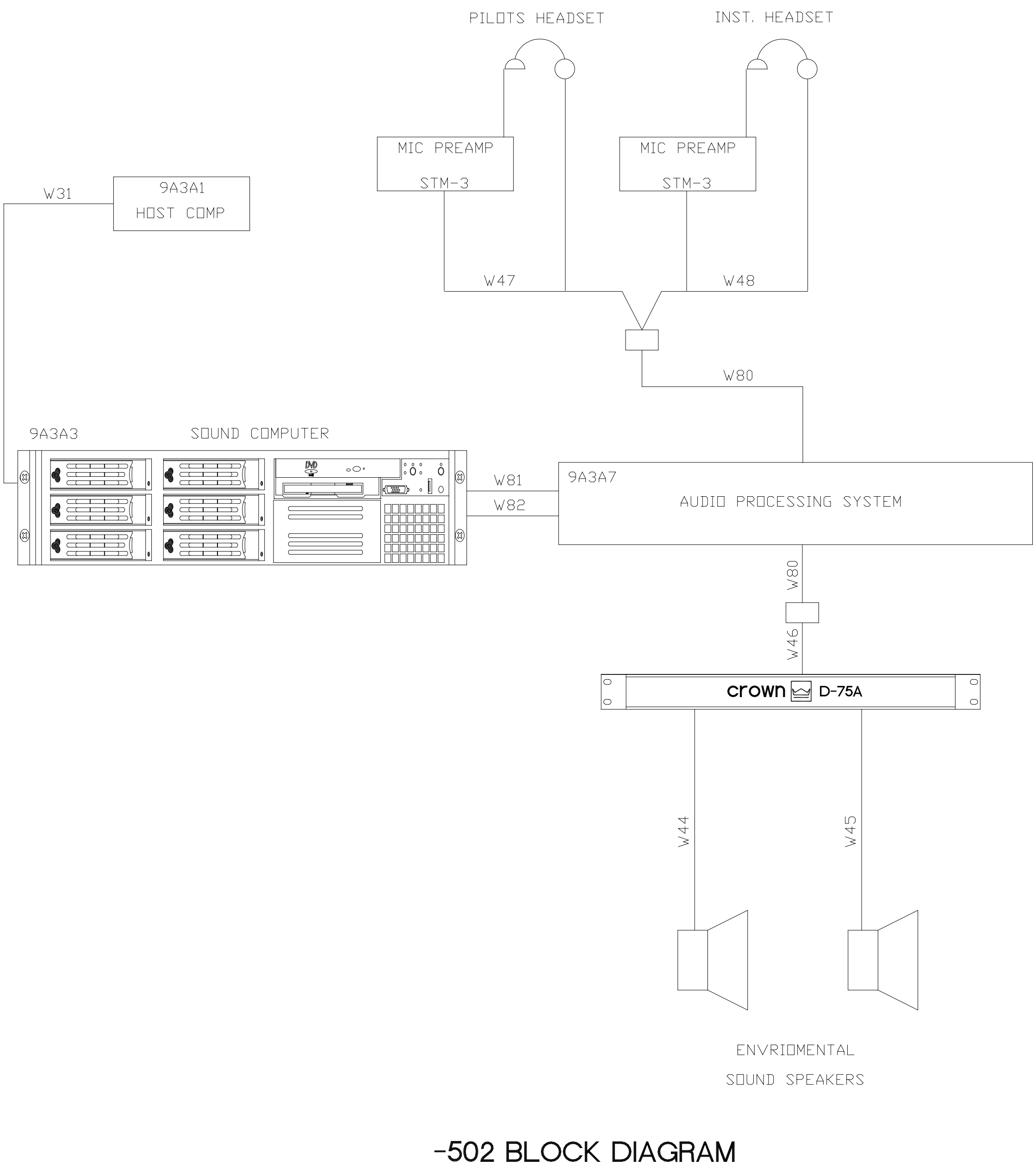

Figure 4-26. APS Unit Block Diagram

4.7. ELECTRIC CONTROL LOADING SYSTEM (ECLS)

The purpose of the ECLS is to operate and control the Digital Remote Interface (DRI) platforms, the Data Acquisition System (DAS) platform, or the DAS II platform for the control loading and motion systems. It responds to the requirements of the training scenario and the instructor by providing the control and monitoring of operating parameters to ensure continued safe operation. Figure 4-27 illustrates the relationship of the ECL Computer, the DRI Platforms and the Fiber Optic Ring Network within the control loading and motion systems. The DRI Platform System is the interface between the control loading and seat motion system. Each DRI platform contains circuits for monitoring and control of the Servo Systems. The DAS is the interface between control loading and seat motion and the ECLS Computer. The DAS contains circuits for monitoring and control of servos. DAS II is discussed in a separate supplement.

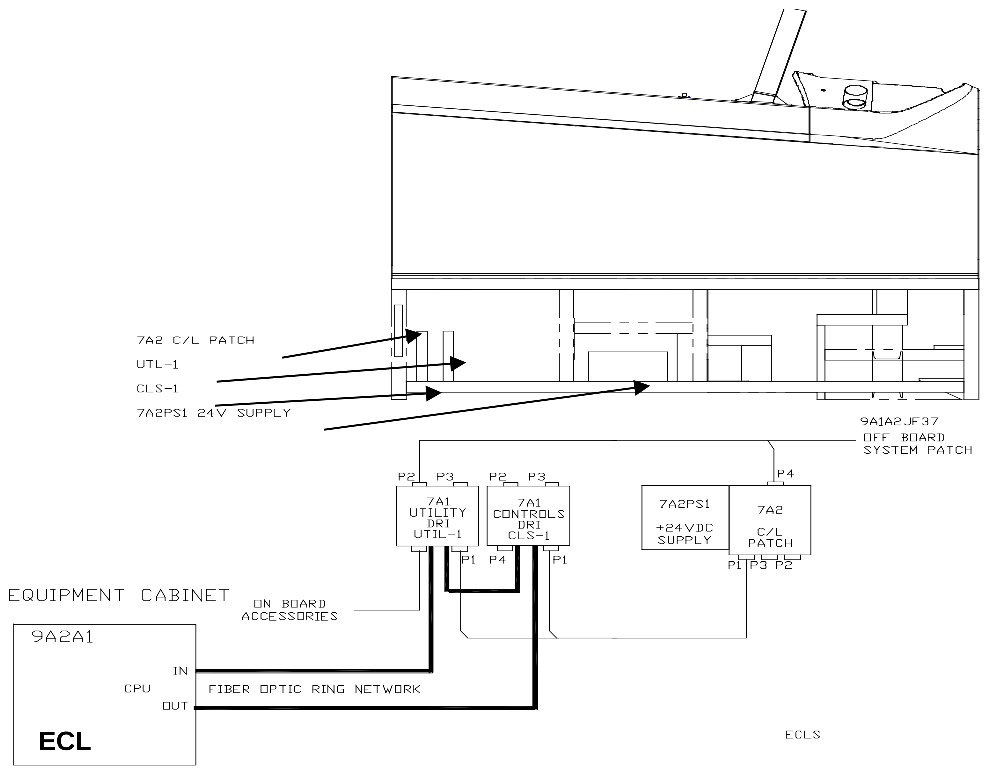

Figure 4-27. DRI Electric Control Loading System

The following paragraphs explain the Control Loading System operation.

- Electric Control Loading Computer
- Digital Remote Interface System
- Servo Loop System
- Fiber Optic Ring Operation

4.7.1. Electric Control Loading (ECL) Computer

The ECL Computer houses the CPU boards that process the models for the control loading and motion systems. The DRI platforms and the DAS platform are processor-controlled modules that house the software for controlling the control loading and motion electrical cylinders/actuators.

The ECL Computer interfaces with the DRI platforms, or the DAS platform, via a Fiber Optic Ring Network. Under the DRI system, the Ring goes to each of the platforms in turn. When a message is tagged for a specific DRI platform, and it arrives at that platform, the platform will input the message and not pass it on. When a platform sees a message that is tagged for another platform further down the ring, it will simply pass the message down the ring without any changes. In the event that a message has been tagged with an invalid address, the message would continue to travel around the ring as an orphan message; however, the Monarch on the Utility DRI platform monitors the messages and will delete the message the second time it receives it.

When the DAS platform is in place, the “Ring” runs between the DAS platform and the ECL computer. All of the activity that takes place between the DRI platforms and the ECL occur between the DAS platform and the ECL computer.

The ECL Computer communicates with the Host Computer over a 100BaseT-dedicated network using User Datagram Protocol interface protocol. The two Ethernet cables interface the ECL directly with the Host Computer. See Figure 4-28.

For information on the DAS II, see Supplement 1.

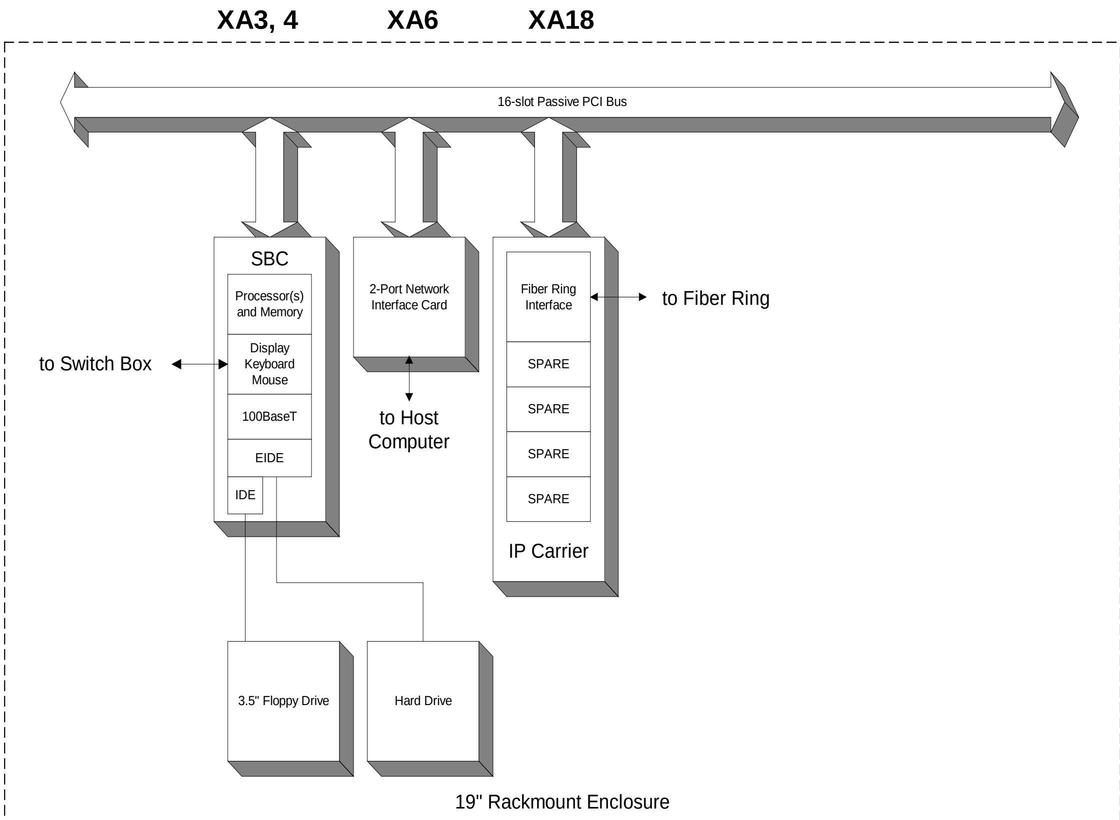

Figure 4-28. Electric Control Loading Computer Diagram

4.7.1.1. Chassis

Several chassis components execute real-time math models associated with flight, navigation, engines, and communication systems:

- 20 slot PCI/ISA Backplane
- Dual Power Supplies (Navy T-6A has only one power supply)
- Single-Board Computer
- Network Interface PCI Bus Board
- IP Carrier Board
- Hard Disk Drive
- Floppy Disk Drive

4.7.1.2. Single-Board Computer

The SBC (XA3, XA4) mounts on a PCI bus and has a 400 MHz Pentium II microprocessor, 256 Mbytes of RAM (T-6B configuration is: 850MHz Pentium III and 1024MB of RAM), two serial ports, one parallel port and 100BaseT Ethernet port. The only backplane wiring at XA3 and XA4 is the computer switch connections to the CompuSwitch (9A2A4).

4.7.1.3. Network Interface PCI Bus Board

The Network Interface PCI bus board (XA6) provides real-time communication. The Ethernet port has a real-time communication with the subsystem computer. The back panel wiring at XA6 is the Ethernet connections to Host Computer.

4.7.1.4. IP Carrier Boards

The ECLS Computer has three IP Carrier boards. The IP carrier board in slot XA18 uses 5 IP for DI data. Each Industry Pack for the DI board has 48 channels for translating PCI bus data to IP bus data. This board is used for digital input data such as sensing switch closure. Logic is 1=High as any input between +2.0VDC and +32VDC with incorporated, current-limited high clamped to +5VDC.

4.7.1.5. Hard Disk Drive

The Hard Disk drive stores the operating system and simulation software. When the computer turns ON, the CPU looks for the operating system program VxWorks. Once the operating system is loaded into memory of the CPU, it checks for the application program.

4.7.1.6. Floppy Disk Drive

The Floppy Disk drive is used to maintain or rebuild the hard drive if there is a failure of the hard drive system. The Floppy Disk drive uses 3.5-inch floppy disk with 1.44-MB capacity.

4.7.2. Digital Remote Interface System

The Digital Remote Interface (DRI) System is used to control the motion and control loading systems on the simulator. The electrical systems consist of the Electronic Control Loading Computer, Flight Controls (Aileron, Elevator, Rudder), Secondary Controls (Left Toe Brake, Right Toe Brake), and Motion Control (Seat) systems. See Figure 4-29.

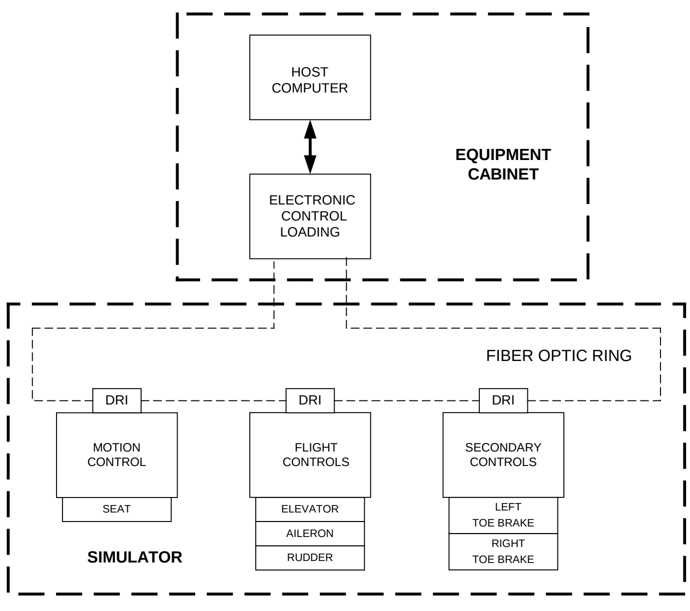

Figure 4-29. DRI System Block Diagram

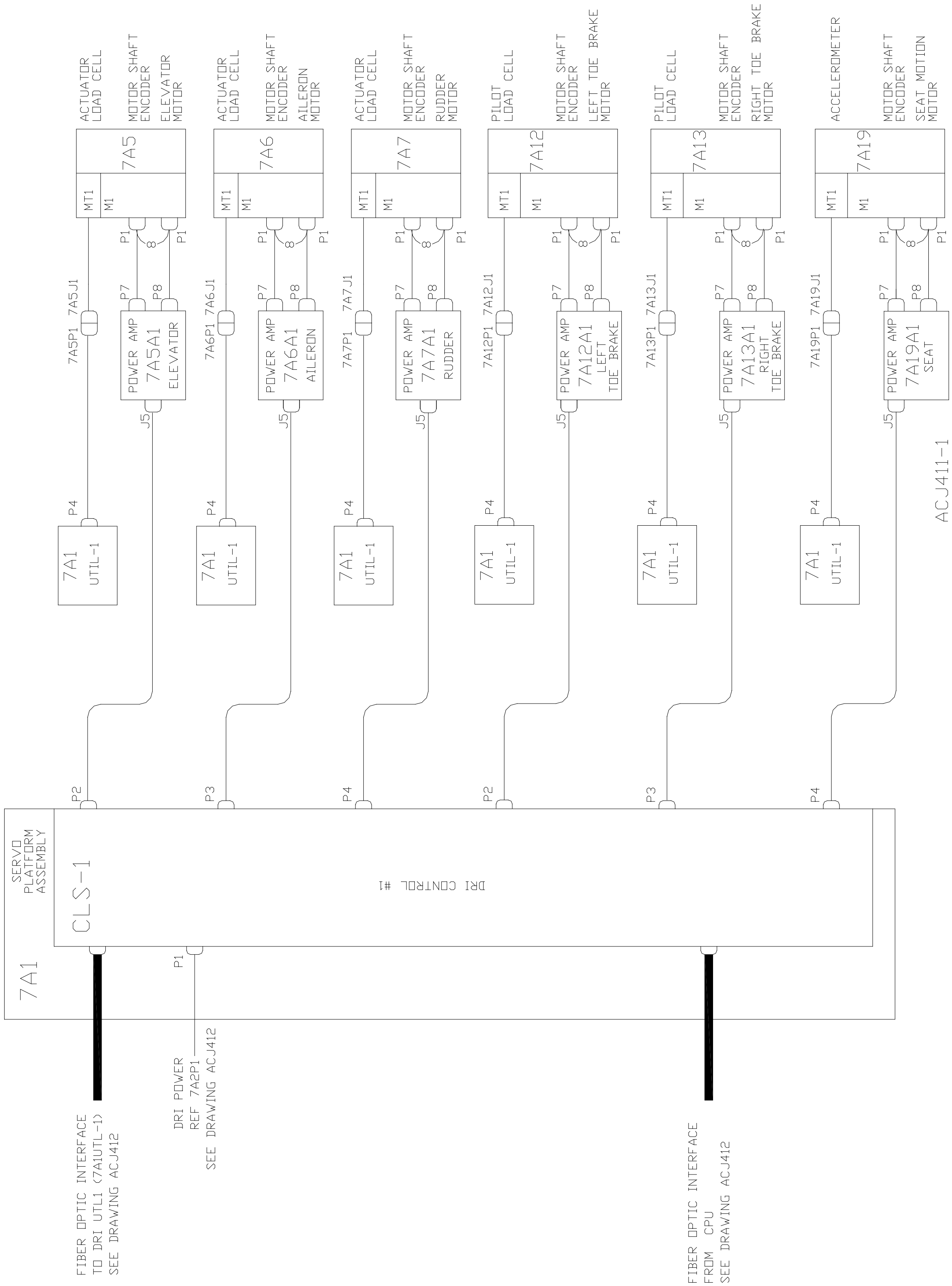

Figure 4-30. DRI Electric Control Loading System Diagram

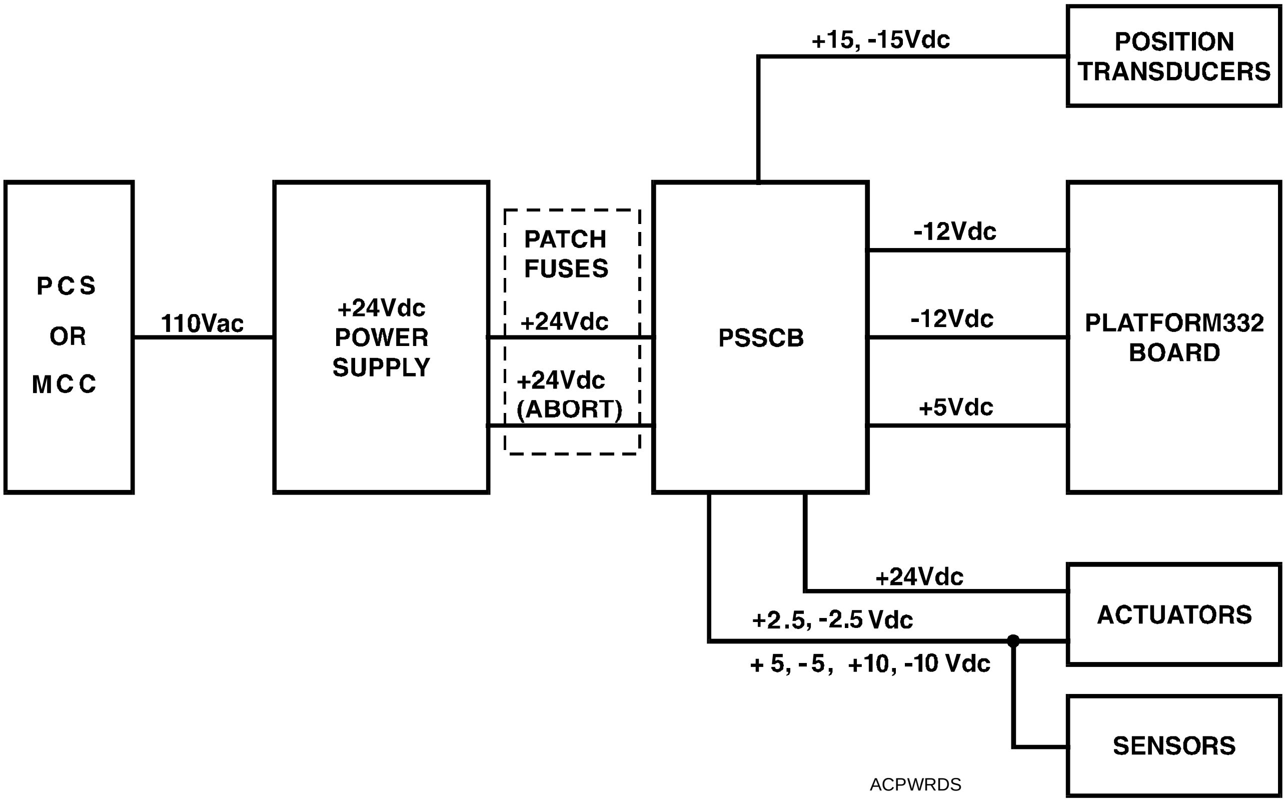

Figure 4-31. AC and DC Power Distribution

4.7.2.1. AC Power

Each DRI Platform Assembly requires a +24VDC external power source for operation. The 24VDC Power Supply (7A2PS1) provides power through the Control Load Patch Distribution (7A2). AC input power to the power supply is 110VAC from the AC Power Control System (9A1A1) routed through the frame distribution box (6A2A1). Refer to Figure 4-31 for the DRI Platform Power Diagram.

4.7.2.2. DC Power

Each DRI Platform assembly requires +24VDC System power as described in paragraph 4.4.1. System power is supplied to the PSSCB through the P5 connector.

The +24VDC Abort power is also supplied to the PSSCB through the P4 connector. The abort power is separately fused and controlled. The +24VDC Abort power is distributed from the DRI Platform to the abort solenoid valves in the electric servo actuators on each cylinder. A loss of the +24VDC abort signal causes an interrupt resulting in an immediate shutdown of that system.

4.7.2.2.1. Power Distribution

The +24VDC power from the DRI power supply is distributed to the DRI platforms through the control-loading patch. The following paragraphs describe the +24VDC power distribution to the DRI platforms.

4.7.2.2.1.1. Control Loading and Seat Motion System

Figure 4-32 shows the Control Loading and Seat Motion System DRI Power Distribution. The control loading patch distribution panel contains the fuses for the +24VDC System and Abort power to the control loading/utility system DRI Platform Assemblies. Fuses F1 and F3 control the Abort power to the utility, control loading, and secondary motion DRI platforms. Fuses F2 and F4 control the System power to the utility, control loading, and seat motion DRI platforms. For information on the principles of operation for the seat motion system refer to paragraph 4.9.7.

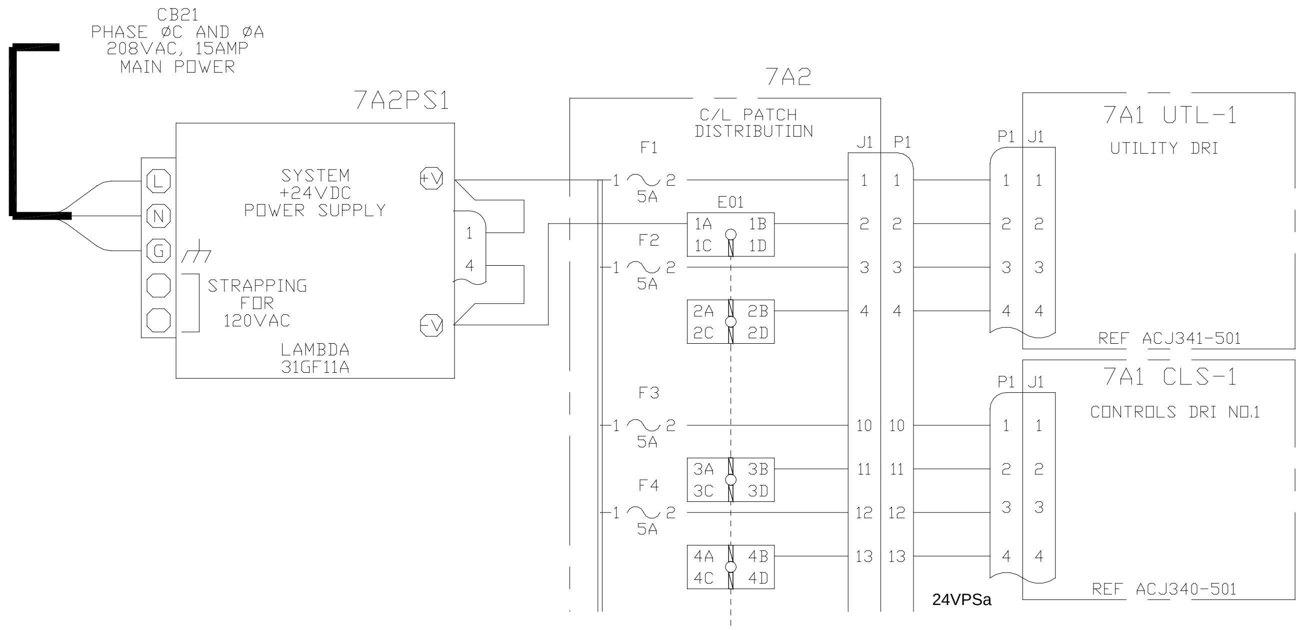

Figure 4-32. DRI Platform C/L Patch Diagram

4.7.2.3. DRI Platform Assembly Components

DRI Platform assemblies are used to position electric actuators in the control loading and motion system. Input and output channels are used to activate and monitor motion and control loading on and off circuits. If any electric component fails, the associated DRI Platform is responsible for initiating a shutdown of the system and activating the appropriate indicators.

Each DRI Platform Assembly consists of two boards:

- Platform332 Board
- Power Supply and Signal Conditioning Board (PSSCB)

The following paragraphs describe the DRI Platform Assembly Components. See Figure 4-33.

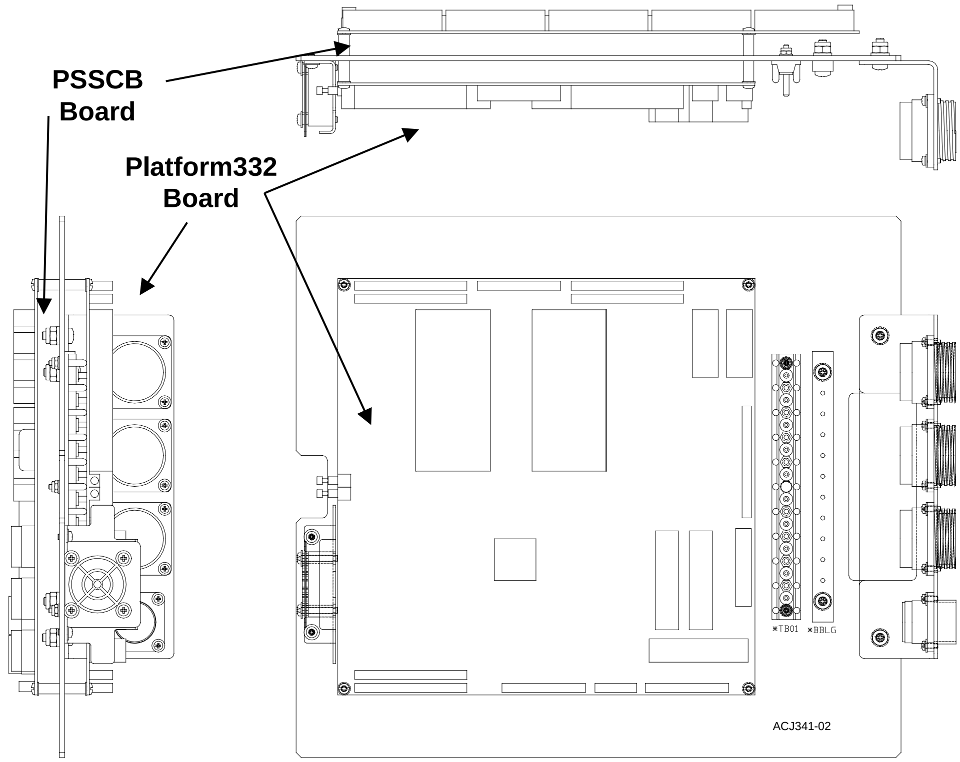

Figure 4-33. DRI Platform Assembly

4.7.2.3.1. Platform332 Board

The Platform332 Board is a stand-alone, single board computer based on the Motorola MC68332 Integrated Microcontroller. The Platform332 board performs all of the monitoring and control functions for the system in which it is installed. Platform332 Boards have designated locations, or slots, which provide for plug-in modules. See Figure 4-34. These modules, or IPs, allow the Platform332 Board to be configured to satisfy the system requirements of monitoring the motion, control loading, and utility components. Each Platform332 Board is populated with IPs that contain the I/O drivers (DI/DO, DA, PWI, and AD) necessary to monitor and control the system in which they are installed. For additional information on the Platform332 board, refer to the vendor User Manual listed in the List of Related Publications in Section 1 of this manual.

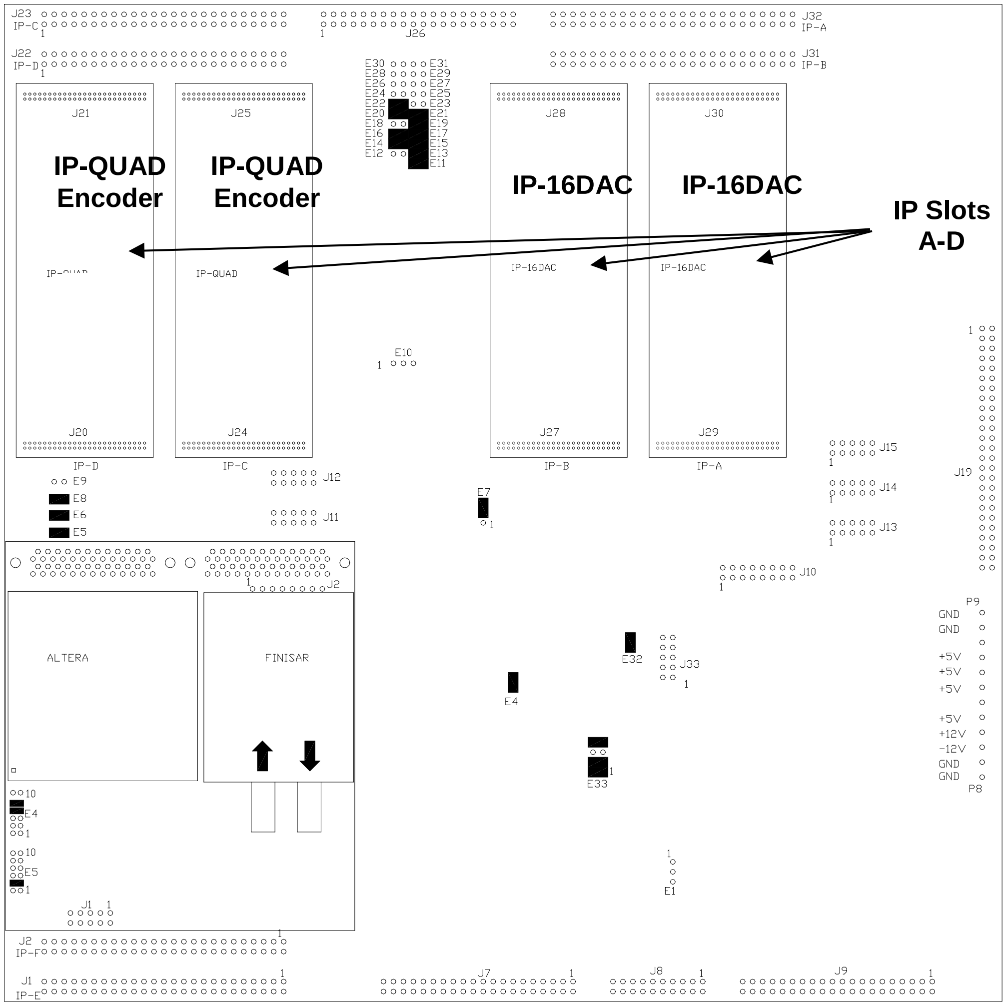

Figure 4-34. Platform332 Board CLS-1

4.7.2.3.1.1. Platform332 IP Packs

For additional information concerning the operation of each of the IP Modules described below, refer to the vendor User Manuals listed in the List of Related Publications in Section 1 of this manual.

4.7.2.3.1.2. IP-UNIDIG Module

Each IP-UNIDIG Pack, or Module, has a total of 16 differential digital inputs (DIs) and eight differential digital outputs (DOs). Each DO and DI requires +24VDC. The IP-UNIDIG occupies Slot B on the Platform332 Board UTL-1. The block diagram shows the functional operation of the module. See Figure 4-36. The ID PROM provides the software program to the IP Bus Interface. A control register and an external double-buffer clock trigger the clock circuit. The clock provides timing to each of the input and output registers.

Digital inputs are compared to an on/off state bias of the 16-voltage comparators. The digital-to-analog (D/A) shift register and 12-bit D/A converter provide the bias. The input registers then clocks the bit status to the IP Bus Interface. Digital outputs are clocked through the MOSFET conditioned output circuits. See Figure 4-35.

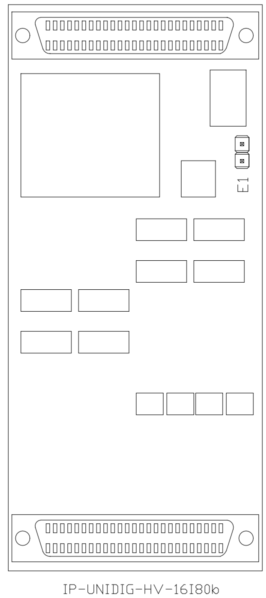

Figure 4-35. IP-UNIDIG Module

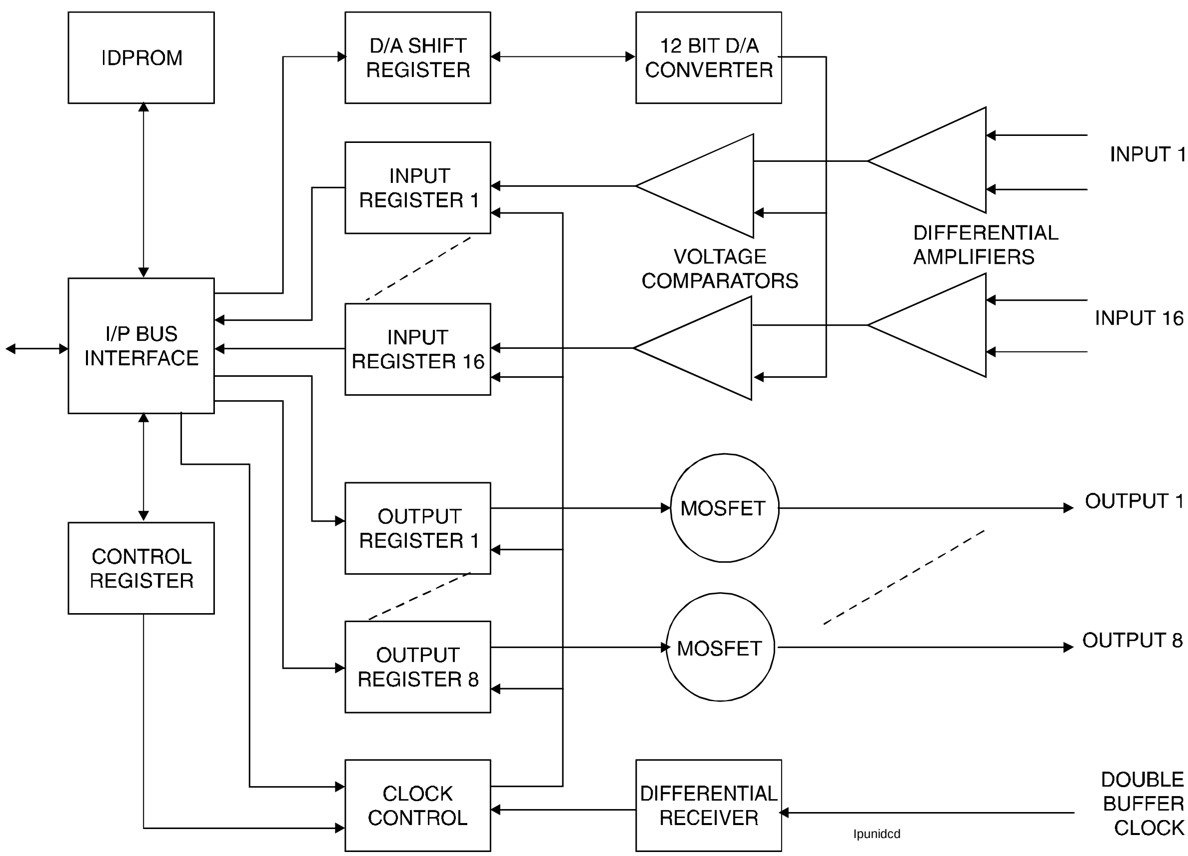

Figure 4-36. IP-UNIDIG-HV Block Diagram

4.7.2.3.1.3. IP-16DAC Module

Each IP-16DAC Module has a total of eight differential digital-to-analog channels (multiplexed). Each digital word input to the DAC is 16 bits long. Source voltage for each DAC is 12VDC provided by the PSSCB, and is scaled to 10VDC in operation. The IP-16DAC module occupies Slots A and B on the Platform332 Board CLS-1.

The IP-DAC Module provides three independent channels of 16-bit digital-to-analog conversions. Inputs to the IP-DAC Module include both address and data. The address is processed by the Board Control and Bus Handler and is output to the three D/A Converters. Data is applied to the 32x8 PROM Program Controllers. ID and D/A conversions are under software control. The three D/A converters change the input digital word into an analog voltage that is conditioned by a buffer amplifier and applied to the appropriate valve drive. The analog outputs are sent to the Digital Servo Amplifiers for actuator movement. See Figure 4-37.

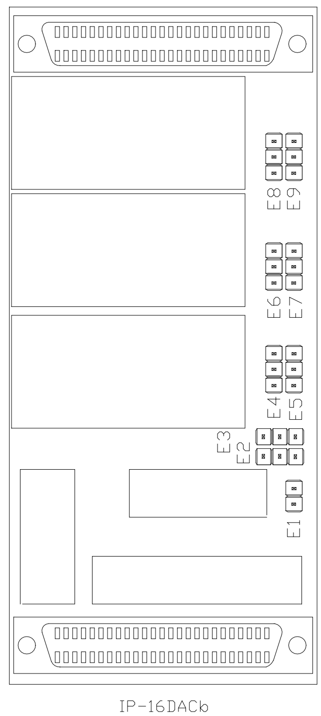

Figure 4-37. IP-16DAC Module

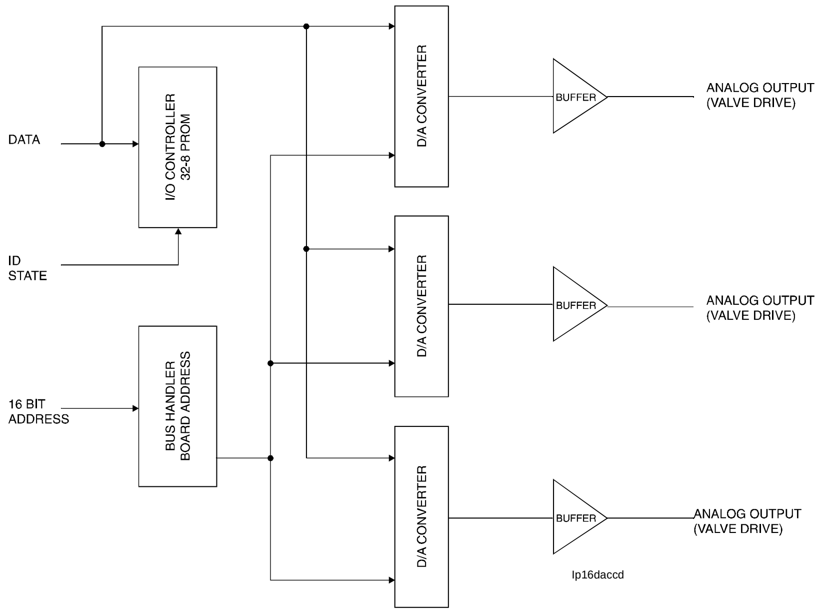

Figure 4-38. IP-16DAC Block Diagram

4.7.2.3.1.4. IP-16ADC Module

IP-16ADC Modules are software configured and do not require jumpers in installation. Each module has a total of eight differential analogs to digital channels (multiplexed). After processing an analog input scaled between 10VDC, the output is a sixteen-bit digital word. Source voltage for the IP-16ADC Module is the ± 15VDC power supply on the PSSCB. The IP-16ADC Module occupies Slot C on the Platform332 Board UTL-1.

The block diagram shows analog signal inputs to the module provided by load cells from primary flight controls, accelerometer transducers from the seat motion under control of the DRI Platform System. The analog signals are multiplexed by the Input Multiplexer (+) and Input Multiplexer (-). A second Multiplexer mixes calibration signals with the analog signals. The Multiplexer also adds the programmable gain signals, which originate on the PSSCB. The Instrumentation Amplifier conditions the signal before it is sent to the analog-to-digital (A/D) Converter.

The A/D converter digitizes the scaled input voltage to provide an output, which is a serially transmitted digital signal. The serial parallel converter changes serial words to parallel words for output to the logic connector. See Figure 4-39 and Figure 4-40.

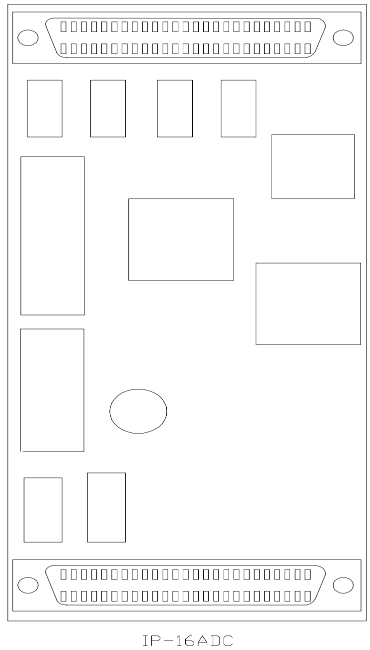

Figure 4-39. IP-16ADC Module

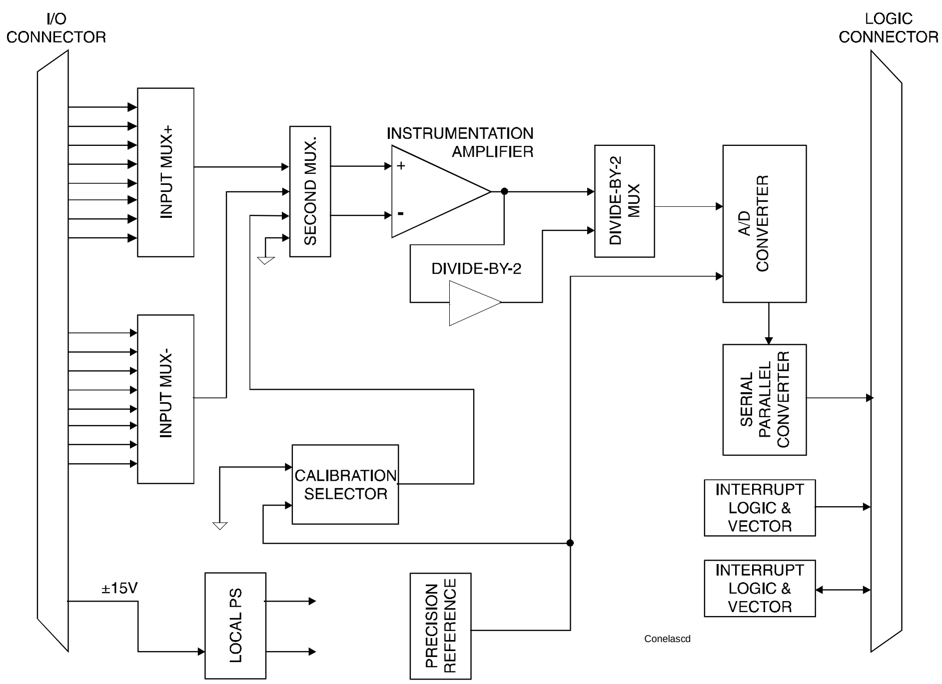

Figure 4-40. IP-16ADC Block Diagram

4.7.2.3.1.5. IP-QUAD Module

IP-QUAD encoder Modules provide a digital 24-bit word output corresponding to the position input from an electric actuator. Each module has a total of four channels, each of which is capable of receiving either differential or single-ended digital inputs. The IP-QUAD Module occupies Slots C and D on the Platform332 Board CLS-1. See Figure 4-41 and Figure 4-42.

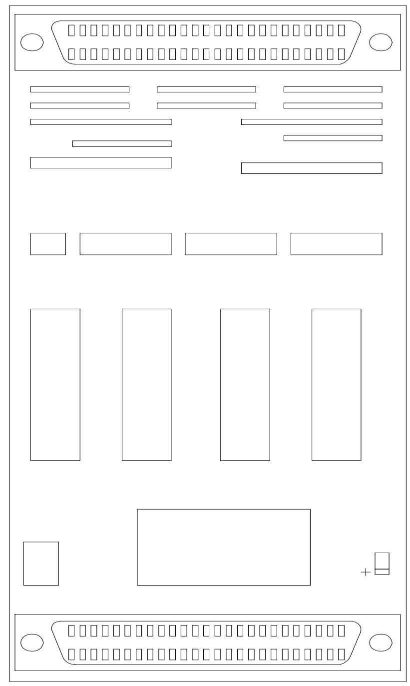

Figure 4-41. IP-QUAD Module

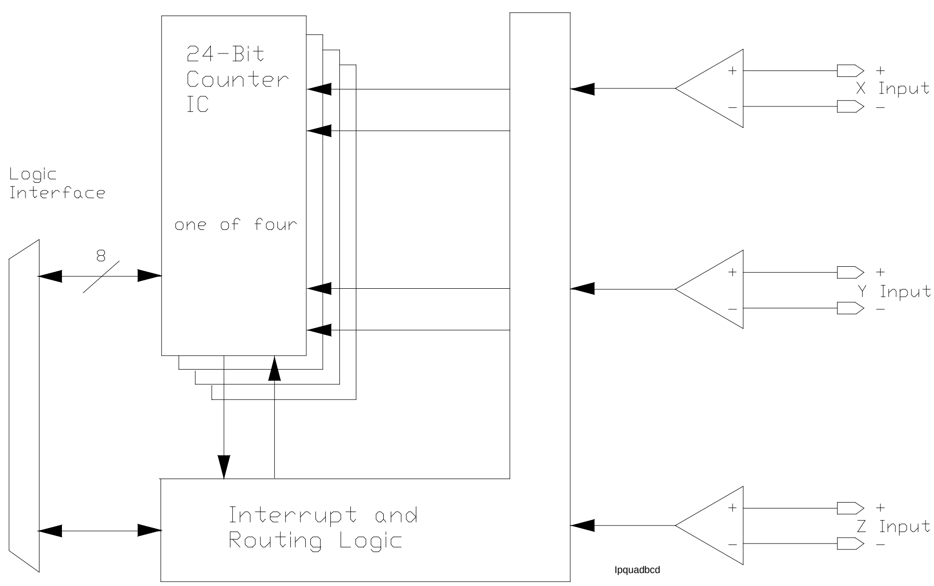

Figure 4-42. IP-QUAD Block Diagram

4.7.2.3.1.6. IP-GSnet Module

The IP-GSnet modules installed on each DRI Platform332 Board transmit and receive data on the fiber optic loop connecting motion, control loading, and utility functions. The IP-GSnet Module occupies Slots E and F on the Platform332 Board.

The IP-GSnet Module is a plug-in module called a NODE, consisting of a fiber optic transmitter and receiver, a control logic chip, which is the NODE Processor, NODE Ram (NRAM), and a First-In-First-Out (FIFO) buffer. The IP-GSnet receiver inputs data from the fiber optic ring to the Control Logic Processor. The transmitter sends data not addressed to this specific DRI Platform back to the ring. Data intended for the DRI Platform Assembly (Host Interface) is placed on the DRI Platform332 Board where it is processed for action. The FIFO handles excess data that exceeds the Ring data rate.

The GSnet control logic chip, where the DRI Platform address is added and placed, processes data from the Host Interface (DRI Platform332 Board) on the fiber optic ring by the transmitter. See Figure 4-43.

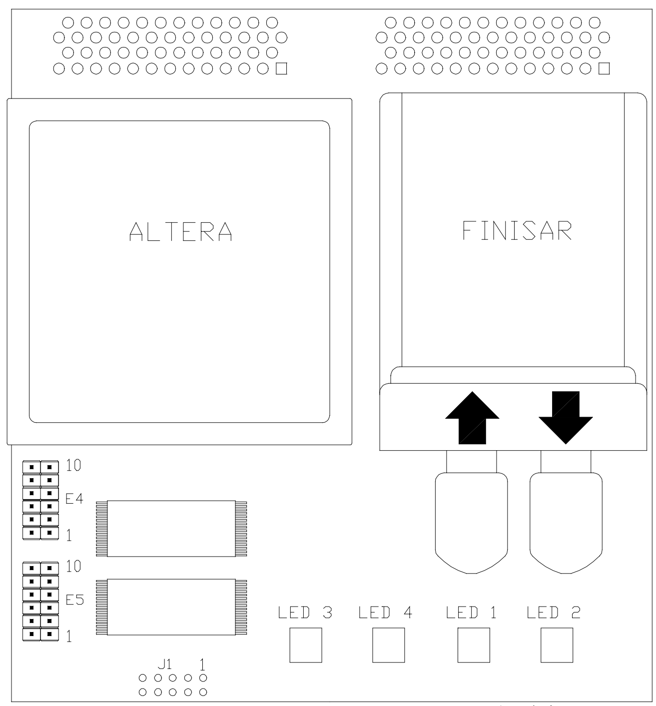

Figure 4-43. IP-GSnet Module

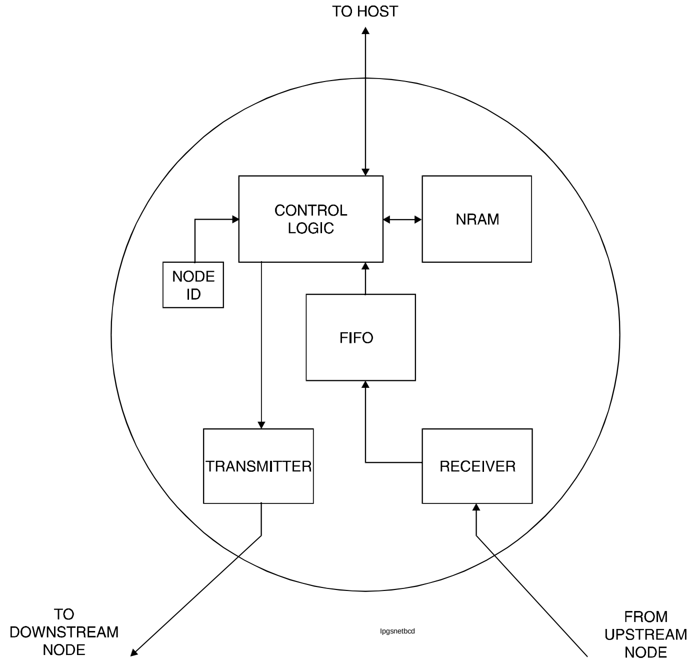

Figure 4-44. IP-Gsnet Block Diagram

4.7.2.3.2. Power Supply and Signal Conditioning Board (PSSCB)

The PSSCB provides the required power supply voltages for the Platform332 board. The board also supplies power to the A/D channels and programmable amplifiers for conditioning the analog signals prior to processing by the IP-ADC module on the Platform332 board.

4.7.2.3.2.1. PSSCB DC Power Conversion

The PSSCB contains the additional power supplies required for operation of the Platform332 Board and the electrical actuators on the control loading systems. Each PSSCB converts +24VDC to various voltages for the Industry Packs (IPs) on the Platform332 Board. The DC voltages that are distributed to the DRI Platform and DRI Platform related components are:

- +5VDC
- +12VDC
- -12VDC
- +15VDC
- -15VDC

+5VDC Power Supply

Power Supply DC5 provides +5VDC for the PSSCB and the Platform332 Board.

±12VDC Power Supplies

Power Supplies DC1 and DC2 provide -12VDC and +12VDC respectively for the PSSCB and the Platform332 Board.

±15VDC Power Supplies

Power Supplies DC3 and FL1 provide -15VDC outputs, and DC4 and FL2 provide +15VDC outputs. These power supplies provide clean, noise-free output power for the IP-ADC Module on the Platform332 Board. Noise filters are located on the PSSCB.

Programmable Power Supplies

There are eight Programmable Power Supplies on the PSSCB. See Figure 4-45. The power supplies are labeled Channel 1 through 8 and are jumper-configured for output voltages as required. FSI Drawing 6520ACJ755 lists the configuration requirements for the programmable power supplies. The following programmable voltages are provided by the PSSCB as required for the DRI system components.

- ±10VDC
- ±5VDC
- ±2.5VDC

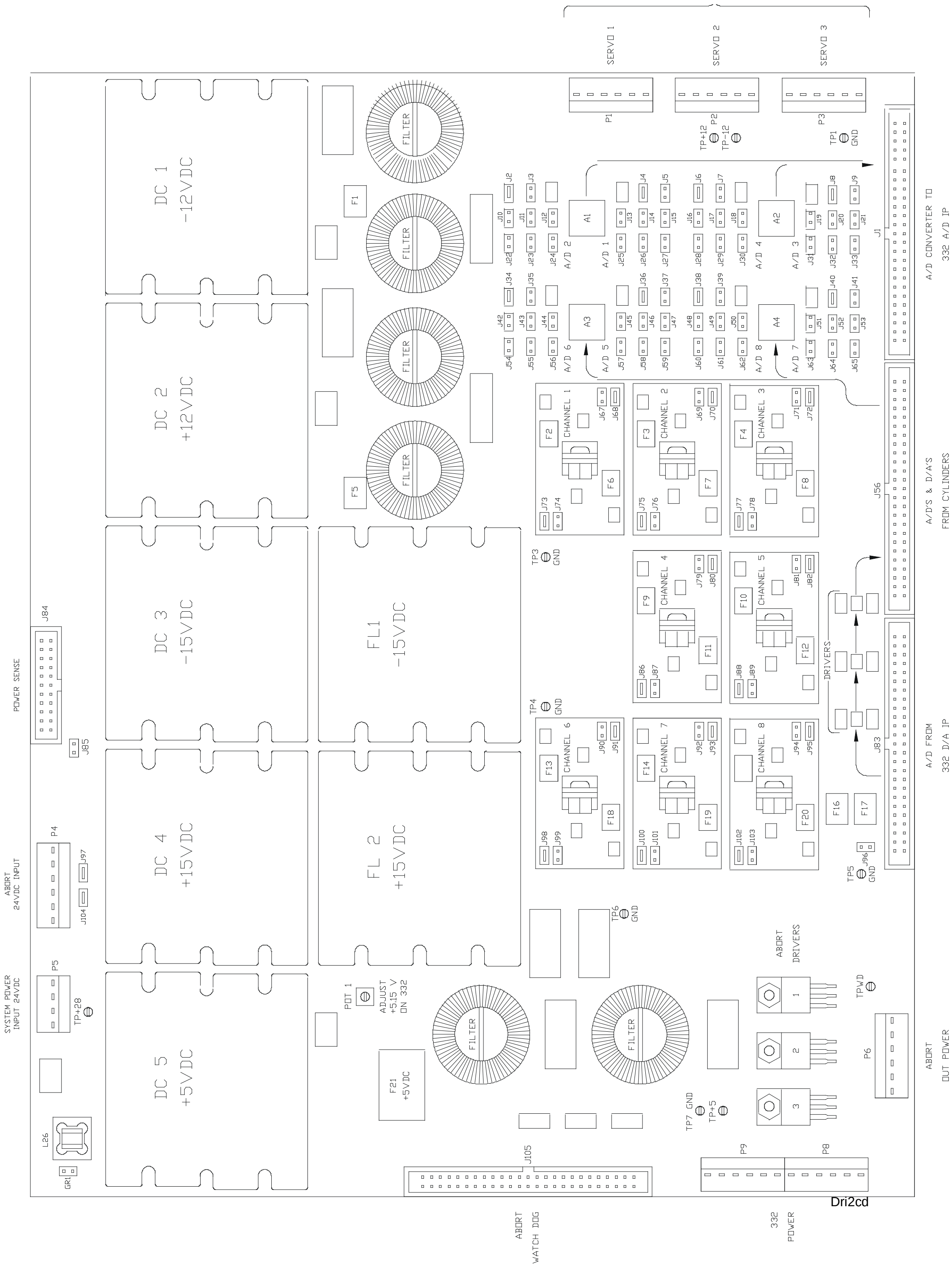

Figure 4-45. PSSCB Board

4.7.3. Data Acquisition System (DAS)

The DAS is the input/output controller for the motion and control loading systems on the simulator. The electrical systems consist of the ECL Computer, Flight Controls (Aileron, Elevator, Rudder), Secondary Controls (Left Toe Brake, Right Toe Brake), and Motion Control (Seat) systems.

The ECL Computer is interfaced to the DAS via a GSNet. The DAS, in turn, interfaces with the Power Amplifiers through the Control Loading Patch. It is the Power Amplifiers that drive the Actuators to move the controls.

4.7.3.1. AC Power

The DAS Platform assembly requires a +24VDC external power source for operation. The ECL AC Power Distribution Panel powers the DAS chassis through the DAS circuit breaker and an outlet strip through the Peripheral circuit breaker. AC input power to the power supply is 110VAC from the AC Power Control System (9A1A1) routed through the frame distribution box (6A2A1).

4.7.3.2. DC Power

The DAS chassis contains the main 12/24VDC power supply that supplies 24 VDC logic and Abort power to the control loading and motion circuits. The 24VDC power is distributed to the control loading and motion circuits by the DC Power Distribution Panel through the ECLS patch assembly. See Figure 4-46.

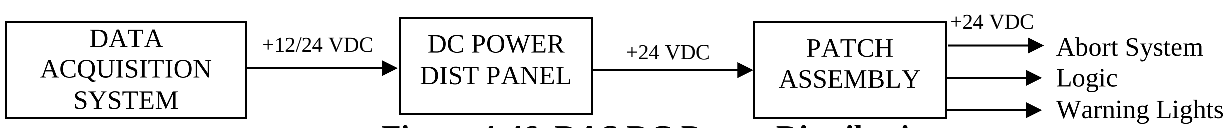

Figure 4-46. DAS DC Power Distribution

The Patch Panel for the ECL Computer is located in the cockpit frame at the 7A2 (7A1 for the Navy T-6A) location. It provides a central distribution point for DC power. It contains components for control (relays) and fault protection (fuses). The fuses are mounted in holders that allow for ready identification of a blown fuse.

The +24VDC Abort power is also supplied to the PSSCB through the P4 connector. The abort power is separately fused and controlled. The +24VDC Abort power is distributed from the PSSCB to the abort solenoid valves in the electric servo actuators on each cylinder. A loss of the +24VDC abort signal causes an interrupt resulting in an immediate shutdown of that system.

4.7.3.3. DAS Chassis Assembly Components

The DAS chassis interfaces interlocks, switches, warning lights, etc., to the ECL computer. It consists of a CPU processor board, a Master and a Slave IP Carrier board, the PSSCB, and the system power supply. The Master and Slave IP carrier boards have IPs installed on them to perform specific I/O interface functions.

4.7.3.3.1. CPU Processor Board

The DAS chassis circuit board consists of:

- Industrial Packs on the PCI Master and Slave IP Carrier
    - The D/A, A/D & Quad IP modules are located on the master PCI board

- o The Digital I/O (DI/DO) IP modules are located on the slave PCI board
- GSNet interface board

The CPU board in the DAS is populated with Industrial Packs (IPs). The IPs contain the I/O drivers (DI/DO, D/A, PWI and A/D). The DI/DO IP is called the Unidig Digital I/O Module. The inputs are compared to an ON/OFF state bias of the 16 voltage comparators. The bias is provided by the D/A shift register and a 12-bit A/D converter.

The A/D is the 16ADC Module. Each module has a total of 8 differential analog-to-digital channels. After processing an analog input scaled between ± 10VDC, the output is a 16-bit digital word. Source voltage for the IP is the ± 15VDC power supply on the PSSCB. The A/D is used to convert analog voltages from load cells, accelerometers, etc., to digital words sent to be used by the software.

The IP-QUAD Module is a four-channel decoder, which decodes the position of electric control loading and secondary motion cylinders.

The D/A is the 16DAC Module. The IP-16DAC module is a three-channel, 16-bit digital-to-analog converter normally used to control the servo valve on the hydraulic cylinders. Each channel controls one device and is normally controlled by software. Control loading and motion hydraulic cylinders are positioned by the assigned channel DAC.

4.7.3.3.1.1. IP-UNIDIG Module

Each IP-UNIDIG Pack, or Module, has a total of 16 differential DIs and eight differential DOs. Each DO and DI requires +24VDC. The IP PROM provides the software program to the IP Bus Interface, a control register and an external double buffer clock trigger. The clock provides timing to each of the input and output registers.

DIs are single-bit commands received by the DAS to monitor the operation and status of the ECLS. They are compared to an on/off state bias of the 16 voltage comparators. The D/A shift register and 12-bit D/A converter provide the bias. The input registers then clock the bit status to the IP Bus Interface. DOs are clocked through the MOSFET conditioned output circuits. See Figure 4-47.

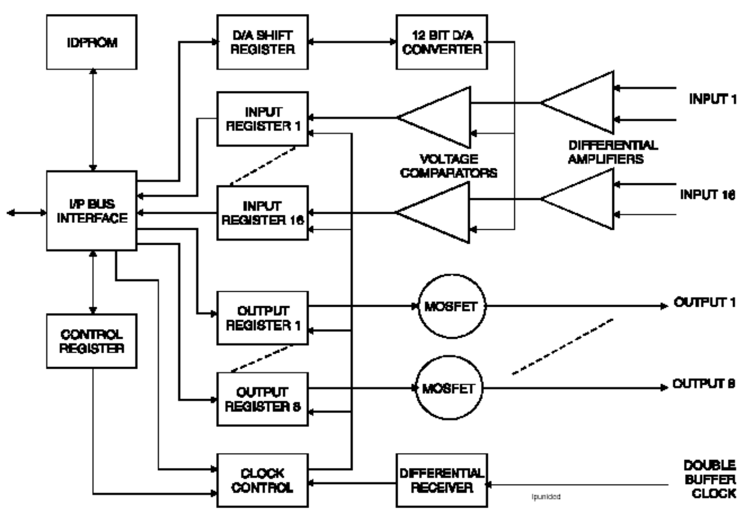

Figure 4-47. IP-UNIDIG Module Block Diagram

4.7.3.3.1.2. IP-16DAC Module

Each IP-16DAC Module has a total of eight differential D/A channels (multiplexed). Each digital word input to the DAC is 16 bits long. Source voltage for each DAC is 12VDC provided by the PSSCB, and is scaled to 10VDC in operation.

The IP-DAC Module provides three independent channels of 16-bit**,** digital-to-analog conversions. Inputs to the IP-DAC Module include both address and data. The address is processed by the Board Control and Bus Handler and is output to the three D/A Converters. Data is applied to the 32x8 PROM Program Controllers. ID and D/A conversions are under software control. The three D/A converters change the input digital word into an analog voltage that is conditioned by a buffer amplifier and applied to the appropriate valve drive. The analog outputs are sent to the Digital Servo Amplifiers for actuator movement. See Figure 4-48.

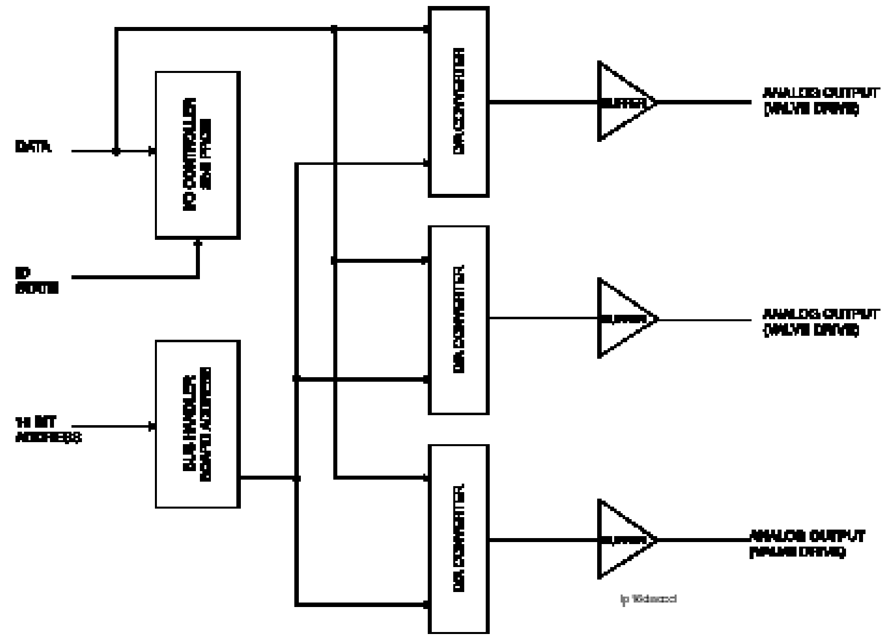

Figure 4-48. IP-16DAC Module Block Diagram

4.7.3.3.1.3. IP-16ADC Module

IP-16ADC Modules are software configured and do not require jumpers in installation. Each module has a total of eight differential analogs-to-digital channels (multiplexed). After processing an analog input scaled between 10VDC, the output is a 16-bit digital word. Source voltage for the IP-16ADC Module is the ± 15VDC power supply on the PSSCB.

The block diagram shows analog signal inputs to the module provided by load cells from primary flight controls, accelerometer transducers from the seat motion under DAS control. The analog signals are multiplexed by the Input Multiplexer (+) and Input Multiplexer (-). A second Multiplexer mixes calibration signals with the analog signals. The Multiplexer also adds the programmable gain signals, which originate on the PSSCB. The Instrumentation Amplifier conditions the signal before it is sent to the A/D Converter.

The A/D converter digitizes the scaled input voltage to provide an output, which is a serially transmitted digital signal. The serial parallel converter changes serial words to parallel words for output to the logic connector. See Figure 4-49.

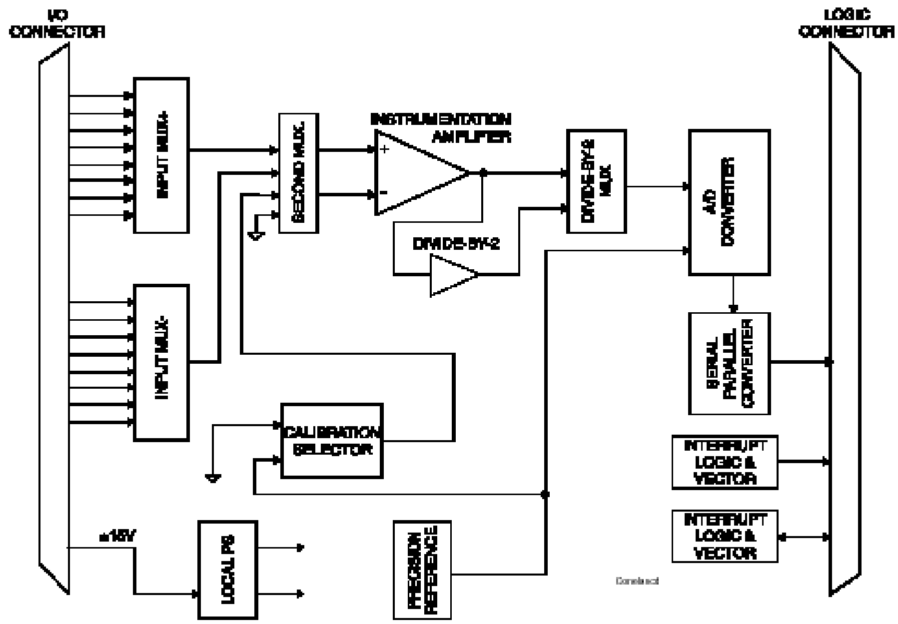

Figure 4-49. IP-16ADC Module Block Diagram

4.7.3.3.1.4. IP-QUAD Module

IP-QUAD encoder modules are used to provide a digital 24-bit word output corresponding to the position input from an electric actuator. Each module has four channels, each of which is capable of receiving either differential- or single-ended digital inputs. See Figure 4-42.

4.7.3.3.1.5. Power Supply and Signal Conditioning Board (PSSCB)

The PSSCB provides the required voltages for the IP Carrier boards. The board also supplies power to the A/D channels and programmable amplifiers for conditioning the analog signals prior to processing by the IP-ADC module.

4.7.3.3.1.5.1. PSSCB DC Power Conversion

The PSSCB contains the additional power supplies required for operation of the IP Carrier Boards and the electrical actuators on the control loading systems. Each PSSCB converts +24VDC to various voltages for the IPs on the IP Carrier Board. The DC voltages distributed to the related components:

- +5VDC
- +12VDC
- -12VDC
- +15VDC
- -15VDC

+5VDC Power Supply

Power Supply DC5 provides +5VDC for the PSSCB and the IP Carrier Board.

+12VDC Power Supplies

Power Supplies DC1 and DC2 provide -12VDC and +12VDC respectively for the PSSCB and the IC Carrier boards.

+15VDC Power Supplies

Power Supplies DC3 and FL1 provide -15VDC outputs, and DC4 and FL2 provide +15VDC outputs. These power supplies provide clean, noise-free output power for the IP-ADC Module on the IP Carrier boards. Noise filters are located on the PSSCB.

Programmable Power Supplies

Sixteen Programmable Power Supplies on the PSSCB are labeled Channel 1 through 16 and are jumper-configured for output voltages as required. FSI Drawing 6520ACJ855 lists the configuration requirements for the programmable power supplies. The programmable voltages provided by the PSSCB as required for the system components:

- ±15VDC
- ±10VDC
- ±5VDC
- ±2.5VDC

The PSSCB contains additional power supplies required for the operation of the PSSCB and the actuators on the motion and control loading systems. Each PSSCB converts +24VDC to voltages used by the IPs to control and monitor the electric actuators. The power supplies are ±15VDC, ±12VDC, and ±5VDC.

The PSSCB excitation voltages and gains should be set to match the board you are removing or configured in accordance with drawing 6520ACJ855. Voltages from the Programmable Power Supplies are: ±15VDC, ±10VDC, ±5VDC, and ±2.5VDC.

4.7.4. DRI Servo Loop System

DRI Platform assemblies control the Flight Controls (Aileron, Elevator, Rudder), Secondary Controls (Left Toe Brake, Right Toe Brake), and Motion Control (Seat) systems. Each platform assembly consists of two circuit boards: the DRI Platform332 board and the PSSCB. See Figure 4-50.

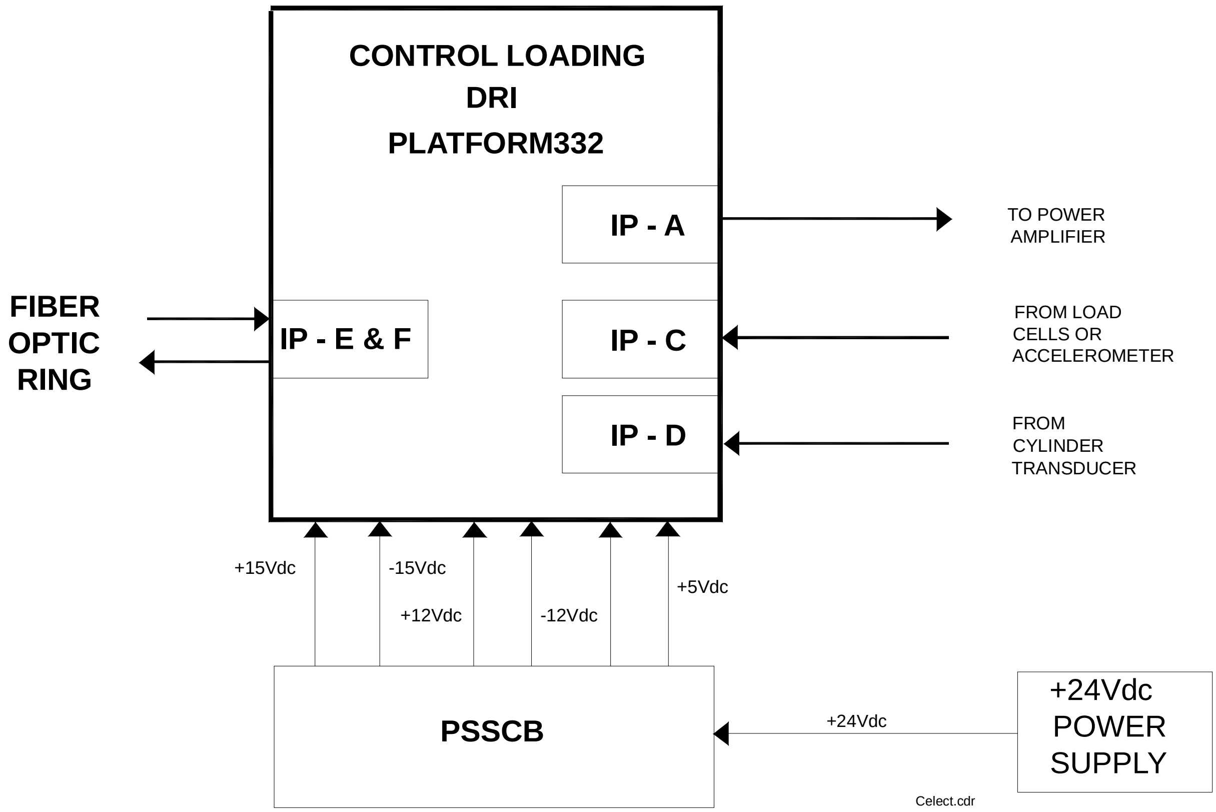

Figure 4-50. Control Loading DRI Interface

4.7.4.1. DRI Platform

The PSSCB receives +24VDC power from the control loading DRI Platform power supply. The PSSCB provides the various DC voltages for the DRI Platform332 Board and controlled systems.

The DRI Platform332 board is a processor-controlled board that has IPs installed to perform specific I/O interface functions. These functions are:

- Analog Inputs
- Analog Outputs

On CLS-1, IP modules A and B are DAC modules and IP modules C and D are IP Quad Packs. On UTL-1, IP module B is a Digital I/O Pack and IP module C is an Analog-to-Digital Converter (ADC) module. IP module E & F are used for the GSnet Fiber Optic Receiver/Transmitter module. The Utility DRI Platform handles digital Inputs and Outputs.

The DRI Platform receives commands from, and sends current status and failure information back to, the ECL Computer via the Fiber Optic Ring.

4.7.4.2. Functional Block Diagram

The Control Loading System simulates the "feel" of the aircraft controls. To accomplish this, the control loading system uses DRI platforms to control and monitor the electric cylinders. Only a typical primary control loading system is discussed here. The secondary controls are similar in operation. See Figure 4-51.

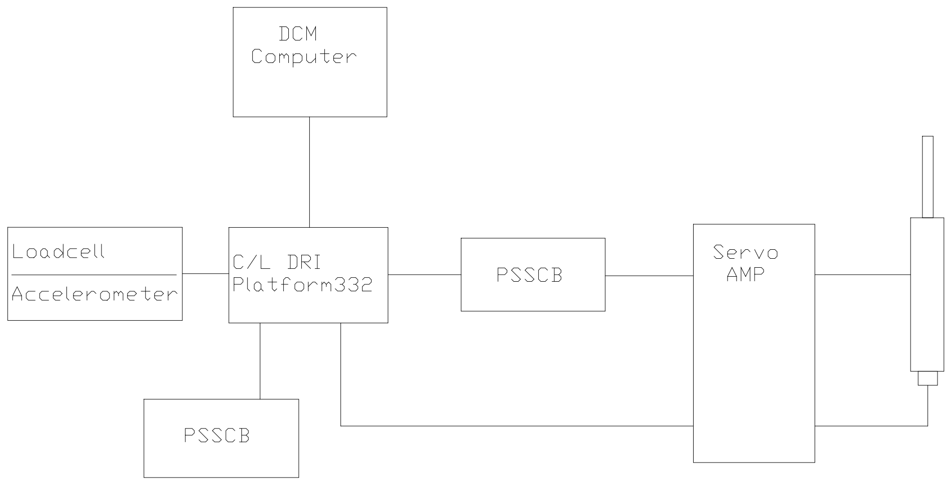

Figure 4-51. Typical Control Loading Block Diagram

The control loading servo loop consists of the DRI platform, PSSCB, load cells, accelerometer, and electric actuators.

The Electric Control Loading (ECL) Computer has the processor boards that run the control loading models. These models combine data from the host computer based on the training environment, aircraft configuration, and aircraft attitude with inputs from the pilot. When the pilot wants to move the aircraft controls, the control column is pushed on, inducing a force on the load cell.

The load cell outputs an analog signal that is input to the DRI Platform, informing the platform that the pilot wants the control to be moved and in which direction. The DRI platform will send the load cell signal to the ECL Computer and wait for a response. Based on the input load cell signal, the DRI platform will send a control signal to the Digital Servo Amplifier that will activate the actuator.

When a side of the actuator is energized, it will move. The actuator is mechanically connected to the aircraft control; therefore, when the actuator is driven, the corresponding aircraft control is moved. The feel of the aircraft controls is created under the direction of the simulation software resident in the host computer. These commands are interpreted by the control loading in much the same way it interprets the pilot's inputs. The system generates a drive signal to the electric components corresponding to the combination of these two inputs and creates the appropriate feel in the aircraft control.

The following paragraphs discuss each of the major components of the servo loop.

4.7.4.3. Electric Control Loading (ECL) Computer

Control loading processors in the ECL Computer receive data from the load cells, determine which control is to be driven, how hard the control is to drive, and which direction it is to be driven. The ECL Computer combines this information with the host data and sends a command to the appropriate DRI platform to generate a servo drive signal in response to the load cell inputs. This drive signal is output to the appropriate servo valve to drive the cylinder. As the cylinder is being driven, the ECL Computer monitors the feedback signal to ensure the servo loop is responding correctly to the drive signal.

4.7.4.4. Load Cells

The pilot's input to the system is through the load cells. They convert physical force (pushing/pulling/turning) to an analog signal representing how hard the control is moved and in which direction the force is being applied. The pushing/pulling force is interpreted for the elevator control, pushing force for the rudder, and the turning force for the aileron control. In-line load cells are installed in the linkage of the servo loops between the electric actuators and the flight controls.

Load cells provide the primary and secondary control force inputs to the ECLS DRI Platform. These inputs provide the necessary information to the control modeling software for accurate flight simulation and personnel safety. Each load cell translates a change in force into a change of voltage.

The sensing element consists of semiconductor strain gages bonded to a high strength member. The load cell uses the piezo-resistive characteristics of the semiconductor strain gages that are electrically connected to form a Wheatstone bridge rectifier circuit which is balanced (0VDC output) when no force is applied. When a force is applied, the bridge circuit becomes unbalanced making the output voltage of the cell proportional to the bridge unbalance and the applied force. There are three types of load cells generally used in simulation. These include the link or in-line (Tyco), the on-column, and the rotary load cells. Depending on the application, any combination of these load cells can be used. The JPATS simulators utilize in-line load cells exclusively. All load cell power, signal amplification, and signal buffering are provided by the DRI Platform.

Although the link load cell can be used in control modeling, it is typically used as a safety device to prevent injury to personnel or damage to equipment should a runaway or unsafe condition occur. It is mounted in line with the mechanical control linkage of the flight control axis and translates changes in tension and compression.

4.7.4.5. Electrical Actuator

Linear actuators are used in the control loading system. The unique design of the GS series actuators allows for the extending rod to rotate. This allows the user to rotate the rod and thread for specific application. An anti-rotation device keeps the rod from rotating and changing its dynamic setting, keeping the linear setting accurate.

Generally, these actuators function the same as a brushless servomotor. The servo amplifier rotates the motor at controlled speed, torque, and move time. This rotary motion is translated into linear motion by the internal planetary roller screw mechanism.

The relationships between the rotary screw and the linear motion of the actuator correspond to the following relationships.

Linear Distance Traveled = (Motor Revolutions) x (Roller Screw Lead)

Linear Speed = (Motor RPM) / 60) x (Roller Screw Lead)

Linear Force = ((Motor Torque) x (2π) x (efficiency)) / (Roller Screw Lead)

All of the above relationships require proper anti-rotation of the actuator rod.

4.7.4.6. Digital Inputs (DIs)

DIs are single-bit commands received by the DRI Platform to monitor the operation and status of the ECLS.

4.7.5. DAS Servo Loop

The control loading servo loop consists of the DAS, Power Amplifiers, PSSCB, load cells, accelerometer, and electric actuators.

The ECL Computer processor boards run control-loading models that combine data from the host computer (based on the training environment, aircraft configuration, and aircraft attitude) with inputs from the pilot. When the pilot moves the aircraft controls, the control column is pushed on, inducing a force on the load cell.

The load cell outputs an analog signal to the DAS, informing the unit that the pilot wants the control to move and in which direction. The DAS sends the load cell signal to the ECL Computer and waits for a response. Based on the input load cell signal, the DAS will send a control signal to the Digital Servo Amplifier to activate the actuator.

When a side of the actuator is energized, it will move. The actuator is mechanically connected to the aircraft control; therefore, when the actuator is driven, the corresponding aircraft control is moved.

The feel of the aircraft controls is created under the direction of the simulation software resident in the host computer. These commands are interpreted by the control loading much the same way as it interprets the pilot’s inputs. The system generates a drive signal to the electric components corresponding to the combination of these two inputs and creates the appropriate feel in the aircraft control. See Figure 4-52.

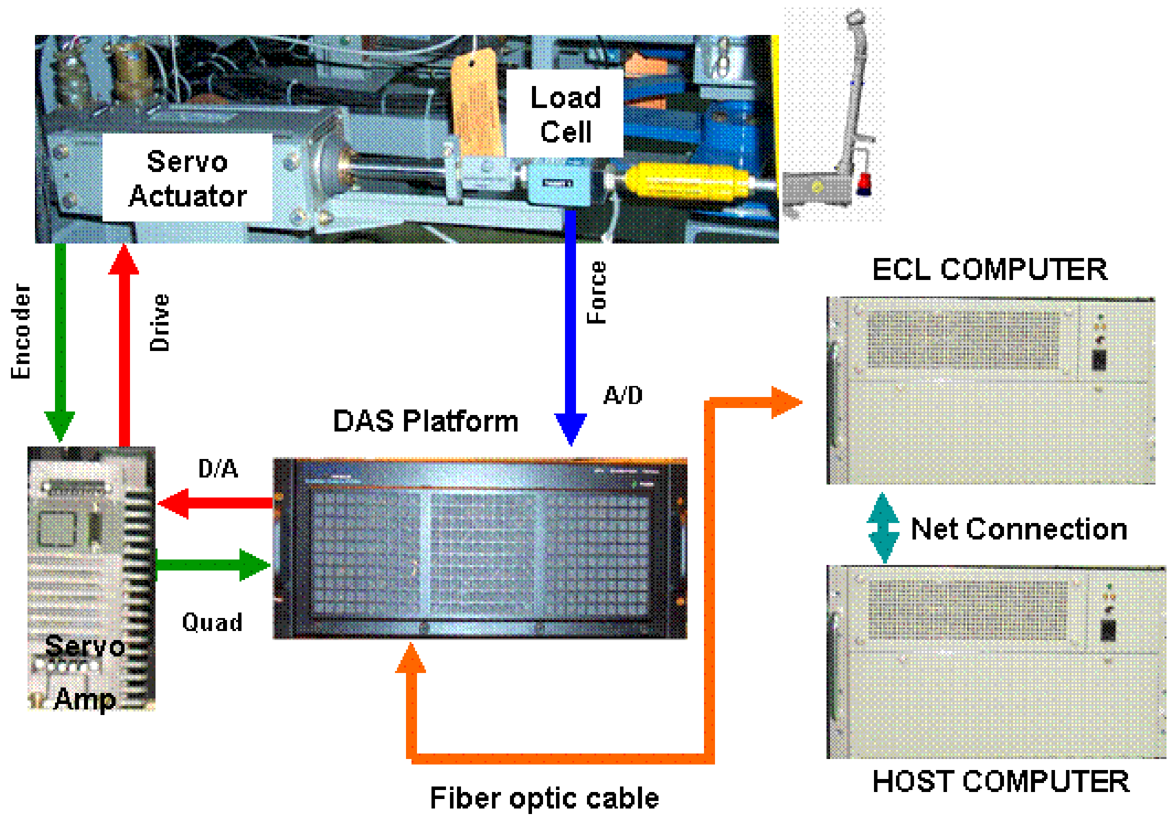

Figure 4-52. DAS Servo Loop

The following paragraphs discuss each of the major components of the servo loop.

4.7.5.1. Electric Control Loading (ECL) Computer

The control loading processors in the ECL Computer receive the data from the load cells, determine which control is to be driven, how hard the control is to drive, and which direction it is to be driven. The ECL Computer combines this information with the host data and sends a command to the DAS platform to generate a servo drive signal in response to the load cell inputs. This drive signal is output to the appropriate servo valve to drive the cylinder. As the cylinder is being driven, the ECL Computer monitors the feedback signal to ensure the servo loop is responding correctly to the drive signal.

4.7.5.2. Load Cells

Load cells take pilot input and convert physical force (pushing/pulling/turning) to an analog signal representing how hard the control is moved and in which direction the force is being applied. The pushing/pulling force is interpreted for the elevator control, pushing force for the rudder, and the turning force for the aileron control. The load cells are inline load cells installed in the linkage of the servo loops between the electric actuators and the flight controls**.**

Load cells provide the primary and secondary control force inputs to the ECL DAS. These inputs provide the necessary information to the control modeling software for accurate flight simulation and personnel safety. Each load cell translates a change in force into a change of voltage.

The load cell uses the piezo-resistive characteristics of the semiconductor strain gages that are electrically connected to form a Wheatstone bridge rectifier circuit which is balanced (0VDC output) when no force is applied. When a force is applied, the bridge circuit becomes unbalanced; the output voltage of the cell is proportional to the bridge unbalance and the applied force. All load cell power, signal amplification, and signal buffering is provided by the DAS.

4.7.5.3. Electrical Actuator

The electrical actuators used in the control loading system are linear actuators. The unique design of the GS series actuators permits extending rod rotation. This allows the user to rotate the rod and thread for specific application. An anti-rotation device keeps the rod from rotating and changing its dynamic setting, keeping the linear setting accurate. Generally, these actuators function the same as a brushless servomotor. The servo amplifier is used to rotate the motor at controlled speed, torque, and move time.

4.7.6. Fiber Optic Ring Operation

The GSnet Fiber Optic Ring is the system that connects all components of the electric system and subsystems together to provide communication to and from all of the components in the DRI Platform system. As shown in Figure 4-53, utility and control load DRI platforms are connected in series with the ECL Computer. The DRI platforms IP-GSnet Modules are located on each Platform332 Board.

When the DAS platform is in place, the fiber optic connection runs between the DAS platform and the ECL computer. All of the activity that takes place between the DRI platforms and the ECL occur between the DAS platform and the ECL computer. See Figure 4-52.

A Monarch configured IP-GSnet Board is required for ring operation. It is located on the Utility DRI Platform332 Board and it serves two purposes:

- Initiates Fiber Optic Ring operation and polling on power-up.
- Deletes all orphan random messages that may occur in the Fiber Optic Ring during operation.

The Monarch option is set up on the IP-GSnet plug-in module by jumper configuration. See Section 2 of this manual for configuration.

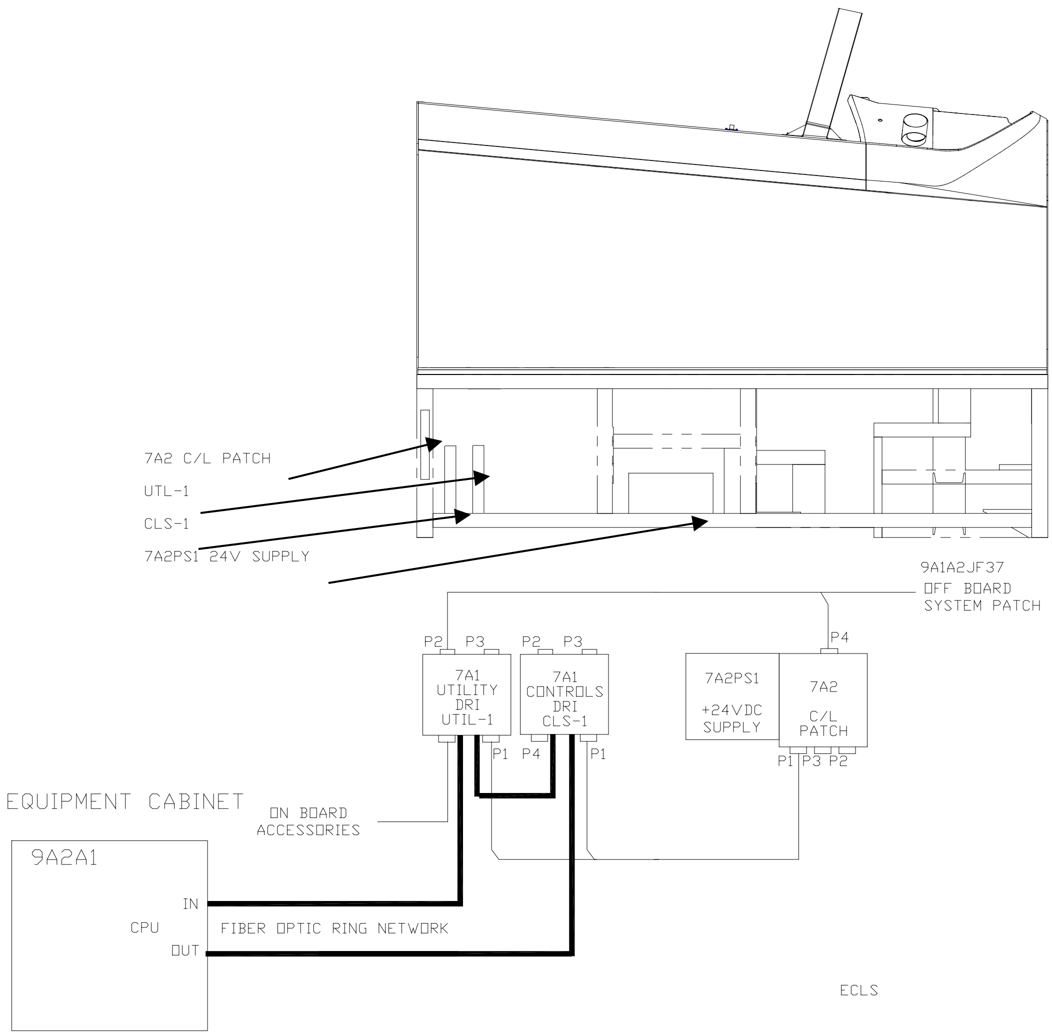

Figure 4-53. DRI Fiber Optic Ring

4.7.7. FLIGHT DECK I/O SYSTEM (FDKIO) (9A2A3)

The FDKIO System communicates with the Host Computer over a 100BaseT-dedicated network using TCP/IP socket interface protocol. The two Ethernet cables interface the FDKIO System directly with the Host Computer, and with the site LAN through the Ethernet hub. See Figure 4-54.

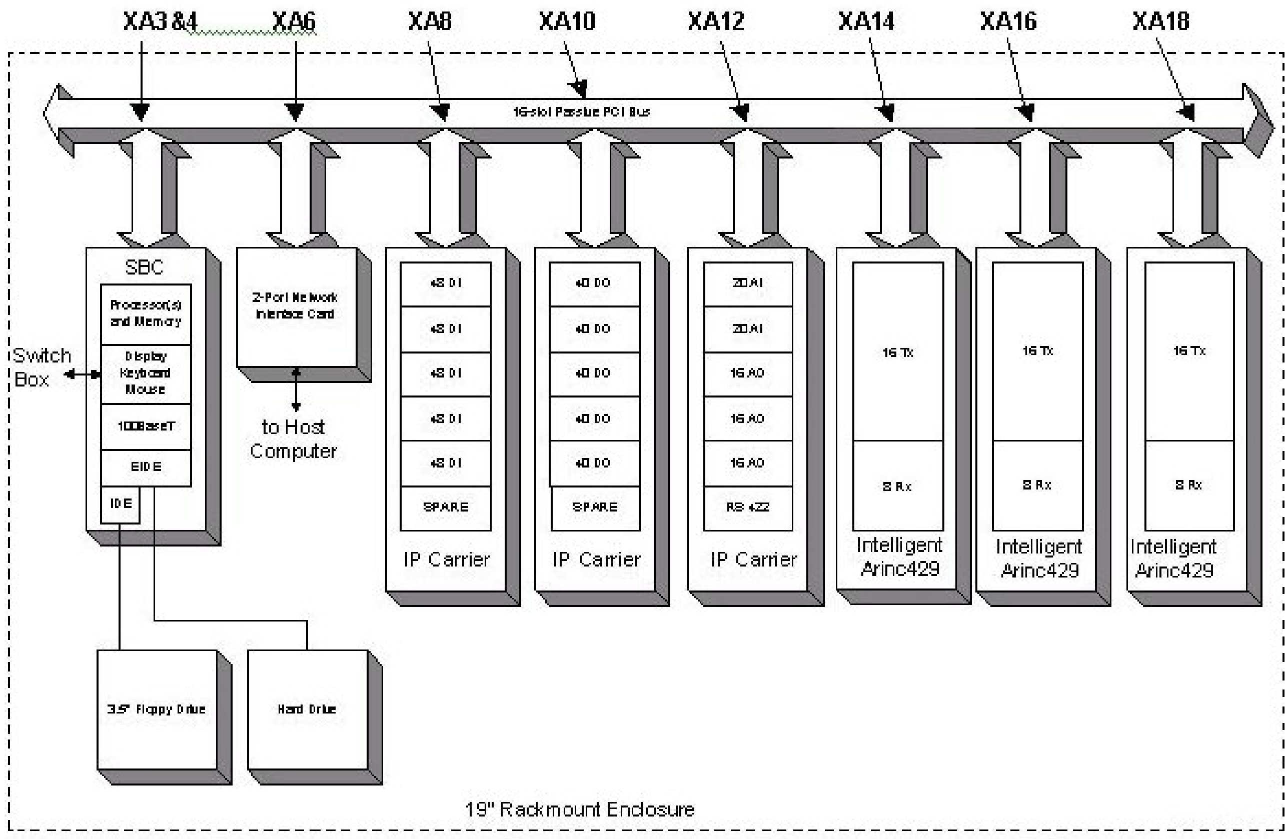

Figure 4-54. FlightDeck I/O Computer

4.7.7.1. Chassis

The FDKIO chassis contains several components to execute real-time math models associated with flight, navigation, engine, and communication systems.

- 20 slot PCI/ISA Backplane
- Dual Power Supplies
- Single Board Computer
- Network Interface PCI Bus Board
- 3 IP Carrier Boards
- 3 ARINC 429 Interface Boards
- Hard Disk Drive
- Floppy Disk Drive

The chassis has a 20-slot PCI/ISA backplane with 16 passive PCI slots. Six drive bays are provided; however, only two are used, one for the Hard Drive and the other for the Floppy Drive. Three cooling fans provide filtered air to the chassis components.

4.7.7.2. Single-Board Computer

The Single-Board Computer is the same as the Host Single-Board Computer. See paragraph 4.5.2 for full description.

4.7.7.3. Network Interface PCI Bus Board

The Network Interface PCI bus board (XA6) is used for real-time communication. The Ethernet port has a real-time communication with the subsystem computers. The back panel wiring at XA6 is the connections to Host Computer and the Ethernet House on-site Computer Hub.

4.7.7.4. IP Carrier Boards

The FDKIO System Computer has three IP Carrier boards. The IP carrier board in slot XA8 uses 5 IPs for DI data. Each Industry Pack for the DI board has 48 channels for translating PCI bus data to IP bus data. This board is used for digital input data such as sensing switch closure. Logic is 1=High as any input between +2.0VDC and +32VDC with incorporated, current-limited high clamped to +5VDC.

The IP carrier board in slot XA10 uses 5 IPs for DO data. Each IP has 40 channels for digital outputs for lamps, etc. These outputs are always off at power-up and cleared after a system reset. Gate pulldowns are provided to prevent momentary output turn-on with power-up. Logic is 1=ON/switch closed, and 0=OFF/switch open. Individual output channels may synchronize up to 1 amp continuous with a total of 10 amps combined.

The IP carrier boards in slot XA12 use 6 IPs, 2 for AI data, 3 for AO data, and 1 for the RS422. The AI boards have 20 channels for digital inputs of ±10VDC. The AO boards have 16 channels for analog outputs to the servomotors. The RS422 board drives the Smartmotor for playback. The module will drive the Power Control Lever (PCL), then the PCL position is sent back through the RS422. The RS422 also gives position and receives movement signals from GPS data.

4.7.7.5. ARINC 429 Interface Boards

The ARINC 429 Interface board is the bridge between the Host computer and the aircraft avionics system. It can transmit, receive, and convert data formats from the aircraft serial data bus to the PCI data bus without actually processing any of that data. It has a 32-bit signal comprised of 24 data bits and 8 label-identification bits. The labels represent specific variables within the simulation. The data bits represent the actual value, or properties, of those variables to be processed.

The ARINC 429 Interface boards reside in slots XA14, XA16, and XA18 of the FDKIO system chassis. These boards can be programmed to transmit or receive data from each bus system.

4.7.7.6. Circuit Breaker Interface System

The Circuit Breaker Interface System allows manipulation of aircraft circuit breakers as directed by the instructor during a training scenario, as well as manipulation during maintenance. The Host Computer and the FDKIO supply the necessary information to the scanned circuit breakers interface board to drive, or pop, the correct circuit breaker. This is accomplished by activating the proper row and column within the circuit breaker matrix to drive the desired breaker.

Figure 4-55 shows the CB System Block Diagram, which illustrates the major components of the Circuit Breaker System.

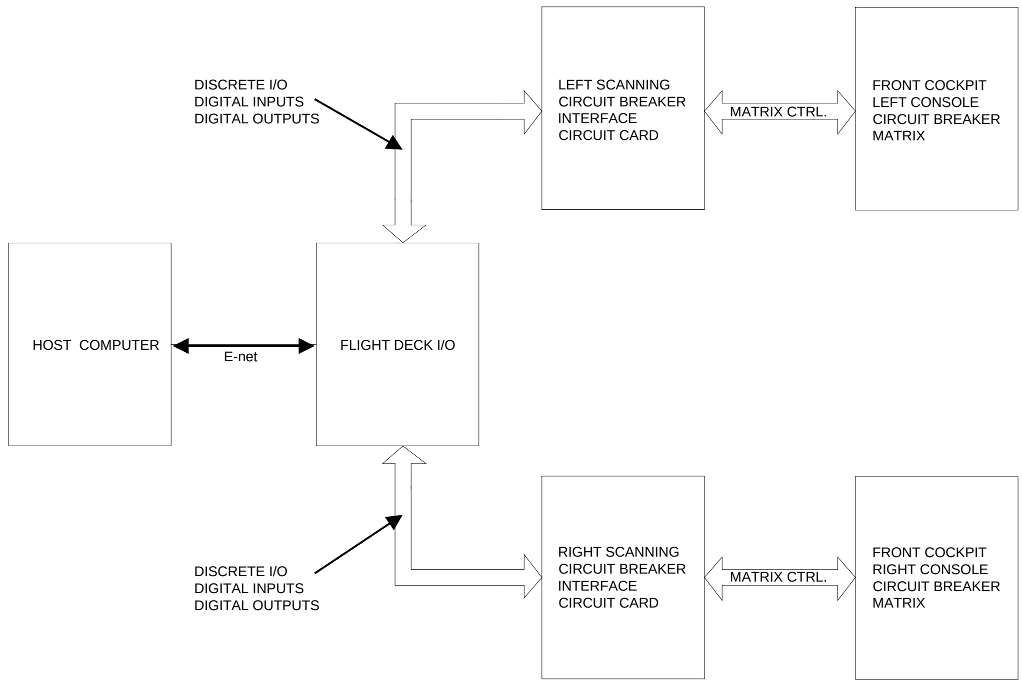

Figure 4-55. CB System Block Diagram

Circuit breakers may be popped one at a time by setting the appropriate Digital Outputs to select the corresponding row and column of the CB of interest.

State of the circuit breaker matrix may be read one column at a time by reading the Digital Inputs.

Table 4-2 shows the CB System Documentation listing the drawings, diagrams, and schematics associated with the Circuit Breaker System.

Table 4-2. CB System Documentation

Document Number	Document Title
6520AGF002	Right Side Console System Diagram
6520AGE002	Left Side Console System Diagram
6520ACP005	Panel Assembly, LH Circuit Breaker
6520ACP005E	Circuit Breaker Panel, Left Console - Wiring Diagram
6520ACP006	Panel Assembly, RH Circuit Breaker
6520ACP006E	Circuit Breaker Panel, Right Console - Wiring Diagram
60001ABK055	PCB Assy, Scanned Circuit Breaker Interface
60001ABK055E	Scanned CB Interface – Schematic Diagram

The Scanned Circuit Breaker Interface (CBI) can be tested at a low level using the I/O system or at a higher level utilizing the IOS pages. Refer to Section 5 of this manual for CBI testing procedures.

4.7.7.7. Hard Disk Drive

The Hard Disk drive stores the operating system and simulation software. When the computer boots, the CPU looks for the operating system program in VxWorks. Once the operating system is loaded into CPU memory, the CPU looks for the application program.

4.7.7.8. Floppy Disk Drive

The Floppy Disk drive is used to maintain or rebuild the hard drive if there is a failure of the hard drive system. The Floppy Disk drive uses 3.5-inch floppy disk with 1.44MB capacity.

4.8. INSTRUCTOR OPERATOR STATION

4.8.1. Instructor Operator Station Computer (IOS)

The IOS communicates with the Host Computer over a 100BaseT-dedicated network using TCP/IP socket interface protocol. The two Ethernet cables interface the IOS chassis directly with the Host Computer and with the site LAN through the Ethernet hub. See Figure 4-56.

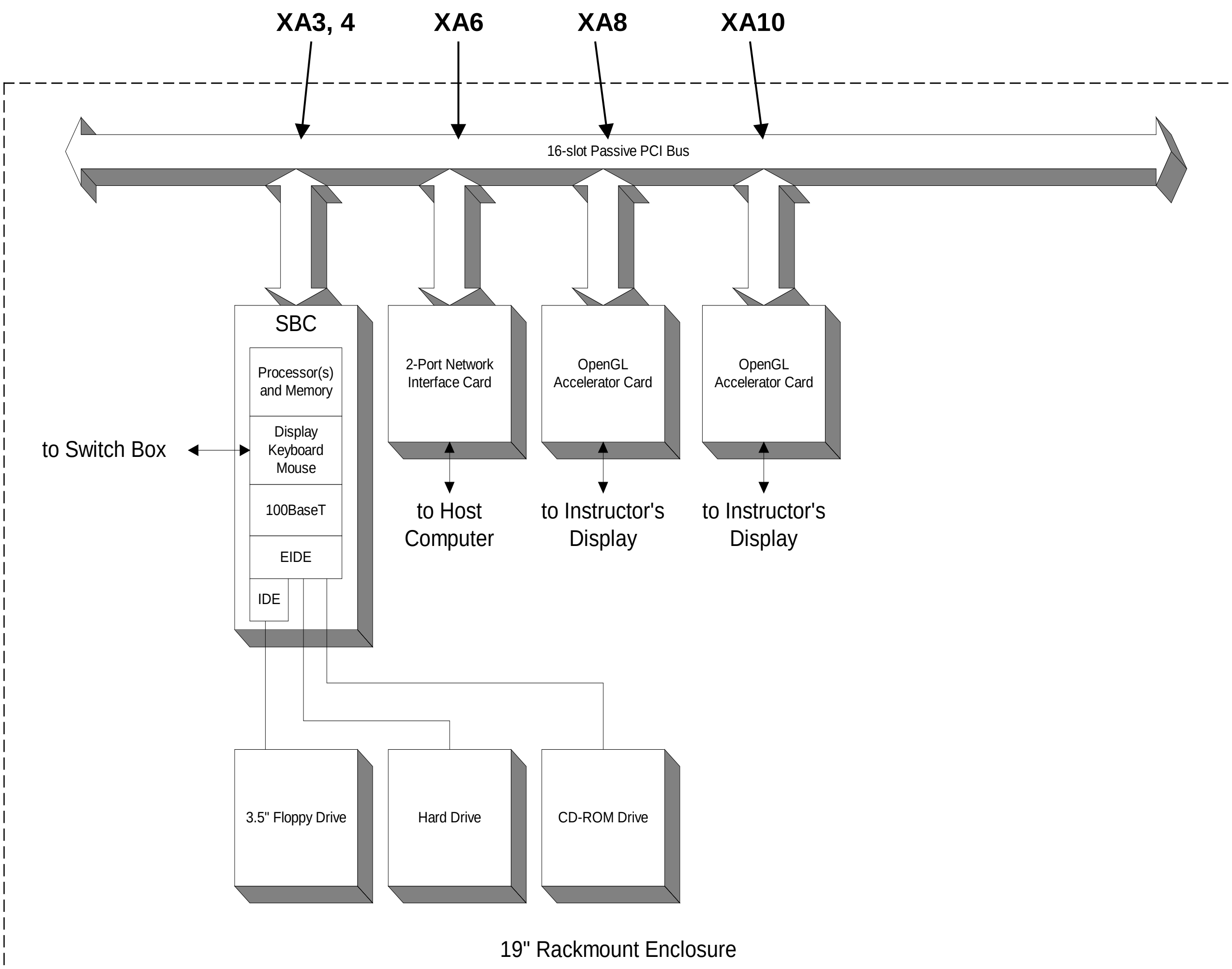

Figure 4-56. IOS Computer

The IOS interfaces the Host Computer with Instructor Station Keyboard and Control Panel inputs. The system allows the instructor to monitor, control, and direct the training environment.

4.8.1.1. IOS Chassis

The chassis contains several components to interface the instructor, simulator and student training environment. The chassis components include:

- 20 slot PCI/ISA Backplane
- Dual Power Supplies (The Navy T-6A uses single power supplies.)
- Single-Board Computer
- Serial Data Port
- 2 Graphics Accelerator PCI Bus Boards
- 2 Network Interface PCI Bus Boards (The Navy T-6A uses 4.)
- Hard Disk Drive
- Floppy Disk Drive
- CD ROM Drive

4.8.1.2. 20 Slot PCI/ISA Backplane

The backplane is a 20-slot PCI/ISA with 16 passive slots non-terminated. The power is supplied by two hot-swappable power supplies (refer to 4.8.1.3.). The chassis has positive pressure cooling supplied by 4 cooling fans that combine for 300 cfm of airflow.

4.8.1.3. Dual Power Supplies

Two hot-swappable 300W power supplies are located in the IOS PCI chassis. Each supplies ± 5VDC and ± 12VDC and has a power switch and a power indicator LED. Located between the two power supplies are two LEDs that illuminate green to indicate the operation status of each power supply and a push button to reset the audible alarm. If a power supply fails, the other supply will assume the load and the audible alarm will sound off indicating an abnormal condition exists.

4.8.1.4. Single-Board Computer

The Single-Board Computer (XA3, XA4) is Intel-processor based and has a minimum of 800 MHz Pentium III microprocessor, 1024 Mbytes of RAM, two serial ports, one parallel port and 100BaseT Ethernet port. The Intel 440X/GX AGP set supports the system and memory buses at both 66MHz and 100MHz speeds.

The BIOS (Flash) is a Hi-Flex AMIBIOS with built-in advanced CMOS setup for system parameters, peripheral management for configuring on-board peripherals, PCI-to-PCI bridge support and PCI interrupt steering. The BIOS chip is a boot-block Flash device – 28F002BX-T120.

The CACHE memory is a non-blocking second level (L2), 512K unified for fast memory access and recently used instructions and data. The speed of the L2 cache is half the CPU core frequency.

The DRAM memory is a two dual in-line memory module (DIMM) socket and supports auto detection of memory up to 512MB of Synchronous DRAM for the 440BX or up to 1GB of SDRAM for the 440GX. The System BIOS automatically detects memory type, size, and speed.

The PCI Local Bus interfaces to the on-board PCI Ultra Wide SCSI controller, to the PCI 100Base-Ethernet controller and to the three Network Interface PCI Bus Boards.

The AGP VGA Interface is a Cirrus Logic GD5465 video interface device with both 3D and 2D capabilities. AGP is designed to off-load the PCI Bus by allowing graphics data to move directly from system memory. The interface supports pixel resolutions up to 1600 x 1200 non-interlaced. The SBC provides 2MB of on-board RAMBUS Memory, which provides a high-bandwidth solution. The on-board video interface is not used in the present configuration because the addition of any PCI VGA device to the bus will automatically inhibit the motherboard VGA port.

4.8.1.5. CompuSwitch Connections

The only backplane wiring at XA3 and XA4 is the computer switch connections to the CompuSwitch (9A2A4).

4.8.1.6. Serial Data Port

The Serial Data Port (XA5) is an extension of the serial port on the Single-Board Computer that resides in slots XA3 and XA4.

4.8.1.7. Network Interface PCI Bus Board

Interface PCI bus board (XA6) is used for real-time communication. The Ethernet port has a real-time communication with the Host computer. Back panel wiring at XA6 connects to the Host Computer.

4.8.1.8. Graphics Accelerator PCI Bus Boards

The Graphics Accelerator PCI bus boards (XA8, XA10) are used for driving one IOS monitor through the CompuSwitch (A2A4) and the other monitor directly. As Graphic Accelerator technology is constantly changing, any Graphic Accelerator that meets the design specification can be used regardless of manufacturer. The minimum specification requirements are:

Architecture:	128 bit
Video Memory:	16MB SDRam
Memory Speed:	125MHz
Max Resolution:	1280 X 1024 (75MHz) @ 32bpp (true color)
RAMDAC:	250MHz
Fill Rate:	180 Million (Pixels per Second)
Triangles/Sec:	6 Million @ peak
Software Support	Must be Hardware OpenGL accelerated.

Any Graphics Accelerator that meets the specification may be used. Refer to drawing 57022AL0009 CKT Card, Graphics Accelerator, PCI Bus.

4.8.1.9. Hard Disk Drive

The Hard Disk drive stores the operating system and simulation software. When the computer boosts, the CPU looks for the operating system program in Windows. Once the operating system is loaded into memory of the CPU, it looks for the application program. The Hard Disk drive has 6.5 GB of formatted capacity.

4.8.1.10. Floppy Disk Drive

The Floppy Disk drive is used to maintain or rebuild the hard drive if there is a hard-drive failure. The Floppy Disk drive uses 3.5-inch floppy disk with 1.44MB capacity.

4.8.1.11. CD ROM Drive

The CD ROM drive is used to load software when necessary.

4.8.2. IOS Control Panel (2A2A4)

4.8.2.1. Main Power Controls

Emergency Power OFF (EPO)

The Emergency Power OFF switch (2A2A4) is one of four emergency power-off switches which trip the K1 main power bus contactor to remove AC power to the simulator. The Emergency Power OFF switch is a normally closed switch which opens the EPO loop when it is pressed. Pressing the EPO switch will immediately remove power from the simulator systems to include the UPS.

Start

The Master Power switch (Start) is one of two Start switches that can apply power to the simulator. These switches are in parallel with each other. The other Start switch is located in the Equipment Cabinet. Upon depressing the Master Power switch, 24VAC power is applied to the K1 main power bus contactor, causing the contacts to close, which will supply AC power to the simulator.

Control Loading Arm

The Control Loading Arm switch (SDS3) can turn on or off the control loading system through the Utility-1 DRI platform IP-UNIDIG #1 or through DAS.

Dynamic Seat Arm

OFT and IFT only: The Dynamic Seat Arm switch (SDS4) can turn on or off the dynamic seat motion system through the Utility-1 DRI platform IP-UNIDIG #1 or through DAS.

4.8.2.2. Freeze Controls

Parameter

The Parameter Freeze pushbutton (SDS5) pops up the “Freezes and Resets” page on the IOS display.

Total Freeze

The Total Freeze pushbutton (SDS6) freezes all simulated systems in their current operating condition and mutes the environmental sound. The simulator will not respond to inputs or changes of controls or switches until the freeze is released. The total freeze function is accomplished through the FDKIO computer.

Crash Override

The Crash Override pushbutton (SDS7) prevents the simulator from going into the crash mode and prevents the crash display from appearing on the visual screen. The FDKIO computer processes the Crash Override function is processed.

4.8.2.3. Reset Controls

T/O Point

The T/O Point pushbutton (SDS8) is used to position the aircraft to the active runway takeoff position at zero airspeed. The active airport and the runway are selected through the IOS keyboard/mouse. The takeoff point can be turned on or off through the FDKIO computer.

Approach IAF

The Approach Initial Approach Fix pushbutton (SDS9) is used to reposition the aircraft 2,000 feet AGL to a position 10 nautical miles from the active runway on the runway heading. The Approach IAF can be turned on or off through the FDKIO computer.

System Reset

The System Reset pushbutton switch (SDS10) allows the instructor to reset systems to initial condition values. Some of these resets include recharge batteries, crew air, brake temperature, clearing generator trips, generator disconnects, all ice, and resetting all tires to good condition with proper inflation. The Flight Deck I/O computer processes the System Reset function.

4.8.2.4. Lighting Controls

Lighting Controls control the lighting of the Instructor Station console, and the instructor compartment.

Compartment

The Compartment pushbutton switch (SDS11) turns on or off the 0-28VDC power to the console spotlights. The Compartment pushbutton is backlit green when off and illuminated amber when on.

Console Spot

The Console Spot light knob (R1) adjusts the small overhead lamps that illuminate the instructor work surface area of the IOS. Push the knob in to turn the lamp off. Pull the selected knob out to turn the lamp on. Rotate the knob to adjust the lamp illumination. Depending upon the installation, knob rotation might also turn the lamps off and on.

Console EL

The Console EL light knob (R2) adjusts the compartment lights. Push the knob in to turn the lamp off. Pull the knob out to turn the lamp on. Rotate the knob to adjust the lamp illumination. Depending upon the installation, knob rotation might also turn the lamps off and on.

4.8.2.5. Simulation Sound Controls

Simulation Sound

The Simulator Sound knob (R3) is a rotary switch that controls the volume of aircraft and the other simulator sounds through the FDKIO computer. Rotating the switch counter clockwise decreases the volume, clockwise increases the volume, and pulling the knob out will mute the sound.

Interphone Volume Control

The Interphone Volume Control knob (R4) adjusts the volume in the instructor’s headset.

UHF, VHF, NAV, MARKER and DME adjust the volume of the associated radio input.

Radio Select allows the instructor to transmit on VHF, UHF, or the Interphone.

MIC Key INPH Select keys the instructor’s microphone when pushed.

Audio V/R/Both allows the instructor to receive VOR indent, voice, or both.

4.8.3. Monitors

The three Monitors located at the Instructor Station are the upper monitor, left monitor, and right monitor. The instructor uses the left and right monitors to control the training session. The instructor uses the mouse to make selections from the monitor display pages within the training environment. The upper monitor displays the visual scene. The UTD does not have the third monitor. The make and model of the monitor may vary from trainer to trainer but many manufacturers can meet the specification. The minimum requirements for the Monitors are:

- SIZE: 21” (19.7 viewable)
- DOT PITCH: 0.28mm or Better
- RESOLUTION: 1600 X1200 non-interlaced
- POWER INPUT: 120VAC 50/60Hz
- POWER MANAGEMENT: Meets or exceeds EPA Energy Star Requirements.

Any monitor that meets the specification may be used. Refer to specification number 57021AA0016-001.

4.8.4. Keyboard and Mouse

The keyboard for the monitors resides on the IOS work surface. Technicians, to perform computer-related maintenance, mainly use the keyboard. Instructors perform training session related functions by use of the mouse to make selections from the various display pages of the IOS database to control the training session. Both the keyboard and mouse are PS2 connector compliant. The mouse may be either a 2- or 3-button mouse. The Keyboard has 105 keys.

4.8.5. Printer

The printer is a color graphics laser printer that reproduces monitor screen pages. Reference Printer User's Guide for information on the operation of the printer. The minimum requirements are:

- Resolution: up to 600dpi
- Connector: IEEE 1284 – compliant parallel
- Compatibility: Windows NT
- Power Input: 120VAC 50/60Hz
- Cable: 35 feet in length

Use any printer that meets these specifications. Refer to specification number 57021AB0001 for the printer and 57021AB0002 for the printer cable.

4.9. STUDENT STATION

4.9.1. Student Station Instruments and Panels

The student station is a life-size replica of the aircraft cockpit. It contains all instrumentation, panels, and consoles in an interactive environment that simulates actual flight parameters. Instruments can be either stimulated or simulated to perform its function: a stimulated instrument is one which the actual aircraft instrument is supplied the proper signals to drive the indicator; a simulated instrument is one that is manufactured to function as an actual instrument without the restrictions where cost or application may make an actual instrument impractical. The main areas of the cockpit are the main instrument panel, right and left consoles, control stick, lighting, and pilot seat.

4.9.2. Main Instrument Panel (1A1)

The main instrument panel contains primary and secondary displays, indicators, panels and annunciators essential for flight coordination and implementation. As these are I/O intensive systems, refer to system prints for application and technical information. See the AGA print series folder for related system prints.

4.9.2.1. Displays and Indicators

- AOA Indexer (M1)
- Standby Compass (M2)
- AOA Indicator (M3)
- Airspeed Indicator Display (M4)
- ADI Display (M5)
- Altitude Indicator Display (M6)
- Clock (M7)
- Accelerometer (M8)
- HSI Display (M9)
- TAS/VVI Display (M10)
- Primary EDI (M11)
- Secondary EDI (M12)
- Engine Fluid (M13)
- Standby Airspeed Indicator (M14)
- Standby Horizon Indicator (M15)
- Standby Altimeter (M16)
- Turn & Slip Indicator (M17)

- Flap Position Indicator (M18)

The Navy T-6A devices are different.

4.9.2.2. Annunciators and Panels

- Glareshield (A1)
- GPS Panel (A2)
- RMU (A3)
- ELT Control Panel (A4)
- TAS Light Plate (A5)
- AHARS Panel (A6)
- Pilot Audio Control Panel (A7)
- Annunciator Panel (A8)
- EFIS Control Panel (A9)
- UHF Backup Control Panel (A10M10)
- Landing Gear Panel (A11)
- Limitations Light Plate (A12)
- Parking Brake Light Plate (A13)
- Gust Lock Lever (A14)
- NWS Annunciator (DS1)
- Speed Brake Annunciator (DS2)

The Navy T-6A devices are different.

4.9.3. Left Side Console (1A5)

The Left Side Console contains various indicators, panels, switches, and annunciators essential for flight coordination and implementation. As these are I/O intensive systems, refer to system prints for application and technical information. See the AGA print series folder for related system prints.

- Forward Left Hand Switch Control Panel (A1)
- Trim Position Indicator (A1M1)
- Power Control Lever Grip (A2)
- Seat Adjustment Panel (A3)
- Canopy Fracture Switch (A4)
- System Test Panel (A5)
- Left Circuit Breaker Panel (A6)

- Maintenance / Anti – G Panel (A7)

The Navy T-6A devices are different.

4.9.4. Right Side Console

The Right Side Console contains various panels, switches, and annunciators essential for flight coordination and implementation. As these are I/O intensive systems, refer to system prints for application and technical information. See the AGA print series folder for related system prints.

- Forward Right Hand Switch Control Panel (A1)
- Environmental Control Panel (A2)
- Oxygen Regulator Panel (A3)
- Right Circuit Breaker Panel (A5)
- Phone Jack / Oxygen Panel (A6)
- Anti-Suffocation Switch (A6S1)
- Utility Light (A6DS1)
- Phone Jack (A6J1)

The Navy T-6A devices are different.

4.9.5. Control Stick (1A8)

The Control Stick contains various switches essential for flight coordination and implementation. As these are I/O intensive systems, refer to system prints for application and technical information. See the AGA print series folder for related system prints. See Figure 4-57.

- Aileron / Elevator Trim Switch (A1S1)
- Trim Interrupt Switch (A1S3)
- Nose Wheel Steering Switch (A1S5)
- Gust Lock Lever (A1S6) (Not shown; not included on Navy T-6A devices.)
- Stick Shaker (A1B1) (Not shown)

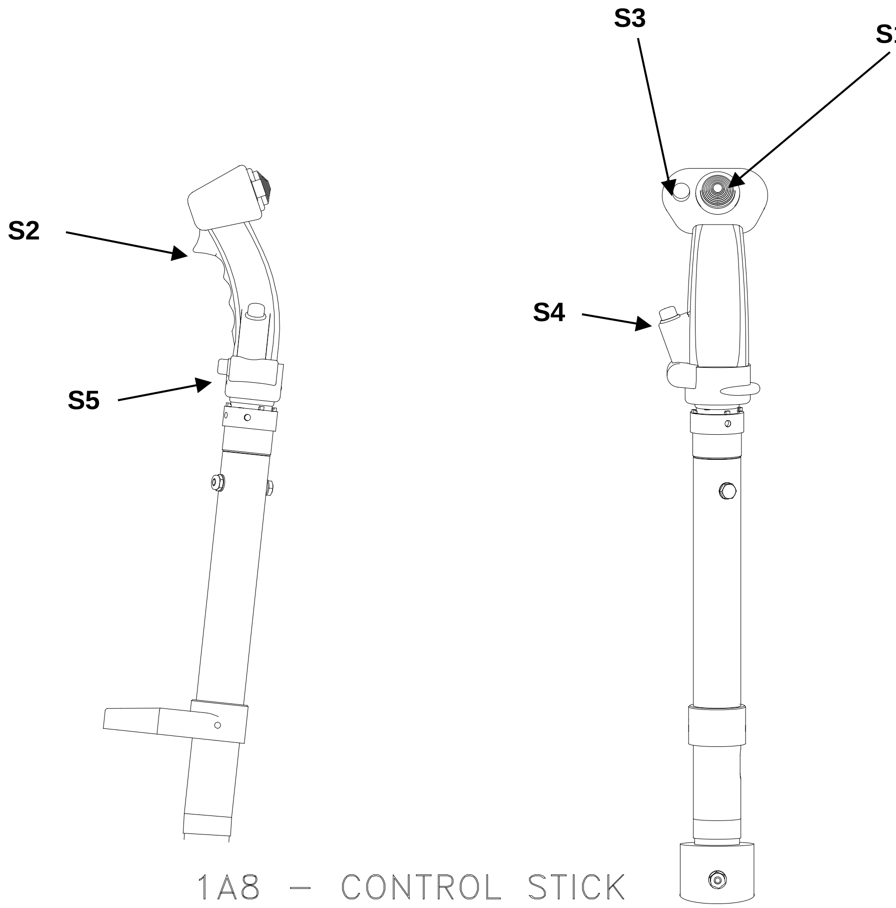

Figure 4-57. Control Stick Switches

4.9.6. Lighting

The Forward Instrument Panel, Side Panels (Left and Right) and Emergency lights all received the 28VDC to 0-5VDC. See Figure 4-58, Figure 4-59, and Figure 4-60.

The Cockpit Day/Night receives 28VDC for daylight scenarios and 14VDC for Night scenarios. See Figure 4-61.

Cockpit Floodlights receive 115VAC for output. See Figure 4-62.

Utility lights receive 28VDC. See Figure 4-63.

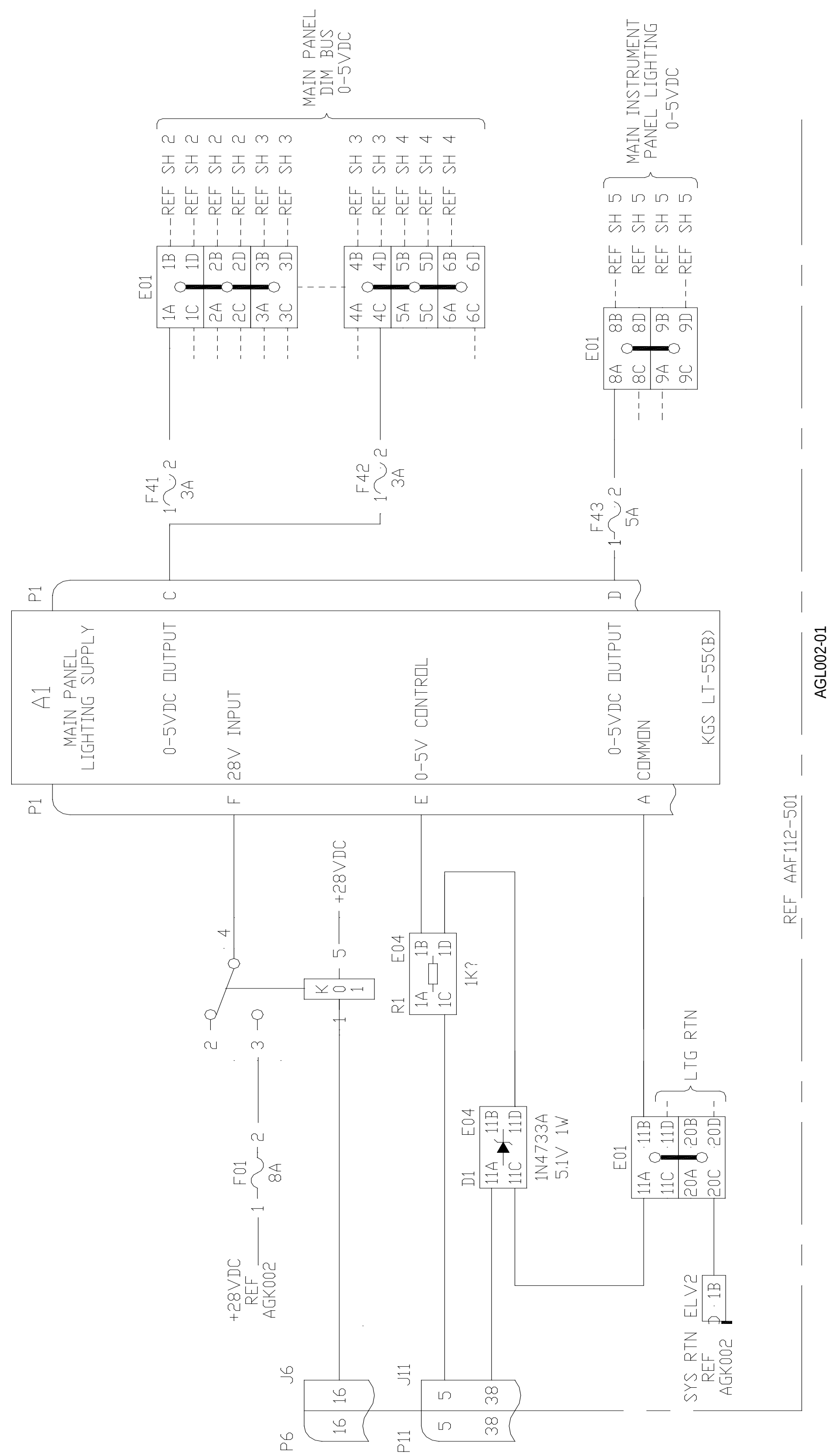

Figure 4-58. Forward Instrument Panel Lighting

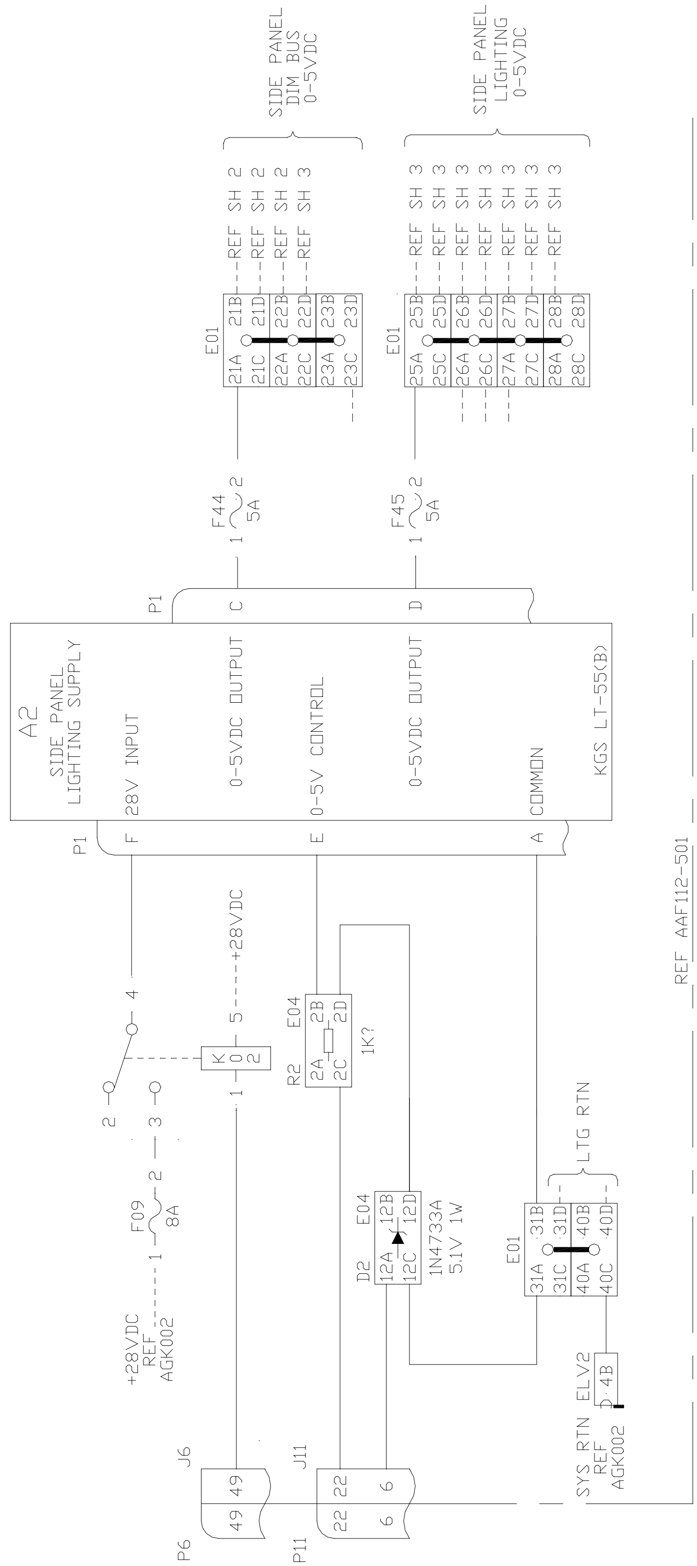

Figure 4-59. Side Panels-Left and Right Lighting

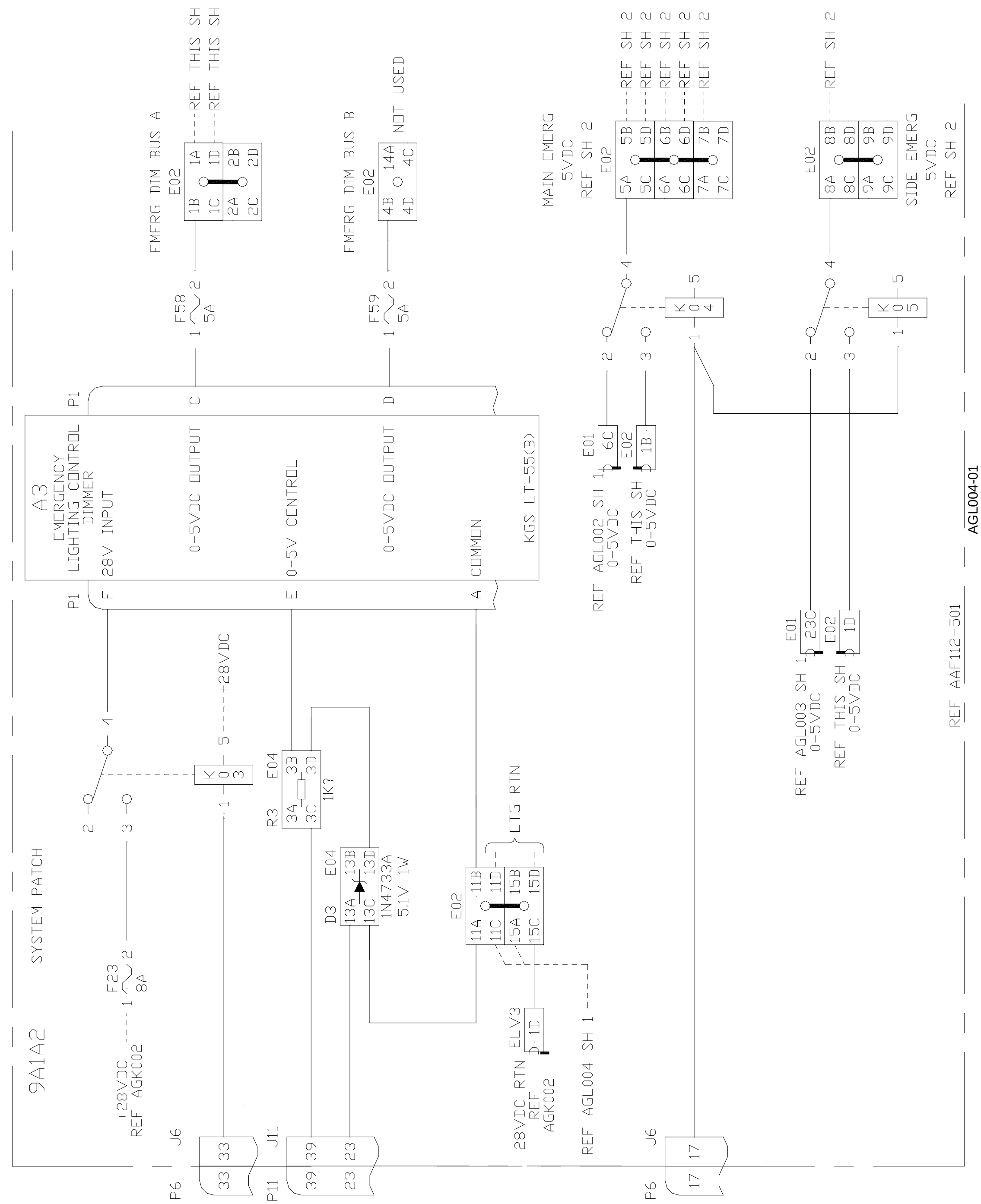

Figure 4-60. Emergency Lighting

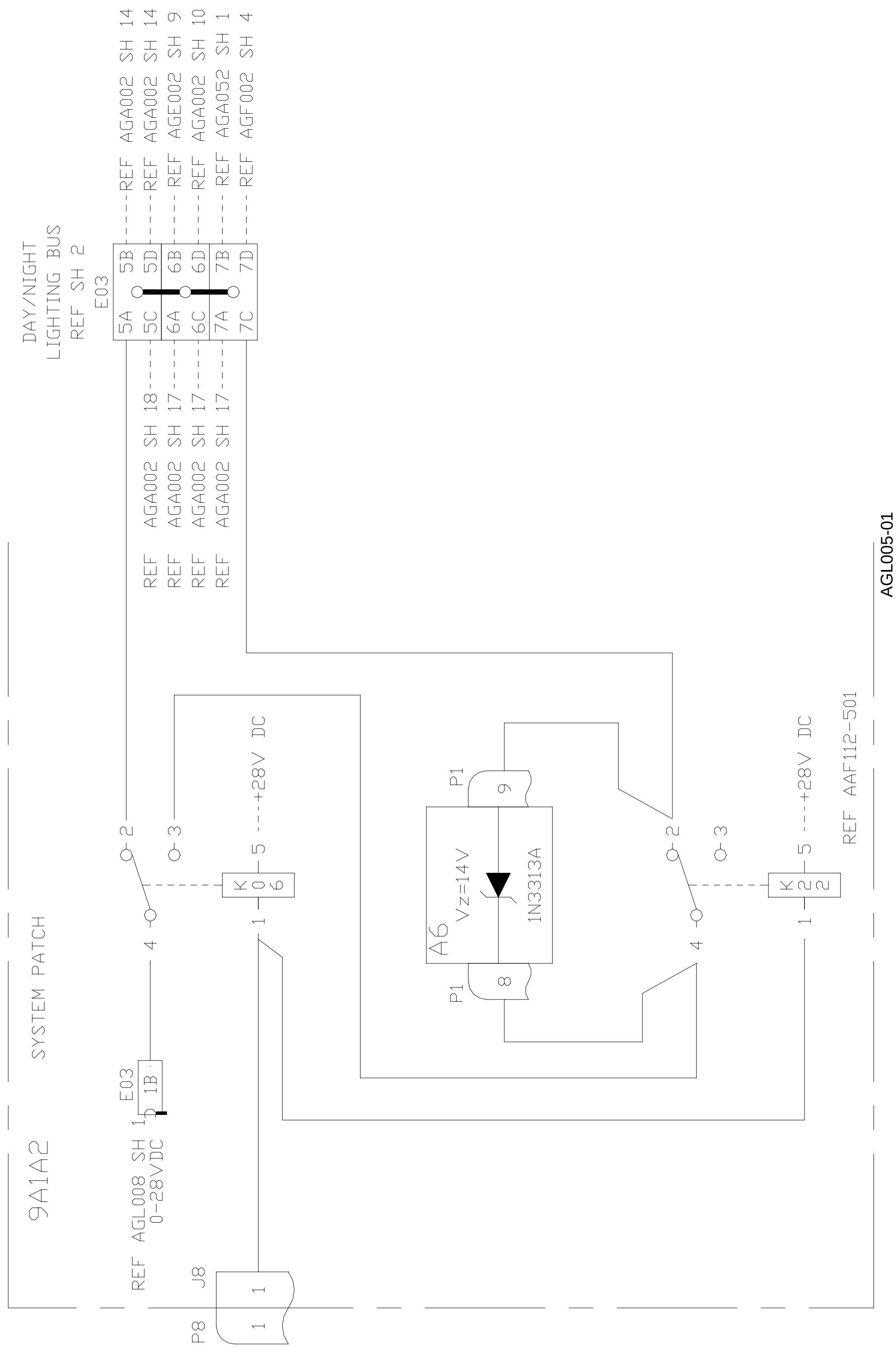

Figure 4-61. Cockpit Day/Night Lighting

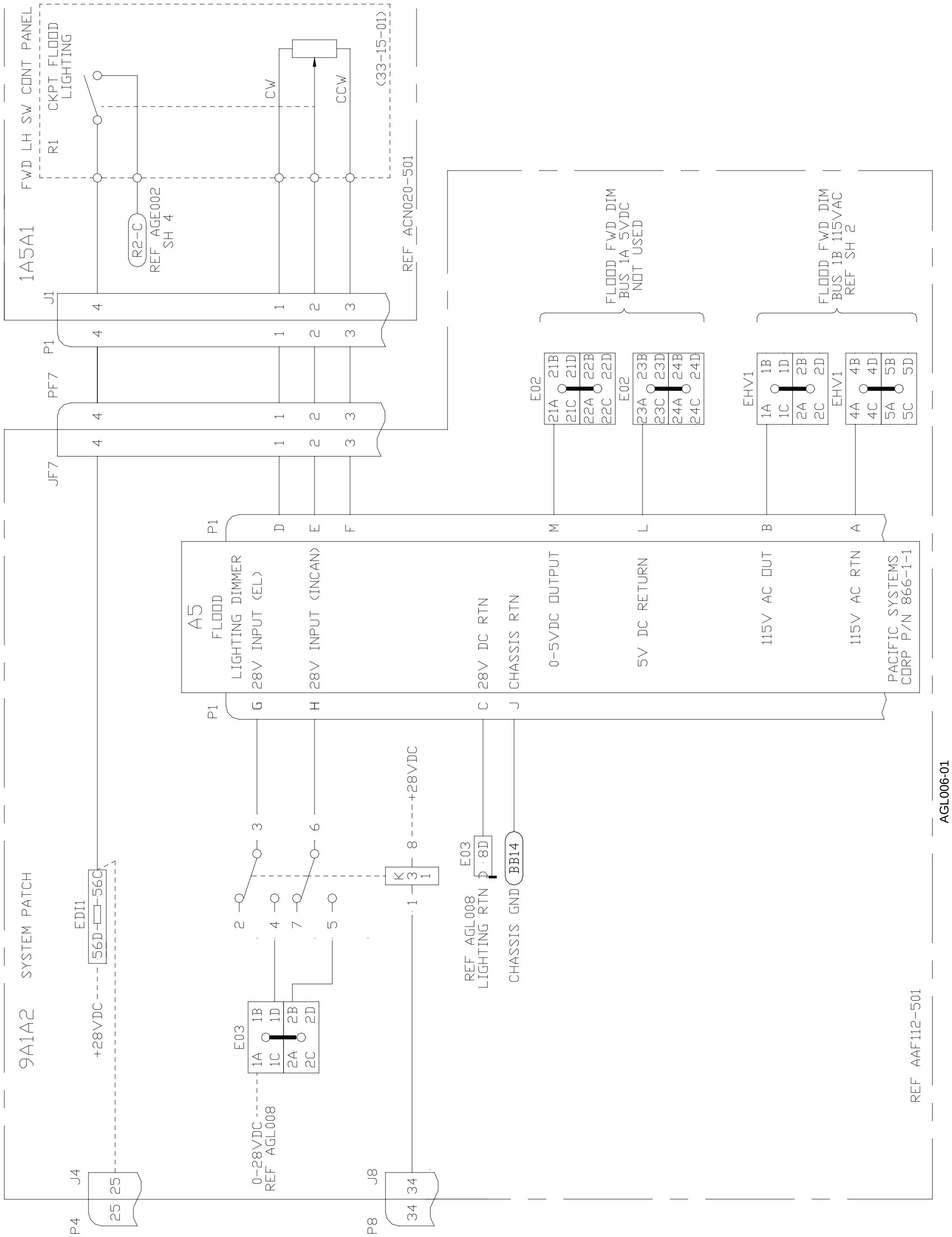

Figure 4-62. Cockpit Flood Lights

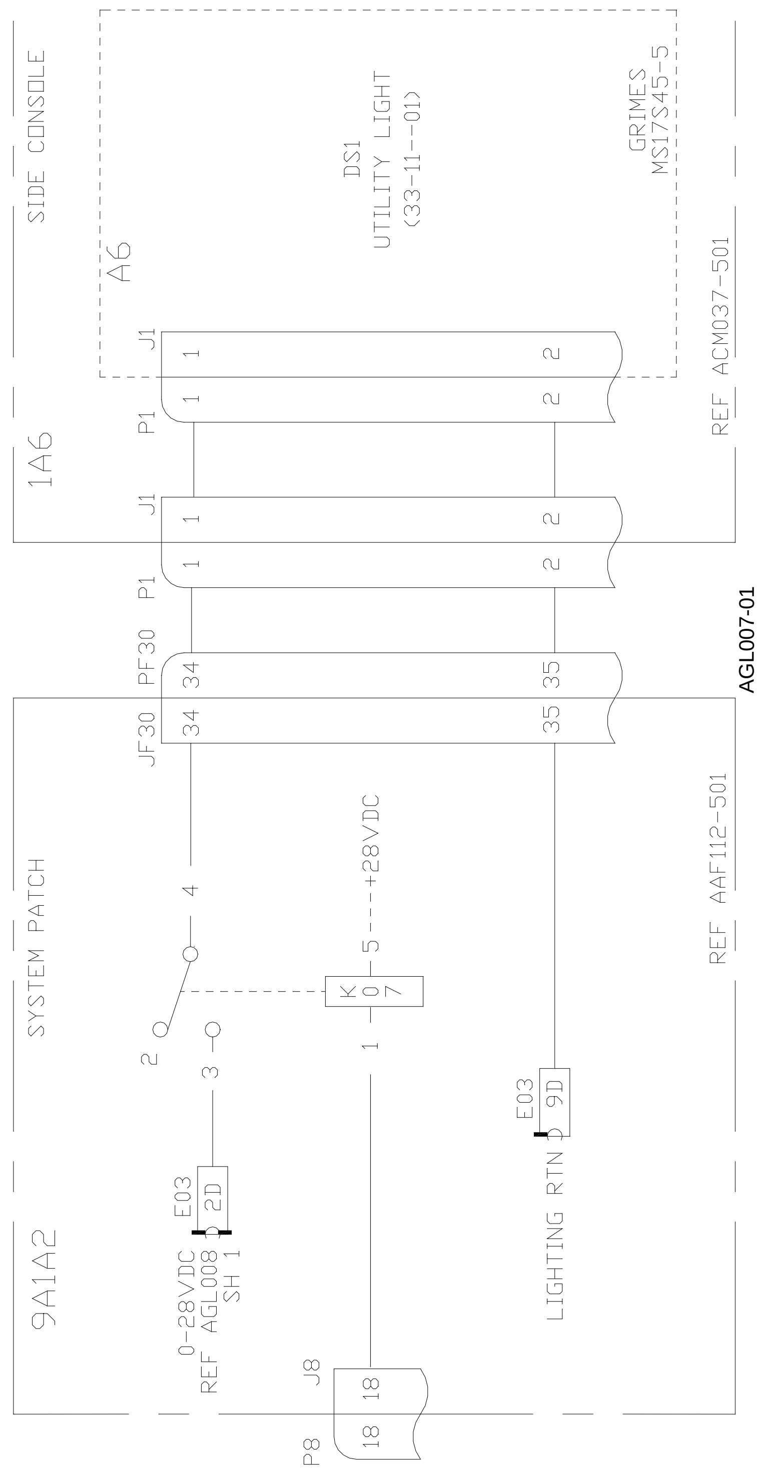

Figure 4-63. Utility Lights

4.9.7. Seat

The Student Station pilot seat has a stature adjust and dynamic seat actuator. The UTD has seat stature adjust but no dynamic seat actuator.

The seat stature adjust is activated by the seat adjustment switch on the left console, the seat actuator controller, and the seat stature adjust actuator, with top and bottom limit switches for controlling the distance of extension and retraction. The stature adjust actuator for the stature adjustment is located in the back of the seat. See Figure 4-64.

The dynamic seat actuator is located on the student station frame left side behind the Power Control Lever actuator motor. An emergency stop pushbutton switch on the seat stature adjust actuator de-energizes the controller and actuator when depressed. Rotate the emergency stop switch clockwise and release to restore power. A red "power ON" indicator is on the control face. Limit switches control actuator extension and retraction, one switch for each movement. The actuator will extend or retract as long as limit switches are not engaged.

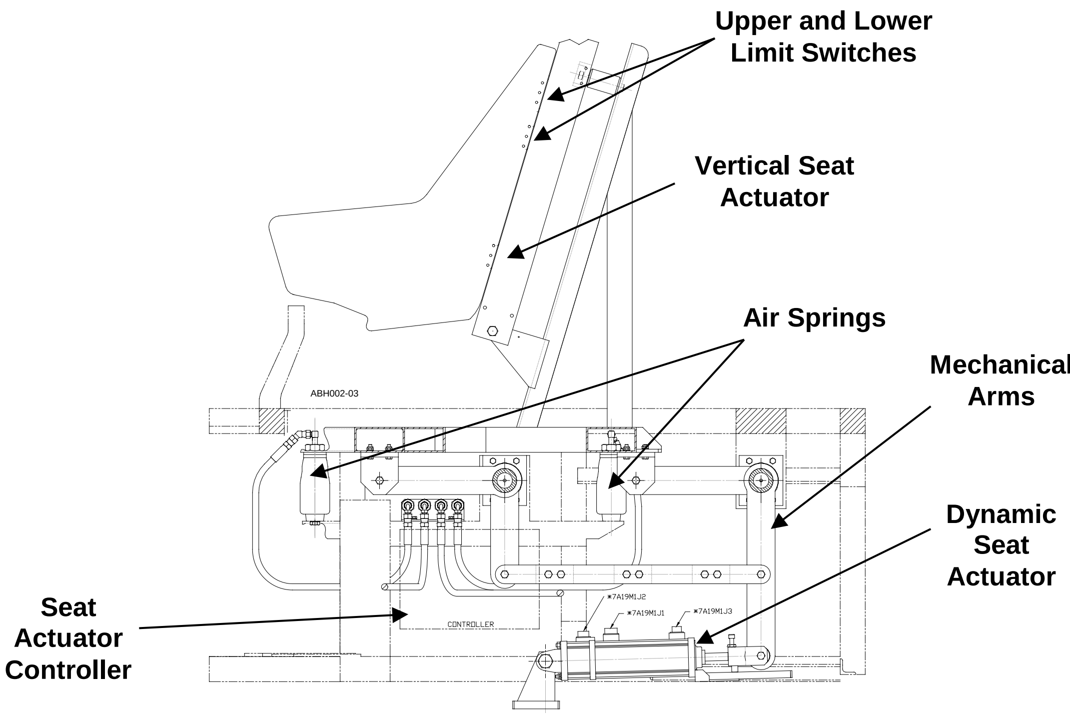

Figure 4-64. Seat Actuators

The dynamic seat actuator for seat motion is mounted to the facility floor. This actuator uses mechanical arms and air springs to vibrate the seat. The dynamic seat actuator is controlled by the DRI Secondary ECLS. The control loading servo loop consists of the DRI platform, PSSCB, accelerometer, and electric actuator. In systems with DAS instead of DRI, the DAS controls the dynamic seat actuator. The control loading servo loop consists of the DAS platform, PSSCB, accelerometer, and electric actuator.

The ECL Computer has processor boards that run the control loading models. These models combine data from the host computer based on the training environment, aircraft configuration, and aircraft attitude with inputs from the pilot. When the actuator activates the seat, the movement induces a force on the accelerometer. The accelerometer outputs an analog signal that is input to the DRI (or DAS) platform, informing the platform of the seat vibration intensity. The DRI (or DAS/DAS II) platform sends the accelerometer signal to the ECL Computer and wait for a response.

Based on the input accelerometer signal, the DRI (or DAS/DAS II) platform sends a control signal to the power amplifier that will activate the actuator. When the actuator is energized, it will move the mechanical linkage connected to the aircraft seat. The feel of the aircraft seat is created under the direction of the simulation software resident in the host computer. These commands are interpreted by the ECLS much the same way as it interprets the pilot inputs. The system generates a drive signal to the electric components corresponding to the combination of these two inputs and creates the appropriate feel in the aircraft seat. Refer to Figure 4-64 and see Figure 4-65 and Figure 4-66.

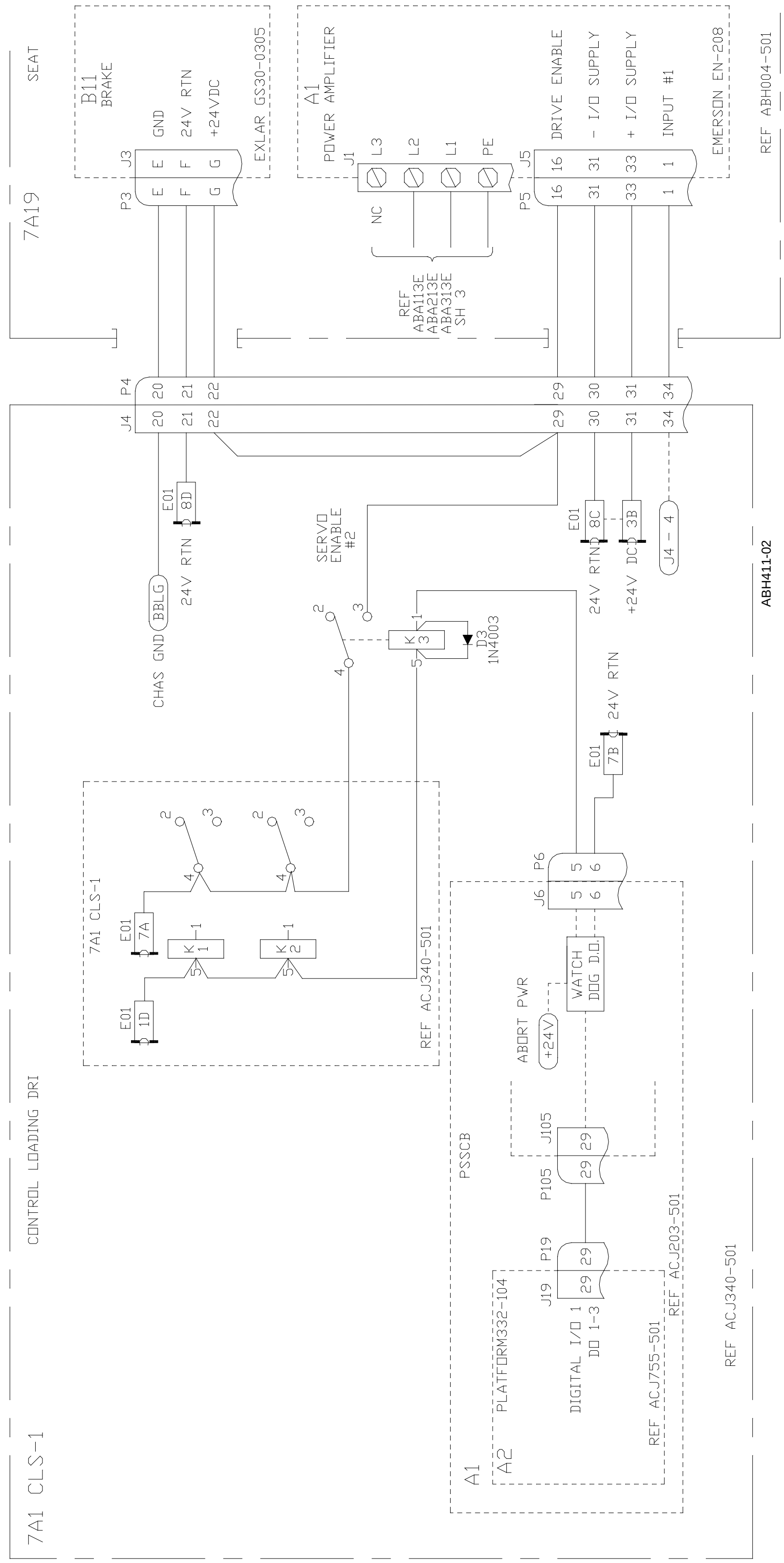

Figure 4-65. Seat Secondary Motion Diagram

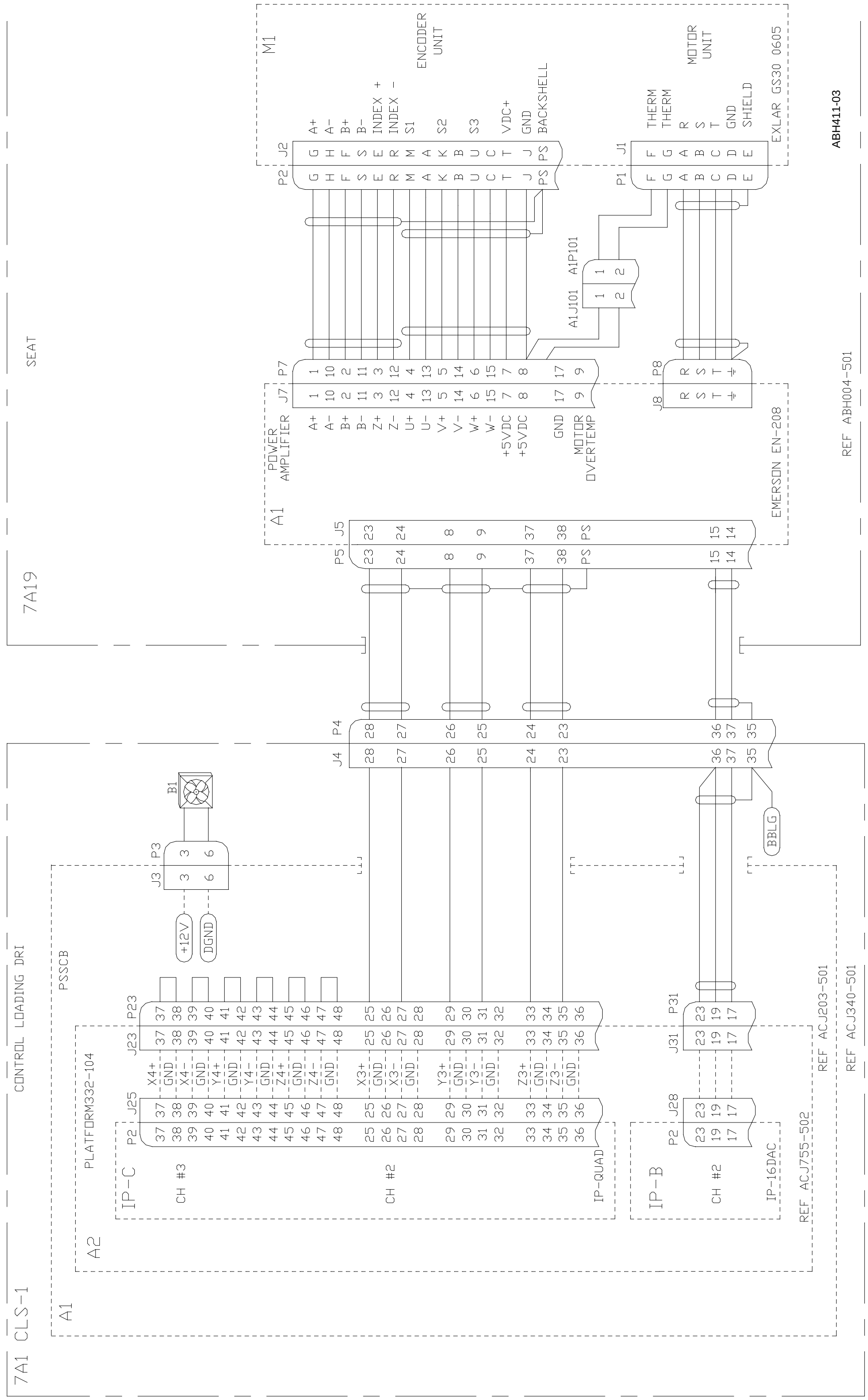

Figure 4-66. Seat Secondary Motion Diagram

4.10. FIRE DETECTION

The Fire Detection Master Control Panel is the control center of the simulator Fire Detection System. It receives 120VAC from the facility. Figure 4-67 shows the block diagram of the power distribution of the Fire Detection System. The 120VAC enter the unit at TB1 on the Power Supply card. From TB1 the 120VAC is sent to transformer T1 where it is converted to 33VAC. From the transformer, the Power Supply card conditions the 33VAC. Appropriate voltages are sent to the Master Control Card for use in monitoring applications. The Master Fire Control and Zone Detection cards distribute the 24VDC through J1, J2 and J4 to power the smoke detectors and temperature sensors in Zones 1 through 3.

Figure 4-68, Figure 4-69, and Figure 4-70 are the block diagrams showing the power distribution of the detection zones for each simulator.

Connectors J1 and J2 distributes the 24VDC to Zones 1 and 2. Zone 1 includes the smoke detectors and temperature sensors for the main instrument panel (1A25), control loading equipment (7A1A1), and the overhead dome temperature sensors (10A0) on the OFT. Zone 2 includes the equipment cabinets (9A2 and 9A3), on the OFT visual cabinets 1 and 2 (10A1 and 10A2) and the IFT visual cabinet 1 (10A1). The UTD has no visual cabinets. Connector J4 distributes 24VDC to Zone 3, which is the smoke detector for the overhead dome (10A0) on the OFT and IFT only.

The IOS manual pull alarm (2A2A7) receives its power from the Master Fire Control and Zone Detection cards through connector J3. Connector J5 is reserved for interface with the facility control panel. Connector J6 is for the Alarm horn and Strobe light (9A7A2).

Control of the Fire Detection System is accomplished through the Master Fire Control Card. The Master Fire Control Card distributes the alarm signals issued by alarm-initiating modules and generates the alarm and trouble signals.

The Fire Detection System contains circuits, which monitor the integrity of the circuits within the system. Indicators located throughout the system alert personnel to problems in the circuits, including faults, shorts, and grounds. See Figure 4-68, Figure 4-69, and Figure 4-70 for the location and description of the indicators.

The fault and ground indicators monitor the circuits for the battery and power supply and indicate whether there is a ground fault or short circuit in the system. The low battery fault (LOW BATT FAULT) indicator illuminates when the system senses that the rechargeable batteries are disconnected or they have deteriorated to 85% of their rated voltage. The power supply fault (PWR SUPPLY FAULT) indicator illuminates when high voltage is detected due to a faulty power supply.

The GROUND FAULT indicator illuminates when a system ground fault is detected. The two separate LEDs indicate whether the fault is in the positive (+) or negative (-) circuit. The SHORT CIRCUIT FAULT indicator illuminates when a short circuit in either of the two alarm-signaling circuits is detected.

TROUBLE indicators are located on the Power Supply Card, the Master Fire Control Card, the Signal Circuit Module, and the Zone Detection Modules. The SYSTEM TROUBLE indicator located on the Power Supply card alerts personnel to trouble in the actuating circuit. The TROUBLE indicator located on the Signal Circuit Module alerts personnel to trouble in the signal circuit. The TROUBLE indicators located on the Zone Detection Modules alert personnel to circuit trouble in the associated zone. When an open, short, or ground is detected in the circuit, its associated indicator illuminates and a sonalert sounds.

All major circuits in the Fire Detection System are independently fused. There are six fuses located on the Master Fire Control Card. Fuse F1 protects Signal Circuit #2, which is not used in this system. Fuse F2 protects the battery charger circuit, fuse F3 protects Signal Circuit #1 which is the alarm horn and strobe circuit, fuses F4 and F5 protect the trouble circuit and F7 protects the auxiliary alarm output circuit which is associated with the Master Box circuit. This circuit is not used in this system. There is also a 6-amp fuse located on the Power Supply card, which protects the power supply circuit.

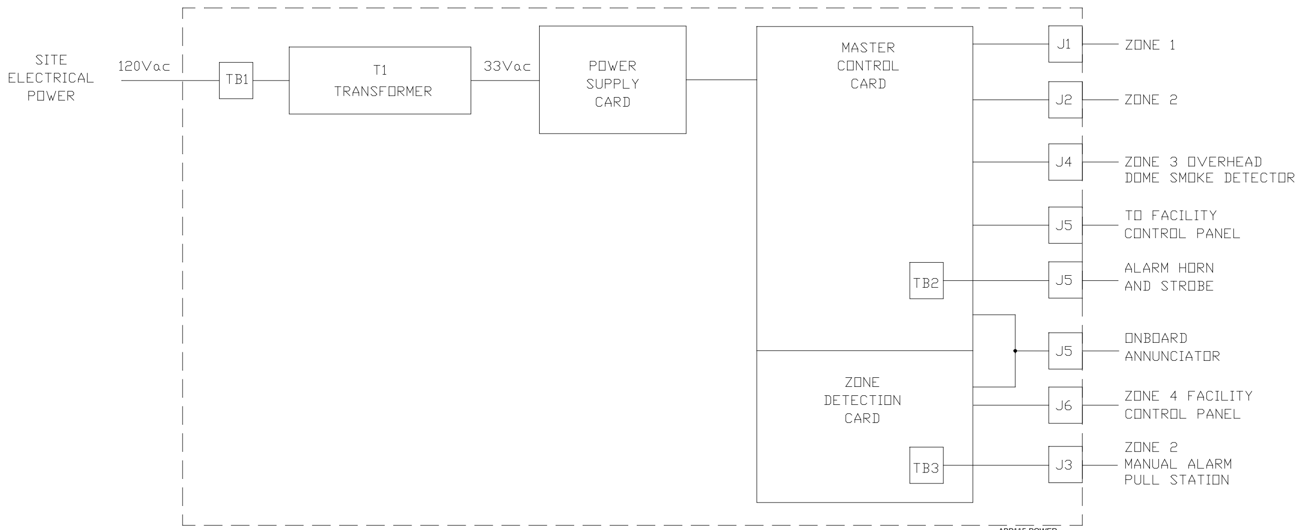

Figure 4-67. Fire Detection Power Distribution

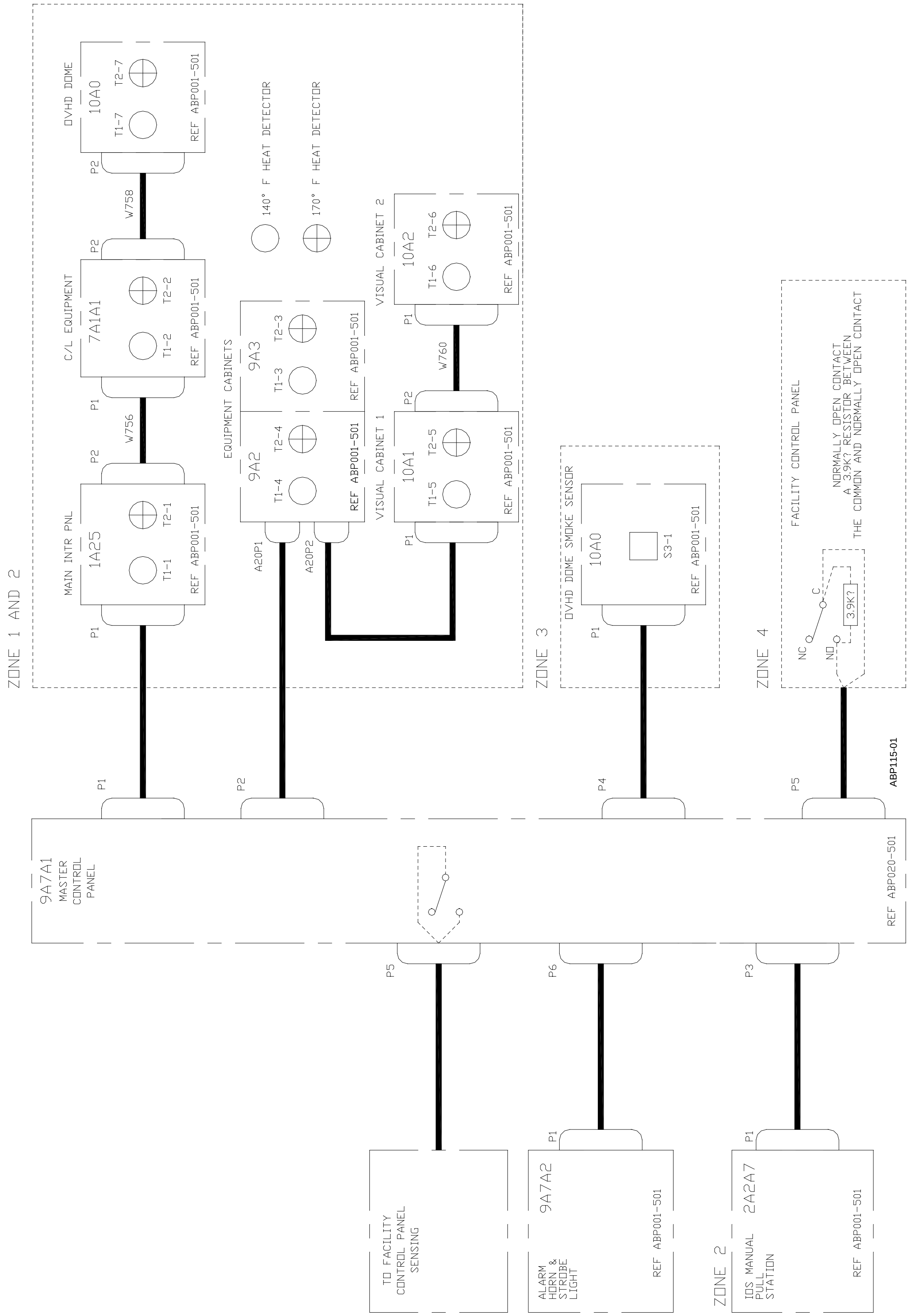

Figure 4-68. OFT Fire Detection Block Diagram

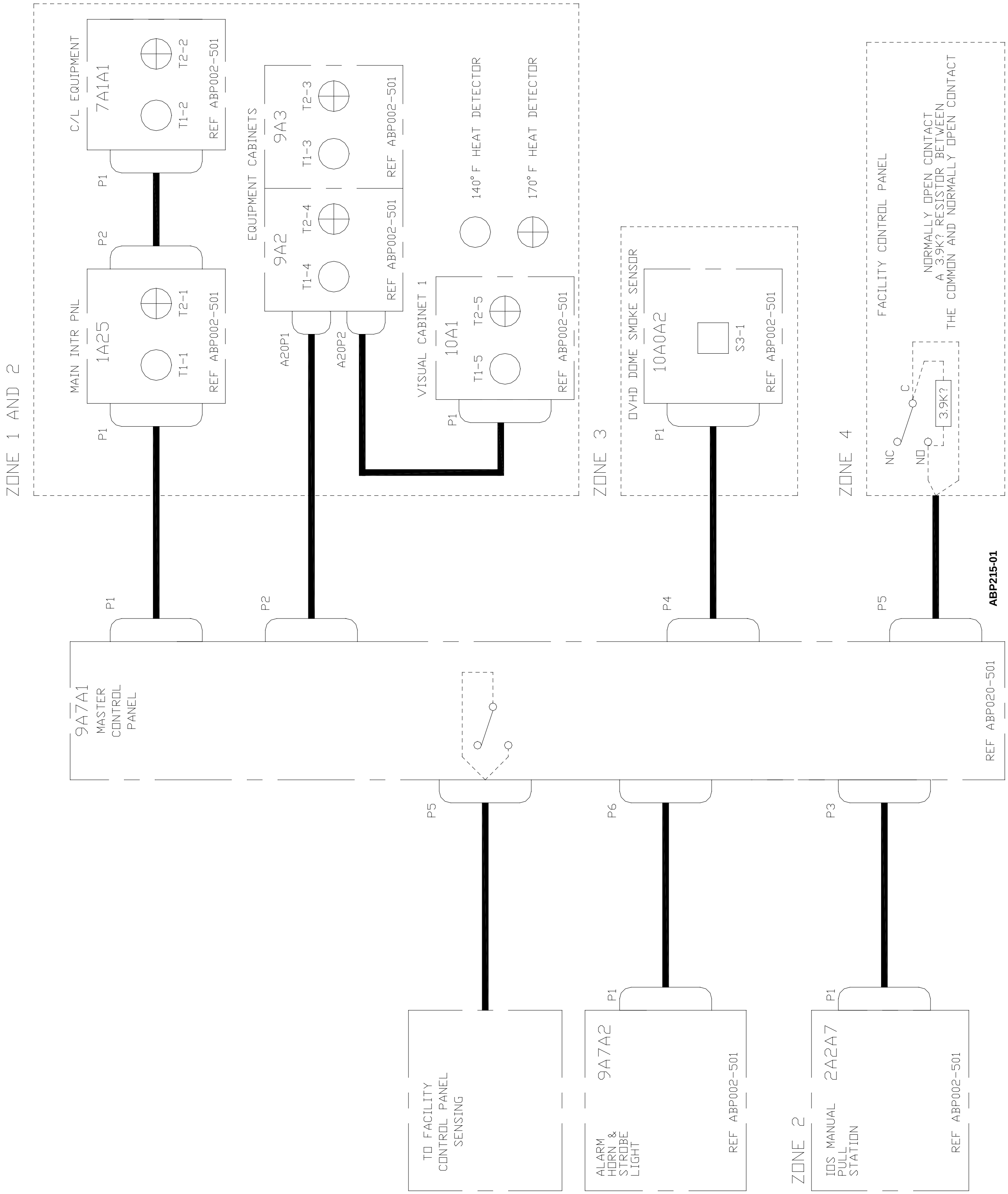

Figure 4-69. IFT Fire Detection Block Diagram

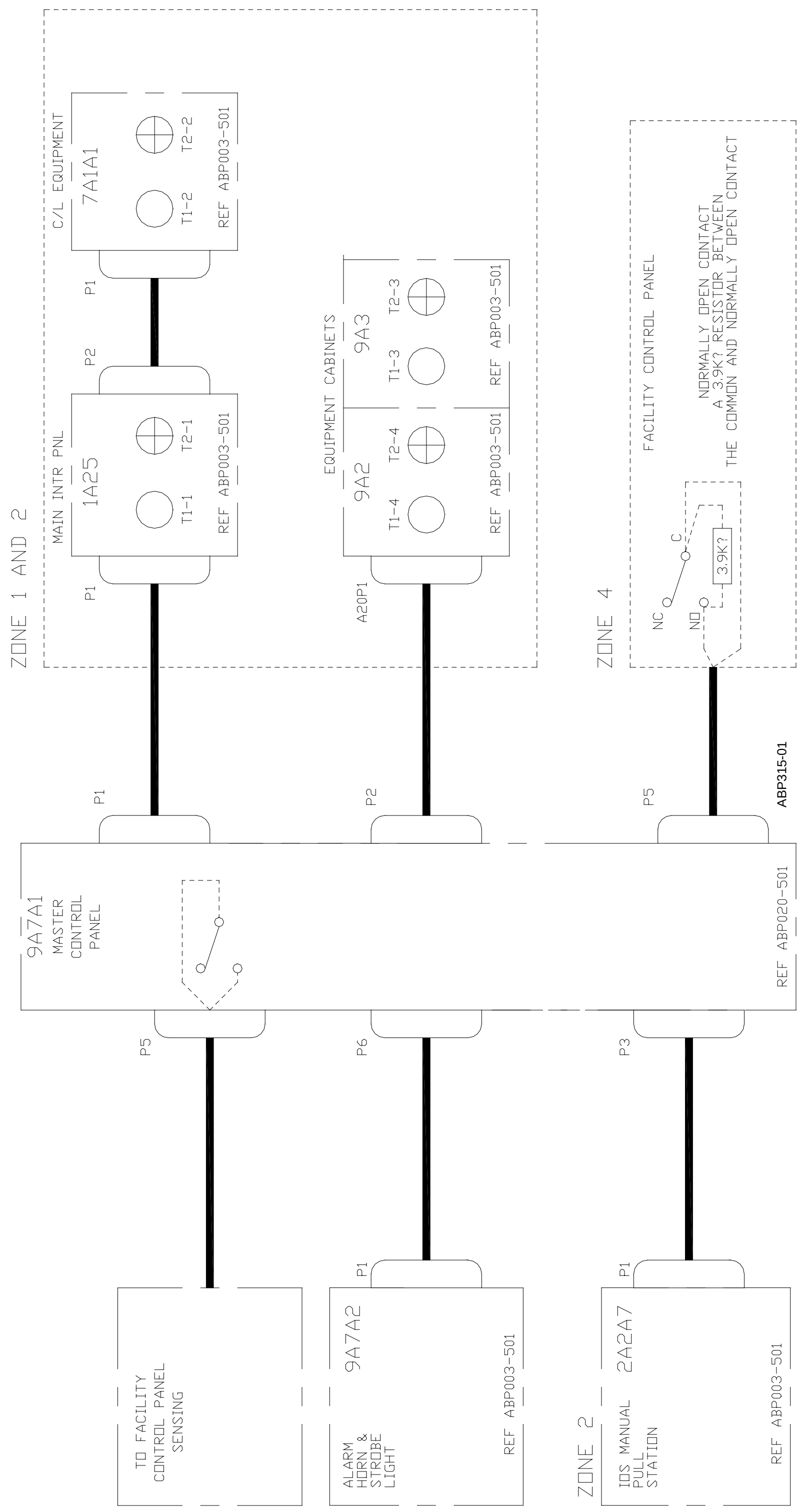

Figure 4-70. UTD Fire Detection Block Diagram

4.11. EQUIPMENT COOLING

4.11.1. Fans

Fans are in the Student Station, Equipment Cabinets, Dome, and Visual Structure. Figure 4-71 is a simplified block diagram of the power distribution of the fans.

The Student Station fans receive 120VAC power from the AC Power Controller. The 120VAC received by the AC powered exhaust fans is distributed from the AC Power Controller to the Frame Distribution Box. From the Frame Distribution Box, the AC power is distributed to all three fans and the blower unit: one fan and the blower unit for the Main Instrument Panel, and two fans for the DRI servo amplifiers behind the pilot seat.

The Equipment Cabinet fans receive 120VAC from circuit breakers in the AC Power Controller. The 120VAC received by the fans is distributed from the AC Power Controller to the AC Power Distribution Boxes (9A2 and 9A3) in the top right corner of each cabinet. From the AC Power Distribution Box the AC power is distributed to each fan.

The Visual Cabinets have no fans.

The OFT Visual cooling fans receive 120VAC from the AC Power Controller. The 120VAC received by the four fans is distributed from the AC Power Controller to the onboard distribution box (6A2A1) to the Fan Junction Box (10A0A8) to each fan.

The three IFT Visual cooling fans receive 120VAC from the AC Power Controller. The 120VAC received by the fans is distributed from the AC Power Controller to the onboard distribution box (6A2A1) to the fans.

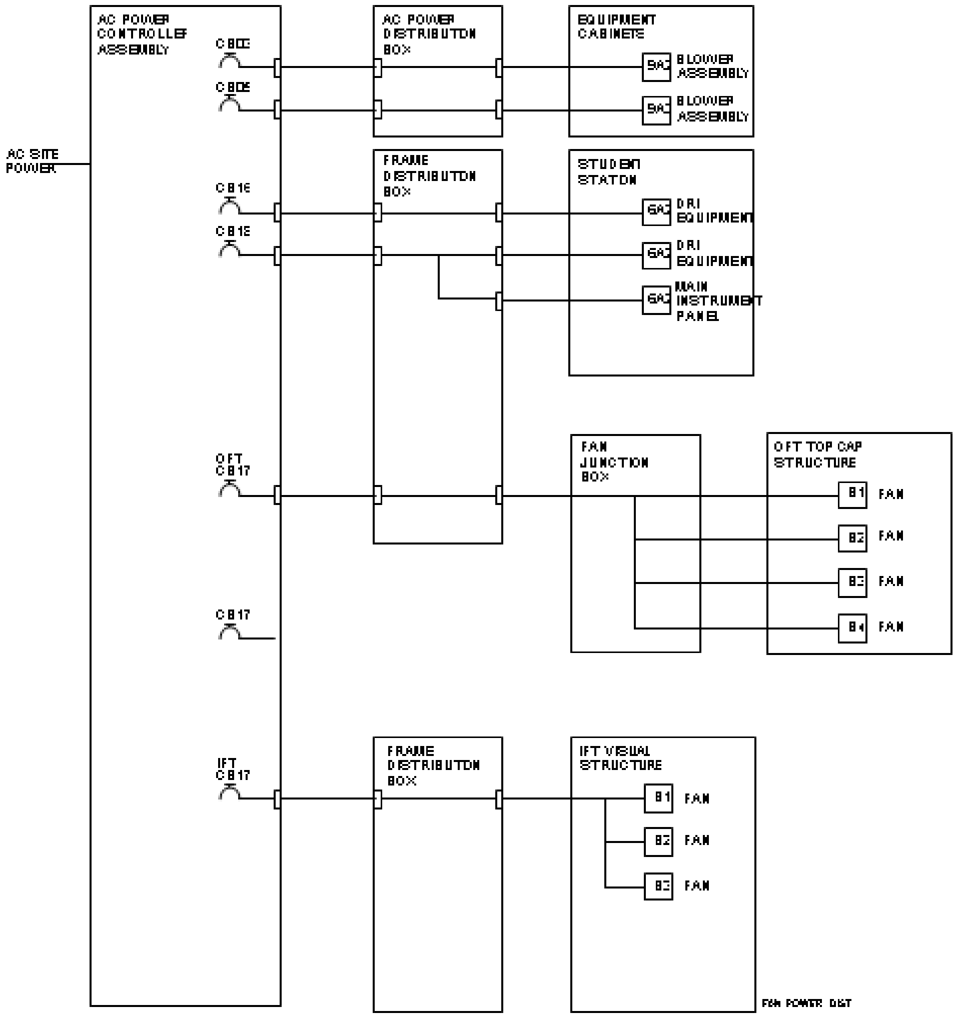

Figure 4-71. Fan Power Distribution