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SECTION 1. COMPONENT DESCRIPTION

The Electric Control Loading System (ECLS) is a computational sub-system used in the simulation of the JPATS T6 training aircraft. In operation, the ECLS replicates aircraft control forces via the primary flight controls, and simulates disturbance cues such as runway roughness and aerodynamic turbulence with motion of the seat. It interfaces the flight controls and dynamic seat to the aerodynamic model in the Host Computer.

ECLS consists in two main sub-systems: the ECLS Computer and the Data Acquisition System, version II (DAS-II) chassis. DAS-II provides discrete interface between the ECLS computer and the servo amplifiers and load-cells. DAS-II communicates with the ECLS computer via an Ethernet data connection. Integration of ECLS and DAS II with the supporting components of the sub-system is illustrated by Figure 1-1.

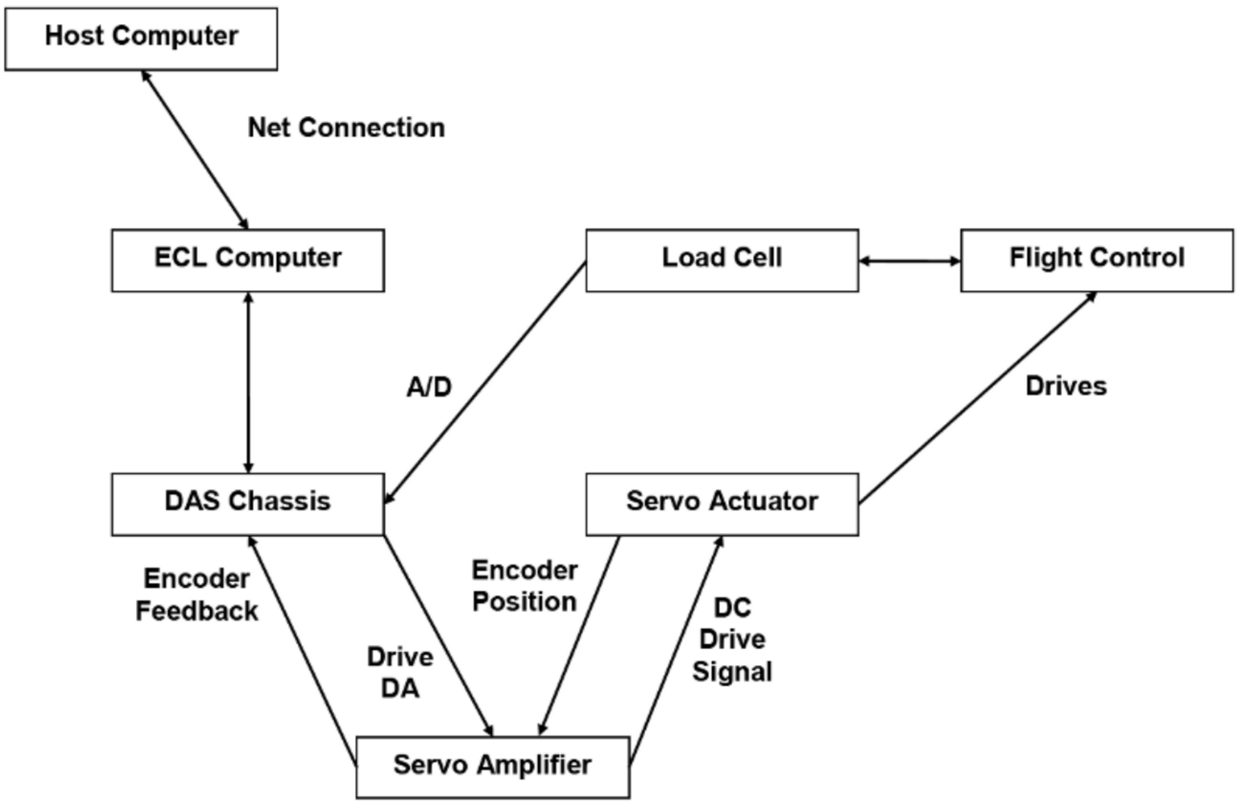

Figure 1-1. ECLS Block Diagram

Principal components of the ECLS are:

ECLS Computer, see paragraph 1.1
DAS-II Chassis, 1.2
Remote Power Controller — Digital Servo, 1.3
Control Loading Patch Panel, 1.4
Digital Servo Amplifiers, 1.5
Load-cell Amplifiers, 1.6
Control Actuators
Seat Motion Assembly

The ECLS computer, DAS-II chassis, and Remote Power Controller are located in the main equipment cabinets as illustrated by Figure 1-2.

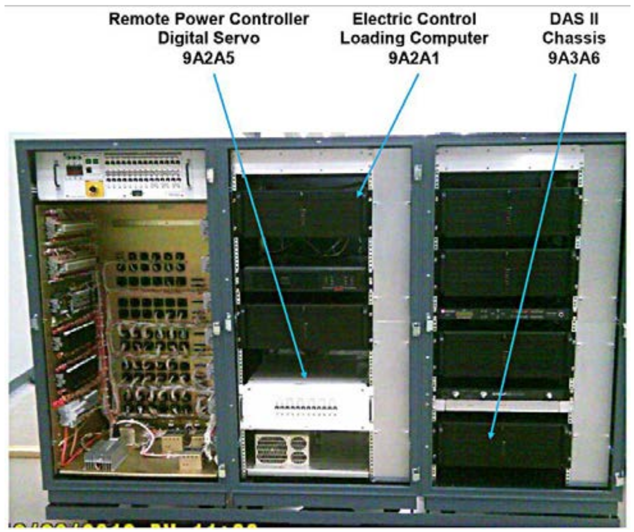

Figure 1-2. ECLS in Equipment Cabinet

Digital Servo Amplifier drives for the actuators are located in the rear cockpit frame behind the seat. In the Operational Flight Trainer (OFT) there are six servo amplifiers, three for the actuators of the primary flight controls, two for the toe-brake system actuators, and one for the seat actuator. In the Unit Training Device (UTD) the seat is a static assembly without an actuator, therefore there are five servo amplifiers instead of six. Figure 1-3. Location shows the location of the servo amplifiers behind the seat under the perforated metal shelf.

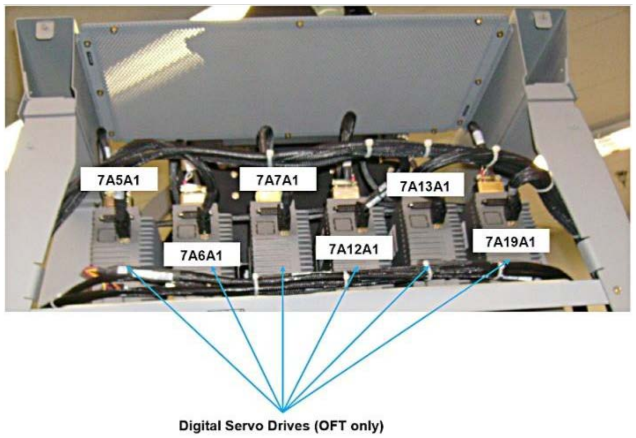

Figure 1-3. ECLS Servo Amp

The control loading patch panel assembly is located in the aft, starboard quarter of the lower cockpit frame assembly, in the space once occupied by the original DRI assembly. The control loading patch panel provides plug compatibility between the DAS-II technology insertion and the original actuator and load- cell combination, thereby minimizing the changes to the overall system needed to support the new technology.

Figure 1-4 shows the installed position of the control loading patch panel assembly. Top half of Figure 1-4 shows a view of the aft end of the base frame; bottom half of Figure 1-4 shows a view of the rear right-side of the base frame.

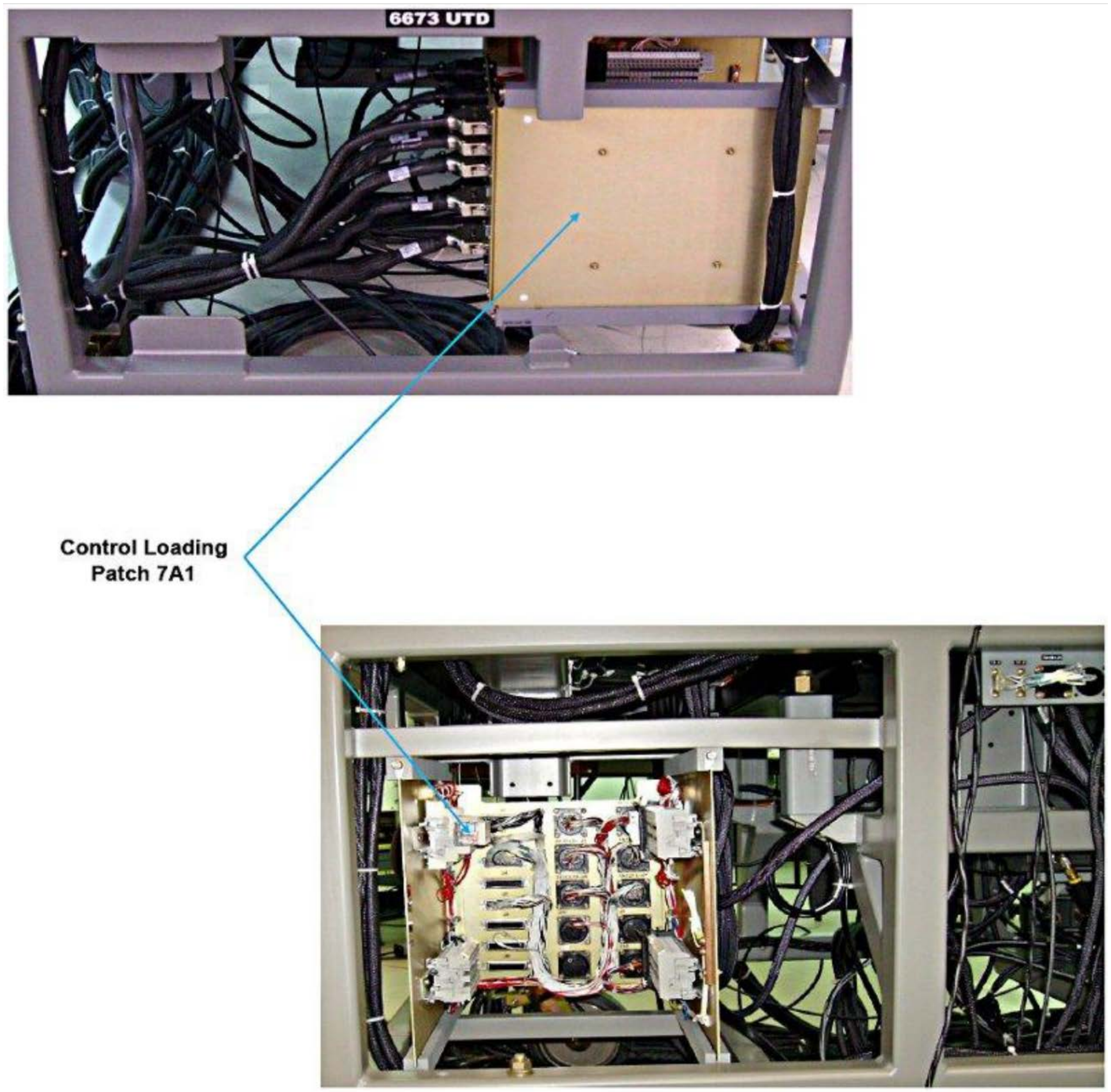

Figure 1-4. ECLS Patch Panel Location

Figure 1-5 shows an overview of the Electric Control Loading System interconnections, including simulation of the aircraft gust-lock mechanism and latency test connection to the visual system on the red video channel.

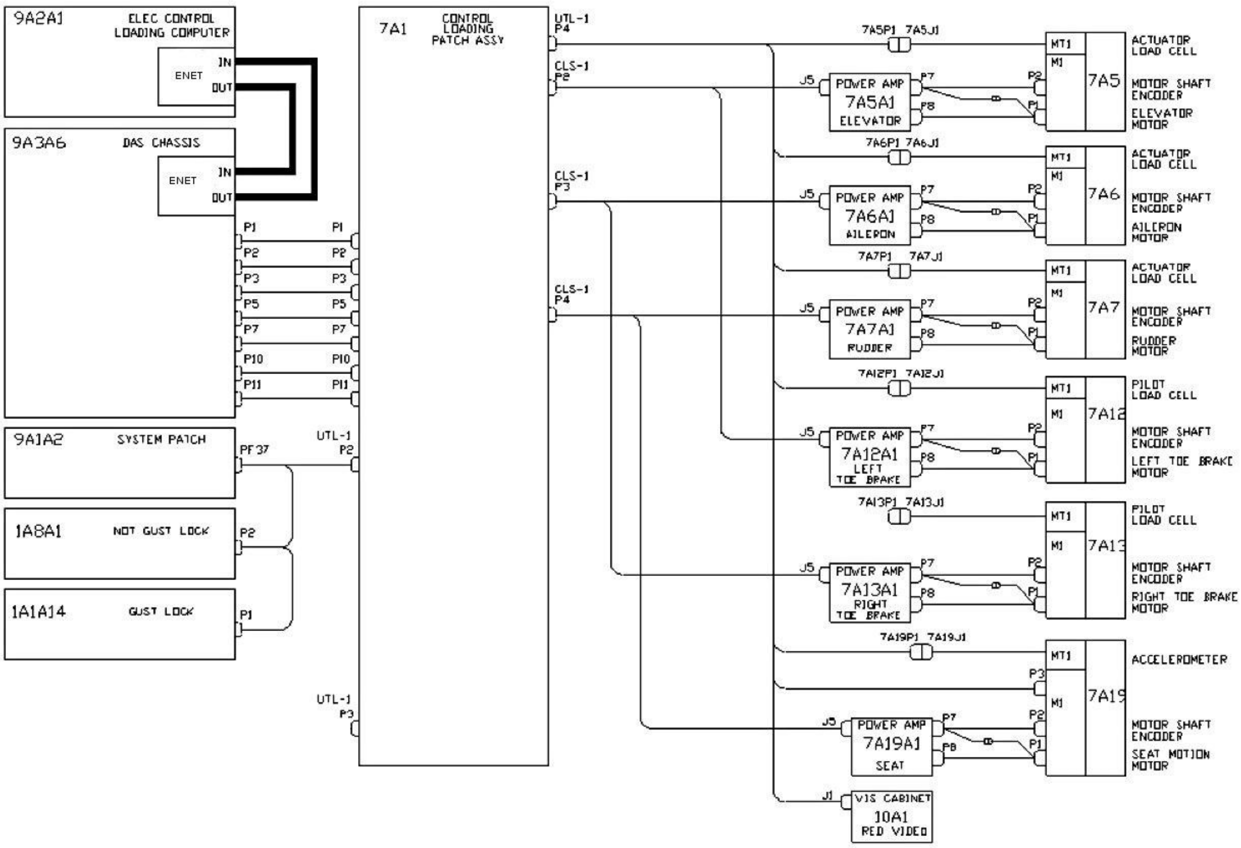

Figure 1-5. ECLS Interconnection Block Diagram

1.1. ECLS Computer

The ECLS computer is allocated to area 9A2A1 in the main equipment cabinet, as shown in Figure 1-2. See Table 1-1for an overview of the ECLS Computer Physical Characteristics.

Table 1-1. ECLS Computer Physical Characteristics

PARAMETERS	SPECIFICATIONS
AC Power Input Voltage	120VAC
AC Power Input Frequency	50-60Hz
Humidity	5-90% non-condensing
Optimum Operating Temperature	70ºF
Dimensions	7”Hx19”Wx26.4”D (17.7cm x48cm x 67.1 cm)
Weight	40 lbs (18 kg)

The ECLS computer executes the real-time software mass models in response to the control inputs to the servo loop. It interfaces with the Host computer and the DAS-II chassis.

Principal components of the ECLS computer are as listed here and illustrated in Figure 1-6 and Figure 1-7.

20-slot PCI/ISA Backplane
Power Supply
Single-Board Computer Network Interface Card (NIC) IP Carrier Board
Hard Disk Drive (HDD) Floppy Disk Drive (FDD)
Internal Cooling Fans (not shown)

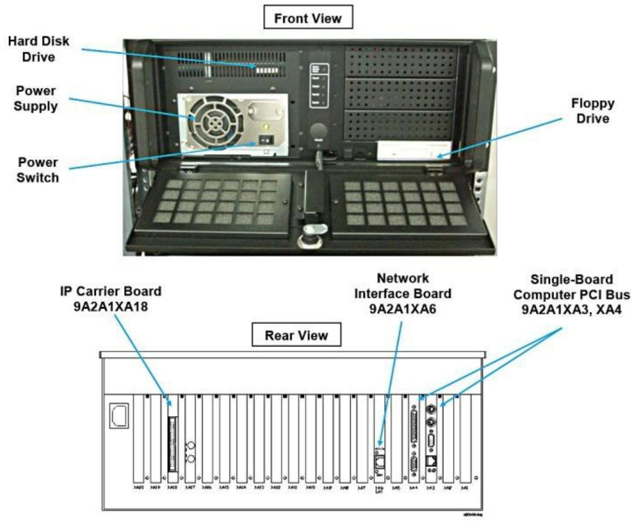

Figure 1-6. ECLS Computer

The ECLS Computer (9A2A1) has a 20-slot Peripheral Component Interconnect / Industry Standard Architecture (PCI/ISA) backplane with 16 passive PCI slots. The Hard Disk Drive occupies an internal drive bay; the Floppy Drive occupies an external bay. Internal cooling fans provide filtered air to the chassis components.

The front of the chassis contains controls and indicators for powering on and resetting the chassis and showing the operational status of the drives.

The ECLS Computer communicates with the Host Computer over a 100BaseT-dedicated network using User Datagram Protocol (UDP). The Ethernet cable interfaces the Electric Control Loading directly with the Host Computer.

The Single-Board Computer (XA3, XA4) mounts on a PCI bus and has at least an 850MHz Pentium III microprocessor; 100MHz front side bus, 1024MB RAM, two (2) serial ports, one (1) parallel port, and 100BaseT Ethernet port.

The Network Interface Card (XA6) uses real-time communication. The rear panel connector on

XA6 is the Ethernet connection to the Host Computer.

The Hard Disk drive stores the operating system and simulation software. When the Host Computer powers; it loads the VxWorks operating system and control loading simulation software.

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

For additional information about the ECLS Computer, refer to vendor data.

1.2. DAS II Chassis

The Data Acquisition System (DAS) computer interfaces servo amplifier control data, interlocks, switches, and warning lights to the ECLS Computer; it is allocated to area 9A3A6 in the main equipment cabinet and acts as the input and output controller of the control loading and seat motion systems. The DAS-II uses the same family of hardware utilized by the ELCS Computer, thereby maintaining commonality of components, the principal components of which are:

- 20-slot PCI/ISA Backplane
- Power Supply
- Single-board computer Network Interface Card (NIC) Two IP Carrier Boards
- Hard Disk Drive (HDD) Floppy Disk Drive (FDD)
- Internal Cooling Fans (not shown)

The Power Supply provides +12VDC to the control loading and seat motion circuits.

+24VDC is derived from the +28VDC power supply in the bottom of the 9A2 equipment cabinet. See Figure 1-7.

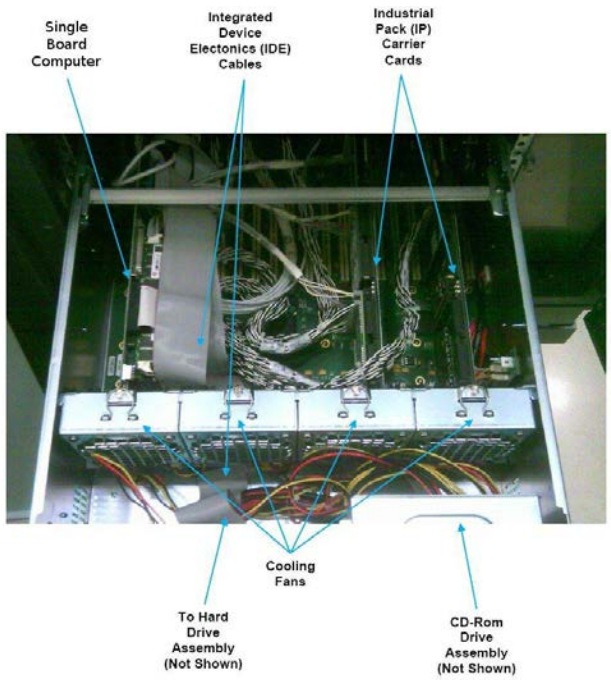

Figure 1-7. DAS II Top Internal View

The DAS-II chassis is located at 9A3A6 in the equipment cabinet as shown by Figure 1-8.

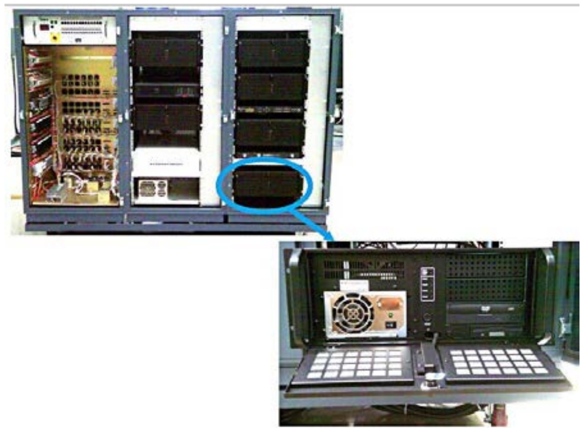

Figure 1-8. DAS II Location

DAS-II utilizes components common to the other major sub-systems, improving Contract Logistics Support (CLS). Compared to DAS, DAS-II represents a dramatic improvement in ergonomic layout that greatly eases general maintenance of the system. It has the same physical characteristics as the ELCS chassis described in Table 1-1.

1.3. Digital Servo Remote Power Controller

The Digital Servo Remote AC Power Controller provides AC power directly to the Digital Servo Amplifiers for the Electric Control Loading System (ECLS) Actuators. It is located in the 9A2A5 equipment cabinet. A circuit breaker protects each servo control system. See Figure 1-9. Physical characteristics are:

AC Power Input: 208/120VAC, 3- Phase, 50-60 Hz, 80 Amps.
Humidity: 20-80% non-condensing.
Optimum operating temperature: 70°F.
Dimensions: 7"H x 17"W x 24"D
Weight: 30lbs.

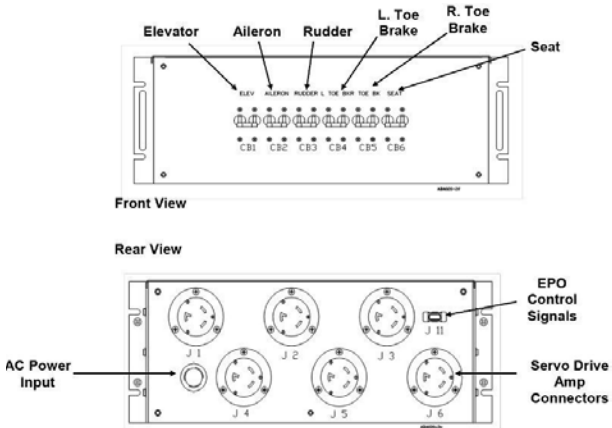

Figure 1-9. Servo Power Controller

1.4. Patch Panel Assembly

The Control Loading Patch Assembly is located at 7A1 in the cockpit frame. It is the main connection point for all Electric Control Loading System (ECLS) signal and DC power wiring, providing plug compatibility with the existing hardware. The Control Loading Patch Assembly contains control relays and fault- protection fuses in holders; allowing for easy identification of a faulty component or blown fuse. See Figure 1-4.

1.5. Digital Servo Drive Amplifier

The Digital Servo Drive Amplifiers are located on the upper, rear portion of the cockpit. The OFT and IFT use six amplifiers, one for each of the primary controls: elevator in area 7A5A1, aileron in area 7A6A1, rudder in area 7A7A1, left toe brake in area 7A12A1, right toe brake in area 7A13A1, and seat in area 7A19A1. The UTD uses five amplifiers – one for each primary control, minus the seat servo amplifier. See Figure 1-10.

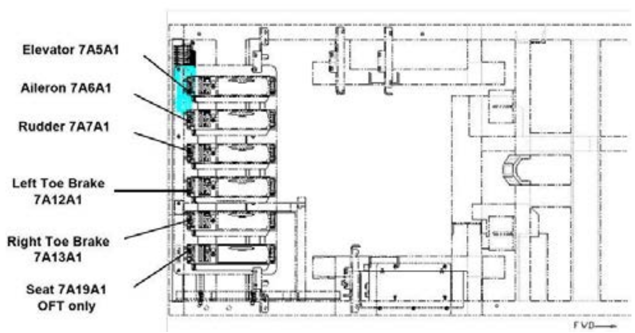

Figure 1-10. Servo Amp. Area Allocation

1.6. Load Cell In-line Amplifiers

The DAS II configuration includes five in-line instrument amplifiers located forward of the ECLS patch panel on the right side of the lower frame assembly. The amplifiers provide power and signal conditioning to the load cells in the primary controls. The amplifiers allow load cell calibration without requiring load cell replacement, reducing delay and expenses associated with setting up the control loading system. See Figure 1-11. The seat is regulated by an accelerometer that does not require amplification.

Figure 1-11. Load Cell Amplifiers

1.7. Electric Linear Actuators

The electrical actuators used in the control loading system are linear actuators manufactured by Exlar. The unique design of the GS series actuators permits the extending rod to rotate, allowing the user to rotate the rod and thread for specific application. A FlightSafety designed anti-rotation device keeps the rod from rotating and changing its position, maintaining an accurate linear setting.

Generally, these actuators function the same as a brushless servomotor. The servo amplifier is used to rotate the motor at a controlled speed, torque, and acceleration. Rotary motion is translated into linear motion by the internal planetary roller screw mechanism.

SECTION 2. Preparation for Use

In this section we present guidelines for the preparation and use of the Electric Control Loading System (ECLS). It is not a comprehensive set of instructions for assembling, testing, or accepting components or the Flight Training Device (FTD) as a whole. This section does address individual components requiring adjustment, configuration, or checkout before operation. Additional procedures may be found in section five of this manual.

2.1. Assumptions

In this section, the technician working on the system has either:

1. Received a course of approved maintenance training for the FTD, or
2. Has received on-the-job training from a senior technician who has received approved maintenance training and had practical experience working on the system.

2.2. Simulator Safety

Refer to the Safety Summary at the front section of the O&M.

2.2.1. Simulator Safety Hazards

Use caution in and around a simulator; people can be injured. Information in this subsection is intended to minimize damage and injury in the event of an emergency.

A simulator is a complex, expensive piece of equipment that can be dangerous. Hazards exist inside and outside the simulator. Improper use and slow or incorrect responses during an emergency can damage the simulator or compound what might have been only minor damage.

2.2.2. ECLS Safety Hazards

CAUTION

- Control loading systems are capable of rapid, sustained movement and represent a serious hazard to personnel.
- Keep clear of mechanical controls during initialization and test.
- Control loading has been known to move violently and oscillate during fault conditions.
- Know the location of the emergency off push-buttons and use them immediately when any sign of abnormal behavior of the control system appears.

2.3. Initial Configuration and Adjustments

Before activating the controls, and with the aid of a flashlight, verify that the excursion envelope of the control column, rudder pedals, and toe-brakes are clear of any obstructions.

For maintenance activity, refer to Section Five.

For periodic inspections refer to the Inspection handbook.

Refer to Section Six for system diagrams showing the interconnection of the ECLS components.

SECTION 3. Operation

This section describes Electric Control Loading System (ECLS) operation for the maintenance technician. For information on instructor operation of Flight Training Devices (FTD), see the Instructor Positional Handbook.

Principal components of the ECLS are:

ECLS computer chassis (Figure 3-1)
DAS-II chassis
Patch panel
Five or six digital servo amplifiers, depending on whether the FTD is a UTD an OFT
Five in-line load-cell amplifiers
One accelerometer for the seat

The ECLS computer and DAS chassis are located in the 9A2 and 9A3 equipment cabinets respectively, and the remaining equipment is located in the cockpit frame.

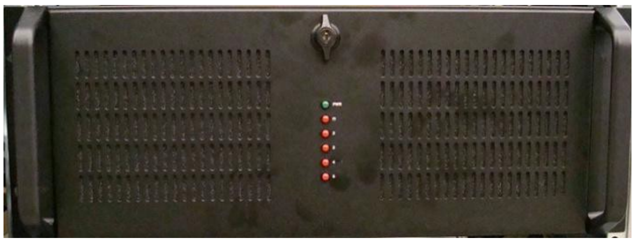

Figure 3-1. ECLS Computer Chassis

3.1. Assumptions

In this section, assumptions are:

1. The FTD as a whole is functional and that it has become necessary, for whatever reason, to start, stop or reset and recalibrate the ECLS.
2. The technician working on the system has either:
    a. Received a course of approved maintenance training for the FTD, or
    b. Has received on-the-job training from a senior technician who has received approved maintenance training and had practical experience working on the system.
3. The technician is competent with experience working on flight simulators and able to interpret the complexities of the system.

3.2. Controls and Indicators

Chassis for the ECLS and DAS-II computers are the same model from Trenton. Figure 3-1 shows a front view with the cover closed. Indicators in the cover are inoperative.

3.2.1. ECLS Computer

Figure 3-2 shows the controls and indicators on the front panel of the ECLS computer with the front panel open. The ECLS computer is located at 9A2A1, area A1 of equipment cabinet 9A2.

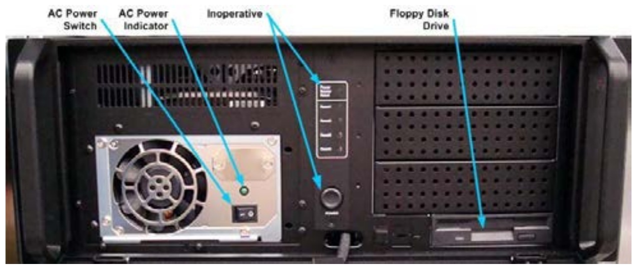

Figure 3-2. ECLS Computer Front Panel Open

3.2.2. DAS II Computer

Figure 3-3 shows the controls and indicators on the front panel of the DAS-II computer with the front panel open. The DAS-II computer is located at 9A3A6, area A6 of equipment cabinet 9A3.

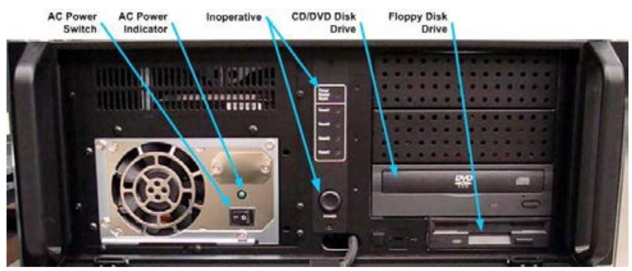

Figure 3-3. ECLS Computer Front Panel Open

3.2.3. Digital Servo Amplifier Remote AC Power Controller

Figure 3-4 shows the digital servo amplifier remote AC power located at 9A2A5, area A5 of equipment cabinet 9A2.

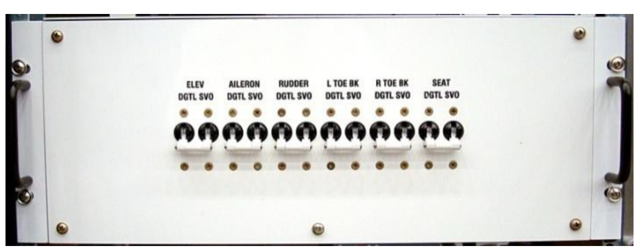

Figure 3-4. ECLS Servo Remote Power Control

The circuit breakers can be used to apply power to and remove power from the servo amplifiers.

3.2.4. Digital Servo Amplifiers

Digital servo amplifiers are located on the upper, rear portion of the cockpit, behind the seat and under the perforated metal shelf in the areas listed here:

Elevator: 7A5A1
Aileron: 7A6A1
Rudder: 7A7A1
Left Toe-brake: 7A12A1
Right Toe-brake: 7A13A1
Seat: 7A19A1 (OFT only)

Figure 3-5 shows the aft-left side of the cockpit assembly, containing the servo amplifiers; the side-skin is removed for visibility into the area. In the foreground is the elevator servo amp, behind that is the aileron amplifier, with additional amplifiers continuing across to the right side in the same sequence as listed above; the seat servo amplifier is located on the far right side of the cockpit assembly.

Figure 3-5. ECLS Servo Amps and Reset

Figure 3-6 shows the servo amplifier front panel display, reset button, system and diagnostic connectors.

Figure 3-6. ECLS Servo Amp Front Panel

3.2.5. ECLS Reset Pushbutton

After FTD system power-on and initialization or after the servo loop has lost synchrony with the Host computer, the control loading reset push-button (PB) will flash. Figure 3-5 shows the CONTROL LOADING reset push-button in the lower left-hand corner of the picture. Figure 3-7 shows a close-up view of the reset button; it is easily accessible from within the cockpit by reaching back from the seat on the left-hand side.

Figure 3-7. ECLS Reset Push Button

3.2.6. ECLS Arming and Disarming Controls

For normal and maintenance operation of the ECLS, arming and disarming is done from the Instructor's Station control panel using the CONTR LDG ARM and DYN SEAT arm push-buttons.

Figure 3-8 identifies the arming-disarming push-buttons on the Instructor's Station control panel.

Figure 3-8. ECLS Arm-Disarm Push Button

3.2.7. ECLS Patch Panel

Located in the cockpit frame at the 7A1 location, the Control Loading Patch Panel distributes all ECLS signals, DC power wiring, and has components for control relays and fault protection fuses. Fuses are mounted in holders, allow for easy identification of a blown fuse.

3.2.8. ECLS and DAS II Computer Console Terminals

Access to the ECLS and DAS-II computer console terminals is accomplished at the Instructor's Operating Station (IOS) by double-striking the NUM LOCK key on the keyboard to invoke the Keyboard-Video- Mouse (KVM) switch On-Screen Display (OSD) menu presented on the left-hand IOS monitor. Figure 3-9 shows the KVM OSD computer sub-system console selection menu highlighted.

Figure 3-9. KVM OSD Menu

3.2.8.1. ECLS Computer Console

Figure 3-10 shows the end-state of the ECLS Computer console after successful start and initialization.

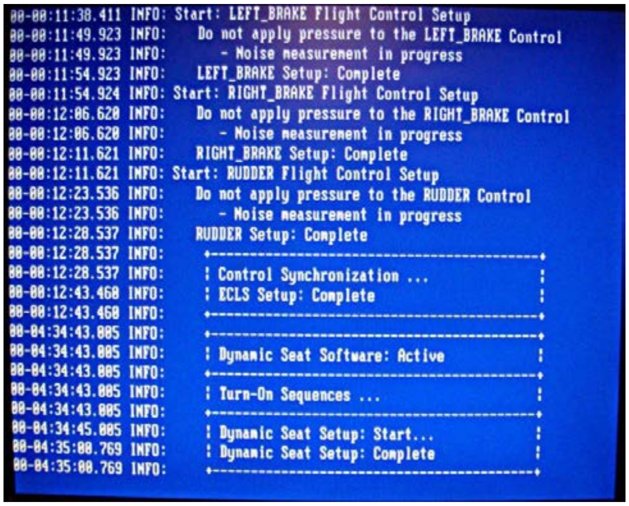

Figure 3-10. ECLS Computer Console Terminal

3.2.8.2. DAS II Computer Console

Figure 3-11 shows the end-state of the DAS-II Computer console after successful start and initialization.

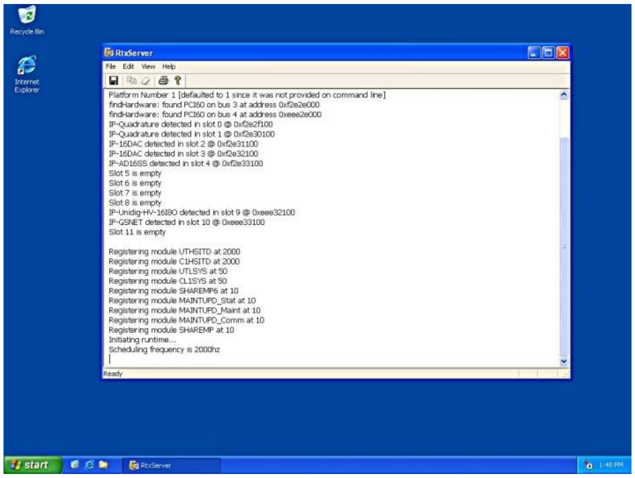

Figure 3-11. ECLS DAS II Console Terminal

3.3. Operation

Since the ECLS is integrated with the FTD, it will be powered when the electrical power is applied to the entire system. Operation of the ECLS is divided into these phases:

Start
Stop
Reset

Keep in mind the assumptions discussed in paragraph 3.1.

3.3.1. Starting the ECLS

Before activating the controls, inspect the cockpit with the aid of a flashlight:

Verify that the control column, rudder pedals, and seat area are clear of any obstructions.

Verify that the rudder pedal stature adjustment is, approximately, in the center of its travel.

Verify that the red gust-lock lever is disengaged.

Verify that all personnel are clear of the controls.

Follow these steps to start the Electric Control Loading System.

1. Inspect the CONTROL LOADING reset button and depress the button if the indicator is flashing.
   a. This action resets the ECLS.
   b. If necessary, refer to paragraph 3.2.5 for more information about this control.
2. Press the T/O POINT button on the IOS control panel.
   a. This action returns the simulator to a known state at the end of the runway.
   b. See Figure 3-12 for identification of this control.

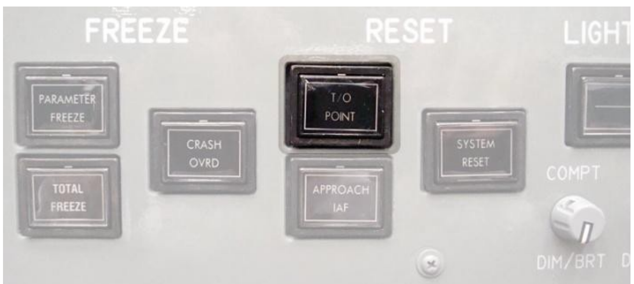

Figure 3-12. IOS T/O Point Push Button

3. Press the CONT LDG ARM button on the IOS control panel to start the controls; see paragraph 3.2.6 for more information on this control.
   a. If this is the first time the controls are started after a reset then a calibration of each channel will be performed in this sequence:
      i. Elevator.
      ii. Ailerons.

iii. Rudders.

iv. Toe-brakes.

b. Calibration involves slowly moving each control channel through its entire range of movement in order to discover the mechanical excursion limits.

The calibration will fail if any obstruction is encountered during this process.

c. If the controls have been calibrated, they will enter the armed state within a few moments as indicated by the next step.

4. When the CONT LDG ARM button displays a steady amber illumination, the controls are calibrated.
5. Press the DYN SEAT ARM button on the IOS control panel to start the dynamic seat; see paragraph 3.2.6 for more information on this control.

a. If this is the first time the seat is started after a reset then a calibration of the seat will be performed, slowly moving the seat through its entire range and then returning to the neutral position.

The calibration will fail if any obstruction is encountered during this process.

b. If the seat has been calibrated then it will enter the armed state within a few moments as indicated by the next step.

6. When the DYN SEAT ARM button displays a steady amber illumination, the controls are calibrated.
7. Verify successful start of the ECLS by examining the ECLS Computer terminal.

a. Double-strike the NUM LOCK key on the IOS keyboard to produce the KVM OSD menu; see Figure 3-9.

b. Select the ECLS menu option.

c. Verify that the ECLS Computer terminal is similar in appearance to Figure 3-10.

d. Return to the IOS Computer console by repeating step-a above and then selecting the IOS menu item.

8. You can verify successful start of the DAS by examining the DAS-II Computer terminal.

a. Double-strike the NUM LOCK key on the IOS keyboard to produce the KVM OSD menu; see Figure 3-9.

b. Select the DAS menu option.

c. Verify that the DAS-II Computer terminal is similar in appearance to Figure 3-11.

d. Return to the IOS Computer console by repeating step-a above and then selecting the IOS menu item.

9. The flight controls in the cockpit should now be free to move and feel like the aircraft controls.

3.3.1.1. Practical Considerations When Starting the ECLS

Control loading is inherently dangerous. In order to simulate the characteristics of the aircraft flying controls it is necessary to have a control loading system capable of extremely rapid response, which means that there will be no time to move out of the way of a malfunctioning system. A significant risk of personal injury exists even though the system is designed to regularly check for abnormal conditions during operation.

Because of the complexity and in-built safety checks, sometimes the ECLS will fail to calibrate, even though it functioned perfectly in the recent past. When this happens, do not panic and start randomly swapping parts, try several times before giving up and delving deeper into the system. Here are some things to consider before beginning technical investigations:

1. Verify that nothing has dropped into the mechanical envelope of the ECLS.

   Wire or other objects leaning against the pulleys and cables will prevent the controls from calibrating.

2. Verify that seat belts, torso and leg harnesses are clear of the controls.
3. Try cycling the power to the servo amplifiers by switching off the CBs on the servo remote power controller waiting a few moments and then switching them on again.

   See paragraph 3.2.3 for more information.

4. Try rebooting the ECLS and DAS Computers.

3.3.2. Stopping the ECLS

The ECLS stops automatically when the FTD stops.

3.3.2.1. Disarming the Control Loading and Seat

Disarm the control loading by pressing the CONT LDG ARM button on the IOS control panel. See paragraph 3.2.6; the button will change color from amber to green, indicating that it is disarmed.

Likewise, disarm the seat by pressing the DYN SEAT ARM button on the IOS control panel; the button will change color from amber to green, indicating that it is disarmed.

3.3.3. Resetting the ECLS

Sometimes it is necessary to reset the ECLS, particularly when the Host Computer is re-started. After a Host re-start, the ECLS CONTROL LOADING reset button will indicate a reset is required by flashing. See paragraph 3.2.5 for more information.

1. Press the CONTROL LOADING reset push-button.
2. Initialize and re-calibrate the control loading by pushing the arm buttons on the IOS control panel, as described in paragraph 3.3.1.

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SECTION 4.Principles of Operation

Purpose of the ECLS is to simulate the feel and performance characteristics of the actual aircraft controls during all phases of the flight envelope.

4.1. ECLS Characteristics

At program inception, most control loading systems were hydraulically operated. A requirement of the JPATS program was no hydraulics, forcing the use of electric control loading.

4.1.1. System Functions and Performance

System functions and performance consists in the control loading and dynamic seat. Design of the ECLS was dictated by the FTD system requirements.

4.1.1.1. Control Loading

Control loading system functions:

- Meets the system requirements
- Simulation of cockpit and control surface characteristics
- Electric load-cell for force sensing
- Electric servo positioning

Control loading system performance:

- Meets the system requirements
- Digital implementation of the controls models
- Minimum of 2000 iterations per second
- Smooth performance
- Control fixed-force frequency bandwidth of 50Hz

Control loading mechanical response:

- Meets system requirements
- Control fixed-force frequency bandwidth of 50Hz

Control loading safety:

- Exceeds system requirements
- Control loading emergency off switches
- Monitor servo tracking
- Monitor host and ECLS computers
- Monitor force, velocity, and accelerations

- Additional FSS safety: startup sequence, power, and output limit

4.1.1.2. Dynamic Seat

Dynamic seat system functions:

- Meets system Requirements
- Onset Cues (heave acceleration)
- Tactical Cues (touchdown bumps, runway cracks, malfunctions, etc…)
- Disturbance Cues (vibrations and buffets due to flaps, gear, engine, etc…)

Dynamic seat system performance:

- Meets system Requirements
- Smooth Performance
- Smooth Initial Engagement
- Smooth State Transition

Dynamic seat mechanical response:

- Meets system requirements
- Excursions of plus and minus one inch
- Frequency response of 20Hz
- Limit application of specific forces to 2 Gs

Dynamic seat safety:

- Meets system requirements
- Monitor and limit specific force
- Monitor servo tracking

4.2. Architecture

Architecture of the ECLS is a combination of hardware and software.

4.2.1. System Architecture

Figure 4-1 shows the overall system architecture of the ECLS and interconnection between the Host, ECLS, and DAS-II computers.

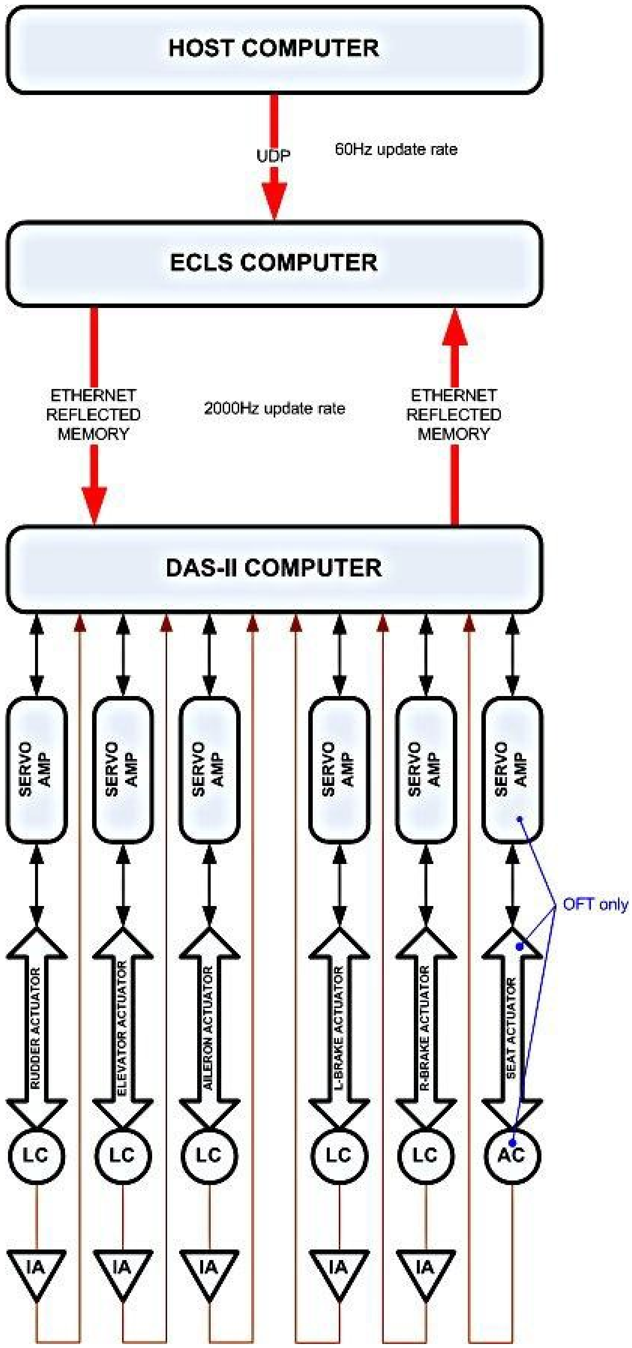


Figure 4-1. ECLS System Architecture

4.2.2. ECLS Computer Architecture

Architecture of the ECLS computer sub-system consists in:

- A chassis with integrated power supply.
- A passive PCI backplane.
- A Single-Board Computer (SBC)

- An Industry Pack (IP) carrier to support a functional variety of IP circuit boards
- An IP Reflective Memory, customized

Figure 4-2 illustrates the ECLS computer architecture.

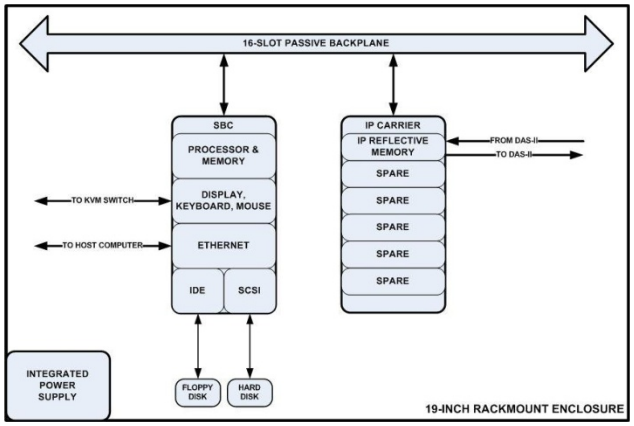


Figure 4-2. ECLS Computer Architecture

4.2.3. Control Loading Model Structure

The control loading model resides in the ECLS computer where it is iterated at a rate of 2,000

Hertz, a speed necessary to provide realistic performance that matches the aircraft.

Dynamic loading of the controls depends on numerous factors, but the most influential is the effect of the aero-load on the flight control surfaces (elevator, ailerons, and rudder) as the aircraft moves through the air, which translates to the characteristic feel of the flying controls as felt by the pilot in a particular phase of flight. It is a two-mass model that is illustrated by Figure 4-3.

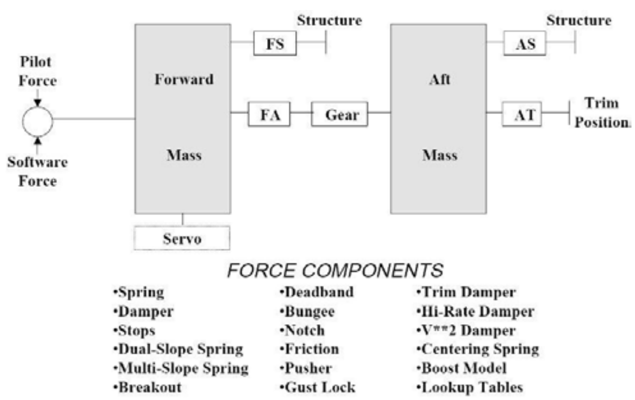


Figure 4-3. ECLS Model Structure

The fore-mass represents the stick and pedal controls, whereas the aft-mass represents the surface controls of the aircraft. They interact with each other through a cable-pulley system. This is modeled as shown in the link FA (Forward-mass to Aft) through the GEAR (gearing factor). The forward mass reacts with the aircraft structure through FS (Forward-mass to Structure). The aft-mass reacts with the aircraft structure through AS (Aft-mass to Structure) and with the trim surfaces through AT (Aft-mass to Trim-surface-position).

4.2.4. Dynamic Seat System Software

Only the OFT and IFT are equipped with a dynamic seat. Software on all three devices are the same. In the UTD, the dynamic seat software is disabled and the hardware components replaced by a static seat support structure.

Figure 4-4 shows the general structure of the dynamic seat system software. There are no adjustments.

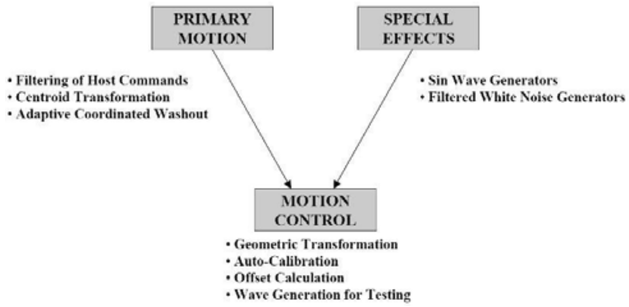


Figure 4-4. ECLS Dynamic Seat Software

4.2.5. Real-Time Modules

Figure 4-5 shows the arrangement of the real-time modules within the ECLS computer. Fast, 2,000 Hertz update rates are accomplished on the reflected memory network that connects the DAS-II computer interface between the servo amplifiers and the ECLS computer. Communication with the Host computer is via a User Datagram Protocol (UDP) bi-directional network link iterated at a slow 60 Hertz.

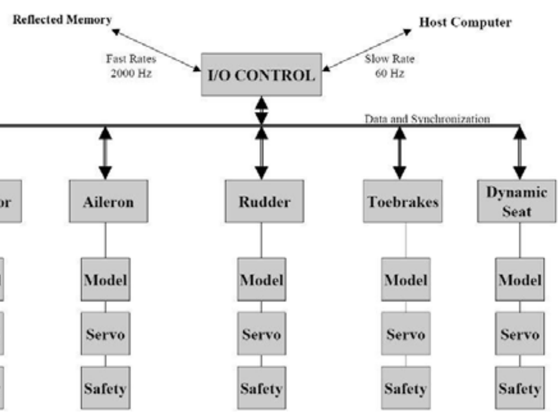


Figure 4-5. ECLS Real-Time Modules

4.2.6. DAS II Computer Architecture

Architecture of the DAS-II computer consists of:

A chassis with integrated power supply.

A passive PCI backplane.

A Single-Board Computer (SBC)

Two Industry Pack (IP) carriers to support a functional variety of industry pack circuit boards.

An IP Reflective Memory, customized

Three IP discrete Input/Output (I/O) boards

An IP Analog to Digital converter

Two Digital to Analog converters

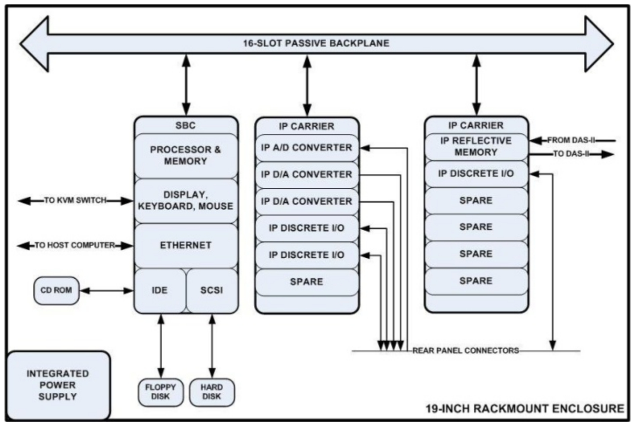


Figure 4-6. ECLS DAS II Architecture Computer

Figure 4-6 illustrates the DAS-II computer architecture. It uses Microsoft Windows OS with real-time extensions.

4.2.7. Modules Interaction

Figure 4-7 shows how the various control loading software functions are distributed among the three computing systems and interact with each other, indicating the most likely troubles are located. Greater detail is in Section 5.

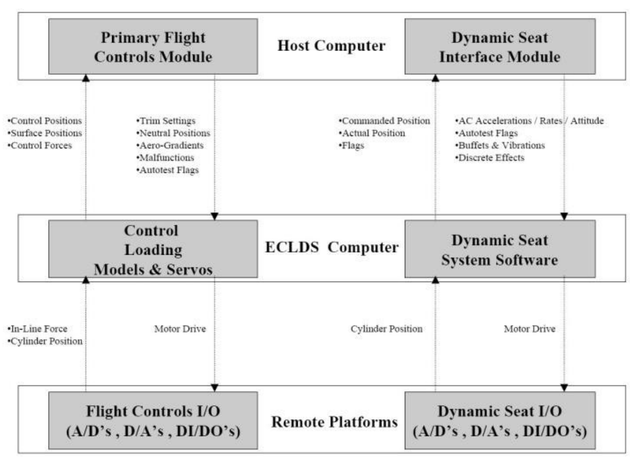


Figure 4-7. ECLS Modules Interaction

4.2.8. Servo Amplifiers

Each control loading channel is a closed servo-loop containing a servo-amplifier that provides the electrical drive for the associated actuator. It receives digital and analog control inputs from the DAS II and outputs a 350VDC, Pulse-Width Modulated (PWM) drive signal to the actuator. The PWM signal is rich in harmonics, leading to Electro-Magnetic Interference (EMI), covered more thoroughly in Section 5.

4.2.9. Load Cells, Load Cell Amplifiers, and Accelerometer

Each control loading channel, except the seat channel, includes a load cell and load-cell amplifier as part of the servo loop. Pilot input is detected by the load cell, which is critical to proper operation of the system. Output signal of the load cell is amplified by an in-line instrument amplifier located in close proximity; the amplifier also permits null-adjustment of any DC offset produced by the load-cell.

In the seat channel of the control loading, an accelerometer closes the servo loop. This channel is driven directly by the software turbulence models and does not require pilot input.

4.3. System Operational Flow

Operational flow of the system is best described by looking at a single channel. Figure 4-8 is a simplified block diagram of the elevator channel; it shows the electrical, mechanical, and software computational systems. Operation of the remaining channels is in essence similar, except for the seat channel that is driven by disturbance cues generated by the flight model.

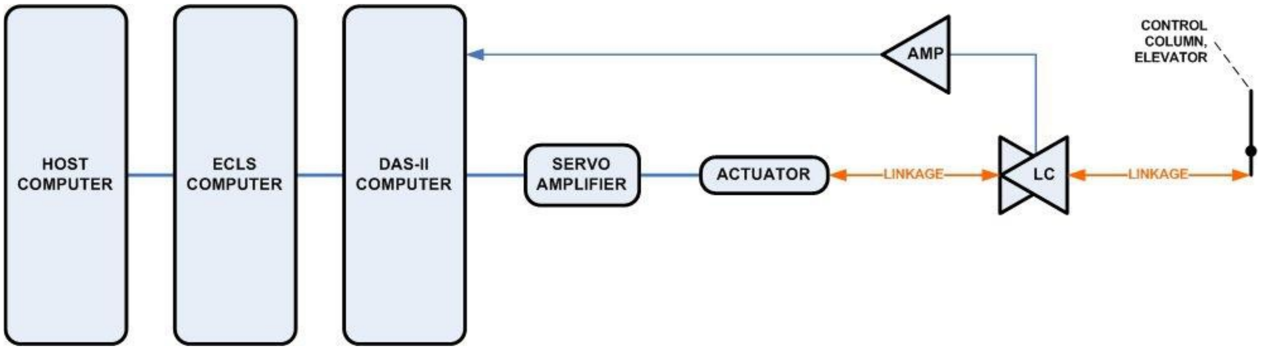


Figure 4-8. ECLS Operational Flow

During initialization or reposition, the controls are trimmed to the position calculated by the flight model within the Host computer; any large step-change is slowly integrated from the old to the new position in order to prevent rapid and dangerous movement of the controls.

While trimming, a pop-up window will appear on the IOS warning that trimming is in progress. Once the controls are trimmed to the new position for the current phase of flight, the trim warning window will close on the IOS and the simulator flight-frozen ready for use.

When removed from flight-freeze, the simulation model in the Host computer and servo model in the ECLS computer become active. Application of a force to the control column is detected by the Load cell (LC), which produces a voltage output that is amplified and sent to the DAS II where it is converted from analog to digital signal that is then passed the servo model in the ECLS computer and to the Host computer. The force input on the stick is used to calculate how far and how fast to move the stick, which is done by an output from the DAS II to the servo amplifier that moves the actuator and mechanical linkage to the new position, at the same time the host calculates elevator movement and appropriate response from the flight model.

It becomes obvious why an iteration rate of 2,000 Hertz is required in the servo loop: too slow would cause a jerky feel.

Some roughness of the controls will feel like a kind of detent. This is felt when the rotor of the actuator moves past the magnetic poles of the stator magnets in the actuator. To some extent this can be mitigated by adjustment, but though it is always present to a greater or lesser degree, it is only really noticeable when you are actively feeling for it. Under normal circumstances, the student pilot is too busy to notice.

SECTION 5. MAINTENANCE

Maintenance instructions in this section are based upon available historical data to identify areas most likely to require attention. Overhaul instructions are not included.

A regular, preventive maintenance program can diminish catastrophic breakdowns and simulator down time. This section presents an effective preventive maintenance program.

5.1. Test Equipment Required

Required test equipment is listed here.

1. Digital Multimeter, Fluke 87V or equivalent.
2. Laptop computer with serial port.
3. Serial interface cable, part number 5416ABH803.
4. Oscilloscope with probes.

5.2. Tools Required

Required tools are listed here.

1. Nonconductive Trimpot Adjustment Tool.
2. Standard Tool Kit.
3. Static Dissipative Field Service Kit.
4. Tensiometer.
5. Inclinometer, Mitutoyo Pro360, part number 950-315.
6. Vacuum Cleaner.
7. Variable Flow Peristaltic Pump (McMaster-Carr 43205K15) or a Hand held vacuum pump kit (McMaster-Carr 9963K11).
8. Grounded Wrist Strap.
9. Jumper with Clip.
10. Bicycle hand pump, Bontrager Charger or equivalent.

5.3. Materials Required

Recommended materials to perform procedures are listed here.

1. Loctite 242.
2. Loctite 609.
3. 3/8" clear hose (McMaster-Carr 5233K56).
4. Connector, Tubing (McMaster-Carr 53415K106).
5. Coupler, P/N – 6608-6-6 (Parker).
6. Female JIC 37° Swivel, P/N – 30682-4-4b (Parker).
7. Flare Union Adapter, P/N – 2027-6-4s (Aeroquip).
8. Lint-Free Cloth.
9. Lubriplate grease.
10. Mild Soap.
11. Oil sample container (894277).
12. O-ring, P/N – 22617-6 (Aeroquip).
13. Paper Tags for labeling wires and cables.
14. Petroleum based gear oil, with an EP additive – ISO grade 100.
15. Two graduated Beakers (McMaster-Carr 4187T43).
16. White Lithium grease.

5.4. Software Required

Software required is listed here:

1. Emerson PowerTools Software.

   This software is supplied with each servo amplifier on a CD-ROM.

5.5. Preventive Maintenance

Preventive maintenance is the key to solving small problems before they become major repair actions. In addition, preventive maintenance can locate an operationally marginal assembly permitting replacement before the component causes a loss of training.

Because all three ECLS configurations use the same mechanical hardware, this section will address only software and software-related issues.

5.5.1. Periodic Inspections

Ideally, accomplish a Daily Inspection and Daily Readiness Test (DRT) after the last operation of the day, prior to maintenance activity, and again after maintenance activity prior first operation the following day. Conduct maintenance tasks within twenty-four (24) hours of next operational day.

Tasks consist in checking training device operation by performing a visual examination and an operational test, as listed in the Inspection Manual, to discover defects and adjustments that, if not corrected, could cause delays to training operation.

5.6. Inspections

Perform inspections on a regular basis in accordance with Inspection Manual. A good time to perform an inspection is immediately after cleaning. An inspection is an opportunity to spot small problems before they become major repairs. Conduct periodic inspections in an orderly manner. Follow circuits from beginning to end, and note component condition. Pay particular attention to components that are prone to failure or recently removed, repaired, or replaced.

WARNING

Disconnect facility power to components before making any inspections.

After facility power is disconnected, use a meter or other device to verify power removal.

5.6.1. Inspection Guidelines

1. Check for component discoloration that indicates overheating or burning.
2. Check electrical connections for tightness.
3. Check for frayed and broken wiring.
4. Check for evidence of arcing.
5. Check cooling fans and filters for cleanliness.
6. Check for odors of burnt or scorched electronics.

5.7. Fault Diagnosis and Diagnostic Tools

In this section we provide the technician with guidance for the diagnosis of faults, using diagnostic tools and techniques.

While we make specific suggestions for isolating faults, please note that it is impossible to address every combination of malfunctions or manifestations of these. Complex equipment can find new ways to break. These paragraphs are merely a guide. Common sense and a thorough visual inspection are keys to quick and accurate fault finding.

Some general principles will help:

- When a failure occurs, systematically check all fuses, circuit breakers, and wiring before investigating the equipment.
- If a circuit breaker has tripped open or a fuse has blown, investigate and correct what caused the overload before replacing the fuse or resetting the circuit breaker.
- Use the schematic diagrams listed in section six to help locate the root cause of a failure.
- Review the Safety Summary at the front of this manual before performing any troubleshooting.

Other considerations:

- Pay close attention to what the equipment is revealing.

  Listen and look carefully.
- Make a complete inspection.
- Do not ignore the obvious.

  Carefully observe what is occurring and compare that to what should occur.
- Use all documentation available.

  Read a procedure from beginning to end before starting to work.
- Make complete use of available self-diagnostics.

  Keep a diagnosis and repair log.
- Do not do anything that is unsafe
- Examine the system when it is in correct working order. Knowing what is normal makes recognizing abnormal behavior easier.

WARNING

Dangerous voltages, capable of causing death, are present in this equipment.

Use extreme caution when handling, testing, and adjusting.

Remove power before touching any component.

5.7.1. Preliminary Diagnostic Inspections

Control loading is an electro-mechanical system. It is susceptible to mechanical wear, tear, and failure. Before doing any low-level fault finding, check the easy things first as described here.

- Often these inspections show several things in combination when it is easier just to reboot the ECLS.
- Sometimes it is necessary to reboot the entire machine to return it to a known state.
- Hardware does fail, but once the system is running in a controlled environment, problems are more likely to be found in these areas:
    - Fuses.
    - Cables and connectors, especially when the system has been disturbed by other work.
    - Slack wire-rope in the mechanical parts of the controls.
    - Loose bolts in the mechanical parts of the controls.
- Improper adjustment of the Expando-bolts can disrupt the controls.
    - Actuator failure.
    - Loose screws in the terminal blocks to which the pull-up resistors are mounted.
- This kind of problem will fail entire blocks of digital inputs and outputs, leading you to suspect the IP modules.

Do resist the urge to start randomly changing parts in the hope of finding the problem. Doing so usually makes the situation worse by confusing what is good and what is bad, which often introduces other problems.

- Software is the least likely source of trouble.

5.7.1.1. Assumptions

Since it is impractical to address every eventuality, procedures assume a transient fault condition has stopped normal operation of the ECLS.

5.7.1.2. Question the Operators

Ask the Instructor what happened just before the ECLS stopped working. Knowing what led to the condition can be helpful.

1. Was there a glitch in the electrical power?

   Though the computers are supplied by uninterruptible power supplies, the servo amplifiers are not.

2. Were the controls operating normally immediately prior to failure?

   Sometimes, the controls can start oscillating, especially when the mechanical linkages are slack.

5.7.1.3. Control Loading Reset Button Inspection

Observe the control loading reset button just to the rear of the seat on the left-hand side.

- Is the light flashing?

  If flashing, push the reset button and reboot the control loading.

5.7.1.4. IOS Systems Debug Page Inspection

Inspect the IOS Systems Debug page and verify that all the software models are checked and running as shown in the Scheduler Enable (Execution Time in mS) box of Figure 5-1, especially the ECLS I/O module in the bottom left-hand corner of the screen.

If not then:

1. Disable the controls and seat by pressing the CONT LDG ARM and DYN SEAT ARM push-buttons on the IOS control panel.
2. Re-check the unchecked software modules.
3. Activate the controls and seat.

   Check that the controls are free to move.
4. If this does not work, reboot the ECLS and the Host computers.

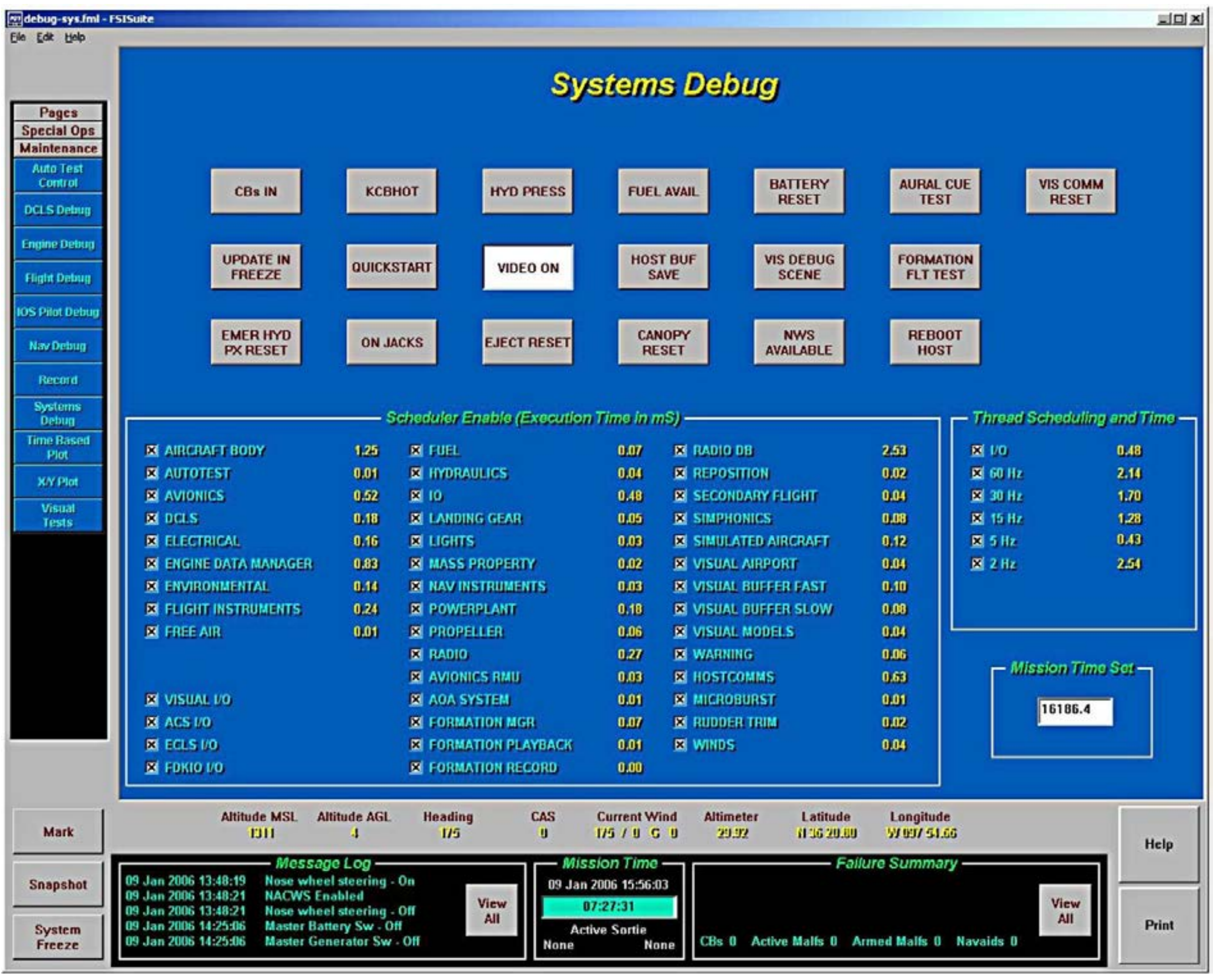


Figure 5-1. IOS Systems Debug Page

5.7.1.5. Servo Amplifier Status Inspection

See Figure 5-2. Inspect each servo amplifier for fault conditions; for example: the amplifier will fail off when the actuator overheats. Overheating happens when the actuator is driven or drifts into its mechanical stops.

The reset button is a dual-purpose button. Its primary function is fault condition reset. It can also be used to select a number of predefined setups; however, in this system the predefined setups are not used and the unit defaults to setup (0).

The status-display on the front of the drive shows the drive-status and fault-codes. When a fault condition occurs, the fault-code will be displayed, overriding the status-code.

Figure 5-2. IOS Systems Debug Page

Verify that the servo amplifiers are operating normally, as shown in paragraph 5.7.1.5.1 Servo Amplifier Normal Operation, below; if not then try restarting the ECLS by:

1. Disarm the control loading and seat by pushing the CONT LDG and DYN SEAT ARM push-buttons on the IOS control panel so that they change color from amber to green.
2. Disable the ECLS I/O link with the Host by unchecking ECLS I/O on the IOS System Debug page.
    a. This will save you from having to reboot the Host and other computers.
    b. Of course you may still have to restart the entire machine, but it’s worth trying this procedure first.
3. Cycle the power to the servo amps by switching OFF and then ON the CBs on the servo remote power control at 9A2A5; this will reset the servo amplifiers.

    If you have a  motor overheat fault, then you must wait for the actuator to cool before you can go much further.
4. Restart the ECLS and DAS computers by cycling their power switches.

    Verify that they are returned to normal by looking at their consoles via the IOS KVM switch

5. Enable ECLS I/O by checking the ECLS I/O on the IOS System Debug page.
6. Arm the control loading and seat by pushing the CONT LDG and DYN SEAT ARM push-buttons on the IOS control panel so that they change color from green to amber.

5.7.1.5.1. Servo Amplifier Normal Operation

Normal operation of the servo amplifiers should display the status codes listed here for each of the control loading channels:

- Elevator, 7A5A1, , Torque.
- Aileron, 7A6A1, , Torque.
- Rudder, 7A7A1, , Velocity.
- L Toe-brake, 7A12A1, , Velocity.
- R Toe-brake, 7A13A1, , Velocity.
- Seat, 7A19A1, , Velocity.

5.7.1.5.2. Servo Amplifier Status Codes

When reflecting status codes, the servo amplifier front panel, fourteen-segment displays as shown in Table 5-1.

The decimal point displays when the drive is enabled and the stop input is inactive. This indicates that the drive is ready to receive commands and any motion command will cause movement of the actuator attached to the amplifier.

Table 5-1 ECLS Servo Amp Status Codes

DISPLAY	STATUS	DESRIPTION
	Brake Engaged, output off	Motor brake is mechanically engaged.
	Disabled	Power stage is disabled.
	Position	Waiting for a command, in Pulse Mode.
	Velocity	Velocity Model operation
	Torque	Torque Mode operation.
	Summation	Summation mode operation.
	RMS Foldback	Motor torque is limited to 80-percent.
	Stall Foldback, EN drive only.	Motor torque is limited to 80-percent of drive stall current.
	Ready to Run	Drive-enabled no Stop input

5.7.1.5.3. Servo Amplifier Fault Codes

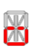
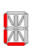
A number of diagnostic and fault detection circuits are incorporated to protect the drive. Some faults, like over voltage and amplifier or motor over temperature, can be reset with the Reset/Setup button. Cycling power off and on (wait until the display turns off), is the only other means to reset other faults, such as the logic supply fault.

The drive accurately tracks rotor position during fault conditions. For example, if there is a “Low DC Bus” fault where the bridge is disabled, the drive will continue to track the rotor’s position provided the logic power is not interrupted.

The CW/CCW Limit faults are automatically cleared when the fault condition is removed. This means that if two faults are active, the higher priority fault will be displayed.

Fault codes are listed in Table 5-2 with associated descriptions. Detailed explanation of each fault, from highest to lowest priority are presented in the following subparagraphs.

Table 5-2 ECLS Servo Amp Fault Codes

DISPLAY	FAULT	ACTION TO RESET	BRIDGE DISABLED
	Watchdog timer	Button	Yes
	Power self-test failure	Power	Yes
	Non-volatile memory invalid	Button	Yes
	Invalid configuration	Power	Yes
	Power stage fault	Button	Yes
	High DC bus fault	Button	Yes
	Low DC bus fault	Button	Yes
	Encoder state	Power	Yes
	Encoder hardware, line fault	Power	Yes
	Motor over temperature fault	Button, Cooling	Yes
	RMS shunt power fault	Button	Yes
	Over-speed fault	Button	Yes
	Following error	Button	Yes
	CW/CCW limit	Auto	No
	All “On” during power-up sequence	Auto, 1 second	Yes

5.7.1.5.3.1. Watch-dog Timer

 The drive contains a watchdog timer to ensure that the firmaware is operating normally. If the firmware fails to reset this timer every 10 milliseconds, the drive hardware will be reset, all inputs and outputs will be cleared (off), and Watchdog Timer fault is generated.

5.7.1.5.3.2. Power-on Self-test Failure

 This fault indicates that the power up self-test has failed. This fault cannot be reset with the reset command or the reset button.

5.7.1.5.3.3. Non-volatile Memory Invalid

At power-up the drive tests the integrity of the non-volatile memory. This fault is generated if the contents of the non-volatile memory are invalid.

5.7.1.5.3.4. Invalid Configuration

This fault code should not normally occur when using an MG series motor.

A function module was attached to the drive on its previous power cycle. To clear, press and hold the Reset button for 10 seconds.

5.7.1.5.3.5. Power Stage Fault

This fault is generated when a power stage over-temperature, over-current, or power stage logic supply occurs. This can be the result of a motor short to ground, a short in the motor windings, a motor cable short, or the failure of a switching transistor.

It can also occur if the drive enable input is cycled “Off” and “On” rapidly, greater than 10 Hz.

5.7.1.5.3.6. High DC Bus Fault

This fault will occur whenever the voltage on the DC bus exceeds 440VDC. The most likely cause of this fault would be an open shunt fuse; a high AC line condition; or an application that requires an external shunt, e.g., a large load with rapid deceleration.

5.7.1.5.3.7. Low DC Bus Fault

This fault will occur whenever the voltage on the DC bus drops below 96 Volts. The most likely cause of this fault is a reduction or loss of the AC power. A 50ms debounce time exists with this fault to avoid faults caused by intermittent power disruption.

5.7.1.5.3.8. Encoder State Fault

Certain encoder states and state transitions are invalid and will cause the drive to report an encoder state fault. This is usually the result of noisy encoder feedback caused by poor shielding.

5.7.1.5.3.9. Encoder Hardware, Line Fault

If any pair of encoder lines are in the same state, an encoder line fault is generated. The most likely cause is a missing or bad encoder connection.

5.7.1.5.3.10. Motor Over-temperature Fault

This fault is generated when the motor thermal switch is open due to motor over-temperature or incorrect wiring.

5.7.1.5.3.11. RMS Shunt Power Fault

This fault is generated when RMS shunt power dissipation is greater that the design rating of the internal shunt.

5.7.1.5.3.12. Over-speed Fault

This fault occurs in any of three circumstances:

1. When the actual motor speed exceeds 150-percent of the maximum motor speed. This maximum over-speed value is not dependent on the applied AC voltage parameter.

2. When the actual motor speed exceeds the user entered over-speed limit parameter. This parameter can be changed with the PowerTools software.
3. In pulse mode operation, when the frequency input actually received generates a motor command speed in excess of 13000 RPM. The input frequency that will cause this is dependent on the command pulse per motor revolution setting.

5.7.1.5.3.13. Following Error Fault

This fault is generated when the following error exceeds the following error limit; default error limit is .2 revs. This is typically used in pulse follower mode.

5.7.1.5.3.14. CW/CCW Limit

This fault is caused when either the CW (+) or CCW (-) Travel Limit input function is active.

5.7.1.5.3.15. All On

This is a normal condition during power up of the drive. It will last for less than 1 second. If this display persists, call Control Techniques for service advice. Normally, "All On" for less than one second during power-up. All segments dimly lit when power is "Off" is normal when an external signal is applied to the encoder inputs (motor or master) or serial port from an externally powered device. The signals applied to the inputs cannot exceed 5.5V level required to drive logic common or drive damage will occur.

5.7.1.6. Controls Abnormal Position

Inspect the controls to see if they are in an abnormal position at one limit or another. If they are, it is good practice to manually move the controls to the center of their travel before restarting. To manually center the controls:

1. Disable the controls and seat by pressing the CONT LDG ARM and DYN SEAT ARM push-buttons on the IOS control panel.
2. Disable the ECLS I/O link with the Host by unchecking ECLS I/O on the IOS System Debug page.

   This prevents the need to reboot the Host and other computers.
3. Disable the servo amplifiers by switching off circuit breakers 1 through 5 on the Digital Remote AC Power Controller (9A2A5).
4. Manually move the controls to their approximate center of travel, which will require you to exert some muscular effort.
5. Enable the servo amplifiers by switching on circuit breakers 1 through 5 on the Digital Remote AC Power Controller (9A2A5).
6. Reboot the DAS-II computer from the IOS by:
   a. Double striking the NUM LOCK key to invoke the KVM menu .
   b. Select the DAS-II computer.
   c. Restart the Windows operating system.

7. Reboot the ECLS computer by:
    a. Double striking the NUM LOCK key to invoke the KVM menu .
    b. Select the ECLS computer.
    c. Press the ENTER key a couple of times to clear some space then type REBOOT followed by the ENTER key.
8. Wait for the reboots to complete.
9. Press the control loading reset button just aft of the seat on the left side.
10. Enable the ECLS I/O link with the Host by checking ECLS I/O on the IOS System Debug page.
11. Enable the controls and seat by pressing the CONT LDG ARM and DYN SEAT ARM push-buttons on the IOS control panel.

    Wait for the controls to calibrate before arming the seat.

5.7.1.7. Host Computer Communication Inspection

Loss of network communication will negatively impact operation of the simulator; it can happen for a variety of reasons. An easy way to verify communication with the various sub-systems is to look at the Host computer console:

1. Double-strike the IOS NUM LOCK key to invoke the KVM selection menu.
2. Navigate to the Host computer console and press ENTER.
3. If the Host console displays rapidly scrolling data then press the SCROLL LOCK key to stop the display, so that you can read the text.
    a. If there is a communication error then the error message should tell you which sub-system has fallen silent.
    b. Press the SCROLL LOCK key again to unlock the display.

Re-start the entire simulator to see if it clears the problem. If that does not work, inspect the Network Interface Cards (NIC). Figure 5-3 shows the rear-panel of the Host computer with the ECLS NIC highlighted and an inset graphic that identifies the NIC indicator lights; the indicator lights tell you the general state of the NIC as described here:

ACT/LNK:

- On:
    - The adapter and switch are receiving power.
    - The cable connection between the switch and adapter is good.
- Off:
    - The adapter and switch are not receiving power.
    - Or you have a driver configuration problem.

This is unlikely as the drive configuration should not have changed since the system was delivered from the factory.

- Flashing:
    - The adapter is sending or receiving network data.
    - The frequency of the flashes varies with the amount of network traffic.

100TX:

- On:
    - Operating at 100 Mbps.

The system is delivered configured for high speed operation at 100 Mbps; the amber LED should always be illuminated.

- Off:
    - Operating at 10 Mbps.

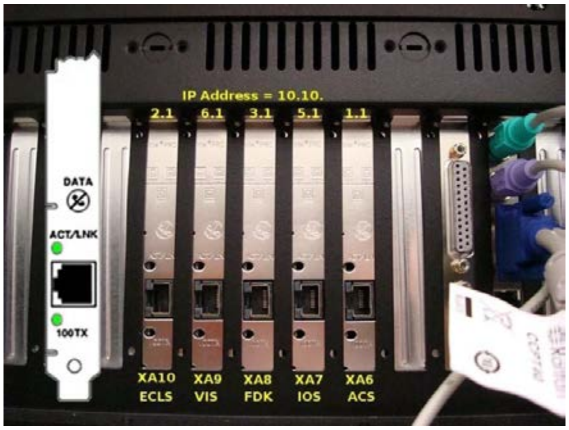


Figure 5-3. Host NIC Indicators

5.7.1.8. ECLS Computer Communication Inspection

Figure 5-4 shows a picture of the rear panel of the ECLS computer, with an inset showing a close-up picture of the network connection on the Single-Board Computer (SBC) that goes to the Host computer. The SBC occupies slots XA3 and XA4 of the Trenton chassis.

The Ethernet interface has two LEDs for status indication and an RJ-45 network connector. Notice the amber and green LED indicators embedded as part of the RJ-45 socket. Definition of these indicators is as listed below:

Green LED reports the Link-Activity status:

- Off:
    - The Ethernet interface did not find a valid link on the network connection.
    - Transmit and receive are not possible.

- On, steady:
    - The Ethernet interface has a valid link on the network connection and is ready for normal operation. Connection speed is reported by the amber LED.
- On, flashing:
    - Indicates network transmit or receive activity. Amber LED reports connection speed:
- Off

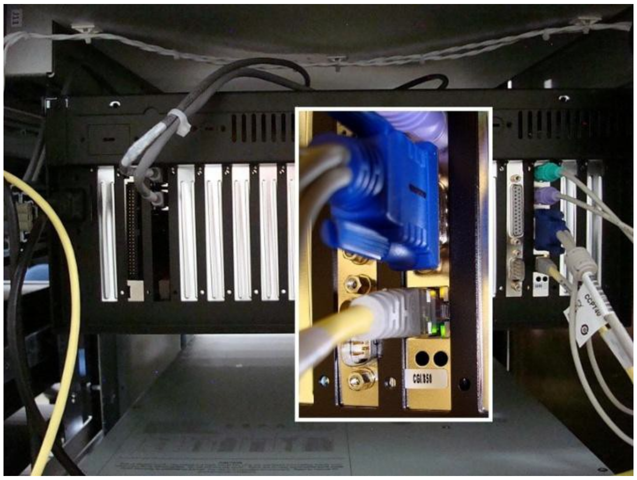


Figure 5-4. ECLS Network Connection

5.7.1.9. DAS II Computer Communication Inspection

Figure 5-9 shows the rear panel of the DAS-II computer with the discrete input- output cabling removed.

- On the left-hand side you can see the two CAT5 network cables connecting the IP reflective memory boards in the DAS II and the ECLS computers.
- On the right-hand side you can see the Single-Board Computer (SBC) that occupies slots XA3 and XA4, and the RJ-45 network connection below the blue VGA connector.

Because the same parts are used in other subsystems, operation of the SBC network connection is that same as described for the ECLS computer in paragraph 5.7.1.8.

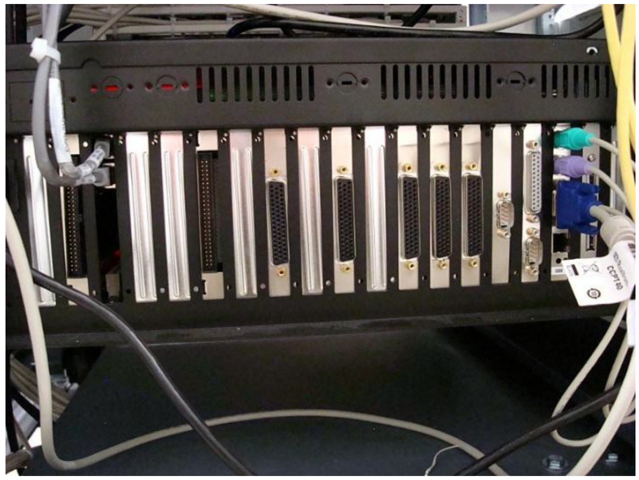


Figure 5-5. DAS II Computer Rear Panel

5.7.1.9.1. DAS II Maintenance Console

Reserved.

5.7.1.10. Actuators

State of the actuators is easily determined by first looking at the status 14-segment display on the servo amplifiers, described in paragraph 5.7.1.5, which will provide indications of overheating.

Over-heating is a consequence of another problem that has caused the actuator to be driven into either of its mechanical stops.

Detailed state of the actuators can be found by examining the data presented by the servo amplifier maintenance displays, accessible through the serial connection on the servo amplifier front panel using the laptop computer, described in paragraph 5.8.2.

5.7.2. Detailed Inspections

Detailed inspections require removal of chassis covers to facilitate inspections of the LED indicators on internal circuit cards.

5.7.2.1. IP Reflective Memory

Each IP Reflective Memory card is equipped with LED indicators mounted on the reverse side of the card. Also, a 3.3VDC power status LED indicator is mounted on the component side of the card.

Status of the 3.3VDC on-card power supply should be visible when you look between the IP card and the IP carrier. Figure 5-6 shows the component side of the IP card; the power status LED is highlighted in green in the top left-hand corner of the picture between capacitor C4 and the edge connector; 3.3V is silk-screened between the LED and the card edge. The on-card switching power supply is functional when this LED is illuminated.

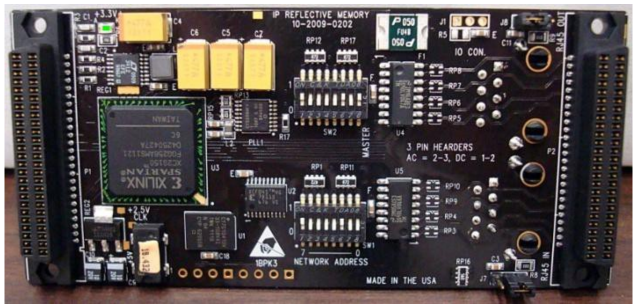


Figure 5-6. IP Reflective Memory – Obverse

Eight status LEDs in two rows of four are shown in Table 5-4, highlighted in green. Table 5-4 identifies each status LED; for easy reference, orientation of the Table 5-4 is the same as the LEDs highlighted in Figure 5-7. LED identification is printed on the card, except for the undefined indicators.

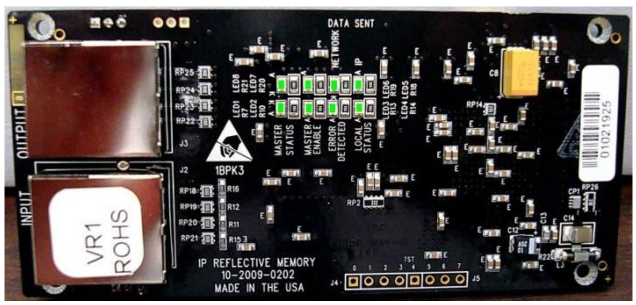


Figure 5-7. IP Reflective Memory – Reverse

Table 5-3 ECLS Servo Amp Fault Codes

UNDEFINED	UNDEFINED	NETWORK	IP
MASTER STATUS	MASTER ENABLE	ERROR DETECTED	LOCAL STATUS

Network:

- Signals data transmission activity on the Cat5e data ring between the ECLS and the DAS-II.

IP:

- Signals changed-data transfer activity between the computer system and the IP Reflective Memory board.

Master Status:

- During initialization, a Master Status message is transmitted by the master node onto the Cat5e data ring. Each slave node that successfully receives the Master Status message will illuminate its Master Status and Network LEDs.
    - A failure in the data ring transmission path will prevent the system from initializing. A problem with the Cat5e cable is the most likely source of trouble.

  - After cold-start on a data ring with multiplenodes, it would be easy to see the failure location. On the outbound leg of the ring, beginning at the Master, slave nodes would show illuminated Master Status and Network LEDs up to the fault; on nodes beyond the fault, these LEDs would be extinguished. Also, with this fault condition, the Master would display an illuminated Error Detected LED.

- Two IP Reflective Memory nodes are employed in each FTD, a Master and a Slave; the Master is located in the ECLS computer chassis, the Slave is installed in the DAS-II computer chassis.

Master Enable:

- Illuminated on Slave nodes, this LED indicates that the initial handshake between the it and Master was successful and that the integrity of the data ring is good.

Error Detected:

- On the Master node this indicates that there was an error during initialization, which implies that the handshake could not propagate around the data ring.

Local Status:

- On a good data ring, this LED will be illuminated on both the Master and the Slave cards.

Figure 5-12 illustrates the LED sequencing of the IP Reflective Memory module.

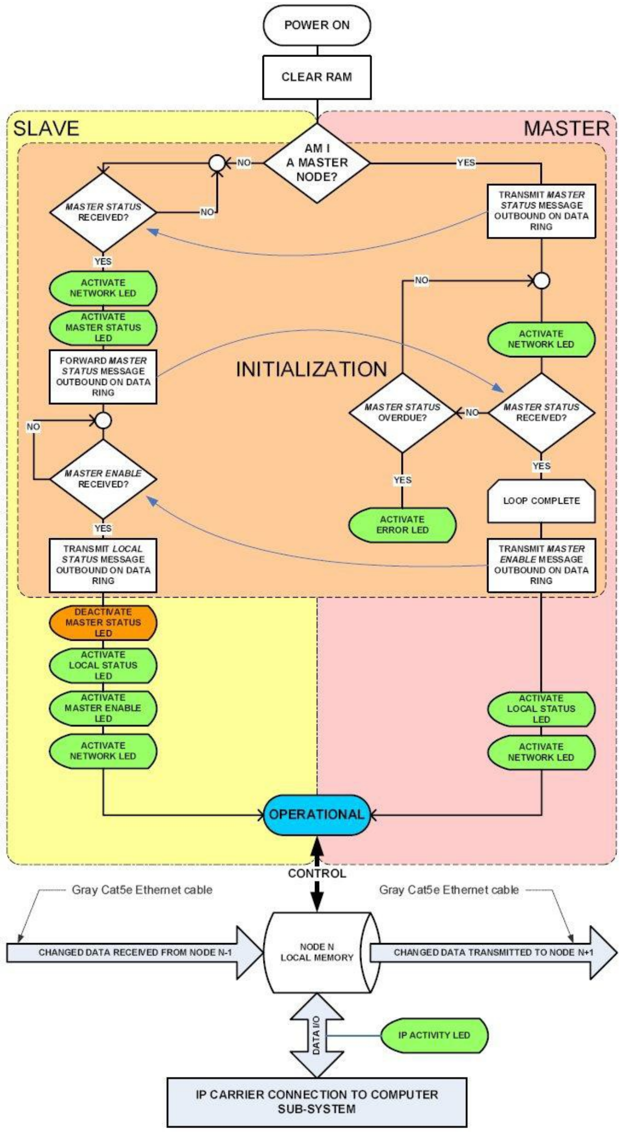


Figure 5-8. IP R Memory LED Sequencing

5.7.2.1.1. Normal Operational Status of the LEDs

After successful initialization with the IP Reflective Memory running under normal fault-free operational conditions, the Slave node in the DAS-II computer chassis will display the LED combination shown in Table 5-4.

Table 5-4 Slave IP Reflective Memory LEDs Normal Operational Status

UNDEFINED	UNDEFINED	NETWORK (FLASHING)	IP (FLASHING)
MASTER STATUS	MASTER ENABLE	ERROR DETECTED	LOCAL STATUS

After successful initialization with the IP Reflective Memory running under normal fault-free operational conditions, the Mater node in the ECLS computer chassis will display the LED combination shown in Table 5-5.

Table 5-5 Master IP Reflective Memory LEDs Normal Operational Status

UNDEFINED	UNDEFINED	NETWORK (FLASHING)	IP (FLASHING)
MASTER STATUS	MASTER ENABLE	ERROR DETECTED	LOCAL STATUS

Note: The Network and IP LEDs only flash when changed data is written into memory on each card. Only changed data is transmitted around the data ring, thereby making economical use of the available bandwidth.

5.7.2.1.2. Abnormal Operational Status of LEDs

Any failure is possible, but, once the system is working, the IP Reflective Memory cards are very reliable. The most likely source of trouble is the cabling of the data ring, especially after maintenance actions in the area that have disturbed the system. Another source of trouble can arise from infestations of rodents or insects.

Table 5-6 shows the abnormal cold-start initialization status of the Master node LEDs in the ECLS computer chassis, caused by a communications failure in the data ring.

Table 5-6 Master IP Reflective Memory LEDs Abnormal Cold-start Status

UNDEFINED	UNDEFINED	NETWORK	IP
MASTER STATUS	MASTER ENABLE	ERROR DETECTED	LOCAL STATUS

Table 5-7 shows the abnormal cold-start initialization status (all off) of the Slave node LEDs in the DAS-II computer chassis caused by a communications failure in the data ring outbound from the Master inbound to the Slave on cable W724 between the ECLS computer (9A2A1 Out) and the DAS-II computer (9A3A6 In).

Table 5-7 Slave IP Reflective Memory LEDs Cable W724 Communications Error

UNDEFINED	UNDEFINED	NETWORK	IP
MASTER STATUS	MASTER ENABLE	ERROR DETECTED	LOCAL STATUS

Table 5-8 shows the abnormal cold-start initialization status of the Slave node LEDs in the DAS-II computer chassis caused by a communications failure in the data ring outbound from the Slave inbound to the Master on cable W723 between the DAS-II computer (9A3A6 Out) and the ECLS computer (9A2A1 In).

Table 5-8 Slave IP Reflective Memory LEDs Cable W723 Communications Error

UNDEFINED	UNDEFINED	NETWORK	IP
MASTER STATUS	MASTER ENABLE	ERROR DETECTED	LOCAL STATUS

An initialization error will cause the indications shown in Table 5-6 and either the indications in Table 5-7 or in Table 5-8, depending on the location of the problem.

5.8. Calibrations

Calibrations and tests for the toe brake are the same as for DRI and DAS and will not be repeated in this document.

Calibration procedures for the load cell amplifiers, however, are somewhat different and are covered in this Supplement.

5.8.1. Load Cell Amplifier Calibration

Signal output of each load-cell is buffered and boosted by an in-line instrument amplifier. Five load-cell amplifiers are located nearby in the center right-hand side of the simulator base-frame, as shown by Figure 5-16. Functions of the instrument amplifiers are to:

- Amplify the load cell signal, thus improving the signal-to-noise ratio, boosting the weak load cell output above the electrical noise inherent to the system.
    - Electrical drive from the servo amplifiers to the actuators is a 350 Volts pulse- width-modulated signal. Square-wave signals produce a lot of odd harmonics that can overpower the small signal produced by the load cell.
- Facilitate nulling of any DC offset produced by the load cell.
    - Lateral force on the load cell produces DC offset to the point that they become unserviceable. Null adjustment provided by the amplifier lengthens the service life of the load-cell and permits more accurate adjustment of the signal returned to the DAS-II computer.

These amplifiers are robust, but they require occasional recalibration to compensate for age and wear-induced drift of the load cell. Of the two components, the load cell is more likely to fail; however, failure of the amplifier will become obvious during the calibration process. In the event an amplifier fails, the replacement unit must be configured in accordance with paragraph 5.9.2, *Load-cell In-line Amplifier Configuration* before re-applying power and beginning the calibration process.

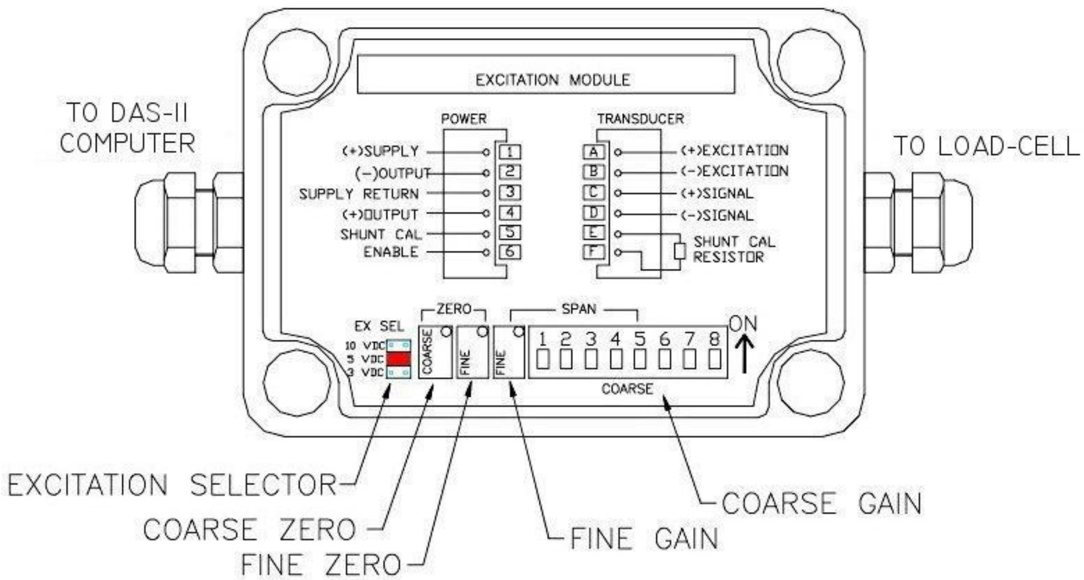


Figure 5-9. DAS II Computer Rear Panel

- Load Cell In-line Amplifier Load Cell Calibration:
    1. After the new load cell has been installed, power up the system, but don't arm the controls. The load cell will be receiving excitation voltage from the amplifier, but will not be experiencing a load of any kind. Thus, the output of the load cell amp should read zero volts output. This can be determined by looking at the DAS II maintenance pages for the analog inputs.
        - The particular analog input should read 32767.
    2. Refer to the label on the inside of the amplifier cover. Adjust the offset trim pots so that the output of the load cell amplifier reads zero volts.
        - Note: it will fluctuate, but just get it close.
    3. Arm the controls.
        - Allow them to go through calibration.
    4. This step requires two people. Using a force-gauge, have one person apply the appropriate force to the appropriate axis. Have the other person adjust the "fine" gain adjustment at the load cell amplifier until the output voltage of the amplifier, as read at the DAS II maintenance pages reads as shown in Table 5-9.

Table 5-9 ECLS In-line Amplifier Calibration

LOAD CELL	FORCE	+1 VDC	-1 VDC
Elevator	13 lbs.	36044	29490
Aileron	12.34 lbs.	36044	29490
Rudder	26.55 lbs	36044	29490
L-Toe brake	33 lbs.	36044	29490
R-Toe brake	33 lbs.	36044	29490

5.8.2. Servo Amplifier Calibration

See O&M paragraph 5.2.4.2 Electric Control Loading System (ECLS) Servo Amplifier Calibration.

5.8.3. Actuator Calibration

RESERVED.

5.9. Component Replacement

Some components must be configured properly before installation. Correct settings must be applied to both hardware and software. Some examples include:

- DIP switch settings.
- Shunt positioning.
- Firmware loading
- Configuration data file adjustment.

For example, the servo amplifiers require version B9 of the firmware and a configuration data file to be installed before they will work properly in the system.

This section covers the steps necessary before replacement components can be installed.

5.9.1. IP Reflective Memory Cards

When replacing defective IP reflective memory cards, verify that the DIP switches are set correctly for the new card. These cards are used in both the ECLS and DAS-II computers. These drawings are relevant:

- 6738ACJ305-501 Card Assembly IP Carrier
- 55963BT0002 IP Reflective Memory Customized

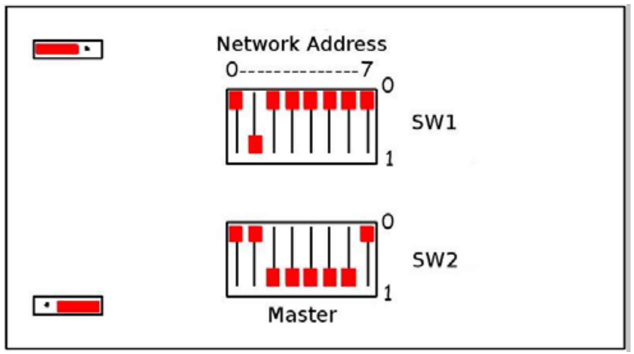


Figure 5-10: ECLS IP Refl. Mem. Settings

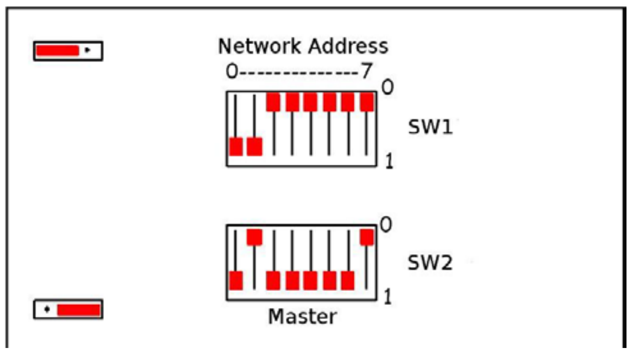


Figure 5-11: DAS IP Refl. Mem. Settings

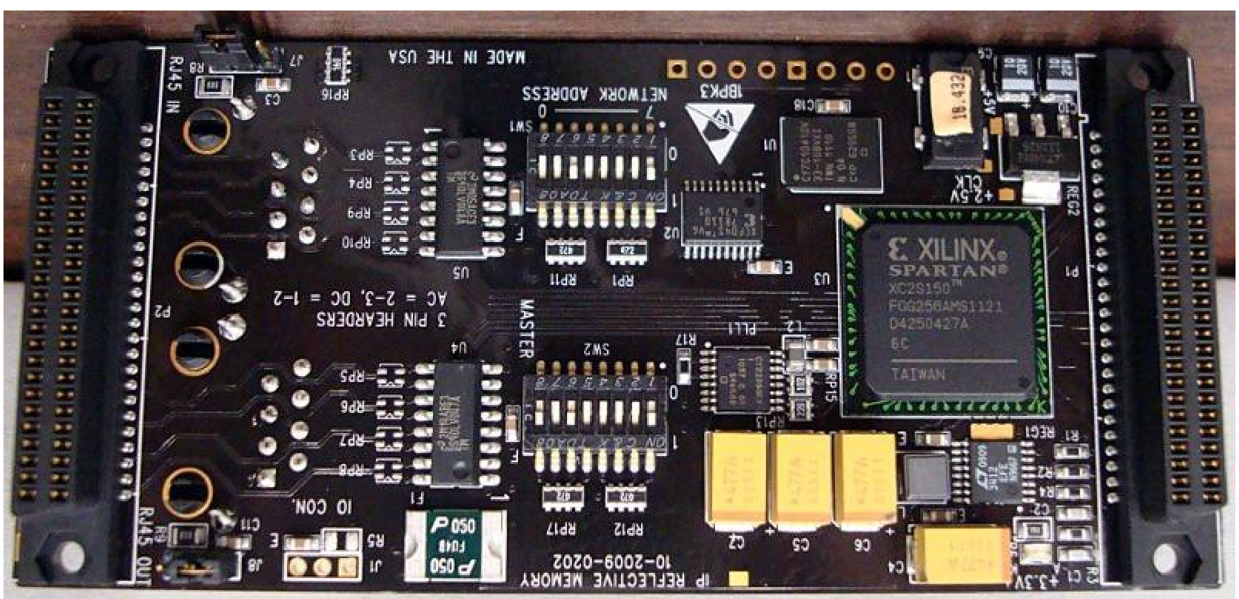


Figure 5-12: IP Reflective Memory Card Obverse

Figure 5-10 shows the correct switch and shunt settings for the ECLS computer; Figure 5-11 shows the correct settings for the DAS-II computer.

Figure 5-12 is a close-up picture of the IP Reflective Memory showing the DIP switches located in the center of the circuit card. Note that the orientation of the picture matches the figures showing the correct switch settings.

5.9.2. Load Cell In-line Amplifier Configuration

When replacing an in-line amplifier, you must adjust the internal DIP-switch settings and shunt positions as described here. Figure 5-13 shows the internal layout of the amplifier and identifies the DIP switches, potentiometers, shunt and terminal blocks.

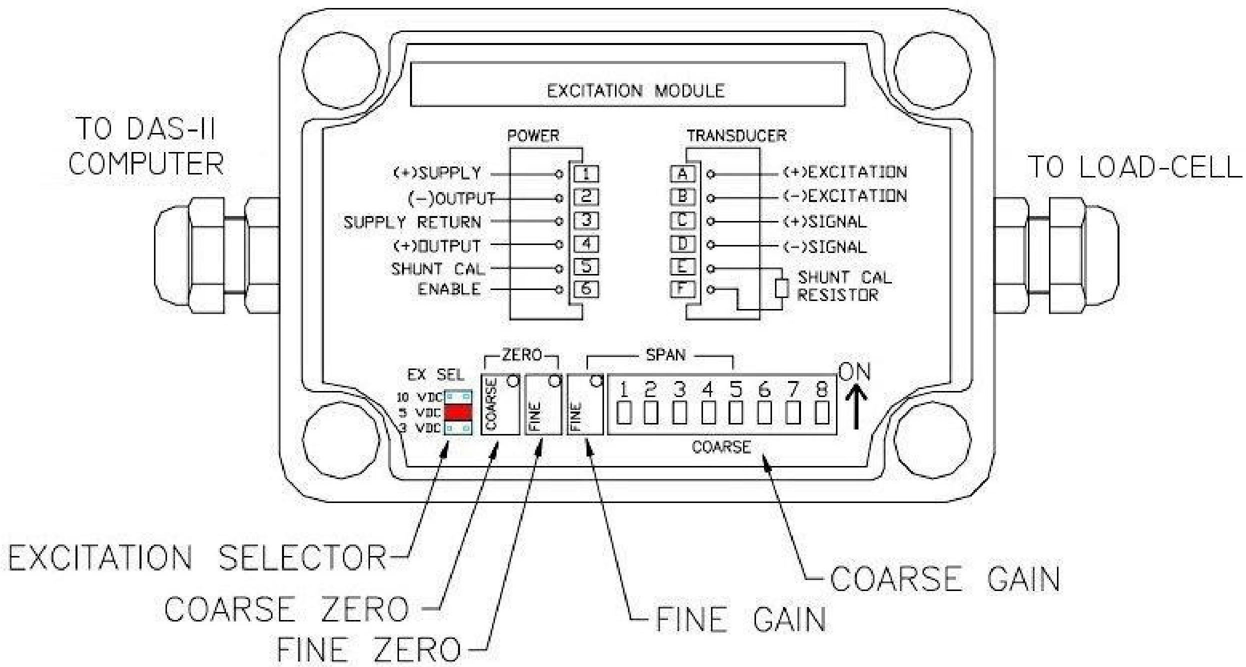


Figure 5-13: ECLS Load-cell In-line Amplifier Layout

- Reference the drawings listed here:
    1. 6738ACJ100E Load Cell Amplifier Panel Wiring Diagram
    2. 6738ACJ511 Digital Electric Control Loading, Logic, Seat Motion System Diagram.

This paragraph defines the initial setting of course gain for each amplifier, which will be refined by the calibration procedure described in paragraph 5.2.4.2 Electric Control Loading System (ECLS) Servo Amplifier Calibration of the O&M.

Figure 5-14 shows an interior view of the amplifier with the shunt block potentiometers and DIP switch highlighted by a red box.

Figure 5-14: In-line Amplifier Interior View

IMPORTANT: Be certain to select 5 VDC excitation of the load-cell by inserting a shunt across the middle pair of excitation selectors; see the red highlighted box in Figure 5-14 and the white shunt installed in the excitation selector block shown at the left end of the red box.

Set the DIP switches for each of the five control loading channels as shown in Figure 5-15, Figure 5-16, Figure 5-17, Figure 5-18, and Figure 5-19.

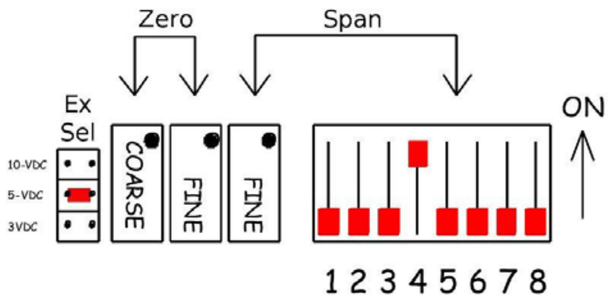


Figure 5-15: Elevator Amp (7A2A1) Configuration

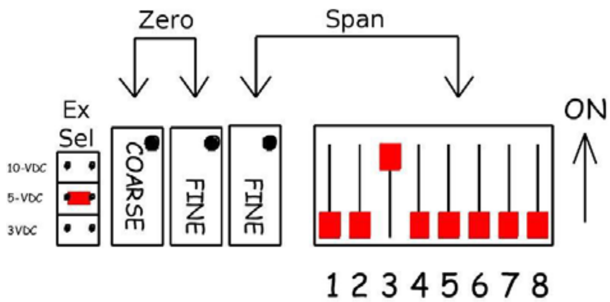


Figure 5-16: Aileron Amp (7A2A2) Configuration

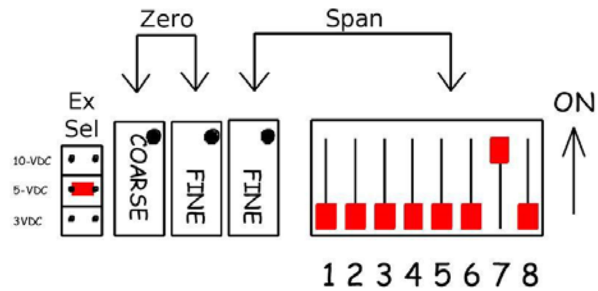


Figure 5-17: Rudder Amp (7A2A3) Configuration

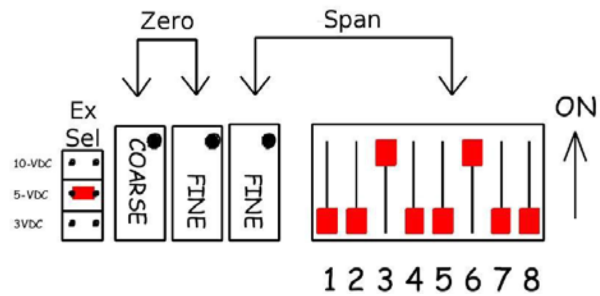


Figure 5-18: Left Toe-brake Amp (7A2A4) Configuration

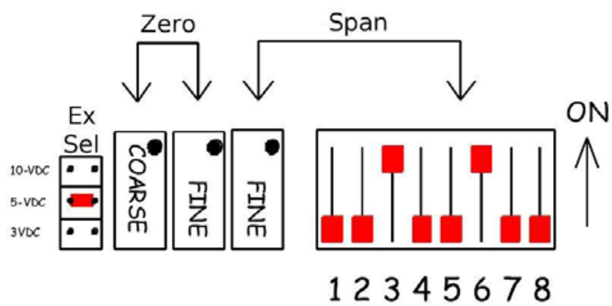


Figure 5-19: Right Toe-brake Amp (7A2A5) Configuration

5.9.3. IP 16 DAC Shunt Settings

Before replacing one of the IP 16-bit Digital to Analog Converter (16DAC) modules, you must adjust the shunts to match the arrangement shown in Figure 5-20.

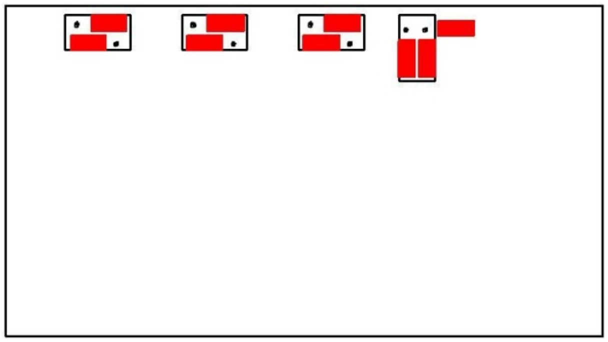


Figure 5-20: IP 16DAC Shunt Settings

5.9.4. Servo Amplifier Removal and Replacement

Enough differences exist between procedures for DAS and DAS II that these steps are presented here.

Required items to remove and replace a servo amplifier are:

- Serial Cable – 5416ABH803-501
- Emerson PowerTools Software
- A desktop or laptop computer with a serial port.

After replacing a servo amplifier, complete these two items before doing anything else.

1. Load revision B9 of the firmware into flash memory.
2. Load the amplifier configuration.

5.9.4.1. Servo Amplifier Removal

1. Turn off AC power to the DAS-II computer.
2. Unplug the servo amplifier power cord from the Digital Servo Remote Power Controller (9A2A5).
3. Tag, label, and disconnect these cables from the servo amplifier:
   a. J1-AC power
   b. J5-Command
   c. J7-Motor feedback
   d. J8-Motor power
4. Disconnect the tie-wraps holding the cables in place.
5. Remove the old server amplifier by removing the four mounting screws.
6. Removal of the servo amplifier is complete.

5.9.4.2. Servo Amplifier Replacement

1. Install the new servo amplifier and secure it to the mounting plate with the four mounting screws.

2. Reconnect these cables to the servo amplifier:
    a. J1-AC power
    b. J5-Command
    c. J7-Motor feedback
    d. J8-Motor power
3. Plug in the servo amplifier power cord to the Digital Servo Remote Power Controller (9A2A5).
4. Place new tie wraps as needed to stabilize the cables.
5. Install version B9 of the servo amplifier firmware as described in Section 7 of this document.
6. Install the servo amplifier configuration file as described in Section 7 of this document.

5.9.5. Actuator Removal and Installation

See paragraph 5.7.3.5.2 and related subparagraphs of the O&M.

5.9.6. Actuator Assembly

Actuator assembly is a procedure separate from removal and installation. New actuators are supplied without the anti-rotation mechanism, which must be added to new units. Assembly of the primary controls actuators differs from that required to assemble the toe-brake actuators. Refer to:

ACJ002-501 Primary Controls Installation

6520ACJ053-501 Actuator, Primary Controls

6520ACJ132-501 Actuator, Toe-brake

Once installed, new actuator assemblies must be charged with cooling oil. To add oil a new actuator, use the procedure described in paragraph 5.2.7.2, *Servo Actuator Oil* in the O&M.

1. With the actuator rod fully extended, install the anti-rotation clamp with the Allen-head gap centered on the flat portion of the rod.
    a. Use Locktite 609 on the inside surface of the collar.
    b. Use Loctite 242 on the Allen threads.
2. Install the anti-rotation tray with a 1/16-in. gap between it and the collar bearing.
3. Install a 7/16” x 20 thread-pitch jam-nut on the rod and tighten it against the anti-rotation clamp.
4. Install the load-cell adapter on the rod and tighten it against the jam-nut.
5. Install a ½” x 20 thread-pitch jam-nut on the adapter.
6. Install the load-cell on the adapter.

Screw it fully home then loosen it just enough to make it level with the anti- rotation tray.

7. Install a ½” x 20 thread-pitch jam-nut on the push-rod.
8. Screw the push-rod into the load cell.

   Screw it fully home then tighten the jam-nut.
9. Install a 3/8” x 24 thread-pitch left-hand-thread jam-nut on the rod-end.

   Thread the nut as far as it will go.
10. Screw the rod-end into the push-rod.

    Screw it fully home.
11. Tighten the jam-nut.
12. Assembly of the actuator is now complete.

SECTION 6. Diagrams

See Section 6 in the O&M.

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SECTION 7. Software Installation

In this section we describe the process of installing software, firmware, and data configuration files on these components of the Electric Control Loading Sub-system:

- Servo amplifier

  Firmware revision B9
  Configuration data file.

- ECLS Computer
- DAS-II Computer

This document is distributed on read-only disk media, containing everything necessary to maintain this document and to cold-start the computer sub-systems.

7.1. ECLS Servo Amplifier

Replacement servo amplifiers must be configured with the B9 version of the firmware and be loaded with the correct configuration data file. You will need these items to perform this work:

- Serial cable 5416ABH803-501
- Emerson PowerTools Software
- A laptop computer equipped with an RS232 serial port

7.1.1. Firmware Installation

This procedure assumes that the new servo amplifier is installed with power applied and that the laptop computer has the PowerTools software installed.

1. Connect the laptop to the servo amplifier using the serial cable.
   a. Connect one end of the cable to the laptop serial port.
   b. Connect the other end to SERIAL port J6 on the servo amplifier front panel.
2. On the laptop, start the Emerson PowerTools program.
3. Go to the TOOLS menu and select UPDATE or PROGRAM FLASH. See Figure 7-1.

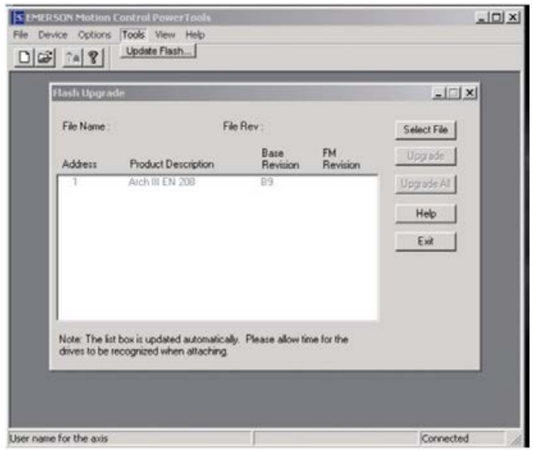

Figure 7-1: ECLS Servo Amp Update Flash

4. Click the SELECT FILE button. See Figure 7-2.
    a. Find the flash input file EN_B9.FSH.
    b. A copy of this firmware is included in the SERVO- AMPLIFIER-SOFTWARE folder on the read-only disk media associated with this document.

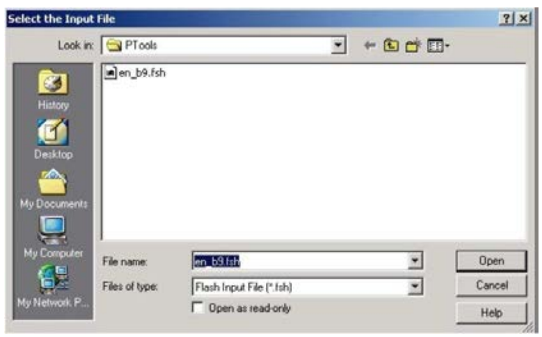

Figure 7-2: ECLS Servo Amp Firmware Select

5. Select the file and then click OPEN. See Figure 7-3.

    A Flash Upgrade window displays with the firmware revision file, FM REVISION displayed adjacent to the BASE REVISION.

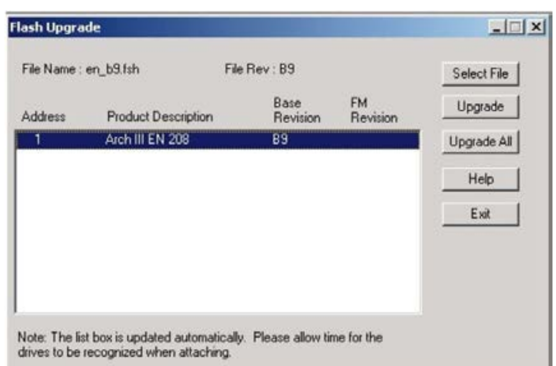

Figure 7-3: ECLS Servo Amp Flash Upgrade

6. Highlight the file.

7. Click the Upgrade button. (This updates amplifier firmware.)
8. An UPDATING DEVICE pop-up window will appear showing progress of the update. See Figure 7-4.

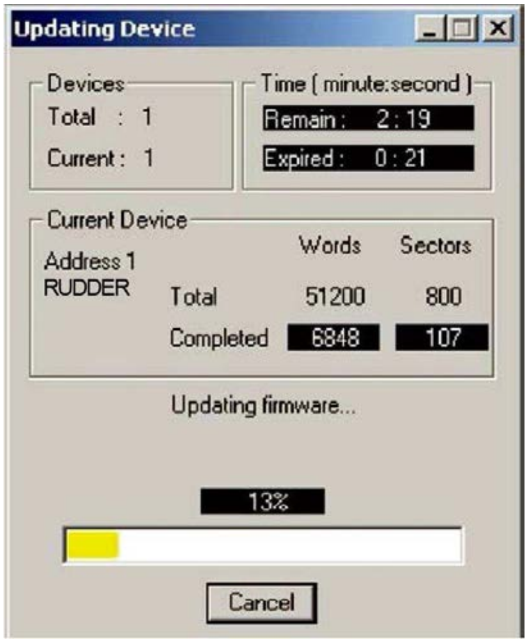

Figure 7-4: ECLS Servo Amp Updating Device

9. When the update is complete, Emerson PowerTools will prompt you to turn off the servo amplifier for several seconds. Follow all prompts.
10. Disconnect the serial cable from the servo amplifier.

Servo amplifier firmware installation is complete.

7.1.2. Configuration Data File Installation

This procedure assumes that the new servo amplifier is installed with power applied and that the laptop computer has the PowerTools software installed.

1. Connect the laptop to the servo amplifier using the serial cable.

   a.Connect one end of the cable to the laptop serial port.

   b.Connect the other end to SERIAL port J6 on the servo amplifier front panel.
2. On the laptop, start the Emerson PowerTools program.
3. Go to the FILE menu and select OPEN.
4. Browse to the folder on the laptop computer where the configuration data file is located for the channel you are working on. See Figure 7-5.

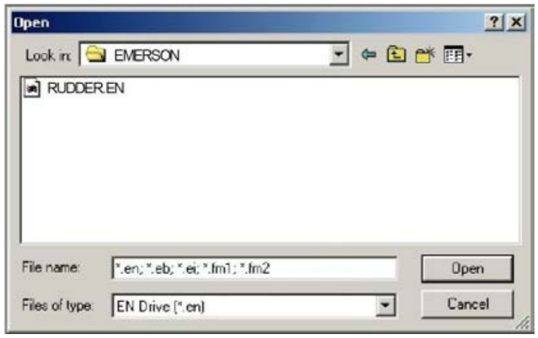

Figure 7-5: ECLS Servo Amp Configuration

a. Configuration data files are delivered on the read-only disk media containing this document and its supporting files, located in the folder labeled: Servo-Amplifier-Software.

b. Each control loading channel has a unique configuration data file:

   i. AILERON.EN

   ii. ELEVATOR.EN

   iii. RUDDER.EN

   iv. LEFTBRAKE.EN

   v. RIGHTBRAKE.EN

5. Select the appropriate configuration data file.
6. Click OPEN to display the DETAILED SETUP tab. See Figure 7-6.

   If not initially displayed, select the DETAILED SETUP tab.

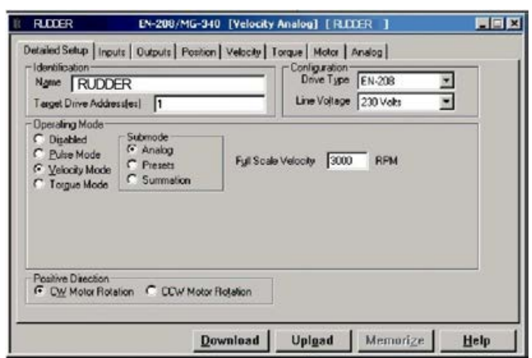

Figure 7-6: ECLS Servo Amp Detailed Setup

7. On the DETAILED SETUP tab, select the Download button.
8. Select YES when asked to reboot.
9. Once reboot is complete, select DISCONNECT on the DETAILED SETUP tab.
10. When prompted to save changes, select NO.
11. Close the setup file.

Installation of the servo amplifier configuration file is complete.

7.2. ECLS Computer Software Installation

In this section we describe the procedures needed to install the ECLS computer software, assuming that you have new hardware that has never before been configured as an ECLS computer.

7.2.1. Required Materials

- JPATS FTD ECLS Cold Start Disk 1 of 2.
- JPATS FTD ECLS Cold Start Disk 2 of 2.

7.2.2. BIOS Settings

1. Turn on the computer.
2. Press the DELETE key to enter S*etup*.
3. Highlight Standard CMOS Setup.
4. Press the ENTER key.
5. Set the date and time.
6. Press the ESCAPE key to return to *Setup*.
7. Highlight Advanced CMOS Setup.
8. Press Enter.
9. With *Quick Boot* highlighted as DISABLE, press either the PAGE-UP or PAGE-DOWN key to ENABLE.
10. Press the down-arrow key to highlight *1st Boot Devic*e, press either the PAGE-UP or the PAGE-DOWN key to show *Floppy Drive* choice.
11. Press the down-arrow key to highlight *2nd Boot Devic*e, press either the PAGE-UP or PAGE-DOWN key to show *1st* I*DE* H*D*D.
12. Highlight 3r*d Boot Device*. Select DISABLED.
13. Ensure S.M.A.R.T. for hard disks is disabled.
14. Press Escape key to return to *Setup*.
15. Press the F10 key to *Save*.
16. At the "*Save and* Ex*i*t" prompt, type Y, and press the ENTER Key.

The ECLS BIOS is configured.

7.2.3. ECLS Computer Software Installation

1. Boot Windows 98 in DOS mode using the disk labeled "*JPATS FTD* ECL*S Cold* S*tart Disk 1 of 2*."

   At the **A:\>** prompt type *fd*is*k*, and press the ENTER Key.
2. At each prompt that appears, type the letter or number as follows, and press the ENTER key; wait as needed when "*Verifying drive in*t*egrit*y" appears:

a. N (ENTER) Do not enable large disk support.

b. 1 (ENTER) Create DOS partition.

c. 1 (ENTER) Create Primary DOS partition.

d. Y (ENTER) Use maximum size and activate partition.

3. Press the ESCAPE key.
4. Switch off power to the computer for a few moments and then switch it on again.
5. Upon restart, at the **A**:**\>** prompt type *format c:* and press the ENTER key.

   a. When prompted proceed with format Y/N, answer Y, and press the ENTER key.

   b. Wait for formatting to complete.

   c. At Volume label, press the ENTER key; i.e., no volume label specified.

6. To lock the hard drive, at the **A**:**\>** prompt, type *lock c:* and press the ENTER key.

   Answer Y at the prompt.

7. To run the *mkboot* batch file, at the A:\>prompt type *mkboot c: bootram.sys* and press the Enter key.

   Answer Y at the prompt.

8. Remove the Windows 98 boot diskette.
9. Insert the disk labeled “*JPATS* F*TD ECLS* C*old Start Disk 2 of* 2.”
10. At the **A:** prompt, type “*load (simulator serial* n*umbe*r)” and press the ENTER key, e.g., *load*<space>*104*<ENTER>.

The ECLS software is installed.

7.3. DAS II Computer Software Installation

This section describes the procedures needed to install the DAS-II computer software, assuming that the computer has never been configured for DAS II.

7.3.1. Required Materials

- DAS-II computer configured per drawing 6738ACJ300-501.
    - Monitor, keyboard, and mouse.
- Windows XP Professional Installation CD
- RTX 8.1 Installation CD
- DAS II Installation CD

7.3.2. BIOS Settings

1. Apply power to the computer and press the DELETE key immediately to access the BIOS Setup pages.
2. Select "*Auto Configuration* with *Optimal Settings*" and press the ENTER key.

   Answer "Y" and press ENTER.
3. Select "*Advanced CMOS Setup*" and press ENTER. Configure the following parameters:
   a. Quick Boot: Enabled
   b. 1st Boot Device: ATAPI CDROM
   c. 2nd Boot Device: Floppy
   d. 3rd Boot Device: 1st IDE-HDD
   e. S.M.A.R.T. For Hard Disks: Enabled
4. Press the ESC key to return to the previous page.
5. Select PCI/Plug and Play Setup and press the Enter key. Configure as:

   Plug and Play Aware O/S? Yes.
6. Press the ESC key to return to the previous page.
7. Select *Save Settings and Exit* and press the ENTER key.

   Answer "Y" and press ENTER.

The BIOS is configured.

7.3.3. Windows XP Professional Installation

1. Insert the *Windows XP Professional* CD into the CDROM disk drive
2. Remove and restore power to the computer.

   Wait for the Windows start screen to appear.

3. Press the ENTER key to set up Windows XP Professional.
4. Press the F8 key to accept the license agreement.
5. Press *C* to create a partition.

   Enter a partition size equal to one half the total disk size and press the ENTER key,e.g., if the total disk size is 76309, make each partition equal to 38154 then press the ENTER key.
6. Select the remaining un-partitioned space and press *C*.
7. Enter the same partition size as earlier and press the ENTER key.
8. Select the *C* partition and press ENTER to setup Windows XP on this partition.
9. Press ENTER to format the partition using the NTFS file system.
10. Accept defaults (English… and US keyboard layout) for *Regional & Language Options* and click NEXT.
11. Name: *JPATS*, Organization: *FlightSafety International*.
12. Enter the product key.
13. Computer name: *OFT-XXXX-DAS*, where *XXXX* = job number.
14. Leave the Administrator password blank.
15. Select Central Time Zone and check the daylight savings time box.
16. Use *Typical Settings*. Click NEXT.
17. Do not add to a Domain at this time. Click NEXT.
18. The computer will automatically reboot.
19. Windows may try to automatically adjust screen size and resolution.
    a. If so, click OK and then click YES.
    b. Then click NEXT to continue.
20. Turn off automatic updates by answering "*not right now*" and click NEXT.
21. Skip over the Internet connection step by clicking SKIP.
22. Answer *NO* to "*Ready to activate Windows*?" question.

    Select, "*Remind me every few days*" and click NEXT.
23. In the "*your name*" box, enter "*das*" and click NEXT. Then click FINISH.
24. Remove the Windows XP Professional installation disk from the CDROM disk drive.

Windows XP Professional is installed.

7.3.4. Activate Windows XP Professional

1. Log-on as user "*das*" (if not automatically logged-on after the reboot).

2. In the taskbar, click the icon representing two keys. This will start the *Activate Windows* application.
3. Select the "*Yes, I want to telephone customer service to activate Windows*" radio button then click NEXT.
4. Select "*United States*" as your location from the list.
5. Telephone the toll-free number listed (888-571-2048) and follow the instructions.
6. Click FINISH.

Windows XP Professional is activated.

7.3.5. Disable Windows Firewall and Turn Off Alerting

1. In the taskbar there will be a little red shield with a white cross on it. Click this icon to open the Windows Security Center.
2. Click "Change the way Security Center alerts me".
3. Uncheck the Firewall box.
4. Uncheck the Automatic Updates box.
5. Uncheck the Virus Protection box.
6. Click OK.
7. At the bottom of the Windows Security Center window click "Windows Firewall".
8. Select "off" to turn off the Firewall and click OK.
9. Close the Security Center window.

Windows firewall and alerting is disabled.

7.3.6. Display and Power Scheme Settings

1. Right-click on the desktop and click on PROPERTIES.
2. Click the *Settings* Tab.
3. Select a screen resolution of 1024 by 768 pixels and a color quality of "medium (16 bit)".
4. Click APPLY.

   Click YES to keep current settings.
5. Click the *Screen Saver* tab.

   Select the *Power Button*.
6. Under "*Power Schemes*" select "*Always On*".
7. Under "*Turn off monitor*" select "*Never*" and click OK.
8. Select screen saver NONE.
9. Click the APPLY button and then click OK.

The display and power scheme is configured.

7.3.7. Windows Explorer Settings

1. Right click the START button and click *Explor*e.
2. Select the "*Local Disk (*C:)".

   Click "show contents of this folder".
3. Click "*Vie*w", "*Details*"
4. Click "*Tool*s", "*Folder* Opt*ions*"
5. Click "*Vie*w" tab.
6. Check "Show hidden files and folders" box.
7. Uncheck "Hide extensions for known file types" box.
8. Uncheck "*Hide protected operating system* files" box. Click YES.
9. Uncheck "Remember each folders view settings" box.
10. Click the "A*pply to A*ll *Folder*s" button. Click YES to set all folders to match the current folder.
11. In Folder Options, click the *Apply* button.
12. In Folder Options, click OK.
13. Close Windows Explorer.

Windows Explorer is configured.

7.3.8. RTX 8.1 Installation

1. Insert the RTX 8.1 installation CD in the CDROM drive.
2. Installation program should start automatically.
3. Select "Install RTX".
4. In the "Welcome to the Installation Wizard for RTX 8.1" window, click NEXT.
5. Select the "accept the terms in the license agreement" radio button, and click NEXT.
6. On the next page, enter the following:
   a. Username: JPATS
   b. Organization: FlightSafety International
   c. Email address: enter your valid business email address.

      Intervalzero will send the RTX software key here.
   d. PAC Key: A valid PAC number, such as 5403-PAC-100-192, obtained from IntervalZero. Click NEXT.
7. Answer NO to the question, "*does* th*is co*m*puter have access to* t*he In*t*ernet*?"

8. Follow the Manual Registration instructions.
   a. Go to a computer with Internet access and visit the following website:

      https://support.ardence.com/license/licenseform.asp

   b. Record the PAC number and Machine ID. Have these handy when you access this website. Follow the instructions on this webpage to obtain the license key. It will be something like, RTX-991-450. Write it down for the next step.
9. Back at the DAS II computer, type the license key obtained in the previous step and click NEXT.
10. Accept the default destination folder and click NEXT.
11. Accept the default features and click NEXT.
12. Click INSTALL and then click FINISH.
13. Answer *YES* to reboot and remove the RTX CD from the CDROM disk drive.

RTX is installed and active.

7.3.9. Apache Web Server Installation

1. Insert the DAS II software CD.
2. Click the START button and select RUN.
3. Click BROWSE and navigate to the *D*:*\DAS\Apache* folder.
4. For "*files of type*" select "*All Files*".
5. Double-click the file "h*ttpd-2.2.16*-w*in32-x8*6-*OpenSS*l-*0.9.8*0.*msi*". Click OK.
6. Once the *Apache* I*nstallation* W*izard* starts, click NEXT to continue.
7. Select the "a*ccept terms in the license agreemen*t" radio button and click NEXT.
8. Click NEXT to begin the install.
9. Enter the following information:
   a. Network Domain: *ssd.*f*si.com*
   b. Server Name: *127.0.0.1*
   c. Administrator's Email Address: *webmaster@ssd.fsi.com*
10. Select the "*for all user's, on Port 80, as a servic*e…" radio button and click NEXT.
11. Select "*typical instal*l" and click NEXT.
12. Accept the default destination folder and click NEXT.
13. Click INSTALL and then click FINISH.

The Apache web-server is installed.

7.3.10. Adobe SVG Viewer Installation

1. Click the START button and select RUN.

2. Click the BROWSE button and navigate to "*D*:*DAS\Adobe SVG* V*iewer*" folder.
3. Double-click the *SV*G*View.exe* file. Click OK.
4. The program will install SVGViewer and then close automatically when completed. Adobe SVG viewer is installed.

7.3.11. DAS II Files Install

1. Right click on START and select EXPLORE.
2. Navigate to the "*D:\DAS**DAS I*I" folder.
3. Copy the *DasPlat.rtss* file to root directory **C:**.
4. Copy the files *jdc*.*exe* and *DasPlot.exe* to the directory: C:\Program Files\Apache Software Foundation\Apache2.2\cgi-bin

5.Copy the file *httpd.co*n*f* to the directory:

   a. c:\Program Files\Apache Software Foundation\Apache2.2\conf
   b. Answer YES to confirm file replacement.

6. Copy the folder *FlightS*a*fety* (and all its contents) to the directory *C:\Program Files*
7. Close Windows Explorer. DAS-II files are installed.

7.3.12. Final Configuration

1. Click the START button and select *All* P*rogram*s-*>Ardenc*e-*>RT*X.
2. Start the *R*T*X Properties* application.
3. Select the SYSTEM TAB:

   Check "Automatic (at boot time)".
4. Select the MEMORY TAB and then set the following parameters:
   a. Local Memory Pool, Pool size (bytes): 18000000
   b. Mapped Memory, Upper Bound (bytes): 67108864
5. Select the HARDWARE TAB.
6. Under the "*Configure* P*lug and Play device to support RT*X" click the SETTINGS button.
7. Click the DEVICE MANAGER button to open the *Windows* D*evice Mana*ge*r*.
8. Right click on the "*Oth*e*r PCI Bridge Devic*e" and select UNINSTALL.

   Click OK.
9. Right click the remaining "*Other PCI Bridge D*e*vic*e" and select UNINSTALL.

   Click OK.
10. Click the ACTION button on the *Device Mana*g*er* toolbar.
11. Select "scan for hardware changes".

The Found New Hardware Wizard will open.

12. Select "*No, not this time*" and click NEXT.
13. Select "*Install from a list or specific location*" and click NEXT.
14. Select "Don't search. I will choose the driver to install" and click NEXT.
15. Select "*RTX drivers*" from the list and click NEXT.
16. Select the first "RTX Device" and click NEXT.

    Answer YES.
17. Click FINISH.
18. Repeat steps 14 through 19 for the other device.
    a. This time when at step 18 select the second "*RTX Device*" and click NEXT.
    b. Answer YES.
    c. Click FINISH.
19. Disable the LPT1 device driver.
20. Close the D*evice Manager*.
21. In the PnP Device Settings window, right click on "*Other PCI Bridge Device*" and select "*Add RTX INF support*".
22. Right click "Other PCI Bridge Device #2" and select "Add RTX INF support".
23. At the *PnP* D*evice Settings* window click APPLY

    Click OK.
24. Click OK to close the *RTX Properties* window.
25. Open a command prompt window.
    a. Click START
    b. Select menu All Programs->Accessories->Command Prompt.
26. Register the *DasPlat.rtss* program to run at boot time from the command prompt window:

    RTSSrun /b C:\DasPlat.rtss [ENTER]
27. Click OK and close the command prompt window.
28. Click the START button and select *All* P*rogram*s.
29. Right click on the Internet Explorer icon and drag and drop it onto the desktop.
30. Click "*copy here*".
31. Right click on the desktop and select *Arrange Icons->Auto Arrange*.
32. Double-click the Internet Explorer shortcut on the desktop.
33. Select "*Run the new connection wizar*d" and click OK.
34. The wizard will start, but click CANCEL.

35. Double-click the Internet Explorer shortcut on the desktop once more.
36. This time, Internet Explorer will start.

    Type in the address block:*http://localhost/* [ENTER]
37. Then select Tools->Internet Options.
38. Click the GENERAL tab.
39. Under the HOME PAGE, click the "use current" button

    Then click OK to close the Internet Options window.
40. Close Internet Explorer.

Final configuration is complete.

7.3.13. System Test

1. Remove any CDs from the CDROM drive.
2. Reboot the computer.
3. Verify that the "*das*" user is logged in automatically.
4. Verify that the RTX server starts automatically and that the data shown in Figure 7-7 is displayed:
5. Note that the addresses given for each device may not match those listed in Figure 7-7.
6. Open Internet Explorer.
7. Verify user interface is displayed correctly.
8. Disable the network port. System test is complete.

```
Shared Map Init Function Start
Shared Map Init Function Done

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Platform Number 1   [defaulted to 1 since it was not.]
Findhardware found PCI60 on bus 3 at address Oxf2ceb000
Findhardware found PCI60 on bus 4 at address OxeecebOOO IP
Quadrature detected in slot 0 @ Oxf2cec100
IP Quadrature detected in slot 1 @ Oxf2ced100
IP-16DAC detected in slot 2 @ Oxf2cee100
IP-16DAC detected in slot 3 @ Oxf2cef100
IP-AD16SS detected in slot 4 @ Oxf2cf0100
Slot 5 is empty
Slot 6 is empty
Slot 7 is empty
Slot 8 is empty
IP-Unidig-HV-16I80 detected in slot 9 @ Oxeecef100
IP-GSNET detected in slot 10 @ Oxeecf0100
Slot 11 is empty

Registering module UTHSITD at 2000
Registering module C1HSITD at 2000
Registering module UTLSYS at 50
Registering module CL1SYS at 50
Registering module SHAREMPG at 10
Registering module MAINTUPD STAT at 10
Registering module MAINTUPD MAINT at 10
Registering module MAINTUPD COMM at 10
Registering module SHAREMP at 10
Initiating runtime..
Scheduler frequency is 2000 Hz
```

Figure 7-7. ECLS DAS II RTX Server Start Messages

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