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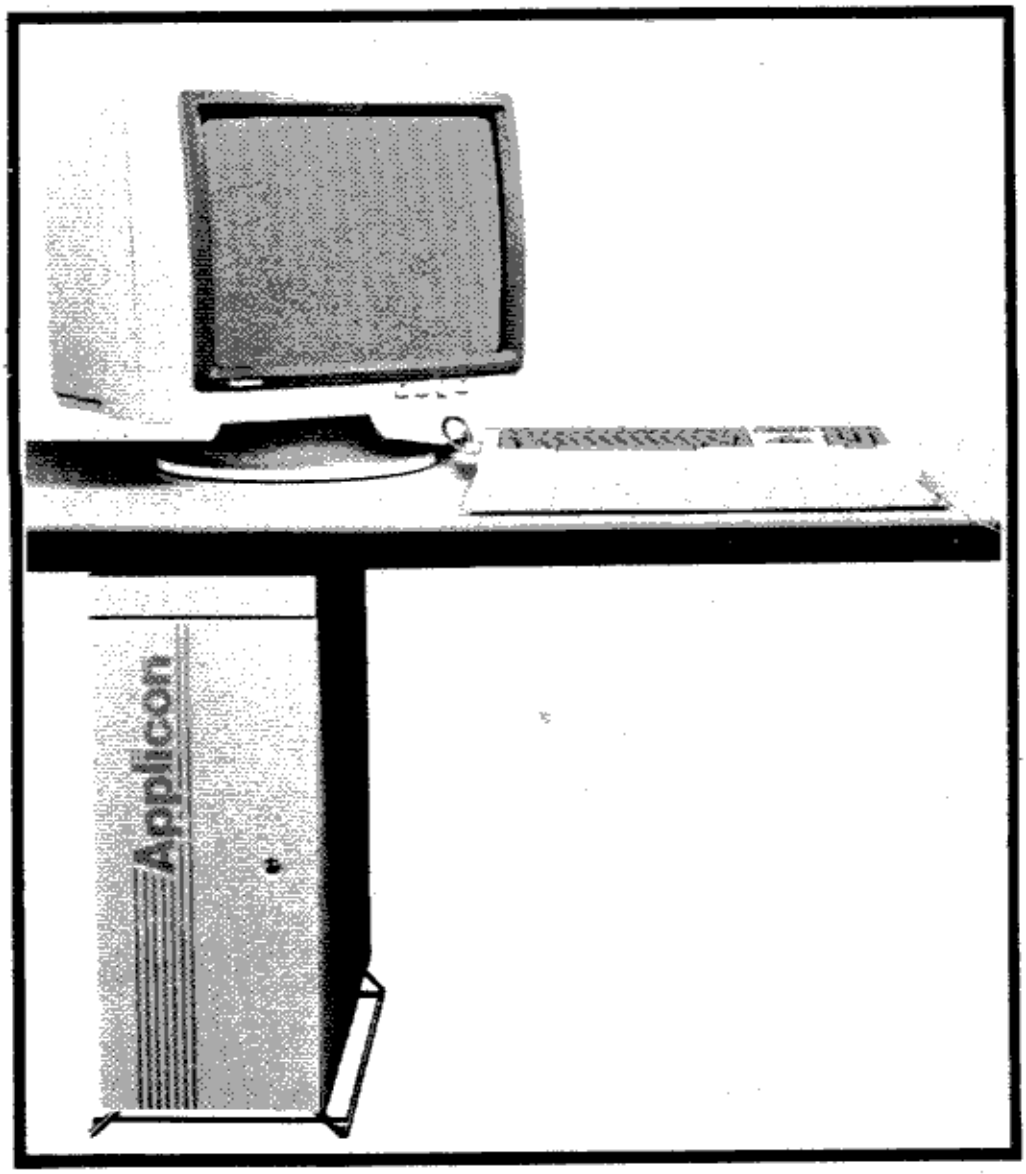

MODEL 4635A/4670 OPERATION AND MAINTENANCE MANUAL

DOCUMENT NO. A-29058-001

APPLICON

Schlumberger

MODEL 4635A/4670

GRAPHICS WORKSTATION

OPERATION AND MAINTENANCE MANUAL

SEPTEMBER 1986

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CHAPTER 1
INTRODUCTION

1.1 PURPOSE OF THIS MANUAL

This manual contains the information necessary to operate and maintain the 4635A and 4670 Graphics Workstations. It describes the operation of the workstations and provides procedures and technical descriptions to assist those who must adjust, troubleshoot and repair the workstations.

The manual contains:

Chapter 1 Introduction
A general description of this manual and of the workstations, their specifications and options.

Chapter 2 System Operation
Describes the setting up of the workstations and basic functions of their components.

Chapter 3 System Interconnection
Describes the connecting cables and signal paths among the functional components.

Chapter 4 Module Theory
Describes the block-level functioning of the components of both workstations.

Chapter 5 Removal and Replacement
Describes the procedures for removing and replacing field replaceable units.

Chapter 6 Maintenance and Adjustments
Describes the adjustments that can be made in the field and the preventive maintenance procedures for the workstations.

Chapter 7 Diagnostics and Troubleshooting
A concise description of diagnostic software for the workstations and a procedure for isolating workstation faults.

Appendix A Parts List
A part number listing for all field replaceable units.

Appendix B Circuit Board Jumpers
Locations and configurations of jumpers to convert the 4635A to Model 4670.

Appendix C Model Upgrade Overview
Specifications and procedure for upgrading the 4635A to Model 4670.

1.2 WORKSTATION DESCRIPTION

The 4635A and 4670 Graphics Workstations consist of a floor-mounted Processing Unit and a desktop color Monitor, Keyboard and Tablet.

- The 4635A emulates the Model 4635 Graphics Workstation
- The 4670 provides display list processing with high-resolution display

The Processing Unit features card cage construction with plug-in circuit boards:

Display List Processor
Graphic Processor
Frame Buffer Controller
Frame Buffer memory (1 in 4635A, 2 in 4670)
Transformation Processor (4670 only)

These circuit boards contain the CPU, random access memory, and control circuitry for translating imaging instructions from a host computer to the signals required by the RBG color monitor, and for communicating keyboard and tablet signals back to the host. The circuit boards also

contain software, in read-only memory, for checking the basic operational components of the workstation. This software executes automatically on power-up and whenever the operator presses the reset button. Three separate d.c power supplies furnish logic and communication voltages to all boards.

The 19-inch RGB Monitor has a resolution of:

4635A: 1280 pixels horizontally by 1024 pixels vertically.

4670 : 1536 pixels horizontally by 1197 pixels vertically.

The monitor, too, is of card-cage construction, allowing quick substitution of faulty modules in the field. (A separate Service Manual is supplied for the Monitronix MX-200 Monitor.)

The keyboard-tablet assembly, used to enter data into the system, consists of a standard 96-character ASCII keyboard for general input, a numeric data keypad with extra spacebar, a four-key pad for alternate cursor control, a function keypad with 16 software-definable keys and four special function keys (Done, Help, Quit, Backup). The 11 by 17-inch tablet and pen provide an alternate way to enter data into the system.

The workstation can communicate with a host computer up to 2000 feet away through a Serial Interface Link (SIL). (If multiple workstations are connected in series, the first must be within 1000 feet of the host computer, and the last no more than 2000 feet from the host or an active repeater.) An auxiliary RS232 port is used for secondary communications with the workstation in VT100 emulator mode.

1.3 WORKSTATION OPTIONS

1. A smaller Tablet, 6 by 17 inches, is available that simply plugs into the Keyboard in place of the standard tablet.

2. An additional 4 megabytes of memory can be (factory) installed in the Display List Processor board (DLP2), to give a total of 8 megabytes.

3. A second Frame Buffer memory board can be installed in the 4670.

4. A solids modeling engine can be installed in the 4670 (by replacing Transformation Processor board).

5. A 34 by 44-inch free-standing digitizing tablet (Tabletizer™) can be used with or in place of the standard tablet.

6. Mouse

7. Hard Copy Unit

8. Ethernet

1.4 WORKSTATION SPECIFICATIONS

TABLE 1-1 WORKSTATION SPECIFICATIONS

Models 4635A and 4670 Applicon Display List Terminals		
Mechanical	**Monitor**	**Processing Unit**
Height	19.5 in. 749 mm	26.0 in. 660 mm
Width	19.5 in. 495 mm	10.0 in. 254 mm
Depth	17.0 in. 432 mm	23.5 in. 597 mm
Weight	70 lbs. 31.75 kg	108 lbs. 48.9 kg
Cable Lengths		
Power	16 ft. 5 m	
Proc.Unit to Monitor	12 ft. 3.7 m	
SIL cables (increments)	50 ft. 15.2 m	
Electrical	**USA, Canada**	**Foreign**
Service	120Vac 60Hz 15A 1ph	220-240Vac 50Hz 13A 1ph
Receptacle	NEMA Std.5-15R	Any applicable
Steady State Parameters		
Nom.Voltage	115Vac+/-10%	230Vac+/-30%
RMS Current	8.0A	4.0A
Power	920W	805W
Transient Parameters		
Inrush Current	(zero crossing switch)	
Surge Current	15A	7.5A
Surge Duration	50ms	50ms
Environmental	**Operating**	**Storage**
Temperature	59-80°F 15-27°C	-40° +159°F -40 +70°C
Humidity	20-85%	5-95%
Altitude	6400 ft. 2.3 km	15.000 ft. 4.9 km
Heat dissipation	792 Kcal/hr	

CHAPTER 2
WORKSTATION OPERATION

2.1 INTRODUCTION

This chapter describes the operator controls and power-up procedures, as well as the locations and descriptions of all switches and indicators.

For more information about workstation setup, see the section on the 4635A in the Series 4000 Systems Installation Manual, Update A-29054-001. For details of the diagnostic software for the 4635A, see Vax-Based Systems Diagnostics Handbook, Update A-29059-001.

2.2 WORKSTATION SETUP

2.2.1 General

The Applicon Model 4635A Graphics Workstation consists of two major components: a Monitor Unit (with keyboard and digitizing tablet) and a Processing Unit. See Chapter 3, System Interconnections, for cable connections between the components and between the workstation and host computer.

NOTE

The processing unit requires space for adequate ventilation. Internal fans draw air into the unit at the bottom and exhaust it through slots along both sides at the top. Do not obstruct these openings (ambient temperature entering the unit must not exceed 90 deg.F).

2.2.2 Setting Terminal ID Switches

The workstation must be identified to the host computer by means of a switch-settable ID code.

Before turning on the power to the workstation, check the switch settings on the Display List Processor board inside the Processing Unit (see Figure 2-1). It is not necessary to remove the board in order to set these switches.

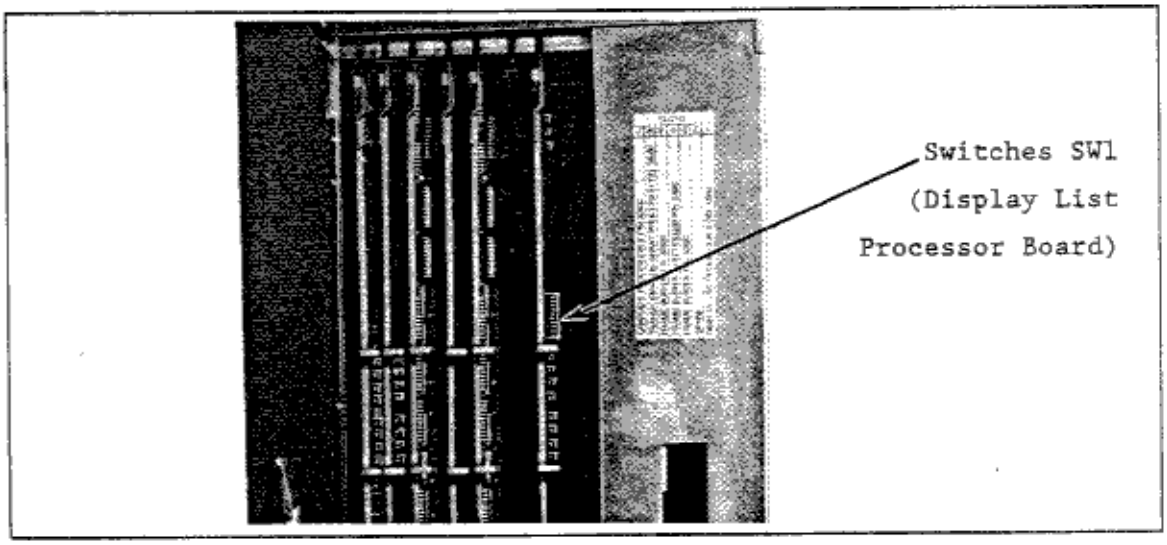

FIGURE 2-1 PCB SWITCH LOCATIONS

The Display List Processor board (DLP2) is in the right-most slot. Switch bank SW1 is near the edge of the board, just above the center bank of LED indicators. The Terminal ID switches SW1-4 through SW1-8 present a binary number from 0 to 1F (hexadecimal), with SW1-4 being the least significant digit, as shown in Figure 2-2. Set these switches to identify the workstation to the host computer. The "ON" position is toward the PCB.

NOTE

Do not use 00 as the Terminal ID number. This number is reserved for the host computer.

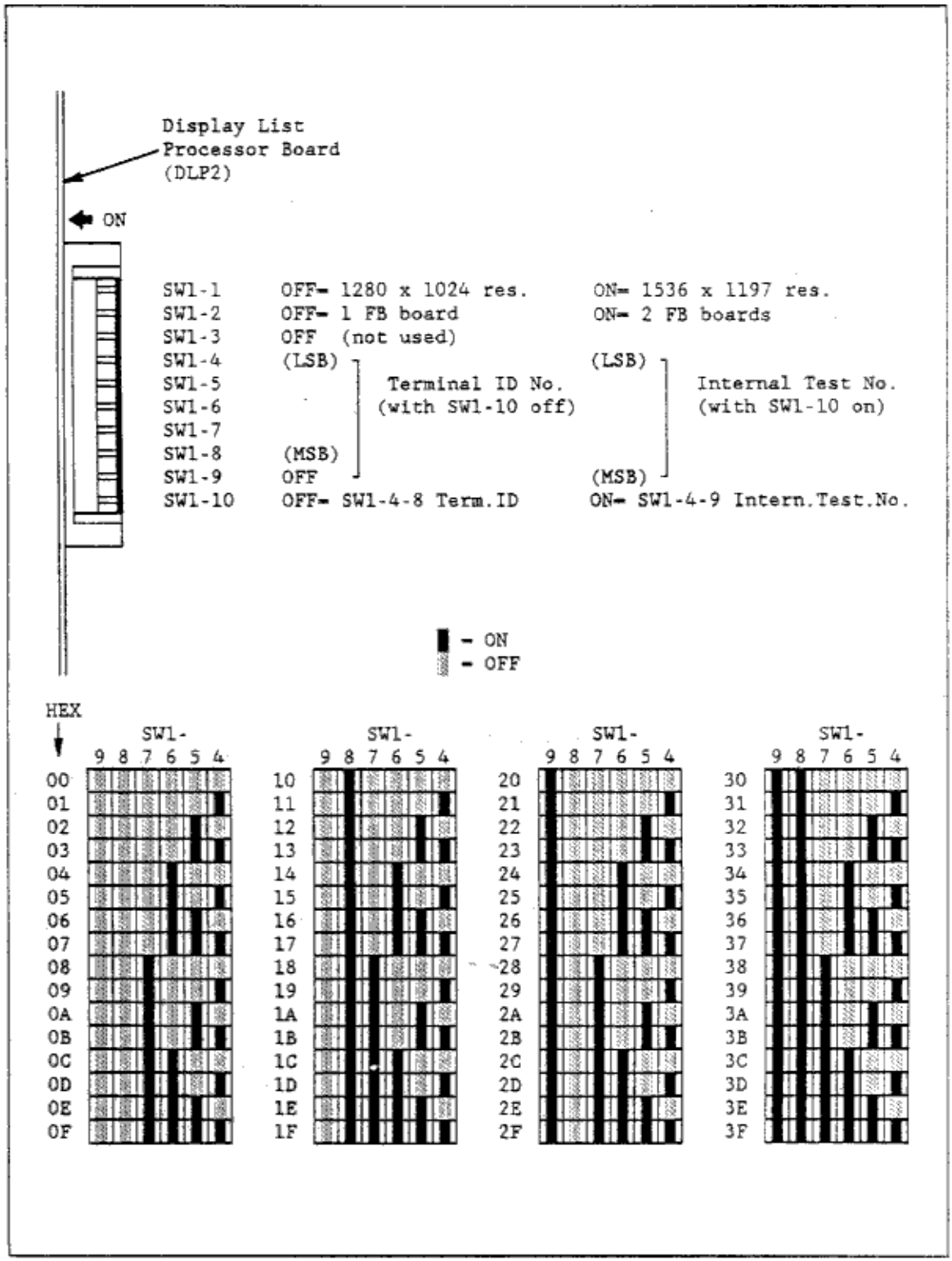

FIGURE 2-2 DLP2 SWITCH SETTINGS

2.3 OPERATOR CONTROLS

Most of the operator controls for the 4635A Graphics Workstation are on the keyboard, the digitizing tablet and the front of the Monitor. The operator should be familiar with these as well as several others, as described below:

2.3.1 Processing Unit Controls

The Processing Unit contains the **main circuit breaker**, at the bottom rear (see Figure 2-3). This switch must be on (up) before any other controls can be used.

Inside the rear door of the Processing Unit, the **power maintenance switch** overrides the voltage detect circuits to power the unit for maintenance functions only. This switch must be held down to operate.

Also inside the rear door is the **On-Line toggle switch**, that connects the workstation to the host computer (see Figure 2-3). This switch must be UP in order to communicate through the SIL cables.

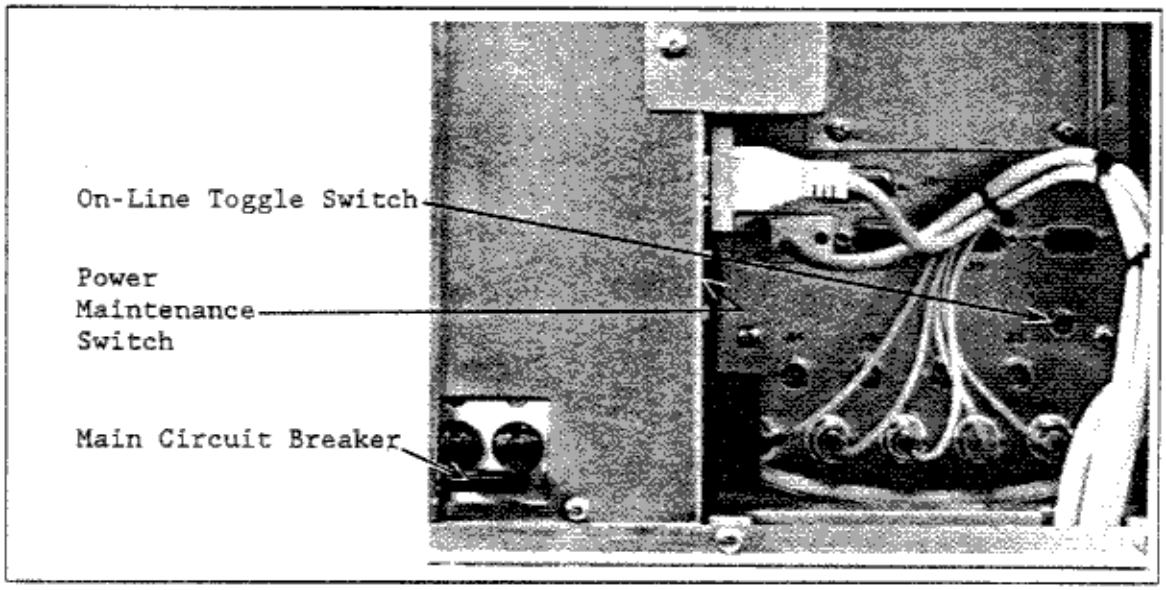

FIGURE 2-3 PROCESSING UNIT CONTROLS

2.3.2 Monitor Controls (see Figure 2-4)

Front:

I	= Power On/Reset - press and hold (Processing Unit main circuit breaker must be on)
O	= Power Off
BRIGHT	= Adjusts image brightness to suit operator.
COPY	= (not used)

Rear:

DEGAUSS	= Press to clear color purity on screen
ON/OFF	= Should always be ON.
75Ω/HI Z	= Five switches should be switched to "75Ω".

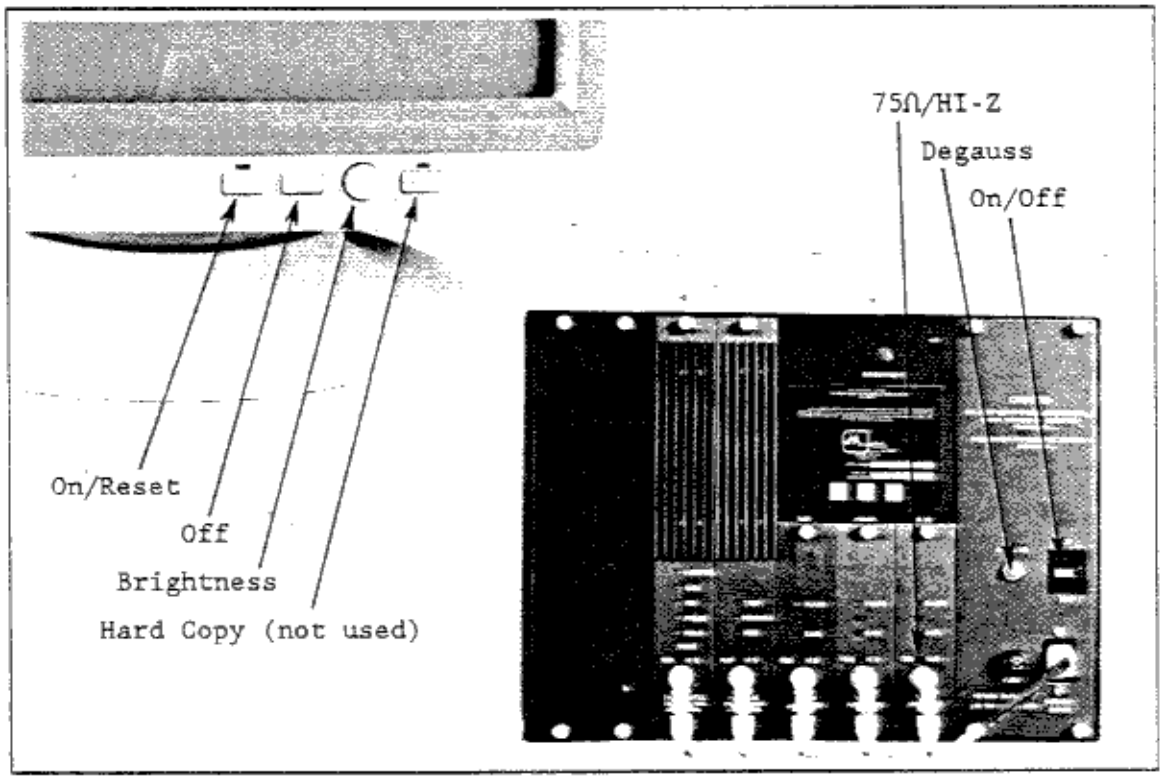

FIGURE 2-4 MONITOR CONTROLS

2.3.3 Keyboard Functions

The keyboard is used to enter text and special commands at the workstation (see Figure 2-5).

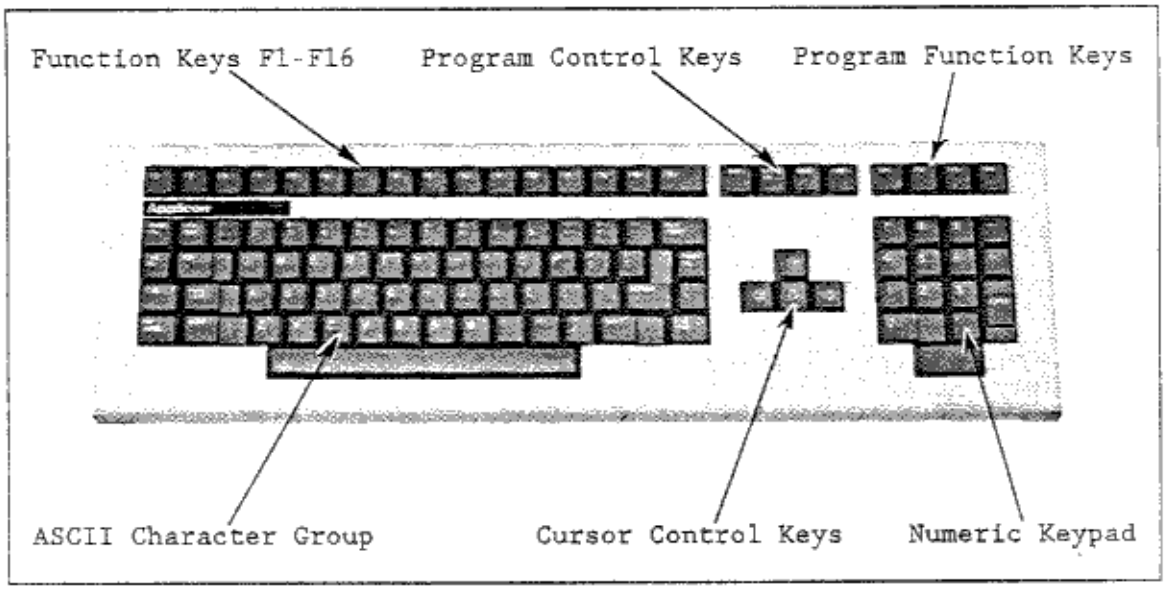

FIGURE 2-5 WORKSTATION KEYBOARD

There are six groups of keys on the keyboard:

ASCII Character Group

The largest group of keys are for entering text into application programs, or when the workstation is being used in VT100 emulation mode.

Function Keys F1 - F16

The function keys across the top of the keyboard are application dependent. During diagnostic testing, for example, several function keys are used for menu item selection. See the instructions for the software being used.

Program Control Keys - QUIT, BACK UP, HELP, DONE

The center cluster at the top of the keyboard are also application dependent, usually used for the functions printed on the keys. See the instructions for the software being used.

Program Function Keys - PF1 - PF4

The keys at the top right corner of the keyboard are application dependent. See the instructions for the software being used.

Cursor Control Keys - (Arrows)

The cursor control cluster is used by the Editor to move a cursor around on the Monitor display, for editing text.

Numeric Keypad

The numeric keypad is used by some applications for easier entry of numeric values, the keys being assigned the same functions as the numeric keys at the top of the ASCII key cluster.

2.3.4 Tablet and Pen

The tablet and pen are the primary means for input to the workstation during graphic operation (see Figure 2-6). When the pen makes light physical contact with the surface of the tablet, a cursor will appear on the monitor screen, and will follow the movements of the pen across the surface.

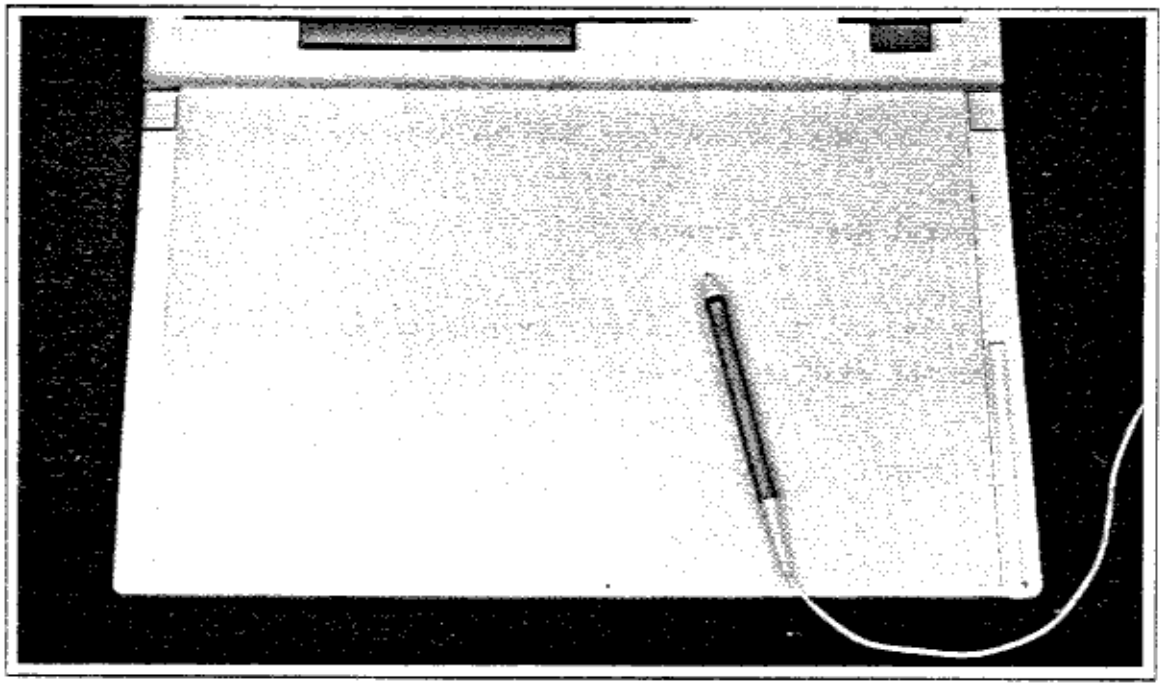

FIGURE 2-6 TABLET AND PEN

The tablet can be unplugged from the keyboard by pressing the two latches at the corners, and pulling the tablet straight out. The pen cable plugs into the rear of the keyboard, near the center.

2.3.5 Circuit Board LED Indicators

On the front edges of the Display List Processor board and the Graphic Processor board are a number of red LED indicators (see Figure 2-7). These indicators show the operation and status of the system, and are useful in installation and diagnostic testing. They are not used in routine operation of the workstation.

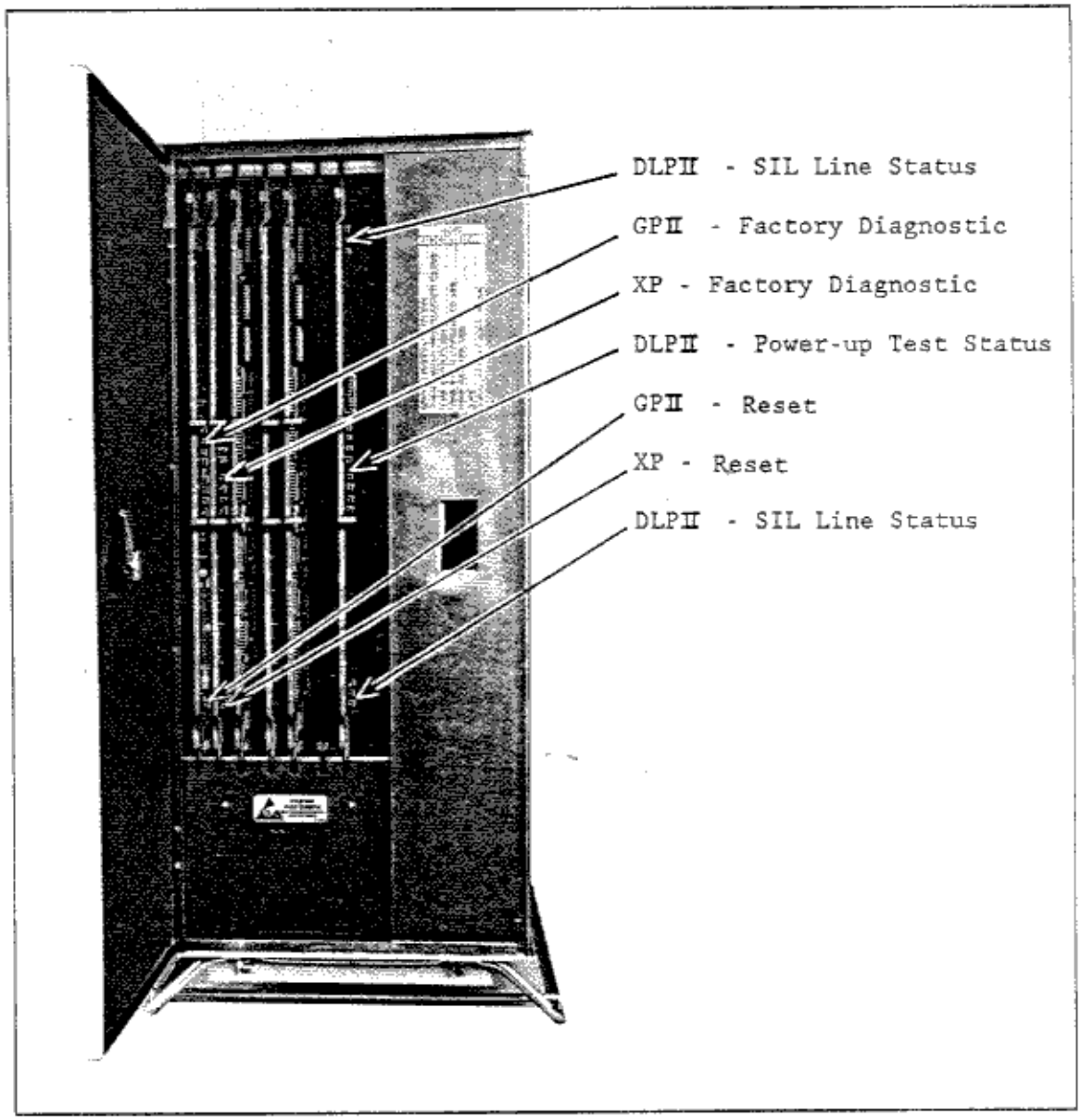

FIGURE 2-7 CIRCUIT BOARD LED INDICATORS

2.3.5.1 Display List Processor Board

During the startup self-tests, the eight LED's near the center of the DLP board front edge show (in binary code) the number of the diagnostic test currently running. If a fault is found, the test indicated by the LED's is the one that failed. Figure 2-8 translates the coding.

If the test is successful, LED-5 will flash on momentarily, then all LED's will go out. If the test fails, the LED's representing the test number and LED-7 will remain lighted.

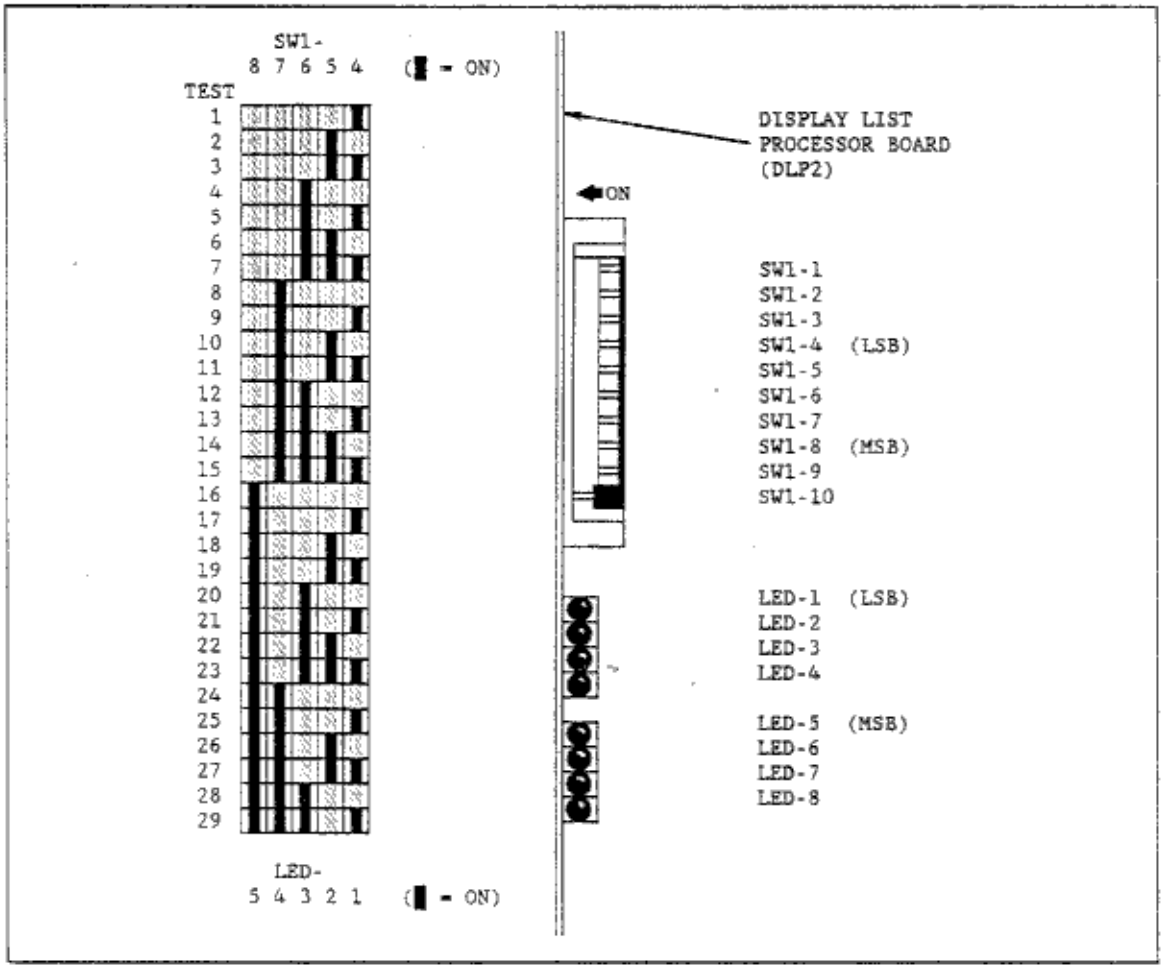

FIGURE 2-8 POWER-UP TEST LED'S

The three LED's at the top of the DLP board show the status of the SIL lines connected to the host computer. The three at the bottom of the DLP board show the status of the SIL lines connected to the next (downstream) workstation. The indications of the three LED's are:

Top: Receive Data

Middle: Transmit Data

Bottom: Carrier Detect

2.3.5.2 Graphic Processor Board

The eight LED's at the center of the GP board (Figure 2-9) are used for factory diagnosis, and are not used in the field.

The single LED at the bottom of the board is activated by "RESL." When lit, it indicates that the GP is executing the reset sequence.

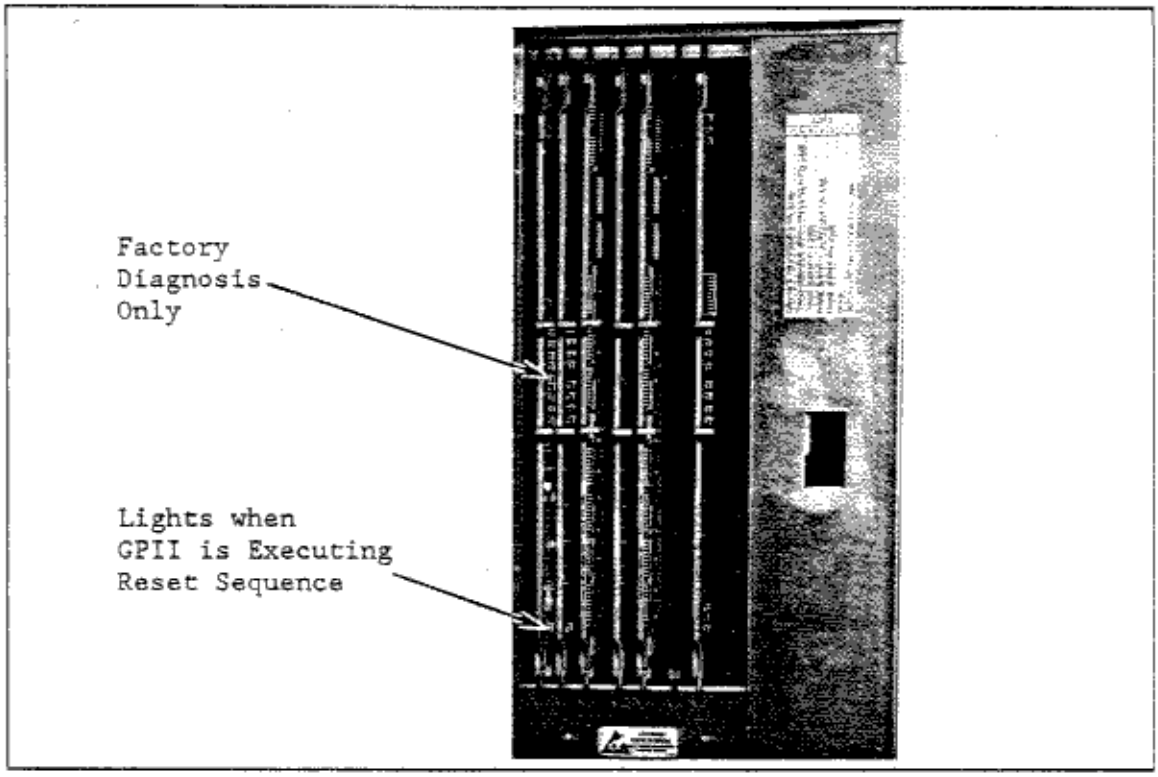

FIGURE 2-9 GRAPHIC PROCESSOR INDICATORS

2.4 POWER-UP

1. With the main circuit breaker off, check to make sure all the cables between the Processor Unit and the Monitor are connected, and that the Monitor rear ON/OFF switch is turned ON.
2. Insert the AC power cord from the Processor Unit into a 115VAC receptacle, then switch the main circuit breaker on.
3. On the Monitor, press and hold the "1" (On/Reset) button. Its indicator should light, the fans in the Processor Unit should start, and in a few moments the status line of the Power-up Self Tests should be visible.
4. Open the front door of the Processor Unit and verify that the LED indicators on DLP2 are flashing.
5. If the status line does not appear within 30 seconds, turn the brightness knob clockwise. If it still does not appear, press the "1" button again.

2.4.1 Power-Up Self Test

Unless disabled by a switch on the Display List Processor board (SW1-10 ON), or aborted by pressing the Reset ("1") button on the front of the Monitor, the resident diagnostic software in the Graphic Workstation will start automatically on power up. A status line will be displayed on the screen, counting downward as the tests proceed. (See the 4635A Diagnostics section in the VAX-Based Systems Diagnostic Handbook for a description of the PUDIAG Power-up Self Test.)

When the self-test is complete, the workstation will pause for three seconds, then attempt to load the terminal software from the host. During this pause, you may elect instead to load and run the system-based diagnostic software. To do this, Press CTRL-D. Otherwise, do nothing, and the terminal software will load. When this is completed, the message "TERMINAL SOFTWARE REVISION #.##" will appear in the upper left-hand corner of the screen.

CHAPTER 3
SYSTEM INTERCONNECTIONS

3.1 INTRODUCTION

This chapter describes the interconnections between the Workstation and host computer, between the Workstation Processing Unit and the Monitor, Keyboard and Digitizing Tablet, and the internal interconnections of the power supply and printed circuit boards.

3.2 OVERVIEW OF WORKSTATION INTERCONNECTIONS

A single power connection provides electrical power for the entire workstation. Serial Interface Link (SIL) cables connect the workstation to the host computer and, optionally, extend the link to other workstations. Between the workstation processing unit and the video monitor, an AC power line, five video cables, a keyboard/tablet I/O cable, and an On/Reset control cable are contained in a single cable. DC power for the printed circuit boards in the processing unit comes from three power supplies enclosed in the unit, and distributed by means of backplane connectors.

Figure 3-1 diagrams the interconnections of the Workstation.

PRECAUTIONS:

The rev of the Host SIL:

PART #	DESCRIPTION	REV NEEDED
30160-001	Host SIL I (Multiwire)	Rev S or higher
31970-001	Host SIL II (Algorex)	Rev G or higher

The reason for this is in the course of bringing up a 4635A on SPAVAX engineering found that the Host SIL was down rev and this affected the ability of the 4635A to download and function over the SIL. The SIL on SPAVAX was at Rev N and should have been at Rev S. Between N and S were ECO's affecting the quality of the signal received at the Host SIL and prom changes affecting the ability of the Host SIL to handle more than 8 terminals. The 4635A appears to require the improved receive function at the Host.

3.3 POWER CONNECTIONS

3.3.1 AC Power

A standard 125V, 15A electrical outlet is needed within 16 feet of the rear of the Processing Unit. While the unit does not require special conditioning of the power source, we recommend that the ground connection to the outlet be electrically isolated from equipment drawing heavy current loads.

The Monitor unit draws all its power from the Processing Unit.

3.3.2 AC Power Supply (ACDU)

A three-wire grounded AC line cord supplies 115Vac power for the Processing Unit and Monitor. This power is switched and routed from the ACDU to a central fuse block in the power supply enclosure.

From the fuse block, 115Vac is distributed (black wires) to the three dc power supplies. Each dc supply is protected by its own fuse. The return (white) line fuse brackets are installed with shunts for domestic applications. The ground lines (green) connect all power supplies together at a central binding post on the back panel.

In the rear compartment, a three-wire cable from the Monitor Unit plugs into a receptacle in the ACDU.

Also in the rear compartment, a Type-D connector from the Monitor Unit carries the ON, OFF and RESET signals into the ACDU.

Under the large sheet metal cover inside the rear compartment, a modular phone-type connector from the backplane carries a voltage detect/thermal protect/INIT cable to the ACDU.

NOTE

A momentary contact switch inside the rear compartment overrides the interlock function of the Monitor ON/OFF line and the voltage detect/thermal protect/INIT lines from the backplane, to allow testing of the power supply without these connections, and to test the control lines themselves.

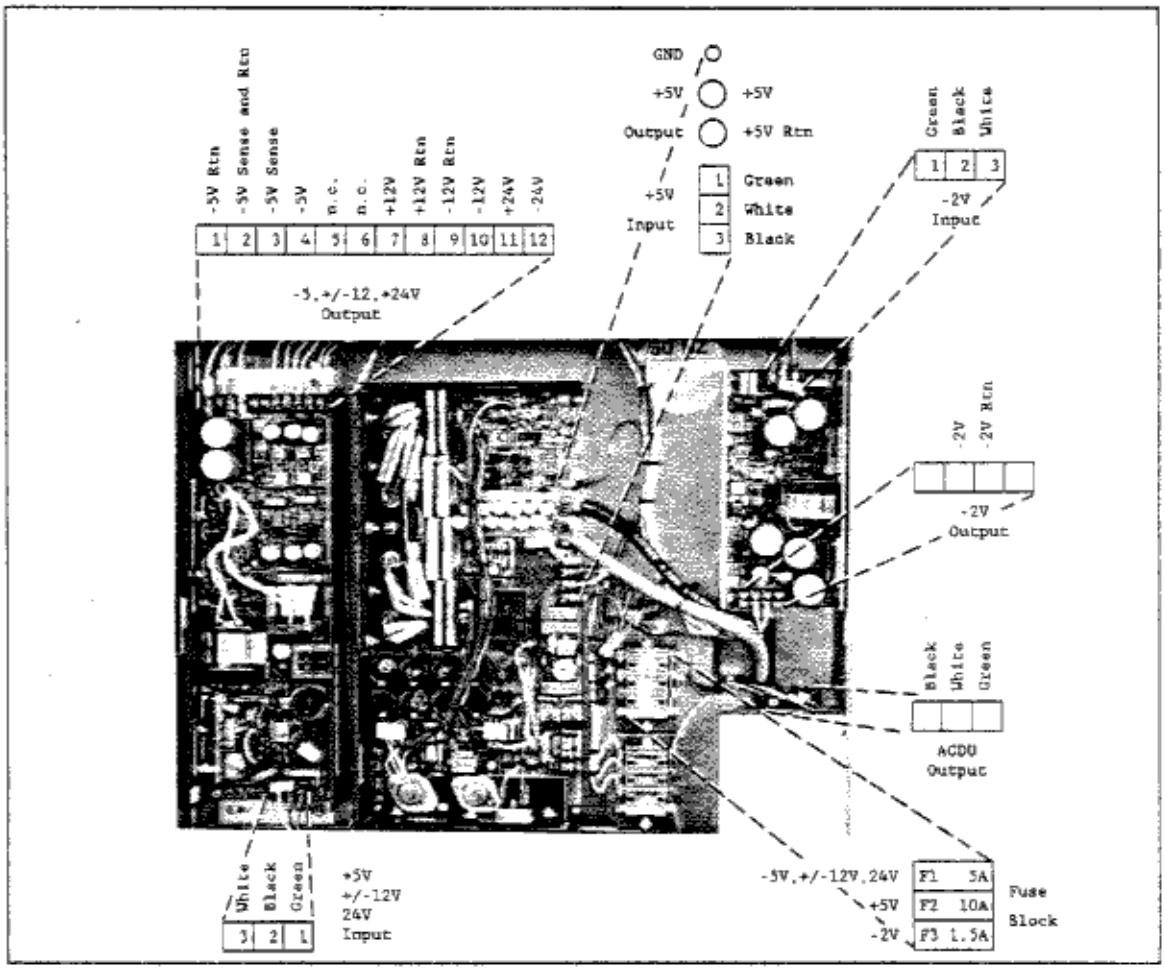

FIGURE 3-2 POWER SUPPLY CONNECTIONS

3.3.3 +5 Volt Power Supply

The +5 volt supply receives 115Vac from the main fuse block (10A fuse) and the ACDU. Besides the three ac lines (black, white, green), a separate (green) ground line is connected to the supply.

The +5 volt output lines (red, black) connect through an opening in the back of the power supply compartment to the backplane connectors inside the rear compartment.

3.3.4 -5 Volt, +/- 12 Volt, +24 Volt Power Supply

This supply receives 115Vac from the main fuse block (5A fuse) and the ACDU through three ac lines (black, white, green).

Output connections at the top of the power supply furnish -5V, +12V, and -12V to the backplane, and +24Vdc for the cooling fans in the Processing Unit.

A pair of -5V sense lines also connect to the backplane.

(Two connectors - #5 and #6 - on the terminal strip are unconnected.)

3.3.5 -2 Volt Power Supply

This supply receives 115Vac from the main fuse block (1.5A fuse) and the ACDU through three ac lines (black, white, green).

Output lines at the top of the supply furnish -2Vdc to the backplane. (Jumpers connect output lines to voltage sense terminals on the power supply.)

3.3.6 Backplane Connections

Power connections to the backplane are behind the large sheet metal panel in the rear compartment, as shown in Figure 3-11. The connections are identified by number, starting at the top of the board.

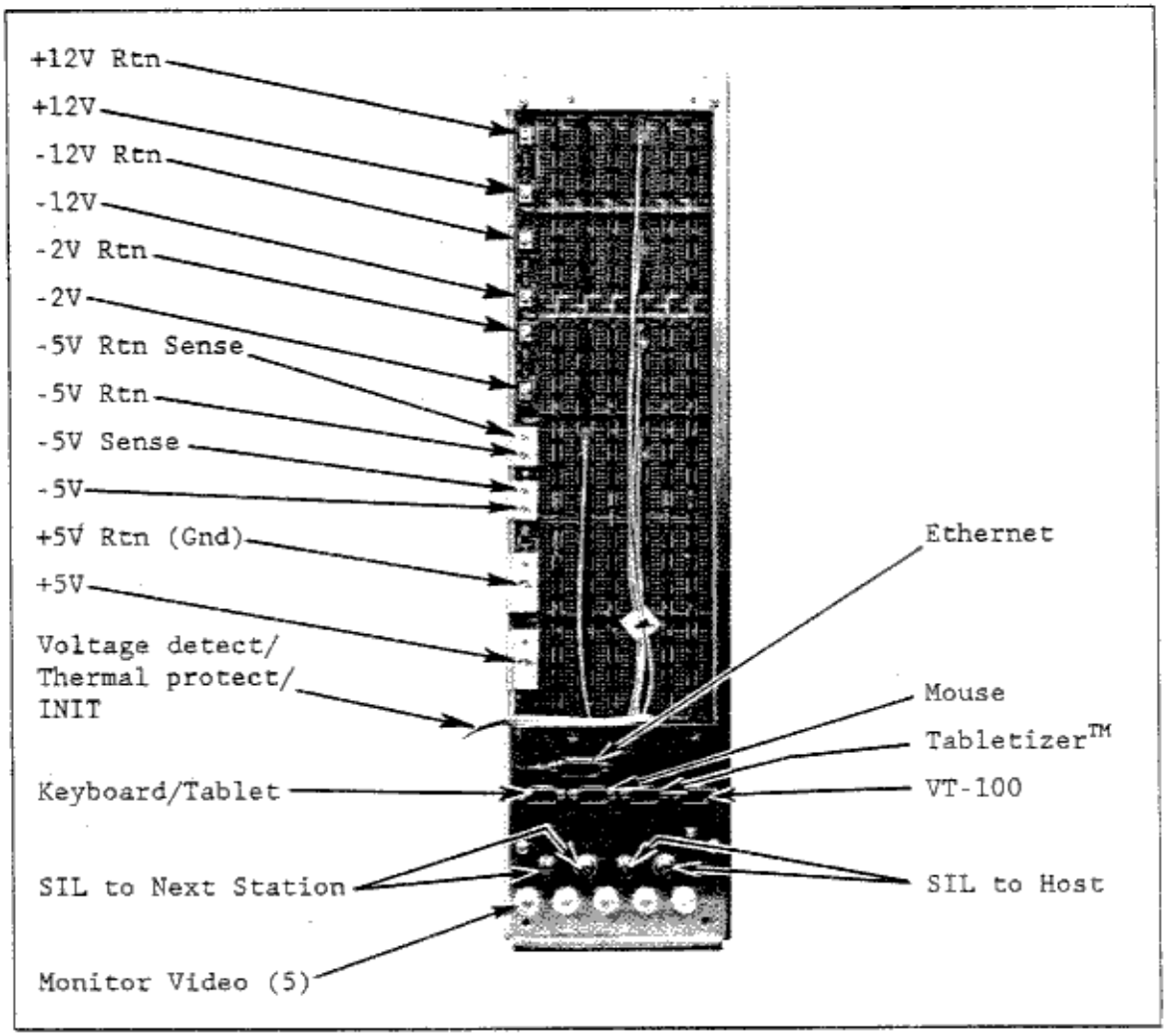

FIGURE 3-3 BACKPLANE CONNECTIONS

Notice that there are two lines #7 and two #8 (large and small). While there are also two terminal lugs each at #9 and #10, only the large lugs are used.

The I/O panel is part of the backplane assembly. It contains five BNT connectors for video signals to the Monitor, four BNT connectors for SIL communication, and four Type-D connectors for RS232 communications. The left-most RS232 connection is for the Keyboard/Tablet. Next to it is a connector for a Tabletizer™, and next to that is a "mouse" port. The right-most connector is used for VT-100 terminal emulation mode communication with a host computer.[1]

The voltage detect/thermal protect/INIT cable to the ACDU is connected behind the I/O panel, and dressed between the connectors on the back of the I/O panel. The cable is held in place with cable ties.

3.4 PROCESSING-UNIT-TO-MONITOR CONNECTIONS

A special cable[1] carries all the power and signal connections between the Monitor and the Processing Unit. At the Processing Unit end, the cable passes through an opening under the rear door and is held by a strain relief bracket before branching to the different connectors inside the Unit.

Each connector at the end of the cable is labeled with the same designation as its respective jack in the Processing Unit (see Figure 3-4).

[1] See Appendix A for cable part numbers.

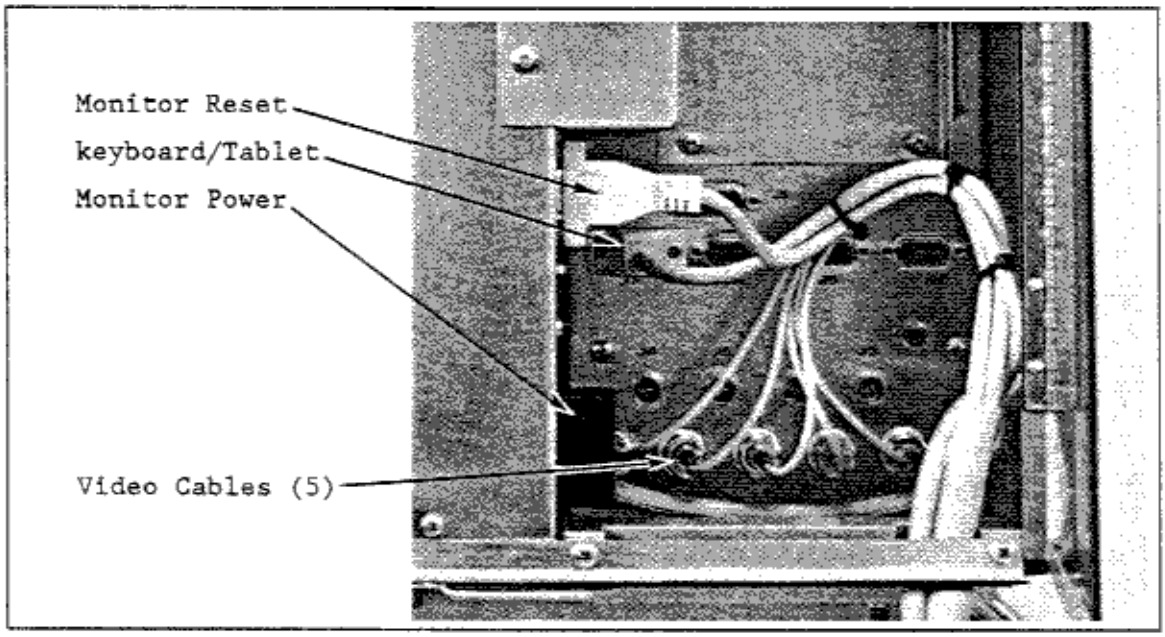

FIGURE 3-4 PROCESSING-UNIT-END CABLE CONNECTIONS

There are likewise eight connectors on the Monitor end of the interconnecting cable:

(1) Monitor AC power connector

(5) Video coaxial (BNT) cables:

- Red
- Green
- Blue
- Vertical sync
- Horizontal sync

(2) Modular (telephone-type) connectors:

- Keyboard-tablet connector (8-pin)
- Reset connector (6-pin)

These should be attached to the appropriate matching connectors on the rear and bottom of the Monitor (see Figure 3-5). Notice that each of the two modular phone-type plugs will fit only the appropriate jack on the bottom of the Monitor. The third jack is for connection of a hard-copy device.

A strain relief bracket holds the cable to the bottom of the Monitor.

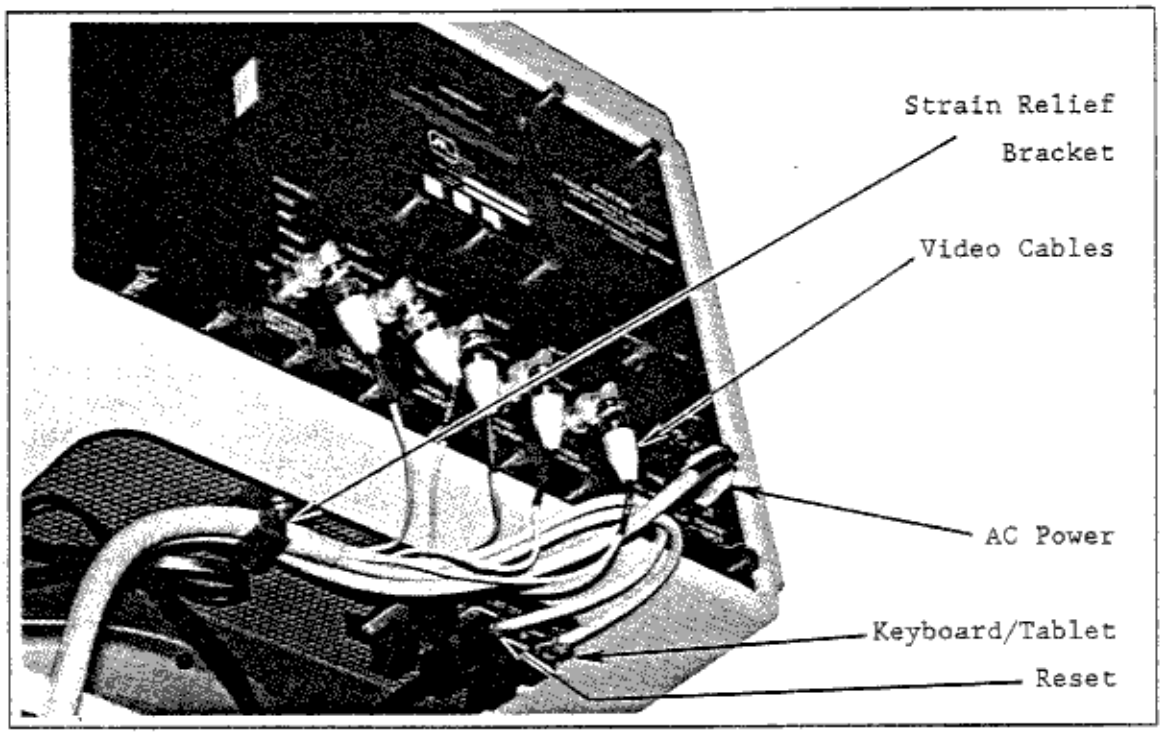

FIGURE 3-5 MONITOR-END CABLE CONNECTIONS

One end of the keyboard-monitor coiled cable plugs into the jack on the left side of the keyboard, and the other end into the left-hand connector on the bottom rear of the Monitor. The digitizing pen cable plugs into the rear of the keyboard.

Figure 3-6 identifies the individual lines in the Processing Unit-to-Monitor cable.

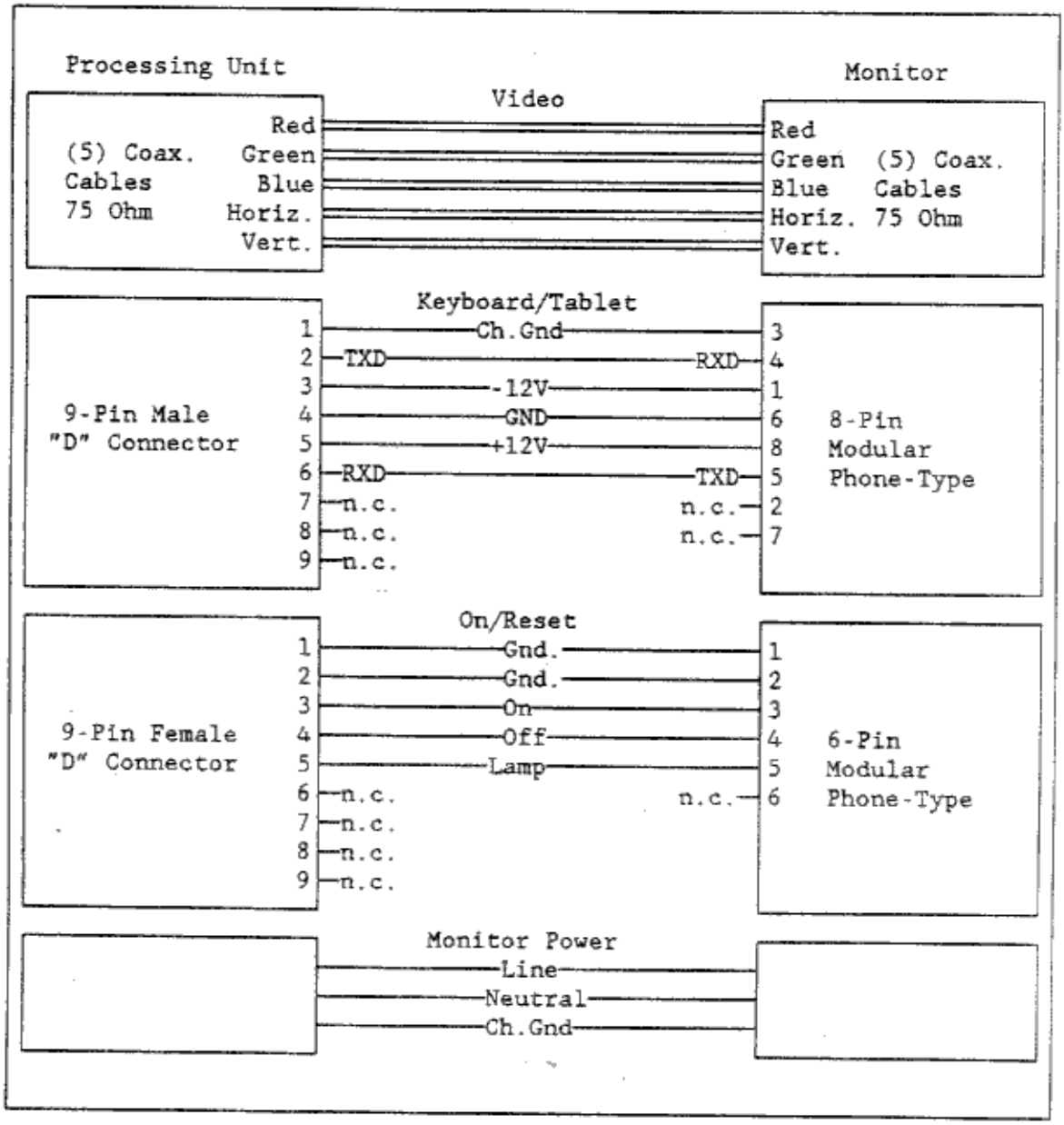

FIGURE 3-6 PROCESSING UNIT-MONITOR INTERCONNECTING CABLES

3.5 SERIAL INTERFACE LINK (SIL) CONNECTIONS

The Workstation is connected to the host computer by means of the Serial Interface Link. This is a "daisy chain" circuit of two coaxial cables, one carrying signals from the host and the other carrying signals to the host[2]. If more than one workstation is connected, the cables run from the host to one workstation, then to the next workstation, etc. (see Figure 3-7).

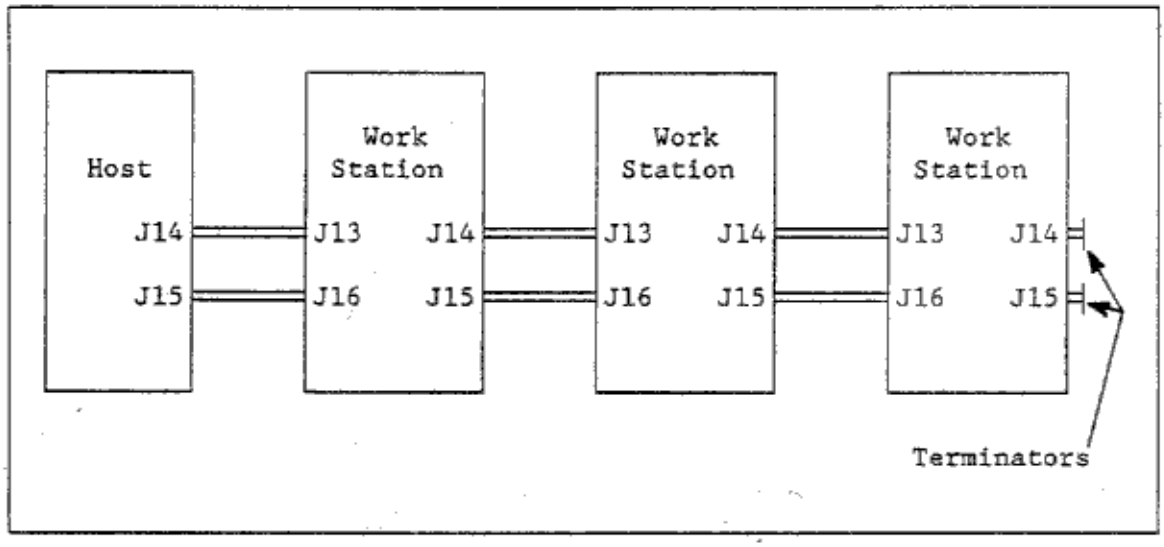

FIGURE 3-7 SIL CABLE CONNECTIONS

On any workstation, the cables running toward the host are connected to jacks J13 and J16, and if there are workstations beyond this one, those cables are connected to J14 and J15. **If this is the last workstation in the chain, terminators must be installed on J14 and J15.**

To install the SIL cables:

1. Turn the main circuit breaker OFF.
2. Open the rear door on the Processor Unit and, with a Phillips screwdriver, loosen the strain relief bracket (see Figure 3-8).

[2] See Appendix A for cable part numbers.

3. Identify the two SIL cables by their tags; at one end, one should be labeled "J16" and the other "J13". At the other end, they are labeled "J14" and "J15".
4. Thread the J13-J16 ends of the cables under the rear of the unit and up through the slot next to the rear door.
5. Plug the cables into the BNT connectors with the same identification.
6. If this is the last terminal in the interface string, install terminators on the connectors J14 and J15.
7. Make sure the On-Line toggle switch (next to connector J13) is in the ONLINE (up) position.
8. Tighten the strain relief bracket and close the rear door.

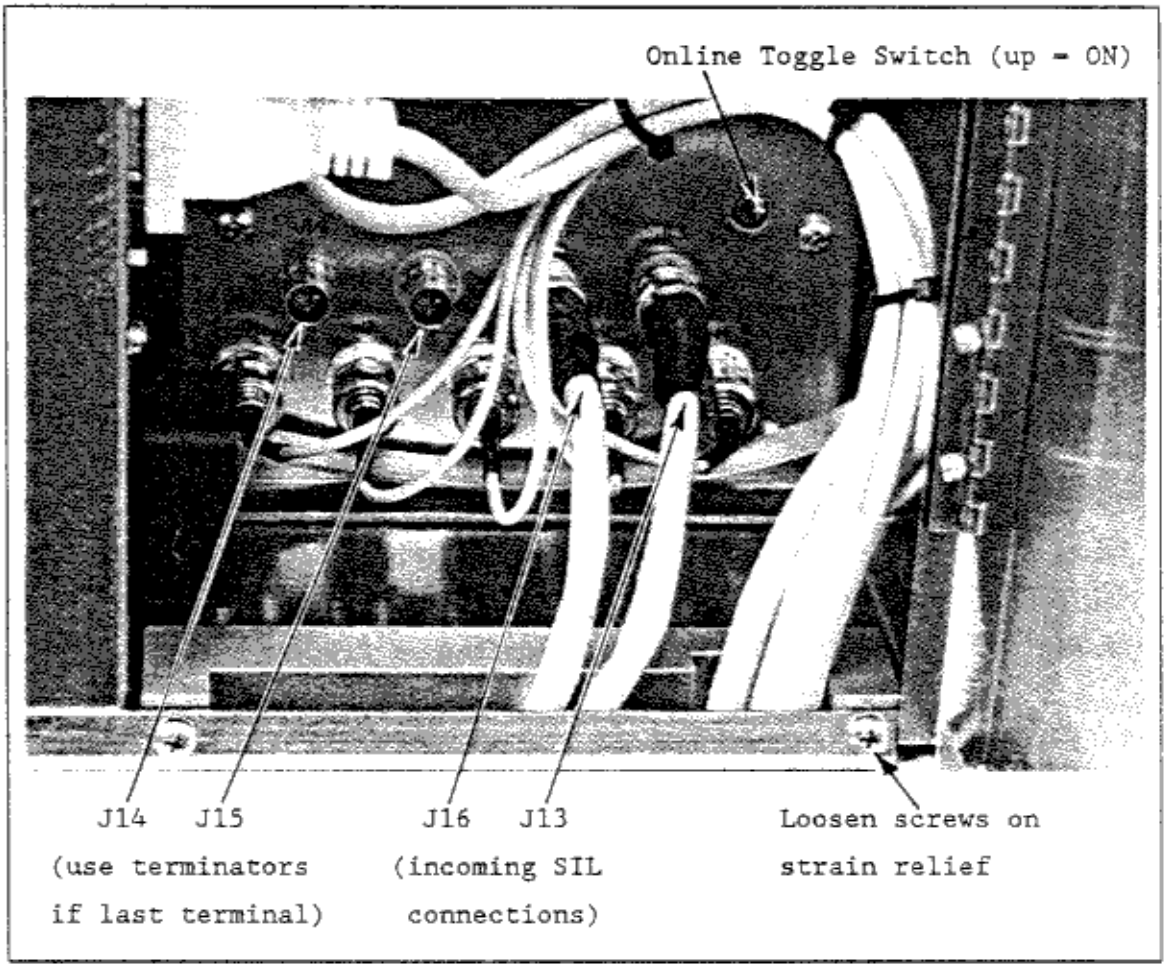

FIGURE 3-8 CONNECTING THE SIL CABLES

CHAPTER 4
THEORY OF OPERATIONS

4.1 INTRODUCTION AND OVERVIEW

This chapter describes the functions of the circuit boards in the 4635A/4670 Graphics Workstation Processing Unit.

The 4635A/4670 Processing Unit consists of a seven-slot backplane and power supplies to support the following circuit boards:

Board	Part Number	
	4535A	4670
Display List Processor (DLP2)	32940-001	32940-002
Graphics Processor (GP2)	32950-001	32950-001
Frame Buffer (FB)	32820-001	32820-002
Frame Buffer Controller (FBC)	32880-001	32880-001
(or)	32880-002	--
Transformation Processor (4670)	--	33030-001
(with solids modeling) (4675)	--	33030-002

The unused slot is reserved for future expansion. Figure 4-1 shows the arrangement of the circuit boards in the backplane, and Figure 4-2 diagrams the general functions of the workstation.

NOTE

The circuit boards must occupy specific slots in the backplane. See Figure 4-1.

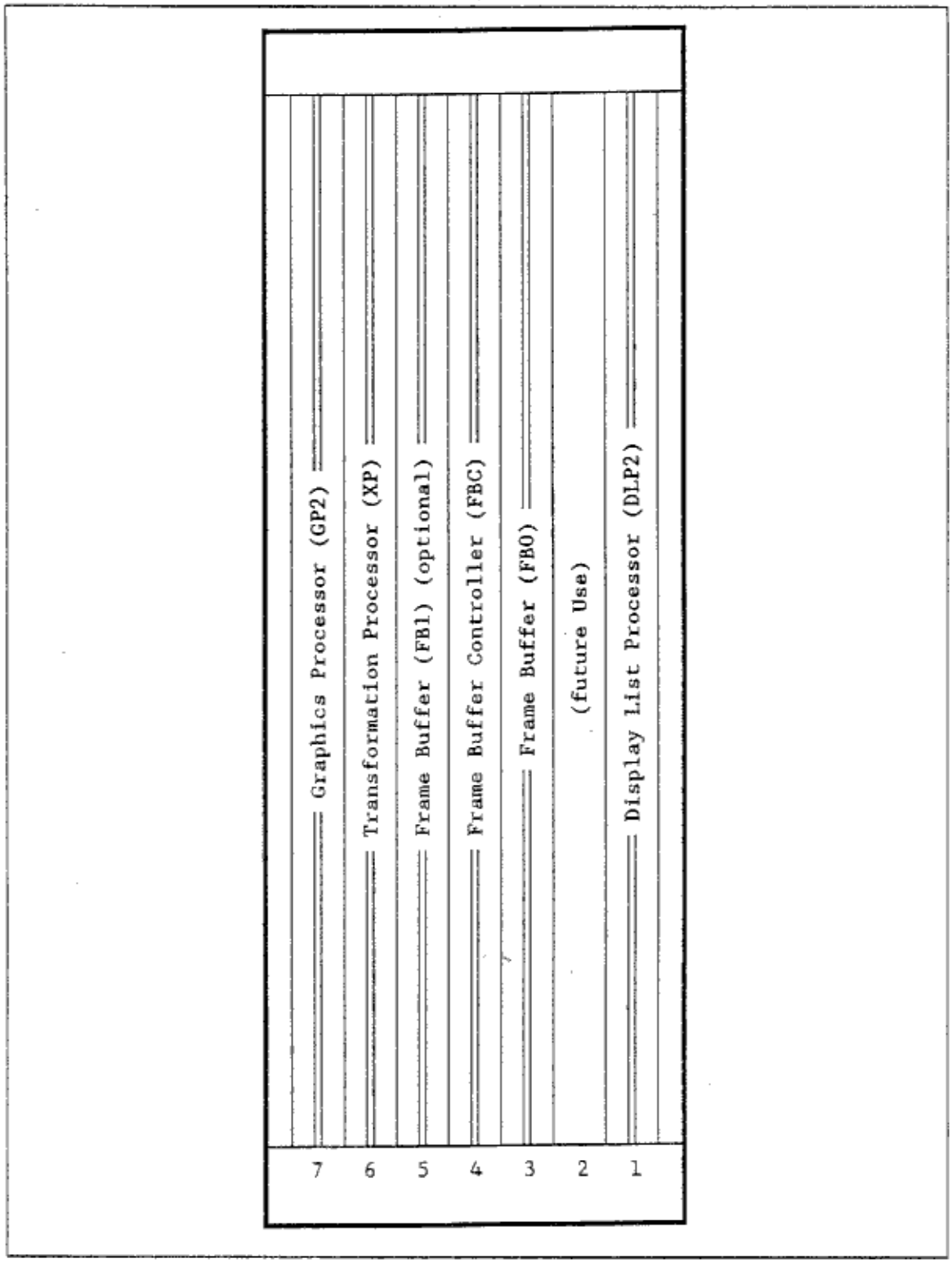

FIGURE 4-1 4635A/4670 CIRCUIT BOARD LOCATIONS (FRONT VIEW)

4.2 SYSTEM BUSES

4.2.1 Terminal Bus

The Terminal Bus is the primary interface between the various terminal modules. All the boards, except the Frame Buffer boards, have a Terminal Bus interface.

The Terminal Bus resembles DEC's Unibus in these ways:

- MSYN and SSYN type handshaking
- 16-bit data and 18-bit addressing
- Same pinouts, including power and ground
- Same physical form factor

It differs from the Unibus in these ways:

- The Terminal Bus is a tri-state bus
- No DMA
- One level "wired OR" interrupt
- Word-only data transfers
- Modified timing

4.2.2 TM Bus

The TM Bus interface provides the necessary buffering, latching, decoding and handshaking to support high-speed transfers between the Frame Buffer memory and the Graphics Processor.

4.3 DISPLAY LIST PROCESSOR

The Display List Processor (DLP2) takes some of the computation load off the host computer for better system performance, particularly in multiple-workstation installations. It does this by storing a copy of the drawing in the display list memory and updating it, rather than

continually updating the disk database. This frees the system resources for plotting and other Unibus-related tasks.

The Display List Processor has three main sections, shown in Figure 4-3:

Processor section Memory section

I/O section

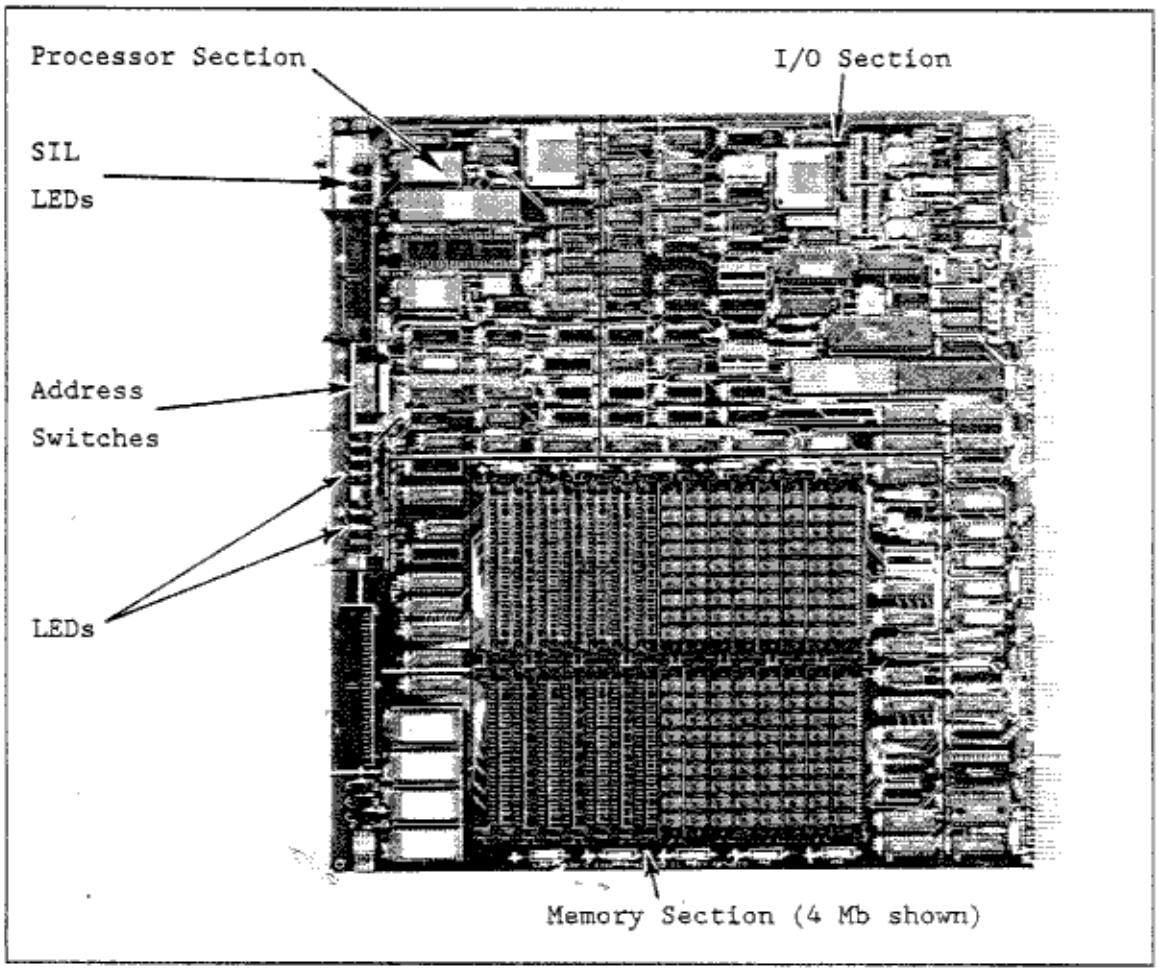

FIGURE 4-3 DISPLAY LIST PROCESSOR BOARD (DLP2)

4.3.1 Processor Section

The Processor section contains a National Semiconductor 32016 32-bit Central Processing Unit (CPU), a National 32081 Floating Point Slave Processor (FPU), and a timing controller.

The CPU receives drawings from the host computer and builds a display list. It also controls the workstation functions. The FPU works with the CPU to provide fast floating point operations, necessary for the graphic display.

4.3.2 Memory Section

The Memory section contains 128Kb of read-only memory (ROM) containing power-up diagnostic programs, RS-232 I/O programs, and SIL I/O programs; and either 4 Mb or 8 Mb of dynamic random-access memory (RAM) for downloaded diagnostic programs, drawings and graphics font data; and the necessary refresh circuitry.

4.3.3 I/O Section

The Input/Output (I/O) section contains the Serial Interface Link (SIL), two dual Universal Asynchronous Receiver/Transmitters (UART) for RS232 Communication (four ports total), and terminal bus interface circuits.

The SIL is used for communication with the host computer in a daisy-chain configuration. Repeater functions restore the host SIL signals for down-line workstations, thus improving the quality of the signal during operation.

One RS232 port (J17) is used for communicating with the keyboard and digitizing tablet. Another one (J20) is used for VT-100 Mode communications. A third port (J19) is connected to the Tablet, and the fourth (J18) is used for mouse operation. All four RS232 ports operate at 9600 bits per second. Both UARTs contain timers, and one is equipped with additional parallel ports used in the DLP2 for control functions.

The DLP2 communicates with the other boards in the workstation through the 16-bit Terminal Bus. It passes vector commands to a FIFO buffer in

the Graphic Processor board (GP2). When terminal software microcode is downloaded from the host computer, the DLP passes the microcoded instructions to the GP.

4.3.4 Switches and Indicators

A bank of ten switches on the DLP2 are used for diagnostic selection, and five of them are used for terminal identification during normal operation (see **WORKSTATION SETUP** in Chapter 2, and the 4635A section in **VAX-BASED SYSTEMS DIAGNOSTIC HANDBOOK**).

A bank of eight LEDs are used for diagnostic purposes. Two banks of three LEDs each permit the monitoring of the SIL line operation to the host and down-line workstations.

4.4 GRAPHICS PROCESSOR

The Graphics Processor (GP2) controls the rasterization of the vector commands received from the Display List Processor board, and sends draw points for vectors, text, arcs and polygon fills into the Frame Buffer. Other functions are color index selection, X-Y register loading, pixel write, and read-modify-write (RMW) operation select.

The GP2 has three main sections, as shown in Figure 4-4:

- Processor section
- Memory section
- FIFO buffer section

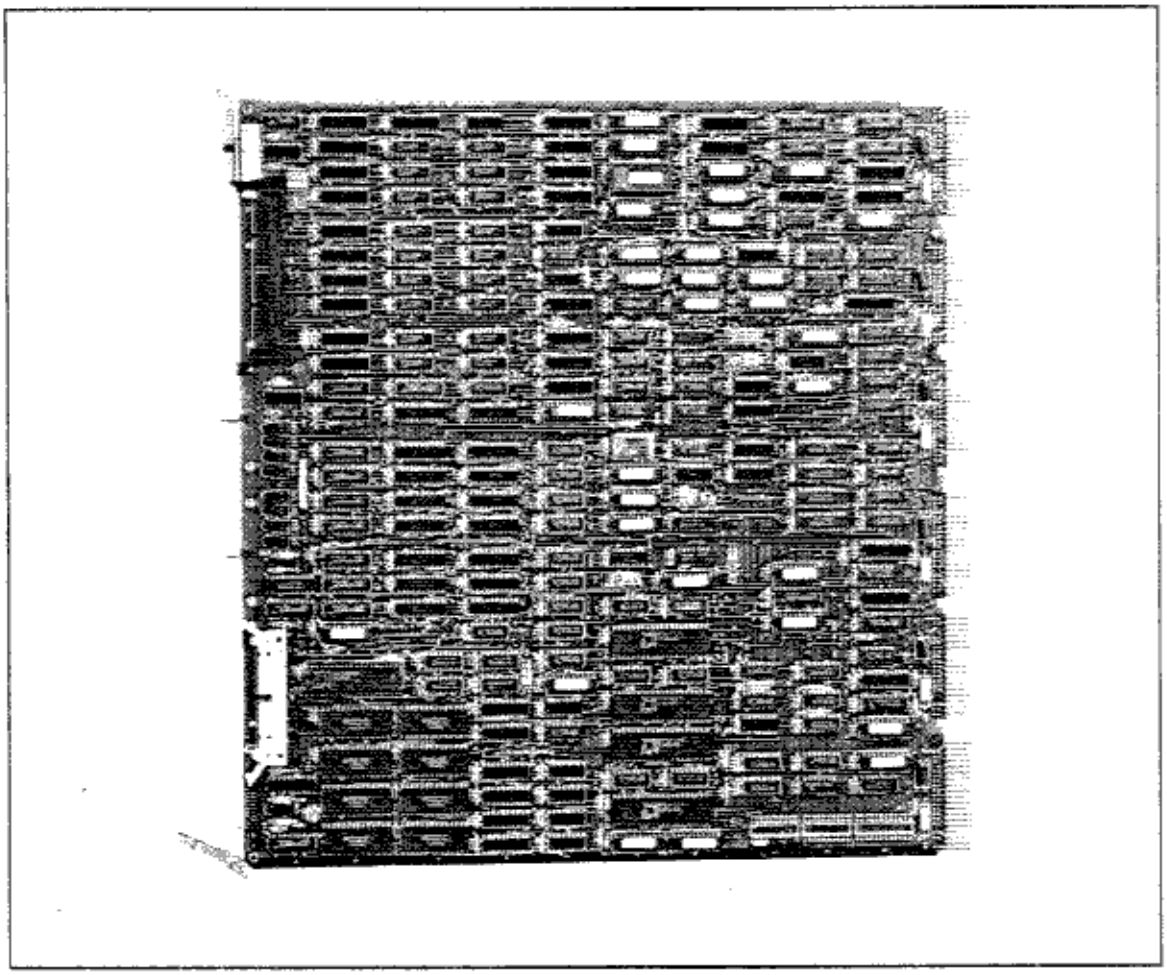

FIGURE 4-4 GRAPHICS PROCESSOR BOARD (GP2)

4.4.1 Processor Section

The CPU is a 2901-based microcode processor, working in bit-sliced mode. It receives commands from the Display List Processor (or Transformation Processor FIFO interface during transformation of an image), and sends pixel data to the Frame Buffer via the TM Bus.

A Writeable Control Store holds microcode in 4K-by-64-bit static RAM.

4.4.2 Memory Section

The 32K byte memory holds character font, bit-map data, and state information.

4.4.3 FIFO Buffer Section

The two First-In-First-Out Buffers are temporary queue buffers between the Graphics Processor and the Display List Processor (DLP) or Transformation Processor (XP). Without the XP installed, the buffers are cascaded together to form a single queue buffer; with the XP, one buffers data from the XP, and the other buffers data to the XP.

4.4.4 Switches and Indicators

A bank of eight LED indicators at the edge of the GP board are used for factory diagnosis, and have no field function.

4.5 TRANSFORMATION PROCESSOR (4670 ONLY)

There are two versions of the Transformation Processor (XP). Both versions perform high-speed floating-point operations for graphic transformations such as image rotations. The XP-SME ("Solids Modeling Engine" or "Tiling Engine") version also performs tiling, shading and hidden-surface removal for solid-object representations. Figure 4-5 shows the arrangement of the XP board with SME.

4.5.1 Transformation Processor Sections

The Transformation Processor operates in a pipeline mode, taking commands and data from the DLP via the FIFO on the GP, performing its operations, and outputting commands and data to the FIFO on the GP.

These operations update the image buffer in the DLP. There may not be a one-to-one correspondance between input and output; the XP may be a command source (for example, a received chained vector command may become a string of position and chain vector commands as a result of clipping) or a command sink (eliminating vectors outside a clipping brick).

4.5.2 Solids Modeling Engine Section

The SME version incorporates, in addition to the XP components, a Z-buffer, Weitek tiling engine VLSI chips, and additional transformation processing microcode to provide shading, hidden-surface removal, sectioning and patterning of displayed images.

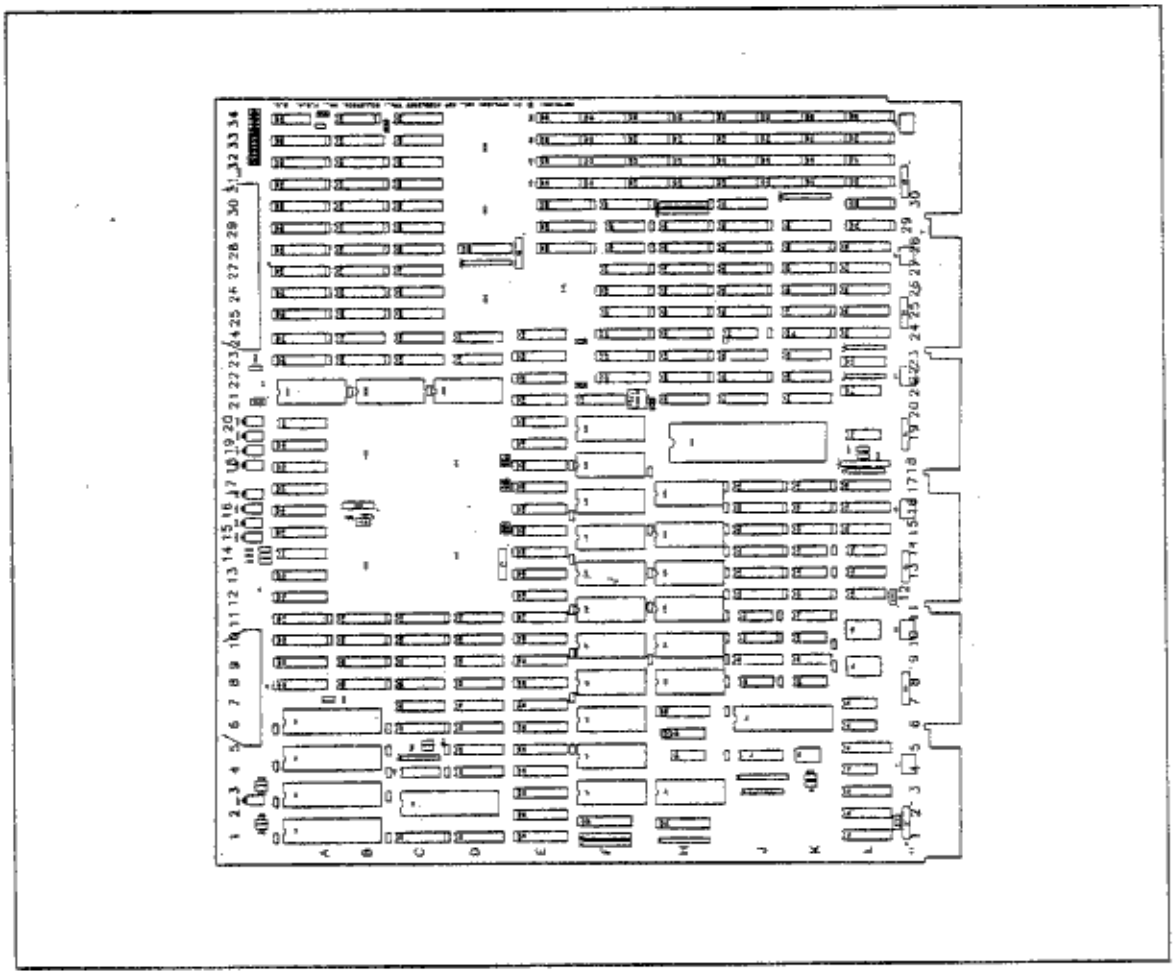

FIGURE 4-5 TRANSFORMATION PROCESSOR BOARD (XP-SME)

4.6 FRAME BUFFER CONTROLLER

The main function of the Frame Buffer Controller (FBC) is to generate images and color for the display. It provides a high-speed interface between the Frame Buffer and the video monitor, receiving video data from the FB and ASCII data from the Terminal Bus, and sending this data through the Color Lookup Table and D/A convertors to the CRT.

The FBC consists of five sections, indicated in Figure 4-6:

- Color lookup table memory
- Character generator
- Timing section
- Video Receivers
- Digital-to-analog convertors

4.6.1 Color Lookup Table Section

The color lookup table stores all the possible color combinations, from data loaded by the terminal software through the DLP. To increase throughput speed, two copies of the table are stored and accessed alternately by two clock circuits in the timing section.

4.6.2 Character Generator Section

The DLP controls the functioning of this section through the terminal bus. The character generator converts ASCII code from the DLP into characters for the display of Editor menus, VT-100 mode text, and VMS messages.

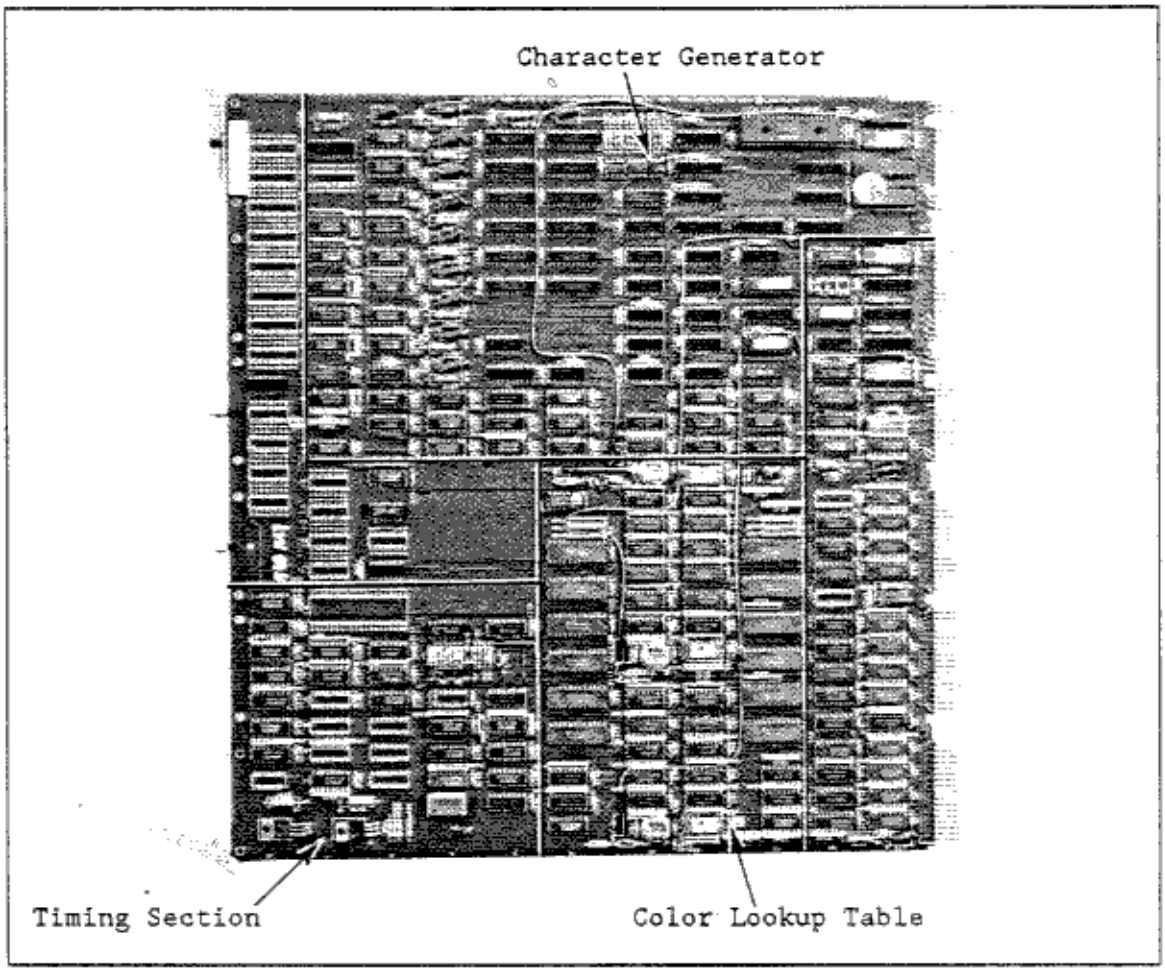

FIGURE 4-6 FRAME BUFFER CONTROLLER BOARD (FBC)

4.6.3 Timing Section

In the timing section two clocks, phased at 180 degrees, alternately access the two copies of the color lookup table to provide the speed necessary to change pixel color on the display.

In the 4670, the Timing Section contains additional circuitry to switch between 150MHz for normal operation and 108MHz for generation of hard-copy output.

4.6.4 Video Receivers

The FBC receives data from the Frame Buffer board over a 24-bit memory bus at 54MHz (4635A) or 75MHz (4670). The memory data is sent to the Color Lookup Tables, then multiplexed into a 108MHz (4635A) or 150MHz (4670) data stream that drives the digital-to-analog (D/A) converters.

When two frame buffers are present, each has its own memory bus. Several options are available: The second frame buffer can serve as a double buffer (for animation) or an overlay, or the Lookup Table can be bypassed. In bypass, or 24-bit, mode, the FBC bypasses the Lookup Table, sending 24 bits of data directly to the D/A converters. This allows for a pallette of 16 million colors, instead of the 4096 colors available when using the Lookup Table.

4.6.5 D/A Convertors

The Digital-to-Analog section converts digital red, blue, green, horizontal sync and vertical sync signals to analog levels compatible with the Monitronics video monitor.

4.7 FRAME BUFFER

The Frame Buffer (FB) is basically a memory board, storing 12 planes of video memory.

The FB consists of four sections, as shown in Figure 4-7:

- Memory
- Pixel conditioner
- TTL-to-ECL translator/multiplexer
- Terminal memory bus interface

4.7.1 Memory Section

The memory section contains 1.5Mbits (4635A) or 2.7Mbits (4670) of RAM. Pixel data is loaded into RAM through the TM bus. RAM control and addressing is generated on the GP board.

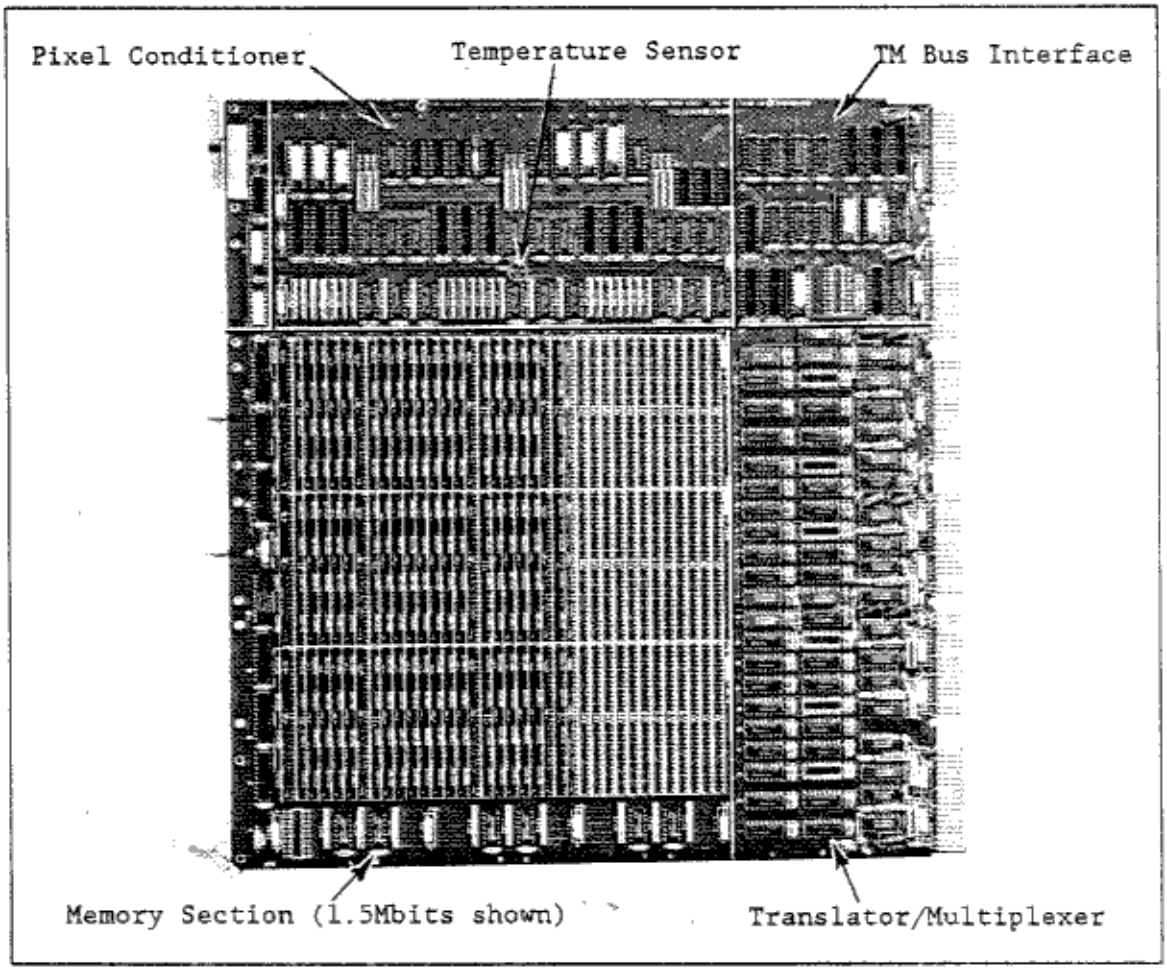

FIGURE 4-7 FRAME BUFFER BOARD (FB)

4.7.2 Pixel Conditioner

The pixel conditioner performs boolean functions to modify color and intensity bits on two sets of data:

The current data in video memory

Input data from the color register

The GP can modify the contents of the color register to vary the color and/or intensity of each pixel.

4.7.3 Translator/Multiplexer Section

The T/M section converts memory data (120 bits in 4635A, 144 bits in 4670) into memory bus data (24 bits). It also converts memory voltage levels (TTL) to ECL levels for the higher speed memory bus.

4.7.4 Terminal Memory Bus (TM Bus) and GP Interface Section

The GP loads the pixel conditioner registers via the TM Bus. Frame Buffer memory can be modified by the GP via a dedicated memory control bus.

4.7.5 Temperature Sensor

A thermal shutdown is controlled by a thermal switch located on the Frame Buffer board. The switch closes at 65 deg.C +/- 8 deg.C, shutting down the ACDU.

After a thermal shutdown, allow the switch to cool down to reset itself before restarting the system.

CHAPTER 5
COMPONENT REMOVAL/REPLACEMENT

5.1 INTRODUCTION

This chapter describes the steps needed to remove and replace all field-replaceable units (FRU) in the workstation. All FRU's can be replaced using tools from the standard CE Tool Kit[1]. A parts list of FRUs is in Appendix A of this manual.

See Chapter 7, **Diagnostics and Troubleshooting**, for procedures to isolate faulty FRU.

5.2 PROCESSING UNIT CIRCUIT BOARD REMOVAL

The 4635A Workstation contains four plug-in logic circuit boards, the 4670 five different boards. All are accessible through the front door of the Processing Unit (see Figure 5-1):

Display List Processor (DLP2)
Graphics Processor (GP2)
Frame Buffer (FB0)
Frame Buffer (FB1) (4670 only)
Frame Buffer Controller (FBC)
Transformation Processor (XP) (4670 only)

[1] While it may be possible in some situations to replace individual components within a FRU, module-level replacement has proven to offer more reliable operation, reduced mean time to repair, and greater overall economy.

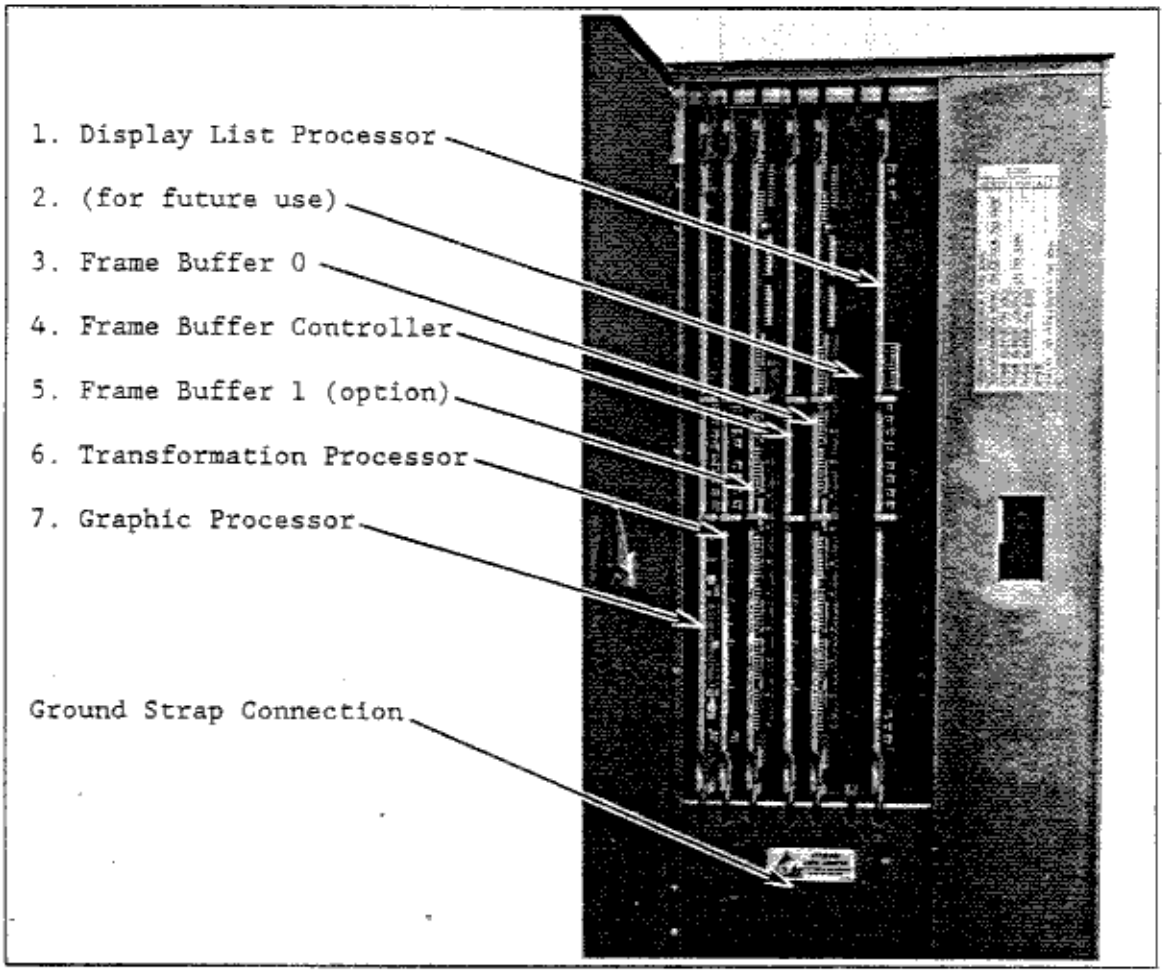

FIGURE 5-1 PROCESSING UNIT CIRCUIT BOARDS

Follow these steps to remove and replace the circuit boards:

*** CAUTION ***

This product is extremely sensitive to electrostatic discharge. Do not remove printed circuit boards from the Processing Unit without antistatic protection.

1. Make sure the power cord of the Processing Unit is plugged into a receptacle (this ensures that the frame is at ground potential). Power to the workstation must be turned off.

2. Use a large flat-bladed screwdriver (a coin may do) to turn the latch on the front door.
2. Prepare an electrostatic mat to lay the circuit board on. Attach the lead of the mat to the frame of the Processing Unit.
3. Attach the clip of an electrostatic wrist strap to the two small holes just under the card cage. Fasten the strap to your wrist.
4. Grasp the two latching levers at top and bottom of the board, and pull them both out at the same time. These levers assist in freeing the board from the backplane connectors.
5. Grasp the board firmly by the metal edge near the center and, with a slight up-and-down rocking motion, pull it free of the backplane. Movement will then become much easier.
6. Withdraw the board and lay it on the antistatic mat. Do not touch the gold-plated contacts that plug into the backplane, and do not lay anything on top of the board.

To replace a circuit board in the Processing unit:

1. Attach the clip of an electrostatic wrist strap to the two small holes just under the card cage. Fasten the strap to your wrist.
2. Pick up the board by its top and bottom edges. Avoid touching the gold-plated contacts as you pick up the board.
3. Turn the board on edge so that the components are to your right, and slide it into the card cage slot. Make sure it is in the proper slot.
4. Using both hands, turn the latching levers outward from the edge of the board and push firmly to insert the board into the back plane connectors. If it feels as though it is against a solid stop, but is not all the way in, it may not be centered in the backplane connectors. Pull it out a little and try again.
5. Engage the slots of the latching levers on the edge of the card cage and push the levers in until they are parallel to the edge of the board. If the levers are not parallel to the edge of the board, the board is not installed properly.

5.3 POWER SUPPLY REMOVAL

To remove any of the power supplies in the Processing Unit:

1. **Disconnect the power cord from the wall receptacle.**
2. Open both front and back doors to the unit.
3. Carefully unscrew two knurled captive screws from the flanges of the side panel.
4. Slide the panel down until the top edge clears the cabinet, and pull it away from the cabinet.

5.3.1 AC Power Supply (ACDU)

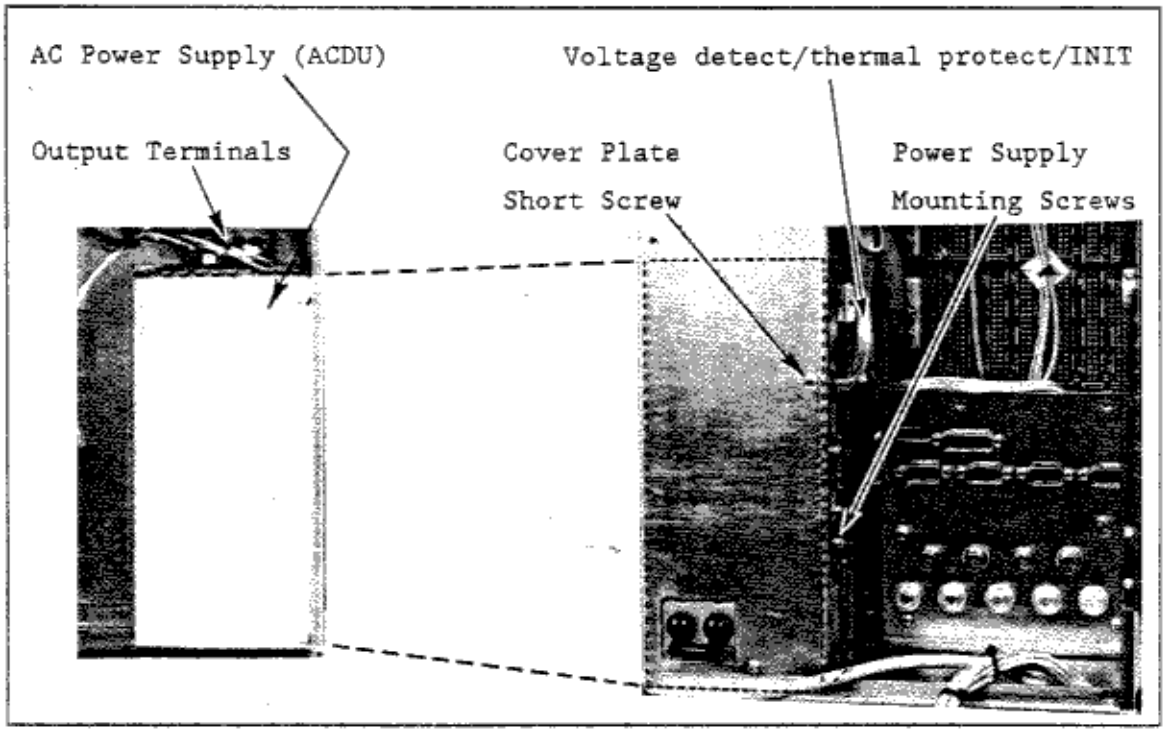

FIGURE 5-2 AC POWER SUPPLY

1. Make sure the power cord is disconnected from the power source.
2. Inside the rear compartment, unplug the Monitor power cord and the Monitor reset cable (the reset cable plug is secured by screws).

3. Remove the large cover plate (nine screws).
4. Unplug the Voltage detect/thermal protect/INIT cable (modular phone-type) leading from the backplane.
5. Referring to Figure 5-2, locate and disconnect three output leads (black, white, green) from the ACDU.
6. Inside the rear compartment remove two screws, and on the rear panel remove one screw holding the power supply in the cabinet (see Figure 5-2).
7. When replacing the large cover plate, be sure the short screw is installed in the bottom hole (Figure 5-2).

5.3.2 +5 Volt Power Supply

1. Make sure the power cord is disconnected from the power source.
2. Referring to Figure 5-3, locate and disconnect three input leads (black, white, green), two +5V output leads (red, black), and one ground lead (green) from the supply.
4. Remove four screws (at the corners) holding the power supply in the cabinet.

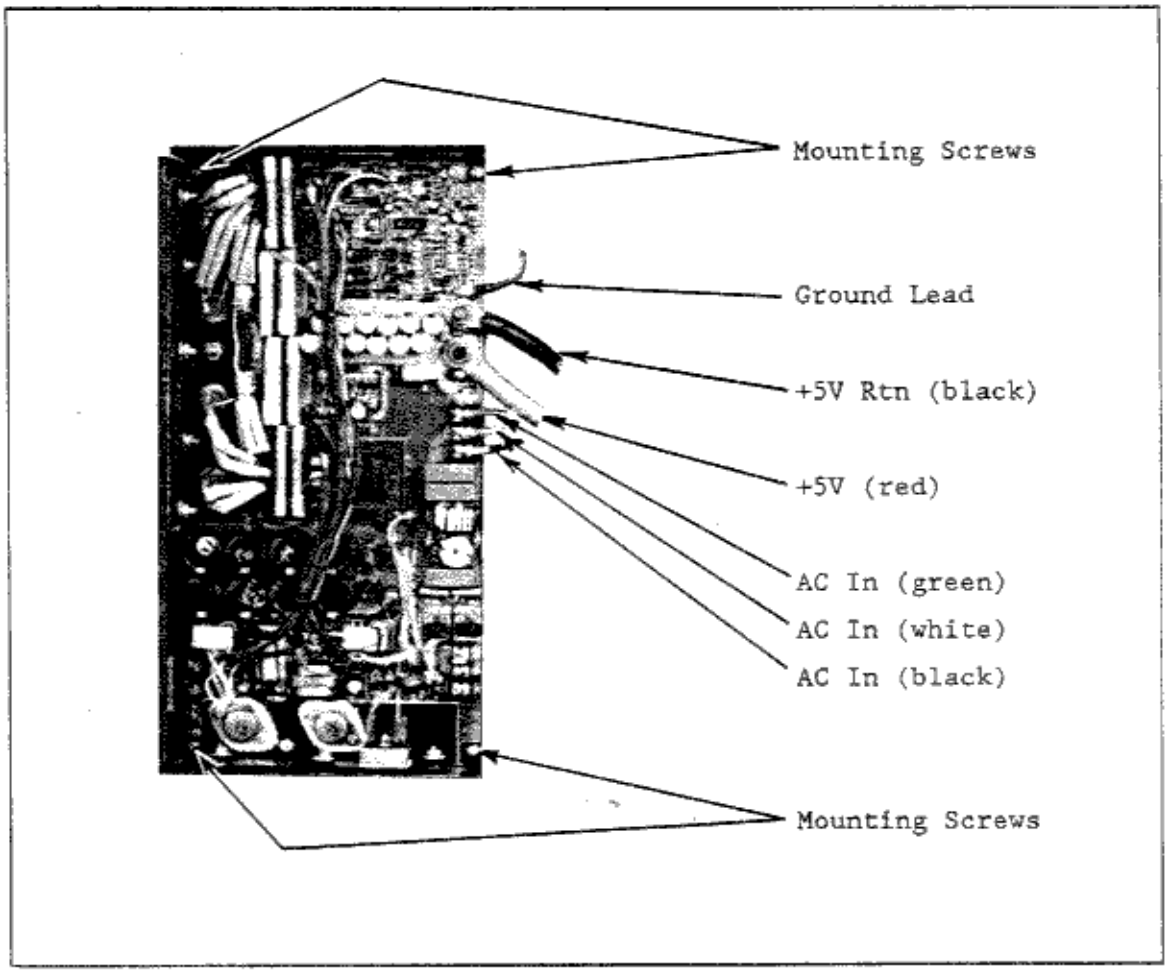

FIGURE 5-3 +5 VOLT POWER SUPPLY

5.3.3 -5V,+/-12V,+24V Power Supply

1. Make sure the power cord is disconnected from the power source.
2. Referring to Figure 5-4, locate and disconnect three input leads (black, white, green, at the bottom) and 10 output leads (terminals 1-4, 7-12, at the top) from the supply.
4. Remove four screws (in the flanges top and bottom) holding the power supply in the cabinet.

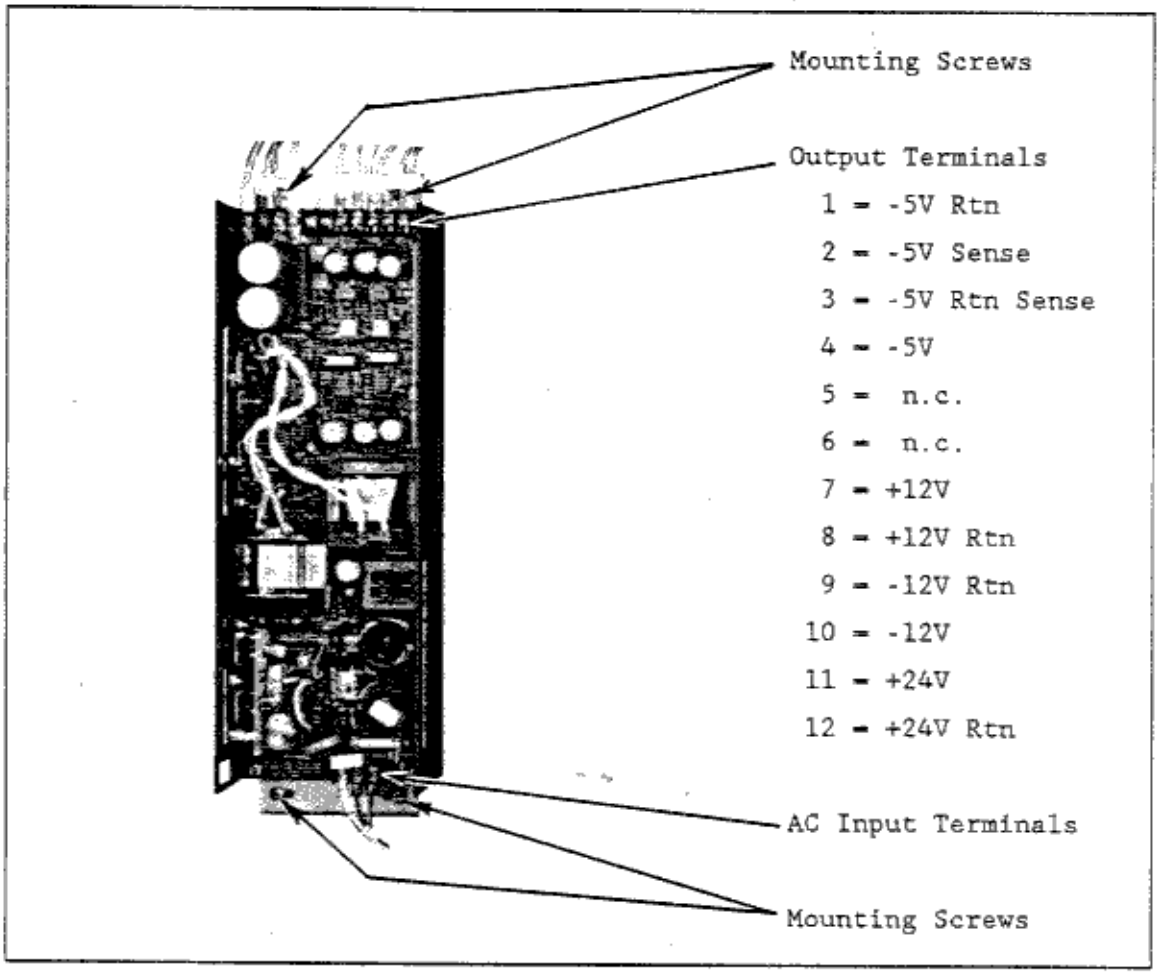

FIGURE 5-4 -5V,+/-12V,+24V POWER SUPPLY

5.3.4 -2 Volt Power Supply

1. Make sure the power cord is disconnected from the power source.
2. Inside the rear compartment, unplug the Monitor reset cable (the reset cable plug is secured by screws).
3. Remove the large cover plate (nine screws).
4. Referring to Figure 5-5, locate and disconnect three input leads (black, white, green, at the top) and two -2V output leads (at the bottom) from the supply.
5. Inside the rear compartment, remove four screws (at the corners) holding the power supply in the cabinet.
6. When replacing the large cover plate, be sure the short screw is installed in the bottom hole (Figure 5-5).

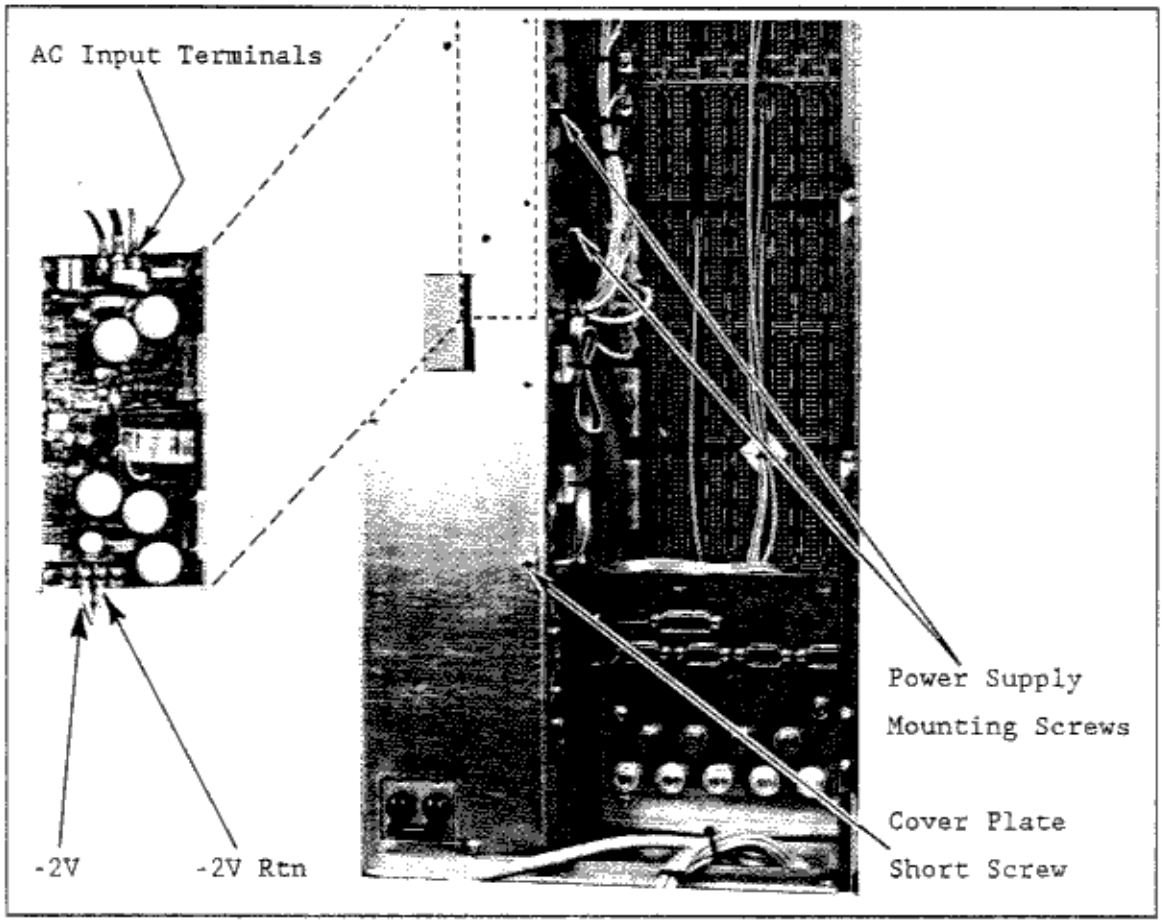

FIGURE 5-5 -2 VOLT POWER SUPPLY

5.4 TABLET REMOVAL

The tablet simply plugs into the front edge of the keyboard. No tools are needed for removal or replacement, but on new equipment it may be easier with two people.

1. Referring to Figure 5-6, press the two release buttons and pull the tablet straight out.

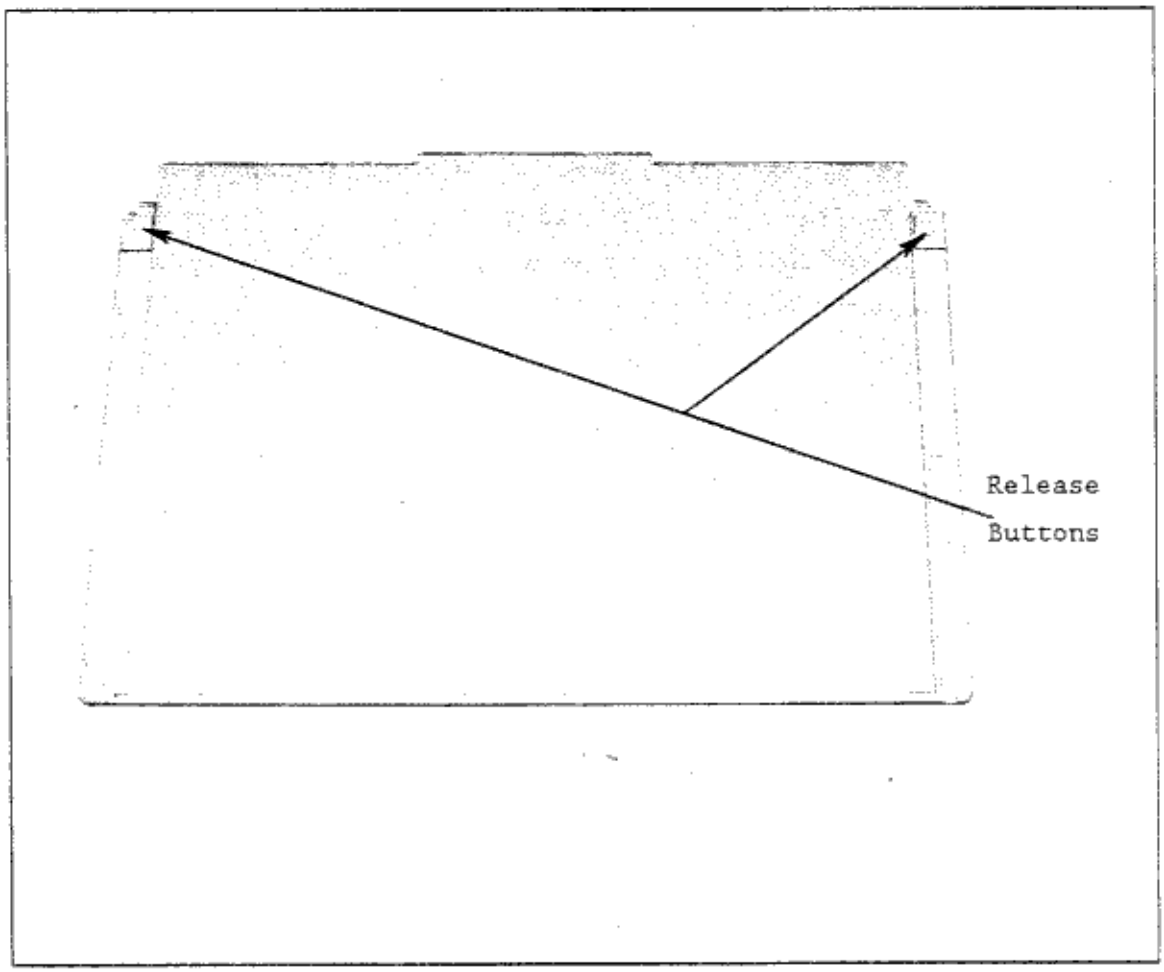

FIGURE 5-6 TABLET REMOVAL

5.5 BACKPLANE REMOVAL

To remove the backplane, all of the circuit boards must first be removed (see Section 5.2).

*** CAUTION ***

This product is extremely sensitive to electrostatic discharge. Do not remove printed circuit boards from the Processing Unit without antistatic protection.

1. Make sure the power cord is disconnected from the power source.
2. Inside the rear compartment, unplug the Monitor power cord and the Monitor reset cable (the reset cable plug is secured by screws).
3. Remove the large cover plate (nine screws).
4. Remove the cable clamp (two screws).
5. Unplug all the cables from the I/O panel.
6. Unplug the Voltage detect/thermal protect/INIT cable (modular phone-type) from the ACDU, and clip the cable ties holding the cable in place (see Figure 5-7).
7. Disconnect the twelve power leads from the terminals along the left edge of the backplane. The top six (J1-J6) are held by screw terminals. There are two leads each on post-type terminals J7 and J8. **The smaller posts on terminals J9 (black) and J10 (red) are not used.**
8. Remove two screws at the top of the backplane assembly and two screws at the bottom. **See Figure 5-7 to identify the proper screws.**
9. Rotate the backplane assembly (counterclockwise, seen from the top) as you pull it away from its mounting posts. Pull it out of the compartment bottom end first. The entire assembly is a field-replaceable unit (FRU).
10. **When replacing the large cover plate, be sure the short screw is installed in the bottom hole (Figure 5-7).**

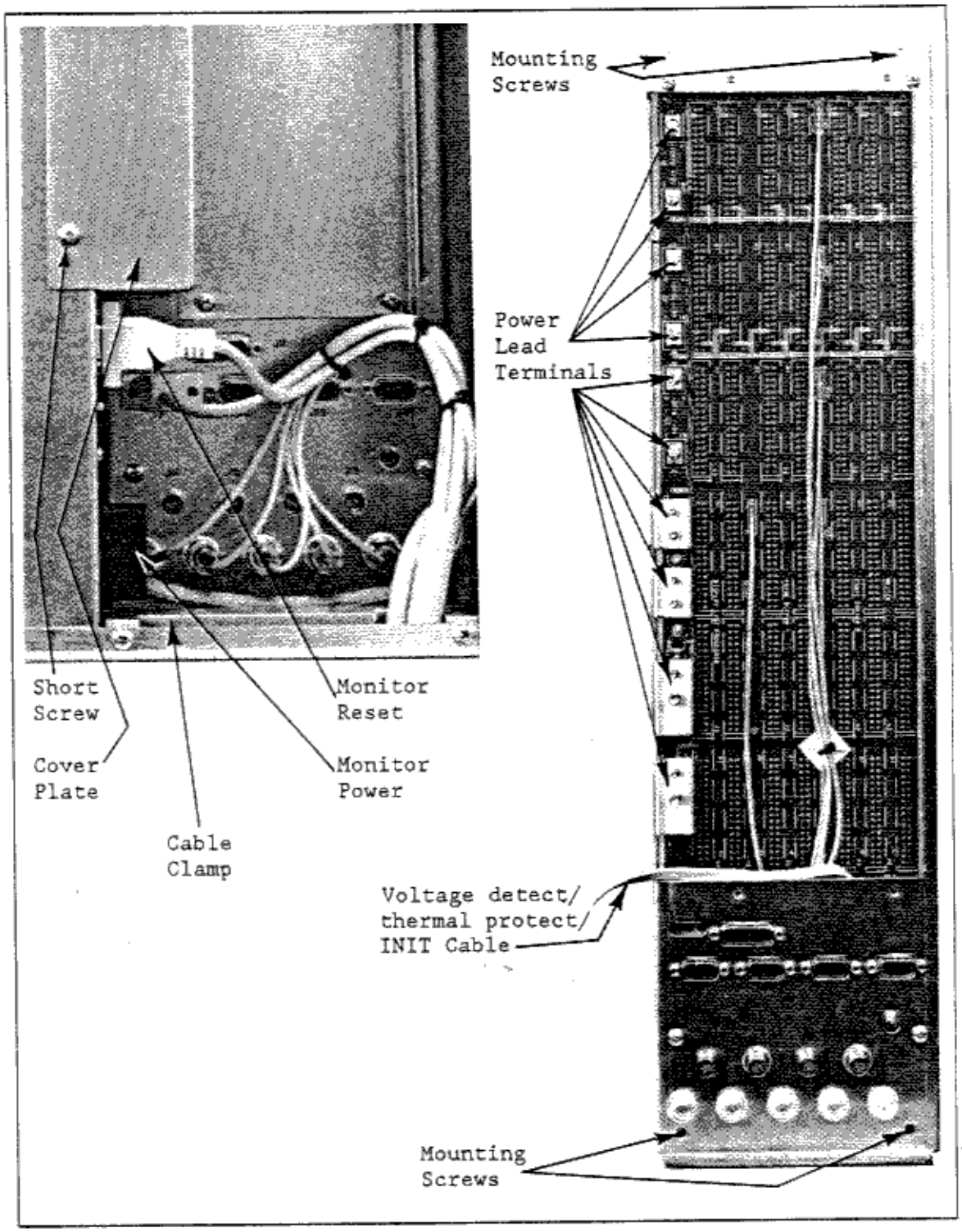

FIGURE 5-7 REMOVING BACKPLANE

CHAPTER 6
ALIGNMENT AND ADJUSTMENTS

6.1 INTRODUCTION

This chapter shows the adjustments that can be made in the field and outlines the preventive maintenance procedures for the workstation.

6.2 POWER SUPPLY ADJUSTMENTS

To check voltages in the Processor Unit power supplies, open both front and rear doors, and remove one screw from each flange of the right-side cover (see Figure 6-1). Swing the cover out an inch or two at the bottom, and slide it down until the top lip clears the cabinet. Set the cover aside.

***** WARNING *****

Exercise care when performing these tests. Voltages present during the following procedures can cause personal injury.. Also, improper use of test probes can severely damage user equipment.

The 4635A has three separate power supplies:

1. +5VDC
2. -5VDC, +/-12VDC, +24VDC
3. -2VDC

Each of these supplies draws from the 115VAC line. Using Figure 6-1 as a guide, measure all six voltages at the terminal strips. Because of voltage drops between supplies and the back plane, each one is slightly higher than nominal:

+5V	should read	+5.20Vdc	to	+5.25Vdc
-5V	should read	-5.20Vdc	to	-5.25Vdc
+12V	should read	+12.20Vdc	to	+12.25Vdc
-12V	should read	-12.20Vdc	to	-12.25Vdc
+24V	should read	+24.20Vdc	to	+24.25Vdc
-2V	should read	-2.00Vdc	to	-2.05Vdc

If necessary, adjust each voltage using a small-bladed screwdriver at the locations indicated in Figure 6-1.

***** CAUTION *****

Be careful to identify the correct adjustment points. Do not adjust those potentiometers marked "C BAR" or "OL ADJ".

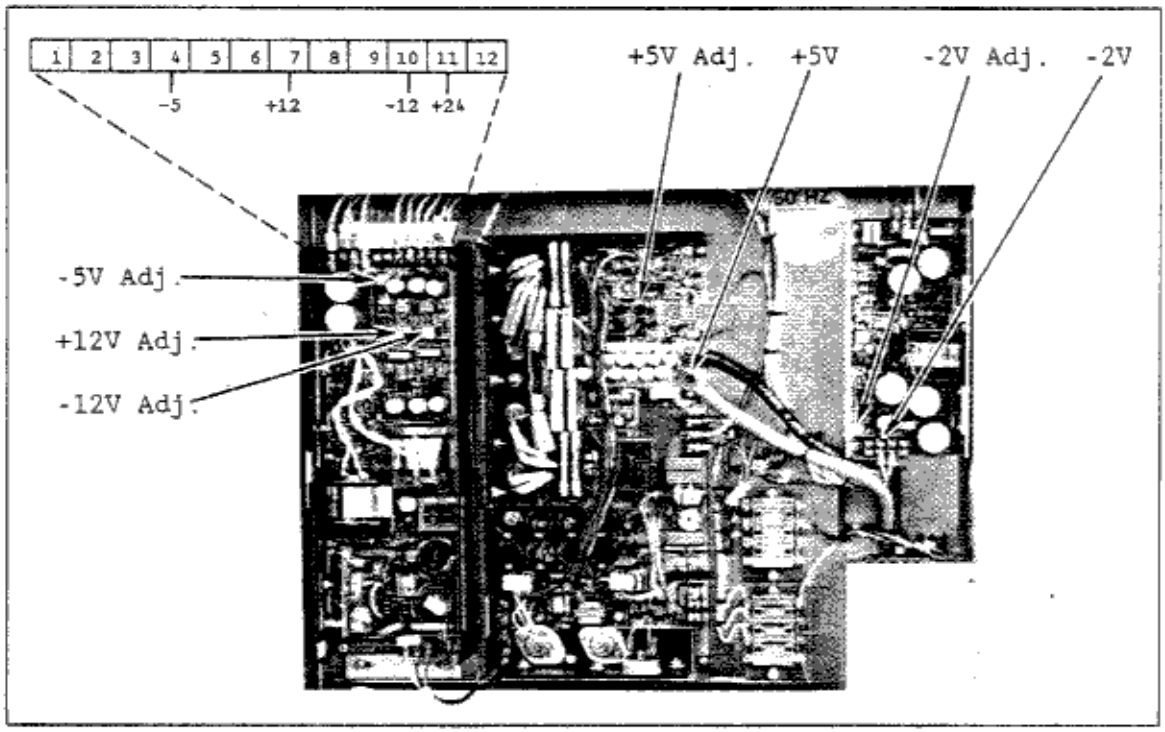

FIGURE 6-1 POWER SUPPLY VOLTAGE ADJUSTMENTS

6.3 PREVENTIVE MAINTENANCE

The 4635A Graphics Workstation requires very little maintenance. Aside from the cooling fans in the Processing Unit and the keyboard keys, there are no moving parts. Table 6-1 shows the recommended steps to take at intervals to make sure the workstation will perform trouble-free throughout its lifetime. Each maintenance step is described in the following sections.

TABLE 6-1 PREVENTIVE MAINTENANCE SCHEDULE

Component	Frequency	Tools Required	Procedure (section)
Monitor Screen	Quarterly	none	Wipe Clean (6.3.1)
Keyboard and Tablet	Quarterly	none	Wipe Clean (6.3.2)
Digitizing Pen	Quarterly	none	Check Operation(6.3.3)
Video Quality	Quarterly	none	Run Diagnostics(6.3.4)
Terminal Operation	Quarterly	none	Run Diagnostics(6.3.5)
Fans and Filter	Quarterly	none	Remove,Clean (6.3.6)
Power Supply Voltages	Quarterly	Screwdriver	Check,Adjust (6.2)

6.3.1 Monitor Screen

Clean the CRT surface with a soft, non-abrasive cloth or tissue, moistened with glass cleaner.

6.3.2 Keyboard and Tablet

Wipe the Keyboard and Digitizing Tablet surfaces with a damp cloth.

6.3.3 Digitizing Pen

Check the operation of the Digitizing Pen. It should roll smoothly across a surface, and actuate reliably. Replace if necessary.

6.3.4 Video Quality

Load and run DLTDIAG.COM, diagnostic EX to exercise and check the quality of the video image.

Use the Degauss control on the back of the Monitor to clarify the color.

Refer to the Monitronix MX-200 Service Manual for alignment and adjustment instructions for the Monitor.

6.3.5 Terminal Operation

Load and run DLTDIAG.COM diagnostic tests.

6.3.6 Fans and Air Filters

The Processing Unit air filters must be removed and cleaned periodically, the frequency of which depends upon the quality of the environment. The scheduled minimum is three months between cleanings.

1. Turn off the Workstation power.
2. Remove the right side panel of the Processing Unit by opening the front and back doors and removing two knurled screws. Slide the panel down to clear the lip of the cabinet, and pull it clear.
3. Unplug the fan power cable from its connector (see Figure 6-2).
4. Turn two captive latch screws, and pull the fan housing out of the cabinet.

5. Pull the mesh air filters (two pieces) up from the Velcro fasteners, wash in mild soap and water, and dry with the exhaust from a vacuum cleaner. Replace.
6. Wipe the fans clean before replacing the housing in the cabinet.
7. Tighten the captive latch screws and plug in the fan power cable.
8. Replace the side panel.

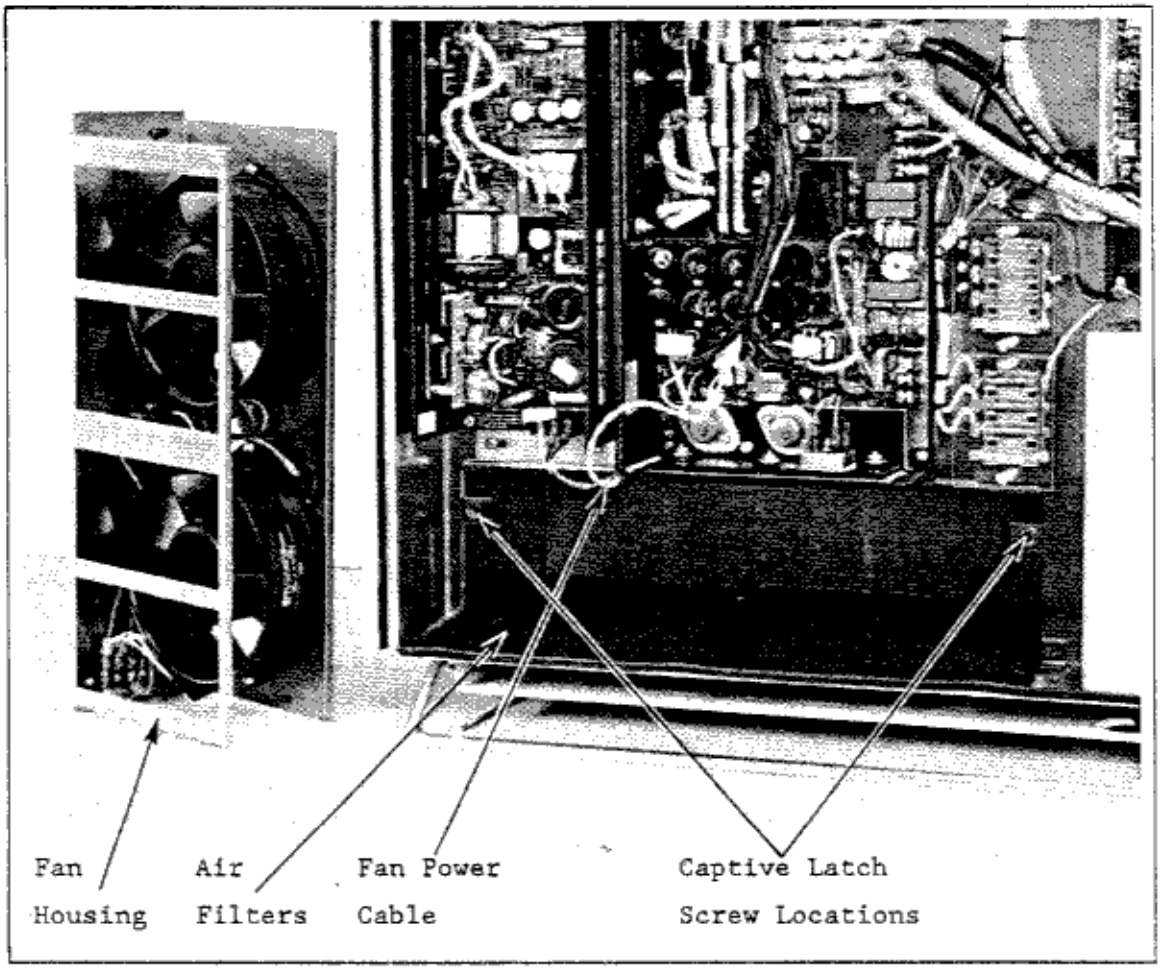

FIGURE 6-2 FANS AND AIR FILTERS

CHAPTER 7
DIAGNOSTICS AND TROUBLESHOOTING

7.1 INTRODUCTION

This chapter provides a concise set of troubleshooting procedures for isolating problems in the workstation, down to the level of field-replaceable units (FRU). The procedures make full use of terminal and system diagnostic software.

For more complete descriptions of the diagnostic software, refer to the Vax-Based Systems Diagnostic Handbook, Update A-29059-001.

7.2 GENERAL TROUBLESHOOTING TECHNIQUES

Troubleshooting computer devices requires a measure of skill that takes time and training to develop. The procedures included here assume that the service person has been trained in troubleshooting practices and has a general knowledge of Applicon products and computer graphics fundamentals.

Following are reminders of general rules for successful troubleshooting:

1. Keep the number of service people working on the device to a minimum. This reduces confusion over just what the problem is and what steps have been taken to correct it.
2. Keep detailed records of all repairs and adjustments made to the equipment. These can be invaluable in future troubleshooting.
3. Correct obvious faults first. Even though such faults may not seem to be related to the main problem or to diagnostic messages, correcting them will improve the operation of the equipment and

increase your level of confidence as you proceed with the troubleshooting.

4. Don't assume anything. As mentioned in the previous rule, just because a known fault seems unrelated to the problem does not eliminate it as the source (or one part of the source) of malfunction.
5. Isolate a fault to a particular device. Substitute components one at a time until the fault is corrected, and keep track of each substitution.
6. If the source of the malfunction is not apparent after a couple hours of troubleshooting, stop and review what you've done and the results. It may be that another approach would be helpful.
7. When you have solved the problem, review the process. If possible, determine whether other procedures might have been successful more quickly. Make notes. They could save you time and effort in the future.

7.3 PRELIMINARY EXAMINATION

7.3.1 User Interview

As soon as you arrive on site, discuss the problem with a knowledgeable user. Even a relatively unskilled user may have observed something that could turn out to be an important troubleshooting clue. Have someone demonstrate, if possible. Get hardcopy evidence if available. Then proceed methodically:

7.3.2 Workstation Inspection

After obtaining user information about the problem and the steps taken, check the following:

1. All switch settings, particularly those on the circuit boards and the back of the monitor (see Chapter 2).
2. All cable connections. Test them by hand, not simply by appearance.
3. Circuit board installation in the backplane.

7.4 TROUBLESHOOTING PROCEDURE

The following steps will help to narrow down the source of the malfunction to a field replaceable unit. See Chapter 5 for removal and replacement procedures.

NOTE

Tape-based system diagnostic software is required for this procedure (see 4635A section in Vax-Based Systems Diagnostic Handbook). This software is not to be left on the customer's system, but must be loaded from tape for each session. At the completion of the session, the software must be deleted from the disk.

1. Turn on power to the workstation by pressing (and holding momentarily) the "I" (On/Reset) button. If the indicator over the "I" button does not light, check the following:
   a. Power cord plugged in.
   b. Power available at the receptacle.
   c. Main circuit breaker on (up). Switch off then on again.
   d. Monitor power switch on rear of monitor on.

2. Remove the side cover from the Processing Unit, and check voltages as described in Chapter 6. If voltages are absent at one of the DC power supplies, check fuses S1, S2, and S3.

NOTE

Do not replace any fuses on the DC power supplies themselves. If one of these fuses is blown, the affected power supply should be replaced.

Adjust voltages if necessary to bring them within specified limits.

3. Press the "1" (ON/Reset) button, and allow the power-up self test PUDIAG to run. It takes approximately one minute.
   a. If the current test number begins flashing on the screen, a fault has been detected. (Testing is halted.) See Table 7-1 to identify the failed test and the location of the fault.
   b. If no message is displayed after the expected execution time, and if any of the LEDs on the DLP board is on or flashing, a fault has been detected. Read the failed test number (in binary code) from the flashing LEDs. See Figure 2-8, Chapter 2.
   c. If no message is displayed but the LEDs are all out, the problem may be in the terminal video subsection. In this case, it may still be possible to load the tape-based system diagnostics to isolate the problem.

TABLE 7-1 POWER-UP TESTS

Test #	Test	Board
1.	Clearing CPU general-purpose registers	DLP2
2.	Set and clear CPU registers	DLP2
3.	Test that CPU registers can add into each other	DLP2
4.	Test FP register	DLP2
5.	Basic CPU instructions	DLP2
6.	CPU integer arithmetic	DLP2
7.	Memory test (data = 0's)	DLP2
8.	Memory test (data = F's)	DLP2
9.	Memory test (data = 5's)	DLP2
10.	Memory test (data = A's)	DLP2
11.	Memory test (data = address)	DLP2
12.	Memory data retention test (data = A's)	DLP2
13.	Memory data retention test (data = 5's)	DLP2
14.	SIL 2K memory test (data = 0's)	DLP2
15.	SIL 2K memory test (data = F's)	DLP2
16.	SIL 2K memory test (data = 5's)	DLP2
17.	SIL 2K memory test (data = A's)	DLP2
18.	SIL 2K memory test (data = address)	DLP2
19.	SIL loopback test (TXSO-RXSI) inside 2652 dma cntr. chip	DLP2
20.	SIL loopback test thru turnaround relays and analog chips	DLP2
21.	DUART 40-pin Channel A RS232 internal loopback test	DLP2
22.	DUART 40-pin Channel B RS232 internal loopback test	DLP2
23.	DUART 24-pin Channel A RS232 internal loopback test	DLP2
24.	DUART 24-pin Channel B RS232 internal loopback test	DLP2
25.	DUART 40-pin interrupt test	DLP2
26.	DUART 24-pin interrupt test	DLP2
27.	Parity low interrupt test	DLP2
28.	Parity high interrupt test	DLP2
29.	SIL interrupt test	DLP2

4. Press "O" (Off) button on the monitor to turn off power to the workstation before exchanging boards.

CAUTION

This workstation is extremely sensitive to electrostatic discharge. Do not remove printed circuit boards from the Processing Unit without antistatic protection. If you must remove a board, have an antistatic pad prepared to lay the board on. Clip the lead of an antistatic wrist strap to the two small holes just inside the front door, and fasten the strap on your wrist. Only then should you remove a board.

5. When the self-test is complete, the workstation will pause briefly before automatically downloading the system software. If you want something other than the software download, you have three seconds to press a control-key combination to select an option:

   CTRL-M Bring up Terminal Power-Up Menu
   CTRL-P Start Power-up Self-test again
   CTRL-D Start System Diagnostics (see next step)

6. Press CTRL-D to load and start DLTDIAG, a command file that prepares the following diagnostic tests (in the SYS$TEST directory) for execution:

TABLE 7-2 DLTDIAG DIAGNOSTIC TESTS

LINK	Host-Terminal Connection Test
DLP	Display List Processor Test
GP	Graphic Processor Test
XP	Transformation Processor Test (not used)
FBC	Frame Buffer Controller Test
FB0	Frame Buffer 0 Test
FB1	Frame Buffer 1 Test (not used)
EX	Graphic Exerciser

The tests are described in Vax-Based Systems Diagnostic Handbook. Once prepared, the individual tests are selected from a menu for loading and execution. (They execute from RAM on the DLP board.)

NOTE

To run the Graphic Exerciser test EX, you must first allow the system software to be loaded. Then, press "1" (On/Reset), and immediately press CTRL-D to load the diagnostics.

7. If the workstation does not respond to the keyboard, check to see that the connecting cables are securely plugged in. If they are, a micro-circuit breaker on the backplane assembly may be tripped. These three circuit breakers (Figure 7-1) protect the RS232 circuits. To reset, press them with a small screwdriver or pencil point.

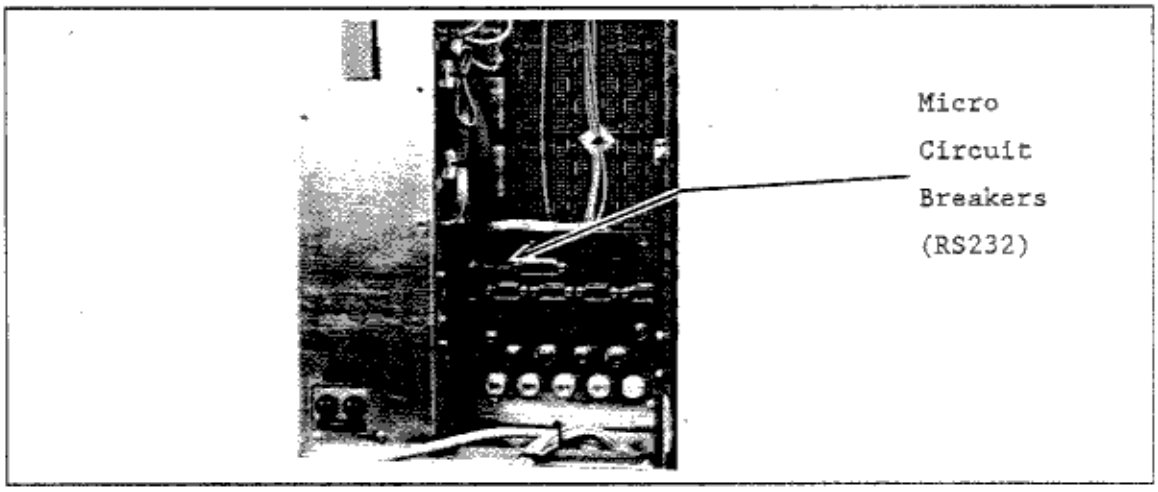

FIGURE 7-1 MICRO-CIRCUIT BREAKERS

8. To run the diagnostic tests, press one of the Function Keys, as indicated in the menu.

NOTE

In the beginning, execute the tests in the order listed (e.g., F1, F2, F3, etc.), to check the more basic functions before those that depend upon them.

The test will be loaded, with a line displayed to indicate progress of the load. Then you will be given the opportunity to select from certain options during the test. If you do nothing, or press <RETURN>, these defaults will apply:

Stop on error
No progress messages
Run one pass thru all tests
Autostart program in 5 seconds
No help information

9. To change any of these defaults, press "N" within five seconds after this list appears on the display. The following questions will be displayed in turn. The default for each is shown in brackets ([ ]). To select the default, simply press <RETURN>. Otherwise, respond with "Y" or "N".

Do you want HELP information [N]?
Do you want to see a directory of all the tests [N]?
Loop on test if error [N]?
Stop on error [Y]?
Run specified test(s) [All]?
(Any response other than RETURN will bring:)
Do you want to select a range of tests to run [N]?
(if RETURN or "N":)
Enter test number of the test you want to run:
(otherwise:)
Enter the starting test number [1]:
Enter the last test number you want to run [max]:
Inhibit progress messages [N]?
Inhibit pass messages [N]?
Loop on test 1k times [N]?

Terminate test after 20 errors [Y]?

Enter the number of passes you want to run [1]?

10. As the tests run, the following keyboard actions will affect the progress of the test, or the display:

    CTRL-C, CTRL-Z, or any Function key will restart the test in progress.

    CTRL-Y or ESC/INT will abort the test and return to the Power-up menu.

    NoScroll will cause the test to pause. Press again to resume. (During the pause, keyboard input is disabled except for NoScroll and ESC/INT keys.)

If an error occurs during execution of one of the tests, a message similar to the example in Figure 7-2 will be displayed:

```
** ERR IN TEST # 12

EXPECTED VALUE (HEX): 00000080
FOUND VALUE (HEX)...: 00000000
XOR OF DATA (HEX)...: 00000080

Failure on test program GP: One of the following, listed in
order of decreasing probability, is faulty:

*****************************
*                           *
* GRAPHIC PROCESSOR faulty *
*                           *
*****************************

<CR> [Continue], T, P [Rerun T_est or P_rogram],
N [Next test], Q [Quit], C [Clear CRT]: __
```

FIGURE 7-2 DIAGNOSTIC ERROR DISPLAY

If you chose the Stop-On-Error option, the program will wait for keyboard input.

11. When a test is completed, the menu will return. Select another test or, to terminate the diagnostics, press "1" (On/Reset) on the Monitor. The power-up self-test will run, then the terminal system software will be loaded automatically.
12. Before leaving the site, be sure to delete the diagnostic programs from the host disk. To do this:
    a. At the OPA0: terminal, enter:

       $@DLTDIAG.COM

       The System Diagnostics Installation Menu will appear.
    b. Enter 2. The tape-based diagnostics will be deleted.