Part No. 070-7571-00

XD88 SERIES GRAPHICS WORKSTATIONS

FIELD SERVICE OVERVIEW

Please check for CHANGE INFORMATION at the rear of this manual

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Tektronix
COMMITTED TO EXCELLENCE

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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SERVICE SAFETY SUMMARY

FOR QUALIFIED PERSONNEL ONLY

Refer also to the Operator Safety Summary.

SYMBOLS ON EQUIPMENT

⚠ ATTENTION — refer to manual.

⏚ Protective ground (earth) terminal.

DO NOT SERVICE ALONE

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

USE CARE WHEN SERVICING WITH POWER ON

Dangerous voltages may exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing the power supply shield, soldering, or replacing components.

X-RADIATION

X-ray emission generated within this instrument has been sufficiently shielded. Do not modify or otherwise alter the high voltage circuitry or the CRT enclosure.

POWER SOURCE

This product is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

DC SUPPLIES

When working with DC power supplies, a potentially dangerous voltage may exist even after turning the power off. Wait at least one minute after the power is disconnected before reaching in to service the supply. This allows the voltage to discharge to a safe level.

HANDLING

Due to the weight of some instruments and component subassemblies, at least two persons may be required to perform installation or service to prevent injury to personnel or damage to the instrument.

DO NOT WEAR JEWELRY

Remove jewelry prior to servicing. Rings, necklaces, and other metallic objects could come into contact with dangerous voltages and currents.

IMPLOSION PROTECTION

The CRT may implode if it is struck or scratched. Use care when handling the CRT. Wear protective clothing and a face shield when handling the CRT.

Section 1

INTRODUCTION

PRODUCT OVERVIEW

This manual set provides field-level service information for the Tektronix XD88 Series products. At this time these products include the following:

- XD88/01 — Compute Server. This is a high-speed application engine that uses the UTek V operating system.
- XD88/05 — Server Node. This is similar to the /01, but it is configured to provide data and software to other machines on the network.
- XD88/20 — 2D Graphics Workstation. This is an /01 computer integrally connnected to a 2D graphics machine (4225).
- XD88/30 — 3D Graphics Workstation. This is an /01 computer driving a 4230-type graphics machine.

All the XD88 products are designed to operate on a network, as depicted in Figure 1-1. In Section 3 we'll talk more about the various systems and configurations that are possible, based on the XD88 family of products.

A central part of the XD88 family is the Compute Engine Module (also called CEM, or Compute Module) that has the following key elements:

- The Motorola 88K RISC processor and related hardware architecture (The "Reduced Insruction Set Computer" provides increased speed).
- UTek V operating system (based on AT&T's Unix System V with Tek's own Berkeley-type enhancements)

It is the purpose of this manual to give you an overview of the XD88 products and their servicing requirements.

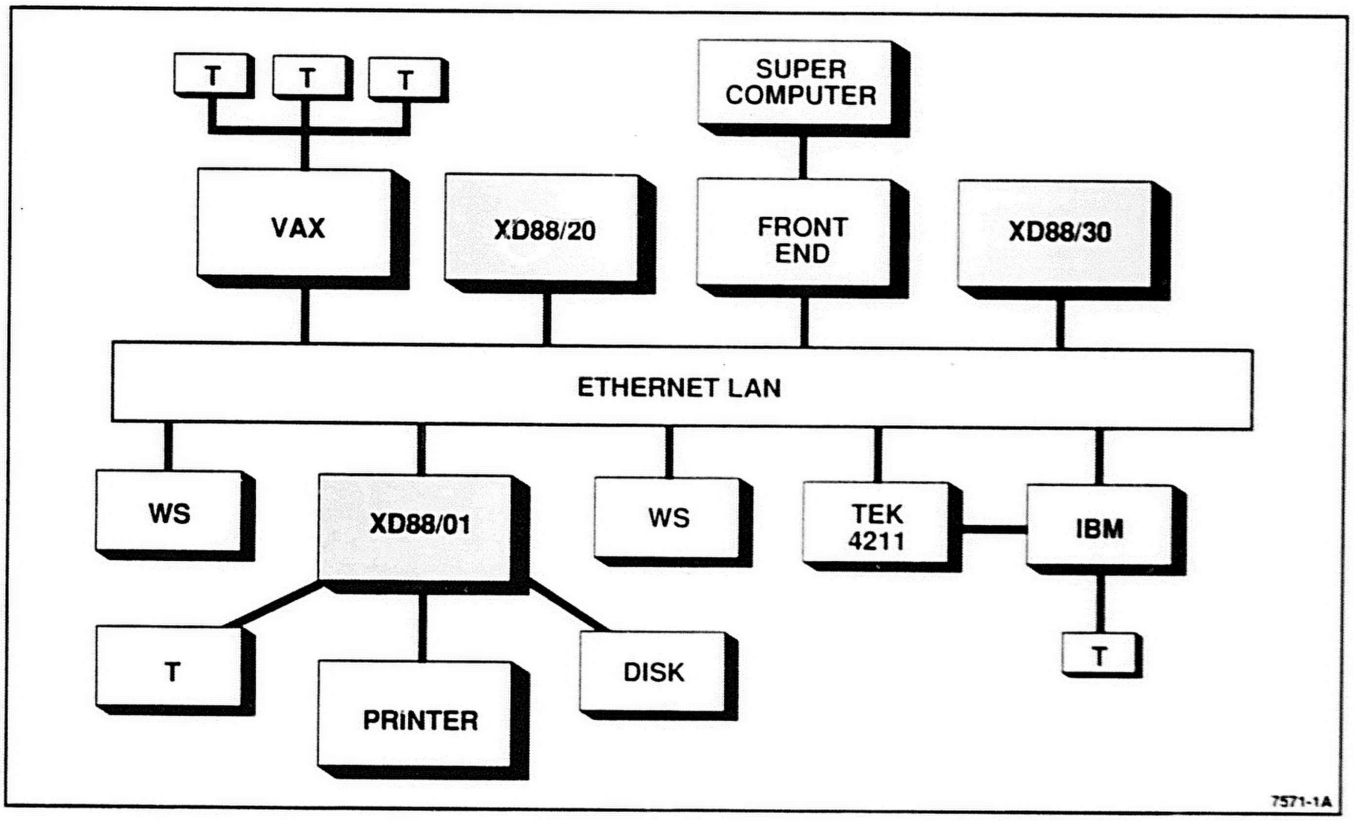

Figure 1-1. XD88 Products on Network.

USING THIS MANUAL SET

The field service documentation for the XD88 products is divided up into several individual manuals, one for each major module in the system. This overview manual is the "glue" that connects these manuals into a coherent and organized set. This overview manual will suggest a logical arrangement for your manuals initially; then it will serve as a roadmap later, directing you to information as you need it.

The XD88 products consist of various hardware "modules" and Table 1-1 shows the manuals that correspond to each of these modules.

Organization of Information

Each manual in this set contains the same catagories of information, arranged in the same approximate order. The section titles are nearly identical from manual to manual for any given section number. This consistency makes it much easy to locate information.

The sections in each manual, generally, follow this order:

Section 1, Introduction

Section 2, Specifications

Section 3, Theory Overview

Section 4, Diagnostics

Section 5, Maintenance Procedures

Section 6, Performance Checks

Section 7, Replaceable Parts List

Section 8, Diagrams

Appendix A, Installation and F01 Upgrade

Appendix B, Strapping Information

Appendix C, Self-test Error Codes <added in later edition>

Table 1-1
XD88 MODULES AND RELATED SERVICE MANUALS

XD88 Module	Manual Title	Part Number
Compute Module	XD88 CEM Field Service	070-7572-00
2D Graphics Module	2D Graphics Engine Module Field Service	070-7374-00
3D Graphics Module	3D Graphics Engine Module Field Service	070-7377-00
16-inch Display Module	16" Display Module Field Service	070-7242-00
19-inch Display Module	19" Display Module Field Service	070-7243-00
Keyboard & Mouse	VT200 Keyboard and Mouse Field Service	070-7244-00
Mass Memory Unit	4944 MSU Field Service	070-7654-00

SYSTEM CONTROLS AND CONNECTORS

An XD88/01 Compute Server and /05 Server Node have essentially the same front connectors; their rear features are the same, too. These are shown in Figure 1-2. The front view shows a flexible disk unit, which is optional.

The XD88/20 and XD88/30 workstations expand on this picture to include Graphics Module controls and connectors as well. The Graphics Module will NOT contain a flexible disk unit, unless it was originally part of a 4220/4230 terminal or 4320/4330 workstation that was upgraded to an XD88 workstation (via F-kit XD88F01). Figures 1-3 and 1-4 show the XD88/20 and XD88/30 GEM front and rear features. Figure 1-5 shows the controls on the display unit.

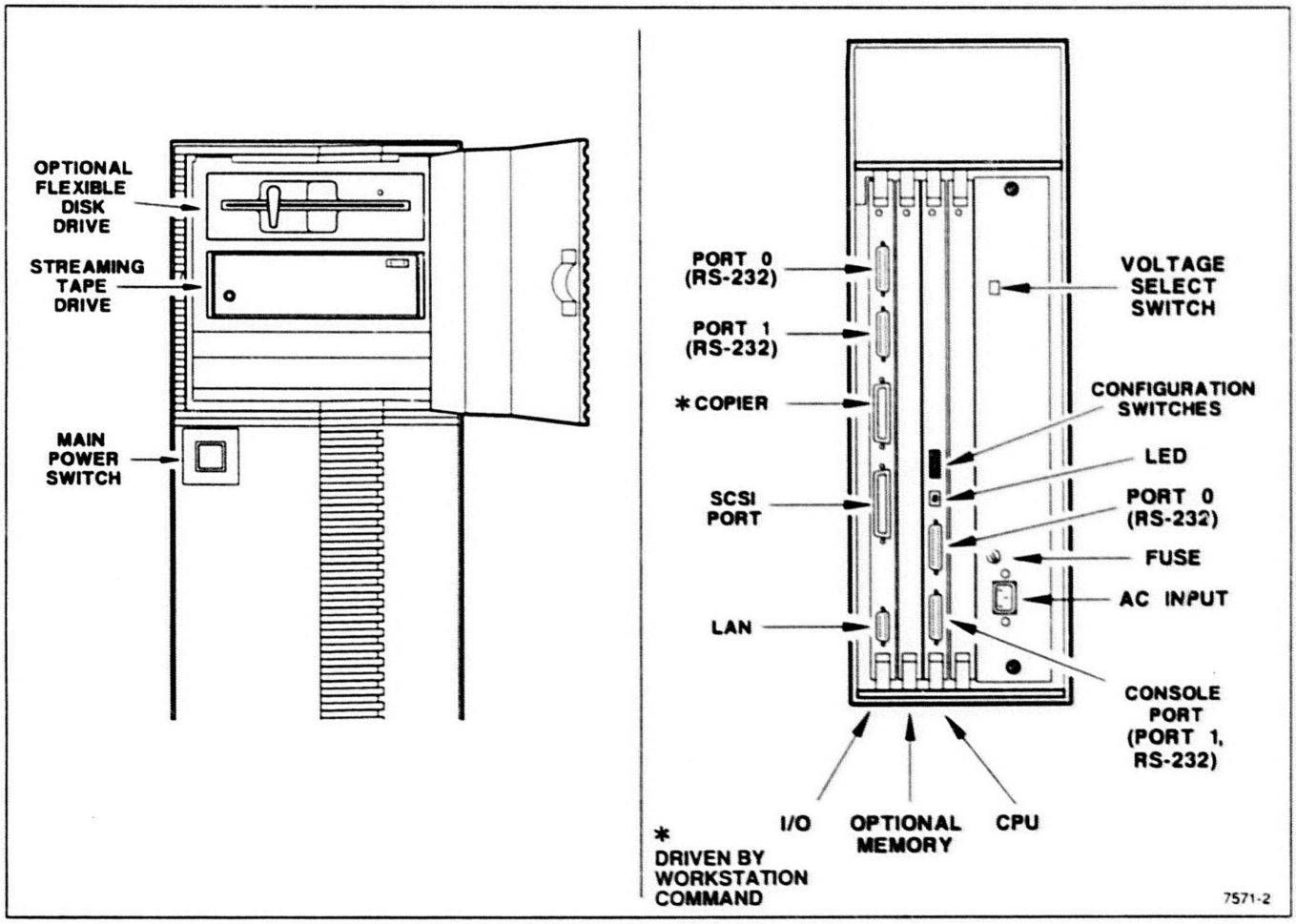

Figure 1-2. XD88/01 and /05 Front and Rear Features.

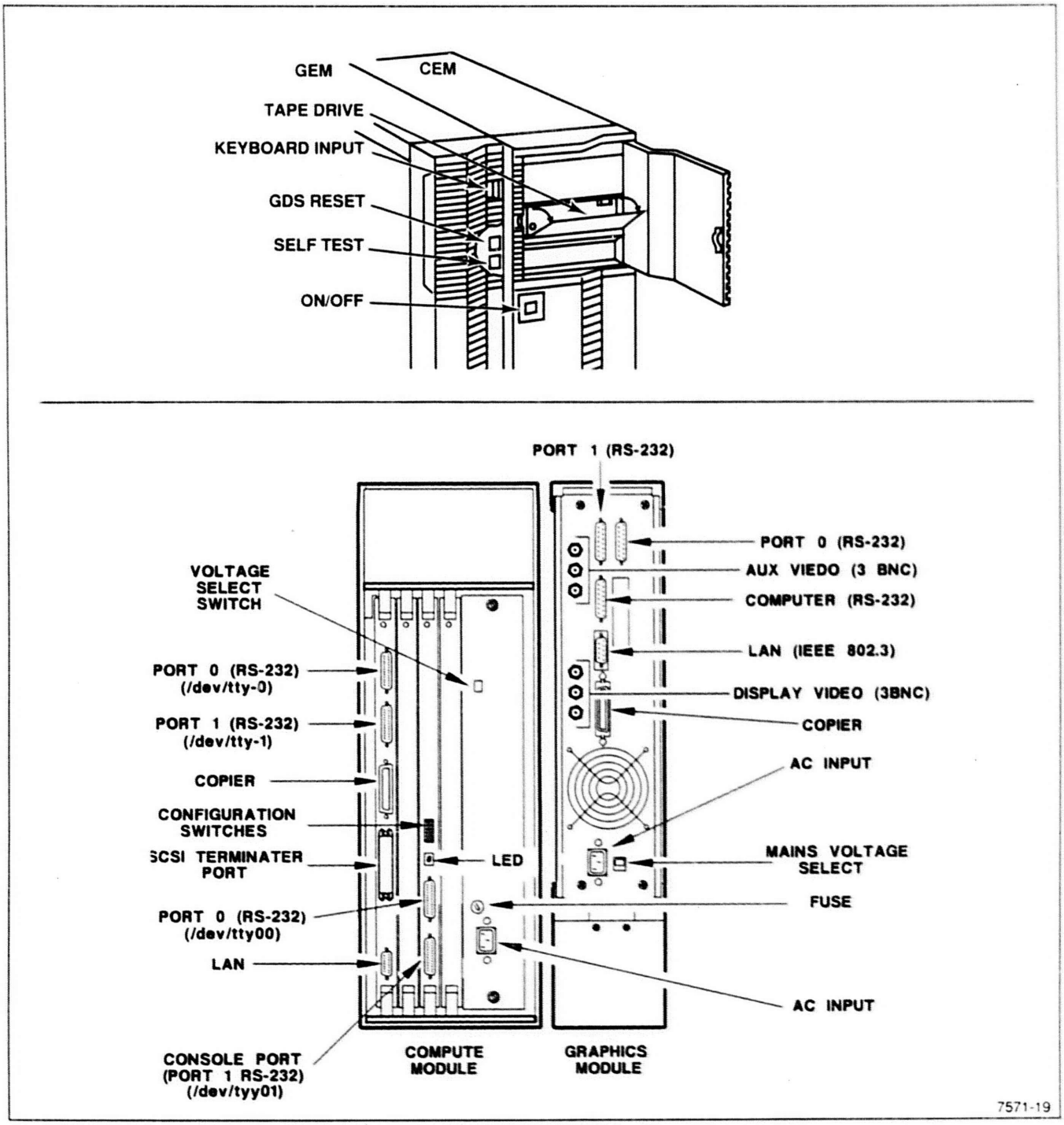

Figure 1-3. XD88/20 (GEM) Front and Rear Features.

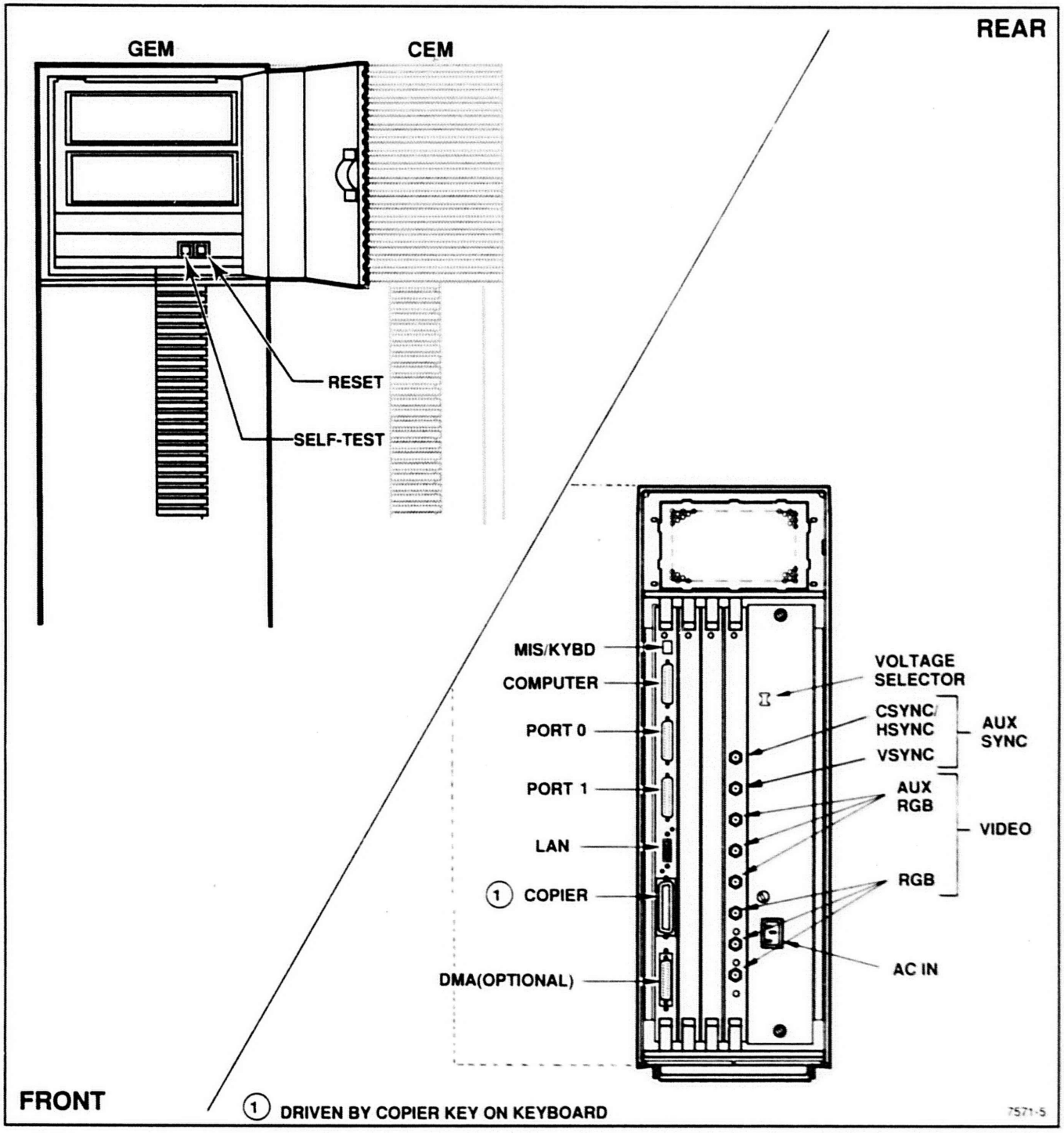

Figure 1-4. XD88/30 (GEM) Front and Rear Features.

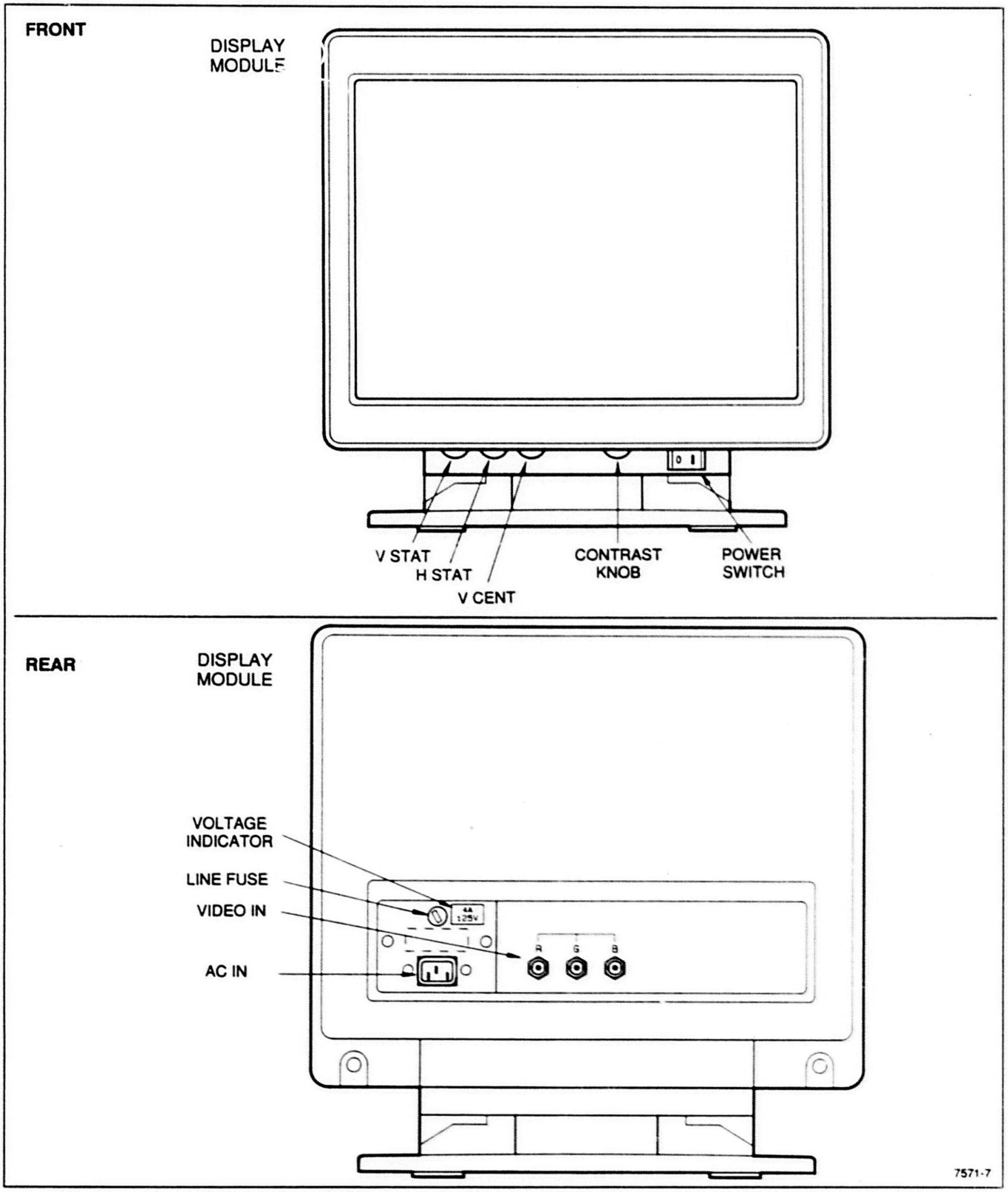

Figure 1-5. XD88 Series Display Module Front and Rear Features.

WHERE TO LOOK FOR DIAGNOSTIC INFORMATION

Diagnostic information is located in this manual in Section 4 and in Appendix C; related information is in Section 4 of each modular manual in this set. (Do NOT overlook information in the other manuals.)

Section 4 of this manual contains a thorough overview of the diagnostics for the XD88 family. It especially focuses on the diagnostics system for the /20 and /30 workstations. Appendix C contains more detailed descriptions of error codes. As you look through the other modular manuals in the set, you'll find diagnostic information that is specific to that module, but this overview manual provides the overall picture of the system diagnostics.

The XD88 diagnostics operate in conjuction with the UTek V operating system. A secondary operating system called "DiNEX-2" manages the diagnostic routines. Normally, it is invisible to the user. During power-up and during Self-test, this operating system calls numerous diagnostic routines that check the CEM's hardware and any GEM hardware that is attached (in a workstation configuration).

In some cases, a malfunctioning machine will never reach the point where it runs UTek V. But it may display the DiNEX-2 system prompt. If you want to exercise DiNEX-2 and need more information about its commands, you can call its man pages to the screen just like with the main operating system. These man pages will explain the use of its commands and help you find your way around in DiNEX-2.

OPTIONS AND ACCESSORIES

Options

Table 1-2 lists the options for all XD88 products. Manuals are listed separately because they are not classified as "options" to the product.

Accessories

The XD88 Series Introduction manual lists all the user-oriented standard and optional accessories (such as manuals). The service person will have particular need for such accessories as the RS-232 loopback connector, display calibration graticule, service manuals for peripherals, and extra host and power cords. The part numbers for these items are listed in Section 7, Replaceable Parts List.

Table 1-2
XD88 OPTIONS LIST

Option	Description	Where Used
A1	220V Euro plug	all
A2	240V UK plug	all
A3	240V Austr plug	all
A5	220V Swiss plug	all
A9	No power cord (set for 220V)	all
E1	1 yr use of Customer Support Center	all
E2	2 yr use of CSC	all
E3	3 yr use of CSC	all
E4	90 day OEM service	all
E9	1 yr CSC & S/W subscription service	all
VA	VT200 Keyboard - UK	/20 /30
VB	VT200 Keybard - French	/20 /30
VC	VT200 Keyboard - Swedish	/20 /30
VF	VT200 Keyboard - Danish/Norw	/20 /30
VG	VT200 Keyboard - Germany	/20 /30
VI	VT200 Keyboard - Italian	/20 /30
VS	VT200 Keyboard - Spanish	/20 /30
1A	Add 8MB main memory (total 16MB)	all
1B	Add 24MB main memory (total 32MB)	all
1C	Add 40MB main memory (total 48MB)	all
1D	Add 56MB main memory (total 64MB)	all
1E	Add 72MB main memory (total 80MB)	all
1F	Add 88MB main memory (total 96MB)	all
1G	Add 104MB main memory (total 112MB)	all
1H	Add 120MB main memory (total 128MB)	all
1J	Add 136MB main memory (total 144MB)	all
1K	Add 152MB main memory (total 160MB)	all
1M	Add 168MB main memory (total 176MB)	all
1U	Add 4 CMMUs (total of 8 CMMUs)	all
08	PAL Video I/F (digital)	all
09	NTSC Video I/F (digital)	all
13	Removable hard disk requires 4944 with Opt. 44	all
14	Add 1.2MB flex drive (for Soft PC)	all
17	300MB hard disk (replaces 156MB disk)	all
18	600MB hard disk (replaces 156MB disk)	all
19	Add 600MB hard disk (total of 1.2 GB) requires Opt. 18 and Opt. 42 or 43	all
20	Add 16MB of Display List Memory	/30
21	Add 8MB of Display List Memory	/30
22	Add 4MB of Display List Memory	/20
3A	RS-232 DMA (needs Opt 3G) = 8 serial ports + Centronics printer port	all
3G	VME Bus Adapter, holds 1 board	all
3S	12 mo Int'l SSS	all
32	19" Display Unit (1280 x 1024)	/20 /30
33	Stereo display unit (19")	/30
34	19" Touch Screen (etched)	/20 /30
35	19" Touch Screen (unetched)	/20 /30
36	Add Z-buffer, total: 8 bit planes + Z Buffer	/30
37	Add 4 bit planes (total 12)	/30
38	Add 8 bit planes, double buffered + Z Buffer	/30
39	Add 16 bit planes, total: 12 planes doulble buffered or 24 true color plus Z buffer	/30
41	Add 1 Graphics Module unit	/30 only
42	Add 1 Compute Module unit	all
43	Add 2 Compute Modules (total 3)	all
DZ	Delete Z buffer	/30

NOTE

Table 1-2 references to "all" are /01, /20, /30; not /05.

Section 2

SPECIFICATIONS

This section lists performance requirements and supplemental information. Use the checks and adjustment procedures in Section 6 to verify the specifications in this section.

The following terms appear as headings in the tables in this section:

Characteristic: A property of the product.

Performance Requirement: Measurable performance characteristics.

Specification: The quantity/value of the characteristic item.

Supplemental Information: Explanations and related performance requirements.

PERFORMANCE CONDITIONS

Characteristics specified in this section are valid only under the following conditions.

1. The workstation must be at an ambient temperature between 68 and 86 degrees F (20 to 30 degrees C).
2. The workstation must be installed properly and must be operating within its environmental limits (see Table 2-8).
3. A warm-up time of at least 30 minutes must precede measurement of characteristics.
4. The workstation's power source must meet specified power requirements. See Section 6, Field Adjustment Procedures, and refer to Tables 2-9 through 2-12. The workstation is designed to operate from a power source whoes neutral line is at or near ground potential. It is not intended for operation from two phases of a multiphase system.

SPECIFICATION TABLES

The following tables are grouped logically, and contain specifications/characteristics for the workstation and its modules.

Table 2-1
SPECIFICATIONS TABLES

Table	Description
PHYSICAL DIMENSIONS	
2-2	CEM Dimensions
2-3	3D-GEM Dimensins
2-4	2D-GEM Dimensions
2-5	Keyboard & Thumbwheels
2-6	Mouse Dimensions
2-7	Valuator Dials Dimensions
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ELECTRICAL SPECIFICATIONS	
2-9	CEM & 3D-GEM Electrical
2-10	2D-GEM Electrical
2-11	Display Module Electrical
2-12	Fuses
SITE CONSIDERATIONS	
2-13	Environmental Specifications
2-14	Installation Requirements
PERFORMANCE SPECIFICATIONS	
2-15	Compute Performance
2-16	Graphics Characteristics
2-17	Alphanumeric Character Sets
2-18	Communications Performance
2-19	Display Module Performance

PHYSICAL DIMENSIONS

Table 2-2
CEM DIMENSIONS

Characteristic	Specification
Weight	68 lbs (30.9 kg)
Width	7.9 in (201 mm)
Height	24.2 in (615 mm)
Depth	23.8 in (605 mm)

Table 2-3
3D-GEM DIMENSIONS

Characteristic	Specification
Weight	60 lbs (27.3 kg)
Width	7.9 in (201 mm)
Height	24.2 in (615 mm)
Depth	23.8 in (605 mm)

Table 2-4
2D-GEM DIMENSIONS

Characteristic	Specification
Weight	29.5 lbs (13.4 kg)
Width	5.0 in (127 mm)
Height	18 in (457 mm)
Depth	20.9 in (530 mm)

Table 2-5
KEYBOARD & THUMBWHEELS DIMENSIONS

Characteristic	Specification
Weight (kybd only)	3.38 lbs (1.5 kg)
Length	
Keyboard	19.75 in (501.6 mm)
Thumbwheels	4.00 in (102 mm)
Height (both)	
Bail Retracted	1.5 in (38.1 mm)
Bail Extended	2.85 in (72.9 mm)
Depth (both)	7.25 in (184.2 mm)

Table 2-6
MOUSE DIMENSIONS

Characteristic	Specification
Weight	6.0 oz (170 g)
Width	2.75 in (69.9 mm)
Height	1.2 in (31 mm)
Length	3.75 in (95.3 mm)

Table 2-7
VALUATOR DIALS DIMENSIONS

Characteristic	Specification
Weight	4.3 lbs (1.95 kg)
Width	11.25 in (286 mm)
Height	8.15 in (207 mm)
Depth	2.20 in (56 mm)

Table 2-8
DISPLAY MODULE DIMENSIONS

Characteristic	Specification	
	16 inch	Optional 19 inch
Weight	65 lbs (29 kg)	85 lbs (38.5 kg)
Width	16 in (406 mm)	18.9 in (480 mm)
Height	16 in (406 mm)	18.7 in (475 mm)
Depth	17.7 in (450 mm)	21 in (533 mm)
Display area	11.6 x 9.3 in (295 x 236 mm)	13.5 x 10.8 in (343 x 274 mm)

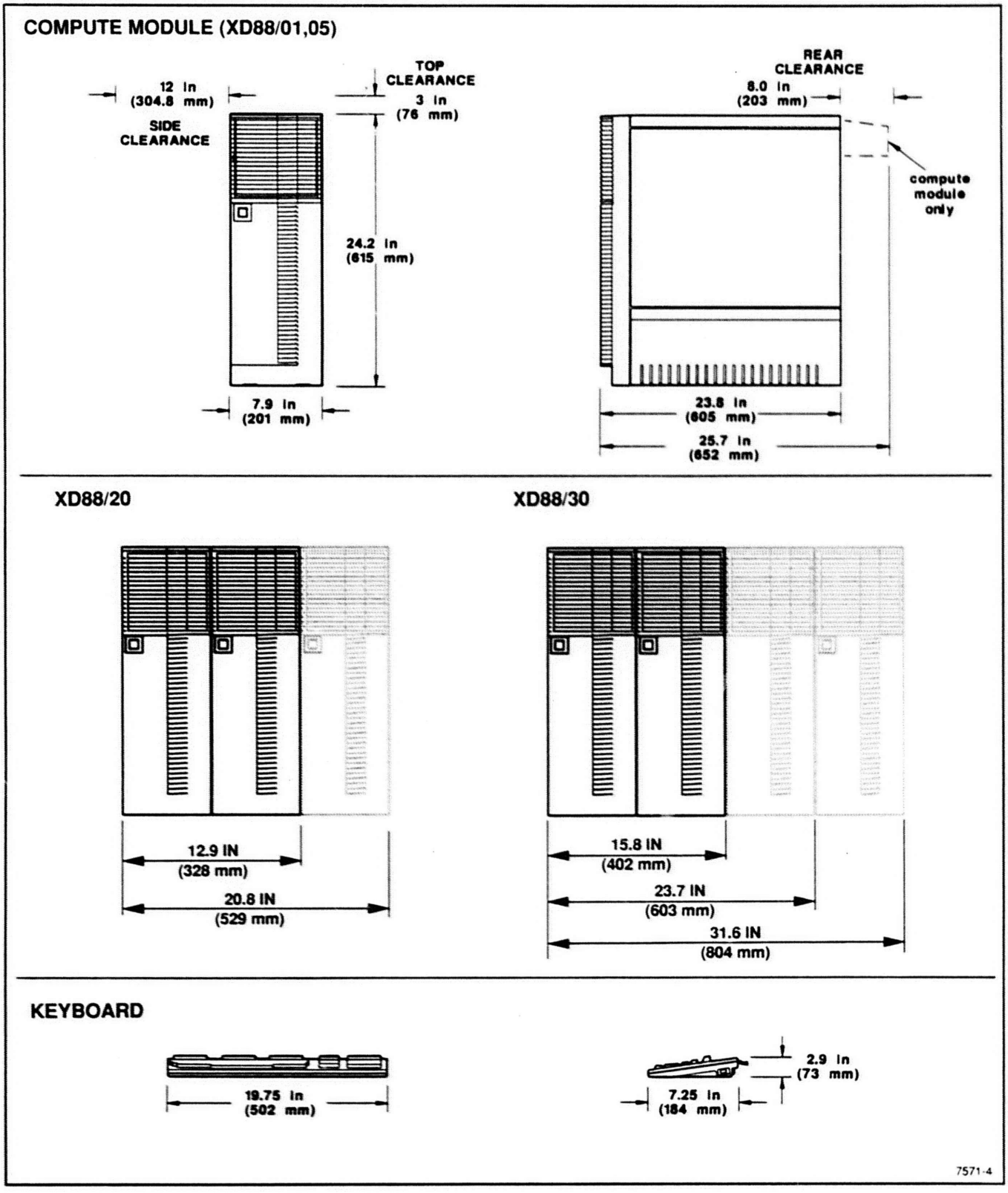

Figure 2-1. Physical Dimensions (Part 1).

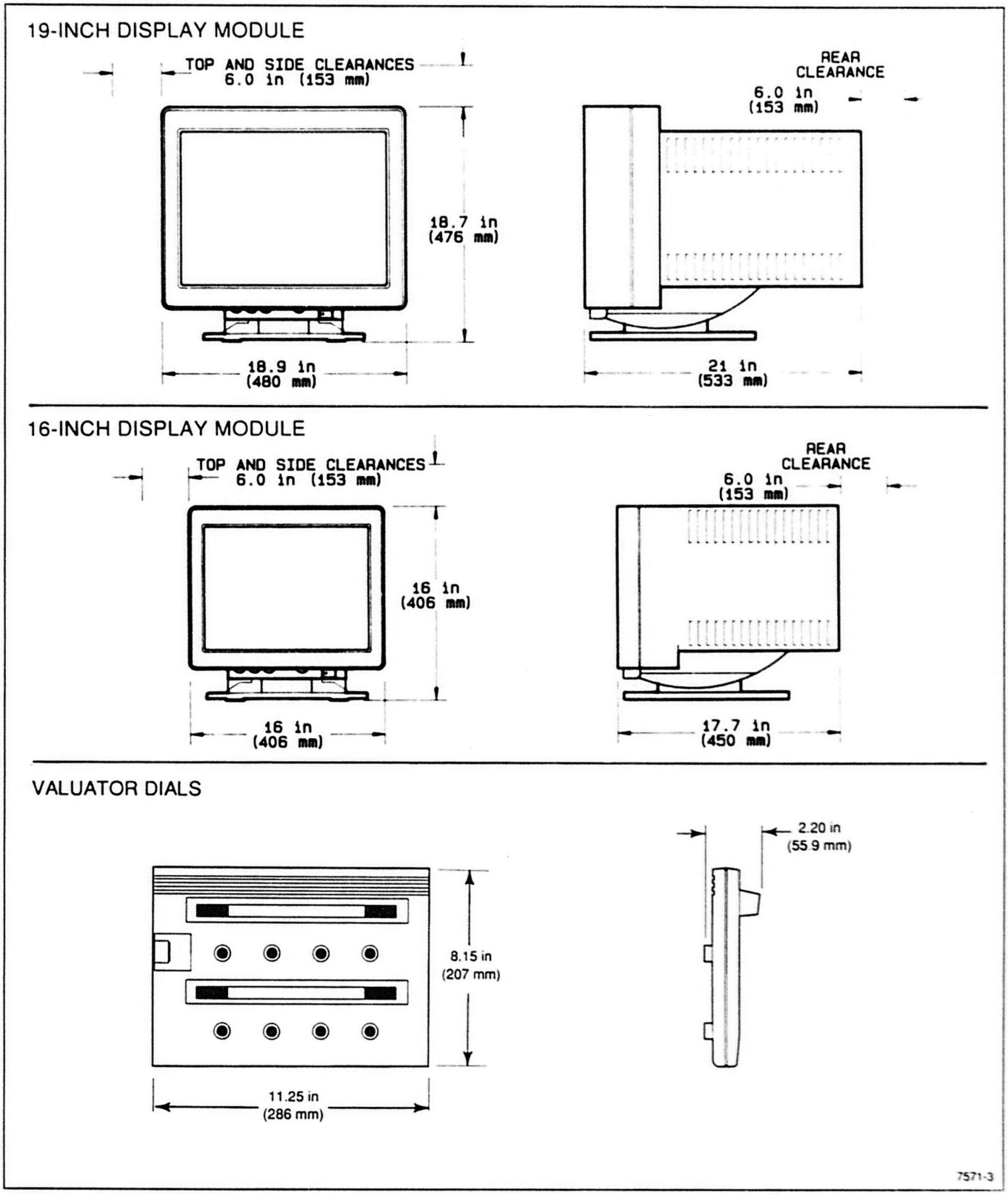

Figure 2-2. Physical Dimensions (Part 2).

ELECTRICAL SPECIFICATIONS

Table 2-9
CEM AND 3D-GEM ELECTRICAL

Characteristic	Performance Requirement
Nominal input voltages	
115V	90-128Vrms @ 47-63 Hz
230V	180-256Vrms@47-63 Hz
Max. input power	see Table 2-14
Fuse (115V or 230V)	15A/250V(type 3AB)
+5.2V	
Regulation	±1% of nominal
Current	
Peak	85A (1 minute)
Continuous	75A
+12V	
Regulation	±3%
Current	
Peak	14A (7 seconds)
Continuous	10A
-12V	
Regulation	±5%
Current	
Peak	1A
Continuous	1A
Fan	
Voltage	+12V to +26V
Current	
Peak	1.5A (2 seconds)
Continuous	1A

Table 2-10
2D-GEM ELECTRICAL

Characteristic	Performance Requirement
Nominal input voltages	
115V	90-128Vrms @ 47-63 Hz
230V	180-256Vrms@47-63 Hz
Max. input power	186W
Typical Input Power	140W
Fuse (115V or 230V)	5A/250V internal
+5.2V	
Regulation	±3% of nominal
Current	
Peak	15.0A
Continuous	14.5A
+12V	
Regulation	±6%
Current	
Peak	5A
Continuous	1.5A
-12V	
Regulation	±10% @ .1-1A load
Current	
Peak	0.7A
Continuous	0.4A

Table 2-11
DISPLAY MODULE ELECTRICAL

Characteristic	Performance	
	16 inch	19 inch
Nominal input voltages		
115V	90-132V	90-132V
230V	180-264V	180-264V
Frequency range	48-63Hz	48-63Hz
Power Consumption	150W (max)	200W (max)
AC line current		
Japan 100V	2.4A	2.6A
U.S. 120V	2.4A	2.6A
Europe 220V	1.4A	1.5A

Table 2-12
FUSES

Fuse	Rating
CEM, 3D-GEM	250 V, 15 A[a]
2D-GEM	250 V, 5 A[a]
16-inch Display	
115V	125V, 4A
230V	250V, 3.15A
19-inch Display	
115V	125V, 4A
230V	250V, 3.15A

a. Fuse suitable for either 110V or 220V operation

SITE CONSIDERATIONS

Table 2-13
ENVIRONMENTAL SPECIFICATIONS

Characteristic	Performance Requirement
Temperature[a]	
Operating	+50° to +104° F (10° C to 40° C)
Nonoperating	(-40° to +149° F (-40° C to +60° C)
Humidity	
Operating	20 to 80%, non-cond.
Nonoperating	10 to 95%, non-cond.
Altitude	
Operating	To 10,000 feet (3050 m)
Nonoperating	To 40,000 feet (12,200 m)
Shock	(Graphics Module only) 20 Gs with 11 msec duration, half sine pulse (non-op)
Electrostatic immunity	
Operating	No interruption of operation, loss of data or change of operating mode from 15 kV discharge.
Nonoperating	No damage to terminal from 20 kV discharge.

a. Derate the upper operating temperature by one degree for every 1000 feet of altitude over 5000 feet.

NOTE

This workstation has been classified as a Class A (FCC), and Class B (VDE), computing/peripheral device. Operation with a non-certified peripheral may result in interference to radio and TV reception.

Table 2-14
INSTALLATION REQUIREMENTS

Characteristic	Performance Requirement
Heat Dissipation	
16-in Display	510 BTU/hr
19-in Display	680 BTU/hr
XD8801 (1 GEM)	2208 BTU/hr
XD8820 min	3540 BTU/hr
XD8820 full	4048 BTU/hr
XD8830 (1 GEM)	3880 BTU/hr
XD8830 (2 GEM)	5150 BTU/hr
Surge current of Graphics module (per chassis)	At plug-in[a]
110V/230V	100A (typical)
Surge current of Display module	At power-up[b]
110V	50A (typical)
230V	80A (typical)
GEM/CEM Wkstn cooling clearance	
Top	3 inches
Sides	12 inches
Back	8 inches
Display module cooling clearance, all sides	6 inches (minimum). Ambient temperature of104° (40° C) must not be exceeded.
Distance from EMI sources	Modules should be as far removed from motors, fans, or other electromagnetic devices as possible

a. Surge current is caused by charging of capacitors when Graphics module's standby supply is plugged in.

b. Surge current is caused by automatic degauss when Display module is turned on. Same values for 16" and 19" modules.

NOTE

Surge currents at power-up or plug-in are short duration and will not blow the fuse, even though it is rated at a much lower amperage. However, if your power source cannot handle such surges, install a surge-current protector in the power source. Such surge protectors also screen out accidental voltage spikes on the AC line.

PERFORMANCE CHARACTERISTICS

Table 2-15
COMPUTE PERFORMANCE

Characteristic	Specification
Compute Performance:	
Dhrystones	32,780 D/sec
Linpack (Fortran)	1.2 Mflops
Linpack (Coded BLAS)	2.1 Mflops

Linpacks are "double precision".

Table 2-16
GRAPHICS CHARACTERISTICS

Characteristic	Specification
Addressability /20 /30	(in pixels) 1024 hor x 768 vert 1280 hor x 1024 vert
Graphics Command syntax	Tek, ANSI, Binary
Line types	Solid, Dashed, Erase and XOR
Graphics primitives	Vectors, panels (polygons), text
Number of colors available	256 colors, selected from 16.7M possibilities (in both, dialog and 8-plane graphics regions)
Interactive graphics	Cursor pad on keyboard, thumbwheels, mouse, trackball and valuator dials may control the cross-hair graphics cursor

Table 2-17
ALPHANUMERIC CHARACTER SETS

Characteristic	Performance Requirement
Character sets	International sets: North American (ASCII) United Kingdom French Swedish Danish/Norwegian German Spanish Italian Special character sets: TEK Supplemental Rulings DEC Supplemental ASCII Supplemental
Characters displayed	Default depends on terminal keyboard 94 or 96 displayable characters, depending on the character set. 128 characters displayable in Snoopy mode (including control characters).
Character Format (screen display)	34 rows by 85 chars 64 rows by 170 chars
Character cell sizes	16 x 30 or 8 x 16 pixel

Table 2-18
COMMUNICATION PERFORMANCE

Characteristic	Specification
Alphanumeric (only) communications rate	38.4 kBaud RS-232-D only
Simple (line) graphics communications rate	38.4 kBaud RS-232-D only
Two Port Peripheral Interface (2PPI)	Two RS-232-D ports; communicates with peripheral devices. 38.4k Baud maximum rate
Hard Copy Interface	Centronics style
SCSI Interface Asynchronous Synchronous	 2Mbyte/sec 3.3Mbyte/sec
LAN	IEEE 802.3 TCP/IP
Video output (aux.)	Video: R, G, B Sync: Vsync, Hsync (TTL)
DMA options 3F Tek 4132 3W	 Q-bus I/F to uVAX or DEC Unibus I/F

Table 2-19
DISPLAY MODULE PERFORMANCE

Characteristic	Performance Requirement
Vertical frequency	60Hz
Active displayed lines per vertical scan	1024 lines
Horizontal pixel count per line	1280 pixels
Horizontal frequency	63.25 KHz
Horizontal blanking time	3.91µs
Vertical blanking time	474µs
Linearity	±5%
Geometry	±1%
Incremental linearity	≤5%
Sync pulse timing (Horizontal) front porch sync pulse width back porch (Vertical) front porch sync pulse back porch	 0.372µs 1.67µs 1.86µs 47.4µs 47.4µs 379µs
Phosphor	p22, med.-short persistence
Luminance (cent., white) 16-inch 19-inch	 > 30 and < 45 fL > 5 and < 40 fL
Spot size	11-16 mil (at 50% intensity)

Section 3

THEORY OVERVIEW

This section is a theory overview for the workstation as a whole. Each of the modular manuals has a theory description for its hardware module. Here you will see the "big picture" of the XD88 workstation architecture and how the pieces fit together. Then you can find more details about each module by reading the theory section in the manual for that module. As we said in Section 1, this is the "glue book" that puts it together.

HARDWARE ARCHITECTURE

The XD88 workstation consists of the following major hardware modules:

- CEM - Compute engine module. This is a computer that runs UTek V (based on Unix System V) and runs graphics applications programs.
- GEM - Graphics engine module. This module contains specialized graphics processing hardware that takes output from the CEM and makes video information for the Display Module.
- Display Module. This module contains the video screen for display of the output from the Graphics Module's frame buffer.
- Keyboard, Mouse & other MIS (input) devices. These are the main user input devices to the system. These connect to the Graphics Module's MIS input, where the GEM is acting as a graphics display terminal to the CEM.
- Valuator Dials. This input device allows the user additional control for 3-D applications running on the system. It also connects to the GEM.
- The XD88/05 File Server might use a 4944 Mass Memory unit to expand its available disk space. The 4944 has a SCSI cable that plugs right into the back of the CEM.
- Other peripherals. The workstations have ports for printers and other output devices; these devices are not discussed here because they are not integral parts of the workstations.

The workstations can include one of several types of GEMs. When it uses a 2-D GEM it is called an XD88/20. When it uses a 3-D GEM it is called an XD88/30. The coupling between the CEM and the GEM is via their VME buses (in the form of a flex link between modules). The output from the GEM is standard video (in R, G, B coax cables).

Figure 3-1 shows the overall architecture at a glance.

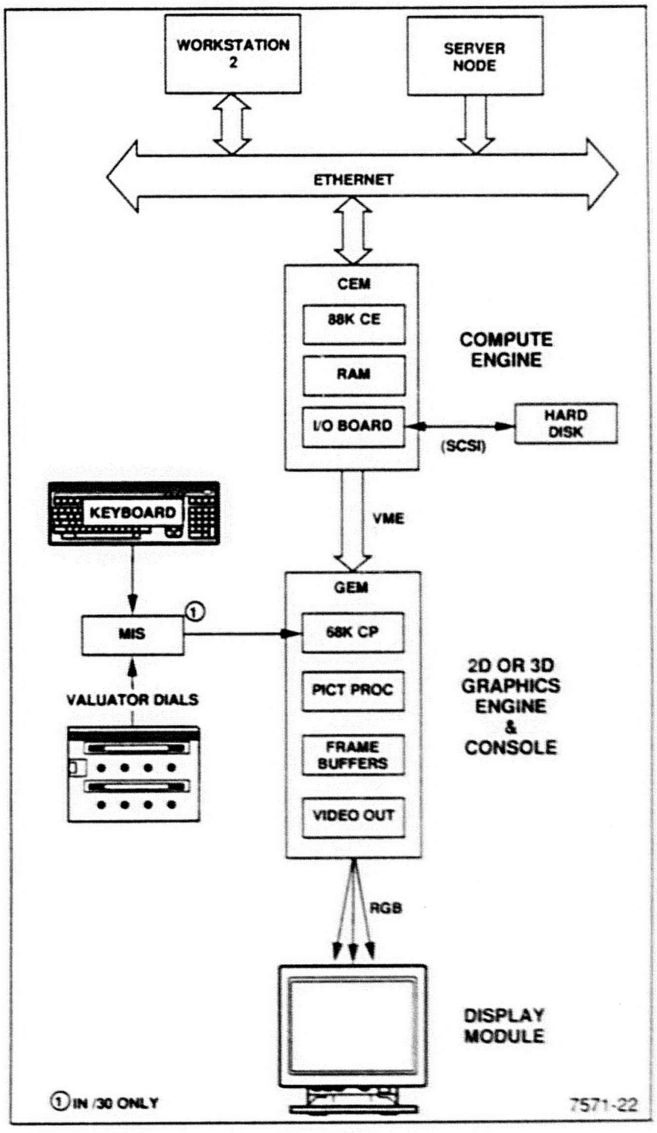

Figure 3-1. Simplified XD88 System Diagram.

Heart of XD88 Is '88K' Processor

The main processor in the XD88 is the M88100 ("88K") CPU on the CEM's CE board. It runs at 20 MHz and uses a dedicated processor bus to support several cache memory management units (CMMUs). Cache memory provides very fast access to frequently used program code and data, so the processor doesn't have to go out to main RAM or disk to access this data each time.

The processor talks to outside devices via:

- Its own I/O ports (RS-232 "Port 1" and "Console").
- The ports on the neighboring I/O board (RS-232, SCSI, Centronics, LAN).
- The VME bus, to attached CEM and GEM units.

The processor's main RAM memory is located on so-called "Daughter" boards. One Daughter board is mounted on the CE board. It can contain either 8 MB (std) or 16 MB (optional) of RAM. If more RAM is needed, optional Memory Controller boards may be installed. Each Memory Controller board can hold one or two Daughter boards. Each Daughter board can hold 16 MB of RAM (for a maximum of 32 MB per Controller board). The system can hold five Memory Controller boards, making a total of 176 MB of system RAM. (This is "system" RAM and does not count the "graphics memory" on the GDS/GEM side of the workstation.)

The Compute Engine (with Graphics Engine) employs an interesting triple-bus architecture. The three buses and hardware blocks are related as shown in Figure 3-2. The processor accesses its on-board memory and the memory on extra boards via its Local Memory bus. The Local Bus Converter board provides a quick connection between the Local Memory bus and the VME bus. This speeds up communication with certain devices that are only accessible via VME bus. Most CEM devices are accessible via the Future bus, which is a new bus maximized for speed.

The processor's CE (compute engine) board plugs into a new backplane board. This backplane has a VME bus and the new Future bus. The CEM's connection to the GEM is via the VME bus (flex-link). Each end of each bus must have the appropriate terminator board.

The CEM's I/O board provides a number of interfaces for communication with standard and optional system peripherals. These interfaces include: RS-232-D, DMA, LAN, SCSI, VMEbus, Centronics-style copier I/F, and Future bus I/F.

XD88 Graphics Processing Architecture

The graphics end of the workstation is referred to in most places as the "GEM" unit(s), and in other places as the "GDS." The GEM refers mostly to the hardware aspect of the graphics side; the GDS (graphics display system) refers to the whole graphics end (hardware and software) of the system.

The workstation products include the GEM unit(s) which do most of the actual graphics processing. The GEM's have a dedicated M68020 processor that manages the graphics processing. The processor is located on the /20 workstation's BLIMP board, and on the /30 workstation's CP board.

The graphics display system has additional display processing on the:

- GraphZ board (GRAPHZ1 or GRAPHZ2) and ALU Sequencer board in /20 workstations
- Picture Processor board (PP2 or PP3) in /30 workstations.

Refer to the modular service manuals for the 2D and 3D GEM units for more details about these graphics processing units and their related hardware.

The video output to the system's Display Module is via RGB coax connectors on the /20's GRAPHZ and on the /30's Frame Buffer board.

The graphics images are stored in memory such as the Frame Buffer boards (in /30) and on the GRAPHZ's on-board frame buffers (in /20). These boards contain overlapping memory called "memory planes" that correspond to the image on the display screen. The picture processor, under command from the main CEM processor (as directed by the application software) manipulates the data in the frame buffers to achieve the desired images on the screen. At the appropriate time this pixel data is retrieved from the memory planes, passed through DACs, and sent out as three video signals to the Display Module.

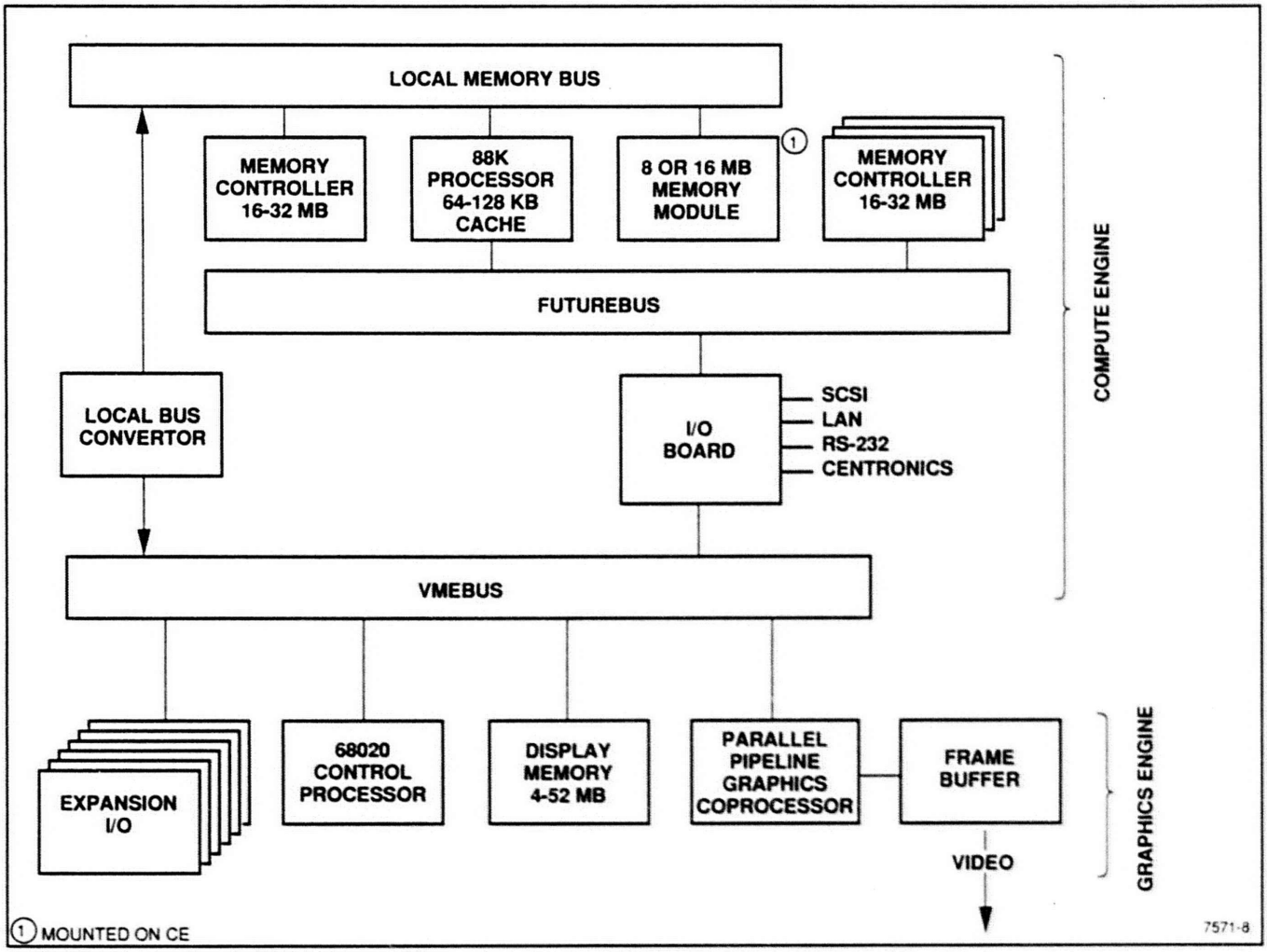

Figure 3-2. XD88 Bus Structure.

Display Module

The Display Module is either a 16" or 19" high-resolution video display unit. The resolution of the crt is 1280 x 1024 pixels. The Display Module operates at a 60 Hz refresh rate. The horizontal scan rate is 64 kHz. The display receives its RGB input from the GEM's video output (color map DAC — on /20's GRAPHZ board, or /30's Frame Buffer board or Color Map board). The number of displayable colors is not a function of the Display Module; it ranges from 256 colors to "true color", depending on the number of memory planes in the Graphics Module.

Both 16" and 19" units contains these replaceable subassemblies:

- A board — Video amplifier, contrast control, synchronizing circuits
- B board — EMI filter
- C board — CRT socket, arc suppression
- D board — Horizontal and vertical deflection, H.V. supply, high voltage protection, high voltage regulation, overbeam protection
- G board — Power supply
- H board — Operator Control board
- K board — Flyback transformer and H.V. block
- L board — Convergence

- L1 board — Dynamic convergence adjustment (on 19" only)
- CRT assembly — Crt and yoke

The stereoscopic display option allows you to view 3D images in true stereo when wearing the special glasses. This option is only available on the /30 (3D) workstations. The hardware for this option is on the Display Module and includes:

- Liquid Crystal Shutter — mounted on the front of the crt.
- Deflection Switch board — receives VSYNC signal from Frame Buffer.
- Shutter Driver board — amplifies signal to the shutter. Both of these boards are mounted on the Deflection board.
- Liquid Crystal Shutter — mounted on the front of the crt.

The stereo option also includes the Trackball (stereo GIN device) as an accessory.

Input Devices

The input devices consist of:

- Keyboard (VT-200-style) — available in many alternate languages. See options list. The keyboard connects to, and is managed by, the GEM's CP board.
- Thumbwheels Unit — attaches to end of keyboard.
- Mouse (3-button) — cable connects to keyboard.
- Valuator Dials — connects to CP board's keyboard input via a MIS box.

The XD88/30's MIS (modular interface system) box allows a keyboard, Valuator Dials, and one other input device to be connected simultaneously to the CP's Keyboard Input connector.

Mass Memory Devices

The CEM's magnetic peripheral subassembly contains the mass storage devices and a cooling fan. The disk drives interface with the CEM via the SCSI interface. Included within this subassembly are the standard 156-Mbyte fixed-disk drive, optional flexible drives (including the required controller board), standard streaming tape or optional cartridge drive, and the cooling fan.

The workstation can have one of several mass memory configurations depending on its use and how it was assembled (factory or F-kits). The typical factory-assembled workstation has one hard disk, located in the CEM. If additional mass storage is needed, an extra hard disk is located in an additional CEM or in an outside SCSI unit (such as the 4944).

The CEM and GEM both read data (such as Self-test code) from the CEM's hard disk.

If the workstation was constructed in the field by mating a 4220/4230 terminal to a XD88F01 Upgrade kit, the GEM will have its own flexible disk drive. The flexible disk is disconnected so the GDS reads its code from the hard disk (called "floppiless boot").

Power Supplies

Each GEM and CEM unit is powered by its own high-efficiency power supply. The keyboard and Valuator Dials also receive their power from the GEM's supply that they are connected to. Each power supply provides these outputs:

- +5V
- +12V
- -12V
- Variable 0V to -17V

The power supplies are described in more detail in the manuals for the CEM and GEM.

NOTE

All CEM and GEM power switches in XD88/30s are connected via the Backplane. This means that only one switch needs to be visible and accessible (the one on the main GEM unit); the one operable switch triggers the other switches. Also, when you upgrade a 4230 terminal to an XD88/30 workstation, cover the switch on the CEM with a blank panel, so only the GEM switch shows.

The Display Module has its own low voltage and high voltage power supplies, which are described in detail in the display service manuals.

Figures 3-4 and 3-5, at the end of this section, are detailed block diagrams of the XD88/20 and XD8/30 respectively.

XD88 ADDRESSING

If you are interested in the addressing structure for the workstation, look at Figure 3-3. This figure shows how the GDS/Console devices map into the VME address space. Then it shows how this VMEbus space correlates to the Futurebus address space.

The CEM's I/O board is responsible for Futurebus-to-VMEbus translation and vise versa. This board also contains the VMEbus management hardware, which includes circuitry for:

- Bus arbitration
- Bus controller
- Bus interrupt circuitry (generator, handler, acknowledge)

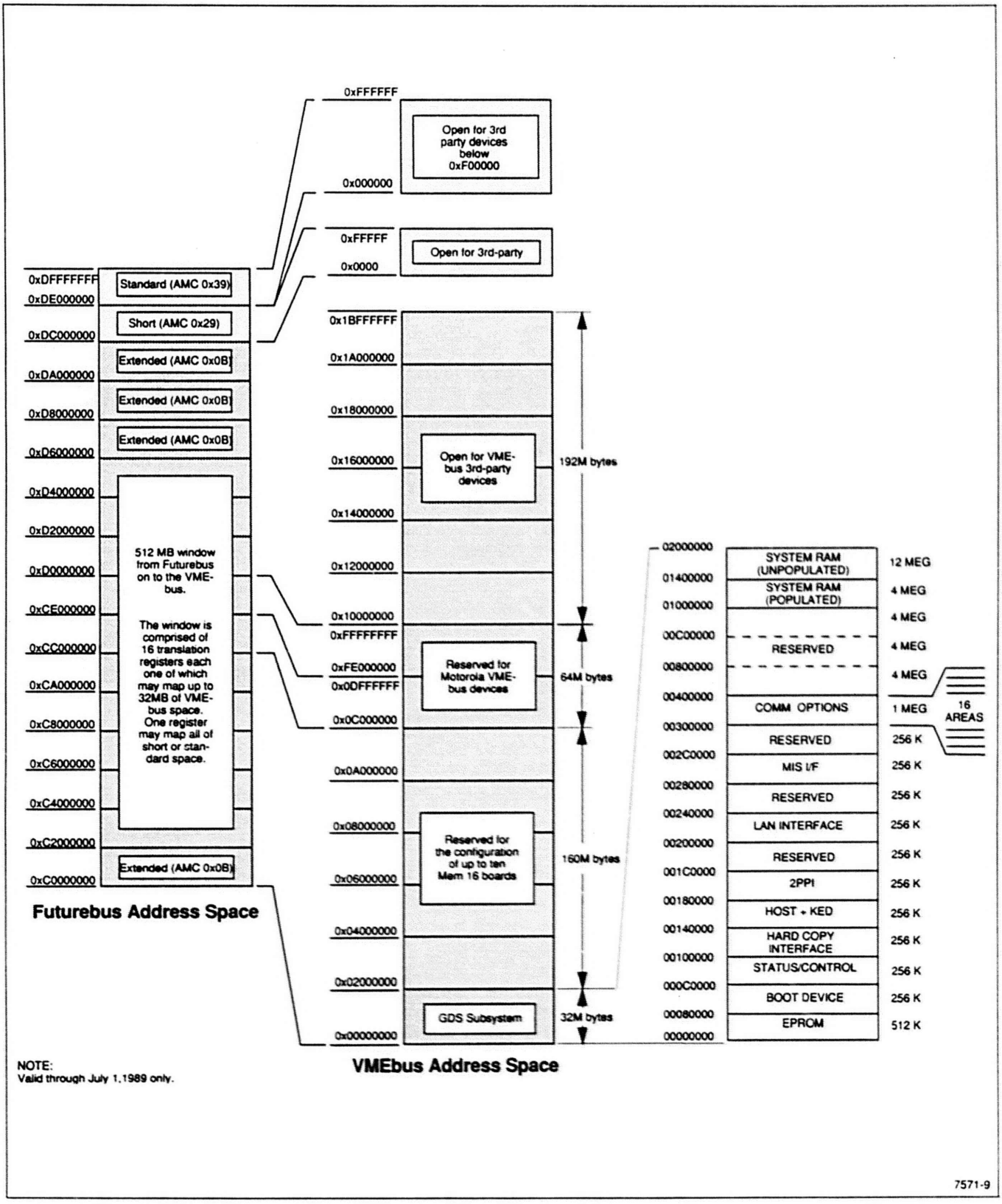

Figure 3-3. VME and Futurebus Address Scheme.

XD88 AS NETWORK DEVICES

The XD88 application server, server node, and workstations may all function as ethernet local network devices.

The workstation talks to other network devices via ethernet. Workstations can share data files, application software (if licenses permit it), and electronic mail on such a network.

The XD88/05 File Server, on a local network, acts as a central store of application software and data for other workstations and diskless nodes on the network.

An XD88/01 Compute Server may also provide compute resources to other workstations, or RS-232 connected terminals, on the local network.

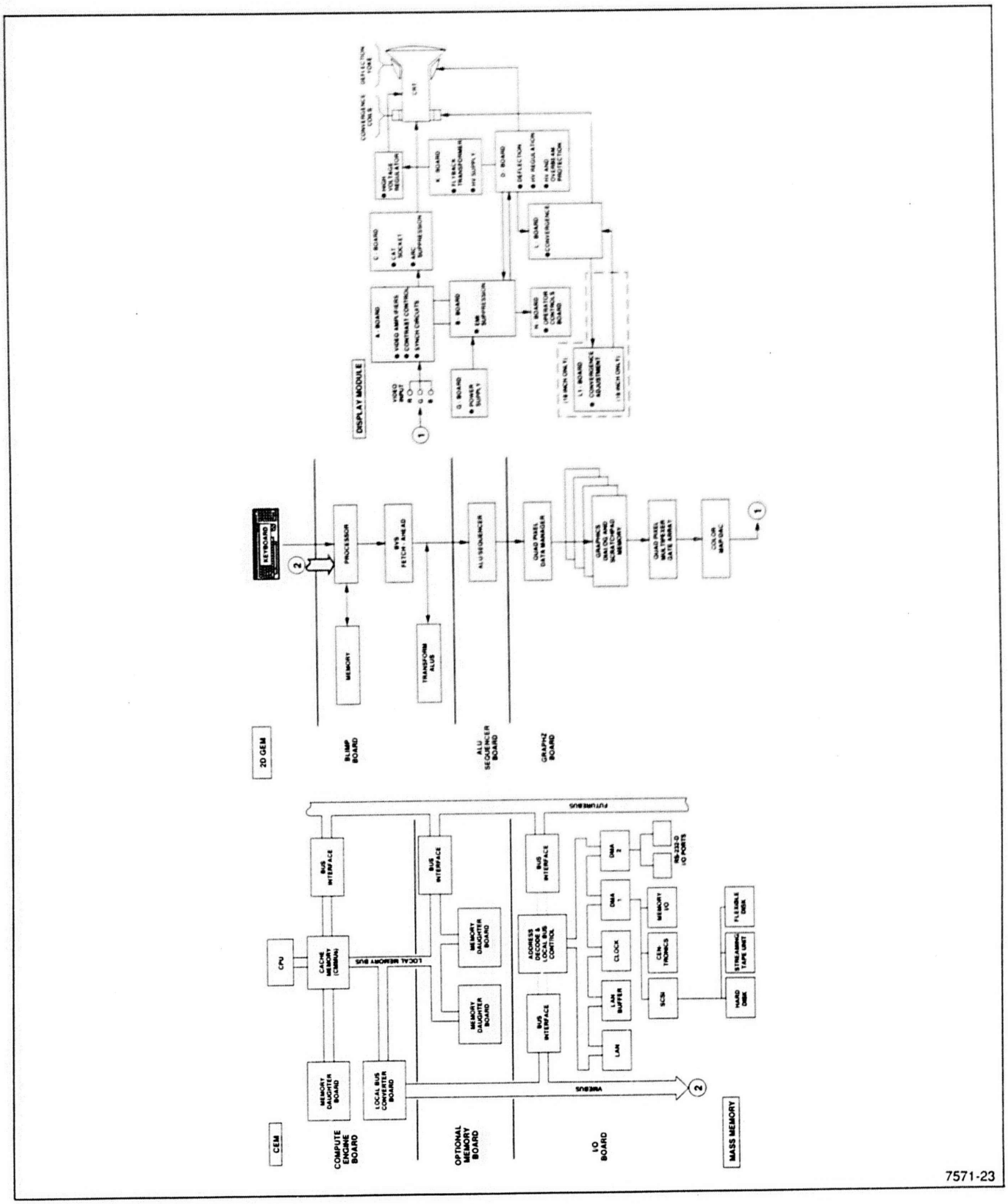

Figure 3-4. XD88/20 Detailed System Diagram.

Section 4

DIAGNOSTICS

INTRODUCTION

This section describes procedures and tools that will help you to diagnose a malfunctioning workstation or compute server in the field. Your main diagnostic tool is the system's Self-test program; actually a set of programs. Also, you may perform certain simple visual checks of the display and keyboard to see if they are functional.

FIRST ANALYSIS AND VISUAL CHECKS

This section contains a lot of detailed information about troubleshooting using Self-test. But before we go into the more complicated aspects, let's first cover some simple procedures for troubleshooting.

Troubleshooting involves logical analysis of a problem, so we should look for the simplest solution first. The workstation is a complex instrument with complex built-in diagnostic tools, but don't let this blind you to possible simple solutions to a malfunction. Upon walking up to a machine that is not working, you should approach it in the following manner:

- Cycle power or press RESET (this runs Power-up tests) to verify that the basic hardware is functioning.

  Power-up Self-test helps determine if a problem is hardware related or software/system related. Most of the time, the users will have determined this before calling you to the repair site, but not always.

- Check power cords and breakers. Be sure the problem is not also occurring on other machines in the workplace (such as intermittent power or networking problems).

- What part of the machine is failing — see if that part of the machine is tested by Self-test. Peripherals (such as printers), and even the display, are not treated as an integral part of the workstation. So XD88 system Self-test does not check the circuitry in those units.

- Check the configuration switches on the back of the CEM unit, to see that they are still set properly for the current configuration of the machine. Refer to "Configuration Switches" later in this section.

After, you've eliminated the simple causes and determined which module or peripheral is causing the problem, you can look further for a cure.

Display Module Checks

Section 4, Diagnostics, in the 16" Display Field Service and in the 19" Display Field Service, contain helpful hints for checking a faulty display module (sometimes called "the monitor"). Table 4-1 in those manuals, is a very handy tool for analyzing display symptoms. You may want to copy it and place it here for your convenience.

Other Helpful Hints

Having just read the Theory Overview (Section 3), you have an idea how the various modules work together to comprise the workstation; you also must realize that if just one of the pieces are not working, you will not see an error report on the display screen.

It is a good idea to have a light-weight "dumb terminal" available to connect to the CEM's console port for CEM error reporting. If the GEM, Display Module, or portions of the CEM are not working, such a console allows you to still read the error reports that Self-test generates. Use the configuration switches on the back of the CEM to specify whatever console port you want to use.

SELF-TEST OVERVIEW

Self-test is a powerful built-in tool that allows you to examine the health of the XD88 workstation. It will point out faults in the CEM or GEM (the most intricate areas of the workstation). It will also call display patterns to the screen so you can evaluate the health of the Display Module.

If Self-test shows that a major module requires adjustment or repair, see the field service manual for that module. (You should have placed it in this binder already.)

HOW TO RUN SELF-TEST

You can picture Self-test as functionally divided into four major parts in a two-sided square. There is a division between the CEM and GDS diagnostics, one direction; and a division between the Power-up and the Extended diagnostics, the other way.

To Run Power-Up

A large share of the CEM tests and of the GDS tests are run at power-up, so most of the time this is the test you'll want to run in the field. To run this set of tests, logoff the system. Then cycle the power button.

To Run Extended Tests

To check the GEM (GDS system): Reset the workstation while holding the GEM's Self Test button in. Hold it in until all the keyboard test lights go out. Then release the button.

NOTE: This can take up to three minutes, so be patient.

For CEM testing: The Configuration Switches on the CEM's rear panel must be set for the level of testing that is desired. Switch 8 determines whether the workstation comes up in "single-user" or "multi-user" mode. When this switch is ON (normal operation) the workstation does an automatic boot (start-up) at power-up/reset, UTek V runs its own diagnostics and goes into multi-user mode.

When switch 8 is OFF the workstation comes up in single-user mode, allowing the technician to run extended tests.

More detailed levels of testing can be set by the other switches:
Set Switches 1 thru 4 to one of the positions shown at the bottom of Table 4-3. (For instance, with switches 1, 2, and 4 OFF, while the others remain ON, it will run the first group of Extended diagnostics upon reset.)

Check These Things First

For Self-test to run properly, check these things first:

- Be sure all cables are connected properly to keyboard and display unit.
- See that you have the latest version GDS firmware (ROM on CP or BLIMP board).
- Be sure the keyboard is connected. It acts as an I/O device for GEM-side tests (input via function keys and output via LEDs).

WHAT SELF-TEST WON'T TELL YOU

There are certain things that the Self-test diagnostics won't tell you about the workstation, and you should be aware of these.

Self-test does not check the Option 3A (or 3G) RS-232 boards. You can connect a loopback connector and manually send a message out and then see if it comes back OK. But there is no automatic test for the board's I/O ports.

There are no tests that check the health of the 16" and 19" Display Module's boards and other hardware. When requested to do so, it places certain patterns on the screen that help adjust the display, but these do not point specifically to ailing hardware.

NOTE

You may find 4220/4230 or 4320/4330 systems that have been upgraded to an XD88 system. Currently, when such an F01 upgrade is done, the flexible disk drive in the GEM unit is disconnected so the GEM will boot from the CEM. Often the flexible disk drive will only be unplugged, but not removed, from the unit. This can cause confusion to users and other servicemen. (Actually, it is good to place a sticker on the front of the drive unit when doing this type of upgrade, to warn others that the drive unit is no longer connected.)

SELF-TEST ARCHITECTURE AND PARTITIONING

There are two major parts to Self-test: CEM-side tests, and GEM-side tests. These two parts of Self-test operate quite independant of each other. The GEM side of Self-test checks the GEM hardware as well as the keyboard (and other input devices), and it places test patterns on the Display Module. The CEM-side tests are limited to the CEM hardware. Each side of Self-test has its own unique structure and reporting system.

Refer to Figure 4-1 while reading the following explanation of how Self-test runs. This should help you visualize the structure system. We begin at powerup or reset of the Compute Module. Immediately following the ROM-based CEM tests, there is a branch point in the flow: If the GDS system is the console, the GDS hardware gets checked first, then the remaining CEM hardware. But, if some other device is the console, the entire CEM hardware is tested first, then the GDS hardware.

The Compute Module diagnostics are located part in ROM and part on the system's mass storage media (either the workstation/server hard disk or on a network file server, in diskless node configurations). Both locations provide tests for automatic Power-up testing and manual execution of Extended Self-test.

At powerup or reset, the CE board's ROMs run an automatic Power-up sequence. ROM-based powerup tests ensure the functionality of hardware required for loading and executing binary files from a load device (hard disk or network).

After the CE ROMs have completed the Power-up checks, which actually test about 80% of the CEM hardware, they call the GDS tests (in a /20 or /30 Workstation). The ROMs load the GDS boot loader which loads and runs GDS tests. Next, the remaining CEM tests are completed under control of the CEM's DiNEX, and finally, the UTek V (System V) operating system is loaded.

The Extended GDS tests can be loaded off of the hard disk by the GDS's own DiNEX-2 in the Interactive mode, and then they run on the GDS side with error reporting on the GDS serial port.

If you are looking at a workstation, continue reading; if you are looking at a compute server or file server, jump to the next heading "Remaining CEM-Side Tests".

NOTE

There are two types of DiNEX-2 running on the system: the CEM's DiNEX, and the GEM's DiNEX. They are similar in overall structure, but different enough that you should not confuse the two or refer to them synonymously.

Graphics System Tests

The workstation's Graphics Display System (GDS) diagnostics are located in both GEM ROM and on mass media (the CEM's hard disk).

As in the CEM, the GEM's ROM-based programs initiate an automatic Power-up diagnostics sequence. These tests ensure the functionality of the GDS hardware required for loading and executing files from a load device.

NOTE

The following paragraph assumes that the selected console is the GDS display.

After the ROM's have completed the kernal tests, they load the GDS's boot loader into the GDS RAMs; this allows the remaining tests to be retreived from the disk. The tests are all loaded and then testing begins, starting with the CP board (or BLIMP board, in /20 workstation). After the 68K's RAM, the picture processor, frame buffers, DACs, etc., are all successfully tested, pSOS® and product code are then booted. At this point, the Graphics Display System has been validated. helps load and control another series of tests. When either the Power-up or Extended set of tests are done, a cursor appears on the display screen. The test path then jumps back to the CEM side.

Remaining CEM-side Tests

Self-test now brings the CEM's DiNEX-2 OS from the hard disk into its Compute Engine memory (RAM) and starts it executing more tests. DiNEX-2 governs the rest of the testing. It runs these CEM tests:

- CMMU tests
- Remainder of CE memory tests
- Interrupts on CE serial port
- All testing of memory controller boards
- Hard copy tests
- I/O board serial ports

The CEM hardware tests are loaded from disk in a fixed order that depends on the product's configuration. These tests ensure the functionality of the hardware before it is used by the UTek V operating system and the applications software. If faults are detected, the test programs assist you in proper diagnosis and repair of the fault, independant of product code operation.

With the successful completion of all of the tests, DiNEX-2 loads and starts the execution of the UTek V operating system.

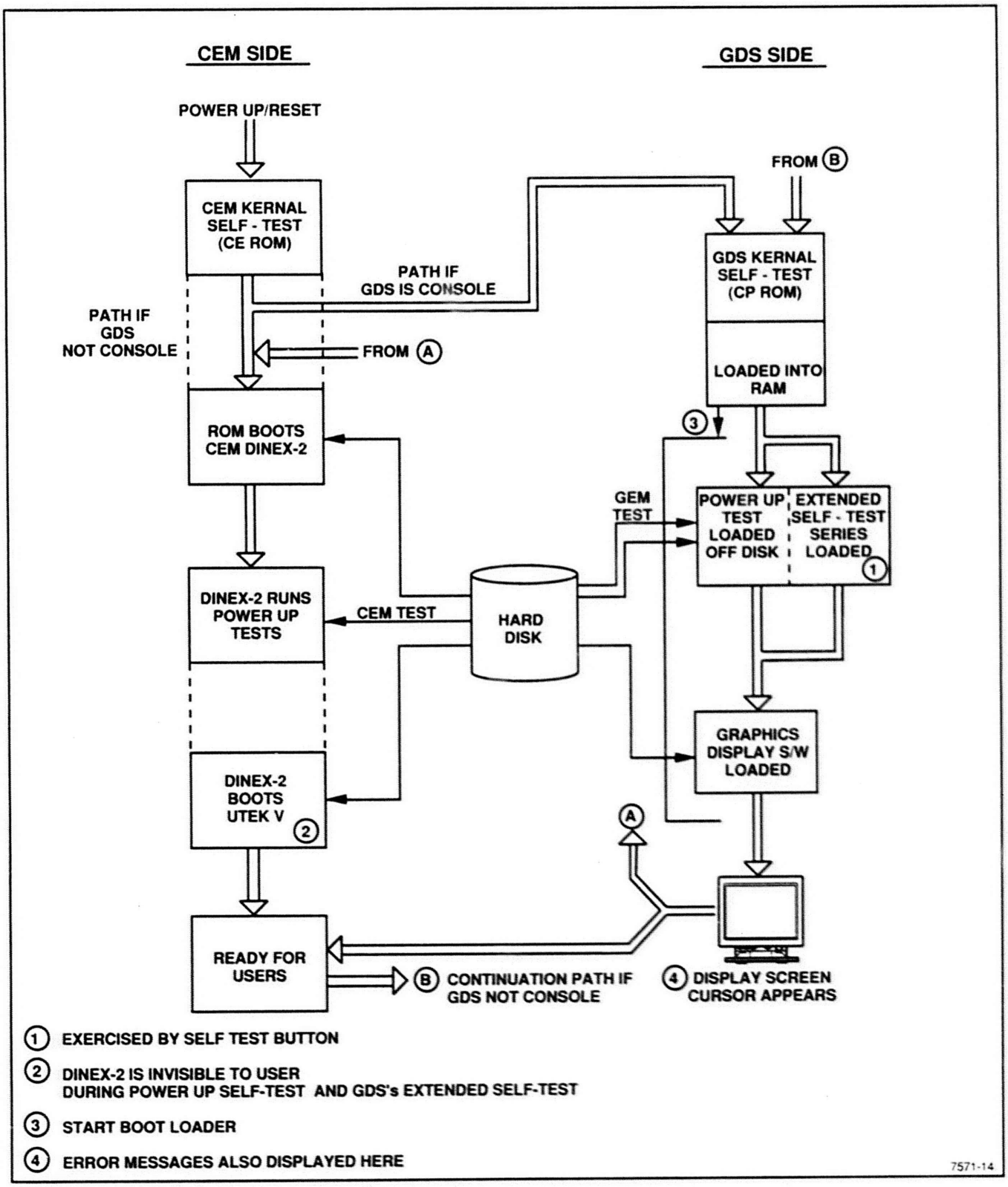

Figure 4-1. Structure of Main Self-Test.

GEM-SIDE TESTS

MODES AND LEVELS OF TESTING

There are two main areas or modes of Self-test: Power-up and Extended.

- Power-up Self-test — This is a quick functional check of the major GDS subsystems and it is triggered by the Reset or Power switches. This level report errors to the user at power-up so he/she can report such errors to a service center over the phone.
- Extended Self-test — This level provides extensive testing of all the hardware on the GDS side. It reports faults to the Field Replaceable Unit (FRU) level. This part of Self-test contains:
  a. A more extensive diagnostic routine than Power-up.
  b. A display pattern generator for calibrating the display module (monitor).
  c. A continuous execution of all non-interactive tests.
  d. Display of a backplane map.

Power-up Mode

Power-up Mode is executed whenever the unit's power is cycled.

The path of execution for the Power-up tests is indicated in the column in Table 4-1 called "Indication". The routine first checks the keyboard (because it is a primary user I/O device). Then it tests the kernal. Next it boots the GDS/GEM system tests from the disk.

The GDS test sequence begins by checking the CP Board's CPU kernel. During the test, the keyboard LEDs are cycled. When the GDS tests are complete, the display cursor blinks, but now it must finish the remaining CEM tests. After the CEM tests are done, the UTek V operating system prompt appears on the screen. This indicated that initialization has occurred and there are no serious faults.

If faults are detected, they are reported on the screen or keyboard LEDs or by the keyboard bell. The workstation then waits for the user to press the spacebar, indicating acknowledgment of the faults. Depending on fault severity, Power-up responds to an acknowledgement of either: *Nonfatal* (terminal initialization proceeds), or *Fatal* (causing an idle loop to execute until another powerup or RESET occurs). The fault must be cleared before initialization can occur.

Extended Self-test Levels

The GDS Extended Self-test is a level in itself, and it also has two main modes: interactive and non-interactive. The interactive mode contains numerous divisions, or levels, such as indicated by the menus that appear. This is all described in greater detail on the next page under the heading "Using Extended Self-test".

SWITCHES AND INDICATORS

The keyboard is the primary means for inputing information. This mainly occurs during Extended Self-test when you are selecting menu items for further testing.

The indicators or output devices are the keyboard LEDs, the display screen, and the Fault LEDs on the GEM's back panel. At the beginning of Self-test a LED comes on and it remains lit until it is sure that the board is fault free.

Error Indicators

Error reports for the Power-up and Service formats of Self-test occur via one or more of the following devices (shown in Section 1):

- **Screen** — Screen reports are concise English messages.
- **Fault LEDs on the GEM's back panel** — The fault LED remains lit until Self-test determines that the corresponding board is fault free.
- **Keyboard LEDs** — During Self-test the keyboard LEDs indicate boot failures and subsystem or FRU faults.
- **keyboard Bell** — During either Power-up or Service testing, the keyboard bell rings three times to indicate a fatal error, twice for a nonfatal error, or once for a warning.

Error Severity Levels

For any errors found during any portion of Self-test, these severity levels apply:

- **Fatal** — A fatal error renders the workstation inoperative at any capacity.
- **Nonfatal** — A nonfatal error signifies a fault condition that allows the workstation to be used, but at less than full capability.
- **Warning** — A warning indicates an unexpected, nonfatal problem that will not result in degradation of workstation operation.

Power-up Screen Reports

Every Power-up Self-test fault message reported to the screen indicates the subsystem that failed and the severity of the fault, as in this example:

```
Display subsystem fault  - FATAL -

Please contact your Tektronix Field Service
Representative
```

Keyboard LED Reports

If a fault is such that Self-test code cannot be brought in from the boot device, the TEK key, transmit (XMT), and receive (RCV) keyboard LEDs flash simultaneously and continuously. If Self-test finds a faulty subsystem, one or more of the Hold, Lock, Compose, and Wait LEDs will flash in unison with the others. These latter LEDs indicate specific subsystem faults, as shown in Table 4-1.

Fault reporting in Power-up Self-test is to the *functional subsystem* level only.

Table 4-1
POWER-UP ERROR LED REPORTS

Reporting Keyboard LED							Indication	Test Location
Tek	XMT	RCV	Hold Screen	Lock	Compose	Wait		
off	off	off	off	on	off	off	Testing kernal	Bootup Sequence
off	off	off	blink	off	off	off	System bus fault	PST errors
off	off	off	off	blink	off	off	Boot ROM fault	same
off	off	off	off	off	blink	off	System RAM fault	same
off	off	off	off	off	off	blink	Boot path fault	same
on	on	on	on	on	on	on	Keyboard tested	same
off	off	off	on	on	on	on	Testing RAM	same
off	off	off	off	on	on	on	Booting PST	same
off	off	off	off	off	on	on	Started PST	same
off	off	off	off	off	off	on	Booting GDS s/w	same
blink	blink	blink	blink	off	off	off	Wrong disk installed	same
blink	blink	blink	off	blink	off	off	Fault during boot	Boot loader
blink	blink	blink	off	off	blink	off	Disk read fault	same
blink	blink	blink	off	off	off	blink	Disk file not found	same
off	off	off	off	off	off	off	Execution of GDS s/w	

NOTE

The term "kernal" as used here denotes core hardware (CPU, CMMUs, etc.).

USING EXTENDED SELF-TEST

Extended Self-test (EST) is an in-depth interactive part of the diagnostic system. It checks errors to a lower level, and provides more detailed reporting than Power-up mode.

To run Extended Selt-test for the GDS, press and hold the GEM unit's Self Test button until the keyboard LEDs go out. NOTE: This takes a long time (about 30 seconds).

EST provides these three test sequences:

- Non-Interactive Tests Sequence (NITS): Once started, this extensive in-depth test requires no human interaction.
- Interactive Test Sequence: This group of tests requires human interaction (such as connecting loopback cables or test equipment.)
- Calibration or Adjustment procedures: displays a menu of test patterns for testing and calibrating the display module.

Press the spacebar to continue.

If you abort EST, the system will reset, rerun the Power-up mode, and be ready for use.

If you choose the non-interactive test, the system will complete the tests, report errors (if any), and go to the interactive test menu. To exit, press F8 on the keyboard for a normal Power-up/reset sequence.

If you choose the interactive mode, this menu appears:

```
Extended Self Test Menu
 F1 - Execute All Non-Interactive Tests
      (NITs).
 F2 - Go To Interactive Test Menu.
 F3 - Go To FRU Test Menu.
 F4 - Go To Display Adjustment Menu.
 F5 - Continuous Execution of All NITS.
 F6 - Backplane Map
 F8 - Exit
 Press the indicated function key for
 your selection.
```

The menu items are explained as follows:

F1 — Execution of All Non-Interactive Tests (NITS)
Executes the NITS continuously and cyclically until interrupted by a RESET or a power-down.

F2 — Go To Interactive Test Menu
Lists the various tests. You select the desired test item by pressing a function key. This menu includes tests such as the Keyboard Echo Test described later in this section.

F3 — Go To FRU Tests Menu
Lists the FRUs. You select the specific FRU to be tested. Only the tests applicable to that FRU are executed.

F4 — Go To Display Adjustment Procedure Menu
Lists the display patterns available for Display Module adjustment.

F5 — Continuous Execution of All NITS
Executes NITS continuously and cyclically until interrupted by a RESET or a power-down.

F6 — Backplane map
Displays a map of the backplane and installed boards.

F8 — Exit
Results in a normal power-up sequence (Power-up mode and system initialization).

Some of the above menu items include secondary menus (*Interactive Test Menu*, *FRU Test Menu*, and *Display Adjustment Procedure Menu*). These secondary menus provide specific tests to isolate communications, FRU, keyboard, or Display Module malfunctions.

Interactive Tests Menu

Select the *Interactives Test Menu* (F2) to execute these tests:

- F1 — Color copier loopback.
- F2 — Host baud rate loopback.
- F3 — Host status line loopback.
- F4 — Host xmt/rcv loopback.
- F5 — PORT 0 baud rate test.
- F6 — PORT 0 status line loopback.
- F7 — PORT 0 xmt/rcv loopback.
- F8 — Exit.
- Shift-F1 — PORT 1 baud rate test.
- Shift-F2 — PORT 1 status line loopback.
- Shift-F3 — PORT 1 xmt/rcv loopback.
- Shift-F4 — LAN loopback (Disconnect the system from the network before running this test!).
- Shift-F5 — Keyboard echo test.

XD88/20 FRU Tests Menu

The */20-FRU Tests Menu* (F3) provides tests to isolate faulty field replaceable units. Select this menu to execute these tests:

- F1 — BLIMP board test
- F2 — GRAPHZ1 test
- F3 — GRAPHZ2 test
- F4 — Extended Memory test
- F5 — ALU Sequencer test

XD88/30 FRU Tests Menu

The */30-FRU Tests Menu* (F3) provides tests to isolate faulty field replaceable units. Select this menu to execute these tests:

NOTE

FB12/12 is tested with the FB12 1st and 2nd board tests.

- F1 — CP board test
- F2 — MEM8/MEM16 (1st board) test
- F3 — MEM16 (2nd board) test
- F4 — MEM16 (3rd board) test
- F5 — MEM16 (4th board) test
- F6 — PP2/PP3 board test
- F7 — Z-Buffer board test
- F8 — Exit
- Shift-F1 — FB4/8 board test
- Shift-F2 — FB8 slave board test
- Shift-F3 — FB12 (1st board) test
- Shift-F4 — FB12 (2nd board) test
- Shift-F5 — CM12 board test

Display Adjustment Menu

The *Display Adjustment Procedure Menu* (F4) consists of these Display Module test patterns:

- F1 — White Panel
- F2 — White Grid
- F3 — Grey Scale
- F4 — Color Scale
- F5 — Dots
- F6 — Stereo (option 33)
- F7 — Toggle text display
- F8 — Exit
- S ERAS — Toggles red video
- G ERAS — Toggles green video
- D ERAS — Toggles blue video

If there is a problem with the images on the display screen, run Self-test to rule out any problems in the display driver portion of the Graphics Engine Module. Consult the *Display Module Field Service* manual for additional information on Display Module calibration.

Keyboard Echo Test

Located under the *Interactive Test Menu* (F2), this test echos any key pressed regardless of order. This allows you to check each key switch, verifying that all keys make contact and display the proper Self-test code. This test displays the press code when the key is pressed down and the release code when the key is released. See Figure 4-3 for the keyboard press and release codes that represent each key.

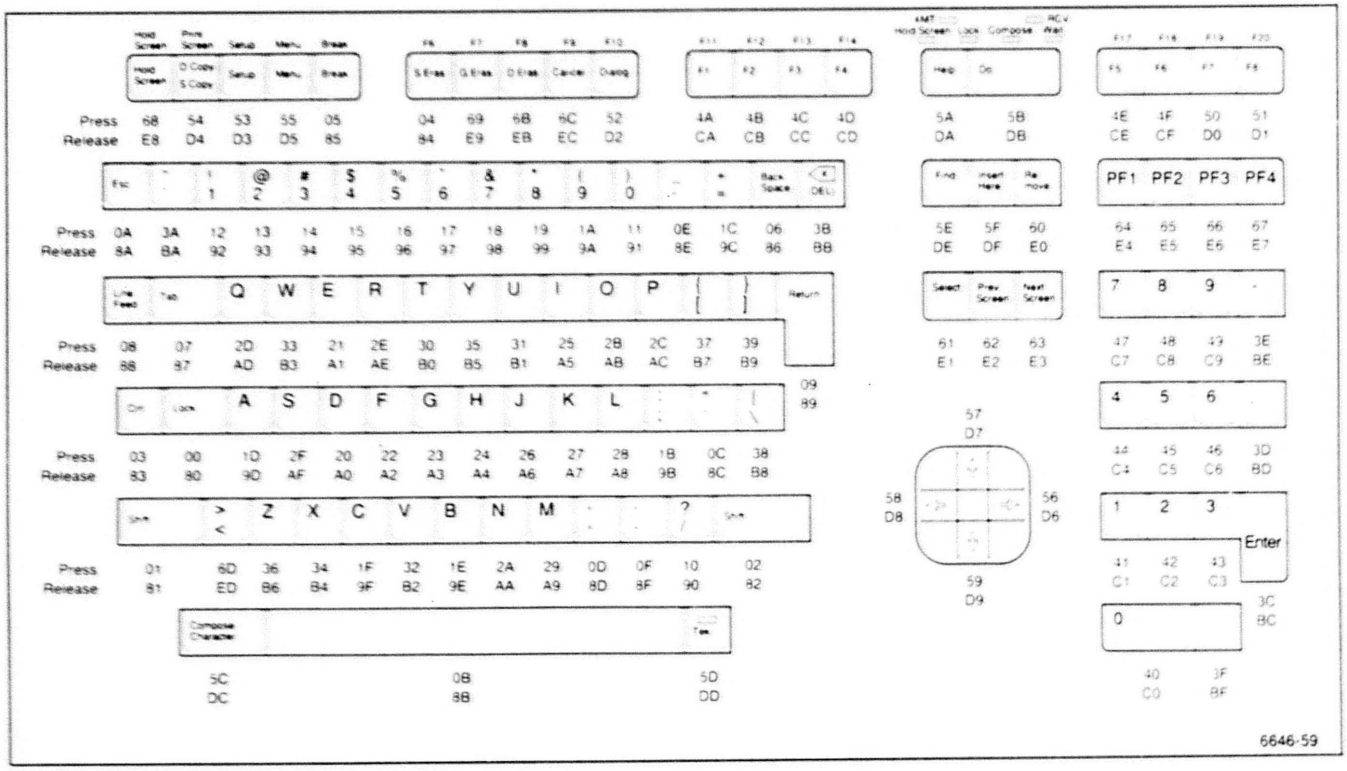

Figure 4-2. Keyboard Press and Release Codes.

Valuator Dials Self-Test

The Valuator Dials Self-test diagnostic routine checks all of the critical functions of the Valuator dials. The Valuator dials diagnostic program executes during both Power-up and Extended Self-test.

During Power-up testing, the Valuator dials routine executes automatically. The routine displays its results on the Valuator dial's LCDs. If the routine finds the Valuator dials error free, this message appears on the LCDs:

```
FOR EXTENDED SELF-TEST, TURN ANY DIAL WITHIN
5 SECONDS
```

If the routine detects an error, an error message appears on the LCDs. To execute the Extended Self-test Valuator dials tests, move any one of the eight dials within 5 seconds after the message appears. If the dials are not turned within 5 seconds, the message disappears from the LCDs; and, as soon as the graphics input (GIN) function of the display system is enabled, all dials are available for the application program.

Execution of the Valuator dial's test routine provides a systematic check for each of the eight dials. Initially, Self-test displays a value of 0 on the LCDs for each dial, with the exception of the dials turned during the 5-second time period. As you rotate any dial clockwise, the value increases. Counter-clockwise rotation results in a decreasing value. Values displayed are in the range of 0 to 255 for each dial. Each dial is assigned a 20-character segment on the LCDs, four dials to each LCD. The dials are numbered 1 to 8, with dial 1 being the top left dial. The values for each dial remain displayed on the LCDs until the GIN function is enabled. Errors encountered during the Extended routine require replacement of the Valuator dials as a FRU.

Touch-Panel Test

Self-test does not check the Touch-panel. If the Touch-panel option is installed, the best way to check its functionality is to do the following procedure.

1. From the keyboard, type:

   cat /dev/tty00 <cr>

2. Then touch the screen with your finger and look for display of the correct X, Y, and Z coordinates on the screen.

Table 4-5 lists the screen position addresses for the four corners of the screen (an X indicates that this value may be any hexadecimal digit).

Table 4-2
TOUCH-PANEL CHECK

Screen Pick Location	Address Reply X Y Z
Upper-right corner of screen	Fx Fx xx
Upper-left	0x Fx xx
Lower-right	Fx 0x xx
Lower-left	0x 0x xx

NOTE

If you are checking one of the early production units, the screen will respond somewhat differently to your touch. You must touch the pick point and then remove your finger before touching the next pick point. For all standard units, you may "drag" your finger around the screen and it will draw a line that tracks the path of your finger.

CEM SYSTEM SELF-TEST

Up to now, Self-test has checked the keyboard, the attached 2D or 3D GDS system, the display module and such devices as the thumbwheels, valuator dials, and touch screen. Now it is ready to complete the testing of the CEM system.

Self-test directly checks the health of the following CEM FRUs:

- Compute Engine (CE) board
- I/O Board
- Memory Controller board
- Memory Daughter boards
- SCSI interface

Self-test indirectly checks the power supply, hard disk unit, cartridge tape unit, and the Option 08/09 Digital Video Board.

As Self-test is running, it performs a number of tests under the control of the ROM-based Kernal Self-test ("KST"). The results of these CEM tests are reported on the 7-segment LED on the end of the CE board and on the selected console (serial port or GDS display) after it is tested and becomes available. At the point where the test sequence stops, it reports either the test in progress or a fault error generated during that test. Test names are indicated by simple hex display, while an fault report has a decimal in front of it. Table 4-4 shows the test and error codes as well as the corresponding names/descriptions.

MODES AND LEVELS

There are three main areas or modes of Self-test: Power-up, Service, and Low-level. These modes are to be used as follows.

- **Power-up mode**. Select Power-up mode for preliminary diagnostic testing and to boot the system. Failures that occur during Power-up mode appear on the seven-segment LED on the CEM's rear panel or on the console. Console devices include:
  - 2-D or 3-D GEM & Display Module
  - CE board's serial port 1
  - I/O board's serial port 1
- **Service mode**. Also called "Extended Mode", this mode invokes the DiNEX diagnostic operating system in interactive service mode. Service mode allows the execution of extended diagnostic tests or testing of major hardware sub-systems present in the CEM. Service mode uses the same set of console devices described for Power-up mode.
- **Low-level mode**. Select Low-level mode for detailed hardware debugging. Routines available in Low-level mode are: Low-level and Extended tests, ROM hardware debug monitor, and DBX debug monitor. These tests are designed to be used with appropriate test equipment for diagnosis of systems that will not boot normally. See the end of this section for more details about using this mode.

CEM-SIDE CONTROLS AND INDICATORS

The switches on the CEM's rear panel are used to select one these three sets of diagnostic routines; the switches also determine the console for fault message output, and the baud rate of transfer to the display.

The main output of Self-test for the CEM-side is screen messages and fault LEDs (see "CEM Indicators").

CEM Configuration Switches

The configuration switches located on the CEM's rear panel control which set of field service diagnostic routines execute at powerup. For example, with the switches set in their normal powerup position, the Power-up diagnostic tests execute automatically. Other switch settings invoke the Service mode routines and disk-based diagnostics at powerup. See Tables 4-3 and 4-4 for details. Figure 4-3 shows these configuration switches as they appear on edge of the CE board.

NOTE

Set the configuration switches before turning the system on. The system reads the switch positions only at Power-up; so changes to their positions afterwards have no effect.

Table 4-3
CONFIG SWITCHES 1 THRU 4

Configuration Switches				Mode Selected	
SW1	SW2	SW3	SW4	Single/Multi User	Boot/Display from ...
on	on	on	on	Multi-user (auto)	Boot from 1st found disk
on	on	on	off	Multi-user (auto)	Boot from 1st disk, verbose
on	on	off	on	Multi-user (auto)	Boot from 1st found LAN
on	on	off	off	Multi-user (auto)	Boot from 1st LAN, verbose
on	off	on	on	Single-user (manual)	Display code from tape
on	off	on	off	Single-user (manual)	Display code from tape, verbose
on	off	off	on	--	Unused/reserved
on	off	off	off	--	Unused/reserved
off	on	on	on	Single-user (manual)	Display code from 1st disk
off	on	on	on	Single-user (manual)	Display code from 1st disk, verbose
off	on	off	on	Single-user (manual)	Display code from 1st LAN
off	on	off	off	Single-user (manual)	Display code from 1st LAN, verbose
off	off	on	on	"Peek-poke" monitor	ROM
off	off	on	off	Extended diags, GRP-1	
off	off	off	on	Extended diags, GRP-2	
off	off	off	off	Extended diags, GRP-3	

Table 4-4
CONFIG SWITCHES 5 THRU 8

Configuration Switches				Mode Selected	
SW5	SW6	SW7	SW8	Console	Baud Rate
on	on	on	on	GDS & display	—
on	on	on	off	IO Bd, Port 1	300 B
on	on	off	on	"	1200 B
on	on	off	off	"	2400 B
on	off	on	on	"	4800 B
on	off	on	off	"	9600 B
on	off	off	on	"	19200 B
on	off	off	off	"	38400 B
off	on	on	on	Null console	—
off	on	on	off	CE Bd, Port 1	300 B
off	on	off	on	"	1200 B
off	on	off	off	"	9600 B
off	off	on	on	"	19200 B
off	off	on	off	Reserved	--
off	off	off	on	"	--
off	off	off	off	"	--

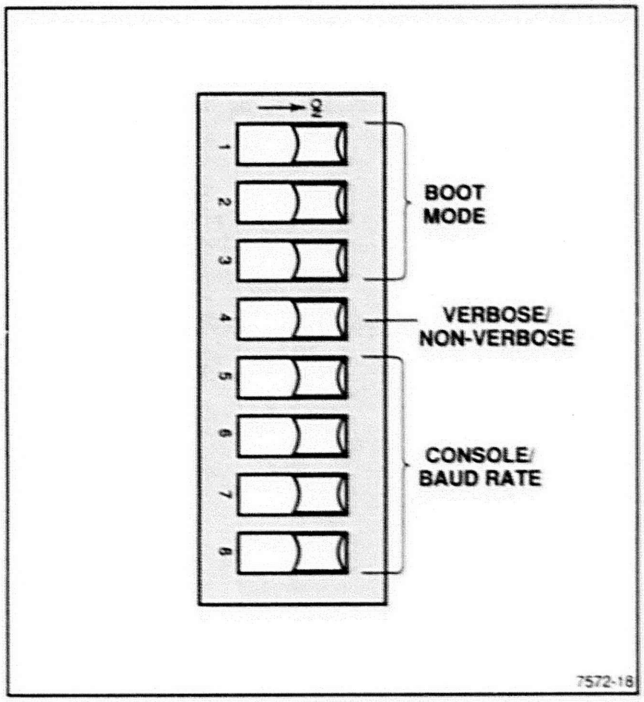

Figure 4-3. Configuration Switches.

CEM Indicators

The CEM has three main ways of reporting errors:

- Screen messages
- 7 Segment LED codes (on back of CEM)
- Single "fault" LED on the back of each board

Assuming that the GDS system is working, the CEM can report errors on the display screen. This is one reason the GDS system is checked before the CEM's final (DiNEX) tests, as shown in Figure 4-1; this verifies GDS functionality as an output device for CEM error codes. Table 4-5 is a short-form listing of these LED codes.

Detailed explanations of Error Codes Each test and fault in Table 4-5 is listed in the order that it occurs during Self-test. Most of these tests are described in more than enough detail for use in the field.

Appendix C of this manual also contains additional details about these tests. It gives the sequence of the tests and exactly what transpires during each individual test.

Table 4-5
DIAGNOSTIC LED CODES

Test	Error	Description
	.8	Displayed initially at hardware reset.
0		ROM checksum tests
	.0	ROM checksum error, byte 0
	.1	ROM checksum error, byte 1
	.2	ROM checksum error, byte 2
	.3	ROM checksum error, byte 3
4		System status register check
	.4	CMMU fault loops
5		LED register tests
	.5	LED register lault loop
5		System control register tests
	.5	System control register fault loops
6		CE DRAM mapper address register tests
	.6	DRAM mapper addr register fault loops
6		CE DRAM mapper static RAM tests
	.6	DRAM mapper static RAM fault loops
6		CE DRAM mapper control register tests
	.6	DRAM mapper control register fault loops
6		CE DRAM mapper sizing algorithm
	.6	DRAM mapper sizing algorithm fault loop
8		CE DRAM map-in algorithm
	.8	CE DRAM map-in algorithm fault loop
7		Byte 0, 1, 2 and 3 DRAM data path tests (CMMU parity checking off)
	.7	DRAM data path fault loops (without parity)
9		Byte 0, 1, 2 and 3 DRAM data path tests (CMMU parity checking on)
	.9	DRAM data path fault loops (with parity)
9		DRAM data ripple test (32-bit size)
	.9	DRAM data ripple fault loop
9		DRAM sizing access tests (8/16/32-bit)(parity off)
	.9	DRAM sizing access fault loops (parity off)
A		March test of first 1Meg of DRAM (parity on)
	.A	March test fault loop
11		CE SCC tests
	.11	CE SCC fault loop (if console is CE serial port)
C		Code/data CMMU cache tests
	.C	Code/data CMMU cache fault loop (CLKVR bits bad)
E		88K exceptions tests
	.E	88K exceptions fault loop
P		Extended CE DRAM test (4-pass march)
	.P	Extended CE DRAM test failure
F		CE Futurebus tests
	.F	CE Futurebus fault loops
L		CE LCA init tests

Test	Error	Description
	.L	CE LCA init fault loops
L		CE LCA register tests
	.L	CE LCA register fault loops
L		CE LCA (s/w) arbitration intrupt tests
	.L	CE LCA arbitration interrupt tests
L		CE LCA message interrupt test
	.L	CE LCA message interrupt fault loops
G		Futurebus scan routine
	.G	No I/O boards found by Fbus scan
H		Numerous I/O Board tests
	.H	I/O Board fault loops if critical fault
U		Boot code executing

USING OTHER DIAGNOSTIC TOOLS

Besides Power-up and Extended Self-test, there are other resident diagnostic tools for checking certain error conditions; these are the "peek-poke" monitor, and the DBX debugger software.

1. The FSD (field service diagnostics) is a separate set of lower-level GDS diagnostic routines. This requires a separate terminal connected to one of the CEM's serial ports. To run FSD, do this:
   a. Enter DiNEX-2 in interactive mode on the CEM side.
   b. cd to the FSD directory on the disk.
   c. Execute FSD virtual floppy load from the FSD file on the disk.
2. To do a SCSI auto boot of the system with an external 4220/4230 terminal as the console, set all configuration switches to on. In this situation, the terminal is connected to one of the CEM's RS-232 ports and the operating system is loaded from an external boot disk via the SCSI port.
3. To run the ROM hardware's "peek-poke" monitor, set the config switches as follows: 1 and 2 are OFF (3 and 4 are ON). Then select the desired monitor using switches 5 thru 8. All consoles are supported, but the CE serial console requires the least amount of hardware working. The I/O board console requires more functional h/w, while the GDS system console requires the most amount of working h/w.
4. To run the DBX debugger, set all config switches to their off positions. The debugger runs only on CE port 0 (SCCI B port) at 38.4K baud. This tool is primarily for system code examination and debugging of special code.
5. You should be reminded that the miniroot tape is a means of restoring a crashed hard disk. Load miniroot first, then load the tape containing system code.

NOTE

At this time, the Miniroot tape only supports certain needed boot utilities but not the full DiNEX-2 system.

Section 5

MAINTENANCE PROCEDURES

INTRODUCTION

This section provides an overview to workstation maintenance procedures by showing diagrams of each workstation module and the arrangement of field replaceable units. Also included are procedures for periodic cleaning and maintenance for each physical module.

NOTE

For detailed instructions on disassembly and reassembly of the individual modules, see the field service manual corresponding to that module.

ELECTROSTATIC PRECAUTIONS

This product contains components that are highly sensitive to electrostatic discharge. To protect these components from damage and maintain product reliability, **DO NOT** touch or remove the circuit boards or components from the modules until these conditions are met.

Handling Static-Sensitive Components

Handle all static-sensitive components and boards containing static-sensitive components (such as RAMs, ROMs, EEPROMs, custom gate arrays) in a static safeguarded area capable of controlling static charge on conductive materials, people, and non-conductive materials. Static protected areas include non-static table tops, non-static floor mats and grounding wrist straps for persons working with static sensitive parts, boards, or equipment.

Transport of Static-Sensitive Components

Transport all static-sensitive components and boards in static shielded containers or packages. A static-shield container protects its contents from static discharge and electromagnetic fields.

SAFETY CONSIDERATIONS

Before performing any of the maintenance procedures listed in this section, carefully read the Safety Summary at the front of this manual. In addition, read ALL warnings and cautions before attempting any cleaning or maintenance procedure.

ROUTINE VISUAL INSPECTION

Inspect the workstation's modules occasionally for defects such as broken connections, damaged circuit boards, loose connectors, bent Backplane connector pins, heat damaged parts, and general mechanical fitness. If the workstation is used in a high vibration environment, pay particular attention to connectors, cable strain reliefs, sheet metal enclosure fasteners, and the CRT mounting system.

The corrective procedure for most visible defects is repair or replacement; however, particular care must be taken if heat damaged components are found. Overheating usually indicates other trouble in the unit. It is important to correct the cause of the overheating to prevent a recurrence of the damage.

PREVENTIVE MAINTENANCE

The design of the workstation is such that it requires very little routine or preventive maintenance. It requires no routine lubrication, and it requires cleaning or maintenance, perform these procedures on a yearly preventive maintenance schedule.

CAUTION

To avoid damage to the plastics used for the workstation's modules, keyboard, and mouse, do NOT use cleaning agents that contain benzene, acetone, toluene, xylini, or similar chemicals.

CAUTION

This cleaning procedure uses water, so avoid getting water on any parts susceptible to water damage; then dry thoroughly.

WARNING

Disconnect the line power cord before cleaning any parts of any module. Dangerous voltages exist inside the module covers and may cause injury if contacted.

CLEANING THE MAIN MODULES

Clean the module's external covers and Display Module's CRT face using a soft cloth dampened with a solution of mild detergent and water. A treated anti-static cloth applied to the CRT face after cleaning may inhibit dust attraction and lengthen the interval between cleanings.

WARNING

After cleaning, be sure to dry all moisture inside the module or keyboard covers. Moisture could conduct a potentially lethal shock to the user when the power is reapplied to the module.

CAUTION

Static charges can be generated by a brush with synthetic bristles. Such static charges will damage solid state components, so use a soft brush with natural-fiber bristles.

Occasionally, remove any accumulated dust from inside the modules. Dust conducts electricity under high humidity conditions. The module interior is best cleaned with a vacuum cleaner. Remove any remaining dust with a soft bristle brush (paint brush) or a cloth dampened with a mild detergent and water solution. To clean narrow spaces, use a cotton-tipped applicator.

Clean all loose debris from the keyboard, thumbwheels, and mouse by directing clean, dry, regulated, compressed air around all key pads, thumbwheels, mouse buttons, and the mouse ball cavity. Clean all external cover surfaces by applying a soft cloth dampened with a solution of mild detergent and water. If liquids such as coffee, chicken soup, or soft drinks have entered the keyboard, mouse, or thumbwheels, refer to the disassembly procedures given in the *VT200 Keyboard and Mouse Field Service* manual.

CLEANING THE MASS MEMORY DEVICES

The hard disk does not permit routine or field cleaning, but the flexible disk, and streaming tape units have recommended cleaning procedures. These procedures are done with the workstation powered-up, so that the drive units will run a cleaning cartridge. Except where noted these procedures do not require Self-test.

60MB Tape Unit Procedure

To clean the head of the 60 MB Streaming Tape Drive, do these steps:

1. Apply a few drops of cleaning solution to the Drive Head Cleaning Cartridge.
2. Insert the cleaning cartridge into the tape drive as you would a regular cartridge tape.
3. Move the handle of the cleaning cartridge up and down to clean the entire head surface.
4. After cleaning, remove the cleaning cartridge and proceed with normal operation.

NOTE

When the 60 MB cleaning tape is phased out, in August '89, use the 150 MB cleaning tape instead.

150 MB Tape Unit Procedure

The cleaning kit for this unit includes cleaning fluid, and cleaning pads, which are used with the cleaning cartridge. To clean the 150 MB Streaming Tape Drive, do these steps:

1. Apply cleaning fluid to the cleaning pad. Use both sides of cleaning pads. Each pad should be used only once!
2. Insert the cleaning cartridge in the drive unit (as a normal data cartridge).
3. Turn on the workstation. This will make the capstan motor run. Run for about 20 seconds.
4. To stop the cleaning, open the door of the tape drive.

The drive unit is now ready for normal operation.

2.3 GB (8mm) Helical Streamer Tape Unit Procedures

The 2.3 GB unit (to be added in the future) should be cleaned about once a month during normal use. Clean it using these steps:

1. Be sure the workstation is on.
2. When the cartridge tape drive power cycle is complete, open the door and remove any data cartridges. Leave the door open.
3. Remove the cap from the cleaning solution bottle.
4. Hold the cleaning cartridge with its cartridge door up and facing you.
5. Release the door latch of the cleaning cartridge and hold the door open.
6. Apply the cleaning solution to the cleaning tape on the **Take-up Reel Side** (this is where the tape enters the cleaning tape cartridge). Continue to apply cleaning solution across the length of exposed cleaning tape until you reach the **Supply Reel Side**.

NOTE

Ensure that the exposed tape is completely saturated with cleaning solution. Place the nozzle of the bottle as far into the cartridge as possible, at the point where the tape enters the cartridge on the Supply Reel Side of the cartridge. Allow the cleaning solution to flow into the cartridge for about 4 to 6 seconds.

7. Allow the cartridge door to close and immediately place the cleaning cartridge into the drive unit. Close the drive unit door.
8. The remainder of the cleaning process is automatic; when done, the tape is automatically ejected from the drive unit. The drive may need a workstation 'reset' (or power cycle) to resume normal operation.
9. When the cleaning process is finished be sure to close the Cleaning Solution bottle tightly.

Flexible Disk Unit Procedures

The flexible disk drive requires no periodic cleaning. Cleaning of the heads is a more involved procedure, so refer to the 4944 Mass Memory Unit Service manual for that kind of detailed information.

WORKSTATION MODULES

The XD88 Series workstation includes these standard and optional modules.

- The Compute Engine Module
- Graphics Engine Module
  - 3D GEM
  - 2D GEM
- The Display Module (or "monitor")
  - 16-inch unit
  - 19-inch unit
- The MIS box and keyboard
- Optional input devices
  - Mouse
  - Thumbwheels
  - Valuator dials
  - Trackball

The workstation may contain multiple CEMs units and a GEM. The easiest way to tell what kind of modules these are is to look at the back side and note the boards and identifications.

The Valuator Dials and Trackball are separate products rather than workstation options. But these are considered principal modules to the workstations.

FIELD REPLACEABLE UNITS

Excluding the keyboard and optional input devices, the workstation's modules each contain a number of field replaceable units (FRUs). The FRUs for both the Graphics Engine Module and Display Module appear in Figures 5-1 and 5-4.

Compute Engine Module FRUs

Figure 5-1 shows the location of some of the Compute Engine Module's FRUs. The *XD88 Compute Engine Module* manual provides additional illustrations of FRUs not shown here.

- Compute Engine (CE) board
- I/O board
- Extended Memory board (optional)
- Memory Daughter board(s)
- Option 08/09 video board
- Auxillary RS-232-D board (p/o CE board)
- Backplane board(s)
- Possible 3D GEM boards in extra slots
- Power supply
- Terminator board(s)
- Local Bus Converter board
- Magnetic Peripheral assembly (with fan)
- Hard Disk unit and controller board
- Streaming Tape unit, and controller board
- Flexible Disk unit (optional)
- Cabinet

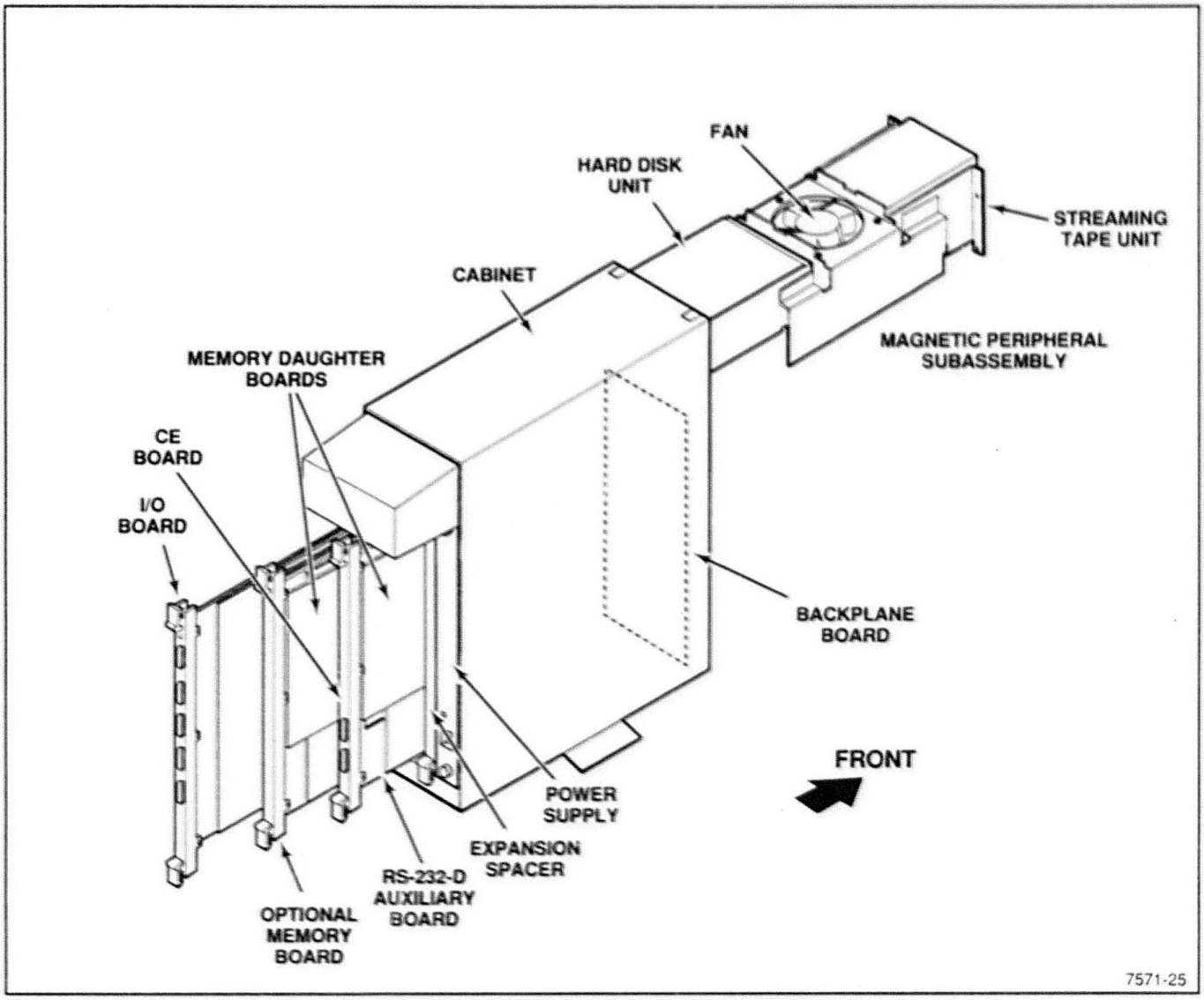

Figure 5-1. Compute Engine Module FRUs.

3D Graphics Engine Module FRUs

Figure 5-2 shows the location of some of the Graphics Engine Module's FRUs. The *3-D Graphics Engine Module* manual provides additional figures that diagram FRUs not shown here.

- Control Processor (CP) board
- I/O Buffer board
- Picture Processor board (PP2 is standard)
- Frame Buffer board(s) (FB8 is standard)
- Backplane board(s)
- Z-Buffer board (ZB24 is standard)
- Color Map board (such as CM12)
- Power supply
- Terminator board(s)*
- Flexible disk drive and fan subassembly
- Option 3F/3W DMA Interface (optional)
- Extended Memory board (optional)*
- Cabinet

* Not shown in Figure 5-2

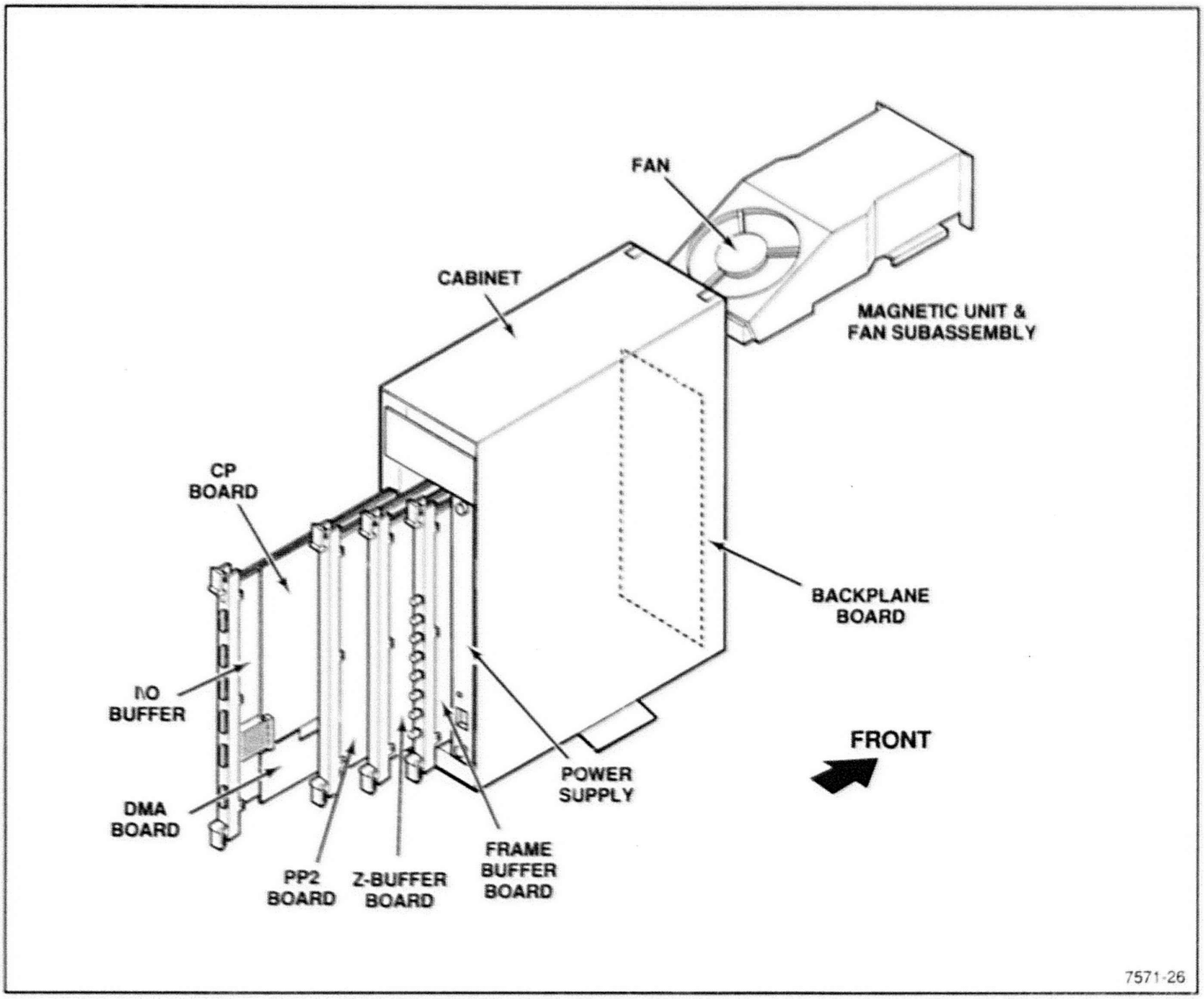

Figure 5-2. 3D Graphics Engine Module FRUs.

2D Graphics Engine Module FRUs

Figure 5-3 shows the location of some of the 2D Graphics Engine Module's FRUs. The *2-D Graphics Engine Module* manual provides additional figures that diagram FRUs not shown here.

- BLIMP and ALU Sequencer boards
- GRAPHZ1 or GRAPHZ2 boards (graphics display control)
- Backplane board
- Fan assembly
- Power supply
- Flexible disk drive
- Extended Memeory board (optional)
- Option 3F/3W DMA Interface (optional)

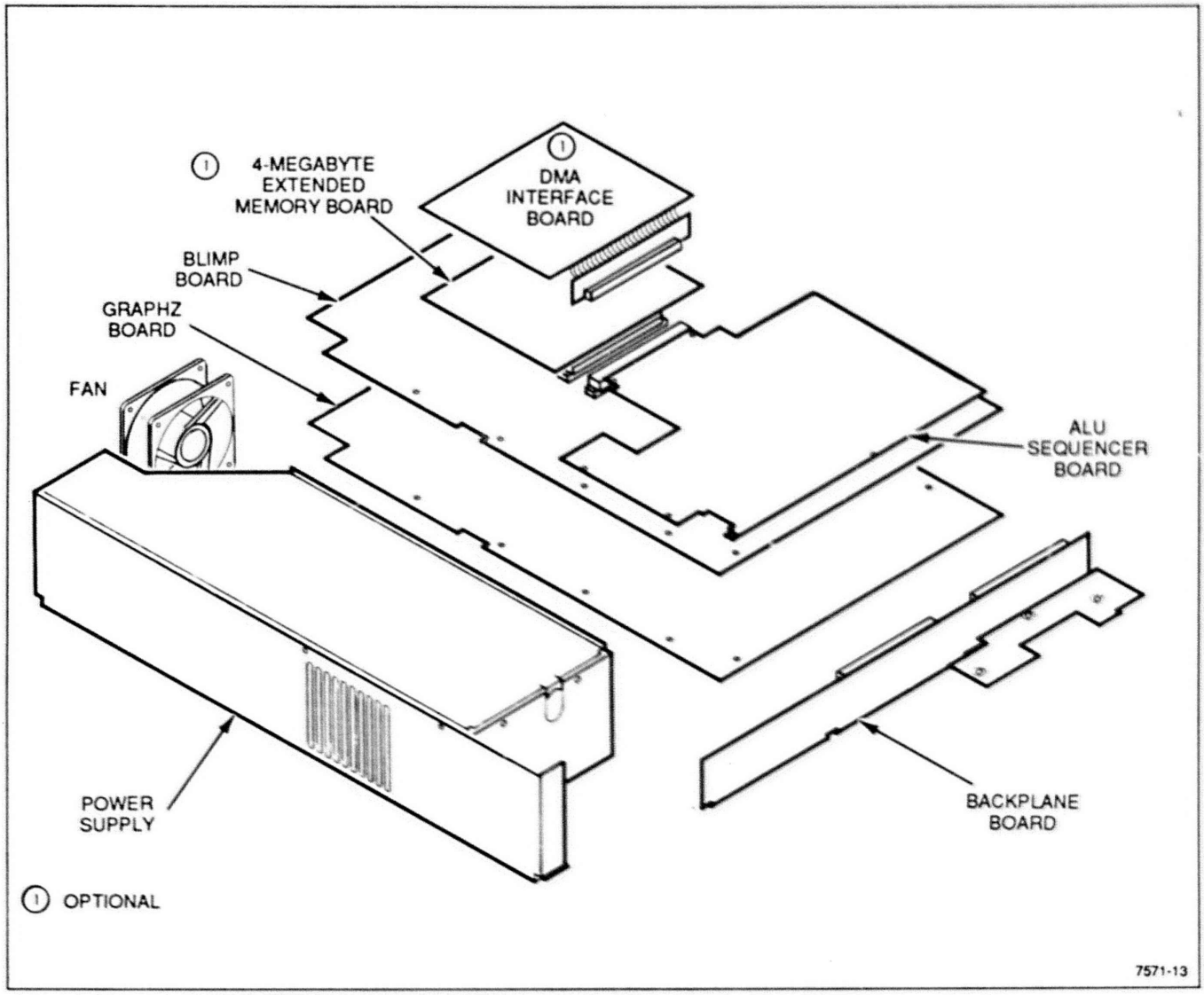

Figure 5-3. 2D Graphics Engine Module FRUs.

Display Module FRUs

Figure 5-4 shows the location of the Display Module FRUs.

- A board — Video amplifiers, contrast control, synchronization circuits
- B board — EMI filters
- C board — CRT socket, arc suppression
- D board — Horizontal and vertical deflection, high voltage supply, high voltage protection, high voltage regulation, overbeam protection
- G board — Power Supply
- H board — Operator Control Board
- K board — Flyback transformer and high voltage power supply
- L board — Convergence
- L1 board —(19-inch Display Module only): Dynamic convergence adjustments
- CRT and Yoke assembly

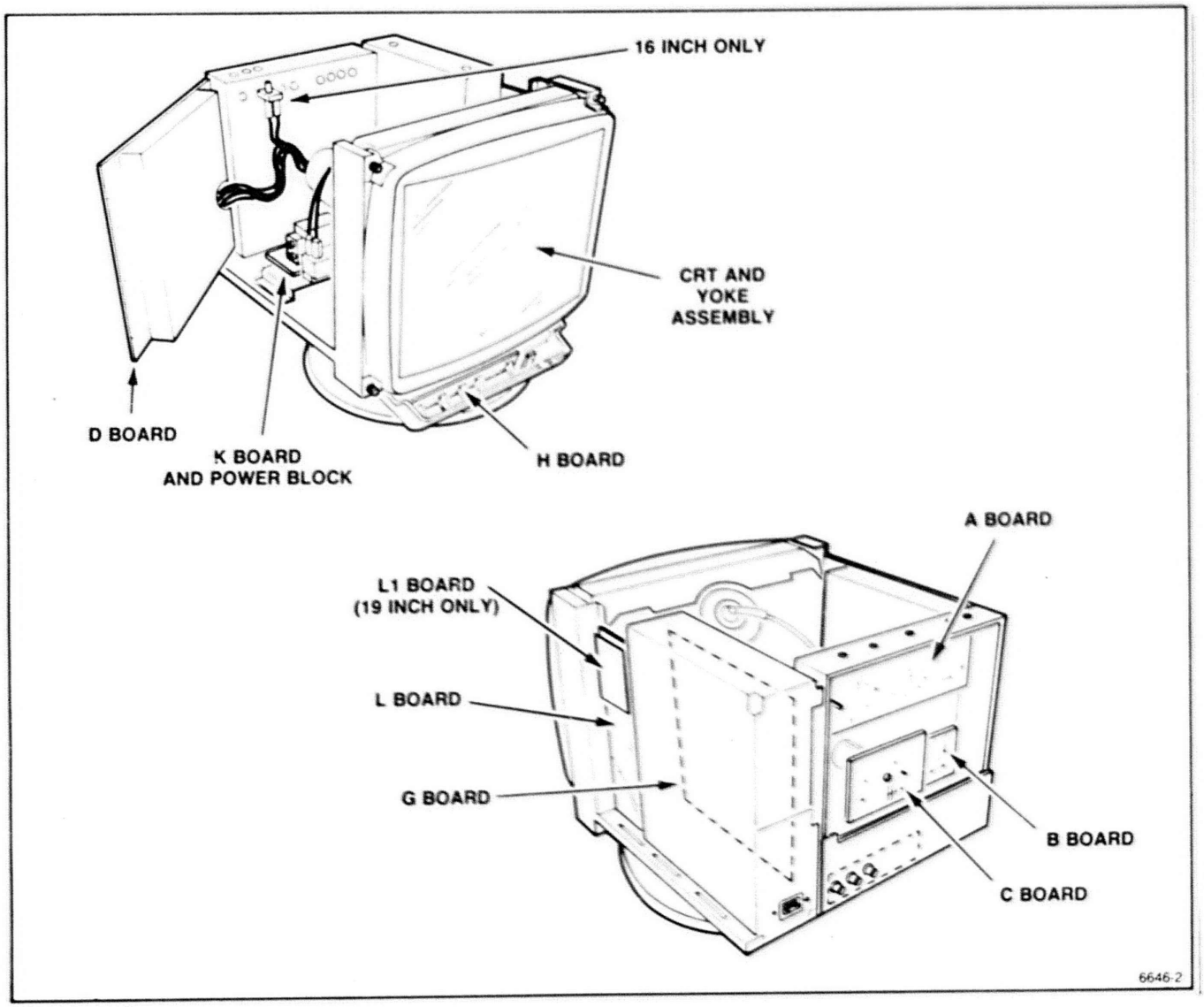

Figure 5-4. Display Module FRUs.

SEPARATING THE MODULES

The CEM and 2D or 3D GEM will be connected together physically to form a single unit. If you need to separate these modules for servicing, use these procedures (see Figure 5-6).

1. Remove the front covers and front EMI shielding from the CEM according to procedures previously described in this section. For procedures describing the removal of the GEM's EMI shield, see the appropriate modular field service manual.
2. Remove the flex link interconnecting the Backplane boards.
3. Remove the eight nuts on the four spacer posts that hold the two modules together.
4. Separate the two modules.
5. The XD88/20 workstation's 2D GEM has a vertical riser attached; you will need to remove this to open the GEM and access its FRUs. See procedures on next page.

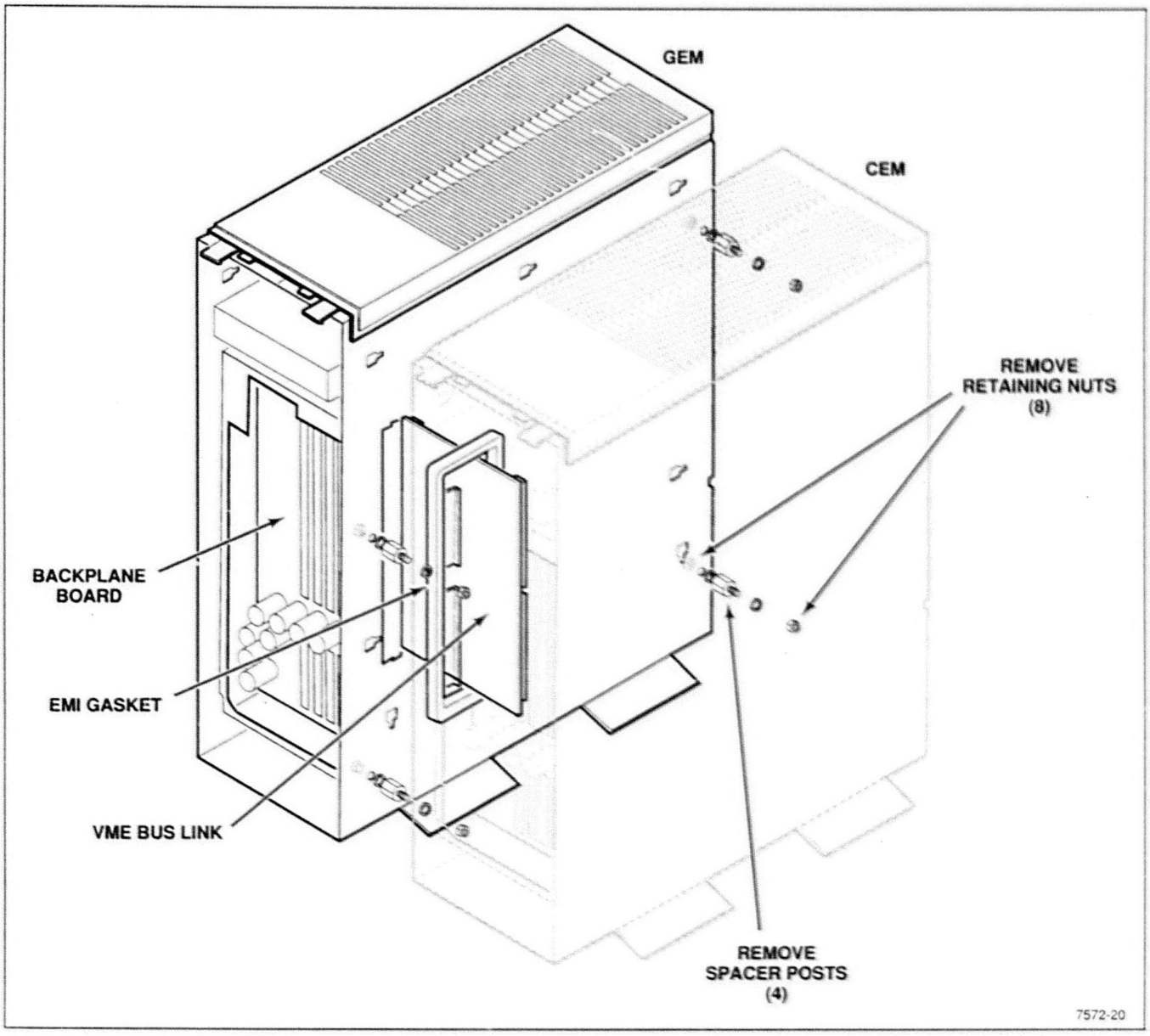

Figure 5-5. Separating the Modules.

Removing the XD88/20 Floor Stand

The XD88/20 floor stand elevates the 2D GEM (as it stands on end) so it matches the height and backplane position of the CEM. To remove this stand, refer to Figure 5-6 while doing these steps:

1. Lift and slide the GEM unit back while holding the floor stand stationary. The lifting action clears the locking pin, and the sliding action clears the mounting clips.
2. Now lift the GEM unit off of the floor stand.

To reinstall the floor stand, do these steps in reverse order.

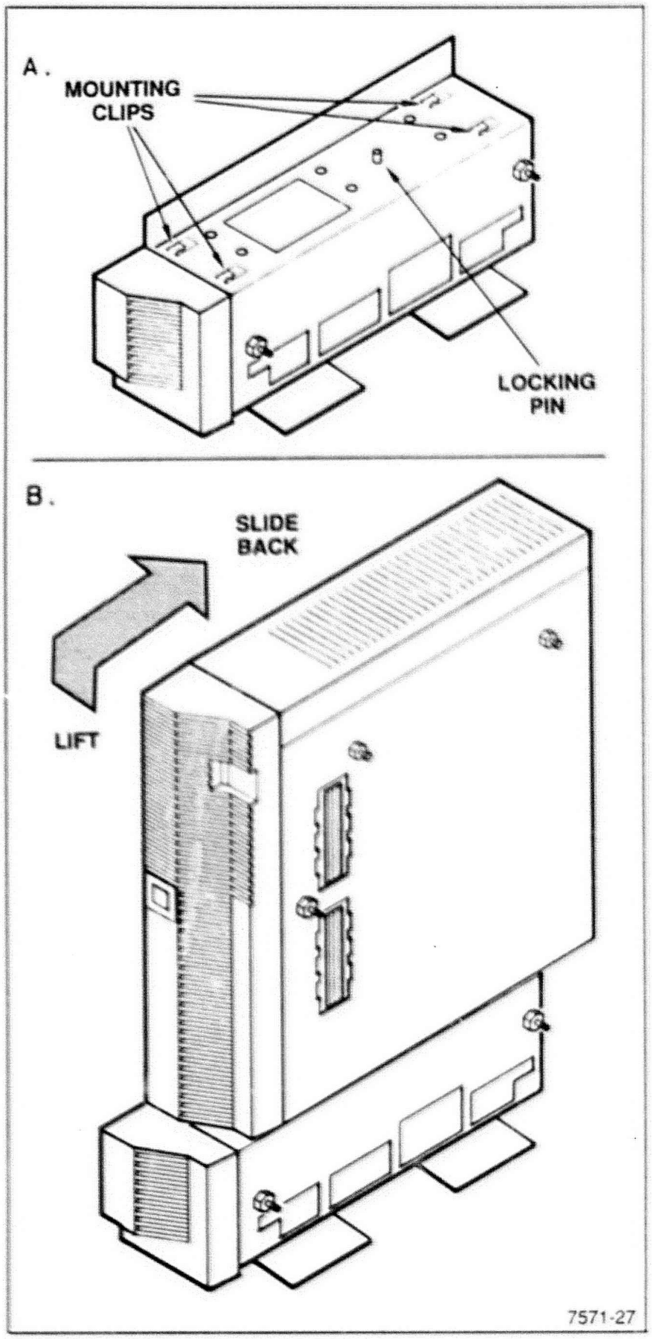

Figure 5-6. Removing the Floor Stand.

CONFIGURATION INFORMATION

When reconnecting modules or reinstalling FRUs/boards in a workstation, you should be aware that only certain arrangements of modules and boards are allowed. The allowed arrangements are dictated by the "configuration rules" which are listed here. Figure 5-7 should help you to visualize these rules.

Cabinet Rules

When reconnecting CEM to GEM modules, obey these rules:

1. 5 cabinets maximum are allowed for XD88/30: 3 CEMs and 2 3D GEMs.
2. 3 cabinets maximum are allowed for XD88/01: 3 CEMs.
3. 4 cabinets maximum are allowed for XD88/20: 3 CEMs and 1 2D GEM.
4. There is a 3-wide limit for Futurebus and the VME bus.
5. VME bus 3-wide limit for XD88/20 **includes** Graphics Module.
6. All CEMs must be adjacent, and on the left-end of the configuration (as viewed from rear). All CEM Futurebuses must be linked.
7. At least one CEM must link the Futurebus and VME bus. This means that the VME bus and Futurebus must overlap in the CEM where they meet (in a four or five wide unit).
8. Only CEMs may have hard disk or streamer tape.
9. All GEMs must be adjacent, on the right side of the configuration (as viewed from rear); and all VME buses must be linked.

Circuit Board Installation Rules

When installing a replacement circuit board, obey these rules. The first list of rules pertains to *overall* locations of circuit boards, while the second list pertains only to *adjacency* rules for boards.

General Board Location Rules:

1. The CEM's I/O board must have access to both Futurebus and VME bus.
2. The CE board must have access to both Futurebus and VME bus.
3. Futurebus boards (I/O board, CE board, Memory Controller) must reside in a CEM.
4. The I/O board must reside in the left-most VME slot, Slot 1 (as viewed from rear). This left-most VME slot must also have a VME bus terminator installed (on opposite side of Backplane).
5. The ZB, PP, GEM's memory, and video boards may reside in either hte CEM or GEM. The Frame Buffers must reside in the GEM; notice any applicable board adjacency rules.
6. The CP (Control Processor) must reside in the left-most slot of the left-most GEM, for access to graphics boards in an adjacent CEM.
7. On 5-wide systems running UTekV 3.1A, the optional Video Board will NOT function in slot 12 or up.

Additional 3D GEM rules are in the "Frame Buffer and Display List Memory Field Kit Instructions" (007-6915-00).

Board Adjacency Rules:

1. The CE (compute engine) board and Z Buffer board **cannot** be adjacent, because both use the Local Memory bus for different data.
2. For performance reasons, the first two Memory Controller boards should be adjacent to the CE board; the CE board uses a local bus to access the Memory Controller. Additional Memory Controller boards use the Futurebus.
3. The new flex-link, 119-3495-00, allows the Picture Processor and/or Z Buffer to be in an adjacent CEM and still use the Local Display Bus.
4. The Picture Processor is the first board to be moved from the GEM to a CEM.
5. All Frame Buffer boards must be adjacent, to use the video bus.

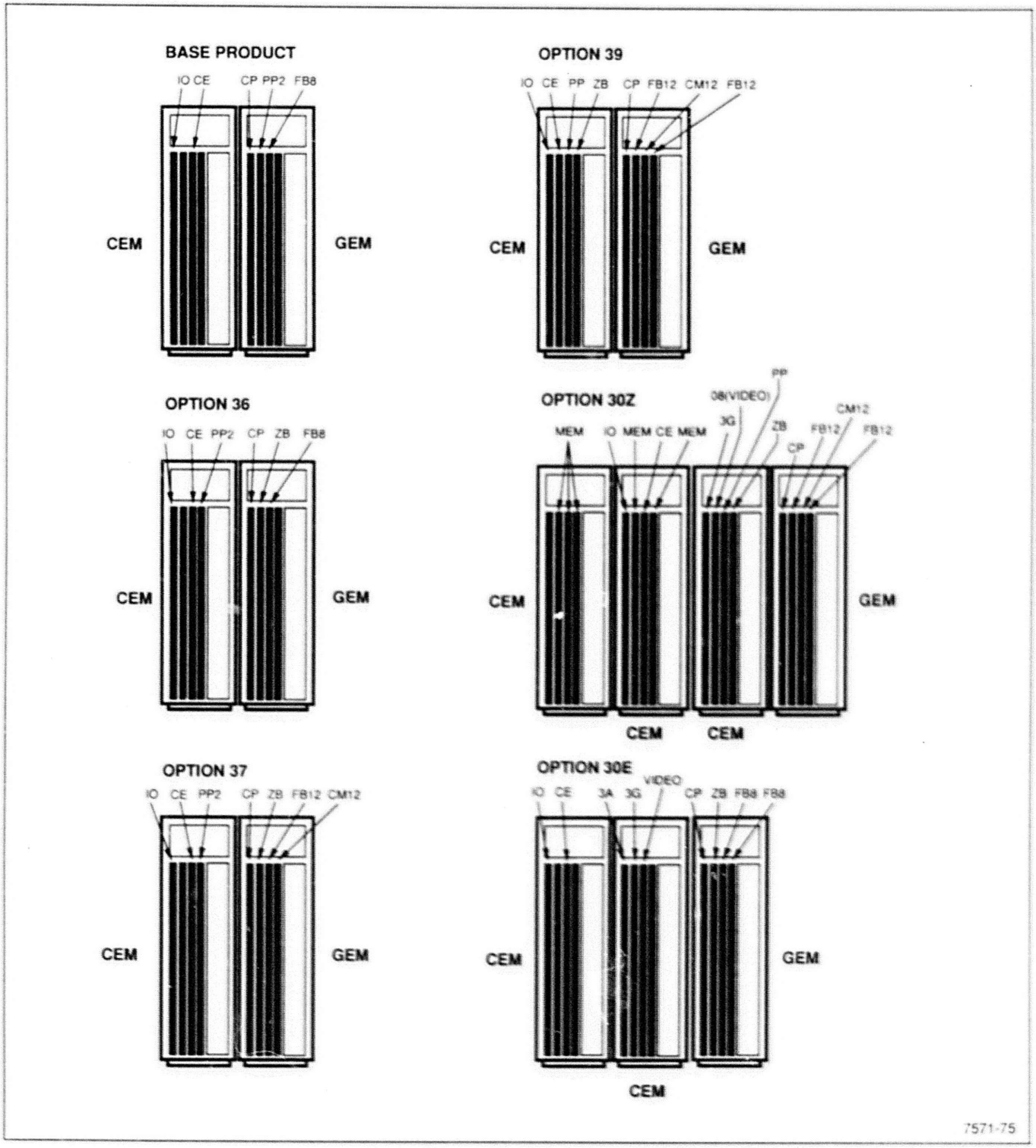

Figure 5-7. Workstation Board Configurations.

Section 6

ADJUSTMENT AND PERFORMANCE CHECKS

INTRODUCTION

This section contains a brief description of the checks and adjustments required to keep the workstation at optimum performance. For detailed procedures that describe the necessary checks and adjustments, and diagrams that show test-point locations for each workstation module, see the field service manual covering the module being tested. Also included in this section is a list of test equipment required to perform the measurements and adjustments described in each module's field service manual and a table that provides a summary of performance checks for the Compute Engine, Graphics Engine, and Display modules.

SAFETY CONSIDERATIONS

Before performing any adjustment to a workstation module, carefully read the Service Safety Summary at the front of this manual. In addition, read ALL warnings and cautions that precede each procedure before attempting any check or adjustment given in the module's field service manual.

WARNING

Lethal voltages are present in the CEM, GEM and Display modules. Be careful when performing adjustment procedures. Avoid contact with exposed components and conductors. Use an isolation transformer to supply power to the module when checking voltages, especially when checking voltages within the module's power supply.

RECOMMENDED TEST EQUIPMENT

Table 6-1 lists the test equipment needed to check and adjust the CEM, GEM and Display modules. The equipment specified here is the minimum required to perform testing on the workstation. If you use different equipment, it must meet or exceed the listed performance specifications.

Table 6-1
RECOMMENDED TEST EQUIPMENT

Description of Equipment	Equipment Specification	Example Equipment
Oscilloscope		Tektronix 2465 or equivalent
Digital Voltmeter	0 to 100 VDC 0.1% accuracy	Tektronix DM501
16" Calibration Graticule	Matches Self-Test pattern	067-1343-00
19" Calibration Graticule	Matches Self-Test pattern	067-1319-00
Photometer		Tektronix Model J-16 with Model P6503 Probe
Convergence Checker		119-1734-00
Color Degaussing Coil		003-1322-00
Magnifying Eyepiece	50X	
Adjustment Tool	Included with Display	

PERFORMANCE CHECK SUMMARY

Table 6-2 gives a convenient summary of all the checks for the CEM, GEMs and Display modules. This information is a condensed version of the performance check procedures detailed in the CEM, GEM and Display Module field service manuals.

Table 6-2
PERFORMANCE CHECK SUMMARY

Check	Expected Result
CEM, GEMs Power Supply	+5.2V, +12.0V, and -12.0V at test points on Backplane board
Display Module Low Voltage	+145V, +59V, +12V, -12V, and +9V at D board test points
Display Module High Voltage	+31V to +32.5V, +9.5V to +9.7V Max. <9.45V at D board test points
White balance Red field Green field Blue field	+40V peak to peak 8.9 fL at screen center 27.3 fL at screen center 4.7 fL at screen center
Absolute positioning	Coincidence of graticule with displayed image at any setting of V-CENT
Graticule circles: Outer circle Center circle Big circle	 1.25% of long axis when module is in north-south orientation 1% of long axis when module is in east-west orientation 0.3mm misconvergence inside circle, 0.5mm misconvergence outside circle
Pincushion	Visual, square corners and rectangular screen patterns
Vertical linearity	No distortion between upper and lower halves of screen
Geometric distortion	All grid intersections are within 1% deviation circles on graticule

KEYBOARD CHECK

The Self-test diagnostics program allows you to check the keyboard. If Self-test reports a keyboard failure, replace the entire unit. See Section 4 for information on using Self-test.

MASS MEMORY DEVICE CHECKS

None of the workstation's mass memory devices (hard disk, streaming tape, or optional flexible disk) require special field testing or adjustments. Section 5, *Maintenance*, gives cleaning procedures for these devices.

Self-test routines in ROM check the condition of all the connected mass memory devices before loading data to/from them. If Self-test reports a failure in a disk drive or streaming tape unit, replace the entire unit.

Section 7

REPLACEABLE PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

```
1 2 3 4 5                    Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
     ....END ATTACHING PARTS....
  Detail Part of Assembly and/or Component
  Attaching parts for Detail Part
       ....END ATTACHING PARTS....
    Parts of Detail Part
    Attaching parts for Parts of Detail Part
         ....END ATTACHING PARTS....
```

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
16428	COOPER BELDEN ELECTRONIC WIRE AND CA SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
S0482	SONY CORP		TOKYO JAPAN
S3109	FELLER	ASA ADOLF AG STOTZWEID CH8810	HORGEN SWITZERLAND
TK1373	PATELEC-CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY
TK1374	TRI-TEC ENGINEERING CORP	13130 S NORMANDIE	GARDENA CA 90249-2128
TK6020	DAINICHI-NIPPON CABLES	NEW KOKUSAI BLDG 4-1 MARUNOUCHI 3-CHOME CHIYODA-KU	TOKYO 100 JAPAN

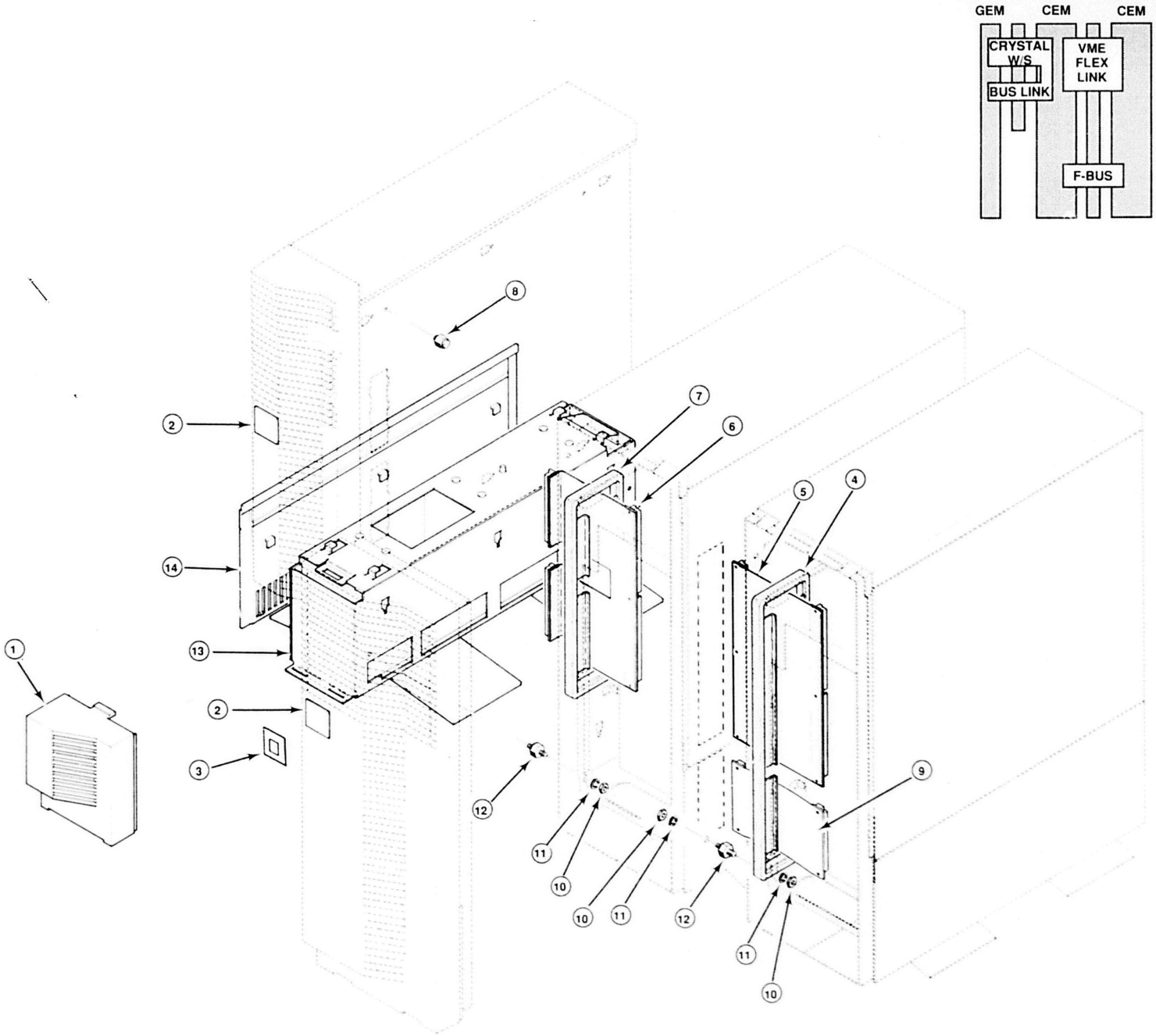

FIG. 1XD88/20 INTRACONNECT

FIG. 1XD88/20 INTRACONNECT

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	200-3470-00			1	COVER,FRONT PNL:	80009	200-3470-00
-2	134-0195-00			1	PLUG,PWR SW:PLASTIC,0.750 SQ	80009	134-0195-00
-3	334-7692-00			1	MARKER,IDENT:MKD LOGO,XD8820	80009	334-7692-00
-6	119-2688-01			1	CABLE,FLEXIBLE:96 PIN CONN	80009	119-2688-01
-7	348-0969-00			1	GASKET:CHASSIS PORT	80009	348-0969-00
-8	129-1214-01			2	SPACER,POST:6-32,0.825 L,THD STUD	80009	129-1214-01
-9	119-3251-00			1	FLEX LINK ASSY:FUTURE BUS	80009	119-3251-00
-10	210-0411-00			3	NUT,PLAIN,HEX:0.25-20 X 0.438 STL CD PL	73743	ORDER BY DESCR
-11	210-0016-00			3	WASHER,LOCK:0.25 ID,SPLIT,0.062 THK,STL	86928	ORDER BY DESCR
-12	129-1231-00			3	SPACER,POST:0.250-20 THD BOTH END X	80009	129-1231-00
-13	441-1808-01			1	CHASSIS ASSY:STANDALONE,ALUMINUM	80009	441-1808-01
-14	200-3357-00			1	COVER,SIDE:PLASTIC	80009	200-3357-00

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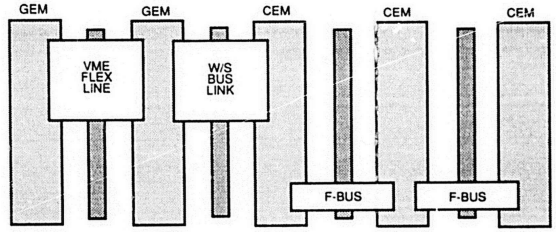
FIG. 2 XD88/30 INTRACONNECT



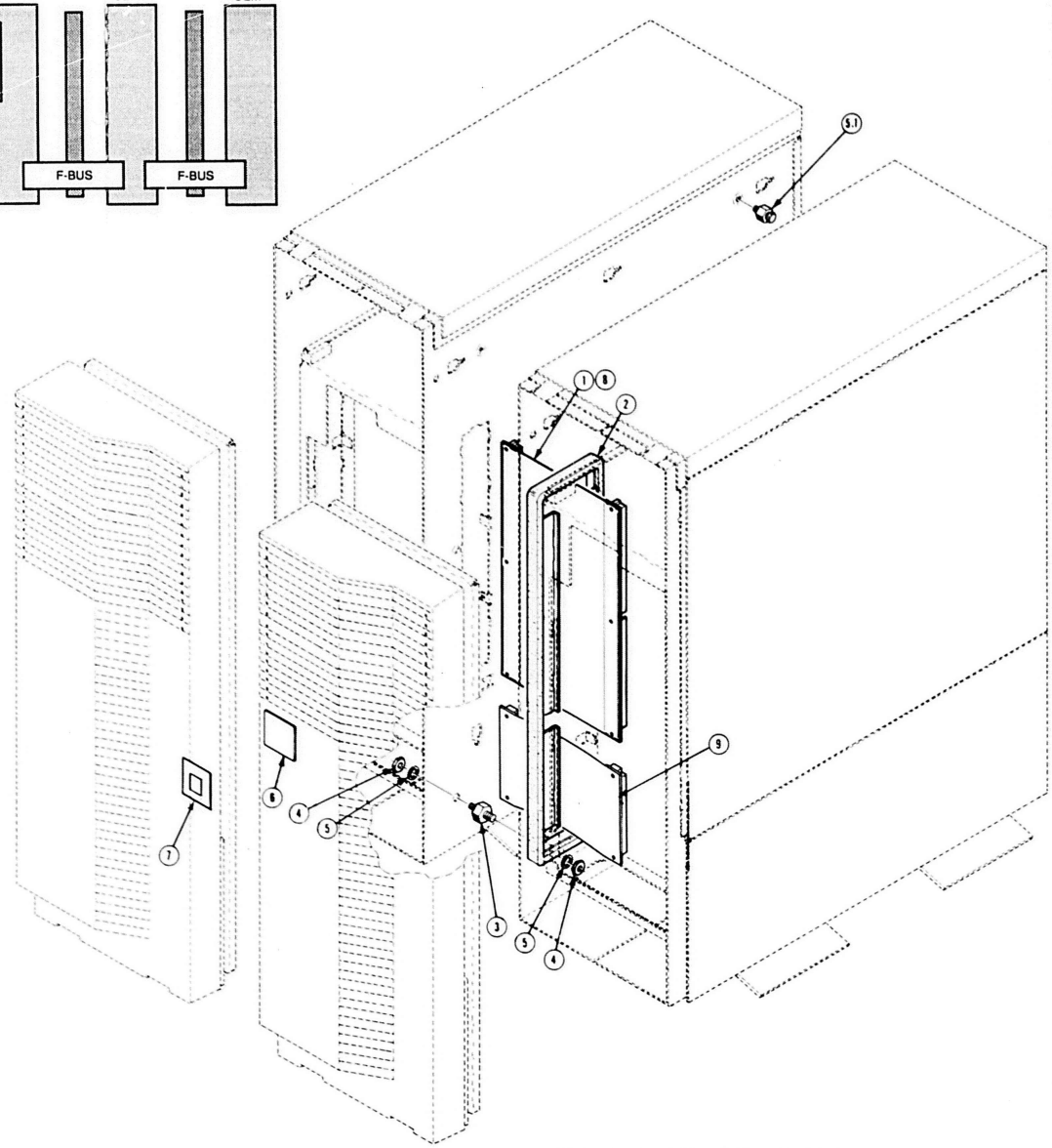


FIG. 2 XD88/30 INTRACONNECT

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-1	119-2598-01			1	FLEX LINK ASSY:VME/LDB BUS LINK	80009	119-2598-01
-2	348-1113-00			1	GASKET:CHASSIS,PORT	80009	348-1113-00
-3	129-1231-00			4	SPACER,POST:0.250-20 THD BOTH END X	80009	129-1231-00
-4	210-0411-00			8	NUT,PLAIN,HEX:0.25-20 X 0.438 STL CD PL	73743	ORDER BY DESCR
-5	210-0016-00			8	WASHER,LOCK:0.25 ID,SPLIT,0.062 THK,STL	86928	ORDER BY DESCR
-5.1	129-1214-01			1	SPACER,POST:6-32,0.825 L,THD STUD	80009	129-1214-01
-6	134-0195-00			1	PLUG,PWR SW:PLASTIC,0.750 SQ	80009	134-0195-00
-7	334-7689-00			1	MARKER,IDENT:MKD LOGO,XD8830	80009	334-7689-00
-8	119-3495-00			1	FLEX LINK ASSY:FLEX CIRUCIT 259-0071-XX	80009	119-3495-00
-9	119-3251-00			1	FLEX LINK ASSY:FUTURE BUS	80009	119-3251-00

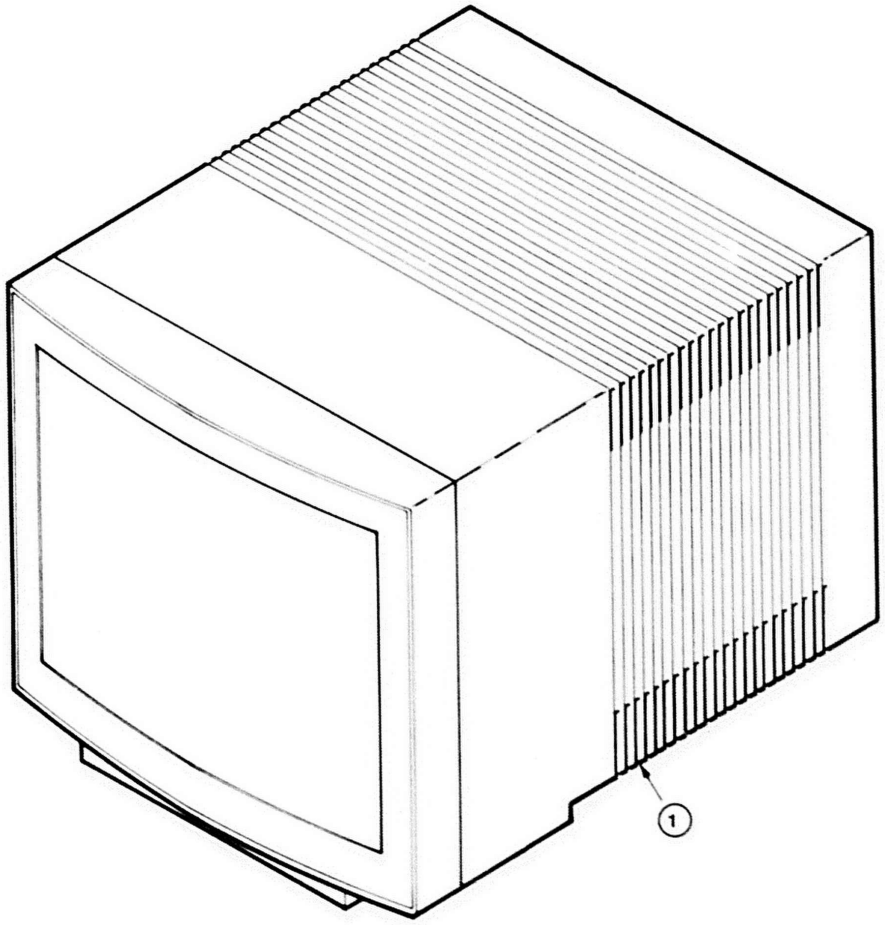


FIG. 3 DISPLAY

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-1	119-2439-00			1	MON,DSPL ASSY:16 IN,1280 X 1024 DISPLAY	80009	119-2439-00
	118-6311-00			1	.CIRCUIT BD ASSY:VIDEO AMP	S0482	A-1296-180-A
	118-6312-00			1	.CIRCUIT BD ASSY:EMI FILTER	80009	118-6312-00
	118-6313-00			1	.CIRCUIT BD ASSY:DEFLECTION	S0482	A-1345-702-A
	118-6314-00			1	.CIRCUIT BD ASSY:LOW VOLTAGE POWER SUPPLY	S0482	A-1477-275-A
	118-6317-00			1	.CIRCUIT BD ASSY:HIGH VOLTAGE ASSY	S0482	A-1465-154-A
	118-6324-00			1	.CIRCUIT BD ASSY:CRT SOCKET	S0482	A-1330-733-A
	118-6331-00			1	.CRT ASSEMBLY:	S0482	8-738-551-92
	118-6335-00			1	.CIRCUIT BD ASSY:AA VIDEO DAUGHTER	80009	118-6335-00
	118-6336-00			1	.CIRCUIT BD ASSY:AB VIDEO DAUGHTER	80009	118-6336-00
	119-2451-00			1	DISPLAY ASSY:19 IN MONITOR,1280 X 1024 (OPTION 32)	80009	119-2451-00
	118-6311-00			1	.CIRCUIT BD ASSY:VIDEO AMP	S0482	A-1296-180-A
	118-6312-00			1	.CIRCUIT BD ASSY:EMI FILTER	80009	118-6312-00
	118-6314-00			1	.CIRCUIT BD ASSY:LOW VOLTAGE POWER SUPPLY	S0482	A-1477-275-A
	118-6335-00			1	.CIRCUIT BD ASSY:AA VIDEO DAUGHTER	80009	118-6335-00
	118-6336-00			1	.CIRCUIT BD ASSY:AB VIDEO DAUGHTER	80009	118-6336-00
	118-6571-00			1	.CIRCUIT BD ASSY:CRT SOCKET	S0482	A-1330-736-A
	118-6574-00			1	.CIRCUIT BD ASSY:CONVERGENCE,L	S0482	A-1235-009-A
	118-6689-00			1	.CIRCUIT BD ASSY:CONVERGENCE CONTROL,L1	S0482	A-1233-065-A
	118-6690-00			1	.HIGH VOLTAGE AS:K	S0482	A-1465-158-A
	118-6735-00			1	.CRT:19 INCH,A-1020-457-A	S0482	A-2010-457-A
	118-6897-00			1	.CIRCUIT BD ASSY:D,DEFLECTION	S0482	A-1345-641-A

FIG. 4 VALUATOR DIALS

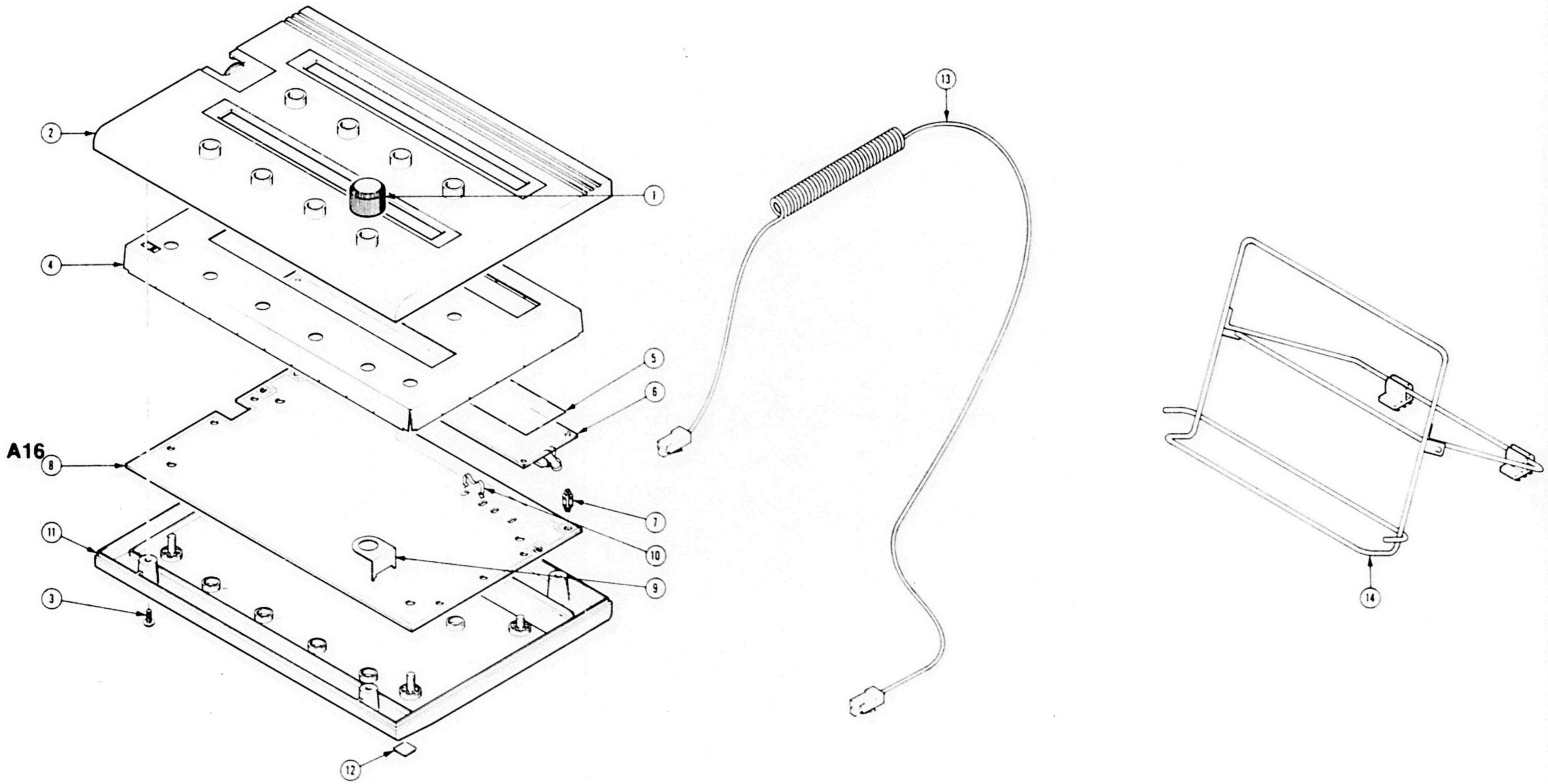


FIG. 4. VALUATOR DIALS

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-1	366-2095-00			1	KNOB:SMOKE TAN,0.23 ID X 0.1 OD X 0.6 H	80009	366-2095-00
-2	200-3215-00			1	COVER,CKT BOARD:VALUATOR,TOP,PLASTIC	80009	200-3215-00
					(ATTACHING PARTS)		
-3	211-0658-00			4	SCR,ASSEM WSHR:6-32 X 0.312,PNH,STL,POZ	78189	S51-060545-0X
					(END ATTACHING PARTS)		
-4	337-3387-00			1	SHIELD,ELEC:EMI	80009	337-3387-00
-5	337-3389-00			2	SHIELD,ELEC:PROTECTIVE	80009	337-3389-00
-6	119-2483-02			2	DISPLAY MODULE:LCD,1 X 80	80009	119-2483-02
-7	361-1429-00			8	SPACER,CKT BD:0.375 L,NYLON	80009	361-1429-00
-8	670-9616-02			1	CIRCUIT BD ASSY:VOLUATOR DIALS	80009	670-9616-02
-9	407-3625-00			8	.BRACKET,SW MTG:	80009	407-3625-00
-10	344-0236-00			2	.CLIP,SPR TNSN:XSTR MTG,CU BE BRIGHT DIP	80009	344-0236-00
-11	200-3216-00			1	COVER,CKT BOARD:VALUATOR,BOTTOM,PLASTIC	80009	200-3216-00
-12	348-0915-00			4	.FOOT,CABINET:NEOPRENE	80009	348-0915-00
-13	012-1198-00			1	CABLE,INTCON:KEYBOARD TO MIS	80009	012-1198-00
-14	348-0914-00			1	FLIPSTAND,CAB.:VALUATOR BOX,ALUMINUM	80009	348-0914-00

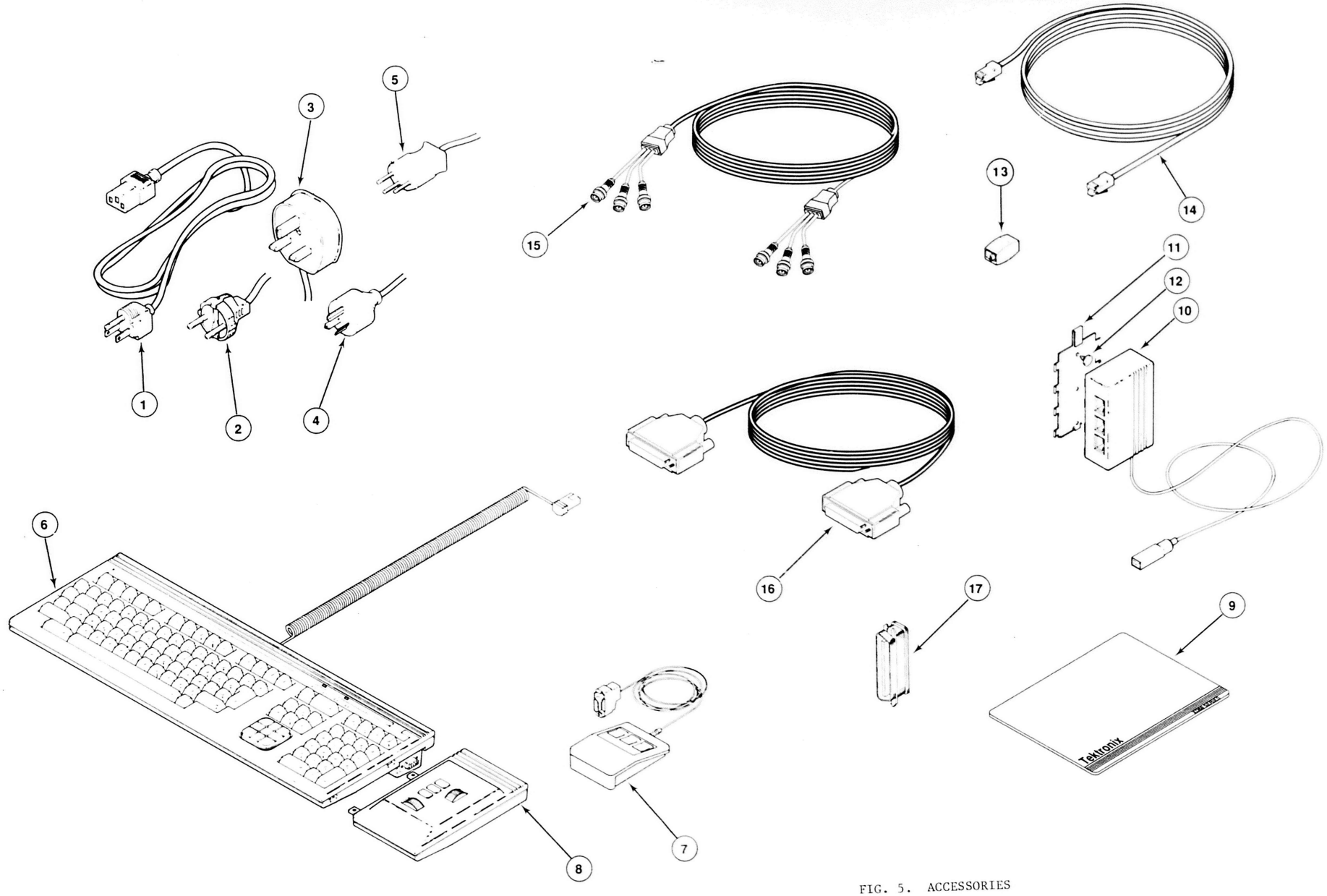


FIG. 5. ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
5-					ACCESSORIES		
-1	161-0123-00			3	CABLE ASSY,PWR,:3,16 AWG,125V,96.01 L (STANDARD)	16428	CH-9028
-2	161-0066-09			3	CABLE ASSY,PWR,:3,0.75MM SQ,220V,99.0 L (EUROPEAN OPTION)	S3109	86511000
-3	161-0066-10			3	CABLE ASSY,PWR,:3,0.75MM SQ,240V,96.0 L (UNITED KINGDOM OPTION)	TK1373	24230
-4	161-0066-11			3	CABLE ASSY,PWR,:3,0.75MM,240V,96.0 L (AUSTRALIAN OPTION)	S3109	ORDER BY DESCR
-5	161-0154-00			3	CABLE ASSY,PWR,:3,0.75MM SQ,240V,6A,2.5M L (SWISS OPTION)	S3109	86515000
-6	119-2468-03			1	KEYBOARD ASSY:ASSII COMPATIBLE,VT-200,SQ CONN	80009	119-2468-03
	119-2690-03			1	KEYBOARD ASSY:UNITED KINGDOM,VT-200,SQ	80009	119-2690-03
	119-2691-03			1	KEYBOARD ASSY:FRENCH,VT-200,SQ CONN	80009	119-2691-03
	119-2692-03			1	KEYBOARD ASSY:SWEDISH,VT-200,SQ CONN	80009	119-2692-03
	119-2693-03			1	KEYBOARD ASSY:DANISH/NORWEGIAN,VT-200,SQ CONN	80009	119-2693-03
	119-2694-03			1	KEYBOARD ASSY:GERMAN,VT-200,SQ CONN	80009	119-2694-03
	119-2695-03			1	KEYBOARD ASSY:ITALIAN,VT-200,SQ CONN	80009	119-2695-03
	119-2696-03			1	KEYBOARD ASSY:SPANISH,VT-200,SQ CONN	80009	119-2696-03
-7	119-1808-00			1	POINTER ASSY:MOUSE	80009	119-1808-00
-8	119-2595-01			1	MODULE:THUMBWHEEL ASSY 422X/423X/432X	80009	119-2595-01
-9	348-1172-00			1	PAD,CUSHIONING:MOUSE	80009	348-1172-00
-10	670-9780-00			1	CIRCUIT BD ASSY:INTERCONNECT	80009	670-9780-00
-11	386-5619-00			1	.PLATE,MOUNTING:BOTTOM	80009	386-5619-00
-12	344-0421-00			3	.CLIP,RTNG:0.442 L,PLSTC,W/FLAT HEAD (END ATTACHING PARTS)	80009	344-0421-00
-13	376-0226-00			1	COUPLER:2 X 4 POS,SLATE GRAY	80009	376-0226-00
-14	012-1252-00			1	CABLE,INTCON:8 COND SHIELD,120.0 L	80009	012-1252-00
-15	012-1189-01			1	CABLE ASSY,RF:75 OHM COAX,120.0 L	TK1374	901750
-16	012-0911-00			1	CABLE,INTCON:144.0 L, RS 232	TK6020	ESF-85249
-17	119-2260-00			1	TERMINATOR ASSY:SCSI,SINGLE END	00779	868875-1
	070-6643-03			1	MANUAL,TECH:2D/3D GRAPHICS COMMAND SUMMARY	80009	070-6643-03
	070-7266-00			1	MANUAL,TECH:USERS, X WINDOW SYSTEM VERSION 11	80009	070-7266-00
	070-7567-00			1	MANUAL,TECH:INTRODUCING YOUR XD88/SERIES WORKSTATION	80009	070-7567-00
	070-7568-00			1	MANUAL,TECH:XD88 SERIES DAILY USE MANUAL	80009	070-7568-00
	070-7569-00			1	MANUAL,TECH:UNPACKING YOUR XD88 SERIES WORKSTATION	80009	070-7569-00
	070-7570-00			1	MANUAL,TECH:INSTALLATION,XD88	80009	070-7570-00
	070-7573-00			1	MANUAL,TECH:UTEK V SYSADMIN GUIDE	80009	070-7573-00
	070-7574-00			1	MANUAL,TECH:REFERENCE,UTEK V SYSADMIN,XD88	80009	070-7574-00
	070-7575-00			1	MANUAL,TECH:USERS GUIDE,UTEK V,XD88	80009	070-7575-00
	070-7576-00			1	MANUAL,TECH:USERS REFERENCE,UTEK V,XD88	80009	070-7576-00
	070-7579-00			1	MANUAL,TECH:QUICK REFERENCE,UTEK V,XD88	80009	070-7579-00
	070-7585-00			1	MANUAL,TECH:USER GUIDE,XD88 UTEK V ASSIT SOFTWARE	80009	070-7585-00
	070-7589-00			1	MANUAL,TECH:USERS GUIDE,UTEK V FACE,XD88	80009	070-7589-00
	070-7591-00			1	MANUAL,TECH:USERS GUIDE,UTEK V NETWORK,XD88	80009	070-7591-00
	070-7592-00			1	MANUAL,TECH:UTEK V NETWORKING SYSTEM ADMINISTRATION	80009	070-7592-00
	070-7595-00			1	MANUAL,TECH:UNIX SYSTEM V PRIMER	80009	070-7595-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
5-								
						OPTIONAL ACCESSORIES		
	012-1241-00			1		CABLE ASSEMBLY:DB9 FEMALE TO DB25 MALE ADAPTER CABLE RS232,180.0 L	80009	012-1241-00
	012-1242-00			1		CABLE ASSEMBLY:DB9 FEMALE TO DB25 FEMALE ADAPTER CABLE,RS232,180.0 L	80009	012-1242-00
	013-0214-01			1		ADAPTER ASSY:COPIER LOOPBACK	80009	013-0214-01
	013-0255-00			1		FIXTURE ASSY:SERIAL PORT LOOPBACK	80009	013-0255-00
	070-6537-00			1		MANUAL,TECH:FLOPPY DISK CONTROLLER	80009	070-6537-00
	070-6644-03			1		MANUAL,TECH:2-D/3-D GRAFHICS PROGRAMMER	80009	070-6644-03
	070-6645-01			1		MANUAL,TECH:PROGRAMMERS,4220/4230 SERIES	80009	070-6645-01
	070-7242-00			1		MANUAL,TECH:FIELD SERVICE,16-INCH DISPLAY MODULE	80009	070-7242-00
	070-7243-00			1		MANUAL,TECH:FIELD SERVICE,19-INCH DISPLAY MODULE	80009	070-7243-00
	070-7244-00			1		MANUAL,TECH:FIELD SERVICE,KEYBOARD AND MOUSE MODULE	80009	070-7244-00
	070-7267-00			1		MANUAL,TECH:INTRODUCTION TO THE X WINDOW SYSTEM(PRENTICE HALL)	80009	070-7267-00
	070-7268-00			1		MANUAL,TECH:REF,X WINDOW SYSTEM,VERSION11	80009	070-7268-00
	070-7335-00			1		MANUAL,TECH:XD88 SERIES PORTING GUIDE	80009	070-7335-00
	070-7359-00			1		MANUAL,TECH:X WINDOW SYSTEM:C LIBRARY & PROTOCOL	80009	070-7359-00
	070-7377-00			1		MANUAL,TECH:FIELD SERVICE,3D GRAPHICS ENGINE MODULE	80009	070-7377-00
	070-7571-00			1		MANUAL,TECH:FIELD SERVICE OVERVIEW,XD88	80009	070-7571-00
	070-7572-00			1		MANUAL,TECH:FIELD SERVICE,XD88CEM	80009	070-7572-00
	070-7577-00			1		MANUAL,TECH:UTEK V PROGRAMMERS GUIDE,XD88	80009	070-7577-00
	070-7578-00			1		MANUAL,TECH:UTEK V PROGRAMMERS REF,XD88	80009	070-7578-00
	070-7586-00			1		MANUAL,TECH:TOOL GUIDE,XD88 UTEK V ASSIT SOFTWARE DEVELOPMENT	80009	070-7586-00
	070-7587-00			1		MANUAL,TECH:UTEK V STREAMS PRIMER	80009	070-7587-00
	070-7588-00			1		MANUAL,TECH:UTEK V STREAMS PROGRAMMERS GUIDE,XD88	80009	070-7588-00
	070-7590-00			1		MANUAL,TECH:UTEK V FMLI PROGRAMMERS GUIDE,XD88	80009	070-7590-00
	070-7593-00			1		MANUAL,TECH:UTEK V NETWORK PROGRAMMERS GUIDE,VOL.1,XD88	80009	070-7593-00
	070-7594-00			1		MANUAL,TECH:UTEK V NETWORK PROGRAMMERS GUIDE,VOL.2,XD88	80009	070-7594-00
	070-7599-00			1		MANUAL,TECH:UTEK V POSIX CONFORMANCE	80009	070-7599-00

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Option	Part Order No.	Name & Description
XD8820	----- -----	88K GRAPHIC WORKSTATION:2D HIGH PERFORMANCE
XD88F14		ADD 1.2MB FLEXIBILE DISK DRIVE
XD88F17		ADD 300MB HARD DISK DRIVE
XD88F18		ADD 600MB HARD DISK DRIVE
XD88F19		ADD 2ND 600MB HARD DISK DRIVE
XD88F1M		ADDED MEMORY:MEMORY CONTROLLER W/16MB MEMORY
XD88F1N		ADDED MEMORY:16MB MEMORY DAUGHTER BOARD
XD88F1U		ADD 4CMMUS:TOTAL 8 CACHE MEM MGMT UNIT
XD88F3A		RS232 DMA BOARD:8 PORTS + CENTRONIX, REQ'S OPTION 3G
XD88F3G		VME BUS ADAPTER:HOLDS 1 BOARD
XD88F42		ADD 1 CEM UNIT:ADD COMPUTE ENGINE MODULE
XD8820 OPTION A1		220V,EUROPEAN PLUG:
XD8820 OPTION A2		240V,UNITED KINGDOM PLUG:
XD8820 OPTION A3		240V,AUSTRAILIAN PLUG:
XD8820 OPTION A5		220V,SWISS PLUG:
XD8820 OPTION A9		NO POWER CORD:INTERNALLY SET FOR 230V
XD8820 OPTION VA		VT200 KEYBOARD:UNITED KINGDOM
XD8820 OPTION VB		VT200 KEYBOARD:FRENCH
XD8820 OPTION VC		VT200 KEYBOARD:SWEDISH
XD8820 OPTION VF		VT200 KEYBOARD:DANISH/NORWEGIAN
XD8820 OPTION VG		VT200 KEYBOARD:GERMAN
XD8820 OPTION VI		VT200 KEYBOARD:ITALIAN
XD8820 OPTION VS		VT200 KEYBOARD:SPANISH
XD8820 OPTION 1A		ADD 8MB COMPUTE ENGINE MEMROY:TOTAL 16MB
XD8820 OPTION 1B		ADD 24MB COMPUTE ENGINE MEMORY:TOTAL 32MB
XD8820 OPTION 1C		ADD 40MB COMPUTE ENGINE MEMORY:TOTAL 48MB
XD8820 OPTION 1D		ADD 56MB COMPUTE ENGINE MEMROY:TOTAL 64MB
XD8820 OPTION 1E		ADD 72MB COMPUTE ENGINE MEMORY:TOTAL 80MB
XD8820 OPTION 1F		ADD 88MB COMPUTE ENGINE MEMORY:TOTAL 96MB
XD8820 OPTION 1G		ADD 104MB COMPUTE ENGINE MEMORY:TOTAL 112MB
XD8820 OPTION 1H		ADD 120MB COMPUTE ENGINE MEMORY:TOTAL 128MB
XD8820 OPTION 1J		ADD 136MB COMPUTE ENGINE MEMORY:TOTAL 144MB
XD8820 OPTION 1K		ADD 152MB COMPUTE ENGINE MEMORY:TOTAL 160MB
XD8820 OPTION 1M		ADD 168MB COMPUTE ENGINE MEMORY:TOTAL 176MB
XD8820 OPTION 1U		ADD 4CMMUS:TOTAL 8 CACHE MEM MGMT UNIT
XD8820 OPTION 3A		RS232 DMA BOARD:8 PORTS + CENTRONIX, REQ'S OPTION 3G
XD8820 OPTION 3G		VME BUS ADAPTER:HOLDS 1 BOARD
XD8820 OPTION 08		PAL VIDEO OUT:DIGITAL VIDEO INTERFACE
XD8820 OPTION 09		NTSC VIDEO OUT:DIGITAL VIDEO INTERFACE
XD8820 OPTION 13		REMOVE HARD DISK:REQUIRES 4944 OPTION 44
XD8820 OPTION 14		ADD 1.2MB FLEXIBLE DISK DRIVE
XD8820 OPTION 17		ADD 300MB HARD DISK DRIVE
XD8820 OPTION 18		ADD 600MB HARD DISK DRIVE
XD8820 OPTION 19		ADD 2ND 600MB HARD DISK DRIVE
XD8820 OPTION 22		ADD 4MB DISPLAY LIST MEMORY
XD8820 OPTION 32		19 INCH DISPLAY:1280 X 1024
XD8820 OPTION 34		19 INCH TOUCH SCREEN:ETCHED
XD8820 OPTION 35		19 INCH TOUCH SCREEN:UNETCHED
XD8820 OPTION 42		ADD 1 CEM UNIT:ADD COMPUTE ENGINE MODULE
XD8820 OPTION 43		ADD 2 CEM UNITS:TOTAL 3 CEMS

Option	Part Order No.	Name & Description
XD8830	----- -----	88K GRAPHIC WORKSTATION:3D HIGH PERFORMANCE
4200F41		ADDITIONAL GRAPHIC ENGINE MODULE UNIT
4200F4D		EVALUATOR DIALS:8 DIAL SET
4200F4M		MOUSE
4200F4T		THUMBWHEEL
XD88F14		ADD 1.2MB FLEXIBILE DISK DRIVE
XD88F17		ADD 300MB HARD DISK DRIVE
XD88F18		ADD 600MB HARD DISK DRIVE
XD88F19		ADD 2ND 600MB HARD DISK DRIVE
XD88F1M		ADDED MEMORY:MEMORY CONTROLLER W/16MB MEMORY
XD88F1N		ADDED MEMORY:16MB MEMORY DAUGHTER BOARD
XD88F1U		ADD 4CMMUS:TOTAL 8 CACHE MEM MGMT UNIT
XD88F3A		RS232 DMA BOARD:8 ADDITIONAL RS232 PORTS
XD88F3G		VME BUS ADAPTER:HOLDS 1 BOARD
XD88F42		ADD 1 CEM UNIT:ADD COMPUTE ENGINE MODULE
XD8830 OPTION A1		220V,EUROPEAN PLUG:
XD8830 OPTION A2		240V,UNITED KINGDOM PLUG:
XD8830 OPTION A3		240V,AUSTRAILIAN PLUG:
XD8830 OPTION A5		220V,SWISS PLUG:
XD8830 OPTION A9		NO POWER CORD:INTERNALLY SET FOR 230V
XD8830 OPTION VA		VT200 KEYBOARD:UNITED KINGDOM
XD8830 OPTION VB		VT200 KEYBOARD:FRENCH
XD8830 OPTION VC		VT200 KEYBOARD:SWEDISH
XD8830 OPTION VF		VT200 KEYBOARD:DANISH/NORWEGIAN
XD8830 OPTION VG		VT200 KEYBOARD:GERMAN
XD8830 OPTION VI		VT200 KEYBOARD:ITALIAN
XD8830 OPTION VS		VT200 KEYBOARD:SPANISH
XD8830 OPTION 1A		ADD 8MB COMPUTE ENGINE MEMROY:TOTAL 16MB
XD8830 OPTION 1B		ADD 24MB COMPUTE ENGINE MEMORY:TOTAL 32MB
XD8830 OPTION 1C		ADD 40MB COMPUTE ENGINE MEMORY:TOTAL 48MB
XD8830 OPTION 1D		ADD 56MB COMPUTE ENGINE MEMROY:TOTAL 64MB
XD8830 OPTION 1E		ADD 72MB COMPUTE ENGINE MEMORY:TOTAL 80MB
XD8830 OPTION 1F		ADD 88MB COMPUTE ENGINE MEMORY:TOTAL 96MB
XD8830 OPTION 1G		ADD 104MB COMPUTE ENGINE MEMORY:TOTAL 112MB
XD8830 OPTION 1H		ADD 120MB COMPUTE ENGINE MEMORY:TOTAL 128MB
XD8830 OPTION 1J		ADD 136MB COMPUTE ENGINE MEMORY:TOTAL 144MB
XD8830 OPTION 1K		ADD 152MB COMPUTE ENGINE MEMORY:TOTAL 160MB
XD8830 OPTION 1M		ADD 168MB COMPUTE ENGINE MEMORY:TOTAL 176MB
XD8830 OPTION 1U		ADD 4CMMUS:TOTAL 8 CACHE MEM MGMT UNIT
XD8830 OPTION 3A		RS232 DMA BOARD:8 PORTS + CENTRONIX, REQ'S OPTION 3G
XD8830 OPTION 3G		VME BUS ADAPTER:HOLDS 1 BOARD
XD8830 OPTION 08		PAL VIDEO OUT:DIGITAL VIDEO INTERFACE
XD8830 OPTION 09		NTSC VIDEO OUT:DIGITAL VIDEO INTERFACE
XD8830 OPTION 13		REMOVE HARD DISK:REQUIRES 4944 OPTION 44
XD8830 OPTION 14		ADD 1.2MB FLEXIBLE DISK DRIVE
XD8830 OPTION 17		ADD 300MB HARD DISK DRIVE
XD8830 OPTION 18		ADD 600MB HARD DISK DRIVE
XD8830 OPTION 19		ADD 2ND 600MB HARD DISK DRIVE
XD8830 OPTION 20		ADD 16MB DISPLAY LIST MEMORY
XD8830 OPTION 21		ADD 8MB DISPLAY LIST MEMORY
XD8830 OPTION 32		19 INCH DISPLAY:1280 X 1024
XD8830 OPTION 33		19 INCH STEREO DISPLAY:1280 X 1024
XD8830 OPTION 34		19 INCH TOUCH SCREEN:ETCHED
XD8830 OPTION 35		19 INCH TOUCH SCREEN:UNETCHED
XD8830 OPTION 36		ADD Z-BUFFER:TOTAL 8 BIT PLANES PLUS Z-BUFFER
XD8830 OPTION 37		ADD 4 BIT PLANES:TOTAL 12 PLANES + Z-BUFFER
XD8830 OPTION 38		ADD 8 BIT PLANES:TOTAL 8 DOUBLE BUFFERED(16) + Z-BUFFER
XD8830 OPTION 39		ADD 16 BIT PLANES:TOTAL 12 DOUBLE BUFFERED(24) + Z-BUFFER
XD8830 OPTION 41		ADD 1 GEM UNIT:ADDITIONAL GRAPHICS ENGINE MODULE
XD8830 OPTION 42		ADD 1 CEM UNIT:ADDITIONAL COMPUTE ENGINE MODULE
XD8830 OPTION 43		ADD 2 CEM UNITS:TOTAL 3 CEMS

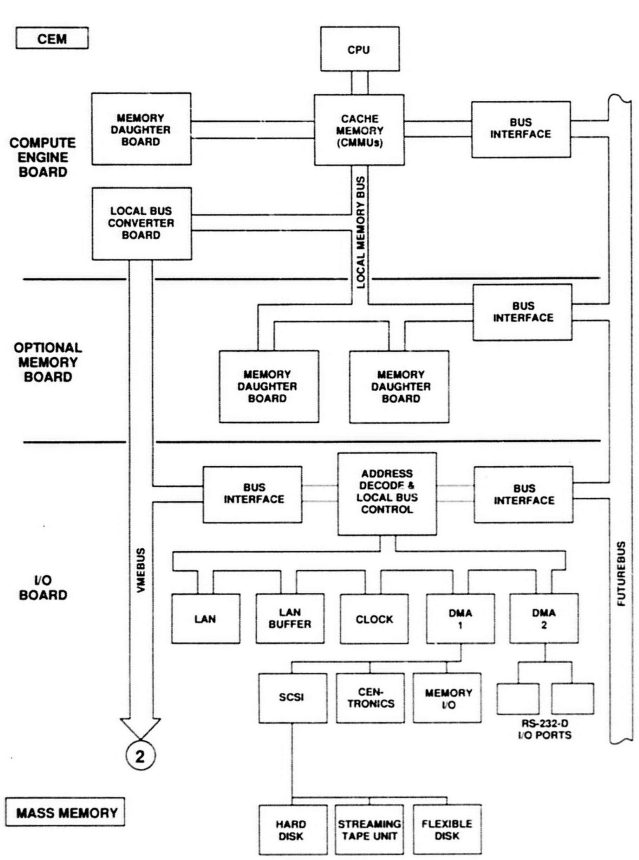
Option	Part Order No.	Name & Description
XD88F01	----- -----	UPGRADE:CONVERT 4220,4230,4320 &4330 TO XD88 SERIES WORKSTATION
XD88F14		ADD 1.2MB FLEXIBILE DISK DRIVE
XD88F17		ADD 300MB HARD DISK DRIVE
XD88F18		ADD 600MB HARD DISK DRIVE
XD88F19		ADD 2ND 600MB HARD DISK DRIVE
XD88F1M		ADDED MEMORY:MEMORY CONTROLLER W/16MB MEMORY
XD88F1N		ADDED MEMORY:16MB MEMORY DAUGHTER BOARD
XD88F1U		ADD 4CMMUS:TOTAL 8 CACHE MEM MGMT UNIT
XD88F3A		RS232 DMA BOARD:8 PORTS + CENTRONIX, REQ'S OPTION 3G
XD88F3G		VME BUS ADAPTER:HOLDS 1 BOARD
XD88F42		ADD 1 CEM UNIT:ADD COMPUTE ENGINE MODULE
XD88F01 OPTION A1		220V,EUROPEAN PLUG:
XD88F01 OPTION A2		240V,UNITED KINGDOM PLUG:
XD88F01 OPTION A3		240V,AUSTRAILIAN PLUG:
XD88F01 OPTION A5		220V,SWISS PLUG:
XD88F01 OPTION A9		NO POWER CORD :NTERNALLY SET FOR 230V
XD88F01 OPTION 1A		ADD 8MB COMPUTE ENGINE MEMROY:TOTAL 16MB
XD88F01 OPTION 1B		ADD 24MB COMPUTE ENGINE MEMORY:TOTAL 32MB
XD88F01 OPTION 1C		ADD 40MB COMPUTE ENGINE MEMORY:TOTAL 48MB
XD88F01 OPTION 1D		ADD 56MB COMPUTE ENGINE MEMROY:TOTAL 64MB
XD88F01 OPTION 1E		ADD 72MB COMPUTE ENGINE MEMORY:TOTAL 80MB
XD88F01 OPTION 1F		ADD 88MB COMPUTE ENGINE MEMORY:TOTAL 96MB
XD88F01 OPTION 1G		ADD 104MB COMPUTE ENGINE MEMORY:TOTAL 112MB
XD88F01 OPTION 1H		ADD 120MB COMPUTE ENGINE MEMORY:TOTAL 128MB
XD88F01 OPTION 1J		ADD 136MB COMPUTE ENGINE MEMORY:TOTAL 144MB
XD88F01 OPTION 1K		ADD 152MB COMPUTE ENGINE MEMORY:TOTAL 160MB
XD88F01 OPTION 1M		ADD 168MB COMPUTE ENGINE MEMORY:TOTAL 176MB
XD88F01 OPTION 1U		ADD 4CMMUS:TOTAL 8 CACHE MEM MGMT UNIT
XD88F01 OPTION 2T		4230 SERIES UPGRADE:UPGRADES 4230 TO XD8830
XD88F01 OPTION 2X		4220 SERIES UPGRADE:UPGRADES 4220 TO XD8820
XD88F01 OPTION 3A		RS232 DMA BOARD:8 PORTS + CENTRONIX, REQ'S OPTION 3G
XD88F01 OPTION 3G		VME BUS ADAPTER:HOLDS 1 BOARD
XD88F01 OPTION 3T		4330 SERIES UPGRADE:UPGRADES 4330 TO XD8830
XD88F01 OPTION 3X		4320 SERIES UPGRADE:UPGRADES 4320 TO XD8820
XD88F01 OPTION 08		PAL VIDEO OUT:DIGITAL VIDEO INTERFACE
XD88F01 OPTION 09		NTSC VIDEO OUT:DIGITAL VIDEO INTERFACE
XD88F01 OPTION 13		REMOVE HARD DISK:REQUIRES 4944 OPTION 44
XD88F01 OPTION 14		ADD 1.2MB FLEXIBLE DISK DRIVE
XD88F01 OPTION 17		ADD 300MB HARD DISK DRIVE
XD88F01 OPTION 18		ADD 600MB HARD DISK DRIVE
XD88F01 OPTION 19		ADD 2ND 600MB HARD DISK DRIVE
XD88F01 OPTION 42		ADD 1 CEM UNIT:ADD COMPUTE ENGINE MODULE
XD88F01 OPTION 43		ADD 2 CEM UNITS:TOTAL 3 CEMS

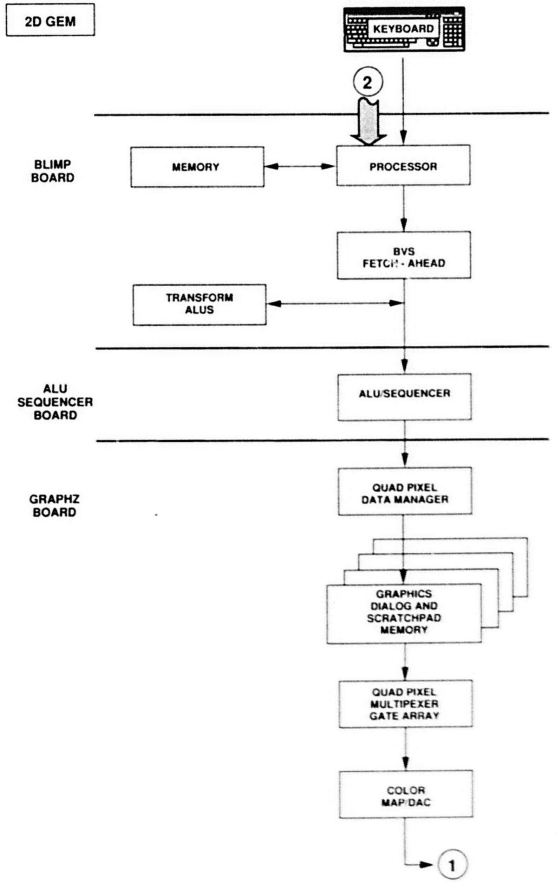
Section 8

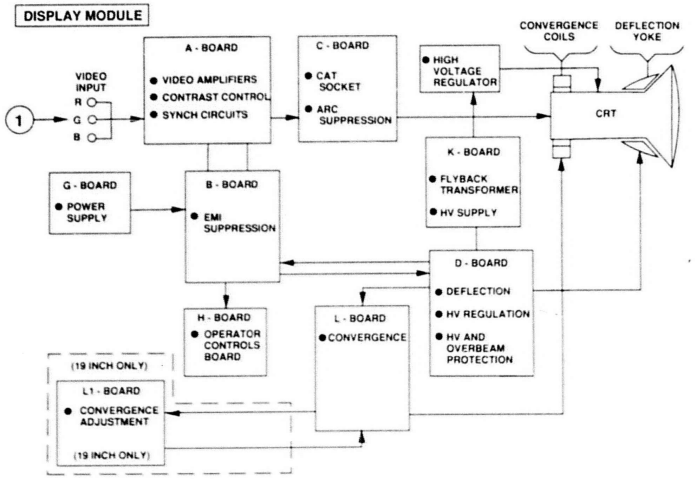
DIAGRAMS

This section includes the interconnect diagrams for the XD88/20 and XD88/30 workstations. These diagrams show how the various workstation configurations are connected electrically.

The other modular manuals that support these products include related diagrams that you may want to place here also.

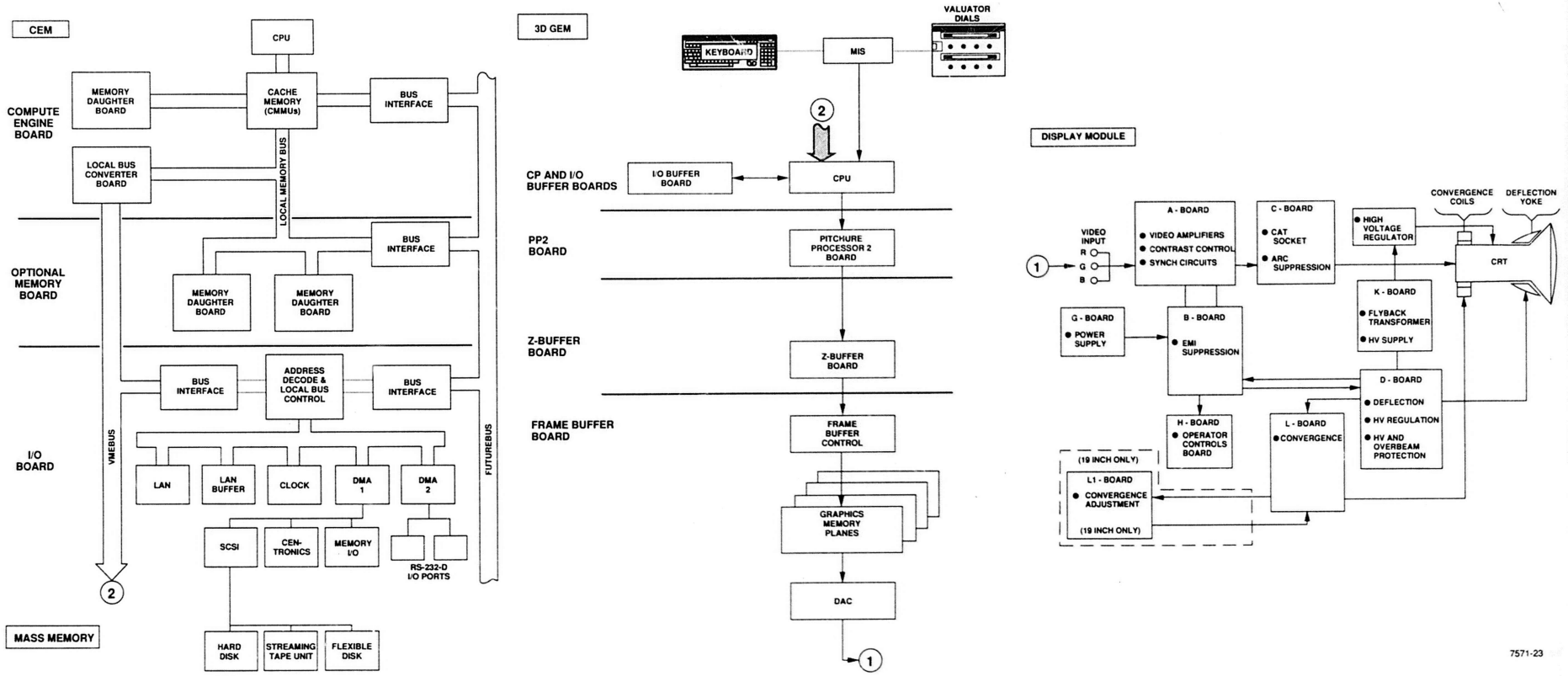






7571-24

XD88/20 SYSTEM DIAGRAM



XD88/30 SYSTEM DIAGRAM

Appendix **A**

CEM DIAGNOSTICS

NOTE

This appendix is an extraction from engineering spec files. It has not yet been edited for proper grammar and word usage. But, we trust you will be able to translate any such jargony terms and get to the information that you need.

INTRODUCTION

This appendix is an expansion of the information in Section 4. We give more detail than normally needed for field repair, so this is primarily a reference for those who desire more information about the CEM Diagnostics (that operate under the Power-up part of Self-test). This appendix covers the main test sequence (divided into "steps") for the CEM-side of the XD88 /20 and /30 workstations.

The power-up firmware has two major modes of operation: service mode and power-up mode.

Service mode is used for hardware debugging. This mode is not as useful for field repair. A selection of Low-level/Extended tests, ROM hardware debug monitor, and DBX debug monitor are available in this mode. The service mode tests are designed to be used with appropriate test equipment to diagnose systems that cannot be booted normally. Manual pages describing these tests are prefixed DT, such as DTtestname( ).

Power-up mode does the preliminary diagnostic tests and boots the system. Manual pages for the power-up diagnostic tests are prefixed PU. Failures of power-up diagnostic tests are reported on the CE (computer) board diagnostic LED and/or the console device via 'printf.' Fatal errors cause the power-up process to stop by halting the processor or entering trouble-shooting scope loops. The console can be a 4220/4230 GEM module, the CE board port 1(SCC A port), or the IO board port 1(SCC A port), or NULL_CONS (NULL Console). Note that no hardware flagging is implemented even at the higher baud rates. (DBX mode is an exception to this and does implement hardware flagging). However software flagging via ^S, ^Q is implemented during output. The NULL_CONS selection will result in all diagnostic messages being sent to the 'bit-bucket'- very risky but no problem if nothing is broken.

The firmware can operate IO board serial port 1 @ 300,1200,2400,4800,9600,19.2K, or 38.4K baud or CE port 1 @ 300,1200,9600 or 19.2K baud. The TNT/Crystal console requires that 'display code' be loaded from some media (SCSI disk/tape or LAN) and downloaded to the GDS CP board. The 4220/4230 console will use a new 'glass-tty' protocol yet to be determined (simple shared memory driver across the VME bus between CE and GEM_CP).

The LAN I/F or SCSI hard disks/streaming tapes may be selected as the boot device when the manual boot monitor mode is selected. In the case of a 'display' console, the 'display code' must first be boot-strapped to bring up the console for the console-interactive boot monitor. Auto-booting from first-found SCSI hard disk and first-found LAN are supported. In this case the 'display code' is expected to reside on these first-found media also. SCSI 'first-found' refers to IOB in lowest FBUS electrical slot# with an attached hard disk. LAN 'first-found' simply refers to LAN I/F on IOB in lowest FBUS slot#. The boot monitor includes a scan of all IOB SCSI buses for all possible controllers and drive units. In the case of a display console the 'media' for obtaining the 'display code' files is selected via the mode switches (1 thru 4). Once a console is established the manual-boot monitor provides a console based, menu driven selection process for the desired boot device (i.e. any IOB/any possible SCSI controller/LAN may be selected). A new utility will also be added to allow viewing/setting the nvram ethernet address (required for diskless station being up-graded with a 'raw' brd shipped to the field).

OPERATING PROCEDURE

In power-up mode, the Switch register is used to select the console device/baud rate, manual/single-user/multi-user mode, boot monitor, and various diagnostic modes. Tables 4-3 and 4-4 (Diagnostics section earlier) shows the modes selected by the various switch settings.

Selecting Modes

The single-multi user distinction determines whether the ROM code will enter the menu driven boot monitor for manual selection of the desired boot device, or automatically boot from 'first-found' hard disk or LAN I/F. It doubles as a flag for DiNEX to go into interactive diagnostic mode and for UTek-V to go single-user rather than multi-user.

The DiNEX executive will be booted from hard disk or LAN and control passed to it. DiNEX in turn will finish up the power-up testing/configuring and boot UTek-V from the same media.

In the case of boot from tape - standalone utilities will be booted and control passed to it. Note- DiNEX is not supported on tape at this time.

Example 1 To do a SCSI auto boot of the system with a TNT/Crystal as the console, all switches should be clear (on).

Example 2 To do a 'tape' manual boot of the system with IOB Port 1 selected @ 9600 baud, switches 2, 6, and 8 should be set (off) while all others are clear (on).

Example 3 To run the ROM hardware 'peek-poke' monitor set switches 1 and 2 (off) [3 and 4 (on)] and select the desired console with switches 5, 6, 7, and 8. All consoles are supported but the CE serial console requires the least amount of hardware working, followed by the IOB serial console, with the display console requiring the most functional hardware.

Example 4 To run the DBX debugger set all switches 1,2,3,4,5,6,7, and 8 to the (off) position. The debugger runs on CE port 0(SCC B port) only @ 38.4K baud.

POWER-UP TESTS SEQUENCE

The remainder of this section shows the order and nature of the various CEM tests that run under the Powerup Sequence. The following test descriptions (and error reports) are an expansion on the information in Table 4-5. .P Each "step" is test or portion of a test. In the explanations, a short description comes first. Then you're told if there is a DiNEX-2 system MAN page that gives test details; if so, the title is listed. Then it tells what the most critical hardware component is for that test. Finally, the name is given of the Self-test Specification file that describes the particular test or segment of test.

Step 1

A '.8' is displayed on the LED on hardware reset. The first 4K of the ROM space contains the initial ROM based vector table. On hardware reset this space is ghosted to physical address 0 so that the first instruction may be fetched from the beginning of the ROM. The instruction here is simply a "br rom_reset". The code at rom_reset then loads r2 with the address of a "de-ghosted" ROM entry point called real_reset and does a "jmp r2". This is done in order to get the ROM code running from its un-ghosted address space as soon as possible (particularly since the code is linked to run in this space!). The initial stack pointer (r31) is set to point to the end of ROM space(no DRAM available yet) and the PSR is set for supervisor mode,disable any special co-processors(except FPU),and disable interrupts. The vector base register is loaded with the de-ghosted address of the rom based vector table(i.e. first location in ROM). The CE LCA status register byte is then read and checked to see if an AUX board is attached.

If it is, then the Switch register will be read to determine the pwr_up scenario (switch register value is saved in a register). Based on the switch setting either the extended diagnostic mode will be entered or the normal pwr_up scenario will be followed. The available extended tests are documented in **DTtests**. Unexpected exceptions will be reported via the LED and an appropriate spin loop executed (rom_traps.s). In the case of a slave CE the pwr_up scenario is always followed.

Critical Function: Boot process halted.

File: reset.s

Step 2

A '0' is displayed on the LED and the ROM checksum test **PUrom( )** is executed. If the byte0 ROM fails a '.0' is displayed on the LED, '.1' for byte1 ROM, '.2' for byte2 ROM, and '.3' for byte3 ROM. On errors the firmware loops on the part number check or checksum algorithm until the system is reset.

The man page titled: **PUrom( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 3

A '4' is displayed on the LED and the CE status register read to determine the location of the lowest code and data CMMU's. If the status does not indicate both(code and data) CMMU's present then a '.4' is displayed and code loops on reading the CE status register. The addresses of these CMMU's are stored in hard-allocated registers for later usage.

The man page titled: **PUstat_reg( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 4

A '4' is written on the LED again and the interfaces to the lowest code and data CMMU's are tested via various CMMU register set accesses. The tests end with parity checking enabled on both code and data CMMU's.

Any failures are reported via a '.4' on the LED and appropriate scope loops entered.

The man page titled: **PUcmmu( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 5

A '5' is written on the LED and a data ripple test of the LED register is executed. Note that the LED display is a 'moot' point if the hardware is broken but it does verify that the LED register is read/write.

A '.5' will be written(temporarily) on error (may be pointless but done for consistency) and appropriate scope loop entered.

The man page titled: **PUled_reg( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 6

A '5' is again written on the LED and the CE control register byte read and verified for the expected value of 0. A data ripple test is then executed on the CE control reg byte (minus the PBDCx bits- too hazardous since they enable optional CMMU's). Note the LCA_PROG bit is toggled by this test. The test ends with the LCA_PROG bit left on (in order to begin LCA initialization) in the control byte.

Errors are reported via a '.5' on the LED and appropriate scope loop.

The man page titled: **PUctl_reg( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 7

A '6' is the displayed on the LED. The CE mapper address register test is then executed.

Errors are reported via a '.6' on the LED and appropriate scope loop.

The man page titled: **PUmemmap_addr( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 8

A '6' is written on the LED again and the CE mapper static ram test executed. The test uses a 4 pass march algorithm and ends with the array zeroed.

Errors are reported via a '.6' on the LED and appropriate scope loop.

The man page titled: **PUmemmap_march( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 9

A '6' is written on the LED again and the CE mapper control register test executed. The test verifies all r/w bits in the register.

Errors are reported via a '.6' on the LED and appropriate scope loop.

The man page titled: **PUmemmap_csr( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 10

A '6' is written on the LED again and the CE DRAM sizing algorithm executed. Sanity of the status register bits in the memmap_csr is verified.

Errors are reported via a '.6' on the LED and appropriate scope loop.

The man page titled: **PUdram_size( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s

Step 11

An '8' is written on the LED and the CE DRAM mapping algorithm executed. The CE DRAM is mapped in beginning at address 0 up to the size determined by the sizing algorithm above. The RAME bit is set in the system control register- de-ghosting the ROM's and enabling the DRAM controller at the end of this test. The only real error is a software fault in calling this routine which results in a '.8' on the LED for now. However, since this is where RAME is turned on for real, the separate LED code is needed as a 'trace' in case the system falls apart here. The .8 is used here out of order since it will be hard to distinguish from a pwr_up .8 and the likely failure mode is a software fault.

The man page titled: **PUdram_mapping( )** describes the test details:

Critical Function: Boot process halted.

File: pwr_up.s

Step 12

A '7' is displayed on the LED and data CMMU parity checking is turned off. For each of the lowest DRAM memory bytes @ addresses 0, 1, 2, and 3- data values of 0x0-0xFF are written/read and verified.

Errors are reported with a '.7' on the LED and appropriate scope loop.

The man page titled: **PUdram_byte_nopar( )** describes the test details:

Critical Function: Boot process halted.

File: pwr_up.s

Step 13

A '9' is displayed on the LED and data CMMU parity checking is turned back on. For each of the lowest DRAM memory bytes @ addresses 0, 1, 2, and 3- data values of 0x0-0xFF are written/read and verified. Special DACC exception handling is enabled for these tests so that parity errors may be flagged as contrasted to data mis-match errors.

Errors are reported with a '.9' on the LED and appropriate scope loop.

The man page titled: **PUdram_byte_par( )** describes the test details:

Critical Function: Boot process halted.

File: pwr_up.s/rom_traps.s

Step 14

A '9' is written on the LED again. With the special parity handling still installed a 32-bit data ripple test at address 0 is executed. Parity errors and data mis-match errors are handled separately.

Errors are reported with a '.9' on the LED and appropriate scope loop.

The man page titled: **PUdram_data_ripple( )** describes the test details.

Critical Function: Boot process halted.

File: pwr_up.s/rom_traps.s

Step 15

A '9' is written on the LED again. Special parity handling is disabled as is data CMMU parity checking for this test. The first 16 bytes (0x0 thru 0xf) are written with unique data and then various size accesses are checked after writing a certain size field within some smaller field.

Errors are reported with a '.9' on the LED and appropriate scope loop.

The man page titled: **PUdram_size_tst( )** describes the test details.

Critical Function: Boot process halted.

File- pwr_up.s

Step 16

An 'A' is displayed on the LED. Special parity handling is re-enabled along with data CMMU parity checking. A 4 pass, 32-bit march test using data of 0xaaaaaaaa and 0x55555555 is then executed on the first 16K of memory. Both data non-compare and parity errors are checked for. The test ends with memory cleared.

Errors are reported with a '.A' on the LED and appropriate scope loop.

The man page titled **PUdram_mrch_tst( )** describes the test details.

Critical Function: Boot process halted.
File: pwr_up.s/rom_trap.s

Step 17

A real stack pointer is set up by initing r31 to INIT_STACK (16K boundary). A new vector table is now built in DRAM beginning at a address 0 and the vbr(vector base register) changed to point here. The ram based vector table will continue to use the same LED codes for un-expected exceptions as the rom vector table until a console becomes available at which time the reporting mechanism is switched to a verbose console based 'printf' (note however that interrupts are still disabled by the PSR_IND bit in the 88K psr reg).

File: pwr_up.s/ram_traps.s

Step 18

Important configuration information that has been stored in hard-allocated registers up to this point is now transferred to global memory locations (in particular- base addresses of lowest code and data CMMU's, on board CE DRAM size, master/slave CE flag, and switch register value read at pwr_up). The switch register value is checked for verbose mode or DBX mode and the appropriate flags inited.

Control is then passed to C-coded testing beginning with the main pwr_up sequencer pwrup_seq.

File: pwr_up.s

Step 19

Default values are filled into the diags configuration table. If it is a master CE then the on-brd mapper SRAM is re-mapped with the FSLD bit turned on.

File: pwrup_seq.c

Step 20

If it is a master CE brd then the switch register value is checked to determine the console selection and do pwr_up testing of the CE serial ports based on this setting. Otherwise both CE serial ports are tested as non- console ports.

An '11' is displayed on the LED and the CE SCC tests **PUscc_tst( )** executed. Note both A and B ports will be tested for register accesses regardless of the console setting.

Illegal or reserved console switch settings will result in a '.=' (D_CONSdp) displayed on the LED and the boot process halted with a scope loop reading the switch register. If the serial port being tested is the selected console then 'looping' will be enabled and any errors will be considered critical- displaying a '.11' on the LED, and halting the boot process with an appropriate scope loop. Otherwise errors will be considered non-critical and an error flag merely set in the event of errors. Note also that the local-loopback test of the serial ports is only executed on a port selected as console (since the test results in the message being sent out the port). The local-loopback message is "firmware version XX" and will appear on a selected serial console at the selected baud rate.

The man page titled **PUscc_tst( )** describes the test details.

If console is serial port: Critical Function- Boot process halted

File: pwrup_seq.c/scc_tst.c

Step 21

If the selected console is one of the CE serial ports and it passed its pwr-up tests then the port will be set up at the selected baud rate and console 'printf's' enabled. In conjunction with this the exception handlers will be converted to using console 'printf' rather than LED codes as indicators (as mentioned above).

File: pwrup_seq.c

Step 22

A 'C' is displayed on the LED and the CE base code CMMU cache tests executed. This includes sufficient testing of the base code CMMU cache to warrant enabling cacheing for increasing the boot speed. Errors are reported via a '.C' on the LED/and console printf if console is available. Errors with the CLKVR bits of the CMMU SRAM are considered fatal while all others simply result in that particular SRAM 'line' being killed. Without a console, the '.C' LED code will be transitory and probably not noticed- for this reason if any errors at all were found they are reported as a simple generic 'code cache errors found' message later after a console becomes available [to see the specific errors one must switch to using the CE serial console].

Critical/Non critical Function: Boot process halted/not halted

File: code_cache_tsts.c

Step 23

If it is the master CE and the special power_up mode switch setting(0xDB) has been selected then a menu driven interface is entered using CE port A @ 9600 baud for a console. This menu can be used to make various pwr_up mode selections such as 88K serializing(on/off), base code cacheing(on/off), verbose(on/off), lan_verbose(on/off),scsi_verbose(on/off), etc before continuing the power_up testing via the exit menu selection. Otherwise base code cacheing will be enabled and the pwr_up testing continued.

Step 24

An 'E' is displayed on the LED and the CE 78K exceptions test executed. MACC, IDIV, IOVF, PRIV, SPV(128), DACC, CACC exceptions are verified. The DACC exception utilizes an expected "bus_error" exception generated by reading the byte address just above the CE on-board decoded DRAM space. The CACC exception utilizes a code jump to above the CE on-board decoded DRAM space.

The R/W and write-only bitbuckets are also tested for correct operation- no DACC's on access except on read of write-only bitbucket. Errors logged via a '.E' on LED/ console printf if available.

Critical Function: Boot process halted.

File: exceptions_tst.c

Step 25

A 'P' is displayed on the LED and a 4 pass 32-bit march test(with parity) of the rest of the CE DRAM from the 16K boundary to the end of on-brd CE DRAM is executed. Errors are reported via a '.P' on the LED/console printf if available, otherwise the results of the test are stored for console logging once a console becomes available.

File: pwrup_seq.c/dram_extend.s/ram_traps.s

Step 26

A 'F' is displayed on the LED and the CE FBUS tests executed.

Critical Function: Boot process halted.

File: CEfbus_tst.c

Step 27

An 'L' is displayed on the LED and the CE LCA init_tst executed. This test downloads and programs the CE LCA from a static data file contained in ROM. It checks and verifies for proper handshake/status responses during the download process.

Critical Function: Boot process halted.

File: LCA_init.c

Step 28

An 'L' is written on the LED again and the CE LCA tests executed. This is largely a general LCA register functionality test. However, it is also the first time that the PSR_IND bit in the 88K psr is disabled and any un-expected 88K interrupt exceptions reported.

Critical Function: Boot process halted.

File: CE_LCA_tst.c

Step 29

An 'L' is written on the LED again and the CE arbitration interrupt tests executed.

This test verifies the functioning of the software settable arbitration based interrupts in the CE LCA.

Critical Function: Boot process halted.

File: CEintr_tst.c

Step 30

An 'L' is written on the LED again and the CE message interrupt tests executed. This test verifies the functioning of the FBUS address based message interrupts.

Critical Function: Boot process halted.

File: CEmsg_intr_tst.c

Step 31

Currently slave CE's will halt here in a spin loop after turning off the slave CE LED.

Step 32

A 'G' is displayed on the LED and the FBUS is scanned to determine the locations of any FBUS boards in the system. NOTE- FBUS slot numbering uses the FBUS standard electrical slot numbers 0-31 (correspondence with physical slot numbering is back-plane design dependent- handled by hard copy documentation). The scan is done by checking for a response at the FBUS status register of each slot. If a status register responds then the FBUS signature PROM for that slot is read to attempt a determination of what kind of brd it is- currently recognized boards are Tek Blackbird CE, IOB, and MEM. Other responding slots are reported as unknown type FBUS boards. Note- the results of the scan are not reported unless the verbose mode has been enabled.

Note also — if the console is not the CE serial port, then no results are reported either (i.e. no console available yet!):

File: fbus_scan.c

Step 33

If no IOB boards are found, a fatal fault is reported (either via an available console or a '.G' on the LED) and the fbus scan is repeated infinitely:

If No IOB's found — Critical Function/Bcot process halted.

File: pwrup_seq.c

Step 34

For each of the IOB's found in the system, an IOB test suite is called as documented below. A selected IOB serial console will be associated with the first-found (lowest fbus slot#) IOB and enabled as a console as soon as it can be tested for serial console functionality. All IOB test faults are handled via a '.H' on the LED and console printf if available. This is because there aren't enough LED codes available.

Step 35

An 'H' is displayed on the LED and the IOB FBUS tests are executed. The IOB's FBUS MSPC is not attached until after the next test.

Critical Function: Boot process halted.

File: IOBfbus_tst.c

Step 36

An 'H' is written on the LED again and the IOB local mapping tests are executed. These tests end with the IOB's FBUS MSPC attached.

Critical Function: Boot process halted.

File: IOBlmap_tst.c

Step 37

A 'H' is written on the LED again and the IOB DMACB register tests executed. This is done here because the IOB SCC test executed next uses this in its hardware path.

Critical Function: Boot process halted.

File: IOBdmac_tsts.c

Step 38

An 'H' is written on the LED again and the IOB SCC tests executed. Both SCC A and B ports are tested for register accesses regardless of the console setting. A selected IOB SCC console will do a local loop back test resulting in the "firmware version XX" displayed on an attached terminal (same tests as done on CE serial ports). As in the CE SCC tests the faults are fatal if the port being tested is the selected console:

If console is serial port: Critical Function- Boot process halted

File: scc_tst.c/pwrup_seq.c

Step 39

If the selected console is one of the IOB serial ports and it passed its pwr-up tests then the port will be set up at the selected baud rate and console 'printf's' enabled. In conjunction with this the exception handlers will be converted to using console 'printf' rather than LED codes as indicators.

File: pwrup_seq.c

Step 40

An 'H' is written on the LED again and the IOB FBUS to VMEbus mapper hardware tests executed.

If display is console: Critical Function- Boot process halted.

File: IOBftv_maptst.c

Step 41

An 'H' is written on the LED again and the IOB LAN DRAM controller is initialized. This is not really a test since there are no expected results.

File: IOBdramc_init.c

Step 42

An 'H' is written on the LED again and the IOB LCA_init test executed. This test downloads and programs the IOB LCA from a static data file contained in ROM. It checks and verifies for proper handshake/status responses during the download process.

Critical Function: Boot process halted.

File: LCA_init.c

Step 43

An 'H' is written on the LED again and the IOB LCA tests executed. This is largely a general LCA register functionality test. However, it is also the first time that interrupts are enabled from the IOB brd [I do not expect any interrupts to be asserted at pwr_up- except the IOB timer interrupt which may still be running but is masked at the IOB LCA], and un-expected interrupt exceptions reported.

Critical Function: Boot process halted.

File: IOB_LCA_tst.c

Step 44

An 'H' is written on the LED again and the IOB DMACA tests executed. This test is a full blown test of the DMACA controller since it will be used for the SCSI boot process. It includes register tests for all channels, memory fill operation (byte size only), mem to mem trxf(quad word size only) along with DMACA interrupt verification, and chained mem to mem trxf (quad word size only). [test is generic, so I may modify testing sizes and trxf block sizes later].

Critical Function: Boot process halted.

File: IOBdmac_tsts.c

Step 45

An 'H' is written on the LED again and the IOB LAN DRAM tests executed. These includes data path testing/access size testing/and 4 pass 32-bit march test. The LANRAM DMACA(ch0) tests include a quad word memory fill from CE mem to LANRAM and quad word mem to mem from LANRAM to CE mem.

Currently this is a Critical Function- Boot process halted [hope to look into making it non-fatal unless LAN boot later].

Critical Function: Boot process halted.

File: IOBlanram_tsts.c

Step 46

An 'H' is written on the LED again and the IOB NVRAM tests executed. Tests include a nvram control register test as well as a checksum test on the NVRAM contents (note- checksum failure is to be expected on a raw brd). If the verbose mode is enabled then the contents of the NVRAM will be displayed. Chksum_tst failure must be saved for later display in the case of a display console.

File: IOBnvram_tsts.c

Step 47

An 'H' is written on the LED again and the IOB LAN tests executed. Tests include a register verification/init_block with polling/init_block with interrupt verification/internal loopback/receiver_CRC check/collision, miss, and CRC error testing and detection. Hope to make tests critical if the LAN is the selected boot device or verbose is selected- look into this later.

Critical Function: Boot process halted.

File: IOBlan_tsts.c/IOBlan_errtst.c/lan_utils.c/lan_print.c

Step 48

A 'U' is displayed on the LED and the IOB SCSI controller tests executed. Tests include register tests, a DMA test of 16 bytes using the special diagnostic mode of the SCSI controller chip and a DMAC flusher test using the same diagnostic mode.

Critical Function: Boot process halted.

File: IOBscsi_tst.c

Step 49

An 'H' is displayed on the LED and the IOB VME local tests executed.

If display is console: Critical Function- Boot process halted.

File: IOBvme_tst.c

Step 50

A VME bus scan is executed to determine if any GEMcp or MEM16/MEM8 boards are on the attached VME bus.

File: vme_scan.c

Step 51

An 'H' is displayed on the LED and the IOB VME software interrupt tests executed.

File: IOBvmeint_tst.c

Step 52

If any GEM MEM16/MEM8 boards were found by the VME scan then the GEM memory board tests are executed on each of these.

File: gem_memtst.c

Step 53

If any GEMcp boards were found by the VME scan then the GEMcp tests are executed. NOTE- the software only supports one GEMcp per attached VME bus.

File: gemcp_tst.c

Step 54

The FBUS to VME bus address recognition is disabled after each IOB brd has completed all of the above tests by disabling the FTV_ENABLE bit in the IOB control register. This is done because the IOB VME tests mentioned above map the Futurebus-to-VMEbus address space at each possible 512_MG window [they end however by mapping each IOB Futurebus-to-VMEbus (F-to-V) space to a separate 512_MG window]. If all of the tests for an IOB have passed then the LED for that IOB will be turned off at this point. The code then jumps back to step 35 and repeats all of the IOB tests for each IOB found in the system.

File: pwrup_seq.c

Step 55

After all of the IOB boards in the system have been tested, a check is made to determine if this is a 'short' FBUS back-plane system (i.e. no FBUS boards plugged in slots 25 thru 30 with the current back-plane). If it is then all of the CE/IOB's in the system are inited for the FBUS short-backplane in their FBUS interface command registers.

Step 56

Next a determination is made of which VME buses each IOB in the system faces, their F-to-V spaces re-allocated accordingly, and their FTV_ENABLE bits turned back on.

Step 57

Finally the new TNT/Crystal 'glass-tty' console is opened/tested [yet to be defined].

I don't like this scenario where the 'display' console cannot be opened and used till after all the IOB's have been tested but I don't see any way around it if (1) I make no assumptions about where F-to-V windows will be allocated and (2) I make no assumptions about which IOB will have the attached TNT/Crystal display system.

This last assumption is desirable from a user standpoint but the diagnostic scenario produced where most of the IOB tests have the same LED code (note massive use of 'H' on the LED above) will make trouble-shooting next to impossible without switching to a serial console. The only consolation is that hopefully the IOB LED's will provide an indication of which boards to 'swap' in getting a system back on line in the field [I am concerned however, that some of the tests in the multiple IOB brd environment could result in mis-leading information in this regard- i.e. some hardware failures on one IOB can/will affect other IOB's]:

File: pwrup_seq.c

Step 58

The boot code is entered at this point. This will include a SCSI scan for all possible controllers/units on each IOB's SCSI bus. Console based diagnostic messages are an integral part of the boot code- i.e. the LED is no longer used but should contain a 'U' until DiNEX is loaded and takes over. The boot scenario may then proceed as documented. boot scenario:

File:
boot.c/scb.c/scsi_utils.c/scsi_scan.c/hd_boot.c/fd_boot.c/tc_boot.c/etc

Appendix **B**

STRAPPING INFORMATION

This section shows field-use strapping information for the XD88. This does not show general strapping for the 2D GEM, 3D GEM, or Display Module. It only shows strapping for the XD88 CEM unit and unique strapping for GEMs used as part of an XD88 workstation.

NOTE

There are no straps on the CP board (and I/O Buffer) or the BLIMP board that need any alteration for connection to an XD88 workstation.

You can assume that if a so-called strap is not identified or described in this appendix, that its use is limited to factory servicing. Such information is only contained in proprietary engineering specification documents.

XD88 CIRCUIT BOARD STRAPS

There are NO field-installable straps on the Memory Controller board.

The Memory Daughter board has only one set of straps, W1210 thru W1212. These relate to the quantity and nature of RAMs installed:

- W1210 = half stuffed board
- W1211 = quarter stuffed board
- W1212 = 4Mbit DRAMs installed

See Figure B-4, later in this section for locations of these straps. Many of the straps on the XD88 boards are actually surface-mount pads. Most square pin test points provide +5V or GND for convenience when testing.

CE Straps

During normal operation there are no jumpers installed on any of the CE board straps. The following conditions specify when any jumpers would be installed.

- J195 — is the debug port for downloading kernal test code. This is used only for code debugging during product development.
- J3310 — forces Local Memory bus onto the Backplane for easy logic analyzer access. This is only for low-level testing. This causes failures in some diagnostics tests.
- Jnnn — All other test pins are either ground or +5V for probe ground or logic probe power.

See Figure B-1 for locations of these straps.

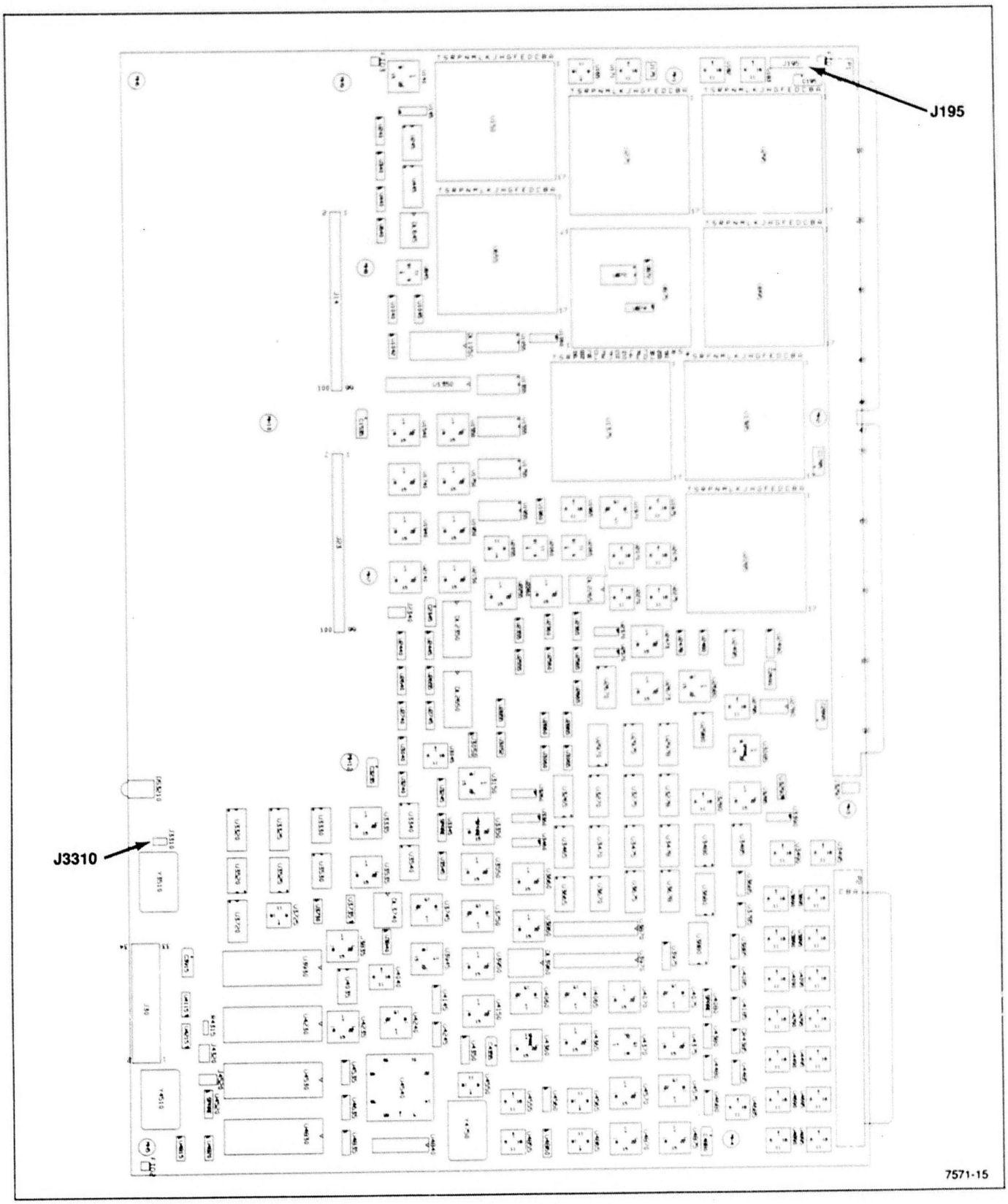


Figure B-1. CE Board Straps.

IO Board Strapping

The IO board has the following test points: TP1 thru TP5. TP2 is +5 V. All other test points are ground.

NOTE

The following straps (J10, 12, 31) are for board test only. For normal operation, they are left unjumpered. See Figure B-2.

The IO board has these jumper straps:

J10 — IOBPBR-0 (pin 1) generates IOB reset when strapped.

J12 — VMEPBR-0 (pin 1) generates VME system reset when strapped.

J31 — BYPASS-0 (pin 1) disables VME to Fbus mapping when strapped.

The functionality of the IO board is determined by which component of the following pairs are installed. These determine which type and frequency of DMA controller chip is used. The resistors called out here are 0 ohm.

These determine which frequency of **Type B** DMA controller chip is used. Install only one.

R38 — for 10 MHz. Normally installed.

R46 — for 18 MHz. Normally open.

These determine which frequency of **Type A** DMA controller chip is used. Install only one.

R3026 — for 18 MHz. Normally open.

R3027 — for 10 MHz. Normally installed.

W2139 (cut strap) is connected to bit D14 of the IOB Status Register. Normally grounded when connected. DO NOT cut this strap in the field; if cut, no pullup is present and the pin *floats*!

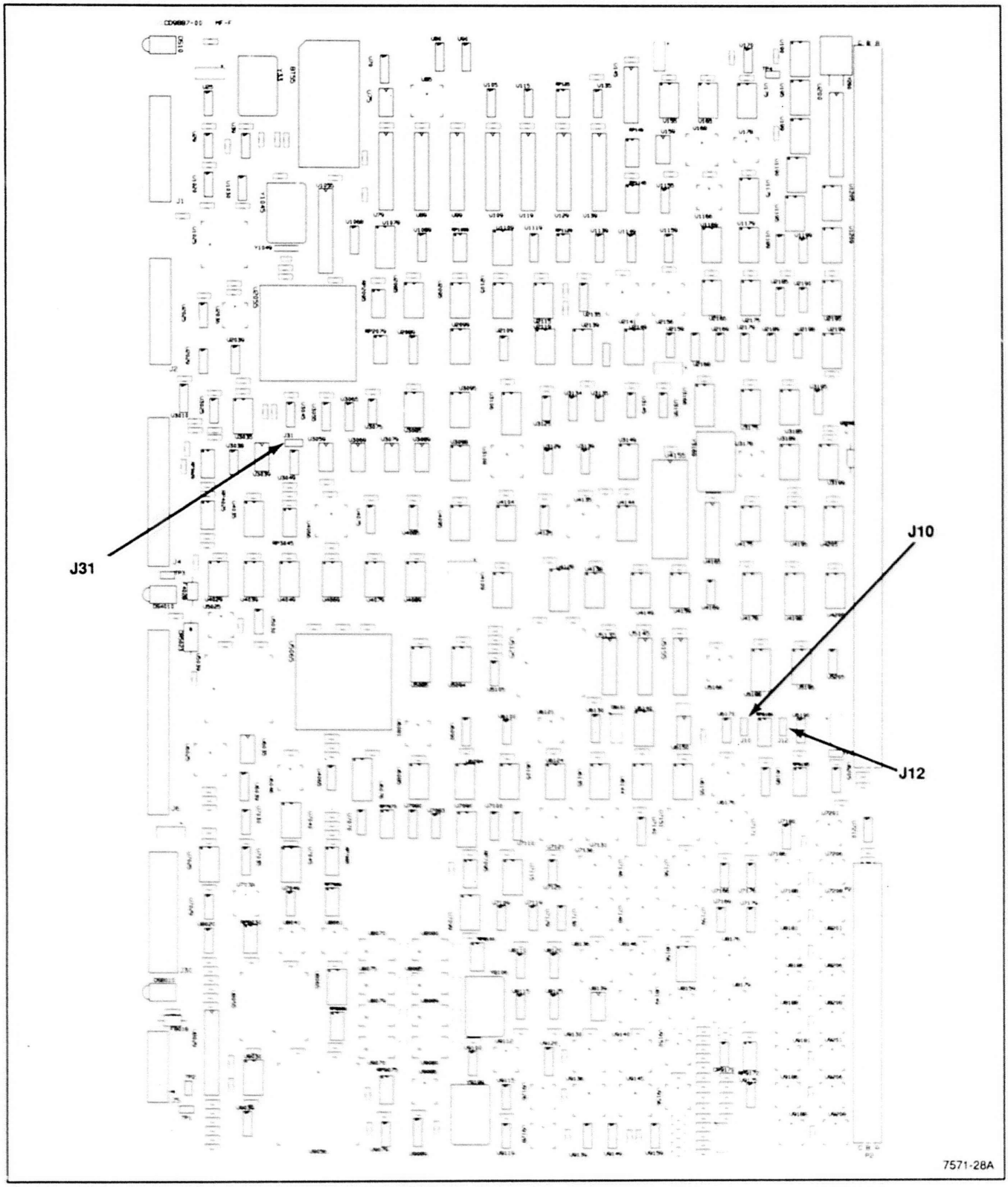


Figure B-2. IO Board Straps.

Backplane Straps

There are five strap option jumpers for each backplane slot. These are accessible on the back side of the backplane by removing the front bezel and the front access cover. (A T15 Torx head driver is required.) See Figure B-3.

The jumpers are on the bus grant and bus acknowledge lines. These signals are normally looped through the circuit cards. When slots are vacant, the jumpers provide continuity for the signals. When slots are vacant, the jumpers provide signal continuity. When boards/cards are removed, added, or moved, these jumpers must be reconfigured appropriately.

WARNING

Improperly configured Backplane jumpers will lead to serious system malfunction. The error messages may not lead directly to the cause.

When viewed from the front of the cabinet (backside of the Backplane), the jumpers are located immediately to the left of their respective backplane slot connectors. They are labeled J30 thru J49. With a flexlink installed, J33, J37, J41, J45 and J49 are under the flexlink.

The general rule is to install all five jumpers when a cardslot is vacant. Remove all five jumpers when a cardslot is occupied. The only exception to this rule is the XD88's CE Board. This board does not access the VME bus directly, so the signals are not looped through. When the LBC board is installed, it provides the loop-through; so jumpers should not be installed on the CE/LBC slot. Conversely, when the LBC is not installed, all five CE slot jumpers are required.

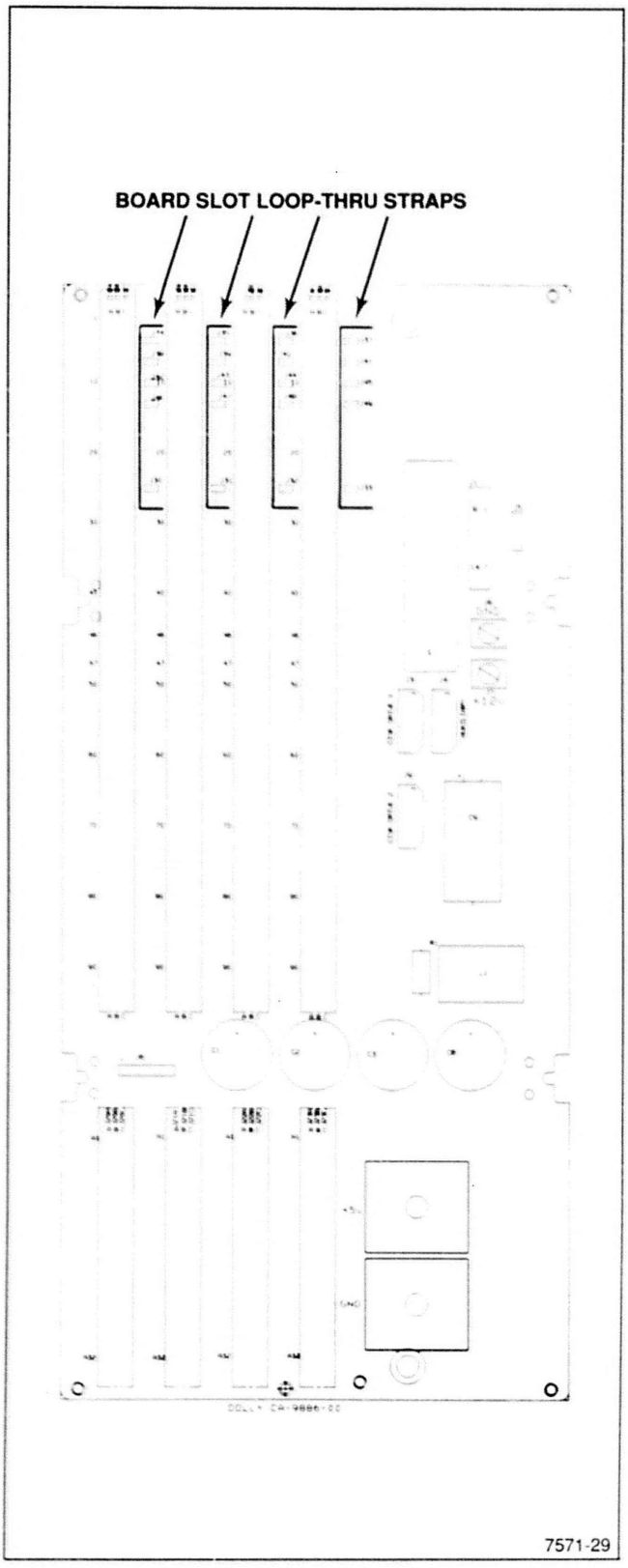


Figure B-3. Backplane Straps.

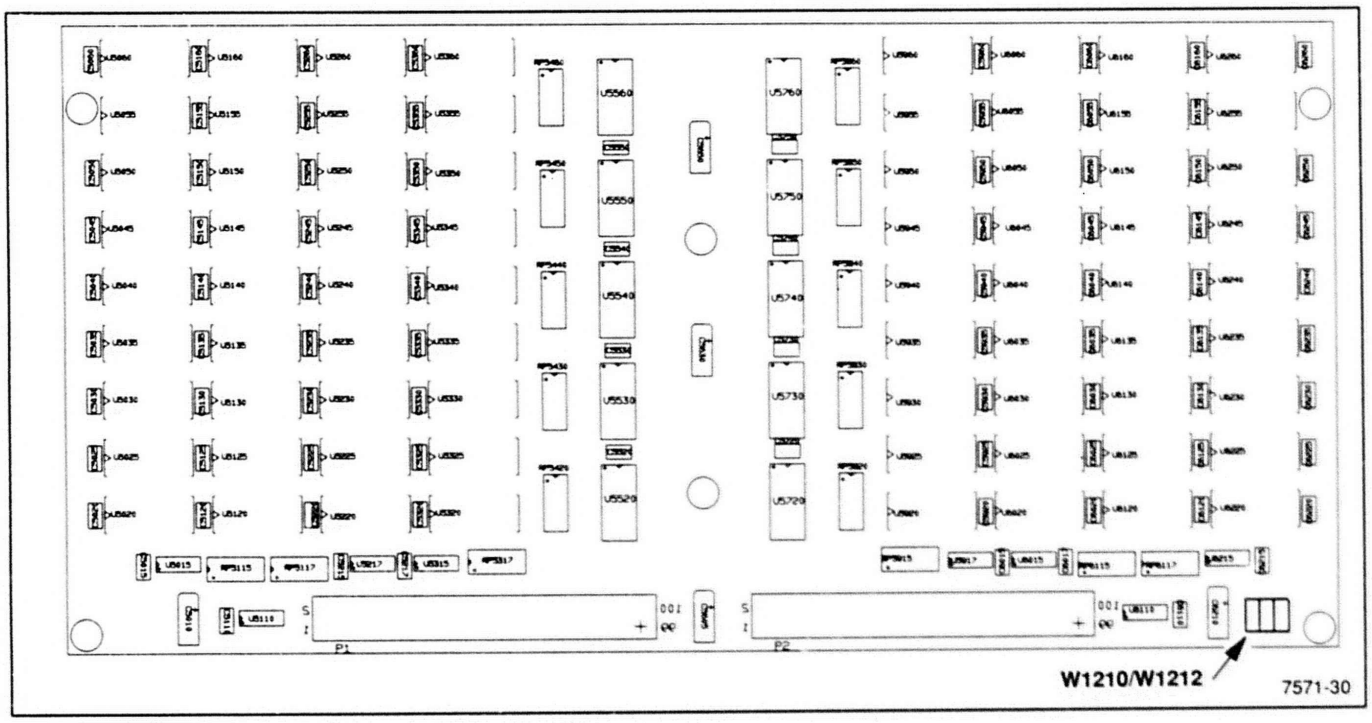


Figure B-4. Memory Daughter Board Straps.

MASS MEMORY DEVICE STRAPPING

The following information shows how to strap the various disk drive units so they can communicate with the XD88 system's via the SCSI interface. These devices have the following SCSI addresses:

- Hard Disk — Address 0
- Flexible Disk — Address 1
- Streaming Tape — Address 2

The following illustrations show how to set the address straps for these devices.

Hard Disk Units

The 156 megabyte disk drive is standard hard disk. There are two types of 156 megabyte disk drives that are used with XD88: types A and B.

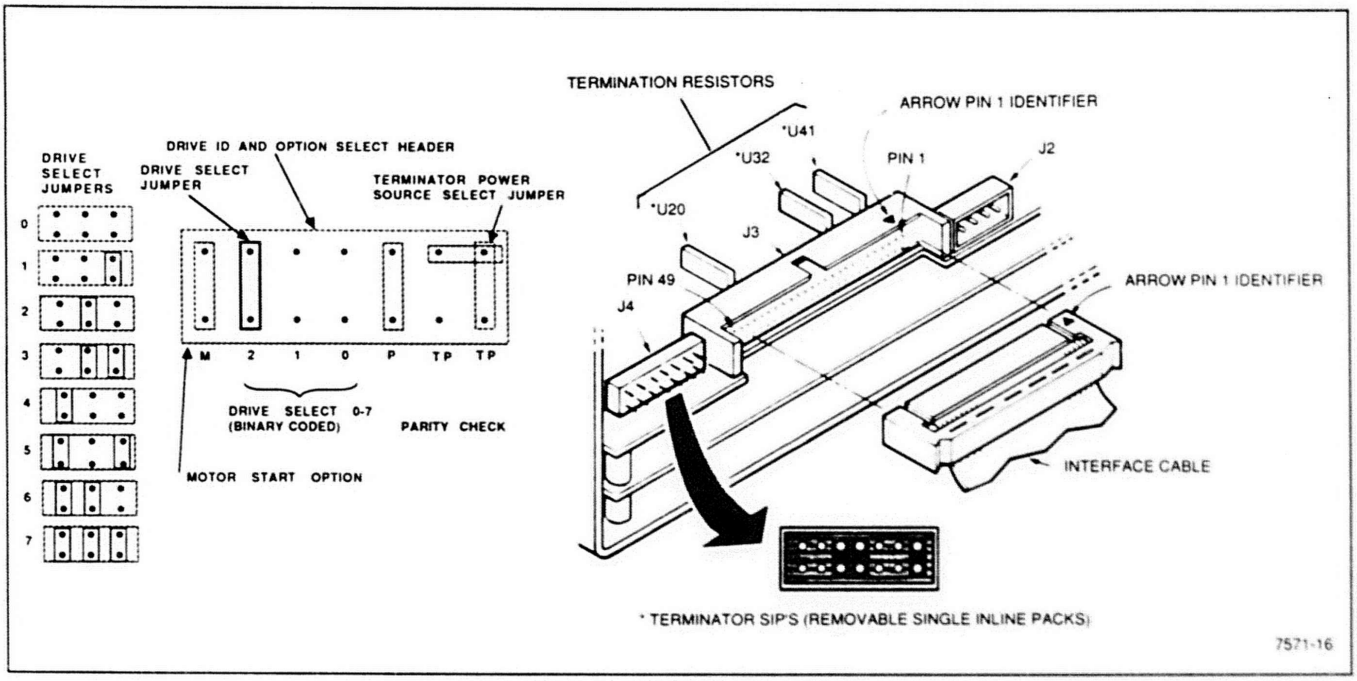
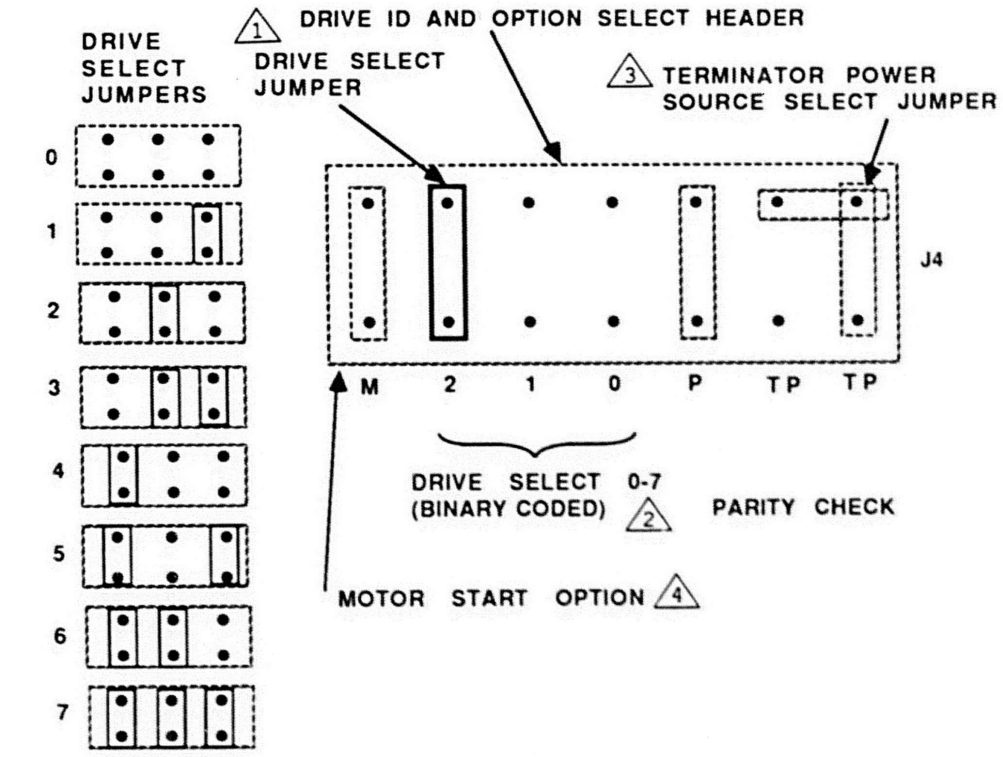


Figure B-5. 156 MB, Type A — Location of Straps.



1. Drive ID is binary coded jumper position (most significant bit on left), ie., jumper in position 2 would be Drive ID 4, no jumpers means ID 0.

2. Jumper plug installed means parity checking by the WREN III is enabled.

3. Jumper in vertical position means terminator powor (+5V) is from WREN III power connector. Jumper in horizontal position means terminator power is taken from interface cable.

   If unit is not terminated, TP jumper is to be left off.

   When a jumper is installed, it must only be in one of the positions shown. Two jumpers must not be installed in the "TP" positions at the same time.

4. Jumper plug installed enables the Motor Start Option. In this mode of operation the drive will wait for a Start Unit Command from the Host before starting the Motor. If the jumper plug is not installed the Motor will start as soon as DC power is applied to the unit. Some early drives did not have this option or jumper.

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Figure B-6. 156 MB, Type A — Drive Select Jumpers.

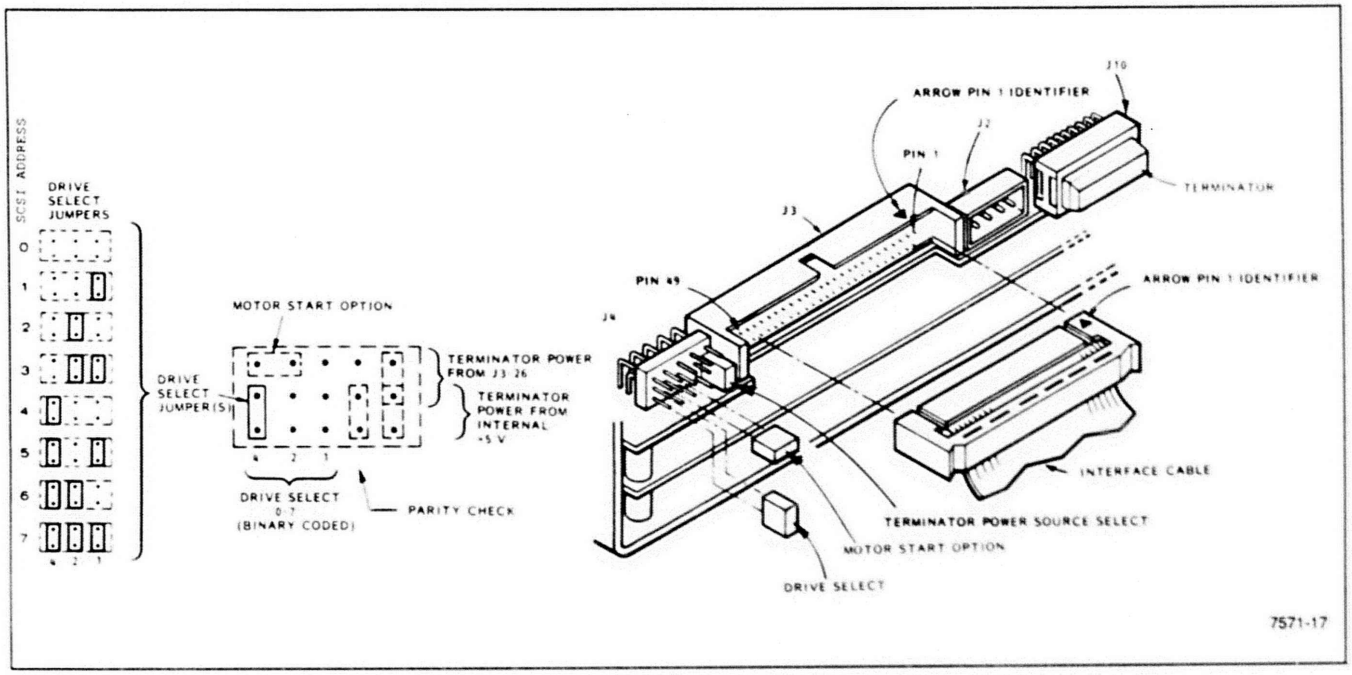
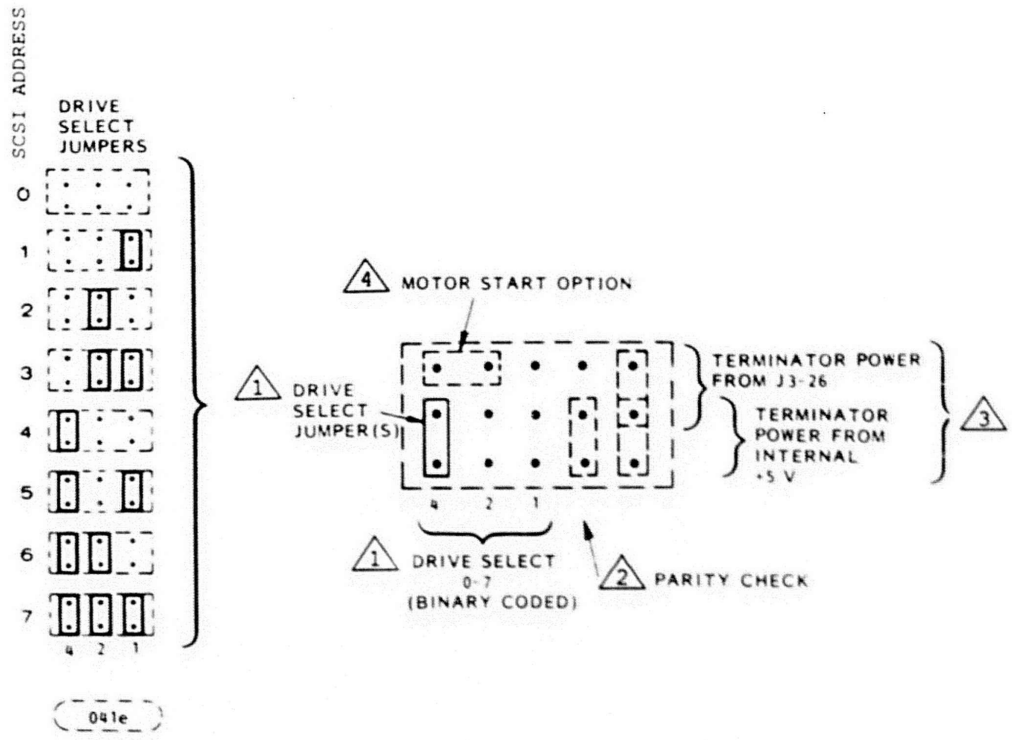


Figure B-7. 156 MB, Type B — Location of Straps.



1. Drive ID is binary coded jumper positon (most significant bit on left). Jumper positons and associated drive logical address are shown at the left part of the figure.
2. Jumper plug installed means parity checking by the WREN III enabled.
3. Jumper in lower position means terminator power (+5 V) is from WREN III power connector. Jumper in upper positon means terminator power is taken from interface cable.

   If unit is not terminated, TP jumper is to be left off.

   When a jumper is installed, it must only be in one of the Positons shown. Two jumpers must not be installed in the "TP" positions at the same time.

4. Jumper plug installed enables the Motor Start Option. In this mode of operation, the drive will wait for a Start Unit command from the Host before starting the motor. If the jumper plug is not installed, the motor will start as soon as DC power is applied to the unit.

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Figure B-8. 156 MB, Type B — Drive Select Jumpers.

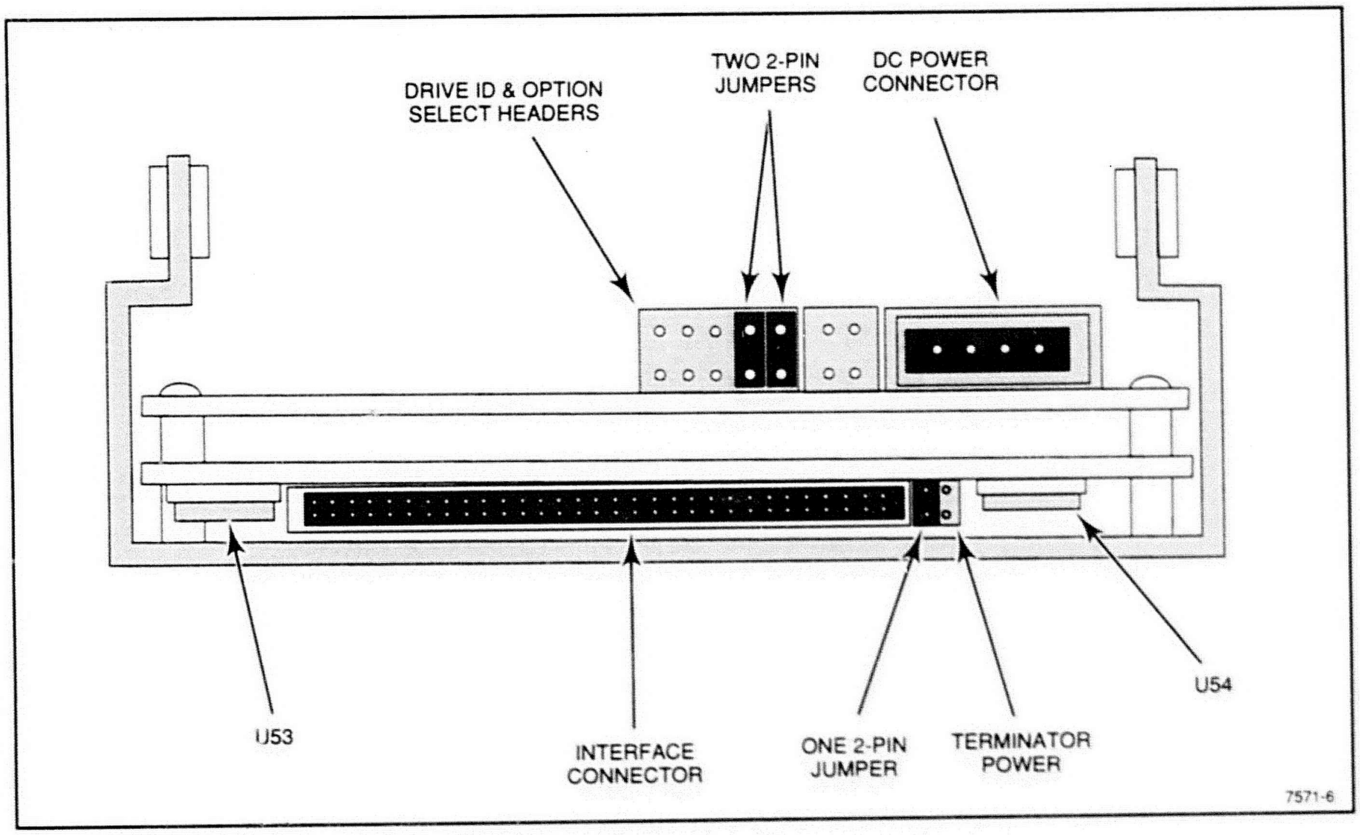
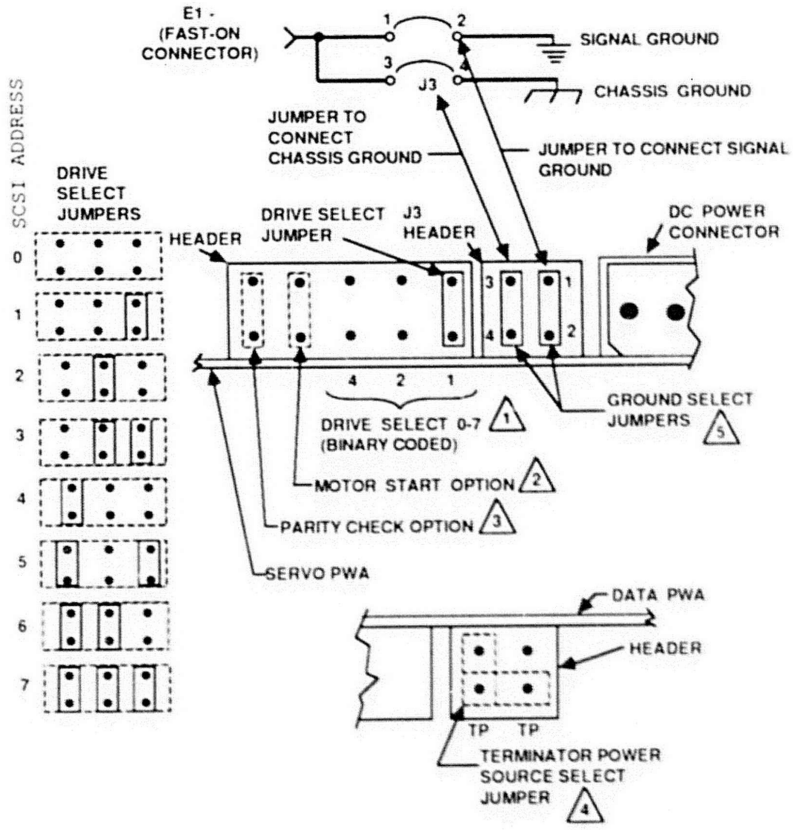


Figure B-9. 300 MB Disk Unit — Location of Straps.

DRIVE ID AND OPTION SELECT HEADERS



1. Drive ID is binary coded jumper position (most significant bit on left), i.e., jumper in position 0 would be Drive ID 1, no jumpers means ID 0.

2. Jumper plug installed enables the Motor Start Option. In this mode of operation the drive will wait for a Start Unit Command from the Host Before starting the Motor. If the jumper plug is not installed the Motor will start as soon as DC power is applied to the unit.

3. Jumper plug installed means parity checking by the WREN IV is enabled.

4. If the unit is not to be terminated, remove terminator resistor DIPs. If installed, the TP jumper must be installed only in one of the two positions shown with dotted lines.

   Jumper in vertical position means terminator power (+5 V) is from WREN IV power connector. Jumper in horizontal position means terminator power is taken from interface cable.

   If the drive is not terminated, the TP jumper need not be installed.

5. The WREN IV is supplied with AC and DC grounds tied together and connected to chassis ground. The installer may modify this ground arrangement to comply with different requirements. The AC to chassis connecting shunt is J3-3, 4. Either ground system may be isolated by removing the appropriate jumper plug.

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Figure B-10. 300 MB Disk Unit — Drive Select Jumpers.

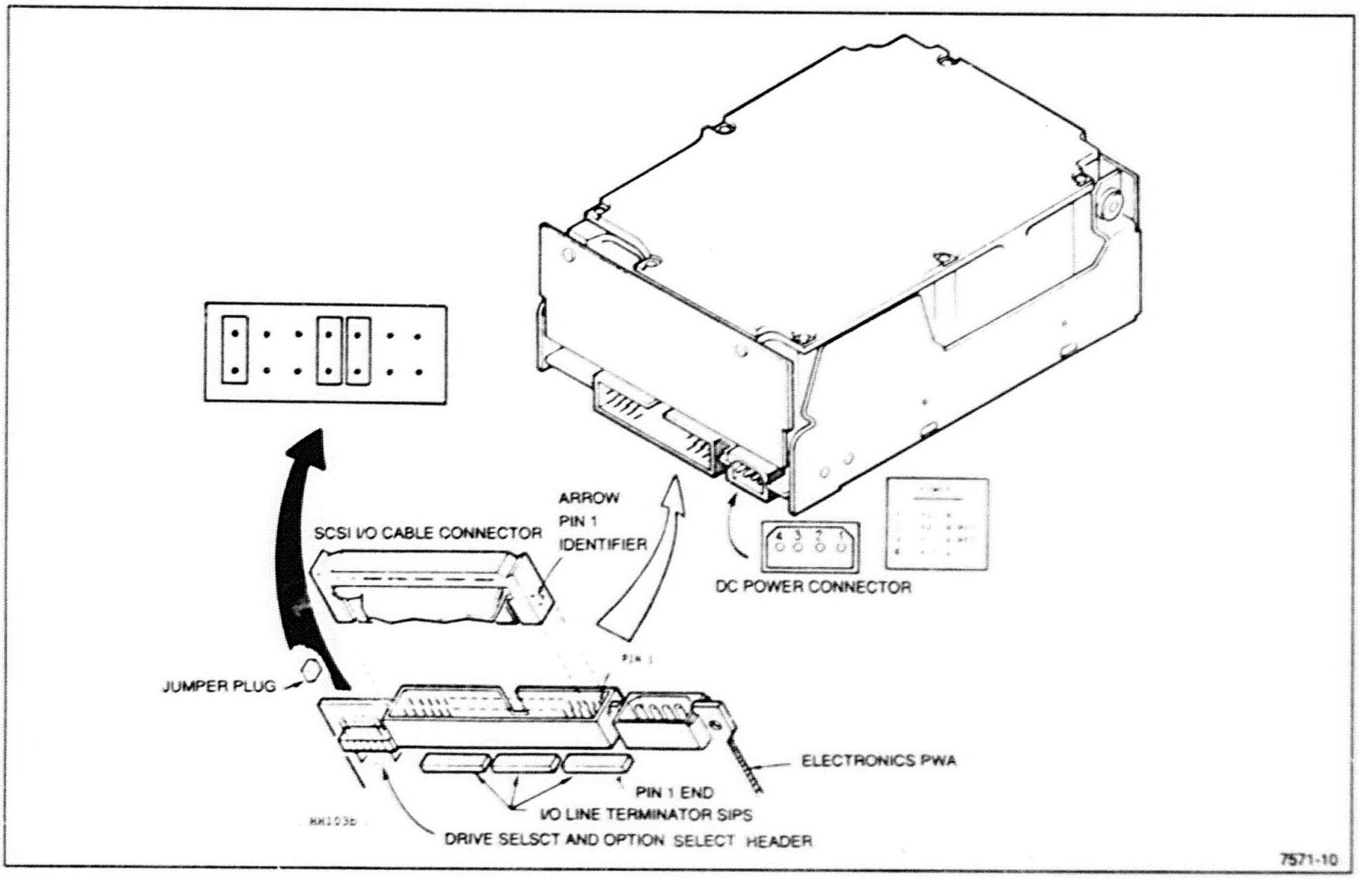
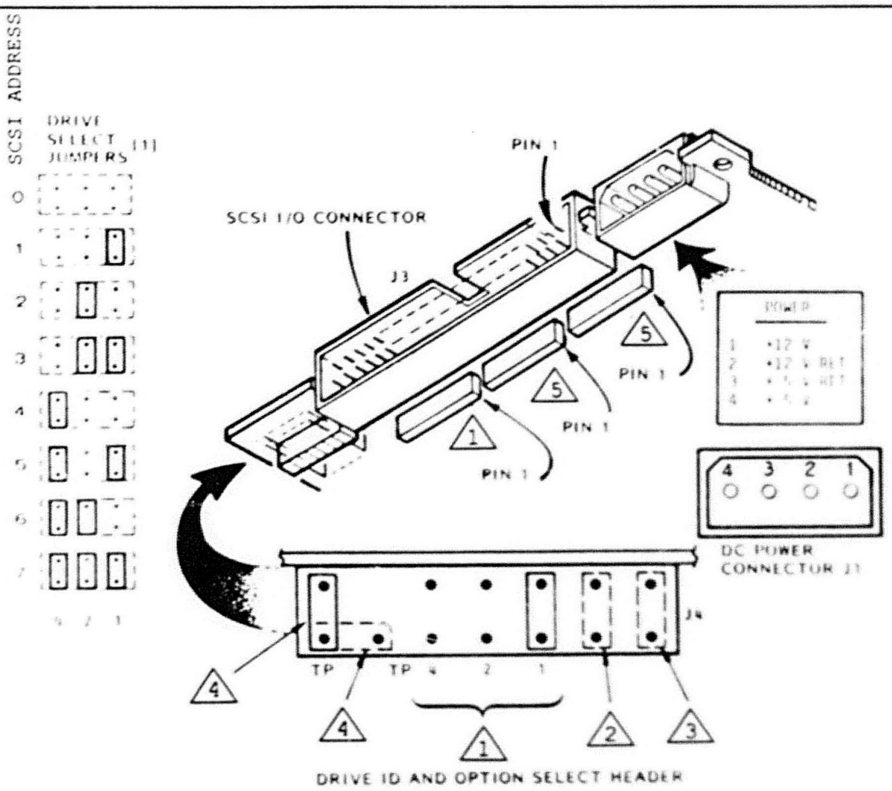


Figure B-11. 600 MB Disk Unit — Location of Straps.



1. Drive ID is binary coded by jumper position (most significant bit on left), ie., jumper in position 1 would be Drive ID 1, no jumpers means ID 0.

2. Jumper plug installed enables the Motor Start Option. In this mode of operation the drive will wait for a Start Unit Command from the Host before starting the motor. If the jumper plug is not installed, the motor will start as soon as DC power is applied to the unit.

3. Jumper plug installed means parity checking by the WREN V is enabled.

4. If the unit is not to be terminated, remove terminator resistor SIPs. If installed, the TP jumper must be installed only in one of the two positions shown in figure above.

   Jumper in vertical position (default position) means terminator power (+5 V) is from WREN V power connector. Jumper in horizontal position means terminator power is taken from interface cable (see CAUTION in Paragraph 2.5.6).

   If the drive is not terminated, the TP jumper need not be installed.

5. Removable I/O Line Terminators.

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Figure B-12. 600 MB Disk Unit — Drive Select Jumpers.

Streamer Tape Straps

There is only one type of streamer tape unit currently supported by the XD88 products, and its strapping is quite simple. See Figures B-13 and B-14.

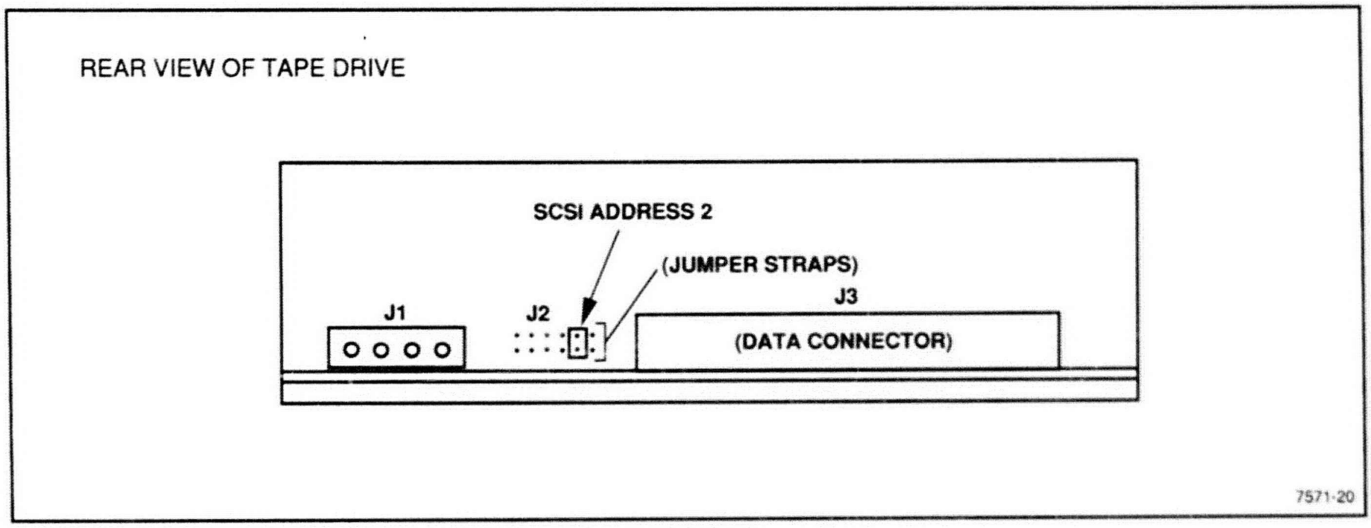

Figure B-13. Streamer Tape Drive Select Straps.

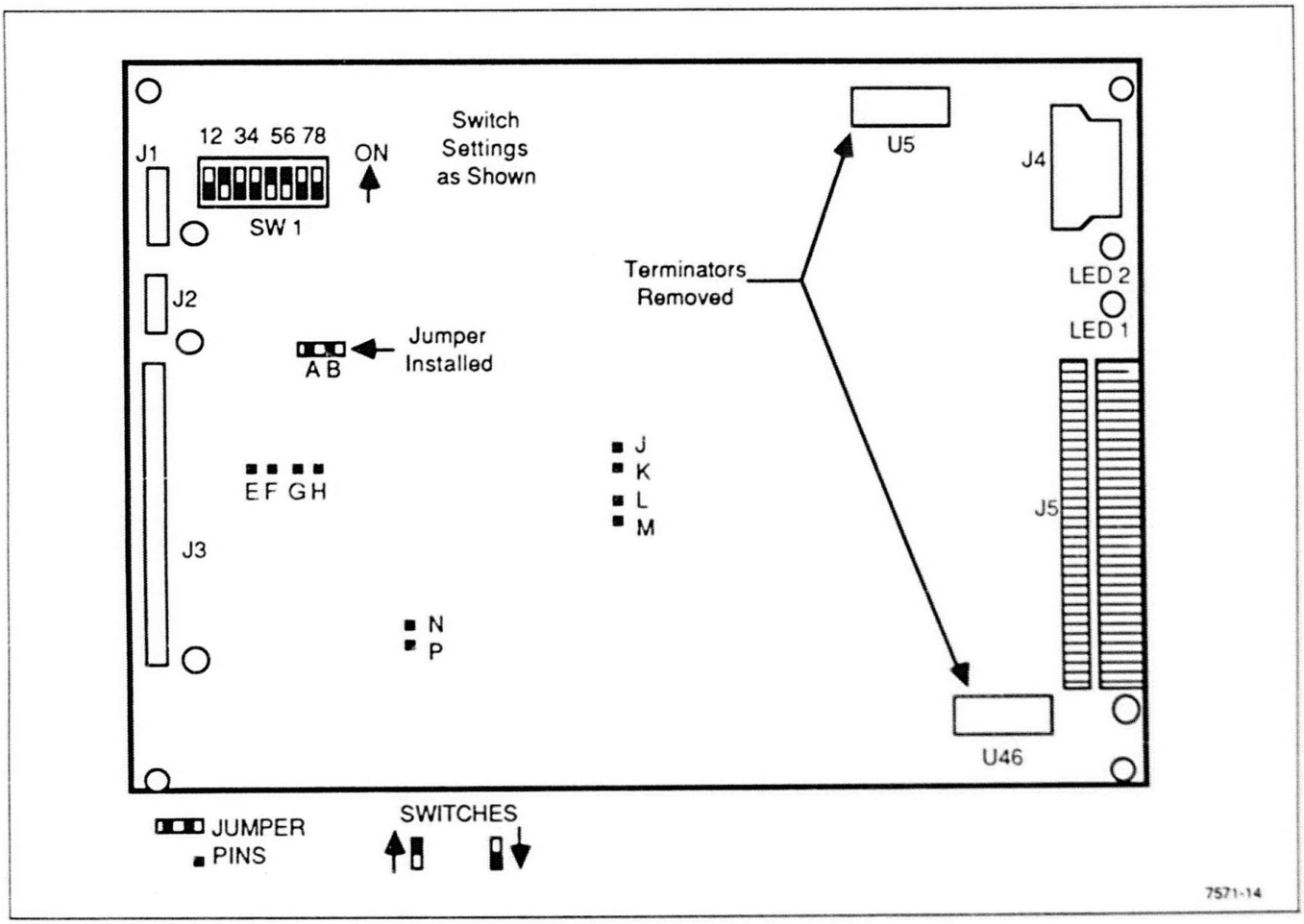

Figure B-14. Tape Drive Controller Board Straps.

Flexible Disk Unit

The flexible disk unit is an option and requires strapping as shown in Figure B-15 for use in the XD88.

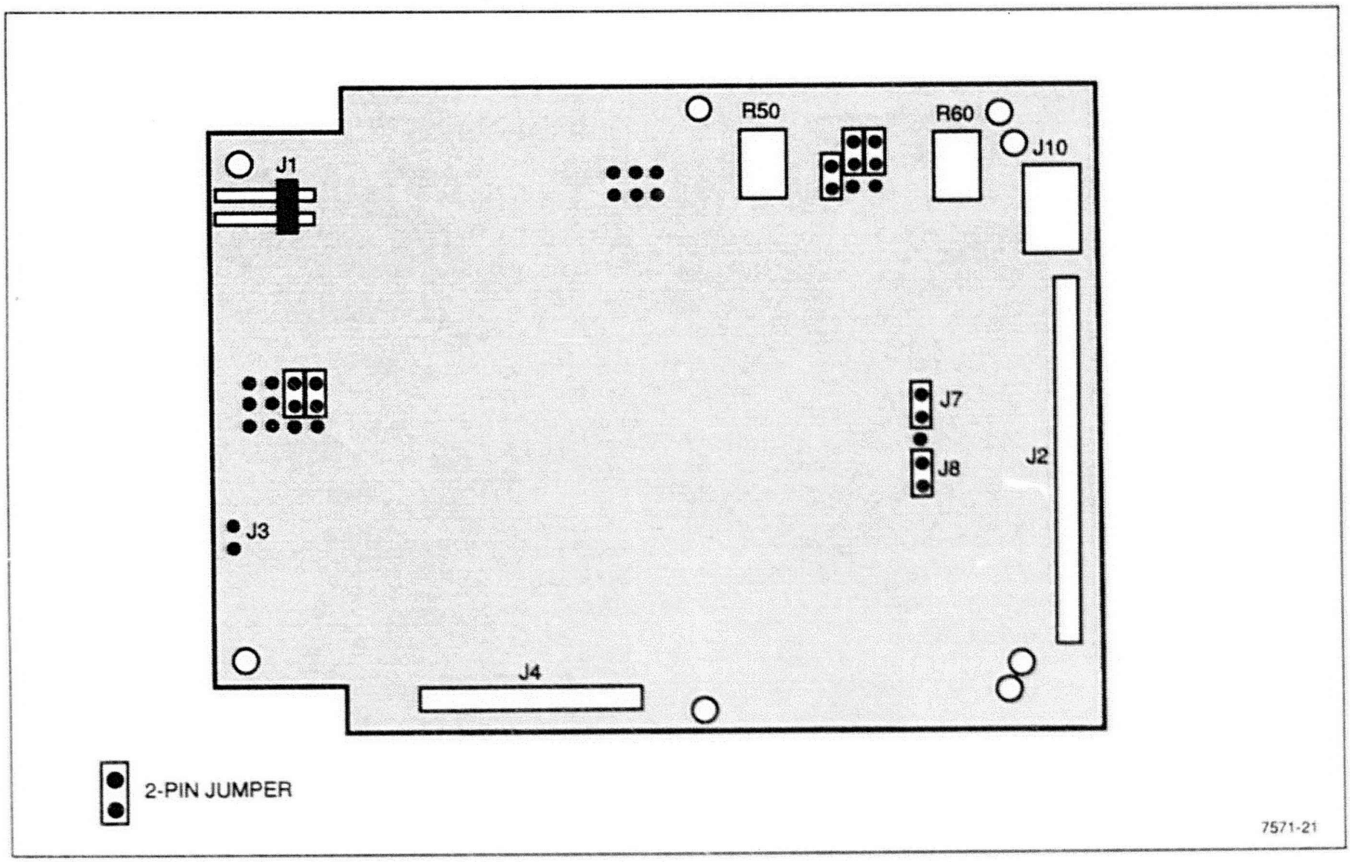

Figure B-15. Flexible Disk Strap Locations.