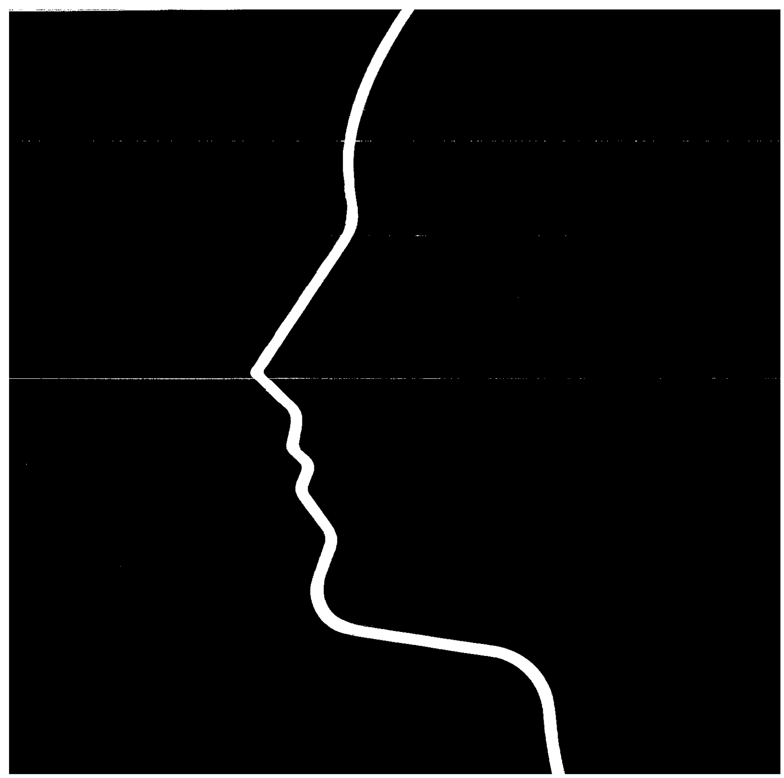
TEXAS INSTRUMENTS

EXPLORER™

SYSTEM FIELD MAINTENANCE



EXPLORER™ SYSTEM FIELD MAINTENANCE

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, can cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computer device pursuant to Subpart J of Part 15 of FCC Rules, which are designated to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference; in which case, the user at his own expense will be required to take whatever measures necessary to correct the interference.

WARNING: Lethal high voltages are present inside the chassis of this equipment. Only qualified service personnel who are familiar with the dangers of high voltages are permitted to open the chassis of this equipment for maintenance, equipment upgrading, or equipment rearrangement.

WARNING: Each system interface board contains a lithium battery. Lithium batteries can explode if the positive and negative terminals are shorted together. DO NOT place the system interface board on a conductive surface. The outside surfaces of all antistatic shipping bags are conductive; do not place the system interface on an antistatic shipping bag.

CAUTION: Do not stack more than two mass storage enclosure units on top of the Explorer 7-slot enclosure. When more than two units are stacked on top of the 7-slot enclosure, there is a danger of the stacked units becoming top heavy and possibly tipping the 7-slot enclosure over.

LIST OF EFFECTIVE PAGES

Insert latest changed pages and discard superseded pages.

Note: The changes in the text are indicated by a change number at the bottom of the page and a vertical bar in the outer margin of the changed page. A change number at the bottom of the page but no change bar indicates either a deletion or a page layout change.

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Page	Change No.	Page	Change No.	Page	Change No.
Cover/Inside Cover	0	OP 1-23 - OP1-24	1	CM 4-13	1
Title Page	1	OP 1-25	0	CM 4-14 - CM4-16	0
Effective Pages	1	OP 1-26	1	CM 4-17	1
Effective Pages (Cont.)	1	OP 1-27 - OP 1-34	0	CM 4-19	1
H/W Manuals Page	1	PM i	0	CM 4-21	0
S/W Manuals Page	1	PM 1-1	0	CM 4-22	1
vii - viii	0	PM 1-3	1	CM 4-23 - CM 4-38	0
GI i - GI ii	0	PM 1-4 - PM 1-6	0	CM 5-1 - CM5-29	0
GI 1-1 - GI 1-11	0	CM i	0	SE i	0
GI 1-12	1	CM ii - CM iii	1	SE 1-1 - SE 1-14	0
GI 1-13 - GI 1-22	0	CM iv	0	MM i - MM ii	0
GI 1-23	1	CM 1-1 - CM 1-28	0	MM 1-1 - MM1-29	0
GI 1-24 - GI 1-40	0	CM 2-1 - CM 2-28	0	PR i - PR ii	0
GI 1-41	1	CM 2-29 - CM 2-30	1	PR 1-1 - PR 1-29	0
GI 2-1 - GI 2-5	0	CM 2-30A	1	PR 1-30 - PR 1-31	1
GI 2-6	1	CM 2-31 - CM 2-39	0	PR 1-32 - PR 1-65	0
GI 2-7 - GI 2-27	0	CM 3-1 - CM 3-7	0	SI i - SI ii	0
OP i - OP ii	0	CM 3-9 - CM3-10	1	SI 1-1 - SI 1-40	0
OP 1-1 - OP1-12	0	CM 3-11 - CM3-14	0	SI 1-41	1
OP 1-13	1	CM 3-15 - CM 3-20	1		
OP 1-14 - OP 1-22	0	CM 4-1 - CM 4-11	0		

continued

Page	Change No.
SI 1-42 – SI 1-52	0
DT i – DT iii	0
DT 1-1 – DT 1-52	0
DT 2-1 – DT 2-11	0
DT 3-1 – DT 3-5	0
MS i – MS iii	0
MS 1-1 – MS 1-34	0
MS 1-35	1
MS 1-36 – MS 1-67	0
OE i – OE iv	0
OE 1-1 – OE 1-31	0
OE 1-32	1
OE 1-33 – OE 1-37	0
OE 2-1 – OE 2-21	0
OE 3-1 – OE 3-23	0
AP i	1
AP A-1	0
AP A-3 – AP A-13	1
AP B-1 – AP B-7	0
AP C-1 – AP C-2	0
AP C-3 – AP C-5	1
Glossary 1 – Glossary 7	0
Index 1 – Index 18	0
User Response	0
Business Reply	0
Inside Cover/Cover	0

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THE EXPLORER™ SYSTEM HARDWARE MANUALS

System Level Hardware Publications

System Enclosure Hardware Publications

Mass Storage Hardware Publications

Mass Storage Hardware Vendor Publications

Optional Equipment Hardware Publications

THE EXPLORER™ SYSTEM SOFTWARE MANUALS

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Explorer Technical Summary	2243189-0001
Explorer Operations Guide	2243190-0001
Explorer Zmacs Editor Tutorial	2243191-0001
Explorer Glossary	2243134-0001
Explorer Communications User's Guide	2243206-0001
Explorer Diagnostics	2533554-0001
Explorer Master Index to Software Manuals	2243198-0001
Explorer System Software Installation	2243205-0001

Programming With the Explorer

Explorer Programming Primer	2243199-0001
Common LISP, The Language, by Guy L. Steele, Jr.	2537175-0001
Explorer Lisp Reference	2243201-0001
Explorer Zmacs Editor Reference	2243192-0001
Explorer Programming Concepts and Tools	2243130-0001
Explorer Window System Reference	2243200-0001
Explorer Command Interface Toolkit User's Guide	2243197-0001

Explorer Toolkits

Explorer Natural Language Menu System User's Guide	2243202-0001
Explorer Relational Table Management System User's Guide	2243203-0001
Explorer Graphics Toolkit User's Guide	2243195-0001
Explorer Grasper User's Guide	2243135-0001
Explorer Prolog Toolkit User's Guide	2243204-0001
Programming in Prolog, by Clocksin and Mellish	2249985-0001
Explorer Color Graphics User's Guide, Support for the Raster Technologies Model One	2537157-0001
Explorer TCP/IP User's Guide	2537150-0001

System Software Internals

Explorer System Software Design Notes	2243208-0001

ABOUT THIS MANUAL

Introduction

This document provides field maintenance information for the Texas Instruments Explorer computer system. The information in this document is a guide to help the field maintenance person isolate a fault to the lowest economically-replaceable subassembly and to replace that subassembly. The intended audience for this document is primarily field maintenance personnel.

Contents of This Manual

This document is organized into 14 parts that are separated by tabs. Each part contains a detailed table of contents and separate sections. A general outline of the 14 parts follows. For details on the contents of each part, refer to the individual Table of Contents at the beginning of each part.

Tab Title	Contents
GI — General Information	Section 1, Explorer System Descriptions Section 2, Explorer Subsystem Descriptions
OP — Operating Procedures	Section 1, Explorer System Operating Procedures
PM — Preventive Maintenance	Section 1, Explorer System Preventive Maintenance
CM — Corrective Maintenance	Section 1, Important Maintenance Information Section 2, Explorer System Troubleshooting Section 3, Display Unit Maintenance Section 4, Explorer Enclosure Maintenance Section 5, Mass Storage Enclosure Maintenance
SE — System Enclosure	Section 1, Explorer Enclosure Field Maintenance Data
MM — Memories	Section 1, Explorer Memory Field Maintenance Data
PR — Processors	Section 1, Explorer Processor Field Maintenance Data
SI — System Interface	Section 1, Explorer System Interface Field Maintenance Data

Tab Title	Contents
DT — Display Terminals	Section 1, Explorer Display Field Maintenance Data Section 2, Mouse Field Maintenance Data Section 3, Keyboard Field Maintenance Data
MS — Mass Storage	Section 1, Mass Storage Subsystem Field Maintenance Data
OE — Optional Equipment	Section 1, NuBus Ethernet Controller Field Maintenance Data Section 2, Ethernet Network Field Maintenance Data Section 3, Model 855 Printer Field Maintenance Data
AP — Appendixes	Appendix A, Family Tree Drawings Appendix B, Network Maintenance Appendix C, Power Requirements and Considerations
GL — Glossary	The glossary contains uncommon words and terms used in this manual. Refer to the *Explorer Glossary* for more details.
IN — Index	The index page references include the manual part abbreviations, such as GI and OP, for locating the indexed items in the different manual parts.

Parts OP, PM, SE, MM, PR, SI, and MS each have only one section at present. This arrangement provides space for future additions of data for updated and new equipment while retaining the information on existing equipment.

The *Explorer System Field Maintenance* manual is available as part of the Explorer System Field Maintenance Documentation Kit, TI part number 2243222-0001, which includes:

- *Explorer System Field Maintenance* manual, TI part number 2243141-0001 (can be ordered separately using this part number)

- Tabset, TI part number 2249995-0001

- Binder, TI part number 2243168-0003

CONTENTS

EXPLORER SYSTEM DESCRIPTIONS 1

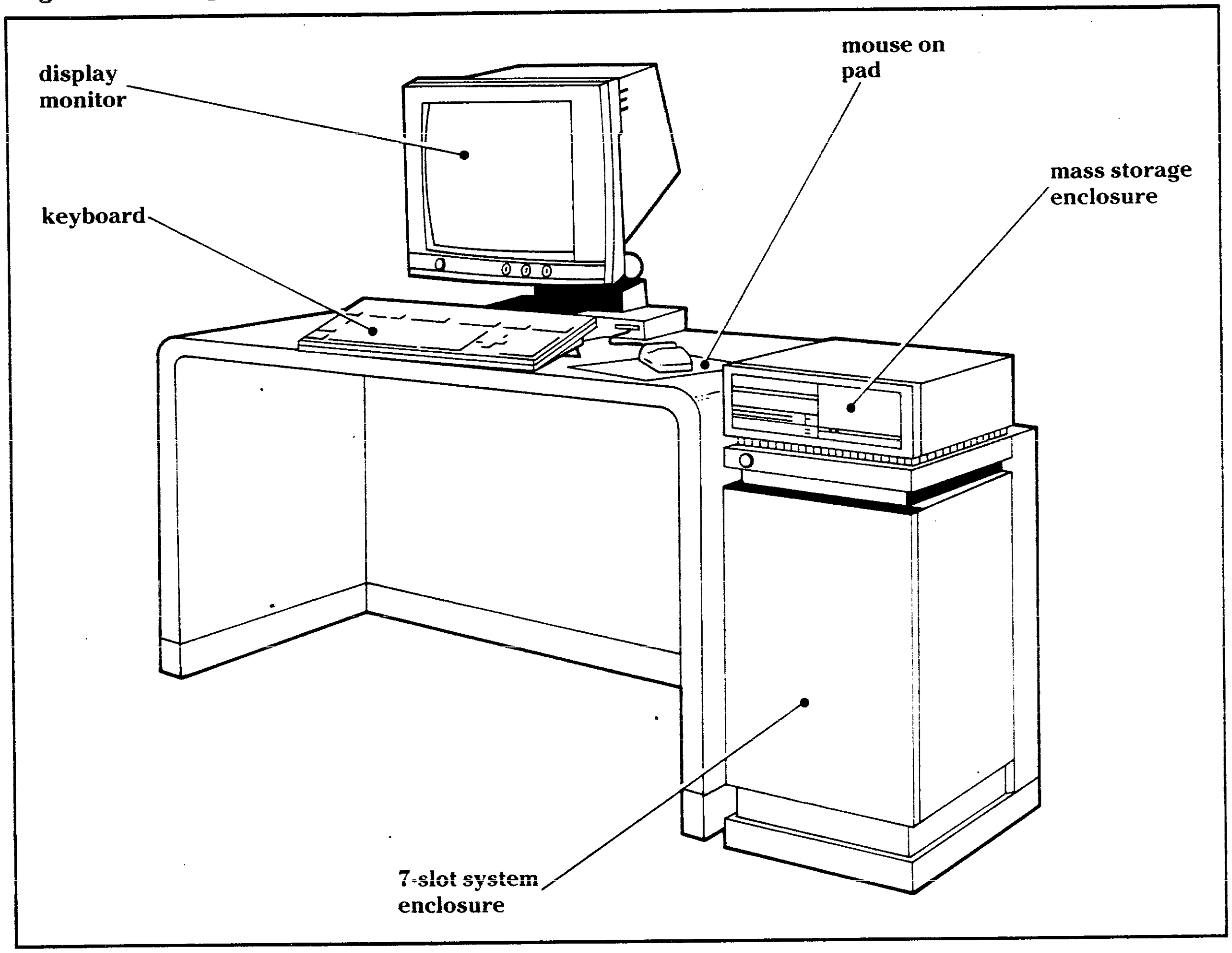
Highlights of This Section

- Display unit description
- System enclosure description
- Eurocard circuit board descriptions
- Mass storage enclosure description
- Bus descriptions
- Configuration ROM description
- System specifications

Introduction

1.1 This section provides a general description of the Explorer computer system shown in Figure 1-1.

Figure 1-1 Explorer Computer System



The Explorer equipment is divided into standard equipment and optional equipment. Standard equipment includes the following:

- System enclosure 2235540
- Memory board 2243910 (early board 2236415)
- Processor 2243881
- Display unit 2235801
- Mouse 2249437

- Keyboard 2235185
- System interface board 2236645 (early board 2236590)
- Mass storage enclosure 2236108
- NuBus peripheral interface (NUPI) board 2238040

Optional equipment is as follows:

- NuBus Ethernet controller 2236400
- Model 855 Printer 2233801
- Headset with microphone
- Handheld microphone

Display Unit Description

1.2 The display unit consists of the following assemblies:

- Display monitor assembly
- Mouse assembly
- Keyboard assembly

Display Monitor Assembly

1.2.1 The display monitor assembly (Figure 1-2) has a high-resolution, 43.5-centimeter (17-inch), monochrome video display mounted on an adjustable base assembly. The display is completely bit-mapped with a horizontal resolution of 1024 pixels and a vertical resolution of 808 pixels, and has a noninterlaced raster to minimize flicker. The display operator controls consist of a power on/off button and controls for contrast, brightness, and volume. Data is interfaced to the display over a fiber-optic cable from the system enclosure. AC power can originate from the system enclosure or from a wall outlet.

The base assembly has a continuous height-adjustment range of 10.9 centimeters (4.3 inches) and a continuous tilt-adjustment range of 5 degrees forward and 20 degrees backward. The base adjustments are controlled by gas-filled cylinders that hold the display in position. The base assembly also has plug-in jacks for the mouse, the keyboard, a headset with microphone, and a handheld microphone.

WARNING: Lethal voltages exist on the internal components of the display monitor when ac power is applied and also after the ac power has been removed for a period of time. Make sure the ac power is disconnected from the display monitor before removing the rear plastic cover from the monitor. Also check that all high voltages have been discharged before performing any maintenance on the internal parts of the monitor.

Figure 1-3 shows a rear internal view of the display monitor. The purpose of this figure is to give maintenance personnel a general understanding of the internal components and configuration of the display monitor. Refer to the Corrective Maintenance part of this manual for component replacement instructions.

Figure 1-2 Display Monitor Assembly

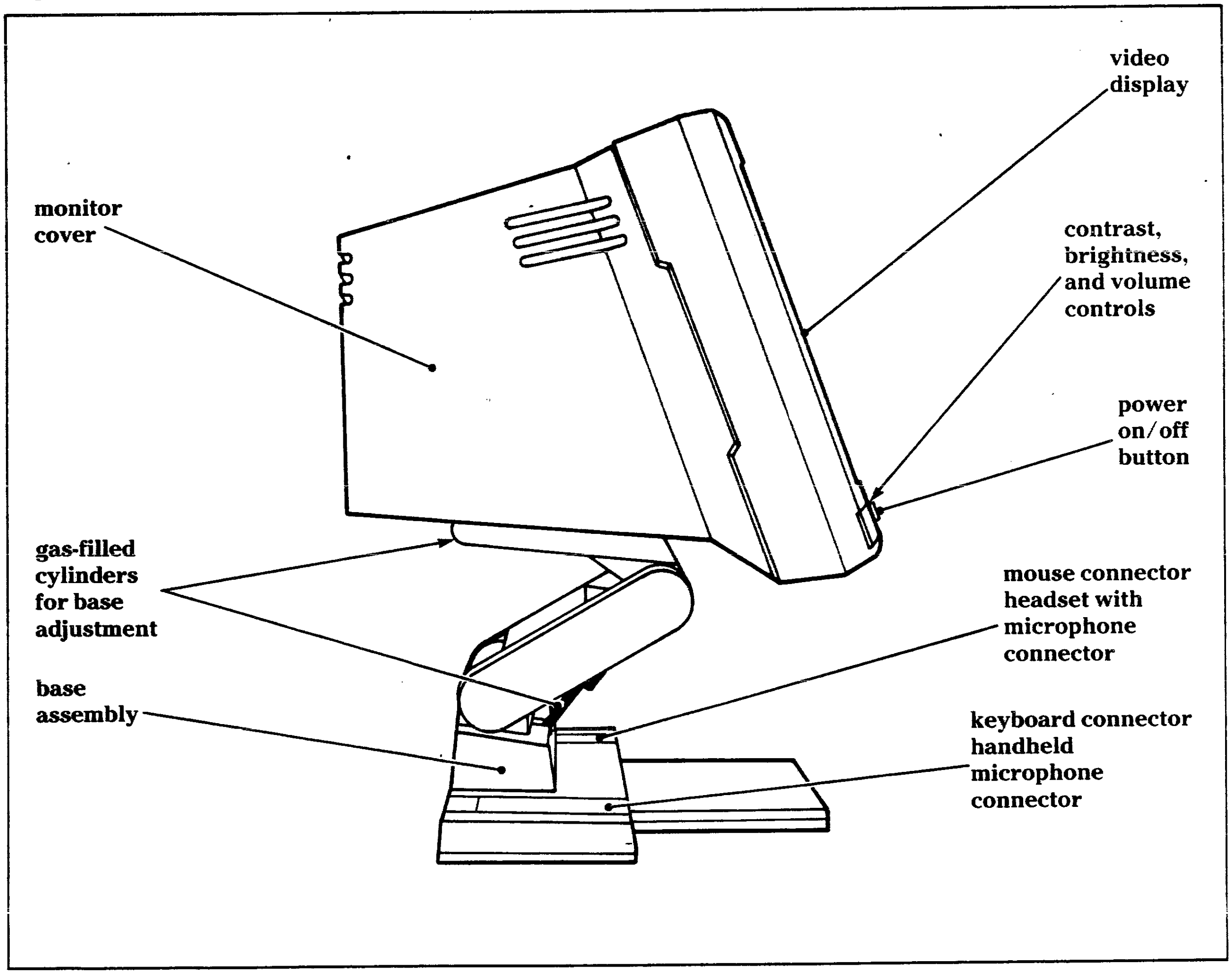
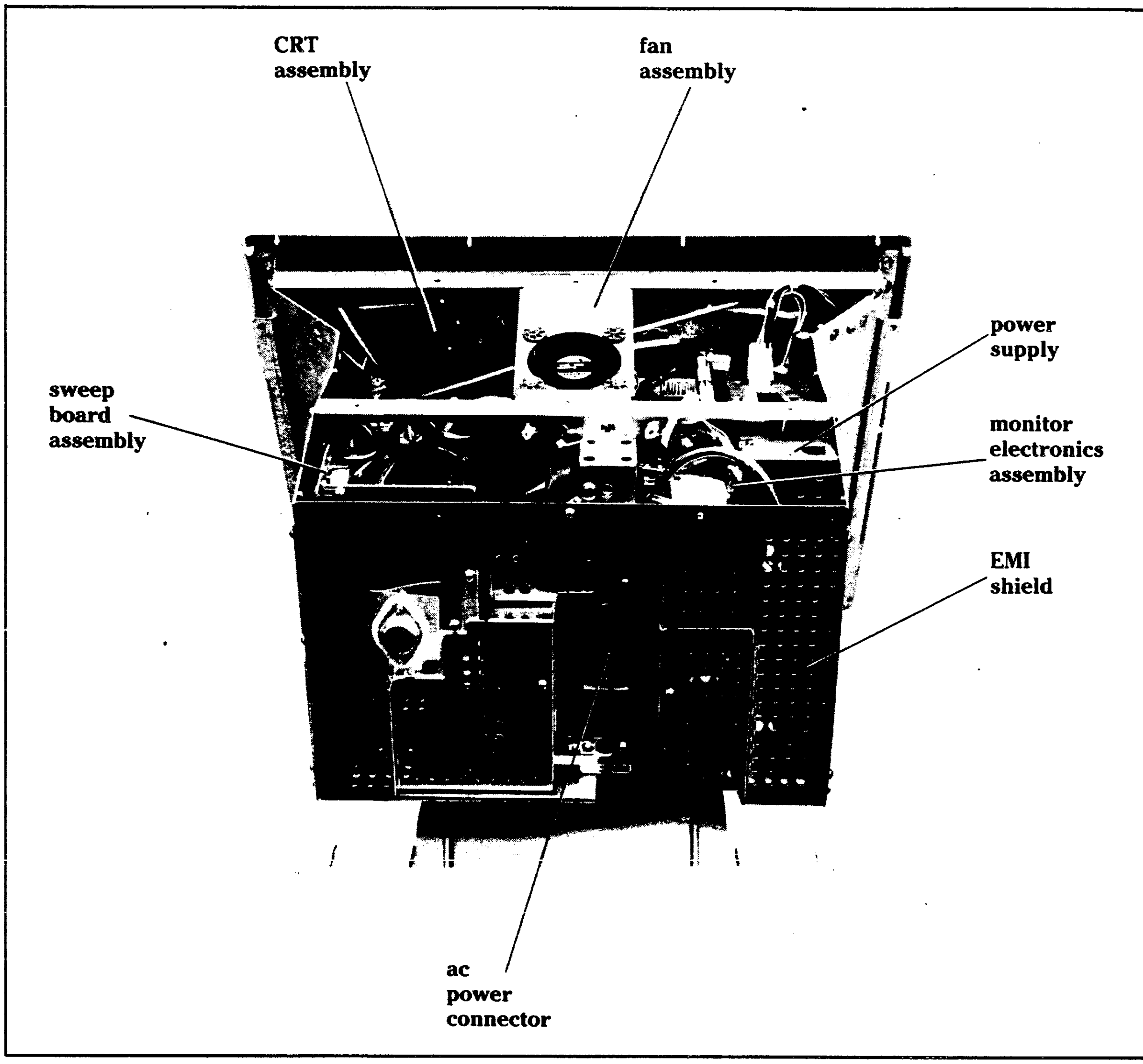


Figure 1-3 Display Monitor Assembly — Internal View



Mouse Assembly

1.2.2 The mouse assembly (Figure 1-4) consists of a mouse and an optical pad. A light source and a light receiver on the bottom of the mouse provide an optical coupling between the mouse and the optical pad.

The mouse has three buttons arranged for easy one-handed operation. The mouse connects to the right receptacle under the lift door on the right side of the base assembly. Positive 5 volts dc is provided to the mouse through the cable connected at the base assembly.

The optical pad has a polished grid of lines that provides input to the mouse as it moves vertically and horizontally on the pad. The mouse movement can be tracked at rates up to 76.8 centimeters (30 inches) per second with a resolution of 512 pixels per centimeter (1300 pixels per inch). Place the optical pad with the wide side in a horizontal position to properly operate the mouse in both vertical and horizontal directions.

Keyboard Assembly

1.2.3 The keyboard assembly (Figure 1-5) is a low-profile keyboard that contains over 100 keys. The keyboard assembly consists of the following key groups:

- Standard QWERTY keys
- Function keys
- A numeric keypad
- Cursor control keys
- Mouse control keys
- Program control keys

Some of the keys have an electronic lock feature that lights a light-emitting diode (LED) on top of the key when the key is in the locked position. All the alphabetic, numeric, and punctuation keys have an optional auto-repeat key feature that can be adjusted or disabled by software. The keyboard contains a microprocessor that produces an ASCII code to identify a particular key that is pressed and to control the electronic lock, boot chords, and mouse.

The keyboard has a coiled cord that connects to the right receptacle under the cover on the left side of the base assembly. Positive 12 volts dc is provided to the keyboard through the cable connected at the base assembly. You can adjust the angle of the keyboard for a slope range of 5 to 15 degrees.

Figure 1-4 **Mouse Assembly**

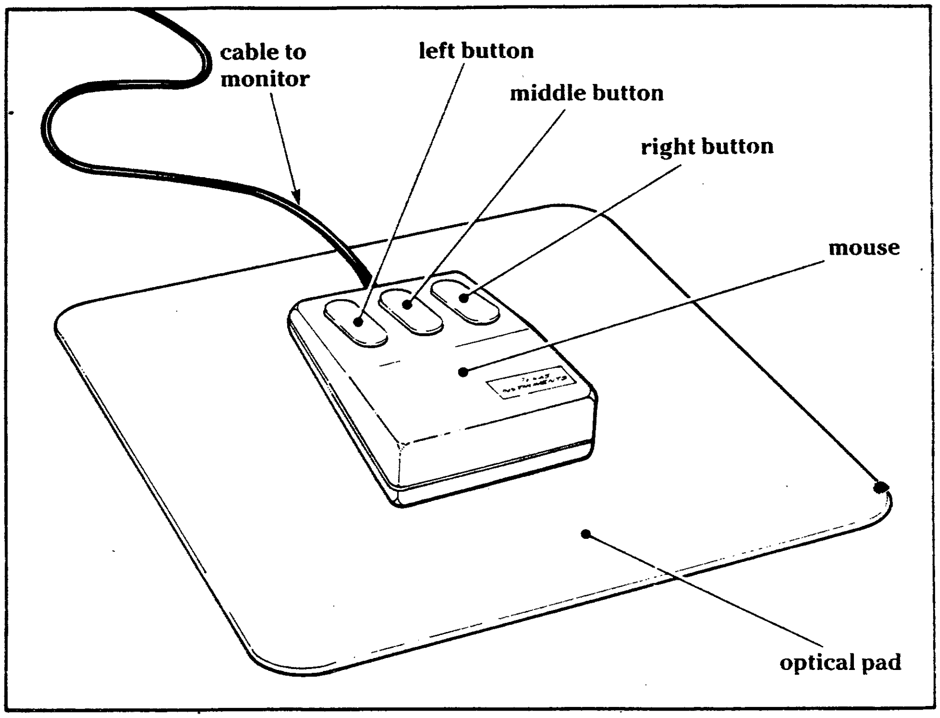
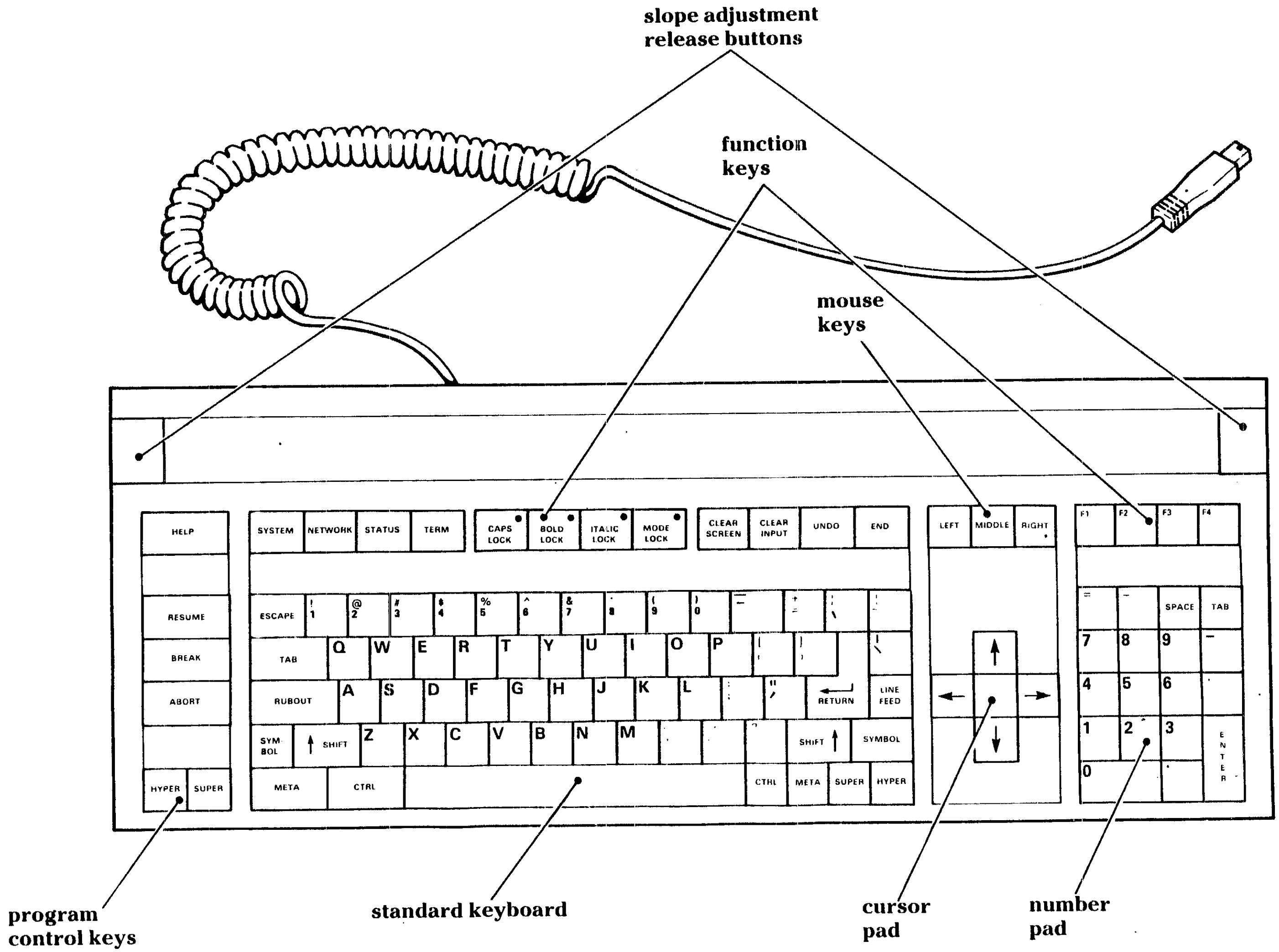


Figure 1-5 Keyboard Assembly



System Enclosure Description

1.3 The system enclosure (Figures 1-6 and 1-7) is a compact cabinet that has an inner metal enclosure within a plastic outer enclosure. The inner metal enclosure provides electromagnetic interference (EMI) shielding. The outer plastic enclosure provides a pleasing appearance and also helps to reduce noise. The front metal door and the rear plastic door have interlock switches that break the ac power input which shuts off all ac power to the system enclosure.

The inner metal enclosure contains the backplane. The backplane is a multilayer printed wiring board (PWB) that contains the NuBus, local bus, input/output (I/O), and system power supply 96-pin DIN connectors. These connectors are arranged in three horizontal rows and eight vertical columns to permit interconnection of the three-high Eurocard circuit boards and the system power supply. Seven of the vertical connector columns each contain three connectors that form slots 0 through 6. The top row of connectors forms the NuBus; the center row of connectors forms the local bus on four slots; and the bottom row of connectors provide I/O access to peripheral devices.

The internal metal enclosure contains card guides that permit the installation of a maximum of seven three-high Eurocard circuit boards into slots 0 through 6 at the front of the enclosure. Card guides are also provided on the rear of the enclosure for the installation of terminators and peripheral adapters.

The Explorer cooling system draws air in at the top of the enclosure. This air circulates over the circuit boards in a down-up-down path and then exits out at the bottom of the enclosure. The air is circulated by a horizontal impeller fan located in the base of the enclosure. The fan is driven by a variable-speed brushless dc motor. The speed of the fan is thermostatically controlled by the motor power supply.

Figure 1-6 Explorer Enclosure — Internal Front View

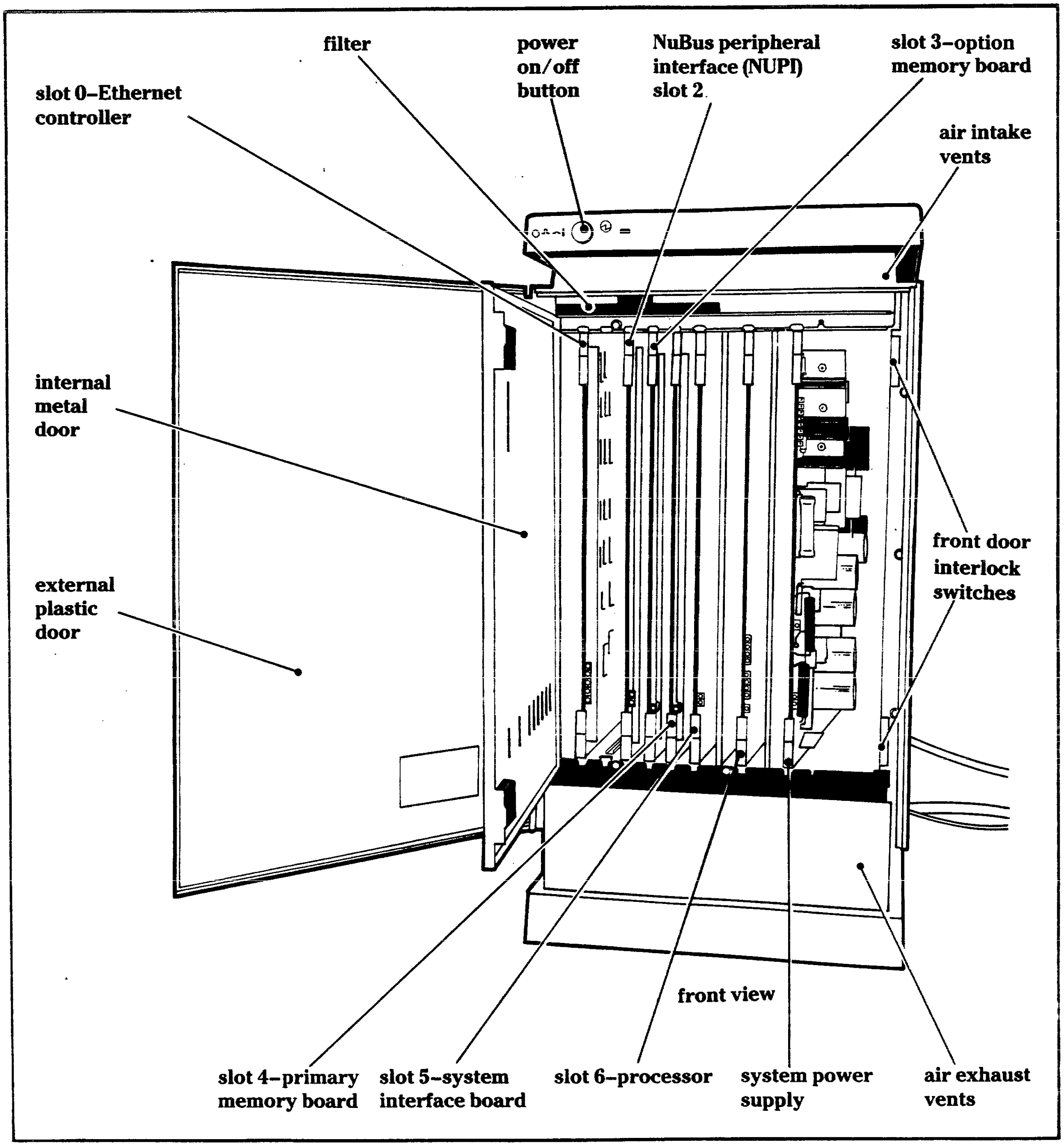
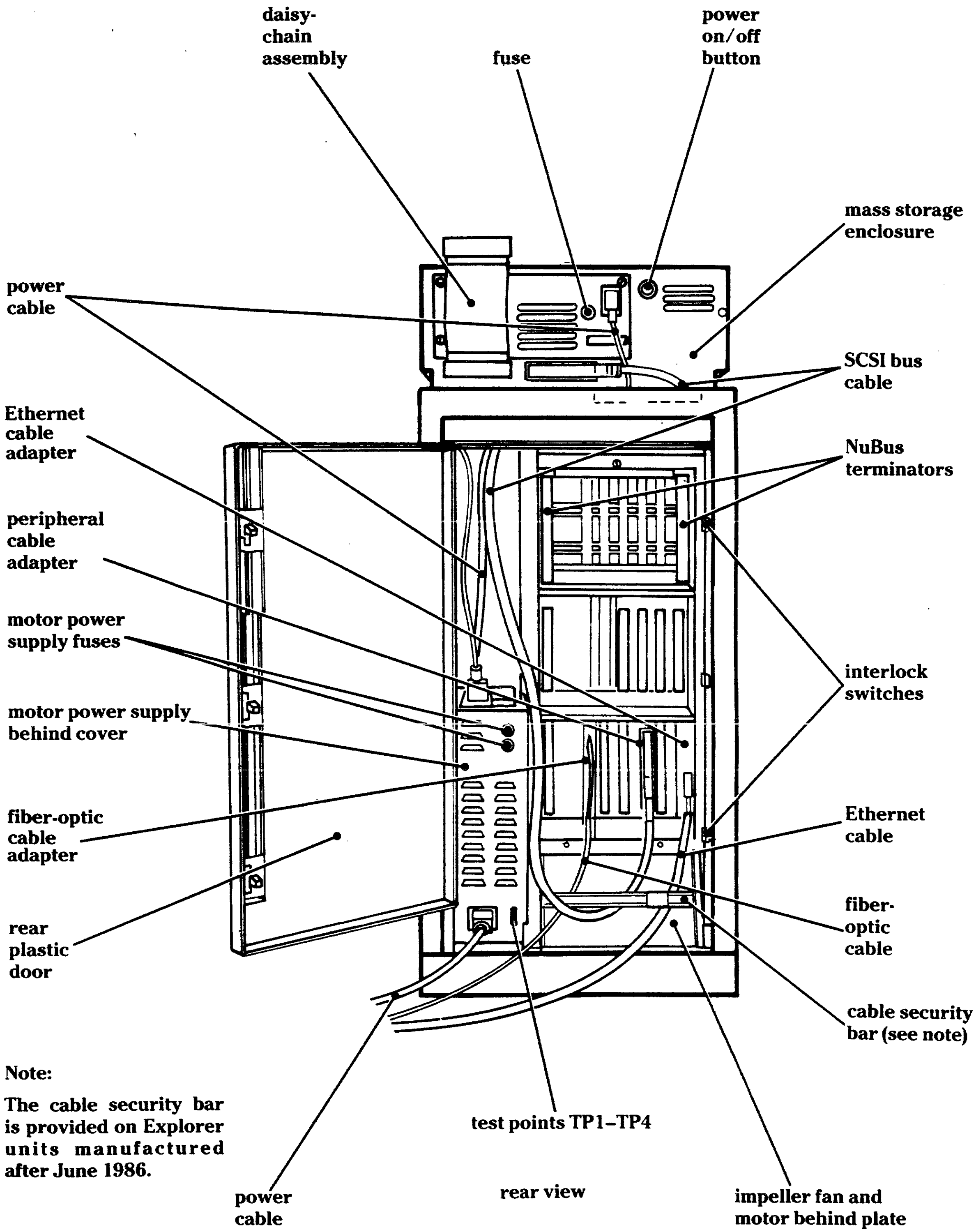


Figure 1-7 Explorer Enclosure — Internal Rear View



Note:

The cable security bar is provided on Explorer units manufactured after June 1986.

Eurocard Circuit Board Descriptions

1.4 The following Eurocard circuit boards are presently used in the Explorer computer system:

- NuBus Ethernet controller
- NuBus peripheral interface
- Explorer memory
- System interface
- Explorer processor
- System power supply

These circuit boards are all standard three-high Eurocard designs with three standard DIN connectors referred to as P1, P2, and P3. The expression *Eurocard* indicates a European mechanical-design standard for circuit boards. The number of connectors on a board indicates the height of the board.

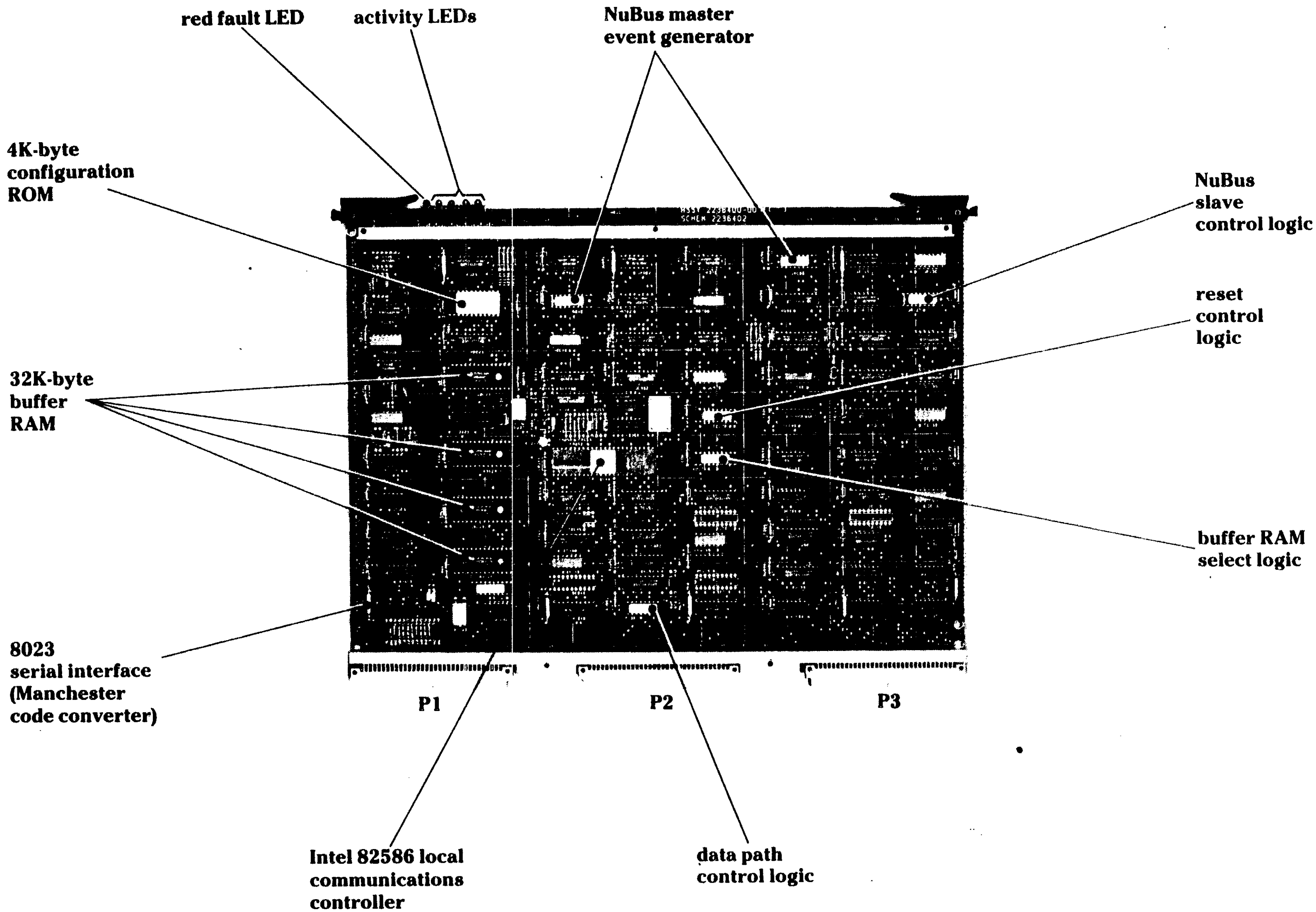
NuBus Ethernet Controller

1.4.1 The NuBus Ethernet controller (Figure 1-8) controls the high-speed communication interface between the NuBus and the Ethernet local area network (LAN). The LAN conforms to the Ethernet/IEEE802.3 standard. The key features of the controller are the Intel 82586 local communications controller (LCC) chip and the 8023 serial interface chip. A 32-kilobyte buffer is provided to maintain full-speed Ethernet operation without loss of packets of information on any standard noncollision-type sequence of Ethernet operation.

The Ethernet controller acts as a NuBus master only to generate events that request service or notify the central processor of an error condition. The Ethernet controller is a slave under all other conditions. A 4-kilobyte configuration ROM provides all applicable configuration information plus self-tests and device driver code. The LCC is driven by control primitives from the NuBus-based central processor. This gives flexibility to the higher level protocols in software while keeping most Ethernet-specific requirements transparent to the software.

The interface data transfer rate is 10 megabits per second using a Manchester data-encoding method and packet-type Ethernet message format. The Ethernet software is compatible with the standard seven-layer Open System Interconnect (OSI) communication model.

Figure 1-8 NuBus Ethernet Controller Board



NuBus Peripheral Interface Board

1.4.2 The NuBus peripheral interface (NUPI) board (Figure 1-9) contains the electronics that provide an interface between the NuBus and the small computer system interface (SCSI) bus. The key features of the NUPI are the 68000 microprocessor, the NCR5385 SCSI protocol controller, and several control programmable array logic (PAL®) chips. Firmware for NUPI configuration data, the 68000 microprocessor, the SCSI bus controller, and self-test diagnostics are all contained in the least significant byte and the most significant byte eight-kilobyte ROMs.

The NUPI can operate as either a NuBus slave or a NuBus master. The NUPI operates as a slave when receiving configuration information, when supplying configuration ROM information or board status flags, and when receiving the start address of the command block. The NUPI becomes a master when the host software writes the starting NuBus physical memory address of the command block to the NUPI command address register. The NUPI then issues commands to obtain the command block from other boards on the NuBus. The NUPI processes the data in the command block and sends the appropriate control signals and data to the SCSI bus controller on the NUPI. The SCSI bus has a transfer rate of up to 1.25 megahertz per second.

Memory Board

1.4.3 The memory board (Figure 1-10) has a capacity of 2 megabytes when using 64-kilobit dynamic random-access memory (DRAM) chips. When equipped with 256-kilobit DRAM chips, the capacity of the board increases to 8 megabytes. The memory chips are arranged in rows of 32 chips for convenience in addressing 32-bit words with 4 bytes in each word. A configuration ROM is provided with NuBus and local bus control logic.

The Explorer memory contains NuBus master and slave logic. The NuBus master logic on the memory board permits the Explorer processor to be a NuBus master through control signals on the local bus. The memory board is always a slave to the local bus. When two memory boards are used in a system with a NuBus and a local bus, one board can access the NuBus at the same time the other board is accessing the local bus.

The memory board contains a base register that allows data from the NuBus or the local bus to change the address range of the memory board so that the full 32-bit address can be used to address very large logical memories. A logical memory can be considered as a memory board that has been loaded with new data; then the base register is used to allow the system software to address this new data at a different logical address, such as ES000000 through ES7FFFFF for an eight-megabyte board. Memory block transfers are supported when the memory board is functioning as a NuBus slave. Block transfers are not supported on the local bus.

Figure 1-1 NuBus Peripheral Interface Board

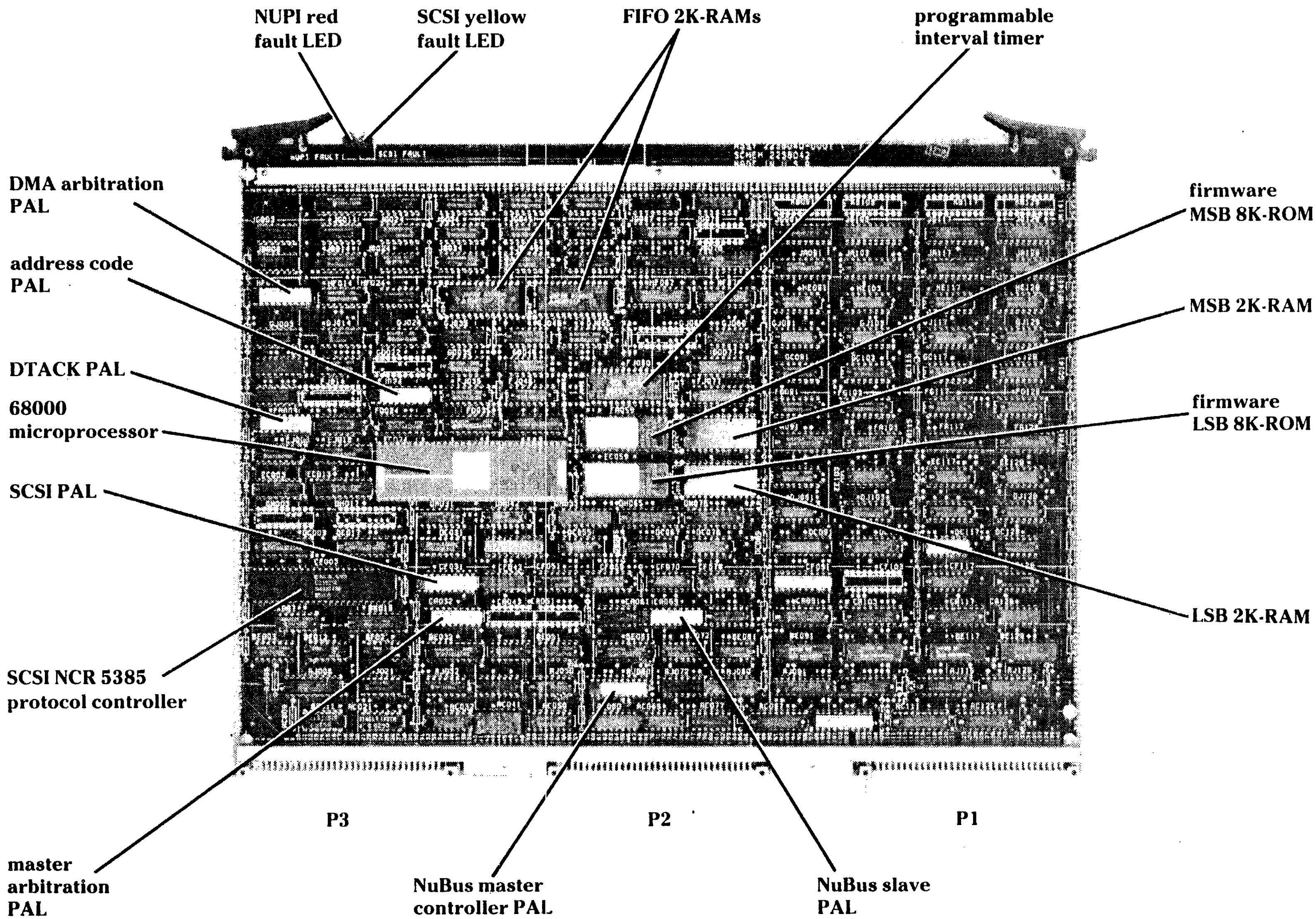
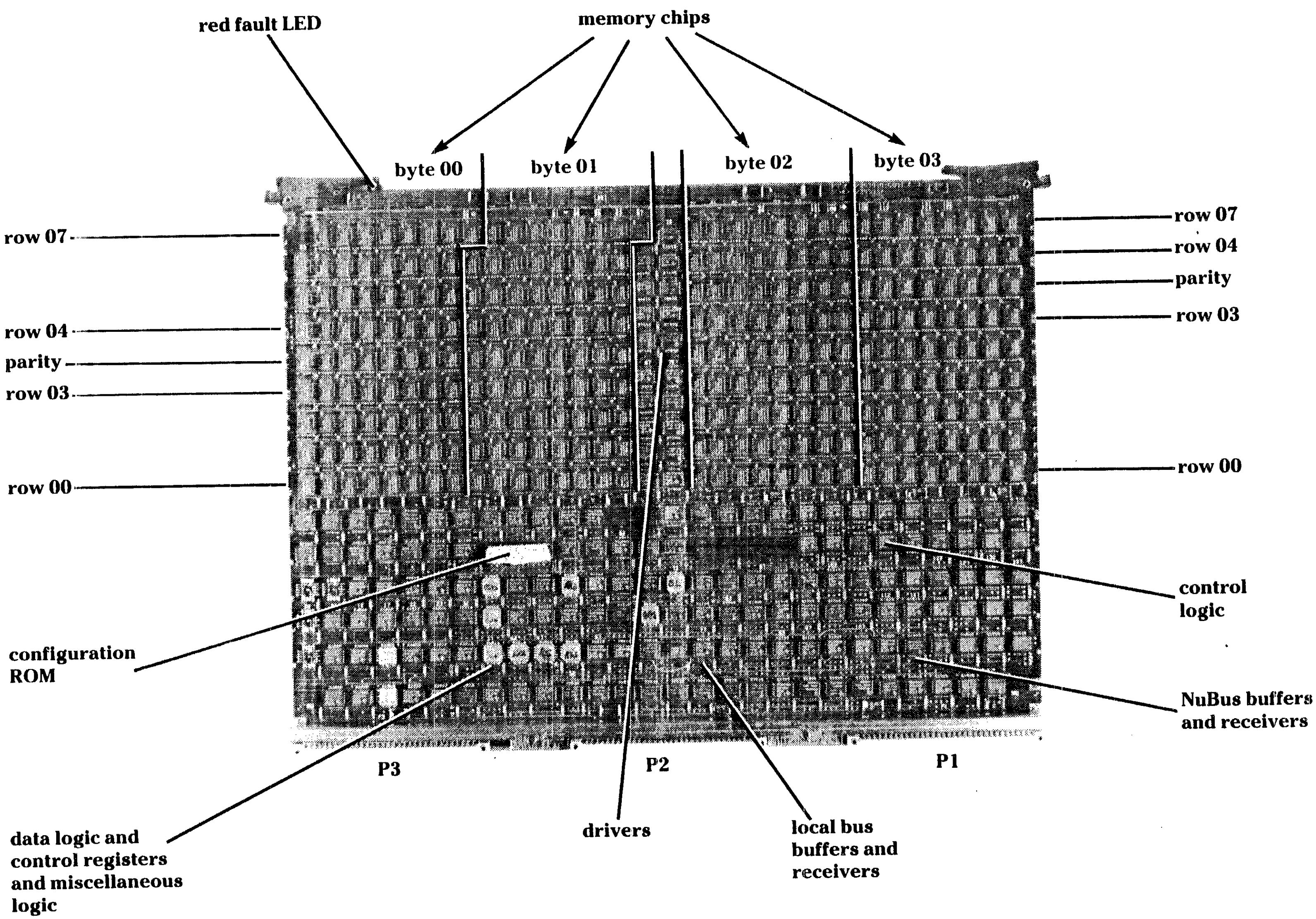


Figure 1-10 Explorer Memory Board



Multiple memory boards of different memory size can have different slot IDs, yet appear as contiguous physical memory to the system software. A memory board must always be present in slot four to accept the NuBus select signal. The memory board in slot four contains the NuBus master interface logic board for the processor assembly.

System Interface Board

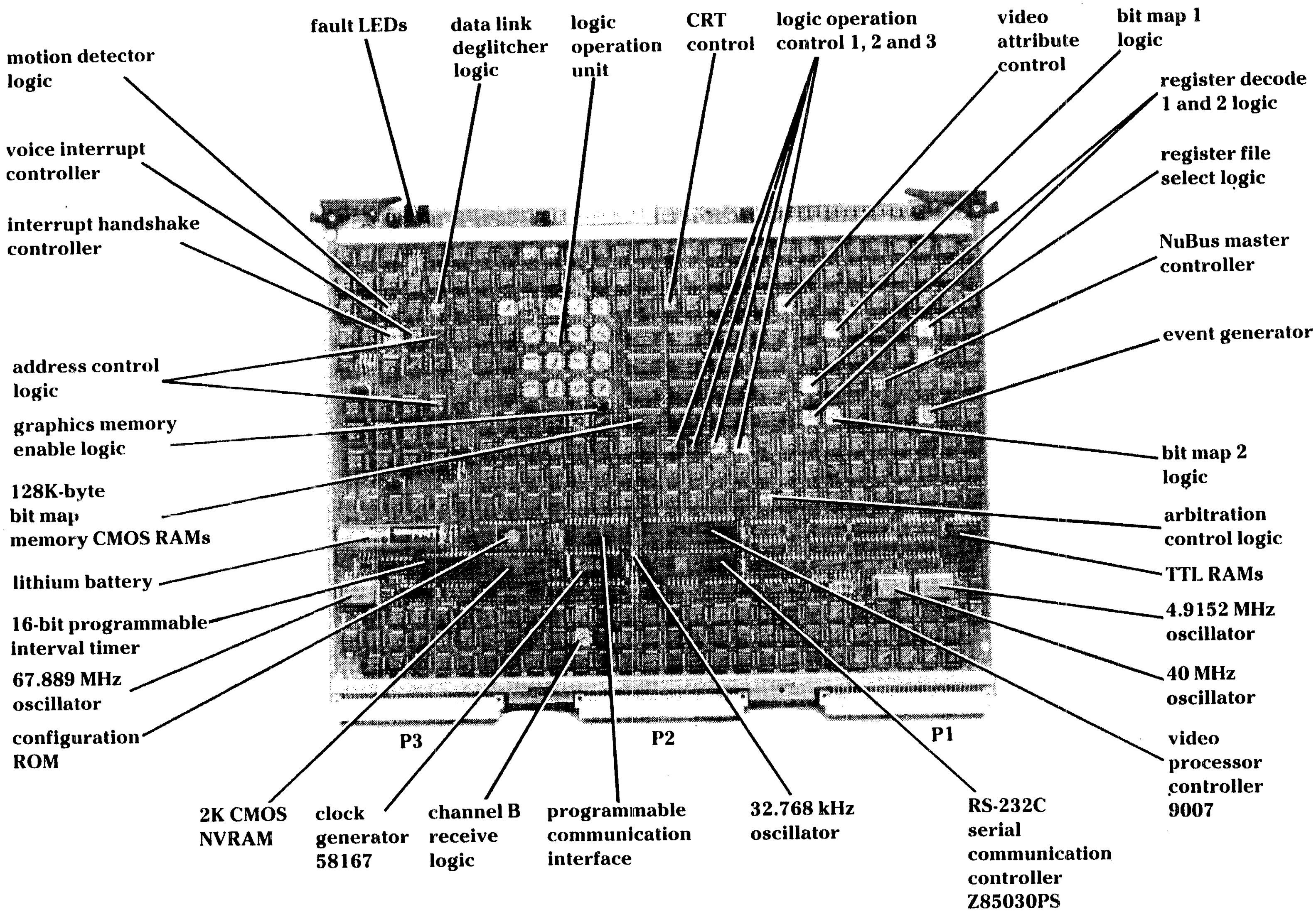
1.4.4 The system interface board (Figure 1-11) provides the interface between the NuBus and the display unit. A high-speed data interface is also provided over the local bus to handle graphics data from the memory board through the system interface board to the display unit. A battery maintains critical data in a 2-kilobyte complementary metal oxide semiconductor (CMOS) RAM during power failures or board removal. A bit-mapped memory of 128 kilobytes of CMOS RAM is provided for high-speed transfers of display data over the local bus or the NuBus to the video display. Data transfers over the NuBus are slightly slower than over the local bus.

Additional features of the system interface board include a 10-megahertz NuBus clock generator, an optical-link interface to the display unit, an RS-232C serial communication interface, a Centronics-compatible parallel printer interface, digital speech output and voice input logic, and keyboard and mouse interface logic.

A battery backup keeps the time and date clock running during power failures and board removals. A special chord detector monitors the keyboard input for a code sequence associated with system reboot operations. A chord is a group of keys that are pressed simultaneously.

CAUTION: When handling the system interface board, do not place it on a conductive surface, such as the static-protective bag that it shipped in, as this can discharge the battery. The outside surface of the static-protective bag has a conductive coating that discharges static charges from your body before you touch the board. It is very important to discharge the static charges from your body before handling the board as static charges can damage the static-sensitive devices on the board.

Figure 1-11 System Interface Board



Processor Assembly

1.4.5 The processor assembly consists of a three-high Eurocard (Figure 1-12) and an auxiliary board (Figure 1-13) connected together by eight 50-pin connectors to form one assembly that fits into a single chassis slot. The processor has direct access to the NuBus through connector P1 during power-up initialization and when operating as a slave to the NuBus. The memory board contains interface logic that permits the processor to be a NuBus master by way of the local bus at connector P2. The processor interfaces with external devices through the memory board. The processor has high-bandwidth access to local memory on the memory board by way of the local bus without the need for NuBus arbitration. Connector P3 of the processor provides access for factory-level testing.

The Explorer processor is a 32-bit general purpose processor with specially designed Lisp microcode and special symbolic logic support for high-speed symbolic processing using the Lisp language. The special Lisp microcode resides in microcode bands on the mass storage device. The system test bootmaster (STBM) loads the special Lisp microcode into the 16K-by-56-bit microinstruction RAMs on the processor board at system initialization after self-tests have been run. The special Lisp microcode and the special symbolic logic built into the processor board gives the Explorer processor high-speed symbolic processing capabilities.

The Explorer system application programs and utilities reside in load bands on the mass storage device. The system application programs and utilities are loaded into the Explorer memory as they are requested by the keyboard operator. The memory on the memory board is available to the processor over the local bus and is considered virtual memory to the processor. In a similar manner, the system application programs and utilities on the mass storage device are also considered a kind of virtual memory to the Explorer memory board. The Explorer processor then has high-speed access to all the data on the mass storage devices.

The processor operates from a 7-megahertz microinstruction clock and a 14-megahertz minor cycle clock. Both these clock frequencies are derived from a 28-megahertz oscillator. Several other clock signals are generated by the clock control logic.

This brief description of the processor and the illustration showing the location of the major circuit groups on the processor are presented here to give the reader a general view of the functional operation of the processor and its associated devices. More information on the functional operation of the processor is given in the Processors part of this manual.

Figure 1-12 Explorer Processor Main Assembly Board

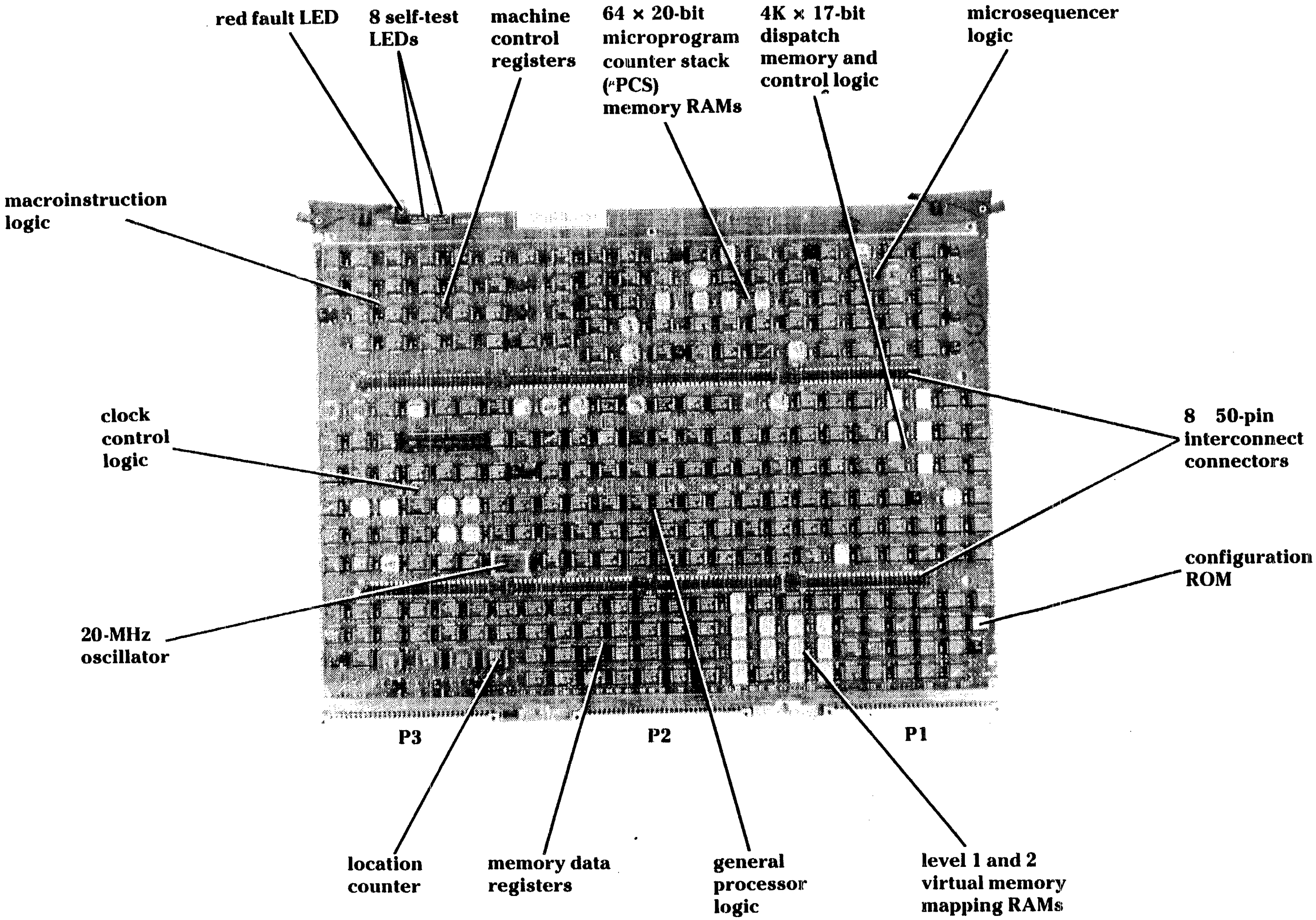
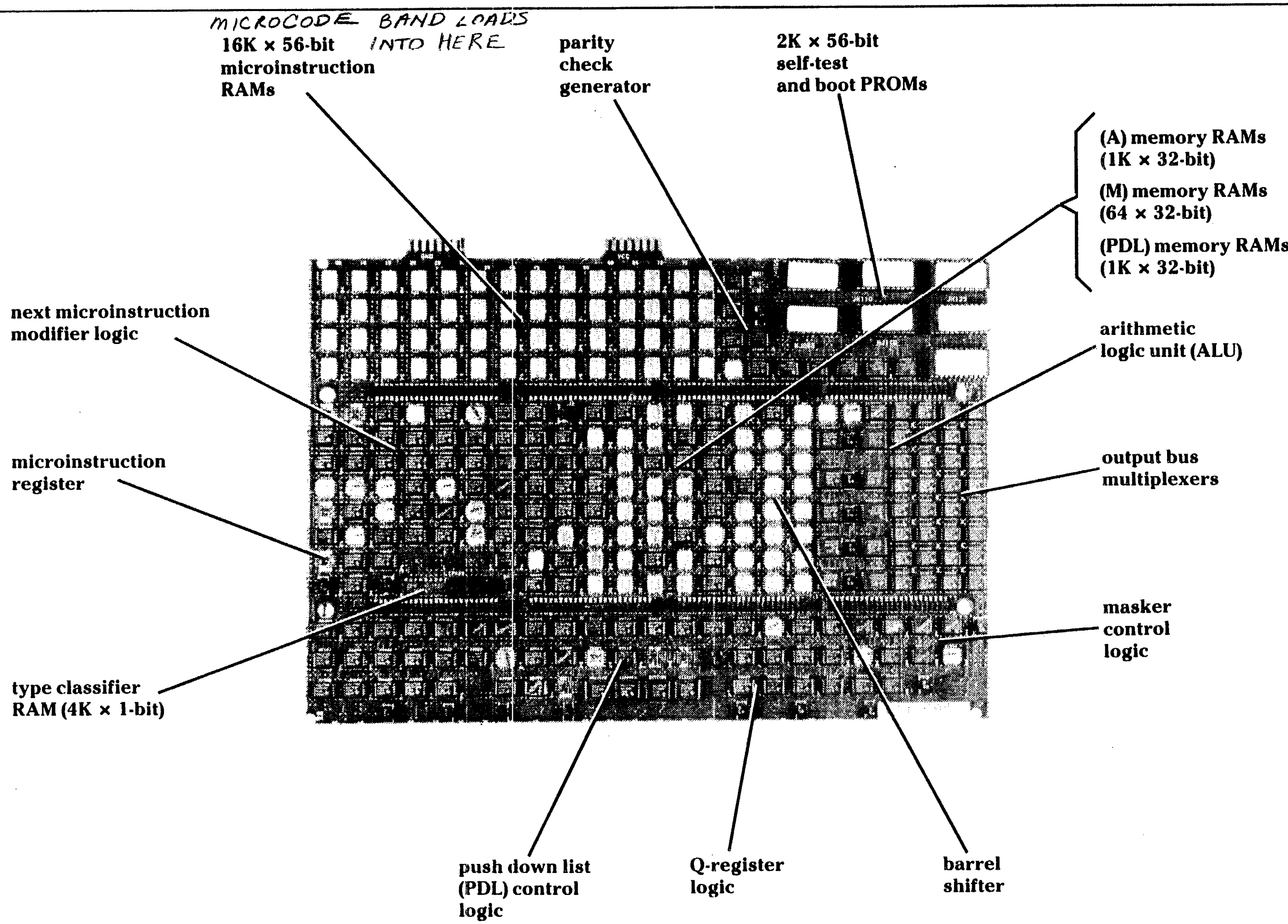


Figure 1-13 Explorer Processor Auxiliary Board



System Power Supply Board

1.4.6 The system power supply (Figure 1-14) is a switching-type power supply that can accept input ac voltages of 120 or 240 volts ac. The system power supply generates +12, −12, +5, and −5 volts dc and the power failure warning pulse (PFWP–), RESET–, TEMP–, and temperature status (TS) control signals.

System power supply board components include the following:

- Neon lamp DS1 indicates the existence of a positive earth ground connection to the power supply.

WARNING: Do not use neon lamp DS1 on the system power supply as an indication of a safe earth ground connection to the 7-slot system enclosure. Neon lamp DS1 only indicates that an unqualified earth ground path exists. Special instruments are required to determine if the earth ground connection is a qualified safety ground.

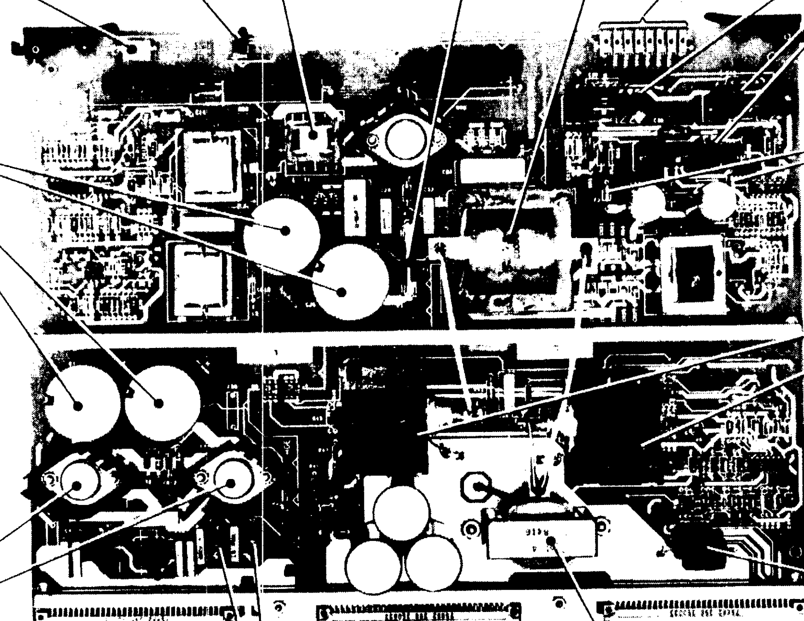
- LED CR28 indicates that +5 volts dc is being generated.

- Fan sensor RT3 includes a local heating element that is cooled by the flow of air over the power supply board. If the fan slows down or stops running, the temperature of RT3 rises immediately, changing the level of the TS signal, a dynamic analog signal that controls the speed of the fan motor. When the amplitude of TS gets high enough, it shuts down the dc output voltages from the system power supply.

- A 5-ampere fuse (F1) and two 3-ampere fuses (F2 and F3) protect the internal components of the system power supply from overload damage. Fuses F1 through F3 are not considered field replaceable. The following eight test points are provided:

Test Point	*Signal*	*Test Point*	*Signal*
TP1	SIG GND	TP5	PFWP–
TP2	+5 Vdc	TP6	−5 Vdc
TP3	TEMP–	TP7	−12 Vdc
TP4	RESET–	TP8	+12 Vdc

Figure 1-14 System Power Supply Board



Mass Storage Enclosure Description

1.5 The mass storage enclosure (shown in Figures 1-15 through 1-17) consists of the following major components:

- Power supply
- Winchester disk drive
- Disk drive formatter
- Cartridge tape drive with formatter

These components are interconnected by cables and a cable interconnect board (CIB). The enclosure has space for two 5¼-inch form-factor drives, such as Winchester disk drives and/or a cartridge tape drive. The standard mass storage enclosure configurations are:

- One or two Winchester disk drives
- One Winchester disk drive and one cartridge tape drive
- One cartridge tape drive

Up to four mass storage enclosures can be connected together using the standard daisy-chain cable assembly at the rear of the enclosures.

The power supply is of a highly efficient switching-type design that generates +5.1 volts dc regulated at 9 amperes and +12 volts dc regulated at 5 amperes. A voltage selection switch selects either 120 or 240 volts ac input power. A cooling fan is located on the front of the power supply, embedded inside the mass storage enclosure.

The disk drive is a 5¼-inch Winchester drive with a capacity of up to 100 megabytes or more of formatted data. The Winchester disk drive is the primary mass storage device of the Explorer system. The disk drive formatter converts small computer system interface (SCSI) signals from the NUPI board into the standard ST506 disk drive interface required by the Winchester disk drive.

The cartridge tape drive uses a removable ¼-inch tape cartridge that provides the primary backup medium for the Winchester disk drive(s). The formatter for the cartridge tape drive is mounted on the tape drive. The tape drive formatter provides the interface between the tape drive and the Winchester disk drive over the 50-pin SCSI bus cable.

Figure 1-15 Mass Storage Enclosure With Tape Drive and Disk Drive

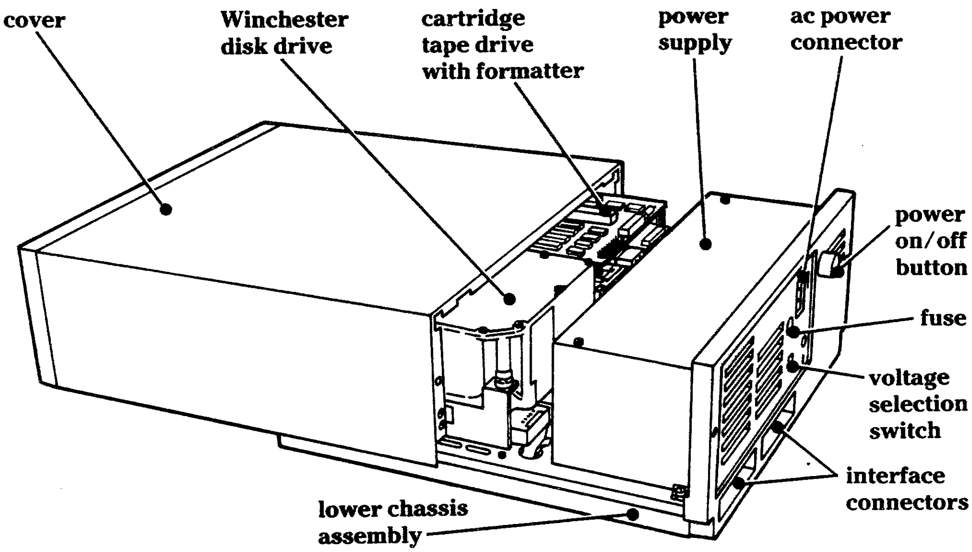


Figure 1-16 Mass Storage Enclosure — Internal View With Tape and Disk Drives

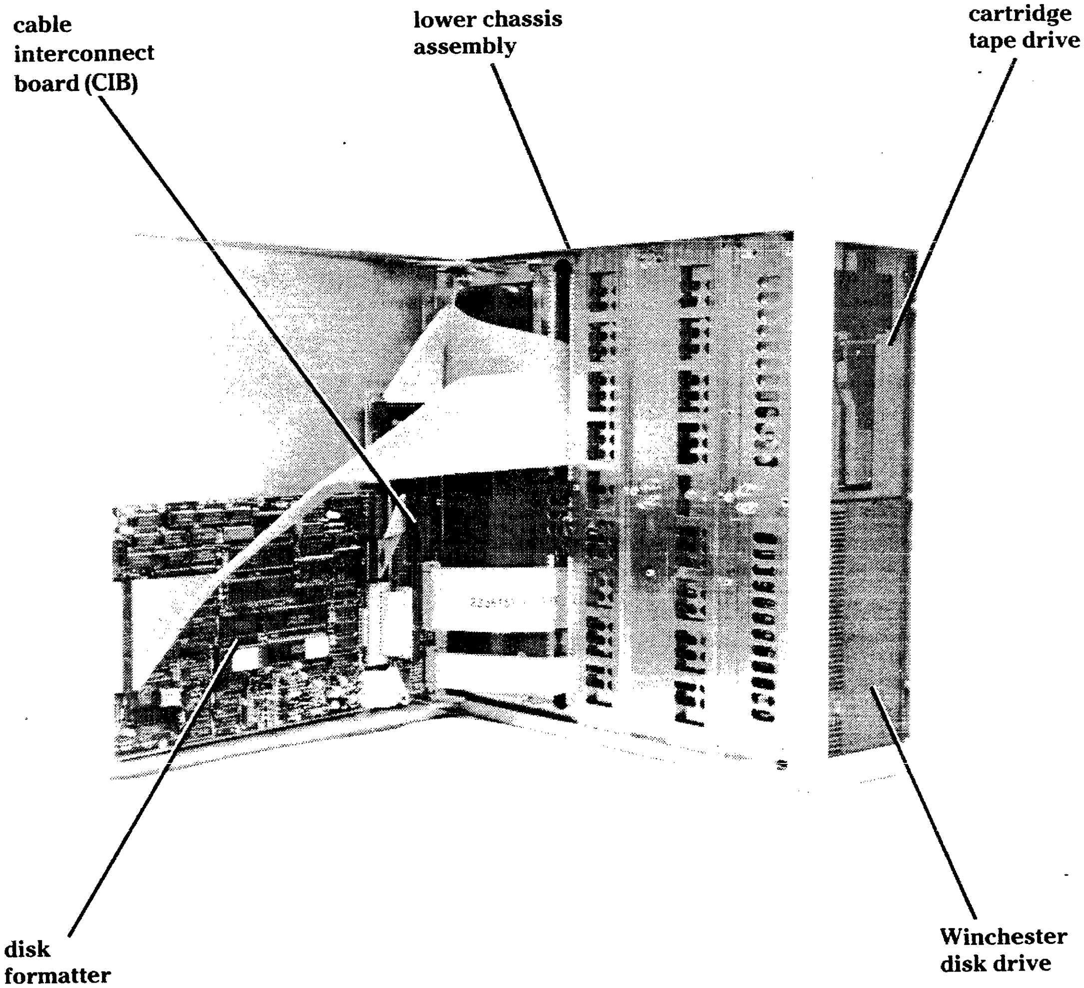
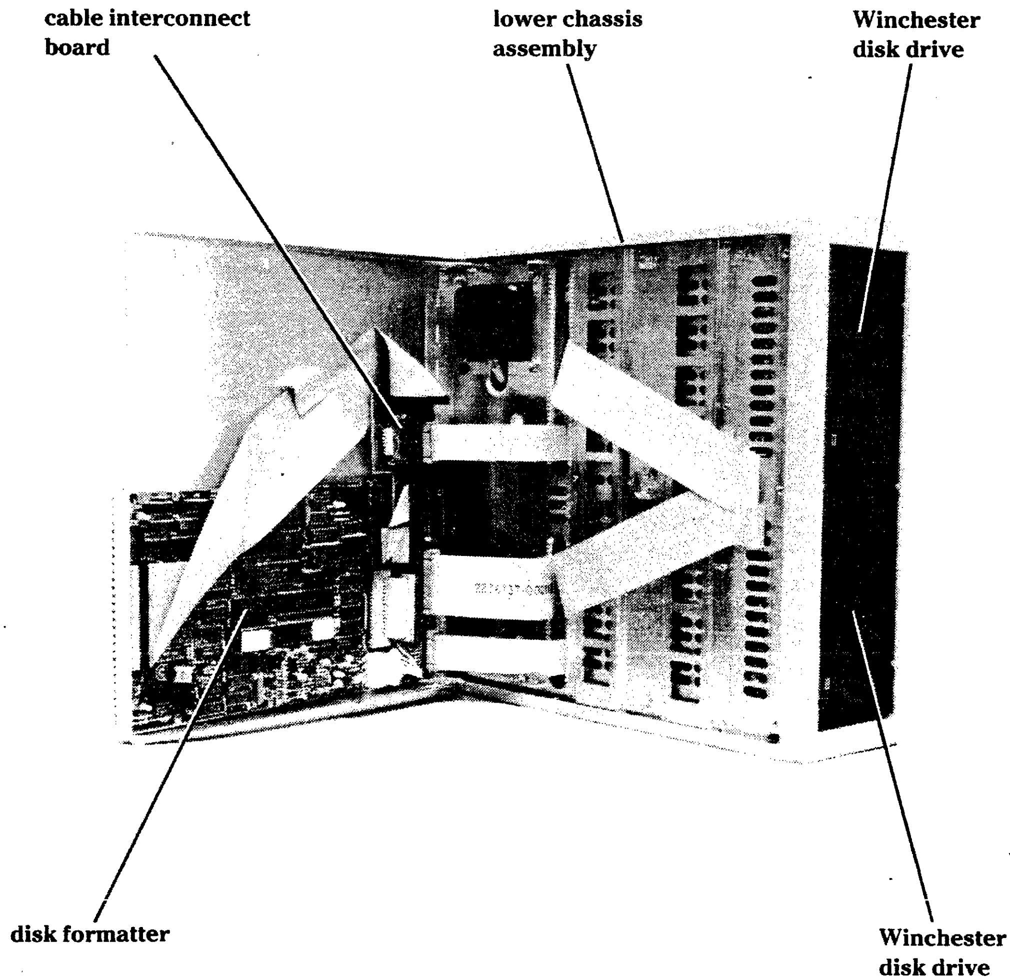


Figure 1-17 Mass Storage Enclosure — Internal View With Two Disk Drives



Bus Descriptions

1.6 General information on NuBus and local bus operation, signal definitions, and connector pin number assignments is given in the following paragraphs. Refer to the *Explorer 7-Slot System Enclosure General Description* manual for detailed information on the operation of the NuBus. Refer to the Memories part of this manual for information on local bus operation and the relationship between the local bus and the NuBus for the Explorer memory board.

NuBus Signals

1.6.1 The NuBus is a high-speed synchronous bus that multiplexes 32-bit data words with 32-bit address codes. It has control signals that allow circuit boards on the NuBus to be master or slave devices over the bus. Arbitration signals give each device on the bus an equal share of the bus bandwidth. A 4-bit identification code allows the insertion of circuit boards into any unrestricted slot without installing any jumpers or setting any switches to identify the slot.

Table 1-1 provides definitions for each of the NuBus signals. Table 1-2 lists the NuBus connector P1 signals and associated pin numbers.

Table 1-1 **NuBus Signal Definitions**

Signal Signature	***Definition***
ICLK–	This clock signal originates at the system interface board. Its main function is to synchronize bus arbitration and data transfers between system modules on the NuBus. This clock signal has a nominal frequency of 10 megahertz with a duty cycle of 75 percent. In general, signals are changed at the rising edge of ICLK– and tested at the falling edge.
START–	This transfer start signal is asserted for only one clock period by the memory board bus master at the beginning of a data transfer operation. START– indicates to the slaves on the NuBus that the address/data signals are carrying a valid address.
ACK–	This transfer acknowledge signal is asserted for one clock period by the memory board when it is a slave to the NuBus. ACK– indicates the completion of a data transfer operation to the memory board from the NuBus.
TM0–, TM1–	These transfer mode signals are asserted by the memory board bus master during start cycles to indicate the type of data transfer being started. These signals are also asserted during acknowledge cycles by the memory board when it is a slave to the NuBus to indicate the type of acknowledgment sent to modules on the NuBus.

Table 1-1 **NuBus Signal Definitions (Continued)**

Signal Signature	*Definition*
RESET–	The reset signal has two functions determined by its interval. When RESET– is asserted for a single clock period, it causes the interface (bus reset) of all boards on the NuBus to be initialized. When RESET– is asserted for more than one clock period, it returns all boards on the NuBus to their initial power-up state (system reset).
AD0–, AD1–	These address signals carry address information during the start cycle of a byte transfer. AD0– and AD1– carry control information during the start cycle of a word or halfword transfer.
AD(31:00)–	These NuBus address/data signals are multiplexed to carry a 32-bit address at the start of a cycle and a 32-bit data code during the remainder of the cycle. Signals AD(31:00)– can be generated by any master on the NuBus, including the memory board.
RQST–	This bus request signal is asserted by any master on the NuBus that wants control of the bus. The memory board can assert this signal when it is a NuBus master.
ARB(3:0)–	These signals form an arbitration binary code that is used by the distributed arbitration logic to determine which component is the NuBus master. Signal code ARB(3:0)– can be generated by any master on the NuBus, including the memory board.
ID(3:0)–	These signals form a slot identification binary code that is used to identify each board by slot location. The ID(3:0)– lines are wired to ground on the backplane to provide a separate code for each of the slots 0 through 15.
SP–, SPV–	These system parity signals are used by some modules on the NuBus. They are not used by the Explorer memory board.

Table 1-2

NuBus Connector P1 Signals

Connector Pin No.	*Row C*	*Signal*	*Row B*	*Signal*	*Row A*	*Signal*
1	(65)	RESET–	(33)	–12V	(01)	–12V
2	(66)	GND	(34)	GND	(02)	GND
3	(67)	+5V	(35)	GND	(03)	SPV–
4	(68)	+5V	(36)	+5V	(04)	SP–
5	(69)	TM0–	(37)	+5V	(05)	TM1–
6	(70)	AD0–	(38)	+5V	(06)	AD1–
7	(71)	AD2–	(39)	+5V	(07)	AD3–
8	(72)	AD4–	(40)	–5V	(08)	AD5–
9	(73)	AD6–	(41)	–5V	(09)	AD7–
10	(74)	AD8–	(42)	–5V	(10)	AD9–
11	(75)	AD10–	(43)	–5V	(11)	AD11–
12	(76)	AD12–	(44)	GND	(12)	AD13–
13	(77)	AD14–	(45)	GND	(13)	AD15–
14	(78)	AD16–	(46)	GND	(14)	AD17–
15	(79)	AD18–	(47)	GND	(15)	AD19–
16	(80)	AD20–	(48)	GND	(16)	AD21–
17	(81)	AD22–	(49)	GND	(17)	AD23–
18	(82)	AD24–	(50)	GND	(18)	AD25–
19	(83)	AD26–	(51)	GND	(19)	AD27–
20	(84)	AD28–	(52)	GND	(20)	AD29–
21	(85)	AD30–	(53)	GND	(21)	AD31–
22	(86)	GND	(54)	GND	(22)	GND
23	(87)	GND	(55)	GND	(23)	GND
24	(88)	ARB0–	(56)	–5V	(24)	ARB1–
25	(89)	ARB2–	(57)	–5V	(25)	ARB3–
26	(90)	ID1–	(58)	–5V	(26)	ID0–
27	(91)	ID2–	(59)	–5V	(27)	ID3–
28	(92)	START–	(60)	+5V	(28)	ACK–
29	(93)	+5V	(61)	+5V	(29)	+5V
30	(94)	+5V	(62)	GND	(30)	RQST–
31	(95)	GND	(63)	GND	(31)	GND
32	(96)	ICLK–	(64)	+12V	(32)	+12V

Local Bus Signals

1.6.2 The local bus is a high-speed synchronous bus that provides separate paths for the 32-bit data words and 32-bit address codes. The local bus provides a high-speed interface between the processor board, system interface board and memory boards. Control signals are provided on the local bus that allow the processor board to become a NuBus master by way of the memory board. The local bus is always a slave to the processor board and the system interface board.

Table 1-3 provides definitions for each of the local bus signals. Table 1-4 lists the local bus connector P2 signals and associated pin numbers. Refer to the Memories part of this manual for more details on the operation of the local bus.

Table 1-3 **Local Bus Signal Definitions**

Signal Signature	*Definitions*
BCLK	This signal is generated by the processor board on the local bus. It is a 50 percent duty cycle signal used on the memory board to generate other clock signals. BCLK has a frequency range of 7 to 10 megahertz. If the BCLK block signal is absent, each memory board will regenerate a 50 percent duty cycle BCLK clock from the NuBus clock. The NuBus clock signal is used for all the circuits on the memory board that are related to the NuBus. The BCLK signal is the clock for all the circuits on the memory board that are not related to the NuBus.
MEMREQ–	This memory request signal is generated by the processor on the local bus. When MEMREQ– is asserted, it tells the memory board that a memory cycle is required. MEMREQ– is checked on the rising edge of the local bus clock.
MEMACK–	This memory acknowledge signal is generated by the memory board. When MEMACK– is asserted, it tells the processor on the local bus that the current memory cycle will be completed on the next rising edge of the local bus clock.
BERR–	This bus error signal is generated by the memory board. When BERR– is asserted, it tells the processor on the local bus that an error was detected during the data transfer.
LAD(31:00)–	These 32-bit address signals are generated by the processor on the local bus.
DAT(31:00)–	These 32-bit data signals can originate at the processor on the local bus, the memory board, or any master on the NuBus.
LTM0–, LTM1–	These local bus transfer mode signals are generated by the processor on the local bus. LTM0– and LTM1– are used with LAD00– and LAD01– to form a 4-bit binary code that tells the memory board the type of transfer mode the processor is requesting. The transfer modes that are available on the local bus are read and write words, halfwords, or bytes.
BS0–	This local bus select signal is generated by the processor on the local bus. BS0– is a line from the processor that is wired to only one of the memory boards. When BS0– is asserted, it tells the specific memory board to which it is wired that that board is the NuBus master.

Table 1-3 **Local Bus Signal Definitions (Continued)**

Signal Signature	Definitions
DECODE–	This decode signal is generated by the memory board. Any memory board currently accessed by the local bus asserts the DECODE– signal. The NuBus master on the memory board uses this signal to determine if any memory board is being accessed by the local bus. If the local bus is not accessing any memory board, the NuBus master on the memory board can access the NuBus and complete a memory cycle.
FAST–	This signal is generated by the processor on the local bus. When FAST– is asserted, it tells the memory board that an Explorer processor is present on the local bus. If a processor other than an Explorer processor is on the local bus, FAST– cannot be asserted.
LOCK–	This signal is generated by the processor on the local bus. When LOCK– is asserted, it tells the memory board that is currently being accessed that the on-board memory resource is locked and cannot be accessed by the NuBus. When locked, the memory board stays locked until LOCK– is negated or unasserted.
FACTEST–	This signal is used for factory test. When FACTEST– is asserted, the read and write parity bits, PEEKIN(3:0) and PEEKOUT(3:0), are available at connector P3.

Table 1-4 **Local Bus Connector P2 Signals**

Connector Pin No.	Row C	Signal	Row B	Signal	Row A	Signal
1	(65)	DAT00–	(33)	LTM0–	(01)	AD00–
2	(66)	DAT01–	(34)	GND	(02)	AD01–
3	(67)	DAT02–	(35)	GND	(03)	AD02–
4	(68)	DAT03–	(36)		(04)	AD03–
5	(69)	DAT04–	(37)	+5V	(05)	AD04–
6	(70)	DAT05–	(38)	+5V	(06)	AD05–
7	(71)	DAT06–	(39)	FACTEST–	(07)	AD06–
8	(72)	DAT07–	(40)		(08)	AD07–
9	(73)	DAT08–	(41)	MEMREQ–	(09)	AD08–
10	(74)	DAT09–	(42)	LOCK–	(10)	AD09–
11	(75)	DAT10–	(43)		(11)	AD10–
12	(76)	DAT11–	(44)	GND	(12)	AD11–
13	(77)	DAT12–	(45)	BS0–	(13)	AD12–
14	(78)	DAT13–	(46)	MEMACK–	(14)	AD13–
15	(79)	DAT14–	(47)		(15)	AD14–
16	(80)	DAT15–	(48)	GND	(16)	AD15–
17	(81)	DAT16–	(49)		(17)	AD16–

Table 1-4 **Local Bus Connector P2 Signals (Continued)**

Connector Pin No.	*Row C*	*Signal*	*Row B*	*Signal*	*Row A*	*Signal*
18	(82)	DAT17–	(50)		(18)	AD17–
19	(83)	DAT18–	(51)	GND	(19)	AD18–
20	(84)	DAT19–	(52)		(20)	AD19–
21	(85)	DAT20–	(53)	BCLK	(21)	AD20–
22	(86)	DAT21–	(54)	BERR–	(22)	AD21–
23	(87)	DAT22–	(55)	GND	(23)	AD22–
24	(88)	DAT23–	(56)	FAST–	(24)	AD23–
25	(89)	DAT24–	(57)		(25)	AD24–
26	(90)	DAT25–	(58)	DECODE–	(26)	AD25–
27	(91)	DAT26–	(59)		(27)	AD26–
28	(92)	DAT27–	(60)	+5V	(28)	AD27–
29	(93)	DAT28–	(61)		(29)	AD28–
30	(94)	DAT29–	(62)	GND	(30)	AD29–
31	(95)	DAT30–	(63)	GND	(31)	AD30–
32	(96)	DAT31–	(64)	LTM1–	(32)	AD31–

NOTES:

The FACTEST– signal is +5V on the NuBus, and has the name SPARE1 on the backplane.

The FAST– signal has the name SLCL– on the backplane.

Configuration ROM Description

1.7 The configuration read-only memory (ROM) data resides in the top part of the on-board control address space. The configuration ROM data is accessed by addresses FSFFFFFF to FSFFE000. The S designation in each address is a four-bit code that identifies the slot that a circuit board occupies. Table 1-5 shows the general contents of the configuration ROM.

All data in the configuration ROM is addressed in byte 0 on address/data lines AD(07:00). This is the reason there are four byte addresses between each byte address of the ROM. Configuration ROM values for different boards are similar for many addresses, but there are differences from board to board. Refer to individual parts of this manual dealing with specific boards for these differences.

Table 1-5 Configuration ROM Contents

Item	*Hexadecimal Address*	*Contents Description*
Serial number (corresponds to the bar code markings)	FSFFFFFC	Contains the week of manufacture expressed by 2 binary coded decimal characters from 01 through 52.
	FSFFFFF8	Contains the year of manufacture expressed by 1 ASCII character from 3 (for 1983) through 9 (for 1989) and A (for 1990) through Z (for 2010), omitting letters G, I, J, O, and Q.
	FSFFFFF4 FSFFFFF0 FSFFFFEC	Contains a site identification code expressed by 3 ACSII characters, omitting letters G, I, J, O, and Q. The most significant character (as A in AUS) is located in the higher address.
	FSFFFFE8 FSFFFFE4 FSFFFFE0	Contains a sequence number that identifies all the assemblies built in one week expressed as a right justified 5-character hexadecimal code
	FSFFFFDC	Contains a weighted check sum of the 11 numeric digits in the above 8 bytes expressed by 2 hexadecimal characters derived as follows: Convert each digit to a weighted number (Y1 through Y11) and calculate the check sum using the formula (1 ×Y1)+(2 ×Y2) . . . (11 ×Y11)/31 to get a remainder from 0 to 30. The character with that weighted number is the check character.

Character—Weighted Number

0—0	8—8	H—16	T—24
1—1	9—9	K—17	U—25
2—2	A—10	L—18	V—26
3—3	B—11	M—19	W—27
4—4	C—12	N—20	X—28
5—5	D—13	P—21	Y—29
6—6	E—14	R—22	Z—30
7—7	F—15	S—23	

Item	*Hexadecimal Address*	*Contents Description*
Configuration ROM revision levels	FSFFFFD8 through FSFFFFC4 FSFFFFC0	Contains 7 ASCII characters. The original release is at FSFFFFC0, the first revision is at FSFFFFC4, and the sixth revision is at FSFFFFD8. If there is no revision letter, an * is inserted. The revision level is always treated as a two character field. For example: The original release is at C0 and C0 (**) The first revision is at C0 and C4 (*A) The sixth revision is at C0 and D8 (*F)
CRC signature	FSFFFFBC FSFFFFB8	Contains 4 hexadecimal characters that represent the CRC signature. The most significant character (MSC) is at FSFFFFBC.
Configuration ROM size	FSFFFFB4	Contains a weighted log2 value that represents the configuration ROM size in bytes.

Table 1-5 Configuration ROM Contents (Continued)

Item	*Hexadecimal Address*	*Contents Description*
Vendor ID	FSFFFFB0 through FSFFFFA4	Contains 4 ASCII characters. TIAU indicates TI Austin. LMI indicates Lisp Machine Inc. The leftmost character is at FSFFFFA4.
Memory board information (bytes 3–7)	FSFFFFA0 (byte 7)	Contains a weighted log2 value of the displacement in K bytes from FS000000. The hexadecimal value FF indicates a base register is present.
	FSFFFF9C (byte 6)	Contains hexadecimal 00.
	FSFFFF98 (byte 5)	Contains a weighted log2 value of the individual blocks of noncontiguous memory.
	FSFFFF94 (byte 4)	Contains a weighted log2 value of the size of the gap between noncontiguous blocks of memory. Hexadecimal FF indicates irregular gaps.
	FSFFFF90 (byte 3)	Contains a weighted log2 value of the size of memory. Hexadecimal FF indicates the memory size is not defined.
Processor board information (bytes 3–7)	FSFFFFA0 (byte 7)	Contains the most significant bits of the processor type code.
	FSFFFF9C (byte 6)	Contains the least significant bits of the processor type code. The Explorer processor code is hexadecimal 00; the 68010 processor code is hexadecimal 01. Additional codes can be added.
	FSFFFF98 (byte 5)	Contains hexadecimal 00.
	FSFFFF94 (byte 4)	Contains a weighted log2 value of the size of on-board cache memory. Hexadecimal 00 indicates no cache memory is present.
	FSFFFF90 (byte 3)	Contains a weighted log2 value of the size of on-board memory. Hexadecimal FF indicates the size is not defined.
NUPI board information (bytes 3–7)	FSFFFFA0 (byte 7)	Contains hexadecimal 00.
	FSFFFF9C (byte 6)	Contains hexadecimal 00.
	FSFFFF98 (byte 5)	Contains hexadecimal 00.
	FSFFFF94 (byte 4)	Contains hexadecimal 00.
	FSFFFF90 (byte 3)	Contains a weighted log2 value of the size of the buffer.

Table 1-5 Configuration ROM Contents (Continued)

Item	*Hexadecimal Address*	*Contents Description*
Board type (bytes 0, 1, 2)	FSFFFF8C FSFFFF88 FSFFFF84	Contains 3 ASCII characters: MEM (memory), CPU (processor), NPI (NuBus peripheral interface), and NEC (NuBus Ethernet controller). The leftmost character is at FSFFFF84.
Part number of memory board	FSFFFF80 through FSFFFF44	Contains 16 ASCII characters that indicate a full part number, right justified with zero fill on the left. The leftmost character is at FSFFFF44. An example is 00002243910-0002.
Configuration register offset	FSFFFF40 FSFFFF3C FSFFFF38	Contains 6 hexadecimal characters. The address is FS000000 plus offset. The MSC is at FSFFFF40.
Device driver offset	FSFFFF34 FSFFFF30 FSFFFF2C	Contains 6 hexadecimal characters. The address is FS000000 plus offset. The MSC is at FSFFFF34.
Diagnostic offset	FSFFFF28 FSFFFF24 FSFFFF20	Contains 6 hexadecimal characters. The address is FS000000 plus offset. The MSC is at FSFFFF28.
Flag register offset	FSFFFF1C FSFFFF18 FSFFFF14	Contains 6 hexadecimal characters. The address is FS000000 plus offset. The MSC is at FSFFFF1C.
ROM flag	FSFFFF10	Contains 8 binary bits that identify the following system information: Bit 0 — 1 = Does self-test 0 = Does not do self-test Bit 1 — 1 = Does NuBus tests 0 = Does not do NuBus tests Bit 2 — 1 = Can be master 0 = Cannot be master Bit 3 — 1 = Has block support 0 = Has no block support Bit 4 — 1 = Has system memory 0 = Has no system memory Bit 5 — 1 = Needs a power failure warning event 0 = No warning event required Bit 6 — Reserved Bit 7 — Reserved

Table 1-5 Configuration ROM Contents (Continued)

Item	*Hexadecimal Address*	*Contents Description*
Layout byte	FSFFFF0C	Contains 2 hexadecimal characters that indicate the configuration ROM revision level.
Test time	FSFFFF08	Contains 2 hexadecimal characters that represent a weighted log2 value. This is the extended self-test time limit in seconds. The standard self-test executes in 20 seconds or less. The standard self-test for STBM executes in 10 seconds or less.
ID byte	FSFFFF04	Contains hexadecimal characters C3, which is a known value for the configuration ROM verification.
Resource type	FSFFFF00	Contains 8 binary bits that identify resources by the bits that are set to 1 as follows: Bit 0 — Memory Bit 1 — Boot source Bit 2 — LAN Bit 3 — Monitor Bit 4 — Bootable processor Bit 5 — Keyboard Bit 6 — Nonvolatile RAM (NVRAM) Bit 7 — Sub-boards (auxiliary boards)
NVRAM offset	FSFFFEFC FSFFFEF8 FSFFFEF4	Contains 6 hexadecimal characters that represent the address of the NVRAM. The address is FS000000 plus offset. The MSC is at FSFFFEFC.
NVRAM size	FSFFFEF0	Contains 1 hexadecimal character that represents a weighted log2 value of the NVRAM size.
Event offset	FSFFFEEC FSFFFEE8 FSFFFEE4	Contains 6 hexadecimal characters that represent the address of event location. The address is FS000000 plus offset. The MSC is at FSFFFEEC.
STBM event offset	FSFFFEE0 FSFFFEDC FSFFFED8	Contains 6 hexadecimal characters that represent the address of the event to be used by a secondary processor during boot operations. The address is FS000000 plus offset. The MSC is at FSFFFEE0.
Restart event offset	FSFFFED4 FSFFFED0 FSFFFECC	Contains 6 hexadecimal characters that represent the address of a non-maskable event. The address is FS000000 plus offset. The MSC is at FSFFFED4.

Table 1-5 Configuration ROM Contents (Continued)

Item	*Hexadecimal Address*	*Contents Description*
Sub-board base address	FSFFFEC8 through FSFFFEAC	Contains 8 hexadecimal characters that represent sub-boards 0 through 7. Sub-board 0 is at address FSFFFEAC. Each sub-board address is at FS000000 plus the sub-board base number.
Self-test code and reserved space	FSFFFEA8 through FSFFFE00	Contains the self-test code used on some Explorer circuit boards in addition to reserved space for future system requirements.

NOTE:

A weighted log2 value is a coding scheme in which the most significant digit is a hexadecimal mantissa (M) and the least significant digit is an exponent (E) to the base 2. The value is M*(2**E).

System Specifications

1.8 Table 1-6 lists the Explorer system specifications.

Table 1-6 Explorer System Specifications

Item	*Specification*
Power requirements:	
Voltage/frequency	90 to 132 Vac, 47 to 63 Hz 180 to 264 Vac, 47 to 63 Hz
Power (maximum)	
System enclosure	610 VA
Mass storage enclosure with two drives	181 VA
Display unit	60 VA
Auxiliary receptacles	850 VA
Ambient temperature:	
Operating	10° to 35° C (50° to 95° F)
Nonoperating	−40° to 65° C (−40° to 149° F)

Table 1-6 **Explorer System Specifications (Continued)**

Item	*Specification*
Relative humidity:	
Operating	20 to 80% noncondensing
Nonoperating	5 to 95% noncondensing
Atmospheric pressure (altitude):	
Operating	−300 to 2000 m (−1000 to 6500 ft)
Nonoperating	−300 to 3000 m (−1000 to 10 000 ft)
Shock:	
Operating	10 g for 11 ms
Nonoperating	20 g for 11 ms
Vibration:	
Operating	0.5 g rms, random
Nonoperating	0.75 g rms, random
Electrostatic discharge:	
Operating	15 kV failure 8 kV failure (operator intervention)
Nonoperating	15 kV failure
Acoustic noise	50 dBA
Air conditioning load (fully loaded Explorer chassis)	610 W (2100 Btu/hr)
Dimensions:	
Three-high Eurocard boards	366.7 mm (14.437 in) wide 280 mm (11.024 in) deep 18.11 mm (0.714 in) maximum thickness with components
System enclosure	330 mm (13 in) wide 457 mm (18 in) deep 635 mm (25 in) high
Display monitor	439 mm (17 in) wide 411 mm (16 in) deep 508 mm (20 in) high
Mass storage enclosure	333 mm (13 in) wide 384 mm (15 in) deep 133 mm (5.2 in) high

Table 1-6 **Explorer System Specifications (Continued)**

Item	*Specification*
Weight:	
System enclosure	26 kg (58 lb) without boards 39 kg (85 lb) with boards
Display unit (includes keyboard and mouse)	18.5 kg (41 lb) 20 kg (44 lb) with anti-glare screen
Mass storage enclosure	16 kg (35 lb) with two disk drives
Logic states:	
Unasserted (high false) Asserted (low true)	>2.0 V at the receiver <0.8 V at the receiver
Local bus clock frequency	7 to 10 MHz (processor determined)
NuBus clock frequency	10 MHz
Electromagnetic emissions	Complies with FCC level A, EMI/RFI office emission requirements

EXPLORER SUBSYSTEM DESCRIPTIONS 2

Highlights of This Section

- Explorer system block diagram
- Power input subsystem
- Display unit subsystem
- Mass storage subsystem
- Ethernet subsystem

Introduction

2.1 A block diagram of the Explorer system is shown in Figure 2-1. The Explorer system has a backplane that provides interconnections between the system power supply and the NuBus, local bus, and I/O connectors. There are seven slots on the backplane, numbered 0 through 6, that are provided for the system circuit boards. A special isolated slot is provided for the system power supply board.

For the purpose of explanation, the Explorer system can be divided into four subsystems. These subsystems are illustrated in Figure 2-1 in the following manner:

- Power input subsystem — The motor power supply block and all of the blocks directly related to it.
- Display unit subsystem — The fiber-optic cable and all of the blocks directly related to it.
- Mass storage subsystem — The peripheral cable adapter and mass storage enclosure block(s).
- Ethernet subsystem — The Ethernet adapter and transceiver blocks.

There are two part numbers shown for the memory boards. Part number 2236414 is an early version of the memory board, and is being replaced by part number 2243910.

The Explorer processor is a two-board assembly, part number 2243881. This assembly consists of a three-high Eurocard, part number 2236410, and an auxiliary board, part number 2236405. These two boards should not be separated in the field due to the large number of connector pins between the boards.

Power Input Subsystem

2.2 Power is distributed to the fan transformer, the fan motor, the two ac receptacles, and the system power supply by the motor power supply shown in Figure 2-2. The high/low switch controls the input connections to the fan transformer and the center tap input to the system power supply for ac power input voltages of 120 volts (low) or 220/240 volts (high). The output of the fan transformer is approximately 50 volts dc at test point TP4 with either 120 volts ac or 220/240 volts ac input to the transformer. Fuse F1 is the main power fuse. Fuse F2 branches off from fuse F1 and provides protection for the ac voltage input to the fan transformer. The electronics on the motor power supply provide speed control for the fan.

Figure 2-1 Typical Explorer System Block Diagram

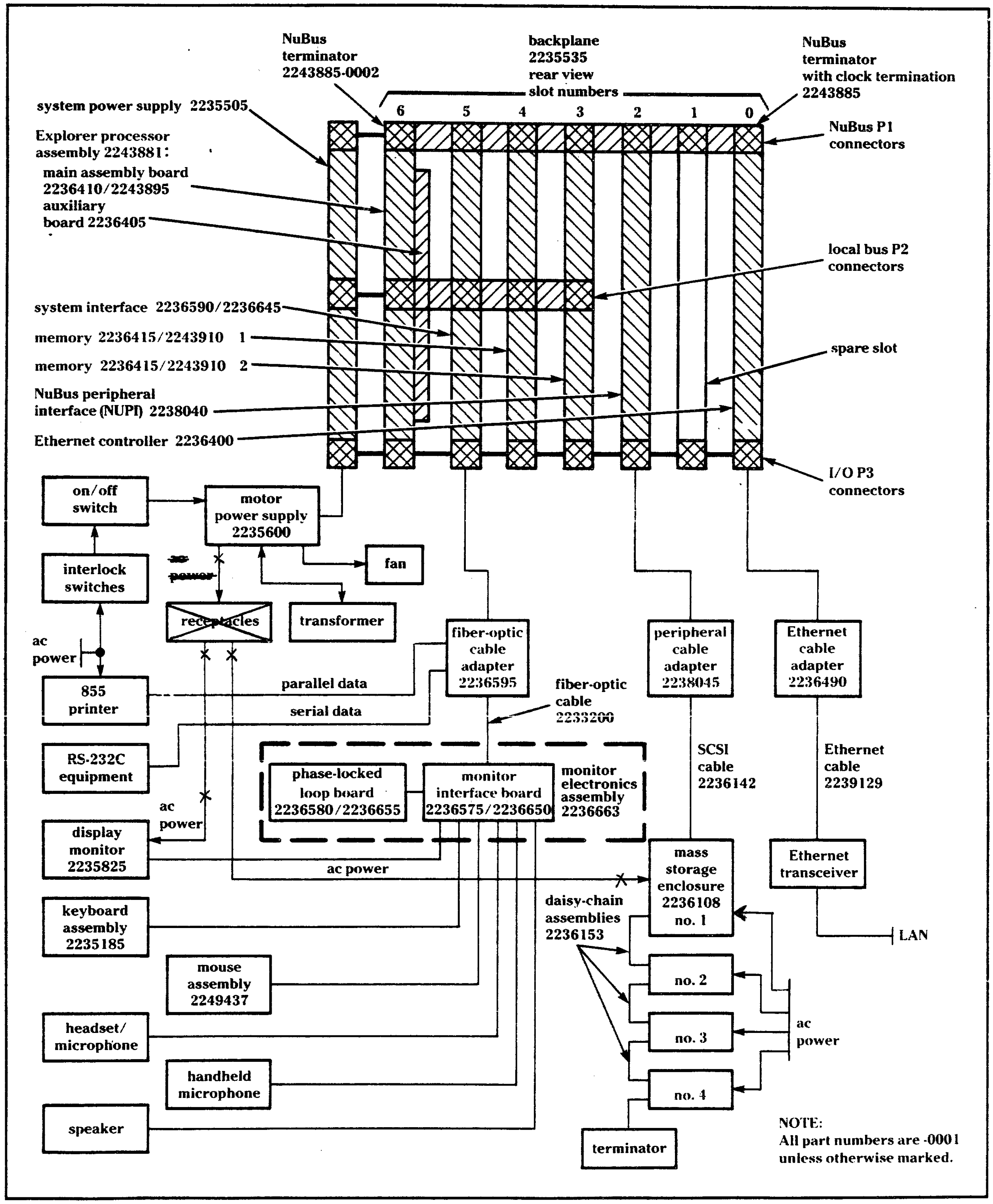
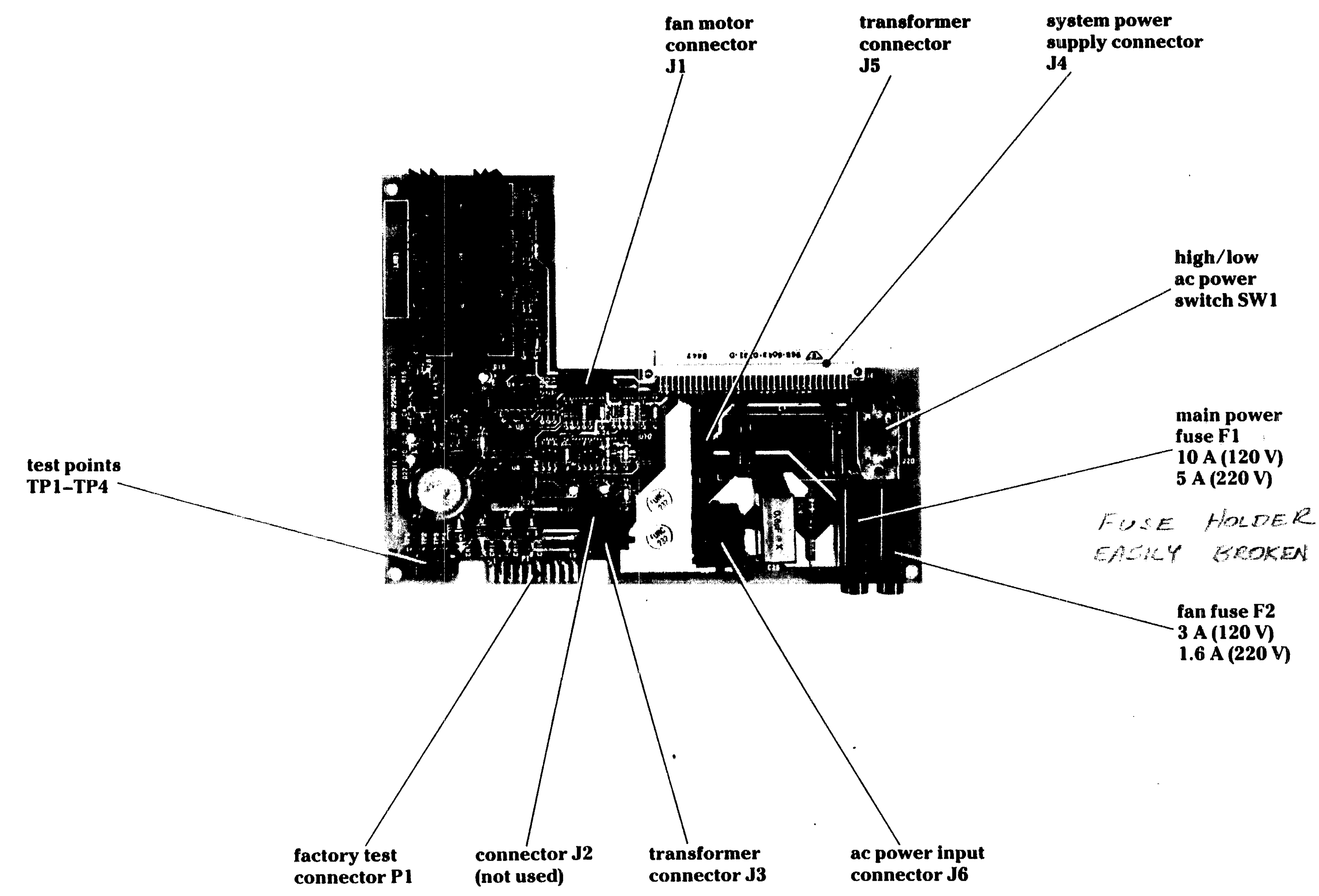


Figure 2-2 Motor Power Supply



The ac and dc power distribution for the entire Explorer enclosure is shown in Figure 2-3. The system power supply generates the following voltages and control signals:

- +12, −12, −5, and +5 volts dc
- Power failure warning pulse (PFWP–)
- Reset (RESET–)
- Temperature (TEMP–)
- Temperature sensor (TS)

The system power supply also contains earth ground lamp DS1, 5-volt LED CR28, and fan sensor RT3. The earth ground sensor is lit when the ac power input earth ground is connected to the system power supply. This safety feature indicates that all metal chassis components are at earth ground. The 5-volt LED is lit when +5 volts are generated at the system power supply.

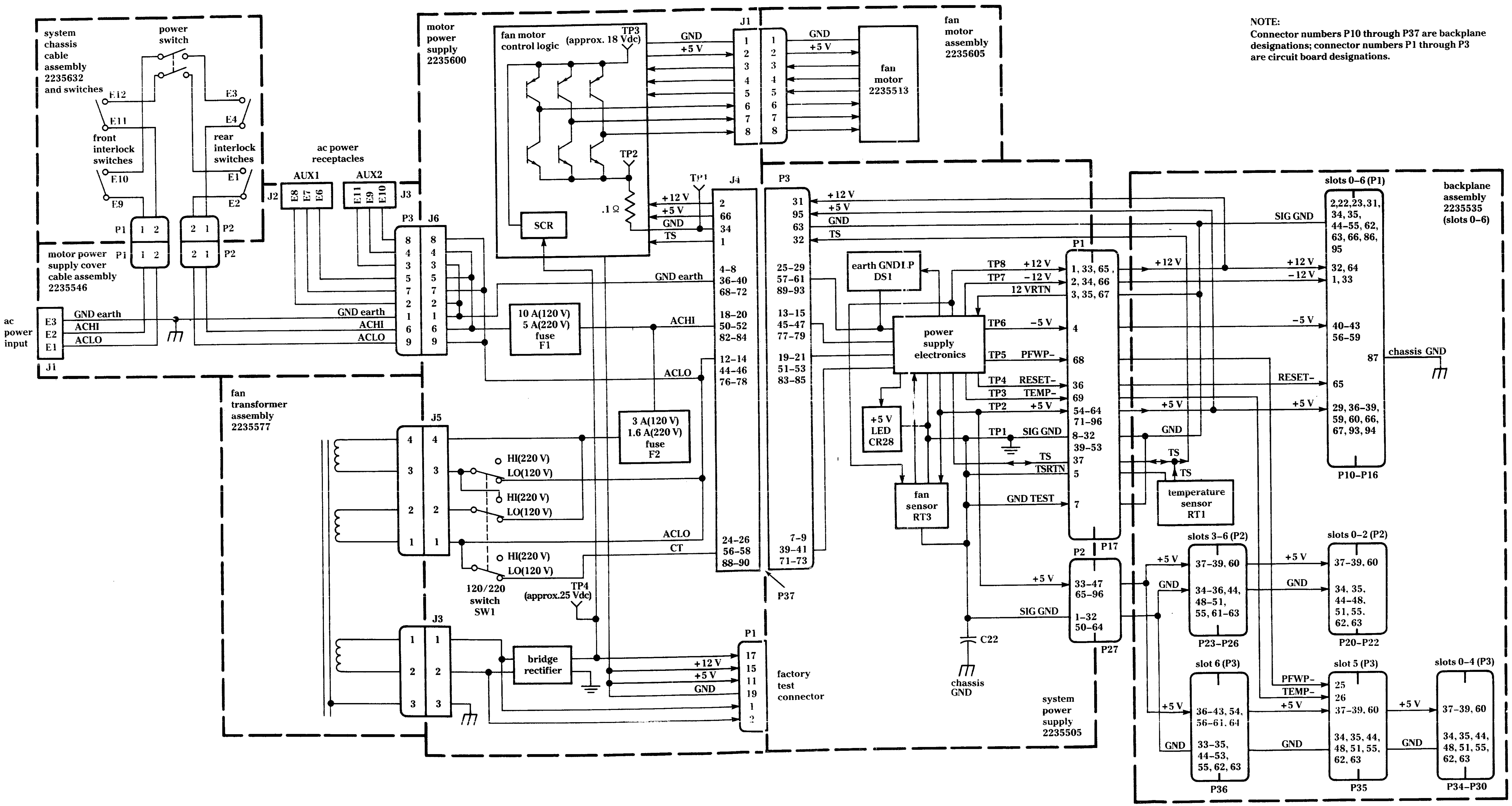
WARNING: Do not use neon lamp DS1 on the system power supply as an indication of a safe earth ground connection to the 7-slot system enclosure. Neon lamp DS1 only indicates that an unqualified earth ground path exists. Special instruments are required to determine if the earth ground connection is a a qualified safety ground.

Fan sensor RT3 monitors the airflow across the system power supply. Temperature sensor RT1, located on the backplane, monitors the ambient temperature for slots 0 through 5. Either sensor can control the speed of the fan motor and shut down all dc voltages generated at the system power supply if the power supply or backplane temperature gets too high. The temperature at sensor RT3 is controlled by a local heat source making RT3 very sensitive to changes in the quantity of airflow over the system power supply. If the airflow decreases, the temperature at RT3 immediately increases, and the output of RT3 increases the speed of the fan or shuts down all dc voltages.

The PFWP– signal provides an advanced power failure warning to the system interface board in slot 5 that dc power is going to fail. This gives the system a brief interval to save important data in battery-protected nonvolatile RAMs (NVRAMs) on the system interface board before the power fails. After the PFWP– signal is asserted, the RESET– signal is asserted and all dc voltages are shut down.

The TEMP– signal provides a warning to the system interface board that the temperature in the system enclosure is above normal but not high enough to shut the system down. This overtemperature warning information is used in the event generator logic on the system interface board to signal the processor board that there is an impending overtemperature condition.

Figure 2-3 Power Distribution Diagram



NOTE:
Connector numbers P10 through P37 are backplane designations; connector numbers P1 through P3 are circuit board designations.

Figure 2-3 shows the voltage distribution from the system power supply to the connectors in slots 0 through 6 on the backplane. Backplane connectors P10 through P16 are connected together to form the NuBus. The local bus is formed by backplane connectors P23 through P26. Backplane connectors P20 through P22 are wired for special optional equipment. The I/O connectors on the Eurocard circuit boards get power from backplane connectors P30 through P36. The two control signals PFWP– and TEMP– are connected through the backplane printed wiring from connector P17 to connector P35. Control signal TS, +12 volts, +5 volts, and signal ground are connected through the backplane from connector P17 to connector P37.

Display Unit Subsystem

2.3 The display unit subsystem consists of a fiber-optic cable adapter board (Figure 2-4) that is connected by a fiber-optic cable to the monitor electronics assembly (Figure 2-5) in the display monitor assembly. Figure 2-6 shows the display unit subsystem components connected together.

The optical adapter provides an interconnect point for pin matching between the system interface board, an RS-232C interface, and a parallel printer interface. Fiber-optic logic on the optical adapter interfaces to the fiber-optic cable. Provision is made for over-temperature (OT–) and power failure warning (PFWP–) signal inputs from circuit boards in other slots as an option.

The monitor electronics assembly provides a fiber-optic interface between the optical adapter and the synchronous amplifier board, mouse, keyboard, handheld microphone, headset with microphone, and speaker. A phase-locked loop board is part of the monitor electronics assembly. The phase-locked loop board maintains a stable synchronous frequency for proper operation of the fiber optics. The monitor interface board also contains a sound amplifier, a microphone preamplifier, a speaker amplifier, and a headset speaker amplifier.

Fiber-Optic Interface Operation

2.3.1 The fiber-optic cable adapter board and the monitor interface board contain similar fiber-optic logic in a nonmetallic connector on each board. The fiber-optic logic on each board consists of fiber-optic transmitters and receivers. The fiber-optic transmitters are light-emitting diodes (LEDs) that transmit light energy over the fiber-optic cable. The fiber-optic receivers are integrated detectors and preamplifiers that detect and amplify the light energy from the fiber-optic cable.

Figure 2-4   Fiber-Optic Cable Adapter With Cover Removed

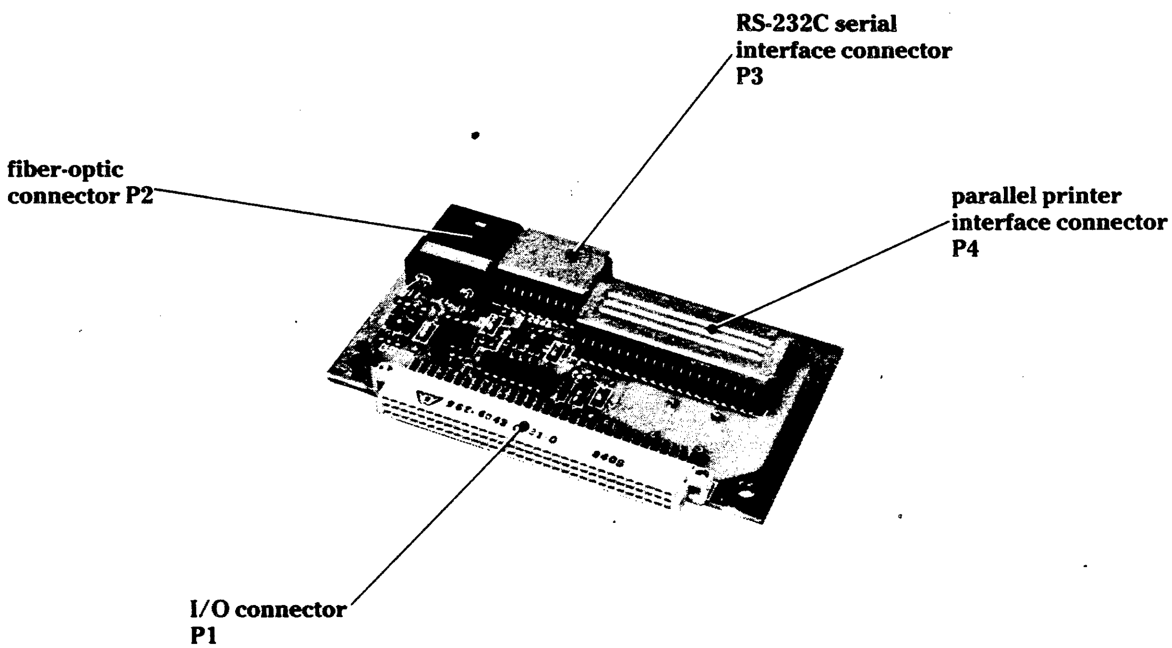


Figure 2-5 Monitor Electronics Assembly

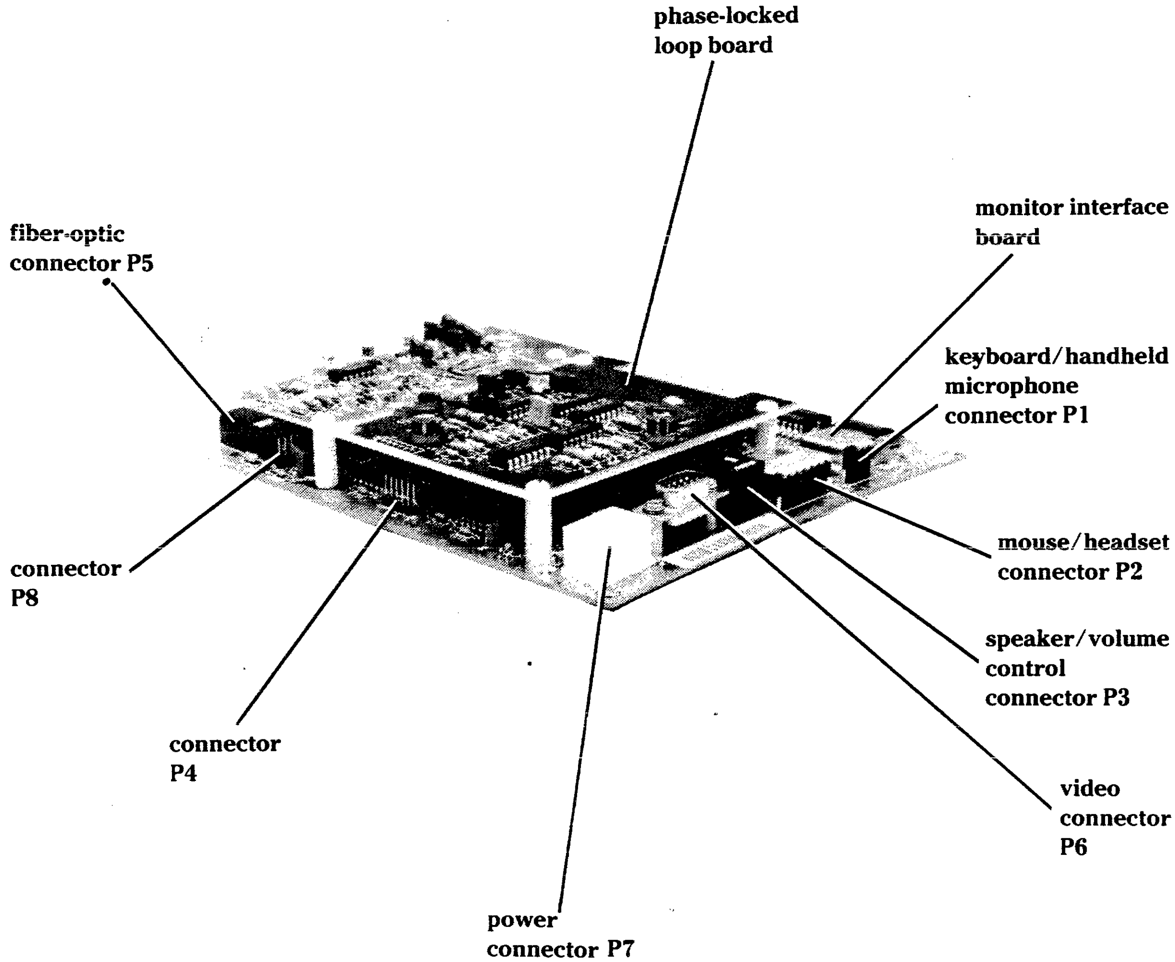
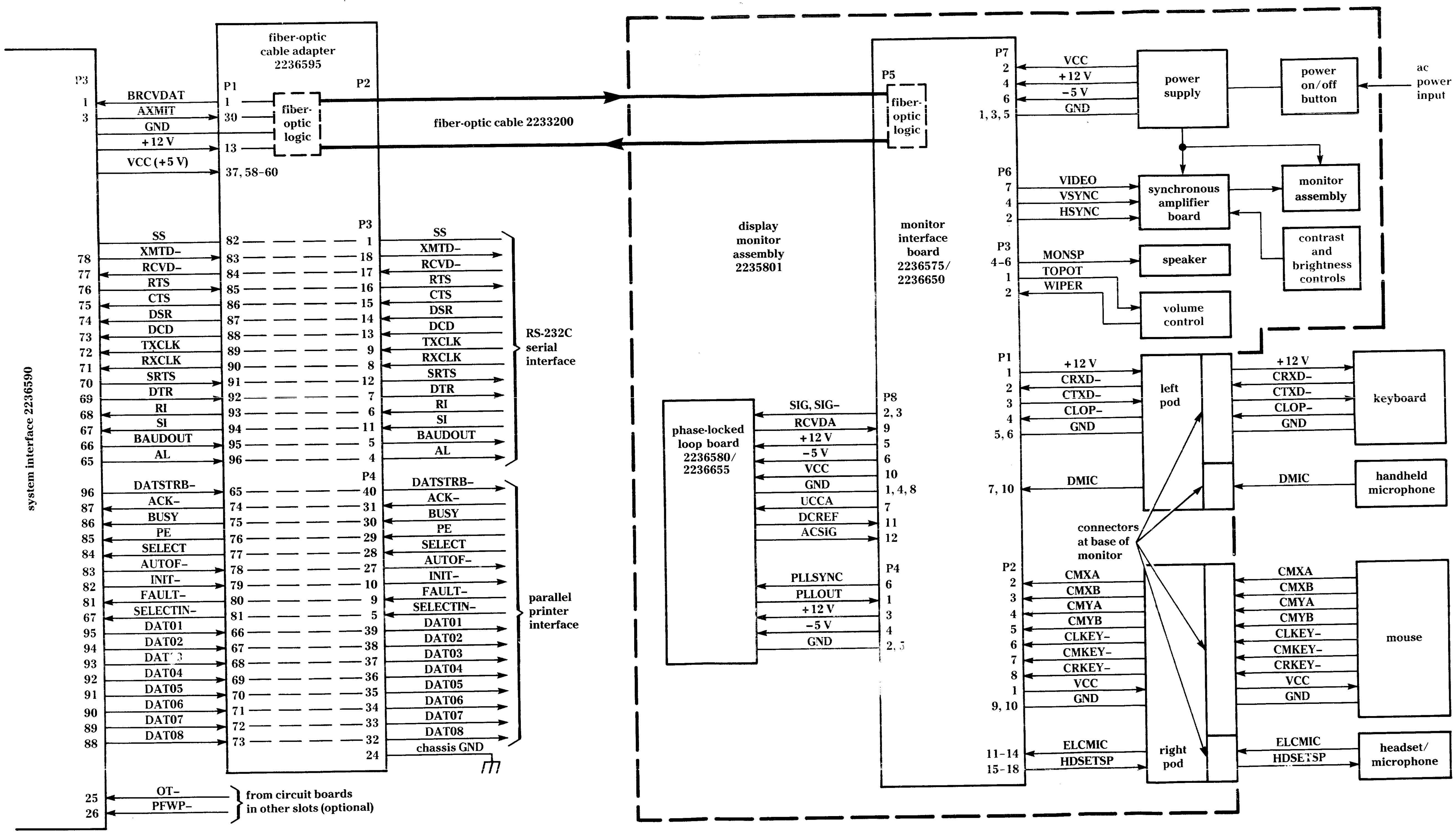


Figure 2-6 Display Unit Subsystem Interconnect Diagram



NOTE:
All part numbers are -0001 unless otherwise marked.

Keyboard Interface Operation

2.3.2 The keyboard output to the monitor interface board consists of an 11-bit, serial, 2400-baud data stream for each key operation. This data stream is a universal asynchronous receiver transmitted (UART) format. The data passes through keyboard logic and is then transmitted over the fiber-optic cable to the system interface board.

Keyboard input from the system interface board is required to operate the LEDs on the keyboard. For each LED, data is transmitted from the system interface board to the keyboard in the same manner as from the keyboard to the interface board. A loopback test circuit is provided on the monitor interface board which is used during self-test operations.

Mouse Interface Operation

2.3.3 The mouse output to the monitor interface board consists of four parallel lines for mouse movement and three parallel lines for mouse key outputs. The mouse motion data is in a quadrature format, with two waveforms to describe the X-axis motion and two waveforms to describe the Y-axis motion. The mouse contains two LEDs that shine light on the optical pad. This light reflects back to photodetectors in the mouse. The pad contains a checkerboard pattern that interrupts the reflected light as the mouse is moved over the pad. One LED generates the X-axis motion and the other LED generates the Y-axis motion as the mouse is moved over the pad.

Voice Interface Operation

2.3.4 The voice interface logic on the monitor interface board contains coder/decoder (codec) voice encoding logic and speech output logic. The voice encoding logic converts analog voice signals from a microphone to a digital data stream for use in the system interface board. The speech output logic converts a digital data stream from the system interface board to analog speech signals. The speech signals are amplified by the sound amplifier circuits to drive the speaker or a headset. The sound amplifier circuits can also produce a variety of complex tone forms programmable from the system interface board.

Mass Storage Subsystem

2.4 The peripheral cable adapter (Figure 2-7) provides an interconnect point for pin matching between the NUPI board 96-pin connector P3 and the small computer system interface (SCSI) 50-pin bus that interfaces with the mass storage enclosure. These connections are shown in Figure 2-8. There is a ground lead for every active signal lead in the SCSI bus. The SCSI bus consists of eight data bus signals (DB0– through DB7–), one data bus parity signal (DBP–), and nine control signals.

Figure 2-9 and Figure 2-10 show the cables that provide control and data connections between the components on the lower chassis assembly of the mass storage enclosure. The 50-pin SCSI bus cable connects to a connector at the rear of the mass storage enclosure. An identical connector is provided for a terminator or a daisy-chain connection between mass storage enclosures. Most internal connections in the mass storage enclosure are made through the cable interconnect board (CIB). These internal connections are indicated by dashed lines on the CIB. The CIB also contains control logic that generates the READY, write fault (WRFAULT–), and write gate (WRGATE–) signals for the disk drive formatter.

The lower chassis assembly has a hinge that permits the chassis assembly to open into a top section and a bottom section. The disk formatter and the CIB are mounted inside the lower chassis assembly on the bottom section. The storage devices (disk and/or tape drives) are mounted outside the lower chassis assembly on the top section. The formatter for the tape drive is mounted on the tape drive.

The CIB has a chassis ground jumper that connects chassis ground to signal ground when the jumper is connected between terminals E1 and E2. Chassis ground and signal ground are not connected together when the jumper is connected between terminals E2 and E3. Chassis ground should be connected to signal ground in the first mass storage enclosure and be left open in all other mass storage enclosures. This jumper arrangement prevents ground loops between enclosures.

SCSI Bus Operation

2.4.1 The 32-bit NuBus handles all communication between the NUPI and the Explorer system while all communication between the NUPI and the mass storage enclosure are by way of the 8-bit SCSI bus. This communication scheme requires that the NUPI be able to translate between 32-bit words for the NuBus and 8-bit bytes for the SCSI bus. The NuBus is discussed in Section 1 of the general information part of this manual.

The SCSI bus is a low-active bus that transfers addresses, data, parity, control, and status information between the NUPI and the mass storage devices. A bus arbitration scheme allows the bus to be under the control of the NUPI board's SCSI logic or any one of up to eight mass storage devices (disk drives and tape drives) at any given time. All information transfers over the SCSI bus are asynchronous and follow a request/acknowledge handshake protocol. Each handshake operation allows the transfer of one 8-bit byte of data.

Figure 2-7 Peripheral Cable Adapter With Cover Removed

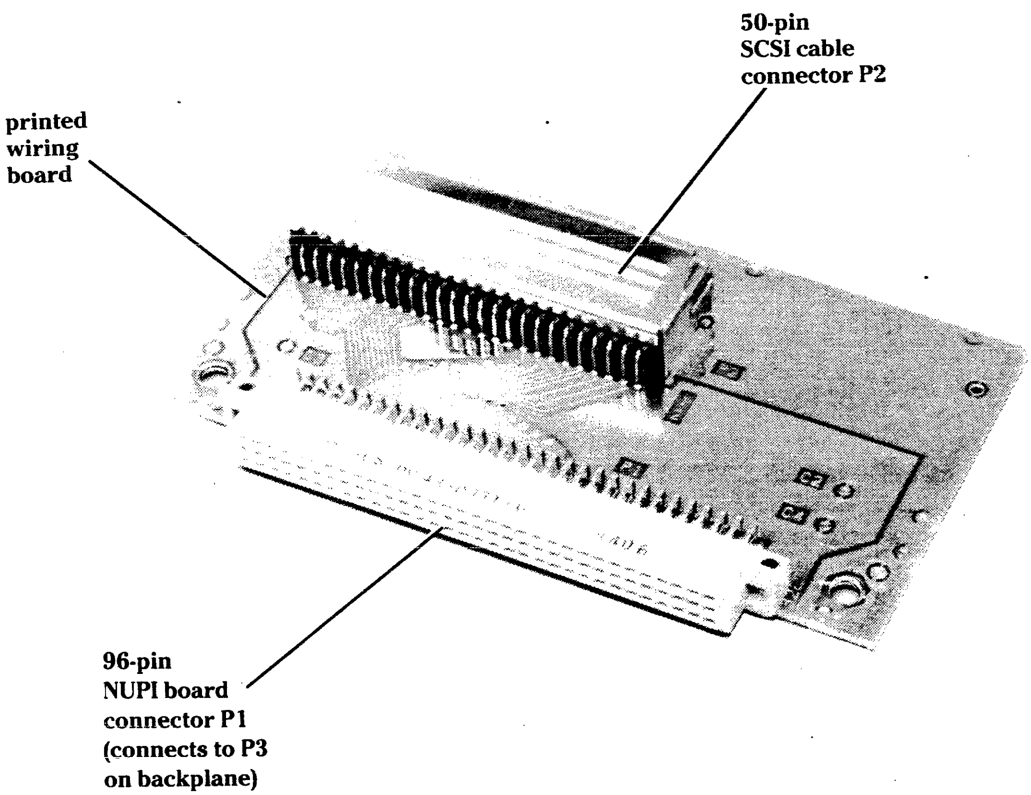
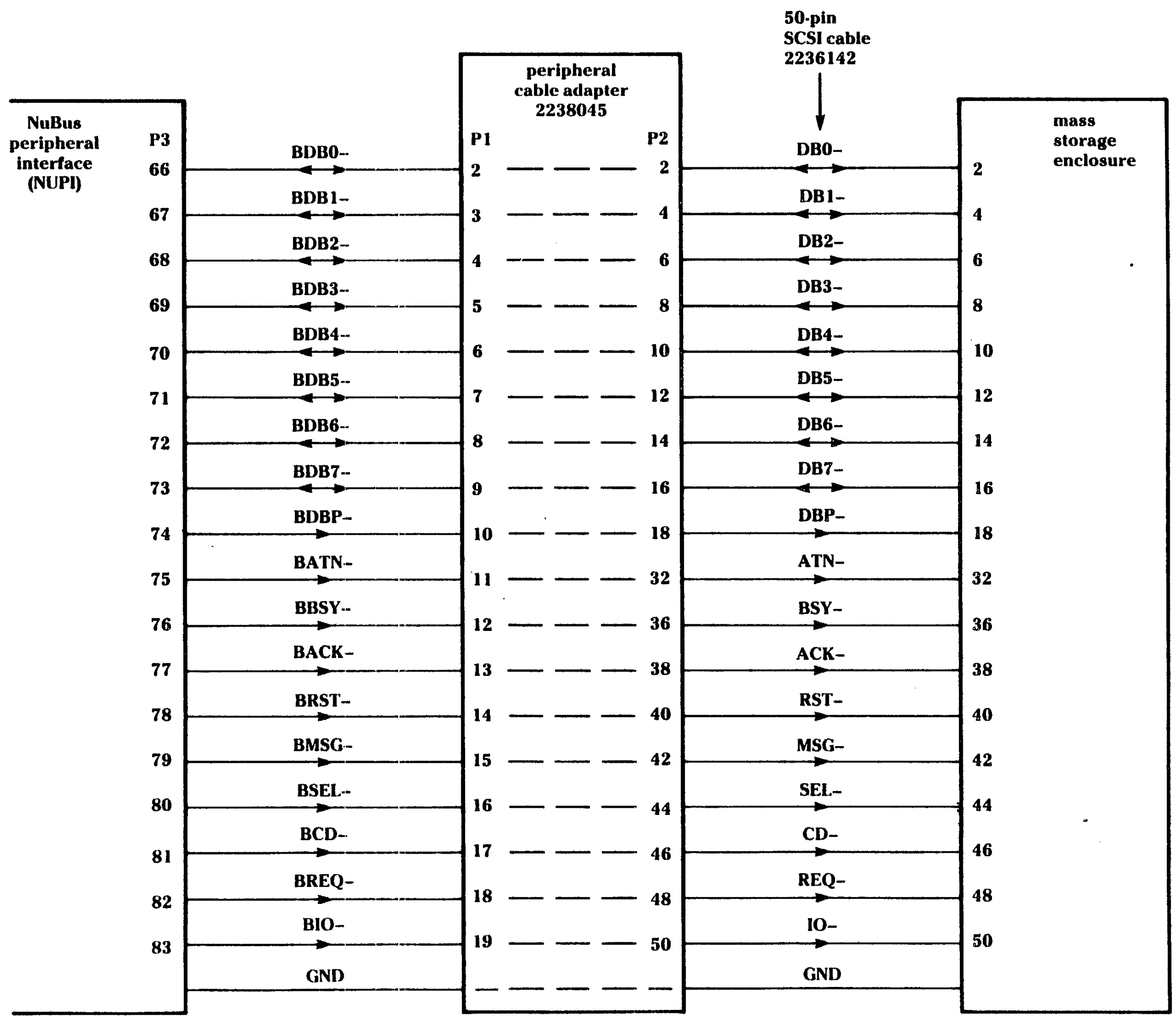
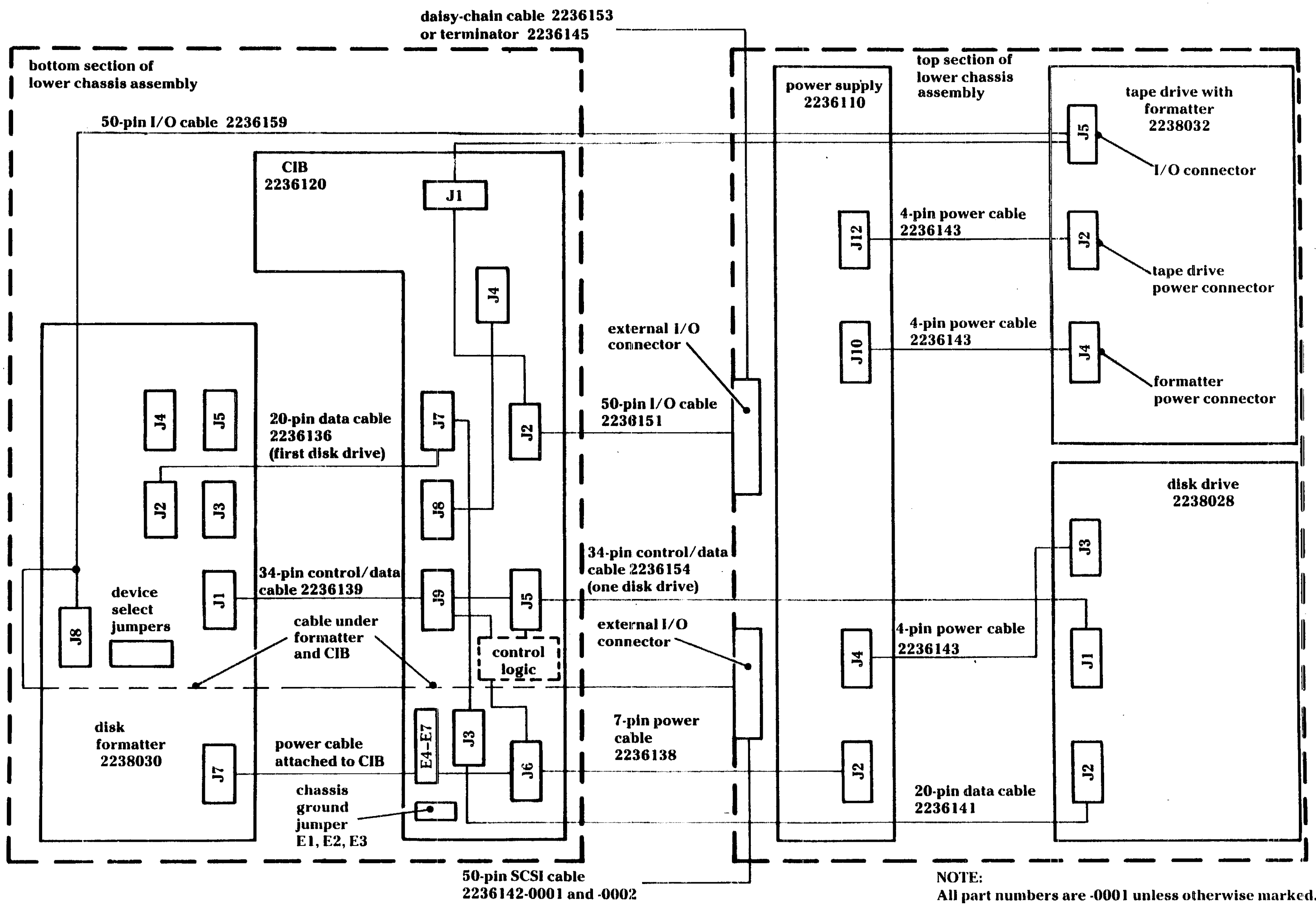


Figure 2-8 Mass Storage Subsystem Interconnect Diagram



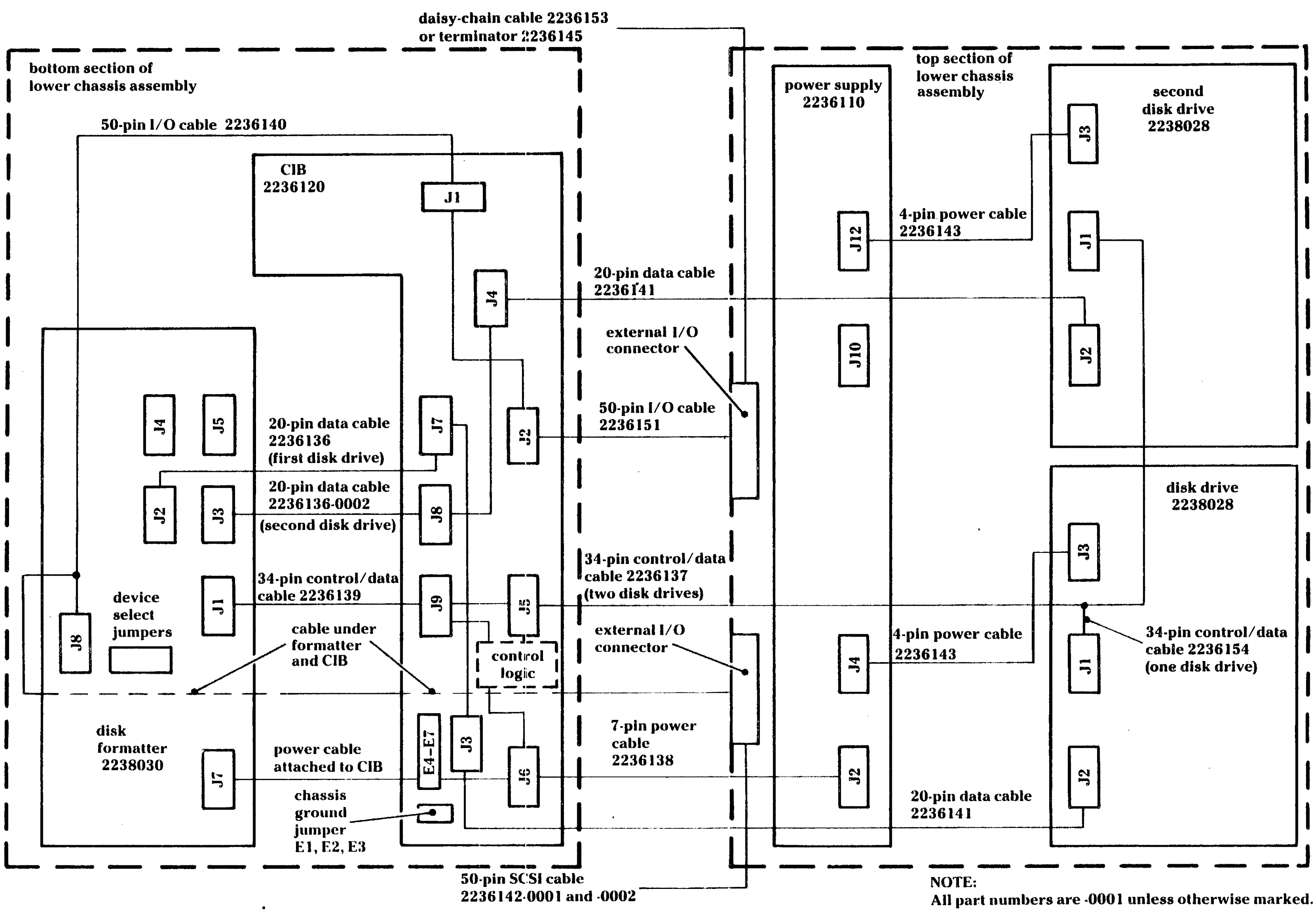
NOTE:
All part numbers are -0001 unless otherwise marked.

Figure 2-9 Mass Storage Enclosure Tape Drive/Disk Drive Cable Diagram



NOTE:
All part numbers are -0001 unless otherwise marked.

Figure 2-10 Mass Storage Enclosure Disk Drives Only Cable Diagram



Communication by way of the SCSI is allowed between only two SCSI devices at one time. A buffer on the tape drive controller allows data transfers over the SCSI bus to other devices while data is being transferred between the buffer and the tape drive. The NUPI is the SCSI bus initiator and the mass storage formatter is the target. The initiator is the device that originates an operation, and the target is the device that performs the operation.

The SCSI architecture includes eight distinct phases. The SCSI bus can only be in one of these phases at any given time. The phases are as follows:

- Bus-free phase — This phase indicates that no SCSI device is actively using the SCSI bus and that the SCSI bus is available for subsequent users.

- Arbitration phase — This phase allows an SCSI device to gain control of the SCSI bus and to assume the functions of either an initiator or a target device.

- Selection phase — This phase allows the initiator to select a target to initiate an operation within the target.

- Reselection phase — This phase allows a target device to reselect an initiator to continue a previously initiated operation that was suspended by the target.

NOTE: The following phases are called information transfer phases. All data and control information transfers occur during these phases.

- Command phase — This phase allows the target device to request command information from the initiator.

- Data phase — This phase consists of the data-in and data-out phases, as follows:

  - During the data-in phase, the target sends data to the initiator.

  - During the data-out phase, the target requests data from the initiator.

- Status phase — During this phase, the target reports the status to the initiator.

- Message phase — This phase consists of the message-in and message-out phases, as follows:

  - During the message-in phase, the target requests messages from the initiator.

- During the message-out phase, the initiator sends messages to the target.

The SCSI bus uses nine control signals to transfer control information, eight data signals to transfer address and data information, and a parity signal to transfer bus parity information. Table 2-1 lists and defines these SCSI signals.

Table 2-1 **SCSI Bus Signal Definitions**

Signal	***Definition***
BBSY–	Bus busy. When active, this signal indicates that the SCSI bus is being used.
BSEL–	Bus select. This signal can be under the control of either the initiator or the target device. The initiator uses BSEL– to select a target, and the target uses the signal to reselect the initiator.
BCD–	Bus control/data. The target device drives this signal low to indicate that the bus is carrying control information and high to indicate that it is carrying data.
BIO–	Bus input/output. The target device drives this signal to indicate the data transfer direction. Low indicates a target-to-initiator transfer; high indicates an initiator-to-target transfer.
BMSG–	Bus message. The target activates this signal during the message phase of an information transfer. Activation during the message-out phase indicates that a message is to be sent from the initiator to the target. Activation during the message-in phase indicates that a message is to be sent from the target to the initiator.
BREQ–	Bus request. The target activates this signal to initiate a request for a data byte transfer.
BACK–	Bus acknowledge. The initiator activates this signal to acknowledge a request for a data byte transfer.
BATN–	Bus attention. The initiator activates this signal to indicate that it has a message ready for the target and that the target can receive this message at its convenience by performing a message-out phase.
BRST–	Bus reset. The NUPI activates this signal to clear all SCSI devices.
BDB7– through BDB0–	Data bus. The data bus transfers addresses, data, and parity between the SCSI devices. BDB7– is the most significant bit while BDB0– is the least significant bit.
BDBP–	Data parity bit. The SCSI bus uses odd parity. All SCSI devices can generate this bit.

Disk and Tape Drive Operation

2.4.2 Refer to the hardware information in the Operating Procedures part of this manual for information on the operation of the disk and tape drives used in the Explorer system.

Ethernet Subsystem

2.5 The Ethernet subsystem provides an interconnection method that permits the rapid transfer of data between systems. This transfer of data provides the following basic user needs:

- Sharing of expensive resources such as printers.
- Sharing of accurate information through common databases.
- Access to high-level services, such as electronic mail.

The Explorer system connects to the Ethernet local area network (LAN) through the Ethernet subsystem. The Ethernet network falls in the middle ground between long-distance, low-speed networks and very high-speed interconnects. The Ethernet can be used in offices, laboratories, and research facilities that require an economical connection to a local communications medium that carries bursts of traffic at high-peak data rates.

The Ethernet subsystem consists of the NuBus Ethernet controller board, an Ethernet cable adapter board, and a transceiver cable. Two Ethernet sybsystem kits are available from TI. The difference between the kits is that one contains a 3Com transceiver and one does not. The Ethernet cable adapter board (Figure 2-11) provides the interconnect point between the NuBus Ethernet controller and the Ethernet cable. The cable adapter board contains no active electronics. The interconnect signals are:

- Transmit (TRMT)
- Receive (RCV)
- Collision sense (CLSN)

The shielded transceiver cable connects the cable adapter board to the transceiver. The transceiver cable contains the differential signal pairs and +12 volts dc as shown in Figure 2-12. The +12 volts is the supply voltage for the transceiver electronics. The signal pairs, TRMT, RCV, and CLSN, are transformer coupled inside the tranceiver to provide isolation.

Figure 2-11 Ethernet Cable Adapter With Cover Removed

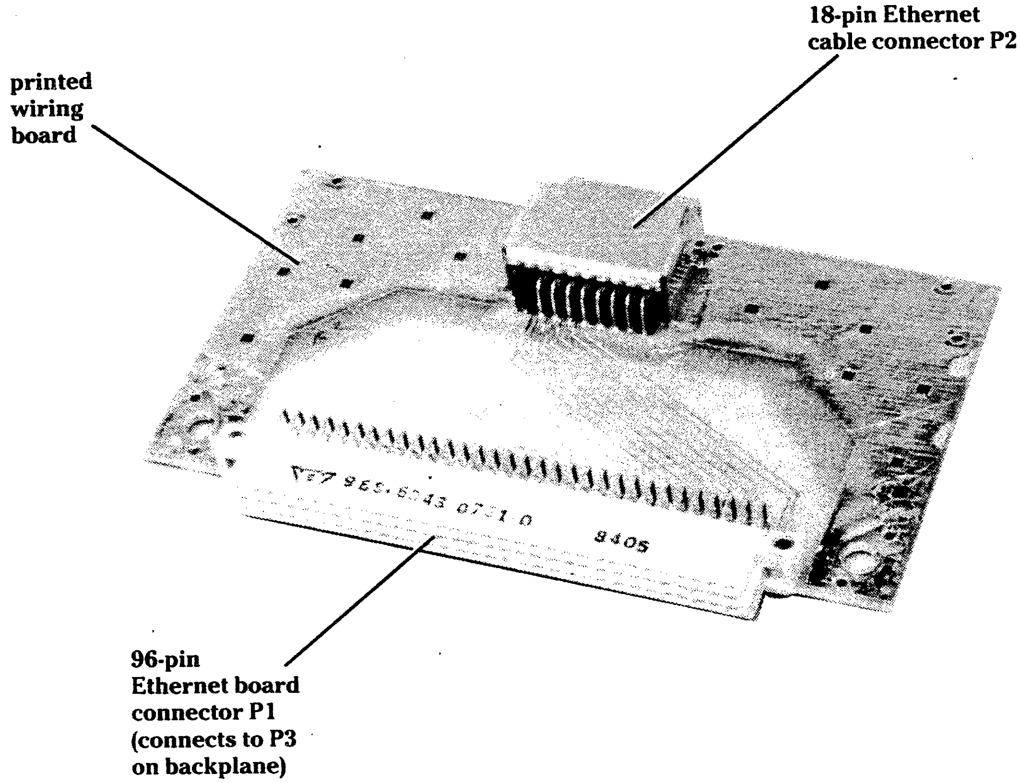
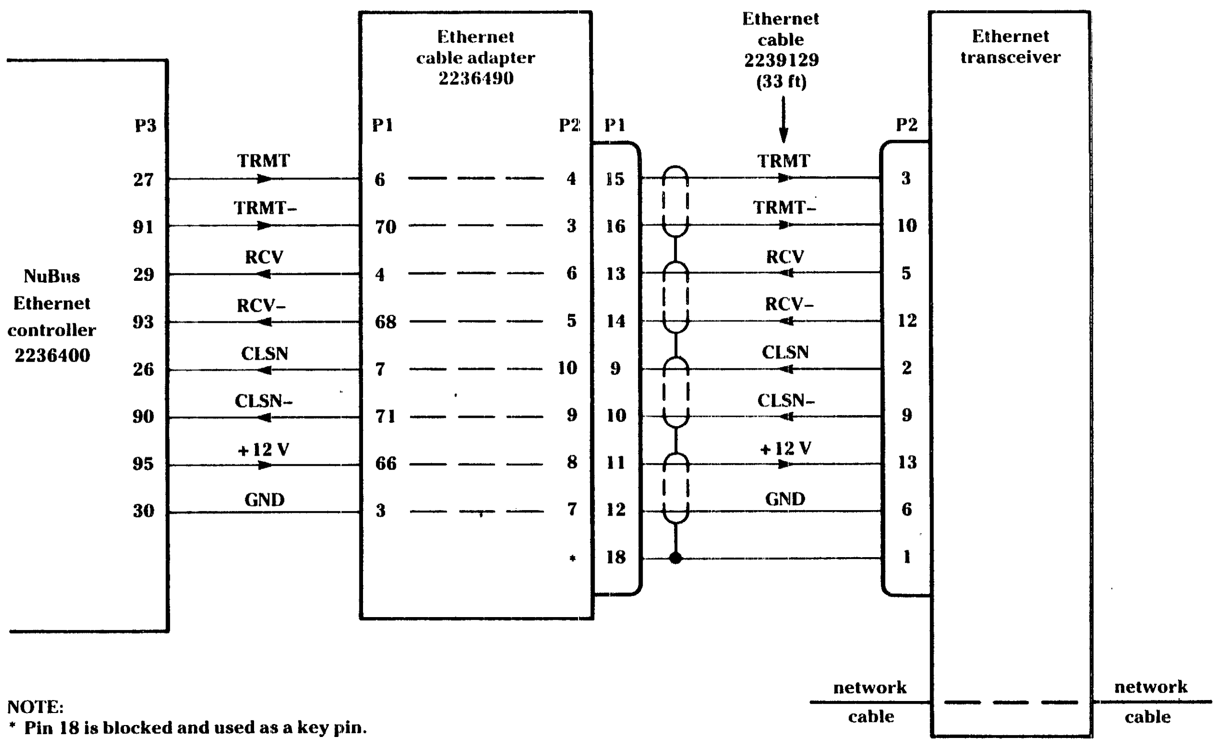


Figure 2-12 Ethernet Cable Adapter Interconnect Diagram



NOTE:
* Pin 18 is blocked and used as a key pin.

Network Cables

2.5.1 There are two types of network cables, thick and thin. The thick cable was designed for Ethernet networks and is marked at intervals of 2.5 meters (8.2 feet) to indicate where transceivers should be connected. The thin Ethernet cable is standard RG58 A/U. Using the thin cable is less expensive and easier to install; but the length of the network segment can only be two-thirds the length of a thick cable network segment, and thin cable is not as durable.

Two styles of transceivers can be used on the thick Ethernet network cable. One style is the inline transceiver, which requires the network cable to be cut and connectors to be installed. The other style, a tap-type transceiver, requires a cable tapping tool. The tapping tool is used to drill through the cable insulation and braided shield of the thick cable. A pin on the transceiver is placed into the hole to contact the center conductor of the cable for network connection.

Only the inline transceiver can be used with the thin Ethernet cable. Adapters, BNC to N-series, are needed to connect the RG58 A/U cable to the inline transceiver. Refer to Appendix A of the *NuBus Ethernet Controller General Description* manual for additional information on Ethernet equipment.

Ethernet Operation

2.5.2 The Ethernet subsystem is designed to interface to a carrier sense multiple access/collision detect (CSMA/CD) network. The Ethernet subsystem conforms to layer 1 and 2 of the 7-layer Open Systems Interconnect model developed by the International Standards Organization. Explorer software products designed to work with the Ethernet subsystem contain the high-level protocols.

The NuBus Ethernet controller board places transmit data in its onboard memory. Transmit data is placed into packets by the local communications processor on the controller board. The packet contains the following informaton:

- Preamble (for synchronization)
- Destination address
- Source address
- Type field (defines the high-level protocol)
- Data field (from 46 to 1500 bytes)
- Frame (packet) check field

The packet information is Manchester encoded before leaving the controller board. Manchester encoding combines the controller board clock with the information in the packet. This encoding ensures a transition in the middle of each bit cell, thus ensuring high data integrity.

When data is to be transmitted, the NuBus Ethernet controller board first checks to see if there is traffic on the network. This is done by sensing for a carrier (carrier sense) on the network. A carrier is only present when a system is transmitting. If no carrier is detected, the controller board passes the packet to the transceiver, which inserts the information on the network. There is the possibility that two or more systems might access (multiple access) the network at the same time. This is called a collision. When a collision occurs, the signal level on the network exceeds a preset level in the tranceiver's collision detect circuitry. The transmitting systems then stop and back off (wait). Each system waits a random time period determined by a random number and an algorithm before retransmitting.

When receiving data, the Manchester decoder uses the preamble of the packet to synchronize itself to the incoming data. The destination address is compared with the address of the controller board. If the addresses compare, the data is stored in the controller on-board memory, and the system processor is notified. Two special destination address codes allow data to be sent to either a number of specific systems (multicast) or to all systems on the network (broadcast).

The networking capability of the Explorer Ethernet subsystem provides the single-user work station with high-speed access to data files on other systems connected to the network, which eliminates the need to maintain multiple copies of the same data. Likewise, networking reduces the duplication of some system peripherals and can reduce paperwork through inner-system communications provided by the mail and message software.

CONTENTS

Tables

EXPLORER SYSTEM OPERATING PROCEDURES

1

Highlights of This Section

- Introduction
- Hardware information
- Software information
- Operating procedures

Introduction

1.1 This section provides a condensed version of the operating procedures for the Explorer system. Basic hardware and software information associated with the operating procedures is also provided. For additional details on system operation, refer to the *Explorer Operations Guide*. A complete list of related hardware and software publications is provided right after the title page of this manual.

Hardware Information

1.2 A typical Explorer system is shown in Figure 1-1. The hardware information is separated into the following topics:

- Display monitor assembly
- System enclosure
- Mass storage enclosure
- System setup and cable routing

A simplified block diagram of the Explorer system is shown in Figure 1-2. This diagram provides a general view of the data flow between the major components of the Explorer system.

Figure 1-1 Explorer System — Front View

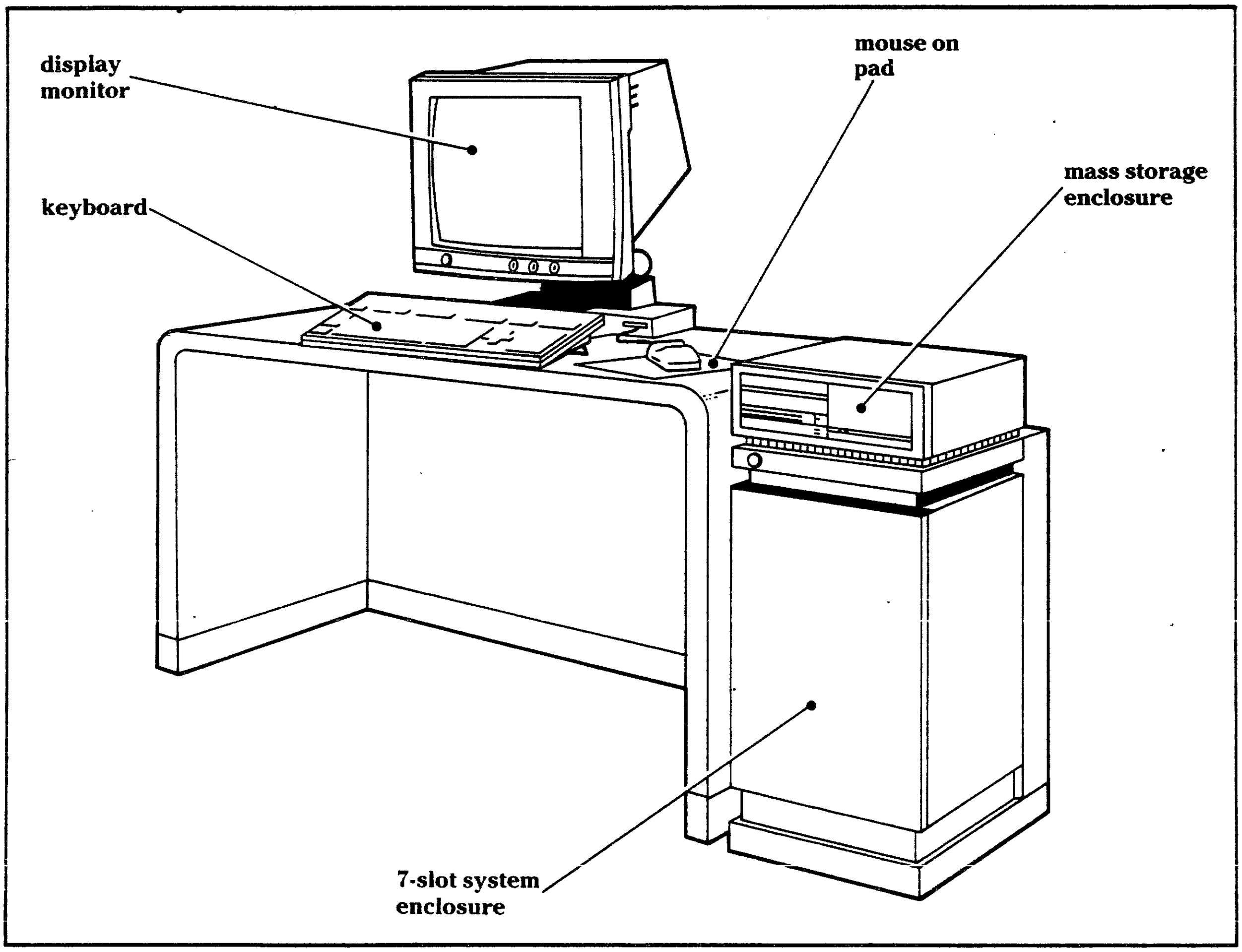
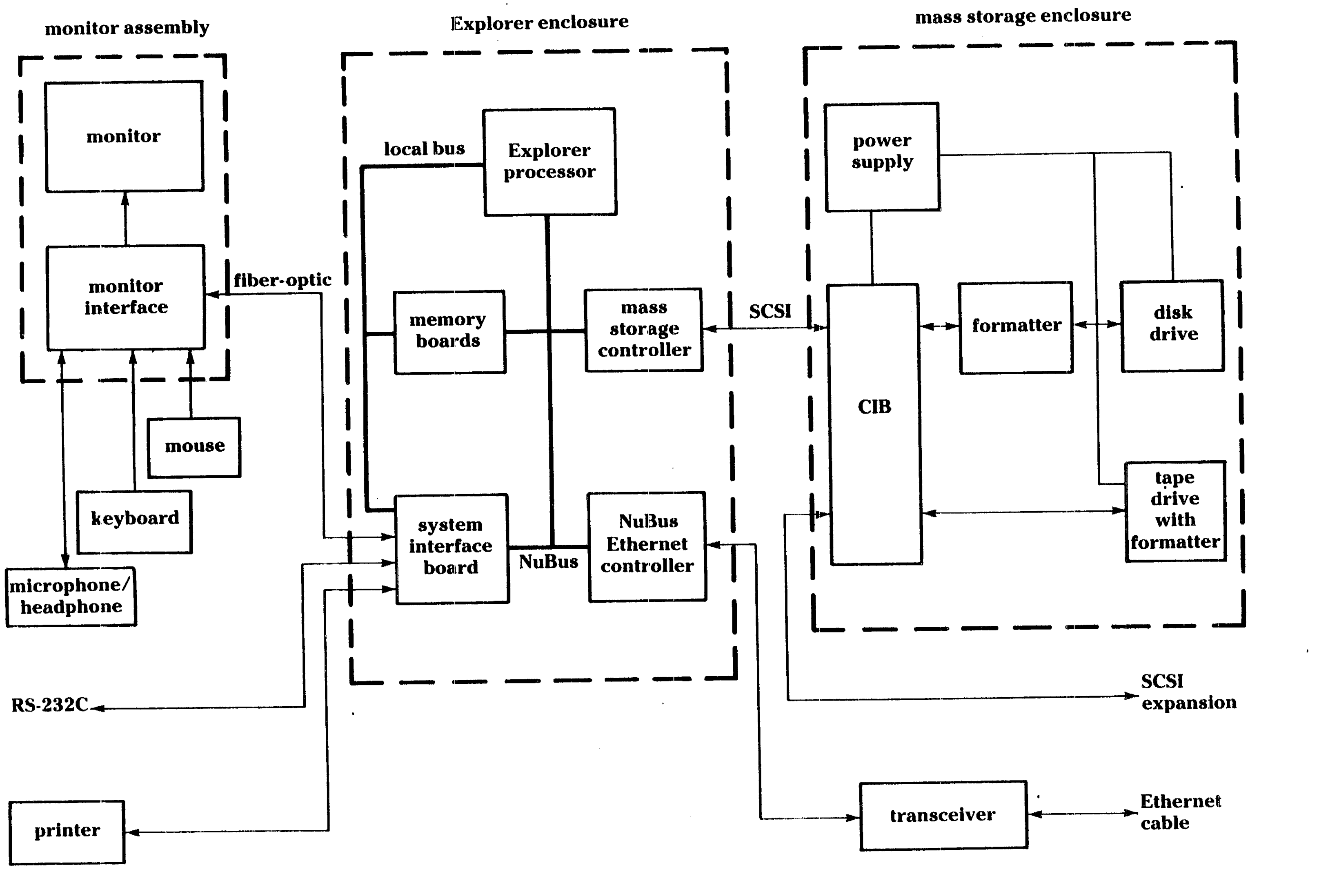


Figure 1-2 Explorer System Block Diagram



Display Monitor Assembly

1.2.1 The monitor assembly contains a monitor and a monitor interface. The monitor includes a cathode-ray tube (CRT), a power supply, a synchronous board, and associated operating controls. The monitor interface provides the interface logic for the mouse, the keyboard, the microphone and headset, and a fiber-optic link to the system interface controller in the system enclosure. The software for the microphone and headset circuits is not supported in this release.

System Enclosure

1.2.2 The Explorer enclosure contains the processor, memory boards, system interface board, NUPI, and Ethernet board (if one is included in the system). All of these boards interact with the mass storage enclosure, monitor assembly, Ethernet communications, RS-232C communications, and parallel printer, and all are interconnected through the NuBus. The processor, memory boards, and system interface board are also interconnected through the local bus. The local bus provides for high-speed data transfers between these boards.

Mass Storage Enclosure

1.2.3 A single mass storage enclosure can contain storage devices in any of the following combinations:

- One disk drive and one tape drive
- Either one or two disk drives
- One tape drive

Up to four mass storage enclosures can be connected together with daisy-chain cables. Information about how data is stored on the disk and on the tape is separated into the following topics:

- Disk drive information
- Tape drive information
- Tape cartridge operating precautions
- Tape cartridge insertion and removal

Disk Drive Information

1.2.3.1 The disk drive (Figure 1-3) is a 5¼-inch Winchester drive that provides the primary mass storage for the Explorer system. Data is recorded on the disk surfaces in sectors formatted as shown in Figure 1-4. The data field in each sector consists of 256 bytes. The various other fields of data in each sector provide data stability and error-correcting information, and a means to identify and locate the data on the disk.

All data on the disk is encoded in modified frequency modulation (MFM) format as shown in Figure 1-5. In MFM encoding, clock bits are entered into the data bit stream when two or more data bit 0s occur in successive order. These clock bits provide synchronization of the data when data bit 1s are not present. Data bit 1s provide both data information and clock synchronization. This eliminates the need for clock bits when data bit 1s are present.

The Explorer system software uses data in 1024-byte data blocks. Since data is stored on the disk in sectors that each contain 256 bytes, it takes four sectors to make one data block. The mass storage controller logic forms each data block from four disk sectors during a read operation. During a write operation, the mass storage controller logic breaks each data block into four sectors for disk recording. During recording, data starts at a specific block and fills each cylinder before the heads are moved by the head-positioning mechanism to the next cylinder. A defective sector on the disk is skipped during data recording and the next spare sector is filled. One spare sector is allotted on each cylinder for defective sectors.

NOTE: The disk drive information presented here is for one particular type of drive. When other disk drives are introduced to the Explorer system, this information can be used for reference. The disk drive information is intended to give the customer representative (CR) some insight into how data is stored on the disk so that the menus that appear later will have more meaning. The information should also help the CR understand the relationship of the disk contents and the Lisp environment.

Figure 1-3 Disk Drive General Features

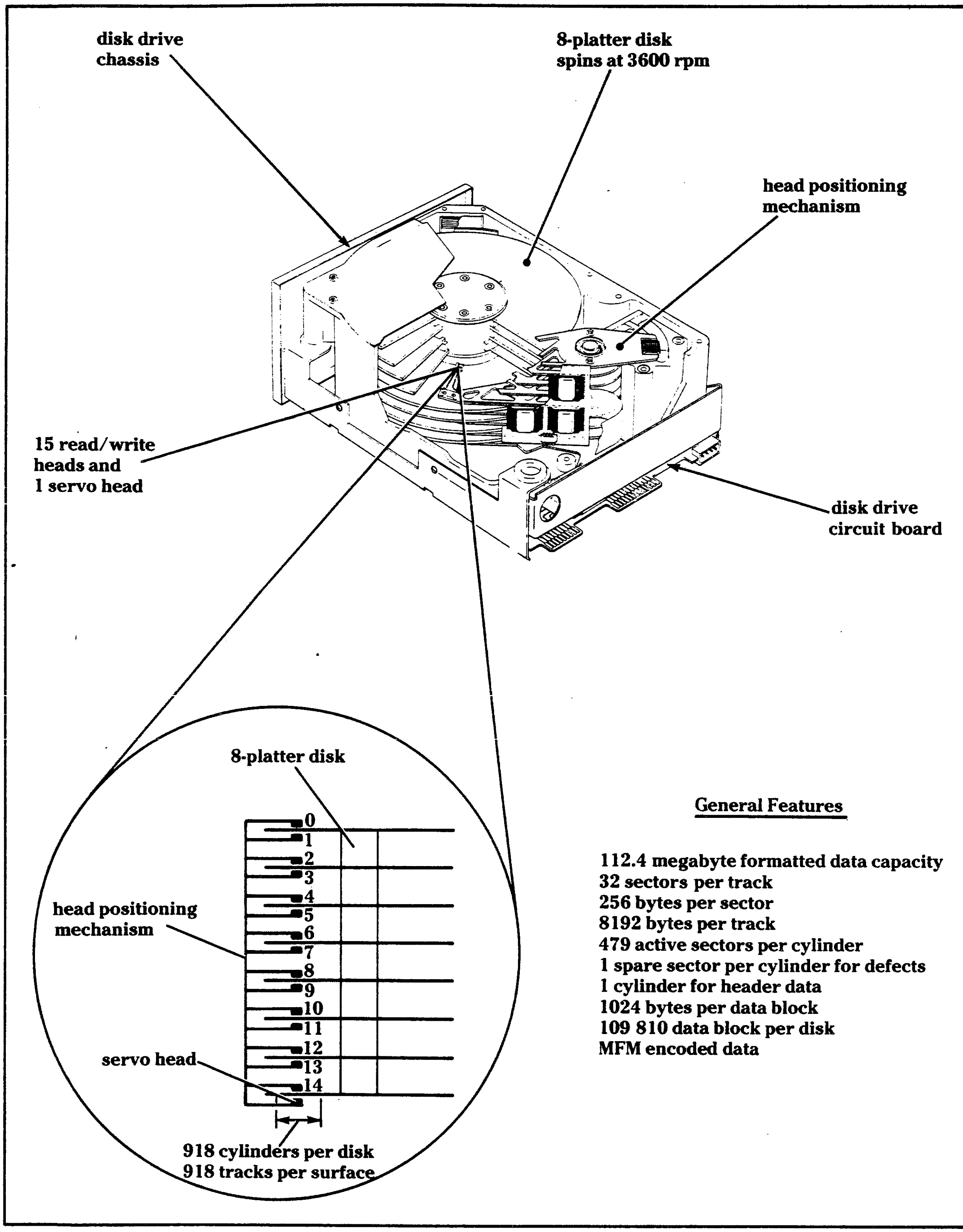


Figure 1-4 Disk Drive Sector Format

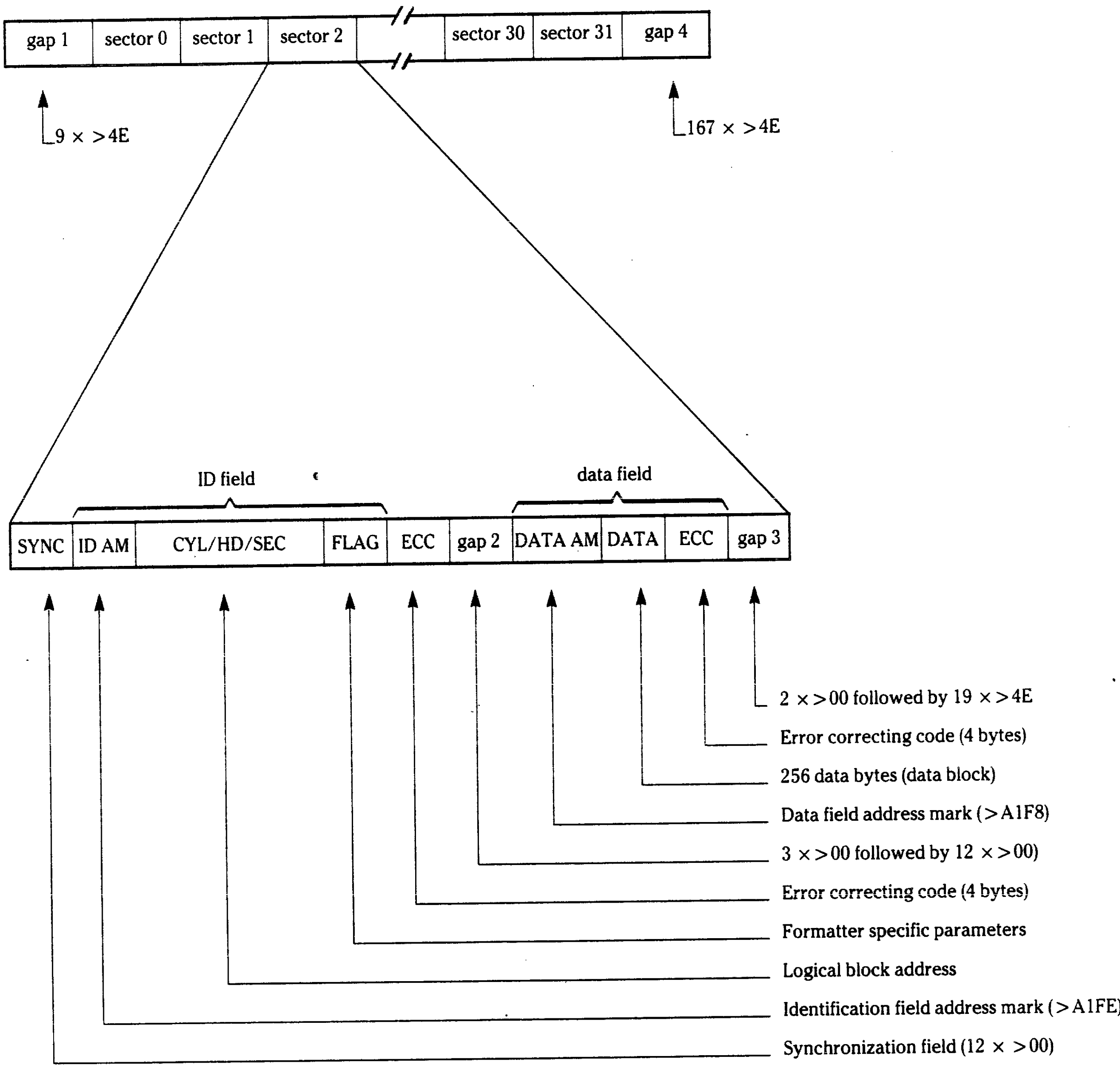
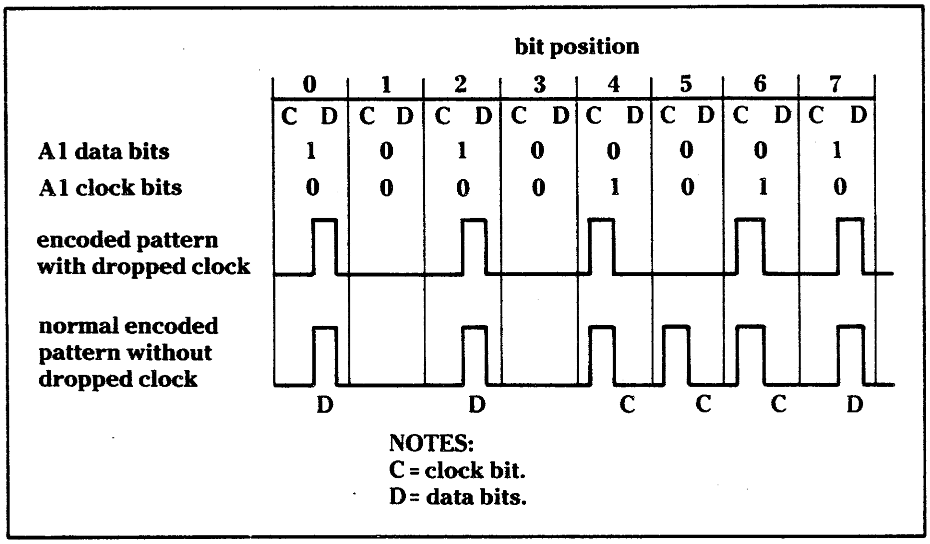


Figure 1-5 **MFM Encoding**



Tape Drive Information

1.2.3.2 The tape drive (Figure 1-6) is a ¼-inch streaming tape drive device used for disk backup and software transportability. The tape drive contains a tape cartridge (Figure 1-7) that is easily inserted, removed, and write protected. The recording tape is wound on two coplanar reels called the supply hub and the take-up hub. The supply hub and the take-up hub are spun by an internal flat drive belt coupled to an internal belt capstan. The flat drive belt rides on top of the recording tape at the supply hub and the take-up hub. A single access door opens when the cartridge is inserted into the drive, which allows the drive motor capstan to contact the internal belt capstan.

Data is recorded on the tape in a nine-track, sequential, serpentine format shown in Figure 1-8. The tape is driven forward to the physical end of tape (EOT) while data is recorded on one track. The tape then reverses direction and is driven to the physical beginning of tape (BOT) while data is recorded on another track in the reverse direction. This process continues until the tape is full or all data is recorded. Data is read in the same manner as data is recorded.

The format of the data recorded on the tape is shown in Figure 1-9. Data is recorded on the tape in 512-byte blocks using the nonreturn-to-zero change-on-ones (NRZI) recording method. In the NRZI method, a data bit 1 is represented by a flux reversal, and a data bit 0 is represented by the absence of a flux reversal. The tape drive formatter provides group code recording so that encoded data has no more than two consecutive data bit 0s.

When the tape cartridge is inserted, it is automatically driven to the BOT, where recording and reading of the tape always begins. When new data is recorded over old data, the old data is erased. You can invoke a window interface to the backup system by pressing SYSTEM B. Select the Help item from this window for instructions on how to use the tape.

If the tape cartridge has been exposed to extreme temperatures, or if you perform a number of small data transfers, the tape should be retensioned. When a tape is retensioned, it is wound to its physical end (EOT), then rewound to its physical beginning (BOT). To retension the tape, refer to the instructions in the Backup System window.

NOTE: The tape drive information presented here is for one particular type of tape drive. When other tape drives are introduced to the Explorer system, this information can be used for reference. The tape drive information is intended to give the CR some insight into how data is stored on the tape and to better explain the use of the tape cartridge.

Figure 1-6 **Tape Cartridge Installation**

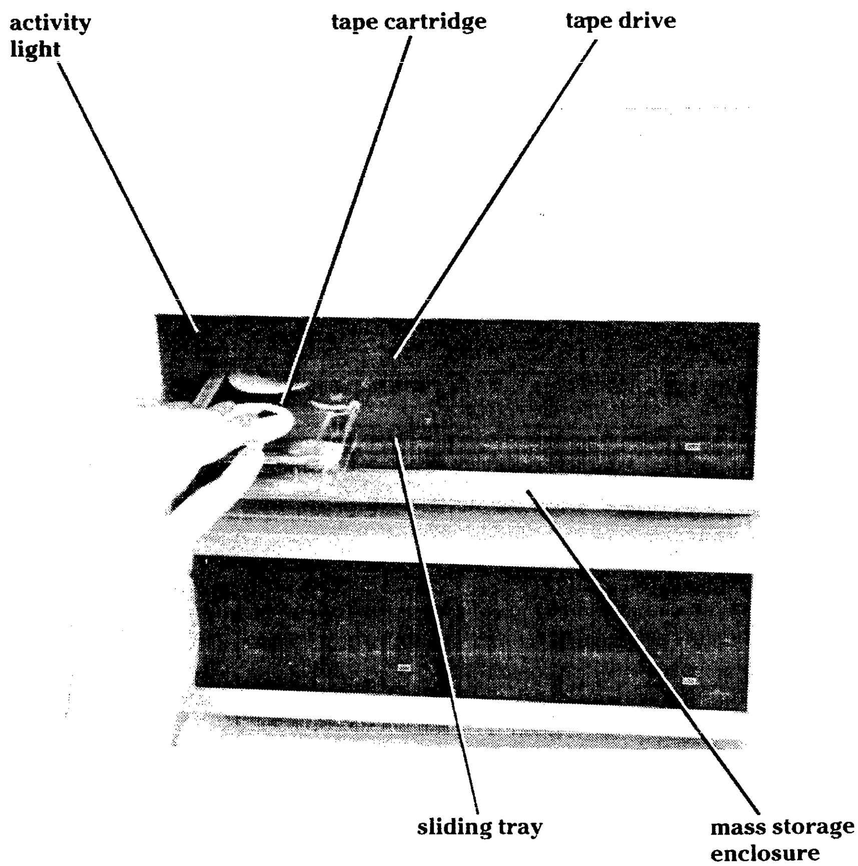
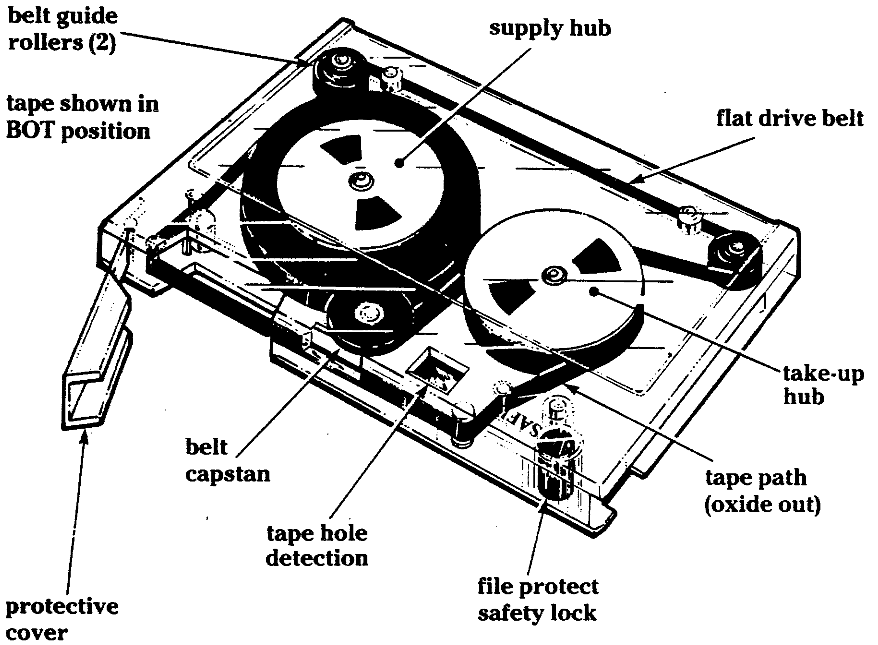


Figure 1-7 **Tape Cartridge General Features**



General Features

60-megabyte formatted data capacity
1/4-inch tape (600-foot length)
90-ips tape speed (bidirectional)
512-byte block size
8000-bpi data density
9 tracks of data in a sequential, serpentine format
Transfer rate (streaming) of 60 megabytes in under 12 minutes

Figure 1-8 Tape Cartridge Physical Features

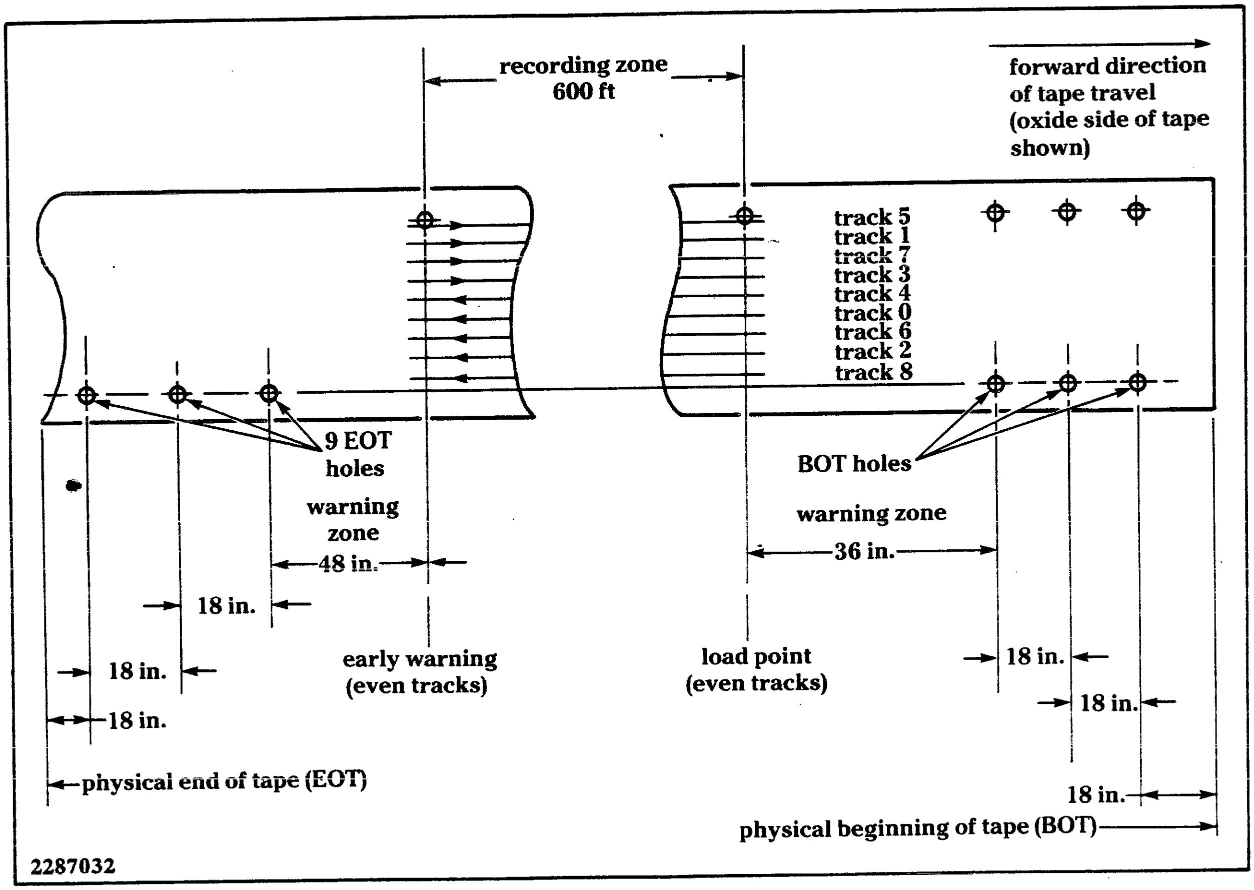
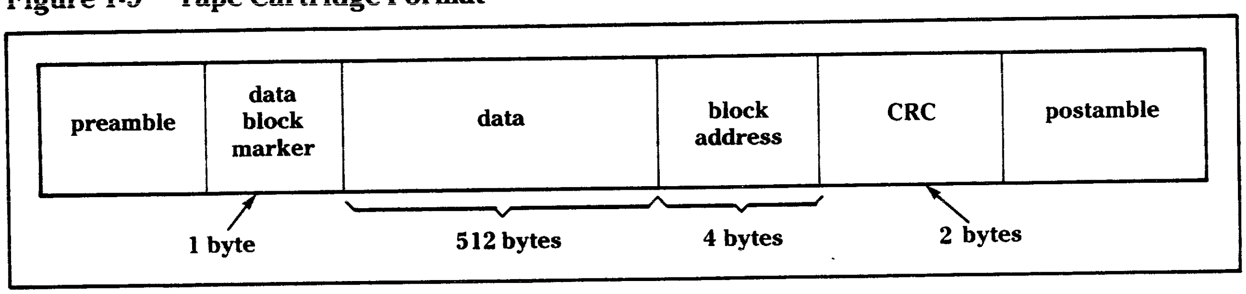


Figure 1-9 Tape Cartridge Format



Tape Cartridge Operating Precautions

1.2.3.3 To prevent the loss of data and extend the life of your equipment, observe the following precautions:

- Make sure the tape drive is not in use before you remove the tape cartridge.
- Use the unload command to prepare the tape cartridge for removal from the tape drive. The unload command places blank leader tape under the access door instead of recording tape, helping to prevent contamination of the recording media. Refer to the Backup System window to execute a tape unload.
- Store your tape cartridge in a dust-free location with temperatures in the range of 5 to 45 degrees Celsius (41 to 113 degrees Fahrenheit) and humidity in the range of 10 to 80 percent. Note that the operating humidity is limited to a range of 20 to 80 percent.
- Keep your tape cartridge away from magnets and machines that produce magnetic fields, such as those produced by fans, typewriters, X-ray machines, and other power machines.
- Do not expose your tape cartridge to heat, direct sunlight, or moisture.
- Keep your tape cartridge away from sticky, oily, or abrasive substances.
- If a tape cartridge is stored at a temperature significantly different from that of the tape drive, let the tape cartridge reach room temperature before using it.
- If you suspect a tape cartridge has been exposed to an extreme temperature, retension the tape (use a command that winds the tape to its physical end, then rewinds it to its physical beginning) before you read from or write to the tape. Refer to the Backup System window to execute a tape retension.

Tape Cartridge Insertion and Removal

1.2.3.4 The tape drive has a sliding tray that holds the tape cartridge in the drive. A lever in front of the tray rotates 90 degrees to lock the tray in the drive. You must pull out the tray before you insert a tape cartridge into the drive. Position the tape cartridge so that its clear plastic side is up, with the tape access door to the right, before you place it in the tray. To write on the tape, set the file protect mechanism so that the arrow points away from the word SAFE. When the arrow points to the word SAFE, the tape is write protected.

When the tape cartridge is inserted, the drive automatically verifies that the cartridge is inserted correctly and then rewinds the tape to the beginning-of-tape (BOT) holes in the tape. If a tape cartridge is not inserted into the tray, lock the empty tray in the drive as a safety precaution.

The read/write heads on the tape drive should be cleaned after approximately 20 hours of use. Refer to the Preventive Maintenance part of this manual for cleaning instructions. For more details on using the tape cartridge, refer to the backup and restoring operating procedures in the *Explorer Operations Guide*.

System Setup and Cable Routing

1.2.4 Figure 1-10 shows the rear view of a typical Explorer system with cables attached. A typical cable setup for the Explorer system is shown in Figure 1-11. Before operating the Explorer system, check that all cables are in place.

CAUTION: Do not unplug any cables while the system is operating; doing so can generate a voltage variation in the power supply that can cause the system to reboot. The fiber-optic cable between the monitor assembly and the system enclosure should be routed clear of pedestrian traffic; it should not exceed a bend radius of 25 millimeters (one inch) around corners, and should never be pulled with a force greater than 11.4 kilograms (25 pounds).

Figure 1-10 **Explorer System — Rear View**

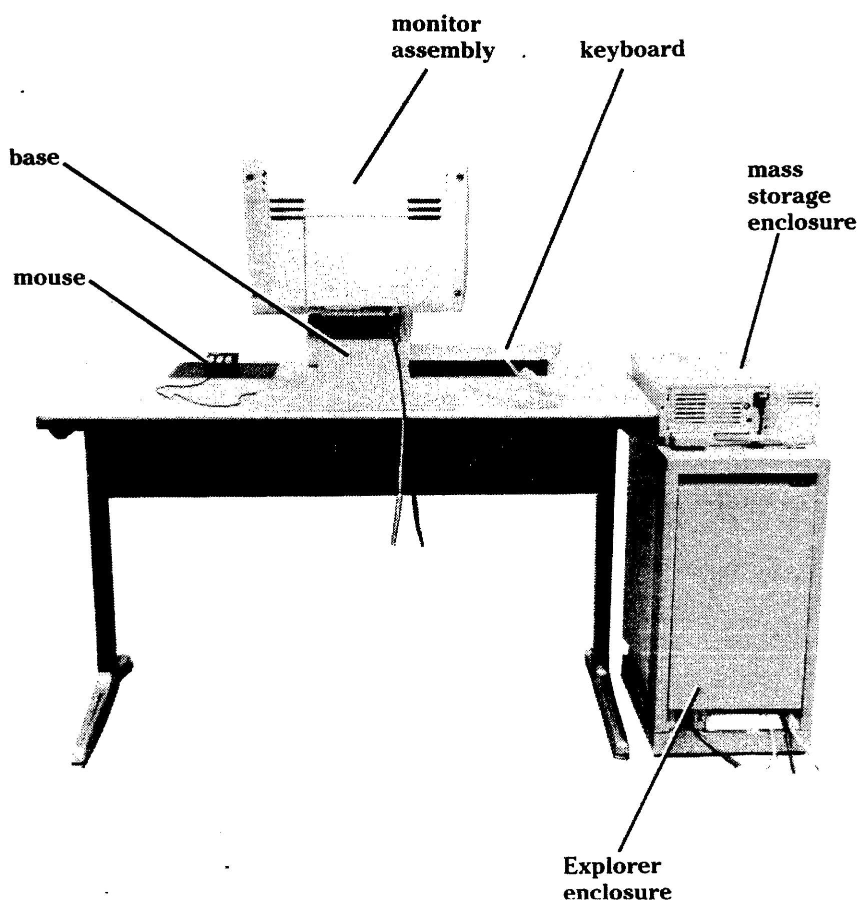
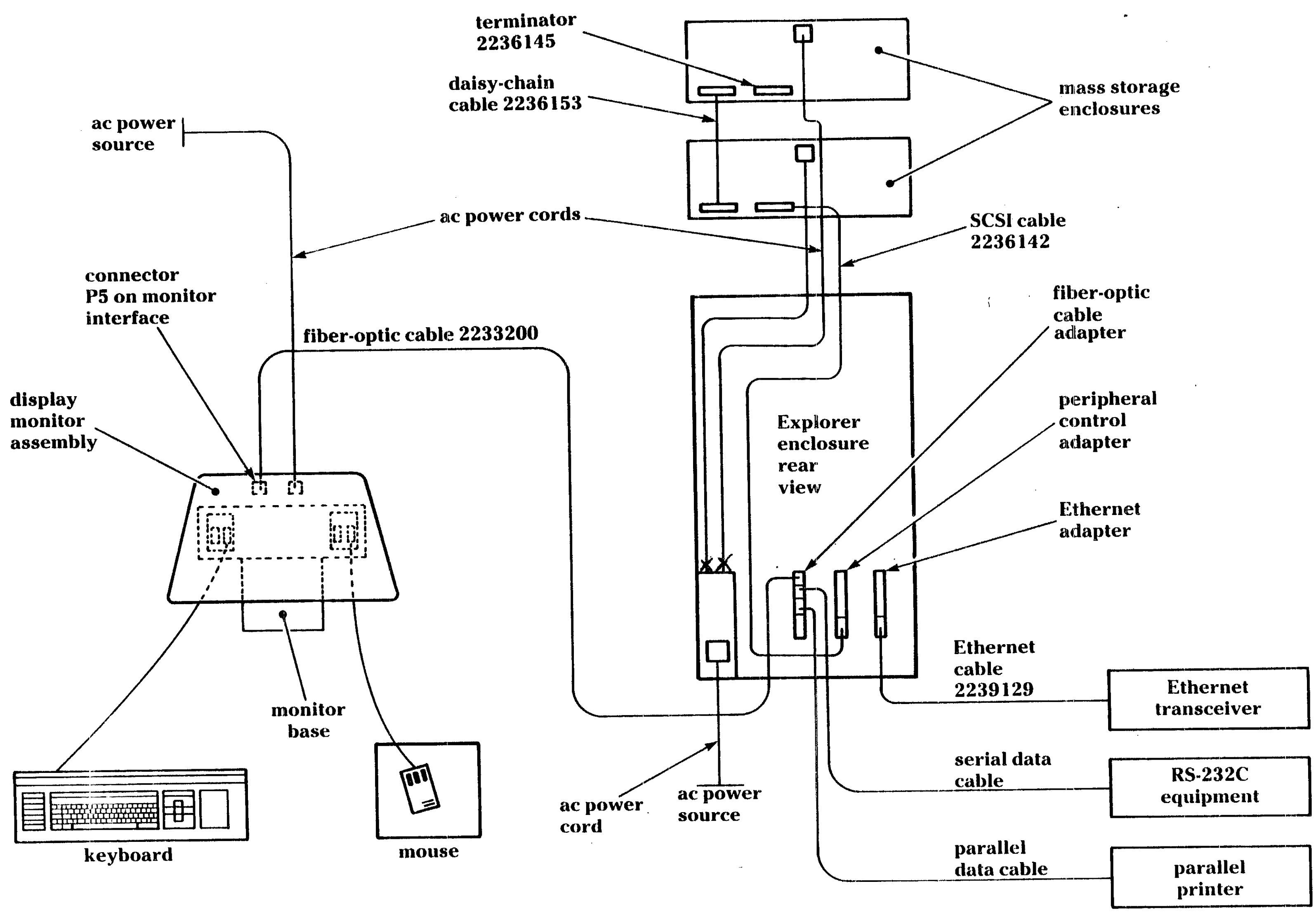


Figure 1-11 Explorer System Cabling Diagram



Software Information

1.3 The software information presented here is limited to the system test and boot master (STBM), the self-tests, and the loadable diagnostics. For information on the application software, refer to the software manuals listed in the front of this manual.

System Test and Boot Master

1.3.1 The STBM is a set of programs that reside in the seven 2K by 56-bit self-test and boot programmable read-only memory (PROM) chips located on the Explorer processor auxiliary board. For detailed information on the STBM, refer to Section 2, Explorer System Troubleshooting, in the Corrective Maintenance part of this manual.

Self-Tests

1.3.2 The self-test software is located in the configuration ROMs on each of the Explorer circuit boards, except for the NuBus peripheral interface (NUPI) board. On the NUPI board, the self-test software resides in a section of the two 8K-byte ROMs that also contain configuration information and software for the on-board 68000 microprocessor. The NUPI board and the processor board are considered to be intelligent boards that run their own self-tests under control of their own on-board processors. On all other Explorer circuit boards, the self-test software in the configuration ROMs is under control of the STBM.

For a discussion of the self-test software operation on each board, refer to Section 2, Explorer System Troubleshooting, in the Corrective Maintenance part of this manual.

Loadable Diagnostics

1.3.3 The loadable diagnostics are provided in a separate partition on a disk in the mass storage enclosure, and they are also available on tape for emergency installation by maintenance personnel. For information on using the loadable diagnostics, refer to the diagnostic software manuals listed in the front of this manual.

Operating Procedures

1.4 The following operating procedures provide enough information to get your system powered up and ready to operate. For additional information, refer to the *Explorer Operations Guide* and other hardware and software manuals listed in the front of this manual. Additional maintenance information on the light-emitting diodes (LEDs) and the screen displays is presented to aid the CR. The operating procedures include the following topics:

- Power-up
- Boot operations
- Login information
- Logout information

~~The system enclosure has convenience receptacles within the system enclosure that can supply ac power to other devices when the ac power on/off button on the system enclosure is pressed to the on (in) position. If your system uses these convenience receptacles, the ac power on/off buttons on the devices connected to the convenience receptacles need only be pressed to the on (in) position one time.~~ DELETED FROM USE BY ECN!

The system test and boot master (STBM) program in the self-test and boot PROMs on the processor board is the firmware that controls the automatic processes that occur during power-up. The STBM is described in Section 2, Explorer System Troubleshooting, in the Corrective Maintenance part of this manual.

Refer to Figure 1-12 for an outline of the keyboard. The location of all LEDs and test points is shown in Figure 1-13.

NOTE: The system-defined displays and windows shown in this section are examples of the software as this manual goes into production. Later changes in the software may cause different displays and windows to appear on your system.

Figure 1-12 Keyboard Layout

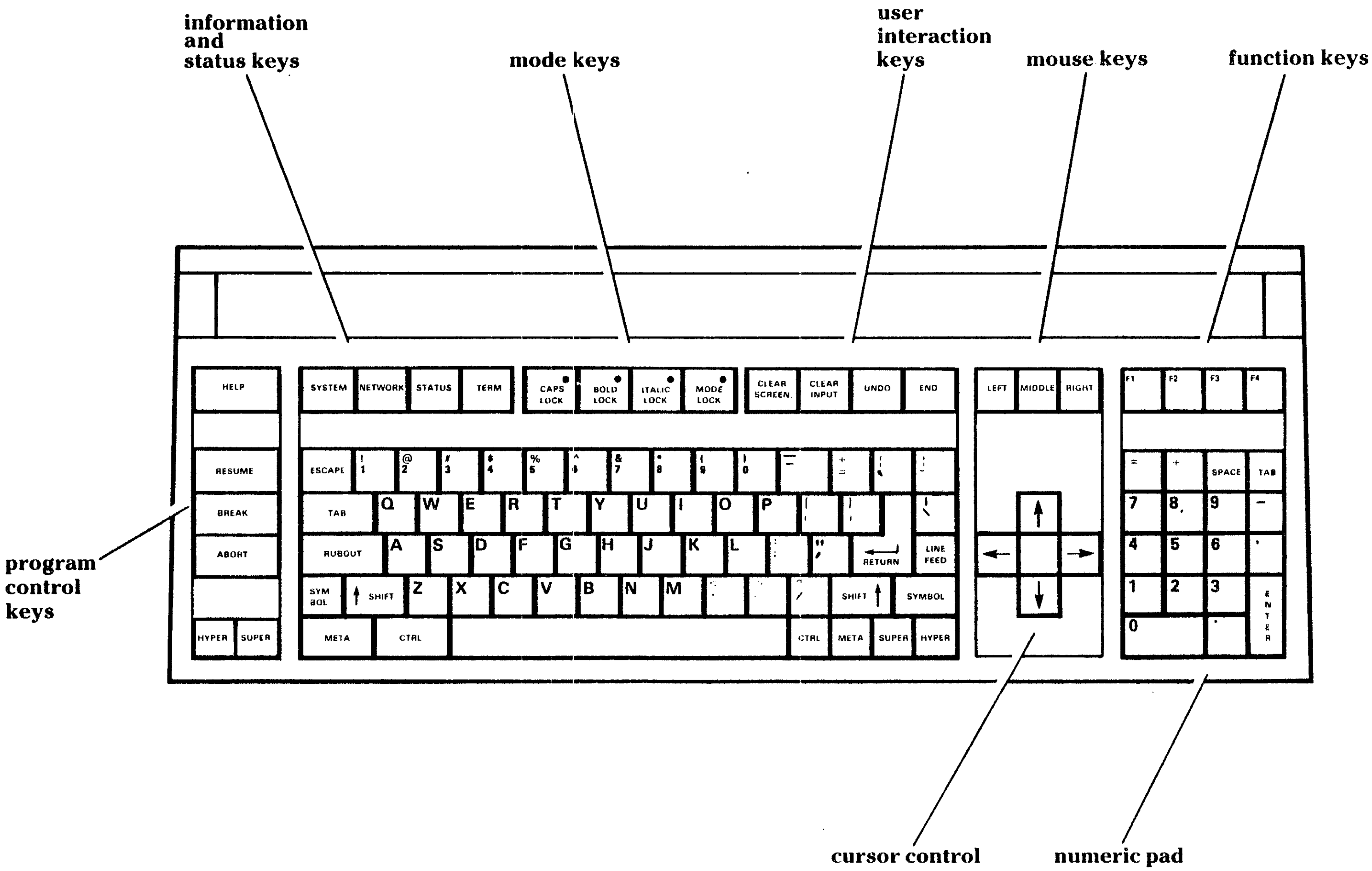
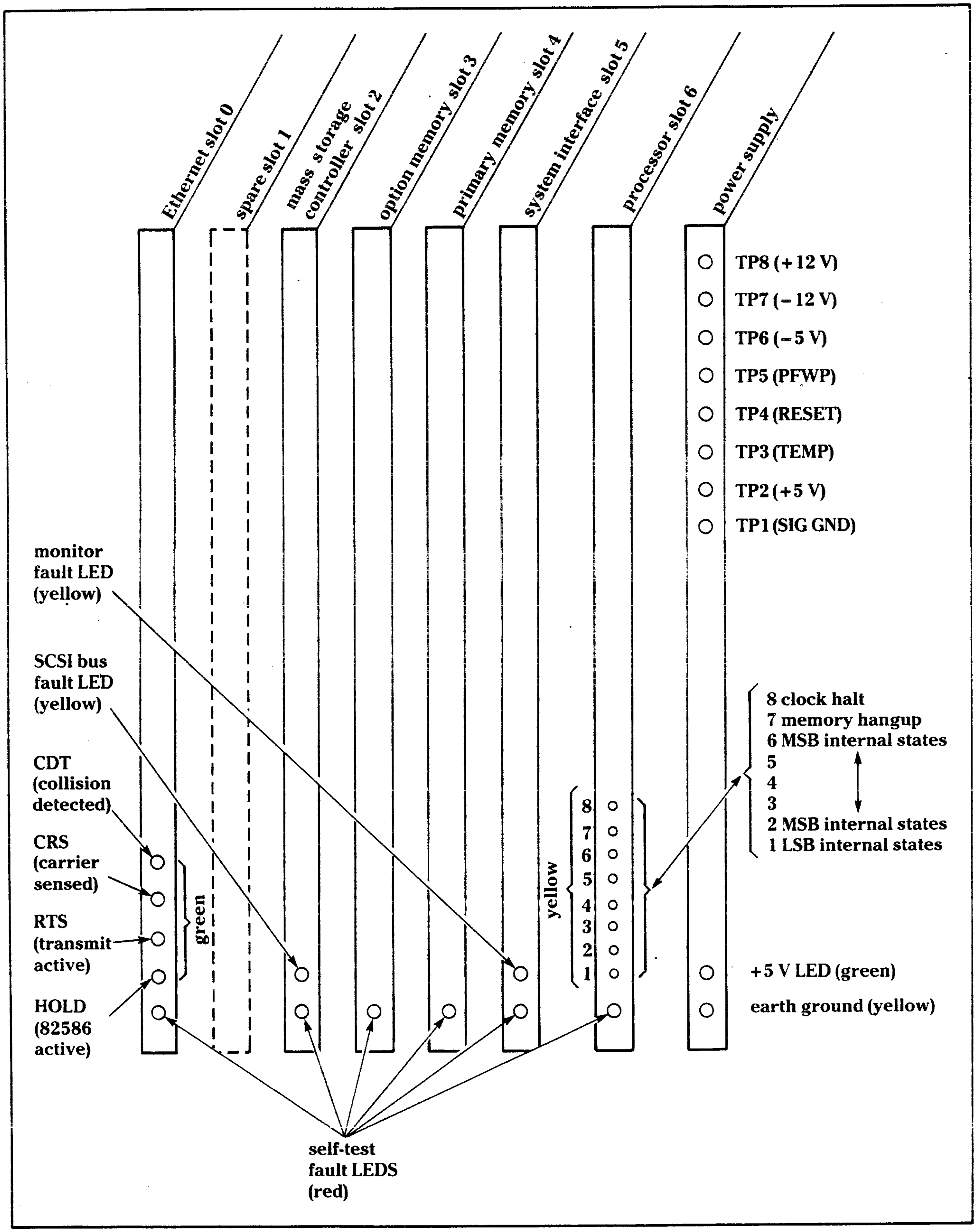


Figure 1-13 System Enclosure Indicators and Test Points



Power-Up **1.4.1** Perform the following procedure to power up the Explorer system:

1. Push the ac power on/off button on the rear of each mass storage enclosure to the on (in) position.

2. Push the ac power on/off button on the front of the display monitor assembly to the on (in) position.

3. Push the ac power on/off button on the front of the system enclosure to the on (in) position. Refer to Table 1-1 for the power-up sequence of LED and video display actions that occur after power-up when the system is operating properly. Figures 1-14 through 1-19 show typical displays that appear during normal conditions, during failures, or by option selections.

4. Listen for evidence that the fan in the system enclosure has come up to speed. Open the outer plastic door on the front of the system enclosure and check for airflow out the air exhaust vents at the bottom of the enclosure. Do not operate the system if the fan is not working.

5. Turn on the ac power to any additional equipment, such as printers.

Table 1-1 **Power-Up Sequence of LED and Video Display Actions**

Sequence	*LED Action*	*Video Display Action*
1	All fault LEDs go on.	Blank
2	NUPI red LED goes off, then yellow LED goes off.	Blank
3	Processor LEDs all go off except for the 7th yellow LED, which flashes dimly.	Goes white
4	There is no LED action at this time.	SLOT 6 TESTING SYSTEM:
5	Memory LED in lowest slot (slot 3 or 4) goes off.	SLOT 6 TESTING SYSTEM:
6	Ethernet controller green LEDs blink and red LED goes off.	SLOT 0 PASSED
7	NUPI red LED blinks on, then off, while the NuBus test is performed.	SLOT 2 PASSED
8	Memory LED in slot 3 turns back on, then off, if a memory board is in this slot.	SLOT 3 PASSED

Table 1-1 **Power-Up Sequence of LED and Video Display Actions (Continued)**

Sequence	*LED Action*	*Video Display Action*
9	Memory LED in slot 4 goes off.	SLOT 4 PASSED
10	System interface red and yellow LEDs go off.	SLOT 5 PASSED
11	There is no LED action at this time.	SLOT 6 PASSED
12	All LEDs go off.	Options line appears for 15 seconds, then an automatic boot begins if no option has been selected.
13	Earth ground yellow neon lamp DS1 stays on at all times.	None

WARNING: Do not use neon lamp DS1 on the system power supply as an indication of a safe earth ground connection to the 7-slot system enclosure. Neon lamp DS1 only indicates that an unqualified earth ground path exists. Special instruments are required to determine if the earth ground connection is a qualified safety ground.

Figure 1-14 **Typical STBM Self-Test Display Without Failures**

```
Slot 6  TESTING SYSTEM

Slot 0  passed
Slot 2  passed
Slot 3  passed
Slot 4  passed
Slot 5  passed
Slot 6  passed

D=Default load, M=Menu load, R=Retest, E=Extended tests :
```

Figure 1-15 **Typical STBM Self-Test Display With Failures**

```
Slot 6  TESTING SYSTEM

Slot 0  passed
Slot 2  NUBUS TESTS FAILED
Slot 3  DIAGNOSTIC TESTS FAILED
Slot 4  passed
Slot 5  DIAGNOSTIC TESTS FAILED
Slot 6  ROM TESTS FAILED

D=Default load, M=Menu load, R=Retest, E=Extended tests :
```

Figure 1-16 Typical STBM Extended Self-Test Display

```
Slot 6 TESTING SYSTEM

Slot 0 NEC (TIAU 00002236400-0001 **)
  ETHERNET BOARD TEST
    E'net memory      : passed
    Initialization    : passed
    SCB commands      : passed
    Diagnose          : passed
    IA setup          : passed
    Configure         : passed
    82586 int lpbk    : passed
    Serial int lpbk   : passed
    Network presence: passed
passed

Slot 2 NPI (TIAU 00002238040-0001 **) passed

Slot 3 MEM (TIAU 00002236415-0001 *G)
  EXTENDED MEMORY TEST
    Interface test      : passed
    Parity test         : passed
    Modified addr test  : passed
    Pattern test (1-8) :12345678 passed
    Chip hit test       : >>ERROR
Diagnostic TESTS FAILED

Slot 4 MEM (TIAU 00002236415-0001 *G)
  EXTENDED MEMORY TEST
    Interface test      : passed
    Parity test         : passed
    Modified addr test  : passed
    Pattern test (1-8) :12345678 passed
    Chip hit test       : passed
passed

Slot 5 SIB (TIAU 00002236590-0001 **)
  SYSTEM INTERFACE TEST
    Initialization                : passed
    Event generation vectors      : passed
    RTC and long interval timers  : passed
    Bit map memory address lines  : passed
    Graphics operations           : passed
    Mouse registers               : passed
    Local keyboard USART check    : passed
    Monitor presence              : passed
    Keyboard presence             : passed
    Mouse loopback circuitry      : passed
    Voice loopback circuitry      : passed
    Parallel port data loopback   : passed
    Battery backup                : passed
    Non-volatile ram              : passed
passed

Slot 6 passed

D=Default load, M=Menu load, R=Retest, E=Extended tests :
```

Callouts:

- **slot testing system**
- **slot number and logic board information**
- **name of board diagnostic test**
- **subtest name and result**
- **summary for this slot**
- **slot information and results (This logic board does not perform diagnostic tests.)**
- **initial boot menu**

Slot 4 MEM (TIAU 00002236415-0001 *G)

1. **slot number**
2. **3-character abbreviation of the logic board name**
3. **manufacturer**
4. **part number**
5. **revision letter**

Boot Operations

1.4.2 The Explorer has the following levels of boot operations, which are explained in subsequent paragraphs.

- System reset boot
- Event-initiated boot
  - Default boot
  - Warm boot
  - Cold boot
  - Menu boot

System Reset Boot 1.4.2.1 On a system reset boot, all circuit boards on the NuBus are returned to their initial power-up state. Activating the NuBus RESET– signal initiates a system reset operation. The RESET– signal can be activated by the system power supply when the ac power input to the system enclosure is recycled. The RESET– signal can also be activated by the key chord reset logic on the system interface board. This is accomplished by keyboard chord META-CTRL-META-CTRL-ABORT if there is enough software running to maintain the fiber-optic link from the display monitor.

Event Initiated Boot 1.4.2.2 An event-initiated boot is a software boot that partially reinitializes the system when certain keyboard chords are pressed. These boot operations can save time when you are correcting certain problems. Since the event-initiated boot operations are generated by software, there can be many of them. Explanations for four event-executed boot operations are as follows:

- Default boot — This boot is executed when you enter a D for default load, or, if you do nothing, it is automatically executed 15 seconds after power-up. This boot loads from a device specified by nonvolatile RAM (NVRAM) and from the default partitions specified by the disk label in the default device.

- Warm boot — This boot is executed when you press the keyboard chord META-CTRL-META-CTRL-RETURN during Lisp operation. A warm boot resets and restarts all processes but does not destroy the contents of virtual memory or edited buffers.

- Cold boot — This boot is executed when you press the keyboard chord META-CTRL-META-CTRL-RUBOUT during Lisp operation. A cold boot loads the load band and the microload band that were running when you pressed the keystroke sequence. Thus, you have a newly initialized Lisp environment with no problems, but you have lost the contents of virtual memory.

- Menu boot — This boot is executed when you enter one of the options in Table 1-2 while the boot options line is displayed at the bottom of one of the self-test menus. It can also be executed when you press the keyboard chord META-CTRL-META-CTRL-M during Lisp operation. Menu load option M takes you to a list of boot utility options shown in Table 1-3. This option accesses code contained in a BOOT partition, so it is separate from and more volatile than the other boot sequence.

Table 1-2 **Menu Boot Options From the Self-Test STBM Menus**

Options	*Description*
D (default load)	This option loads from a device specified by nonvolatile RAM (NVRAM) and from the default partitions specified by the disk label in the default device. The D option can be executed during STBM operation.

Table 1-2 **Menu Boot Options From the Self-Test STBM Menus (Continued)**

Options	*Description*
M (menu load)	This option tells the STBM to display a menu of the available load devices (Figure 1-17). After you choose a device, the STBM loads a boot utility from the specified device and displays a menu of boot choices (Figure 1-18). Refer to Table 1-3 for an explanation of the options in Figure 1-18. The M option can be executed during STBM or Lisp operations.
R (retest)	This option repeats the power-up self-tests. The R option can be executed only during STBM operation.
E (extended tests)	This option executes the extended self-tests. The E option can be executed only during STBM operation.
S (select device)	This is an unlisted option that displays a menu similar to Figure 1-17. After you choose an option, it loads the default load and microload bands specified in the disk label of the specified device. The S option can be executed only during STBM operation.
N (named option)	This is an unlisted option that prompts you for a four-character name of a microcode band, such as MCR1, and a system load band, such as LOD1. See Figures 1-19 and 1-20. After you have supplied the names for the selected bands, the system asks you to choose a device that contains these bands from a menu similar to Figure 1-17. The N option can be executed only during STBM operation.
G (GDOS)	This is an unlisted option that displays a menu similar to that shown in Figure 1-17. After you choose a device that has the General Diagnostic Operating System (GDOS), the STBM loads the top level menu of GDOS as shown in Figure 1-21. The G option can be executed only during STBM operation.

NOTE: The terms *bands* and *partitions* are used interchangeably in Tables 1-2 and 1-3. Microload bands are partitions on a disk that contain the microcode that is generally loaded into the RAMs on the processor board. Load bands are partitions on a disk that contain Lisp-type operating software that is loaded into the memory boards.

Table 1-3 **Menu Options From the Boot Utilities Menu**

Options	*Description*
L (Lisp load)	This option displays a menu of load bands (Figure 1-19) from which you can select. It then displays a menu of the microload bands (Figure 1-20) from which you can select.
M (multi-unit load)	This option allows you to boot from a load band on one device and a microload band on another device.
D (diagnostic load)	This option displays a menu of the devices that may contain diagnostic bands. After you select a device, a menu of the diagnostic bands on that disk is displayed. You can then select a diagnostic band from which to boot. This option provides access to diagnostic bands that can include customized diagnostics to supplement the GDOS.
P (print device label)	This option displays a menu of devices on which you can view the device label. When you select a device, a label similar to Figure 1-22 is displayed.

Figure 1-17 **Typical Choices of Available Boot Devices**

```
AVAILABLE LOAD DEVICES

   A= Slot 0 Enet 00
   B= Slot 2 Disk 00
 * C= Slot 2 Disk 01
   D= Slot 2 Tape 07

Choice:
```

Figure 1-18 **Typical Menu Boot Display**

```
L=Lisp load, M=Multi-unit load, D=Diagnostic load, P=Print device label:
```

Figure 1-19

Typical System Load Partitions

```
AVAILABLE SYSTEM LOAD PARTITIONS

 * A= LOD1 HAL 1.63 tkit+5.29
   B= LOD2 HAL 1.88 tkit+M183
   C= LOD3 HAL 1.63 basic

Select partition :
```

Figure 1-20

Typical Microcode Partitions

```
AVAILABLE MICROLOAD PARTITIONS

   A= BOOT Menuboot 14
   B= MCR1 Control 502
 * C= MCR2 Control 183
   D= XDE2 Abort 41
   E= MCR4 Control 179
   F= MCR5 Control 5
   G= TST1 Extended-test 10
   H= GDOS GDOS-3 41
   I= MCR3 Control 182

Select partition :
```

Figure 1-21

Typical GDOS Top Level Menu

```
              General Diagnostic Operating System (GDOS)
                       Revision:        Date:
                           TOP LEVEL MENU

1 Run All Diagnostics .  .  .  .  .  .  .  .  .  .  .   Execute
2 Run Selected Diagnostics.  .  .  .  .  .  .  .  .  .   Execute
    Test NUPI and Disk.  .  .  .  .  .  .  .  .  .  .     No
    Test NUPI and Tape.  .  .  .  .  .  .  .  .  .  .     No
    Test System Interface Board  .  .  .  .  .  .  .      No
    Test NuBus Ethernet Controller Board .  .  .  .       No
    Test Monitor/Mouse.  .  .  .  .  .  .  .  .  .  .     No
3 Enter Extended Diagnostics Mode Menu.  .  .  .  .   Execute
4 Enter Menu to Change GDOS Operational Parameters.  .   Execute


HELP = HELP,  F3 = Reverse Video
```

Figure 1-22 **Typical Condensed Disk Label**

```
Disk: May

  BOOT  Menuboot 14
  MCR1  Control 502
  LOD1  H1.63tkit+5.29
* MCR2  Control 183
  DIAG  GDOS F/S 3201708
  ELOG  Control 172
  XDE2  Abort 42
  MCR4  Control 185
  TST1  Extended-test 10
* LOD2  H1.88tkit+M183
  GDOS  GDOS-3 41
  METR  Control 182
  MCR3  Control 182
  RSVD  End-of-disk1

  L=Lisp load, M=Multi-unit load, D=Diagnostic load, P=Print device label:
```

Login Information

1.4.3 After the system has completed its boot operations, the Lisp Listener becomes active and the words `Lisp Listener 1` appear in the lower left corner of the window (Figure 1-23) to indicate that the interactive Lisp interpreter is active. The *herald* then appears in the upper portion of the window. The herald is a list of the following information about your system:

- Name of system
- Memory available
- Name and version of software
- Logical name of machine
- List of application software versions

A prompt symbol (>) and a flashing keyboard cursor are displayed at the bottom of the herald. This prompt indicates that the system is ready for you to log in. The `lm` in the login example specifies that, for this session, the system should consider this machine as your file server. The `t` in the login example indicates that you do not want to use an initialization file. If you do have an initialization file you want to use, simply omit the `t`. When you type the closing parenthesis, the system executes your login entry. A typical login entry is as follows:

```
> (login 'Explorer 'lm t)
```

When the blinking keyboard cursor reappears and the status message `Keyboard` appears in the status line, your system is ready for operation. The following operations display some important labels and menus that can be useful during maintenance:

- Enter `(print-disk-label)` after the > prompt on the Listener display to call up a disk label similar to Figure 1-24.
- Press the SYSTEM B key sequence to invoke the backup system window. Use the mouse to select the List Contents command from the backup menu. This command lists the contents of a tape that looks similar to Figure 1-25. Refer to the section entitled Backing Up and Restoring in the *Explorer Operations Guide* for more information on the backup window.
- Press the SYSTEM HELP key sequence to display the list of software utilities (Figure 1-26) that are available in the machine.

Refer to the *Explorer Operations Guide* for detailed information on operating the system. A good way to become familiar with the Lisp environment is to practice the instructions in the *Explorer Zmacs Editor Tutorial.* A complete list of hardware and software manuals is included at the beginning of this manual.

Ending a Session

1.4.4 When you are ready to end your session with the Explorer, save any editing buffers that you want to keep and then log out. Refer to the *Explorer Operations Guide* for a discussion on saving buffers and files. The following paragraphs describe how to log out and, if necessary, how to power down the system. Normally, the Explorer system should remain powered up at all times. The power-down procedure is for maintenance use or for when the system is not going to be used for several days.

Logout Information

1.4.4.1 The following logout procedure does not change the environment, destroy the contents of buffers, or kill or bury windows. It allows you to log in again without recycling the ac power input to the system enclosure.

1. Press the SYSTEM L key sequence to return to the Lisp Listener
2. Type `(logout)`

Power-Down Information

1.4.4.2 The following procedure stops the system clock, which makes it necessary to recycle the ac power input to the system enclosure before you can log in again. The ac input power to the system enclosure should always be turned off in a power-down procedure.

CAUTION: If the system being powered down is part of a network of stations and is providing a file system or a printer for the other stations, notify the other stations before performing the following power-down procedure.

1. Press SYSTEM L to return to the Lisp Listener.
2. Type `(logout)` and, before continuing with the next step, wait until all disk activity stops, the run bars disappear, and the status line does not report any file activity.
3. After the > prompt, type `(fs:dismount-file-system)`.
4. After the next > prompt, type `(si:shutdown)`.
5. Turn off the ac power to all the components in the system.

Figure 1-23 Typical Initial Listener Display

```
> (print-herald)
************************************************************************
                       RESTRICTED RIGHTS LEGEND

Use, duplication, or disclosure by the Government is subject to
restrictions as set forth in subdivision (b)(3)(ii) of the Rights in
Technical Data and Computer Software clause at 52.227-7013.

                   TEXAS INSTRUMENTS INCORPORATED
                            P.O. Box 2909
                        Austin, Texas  78769
                              MS 2151

Copyright (c) 1985, Texas Instruments. All Rights Reserved.
Explorer is a trademark of Texas Instruments Incorporated.
************************************************************************
TI Explorer System, band LOD2 of disk1. (Rel1.0Min Aus)
4 MB of physical memory, 74 MB of virtual memory.
 Explorer System Software   1.0.1+
 SYSTEM                     1.104
 Compiler                   1.14
 Window System              1.13
 ZMACS                      1.10
 Explorer-Net               1.11
 Telnet                     1.2
 VT100                      1.1
 Local-File                 1.31
 Net-Config                 1.24
 Explorer Streamer Tape     1.19
 User Profile Utility       1.7
 Experimental IMAGEN        2.0
 PROLOG                     1.0
 Microcode                  213
TI_AUSTIN_RESEARCH HORTENCE, with associated machine L10.
>
>
> (login 'Explorer t)
T
>

Lisp Listener 2
```

Figure 1-24 Typical Expanded Disk Label

```
> (print-disk-label)
Hortence: Alpha-S/W, Prototype, physically 1
LABL version 2, DISK
1024 bytes per block, 256 bytes per sector,
15 sectors per track, 32 heads,
918 cylinders, 500 sectors for defects,
Current microload = MCR2, current virtual memory load (band) = LOD6
Partition table PTBL, starting block 2, length 1
Save area SAVE, starting block 3, length 1
10 partitions, 8-word descriptors:
  MCR1 (Explorer Microcode) at block 17, 148 blocks long, "CTL 163 (Ford)"
* MCR2 (Explorer Microcode) at block 165, 148 blocks long, "CONTROL 188"
  MCR3 (Explorer Microcode) at block 313, 148 blocks long, "CONTROL 186"
  LOD7 (Load Band) at block 461, 27536 blocks long, "HAL 1.53 basic"
* LOD6 (Load Band) at block 27997, 48319 blocks long, "ICE 1.1 cm TKIT"
  MCR5 (Explorer Microcode) at block 76316, 148 blocks long, "CONTROL 179"
  LOD3 (Load Band) at block 76464, 33136 blocks long, "Ford Tlkt u163"
  RSVD (Test Zone) at block 109600, 0 blocks long, "End-of-Disk"
  MCR4 (Explorer Microcode) at block 109600, 148 blocks long, "CONTROL 172"
  ELOG (Test Zone) at block 109748, 2 blocks long, ""
NIL
```

Figure 1-25 Typical List of Contents of a Tape

```
                                   Backup System
Preparing ... PREPARE-TAPE complete.
Listing contents ...
L11: MFG-UTILITIES.TAPES;TEMP-RESTORE-FILE.LISP #1     5     4935(8)  4/17/85 05:02:42     CORN
ISH
End of recorded media on unit 6.
 LIST-CONTENTS complete.

Backup Typeout Window
Read file headers from tape and display them until a double EOF is encountered.

04/17/85 05:35:09AM ROSEMARY    USER:    Keyboard          FILE serving C8
```

```
Backup Command Menu
      Prepare Tape
      Unload Tape

    Erase Entire Tape
       Re-Tension

         Rewind
    Prepare to Append
 Position Past File (EOF)
   Position Past Blocks

       Backup File
  Backup Multiple File
    Backup Partition

      Restore File
  Restore Multiple File
    Restore Partition
    Restore Boot Tape

       Verify File
  Verify Multiple File
    Verify Partition

  Load Distribution Tape

       Write EOF
     List Contents
         Help
         Exit
```

Figure 1-26 Typical Software List

```
Type System followed by one of these characters to select the corresponding program:

B       Backup System
C       Converse
D       Database Interface
E       Editor
F       Font Edit
G       Graphics Editor
I       Inspector
L       Lisp
P       Peek
R       Tree Editor
S       Supdup
T       Telnet
W       Window Debugger
Z       Glossary System

Type System control-<character> to create a new window of a particular type.
Type Rubout after System to do nothing (if you typed System by accident).

Press the space bar to remove this message.
```

CONTENTS

1 EXPLORER SYSTEM PREVENTIVE MAINTENANCE

Highlights of This Section

- PM schedule summary
- Explorer 7-slot enclosure PM procedures
- Mass storage enclosure PM procedures

Introduction

1.1 This section provides preventive maintenance (PM) procedures for the Explorer system. A summary of the PM schedule is listed in Table 1-1.

Table 1-1 **PM Schedule Summary**

Schedule	*Action*
As needed	Clean all enclosures.
Every 20 hours of tape drive operation	Clean the tape drive read/write heads.
Every six months	Clean the Explorer enclosure air filter.
Once a year	Replace the Explorer enclosure air filter.

CAUTION: The anti-glare video display should be cleaned using a neutral cleaner (detergent) and a lint-free cloth. Do not use an acid or alkaline cleaner to clean the video display as this may damage the screen.

Explorer 7-Slot Enclosure PM

1.2 For efficient operation, cooling air must be supplied to the computer circuit boards and power supply board. If the filter clogs with dust, airflow is restricted and the electronics can then overheat.

CAUTION: Carefully monitor the condition of the air filter. Set up a schedule for more frequent cleanings and filter replacements if the filter collects excess dust between scheduled cleanings and replacements. Dust buildup can lead to overheating, accelerated aging, and reduced reliability.

Keep the enclosure clean and dust free by wiping down the exterior with a damp (not wet) cloth and mild detergent.

CAUTION: Do not use strong detergents, cleaners, or solvents to clean the enclosure.

Perform the following procedure to clean and/or replace the air filter:

1. Set the ac power on/off button on the front of the enclosure (Figure 1-1) to the off (out) position.

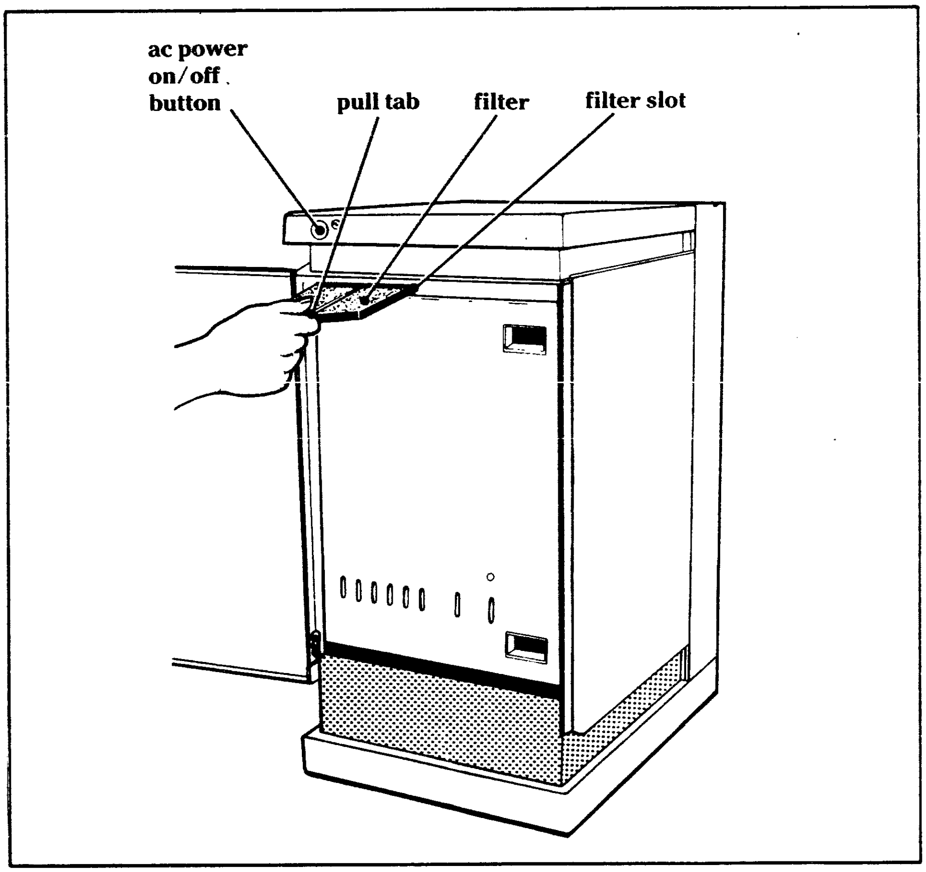
2. Open the front plastic door to the enclosure and locate the air filter at the upper left corner above the chassis assembly.

3. Remove the air filter by pulling straight out on the pull tab of the air filter.

4. Clean the air filter in warm water with a mild detergent. Allow the filter to dry thoroughly before installing it in the chassis.

5. Install the air filter by inserting it into the filter slot with the pull tab out. Close the enclosure door and apply the ac power to the enclosure.

Figure 1-1 **Explorer Enclosure Air Filter Replacement**



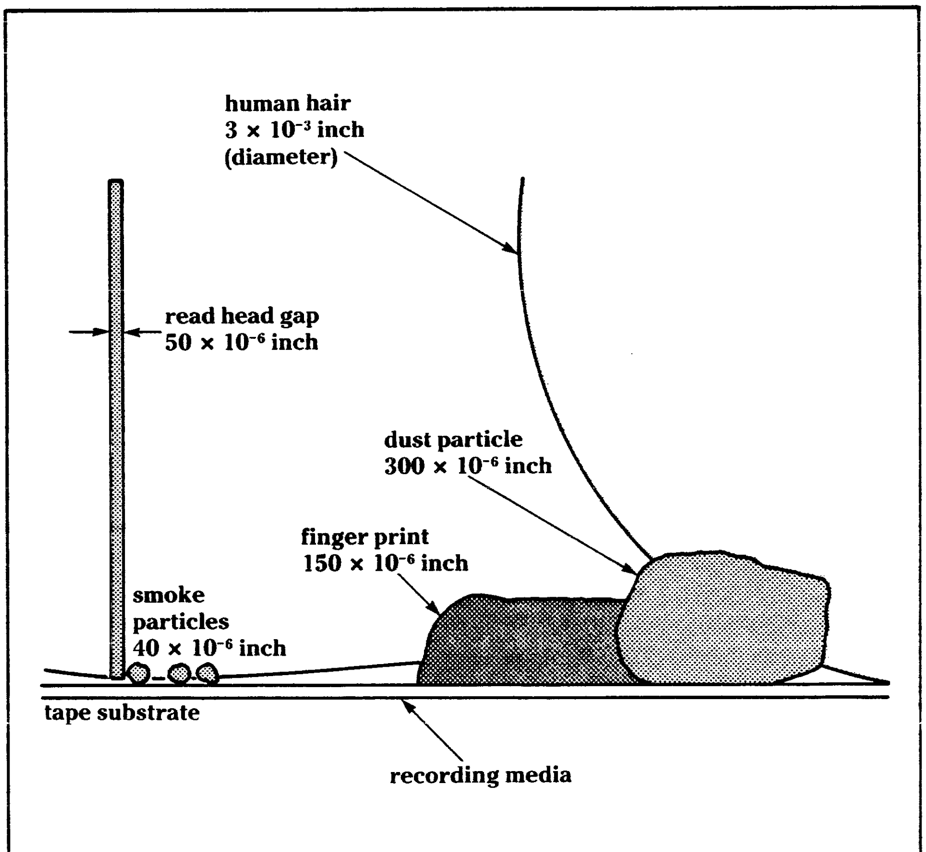
Mass Storage Enclosure PM

1.3 The mass storage enclosure PM consists of cleaning the enclosure as needed, and cleaning the read/write heads on the tape cartridge. Keep the enclosure clean and dust free by wiping down the exterior with a damp (not wet) cloth and mild detergent as needed.

CAUTION: Do not use strong detergents, cleaners, or solvents to clean the enclosure.

The read/write heads of the tape drive can accumulate metal oxides and dust. Figure 1-2 shows how small particles of dust, smoke, and fingerprints can block the gap between the heads and the tape substrate and cause errors during read/write operations. A large accumulation of material on the read/write heads also can cause poor performance. To ensure good performance from the tape drive, clean the read/write heads after every 20 hours of drive use. If you are using only new tapes, you may need to clean the heads more often to remove the accumulation of metal oxides.

Figure 1-2 **Relative Contamination Particle Sizes**



Clean the read and write heads as follows:

1. Set the ac power on/off button on the rear of the mass storage enclosure to the off (out) position.

2. Remove the tape cartridge (if installed) from the tape drive.

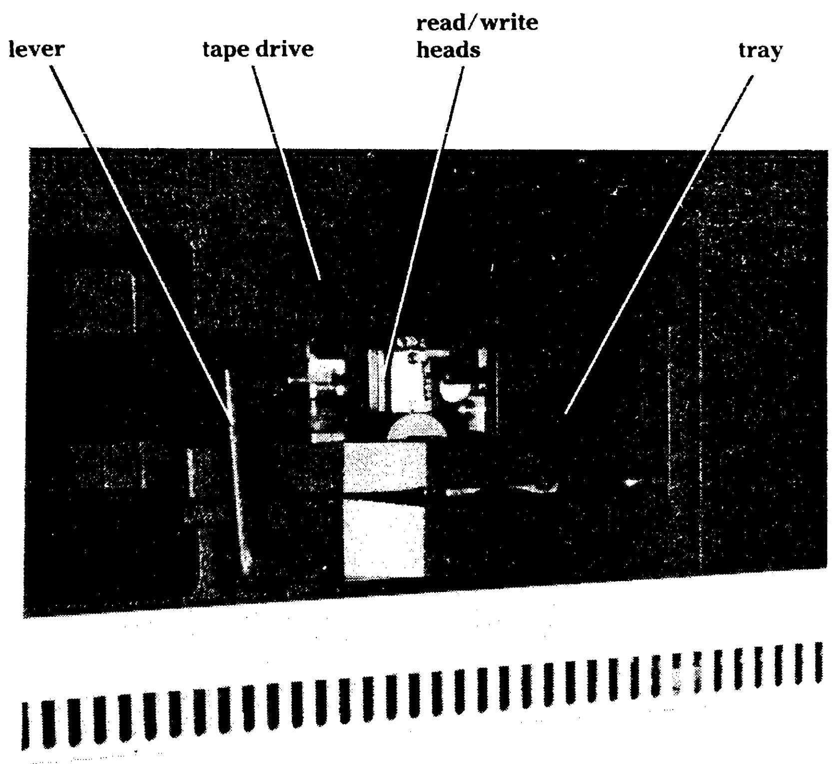
3. Rotate the lever on the front of the tape drive counterclockwise to its vertical position to orient the heads forward. The heads (Figure 1-3) are located in the drive along the right side of the opening where the tape cartridge is inserted. The heads are part of the brass-colored rectangular piece that measures about 13 millimeters (½ inch) by 19 millimeters (¾ inch).

4. Gently clean the mirror-polished surfaces of the read/write heads with a lint-free swab moistened with CDC head-cleaning solvent number 82365800 (TI part number 0943849-1513). This is a Freon™ solution mixed with a small amount of alcohol. Pour the solution on the swab. Do not dip the swab into the bottle.

5. Allow the heads to dry thoroughly before using the tape drive.

Freon is a trademark of E.I. du Pont de Nemours & Company, Inc.

Figure 1-3 **Tape Drive Read/Write Head Location**



CONTENTS

Figures

IMPORTANT MAINTENANCE INFORMATION

1

Highlights of This Section

- Maintenance philosophy
- Maintenance support resources
- Guidelines for handling circuit boards
- Guidelines for reducing/preventing EMI
- The structured service call

Introduction

1.1 This section provides information that all maintenance personnel should study and understand before performing any maintenance on the Explorer system. This information applies primarily to TI customer representatives (CRs) and to customers who perform their own maintenance. This information should be used as a guideline for proper field-level maintenance.

Maintenance Philosophy

1.2 The maintenance philosophy is centered around the idea that customers can perform a large part of their own maintenance on the Explorer system. The Explorer system is designed so that the customer can replace most of the faulty subassemblies, units, or parts. Components that are soldered to circuit boards are not normally replaceable; these components are normally replaced at a depot type facility.

Self-tests and diagnostics that are built into the system make it easy to determine the faulty component(s) when a problem occurs. TI also maintains a comprehensive maintenance organization that is ready to help customers solve system problems by telephone or on site as necessary.

Because many special maintenance situations can develop at different customer sites, use the following general summary as a guideline to help establish good maintenance techniques for both the customer and the CR.

- Explorer system operating requirements:
  - The system must operate in a reasonably clean and dust free environment with temperatures and humidity conditions that are within the system specifications. Refer to Section 1 of the General Information part of this manual for system specifications.
  - The system must operate from an ac power and ground system that is within the system specifications.
  - The system must operate in an environment that meets acceptable electromagnetic interference (EMI) requirements as outlined in the paragraph entitled Reducing and/or Preventing EMI.
- Customer responsibilities:
  - Be able to perform self-tests and diagnostics on the equipment.
  - Be able to identify defective components by observing the fault LEDs on assemblies and/or messages displayed on the video display.
  - Be able to replace faulty components with spares or components from TI's fixed-price repair facility.
  - Be able to perform the Preventive Maintenance procedures in the PM part of this manual.

- CR responsibilities:
  - Have a thorough knowledge of the hardware and software associated with the Explorer system.
  - Be available to give advice to customers who are unable to perform their own maintenance.
  - Go to the customer's site to solve problems that customers cannot solve on their own.
  - Follow the recommended service methods outlined in the structured service-call flowchart (Figure 1-3) and Table 1-1.
  - Know how to use all of the maintenance support resources discussed in the next paragraph.

Maintenance Support Resources

1.3 Maintenance resources are available that support the CR and the customer. A customer telephone hot line is available to the customer. This hot line operates in the same manner as the CR telephone hot line. The following maintenance support resources are primarily for the CR:

- Maintenance standard
- Field information system (FIS)
- Failure notification system (FNS)
- CR and customer telephone hot lines
- Spare parts and test equipment
- Technical manual library

Additional help is available from other CRs, systems engineers, systems analysts, and the regional operations manager. Consult your local field service office for information on how to access the support resources. The following paragraphs describe each resource and explain how they can be of use.

Maintenance Standard

1.3.1 The *Explorer Maintenance Standard*, TI part number 2308948-9701, is the document that sets performance standards for the Explorer system and defines what is needed to meet those standards. The maintenance standard is available from your local TI field service office.

Field Information System

1.3.2 The field information system (FIS) is a computer database that contains detailed historical data and service information on TI equipment installed throughout the United States. Historical information on repeated failures is automatically obtained from the failure notification system (FNS) over computer communication links between the FIS and then the FNS. Local service information is placed on the FIS in the form of tickets (database files). Several types of tickets are briefly described as follows:

- Remedial — A record of service calls.
- Installation — A record of equipment installation.
- Preventive maintenance (PM) — A record of PM.
- Site inspection — A record of site inspection.
- Depot maintenance — A record of depot maintenance.
- Special cases — A record of miscellaneous customer contacts.

Tickets are normally started, maintained, and closed out by administrative field service personnel. Each type of ticket has a prearranged format that has blank areas for all important information, including a plan of action by the CR for difficult problems that need further maintenance. A numbering scheme is used to keep track of the tickets so that field service information is available to all TI maintenance personnel.

Data is entered on the tickets from a computer terminal. When CRs are out on a call, they can enter data using a portable terminal or call and have the dispatcher enter the data.

Failure Notification System

1.3.3 The FNS is a computer database that contains detailed information on TI equipment installed throughout the United States that had repeated failures. When a customer whose equipment has had repeated failures calls in, the serial number of his equipment is entered into the FNS. This triggers the FNS database to automatically send messages to the appropriate CRs, systems analysts, and the regional operations manager informing them of the failure. The message includes detailed information on the history of the equipment, the nature of past failures, and a plan of action to take.

CR and Customer Telephone Hot Lines

1.3.4 There are separate telephone hot lines available to the CR and the customer. These hot lines provide an immediate source of technical information. These hot lines are operated by computer experts who can answer most technical questions and give advice on how to isolate and correct a problem.

Spare Parts and Test Equipment

1.3.5 Stocks of spare parts and test equipment are maintained at several different levels. Each higher level of spare parts and test equipment has a more complete inventory than its lower level. This gives the CRs access to most of the parts in the Explorer system. Parts and test equipment that are used the most are stocked at lower levels, while less used parts and test equipment are stocked at higher levels. The levels of supply for spare parts and test equipment are:

1. CR's personal stock

2. Local field service office

3. Regional field service office

4. National distribution center

Technical Manual Library

1.3.6 Each field service office has an up-to-date library of hardware and software documents associated with the TI equipment that is installed in the service area. This library is available to all TI maintenance personnel. The CRs must have a thorough understanding of the hardware and software associated with the equipment they service. The technical manual library is a prime source for this knowledge.

Handling Circuit Boards

1.4 Always handle circuit boards with care. Static electricity and incorrect handling can easily cause damage to the circuit boards. With boards that have a battery, use special care to prevent accidental discharge of the battery.

Preventing Static-Electricity Damage

1.4.1 Most circuit boards contain static-sensitive electronic components. To prevent damage to these components, make sure that you are properly grounded before handling any circuit board.

The recommended grounding method is to use a static-control system composed of a static-control floor and/or table mat and a static-control wrist strap (these are commercially available). If you do not have a static-control system, you can discharge any static charge by touching a properly grounded object prior to handling a board. Then, as an additional safety measure, put the board on a grounded work surface after removing it from the system enclosure or its static-protective bag (Figure 1-1).

NOTE: The system interface board has a battery to keep the nonvolatile random-access memory (NVRAM) chips alive. When handling this board, do not place it on a conductive surface, such as the static-protective bag shown in Figure 1-1, as this can discharge the battery. The outside surface of the static-protective bag has a conductive coating that is designed to discharge static charges from your body before you touch the board.

Before transporting or storing the board, return it to the static-protective bag or the system enclosure.

Preventing Physical Damage

1.4.2 Always keep unused circuit boards inside a circuit board storage container, such as that shown in Figure 1-2, to prevent physical damage to the board. Be sure to follow the static-electricity recommendations in the previous paragraph when handling the circuit boards.

CAUTION: The large number of connector pins on the rear edges of the circuit boards makes them particularly susceptible to bending. Be extra careful when inserting a board into the backplane; bent pins can cause unusual problems in the system, and they are hard to find when all the boards are in place. Use the same care with cable connectors.

Figure 1-1 Removal of Static-Protective Bag

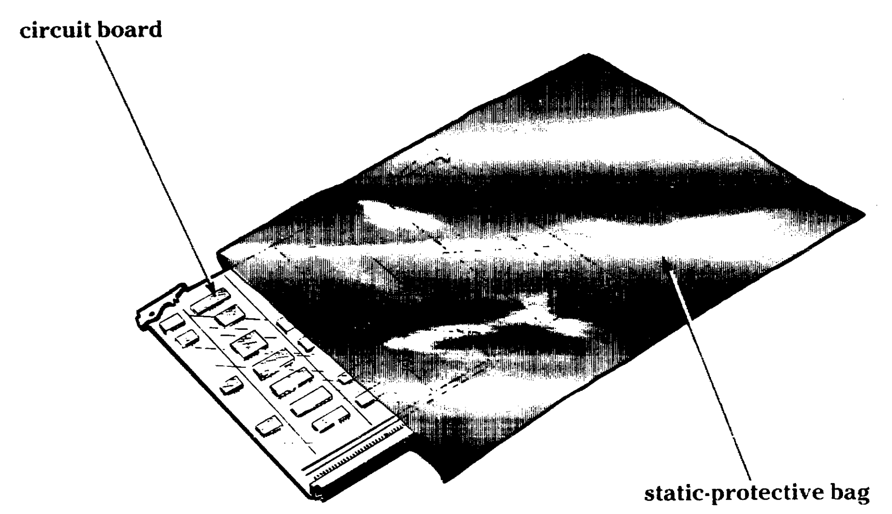
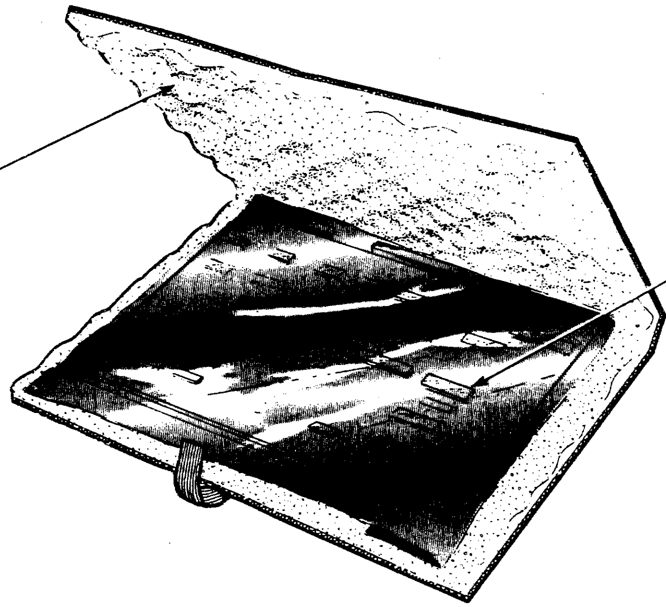


Figure 1-2 Circuit Board in Storage Container



Reducing and/or Preventing EMI

1.5 To keep the TI equipment operating properly, use the following guidelines for reducing and preventing electromagnetic interference (EMI):

- Ensure that all grounds removed during disassembly are reinstalled after repairs are made.
- Ensure that the insulation and shielding on all cables are in good condition.
- Ensure that only TI approved cables are used on TI equipment.
- Ensure that excess electrical cable lengths are stored in flattened bundles rather than coils to lessen the effect of coil radiation. This does not apply to fiber-optic cables.
- Ensure that all metal doors are closed after repairs are made.
- Check the site and nearby areas for evidence of the installation of high-powered radio and/or television transmitters or any high-powered electrical transmission lines and equipment that could cause electromagnetic radiation interference. Report any new developments that could cause electromagnetic radiation interference to the customer and record this information in the CR log.

Structured Service Call

1.6 The structured service call is a recommended method that field service personnel should follow when making a service call.

The CR needs to log all actions taken during the structured service call procedure. If at any point the CR has to leave the service call site, a copy of the log should be left at that site for use by the next CR calling at the site. The structured service call is divided into the following six sections:

- Section A — Gathering data before going to the site
- Section B — Duplicating the symptom
- Section C — Course of action for the duplicatable symptom
- Section D — Course of action for the intermittent duplicated symptom
- Section E — Course of action for the nonduplicatable symptom
- Section F — Determining the cause of failure

The six sections of the structured service call are all shown on one flowchart (Figure 1-3) for convenience. Table 1-1 provides detailed information on how to interpret the flowchart.

Figure 1-3 Structured Service Call Flowchart

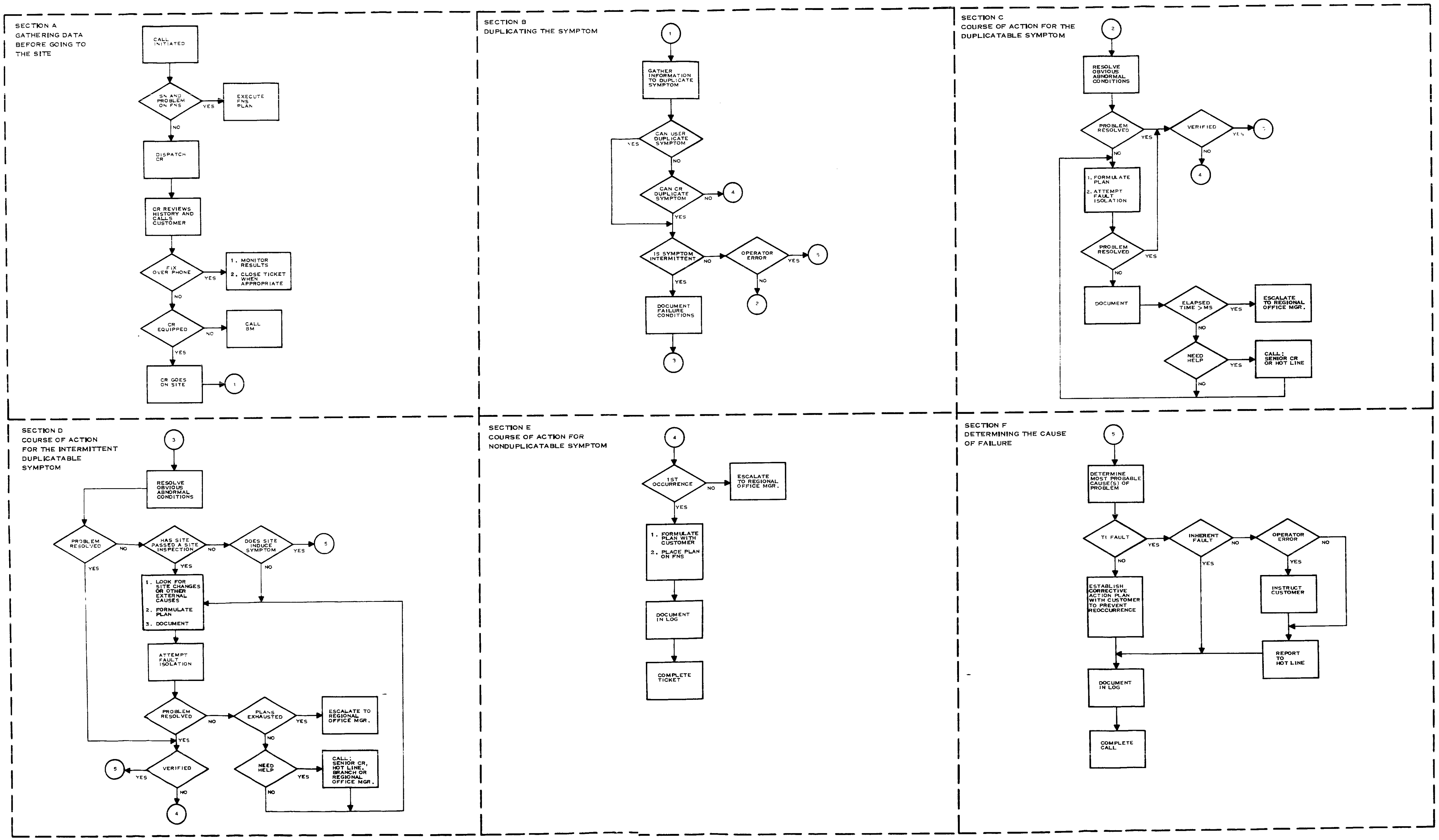


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Table 1-1 Structured Service Call Explanation

Section A — Gathering data before going to the site

Part A-1 Call initiated by customer	1. The customer reports a problem. 2. Call screening occurs (if available for that product) to attempt to resolve the problem over the phone. 3. If the problem cannot be resolved over the phone, then a field information system (FIS) ticket is opened and as much clarifying information as possible is noted on the ticket.
Part A-2 Is SN on FNS?	1. If the serial number (SN) is on the failure notification system (FNS), take the appropriate action. Examples are: ■ Send out a systems engineer (SE). ■ Send out another CR. ■ Notify the same CR that originally went on the call. ■ Notify the regional operations manager. 2. If the SN is not on the FNS, a CR is dispatched to the customer's site.
Part A-3 CR reviews history and calls customer	1. The objective here is to identify any previous problems, either with the site or the equipment. The CR should note all parts that were changed on previous calls. These parts should be considered good until self-tests and other approaches to solving the problem are made. If self-tests fail and the problem still exists, consider the possibility that a previously replaced part has failed. 2. Review the history of the site and the equipment. ■ Check the ticket for any problem descriptions, call screening data, and previous tickets. ■ Identify if there is any history of failures: ▪ Problems at this location ▪ Failures with this piece of equipment ■ Sources of history: ▪ FIS tickets ▪ Customer ▪ Other CRs ▪ Dispatchers (they may know of other calls at the site)

3. The CR calls the customer:
   - To set up an appointment
   - To verify call screening data
   - To obtain more data to appraise the problem
   - To determine the proper equipment to take to the site if necessary

Part A-4
Fix problem over the telephone

1. Many problems can be solved by a phone call, for example:
   - The operator is entering keystrokes incorrectly.
   - Switches, options, or configurations are set incorrectly.
   - The customer needs to perform PM (clean tape heads, replace filters, and so on).
   - The brightness or volume is turned too low.
2. If the problem can be fixed over the phone:
   - Monitor the results.
   - Close the ticket when appropriate.
3. If the problem cannot be fixed over the phone, the CR will have to go out on the call.

Part A-5
Is CR equipped to make call?

1. Before going to the site, the CR needs to ensure that he/she:
   - Has the proper parts, tools, test equipment, and diagnostics.
   - Has enough knowledge of the equipment to attempt repair (is certified).
   - If the CR is not equipped, he/she should notify the branch manager.
2. If the CR is equipped, he/she needs to go to the site, keeping the following items in mind when making a call:
   - Notify the branch manager if there is a low probability of success.
   - Be familiar with the history of the site and have all necessary equipment.
   - Do not spend excessive time trying to fix the problem over the phone if you are not making progress in solving the problem.

The next phase of the call is Section B, Duplicating the symptom.

Section B — Duplicating the symptom

Part B-1
Four types of symptoms

1. Duplicatable — The symptom is a repeatable malfunction that occurs in a predictable manner.
2. Duplicatable, but intermittent — The symptom appears to be random.
3. Nonduplicatable, first occurrence — The symptom cannot be duplicated within a reasonable amount of time and has no previous history.
4. Nonduplicatable, not first occurrence — The symptom cannot be duplicated within a reasonable amount of time and has a history of the same symptom.

Part B-2
Gathering information and duplicating the symptom

1. When interviewing the customer, the CR should use good customer management skills. The following questions are helpful in identifying potential problem areas.
2. Identify the person who knows what the problem is and ask the following initial questions:
   - Was the equipment working before? If so, what was done before it stopped working?
   - What operation were they performing?
   - What unit did the problem occur on?
   - What was the error? (Note the error message.)
3. Document any pertinent facts provided by the customer for future reference.

Part B-3
Can user duplicate symptom?

1. Have the user duplicate the symptom. The CR should not try to duplicate the symptom for the user.
2. Recognize abnormal/normal operation by closely observing the way the operator performs the operation, and look for possible errors.
3. If the user is able to duplicate the symptom, the CR should check if the symptom is intermittent in part B-5, that is, try to duplicate the symptom again.
4. If the user cannot duplicate the symptom, the CR should attempt to duplicate the symptom.

Part B-4
Can CR duplicate symptom?

1. Here, the CR attempts to duplicate the symptom. The first task is to gather information by asking equipment-related questions, for example:
   - Has the system configuration been changed?
   - Is there new software? This could cause terminals not to be acknowledged, programs not to work, printers to print bad, and so on.

- Has equipment been moved? This could cause cables, boards, or parts to come loose.
- Has anyone worked on or near the equipment? They may have broken a cable or caused something to come loose.
- Has anything else been changed?

2. Review other possibilities, for example:
   - Faulty interlock switches? Test the switches.
   - Cables damaged? Wiggle the wires.
   - Improperly installed cables? Check the cables.
   - Improperly seated boards? Reseat the boards.
3. Reexecute the operation several times using a different approach each time if possible.
4. Run the diagnostics.
5. If the symptom is duplicatable, perform the following:
   - If the system failed while running the diagnostics, the CR should consider if this failure relates to the original symptom. The failure identified by the diagnostics must be resolved.
   - Determine if the symptom is intermittent in part B-5.
6. If the symptom is not duplicatable, go to Section E, Course of action for nonduplicatable symptom.

Part B-5
Is symptom intermittent?

1. If the symptom is intermittent, perform the following:
   - Document the failure conditions.
   - Go to Section D, Course of action for the intermittently duplicatable symptom.
2. If the symptom is not intermittent, determine if the operator is performing the operation correctly by doing the following:
   - If it is an operator error, go to Section F, Determining the most probable cause of failure.
   - If it is not an operator error, go to Section C, Course of action for the duplicatable symptom.

Section C — Course of action for the duplicatable symptom

Part C-1
Resolve obvious abnormal conditions

1. Duplicatable failures can be caused by factors involving ac power, heat, software, and so on, but it is more probable that duplicatable failures are caused by hardware. This section concentrates on hardware-related faults. The CR should document whether the symptom has cleared or changed as actions are taken.
2. Remove all customer furnished equipment. The only exceptions are ac power and data communications equipment.
3. Correct any problems you can find, for example:
   - Is the unit plugged in?
   - Are the interlock switches operating properly? Test the switches.
   - Are there any burned-out lamps?
   - Are there any loose or damaged cables? Wiggle the cables.
   - Are the cables installed properly?
   - Are the boards seated properly? Reseat the boards.
   - Is the equipment configuration correct?
   - Check the results of the built-in self-tests and diagnostics.

Part C-2
Problem resolved

1. Repeat the operation that demonstrates the problem and verify proper operation.
2. Run appropriate tests to ensure proper operation. Ensure that what was done has not caused another problem.
3. If the problem has been resolved, go to part C-6 to verify the results.
4. If the problem has not been resolved, the CR must begin troubleshooting.

Part C-3
Formulate a plan

1. The CR should develop a troubleshooting plan based on the equipment type, symptoms, past experience, and so on. The plan should be a step-by-step process identifying:
   - The areas that could not cause the fault
   - At least three areas that might cause the fault
   - The process used to locate the fault

2. The following steps are offered as typical steps in most troubleshooting processes:

   - Look at all data available.
   - Ensure all field change orders (FCOs) have been implemented.
   - Recall problems that have previously occurred at this location.
   - Consult and interpret equipment logs and system logs.
   - Consult flowcharts, self-tests, and diagnostic error code tables.
   - Consult any technical notices, such as field service bulletins (FSBs) and any alert memos that may apply to this situation.
   - Gather any additional information needed.

Part C-4
Attempt fault isolation techniques

1. Try the easiest checks first:

   - Check the voltages.
   - Check any alignments and/or adjustments that could cause the problem.
   - Remove all nonessential parts if the system does not load.
   - Run the diagnostics.
   - Use a controlled search technique: isolate to an area, then to a section in that area, and then to the faulty part.
   - Utilize any special test equipment.

2. If parts need to be replaced, consult with the customer as follows:

   - If the customer is responsible for charges, they need to be told what is required to repair the equipment so they can decide whether to proceed or not.
   - If the problem was caused by a catastrophic failure (fire, flood, operator disaster, and so on), field repairs may be too expensive. You can suggest a factory rework of the equipment.

3. Keep track of the parts removed from the equipment and the spare parts used from inventory.

4. Review the following different fault isolation techniques for advantages and disadvantages:

   - Fix the easiest problems and move on when there are multiple failures.
   - Replace parts individually, starting with those most likely to fail.
   - Avoid changing a part that could possibly destroy the spare. An example could be replacing the motor instead of the board that drives the motor. Even though it is more difficult to replace, the motor could be damaged in such a way that it would destroy the replacement board. The board is less likely to destroy the motor.
   - Replace parts in associated groups, then substitute one part at a time to find the faulty part in the group.

NOTE: The following steps are examples of controlled board swapping, not shotgunning, and are acceptable. Shotgunning is the indiscriminate replacement of parts with no logic or reason behind it. Shotgunning is normally the direct result of panic on the part of the CR.

   - Exchange boards using a planned and logical problem-solving sequence using marked or labeled boards for identification.
   - Document the results of each step carefully.
   - Replace more than one part at a time only if replacing one part could damage an associated part.
   - Replace the original parts that were replaced if they do not correct the problem.
   - Be alert for possible multiple problems.

Part C-5
Problem resolved

1. Repeat the operation that demonstrated the problem to verify proper operation.
2. Run the appropriate tests to ensure proper operation of the replacement part to ensure that the replacement part has not induced another problem.
3. If the problem is resolved, go to part C-6.
4. If the problem is not resolved, go to part C-7.

Part C-6
Repairs verified

1. If the equipment is placed back to its original condition (original boards reinstalled) and the symptom does not return, the symptom has become nonduplicatable. Go to Section E, Course of action for nonduplicatable symptoms.

2. Try to verify that what was done repaired the problem. Examples:

   - Unplugging the unit
   - Wiggling the interlock switches
   - Reinstalling the burned-out lamps
   - Wiggling the damaged cable
   - Going back to the original equipment configuration
   - Reinstalling the broken part (only if feasible) to ensure that the symptom returns

3. If you can verify the fix, go to Section F, Determining the most probable cause of failure.

4. If you cannot verify the fix, go to Section E, Course of action for the nondupli-catable symptom.

Part C-7
Document

1. Document everything done to make the repair and document the tests that were made to verify the repair.

Part C-8
Elapsed time greater than maintenance standard

1. The maintenance standard determines the time limit to troubleshoot a particular piece of equipment. If you are approaching or have exceeded the time limit and have not corrected the problem, proceed as follows:

   - Review all notes and documentation.
   - Contact the regional operations manager and discuss alternatives, such as:
     - Discussing the problem with other CRs and/or the hot line
     - Placing the call on hold
     - Enlisting the help of a systems engineer
     - Putting together a tiger team (a group of experienced high-level maintenance people)
   - Your main objective must be to get the customer's equipment operational as quickly as possible. TI does not expect the CR to fix 100 percent of the problems. TI does, however, expect the CR to use team effort, when appropriate, in order to get the customer's equipment operational as quickly as possible.

Part C-9
Need help

1. If help is required:
   - Review all notes and documentation before calling for help.
   - Call alternate resources, such as:
     - The CR hot line
     - A senior CR in the office
2. If help is not required, continue the fault isolation process in part C-4.

Part C-10
Things you should not do

1. Do not reinstall the suspected part if it will destroy something else.
2. Do not reinstall the suspected part if it will cause too much work or excessive equipment downtime.
3. Do not exchange boards at random (shotgun approach).
4. Do not get parts from the spares kit mixed up with the equipment parts.
5. Do not keep trying to repair the problem if you asked for help and they cannot duplicate or fix the problem.
6. Do not let personal feelings get in the way of asking for help from higher authority.
7. Do not give up when the assistance arrives. Keep in mind that problem solving is a team effort at this point.

Section D — Course of action for intermittent duplicatable symptom

Part D-1
Keeping the situation under control

1. Hardware can cause intermittent failures; but it more likely that external factors are involved. Keep in mind that these external factors may not be the cause of the problem. When troubleshooting an intermittent duplicatable failure, the CR should control the situation by using some of the following techniques:
   - Step away and think.
   - Keep a logical approach.
   - Use customer management skills (CMS) to avoid customer pressure.
   - Assure the customer that the problem is being resolved.
   - Review previous documentation.

Part D-2
Resolve obvious abnormal conditions

1. Correct any problems you can find during a visual inspection, for example:

   - Check for any loose or damaged cables by wiggling the wires.
   - Ensure that the boards are seated properly.
   - Check for proper equipment configuration.
   - Look for dusty and dirty equipment.

Part D-3
Problem resolved

1. Repeat the operation that demonstrated the symptom and verify proper operation.
2. Run the appropriate tests to ensure that whatever was done has not induced another problem.
3. If the problem is resolved, go to part D-10.
4. If the problem is not resolved, find out if a site inspection was performed.

Part D-4
Has site passed previous site inspection

1. If no site inspection was performed:

   - Ensure that a site inspection gets scheduled for a specific date and time.
   - Go to part D-5.

2. If a site inspection was performed and the site passed, go to part D-5.
3. If a site inspection was performed and the site did not pass, find out if the site induced the symptom. For example, no safety ground causes intermittent errors or 120-volt impulse on neutral causes intermittent system crashes.

   - If the site induced the symptom, go to Section F, Determining the most probable cause of failure.
   - If it does not, go to part D-5.

Part D-5
Look for external factors

1. Look for environmental sources that can cause a site to induce the symptom, such as:

   - Any site changes identified by earlier questioning. For example:
     - The electrician was in — check the ac power.
     - The site is too hot or too cold — advise customer of this condition.
     - The site is prone to electrostatic discharge — if humidity is too low, advise the customer of this condition.
   - Check for dirt and other contaminants in the air filter — this could be causing heat problems.

2. Look closely at other external factors, such as:
   - Data communications
   - Media problems (poor quality)
   - Application software
   - Electrostatic discharge and/or electromagnetic interference

Part D-6 Formulate a plan

1. The CRs should develop a troubleshooting plan based on the equipment type, symptoms, past experience, and so on. The plan should be a step-by-step process identifying:
   - The areas that could not cause the fault
   - At least three areas that might cause the fault
   - The process used to locate the fault
2. To help develop the plan:
   - Ensure that all FCOs have been implemented.
   - Look at all available data:
     - Consult any technical notices such as FSBs and alert memos that may apply to this situation.
     - Recall any previous problems that have occurred at this location.
     - Consult and interpret equipment logs and system error logs.
     - Consult flowcharts, self-tests, and diagnostic error code tables.
     - Recall any external problems encountered.
     - Recall all steps taken to duplicate the symptom.

Part D-7 Document

1. Document everything done to make the repair and document the tests that were made to verify the repair.

Part D-8 Attempt fault isolation

1. Check the voltages.
2. Check any alignments and/or adjustments that could cause the problem.
3. If parts are to be replaced as a part of the isolation process:
   - Discuss the problem with the CR hot line.
   - Reinstall the original part if the failure is not corrected.

Part D-9
Problem resolved

1. Repeat the operation that demonstrated the problem and verify proper operation.

2. Run the appropriate tests to ensure proper operation of the replacement part and to ensure that the replacement part has not induced another problem.

3. If the problem is resolved, go to part D-10.

4. If the problem is not resolved, go to part D-11.

Part D-10
Repair verified?

1. If the unit is placed back to the original condition and the symptom does not return, the symptom has become nonduplicatable.

2. Try to verify that what was done repaired the problem. For example:

   - Wiggling the interlock switches.

   - Going back to the original equipment configuration.

   - Reinstalling the damaged cable (only if feasible) to ensure that the problem returns.

   - Reinstalling the broken part (only if feasible) to ensure that the problem returns.

3. If you can verify the fix, go to Section F, Determining the most probable cause of failure.

4. If you cannot verify the fix, go to Section E, Course of action for the nonduplicatable symptom.

Part D-11
Plan(s) exhausted

1. If the plan(s) is exhausted:

- Review all notes and documentation.

- Contact the regional operations manager and discuss alternatives, such as:

   - Discussing the problem with other CRs and/or the hot line.

   - Placing the call on hold.

   - Enlisting the help of a systems engineer.

   - Putting together a tiger team (a group of experienced high-level maintenance people).

- If the plan is not exhausted, proceed to part D-12 to determine if help is required.

Part D-12
Need help

1. To determine if you need help:
   - Review all notes and documentation before calling for help.
   - Call alternate resources, such as:
     - CR hot line
     - A senior CR
     - The branch manager (for customer relations problems)
   - Proceed to part D-13.

Part D-13
Things you should not do

1. Do not let suspected external problems get in the way of fixing the problem.
2. Do not concentrate on one isolated area for the failure.
3. Do not replace media just because it is not TI media.
4. Do not let customer pressure lead you into replacing unnecessary parts.
5. Do not replace parts without a logical plan. Use best judgement on replacing suspicious parts.
6. Do not reinstall the suspected part if it will destroy something else.
7. Do not reinstall the suspected part if it will cause excessive work or downtime.
8. Do not exchange boards at random. Always have a logical problem-solving technique or rational procedure of some kind before exchanging boards.
9. Do not let personal feelings get in the way of asking for help from a higher authority.
10. Do not give up when the assistance arrives. Keep in mind that problem solving is a team effort at this point.

Section E — Course of action for nonduplicatable symptom

Part E-1
First occurence
of problem

1. Determine if the problem has occurred before by questioning the customer and obtaining as much data as possible.
2. Review all notes and documentation.
3. Contact the regional operations manager to discuss alternatives such as:
   - Discussing the problem with other CRs and/or the hot line
   - Placing the ticket on hold
   - Enlisting the help of a systems engineer
   - Putting together a tiger team (a group of experienced high-level maintenance people)
4. If the problem has not occurred before, establish a plan of action with the customer.

Part E-2
Formulate plan
with customer

1. Discuss the situation with the customer.
2. Formulate a corrective action plan for the next time the problem occurs.
   - Present all alternatives.
   - Recommend a course of action.
   - Instruct the customer to obtain the following details the next time the problem occurs:
     - What time of day the problem occurred.
     - What operation was being performed.
     - What unit the problem occurred on.
     - Exactly what the error was (the error message).
     - What else was running at that time (machinery, programs, and so on).
   - Instruct the customer to leave the equipment in the condition it was in at the time of the error.
   - Instruct the customer to request the same CR, and state that this is a repeat call.
3. Place the plan on the failure notification system (FNS).
4. Document the plan in the equipment log.
5. Complete the ticket.

Section E — Course of action for nonduplicatable symptom (Continued)

Part E-3
Things you should not do

1. Do not let personal feelings get in the way of asking for help from a higher authority.
2. Do not give up when the assistance arrives. Keep in mind that problem solving is a team effort at this point.
3. Do not let customer pressure lead you into replacing unnecessary parts.
4. Do not replace parts without being able to duplicate the symptom.
5. Do not replace parts without documenting the steps that were taken to replace the parts.

Section F — Determining the most probable cause of failure

Part F-1
Determine most probable cause of problem

1. At this point the symptom has been identified and a problem has been found. Now, the CR needs to determine the most likely cause of the problem and who is responsible. Some examples are:
   - TI responsibilities:
     - Common hardware failures, such as component failures on a circuit board
     - Poor documentation that is causing operator errors
     - Hardware failures due to the design and quality of the equipment
   - Customer responsibilities:
     - Improper operating temperature
     - Dirty facility
     - Faulty power input (noise on line, voltage out of tolerance, distorted waveform, spikes on line, inadequate conductor size, and incorrect grounding)
     - Dirty or damaged disk packs
     - Poor quality supplies, such as media and ribbons
     - Configurations incorrectly set up, such as switches, jumpers, or software system configurations.
     - Improper preventive maintenance
     - Application software faults
     - Operator errors
     - Improper system use

Part F-2
Customer responsibility

1. If the customer is responsible, perform the following:

   - Establish a corrective action plan with the customer to prevent recurrence of the problem.
   - Document the cause of the problem and the corrective action plan in the equipment log.
   - Complete the ticket, and bill the customer.

Part F-3
TI responsibility

3. If TI is responsible, determine the type of failure.

   - If it is a common hardware failure:
     - Document the failure and the method of repair in the equipment log.
     - Complete the ticket.
   - If the failure appears to be a design or quality problem, go to part F-4.

Part F-4
Operator error

1. If the operator is performing the operation correctly, the failure may be a design or quality problem.

   - Document the problem in the equipment log.
   - Complete the ticket.
   - Report the problem to the hot line.

2. If the operator is performing the operation incorrectly, there may be a TI documentation problem.

   - Instruct the customer on how to perform the operation correctly.
   - Document the problem in the equipment log.
   - Complete the ticket.
   - Report the problem to the hot line so they can correct the manual that caused the operator problems.

EXPLORER SYSTEM TROUBLESHOOTING 2

Highlights of This Section

- Introduction
- System test and boot master
- System/subsystem self-tests
- System/subsystem troubleshooting

Introduction

2.1 The Explorer system troubleshooting consists of running self-tests and loadable diagnostics, and performing other troubleshooting tests that are not included in the self-tests and diagnostics. The philosophy behind Explorer system troubleshooting is for maintenance personnel to have a basic understanding of the following information:

- What the Explorer system consists of and how it operates
- How the system test and boot master (STBM) and the nonvolatile random-access memory (NVRAM) function during self-test operations
- What the self-test operations consist of
- Where to find information on running loadable diagnostics
- Test information that is not included in the self-tests and diagnostics

System Test and Boot Master

2.2 The STBM is a set of ROM-based programs designed for NuBus systems. The STBM is separated into the following topics:

- STBM general overview
- STBM algorithm description
- Disk/tape label definitions
- NVRAM data structure definitions
- Setup and changing NVRAM functions

STBM General Overview

2.2.1 The functions of the STBM are implemented in ROM devices located on the various boards of the system. The STBM has the following four basic programs:

- STBM algorithm
- Self-tests
- Interface diagnostics
- Device drivers

STBM Algorithm **2.2.1.1** The STBM algorithm manages board self-tests, boots the system, and can function in multiprocessor systems. In multiprocessor systems the STBM selects one processor to be the STBM processor and treats the others as secondary processors. The present Explorer systems have only one processor, which is always the STBM processor. The STBM algorithm always checks for more than one processor to determine which one is to be the STBM processor even though there is only one processor present. This is why the terms STBM processor and secondary processor appear in some of the following paragraphs.

Each processor board in the system includes the internal ROM-based STBM algorithm. This algorithm determines what roles the processor takes (STBM or secondary) to perform system tests and then to load an initial program. If the processor is a secondary processor, the algorithm provides the mechanism to communicate with the STBM processor, as appropriate, to participate in system testing, to receive program load instructions from the STBM, and finally, to load an initial program.

The STBM algorithm is implemented in the native code of the STBM processor. The algorithm contains the logic to directly perform operations such as scanning the NuBus for boards and reading and verifying configuration ROM fields. When necessary, the STBM uses a subprogram called the diagnostic engine interpreter to interpret diagnostic engine code stored in ROMs on its own or other boards. Diagnostic engine code is processor independent; that is, it is not a native mode of any processor, but can be interpreted by any processor by implementing the processor native code of the standard diagnostic engine interpreter. Interface diagnostics and device drivers are implemented in diagnostic engine code.

Self-Tests **2.2.1.2** Each board in the system that has a local processor implements its own self-tests. Self-tests are programmed in the local processor's native code so that the self-tests run on the onboard logic circuits as quickly and thoroughly as possible. The maximum time allowed for self-tests is 10 seconds for STBM candidates and 20 seconds for all other boards. The first time limit is used to determine the STBM processor for the system. The second time limit allows the STBM to determine when a board is stuck in self-tests and also to keep the delay time between power-up and initial program load to a tolerable length.

Interface Diagnostics

2.2.1.3 Interface diagnostics are implemented on each board in the system to provide testing beyond the capabilities of self-tests and to communicate board-specific test messages to the operator. Interface diagnostics are implemented in diagnostic engine code in the ROMs on the boards which the diagnostics test. The STBM interprets an interface diagnostic as part of the tests it performs on each board. For boards with no on-board processor, the interface diagnostic is the only mechanism that can test the board. For boards with an on-board processor, the interface diagnostic tests the parts of the board that self-tests do not test. The interface diagnostics are also used to display messages about test results from the on-board processor to the operator. The STBM actually executes the interface diagnostic code by way of the diagnostic engine interpreter. The interface diagnostic can communicate with a board's local processor to command it to perform special tests or to request messages for output.

The STBM cannot interpret the tests until the final pass/fail status that returns after the interface diagnostic completes. This allows the STBM to perform any special operations necessary to test a board without prior knowledge of those operations by the STBM. Finally, the STBM provides a mechanism for interface diagnostics to display test-specific messages on the video display.

Device Drivers

2.2.1.4 Three types of device drivers are required for STBM operations. Two of these drives support the interface of the STBM to the operator by way of a display monitor and keyboard. Separate, independent device drivers are required for the monitor and keyboard so that the interfaces for these devices can be located on separate boards in the system. A third device driver allows the STBM to access the program load-source devices.

The monitor device driver enables the STBM to initialize the monitor and then to output one character at a time to the video display. Character output is a standardized TTY format. The monitor device driver supports only the display of ASCII text and command characters for new lines (line feed or carriage return), for clear screen (form feed), and the bell. The interface complexity has been minimized to simplify the code required to support the user interface and to allow a wide variety of devices to be used as the STBM monitor.

The keyboard device driver allows the STBM to initialize the keyboard interface and then to poll for the input of a single character from the keyboard. The characters of the keyboard used are mapped by the keyboard device driver to standard, single-character ASCII codes so that the STBM sees either an ASCII character or a hexadecimal 00 (no key pressed).

Load-source device drivers enable the STBM to query the load for source status and then to load programs or other partitions from the load device to memory. The diagnostic engine code of a load-source device driver is interpreted by the STBM to either directly perform load operations or to communicate with a load-source interface board with an on-board processor to perform load operations. In either case, the load-source device driver allows the STBM to do the following:

- Initialize both the device interface and an individual device
- Ask the interface what devices are available and their status
- Load a partition from a device to NuBus memory.

STBM Algorithm Description

2.2.2 The Explorer processor conforms to the STBM algorithm described in the following paragraphs. There are several phases of the algorithm. During each phase, the processor performs several specific operations.

Self-Tests and STBM Determination

2.2.2.1 Following power-up or NuBus reset, each STBM candidate does the following:

1: Initializes the board flag register bits using hardware to indicate that self-tests are in progress.

2. Performs on-board self-tests and reports the results on the board fault LED(s) and flag register status bits. If the slot self-tests failed, the processor halts at this point.

3. Participates in STBM arbitration by scanning for any STBM candidate in a lower numbered slot that passes its self-tests within 10 seconds. If an STBM candidate is found, it assumes the role of a secondary processor, and the processor in the lower numbered slot becomes the STBM.

STBM Slot Tests

2.2.2.2 When the Explorer processor determines that it has won the arbitration to be the STBM, it tests each board in the system as follows:

1. Locates the NVRAM by scanning slots 0 through 6.

2. Locates a display monitor from NVRAM or by scanning slots 0 through 6.

3. Displays the STBM identity on the video display.

4. Finds and tests system memory by scanning slots 0 through 6.

5. Tests the board in each slot and displays the test results. If any test fails while testing a slot, skip the rest of the tests for that slot. The tests on each board function as follows:

   a. Test to determine if a board is present in the slot.

   b. Test to determine if the configuration ROM contents are valid.

   c. Wait up to 20 seconds for the slot self-tests to complete.

   d. Check for on-board self-test failure.

   e. If the board under test has the capability, command it to perform the NuBus test and check the results.

   f. Interpret the board interface diagnostic if one is available.

   g. If all tests for a slot have passed, turn the slot test LED off and display the word passed.

Explorer STBM User Options

2.2.2.3 After all boards are tested, the STBM sounds the monitor bell to indicate that testing is complete and then requests the operator to select between the following options. If no option is selected within 15 seconds, an automatic default load occurs.

- D=Default load — Causes the STBM to attempt to load a default program from a load source (disk, tape, or other) designated by NVRAM or found by scanning for the first online device. The determination of which is the default program is done by the device driver for the selected device.

- M=Menu load — Allows load device selection then causes a program boot to be loaded from the selected device. The boot program provides the menu(s) to allow further operator-load option selections.

- R=Retest — Causes the STBM to run the slot tests in the power-up mode.

- E=Extended tests — Causes the STBM to run the slot tests in the extended mode.

- S=Select device — Hidden option that allows the user to select a load device from which the default program is loaded.

- G=GDOS load — Allows load device selection then causes the General Diagnostic Operating System (GDOS) program to be loaded from the selected device.

- N=Named load — Causes the STBM to request two 4-character names for the system load and the microload. After keying in the specific names of the desired programs, the STBM allows the operator to specify the load device where the programs can be found. This technique allows the program(s) to be loaded directly.

Disk/Tape Label Structures

2.2.3 Standard structures for the volume information (label) on disks and tapes allow firmware and software of various system implementations to share mass storage interface hardware. The device drivers for the STBM program-load sources reside in ROMs on the interface boards for disks, tapes, or other load-source devices. The device-driver routines are interpreted by the STBM during program-load operations to search through the standardized volume label structure to locate and then load a desired program.

Several standard partitions (contiguous sections of the allocatable media) are defined. These include:

- Volume label partition
- Partition table partition
- Save partition
- Test zone partition
- Format information partition

The following sections briefly describe the function of each partition.

Volume Label Partition

2.2.3.1 Each volume contains a variety of partitions that are accessed through a minimal directory whose root is the volume label. The label, in logical blocks 0 and 1 of the volume, is the only partition with a fixed location. All other partition locations are determined indirectly by way of pointers found first in the label, then in the partition table. The label contains information about the physical and logical characteristics of the volume and also provides pointers to the save and partition table partitions.

The second block of the label (logical block 1) is reserved as a fixed location, emergency data-save area of exactly one block length. The use of this block is optional.

Save Partition

2.2.3.2 The save partition provides a quickly accessible partition (accessed by way of the volume label) that enables a system to save a large amount of data quickly. The size of the save partition is adjustable to the needs of the system in which it is used; so it should be set to zero length if not needed.

Partition Table Partition

2.2.3.3 The partition table partition provides the name, characteristics, pointer, and size information for each partition on the volume. The first section of the partition table partition provides information about the table format, such as the number of partitions in the table, the size of each entry, and the offset in each entry to comments.

Following the table format information is the table of individual entries describing each partition. Each entry in the table has a set of partition key characteristics which include:

- Name of the partition
- Partition type
- Partition user type
- Partition attribute bits

Any combination of the characteristics can be used to uniquely identify a particular partition. For example, a partition with a particular name (MCR1), partition type (>01=microload), and user type (>0000=Explorer) can be found, even though other partitions may have the same name or partition or user type. Likewise, the default partition, identified by the default bit (Default attribute=1), partition type (>01=microload), and user type (>0000=Explorer) can be located regardless of what name the partition has. This is the mechanism used in the booting process to locate default partitions of specific types. Additional comments about partitions and key values are as follows:

- Name, partition type, and user type combinations should be unique. A single name, however, can be used again for a different partition type and/or user type, and obviously both partition and user type can be used many times.
- Multiple entries in the table can point to the same physical partition using different key characteristics to identify the partition.
- All searches through the partition table should start at the beginning of the table and continue until either a match of the desired key characteristic occurs, or the end of the table is reached.
- The order of the entries in the partition table does not infer information about the physical order of partitions on the volume.
- Zero length partitions are allowed and are sometimes even used as markers.
- There may be space on the volume that is not allocated to any partition and, therefore, does not appear in the table.

Test Zone Partition

2.2.3.4 The test zone partition is provided to accommodate the testing of the hardware that is used to access the volume. This is done without disturbing system or user data. The test zone partition includes fixed data patterns that can be used to test data-read channels and blocks that are reserved for write-then-read tests to check write channels.

Format Information Partition

2.2.3.5 The format information partition contains details about the way the volume media was tested and formatted. Several sections of data are recorded, including physical sector and track data formats, surface analysis methods used, and detailed lists of defects found when the media was initialized.

NVRAM Data Structure Definitions

2.2.4 A NuBus system makes use of NVRAM during system testing and booting to locate resources and later, for storing and retrieving a variety of other information. It is necessary, therefore, to specify a standard data structure for the NVRAM so that all processors can use the same NVRAM. This specification provides for a set of standard required data structures and also provides a control mechanism for adding future data structures so that they do not break previous implementations. Note that the following data structures are only required in the NVRAM which is designated as the system NVRAM by the resource byte of the configuration ROM of the board on which the NVRAM resides.

The NVRAM data structure is divided into several independent sections. The first section contains information about the location of resources (monitor, keyboard, and load device) required for system testing and booting. The next section contains information about the last system shutdown, including the cause of shutdown, when the previous system boot occurred, and how long the system was running before it shut down. Crash record registers make up the next section, providing control for a circular buffer of crash records. The crash record buffer is located in the same NVRAM, after additional standard sections. Following the crash record registers is a small section that provides dynamic allocation management for the rest of the NVRAM, including the typed block buffer area. The last standard fixed-addressed section is the buffer for the typed blocks, where a variable number of 32-byte uniquely typed blocks are located so that either direct information or additional buffer control structures can be added.

Test and Boot Resources

2.2.4.1 The NVRAM contains values which the STBM references to find preselected resources. The NuBus slot and a 24-bit logical unit number are provided for a monitor, a keyboard (for user interaction), and a default load source (to be used if a default system load occurs).

Since the NVRAM contents may be invalid if the NVRAM has not been initialized or if the battery runs low, it is necessary to validate the contents of the NVRAM before they are used. Three mechanisms are provided for this function, although all may not be used in some implementations. First, the NVRAM data structure format generation and revision are stored so that they can be validated. The format generation should never change from hexadecimal 01 if it conforms to this specification, but the revision can change as features are added to the NVRAM so that they are upward compatible. Second, the test and boot resource information and the format generation and revision fields are (optionally) protected by a 16-bit cyclic redundancy check (CRC) value. The CRC used is identical to that used in the configuration ROM and provides protection for the first 14 bytes of the NVRAM. Finally, a configuration check sum (optionally) is stored in the NVRAM so that the chassis configuration can be verified as being unchanged from when the NVRAM test and boot resources information was last updated.

Last Shutdown Information

2.2.4.2 Information is stored in the NVRAM that can be used following a system boot to determine information about the previous system boot and shutdown. The shutdown information includes the date and time of the last boot, how long the system was running before the shutdown, and the cause of the shutdown. After the operating system reads and logs the information in the shutdown fields from the previous system boot, the system updates the information to reflect the current boot date and time. The elapsed time since the boot is updated periodically (at least once per minute) so that it is current if an unexpected shutdown occurs. When a system shutdown occurs, the causes for the shutdown are logged in the NVRAM, and the shutdown-information valid character is set to allow the next boot operation to determine that the shutdown causes were correctly recorded.

Crash Record Registers

2.2.4.3 The crash record registers are a set of dedicated NVRAM locations that provide a control structure for a circular buffer (located in the NVRAM) where a system processor stores a predefined set of information when it detects a system crash condition. Since it is desirable to have a history of several previous crashes stored in the NVRAM at one time, the buffer must be managed so that at any time a new crash record can be added to the buffer, and so that system software can retrieve the crash history without confusion. The crash record registers provide the data necessary for this management function. They include information about the crash record format and size, buffer location in NVRAM and size (pointers to first and last records), and a pointer to the currently active crash record.

NVRAM Allocation Management

2.2.4.4 The NVRAM allocation management can reserve and then dynamically allocate areas of the NVRAM for future storage of information without destroying previously entered information. The NVRAM allocation management information allows future additions to be made in a predefined, controlled manner. This is accomplished using a pointer to the beginning of the as yet unallocated area of NVRAM. Allocation of new areas of the NVRAM requires reading the pointer to determine where the new allocation will begin and then updating the pointer to just beyond the newly created buffer area. Since the location of any new area in NVRAM is dependent on all previous allocations in the NVRAM, a consistent method must be provided to establish pointers for the new area. This can be done using the typed blocks as described in the next paragraph.

Typed Blocks

2.2.4.5 The typed block mechanism allows upward compatible additions of data and control structures to the NVRAM. Different systems are expected to have requirements for storing unique types of data and for establishing unique buffer areas in the NVRAM. If these new requirements were met by adding new standard structures, the NVRAM resource would soon be exhausted. Instead, the typed blocks allow a system to add features to the NVRAM so that they are uniquely accessible by the system originating them, but not excess baggage for other systems.

Typed blocks are 32-byte data structures with the first 2 bytes providing a unique type number that identifies either that the block is unused (>FFFF), or that it is in use. The rest of the block (30 bytes) can contain whatever data or data structures the user program desires. The typed blocks reside in a fixed-location, variable-size buffer in the NVRAM. The base of the buffer is fixed at the NVRAM address >F5FA0100. The size of the buffer is set at the NVRAM setup to include some integral number of 32-byte typed blocks, with the total number of blocks stored in the 2 bytes preceding the buffer. Access to typed blocks is done by searching through the blocks until the type of block desired is found.

For example, a program that needs to add a new buffer area in the NVRAM can do the following:

1. Use the NVRAM allocation management to locate an available area.
2. Allocate the area by adjusting the unallocated pointer.
3. Search through the typed blocks until an unused block is found.
4. Mark the unused block with a preassigned type number.
5. Store a buffer access control data structure in the data area of the block.

When the same or another program requires access to the new buffer it can do so by:

1. Searching through the typed blocks until it finds the one uniquely typed as containing the control data structure for the buffer.

2. Using the control structure to access the buffer in the NVRAM.

NVRAM Format **2.2.4.6** Table 2-1 provides specific information about the NVRAM standard data structures when the NVRAM is on the system interface board in slot 5.

Table 2-1 NVRAM Data Structure Definitions

Item	*Address*	*Contents Description* *
System default configuration information	F5FA0000	STBM monitor unit LS byte
	F5FA0004	STBM monitor unit MID byte
	F5FA0008	STBM monitor unit MS byte
	F5FA000C	STBM monitor slot >FF=none
	F5FA0010	STBM keyboard unit LS byte
	F5FA0014	STBM keyboard unit MID byte
	F5FA0018	STBM keyboard unit MS byte
	F5FA001C	STBM keyboard slot >FF=none
	F5FA0020	Boot source device unit LS byte
	F5FA0024	Boot source device unit MID byte
	F5FA0028	Boot source device unit MS byte
	F5FA002C	Boot source device slot >FF=none
	F5FA0030	NVRAM format generation number
	F5FA0034	NVRAM format superset revision number
	F5FA0038	NVRAM CRC LS byte
	F5FA003C	NVRAM CRC MS byte

NOTE: The CRC is calculated the same as for the configuration ROMs, except that it covers only the system default configuration information from addresses F5FA0000 through F5FA0034.

Configuration check sum	F5FA0040	Configuration check sum LS byte
	F5FA0044	Configuration check sum MS byte

NOTE: A 16-bit sum (overflow ignored) is generated by adding together all 16 bytes of the part number field of every slot configuration ROM. If a slot is empty or does not appear to contain a configuration ROM, it does not affect the check sum. This value can be used to verify that the system configuration has not changed. (Note that moving a board to another slot does not change the check sum.)

NOTE:

* The content description is binary unless otherwise noted.

Table 2-1 NVRAM Data Structure Definitions (Continued)

Item	*Address*	*Contents Description* *
	F5FA0048	Reserved (>4C used in board tests of NVRAM)
Last shutdown information	F5FA0050	Abnormal shutdown valid character. Set to ASCII V (>56) if valid shutdown information was stored (ASCII).
	F5FA0054	Shutdown cause: >00=Overvoltage shutdown >01=Undervoltage shutdown >02=Overvoltage after high temperature >03=High temperature shutdown >04->FF=Reserved
	F5FA0058	Reserved
	F5FA0060	Month of boot (Jan.=1, Feb.=2 . . . Dec.=12)
	F5FA0064	Day of month of boot (1 . . . 31)
	F5FA0068	Hour of day of boot (0–23)
	F5FA006C	Minute of hour of boot (0–59)
	F5FA0070	Seconds since boot LS byte
	F5FA0074	Seconds since boot
	F5FA0078	Seconds since boot
	F5FA007C	Seconds since boot MS byte
Crash records registers	F5FA0080	Format processor type LS byte
	F5FA0084	Format processor type MS byte
	F5FA0088	Format revision
	F5FA008C	Reserved
	F5FA0090	Allocation pointer LS byte
	F5FA0094	Allocation pointer MS byte
	F5FA0098	Allocation size LS byte
	F5FA009C	Allocation size MS byte
	F5FA00A0	Allocation last LS byte
	F5FA00A4	Allocation last MS byte
	F5FA00A8	Allocation base LS byte
	F5FA00AC	Allocation base MS byte
	F5FA00B0 through F5FA00EC	Reserved
NVRAM allocation management	F5FA00F0	Start of unallocated NVRAM LS byte
	F5FA00F4	Start of unallocated NVRAM MS byte
	F5FA00F8	Number of 32-byte typed blocks LS byte
	F5FA00FC	Number of 32-byte typed blocks MS byte

Table 2-1 NVRAM Data Structure Definitions (Continued)

Item	*Address*	*Contents Description* *
Type block list	F5FA0100	First block type identifier LS byte
	F5FA0104	First block type identifier MS byte Control to be unique 16-bit number identifying block type: 0000–0007 = Reserved for TI diagnostics 0008–000F = Reserved for TI Lisp 0010–0017 = Reserved for TI UNIX™ 0018–00FF = Reserved 0100–FFFE = Available for assignment FFFF = Unused block
	F5FA0108 through F5FA017C	Defined by specific block type

NOTES:

LS = Least significant.
MID = Middle.
MS = Most significant.

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Setup and Changing NVRAM Functions

2.2.5 Nonvolatile random-access memory (NVRAM) is located on the system interface board where it is protected by a battery input. The NVRAM code specifies where to locate the monitor, keyboard, and the device that contains the load and microload bands. The NVRAM is set up when a system is installed or when the contents of NVRAM have been corrupted by an inadvertent NuBus write operation. The NVRAM contents may need changing for one of the following reasons:

- The monitor, keyboard, or load ROM on the system interface board was moved to a slot other than the default slot of 5.
- The previous default load ROM was moved.
- The contents of NVRAM were inadvertently changed.

The **si:setup-nvram** function initiates the NVRAM and sets the locations for devices to the default values specified in the **si:edit-nvram** functions. The **si:change-nvram** function displays a menu that provides more detailed information. Initializing the NVRAM enables the STBM to locate the monitor, the keyboard, and the mass storage device that contains the load and microload bands.

To determine the logical disk unit number that contains the default load band, multiply the formatter number by 8 then add this to the unit number. Convert this value to hexadecimal to use as the argument as shown in the following example:

Formatter Number	*Unit Number*	*Sum of Values*	*Example*
Formatter #0	Unit #1	#x01	**si:setup-nvram #01**
Formatter #2	Unit #0	#x10	**si:setup-nvram #10**

The **si:change-nvram** function sets values in NVRAM to enable the STBM to locate the monitor, the keyboard, and the mass storage device that contains the load and microload bands. This function takes a pair of keywords and the values as arguments. If you do not specify a keyword and its associated value, that value in NVRAM is set to the default value. An example of this function is as follows: (**si:change-nvram :monitor-unit 1**).

- **:monitor-unit** specifies the unit number of the monitor. The default value is 0.
- **:monitor-slot** specifies the slot in the system enclosure that contains the system interface board. The default value is 5.
- **:keyboard-unit** specifies the unit number of the keyboard. The default value is 0.
- **:keyboard-slot** specifies the slot in the system enclosure that contains the system interface board. The default value is 5.
- **:load-unit** specifies the unit number of the mass storage device that contains the default load band. The default value is 2.
- **:load-slot** specifies the slot in the system enclosure that contains the mass storage controller board. The default value is 2.
- **:ns** specifies the slot in the system enclosure that contains the NVRAM. The default value is 5, the system interface board.
- **:no** specifies the offset from the starting address of the board which contains the NVRAM to the starting address of the NVRAM. The default value is #SFA0000.

Self-Test Operation

2.3 The self-test operations are separated into the following topics:

- Processor board self-tests
- NuBus Ethernet controller self-tests
- NUPI board self-tests
- Memory board self-tests
- System interface board self-tests

The self-tests that run during power-up are the same as the self-tests that run under extended tests with the following exceptions:

- Only 256 kilobytes of memory on each memory board are tested during power-up.
- The battery backup on the system interface board is tested only during power-up.

The processor board contains the main self-test software that initializes and controls the testing of each of the other boards in the system. This software is called the system test and boot master (STBM). There is additional self-test software in the configuration ROM on each board in the system. The processor board controls the execution of the self-tests on each board, except for the NUPI board. The NUPI board has its own microprocessor which controls the self-tests on the NUPI board. The results of the NUPI board self-tests are transferred to the processor board for display purposes.

Processor Board Self-Tests

2.3.1 On power-up or load the PROM-resident self-tests execute on the processor. These self-tests exercise as much of the hardware as possible. One large LED indicates whether the self-tests passed or failed. The six miniature fault LEDs indicate why the self-tests failed or why the system crashed during normal operation. All of the internal processor registers that can be written into can also be read by the processor. This provides a high degree of feedback for the self-tests. All of the internal memories of the processor, including the control store memory, can be read by the processor self-tests. Some of the exercises and tests performed by the processor self-tests are:

- Tests the internal paths of the processor
- Tests the internal RAM of the processor
- Initializes the internal RAM of the processor
- Executes a representative sample of the microinstructions through the processor

If the processor self-tests are successful, the fault LED is extinguished, and the processor proceeds to run the self-tests on other boards. If the processor self-tests fail, an error code is displayed in the six miniature LEDs to indicate a possible cause of the failure.

The memory mapper on the processor is tested in stages. The self-test portion that performs the tests on internal RAMs and data paths has full access to the entire contents of the mapping RAM. Extensive testing of the mapper can take place without initiating a memory cycle.

The second level of testing involves using the local memory to aid in testing the mapper. Using a logical-equals-virtual translation algorithm, the local memory can be filled with a known data pattern. The mapper tables are then changed to test the boundary conditions that exist in the hardware and the local memory to see if the expected patterns are in their proper location in local memory. Also, the ability to access memory with the mapper bypassed greatly enhances the ability to test the mapper and the local memory.

NuBus Ethernet Controller Board Self-Tests

2.3.2 The NuBus Ethernet controller board self-tests are as follows:

- Ethernet memory test — This test determines board size, performs pattern sensitivity and address uniqueness memory tests, and initializes on-board memory to zero. The NuBus slave control logic and the NuBus clock must be operating for this test to function.

- Initialization test — This test sets up the system configuration pointer, the intermediate system configuration pointer, and the system command block, then resets the board to its initial state and enables event posting. The NuBus clock and the 82586 local communications controller clock must be operating for this test to function.

- System control block (SCB) commands test — This test exercises the SCB commands by causing the local area network (LAN) coprocessor to execute a circular command block of nonoperation instructions. These instructions are started, suspended, resumed, and aborted. The test then checks the SCB status to determine if the commands executed properly.

- Diagnose command test — This test issues the diagnose command, checks the status, and determines if event posting has occurred.

- Individual address (IA) setup command test — This test issues the IA setup command, checks the status, and determines if event posting has occurred. The clock sources for the 8023 Manchester code converter must be operating for this test to function. These clock sources consist of a phase-locked loop circuit within the 8023 and an external 20-megahertz crystal oscillator. The clock source switches to the external oscillator when the phase lock of the Ethernet carrier is lost. During this test, the 8023 is kept in the internal loopback mode, which prevents a switch to the external oscillator. The internal phase-locked loop circuit generates clock signals that run certain 82586 local communications controller data registers.

- Configure command test — This test issues the configure command, checks its status, and determines if event posting has occurred.

- 82586 internal loopback test — This test runs at half speed to thoroughly check the 82586 local communications controller as follows:

    1. Issues the command, checks its status, and determines if event posting has occurred.

    2. Sets up the transmit/receive buffers, issues the transmit command, and checks its results.

    3. Checks receiver status and compares the transmit and receiver buffers.

- Serial internal loopback test — This test checks the operation of the 8023 manchester code converter. This test is identical to the 82586 internal loopback test except that it sets up the serial interface for the internal loopback test prior to setting up the transmit/receive buffers.

- Network presence test — This test checks the operation of the tranceiver, when present. This test is identical to the serial internal loopback test except that it sets up the serial interface for normal operation instead of for internal loopback operation.

NUPI Board Self-Tests

2.3.3 The NUPI board self-tests are as follows:

- Short microprocessor test

- ROM CRC test

- Full RAM test

- Board control test (discrete lines, XCNT and SCNT)

- Page address register and processor address loopback test

- DMA FIFO RAM test

- I/O bus latch and NuBus direct memory access (DMA) counter test
- Internal DMA operation test
- Small computer system interface (SCSI) chip test
- Interrupt test
- DMA NuBus loopback test
- Device read/write test

Memory Board Self-Tests

2.3.4 The memory board self-tests are as follows:

- Interface test — Tests the interface logic by writing and reading to a register.
- Parity test — Tests the parity circuit by causing a parity error then checking for the error.
- Modified address test — Tests for cell opens and shorts, address uniqueness, and pattern sensitivity by writing and reading addresses from selected address lines.
- Pattern sensitivity test — Tests pattern sensitivity, cell opens and shorts, and refresh for 256 kilobytes of memory where the General Diagnostic Operating System (GDOS) will reside. In the extended mode, it tests the entire capacity of the memory boards. This test writes and reads the following hexadecimal values at all memory locations:

```
FFFF0000
FF00FF00
F0F0F0F0
CCCCCCCC
AAAAAAAA
55555555
00000000
```

- Chip hit test — Tests for the existence of memory chips.

System Interface Board Self-Tests

2.3.5 The system interface board self-tests are as follows:

- Initialization — Initialization does the following:
  - Clears the pass/fail flag
  - Sets up some pattern arrays

- Initializes the monitor

- Initializes the universal synchronous/asynchronous receiver transmitter (USART)

■ Event generation vectors test — This test writes test patterns to all 16 addresses in the event generator register file, then reads them back to verify that the file can be programmed properly.

■ NVRAM test — This test performs the following:

1. Checks read/write operations at address F5FA004C.

2. Saves the contents of the NVRAM.

3. Writes a series of patterns to the NVRAM to verify its read/write capabilities.

4. Restores the original contents of the NVRAM.

NOTE: Extended tests erase the date and time information from the NVRAM, making it necessary to re-enter this information after these tests are run.

■ RTC and long interval timers test — This test verifies the operation both of the real-time clock (RTC) and the long-term interval timer. It also checks that both devices can generate an interrupt to the event generator and that both events can be posted. The RTC and long interval timers are reset by Lisp software.

■ Bit map memory address lines test — This test checks the graphics bit-mapped memory as follows:

1. Writes a predetermined, 32-bit word pattern to each address of the graphics bit-mapped memory and verifies that they are correct.

2. Repeats the operation with a new pattern until 12 different patterns have been written and verified for correctness.

■ Graphics operation test — This test checks the graphics bit-mapped memory for proper operation as follows:

1. Writes 32-bit words to random graphics memory addresses, then reads them to verify that they were written correctly.

2. Repeats step 1 using halfwords, then bytes.

3. Verifies the 32-bit mask register for proper operation.

4. Performs a read-modify-write test as follows:

   a. Writes 32-bit words to all graphics memory addresses.

   b. Modifies the words by using the contents of the mask register to perform an operation on them.

   c. Reads the modified words to verify that they were modified correctly.

   d. Repeats steps 4a, 4b, and 4c until 16 different logical operations have been performed and checked.

5. Repeats step 4 using halfwords, then bytes.

- Mouse registers test — This test writes data patterns to the mouse register, then reads the data patterns to verify proper operation.

- Local keyboard USART test — This test is a routine that tests the USART chip and its associated circuits by forcing framing errors, overrun errors, and break-detect errors, and then by checking the status byte register to verify that the errors occurred.

- Monitor presence test — This test checks for the presence of a monitor.

- Keyboard presence test — This test checks for the presence of a keyboard.

- Mouse loopback circuitry test — This test writes a data pattern to the diagnostic data register then checks the motion keyswitch register to verify that the data has looped back.

- Voice loopback circuitry test — This test writes a data pattern to the diagnostic register, then checks the voice register to ensure that the data has looped back.

- Parallel port data loopback test — This test writes test patterns to parallel printer port register 0, loops them back to the same register, and then reads them to verify that they are correct.

- Battery backup test — This test is performed only during power-up or a recycle of the ac power. This test is not repeated during extended self-tests.

System/ Subsystem Troubleshooting

2.4 The system/subsystem troubleshooting information is separated into the following topics:

- Tool and test equipment
- General Diagnostic Operating System (GDOS)
- Boot error code listings
- Explorer system test information
- Basic 2-card NUPI board test
- Basic 3-card processor board test
- System power supply board test information
- Display monitor test information
- Mass storage enclosure power supply test information
- Disk formatter test information
- Disk drive test information
- Tape drive test information
- Mass storage subsystem fault isolation hints
- Crash analysis support

Refer to Sections 3 and 4 of the Corrective Maintenance part of this manual for troubleshooting flowcharts on the display unit and the Explorer system enclosure.

Tools and Test Equipment

2.4.1 The tools and test equipment for the Explorer system are all included in the standard Explorer tookit which contains the items listed in Table 2-2.

Table 2-2 **Standard Explorer Toolkit**

Quantity	*Item Description*
1	Longnose pliers
1	Medium size flat-head screwdriver
1	¼-inch nut driver with 6-inch extension
1	Digital volt ohmmeter
1	Medium size Phillips-head screwdriver

Table 2-2 **Standard Explorer Toolkit (Continued)**

Quantity	*Item Description*
1	Starter screwdriver
1	Diagonal pliers
1	Regular pliers
1	Wire strippers
1	4-inch crescent wrench
1	Optical loopback assembly
1	Cheater bar to bypass the front interlock switches on the Explorer system enclosure

CAUTION: Use of the cheater bar to bypass the front interlock switches should be limited to short periods. When the cheater bar is installed, the front metal door must be open. This disrupts the cooling air flow in the Explorer enclosure which can cause component overheating.

General Diagnostic Operating System

2.4.2 The GDOS consists of loadable diagnostic programs that run expanded versions of tests that are similar to those listed under extended self-tests. These expanded tests allow for more detailed testing of individual boards. The GDOS programs are loaded from a disk drive or a tape drive into the main Explorer memory where they are then executed. The self-tests, on the other hand, are part of the code in the configuration ROMs on the individual boards.

Refer to the *Explorer Diagnostics* manual for detailed information on how to use the loadable diagnostics. The loadable diagnostics are included on one of the mass storage disks in each system; they are also available on cartridge tape for use by maintenance personnel. The Explorer diagnostic bootable tape is part number 2249964-1301.

The loadable diagnostics have online instructions for the customer and maintenance personnel. These online instructions include maintenance and troubleshooting information, extensive error code lists, and other diagnostic information on the Explorer system.

Refer to the appendixes in this manual for diagnostic maintenance information on communications networks and other information that can be used during maintenance.

Boot Error Code Listings

2.4.3 The boot error codes are listed in Tables 2-3 through 2-5.

Table 2-3 **STBM Error Codes**

Hexadecimal Code Number	*Description and Comments*
00000002	Load device is offline or not responding. The device is powered down or is not connected.
00000003	Load device error. The load device experienced an unrecoverable error.
00000004	Memory board unavailable. The processor could not find a memory board that passed all tests.
00000005	NuBus error. The processor received a NuBus error while executing diagnostic engine code in a device driver.
00000006	Command time-out. The NUPI device driver did not complete a command block before the maximum time (10 seconds) elapsed.
00000009	Network down. Ethernet is disconnected, shorted, or open.
00000010	Boot unit slot empty or bad diagnostic engine (DE) instruction header. The STBM found a board with a valid configuration ROM, but the diagnostic offset or device driver offset points to DE code that has an invalid header. The configuration ROM may be bad or the boot unit slot is empty.
00000011	Invalid DE request. The ROM on the board is good, but a request was made that could not be handled by that board, such as a boot request issued to the monitor. The contents of NVRAM are probably invalid. To correct this, use Menu Boot to specify the boot unit. After the system boots, execute the **si:setup-nvram** function.
00000012	DE instruction space problems. The processor found an invalid instruction when trying to interpret DE code contained in the ROM on a logic board. This error can occur when interpreting either a diagnostic or device driver, or the ROM may be bad.
00000013	DE internal data space (Dspace) problem. While the processor was interpreting DE code it found one of the following problems: ■ Internal data stack overflow or underflow ■ Dspace variable out of range This error can occur when executing either a diagnostic or a device driver. The ROM may be bad or the code being executed may be faulty.

Table 2-3 **STBM Error Codes (Continued)**

Hexadecimal Code Number	*Description and Comments*
0000000A	Invalid unit number for the load device.
0000000B	Ethernet board failed to initialize properly.
6nnnnnnn	NUPI command status. These error codes are returned by the NUPI device driver as a copy of the status field of the NUPI command block.

Table 2-4 **Menu Boot Error Codes**

Hexadecimal Code Number	*Description and Comments*
00000014	Device access error. The NUPI returned a bad status.
00000015	Invalid volume label. The first word of block 0 did not contain the string LABL.
00000016	Invalid volume partition table. The first word of the partition table did not contain the string PRTN.
00000017	No available microload band. The volume partition table did not contain an Explorer microcode partition.

Table 2-5 **Processor Error Codes**

Hexadecimal Code Number	*Description and Comments*
40	The system is waiting on memory access to finish.
80	System failure. The processor could not isolate to a board assembly.
89	The processor failed internal self-test.
8A	No memory found. If the processor can find a monitor, it also displays `ERROR: 00000C04`.

Table 2-5 **Processor Error Codes (Continued)**

Hexadecimal Code Number	*Description and Comments*
8B	No boot device. This error occurs if the processor cannot find either a boot device or a monitor on which to display a message.
8C	Microload problems. This error occurs if the processor cannot find a monitor in which to display the message `Bad Microcode Format`.
8D	Diagnostic engine (DE) problems. This error occurs if the processor cannot find a monitor on which to display device errors 10 through 13 (described in Table 2-3) for boot error codes.
8E	Monitor device driver problems. The processor received a nonzero completion code on a call to the monitor device driver.
8F	Unable to initialize the monitor. The monitor device driver returned a nonzero completion code on the initialize-monitor call.
90	Unable to initialize the keyboard. The keyboard device driver returned a nonzero completion code on the initialize-keyboard call.

Explorer System Testing

2.4.4 The Explorer system testing is done primarily by self-tests and loadable online diagnostics. Additional test information that is not included in the self-tests and diagnostics is provided in the following paragraphs. This test information is primarily for maintenance personnel. The following load currents for the system enclosures are provided for reference.

NOTE: Be sure you fully close the front and rear doors on the Explorer enclosure after you perform any maintenance. A partially closed door causes the interlock switches to remain open, which prevents the application of ac power to the enclosure.

CAUTION: All circuit boards in the Explorer system contain static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing or handling the printed circuit boards.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These are commercially available. If you do not have a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling a board. Then, as a further precaution, place the printed circuit board on a grounded work surface after removing it from the assembly or its protective package.

Before storing or transporting the printed circuit board, return it to its protective package or the assembly.

Component	*120 Vac*	*220 Vac*	*240 Vac*
System enclosure	7.5 A	4.8 A	4.5 A
Monitor enclosure	1.7 A	0.9 A	0.9 A
Mass storage enclosure (with two drives)	2.0A	1.0A	1.0A

Basic 2-Card NUPI Board Test

2.4.5 If you suspect that the NUPI board might be faulty, you can isolate the NUPI from the other boards, thus preventing an interaction between boards through the NuBus, which can cause an apparent malfunction in the NUPI board. The following procedure provides a method for isolating the NUPI board.

1. Turn off the ac power to the system enclosure.

2. Pull all the boards except the power supply, the system interface board in slot 5 (to provide a NuBus clock), and the NUPI board in slot 2 from their connectors on the backplane.

3. Turn the ac power back on and observe the action of the red fault LED on the NUPI board. If the NUPI board is functioning properly, the LED will turn on, the self-tests will run, and then the LED will turn off.

4. If the NUPI board red fault LED indicates a faulty NUPI board, turn off the ac power and replace the NUPI board. Repeat the test to verify the faulty board.

5. If the problem is solved, turn off the ac power and install all the boards that were loosened from their connectors. Turn on the ac power and check out the system in the normal manner. If the NUPI board red fault LED comes on with other boards installed, the NUPI board NuBus test is probably failing. The memory boards or the processor assembly can also be faulty.

The NUPI has red and yellow LEDs. The red LED indicates a NUPI board fault; the yellow LED indicates an SCSI bus fault. The NUPI firmware sets the NUPI LEDs when one of the following occurs:

LED	***Conditions***
Red	1. Self-test failure 2. Bus test failure 3. 68000 hardware error trap 4. 68000 software error trap 5. Occurrence of unused NCR 5385 testability or invalid command interrupts 6. Set by operating system (configuration register bit 2)
Yellow	1. Self-test failure 2. Selected interrupt from NCR 5385 3. Received an NCR function complete interrupt with no apparent cause 4. Illegal message for reconnect phase 5. Reconnection to a device not waiting for reconnection 6. Reselection without a valid SCSI ID 7. A command time-out for an SCSI bus hung condition

Basic 3-Card System Interface Board Test

2.4.6 If you suspect that the system interface board might be faulty, isolate the system to a minimum number of boards. Power-up the system with only the following boards connected to the backplane connectors:

- Power supply
- Processor board in slot 6 for STBM functions
- Memory board in slot 4 for NuBus master functions
- System interface board in slot 5 (with the fiber-optic cable disconnected) for the NuBus clock source

The results of this test are as follows if the boards are good:

1. The red and yellow LEDs on the system interface board turn on, the self-test runs, and the red LED turns off when the self-test completes.

2. The yellow LED on the system interface board remains on since the display unit is disconnected.

3. The yellow LEDs on the processor board display a hexadecimal code 8D. The most significant bit is associated with the top LED.

Replace the system interface board if the preceding test indicates that it is faulty.

If you suspect that a problem exists in the fiber-optic data link or the display unit, perform the basic 3-card system interface test with the fiber-optic cable connected. The results of this test under these conditions are the same as for good boards except that the yellow LED on the system interface board should turn off after the self-test completes.

If the basic 3-card system interface test indicates a faulty fiber-optic data link, replace the components in the fiber-optic data link one at a time and repeat the test each time to isolate the problem.

Isolation of Memory, Processor, and Ethernet Boards

2.4.7 If you suspect that the memory, processor, or Ethernet board might be faulty, isolate the faulty board as follows:

- If your system has two memory boards, you can try each memory board in slot 4 to find the bad memory board. The system will power up and run the self-tests with one memory board in slot 4.

- If you suspect the processor board is faulty, the best thing to do is replace it with a known good board.

- The Ethernet board can be isolated by unplugging it from the backplane, and then powering up the system to check self-test indications.

System Power Supply Board Testing

2.4.8 The following test data is provided for the system power supply board:

Item	*Description*
Input voltages	120/240 Vac from the motor power supply
Output voltages	+5.1 Vdc (±3%) at 70 A (5 A minimum) +12 Vdc (±5%) at 1 A -12 Vdc (±5%) at 1 A -5 Vdc (±5%) at 0.1 A
Test points on edge of board	TP8 — +12 Vdc TP7 — -12 Vdc TP6 — -5 Vdc TP5 — PFWD- TP4 — RESET- TP3 — TEMP- TP2 — +5 Vdc TP1 — GND

Display Monitor Testing

2.4.9 The test information for the display monitor consists of three LEDs on the monitor power supply assembly and a list of the adjustments available on the monitor synchronous board assembly. To gain access to the LEDs and make the adjustments, remove the monitor cover from the display monitor assembly. Be sure to turn off the ac power to the display monitor, disconnect the ac power cord, and observe the following warning when you remove the monitor cover.

WARNING: Lethal voltages can exist on the components inside the monitor cover. Always wait at least one minute after the ac power has been removed from the display monitor before removing the cover. Use a standard field service authorized high-voltage discharge probe to make sure all high voltages have been discharged before touching any components on the monitor chassis.

CAUTION: The fiber-optic cable between the monitor assembly and the system enclosure should be routed clear of pedestrian traffic, should not be bent around corners that have a radius less than 25 millimeters (1 inch), and should never be pulled with a force greater than 11.4 kilograms (25 pounds).

The display monitor power supply LED markings and locations are as follows:

Power Supply LED Markings	***LED Locations***
+5 Vdc	Nearest to the front of the monitor
+12 Vdc	Behind the +5 Vdc LED
-5 Vdc	Behind the +12 Vdc LED

Eight video display adjustments are located along the top of the monitor synchonous board assembly. These adjustments are not normally adjusted in the field; they are listed for reference only.

- Vertical height
- Vertical hold
- Vertical linearity
- Vertical position
- Horizontal hold
- EHT adjustment (adjusts all four sides)
- Focus
- Brightness

Mass Storage Enclosure Power Supply Test Information

2.4.10 The following test data is provided for the mass storage enclosure power supply:

Item	*Description*
Input voltages	+90 to +132 Vac, 47 to 63 Hz, 3 A +180 to +264 Vac, 47 to 63 Hz, 1.3 A
Output voltages	+5.1 Vdc (±3%) at 9 A +12 Vdc (±5%) at 5 A (surge)

The power supply has an internal 10-ampere fuse that protects the internal circuits of the power supply. This fuse is not field replaceable.

A good place to check the power supply voltages when the power supply is installed in the mass storage enclosure is at cable interconnect board (CIB) terminals E04 through E07. These terminals are identified as follows:

Terminal	*Signal*
E04	+5 Vdc
E05	GND
E06	GND
E07	+12 Vdc

Disk Formatter Testing

2.4.11 The disk formatter is capable of looping on its own self-test and displaying a code with the LED on the disk formatter that tells you what portion of the logic is failing. If you suspect that there is a problem with the disk formatter, power down the mass storage enclosure, open the lower chassis assembly and install the diagnostic jumper in the disk formatter, then power up the enclosure. The self-test on the disk formatter will repeat, and if there is a failure, the red fault LED on the disk formatter will flash an error code. The lack of any flashing error code indicates the disk formatter passed its self-test successfully. The following chart shows the error sources for the flashing LED codes:

LED Flash Code	*Error Source*
Solid light	Board/8085 microprocessor
1 flash	27218 EPROM
2 flashes	8156 local RAM
3 flashes	6116 working RAM failure
4 flashes	AIC-010 SERDES
5 flashes	AIC-300 buffer controller

Disk Drive Testing

2.4.12 The operation of the disk formatter and the disk drive is verified by running the extended diagnostics. Another method to verify the operation of the disk formatter and the disk drive is to use the Lisp commands associated with the disk drive.

Tape Drive Testing

2.4.13 The tape drive formatter has internal self-tests which verify the operation of the tape drive. The tape drive operation can also be verified by running the extended diagnostics and by using the Lisp commands associated with the tape drive.

The tape drive formatter has an LED that can be observed by sliding the cover of the mass storage enclosure back about two inches. This LED blinks during the operation of the tape drive formatter internal self-tests to indicate the self-tests have passed.

There is also an LED on the front bezel of the tape drive. This LED indicates tape drive activity. It remains on while the tape drive is executing a command, and is turned off after the Unload command is executed.

Mass Storage Subsystem Fault Isolation Hints

2.4.14 Much can be determined by observing the various LEDs in the mass storage subsystem. The NUPI board inside the system enclosure has two LEDs that are lit on power-up (the red LED is also lit on a boot chord reset). If the red LED remains on, it indicates a self-test fault. If the yellow LED remains on, it indicates a SCSI bus fault.

In the mass storage enclosure, there are several LEDs which indicate activity. The disk formatted LED is visible through the air-vent slots in front of the lower chassis assembly. The disk drive activity LED is visible on the front of the disk drive. The tape drive also has a visible LED that is on when a tape cartridge is installed and off when the tape cartridge is removed or unloaded by an Explorer command. The tape drive also has an internal LED on the tape formatter that is not visible without removing the mass storage enclosure cover. This LED is normally blinking when the tape drive is operational.

By observing the various LEDs in the mass storage subsystem, some fault isolation can easily be accomplished. During normal Explorer operation, the NUPI board periodically polls the devices on the SCSI bus. This in turn causes the disk formatter and the disk drive LEDs to flicker. During boot operations, the disk formatter LED flickers; and when boot devices are selected, all disk activity LEDs should begin to flicker about every two seconds.

If the disk formatter LED is flickering but the disk drive LED is not (following a boot device selection), then communication between the formatter and the NUPI board is okay, but something is wrong between the disk formatter and the disk drive. This could be faulty cabling, a faulty disk formatter, or a faulty disk drive. If the disk formatter LED does not flicker, the problem is between the disk formatter and the NUPI board.

A fault also exists if any of the disk or formatter activity LEDs are stuck on or off. For example, if the SCSI cable is improperly connected, shorts can develop in the signal lines that can cause the disk formatter LED and the disk drive LED to be stuck on. Any deviation from the normal LED states should be noted to determine the nature of faults in the mass storage subsystem.

The flow chart shown in Figure 2-1 gives an overview of the investigation sequence to follow. The fault isolation data in Table 2-6 provides additional information on symptoms and what to do and look for during fault isolation.

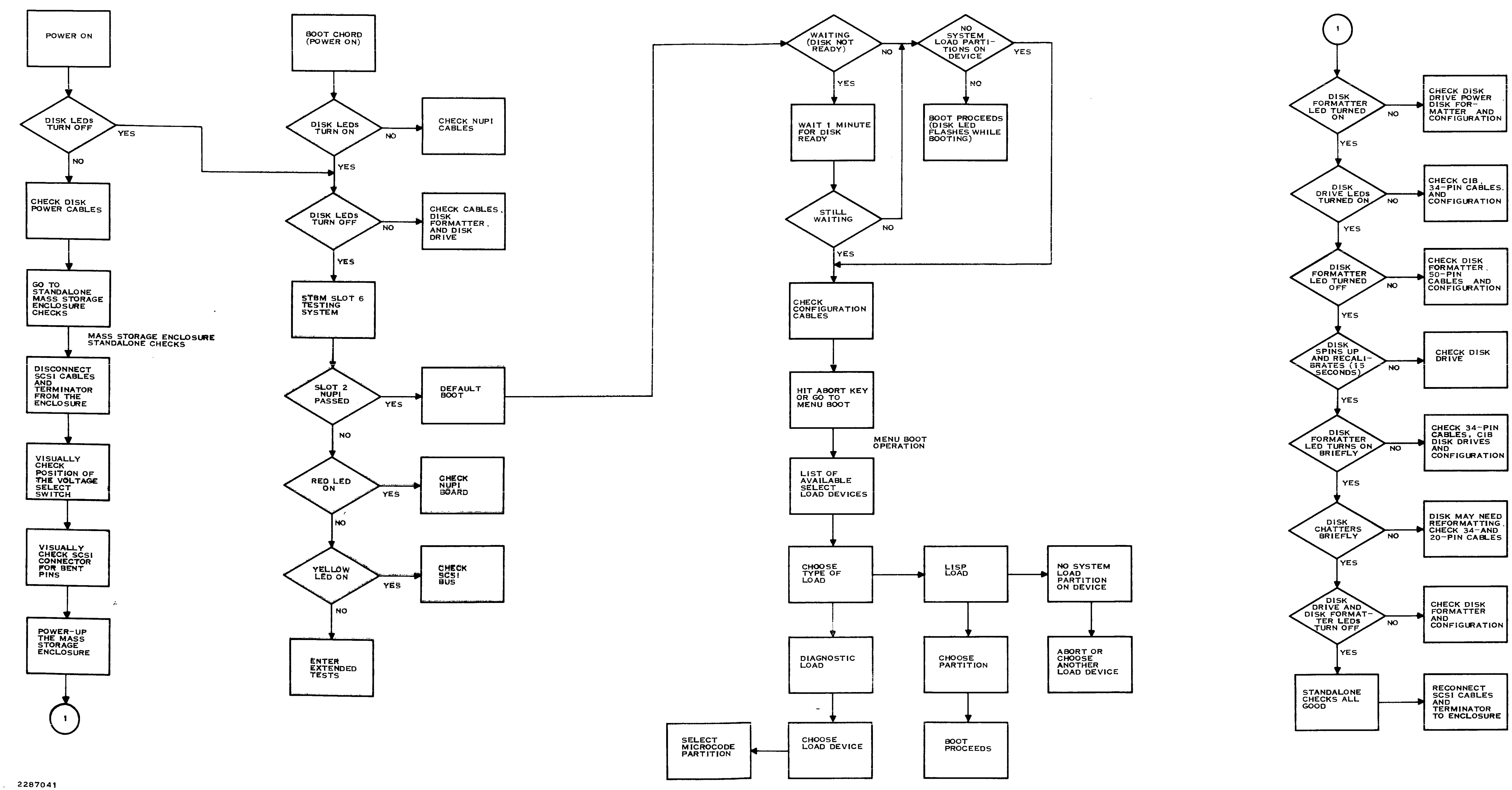

POWER ON
DISK LEDS TURN OFF
YES
NO
CHECK DISK POWER CABLES
GO TO STANDALONE MASS STORAGE ENCLOSURE CHECKS
MASS STORAGE ENCLOSURE STANDALONE CHECKS
DISCONNECT SCSI CABLES AND TERMINATOR FROM THE ENCLOSURE
VISUALLY CHECK POSITION OF THE VOLTAGE SELECT SWITCH
VISUALLY CHECK SCSI CONNECTOR FOR BENT PINS
POWER-UP THE MASS STORAGE ENCLOSURE
1
BOOT CHORD (POWER ON)
DISK LEDS TURN ON
CHECK NUPI CABLES
DISK LEDS TURN OFF
CHECK CABLES, DISK FORMATTER, AND DISK DRIVE
STBM SLOT 6 TESTING SYSTEM
SLOT 2 NUPI PASSED
DEFAULT BOOT
RED LED ON
CHECK NUPI BOARD
YELLOW LED ON
CHECK SCSI BUS
ENTER EXTENDED TESTS
WAITING (DISK NOT READY)
NO SYSTEM LOAD PARTITIONS ON DEVICE
WAIT 1 MINUTE FOR DISK READY
BOOT PROCEEDS (DISK LED FLASHES WHILE BOOTING)
STILL WAITING
CHECK CONFIGURATION CABLES
HIT ABORT KEY OR GO TO MENU BOOT
MENU BOOT OPERATION
LIST OF AVAILABLE SELECT LOAD DEVICES
CHOOSE TYPE OF LOAD
LISP LOAD
NO SYSTEM LOAD PARTITION ON DEVICE
DIAGNOSTIC LOAD
CHOOSE PARTITION
ABORT OR CHOOSE ANOTHER LOAD DEVICE
SELECT MICROCODE PARTITION
CHOOSE LOAD DEVICE
BOOT PROCEEDS
DISK FORMATTER LED TURNED ON
CHECK DISK DRIVE POWER DISK FORMATTER AND CONFIGURATION
DISK DRIVE LEDS TURNED ON
CHECK CIB, 34-PIN CABLES, AND CONFIGURATION
DISK FORMATTER LED TURNED OFF
CHECK DISK FORMATTER, 50-PIN CABLES AND CONFIGURATION
DISK SPINS UP AND RECALIBRATES (15 SECONDS)
CHECK DISK DRIVE
DISK FORMATTER LED TURNS ON BRIEFLY
CHECK 34-PIN CABLES, CIB DISK DRIVES AND CONFIGURATION
DISK CHATTERS BRIEFLY
DISK MAY NEED REFORMATTING. CHECK 34-AND 20-PIN CABLES
DISK DRIVE AND DISK FORMATTER LEDS TURN OFF
CHECK DISK FORMATTER AND CONFIGURATION
STANDALONE CHECKS ALL GOOD
RECONNECT SCSI CABLES AND TERMINATOR TO ENCLOSURE
2287041

Table 2-6 Mass Storage Subsystem Fault Isolation Data

Item	*Symptoms*	*Causes/Things to Check*
Cables	Disk LEDs do not come on at power-up.	a. Check internal cables. b. Check for bent SCSI connector pins.
	Disk LEDs do not come on with boot chord but do come on at power-up.	a. Check SCSI cable to NUPI board. b. Check that NUPI is in same slot as PCA. c. Check SCSI daisy-chain cable.
	Disk LEDs stay on too long at power-up.	a. Check internal cables.
	Disk formatter LED stays on or off.	a. Check internal/external cables.
	Boot waiting or disk is not available.	a. Check SCSI cable to NUPI board. b. Check that NUPI is in same slot as PCA. c. Check SCSI daisy-chain cable.
CIB	Disk formatter LED is not on at power-up.	a. Check CIB power cables.
	Disk drive LEDs do not come on at power-up.	a. Check CIB signal routing.
	Disk formatter LED does not come on at disk drive recalibration.	a. Check CIB signal routing.
Configuration	Default boot is waiting.	a. Try menu boot, then check NVRAM set up values.
	Default boot error number is 00000010.	a. Check to see if NVRAM is looking for the NUPI in the wrong slot.
	Menu boot load device is not available.	a. Check for conflicts in the formatter unit selects. b. Check that NUPI is in same slot as PCA.
	Boot microload is not found.	a. Check that disk is formatted.
	No system load partitions are on load device.	a. Check that right disk is selected.
Disk drive	Disk LEDs do not turn off at power-up.	a. Check for continuous recalibration sounds on disk, which indicates a bad disk drive. b. No recalibration sounds at all on disk indicates a bad disk drive.
	Boot load device is not available.	a. Check for conflicts in disk drive selects. b. Check that one minute has been allowed for the disk drive to ready itself.
Disk formatter	Disk drive LEDs do not turn on at power-up.	a. Check for unit select conflicts at the disk formatter.
	Disk formatter LED stays on or off.	a. Disk formatter is faulty.
	Seek errors or ID errors are indicated.	a. Disk formatter is faulty.

Table 2-6 Mass Storage Subsystem Fault Isolation Data (Continued)

Item	*Symptoms*	*Causes/Things to Check*
Enclosure power	No LEDs turn on at power-up.	a. Check that cooling fan is operating. b. Check ac input voltage switch setting. c. Check that the power cord is plugged in and that the power button is on. d. Check internal power cables. e. Check internal signal cables.
	Power appears to be on but disk drive LED stays off.	a. Check internal power cables. b. Check internal signal cables. c. Check disk drive. d. Check disk formatter.
NUPI board	NUPI red LED turns off at power-up.	a. NuBus test failed. b. Memory board is faulty.
	NUPI red LED stays on after power-up.	a. NUPI board is faulty.
	NUPI yellow LED stays on after power-up.	a. Check for bent pins at SCSI connectors. b. Check configuration. c. Check disk formatter. d. Check tape drive.
	Disk drive LEDs do not respond to boot chord.	a. Check cable at PCA. b. Check that NUPI is in same slot as PCA. c. NUPI board is faulty.
SCSI bus	NUPI yellow LED is on.	a. Check for bent pins at SCSI connectors. b. There are conflicts in disk formatter unit selects. c. SCSI cables have shorts or opens.
Tape drive	Tape LED stays off when tape cartridge is inserted.	a. Tape drive/formatter is faulty.
	Tape formatter LED is not blinking.	a. Tape drive/formatter is faulty.
	Boot menu does not show available tape.	a. Tape media is not installed or positioned yet (can take two minutes)
	Error occurred during preparation of tape (unit=NIL).	a. Tape drive/formatter is faulty. b. Internal cables are faulty. c. Wrong formatter unit select
	Excessive read/write errors are indicated.	a. Check tape drive head for wear. b. Check for TI certified media.
	Tape position errors are indicated.	a. Tape drive is faulty. b. Check for TI certified media.
Tape media	Excessive read/write errors and head position errors are indicated.	a. Check for TI certified media. b. Check that tape media has not exceeded 100 full tape reads/writes.

Crash Analysis Support

2.4.15 The crash analyzer consists of a number of Lisp routines that report the contents of crash records to the user in a readable format. The two user-callable functions to invoke the crash analyzer are **si:report-last-shutdown** and **si:report-all-shutdowns**.

NOTE: For access to online documentation for any function, enter the chord CTRL-SHIFT-D before you type the ending parenthesis for the function.

For more information on crash analysis support, refer to the *Explorer System Software Design Notes* and the loadable diagnostics online instructions.

DISPLAY UNIT MAINTENANCE 3

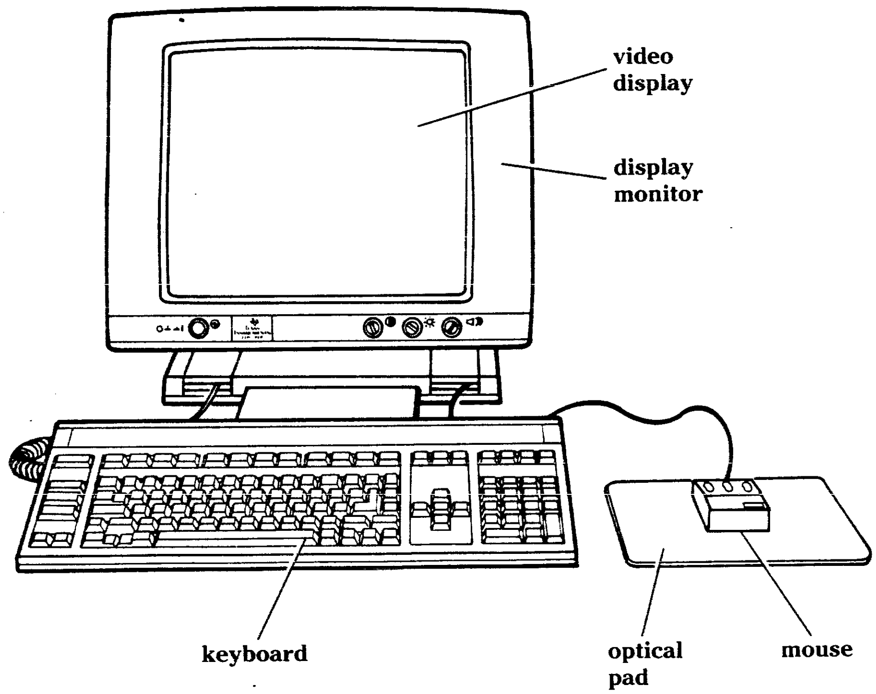
Highlights of This Section

- Diagnostics and troubleshooting
- Replaceable components
- Component replacement procedures
  - Monitor assembly/base assembly
  - Monitor electronics assembly
  - Keyboard/microphone and mouse/headset cables

Introduction

3.1 This section provides field-level maintenance information for the Explorer display unit shown in Figure 3-1. The standard Explorer toolkit has all the hand tools and test equipment required for field maintenance.

Figure 3-1 **Explorer Display Unit**



Diagnostics and Troubleshooting

3.2 Fault isolation and verification of repair of the display monitor are accomplished by the loadable diagnostics and troubleshooting information. There are no self-tests for the display monitor.

- Refer to the *Explorer Diagnostics* manual for diagnostic procedures and error code troubleshooting information.

- Refer to Section 2, Explorer System Troubleshooting, in the Corrective Maintenance part of this manual for information on Explorer system troubleshooting. Use the following diagrams as troubleshooting aids:

  - Figure 3-2, Display Unit Subsystem Troubleshooting Flowchart

  - Figure 3-3, Display Unit Subsystem Interconnect Diagram

- Refer to the *CRT Data Display Service Manual*, TI part number 2537139-0001, Panasonic code number FTD85055057C1 G-4, for service information on the monitor display.

Replaceable Components

3.3 Table 3-1 lists the display unit subassembly field-level replaceable components. Refer to the monitor family tree, part number 2235800, in Appendix A for additional information on other replaceable components.

Figure 3-2 Display Unit Subsystem Troubleshooting Flowchart

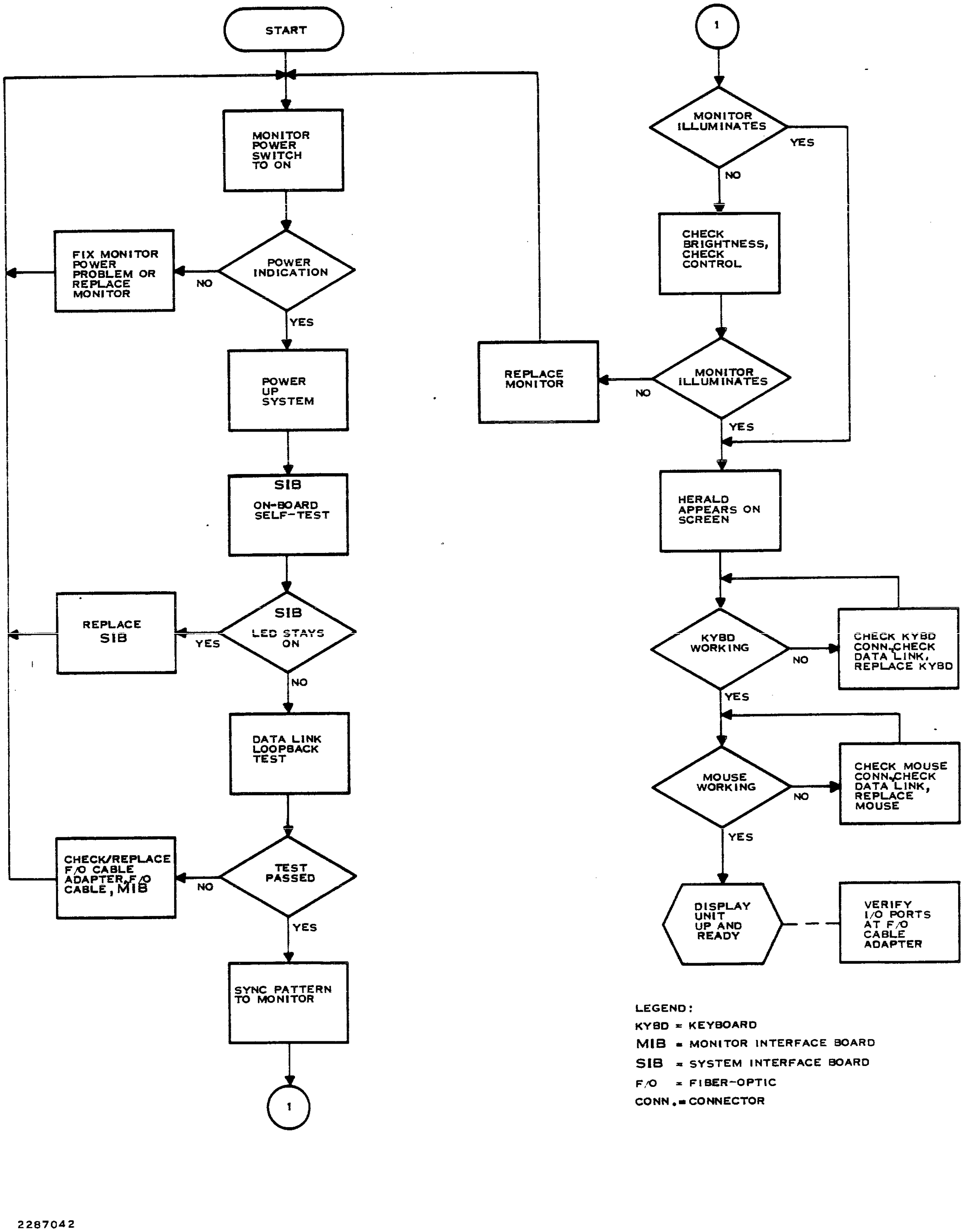
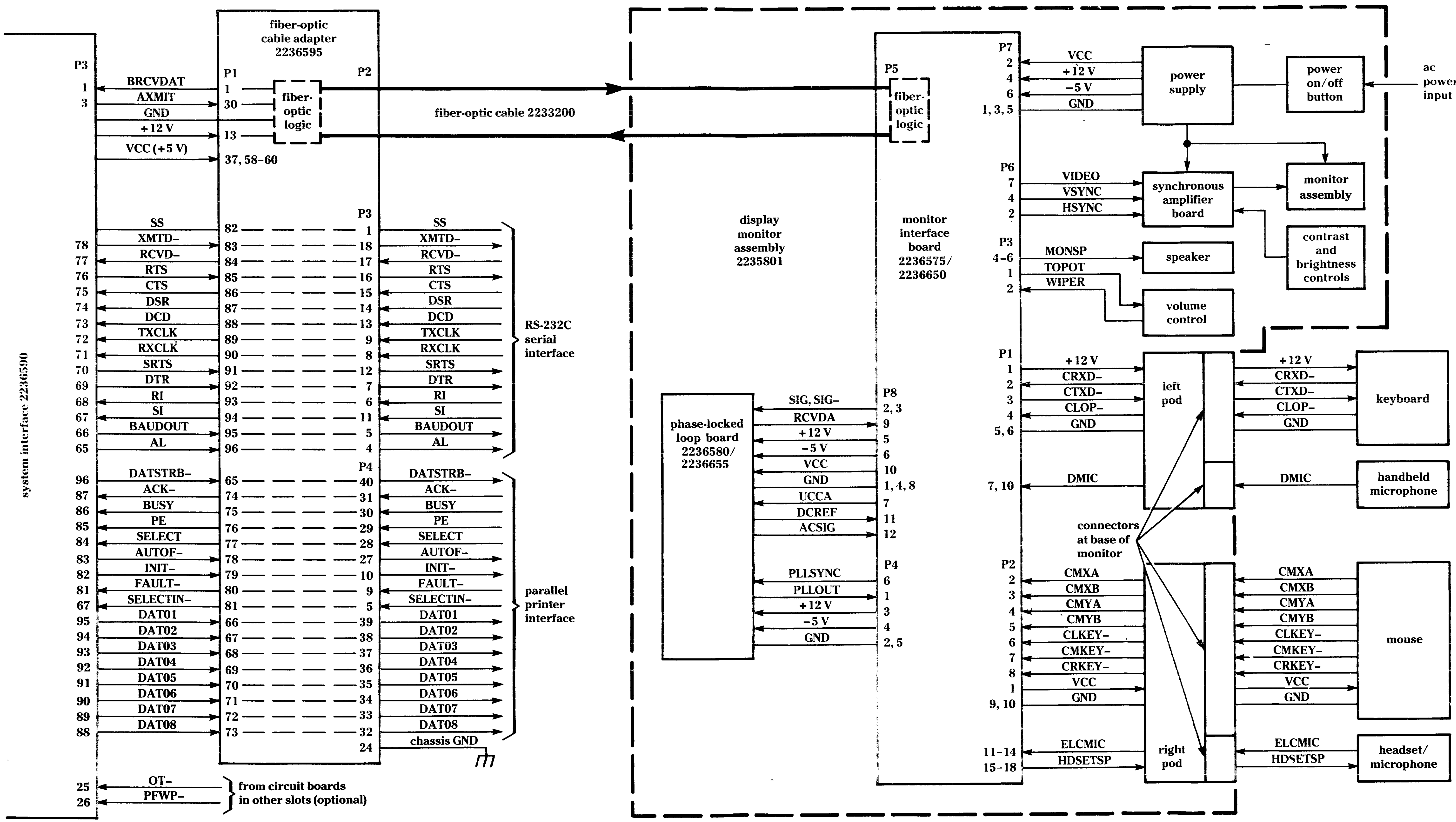


Figure 3-3 Display Unit Subsystem Interconnection Diagram



NOTE:
All part numbers are -0001 unless otherwise marked.

Table 3-1 **Display Subassembly Field-Level Replaceable Components**

Component Description	*Part Number*
Monitor assembly (includes standard CRT, polished glass, power supply board, synchronous board, and so on)	2236585-0001
Etched glass screen CRT	2236585-0002
Anti-glare screen CRT	2236585-0003
Monitor base assembly (includes monitor stand, tilt and height gas cylinder mechanism, and so on)	2235802-0001*
Monitor interface board (early model)	2236575-0001*
Phase-locked loop board (early model)	2236580-0001*
Monitor electronics assembly	2236663-0001
Monitor interface board	2236650-0001*
Phase-locked loop board	2236655-0001*
Fiber-optic cable (standard), 15 m (50 ft)	2233200-0001
Fiber-optic cable (standard), 60 m (197 ft)	2233200-0002
Fiber-optic cable (plenum duty), 30 m (98 ft)	2233200-0003
Fiber-optic cable (plenum duty), 60 m (197 ft)	2233200-0004
Keyboard/microphone cable	2235822-0001
Mouse/headset cable	2235823-0001
Mouse with optical pad (black)	2249437-0001
Mouse with optical pad (gray)	2249437-0004
Mouse only (black)	2249437-0002
Mouse only (gray)	2249437-0005
Optical pad only	2249437-0003
Keyboard assembly (low profile)	2241330-0001
Keyboard assembly (Explorer 2)	2241330-0002
Blower assembly	2235877-0001
Keyboard assembly cable	2229001-0001
Power cord (for convenience outlet)	2247530-0001
Power cord (100/120 V)	2247530-0004
Power cord (220 V)	2210758-0002
Power cord (240 V)	2247599-0002

NOTE:

* Assembly not stocked in local maintenance supply.

Component Replacement Procedures

3.4 The remainder of this section describes the replacement procedures for the following display unit subsystem components:

- Monitor assembly/base assembly
- Monitor electronics assembly
- Keyboard/microphone and mouse/headset cables

Refer to Figure 3-4 through Figure 3-6 as required during all of the component replacement procedures.

CAUTION: All circuit boards in the Explorer system contain static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing or handling the printed circuit boards.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These are commercially available. If you do not have a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling a board. Then, as a further precaution, place the printed circuit board on a grounded work surface after removing it from the assembly or its protective package.

Before storing or transporting the printed circuit board, return it to its protective package or the assembly.

WARNING: Lethal high voltages are present inside the chassis of this equipment. Only qualified service personnel who are familiar with the dangers of high voltages are permitted to open the chassis of this equipment for maintenance, equipment upgrading, or equipment rearrangement.

WARNING: Each system interface board contains a lithium battery. Lithium batteries can explode if the positive and negative terminals are shorted together. DO NOT place the system interface board on a conductive surface. The outside surfaces of all antistatic shipping bags are conductive; do not place the system interface on an antistatic shipping bag.

CAUTION: Do not stack more than two mass storage enclosure units on top of the Explorer 7-slot enclosure. When more than two units are stacked on top of the 7-slot enclosure, there is a danger of the stacked units becoming top heavy and possibly tipping the 7-slot enclosure over.

Figure 3-4 Display Monitor Assembly

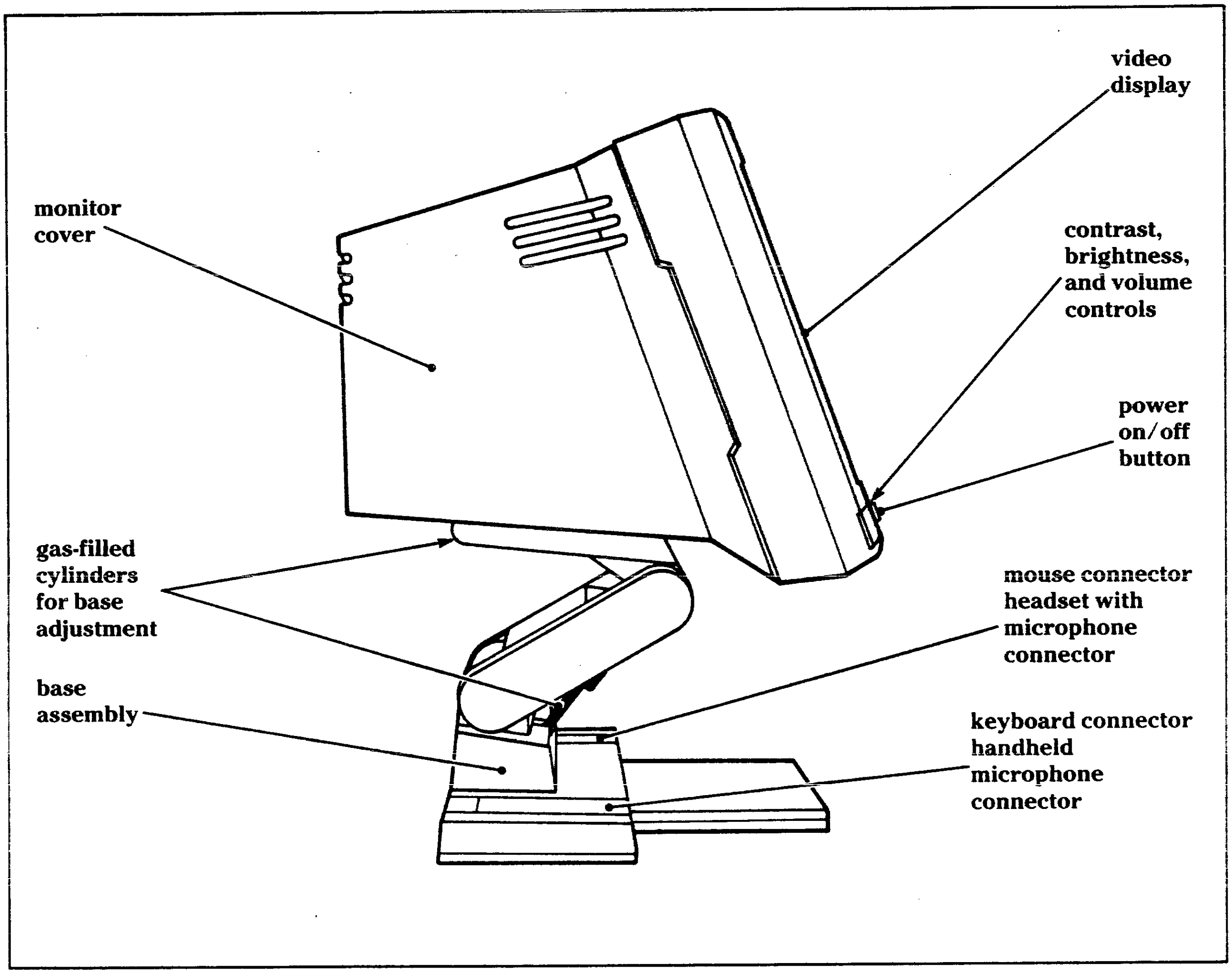
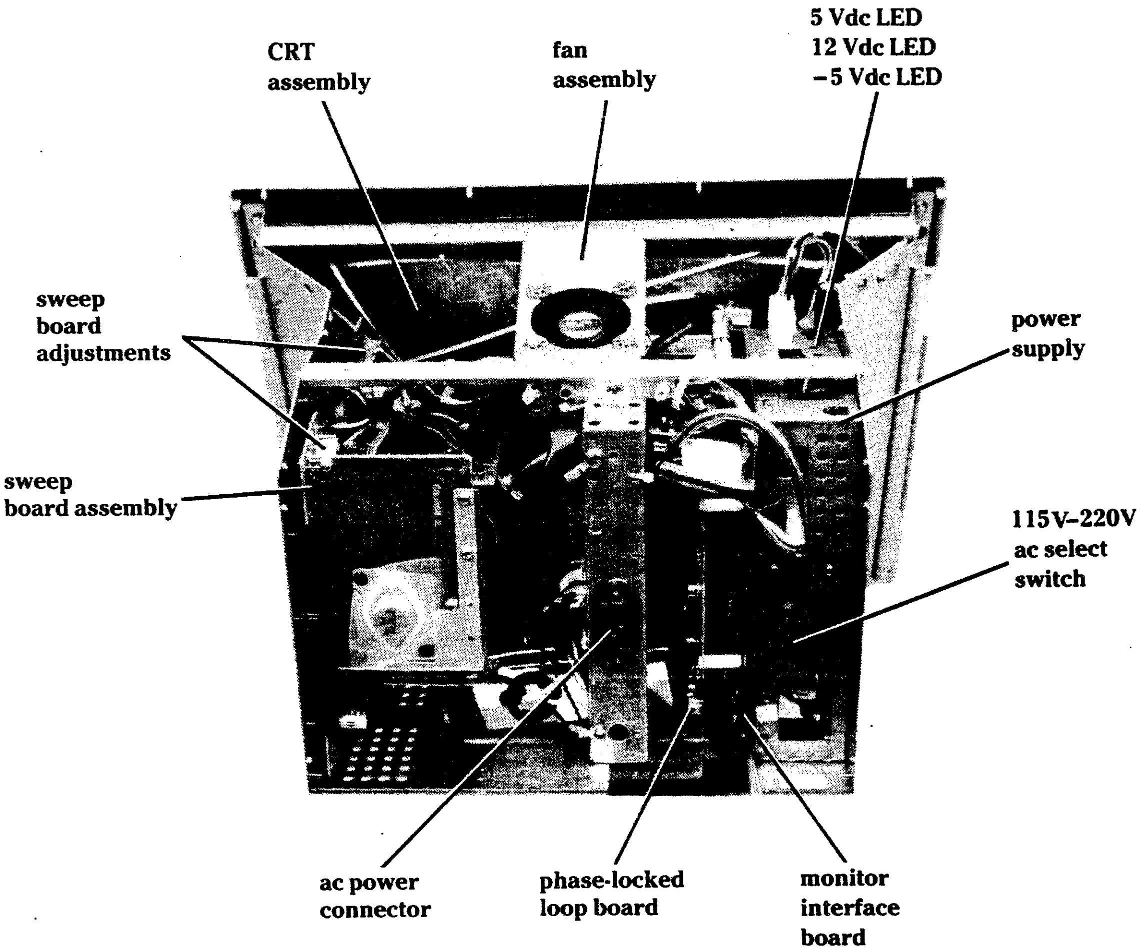
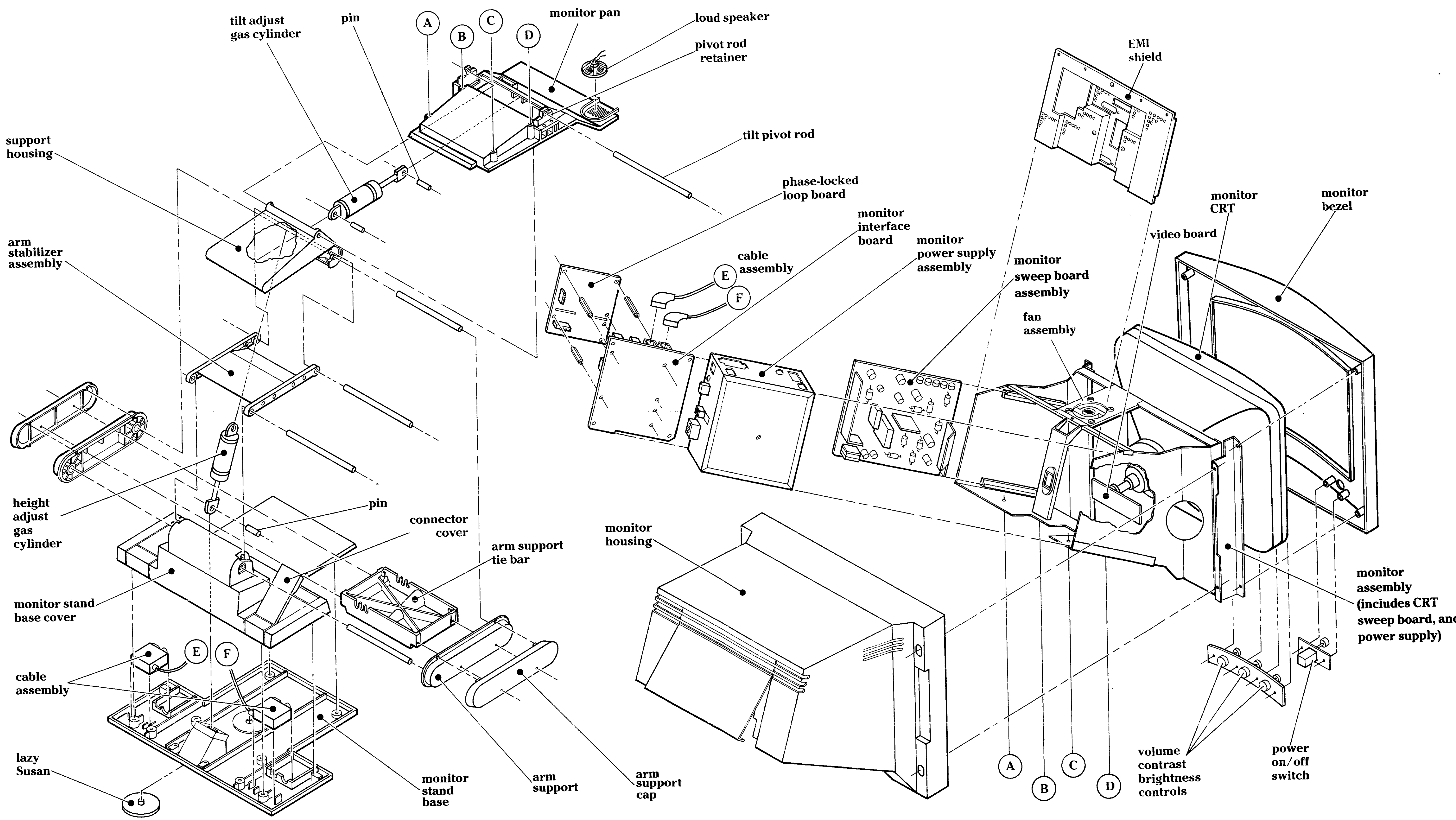


Figure 3-5 Display Monitor Assembly — Internal View



NOTE:
The monitor interface board and the phase-locked loop board make up the monitor electronics assembly.

Figure 3-6 Display Monitor Assembly — Exploded View



Monitor Assembly/ Base Assembly Replacement

3.4.1 This procedure explains how to remove and install the monitor assembly and/or the monitor base assembly.

WARNING: Lethal voltages on the monitor CRT must be discharged before performing any maintenance on the monitor assembly when the monitor cover is removed. Use a high-voltage discharge probe authorized by field service to check that all high voltages are discharged before performing any maintenance when the monitor cover is removed.

---

1. Set the power on/off button on the display monitor to the off (out) position.
2. Unplug the ac power cord from the rear of the display monitor and from the wall socket.
3. Disconnect the following external cables that are connected to the display monitor:
   a. Fiber-optic cable at P5 on the bottom of the monitor assembly
   b. Keyboard cable at mounting base
   c. Mouse cable at mounting base
   d. Handheld microphone cable at mounting base
   e. Headset/microphone cable at mounting base
4. Remove the four screws that attach the monitor cover to the monitor assembly and slide the cover off of the monitor assembly. Be sure to observe the high-voltage warning before touching any component within the monitor assembly.
5. Remove the six screws that secure the EMI shield to the rear of the monitor assembly and remove the EMI shield.

6. Disconnect the following internal cables connected to the monitor electronics assembly (Figure 3-7):

   a. Keyboard cable at connector P1 (F on Figure 3-6)

   b. Mouse cable at connector P2 (E on Figure 3-6)

   c. Speaker cable at connector P3

   d. Video cable at connector P6

   e. Power cable at connector P7

7. Remove the screw next to P1 that holds the monitor electronics assembly to the power supply chassis.

8. Slide the monitor electronics assembly out of the monitor assembly.

9. Disconnect the two power cables connected to the power supply.

10. Remove the two screws that hold the power supply to the monitor assembly; then, lift and slide the power supply out of the monitor assembly.

11. Remove the four screws that hold the monitor bezel to the monitor assembly, and lay the monitor bezel in front of the monitor assembly with wires attached.

12. Remove the four screws that hold the plate with the volume, brightness, and contrast controls to the bezel; then, remove the brightness and contrast controls from the plate. Do not disconnect any wires from the controls. Remove the knobs by pulling them from the two controls; they are used on the new assembly monitor.

13. Remove the two screws that hold the power on/off switch assembly to the bezel; then, remove the switch assembly intact with knob, bracket, and wires attached.

14. Remove the four screws (designated A through D in Figure 3-6) that hold the monitor assembly to the monitor pan on the monitor base assembly. Move the speaker and volume control cables to the side; then, lift the monitor assembly from the monitor pan. The keyboard and mouse cables, disconnected from P1 and P2, will slide through the cable slot in the base of the monitor assembly. Leave the cable clamp attached to these cables.

CAUTION: The keyboard and mouse cables each have a short piece of insulation removed where a metal clamp is fastened to ground the shielding on both cables for EMI purposes. This metal clamp is connected to the metal chassis of the monitor assembly at the left-front mounting screw (viewed from the rear) that holds the monitor assembly to the monitor pan. Make sure that this clamp is securely fastened to the copper foil tape around the shielding on both cables and to the metal chassis when replacing the monitor assembly or the monitor base assembly.

A recommended plan for reassembling the monitor assembly to the monitor base assembly is to first lay the monitor assembly on its rear side. Next, bring the monitor base assembly into position while threading the keyboard and mouse cables through the hole in the base of the monitor assembly. These cables should pass to the left and under the neck of the CRT. Hold the monitor base assembly in position while you insert the four screws that secure the monitor assembly to the monitor base assembly.

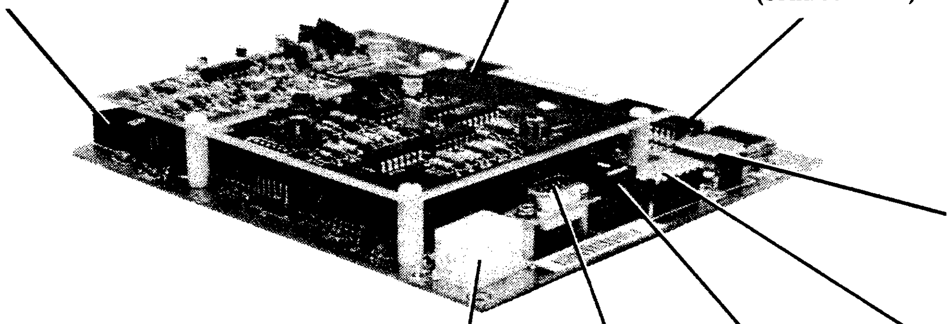
15. Replace the monitor assembly or the monitor base assembly as required, and reassemble the monitor assembly to the base assembly in the reverse order that they were disassembled. Note that a new knob, a bracket, and two screws are required to mount the power on/off switch to the bezel. These parts are provided in the kit, part number 2541301-0001, which contains the following items.

Part Number	*Quantity*	*Item*
2235834-0001	1	Knob, switch
2235859-0001	1	Bracket, switch
2410000-0042	2	Screw, bracket

Be sure you mount the brightness and contrast controls in the proper positions on the bezel plate. The brightness control has yellow, violet, and blue wires, and it mounts in the middle hole on the bezel plate.

16. After the monitor assembly and monitor base assembly are reassembled, check the operation of the monitor subsystem by performing the applicable loadable diagnostic procedures.

Figure 3-7 Monitor Electronics Assembly



Monitor Electronics Assembly Replacement

3.4.2 This procedure explains how to remove and install the monitor electronics assembly in the monitor assembly.

WARNING: Lethal voltages on the monitor CRT must be discharged before performing any maintenance on the monitor assembly when the monitor cover is removed. Use a high-voltage discharge probe authorized by field service to check that all high voltages are discharged before performing any maintenance when the monitor cover is removed.

1. Set the power on/off button on the display monitor to the off (out) position.

2. Unplug the ac power cord from the rear of the display monitor and from the wall socket and disconnect the fiber-optic cable at connector P5.

3. Remove the four screws that attach the monitor cover to the monitor assembly and slide the cover off of the monitor assembly. Be sure to observe the high-voltage warning before touching any component within the monitor assembly.

4. Remove the six screws that secure the EMI shield to the rear of the monitor assembly and remove the EMI shield.

5. Disconnect the following cables connected to the monitor interface board:

   a. Keyboard cable at connector P1

   b. Mouse cable at connector P2

   c. Speaker cable at connector P3

   d. Video cable at connector P6

   e. Power cable at connector P7

6. Remove the screw next to P1 that holds the monitor electronics assembly to the power supply chassis.

7. Slide the monitor electronics assembly out of the monitor assembly.

NOTE: Do not separate the monitor interface board from the phase-locked loop board in the field as special adjustments are required when reassembling these two boards.

---

8. Install a new monitor electronics assembly in the reverse order that the faulty board was removed.

9. Check the operation of the monitor electronics assembly by performing the applicable loadable diagnostic procedures.

Keyboard/ Microphone and Mouse/Headset Cables Replacement

3.4.3 This procedure explains how to remove and install the keyboard/ microphone and mouse/headset cables (designated E and F in Figure 3-6) in the display monitor assembly.

WARNING: Lethal voltages on the monitor CRT must be discharged before performing any maintenance on the monitor assembly when the monitor cover is removed. Use a high-voltage discharge probe authorized by field service to check that all high voltages are discharged before performing any maintenance when the monitor cover is removed.

---

1. Refer to paragraph 3.4.1 to remove the monitor assembly from the monitor base assembly. This is necessary to gain access to the clamp on the keyboard and mouse cables.

2. Remove the clamp from the keyboard and mouse cables.

NOTE: When installing the clamp on new cables, be sure the copper foil tape is properly placed over the shield on each cable before the clamp is tightened.

---

3. Remove the 13 screws that attach the monitor stand base to the monitor stand base cover and remove the monitor stand base.

4. Remove the two cables by threading them through the various cutout openings of the monitor base assembly.

5. Install the cables in the reverse order that they were removed.

6. Check the operation of the keyboard/microphone and mouse/headset cables by performing the applicable loadable diagnostic procedures.

7-SLOT ENCLOSURE MAINTENANCE 4

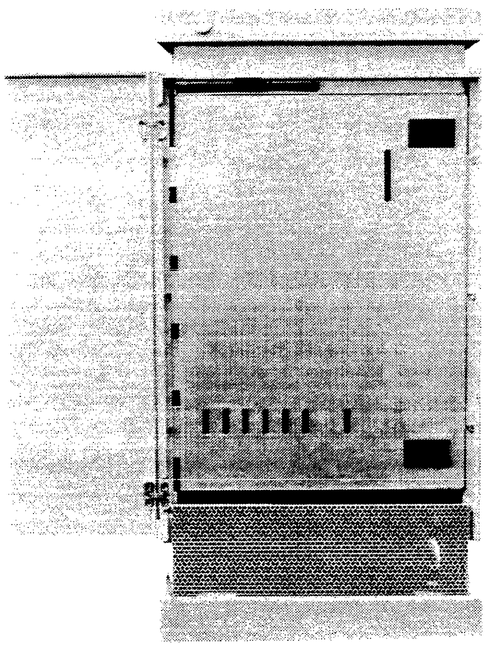
Highlights of This Section

- Self-tests, diagnostics, troubleshooting, and preventive maintenance (PM)
- Replaceable components
- Component replacement procedures

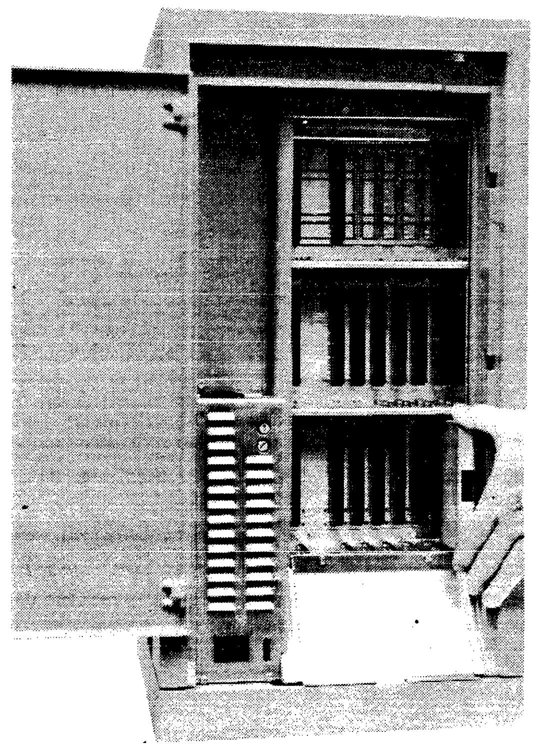
Introduction

4.1 This section provides field-level maintenance information for the Explorer 7-slot enclosure shown in Figure 4-1. The standard Explorer toolkit has all the hand tools and test equipment required for field maintenance.

Figure 4-1 Explorer 7-Slot Enclosure — Front/Rear Views



front view with plastic door open



rear view with plastic door open

Self-Tests, Diagnostics, Troubleshooting and PM

4.2 Fault isolation and verification of repair are accomplished by the self-tests, the diagnostics, and troubleshooting.

- Refer to the self-test information in Section 2, Explorer System Troubleshooting, in the Corrective Maintenance part of this manual, and also to the *Explorer Operations Guide* for additional self-test information.

- Refer to the *Explorer Diagnostics* manual for diagnostic procedures and error code troubleshooting information.

- Refer to Section 2, Explorer System Troubleshooting, in the Corrective Maintenance part of this manual for information on system troubleshooting. Use the following diagrams as troubleshooting aids:

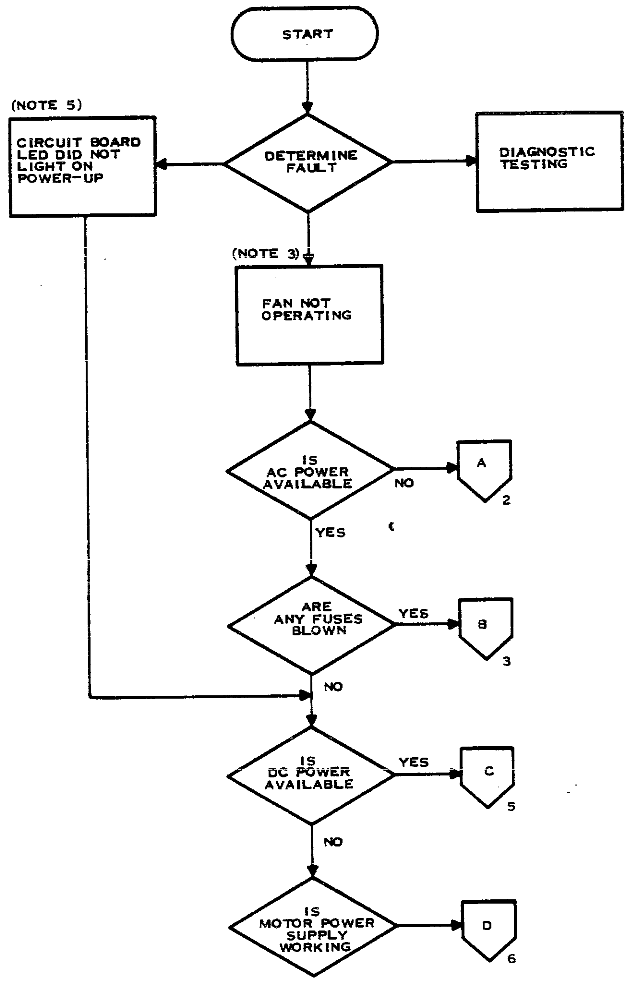
  - Figure 4-2, 7-Slot Enclosure Troubleshooting Flowchart

  - Figure 4-3, System Power Distribution Diagram

- Clean the Explorer enclosure filter every six months and replace the filter every year. For details on cleaning the filter, refer to the Preventive Maintenance part of this manual.

This paragraph gives a brief description of how to use the troubleshooting flowchart shown in Figure 4-2. On the first page the technician is directed to the troubleshooting procedure that is determined by the fault. For example, if the technician knew that ac power was available, he/she would proceed to the blown fuse check. If the blown fuse procedure passed, he/she would proceed with the dc power check. The chart is set up so that the technician can start at any point in the logic. When a power-on or power-off block is encountered, the technician should turn the power on or off at the enclosure power switch.

Figure 4-2 7-Slot Enclosure Troubleshooting Flowchart (Sheet 1 of 6)



NOTES:

1. THE (B) SYMBOL INDICATES AN OFF-PAGE CONNECTOR.
2. THE (1) SYMBOL INDICATES AN ON-PAGE CONNECTOR.
3. IF ENCLOSURE SHUTS DOWN DURING OPERATION, TURN POWER OFF FOR APPROXIMATELY FIVE MINUTES. THEN TURN POWER BACK ON TO DETERMINE IF SHUT DOWN WAS CAUSED BY THERMOPROTECTION CIRCUIT OR OVER VOLTAGE PROTECTION CIRCUIT.
4. IF ENCLOSURE FAILS AGAIN, REPLACE THE POWER SUPPLY BOARD.
5. IF A SINGLE CIRCUIT BOARD RED FAULT LED DOES NOT LIGHT AT TURN ON--REFER TO DIAGNOSTIC TROUBLESHOOTING OR REPLACE BOARD.

WARNING

1. LETHAL VOLTAGE EXISTS ON THE POWER SUPPLY BOARD. DO NOT HANDLE UNTIL POWER HAS BEEN OFF FOR ONE MINUTE.
2. HEAT SINKS AND OTHER COMPONENTS MAY BE HOT ENOUGH TO CAUSE SKIN BURN. HANDLE WITH CARE.
3. DO NOT PROBE EQUIPMENT EXCEPT AT TEST POINTS.

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Figure 4-2 7-Slot Enclosure Troubleshooting Flowchart (Sheet 2 of 6)

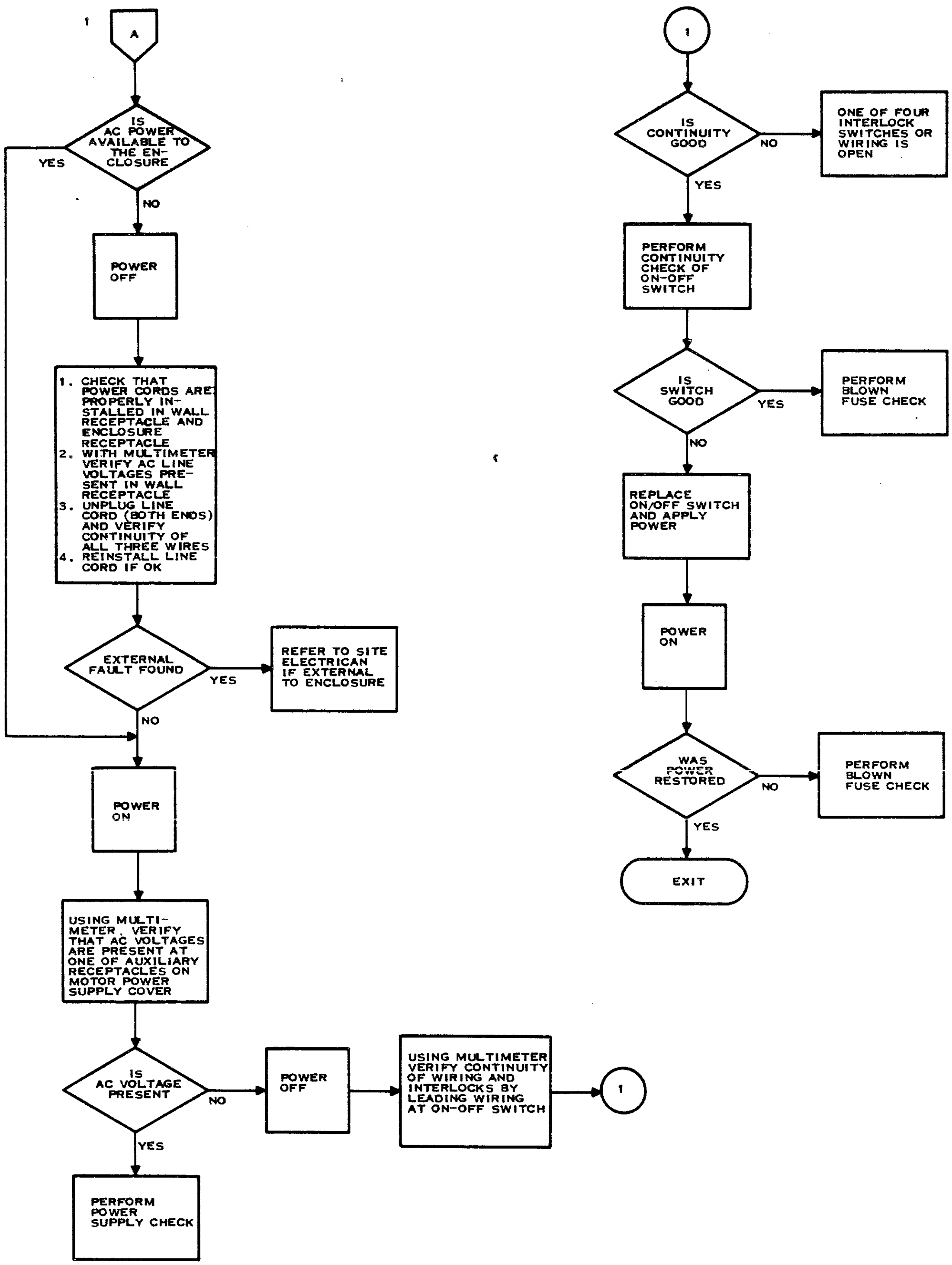

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Figure 4-2 7-Slot Enclosure Troubleshooting Flowchart (Sheet 3 of 6)

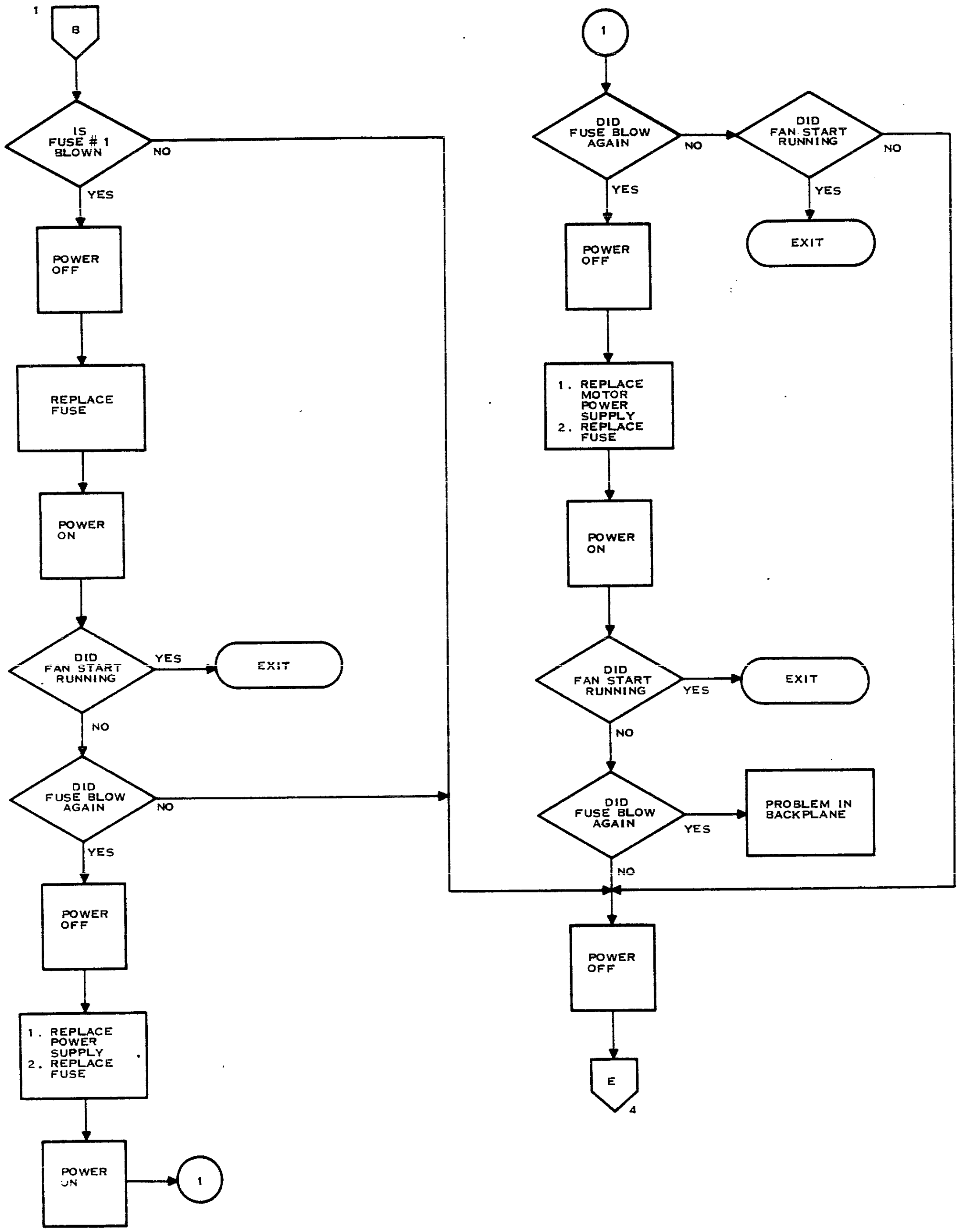

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Figure 4-2 7-Slot Enclosure Troubleshooting Flowchart (Sheet 4 of 6)

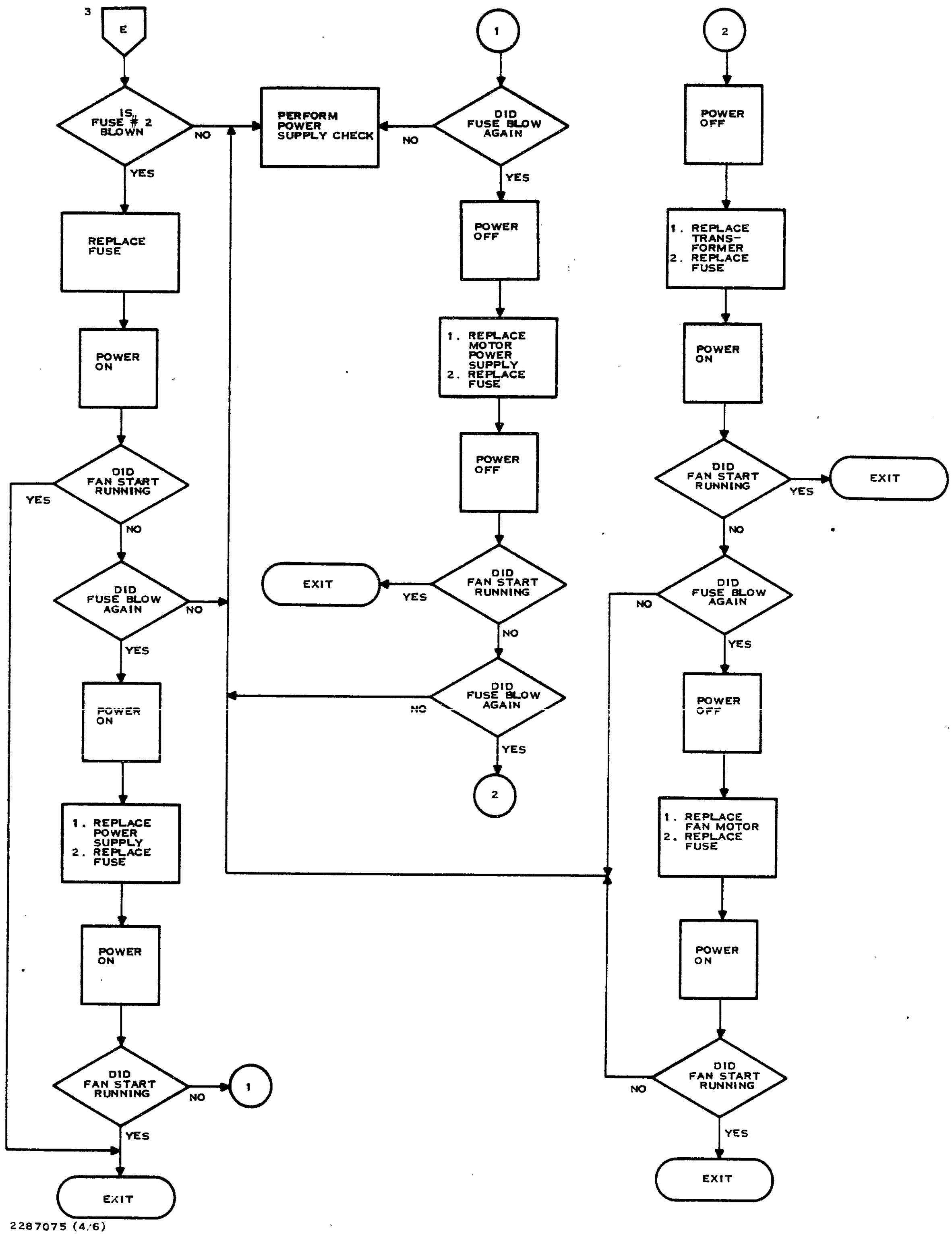

Figure 4-2 7-Slot Enclosure Troubleshooting Flowchart (Sheet 5 of 6)

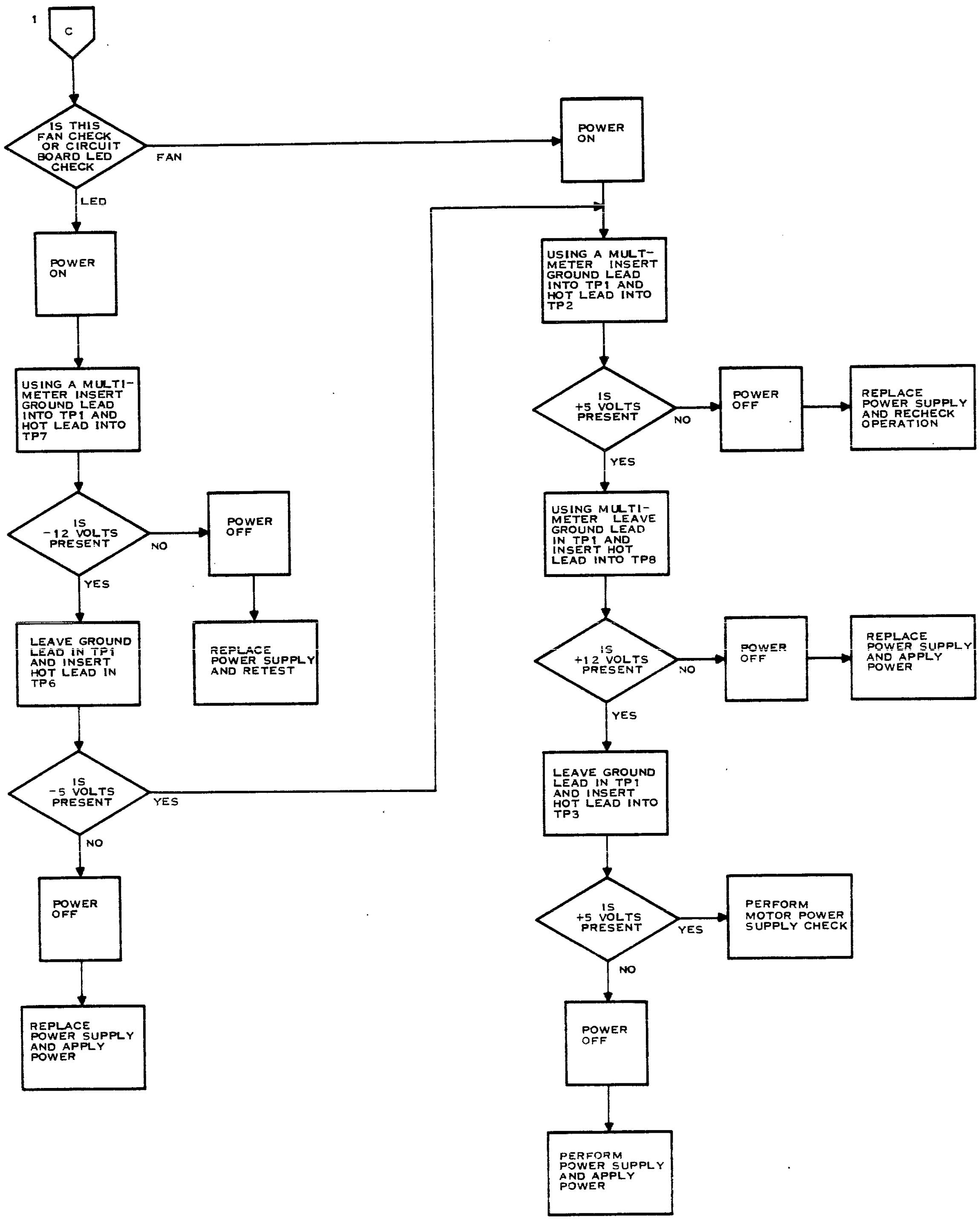

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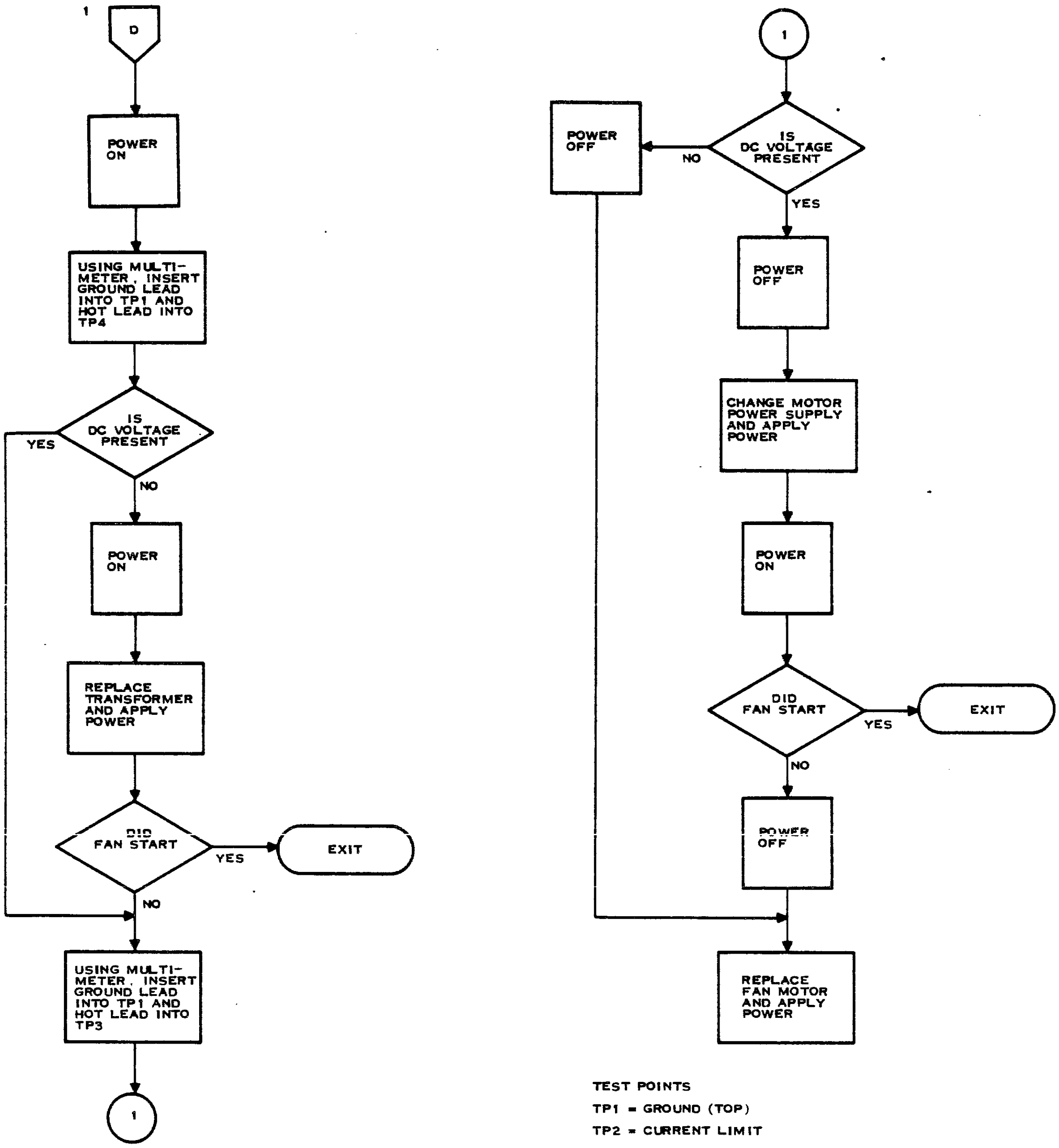
Figure 4-2 7-Slot Enclosure Troubleshooting Flowchart (Sheet 6 of 6)



TEST POINTS

TP1 = GROUND (TOP)

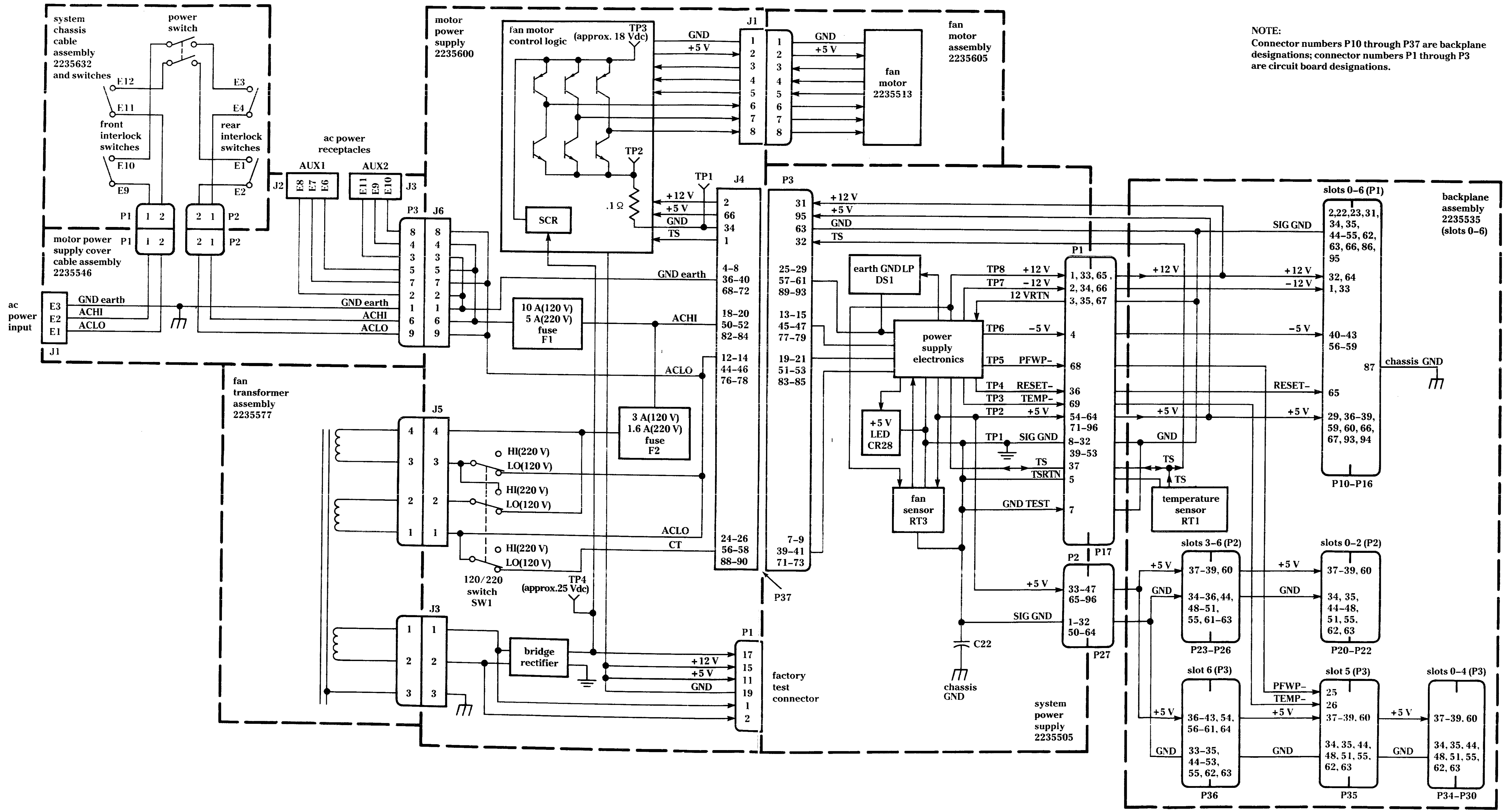
TP2 = CURRENT LIMIT

TP3 = FAN MOTOR

TP4 = TRANSFORMER OUTPUT

2287075 (6/6)

NOTE:
Connector numbers P10 through P37 are backplane designations; connector numbers P1 through P3 are circuit board designations.



Replaceable Components

4.3 Table 4-1 lists the field-level replaceable components for the Explorer enclosure. Refer to the Explorer system family tree, part number 2249427, in Appendix A for additional information on other replaceable components.

Table 4-1 **Explorer Enclosure Field-Level Replaceable Components**

Component Description	*Part Number*
Explorer enclosure equipment:	
System power supply	2235505-0001
Backplane assembly	2235532-0001
System motor power supply	2235600-0001
Fuse (10 A, 125 V)	0416434-0005
Fuse (3 A, 250 V)	0416434-0303
Fuse (5 A, 125 V)	2210403-0023
Fuse (1.6 A, 250 V)	2210403-0018
Fan motor assembly	2235605-0001
Impeller assembly	2235556-0001
Impeller	2235514-0001
Bearing	2247557-0001
Bearing adapter	2235532-0001
Bearing mount	2235531-0001
Fan drive	2235582-0001
Power on/off switch	2247571-0001
Transformer	2235577-0001
Interlock switches	2247527-0001
System chassis cable assembly	2235632-0001
Motor power supply cover assembly	2235578-0001
Filter	2235567-0001
Power cord (100/120V) (early model)	2247530-0003
Power cord (100/120V	2249468-0001
Power cord (220 V) (early model)	2210758-0002
Power cord (220 V)	2249468-0002
Power cord (240 V) (early model)	2247599-0001
Power cord (240 V)	2249468-0003
Installed equipment:	
Explorer processor assembly (early model)	2243881-0001
Processor main assembly board	2236410-0001
Processor auxiliary board	2236405-0001
Explorer processor assembly	2243881-0002
Processor main assembly board	2243958-0001
Processor auxiliary board	2236405-0001
Explorer memory board (2-megabyte early model)	2236415-0001
Explorer memory board (2-megabyte)	2243910-0001
Explorer memory board (4-megabyte)	2243910-0004
Explorer memory board (8-megabyte)	2243910-0003
System interface board (early model)	2236590-0001
System interface board	2236645-0001
NUPI board	2238040-0001
Peripheral cable adapter	2238045-0001
SCSI cable	2236142-0001

Table 4-1

Explorer Enclosure Field-Level Replaceable Components (Continued)

Component Description	*Part Number*
Installed equipment (continued):	
Fiber-optic cable adapter	2236595-0001
Fiber-optic cable	2233200-0001
NuBus Ethernet controller	2236400-0001
Ethernet cable adapter	2236490-0001
Ethernet cable	2239129-0001
Terminator (with clock termination)	2243885-0001
Terminator	2243885-0002

Component Replacement Procedures

4.4 The remainder of this section discusses the replacement procedures for the following Explorer enclosure components:

- System circuit boards
- Cable adapters
- System power supply board
- Motor power supply board
- Fan motor and impeller assembly
- Power on/off switch assembly
- Transformer assembly
- Interlock switches
- System chassis cable assembly
- Motor power supply cover cable assembly
- Backplane

Refer to Figure 4-4 through Figure 4-6 as necessary during all of the component replacement procedures.

NOTE: Be sure you fully close the front and rear doors on the Explorer enclosure after you perform any maintenance. A partially closed door can cause the interlock switches to remain open, preventing the application of ac power to the enclosure.

CAUTION: All circuit boards in the Explorer system contain static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing or handling the printed circuit boards.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These are commercially available. If you do not have a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling a board. Then, as a further precaution, place the printed circuit board on a grounded work surface after removing it from the assembly or its protective package.

Before storing or transporting the printed circuit board, return it to its protective package or the assembly.

System Circuit Board Replacement

4.4.1 This procedure explains how to remove and install any of the system circuit boards in the Explorer enclosure. The Explorer is shipped with all system circuit boards installed in the following slots:

Board	***Slot***
NuBus Ethernet controller	0
Option slot	1
NuBus peripheral interface	2
Explorer memory (option board)	3
Explorer memory (primary board)	4
System interface	5
Explorer processor	6

CAUTION: The Explorer processor consists of two boards mounted together by eight 50-pin connectors to form a single unit. These two boards should not be separated in the field due to the large number of pins that must seat properly when reconnecting the boards.

Figure 4-4 Explorer 7-Slot Enclosure — Internal Front View

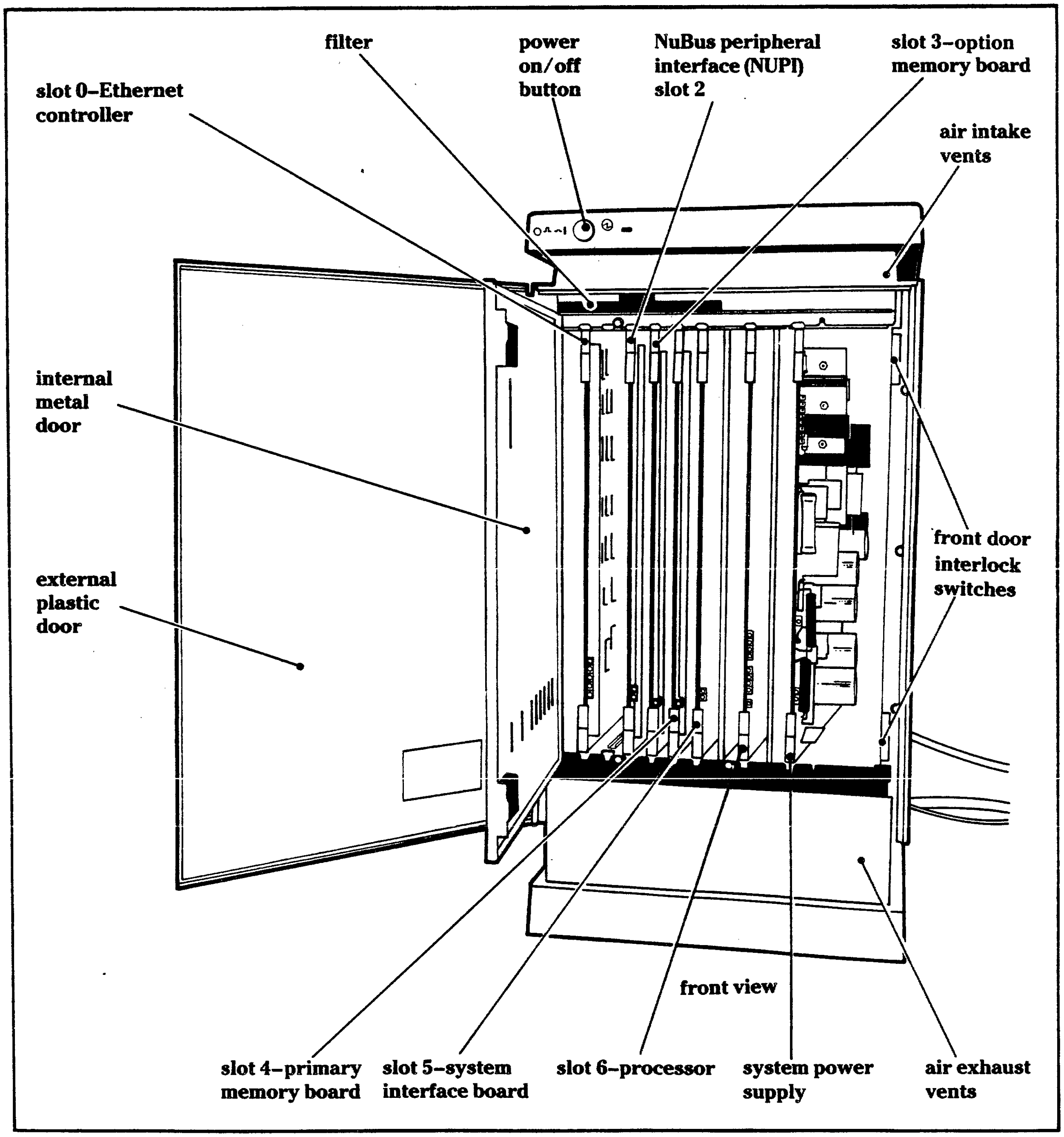
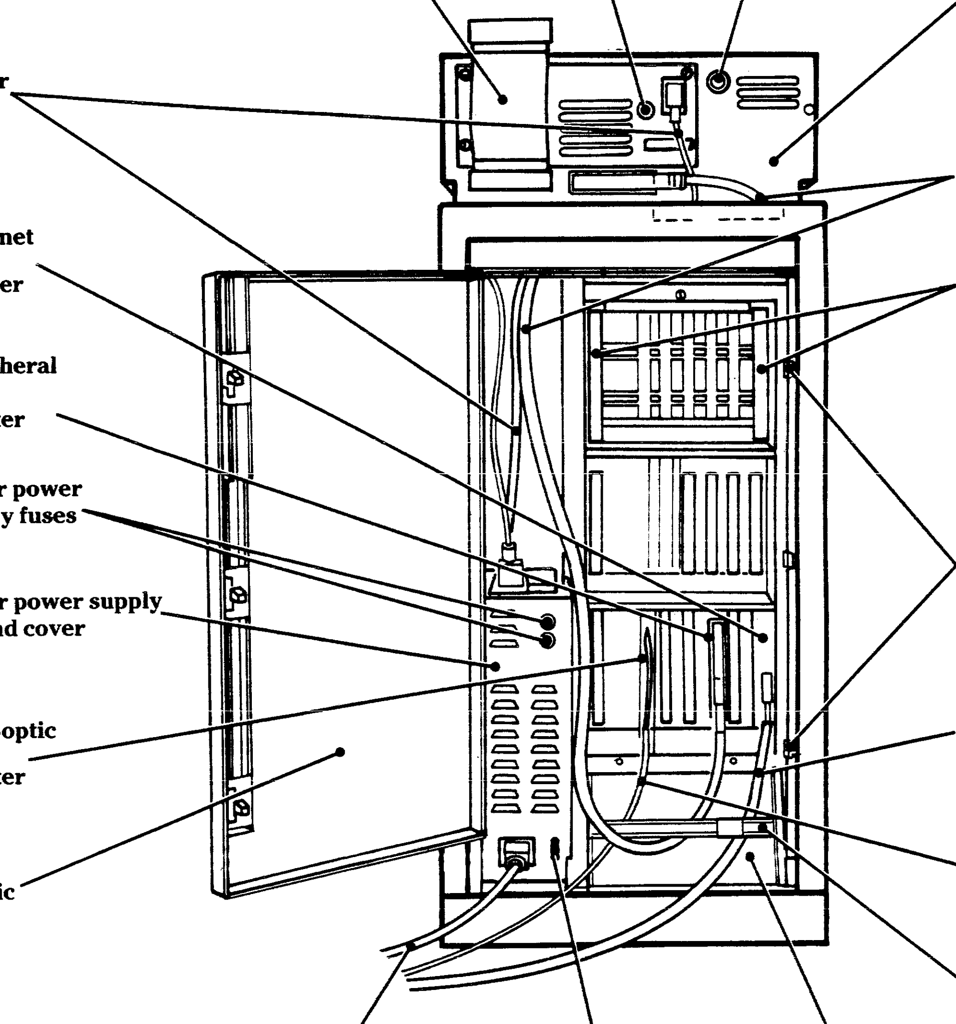


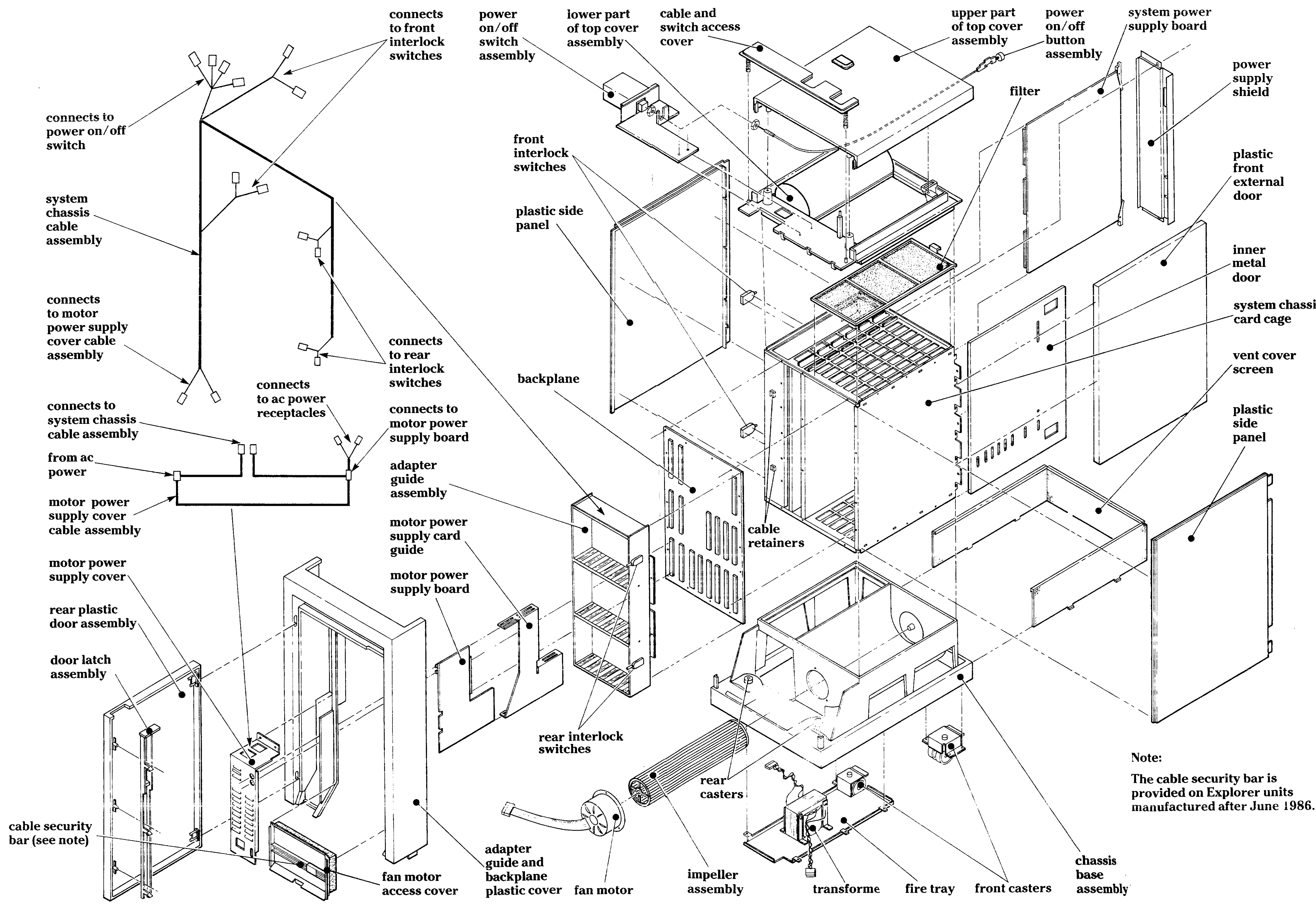
Figure 4-5 Explorer 7-Slot Enclosure — Internal Rear View



Note:

The cable security bar is provided on Explorer units manufactured after June 1986.

Figure 4-6 Explorer Enclosure — Exploded View



1. Set the power on/off button on the enclosure to the off (out) position.

2. Open the plastic front external door and the inner metal door of the Explorer enclosure.

CAUTION: When removing circuit boards from the Explorer enclosure, grip the ejectors with the thumb and forefinger of each hand such that your knuckles do not hit any sharp edges when the board dislodges from the backplane connectors.

NOTE: When removing the system power supply board, you must first remove the power supply shield. To do this, remove the screw at the top of the shield and loosen the screw at the bottom, then lift up and out on the shield.

---

3. Using both hands, pull on the hand-grip portion of both ejectors on a board at the same time. This unseats the board connectors from the backplane connector.

4. Pull the board straight out of the enclosure.

5. To install a board, slide it into its proper slot with connector P1 at the top; with both hands, push in on the outside part of both injectors to properly seat the boards into the backplane connectors. Both injectors should be flush with the front edge of the boards when the boards are properly installed.

6. Check the operation of the new boards by performing the applicable self-test and diagnostic procedures.

Cable Adapter Replacement

4.4.2 This procedure explains how to remove and install any cable adapter in the Explorer enclosure. The cable adapters should be installed in connector P3 in the same slots as the associated Eurocard circuit boards. These slots are:

Cable Adapter	*Associated Eurocard Circuit Board*	*Slot*
Fiber-optic cable adapter	System interface	5
Peripheral cable adapter	NuBus peripheral interface	2
Ethernet cable adapter	NuBus Ethernet controller	0

CAUTION: Use care when you remove the adapter boards as the metal fingers that provide ground connection pressure to the edge of the adapter boards are sharp enough to cause cut fingers and hands. It is a good idea to wear leather gloves when you remove the adapter boards.

1. Set the power on/off button on the Explorer enclosure to the off (out) position.
2. Turn off the ac power to the interface unit associated with the cable adapter that is to be replaced.
3. Open the rear door of the enclosure by pressing and holding down on the latch located at the top right corner of door while you pull the door open.
4. Open the cable security bar (Figure 4-5) and disconnect the interface cable(s) from the cable adapter to be removed.
5. To remove the cable adapter, pull it straight away from the backplane.
6. To install the cable adapter, insert it into the selected backplane slot that matches the Eurocard board installed on the other side of the backplane. Be careful not to bend the backplane pins when installing cable adapters.

CAUTION: The cable adapters can only be inserted one way to mate with backplane shroud pins. When inserting the cable adapters, you will feel a slight resistance. If an excessive amount of resistance is felt, remove and inspect the adapter to ensure that the pins are not bent.

7. Check the operation of the new cable adapters by performing the applicable self-test and diagnostic procedures.

System Power Supply Board Replacement

4.4.3 This procedure explains how to remove and install the system power supply board.

WARNING: When removing the power supply board, allow one minute bleedoff time after turning off the power to the enclosure. Pins ACHI, ACLO, and CT on connector J37 have lethal potential for a short time after power is disconnected.

1. Set the power on/off button on the enclosure to the off (out) position.

2. Open the plastic front external door and the inner metal door of the Explorer enclosure.

3. Remove the screw at the top of the power supply shield and loosen the screw at the bottom of the shield, then lift up and out to remove the shield.

CAUTION: If power has recently been applied to the power supply board, some of the components on the board may still be hot enough to burn your skin if you touch them. Wait until the board has cooled before removing it.

---

4. Using both hands, pull on the hand-grip portion of both ejectors on the board at the same time. This unseats the board connectors from the backplane connector.

5. Pull the board straight out of the enclosure.

6. To install a board, slide it into its proper slot with connector P1 at the top; with both hands, push in on the outside part of both injectors to properly seat the boards into the backplane connectors. Both injectors should be flush with the front edge of the boards when the boards are properly installed.

7. Install the cheater bar to bypass the interlock switches for the front metal door so that this door can be left open while using the test points on the system power supply board.

8. Check the operation of the new system power supply board by applying ac power to the system and then checking for the proper dc voltages and signals at the following test points on the system power supply board:

   TP8 — +12 Vdc (±5%)
   TP7 — -12 Vdc (±5%)
   TP6 — -5 Vdc (±5%)
   TP5 — PFWD-
   TP4 — RESET-
   TP3 — TEMP-
   TP2 — +5.1 Vdc (±3%)
   TP1 — GND

Motor Power Supply Board Replacement

4.4.4 Due to the complex cable connections on the motor power supply board, separate removal and installation procedures are provided.

Removal of the Motor Power Supply Board

4.4.4.1 This procedure explains how to remove the motor power supply board.

WARNING: To ensure that high-voltage capacitors on the power supply have had time to discharge, allow one minute after the ac power has been removed from the enclosure before removing the motor power supply.

---

1. Set the power on/off button on the Explorer enclosure to the off (out) position. Wait one minute for the high-voltage capacitors to discharge.

2. Unplug the ac power cord from the Explorer enclosure at the wall receptacle.

3. Open the rear door by pressing and holding down on the latch located at the top right corner of the door while you pull the door open.

4. Remove the ac power cord from the motor power supply cover receptacle.

5. If installed, remove the power cords from the auxiliary receptacles located at the top of the motor power supply cover.

6. Remove the motor supply cover (see Figure 4-7) as follows:

   a. Using a nut driver, remove the two screws located at the top of the motor power supply cover.

   b. Tilt the cover back and then lift it up to clear the retaining ridge on the chassis base assembly.

   c. Once the cover has cleared the retaining ridge, disconnect the 9-pin connector with locking tabs from motor power supply connector J6 (Figure 4-8). Release the locking tabs by squeezing them together and pulling straight back from the connector body. Release the two connectors from the system chassis cable assembly and remove the motor power supply cover.

7. Disconnect connectors J3 and J5 that lead to the transformer from the motor power supply. These are 3-pin and 4-pin connectors with locking tabs. Press the locking tabs together and pull straight away from the transformer.

8. Hold the motor power supply at the center edge and pull straight out about 25.4 millimeters (1 inch).

9. Disconnect the ribbon connector from J1 on the motor power supply that leads to the fan, and remove the motor power supply.

Figure 4-7 Motor Power Supply Cover Assembly

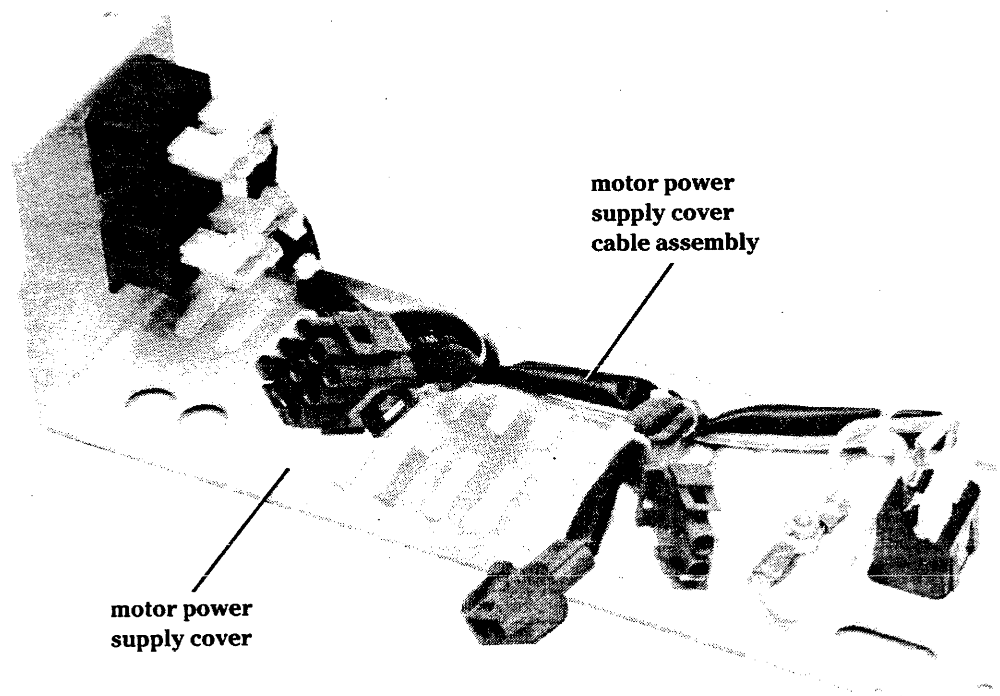
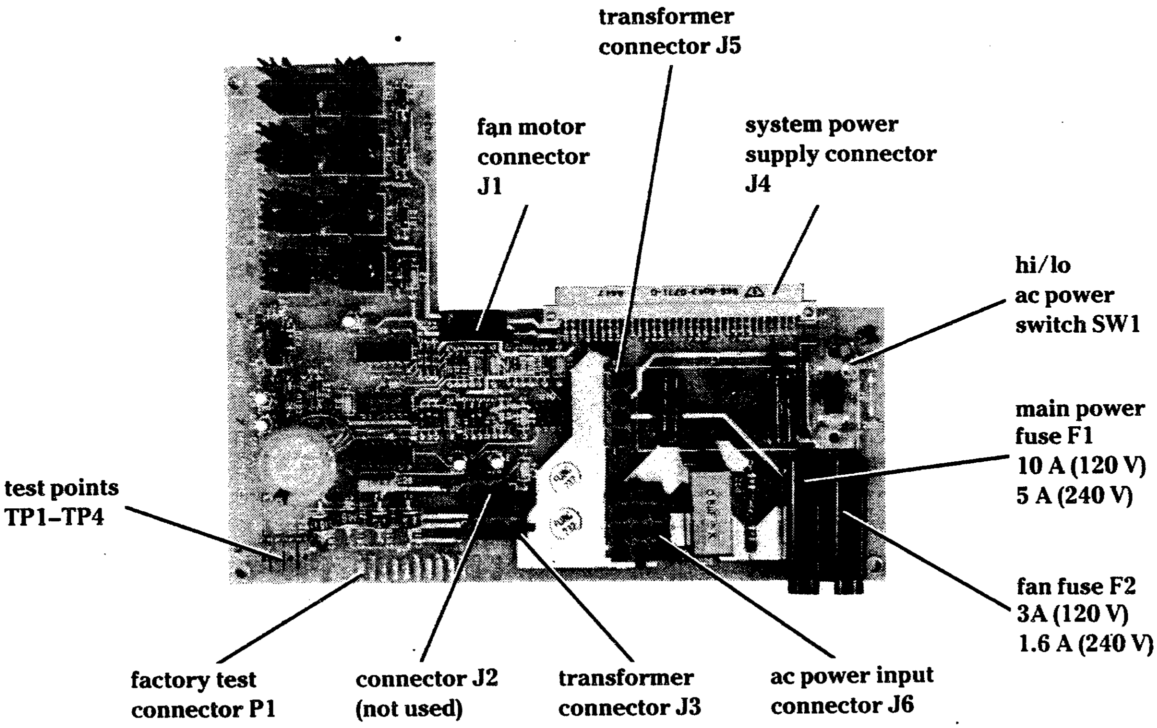


Figure 4-8 Motor Power Supply Board



Installation of the Motor Power Supply Board

4.4.4.2 If you are installing a new board, verify that the part number corresponds to the number on the unit you removed.

WARNING: Ensure that the ac power is disconnected from the enclosure prior to installing the motor power supply.

---

1. Insert the motor power supply board in the motor power supply card guide and slide the board forward until you can connect the ribbon cable from the fan to the J1 connector on the motor power supply board.

2. Connect the ribbon cable from the fan motor to connector J1 on the motor power supply.

CAUTION: When inserting the motor power supply board, make sure the cable from the fan motor is out of the way so you do not damage this cable.

---

3. Push the motor power supply board forward until it seats in the backplane connector.

4. Connect the 3-pin and 4-pin connectors from the transformer to motor power supply board connectors J3 and J5.

5. Place the motor power supply cover behind the retaining ridge on the chassis base assembly with the auxiliary receptacle at the top. Connect the 9-pin connector on the motor power supply cover cable assembly to motor power supply board connector J6. Connect the other two connectors on the motor power supply cover cable assembly to the associated connectors on the system chassis cable assembly.

6. Tilt the cover toward the backplane until the top of the cover is flush with the backplane. Align the screw holes in the cover with the screw holes in the backplane and insert and tighten the two screws.

7. Connect the external ac power cord to the motor power supply receptacle.

8. Connect the external ac power cords to the auxiliary receptacles if used.

9. Close the back door of the enclosure.

10. Check the operation of the new motor power supply board by applying ac power to the system and then checking for the proper dc voltages using a volt/ohmmeter (VOM) at the following test points on the motor power supply board:

    TP4 — In the range of +20 to +30 Vdc
    TP3 — Approximately +18 Vdc
    TP2 — Not measurable
    TP1 — GND

Fan Motor and Impeller Assembly Replacement

4.4.5 This procedure explains how to remove and install the fan motor and the impeller assembly in the Explorer enclosure. Instructions on the inspection and replacement of parts associated with the impeller are also provided.

WARNING: To ensure that high-voltage capacitors on the power supply have had time to discharge, allow one minute after the ac power has been removed from the enclosure before removing the motor power supply.

---

1. Perform the removal procedure for the motor power supply board to gain access to the fan cable attached to motor power supply connector J1.

2. Disconnect the fan cable from the motor power supply board.

3. Using a nut driver, remove the two screws at the top of the fan motor access cover and remove the cover. Retain the screws for reinstallation.

4. Using a nut driver, remove the three screws that attach the fan motor to the chassis base assembly. Retain the screws for installation.

NOTE: If you do not want to remove the impeller assembly with the fan motor, rock the fan motor while pulling it from the impeller assembly to break the contact with the impeller assembly.

---

5. To remove the fan motor, pull it away from the chassis base assembly. As you are pulling the fan motor away, guide the fan cable through the slot that leads to the motor power supply board.

6. Remove the impeller assembly from the chassis base assembly and inspect the parts of the impeller assembly (Figure 4-9) for wear.

7. Replace any parts associated with the impeller assembly that appear to have excessive wear.

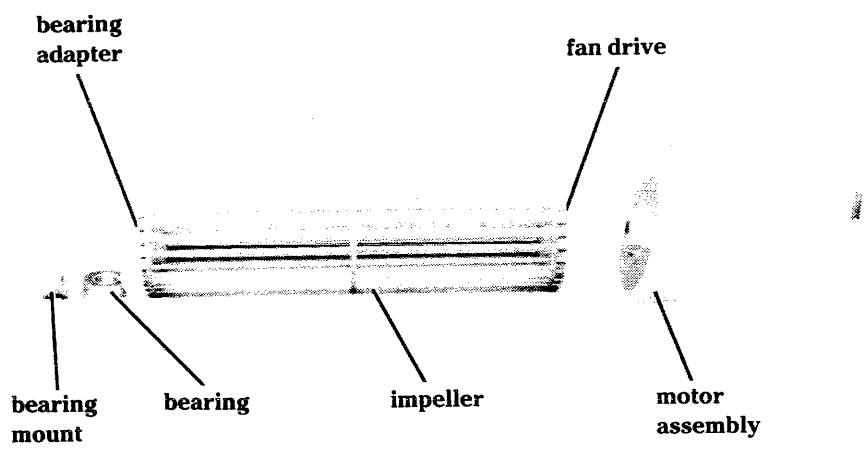
8. Insert the impeller assembly into the chassis base assembly and ensure that the impeller assembly is mounted flush against the rear bearing mount before mating the fan motor to the impeller assembly.

9. Mate the fan motor to the impeller assembly. A slight turning of the fan motor may be required to mate the fan motor with the impeller assembly.

10. Install the fan motor and all associated hardware that was removed or disconnected during the removal of the fan motor.

11. Check the operation of the fan motor and impeller assembly by applying ac power to the system. Listen to the operation of the fan motor and note that the sound level and the flow of cooling air are both normal.

Figure 4-9 **Impeller Assembly**



Power On/Off Switch Replacement

4.4.6 This procedure explains how to remove and install the ac power on/off switch on the Explorer enclosure.

WARNING: Ensure that ac power is disconnected from the enclosure prior to removing the power on/off switch.

---

1. Set the ac power on/off button on the Explorer enclosure to the off (out) position.
2. Disconnect the ac power cord at the wall outlet and from the rear of the Explorer enclosure.
3. Push the rear of the cable and switch access cover on the top cover assembly down and back into the adapter guide and backplane plastic cover.
4. Using a small flat-bladed screwdriver, disengage the pushrod that is attached to the rod adapter on the power on/off switch.
5. Remove the two screws holding the switch mount, then lift the switch assembly out through the cable and switch cover opening. As soon as the switch is above the opening, disconnect the four wires attached to the switch.

6. Replace the power on/off switch on the switch assembly. Refer to Figure 4-10 for a detailed part breakdown.

7. Place the four disconnected wires through the cutout below the switch; then connect these four wires to the correct switch connectors as shown in Figure 4-10.

8. Place the switch assembly in position and secure it with the two screws removed during disassembly.

9. Attach the pushrod in the center hole in the rod adapter on the switch.

10. Check the mechanical action of the switch using the power on/off button. You can adjust the pushrod if the mechanical action of the switch is not smooth.

11. Push the cable and switch cover forward until it slides into place.

12. Connect the ac power cord to the wall outlet and to the rear of the Explorer enclosure.

13. Check the electrical operation of the power on/off switch by checking for the proper ac voltage at the auxiliary power receptacles while operating the switch.

Transformer Replacement

4.4.7 This procedure explains how to remove and install the transformer in the Explorer enclosure.

WARNING: Ensure that the ac power is disconnected from the enclosure prior to removing the transformer.

---

1. Set the ac power on/off button on the Explorer enclosure to the off (out) position.

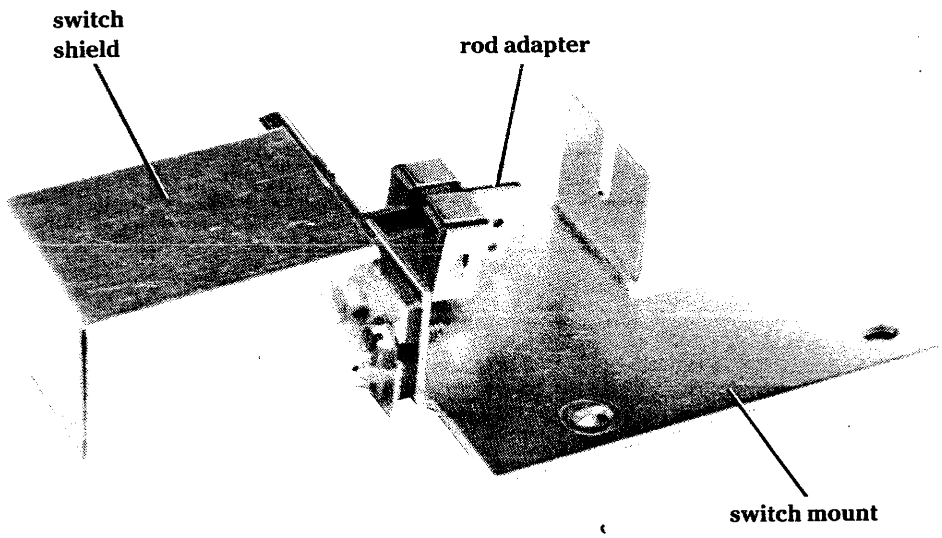
2. Remove the mass storage enclosure(s) from the top of the Explorer enclosure.

3. Open the rear door assembly by pressing and holding down on the latch located at the top right corner of the door while you pull the door open.

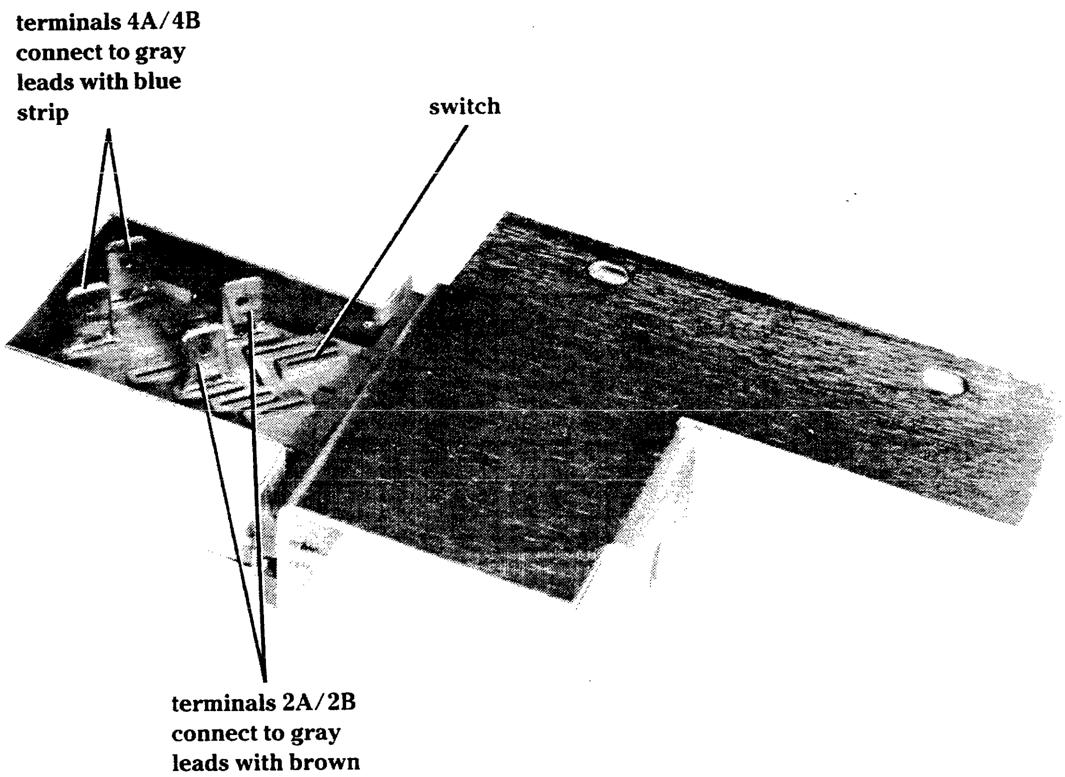
4. Disconnect any interface cables attached to the cable adapter boards.

5. Disconnect the transformer connectors from the motor power supply board. Refer to the motor power supply board removal procedure.

Figure 4-10 Power On/Off Switch Assembly



top view



bottom view

6. Place the Explorer enclosure on its front side to gain access to the fire tray on the bottom of the enclosure.

7. Remove the six retaining screws from the fire tray, and remove the fire tray which contains the transformer.

8. Replace the transformer on the fire tray. Four retaining nuts secure the transformer to the fire tray.

9. Route the transformer cables to the motor power supply board, and secure the fire tray to the base chassis assembly with the six retaining screws.

10. Place the Explorer enclosure in an upright position.

11. Connect the transformer cables to the motor power supply board.

12. Install and reconnect any components and cables that were removed or disconnected in this procedure.

13. Check the operation of the new transformer by applying ac power to the system and checking the voltage at TP4 on the motor power supply. This voltage should be in the range of +20 to +30 volts dc. Also note whether the fan motor is operating properly.

Interlock Switch Replacement

4.4.8 This procedure explains how to remove and install the front or rear interlock switches in the Explorer enclosure.

WARNING: Ensure that the ac power is disconnected from the enclosure prior to removing any interlock switch.

---

1. Set the ac power on/off button on the Explorer enclosure to the off (out) position.

2. Disconnect the ac power cord from the rear of the Explorer enclosure and from the wall outlet.

3. Perform the following steps to remove the adapter guide and backplane plastic cover:

   a. Open the rear door by pressing down and holding the latch located at the top right corner of the door while you pull the door open.

   b. Using a nut driver, remove the two screws at the top of the fan motor access cover and remove the cover.

   c. Remove the one screw that secures the backplane plastic cover to the lower part of the top cover assembly.

   d. Using both hands, apply fingertip pressure to the backplane cover and the top cover assembly and tilt the backplane plastic cover away from the top cover assembly just enough to gain access to the cable connected to connector J6 on the motor power supply.

   e. Disconnect the cable connected to connector J6 on the motor power supply; then lift the backplane plastic cover with the attached motor power supply cover from the enclosure.

   f. Disconnect the two cables that connect the motor power supply cover cable assembly to the system chassis cable assembly. This disconnects the backplane cover from the enclosure.

4. Perform the following steps to replace a faulty rear interlock switch:

   a. Remove the two nuts and washers that secure the interlock switch to the adapter guide assembly, and remove the interlock switch.

   b. Disconnect the leads from the faulty interlock switch, and reconnect the leads to a new interlock switch. The leads can be connected to the terminals in any order.

   c. Install a new interlock switch in the reverse order that was used to remove the faulty rear interlock switch.

5. Perform the following steps to replace a faulty front interlock switch:

   a. Using a nut driver, loosen the three screws that secure the plastic side panel covering the front interlock switches; then pull down and out on the side panel to remove it from the enclosure.

   b. Disconnect the leads from the faulty front interlock switch.

   c. Remove the two nuts and washers that secure the interlock switch to the system chassis card cage, and remove the switch.

   d. Install a new interlock switch in the reverse order that was used to remove the faulty front interlock switch.

6. Install the adapter guide and backplane plastic cover in the reverse order that was used to remove it.

7. Set the ac power on/off button on the Explorer enclosure to the on (in) position, and check the operation of the interlock switches by measuring the ac power at the ac power receptacles on the motor power supply cover asssembly. When the doors of the enclosure are closed, ac power should be present at these receptacles; when the doors are open, ac power should be removed.

System Chassis Cable Assembly Replacement

4.4.9 This procedure explains how to remove and install the system chassis cable assembly in the Explorer enclosure.

WARNING: Ensure that the ac power is disconnected from the enclosure prior to removing the system chassis cable assembly.

1. Set the ac power on/off button on the Explorer enclosure to the off (out) position.

2. Disconnect the ac power cord from the rear of the Explorer enclosure and from the wall outlet.

3. Disconnect and remove the mass storage enclosure from the Explorer enclosure if it is installed.

4. Perform the following steps to remove the adapter guide and backplane plastic cover:

   a. Open the rear door by pressing down and holding the latch located at the top right corner of the door while you pull the door open.

   b. Using a nut driver, remove the two screws at the top of the fan motor access cover and remove the cover.

   c. Remove the one screw that secures the backplane plastic cover to the lower part of the top cover assembly.

   d. Using both hands, apply fingertip pressure to the backplane plastic cover and the top cover assembly and tilt the backplane cover away from the top cover assembly just enough to gain access to the cable connected to connector J6 on the motor power supply.

e. Disconnect the cable connected to connector J6 on the motor power supply; then lift the backplane plastic cover with the attached motor power supply cover from the enclosure.

f. Disconnect the two cables that connect the motor power supply cover cable assembly to the system chassis cable assembly. This disconnects the backplane cover from the enclosure..

5. Perform the following steps to remove both plastic side panels fron the enclosure:

   a. Using a nut driver, loosen the three screws that secure the plastic side panel covering the front interlock switches; then pull down and out on the side panel to remove it from the enclosure.

   b. Using a nut driver, loosen the three screws that secure the plastic side panel covering the rear interlock switches. This side panel is attached to the plastic front external door. Pull down and out on the side panel to remove it from the enclosure with the door attached.

6. Disconnect the leads attached to the four interlock switches and the leads attached to the power on/off switch.

7. Slide the system chassis cable assembly out of the two cable retainers on the rear of the system chassis card cage, and remove the cable assembly from the enclosure.

8. Install a new system chassis cable assembly in the reverse order that was used to remove the faulty cable assembly.

9. Set the ac power on/off button on the Explorer enclosure to the on (in) position, and check the operation of the system chassis cable assembly by observing that ac power is properly applied to the enclosure. A good way to make this check is to measure the ac voltages at the ac power receptacles on the motor power supply cover assembly.

Backplane Replacement

4.4.10 This procedure explains how to remove and install the backplane in the Explorer enclosure.

WARNING: Ensure that the ac power is disconnected from the enclosure prior to removing the backplane.

---

1. Set the ac power on/off button on the Explorer enclosure to the off (out) position.

2. Disconnect the ac power cord from the rear of the Explorer enclosure and from the wall outlet.

3. Disconnect and remove the mass storage enclosure from the Explorer enclosure if it is installed.

4. Perform the following steps to remove the adapter guide and backplane plastic cover:

   a. Open the rear door by pressing and holding down the latch located at the top right corner of the door while you pull the door open.

   b. Using a nut driver, remove the two screws at the top of the fan motor access cover and remove the cover.

   c. Remove the one screw that secures the backplane plastic cover to the lower part of the top cover assembly.

   d. Using both hands, apply fingertip pressure to the backplane cover and the top cover assembly and tilt the backplane cover away from the top cover assembly just enough to gain access to the cable connected to connector J6 on the motor power supply.

   e. Disconnect the cable connected to connector J6 on the motor power supply; then lift the backplane cover with the attached motor power supply cover from the enclosure.

   f. Disconnect the two cables that connect the motor power supply cover cable assembly to the system chassis cable assembly. This disconnects the backplane plastic cover from the enclosure.

5. Disconnect the cables at connectors J1, J3, and J5 on the motor power supply board and remove the board.

6. Remove the three screws that hold the motor power supply card guide to the backplane and remove the card guide.

7. Disconnect all the cables at the cable adapters in the adapter guide assembly, and then remove all the cable adapters.

8. Using a nut driver, loosen the three screws that secure the plastic side panel with the attached plastic front external door; then pull down and out on the side panel to remove it from the enclosure with the door attached.

9. Disconnect the leads attached to the two interlock switches on the adapter guide assembly.

10. Using a nut driver, remove the eight screws that secure the adapter guide assembly to the backplane and remove the adapter guide assembly.

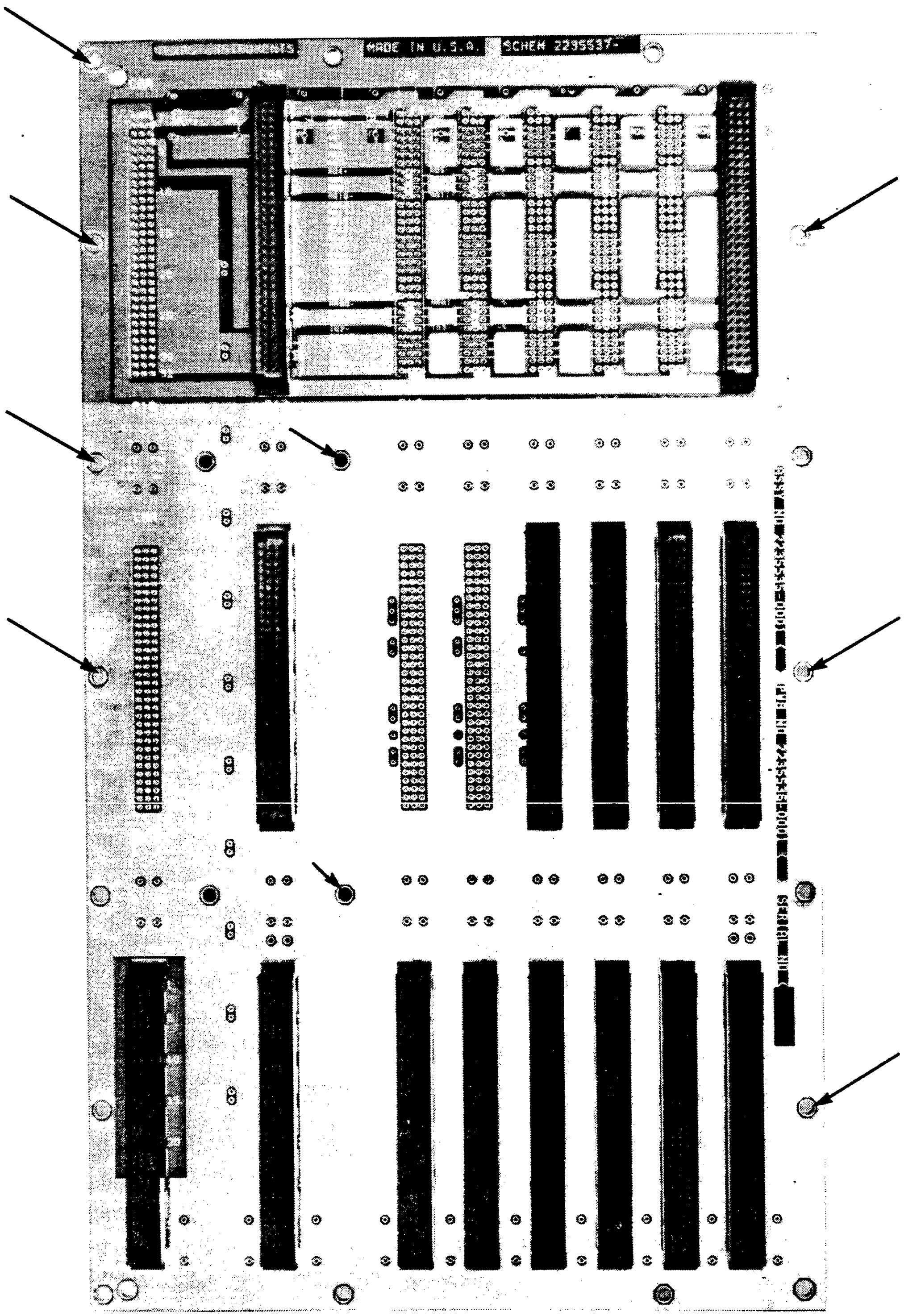
11. Open the inner metal door of the enclosure and remove all the circuit boards, including the system power supply board.

12. Using a nut driver, remove the nine screws that secure the backplane (Figure 4-11) to the system chassis card cage and remove the backplane.

13. Install a new backplane in the reverse order that was used to remove the faulty backplane. Be sure to install the nine screws in the positions they were removed from as indicated in Figure 4-11.

14. Check the operation of the new backplane by applying ac power to the system and observing that the normal system self-test operates properly.

Figure 4-11 Backplane — Rear View



Note:
The nine screws that secure the backplane to the system chassis are shown by the arrows.

MASS STORAGE ENCLOSURE MAINTENANCE 5

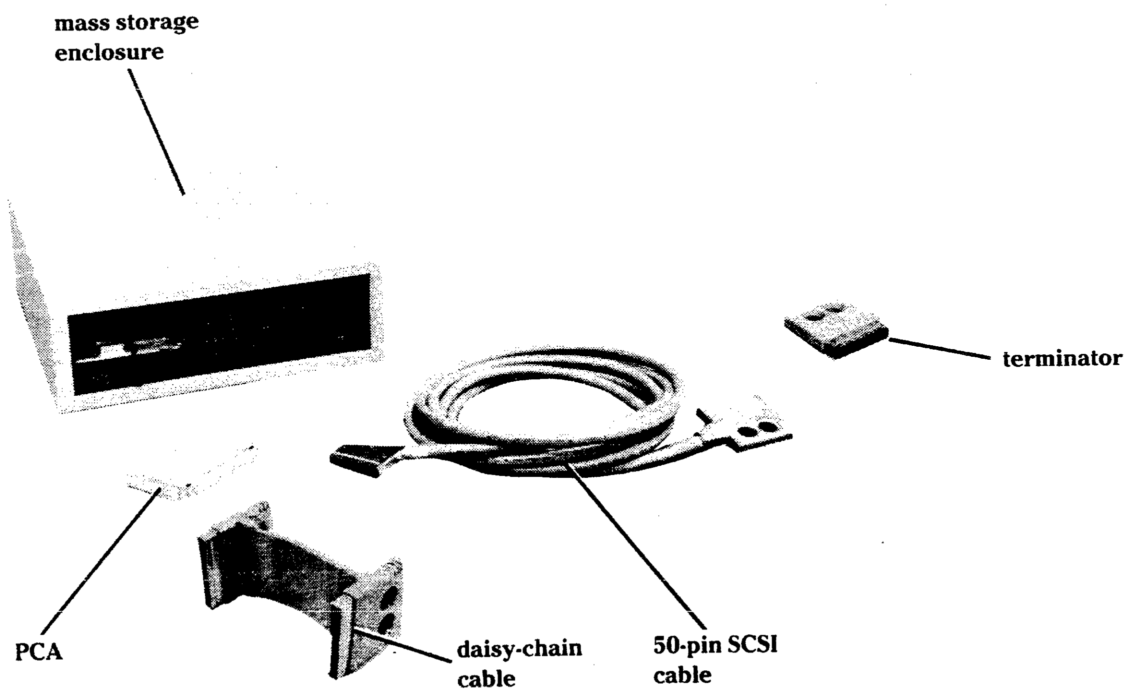
Highlights of This Section

- Self-tests, diagnostics, troubleshooting, and preventive maintenance
- Device jumper and switch configurations
- Field installable disk drive kits
- Replaceable components
- Component replacement procedures

Introduction

5.1 This section provides field-level maintenance for the mass storage enclosure shown in Figure 5-1. The standard Explorer toolkit has all the tools required for field maintenance.

Figure 5-1 Mass Storage Enclosure With Cables and Adapters



Self-Tests, Diagnostics, and Troubleshooting

5.2 Fault isolation and verification of repair are accomplished by the self-tests, the diagnostics, and troubleshooting.

- Refer to the self-test information in Section 2, Explorer System Troubleshooting in this part of the manual, and also to the *Explorer Operations Guide* for additional self-test information.

- Refer to the *Explorer Diagnostics* manual for diagnostic procedures and error code troubleshooting information.

- Refer to Section 2, Explorer System Troubleshooting, in this part of the manual for information on mass storage enclosure troubleshooting. Use the following diagrams as troubleshooting aids.

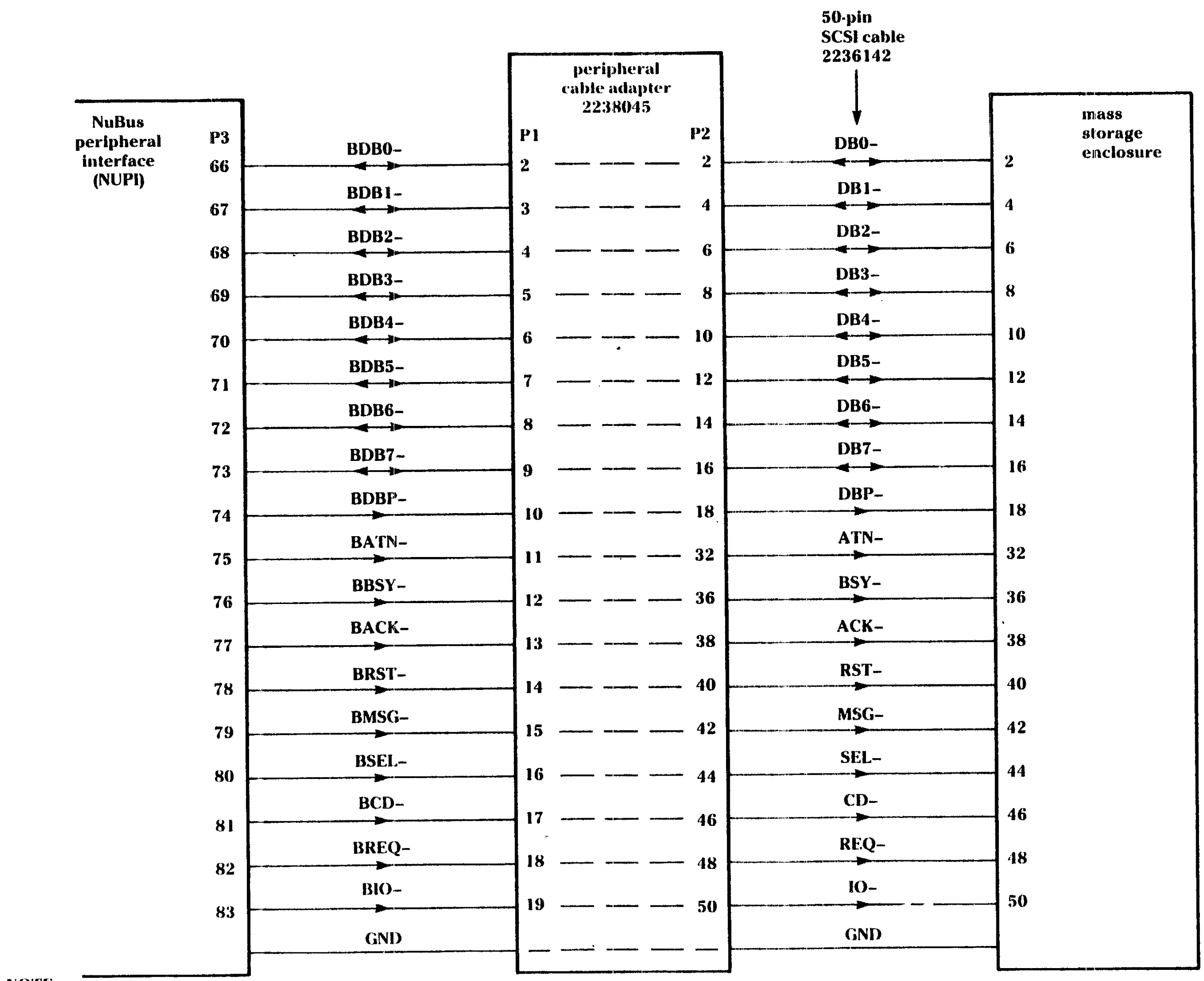
  - Figure 5-2, Mass Storage Subsystem Interconnect Diagram

  - Figure 5-3, Mass Storage Enclosure Cable Diagram (Tape and Disk Drives)

  - Figure 5-4, Mass Storage Enclosure Cable Diagram (Two Disk Drives)

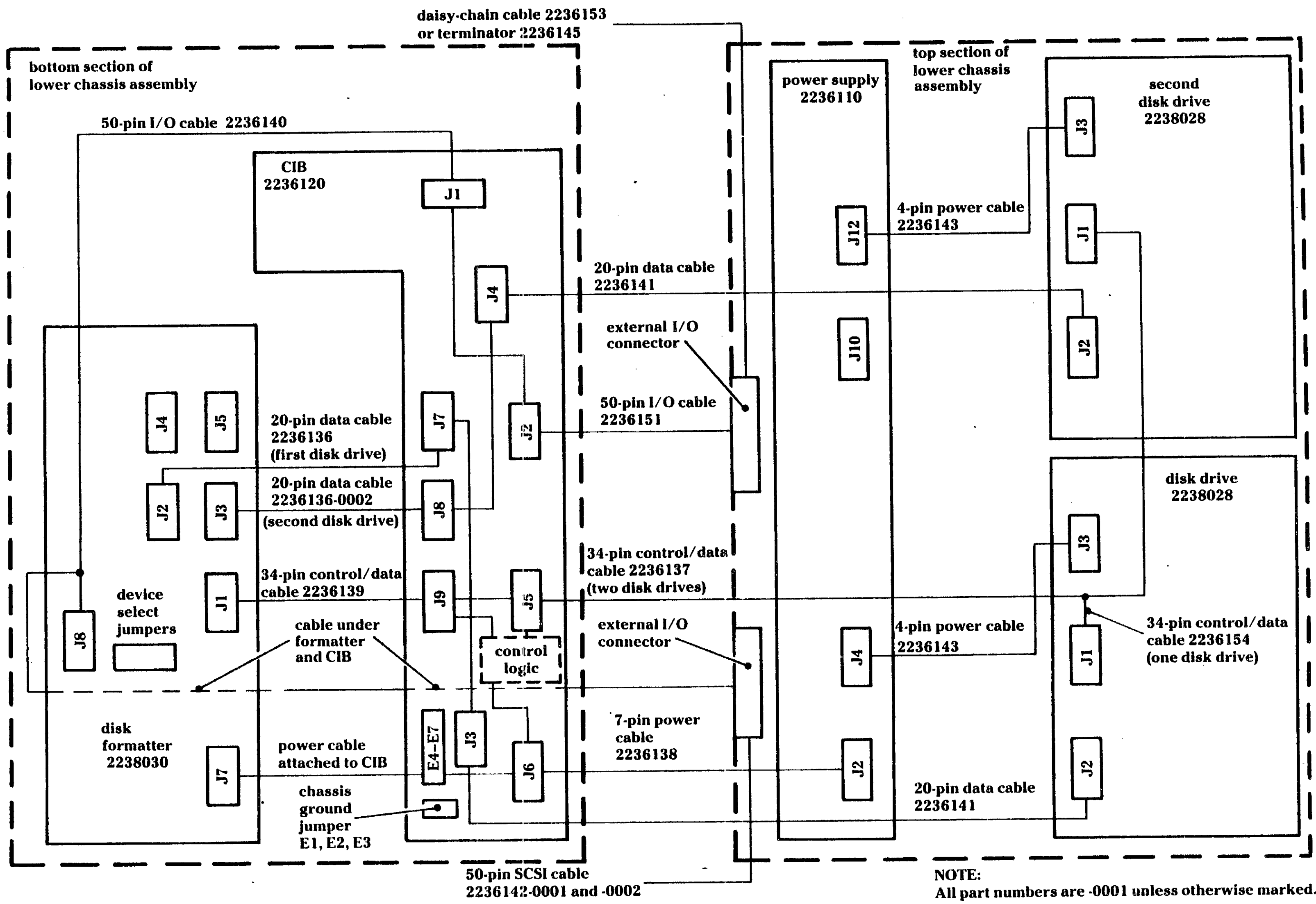
- Refer to the Preventive Maintenance part of this manual for details on mass storage enclosure preventive maintenance. Note that you should clean the read/write heads on the tape drive after every 20 hours of use.

Figure 5-2 Mass Storage Subsystem Interconnect Diagram



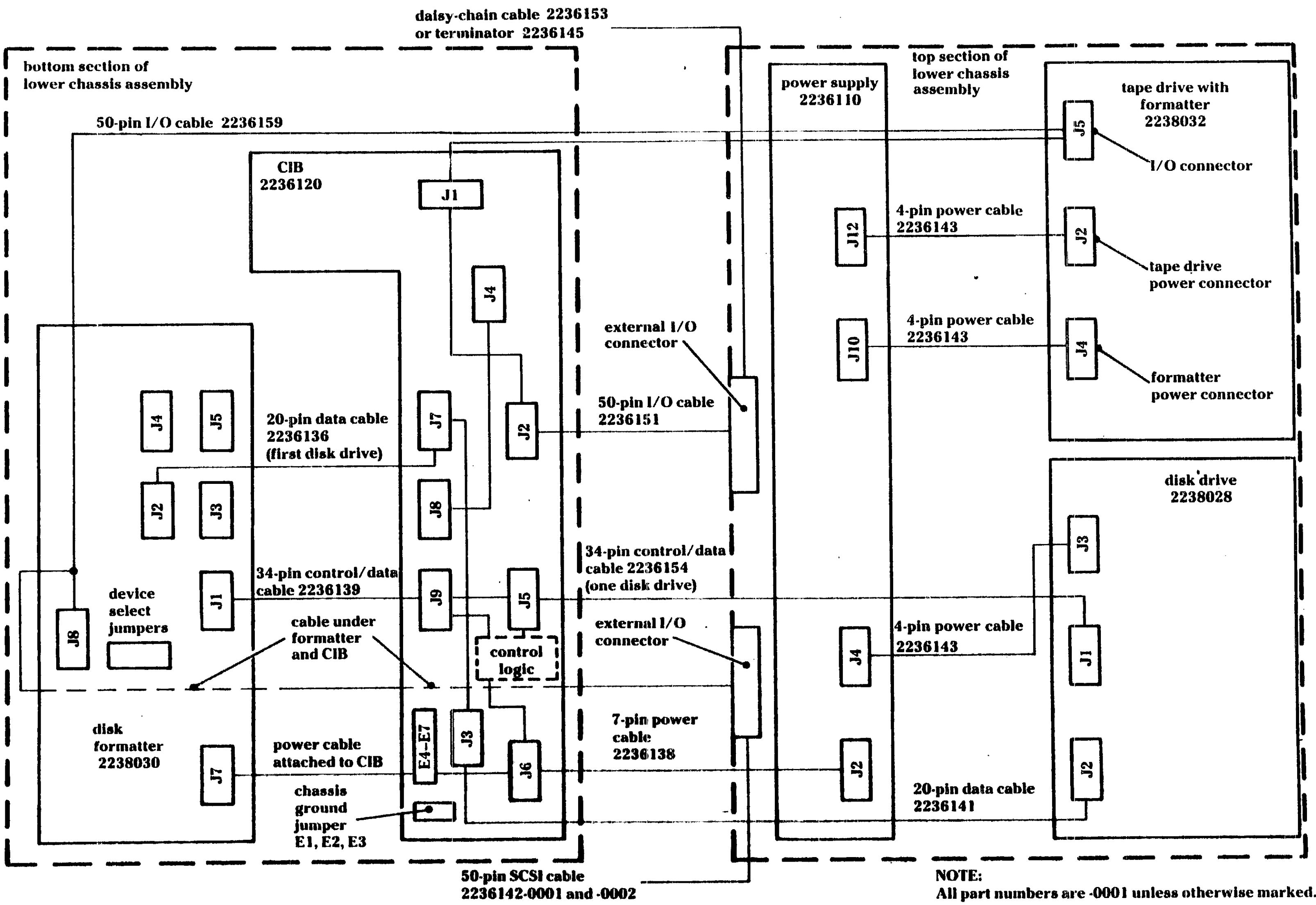
NOTE:
All part numbers are -0001 unless otherwise marked.

Figure 5-3 Mass Storage Enclosure Cable Diagram (Two Disk Drives)



NOTE:
All part numbers are -0001 unless otherwise marked.

Figure 5-4 Mass Storage Enclosure Cable Diagram (Tape and Disk Drives)



NOTE:
All part numbers are -0001 unless otherwise marked.

Device Select Jumper and Switch Configurations

5.3 Refer to Table 5-1 and Figure 5-5 for the device select jumper configurations on the disk formatter shown in Figure 5-6. If a disk drive is added or replaced, verify that the device select jumper at J7, and the jumpers at JA, JC, and JD shown in Figure 5-7, are installed correctly. If the mass storage enclosure has two disk drives, logical disk drive 0 is on the right as you are facing the front of the enclosure, and logical disk drive 1 is on the left. If the mass storage enclosure has a tape drive and a disk drive, or only one disk drive, logical disk drive 0 is on the right. The jumper should be installed as follows:

Logical Disk Drive	*Early Model Jumpers at J7*	*Later Model Jumpers at J7*
0	5–6	1–C
1	4–5	C–2

If there are two disk drives in the enclosure, logical disk drive 1 must have a terminator resistor pack at U25. If there is only one disk drive in the enclosure, logical disk drive 0 must have a terminator resistor pack at U25.

Table 5-1 **Disk Formatter Jumper Configurations**

Jumper	*Definition*	*Comment*
A–B	Reset enable	Always installed
C–D	Reserved	Always removed
E–F	Reserved	Always removed
G–H	Reserved	Always removed
J–K	DMA speed control	Always installed
DIAG	Diagnostic mode bit	Always removed
PAR	Parity mode bit	Always installed
A4	Formatter address bit	Refer to Figure 5-5
A2	Formatter address bit	Refer to Figure 5-5
A1	Formatter address bit	Refer to Figure 5-5

If a tape drive is added or replaced, check that the switch settings on the tape drive formatter are set to the standard settings shown in Table 5-2 for one tape drive. Also verify that there are no terminator resistor packs at locations U27 and U41. The tape drive components locations are shown in Figure 5-8.

If you have more than one tape drive, the first three switches must be set as follows:

Switch SW1	*First Drive*	*Second Drive*	*Third Drive*
1	On (1)	On (1)	On (1)
2	On (1)	Off (0)	On (1)
3	Off (0)	Off (0)	On (1)

Table 5-2 **Tape Drive Formatter Switch Settings**

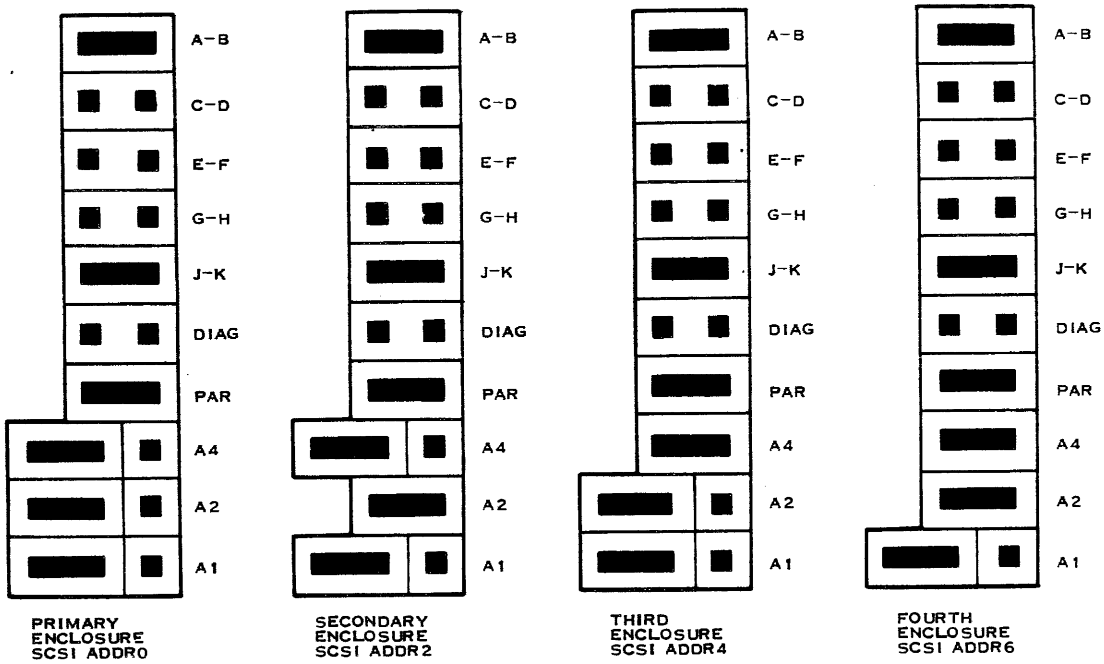
Switch SW1	*Standard Setting*	*Switch Function*
1	On (1)	SCSI bus address bit 0
2	On (1)	SCSI bus address bit 1
3	Off (0)	SCSI bus address bit 2
4	Off (0)	Not used
5	Off (0)	Tape drive type (Cipher 540)
6	Off (0)	Tape drive type (Cipher 540)
7	Off (0)	Tape drive type (Cipher 540)
8	On (1)	SCSI bus parity check

The cable interconnect board (Figure 5-9) has three terminals designated:

E1 — Signal ground
E2 — Chassis ground
E3 — Chassis ground

The primary mass storage enclosure should have a jumper between E1 and E2 to connect signal ground to chassis ground. All other enclosures should have a jumper between E2 and E3. The socket at location U3 is for a spare disk drive terminator.

Figure 5-5 Disk Formatter Jumper Configurations



NOTE:
JUMPER J-K MAY BE HARD-WIRED INSTEAD OF HAVING A JUMPER INSTALLED.

2286198

Figure 5-6 Disk Formatter Key Component Locations

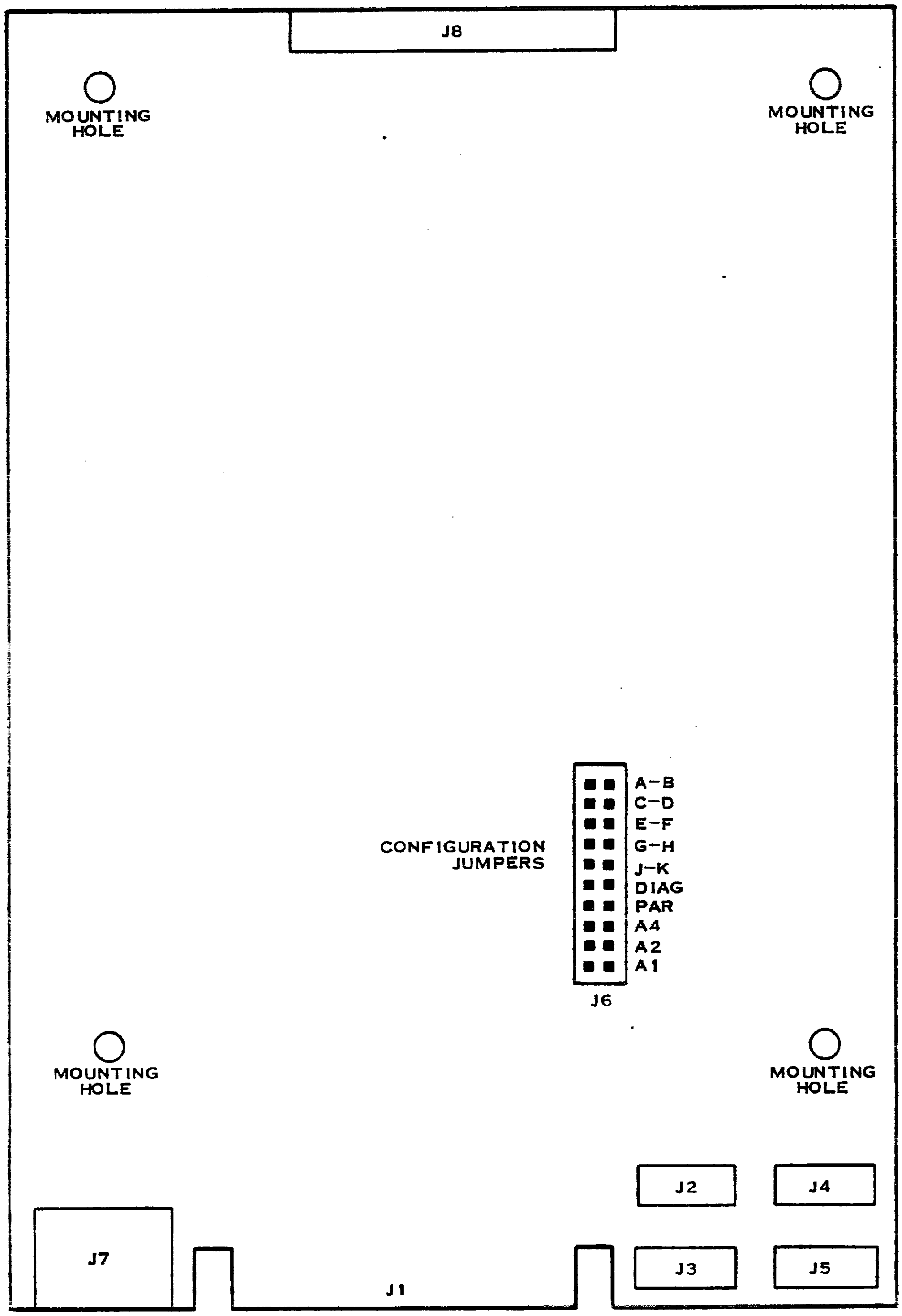


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Figure 5-7 Disk Drive Jumper and Terminator Locations

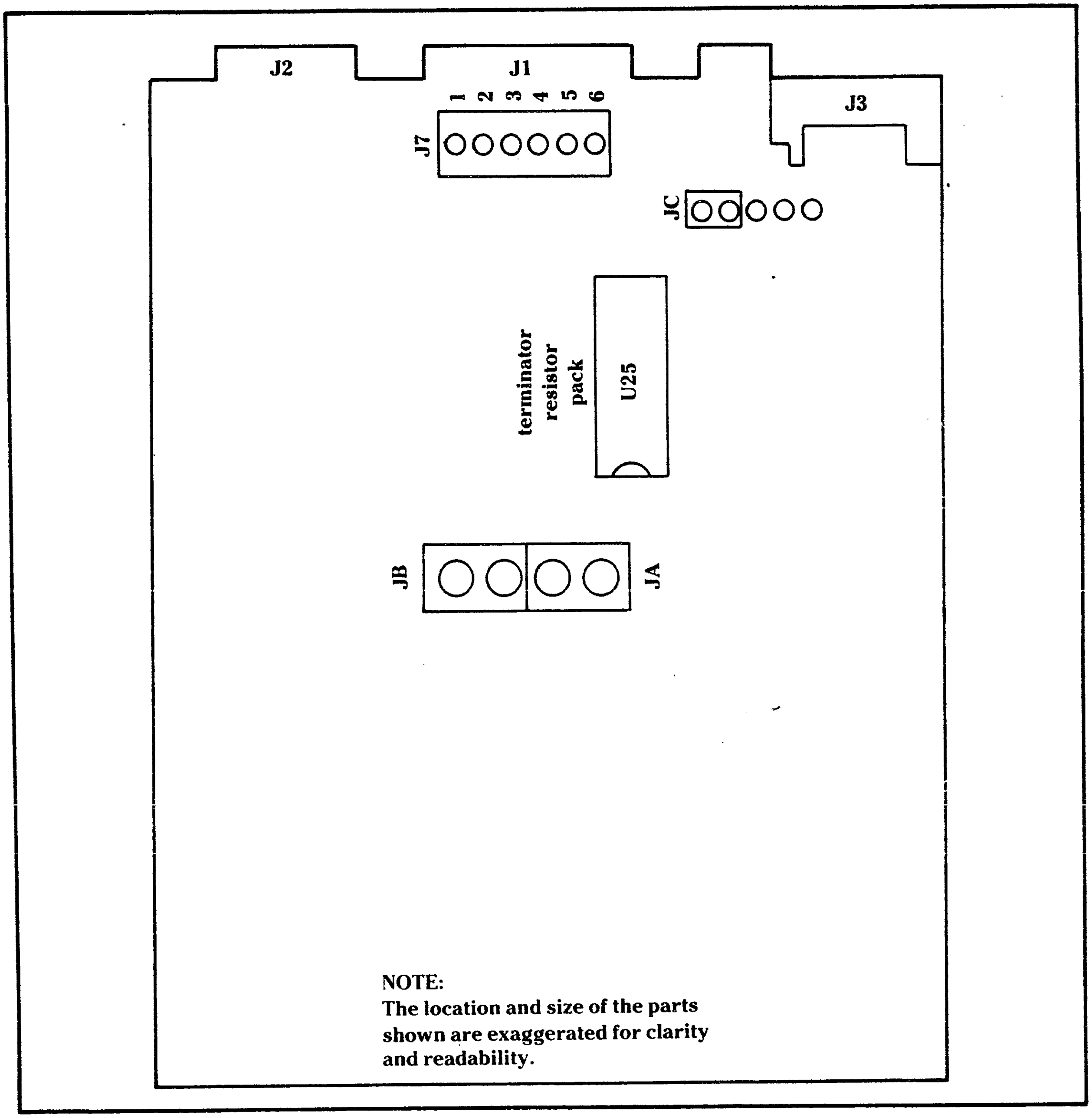


Figure 5-8 Tape Drive Component Locations

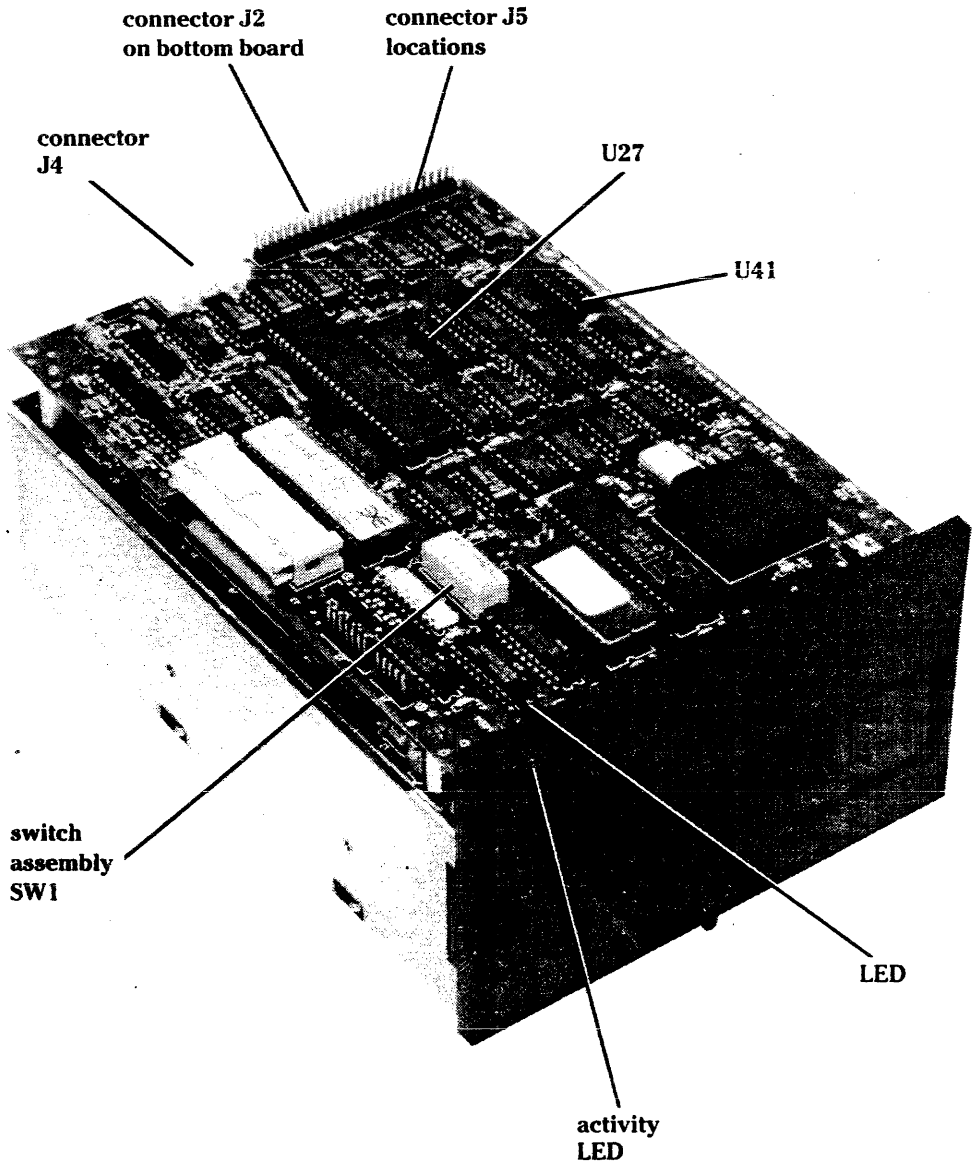
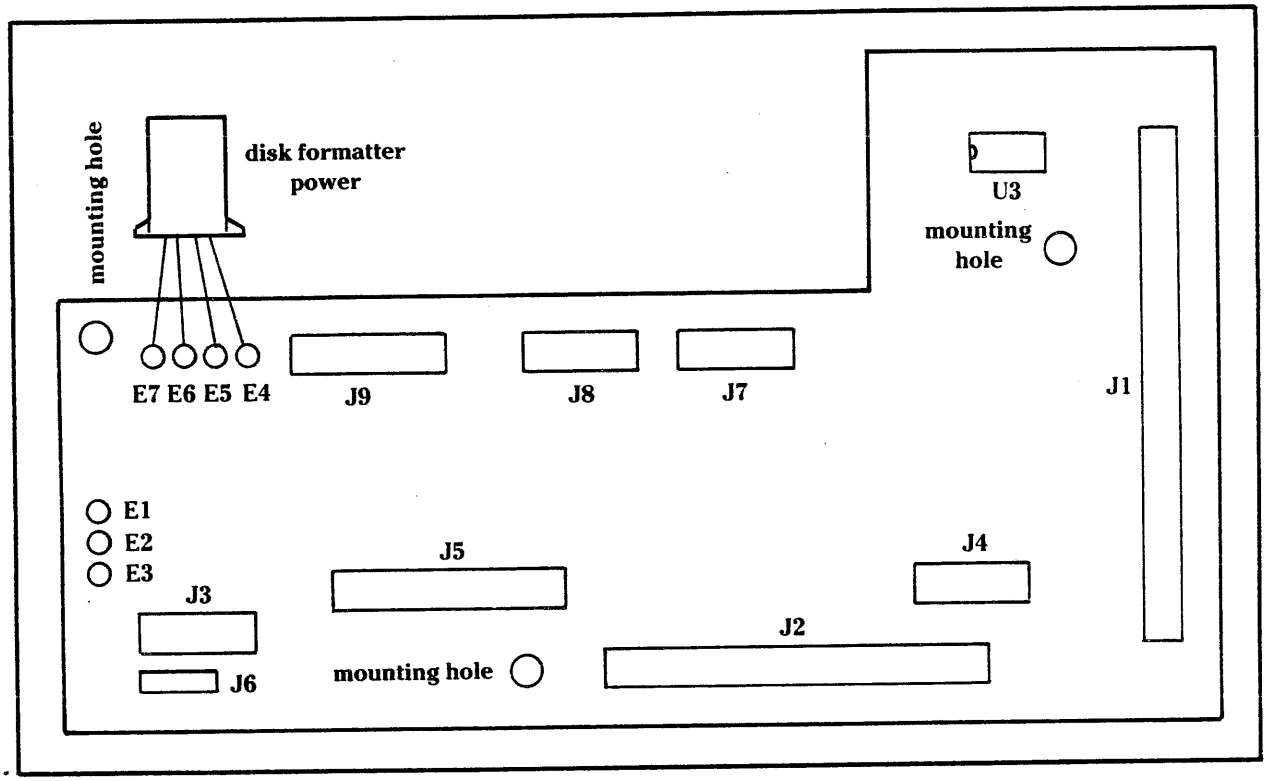


Figure 5-9 Cable Interconnect Board Component Locations



Field Installable Disk Drive Kits

5.4 The following field installable disk drive kits are available for expansion of the mass storage system:

- Field installable disk kit, TI part number 2249432-0001
- Field installable disk kit with formatter, TI part number 2249432-0002

NOTE: The locator plate for a two disk drive enclosure configuration is different from the locator plate for a tape drive and disk drive enclosure configuration. For this reason no field installable tape drive kits are available.

Tables 5-3 and 5-4 list the contents of the field installable disk drive kits. These kits should be installed according to the disk drive and disk formatter replaceable components procedures in paragraphs 5.6.1 and 5.6.2. Replace the identification label on the rear of the enclosure if a new label is available. If a new label is not available, mark the identification label (Figure 5-10) on the rear of the enclosure as follows:

1. Draw a line through the old dash number of the mass storage enclosure so it is still readable.

2. Write the new dash number of the mass storage enclosure on the label using a permanent nonsmearing black ink pen.

Table 5-3 **Field Installable Disk Kit**

Quantity	*Component Part Number*	*Component Description*
1	2238028-0001	112-megabyte Winchester disk drive
4	0996955-0013	Hex head screws (6-32 × .312)
1	2236141-0001	Cable assembly (20-pin, CIB-DDR)
1	2236137-0001	Cable assembly (34-pin, CIB-DDR-DDR)
1	2236143-0001	Cable assembly (4-pin, PS-DDR/TDR)
1	2236136-0001	Cable assembly (20-pin, FMTTR-CIB)
1	2220354-0001	Cable clamp
1	2211488-0001	Plain plastic bag, 229 mm (9 in) by 305 mm (12 in)

NOTE:

The following list explains the acronyms used in this table:

FMTTR indicates formatter.
CIB indicates cable interconnect board.
TDR indicates tape drive.
DDR indicates disk drive.
PS indicates power supply.

Table 5-4 **Field Installable Disk Kit With Disk Formatter**

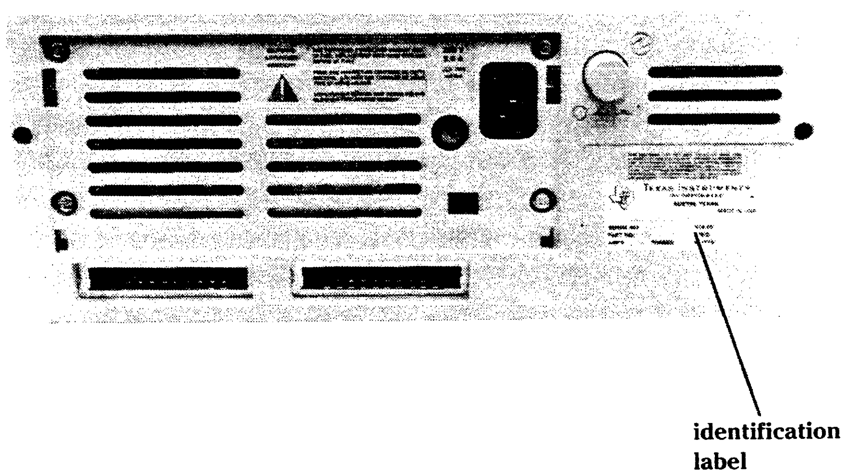
Quantity	*Component Part Number*	*Component Description*
1	2238028-0001	112-megabyte Winchester disk drive
1	2238030-0001	Disk formatter board
4	0996955-0013	Hex head screws (6-32 × .312)
1	2236141-0001	Cable assembly (20-pin, CIB-DDR)
1	2236154-0001	Cable assembly (34-pin, CIB-DDR)
1	2236143-0001	Cable assembly (4-pin, PS-DDR/TDR)
1	2236136-0002	Cable assembly (20-pin, FMTTR-CIB)
1	2236139-0001	Cable assembly (34-pin, FMTTR-CIB)
1	2211488-0001	Plain plastic bag, 229 mm (9 in) by 305 mm (12 in)

NOTE:

The following list explains the acronyms used in this table:

FMTTR indicates formatter.
CIB indicates cable interconnect board.
TDR indicates tape drive.
DDR indicates disk drive.
PS indicates power supply.

Figure 5-10 **Mass Storage Enclosure — Rear View**



Replaceable Components

5.5 Table 5-5 lists the mass storage subsystem field-replaceable components. Refer to the mass storage enclosure family tree diagram, part number 2236107, in Appendix A for additional information on other components that can be replaced.

Table 5-5 **Mass Storage Subsystem Replaceable Components**

Component Description	*Part Number*
Cable interconnect board	2236120-0001
Power supply assembly	2236110-0001
112-megabyte Winchester disk drive	2238028-0001
Cartridge tape drive	2238032-0001
Cartridge tape (450 feet)	2270391-0001
Cartridge tape (600 feet)	2249438-0001
Disk formatter board	2238030-0001
Terminator	2236145-0001
Daisy-chain assembly	2236153-0001
Fuse (U.S.) (5 A @ 120 V rms)	0416434-0503
Fuse (European) (2 A @ 220 V rms)	2220531-0004
Power cord (for accessory outlet)	2247530-0002
Power cord (100/120 V)	2247530-0004
Power cord (220 V)	2210558-0002
Power cord (240 V)	2247599-0002
Cable assembly (I/O)	2236142-0001
Cable assembly (I/O)	2236142-0002
Cable assembly (50-pin, I/O-FMTTR-CIB-TDR)	2236159-0001
Cable assembly (50-pin, I/O-FMTTR-CIB)	2236140-0001
Cable assembly (50-pin, I/O-CIB)	2236151-0001
Cable assembly (34-pin, CIB-DDR)	2236154-0001
Cable assembly (34-pin, FMTTR-CIB)	2236139-0001
Cable assembly (34-pin, CIB-DDR-DDR)	2236137-0001
Cable assembly (20-pin, FMTTR-CIB)	2236136-0001
Cable assembly (20-pin, FMTTR-CIB)	2236136-0002
Cable assembly (20-pin, CIB-DDR)(2)	2236141-0001
Cable assembly (4-pin, PS-DDR/TDR)(2)	2236143-0001
Cable assembly (7-pin, PS-CIB)	2236138-0001

NOTE:

The following list explains the acronyms used in this table:

FMTTR indicates formatter.
CIB indicates cable interconnect board.
TDR indicates tape drive.
DDR indicates disk drive.
I/O indicates I/O to SCSI bus.
PS indicates power supply.

Component Replacement Procedures

5.6 The remainder of this section describes the replacement procedures for the following mass storage enclosure components.

- Disk drive
- Disk formatter
- Tape drive
- Power supply
- Cable interconnect board

Refer to Figures 5-11 through 5-14 for all of the component replacement procedures.

CAUTION: All circuit boards in the Explorer system contain static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing or handling the printed circuit boards.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These are commercially available. If you do not have a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling a board. Then, as a further precaution, place the printed circuit board on a grounded work surface after removing it from the assembly or its protective package.

Before storing or transporting the printed circuit board, return it to its protective package or the assembly.

Figure 5-11 Mass Storage Enclosure With Tape and Disk Drives

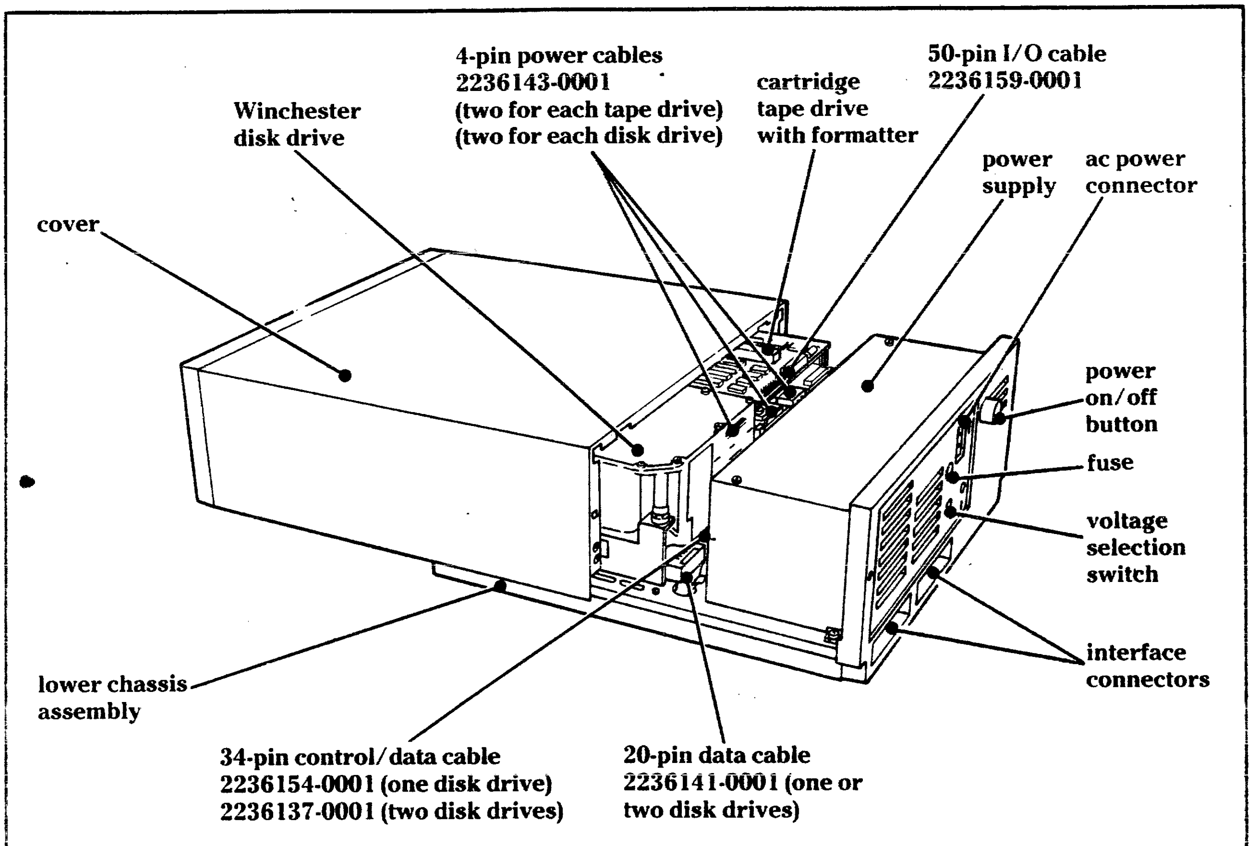


Figure 5-12 Lower Chassis Assembly Cables With Tape and Disk Drives

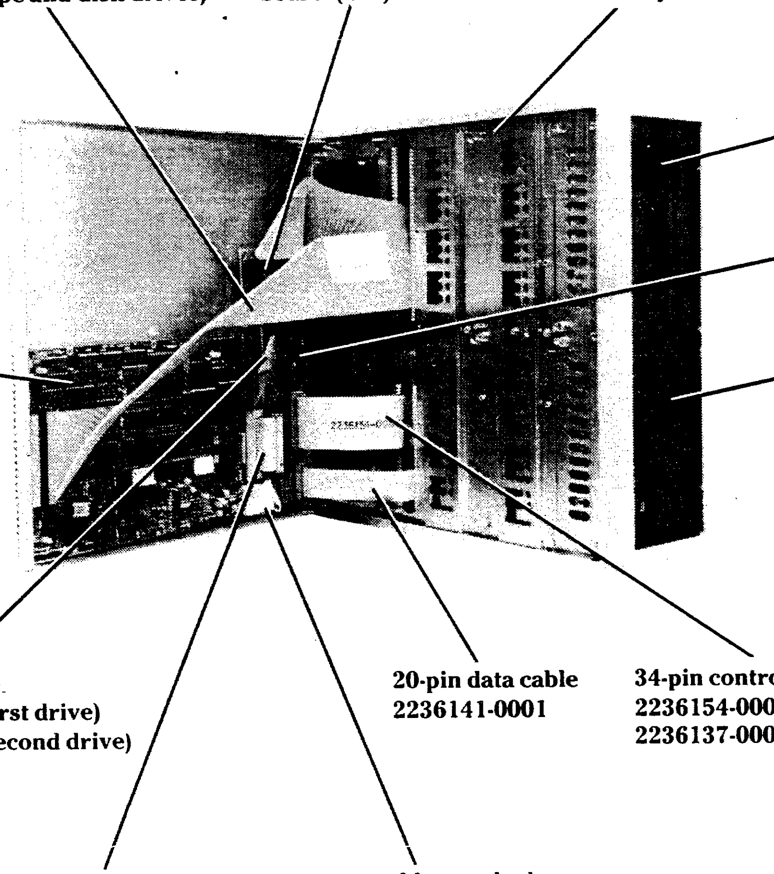


Figure 5-13 Lower Chassis Assembly Cables With Two Disk Drives

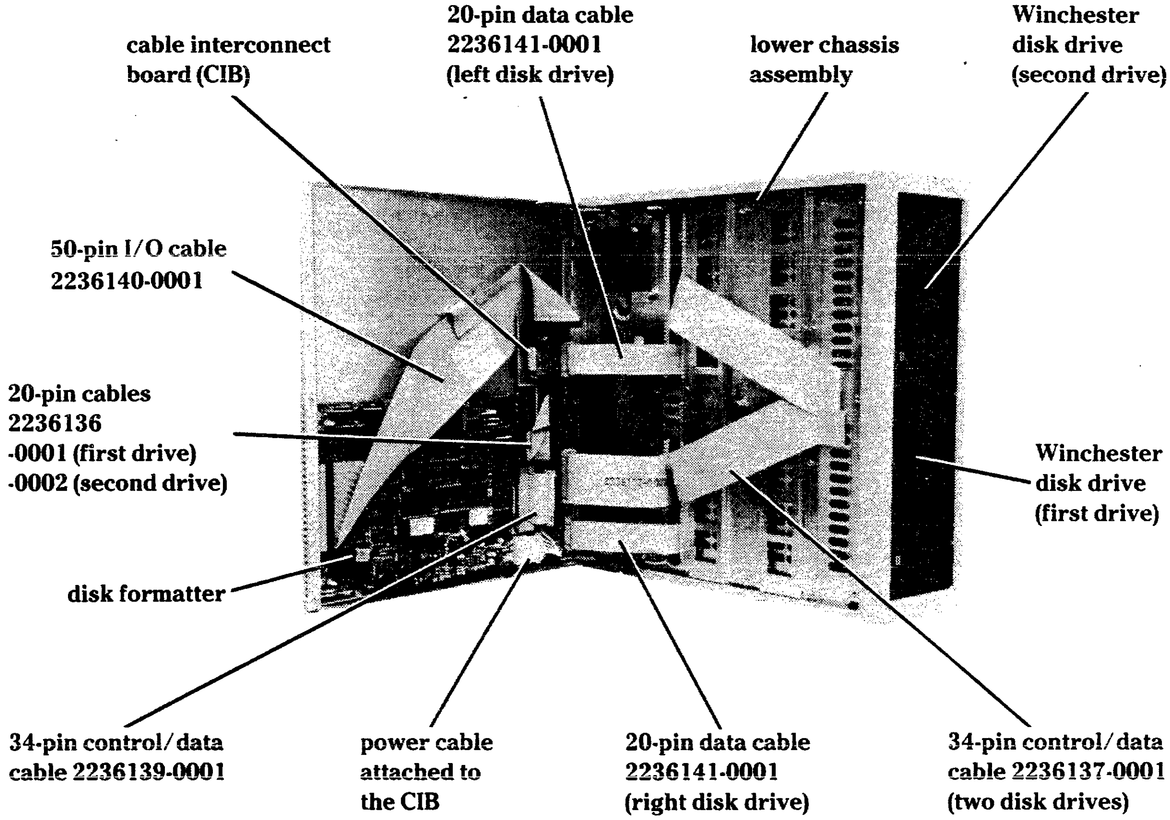
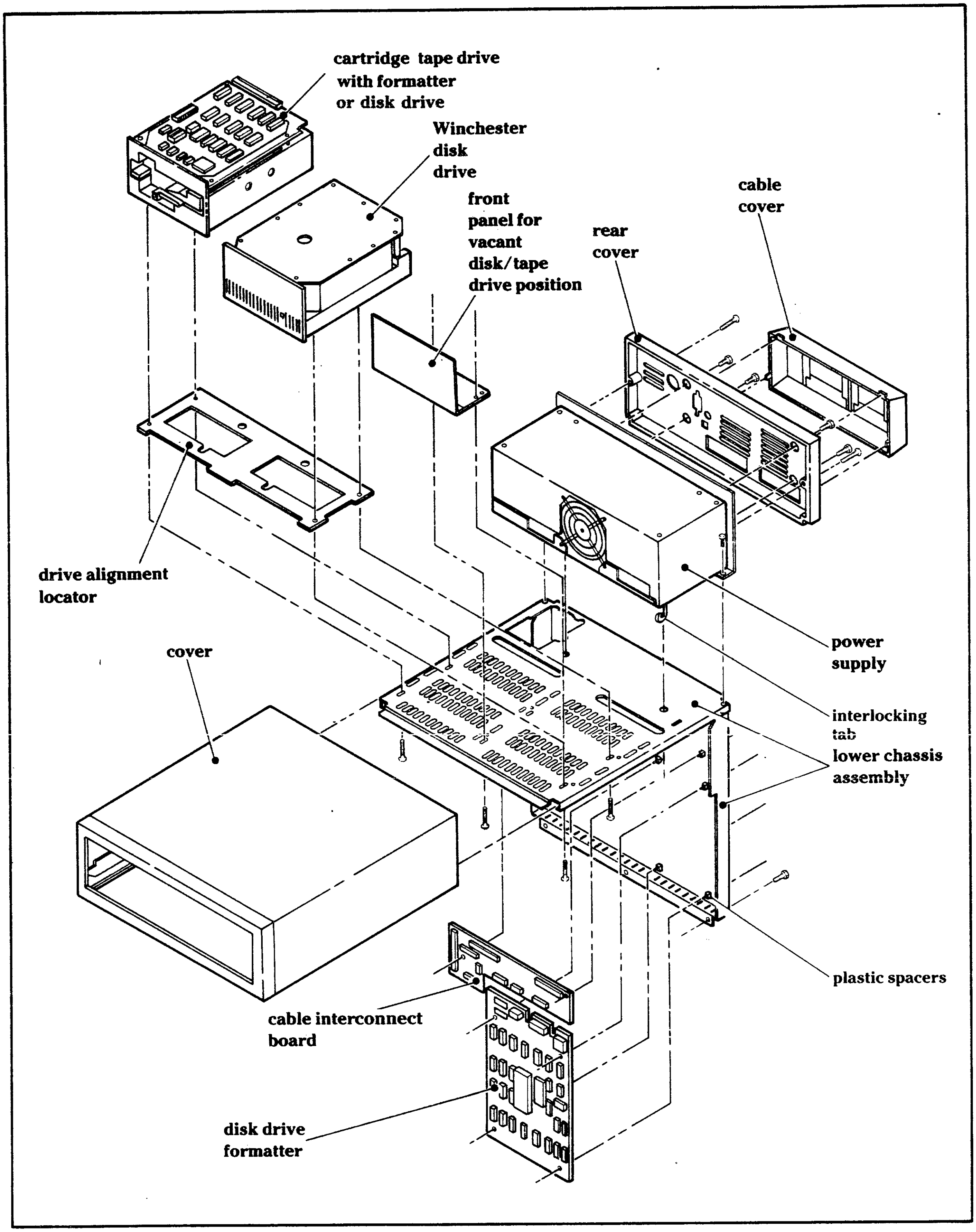


Figure 5-14 Mass Storage Enclosure — Exploded View



Disk Drive Replacement

5.6.1 This procedure explains how to remove and install a disk drive in the mass storage enclosure.

1. Remove ac power from the mass storage enclosure by pressing the ac power on/off button on the rear of the enclosure to the off (out) position, and by disconnecting the ac power cable at the ac power receptacle on the rear of the enclosure.

2. Remove the terminator, TI part number 2236145-0001 (if installed), and disconnect the following external cables:

   a. 50-pin SCSI cable, TI part number 2236142-0001 or -0002

   b. Daisy-chain cable, TI part number 2236153-0001 (if installed)

3. Remove the two screws at the right and left edges of the plastic rear plate of the enclosure that secure the cover to the plastic rear plate and slide the cover off (toward the front) of the lower chassis assembly.

4. Remove the three screws at the front of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly as some of the internal cables are very short.

5. Disconnect the following internal cables:

   a. 34-pin control/data cable, TI part number 2236154-0001 (for one disk drive)

   b. 34-pin control/data cable, TI part number 2236137-0001 (for two disk drives)

   c. 20-pin data cable, TI part number 2236141-0001

   d. 4-pin power cable, TI part number 2236143-0001

6. Remove the four screws that secure the disk drive to the top section of the lower chassis assembly and remove the disk drive. These screws are located under the disk drive within the lower chassis assembly.

7. Before you install the new disk drive, verify that the unit select jumper and the terminator pack on the disk drive are correct for the mass storage enclosure configuration. Refer to paragraph 5.3 for configuration information.

8. Install the disk drive in the reverse order that the disk drive was removed. Before you install the cover, verify that the device select jumper configuration on the disk formatter is correct as indicated in paragraph 5.3.

9. Install the terminator and the cables removed in step 2. The terminator should always be installed in the last mass storage enclosure in the system.

10. Check the operation of the disk drive by performing the applicable system self-test and diagnostic procedures.

Disk Formatter Replacement

5.6.2 This procedure explains how to remove and install a disk formatter in the mass storage enclosure.

1. Remove the ac power from the mass storage enclosure by pressing the ac power on/off button on the rear of the enclosure to the off (out) position, and by disconnecting the ac power cable at the ac power receptacle on the rear of the enclosure.

2. Remove the terminator and disconnect the following external cables:

   a. Terminator, TI part number 2236145-0001 (if installed)

   b. 50-pin SCSI cable, TI part number 2236142-0001 or -0002

   c. Daisy-chain cable, TI part number 2236153-0001 (if installed)

3. Remove the two screws at the right and left edges of the plastic rear plate of the enclosure and slide the cover off (toward the front) of the lower chassis assembly.

4. Remove the three screws at the front of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly as some of the internal cables are very short.

5. Disconnect the following cables at the disk formatter:

   a. 34-pin control/data cable, TI part number 2236139-0001

   b. 20-pin data cable, TI part number 2236136-0001 (for the first disk drive)

   c. 20-pin data cable, TI part number 2236136-0002 (for the second disk drive)

   d. 4-pin power cable from the CIB

6. Use a pair of long-nosed pliers to squeeze the four plastic spacers that secure the formatter to the lower chassis assembly and remove the formatter with one of the following cables attached:

   a. 50-pin I/O cable, TI part number 2236140-0001 (for disk drives only)

   b. 50-pin I/O cable, TI part number 2236159-0001 (for tape and disk drives)

   Disconnect the attached cable to completely remove the formatter.

7. Install the disk formatter in the reverse order that was used to remove the disk formatter. Check that the appropriate 50-pin I/O cable is routed underneath the disk formatter. Before you close the lower chassis assembly perform the following checks and self-tests:

   a. Verify that the device select jumper configuration on the disk formatter is correct as indicated in paragraph 5.3. Also verify that there are two blank terminator sockets near connector J8. The SCSI cable is terminated by an external terminator on the rear of the mass storage enclosure.

   b. Install the diagnostic jumper at the DIAG position of J6 on the disk formatter to prepare to run the internal disk formatter self-tests.

   c. Connect the ac power cable to the mass storage enclosure and apply ac power to the enclosure using the ac power on/off button on the rear of the enclosure. The internal self-tests should run. If there are no errors, the LED on the disk formatter will blink on and off. If there are errors, the LED will flash an error code to indicate the new disk formatter is faulty.

   d. If there are no errors during the disk formatter internal self-tests, turn off the ac power from the mass storage enclosure, remove the diagnostic jumper, and close the lower chassis assembly.

8. Reinstall the terminator and the cables removed in step 2. The terminator should always be installed in the last mass storage enclosure in the system.

9. Check the operation of the mass storage enclosure by performing the applicable system self-test and diagnostic procedures.

Tape Drive Replacement

5.6.3 This procedure explains how to remove and install a tape drive in the mass storage enclosure.

1. Remove the ac power from the mass storage enclosure by pressing the ac power on/off button on the rear of the enclosure to the off (out) position, and by disconnecting the ac power cable at the ac power receptacle on the rear of the enclosure.

2. Remove the terminator and disconnect the following external cables:

   a. Terminator, TI part number 2236145-0001 (if installed)

   b. 50-pin SCSI cable, TI part number 2236142-0001 or -0002

   c. Daisy-chain cable, TI part number 2236153-0001 (if installed)

3. Remove the two screws at the right and left edges of the plastic rear plate of the enclosure and slide the cover off (toward the front) of the lower chassis assembly.

4. Remove the three screws at the bottom of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly as some of the internal cables are very short.

5. Disconnect the following cables at the drives:

   a. Two 4-pin power cables, TI part number 2236143-0001

   b. 50-pin I/O cable, TI part number 2236159-0001

6. Remove the four screws that secure the tape drive to the top section of the lower chassis assembly and remove the tape drive. These screws are located under the tape drive within the lower chassis assembly.

7. Install the tape drive in the reverse order that was used to remove the faulty tape drive. Before you install the cover, verify the following:

   a. SCSI address switches S1, S2, and S3 are in the desired position as indicated in paragraph 5.3.

   b. Parity switch S8 is in the on position.

   c. Terminators at U27 and U41 have been removed.

8. Install the terminator and the cables removed in step 2. The terminator should always be installed in the last mass storage enclosure in the system.

9. Insert a scratch tape cartridge and turn on the ac power using the ac power on/off button on the rear of the mass storage enclosure. Observe that after several seconds the LED on the tape drive formatter starts to blink. This is an indication that the tape drive formatter has passed its internal self-tests and is functioning properly. If the LED does not blink, it indicates the new tape drive is faulty.

10. Turn off the ac power to the mass storage enclosure, remove the scratch tape, and install the cover.

11. Check the operation of the mass storage enclosure by performing the applicable system self-test and diagnostic procedures.

Power Supply Replacement

5.6.4 This procedure explains how to remove and install a power supply in the mass storage enclosure.

1. Remove the ac power from the mass storage enclosure by pressing the ac power on/off button on the rear of the enclosure to the off (out) position, and by disconnecting the ac power cable at the ac power receptacle on the rear of the enclosure.

2. Remove the terminator and disconnect the following external cables:

   a. Terminator, TI part number 2236145-0001 (if installed)

   b. 50-pin SCSI cable, TI part number 2236142-0001 or -0002

   c. Daisy-chain cable, TI part number 2236153-0001 (if installed)

3. Remove the two screws at the right and left edges of the plastic rear plate of the enclosure and slide the cover off (toward the front) of the lower chassis assembly.

4. Disconnect the following cables at the tape drive:

   a. Two 4-pin power cables, TI part number 2236143-0001 (for the tape drive)

   b. One or two 4-pin power cables, TI part number 2236143-0001 (for the disk drives)

   c. 7-pin power cable, TI part number 2236138-0001 (for the CIB)

5. Remove the four screws that secure the plastic rear plate to the power supply and remove the plastic rear plate.

6. Remove the two screws that secure the power supply to the lower chassis assembly and remove the power supply.

7. Install the power supply in the reverse order that was used to remove the faulty power supply. Verify that the voltage selection switch on the rear of the power supply is set correctly and that the proper fuse is installed. On 120-volt systems the fuse should be 5 amperes; on 220-volt systems the fuse should be 3 amperes.

8. Install the terminator and the cables removed in step 2. The terminator should always be installed in the last mass storage enclosure in the system.

9. Check the operation of the mass storage enclosure by performing the applicable system self-test and diagnostic procedures.

Cable Interconnect Board Replacement

5.6.5 This procedure explains how to remove and install a cable interconnect board (CIB) in the mass storage enclosure.

1. Remove the ac power from the mass storage enclosure by pressing the ac power on/off button on the rear of the enclosure to the off (out) position and by disconnecting the ac power cable at the ac power receptacle on the rear of the enclosure.

2. Disconnect the following external cables:

   a. 50-pin SCSI cable, TI part number 2236142-0001 or -0002.

   b. 50-pin daisy-chain cable, TI part number 2236153 (when used).

3. Remove the three screws at the front of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly as some of the internal cables are very short.

4. Disconnect the following internal cables:

   a. Two 4-pin power cables, TI part number 2236143-0001 (from the CIB to the tape drive)

   b. One or two 4-pin power cables, TI part number 2236143-0001 (from the CIB to the disk drives)

   c. 7-pin power cable, TI part number 2236138-0001 (from the CIB to the power supply)

   d. 34-pin control/data cable, TI part number 2236139-0001 (from the CIB to the formatter if present)

   e. 20-pin data cable, TI part number 2236136-0001 (from the CIB to the disk formatter for the first disk drive if present)

f. 20-pin data cable, TI part number 2236136-0002 (from the CIB to the disk formatter for the second disk drive if present)

g. 4-pin power cable to the disk drive formatter

h. 50-pin I/O cable, TI part number 2236140-0001 (from the CIB to the disk formatter if present)

i. 50-pin I/O cable, TI part number 2236159-0001 (from the CIB to the tape drive and disk formatter if present)

j. 50-pin I/O cable, TI part number 2236151-0001 (from the CIB to the external I/O connector)

5. Remove the ¼-inch screw near the 4-pin power cable attached to the CIB at terminals E04 through E07.

6. Use a pair of long-nosed pliers to squeeze the two plastic spacers that secure the CIB to the lower chassis assembly and remove the formatter.

7. Install the CIB in the reverse order that was used to remove the faulty CIB. Verify that the signal ground to chassis ground jumper between terminals E1 and E2 is installed on the primary mass storage enclosure only. All other enclosures should have this jumper between terminals E2 and E3. The socket at location U3 is for a spare disk drive terminator. If there are two disk drives in one enclosure, only one will need a terminator.

8. Install the terminator and the cables removed in step 2. The terminator should always be installed in the last mass storage enclosure in the system.

9. Check the operation of the mass storage enclosure by performing the applicable system self-test and diagnostic procedures.

CONTENTS

7-SLOT ENCLOSURE WITH LOCAL BUS OR NUBUS-ONLY BACKPLANE AND 110-AMPERE POWER SUPPLY

1

Introduction

1.1 This section is arranged under the following topics:

- 7-slot enclosure description
- Reference information
- Troubleshooting procedures
- Component replacement procedures

7-Slot Enclosure Description

1.2 Refer to the procedures in the existing *Explorer System Field Maintenance* manual for general maintenance information for the 7-slot enclosure with the local bus backplane and the 80-ampere power supply. This section includes maintenance information for the 110-ampere power supply and the NuBus-only backplane. Figures 1-1 and 1-2 show the front and rear internal views of the 7-slot enclosure with the local bus backplane or the NuBus-only backplane, and the 110-ampere power supply.

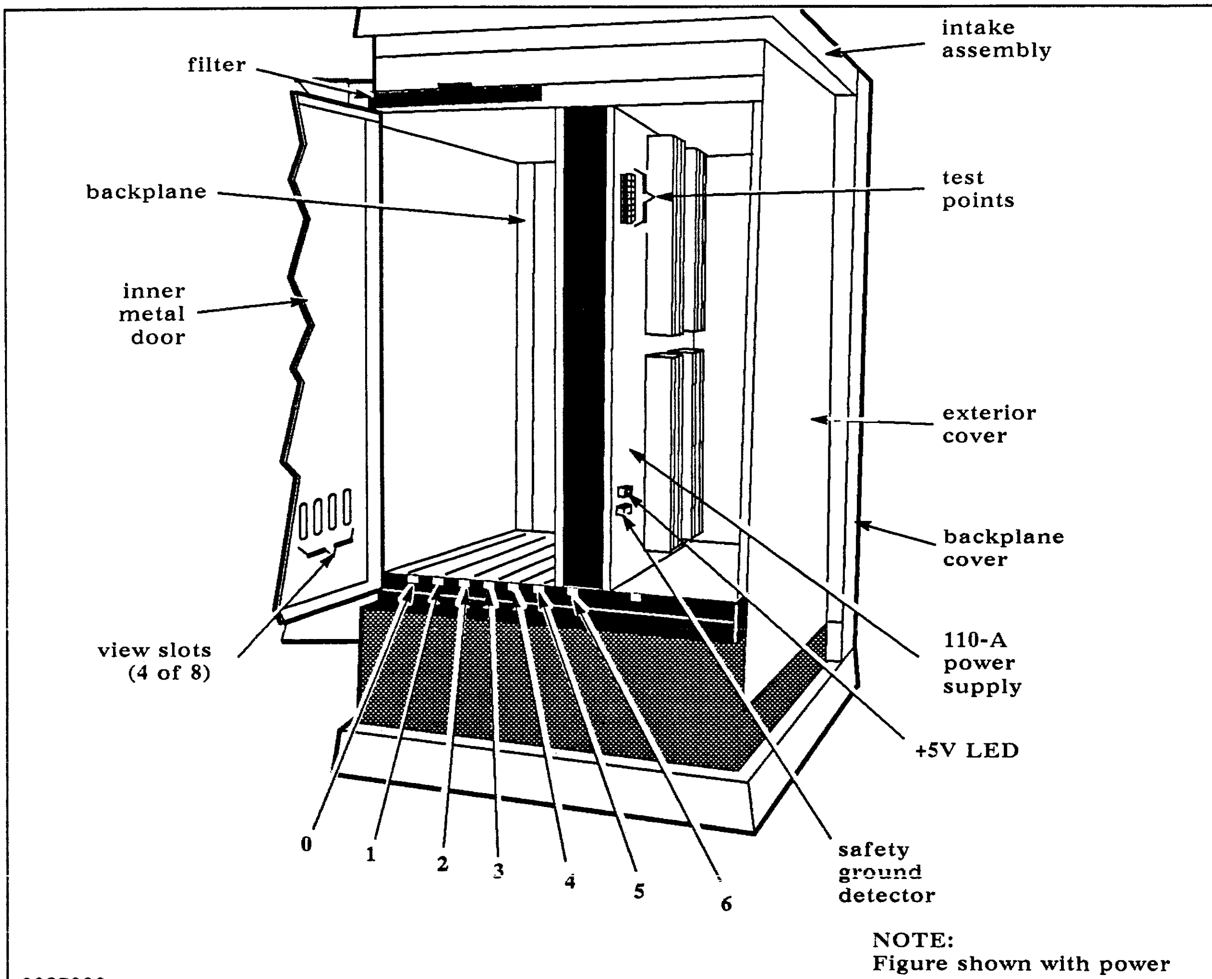
The 7-slot enclosure with the 110-ampere power supply has a power supply interface cover that has a circuit breaker but does not have the ac power auxiliary receptacles used with the 80-ampere power supply. Also, with the 110-ampere power supply, the fan motor is driven directly from the power supply board. The transformer that was formerly located on the fire tray is no longer used with the 110-ampere power supply.

The physical layout of the 110-ampere power supply is shown in Figure 1-3. A functional block diagram of the 110-ampere power supply is shown in Figure 1-4. The 110-ampere power supply is a switching type power supply that generates all of the dc voltages required by the 7-slot enclosure. The fan sensor and control logic and the warning signal logic are all located on the power supply board. A small auxiliary supply is provided on the power supply board. This auxiliary supply provides +320 Vdc and +11 Vdc, which are used to control the high-voltage switchers, the 3525A controller, and all other logic on the board.

CAUTION: The 110-ampere power supply has many heavy duty components that get extremely hot during operation. Also, the high-voltage filter capacitors retain their charge much longer than they did on the 80-ampere power supply. Be sure to observe all the warnings and cautions that are presented in the component replacement procedures.

The 7-slot enclosure can have either a local bus backplane or a NuBus-only backplane. The local bus backplane refers to a backplane with a local bus, a NuBus, and I/O connectors. The NuBus-only backplane refers to a backplane with only a NuBus and I/O connectors.

Figure 1-1 7-Slot Enclosure With 110-Ampere Power Supply — Front Interior View



NOTE:
Figure shown with power supply shield removed.

Figure 1-2 7-Slot Enclosure With 110-Ampere Power Supply — Rear Interior View

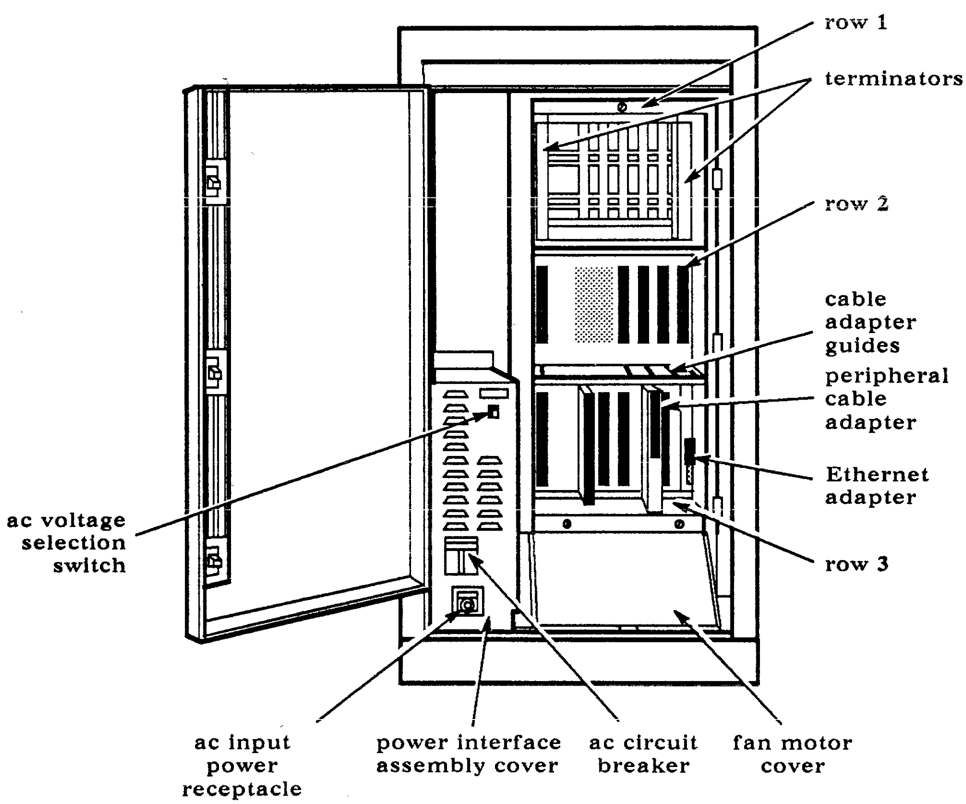


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Figure 1-3 110-Ampere Power Supply

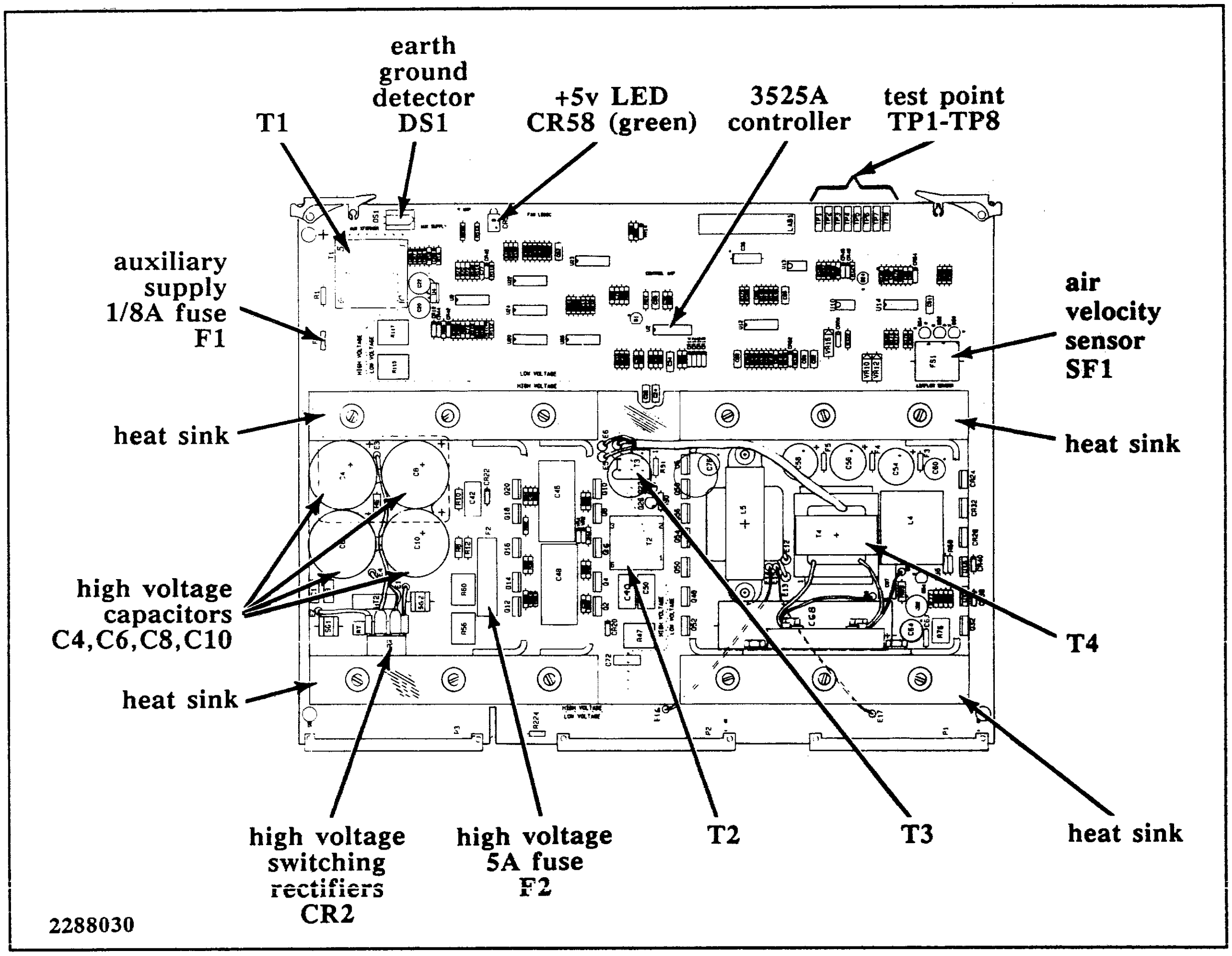
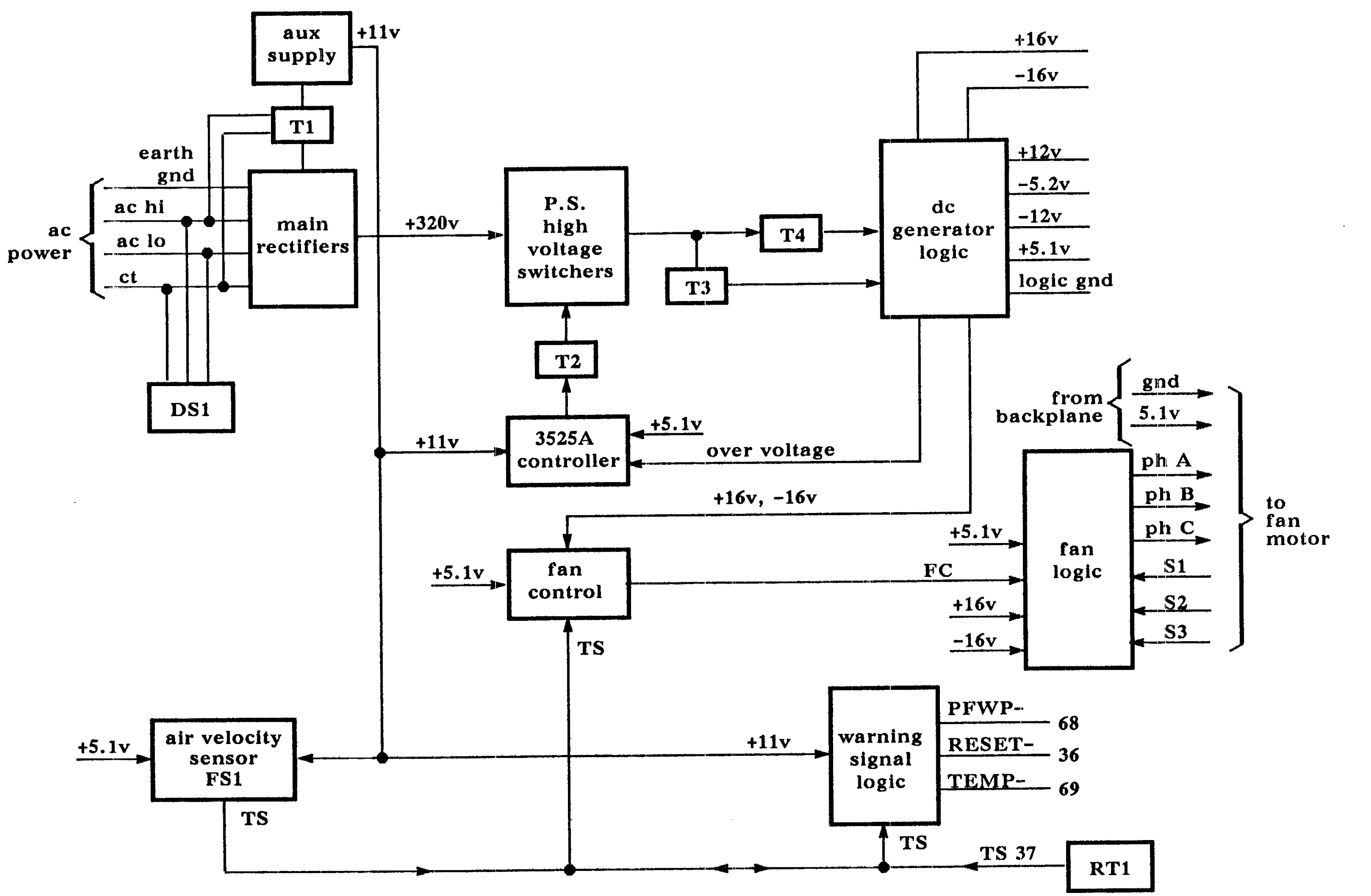


Figure 1-4 110-Ampere Power Supply Functional Block Diagram



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Reference Information

1.3 The primary reference information associated with 7-slot enclosures with the local bus backplane or the NuBus-only backplane and either an 80-ampere power supply or a 110-ampere power supply are as follows:

- *Explorer System Field Maintenance*, TI part number 2243141-0001
- *System 1000 Series, Model 1500 Field Maintenance* manual, TI part number 2534849-0001
- *7-Slot System Enclosure General Description*, TI part number 2243143-0001

Table 1-1 lists additional documents that can be used for more detailed technical information.

Table 1-1 Additional Reference Information

Item Identification	Part Number
Explorer Enclosure Family Tree	2235534-0001
Explorer Enclosure Assembly	2235540-0001
Explorer Enclosure Backplane Assembly (with local bus)	2235535-0001
Explorer Enclosure Backplane Logic Diagram	2235537-0001
Explorer Enclosure Backplane Specification	2235539-0001
Explorer Enclosure Backplane Assembly (with NuBus-Only)	2235855-0001
Explorer Enclosure Backplane Logic Diagram	2235857-0001
Explorer Enclosure Backplane Specification	2235859-0001
80-Ampere Power Supply Assembly	2235505-0001
80-Ampere Power Supply Logic Diagram	2235507-0001
80-Ampere Power Supply Specification	2235509-0001
Motor Power Supply Assembly (80-Ampere power supply)	2235600-0001
Motor Power Supply Logic Diagram	2235602-0001
Motor Power Supply Specification	2235604-0001
Power Supply Upgrade Procedure (80-Ampere power supply chassis to 110-Ampere power supply chassis)	2537300-0001
110-Ampere Power Supply Assembly	2542005-0001
110-Ampere Power Supply Logic Diagram	2542007-0001
110-Ampere Power Supply Specification	2542009-0001
Power Interface Board Assembly	2542010-0001
Power Interface Board Logic Diagram	2542012-0001
Power Interface Board Specification	2542014-0001
NuBus Terminator Assembly (local bus backplane with clock termination)	2243885-0001
NuBus Terminator Assembly (local bus backplane)	2243885-0002

Troubleshooting Procedures

1.4 Troubleshooting the 7-slot enclosure consists of checking the power supply input and output voltages and using the 110-ampere power distribution diagrams (Figures 1-5 or 1-6) to check for proper voltages on the backplane. The input and output voltages and test point information for the power supply are as follows:

Item	Description
Input voltages	102 to 132 Vac, 47 to 63 Hz, at 12 A 187 to 264 Vac, 47 to 63 Hz, at 6.4 A
Output voltages	+5.1 Vdc (+/-3%) at 110 A (10 A minimum) +12 Vdc (+/-5%) at 1.5 A -12 Vdc (+/-5%) at 1 A -5.2 Vdc (+/-3% at 4 A
Test points on edge of board	TP8 — +12 Vdc TP7 — -12 Vdc TP6 — -5 Vdc TP5 — PFWP- TP4 — RESET- TP3 — TEMP- TP2 — +5 Vdc Tp1 — GND

Refer to the local bus and NuBus-only backplane configuration drawings (Figures 1-7 or 1-8) for local bus and NuBus signal information that can be used to troubleshoot the backplanes. Table 1-2 provides connector pin conversion information for the connectors on the backplane.

Table 1-2 **Connector Pin Number Conversion**

	Columns		
Row	**A**	**B**	**C**
1	1	33	65
2	2	34	66
3	3	35	67
4	4	36	68
5	5	37	69
6	6	38	70
7	7	39	71
8	8	40	72
9	9	41	73
10	10	42	74
11	11	43	75
12	12	44	76
13	13	45	77
14	14	46	78
15	15	47	79
16	16	48	80
17	17	49	81
18	18	50	82
19	19	51	83
20	20	52	84
21	21	53	85
22	22	54	86
23	23	55	87
24	24	56	88
25	25	57	89
26	26	58	90
27	27	59	91
28	28	60	92
29	29	61	93
30	30	62	94
31	31	63	95
32	32	64	96

NOTES:

This conversion does not apply to the motor power supply or cable adapters that plug into the rear side of the backplane.

The actual lettering on the backplane in each column is numbers 1 through 32.

Figure 1-5 Power Distribution Diagram With 110A Power Supply and Local Bus Backplane

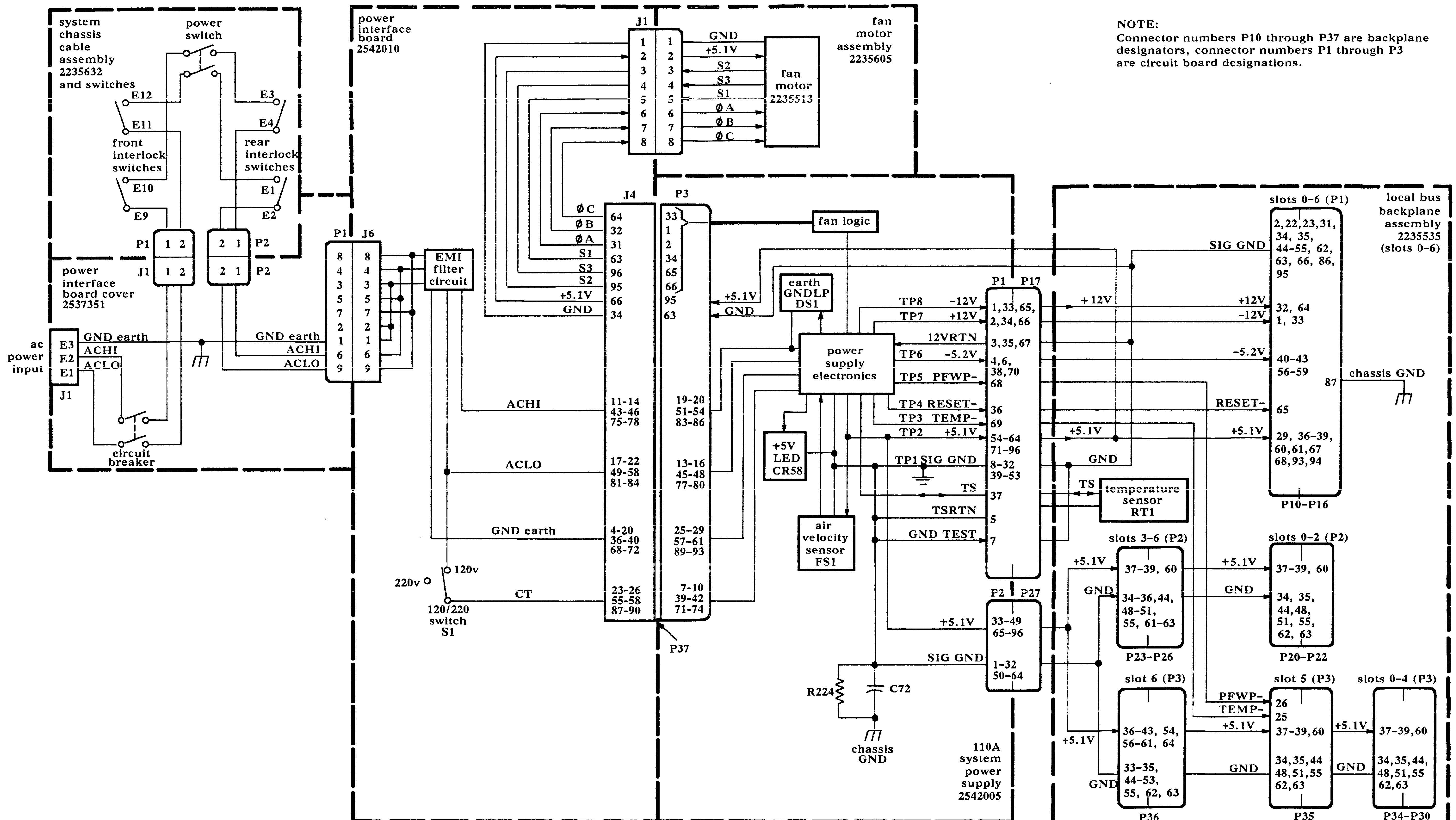

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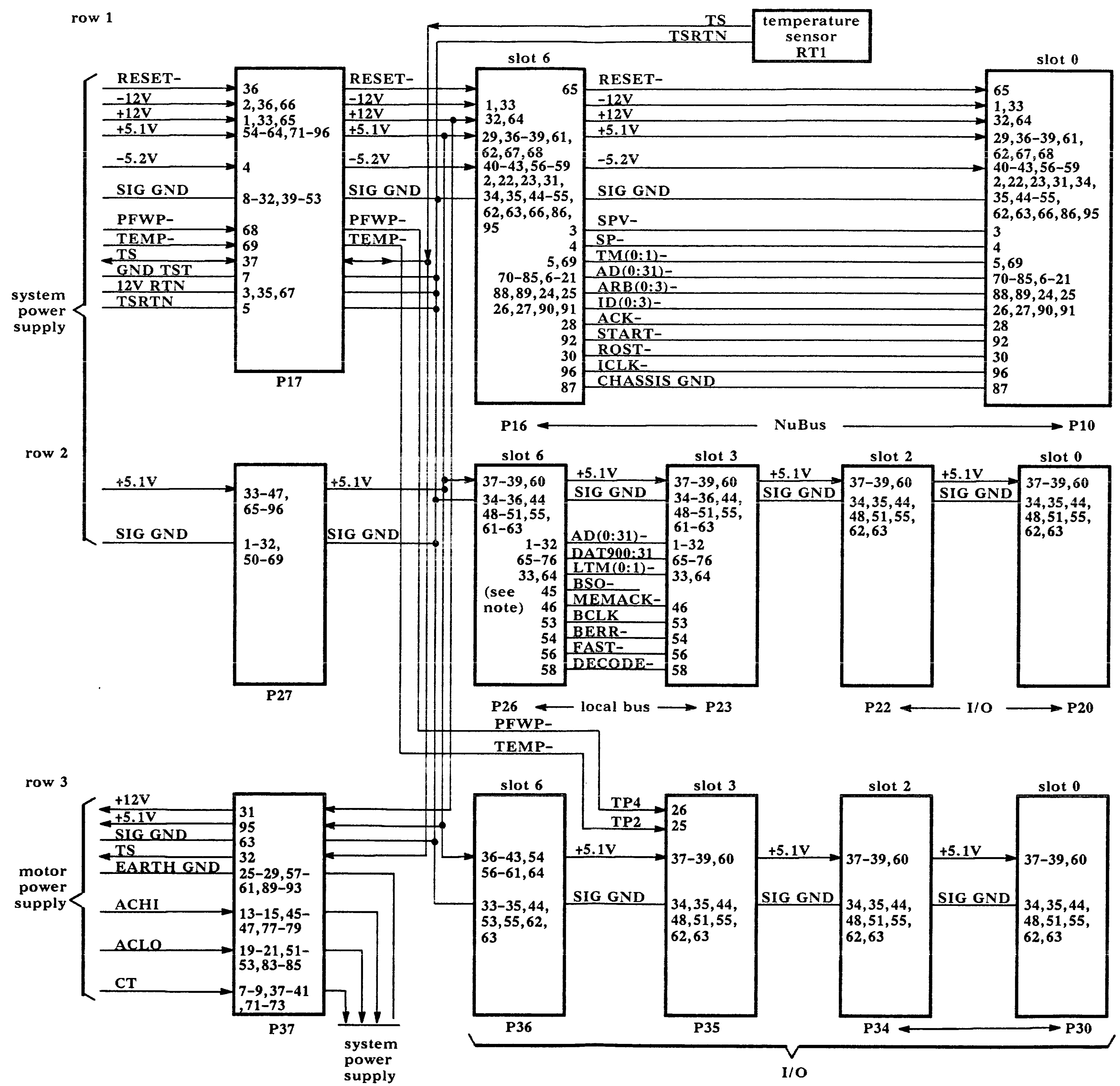
Figure 1-7 Backplane Configuration With NuBus and Local Bus



NOTE:
Signal BSO- connects to pin 45 in slots 4,5, and 6 only.

Component Replacement Procedures

1.5 Table 1-3 lists the field-replaceable components for the Explorer enclosure with a local bus and a 110-ampere power supply. Refer to the Explorer system family tree, TI part number 2537343-0001, in Appendix A at the end of this section for additional information on other replaceable components.

Table 1-3 **Field-Level Replaceable Components (110-Ampere Power Supply and Local Bus)**

Component Description	Part Number
AC power switch	2247571-0001
Air filter	2235567-0001
Backplane (with local bus)	2235532-0001
Cable assembly (power interface board cover)	2235546-0001
Cable assembly (system chassis)	2235632-0001
Circuit breaker	2224008-0002
Fan bearing	2247557-0001
Interlock switch	2247527-0001
Power cord (US/Canada)	2249468-0001
Power cord (Western Europe)	2249468-0002
Power cord (British)	2249468-0003
Power interface board	2542010-0001
Power supply (110-ampere)	2542005-0001
Terminator (active)	2243885-0001
Terminator (passive)	2243885-0002

Refer to the exploded view of the Explorer enclosure (Figure 1-9) as necessary while using the following replacement procedures:

- System circuit board replacement
- Cable adapter replacement
- 110-Ampere power supply replacement
- Power interface board replacement
- Replacement of other components

CAUTION: All circuit boards in the Explorer system contain static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing or handling the printed circuit boards.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These are commercially available. If you do not have a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling a board. Then, as a further precaution, place the printed circuit board on a grounded work surface after removing it from the system enclosure or its protective package.

Before storing or transporting the printed circuit board, return it to its protective package or the system enclosure.

NOTE: Be sure you fully close the front and rear doors on the Explorer enclosure after you perform any maintenance. A partially closed door can cause the interlock switches to remain open, preventing the application of ac power to the enclosure.

System Circuit Board Replacement

1.5.1 Refer to the procedures in the existing *Explorer System Field Maintenance* manual to replace any of the system circuit boards in the Explorer enclosure. Refer to the *Explorer LX System Installation* manual for details on different slot locations for circuit boards in the Explorer LX system. In most cases, the circuit boards will be in the following slots:

Slot	Boards in Basic LX Systems	Boards in Advanced LX Systems
0	Ethernet controller	Communication carrier
1	68020-based processor	68020-based processor
2	NUPI disk controller	SMD/SCSI disk controller
3	Option memory	Ethernet controller
4	Primary memory	Primary memory
5	System interface	System interface
6	Explorer I processor	Explorer II processor

Figure 1-9 7-Slot Enclosure Exploded View

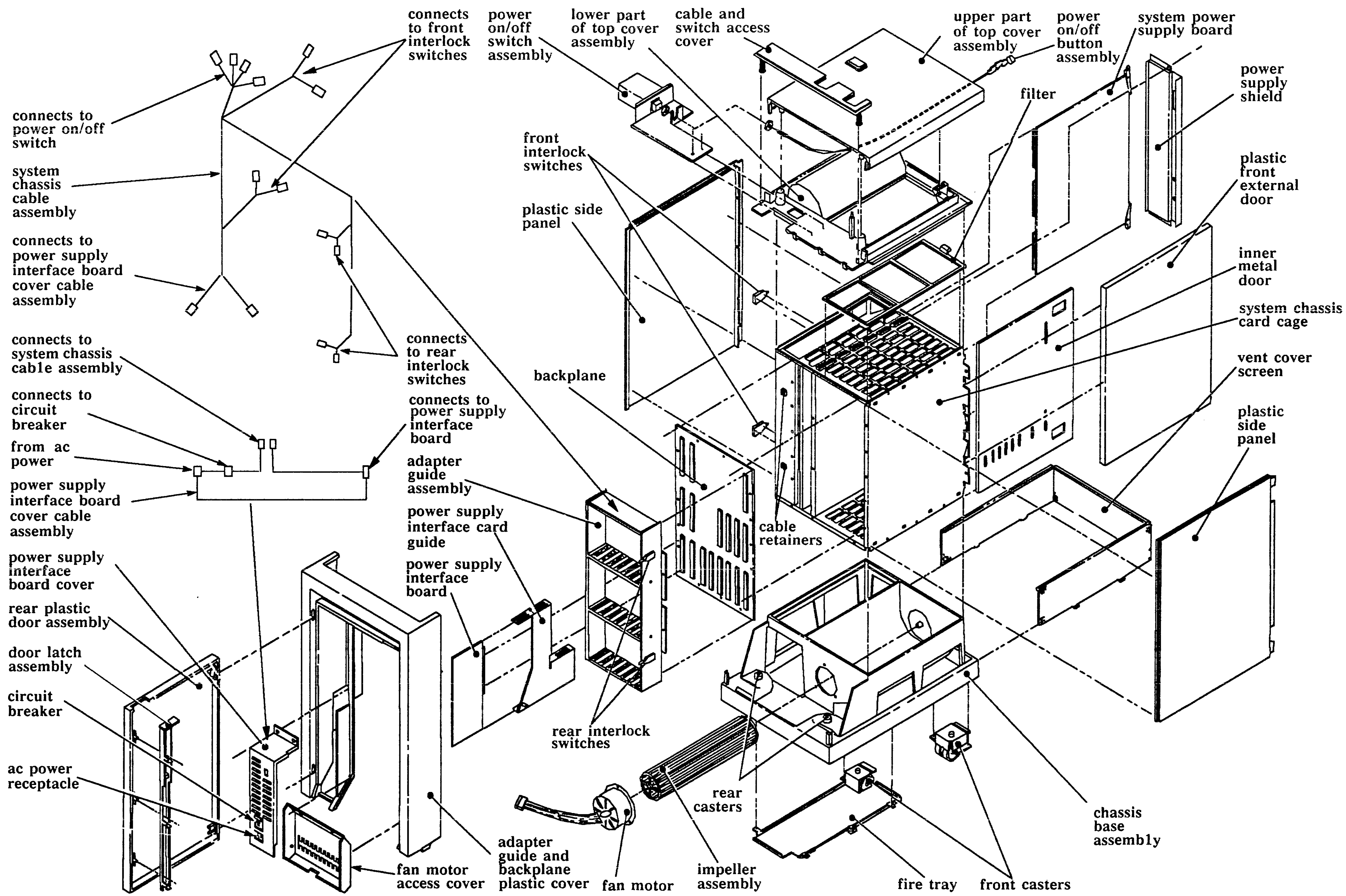


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Figure 1-10 Power Interface Board Cover

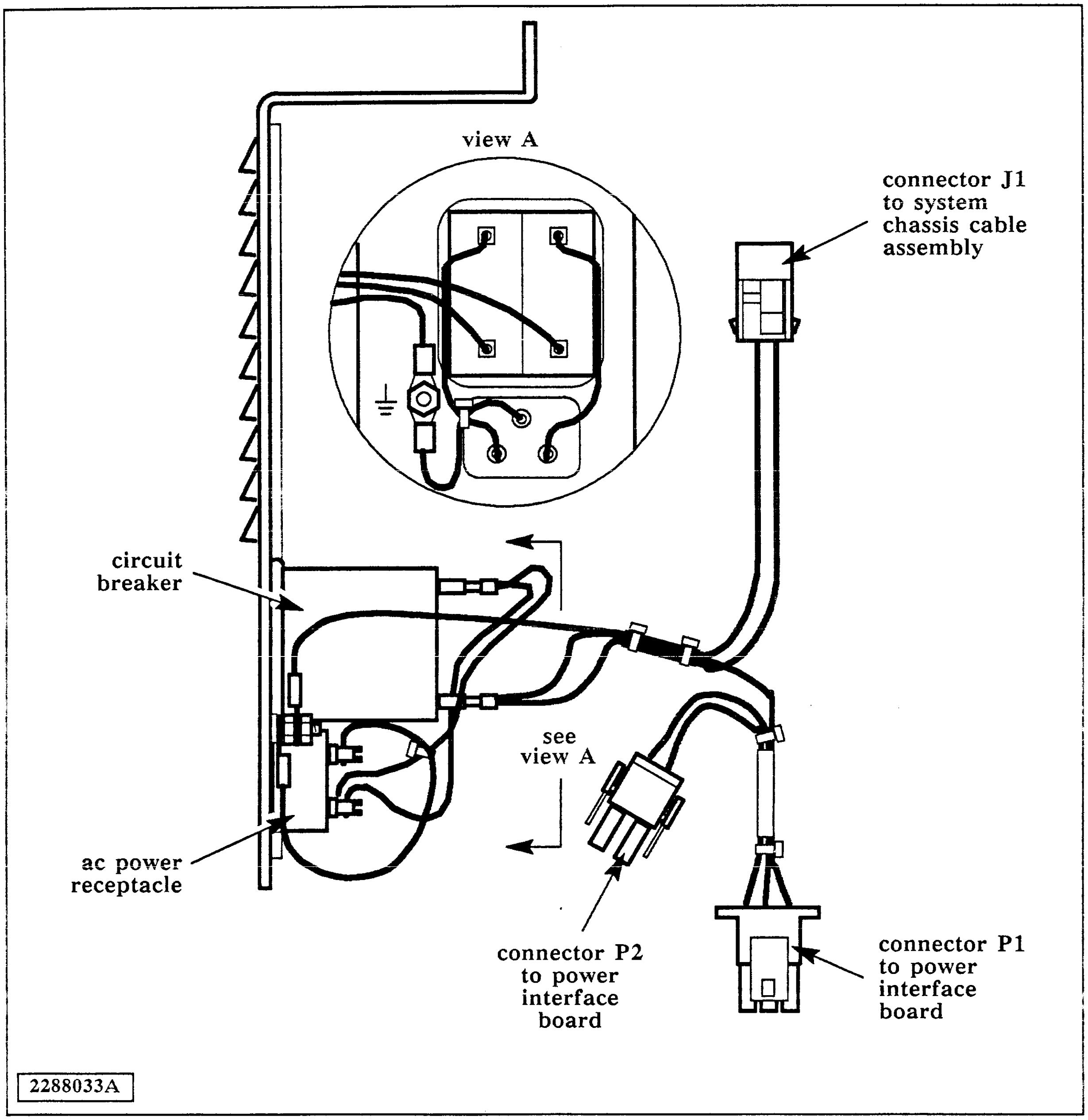
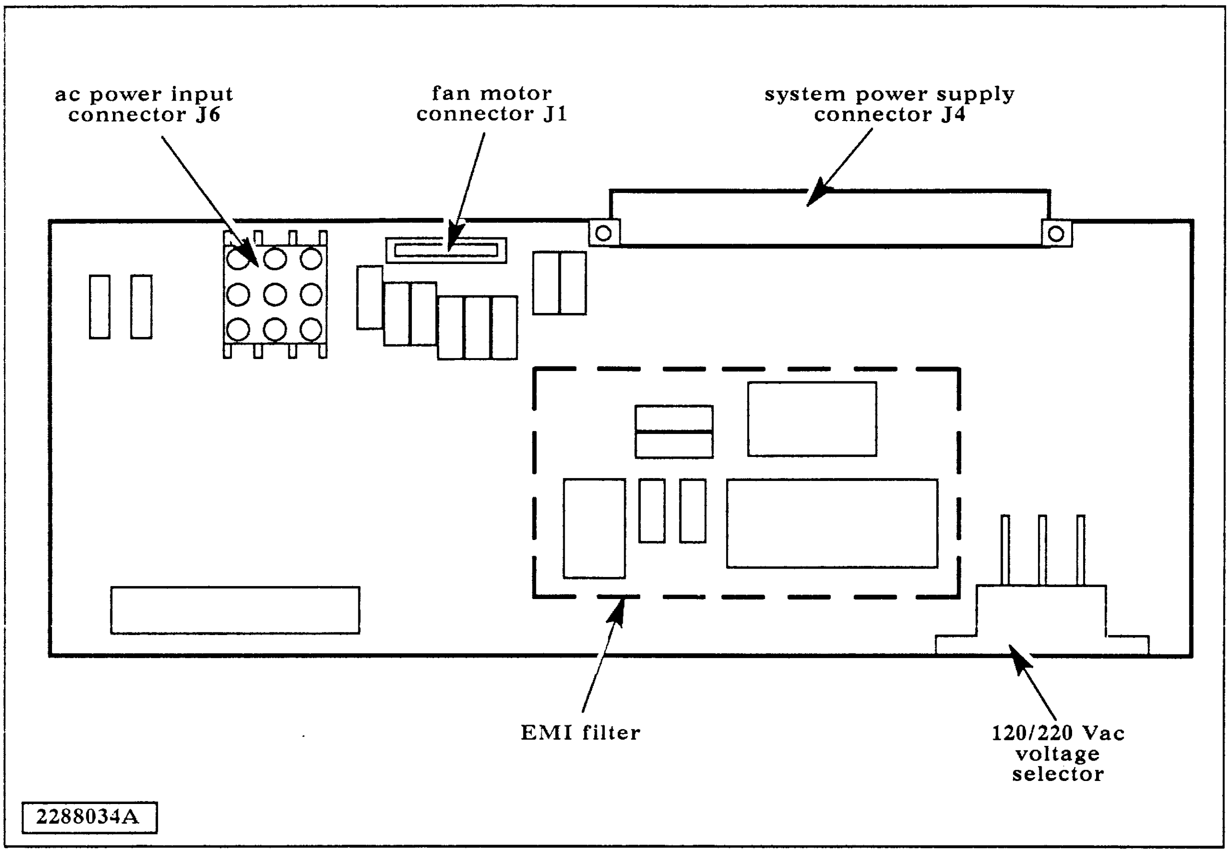


Figure 1-11 Power Interface Board



Replacement of Other Components

1.5.5 Refer to the procedures in the existing *Explorer System Field Maintenance* manual to replace the following components in the Explorer enclosure.

- Fan motor and impeller assembly
- Power on/off switch assembly
- Interlock switches
- System chassis cable assembly
- Backplane with local bus and NuBus
- Backplane with NuBus only

FAMILY TREE DRAWINGS

A

This appendix contains the following family tree drawings:

- Explorer system enclosure family tree, part number 2537343-0001

Figure A-1 Explorer System Family Tree, Part Number 2537343 (Sheet 1 of 2)

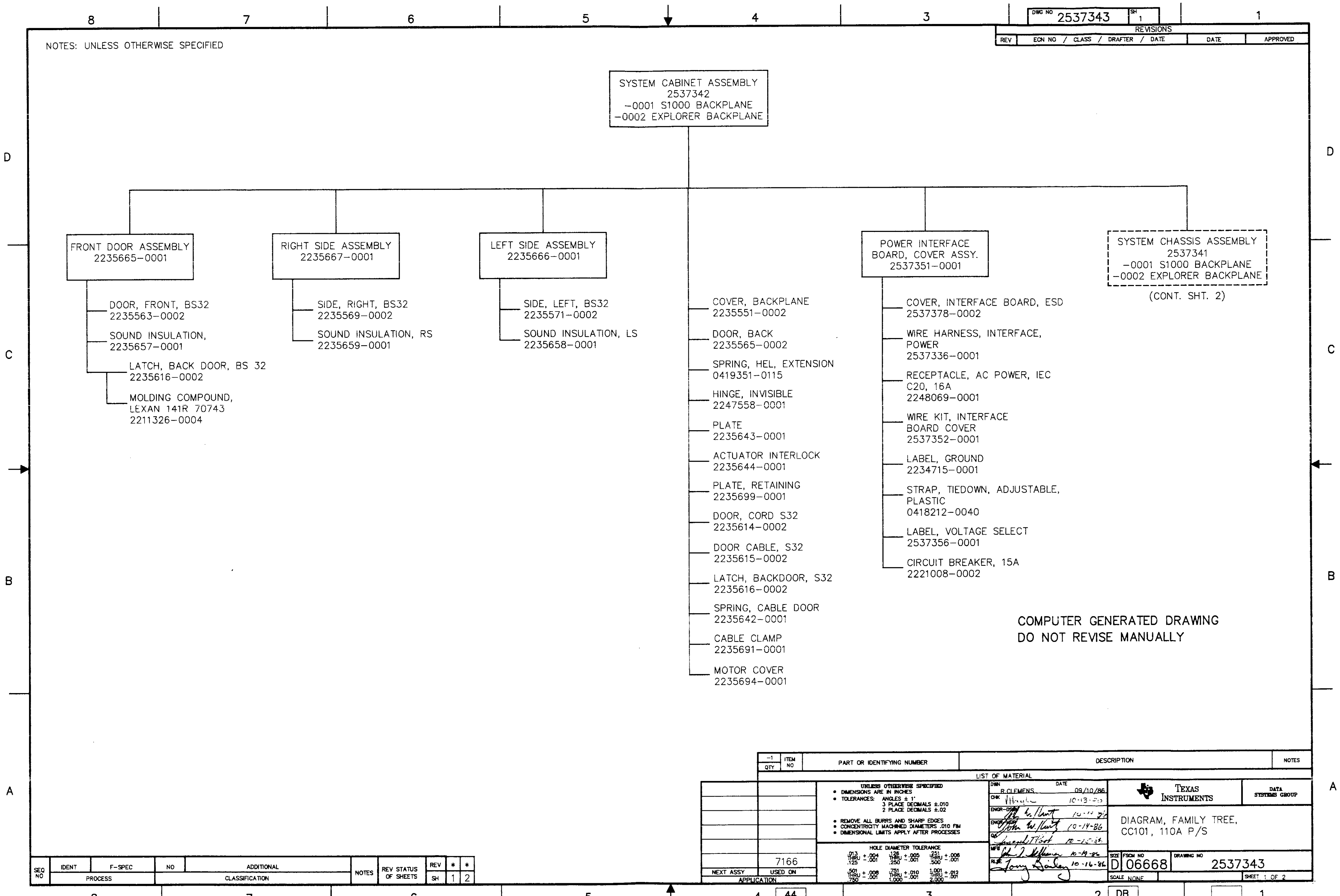


Figure A-1 Explorer Systems Family Tree, Part Number 2249427 (Sheet 3 of 3)

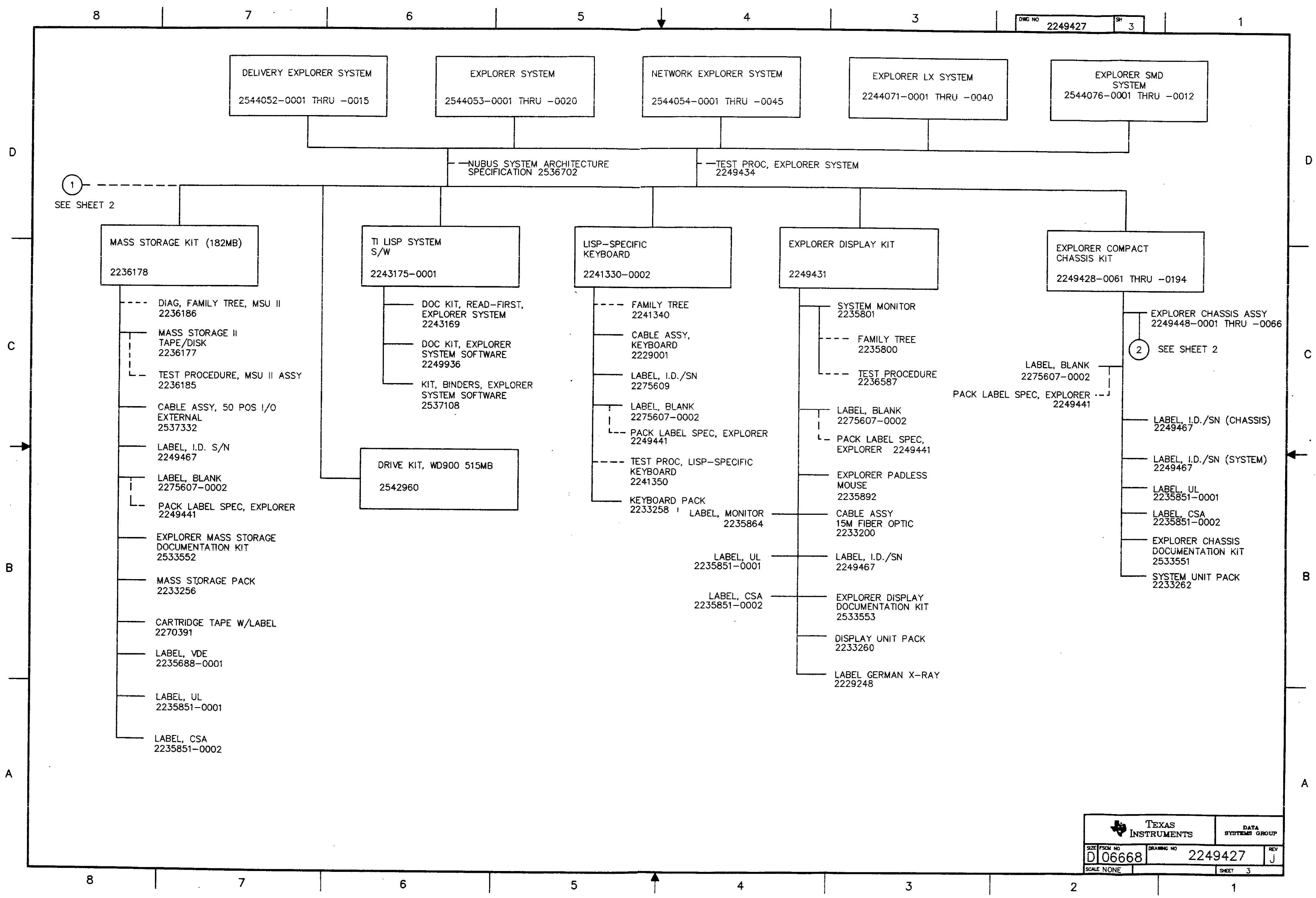
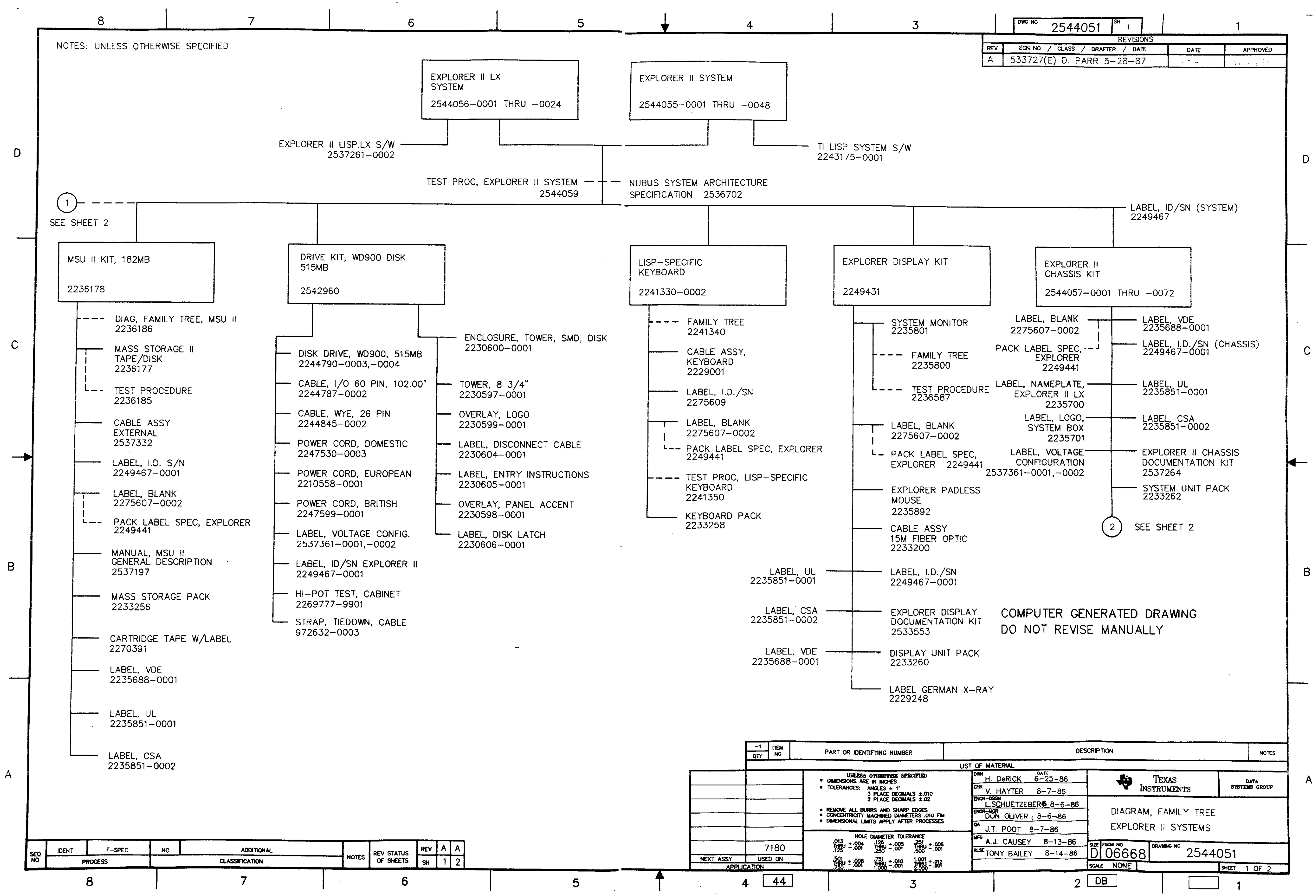


Figure A-2 Explorer II Systems Family Tree, Part Number 2244051 (Sheet 1 of 2)



CONTENTS

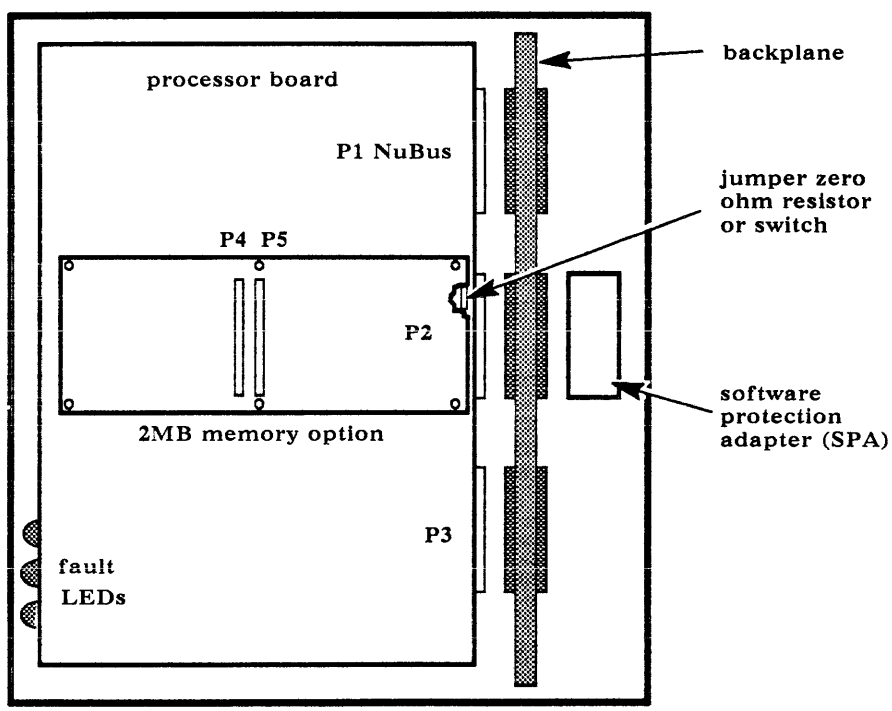
68020-BASED PROCESSOR SUBSYSTEM

1

Introduction

1.1 Refer to Section 4 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of of this documentation kit for field maintenance information on the 68020-based processor subsystem shown in Figure 1-1.

Figure 1-1 68020-Based Processor Subsystem



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NOTE: The 68020-based processor, TI part number 2535860-0001, can have a jumper, a surface mounted zero-ohm resistor, or a switch between pins 1 and 2 at board location AB080. For LX systems in chassis with a local bus backplane, the jumper must be cut or the switch open (up position). The surface mounted zero-ohm resistor should be removed only at the factory. The reason for this operation is to remove the chassis ground at pin 87 on connector P1, which disables the power failure warning (PFW–) signal at the processor.

Reference Information

1.2 The following reference information provides additional technical information on the 68020-based processor:

- *Explorer System Field Maintenance*, TI part number 2243141-0001
- *System 1000 Series, Model 1500 Field Maintenance* manual, TI part number 2534849-0001
- *68020-Based Processor General Description* manual, TI part number 2537240-0001
- *68020-Based Processor Assembly*, TI part number 2535860-0001
- *68020-Based Processor Logic Diagram*, TI part number 2535862-0001
- *68020-Based Processor Specification*, TI part number 2535864-0001
- *68020-Based Processor PAL® (Programmable Array Logic) Equations*, TI part number 2247467-0012
- *68020-Based Processor Expansion Memory Assembly*, TI part number 2535870-0001
- *68020-Based Processor Expansion Memory Logic Diagram*, TI part number 2535872-0001
- *68020-Based Processor Expansion Memory Specification*, TI part number 2535874-0001

Diagnostic Information

1.3 The 68020-based processor is tested by the self-tests at power-up or during a reboot of the system. The NuBus and multiprocessor diagnostics can be run from either the Explorer GDOS or the System 1500 GDOS. Refer to Appendix A in either the *Explorer Diagnostics*, TI part number 2533554-0001, or the *System 1500 Diagnostics User's Guide*, TI part number 2534850-0001, for details on running the NuBus and multiprocessor diagnostic. You can also refer to Section 3 of System Troubleshooting in this manual. The diagnostic software is as follows:

- *Explorer Diagnostics Bootable Tape*, TI part number 2537711-0001
- *System 1500 Diagnostics Tape*, TI part number 2540570-0001

NOTE: Although Explorer LX allows you to load the S15A diagnostics, the diagnostics will execute only if you have at least two 68020-based processors in a chassis.

Unlike its Explorer counterpart, the single 68020-based processor board is tested as part of the self-tests occurring at boot-time. Therefore, System 1500 has no direct equivalent to the Explorer standalone diagnostics in a single-processor system.

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EXPLORER II PROCESSOR

2

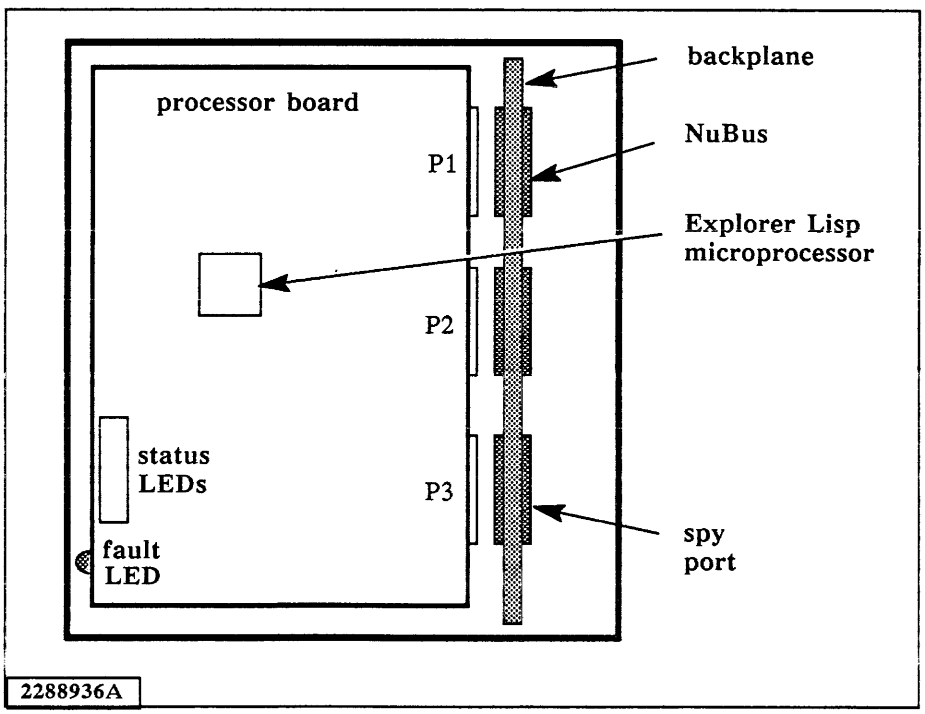
Introduction

2.1 This section provides general information on the Texas Instruments Explorer II processor (Figure 2-1). This information is organized under the following topics:

- Reference information
- Diagnostic information
- Troubleshooting information

The Explorer II processor is a standard three-high Eurocard board that is used as the Lisp processor in an Explorer 7-slot system enclosure. The processor board interfaces over the NuBus (connector P1) as a master or slave to other elements in the 7-slot system enclosure. Connector P2 is available for future options. A spy port at connector P3 is provided for an external testing device. Status and fault light-emitting diodes (LEDs) are provided for maintenance information on the processor board.

Figure 2-1 **Explorer II Processor**



Reference Information

2.2 The reference information listed in Table 2-2 provides additional technical information on the Explorer II processor.

Table 2-1 Reference Information

Category	Document	TI Part Number
Primary Documents	Explorer System Field Maintenance	2243141-0001
	Explorer System Field Maintenance Supplement	2537183-0001
	Explorer II Processor Board Assembly	2540830-0001
	Explorer II Processor Board Logic Diagram	2540832-0001
	Explorer II Processor Board Specification	2540834-0001
	32-Bit Lisp Microprocessor Specification (Explorer Lisp Microprocessor)	2248114-0001
Secondary Documents	Explorer NuBus System Architecture General Description	2537171-0001
	Explorer Processor General Description	2243144-0001
	NuBus Specification	2242825-0001
	Explorer Backplane Specification (Local Bus & NuBus)	2235539-0001
	System 1500 Backplane Specification (NuBus-Only)	2535855-0001
	Explorer I Processor Two-Board Assembly	2243881-0001
	Explorer I Processor Main Board Assembly	2243895-0001
	Explorer I Processor Main Board Logic Diagram	2243897-0001
	Explorer I Processor Auxiliary Board Assembly	2236405-0001
	Explorer I Processor Auxiliary Board Logic Diagram	2236407-0001
	Explorer I Processor Specification	2236414-0001

Diagnostic Information

2.3 To test the Explorer II processor board, use the Explorer II processor standalone diagnostics (EXP2). To use the EXP2 standalone diagnostics, proceed as follows:

1. Reboot the system so that the self-tests run; then press N to select the name load option which appears as follows:

```
Microload name:
System load name:
```

2. After `Microload name:`, type EXP2 and press RETURN twice. The system displays a select device prompt similar to the following:

```
AVAILABLE LOAD DEVICES:

 A=  SLOT 0 ENET 00
*B=  SLOT 2 DISK
 C=  SLOT 2 TAPE

SELECT LOAD DEVICE :
```

3. Type the letter associated with the device containing the EXP2 standalone diagnostics. The Explorer II processor standalone diagnostics main menu (Figure 2-2) now appears.

Figure 2-2 Explorer II Processor Standalone Diagnostics Main Menu

```
 EXP2 Diagnostic                                            Revision ddd/yy
**                              Main Menu
**
**   A = Execute All Processor Tests
**   B = Loop on All Processor Tests
**   C = Modify Test Multiplier (0001)
**   D = LISP-CHIP FUNCTIONAL Test Menu
**   E = LISP-CHIP MEMORY Test Menu
**   F = BOARD STATIC RAM Test Menu
**   G = BOARD SUPPORT Test Menu
**   H = BOARD VIRTUAL LOGIC Test Menu
**   I = BOARD CACHE LOGIC Test Menu
**   J = BOARD TRANSPORT LOGIC Test Menu
**   K = BOARD NUBUS LOGIC Test Menu
**   L = BOARD MACRO Test Menu
**   M = Execute External Memory Tests
**
**   W = Utilities Menu, Y = Debug Menu, Z = Parameter Menu

                         Select the desired option:
```

4. To execute a menu entry, type the number or letter that corresponds to the desired entry.

5. Refer to *Explorer Diagnostics*, part number 2533554-0001, for more details. You can also refer to Sections 3 and 4 of System Troubleshooting in this manual for more details. The diagnostic software is as follows:

   - *Explorer Diagnostics Bootable Tape*, TI part number 2537711-0001
   - *System 1500 Diagnostics Tape*, TI part number 2540570-0001

Troubleshooting Information

2.4 Troubleshooting information for the Explorer II processor includes the following:

- Running the EXP2 standalone diagnostics. Refer to paragraph 2.3 in this section.
- Reading and interpreting the fault indicator LEDs on the processor board. Refer to Section 4 of System Troubleshooting in this manual.
- Replacing the Explorer II processor board. Refer to the existing *Explorer System Field Maintenance* manual.

EXPLORER 32-MEGABYTE MEMORY

3

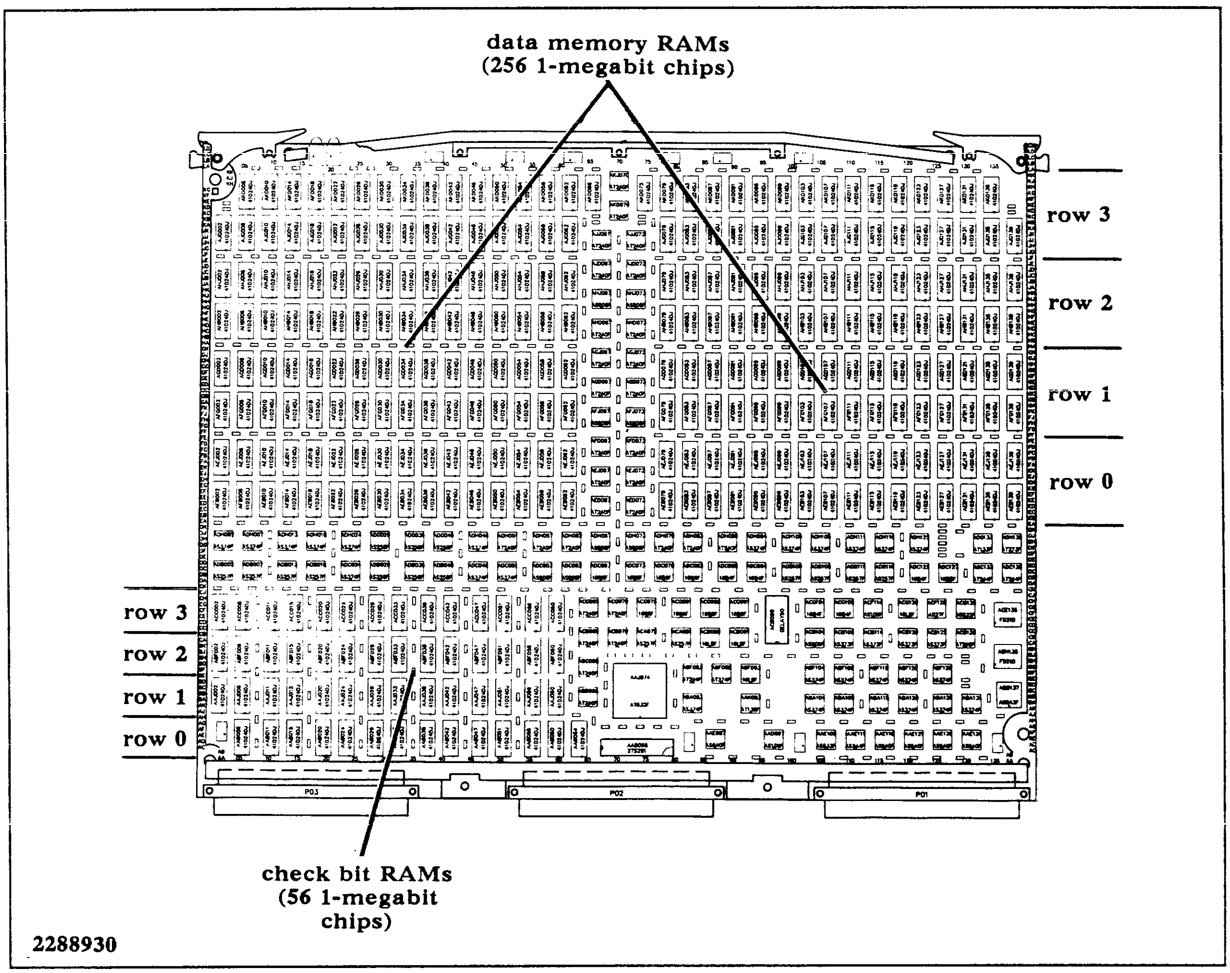
Introduction

3.1 This section provides general information on the Explorer 32-megabyte memory board (Figure 3-1). This information is organized under the following topics:

- Reference information
- Diagnostic information

The memory board is a standard three-high Eurocard board that is used as primary and/or secondary memory in an Explorer 7-slot system enclosure. The memory board interfaces over the NuBus as a slave to other elements in the 7-slot system enclosure.

Figure 3-1 Explorer 32-Megabyte Memory Board



The memory board can be populated with memory chips for 8-, 16-, or 32-megabyte operation. The memory board has no jumpers. The different capacity boards have the following part numbers:

Part Number	Memory Board
2540835-0001	32 megabytes
2540835-0003	16 megabytes
2540835-0004	8 megabytes

The memory board is organized into four horizontal rows of 64 memory data chips. Each row consists of two memory banks (bank A and B) with 32 memory data chips in each bank. Four corresponding rows of 14 check-bit data chips provide storage for seven check bits for each 32-bit memory data word.

The memory data address consists of 23 bits: 2 address bits are used for row selection; 1 address bit is used for bank selection; 10 address bits are used for memory chip row address selection; and 10 address bits are used for memory chip column address selection. These 23 bits are capable of addressing the maximum board capacity of 32 megabytes.

Reference Information

3.2 The following reference information provides additional technical information on the Explorer 32-megabyte memory board:

- *Explorer System Field Maintenance,* TI part number 2243141-0001
- *Explorer System Field Maintenance Supplement,* TI part number 2537183-0001
- *Explorer II Memory Board Assembly,* TI part number 2540835-0001
- *Explorer II Memory Board Logic Diagram,* TI part number 2540837-0001
- *Explorer II Memory Board Specification,* TI part number 2540839-0001
- *Explorer System Specification,* TI part number 2236600-0001
- *NuBus Specification,* TI part number 2242825-0001

NOTE: The titles *Explorer II Memory Board* and *Explorer 32-Megabyte Memory Board* refer to the same memory board. The *Explorer 32-Megabyte Memory Board* title was used in this manual because it is more descriptive.

Diagnostic Information

3.3 Memory diagnostics are part of the Explorer I processor standalone diagnostics (EXPT) and Explorer II processor standalone diagnostics (EXP2). To use EXPT or EXP2 to test the memory board, proceed as follows:

1. Reboot the system so that the self-test runs, then, press N to select the name load option, which appears as follows:

```
Microload name:
System load name:
```

2. After `Microload name:` type EXPT and press RETURN twice. The system displays a select device prompt similar to the following:

```
AVAILABLE LOAD DEVICES:

 A=  SLOT 0 ENET 00
*B=  SLOT 2 DISK
 C=  SLOT 2 TAPE

SELECT LOAD DEVICE :
```

3. If you have an Explorer I processor system, type the letter associated with the device containing the EXPT standalone diagnostics. The Explorer I Processor Standalone Diagnostics Main menu (Figure 3-2) now appears.

Figure 3-2 Explorer I Processor Standalone Diagnostics Main Menu

```
***  System Configuration
***  Slot 2 NPI
***  Slot 3 MEM  16MB
***  Slot 5 SIB
***  Slot 6 CPU
***
***                       Explorer Standalone Diagnostics
***                           Version: EXPT ddd/yy
***                               Main Menu
***
***   0  Run All Standalone Diagnostics
***   1  Enter Menu to Run Explorer Processor Diagnostic
***   2  Enter Menu to Run Explorer Memory Diagnostic
***   P  Enter Menu to Change Operational Parameters
***   R  Return to Previous Menu
***   K  Clear Screen
***
***   To execute, select the desired option :
```

4. To execute the memory diagnostics, place the cursor on item 2 — `Enter Menu to Run Explorer Memory Diagnostics` —, and press RETURN. The Explorer Memory Diagnostic Main menu shown in Figure 3-3 is now displayed.

Figure 3-3 Explorer Memory Diagnostic Main Menu

```
***                    Explorer Standalone Diagnostics
***                       Explorer Memory Diagnostic
***                               Main Menu
***  0  Execute Memory Diagnostic With the Following Parameters :
***  1     Memory Intervals         1
***  2     Starting RAM Address     F4000000
***  3     Number of Words          00100000
***  4     RAM Test Type            All RAM Tests
***  5     RAM Access Mode          word
***  6  Reset Memory Diagnostic Default Parameters
***  7  Enter Menu to Execute Memory Utilities
***  P  Enter Menu to Change Operational Parameters
***  R  Return to Previous Menu
***  K  Clear Screen
***
***
***  To execute, select the desired option :
```

5. If you have an Explorer II processor system, type the letter associated with the device containing the EXP2 standalone diagnostics. The Explorer II Processor Standalone Diagnostics Main menu (Figure 3-4) now appears.

Figure 3-4 Explorer II Processor Standalone Diagnostics Main Menu

```
 EXP2 Diagnostic                                          Revision ddd/yy
**                               Main Menu
**
**   A = Execute All Processor Tests
**   B = Loop on All Processor Tests
**   C = Modify Test Multiplier (0001)
**   D = LISP-CHIP FUNCTIONAL Test Menu
**   E = LISP-CHIP MEMORY Test Menu
**   F = BOARD STATIC RAM Test Menu
**   G = BOARD SUPPORT Test Menu
**   H = BOARD VIRTUAL LOGIC Test Menu
**   I = BOARD CACHE LOGIC Test Menu
**   J = BOARD TRANSPORT LOGIC Test Menu
**   K = BOARD NUBUS LOGIC Test Menu
**   L = BOARD MACRO Test Menu
**   M = Execute External Memory Tests
**
**   W = Utilities Menu, Y = Debug Menu, Z = Parameter Menu
                          Select the desired option:
```

6. To execute the memory diagnostics, place the cursor on item `N` — `Execute External Memory Tests` —, and press RETURN. The Execute External Memory Tests menu (Figure 3-5) is now displayed.

Figure 3-5 Execute External Memory Tests

```
EXP2 Diagnostic                                                    Revision ddd/yy
**
**                              EXTERNAL MEMORY TEST
**
**   (00000004) Slot number of board under test          : 00000004
**          (Y) Address memory via Base Register?     Y/N : Y
**   (00000000) Beginning Base Register address offset    : 00000000
**   (00200000) Size in bytes of memory under test        : 00200000
**   (FFFFFFFF) Beginning test pattern                    : FFFFFFFF
**   (00000002) Number of test patterns per location      : 00000002
**   (01111111) Test mode enables (x,DATA,ADR,CELL,BYTE,HFWD,BLOCK,RETN) : 01111111
**   (00001111) Block mode enables (x,x,x,x,16wd,8wd,4wd,2wd) : 00001111
**   (00000011) Retension test mode (x,x,x,x,x,x,UNMAPPED,BLOCKED) : 00000011
**
**
**                        Any changes needed? Y/N : N
**
**    DATA PATH TEST                    Executing...
**    ADDRESS TEST                      Executing...
**    BIT CELL TEST                     Executing...
**    BYTE MODE TRANSFER TEST           Executing...
**    HALF WORD TRANSFER TEST           Executing...
**    BLOCK TRANSFER TEST               Executing...
**    UNMAPPED RETENTION TEST           Executing...
**    BLOCK RETENTION TEST              Executing...
```

7. Refer to the *Explorer Diagnostics,* part number 2533554-0001, for more details on running the memory diagnostics. You can also refer to Sections 3 and 4 of System Troubleshooting in this manual for additional information. The diagnostic software is as follows:

   - *Explorer Diagnostics Bootable Tape,* TI part number 2537711-0001
   - *System 1500 Diagnostics Tape,* TI part number 2540570-0001

CONTENTS

Paragraph	Title	Page

A **Family Tree Drawings**

Figures

Tables

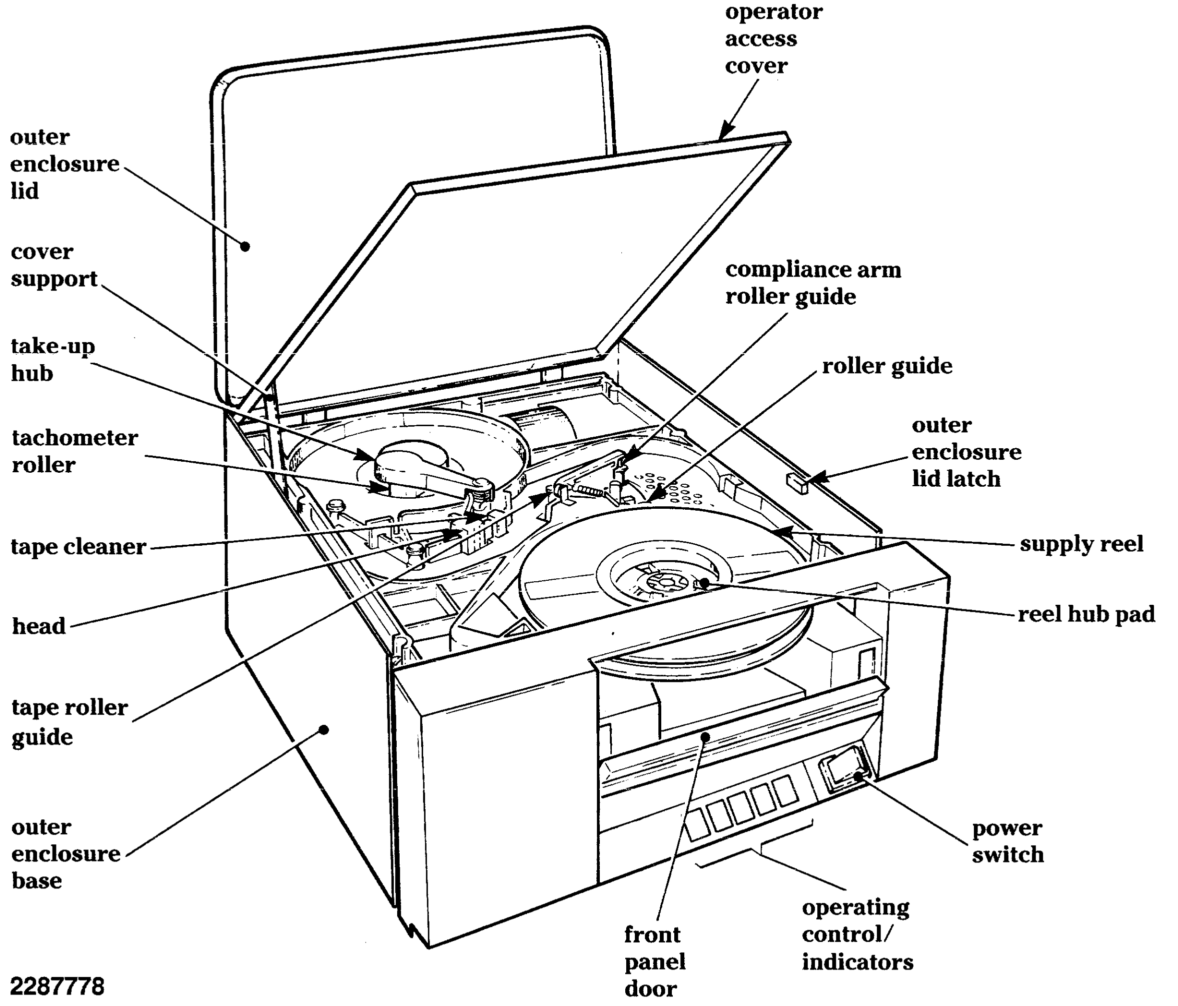
MT3201 1/2-INCH TAPE DRIVE

1

Introduction

1.1 Refer to Section 5 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of of this documentation kit for field maintenance information on the MT3201 1/2-inch tape drive shown in Figure 1-1.

Figure 1-1 MT3201 1/2-Inch Tape Drive



Reference Information

1.2 Table 1-1 provides additional technical information on the MT3201.

Table 1-1 MT3201 Reference Information

Category	Title	TI Part Number
Primary Documents	Explorer System Field Maintenance manual	2243141-0001
	System 1000 Series, Model 1500 Field Maintenance manual	2534849-0001
	SMD/515-Megabyte Mass Storage Subsystem General Description	2537244-0001
	MT3201 1/2-Inch Tape Drive General Description	2537246-0001
	Explorer Diagnostics	2533554-0001
	System 1500 Diagnostics User's Guide	2540570-0001
Secondary Documents	Explorer NuBus Peripheral Interface General Description	2243146-0001
	Cipher CacheTape Documentation Kit	2246130-0001
	Addendum to Cipher Data Products M890 and M891 CacheTape Unit, Volumes I, II, and SCSI Addendum	2246132-9701
	Models M890 and M891 CacheTape Unit, Volume I, Operation and Maintenance, Cipher Data Products, Technical Manual No. 799816-006	2246126-0001
	Models M890 and M891 CacheTape Unit, Volume II, Theory of Operation, Cipher Data Products, Technical Manual No. 799816-007	2246126-0002
	SCSI Addendum, Cipher 1/2-Inch Reel-to-Reel, Cipher Data Products, Technical Manual No. 799893-001	2246126-0003
	MT3201 1/2-Inch Tape Drive Equipment Specification	2542993-0001
	ANSI X3.131-1986 SCSI Specification	
Diagnostic Software	Explorer Diagnostics Bootable Tape	2537711-0001
	System 1500 Diagnostics Tape	2540570-0001

Diagnostic Information

1.3 To test the MT3201 1/2-inch tape drive, use the General Diagnostic Operating System (GDOS). To use GDOS, proceed as follows:

1. Reboot the system so that the self-tests run; then, enter G to boot GDOS. The top-level GDOS menu is now displayed.

2. On the top-level GDOS menu, place the cursor on item 3 — `Enter menu for Extended-Interactive Diagnostic Mode` — and press RETURN. The Extended-Interactive Diagnostic Mode menu is now displayed. You can now load the tape diagnostics or run the Backup/Restore and Edit Label Utility, whichever you need.

3. If you want to run the tape diagnostics, place the cursor on item 1 — `Load a Diagnostic by Menu or Name and Show Its Main Menu` — and press RETURN. The Diagnostic load menu is now displayed. Place the cursor on item 2 — `Tape Diagnostic` — and press RETURN. The Tape Diagnostic menu is now displayed. Check that you have Tape Diagnostic Version XTCTST 025/87 or later. You can now run any test in the Tape Diagnostic menu.

4. If you want to run the Backup/Restore and Edit Label Utility, place the cursor on item 8 — `Enter Backup/Restore and Edit Label Utility` — and press RETURN. The Backup/Restore and Edit Label Utility menu is now displayed. You are now ready to use this utility.

In an Explorer LX system, either the Explorer diagnostics or the System 1500 diagnostics can be used to test the MT3201 1/2-inch tape drive. The System 1500 diagnostics are preferred since they boot first.

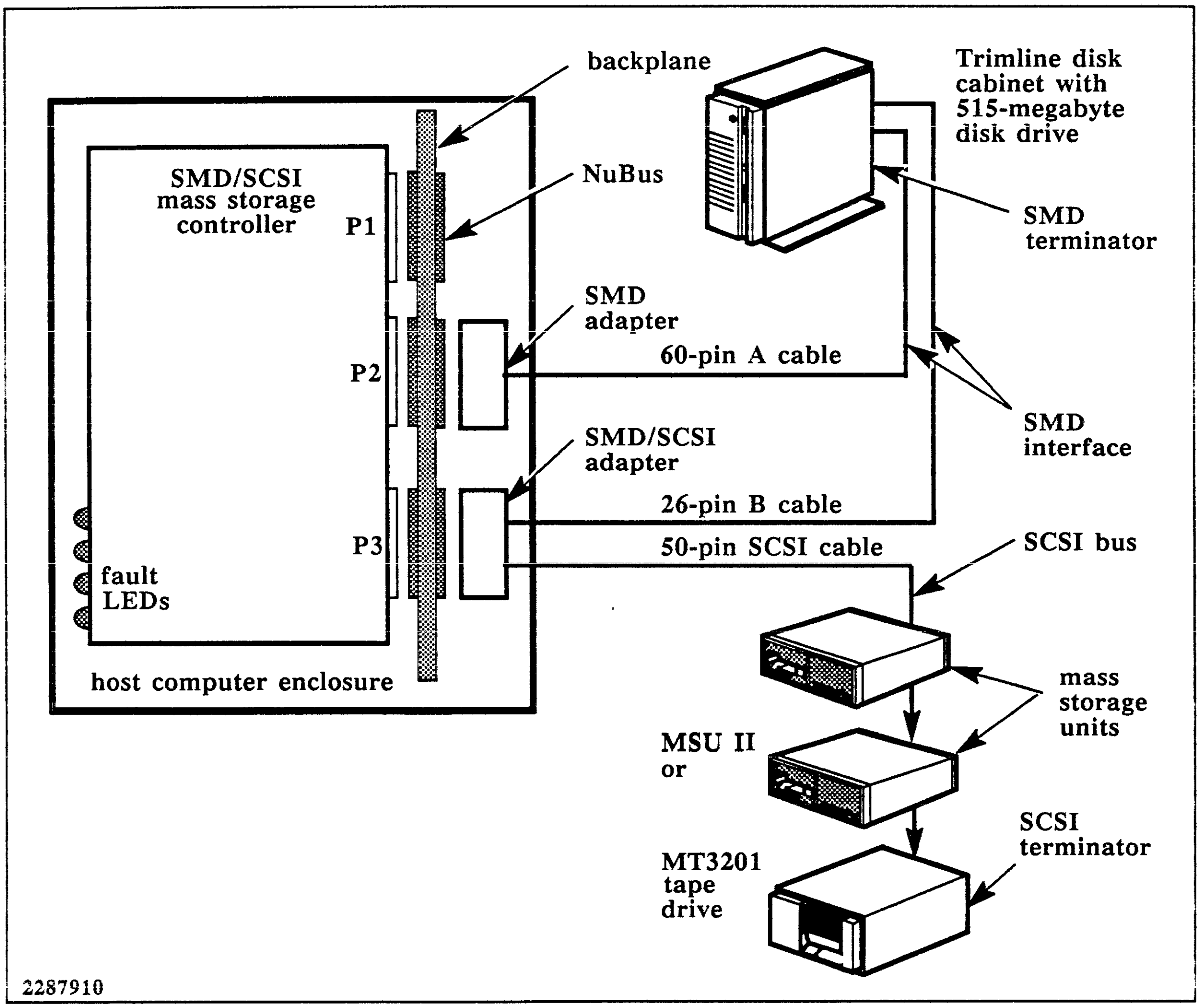
SMD/515-MEGABYTE MASS STORAGE SUBSYSTEM

2

Introduction

2.1 Refer to Section 5 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of this documentation kit for field maintenance information on the SMD/515-megabyte mass storage subsystem shown in Figure 2-1. The MSU I mass storage units and the MT3201 tape drive are included as optional units.

Figure 2-1 SMD/515-Megabyte Mass Storage Subsystem



Reference Information

2.2 Table 2-1 lists reference information that provides technical information on the SMD/515-megabyte mass storage subsystem.

Table 2-1 SMD/515-Megabyte Subsystem Reference Information

Category	Document	TI Part Number
Primary Documents	Explorer System Field Maintenance manual	2243141-0001
	System 1000 Series, Model 1500 Field Maintenance manual	2534849-0001
	SMD/515-Megabyte Mass Storage Subsystem General Description	2537244-0001
	MT3201 1/2-Inch Tape Drive General Description	2537246-0001
	Mass Storage Unit (MSU II) General Description	2537197-0001
	Explorer Diagnostics	2533554-0001
	System 1500 Diagnostics User's Guide	2540570-0001
Secondary Documents	Mass Storage Controller Assembly	2537780-0001
	Mass Storage Controller Logic Diagram	2537782-0001
	Mass Storage Controller Specification	2537784-0001
	SMD Cable Adapter Assembly	2537790-0001
	SMD Cable Adapter Logic Diagram	2537792-0001
	SMD Cable Adapter Specification	2537794-0001
	SMD/SCSI Cable Adapter Assembly	2537795-0001
	SMD/SCSI Cable Adapter Logic Diagram	2537797-0001
	SMD/SCSI Cable Adapter Specification	2537799-0001
	Small Computer System Interface (SCSI) Specification, ANSI X3.131-1986	
	Storage Module Interface Specification, ANSI X3T9.3/84-51, revision 2.0, draft proposal (April 22, 1985)	
	Trimline Disk Cabinet Assembly	2542960-0001 through -0007
	WD900 Disk Drive Specification	2244790-0001
	Installation Instruction, Add-On Disk	2230607-0001
	Mass Storage Kit, 515MB Add-On (120 Volts)	2542962-0001
	Mass Storage Kit, 515MB Add-On (220/240 Volts)	2542962-0002

Table 2-1 SMD/515-Megabyte Subsystem Reference Information (Continued)

Category	Document	TI Part Number
Secondary Documents (Continued)	515-Megabyte Disk Drive Documentation Master Kit (Volumes 1, 2, and 3), Control Data Corporation	2246129-0002
	Addendum to CDC® Fixed Storage Drive, Volumes 1 and 2	2246133-9701
	CDC Fixed Storage Drive, PA5G1, PA5G2, PA5N1, and PA5N2, General Description, Operation, Installation and Checkout, and Parts Data, Hardware Maintenance Manual, Volume 1, CDC part number 833424760	2246125-0004
	CDC Fixed Storage Drive, PA5G1, PA5G2, PA5N1, and PA5N2, Theory of Operation, General Maintenance Information, Trouble Analysis, Electrical Checks, and Repair Information, Hardware Maintenance Manual, Volume 2, CDC part number 833424770	2246125-0005
	CDC Fixed Storage Drive, PA5G1, PA5G2, PA5N1, and PA5N2, Diagrams, Hardware Maintenance Manual, Volume 3, CDC part number 833424780	2246125-0006
Diagnostic Software	Explorer Diagnostics Bootable Tape	2537711-0001
	System 1500 Diagnostics Tape	2540570-0001

CDC is a registered trademark of Control Data Corporation.

Diagnostic Information

2.3 To test the SMD/515-megabyte subsystem, use the General Diagnostic Operating System (GDOS). To use GDOS, proceed as follows:

1. Reboot the system so that the self-tests run; then, enter G to boot GDOS. The top-level GDOS menu is now displayed.

2. On the top level GDOS menu, place the cursor on item 3 — `Enter menu for Extended-Interactive Diagnostic Mode` — and press RETURN. The Extended-Interactive Diagnostic Mode menu is now displayed. Check that the cursor is on item 1 — `Load a Diagnostic by Menu or Name and Show its Main Menu` — and press RETURN. The Diagnostic/Load menu is now displayed. You can now load the disk diagnostics, run the Disk Surface Analysis, Format/Verify Utility, or run the Enter Backup/Restore and Edit Label Utility, whichever you need.

3. If you want to run the disk diagnostics, place the cursor on item 1 — `Disk Diagnostic` — and press RETURN. The Disk Diagnostic menu is now displayed. Check that you have disk diagnostic version DXETST 025/87 or later. You can now run any test in the Disk Diagnostic menu.

4. If you want to run the Disk Surface Analysis, Format/Verify Utility, place the cursor on the item for this utility and press RETURN. The Disk Media Utilities Main menu is now displayed. Check that you have disk media utilities Version SA 025/87 or later. You are now ready to use this utility.

5. If you want to run the Backup/Restore and Edit Label Utility, place the cursor on item 8 — `Enter Backup/Restore and Edit Label Utility` — and press RETURN. The Backup/Restore and Edit Label Utility is now displayed. You are now ready to use this utility.

In an Explorer LX system, either the Explorer diagnostics or the System 1500 diagnostics can be used to test the SMD/515-megabyte subsystem. The System 1500 diagnostics are preferred since they boot first.

MASS STORAGE UNIT (MSU II)

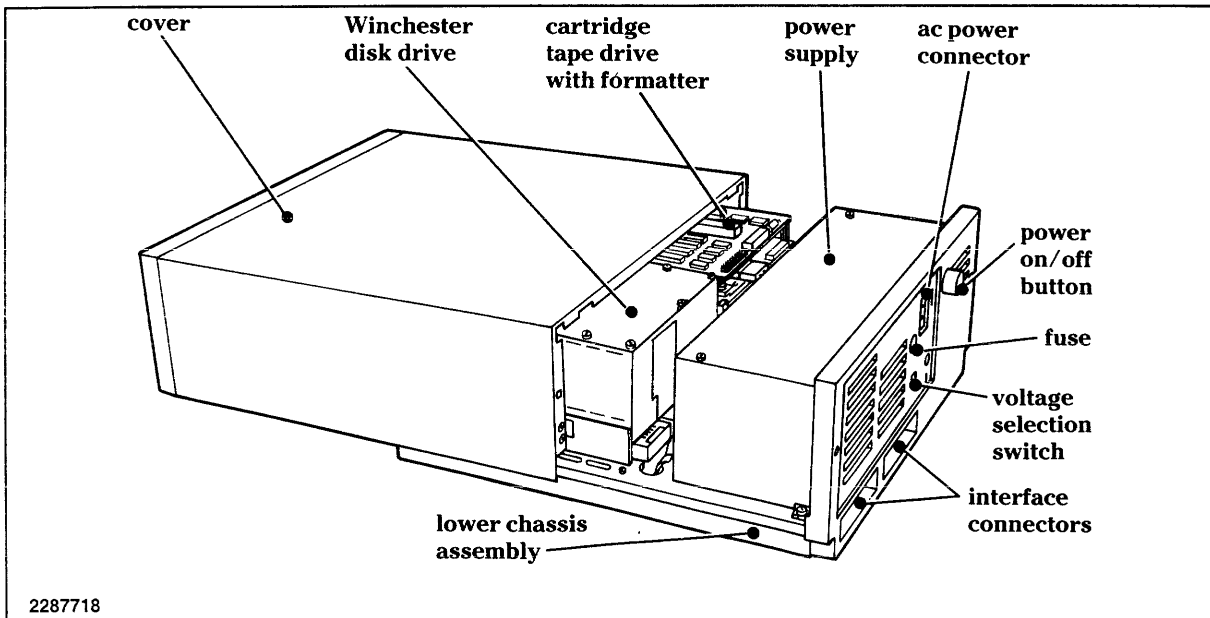
3

Introduction

3.1 This section presents the field maintenance information for the MSU II (Figure 3-1) under the following major headings:

- Maintenance information
- Troubleshooting
- Component replacement

Figure 3-1 Mass Storage Unit (MSU II)



Maintenance Information

3.2 The maintenance information for the components in the MSU II includes the following:

- Reference documents
- MSU II configurations
- Power supply shutdowns
- 1/4-inch tape drive formatter configurations
- SCSI/ESDI disk drive formatter configurations
- 182-megabyte disk drive configurations

Reference Documents

3.2.1 Table 3-1 lists reference information that provides additional technical data on the MSU II:

Table 3-1 MSU II Reference Information

Category	Document	TI Part Number
Primary Documents	Explorer System Field Maintenance manual	2243141-0001
	System 1000 Series, Model 1500 Field Maintenance manual	2534849-0001
	Mass Storage Unit (MSU II) General Description	2537197-0001
	Explorer NuBus Peripheral Interface General Description	2243146-0001
	Series 540 Cartridge Tape Drive Product Description, Cipher Data Products, Inc. Bulletin Number 01-311-0284-1K (1/4-inch tape drive)	2249997-0001
	MT01 Tape Controller Technical Manual, Emulex Corporation part number MT0151001 (formatter for the 1/4-inch tape drive)	2243182-0001
	Product Specification for WREN™ III Disk Drive Model 94166, Control Data Corporation part number 77738212 (182-megabyte disk drive)	2546867-0001
	OEM Manual for WREN III Disk Drive Model 94166, Control Data Corporation part number 77738216	
Secondary Documents	ANSI X3.131-1986 SCSI Standard	
	Common Command Set (CCS) of the Small Computer System Interface (SCSI), ANSI X3T9.2/85-52 revision 4.B	
	ANSI Enhanced Small Device Interface (ESDI) Specification	2546847-0001
	MSU II Assembly	2236178-0001
	MSU II Cable Interconnect Board Assembly	2236180-0001
	MSU II Cable Interconnect Board Logic Diagram	2236182-0001
	SCSI/ESDI Disk Drive Formatter Assembly	2238060-0001
	SCSI/ESDI Disk Drive Formatter Logic Diagram	2238062-0001
	SCSI/ESDI Disk Drive Formatter Specification	2238064-0001
	182-Megabyte Disk Drive Field Installable Disk Kit	2236189-0001
	182-Megabyte Disk Drive Specification	2238078-0001
	1/4-Inch Tape Drive Specification	2238032-0001

WREN is a trademark of Control Data Corporation.

MSU II Configurations

3.2.2 Each MSU II can be configured in one of the following four ways:

- MSU II with a tape drive and a disk drive
- MSU II with two disk drives
- MSU II with a single disk drive
- MSU II with a single tape drive

Figures 3-2 through 3-5 show internal views of the MSU II configurations. The SCSI/ESDI disk drive formatter is the active formatter for the disk drives. The tape drive formatter is part of the tape drive. When a tape drive is present with a disk drive, the SCSI/ESDI disk drive formatter provides a cable-connecting path for the SCSI bus signal to the formatter on the tape drive. When a tape drive is present without a disk drive, the SCSI/ESDI disk drive formatter is replaced with the cable interconnect board (CIB), and the SCSI bus signals are connected through the CIB to the formatter on the tape drive. The CIB is used as a cable interconnection point and does not contain any active components.

Figure 3-2 MSU II Internal View With Tape and Disk Drives

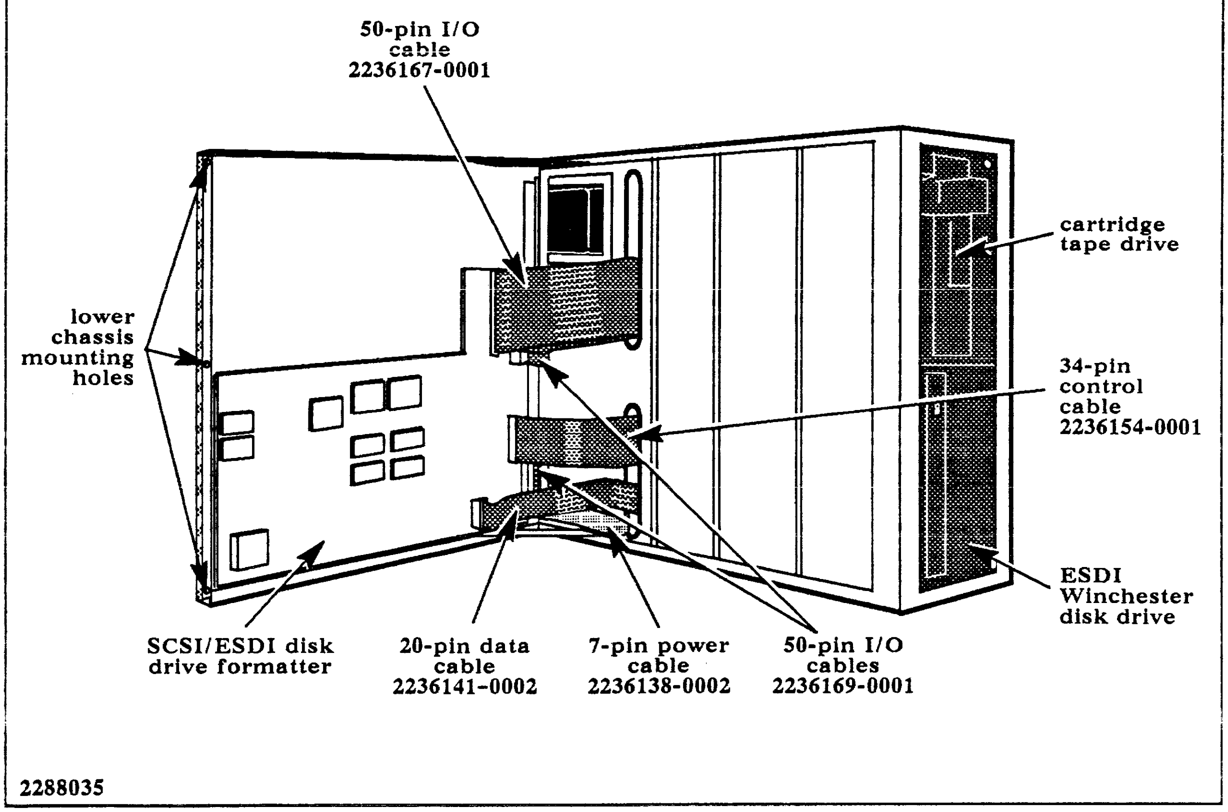


Figure 3-3 MSU II Internal View With Two Disk Drives

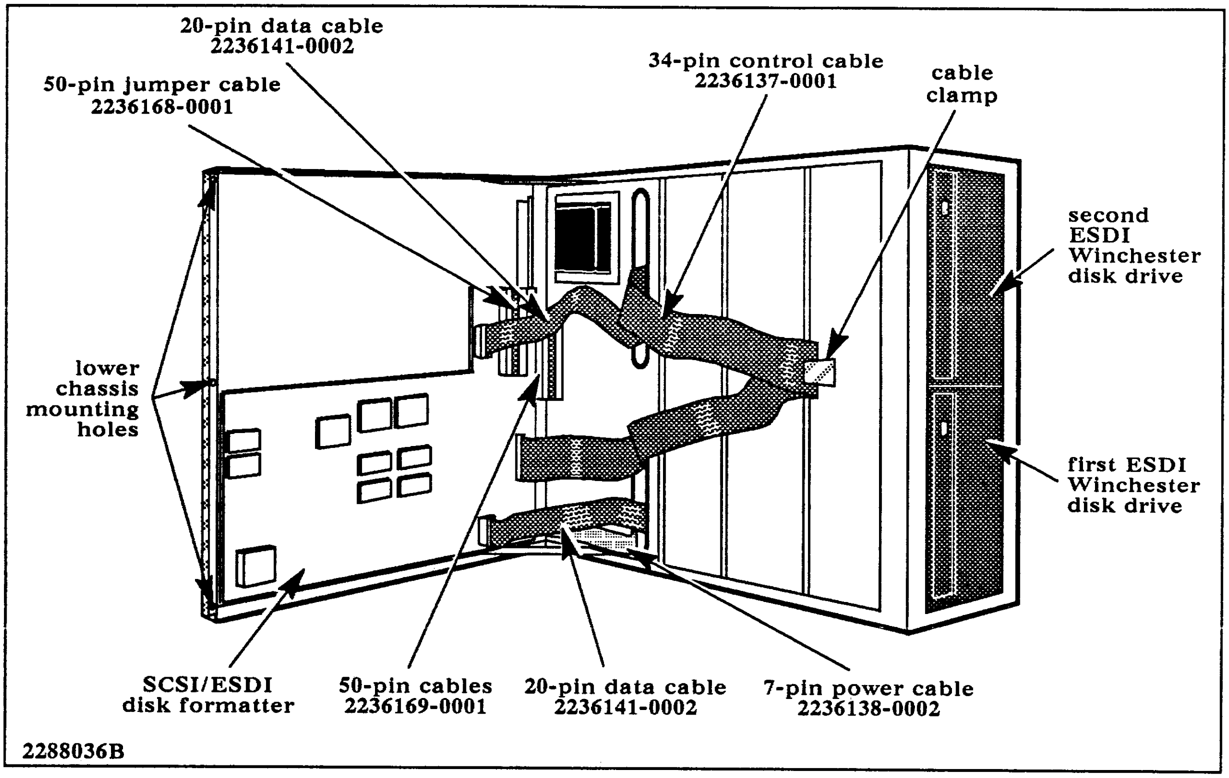


Figure 3-4 MSU II Internal View With One Disk Drive

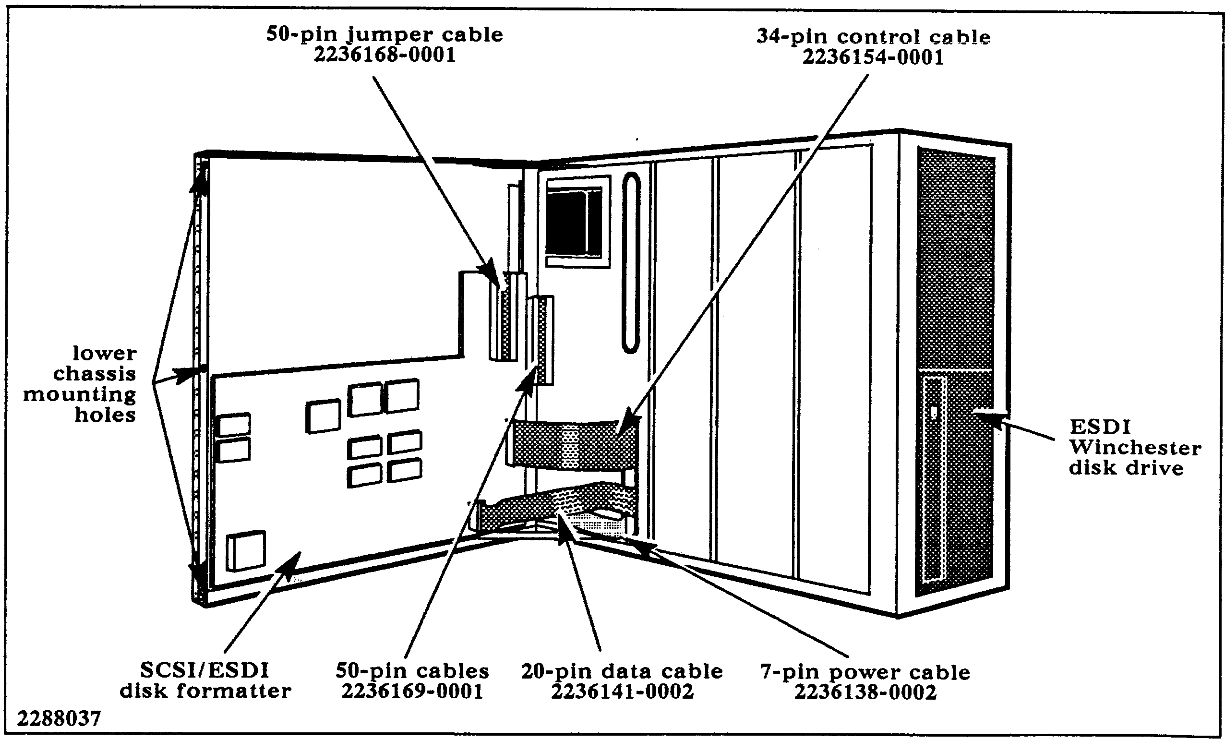
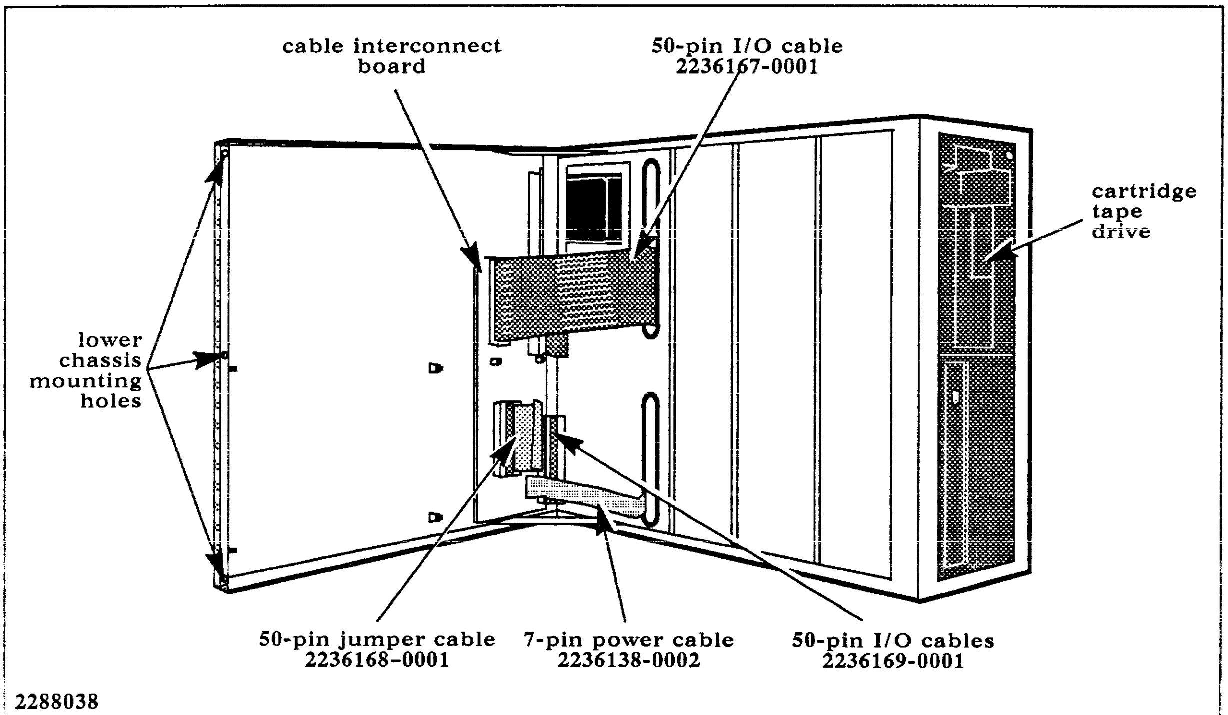


Figure 3-5 MSU II Internal View With a Single Tape Drive



Power Supply Shutdowns

3.2.3 The following paragraphs explain how to recover from several types of power supply shutdowns:

Undervoltage

3.2.3.1 Set the power on/off switch to position 0 (off). After the cause of the undervoltage has been removed, set the power switch back to position 1 (on) to restore normal service.

Current Limiting

3.2.3.2 Since the current-limiting action involves reducing the voltage, recovery is the same as for undervoltage shutdowns.

Overvoltage

3.2.3.3 Since an overvoltage shutdown probably involves a component failure in the power supply, corrective measures will generally include field replacement of the power supply.

Thermal Shutdown

3.2.3.4 To recover from a thermal shutdown, first determine the cause of overheating. Consider the following:

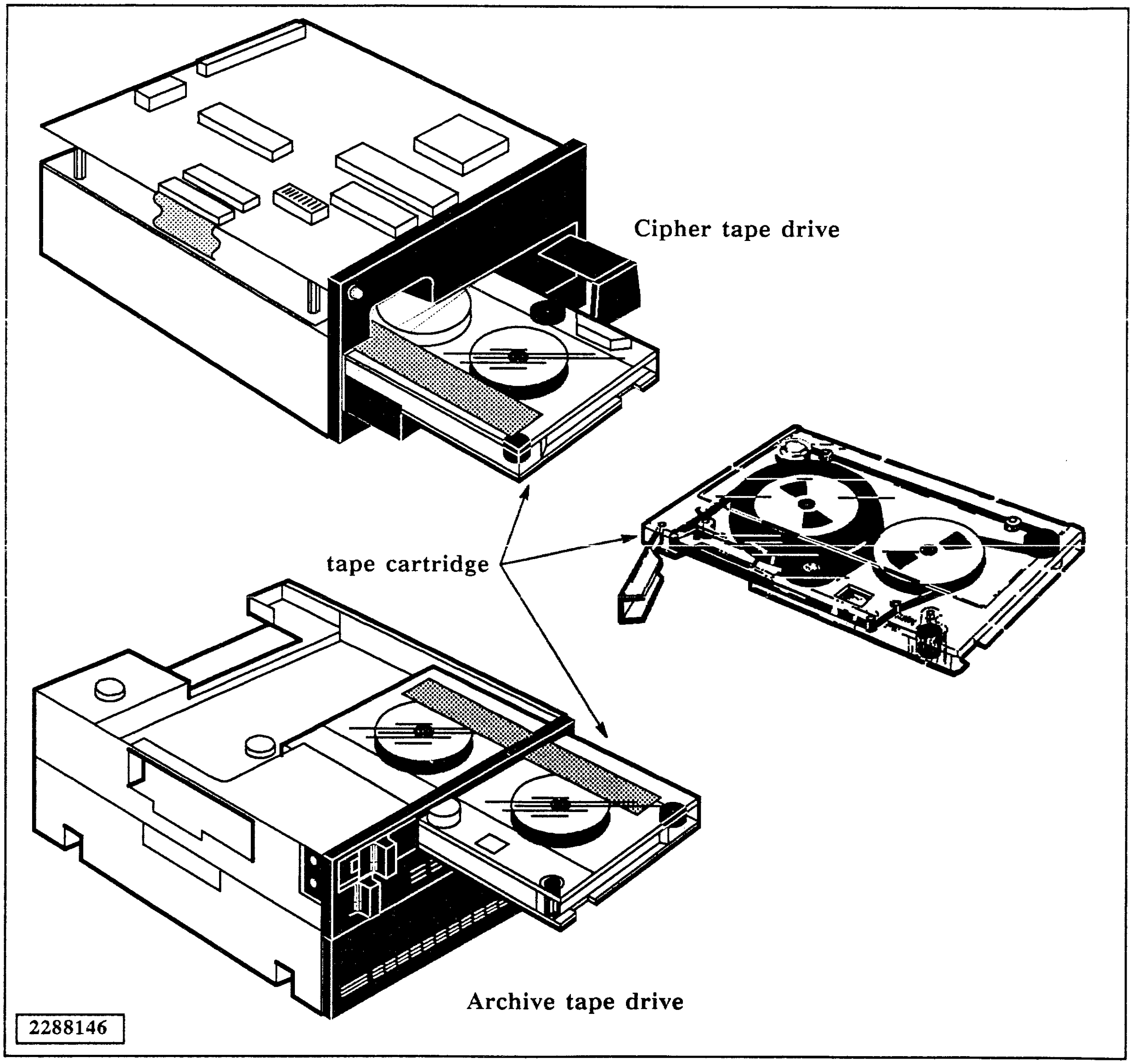
- Is the ambient air abnormally warm?
- Is the room ventilation inadequate?
- Is the space around the enclosure too cramped for free circulation of air?
- Are there any obstructions near the unit to hinder free air circulation?

1/4-Inch Tape Drive Formatter Configurations

3.2.4 The 1/4-inch tape drive equipment (Figure 3-6) for the MSU II is available from the following manufacturers:

- Cipher™ Data Products, Inc.
- Emulex™ Corporation
- Archive™ Corporation

Figure 3-6 1/4-Inch Cipher and Archive Tape Drives



Cipher is a trademark of Cipher Data Products, Inc.
Emulex is a trademark of Emulex Corporation.
Archive is a trademark of Archive Corporation.

If the answer is yes to any of these questions, and it is not feasible to correct the condition, you may need to move the system to a better environment. If the condition can be corrected where the unit is now installed, or if the cause of the condition is corrected in some other way, restore the enclosure to normal service by setting the power on/off switch to position 0 (off), then back to position 1 (on).

The Cipher tape drive has a formatter manufactured by the Emulex Corporation. The TI formatter configurations for the Cipher and Archive tape drives are described in the following paragraph.

Cipher/Emulex Tape Drive Formatter Configuration

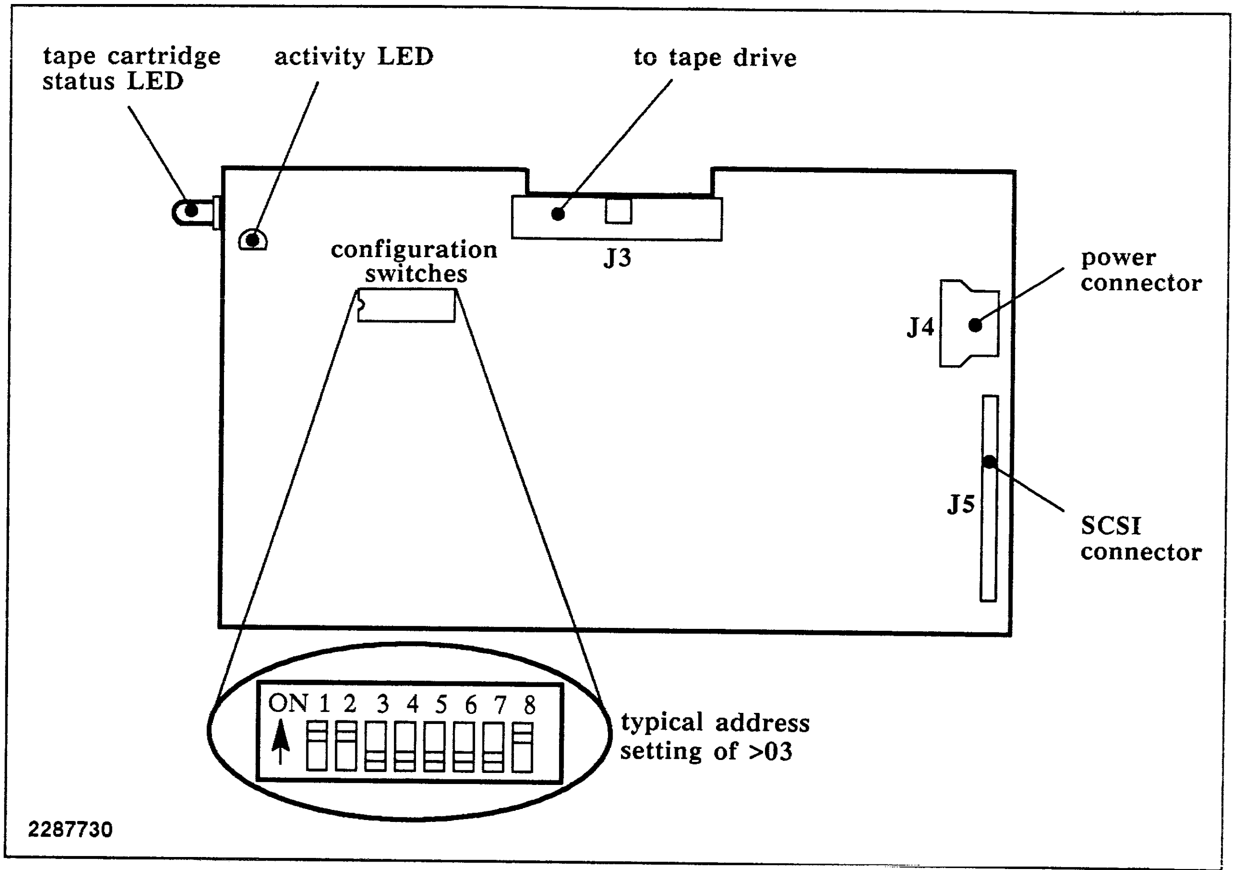
3.2.4.1 A set of dual inline package (DIP) switches (Figure 3-7) allows selection of the various options. The functions of these DIP switches are as follows:

Switch Number	Function
1	SCSI bus address bit 0
2	SCSI bus address bit 1
3	SCSI bus address bit 2
4	Not used
5	Tape drive type
6	Tape drive type
7	Tape drive type
8	SCSI bus parity check

Switches 1 through 3 allow the selection of any one of eight possible SCSI bus addresses. This selected address establishes the identity of the tape drive in relation to other devices on the SCSI bus. An initiator on the bus must specify this address to select the tape drive. Switches 5 through 7 specify the type of tape drive connected to the formatter. The only type of tape drive currently supported is the Cipher 540S, for which all three switches must be set to off. The recommended addresses are as follows:

Switch Settings			Device	Recommended
1	**2**	**3**	**Address**	**Address**
off	off	off	00	
on	off	off	01	Second tape drive
off	on	off	02	
on	on	off	03	First tape drive
off	off	on	04	
on	off	on	05	
off	on	on	06	
on	on	on	07	Third tape drive

Figure 3-7 Cipher Tape Drive Formatter Key Component Locations



Archive Tape Drive Formatter Configuration

3.2.4.2 Figure 3-8 shows the location of the jumpers on the Archive tape drive formatter. The TI configuration for the Archive tape drive formatter has jumpers arranged as shown in Figure 3-9.

Figure 3-8 Rear View of the Archive Tape Drive

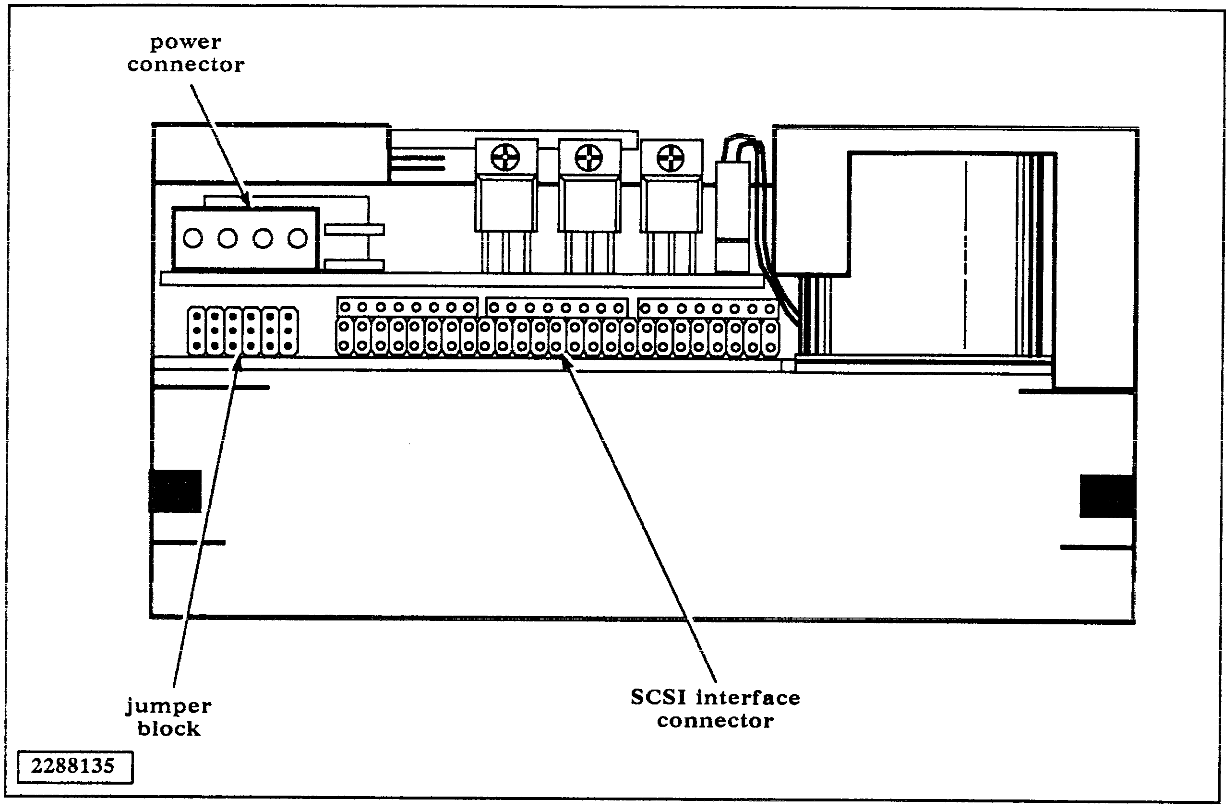
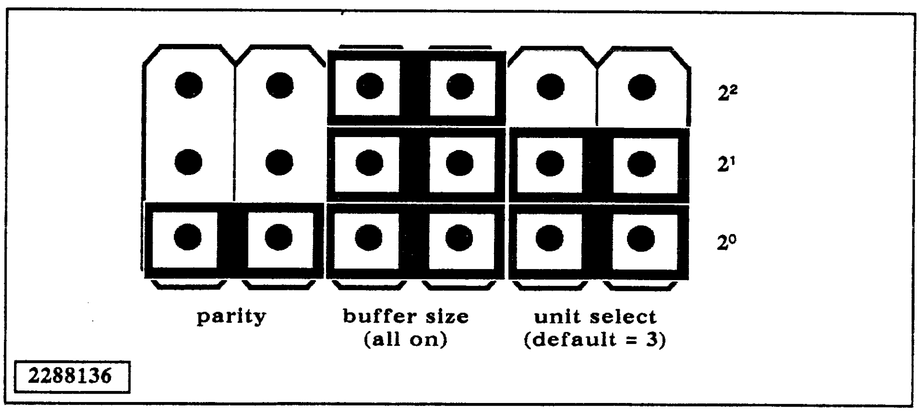


Figure 3-9 Archive Tape Drive Jumper Configuration

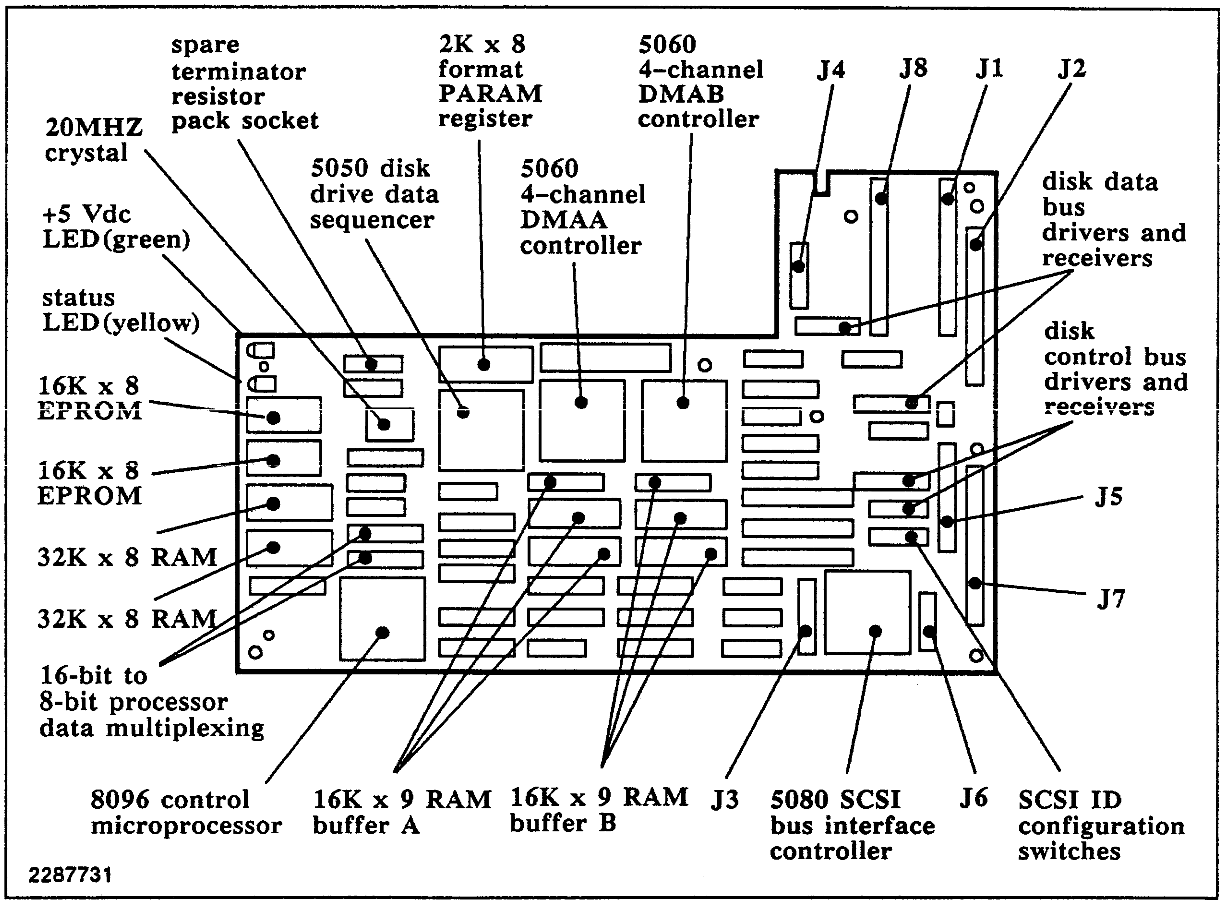


SCSI/ESDI Disk Drive Formatter Configurations

3.2.5 The functions of the SCSI ID configuration switches on switch assembly SW01 are as follows (refer to Figure 3-10):

Switch	Function With Switch On
1	Logic to chassis ground connection
2	SCSI ID (LSB)
3	SCSI ID
4	SCSI ID (MSB)
5	Parity disable
6	Self-test loop control (LSB)
7	Self-test loop control
8	Self-test loop control (MSB)

Figure 3-10 SCSI/ESDI Disk Drive Formatter



182-Megabyte Disk Drive Configurations

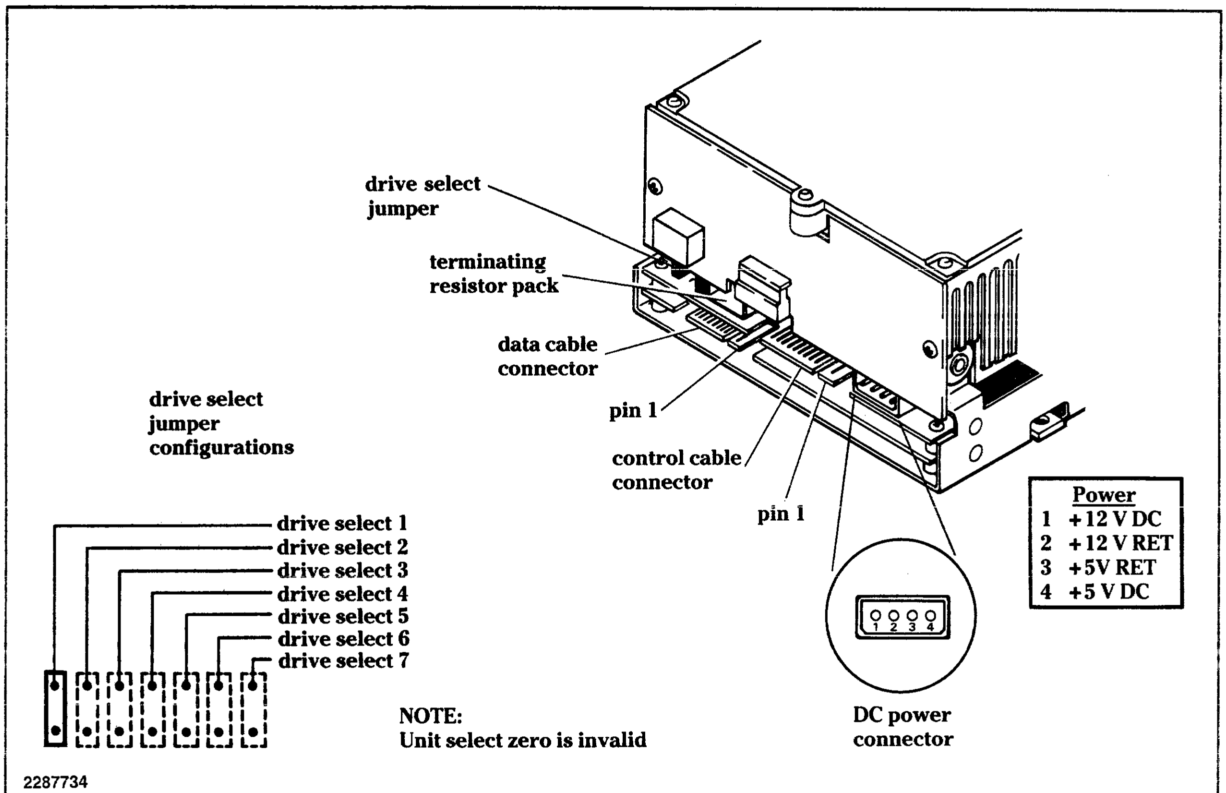
3.2.6 The installation of drive select jumpers and terminators and the setting of configuration switches on the disk drives are explained in the following paragraphs.

Drive-Select Jumper

3.2.6.1 In an MSU II containing one disk drive, the disk drive is located on the right when you are facing the front of the enclosure. This disk drive is designated disk drive 0. In an MSU II having two disk drives, the one on the right is disk drive 0, and the one on the left is disk drive 1. The drive select jumper (Figure 3-11) has seven possible positions. Only two jumper positions apply in the MSU II. The possible jumper positions are as follows:

- Disk drive 0 — Jumper in drive select 1
- Disk drive 1 — Jumper in drive select 2

Figure 3-11 Disk Drive Select Jumpers and I/O Connectors



Control Cable Termination

3.2.6.2 The last drive in a given enclosure (drive 0 for a one-drive configuration; drive 1 for a two-drive configuration) must have a terminator resistor pack installed as shown in Figure 3-12. The terminator resistor pack terminates the disk drive control cable. If the disk drive is not the last drive in the enclosure, the terminator resistor pack must be removed.

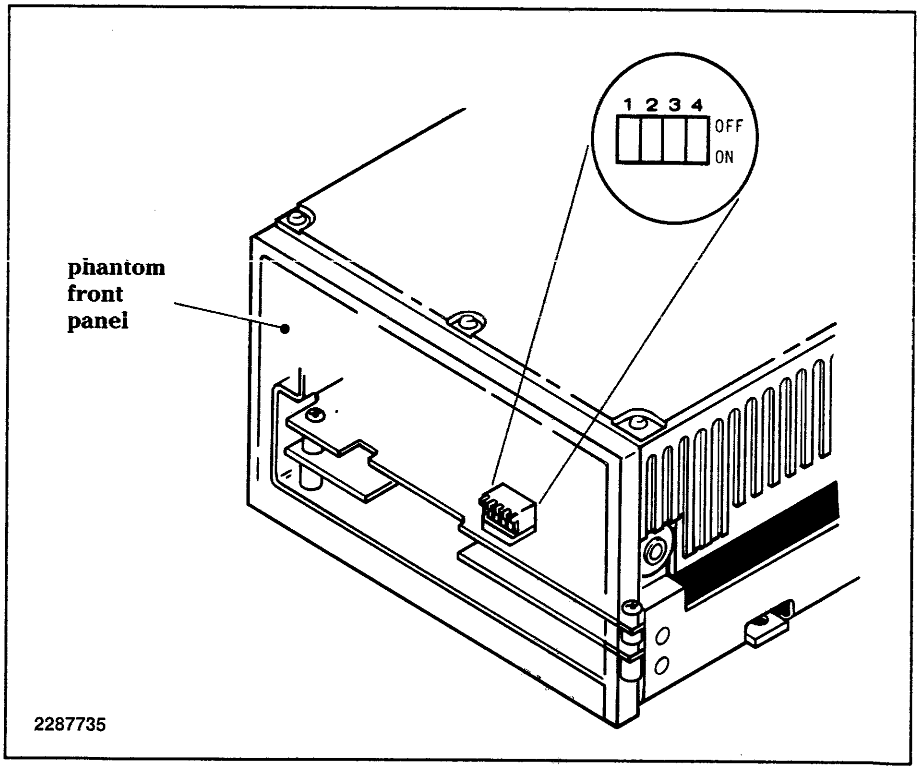
Configuration Switches

3.2.6.3 There are four configuration switches on switch assembly SW1, which is located behind the front plate of the disk drive as shown in Figure 3-12. These switches are set at the factory and should not be reset in the field. For information purposes, these switch functions and settings are:

Switch Number and Position 1	2	3	4	Switch Function/Configuration
off				Motor start on power-up
on				Motor start with command
	off	off	off	64 sectors per track
	on	off	off	64 sectors per track
	off	on	off	36 sectors per track
	on	on	off	34 sectors per track
	on	on	on	Soft sector operation
off	off	on	off	Standard TI configuration

To gain access to these switches, you must remove the two screws located on each side of the disk drive (see Figure 3-12) and lift off the front plate.

Figure 3-12 **Location of Configuration Switches on Disk Drive**



Troubleshooting Information

3.3 In an Explorer LX system, either the Explorer diagnostics or the System 1500 diagnostics can be used to test the MSU II disk drives and tape drives. The System 1500 diagnostics are preferred since they boot first. Refer to the following documents for troubleshooting information on the MSU II:

- Disk drive and SCSI/ESDI formatter error code information that is displayed on the system monitor is explained in the *Mass Storage Unit (MSU II) General Description*, TI part number 2537197-0001.
- Fault isolation information is provided in Section 2 of the *Explorer System Field Maintenance* manual, TI part number 2243141-0001. Fault isolation for the MSU II is similar for the MSU I.
- Troubleshooting the SCSI/ESDI formatter consists of running the SCSI/ESDI formatter self-tests and checking the self-test LED flash codes.
- Troubleshooting the MSU II disk and tape drives consists of running the disk drive and tape drive diagnostics.

SCSI/ESDI Formatter Self-Test LED Flash Codes

3.3.1 The SCSI/ESDI formatter self-tests consist of seven separate tests: a CRC test, a scratch RAM test, a program space RAM test, a sequencer test, a DMA test, and two SCSI tests. If any of these tests fail, the formatter will either repeatedly flash an error code on the status LED, or loop on various tests as defined by SCSI ID configuration switches S6, S7, and S8. These switches can be set as follows:

	Switch		
S8	**S7**	**S6**	**Code Function**
off	off	off	Normal operation. Error code flashes during a failure.
off	off	on	Normal operation. Test loops on failing test
off	on	off	Loop on all tests. Test loops on failing test.
off	on	on	Loop on all tests. Error code flashes during a failure.
on	off	off	Loop on all tests. Test continues to loop on failure.
on	off	on	Reserved
on	on	off	Reserved
on	on	on	Reserved

If an error code is flashed, the sequence consists of several seconds of LED off, several seconds of LED on, several seconds of LED off, followed by the flash code. The actual flash code consists of short flashes that represent logic 0 and long flashes that represent logic 1. It takes eight flashes to represent one of the hexadecimal codes shown in Table 3-2.

Table 3-2 SCSI/ESDI Formatter Self-Test LED Flash Codes

Self-Test Category	Hexadecimal Code	Indicated Self-Test Failure
Program CRC and RAM Compare Errors	01	Program CRC check failed
	10	Scratch RAM compare error, address
	11	Scratch RAM compare error, address–
	12	Program space RAM compare error, address
	13	Program space RAM compare error, address–
Sequencer and FPR Errors	20	Sequencer failed register 14 test
	21	Sequencer failed register 15 test
	22	Sequencer parameter RAM failure, count
	23	Sequencer parameter RAM failure, value
	2A	State detect interrupt failure
DMAA and DMAB Errors	40	DMAA count status failure
	41	DMAA count status failure
	42	DMAA count status failure
	43	DMAA count status failure during write, channel 0
	44	DMAA failed to show complete status, channel 0
	45	DMAA, no interrupr logged in HSI FIFO
	46	DMAA, HSI status error
	47	DMAA, write/read test data compare error
	49	DMAA, channel 0 not still enabled on auto continue
	4A	DMAB count status failure
	4B	DMAB count status failure
	4C	DMAB count status failure
	4D	DMAB count status failure during write, channel 0
	4E	DMAB failed to show complete status, channel0
	4F	DMAB, no interrupt logged in HSI FIFO
	50	DMAB, HSI status error
	51	DMAB, write/read test data compare error
	53	DMAB, channel 0 not still enabled on auto continue
SCSI Chip and I/O Mode Errors	70	5080 chip status error
	72	Timeout while waiting for no SEL
	73	ACK signal failure
	74	ATN signal failure
	75	SEL signal failure
	76	Clear error
	77	REQ signal failure
	78	I/O signal failure
	79	C/D signal failure
	7A	MSG signal failure
	7B	Clear error
	7C	Data error on SCSI bus
	7D	Data error on SCSI bus
	7E	Parity error
	7F	Data error on SCSI bus
	80	Parity clear error

Table 3-2 SCSI/ESDI Formatter Self-Test LED Flash Codes (Continued)

Self-Test Category	Hexadecimal Code	Indicated Self-Test Failure
SCSI DMA Mode Errors	90	Chip status error
	92	Timeout while waiting for no SEL
	93	Timeout while waiting for REQ
	94	Timeout while waiting for no REQ
	95	EFRACTIVE signal error
	96	Channel 2 not finished as expected
	97	Data compare error
	98	Channel 0 not finished as expected
	99	Data compare error
	9A	XFRACTIVE signal error
	9B	Channel 2 not finished as expected

Disk Drive Diagnostic Information

3.3.2 To test the MSU II disk drives, use the General Diagnostic Operating System (GDOS). To use GDOS, proceed as follows:

1. Reboot the system so that the self-tests run; then, enter G to boot GDOS. The top-level GDOS menu is now displayed.

2. On the top-level GDOS menu, place the cursor on item 3 — `Enter menu for Extended-Interactive Diagnostic Mode` — and press RETURN. The Extended-Interactive Diagnostic Mode menu is now displayed. Check that the cursor is on item 1 — `Load a Diagnostic by Menu or Name and Show its Main Menu` — and press RETURN. The Diagnostic load menu is now displayed. You can now load the Disk Diagnostics or run the Disk Surface Analysis, Format/Verify Utility, whichever you need.

3. If you want to run the Disk Diagnostics, place the cursor on item 1 — `Disk Diagnostic` — and press RETURN. The Disk Diagnostic menu is now displayed. Check that you have Disk Diagnostic Version DXETST 025/87 or later. You can now run any test in the Disk Diagnostic menu.

4. If you want to run the Disk Surface Analysis, Format/Verify Utility, place the cursor on the item for this utility and press RETURN. The Disk Media Utilities Main Menu is now displayed. Check that you have Disk Media Utilities Version SA 025/87 or later. You are now ready to run the tests in this utility.

Tape Drive Diagnostic Information

3.3.3 Using GDOS, test the MSU II tape drives as follows:

1. Reboot the system so that the self-tests run; then, enter G to boot GDOS. The top-level GDOS menu is now displayed.

2. On the top-level GDOS menu, place the cursor on item 3 — `Enter menu for Extended-Interactive Diagnostic Mode` — and press RETURN. The Extended-Interactive Diagnostic Mode menu is now displayed. You can now load the Tape Diagnostics or run the Backup/Restore and Edit Label Utility, whichever you need.

3. If you want to run the Tape Diagnostics, place the cursor on item 1 — `Load a Diagnostic by Menu or Name and Show Its Main Menu` — and press RETURN. The Diagnostic load menu is now displayed. Place the cursor on item 2 — `Tape Diagnostic` — and press RETURN. The Tape Diagnostic menu is now displayed. Check that you have Tape Diagnostic Version XTCTST 025/87 or later. You can now run any test in the Tape Diagnostic menu.

4. If you want to run the Backup/Restore and Edit Label Utility, place the cursor on item 8 — `Enter Backup/Restore and Edit Label Utility` — and press RETURN. The Backup/Restore and Edit Label Utility menu is now displayed. You are now ready to run the tests in this utility.

In an Explorer LX system, either the Explorer diagnostics or the System 1500 diagnostics can be used to test the MSU II tape drive. The System 1500 diagnostics are preferred since they boot first.

Component Replacement

3.4 Table 3-3 lists the MSU II replaceable components. Instructions for replacing the major components in the MSU II are arranged under the following headings:

- Disk drive replacement
- SCSI/ESDI formatter replacement
- Tape drive replacement
- Power supply replacement
- CIB replacement

Refer to Figures 3-13 through 3-16 when necessary to replace all MSU II components.

Table 3-3 **MSU II Replaceable Components**

Component Description	Part Number
Power supply assembly	2236110-0001
182-megabyte Winchester disk drive	2238078-0001
Cartridge tape drive (Cipher/Emulex)	2238032-0001
Cartridge tape drive (Archive)	2238108-0001
Cartridge tape (450 feet)	2270391-0001
Cartridge tape (600 feet)	2249438-0001
SCSI/ESDI disk drive formatter	2238060-0001
Terminator	2236188-0001
CIB	2236180-0001
Daisy-chain assembly	2236187-0001
Fuse (U.S.)(5A @ 120 V rms)	0416434-0503
Fuse (European)(2 A @ 220 V rms)	2220531-0004
Power cord (100/120 V)	2247530-0004
Power cord (220 V)	2210558-0002
Power cord (240 V)	2247599-0002
Cable assembly (I/O)(10 feet)	2236190-0001
Cable assembly (I/O) (3.3 feet)	2236190-0002
Cable assembly (SCSI bus)(3.3 feet)	2230602-0001
Cable assembly (SCSI bus) (6.6 feet)	2230602-0002
Cable assembly (SCSI bus) (10 feet)	2230602-0003
Cable assembly (50-pin, I/O-FMTTR-TDR/CIB)	2236167-0001
Cable assembly (50-pin, I/O-FMTTR/CIB)	2236169-0001
Cable assembly (34-pin, FMTTR-DDR-DDR))	2236137-0001
Cable assembly (34-pin, FMTTR-DDR)	2236154-0001
Cable assembly (20-pin, FMTTR-DDR)	2236141-0002
Cable assembly (7-pin, PS-FMTTR/CIB)	2236138-0002
Cable assembly (4-pin, PS-DDR/TDR)	2236143-0001

NOTE:
The following list explains the acronyms used in this table:

FMTTR indicates formatter.
CIB indicates cable interconnect board.
TDR indicates tape drive.
DDR indicates disk drive.
I/O indicates I/O to SCSI bus.
PS indicates power supply.

Figure 3-13 MSU II Cable Diagram (Tape and Disk Drives)

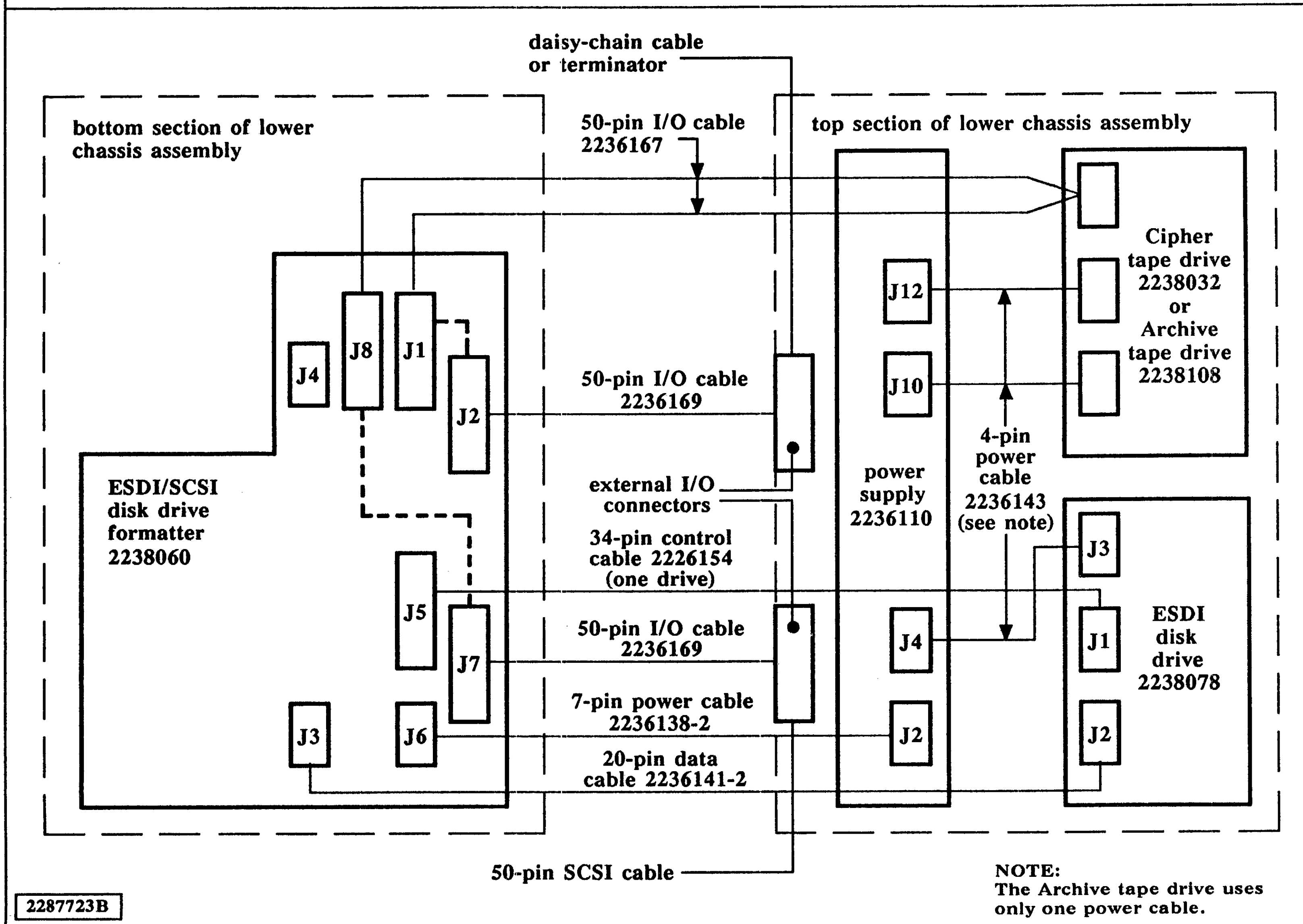


Figure 3-14 MSU II Cable Diagram (One or Two Disk Drives)

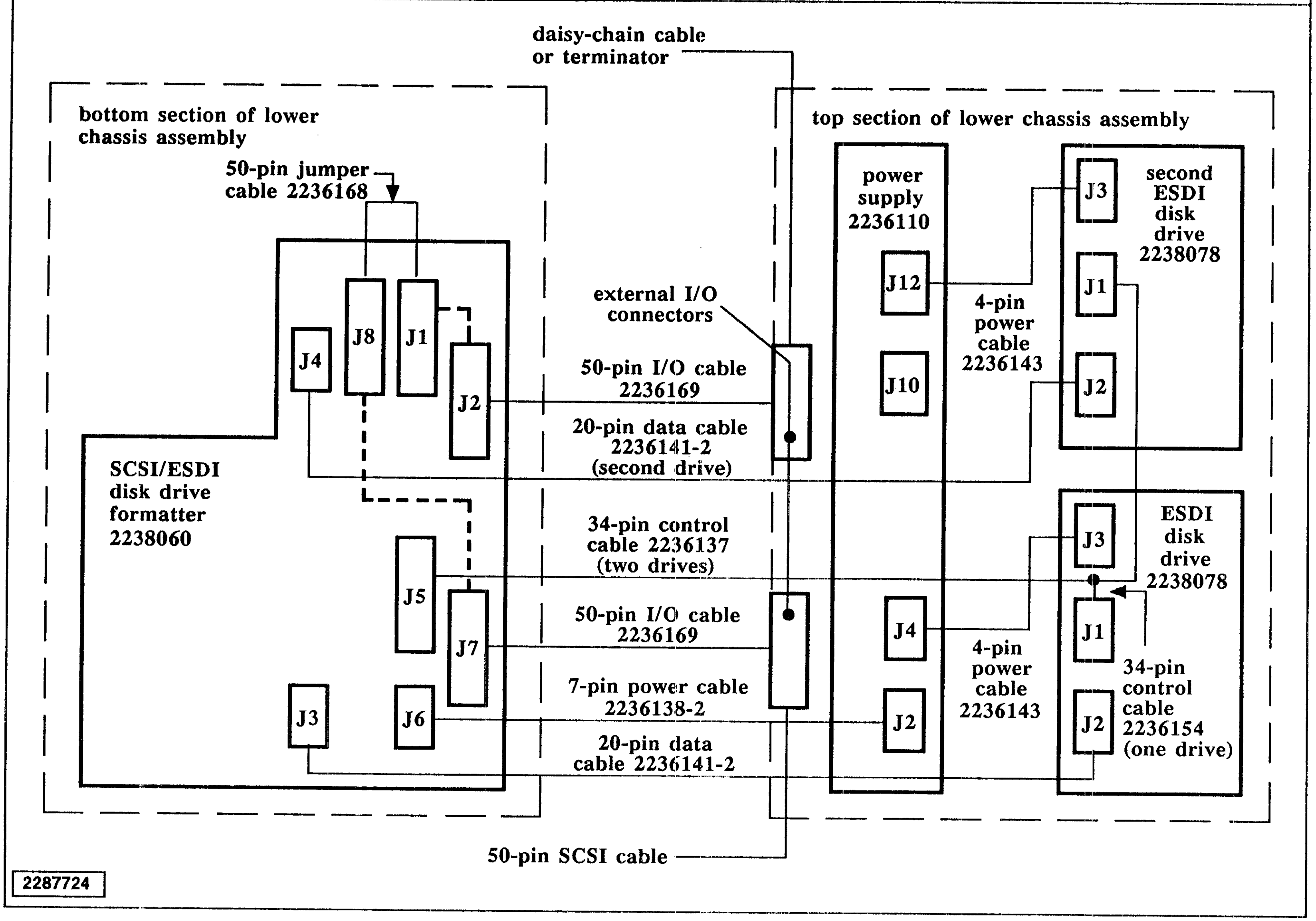


Figure 3-15 MSU II Cable Diagram (Tape Drive Only)

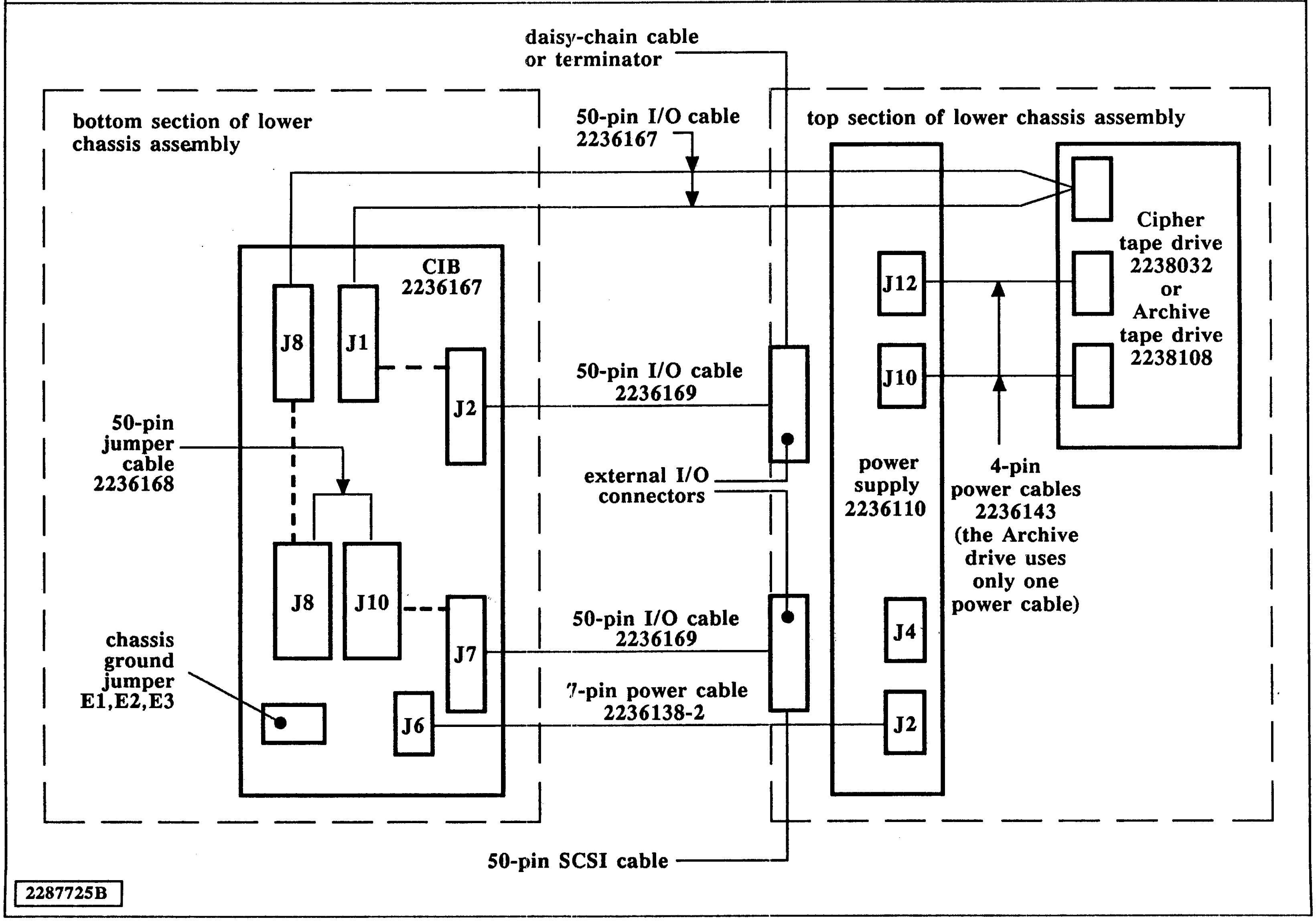
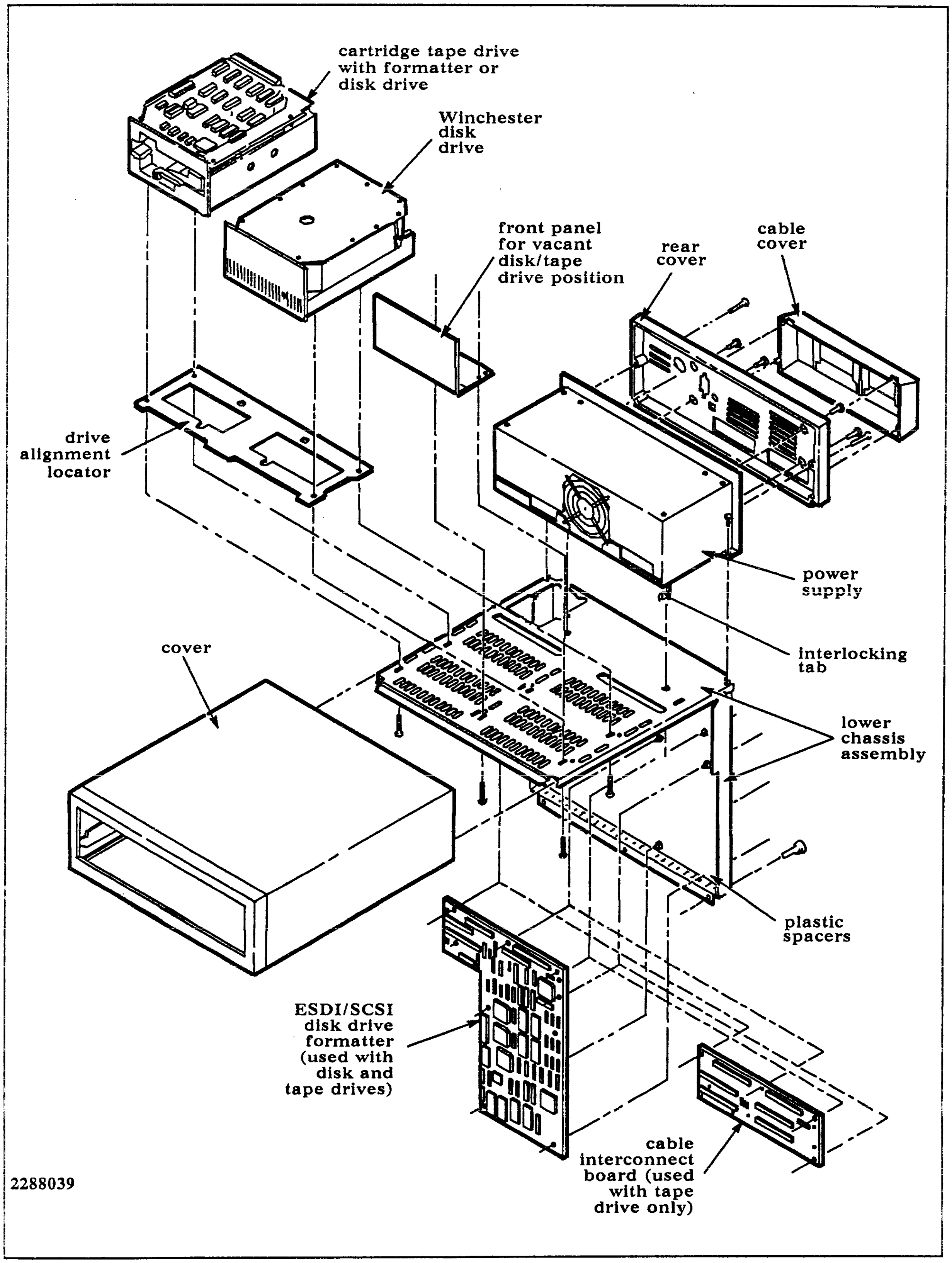


Figure 3-16 MSU II Exploded View



CAUTION: The printed circuit boards in the mass storage enclosure contain static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing or handling the printed circuit boards.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These are commercially available. If you do not have a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling a board. Then, as a further precaution, place the printed circuit board on a grounded work surface after removing it from the assembly.

Before storing or transporting the printed circuit board, return it to its protective package or the assembly.

Disk Drive Replacement

3.4.1 This procedure explains how to remove and install a disk drive in the MSU II:

1. Remove ac power from the MSU II by pressing the ac power on/off button on the rear of the MSU II to the off (out) position and by disconnecting the ac power cable at the ac power receptacle on the rear of the MSU II.

2. Remove the following external cables:

   a. One 50-pin SCSI cable, TI part number 2236190-0001 or -0002

   b. One daisy-chain cable, TI part number 2236187-0001 (if installed)

NOTE: If more than one MSU II is involved, disconnect the power cords from all units and remove all daisy-chain cables, from the top enclosure down to the one you want to access.

---

3. Remove the two screws at the right and left edges of the plastic rear plate of the MSU II that secure the cover to the plastic rear plate and slide the cover off (toward the front) of the lower chassis assembly.

4. Remove the three screws at the front of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly, as some of the internal cables are very short.

5. Disconnect the following internal cables at the disk drive:

   a. One 34-pin control/data cable, TI part number 2236154-0001 (for one drive) or TI part number 2236137-0001 (for two drives) at connector J1

   b. One 20-pin data cable, TI part number 2236141-0002, at connector J2

   c. One 4-pin power cable, TI part number 2236143-0001, at connector J3

6. Remove the four screws that secure the disk drive to the top section of the lower chassis assembly and remove the disk drive. These screws are located under the disk drive within the lower chassis assembly.

7. Before you install the new disk drive, verify that the unit select jumper and the terminator pack on the disk drive are correct for the MSU II configuration. Refer to paragraph 3.2.6 in this section for configuration information.

8. Install the disk drive in the reverse order that the disk drive was removed.

9. Install the cables removed in step 2. The terminator should always be installed in the last MSU II in the system.

10. Check the operation of the disk drive by performing the applicable system self-test and the diagnostic procedures.

SCSI/ESDI Formatter Replacement

3.4.2 This procedure explains how to remove and install the SCSI/ESDI formatter in the MSU II:

1. Remove ac power from the MSU II by pressing the ac power on/off button on the rear of the MSU II to the off (out) position, and by disconnecting the ac power cable at the ac power receptacle on the rear of the MSU II.

2. Remove the following external cables:

   a. One 50-pin SCSI cable, TI part number 2236190-0001 or -0002

   b. One daisy-chain cable, TI part number 2236187-0001 (if installed)

NOTE: If more than one MSU II is involved, disconnect the power cords from all units and remove all daisy-chain cables, from the top enclosure down to the one you want to access.

---

3. Remove the three screws at the front of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly, as some of the internal cables are very short.

4. Disconnect the following cables at the SCSI/ESDI formatter:

   a. One 34-pin control/data cable, TI part number 2236154-0001 (for one drive) or TI part number 2236137-0001 (for two drives) at connector J5

   b. One 20-pin data cable, TI part number 2236141-0002, at connector J3 (for the first disk drive)

   c. One 20-pin data cable, TI part number 2236141-0002, at connector J4 (for the second disk drive)

   d. One 7-pin power cable, TI part number 2236138-0002, at connector J6

   e. Two 50-pin I/O cables, TI part number 2236169-0001, at connectors J2 and J7

   f. Two 50-pin I/O cables, TI part number 2236167-0001, at connectors J1 and J8

5. Remove the 1/4-inch screw near the 7-pin power cable attached to the formatter at terminals E1 through E3. Using a pair of long-nosed pliers, squeeze the nine plastic spacers that secure the formatter to the lower chassis assembly and remove the SCSI/ESDI formatter.

6. Install the SCSI/ESDI formatter in the reverse order that it was removed. Before you close the lower chassis assembly, perform the following checks and self-tests:

   a. Verify that the SCSI ID configuration on the formatter is correct. Refer to paragraph 3.2.5 in this section for SCSI ID configuration information.

   b. Connect the ac power cable to the MSU II and apply power to the enclosure using the on/off button on the rear of the enclosure. The internal self-tests should run. If there are no errors, the green LED on the formatter will be on, and the yellow LED will be off. If there are errors, the yellow LED will flash an error code to indicate the new formatter is faulty.

   c. If there are no errors during the formatter internal self-tests, turn off the ac power from the MSU II, and close the lower chassis assembly.

7. Install the cables removed in step 2. The terminator should always be installed in the last MSU II in the system.

8. Check the operation of the MSU II by performing the applicable system self-test and diagnostic procedures.

Tape Drive Replacement

3.4.3 This procedure explains how to remove and install the tape drive in the MSU II:

1. Remove ac power from the MSU II by pressing the ac power on/off button on the rear of the MSU II to the off (out) position and by disconnecting the ac power cable at the ac power receptacle on the rear of the MSU II.

2. Remove the following external cables:

   a. 50-pin SCSI cable, TI part number 2236190-0001 or -0002

   b. Daisy-chain cable, TI part number 2236187-0001 (if installed)

NOTE: If more than one MSU II is involved, disconnect the power cords from all units and remove all daisy-chain cables, from the top enclosure down to the one you want to access.

---

3. Remove the two screws at the right and left edges of the plastic rear plate of the MSU II that secure the cover to the plastic rear plate and slide the cover off (toward the front) of the lower chassis assembly.

4. Remove the three screws at the front of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly as some of the internal cables are very short.

5. Disconnect the following cables at the tape drive:

   a. One 50-pin I/O cable, TI part number 2236167-0001, at connectors J5

   b. Two 4-pin power cables, TI part number 2236143-0001, at connectors J2 and J4

6. Remove the four screws that secure the tape drive to the top section of the lower chassis assembly and remove the tape drive. These screws are located under the tape drive within the lower chassis assembly.

7. Install the tape drive in the reverse order that it was removed. Before you install the cover, verify that the tape drive formatter configuration switches or jumpers on the applicable tape drive are arranged properly, as indicated in paragraph 3.2.4 in this section.

8. Install the cables removed in step 2.

9. Insert a scratch tape cartridge and turn on the ac power using the ac power on/off button on the rear of the MSU II. Observe that after several seconds the LED on the tape drive formatter starts to blink. This is an indication that the tape drive formatter has passed its internal self-tests and is functioning properly. If the LED does not blink, it indicates the new tape drive is faulty.

10 Turn off the ac power to the MSU II, remove the scratch tape, and install the cover.

11. Check the operation of the disk drive by performing the applicable system self-test and diagnostic procedures.

Power Supply Replacement

3.4.4 This procedure explains how to remove and install the power supply in the MSU II:

1. Remove ac power from the MSU II by pressing the ac power on/off button on the rear of the MSU II to the off (out) position and by disconnecting the ac power cable at the ac power receptacle on the rear of the MSU II.

2. Remove the terminator, TI part number 2236188-0001 (if installed), and disconnect the following external cables:

   a. 50-pin SCSI cable, TI part number 2236190-0001 or -0002

   b. Daisy-chain cable, TI part number 2236187-0001 (if installed)

NOTE: If more than one MSU II is involved, disconnect the power cords from all units and remove all daisy-chain cables, from the top enclosure down to the one you want to access.

---

3. Remove the two screws at the right and left edges of the plastic rear plate of the MSU II that secure the cover to the plastic rear plate and slide the cover off (toward the front) of the lower chassis assembly.

4. Disconnect the following cables at the power supply:

   a. One 7-pin power cable, TI part number 2236138-0002, at connector J2 (for the formatter or CIB)

   b. Two 4-pin power cables, TI part number 2236143-0001, at connectors J12 and J10 (for the tape drive)

   c. One 4-pin power cable, TI part number 2236143-0001, at connector J4 (for the disk drive)

5. Remove the four screws that secure the plastic rear plate to the power supply and remove the plastic rear plate.

6. Remove the two screws that secure the power supply to the lower chassis assembly and remove the power supply.

7. Install the power supply in the reverse order that was used to remove it. Verify that the voltage selection switch on the rear of the power supply is set correctly and that the proper fuse is installed. On 120-volt systems the fuse should be 5 amperes; on 220-volt systems the fuse should be 3 amperes.

8. Install the terminator and the cables removed in step 2. The terminator should always be installed in the last MSU II in the system.

9. Check the operation of the disk drive by performing the applicable system self-test and diagnostic procedures.

Cable Interconnect Board Replacement

3.4.5 This procedure explains how to remove and install the cable interconnect board (CIB) in the MSU II:

1. Remove ac power from the MSU II by pressing the ac power on/off button on the rear of the MSU II to the off (out) position and by disconnecting the ac power cable at the ac power receptacle on the rear of the MSU II.

2. Remove the terminator, TI part number 2236188-0001 (if installed), and disconnect the following external cables:

    a. 50-pin SCSI cable, TI part number 2236190-0001 or -0002

    b. Daisy-chain cable, TI part number 2236187-0001 (if installed)

NOTE: If more than one MSU II is involved, disconnect the power cords from all units and remove all daisy-chain cables, from the top enclosure down to the one you want to access.

3. Remove the three screws at the front of the lower chassis assembly that secure the bottom section of the lower chassis assembly to the top section and open the lower chassis assembly. Use care when opening the lower chassis assembly, as some of the internal cables are very short.

4. Disconnect the following cables at the CIB:

    a. One 7-pin power cable, TI part number 2236138-0002, at connector J6

    b. Two 50-pin I/O cables, TI part number 2236169-0001, at connectors J2 and J7

    c. Two 50-pin I/O cables, TI part number 2236167-0001, at connectors J1 and J11 (for the tape drive)

    d. 50-pin jumper cable, TI part number 2236168-0001, at connectors J8 and J10

5. Remove the 1/4-inch screw near the 7-pin power cable attached to the CIB at terminals E1 through E3. Use a pair of long-nosed pliers to squeeze the two plastic spacers that secure the CIB to the lower chassis assembly and remove the CIB.

6. Install the CIB in the reverse order that was used to remove it. Verify that the signal ground to chassis ground jumper between terminals E1 and E2 is installed on the primary MSU II only. All other MSU IIs should have this jumper between terminals E2 and E3.

7. Install the terminator and the cables removed in step 2. The terminator should always be installed in the last MSU II in the system.

8. Check the operation of the disk drive by performing the applicable system self-test and diagnostic procedures.

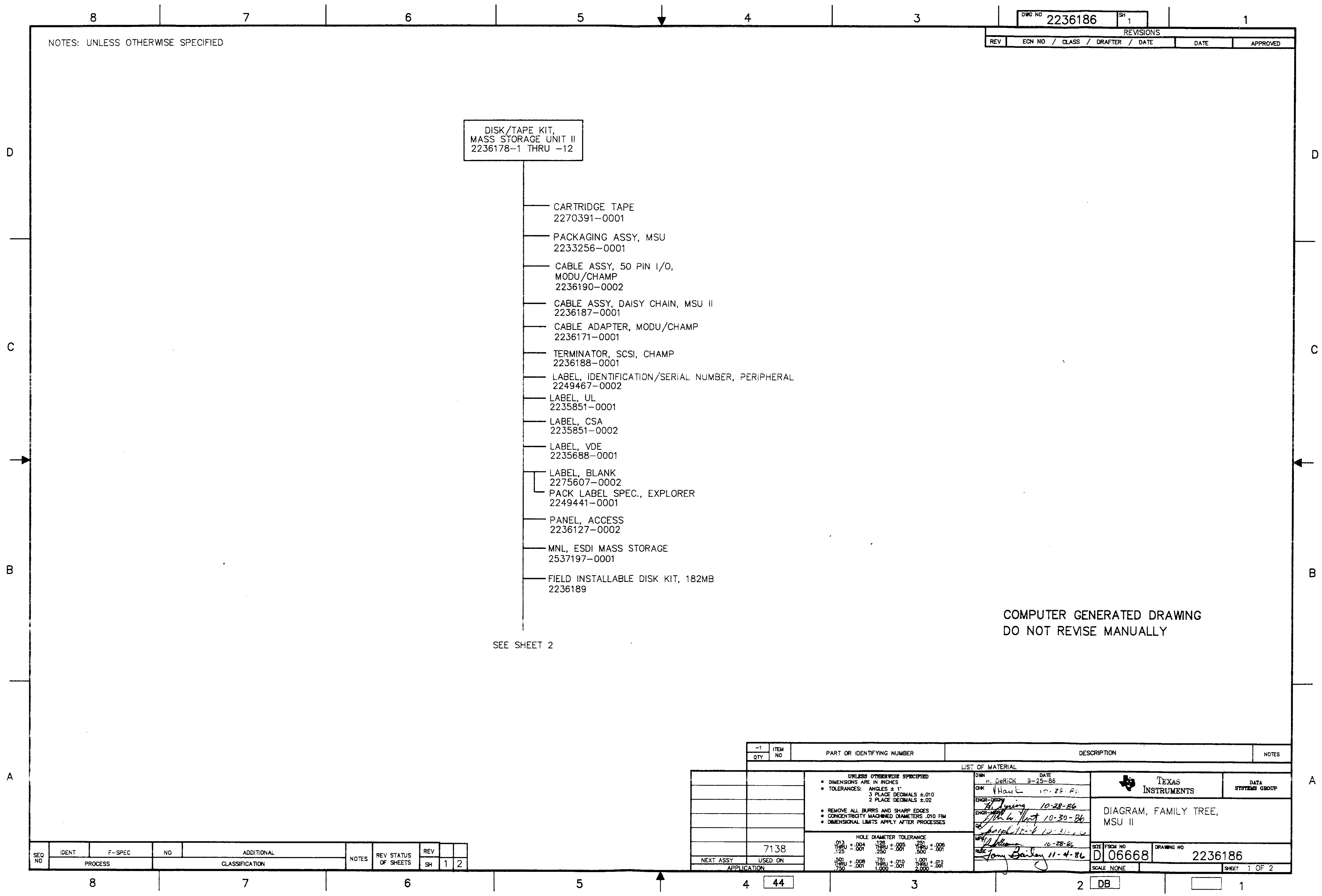
FAMILY TREE DRAWINGS

A

This appendix contains the following family tree drawings:

- Mass Storage Unit (MSU II) family tree, part number 2236186-0001

Figure A-1 Mass Storage Unit (MSU II) Family Tree, Part Number 2236186 (Sheet 1 of 2)



CONTENTS

COMMUNICATIONS CARRIER/OPTIONS SUBSYSTEM

1

Introduction

1.1 Refer to Section 7 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of this documentation kit for field maintenance information on the communications carrier/options subsystem components shown in Figures 1-1 and 1-2.

Figure 1-1 Communications Carrier/Options Subsystem

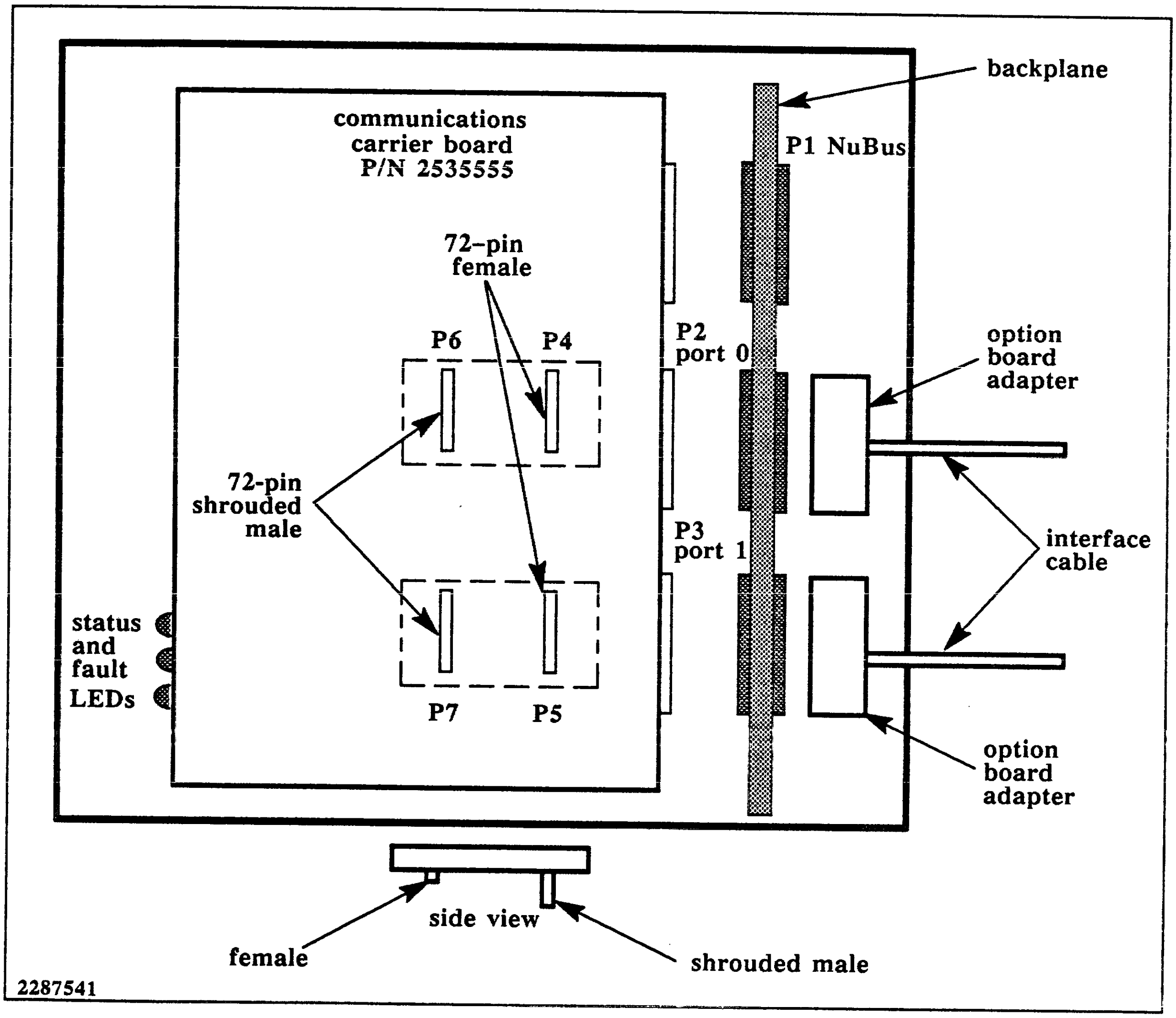
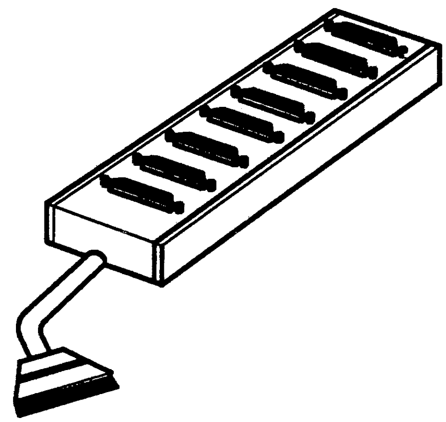


Figure 1-2 **8-Channel RS-232-C Connector Strip**



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Reference information

1.2 Table 1-1 lists reference information that provides additional technical information on the communications carrier/options subsystem:

Table 1-1 Reference Information

Category	Document	TI Part Number
Primary Documents	Explorer System Field Maintenance manual	2243141-0001
	System 1000 Series, Model 1500 Field Maintenance manual	2534849-0001
	Communications Carrier Board and Options General Description	2537242-0001
	System 1500 Diagnostics User's Guide	2540570-0001
Secondary Documents	Communications Carrier Board Assembly	2535555-0001
	Communications Carrier Board Logic Diagram	2535557-0001
	Communications Carrier Board Specification	2535559-0001
	4-Channel Async Option Board Assembly	2535560-0001
	4-Channel Async Option Board Logic Diagram	2535562-0001
	4-Channel Async Option Board Specification	2535564-0001
	4-Channel Async Adapter Assembly	2535565-0001
	4-Channel Async Adapter Logic Diagram	2535567-0001
	4-Channel Async Adapter Specification	2535569-0001

Table 1-1 Reference Information (Continued)

Category	Document	TI Part Number
Secondary Documents (Continued)	8-Channel Async Option Board Assembly	2535570-0001
	8-Channel Async Option Board Logic Diagram	2535572-0001
	8-Channel Async Option Board Specification	2535574-0001
	8-Channel Async Adapter Assembly	2535575-0001
	8-Channel Async Adapter Logic Diagram	2535577-0001
	8-Channel Async Adapter Specification	2535579-0001
	8-Channel RS-232-C Connector Strip Assembly	2537333-0001
	Multichannel Option Board Assembly	2535580-0001
	Multichannel Option Board Logic Diagram	2535582-0001
	Multichannel Option Board Specification	2535584-0001
	Multichannel Adapter Assembly	2535585-0001
	Multichannel Adapter Logic Diagram	2535587-0001
	Multichannel Adapter Specification	2535589-0001
	LANBOP Option Board Assembly	2535590-0001
	LANBOP Option Board Logic Diagram	2535592-0001
	LANBOP Option Board Specification	2535594-0001
	Ethernet Adapter Assembly	2535600-0001
	Ethernet Adapter Logic Diagram	2535602-0001
	Ethernet Adapter Specification	2535604-0001
	V.35 Adapter Assembly	2535605-0001
	V.35 Adapter Logic Diagram	2535607-0001
	V.35 Adapter Specification	2535609-0001
Diagnostic Software	System 1500 Diagnostics Tape	2540570-0001

Diagnostic Information

1.3 The communications carrier/options subsystem can be tested by the System 1500 diagnostics. The following four GDOS diagnostic programs are included for this purpose:

- CCB diagnostic program
- LAN option board diagnostic program
- Asynchronous communications board diagnostic program
- Synchronous communications board diagnostic program

Refer to the *System 1500 Diagnostics User's Guide* for details on the above diagnostic programs.

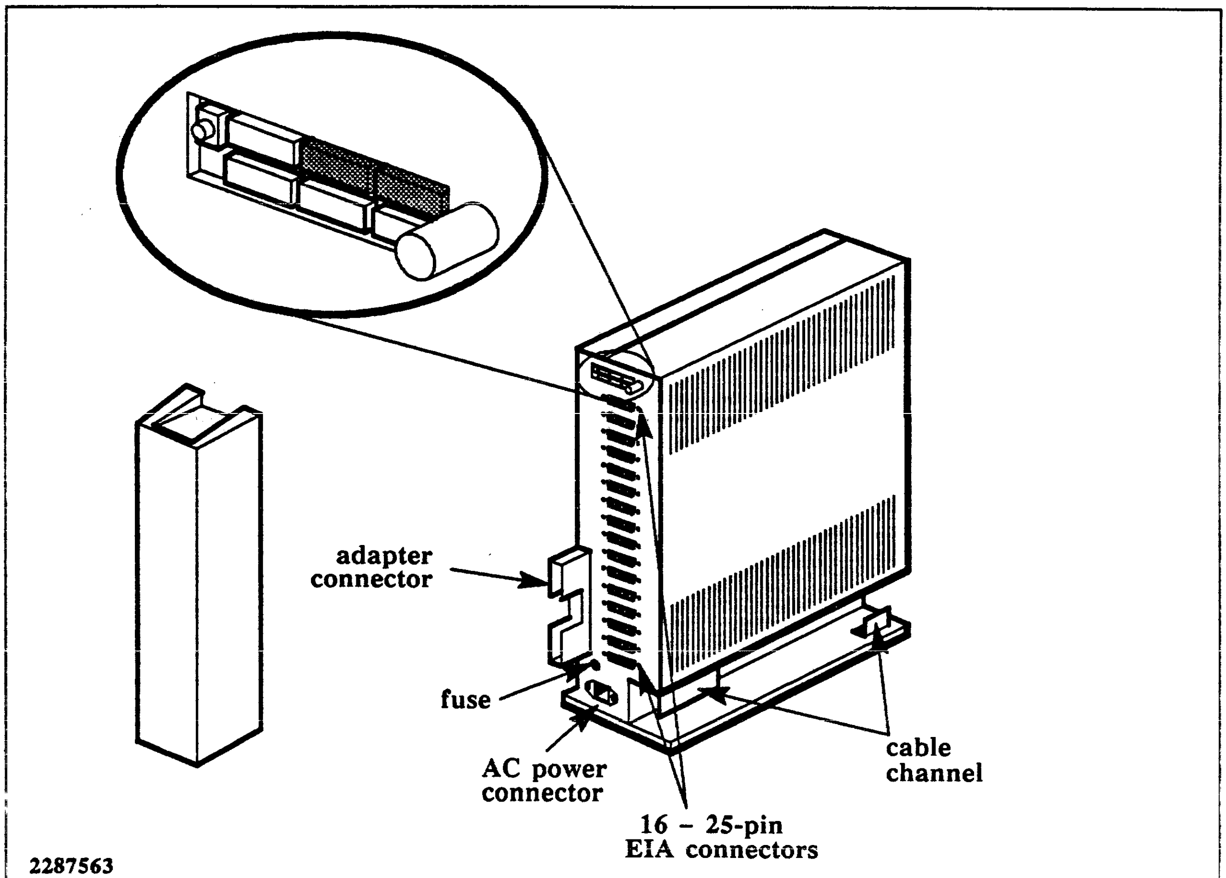
NETWORK TERMINAL CONCENTRATOR

2

Introduction

2.1 Refer to Section 8 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of this documentation kit for field maintenance information on the network terminal concentrator shown in Figure 2-1.

Figure 2-1 Network Terminal Concentrator



Reference Information

2.2 The following reference information provides additional technical information on the network terminal concentrator:

- *Explorer System Field Maintenance*, TI part number 2243141-0001
- *System 1000 Series, Model 1500 Field Maintenance*, TI part number 2534849-0001
- *Communications Carrier Board and Options General Description*, TI part number 2537242-0001
- *Terminal Concentrator Enclosure Assembly*, TI part number 2537305-0001 through -0003
- *Terminal Concentrator Board Assembly*, TI part number 2539000-0001
- *Terminal Concentrator Board Logic Diagram*, TI part number 2539002-0001
- *Terminal Concentrator Board Specification*, TI part number 2539004-0001
- *Terminal Concentrator Power Supply Assembly*, TI part number 2223037-0001

Diagnostic Information

2.3 The terminal concentrator board in the network terminal concentrator has its own self-test program. These self-tests run during the initial boot of the system. There are no other diagnostics for the network terminal concentrator.

LAN MAINTENANCE

3

Introduction

3.1 Refer to Section 11 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of this documentation kit for field maintenance information on devices connected to local area networks (LANs) as shown in Figure 3-1.

Reference Information

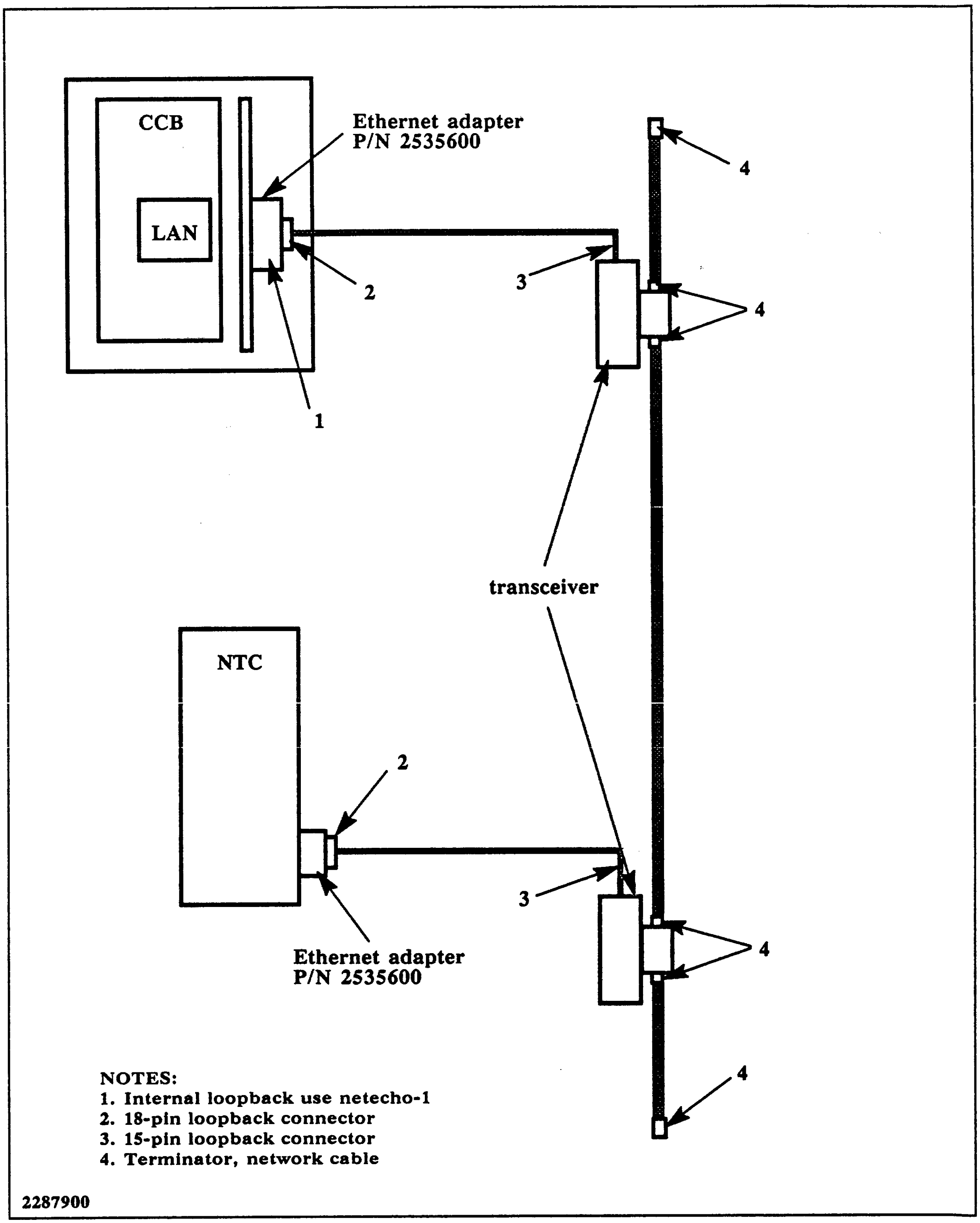
3.2 The following reference information provides additional technical information on the network terminal concentrator:

- *Explorer System Field Maintenance*, TI part number 2243141-0001
- *System 1000 Series, Model 1500 Field Maintenance*, TI part number 2534849-0001
- *Communications Carrier Board and Options General Description*, TI part number 2537242-0001
- *Explorer Communications User's Guide*, TI part number 2243206-0001
- *Explorer NuBus Ethernet Controller General Description*, TI part number 2243161-0001
- *990 Family Communications Systems Field Reference*, TI part number 2276579-9701
- *EI990 Ethernet Interface Installation and Operation*, TI part number 2234392-9701

Diagnostic Information

3.3 The LAN option board diagnostic program of the System 1500 diagnostics is used to test the LAN-connected devices when the communications carrier board (CCB) is used. The NEC diagnostics of the Explorer diagnostics are used to test the LAN-connected devices when the Explorer Ethernet controller is used. Refer to the *System 1500 Diagnostics User's Guide*, TI part number 2534850-0001, for details on using the LAN option board diagnostic program with the CCB. Refer to the *Explorer Diagnostics User's Guide*, TI part number 2533554-0001, for details on using the NEC diagnostics with the Explorer Ethernet controller.

Figure 3-1 LAN-Connected Devices



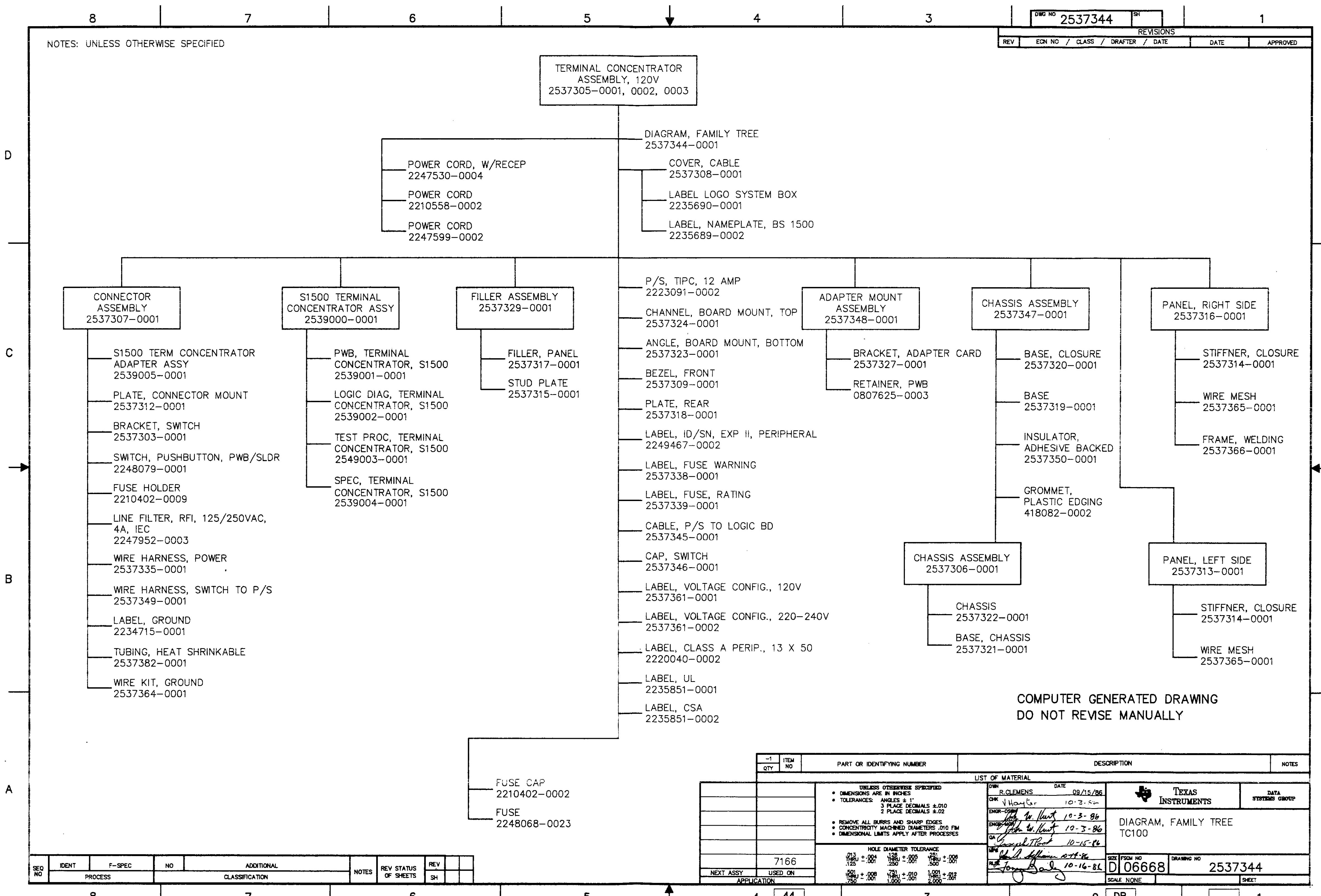
FAMILY TREE DRAWINGS

A

This appendix contains the following family tree drawings:

- Terminal Concentrator family tree, part number 2537344-0001

Figure A-1 Terminal Concentrator Family Tree, Part Number 2537344



CONTENTS

EXPLORER PADLESS MOUSE

1

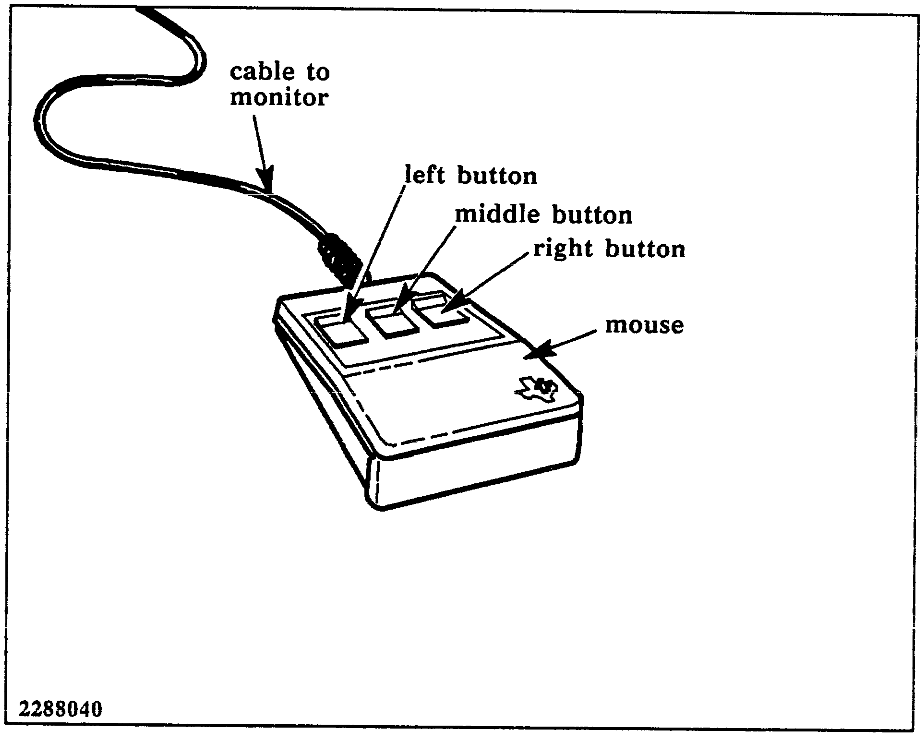
Introduction

1.1 This section covers the maintenance data for the padless mouse shown in Figure 1-1.

The mouse assembly contains a ball that freely rotates as the mouse assembly is moved over a flat surface. The ball mechanically drives two photoencoder wheels located at right angles to each other within the mouse assembly. The photoencoder wheels break the light path between LEDs and associated light detectors that generate pulse signals in a quadrature format, which are transmitted to the display monitor. The padless mouse assembly also contains three switches that are activated by three buttons. These buttons operate in the same manner as for the optical mouse presently being used in the Explorer system.

The resolution of the padless mouse is 320 dots-per-inch as opposed to 200 dots-per-inch for the presently used optical mouse. There are no restrictions on the orientation or movement of the padless mouse as there are for the optical mouse. The padless mouse has the same signals and connector pin arrangement as the optical mouse. It connects to the display monitor as an exact replacement for the optical mouse.

Figure 1-1 **Explorer Padless Mouse**



Specifications

1.2 Table 1-1 lists the general specifications of the padless mouse.

Table 1-1 **Padless Mouse Specifications**

Item	Specifications
Dimensions:	Length — 96.5 mm (3.8 in) Width — 68 mm (2.7 in) Height — 27 mm (1.1 in)
Cable length:	762 mm (30 in)
Temperature:	
Operating	10 to 35° C (50 to 95° F)
Storage	-40 to 65° C (-40 to 149° F)
Humidity:	10% to 90% noncondensing
Resolution:	320 dots per inch
Power:	5 Vdc (+/-5%) at 80 mA (supplied by the display monitor)

Maintenance Data

1.3 The padless mouse, TI part number 2235892-0001, is replaced as a whole unit when it is suspected of being faulty. The ball can be removed for cleaning by twisting the retaining clip on the bottom of the mouse assembly. The retaining clip and the ball drop out of the bottom of the mouse assembly when the retaining clip is turned to the proper position.

Clean the ball when necessary with warm water and a mild detergent.

Refer to *Explorer Diagnostics*, TI part number 2533554-0001, for details on testing the padless mouse. Use the Explorer diagnostic software on the disk or the Explorer Diagnostic Bootable Tape, TI part number 2537111-0001.

Reference Information

1.4 Refer to the following information for operation, troubleshooting, preventive maintenance, and corrective maintenance on the applicable Explorer display unit with the padless mouse:

- *Explorer System Field Maintenance*, TI part number 2243141-0001
- *Explorer Display Unit General Description*, TI part number 2243141-0001
- *CRT Data Display Service Manual*, Panasonic code number FTD85055057C, TI part number 2243141-0001
- *LOGIMOUSE P-7, User Documentation and Specifications*, LOGITECH, INC., 805 Veterans Blvd., Redwood City, California 94063

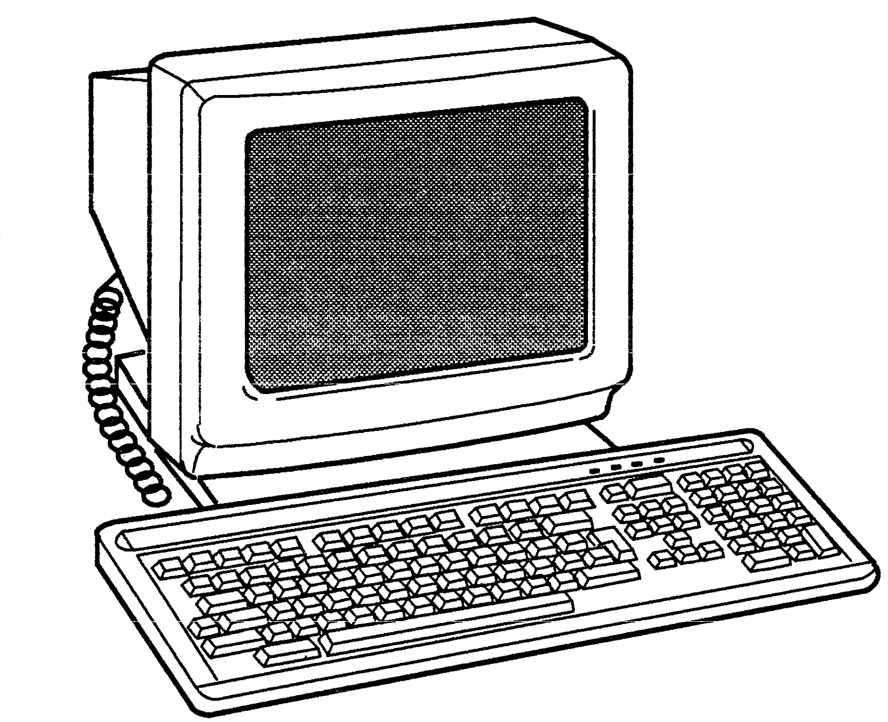
MODEL 924 VIDEO DISPLAY TERMINAL

2

Introduction

2.1 Refer to Section 9 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of this documentation kit for field maintenance information on the Model 924 Video Display Terminal shown in Figure 2-1.

Figure 2-1 **Model 924 Video Display Terminal**



2287684

Reference Information

2.2 Refer to the following information for operation, troubleshooting, preventive maintenance, and corrective maintenance on the applicable Explorer display unit with the padless mouse:

- *Explorer System Field Maintenance,* TI part number 2243141-0001
- *System 1000 Series, Model 1500 Field Maintenance,* TI part number 2534849-0001
- *Model 924 Video Display Terminal User's Guide,* TI part number 2544365-0001
- *Model 924 Video Display Terminal Maintenance Manual,* TI part number 2540724-0001

COLOR CONSOLE SUBSYSTEM

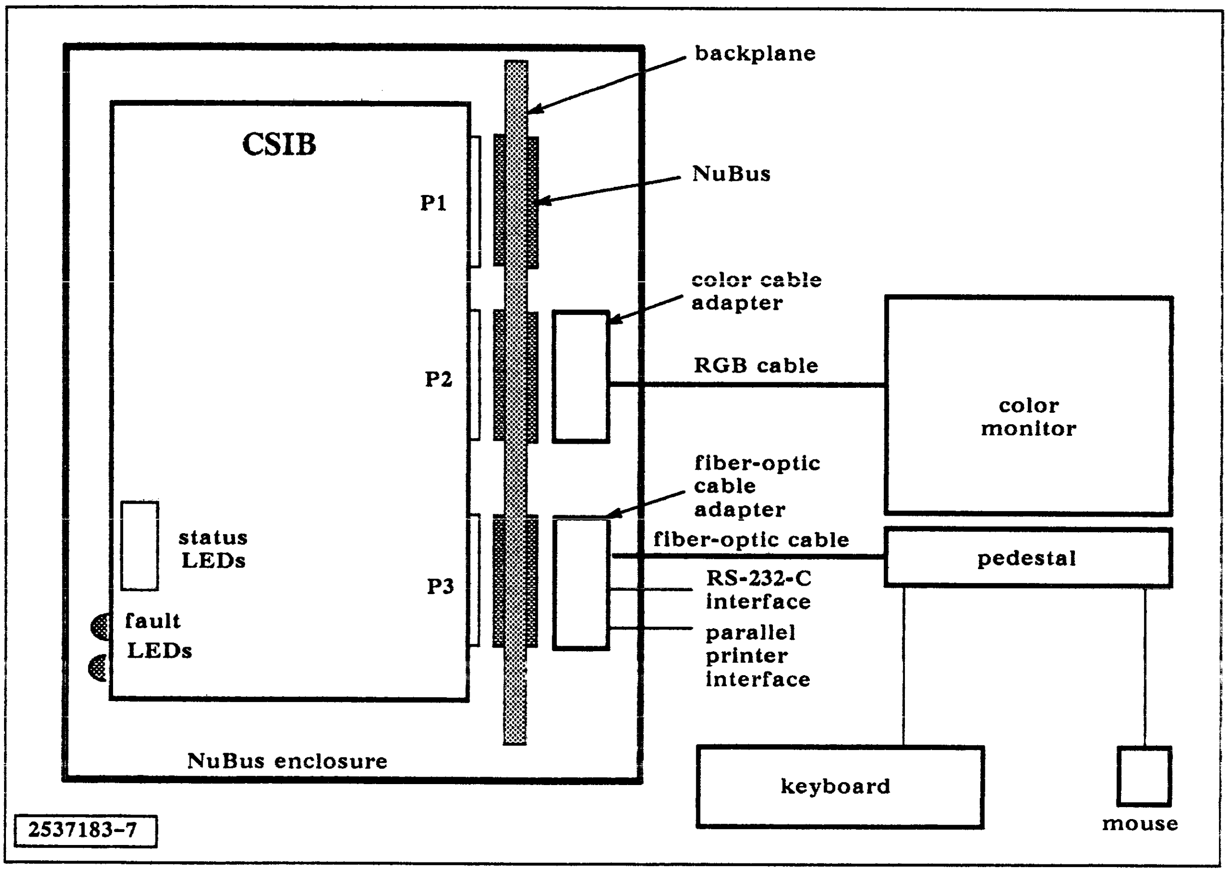
3

Introduction

3.1 This section presents the field maintenance information for the color console subsystem (Figure 3-1) under the following headings:

- Reference information
- Troubleshooting information
- Component replacement

Figure 3-1 Explorer Color Console Subsystem



Reference Information

3.2 The reference information in Table 3-1 provides additional technical data on the color system.

Table 3-1 Reference Information

Category	Document	TI Part Number
Primary Documents	Explorer System Field Maintenance	2243141-0001
	Explorer Color Console General Description	2537195-0001
	Explorer Color System Interface Board General Description	2537189-0001
	TRINITRON Graphic Display Monitor GDM-1603 Service Manual, Sony part number 0-558-986-01	2551107-0001
	Color Monitor Family Tree	2549619-0001
	Explorer Color System Interface Board Assembly	2534330-0001
	Explorer Color System Interface Board Logic Diagram	2534332-0001
	Explorer Color System Interface Board Specification	2534334-0001
	Explorer Color Adapter Assembly	2534335-0001
	Explorer Color Adapter Logic Diagram	2534337-0001
	Explorer Color Adapter General Description	2534339-0001
	Explorer Fiber Optic Adapter II Assembly	2534340-0001
	Explorer Fiber Optic Adapter II Logic Diagram	2534342-0001
	Explorer Fiber Optic Adapter II General Description	2534344-0001
	Color Monitor Base Assembly	2549620-0001
	Power Supply Assembly (Color Monitor Base)	2549605-0001
	Power Supply Logic Diagram	2549607-0001
	Power Supply Specification	2549609-0001
	Monitor Electronics Assembly (Color Monitor Base)	2236663-0001
	Monitor Interface Board Assembly	2236650-0001
	Monitor Interface Board Logic Diagram	2236652-0001
	Monitor Interface Board Specification	2236579-0001
	Phase-Locked Loop Board Assembly	2236655-0001
	Phase-Locked Loop Board Logic Diagram	2236584-0001
	Phase-Locked Loop Board Specification	2236584-0001
	Color RGB Cable Assembly 3.0 m (10 ft)	2549987-0003
	Color RGB Cable Assembly 8.6 m (28 ft)	2549987-0004
	Fiber-Optic Cable (standard) 15.0 m (50 ft)	2233200-0001
	Power Cord (120 V)	2247530-0006
	Power Cord (220V)	2210558-0001
	Power Cord (240 V)	2247599-0001
	Power Cord (convenience outlet)	2247530-0005

Table 3-1 Reference Information (Continued)

Category	Document	TI Part Number
Secondary Documents	Padless Mouse	2235892-0001
	Keyboard Assembly (Explorer II)	2241330-0002
	Explorer Color Subsystem Specification	2549991-0001
	Explorer Color System Interface Firmware Specification	2534350-0001
	Explorer NuBus System Architecture General Description	2537171-0001
	High-Resolution Color Monitor Specification	2534328-0001
	High-Resolution Monochrome Monitor Specification	2236586-0001
	Low-Profile Keyboard Specification	2241327-0001
	Explorer System Specification	2236600-0001
	NuBus System Architecture Specification	2536702-0001
Diagnostic Software	Explorer Diagnostics Bootable Tape	2537711-0001
	System 1500 Diagnostics Tape	2540570-0001

Troubleshooting Information

3.3 Fault isolation and verification of repair of the color console subsystem are accomplished primarily by the loadable diagnostics and the following troubleshooting information:

- Refer to the System Troubleshooting (ST) part of this supplement for system level troubleshooting of the color console subsystem. The ST part is divided into the following sections:
  - Section 1, Explorer systems hardware summary
  - Section 2, Explorer systems software summary
  - Section 3, Explorer systems diagnostics summary
  - Section 4, Explorer systems troubleshooting
- Refer to Figure 3-2, Color Console Subsystem Troubleshooting Flowchart, for troubleshooting guidelines.
- Refer to Figure 3-3, Monitor Interface Board and Fiber-Optic Cable Adapter Interconnect diagram, for signal interconnect information.
- Refer to the TRINITRON Graphic Display Monitor GDM-1603 Service Manual, Sony part number 0-558-986-0, TI part number 2551107-0001, for service information on the color monitor.

To test the color console, use the General Diagnostic Operating System (GDOS). To use GDOS, proceed as follows:

1. Reboot the system so that the self-tests run; then, enter G to boot GDOS. The top-level GDOS menu is now displayed.

2. On the top level GDOS menu, place the cursor on item 3 — `Enter menu for Extended-Interactive Diagnostic Mode` — and press RETURN. The Extended-Interactive Diagnostic menu is now displayed. Check that the cursor is on item 1 — `Load a Diagnostic by Menu or Name and Show its Menu` — and press RETURN. The Diagnostic Load menu is now displayed.

3. Place the cursor on the item for the `Color System Interface Board diagnostic` and press RETURN. The color system main menu shown is now displayed.

4. Refer to the color system diagnostic tests in paragraph 4.9 of the ST part of this manual for the color system main menu and a list of interactive and noninteractive tests for the color system.

5. For more details on diagnostics, refer to the *Explorer Diagnostics* manual and the Explorer online diagnostics.

Component Replacement

3.4 The following reference information provides additional technical information on the color console:

- Color monitor replacement
- Pedestal component replacement procedures

Table 3-2 **Color Console Replacement Components**

Component Description	Part Number
Color monitor assembly	2534328-8001
CSIB	2534330-8001
Mouse	2235892-8001
Keyboard	2241332-0002
Keyboard cable	2235822-0001
Color cable adapter	2534335-0001
Fiber-optic cable adapter II	2534340-0001
Fiber-optic cable, 15 m (50 ft)	2233200-0001
RGB cable, 3 m (10 ft)	2549987-0003
RGB cable, 8.6 m (28 ft)	2549987-0004
Power cord, 120-volts, 2 m (6.5 ft)	2247530-0006
Power cord, 220-volts, 2.5 m (8 ft)	2210558-0001
Power cord, 240-volts, 2.5 m (8 ft)	2247599-0001
Power cord (pedestal convenience outlet)	2247530-0005
Pedestal assembly	2549620-0001
Power supply	2549605-8001
Power module	2549617-0001
Line filter	2549982-0001
Monitor electronics assembly	2236663-8001
Keyboard/microphone cable	2549976-0001
Speaker/volume control cable	2549978-0001
Mouse/headset cable	2549977-0001
AC power cable	2549624-0001
DC power cable	2549625-0001

Color Monitor Replacement

3.4.1 This procedure explains how to remove and install the color monitor on the pedestal.

1. Set the ac power switches on the monitor and the pedestal (Figure 3-4) to the off (0) position.
2. Disconnect the ac power cord at the wall outlet and at the rear of the pedestal (Figure 3-5).
3. Disconnect and remove the short ac power cord between the monitor and the pedestal.
4. Disconnect the keyboard and the mouse from the pedestal.
5. Disconnect the headset and microphone (if used) from the pedestal.

Figure 3-4 Color Console Front View Operating Controls

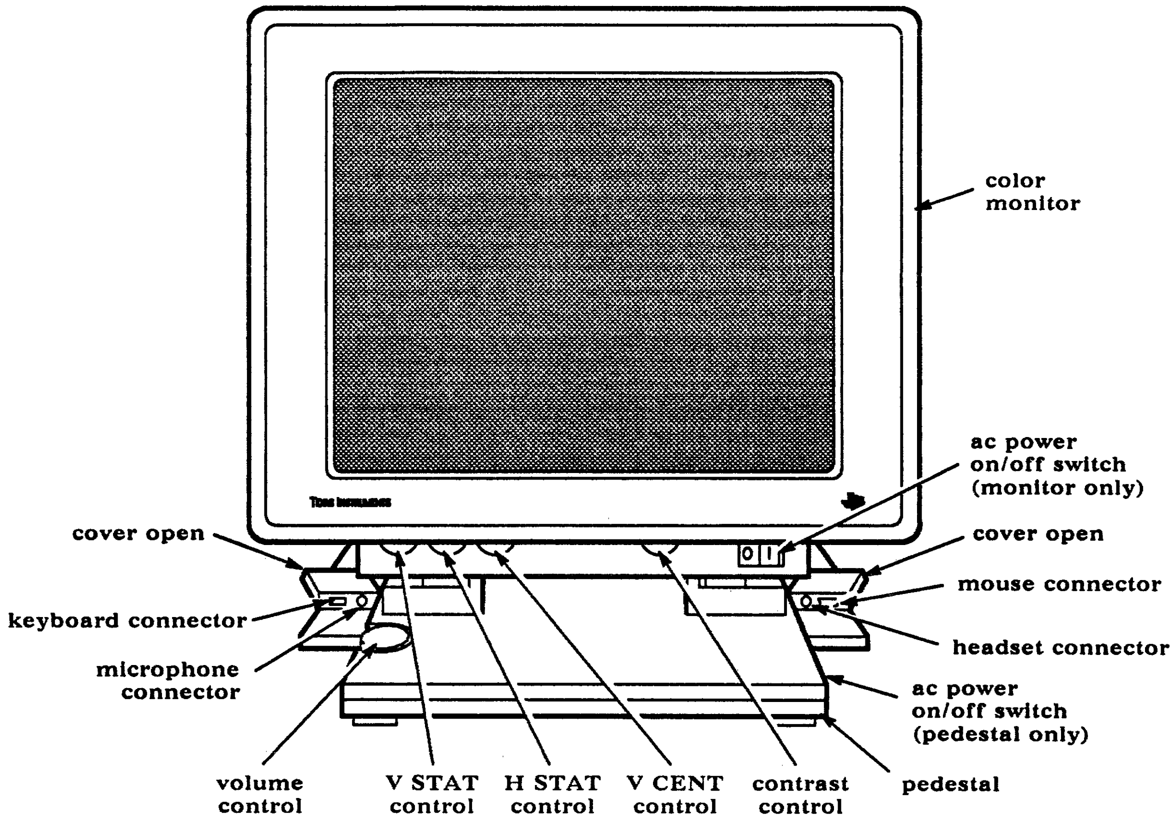


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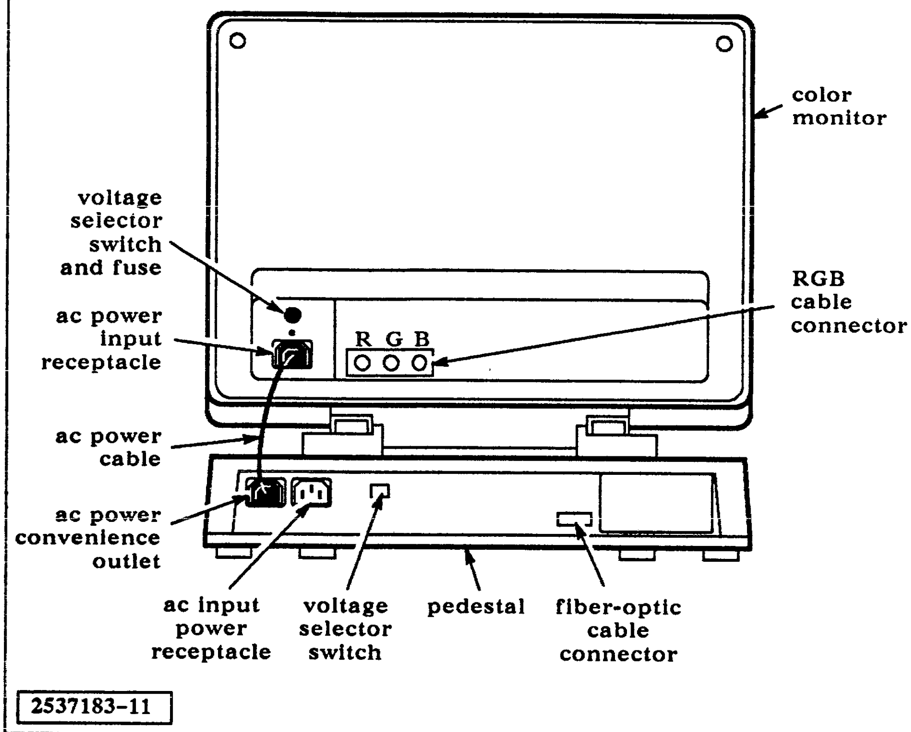
Figure 3-5 Color Console Rear View Operating Controls



WARNING: The color monitor without the pedestal weighs approximately 26.5 kg (58 lb). When lifting or moving the monitor, be sure there are two persons available who are in the proper physical condition to perform the lifting or moving tasks.

---

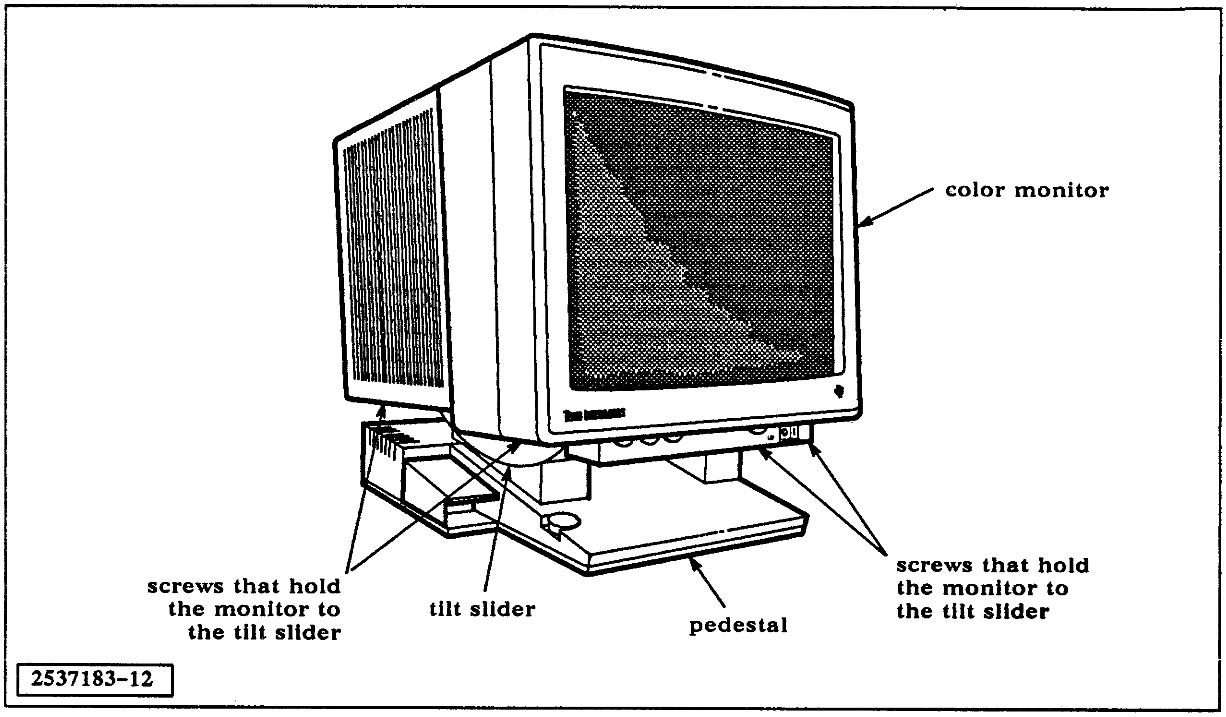
6. Using a 90-degree-angle Phillips head screwdriver, remove the four screws (Figure 3-6) that hold the monitor to the tilt slider on the pedestal; then, lift the monitor off of the pedestal. Lay the monitor on its side on top of a piece of foam insulation to prevent damage to the monitor.

7. Before installing the new monitor, perform the following:

   a. Remove the new monitor from its shipping box, and lay the monitor on its side on top of a piece of foam insulation to prevent damage to the monitor. Note that the slider and mounting hardware in the shipping box are not used.

   b. Remove the four plastic feet from the base of the new monitor and install them on the old monitor, then place the old monitor in the shipping box that the new monitor was shipped in. Leave the slider and mounting hardware in the shipping box with the old monitor. Do not seal the shipping box until you have installed and checked out the operation of the new monitor. If the new monitor operates properly, then return the old monitor to Texas Instruments.

Figure 3-6 Mounting the Color Monitor on the Pedestal



8. Set the new or existing monitor on the tilt mechanism on top of the pedestal. Install the four Phillips-head screws that were removed in step 6 to secure the monitor to the tilt mechanism.

9. Connect the short ac power cord removed in step 3 between the monitor and the pedestal.

10. Check that the voltage selector setting and the fuse on the rear of the monitor are correct for the ac input voltage at your site. You should have a 4-ampere, 125 V fuse for 115-volt site power, or a time-delay or time-lag T3.15-ampere, 250 V fuse for 220-volt site power.

11. Connect the ac power cord removed in step 2 to the wall outlet and to the receptacle on the rear of the pedestal.

12. Connect the keyboard and mouse to the pedestal.

13. Check the operation of the monitor and the pedestal by performing the applicable system self-tests, extended self-tests, and diagnostic procedures.

Pedestal Component Replacement Procedures

3.4.2 These procedures explain how to remove and install the field replaceable components in the pedestal. The following procedures provide detailed instructions for replacing the field replaceable components:

- Bottom plate assembly removal and installation
- Power supply replacement
- Monitor electronics assembly replacement
- Power module and line filter replacement
- Cable replacement

Bottom Plate Assembly Removal and Installation

3.4.2.1 This procedure explains how to remove and install the bottom plate assembly in the pedestal. Refer to Figures 3-7 and 3-8.

1. Set the ac power switches on the monitor and the pedestal to the off (0) position.

2. Disconnect the ac power cord at the wall outlet and at the rear of the pedestal.

3. Disconnect and remove the short ac power cord between the monitor and the pedestal.

4. Using a medium-sized flat-bladed screwdriver, pry up under the volume control knob to slide this knob off the shaft of the volume control.

WARNING: The color monitor with the pedestal weighs approximately 34 kg (75 lb). When lifting or moving the monitor, be sure there are two persons available who are in the proper physical condition to perform the lifting or moving tasks.

---

5. Lay the monitor with pedestal on its side with a foam pad under the monitor to prevent damage to the monitor.

6. Using a TORX® T-10 torque driver, remove the four TORX-head screws and rubber feet that secure the bottom cover to the pedestal.

7. Using a 1/4-inch hex nut driver, remove the two hex nut screws that secure the bottom cover to the pedestal.

8. Lift the bottom cover and the bottom plate assembly from the pedestal.

9. Install the new bottom plate assembly in the reverse order that it was removed.

TORX is a registered trademark of Textron, Inc.

10. Check the operation of the monitor and the pedestal by performing the applicable system self-tests, extended self-tests, and diagnostic procedures.

Figure 3-7 Bottom Plate Assembly

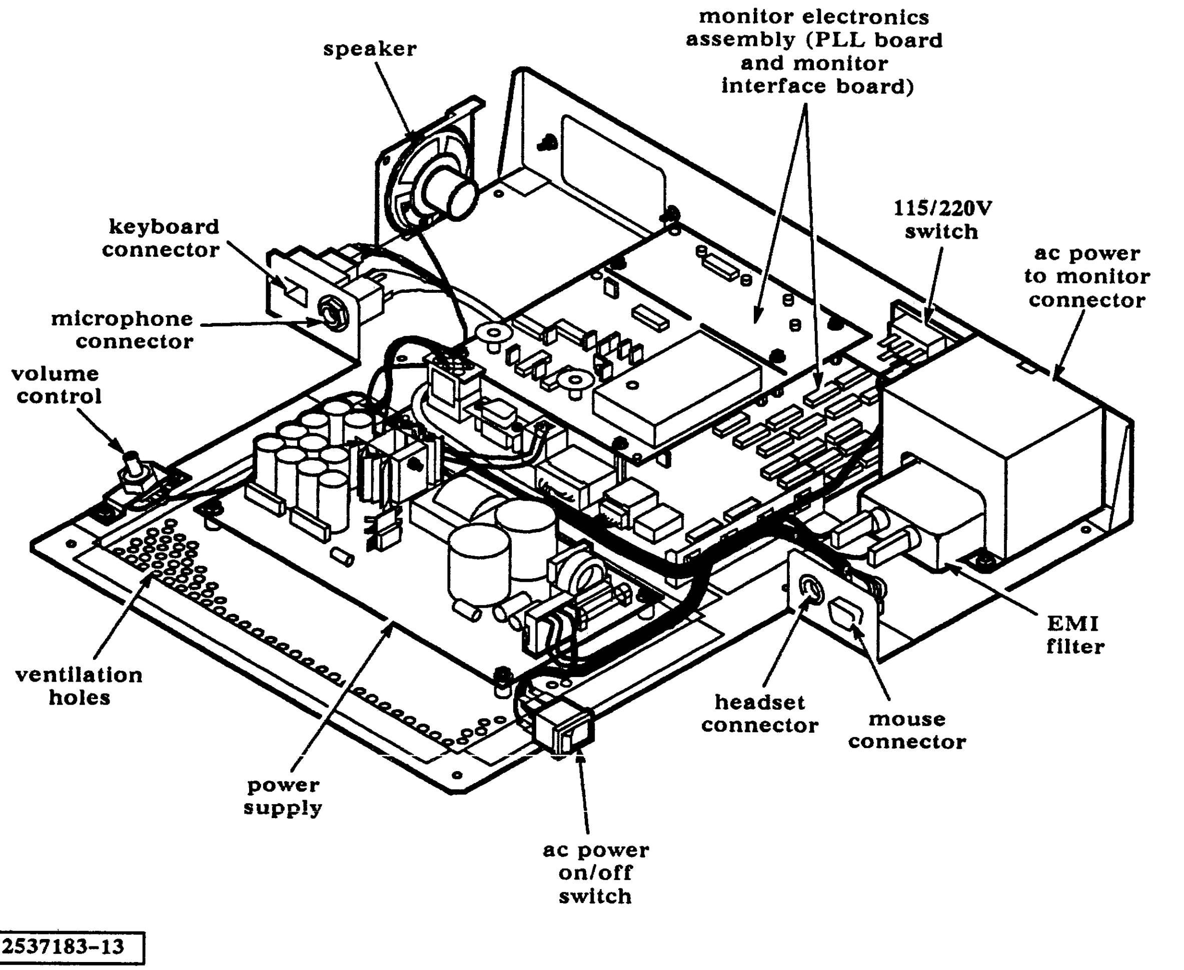


Figure 3-8 Pedestal Exploded View

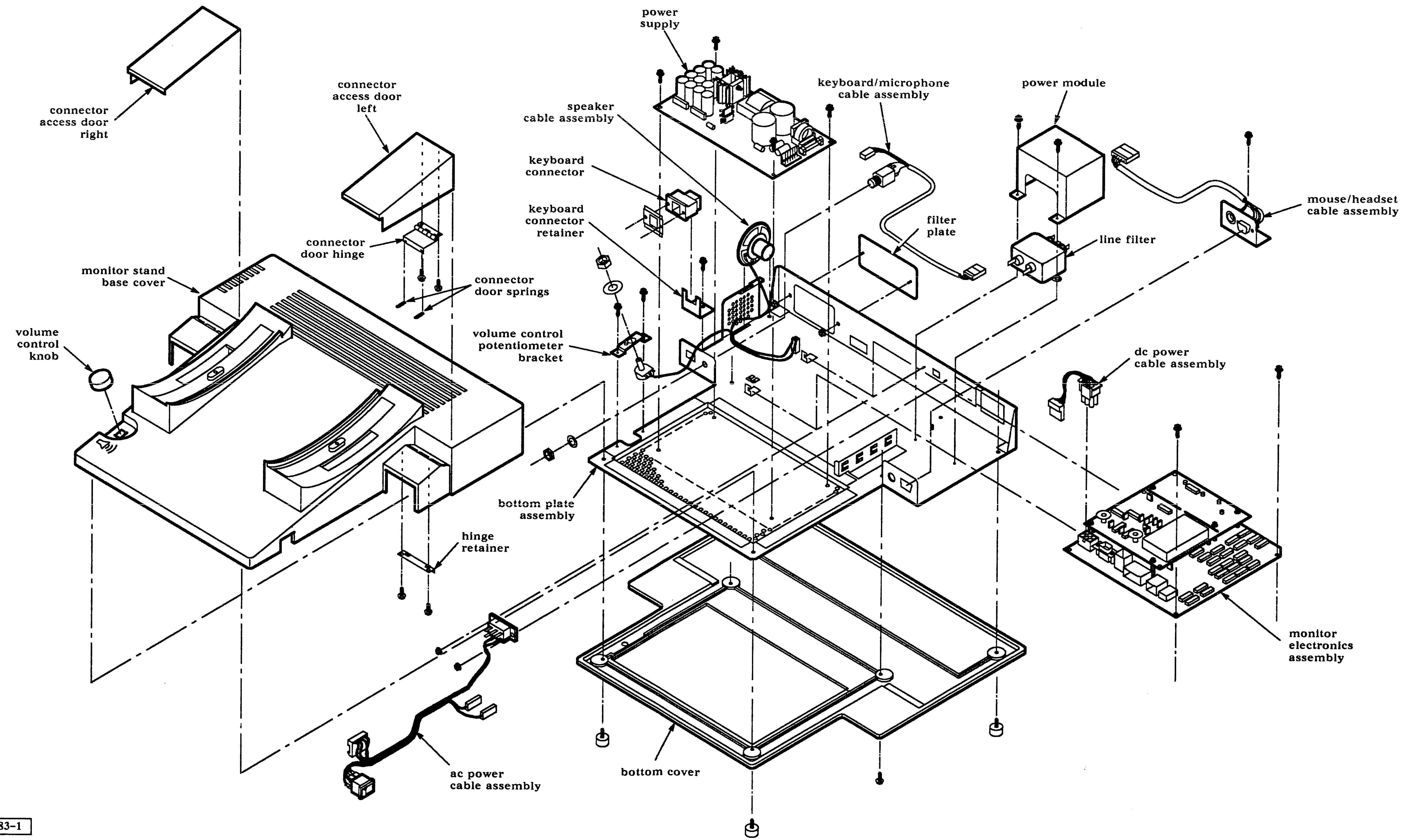


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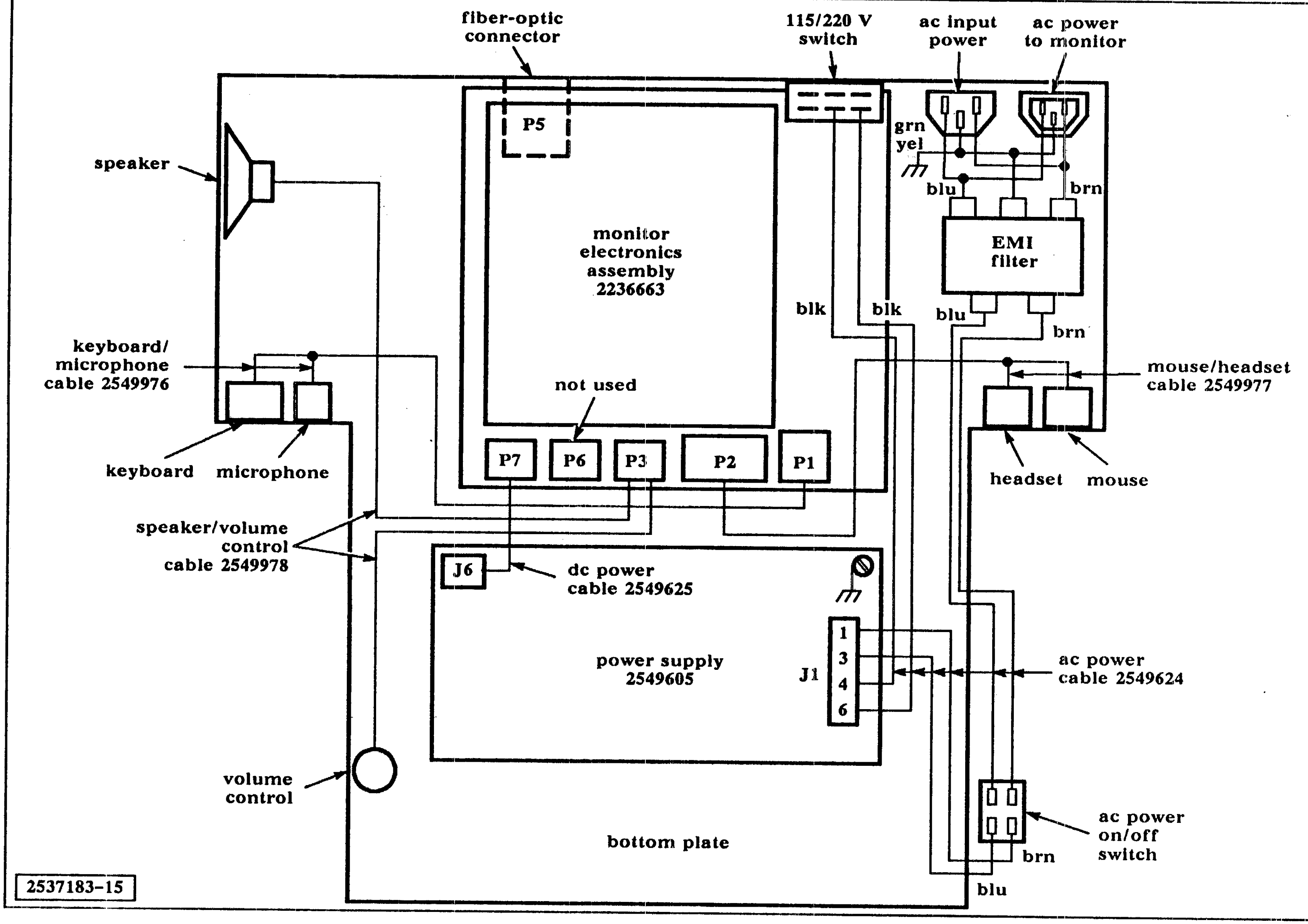
Figure 3-9 Pedestal Interconnect Diagram



Power Module and Line Filter Replacement

3.4.2.4 This procedure explains how to remove and install the power module and the line filter in the pedestal. Refer to Figures 3-7, 3-8, and 3-9 as necessary to perform this procedure.

1. Remove the bottom plate assembly from the pedestal using the instructions in paragraph 3.4.2.1.

2. Pull the blue and brown leads of the ac power cable assembly, part number 2549624-0001, from the line filter.

3. Using a 1/4-inch hex nut driver, remove the two screws that secure the power module and the line filter to the bottom plate assembly.

4. Hold the power module to the side while you remove the nut from under the power module that secures the green/yellow ground lead to the bottom plate assembly. Lift the power module and the line filter, which are connected together by three leads, from the bottom plate assembly.

5. Pull the blue, yellow, and brown leads from the line filter.

6. Install the new power module and line filter in the reverse order that they were removed. Make sure all leads are connected as shown in Figure 3-9.

7. Check the operation of the monitor and the pedestal by performing the applicable system self-tests, extended self-tests, and diagnostic procedures.

Cable Replacement

3.4.2.5 This procedure explains how to remove and install the cables in the pedestal. Refer to Figures 3-7, 3-8, and 3-9 as necessary to perform these procedures.

1. Remove the bottom plate assembly from the pedestal using the instructions in paragraph 3.4.2.1.

2. Use the following procedure to replace the dc power cable assembly, part number 2549625-0001:

   a. Unplug the dc power cable from connector P7 on the monitor electronics assembly and connector J6 on the power supply and remove the cable assembly.

   b. Install the new dc power cable in the reverse order that it was removed.

   c. Check the operation of the monitor and the pedestal by performing the applicable system self-tests, extended self-tests, and diagnostic procedures.

3. Use the following procedure to replace the ac power cable assembly, part number 2549624-0001:

   a. Unplug the ac power cable from connector J1 on the power supply.

   b. Remove the screws that secure the 115/220-volt switch to the rear of the bottom plate assembly.

   c. Pull the blue and brown leads from their terminals on the line filter, and remove the cable assembly.

   d. Install the new ac power cable in the reverse order that it was removed.

   e. Check the operation of the monitor and the pedestal by performing the applicable system self-tests, extended self-tests, and diagnostic procedures.

4. Use the following procedure to replace the speaker/volume control cable assembly, part number 2549978-0001:

   a. Unplug the speaker/volume control cable assembly from connector P3 on the monitor electronics assembly.

   b. Using a 1/4-inch hex nut driver, remove the screw that secures the keyboard connector retainer to the bottom plate assembly.

   c. Using a 1/4-inch hex nut driver, remove the two screws that secure the cable to the volume control.

   d. Remove the screw that holds the speaker in its slot; then, slide the speaker out of its slot and remove the cable.

   e. Install the new speaker/volume control cable assembly in the reverse order that it was removed.

   f. Check the operation of the monitor and the pedestal by performing the applicable system self-tests, extended self-tests, and diagnostic procedures.

5. Use the following procedure to replace the mouse/headset cable assembly, part number 2549977-0001:

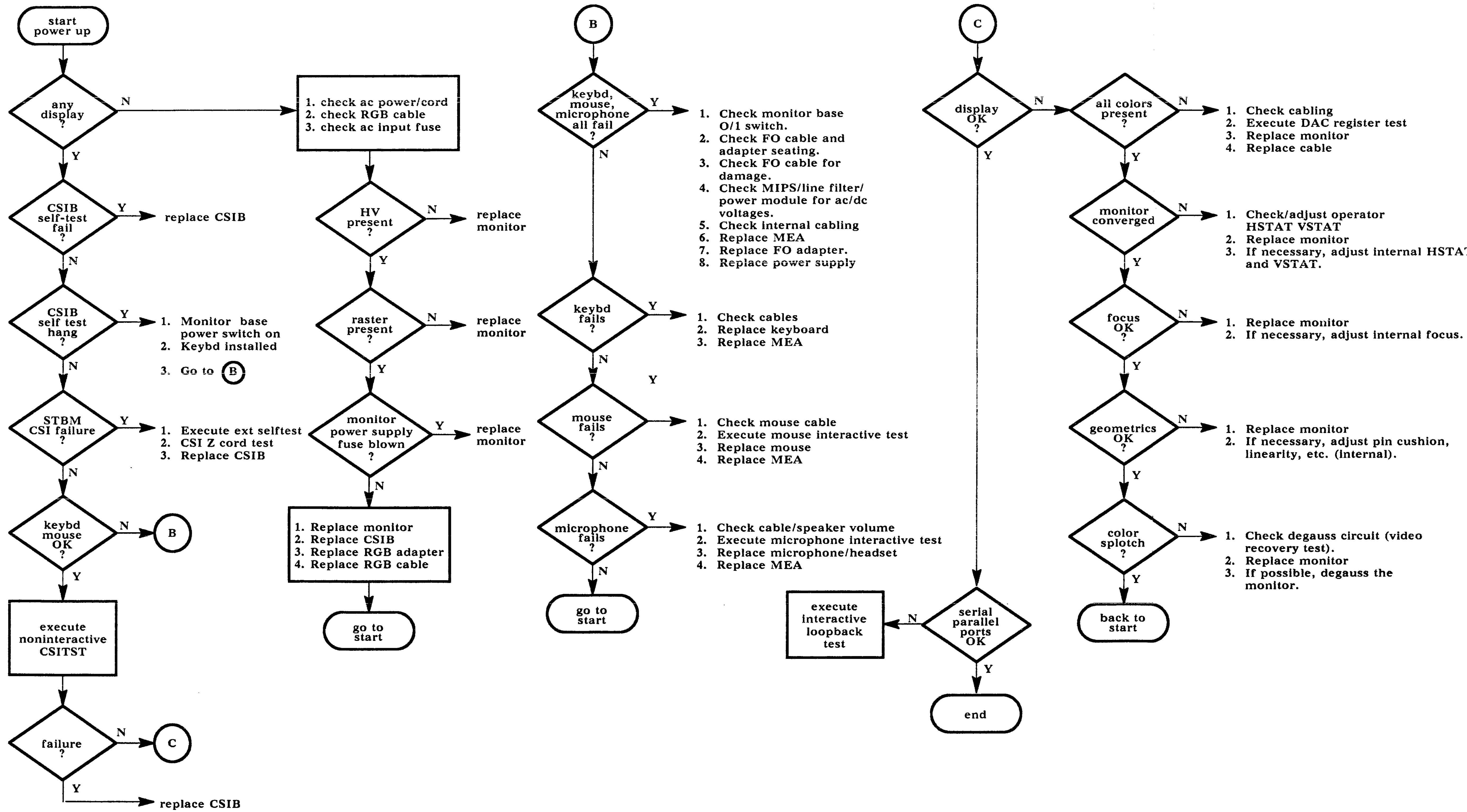
   a. Unplug the mouse/headset cable assembly from connector P2 on the monitor electronics assembly.

   b. Using a 1/4-inch hex nut driver, remove the screw that secures the mouse/headset connector retainer to the bottom plate assembly, and remove the cable assembly.

   c. Install the new mouse/headset cable assembly in the reverse order that it was removed.

   d. Check the operation of the monitor and the pedestal by performing the applicable system self-tests, extended self-tests, and diagnostic procedures.

Figure 3-2 Color Console Subsystem Troubleshooting Flowchart



2537183-8

FAMILY TREE DRAWINGS

A

This appendix contains the following family tree drawings:

- Keyboard family tree, part number 2241340-0001
- Color Monitor family tree, part number 2549619-0001

Figure A-2 Color Monitor Family Tree, Part Number 2549619-0001

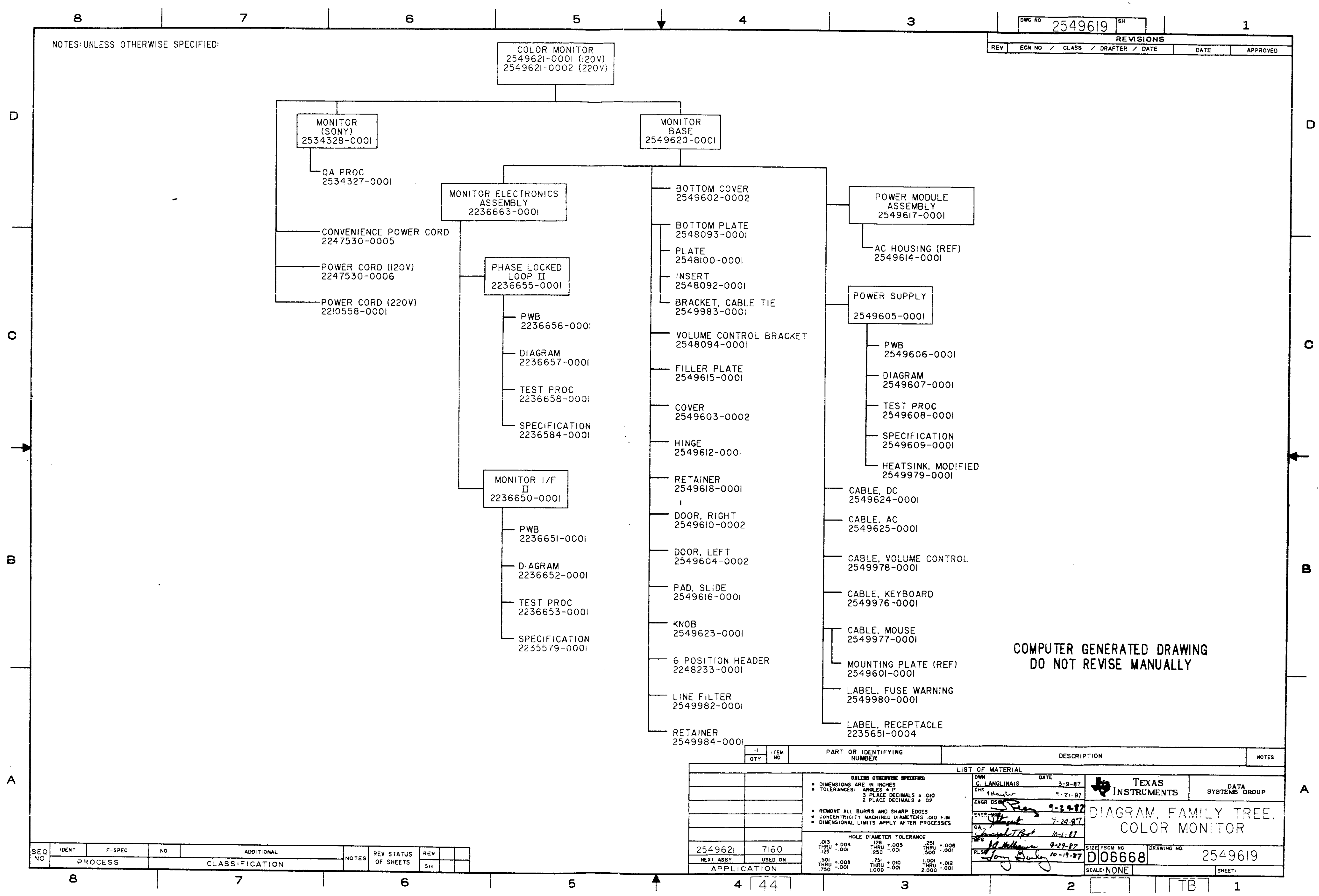
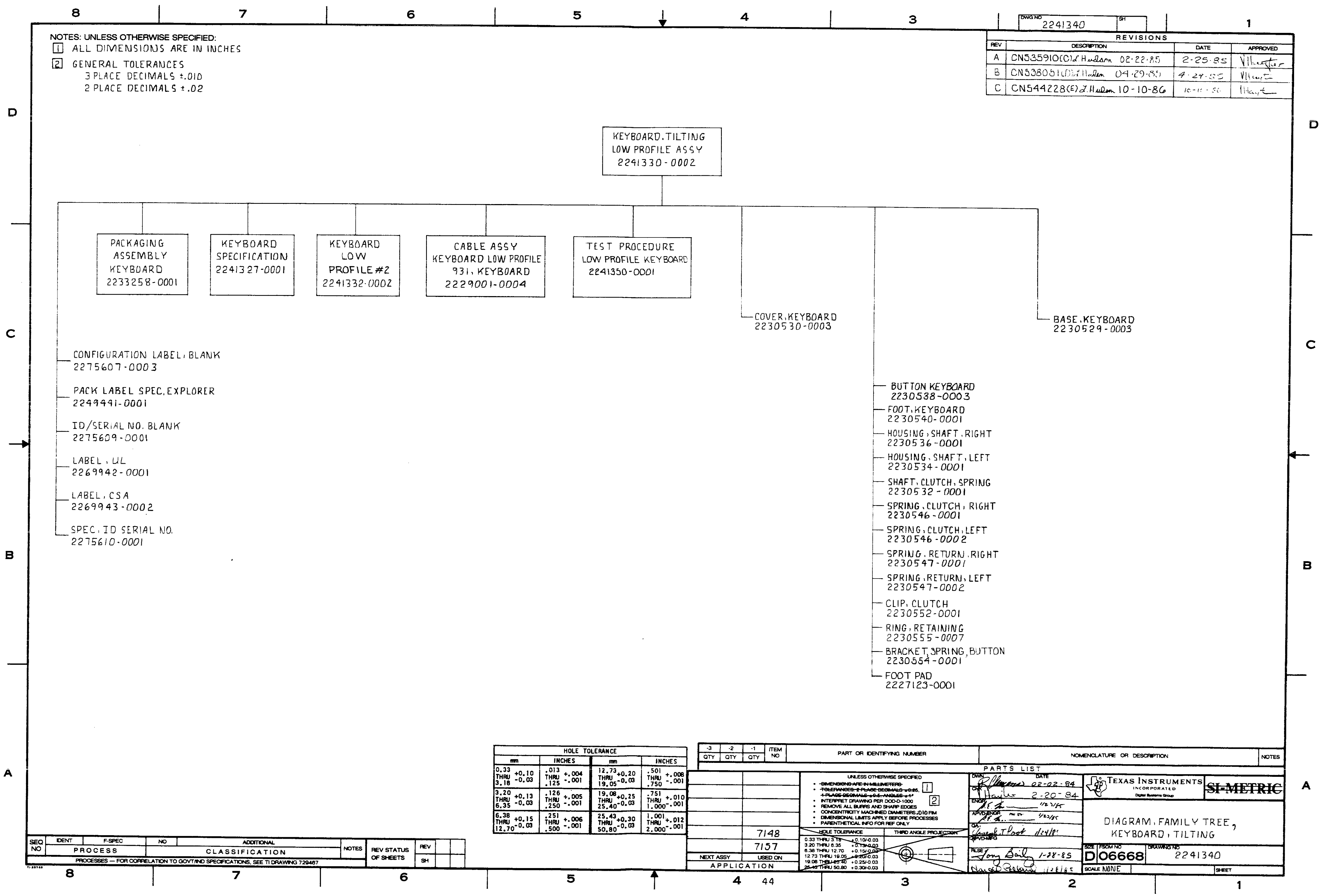


Figure A-1 Keyboard Family Tree, Part Number 2241340



CONTENTS

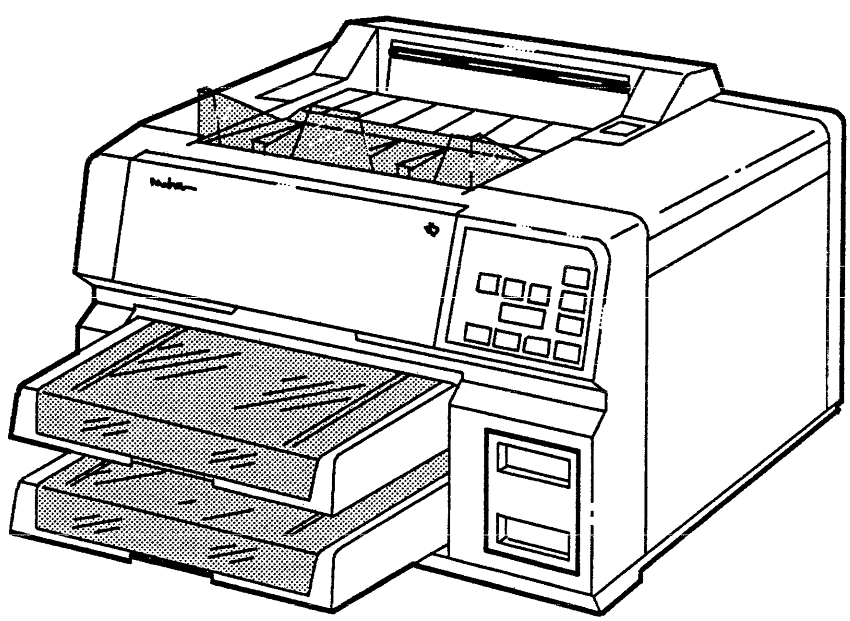
PRINTER EQUIPMENT

1

Introduction

1.1 Refer to Section 10 in the *System 1000 Series, Model 1500 Field Maintenance* manual in part RD of of this documentation kit for field maintenance information on general printer equipment. Figure 1-1 shows a typical OmniLaser page printer. Refer to the applicable reference documents for maintenance information on the OmniLaser printers.

Figure 1-1 Typical OmniLaser Page Printer



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Reference Information

1.2 Refer to the following information for operation, troubleshooting, preventive maintenance, and corrective maintenance on the applicable OmniLaser page printers:

- *OmniLaser Maintenance Training Student Guide*, TI part number 2238234-0001
- *OmniLaser 2015 Video Instruction Tape*, TI part number 2238236-0001
- *OmniLaser 2015 Page Printer Operator's Manual*, TI part number 2539178-0001
- *OmniLaser 2015 Page Printer Technical Reference Manual*, TI part number 2539179-0001
- *OmniLaser 2015 Page Printer Maintenance Manual*, TI part number 2539180-0001
- *OmniLaser 2108 Page Printer Operator's Manual*, TI part number 2546348-0001
- *OmniLaser 2108 Page Printer Technical Reference Manual*, TI part number 2546349-0001
- *OmniLaser 2108 Page Printer Maintenance Manual*, TI part number 2546350-0001
- *OmniLaser 2115 Page Printer Operator's Manual*, TI part number 2546344-0001
- *OmniLaser 2115 Page Printer Technical Reference Manual*, TI part number 2546345-0001
- *OmniLaser 2115 Page Printer Maintenance Manual*, TI part number 2546346-0001

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