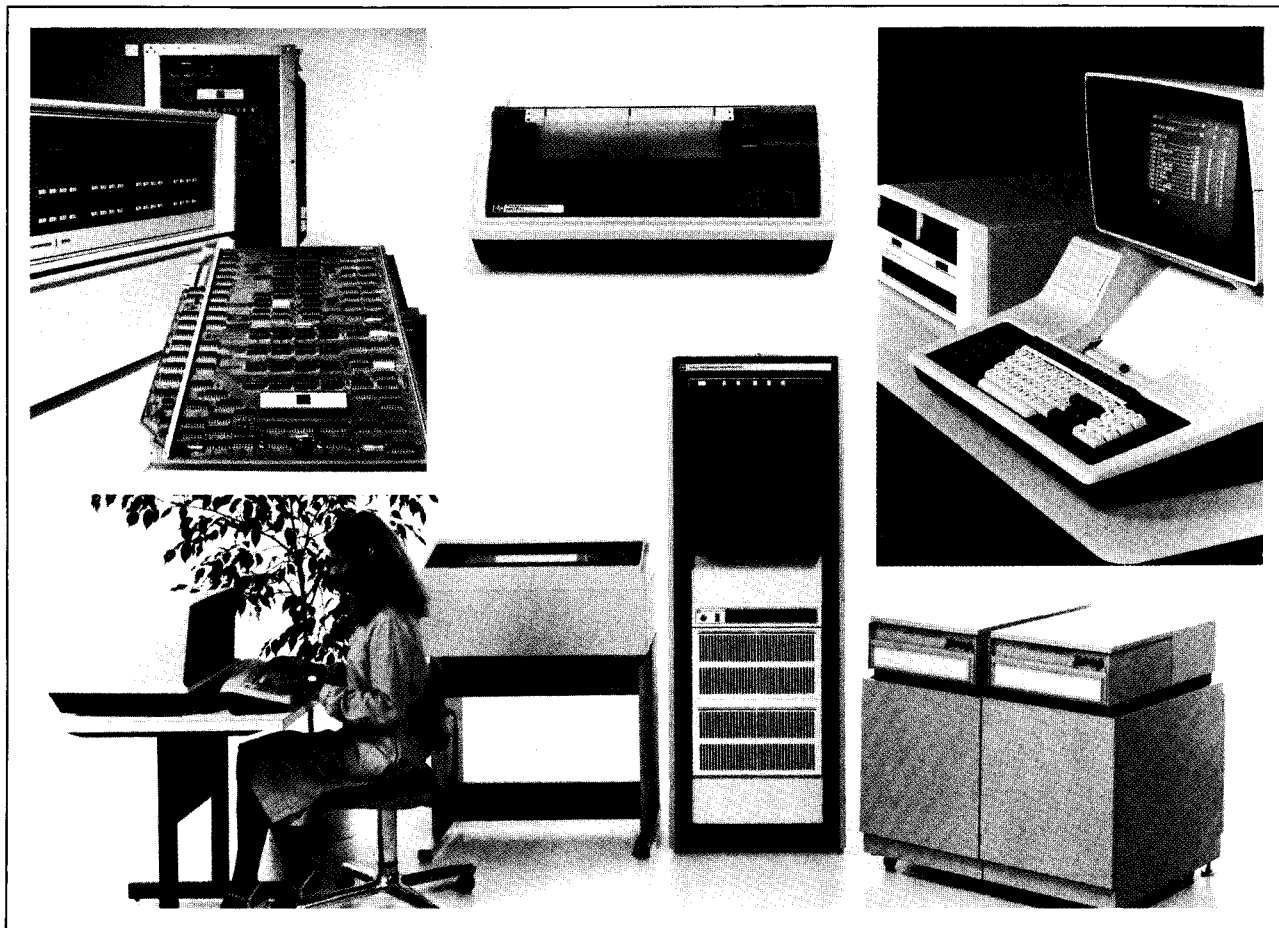

DS990 Models 4, 6, and 8 Systems Installation and Operation Manual



Part No. 946284-9701 *A
15 September 1980



TEXAS INSTRUMENTS

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MANUAL REVISION HISTORY

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Preface

This manual covers installation and operation instructions for the DS990 disk systems described in Section 1. The manual is intended for use by trained customer representatives (CR) or other qualified maintenance personnel. This manual is organized into four sections and one appendix as follows.

Section

- 1 General Description — This section defines the DS990 systems and gives descriptive information on the standard and optional components.
- 2 Installation — This section provides detailed instructions for installing and testing the DS990 systems and configurations.
- 3 Operation — This section provides operating information for the standard DS990 systems components.
- 4 Preventive Maintenance — This section provides operator type preventive maintenance for the standard DS990 systems.

Appendix

- A Cable Installation in 990 Computer 17-Slot Chassis.

The following related publications are available as reference material for support of this manual:

Title	Part Number
System Manuals	
<i>DS990 Models 4, 6, and 8 Systems Site Preparation Manual</i>	2250361-9701
<i>DS990 Models 4, 6, and 8 Systems Unpacking and Inventory Guide</i>	2268698-9701
<i>DS990 Systems Field Engineering Reference Handbook</i>	2268678-9701
<i>DS990 Models 4 through 30 Systems Operator's Service Guide</i>	2270533-9701

Title	Part Number
Hardware Manuals	
<i>Model 990/10 Computer System Hardware Reference Manual</i>	945417-9701
<i>Model 990 Computer TILINE Coupler User's Guide</i>	2268688-9701
<i>Model 911 Video Display Terminal Installation and Operation</i>	945423-9701
<i>Model DS10 Cartridge Disk System Installation and Operation</i>	946261-9701
<i>Model DS25/DS50 Disk System Installation and Operation</i>	946231-9701
<i>Model 979A Magnetic Tape System Installation and Operation</i>	946229-9701
<i>Model 979A Tape Transport Installation and Operation</i>	949612-9701
<i>Model FD800 Floppy Disk System with International Chassis Installation and Operation</i>	2250697-9701
<i>Model FD1000 Flexible Disk System with International Chassis Installation and Operation</i>	2250698-9701
<i>Model 990 Computer Communications System Installation and Operation</i>	945409-9701
<i>Model 743 KSR Data Terminal Installation and Operation</i>	943462-9701
<i>Model 810 Printer Installation and Operation</i>	939460-9701
<i>Model 820 KSR Installation and Operation</i>	2250454-9701
<i>Model 2230 and 2260 Line Printers Installation and Operation</i>	946256-9701
<i>Model 804 Card Reader Installation and Operation</i>	945262-9701
Software Manuals	
<i>Model 990 Computer/TMS 9900 Assembly Language Programmer's Guide</i>	943441-9701

Title	Part Number
Software Manuals (Continued)	
<i>Model 990 Computer Diagnostics Handbook Volumes 1 through 7</i>	945400-9701 through 945400-9707
<i>Model 990 Computer FORTRAN Programmer's Guide</i>	945411-9701
<i>Model 990 Computer FORTRAN Programmer's Reference Manual</i>	946260-9701
<i>Model 990 Computer TI Pascal User's Manual</i>	946290-9701
<i>Model 990 Computer DX10 Operating System — Release 3 COBOL Programmer's Guide</i>	946266-9701
<i>Model 990 Computer Report Program Generator (RPG II) Programmer's Guide</i>	939524-9701
<i>Model 990 Computer BASIC Programmer's Guide</i>	946251-9701
<i>Model 990 Computer Data Base Management System Programmer's Guide</i>	2250425-9701
<i>Query-990 User's Guide</i>	2250466-9701
<i>Model 990 Computer TIFORM Reference Manual</i>	2250374-9701
<i>Model 990 Computer Sort/Merge User's Guide</i>	946252-9701
<i>Model 990/10 DX10/3270 Information Display System Emulator Operator's Manual</i>	2250954-9701
<i>Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume I Concepts and Facilities</i>	946250-9701
<i>Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume II Production Operation</i>	946250-9702
<i>Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume III Application Programming Guide</i>	946250-9703
<i>Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume IV Developmental Operation</i>	946250-9704

Title	Part Number
Software Manuals (Continued)	
<i>Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume V System Programming Guide</i>	946250-9705
<i>Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume VI Error Reporting and Recovery</i>	946250-9706
<i>Model 990 Computer DX10 Operating System Installation Guide</i>	939152-9701
<i>Model 990 Computer FORTRAN Installation Guide</i>	939430-9701
<i>Model 990 Computer COBOL Installation Guide</i>	939431-9701
<i>Model 990 Computer Sort/Merge Installation for DX10 Release 3</i>	939432-9701
<i>TI 990 BASIC Reference Manual</i>	2250304-9701
<i>DX10 3780/2780 Emulator User's Guide</i>	946289-9701
<i>Model 990 Computer Link Editor Reference Manual</i>	949617-9701
<i>Model 990 Computer DX10 Operating System Release 3 Programmer's Card</i>	939417-9701
<i>Model 990 Computer Universal ROM Loader User's Guide</i>	2270534-9701

General Description

1.1 INTRODUCTION

This manual provides installation and operation information for the DS990 disk-based minicomputer packaged systems. This section of the manual presents a general description of the DS990 Models 4, 6, and 8 systems, and DS990 Models 4 and 8 performance package systems including hardware options, software options, major features, and general specifications (see Figures 1-1 through 1-4).

The DS990 packaged systems are available in two categories. The first category consists of the DS990 Models 4, 6, and 8 base systems as described in paragraph 1.1.1. The second category consists of the DS990 Models 4 and 8 performance package systems as described in paragraph 1.1.2.

1.1.1 DS990 Base Systems

Base systems are provided in DS990 Models 4, 6, and 8 that incorporate the following features:

- Model 990/10 minicomputer, memory, and controllers mounted in a 13-slot chassis with 40-ampere power supply. The Models 4, 6, and 8 systems have a minimum of 128 kilobytes of error-correcting memory.
- Read only memory (ROM) is supplied with each system for loading and front panel utilities.
- Model 911 video display terminal (VDT) with 1920-character high-resolution display, separate keyboard with added single-function keys, and 11-key numeric pad.
- Model 4 has one DS10 disk drive with five megabytes of fixed and five megabytes of removable cartridge capacity. Model 6 has two DS25 removable disk pack drives for a total capacity of 45 megabytes. Model 8 has two DS50 removable disk pack drives for a total capacity of 89 megabytes.
- Up to seven additional full-size chassis (14 half-size) slots for system expansion and additional peripherals.
- The Model 4 comes in a choice of enclosures; a single-bay desk, a double-bay desk, a 1.78-meter (70-inch) cabinet or a 762-millimeter (30-inch) cabinet. Models 6 and 8 come in either a single-bay desk or a 1.78-meter (70-inch) cabinet or a 762-millimeter (30-inch) cabinet. On the Models 6 and 8, the disk drives are mounted on pedestals.

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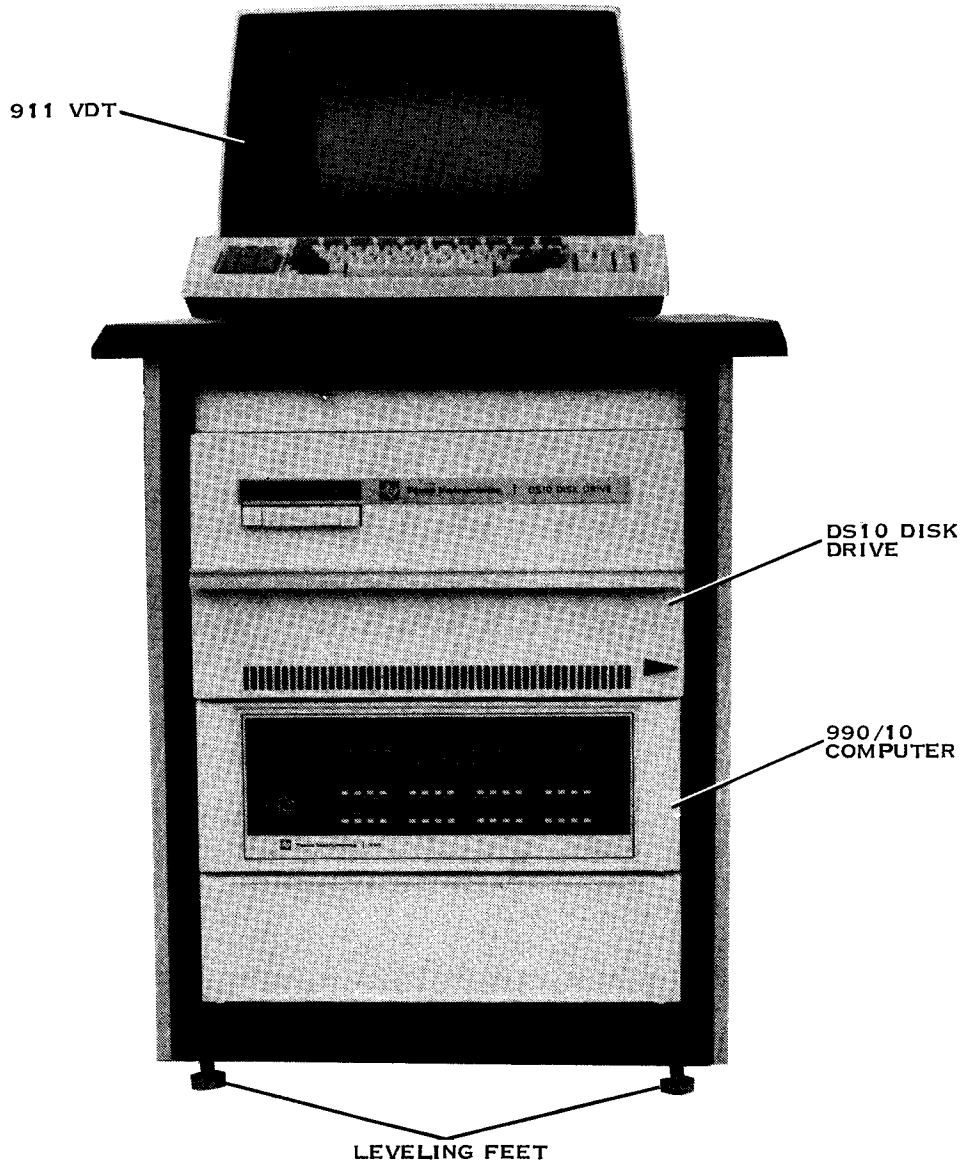
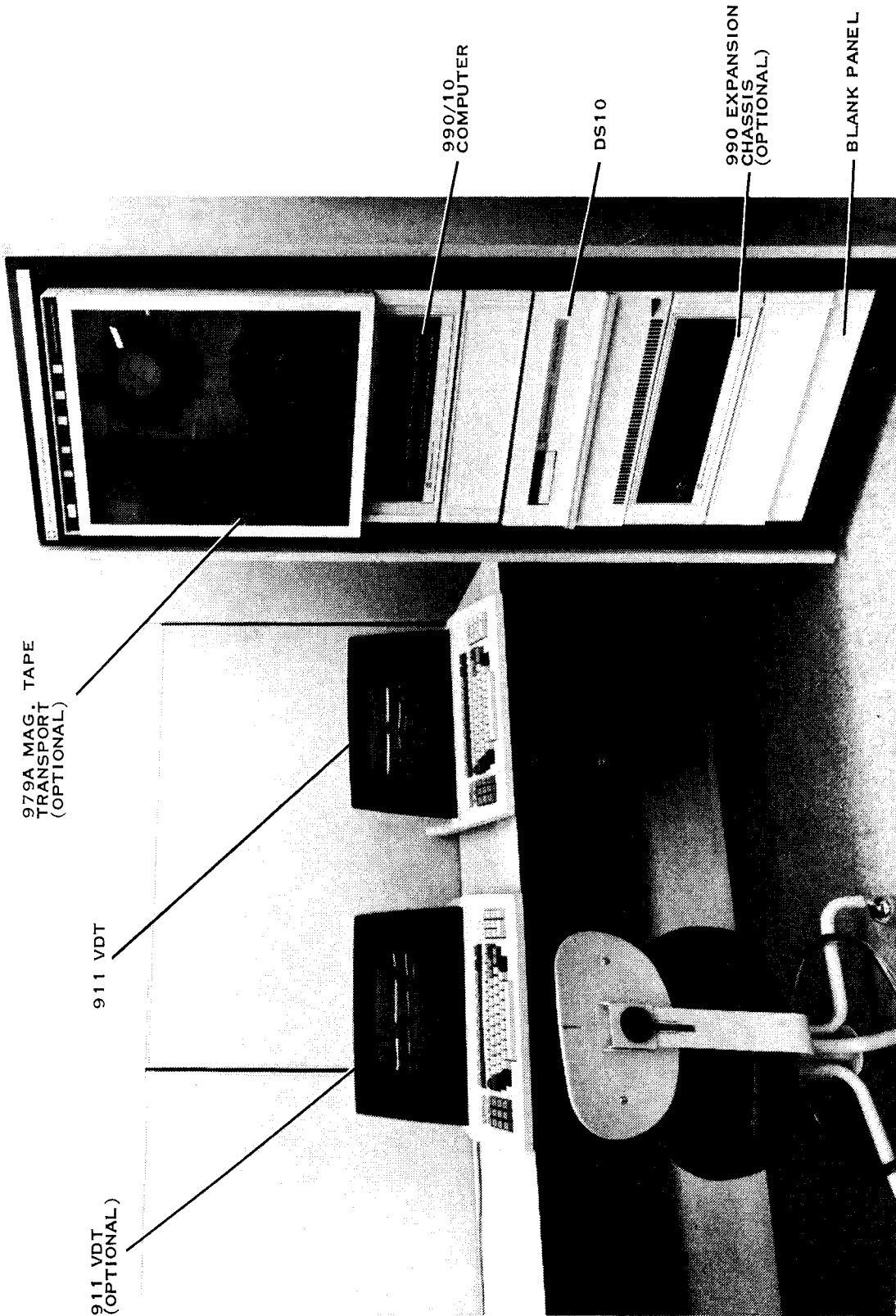
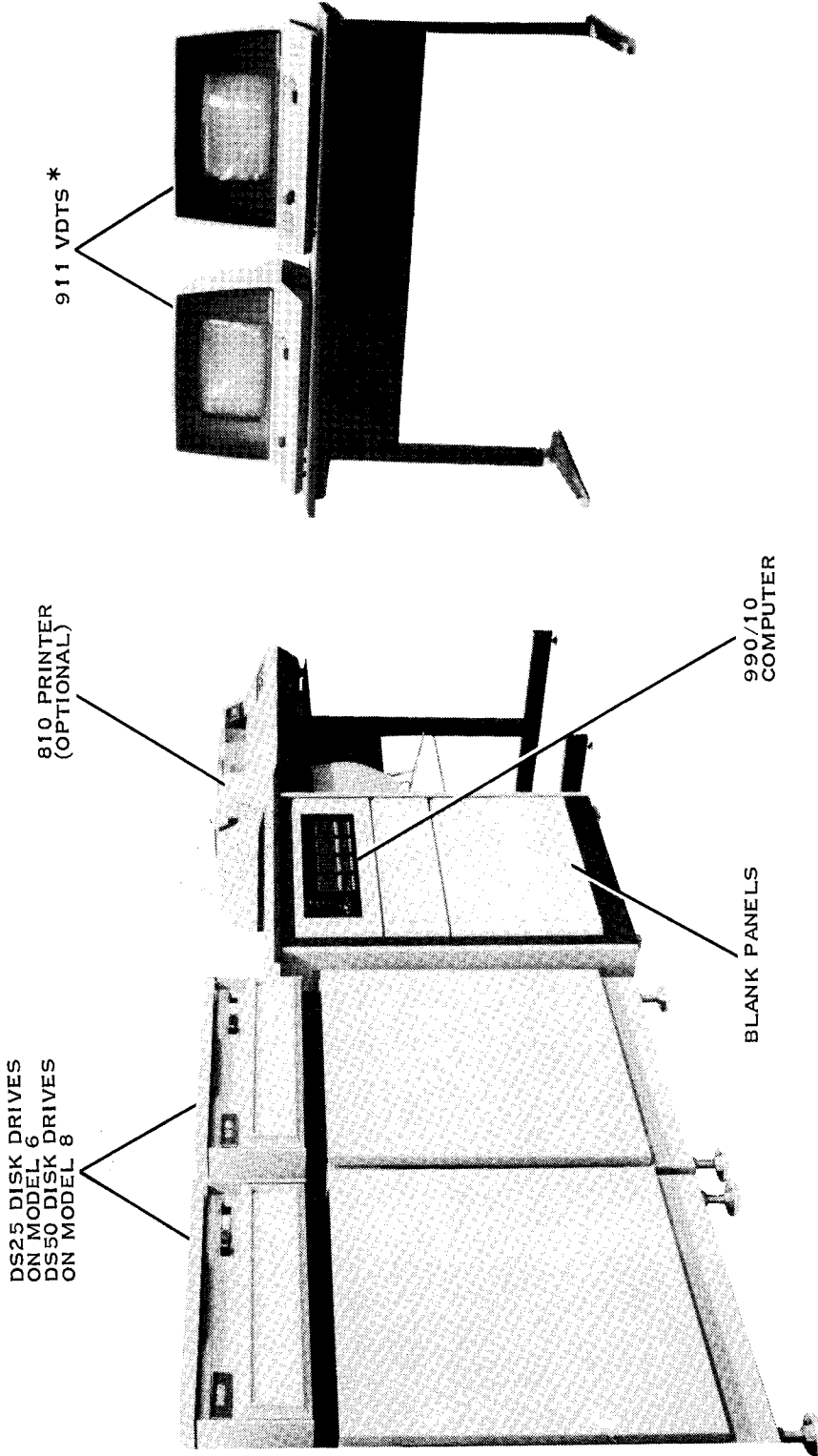


Figure 1-1. DS990 Model 4 762-Millimeter (30-Inch) Cabinet System



(A) 140193

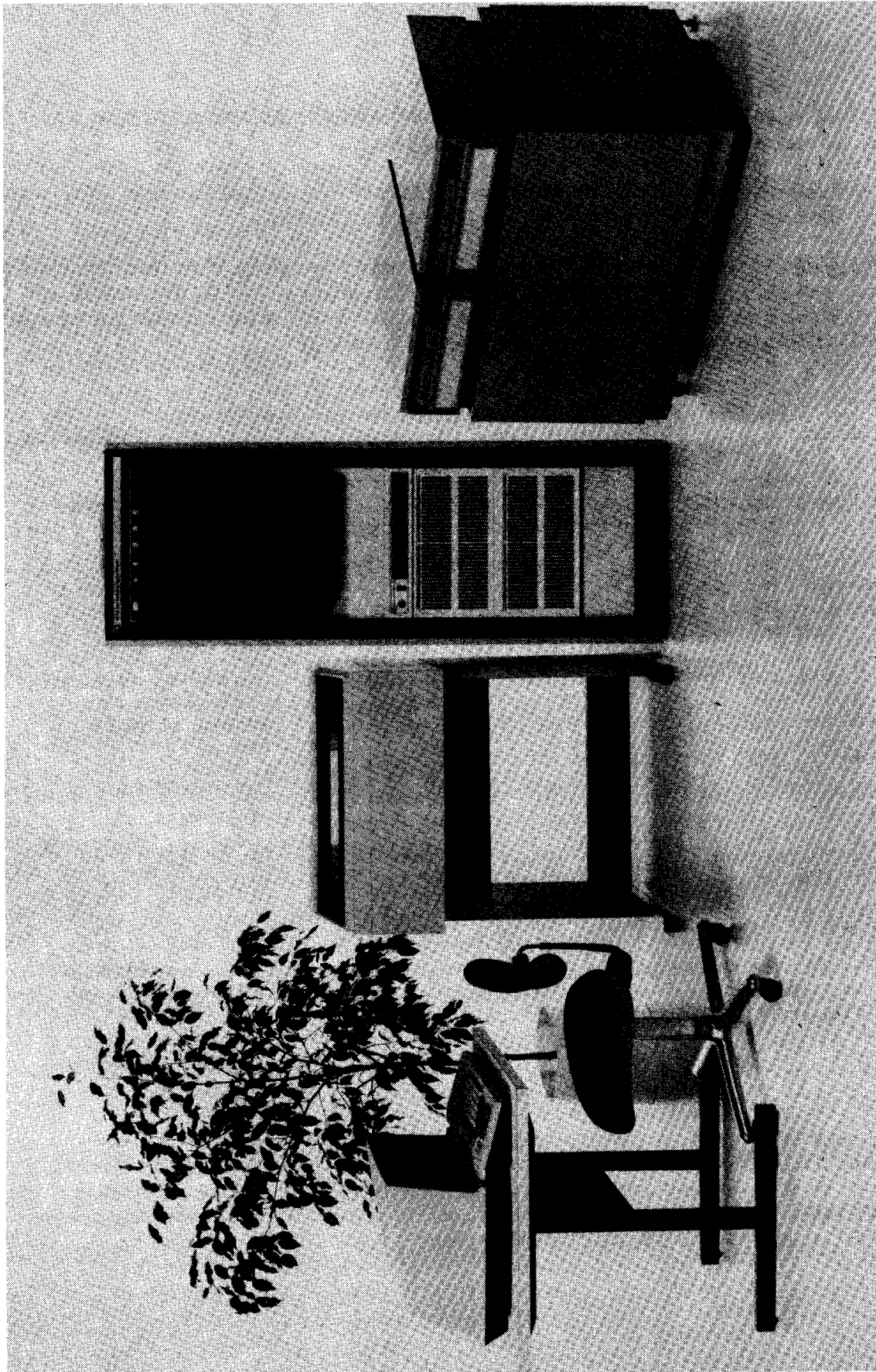
Figure 1-2. DS990 Model 4 1.78-Meter (70-Inch) Cabinet System



* NOTE:
SECOND 911 VDT OPTIONAL ON BASE MODELS.

(A) 143185A

Figure 1-3. DS990 Models 6 and 8 762-Millimeter (30-Inch) Cabinet System



(A)142005A

Figure 1-4. DS990 Model 8 Performance Package System with Two DS50s, Optional 979A, and 2230

- Hard copy device options include *Silent 700** terminals and Model 820 KSR, Model 810 printer, and Models 2230 and 2260 line printers.
- System software license provides use of DX10 software on disk cartridge, DX10 linkable modules for custom generation, and programming manuals.

The base systems are available in hardware-only kits. These kits consist of the hardware and hardware manuals with no system software or diagnostic software. The DX10 software and the diagnostics software are optionally available with all system kits. The base system configurations for the DS990 Models 4, 6, and 8 kits are as shown in Table 1-1.

Table 1-1. Base System Configurations for Hardware-Only Kits

Model 4 P/N 945062-XXXX ¹	Model 6 P/N 945081-XXXX ¹	Model 8 P/N 945084-XXXX ¹
Single-bay desk, double-bay desk, 1.78-m (70-in.) cabinet, or 762-mm (30-in.) cabinet.	Single-bay desk, or 1.78-m (70-in.) cabinet, or 762-mm (30-in.) cabinet.	Single-bay desk, or 1.78-m 1.78-m (70-in.) cabinet, or 762-mm (30 in.) cabinet.
One 990/10 computer in 13-slot chassis with minimum of 128 KB memory	One 990/10 computer in 13-slot chassis with minimum of 128 KB memory	One 990/10 computer in 13-slot chassis with minimum of 128 KB memory
One 911 VDT with controller	One 911 VDT with controller	One 911 VDT with controller
One DS10 disk drive with controller	Two DS25 disk drives with controller	Two DS50 disk drives with controller

Note:

¹ The XXXX of the dash number is determined by the options chosen, i.e., memory size, 911 VDT keyboard, system enclosure, and power as shown in the current Texas Instruments Price List.

1.1.2 DS990 Performance Package Systems

The DS990 Models 4 and 8 performance package systems are available in hardware-only kits that consist of the hardware and hardware manuals. The DX10 software and the diagnostics software are optionally available with all system kits. The performance package system configurations for the DS990 Models 4 and 8 kits are as shown in Table 1-2.

Table 1-2. Models 4 and 8 Performance Package Hardware-Only Kits

Model 4 P/N 2268032-XXXX¹	Model 8 P/N 2268048-XXXX¹
762-mm (30-in.) pedestal cabinet, or 1.78-m (70-in.) cabinet	762-mm (30-in.) pedestal cabinet, or 1.78-m (70-in.) cabinet
One 990/10 computer in 13-slot chassis with cache and 256 KB memory	One 990/10 computer in 17-slot chassis with cache and 256 KB memory
Two 911 VDTs with dual controller	Two 911 VDTs with dual controller
One DS10 disk drive with controller	Two DS50 disk drives with controller

Note:

¹ The XXXX of the dash number is determined by the options chosen, i.e., memory size, 911 VDT keyboard, system enclosure, and power as shown in the current Texas Instruments Price List.

Existing DS990 standard options are available except the FD800, which is unavailable with the DS990 Model 8 performance package system.

1.2 HARDWARE OPTIONS

The following hardware optional equipment is available for the DS990 Models 4, 6, and 8 systems and for the DS990 Models 4 and 8 performance package systems:

- Model 810 Printer Kit, part number 938120-0001
- Model 2230/2260 Line Printer Kit, part number 937485-0001/937492-0001
- Model 743 KSR Data Terminal Kit, part number 948977-0001
- Model 820 KSR Data Terminal Kit, part number 2262090-0001
- Model 804 Card Reader Kit, part number 945083-0001
- Model 979A Magnetic Tape Drive Kit (800 bpi), part number 949008-0001

- Model FD800 Flexible Disk Drive Kit, part number 2269929-XXXX^{1,2}
- Model FD1000 Flexible Disk Drive Kit, part number 2261685-XXXX¹
- Communications equipment
- Rackmounting Cabinets, 762-millimeter (30-inch) and 1.78-meter (70-inch) high
(30-inch, part number 949147)
(70-inch, part number 945080)
- 13-Slot Expansion Chassis with 40-ampere Power Supply, part number 945050
- CRU Expansion Kit Circuit Boards and Cables, part number 944985
- TILINE³ Bus Expansion Kit, part number 945091
- Up to a total of 2048 kilobytes of semiconductor error correcting memory
- Additional DS10, DS25, and DS50 Disk System Kits
- Additional 1920-character 911 VDTs

1.3 SOFTWARE OPTIONS

The following software options are available for the DS990 Models 4, 6, and 8 systems and for the DS990 Models 4 and 8 performance package systems:

- DX10 COBOL License, part number 937860
- DX10 FORTRAN License, part number 937855
- DX10 990 BASIC⁴ License, part number 2250489
- DX10 Sort/Merge License, part number 936043
- RPG II License, part number 2261812
- TI 990 Pascal License, part number 2250000
- DBMS-990 License, part number 2250427
- DX10 3270 ICS License, part number 2250972

¹ XXXX depends on number of disk drives in kit.

² Not available with Model 8 Performance Package System.

³ Trademark of Texas Instruments Incorporated.

⁴ BASIC is a trademark registered by the trustees of Dartmouth College, Hanover, New Hampshire.

- 3780/2780 Emulator License, part number 2250907
- TIFORM 990 License, part number 2250493
- QUERY-990 License, part number 2250462

For the software options, the dash numbers for different types of disk media are as indicated in the following list:

Software License Dash Numbers

Dash No.	Media
0005	DS25
0006	DS50
0010	DS10
0077	DS25/50 Add-on

1.4 HARDWARE DESCRIPTION

The following paragraphs give a brief physical and functional description of system hardware including options. The following items are covered.

- Model 990/10 computer
- Model 911 VDT
- Model DS10 disk drive
- Model DS25/DS50 disk drive
- Model 810 printer (optional)
- Model 2230/2260 line printer (optional)
- Model 743 KSR data terminal (optional)
- Model 820 KSR data terminal (optional)
- Model 804 card reader (optional)
- Model 979A magnetic tape drive (optional)
- Model FD800 flexible disk drive (optional)
- Model FD1000 flexible disk drive (optional)
- Communications equipment (optional)

- Rackmounting cabinet
- Single-bay cabinet
- 17-Slot chassis
- 13-Slot expansion chassis (optional)
- CRU expansion (optional)
- TILINE bus expansion (optional)
- Memory expansion (optional)
- Cache controller

1.4.1 Model 990/10 Computer

The Model 990/10 computer used with the DS990 Models 4, 6, and 8 base systems is discussed in paragraph 1.4.1.1. The 990/10 computer used with the DS990 Model 4 performance package system is discussed in paragraph 1.4.1.2. The Model 990/10 computer used with the DS990 Model 8 performance package system is discussed in paragraph 1.4.1.3.

1.4.1.1 Model 990/10 Computer For Base Models 4, 6, and 8. This configuration of the 990/10 (figure 1-2) consists of a 13-slot chassis with a 40-ampere power system, a programmer panel, an arithmetic unit (AU1) circuit board, and a system memory interface board with mapping (SMI/M). Other features of the 990/10 computer are as follows:

- Memory controller with error checking and error correcting (ECC)
- Minimum of 128K bytes of ECC dynamic RAM
- Memory mapping for addressing the 2048K bytes of TILINE address space
- TILINE bus
- Communications register unit (CRU) bus
- Instruction set of 72 machine instructions
- 16 vectored interrupt levels
- DX10 ROM loader
- Real-time clock

Refer to Figure 1-5 for a block diagram of the DS990 Models 4, 6, and 8 systems. For additional information on the 990/10 computer, refer to the *Model 990/10 Computer System Hardware Reference Manual*.

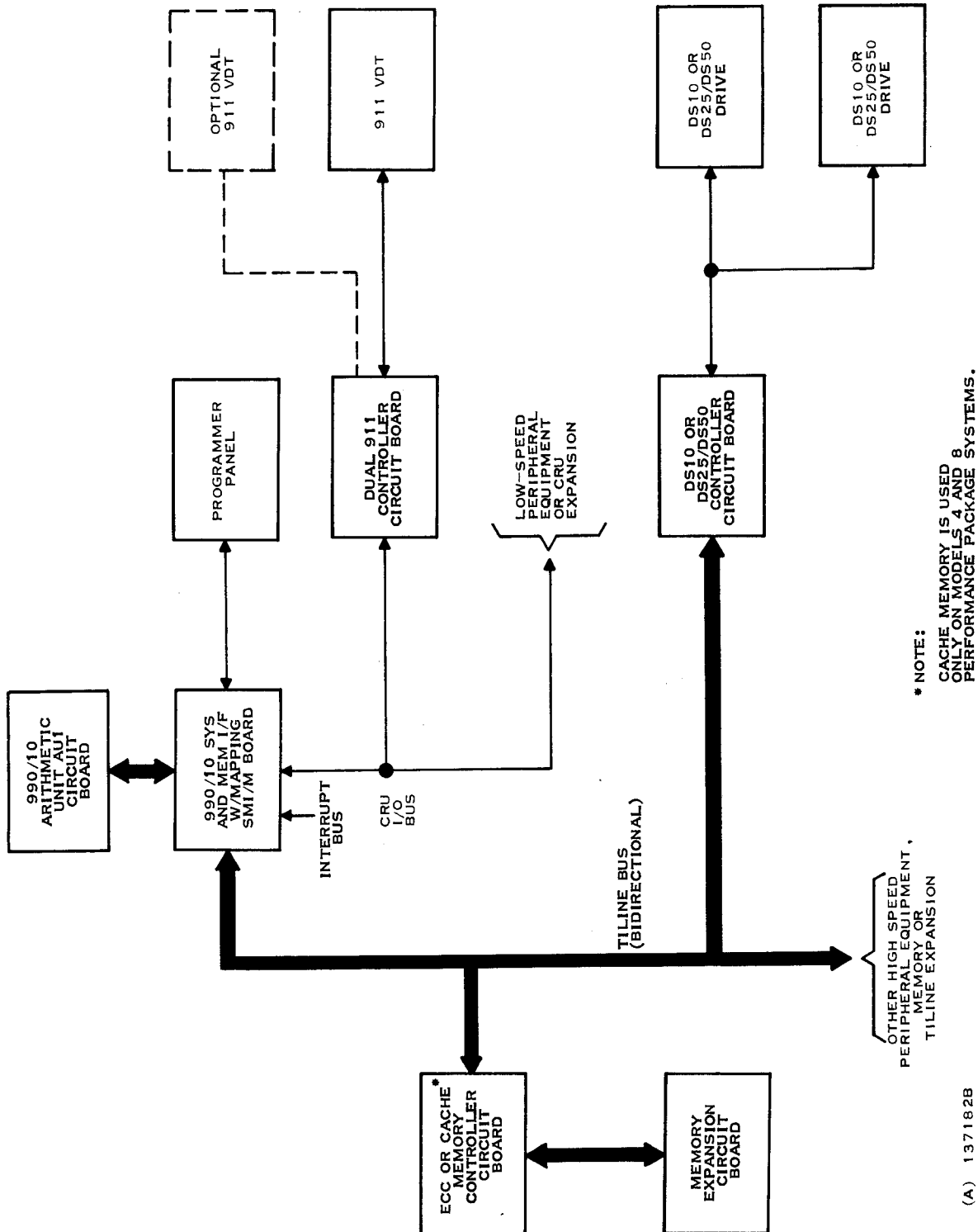


Figure 1-5. DS990 Models 4, 6 and 8 Systems Block Diagram

(A) 137182B

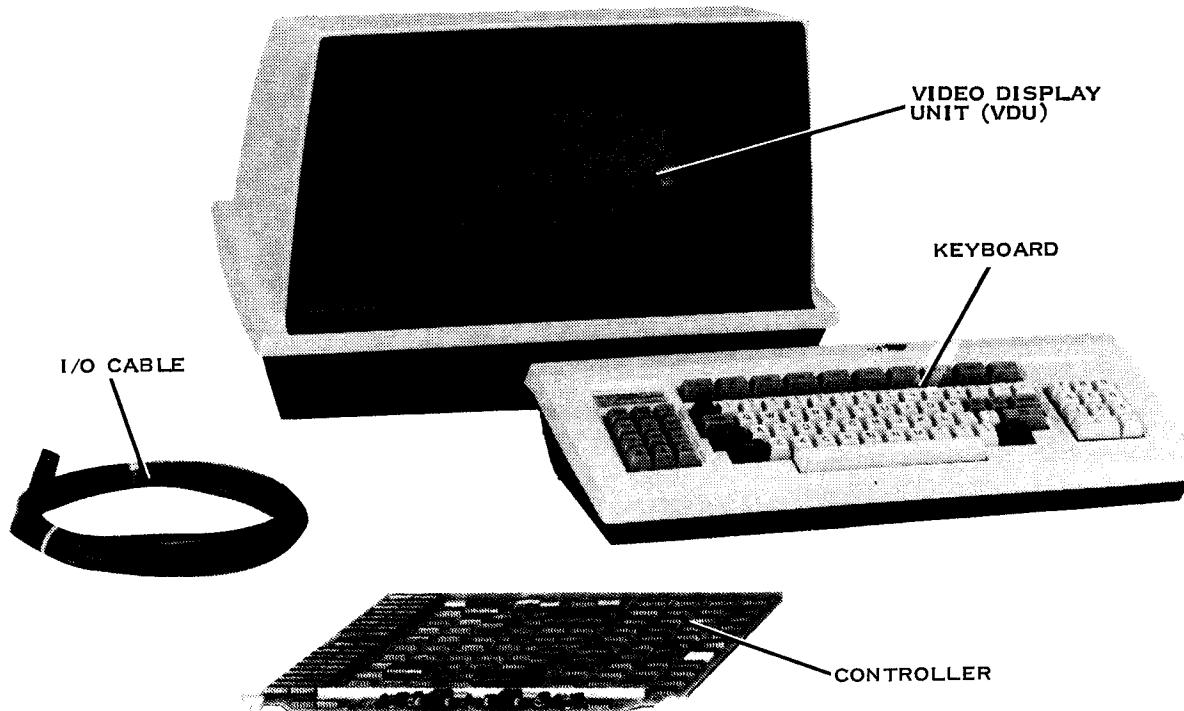
1.4.1.2 Model 990/10 Computer for Model 4 Performance Package System. This configuration is identical to that described in paragraph 1.4.1.1 except for the memory. The computer for the model 4 performance package system is equipped with a cache memory subsystem that includes a cache memory controller and a total of 256K bytes of ECC memory.

1.4.1.3 Model 990/10 Computer for Model 8 Performance Package System. This configuration of the 990/10 computer (figure 1-4) consists of a 17-slot chassis with a matching programmer panel, an 80-ampere power system, an AU1 board, an SMI/M board, a cache memory controller and a total of 256K bytes of ECC memory. In other respects, this configuration of the 990/10 computer is identical to that described in paragraph 1.4.1.1. Paragraph 1.4.16 presents a description of the 17-slot chassis.

1.4.2 Model 911 VDT

The 911 VDT consists of a video display unit (VDU) , a keyboard, a controller, and an I/O cable as shown in Figure 1-6. The VDU and keyboard are normally placed on top of the desk or table. The controller mounts in a full slot of the computer chassis and connects to the VDU by the I/O cable. One controller is capable of handling two 911 VDTs. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the CRU address, and the location for the controller.

The function of the 911 VDT is to provide keyboard and interactive VDT facilities between an operator and the 990 computer. The VDU will display 24 lines of 80 characters in each line. All characters of the full ASCII code may be displayed and entered on the keyboard. For more details refer to the *911 Video Display Terminal Installation and Operation*.



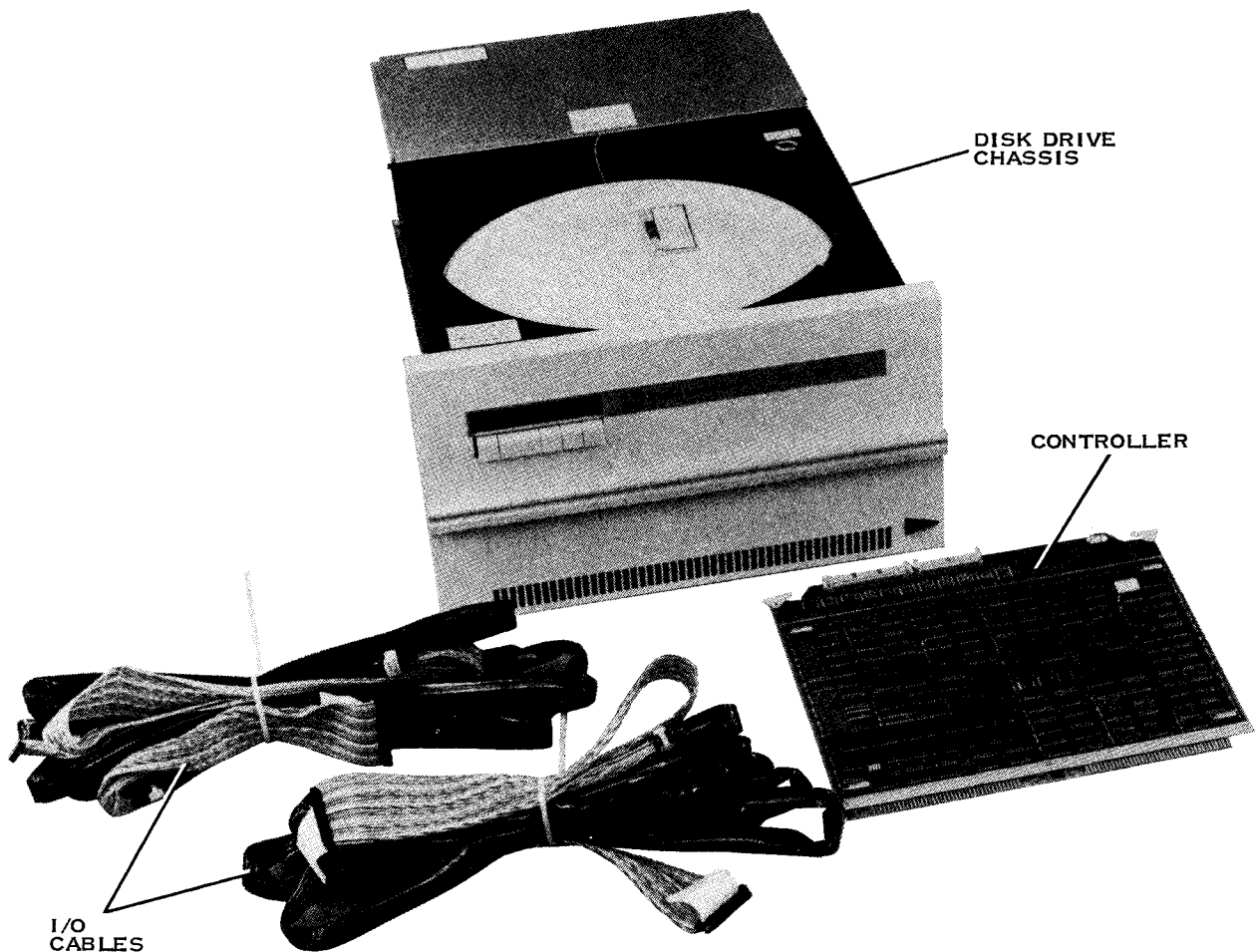
(A)137183 (911-477-39-3)

Figure 1-6. Components of 911 VDT Kit

1.4.3 Model DS10 Disk Drive

The DS10 disk drive consists of the disk drive chassis, 40-pin and 50-pin I/O bus cables, a controller, and terminators. Refer to Figure 1-7. A secondary disk drive may be mounted in the desk or rackmounted cabinet as desired. The DS10 controller mounts in a full slot of the computer chassis. One controller is capable of handling two disk drives. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the TILINE address and the slot location for the controller.

The model DS10 disk is a dual platter, single access moving head disk drive. A total storage of 10 megabytes is recorded on one 5-megabyte fixed nonremovable platter and a 5-megabyte 5440 type



(A)143228

Figure 1-7. Components of DS10 Disk Drive Kit

General Description

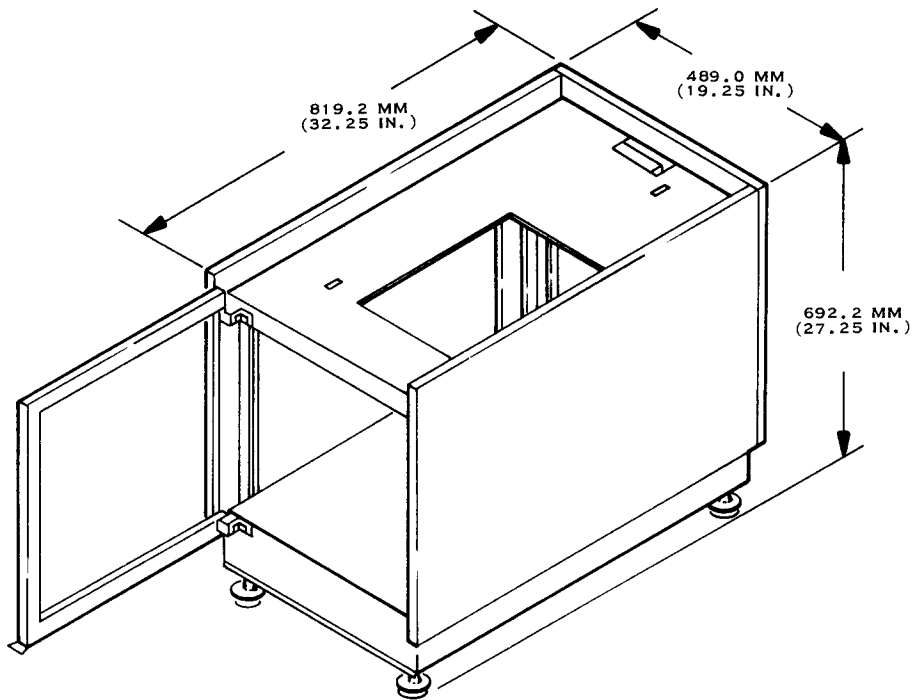
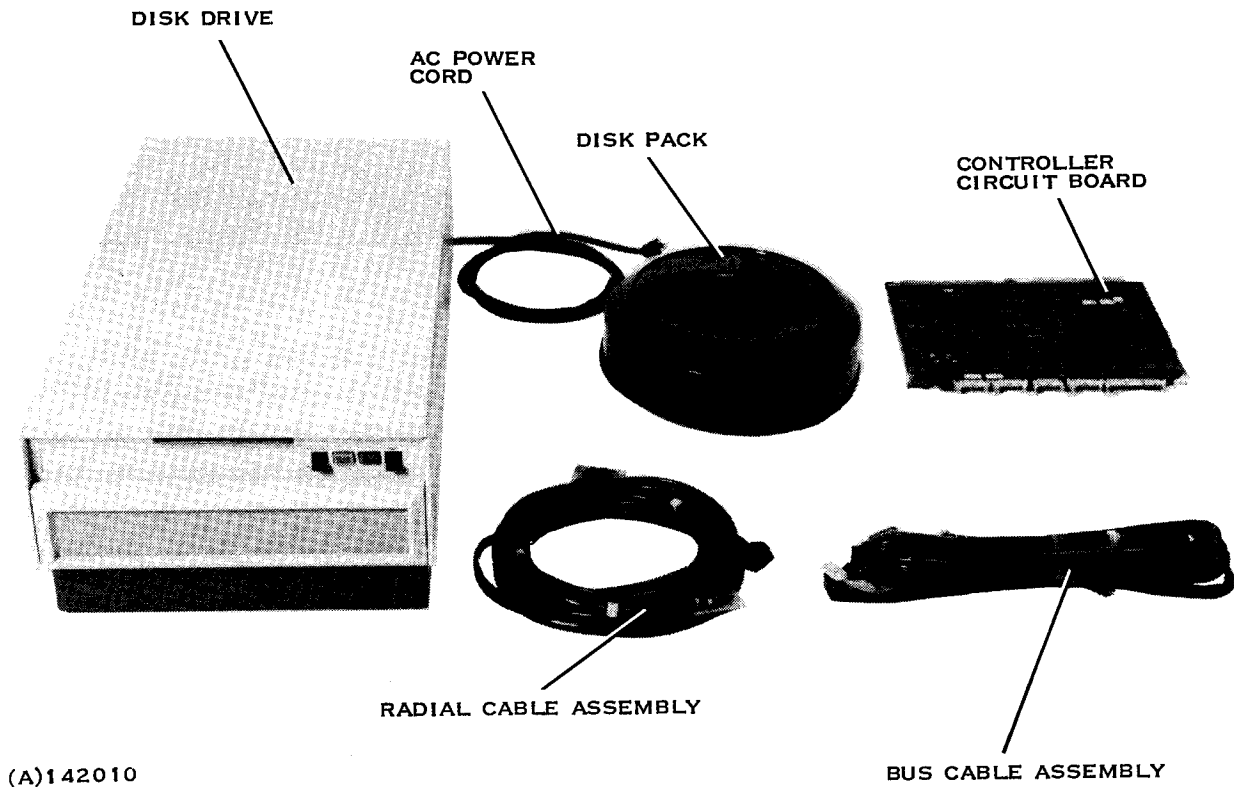


Figure 1-8. Disk Drive Master Kit with Pedestal, Part Number 947521-1001 for DS25, and 947580-1001 for DS50

disk cartridge. The disk format is 288 bytes per sector, 20 sectors per track, 816 tracks per platter, 2 platters (also 2 logical units) per disk. Single track seek time is 7.5 ms, average seek time is 35 ms, with average latency time of 12.5 ms. Transfer rate is 312K bytes per second. For more details refer to the *DS10 Disk Drive Installation and Operation*, part number 946261-9701.

1.4.4 Model DS25/DS50 Disk Drives

The DS25/DS50 disk drive consists of the disk drive assembly, a controller, bus, radial, and daisy chain cables, and a pedestal (Figures 1-8 and 1-9). The disk drive rests on the pedestal in normal

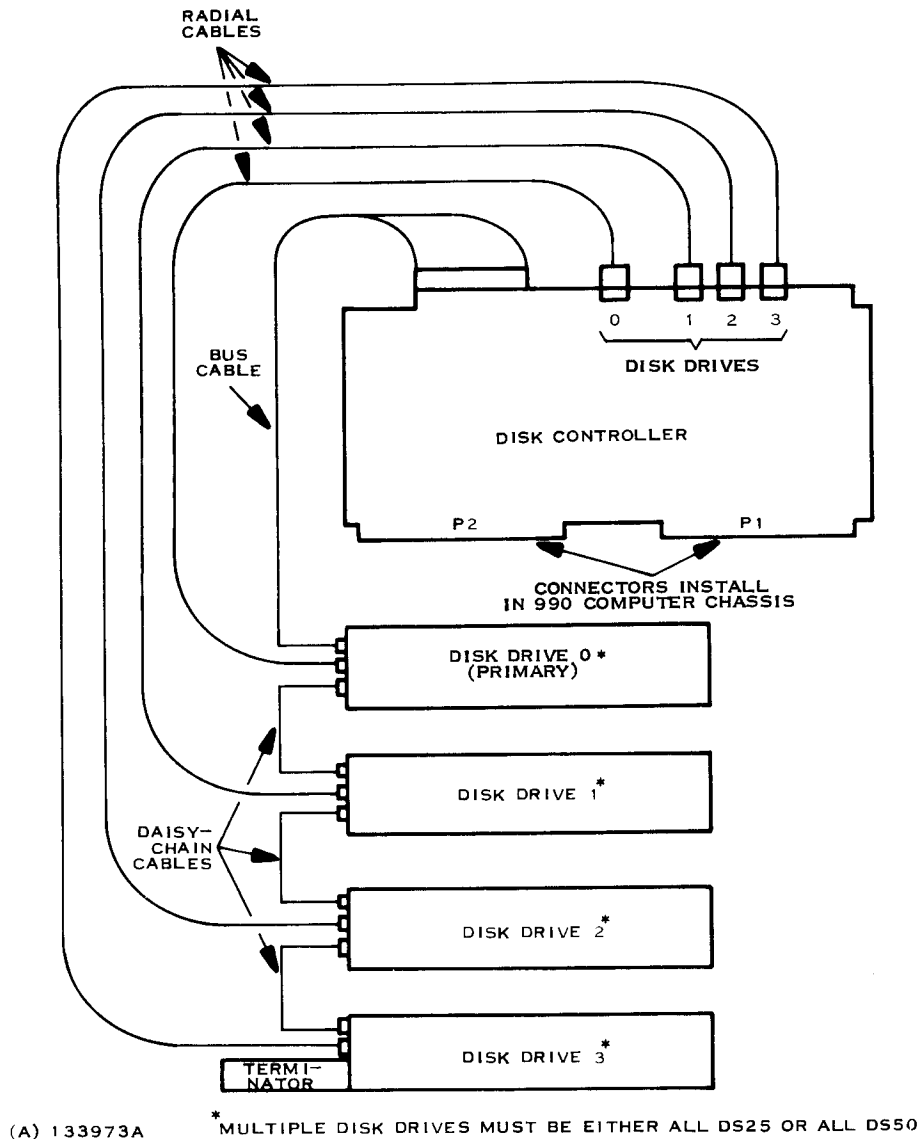


Figure 1-9. Four DS25/DS50 Disk Drive System Interconnect Configuration

operation. The controller mounts in a full slot of the computer chassis. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the TILINE address, and the slot location for the controller.

Models DS25 and DS50 disk drive units are functionally identical. The primary difference between the two models is in their storage capability. Model DS25 has 408 (000-407) cylinders per disk pack, and Model DS50 has 815 (000-814) cylinders per pack. The formatted data storage per pack is 22.3 megabytes for the DS25 and 44.5 megabytes for the DS50.

A typical disk drive system configuration allows up to four disk drives to be operated by a single controller as shown in Figure 1-9. A bus cable connects the controller to the primary disk drive. A daisy chain cable interconnects the remaining disk drives. A radial cable is connected from the controller to each disk drive in the system. The last disk drive in the system requires a terminator to be installed on the unused (bus out) connector.

The Models DS25/DS50 disk drives utilize a magnetic, high-density (4040 BPI) disk pack and flying heads that move laterally over the disk surfaces to select different cylinders. The disk drive assembly includes the mechanical, electromechanical, and electronic components required to rotate the disk and to perform track selection. These components are also used to read and write data on the disk. For more details refer to *Model DS25/DS50 Disk Systems Installation and Operation*.

1.4.5 Model 810 Printer

The 810 Printer consists of the printer, power cable, I/O cable, paper basket, and interface module as shown in Figure 1-10. The printer is normally placed on an optional stand or on top of the desk or table. The interface module mounts in a half slot of the 13-slot computer chassis. The interface module connects to the printer by the I/O cable. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the CRU address, and the slot location for the controller.

The function of the 810 printer is to provide hard copy output from the 990 computer. The printer functions as a receive only device that impact prints a 7-row by 9-column dot matrix pattern at 150 characters per second. Printing is bidirectional and may include either the limited 64 character or full 96 character ASCII code set. For more details refer to *810 Printer Installation and Operation*.

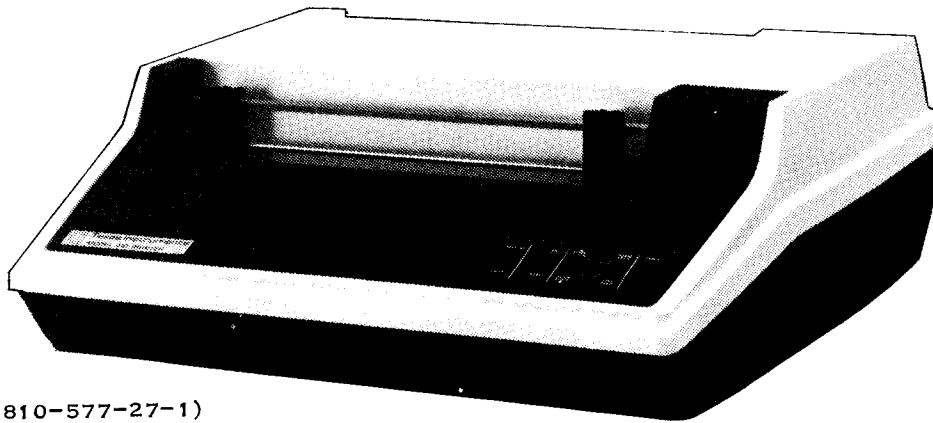
1.4.6 Model 2230/2260 Line Printer

The 2230/2260 line printer consists of a 2230 or 2260 line printer assembly, a 16 I/O TTL data module, an I/O cable assembly and a paper receptacle as shown in Figure 1-11. The line printer assembly rests on the floor near an ac power outlet. The data module plugs into a half slot in the computer or expansion chassis. The data module connects to the line printer assembly by the I/O cable. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the CRU address, and the slot location.

The function of the line printer is to print the 64 character ASCII code at a rate of 300 lines per minute (Model 2230) or 600 lines per minute (Model 2260). Each line may contain a maximum of 136 characters. Standard fan-fold and edge-punched paper with a width of 102 to 425 millimeters (4 to 16.75 inches) may be used. A 12 channel tape controlled vertical format unit (VFU) is provided. For more details refer to *Model 2230 and 2260 Line Printers Installation and Operation*.

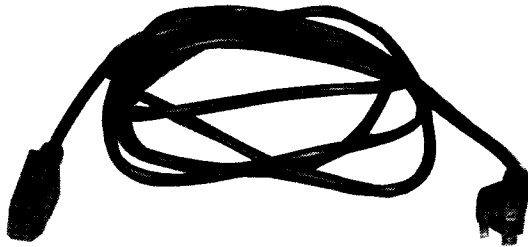
1.4.7 Model 743 KSR Data Terminal

This lightweight data terminal consists of three major units that are modular in construction:



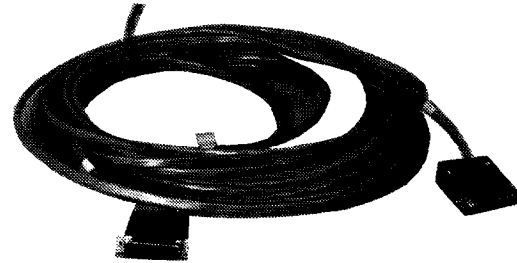
(810-577-27-1)

MODEL 810 PRINTER,
PART NO. 938152-1 THRU -6



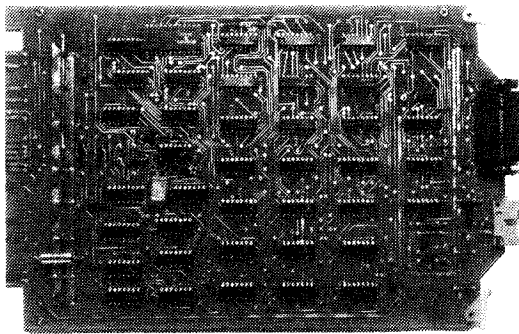
(820-1278-3-3)

POWER CABLE,
PART NO. 996289-1



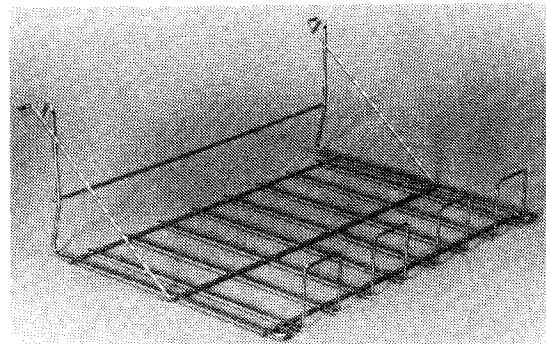
(600-577-28-5)

I/O CABLE ASSEMBLY,
PART NO. 938114-0001



(810-577-27-4)

TTY/EIA INTERFACE MODULE,
PART NO. 945075-0001



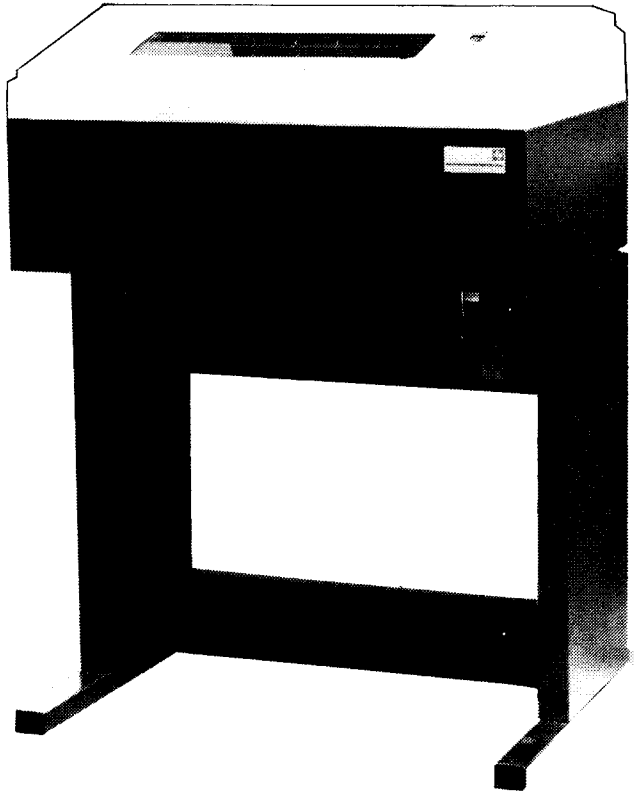
(810-577-27-5)

PAPER BASKET,
PART NO. 994176-0001

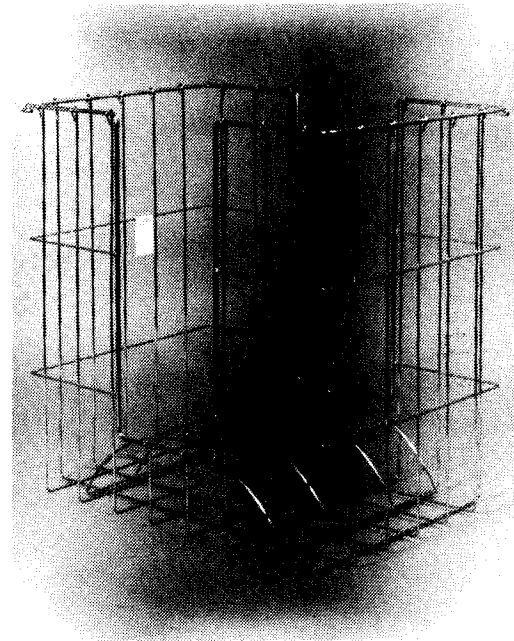
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Figure 1-10. Components of 810 Printer Kit

General Description

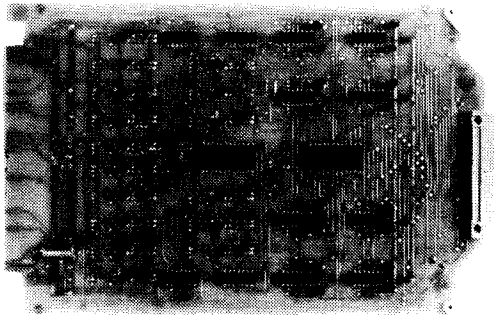


MODELS 2230 OR 2260 LINE PRINTER



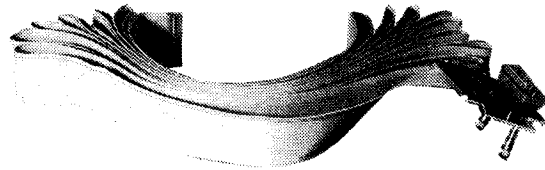
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PAPER RECEPTACLE



(DSD-577-30-1)

16 I/O TTL DATA MODULE



(DSD-577-30-3)

CABLE ASSEMBLY

(A)137470A

Figure 1-11. Components of 2230/2260 Line Printer Kit

keyboard, printer, and transmit/receive electronics. These modular units provide the following capabilities for the data terminal:

- A standard ASCII keyboard to allow manual data entries and to transmit characters to the Model 990 computer in seven-level code.
- A printer assembly to perform thermal printing operations by using a solid-state thermal printhead to transfer characters to heat-sensitive paper.
- Transmit/receive electronics to control data communications with the Model 990 computer.

Included in the Model 743 data terminal kit (Figure 1-12) is an interface module that plugs into a CRU I/O slot in the 990 mainframe or expansion chassis to provide the necessary circuitry for communications between the computer and the data terminal. The standard communications interface between the Model 990 computer and the Model 743 data terminal conforms to EIA RS-232-C.

The function of the Model 743 KSR data terminal is to provide a data entry/inquiry terminal with half- or full-duplex communication at 30 characters-per-second (300 baud). The terminal transfers data to or from a computer in either the local or the remote mode of operation. The remote mode of operation requires that an internal modem is installed in the 990 chassis or an external modem/data set.

1.4.8 Model 820 KSR Data Terminal

The 820 KSR data terminal consists of a keyboard/impact printer assembly, an interface module, interconnecting cables, and a paper receptacle as shown in Figure 1-13. The 820 KSR is normally placed on a desk or table. The interface module mounts in the 990 computer chassis and connects to the 820 KSR data terminal with the supplied cable.

The function of the 820 KSR data terminal is to provide keyboard interaction with the 990 computer (or other terminals) and multicopy impact printout at up to 150 characters-per-second.

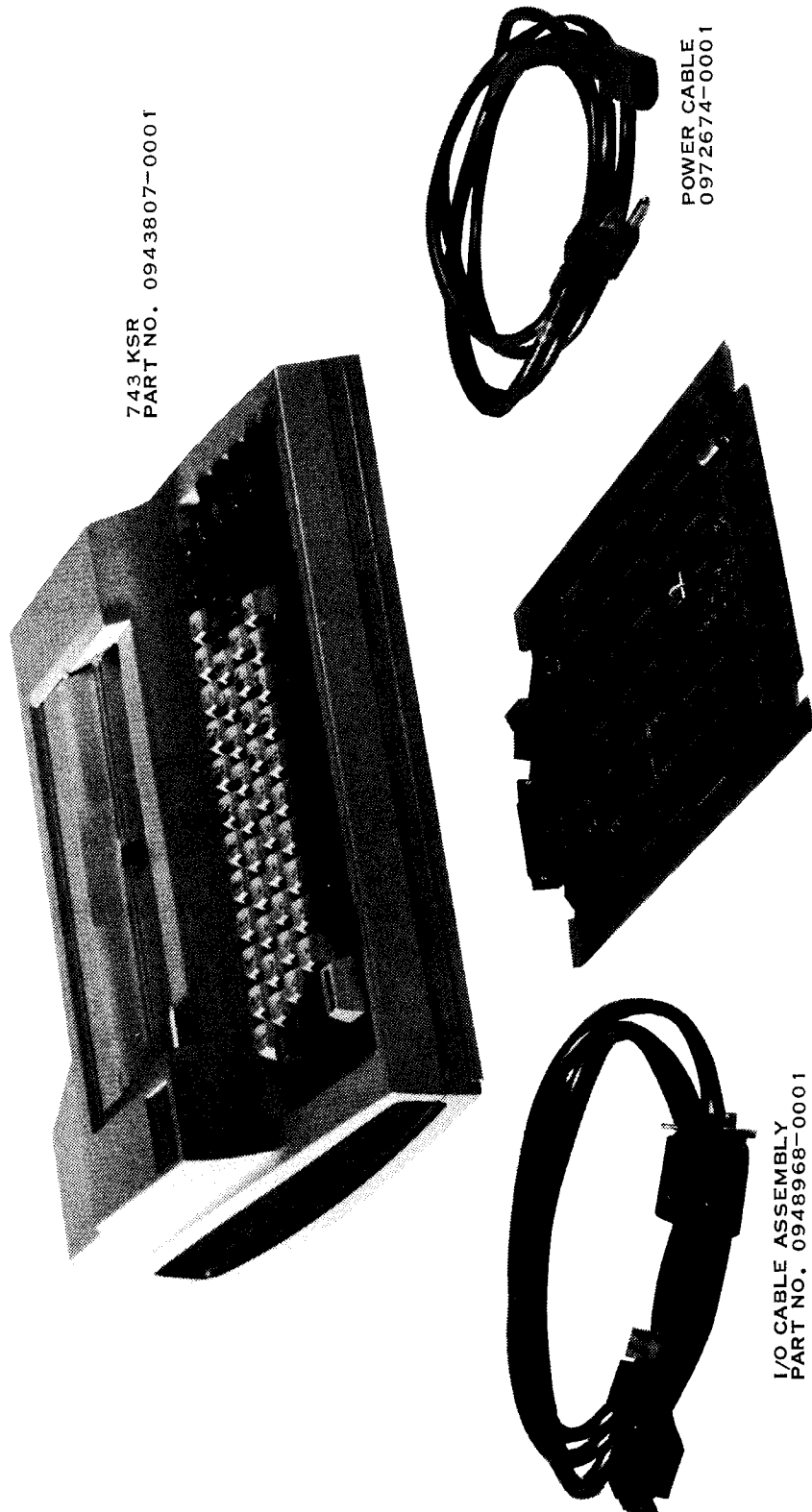
1.4.9 Model 804 Card Reader

The 804 card reader consists of a card reader, a controller, and an I/O cable shown in Figure 1-14. The card reader is normally placed on top of the desk or table. The controller mounts in a half slot of the 13-slot computer chassis. The controller connects to the card reader by the I/O cable. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the CRU address, and the slot location for the controller.

The function of the 804 card reader is to read the punched data from standard size 80-column tabulating cards. This data is then fed into the 990 computer via the I/O cable and the controller. Data is read from the tabulating cards at a rate of approximately 400 cards per minute in response to commands issued from the 990 computer. For more details refer to the *804 Card Reader Installation and Operation Manual*, part number 945262-9701.

1.4.10 Model 979A Magnetic Tape Drive

The 979A tape drive consists of either an 800 or a 1600 bytes per inch (2.54 cm) tape transport and TILINE tape controller, a TMTC/transport cable, and a terminator as shown in Figures 1-15 and 1.16. The tape transport is mounted at the top of a 1.78-meter (70-inch) rackmounting cabinet. One TILINE tape controller will interface with a maximum of four tape transports. The primary tape transport connects to the TILINE tape controller by the TMTC/transport cable. Secondary tape



743 KSR
PART NO. 0943807-0001

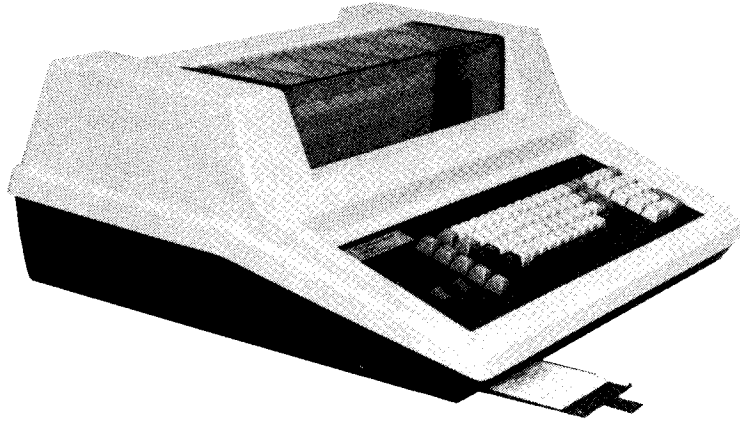
POWER CABLE
0972674-0001

TTY/EIA INTERFACE MODULE
PART NO. 0945075-0001

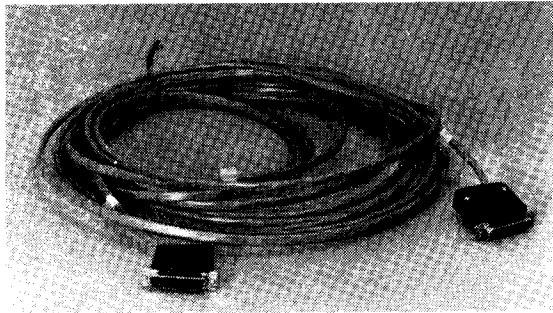
I/O CABLE ASSEMBLY
PART NO. 0948968-0001

(A) 140194 (743-976-18-7)

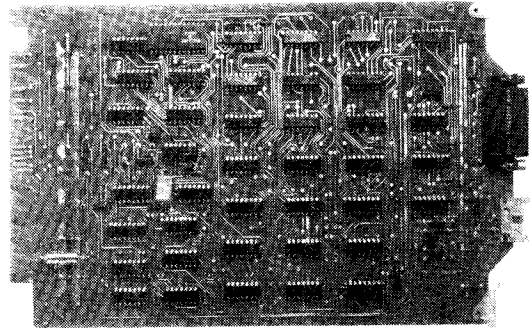
Figure 1-12. Model 743 KSR Data Terminal Kit, Part Number 948977-0001



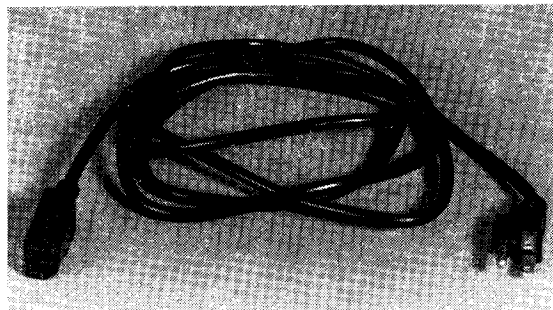
MODEL 820 KSR DATA TERMINAL
PART NO. 2262091-0001 (110-115VAC)
-0002 (220-240VAC)



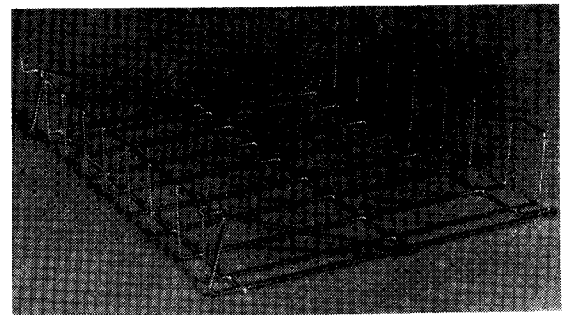
I/O CABLE ASSEMBLY
PART NO. 2262093-0001 (TTY/EIA)
OPTIONAL EXTENSION CABLE
PART NO. 2262094-0001 15.2M (50 FT.)



TTY/EIA INTERFACE MODULE
PART NO. 945075-0001
(USED ONLY WITH 990 COMPUTERS
THAT DO NOT HAVE INTERNAL
EIA INTERFACES)



POWER CABLE - 115VAC
PART NO. 996289-0001



PAPER - CATCH TRAY
PART NO. 999838-0001

(A)142017

Figure 1-13. Model 820 KSR Data Terminal Subsystem

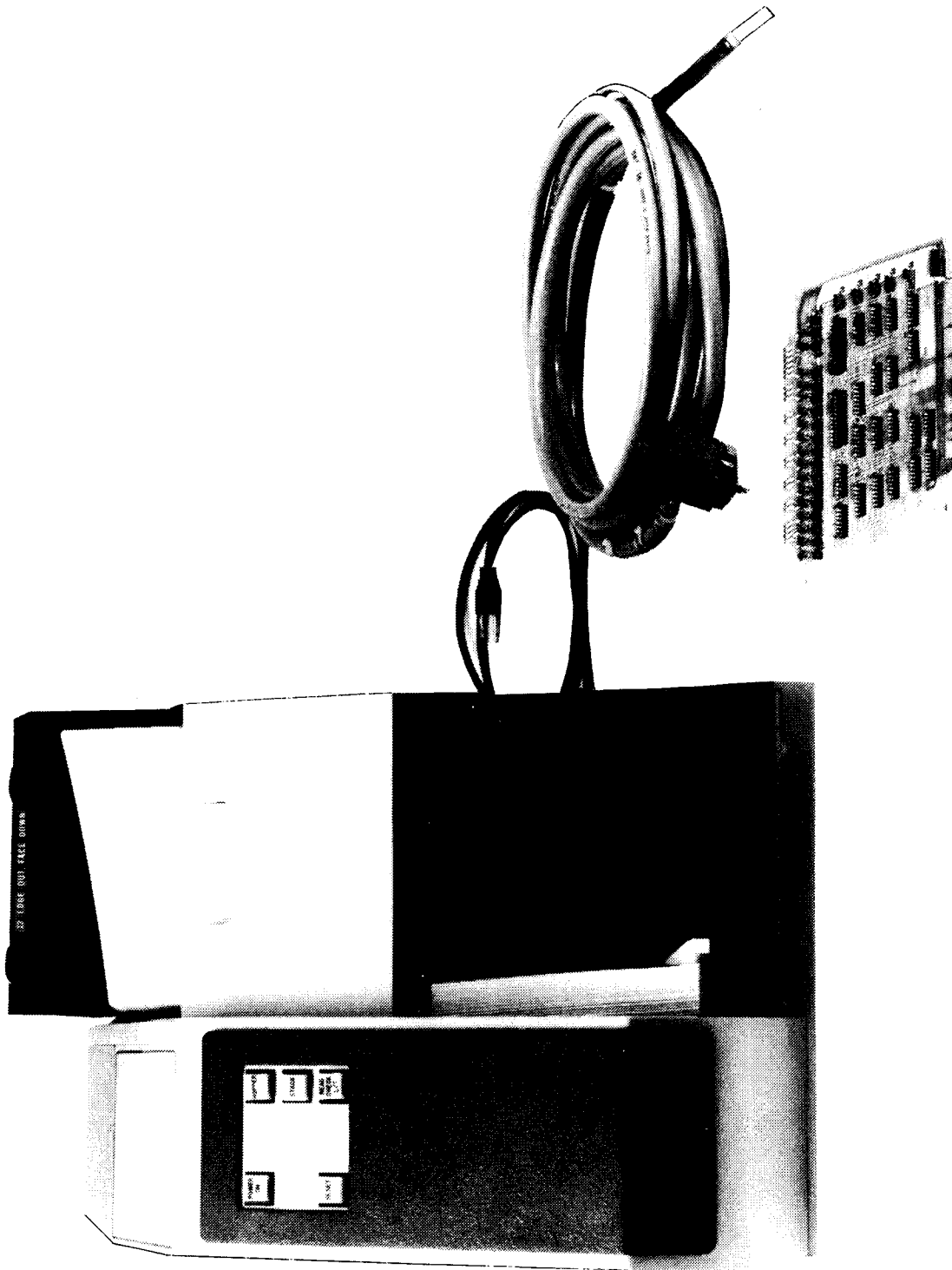
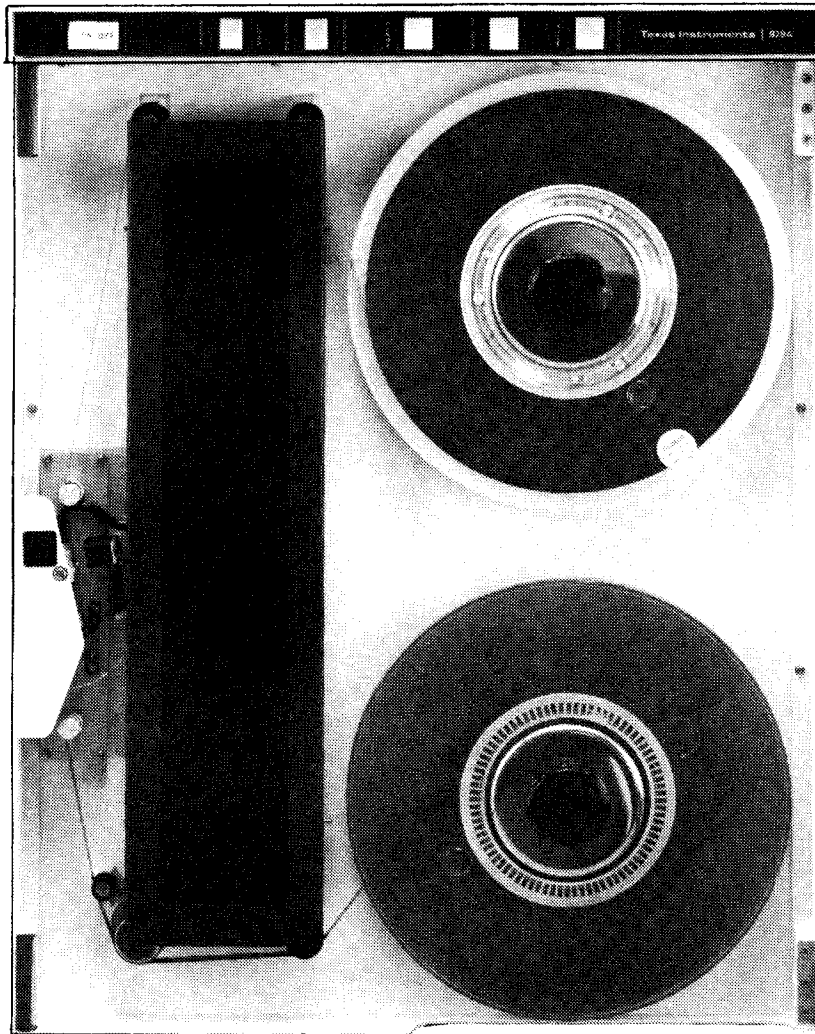


Figure 1-14. Components of 804 Card Reader Kit

(A) 133390 (990-276-4-5)

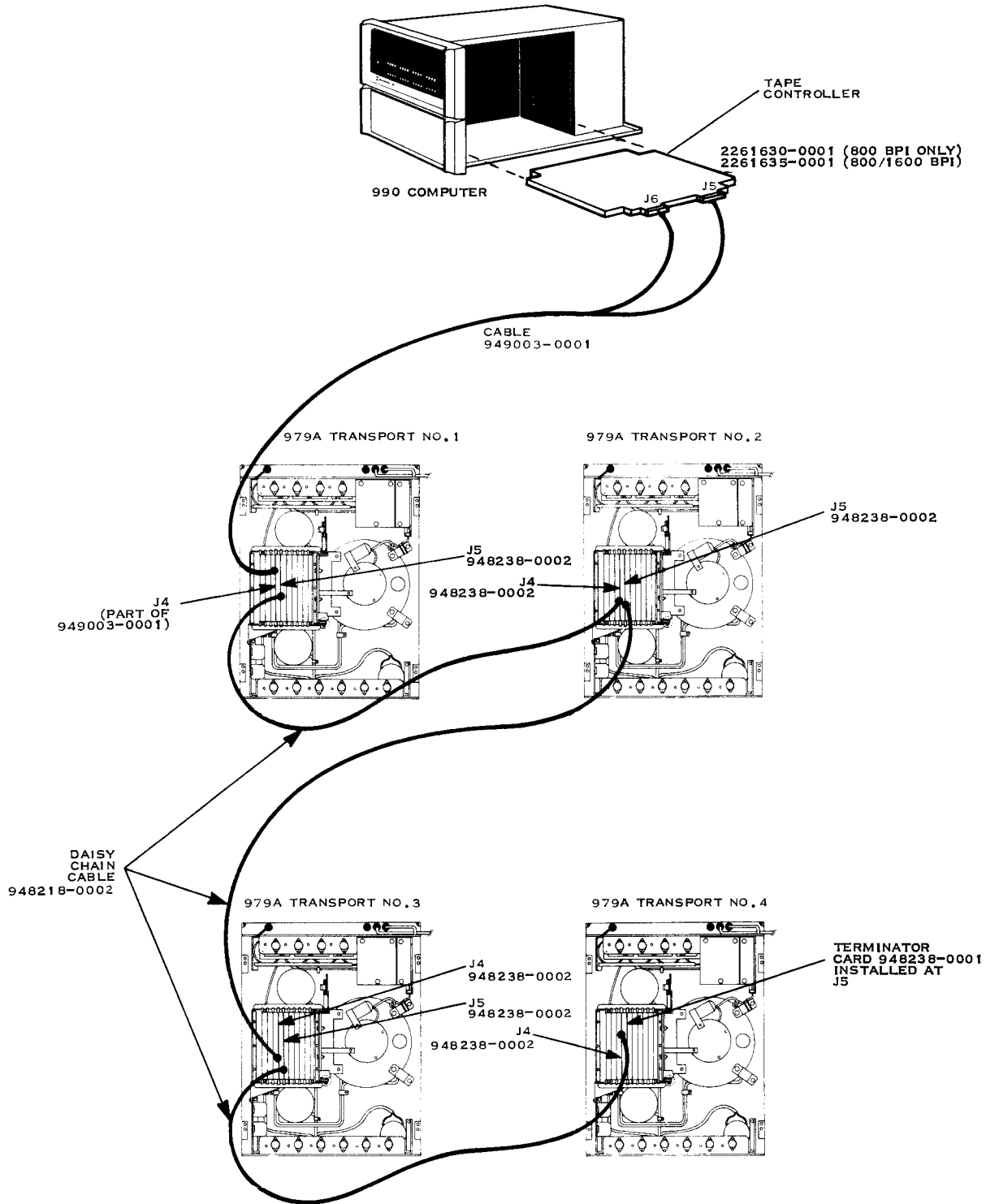
transports connect together by the daisy chain cables. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the TILINE address, and the slot location for the TILINE tape controller.

The function of the magnetic tape drive is to provide serial-access, mass data storage for the 990/10 computer. The tape drive uses an IBM-compatible tape head and guide geometry. The tapes are 1.27 millimeter (0.5 inch) on 15.24 millimeters (6 inches) to 266.7 millimeter (10.5 inches) IBM or NAB reels; the tape speed is 952.5 millimeters/second (37.5 inches/second) recording/playback. Recording on the tape is in nine tracks, including parity. For more details refer to *979A Magnetic Tape System Installation and Operation*.



133966 (979-876-6-1

Figure 1-15. Model 979A Tape Transport, Part Number 948209-00XX



(B)133959C

Figure 1-16. Multiple 979A Tape Transport System Cabling

1.4.11 Model FD800 Flexible Disk Drive

The FD800 floppy disk dual drive consists of a dual drive chassis, a controller, and associated I/O cable as shown in Figure 1-17. The controller is connected to the dual drive by the I/O cable. Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the CRU address, and the slot location for the controller.

The FD800 floppy disk dual drive functions as a random access, mass storage peripheral of the 990 computer. It will handle two single-sided diskettes that each have a standard IBM format capacity of 256K bytes with a transfer rate of 31K bytes per second. For more details refer to *FD800 Floppy Disk System with International Chassis Installation and Operation*.

1.4.12 Model FD1000 Flexible Disk Drive

The FD1000 flexible disk system (Figure 1-18) consists of a chassis containing two flexible disk drives and power supply, slide kit, a TILINE flexible disk controller (TFDC), an I/O cable and double-sided, double-density (DSDD) diskettes (the slide kit is not shown in Figure 1-18). Refer to Tables 2-3, 2-4, and 2-5 for the assignment of the interrupt level, the CRU address, and the slot location.

The FD1000 functions as a random-access, mass-storage peripheral for the 990 computer. Each DSDD diskette provides a formatted capacity of more than 1.15 megabytes at a transfer rate of 500 kilobits per second. Up to four disk drives can be used in the FD1000 system for a total formatted storage capacity of more than 4.6 megabytes. For additional information, refer to *Model FD1000 Flexible Disk System with International Chassis Installation and Operation*.

1.4.13 Communications Equipment

Texas Instruments provides the following optional interface equipment, allowing access to remote computers or terminals via the CRU interface:

- Communications Interface Module Kit, part number 946104-0001
- Bell Data Set Interface Kit, part number 946104-0002
- 990 Asynchronous Modem Kit, part number 945114-0002, -0003
- 990 Synchronous Modem Kit, part number 945094-0003
- 990 Auto-Call Unit Kit, part number 945163-0001
- 990 External Auto-Call Unit Interface Kit, part number 2263907-0001
- 990 Data Coupler (DAA) Kits, part number 2265156-0001, -0002

This equipment is compatible with U.S. domestic telephone systems. International users should consult with their Texas Instruments representative concerning communication adapters and communication protocols. For additional information, refer to the *DS990 Models 4, 6, and 8 Systems Site Preparation Manual*, and *Model 990 Computer Communications System Installation and Operation*.

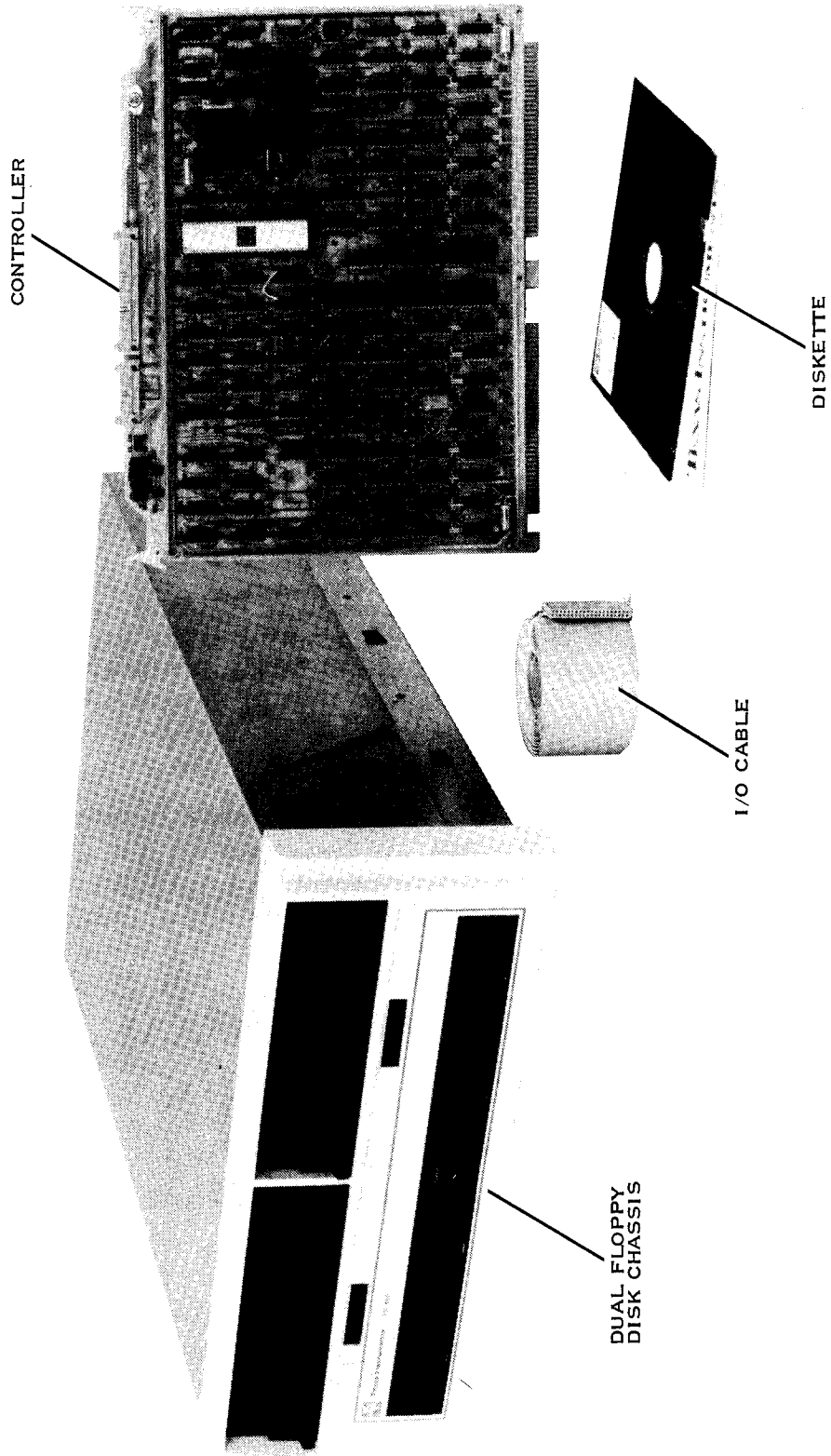


Figure 1-17. Model FD800 Floppy Disk System with International Chassis

(A)141799

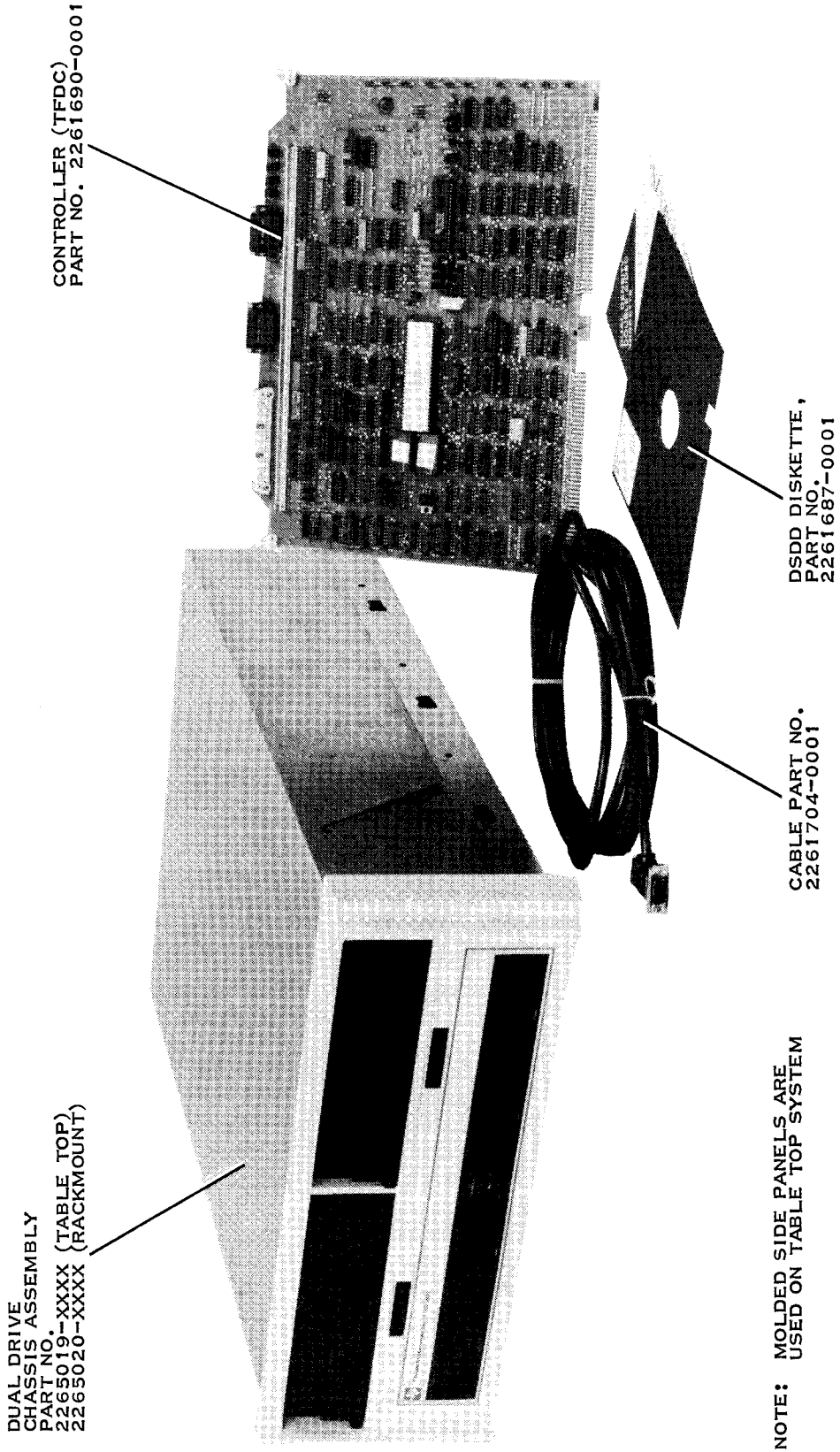


Figure 1-18. Model FD1000 Flexible Disk System with International Chassis

(A)142018

1.4.14 Rackmounting Cabinet

A 1.78-meter (70-inch) high rackmounting cabinet with a 1.6-meter (63-inch) mounting space for standard 483-millimeter (19-inch) components is available. The cabinet has removable doors, a vertical power strip, a system circuit breaker, and a 3.7-meter (12-foot) ac power cord with a 30-ampere twistlock type plug.

Cooling air is drawn into the cabinet through a large, washable aluminum filter on the rear door and exhausted by an enclosed 600-cfm fan at the top of the cabinet. A minimum 610 millimeters (24 inches) of rear clearance is required for proper air flow, and a clearance of 610 millimeters (24 inches) above the exhaust fan is also required.

The cabinet is capable of exhausting approximately 2000 watts or 6826 Btu/hour of heat with a clean air filter. When configuring cabinet layout, consider obstructions that create dead air space, start-up power for equipment such as DS10, and maximum heat load within the enclosure.

Cables and ac power enter the cabinet through a panel on the rear of the cabinet. The signal cable entry has a built-in adjustable strain-relief clamp. Ac power enters the cabinet via a recessed twistlock connector and a 3.7-meter (12-foot) heavy duty 3-wire cable, requiring a NEMA L5-30 power outlet. Power is controlled by a 20-ampere circuit breaker on the power input panel. An ac power distribution strip is mounted in the cabinet. The circuit breaker allows a 200 percent overload for 2.5 seconds.

A 610-millimeter (24-inch) arc of clear area behind the cabinet is required to open the rear door. The bottom of the door is 260 millimeters (10.25 inches) above floor level (with casters installed). Standard front to rear mounting dimension for rails is 610 millimeters (24 inches). Two cabinets can be placed side-by-side if the intervening side panels are removed to allow unrestricted air flow.

1.4.15 Single-Bay Cabinet

The single-bay cabinet is the basic element of all the office enclosures. The cabinet is 762 millimeters (30 inches) high and has 622 millimeters (24.5 inches) of EIA rackmount space. A cable slot at the rear of the work surface provides an unobtrusive cable route from desktop equipment, such as a display terminal, to the rackmounted equipment. A cable plug fills the slot if desktop to bay cabling is unnecessary.

The side and rear panels are slotted to allow sufficient movement of cooling air through the equipment bay. A minimum of 305 millimeters (12 inches) of side clearance and 152 millimeters (6 inches) of rear clearance is required for convection cooling of the equipment bay. Two cabinets can be placed side-by-side if the intervening side panels are removed to allow unrestricted air flow.

1.4.16 17-Slot Chassis for Model 8 Performance Package System

The 990/10 computer for the Model 8 performance package system is housed in the 17-slot chassis to provide more power and more chassis space. This permits using larger systems without the need for an expansion chassis, but still allows adding an expansion chassis for an even larger system if desired.

The 17-slot chassis assembly consists of a chassis and backpanel that accommodate 17 full-size logic boards, an 80-ampere power system, and a matching programmer panel. The backpanel is wired to accept the SMI board in slot 1. The other 16 slots are wired to accept one full-size logic board or two half-size logic boards in each slot.

The AU1 board usually resides in slot 2 because of short interface cables between the AU1 and SMI boards. The 24 CRU module select signals generated on the SMI board are wired to slots 6 through 17 to accommodate CRU interface boards for CRU devices such as terminals, printers, communications systems, etc.

1.4.17 13-Slot Expansion Chassis

The 13-slot expansion chassis is the same as the 13-slot computer chassis except that an operator panel is provided replacing the programmer panel. Refer to Table 2-5 for preferred expansion configurations.

1.4.18 CRU Expansion

If a computer system requires more CRU slots than are available in the main chassis, one or more 13-slot CRU expansion chassis can be added. A CRU address map for the standard expansion implementation is shown in Figure 1-19. One ribbon cable is required to connect each expansion chassis. The chassis and backpanel used in the expander chassis are identical to those used for the 305-millimeter (12-inch) main chassis. The expander board installed in the main chassis contains line drivers and receivers for the expansion cable. The buffer board installed in the expansion chassis decodes module select signals, contains buffers and receivers for the CRU address and data, and generates clock signals for the expander chassis cards. The buffer board also implements an interrupt scanner for up to 24 interrupts per expansion chassis. Software can use the interrupt scanner to construct vectored interrupts for each slot of the expander chassis, eliminating the need to poll devices to determine the source of the interrupt. For more details on the CRU, refer to the *Model 990/10 Computer System Hardware Reference Manual*.

1.4.19 TILINE Bus Expansion

Some applications of the 990/10 require more circuit cards than can physically fit into the standard 13-slot or 17-slot chassis. Both 990/10 input/output systems, the CRU interface and the TILINE, can be extended into either separate or the same additional chassis modules. The reasons for connecting multichassis systems with TILINE couplers include the following:

- Memory expansions
- TILINE peripheral expansions
- Multiprocessor applications

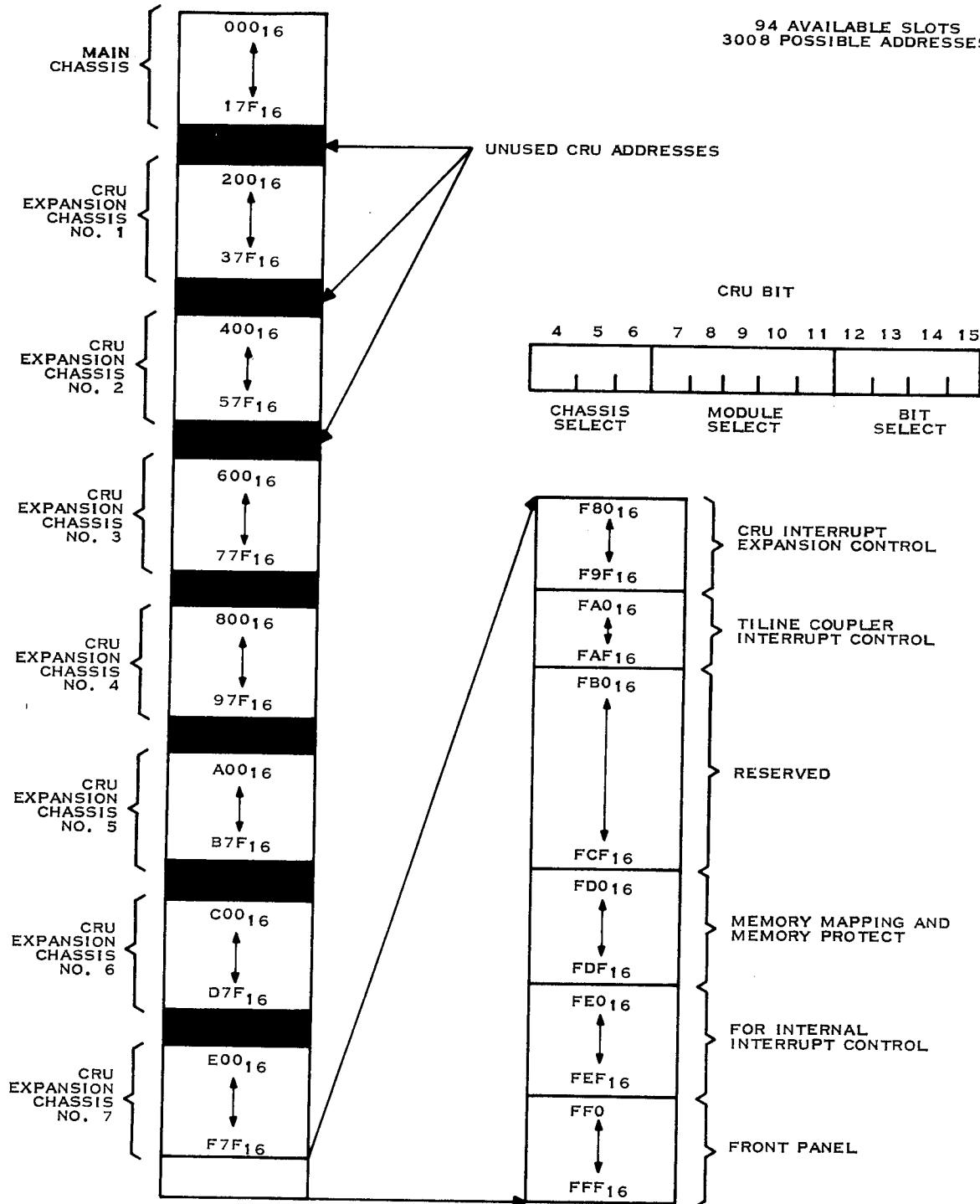
The TILINE is extended to an additional chassis by use of a TILINE coupler board in each of the two chassis and interconnecting cables.

The signal line that establishes positional priority among TILINE master devices is wired along the P2 side of the chassis and is looped through boards plugged into the chassis. The conductor in the motherboard for this signal (TLAG) shorts across all the P2 connectors (pin 5 to pin 6) except slot 1, and slot 7 in the 13-slot chassis. The first TILINE master device plugged into the chassis should go into slot 7. Additional master devices may be plugged into other slots if the jumper between pins 5 and 6 of that slot is removed. For more details on the TILINE, refer to the *Model 990/10 Computer System Hardware Reference Manual* or the *Model 990 Computer TILINE Coupler User's Guide*.

1.4.20 Memory Expansion

The number of expansion boards that may be installed in a 990/10 system is determined by the

94 AVAILABLE SLOTS
3008 POSSIBLE ADDRESSES



NOTE: THESE ADDRESSES ARE ABSOLUTE CRU ADDRESSES AS THEY APPEAR ON THE CRUBIT4-15 LINES. AN ABSOLUTE CRU ADDRESS IS HALF THE VALUE OF THE CRU BASE ADDRESS IN WORKSPACE REGISTER W12.

(A)133133A

Figure 1-19. CRU Absolute Address Map for Standard Expansion Implementation

number of TILINE slots in the chassis and by the maximum addressing capability of the 990/10 (2048K bytes with mapping).

The memory expansion boards communicate with the CPU via the TILINE high-speed parallel data bus. Motherboard wiring carries the TILINE signals between the chassis slot connectors of the CPU and the other board positions of the chassis.

Memory boards are addressed in blocks of consecutive addresses. The board starting address is set by pencil switches on the board to any 16K word boundary in the address space. The address switches correspond to the eight most significant bits (MSBs) of the 20-bit TILINE address. The upper limit address is the starting address plus the storage capacity of the board. Size strapping that corresponds to the board storage capacity is installed at the time of manufacture. Refer to *Model 990/10 Computer System Hardware Reference Manual* for additional details.

1.4.21 Cache Controller

The cache controller is a printed circuit board that contains all memory control logic, storage elements for 64K bytes of primary memory and 2K bytes of cache memory. It also contains the control logic for up to 1 megabyte of expansion memory on associated add-on memory array boards. Up to four of the 256K bytes add-on memory array boards may be controlled by the cache controller. Cycle control and refresh control for the add-on array boards are provided by the cache controller.

The cache controller uses a cache technique to improve the effective operating speed of primary memory. Under the cache concept, frequently used data is copied from the relatively slow primary memory into a small, fast cache memory. Subsequent requests for data residing in the cache memory can be honored faster than data from primary memory, resulting in a shorter average memory response time.

1.5 SOFTWARE DESCRIPTIONS

The following paragraphs give a brief physical and functional description of all base and optional software. The following items are covered:

- DX10 operating system
- DX10 COBOL
- DX10 FORTRAN
- DX10 990 BASIC
- DX10 Sort/Merge
- TI 990 Pascal
- RPG II
- DBMS-990
- QUERY-990

- DX10 3270 ICS
- TIFORM
- DX10 2780/3780 Emulator

1.5.1 DX10 Operating System

DX10 is a general purpose, multitasking operating system designed to operate on the Texas Instruments 990/10 minicomputer. DX10 is a versatile operating system capable of supporting a wide range of commercial and industrial applications. It is a disk-based operating system featuring a powerful file management package, including multikey indexed files. DX10 is interactively oriented although a batch mode is also supported. It is also a multiterminal system capable of making each of several users appear to have exclusive control of the system.

In addition to providing multiterminal application support, DX10 features advanced program development support. A text editor is provided to enter source programs or data into the system. A macro assembler is provided for assembly language programs. Higher level language support is available for several languages. A link editor as well as debugging facilities are provided to further support development. A variety of utility programs and a comprehensive sort/merge package are supported.

The DX10 licensed software package includes manuals and a programmed disk and is available as follows:

- Part number 936047-0010 for the DS10 disk system
- Part number 936047-0005 for the DS25 disk system
- Part number 936047-0006 for the DS50 disk system

Refer to Section 2 of this manual for a detailed inventory of the above software packages.

1.5.2 COBOL

COBOL is a high-level computer language that allows problems to be stated in words and syntax similar to the English language. COBOL consists of a set of English words and symbols that the programmer may use to define the problem and to create a program to solve that problem. Because of its similarity to English, programs written in COBOL are almost self-documenting, and the time required to train a new programmer in the language is greatly reduced.

The COBOL compiler conforms to the ANSI COBOL subset as defined in ANSI document X3.23-1974 and incorporates extensions to this subset to provide added capabilities. The compiler package employs the following ANSI 74 standard COBOL modules at the level indicated.

Features

Level 1	Level 1 + *
Segmentation	Nucleus Table Handling
Library	Sequential I/O
Inter-Program Communications	Relative I/O Indexed I/O
* Selected features from level 2	

The debug and accept/display modules are nonstandard but are designed for ease of use on VDTs.

COBOL programs may be executed directly with system command interpreter (SCI) execute COBOL commands, or they may be link-edited and installed in DX10 program files.

1.5.3 FORTRAN

FORTRAN is an easy to use, high-level computer language that allows complex problems to be stated in common mathematical expressions for input to the computer. FORTRAN programs must be processed by a FORTRAN compiler program and a link edit is required to join the compiled program with runtime support and called subroutines.

The FORTRAN compiler for the Texas Instruments Model 990 Computer translates FORTRAN language input code into Model 990 computer machine code. The FORTRAN compiler conforms to the ANSI standard FORTRAN, or FORTRAN IV. The compiler also incorporates the extensions recommended by the Instrument Society of America in their document ISA-S-61.1, 1975 and in their document ISA-61.2, 1976.

Texas Instruments has incorporated several useful attributes into the FORTRAN compiler that enable more effective coding and program development. These added features include the following:

- Direct disk I/O
- Overlapped I/O
- Free format source input
- Internal data manipulation statements
- Literal character strings represented in quotes
- Variable names of any length

- Double-word (32-bit) integer data type
- Implicit variable typing
- General integer expressions in subscripts
- Data statement array names
- Mixed mode expressions
- Hollerith and hexadecimal constants and assignments
- Scaled binary data types
- Copy directives
- Accept and display directives for interfacing with a VDT

Optionally, the compiler can generate a cross reference listing for each variable in the program, provide a debug module that references specific line numbers in the source program input during execution, provide a list of generated object code in readable form, provide conditional compilation, allow free format, and generate assembly language source code.

A FORTRAN function library is provided that includes all intrinsic functions and the basic external functions defined in the ANSI standard. This library contains all run-time support to interface with the DX10 operating system. In addition, several generally useful routines such as a random number generator are provided. Additional libraries are provided to allow execution of FORTRAN programs under the TX990 and TX5 operating systems or in a stand-alone mode. These are particularly effective for DX10 users who are cross-supporting smaller 990 configurations.

1.5.4 DX10 990 BASIC

DX10 990 BASIC is a business-oriented, interpretive, interactive computer language. The interpreter conforms to the ANSI minimal standard (X3.60-1978) with extensions to enhance its use in business application. Users of DX10 990 BASIC benefit from simple statements and operator commands that facilitate the development and execution of commercial applications on the DS990 systems. Programs are developed through prompted input of program statements and system commands on the system interactive device. Programs may be either executed interactively by the operator through keyboard control on a line-by-line basis or may be stored for later execution as an application program. DX10 990 BASIC supports a multiuser application environment with up to four workstations on the DS990 systems. Program development is in a single-user environment only. For more details, refer to the *TI 990 BASIC Reference Manual*.

1.5.5 Sort/Merge

The DX10 system supports a comprehensive Sort/Merge package that may be accessed in several ways. The SCI provides commands to access Sort/Merge in batch or interactive mode. COBOL, FORTRAN, and BASIC programs may interface to Sort/Merge by using the CALL statement. Both Sort and Merge support the following features:

- Record selection

- Reformatting on input
- Summarizing on output

Ascending key order, descending key order, or an alternate collating sequence may be specified. Any number of keys may be specified as long as their total length is less than 256 characters. The Merge process supports up to five input files. The Sort process allows the following:

- Key sort (tag-along)
- Summary sort (summary tag-along)
- Address-only sort

Figure 1-20 shows an example of the Sort/Merge process with printouts of results at each step. Additional information describing Sort/Merge is found in the *Model 990 Computer Sort/Merge User's Guide*.

1.5.6 PASCAL

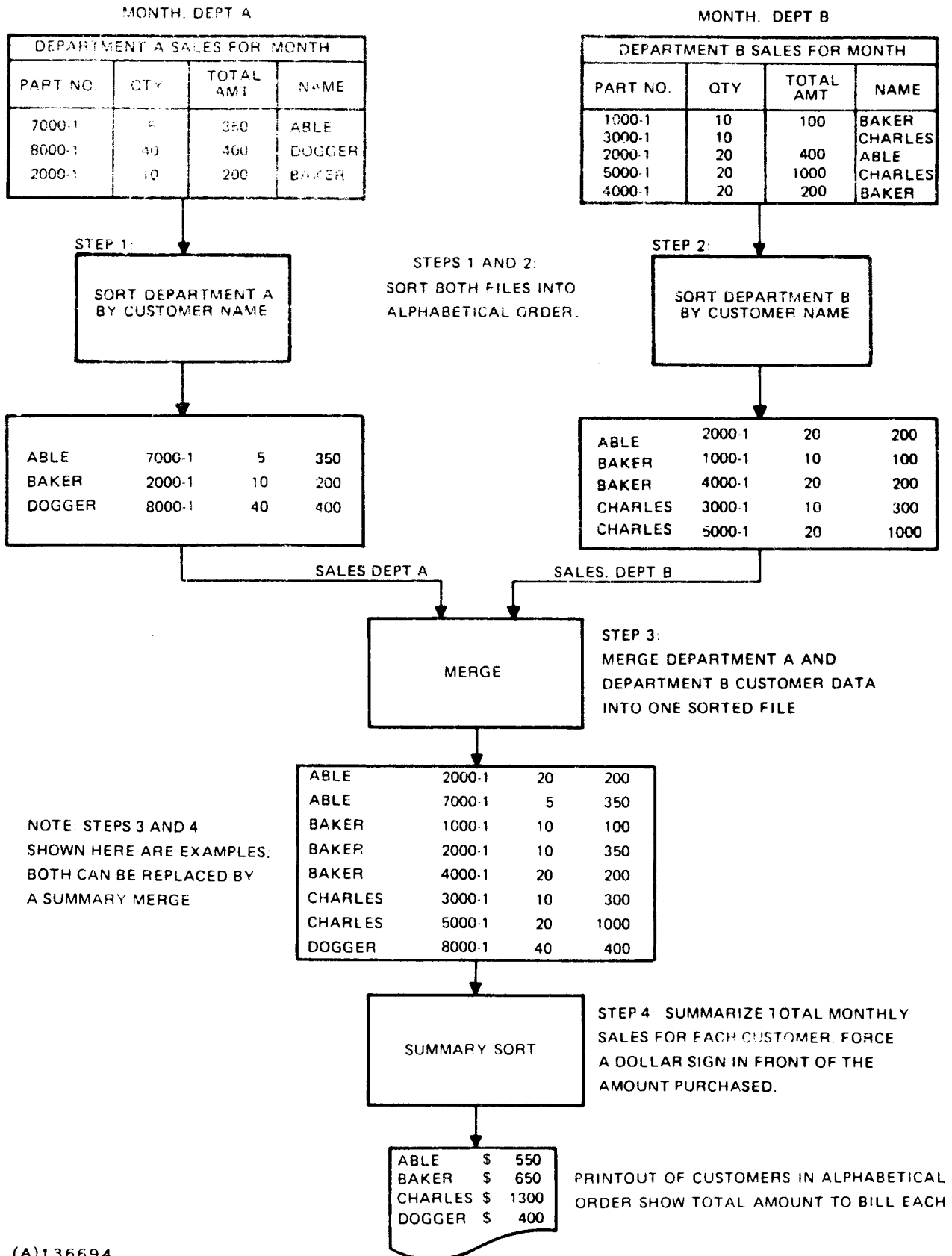
Texas Instruments version of Pascal for the 990 computer is a general-purpose language well suited for a variety of applications. Originally designed as a language for teaching a systematic concept of programming, Pascal is straightforward to learn and to use. Its readability makes the language especially useful when programs must be maintained by users other than the original author.

A popular application of Pascal is the development of systems software. The Pascal compiler is itself written in Pascal as are a number of other 990-system software modules. Pascal is also ideal for scientific or engineering applications that traditionally are written in FORTRAN or ALGOL. Its general-purpose structure is even useful for many business problems, although Pascal is seldom found in this application.

Some of the more significant features of Pascal include:

- Block-structured format that directly supports structured programming concepts
- Stack allocation of variables for each routine
- Recursive routines
- User-defined data structures that are adaptable to data used in application
- User-defined data types and type checking
- Excellent bit-manipulation capability.

Texas Instruments version of Pascal is closely compatible with the standard Pascal as defined by Jensen and Wirth in their *Pascal User Manual and Report*. For additional information regarding Texas Instruments version of Pascal, refer to the *Model 990 Computer TI Pascal User's Manual*.



(A)136694

Figure 1-20. Sort/Merge Process Showing Printouts of Results of Each Step

1.5.7 Report Program Generator, Version II (RPG II)

RPG II is an easy-to-use, high-level language for business data processing. Based upon a predetermined sequence that reads a record, processes the data, and outputs the results, RPG II is especially suited for applications requiring file maintenance or report generation. A series of six basic specification formats is used to input the specific actions to be taken within the RPG II sequence of execution.

Texas Instruments version of the RPG II language is closely compatible with the widely used IBM System/3 RPG II. Extensions of many of the System/3 features have been included in RPG II to provide more flexible programming. A utility program is provided with RPG II to copy System/3 or System/32 source programs or files from diskette to DS990 files.

The RPG II package also includes an RPG II-oriented VDT text editor and a trace feature that prints each major step occurring during execution of an RPG II program. A System/3-compatible sort/merge capability is provided by the optional Sort/Merge package, and communication of RPG II files is available through the optional DX10 3780 emulator package.

The RPG II compiler has the following significant features:

- Efficient one-pass compiler
- Run-time trace that speeds the checking of the program
- Right- or left-hand sign handling
- ASCII or EBCDIC internal character set
- Capability to produce more than 500 unique diagnostic messages
- Alphabetic summary listing of all fields, labels, arrays, and tables
- Listing of all indicators specified in a program.

For additional information regarding the Texas Instruments version of RPG II, refer to the *Model 990 Computer Report Program Generator (RPG II) Programmer's Guide*.

1.5.8 Data Base Management System (DBMS)

The DBMS-990 is designed for minicomputer data-base applications. Some of its major features are as follows:

- Fast data access
- Data access in logical format
- Format easily equated with physical documents or records
- No program constraints due to physical considerations such as record size, blocking, and relative field positions.

The physical considerations are resolved by the user when the data base is initially defined. Thus, the user can concentrate fully on the logical data formats needed for interface.

The independence of the data format definitions from the application software allows modification of the data base without impact to existing programs. It also provides a single, centralized copy of the data for all application subsystems. (Conventional file management provides fragmented and multiple copies of data held in a wide variety of files, each file used by only one application.) This centralized copy results in more efficient data storage on disk, uniform processing of data requests, and centralized control of the data-base maintenance function. In addition, DBMS-990 provides optional password security for the most elementary data level; this provides control and protection of the data base from unauthorized access or tampering.

For additional information regarding the DBMS-990, refer to the *Model 990 Computer Data Base Management System Programmer's Guide*.

1.5.9 Query-990

Query-990 is an easy-to-use data processing tool that combines interactive data accessing with reporting. Coupled with DBMS-990, Query-990 enhances both access to, and utilization of, a firm's data-base resources. Users who are unfamiliar with programming languages such as COBOL, FORTRAN and Pascal can easily learn Query-990. The incorporation of concise and powerful English-like commands results in Query-990's simplicity.

Simplified access to data encourages greater use of data resources by authorized personnel. Outside users directly developing and satisfying many of their own information requests reduce reliance on the programming staff for reports and analysis.

Programmers will find Query-990 to be a convenient and powerful software development utility. Program debugging and testing is made easy and comprehensive through Query-990. Programmers are able to alter the DBMS-990 data base via application programs written in a host language (COBOL, FORTRAN, or Pascal) and then can check these alterations using Query-990.

When viewing data on a 911 VDT or in printed report form, Query-990 spares the user the programming detail necessary in other computer languages. Programming in areas such as editing, end of file, relative data position, file structure and data type is eliminated.

Query-990 users can use either of two types of information requests: input query and guided query. Input query incorporates every feature of Query-990. Guided query is a subset of input query. Interactively via VDTs, guided query prompts users for the minimum information required to fulfill a user request. For additional information, refer to the *Query-990 User's Guide*.

1.5.10 DX10 3270 ICS

The 990 DX10 3270 interactive communication software (ICS) provides the DS990 family of minicomputer systems with a means of interactive remote communications with an IBM host computer. A complete functional information display system for alphanumeric display applications is provided by emulating a subset of the IBM 3270 system. This includes emulation of a 3271 control unit, 3277 display station/keyboards, and 3284 printers.

The 990 ICS operates under control of the DX10 system software. Any combination of eight emulated display stations and printers may operate in a DX10 multitasking environment using local 911 VDTs and DX10-supported printers.

User-supplied tasks may be developed to assume the identity of an emulated station. Run-time packages are available for FORTRAN, COBOL, Pascal and 990 assembly language. These

packages provide control of the station, operate on its display fields and invoke the reception and transmission of data.

For additional details, refer to the *Model 990/10 DX10/3270 Information Display System Emulator Operator's Manual*.

1.5.11 TIFORM

The Texas Instruments form-generating software package, TIFORM, is a powerful means of controlling the I/O formats of a VDT. It permits the application programmer to design applications without regard for the physical characteristics of the VDT. TIFORM also provides editing facilities for the input and controls the display characteristics of the output. These facilities free the application program from terminal management and provide a high degree of form design flexibility. The screen formats and their components and attributes, collectively, are called a form. A form may consist of one formatted screen or several screens that are logically related. A form can be modified or installed on a different terminal supported by the DX10 operating system without affecting the data processing application.

TIFORM is easily understood and used. However, the user of TIFORM is assumed to be an experienced programmer or someone well acquainted with the concepts and language of data processing. TIFORM interfaces with three procedural languages: COBOL, FORTRAN and Pascal. The description of the application interface assumes that the reader has some familiarity with COBOL.

Designed to be implemented on Texas Instruments 990 minicomputers with a minimum of 128 kilobytes of memory, TIFORM operates under the supervision of the DX10 Release 3 Operating System. For additional information, refer to the *Model 990 Computer TIFORM Reference Manual*.

1.5.12 DX10 3780/2780 Emulator

The DX10 3780/2780 emulator communications package provides a remote job entry, binary synchronous communications capability with an IBM 360/370 or other host computer equipped with 3780 or 2780 communications software. Communication between two 990 computer systems is supported if both are equipped with 3780/2780 emulator software. Communications consists of exchanging data files between master and slave stations over leased point-to-point or switched telephone lines. Data transmission is in EBCDIC (conversion to ASCII is transparent to the user) in half-duplex mode at selectable line speeds of up to 9600 bits per second (bps). Unattended operation is provided over switched lines, and either 990 emulator system may be operated as a host or a slave station. For additional information, refer to the *DX10 3780/2780 Emulator User's Guide*.

1.6 SPECIFICATIONS

For the DS990 Models 4, 6, and 8 systems general specifications, refer to the *DS990 Models 4, 6, and 8 Systems Site Preparation Manual*.

Table 1-3 presents dc power available with the 13-slot and 17-slot primary chassis and the 13-slot expansion chassis. Table 1-4 presents the dc power requirements for various memory and equipment configurations.

Table 1-3 can be used to determine the power available from the power supplies of each specific chassis. Table 1-4 can be used to determine the amount of power required with the present system configuration. By subtracting the values of power required (determined from Table 1-4) from the power available (determined from Table 1-3), the power available for adding components to the

system can be determined. This procedure will also prevent inadvertent overloading of the system and indicate when it is necessary to add an expansion chassis and power supply.

Table 1-3. 990 Chassis Dc Power Availability

Description	Panel	Standby Power	Vacant ⁴ Chassis Slots Per Unit	Dc Power Per Unit Available Current in Amps			
				+ 5 V ²		+ 12 V ²	
				Main	Mem ¹	Main	Mem ¹
13-Slot Chassis with mapped 990/10	Programmer	Without	11	31.5	0	4.00	0
	Programmer	With	11	31.5	2.50	4.00	4.00
17-Slot Chassis with mapped 990/10 (80 Amp power supply) ³	Programmer	Without	15	71.5	0	6.00	0
13-Slot CRU Expansion ⁵ Chassis	Operator	—	12	39.1	0	4.00	0
13-Slot TILINE Expansion Chassis	Operator	—	12	38.8	0	4.00	0
13-Slot CRU and TILINE Expansion Chassis ⁵	Operator	—	11	37.9	0	4.00	0

Notes:

- ¹ Dc current available from standby power supply for protection of volatile memory.
- ² Available negative (–) power is not shown because normally the positive (+) power supply will be overloaded before it is possible to overload the negative power supply.
- ³ An additional 40 Amp +5 V or 6 Amp ± 12 V power supply module can be installed.
- ⁴ Some vacant slots are not always usable.
- ⁵ Includes CRU buffer PCB.

Table 1-4. Dc Power Requirements for Various Memory and Equipment Configurations

Description	Chassis Slots Required Per Unit	Dc Power Per Unit Current Required in Amps			
		+ 5 V ²		+ 12 V ²	
		Main	Mem ³	Main	Mem ³
128K-byte EC Memory Subsystem	2	2.30	0.95	0	0.91
192K-byte EC Memory Subsystem	2	2.31	0.95	0	1.00
256K-byte EC Memory Subsystem	2	2.32	0.95	0	1.09
For Cache Memory Subsystems add	0	5.00	0	0	0
FD800 Diskette Master Kits	1	3.00	0	0.20	0
FD1000 Diskette Master Kits	1	4.50	0	0.20	0
DS10 Master Kits ¹	1	6.00	0	0	0
DS25 Master Kit ¹	1	8.00	0	0	0
DS50 Master Kit ¹	1	8.00	0	0	0
DS200 Master Kit ¹	1	8.00	0	0	0
979A Master Kit, 800 bpi ¹	1	5.00	0	0	0
979A Master Kit, 800/1600 bpi ¹	1	7.00	0	0	0
911 VDT Kit, Dual Display Controller	1	4.20	0	0.24	0

Notes:

¹ No additional dc power required for secondary kit.

² Negative (–) power requirements are not shown because normally the positive (+) power supply will be overloaded before it is possible to overload the negative power supply.

³ Dc current required of standby power supply for protection of volatile memory.

Table 1-4. Dc Power Requirements for Various Memory and Equipment Configurations (Continued)

Description	Chassis Slots Required Per Unit	Dc Power Per Unit Current Required in Amps			
		+ 5 V ²		+ 12 V ²	
		Main	Mem ³	Main	Mem ³
743 Master Kit	.5	0.38	0	0.02	0
810 Printer Master Kit	.5	0.38	0	0.02	0
820 KSR Master Kit	.5	0.38	0	0.02	0
2230/2260 Printer Master Kit	.5	0.53	0	0.00	0
804 Card Reader Master Kit	.5	0.60	0	0	0
TTY/EIA Interface Module	.5	0.38	0	0.02	0
990 Communication Interface Module	.5	1.50	0	0.10	0
Bell Data Set Interface Kit	.5	1.50	0	0.10	0
990 Asynchronous Modem Kit	.5	0.15	0	0.15	0
990 Synchronous Modem Kit	.5	0.20		0.20	
External ACU Interface Module	.5	1.00	0	0.10	0
Internal ACU Module	.5	1.00	0	0.10	0
CRU Expander	1	0.90	0	0	0
TILINE Coupler	1	1.20	0	0	0

Note:

² Negative (–) power requirements are not shown because normally the positive (+) power supply will be overloaded before it is possible to overload the negative power supply.

³ Dc current required for standby power supply for protection of volatile memory.

Installation

2.1 INTRODUCTION

This section provides instructions for the installation and checkout of the standard desk or cabinet DS990 systems. These instructions should also be used as a guide when installing and testing DS990 system optional equipment.

2.2 SITE PLANNING

Site planning consists of determining the power, space, and environmental requirements of the system. The general requirements for the standard systems are discussed in the following paragraphs. When optional equipment is used with a DS990 system, requirement variations can be determined from the specifications given in the *DS990 Model/s 4, 6, and 8 Systems Site Preparation Manual*. External power and data cables for peripherals must be routed to eliminate physical damage.

2.2.1 Power Requirements

The equipment power cables at a standard desk or cabinet system are normally plugged into the power outlet strip within the enclosure. Power is supplied to the power outlet strip in the desk or cabinet over a single cable and circuit breaker. Refer to the *DS990 Models 4, 6, and 8 Systems Site Preparation Manual* for additional information on power requirements.

No other equipment should be connected to the source supplying power to the system. The ac power supplied must be clean and free from noise. Electrically noisy equipment such as copying machines, fluorescent lights, and motors should be located away from the system and on different ac power circuits.

WARNING

For personnel and equipment safety, make certain the wall outlet for the desk or cabinet input ac power has a separate ground terminal (third lead) that is in fact an earth ground. The wall outlet installation should also meet all national and local electrical code requirements.

Due to their high starting current, a separate power circuit must be provided for the DS25/50 disk drives. This power circuit must be capable of supplying a minimum starting current of 26 A for 12 seconds at 100 to 127 Vac or 13 A for 12 seconds at 162 to 264 Vac.

CAUTION

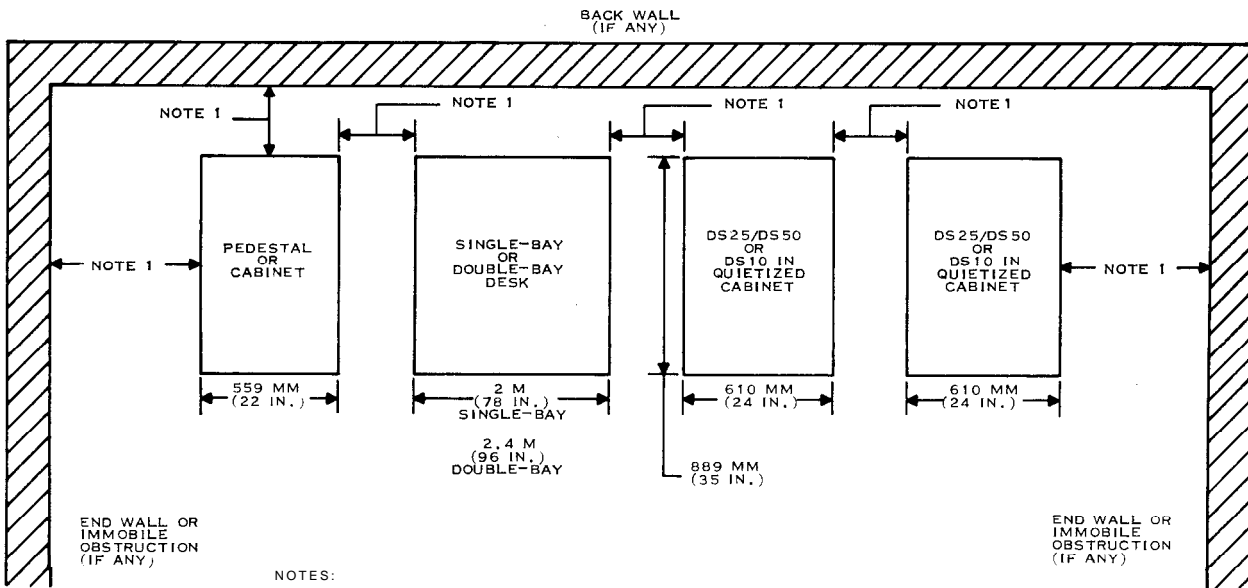
If any ac power extension cables are used, make sure they have the proper power ratings and are approved by UL, VDE, or other appropriate standards organizations. Cables should be routed to avoid physical damage.

2.2.2 Space Requirements

Space required for the system is determined by the equipment dimensions, air circulation requirements, and the amount of room required by operating and maintenance personnel (see Figure 2-1). Refer to the *DS990 Models 4, 6, and 8 Systems Site Preparation Manual* for equipment dimensions. For proper air circulation, the desk and cabinet enclosures containing the computer and electronic equipment require 300 millimeters (12 inches) of clearance (see Figure 2-1). The space required by operating and maintenance personnel is determined by local conditions.

CAUTION

Do not place furnishings or structures immediately adjacent to the enclosures or rack ends; this will prevent proper air circulation through the equipment.



NOTES:

1. REFER TO THE DS990 MODELS 4, 6, AND 8 SYSTEMS SITE PREPARATION MANUAL FOR CLEARANCE TO WALL AND ADJACENT EQUIPMENT.
2. ROOM SHOULD BE ALLOWED TO PULL THE EQUIPMENT APPROXIMATELY 1000 MILLIMETRES (39 INCHES) FROM THE WALL FOR SERVICE ACCESS.
3. MEASUREMENTS TO THE END WALL ARE WITH RESPECT TO THE LAST EQUIPMENT UNIT ON THAT END OF THE DS990 SYSTEM.

(B) 140205A

Figure 2-1. Space Requirements for DS990 Enclosures

2.2.3 Environmental Requirements

As the system components have been equipped with fans for air circulation, if site conditions are reasonably open and air-conditioned, they require no additional air conditioning. If the system is to be set up in a small enclosed office, however, verify that the ambient air temperature will stay in the range of 16 to 32 degrees Celsius (60 to 90 degrees Fahrenheit). The relative humidity may range from 20% to 80% (noncondensing). To determine the overall Btus per hour a particular system with options will add to the heat load of a site's air conditioning system, refer to the *DS990 Models 4, 6, and 8 Systems Site Preparation Manual*.

2.2.4 Parts List

Table 2-1 provides a consolidated parts list for DS990 Models 4, 6, and 8 base systems and for DS990 Models 4 and 8 Performance Package Systems. This table may be used for inventorying the equipment while unpacking the system.

NOTE

Texas Instruments recommends supplies available from our current price list. TI will not be responsible for equipment malfunctions due to the use of disk packs, magnetic tapes, or other supplies not meeting Texas Instruments specifications.

Table 2-1. **DS990** Models 4, 6, and 6 Consolidated Parts List

Quantity	Part Number	Description
1	937498-0001	Desk (100 V, 50160 Hz or 115 V, 60 Hz single-bay desk systems)
1	937498-0002	Desk (220 V to 240 V, 50 Hz single-bay desk systems)
1	946738-0001	Desk (100 V, 50160 Hz or 115 V, 60 Hz double-bay desk systems), Model 4 only
1	946738-0002	Desk (220 V to 240 V, 50 Hz double-bay desk systems), Model 4 only
1	937528-0001	762-mm(30-in.) cabinet (100 V, 50160 Hz or 115 V, 60 Hz)
1	937528-0002	762-mm(30-in.) cabinet (220 V to 240 V, 50 Hz)
1	973730-0001	1.78-m (70-in.) cabinet (115 V, 60 Hz)
1	973730-0002	1.78-m (70-in.) cabinet (220 V to 240 V, 50 Hz)
1	945050-0024	13-slot computer chassis with 40 A power supply and programmer panel (115 V, 60 Hz systems)
1	945050-0034	13-slot computer chassis with 40 A power supply and programmer panel (220 V, 50 Hz systems)

Table 2-1. **DS990** Models 4, 6, and 6 Consolidated Parts List (Continued)

Quantity	Part Number	Description
1	945050-0026	13-slot computer chassis with 40 A power supply and programmer panel (240 V, 50 Hz systems)
1	945050-0025	13-slot computer chassis with 40 A power supply and programmer panel (100 V, 50160 Hz systems)
1	2265251-0001	17-slot computer chassis with 80 A power supply and programmer panel (100 V, 50160 Hz systems), Model 8 performance package only
1	2265251-0002	17-slot computer chassis with 80 A power supply and programmer panel (115 V, 50160 Hz systems), Model 8 performance package only
1	2265251-0003	17-slot computer chassis with 80 A power supply and programmer panel (200 V, 50160 Hz systems), Model 8 performance package only
1	2265251-0004	17-slot computer chassis with 80 A power supply and programmer panel (208 V, 50160 Hz systems), Model 8 performance package only
1	2265251-0005	17-slot computer chassis with 80 A power supply and programmer panel (220 V, 50160 Hz systems), Model 8 performance package only
1	226525 I-0006	17-slot computer chassis with 80 A power supply and programmer panel (240 V, 50160 Hz systems), Model 8 performance package only
1	945127-0001	Chassis slide kit
1	944930-0001	990110 AU1 arithmetic unit circuit board
1	944950-0001	990110 SMI/M interface board with mapping
1	2261990-0001	990 cache controller (Models 4 and 8 performance package only)
1	2261980-0003	990/10 EC 64K bytes memory controller board
1	2261980-0004	990110 EC 96K bytes memory controller board
1	948955-0001	990110 EC 64K bytes expansion memory board
1	948955-0002	990110 EC 128K bytes expansion memory board
1	948955-0003	990110 EC 192K bytes expansion memory board
1	948955-0004	990110 EC 256K bytes expansion memory board

Table 2-1. DS990 Models 4, 6, and 6 Consolidated Parts List (Continued)

Quantity	Part Number	Description
2	936401-0001	Cable assembly, memory expansion
1	945134-0014	DX10 loader ROMs for 990110 SMI/M interface board
1	945134-0019	DX10 loader ROMs for 990/10 SMI/M interface board
1	937513-0001	DS10 disk drive chassis (115 V, 60 Hz systems), Model 4 only
1	937513-0010	DS10 disk drive chassis (240 V, 50 Hz systems), Model 4 only
1	937513-0009	DS10 disk drive chassis (220 V, 50 Hz systems), Model 4 only
1	937513-0003	DS10 disk drive chassis (100 V, 50 Hz systems), Model 4 only
1	937513-0002	DS10 disk drive chassis (100 V, 60 Hz systems), Model 4 only
1	937505-0001	DS10 disk controller, Model 4 only
1	937515-0001	DS10 40-pin cable, 6.1 m (20 ft), Model 4 only
1	937515-0003	DS10 40-pin cable, 3 m (10 ft), Model 4 only
1	937516-0001	DS10 50-pin cable, 6.1 m (20 ft), Model 4 only
1	937516-0003	DS10 50-pin cable, 3 m (10 ft), Model 4 only
1	937510-0001	DS10 cable adapter, Model 4 only
1	940065-0002	DS25 disk controller, Model 6 only
1	940065-0001	DS50 disk controller, Model 8 only
2	947524-0007	DS25 disk drive, (100 V to 127 V, 60 Hz systems), Model 6 only
2	947524-0008	DS25 disk drive, (100 V to 127 V, 50 Hz systems), Model 6 only
2	947524-0012	DS25 disk drive, (190 V to 240 V, 50 Hz systems), Model 6 only
2	947524-0001	DS50 disk drive, (115 V, 60 Hz systems), Model 8 only
2	947524-0002	DS50 disk drive, (100 V to 127 V, 50 Hz systems), Model 8 only

Table 2-1. DS990 Models 4, 6, and 8 Consolidated Parts List (Continued)

Quantity	Part Number	Description
2	947524-0006	DS50 disk drive, (190 V to 240 V, 50 Hz systems), Model 8 only
1	947587-0001	DS25/DS50 bus cable, Models 6 and 8 only
2	947616-0001	DS25/DS50 radial cable, Models 6 and 8 only
1	947528-0001	DS25/DS50 signal terminator assembly, Models 6 and 8 only
1	947589-0002	DS25/DS50 daisy chain cable, Models 8 and 8 only
2	947535-0001	DS25/DS50 console stand, Models 6 and 8 only
1	946075-0001	911 VDU (115 V, 80 Hz systems)
1	946075-0002	911 VDU (100 V, 50 Hz system)
1	946075-0003	911 VDU (220 V, 50 Hz systems)
1	946075-0004	911 VDU (240 V, 50 Hz systems)
1	946075-0005	911 VDU (100 V, 60 Hz systems)
1	946076-0005	911 dual controller with graphics, 60 Hz United States
1	946076-0011	911 dual controller with graphics, 50 Hz, United States and French
1	946076-0111	911 dual controller with graphics, 50 Hz, Great Britain
1	946076-0211	911 dual controller with graphics, 50 Hz, Germany
1	946076-0311	911 dual controller with graphics, 50 Hz, Denmark/Norway
1	946076-0411	911 dual controller with graphics, 50 Hz Sweden/Finland
1	2263490-0003	911 dual controller with graphics, 60 Hz, Japan
1	2263490-0007	911 dual controller with graphics, 50 Hz, Japan
1	948561-0001	911 I/O cable, VDU to controller
1	936500-0001	911 I/O cable, VDU to controller, German keyboard only
1	948560-0001	911 keyboard, United States
1	948560-0002	911 keyboard, Japan
1	948560-0003	911 keyboard, Great Britain
1	948560-0004	911 keyboard, France

Table 2-1. DS990 Models 4, 6, and 6 Consolidated Parts List (Continued)

Quantity	Part Number	Description
1	948560-0005	911 keyboard, Germany
1	948560-0006	911 keyboard, Sweden/Finland
1	948560-0007	911 keyboard, Denmark/Norway
1	2250442-0110	Software documentation package (hardware systems), Model 4 only
1	2250442-0105	Software documentation package (hardware systems), Model 6 only
1	2250442-0106	Software documentation package (hardware systems), Model 8 only
1	939475-0001	DS990 letter package
1	942931-0001	CPU letter package
1	944904-0013	Card cage configuration label
—	945130-XXXX	Blank front panel as appropriate
2	9400450001	Center card guide kit
1	996745-0001	Cable carrier (quantity 2 for Model 4 only)

2.3 UNPACKING AND ASSEMBLY (STANDARD EQUIPMENT)

The following paragraphs provide separate unpacking and assembly instructions for the equipment shipped in enclosures and the equipment shipped separately. The unpacking instructions provided here are for record purposes only. The *DS990 Models 4, 6, and 8 Systems Unpacking and Inventory Guide* found in the **letter packet** fastened to the outside of the shipping crates should be used when unpacking and inventorying the system.

2.3.1 System Unpacking and Assembly

Unpack and assemble the single-bay desk, double-bay desk, cabinet, or chassis options in accordance with the following paragraphs.

2.3.1.1 System Unpacking instructions. The following steps include unpacking, inspection, and inventory instructions for the **DS990** Models 4, 6, and 8 enclosure kits. While proceeding through these steps, visually inspect the individual shipping containers and the unpacked components for shipping damage. Report any shipping damage and/or missing components in accordance with local practices and procedures. No equipment, software, or manuals will be in the crate for the **1.78-meter (70-inch)** cabinet. Unpack the desk kit as follows:

CAUTION

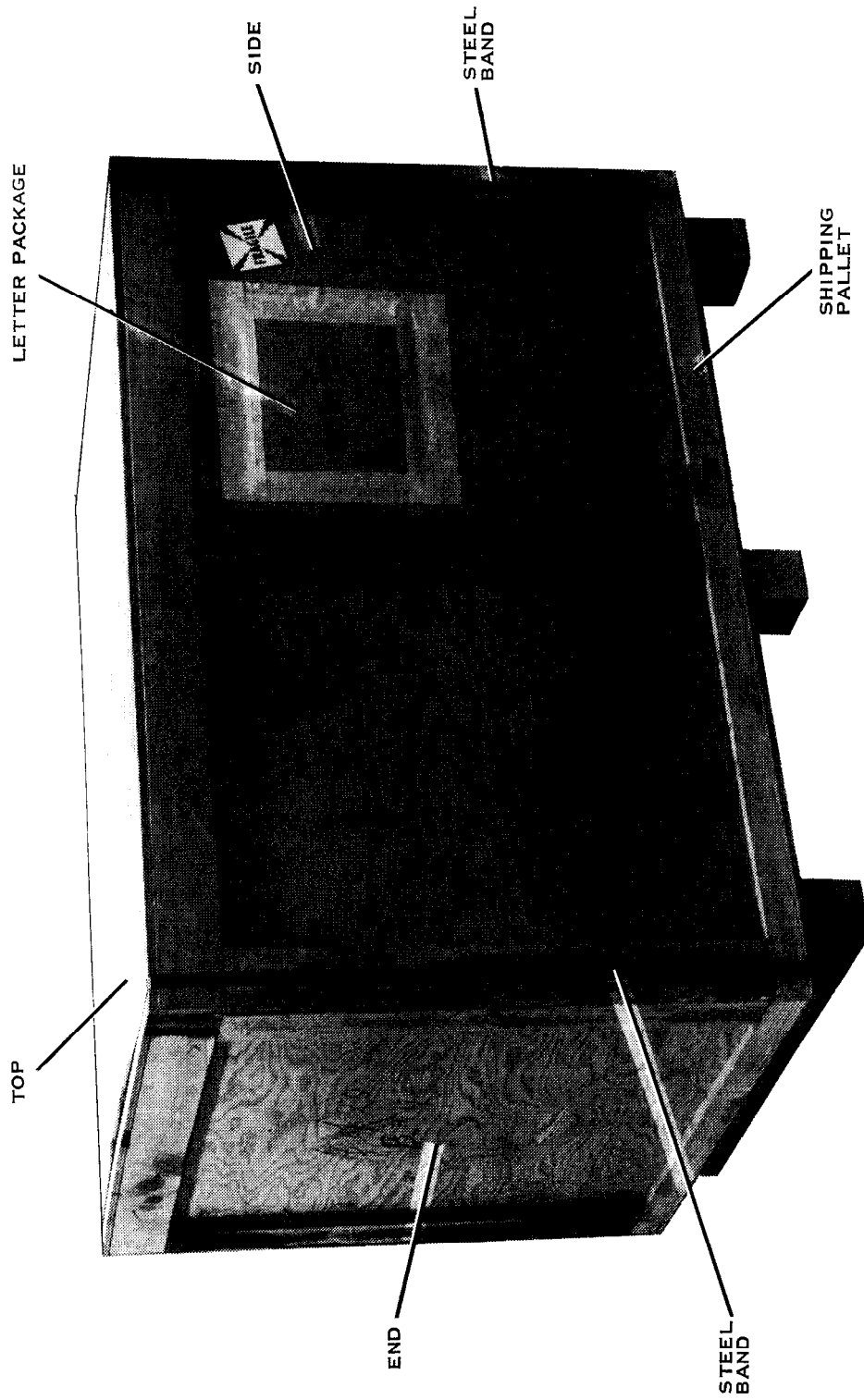
Do not discard any packing materials until unpacking, inspection, and inventory have been completed.

1. Remove and read the documents in the letter package labeled "OPEN ME FIRST" that are located on the side of the shipping crate, as shown in Figure 2-2. The letter package contains the following documents:
 - a. System serial number on envelope
 - b. *DS990 Models 4, 6, and 8 Systems Unpacking and Inventory Guide*
 - c. Texas Instruments installation and service request information sheet
 - d. Texas Instruments field service locations and service information

WARNING

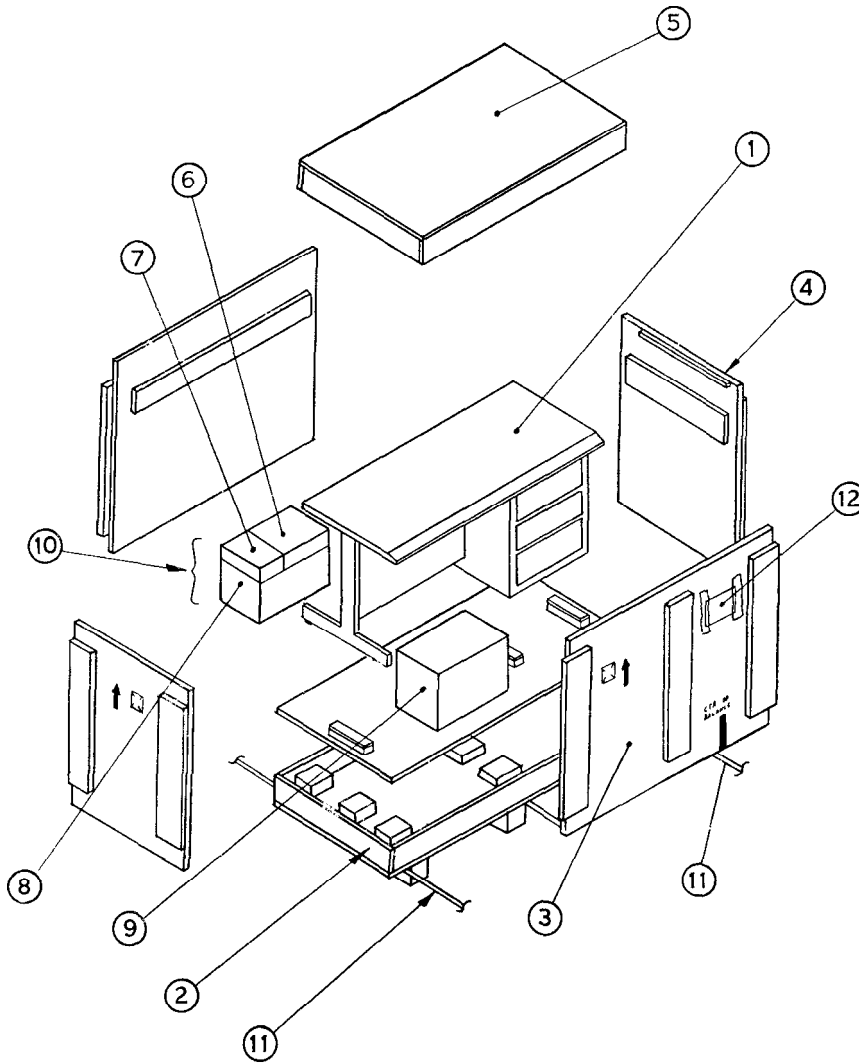
When the steel bands holding the shipping crate together are cut, all personnel **shall avoid injury from the flying loose ends of the cut steel bands by standing clear.**

2. Using an appropriate band cutter, cut the two steel bands (shown in Figures 2-2 through 2-6) which hold the shipping crate together. Remove the staples and two steel bands.
3. Lift the top, sides, and ends of the shipping crate from the shipping pallet. Refer to Figures 2-2 through 2-6.



(A)137185 (990-777-28-1)

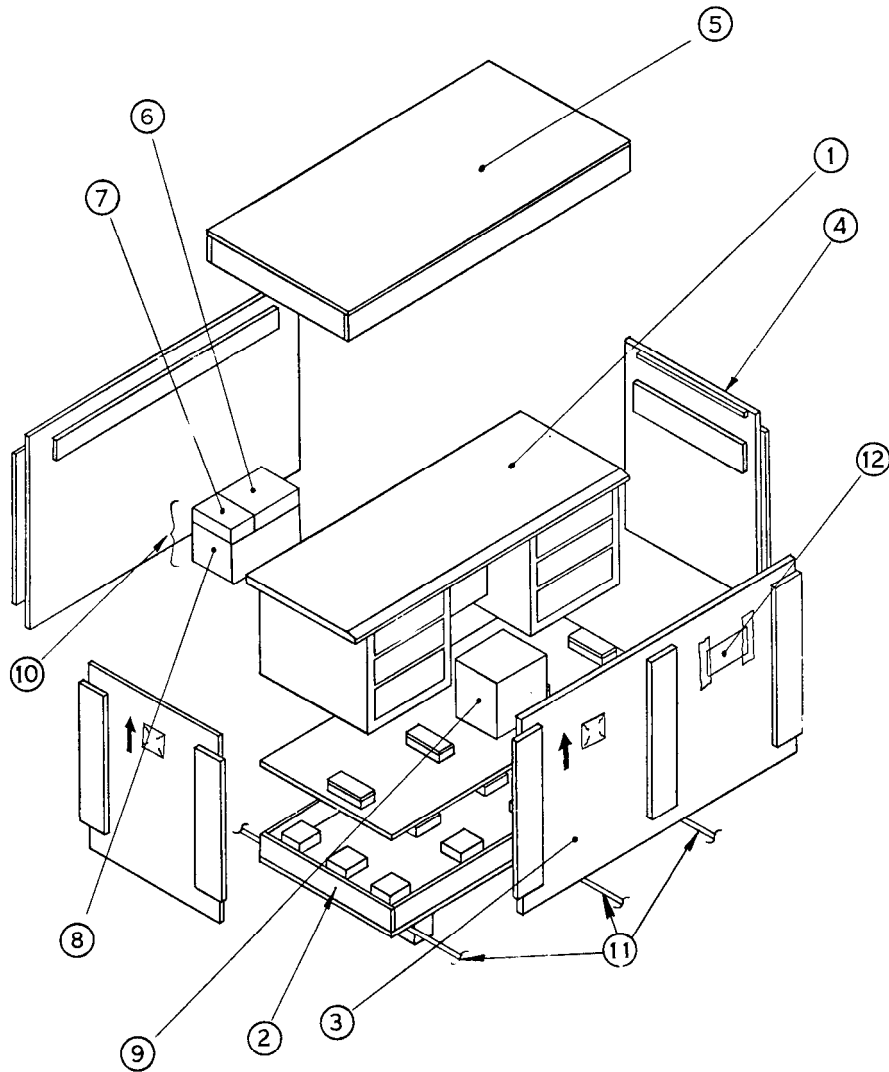
Figure 2-2. DS990 Desk System Packing Crate



- 1 | **SINGLE BAY DESK ASSY**
- 2 | BOTTOM, CONTAINER
- 3 | SIDE, CONTAINER
- 4 | END, CONTAINER
- 5 | TOP, CONTAINER
- 6 | MISCELLANEOUS OPTIONS
- 7 | SOFTWARE OPTIONS
- 8 | KEYBOARD OPTIONS
- 9 | VDT OPTIONS
- 10 | AVIS STRAP
- 11 | STEEL BANDS
- 12 | LETTER PACKAGE

(A) 137353 (936513)

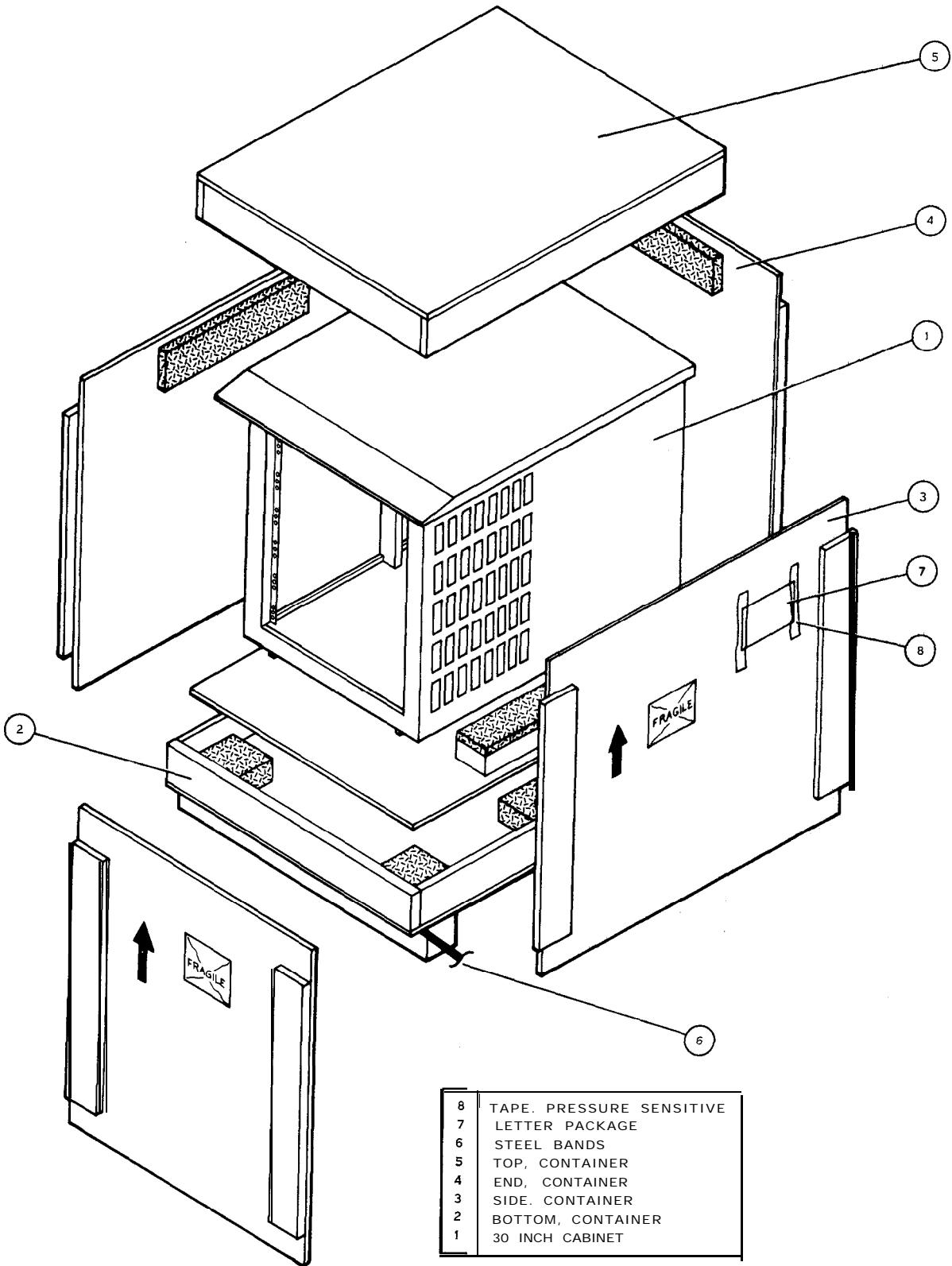
Figure 2-3. Single-Bay Desk Packing Crate Exploded View



- 1 | DUAL BAY DESK ASSY
- 2 | BOTTOM, CONTAINER
- 3 | SIDE, CONTAINER
- 4 | END, CONTAINER
- 5 | TOP, CONTAINER
- 6 | MISCELLANEOUS OPTIONS
- 7 | SOFTWARE OPTIONS
- 8 | KEYBOARD OPTIONS
- 9 | VDT OPTIONS
- 10 | AVIS STRAP
- 11 | STEEL BANDS
- 12 | LETTER PACKAGE

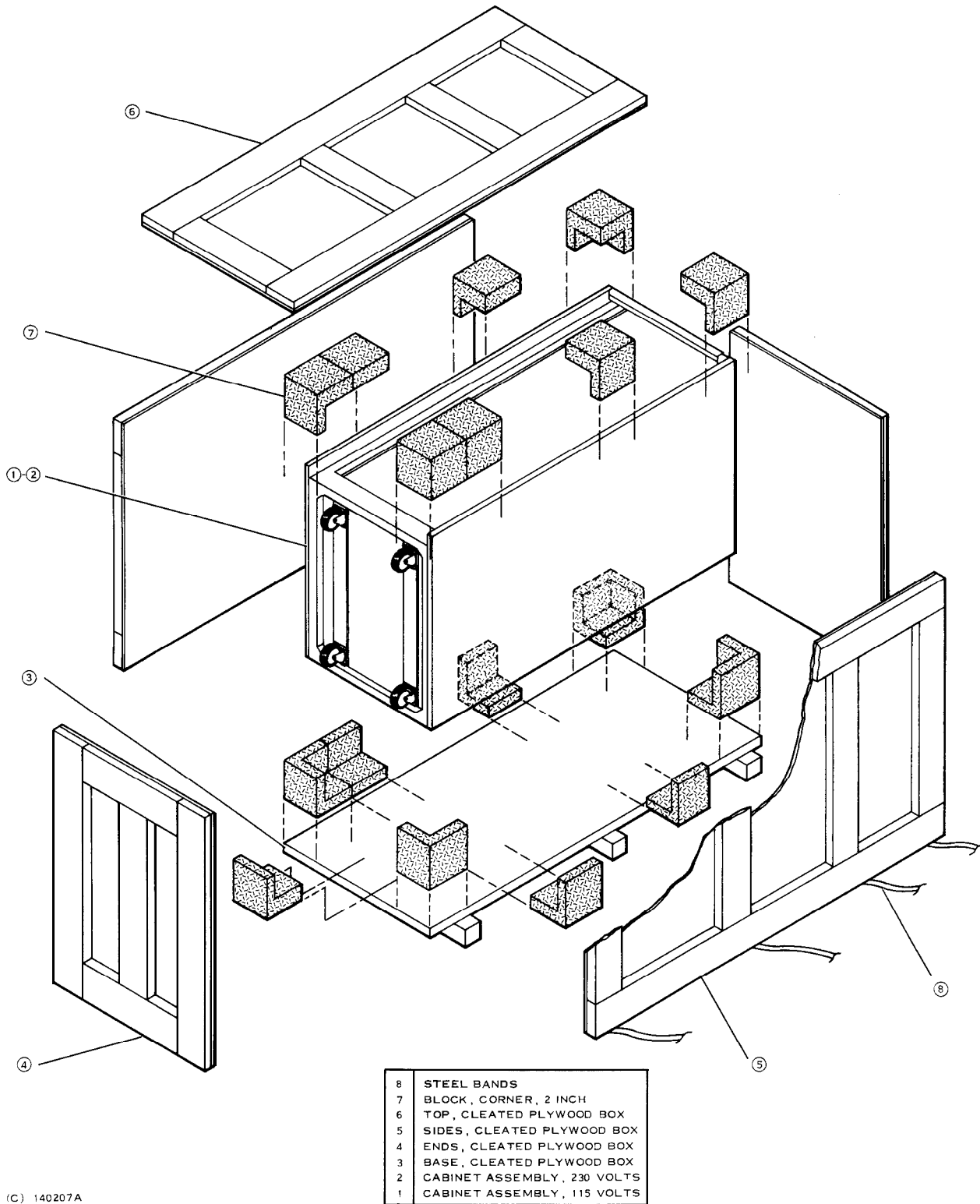
(A) 137352A

Figure 2-4. Double-Bay Desk Packing Crate Exploded View



(C)140206B

Figure 2-5. DS990762-Millimeter (30-Inch) Cabinet Packing Crate Exploded View



(C) 140207A

Figure 2-6. DS9901.78-Meter (70-Inch) Cabinet Packing Crate Exploded View

4. If present, remove the software and documentation package (items 6 and 7 of Figures 2-3 and 2-4) from the shipping pallet. (With some systems the software may be shipped in a separate package.) Unpack and check the contents of the software and documentation package. Inventory the contents against Table 2-2.

Table 2-2. Contents of Documentation Package for Hardware Systems

Quantity	Description
—	System binders as required
1	<i>DS990 Models 4, 6, and 8 Systems Installation and Operation Manual</i> , part number 946284-9701
1	<i>DS990 Models 4, 6, and 8 Systems Site Preparation Manual</i> , part number 2250361-9701
1	<i>DS990 Models 4, 6, and 8 Systems Unpacking and Inventory Guide</i> , part number 2268698-9701
1	<i>DS990 Models 4 through 30 Systems Operator's Service Guide</i> , part number 2270533-9701
1	<i>Model 911 Video Display Terminal Installation and Operation</i> , part number 945423-9701
1	<i>TMS 9900 Microprocessor Assembly Language Programmer's Guide</i> , part number 933441-9701
1	<i>Model DS10 Cartridge Disk System Installation and Operation</i> , part number 946261-9701
1	<i>Model DS25/DS50 Disk Systems Installation and Operation</i> , part number 946231-9701
1	<i>Model 990110 Computer System Hardware Reference Manual</i> , part number 945417-9701
1	990 <i>Site Log Manual</i> , part number 946263-9701
2	Blank Type 5440 High-Density Disk Cartridges, part number 937507-0001 (Model 4 only)
2	Blank Type T-25150 Disk Packs, part number 947533-0001 (Models 6 and 8 only)

5. If software was ordered with the system, locate and unpack the software package(s) and inventory against the product documentation package (PDP) or inventory card shipped with each package.

WARNING

To avoid backstrain when lifting heavy items, use proper lifting techniques. Also, have sufficient personnel or lifting equipment available to properly lift the enclosure, VDT, and disk drives.

6. Remove, unpack and inventory the 911 VDT package (item 9 of Figures 2-3 and 2-4). This package contains the 911 VDT and the 911 VDT keyboard assembly.
7. With two men on the rack end and one on the T-bar end of the single-bay desk, or with two men on each end of the double-bay desk, or with two men on the single cabinet, lift the enclosure from the shipping pallet.
8. Remove the levelers taped to the T-bar of the desk on single-bay desks. Install levelers under the T-bar so that the desk rests evenly on its four casters and two levelers. Use 0.5inch and 0.75inch open-end wrenches to tighten levelers.
9. To view the internal arrangement of the enclosures, pull the rear louvered cover and the side louvered cover from the enclosure. These covers are held in place by snap-lock fasteners. The internal views of the computer chassis shown in figures 2-7 and 2-8 show the cables in place and connected.

NOTE

The installer should assume that the correct circuit boards and options have been installed in the computer chassis and should not remove the circuit boards. Information is given so that a check may be made to determine if the correct options are installed, if necessary.

10. The 17-slot chassis for the model 8 performance package system is packaged separately. Refer to paragraph 2.3.1.3 for unpacking instructions.
11. Slide the 990 computer chassis out from the enclosure. If necessary, remove the two circuit card retention brackets and the circuit cards, and then refer to the circuit cards contents chart on top of the 990 computer chassis or Tables 2-3, 2-4, and 2-5 to verify the presence of the proper circuit cards. Refer to Figure 2-9 and verify the presence of the **DX10** loader ROMs on the **SMI/M** circuit board as follows:

DX10 Loader ROM Kit, part number 945134-0014

975383-0029 location UJ21
 975383-0030 location UH21
 975383-0031 location UF21
 975383-0032 location UE21

DX10 Loader ROM Kit, part number 945134-0019

975383-0047 location UJ21
 975383-0048 location UH21
 975383-0045 location UF21
 975383-0046 location UE21

Table 2-3. Models 4, 6, and 6 Main Chassis Preferred Configuration (Including Model 4 Performance Package)

Slot	Interrupt PI Left	Level P2 Right	CRU P1 Left	Address P2 Right	TL Peripheral Control Address	Device	Notes
1	—		—	—		990/10 SMI/M	
2	—	—	2E0	2co		990110 AU1	9
3		—	2A0	280	FBO0	Memory controller	6
4			260	240		Memory	6
5	—	—	220	200			6
6	—	—	1E0	1C0			6
7	13	13	1A0	180	F800	DS10 Model 4, or DS25 Model 6, or DS50 Model 8 (system disk)	6
8	9	9	160	140	F820 F880	TILINE Coupler TL Disk TL Tape	6 5,6 6
9	8	10	120	100		911 VDT	7
10	12	11	0E0	oco		CRU expander 911 VDT	1,3,6 7,3
11	3	7	0A0	080	F810	FD800 FD1000 CRU expander	1,3,4,6 4,5,6 3,6
12A	14		060			LP or 820 KSR	3,4,6
12B		4		040		Comm I/F card reader	3,4 3,4
13A	15		020			PROM Programmer	3,4
13B		6		000		743 KSR	3,4,6

Table 2-3. Models 4, 6, and 6 Main Chassis Preferred Configuration (Including Model 4 Performance Package) (Continued)

Notes:

1. Preferred location.
2. Where more than one device is shown for a slot, they are listed in order of preference.
3. For slots that share interrupts between each other (intra-slot interrupt sharing) the following rule must be followed:
 TILINE devices cannot share an interrupt with another TILINE or CRU device. But CRU devices of different or the same type may share interrupts and will be supported by DX10 or DPOS.
4. Full or half size boards may occupy slots 11, 12, and 13 if not otherwise occupied. Recommended second line printer location is 12B if card reader is absent. If card reader is present, slots shall be used in the priority 13A, 13B, and then 12A of the expansion chassis.
5. Where more than one TILINE disk interface is used, the priority is as follows:
 1. DS10
 2. DS25
 3. DS50
 4. DS200
 The highest priority device shall be placed in a higher numbered slot than the next highest priority device.
6. Refer to the DS990 Systems Field Engineering Reference Handbook for TL memory, TL interface, and CRU interface board jumper and switch configurations.
7. 911 VDT should be installed in slot 9. Additional locations are optional.
6. When internal modem and auto call are used, they may be installed in any empty slot.
9. Jumper EI to E2 on 990110 AU1 must be installed. When removed the system will boot on power up.

Table 2-4. Model 8 Performance Package Main Chassis Preferred Configuration

Slot	Interrupt Level		CRU Address		TL Peripheral Control Address	Device	Notes
	P1 (Top)	P2 (Bottom)	P1 (Top)	P2 (Bottom)			
1	—	—	—	—		990110 SMI/M	9
2	—	—	—	—		990/10 AU1	9
3	—	—	—	—	FB10	Cache Memory Controller	3,4,9
4	—	—	—	—		Memory	3,4,9
5	11	11		—		Memory	1,3,4,9
6	10	10	2E0	2co		Memory CRU device	1,3,4,8 5
7	15	15	2A0	280		Memory TL device CRU device	1,3,4 1,2,4,6 5

Table 2-4. Model 8 Performance Package Main Chassis Preferred Configuration (Continued)

Slot	Interrupt Level		CRU Address		TL Peripheral Control Address	Device	Notes
	P1 (Top)	P2 (Bottom)	P1 (Top)	P2 (Bottom)			
8	12	12	260	240		Memory Controller TL device CRU device	1,3,4 1,2,4,6 5
9	8	8	220	200		Memory TL device CRU device	1,3,4 1,2,4,6 5
10	3	3	1E0	1C0		Memory 2nd COMM I/F TL device	1,3,4 1,3,4,5 1,2,4,6
11	13	13	1A0	180	>F800	System disk	4,6
12	9	9	160	140	>F880	979A MAG tape TL device	1,2,4,6 1,2,4,6
13	10	10	120	100		911 VDT #2/#1	7,8
14	11	11	0E0	oco		CRU expander 911 VDT	1,5,8 1,8
15	7	7	0A0	080		CRU floppy I/F TL device TL coupler	1,5 1,2,4,6 1,4,6
16A	14		060			Line printer	1,5
16B		4		040		COMM I/F card reader TL device	1,5 1,5 1,2,4,6
17A	6		020			Auto call unit	1,5
17B		6		000		Modem EIA terminal TL device	1,5 1,5 1,2,4,6

Notes:

The devices shown are standard for those locations. Where more than one device is shown for a slot, they are listed in order of preference. When possible, all TILINE devices should be placed in the main chassis.

1. Full- or half-size boards may occupy slots 6 through 10 and 14 through 17 if not otherwise occupied. Slot 5 may be used for TILINE controller if slot 14 is not used or if slot 14 is used for a device that does not have an interrupt. Slot 5 may also be used for a device that does not require the CRU interface, but requires only power (such as a modem). A recommended second line printer location is 16B if a card reader or COMM I/F is absent. If card reader or COMM I/F is present, slots shall be used in the priority 17A, 17B, and then 12A of an expansion chassis (when used).

Table 2-4. Model 8 Performance Package Main Chassis Preferred Configuration (Continued)

2. Where more than one TILINE disk interface is used, the priority is as follows: **DS10, DS25,50,200**. The highest-priority device shall be placed in a higher-numbered slot than the next highest-priority device.
3. **16K** RAM-type memory is recommended. When 4K RAM is used, system performance will be degraded.
4. Refer to the *DS990 Systems Field Engineering Reference Handbook* for memory installation instructions and TILINE interface configurations.
5. Refer to each device installation and operation manual for CRU interface board jumper and switch configurations.
6. A maximum of 10 TILINE device controllers may be installed in the 17-slot chassis excluding memory and AU.
7. The first 911 VDT controller should be installed in slot 13. Additional locations are optional.
8. For slots that share interrupts between each other (intra-slot interrupt sharing) the following rule must be followed:

TILINE devices cannot share an interrupt with another TILINE or CRU device. But CRU devices of a different or the same type may share interrupts and will be supported by **DX10**.
9. These slots are dedicated to the devices indicated.

Table 2-5. Models 4, 6, and 8 Expansion Chassis Preferred Configuration (Including Models 4 and 8 Performance Package)

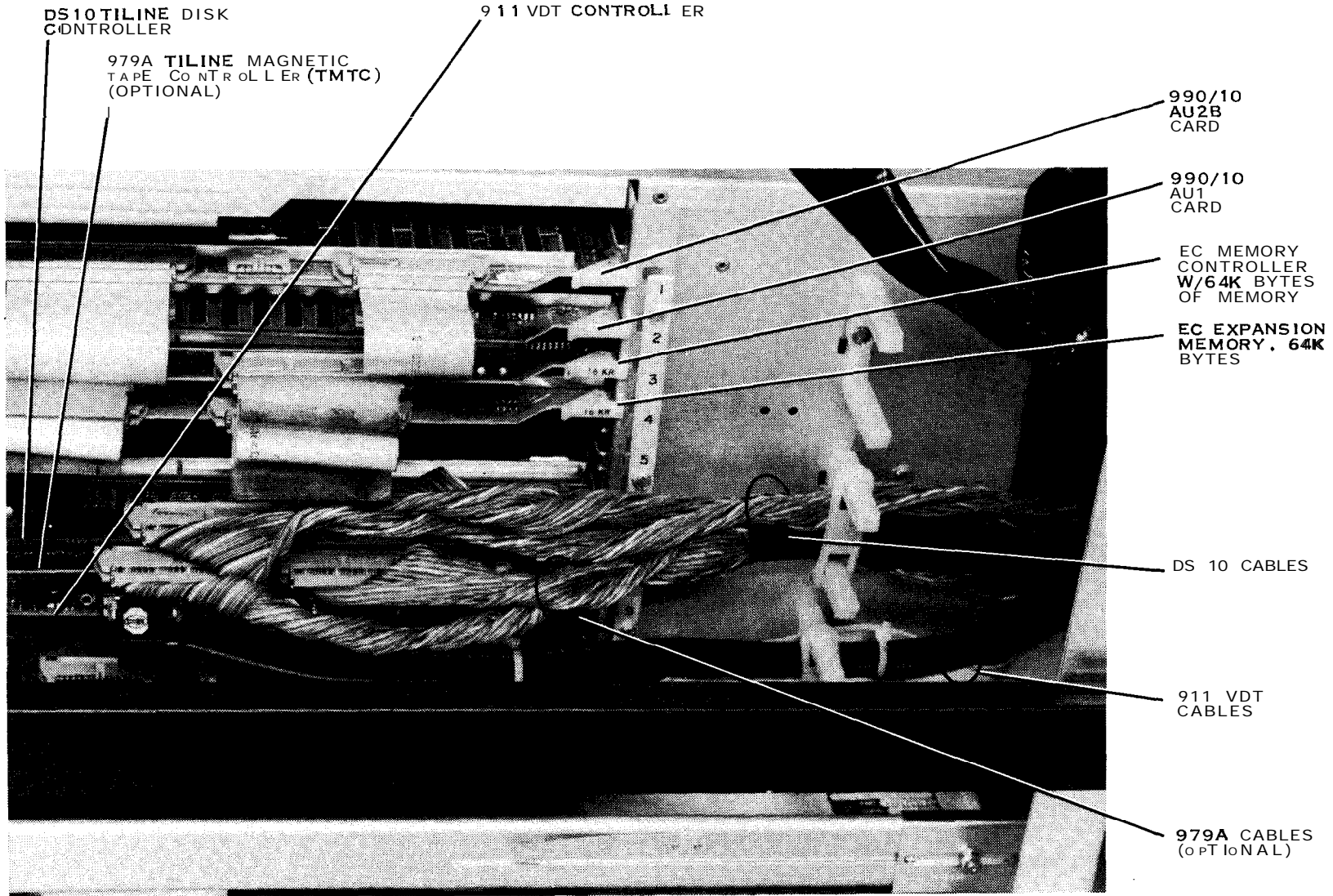
Slot	Interrupt Level		CRU Address		TL Peripheral Control Address	Device	Notes
	P1 Left	P2 Right	P1 Left	P2 Right			
1	—	—	—	—		CRU buffer	3,6
2	—	—	6E0	6C0		TILINE Coupler	3,5,6
3	—	—	6A0	680		Memory	6
4	—	—	660	640		Memory	6
5	—	—	620	600		Memory	6
6	—	—	5E0	5co		Memory	6
7	13	13	5A0	580	F820	TL disk	6
8	9	9	560	540	F880 F830	TL tape TL disk	1,6 6
9	8	10	520	500		911 VDT	
10	12	11	4E0	4co		911 VDT	

Table 2-5. Models 4, 6, and 6 Expansion Chassis Preferred Configuration (Including Models 4 and 6 Performance Package) (Continued)

Slot	Interrupt Level		CRU Address		TL Peripheral Control Address	Device	Notes
	P1 Left	P2 Right	P1 Left	P2 Right			
11	3	7	4A0	480	F850	FD800 FD1000	2,6 6
12A	14		460				2
12B		4		440			2
13A	15		420				2
13B		6		400			2

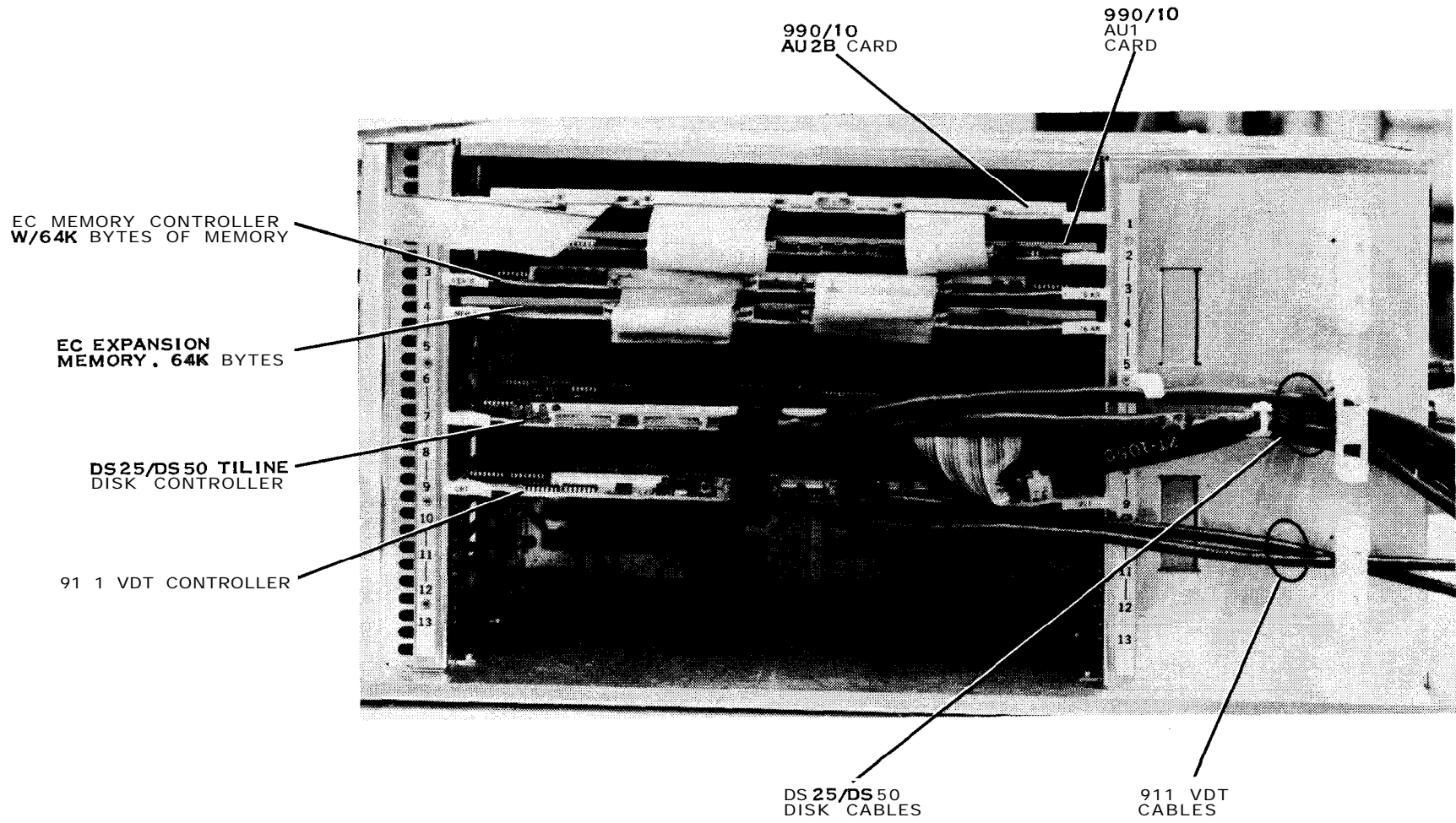
Notes:

1. For mag tape installation to allow direct interrupt through the TILINE coupler, rewire the interrupt jumper assembly as follows: Change from Start 8P2—level 9 Finish to Start 8P2—2P2 Finish.
2. If the slot is not occupied by the indicated device then full or half size CRU boards may be placed in the slot.
3. CRU expansion system is required if CRU controllers are to be used in the expansion chassis. It is also required for the purpose of interrupt handling for more than one TILINE master device controller.
4. When more than one TILINE master controller is installed, only one may use the direct TILINE coupler interrupt. All others must use the CRU expander interrupt with slot (interrupt) positioning.
5. TILINE coupler notes:
 1. J8, CRU maskable interrupt is in the range of 1F40 to 1F5C with position 1 standard.
 2. J7 installed disables the TILINE peripheral control space.
6. Refer to the *DS990 Systems Field Engineering Reference Handbook* for TILINE memory, TILINE interface, CRU interface board switch and jumper configurations, and interrupt jumper plug configurations.



(A) 140208

Figure 2-7. Internal View of DS990 Model 4 with Optional 979A



(A) 140209

Figure 2-8. Internal View of DS990 Models 8 and 8

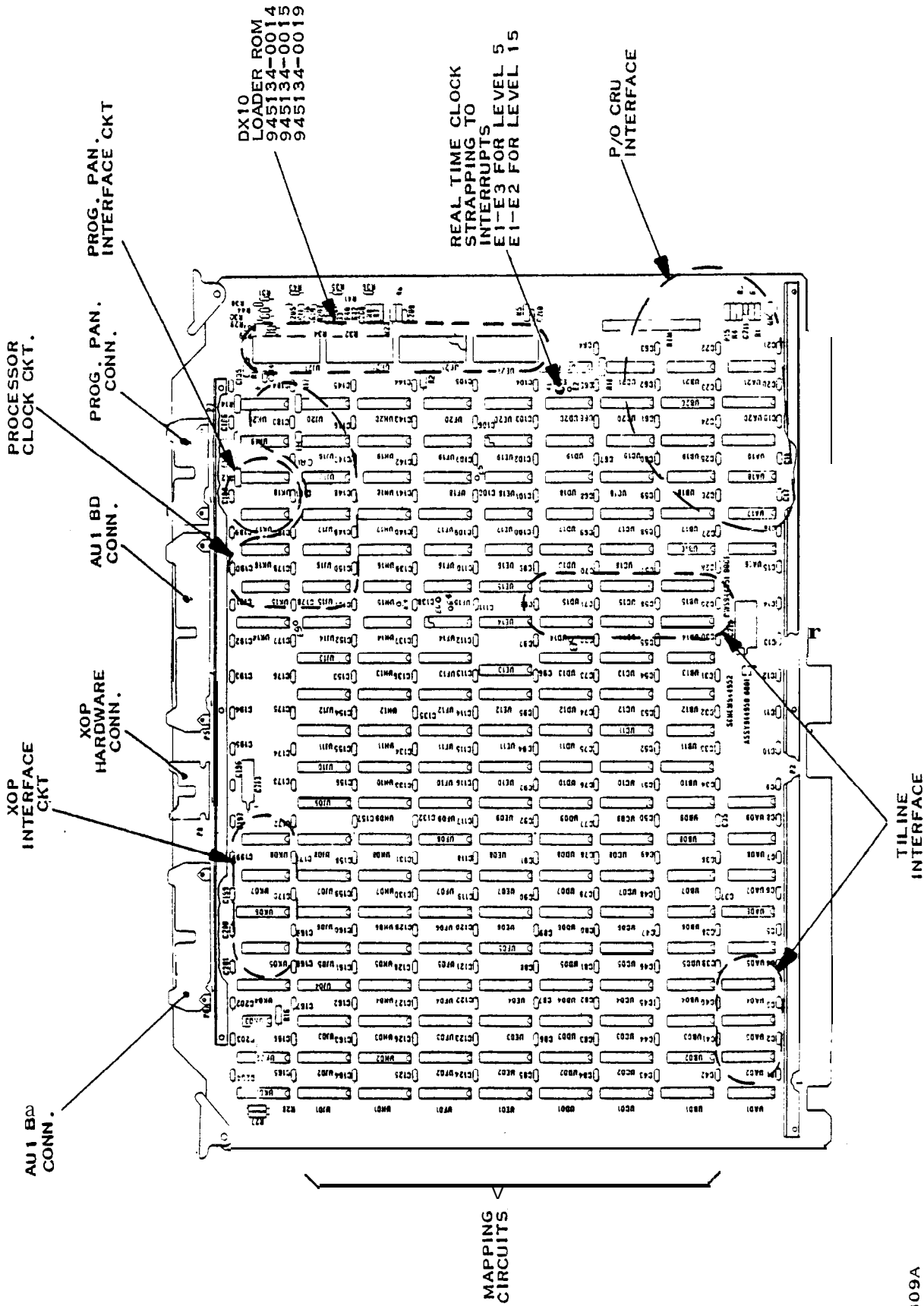


Figure 2-9. 990/10 SMIM Circuit Card

(A)133809A

12. After following unpacking instructions in paragraph 2.3.2, install the **DS10** disk drive in the enclosure in accordance with instructions in paragraph 2.3.2. Also consult the manual, *Model DS10 Disk System Installation and Operation*.
13. Slide the **DS10** disk drive chassis out from the enclosure. Remove the cover shown in Figure 2-10 that protects the read/write head mechanism, power supply, and circuit card cage. Remove the lock pin shown in Figure 2-1 1 that holds the read/write heads in place. Store this pin on the side of the magnet. Replace the cover and set the MAIN ac power switch and the 34 volts dc switch to ON. To prevent inductive pickup of power line noise in the signal cables, use releasable **tiwraps** to install the power cable along the top edge of the cable carrier. Plug the power cable into the enclosure power strip. Connect the **I/O** cable to the disk controller.
14. Visually inspect the rack mounting of the **DS10** disk drive chassis and the 990 computer chassis to verify that each chassis is secure in its mounting and has not shifted or dropped.
15. Visually inspect the VDT case, keyboard, and CRT for possible shipping damage.
16. Visually inspect the enclosure and all supporting members for possible shipping damage.

2.3.1.2 System Assembly Instructions. When the peripherals are ordered with the **DS990** system, the controllers are already configured for the system and installed in the computer chassis. Selection of necessary jumpers, setting of switches, placement of terminators, and proper power connections have all been accomplished at the factory before shipment. For more details, refer to the installation and operation manual for each peripheral.

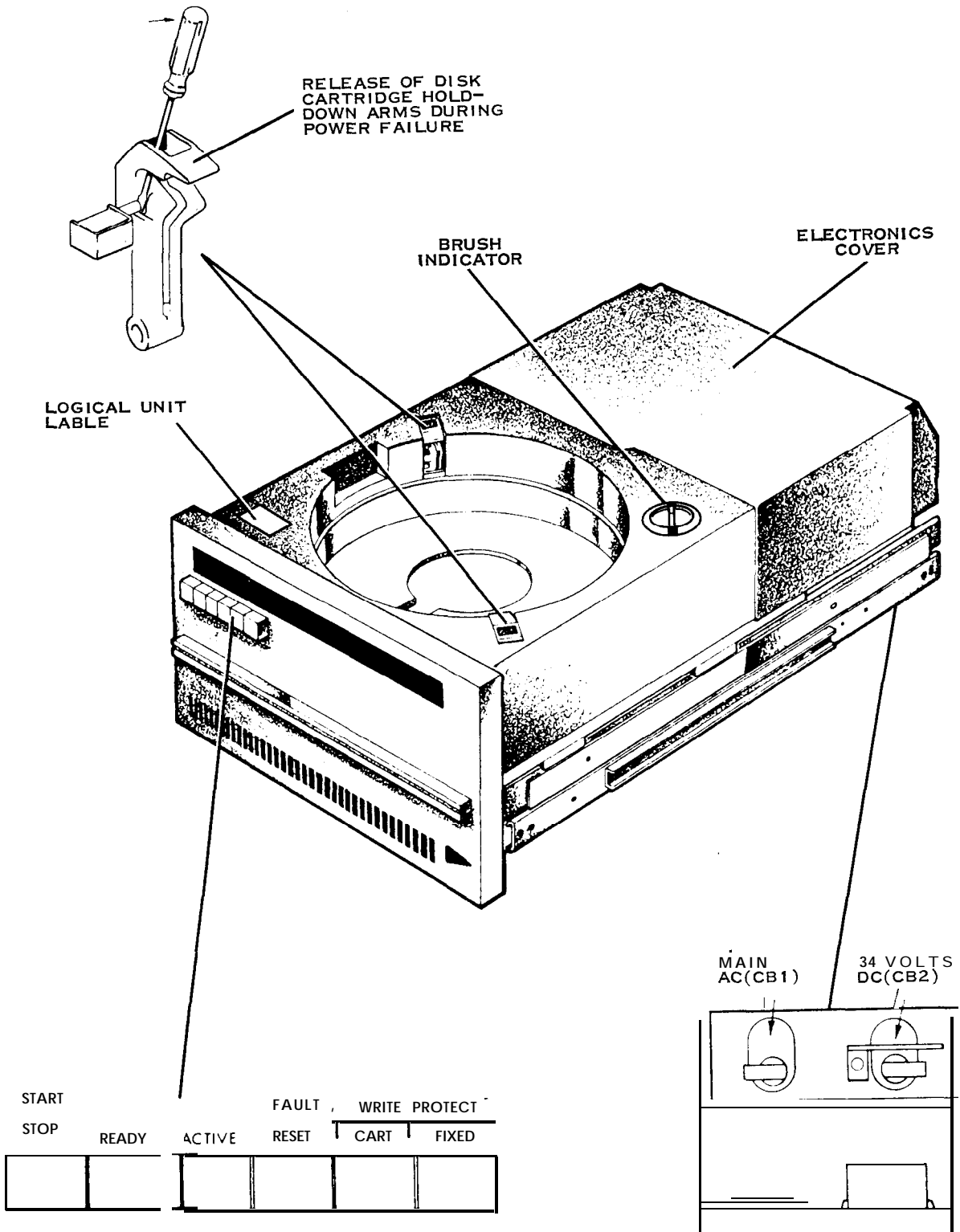
1. Multiple 1.78-meter (70-inch) cabinets

Multiple 1.78-meter (70-inch) cabinets may be bolted together for a neater system appearance and intercabinet cabling that does not run cables outside the cabinets. For the Model 8 Performance Package, bolting the cabinets is a requirement when more than one cabinet is used. Bolting the cabinets together adds mechanical stability, especially when one cabinet contains only a magnetic tape that is mounted at the top of the cabinet.

To accomplish this, remove adjacent cabinet doors by removing the ground straps and lifting the doors off the hinges. Remove the hinges and move the two cabinets together so that the six fastening holes in each cabinet are aligned (see Figure 2-12). Adjust the leveling feet so that the cabinets are level. Fasten the two cabinets together. Using the hardware shown in the illustration, readjust leveling feet if necessary before installing equipment into cabinets.

2. Enclosure access

- a. Desk and 762-millimeter (30-inch) cabinets — Remove the rear louvered cover and the side louvered cover at the rack end of the desk or cabinet to gain access to the internal rack compartments.



(A)1 37350A

Figure 2-10. DS10 Disk Drive Control and Indicator Locations

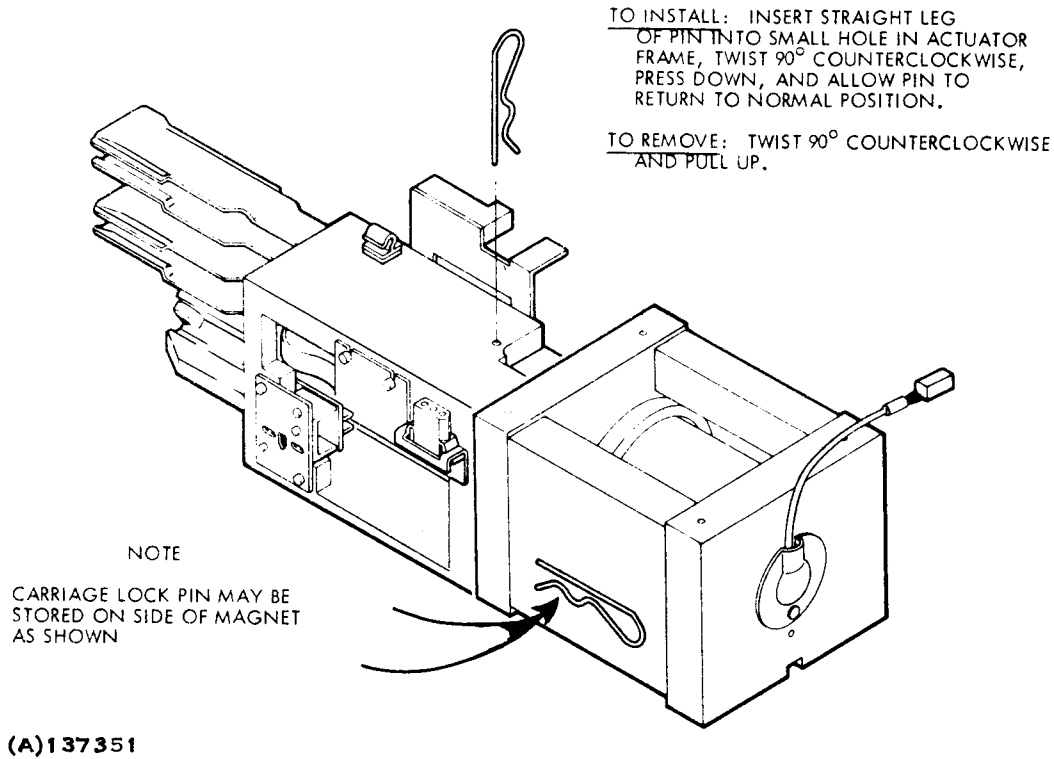


Figure 2-11. DS10 Disk Drive Carriage Lock Pin Location

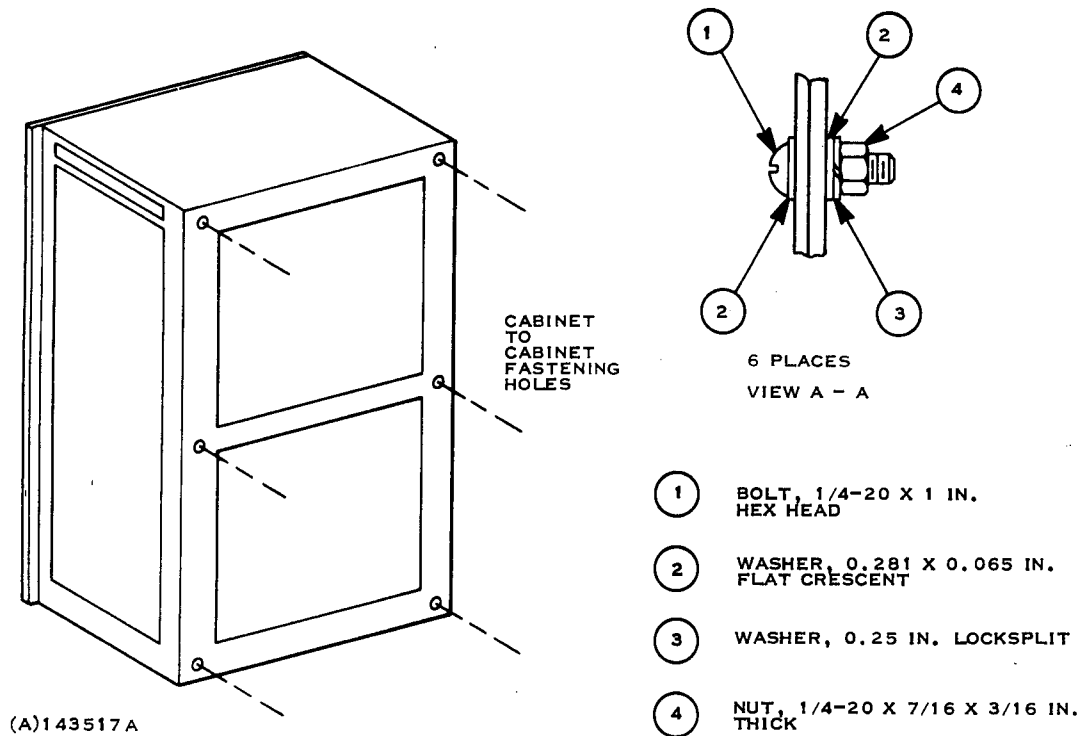
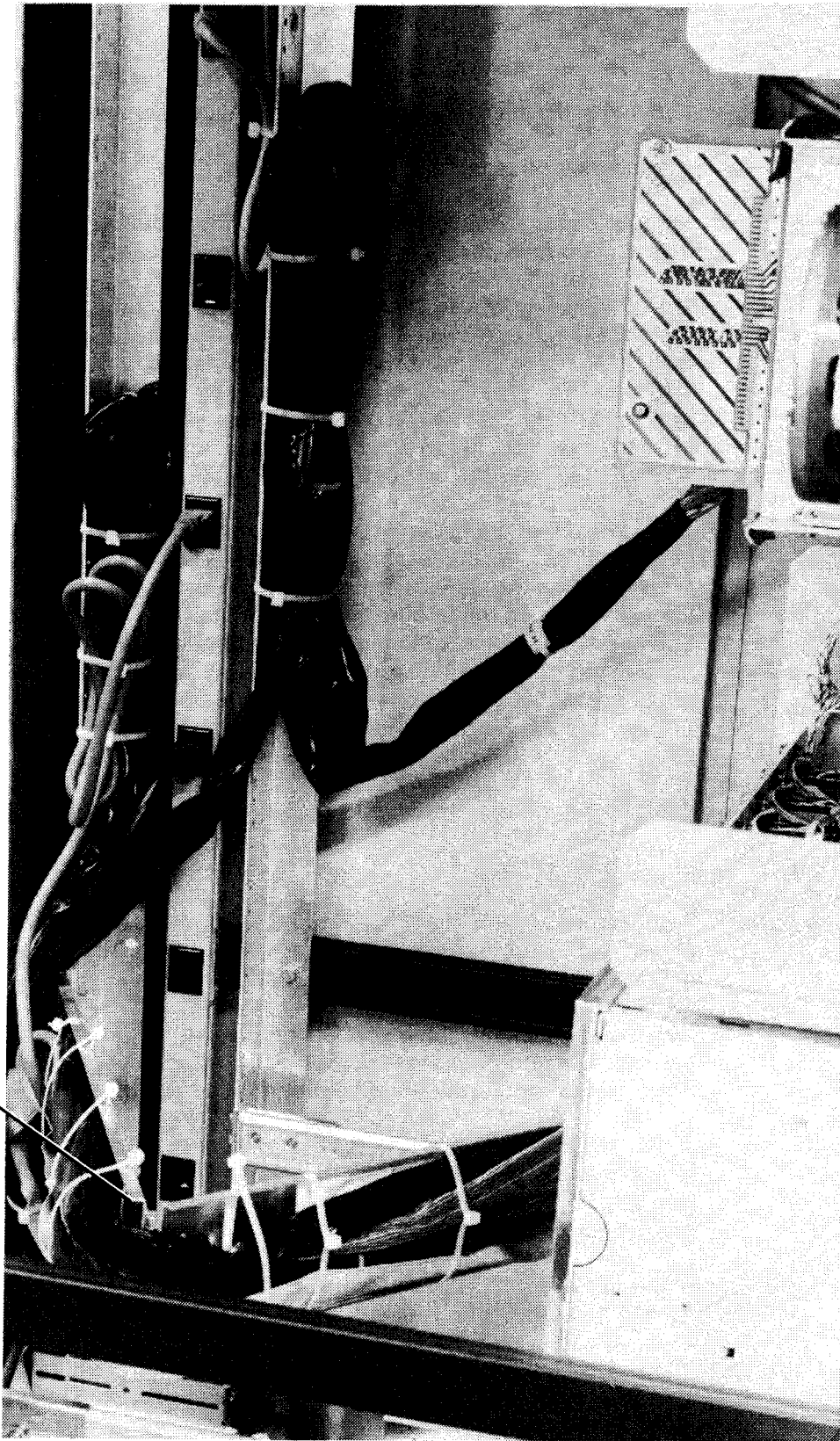


Figure 2-12. Cabinet-to-Cabinet Fastening Details

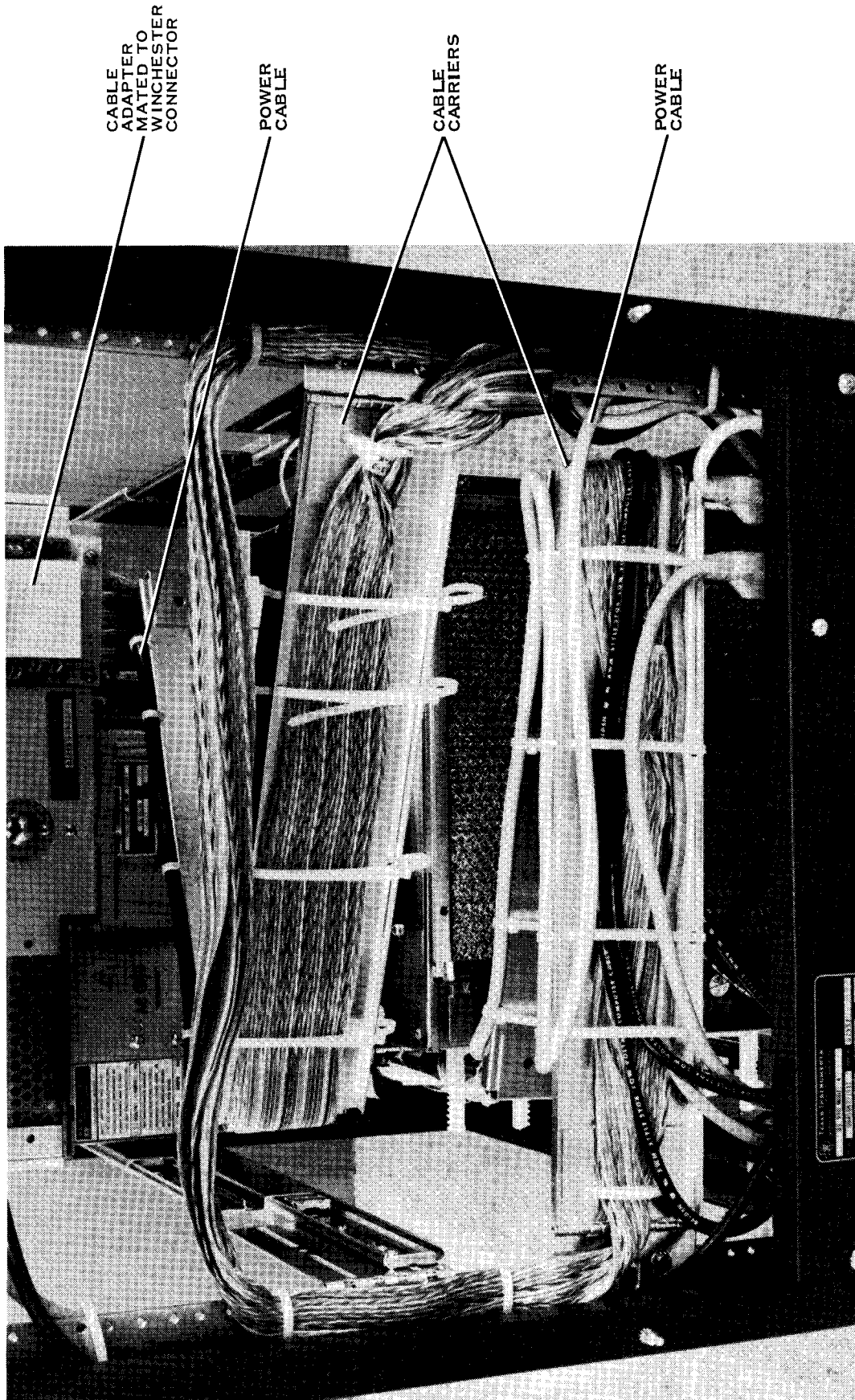
- b. 1.78-meter (70-inch) cabinets — To gain access, open the side and rear doors.
3. Chassis and disk drive installation
 - a. Refer to paragraph 2.3.1.4 for installation instructions for the 17-slot chassis used with the Model 8 performance package system.
 - b. The 990 chassis will have restraining brackets holding the printed circuit cards in the chassis. These brackets should be left in place, as even with vibration from fans, disk drives or tape drives, they will keep the boards well seated.
 - c. Desk and 762-millimeter (30-inch) cabinets — Adjust the leveling feet on 30-inch cabinet to prevent tilting when the DS10 is installed. Install the DS10 disk drive (if so equipped) into the enclosure using paragraph 2.3.2 of this manual.
 - d. 1.78-meter (70-inch) cabinets — These systems are shipped with only the slides, cable carriers and cables installed. First, adjust the leveling feet so that the cabinet is level. Install the various chassis and disk drives into their cabinet slides with the individual unpacking and installation instructions in Section 2 of this manual. Install the optional magnetic tape drive(s). Connect the I/O cables that are located on the cable carrier (see Figures 2-13 and 2-14) to the corresponding controller board in the computer chassis or expansion chassis (see Figures 2-7 and 2-8 and Tables 2-3, 2-4, and 2-5). To avoid inductive pickup of power line noise in the signal cables, use releasable tiewraps to install the chassis power cord along the top edge of the chassis cable carrier. Note that connectors for the DS10 (and other) ribbon cables should be aligned as described in paragraph 2.3.2.4.
4. Enclosure power cables
 - a. Desk and 762-millimeter (30-inch) cabinets — Uncoil the desk power input cable and thread it through the hole at the rear of the desk as shown in Figure 2-15. Do not connect to the wall power outlet at this time.
 - b. 1.78-meter (70-inch) cabinets — Uncoil the cabinet power cable taped to one of the cabinet rails and connect the twist lock connector of the cable to the cabinet. Do not connect to the wall power outlet at this time.
 - c. 200 to 240 volt systems — These systems are supplied with a twist lock connector taped to one of the enclosure rails. Using this connector, make a power cable with wire and wall connector that meets local standards. Make sure to use a power ground wire in the cable.
5. Equipment power cords — Check that all power cords for equipment mounted in the enclosure are plugged into the enclosure's plugmould strip.
6. Input/Output cables — Uncoil and untape all of the I/O cables that connect to devices outside of the enclosure. Route the cables through the cable opening in the back of the enclosure to their respective devices. For devices that mount on the computer desk tops, route the I/O and power cables through the slot in the top of desk. Replace the block in the cable access hole in the desk top.

CABLE
CARRIER



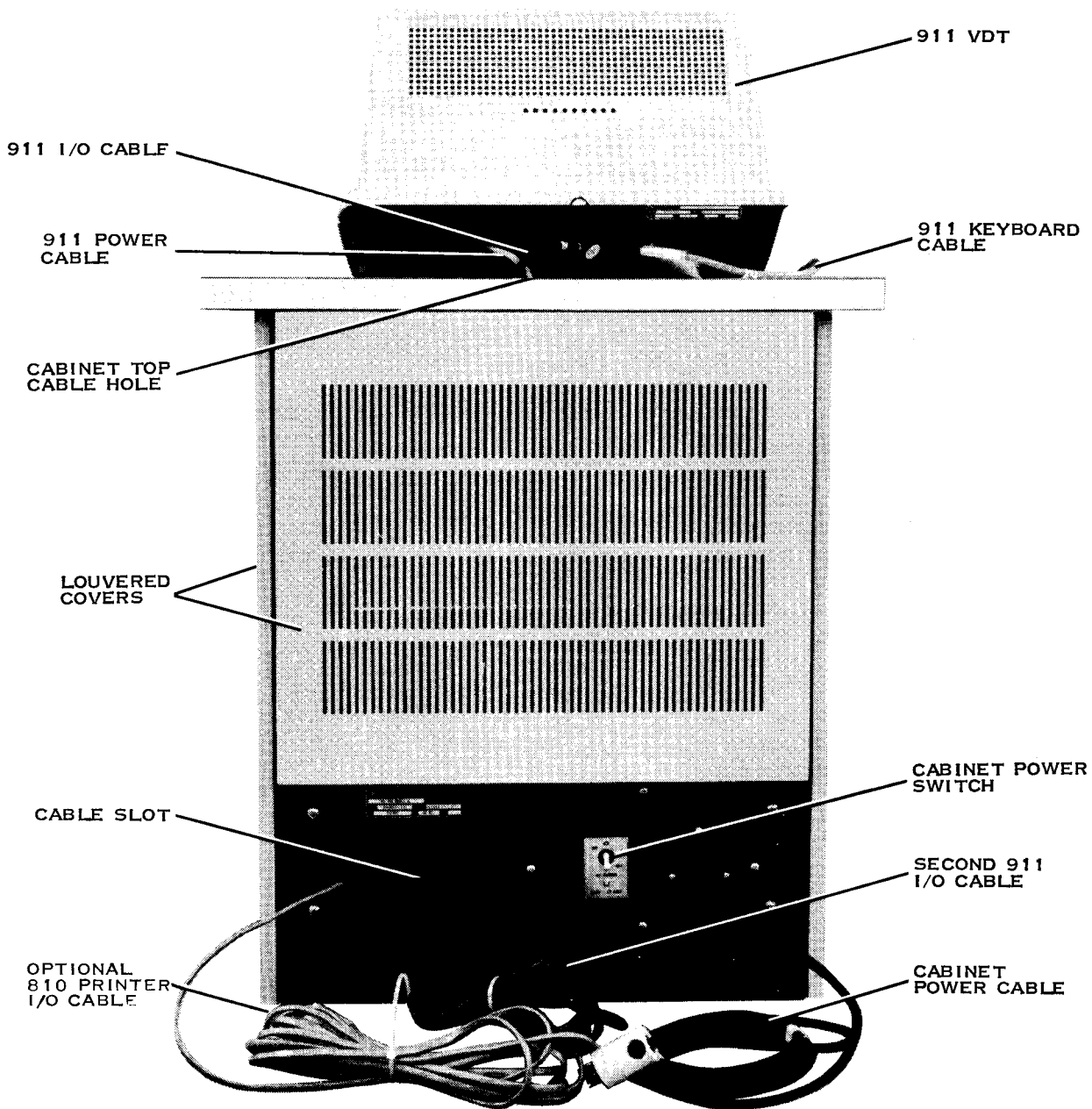
(A) 140210

Figure 2-13. Cable Carrier Side View, DS990 System



(A)140211

Figure 2-14. Cable Carrier Back View, DS990 System



(A)137194

Figure 2-15. Rear View of 762-Millimeter (30-Inch) Cabinet System with Cables Installed

7. 911 keyboard cable — Uncoil and connect the 911 CRT keyboard cable to J5 on the rear of the 911 CRT display.
8. Desktop device cables — Plug the power cords of the desk top devices into the power plugmould strip in the bottom of the desk. Connect all the I/O cables to their respective devices, carefully routing the cables so they are not under stress and present no tripping hazard to the operator.
9. Cable carriers — Verify that the cable carriers for the computer chassis, expansion chassis, and DS10 work smoothly without binding any cables by sliding the chassis or drive in and out of the enclosure while visually watching their operation, Figure 2-14.
10. Cable dress — Visually inspect all cable connections and cable placements for proper alignment, seating, and dress. Check that the cables are not crimped or under undue stress in the enclosure or enroute to the devices. Where necessary, add tie wraps to secure cables and to achieve a neat appearance.
11. Power turn-on — Refer to paragraph 2.5.2 for system power up and checkout.

2.3.1.3 Unpacking the 17-Slot Chassis For Model 8 Performance Package System. The 17-slot chassis, complete with installed circuit boards and cables, is shipped in one of the two containers illustrated in Figure 2-16, depending on system cable configuration. To unpack, refer to Figure 2-16 and remove the chassis from its container by performing the following steps:

1. Remove and save the shipping label/pack index from the front of the crate.
2. Remove and save the contents of the letter package (labeled OPEN ME FIRST) located on the outside of the shipping crate (Figure 2-16) if not already done.

WARNING

Have all personnel stand clear while steel bands are being cut to avoid injury from the flying loose ends of the bands.

3. Use a band cutter to cut the steel bands holding the shipping container together. Remove the steel bands.

NOTE

Do not discard any packing material while unpacking and inventorying the system.

4. Depending on the shipping container used, perform one of the following steps:
 - a. Lift the corrugated carton up and away from the shipping pallet and chassis, and remove any top padding material (Figure 2-16 (A)).

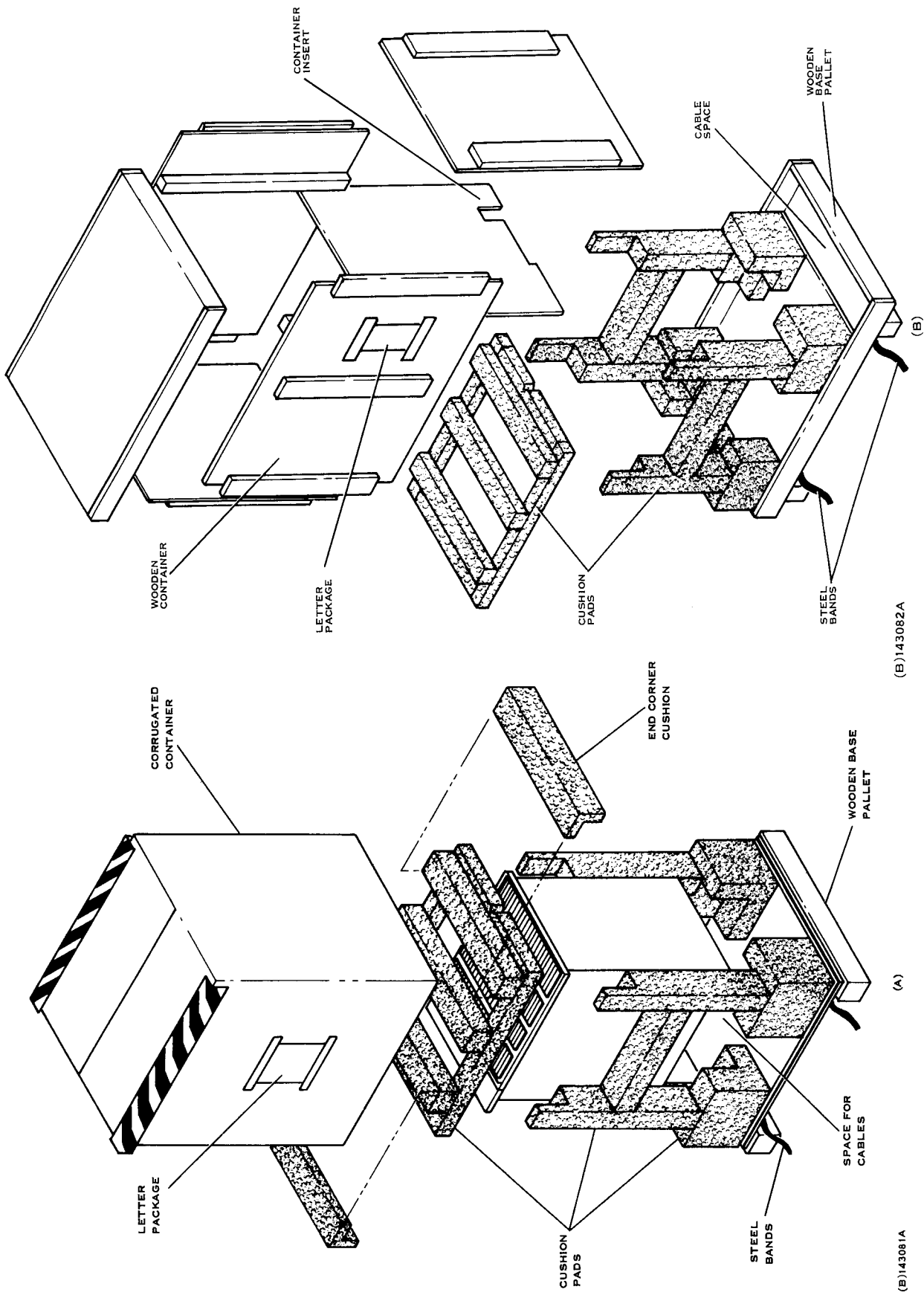


Figure 2-16. 17-Slot Chassis Shipping Containers

- b. Using appropriate tools, remove the top cover, sides, ends and insert. Also remove any top padding material (Figure 2-16 (B)).

WARNING

Use proper lifting techniques to avoid backstrain when lifting the computer chassis.

5. Since the 17-slot chassis has cables installed, it is necessary to lift the cables out of the crate as the chassis is removed.
6. Lift the 17-slot chassis up and off the bottom corner pads. To avoid undue stress on the chassis assembly, lift from underneath the chassis. Place the chassis near the cabinet in which it will be installed.
7. Remove and save the programmer panel keys located in the plastic bag taped to the top of the 17-slot chassis.
8. Remove and save any additional cables and rackmounting hardware if present.

2.3.1.4 17-Slot Chassis Installation in Rackmount Cabinets. Use the following procedure to install the 17-slot chassis in 1.78-meter (70-inch) and 762-millimeter (30-inch) cabinets.

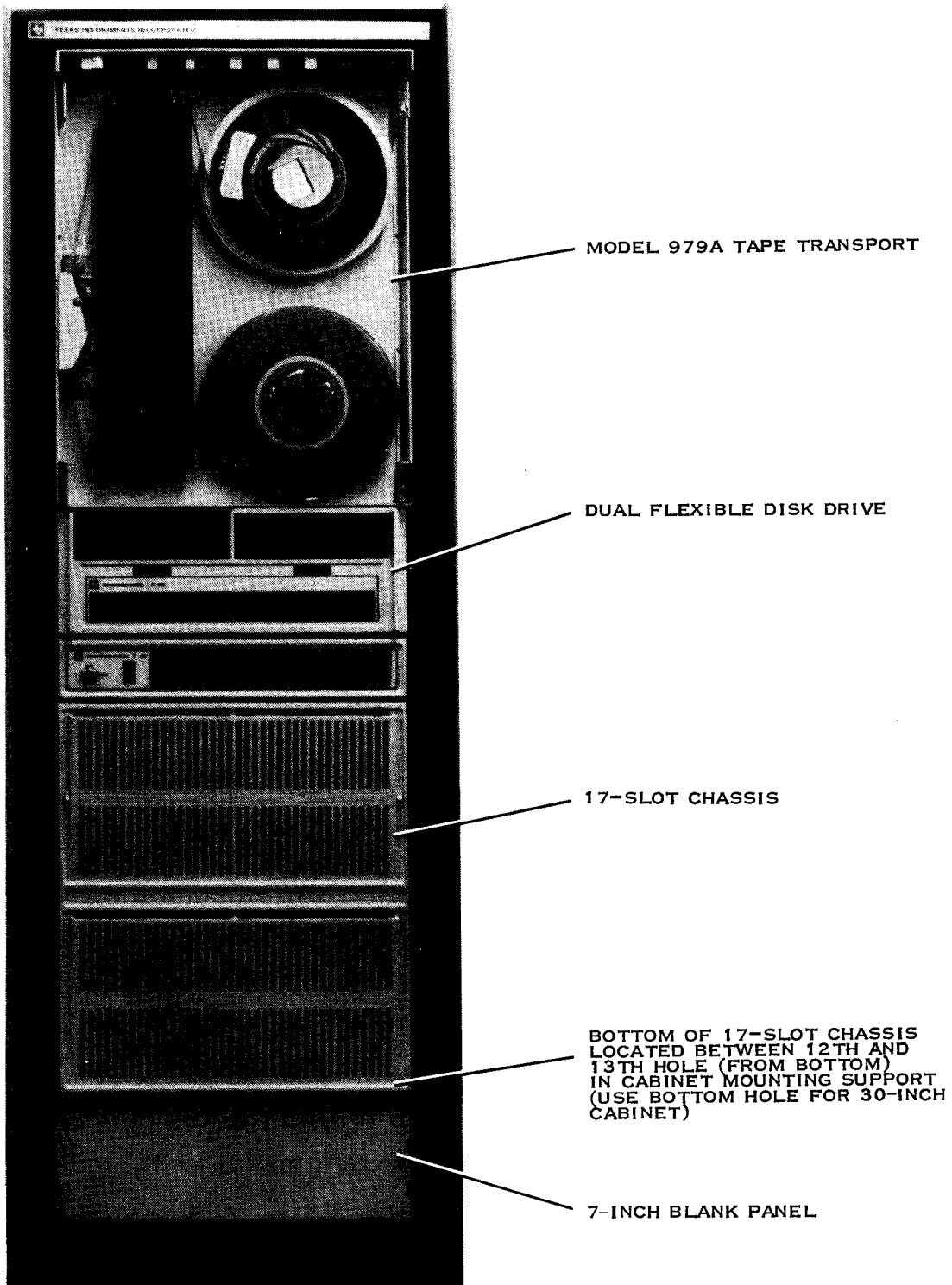
Figure 2-17 shows the recommended location of the 17-slot chassis in the 1.78-meter (70-inch) cabinet. The 177.8-millimeter (7-inch) blank panel at the bottom of the cabinet spaces the chassis to provide clearance at the rear of the cabinet for opening the rear access cover of the 17-slot chassis.

The Model 979A tape transport may be replaced with two 311-millimeter (12.25-inch) blank panels when the transport is not part of the system. The dual flexible disk drives may be replaced with a 177.8-millimeter (7-inch) blank panel when the drives are not part of the system.

NOTE

If the mounting rails are already installed in the cabinet, skip to step 6.

1. Locate the front and rear mounting supports in the cabinet (Figure 2-18).
2. The cabinet mounting supports have holes spaced on 15.875-millimeter (0.625-inch) centers and 12.70-millimeter (0.5-inch) centers. The bottom edge of the front panel must be centered between two holes that are 12.70 millimeters (0.5 inch) apart, as illustrated in Figure 2-19. Mark the upper of the two holes on the front and rear supports (four places). The upper hole should be the thirteide of the mounting supports.
3. From the cabinet mounting hardware, select and attach the four rail angles (part number 2265445-0001) to the cabinet mounting supports using the machine screws (part number 996739-0033) supplied with the mounting hardware (Figure 2-20). The screw in the bot-



(A)142216

Figure 2-17. Component Locations in 1.78-Meter (70-Inch) Rackmount Cabinet

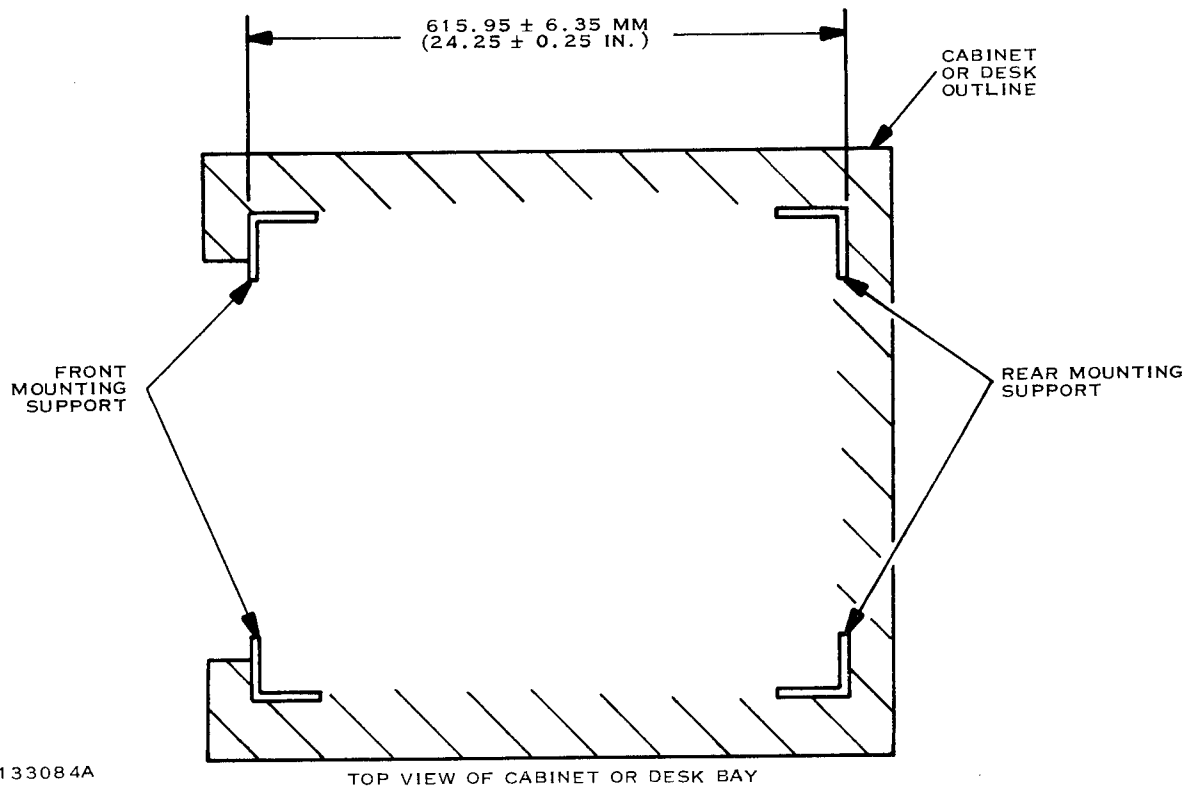


Figure 2-18. Mounting Support Locations in 1.78-Meter (70-Inch) Cabinet

tom part of the rail angle mates with the holes marked in Step 2. Note that the edge of the rail angle must be flush with the edge of the mounting support and that mounting screws are installed so that the heads of the screws are on the inside of the mounting supports.

4. Install speednuts (part number 972802-0010) on the top and bottom holes of the front rail angles as shown in Figure 2-20.
5. Position the mounting rail (part number 2265444-0001) against the rail angles as shown in Figure 2-21, matching the round holes in the mounting rail with the speednuts installed in step 4. Mark the two holes on the top and bottom of the rear rail angles that best match the slots in the mounting rails. Install the speednuts in these holes as shown in Figure 2-21. Screw the mounting rails to the rail angles using the thread-forming screws supplied (part number 996741-0002).

CAUTION

Before installing the 17-slot chassis in rackmount cabinet, adjust the leveling feet so that cabinet is level.

MARK THESE HOLES (1 3rdHOLE FROM BOTTOM IN 70-INCH CABINET, BOTTOM HOLE IN 30-INCH CABINET)

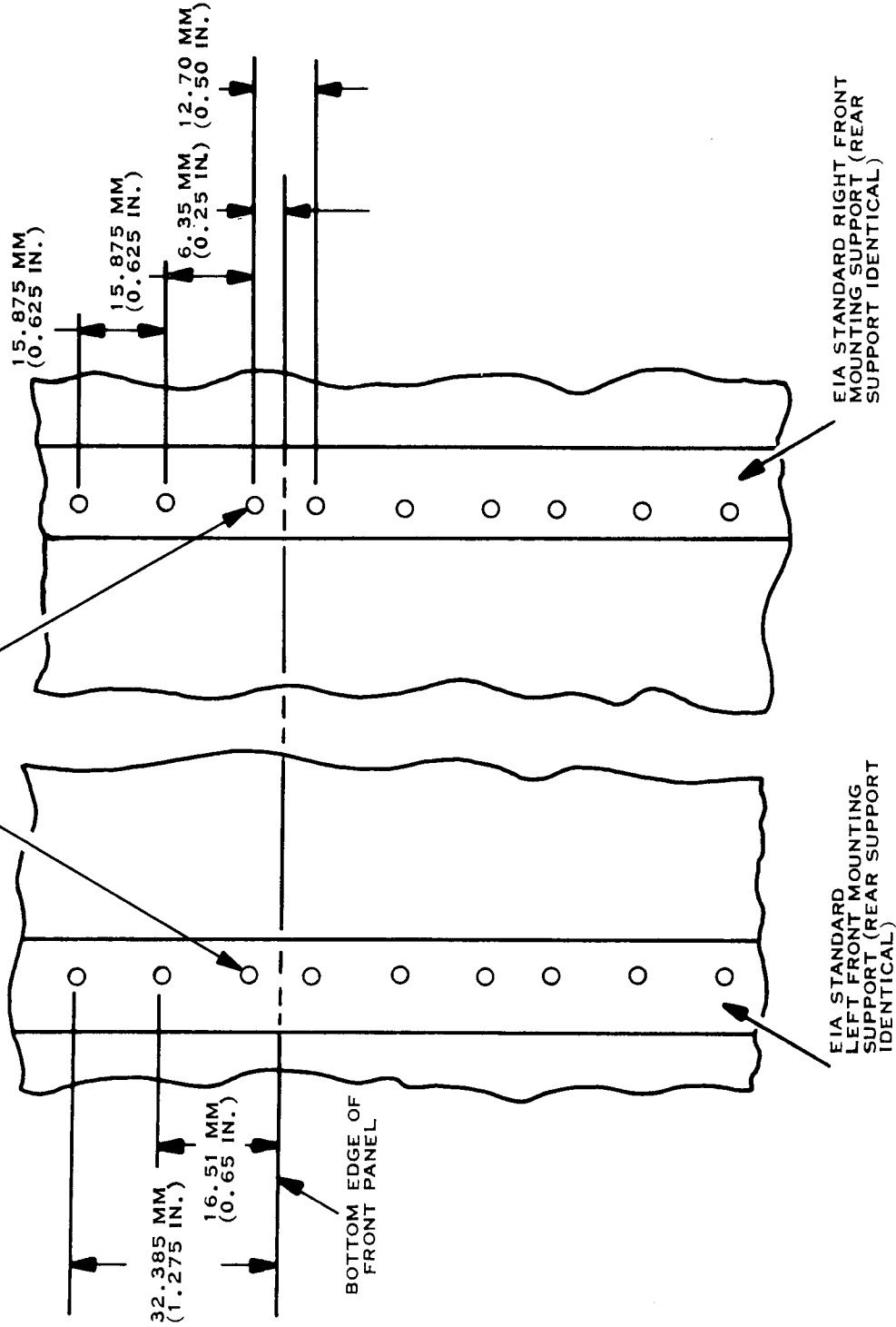


Figure 2-19. Mounting Hole Positioning

(A)142217

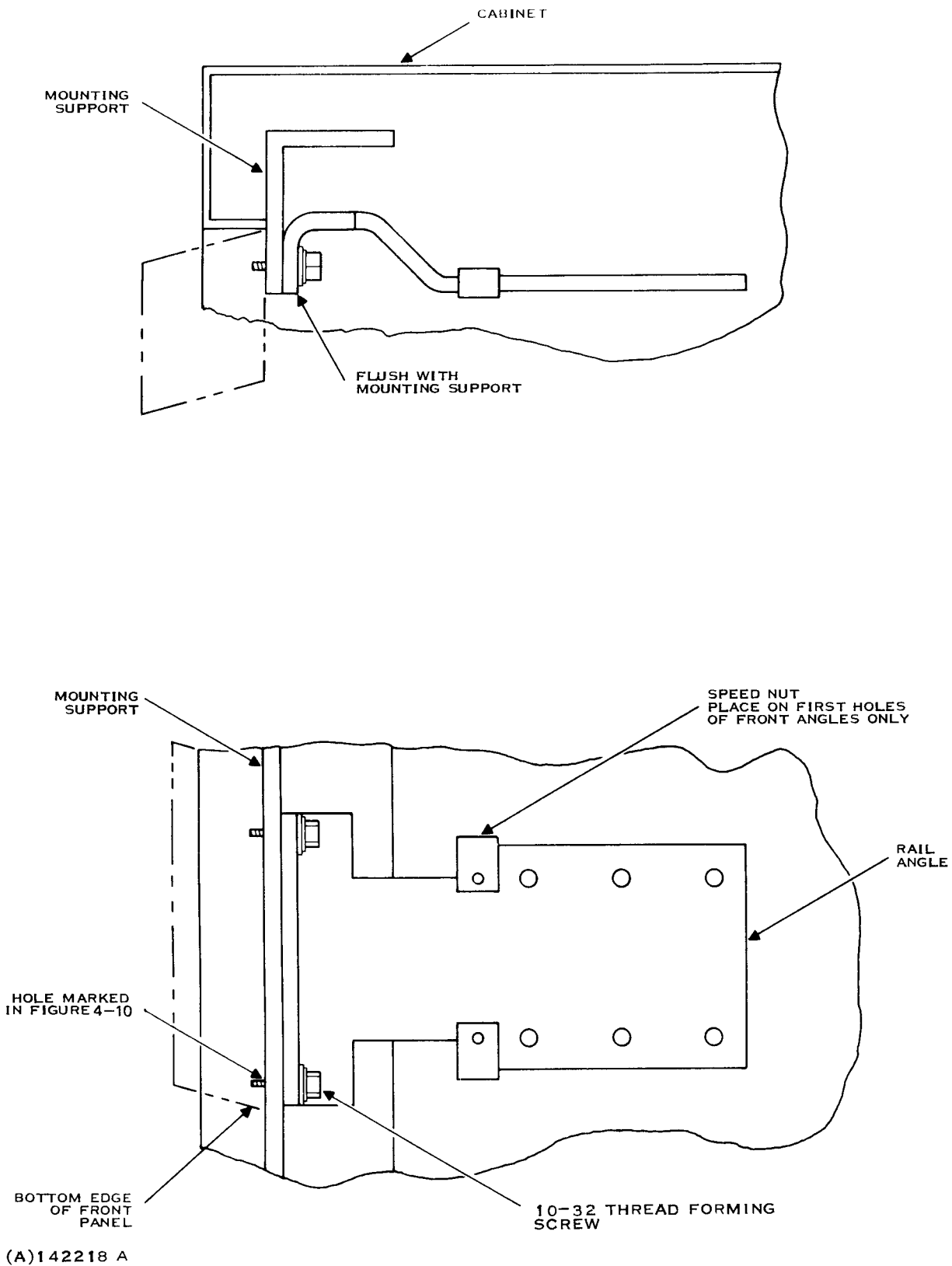


Figure 2-20. Typical Bracket Location (Four Places)

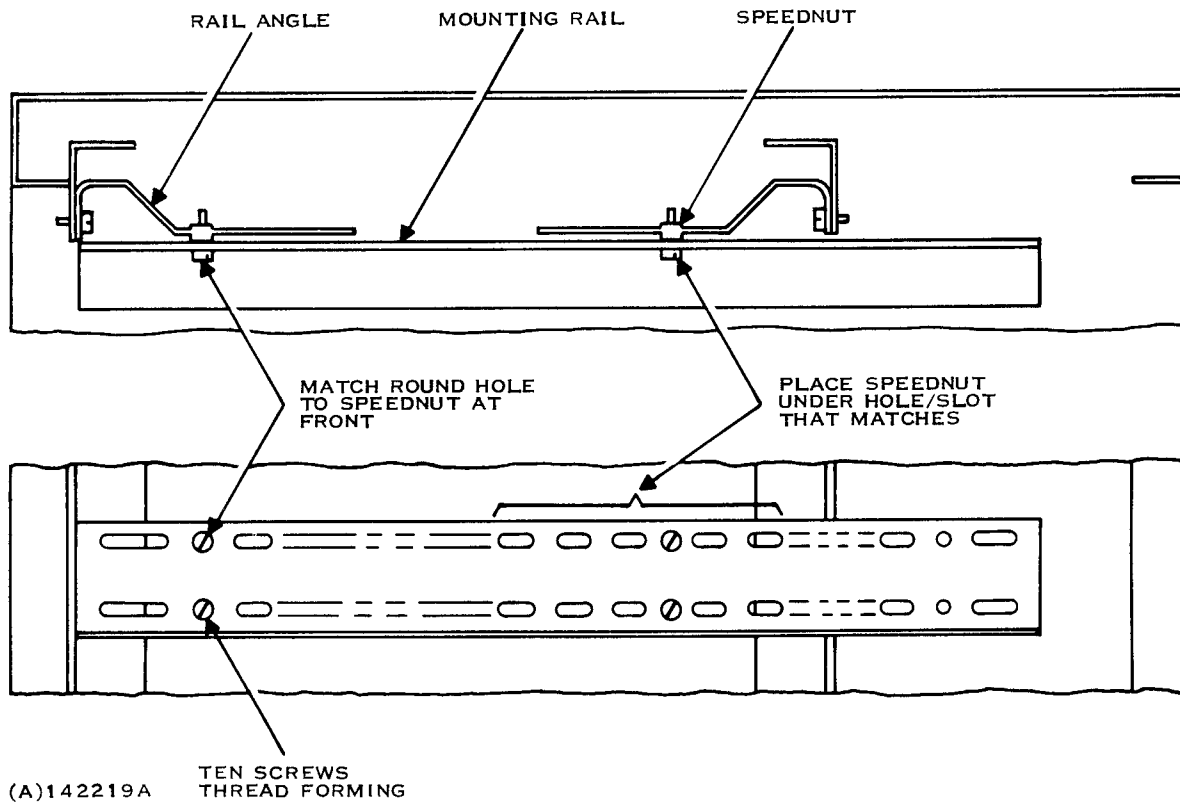


Figure 2-21. Typical Mounting Rail Location (Two Places)

6. Push upward on the two release latches (Figure 2-22) at either side of the filter panel assembly on the 17-slot chassis to release the filter panel. Remove the filter panel assembly from the front of the 17-slot chassis by pulling outward. Place the chassis on the mounting rails and slide the chassis into the cabinet until the mounting flanges on the chassis contact the cabinet mounting supports.
7. To release the programmer panel from its chassis front panel mounting flanges, grasp the two latching tabs at each side of the bottom of the programmer panel front panel and press upward (Figure 2-22). Withdraw the programmer panel from the front panel far enough to expose the two mounting holes in the chassis mounting flange. Loosely install the supplied machine screws into the 10 mounting holes in the chassis mounting flange. Tighten the two top screws and reinstall the programmer panel. Tighten the remaining screws.
8. The 17-slot chassis is shipped with the computer, system logic boards, and interconnecting cables installed. The cables are connected at the computer end and are dressed out the back of the chassis. Route the other end of each cable to the appropriate device and connect it according to the installation instructions for that device (presented in Section 2 of this manual). If it becomes necessary to install cables in the 17-slot chassis, refer to Appendix A of this manual.

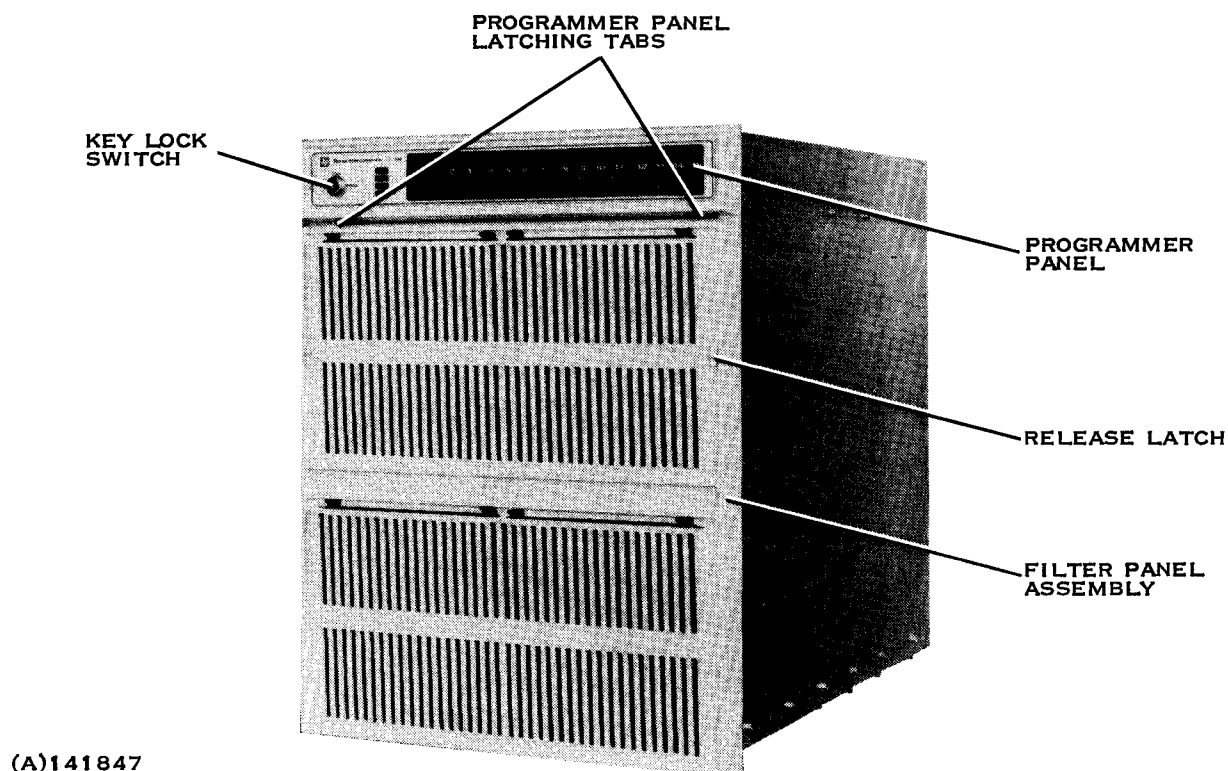


Figure 2-22. Front View of 17-Slot Chassis

2.3.2 Model DS10 Disk Drive Unpacking and Assembly

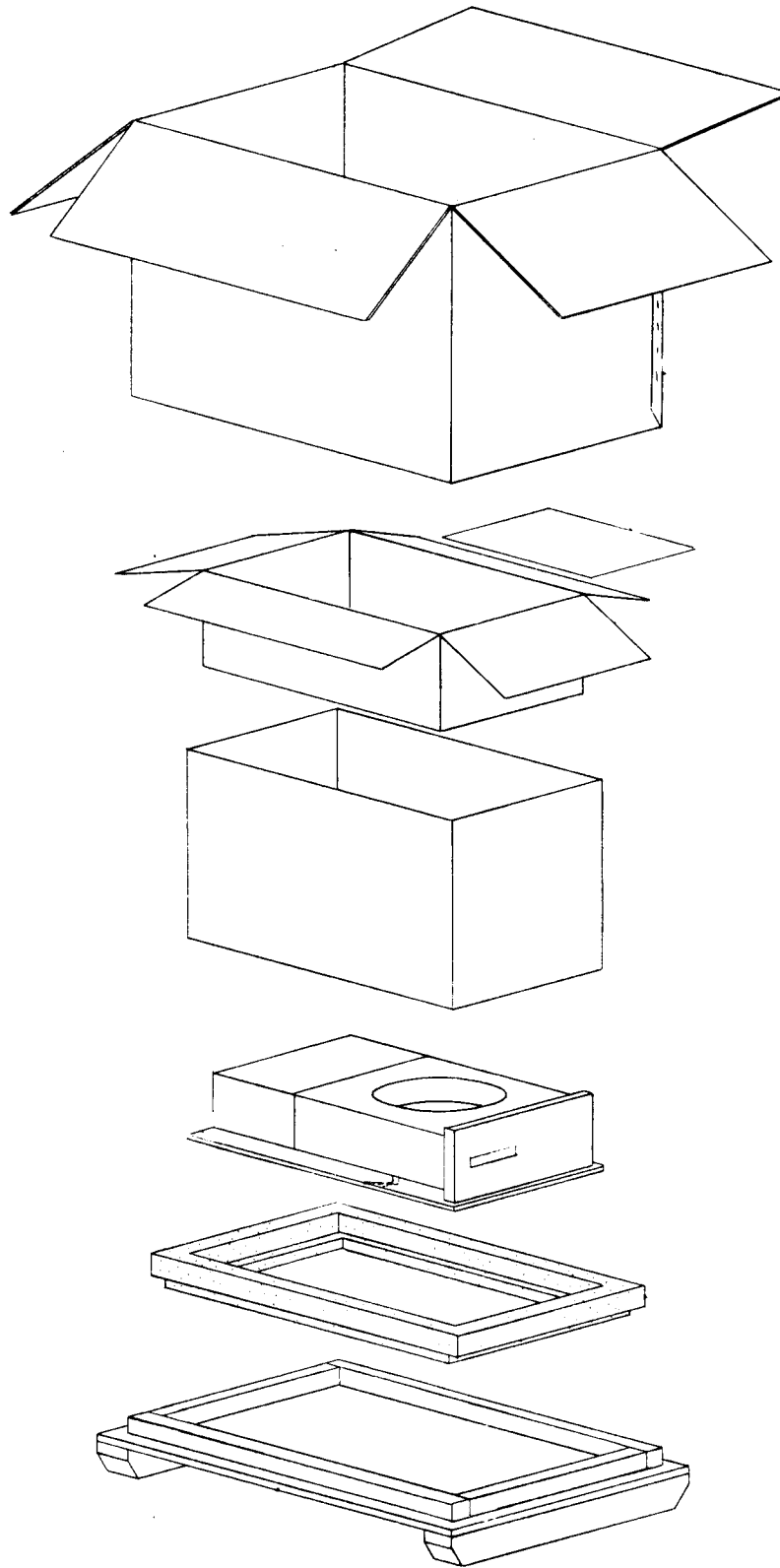
The following procedure presents unpacking and assembly instructions for the DS10 disk drive. While performing this procedure, visually inspect the individual components for shipping damage. Report any shipping damage and/or missing components in accordance with local practices and procedures. For more details refer to *Model DS10 Cartridge Disk System Installation and Operation*.

The DS10 disk drive is shipped in a container as shown in Figure 2-23. If the DS10 disk drive is shipped at the same time as the computer system, the disk controller and the interconnecting cables will be installed in the computer system. Otherwise, these items plus the installation and operation manual will be packaged separately from the disk drive in polyethylene bags and boxed with bubblepack filler material.

Upon receipt of the container, inspect it to ensure that no physical damage occurred during shipment. If damage is apparent, notify carrier immediately.

NOTE

The unpacked rackmount disk drive weighs approximately 67.2 kg (148 lbs). When unpacked, handling of the unit requires assistance of another person or use of a portable hoist or hydraulic lift.



(A) 137233

Figure 2-23. DS10 Disk Drive Shipping Configuration

NOTE

Except where noted, save all shipping materials for use in reshipment of unit.

After ensuring that no damage has been done to the container or its contents during shipping, unpack the disk drive according to the following instructions:

1. Position the container so that the address label is upright.
2. Cut and discard the metal bands around the shipping container.
3. Open the top flaps of the shipping container and lift the shipping container by its flaps up and off the assembly.
4. Remove the manual from the top of the accessory package and read the unpacking instructions.
5. Grasp the accessory package by its sides, lift it out of the inner tube, and set it aside.
6. Lift the cardboard inner tube off the disk drive and set aside.

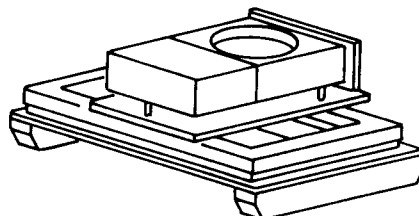
CAUTION

The following step requires at least two persons.

7. By placing your fingers underneath the sides of the unit, grasp the disk drive and lift it clear of the base. As shown in Figure 2-24, rotate the unit 90 degrees and set it on the foam base to expose the mounting bolt heads underneath the wood base.

CAUTION

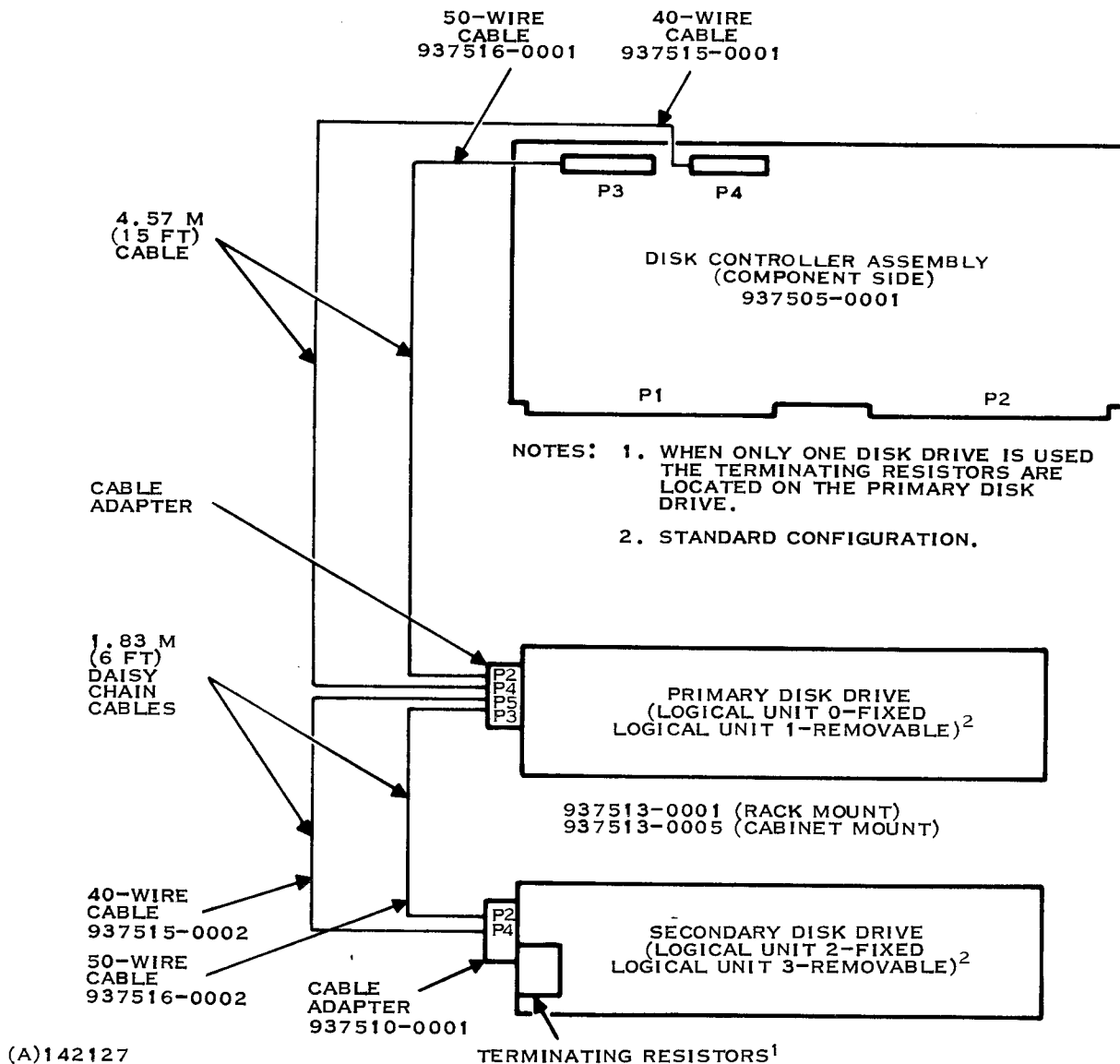
Do not place the unit on its side.



(A) 137235

Figure 2-24. Placement of DS10 Disk Drive for Shipping Bolt Removal

8. Remove the three mounting bolts from beneath the wood base.
9. Open the plastic bag surrounding the disk drive and press the bag down around the disk drive sides. The unit can now be lifted free of the wood base and the plastic protective bag.
10. Remove the three screws that hold the electronics cover in place and then remove the electronics cover (Figure 2-10).
11. By rotating the head of the pin 90 degrees counter-clockwise and pulling straight up, remove carriage lock pin. Store the pin on the side of the magnet, as shown in Figure 2-11.



(A)142127

Figure 2-25. Interconnection of Disk Controller and Two Disk Drives

NOTE

In systems with two DS10 drives, check the logical unit label (see Figure 2-10) to identify logical units 2 and 3. This drive should be placed at the end of the daisy chain (see Figure 2-25).

2.3.2.1 Voltage Conversion Procedures. If the DS10 was shipped with the DS990 system, it was configured for the correct voltage at the factory and this procedure may be disregarded. If the DS10 was not shipped with the DS990 system, configure the voltage by following the procedure outlined below:

1. Remove the voltage adapter assembly (Figure 2-26) at the lower left rear of the drive next to the power cord.

NOTE

For each voltage option, there are two jumpers. One end of each jumper is fixed (pins 14 and 15, Figure 2-27) and should not be removed.

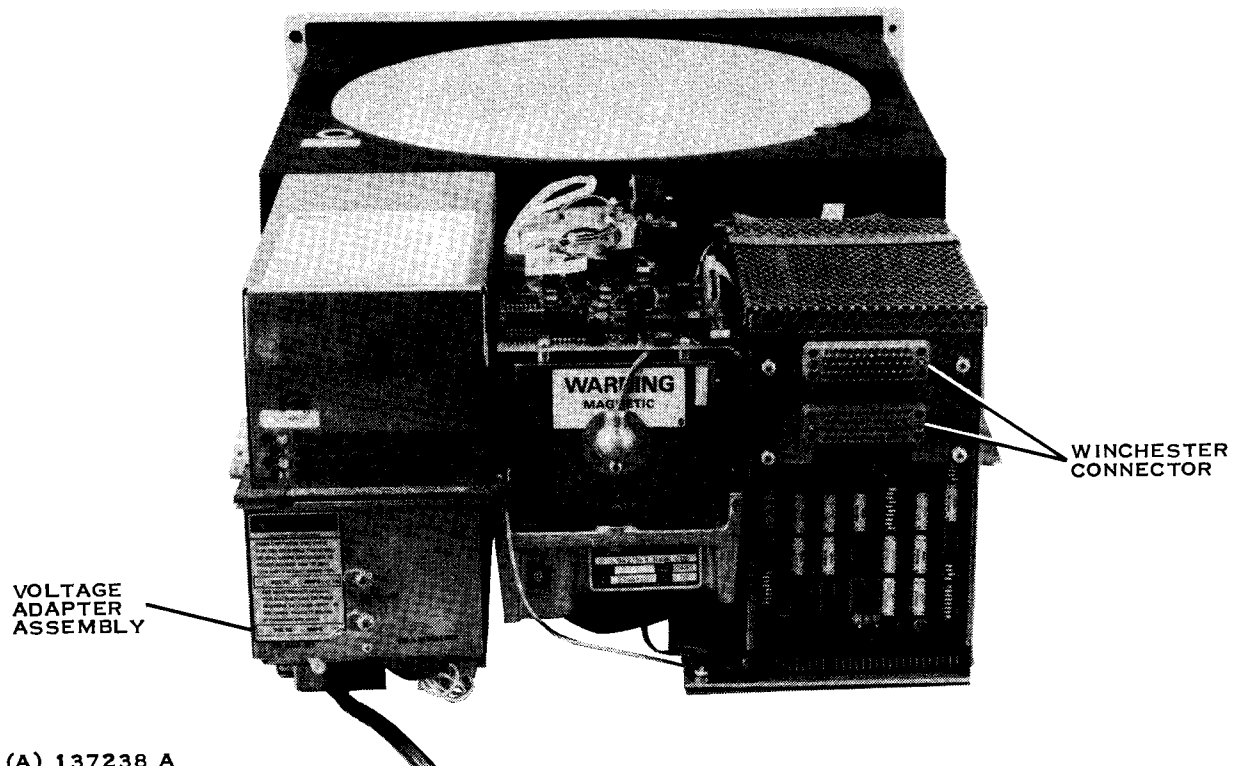


Figure 2-26. DS10 Rear View with Cover Removed

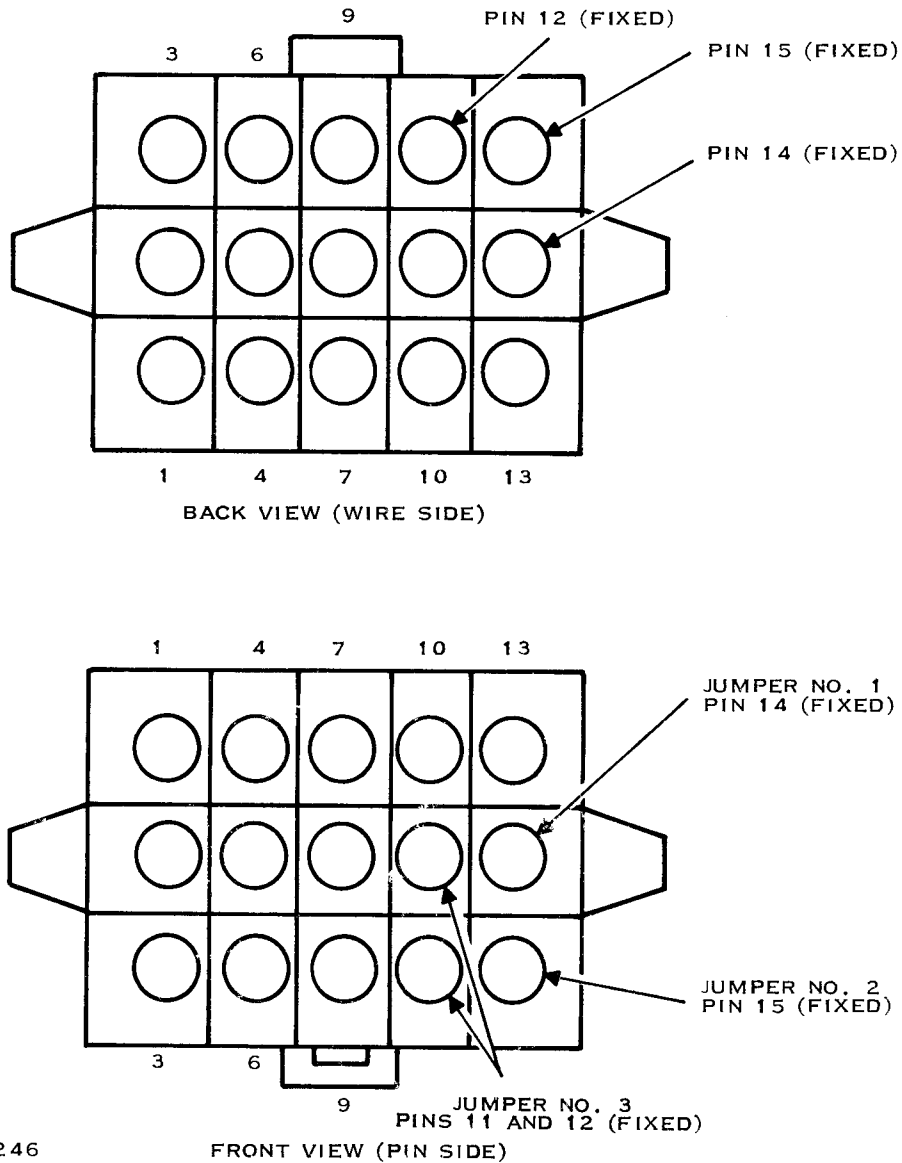


Figure 2-27. Voltage Jumper Plug and Connector

2. Refer to Table 2-6 for proper jumper connections.
3. Pull the moveable end of each jumper out of the plug and reinsert it into the location indicated in Table 2-6.
4. Install the jumper plug into the connector.
5. If necessary, for proper mating of line cord with power outlet, remove the existing line cord plug and replace it with a new one (customer-supplied).

Table 2-6. Disk Drive Input Voltage Jumper Connections

Voltage	Jumper No. 1		Jumper No. 2	
	Fixed Pin	Moveable Pin	Fixed Pin	Moveable Pin
100*	14	4	15	
110	14	3	15	7
120*	14	2	15	7
130	14	1	15	7
140	14	6	15	8
150	14	5	15	8
160	14	4	15	8
170	14	3	15	8
180	14	2	15	8
190	14	1	15	8
200*	14	6	15	9
210	14	5	15	9
220*	14	4	15	9
230	14	3	15	9
240*	14	2	15	9
250	14	1	15	9

Note:

* Standard voltage drives.

6. Alter the voltage designation of ID plate at rear of disk drive to reflect new operating voltage.
7. Reinstall the electronics cover.

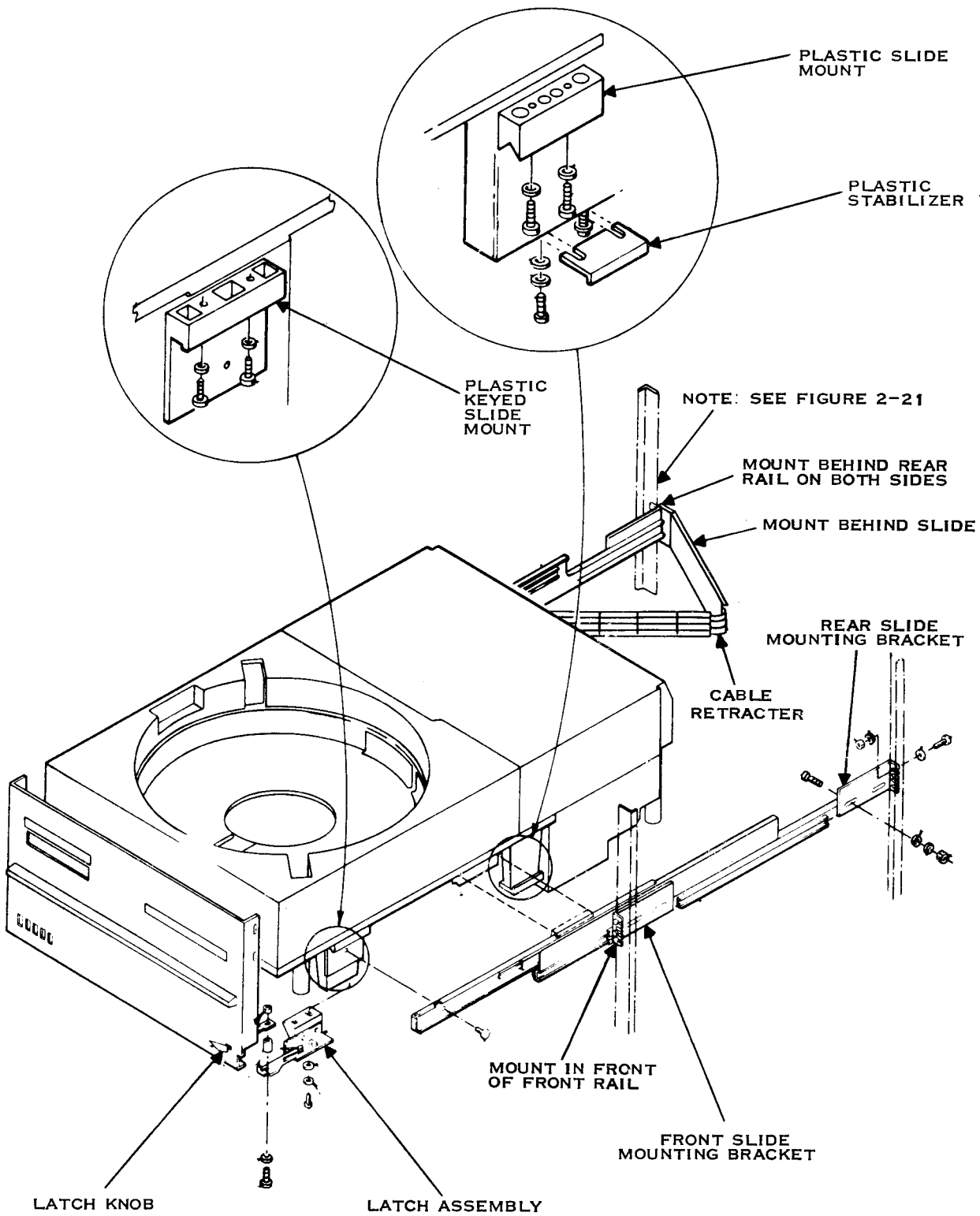
2.3.2.2 Installation of Rackmount Disk Drive. To install the rackmount disk drive, make sure the enclosure main power circuit breaker or switch is in the off position, then perform the following steps:

CAUTION

Before installing the DS10 on the slides of a 30-inch cabinet, adjust the leveling feet on the front of the cabinet. (If the leveling feet are not properly leveled to carry the load, the cabinet may tilt when the DS10 is pulled on its slides out of the cabinet.)

NOTE

Refer to Figure 2-28 while performing the following steps.



(A) 137248

Figure 2-28. Rack Slide Assembly Mounting for DS10 Disk Drive

1. Attach a plastic slide mount and a plastic keyed slide mount to each side of the disk drive with 8-32 × 5/8-inch machine screws and No. 8 internal-tooth lock washers.

NOTE

Orient V-groove channel in unkeyed plastic mount downward.
Orient flat sides of keyed mounts inward and downward.

2. Attach a plastic stabilizer to each side of disk drive with 8-32 × 1/2-inch machine screws, No. 8 internal-tooth lock washers, and No. 8 flat washers.

NOTE

The stabilizers should be mounted with their keys extending downward. Leave stabilizers slightly loose at this time.

3. Extend slides to full extension. The intermediate catches at 460 millimeters (18 inches) must be released on both sides. Slides lock at full extension.
4. With the aid of an assistant or a lift, set the disk drive on top of the slides ensuring that all four plastic slide mounts rest on the top edges of the slides and that keys of front mounts engage notches in slides.

NOTE

The flanges can be located as much as 25.4 millimeters (one inch) in front of the slide ends to accommodate certain rack dimensions. This reduces maximum extension of the unit out of the rack.

5. Coat threads of two 8-32 × 5/16-inch pan head screws with Grade C Loctite (or equivalent) and install through each slide into keyed slide mounts.
6. Adjust stabilizers installed in step 2 to prevent wobbling and to provide smooth slide operation. Tighten stabilizers.
7. Attach latch assembly to disk drive with 8-32 × 5/8-inch pan head machine screws, No. 8 lock washers and No. 8 flat washers. Leave screws slightly loose at this time.
8. Insert knob through front panel and attach to latch assembly with an 8-32 × 5/8-inch pan head machine screw, a No. 8 internal-tooth lock washer, an 8-32 × 1/4-inch spacer, and an 8-32 hex machine nut.
9. Adjust latch so it catches front vertical rack rail and securely holds disk drive in retracted position and releases easily when knob is pushed to left.

2.3.2.3 DS10 Cabling. The DS10 I/O cables are shipped mounted on the cable carrier in the cabinet. The DS10 power cord is shipped with the disk drive and must be installed on the cable carrier. A cable retractor bracket kit with hardware and installation instructions is packaged in a plastic bag and shipped with the system. This bracket must be installed to connect the cable carrier to the DS10.

At the computer chassis, verify that the disk controller is installed in the correct slot (Tables 2-3, 2-4, and 2-5). Verify that the ends of the I/O cables that attach to the computer are attached as shown in Figures 2-25 and 2-29.

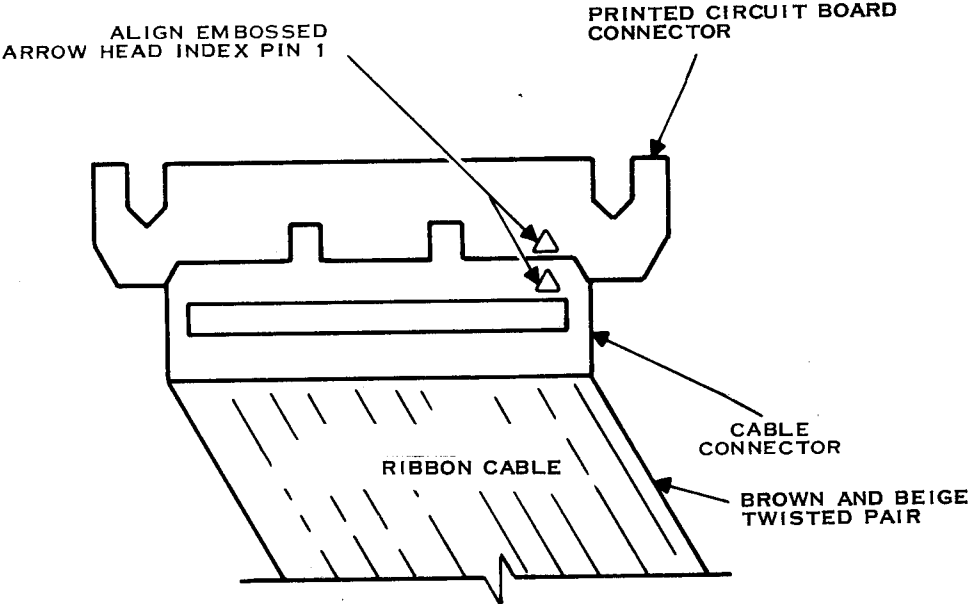
To install the DS10 power cord and the cable retractor bracket, and to properly dress out the I/O cables, perform the following steps:

1. Verify that the enclosure main power circuit breaker or switch is in the off position and then open the rear door or cover.
2. At the front of the enclosure, pull the DS10 disk drive all the way out on its slides and remove the top cover.
3. Refer to Figure 2-30 and remove the two screws from the right rear of the DS10 disk drive. Mount the retractor bracket.
4. Swing the cable carrier into the extended position and fasten the hinge to the retractor bracket, using the hardware provided.
5. Loosen existing tie-wraps and route the power cord along the edge of the cable carrier (see Figures 2-14 and 2-30).

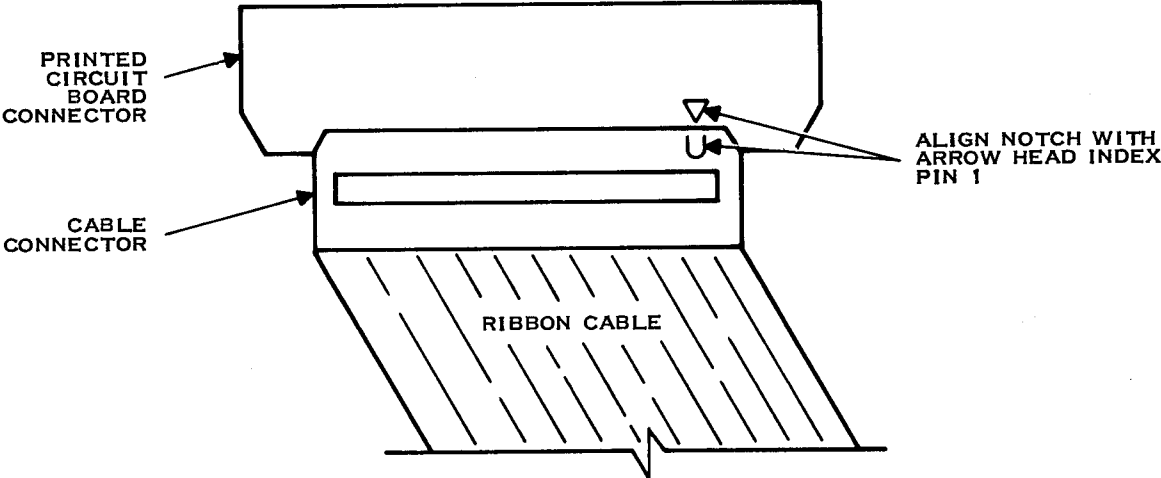
NOTE

The tie-wraps provided are releasable and reusable. To release, insert fingernail under tab attached to tie-wrap jaw and apply modest pressure while pulling the tie-wrap end from the jaw.

6. Connect the DS10 power cord to the power outlet in the enclosure.
7. Mate the cable adapter attached to the ends of the ribbon I/O cables to the disk drive Winchester connector (see Figures 2-14 and 2-30) and tighten the retaining screws.
8. Dress out cables on the cable carrier so they do not bind or chafe at hinges when the cable carrier moves from fully extended to fully closed.
9. Tighten the tie-wraps and tuck the tie-wrap ends out of the way.



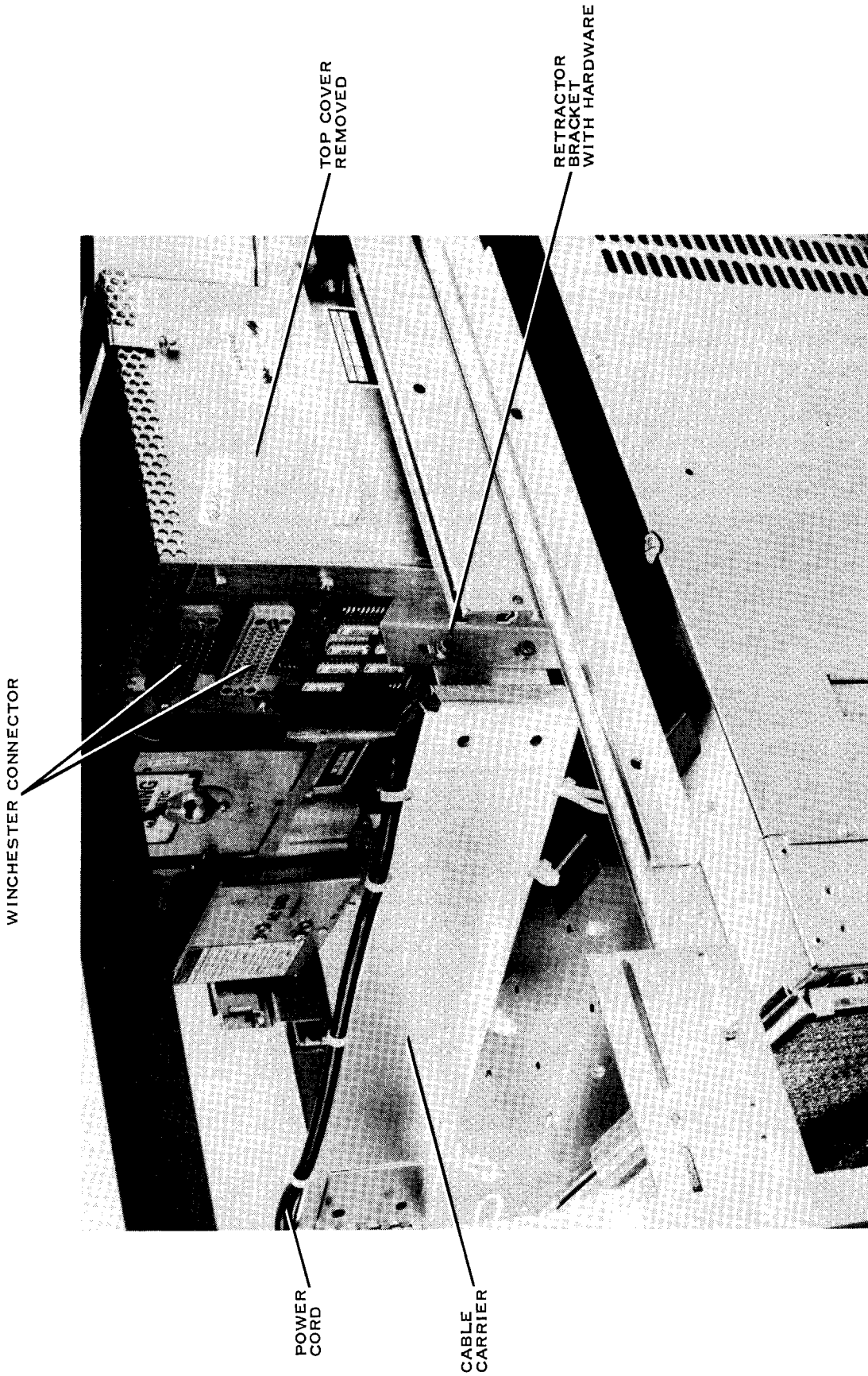
(A) FORMER CONFIGURATION



(B) NEW CONFIGURATION

(A)143516

Figure 2-29. Ribbon Cable Connector Mating to PCB Connector



(A)143317

Figure 2-30. Rackmount DS10 Showing Cable Carrier, Retractor Bracket, and Winchester Connector

2.3.2.4 Purging the DS10 Air Filtering System. Prior to using the disk drive on the system, it is necessary to purge the air filtering system of contaminants. This can be accomplished by performing the following steps:

1. Verify that the MAIN circuit breaker is set to OFF.
2. Unplug A1P2 on the actuator visible at top center of the drive when the back cover is removed.
3. Install a scratch cartridge.
4. Set the MAIN circuit breaker to ON.
5. Depress the START/STOP button to START.
6. Allow the disk drive to spin up and run with the heads retracted for 30 minutes.
7. Depress the START/STOP button to STOP.
8. Turn main circuit breaker to OFF.
9. Reconnect A1P2.
10. Remove the scratch cartridge.
11. Replace DS10 top cover.
12. Close the enclosure rear door or replace cabinet cover.

2.3.3 Model DS25/DS50 Disk Drive Unpacking and Assembly

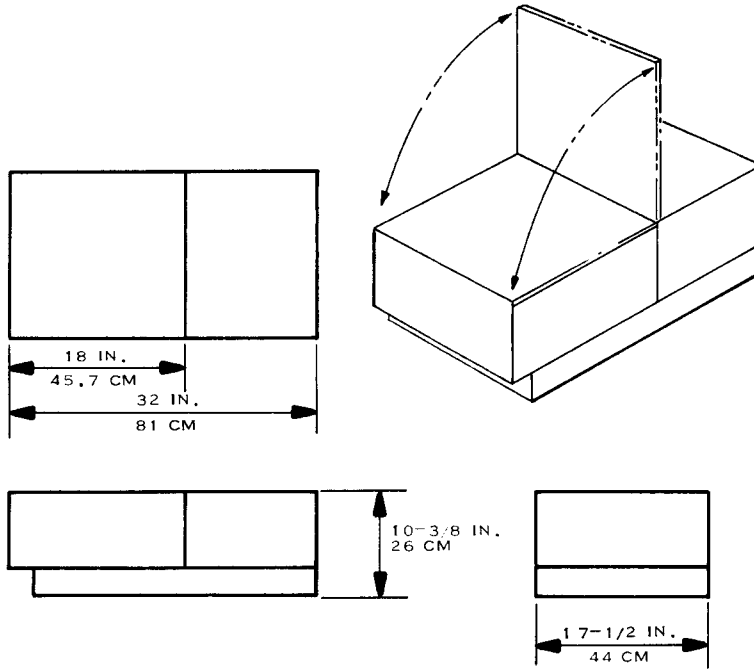
The following paragraphs include unpacking and assembly instructions for the DS25/DS50 disk drives. While performing this procedure, visually inspect the individual components for shipping damage. Report any shipping damage and/or missing components in accordance with local practices and procedures.

The user should read paragraph 2.3.3 in its entirety before proceeding with the installation. Circumstances that are unique to the user's site may dictate that the installation procedures be performed in a different order than set forth in this section. Familiarity with the entire installation procedure will provide a basis for planning the task before starting. Outline dimension drawings, which indicate the stand-alone space requirements for the disk drives, are shown in Figure 2-31.

CAUTION

Do not connect or disconnect any plug or circuit board when power is applied as voltage transients may damage electronic parts.

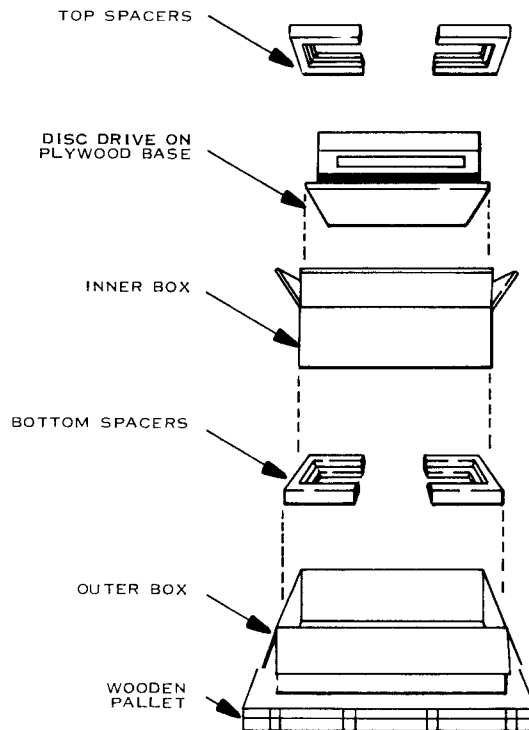
The disk drives are shipped in containers as shown in Figure 2-32. If the equipment is shipped at the same time as the computer system equipment, the disk controller and the interconnecting



WEIGHT-200 POUNDS (91 KG)

(A)133976

Figure 2-31. DS25/DS50 Disk Drive Outline Dimensions



(A)133977

Figure 2-32. DS25/DS50 Disk Drive Shipping Configuration

cables will be installed in the computer. Otherwise, these items plus the installation and operation manual will be packaged separately from the disk drive in polyethylene bags and boxed with bubblepack filler material.

2.3.3.1 Unpacking the Disk Drive. Upon receipt of the container, inspect it to ensure that no physical damage occurred during shipment. If damage occurred, notify the carrier at once.

NOTE

The unpacked disk drive unit weights approximately 99.8 kg (220 lbs.). When unpacked, handling of the unit is simplified by using a portable hoist or hydraulic lift.

After preliminary inspection, unpack using the following procedures:

1. Move the unpacked container by fork lift to the receiving station workbench near the final location.
2. Cut and discard the metal bands securing the shipping container. Open the top flaps.
3. Remove the two spacers from the top of the inner container. Also, remove and retain any loose items packed between the inner and outer containers.

CAUTION

Be especially careful when cutting or slitting the cardboard containers. Be sure the knife blade does not go through and mar the disk unit's finish or damage the ac power cord.

4. Cut through the tape along the top of the inner container and open the top flaps.
5. Cut down and through the four corners of the outer container so that the four sides can be laid flat.
6. Repeat step 5 for the inner container.
7. Remove and retain any loose items that may be packed between the inner container and the disk drive unit.
8. Remove and retain the cardboard collar surrounding the unit. The plastic-enclosed unit is now fully accessible. Remove the tape that holds the plastic sheeting to the plywood base, but leave the sheeting in place to protect the finish of the unit.
9. Slide the front end of the unit, the plywood base, and the packing containers over the edge of the supporting bench just far enough to bend down the cardboard container and to remove the bottom front spacer.

10. On the bottom of the plywood base, locate two machine bolts that attach the base to the front of the unit frame. Remove both bolts.
11. Slide the rear end of the unit, the plywood base, and the packing containers over the edge of the support surface just far enough to remove the remaining bottom spacer and the two bolts that attach the back of the unit frame to the plywood base. Remove both bolts.

WARNING

The center of gravity of the unit is towards the rear. Be careful when hoisting. Refer to Figure 2-33.

12. Lift the unit free of its plywood base and the other packing materials, preferably using a hoist as described in steps 13 and 14. (Refer to Figure 2-33).

WARNING

If the disk drive unit must be lifted without a hoist, have at least three persons on hand: two to lift the unit and a third to remove the packing material and assist in lifting. Be careful to avoid injury to the fingers when setting the unit down.

13. If a lifting hoist is available, observe the two wide grooves cut in the top of the plywood base to accommodate the webbing, or lifting straps. Raise one end of the unit at a time and slip the nylon lifting straps under the unit at these grooves. The loop diameter of the lifting straps should be maintained by a cradle or lifting bar.
14. Take up the slack in the lifting straps by raising the bar, and place several layers of corrugated cardboard (cut from the collar) between the top edges of the unit and each strap. The cardboard protects the top covers from being distorted by the straps.

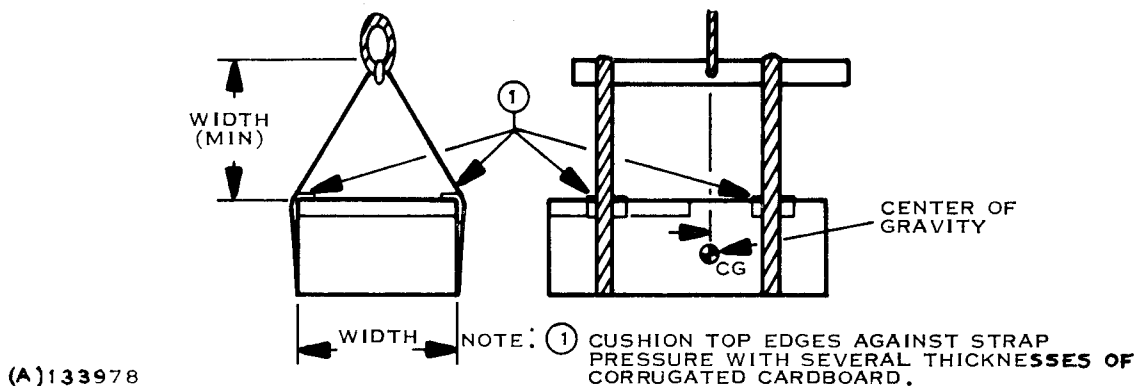


Figure 2-33. Hoisting DS25/DS50 Disk Drive

15. Lift the unit slightly and check for balance (the rear of the unit is heavier). Loosen and readjust the lifting bar for the proper balance point.
16. Lift the unit free of the plywood base and other packing material.
17. Move the unit by hoist or dolly to the installation location.

2.3.3.2 Situating the Disk Drive. To locate the disk drive at a permanent place on a floor stand, obtain a 947535 pedestal (shown in Figure 1-8), place it at the desired location, and set the unit on the console. The front of the unit must be oriented towards the door with the latch. At the rear of the console is a cutout in the flange to accommodate cable routing to the disk drive unit. The mounting plate in the console has three holes for securing the disk drive to the plate. The bolts from the plywood shipping base may be used for this purpose.

WARNING

Since the net weight of the disk drive is in excess of 99.7 kg (200 lbs), four persons are needed to place the unit onto the console cabinet without a hoist.

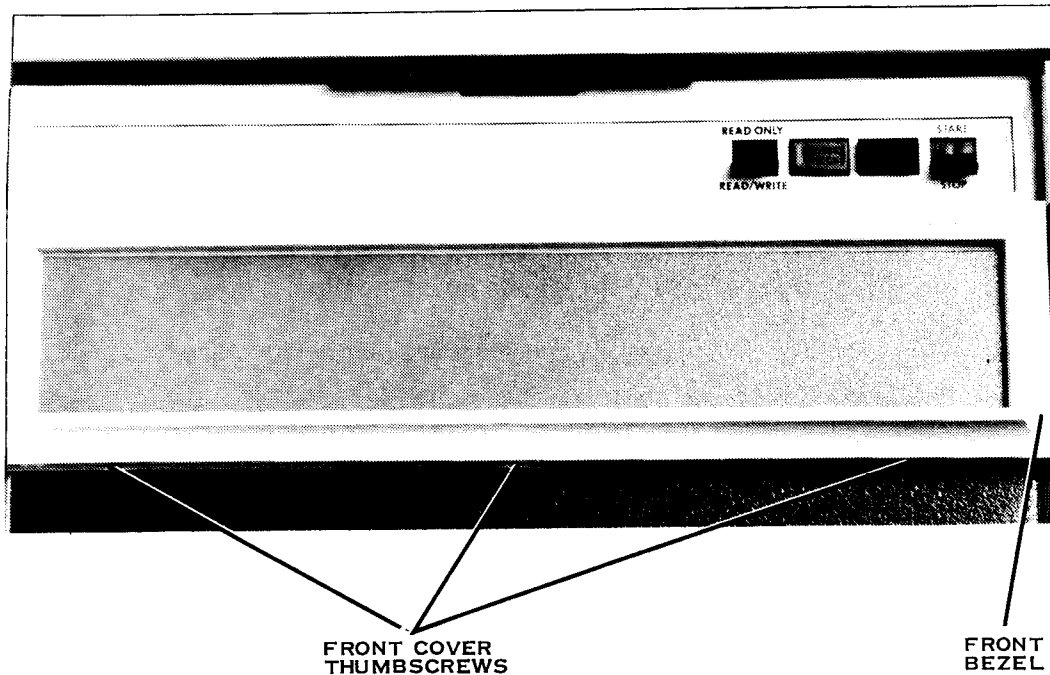
2.3.3.3 Unpacking and Handling Disk Packs. The disk packs are shipped in reusable corrugated shipping containers that are lined with polyurethane foam. The entire container, including the disk pack, can be handled by one person and provides adequate storage protection with no degradation of performance. Disk packs in a library should always be kept in their plastic cases unless mounted in a disk drive unit. The case of the disk pack consists of a clear plastic top cover with a handle and a bottom cover. When possible, the disk packs should be stored in the same room environment as the disk drive or should be brought into the same room no less than two hours before use.

CAUTION

The disk pack used with the Models DS25 and DS50 must be per TI Specification 947533-0001. The pack must be error free. The label should contain the manufacturer's name, part number, serial number, and addresses of any bad tracks. Error mapped packs are not recommended.

2.3.3.4 Preparation of the Disk Drive Unit. Preparation of the disk drive unit includes visual inspection, removing the exterior covers, shipping bolt, and internal shipping restraints, and checking for proper installation of the ground shorting jumper and input power jumper. These procedures are described in the following paragraphs.

2.3.3.5 Removing Disk Drive Covers. To remove the front cover, unscrew the three thumbscrews under the front bezel as shown in Figure 2-34. Then pull the cover straight forward until it clears the unit. To remove the rear cover, unscrew the two screws at the rear as shown in Figure 2-18. Then slide the cover rearward and lift up until it clears the unit.



(A)133980 (DSD-876-13-6)

Figure 2-34. DS25/DS50 Disk Drive Front View

2.3.3.6 Installing Covers. Installation of the cover is essentially the reverse of its removal. For the two covers to fit properly, the lip on the bottom of each cover must fit over the flange of the bottom case.

2.3.3.7 Removal of Shipping Bolt. Located at the center of the disk drive unit's rear panel is a 3/8-inch allen-head shipping bolt (Figure 2-35) that locks the unit deck casting to the frame assembly during shipment. Remove the bolt, lockwasher, and flat washer, and save them for reshipment.

2.3.3.8 Removal of Internal Shipping Materials. Remove the internal shipping materials and restraints per the following:

1. Remove the glass tape that holds the plug-in circuit boards in the card cage assembly.

CAUTION

While removing the glass tape that secures the T-block assembly, hold the T-block in the retracted position. Otherwise, the heads may slide forward off their camming surfaces, causing head damage.

2. Remove the transparent air shroud that encloses the retracted heads and T-block assembly. Cut the glass tape that secures the T-block assembly in the retracted position. See Figure 2-36.

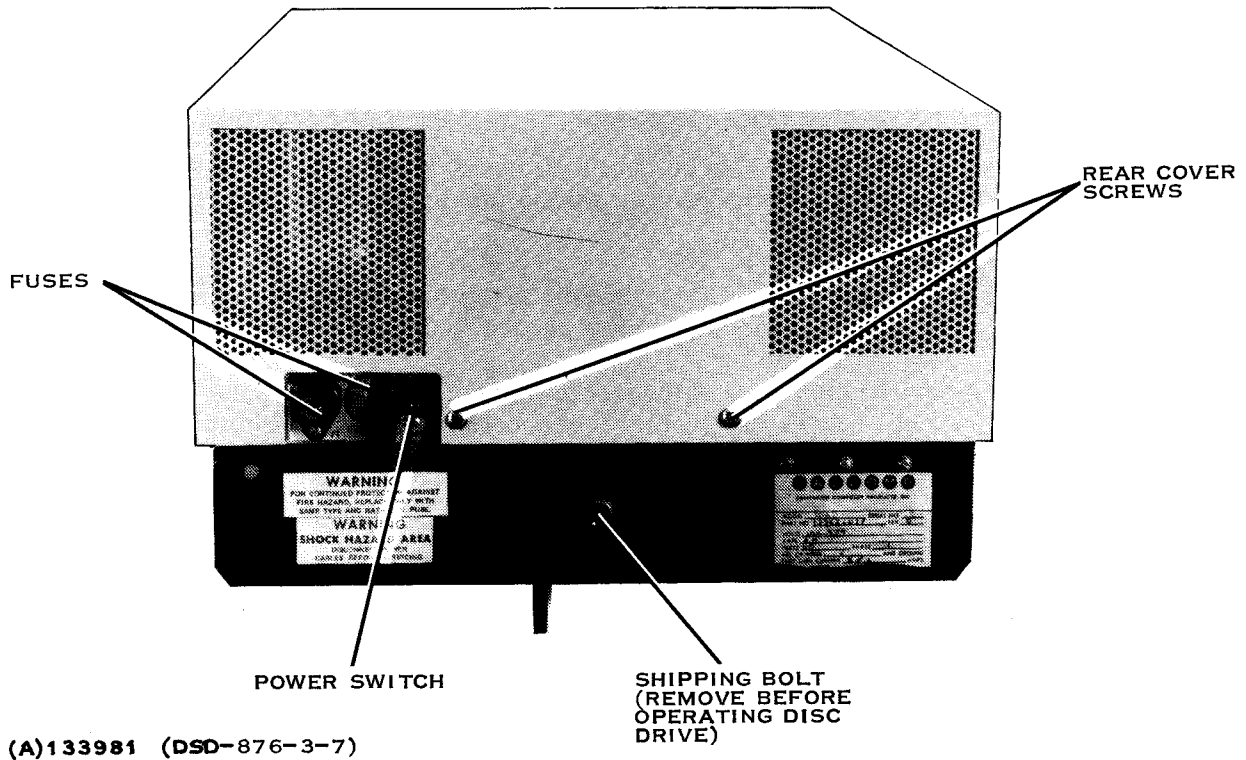


Figure 2-35. DS25/DS50 Disk Drive Rear View

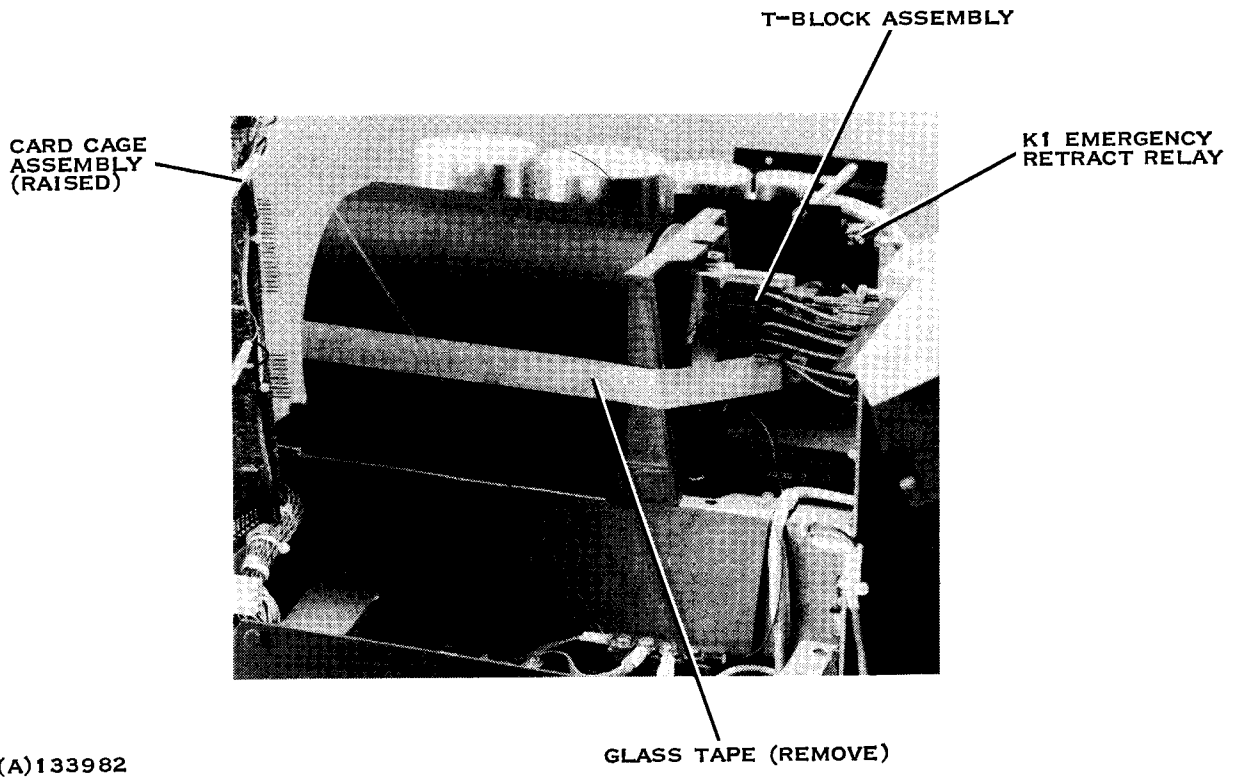


Figure 2-36. DS25/DS50 Disk Drive T-Block Assembly Shipping Restraints

3. Remove the glass tape from the T-block assembly and the linear motor. Reinstall the transparent air shroud.
4. Unlatch and open the pack area lid, and then check for and remove any tape or other packing material inside the disk pack air shroud. Manually rotate the spindle to assure it turns freely.

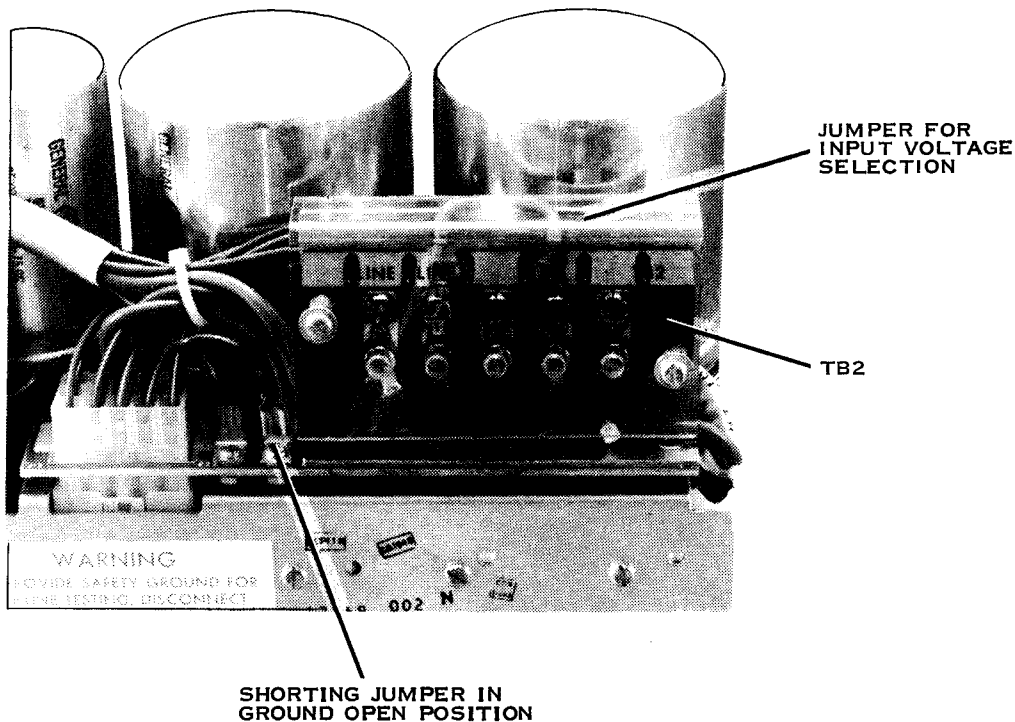
2.3.3.9 Checking Power Configurations. Prior to reinstalling the covers on the disk drive unit, verify that the internal power connections are made per the following instructions:

1. Check the identification plate at the rear of the unit for voltage, phase, and frequency of the required input power. Make sure these match the available power.

WARNING

Never operate the disk drive as a stand-alone unit without the ac and dc grounds being shorted together at the power supply. A potential as high as 60 volts can develop between the logic ground and the frame.

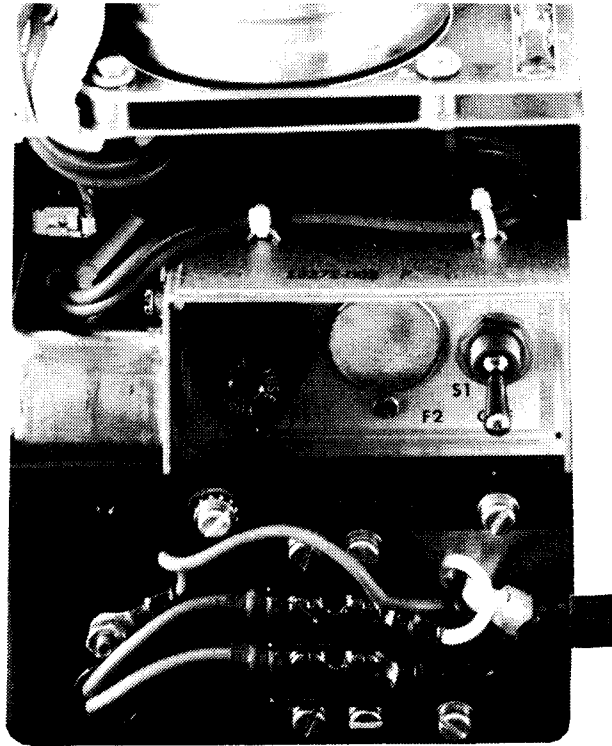
2. Move the shorting jumper to the spade terminal marked AC/DC GRD SHORT (Figure 2-37).



(A)133984 (DSD-876-13-3)

Figure 2-37. DS25/DS50 Disk Drive Ground Short and Voltage Select Jumpers

3. Check terminal board TB2 (Figure 2-37) on the power supply assembly for a jumper wire between the terminal marked OB/NRL and the terminal corresponding to the available source voltage.



(A)133985 (DSD-876-13-1)

Figure 2-38. DS25/DS50 Disk Drive Power Cable Terminal Board TB1

4. Remove the cover from the power cable terminal TB1. Make sure that all three wires are connected as shown in Figure 2-38 and that the terminals are tight. Reinstall the cover.

2.3.3.10 Purging the DS25/DS50 Air Filtering System. Prior to installing the drive on the system and after inspecting and configuring power it is necessary to purge the air filtering system. This can be accomplished by performing the following steps:

1. Turn the ac power switch to OFF.
2. Remove the emergency retract relay on power module (figure 2-36).
3. Install a scratch pack (see paragraph 2.3.3.13).
4. Plug DS25/DS50 power cable into correct power source.
5. Turn the ac power switch to ON.
6. Put START/STOP switch to START.

7. Allow disk to spin up and run with the heads retracted for 30 minutes.
8. Put START/STOP switch to stop and allow pack to come to a complete stop.
9. Turn ac power switch to OFF.
10. Reinstall emergency retract relay.
11. Move the shorting jumper to the ground OPEN position (figure 2-37) before installing the DS25/DS50 into the DS990 system.
12. Reinstall external covers.

2.3.3.11 Installing Disk Drive I/O Cables. When the disk drive is shipped with the DS990 system, the disk controller is already installed in the computer chassis and the I/O cables are mounted on the cable carriers in the enclosure. Refer to Figures 2-39 and 2-29 to connect the cables and terminators. For additional information refer to the manual *DS25/DS50 Disk Systems Installation and Operation*.

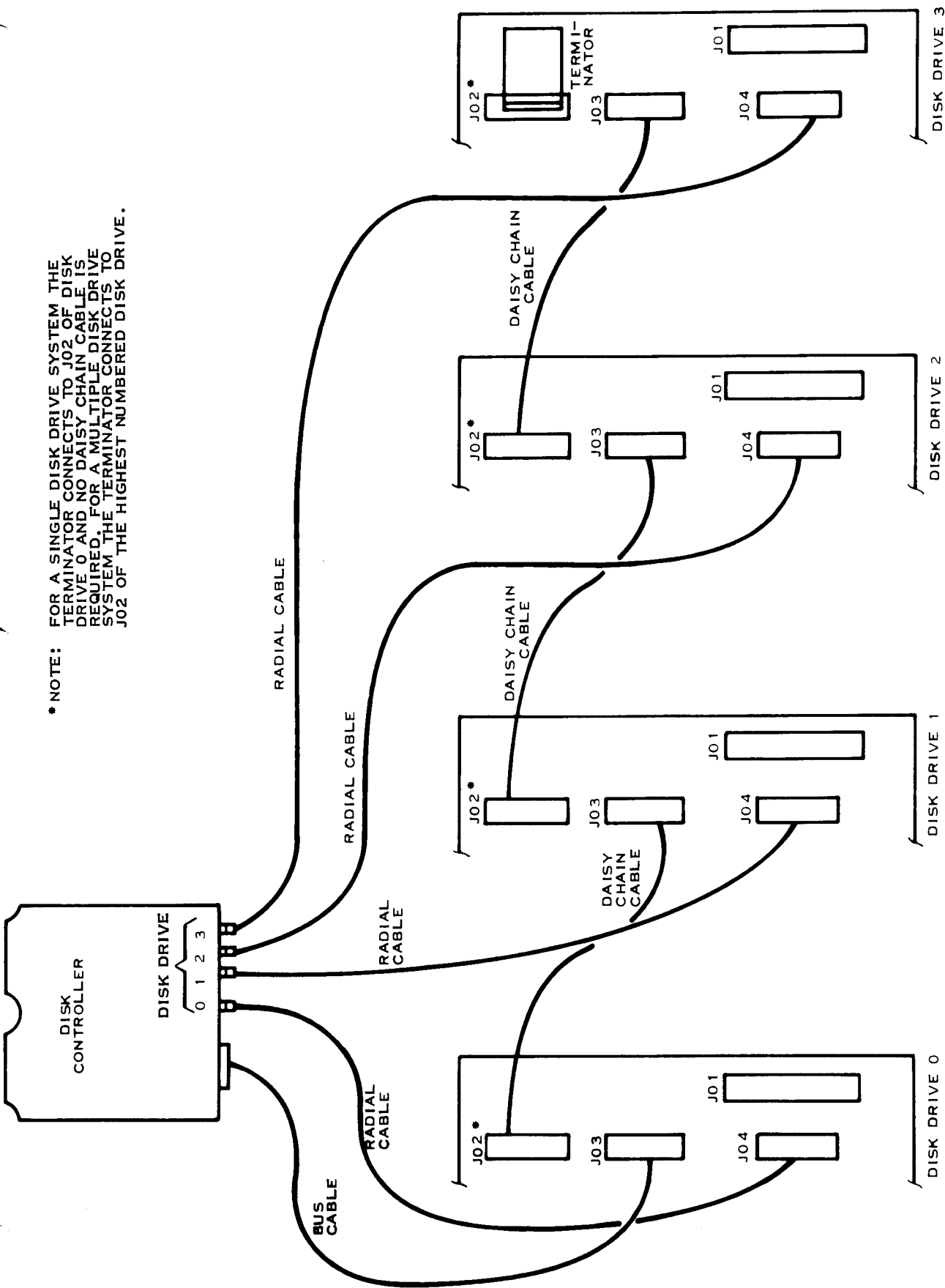
2.3.3.12 Disk Pack Installation and Removal. The installation and removal of disk packs from a disk drive unit require that power be applied to the unit. Therefore, the information in this paragraph should be coordinated with the procedures in Section 3 for applying power to the disk system.

WARNING

When the drive is up to speed, be sure the green File Ready indicator is extinguished and rotation has stopped before opening the air shroud lid. The spindle and pack rotate at 3600 RPM.

2.3.3.13 Installing Disk Pack. To install a disk pack use the following procedure:

1. Make sure that the disk drive START/STOP switch is set to STOP and that the green File Ready indicator is extinguished.
2. Unlatch and open the air shroud lid of the disk drive. The lid latch is located beneath the front edge overhand at the center.
3. Check that the interior of the air shroud is clean, and that heads and brushes are completely retracted from the disk pack area.
4. Remove the lower cover from the disk pack by pressing two plastic ears together, and carefully lower the top cover with the disk pack onto the disk drive spindle.
5. Press down the top cover handle to engage the spindle-locking mechanism. Rotate the handle clockwise to lock the disk pack to the spindle and disengage the top cover.
6. Carefully lift and remove the top cover from the disk drive, and close the air shroud lid. Make sure that the lid latch locks.



* NOTE: FOR A SINGLE DISK DRIVE SYSTEM THE TERMINATOR CONNECTS TO J02 OF DISK DRIVE 0 AND NO DAISY CHAIN CABLE IS REQUIRED. FOR A MULTIPLE DISK DRIVE SYSTEM THE TERMINATOR CONNECTS TO J02 OF THE HIGHEST NUMBERED DISK DRIVE.

Figure 2-39. Interconnections for DS25/DS50 Disk Drive System

(A)142123A

NOTE

Disk will write protect only if START/STOP switch is in STOP position before READ/WRITE switch is placed in READ ONLY position.

7. If the installed disk pack is a permanent record or a head alignment pack, protect the pack from being written on by setting the READ ONLY - READ/WRITE switch to READ ONLY. If writing is to be permitted, set this switch to READ/WRITE.
8. To minimize dust accumulation inside the case, store the top and bottom covers of the disk pack together.
9. Set the START/STOP switch to START.

2.3.3.14 Removing Disk Pack. To remove a disk pack from the disk drive unit, perform the following:

1. Stop rotation of the disk drive spindle by setting the START/STOP switch to STOP. The green File Ready indicator begins flashing.
2. Wait until the File Ready indicator stops flashing (about 20 seconds), and then unlatch the disk drive air shroud lid and open the lid.
3. Separate the top and bottom covers of the disk pack. Use its handle to lower the top cover over the disk pack.
4. Press down the top cover handle to engage the spindle-locking mechanism. Rotate the handle counter-clockwise to unlock the disk pack from the spindle and to reengage the top cover.
5. Carefully lift the top cover and disk pack from the disk drive unit, and then close the air shroud lid.
6. Replace the bottom cover on the disk pack, and return the pack to storage.

2.4 UNPACKING AND ASSEMBLY (OPTIONAL EQUIPMENT)

The following paragraphs provide unpacking and assembly instructions for the optional equipment listed below:

- Model 810 Printer
- Models 2230/2260 Line Printer
- Model 979A Tape Transport
- Model FD800 Flexible Disk Drive
- Model FD1000 Flexible Disk Drive

- Communications Equipment
- Model 804 Card Reader
- Model 743 KSR Data Terminal
- Model 820 KSR Data Terminal

NOTE

If optional equipment was ordered with the DS990 system, the optional equipment controllers are factory installed in the correct slots in the 13-slot computer chassis or expansion chassis. In the 17-slot chassis, optional equipment controllers and cabling are installed. In this case, omit any instructions in the following paragraphs for the installation of the controllers.

Refer to Tables 2-3, 2-4, and 2-5 for the slot locations, interrupt levels, and CRU addresses of the controllers for DS990 system optional and standard equipment. To change any slot locations, interrupt levels, or CRU addresses for the controllers, refer to the *990/10 Computer System Hardware Reference Manual*.

2.4.1 Model 810 Printer

To unpack the 810 printer kit components and assemble them into the DS990 system, perform the following procedure:

NOTE

This is a general outline procedure. For details, refer to *Model 810 Printer Installation and Operation*.

1. Unpack the 810 printer kit shipping container. Refer to Figure 1-10 and check that the following items are present and do not have shipping damage:
 - 810 Printer, part number 938152-XXXX
 - Power Cable, part number 996289-XXXX
 - I/O Cable, part number 938114-0001 (may be located in enclosure)
 - TTY/EIA Controller, part number 945075-0001
 - Paper Basket, part number 994176-0001
 - Floor Mounting Stand, part number 994423 (optional)
 - Extension Cable, part number 975056-XXXX (optional)

- *Model 810 Printer Installation and Operation*, part number 939460-9701.
2. Place the 810 printer in its normal operating location and check that the input voltage and frequency of the printer are compatible with that of the DS990 system.
 3. Provide access to the computer 13-slot chassis circuit card slots on the desk system by pulling the rear and side louvered covers from the desk rack as shown in Figure 2-15. Similar access is available on the cabinet enclosures.

If the option was ordered with the 17-slot chassis, the controller is installed in the chassis and the interface cable is connected to the controller and routed out the back of the chassis.

4. Connect the I/O cable between the TTY/EIA controller and the 810 printer.
5. Connect the power cable between the 810 printer and the enclosure's ac power outlet strip (or an appropriate ac wall socket with the correct ac voltage and frequency).
6. Use cable ties to neatly secure the I/O cable and the power cable in place.
7. Replace the rear and side louvered covers on the enclosure, as shown in Figure 2-15.

2.4.2 Models 2230/2260 Line Printer

To unpack the 2230/2260 line printer kit components and assemble them into the DS990 system, perform the following procedure:

NOTE

This is a general outline procedure. For details refer to *Model 2230/2260 Line Printer Installation and Operation*.

1. Unpack the 2230/2260 line printer kit shipping container. Refer to Figure 1-11 and check that the following items are present and do not have shipping damage:
 - Model 2230 or 2260 Line Printer, part number 841039
 - 16 I/O TTL Data Module (controller), part number 945145-0003
 - I/O Cable Assembly (may be located in enclosure) part number 937490-0001
 - Paper Receptacle
 - *Model 2230 and 2260 Line Printer Installation and Operation*, part number 946256-9701
2. Place the 2230/2260 line printer in its normal operating location and check that the input voltage and frequency of the line printer are compatible with that of the DS990 system.

3. Provide access to the computer 13-slot chassis circuit card slots on the desk system by pulling the rear and side louvered covers from the desk rack, as shown in Figure 2-15, or by opening the doors of a 1.78-meter (70-inch) cabinet.

If the option was ordered with the 17-slot chassis, the controller is installed in the chassis and the interface cable is connected to the controller and routed out the back of the chassis.

4. Connect the I/O cable between the 16 I/O TTL controller and the 2230/2260 line printer, routing it through the cable hole in the rear of the enclosure.
5. Connect the power cable between the 2230/2260 line printer and the enclosure's ac power outlet strip (or to an appropriate ac wall socket that has the correct ac voltage and frequency).
6. Use cable ties to neatly secure the I/O cable and the power cable in place.
7. Replace the rear and side louvered covers on the enclosure, as shown in Figure 2-15.

2.4.3 Model 979A Tape Transport

To unpack the 979A tape transport kit components and assemble them into the DS990 system, perform the following procedure:

NOTE

This is a general outline procedure. For details refer to 979A *Magnetic Tape System Installation and Operation*.

1. Unpack the 979A tape transport kit shipping container. Refer to Figures 1-15 and 1-16 and check that the following items are present and do not have shipping damage:

Component	Part Number
800 bpi:	
Model 979A tape transport (800 bpi)	948209-00XX
TILINE magnetic tape controller (800 bpi) ¹	2261630-0001
Cable assembly, controller to transport ¹	949003-0001
	(may be located in enclosure)
Cable assembly, transport to transport (optional)	949004-0001
Terminator	948238-0001
Tape	966799-0001
1600 bpi:	
Model 979 tape transport (1600 bpi)	948209-00XX
TILINE magnetic tape controller (800/1600 bpi) ¹	2261635-0001

¹ Installed in computer chassis if 979A is ordered with the DS990 system.

Component	Part Number
Cable assembly, controller to transport ¹	949003-0001 (may be located in enclosure)
Cable assembly, transport to transport (optional)	949004-0001
Terminator	948238-0001
Tape	966799-0001
Documentation:	
<i>Model 990 Computer Model 979A Magnetic Tape System Installation and Operation</i> (included with kit purchase)	946229-9701
<i>Model 979A Tape Transport Installation and Operation</i> (included with purchase of transport)	949612-9701

2. Attach the 979A tape transport mounting hardware to the rackmounting cabinet (see Figure 2-40), and then use a fork lift or other mechanical aid to lift the 979A tape transport into place on the cabinet.

WARNING

- a. **The 979A tape transport weighs 61.2 kg (135 lbs). A power fork lift or mechanically aided lift is recommended for installation. If mechanical assistance is not available, provide adequate people and observe safe lifting procedures.**
- b. **Ensure that the cabinet is blocked at rear to prevent backing away.**
- c. **Do not attempt to move the cabinet with the installed transport without first ascertaining that the transport is secured by a panel or screws (Figure 2-40) to limit upward motion that would disengage the rack hangers.**

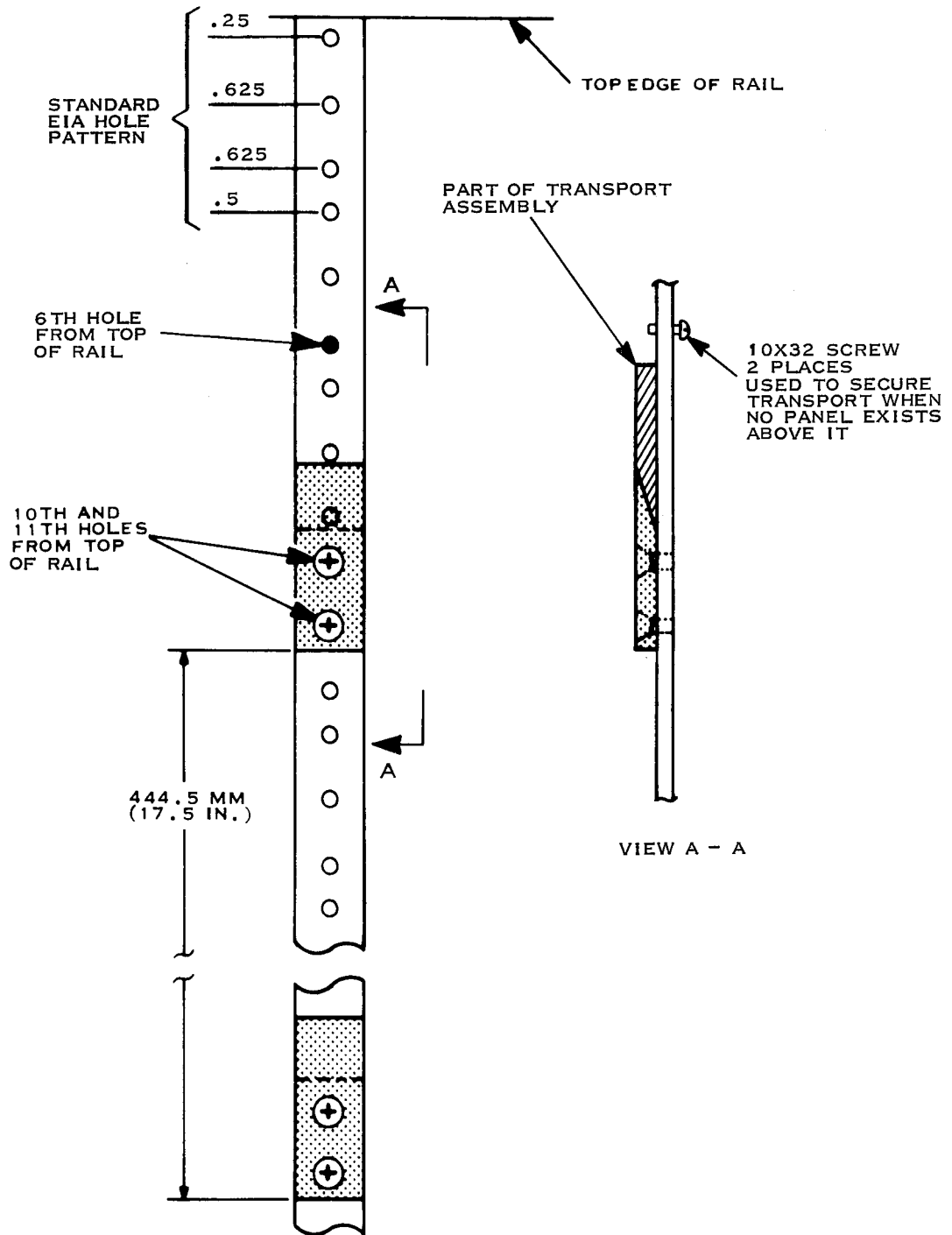
CAUTION

Do not use the reel hubs, tape heads, tape guides, or capstan motor as handholds.

3. Provide access to the computer 13-slot chassis circuit card slots on the desk system by pulling the rear and side louvered covers from the enclosure desk rack as shown in Figure 2-15, or by opening the doors of the 1.78-meter (70-inch) cabinet.

If the option was ordered with the 17-slot chassis, the controller is installed in the chassis and the interface cable is connected to the controller and routed out the back of the chassis.

¹ Installed in computer chassis if 979A is ordered with the DS990 system.



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Figure 2-40. 979A Tape Transport Mounting Rack Hangers in EIA Standard Rack

4. Connect the I/O cable between the controller and the 979A tape transport, routing it through the cable hole in the rear of the enclosure. If multiple 979A tape transports are used, install the daisy chain cables as required. Refer to Figure 2-41.
5. Connect the 979A tape transport power cable to the power outlet strip inside the rack-mounted cabinet.
6. Use cable ties to neatly secure the I/O cables and the power cables so they are not in close proximity to each other.
7. Replace the enclosure's rear and side louvered covers, as shown in Figure 2-15.

2.4.4 Model FD800 Flexible Disk Drive

To unpack the FD800 flexible disk drive kit components and assemble them into the DS990 system, perform the following procedure:

NOTE

This is a general outline procedure. For details refer to *FD800 Floppy Disk System with International Chassis Installation and Operation*.

1. Unpack the FD800 flexible disk drive kit shipping container, and check that the contents do not have shipping damage. Inventory the contents, using the pack list and the following component and part number list:

Component	Part Number
Tabletop Chassis Assembly	2267292-XXXX*
or	
Rackmount Chassis Assembly	2267291-XXXX*
FD800 Flexible Disk Controller	0945940-0001
Cable:	
Single Chassis	2267294-0001
3.05m (10 ft) overall	
or	
Dual Chassis	2269928-0001
3.05m (10 ft) overall	
762 mm (30 in.) between chassis	
Single-Sided, Single Density Diskette	0945965-0001
Documentation:	
<i>Model 990 Computer Model FD800 Floppy Disk System with International Chassis Installation and Operation</i>	2250697-9701

* XXXX is determined by number of drives (one or two) and frequency.

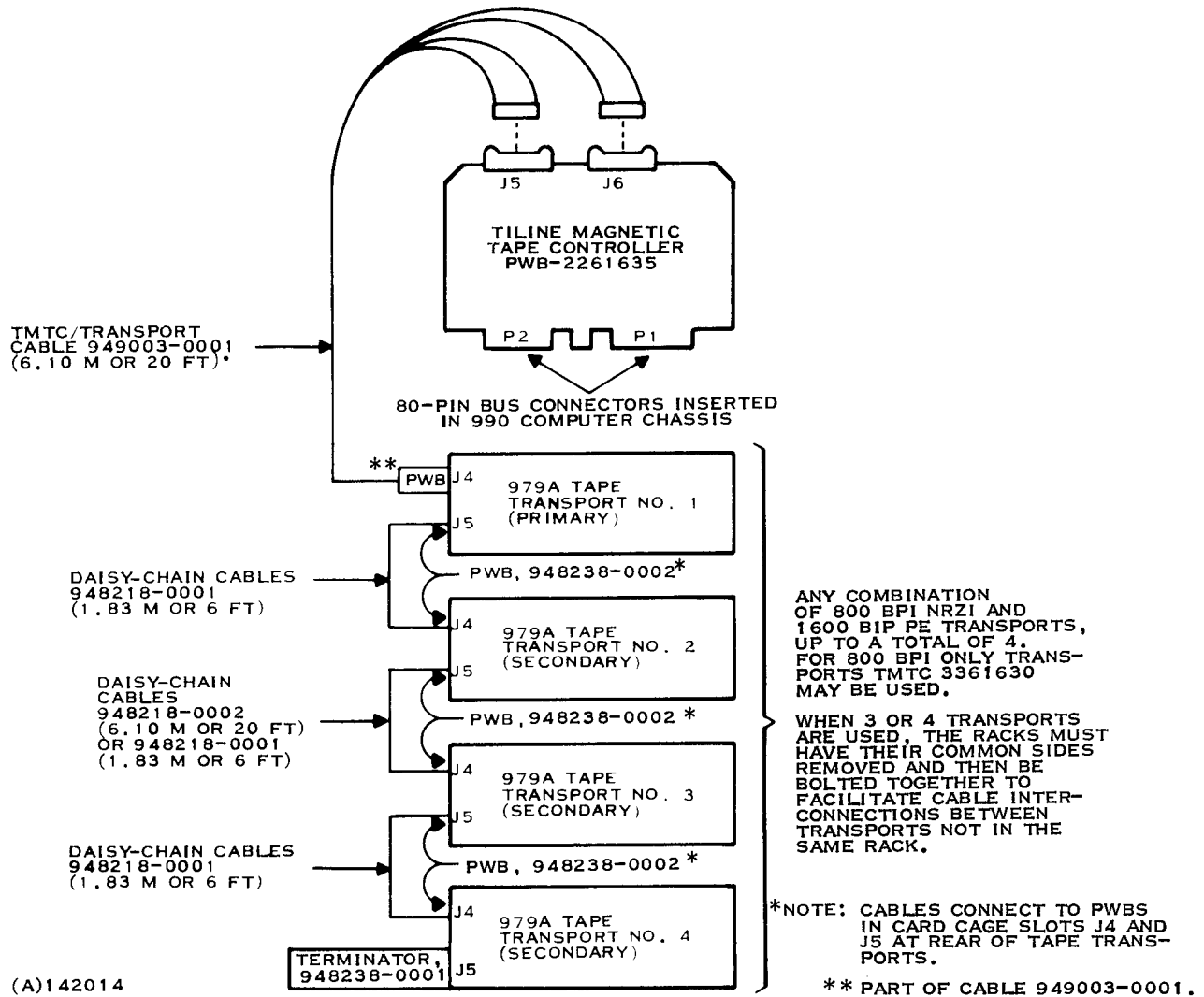


Figure 2-41. Phase-Encoded or Mixed PE/NRZI Tape System Configuration

2. If FD800 was ordered with a tabletop enclosure, mount it in its normal operating location and check that the disk drive voltage and frequency are compatible with that of the DS990 system.
3. Be sure the enclosure circuit breaker or main switch is set to OFF. Provide access to the computer 13-slot chassis circuit card slots by pulling the rear and side louvered covers from the enclosure (see Figure 2-15), or by opening the doors to the 70-inch cabinet.

NOTE

The I/O cable and the power cable may be routed through the desk top cable hole on the desk or 30-inch cabinet system (Figure 2-15).

4. If your FD800 was ordered with the DS990 system, the disk controller is already configured for your system and installed in the correct chassis slot.
5. Refer to Figure 2-29 and align the notch on the cable connector with the arrowhead on the controller connector.
6. Connect the I/O cable(s) between the disk controller and the disk drive as shown in Figure 2-42 or 2-43, depending on the number of disk drives in the system (refer to Tables 2-3, 2-4, and 2-5 for chassis slot locations, interrupt levels, etc.).
7. Install the power cable into the recessed power cord socket on the right rear (back view) of the FD800 chassis. Connect the FD800 power cable to the correct ac power outlet in the desk or cabinet as applicable. Place the power switch on the right rear (back view) of the the FD800 chassis in the ON position.
8. Use cable ties to neatly secure the cables. To prevent inductive pickup of electrical noise from the power cable, keep the ribbon I/O cable well separated from the power cable.

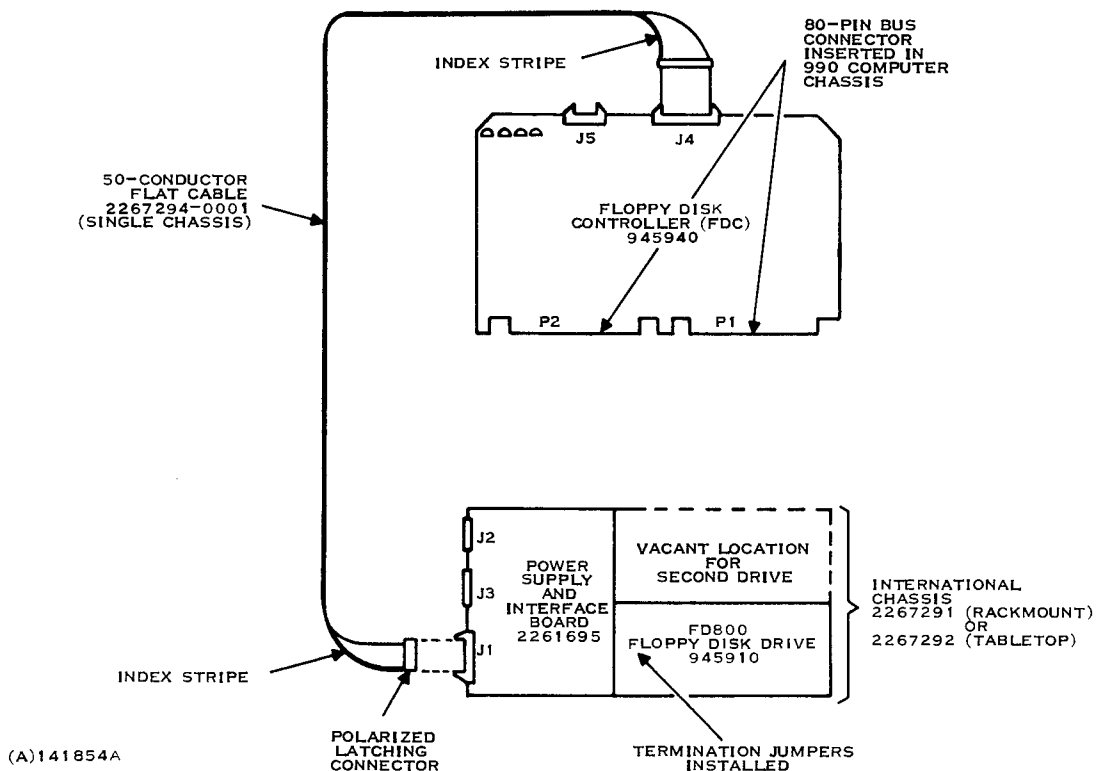


Figure 2-42. FD800 International Configuration — Single Drive

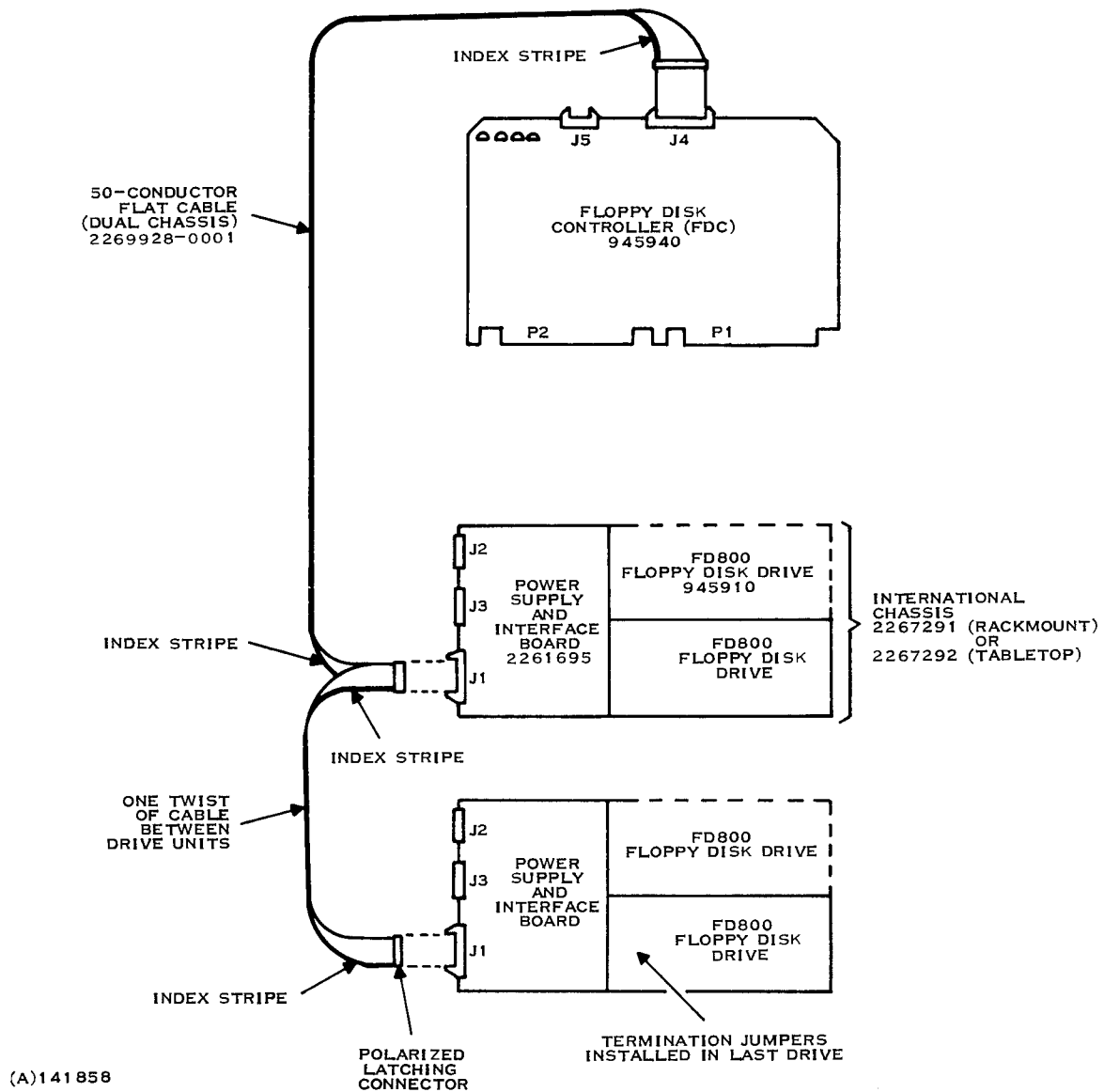


Figure 2-43. FD800 International Configuration — Four Drives

9. Replace the rear and side louvered covers on the enclosure (Figure 2-15), or close the cabinet doors as appropriate. This completes the installation of the tabletop FD800.
10. If you ordered an FD800 for rack mounting, install it in the cabinet as described in paragraph 2.4.5, step 5.
11. When the FD800 flexible disk system is ordered with the DS990 System, the computer end of the I/O cable (Figures 2-42 and 2-43) is already connected to J4 of the Flexible Disk Controller (FDC). (The controller has been configured for the DS990 system and mounted in the correct computer chassis slot.) The other end of the I/O cable is routed out of the computer chassis. Attach the I/O cable to the cable tie on the right rear rail of primary cabinet. Route this cable to the back of the FD800 chassis and connect it to J1 on the right rear (back view) of the chassis.

When two FD800 chassis are used (three or four drives), the installation is as shown in Figure 2-43.

12. Install the power cable into the recessed power cord socket on the right rear (back view) of the FD800 chassis. Plug the power cable into a power socket provided in the cabinet rack. Place the power switch on the right rear (back view) of the FD800 chassis in the ON position.

2.4.5 Model FD1000 Flexible Disk Drive

To unpack the FD1000 flexible disk kit and assemble it into the DS990 System, perform the following procedure:

NOTE

This is a general outline procedure. For details, refer to *Model FD1000 Flexible Disk System with International Chassis Installation and Operation*.

1. Unpack the FD1000 flexible disk kit shipping container. Refer to Figure 1-18 and check that the following items are present and do not have shipping damage:
 - Double Density Flexible Disk Assembly
Rackmount, part number 2265020-XXXX¹
 - TILINE Flexible Disk Controller (may be located in computer enclosure), part number 2261690-0001
 - Remote Bus Cable (maybe located in computer enclosure):
5 meters (16 feet, 5 inches), part number 2261704-0001
10 meters (32 feet, 10 inches), part number 2261704-0002
 - Extender Cable (optional):²
8 meters (26 feet, 3 inches), part number 2265021-0001
15 meters (49 feet, 3 inches), part number 2265021-0002
30 meters (98 feet, 5 inches), part number 2265021-0003
60 meters (196 feet, 10 inches), part number 2265021-0004
90 meters (295 feet, 3 inches), part number 2265021-0005
 - Diskette:
Double-Sided, Double-Density, part number 2261687-0001
Single-Sided, Single-Density, part number 0945965-0001
 - Documentation:
Model FD1000 Flexible Disk System with International Chassis Installation and Operation, part number 2250698-9701

¹ XXXX depends on number of drives (one or two), frequency, and voltage.

² Maximum allowable total length from controller to chassis is 100 meters (328 feet).

2. If the FD800 was ordered with a tabletop enclosure, mount it in its normal operating location and check that the voltage and frequency of the disk drive are compatible with that of the DS990 system.
3. Be sure the enclosure circuit breaker or main switch is set to OFF. Provide access to the computer 13-slot chassis circuit card slots by pulling the rear and side louvered covers from the enclosure (see Figure 2-15), or by opening the doors to the 70-inch cabinet.

NOTE

The I/O cable and the power cable may be routed through the desk top cable hole on the desk or 30-inch cabinet systems (Figure 2-15).

4. Connect the I/O cable(s) between the FD1000 controller and the disk drive as shown in Figures 2-44 and 2-45, depending on the number of disk drives in the system (refer to Tables 2-4, 2-5, and 2-6 for chassis slot locations, interrupt levels, etc.).

If the FD1000 was ordered with the 17-slot chassis computer system, the FD1000 controller is already installed in the chassis and the I/O cable(s) are connected to the controller and routed out the back of the chassis.

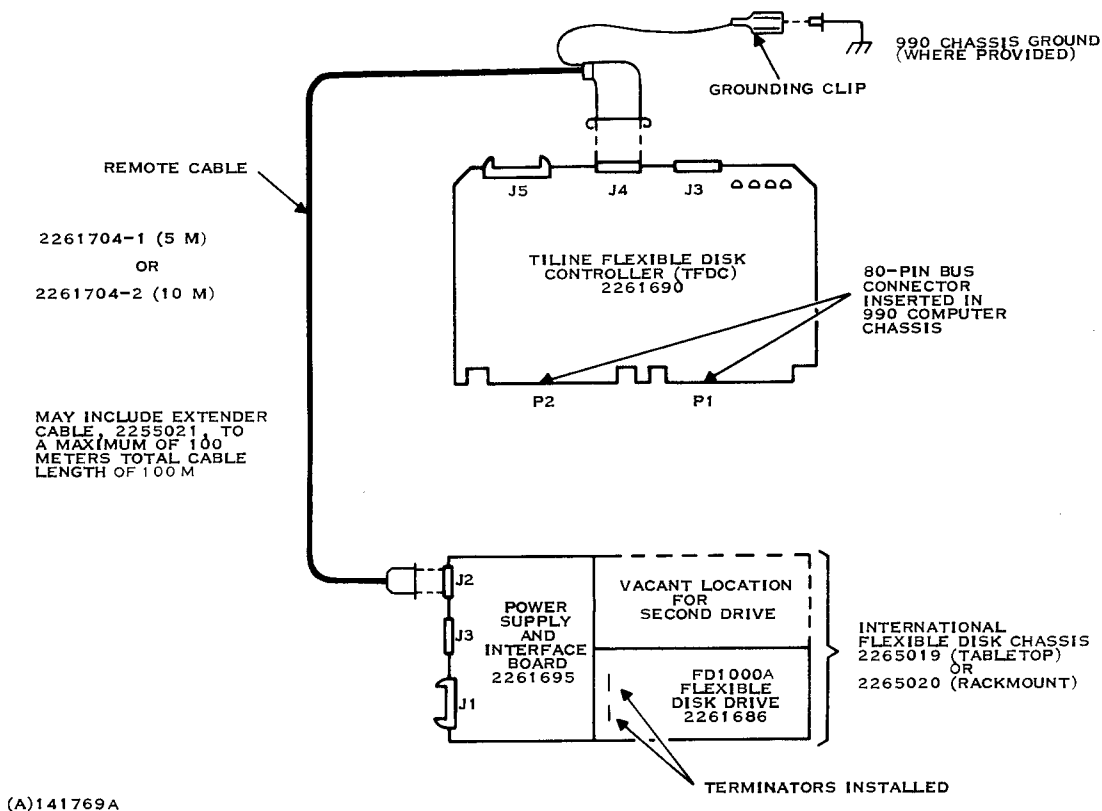
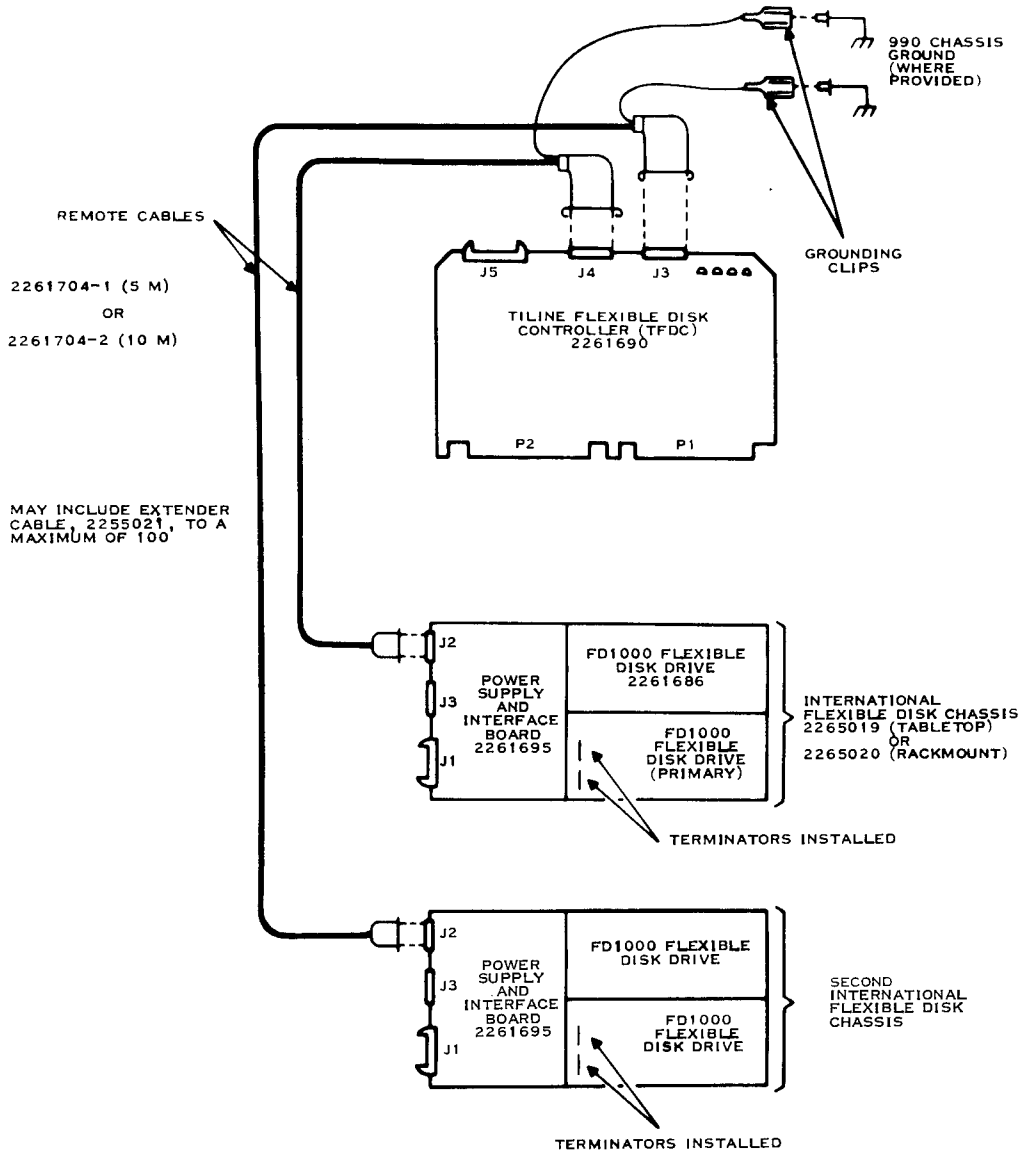


Figure 2-44. FD1000 International Configuration — Single Drive



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Figure 2-45. FD1000 International Configuration — Four Drives

- For rack mounting, install the chassis in an EIA standard 19-inch rack on the provided drawer slides. The slide-mounting kit includes left and right side telescoping slides, two rear mounting brackets for the slides, and a ball stud retaining latch. The ball stud retaining latch consists of a bracket, which mounts to the chassis, a ball stud, which mounts on the bracket, and a latching receptacle, which mounts on the rear rail of the rack. Miscellaneous mounting hardware (screws, washers, lockwashers) is also provided.

NOTE

The dimension between the front and rear rack mounting rails must be 616 ± 5 millimeters (24.25 ± 0.2 inches) in order to install the slide mounting brackets. See Figure 2-46 (slides already installed when FD1000 is ordered with the DS990 system).

Use the following procedure to mount the disk chassis in an EIA standard rack:

- a. Determine where (vertically) in cabinet the bottom edge of the front panel will be located. The bottom edge of the front panel will always be centered between two holes that are 12.7 millimeters (0.5 inches) apart, as shown in Figure 2-47.

Note that the pattern of hole spacing is 12.7 - 15.9 - 15.9 - 12.7 ... millimeters (0.5 - 0.625 - 0.625 - 0.5 ... inches). Use a pencil to place a mark on each rail halfway between the selected pair of holes. Make sure that there is a free space of at least 178 millimeters (7 inches) above that mark (for front panel clearance).

- b. Assemble the rear mounting brackets to the slides using a 10-32, 0.375 pan head screw, lockwasher and flat washer for each mounting hole.
- c. Locate the slide mounting holes in the cabinet rails. These are the second and third holes above the locating marks described in step a. Mount the slides on the rails using a 10-32, 0.25 pan head screw, lockwasher, and flat washer for each mounting hole (8 total). The top slot of the mounting bracket should rest on the ends of the upper mounting screw.
- d. Extend the slides and defeat the quick-disconnect mechanism. Remove the inner members of the slides and attach the numbers to chassis sides using the 0.375-inch screws provided.

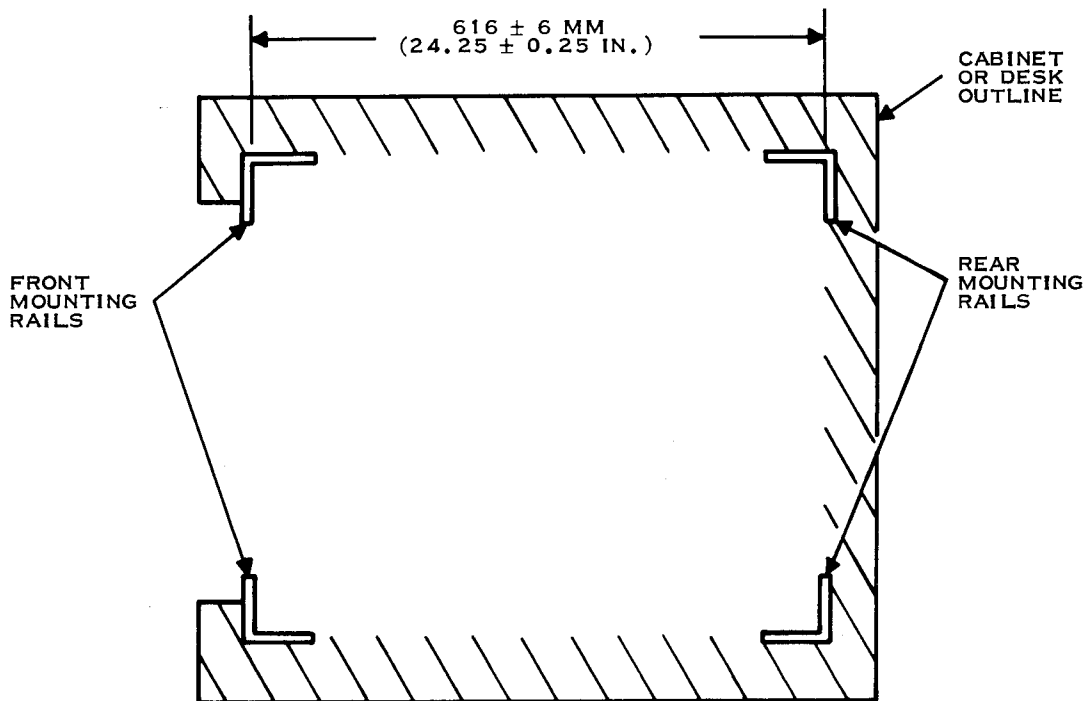
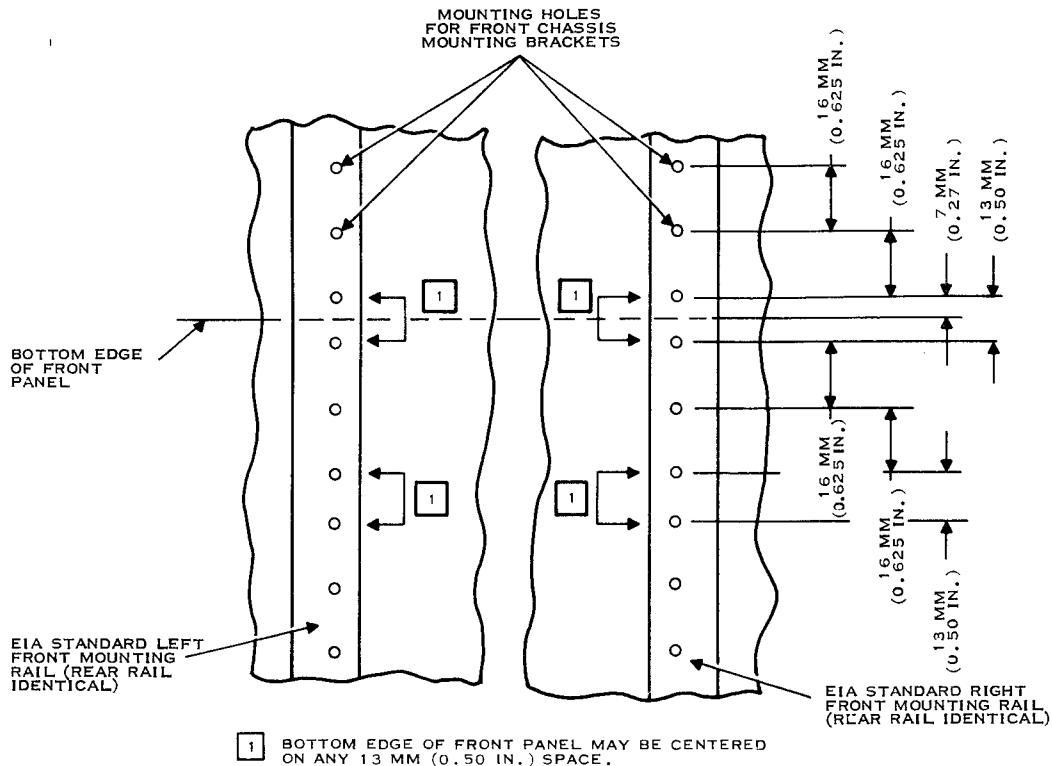


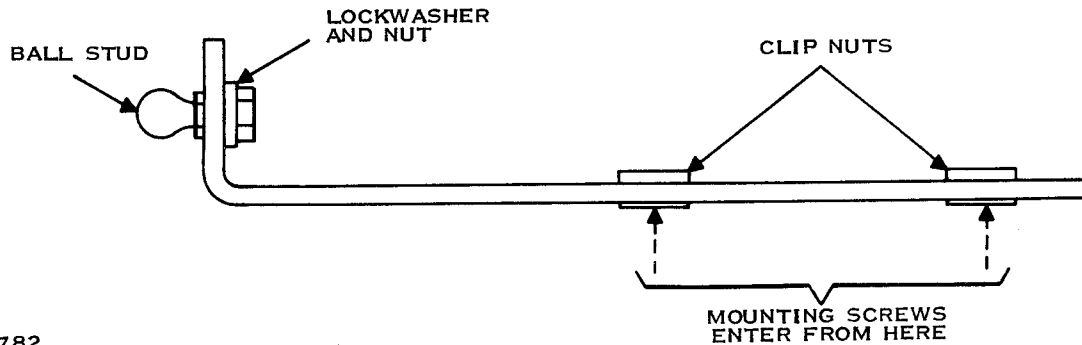
Figure 2-46. Top View of Cabinet or Desk



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Figure 2-47. Vertical Mounting Rails

- e. Assemble the ball stud to the ball stud mounting bracket using a #6 lockwasher and 6-32 nut. The ball stud mounting bracket (Figure 2-48) is a right-angle metal strip with two clip nuts on the long edge and a ball stud mounting hole on the short edge.
- d. Mounting slots for the ball stud mounting bracket are located on the left side (viewed from rear) of the chassis bottom plate. Mount the bracket to the chassis bottom plate as shown in the two views of Figure 2-49, using two 6-32 machine screws. Do not tighten the screws at this time as the bracket position is adjusted in step 10.
- g. Insert the chassis into the extended slides, defeat the quick-disconnect mechanism and push the chassis into the rack. Adjust the slides, if necessary, to prevent binding. Verify that the unit cannot be pulled free of the cabinet on the slide tracks.
- h. Assemble the ball stud catch (Figure 2-50) by mounting the ball stud receptacle to the stop plate using 4-40, 0.375 machine screws, lockwashers, and nuts. The ball stud receptacle is a small spring-steel device. The stop plate is an L-shaped plate with ears for rail mounting and a cutout for the ball stud receptacle.



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Figure 2-48. Detail of Ball Stud Mounting Bracket

- i. Mount the ball stud catch on the left rear rail (viewed from rear) using 10-32, 0.500 machine screws, lockwashers, and flat washers. Refer to Figure 2-50. The ball stud should catch in the receptacle when the chassis is pushed into the cabinet.
- j. Adjust the ball stud mounting bracket so that the ball stud absorbs the force when the chassis is pushed all the way into the cabinet. Tighten the mounting screws that hold the bracket.

CAUTION

If the ball stud mounting bracket is maladjusted, the plastic front panel may be damaged when the chassis is pushed all the way into the cabinet.

CAUTION

Do not install or remove circuit boards or connectors while power is applied to the system.

6. When the FD1000 flexible disk system is ordered with the DS990 system with a 17-slot chassis, the computer end of the I/O cable (right-angle connector, Figure 2-44 is already connected to J4 of the TILINE Flexible Disk Controller (TFDC). The controller is already configured for the DS990 system and mounted in the proper computer chassis slot. The other end of the I/O cable is routed out the back of the computer chassis. Attach the I/O cable to the cable tie on right rear rail of primary cabinet. Route this cable to the back of the FD1000 chassis and connect to J2 on the left rear (back view) of the chassis.

When two FD1000 chassis are used (three or four drives) the installation will be as shown in Figure 2-26.

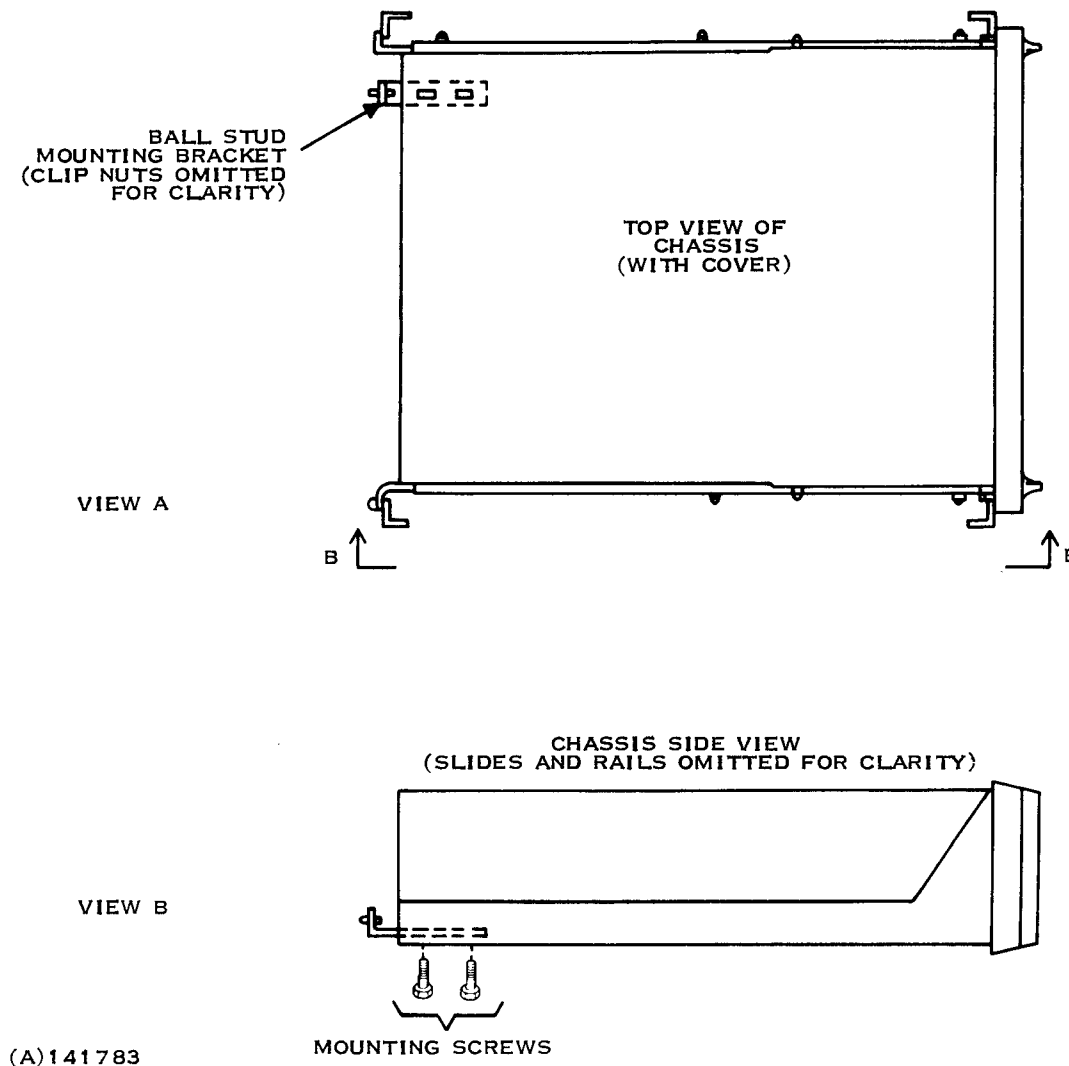


Figure 2-49. International Chassis Rackmount Installation

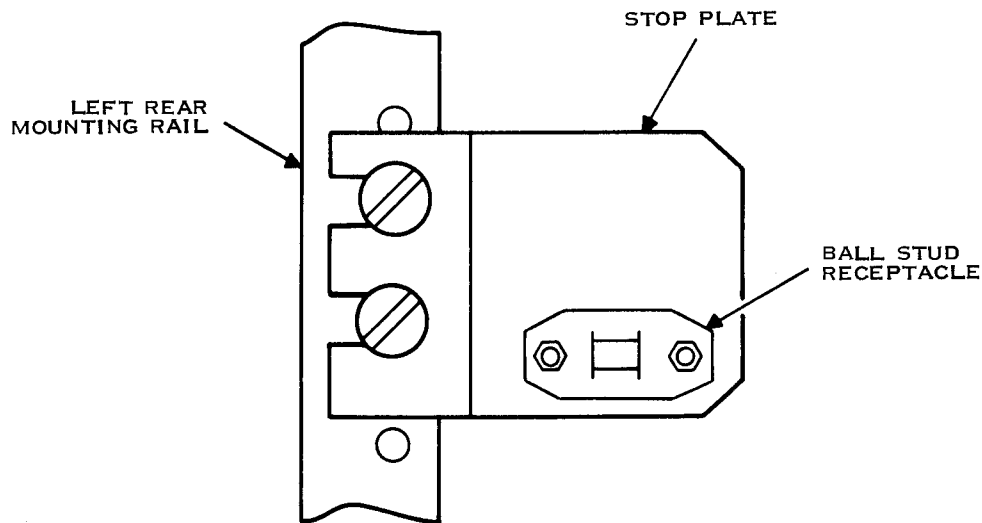
7. Install the power cord into the recessed power cord socket on the right rear (back view) of the FD1000 chassis. Plug the power cord into power sockets provided in the cabinet rack. Place the power switch on the right rear (back view) of the FD1000 chassis in the on position.

2.4.6 Communications Equipment

Perform the following procedure to unpack and assemble the communications equipment into the DS990 System.

NOTE

This is a general outline procedure. For details refer to *Model 990 Computer Communications System Installation and Operation*.



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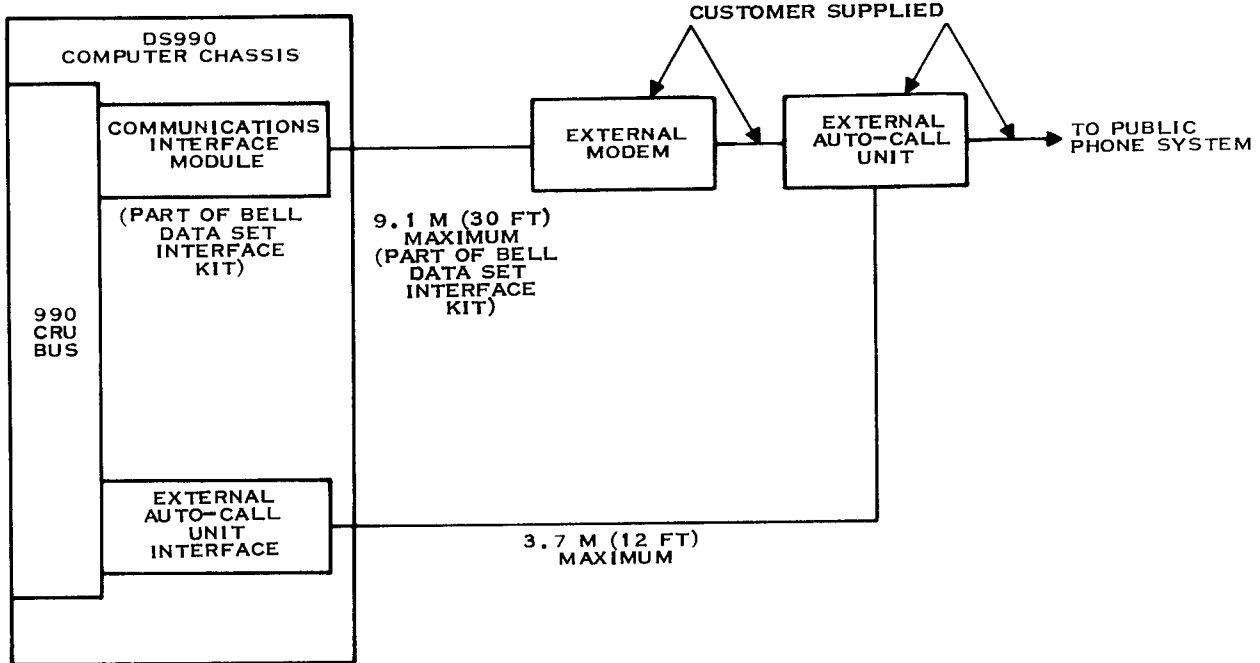
Figure 2-50. Ball Stud Catch Mounting

1. Unpack the communications equipment shipping container and inventory the contents by referring to the Sales Order and pack list. Check that shipping damage has not occurred. Refer to Figures 2-51 and 2-52 for communication systems with external and internal configurations for modems and autocal units.
2. When a communications interface module and an external automatic calling (ACU) interface module are ordered with the DS990 System (to interface with customer supplied modem and ACU, Figure 2-51), the interface modules are already configured for the system and installed in the computer chassis. The I/O cables are already installed at the interface module end and the other end of each cable is routed out the back of the computer chassis.

To install the I/O cables, route the cables to the external modem and ACU then connect as shown in Figure 2-53.

3. When an internally mounted modem and automatic calling unit communication system is ordered with the DS990 System, the circuit boards for the communications interface module, the modem, and the ACU are already installed in the computer chassis. The cables interconnecting these circuit boards also are already installed (see Figure 2-54). If a data coupler is ordered with the system, the modem-to-data coupler I/O cable is already connected at the modem end. The data coupler end is dressed out the back of the computer chassis. Route this cable to the data coupler. Instructions for installation of the data couplers appear in step 4 of this procedure.

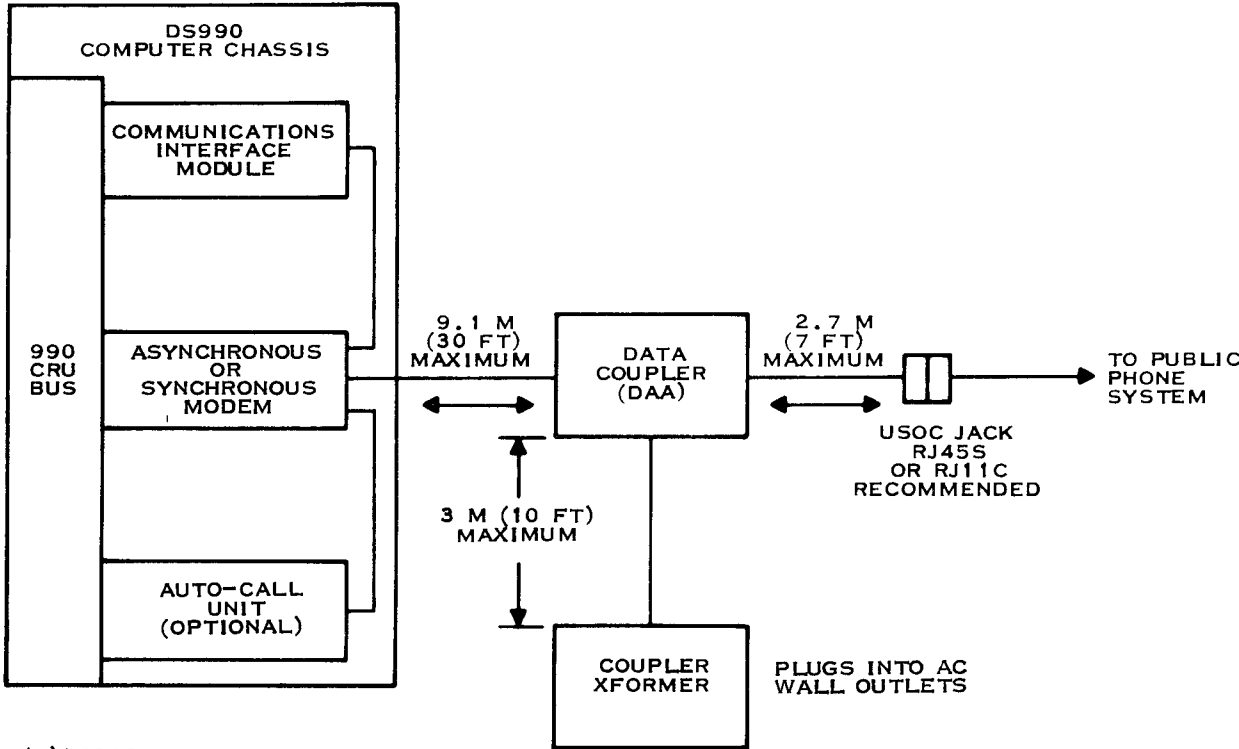
The communications interface module, the modem, and the ACU are installed in the 990/10 chassis (refer to Tables 2-3, 2-4, and 2-5). Figure 2-54 shows the interconnections for switched network operations and gives part numbers.



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Figure 2-51. Communications System with External Modem and External ACU Unit

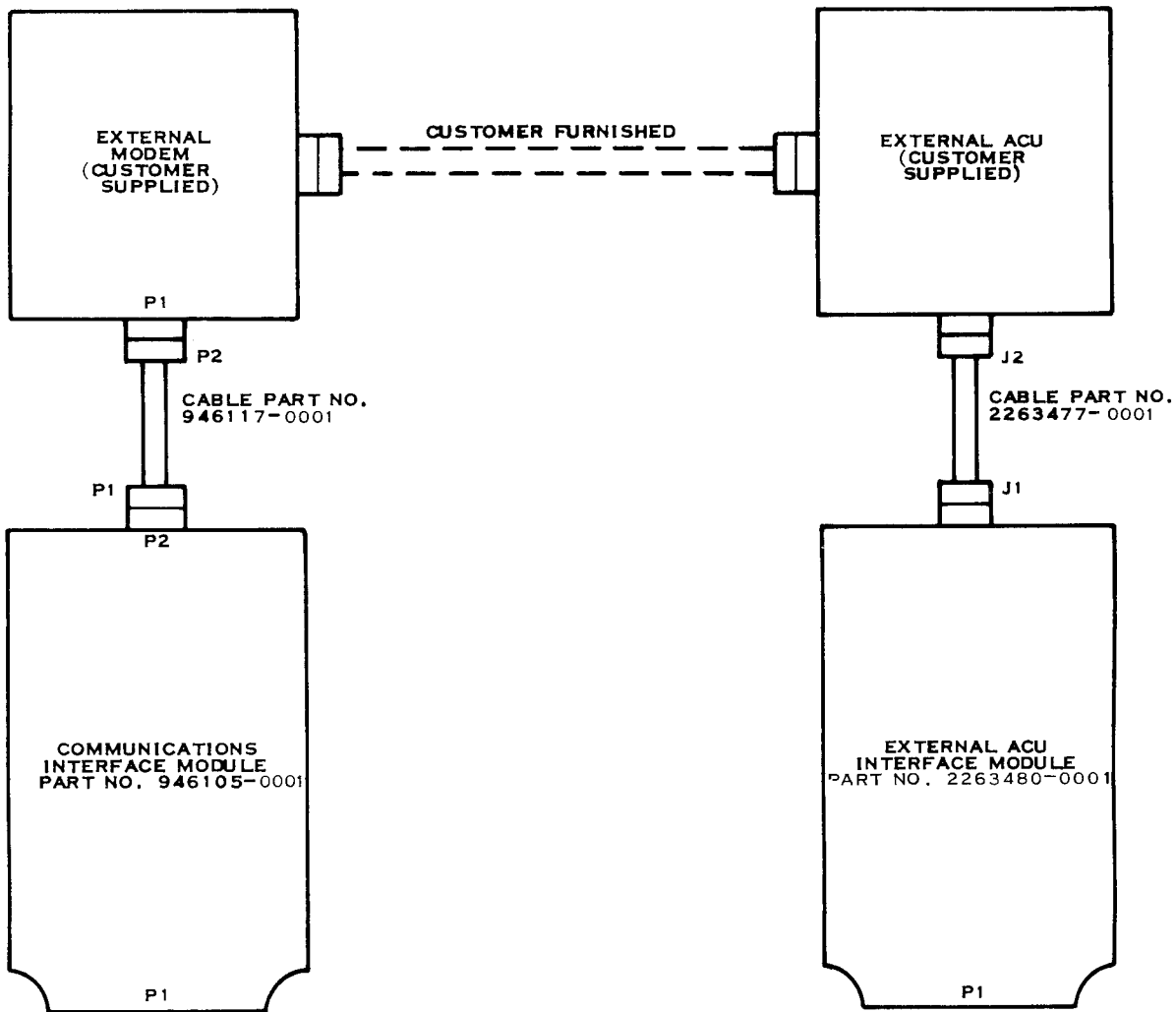
4. When a data coupler (DAA) is ordered with the DS990 System, installation on a vertical wall is recommended. Texas Instruments furnishes data couplers manufactured by General DataComm and Elgin Electronics. Either may be furnished with your order depending on availability. The procedures that follow describe how to install both types. Use the procedure that applies to your data coupler:
 - a. If the data coupler is made by General DataComm, choose a convenient mounting location, observing cable length limitations shown in Figure 2-52. Mount the data coupler by performing the following steps:
 - Install two furnished screws into the mounting surface spaced to match mounting holes on back of the data coupler. Now place the data coupler keyed mounting holes over the screw heads and slide the coupler downward to secure the coupler in place. If the data coupler is not securely mounted, remove it and tighten the screws slightly then remount the data coupler.
 - Locate the modem to data coupler I/O cable. Refer to Figure 2-54. At the data coupler end, connect the I/O cable to the data coupler as shown. The data coupler terminals can be accessed by lifting the small hinged door on the bottom of the data coupler snap-on plastic cover. If necessary, the plastic cover may be removed by grasping it and gently lifting it up and away from the data coupler. To replace, mount the bottom part of the cover first and while pressing gently upward, press the top of the cover to its normal position.



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Figure 2-52. Communications System with Internal Modem, ACU and TI-Supplied Data Coupler

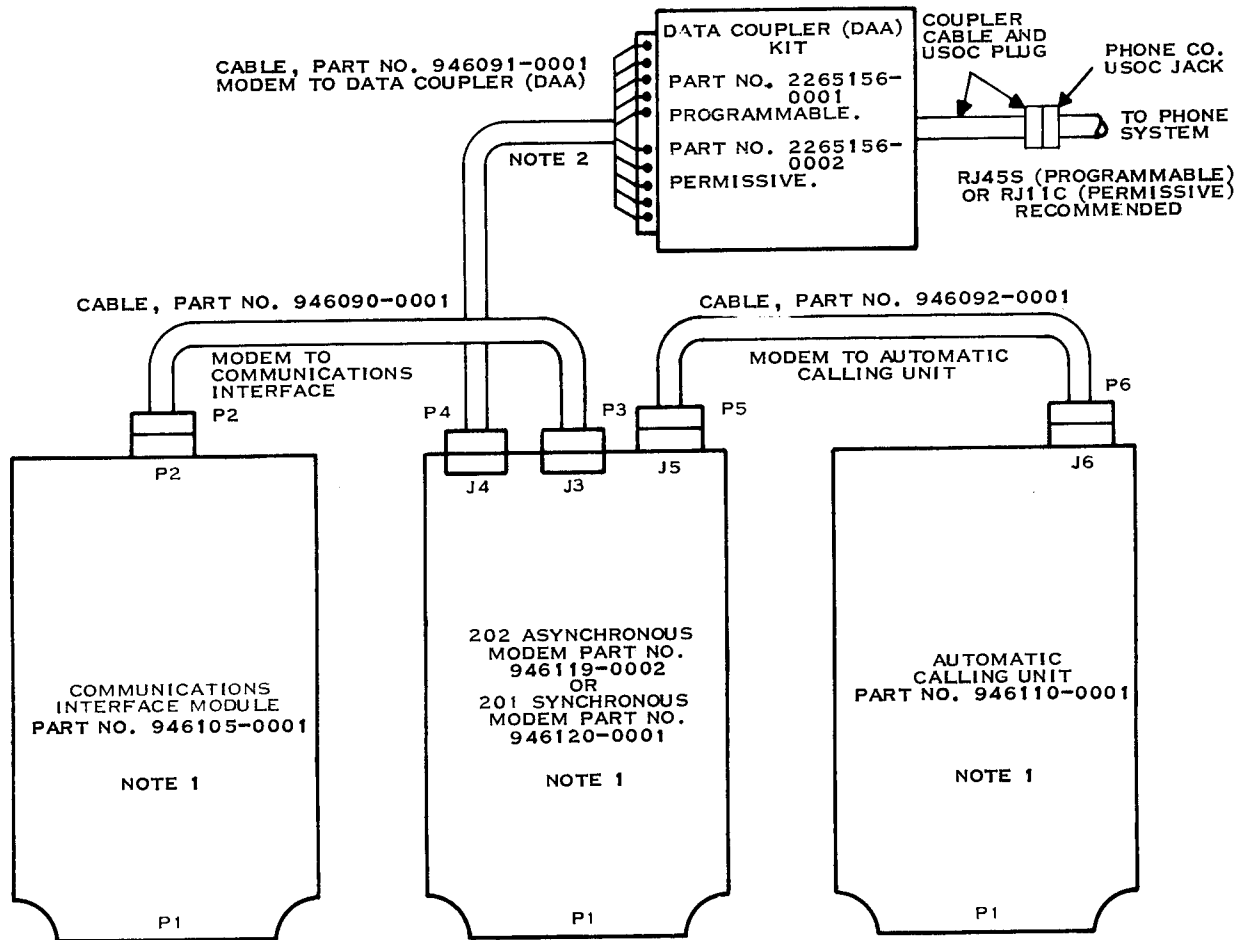
- Verify that the correct USOC plug is furnished to mate with the telephone company USOC jack, then connect the plug to the jack (see Figure 2-54).
 - A plug-in power transformer is supplied with the cable already connected to the data coupler end. After all other connections are complete and the system is ready for power-up, plug this transformer into a convenient electrical outlet of the proper voltage and frequency.
- b. If the data coupler is made by Elgin Electronics, mount it at a convenient location observing cable length limitations (see Figure 2-52). Perform the following steps:
- Remove the plastic snap-on cover by grasping it and gently lifting it up and away from the data coupler.
 - Remove the printed circuit board from the plastic base by removing the four retaining screws. This allows access to the mounting holes in the base. Note how wires and cables are dressed out so they may be arranged in similar fashion when the circuit board is replaced.
 - Attach the base to the selected location with the two supplied screws using one keyed hole and one regular hole provided in the base.



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Figure 2-53. Communications System Cabling with External ACU and Modem

- Make sure wires and cables are arranged as they were before the circuit board was removed. Reattach the circuit board assembly to the base using the four retaining screws removed earlier.
- Locate the modem to data coupler I/O cable. Refer to Figure 2-54. At the data coupler end, connect the I/O cable to the data coupler as shown.
- Replace the snap-on plastic cover on the data coupler.
- Verify that the correct USOC plug is furnished to mate with the telephone company USOC jack, then connect the plug to the jack (see Figure 2-54).



NOTES:

1. THIS CONFIGURATION IS INTERNAL MODEM WITH AUTOMATIC ANSWER AND INTERNAL AUTOMATIC CALLING.
2. TO ACCESS THE DATA COUPLER TERMINALS LIFT COVER AT THE BOTTOM EDGE OF THE PLASTIC CASE. THE MODEM TO DATA COUPLER CONNECTIONS ARE IDENTICAL FOR BOTH TYPES OF COUPLER. THE CONNECTIONS AT THE DATA COUPLER ARE AS SHOWN BELOW.

CUT THE LUGS OFF BLACK WIRE DR2 AND WHITE WIRE DT2 AND CRIMP A SPARE WIRE CAP ON EACH. CONNECT THE REMAINING EIGHT WIRES TO THE DATA COUPLER TERMINALS AS SHOWN.

WIRE COLOR CODE	DATA COUPLER TERMINAL
BROWN	DR
RED	DT
ORANGE	RI
YELLOW	OH
GREEN	CCT
BLUE	DA
BLACK, CLEAR, OR VIOLET (LARGER THAN OTHER WIRES)	SG
GRAY	SH

(A)142130

Figure 2-54. Communications System Cabling with Internal ACU and Modem

- A plug-in power transformer is supplied with the cable already connected at the data coupler end. At the transformer end, connect the wire marked P1 to terminal 1 on the transformer; connect wire P2 to terminal 2 and wire P3 to terminal 3. After all other connections are complete and the system is ready for power-up, plug this transformer into a convenient electrical outlet of the proper voltage and frequency.

2.4.7 Model 804 Card Reader

To unpack the 804 card reader kit components and assemble them into the DS990 system, perform the following procedure:

1. Unpack the 804 card reader kit shipping container. Refer to Figure 1-14 and check that the following items are present and do not have shipping damage:
 - 804 card reader, part number 974911-XXXX
 - Controller, part number 945185-0001
 - I/O cable, part number 974914-0001 (may be located in enclosure)
 - *Model 804 Card Reader Installation and Operation*, part number 945262-9701
2. Place the 804 card reader in its normal operating location and check that the input voltage and frequency stamped on its nameplate are compatible with that of the DS990 system.
3. Provide access to the 13-slot computer chassis circuit card slots on the desk system by pulling the rear and side louvered covers from the desk rack (as shown in Figure 2-15), or by opening the doors of the 1.78-meter (70-inch) cabinet. Connect the I/O cable from the card reader interface module to the interface connector on the back of the card reader.

If the option was ordered with the 17-slot chassis, the controller is installed in the chassis and the interface cable is connected to the controller and routed out the back of the chassis.

2.4.8 Model 743 KSR Data Terminal

To unpack and install the 743 KSR, perform the following steps:

1. Unpack and insure that the components (illustrated in Figure 1-12) are present and undamaged.
2. Place the 743 KSR in the desired location and check that the input voltage and frequency of the terminal are compatible with that of the DS990 system.
3. Be sure the enclosure circuit breaker or main switch is set to OFF. Provide access to the computer 13-slot chassis circuit card slots by pulling the rear and side louvered covers from the enclosure (see Figure 2-15), or by opening the doors of the 70-inch cabinet.

NOTE

The I/O cable and the power cable may be routed through the desk top cable hole on the desk or 30-inch cabinet systems (Figure 2-15).

4. Connect the I/O cable between the TTY/EIA module and the 743 KSR, as shown in Figure 2-55 (refer to Tables 2-3, 2-4, and 2-5 for chassis slot locations, interrupt levels, etc.).

If the 743 KSR was ordered with the 17-slot chassis computer system, the TTY/EIA module has been installed in the chassis and the I/O cable connected to the module and routed out the back of the chassis.

5. Connect the power cable to the proper power source.
6. Set the ac power switch on the top right rear of the 743 KSR to ON (toggle arm toward the rear of the unit).

2.4.9 Model 820 KSR Data Terminal

To unpack the 820 KSR kit components and assemble them into the DS990 system, perform the following procedure:

NOTE

This is a general outline procedure. For more details refer to *Model 820 KSR Installation and Operation*.

1. Unpack the 820 KSR kit shipping container. Refer to Figure 1-13 and check that the following items are present and do not have shipping damage:

- 820 KSR, part number 2262091-XXXX

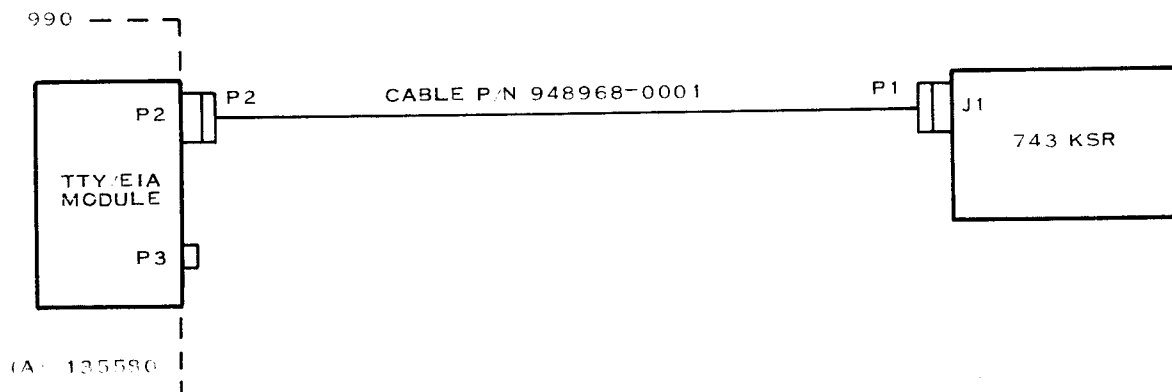


Figure 2-55. 990 Computer/743 KSR Interface, Cable Interconnection

- I/O Cable, part number 2262093-0001 (may be located in enclosure)
 - TTY/EIA Controller, part number 945075-0001
 - Paper Basket, part number 999838-0001
 - Floor Mounting Stand, part number 994423 (optional)
 - Extension Cable, part number 975056-XXXX (optional)
 - *Model 820 KSR Installation and Operation*, part number 2250454-9701
2. Place the 820 KSR in the normal operating location and check that the input voltage and frequency of the terminal are compatible with that of the DS990 system.
 3. Provide access to the computer 13-slot chassis circuit card slots by pulling the rear and side louvered covers from the enclosure.

The I/O cable and the power cable may be routed through the desk top cable hole or the optional cable hole on the single-bay desk system as shown in Figure 2-15. The double-bay desk has similar cable holes in both the left and right racks.

If the option was ordered with the 17-slot chassis, the controller is installed in the chassis and the interface cable is connected to the controller and routed out the back of the chassis.

4. Connect the I/O cable between the TTY/EIA controller and the 820 KSR.
5. Connect the power cable between the 820 KSR and the ac power outlet strip in the enclosure (or to an appropriate ac wall socket that has the correct ac voltage and frequency).
6. Use cable ties to neatly secure the I/O cable and the power cable in place.
7. Replace the rear and side louvered covers on the enclosure.

2.5 INSTALLATION CHECKOUT

2.5.1 General Information

The installation checkout consists of powering up the system and performing the applicable 990/10 diagnostic procedures. Refer to Section 3 of this manual for the locations and functional descriptions of the equipment operating controls and indicators. Also, refer to the applicable installation and operation manuals for details on any particular peripheral device.

The documentation for the diagnostic procedures is in one of the notebooks found in the software package. A detailed list of the software package contents is provided in the unpacking instructions. The diagnostic test procedures, in object code, are contained on the following disks:

- Type 5440 high-density disk cartridge, part number 937507-0001, which contains the DOCS diagnostic kit object code, part number 2250549-0001 (Model 4 only)

- Type T-25/50 disk pack, part number 947533-0001, which contains the DOCS diagnostics kit object code, part number 2250549-0001 (Models 6 and 8 only)

For a description of the diagnostic modules refer to the diagnostic kit object code, part number 2261796-0001, which is located in the software package. Also refer to Volumes 1 through 7 of the *990 Computer Diagnostic Handbook*.

2.5.2 System Checkout Procedure

The checkout procedure consists of powering up the system, running the applicable diagnostics, and loading the DX10 operating system. This procedure covers the possibility of having a system with any combination of DS10, DS25, and/or DS50 disk drives. Because it is very general, the operator is cautioned to be familiar with the operating instructions for each applicable component before performing this procedure. Perform the checkout procedure as follows:

1. Ensure that the desk or cabinet power circuit breaker is set to OFF, that all other components power switches or circuit breakers are set to ON, and that the key switch on the computer programmer panel is set to UNLOCK or ENABLE (depending on type of programmer panel). Plug the desk or cabinet power cable into an appropriate wall outlet.
2. If the system has DS25 or DS50 disk drives, ensure that the START/STOP switch is in the STOP position. If the system has one or more DS10 disk drive(s), ensure that each START/STOP push button switch is in the STOP (out) position.
3. Set the enclosure power circuit breaker to ON and check the following conditions:
 - a. The POWER, FAULT, and RUN Light-Emitting Diodes (LEDs) on the computer programmer panel should be lit.
 - b. Press the HALT/SIE switch on the computer programmer panel and verify that the RUN LED goes dark.
 - c. Press the RESET switch on the computer programmer panel and verify that the FAULT LED goes dark.
 - d. Press the LOAD switch on the computer programmer panel and verify that the DATA, FAULT, and RUN LEDs are initially lit. After a few seconds, the FAULT LED should become dark.
4. Press the HALT/SIE switch and the RESET switch and verify the following memory location contents. Refer to paragraph 3.3 for details on the programmer panel operation.
 - a. Memory location >80 contains >FFFF.
 - b. Memory location >82 contains >F800.
 - c. Memory location >84 contains >0800.
 - d. Memory location >F800 contains >X0X0 (X indicates any hexadecimal number).
 - e. Memory location >F80E contains A800, A000, A900, or A100.

5. Perform the head alignment procedure on all the disk drives in the system. Refer to the specific disk drive vendor maintenance manual for detailed instructions on this operation.

CAUTION

To perform these head alignment procedures requires special tools and special training. Therefore, contact a Texas Instruments Field Service Office to secure a Customer Representative to perform this operation.

6. The Customer Representative should load, via an appropriate device, and execute the 990/10 Arithmetic Unit Test (AU10).
7. The Customer Representative should load, via an appropriate device, and execute the 990/10 Random Access Memory Test (RAMTST).
8. Upon successful completion of steps 1-7, place the desired disk in the appropriate disk drive. Set the READ ONLY/READ WRITE switch to the READ WRITE position on the DS50 or DS25; then set the START/STOP switch to START and verify that the green FILE READY light blinks for approximately 20 seconds. When the light shows a steady green, the disk unit is up to speed and ready for use. If there is more than one disk unit, the next unit may be loaded and started. For the DS10 unit press the START/STOP push button to the IN (START) position. Verify that the button lights. After approximately 65 seconds, the ready light illuminates, indicating that the unit is up to speed and ready for use. The protect switches should be set as required. The next disk unit may be started after the DS10 is ready.
9. Install the DOCS diagnostic disk in an appropriate disk drive. On the DS10 disk drive, set the WRITE PROTECT FIXED switch to ON (in position), and then press the START/STOP switch to the START position (in position). On the DS25/DS50 disk drive set the READ ONLY-READ/WRITE switch to the READ ONLY position, then set the START/STOP to the START position.
10. After the disk drive indicates it is ready, press the HALT/SIE, RESET, and LOAD buttons (in that order) on the computer programmer panel.
11. Wait 10 seconds, and then enter a capital Y on the 911 VDT. Refer to Volume 1 of the *990 Computer Diagnostics Handbook* and follow its instructions for initializing DOCS.
12. Select and perform the diagnostic for the 911 VDT, and upon completion perform the diagnostics for all the other equipment on the system (refer to Volumes 1 through 7 of the *990 Computer Diagnostics Handbook*).

CAUTION

If system software is installed on the DS10 fixed platter, the platter should be protected when running the diagnostics, and the diagnostic test for the disk drive should be limited to the removable cartridge.

13. Upon completion of the diagnostics, the system software may be loaded.
14. Language Installation (systems with software only):
 - a. Systems with add-on languages have selected languages factory-installed on the system disk. The language add-on files still exist on the disk for possible future need. The installation batch streams and output listings for the installed languages may be found in the envelope in the system disk box. Refer to the appropriate Read First language installation document for each language that must be installed.
 - b. To install languages from a disk other than the system disk, refer to the appropriate Read First language installation document.

Operation

3.1 INTRODUCTION

This section provides operating information for the following DS990 system components:

- Desk and cabinet units
- Programmer panels
- 911 VDT
- DS10 disk drive
- DS25/DS50 disk drive

For additional details refer to the installation and operation manuals for the individual system components.

3.2 DESK AND CABINET UNITS

The desk and cabinet units are supplied with appropriate power input connectors, circuit breakers, and/or switches to accommodate domestic and international requirements. The circuit breaker located at the rear of the primary cabinet or desk must be set to the ON position (up) before power can be applied to the equipment packaged in the cabinet or desk. For the Model 8 performance package system with the computer chassis packaged in a 762-millimeter (30-inch) cabinet, the computer chassis circuit breaker below the rear door of the cabinet must be set to the ON position (right) to apply power to the computer.

NOTE

Each cabinet and desk in the system has a circuit breaker at the rear that must be set to ON so that power can be distributed to the contained equipment.

Refer to the *DS990 Models 4, 6, and 8 Systems Site Preparation Manual* for input cable, connector, circuit breaker, and/or switch details. See also the DS990 Models 4 through 30 systems operator's service guide.

3.3 PROGRAMMER PANELS

Two programmer panels are used with the DS990 systems, one with the 13-slot chassis and another with the 17-slot chassis. They differ only slightly in functional detail, but differ considerably in physical size and appearance. The programming functions are identical on each. Paragraph 3.3.1 discusses controls and indicators for the 13-slot chassis programmer panel. Paragraph 3.3.2 discusses controls and indicators for the 17-slot chassis programmer panel. Paragraph 3.3.3 discusses operation of both programmer panels.

3.3.1 Programmer Panel Controls and Indicators, 13-Slot Chassis

Refer to Table 3-1 and Figure 3-1 for the description and location of all programmer panel controls and indicators. The reference numbers in Figure 3-1, associated with panel markings, are keyed to the description of the switches and indicators and to their functional descriptions in Table 3-1.

Table 3-1. Programmer Panel Controls and Indicators

Reference Number	Switch or Indicator	Function
1	Data LEDs	In the run mode, all data LEDs light except when the computer halts. At this point, the contents of the CPU's program counter is displayed. A lit LED denotes logic 1; an unlit LED denotes logic 0. The least significant bit (LSB) is displayed on the far right of the LEDs. In the halt mode, the LEDs display the contents of a register in the computer, the contents of memory, or a value entered into computer memory or register via the data entry switches, depending on which switches are pressed (see reference numbers 5 through 14).
2	Data entry switches	These are used in conjunction with the ENTER switches on the panel to enter data and addresses into selected computer registers and memory locations (active only when the panel is in the halt mode). In the halt mode, the data LED located immediately above each data entry switch changes to the opposite state as each switch is pressed (i.e., if off, goes on; if on, goes off). The value indicated by the data LED is then stored in the register or memory location selected by the entry switches.
3	CLR switch	When pressed, the CLR (clear) switch clears the data LED displays.
4	MDE switch	The memory data enter (MDE) switch is pressed to transfer a value displayed on the data LEDs to the memory location defined by the contents of the memory address (MA) register in the computer.
5	MAI switch	The memory address increment (MAI) switch is pressed to increment by two the value stored in the CPU's MA register. The new value is also displayed on the data LEDs.

Table 3-1. Programmer Panel Controls and Indicators (Continued)

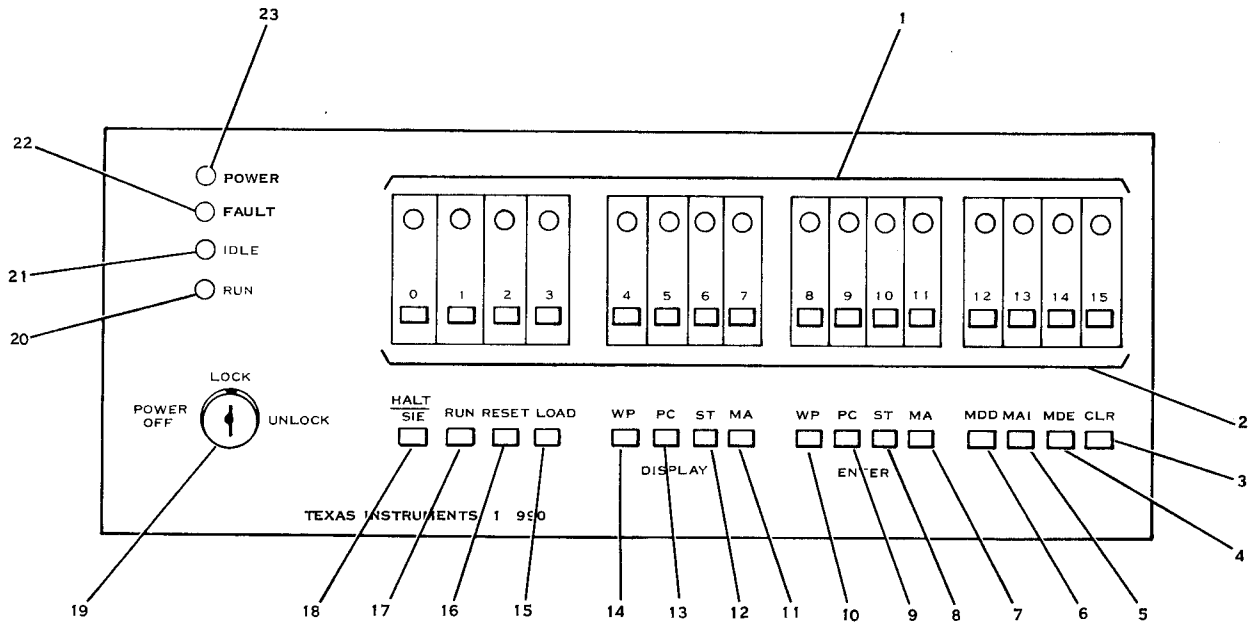
Reference Number	Switch or Indicator	Function
6	MDD switch	When pressed, the memory data display (MDD) switch causes the contents of the memory location defined by the contents of the MA register to be displayed on the data LEDs.
7	ENTER MA switch	When pressed, this switch causes the value displayed by the data LEDs to be entered into the computer's memory address register (MA).
8	ENTER ST switch	When pressed, this switch causes the value displayed on the data LEDs to be entered into the computer's status register (ST).
9	ENTER PC switch	When pressed, this switch causes the value displayed on the data LEDs to be loaded into the computer's program counter (PC).
10	ENTER WP switch	When pressed, this switch causes the value displayed on the data LEDs to be loaded into the computer's workspace pointer (WP).
11	DISPLAY MA switch	When pressed, this switch causes the value stored in the computer's MA register to be displayed on the data LEDs.
12	DISPLAY ST switch	When pressed, this switch causes the contents of the computer's ST register to be displayed on the data LEDs.
13	DISPLAY PC switch	When pressed, this switch causes the contents of the computer's PC to be displayed on the data LEDs.
14	DISPLAY WP switch	When pressed, this switch causes the contents of the computer's WP to be displayed on the data LEDs.
15	LOAD switch	When the panel is in the halt mode, pressing this switch causes the computer to trap to the ROM loader starting address.
16	RESET switch	Pressing this switch generates an IORESET pulse that resets all units in the system.
17	RUN switch	When the computer is halted (the programmer panel is active), pressing the RUN switch returns the computer to the run mode of operation and deactivates the panel.

Table 3-1. Programmer Panel Controls and Indicators (Continued)

Reference Number	Switch or Indicator	Function
18	HALT/SIE switch	When the computer is in the run mode, pressing the HALT/SIE switch causes the computer to halt and begin processing the front panel software if the key switch is set to the UNLOCK or ENABLE position. Pressing this switch when the computer is not in the run mode causes the computer to execute a single instruction at the present PC address. The contents of the PC are incremented by two and displayed on the data LEDs.
19*	Key Switch	<p>The key switch (OFF/LOCK/UNLOCK switch) prevents unauthorized computer turn on or program intervention. To apply ac power to the chassis, the key must be inserted into the switch and the switch must be set to the LOCK position. At this point, power is applied to the computer, but the programmer panel is locked out. When the switch is in the UNLOCK position, the computer may be halted by pressing the HALT/SIE switch.</p> <p>The key may be removed from the switch in any position.</p>
20	RUN LED	<p>The RUN LED lights when a low-active RUN signal is generated by the computer, indicating that the computer is in the run mode. When this LED is lit, all switches on the panel except the HALT/SIE switch are disabled and the data LEDs are driven under program control.</p> <p>When the RUN LED is unlit, the panel controls are active.</p>
21	IDLE LED	This indicator lights when the computer is executing an idle instruction (indication of computer inactivity for most interrupt-driven software).
22	FAULT LED	The FAULT LED lights when the computer has detected a diagnostic test failure. The LED is extinguished by executing an RSET instruction, by an SBO or SBZ addressed to panel bit 11, or by pressing the RESET switch on the panel.
23*	POWER LED	This indicator lights when power is applied to the programmer panel (the key switch on the panel is set to the LOCK or UNLOCK position).

Note:

* 13-slot chassis programmer panel only. See paragraph 3.3.2 for 17-slot chassis programmer panel.



(A) 143235

Figure 3-1. 990 Programmer Panel Controls and Indicators, 13-Slot Chassis

3.3.2 Programmer Panel Controls and Indicators, 17-Slot Chassis

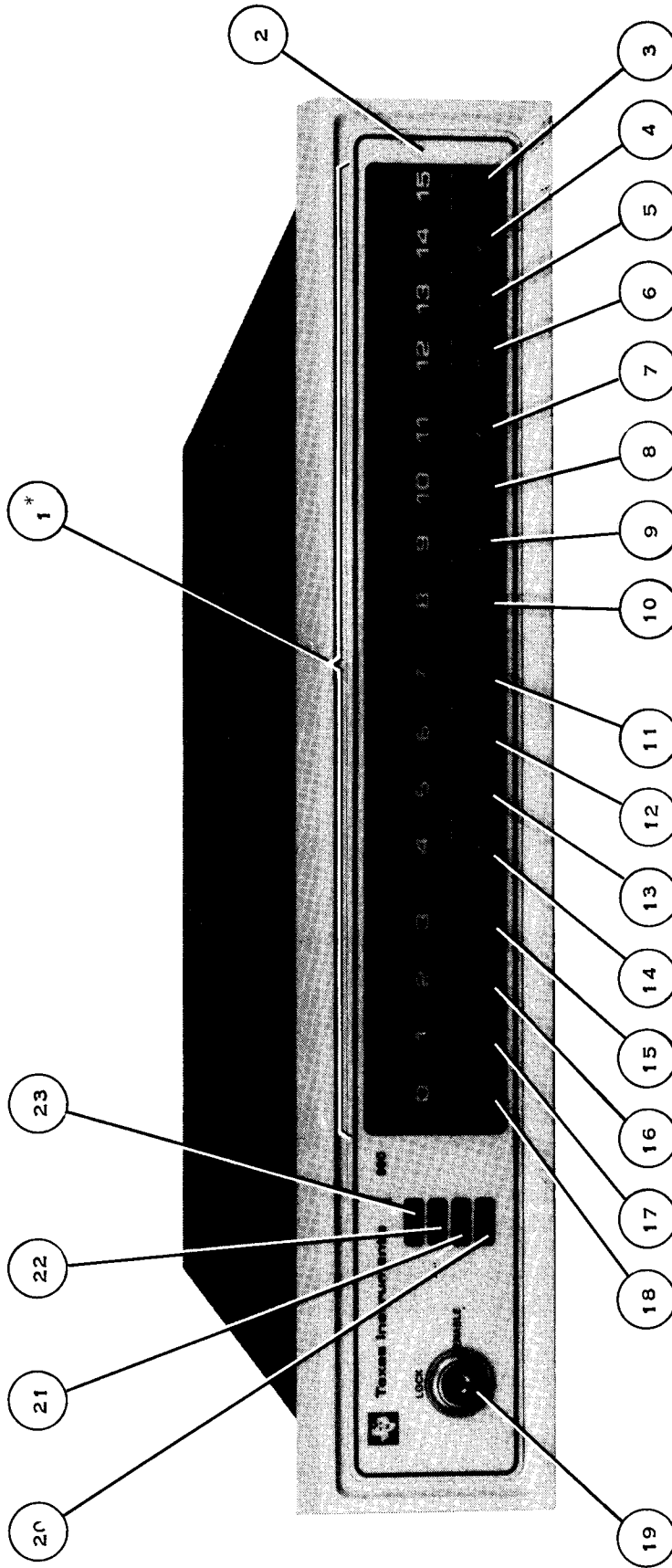
The 17-slot chassis programmer panel is shown in Figure 3-2. Functionally the controls and indicators for this programmer panel are identical to those described in Table 3-1 (except as noted for reference numbers 19 and 23). For the 17-slot chassis programmer panel reference numbers 19 and 23 are changed as follows:

- | | | |
|----|------------|--|
| 19 | KEY SWITCH | Placing the key switch (LOCK/ENABLE) in the LOCK position prevents unauthorized computer program intervention. Placing the key switch in the ENABLE position allows the operator to halt the computer by pressing the HALT/SIE switch. |
| | | The key may be removed from the switch in either the ENABLE or LOCK position. |
| 23 | POWER LED | This indicator lights when power is applied to the programmer panel. |

3.3.3 Programmer Panel Operation, 13- and 17-Slot Chassis

The programmer panel may function in one of the following two modes:

- Run mode
- Halt mode.



* DATA LEDS NOT VISIBLE IN PHOTOGRAPH

(A) 143421A

Figure 3-2. Programmer Panel Controls and Indicators, 17-Slot Chassis

In the run mode (RUN LED lit), all programmer controls are inoperative except for the HALT/SIE switch. The switch may be enabled by setting the key switch to the UNLOCK or ENABLE position. If the key switch is in the LOCK position, all panel controls are disabled.

Pressing the HALT/SIE switch while the computer is in the run mode causes the front panel software to execute; this places the computer in the halt mode (RUN LED not lit), enabling all other front panel switches. The data LEDs on the front panel display the contents of the computer program counter. Pressing the HALT/SIE switch while the computer is in the halt mode generates the single instruction execute (SIE) signal. The SIE signal causes the computer to execute a single instruction located at the address indicated by the program counter and then to increment the program counter by a value of two bytes. The new contents of the program counter are then displayed on the data LEDs. This sequence is repeated each time the HALT/SIE switch is pressed while the computer is in the halt mode.

The contents of individual computer memory locations and front panel workspace registers may be displayed and altered from the front panel. Generally, this can be done by displaying the binary value to be checked/alterd on the data LEDs, altering the data LEDs as desired, and returning the new value to its original memory or workspace register location. The general procedure for accomplishing computer memory and workspace register content alterations is as follows:

1. Press the DISPLAY MA switch to display on the data LEDs the address value in the front panel MA register for alteration or verification purposes.
2. Verify or alter the binary value on the data LEDs as desired.
3. Press the ENTER MA switch to enter into the front panel MA register the address value displayed on the data LEDs.
4. Press the MDD switch to display on the data LEDs the data at the memory location defined by the MA register.
5. Verify or alter the binary value on the data LEDs as desired.
6. Press the MDE switch to enter the data from the data LEDs to the memory location defined by the MA register.
7. Press the MAI switch to increment the address stored in MA register by a value of two bytes.
8. Press the CLR switch when it becomes necessary to clear the data LEDs for any reason.
9. Press the DISPLAY ST, DISPLAY PC, or DISPLAY WP switch to display on the data LED the contents of the computers ST, PC, or WP (contained in front panel workspace registers 13, 14, or 15).
10. Verify or alter the binary value on the data LEDs as desired.
11. Press the ENTER ST, ENTER PC, or ENTER WP switch to enter the value displayed on the data LEDs into the ST, PC, or WP front panel workspace registers.
12. Press the RUN or HALT/SIE switch to load the values of the ST, PC, and WP front panel workspace registers into the internal registers of the computer.

3.4 911 VIDEO DISPLAY TERMINAL

A general description of the keyboard and the display unit controls and indicators is given in the following paragraphs. For more details and for other 911 VDT keyboards refer to *Model 911 Video Display Terminal Installation and Operation*.

NOTE

The Model 911 VDT cannot be operated unless properly connected to a Model 990 family computer with the applicable software loaded.

The function of each key on the keyboard depends on the controlling input/output program resident in the computer. Therefore, before using the Model 911 VDT, the operator must know the programmed function of each key on the keyboard. This ensures that the data entered into the system is correctly interpreted by the software. In addition to the keyboard controls, controls and indicators appear on the display unit to optimize the video and audio presentation. An indicator also appears on the VDT controller board for maintenance purposes.

3.4.1 911 Keyboard

The standard keyboard consists of 88 keys grouped as shown in Figure 3-3. The key codes can be interpreted by software to perform various functions. The standard keyboard layout illustrated in the figure is organized into four types of keys:

- Data entry keys
- Cursor control and edit keys
- Numeric keys
- Special control keys

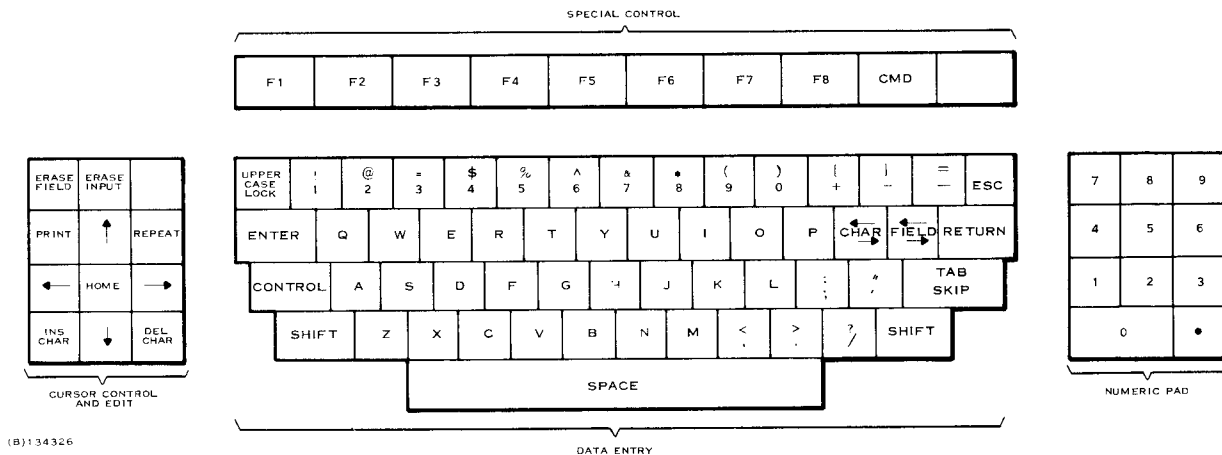


Figure 3-3. Standard 911 VDT Keyboard

The keyboard produces an 8-bit code for each key except the REPEAT, SHIFT, CONTROL, and UPPERCASE LOCK keys. The 8-bit code produced by a specific key depends upon the keyboard mode determined by the SHIFT, CONTROL, and UPPERCASE LOCK keys as follows:

SHIFT	CONTROL	UPPERCASE LOCK	Mode
Up	Up	UP	Lowercase
Up	Up	Down	Uppercase
Don't Care	Down	Don't Care	Control
Down	Up	Don't Care	Shift

Keyboard interpretations for the four modes are shown in *Model 911 Video Display Terminal Installation and Operation*. The related input/output (I/O) software examines the code to determine the function. The repeat feature permits the operator to hold down the REPEAT key and then press any other key to generate the accompanying character (or function) at a rate of 10 ± 2 characters per second. Refer to Table 3-2 for a description of the purpose of the keys supported by DX10.

NOTE

Because all commands and responses to commands must be entered in uppercase mode, the UPPERCASE LOCK key should be locked down at the beginning of every terminal session at a Model 911 terminal.

Table 3-2. Purpose of Model 911 VDT Keys Supported by DX10

Key	Purpose
Alphabetic, Numeric, and Special Character Keys	These keys are used to enter information such as commands, parameters, and responses to requests for information into the computer.
Arrow Keys	Right (→) and left (←) arrow keys move the cursor left or right one character position on the display screen in the direction shown by the arrow on the key. Up (↑) and down (↓) arrow keys allow the user to increment or decrement a line for special edit functions.
CONTROL	Holding the control key down and pressing a character key causes the character key to be a control character (producing a different and unique code for each control character selected). For example, the code generated by the character P is a different code from a control P code. Both codes are unique.

Table 3-2. Purpose of Model 911 VDT Keys Supported by DX10 (Continued)

Key	Purpose
DEL CHAR	This key deletes the character over which the cursor is positioned. Any character or character string to the right of the cursor and in the current field automatically moves one character position to the left. A blank is inserted in the rightmost position of the field.
ERASE FIELD	This key erases the contents of a field.
INS CHAR	To insert characters in a field, operators press the INS CHAR key and type the characters to be inserted. As each character is inserted, the cursor moves right one character position.
REPEAT	Holding this key down and then pressing a data entry key (alphabetic, numeric, or special character key) causes the computer to repeat the character specified by the data entry key. The character repeats until the user releases the REPEAT key.
RETURN	The RETURN key terminates entry of data into a field and submits the data entered to the computer for processing.
UPPERCASE LOCK ¹	This key locks the terminal in uppercase mode until the key is pressed a second time. The LOCK key affects only the alphabetic keys and does not affect the control keys or numeric keys.

Note:

¹ Because all commands and responses to commands must be entered in uppercase mode, the UPPERCASE LOCK key should be locked down at the beginning of every terminal session at a Model 911 terminal.

3.4.2 911 Display Unit Controls and Indicators

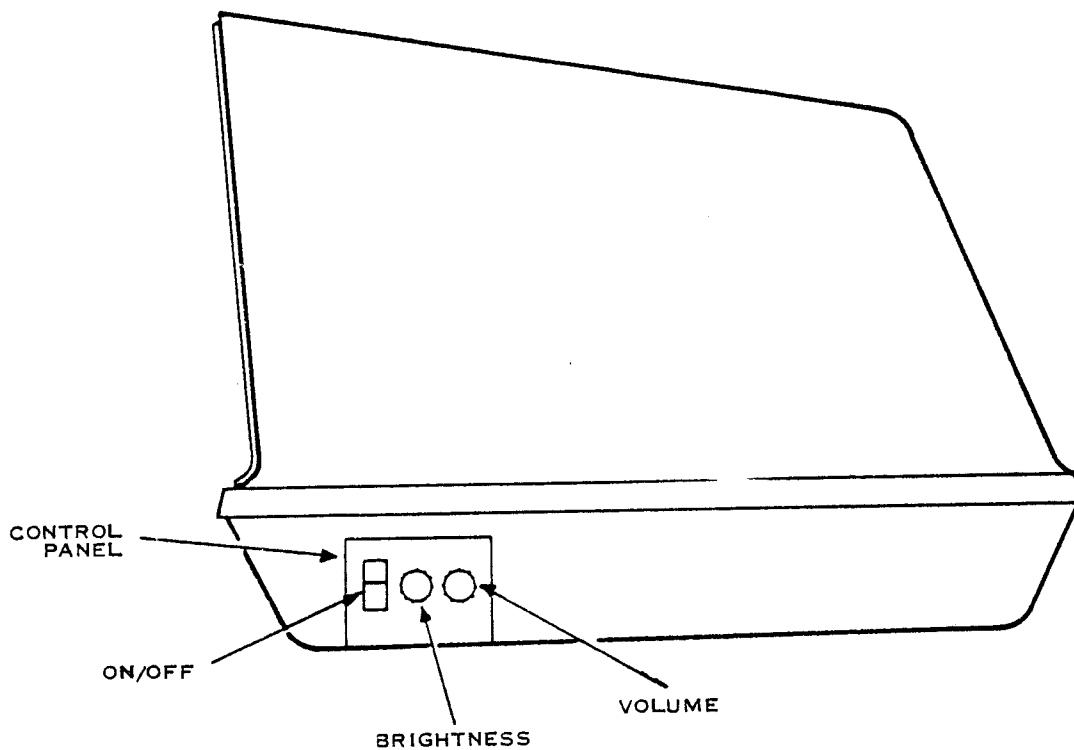
The display unit has controls and indicators in two positions on the display housing: the side and rear of the cabinet. The following paragraphs describe the functions of each of these controls and indicators.

3.4.2.1 911 Control Panel. Three controls mounted on the right side of the 911 monitor housing comprise the control panel. Figure 3-4 shows the switches.

The ON/OFF switch is a rocker switch that controls ac power to the terminal.

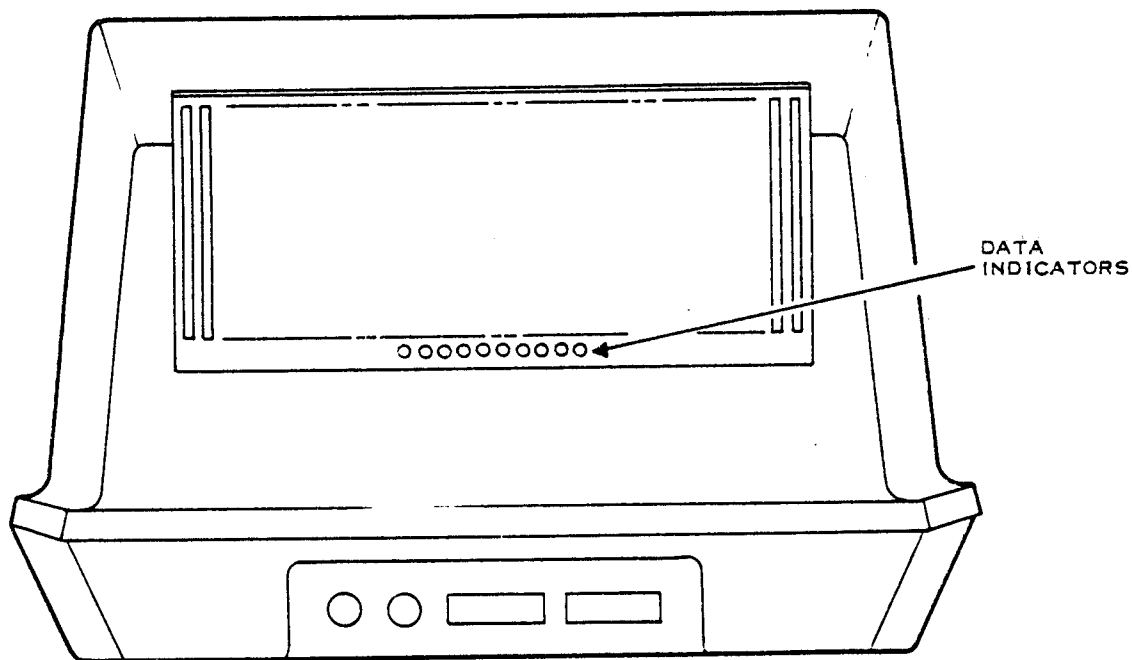
The brightness and volume controls are rotary controls that allow the operator to vary the brightness of characters on the display and the loudness of the audio alarm, respectively.

3.4.2.2 911 Data Indicators. A row of 10 LED indicators are located in the center of the rear panel of the display unit housing as shown in Figure 3-5. Figure 3-6 depicts a closer view of the indicators.



(A)134327

Figure 3-4. 911 VDT Display Unit Control Panel



(A)134328

Figure 3-5. 911 VDT Data Indicator Locations

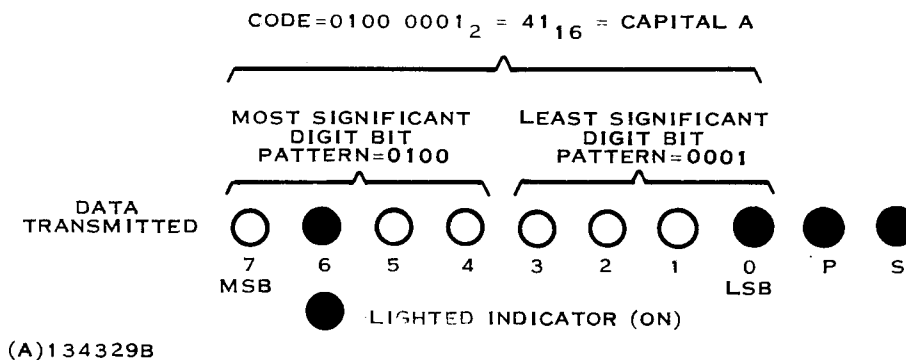


Figure 3-6. VDT Data Indicators Sample Pattern

When lighted, the rightmost indicator (S) indicates that the video sync pulse is being received from the 911 controller. This indicator should always be lighted if computer interface cables are properly installed, computer and 911 power is on, and the 911 controller is inserted into the computer chassis and is working properly.

When lighted, the parity indicator (P) indicates that the parity bit sent to the 911 controller with the last character bits was correct. This indicator should always be on if the system is connected properly, power is on, and the display unit is transmitting data properly to the 911 controller.

The remaining indicators display the code of the character last entered on the keyboard. The indicators light to display a one bit and remain dark to display a zero bit. Figure 3-6 illustrates a sample display for the character A. The MSB of the character code is on the left; therefore, the indicators must be read from left to right.

3.4.3 911 Controller Indicator

The LED on the 911 controller lights when the computer performs an SBO instruction to 911 controller bit 9 or 19 to select either display section of a dual controller for self-test mode. The indicator may be lighted as a flag in a multicontroller system to identify an inoperative controller.

3.5 DS10 DISK DRIVE

The following paragraphs give a general discussion of the DS10 controls and indicators and the associated operating instructions. These paragraphs include the following:

- Description of DS10 controls and indicators
- Operating instructions
- Write protect feature
- Disk drive stopping and power removal
- Fault operating procedures

- Maintenance aids
- Definition of disk terms
- Sector format explanation

For more details refer to the *Model DS10 Disk System Installation and Operation*.

3.5.1 Controls and Indicators

Figure 2-10 illustrates the locations of the controls and indicators and the logical unit label on the disk drive. Figure 3-7 illustrates the details of the logical unit label. The following paragraphs describe the operation of the controls and indicators.

DS10 LOGICAL UNIT NO.
(0 — 3 POSSIBLE UNITS)
REMOVABLE DISK: UNIT 1
FIXED DISK: UNIT 0

Figure 3-7. Typical Logical Unit Label

3.5.1.1 Ac Circuit Breaker. The ac circuit breaker (labeled MAIN) on the rear of the disk drive protects the disk drive power supply, spindle motor, and fan motor from damage due to overload conditions. It also provides main power switching for the disk drive. Normally, the circuit breaker is set to ON during installation and checkout of the disk drive, then is left on for normal operation.

3.5.1.2 Dc Circuit Breaker. The dc circuit breaker (labeled 34 volts) on the rear of the disk drive provides the logic circuitry with overload protection due to circuit malfunctions. Normally, the breaker is set to ON during installation and checkout of the disk drive, and is left on for normal operations.

3.5.1.3 START/STOP Switch/Indicator. The START/STOP switch/indicator is an alternate action switch with a lighted pushbutton. If the indicator is not lighted and is operational, pressing the switch energizes the spindle motor and initiates the first seek mode provided the following conditions exist:

- Circuit breakers closed
- Disk cartridge dust cover properly installed
- Cartridge hold-down arms properly positioned

When the spindle motor is energized, the START/STOP indicator is lighted and remains lighted until the spindle motor stops in response to START/STOP switch operation. Pressing the START/STOP switch while the indicator is lighted (spindle motor is energized) deenergizes the spindle motor.

When the START/STOP switch is pressed to deenergize the spindle motor, the indicator remains lighted until the following occurs:

- Disk rotation stops
- Interlock solenoids energize to release the disk cartridge

NOTE

The first seek mode is automatic and requires approximately 65 seconds. The disk drive can be reset at any time after initiation of the start sequence. In the event of a potentially damaging fault during the first seek mode, the heads automatically retract and the disk drive stops.

3.5.1.4 READY Indicator. The READY indicator is lighted when the spindle motor has reached operating speed, the heads are loaded, and the disk drive is ready for use. The READY indicator is extinguished during any fault, emergency retract, or stop operation.

3.5.1.5 ACTIVE Indicator. The ACTIVE indicator lights to indicate that the disk is actively engaged in seeking and writing.

3.5.1.6 FAULT Indicator/Switch. The FAULT indicator/switch is lighted to indicate any fault except ac power failure. If a momentary ac power drop occurs, the heads automatically go into emergency retract and disk drive stops. The disk drive automatically starts when ac power returns to normal.

The FAULT indicator lights to indicate the occurrence of a nondamaging fault, i.e., more than one head selected, simultaneous read and write instructions, etc. The FAULT indicator is extinguished by a RETURN-TO-ZERO-SEEK command.

If a momentary nondamaging fault occurs, pressing the FAULT switch clears the fault logic and extinguishes the indicator. The FAULT switch cannot be used to clear a persistent fault.

3.5.1.7. WRITE PROTECT CART Indicator/Switch. The Write Protect Cartridge (WRITE PROTECT CART) indicator/switch for the removable cartridge is an alternate-action pushbutton switch with a lighted pushbutton. Pressing the switch when the indicator is not lighted inhibits writing and erasing of data on the disk and lights the indicator. When the indicator is lighted, the pushbutton remains partially depressed. Pressing the pushbutton with the indicator lighted removes the protect condition and extinguishes the indicator.

3.5.1.8. WRITE PROTECT FIXED Indicator/Switch. The Write Protect Fixed (WRITE PROTECT FIXED) indicator/switch for the fixed disks is an alternate-action pushbutton switch with a lighted pushbutton. Pressing the switch when the indicator is not lighted inhibits writing and erasing of data on the fixed disk and lights the indicator. When the indicator is lighted, the pushbutton remains partially depressed. Pressing the pushbutton with the indicator lighted removes the protect condition and extinguishes the indicator.

3.5.2 Operating Instructions

The following paragraphs describe normal operating procedures for the disk system, including the following:

- Precautions
- Power application for on-line operation
- Disk cartridge installation and removal
- Write protect
- Stop and power removal
- Fault operating procedures

3.5.2.1 Operating Precautions. The following precautions should be observed while operating the disk system:

- If a pinging or scratching noise is heard (caused by head-to-disk contact), stop the disk drive by using the disk drive stopping and power removal instructions in paragraph 3.5.4, and call the customer representative.

NOTE

Appropriate steps should be taken to safeguard data until the problem can be remedied. Such steps may include leaving the disk drive deenergized, replacing the disk cartridge with a scratch cartridge, and/or immediate transfer of the data on fixed disk.

- Follow the disk cartridge installation and removal procedures described in paragraphs 3.5.2.3 through 3.5.2.5.
- Never attempt to override any interlock.

3.5.2.2 Power Application for On-Line Operation. Apply power for the on-line operation as follows:

NOTE

Steps 1, 2, 4, and 5 of this procedure are to be performed by maintenance personnel only.

1. Ensure that all system interconnection cables and power cables are properly connected and in good condition.
2. Verify that the disk drive is properly configured for local ac line power.

3. Ensure that the START/STOP switch/indicator is in the STOP position (pushbutton raised and indicator extinguished).
4. Close the dc circuit breaker.
5. Close the ac circuit breaker, and verify the operation of the blower motor.
6. Install the disk cartridge in accordance with paragraph 3.5.2.3.
7. Press the START/STOP switch/indicator. Ensure that the pushbutton stays partially depressed and that the indicator lights.
8. Verify that the FAULT indicator/switch remains extinguished.

NOTE

If the FAULT indicator lights, perform the fault operating procedure in paragraph 3.5.6.

9. Approximately 65 seconds after pressing the START/STOP switch, the READY indicator lights and the disk drive is ready for operation initiated by the computer.

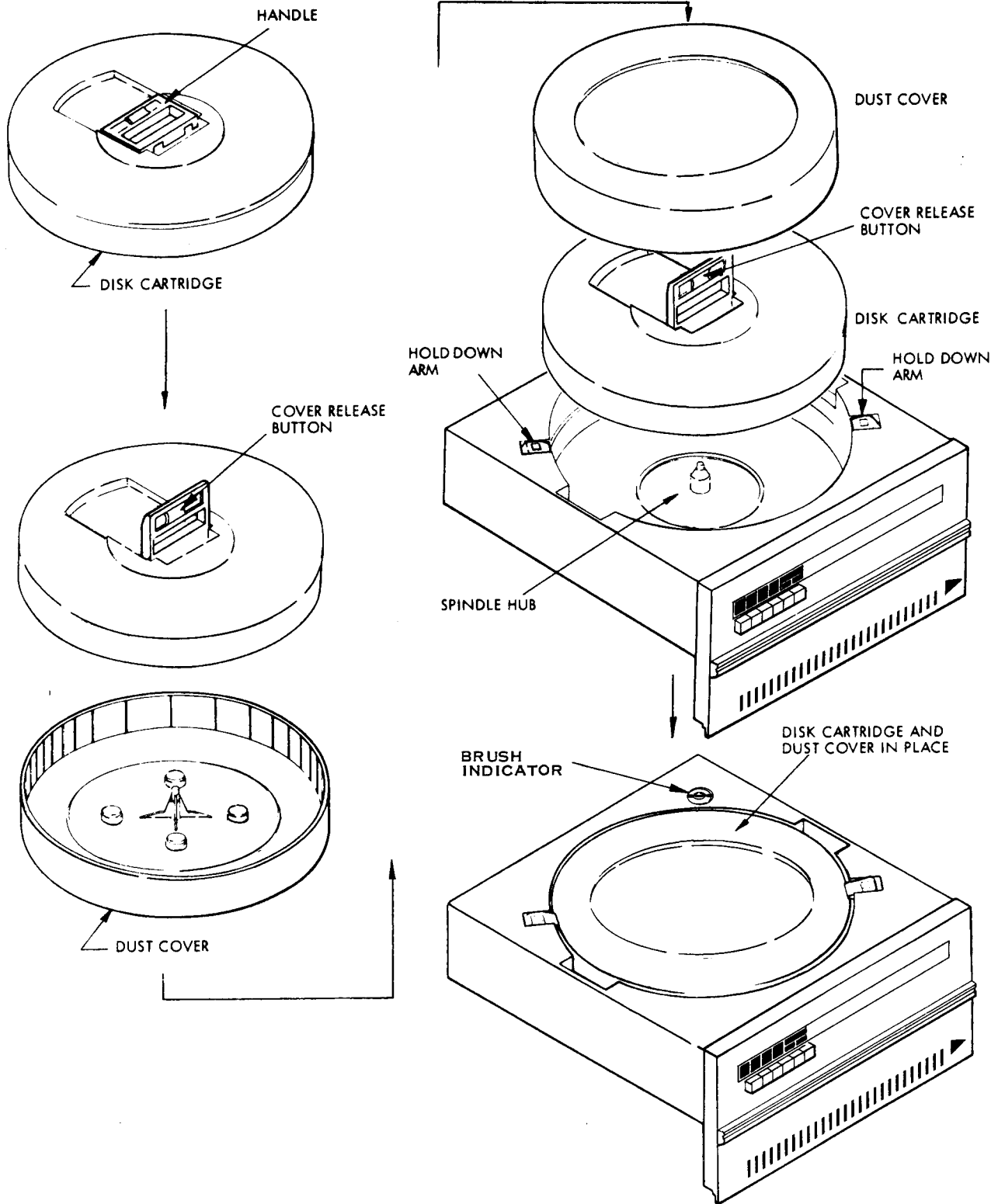
3.5.2.3 Disk Cartridge Installation. Install the disk cartridge (refer to Figure 3-8) as follows:

1. Pull the disk drive out of the rack on its slides, if rack mounted. Open access cover if disk drive is pedestal mounted.

NOTE

Power must be on and the STOP/START lamp must be extinguished to release the lock on the hold-down arms.

2. Pull back the hold-down arms.
3. Set the disk cartridge upright on a firm supportive surface.
4. Hold the disk cartridge cover release button to the left while lifting the cartridge handle to separate the dust cover and disk.
5. Disengage the dust cover from the disk. Set the cover aside.



(A) 137260A

Figure 3-8. DS10 Disk Cartridge Installation

CAUTION

Do not attempt to install or remove a cartridge unless the read/write heads and brushes are completely out of the disk area. Verify that the slot is aligned with the black area of the brush indicator on top of the disk drive (see Figure 3-8). Align the slot with the black area, using a coin or screwdriver if they are not aligned.

Do not make abusive contact between the disk and the spindle. Remove any dust from the magnetic chuck.

6. Position the head opening of the disk toward the rear of the disk drive, and place the disk onto the spindle hub.
7. Rotate the cartridge slowly back and forth until the cartridge seats over the spindle.
8. Turn the handle down to seat the cartridge.
9. Place the dust cover (removed in step 5) open end down over the cartridge.
10. Position the hold-down arms over the cartridge and dust cover.
11. Push the disk drive into the rack if rack mounted. Close access cover if disk drive is pedestal mounted.

3.5.2.4 Disk Cartridge Removal (Normal). Remove the disk cartridge as follows:

1. Press the START/STOP switch, and wait for the START/STOP indicator to be extinguished.

CAUTION

If the START/STOP indicator is still illuminated after 2½ minutes and the brushes are not fully retracted, contact the customer service representative.

2. Pull the disk drive out of the rack on its slides, if rack mounted. Open access cover if disk drive is pedestal mounted.
3. Verify that slot is aligned with black area of brush indicator (Figure 3-8). Use screwdriver or coin to align if necessary.
4. Pull back the hold-down arms. (The arms will not move until the cartridge rotation has stopped.)
5. Remove the cartridge dust cover.

6. Lift the cartridge handle, hold the cover release button to the left, and lift the cartridge up and out of the disk drive by the handle.
7. Place the cartridge inside the dust cover and fold down the handle until a snap is heard, indicating that the cartridge and dust cover are locked together.
8. Push the disk drive back into the rack, if rack mounted. Close access cover if disk drive is pedestal mounted.

3.5.2.5 Disk Cartridge Removal (During Power Failure or Emergency). Removal of the disk cartridge following power failure or in an emergency situation should normally be performed only by the customer representative.

1. Wait approximately three minutes for the cartridge to stop spinning.
2. Pull the disk drive out of the rack on its slides, if rack mounted. Open access cover if disk drive is pedestal mounted.
3. Verify that brushes are retracted. Use a screwdriver or coin to align the slot with the black area of brush indicator if necessary (Figure 3-8).
4. Release the pack locks by inserting a flat head screwdriver (or similar object) into the hole on top of the pack lock (see Figure 2-10). Press the solenoid plunger into the solenoid, and tilt the pack lock.
5. Pull back the hold-down arms.
6. Remove the cartridge dust cover.
7. Lift the cartridge handle, hold the cover release button to the left, and lift the cartridge up and out of the disk drive by hand.
8. Place the cartridge inside the dust cover, and fold down the handle until a snap is heard, indicating that the cartridge and dust cover are locked together.
9. Push the disk drive back into the rack, if rack mounted. Close access cover if disk drive is pedestal mounted.

3.5.3 WRITE PROTECT

Write protect operation can be initiated by the disk controller or by the operator. The operator initiates write protect operation by pressing either the W/PROT CART or W/PROT FIXED switch and verifying that the appropriate indicator lights. The selected disk cartridge or fixed disk is then protected from writing and/or erasing.

3.5.4 Disk Drive Stopping and Power Removal

To stop the disk drive and to remove power, observe the following sequence:

1. Press the START/STOP switch, and verify that the following happens:
 - a. READY indicator is extinguished

- b. START indicator is extinguished
 - c. Spindle stops
 - d. Brushes are retracted
 - e. Pack locks open
2. Remove the disk cartridge, if desired, in accordance with the instructions in paragraph 3.5.2.5.

NOTE

Step 3 must be performed by maintenance personnel only.

3. Set the ac circuit breaker (labeled MAIN) on the rear of the disk drive to OFF.

3.5.5 Changing Disk Assignments

The logical unit assignment of the fixed disk and the cartridge disk for purposes of reassignment is made by a jumper plug on cable adapter board 937510-0001 on the rear of the DS10 chassis. In the manual arrangement, the jumper plug is placed in storage location J1 to J2. With the jumper plug in storage, the fixed disk in the primary disk drive is designated 0, and the fixed disk in the secondary disk drive is designated 2. The removable disk cartridges are designated 1 and 3, respectively, for the primary and secondary disk drives. These designations may be reversed by changing the locations of the jumper plug as indicated in the chart below.

Disk Drive	Fixed Disk	Disk Cartridge	Jumper
Primary	0	1	J1-J2 (Storage)
Primary	1	0	J1-J3
Secondary	2	3	J1-J2 (Storage)
Secondary	3	2	J1-J4

On the cable adapter board, the designation UNIT 0 FIXED at J3 indicates that the fixed disk in the primary disk drive is designated 0 when the jumper wire is in storage. The designation UNIT 2 FIXED at J4 indicates that the fixed disk in the secondary disk drive is designated 2 when the jumper wire is in storage.

3.5.6 Fault Operating Procedures

If the FAULT indicator lights during normal operation or power application, proceed as follows:

- 1. Press the FAULT switch. If the FAULT indicator is extinguished, normal operation can be continued. If the FAULT indicator remains lighted, proceed to step 2.
- 2. Press the START/STOP switch, and allow the spindle to stop rotating.

3. Press the START/STOP switch, and observe the FAULT indicator. If the FAULT indicator is extinguished, normal operation can be resumed. If the FAULT indicator remains lighted, proceed to step 4.
4. Perform the disk drive stopping and power removal procedure described in paragraph 3.5.4.
5. Call the customer representative.

3.5.7 Maintenance Aids

There are four LEDs on the disk controller. These four LEDs are visible when the cover is removed from the computer by maintenance personnel and provide the following information to the maintenance personnel:

- **FAULT** — When lighted, the FAULT LED indicates that a microprogram type of failure has occurred and that the controller must be repaired. Specifically, the FAULT LED lights when the command timer on the controller times out. This indicates that the controller-initiated operation was not completed within the prescribed 200 ± 20 milliseconds, or that a self-diagnostic failure occurred. The FAULT indicator is dimly lighted during normal operation. The indicator is lighted during self-test.
- **CLK** — Operation of the CLK LED is as follows:
 - LED not lighted — Disk controller clock not running. Possible TILINE access granted problem.
 - LED lighted — Clock running normally
- **BUSY** — The BUSY LED, when lighted, indicates that the controller is either servicing a TILINE I/O reset or executing a command, a master power reset, or a power failure warning. When the BUSY LED is lighted, the controller cannot accept any commands.
- **INT** — The INT LED lights to indicate when the disk controller is issuing a TILINE interrupt.

3.6 DS25/DS50 DISK DRIVE

The following paragraphs give a general discussion of the DS25/DS50 controls and indicators and the associated operating instructions. These paragraphs include the following:

- Description of DS25/DS50 controls and indicators
- Operating instructions
- Maintenance aids

For more details refer to the *Model DS25/DS50 Disk System Installation and Operation*.

3.6.1 Controls and Indicators

Refer to Table 3-3 for a description of the DS25/DS50 controls and indicators. The location of the controls and indicators is shown in Figure 3-9.

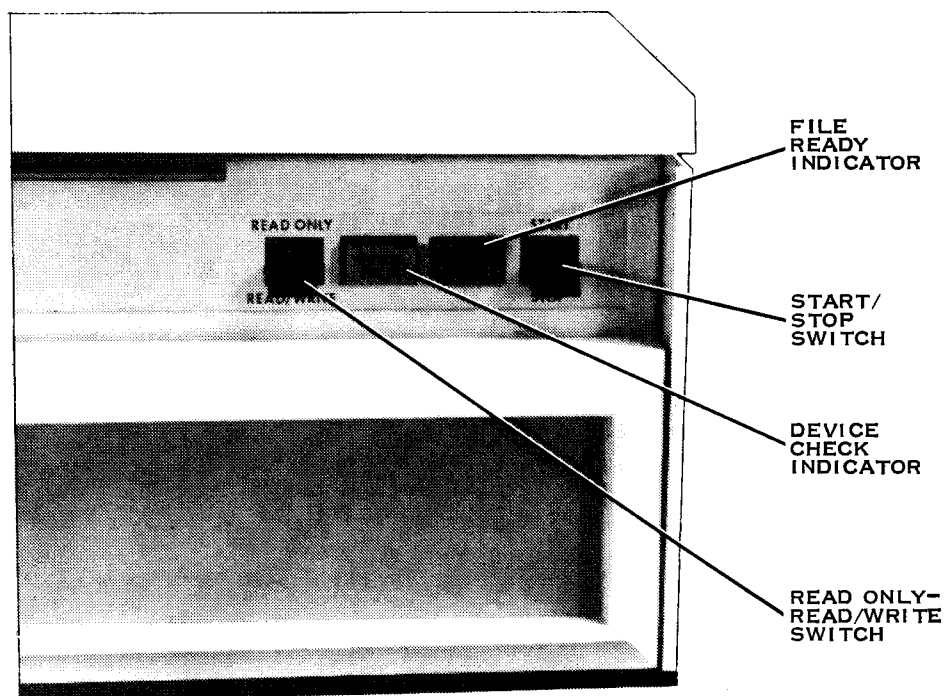
Table 3-3. Model DS25/DS50 Operator Controls and Indicators

Control	Description
READ ONLY- READ/WRITE Switch	Two-position toggle switch that provides disk-pack file protection. READ ONLY position inhibits write commands from writing on pack (an operational Device Check). READ/WRITE position enables both data-read and data-write operations to be performed. Any changes in the state of this switch are ignored if the unit is selected by the controller. This is to prevent the operator from interrupting a disk-write operation. This disk drive unit may be deselected by performing an I/O reset or by selecting another unit.
DEVICE CHECK Indicator	Lights when a Device Check error has been detected by the unit. Remains lit until the controller resets the Device Check error detector or until the unit is powered down. Condition of the indicator lamp can be tested by temporarily swapping positions with the green file ready indicator lamp.
File Ready Indicator	Indicator flashes during power-up and power-down sequencing. The drive is in the ready condition (powered up and heads loaded) when the indicator stays lit.
START/STOP switch	Two-position toggle switch that permits manual power-up and power-down sequencing. The START position turns on the spindle drive motor and loads the heads (older drive also initiated a brush cycle upon start-up). Heads cannot load and a seek incomplete results if a disk pack is not installed or an unsafe condition exists. The STOP position retracts the heads, turns off the spindle drive motor, and activates the brake to stop the pack. (Drives for use in the U.S. have an electrical brake. Some of the drives for use outside of the U.S. have a mechanical brake.)

3.6.2 Operating Instructions

NOTE

For manual or automatic sequencing of disk drive in a multiple unit system refer to paragraph 3.6.2.2.



(A)134010 (DSD-876-13-8)

Figure 3-9. DS25/DS50 Front Panel Controls and Indicators

Normally, the disk drive system is operated on-line using the disk controller and the DS990 computer system. To put the disk drive unit in a ready condition for normal operation, perform the following steps:

1. Verify that a disk pack is properly installed. (Refer to paragraph 2.3.3 for installation instructions.) Check that the air shroud is latched closed.
2. Verify that the ac line cord is installed in a compatible power outlet. Verify that the disk drive PWR ON/OFF switch on the rear of the unit is set to ON.
3. Check the position of the READ ONLY-READ/WRITE switch. It should be set to READ ONLY for file protection or set to READ/WRITE to allow writing on the disk pack.
4. Set the START/STOP switch to START. The spindle drive motor should start and indicate by sound that the speed is increasing. The green File Ready indicator should start flashing.
5. After about 20 seconds, the green File Ready indicator should stop flashing and remain lit. The DEVICE CHECK indicator should be extinguished.

NOTE

If the File Ready indicator continues to flash, this means the first seek operation has not been completed. In that case, set the START/STOP switch to STOP, wait for the spindle to stop rotating, and repeat step four to attempt a restart.

If the indications of step 5 are normal, the disk drive is ready for on-line operations under control of the computer and the software program. No further operator intervention is required unless a change of the disk pack is requested or the red DEVICE CHECK light comes on, indicating that a malfunction has occurred.

3.6.2.1 Clearing a Device Check. Most Device Check errors will be cleared by the operating system or the diagnostic tests via the controller when the disk drive is on-line. However, if the disk drive is being operated off-line or the red DEVICE CHECK indicator lights when the unit is operating on-line, intervention of the operator is required. Proceed as follows:

1. Set the START/STOP switch to STOP.
2. If the red DEVICE CHECK indicator lights again after power-down and power-up sequencing, an equipment malfunction is indicated and maintenance action is required.

3.6.2.2 Sequencing Disk Drive Units During Power-Up. Following a TILINE master reset operation that occurs upon power-up, the disk controller will be busy for a minimum of 20 seconds before it starts sequencing the disk drive units. The reason for this delay is to allow time for the spindle to stop in the event of a power transient. After the 20 seconds have elapsed, the controller will sequence to the first disk drive, unit 0, and will systematically start up each unit that is connected to the system in an ascending order.

When the spindle of a disk drive unit starts to rotate, an initial high start-up current is required. In about 20 seconds after start-up, the current will decay to normal running current, at which time the controller sequences the next unit.

After sequencing unit 0, the controller will check to see that unit 1 is installed. If it is, the controller will wait 20 seconds before sequencing unit 1. If unit 1 is not installed, the controller will sequence unit 1 without delay and check whether unit 2 is installed. This procedure will continue until all units have been sequenced, allowing 20 seconds minimum between sequences of installed units.

While the controller is in the disk sequence mode, it will be busy and will not be able to execute any commands. The sequence mode will last a minimum of 20 seconds and a maximum of 80 seconds, depending upon how many units are installed.

If the operator wants the automatic sequencing to take place, the following procedure must be used:

1. Turn off power to the computer system.
2. Make sure the ac line cords of all units and components are connected to a power source.

3. Set the PWR switch on all disk drive units to ON.
4. Set the START/STOP switch on all disk drive units to START.
5. Apply power to the computer system.

If the operator does not choose this option of automatic sequencing, the power-up sequence must be performed manually, using the START/STOP switch on each disk drive unit. A minimum of 20 seconds between successive starts must be allowed.

3.6.3 Maintenance Aids

The disk controller has the following four indicators that indicate the status or operating condition of the disk drive system:

- **FAULT** — This indicator signals that a hardware microprogram-type failure has occurred and that the controller must be repaired.
- **CLK ON** — This indicator should always be lit indicating that the clock for the microprogram control unit is active. When this indicator is extinguished, the controller cannot gain access to the TILINE or is hung in a master cycle.

3.7 STARTING, LOADING, INITIALIZING, AND SHUTTING DOWN THE DS990 SYSTEM

The following paragraphs discuss starting the computer (powering up), loading the operating system, initializing and shutting down the system.

3.7.1 Starting the 990/10 Computer

The procedure for starting the computer varies with the chassis in which it is mounted. The computer starting procedure for the 13-slot chassis is discussed in paragraph 3.7.1.1 and the computer starting procedure for the 17-slot chassis is discussed in paragraph 3.7.1.2.

3.7.1.1 Starting the 990/10 Computer, 13-Slot Chassis. To apply power to the computer and to enable the programmer panel, perform the following steps:

1. Set the circuit breaker or main switch on the back of the primary enclosure to the ON position.
2. Set the key switch to the UNLOCK position. (The POWER LED lights, power is applied to the computer, and the programmer panel is enabled.)

3.7.1.2 Starting the 990/10 Computer, 17-Slot Chassis. To apply power to the computer and to enable the programmer panel, perform the following steps:

1. Access the rear of the 17-slot chassis by opening the rear door of the primary enclosure (not required for 30-inch cabinet).
2. Set the power switch on the rear of the 17-slot chassis to the ON position. With the 30-inch cabinet system, power is applied to the computer and the POWER LED lights.
3. Close the rear door of primary enclosure (not required for 30-inch cabinet).

4. Set the main circuit breaker on the back of the primary enclosure to the ON position (not required for 30-inch cabinet). Power is applied to the computer and the POWER LED lights.
5. Set the key switch to the ENABLE position. (The programmer panel is enabled.)

3.7.2 Loading DX10

The following procedure shows the steps needed to load DX10 from the system disk drive unit 0. The loader program from the 990/10 ROM is executed to load the DX10 operating system from the system disk into computer memory.

1. Place the disk cartridge containing the DX10 operating system on the system disk drive unit 0, and ready the disk drive for operation with the write-protect feature disabled.
2. Press the HALT/SIE switch on the programmer panel.
3. Press the RESET switch on the programmer panel.
4. Press the LOAD switch on the programmer panel.
5. The loader program executes loading DX10 into memory. The system is now ready for activation of the SCI at a terminal and for entry of the Initialize System (IS) command.

For additional information regarding loading, and information regarding initializing, and shutting down the system, refer to Section 14, paragraphs 14.2 through 14.6 of the *DX10 Operating System Release 3 Reference Manual, Volume II, Production Operation*.

3.8 DX10 SYSTEM GENERATION

A TI-supplied disk cartridge or pack that contains a base DX10 system is used to generate a custom DX10 system. Alternatively, a base DX10 disk may be built from magnetic tape. The base system supports only the minimum required devices and is generated with parameters that are operational in a wide variety of hardware configurations. The disk contains the required and optional piece parts of DX10 that are combined during system generation to produce the target custom DX10. A custom DX10 system supports all the specific devices and resources of a particular hardware configuration. Custom system generation allows the user to include those portions of the system that a specific application requires and to omit unused portions that occupy disk and/or memory space.

Custom system generation consists of executing the SYSGEN program. The SYSGEN program is run interactively. This program is used to obtain user specifications for the custom DX10. It outputs the source code to a system data module that is assembled for the custom system. The SYSGEN program also generates the command stream for a link editing operation. After the system is configured, the user assembles the generated source module and links it with the required system modules and any optional user-supplied modules. Link edit output is directed to a DX10 image file. The new image may be specified as a temporary primary system. When it has been loaded and executed properly, the user may designate the new system as the permanent primary image. Otherwise, the user may load the previous system and modify the custom DX10 to correct any problems.

The SYSGEN process allows a user to incorporate special device drivers, custom supervisor calls or extended operation (XOP) processors, and an initialized system common module. For additional information, refer to *DX10 Operating System Reference Manual, Release 3 Volume V, System Programming Guide*.

Preventive Maintenance

4.1 INTRODUCTION

This section provides preventive maintenance for the following DS990 system components:

- Computer chassis
- Model 911 VDT
- Model DS10 disk drive
- Model DS25/DS50 disk drive
- Model 810 printer
- Model 2230/2260 line printer
- Model 979A tape transport
- Model FD800 flexible disk drive
- Model FD1000 flexible disk drive
- Model 804 card reader
- Model 743 KSR data terminal
- Model 820 KSR data terminal
- Disk pack

4.2 OPERATOR PREVENTIVE MAINTENANCE SCHEDULE

Table 4-1 lists a general schedule for operator preventive maintenance on the components of the DS990 system.

Table 4-1. Operator Preventive Maintenance Schedule

Schedule	Component	Maintenance	Paragraph Reference
As required	911 VDT	Clean VDU screen	4.3.2
Daily	DS10 disk drive	Dust front panel and/or cabinet	4.3.3
	FD800 flexible disk drive	Keep diskette and disk drive clean	4.3.8
	FD1000 flexible disk drive	Keep diskette and disk drive clean	4.3.8
	743 KSR data terminal	a. Clean exterior of case b. Clean printhead	4.3.10
	979A tape transport	Clean tape heads, guides, and crosstalk shield	4.3.7
Monthly	990110 computer chassis	Clean and wash filter	4.3.1
	810 printer	Vacuum as required	4.3.5.1
	820 KSR data terminal	Vacuum	4.3.1.1
	223012260 line printer	Check for cleanliness, and that blower and all indicators are operational	4.3.6
	DS25/DS50 disk drive	Inspect and clean disk pack area	4.3.4.1
		Clean and lubricate spindle	4.3.4.2
		Clean intake air filter	4.3.4.3
		Check indicator lamps	4.3.4.4
979A tape transport	Clean vacuum column and capstan	4.3.7	
Six weeks	FD800 flexible disk drive	Remove and vacuum air filters	4.3.8
	FD1000 flexible disk drive	Remove and vacuum air filters	4.3.8
Bimonthly	810 printer	Oil guide rods and clean ribbon guides	4.3.5.2

Table 4-1. Operator Preventive Maintenance Schedule (Continued)

Schedule	Component	Maintenance	Paragraph Reference
	820 KSR data terminal	a. Clean ribbon guides b. Clean and oil both printhead carriage guide rods.	4.3.11
Semi-annually	223012260 line printer	Visual inspection	4.3.6
	FD800 flexible disk drives	Install new air filters	4.3.8
	FD1000 flexible disk drives	Install new air filters	4.3.8

4.3 OPERATOR PREVENTIVE MAINTENANCE PROCEDURES

Operator preventive maintenance procedures are given in the following paragraphs.

4.3.1 Computer Chassis

Operator preventive maintenance for the 990110 computer 13-slot chassis consists of cleaning the washable intake filter located on the rear of the computer chassis. This filter should be washed in clean water once a month (more often if required due to dusty conditions). Using the fingers, slide the filter up and out of its mounting slot. Make sure the filter is dry before reinstalling it. Install the filter in the reverse order of removal.

Operator preventive maintenance for the 990110 computer 17-slot chassis consists of cleaning the four washable intake filters located on the front of the computer chassis. These filters should be washed in clean water once a month (more often if required due to dusty conditions). Remove the filters by pulling them up and out of the slots. Make sure the filter is dry before reinstalling. Install the filter in the reverse order of removal.

4.3.2 Model 911 VDT

The operator should wipe the screen and cabinetry of the keyboard and display unit as required with a soft, clean, lint-free noncotton cloth. The screen and cabinetry should be wiped with a cloth dampened (not wet) with water as necessary to remove smudges, etc.

4.3.3 Model DS10 Disk Drive

Operator preventive maintenance is restricted to daily dusting the outside of the cabinet (cabinet mount drive) or the front panel of the rackmount disk drive.

4.3.4 Model DS25/DS50 Disk Drive

Operator preventive maintenance consists primarily of periodic inspection, cleaning, and lubrication. For most corrective maintenance, refer to the *CalComp Trident Series Disk Drives*

Maintenance Manual, part number 10194-901-002-1. Also refer to this maintenance manual for additional details on preventive maintenance.

4.3.4.1 **Cleaning the Disk Pack Area.** Clean the disk pack area as follows:

1. Open the pack area lid, and remove the disk pack.
2. Wipe the inside of the air shroud with a lint-free cloth dampened with alcohol. Wipe it dry, and remove all residue.
3. Clean the inside of the pack area lid with the alcohol-dampened cloth. Wipe it dry, and remove all residue.
4. Inspect the lid gasket for evidence of deterioration, and wipe the gasket clean **if necessary**.

4.3.4.2 **Cleaning and Lubricating the Spindle.** Clean and lubricate the spindle as follows:

1. Open the pack area lid and remove the pack.
2. Inspect the spindle surface for dirt or other contamination and for wear.

CAUTION

Do not saturate the spindle surface with alcohol. Alcohol runoff into **the** spindle bearing will cause damage.

3. Clean the spindle surface with alcohol and a lint-free cloth and wipe the surface dry.
4. Use an alcohol-moistened cotton swab to remove contamination and grease from the threads of the spindle hole. Use a dry swab to soak up any remaining alcohol.
5. Apply a light coat of molybdenum grease to a swab, and lubricate the threads of the spindle hole. *Do not allow lubricant to get on the surface of the spindle.*
6. **Place a disk pack** on the spindle to make sure that it can be installed and removed easily.
7. Operate the spindle lock by hand to verify that it engages and disengages freely.

4.3.4.3 **Cleaning the Intake Air Filter.** The intake air filter is a foam filter element located behind the dress bezel of the front cover. It prefilters all air going to the blower and should be cleaned monthly as follows:

1. Remove the front cover to gain access to the intake filter.
2. Pull out the foam filter element from its recess in the front of the unit; wipe the inside of the recess with a damp, lint-free cloth, and dry the recess well.

CAUTION

Do not operate the machine with the intake air filter removed, as this will cause the absolute air filter inside the unit to load up prematurely.

3. Wash the foam filter element in a weak solution of detergent in warm water, rinse the element thoroughly in cold water, and blow the element absolutely dry with air before reinstalling it.
4. Reinstall the clean, dry filter element (or a new filter element if deterioration has **occurred**) in the filter recess, and replace the front cover.

4.3.4.4 Indicator Lamp Replacement. To change an indicator lamp, grasp the indicator tile and pull it straight out. The lamp can then be removed from the back side of the tile. After a new lamp has been installed in the tile, press the tile firmly back into the socket.

4.3.5 Model 810 Printer

Operator maintenance consists of cleaning and lubrication as covered in the following paragraphs.

4.3.5.1 Vacuuming Printhead Area. Carefully vacuum paper chaff from the printhead and ribbon path areas.

4.3.5.2 Oiling Guide Rods and Cleaning Ribbon Guides. Oil the guide rods and clean the ribbon guides as follows:

CAUTION

Do not use chlorinated hydrocarbons (such as carbon tetrachloride) as a cleaning agent.

1. Clean both guide rods and all ribbon guides with a clean cloth soaked with a small amount of denatured alcohol (TI part number 230007-0000).
2. Lubricate both guide rods with a light machine oil (TI part number 199594-0001).
3. Slide the printhead carriage back and forth several times to lubricate the printhead carriage bearings.

4.3.8 Model 223012280 Line Printer

Every 180 hours (power-on time) or once a month perform the following operator preventive maintenance on the 223012260 line printer.

1. Verify the general cleanliness of the printer.
2. Verify that the cooling blower is operational.

3. Verify that all operator control panel indicators (including fault indicators) are operational as follows:

POWER ON indicator — Will illuminate approximately four seconds after the MAIN POWER circuit breaker is set to ON, indicating the dc voltages are stabilized.

ALARM indicator — Will illuminate when any fault is detected and when the PRINT INHIBIT switch is set to inhibit the print position.

READY indicator — Will illuminate when all fault circuits are cleared, even when the PRINT INHIBIT switch is set to inhibit the print position.

ON LINE indicator — Will illuminate when the printer is in the ready state and the ON/OFF LINE switch is activated.

HAMMER fault — While printing, set the PRINT INHIBIT switch to ON, then to OFF. The HAMMER fault and ALARM indicator will illuminate, indicating the hammer fault circuit is operating properly. To clear, set the MAIN POWER circuit breaker to OFF, then ON.

FORMAT fault — While stepping paper, alternately place the 6LPI/8LPI switch on the operator control panel in the 6LPI and 8LPI positions. The FORMAT fault indicator will illuminate, indicating the format fault circuit is operational. To clear, press the FORMS RESET switch on the operator control panel.

GATE fault — Will illuminate as soon as the drum gate latch is pulled and will go out as soon as the gate is latched again.

PAPER fault — Will illuminate as soon as the paper is removed from the left tractor. The indicator should stay illuminated when the paper is reinstalled. This indicates the fault and latch circuits are operational. To clear, press the CLEAR switch.

TAPE fault — (This fault circuit/indicator is active only when the VFU option is installed.)

From the exerciser, self-test panel, or user system select tape channel 15 (bits 1 through 4 high). The FORMAT and TAPE fault indicators should illuminate, indicating the tape fault circuit is operational. To clear, press the Tape Manual Start switch on the VFU tape reader.

Every 1,080 hours (power-on time) or once every six months, perform the following operator preventive maintenance:

1. Perform all monthly operator preventive maintenance.
2. Verify that all connectors are secure.
3. Inspect for damaged parts and components.
4. Verify that all hardware is secure.
5. Ensure that the blower intake is free of all obstructions.

6. Ensure that the character drum is clean.
7. Ensure that the ribbon is tracking and reversing properly.

4.3.6.1 **Self-Test Option.** Self-test circuit card A22 aids in maintaining the printer. The self-test card is located within the printer logic enclosure with its control switches protruding from the top of the enclosure. Utilizing the Self-Test Switch Setting Instructions and the Code chart (refer to Figure 4-1) located on the inside of the logic enclosure door, data patterns may be generated from the self-test logic or input data may be received from the user system.

4.3.6.2 **Self-Test Operation.** The self-test circuit card contains eleven control switches. Refer to Figure 4-2. Three of the switches are used to select the function, pattern, and column layout for the desired test pattern. The remaining eight switches select format codes, character codes, or line length.

The FUNCTION SELECT switch has three positions: SET BANK, TEST, and ON LINE; it is used as follows:

1. The SET BANK position is used when setting hammer flight times. In this position, all print hammers are fired simultaneously rather than sequentially as for normal printing.
2. The TEST position allows self-test data to be applied to the printer.
3. The ON LINE position disables the self-test circuit card and routes user system data from the interface connector to the printer. During normal operation, the FUNCTION SELECT switch will be in the ON LINE position.

The PATTERN switch has three positions: FIXED, SGL CHAR, and SLIDING; it is used as follows:

1. The FIXED position of the PATTERN switch is selected when all lines are to be printed with an identical character sequence. In this case, the DATA switches are used to enter the (binary) number of columns (1 to 136) to be printed.
2. The SGL CHAR (single character) position of the PATTERN switch is selected when it is desired to print all characters in a line with the same character. In this case, the DATA switches are set for the desired character code (see the code chart in figure 4-1). During this mode of operation, a control character is generated automatically as a hardwired function of the self-test logic. Only single line steps can be performed in the single character mode.
3. The SLIDING position of the PATTERN switch is selected to obtain a sliding printout. In this mode, as consecutive lines are printed the characters will be shifted one column to the left. The printout will appear to be sliding. In this mode, the DATA switches are set to represent a legal control character that is sent to the printer at the end of each print line.

The COLUMN switch has three positions: EVEN, BOTH, and ODD. This switch is used to print only even columns, only odd columns, or both even and odd columns. It is convenient when setting hammer bank flight time to have this switch in the ODD or EVEN position.

CODE CHART									
7 (P.I.)	6	5	4	3	2	1	0	1	0
0 0 0 0	0	0	0	0	0	0	0	1	0
0 0 0 1	0	0	1	1	0	0	1	1	0
0 0 1 0	0	1	0	1	0	0	0	1	1
0 0 1 1	0	1	1	0	0	0	0	0	1
0 1 0 0	0	1	0	0	0	0	0	1	0
0 1 0 1	0	1	0	1	0	0	0	0	1
0 1 1 0	0	1	1	0	0	0	0	0	1
0 1 1 1	0	1	1	1	0	0	0	0	1
1 0 0 0	0	0	0	0	0	0	0	0	1
1 0 0 1	0	0	0	1	0	0	0	0	1
1 0 1 0	0	0	1	0	0	0	0	0	1
1 0 1 1	0	0	1	1	0	0	0	0	1
1 1 0 0	0	1	0	0	0	0	0	0	1
1 1 0 1	0	1	0	1	0	0	0	0	1
1 1 1 0	0	1	1	0	0	0	0	0	1
1 1 1 1	0	1	1	1	0	0	0	0	1
		SPACE	!	@	P	a	q	CH 1	STEP 0
		"	1	A	O	b	r	CH 2	STEP 1
		#	2	B	R	c	s	CH 3	STEP 2
		\$	3	C	S	d	t	CH 4	STEP 3
		%	4	D	T	e	u	CH 5	STEP 4
		&	5	E	U	f	v	CH 6	STEP 5
		'	6	F	V	g	w	CH 7	STEP 6
		(7	G	W	h	x	CH 8	STEP 7
)	8	H	X	i	y	CH 9	STEP 8
		*	9	I	Y	j	z	CH 10	STEP 9
	PF	:		J	Z	k		CH 11	STEP 10
		+		K		l		CH 12	STEP 11
	FF	<		L				ILLEGAL	STEP 12
	CR	=		M		m		ILLEGAL	STEP 13
		>		N		n		ILLEGAL	STEP 14
		?		O		o		ILLEGAL	STEP 15

1 THESE COLUMNS APPLY TO MACHINES WITH VFU ONLY.

SELF TEST SWITCH SETTINGS.

TO PRINT SLIDING PATTERN

- 1 - FUNCTION SW TO "TEST"
- 2 - PATTERN SW TO "SLIDING"
- 3 - COLUMN SW TO "BOTH"
- 4 - DATA SW'S TO FORMAT CODE
(SEE CODE CHART)

TO PRINT SINGLE CHARACTERS

- 1 - FUNCTION SW TO "TEST"
- 2 - PATTERN SW TO "SGL CHAR"
- 3 - COLUMN SW TO "BOTH"
- 4 - DATA SW'S TO CHARACTER
CODE (SEE CODE CHART)

TO VARY LINE LENGTH

- 1 - FUNCTION SW TO "TEST"
- 2 - PATTERN SW TO "FIXED"
- 3 - COLUMN SW TO "BOTH"
- 4 - DATA SW'S TO LINE LENGTH
(SEE CODE CHART)

TO SET HAMMER BANK

- 1 - FUNCTION SW TO "SET BANK"
- 2 - PATTERN SW TO "FIXED"
- 3 - COLUMN SW TO "EVEN"
- 4 - DATA SW'S TO LINE LENGTH
(SEE CODE CHART)

TO EXERCISE VFU OPTION

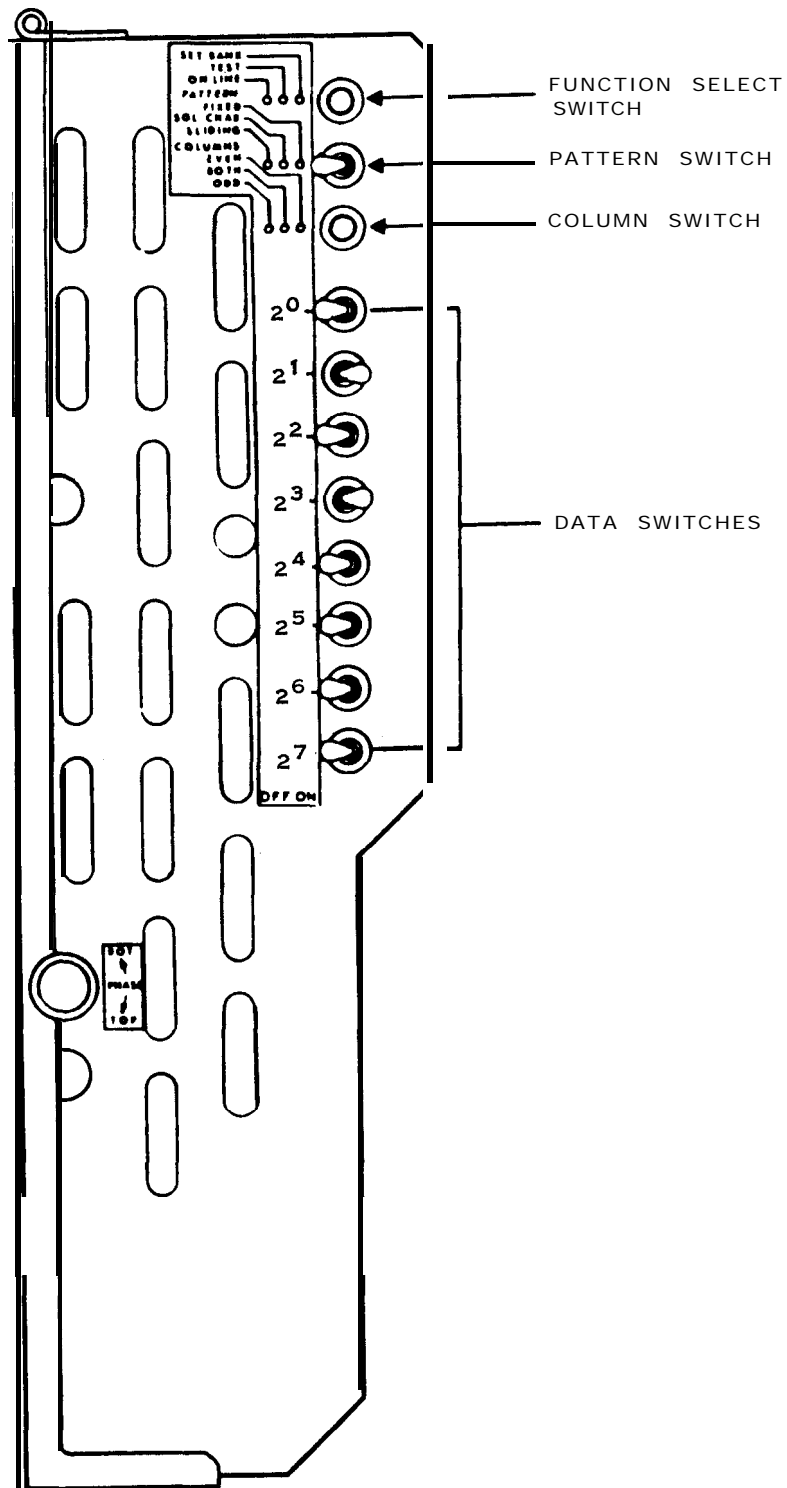
- 1 - FUNCTION SW TO "TEST"
- 2 - PATTERN SW TO "SLIDING"
- 3 - COLUMN SW TO "BOTH"
- 4 - DATA SW'S TO "PAPER" INST.
"CODE" (SEE CODE CHART)

TO OPERATE FROM AN EXTERNAL SOURCE

- 1 - FUNCTION SW TO "ON LINE"

(A)1 37477

Figure 4-1. 223012280 Line Printer Self-Test Switch Instructions



(A)1 36390

Figure 4-2. 223012260 Line Printer Self-Test Switch Configuration

The DATA switches are set as desired for character code, format, or line length. Specific combinations of switch settings for specific tests are shown in Figure 4-1.

4.3.7 Model 979A Tape Transport

Cleanliness is an absolute must in the handling, care, and storage of magnetic tapes. Dust on tapes will cause premature head wear and data dropouts. The transport surfaces that contact the tape must also be kept free of dust and oxide build-up. In cases of erratic operation, the cleaning procedures and a fresh tape should be tried before calling for maintenance personnel.

CAUTIONS

1. Before cleaning, the transport should be unloaded and **the tape removed.**
2. Use only denatured alcohol on **the tape heads.**
3. Avoid finger contact with tape heads or other surfaces that contact the tape.
4. Care must be taken not to misalign or to scratch the tape **heads, crosstalk shield, beginning-of-tape (bot) sensor, or tape guides.**

4.3.7.1 Daily Transport Cleaning Procedures. Perform the following transport cleaning procedures on a daily basis:

1. Open the transport door and wipe all exposed surfaces and the door interior with a **lint-free cloth.**
2. Wipe off the tape guide surfaces and check for loose oxide under the lower ceramic guide ring. Brush out loose oxide where necessary. Use denatured alcohol, a lint-free cloth, and a small brush as necessary.
3. Wipe off the tape head and cross-shield surfaces using denatured alcohol and cotton swabs.
4. Inspect the tape cleaner and lightly brush off the dust and oxide contaminants as necessary.

NOTES

1. All motors, guides, and bearings are permanently lubricated. No lubricants are required for any of the transport assemblies.
2. The vacuum column and capstan should be cleaned on a periodic schedule of approximately 150 hours operation. This assumes operation in a dust-free environment with the doors closed. Those users who operate under other environmental conditions will need to clean more frequently to assure best reliability.

CAUTIONS

1. The vacuum column cover is made in two parts, one of which is a glass plate. Take care not to drop the glass plate or twist it against the guide pins during assembly or disassembly.
2. Use only denatured alcohol on the capstan assembly; other cleaners may damage the rubberized surface.

4.3.7.2 Monthly Transport Cleaning Procedures. Perform the following transport cleaning procedures on a monthly basis:

1. Remove the vacuum column trim cover by pressing it inward and sliding it upward about 6 millimeters (0.25 inch) off the cover retaining pins.
2. Remove the plastic plate by lifting it straight outward off its guide pins, taking care not to twist or to drop the plastic plate during disassembly.
3. Wipe the plastic plate and vacuum column tape tracks using denatured alcohol and a lint-free cloth.
4. Clean oxide deposits and foreign matter from the turnaround rollers. Use denatured alcohol and cotton swabs as necessary.
5. Wipe oxide deposits and other contamination from the capstan using denatured alcohol and cotton swabs. Do not substitute other cleaners, as they may damage the rubberized surface of the capstan.
6. Carefully replace the vacuum column glass plate and trim cover in the reverse order of disassembly.

4.3.8 Models FD800 and FD1000 Flexible Disk Drives

Operator preventive maintenance is identical for the FD800 and FD1000 flexible disk systems; therefore, this procedure applies to both.

The lifetime of the disk drive units and the diskettes is very dependent on the cleanliness of the air that enters the chassis. The operator should keep the chassis and the general area clean and **dust-free**.

CAUTION

Do not use strong solvents to clean the front panel of the chassis. Use a mild detergent and water on a damp cloth.

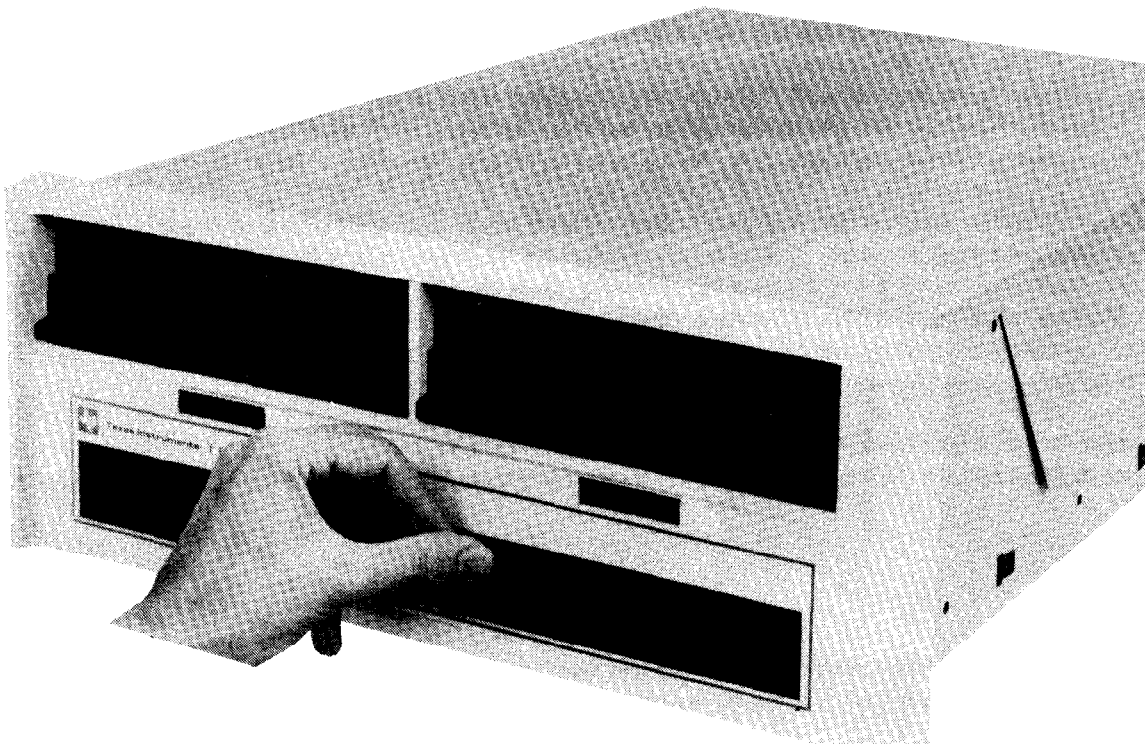
Cooling air for the drive electronics and the chassis power supply passes through snap-in filters in the front panel. These filters require periodic preventive maintenance as follows to retain peak efficiency:

Operation	Interval
Remove and vacuum air filters	Every six weeks
Discard old filter and replace with new filter, part no. 2265041-0001	Every six months

The air filters snap into and out of front panel cutouts as shown in Figure 4-3.

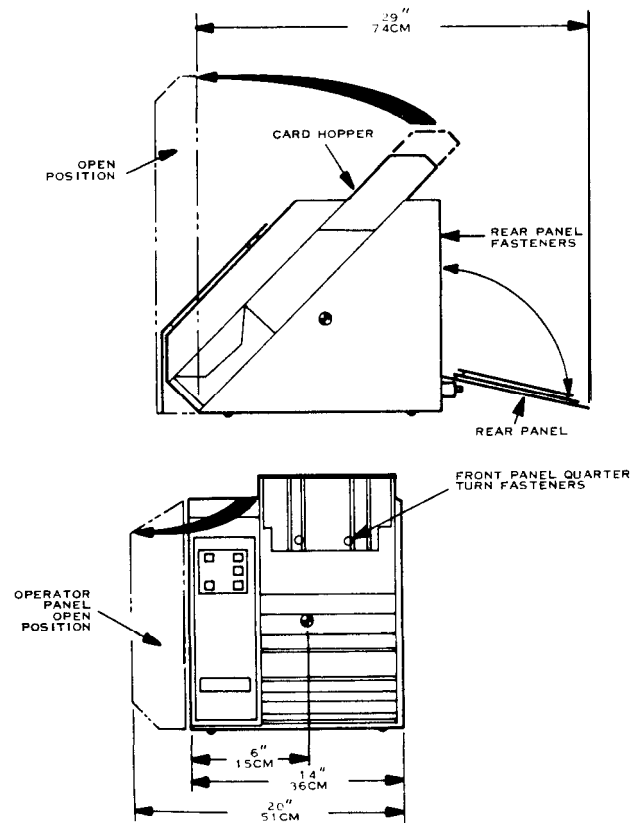
4.3.9 Model 804 Card Reader

Preventive maintenance consists primarily of keeping the drum and transport assembly clean and free of foreign material. All working parts should be periodically examined for wear or noticeable faults. Preventive and corrective maintenance is performed with the card reader panels open (see Figure 4-4).



(A)141 766

Figure 4-3. Air Filter Installation/Removal



(A) 33768

Figure 4-4. 804 Card Reader Panel Openings

4.3.9.1 Opening of Card Reader Panels. Open the card reader panels as follows:

1. The front panel (including the operator controls) swings out to the left when pulled open from the recessed area next to the stacker.
2. The back panel is secured by two quarter-turn fasteners. Turning these fasteners allows the back panel to swing down to the rear.
3. The input hopper panel is secured by two slotted-head, quarter-turn fasteners. Releasing these fasteners allows the hopper assembly to swing forward until it rests on the support foot at the base of the assembly.

4.3.9.2 Cleaning Card Reader Cabinet. To clean the inside of the card reader cabinet, remove dust (such as card dust) and foreign material with a soft brush or vacuum. It is essential for long term reliability that the transport mechanism remain clean.

4.3.10 Model 743 KSR Data Terminal

The TI Model 743 data terminal is designed and built to provide long term trouble-free operation under rigorous operating conditions. To ensure continuation of the highest performance levels, the machine should be cleaned at regular intervals. The printer mechanism and printhead should be kept clean and free of foreign objects.

To ensure that the printer mechanism continues to provide maximum print quality, the printhead should be cleaned periodically as follows:

1. Remove the thermal paper from the platen and paper chute. If necessary, cut the paper where it enters the chute. Press and hold the PAPER ADV key until the short piece exits the window/pinch roller.
2. On a sheet of good quality bond paper, wet a two-inch wide area with denatured alcohol.
3. Insert the alcohol-wetted paper through the paper chute, around the platen, and under the window/pinch roller. Use the PAPER ADV key to advance the bond paper.
4. Type four to six lines on the alcohol-wetted area. Use the REPT key to accelerate the process. Then advance the paper to a dry area and type two more lines.

NOTE

The thermal printhead will not print visibly on conventional paper.

5. Press and hold the PAPER ADV key to remove the cleaning paper and reload the thermal paper supply.

The printhead should be cleaned each time a new roll of paper is loaded into the printer. Clean the printhead more often if the printed images start to fade as a result of residue accumulating on the printhead.

The exterior case should be cleaned as required. Use a soft, damp cloth or sponge and any nonabrasive household-type detergent to clean the exterior surfaces of the Model 743 case. Take care not to spill liquids on any electrical components; short-circuits could result.

For additional maintenance information, refer to the *Model 743 KSR, Model 745 Portable Maintenance Manual*, part number 984025-9701.

4.3.11 Model 820 KSR Data Terminal

To ensure proper operation of the 820 KSR in normal usage the following preventive maintenance should be performed.

1. Once per month lift the cover and carefully vacuum paper chaff from the printhead and ribbon path areas.
2. Every two months clean ribbon guides with a clean cloth soaked with a small amount of denatured alcohol.

CAUTION

Do not use cleaning agents containing chlorinated hydrocarbons.

3. Every two months clean both printhead carriage guide rods with a clean cloth soaked with a small amount of denatured alcohol. Lubricate both guide rods with a light machine oil and slide printhead carriage back and forth several times to lubricate the printhead carriage bearings.

For additional maintenance information, refer to the *Mode/ 820 Maintenance Manual*, part number 999853-9701.

4.4 QUALIFIED VENDOR OR MANUFACTURER DISK PACK PREVENTIVE MAINTENANCE

Preventive maintenance for mass memory disk system disk packs is necessary on a regularly scheduled basis. The following subparagraphs explain the basis for this requirement and **the procedures** for scheduling the preventive maintenance.

NOTE

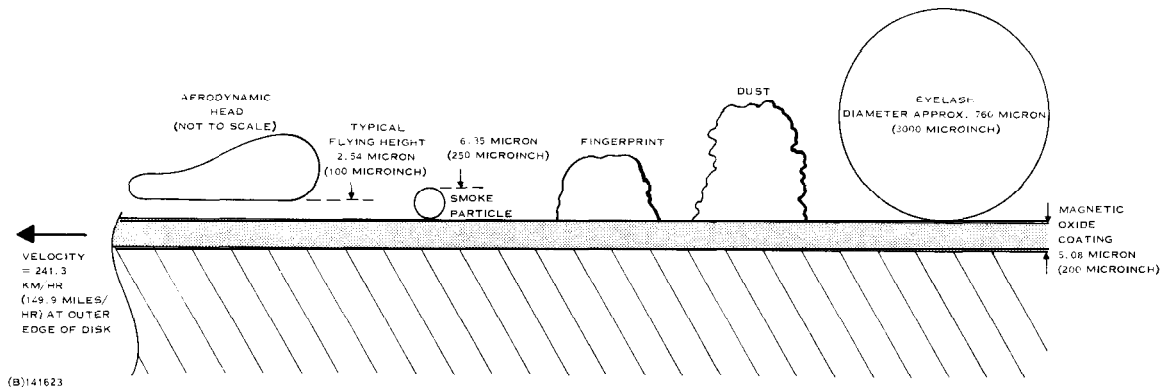
Regular preventive maintenance (PM) procedures must be performed on all disk packs and disk cartridges every six months.

The disk pack is one of today's most advanced mass information storage systems. However, this seemingly ideal system requires special care to maintain optimum performance. Manufacturers originally considered disk packs and disk cartridges to be maintenance free. However, they have come to realize that regular cleaning and inspection are necessary to prevent costly system crashes, rerun time, and loss of valuable data. Regular PM is necessary on disk packs to alleviate costly problems that can arise to degrade the quality of data storage, render the disk packs unusable, or damage disk drives.

The need for PM arises in the following manner: Read/write heads fly over disk surfaces on an air bearing of 20 to 135 microinches, depending on the type of disk pack. Contamination in the form of dust, grease, metal filings, smoke particles, etc., builds up on the disk recording surfaces, decreasing the separation between read/write heads and disk surfaces.

CAUTION

Damaged or questionable-quality disk packs must never be installed in a disk drive. Disk drives must not be used without a clean and serviceable air filter. To prevent damage to the disk packs, the filter must be checked at least twice a year, and monthly in dusty or nontemperature-controlled locations.



Disk Contaminants

Disk contaminants cause temporary errors, retries, and data checks. At this stage, most data should be recoverable by thorough cleaning of the disk surfaces. If foreign particles are allowed to build up, head crashes and other permanent damage to heads and disk surfaces are inevitable.

For these reasons, all disk packs should be removed from service and PM performed by a qualified vendor or manufacturer every six months. Contact your local TI sales and service office for help in locating a qualified vendor convenient to you. Normally the PM is performed at the customer's location. Be sure to call in advance to schedule the PM.

During PM procedures, the vendor should clean and inspect the following areas in the disk pack:

- Top and bottom for cracks, chips, dirt, wear
- Spindle retainer for condition and wear
- Trim shield retaining screws for condition and tightness
- Spindle lock for wear, dirt, binding
- Thrust bearing, races, washers for damage and wear
- Hub and cone area for dirt, film, nicks, burrs
- Index (bottom protective) disk for bends, damage, axial runout
- Recording disks inspected, cleaned, and checked for surface damage and axial runout.

The vendor performing PM on disk packs will indicate the status of each pack cleaned and inspected. This will detail whether the pack is good, requires repair, or is nonrepairable. Many problems can be corrected by cleaning, but if a pack is found to be damaged, it must not be used again and should be scrapped or repaired before returning to service. Replacing disk packs can be costly, but quite inexpensive compared to system downtime due to a disk drive crash or loss of data on a pack. Some packs may be repairable, in which case the repairs are usually done at the PM vendor's office.

Appendix A

Cable Installation in 990 Computer 17-Slot Chassis

A.1 INTRODUCTION

This appendix describes a procedure for cable installation in the 990 computer 17-slot chassis. Prerequisites for this procedure are removal of the filter panel assembly from the front of the 17-slot chassis, and mounting the chassis in its enclosure. Both are described in paragraph 2.3.1.4 of this manual.

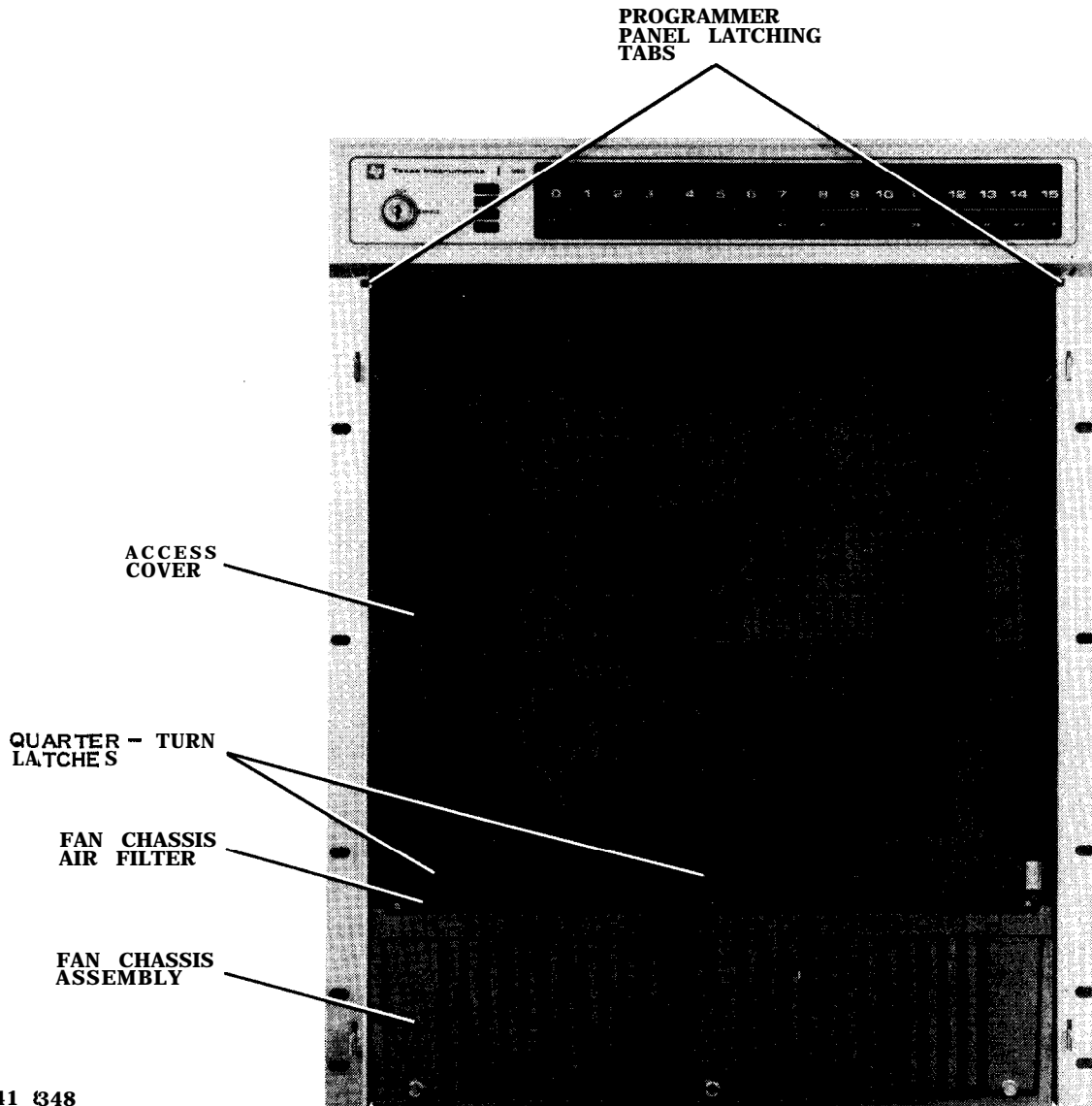
A.2 CHASSIS PREPARATION

Perform the following steps to prepare the chassis for cable installation:

1. Refer to Figure A-1. Using a coin or screwdriver, release each of six quarter-turn latches on the access cover. Remove the access cover to expose the installed logic boards.
2. Slide the PWB retainer to its leftmost position.
3. Remove logic boards 1 through 3 (if installed) and remove the baffle board that slides into an unnumbered chassis slot just to the right of chassis slot 1 as viewed from the front of the chassis.
4. On the upper cable tray (just below and toward the front of the chassis from the logic boards), release each of five quarter-turn latches. Remove the upper cable tray, exposing to view the lower cable tray.
5. Using a coin or screwdriver, release each of 11 quarter-turn latches on the chassis rear cover (Figure A-2). Open the rear cover. The cover will be supported by the **chassis-to-rear cover wire hinges**.
6. The chassis is now ready to accept the system cables. It is necessary to understand the routing path and method of securing the cables in place proceeding with this installation. The explanation of the correct method of routing and securing the cables contained in the next paragraphs should be read and understood before proceeding with the installation.

A.3 17-SLOT CHASSIS CABLE INSTALLATION

The cable path (illustrated in Figure A-3) is through the cable port, up and along the left side sheetmetal (as viewed from the rear), through a cable tie, forward along the sheetmetal to another cable tie, arcing downward along the sheetmetal to another cable tie, and down to the lower cable tray. In the lower cable tray, the cable goes through a cable tie, across the cable tray from right to left (as viewed from the front of the cabinet), through another cable tie (or ties as necessary), and then is bent towards the card cage through another cable tie and up to the logic board.



(A)141 348

Figure A-1. Front View of 17-Slot Chassis with Filter Panel Assembly Removed

The cable ties (part number 972632-0002) are installed as shown in Figure A-4. Note that the ties are installed from one side of the panel only, without access to the rear of the panel, by doubling the tie, inserting the doubled tie into the hole, and looping the doubled end around the elbow. The cable may then be secured across the tie location in one of two orientations as shown in Figure A-4.

To install a cable, insert the board connector through the cable opening and follow the routing described previously without installing cable ties. Mate the connector to the logic board and route the cable straight down to the lower cable tray leaving just enough slack to disconnect the cable

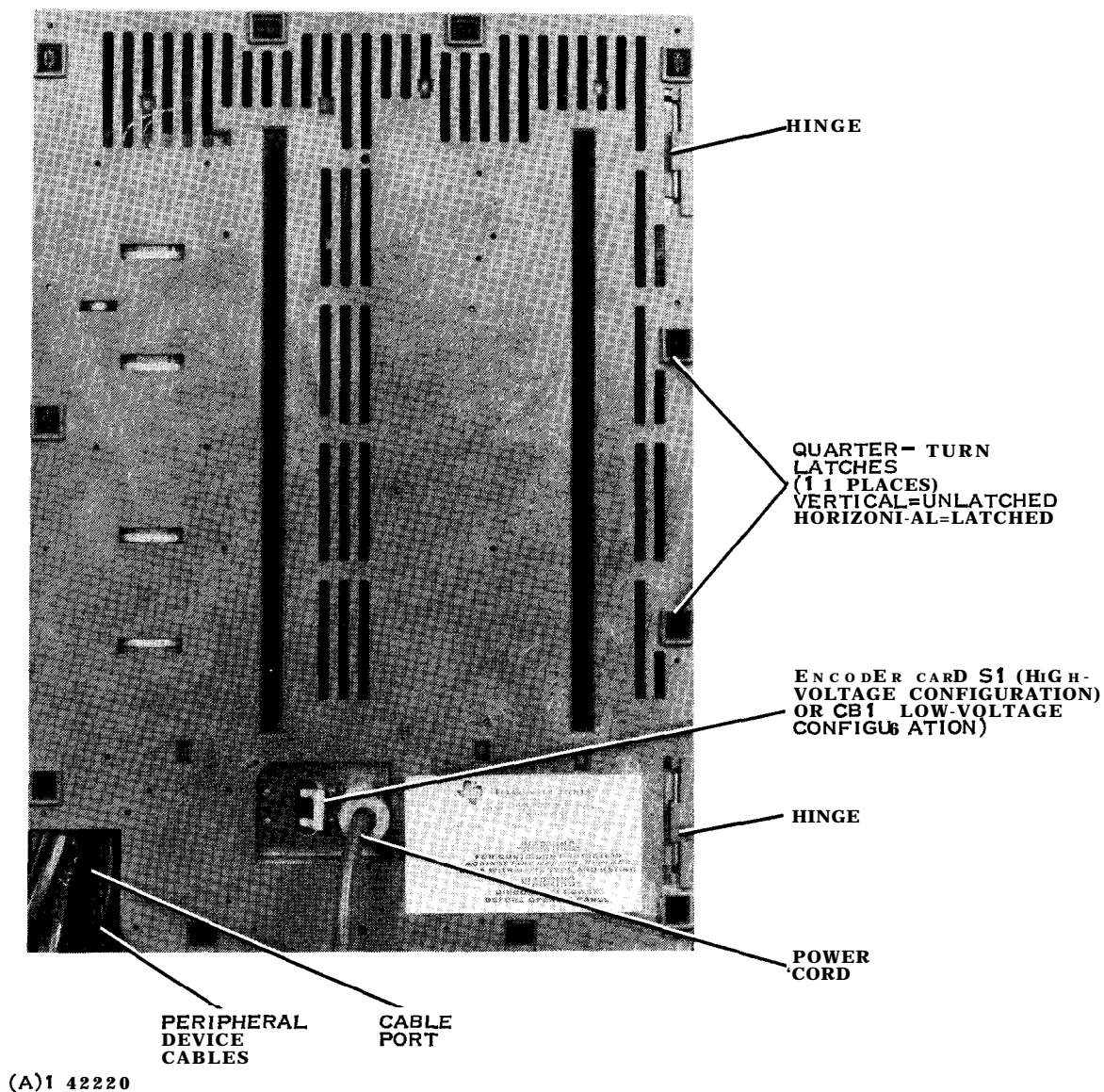
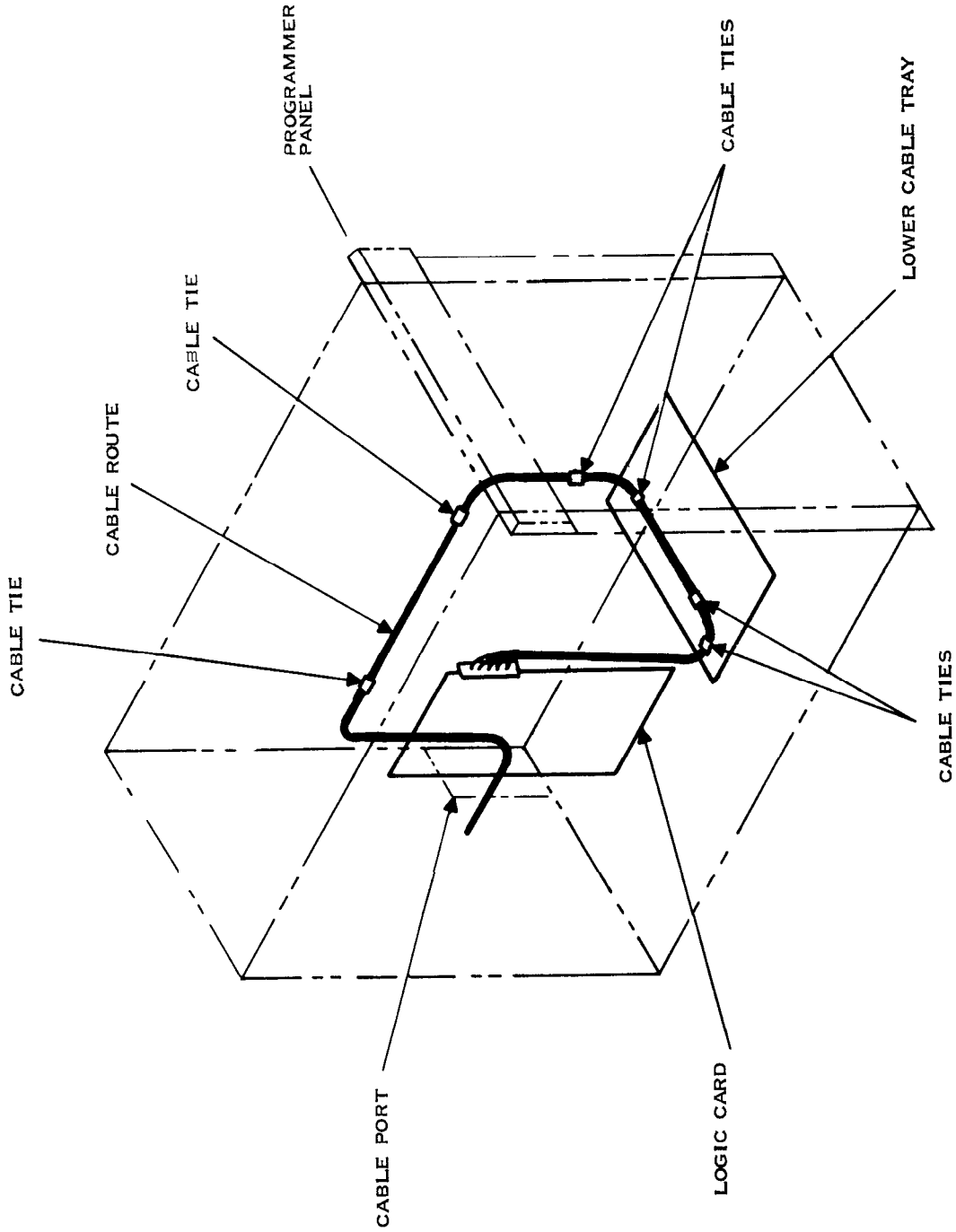


Figure A-2. Rear View of 17-Slot Chassis

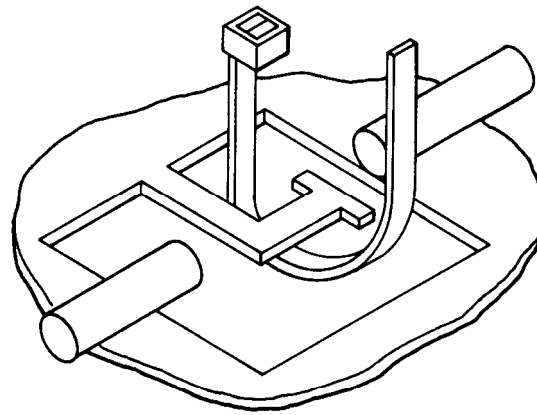
when necessary. Secure the cable to the lower cable tray with a cable tie. Work the cable back along the route described earlier, securing the cable with ties at the locations described. The cables must be routed neatly and tied securely. Note that it may be necessary to remove boards from the lower numbered slots after making the initial tie in order to facilitate making ties to the sheetmetal side of the chassis. Boards may be removed by sliding the board restraint to the left, leaving the board free of the connectors, and pulling the board from the chassis.

In routing the cables, it is necessary to start with the lowest numbered board slot first and work to the highest. The first cable should be routed along the lower cable tray over the cable tie locations nearest the bottom of the chassis. Subsequent cables are worked toward the front of the cable tray and toward the top of the sheetmetal side of the cabinet.

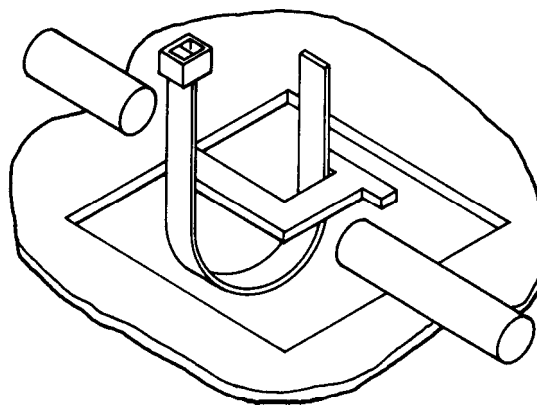


(A) 141785

Figure A-3. Cable Routing in 17-Slot Chassis



ALTERNATE A



ALTERNATE B

(A) 142221

Figure A-4. Cable Tie Installation Method

When the lower cable tray is full, the upper cable tray is reinstalled and cables are then routed across it in the same manner as they were in the lower tray. In a system that has enough cables to fill the lower tray, it will be necessary to stack the cables two deep along the sheetmetal side of the chassis. Cable ties previously used to secure single cables should be replaced with a single tie securing both cables.

Close and secure the power module (rear door). The power cord may be connected at this time, but ensure that the power switch is in the OFF position.

Reinstall any logic boards removed to facilitate cable installation and connect all cables to the proper boards.

Reinstall the baffle board. Slide the board restraint to the right (as viewed from the front of the chassis). Reinstall the front access cover and filter panel.

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- Sections — Reference to Sections of the manual appear as “Sections x” with the symbol x representing any numeric quantity.
- Appendixes — Reference to Appendixes of the manual appear as “Appendix y” with the symbol y representing any capital letter.
- Paragraphs — Reference to paragraphs of the manual appear as a series of alphanumeric or numeric characters punctuated with decimal points. Only the first character of the string may be a letter; all subsequent characters are numbers. The first character refers to the section or appendix of the manual in which the paragraph may be found.
- Tables — References to tables in the manual are represented by the capital letter T followed immediately by another alphanumeric character (representing the section or appendix of the manual containing the table). The second character is followed by a dash (-) and a number.

Tx-yy

- Figures — References to figures in the manual are represented by the capital letter F followed immediately by another alphanumeric character (representing the section or appendix of the manual containing the figure). The second character is followed by a dash (-) and a number.

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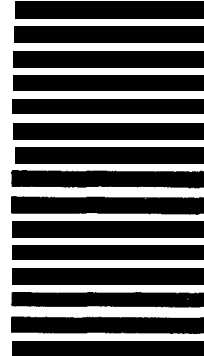
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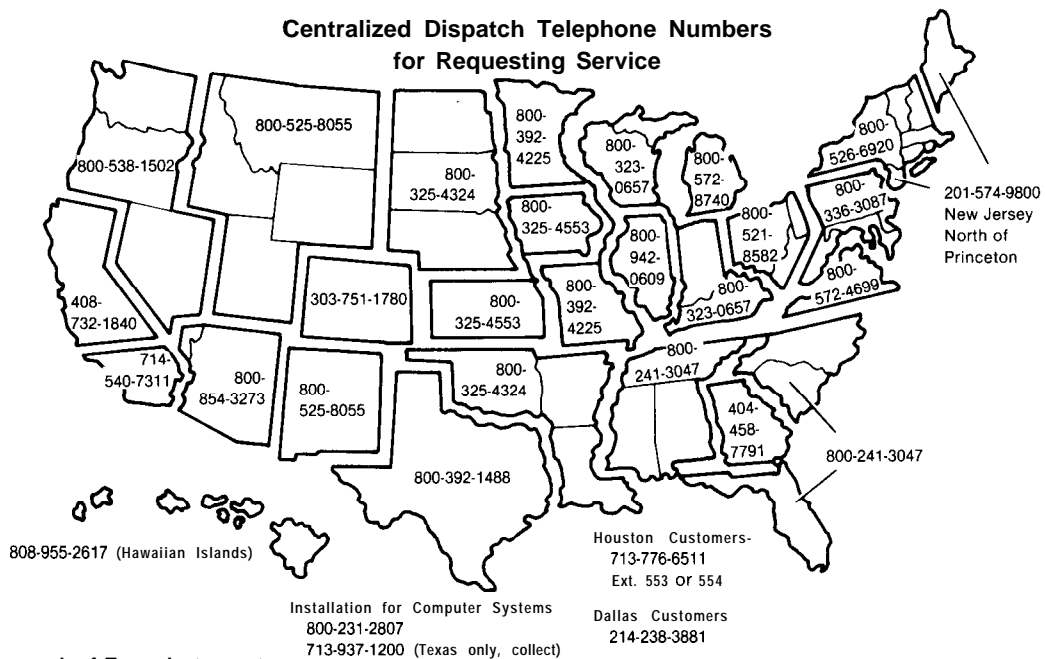
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