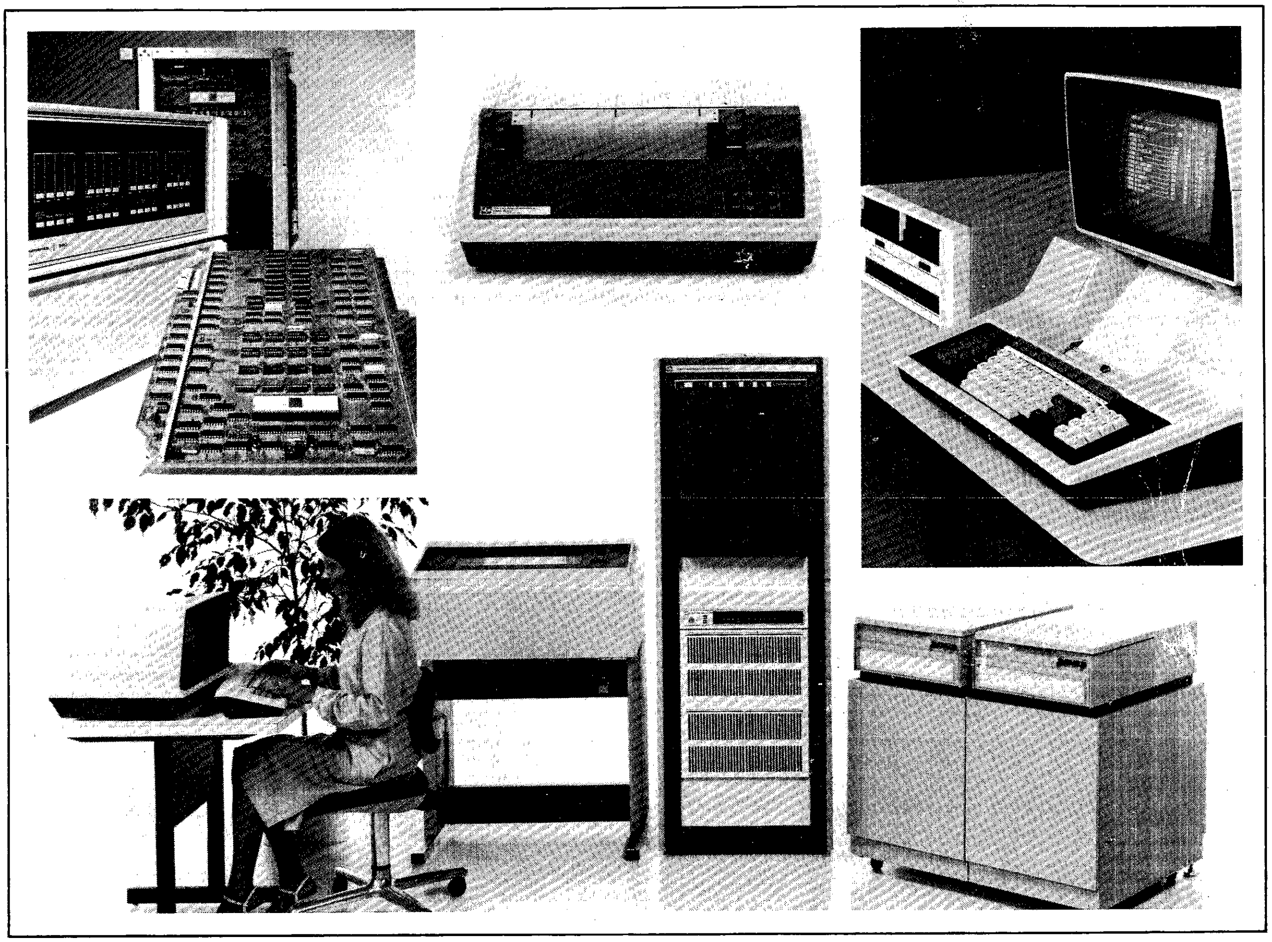
DS990 Systems
Field Maintenance Manual



Part No. 2250696-9701 *A
1 December 1981

TEXAS INSTRUMENTS

MANUAL REVISION HISTORY

DS990 Systems Field Maintenance Manual (2250696-9701)

Original issue .... 1 January 1981
Revision .... 1 December 1981

The total number of pages in this publication is 756.

Preface

The purpose of this manual is to present enough basic information about the DS990 systems and the associated peripheral devices to serve as a guide for the customer representative (CR) who maintains these computer systems in the field. Even though this manual is oriented toward standard packaged systems, it can also be used to troubleshoot and service nonstandard systems as well.

This manual contains field-level maintenance information concerning the following DS990 systems:

- Model 2
- Model 3
- Model 4
- Model 4PP (Model 4 performance package)
- Model 6
- Model 7
- Model 8
- Model 8PP (Model 8 performance package)
- Model 9
- Model 20
- Model 29
- Model 30

The CR should use this manual along with the *DS990 Field Engineering Reference Handbook*, part number 2268678-97001, as his sources of information in the field. If more detailed information is required, refer to the GI — General Information section for a list of associated publications.

This manual is organized into 12 major divisions, each division beginning with a tab divider and table of contents. Each division includes the associated peripherals, components, or subsystems, as follows:

- GI — General Information
  - Section 1, Systems Description — Contains a configuration of components for all systems, illustrations of various systems, and hardware and software options.
  - Section 2, Related TI Publications — Lists associated hardware and software reference manuals. Defines structure of manuals as applied to systems, peripheral devices, and software.
- OP — Operating Procedures
  - Section 1, System Loading and Loader Errors — Contains ROM loader part numbers, loading procedures, and loading error indications.
  - Section 2, System Initialization Procedures and Errors — Contains procedures for initializing the operating systems and error indications associated with initialization.
  - Section 3, ROM Loaders, Programmer Panels, SCI Commands — Contains a summary of all ROM loader devices, programmer panel controls and indicators, and lists of operating system SCI commands.
  - Section 4, Online Diagnostics — Provides procedures, prompts, commands, and examples for conducting diagnostics while the system is operating.
  - Section 5, System Log Task Analysis — Provides procedures for analyzing and reporting on system log files.
  - Section 6, Disk Copy Procedures — Contains special procedures for copying disks and loading the operating system.
- PM — Preventive Maintenance. Section 1 contains preventive maintenance (PM) schedules for standard models.
- TR — Troubleshooting. Section 1 presents system troubleshooting flowcharts, power supply analysis, system lockup and crash analysis, and system log examples and messages.
- CP — Computers
  - Section 1, Computer CPU Boards — Presents information on options, switch settings, and ROM loaders for the computer central processing unit (CPU) boards.
  - Section 2, Computer Memory Boards — Contains selectable options, memory error mapping, LED indicators, and memory allocations on the various computer memory boards.

- CC — Computer Chassis. Contains chassis configurations, interrupts, read-only memory (ROM) loaders, TILINE access granted (TLAG) jumpers, and field-replaceable components for the various computer chassis:
  - Section 1, 990/5 6-Slot and 990/10 6-Slot Computer Chassis
  - Section 2, 990/5 13-Slot Computer Chassis
  - Section 3, 990/10 13-Slot Computer Chassis
  - Section 4, 13-Slot Expansion Chassis
  - Section 5, 17-Slot Computer Chassis
  - Section 6, communications register unit (CRU) Expansion Chassis
  - Section 7, TILINE Expansion Chassis
- DT — Data Terminals. Provides information about operating controls and indicators, switch settings, options, cabling configurations, and field replaceable components for the following data terminals:
  - Section 1, 911 Video Display Terminal
  - Section 2, 733 ASR/KSR Data Terminal
  - Section 3, 743 KSR Data Terminal
  - Section 4, 820 KSR Data Terminal
- DD — Disk Drives. Provides information about operating controls and indicators, switch settings, options, control word formats, cabling configurations, and field-replaceable components for the following disk drives:
  - Section 1, DS10 Disk Drive System
  - Section 2, DS25/50 Disk Drive System
  - Section 3, DS200 Disk Drive System
  - Section 4, CD1400 Disk Drive System
  - Section 5, FD800 Flexible Disk Drive System
  - Section 6, FD1000 Flexible Disk Drive System

- MT — Magnetic Tape
  - Section 1, 979A Magnetic Tape Transport — Contains information about controls and indicators, controller configurations, system cabling, and field-replaceable components.
- PR — Printers. Provides information about operating controls and indicators, controller requirements, cabling configurations, and field-replaceable components for the following printers:
  - Section 1, 810 Printer
  - Section 2, LP300/LP600 Line Printers
  - Section 3, LQ45 Letter Quality Printer
  - Section 4, 2230/2260 Line Printers
- CM — Communications Systems
  - The information on communications systems has been omitted in deference to *990 Family Communications Systems Field Reference Manual*, part number 2276579-9701.
- AP — Appendixes
  - Appendix A, DX10 System Crash Error Reporting — Contains a list of system crash codes and messages, and probable causes of each.
  - Appendix B, TILINE* and CRU Pinouts — Contains lists of pinouts for computer chassis and peripherals.
  - Appendix C, Standard Cabinet Configurations and AC Power Wiring — Provides illustrations of arrangement of equipment in the various standard cabinets, as well as cabinet power wiring and ac outlets.
  - Appendix D, CRU Bit Assignments — Contains interface information about peripheral devices that interface with the computer via the CRU.
  - Appendix E, Logic Common Grounding — Contains information that will permit isolating logic common circuitry from power grounds in the various peripheral devices.

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* TILINE is a registered trademark of Texas Instruments Incorporated.

General Contents

GI — General Information

OP — Operating Procedures

PM — Preventive Maintenance

TR — Troubleshooting

CP — Computers

CC — Computer Chassis

DT — Data Terminals

DD — Disk Drives

MT — Magnetic Tape

PR — Printers

CM — Communications

AP — Appendixes

IN — Master Alphabetical Index

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GI — General Information

Tables

1

Systems Description

1.1 INTRODUCTION

The configuration of all standard DS990 systems is based on a specific model of 990 computer (990/5, 990/10, or 990/12), a set of associated equipment, and optional peripheral devices. The DS990 systems with specifically-defined configurations that are covered by this manual are as follows:

- Models 2 and 3 systems
- Models 4, 6, 7, 8 and 9 systems
- Models 4 and 8 performance package (4PP and 8PP) systems
- Models 20, 29, and 30 systems

This section contains block diagrams that show the relationship among the equipment of the various systems, photographs that depict examples of typical system configurations, and lists of hardware and software options available for use with the DS990 systems.

Section 2 lists the applicable hardware and software manuals associated with DS990 systems, peripheral devices, optional equipment, and supporting software and programming documentation.

1.1.1 Standard Hardware Options

Table 1-1 lists the hardware requirements and the options used with each standard model. The different model systems are arranged along the top row of the table, and the required equipment and options are listed in the left-hand column. The left-hand column lists equipment in the following order:

- Computer models
- Memory
- Computer chassis
- Disk drives
- Printers

GI — General Information

- Data terminals
- Expansion chassis and communications options
- Enclosure configurations

To use the table, find the desired model listed in the Models row and then read down the associated column to determine the standard and optional equipment.

As an example of using the hardware options table, the Model 8 system uses the following standard and optional equipment:

- 990/10 computer with 128KB or 256KB as standard memory
- Additional memory is optional
- 13-slot chassis is the main computer chassis
- Two DS50 disk drives are standard
- All disk drives other than the DS50 are optional
- All printers are optional
- A single 911 VDT with a dual controller is the standard terminal
- All other data terminals are optional
- Other acceptable options are:
  - 979A magnetic tape transport
  - CRU and TILINE expansion
  - Communications interface
  - Internal modem
  - Four channel communications
- Enclosure options are:
  - Single-bay desk
  - 762-millimeter (30-inch) cabinet
  - 1.78-meter (70-inch) cabinet

Table 1-1. DS990 Models Standard Systems Hardware Options

DEVICES	DS990 SYSTEM MODELS											
	2	3	4	4PP	6	7	8	8PP	9	20	29	30
PROCESSOR												
990/5	(1)											
990/10		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			
990/12										(1)	(1)	(1)
MEMORY:												
64KB	(1)											
96KB		(1)										
128KB			(2)		(2)	(2)	(2)		(2)			
256KB			(2)		(2)	(2)	(2)		(2)			
256KB CACHE				(1)				(1)		(1)	(1)	(1)
EXP. MEM.		OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
CHASSIS:												
6-SLOT	(2)	(2)										
13-SLOT	(2)	(2)	(1)	(1)	(1)	(1)	(1)		(1)			
17-SLOT								(1)		(1)	(1)	(1)
TILINE DEV:												
FD1000	(1)	(2)	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
DS10	OPT	(2)	(1)	(1)	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
DS25			OPT	OPT	(4)	OPT	OPT	OPT	OPT	OPT	OPT	OPT
DS50			OPT	OPT	OPT	OPT	(4)	(4)	OPT	(1)	OPT	OPT
DS200			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	(1)
CD1400/32			OPT	OPT	OPT	(1)	OPT	OPT	OPT	OPT	OPT	OPT
CD1400/96			OPT	OPT	OPT	OPT	OPT	OPT	(1)	OPT	(1)	OPT
979A			OPT	OPT	OPT	OPT	OPT	OPT	OPT	(2)	OPT	(2)
CRU DISK												
FD800			OPT	OPT	OPT	OPT	OPT		OPT			
PRINTERS												
810 LP	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
LP300			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
LP600			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
LQ45			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
2230 LP			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
2260 LP			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
DATA TERM:												
911 VDT	(2)	(3)	(3)	(4)	(3)	(3)	(3)	(4)	(3)	(4)	(4)	(4)
743 KSR			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
733 ASR			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
820 KSR	(2)		OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
EXPAN.&COMM												
CRU EXP.			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
TILINE EXP.			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
COMM. I/F	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
INT. MODEM	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
FCCC			OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
ENCLOSURES												
TABLE TOP	(2)	(2)										
1-BAY DESK			(2)		(2)		(2)					
2-BAY DESK			(2)									
30-INCH CAB	(2)	(2)	(2)	(2)	(2)		(2)	(2)				
44-INCH CAB						(1)			(1)			
60-INCH CAB											(1)	
70-INCH CAB			(2)	(2)	(2)		(2)	(2)			(1)	(1)

NOTES:

(1) MEANS THE ITEM IS STANDARD WITH THE LISTED MODEL.
(2) MEANS THE ITEM IS DEPENDENT ON SELECTION OF THE PRIMARY SYSTEM PART NUMBER.
(3) MEANS ONE 911 VDT WITH A DUAL CONTROLLER IS USED.
(4) MEANS TWO UNITS OF THE ITEM ARE USED
OPT MEANS THE ITEM IS OPTIONAL.

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GI — General Information

1.1.2 Standard Software Options

The software options supported on the standard DS990 systems are listed in Table 1-2. This table lists the operating systems associated with each model and the languages and utilities supported on each.

Table 1-2. DS990 Systems Software Options

3270				X	X	X	X	X	X	X	X	X	X
3780/2780	X	X	X	X	X	X	X	X	X	X	X	X	X
TIFORM				X	X	X	X	X	X	X	X	X	X
SORT/ MERGE		X	X	X	X	X	X	X	X	X	X	X	X
QUERY						X	X	X	X	X	X	X	X
DBMS						X	X	X	X	X	X	X	X
PASCAL	X(1)			X	X	X	X	X	X	X	X	X	X
RPGII				X	X	X	X	X	X	X	X	X	X
COBOL		X(1)	X	X	X	X	X	X	X	X	X	X	X
BASIC	X			X	X	X	X	X	X	X	X	X	X
FORTRAN	X			X	X	X	X	X	X	X	X	X	X
ASSEMBLY	X		X	X	X	X	X	X	X	X	X	X	X
OPERATING SYSTEM	TX5	DX5	DX7	DX10	DX10	DX10	DX10	DX10	DX10	DX10	DX10	DX10	DX10
MODEL	2	2	3	4	4PP	6	7	8	8PP	9	20	29	30

NOTE:
1. RUNTIME VERSION OF LANGUAGE.

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1.2 MAINTENANCE PHILOSOPHY

The maintenance philosophy for the DS990 systems is based upon servicing and maintaining standard systems that are configured according to the family models. The model concept provides a set of scaled systems that promote better communication among individuals and allows more specialized training among service personnel. Also, the service time required for operations such as installation, repair, and maintenance can be more readily standardized. Specific service product codes are assigned to each model. This facilitates tracking by Field Information Service (FIS). In this way, the field performance of systems can be monitored.

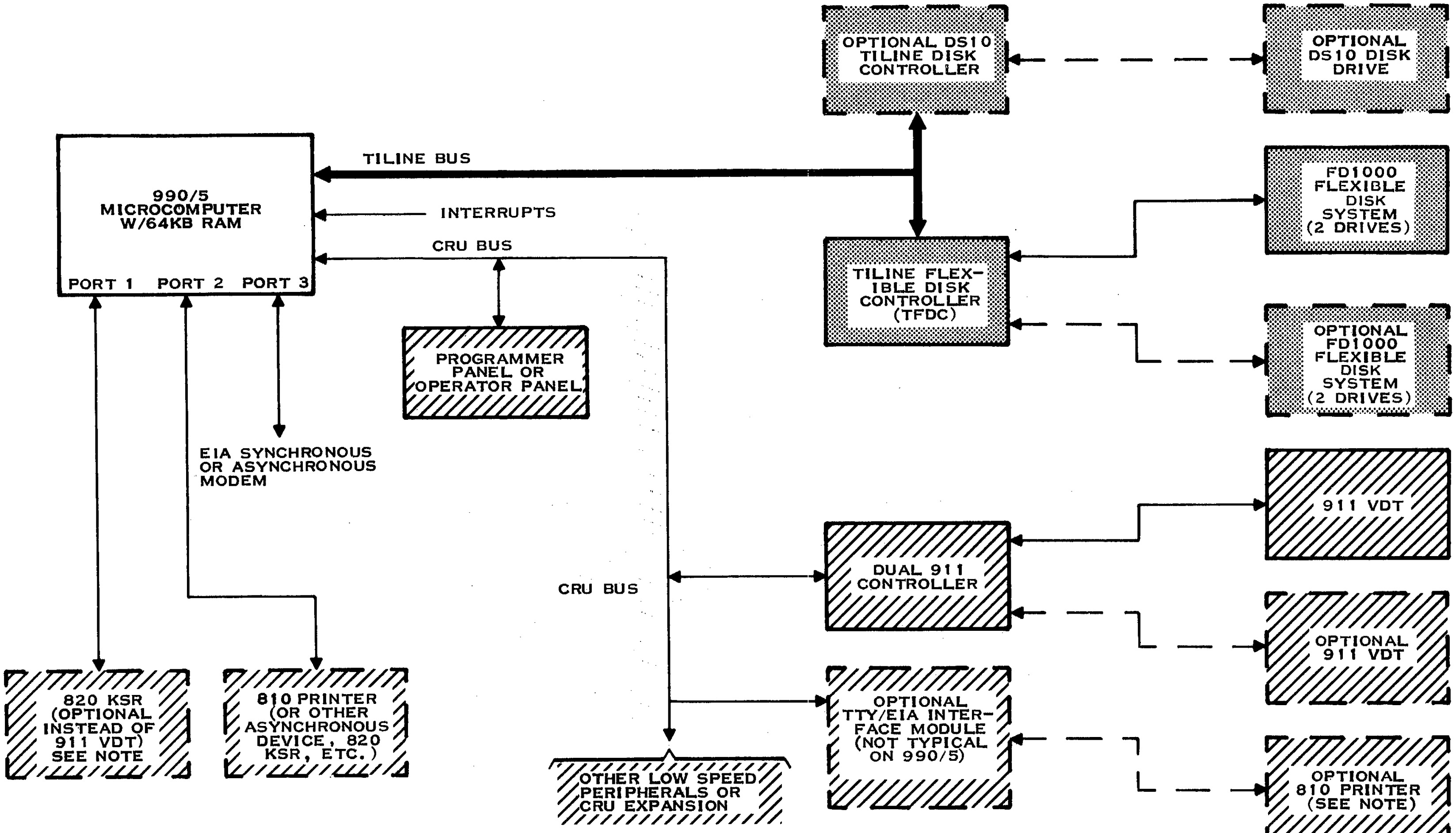
The objective of maintenance is to keep the equipment online and operating properly with a minimum of downtime. When malfunctions occur, fault isolation practices are intended to isolate the problem to a peripheral or subsystem. Further troubleshooting will localize the malfunction to a field-replaceable part or a faulty adjustment/alignment. The part will be replaced or the adjustment/alignment corrected and the equipment restored to normal operating condition. When repairs have been completed, diagnostics will be run to verify that the malfunction has been corrected and that the operating system is functioning properly. Replaced parts will be returned to Returned Material Repair (RMR) for repair, testing on unit and system levels, and cycling back into spares stock.

The diagnostics used by Field Service to troubleshoot a system will be the latest released version of standard 990 diagnostics.

1.3 TYPICAL SYSTEM CONFIGURATIONS

The following illustrations portray examples of typical DS990 systems equipment:

GI — General Information



NOTE:

THE 810 PRINTER AND THE 820 KSR REQUIRE NO INTERFACE MODULE WHEN OPERATED ON 990/5 PORTS 1 OR 2.

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Figure 1-1. DS990 Model 2 System Block Diagram

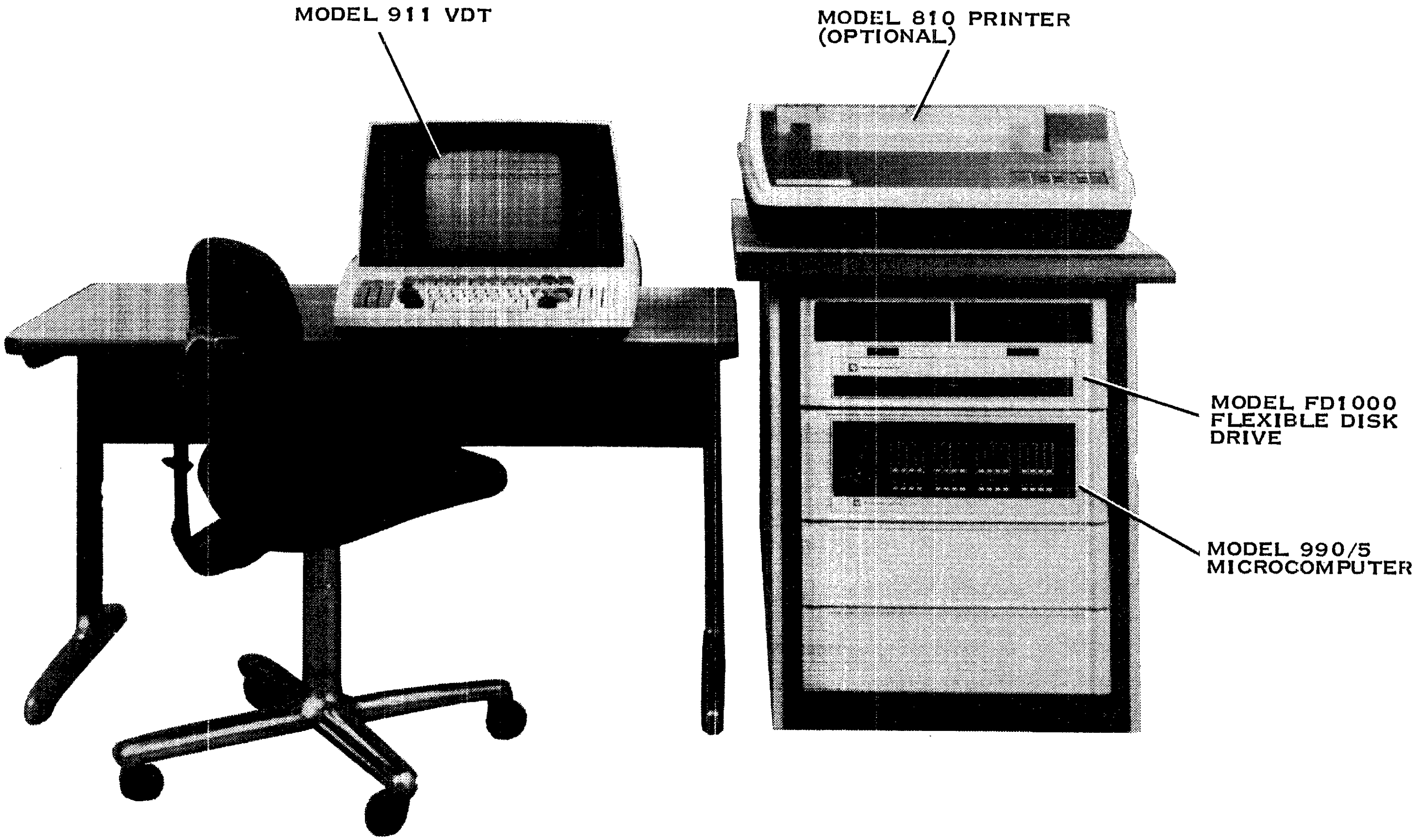

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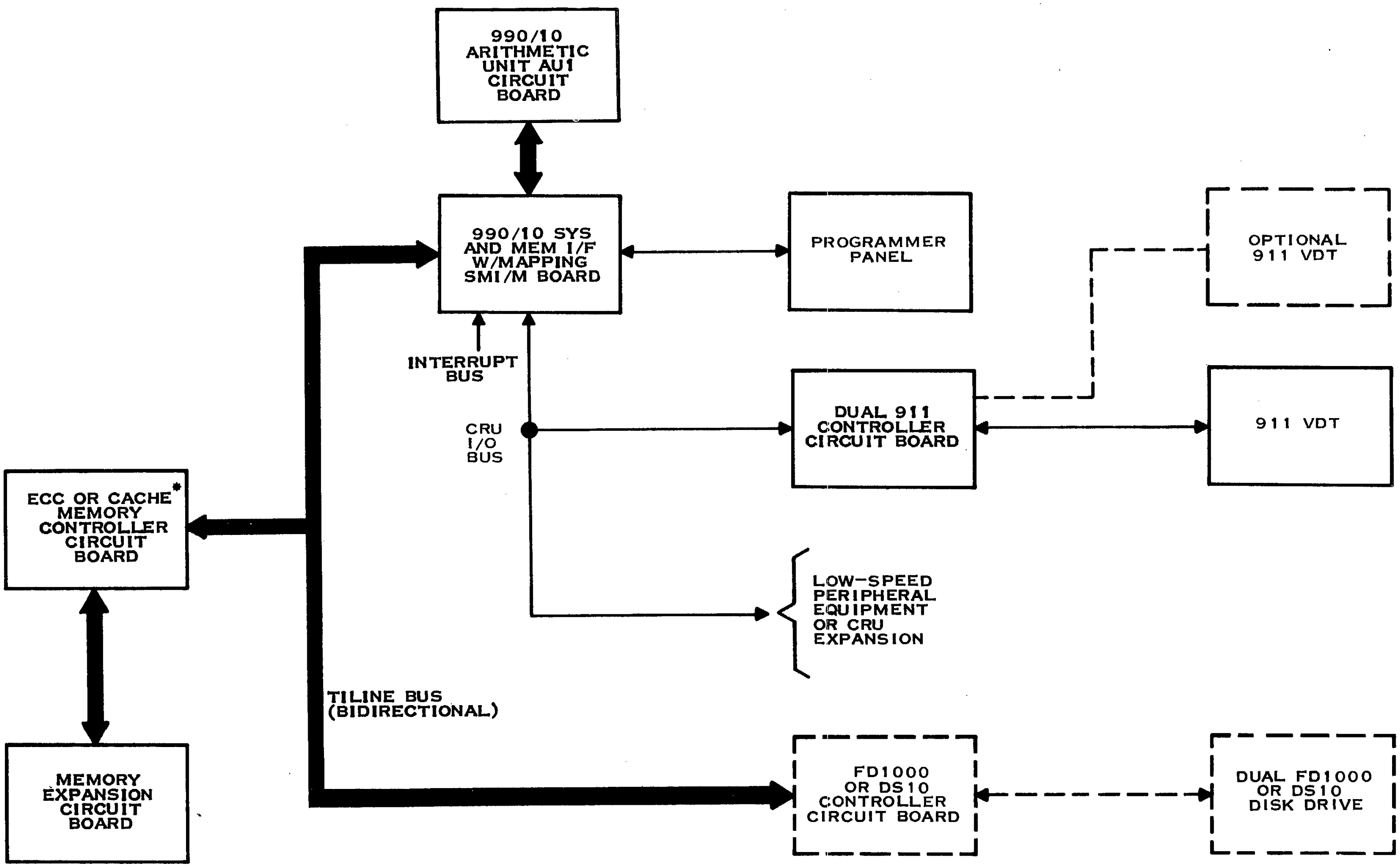
Figure 1-2. DS990 Models 2/3 Pedestal Cabinet System with 911 VDT and Optional 810 Printer



* NOTE:

CACHE MEMORY IS USED ONLY ON MODELS 4 AND 8 PERFORMANCE PACKAGE SYSTEMS.

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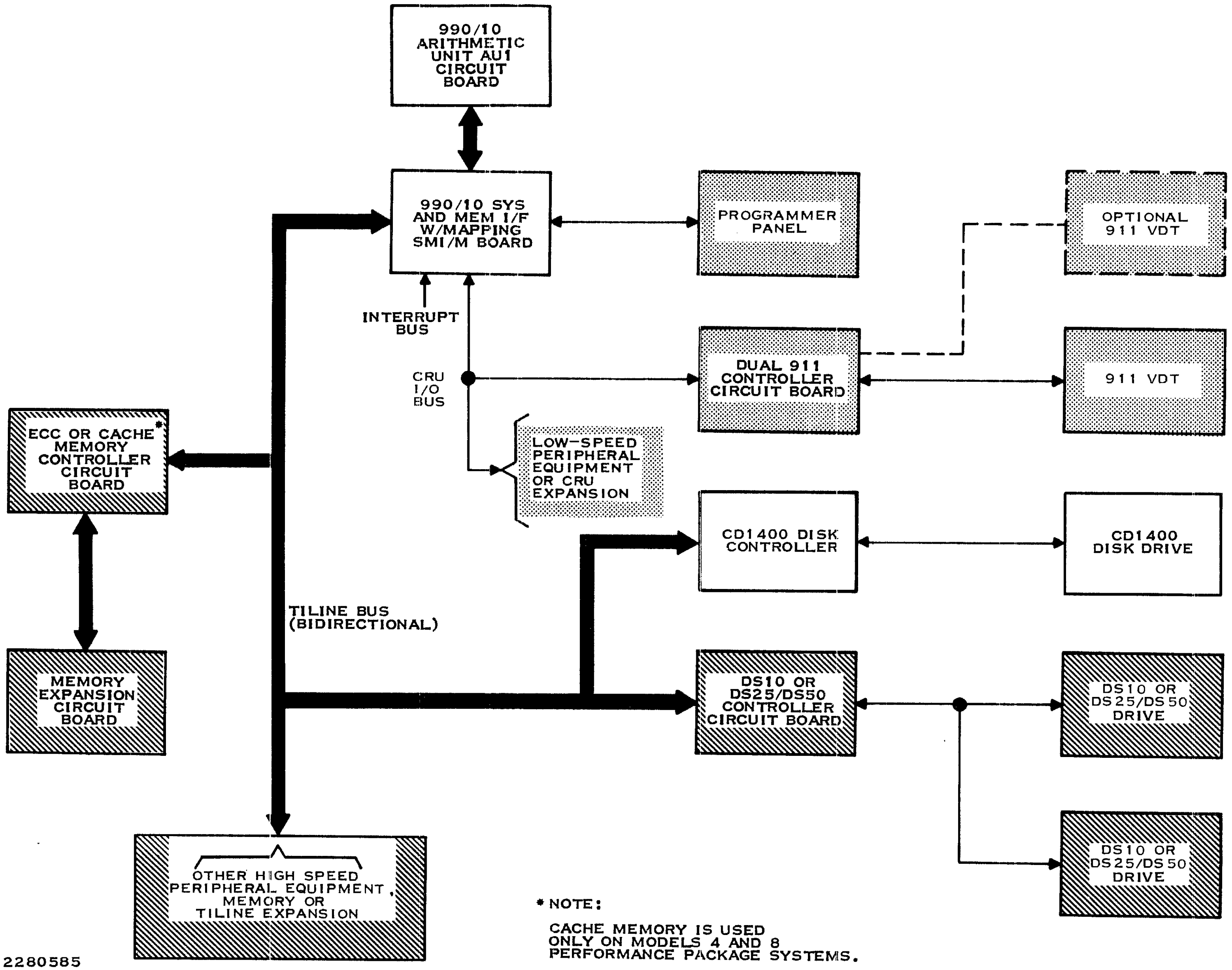
Figure 1-3. DS990 Model 3 System Block Diagram



* NOTE:

CACHE MEMORY IS USED ONLY ON MODELS 4 AND 8 PERFORMANCE PACKAGE SYSTEMS.

Figure 1-4. DS990 Models 4 Through 9 Systems Block Diagram

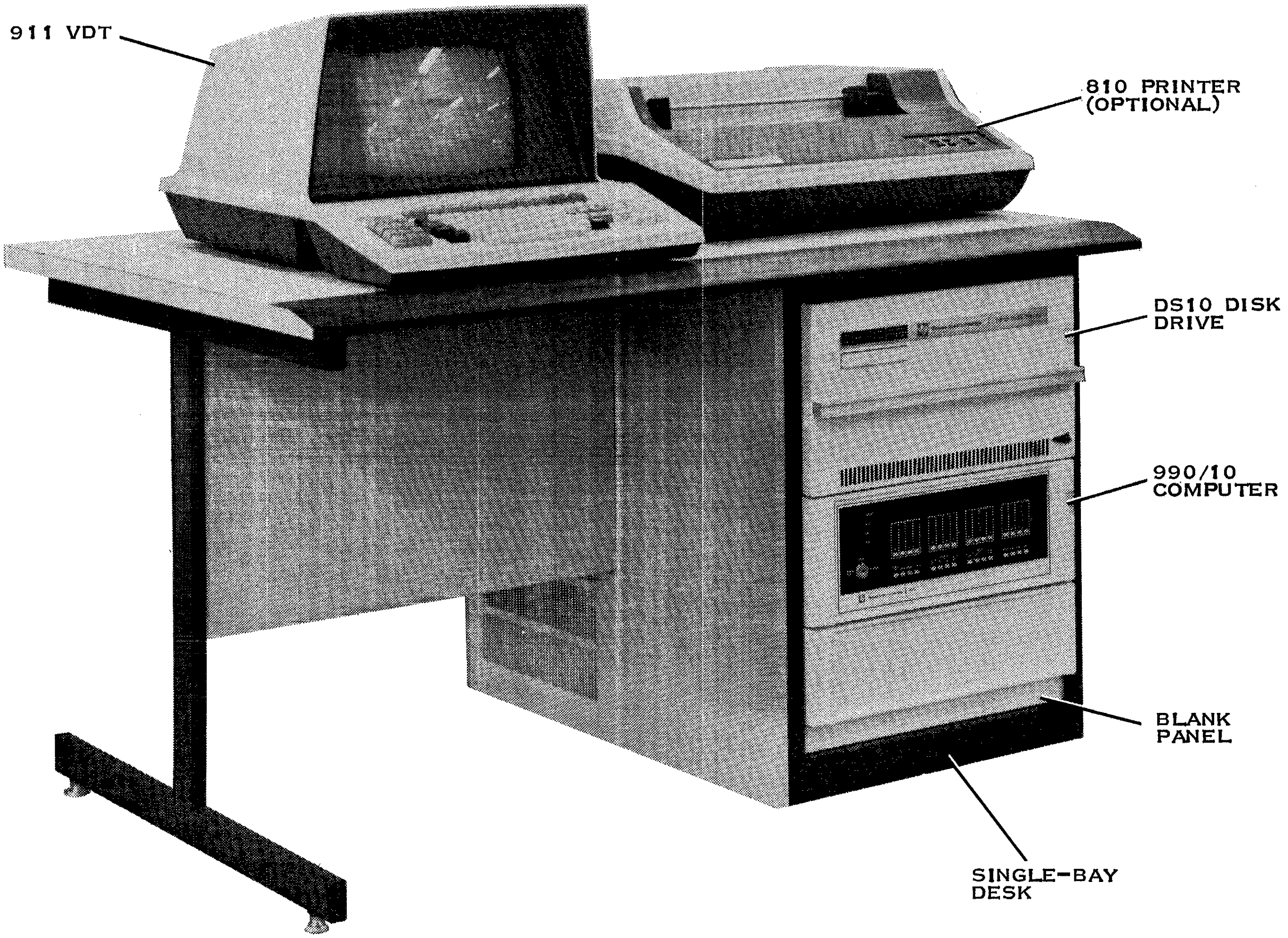


Figure 1-5. DS990 Model 4 Single-Bay Desk System

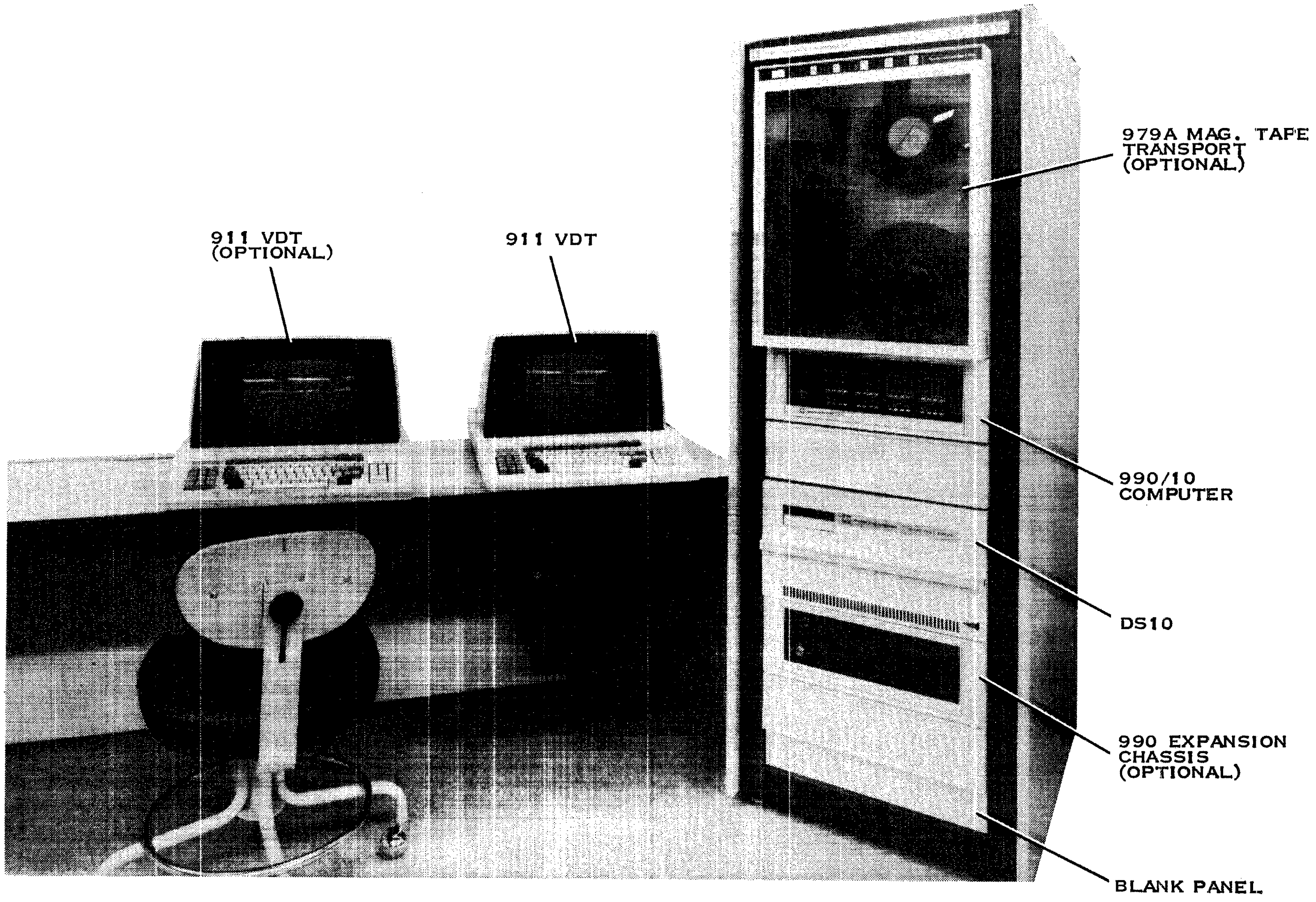


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Figure 1-6. DS990 Model 4 1.78-Meter (70-Inch) Cabinet System

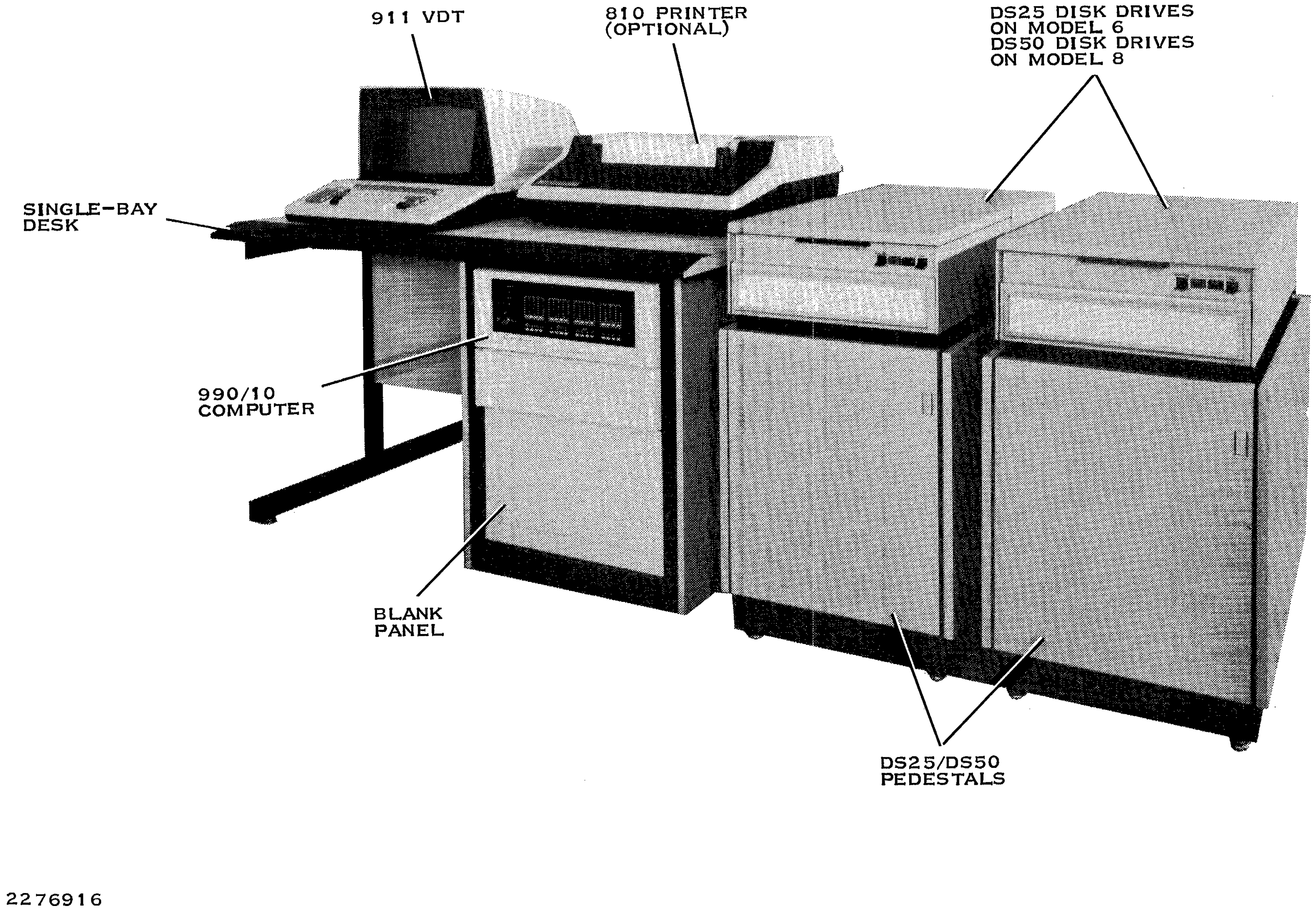

Figure 1-7. DS990 Models 6 and 8 Single-Bay Desk System with Two DS25/50 Disk Drives

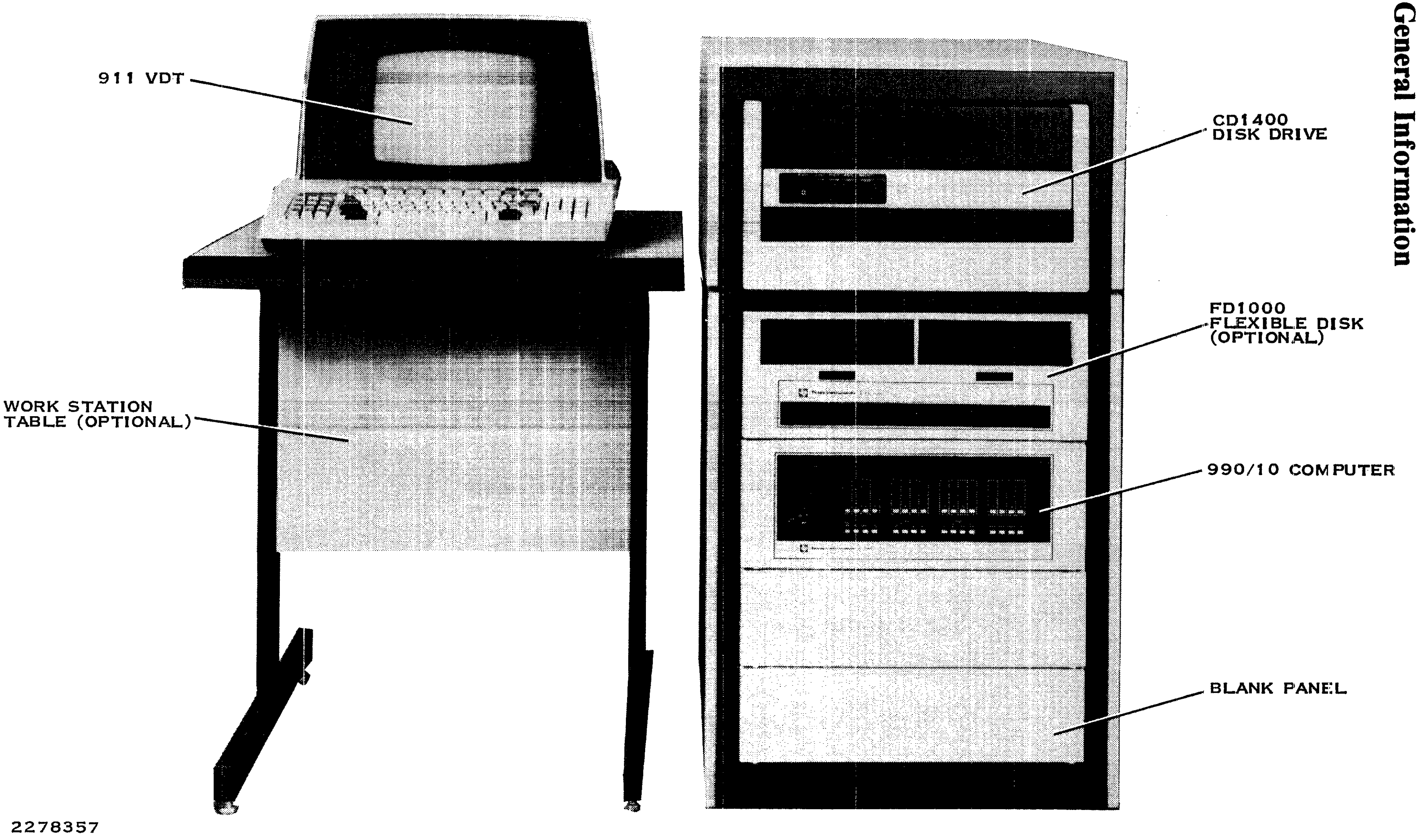

Figure 1-8. DS990 Model 7 or 9 System with Optional FD1000

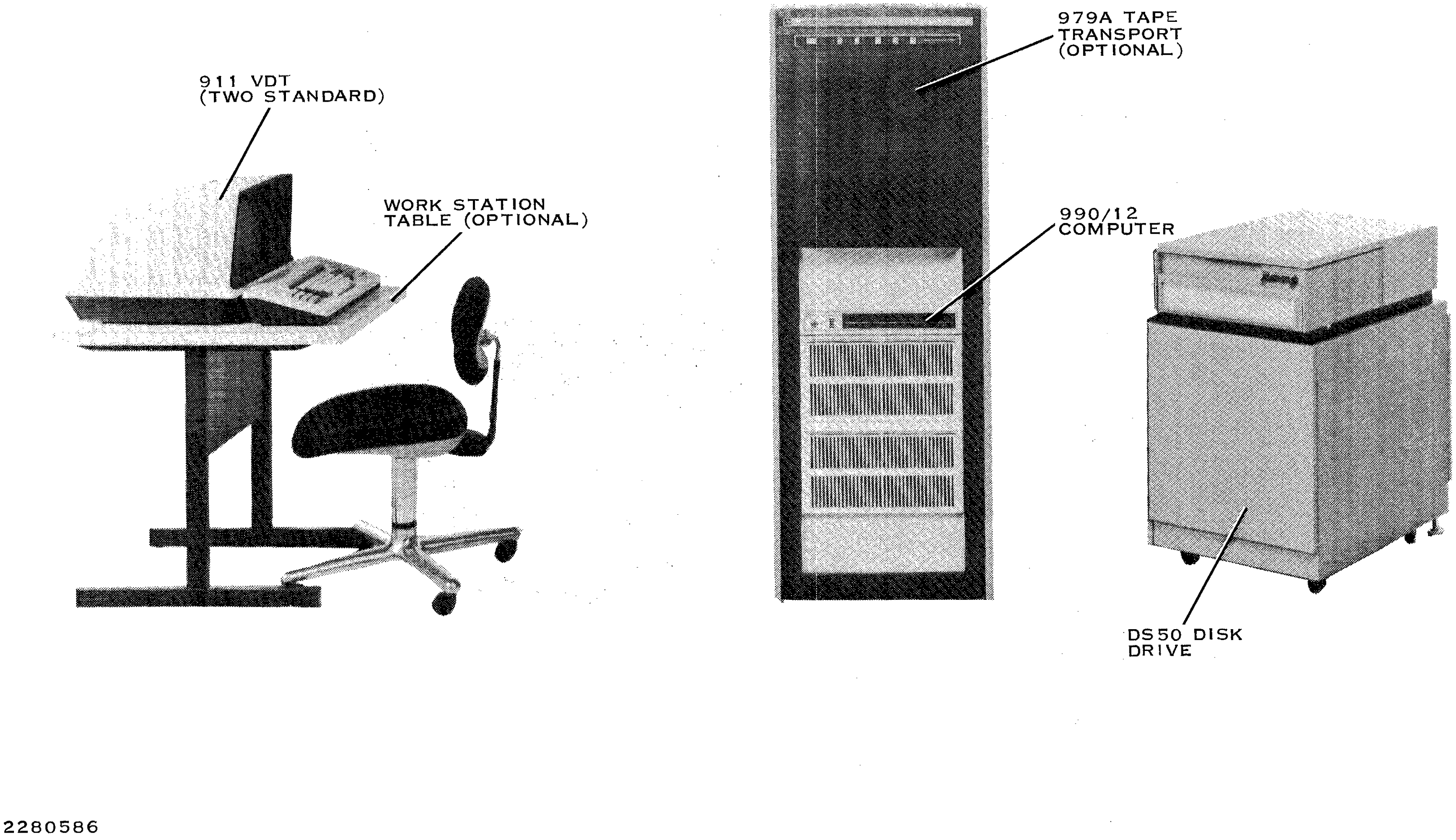

Figure 1-9. DS990 Model 20 System with DS50 Disk and 979A Tape Transport

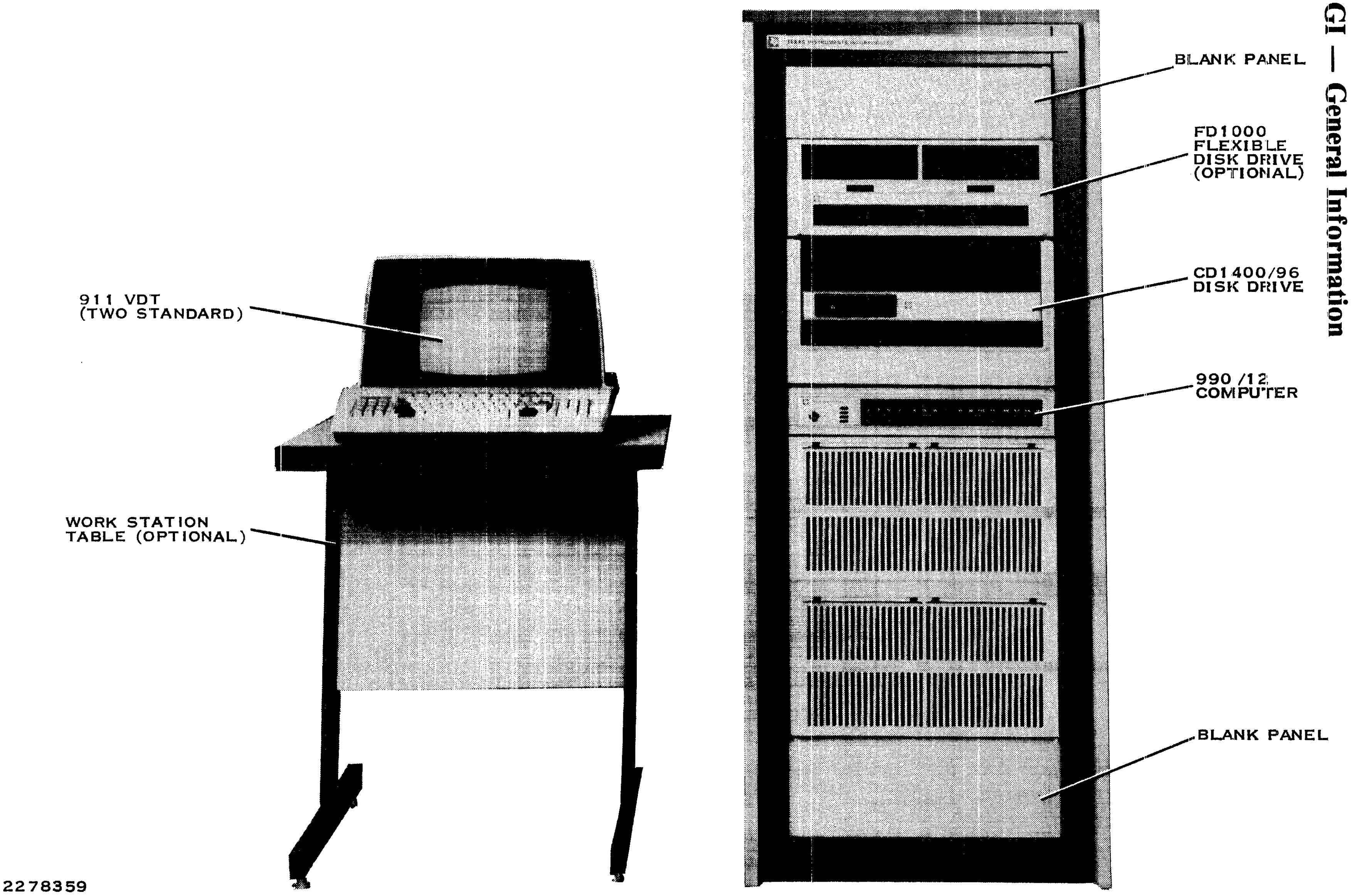

Figure 1-10. DS990 Model 29 System

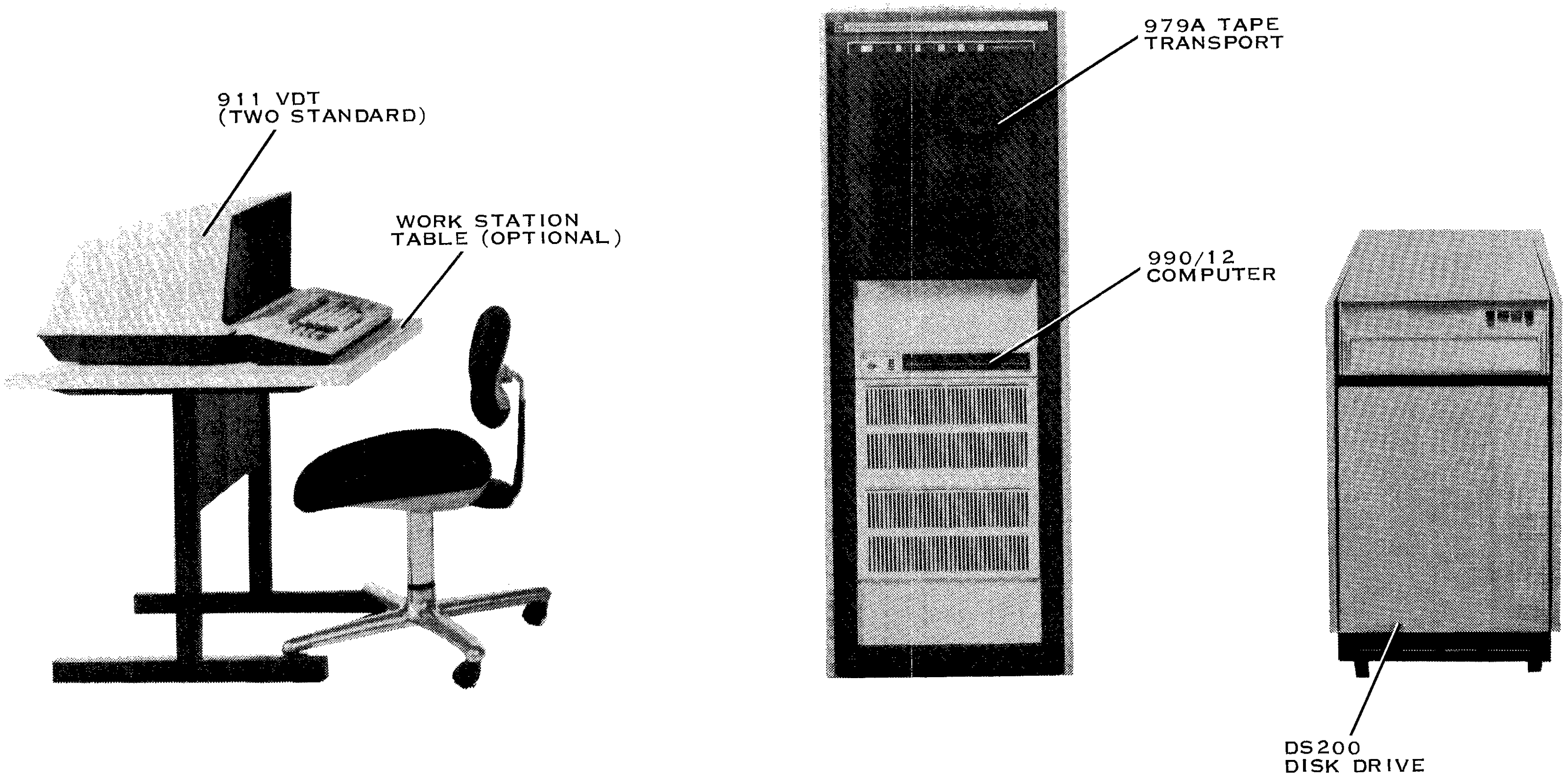

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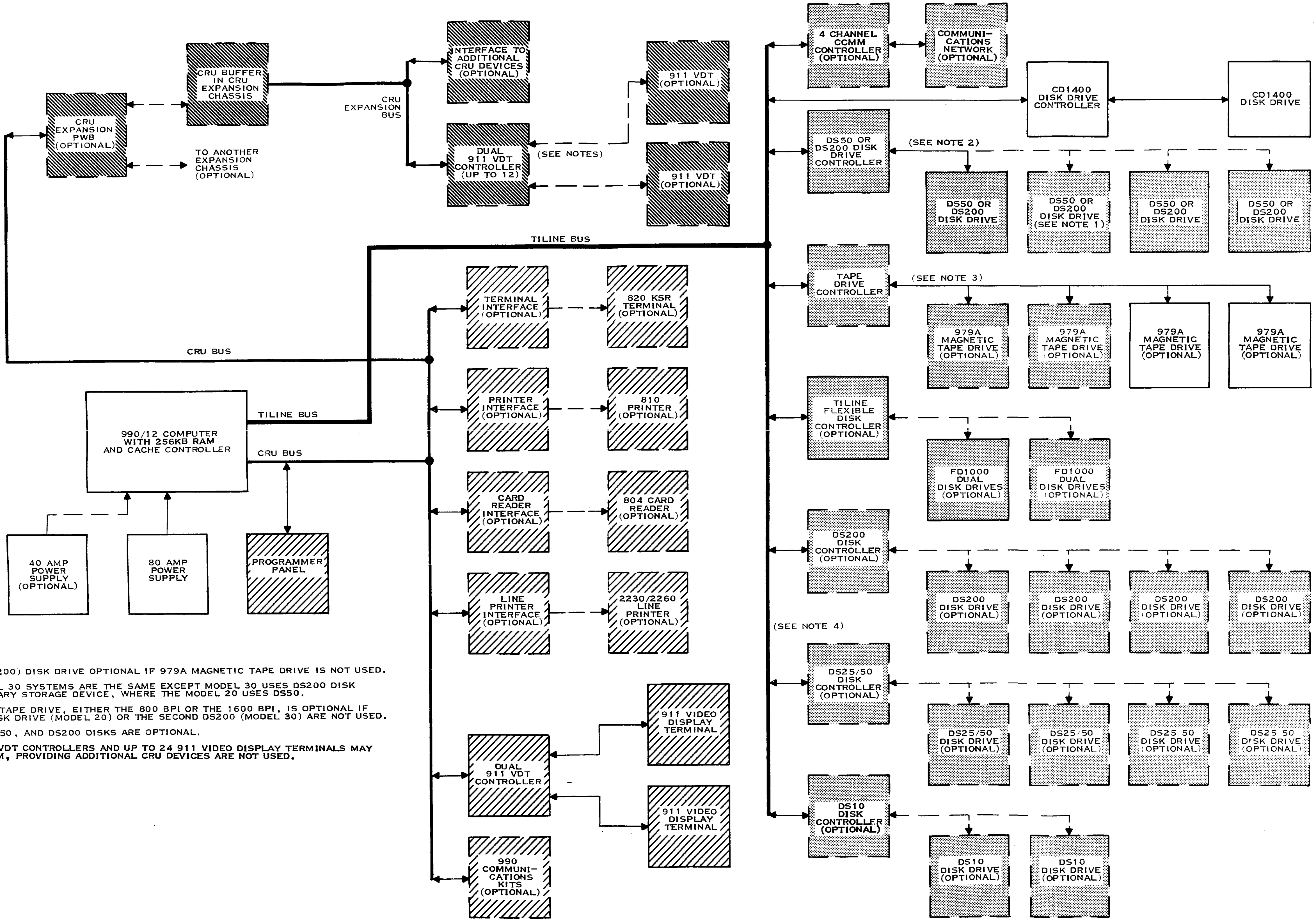
Figure 1-11. DS990 Model 30 System with DS200 Disk and 979A Tape Transport



NOTES:

1 SECOND DS50 (OR DS200) DISK DRIVE OPTIONAL IF 979A MAGNETIC TAPE DRIVE IS NOT USED.

2 MODEL 20 AND MODEL 30 SYSTEMS ARE THE SAME EXCEPT MODEL 30 USES DS200 DISK DRIVES AS THE PRIMARY STORAGE DEVICE, WHERE THE MODEL 20 USES DS50.

3 THE 979A MAGNETIC TAPE DRIVE, EITHER THE 800 BPI OR THE 1600 BPI, IS OPTIONAL IF THE SECOND DS50 DISK DRIVE (MODEL 20) OR THE SECOND DS200 (MODEL 30) ARE NOT USED.

4 THE DS10, DS25, DS50, AND DS200 DISKS ARE OPTIONAL.

5 UP TO 12 DUAL 911 VDT CONTROLLERS AND UP TO 24 911 VIDEO DISPLAY TERMINALS MAY BE USED PER SYSTEM, PROVIDING ADDITIONAL CRU DEVICES ARE NOT USED.

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Figure 1-12. DS990 Models 20, 29, and 30 Systems Block Diagram

2

Related TI Publications

2.1 SERVICE-RELATED TECHNICAL MANUALS

This section lists the TI technical manuals that are applicable to DS990 systems and optional equipment. The following paragraphs define the service-related manuals and explain the relationship between different types of manuals. Figure 2-1 identifies the various types of 990 computer-based hardware and customer-oriented manuals. A reference list of hardware and software manuals is contained in Table 2-1. A general description of hardware manuals follows:

- *DS990 Systems Field Maintenance Manual* is the manual you are reading and is the starting point for CRs who service DS990 Model 2 through Model 30 systems. This manual introduces the various DS990 configurations and covers essential operating procedures, troubleshooting, and peripherals.

- Peripheral equipment field maintenance manuals (FMMs) are based on the field service philosophy for each peripheral subsystem (peripheral, controller, and cables). Each manual introduces the subsystem components and identifies and describes the field-replaceable parts. Also included are PM schedules and procedures for the peripheral subsystems and troubleshooting, alignment/adjustment, and removal/replacement procedures based on the field service philosophy.

- Computer FMMs cover the CPU, supporting memories, and computer chassis with the same type of information as described for a peripheral subsystem.

- The diagnostic handbook (seven volumes) contains procedures and supporting information used to exercise the 990 diagnostics.

- The field engineering reference handbook is a handy-sized reference guide to switch settings, jumper schedules, LED indicators, chassis configurations, TILINE peripheral control space (TPCS) word definitions, and other useful information to assist in field support of DS990 systems and 990 computers in general.

- Peripheral equipment depot maintenance manuals (DMMs) are available for most TI-designed equipment. On a disk drive subsystem, for example, the DMM concentrates on the TI-designed controller and refers to the vendor maintenance manual for the disk drive. The DMMs introduce the peripheral subsystem, provide detailed theory on the controller, and include troubleshooting to the component level based on the depot service philosophy. DMMs contain logic diagrams and LM/assembly drawings.

- Computer DMMs in the past have covered the CPU, memories, and chassis in a single manual. Beginning with the 990/12 computer, these three areas are covered in separate manuals to reduce duplication (the modular approach).

- Vendor maintenance manuals are used at the depot and in some cases are used in the field where a TI-written manual has not been generated.

- The computer family drawing manual is a five-volume set that contains logics/-schematics and LM/assembly drawings as follows:

  Volume I — *Computer Chassis and Enclosures*
  Volume II — *Processors and Memories*
  Volume III — *CRU Expansion and Peripherals*
  Volume IV — *TILINE Expansion and Peripherals*
  Volume V — *AMPL Systems*

- Customer manuals include several manuals the DS990 customer receives with his system that could be useful to the CR. Site preparation, unpacking, and installation instructions sent to the customer are not duplicated in the service manuals to keep the size of the service manuals to a minimum. The 990 hardware manuals intended for the customer are either system-level or equipment-level. At the system level, the DS990 site preparation manuals outline in detail the preparations the customer must make to ensure smooth installation of the system. The system-level unpack/inventory and installation/operation manuals cover what their titles imply; the operator's service guides contain operation and service instructions for the customer, not the CR. The equipment-level hardware manuals for the customer cover site preparation, unpacking, and installation instructions for the equipment described, i.e., a 990 computer, disk drive, terminal, etc. The DS990 customer receives both the system-level and equipment-level manuals. The customer who buys only a 990 computer or peripheral will receive only the equipment-level manuals for the equipment purchased.

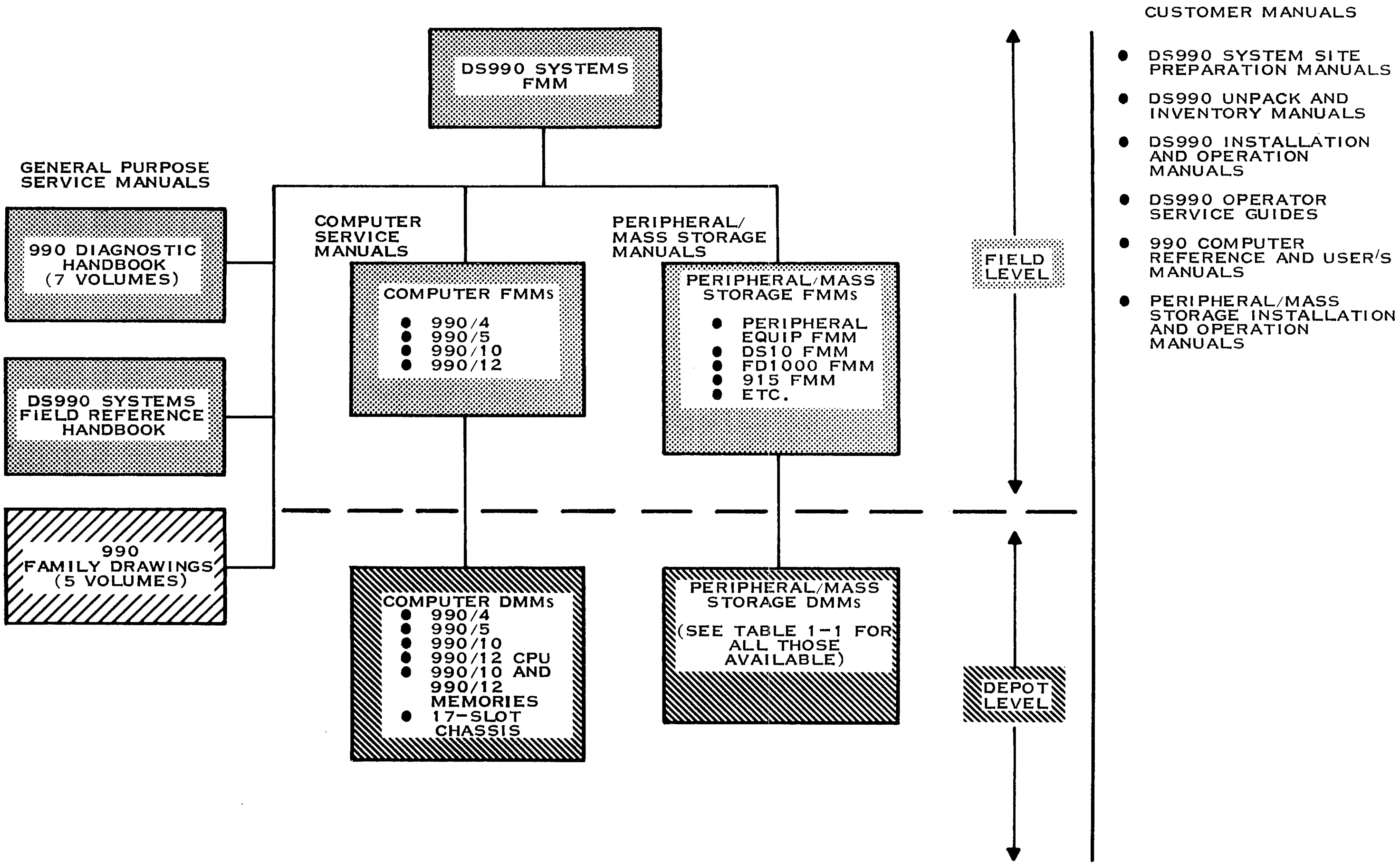

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Figure 2-1. DS990-Related Service and Customer Manuals

GI — General Information

Table 2-1. List of Related Manuals

Title	Part Number
DS990 Systems Field Engineering Reference Handbook	2268678-9701
DS990 Models 2 Through 30	
DS990 Models 2 and 3 Systems Site Preparation Manual	2250359-9701
DS990 Models 2 and 3 Systems Unpacking and Inventory Guide	2250360-9701
DS990 Models 2 and 3 Systems Installation and Operation Manual	2250357-9701
DS990 Models 4 Through 9 Systems Site Preparation Manual	2250361-9701
DS990 Models 4 Through 9 Systems Unpacking and Inventory Guide	2268698-9701
DS990 Models 4 Through 30 Systems Installation and Operation Manual	2276581-9701
DS990 Models 20, 29, and 30 Systems Site Preparation Manual	2250692-9701
DS990 Models 20, 29 and 30 Systems Unpacking and Inventory Guide	2250695-9701
DS990 Models 2 through 30 Systems Operator's Service Guide (International Edition)	2270533-9701
Model 990 Computer Product Instruction Manual (Domestic Edition)	2270533-9702
Computers	
Model 990 Computer Diagnostic Handbook (7 Volumes)	0945400-9701 through 0945400-9707
Model 990 Computer Family Maintenance Drawings Volume I, Computer Chassis and Enclosures	0945421-9701
Model 990 Computer Family Maintenance Drawings Volume II, Processors and Memories	0945421-9702

Table 2-1. List of Related Manuals (Continued)

Title	Part Number
Model 990/5 Computer Hardware User's Manual	0946294-9701
Model 990/5 Computer Field Maintenance Manual	0946295-9701
Model 990/5 Computer Depot Maintenance Manual	0946296-9701
Model 990/10 Computer System Hardware Reference Manual	0945417-9701
Model 990/10 Computer System Field Maintenance Manual	0945402-9701
Model 990/10 Computer System Depot Maintenance Manual	0945404-9701
Model 990/12 Computer Hardware User's Manual	2263336-9701
Model 990/12 Computer System Field Maintenance Manual	2264447-9701
Model 990/12 Computer Central Processing Unit Depot Maintenance Manual	2264448-9701
Model 990/10 and 990/12 Memories Depot Maintenance Manual	2250690-9701
Model 990/10 to Model 990/12 Computer Upgrade Manual	2268682-9701
Model 990 Computer TILINE Coupler User's Guide	2268688-9701
Peripheral Devices	
Model 990 Computer Family Maintenance Drawings Volume III, CRU Expansion and Peripherals	0945421-9703
Model 990 Computer Family Maintenance Drawings Volume IV, TILINE Expansion and Peripherals	0945421-9704
Model 990 Computer Peripheral Equipment Field Maintenance Manual	0945419-9701

GI — General Information

Table 2-1. List of Related Manuals (Continued)

Title	Part Number
911 VDT	
Model 911 Video Display Terminal Installation and Operation Manual	0945423-9701
Model 990 Computer Peripheral Equipment Field Maintenance Manual	0945419-9701
Model 911 Video Display Terminal Depot Maintenance Manual	0945424-9701
DS10 Disk Drive	
Model DS10 Disk System Installation and Operation Manual	0946261-9701
Model 990 Computer Model DS10 Cartridge Disk System Field Maintenance Manual	0945419-9701
Model 990 Computer Model DS10 Cartridge Disk System Depot Maintenance Manual	0946202-9701
DS25/50/200 Disk Drives	
Model 990 Computer Model DS25/DS50 Disk System Installation and Operation Manual	0946231-9701
Model 990 Computer Model DS25/DS50 Disk System Depot Maintenance Manual	0946238-9701
DS200 Disk Drive	
Model 990 Computer Model DS200 Disk System Installation and Operation Manual	0949615-9701
CD1400 Disk Drive	
Model CD1400 Disk System Installation and Operation Manual	2272081-9701
CD1400 Disk System Field Maintenance Manual	0945419-9701
CD1400 Disk System Controller Depot Maintenance Manual	2272082-9701
FD800 Flexible Disk	
Model 990 Computer Model FD800 Floppy Disk Installation and Operation Manual	0945253-9701

Table 2-1. List of Related Manuals (Continued)

	Part Number
Model 990 Computer Model FD800 Floppy Disk System with International Chassis Installation and Operation	2250697-9701
Model 990 Computer Floppy Disk Controller Depot Maintenance Manual	0945418-9701
FD1000 Flexible Disk	
Model 990 Computer Model FD1000 Flexible Disk System Installation and Operation	2261886-9701
Model 990 Computer Model FD1000 Flexible Disk System with International Chassis Installation and Operation	2250698-9701
Model 990 Computer Model FD1000 Flexible Disk System Field Maintenance Manual	0945419-9703
Model 990 Computer Model FD1000 Flexible Disk Controller Depot Maintenance Manual with International Chassis Power Supply (2 volumes)	2261885-9701 and 2261885-9702
979A Tape Transport	
Model 990 Computer Model 979A Magnetic Tape System Installation and Operation	0946229-9701
Model 979A Tape Transport Installation and Operation	0945419-9701
Model 990 Computer Peripheral Equipment Field Maintenance Manual	0945419-9701
Model 979A Tape Transport Subsystem Maintenance Manual	0949613-9701
Model 979A Tape Controller Depot Maintenance Manual	0946237-9701
733 ASR/KSR Data Terminal	
Model 990 Computer Model 733 ASR/KSR Data Terminal Installation and Operation	0945259-9701
Silent 700 Electronic Data Terminal Model 733 ASR/KSR Maintenance Manual	0960129-9701

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Table 2-1. List of Related Manuals (Continued)

Title	Part Number
743 KSR Data Terminal	
Silent 700 Electronic Data Terminals Model 743 KSR and Model 745 Portable Maintenance Manual	0984025-9701
820 KSR Data Terminal	
Model 990 Computer Model 820 KSR Data Terminal Installation and Operation	2250454-9701
Operating Instructions for Model 820 KSR	0949854-9701
Model 820 KSR Terminal Maintenance Manual	0999853-9701
810 Printer	
Model 990 Computer Model 810 Printer Installation and Operation Manual	0939460-9701
Model 810 Printer Maintenance Manual	0994386-9701
2230/2260 Printer	
Model 990 Computer Model 2230/2260 Line Printer Installation and Operation Manual	0946256-9701
LQ45 Printer	
Model 990 Computer Model LQ45 Letter Quality Printer System Installation and Operation Manual	2268695-9701
Model 990 Computer Model LQ45 Letter Quality Printer System Field Maintenance Manual	0945419-9705
LP300/LP600 Printer	
Model 990 Computer Model LP300/LP600 Line Printers Installation and Operation Manual	2250364-9701
Model 990 Computer Model LP300/LP600 Line Printers Field Maintenance Manual	0945419-9704

Table 2-1. List of Related Manuals (Continued)

Title	Part Number
Model RTS/915 Terminal	
Model 990 Computer Remote Terminal System (RTS) Hardware Installation Manual (Domestic Edition	2272053-9701
Model 990 Computer RTC Supplement to Model 990/5 Microcomputer	2268694-9701
Model 915 Remote Terminal Site Preparation Manual	2253085-9701
Model 915 Remote Terminal Field Maintenance Manual	2250386-9701
Communications	
990 Family Communications Systems Field Reference Manual	2276579-9701
Model 990 Computer Communications System Installation and Operation	0945409-9701
Model 990 Computer Four Channel Communications Controller Maintenance Manual	2263878-9701
Model 990 Computer Four Channel Communications Controller Installation and Operation Manual	2263879-9701
TTY/EIA Manuals	
Model 990 Computer 16 Input/16 Output EIA Data Module Installation and Operation Manual	094283-9701
Model 990 Computer 16 Input/16 Output EIA Data Module Depot Maintenance Manual	094414-9701
Model 990 Computer 16 Input/16 Output TTL Data Module Installation and Operation Manual	0946285-9701
Model 990 Computer 16 Input/16 Output TTL Data Module Depot Maintenance Manual	0945407-9701
Model 990 Computer TTY/EIA Terminal Interface Module Depot Maintenance Manual	0945408-9701
Programming Manuals	
Model 990 Computer 990/10 and 990/12 Assembly Language Programmer's Guide	2270509-9701

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Table 2-1. List of Related Manuals (Continued)

Title	Part Number
Model 990 Computer FORTRAN Programmer's Reference Manual	0946260-9701
Model 990 Computer DX10 COBOL Programmer's Guide	2270518-9701
Model 990 Computer TX990 Operating System Programmer's Guide	0946259-9701
Model 990 Computer Terminal Executive Development System (TXDS) Programmer's Guide	0946258-9701
Model 990 Computer TX990 Operating System Documentation	0944776-9701
Model 990 Computer DX10 Operating System Programmer's Card	2272064-9701
Model 990 Computer Report Program Generator (RPG II) Programmer's Guide	0939524-9701
Model 990 Computer BASIC Reference Manual	2250304-9701
Model 990 Computer DX10 Data Base Management Programmer's Guide	2250304-9701
Model 990 Computer DX10 Data Base Administrator User's Guide	2250426-9701
Model 990 Computer TX5 Operating System Programmer's Guide	2276585-9701
Model 990 Computer DX10 Remote Terminal Subsystem System Generation and Programmer's Reference Manual	2272054-9701
Other Software Manuals	
Model 990 Computer Query User's Guide	2250466-9701
Model 990 Computer TIFORM Reference Manual	2250374-9701
Model 990 Computer TI Pascal User's Manual	0946290-9701
Model 990/10 Computer DX10/3270 Information Display System Emulator Operator's Manual	2250954-9701

Table 2-1. List of Related Manuals (Continued)

Title	Part Number
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume I Concepts and Facilities	0946250-9701
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume II Production Operation	0946250-9701
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume III Application Programmer's Guide	0946250-9703
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume IV Development Operation	0946250-9704
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume V Programming Guide	0946150-9705
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume VI Error Reporting and Recovery	0946250-9706
Model 990 Computer DX 3780/2780 Emulator User's Guide	0946289-9701
Model 990 Computer Link Editor Reference Manual	0949617-9701
Model 990 Computer Sort/Merge User's Guide	0946252-9701
Model 990 Computer Universal ROM Loader User's Guide	2270534-9701
Model 990 Computer DX10 Remote Terminal Subsystem (RTS) Operator's Guide	2272055-9701

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1

System Loading and Loader Errors

1.1 GENERAL

This section contains information concerning:

- List of current ROM loader sets
- Description of system loading sequences
- Loading procedures for system software
- Loading procedures for diagnostics
- Self-test errors
- ROM loader errors

1.1.1 Resolution of Loading Procedures

The loading procedures for system software depend upon the following:

- The particular model of DS990 system being loaded
- The type of operating system being loaded
- The ROM loader set being used
- The type of front panel on the system

NOTE

> Kit numbers and part numbers for ROM loader sets currently in use are given in the following paragraphs. **All of the system loading procedures and operating instructions in this manual assume the use of the current revision ROM loader sets that are listed.**

1.1.2 Programmer Panels

Two programmer panels are used with the DS990 systems, one with the Models 2 through 9 and 4PP systems, and one with Models 20 through 30 and 8PP systems. These two programmer panels differ considerably in physical size and appearance, but differ only slightly in functional detail. The programming functions are identical on each of the panels. These panels are illustrated and described in Section 3.

OP — Operating Procedures

1.2 UNIVERSAL ROM LOADERS

Operating systems such as DX5, TX5, DX7, and DX10 are loaded via the universal ROM loaders specified in the following subparagraphs. The universal ROM loader consists of a set of ROM integrated circuits (ICs) that contains a loader, a self-test routine, and the front panel routine for 990/5, 990/10, and 990/12 computers. The ROM loaders are considered to be "universal" because:

- The same type of peripheral devices may be used to load the different operating systems.

- The same sequence of instructions is used to load the operating systems in all DS990 systems.

1.2.1 Current Production ROM Loaders

NOTE

> All of the ROM loader kits that are used on all DS990 systems, along with the associated part numbers, are listed and described in Section 3.

The loading and operating instructions in this section assume the use of the current revision loader ROMS for standard DX5, TX5, DX7, and DX10 operating systems, as follows:

- DX5, TX5: Model 2 (990/5 computer), part number 2261927-0002

ROM Part Numbers	Location
2261929-0003	UN P07
2261929-0004	UN P06

- DX7, DX10: Models 3, 4, 4PP, 6, 7, 8, 8PP, and 9 (990/10 computer) SMI/M board

  PWB kit part number 945134-0019

ROM Part Numbers	Location
0975383-0045	UF21
0975383-0046	UE21
0975383-0047	UJ21
0975383-0048	UH21

Multiwire board kit part number 0945134-0020

ROM Part Numbers	**Location**
0975383-0045	K08
0975383-0046	K09
0975383-0049	C10
0975383-0050	C11
0975383-0051	B10
0975393-0052	B11

- DX7, DX10: Models 20, 29, 30 (990/12 computer) SMI board 2261975-0001

ROM Part Numbers	**Location**
2262025-0007	UG03
2262025-0008	UG02

NOTE

Refer to *Model 990 Computer Universal ROM Loader User's Guide*, part number 2270534-9701, for further information regarding the universal ROM loaders.

1.3 GENERAL LOADING INFORMATION

1.3.1 Types of Loading Devices

In this manual, the device in which the load medium is mounted is referred to as the loading device. The loading medium is the disk, diskette, magnetic tape reel, or cassette that contains the operating system software to be loaded.

Typical loading devices are as follows:

- Hard disks (from disk drive units)
- FD800 flexible disk
- FD1000 flexible disk
- Cassette unit (from data terminals)
- Magnetic tape unit
- Maintenance diagnostic unit (MDU) cassette

1.3.2 Loading Code Information and Loading Sequences

When loading, the ROM loader reads the following code:

- When loading from a hard disk or from a double-sided, double-density (DSDD) diskette, the ROM loader reads track 0 sector 0 to determine from which track (usually track 1) to load memory image (binary) code.
- When loading from a single-sided, single-density (SSSD) diskette (on an FD800 unit), the loader loads memory image (binary) code from track 0.
- When loading from magnetic tape or cassette (either from a 733 ASR or the MDU cassette unit), the loader loads object (ASCII) code.

Prior to loading an operating system, the loader executes a self-test routine appropriate for the computer. Then the loader stores the code from the load medium in the memory of the computer and transfers control to the code it has loaded. This code may be a more complex loader that in turn loads the operating system software. Figure 1-1 is a flowchart of the loading sequence.

1.3.3 Defaults

1.3.3.1 Programmer Panel Defaults. When the programmer panel is connected to the CPU, the universal ROM loader loads a routine from disk unit 0 on the controller at TILINE address >F800 by default. The user can alter the contents of addresses in memory to select another disk unit, to select a magnetic tape unit, or to select some other device. When the specified disk unit or tape unit is not ready, the loader waits for the device to be made ready.

1.3.3.2 Operator Panel Defaults. When the operator panel is connected, the loader attempts to load a routine from a magnetic tape unit on a controller at TILINE address >F880, or from a disk unit at TILINE address >F800. The sequence of units from which the loader attempts to load the system is:

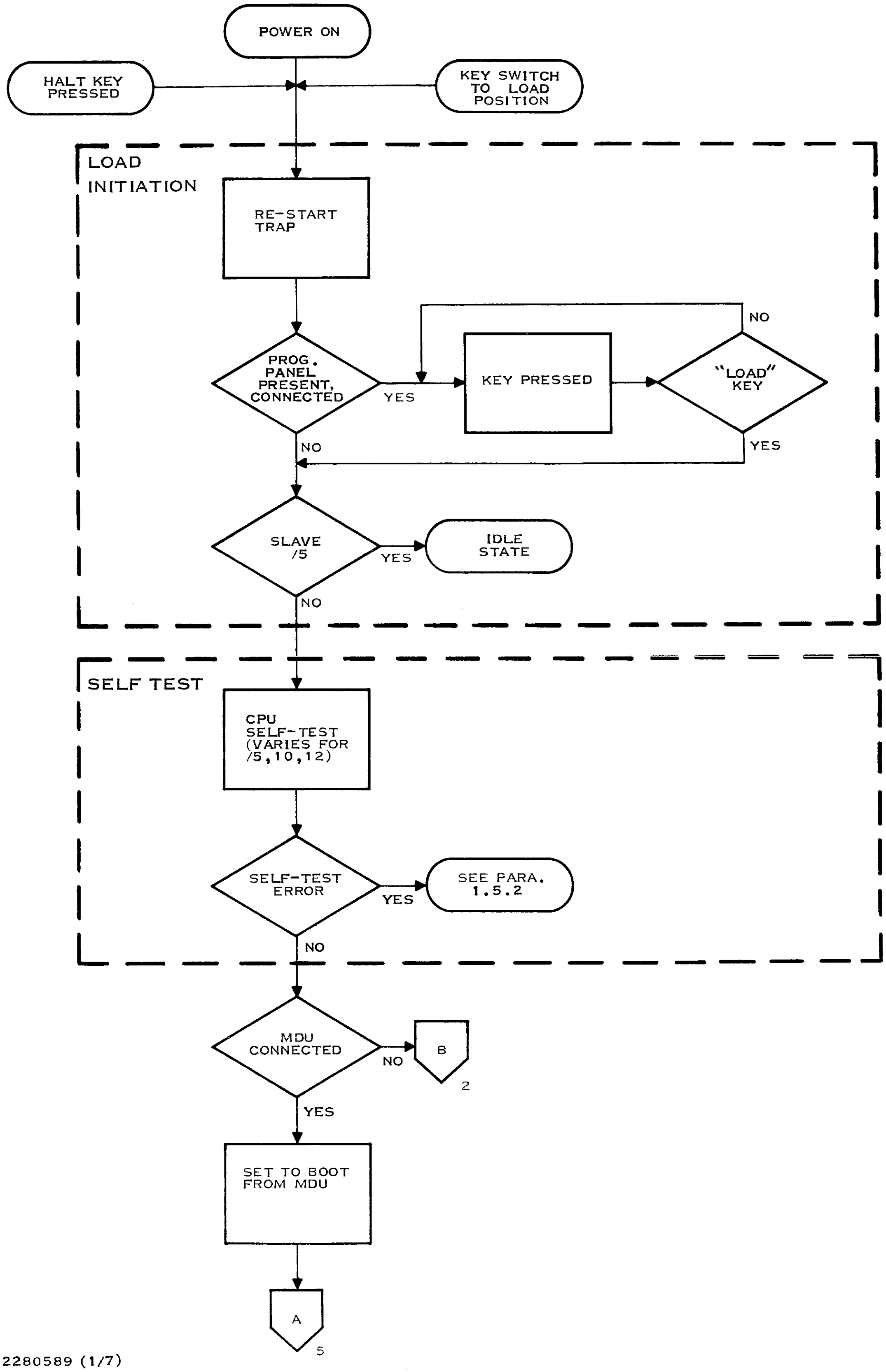
1. The lowest-numbered ready tape unit, if any
2. The lowest-numbered ready and write-protected disk unit, if any
3. The lowest-numbered ready disk unit

1.3.3.3 Other Defaults. When no device is ready, the loader continues to attempt to locate a ready device. Mounting a tape or disk and making it ready causes the loader to load from the tape or disk.

The ROM loader attempts to load a routine from the MDU whenever the MDU is connected. Operation is described in the *Model 990/10 Computer System Field Maintenance Manual.*

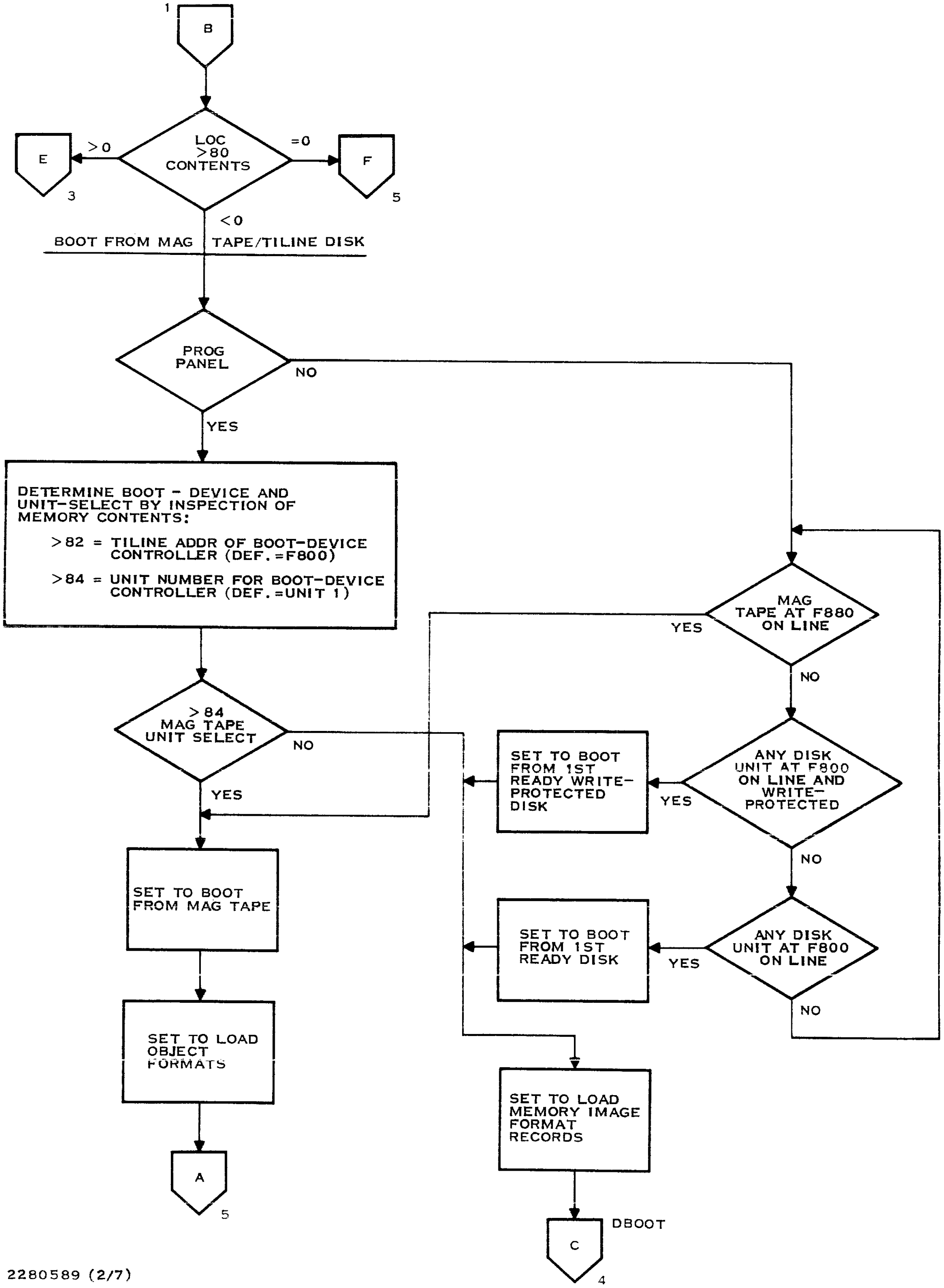
1.4 PROCEDURES FOR LOADING OPERATING SYSTEMS SOFTWARE

Procedures for loading system software using every loading device and option are described in the paragraphs following Figure 1-1.



2280589 (1/7)

Figure 1-1. DS990 Loading Sequence Flowchart (Sheet 1 of 7)



2280589 (2/7)

Figure 1-1. DS990 Loading Sequence Flowchart (Sheet 2 of 7)

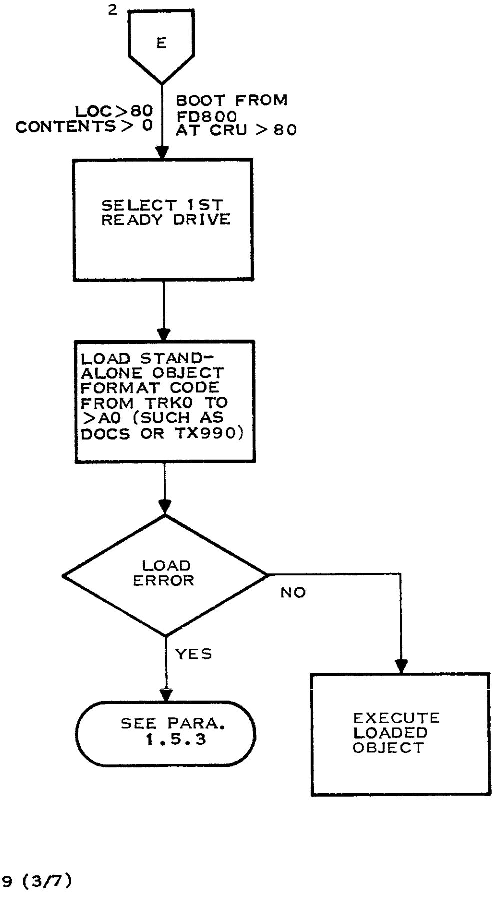


Figure 1-1. DS990 Loading Sequence Flowchart (Sheet 3 of 7)

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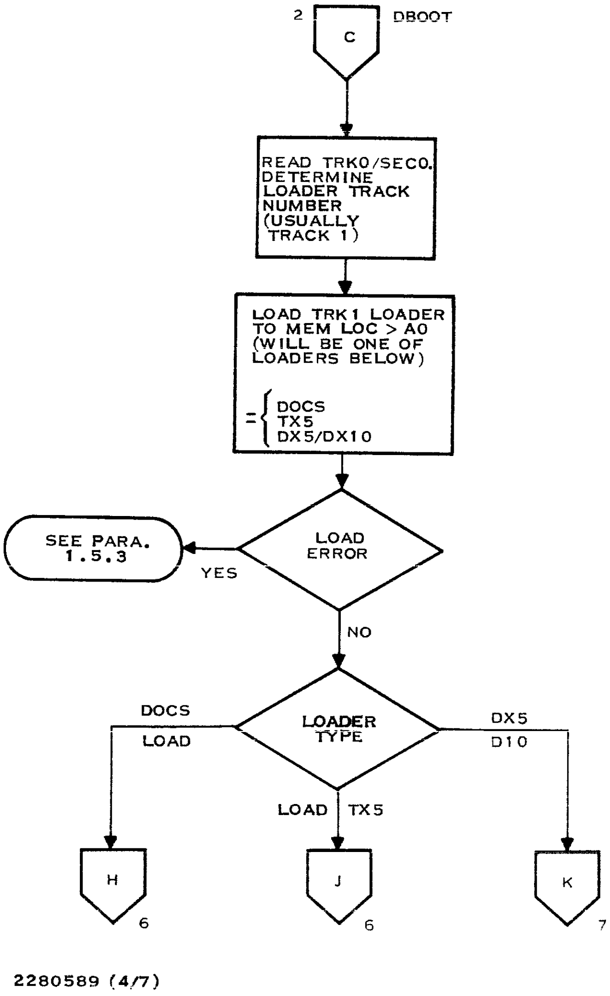

Figure 1-1. DS990 Loading Sequence Flowchart (Sheet 4 of 7)

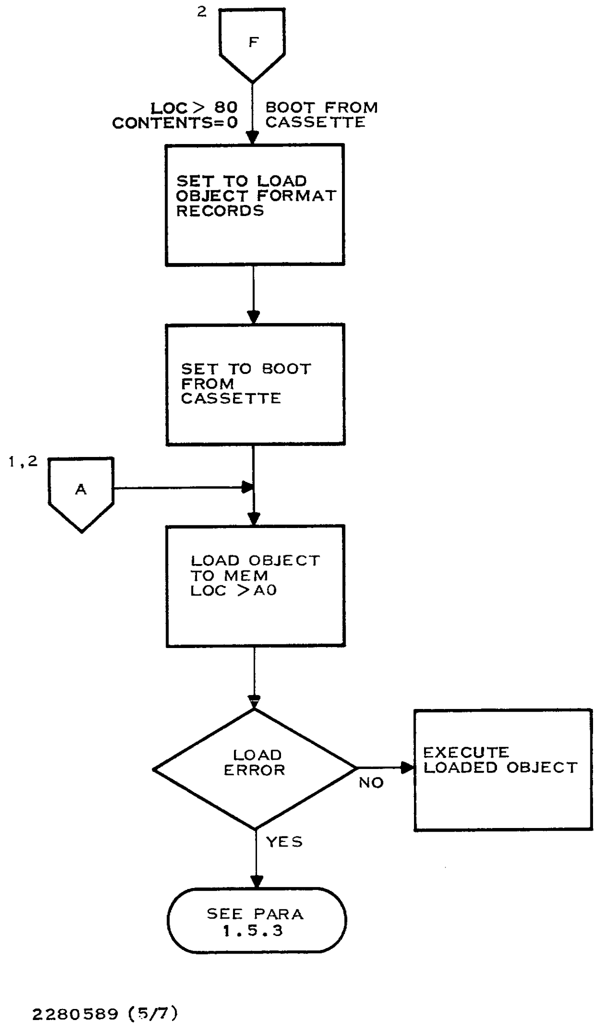

Figure 1-1. DS990 Loading Sequence Flowchart (Sheet 5 of 7)

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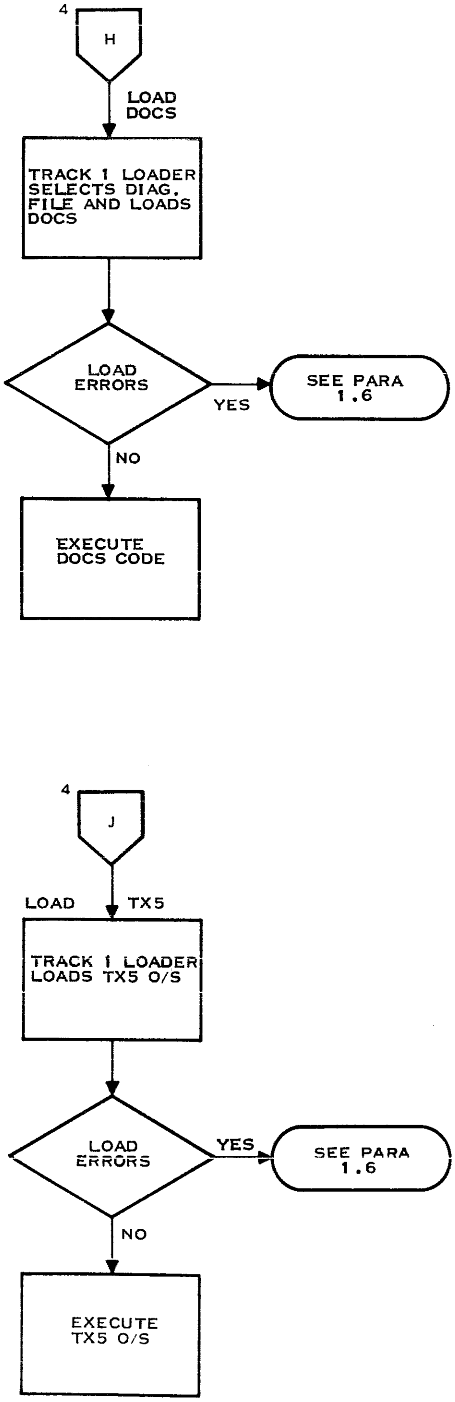

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Figure 1-1. DS990 Loading Sequence Flowchart (Sheet 6 of 7)

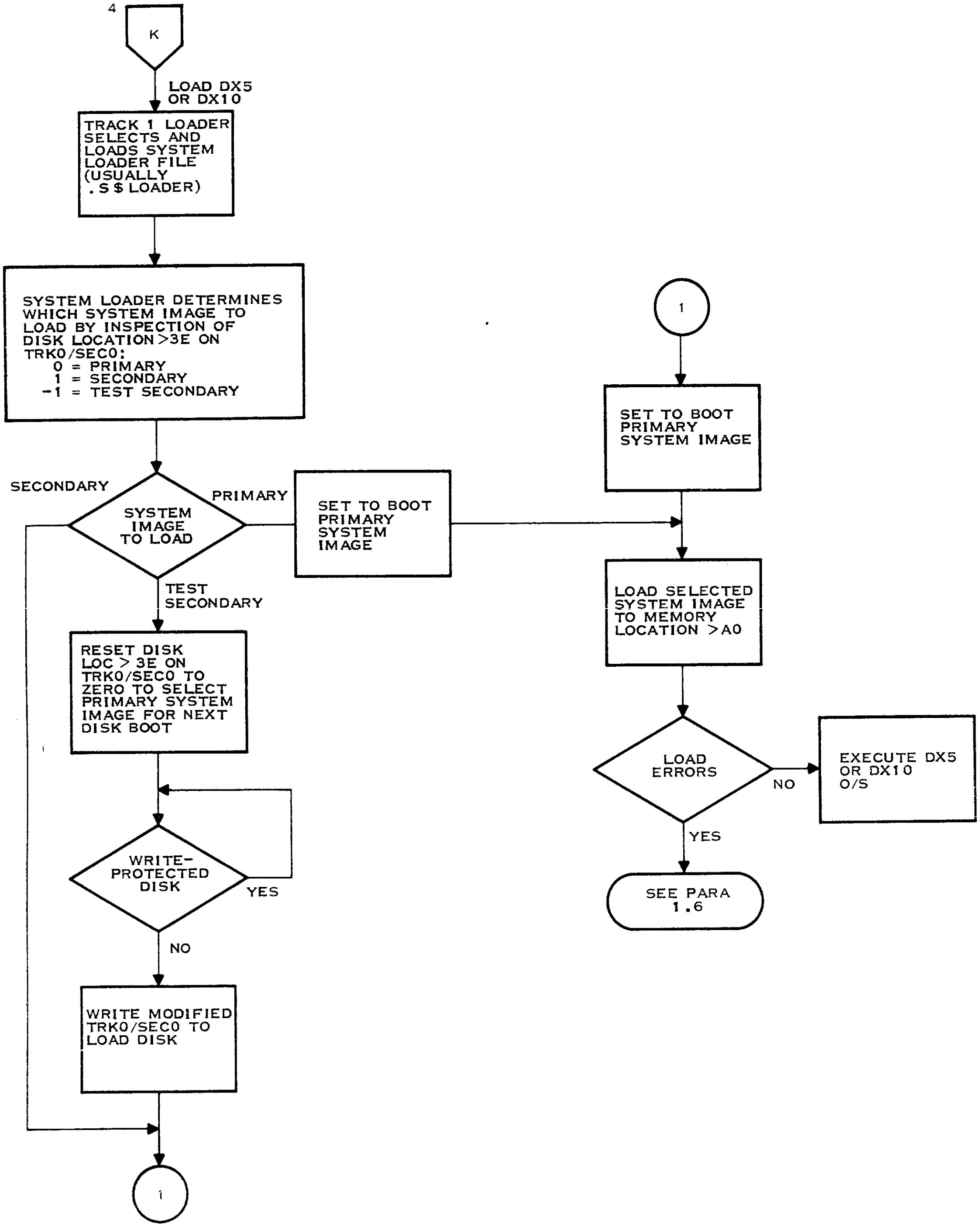

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Figure 1-1. DS990 Loading Sequence Flowchart (Sheet 7 of 7)

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1.4.1 Loading from a Disk

Before performing any of the following disk loading procedures, the load disk or disk pack must be mounted and the load device must be ready. These procedures apply to DSDD diskettes, mounted in FD1000 flexible disk units connected to a TILINE controller, and to the various types of hard disks used with DS990 systems. The disk may be write-protected. However, the software being loaded often requires that write protection be off.

1.4.1.1 Using the Programmer Panel to Load from a Disk. The switches on the programmer panel may be used to select the load device, and the indicators on this panel will display any error codes issued by the self-test or the loader.

Loading from a Default Disk Unit. The default disk unit is unit 0 of the disk controller at TILINE address >F800. To load from the default disk unit, perform the following steps at the programmer panel:

1. Press the HALT/SIE switch.
2. Press the RESET switch.
3. Press the LOAD switch.

The load should now take place.

Loading from a Specific Disk Unit. The following procedure applies when the load device is a disk unit other than unit 0 on the disk controller at TILINE address >F800. To load from a specific disk unit at the default TILINE address, perform the following steps at the programmer panel:

1. Press the HALT/SIE switch.
2. Press the RESET switch.
3. Press the CLR switch.
4. Set the data switches to >0084.
5. Press the MA switch under ENTER.
6. Press the CLR switch.
7. Set the data switches to the select code shown in Table 1-1 for the load device.
8. Press the MDE switch.
9. Press the LOAD switch.

The load should now take place.

Table 1-1. Disk Unit Select Codes

Disk Unit	Select Code (Hexadecimal)
0	0800
1	0400
2	0200
3	0100

Loading at a Different Disk Controller Address. The following procedure is appropriate when the disk controller (or the one that controls the desired disk unit) is not at TILINE address >F800. To load from a specific disk unit at a nondefault TILINE load address, perform the following steps at the programmer panel:

1. Press the HALT/SIE switch.
2. Press the RESET switch.
3. Press the CLR switch.
4. Set the data switches to >0082.
5. Press the MA switch under ENTER.
6. Press the MDD switch.
7. Set the data switches to the TILINE address of the desired disk controller.
8. Press the MDE switch.
9. Press the MAI switch.
10. Set the data switches to the select code shown in Table 1-1 for the load device.
11. Press the MDE switch.
12. Press the LOAD switch.

The load should now take place.

1.4.1.2 Using the Operator Panel to Load from a Disk. The operator panel does not provide any means of selecting the TILINE address or unit select of the load device. Therefore, selecting the disk unit requires the magnetic tape units at TILINE address >F880 and other disk units at TILINE address >F800 to be not-ready. The load device is the lowest-numbered write-protected disk unit. If no ready disk units are write-protected, then the lowest-numbered ready unit is the load device. The software being loaded often attempts to write to the load device.

NOTE

> The load device must be connected to the controller at TILINE address >F800.

To load using the operator panel, perform the following steps:

1. Ensure that no magnetic tape unit connected to the controller at TILINE address >F880 is ready.
2. Ensure that no disk unit on the controller at TILINE address >F800 is write-protected, other than the load device.
3. Ensure that no disk unit on the controller at TILINE address >F800 having a number lower than that of the load device is ready.
4. Turn the key switch on the operator panel to the LOAD position and release.

The load should now take place.

1.4.2 Loading from Magnetic Tape

Before performing either the programmer panel or the operator panel load procedures listed in the following paragraphs, mount the load tape reel, position the tape at the load point, and make the magnetic tape unit ready, as described in the MT — Magnetic Tape section of this manual.

NOTE

> Ensure that the correct tape is being used. In case of DX10 disk build tapes, the first tape of the tape set must be loaded first

1.4.2.1 Using the Programmer Panel to Load from Magnetic Tape. To load from a magnetic tape, perform the following steps at the programmer panel:

1. Press the HALT/SIE switch.
2. Press the RESET switch.
3. Press the CLR switch.
4. Set the data switches to >0082.

5. Press the MA switch under ENTER.
6. Press the MDD switch.
7. Set the data switches to the TILINE address of the desired magnetic tape controller (typically, >F880).
8. Press the MDE switch.
9. Press the MAI switch.
10. Set the data switches to the select code shown in Table 1-2 for the load device.
11. Press the MDE switch.
12. Press the LOAD switch.

The load should now take place.

Table 1-2. Tape Unit Select Codes

Tape Unit	Select Code (Hexadecimal)
0	8000
1	4000
2	2000
3	1000

1.4.2.2 Using the Operator Panel to Load from Magnetic Tape. The operator panel provides no means of selecting the load device. Therefore, selecting the load device requires that any lower-numbered magnetic tape units not used for loading are not-ready. The load device must be connected to the controller at TILINE address >F880. To load a routine, perform the following steps:

1. Ensure that all magnetic tape units on the controller at TILINE address >F880 that have numbers lower than that of the load device be not-ready.
2. Turn the key switch on the operator panel to the LOAD position and release.

The load should now take place.

1.4.3 Loading from Single-Sided, Single-Density Diskette

Before attempting to load from a SSSD diskette, verify that the diskette controller is installed at CRU address >0080, that the load diskette is mounted, and that the flexible disk drive is in the ready state. Diskette unit 0 must be the load device, or the units with numbers lower than that of the load device must be not-ready. To load a software routine, perform the following steps at the programmer panel.

1. Press the HALT/SIE switch.
2. Press the RESET switch.
3. Press the CLR switch.
4. Set the data switches to >0080.
5. Press the MA switch under ENTER.
6. Press the MDE switch.
7. Press the LOAD switch.

The load should now take place.

1.4.4 Loading from a Cassette

When loading from a cassette, the following considerations apply:

- To load software into a 990/10 or 990/12 computer from a cassette, the 733 ASR must be at CRU address >0000.
- To load software into a 990/5 computer, the 733 ASR must be at CRU address >1700.
- The load cassette must be mounted in the playback cassette unit as determined by the position of the RECORD/PLAYBACK switch on the 733 ASR switch panel.
- The cassette tape must be positioned at the load point by rewinding to the beginning of the tape and pressing the LOAD switch for the cassette unit.
- The TAPE FORMAT switch on the switch panel must be set to the LINE position.

To load a software routine, perform the following steps at the programmer panel:

1. Press the HALT/SIE switch.
2. Press the RESET switch.
3. Press the CLR switch.
4. Set the data switches to >0080.
5. Press the MA switch under ENTER.

6. Press the CLR switch.
7. Press the MDE switch.
8. Press the LOAD switch.

The load should now take place.

1.4.5 Loading from the Maintenance Display Unit

NOTE

> For complete information on connecting and operating the maintenance display unit (MDU), *Model 990/10 Computer Field Maintenance Manual*, part number 946295-9701.

To load software from the MDU, verify that the MDU has been connected in place of the programmer panel or operator panel of the computer. Mount the load cassette in the MDU cassette unit. To load from the MDU cassette, perform the following steps:

1. Press the RESET switch on the MDU.
2. Press the REWIND switch on the MDU.
3. Press the HALT/SIE switch on the programmer panel of the MDU.
4. Press the RESET switch on the programmer panel of the MDU.
5. Press the LOAD switch on the MDU, *not on the MDU programmer panel.*

The load should now take place.

1.4.6 MDU Programmer Panel

The MDU programmer panel may be used like the standard 990 programmer panel when connected in place of the programmer panel or operator panel, except as noted in the paragraphs on error indications in this section.

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1.5 LOADING ERRORS

The universal ROM loader contains a self-test that is executed prior to loading the software. The self-test exercises the computer to determine that the computer is sufficiently operational to load and to execute software. If it is not operational, the self-test displays error indications and halts without performing the load operation.

CAUTION

Attempting to execute the loader following a self-test failure without first repairing the computer can destroy the software. Be sure to have a backup copy of the load medium before loading after a self-test failure.

The error indications are displayed on the programmer panel and are supplemented by error indicators on the circuit boards of the computer. The tests, and therefore the errors, differ for each computer. The self-test errors are described in the following paragraphs. Following the self-test error descriptions are lists of the loader errors. Loader error codes also are displayed on the programmer panel.

1.5.1 ROM Loader Error Reporting

There are some changes in the way errors are reported in the new universal loader ROMs for the 990/5, 990/10, and 990/12 computers. The different error reporting methods are described in Table 1-3.

Table 1-3. Old and New Error Reporting Methods

Error On	Old	New
Object load	IDLE light set.	FAULT light flashing, number of record in error is displayed in data lights.
CRU floppy boot	If no default device: FAULT light flashing, >F001 displayed in data lights.	Retries floppy boot.
	If default device: Try loading from default device.	Retries floppy boot.
CRU floppy unit error	FAULT light flashing, controller status word displayed in data lights with nonerror bits masked.	FAULT light flashing, controller status word displayed in data lights.

Table 1-3. Old and New Error Reporting Methods (Continued)

Error On	Old	New
TILINE load	Controller error: >D002 (disk) or >D001 (mag tape) displayed in data lights.	Controller status word displayed in data lights with bits 0-6 masked out. RUN LED lit; FAULT LED flashes.
	Device error: >D002 (disk) or >D001 (mag tape) displayed in data lights.	Device status words displayed in data lights with bits 8-15 masked out. RUN LED lit; FAULT LED flashes.
Checksum error in ROM code	990/5: FAULT light flashing. BAD displayed in data lights.	FAULT light flashing, >FFFF displayed in data lights.
	990/10: IDLE light set.	FAULT light flashing, >FFFF displayed in data lights.

1.5.2 ROM Loader Self-Test Errors

1.5.2.1 990/5 Computer Self-Test Errors. The ROM self-test for the 990/5 computer tests the following:

- CPU test — Exercises the CPU instructions.
- Memory test — Checks all memory locations through >F7FE except for the workspace used by the self-test routine.
- I/O port test — Exercises the TMS 9902 and TMS 9903 I/O ports in the test mode that is provided in the port circuitry.
- ROM checksum test — Verifies the integrity of the contents of the universal ROM loader.

When the CPU test fails:

1. The computer enters a loop.
2. The display on the programmer panel is undefined, but the RUN and FAULT indicators are lit.
3. The loader cannot be executed until the CPU has been repaired.

When the memory test fails:

1. The self-test flashes the failing memory address on the programmer panel display. The memory address is displayed five times with the FAULT indicator off.
2. Following the flashing display, the IDLE, FAULT, and RUN indicators are lit.
3. Press HALT and RUN to execute the loader.
4. To display the failing memory address (in register 7 of the self-test workspace), press the HALT/SIE switch and the MA switch under DISPLAY on the programmer panel.

When the I/O port test fails:

1. The self-test flashes the CRU address of the failing I/O port on the programmer panel display five times with the FAULT indicator lit.
2. Following the flashing display, the IDLE and RUN indicators are lit.
3. Press HALT and RUN to execute the loader.
4. To display the CRU address of the failing I/O port (in register 7 of the self-test workspace), press the HALT/SIE switch and the MA switch under DISPLAY on the programmer panel.

When the ROM checksum test fails:

1. The computer enters a loop with >FFFF displayed on the programmer panel.
2. The RUN indicator is lit.
3. The FAULT indicator is flashing.

1.5.2.2 990/10 Computer Self-Test Errors. The self-test for the 990/10 computer verifies the integrity of the contents of the universal ROM loader.

When the 990/10 computer self-test fails:

1. The computer enters a loop with >FFFF displayed on the programmer panel.
2. The RUN indicator is lit.
3. The FAULT indicator is flashing.

1.5.2.3 990/12 Computer Self-Test Errors. The self-test for the 990/12 computer tests the following:

- Microcode test (Test #1) — Executes an Execute Microdiagnostic (EMD) instruction to test the microcode.
- Assembly language instructions (Test #2) — Exercises the assembly language instructions.

- TILINE operation test (Test #3) — Exercises the TILINE addressing and mapping circuitry.
- Memory test (Test #4) — Exercises locations >00000 through >000FE, >00120 through >0F7FE, and >10000 through >1FFFE.
- Level 2 (internal) interrupt test (Test #5) — Checks that an interrupt actually occurs for each internal error condition, and the interrupt sets the error interrupt status register correctly.
- Levels 3 through 15 (external) interrupt test (Test #6) — Verifies that the interrupt priority is observed and that lower priority pending interrupt occurs when higher priority interrupt processing has completed.

Errors in executing the 990/12 self-test are indicated on the programmer panel and on the fault indicators on the arithmetic unit (AU) board and system mapping interface (SMI) board of the CPU. Table 1-4 lists the error codes displayed on the programmer panel. When an error occurs in a subtest, the FAULT indicator on the programmer panel is lit. Additional indicators may be lit as shown in Table 1-4.

Table 1-4. 990/12 Computer Self-Test Errors

	Board LEDS			Programmer Panel LEDs			
Test	AU CR1	SMI CR2	SMI CR1	Fault	Run	Data Display	AU Lockup
EMD							
AU	X		X	X			Yes
SMI		X	X	X			Yes
AU or SMI			X	X			Yes
ALC Self-Test							
Hung				X	X	>0100	Yes
Runaway Program				X	X	>0200	No
Instruction				X	X	>0400	No
TILINE				X	X	>0800	No
Memory*				X	X	>1000	No
Level 2 Int.				X	X	>2000	No
Levels 3-15 Int.					X	>4000	No

Notes:

* One memory error: The 20-bit TILINE address is stored in programmer panel workspace register 8 (normally MA 0088 containing the 4 MSB) and register 10 (normally MA 008A containing the 16 MSB).

1. EMD = Execute Microdiagnostics; ALC = Assembly Language Code.
2. Power applied to chassis executes EMD.
3. LOAD button executes EMD and ALC self-test.
4. To recover from a lock-up, cycle ac power. (Errors in four of the tests leave the AU locked up.)

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When the load device is the MDU cassette, the RUN indicator on the programmer panel remains off; furthermore, the procedure (paragraph 1.4.5) for executing the loader without having successfully completed the self-test does not apply. The only recovery when loading from the MDU cassette is to repair the computer.

To repair the computer, notice the fault indicators on the AU and SMI boards. If the fault indicator on either board is lit, replace that board. If the fault indicators on both boards are lit, or if the indicators are both off, replace both boards.

Four of the 990/12 self-test errors leave the computer locked up. In the lockup condition, the computer is executing microcode without returning to the instruction level. The HALT/SIE switch on the programmer panel cannot transfer control to the programmer panel routine; that is, none of the switches on the programmer panel affect the operation of the computer. To recover from a lockup, turn the ac power to the computer off and then on. The ac power switch is at the rear of the computer chassis.

CAUTION

In case of a self-test failure, be sure to make a backup copy of the load medium before executing the loader. Attempting to load the software without repairing the computer can destroy the load medium.

To load software when the self-test has failed, enter the loader routine at the starting address and execute the loader. The hardware failure that caused the self-test to fail may interfere with proper loading and/or execution of the software. The failure may also destroy the software being loaded, or other data on the medium from which the software is loaded. The following procedure does not apply when software is being loaded from the MDU cassette. To execute the loader routine, perform the following steps at the programmer panel:

1. Press the HALT/SIE switch.
2. Press the CLR switch.
3. Set the data switches to >0080.
4. Press the MA switch under ENTER.
5. Press the MDD switch to display the contents of address >0080.
    a. When loading from a disk, DSDD diskette, or magnetic tape, skip to step 8 if the display shows a negative number.
    b. When loading from an SSSD diskette, skip to step 16 if the display shows a positive number.
    c. When loading from a 733 ASR cassette, skip to step 16 if the display shows zero.

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6. Perform the following substep that applies to the loading device:
    a. When loading from a disk, DSDD diskette, or magnetic tape, set the data switches to >8000.
    b. When loading from an SSSD diskette, press the MA switch under DISPLAY.
    c. When loading from a 733 ASR cassette, press the CLR switch.
7. Press the MDE switch. When loading from a SSSD diskette or a 733 ASR cassette, skip to step 16.
8. Press the MAI switch.
9. Press the MDD switch to display the TILINE address of the loading device. The typical TILINE address is >F800 for disk or DSDD diskette, or >F880 for magnetic tape. When the address is correct, skip to step 12.
10. Set the data switches to the correct TILINE address.
11. Press the MDE switch.
12. Press the MAI switch.
13. Press the MDD switch to display the unit select code.

    The correct codes are as follows:

Disk unit 0	>0800
Disk unit 1	>0400
Disk unit 2	>0200
Disk unit 3	>0100
Tape unit 0	>8000
Tape unit 1	>4000
Tape unit 2	>2000
Tape unit 3	>1000

If the unit select code is already correct, skip to step 16.

14. Set the data switches to the correct unit select code.
15. Press the MDE switch.
16. Set the data switches to >FC1C.
17. Press the PC switch under ENTER.
18. Press the RUN switch.

1.5.3 Loader Error Codes

Loader error indications are displayed on the programmer panel; the displays are the same for all computers, but different for different load devices. When the load device is a disk or DSDD diskette unit, a loader error causes the RUN indicator to remain lit, the FAULT indicator to flash, and the display to contain a value other than >FFFF. The value is an error code listed in Table 1-5.

Table 1-5. Disk Loader Error Codes

Error Code (Hexadecimal)	Meaning
01XX	Controller error. The status bits 7 - 15 from the controller are represented by 01XX.
XX00	Unit error. The unit status bits from the controller are represented by XX.
D001	The disk does not contain software on track 1 that the loader can load. The byte count in track 0, sector 0, is zero. (This does not apply to a system disk.)

The controller status bits and unit status bits returned by the controller are described in the applicable section of this manual for the specific disk or diskette unit. (See DD — Disk Drives.)

When the load device is a magnetic tape unit, a loader error causes the RUN indicator to remain lit, the FAULT indicator to flash, and the display to contain a value other than >FFFF. The value is an error code listed in Table 1-6.

Table 1-6. Tape Loader Error Codes

Error Code (Hexadecimal)	Meaning
0XXX	Controller error. The status bits from the controller are represented by XXX.
XX00	Unit error. The unit status bits from the controller are represented by XX.
XXXX	Error in reading record XXXX.

The controller status bits and unit status bits returned by the controller are described in the MT — Magnetic Tape section of this manual.

When the load device is a cassette unit (733 ASR or MDU), a loader error causes the RUN indicator to remain lit, the FAULT indicator to flash, and the display to contain a value other than >FFFF. The value is the number of the record in the file being loaded in which the failure occurred.

When the load device is a SSSD diskette unit, a loader error causes the RUN indicator to remain lit, the FAULT indicator to flash, and the display to contain a value other than >FFFF. The value displayed is the status word returned by the FD800 controller. The status word is described in the disk drive section for the FD800 diskette unit.

1.6 OPERATING SYSTEM LOADER ERRORS

The intermediate loader that is read into memory by the ROM loader will encounter errors if the proper files and control information are not present on the system disk(ette). This class of loading error may be recognized by the distinctive display in the data lights. When this type of error occurs, the FAULT light and the leftmost eight data lights flash on and off while the error code is constantly displayed in the rightmost eight data lights. Thus, this type of error is commonly called a "flash crash" and the error code displayed is called a "flash code". The flash codes for each operating system are listed in the following paragraphs.

1.6.1 TX5 (Model 2) Flash Codes

The system loader error codes for the TX5 system are defined in Table 1-7.

Table 1-7. TX5 System Loader Error Codes

Error Code (Hexadecimal)	Error Message
0010	Abnormal completion
0011	ID word error
0012	Rate error
0013	Controller timeout
0015	Data error
0016	TILINE timeout
0017	Search error
0018	Offline
0019	Not ready
001A	Write protect
001B	Unit check
001C	Illegal disk address
001D	Seek incomplete
0030	Premature end-of-file encountered
0062	Checksum error
0063	System file not found (possibly not a system disk)

1.6.2 DX5, DX7, and DX10 Error Flash Codes

The set of error codes that may be displayed on the front panel by the DX5, DX7, and DX10 system loaders are listed in Table 1-8. Additional DX5 error flash codes are listed in Table 1-9.

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Table 1-8. DX5, DX7, and DX10 Error Flash Codes

Error Code	Error Message	Action/Explanation
01	DISK I/O ERROR	System Error: A hardware error prevents proper reading of the disk being booted. User Action: Retry the boot operation. If it is still unsuccessful, examine the disk drive and disk cartridge for physical damage or malfunction.
02	NOT ENOUGH MEMORY IN THE SYSTEM	System Error: The system hardware configuration contains less than the minimum amount of memory needed to support DX10. User Action: Check to see if physical memory is adequate and working properly.
03	UNABLE TO FIND SYSTEM DISK PDT	System or User Error: The system configuration does not include a physical device table for the disk from which the system is to be booted. Either one has not been generated into the system, or the structure has been destroyed. User Action: Check the system configuration to make sure it includes the system disk, or move the cartridge to a drive that is included and reboot.
04	ERROR IN PROGRAM FILE DIRECTORY	System Error: The loader cannot locate the system to be booted in the system image file, .S$IMAGES. User Action: Check to see if the file and the desired system exist. If necessary, use the Modify Volume Information (MVI) command or the Install Generated System (IGS) command to set up the system.
05	SYSTEM MEMORY MANAGEMENT ERROR	System Error: An error has been detected in system memory management routines, possibly memory parity or software problems. User Action: Retry the boot.
06	DISK BIT MAP ROUTINE ERROR	System Error: An error has been detected in the system disk bit map handler routine. User Action: Retry the boot.
07	UNABLE TO BID MEMORY RESIDENT TASK	System Error: The system loader is unable to bid a memory resident task. User Action: Boot a backup system and issue a Map Program File (MPF) command for the new system's program file. Check to see if all the memory-resident tasks are correctly entered in the system program file.

Table 1-8. DX5, DX7, and DX10 Error Flash Codes (Continued)

Error Code	Error Message	Action/Explanation
08	UNABLE TO FIND LOADER FILE	System Error: The loader on track 1 cannot access the intermediate loader (.S$LOADER).
		User Action: Boot a backup disk. The bad disk may be recovered by copying all its files to the backup disk, performing an INV on the bad disk, and recopying the files to it.
09	UNABLE TO FIND SYSTEM IMAGE FILE	System or User Error: The system image file cannot be found.
		User Action: Boot a backup system and use MVI to check for correct volume information. If so, verify that the system file exists.
0A	UNABLE TO FIND A SYSTEM SEGMENT	System Error: One of the task or overlay segments of the segments of the system is missing from the system image program file.
		User Action: Boot a backup system. Check the link map of the bad system to verify that all segments were linked properly.
0B	UNABLE TO FIND VCATALOG	System Error: The disk volume catalog cannot be accessed.
		User Action: Boot a backup disk. The bad disk probably needs to be initialized.
0C	UNABLE TO FIND SYSTEM OVERLAY FILE	System or User Error: The system overlay file has been destroyed or the volume information is incorrect.
		User Action: Boot a backup system. Use MVI to verify the volume information, then check to see that the overlay file exists.
0D	UNABLE TO FIND SYSTEM PROGRAM FILE	System or User Error: The system program file has been destroyed or the volume information is incorrect.
		User Action: Boot a backup system. Use MVI to verify the volume information, then verify that the program file exists.
0E	UNABLE TO FIND SYSTEM ROLL FILE	System or User Error: The roll file does not exist.
		User Action: Boot a backup disk. Use MD to map the bad disk and verify that the roll file (.S$ROLLA) does exist, or use CSF to create it.

Table 1-8. DX5, DX7, and DX10 Error Flash Codes (Continued)

Error Code	Error Message	Action/Explanation
0F	OVERLAY FILE CHARACTERISTICS CONFLICT	User Error: A copy of the .S$OVLYA file has conflicting characteristics: file is not relative record file, record length does not equal 800, or file is blank suppressed. Action: Create file correctly.
10	INTERRUPT 2 TRAP	Hardware Error: Hardware error in S$LOADER. There was a task error: parity error, illegal instruction, TILINE time-out, or mapping error. Action: Refer to troubleshooting flowchart.
11	WCS FILE NOT AVAILABLE	User Error: For 990/12, file specified in MVI for Writeable Control Store (WCS) was not found. Action: Verify that filename specified is correct.

Table 1-9. Additional DX5 Flash Codes

Code (Hexadecimal)	Meaning	Action/Explanation
0046	Volume name of system disk is blank	The volume information record does not contain the volume name. Load system from another disk. Verify the disk.
0047	System program file name is blank	The volume information record does not contain the system program file name. Load system from another disk. Verify the disk.
0048	System program file specified is not a program file	The file specified as the system program file in the volume program file information record is not a program file. Load system from another disk. Verify the disk.
0049	Unable to assign LUNO to S$FGTCA file or close S$FGTCA file	The close or assign LUNO operations are failing, or the disk does not have space for the S$FGTCA file. Load system from another disk. Verify the disk.
004A	Unable to assign LUNO to S$TCALIB file	The assign LUNO operation is failing, or the disk does not have space for the S$TCALIB file. Load system from another disk. Verify the disk.

Table 1-9. Additional DX5 Flash Codes (Continued)

Code (Hexadecimal)	Meaning	Action/Explanation
004B	Unable to assign LUNO to system program file or file management or file utility error	File management or file utility operations are failing, or system program file does not exist. Load system from another disk. Verify the disk.
004C	System disk is write-protected	Remove write protection and load the system.

1.7 LOADING DOCS

The diagnostic operational control system (DOCS) may be loaded by the standard ROM loader. If DOCS is being loaded from the system disk drive unit (TILINE >F800 and Unit 0), the procedure in paragraph 1.4.1 may be followed, except that it is required that the disk unit be write-protected (DS10) or set to READ ONLY (DS25/50/200). DOCS media CRU diskettes and cassette tapes may be loaded from the appropriate load devices by following instructions in paragraphs 1.4.4 through 1.4.6. Refer to *Model 990 Computer Diagnostic Handbook*, Volume I, part number 945400-9701 for DOCS initialization procedures.

1.7.1 Diagnostic Procedures - DX10/DOCS Coresident

The following is a procedure to use for diagnostics when DOCS and DX10 are coresident on a customer's disk or the system backup disk.

All customers are advised in the DX10 release information to make a backup copy of their system disk before any alterations are made to it. Therefore, DMXDOCS and the diagnostic tests should be the selected software on the customer's system disk and/or system backup disk. Enter the list directory (LD) command to verify that DMXDOCS and the diagnostic are indeed available. Use .VCATALOG as the pathname for the system disk, or <backup disk name>.VCATALOG as the pathname for the backup disk. In the following example of the LD command, <CR> indicates carriage return.

```
LIST DIRECTORY
                    PATHNAME:  .VCATALOG<CR>
         LISTING ACCESS NAME:  <CR>
```

If DMXDOCS and the applicable diagnostic tests are not available, they must be supplied by the CR. When DOCS and DX10 are coresident on a disk, DOCS must be the software that is selected to run diagnostics. Either DOCS or DX10 may be made the selected software on a disk by using the MVI SCI command. The parameter used to place the software in the selected position is the SELECT flag. This parameter should be changed from primary (P) to test (T) or from primary (P) to secondary (S). Selection of (T) allows DOCS to be booted one time, while selection of (S) allows DOCS to be booted repeatedly. It is recommended that parameter (T) be selected the first time to eliminate the possibility of making the customer's disk unable to boot DX10. In the following example of MVI command, <CR> indicates carriage return. Note that first level file names specified while using this command are not preceded by a period (.).

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```
MODIFY VOLUME INFORMATION
  CONTROL ACCESS NAME: ME <CR>

MVI 05/03/79
DISC?: <CR>
COMMAND (L,C,Q,S)?:         C <CR>
WHICH ITEM (S,O,P,L,D,V,W)?:  L   <CR>
PRIMARY:     S$LOADER <CR>
SECONDARY: DMXDOCS <CR>
SELECT:        P    T <CR>
COMMAND (L,C,Q)?:   Q <CR>
MVI TERMINATED
```

The disk must now be rebooted to load DOCS. After DOCS is loaded, the disk must be write-protected to run diagnostic tests. After diagnostic testing is complete, DX10 may be reloaded without rebooting by using the DOCS system loader verb (.LD). The DX10 loader .S$LOADER should be selected from the DOCS loader menu as the test to be loaded by DOCS, with a load bias of >A0. When this is done, the following message may be displayed:

```
***** WARNING **** THIS MAY OVERLAY DOCS

        DOCS MAY HAVE TO BE RELOADED TO UPPER MEMORY
        ARE YOU SURE?
        DEFAULT = 0 — 1 <CR>
```

A logic one is entered to allow overlay of DOCS by system loader .S$LOADER. DX10 will boot, but write-protect must be removed from the disk before DX10 is useful.

The CR should leave the customer's disk(s) in the same state as before any testing was done. Specifically, if the MVI command was used to change the loader from the (P) to the (S), it should be changed back at this time. If the customer's disk(s) would not boot after testing was done, a flash code of >FF08 will indicate that the specified loader could not be found. This condition may be corrected by the following: Modify word >7E of track 0, sector 0, to zero. This is the LOADER SELECT flag. Values (hexadecimal) of this word are:

- FFFF — Test
- 0000 — Primary
- 0001 — Secondary

2

System Initialization Procedures and Errors

2.1 GENERAL

This section contains information on the following:

- Initialization of the operating system
- Operating system initialization errors

2.2 OPERATING SYSTEM INITIALIZATION — WARMSTART PROCEDURES

The following paragraphs describe warmstart initialization procedures to be performed when the system software has been loaded from the system disk or diskette. Choose the procedure that corresponds to the operating system being loaded.

2.2.1 TX5 Initialization Procedures

The following paragraphs provide two initialization procedures: one for use when the operator communication package (OCP) is included in the operating system, and the other for use when the control program is included. When OCP is included, the OCP commands may be entered on the system console; when the control program is used, responses also may be entered on the system console. The device that printed the header message is the system console. The system console may be a Model 733 ASR data terminal, a Model 820 KSR data terminal, or a Model 911 VDT, as specified during system generation.

2.2.1.1 Initializing TX5 Using OCP. To initialize using OCP, proceed as follows:

1. Reset the terminal by pressing the blank orange key on the 911 VDT. (ESC key on the 733 and 820.)

2. Enter an exclamation point (!) at the keyboard of the system console. This activates OCP which responds by printing a period (.) to request entry of a command.

3. Assign LUNO 1 to an output device on which information is to be displayed or printed. Table 2-1 lists device names in the operating system supplied by Texas Instruments. The standard TX5 system assigns LUNO 1 to the system console. The following is an example of a command to assign LUNO 1 to a line printer. The command is followed by a carriage return.

```
.AL,1,LP01.
```

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4. When TX5 includes date and time support, initialize the date and time by entering the following command followed by a carriage return:

```
.ID,<year>,<month>,<day>,<hour>,<minute>.
```

All operands are numeric values.

The operating system responds by printing time and date information in the following format:

```
15:42:18 APR 3, 1980
```

At this point, TX5 is initialized and other commands may be entered to perform available functions.

Table 2-1. Standard TX5 Device Names

Device	Device Name
733 ASR/KSR keyboard/printer	ST01
743 KSR keyboard/printer	ST01
820 KSR keyboard/printer	ST01
733 ASR cassette unit 1 (unit on left)	CS01
733 ASR cassette unit 2 (unit on right)	CS02
Line printer	LP01
911 VDT	ST01
Dummy	DUMY
Disk unit	DSnn*
979A magnetic tape unit	MT01

Note:

* Characters nn represent the number of the disk drive, e.g., 01, 02, etc.

2.2.1.2 Initializing TX5 Using the Control Program. To initialize using the control program, proceed as follows:

1. Press the blank orange key to reset (ESC key on the 733 and 820).
2. Enter an exclamation point (!) at the keyboard of the system console. This activates the control program which prints the following header and prompt:

```
TX5DS:     v.r.e    yy.ddd
PROGRAM:
```

3. Activate the disk OCP system utility program (SYSUTL) by responding as follows:

```
PROGRAM:     .SYSUTL/SYS*
```

4. SYSUTL prints the following header and prompt:

```
SYSUTL:     v.r.e   yy.ddd   SYSTEM UTILITY
OP:
```

5. Initialize the time and date by responding to the prompt as follows:

```
OP:ID,<year>,<month>,<day>,<hour>,<minute>.TE.
```

The operands are decimal numeric values. SYSUTL returns control to the control program which repeats the PROGRAM: prompt.

TX5 initialization is complete.

2.2.2 DX5, DX7, and DX10 Initialization Procedures

Upon initial load of DX10, the front panel indicator lights (on the programmer panel) represent graphs of system disk and CPU use. The leftmost eight lights represent a dynamic bar graph (originating from the left) of system disk use based on a disk state of busy. The rightmost eight lights represent a dynamic bar graph (originating from the right) of CPU use based on the assumption that the CPU is being used when not executing an IDLE instruction. The actual display represents a collection of samples averaged over a one-second interval, and therefore does not display instantaneous fluctuations in either CPU or disk use.

After loading the operating system (OS) and activating the SCI at a terminal (on the 911 VDT by pressing the blank orange key, followed by SHIFT and !), a user can enter the Initialize System (IS) command to ready the OS for operation. The IS command initializes the system with information entered by the user and information supplied to the system by the IS command itself.

The IS command automatically assigns the global LUNOs needed by the system to operate. If properly set up, the IS command also defines the characteristics of the terminals in the system. (This does not apply to DX5.) To set up the IS command so that it automatically assigns characteristics to terminals, users must add Modify Terminal Status (MT) commands to the text of the IS command itself by following the procedure given in Section 15 of *DX10 Operating System Release 3, Volume II, Production Operation*.

Besides the actions automatically taken by the IS command, the command also interacts with the user to initialize the following:

- System date and time
- System log (not supported on DX5 or DX7)

NOTE

> On DX7 systems, the IS command default mode for all terminals is no log-in and the data terminal (VDT) mode.

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2.2.2.1 DX7 DSDD Secondary Drive Operation. On DX7 systems, if a secondary DSDD drive access door is opened during system operation, the current volume on the secondary drive must be unloaded using the Unload Volume (UV) command before any access to the secondary drive is attempted. Otherwise, a system crash will occur. The same volume or another volume can then be loaded using the Install Volume (IV) command.

2.2.2.2 IS Command Format. The IS command format is as follows:

```
[ ]IS
INITIALIZE SYSTEM
INITIALIZE DATE AND TIME
YEAR:
MONTH:
DAY:
HOUR:
MINUTE:
INITIALIZE SYSTEM LOG*
ATTENTION DEVICE:*
LOGGING DEVICE:*
FILE PROCESSING?:*
SYSTEM LOG PROCESSING TASK ID:* (Messages appear only if file processing is
                                specified)
USER LOG PROCESSOR TASK ID:*
```

Note:
* Does not apply to DX7

2.2.2.3 IS Command User Responses. The IS command prompts and responses are as follows:

System Prompts	User Responses
YEAR:	Four decimal numeric characters representing the current year.
MONTH:	One or two decimal numeric characters representing the current month or the first three alphabetical characters of the month.
DAY:	One or two decimal numeric characters representing the current day.
HOUR:	One or two numeric characters representing the current hour (according to the 24-hour clock).
MINUTE:	One or two decimal numeric characters representing the current minute.

System Prompts	User Responses
ATTENTION DEVICE:*	A device name to specify a device as the receiver of attention messages output by the system during logging process. Do not use disk device name. Instead, use the name of the terminal (810, 820, 743, 911) as LP01, ST01, etc.
LOGGING DEVICE:*	A device name to specify a device to which the system log is output. DUMY is specified if logging to a device is not desired. Do not use disk device name. Instead, use the name of the terminal (810, 820, 743, 911) as LP01, ST01, etc.
FILE PROCESSING?:*	To allow processing of log files, the user has the option of specifying that one or two tasks be bid whenever a log file is full by responding to this prompt with a Y (yes).
SYSTEM LOG PROCESSOR TASK ID:*	Respond to this prompt with the task ID of an installed task on the system program file. The task will be bid when a log file is filled. This parameter is to be used by add-on packages to DX10. An ID of 0 indicates that no task is to be bid.
USER LOG PROCESSOR TASK ID:*	Respond to this prompt with the task ID of an installed task on the system program file. The task will be bid when a log file is filled. This parameter is to be used with a user-supplied task. An ID of 0 indicates that no task is to be bid.

Note:

* Does not apply to DX7.
All user responses are required.

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2.2.2.4 IS Command Example. The following example shows how a user would enter an IS command to initialize a system that employed logging files.

```
WARNING: SYSTEM IS NOT INITIALIZED
[] IS
INITIALIZE SYSTEM
INITIALIZE DATE AND TIME
  YEAR: 1980
  MONTH: 8
  DAY: 10
  HOUR: 17
  MINUTE: 35
INITIALIZE SYSTEM LOG*
  ATTENTION DEVICE:* ST02
  LOGGING DEVICE:* ST02
  FILE PROCESSING?:* NO
WARMSTART PROCEDURE COMPLETE:
[]
```

Note:
* Does not apply to DX7

2.3 SYSTEM INITIALIZATION ERRORS

The system software may stop normal operation when a hardware error or system inconsistency occurs. This state is often referred to as a system crash. The following paragraphs describe the error reporting of TX5 and DX10.

2.3.1 TX5 Errors

When a TX5 internal error occurs, the FAULT light illuminates. An error code of 7 is displayed on the programmer panel data lights when an illegal interrupt occurs.

2.3.2 DX5 Errors

When a system error that makes the system inoperative is detected on a DS990 Model 2 system (990/5 computer), the crash code is displayed as follows: The FAULT lamp lights, the left eight front panel indicators are off, and the right eight front panel indicators display the crash code. The DX5 crash codes are listed in Table 2-2.

Table 2-2. DX5 Crash Codes

Code (Hexadecimal)	Meaning	Action/Explanation
0001	Memory parity error occurred	Can occur only if the computer is equipped with the memory parity or error correction feature. An error has occurred during execution of a system routine. Perform another Initial Program Load (IPL).
0002	Undefined instruction	An illegal operation code has been detected in system code. Perform another IPL.
0003	Illegal TILINE address	A nonexistent TILINE peripheral or a nonexistent memory location was addressed in system code. Perform another IPL.
0004	Illegal XOP	An extended operation (XOP) instruction wit with an undefined operation number (or an illegal supervisor call (SVC) was executed in system code. Perform another IPL.
0005	Invalid memory address	An access outside the address space defined by the current map was attempted in system code. Perform another IPL.
0006	Privileged instruction	A privileged instruction was attempted in nonprivileged mode within system code. Perform another IPL.
0007	Illegal interrupt	An external interrupt for which there is no interrupt routine has occurred within system code. Identify the interrupt level from the interrupt mask contents in the status register. Clear the interrupt, and perform another IPL.
003A	Unable to allocate system table area	Too many LUNOs have been assigned. Perform another IPL. Check assignment and release of LUNOs, and release LUNOs when they are no longer required.
00F0	Task loader error	Task loader cannot load task into memory. When this error occurs during IPL, check that SCI exists in program file. When this error occurs during the loading of a user task, check system program file.

2.3.3 DX7 and DX10 Errors

DX10 contains many internal consistency checks (i.e., checks for proper internal file structure, memory queues, counters, etc.). If an error is detected within the system by one of these checks, the result is a system crash.

A system crash has occurred if all terminals are locked out and the POWER, FAULT, IDLE, and RUN lights on the front panel are on. The front panel data lights at this point represent a hexadecimal crash code. The system must be rebooted to continue.

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System crashes usually occur as the result of a critical hardware error or a bug in the system software. Since these crashes result from unexpected or unforeseen circumstances, it is difficult to describe beforehand any action the user could take to correct the problem, beyond identifying (if possible) and avoiding the sequence of events that preceded the crash. If it is an obvious software problem, and the CPU, memory, and system disk controller are good, a crash dump should be analyzed to determine the cause of the system crash.

Appendix A lists the system crash codes and a description of their causes. Auxiliary information is listed with the codes that enables the user to initiate corrective action.

When the system crashes, all terminals in the system are inoperative and DX10 displays the following information on the front panel of the computer:

- The CPU data lights on the front panel of the computer display one of the system crash error codes described in Appendix A.
- The POWER, FAULT, IDLE, and RUN indicators are lit.

3

ROM Loaders, Programmer Panels, SCI Commands

3.1 GENERAL

This section contains information on the following:

- Summary of loader ROMs for all model DS990 systems
- Programmer panel controls and indicators
- Operating system SCI commands

3.2 LOADER ROMS DEVICE SUMMARY

Table 3-1 lists the part numbers of the loader ROM kits for the computers used with the various DS990 system models, along with the ROM locations and the load device summary for each set of ROMs. In each case, the part numbers of the current production ROMs are listed first, followed by ROMs used in earlier versions that are still in use in the field. The loader ROMs for the 990/5 are located on the CPU board. On the other computers, the loader ROMs are located on the SMI interface boards. All addresses are in hexadecimal notation.

Table 3-1. Loader ROMs, Locations, and Load Device Summary

Notations used in this table:

All addresses are hexadecimal
TA = TILINE Address
US = Unit Select
CA = CRU Address
DEF = Default Device
SEQ = Sequences through all units
\+ = Positive number
R/O = Read Only
Default is TILINE address >F800
Unit Select = >0800

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Table 3-1. Loader ROMs, Locations, and Load Device Summary (Continued)

ROM P/N	Loc.	Hard Disk	FD800	FD1000	979A	733 ASR	Operator Panel
			990/5 ROMs for Model 2				
2261929-0003*	UNP07	82=TA	80= +	Def	82=TA	80=0	979A = F880
2261929-0004*	UNP06	84=US	(CRU=80)	82=TA	84=US	(CRU=0)	Disks= F800
							Online, R/O, Seq.
2261929-0007	UNP07	Def	Def #2	Def	82=TA	80=0	Default only
2261929-0008	UNP06	82=TA	or 80= +	82=TA	84=US	82=CA	
		84=US	82=CA	84=US			
		Seq.	Seq.	Seq.			
			990/10 Map PWB ROM Kits for Models 3, 4, 4PP, 6, 7, 8, 8PP, 9				
945134-0019*							
975383-0047	UJ21	Def	80= +	82=TA	82=TA	80=0	979A = F880
975383-0048	UH21	82=TA	(CRU=80)	84=US	84=US	(CRU=0)	Disks= F800
975383-0045	UF21	84=US					Online, R/O, Seq.
975383-0046	UE21						
945134-0015							
975383-0037	UJ21	Def	80= +	82=TA	82=TA	80=0	Default only
975383-0038	UH21	82=TA	(CRU=80)	84=US	84=US	(CRU=0)	
975383-0039	UF21	84=US					
975383-0040	UE21						
945134-0014							
975383-0029	UJ21	Def	80= +	No	82=TA	80=0	Default only
975383-0030	UH21	82=TA	(CRU=80)		84=US	(CRU=0)	
975383-0031	UF21	84=US					
975383-0032	UE21						
			990/10 Multiwire ROM Kits for Models 4, 4PP, 6, 8, 8PP				
945134-0020*							
975383-0049	C10	Def	80= +	82=TA	82=TA	80=0	979A = F880
975383-0050	C11	82=TA	(CRU=80)	84=US	84=US	(CRU=0)	Disks= F800
975383-0045	K08	84=US					Online, R/O, Seq.
975383-0046	K09						
975383-0051	B10						
975383-0052	B11						
945134-0018							
975383-0041	C10	Def	80= +	82=TA	82=TA	80=0	Default only
975383-0042	C11	82=TA	(CRU=80)	84=US	84=US	(CRU=0)	
975383-0039	K08	84=US					
975383-0040	K09						
975383-0043	B10						
975383-0044	B11						

Table 3-1. Loader ROMs, Locations, and Load Device Summary (Continued)

ROM P/N	Loc.	Hard Disk	FD800	FD1000	979A	733 ASR	Operator Panel
945134-0013							
975383-0033	C10	Def	80 = +	No	82 = TA	80 = 0	Default only
975383-0034	C11	82 = TA	(CRU = 80)		84 = US	(CRU = 0)	
975383-0031	K08	84 = US					
975383-0032	K09						
975383-0035	B10						
975383-0036	B11						
990/12 ROMS for Models 20, 29, 30							
2262025-0007*	UG03	Def	80 = +	82 = TA	82 = TA	80 = 0	979A = F880
2262025-0008*	UG02	82 = TA	(CRU = 80)	84 = US	84 = US	(CRU = 0)	Disks = F800
		84 = US					Online, R/O, Seq.
2262025-0005	UG03	Def	Def #2	Def	82 = TA	80 = 0	Default only
2262025-0006	UG02	82 = TA	or 80 = +	82 = TA	84 = US	82 = CA	
		84 = US	82 = CA	84 = US			
		Seq.	Seq.	Seq.			
2262025-0003	UG03	Def	Def #2	Def	No	80 = 0	Default only
2262025-0004	UG02	82 = TA	or 80 = +	82 = TA		82 = CA	
		84 = US	82 = CA	84 = US			
		Seq.	Seq.	Seq.			

Note:

* Designates current production ROMs.

3.3 PROGRAMMER PANEL OPERATING MODES

The programmer panel may function in one of two modes, run mode or halt mode. In the run mode (RUN LED lit), all programmer controls are inoperative except for the HALT/SIE switch. The HALT/SIE 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 in the loader ROM 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 at the time the HALT/SIE switch is pressed. 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. The new contents of the program counter then are 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.

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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 or altered on the data LEDs, altering the LEDs as desired, and returning the new value to its original memory or workspace register location.

3.3.1 Programmer Panel Controls and Indicators

The functional descriptions of the front panel controls and indicators are given in Table 3-2. The reference numbers in the table are keyed to the associated panel markings in Figures 3-1 and 3-2.

Table 3-2. Programmer Panel Controls and Indicators

Reference Number	Control or Indicator	Function
1	DATA LEDs	A lighted LED denotes logic 1 and an extinguished LED denotes logic 0. The LSB is displayed as the rightmost of the LEDs. In the run mode for DX10 operation, these LEDs represent bar graphs of system disk and CPU utilization. Alternatively, the LEDs can display the contents of the computer's program counter (PC). In the halt mode the LEDs display the contents of the computer register, or a value entered into computer memory via the data entry switches.
2	DATA entry switches	These switches are used in conjunction with the entry 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 of operation). In the halt mode, the DATA LED located immediately above each data entry switch changes states as each switch is pressed. The value indicated by the DATA LEDs is then stored in the register or memory address selected by the entry switches.
3	CLR switch	When pressed, this 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 memory address register of the CPU.
6	MDD switch	When the memory data display (MDD) switch is pressed, the contents of the memory location defined by the contents of the MA register is 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.
8	ENTER ST switch	When pressed, the value displayed on the DATA LEDs is entered into the computer's status register.

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Table 3-2. Programmer Panel Controls and Indicators (Continued)

Reference Number	Control or Indicator	Function
9	ENTER PC switch	When pressed, the value displayed on the DATA LEDs is entered into the computer's program counter.
10	ENTER WP switch	When pressed, the value displayed on the DATA LEDs is loaded into the computer's workspace pointer register.
11	DISPLAY MA switch	When pressed, the value stored in the computer's memory address register is displayed on the DATA LEDs.
12	DISPLAY ST switch	When pressed, the contents of the computer's status register is displayed on the DATA LEDs.
13	DISPLAY PC switch	When pressed, the contents of the computer's program counter is displayed on the DATA LEDs.
14	DISPLAY WP switch	When pressed, the contents of the computer's workspace pointer register is 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 the RESET switch results in an IORESET pulse being generated that resets all units in the system.
17	RUN switch	When the computer is halted (programmer panel is active), pressing the RUN switch returns the computer to the run mode of operation and deactivates the panel.
18	HALT/SIE switch	When the computer is in the run mode (RUN LED is lit), pressing the HALT/SIE switch causes the computer to halt and begin processing the front panel software if the key switch is set to UNLOCK or ENABLE position. Pressing the 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	The key switch prevents unauthorized computer turn-on or program intervention. In order to apply ac power to the 13-slot chassis, the key must be inserted into the switch and the switch set to the LOCK position. Use switch on rear panel to apply ac power to the 17-slot chassis. At this point, power is applied to the computer, but the programmer panel is locked out. In the UNLOCK or ENABLE position the computer may be halted by pressing the HALT/SIE switch. The key may be removed from the switch in any position.

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Table 3-2. Programmer Panel Controls and Indicators (Continued)

Reference Number	Control or Indicator	Function
20	RUN LED	The RUN LED lights when a low-active RUN-signal is generated by the computer to indicate 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. When the RUN LED is extinguished, the panel controls are active.
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	This indicator lights when the computer has detected a diagnostic test failure.
23	POWER LED	This indicator lights when power is applied to the unit (key switch set to LOCK, UNLOCK, or ENABLE position).

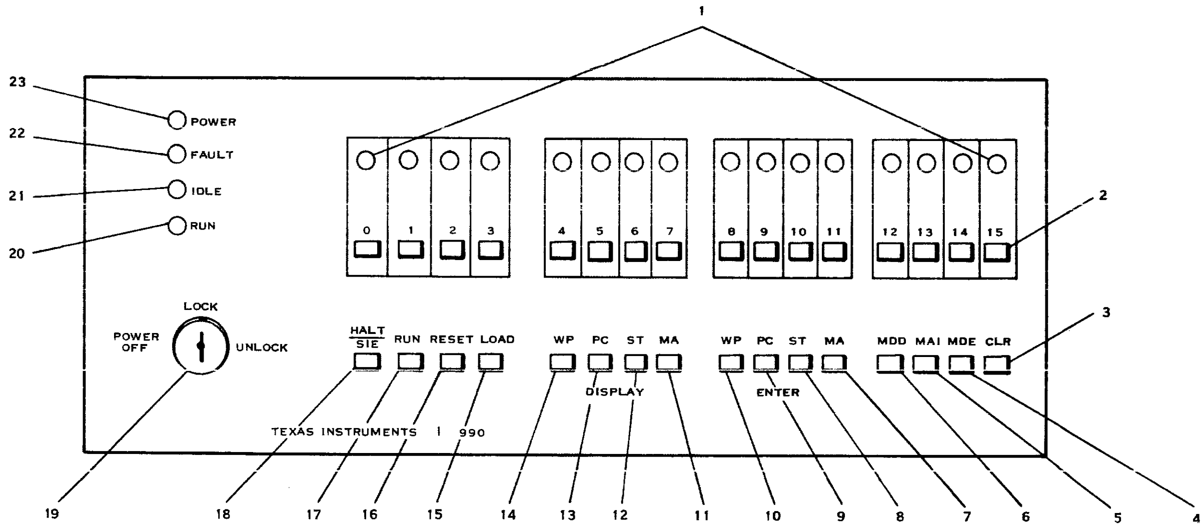
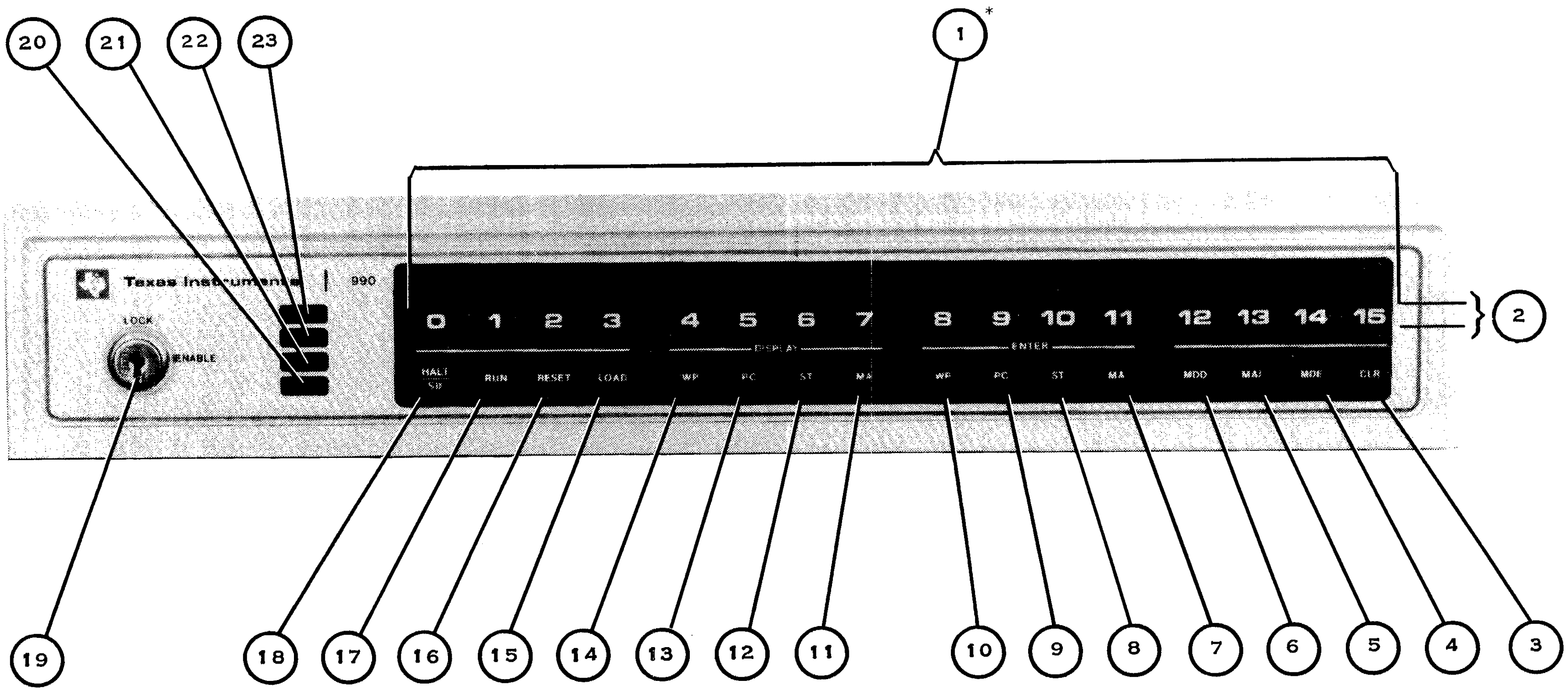


Figure 3-1. Programmer Panel, 13-Slot Chassis



*DATA LEDS NOT VISIBLE IN PHOTOGRAPH

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Figure 3-2. Programmer Panel, 17-Slot Chassis

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3.4 OPERATING SYSTEM COMMANDS

3.4.1 TX5 Commands

A list of TX5 OCP commands is given in Table 3-3. For a complete description of TX5 commands, refer to *TX5 Operating System Programmer's Guide* and *Terminal Executive Development System (TX5DS) Programmer's Guide.*

Table 3-3. Syntax of TX5 OCP Commands

Command	Syntax
OCP Task Support Commands	
Assign LUNO	{AL : ALUNO},<luno>,<pathname>.
Release LUNO	{RL : RLUNO},<luno>.
Load Program	{LP : LPROG},<pathname>[,<priority>][,P].
Load Real-Time Program	{LR : LRPROG},<pathname>[,<priority>][,P]
Execute Task	{EX : EXECUTE},<task id>[,<parm1>[,<parm2>]].
Install Task	{IT : ITASK},<pathname>,<task id>[,<priority>][,<procedure id>][,P][,N].
Install Real-Time Task*	{IR : IRTASK},<pathname>,<task id>[,<priority>][,<procedure id>][,P][,N].
Install Procedure*	{IP : IPROC},<procedure id>.
Delete Task	{DT : DTASK},<task id>.
Delete Procedure	{DP : DPROC},<procedure id>.
OCP Debugging and Error Recovery Commands	
Dump Memory	{DM : DMEM},<starting address>[,<ending address>].
Load Memory	{LM : LMEM},<address>,<value>[,<value]... .
Set Breakpoint	{SB : SBKPT},<address>.
Clear Breakpoint	{CB : CBKPT}[,<address>]>
Add	{AD : ADD},<value>,<value>.
Subtract	{SU : SUB},<value>,<value>.
Jump	{JM : JMP},<address>,<address>.

Table 3-3. Syntax of TX5 OCP Commands (Continued)

Command	Syntax
Dump Workspace	{DW : DWKSP},<task id>.
Kill Task	{KT : KTASK},<task id>.
Kill I/O Operation	{KI : KIO},<luno>.
Trace	{TR : TRACE}[,<address>].
OCP I/O Utility and Status Request Commands	
Rewind Device	{RE : REWIND},<luno>.
Forward Space	{FS : FSPACE},<luno>,<number>.
Backspace	{BS : BSPACE},<luno>,<number>.
Show Task Status	{ST : STASK}[,<task id>].
Show I/O Status	{SI : SIO}[,<luno>].
Show Procedure Status*	{SP : SPROC}[,<procedure id>].
Initialize Time and Date	{ID : IDATE},<year>,<month>,<day>,<hour>, <minute>.
Print Time and Date	{TI : TIME}.
OCP Termination Command	
Terminate OCP	{TE : TERMINATE}.

Note:

* Denotes that the command is available only with multiple dynamic task support.

3.4.2 DX5 SCI Commands

Table 3-4 lists the SCI commands supported by the DX5 operating system. Most of these commands are identical to DX10 commands. Those that differ are described in the reference note.

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Table 3-4. DX5 SCI Commands

Command	Meaning	Privilege	Command	Meaning	Privilege
AF	Append File[1]	0	MD	Map Disk[1]	0
AGL	Assign Global LUNO[2]	0	MDS	Modify Device State	6
AL	Assign LUNO[2]	0	MFN	Modify File Name[1]	2
AS	Assign Synonym[1]	0	MFP	Modify File Protection[1]	2
AUI	Assign User ID	4	MKF	Map Key-Indexed File[1]	0
BATCH	Begin Batch Execution	0	MKL	Modify KIF Logging	2
BD	Backup Directory[1]	0	ML	Move Lines	0
BL	Backspace LUNO[2]	0	MPF	Map Program File[1]	0
CC	Copy/Concatenate[1]	0	MPI	Modify Program Image[4]	2
CF	Copy Directory[1]	0	MR	Modify Roll	0
CFDIR	Create Directory File[1]	0	MRF	Modify Relative to File[1]	2
CFKEY	Create Key Indexed File (KIF)[1]	0	MRM	Modify Right Margin	0
CFREL	Create Relative Record File[1]	0	MS	Modify Synonym	0
CFSEQ	Create Sequential File[1]	0	MSG	Display a Message	0
CKD	Check Disk for Consistency[1]	0	MT	Modify Tab Settings	0
CKS	Copy KIF to Sequential File[1]	0	MTS	Modify Terminal Status	4
CL	Copy Lines	0	MUI	Modify User ID	4
CSD	Change System Disk[3]	2	MVI	Modify Volume Information[1]	2
CSK	Copy Sequential File to KIF[1]	0	PF	Print File	0
CSM	Copy/Verify Sequential Media Utility[1]	0	PS	Patch DX5 System	
DCOPY	Disk Copy/Restore Utility	2	Q	Quit SCI	0
DD	Delete Directory[1]	2	Q$SYN	Clear Secret Synonyms	0
DF	Delete File[1]	2	QE	Quit Edit[1]	0
DL	Delete Lines	0	RCRU	Read Contents of Specified CRU Address[1]	6
DS	Delete String	0	RD	Restore Directory[1]	2
DUI	Delete User ID	4	RGL	Release Global LUNO[2]	0
EBATCH	End Batch Execution	0	RL	Release LUNO[2]	0
EC	Batch Stream Error Counter	0	RS	Replace String	0
ENDKEY	Terminate Key Specifications	0	RWL	Rewind LUNO[2]	0
FL	Forward Space LUNO[2]	0	SAD	Show Absolute Disk[1]	2
FS	Find String	0	SADU	Show Allocatable Disk Unit[1]	2
IDT	Initialize Date and Time	4	SDT	Show Date and Time	0
IF	Insert File[1]	0	SF	Show File[1]	0
INV	Initialize New Volume	2	SIS	Show I/O Status	0
IS	Initialize System	4	SL	Show Line	0
KEY	CFKEY Key Specification	0	SPI	Show Program Image[4]	2
LC	List Commands	0	SRF	Show Relative to File[1]	2
LD	List Directory[1]	0	STI	Show Terminal Information	0
LLR	List Logical Record[1]	2	SV	Show Value	0
LS	List Synonyms[1]	0	SVL	Save Lines	0
LTS	List Terminal Status[1]	0	SVS	Show Volume Status	0
LUI	List User IDs[1]	4	VB	Verify Backup[1]	0
MAD	Modify Absolute Disk[1]	6	VC	Verify Copy[1]	0
MADU	Modify Allocatable Disk Unit[1]	6			

Table 3-4. DX5 SCI Commands (Continued)

Command	Meaning	Privilege	Command	Meaning	Privilege
WCRU	Write Value to Specified CRU Address	6	XES	Execute Text Editor with Scaling	0
XB	Execute Batch[1]	0	XPS	Execute Patch Synonym Processor	0
XE	Initiate Text Editor	0			

Notes:

[1] File pathnames are limited to three levels representing volume, directory, and file.

[2] Global LUNOs and task LUNOs are equivalent in scope; task LUNOs are released when the task completes.

[3] Described in DX5 Operating System Programmer's Guide, part number 2250455-9701.

[4] The module ID and not the module name must be entered for an MPI or SPI command.

3.4.3 DX7 and DX10 SCI Commands

Table 3-5 lists all of the factory-supplied DX7 and DX10 SCI commands and the meaning of each. For a detailed explanation of DX10 system commands, refer to Section 1 of *DX10 Operating System Release 3 Reference Manual, Volume II, Production Operation.*

For a detailed explanation of DX7 system commands, refer to *DX7 Operating System Programmer's Guide,* part number 2276561-9701.

3.4.3.1 DX7 Systems on DSDD. For DX7 systems on DSDD there are four diskettes. Each diskette contains parts of the operating system suited for a particular purpose. Each of the diskettes is executable on a Model 3 system. The four diskettes are referred to as the following:

- Execution disk
- Development disk
- Utility disk
- Sysgen disk

In Table 3-5, an alphabetical character appears under the "DX7 Disk" column that represents which diskette command applies, as follows:

A — means that the associated command is on all diskettes (utility, development, execution, and sysgen).
U — means utility diskette only
D — means development diskette only

There are no commands that are only on the sysgen or execution disks.

DX7 DSDD Secondary Drive Operation. If a secondary DSDD drive access door is opened during system operation, the current volume on the secondary drive must be unloaded using the unload volume (UV) command before any access is attempted to the secondary drive. Otherwise, a system crash will occur. After the UV command, the same volume or another volume can be loaded using the install volume (IV) command.

Table 3-5. DX7 and DX10 SCI Commands

Command	DX7 Disk	Description
AA	A	Add Alias
AB[1]		Assign Breakpoint
AF	A	Append File
AGL	A	Assign Global LUNO
AL	A	Assign LUNO
ALGS	U	Assemble and Link Generated System
AS	A	Assign Synonym
ASB[1]		Assign Simulated Breakpoint
AT	A	Activate Task
AUI	A	Assign User ID
BACC[2]		Break Apart COBOL Compiler
BATCH[3]	A	Begin Batch Execution
BD	U	Backup Directory
BL	A	Backspace LUNO
CC	A	Copy/Concatenate
CD	A	Copy Directory
CDKP	U,D	Copy Directory to Key Indexed Procedure File
CF	A	Create File
CFDIR	A	Create Directory File
CFIMG	A	Create Image File
CFKEY	A	Create Key-Indexed File
CFPRO	A	Create Program File
CFREL	A	Create Relative-Record File
CFSEQ	A	Create Sequential File
CKD	U	Check Disk for Consistency
CKPS	U,D	Copy a Key Indexed Procedure to a Sequential File
CKS	U	Copy KIF to Sequential File
CKSR	U	Copy KIF to Seqential File Randomly
CL[1]	D	Copy Lines
CM	A	Create Message
CPI	A	Copy Program Image
CPKK	U,D	Copy Proc from KIF to KIF
CSF	U	Create System Files
CSK	U	Copy Sequential File to KIF
CSKP	U,D	Copy Sequential File to Key-Indexed Procedure File
CSM	U	Copy/Verify Sequential Media Utility
DA	A	Delete Alias from Pathname
DB		Delete Breakpoint
DCOPY[1]	U	Diskette Copy/Restore Utility
DD	A	Delete Directory
DF	A	Delete File
DKP	U,D	Delete a Key-Indexed Procedure
DL[1]	D	Delete Lines
DO	A	Delete Overlay
DP	A	Delete Procedure
DPB[1]		Delete and Proceed from Breakpoint
DS	D	Delete String
DSB[1]		Delete Simulated Breakpoint
DT	A	Delete Task
DUI	A	Delete User ID
DXTX[1]		DX10 File to Diskette File
EBATCH[3]	A	End Batch Execution
EC	A	Error Count
ENDKEY[3]	A	End CFKEY Specification
FB[1]		Find Byte
FL	A	Forward Space LUNO
FS[1]	D	Find String
FW[1]		Find Word
HO	A	Halt Output at Device
HT		Halt Task
IBMUTL	U	IBM Conversion Utility
IDS	U	Initialize Disk Surface

Notes:

[1] Foreground only.

[3] Batch only.

Table 3-5. DX7 and DX10 SCI Commands (Continued)

Command	DX7 Disk	Description
IDT	A	Initialize Date and Time
IF[1]	D	Insert File
IGS	A	Install Generated System
INV	U	Initialize New Volume
IO	A	Install Overlay
IP	A	Install Procedure
IRT	D	Install Real Time Task
IS[1]	A	Initialize the System
ISL	U	Initialize System Log
ISO	U	Install System Overlay
IT	A	Install Task
IT$		Used by IT and IRT
IT$$		Used by IT and IRT
IV	A	Install Volume
KBT[1]	A	Kill Background Task
KEY[3]	A	CFKEY Key Specification
KO	A	Kill Output at Device
KT	A	Kill Task
LB[1]		List Breakpoints
LC	A	List Commands
LD	A	List Directory
LDC	U	List Device Configuration
LLR	U	List Logical Record
LM		List Memory
LS	A	List Synonyms
LSB[1]		List Simulated Breakpoints
LTS	A	List Terminal Status
LUI	A	List User IDs
MAD	U	Modify Absolute Diskette
MADU	U	Modify Allocable Diskette Unit
MCC	A	Modify Country Code
MD	U	Map Disk
MDS	A	Modify Device State
MFN	A	Modify File Pathname
MFP	A	Modify File Protection
MIR[1]		Modify Internal Registers
MKF	D	Modify Key-Indexed Files
MKL	A	Modify KIF Logging
ML[1]	D	Move Lines
MLP	A	Modify LUNO Protection
MM[1]		Modify Memory
MOE[1]	A	Modify Overlay Entry
MPE[1]	A	Modify Procedure Entry
MPF	D	Map Program File
MPI	A	Modify Program Image
MR[1]	D	Modify Roll
MRF[1]	U	Modify Relative to File
MRM[1]	A	Modify Right Margin
MS[1]	A	Modify Synonym
MSG	A	Send a Message
MT[1]	D	Modify Tab Settings
MTE[1]	A	Modify Task Entry
MTS	A	Modify Terminal Status
MUI	A	Modify User ID
MVI	U	Modify Volume Information
MWR[1]		Modify Workspace Registers
PB[1]		Proceed from Breakpoint
PF	A	Print File
PGS	U	Patch Generated System
Q	A	Quit SCI
QD[1]		Quit Debug Mode
QE[1]	D	Quit Text Editor
Q$SYN	A	Erase Secret Synonym
RAL	U	Release all LUNOs
RCD	U	Recover Disk
RCRU	U	Read Contents of Specified CRU Address
RD	U	Restore Directory
RE	D	Recover Edit
RGL	A	Release Global LUNO
RL	A	Release LUNO
RO	A	Resume Output at Device
RPGCONV		RPG II Diskette Conversion Utility
RPGEDIT		RPG II Source Editor
RS[1]	D	Replace String
RST[1]		Resume Simulated Task
RT[1]		Resume Task
RWL	A	Rewind LUNO
SAD	U	Show Absolute Diskette
SADU	U	Show Allocable Diskette Unit
SBS[1]	A	Show Background Status
SCC	A	Show Country Code
SDT	A	Show Date and Time
SF	A	Show File
SIR[1]		Show Internal Registers

Notes:

[1] Foreground only.

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Table 3-5. DX7 and DX10 SCI Commands (Continued)

Command	DX7 Disk	Description
SIS	A	Show I/O Status
SL[1]	D	Show Line
SMM	A	Show Memory Map
SMS	A	Show Memory Status
SMM		Show Memory Map
SOS	A	Show Output Status
SP[1]		Show Panel
SPI	A	Show Program Image
SRF	U	Show Relative to File
ST[1]		Simulate Task
STI	A	Show Terminal Information
STS	D	Show Task Status
SV1	A	Show Value
SVL	D	Save Lines
SVS	A	Show Volume Status
SWR[1]		Show Workspace Registers
TGS	U	Test Generated System
TXCM		Compress Diskette File
TXCP[1]		Change Diskette File Protect
TXDF		Delete Diskette File
TXFD[1]		Format Diskette
TXMD[1]		Map Diskette
TXSF[1]		Set System File
UV	A	Unload Volume
VB	U	Verify Backup
VC	U	Verify Copy
WAIT[1]	A	Wait for Background
WCRU	U	Write Value to Specified CRU Address
WEOF	A	Write EOF to LUNO
XANAL[1]	U	Analyze DX10 Crash File
XB[1]	A	Execute Batch SCI
XBB[1]		Execute Business Basic
XBSM[1]		Execute Batch Sort/Merge
XCC		Execute COBOL Compiler
XCCF[1]		Execute COBOL Compiler in Foreground
XCP		Execute COBOL Program
XCPF[1]		Execute COBOL Program in Foreground
XCT		Execute COBOL Task
XCTF[1]		Execute COBOL Task in Foreground
XCU[1]		Execute 2.2 to 3.0 DX10 Conversion
XD[1]		Initiate Debug Mode
XE[1]	D	Initiate Text Editor
XES	D	Initiate Text Editor with Scaling
XFC		Execute FORTRAN Compiler
XFCF[1]		Execute FORTRAN Compiler in Foreground
XFT		Execute FORTRAN Task
XFTF[1]		Execute FORTRAN Task in Foreground
XGEN[1]	U	Execute GEN990 — Auto-Sysgen Program
XHT		Execute and Halt Task
XLE	D,U	Execute Linkage Editor
XMA	U	Execute Macro Assembler
XPS	U	Execute Patch Synonym Processor
XRPGB		Bind RPG II Program
XRPGC		Execute RPG II Compiler
XRPGCF		Execute RPG II Compiler in Foreground
XRPGT		Execute RPG II Task
XRPGTF		Execute RPG II Task in Foreground
XSB[1]		Execute Scientific BASIC
XSM[1]		Execute Sort/Merge
XSMF[1]		Execute Sort/Merge in Foreground
XT	A	Execute Task
XTS	A	Execute Task and Suspend SCI
XTU[2]		Execute Transliteration Utility
XTUM[2]		Execute Transliteration Utility Using MIRA

Notes:

[1] Foreground only.
[2] With source packages only.
[3] Batch only.

4

Online Diagnostics

4.1 INTRODUCTION

Online diagnostics provide vital information about the performance of peripheral devices while normal system operation continues. These diagnostics are executed online as nonprivileged application-level tasks under the operating system. This online evaluation of errors provides an early warning of the need for running unit diagnostics (which would require shutting down the system). Online diagnostics can execute up to 36 device diagnostic tasks at one time.

4.1.1 Structure of Online Diagnostics System

Online diagnostics are initiated and controlled from any one (but only one) TTY device or 911 VDT identified as the control terminal. The control terminal must be properly logged on to the operating system and the SCI must be active.

The online diagnostics system consists of the following:

- *Online diagnostics driver* — controls and services the diagnostic tasks. This driver is activated using SCI commands from the control terminal. (A control terminal is defined as any 911 VDT data terminal that is properly logged on to the operating system.) The diagnostics driver performs the following functions:
  - Activates, controls, and terminates diagnostic tasks
  - Processes requests for services and messages
  - Records all control terminal activity to the diagnostics history file
- *Diagnostics tasks* — exercise and test peripheral devices. Once the diagnostics driver is started, the operator selects a task with a command verb, choosing options or accepting defaults. These diagnostic tasks execute in one of two modes:
  - Diagnostic test execution mode, in which a group of tests are used for the particular class of device
  - Specific operation execution mode, in which one specific supervisor call (SVC) operation code is executed

Each diagnostic task can execute as follows:

- Diagnostic test execution mode:
  - All tests, or any one test by number
  - A specified number of passes through the tests

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- Specific operation execution mode:
  - For a specified number of executions of any one operation
- In either diagnostic test execution or specific operation mode:
  - For a specified time period
  - Until a minimum number of errors has occurred
  - Continuously, until the operator terminates the diagnostic

The classes of peripheral devices supported by online diagnostics are as follows:

Device	**Class**
CD1400 disk drive	DS
DS10 disk drive	DS
DS25/DS50 disk drive	DS
DS200 disk drive	DS
DS31/DS32 disk drive	DS
FD1000 disk drive	DS
810 line printer	LP, RP
2230/2260 printers	LP
979A magnetic tape	MT
820 KSR data terminal	ST
911 VDT display terminal	ST
Start all available devices	ALL

4.2 GENERAL PROCEDURES FOR USING ONLINE DIAGNOSTICS

The diagnostic session can be one of two types:

- An interactive session for interaction with the online diagnostics driver at a terminal (foreground execution is recommended).
- A batch session in which the driver reads a batch input file previously prepared by the operator (background execution is recommended).

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NOTE

> The control terminal itself (e.g. ST02) cannot be tested with online diagnostics during the diagnostic session. For example, if ST02 is the control terminal, then the diagnostic task for ST02 cannot be started during this diagnostic session.

A list of general procedures for a diagnostic session is as follows:

1. Log on the control terminal to the operating system via the SCI.
2. Place the target devices in the appropriate device state (online, diagnostic, offline).
3. Activate the Execute Online Diagnostics Driver (XODD) command. Specify the following:
    a. Command input
    b. Message output
    c. Diagnostics history file
    d. Command log file
    e. Foreground or background execution
4. Respond to the command prompt with a valid command to:
    a. Start diagnostics tasks
    b. Alter diagnostics tasks
    c. Terminate diagnostics tasks
5. Press the CMD key to redisplay the command prompt.
6. Repeat steps 4 and 5 until testing is complete.
7. Enter the Quit Online Diagnostics (QD) verb.
8. Replace the target devices (devices to be tested) in the online device state.

4.2.1 Devices in the Diagnostic State

Target devices must be in one of three states before the online diagnostics driver can test them:

- Online state (ON command)
- Diagnostic state (DIAG command)
- Offline state (OFF command)

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All target devices except disk drive units must be in the diagnostic state before testing. Disk drive units may be tested while in the online state, because disks contain a separate file of test data maintained by the operating system to be used for diagnostic testing. Online diagnostics do not use the offline device state.

Devices to be tested in the diagnostic state must be placed in the diagnostic state before the diagnostic session begins. They must be returned to the online state after the session concludes. The SCI commands DIAG and ON change the device states. They cannot be executed for devices that are in use, as in the case of terminal devices that are logged on to SCI.

For disks, the ON and DIAG commands cannot be executed for a disk drive that has a volume installed. The Unload Volume (UV) command must be executed before the DIAG or ON commands can be executed. For more information about the UV command, refer to the *DX10 Operating System Reference Manual, Volume II, Production Operation.*

The formats of the DIAG and ON commands are as follows:

```
[] DIAG
   PLACE DEVICE IN DIAGNOSTIC STATE
                        DEVICE NAME:  devicename

[] ON
   PLACE DEVICE IN ONLINE STATE
                        DEVICE NAME:  devicename
```

devicename	A valid four-character device name. The first two characters are the device class, and the last two are the device number. For example, LP01 is the device name for Line Printer number one.

4.2.2 XODD Command

The Execute Online Diagnostics Driver (XODD) command activates the online diagnostics driver task at the control terminal. Enter the pathnames of files or devices to be used for command input, message output, the diagnostics history file, and the command log file. The default file pathnames are displayed on the screen.

Execute the XODD command as follows:

1. Enter the XODD command:

   ```
   [] XODD
   ```

2. The online diagnostic driver displays the following:

   ```
   DX10 ONLINE DIAGNOSTICS VERSION 2.0.0
              COMMAND INPUT:  STxx
             MESSAGE OUTPUT:  STxx
           COMMAND LOG FILE:  volumename.S$ODIAG.CMD
               HISTORY FILE:  volumename.S$ODIAG.HISTORY
                 MODE (F,B):  FOREGROUND
   ```

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COMMAND INPUT

Command input is the file or class ST device from which responses to the prompts of the diagnostic command verbs are entered. The default is the name of the control terminal. Do not use the control terminal for COMMAND INPUT to execute online diagnostics in background. Do not assign the same file for both COMMAND INPUT and COMMAND LOG FILE. When specifying a device, enter responses to the prompts at that device. When a file is specified, the driver reads the file as a batch input.

MESSAGE OUTPUT

Message output is the file or device where the messages and prompts of the command verbs are displayed. The default is the name of the control terminal. Do not use the control terminal for MESSAGE OUTPUT to execute online diagnostics in the background.

COMMAND LOG FILE

The command log file is used by the driver to store responses to the prompts of the command verbs. It is a log of the COMMAND INPUT activity, and can be used for a batch input file as COMMAND INPUT in a later diagnostic session. The default pathname is: volumename.S$ODIAG.CMD. Any valid DX10 file pathname may be substituted. The XODD command creates the file if it does not exist. Do not assign the same file for both COMMAND LOG FILE and COMMAND INPUT.

HISTORY FILE

The history file is a file or device used by the driver to store diagnostic error and progress messages from the diagnostic tasks. System errors do not necessarily correspond to diagnostic errors and the history file does not match the system log. For example, a device error that is correctable within the acceptable number of retries causes a system log error, but not a history file error. The default pathname for the history file is: volumename.S$ODIAG.HISTORY. Any valid DX10 device or file pathname may be substituted. However, if anything other than a valid file pathname is substituted, the Show History (SH) command verb cannot execute. If the specified file does not exist, the XODD command creates it.

MODE

Online diagnostics can execute in either foreground or background. Foreground execution is recommended for interactive diagnostic sessions. Background execution is recommended for batch input diagnostic sessions. Diagnostic sessions that are mixed interactive and batch input should be executed in foreground.

When all the fields of the XODD command have been completed, the following messages are displayed at the control terminal:

```
ONLINE DIAGNOSTICS VERSION 2.0.0 BEGINNING EXECUTION.

AT ANY TIME, ENTER THE WORD 'HELP' FOR MORE INFORMATION.

ENTER COMMAND VERB?
```

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The prompt ENTER COMMAND VERB is referred to throughout this section as the command prompt. When it is displayed, a command verb (Table 4-1) can be entered.

4.2.3 Creating and Using Batch Input Files

The online diagnostics driver can read a prepared batch input file instead of requiring interactive input from a terminal device. This file can be created in two different ways, as described in the following paragraphs.

4.2.3.1 Method 1. The easiest method of creating a batch input file is to name a separate DX10 file as the COMMAND LOG FILE for an interactive diagnostic session. During that session, execute all the command verbs that are desired to be in the batch input file. When the session is finished, use the text editor to insert a Quit Batch (QB) command verb just before the Quit Online Diagnostics Driver (QD) command verb. This file is now a complete batch input file for the online diagnostics driver. The diagnostic session resulting from this batch input file must be executed in background. (This is just one way to use the QB command verb. For more information, see the command verbs, paragraph 4.3.)

4.2.3.2 Method 2. The second method of creating a batch input file is to create the entire file with the text editor. This method requires a thorough knowledge of the order of the prompts within the command verbs. The data begins in column one, and there is one response per line, as follows:

EXAMPLE 1

```
XD
DS01
YES
QB
QD
```

4.2.3.3 Using a Batch Input File. To use the batch input file, enter the name of the file as COMMAND INPUT for the XODD command. If the entire session is to be batch input (that is, the batch input file contains a QD command verb), execute the session in background. If the session is to be partially interactive (that is, the batch input file does not contain a QD command verb), execute the session in foreground.

4.2.4 Message Levels

The online diagnostics driver communicates at the file or device specified as MESSAGE OUTPUT by displaying prompts and messages. There are two levels of messages, novice and expert. The novice message level displays detailed explanations of each prompt and the valid responses. The expert message level displays only the prompt.

4.2.4.1 Changing Message Levels. The driver starts the diagnostic session on the expert message level. To change to the novice level, enter the Change Message Level (CM) command verb, as follows:

```
ENTER COMMAND VERB?
CM

ENTER MESSAGE LEVEL (NOVICE, EXPERT)? EXPERT
```

To change back to the expert message level, enter the CM command verb again.

The following example shows the expert level display for the first prompt of the Execute Diagnostic (XD) command verb.

EXAMPLE 2

```
ENTER DEVICE NAME? ALL
```

The following example shows the novice level display for the same prompt, as follows:

EXAMPLE 3

```
YOU HAVE CHOSEN TO EXECUTE ONE DEVICE DIAGNOSTIC TASK. YOU CAN SELECT
ALL AVAILABLE DEVICES, ALL DEVICES OF ONE CLASS (SUCH AS ALL DISKS), OR ANY
ONE SPECIFIC DEVICE. ENTER YOUR SELECTION AS FOLLOWS:

    ALL — SELECTS ALL DEVICES AVAILABLE
    ST — SELECTS ALL TERMINAL DEVICES AVAILABLE
    DS — SELECTS ALL TILINE DISK DEVICES AVAILABLE
    MT — SELECTS ALL MAG TAPE DEVICES AVAILABLE
    LP — SELECTS ALL PRINTER DEVICES AVAILABLE
    RP — SELECTS ALL REMOTE LP810 DEVICES AVAILABLE
    COMPLETE DEVICE NAME (ST02, DS01) — SELECTS THAT DEVICE
    REJECT — RETURN TO COMMAND PROMPT


ENTER DEVICE NAME? ALL
```

4.2.4.2 HELP Feature. The online diagnostics HELP feature displays the novice level message for the current prompt when the word HELP is entered. This feature operates regardless of the message level being executed at the time. Entering the HELP feature while on the novice message level has the effect of repeating the novice level message. The feature displays the novice message level only for the current prompt, and has no effect on the message level status.

4.2.5 Diagnostics Execution Modes

Diagnostic tasks for all devices except disks can execute in test execution mode or operation execution mode. For disk drives, only the test execution mode is valid.

The test execution mode can consist of the entire group of tests for the target device class, or any one of those tests. The tests for each device class are listed and described later in this section.

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The operation execution mode consists of the repeated execution of one of the valid Supervisor Calls (SVC), specified by an operation code. The valid operations for each device class are displayed by the Show SVC Operation Codes (SO) command verb.

Tests and operations are defined as follows:

- Tests are numbered programs that exercise specific hardware capabilities and attempt to provoke a specific range of hardware errors.
- Operations are SVC operation codes such as Read, Write, Close, and Open.

The test or operation execution mode is selected with responses to prompts of the XD command verb. The execution modes can be altered with the Change Execution Mode (CE) command verb. Figure 4-1 illustrates the execution modes.

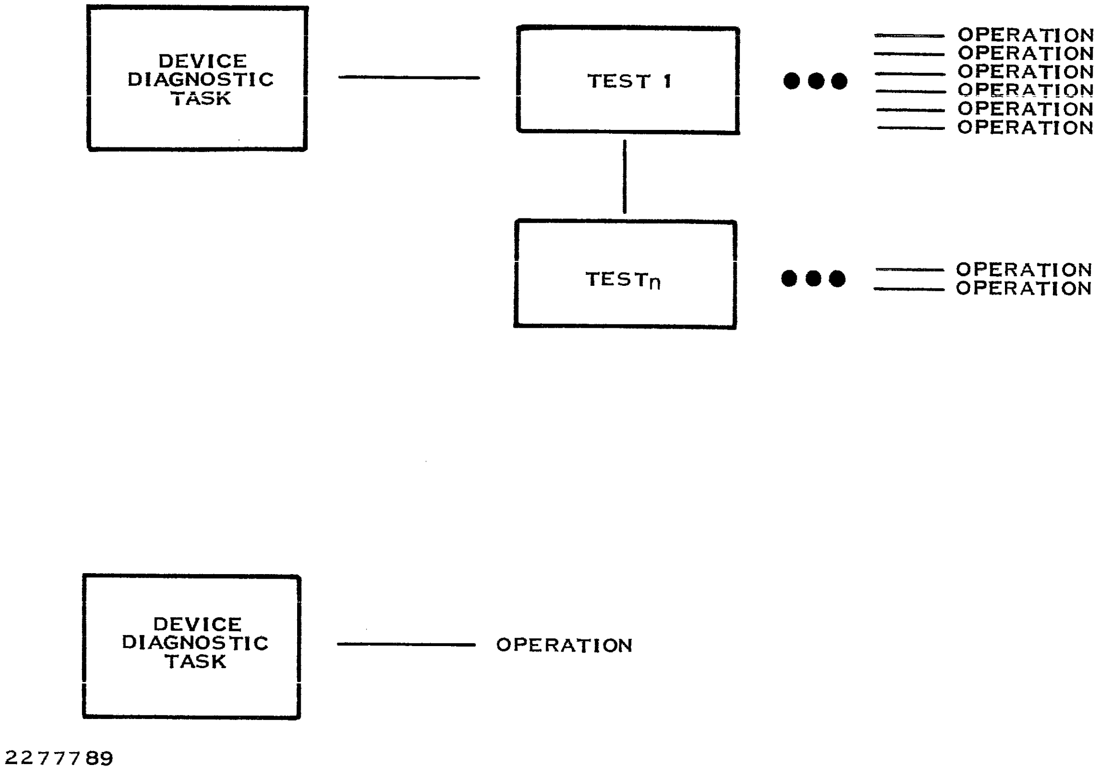

Figure 4-1. Execution Modes of Diagnostic Tasks

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4.3 COMMAND VERBS

The online diagnostics driver is controlled with command verbs. There are five groups of command verbs:

- Execute verbs — start diagnostic tasks and select execution options.
- Change verbs — alter the execution options of the diagnostic tasks while they are executing.
- Show verbs — display information about the diagnostic session.
- Terminate verbs — end the diagnostic tasks and end the diagnostic session.
- Miscellaneous verbs — perform additional functions such as initiating the HELP feature.

Each command verb has a two-character mnemonic. It is entered at the control terminal keyboard in response to the command prompt, or it may be used as part of the batch input file. In some cases, the two-character mnemonic of a command verb may be the same two characters as the mnemonic of an SCI command. For this reason, all interactive diagnostic sessions should be executed in foreground.

Table 4-1 lists the command verbs by group.

Table 4-1. Command Verbs

Verb	Description
XA	Execute All Diagnostic Tasks
XD	Execute Device Diagnostic Task
CE	Change Execution Mode
CM	Change Message Level
CP	Change Task Priority
CT	Change Termination Mode
SD	Show Device List
SH	Show History File
SO	Show SVC Operation Codes
SS	Show Diagnostic Task Status
KD	Kill Diagnostic
QB	Quit Batch and Wait on Diagnostic Task
QD	Quit Online Diagnostics
CQ	Check Diagnostic Message Queue
HELP	Display Novice Message for Current Prompt
REJECT	Return to Previous Prompt

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4.3.1 Using Command Verbs

The command verbs ask for information that must be supplied by the operator. Since the driver is inactive while waiting for a response, the diagnostic tests that require servicing must wait for a response before they can proceed. Whenever the cursor appears at the control terminal, the driver and any diagnostics needing service are waiting. If the diagnostics must execute while the system is unattended, the operator must allow for driver-waiting by executing the Check Diagnostic Message Queue (CQ) command verb. For more information, refer to the CQ command verb description later in this section.

Most command verbs display additional prompts that ask for detailed information. These prompts are displayed as questions. The data within parentheses represents the valid responses, and the data displayed after the question mark is the initial default value; for example, the prompt for the Change Priority (CP) command verb looks like this:

EXAMPLE 4

```
ENTER PRIORITY LEVEL (1, 2, 3)? 3
```

The valid responses are 1, 2, and 3. The original default value for task priority is 3. The cursor appears on the line below the prompt. To select the default option, press the RETURN key without entering any value. To select one of the other valid responses, enter the response and press the RETURN key.

4.3.1.1 Equivalence File. All command verb prompts have a range of valid responses. These responses correspond to numeric values in a preprogrammed response table used by the online diagnostics driver. Table 4-2 shows the contents of the preprogrammed table.

The driver also uses a file called the equivalence file that contains alternate responses assigned to the same numeric values. The equivalence file is a text editor file named: volumename .S$ODIAG.EQFILE. This file can be edited to customize the alternate responses.

When the response to a prompt is entered, the driver searches the equivalence file for the characters entered. If the characters are present, the driver uses the corresponding numeric value to perform the appropriate function.

If the characters entered are not present on the equivalence file, the driver searches the preprogrammed table for the characters. If the characters are present, the driver uses the corresponding numeric value to perform the appropriate function. If the characters are not present on the preprogrammed table or the equivalence file, the following error message is written to the file or device specified as MESSAGE OUTPUT during the XODD command:

```
ILLEGAL INPUT! INPUT = xxxxxx
```

The driver completes the field INPUT = xxxxxx by replacing the xxxxxx with the characters entered. Because the driver searches the equivalence file first, the responses to command verb prompts can be customized without affecting the online diagnostics system software.

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To change the equivalence file, enter the characters of the custom response starting in column 1. On the same line, enter the numeric value of the original response from Table 4-2, starting in column 9. For example, in Table 4-2 the numeric value of the original response OPERATION is 41. To save key stroke effort, assign a shorter response to the numeric value 41 by adding it to the equivalence file.

The following example shows an equivalence file that allows the user to enter Y instead of YES, N instead of NO, OP instead of OPERATION, and R instead of REJECT.

EXAMPLE 5

```
Y   15
N   16
R   31
OP  41
```

Table 4-2. Response Numeric Equivalents

Prompt Response	Numeric Value
XA	1
XD	2
CE	3
CP	4
CT	5
SD	7
SH	8
SO	9
SS	10
KD	12
QD	13
CM	14
YES	15
NO	16
ALL	17
CQ	25
ST	26
DS	27
MT	28
LP	29
HELP	30
REJECT	31
IGNORE	32
EXPERT	37
NOVICE	38
TEST	40
OPERATION	41
QB	49
RP	50

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4.3.1.2 Returning to the Command Prompt. At the end of the series of prompts for each command verb the following message is displayed:

```
*** PRESS THE 'CMD' KEY TO CONTINUE ***
```

When this message is displayed, the driver is not monitoring the input. The diagnostics started are executing. The driver is monitoring the diagnostic message queue, waiting for one of the diagnostic tasks to require service. Any further command verbs cannot be entered at this point.

To regain the attention of the driver, press the CMD key and wait for the command prompt to be displayed.

4.3.2 Execute Command Verbs

The group of execute command verbs consists of two verbs, XA and XD. The XA command verb starts diagnostic tasks for all devices that are in the appropriate device state. The XD command verb starts the diagnostic task for the device specified, providing it is in the appropriate device state.

The execute command verbs are as follows:

XA	Execute All Diagnostic Tasks
XD	Execute Device Diagnostic Task

4.3.2.1 XA — Execute All Diagnostic Tasks. The XA command verb selects all devices configured on the system that are in the appropriate device state and starts executing diagnostic tasks for those devices, using the following default execution options:

Priority Level = 3
Execution Mode = TEST
Tests Selected = ALL
Disk Write Tests = NO
Interactive Tests = NO
Paper Width = 80
Timed Test Interval = 1 SECOND
Termination Mode = ONE PASS

Alternate execution options cannot be chosen when using the XA command verb. However, by using the CE (Change Execution Mode), CT (Change Termination Mode), and CP (Change Priority) command verbs, the execution options of any diagnostic task can be altered while the task is executing.

To be selected by the XA command verb, disk devices (class DS) must be in either the diagnostic or online device state. Other devices must be in the diagnostic device state.

The format of the XA command verb is as follows:

```
ENTER COMMAND VERB?
XA

DEVICE xxxx HAS STARTED EXECUTION
DEVICE xxxx HAS STARTED EXECUTION
  "     "     "     "     "
  "     "     "     "     "
DEVICE xxxx HAS STARTED EXECUTION
```

The message DEVICE xxxx HAS STARTED EXECUTION is displayed for each device selected by the XA command verb.

4.3.2.2 XD — Execute Device Diagnostic. The XD command verb starts the diagnostic task for a single device. Choose the target device and select the execution options by responding to the prompts of the XD command verb.

The diagnostic task can be customized by selecting the most suitable execution options, or the default options can be selected. The choice of execution options can be altered while the task is executing with the Change Execution Mode (CE), Change Termination Mode (CT), and Change Priority (CP) command verbs.

Before the XD command verb can start a diagnostic task, the target device must be in the appropriate device state. Class DS devices must be in either the diagnostic or the online device state. Other devices must be in the diagnostic device state.

Figure 4-2 shows all the prompts of the XD command verb. The relationship between the prompts is shown by indentation. Those prompts indented below a prompt are subordinate to it and are displayed only under certain conditions. Study Figure 4-2 and become familiar with the order and subordination of the prompts.

The first prompt of the XD command verb is ENTER DEVICE NAME. The device name entered is the target device. The valid responses to the prompt ENTER DEVICE NAME are:

1. The full device name of the target device, which selects that device if it is in the appropriate device state. When the device name entered is accepted, the diagnostic task for that device is started and the following acknowledgement message is displayed:

   ```
   DEVICE xxxx HAS STARTED EXECUTION
   ```

2. A two-character device class, which selects all devices in the class that are in the appropriate device state. When a two-character device class is entered, the acknowledgement message for each device is displayed before the remaining prompts of the XD command verb for each device.

3. The word ALL, which selects all of the devices configured in the system that are in the appropriate device state. When the word ALL is entered, the acknowledgement message is displayed for each device followed by the remaining prompts of the XD command verb for each device.

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The remaining prompts of the XD command verb select the task priority level, the execution mode options, and termination mode options. Some prompts are valid only for certain device classes.

Whether or not to use the default execution options must be chosen. The default execution options are:

Priority Level = 3
Execution Mode = TEST
Tests Selected = ALL
Disk Write Tests = NO
Interactive Tests = NO
Paper Width = 80
Timed Test Interval = 1 SECOND
Termination Mode = ONE PASS

```
ENTER COMMAND VERB?
XD

ENTER DEVICE NAME? ALL

USE DEFAULT OPTIONS (YES, NO)? YES

ENTER PRIORITY LEVEL (1, 2, 3)? 3

CHANGE EXECUTION MODE (YES, NO)? NO

  ENTER NEW EXECUTION MODE (TEST, OPERATION))? TEST
    ENTER DIAGNOSTIC TEST (INTEGER, ALL)? ALL
      DO YOU WANT TO EXECUTE THE DISK WRITE TESTS (YES, NO)? NO
      DO YOU WANT TO EXECUTE THE INTERACTIVE TERMINAL TESTS (YES, NO)? NO
      DO YOU WANT TO EXECUTE THE INTERACTIVE TAPE TESTS (YES, NO)? NO
      ENTER TIMED TEST INTERVAL (0..59)? 1
      ENTER PAPER WIDTH (40..136)? 80

  ENTER SVC I/O OPERATION CODE (HEX 0..0F)? 0B
    ENTER NUMBER OF RECORDS TO SKIP (1..32767)? 1
    ENTER DATA BUFFER LENGTH (1..8192 BYTES)? 161
    ENTER DATA PATTERN (HEX 0..0FFFF)? 03737

CHANGE TERMINATION MODE (YES, NO)? NO
  EXECUTE CONTINUOUSLY (YES, NO)? NO
  ENTER NUMBER OF MINUTES FOR TASK EXECUTION (1..32767)? IGNORE
  ENTER MINIMUM NUMBER OF ERRORS FOR TERMINATION (1..32767)? IGNORE
  ENTER NUMBER OF PASSES OR SPECIFIC OPERATIONS (1..32767)? 1
```

Figure 4-2. XD Command Verb Prompts

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To choose the default options or select other options respond to the following prompt:

```
USE DEFAULT OPTIONS (YES, NO)? YES
```

When YES is entered, the default options are selected, and the XD command verb is complete when all the acknowledgement messages have been displayed.

When NO is entered, the remaining prompts for the execution options are displayed.

Task Priority Level. The first execution option is task priority. There are three levels of task priority, 1, 2, and 3. This priority level helps the operating system allocate system resources in order to balance the workload and give special consideration to the most important tasks. Priority level 1 is the highest level, and those tasks assigned to level 1 have the majority of system resources. Before assigning level 1 to a diagnostic task, carefully consider the rest of the workload on the system.

Select the task priority by responding to the following prompt:

```
ENTER PRIORITY LEVEL (1, 2, 3)? 3
```

The default task priority is level 3.

Execution Mode. The execution mode prompt allows choosing whether the diagnostic task executes the diagnostic tests or repeatedly executes one specific SVC operation.

NOTE

Only the test execution mode is valid for testing disk devices.

For the diagnostic test execution mode, the decision must be made whether to execute one test or all the tests. Each device has a different number of tests associated with its diagnostic task. The test number ranges for each device are shown in Table 4-3. This information is displayed at the control terminal in the novice mode, or when the HELP message function is entered. When all of the tests are to be executed, respond to additional prompts for disk, printer, magnetic tape and keyboard terminal devices (classes DS, LP, RP, MT, and ST). These additional prompts request information that is used by the diagnostic task for each device.

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Table 4-3. Test Numbers by Device Class

Device	Test Numbers
DS - ALL	1 through 4
LP - 810	1 through 11
LP - 2260	1 through 6
MT - 979A	1 through 8
RP - 810	1 through 11
ST - 911	1 through 5
ST - 820	1 through 12

For the specific SVC operation mode, select the SVC to be repeatedly executed, and for certain SVCs select the data buffer length and ASCII data pattern. Only certain SVCs are valid for each device class. The valid SVCs for each device class are shown as the output of the Show SVC Operation Codes (SO) command verb. Certain SVC operation codes require special conditions or prerequisite actions by the operator. For example, the read ASCII operation for a Model 911 VDT requires the operator to be present at the target 911 VDT to press the RETURN key for each operation performed.

NOTE

> The specific SVC operation execution mode is not valid for disk devices.

To select the execution mode, respond to the following prompts:

```
CHANGE EXECUTION MODE (YES, NO)? NO
```

For a NO response, the prompt for termination mode selection is displayed. For a YES response, the following prompt is displayed:

```
ENTER NEW EXECUTION MODE (TEST, OPERATION)? TEST
```

Test Execution Mode. The following paragraphs describe the prompts that are displayed when the test execution mode is chosen. Not all prompts are displayed under all conditions.

When TEST is entered as the new execution mode, the following prompt is displayed:

```
ENTER DIAGNOSTIC TEST (INTEGER, ALL)? ALL
```

Any one of the numbered tests can be executed by entering the test number. For valid test numbers, refer to Table 4-3. All of the tests can be executed in order by entering ALL.

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When the target device is a disk and the option to execute all of the tests has been chosen, the following prompt is displayed:

```
DO YOU WANT TO EXECUTE THE DISK WRITE TESTS (YES, NO)? NO
```

Choose whether or not to execute the disk write tests. The disk write tests use a special file, called the diagnostic write file, that is created by the disk write tests. Therefore, no disk space containing operator data is used. The file pathname is: volumename.S$ODDWRT. For more information, refer to the disk test descriptions in the *Model 990 Computer DX10 Online Diagnostics*, part number 2270531-9701.

When the target device is a keyboard terminal (class ST) and all of the tests are to be executed, the following prompt is displayed:

```
DO YOU WANT TO EXECUTE THE INTERACTIVE TERMINAL TESTS (YES NO)? NO
```

The interactive tests require operator presence at the target device to respond to the test. After either YES or NO is entered, the following prompt is displayed:

```
ENTER TIMED TEST INTERVAL (0..59)? 1
```

The timed test interval is used for several items in the diagnostic tests for class ST devices. For further information refer to the test descriptions in the online diagnostics manual.

When the target device is a magnetic tape drive (class MT) and all of the tests are to be executed, the following prompt is displayed:

```
DO YOU WANT TO EXECUTE THE INTERACTIVE TAPE TESTS (YES, NO)? NO
```

When the test execution mode for magnetic tape devices is selected, choose whether or not to execute the interactive tests. For further details on the interactive tests, refer to the test descriptions in the online diagnostics manual.

When the target device is a class LP or RP device, or an 820 KSR (class ST), and all of the tests are to be executed, the following prompt is displayed:

```
ENTER PAPER WIDTH (40..136)? 80
```

Operation Execution Mode. The following paragraphs describe the prompts of the XD command verb that are displayed when OPERATION is entered as the new execution mode. Not all prompts are displayed under all conditions.

When OPERATION is entered as the new execution mode, the following prompt is displayed:

```
ENTER SVC I/O OPERATION CODE (HEX 0..0F)? 0B
```

When the characters SO are entered, the output of the SO command verb for this device class is displayed. For more information, refer to the SO command verb description later in this section.

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When the operation code >06, >07, >09, >0A, >0B or >0C is entered, the following prompt is displayed:

```
ENTER DATA BUFFER LENGTH (1..8192 BYTES)? 161
```

Enter the number of bytes to be allocated for the buffer used by the operation code. This prompt allows the operator to exercise varying buffer lengths and even and odd buffer lengths. When operation code >06 or >07 is entered, the following prompt is displayed:

```
ENTER NUMBER OF RECORDS TO SKIP (1..32767)? 1
```

This prompt allows forward spacing or backspacing a number of records within the range 1 through 32,767. Enter the number of records to forward space or backspace.

When operation code >0B or >0C is entered, the following prompt is displayed:

```
ENTER DATA PATTERN (HEX 0..0FFFF)? 03737
```

Enter the hexadecimal number that represents the two-character ASCII code to be used as the data pattern. For example, the default value >3737 is the hexadecimal representation of the ASCII 77, and >4141 is the hexadecimal representation of the ASCII AA.

Termination Mode. The following paragraphs describe the prompts of the termination mode execution option. Not all prompts are displayed under all conditions. Refer to Figure 4-2 for subordination relationships between these prompts and the remainder of the XD command verb prompts.

The first prompt of the termination mode execution option is as follows:

```
CHANGE TERMINATION MODE (YES, NO)? NO
```

When the response is NO, the default termination mode of one pass is used.

When the response is YES, the prompts for selecting the termination options are displayed. The termination options are:

- Execute continuously, until the Kill Diagnostic (KD) command verb is entered.
- Execute for a specified number of minutes.
- Execute until a specified minimum number of errors occur.
- Execute a specified number of passes through all of the tests or a specified number of operations.

The next prompt to be displayed is as follows:

```
EXECUTE CONTINUOUSLY (YES, NO)? NO
```

When YES is entered, the diagnostic task executes until a KD command verb is entered.

When NO is entered, the following prompt is displayed:

```
ENTER NUMBER OF MINUTES FOR TASK EXECUTION (1..32767)? IGNORE
```

When a decimal number within the range 1 through 32,767 is entered, the task executes until the entered number of minutes elapse. If IGNORE is entered, this termination option is not selected. The following prompt is displayed whenever any valid response (including IGNORE) is entered:

```
ENTER MINIMUM NUMBER OF ERRORS FOR TERMINATION (1..32767)? IGNORE
```

When a decimal number within the range 1 through 32,767 is entered, a counter is initialized and the task executes until the number of errors counted equals the number entered. When IGNORE is entered, this termination option is not selected. The following prompt is displayed whenever any valid response (including IGNORE) is entered:

```
ENTER NUMBER OF PASSES OR SPECIFIC OPERATIONS (1..32767)? 1
```

When the TEST execution mode has been chosen, the task executes until the number of passes through all of the tests is equal to the decimal number entered. When the OPERATION execution mode has been chosen, the task executes until the number of Supervisor Calls executed is equal to the decimal number entered. If IGNORE is entered, this termination option is not selected.

4.3.3 Change Command Verbs

The change command verbs allow the operator to respecify the execution options of the XD command verb for a diagnostic task while it is executing, without stopping and restarting the task. The prompts of the change command verbs are the same as, or similar to, the prompts of the XD command verb. For this reason, details of responses to the change command verb prompts are not provided in the following paragraphs. For details of responses to the change verb prompts, refer to the XD command verb description. Of course, any time online diagnostics are being used, the word HELP can be entered for a detailed explanation of the individual prompts and the valid responses.

The change command verbs are as follows:

CE	Change Execution Mode
CM	Change Message Level
CP	Change Task Priority Level
CT	Change Termination Mode

4.3.3.1 CE — Change Execution Mode. The CE command verb modifies the execution mode of the diagnostic task after it begins execution.

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The prompts and default options of the CE command verb are as follows:

```
ENTER COMMAND VERB?
CE

ENTER DEVICE NAME? ALL

ENTER NEW EXECUTION MODE (TEST, OPERATION)? TEST
  ENTER DIAGNOSTIC TEST (INTEGER, ALL)? ALL
    DO YOU WANT TO EXECUTE THE DISK WRITE TESTS (YES, NO)? NO
    DO YOU WANT TO EXECUTE THE INTERACTIVE TERMINAL TESTS (YES, NO)? NO
    DO YOU WANT TO EXECUTE THE INTERACTIVE TAPE TESTS (YES, NO)? NO
    ENTER TIMED TEST INTERVAL (0..59)? 1
    ENTER PAPER WIDTH (40..136)? 80

  ENTER SVC I/O OPERATION CODE (HEX 0..0F)? 0B
    ENTER THE NUMBER OF RECORDS TO SKIP (1..32767)? 1
    ENTER BUFFER LENGTH (1..8192 BYTES)? 161
    ENTER DATA PATTERN (HEX 0..0FFFF)? 03737
```

4.3.3.2 CM — Change Message Level. The CM command verb changes the message level of the user/driver interface from the current level to the specified new level. The new level is in force until the next CM command verb is executed.

The user/driver interface message levels are novice and expert. The diagnostic session always begins on the expert level, displaying only command prompts. The novice level displays charts and expanded explanations of the command prompts.

The prompts and default options of the CM command verb are as follows:

```
ENTER COMMAND VERB? ALL
CM

ENTER NEW MESSAGE LEVEL (EXPERT, NOVICE)? EXPERT
```

4.3.3.3 CP — Change Task Priority. The CP command verb changes the priority of a diagnostic task while it is executing. The default priority is 3, selected by pressing RETURN without entering any value. The priority change takes place at the first opportunity after the request has been processed.

The prompts and default options of the CP command verb are as follows:

```
ENTER COMMAND VERB?
CP

ENTER DEVICE NAME? ALL

ENTER PRIORITY LEVEL (1, 2, 3)? 3
```

4.3.3.4 CT — Change Termination Mode. The CT command verb changes the termination mode of the diagnostic task while it is executing.

The prompts and default options of the CT command verb are as follows:

```
ENTER COMMAND VERB?
CT

ENTER DEVICE NAME? ALL
  EXECUTE CONTINUOUSLY (YES, NO)? NO
    ENTER NUMBER OF MINUTES FOR TASK EXECUTION (1..32767)? IGNORE
    ENTER MINIMUM NUMBER OF ERRORS FOR TERMINATION (1..32767)? IGNORE
    ENTER NUMBER OF PASSES OR SPECIFIC OPERATIONS (1..32767)? 1
```

4.3.4 Show Command Verbs

The Show Command verbs display information at the control terminal. The Show Command verbs are as follows:

SD	Show Device List
SH	Show History File
SO	Show SVC Operation Codes
SS	Show Diagnostic Task Status

4.3.4.1 SD — Show Device List. The SD command verb displays a list of all devices on your system and the status associated with them. This status includes device state and availability for testing with online diagnostics for devices supported by online diagnostics. The device list is not sorted. It appears in the same order as the system physical device table (PDT). The SD command verb has no prompts.

In response to the SD command verb, the online diagnostics driver displays the device state information in the following format:

```
        DEVICE          STATE               AVAILABLE FOR TEST
--------------------------------------------------------------------

         DS02          OFFLINE                     NO
         DS03          DIAGNOSTIC                  YES
         LP01          ONLINE                      NO
         LP02          DIAGNOSTIC                  YES
         ST01          ONLINE                      NO
         ST02          OFFLINE                     NO
         ST03          DIAGNOSTIC                  YES
         DS01          ONLINE                      YES
```

To suspend the upward scrolling of the SD command verb display on a Model 911 VDT, press the blank orange key. To resume, press the blank orange key again.

CAUTION

If the blank orange key is pressed to suspend upward scrolling, do not press the CMD key for any reason until some other key (such as RETURN) has been pressed. Pressing the CMD key immediately after pressing the blank orange key causes an unconditional end-of-task by the DX10 Operating System.

4.3.4.2 SH — Show History File. The SH command verb displays the history file at the control terminal. If the diagnostic history file pathname was entered as anything other than a DX10 file pathname, the SH verb cannot be executed. The SH command verb cannot be included in a batch input file. The SH command verb has no prompts.

The display of the file is manipulated with the following keys on a 911 VDT:

CMD	Exits SH display
F1	Display next page of file
F2	Display previous page of file

For more information about the diagnostics history file, refer back to the introductory part of this section.

4.3.4.3 SO — Show SVC Operation Codes. The SO command verb displays a chart of all the SVC operation codes and a validity code for each device class except class DS. The legend at the bottom of the chart explains the validity codes.

The SO command verb displays the following prompt:

ENTER DEVICE CLASS?

Enter a valid two-character device class: LP, MT, RP or ST.

Figure 4-3 shows the SO command verb display output when you enter LP as the device class. The display is valid for both class LP and RP devices. The name of the operation is shown, along with the hexadecimal operation code. The validity column of the chart shows the letters R, I, or E for each operation code. The letter R indicates that devices in this class respond to that operation code. The letter I indicates that devices of this class ignore that operation code. The letter E indicates that an error condition is produced when devices of this class attempt to execute that operation code.

4.3.4.4 SS — Show Diagnostic Task Status. The SS command verb lists the status of all diagnostic tasks as follows:

STATUS FOR xxxx: ERRORS = nnnn, PASSES = nnnn, OPERATIONS = nnnn

The field xxxx is replaced by the device name of the diagnostic task, and the fields nnnn are replaced by the appropriate numbers.

```
           *** ONLINE DIAGNOSTICS DEVICE OP CODE CHART ***
                        DEVICE CLASS: LP, RP

+--------------------------------+--------------------------------+
| OPERATION      CODE   VALIDITY | OPERATION       CODE   VALIDity |
|                                |                                |
|  OPER           00       R     |  UNUSED          08       E     |
|  CLOSE          01       R     |  READ ASCII      09       E     |
|  CLOSE/EOF      02       R     |  READ DIRECT     0A       E     |
|  OPEN/REWIND    03       R     |  WRITE ASCII     0B       R     |
|  CLOSE/UNLOAD   04       R     |  WRITE DIRECT    0C       E     |
|  READ STATUS    05       I     |  WRITE EOF       0D       R     |
|  FORWARD SPACE  06       I     |  REWIND          0E       R     |
|  BACK SPACE     07       I     |  UNLOAD          0F       I     |
+--------------------------------+--------------------------------+

FOR VALIDITY = R, DEVICE RESPONDS TO OP CODE
               I, DEVICE IGNORES OP CODE
               E, DEVICE RETURNS ERROR CODE
ENTER THE WORD "REJECT"
```

Figure 4-3. SO Command Verb Display

4.3.5 Termination Command Verbs

The termination command verbs cause a normal end-of-job for the individual diagnostic task or the online diagnostics driver task. The termination command verbs are as follows:

KD	Kill Diagnostic
QB	Quit Batch and Wait on Diagnostic Task
QD	Quit Online Diagnostics

4.3.5.1 KD — Kill Diagnostic. The KD command verb terminates diagnostic tasks but does not affect the online diagnostics driver. With the KD command verb, one, several, or all diagnostic tasks can be terminated. When the EXECUTE CONTINUOUSLY termination mode has been selected, the task must be terminated with the KD command verb.

The device name for the task to be terminated must be entered. When the full four-character device name has been entered (for example DS01), only the task for that device is terminated. When the two-character device class (for example DS) is entered, all tasks for devices of that class are terminated. When ALL is entered, all diagnostic tasks are terminated.

The prompts and default options of the KD command verb are as follows:

```
ENTER COMMAND VERB?
KD

ENTER DEVICE NAME? ALL
```

The following messages are displayed for each diagnostic task:

```
DEVICE xxxx TERMINATION STARTED

DEVICE DIAGNOSTIC xxxx TERMINATED WITH nnnn ERRORS, nnnn PASSES,
AND nnnn SPECIFIC OPERATIONS.
```

The field xxxx is replaced by the device name of the diagnostic task. The fields nnnn are replaced by the appropriate numbers.

4.3.5.2 QB — Quit Batch and Wait on Diagnostic Task. The QB command verb is used only in batch input files (COMMAND INPUT) to terminate the reading of the batch input file and cause the driver to monitor the diagnostic message queue (as if a CQ command verb had been entered) until the diagnostic task(s) terminates. Then the driver reads the remainder of the batch input file. When the remainder of the file contains a QD command verb, the diagnostic session ends. When it contains another command verb, the batch input file is read until the next QB command verb.

If there is no remainder of the file (the QB command verb is the last element of the file), the driver returns control to the control terminal and the diagnostic session can be continued from the control terminal. This may be helpful in cases when you need to execute batch mode diagnostics, but must return to interactive execution to view the diagnostics history file or show device status from the batch execution.

The QB command verb prevents the QD command verb from ending a batch mode diagnostic session too early. The following example shows a batch input file that does not contain a QB command verb. When this file is read, the driver reads and executes the QD command verb after reading the other input, ending the diagnostic session immediately. The disk diagnostic tasks do not execute.

EXAMPLE 6

```
XD
DS
YES
QD
```

The following example shows one type of correct usage of the QB verb. The diagnostic session ends after all the diagnostics are complete.

EXAMPLE 7

```
XD
MT02
YES
XD
LP03
YES
XD
DS01
YES
QB
QD
```

The following example shows another type of correct usage of the QB command verb. In this example, several QB command verbs have been used in the batch input file. The diagnostic session ends after the diagnostic for LP01 is complete.

EXAMPLE 8

```
XD
DS01
YES
QB
XD
MT01
YES
XD
LP02
YES
QB
XD
LP01
YES
QB
QD
```

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The following example shows another type of correct usage of the QB command verb. In this example, the QB command verb ends the batch execution, but the diagnostic session does not end because there is no QD command verb. The driver returns control to the control terminal for further input after the diagnostic task for DS01 is complete. This is an example of a diagnostic session that is both batch and interactive.

EXAMPLE 9

```
XD
DS01
YES
QB
```

4.3.5.3 QD — Quit Online Diagnostics. The QD command verb ends the diagnostic session, returning the control terminal to the SCI. The target devices that have been placed in the diagnostic device state remain in that state even though the diagnostic session is over. (Use the ON command to place these devices back in the online state).

Normally, all diagnostic tasks terminate before the QD verb is entered. Either they terminate according to specified termination mode options, or they may be terminated with the KD verb. However, when diagnostic tasks are still executing at the time the QD verb is entered, the online diagnostics driver terminates these tasks first before terminating itself. The driver displays the following messages for each task it terminates:

```
DEVICE xxxx TERMINATION STARTED.

DEVICE xxxx TERMINATED WITH nnnn ERRORS, nnnn PASSES,
AND nnnn SPECIFIC OPERATIONS.
```

The field xxxx is replaced with the device name of the target device: the fields nnnn are replaced by the appropriate numbers. Interactive tasks awaiting I/O are not terminated.

4.3.6 Miscellaneous Command Verbs

The miscellaneous command verbs perform additional functions during the diagnostic session. They are as follows:

CQ	Check Diagnostic Message Queue
HELP	Display Novice Message For Current Prompt
REJECT	Return to Previous Prompt

4.3.6.1 CQ — Check Diagnostic Message Queue. The CQ command verb causes the online diagnostics driver to monitor the diagnostic message queue for diagnostic tasks in need of service. When a diagnostic task is in need of service, it places a signal on the queue and is suspended until the driver answers it. The driver will not know that the task is waiting if, at the same time, the driver is waiting for a response to be entered at the control terminal.

Any time the message *** PRESS 'CMD' KEY TO CONTINUE *** is not displayed at the control terminal, the driver is waiting for a response to be entered, and all diagnostic tasks requiring service are suspended. To force the driver to monitor the diagnostic message queue, enter the CQ command verb in response to the command prompt.

The CQ command verb can be useful during an interactive diagnostic session in which the operator must be absent from the control terminal for a short period. (For a long period of absence, use batch input).

4.3.6.2 HELP. The HELP command verb invokes the HELP feature which displays the novice level message for the current prompt. HELP can be entered at any time during the diagnostic session. For more information, refer back to paragraph 4.2, Using Online Diagnostics.

4.3.6.3 REJECT. The REJECT command verb causes the driver to display the previous prompt in any series, or to display the *** PRESS 'CMD' KEY TO CONTINUE *** message when you enter REJECT at the first prompt of a series. It is valid at any time during the diagnostic session. Many novice level messages provide information about the effect of REJECT at a given point in the diagnostic session.

4.4 ONLINE DIAGNOSTIC MESSAGES

The following paragraphs describe and list the online diagnostic messages, as installed in the file: volumename.S$ODIAG.MSG. Each message is shown as it is displayed, followed by information about the message and any actions the operator should take.

4.4.1 Message Format

The messages are composed of a maximum of five lines of 75 characters each. There are three fields: message serial number, message type code, and message text. The message text is the only field that may be modified.

The message serial number is four hexadecimal digits formatted as follows:

DTNN

where:

D = Number representing the device type or name of the originating task

T = Test number, if originated from a device diagnostic task

NN = Number of the message within the test

Table 4-4 lists the numbers in the D field of the message serial number.

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Table 4-4. Message Module/Device Numbers

Number	Module/Device
0	Online Diagnostics Driver
1	ST820
2	LP810, RP810
3	LP2260
4	Reserved
5	ST911
6	DS
7	Reserved
8	MT979

As an example, the message serial number for the ST911 test one, message number two, is as follows:

5102

The message type code is one character. It indicates the classification of the message. Table 4-5 lists the message type codes and associated classifications.

Table 4-5. Message Type Codes

Code	Classification
E	Error
F	Fatal
I	Informational
W	Warning
O	Operator Error
S	Suppress From History File

The message text is from 1 to 155 characters. The message text is in an abbreviated form to conserve space at the message output device and the history file. Many of the message text fields contain variable data items, called fill-ins. In the following paragraphs, these fill-ins are represented by the characters ?n. The n is the relative number of the fill-in within the message.

The messages in the following paragraphs are listed in ascending order of hexadecimal message serial number. The message text is shown as it appears at the control terminal. The variable fill-in fields are represented by the character ?n. The n represents the relative number of the fill-in within the message. The message is described, and any action that should be taken is detailed.

4.4.2 Online Diagnostics Driver Messages

The following messages are issued by the online diagnostics driver. Most messages provide information about driver activities. However, some messages indicate abnormal internal conditions that require re-installation of the online diagnostics object kit.

```
0001 I DX10 ONLINE DIAGNOSTICS VERSION 2.0 BEGINNING EXECUTION
       AT ANY TIME, ENTER THE WORD 'HELP' FOR MORE INFORMATION.
```

This is the message displayed by the driver in response to the XODD command.

```
0002 W MESSAGE ?1 IS TOO LONG FOR MESSAGE BUFFER.
```

The message text of the indicated message serial number (?1) is larger than maximum allowable characters.

```
0003 S DEVICE ?1 MUST BE IN THE DIAGNOSTIC STATE TO TEST.
       TO PLACE THE DEVICE IN THE DIAGNOSTIC STATE,
       USE THE DX10 'DIAG' PROCEDURE.
```

The target device (?1) is not in the proper device state. Execute the DIAG command from a terminal other than the control terminal.

```
0004 F SVC ERROR >2B?1 WHILE ATTEMPTING TO BID
       DEVICE DIAGNOSTIC ON ?2.
```

The SVC (>2B) generated the error (?1) when the driver attempted to start a diagnostic task for the device (?2).

```
0005 S DEVICE ?1 IS ALREADY EXECUTING!
```

A diagnostic for a device (?1) that is being tested has been attempted.

```
0006 S DEVICE ?1 NOT FOUND IN THE PHYSICAL DEVICE TABLE!
```

You have attempted to start a diagnostic for a device that is not configured on the system.

```
0007 S DEVICE ?1 IS NOT EXECUTING!
```

You have attempted to modify or inquire about a nonexistent diagnostic task.

```
0008 S DEVICE ?1 IS SELECTED.
```

The device (?1) has been selected by the driver for testing.

```
0009 S DEVICE ?1 HAS STARTED EXECUTION.
```

The diagnostic for the device (?1) has started.

```
000A S *** PRESS 'CMD' KEY TO CONTINUE ***
```

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The driver is monitoring the diagnostic message queue. The diagnostic session may now remain unattended. To regain the attention of the driver, press the CMD key.

```
000B F A MESSAGE REQUEST CAME FROM A TASK WITH THE
       RUNTIME ID OF ?1. THIS DEVICE DOES NOT EXIST
       IN THE ONLINE DIAGNOSTIC DRIVER'S CATALOG
```

A message from an unidentified task was found in the diagnostic message queue. Terminate this diagnostic session and start again.

```
000C W MESSAGE ?1 NOT FOUND IN THE MESSAGE FILE.
```

The message number (?1) was not on file when the driver tried to access it.

```
000D S ILLEGAL INPUT. ENTER CORRECT INPUT OR ENTER
       'HELP' FOR ASSISTANCE.
```

An invalid input was entered. Re-enter the correct input or use the HELP feature.

```
000F S DEVICE ?1 TERMINATION STARTED.
```

The diagnostic task for device name ?1 has begun end of task procedures.

```
0010 W FILL IN MATERIAL FOR MESSAGE IS TOO LONG.
```

The variable data is larger than the allotted space.

```
0011 F DEVICE DIAGNOSTIC TERMINATION MESSAGE RECEIVED
       FROM AN UNKNOWN TASK.
```

A termination message from an unidentified task was found in the diagnostic message queue. Terminate this diagnostic session and start again.

```
0014 W SH COMMAND VERB INVALID IN BATCH INPUT FILE.
```

The Show History command verb is valid only during interactive diagnostic sessions.

```
0015 S SH COMMAND VERB INVALID WHEN DIAGNOSTIC HISTORY
       NOT A DX10 FILE.
```

A device rather than a file has been assigned, or the null file name DUMY has been assigned to the diagnostics history file. The Show History command verb does not work under such conditions.

```
0016 S PRESS F1 TO SCROLL FORWARD, F2 TO SCROLL BACKWARD
       OR CMD TO LEAVE SH.

0017 S END OF HISTORY FILE. PRESS F2 TO SCROLL BACKWARD
       OR CMD TO LEAVE SH.
```

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These are instructions for manipulating the Show History display on a Model 911 VDT.

```
0018 F STARTING STATE NOT FOUND!
0019 F ACTION NOT FOUND. ACTION NAME: ?1
001A F ACTION ?1 HAS UNDEFINED TASK, OVERLAY,
        OR FUNCTION NUMBERS!
001B F TOO MANY ACTIONS!
001C F UNKNOWN STATE ERROR NAME! ERROR NAME = ?1
001D F UNKNOWN STATE ESCAPE NAME!
```

These messages indicate abnormal internal conditions in the driver. Re-install the online diagnostics object kit.

```
001E S ILLEGAL INPUT! INPUT = ?1
```

The data entered (?1) is not valid.

```
001F F NEW STATE IS UNDEFINED! STAYING IN SAME STATE.
0020 F FUNCTION NOT FOUND! FUNCTION NUMBER = ?1
0021 F TOO MANY DEFAULT STATES!
0022 F CANNED FUNCTION NUMBER OUT OF RANGE! FUNCTION NUMBER = ?1
0023 F INPUT PARAMETER TO ACTION OUT OF RANGE!
```

These messages indicate abnormal internal conditions in the driver. Re-install the online diagnostics object kit.

```
0024 S TOP OF HISTORY FILE. PRESS F1 TO SCROLL FORWARD OR
       CMD TO LEAVE SH.

0025 S PRESS CMD TO LEAVE SH DISPLAY.
```

These are instructions for manipulating the Show History display on a Model 911 VDT.

```
0026 S ATTEMPT TO RUN A DIAGNOSTIC ON A DEVICE NOT
       SUPPORTED BY ONLINE DIAGNOSTICS. SEE USER'S GUIDE
       FOR A LIST OF SUPPORTED DEVICES.
```

The supported device classes are: DS (all models), LP (Models 810, 2230, 2260), MT (Model 979A), RP (Model 810), ST (Models 911, 820).

```
0027 F DEVICE DIAGNOSTIC ?1 TERMINATED ABNORMALLY.
```

A fatal runtime error diagnostic task for the device name (?1) has occurred.

```
0040 E ERROR PERFORMING I/O ?1. ERROR FROM MODULE ?2.
       MODULE CALLED FROM ?3. I/O STATUS = >?4.
```

An I/O SVC error has occurred.

```
0010 I STATUS FOR ?1: ERRORS = ?2, PASSES = ?3,
       OPERATIONS = ?4.
```

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This is the output of the SS command verb.

```
0402 I DEVICE DIAGNOSTIC TERMINATED WITH ?2 ERRORS, ?3 PASSES,
       AND ?4 SPECIFIC OPERATIONS.
```

This message lists the number of errors, the number of passes through all of the tests, or the number of executions of specific SVC operations.

```
0910 E I/O STATUS ERROR >?1 IN SPECIFIC OPERATION REQUEST >?2.
```

An SVC error (?1) has occurred during the specific operation code (?2).

```
0911 E REQUESTED SVC OPCODE IS UNUSED!
```

You selected an SVC operation code that is not used for this device.

```
0912 E INVALID SPECIFIC OPERATION WAS REQUESTED!
```

A number that is not a valid SVC operation code for this device has been entered. To list the valid SVC operation codes enter the characters SO.

```
0913 E INVALID TEST NUMBER REQUEST!
```

A test number that is not within the range of valid test numbers for this device has been entered. Enter the word HELP or refer to the online diagnostics manual.

```
0914 E ASSIGN LUNO SVC ERROR >27 - THE DISK VOLUME DOES
       NOT CONTAIN THE DIAGNOSTIC FILE '.S$DIAG'. THE
       PACK MAY NEED TO BE INITIALIZED.
```

All disk packs initialized under DX10 3.3 or later should contain a diagnostic file named volumename.S$DIAG.

```
0915 E ASSIGN LUNO SVC ERROR >21 - THE DRIVE DOES NOT HAVE
       A DISK VOLUME INSTALLED IN IT. INSTALL A DISK VOLUME
       AND RETRY THIS DEVICE.
```

An attempt has been made to start a diagnostic for a disk drive that has no volume installed.

```
0916 E ERROR PERFORMING A CHANGE TASK PRIORITY. ERROR
       FROM MODULE CHGPRI. MODULE CALLED FROM REDMSG.
       ERROR CODE = >11?1.
```

A request for a change in task priority generated an error.

4.4.3 Other Online Diagnostic Messages

Messages for other target devices are contained in Appendix D of the *DX10 Online Diagnostic Manual*, part number 2250531-9701. These devices are as follows:

ST820	820 KSR Terminal messages
LP810	810 Line Printer messages
LP2260	2230/2260 Line Printer messages
ST911	911 VDT messages
DS	Disk drive messages
MT979	979A Magnetic Tape messages

5

System Log Analysis Tasks

5.1 GENERAL INFORMATION

The system log analysis tasks provide information about the reliability of hardware devices on the system by analyzing and reporting on the system log files. The system log files are maintained by the operating system. When certain errors and events occur, the operating system writes records to the system log files that describe the error or event. This recording of system activity occurs at all times when the operating system is active.

The system log analysis tasks use files on the system disk. The two major files are: volumename.S$DML, to which compressed system logs are concatenated; and: volumename.S$SLARPT, to which the analysis reports are written when an LP device is not assigned for output.

There are many types of system log records. However, the system log analysis tasks analyze and report on only the following types:

- Device errors
- Memory errors
- Device statistics.

There are two system log analysis tasks. They both compress, sort, and analyze the system log files. One task produces the level one report, which is a summary of the system activity. The other task produces the level two report, which describes each system error and event in detail. The operator decides which level of report best suits his needs.

The system log analysis tasks is initiated in one of two ways. First, one of the tasks executes automatically when the system log files are filled. Second, a system log analysis task can be executed at any time by entering the Execute System Log Analyzer (XSLA) command.

5.2 RELATIONSHIP TO ONLINE DIAGNOSTICS

Online diagnostics provoke certain system error conditions and events. The operating system is active when Online diagnostics are executed, and it writes records of these provoked system errors and events to the system log files. There is no distinction made between those system log records resulting from usual system activity and those resulting from online diagnostics. Therefore, there is no distinction made on the system log analysis tasks reports.

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Online diagnostics have error messages identifying specific diagnostic test failures. They are listed in Section 4. They are not part of the system log and are not included in the System Log Analysis Task reports. While they may coincide with system log errors under some conditions, this is not always true, as in the case of correctable device errors. Such errors cause a system log record, but not a diagnostics error message nor a history file record.

5.3 EXECUTING THE SYSTEM LOG ANALYSIS TASKS

The system log analysis tasks execute in one of two ways. Either the tasks execute automatically when the system log files are filled, or they execute when the operator enters the Execute System Log Analyzer (XSLA) command.

When the tasks begin execution, they compress the system log files and concatenate them onto a relative record file named volumename.S$DML. This file is limited in size to 20 compressed records and is not expandable. The record length is 1024 bytes. When the file is full, newly compressed logs are written over previously compressed logs. The compressed data on this file is analyzed by the System Log Analysis Tasks. The reports are printed at the output device the operator specifies as the ANALYSIS OUTPUT PRINTER.

5.3.1 Automatic Execution

The Initialize System Log (ISL) command requires the operator to specify the System Log Analysis Task that is desired to execute automatically when the log files are filled. The automatic execution option reports only on the current log file. For analysis of the complete volumename.S$DML file containing all previously compressed log files, refer to the instructions for the XSLA command later in this section.

The ISL command is as follows:

```
   [ ] ISL

        INITIALIZE SYSTEM LOG
                   ATTENTION DEVICE:  pathname
                     LOGGING DEVICE:  pathname
   SYSTEM LOG PROCESSOR TASK ID:  05E
          ANALYSIS OUTPUT PRINTER:  LP01
       USER LOG PROCESSOR TASK ID:  0
```

In response to the prompt SYSTEM LOG PROCESSOR TASK ID, enter the task ID for the system log analysis task reporting level desired, as follows:

Level One	>05E
Level Two	>05F

For ANALYSIS OUTPUT PRINTER, enter the name of the device that is to print the System Log Analysis reports. The valid responses are LP01 through LP09 or blanks. When blanks are entered, the reports are written to a file named volumename.S$SLARPT. This file is overwritten each time it is used.

For more information about the ISL command, including the other prompts of the ISL command, refer to the production operation manual for the DX10 Operating System.

5.3.2 The XSLA Command

The XSLA command compresses the current log file regardless of whether or not it is full, concatenates it onto volumename.S$DML, and reports on the entire contents of that file including the previously compressed log files. The XSLA command can be executed at any time.

Enter the XSLA command as follows:

```
   [ ] XSLA

 EXECUTE LOG ANALYZER REPORT
                      LEVEL(1,2):  1
  ANALYSIS OUTPUT PRINTER(0-9):  0
```

Enter the number of the report level and a number within the range 0 through 9 for ANALYSIS OUTPUT PRINTER. When 0 is entered, the report is written to the file named volumename.S$SLARPT. When a number within the range 1 through 9 is entered, the report is written to the LP device having that number. For example, LP02 prints the report when the number 2 is entered for ANALYSIS OUTPUT PRINTER.

5.4 SYSTEM LOG RECORDS

The system log analysis tasks analyze and report on certain types of records on the system log. Both level one and level two reports use these records. Each type of system log record analyzed by the tasks is described in the following paragraphs. The system log files are identified as .S$SLG1 and .S$SLG2.

All system log records contain the date and time of occurrence of the recorded event as the first two fields of the record. The date is expressed as a Julian date, and the time is expressed relative to the 24-hour clock.

Figure 5-1 is an example of a printout of system log records.

```
003:0915 **** LOG STARTED ************************************************
003:0915+ST07 ERR=07 IID=FF L=08 A=0020 107B
                ST05 RID=1C F=00 B=0000 0000
003:0926 MEM  BIT=15 ROW=02 CORRECT=Y BASE=00000 MEM=64KB TYPE=1 TPCS=FB10
003:0927 STAT DEV=DS06 READS=0010 WRITER=0000 OTHER=0001 RETRIES=0000
003:0927+DS07 ERR=18 IID=37 L=04 A=F0F0 0600 0000 0000 0006 15FA 0800 9001
                ST08 RID=3C F=00 B=0001 0400 0000 0000 0006 15FA 0800 1000
003:0928 STAT DEV=DS05 READS=0174 WRITES=0000 OTHER=0002 RETRIES=0000
003:0930 STAT DEV=DS05 READS=016E WRITES=0000 OTHER=0001 RETRIES=0000
003:0930 STAT DEV=DS06 READS=0168 WRITES=0000 OTHER=0000 RETRUES=0000
003:0931+DS05 ERR=14 IID=07 L=11 A=00F0 0300 0100 0000 E506 062E 0801 9880
                ST08 RID=07 F=06 B=0001 0300 0100 0000 1B00 0626 0803 1000
003:0931+DS05 ERR=14 IID=07 L=11 A=00F0 0300 0100 0000 E506 062E 0801 9880
                ST08 RID=07 F=06 B=0001 0300 0100 0000 1B00 0626 0803 1000
003:0931+DS05 ERR=14 IID=07 L=11 A=00F0 0300 0100 0000 E506 062E 0801 9880
                ST08 RID=07 F=06 B=0001 0300 0100 0000 1B00 0626 0803 1000
003:0931+DS05 ERR=14 IID=07 L=11 A=00F0 0300 0100 0000 E506 062E 0801 9880
                ST08 RID=07 F=06 B=0001 0300 0100 0000 1B00 0626 0803 1000
003:0942 MEM  BIT=15 ROW=02 CORRECT=Y BASE=00000 MEM=64KB TYPE=1 TPCS=FB10
003:0949+MT01 ERR=45 IID=26 L=05 A=0000 0000 5452 0000 0000 BA80 8603 8A20
                ST08 RID=79 S=03 B=0000 0000 0000 0000 2580 4F80 8603 1000
```

Figure 5-1. Typical System Log File Listing

5.4.1 Device Error Records

Device error records are generated by the device service routine (DSR) for that device. The following is an example of a device error record.

EXAMPLE 1

```
311:1538+MT02 ERR=43 IID=0D L=06 A=8000 0000 0000 0000 0048 1AE0 4602 8A01
                STFF RID=6B F=00 B=0000 0000 0000 0000 0048 1AE0 4602 1000
```

The fields of the device error record are as follows:

ERR	Type of error shown in hexadecimal. This number is from errors occurring when SVC >00 is issued.
IID	Installed task ID, shown in hexadecimal.
L	LUNO assigned for this I/O request, shown in hexadecimal.
A	Controller image after the error occurred. For TILINE devices, eight words of data follow. For CRU devices, two words of data follow. Shown in hexadecimal.
P	Occurs only when error is in the SVC call block, such as an illegal operation code. The following six words show the SVC call block in hexadecimal.

STxx	Station requesting I/O services, shown in decimal.
RID	Task run ID, shown in hexadecimal.
S, F	Number of controller retries, shown in decimal. When S, operation successfully completed. When F, operation failed.
B	Controller image before the error occurred, shown in hexadecimal. (Valid for TILINE devices only.)

5.4.2 Memory Error Records

Computer memory can have two types of errors, correctable and noncorrectable. Correctable errors cause a log record describing the error to be written. Noncorrectable errors cause a level two interrupt.

An example of a memory log record is as follows:

EXAMPLE 2

```
311:1411 MEM  BIT=00 ROW=0C CORRECT=Y BASE=00000 MEM=64KB TYPE=1 TPCS=FB10
```

The fields of the memory error record are as follows:

BIT	The number of the failing bit shown in hexadecimal. Bits >0 through >0F represent memory data, bits >10 through >15 represent ECC bits.
ROW	The row of memory chips in which the error occurred, shown in hexadecimal. The value is within the range >0 through >03F. (There are 32K bytes of memory per row.)
CORRECT	The letter Y indicates a correctable error. The letter N indicates a noncorrectable error.
BASE	Starting physical memory address of the memory on the controller board, shown in hexadecimal.
MEM	Number of kilobytes (KB) of memory on the controller board, shown in decimal.
TYPE	Memory type. 0 = memory, 1 = cache memory.
TPCS	TILINE Peripheral Control Space address, shown in hexadecimal. The controller interrogates the memory through this address.

5.4.3 Cache Memory Error Records

Cache memory errors produce an additional log record. The following is an example of a cache memory error.

EXAMPLE 3

```
311:1459 MEMC BANK=B PARITY: A=G, B=G BASE=15000 MEM=64KB EVEN=N TPCS=FB10
```

The fields of the cache memory error record are as follows:

BANK	The memory bank (A, B) where the error occurred.
PARITY	Status of parity bit in the bank. For example, PARITY A = G indicates that the parity in bank A is good. Values are banks A or B, G for good, B for bad.
BASE	Starting physical memory address of the memory on the controller board, shown in hexadecimal.
MEM	Number of kilobytes (KB) of memory on the controller board, shown in decimal.
EVEN	Y indicates that the error occurred on an even-address word boundary. N indicates that the error occurred on an odd-address word boundary.
TPCS	TILINE Peripheral Control Space address, shown in hexadecimal. The controller interrogates the memory through this address.

5.4.4 Statistics Records

The DSRs generate log records that summarize statistics of device use. Three counters are kept for all devices; one each for reads, writes, and other events. A fourth counter counts disk errors. The statistics record is written when the number in any of these counters exceeds >7FFF. Additionally, statistics records for disk devices are written when a disk is unloaded.

The following is an example of a statistics record.

EXAMPLE 4

```
311:1437 STAT DEV=DS07 READS=009E WRITES=0030 OTHER=0000 RETRIES=0000
```

The fields of the statistics record are as follows:

DEV	Device name.
READS	Number of read operations performed, shown in hexadecimal.
WRITES	Number of write operations performed, shown in hexadecimal.

OTHER	Number of other operations performed, shown in hexadecimal.
RETRIES	Number of errors received from the controller, shown in hexadecimal. Applies only to disks.

5.5 SYSTEM LOG ANALYSIS TASK REPORTS

The following paragraphs describe the reports generated by the system log analysis tasks. Information about reading and interpreting each report is included, along with the report examples.

5.5.1 Level One Report

The level one report is the short form report designed for the system operator and data center manager. This report presents summarized system log record information in the following order:

1. Device class
2. Device number
3. The date/time of this report
4. Ascending hexadecimal error number

The system log records are analyzed by device number within device class. Memory is treated as a device class. Devices that have not generated log records are not included in the reports. The summarized information is listed in ascending order of hexadecimal error number.

The order of appearance of device classes is as follows:

CRxx, CSxx, DKxx, DSxx, LPxx, MTxx, RPxx, MEM, MEMC

For example, when there are records only for class DS and class MT, the DS class records are presented first, (DS01 followed by DS02, DS03, etc.) before the MT class records are presented. The last two device classes presented are memory (MEM) and cache memory (MEMC).

5.5.1.1 Level One Recommendations. The system log analysis tasks level one report includes messages recommending that the user contact hardware maintenance personnel either immediately or in the near future. These recommendations are based on a statistical analysis of errors occurring on hardware devices. Errors caused by faulty media are included in this analysis. The user is cautioned to review the report for media-related errors before placing a service call to hardware maintenance personnel. Recommendations are based on a mathematical evaluation of error severity and frequency. They are only recommendations. The ultimate decision to take recommended action rests with the user.

5.5.1.2 Example, Level One Report. Figure 5-2 is an example of a level one report, described in the following paragraphs.

The title at the top of the report states that this is a level one report. The date shown after the device name category is FROM the date and time of the last statistics record logged for that device, TO the date and time of this system log report.

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```
          SYSTEM LOG ANALYSIS REPORT -- LEVEL ONE

    DS05 FROM 11/20/80 AT 15:02    TO 11/20/80 AT 15:02

              1    18 - DEVICE IS OFFLINE

    DS07 FROM 11/18/80 AT 15:33    TO 11/20/80 AT 15:31

              1    1B - UNIT CHECK ERROR DURING DISK I/O

           READS=02C5, WRITES=0054, OTHERS=0001, ERRORS=0001

             15    1B - UNIT CHECK ERROR DURING DISK I/O

    DS08 FROM 11/19/80 AT 16:38     TO 11/20/80 AT 15:33

              1    1B - UNIT CHECK ERROR DURING DISK I/O

            READS=0010, WRITES=0000, OTHERS=0000, ERRORS=0001

              1    1D - SEEK INCOMPLETE DISK ERROR

            READS=000A, WRITES=0000, OTHERS=0001, ERRORS=0001

    MEM FROM 11/20/80 AT 08:53   TO 11/20/80 AT 15:33

            11    BIT = 00, ROW = OC, ERROR WAS CORRECTABLE

    RECOMMENDATIONS:

     MARGINAL ERROR RATE-MEM MAY BE CONSIDERED FOR PREVENTIVE
        MAINTENANCE

     EXCESSIVE ERROR RATE-DS07 SHOULD BE SCHEDULED FOR
        PREVENTIVE MAINTENANCE

         END OF SYSTEM LOG ANALYSIS REPORT
```

Figure 5-2. Level One Report

The first category of devices in the report is the disk (DS) devices. This is because there were no system log records found for the device classes CR, CS, and DK.

The DS category begins with DS05. Devices DS01 through DS04 have had no errors since the last report, and so no mention of them appears. DS05 has had one error involving attempted access while the device was offline. The hexadecimal error number is >18. DS07 has had 16 errors involving I/O unit checks; the hexadecimal error number is >1B. One of the errors occurred before a statistics record and 15 occurred after a statistics record. The statistics record shows >02C5 read operations, >0054 write operations, one other operation, and one error (the one occurring before this statistics record). The recommendation suggests that device DS07 has an excessive error rate and should be scheduled for preventive maintenance. DS08 has had one >1B error, and one >1D error, with a statistics record occurring in between. The first statistics record reflects >0010 read operations and one error. The second statistics record shows >000A read operations, one other operation and one error.

The next device category is MEM. The memory of this system has had 11 correctable errors involving bit 00 of row >0C. The recommendation suggests that device MEM has a marginal error rate and should be considered for scheduled preventive maintenance.

5.5.2 Level Two Report

The level two report is the long form report designed for the use of those persons familiar with system hardware and software, and for system maintenance personnel. This report presents summarized system log information and also details each record on the log. The records are sorted in the same order as the level one report: device class, device number, date, and ascending hexadecimal error number. As with the level one report, entries appear only for those devices or device classes for which error records exist on the system log files.

5.5.2.1 Level Two Recommendations. Recommendations are based on the same statistical evaluation of system log errors as the level one report.

5.5.2.2 Example, Level Two Report. Figure 5-3 is an example of a level two report. The following paragraphs describe the report.

The title at the top of the report states that this is a level two report. The first device class to be reported is DSxx. There was one attempt to write on DS05 while it was write-protected, resulting in an error number >1A. Following the summary statement of this error is the error record itself and a statistics record. The device DS07 had one error number >1B (unit check during disk I/O). The error record is displayed after the summary, followed by a statistics record. DS08 is the last disk to have errors.

The remaining devices on the example report are MT01 and MEM. The MEM errors caused a recommendation that device MEM be considered for preventive maintenance.

```
              SYSTEM LOG ANALYSIS REPORT -- LEVEL TWO

  DS05 FROM 11/06/80 AT 15:51   TO 11/06/80 AT 17:56

            1    1A - DISK UNIT IS WRITE PROTECTED

311:1551+DS05 ERR=1A IID=0B L=D5 A=20F0 0300 010E 0003 FF78 7726 0800 9801
                STFF RID=0B F=00 B=0001 0300 010E 0003 0086 7726 0801 1000
         READS=009C, WRITES=0084, OTHERS=0003M ERRORS=0001

 DS07 FROM 11/06/80 AT 14:58    TO 11/06/80 AT 15:57

            1   1B - UNIT CHECK ERROR DURING DISK I/O

311:1458+DS07 ERR=1B IID=16 L=D0 A=10F0 0600 0100 0000 00A4 13AC 0802 9001
                STFF RID=16 S=01 B=0001 0200 0100 0000 00A4 13AC 0802 1000
         READS=054E, WRITES=0050, OTHERS=0000, ERRORS=0001

 DS08 FROM 11/06/80 AT 15:37     TO 11/06/80 AT 15:37

            1   18 - DEVICE IS OFFLINE

311:1537+DS08 ERR=18 IID=37 L=06 A=F0F0 0600 0000 0000 0006 1862 0400 9001
                ST09 RID=67 F=00 B=0001 0400 0000 0000 0006 1862 0400 1000

  MT01 FROM 11/06/80 AT 15:39     TO 11/06/80 AT 15:39

            1   43 - DEVICE IS OFFLINE

311:1539+MT01 ERR=43 IID=0D L=06 A=8000 0000 0000 0000 0048 37E0 8602 8A01
                STFF RID=6E F=00 B=0000 0000 0000 0000 0048 37E0 8602 1000

 MEM  FROM 11/06/80 AT 14:11   TO 12/01/80 AT 15:44

            2   BIT = 00, ROW = 0C, ERROR WAS CORRECTABLE

311:1411 MEM  BIT=00 ROW=0C CORRECT=Y BASE=00000 MEM=64KB TYPE=1 TPCS=FB10
336:1544 MEM  BIT=00 ROW=0C CORRECT=Y BASE=00000 MEM=64KB TYPE=1 TPCS=FB10

RECOMMENDATIONS:

 MARGINAL ERROR RATE-MEM  MAY BE CONSIDERED FOR PREVENTIVE MAINTENANCE

               END OF SYSTEM LOG ANALYSIS REPORT
```

Figure 5-3. Level Two Report

5.6 ABNORMAL CONDITIONS

Under certain adverse conditions, one or more of the following messages may be output by the system log analysis tasks. This indicates the existence of abnormal conditions.

```
ERROR IN READING THE SYSTEM LOG FILE, ERROR =
ERROR IN DEVICE CASE STATEMENT, DML =
ERROR IN NON-DEVICE CASE STATEMENT, DML =
DML FILE READ OF CAT RECORD FAILED, ERROR =
SVC CALLED TO GET FILE CHARACTERISTICS FAILED, ERROR =
FIRST SVC CALL FAILED, ERROR =
SECOND SVC CALL FAILED, ERROR =
BUF WRITE FAILED, ERROR =
CAT WRITE FAILED, ERROR =
ERROR IN DECODE OF DEVICE MESSAGE, DML =
ERROR IN CACHE MEMORY MESSAGE CONVERSION, DML =
ERROR IN STATUS MESSAGE CONVERSION, DML =
ERROR IN SYSTEM MESSAGE CONVERSION, DML =
ERROR IN TASK MESSAGE CONVERSION, DML =
DML FILE WRITE ERROR, ERROR =
ERROR IN MEMORY MESSAGE CONVERSION, DML =
ERROR IN DML FILE READ, STATUS =
```

NOTE

File, read, and write errors give a status code error. This code is listed in the Error Reporting and Recovery Manual for the DX10 Operating System. For the DML FILE READ messages, the error code 0030 indicates that the file volumename.S$DML is a null file.

5.6.1 Task Abnormal Termination Messages

When a task terminates abnormally, a log message is output describing the reason for the termination. If the task has an end action routine that resets end action, then no message will be output. If the end action routine does not reset end action, then the following log message will be output when the task finally terminates.

```
202:1006 TASK ERR=01 IID=02 RID=03 ST04 WP=535E PC=3714 ST=D88F
```

where:

ERR is the type of error (refer to Table 5-1)

IID	is the installed ID of the task requesting services from the DSR.
RID	is the run-time ID of the task requesting services from the DSR.
STxx	is the station of the task requesting services, where xx is the station number.
WP	is the workspace pointer.

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PC	is the program counter.
ST	is the contents of the status register.

Table 5-1. Task Error Code Meaning

Error Code	Meaning
01	A nonrecoverable memory parity error occurred.
02	The task tried to execute an undefined instruction.
03	The task accessed an illegal TILINE address; the illegal address could be an address of a memory location that is not provided for the system installed.
04	The task tried a SVC call with an illegal SVC code.
05	The task tried to access a memory address outside of its memory area.
06	The task tried to execute a privileged instruction.
07	The task was terminated with a Kill Task SVC.
08	The installed memory configuration is not big enough to allow the task to be loaded.
09	The accessed map segment was not present in memory.
0A	An execute protection violation occurred.
OB	The task performed a write-protected segment.
OC	The task caused a condition where the stack parameters were exceeded (stack overflow).
OD	A hardware breakpoint address error occurred.
OE	Timeout error (the 12-millisecond clock expired).
OF	An overflow protection violation occurred.
10	Task aborted by terminal. (Reset, CMD key sequence.)

Note:

In both device and task error messages, a station ID of >FFFF means no station.

6

Disk Copy Procedures

6.1 INTRODUCTION

This section contains procedures used to copy DS990 system disks; specifically, the procedures used to copy and load the operating system from the fixed and removable media of the CD1400 disk drive.

NOTE

> The two disks of the CD1400 are treated as two separate disk drives. The master cartridge containing the DX10 operating system is mounted in the disk drive as the removable cartridge. Then, either the fixed platter or the removable cartridge may be used as the system disk.

6.1.1 Background Information

The backup/copy/restore functions on most DS990 systems use standard utilities. There are two different backup procedures that may be used to copy the system disk: DCOPY (Disk Copy/Restore) or CD (Copy Directory). DCOPY is faster than CD but offers no disk compression and is restricted to copying disks of the same type only. CD is a more general copying procedure that copies disks of different types and offers disk compression. Normally, CD directory copying uses the following utilities:

- Backup Directory (BD)
- Verify Backup (VB)
- Copy Directory (CD)
- Verify Copy (VC)
- Restore Directory (RD)

DCOPY and CD procedures are described in detail in the *DX10 Operating System Production Operation Manual, Volume II,* part number 946250-9702.

The CD1400 media is not guaranteed to be error-free, and copying problems occur if there are bad tracks on the disk. If a bad track is identified, BD, CD, and RD treat that disk space as being used already and copy the data elsewhere. Also, DCOPY may copy a good track onto a bad track if the bad tracks on both disks are asymmetrical. Hence, copies of the CD1400 media using the DCOPY procedures cannot be made properly.

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NOTE

The following procedures describe the steps that must be performed in order to copy a DX10 3.4 operating system from a removable disk cartridge (with or without bad tracks) to a fixed platter (with or without bad tracks) in a CD1400/32 or CD1400/96 disk drive.

6.2 HARDWARE CONFIGURATION

In order to perform an initial program load, the hardware must be configured as follows:

Device	Interrupt	Address
CD1400	13	TILINE >F800

At least one of the system devices must be configured as follows:

Device	Interrupt	CRU Address
911 VDT	10	>100
913 VDT	11	>0C0
733 ASR/KSR	6	>000

6.3 NOTATION CONVENTIONS

In the detailed procedures of this section, the following conventions are used to describe user interaction when responding to SCI prompts.

- <CR> denotes a carriage return when using the RETURN key on the 911 VDT or the NEWLINE key on the 913 VDT.
- When user responses are required for interactive prompts, those responses are preceded by @. For example, @ INV <CR> means the user enters INV, followed by a carriage return.
- The default value to an interactive prompt is enclosed in parentheses. For example, UNIT NAME: (DS01) means the default, DS01, is accepted by entering <CR>.

6.4 SUMMARY OF CD1400 INITIALIZE/COPY/LOAD PROCEDURES

The procedures of paragraph 6.5 give detailed steps for copying a DX10 operating system from the master disk onto the CD1400 fixed platter and then loading the system from the CD1400. A summary of these procedures, using the same numbered steps as the detailed procedures of paragraph 6.5, follows.

1. Install cartridge with DX10 operating system in CD1400.
2. Perform an Initial Program Load (IPL) from the removable cartridge using the programmer's or operator's panel.
3. Bid SCI.
4. Initialize System (IS).
5. Modify Terminal Status (MTS) to VDT mode.
6. Quit (Q).
7. Bid SCI.
8. Initialize New Volume (INV) or Initialize Disk Surface (IDS) for the fixed platter.
9. Show Volume Status (SVS).
10. Copy Directory (CD).
11. Create System Files (CSF).
12. Modify Volume Information (MVI).
13. Perform IPL from fixed platter and check operating system.
14. Quit (Q).

6.5 DETAILED CD1400 COPY AND LOAD PROCEDURES

To copy and load the operating system from CD1400 disk drives, perform the following steps:

1. Install the master disk cartridge containing the DX10 operating system in the CD1400 disk drive and powerup the drive as follows:
    a. Install the cartridge in the disk drive.
    b. Actuate the START/STOP switch and verify that the indicator is lit.
    c. Verify that the READY indicator ceases blinking and remains lit.

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   d. Verify that the FAULT indicator is extinguished.

   e. Remove write protection from the removable cartridge by deactivating the WRITE PROTECT CART switch. Verify that the corresponding indicator is extinguished.

2. Perform an IPL from the removable cartridge using the programmer's panel (standard) or operator's panel (alternate), as follows;

   a. Change the contents of address >84 from >0800 to >0400 and perform a program load from the programmer's panel as follows:

      (1) Press the HALT/SIE switch.

      (2) Press the RESET switch.

      (3) Press the CLR switch.

      (4) Press the 8 data switch.

      (5) Press the 13 data switch.

      (6) Press the MA (ENTER) switch.

      (7) Press the MDD switch.

      (8) Press the 4 data switch.

      (9) Press the 5 data switch.

      (10) Press the MDE switch.

      (11) Press the LOAD switch.

   b. Alternately, perform a program load from the operator's panel as follows:

      (1) Remove write protection from the fixed platter by actuating the WRITE PROTECT FIXED switch. Verify that the corresponding indicator is extinguished.

      (2) Write-protect the removable cartridge by actuating the WRITE PROTECT CART switch. Verify that the corresponding indicator is lit.

      (3) Turn the front panel key switch to LOAD and then back to ON.

      (4) Wait a few seconds and then remove write protection from the removable cartridge. Verify that the WRITE PROTECT CART indicator is extinguished.

3. Bid SCI. This is accomplished using the blank orange key and the ! key on the 911 VDT or the RESET key and the ! key on the 913 VDT. The DX10 menu will appear.

4. Initialize the system using the following procedures.

   a. Enter IS <CR>.

   b. Respond to prompts as follows:

```
INITIALIZE DATE AND TIME

          YEAR:   @ 1981 <CR>          Enter current year

         MONTH:   @ 9 <CR>             Enter current month

           DAY:   @ 20 <CR>            Enter current day

          HOUR:   @ 15 <CR>            Enter hour (24 hour clock)

        MINUTE:   @ 30 <CR>            Enter current minute

INITIALIZE SYSTEM LOG

                 ATTENTION DEVICE:    @ LP01 (See note)

                   LOGGING DEVICE:    @ LP01 (See note)

SYSTEM LOG PROCESSOR TASK ID:         (05E) <CR>

         ANALYSIS OUTPUT PRINTER:     (LP01) <CR>

  USER LOG PROCESSOR TASK ID:         (0) <CR>

111:0925 **** LOG STARTED ************************

WARMSTART PROCEDURE COMPLETE
```

NOTE

In the ISL procedure use any output device available (i.e., any printer, KSR, ASR, or VDT, with hardcopy devices being preferable). Use ME as a final option only. If a LP300/LP600 printer is selected, modify the device state as follows: A Modify Device State (MDS) command must be used with printers that use 8-bit code, because DX10 is set for 7-bit code by default. The List Device Configuration (LDC) command will display the code bit status for each device. DX10 responds to the LDC command with a column CODE8, with an N to indicate a 7-bit code and a Y to indicate an 8-bit code for the device. To change an 8-bit code for a printer enter: MDS DN = LPXX, CODE8 = Y <CR>, where LPXX is the printer name. The MDS command must be repeated each time an IPL is performed.

OP — Operating Procedures

   c. Enter <CR>.

5. Perform a Modify Terminal Status (MTS) command in order to put the terminal in the VDT mode, as follows:

    a. Enter MTS <CR>.

    b. Respond to the prompts as follows:

MODIFY TERMINAL STATUS

TERMINAL NAME: (ST02) <CR> (See note)

NEW STATUS (ON/OFF): <CR>

NEW MODE (TTY/VDT): @ V <CR>

LOGIN REQUIRED?: @ N <CR>

USER PRIVILEGE CODE: <CR>

DEFAULT MODE (TTY/VDT): @ V <CR>

NOTE

The control monitor will display the station identification assigned to the control terminal presently in use.

6. Quit SCI by entering Q <CR>.

7. Bid SCI. The DX10 menu will appear.

8. Initialize New Volume (INV) as described in the following.

    a. Enter INV <CR>.

    b. Respond to the prompts as follows:

INITIALIZE NEW VOLUME

UNIT NAME: @ DS02 <CR>

VOLUME NAME: @ VL02 <CR>

NUMBER OF VCATALOG ENTRIES: (342) <CR>

BAD TRACK ACCESS NAME: <CR>

DEFAULT PHYSICAL RECORD SIZE: (768) <CR>

HARDWARE INTERLEAVING FACTOR: (1) <CR>

FORCE CLEARING OF DISK: (NO) <CR>

USED AS SYSTEM DISK?: (YES) <CR>

LISTING ACCESS NAME: <CR>

TRACK 1 LOADER ACCESS NAME

LOADER ACCESS NAME: <CR>

NOTE

If the INV command executes properly, proceed to step 9. The DX10 menu will appear. If the INV command does not execute properly, proceed with the following substep c.

c. If the fixed platter has not been initialized after the INV prompts are completed, the IDS prompt will appear on the monitor, as follows:
IDS — USER MUST EXECUTE IDS COMMAND BEFORE FIRST INV COMMAND. To execute IDS, proceed as follows:

   (1) Enter <CR>.

   (2) Enter IDS <CR>,

d. Respond to prompts as follows:

INITIALIZE DISK SURFACE

UNIT NAME: @ DS02 <CR>

INITIALIZE NEW VOLUME: (YES) <CR>

BAD TRACK ACCESS NAME: <CR>

LISTING ACCESS NAME: <CR>

INITIALIZE NEW VOLUME

VOLUME NAME: @ VL02 <CR>

NUMBER OF VCATALOG ENTRIES: (342) <CR>

DEFAULT PHYSICAL RECORD SIZE: (768) <CR>

HARDWARE INTERLEAVING FACTOR: (1) <CR>

```
        USED AS SYSTEM DISK?:    (YES) <CR>

        LOADER ACCESS NAME:      <CR>
```

9. Perform the Show Volume Status (SVS) command as follows:

   a. Enter SVS <CR>.

   b. Respond to prompts as follows:

   ```
   SHOW VOLUME STATUS

           VOLUME NAME:    <CR>

            DRIVE NAME:    @ DS01 <CR>

   OUTPUT ACCESS NAME:    <CR>
   ```

   c. The monitor display resulting from SVS is shown in the following. The VOLUME NAME and other information about the operating system in the removable cartridge is given. Record the VOLUME NAME and use it in step 10 in response to the INPUT PATHNAME prompt.

```
VOLUME NAME:  REL34   ADUS:  52544   #BAD:  0   BYTES/ADU:  256

AVAILABLE:  52061   LARGEST AVAILABLE BLOCK:  52061   CONTROLLER ERROR:  0

PRIMARY SYSTEM IMAGE:  RLSYS   SECONDARY SYSTEM IMAGE:

NAME INSTALLED:  REL34
```

10. Perform the Copy Directory (CD) command as follows:

    a. Press CMD to return to the SCI menu.

    b. Enter CD <CR>.

    c. Respond to the prompts as follows:

    ```
    COPY DIRECTORY

          INPUT PATHNAME:     @ REL34 <CR>   Enter VOLUME NAME
                                             recorded in step 9

         OUTPUT PATHNAME:     @ VL02 <CR>

    CONTROL ACCESS NAME:     <CR>

     LISTING ACCESS NAME:     <CR>

                 OPTIONS:     (ADD) <CR>
    ```

NOTE

It may take 45 minutes for copy directory to execute, depending on memory size.

11. Perform the Create System Files (CSF) command as follows:

    a. Press CMD to return to the SCI menu.

    b. Enter CSF <CR>.

    c. Respond to the prompts as follows:

```
CREATE SYSTEM FILES

              VOLUME NAME:    @ VL02 <CR>

   MEMORY SIZE IN KBYTES:     (128) <CR>

DISK SECTOR SIZE IN BYTES:    (256) <CR>
```

NOTE

Error 27 will be reported the first time CSF is entered on DX10 release 3.4.1. It is not necessary to repeat CSF because error 26 will be reported on any further attempts. Ignore these errors.

12. Perform the Modify Volume Information (MVI) command as follows:

    a. Press CMD to return to the SCI menu.

    b. Enter MVI <CR>.

    c. Respond to the prompts as follows:

```
MODIFY VOLUME INFORMATION

       CONTROL ACCESS NAME:    (ME) <CR>

                       MVI

                    DISC?:    @ DS02 <CR>

      COMMAND (L, C, S, Q)?:    @ C <CR>     L = List, C = Change;
                                             S = Switch (primary/
                                             secondary); Q = Quit
```

OP — Operating Procedures

```
WHICH ITEM (S, O, P, L, D, V, W)?:   @ S <CR>       S = System image;
                                                    O = Overlay; P = Program;
                                                    L = Loader; W = WCS;
                                                    D = Diagnostics;
                                                    V = Volume name

                         PRIMARY:   @ RLSYS <CR>

                       SECONDARY:   @ <CR>

                          SELECT:   @ (P) <CR>

              COMMAND (L, C, S, Q)?:   @ C <CR>

WHICH ITEM (S, O, P, L, D, V, W)?:   @ O <CR>

                         PRIMARY:   @ S$OVLYA <CR>

                       SECONDARY:   @ <CR>

                          SELECT:   @ (P) <CR>

              COMMAND (L, C, S, Q)?:   @ C <CR>

WHICH ITEM (S, O, P, L, D, V, W)?:   @ P <CR>

                         PRIMARY:   @ S$PROGA <CR>

                       SECONDARY:   @ <CR>

                          SELECT:   @ (P) <CR>

              COMMAND (L, C, S, Q)?:   @ C <CR>

WHICH ITEM (S, O, P, L, D, V, W)?:   @ L <CR>

                         PRIMARY:   @ S$LOADER <CR>

                       SECONDARY:   @ DMXDOCS <CR>

                          SELECT:   @ (P) <CR>

              COMMAND (L, C, S, Q)?:   @ L <CR>
```

The displayed listing should be as follows:

```
                      PRIMARY       SECONDARY     SELECTED

    SYSTEM IMAGE:     RLSYS                           P

    PROGRAM FILE:     S$PROGA                         P

    OVERLAY FILE:     S$OVLYA                         P

     LOADER FILE:     S$LOADER       DMXDOCS          P

        WCS FILE:                                     P

     DIAGNOSTICS:                    -------          N

     VOLUME NAME:     VL02

COMMAND (L, C, S, Q)?:
```

If a discrepancy is noted in any of the above entries, enter: C <CR>. Make the changes required. If all are correct, enter: Q <CR>.

d. Perform a quit SCI command by entering: Q <CR>. The operating system should now be on the fixed platter.

13. Perform an IPL procedure from the fixed platter using either the programmer's panel (standard) or the operator's panel (alternate) and check the operating system, as follows:

    a. Load the operating system using the programmer's panel as follows:

        (1) Press the HALT/SIE switch.

        (2) Press the RESET switch.

        (3) Press the LOAD switch.

        The operating system should now load.

    b. Alternately, load the operating system using the operator's panel as follows:

        (1) Write protect the fixed platter by actuating WRITE PROTECT FIXED and verifying the indicator is lit.

        (2) Remove write protection from the removable cartridge by deactivating WRITE PROTECT CART and verifying the indicator is extinguished.

        (3) Turn the front panel key switch to LOAD and then back to ON.

OP — Operating Procedures

(4) Wait a few seconds and remove write protection from the fixed platter.

The operating system should now load.

c. Perform the following commands to ensure that the copied operating system is operational:

(1) Bid SCI

(2) Perform an Initialize System (IS) command.

(3) Perform a Modify Terminal Status (MTS) command.

(4) Enter Quit (Q).

(5) Bid SCI.

(6) Perform a List Device Configuration (LDC) command. This command will show how the operating system has been sysgened. In order to test any device, it must be configured as indicated in the LDC listing.

(7) Perform a List Directory (LD) command.

(8) Perform a Print File (PF) command.

14. Enter Quit (Q).

NOTE

If the customer's media was used, the disk copy procedures are now complete. If not, perform the following procedures to erase the fixed platter.

15. Perform an IPL from the removable cartridge by performing the procedures of the preceding step 2.
16. Bid SCI.
17. Erase the operating system from the fixed platter (DS02) by performing an Initialize New Volume (INV) as previously described.
18. Enter Quit (Q).
19. Halt the computer.
20. Remove the removable cartridge from the disk drive.

Contents

PM — Preventive Maintenance

1

Preventive Maintenance

1.1 INTRODUCTION

NOTE

> By publication of the preventive maintenance schedules, procedures, and time intervals in this section, Texas Instruments assumes no liability or contractual requirement. The procedures are intended as a guide for use by customers, TI CRs, or other qualified service personnel and may be performed during routine service calls. They are for reference only and are subject to change without notice.

Preventive maintenance (PM) is a recommended scheduled maintenance program to keep equipment in good working order in a wide range of environments with varied rates of usage. PM is intended to minimize downtime and reduce the frequency of service calls.

PM is useful for assuring consistent system performance. However, when performing PM procedures be careful to avoid inducing system problems. Aggressive cleaning can cause unwarranted system downtime. Dirty environments may require more frequent PM procedures than those recommended.

A good visual inspection is the first step in every scheduled maintenance task. Look for dirt, corrosion, wear, binds, and loose connections. Correcting these conditions will prolong usable equipment life and increase reliability. Do no more than the recommended PM on equipment that is operating properly.

At the conclusion of the PM procedures have the user bring the system up and verify that all units are working correctly in response to the operating system. In the following procedures, customer PM is limited to:

- Cleaning the exterior of components and enclosures
- Cleaning the filter for the 17-slot chassis
- Cleaning and inspecting the 979A tape transport as follows:
    - Heads and capstan (daily)
    - Vacuum column (weekly)
    - Phototransistors (weekly)

PM — Preventive Maintenance

1.2 SCHEDULE CHART

The following charts describe the standard configuration PM schedules. Unless otherwise noted the numbers represent the recommended time intervals in months.

DS990 Model 2	6/13-Slot Chassis	FD1000	911	820
Clean Exterior	3	3	3	3
Clean Filter	3			
Run Diagnostics	3	3	3	3
Inspect Heads		3		
Inspect Belt		3		
Clean Stepper Motor		3		
Inspect Ribbons				3
Clean Carriage Rods				3
Lubricate Guide Rods				3
Oil Gear Eyelet				3
Vacuum Interior				3
Vacuum Interior		12	12	
Check Head Align		12		
Clean Filter		12		

DS990 Model 3	6/13-Slot Chassis	FD1000	DS10
Clean Exterior	3	3	3
Clean Filter	3		3
Run Diagnostics	3	3	3
Vacuum			3
Inspect Heads		3	3
Inspect Spindle			3
Inspect User's Cartridge			3
Inspect Belt			3
Clean Stepper Motor		3	
Inspect Fixed Head and Disk			6
Replace Absolute Air Filter			6
Check Head Alignment			6
Check Index to Burst			6
Check Power Supply			6
Purge Air System			6

PM — Preventive Maintenance

DS990 Model 4	**13-Slot Chassis**	**DS10**	**911**
Clean Filter	3	3	
Clean Exterior	3	3	3
Run Diagnostics	3	3	3
Vacuum		3	
Inspect Heads		3	
Inspect Spindle		3	
Inspect Users Cartridge		3	
Inspect Belt		3	
Inspect Fixed Head and Disk		6	
Replace Absolute Air Filter		6	
Check Head Alignment		6	
Check Index to Burst		6	
Check Power Supply		6	
Purge Air System		6	
Vacuum Interior			12

DS990 Model 6	**13-Slot Chassis**	**DS25**	**911**
Clean Exterior	3	3	3
Clean Filter	3	3	
Run Diagnostics	3	3	3
Inspect Heads		3	
Lubricate Spindle		3	
Inspect Lid Gasket		3	
Inspect Disk Pack Area		3	
Inspect Drive Belt		3	
Replace Absolute Air Filter		6	
Check R/W System Alignment		6	
Check Positioning System Alignment		6	
Check Spindle Drive System		6	
Check Spindle Grounding Brush		6	
Purge Air System		6	
Vacuum			12

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DS990 Models 7 and 9	13-Slot Chassis	CD1400	911
Clean Exterior	3	3	3
Clean Filter	3		
Run Diagnostics	3		3
Replace Absolute Filter		12	
Clean Inner Prefilter		12	
Vacuum Interior			12
Purge Air System		12	
Run Diagnostics		12	

DS990 Model 8	13-Slot Chassis	DS50	911
Clean Exterior	3	3	3
Clean Filter	3	3	
Run Diagnostics	3	3	3
Inspect Heads		3	
Lubricate Spindle		3	
Inspect Lid Gasket		3	
Inspect Disk Pack Area		3	
Inspect Drive Belt		3	
Replace Absolute Air Filter		6	
Check R/W System Alignment		6	
Check Positioning System Alignment		6	
Check Spindle Drive System		6	
Check Spindle Grounding Brush		6	
Purge Air System		6	
Vacuum			12

PM — Preventive Maintenance

DS990 Models 8PP/20	**17-Slot Chassis**	**DS50**	**911**	**979A**
Inspect/Clean Capstan				Daily
Inspect/Clean Vacuum Column				Weekly
Inspect/Clean Phototransistors				Weekly
Clean Filters	3	3		
Clean Exterior	3	3	3	3
Run Diagnostics	3	3	3	3
Inspect Heads		3		3
Lubricate Spindle		3		
Inspect Lid Gasket		3		
Inspect Disk Pack Area		3		
Inspect Drive Belt		3		
Replace Absolute Air Filter		6		
Check R/W System Alignment		6		
Check Positioning System Alignment		6		
Check Spindle Drive System		6		
Check Spindle Grounding Brush		6		
Purge Air System		6		
Inspect Relay Contacts				6
Check Skew Adjustment				6
Check Speeds				6
Check Power Supplies				6
Vacuum			12	

DS990 Model 29	**17-Slot Chassis**	**CD1400**	**911**
Clean Exterior	3	3	3
Clean Filter	3		
Run Diagnostics	3		3
Run Diagnostics		12	
Replace Absolute Filter		12	
Clean Inner Prefilter		12	
Purge Air System		12	
Inspect Cartridge R/W Heads		12	
Run Diagnostics		12	
Vacuum			12

PM — Preventive Maintenance

DS990 Model 30	**17-Slot Chassis**	**DS 200**	**911**	**979A**
Inspect/Clean Capstan				Daily
Inspect/Clean Vacuum Column				Weekly
Inspect/Clean Phototransistors				Weekly
Clean Exterior	3	3	3	
Clean Filters	3	3		
Run Diagnostics	3	3	3	3
Inspect Disk Pack Area		3		
Lubricate Spindle		3		
Inspect R/W Heads		3		3
Inspect Drive Belt		3		
Check Spindle Grounding Brush		3		
Check R/W System Alignment		6		
Check Positioning Alignment		6		
Check Spindle Drive System Alignment		6		
Replace Absolute Air Filter		6		
Purge Air System		6		
Inspect Relay Contacts				6
Check Skew Adjustment				6
Check Speeds				6
Check Power Supplies				6
Vacuum			12	

Equipment	**Interval (Months)**	**Procedure**	**Reference Paragraph**
990 6-slot chassis	3	1. Clean exterior 2. Clean filter 3. Run performance demonstration test (PDT) under DOCS	1.3
990 13-slot chassis	3	1. Clean exterior 2. Clean filter 3. Run PDT under DOCS	1.3
990 17-slot chassis	3	1. Clean exterior 2. Clean filters 3. Run PDT under DOCS	1.4

PM — Preventive Maintenance

Equipment	Interval (Months)	Procedure	Reference Paragraph
911 VDT	3	1. Run Diagnostics	1.5
	12	2. Vacuum	
DS10 disk drive	3	1. Vacuum 2. Inspect heads 3. Clean filter 4. Inspect spindle area 5. Inspect user disk cartridge 6. Run PDT under DOCS 7. Inspect platter brushes	1.6
	6	1. Complete 3 months PM 2. Inspect fixed head and disk 3. Replace absolute air filter 4. Check head alignment 5. Check index to burst adjustment 6. Check power supply voltages 7. Check static eliminator 8. Perform purge procedures	
DS25/50 disk drive	3	1. Inspect heads 2. Lubricate spindle 3. Inspect lid gasket 4. Inspect disk pack area 5. Clean filter 6. Inspect drive belt 7. Run diagnostics	1.7
	6	1. Complete 3 months PM 2. Replace absolute air filter 3. Check R/W system alignment 4. Check positioning system alignment 5. Check spindle drive system 6. Check spindle grounding brush 7. Perform purge procedures	

PM — Preventive Maintenance

Equipment	Interval (Months)	Procedure	Reference Paragraph
DS200 disk drive	3	1. Inspect disk pack area 2. Lubricate spindle 3. Clean intake filter 4. Inspect R/W heads 5. Inspect drive belt 6. Run PDT under DOCS 7. Inspect grounding brush	1.8
	6	1. Complete 3 months PM 2. Check spindle grounding brush 3. Vacuum internal cabinet 4. Check R/W system alignment 5. Check positioning system alignment 6. Check spindle drive system alignment 7. Replace absolute air filter 8. Perform purge procedures	
CD1400 disk drive	12	1. Replace absolute air filter 2. Clean inner prefilter 3. Run diagnostics 4. Perform purge procedures	1.9
FD800/FD1000 flexible disk	3	1. Inspect and clean heads, using diskette head cleaning kit 2. Run diagnostics 3. Inspect belt 4. Clean stepper motor	1.10
	12	1. Complete 3 months PM 2. Check head alignment 3. Clean filters 4. Vacuum base	
979A tape drive	Daily	Inspect/clean capstan	1.11
	Weekly	1. Inspect/clean vacuum column 2. Inspect/clean phototransistors	

PM — Preventive Maintenance

Equipment	Interval (Months)	Procedure	Reference Paragraph
	3	1. Run diagnostics 2. Inspect/clean tape path components	
	6	1. Complete 3 months PM 2. Inspect relay contacts 3. Check skew adjustment 4. Check forward/reverse speeds 5. Check power supply voltages	
2230/2260 printers	3	1. Inspect cowl 2. Inspect character drum 3. Check indicators 4. Run diagnostics	1.12
	6	1. Complete 3 months PM 2. Check hammer bank servo 3. Check paper feed servo 4. Check drum alignment	
LQ45 printer	6	1. Lubricate ribbon lift 2. Lubricate paper feed gear 3. Clean/lubricate platen 4. Clean/lubricate print hammer 5. Lubricate lower carriage bearings/rails 6. Lubricate carriage pulley 7. Lubricate right-hand lever pivot 8. Lubricate platen gear drive 9. Lubricate platen shaft assemblies 10. Lubricate forms tractor	1.13

PM — Preventive Maintenance

Equipment	Interval (Months)	Procedure	Reference Paragraph
LP300/LP600 printers	6	1. Clean air filter 2. Clean hammer bank 3. Lubricate shuttle cam 4. Lubricate anti-rotation arm 5. Lubricate counterbalance assembly 6. Check shuttle drive belt tension 7. Check paper feed belt tension	1.14

1.3 6-SLOT AND 13-SLOT CHASSIS

Exterior panels may be cleaned with a damp cloth and wiped dry. The 6-slot and 13-slot chassis have a washable metallic air filter located at the rear of the chassis. This filter should be cleaned using the following procedure:

1. Turn off power to the computer.
2. Remove the cover from the tabletop 6-slot chassis to gain access to the filter.
3. Slide out the filter from the rear of the chassis.
4. Clean the filter with a mild spray detergent.
5. Rinse the filter in warm water and shake off excess water.
6. Dry the filter with paper towels or an absorbent cloth.

CAUTION

Do not reinstall the filter until it is completely dry. Moisture injected by the fan may damage the CPU.

1.4 17-SLOT CHASSIS

The 17-slot chassis has four filters located behind the front grill. Clean these filters as described in paragraph 1.3. Run the diagnostics that apply to the computer system configuration.

1.5 MODEL 911 VIDEO DISPLAY TERMINAL

The screen and cabinetry should be wiped with a cloth dampened with water to remove smudges. The Model 911 has no mechanical moving parts, therefore, PM for the unit is minimal. Good housekeeping practices by both the CR and the user should keep the terminal in good operating condition. The CR should vacuum the interior annually.

CAUTION

The CRT retains high voltage even after power is removed from the unit.

1.6 DS10 DISK DRIVE

The PM procedural details for the DS10 disk drive are listed in the field maintenance manual, part number 945419-9702, Section 2.

1.7 DS25/50 DISK DRIVE

Detailed procedures pertaining to the DS25/50 disk drives are listed in the Century Data Systems maintenance manual, part number 10204-901-002-1. Section 2 lists cleaning, lubrication, and general checks. Major alignment procedures and adjustments are outlined in Section 3 of the maintenance manual.

1.8 DS200 DISK DRIVE

Century Data Systems maintenance manual, part number 10204-901-002-0, Section 2, contains procedures for cleaning, inspection, and lubricaton. Section 3 provides detailed instructions on alignment procedures and checks.

1.9 CD1400 DISK DRIVE

Detailed procedures pertaining to the CD1400 disk drive are listed in the *Model CD1400 Disk System Field Maintenance Manual*, part number 945419-9706. Section 2 lists preventive maintenance procedures.

1.10 FLEXIBLE DISK DRIVES FD800 AND FD1000

The FD800 reference manual is the Shugart LSA800/801 maintenance manual. Section 3 contains cleaning and inspection procedures and Section 4 details alignment checks and procedures.

The FD1000 field maintenance manual, part number 945419-9703, Section 2, provides cleaning and inspection instructions. Section 3 provides the details for checks and alignments.

PM — Preventive Maintenance

1.11 979A MAGNETIC TAPE DRIVE

Chapter 2 of the 990 peripheral field maintenance manual, part number 945419-9701, contains the PM procedures for the 979A tape drive.

1.12 2230/2260 LINE PRINTER

General PM procedures and adjustments, checks, and alignment procedures are listed in the DPC manual 241735H (TI part number 2272145-9701), Section 6, for the 2230 and DPC manual 239541G (TI part number 2272146-9701) for the 2260.

1.13 LQ45 LETTER QUALITY PRINTER

Detailed procedures pertaining to the LQ45 printer are listed in the *Model LQ45 Letter Quality Printer System Field Maintenance Manual*, part number 945419-9705. Paragraph 2.3 lists cleaning and lubrication procedures.

1.14 LP300/LP600 LINE PRINTERS

Detailed procedures pertaining to the LP300/LP600 printers are listed in the *Model LP300/LP600 Line Printers Field Maintenance Manual*, part number 945419-9704. Paragraph 2.1.2 lists cleaning and lubrication procedures.

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1

System Troubleshooting

1.1 INTRODUCTION

This section provides troubleshooting aids for the CR to use when a DS990 system malfunction has occurred. This information is useful when the CR has been dispatched to diagnose and correct a problem, to return the system to service, and to make the appropriate entries in the site log.

NOTE

> Communications troubleshooting is not covered in this section, but is included in the *990 Family Communications Systems Field Reference Manual*, part number 2276579-9701.

When troubleshooting a problem in a DS990 computer system, take a logical, step-by-step approach. It is important that no steps be left out in any phase of diagnosing and correcting the problem. A skipped step may be the one that leads to the correct solution. It is also important to keep a step-by-step record of proceedings so that a clear map can be made of tasks that have been accomplished and tasks remaining to be done.

1.1.1 Minimum Configuration Technique

In some instances the minimum configuration technique is used to diagnose and to isolate the system malfunction. The minimum configuration technique consists of removing all of the peripherals and devices except for the CPU, minimum memory, and one I/O device. Diagnostics and other troubleshooting techniques then can be applied to this minimum configuration. Once this minimum configuration performance is satisfactory, controllers for peripherals can be introduced one at a time and problems cleared as they appear.

1.1.2 Environment Evaluation

In diagnosing a system failure and evaluating system performance, the CR should comprehend the overall system environment. System performance, system reliability, and consequently system failure, are direct functions of the environment. A dirty environment will lead to a shortened system component filter life, which if unserviced can lead to system failure. Poor electrical power service, such as electrical noise and ground loops, can lead to intermittent and unreliable system performance.

NOTE

> Sometimes problems in a system such as electrical noise, intermittents, and transients may be caused by improper grounding. Refer to Appendix E for a discussion of grounding techniques and the advantages of system single-point grounding. Refer to the applicable site preparation manual for the proper electrical power system grounding.

1.1.3 General Problem Evaluation

The following information should be requested in order to assist the CR in establishing the reported customer problem. This suggested list is not intended to deviate from current established field service procedures. The following questions are intended to alert the CR to internal and external computer equipment conditions that can affect system performance.

List the problems encountered:

- Is the problem intermittent and/or repetitive?
- Has the system ever worked properly; i.e., is it an installation problem?
- Has any new equipment been added to the system that might have caused the problem?
- Any unusual weather, such as a lightning storm?
- Was any equipment moved when the problem surfaced?
- Any electrical problems or new construction at the site?
- Does the problem seem to be software-related?
  - Has the software been changed or resysgened?
  - Have the latest software patches been applied?
- Does the problem seem to be hardware-related?
  - Is it an obvious CPU problem?
  - Is it an obvious peripheral problem?
- Does the site meet system power and environmental specifications? (Refer to the applicable site preparation manual.)

- Ask the customer to demonstrate the problem. Can it be duplicated?
- Check the system site log for problem history. Are any error messages entered?
- Is the system dead?
- Is the CPU front panel locked up?
- Will the system boot?

1.1.4 Troubleshooting Flowcharts

The DS990 systems troubleshooting flowchart shown in Figure 1-1 provides systematic procedures to isolate the problem to a particular subsystem and/or board. Where appropriate, Figure 1-1 provides exits for troubleshooting with other stand-alone troubleshooting flowcharts on power supplies and peripheral devices. The flowcharts have details to isolate more than 90% of the problems to the subsystem/board level.

The objective of the flowcharts is to guide the CR in obtaining and verifying the over-all system status at the time of the system failure. This information includes the following status indications:

- Program counter (PC)
- Workspace pointer (WP)
- CPU status indicators
- Crash codes
- Controller and interface board LEDs
- Other system status indicators

This information is used to point to the subsystem, device, or board causing the problem.

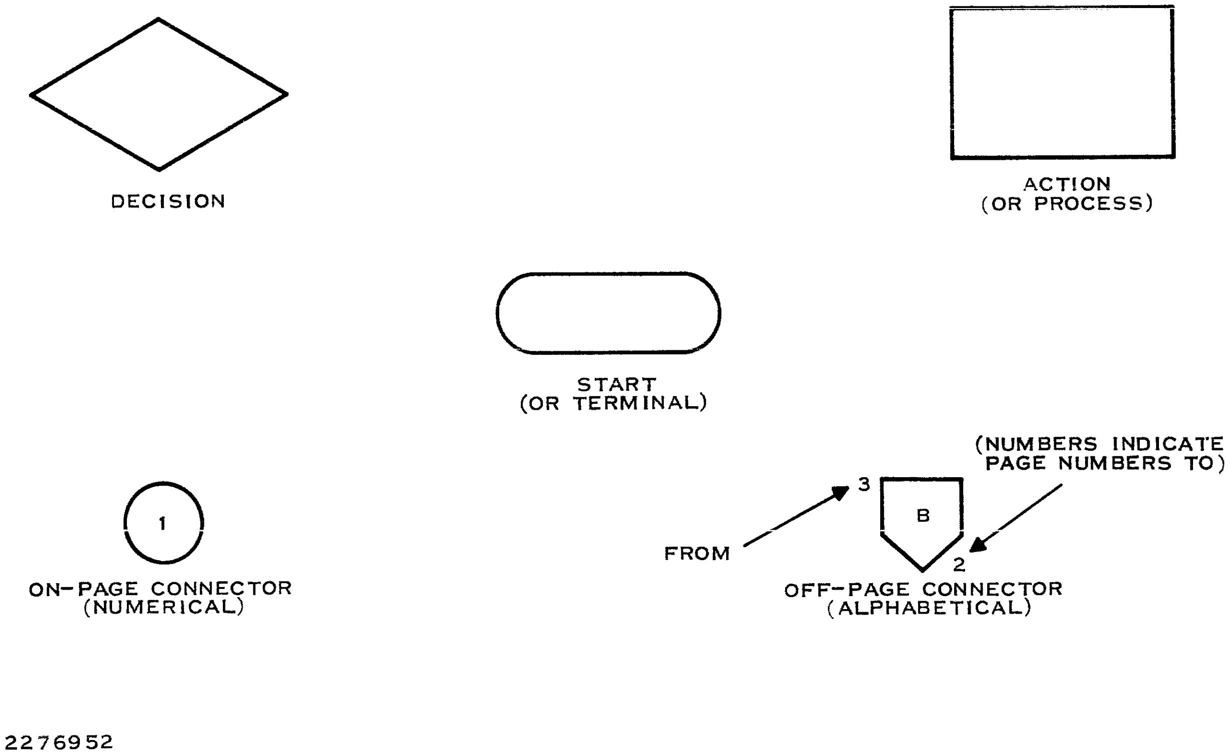
1.2 ILLUSTRATIONS

The following illustrations are used in this section to support troubleshooting the DS990 systems and the computer chassis power supplies:

1.3 TROUBLESHOOTING FLOWCHARTS

Figure 1-1 is the DS990 systems troubleshooting flowchart. Figure 1-2 is a troubleshooting flowchart for the 6-slot/13-slot chassis power supply. Figure 1-3 is an ac wiring diagram of the 6-slot chassis, and Figure 1-4 is an ac wiring diagram of the 13-slot chassis. These wiring diagrams support Figure 1-2.

The following symbols are used in the flowcharts:



Flowchart Symbols

TR — Troubleshooting

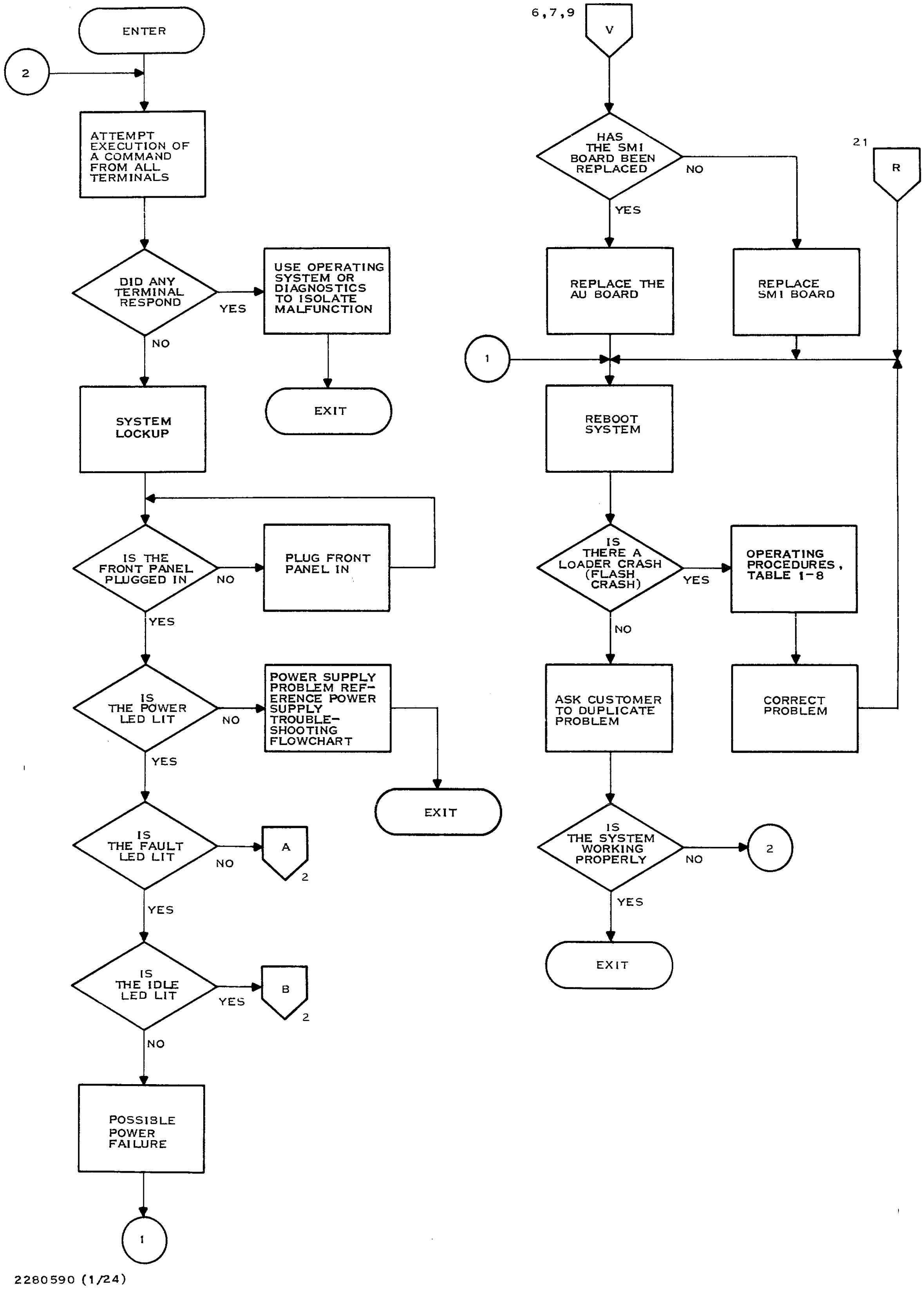
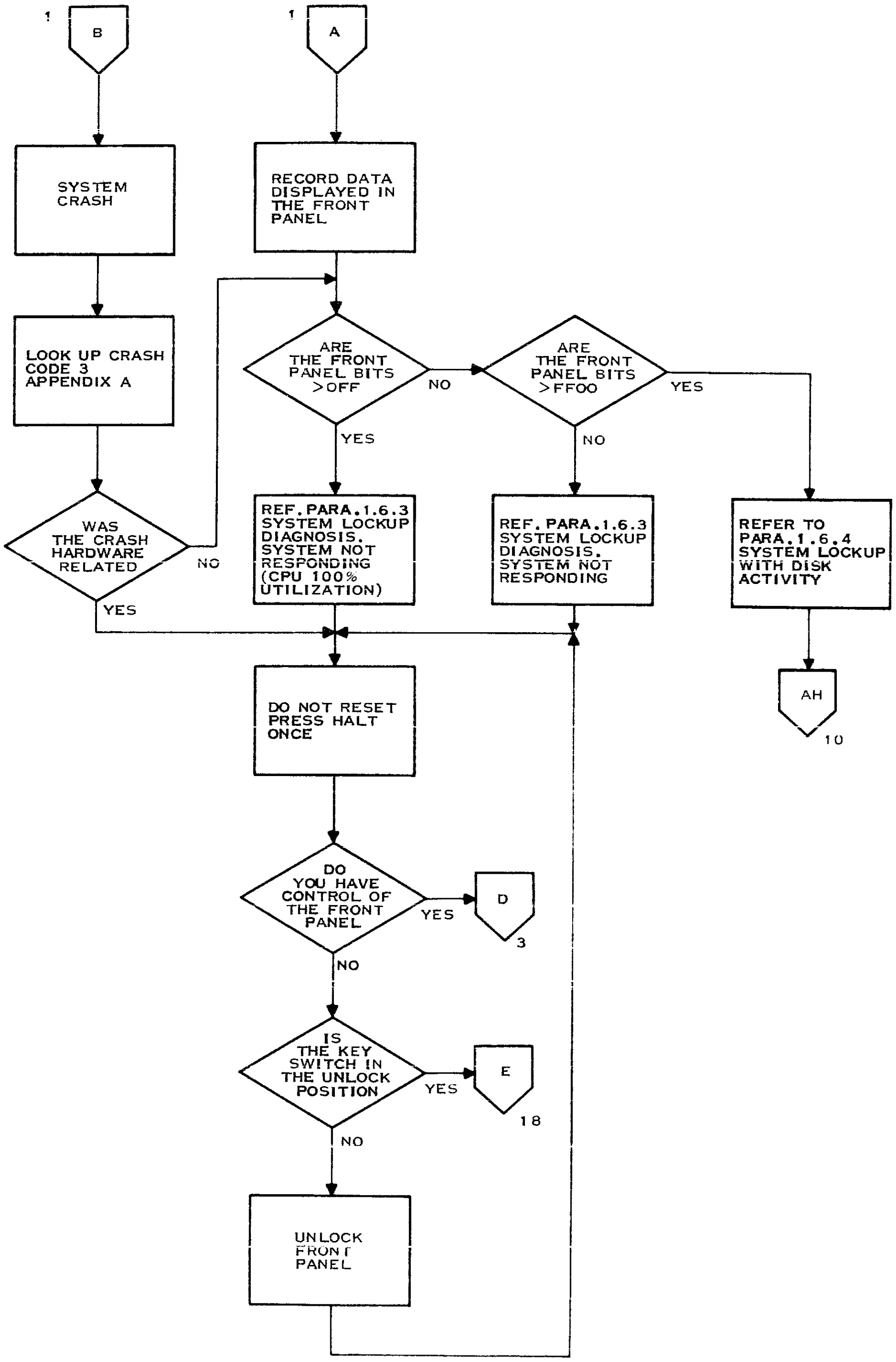


Figure 1-1. DS990 System Troubleshooting Flowchart (Sheet 1 of 24)

TR — Troubleshooting



2280590 (2/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 2 of 24)

TR — Troubleshooting

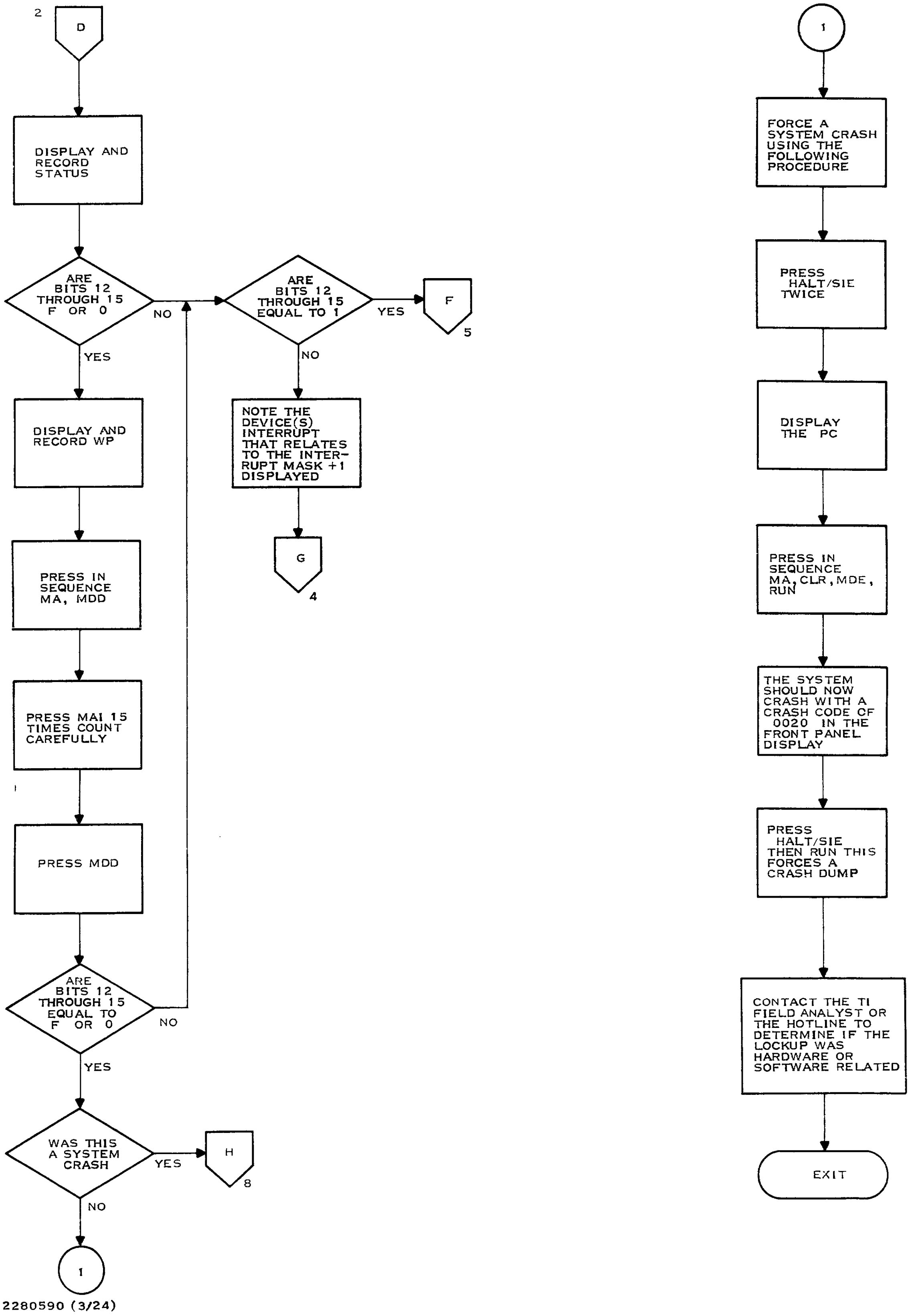
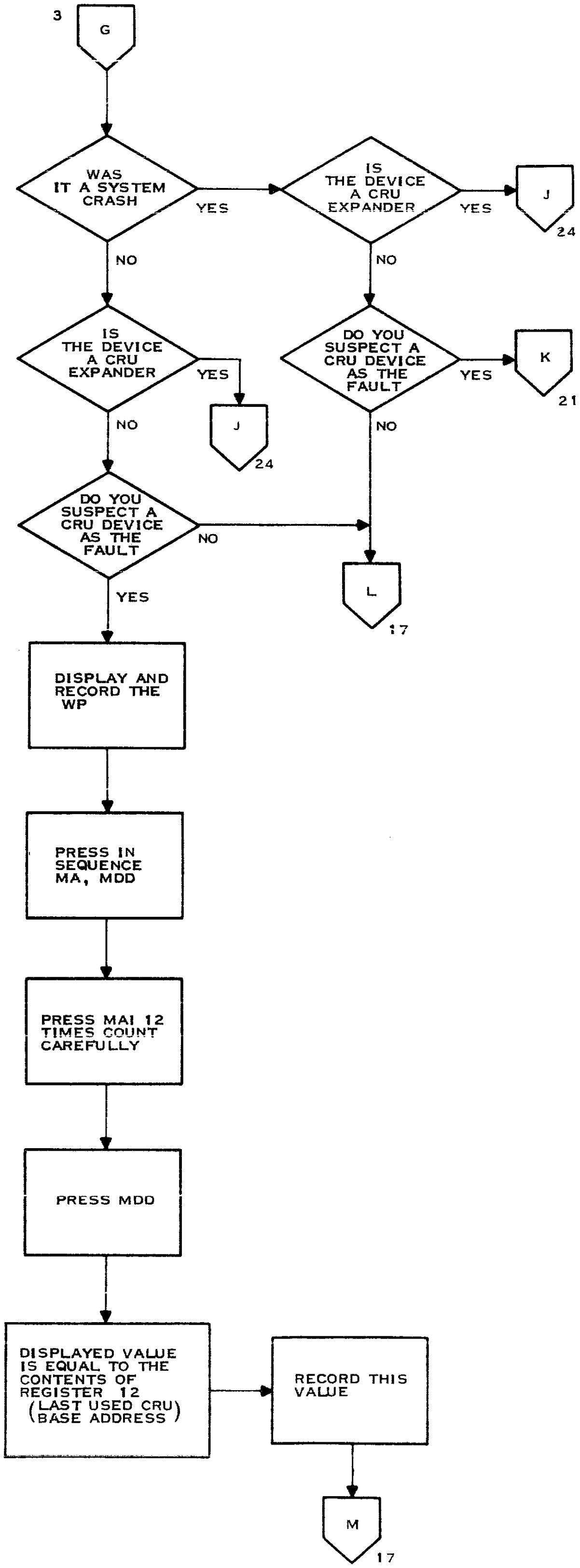


Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 3 of 24)

TR — Troubleshooting



2280590 (4/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 4 of 24)

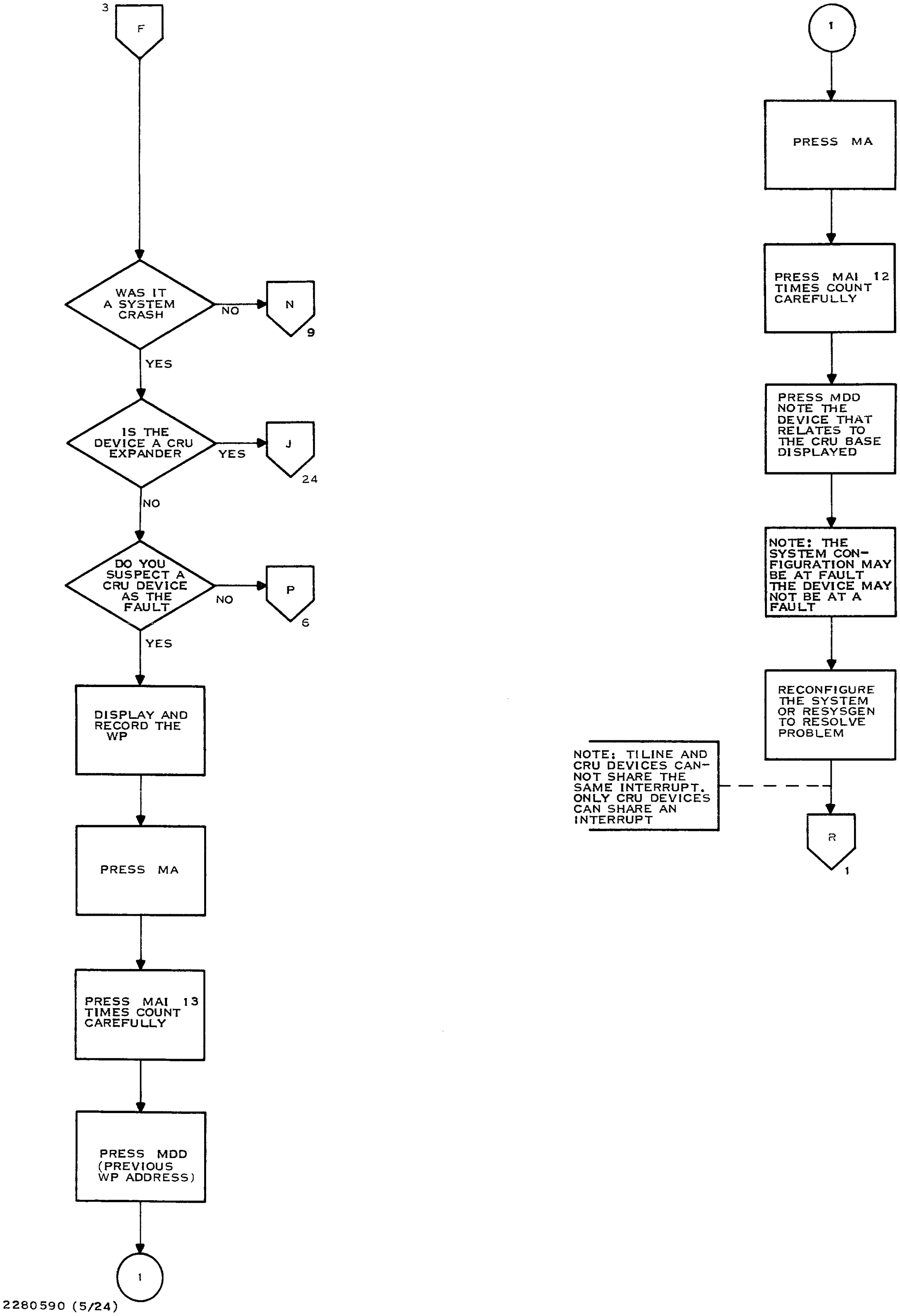
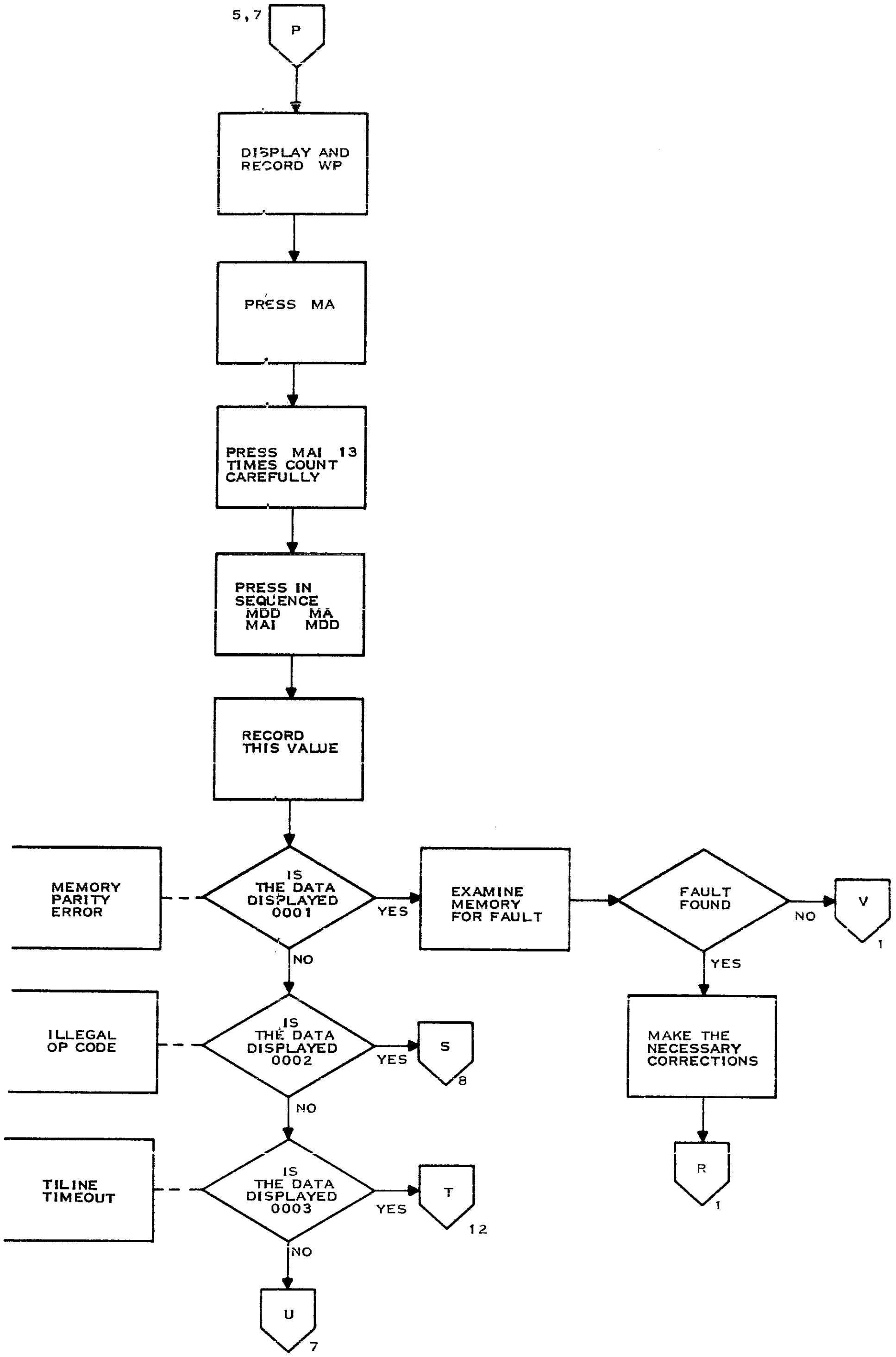


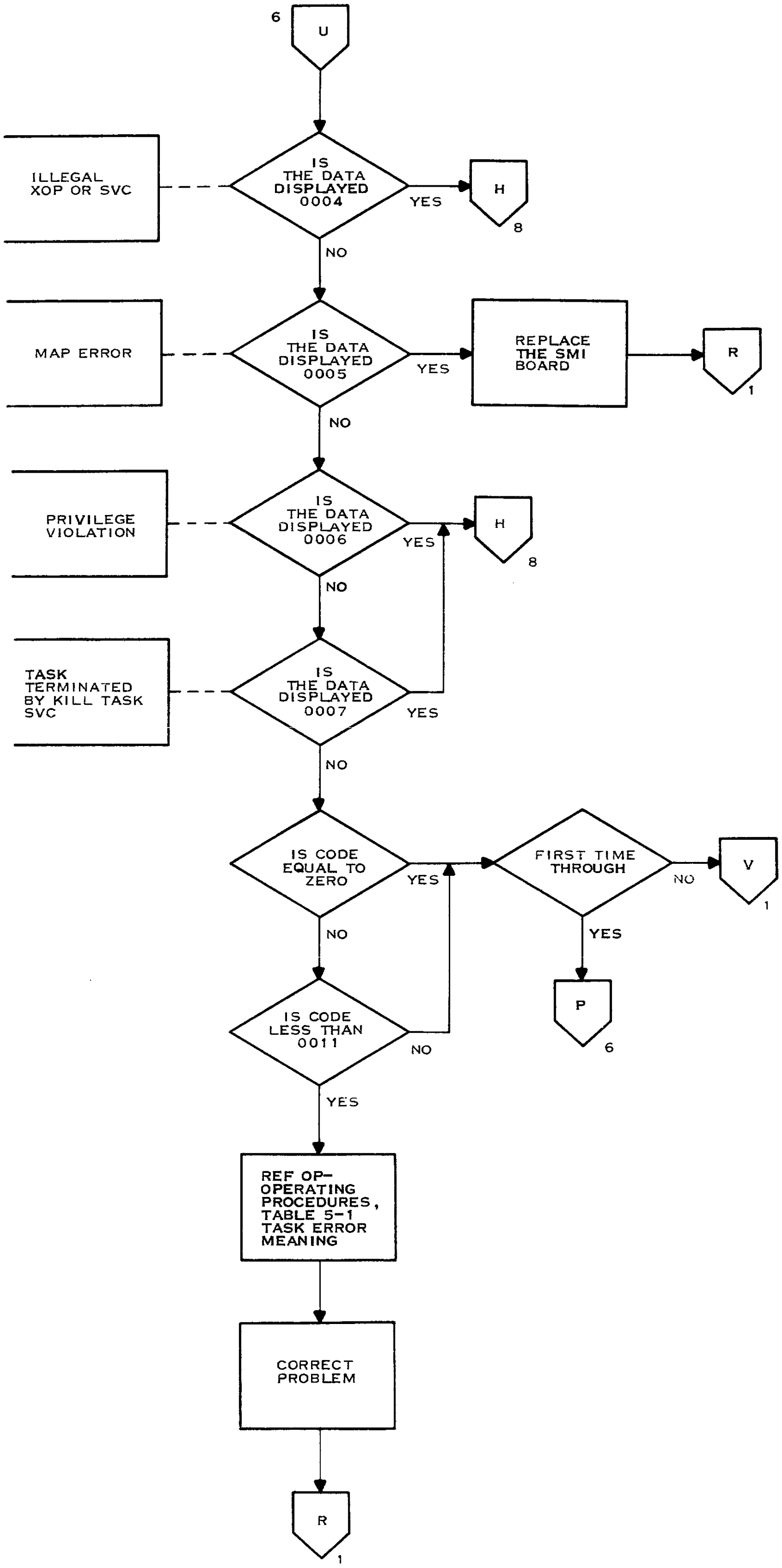
Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 5 of 24)

TR — Troubleshooting



2280590 (6/24)

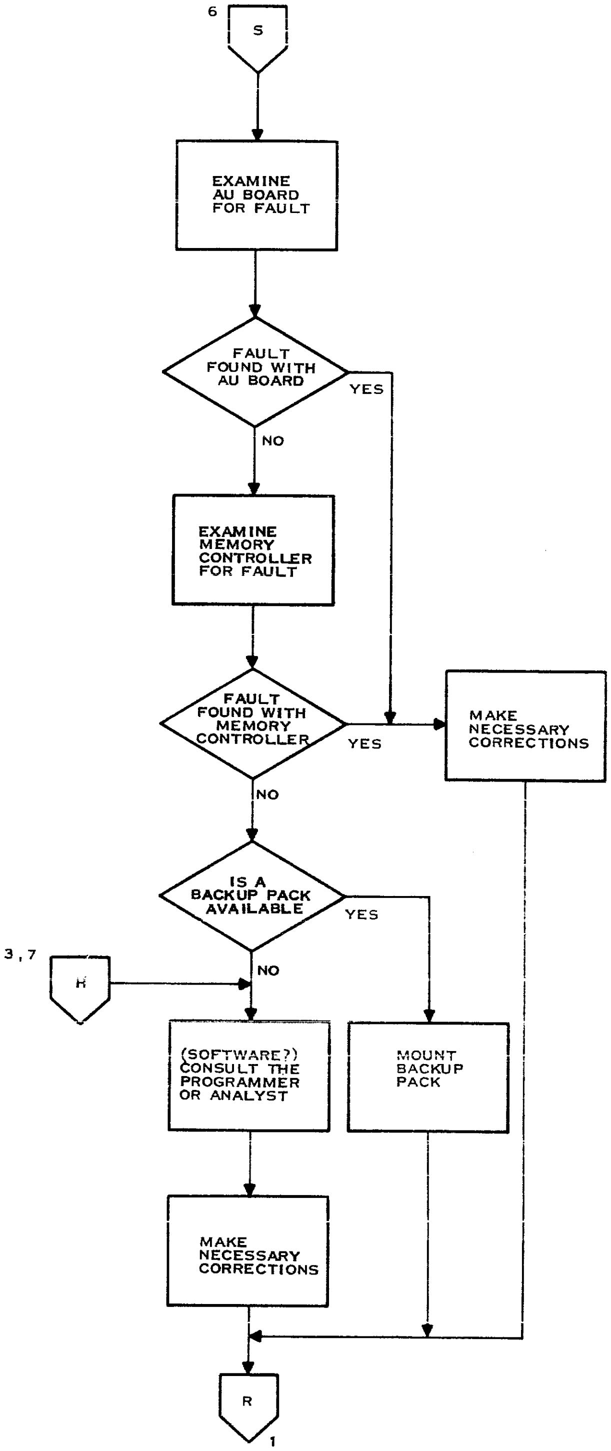
Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 6 of 24)



2280590 (7/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 7 of 24)

TR — Troubleshooting



2280590 (8/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 8 of 24)

TR — Troubleshooting

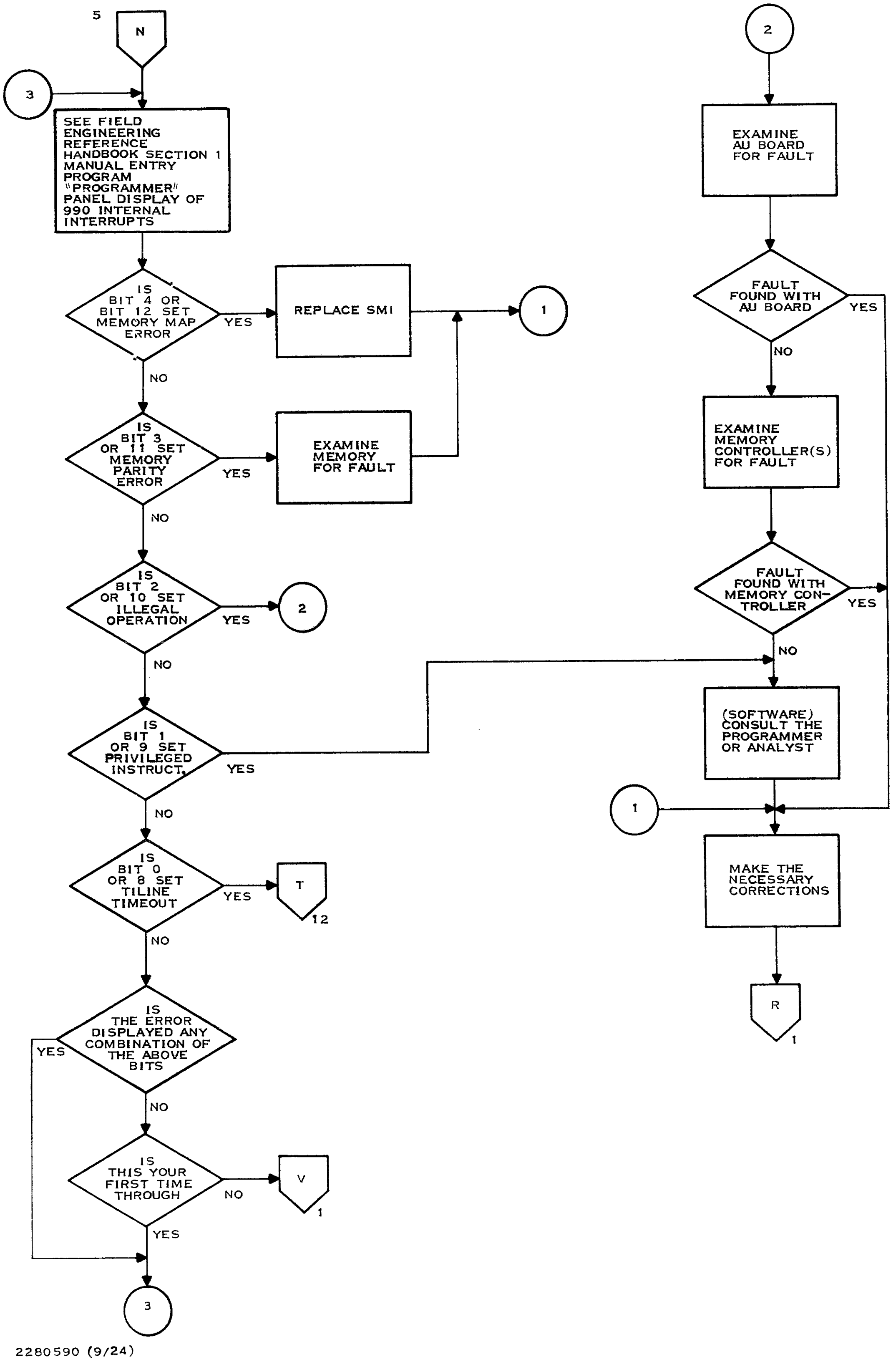


Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 9 of 24)

TR — Troubleshooting

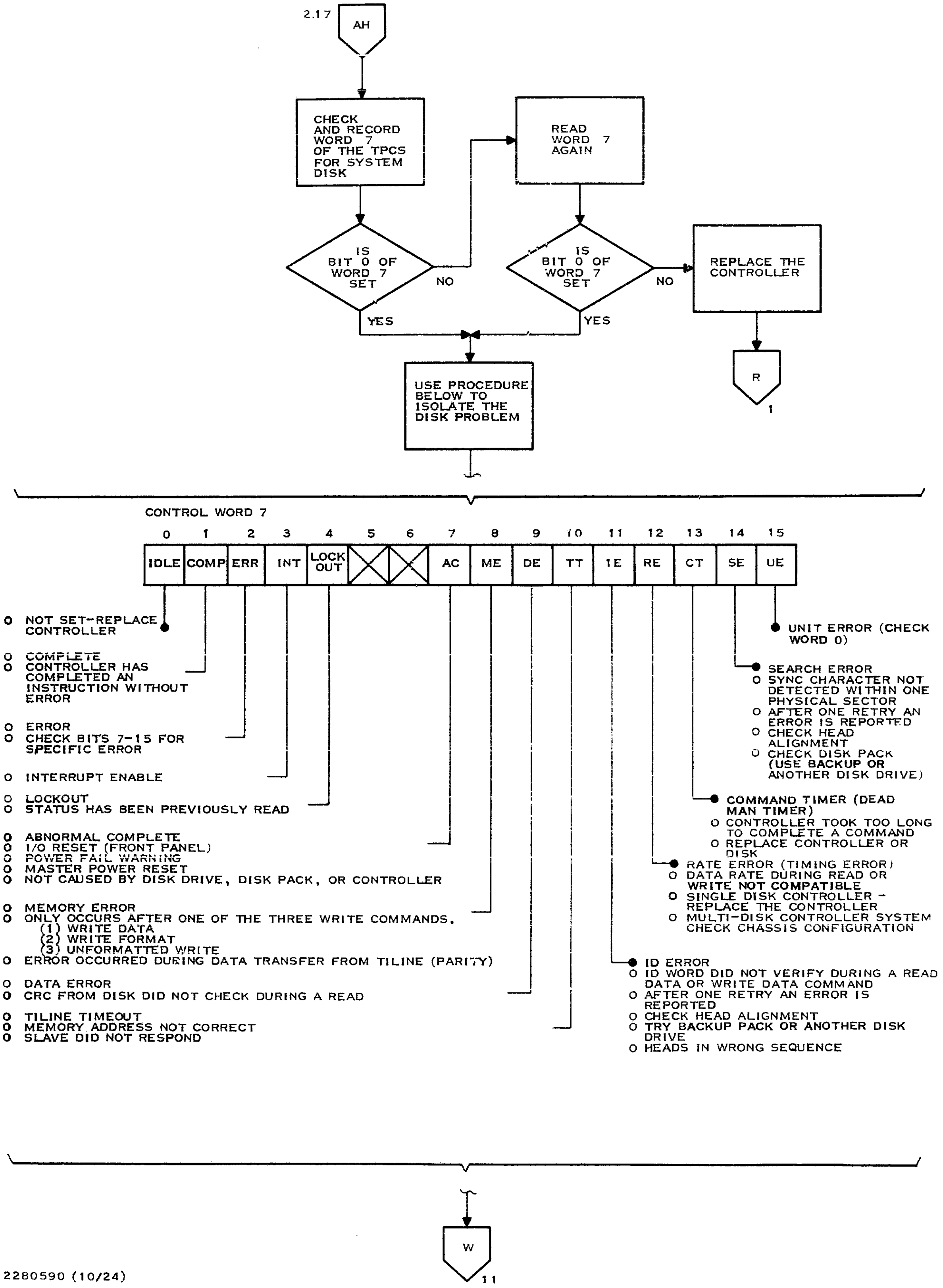
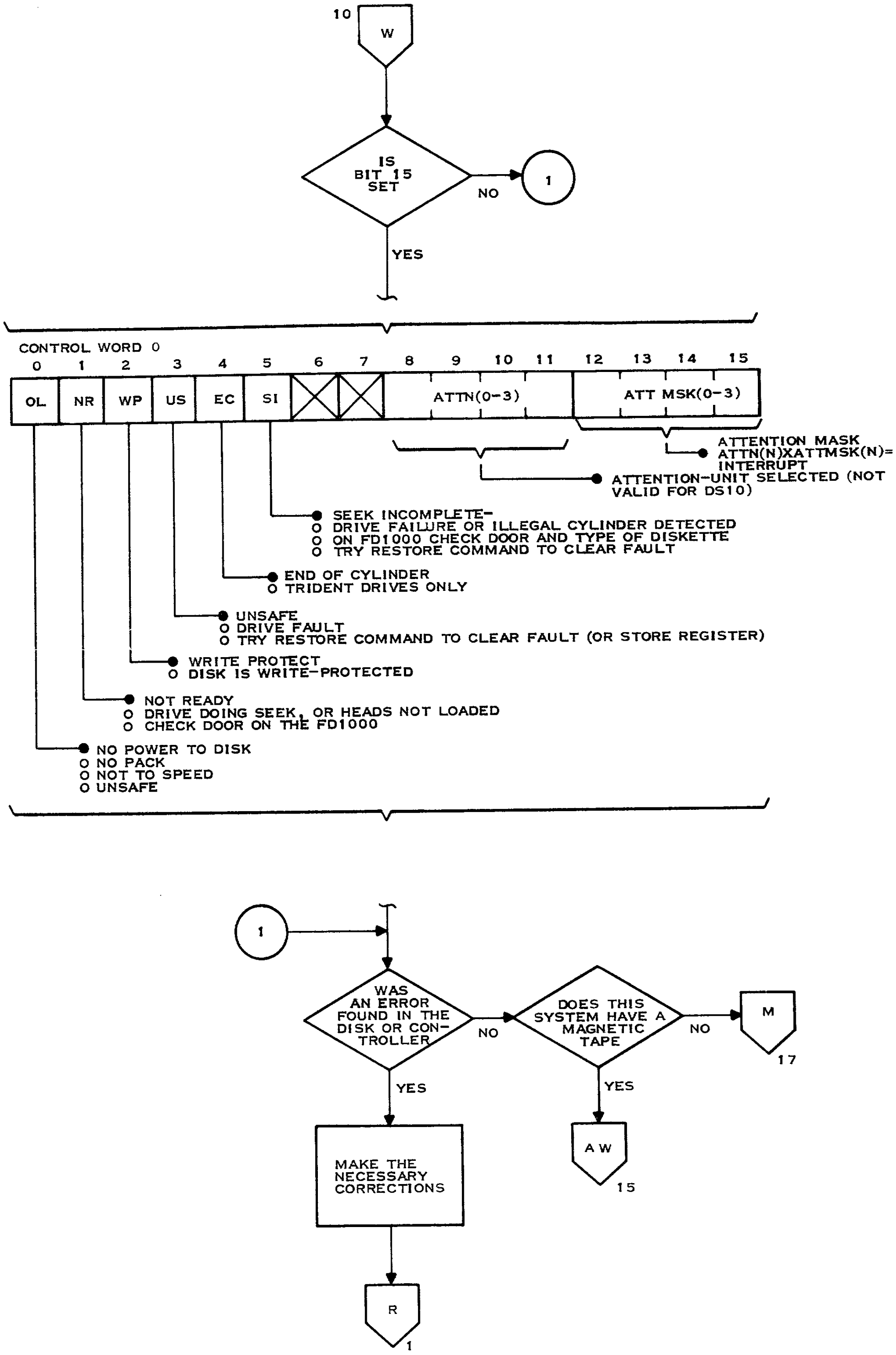


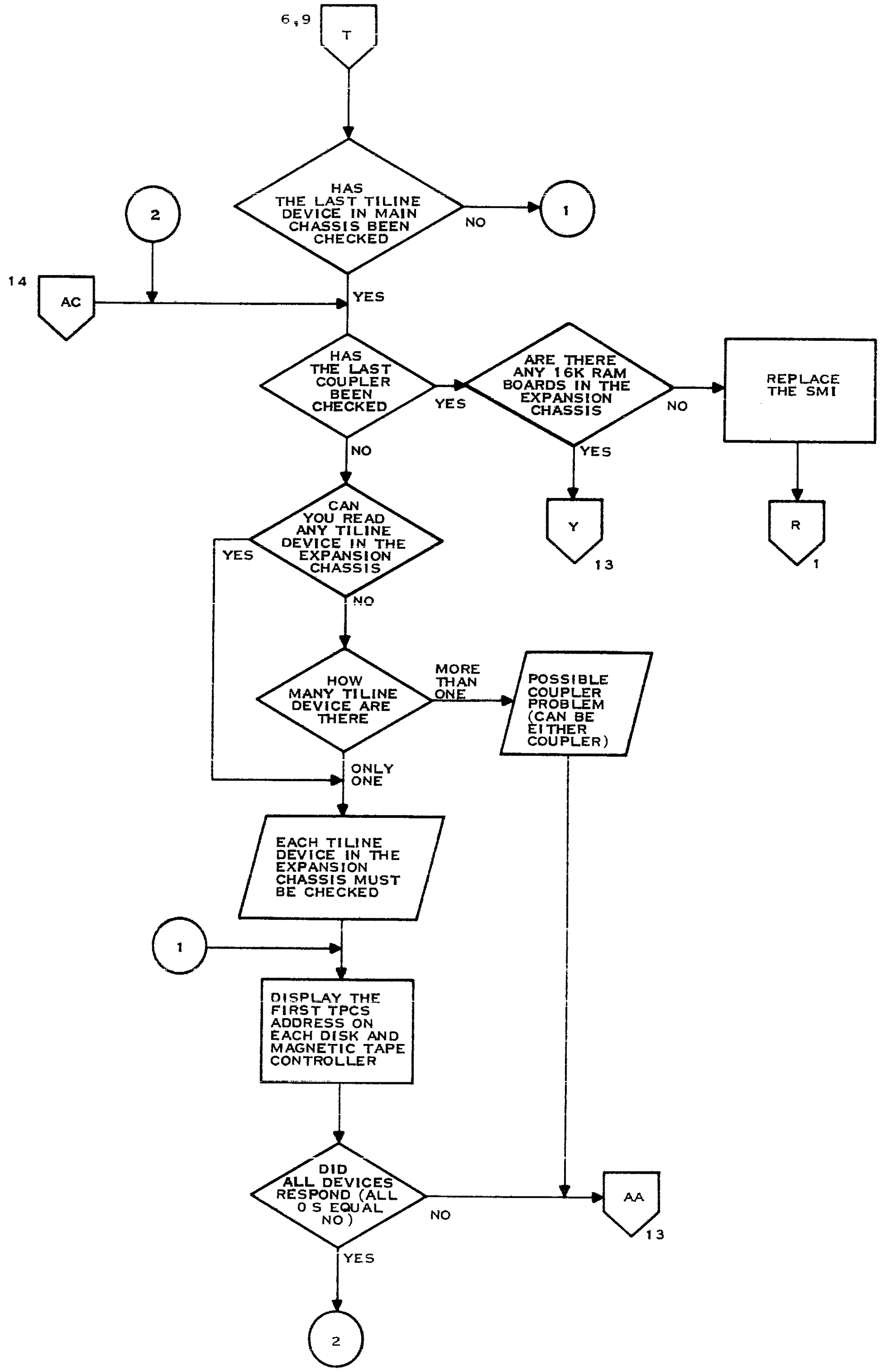
Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 10 of 24)



2280590 (11/24)

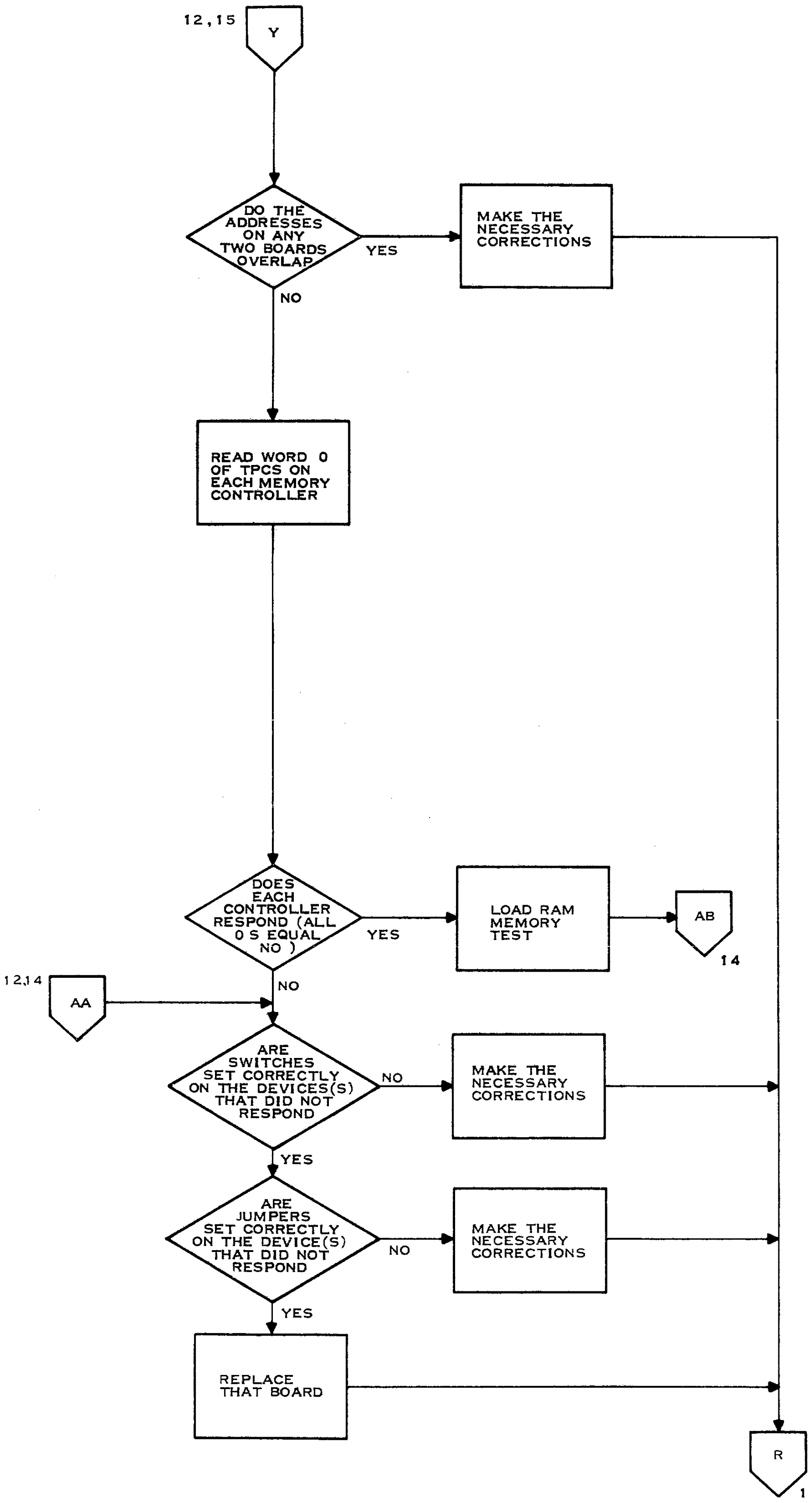
Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 11 of 24)

TR — Troubleshooting



2280590 (12/24)

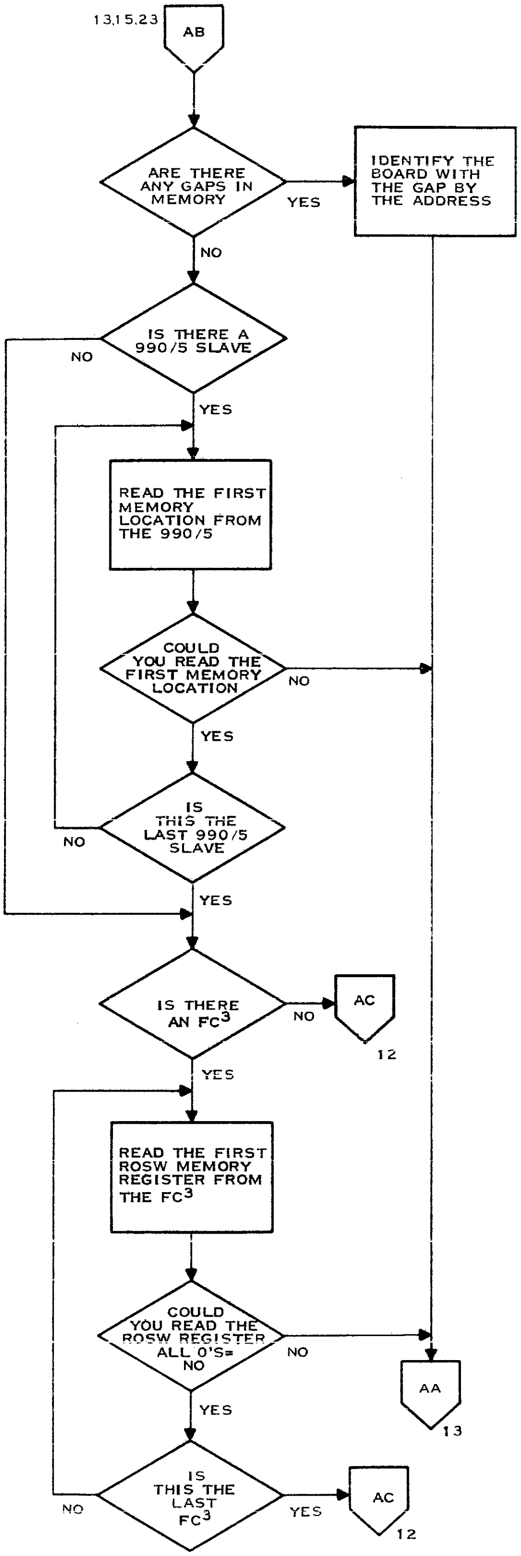
Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 12 of 24)



2280590 (13/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 13 of 24)

TR — Troubleshooting



2280590 (14/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 14 of 24)

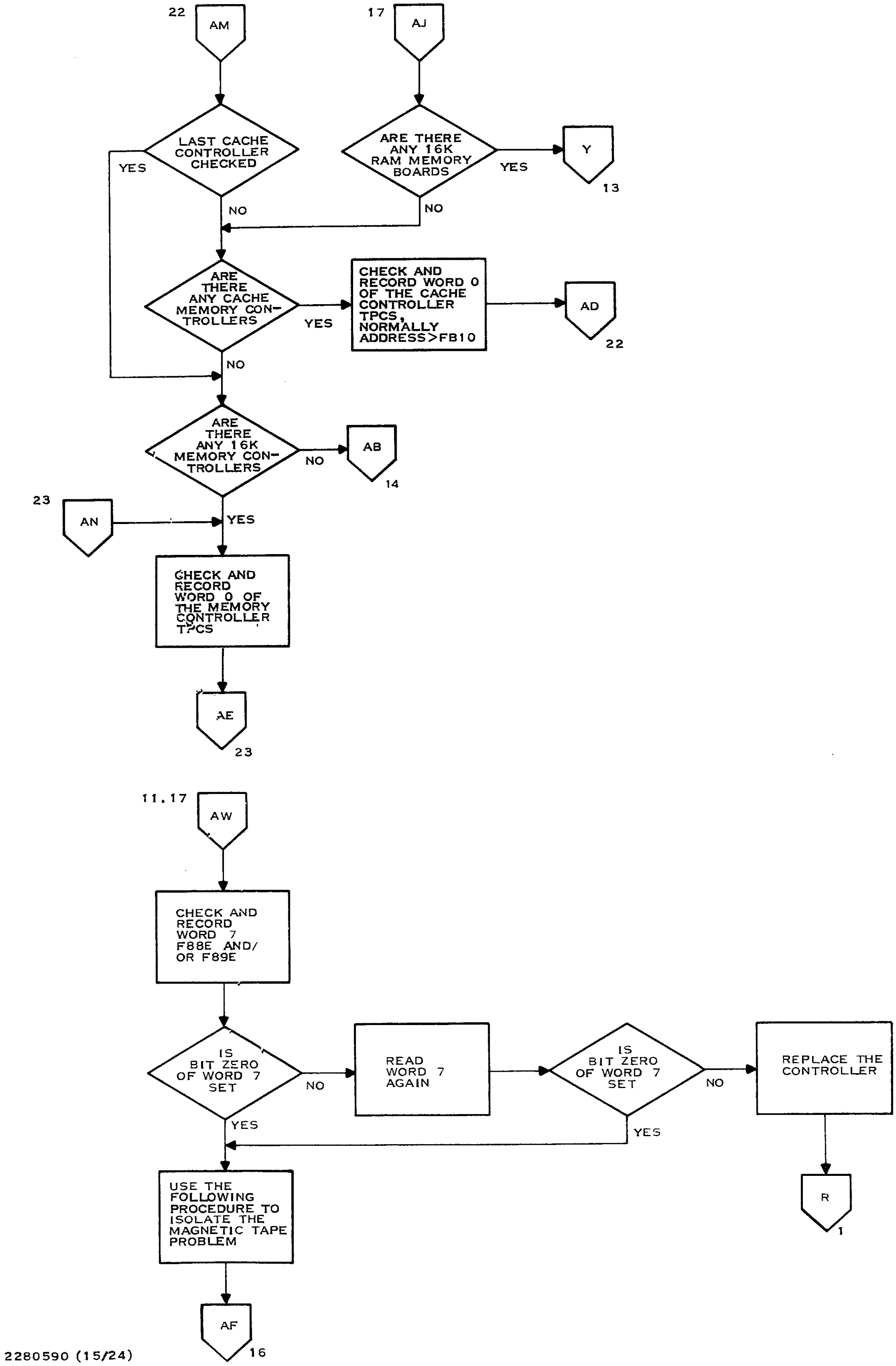
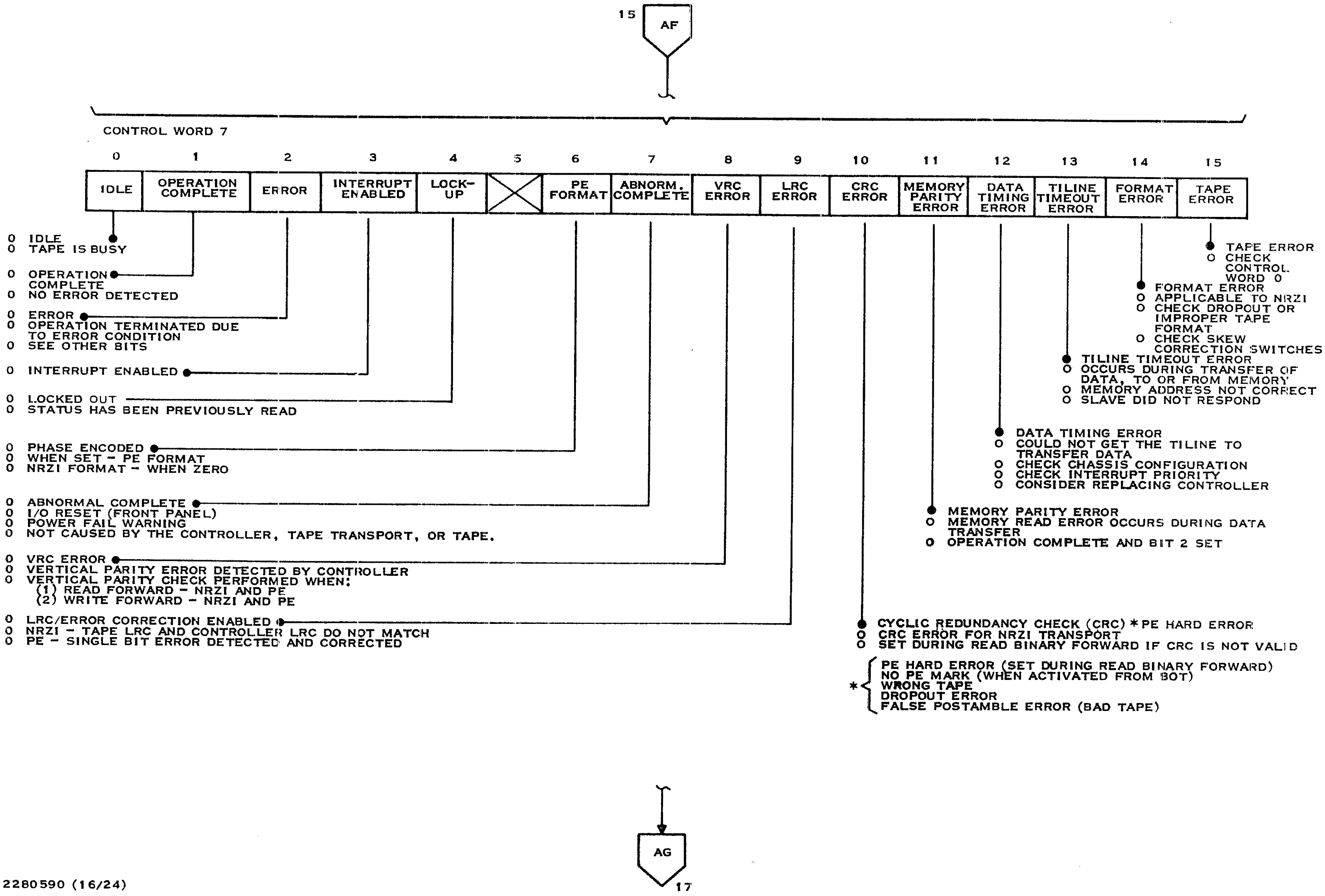


Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 15 of 24)



○ IDLE
○ TAPE IS BUSY

○ OPERATION COMPLETE
○ NO ERROR DETECTED

○ ERROR
○ OPERATION TERMINATED DUE TO ERROR CONDITION
○ SEE OTHER BITS

○ INTERRUPT ENABLED

○ LOCKED OUT
○ STATUS HAS BEEN PREVIOUSLY READ

○ PHASE ENCODED
○ WHEN SET – PE FORMAT
○ NRZI FORMAT – WHEN ZERO

○ ABNORMAL COMPLETE
○ I/O RESET (FRONT PANEL)
○ POWER FAIL WARNING
○ NOT CAUSED BY THE CONTROLLER, TAPE TRANSPORT, OR TAPE.

○ VRC ERROR
○ VERTICAL PARITY ERROR DETECTED BY CONTROLLER
○ VERTICAL PARITY CHECK PERFORMED WHEN:
(1) READ FORWARD – NRZI AND PE
(2) WRITE FORWARD – NRZI AND PE

○ LRC/ERROR CORRECTION ENABLED
○ NRZI – TAPE LRC AND CONTROLLER LRC DO NOT MATCH
○ PE – SINGLE BIT ERROR DETECTED AND CORRECTED

● TAPE ERROR
○ CHECK CONTROL WORD 0

● FORMAT ERROR
○ APPLICABLE TO NRZI
○ CHECK DROPOUT OR IMPROPER TAPE FORMAT
○ CHECK SKEW CORRECTION SWITCHES

● TILINE TIMEOUT ERROR
○ OCCURS DURING TRANSFER OF DATA, TO OR FROM MEMORY
○ MEMORY ADDRESS NOT CORRECT
○ SLAVE DID NOT RESPOND

● DATA TIMING ERROR
○ COULD NOT GET THE TILINE TO TRANSFER DATA
○ CHECK CHASSIS CONFIGURATION
○ CHECK INTERRUPT PRIORITY
○ CONSIDER REPLACING CONTROLLER

● MEMORY PARITY ERROR
○ MEMORY READ ERROR OCCURS DURING DATA TRANSFER
○ OPERATION COMPLETE AND BIT 2 SET

● CYCLIC REDUNDANCY CHECK (CRC) *PE HARD ERROR
○ CRC ERROR FOR NRZI TRANSPORT
○ SET DURING READ BINARY FORWARD IF CRC IS NOT VALID

* PE HARD ERROR (SET DURING READ BINARY FORWARD)
NO PE MARK (WHEN ACTIVATED FROM BOT)
WRONG TAPE
DROPOUT ERROR
FALSE POSTAMBLE ERROR (BAD TAPE)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 16 of 24)

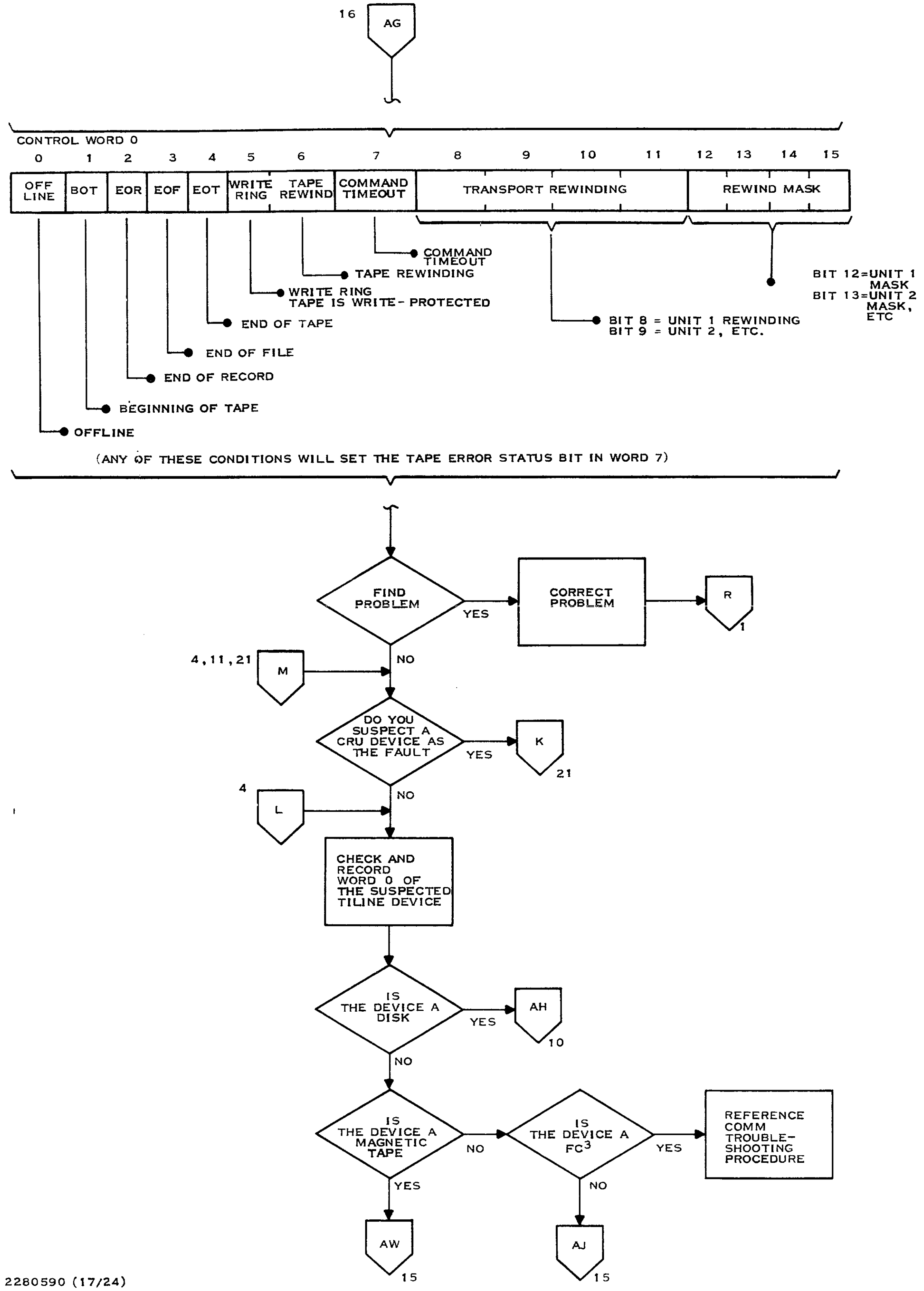
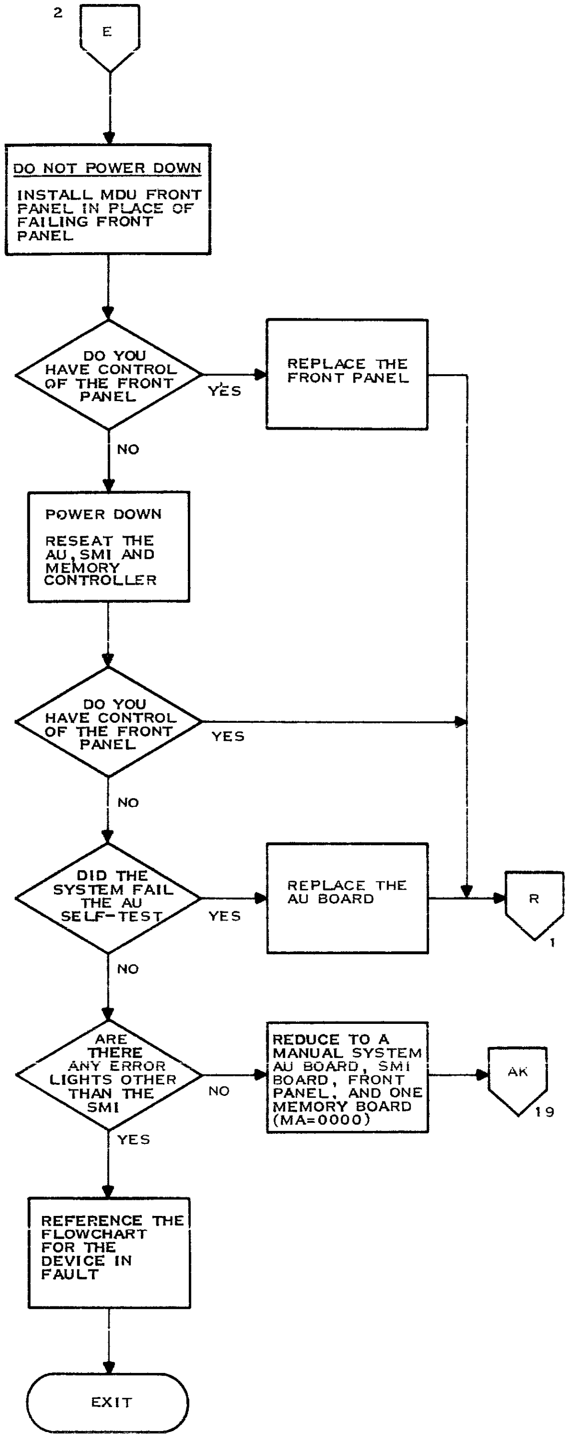


Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 17 of 24)

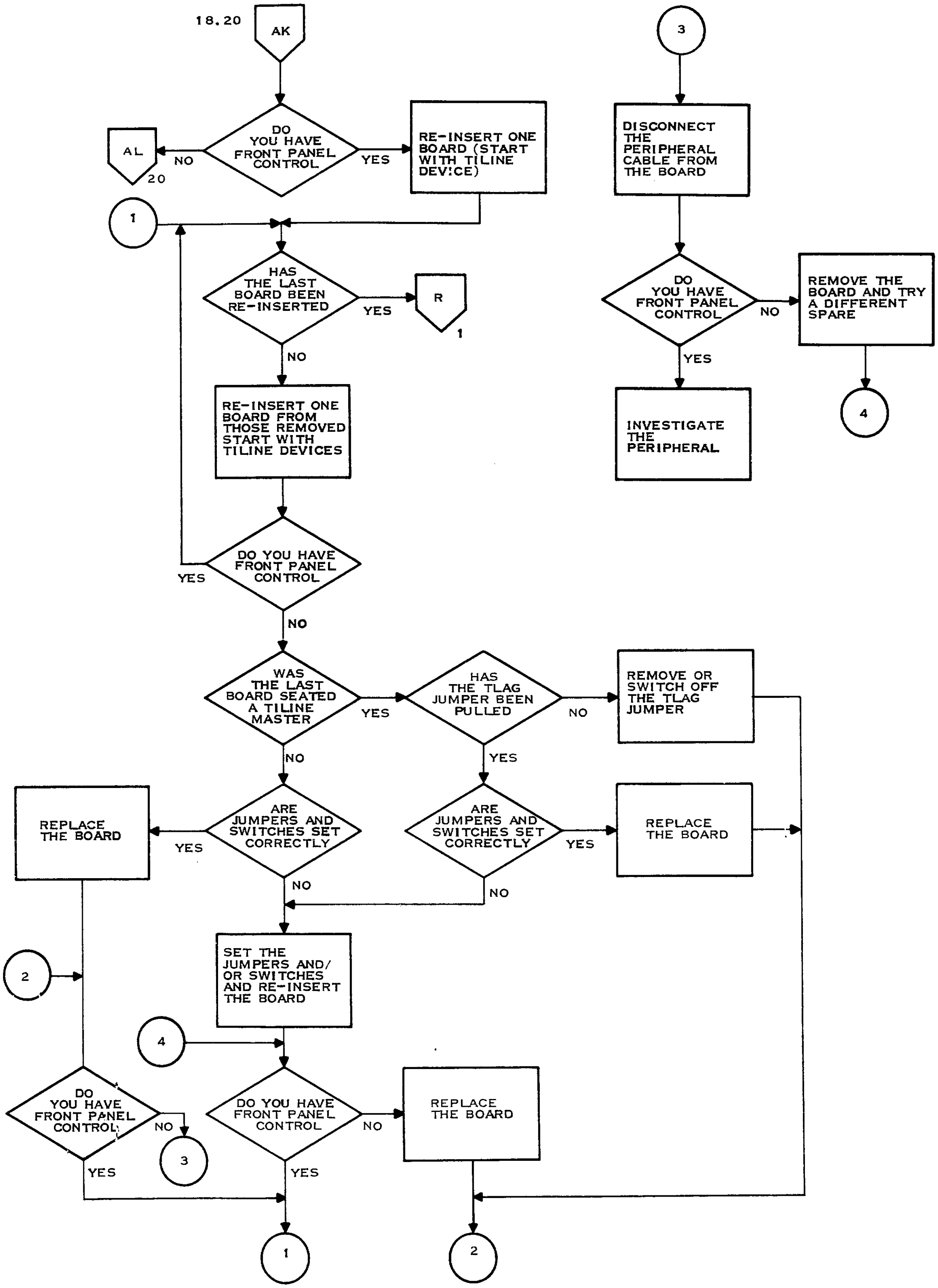
TR — Troubleshooting



2280590 (18/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 18 of 24)

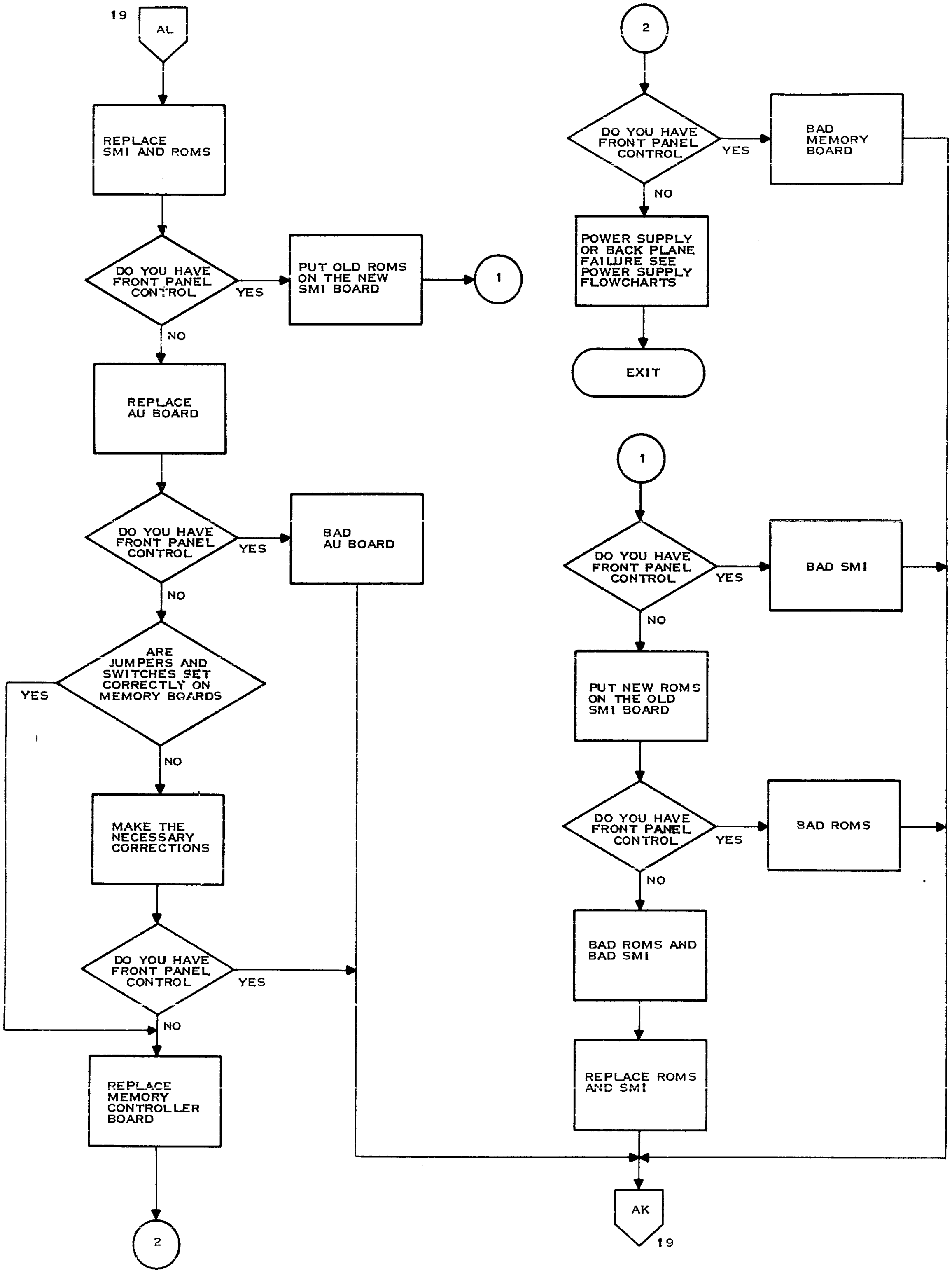
TR — Troubleshooting



2280590 (19/24)

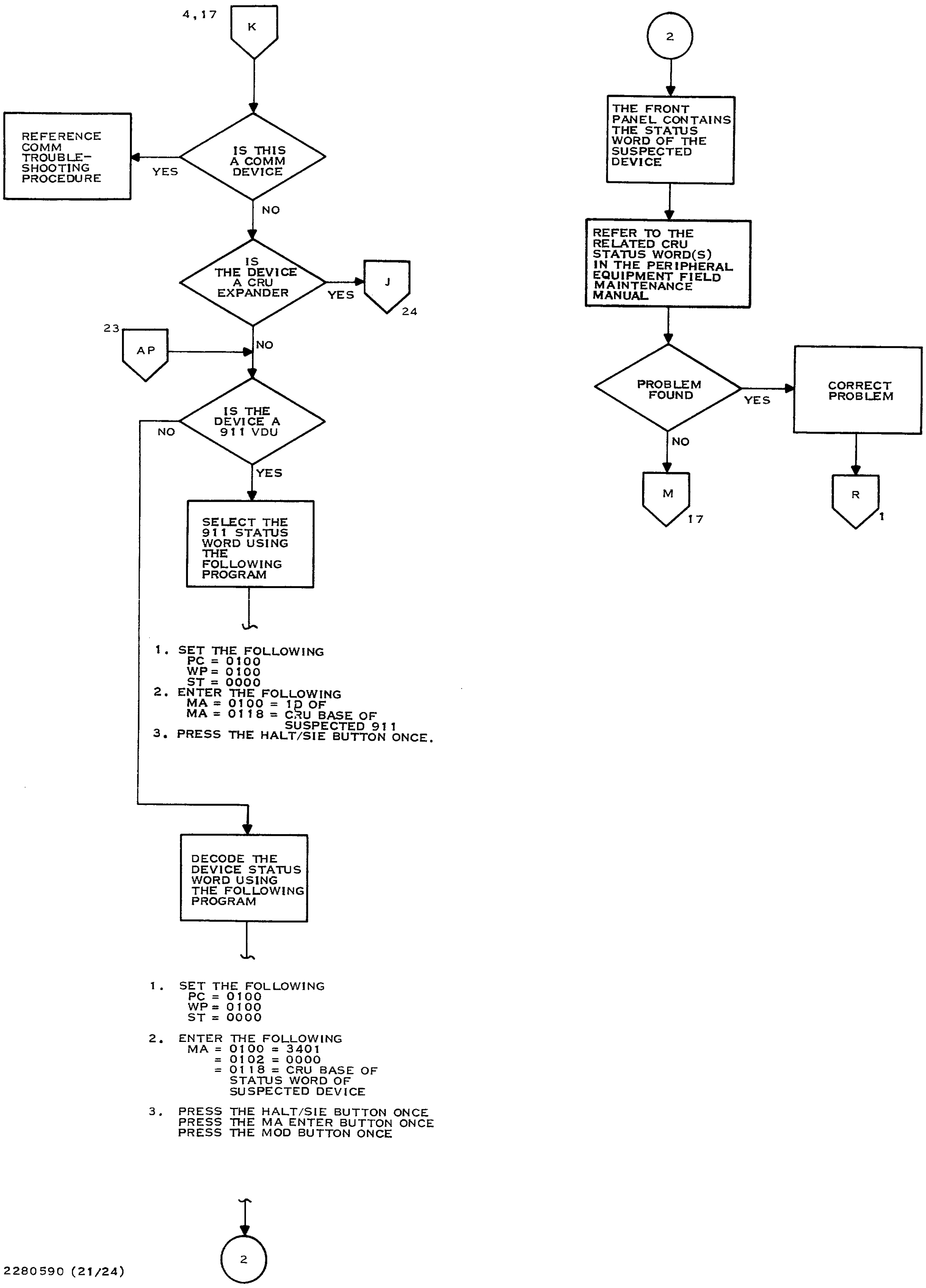
Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 19 of 24)

TR — Troubleshooting



2280590 (20/24)

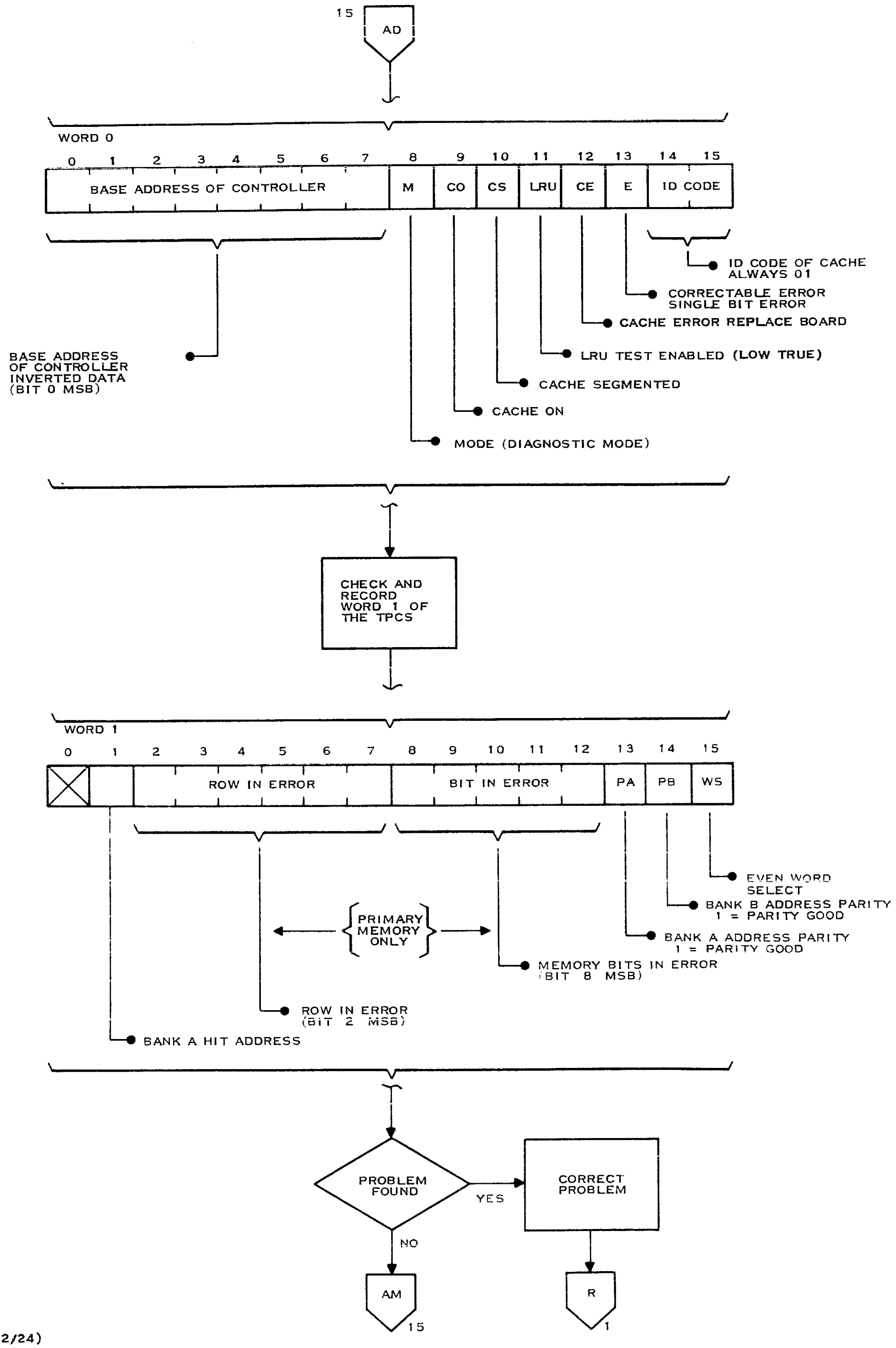
Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 20 of 24)



2280590 (21/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 21 of 24)

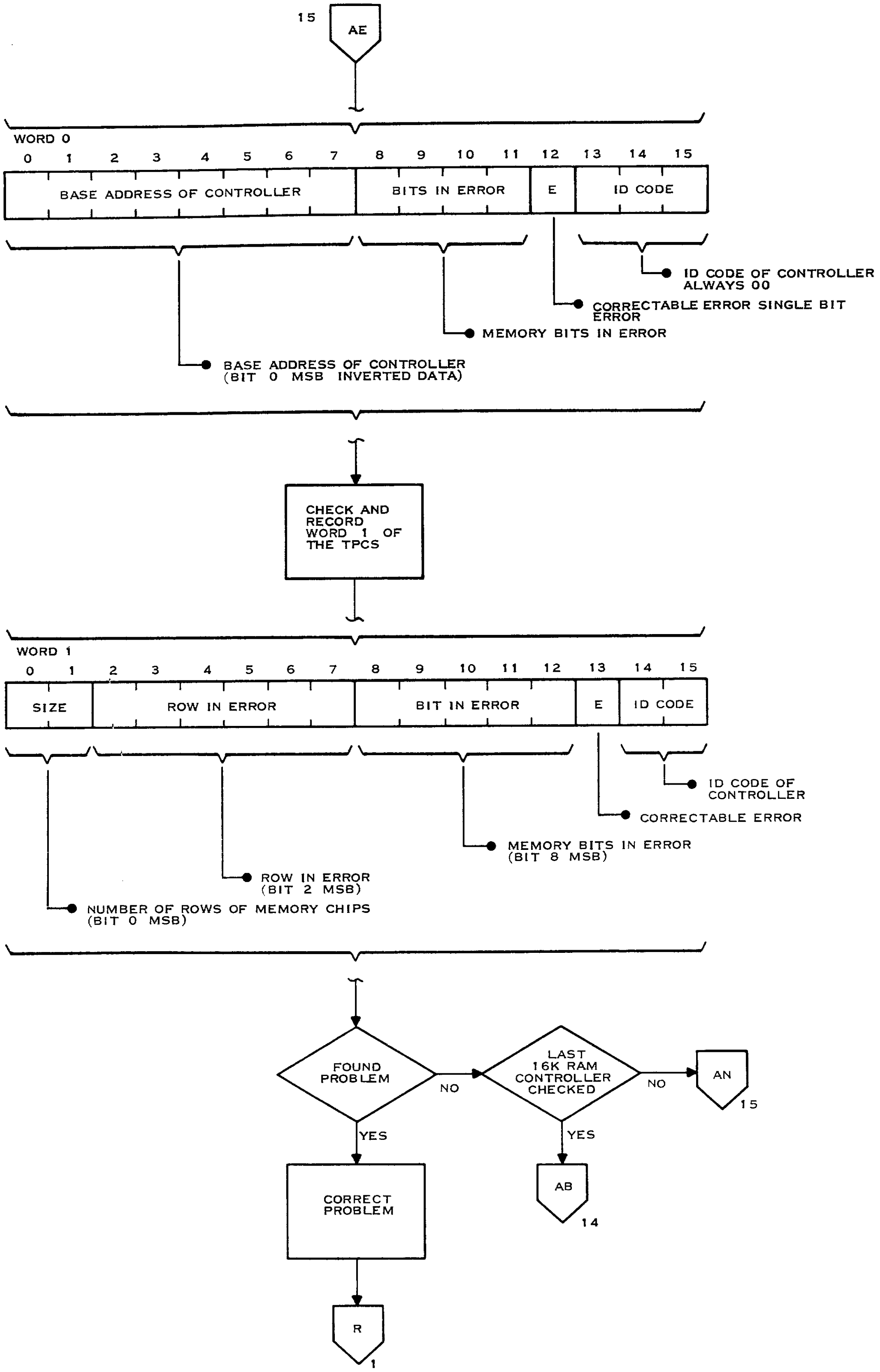
TR — Troubleshooting



2280590 (22/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 22 of 24)

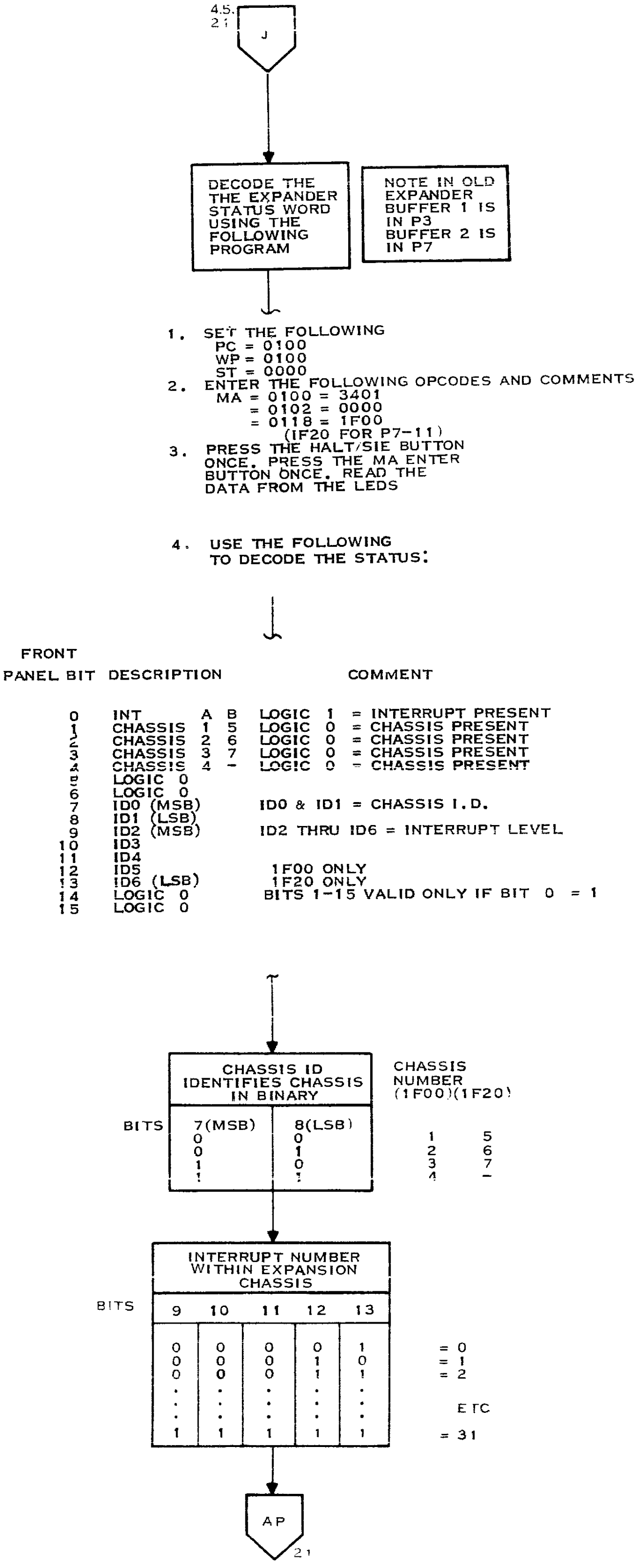
TR — Troubleshooting



2280590 (23/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 23 of 24)

TR — Troubleshooting



DECODE THE THE EXPANDER STATUS WORD USING THE FOLLOWING PROGRAM

NOTE IN OLD EXPANDER BUFFER 1 IS IN P3 BUFFER 2 IS IN P7

```
1.  SET THE FOLLOWING
     PC = 0100
     WP = 0100
     ST = 0000
2.  ENTER THE FOLLOWING OPCODES AND COMMENTS
     MA = 0100 = 3401
          = 0102 = 0000
          = 0118 = 1F00
               (IF20 FOR P7-11)
3.  PRESS THE HALT/SIE BUTTON
    ONCE. PRESS THE MA ENTER
    BUTTON ONCE. READ THE
    DATA FROM THE LEDS


4.  USE THE FOLLOWING
    TO DECODE THE STATUS:
```

FRONT PANEL BIT	DESCRIPTION			COMMENT
0	INT	A	B	LOGIC 1 = INTERRUPT PRESENT
1	CHASSIS	1	5	LOGIC 0 = CHASSIS PRESENT
2	CHASSIS	2	6	LOGIC 0 = CHASSIS PRESENT
3	CHASSIS	3	7	LOGIC 0 = CHASSIS PRESENT
4	CHASSIS	4	-	LOGIC 0 = CHASSIS PRESENT
5	LOGIC 0			
6	LOGIC 0			
7	ID0 (MSB)			ID0 & ID1 = CHASSIS I.D.
8	ID1 (LSB)			
9	ID2 (MSB)			ID2 THRU ID6 = INTERRUPT LEVEL
10	ID3			
11	ID4			
12	ID5			1F00 ONLY
13	ID6 (LSB)			1F20 ONLY
14	LOGIC 0			BITS 1-15 VALID ONLY IF BIT 0 = 1
15	LOGIC 0			

CHASSIS ID IDENTIFIES CHASSIS IN BINARY

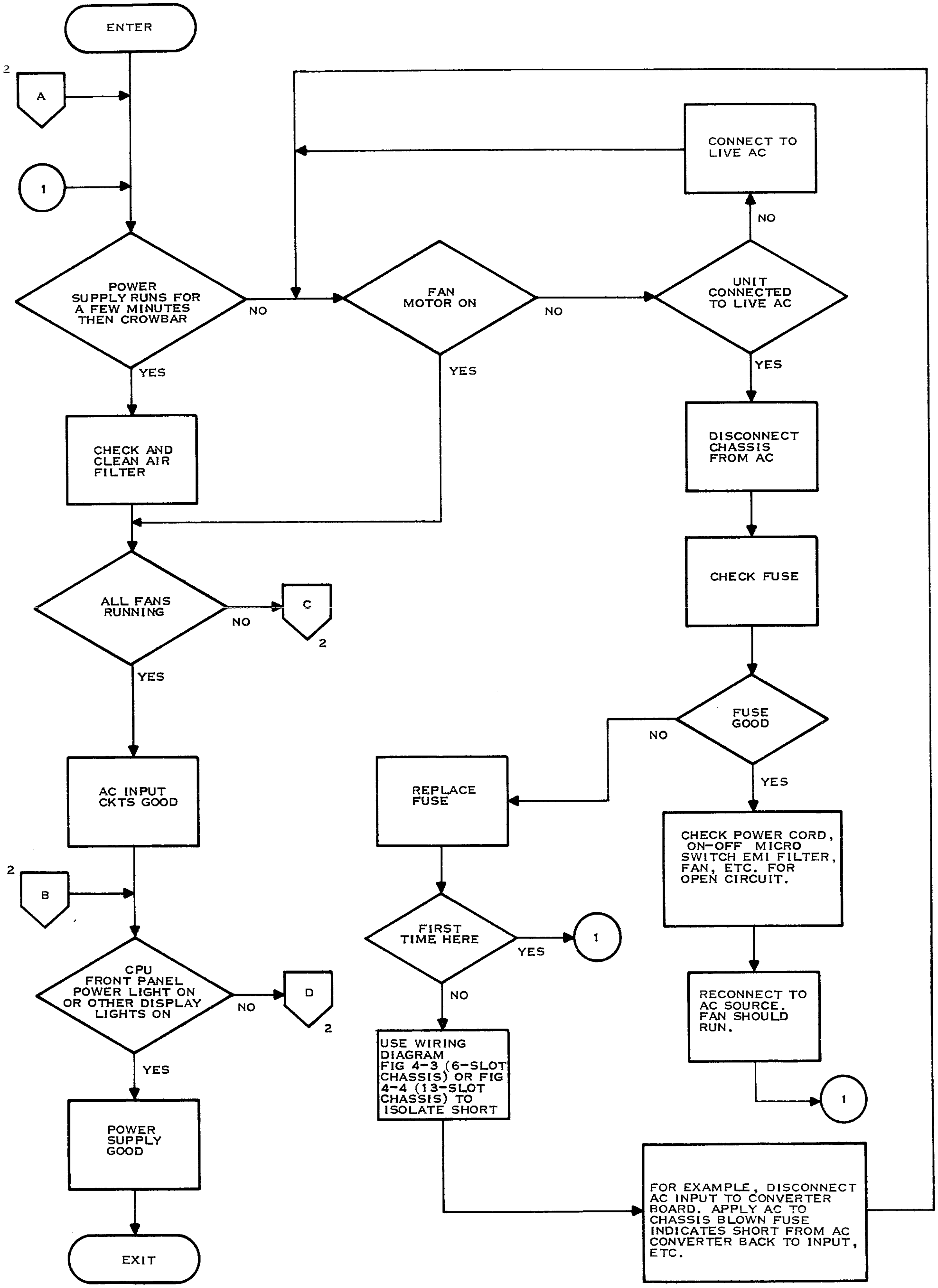
BITS 7(MSB)	8(LSB)	CHASSIS NUMBER (1F00)	(1F20)
0	0	1	5
0	1	2	6
1	0	3	7
1	1	4	-

INTERRUPT NUMBER WITHIN EXPANSION CHASSIS

BITS 9	10	11	12	13	
0	0	0	0	1	= 0
0	0	0	1	0	= 1
0	0	0	1	1	= 2
.	.	.	.	.	
.	.	.	.	.	ETC
.	.	.	.	.	
1	1	1	1	1	= 31

2280590 (24/24)

Figure 1-1. DS990 Systems Troubleshooting Flowchart (Sheet 24 of 24)



2276954 (1/3)

Figure 1-2. 6-Slot/13-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 1 of 3)

TR — Troubleshooting

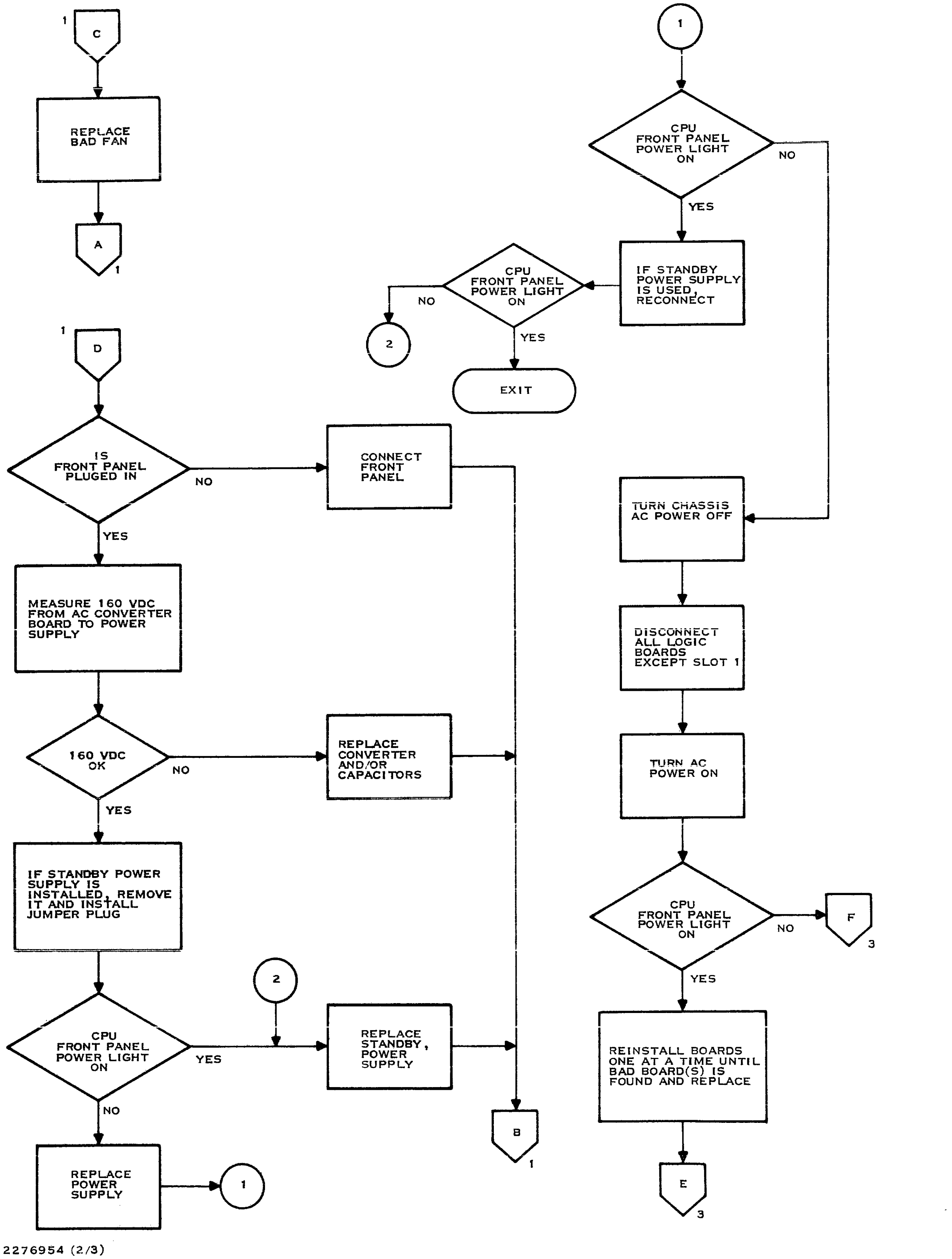
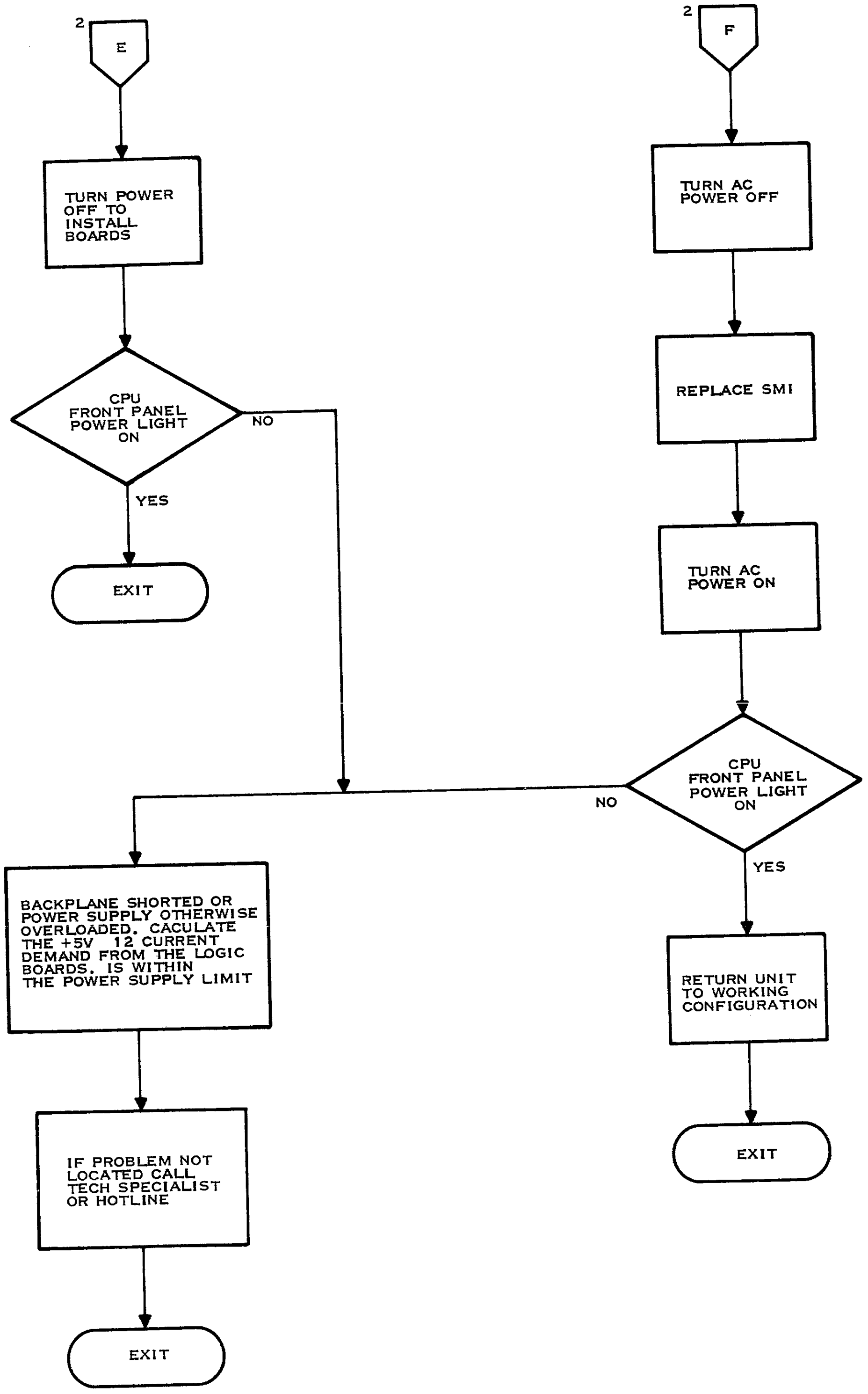
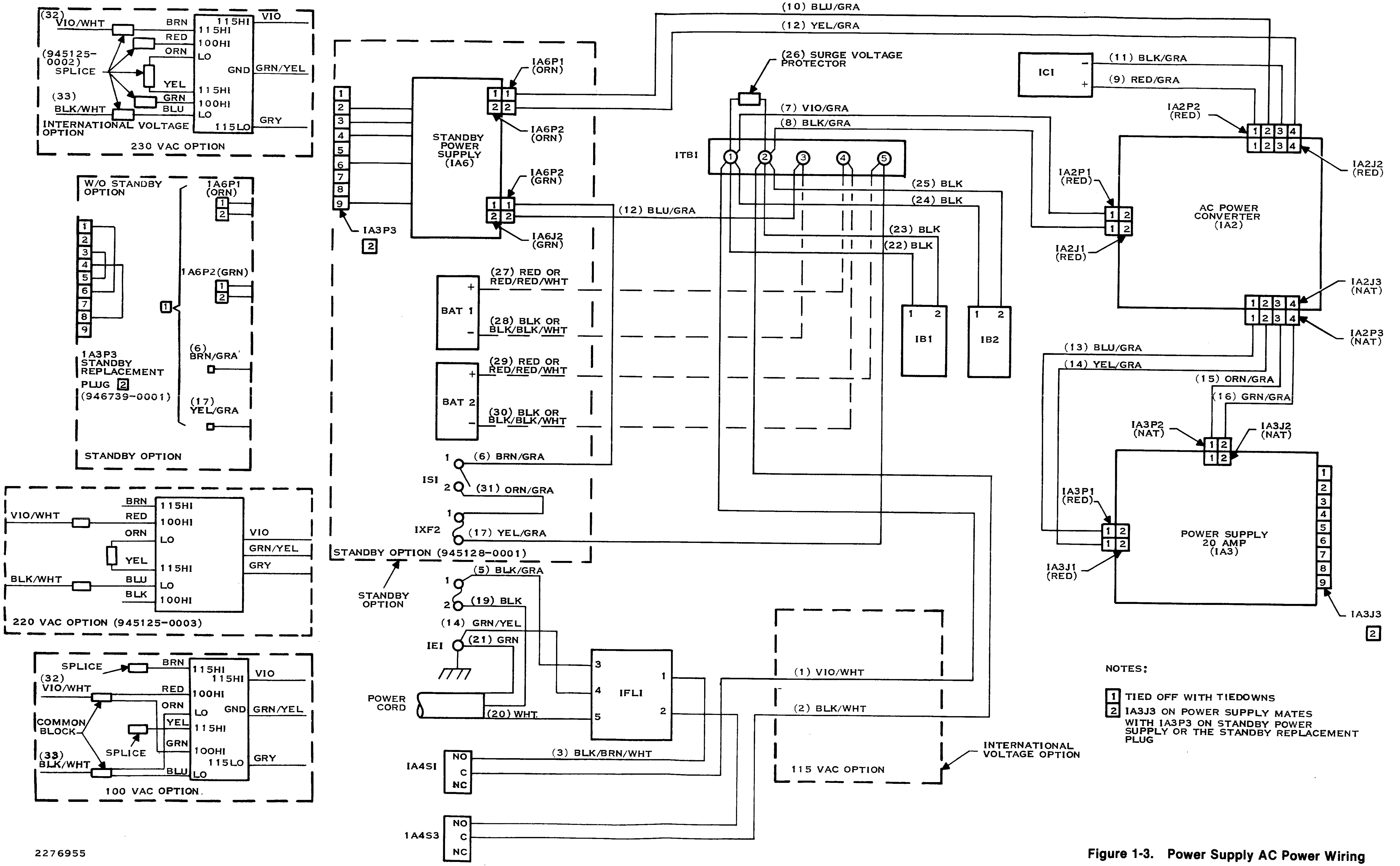


Figure 1-2. 6-Slot/13-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 2 of 3)



2276954 (3/3)

Figure 1-2. 6-Slot/13-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 3 of 3)

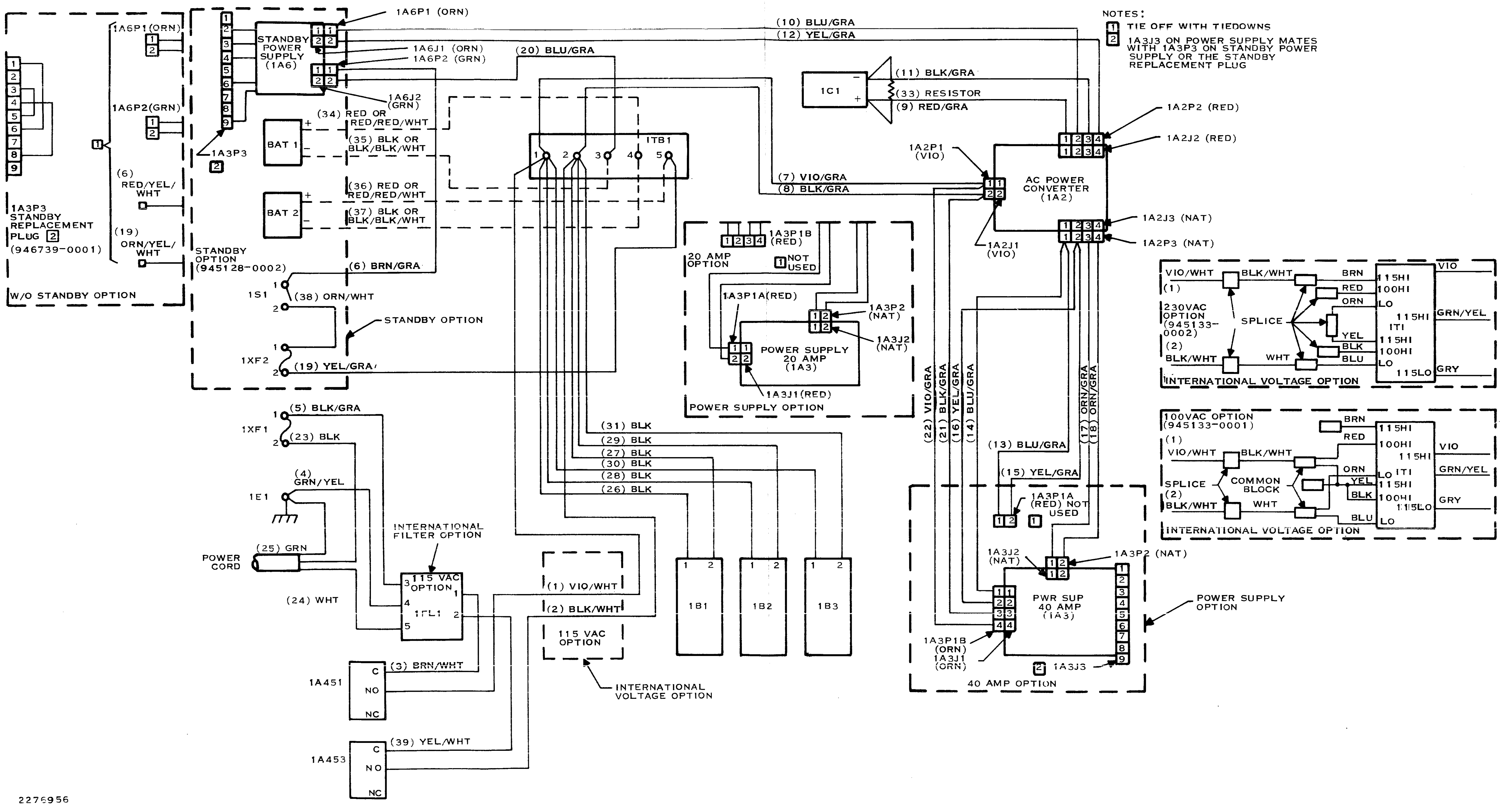


NOTES:

1 TIED OFF WITH TIEDOWNS

2 IA3J3 ON POWER SUPPLY MATES WITH IA3P3 ON STANDBY POWER SUPPLY OR THE STANDBY REPLACEMENT PLUG

Figure 1-3. Power Supply AC Power Wiring Diagram for 6-Slot Chassis



NOTES:

1 TIE OFF WITH TIEDOWNS

2 1A3J3 ON POWER SUPPLY MATES WITH 1A3P3 ON STANDBY POWER SUPPLY OR THE STANDBY REPLACEMENT PLUG

Figure 1-4. Power Supply AC Power Wiring Diagram for 13-Slot Chassis

1.4 17-SLOT CHASSIS POWER SUPPLY DESCRIPTION

The troubleshooting flowchart for the 17-slot chassis power supply is presented in Figure 1-5. The power supply for the 17-slot chassis (Figure 1-6) is accessible when the rear cover (Figure 1-7) is opened at the rear of the computer chassis. A schematic for the 17-slot chassis power system is shown in Figure 1-8.

The following paragraphs give a brief functional description of the encoder board, converter board, and power modules for the 17-slot chassis power supply. A few troubleshooting aids are also described for the entire power supply assembly.

Note that many connectors are used in this modular power supply. When troubleshooting, do not overlook the possibility of a slipped or recessed pin at any one of the connectors making intermittent or no connection.

1.4.1 Power Supply Troubleshooting

Power supply troubleshooting can be greatly simplified by observing the POWER light behavior during power-up. If the POWER light turns on momentarily, at least one of the +5-volt supply modules is working. However, one of the other voltages that the power supply controller monitors has failed outside the proper operating range. Therefore, a power shutdown was processed by the power supply controller board.

If the POWER light turns on and then turns off after a few minutes, the temperature sensing circuits are likely to be initiating the shutdown. This is indicative of insufficient airflow through the controller board where the temperature sensing circuits are located; faulty temperature sensing circuits will give the same symptoms.

If the +5 volts is present, the POWER light should turn on during power-up provided:

- The interconnection is made at the front panel.
- The interconnection is made at the interrupt plug.
- The SMI board is functioning properly.

These points are specifically addressed in the flowcharts (Figure 1-5).

A schematic diagram of the power system for the 17-slot chassis is presented in Figure 1-8.

TR — Troubleshooting

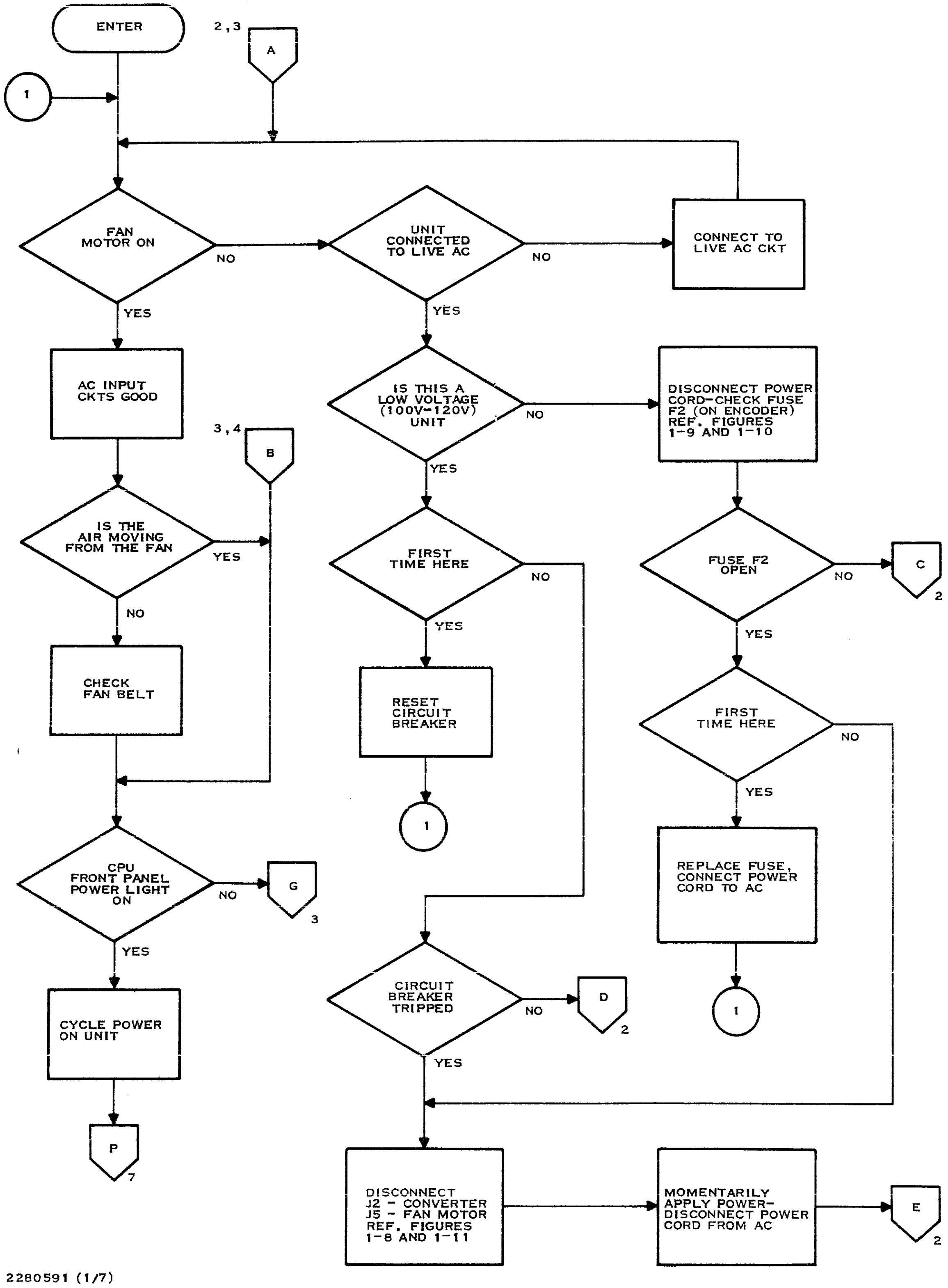


Figure 1-5. 17-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 1 of 7)

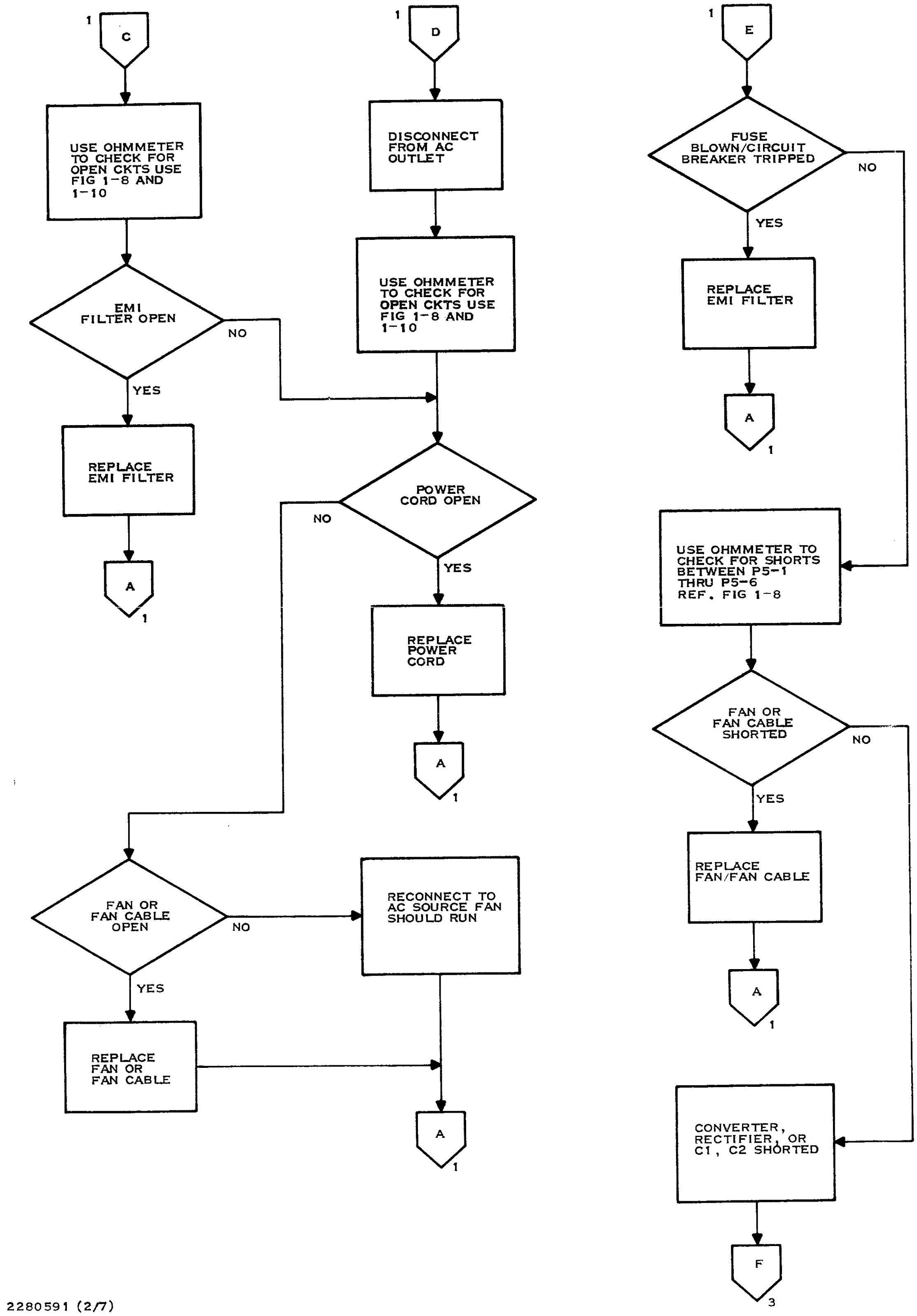


Figure 1-5. 17-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 2 of 7)

TR — Troubleshooting

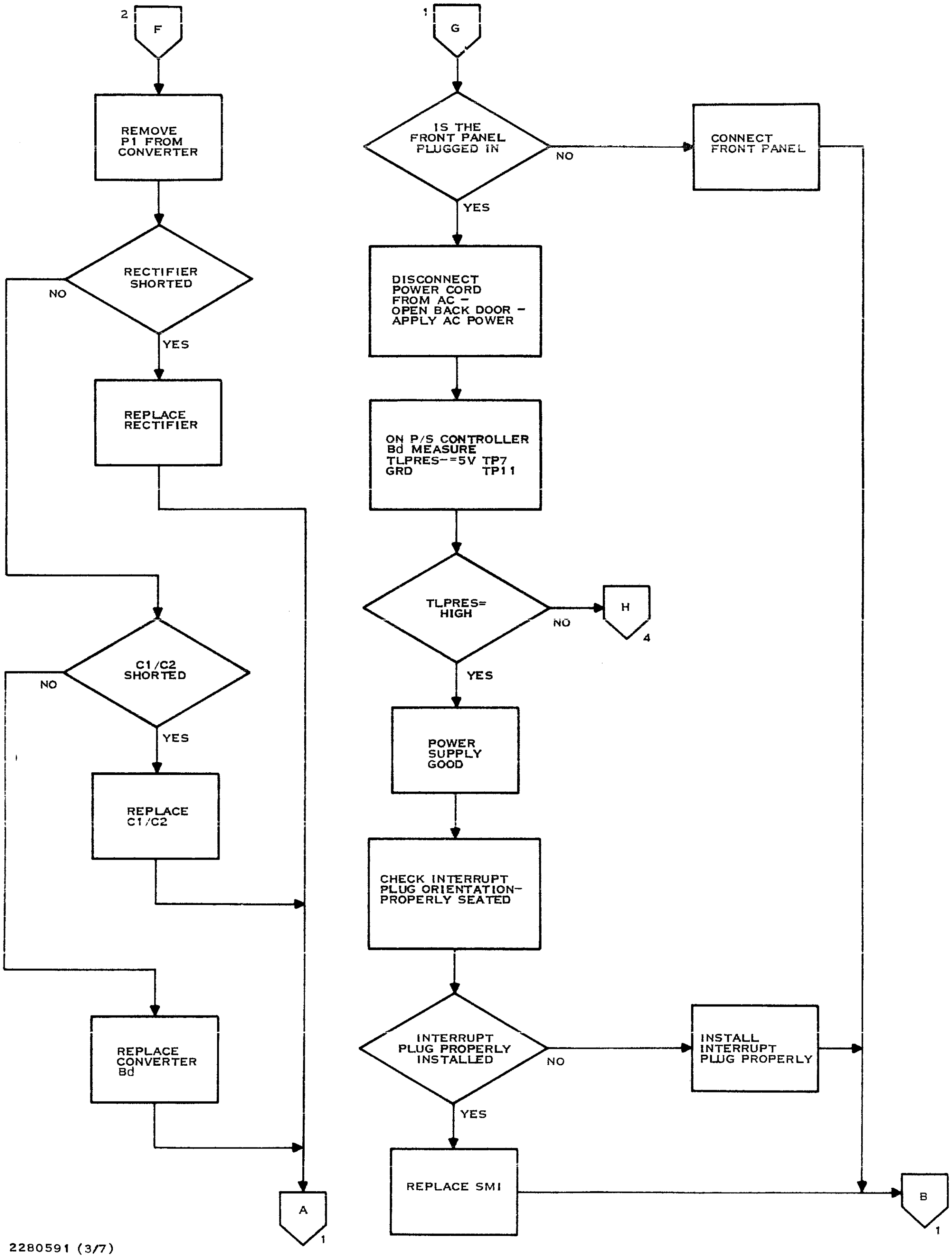
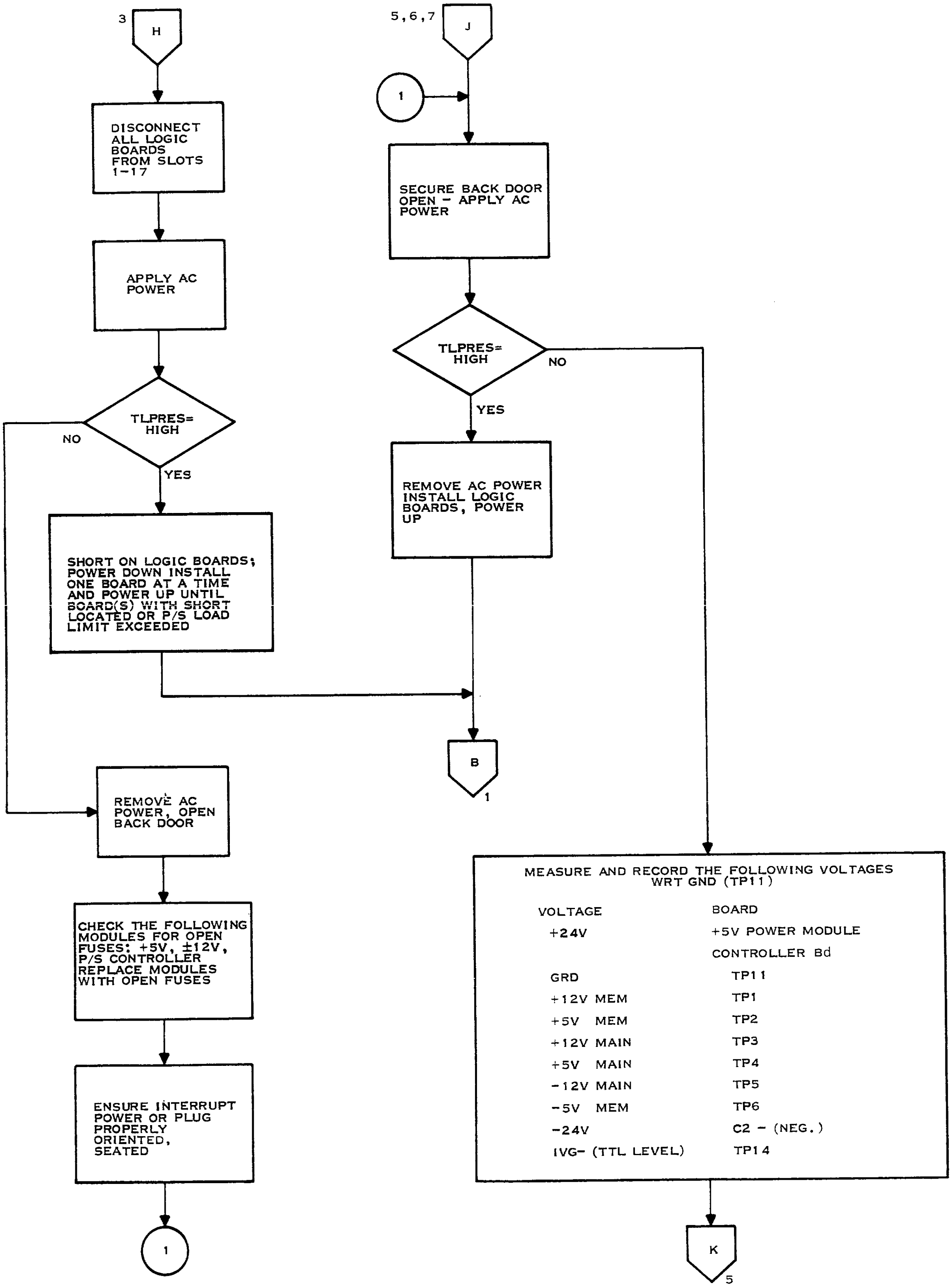


Figure 1-5. 17-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 3 of 7)



VOLTAGE	BOARD
+24V	+5V POWER MODULE
	CONTROLLER Bd
GRD	TP11
+12V MEM	TP1
+5V MEM	TP2
+12V MAIN	TP3
+5V MAIN	TP4
-12V MAIN	TP5
-5V MEM	TP6
-24V	C2 - (NEG.)
IVG- (TTL LEVEL)	TP14

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Figure 1-5. 17-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 4 of 7)

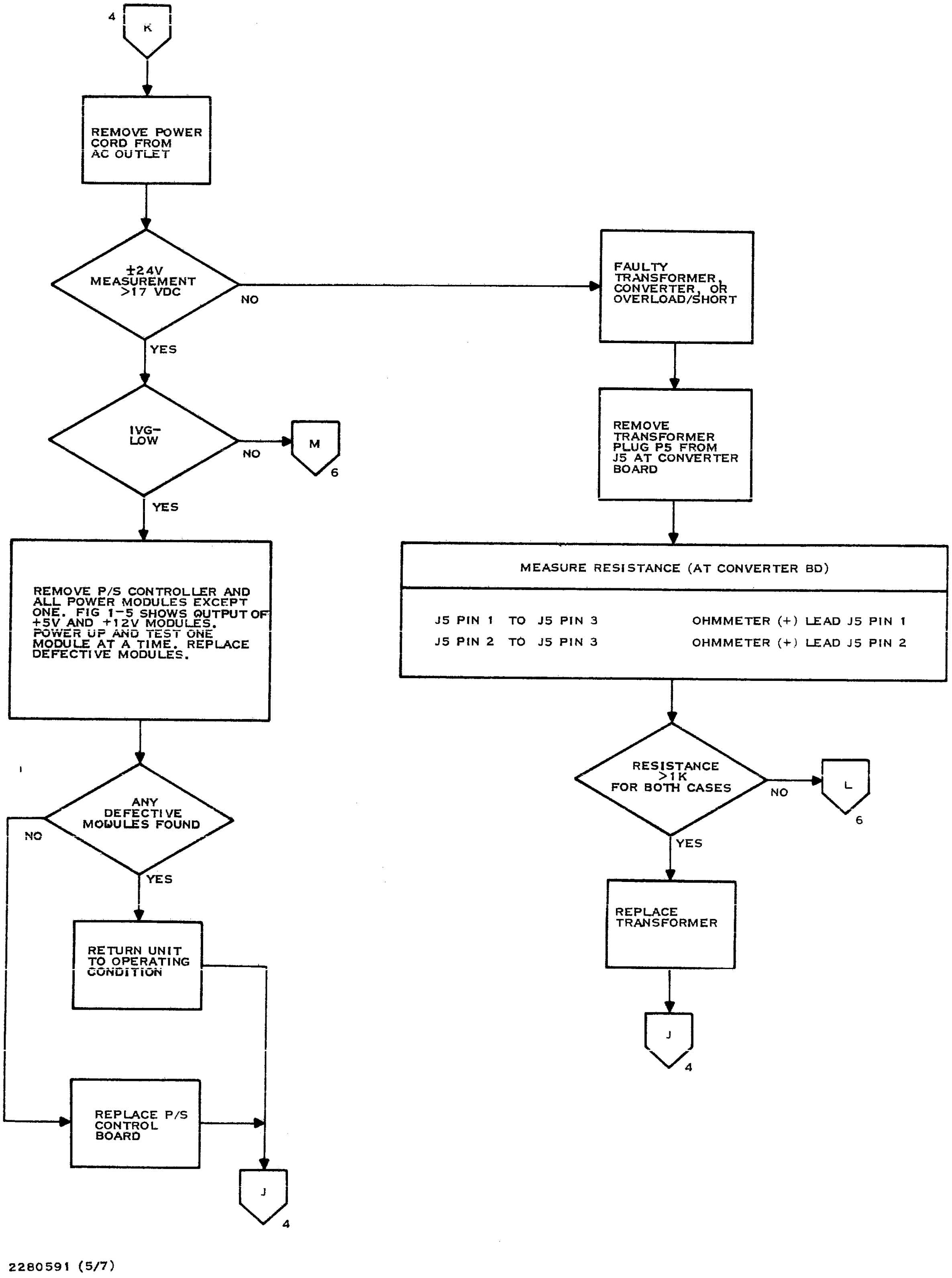
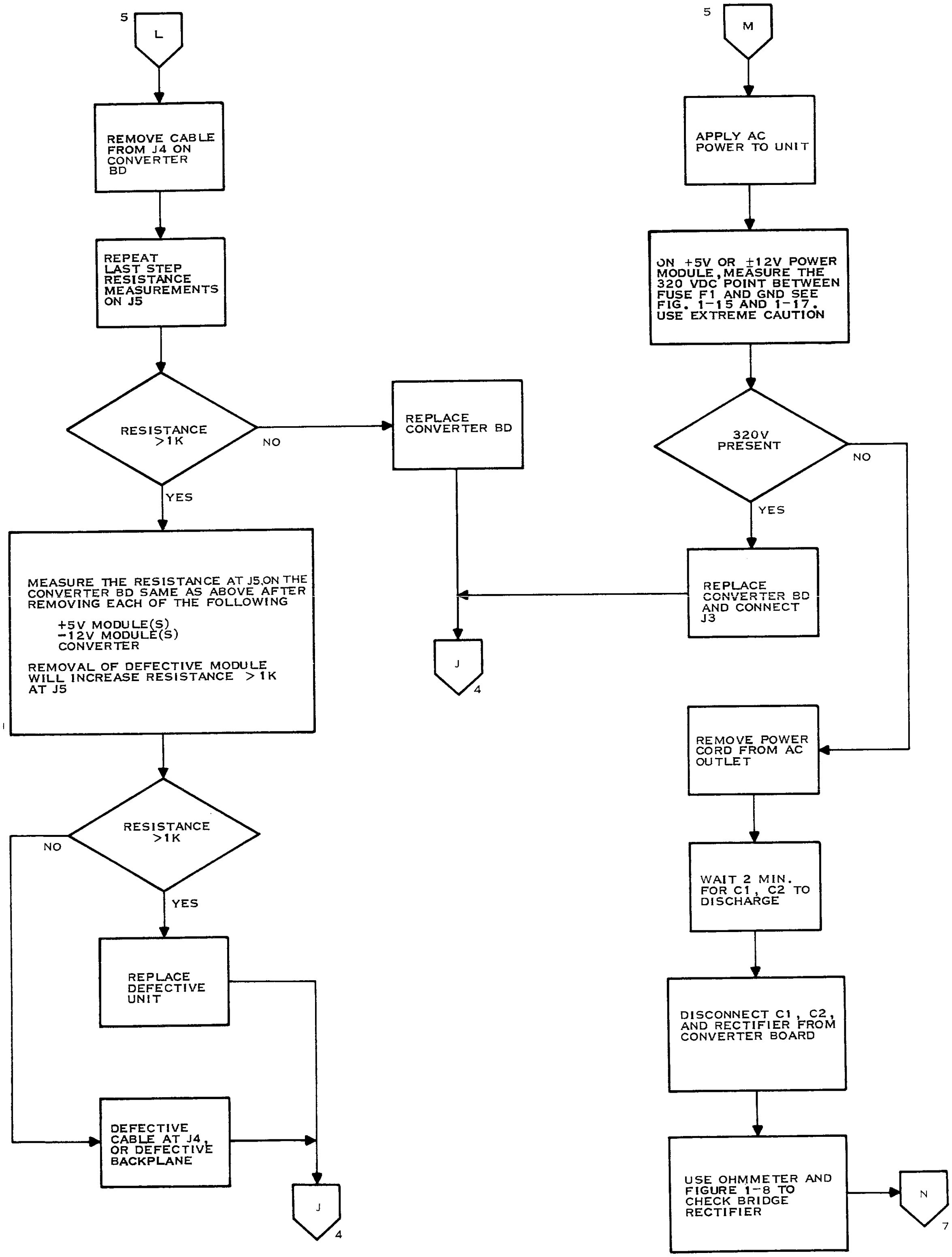
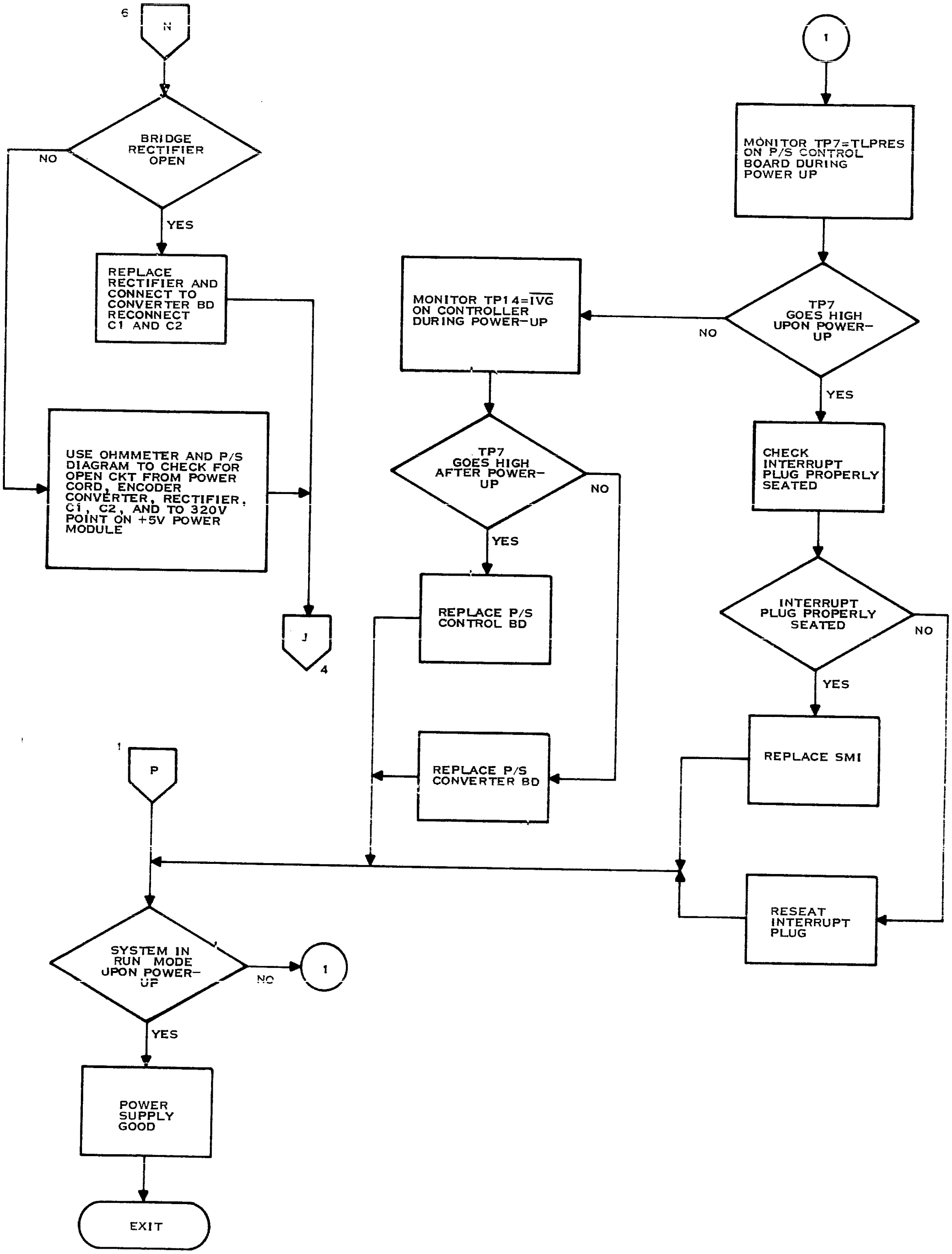


Figure 1-5. 17-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 5 of 7)



2280591 (6/7)

Figure 1-5. 17-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 6 of 7)



2280591 (7/7)

Figure 1-5. 17-Slot Chassis Power Supply Troubleshooting Flowchart (Sheet 7 of 7)

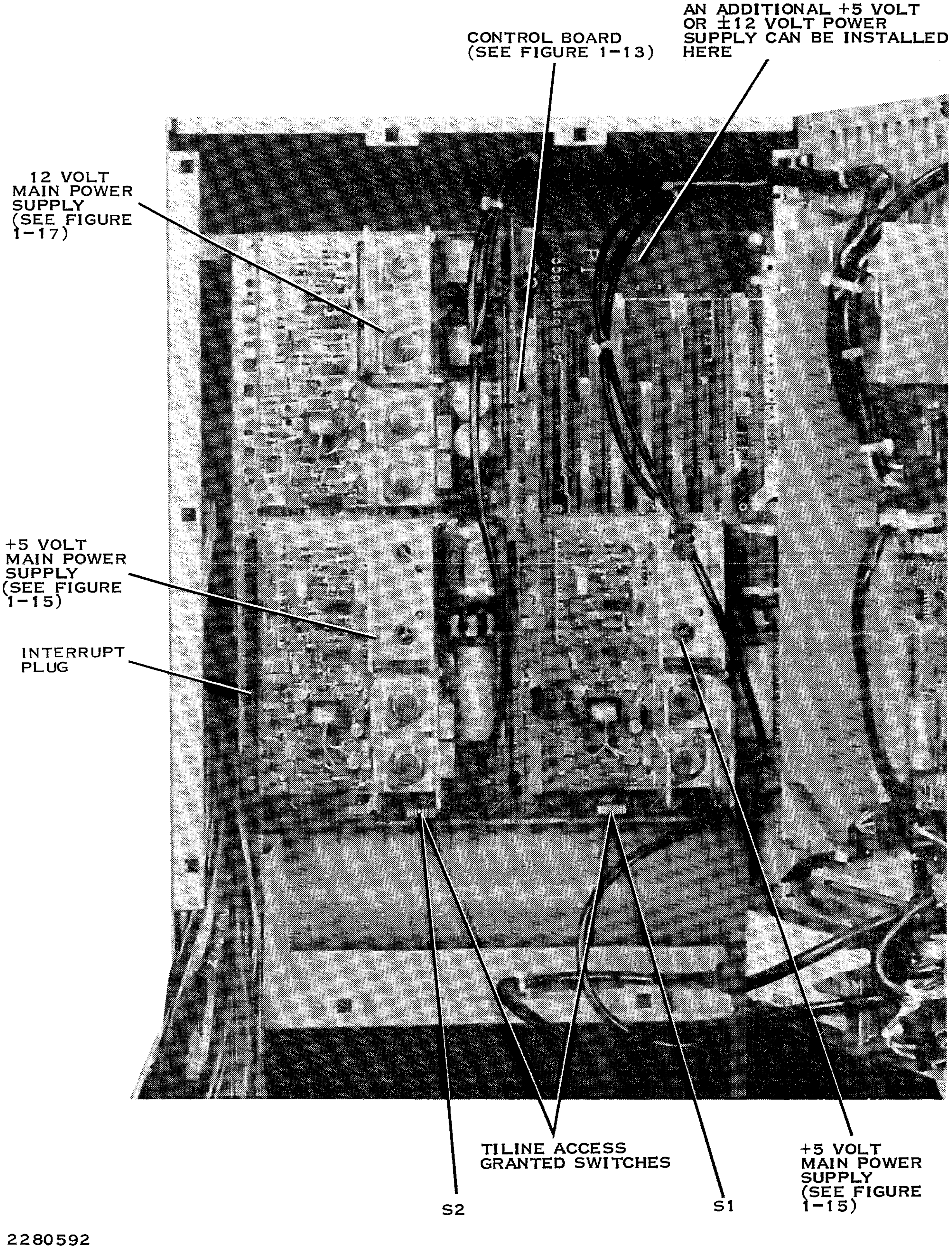


Figure 1-6. 17-Slot Chassis, Rear View

TR — Troubleshooting

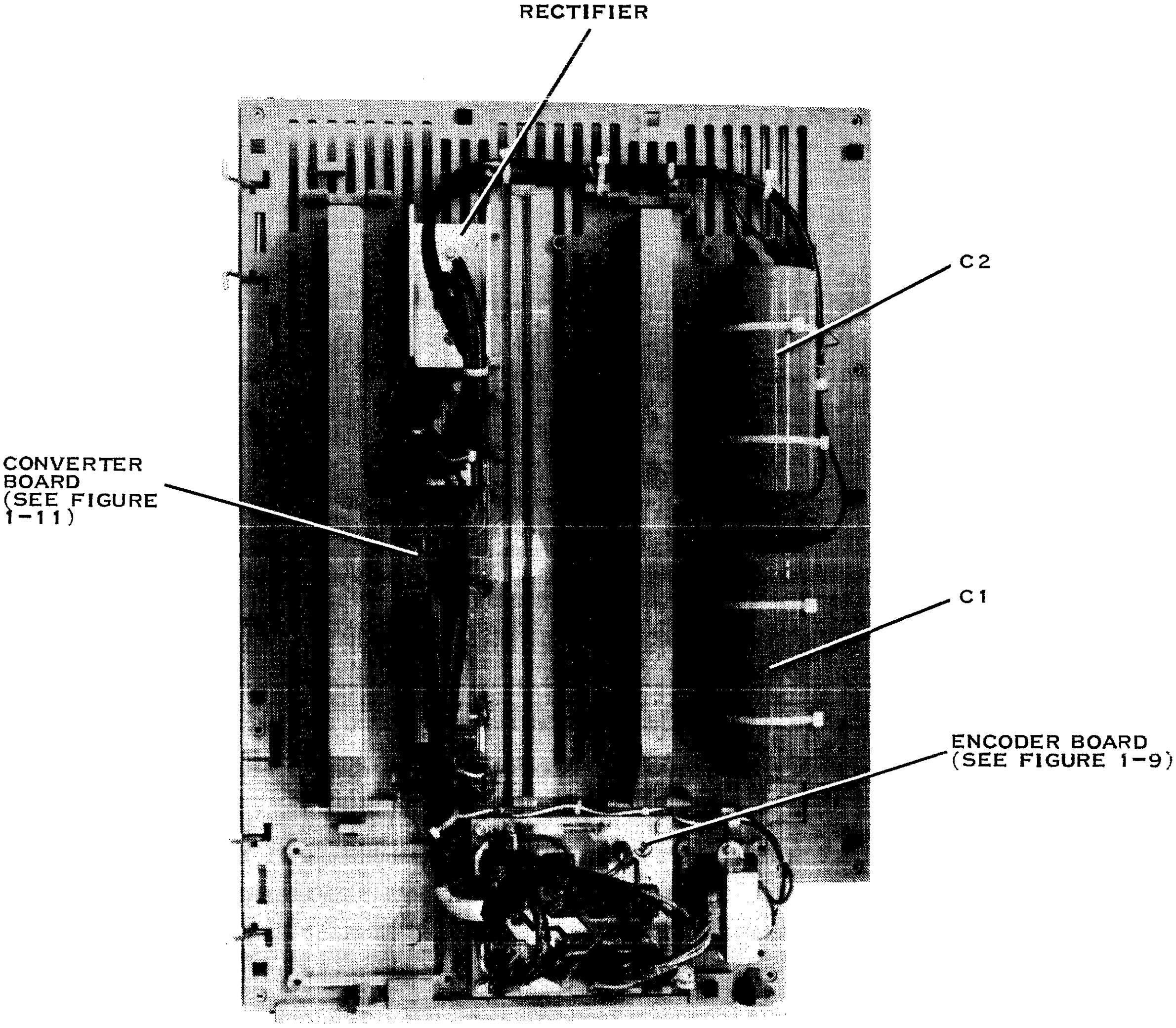


Figure 1-7. Rear Cover, 17-Slot Chassis

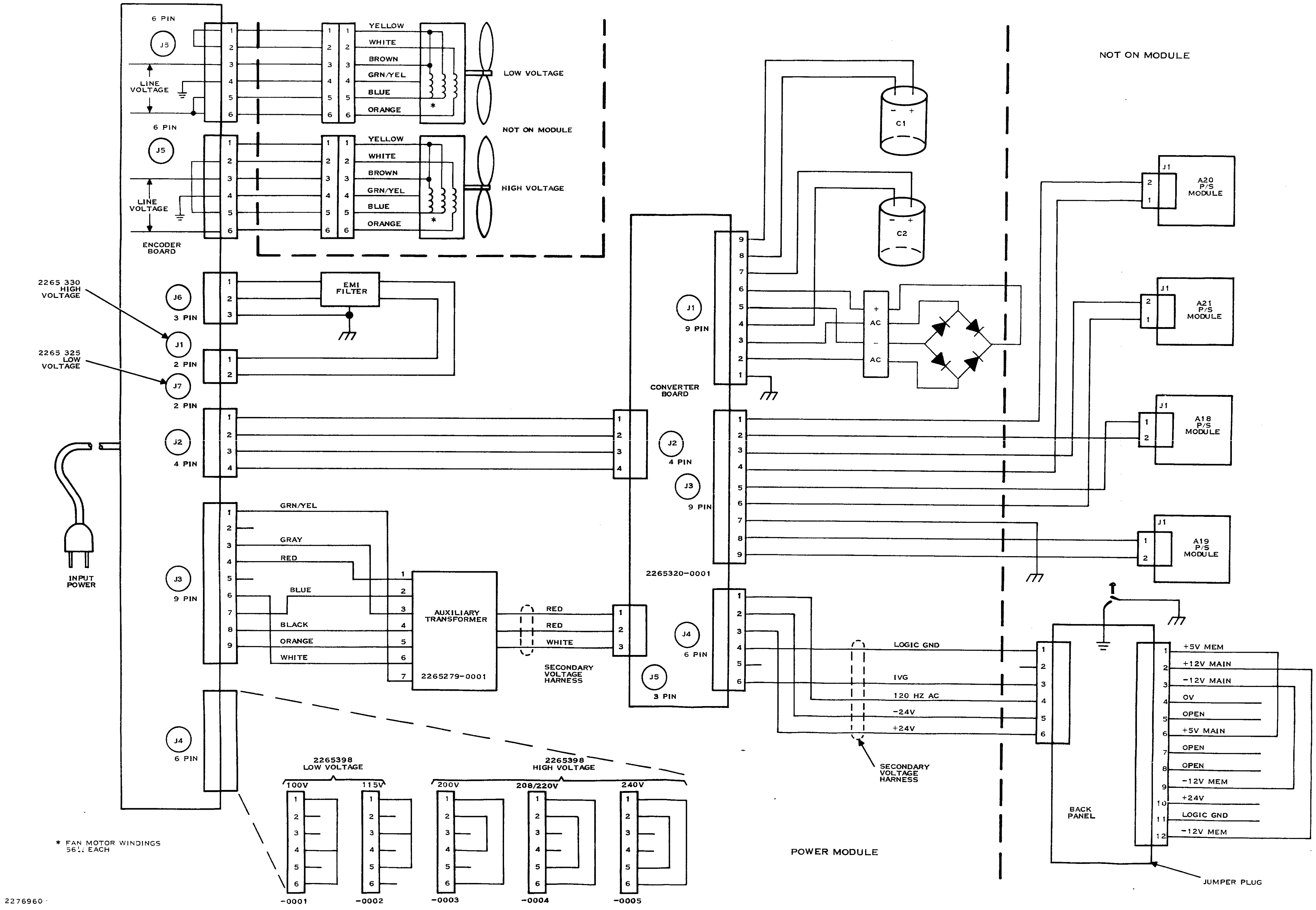


Figure 1-8. AC Power System Schematic

1.4.2 Encoder Board Description

On high-voltage units (200 - 240 volts), ac power is applied to the encoder board (Figure 1-9) through the power cord and fuse F2. (Refer to Figure 1-10.) Current then flows through S1, J7, EMI filter, and back to the encoder board through J6. J5 provides ac power to the fan motor. J2 supplies power to the converter board. The auxiliary transformer is fused by F1 (1/2 ampere) on the encoder board. Connection to the transformer is through J3. The plug on J4 is used to adapt the power supply to the different input voltages.

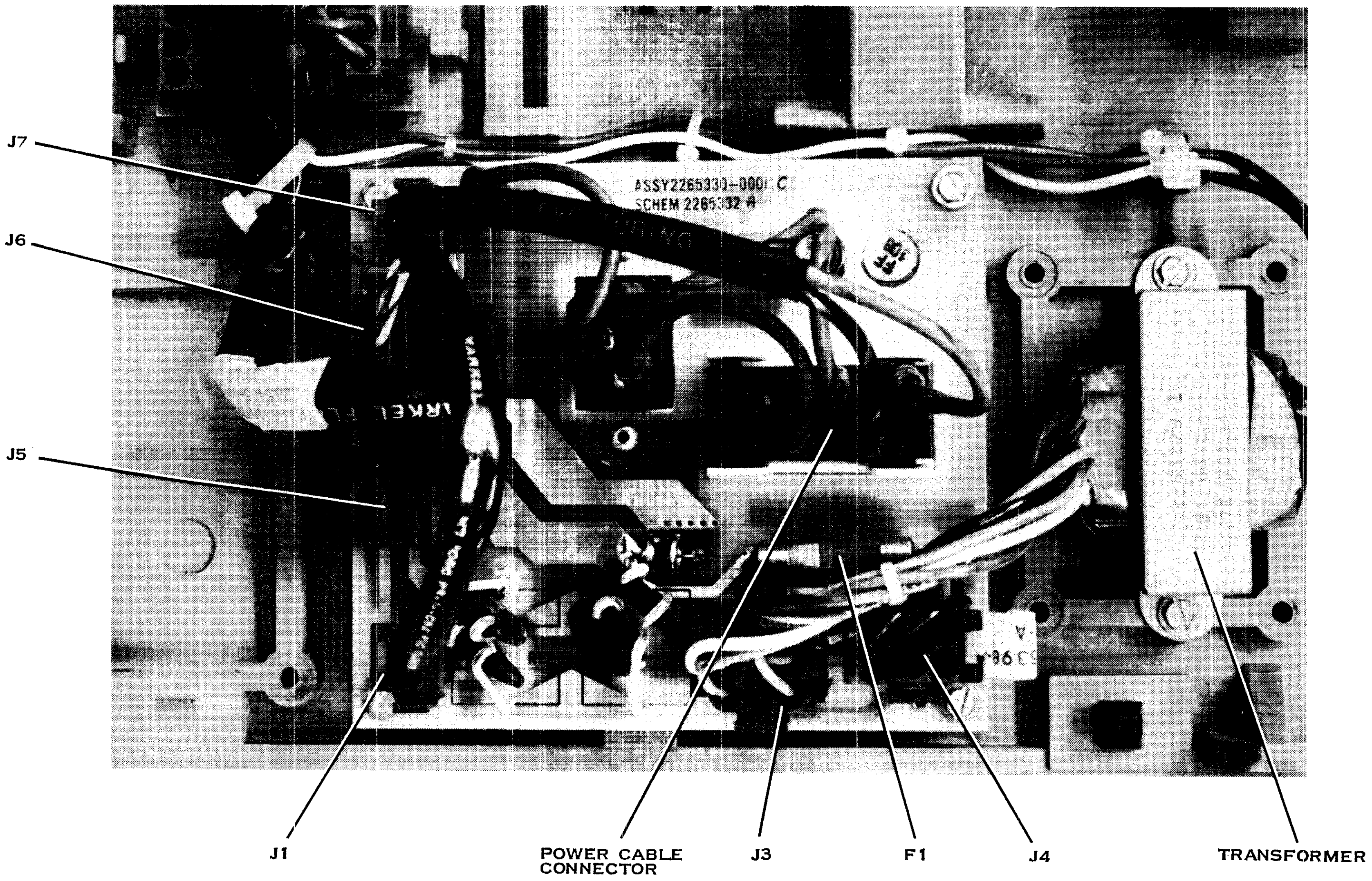
The low-voltage configuration is the same as the high-voltage configuration with the following exceptions:

- The EMI filter is bypassed.
- Circuit breaker CB1 is used instead of fuse F2.

1.4.3 Converter Board

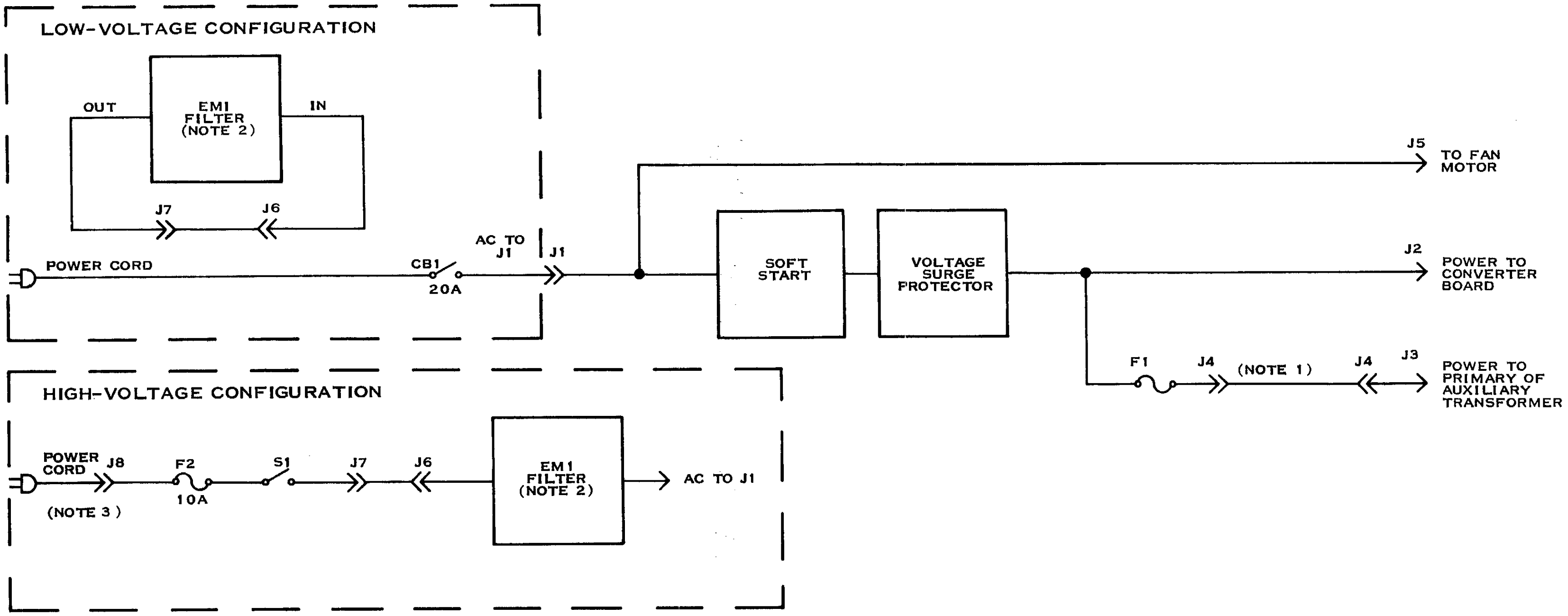
Main power is applied to the converter board (Figure 1-11) through J2. (Refer to Figure 1-12). AC is rectified and filtered by capacitors C1 and C2 and the bridge rectifier which is located on the power supply rear cover (Figures 1-7 and 1-8). J1 makes connection to and from the filtering and rectifying components. The filtered dc (320 volts) is then applied to the +5-volt and ±12-volt power modules through the converter connector J3 and backpanel.

The auxiliary transformer secondary connects to the converter board through J5. The converter board supplies IVG, +24V, -24V, and 120HZ ac clock to the backpanel through J4.



2276961

Figure 1-9. Encoder Board (High Voltage)



NOTES:

1. THE APPROPRIATE 1 OF 5 POWER CONVERTER PLUGS IS INSERTED ACROSS PINS OF J4 TO ACCOMMODATE VARIOUS PRIMARY AC INPUT VOLTAGES TO THE AUXILIARY TRANSFORMER.
2. EMI FILTER IS NOT PART OF THE ENCODER BOARD. THE EMI FILTER IS MOUNTED ON THE POWER MODULE.
3. POWER CORD IS NOT INTEGRAL PART OF HIGH-VOLTAGE ENCODER BOARD AND DIFFERS TO ACCOMMODATE VARIOUS PRIMARY AC INPUT VOLTAGES.

2276962

Figure 1-10. Functional Diagram for the Encoder Board

TR — Troubleshooting

1.4.4 Power Supply Control Board

The power supply control board (Figures 1-13 and 1-14) monitors all main voltage and memory voltages from the power supplies for undervoltage conditions, and it also monitors the input dc voltage-good signal (IVG-) from the converter board. Power-down sequence signals are issued when IVG- goes high, indicating that the input dc voltage to the converter board has dropped to 205 volts dc or less. A -5-volt series regulator on the control board provides the -5V MEM supply for the backpanel from the -24V and -12V MEM inputs to the control board. Overvoltage detection is provided on the control board for the -5V MEM supply.

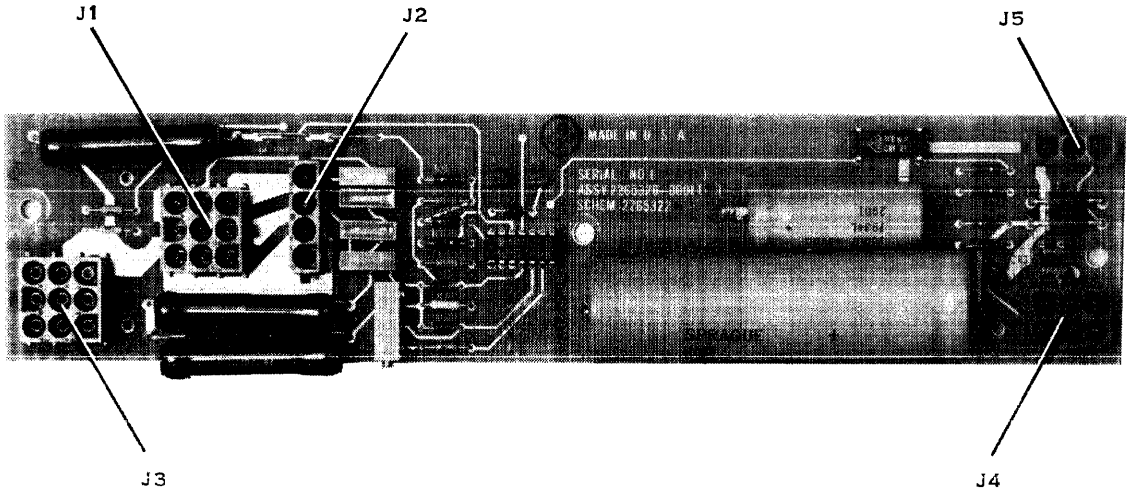


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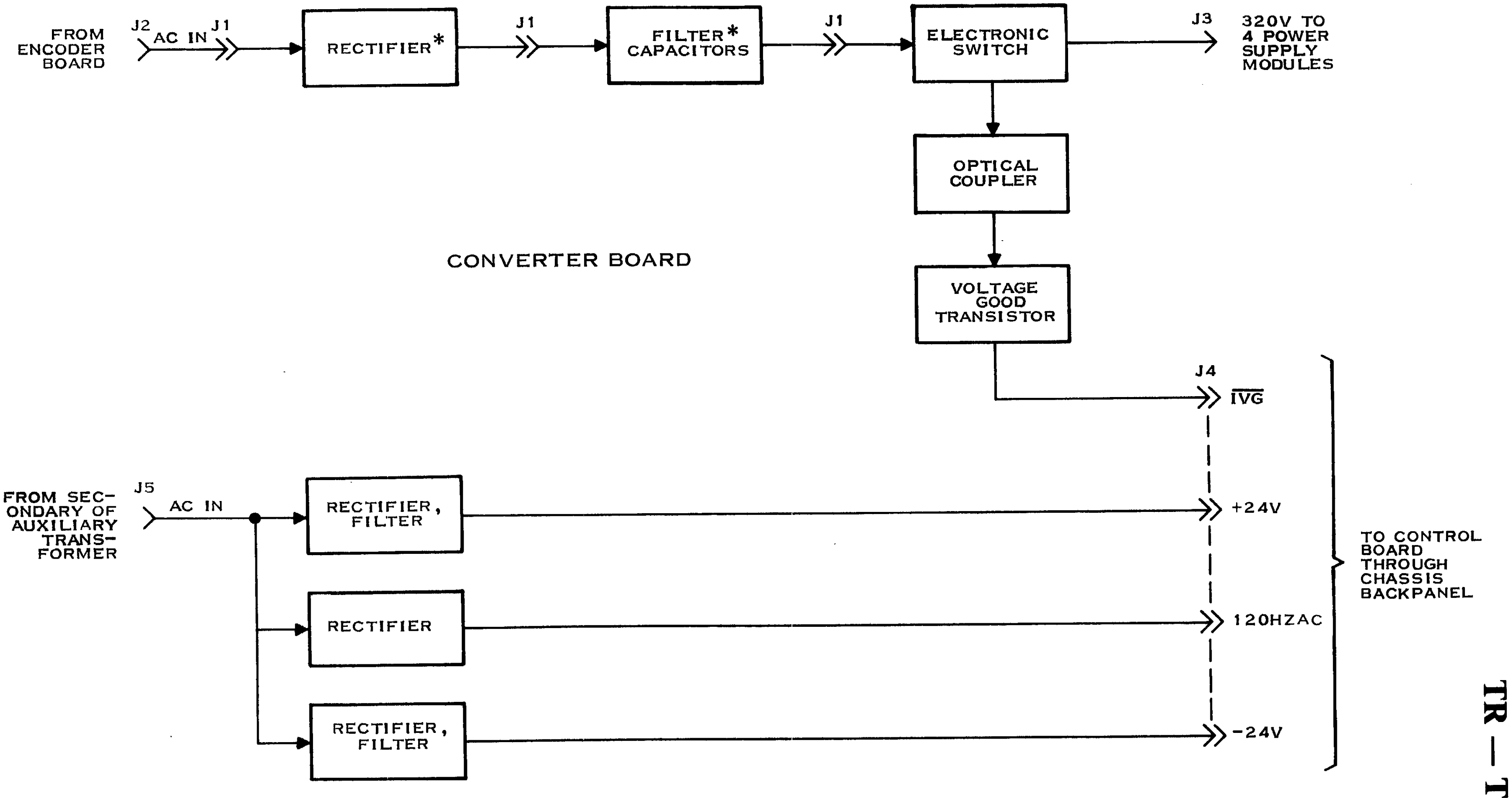
Figure 1-11. Converter Board



*RECTIFIER AND CAPACITORS ARE NOT PART OF THE CONVERTER BOARD BUT ARE PART OF THE POWER MODULE ASSEMBLY.

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Figure 1-12. Functional Diagram for the Converter Board

TR — Troubleshooting

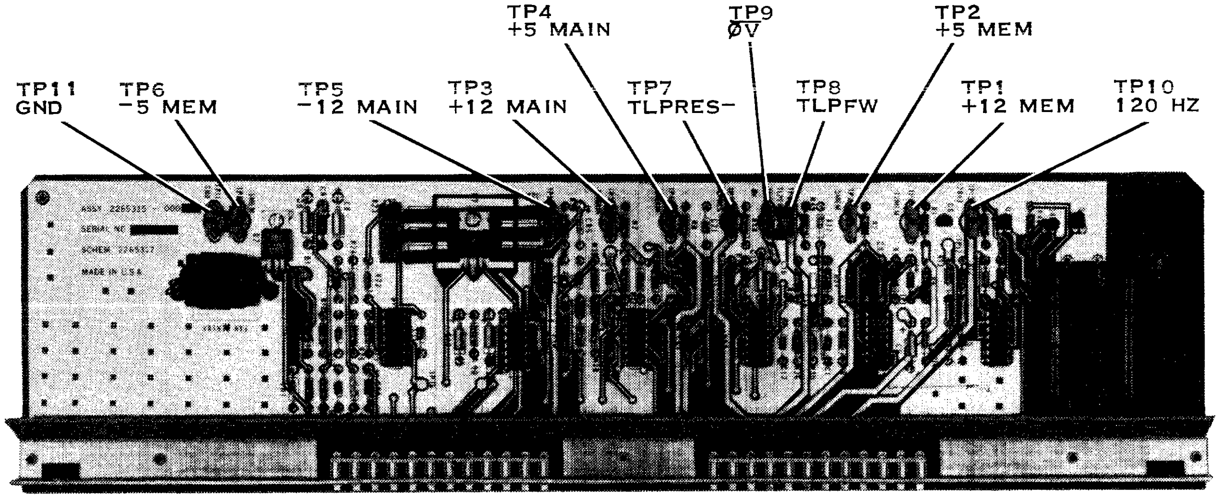

Figure 1-13. Power Supply Control Board

1.4.5 + 5-Volt and ± 12-Volt Power Modules

The + 5-volt power module (Figures 1-15 and 1-16) and the ± 12-volt power module (Figures 1-17 and 1-18) use the unregulated 320-volt dc input power from the converter board to provide + 5 volts and ± 12 volts dc to the 17-slot chassis backpanel. The + 24 volts developed on the converter board is also applied to the + 5-volt and ± 12-volt power modules via the chassis backpanel.

The + 5-volt and ± 12-volt interconnection to the 17-slot chassis backpanel is such that any combination of + 5-volt modules and/or ± 12-volt modules can be used and interchanged.

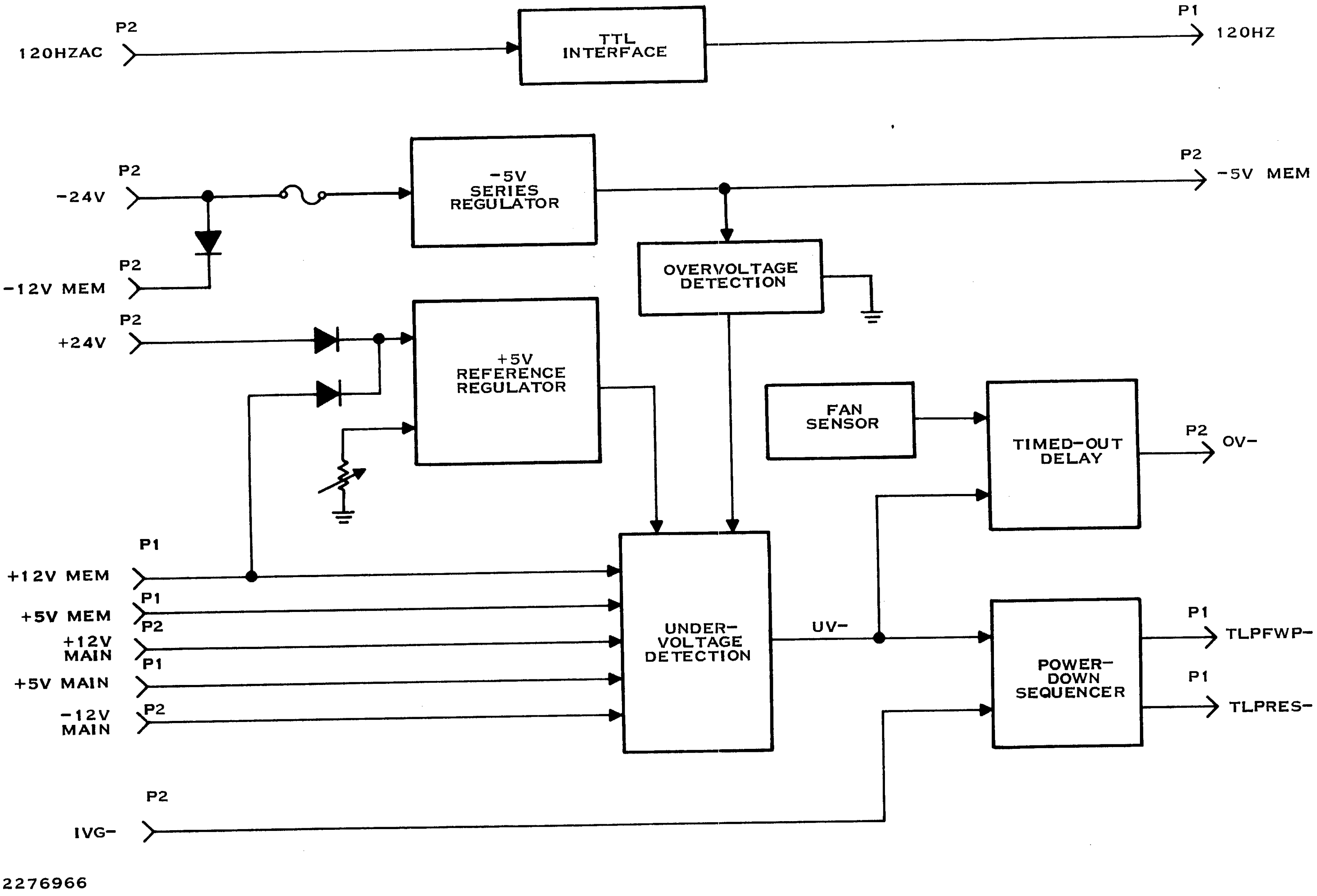

Figure 1-14. Functional Diagram for the Control Board

TR — Troubleshooting

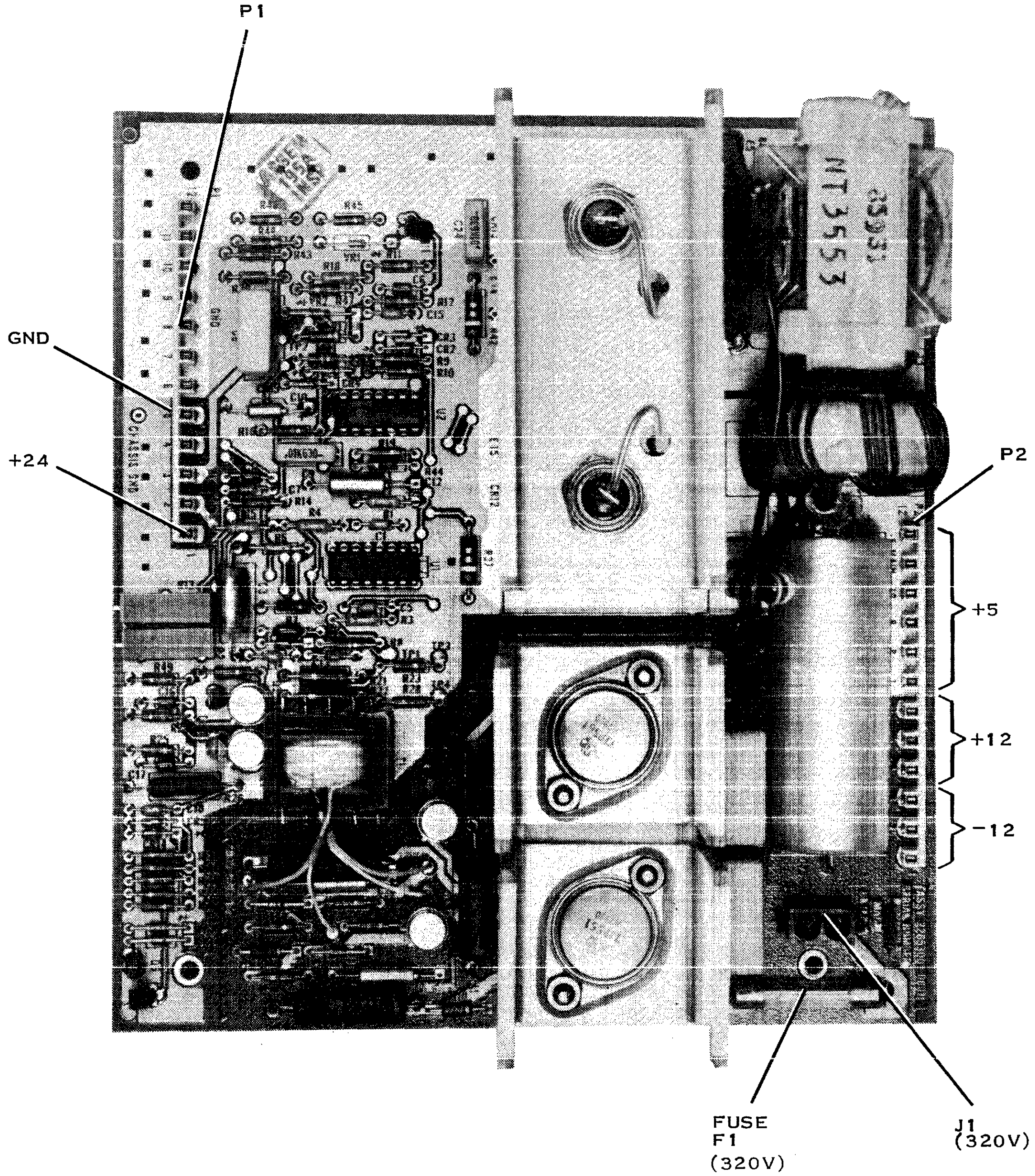

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Figure 1-15.   + 5-Volt Main Power Supply

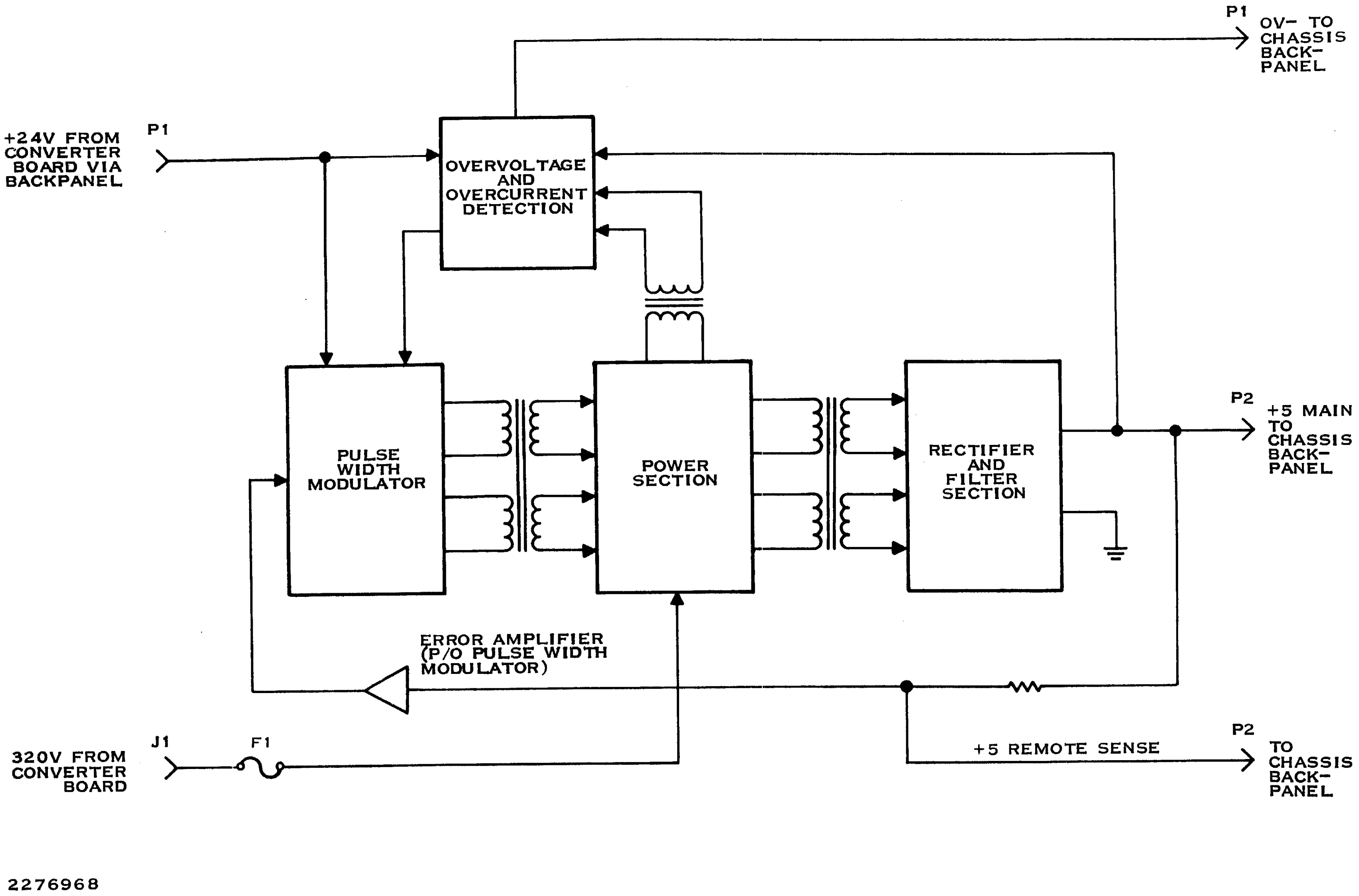

Figure 1-16. Functional Diagram for the + 5-Volt Main Power Supply

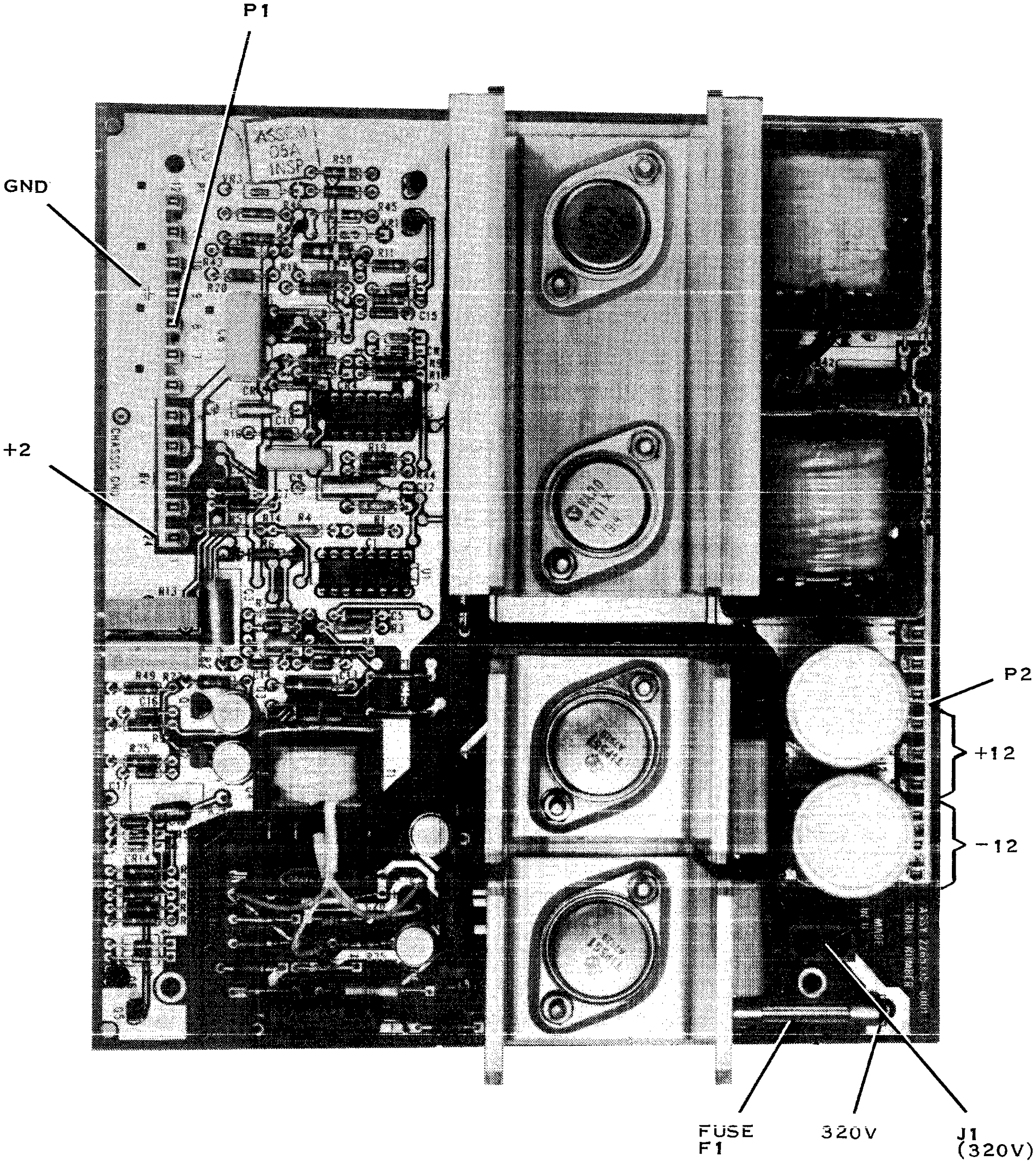

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Figure 1-17. ± 12-Volt Main Power Supply

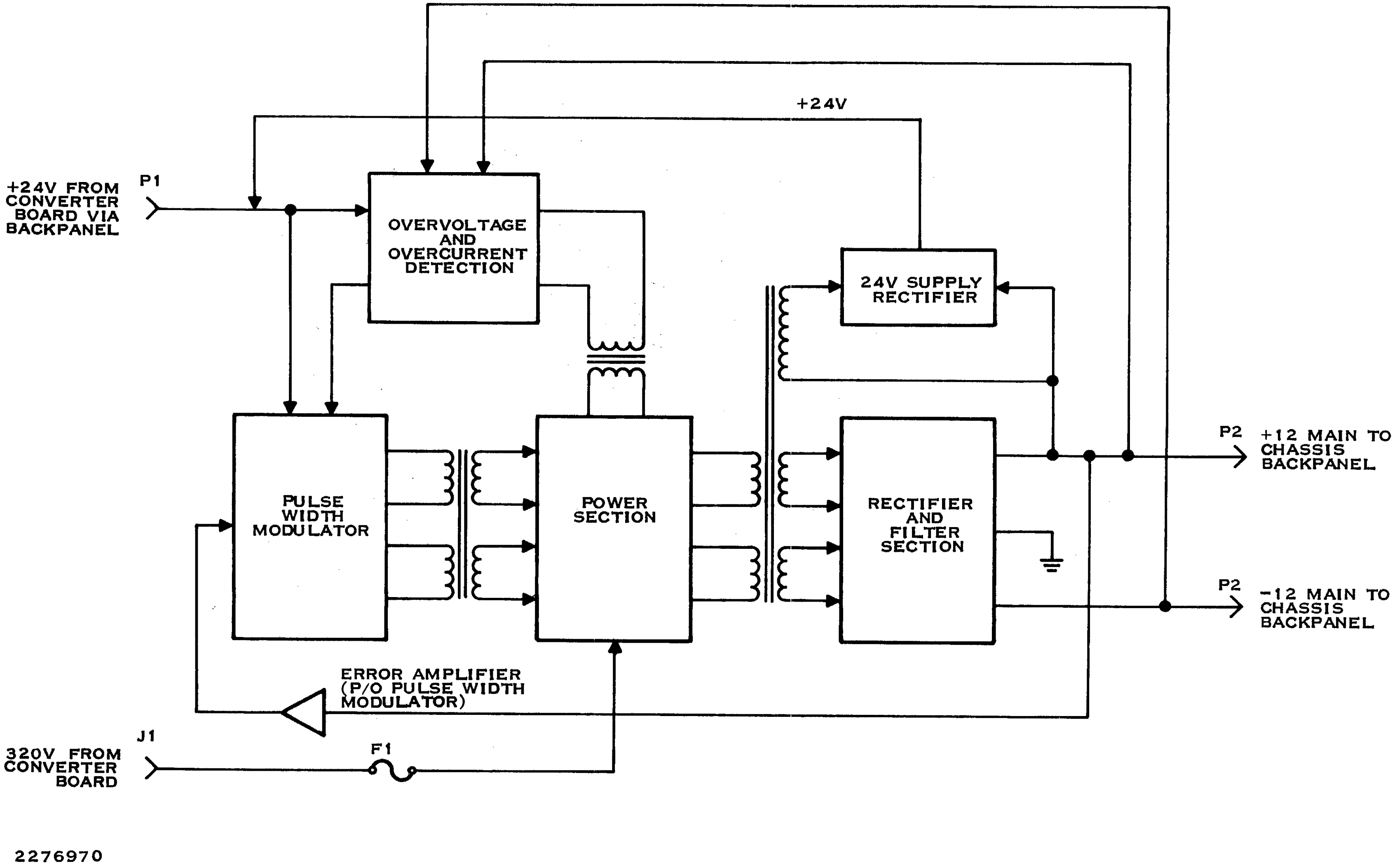

Figure 1-18. Functional Diagram for the ± 12-Volt Main Power Supply

TR — Troubleshooting

1.5 POWER SUPPLY TEST POINT BOARD

The power supply test point board (Figure 1-19) is a tool that allows easy access to all of the voltage points in any 990 computer chassis. The test point board is a PWB that can be plugged into any full-size chassis slot at the front of any 990 computer chassis. It contains 12 barrel-type test points, one pair for each voltage in the chassis. The test points are color-coded and marked. They are readily accessible to allow monitoring of each voltage with a voltmeter or oscilloscope to verify that the voltage is within tolerance. The board also contains six LEDs, one for each voltage. When the board is plugged into a chassis, the LEDs light to indicate the presence of voltage.

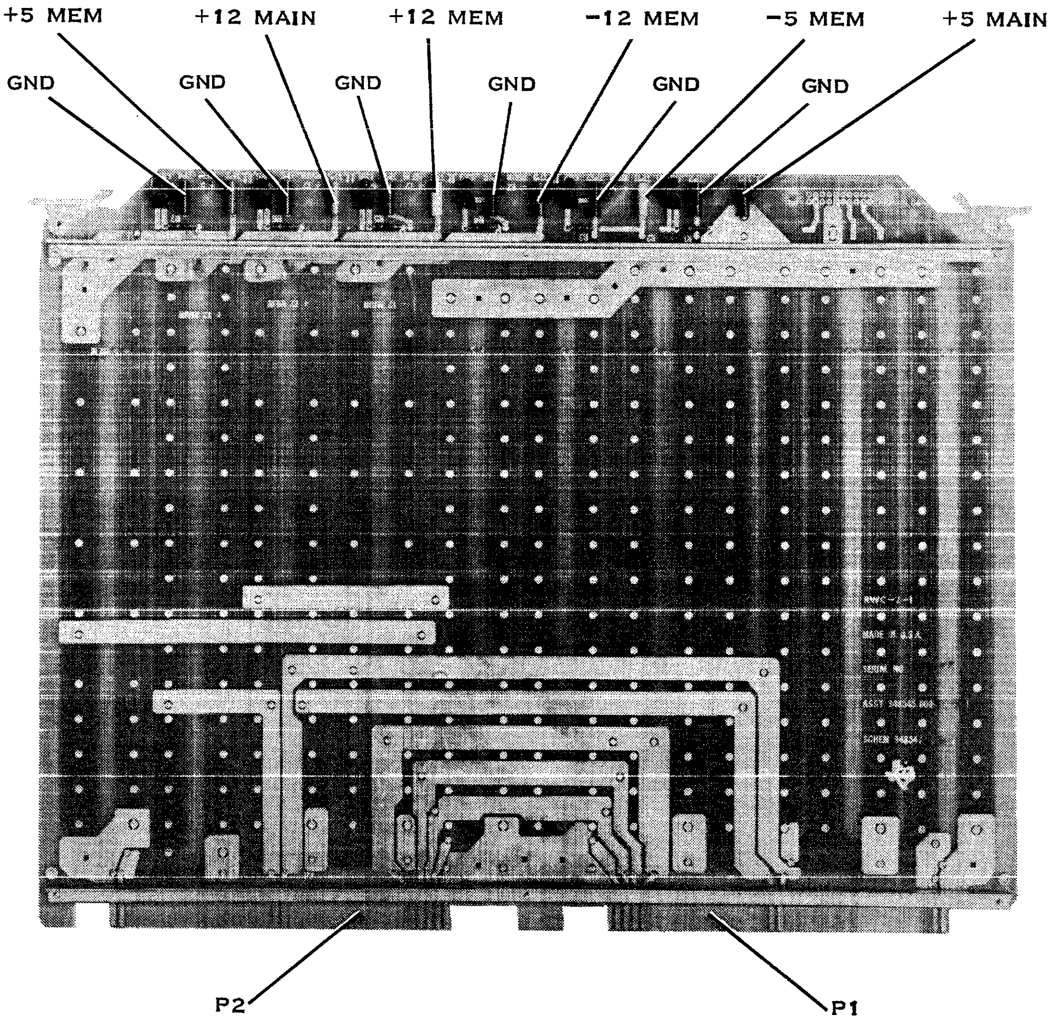

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Figure 1-19. Power Supply Test Point Board

1.6 SYSTEM LOCKUP AND CRASH ANALYSIS

This section discusses actions that may be taken to determine the cause(s) of system lockup or crash conditions. It is important to determine whether the problem is due to hardware failure or to a programming error. It is also important to determine if the problem is of a serious nature so that no valuable data will be destroyed if an initial program load (IPL) is attempted. Error messages and status codes may provide useful information that can be used to determine the nature and sometimes the cause(s) of the problem.

1.6.1 System Lockup Diagnosis

When a system lockup occurs, the system will not respond to inputs from system I/O devices (911 VDT, 733 ASR, 820 KSR, etc.). When a system lockup is detected, observe the FAULT light on the CPU front panel. If the FAULT light is lit, a fatal system crash or a power problem is indicated. Refer to paragraph 1.6.2, System Lockup with FAULT Light On. If the FAULT light is not lit, refer to paragraph 1.6.3, System Not Responding, and to the troubleshooting flowcharts. If the FAULT light is not lit and the left byte data lights on the CPU front panel are all lit, refer to paragraph 1.6.4, System Lockup with Disk Activity, and to the troubleshooting flowcharts for further diagnosis.

1.6.2 System Lockup with FAULT Light On

A fatal system crash is indicated by illumination of the FAULT, IDLE, and RUN lights and by display of a system crash code on the programmer panel. Record the crash code shown on the data lights and refer to Appendix A for crash code descriptions. By the description of the problem, determine if it could be caused by a hardware failure. If the system crash code is >20, >27, >A0, or >100, a possible level 2 interrupt in a system task could have caused the task to terminate. Check the CPU status register and workspace register for a logic 1 in the interrupt mask (indicating that a level 2 interrupt has occurred), and refer to the troubleshooting flowcharts for level 2 interrupt diagnosis from a system crash. Level 2 interrupts may also be caused by improper software configurations or by programming errors, but only a level 2 interrupt in a system task can cause a system crash, usually code >20.

Software programming errors will usually be very consistent. If a problem in the operating system is suspected, a crash dump may be taken that records all system memory and tasks in a special format on the system disk in the crash file. File .S$CRASH may be analyzed to determine the problem. Ensure that a backup system is available before writing the system crash information to the crash file.

1.6.3 System Not Responding

In some cases, a hardware failure other than a disk error or system crash may cause a system lockup. The system will not respond and no useful work on the system can be accomplished. Typical hardware failures that can cause this type of system lockup are:

- A faulty TILINE address or data signal line may be destroying (or may have destroyed already) the system memory area, causing a system routine to get hung in a tight loop.
- The system may be locked up trying to clear an interrupt line that will not toggle.
- A faulty interface board may prevent the system from responding.
- The system may be locked up waiting for an interrupt from a system disk controller that is malfunctioning.

Refer to the troubleshooting flowcharts for procedures to determine whether the lockup is due to software or hardware, and which component may have failed. In some cases where an unforeseen operating system problem is suspected to be the cause of the system lockup, a system crash can be forced that will save the system memory and the task information on the crash file .S$CRASH for the system disk.

Ensure that a backup system is available before writing the system crash information to the crash file. The crash dump information may then be analyzed by a system analyst to determine the cause of the problem. To force a system crash, refer to the troubleshooting flowcharts, Figure 1-1, sheet 3.

1.6.4 System Lockup with Disk Activity

A system disk error during a roll-in or roll-out operation can cause the operating system to lock up while trying to recover from the error. This condition may be indicated by the left byte data lights on the front panel all being on and no response from any system I/O devices. Absence of a disk interrupt can also lock up the system. Halt the computer and record the eight TILINE peripheral control space (TPCS) words for the system disk controller (normally >F800). Refer to the *DS990 Systems Field Engineering Reference Handbook* and the troubleshooting flowcharts for descriptions of each word in the TPCS. By the description of the bits that are set in the disk controller status registers, determine if the problem is caused by a read error or by a write error, or by an interrupt that did not occur after a seek operation. Ensure that the customer is using the correct media if a media problem is suspected. Isolate the problem to a specific assembly and replace it.

An interrupt is issued after completion of disk operation under two conditions:

1. The interrupt enable bit and either the complete bit or error bit in the controller status words are set. (The operating system resets the complete bit and error bit to disable the interrupt after servicing the interrupt.)
2. The unit attention interrupt mask bit and the corresponding unit attention bit are set.

If an interrupt condition exists, display the CPU status register and determine by the interrupt mask if the CPU has recognized the disk interrupt. If it has not, press RUN, then repeat the above operation to see if the disk interrupt has been recognized. If the interrupt condition has not been cleared by the system, check the chassis interrupt jumper plug because the interrupt is not reaching the CPU.

1.7 SYSTEM CONFIGURATION - LDC COMMAND

Table 1-1 is an example of the system software List Device Configuration (LDC) command. This command will list the devices that were sysgened into the system and their current status. Check each entry for the correct address, interrupt, and chassis location according to the actual hardware configuration.

Table 1-1. Example of LDC Command

Device	Type	Address (Hexadecimal)	Int	Chas	Pos	State	Code8
DS01	Disk	F800	13			On	N
DS02	Disk	F800	13			On	N
DS03	Disk	F810	11			On	N
DS04	Disk	F810	11			On	N
MT01	Tape	F880	9			On	N
LP01	Printer	0060	14			On	N
LP02	Printer	0020	15			On	N
ST01	VDT	0100	10			On	N
ST02	VDT	0120	8			On	N
ST03	VDT	0440	7	1	4	On	N
ST04	VDT	0460	7	1	14	On	N
ST05	VDT	04C0	7	1	11	On	N
ST06	VDT	04E0	7	1	12	On	N
ST07	VDT	0500	7	1	10	On	N
ST08	VDT	0520	7	1	8	On	N
ST09	VDT	0540	7	1	9	On	N
ST10	VDT	0560	7	1	9	On	N
ST11	VDT	0580	7	1	13	On	N
ST12	VDT	05A0	7	1	13	On	N

Note:

The column headings have the following meanings:

Device — DX10 legal device name.
Type — Description of device.
Address — The TILINE or CRU address of the device.
Int — The interrupt assigned to the device.
Chas — The chassis in which the device is located:
No entry — main chassis.
1 — first expansion chassis, etc.
Pos — The interrupt assigned to a device in an expansion chassis.
State — The system software state of the device. The device must be in the ON state in order for the software to access the device. The SCI MDS command is used to modify this state.
Code8 — Entry (Y = yes, N = no) designates if the device is capable of handling 8-bit ASCII character codes.

1.8 SYSTEM LOG AND SYSTEM LOG MESSAGES

The system log is used by the DX10 operating system and records significant events that occur during system operation over a period of time. The system log can be a useful tool for diagnosing equipment problems. The log can document intermittent problems or show the gradual degradation of a particular peripheral component. It is also useful in determining if a disk drive or only a particular disk pack is experiencing errors. For TILINE devices, the eight-word TPCS is saved by DX10 for each I/O request. If an uncorrectable error occurs after a specific number of software retries, the original TPCS image is recorded along with the error results. For 16K ECC RAM and cache memory, DX10 records the occurrence of correctable and uncorrectable errors in the system log.

A complete explanation of system log records along with examples is given in the OP — Operating Procedures section of this manual, Section 5, System Log Analysis Tasks.

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2 — Computer Memory Boards

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Tables

1

Computer CPU Boards

1.1 GENERAL

This section contains information about options, ROM loaders, and field-replaceable components for the 990/5, 990/10, and 990/12 computer central processor PWBs.

1.2 990/5 COMPUTER

The component layout of the 990/5 computer PWB (part number 2261930) is shown in Figure 1-1. The functions and positions of the option switches are listed in Table 1-1.

Table 1-1. Function and Position of Option Switches on the 990/5 Computer

Socket Location	Function with Switch in ON Position	Normal Position
UG09-1	RESET causes power-up through load trap	ON
UG09-2	RESET causes power-up through reset trap	OFF
UG09-3	Real-time clock interrupt connected to interrupt level 15	OFF
UG09-4	Real-time clock interrupt connected to interrupt level 5	ON
UG09-5	Backpanel interrupt 5 connected to level 5	OFF
UG09-6	This unit functions as a slave processor	OFF
UG09-7	32KB configuration	
	2261930-0001 Board (32KB)	ON
	2261930-0002 Board (64KB)	OFF
UG09-8	Disable ROM (factory use only)	OFF

CP — Computers

Table 1-1. Function and Position of Option Switches on the 990/5 Computer (Continued)

Socket Location		Function with Switch in ON Position	Normal Position
UN08-1	SPID0(MSB)	Slave Processor ID	ON for 0 OFF for 1
UN08-2	SPID1		
UN08-3	SPID2		
UN08-4	SPID3(LSB)		
UT05-1	SASW0(MSB)	TILINE starting address switches*	ON for 0 OFF for 1
UT05-2	SASW1		
UT05-3	SASW2		
UT05-4	SASW3		
UT05-5	SASW4		
UT05-6	SASW5		
UT05-7	SASW6		
UT05-8	SASW7(LSB)		
UU07-1		Port 1 interrupt connected to interrupt level 8 (INT08) (P4)	ON
UU07-2		Port 2 interrupt connected to interrupt level 14 (INT14) (P5)	ON
UU07-3		Port 3 interrupt connected to interrupt level 6 (INT06) (P6)	ON

* ON represents logic 0 TILINE address (i.e., the standard position). All switches ON represents 0000.

1. Port 1 (P4) and port 2 (P5) are asynchronous.
2. Port 3 (P6) is synchronous/asynchronous (not implemented on early production models).
3. 733 ASR cable, part number 2261936-0001, connects to P4.
4. 743 KSR cable, part number 2261937-0001, connects to P4.
5. 810 printer cable, part number 2261935-0001, connects to P5.
6. 820 KSR cable, part number 2262096-0001, connects to P5.
7. Test connector part number is 948550-0001.

Table 1-1. Function and Position of Option Switches on the 990/5 Computer (Continued)

Socket Location		Function with Switch in ON Position	Normal Position
UU07-4	ID4(LSB)	Communication station ID for TMS 9903 port 3 (P6)	ON for 1 OFF for 0
UU07-5	ID3		
UU07-6	ID2		
UU07-7	ID1		
UU07-8	ID0(MSB)		

4. 743 KSR cable, part number 2261937-0001, connects to P4.
5. 810 printer cable, part number 2261935-0001, connects to P5.
6. 820 KSR cable, part number 2262096-0001, connects to P5.
7. Test connector part number is 948550-0001.

1.2.1 ROM Loaders, 990/5 Computer

The ROM loaders for the 990/5 contain self-test and loader software. The two ROMs, which contain 1024 16-bit words each, are as follows:

2261929-0003	Location: UNP07
2261929-0004	Location: UNP06

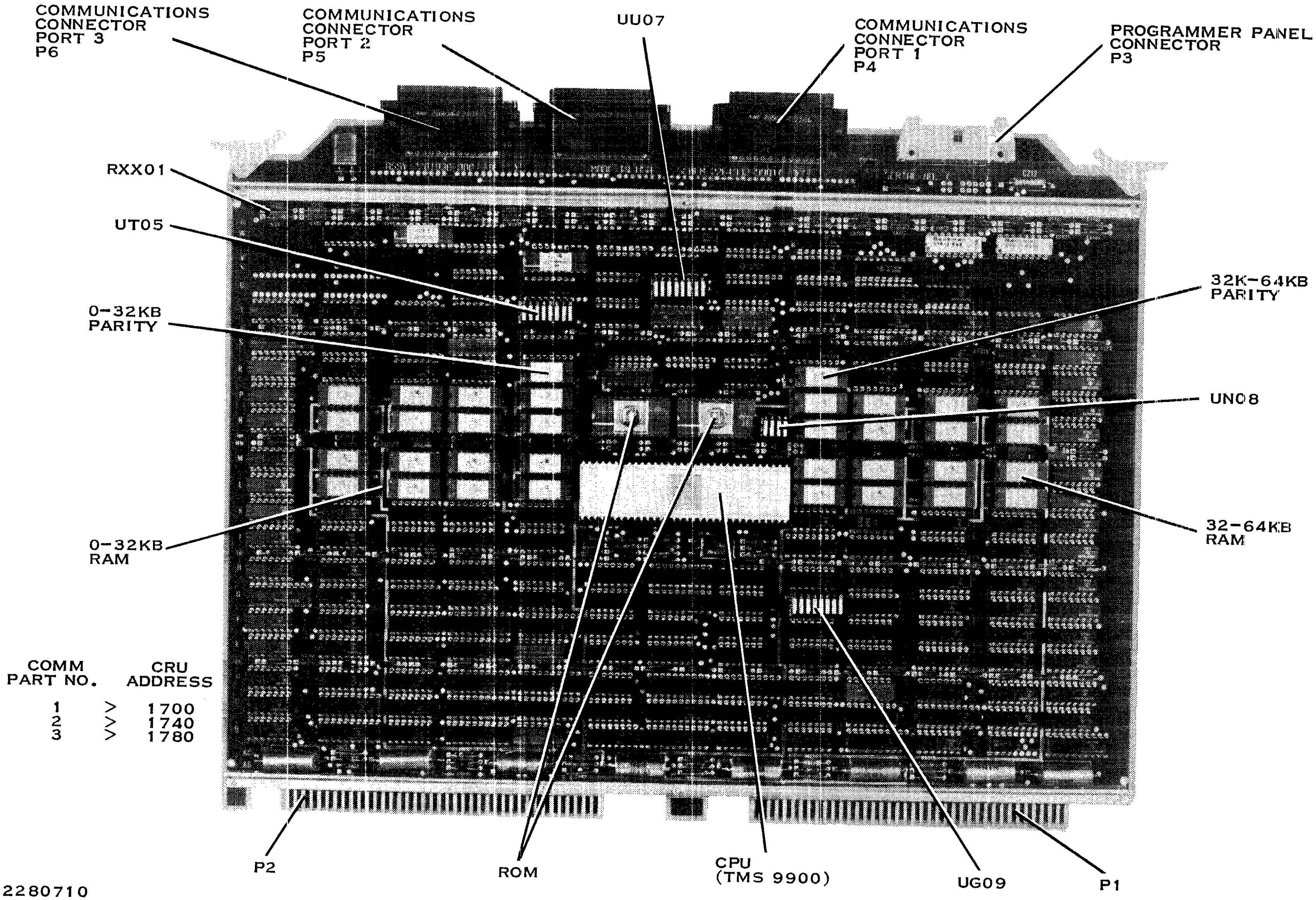
1.3 990/10 COMPUTER

The SMI/M (SMI with mapping option) circuit board for the 990/10 computer (part numbers 944930-0001 and 944950-0001) is shown in Figure 1-2.

1.3.1 ROM Loaders, 990/10 Computer

The standard DS990 ROM loaders for the SMI/M board, part number 944950, are as follows:

1. Kit, part number 945134-0014
    a. 975383-0029, Location: UJ21
    b. 975383-0030, Location: UH21



COMM PART NO.		CRU ADDRESS
1	>	1700
2	>	1740
3	>	1780

Figure 1-1. Model 990/5 Component Layout

   c. 975383-0031, Location: UF21
   d. 975383-0032, Location: UE21

2. Kit, part number 945134-0015 (includes TILINE FD1000)
   a. 975383-0037, Location: UJ21
   b. 975383-0038, Location: UH21
   c. 975383-0039, Location: UF21
   d. 975383-0040, Location: UE21
3. Kit, part number 945134-0019 (family loader ROMs)
   a. 975383-0047, Location: UJ21
   b. 975383-0048, Location: UH21
   c. 975383-0045, Location: UF21
   d. 975383-0046, Location: UE21

NOTE

For complete information on all loader ROMs (PWB and multiwire boards for all computers), refer to Section 3 of the OP — Operating Procedures section of this manual.

1.4 990/12 COMPUTER

The SMI board for the 990/12 computer, part number 2261975, is shown in Figure 1-3.

1.4.1 ROM Loaders, 990/12 Computer

The standard DS990 family ROM loaders for the 990/12 SMI board are as follows:

- 2262025-0001, Location: UG03
  2262025-0002, Location: UG02

- 2262025-0003, Location: UG03
  2262025-0004, Location: UG02

- 2262025-0005, Location: UG03
  2262025-0006, Location: UG02

- 2262025-0007, Location: UG03
  2262025-0008, Location: UG02

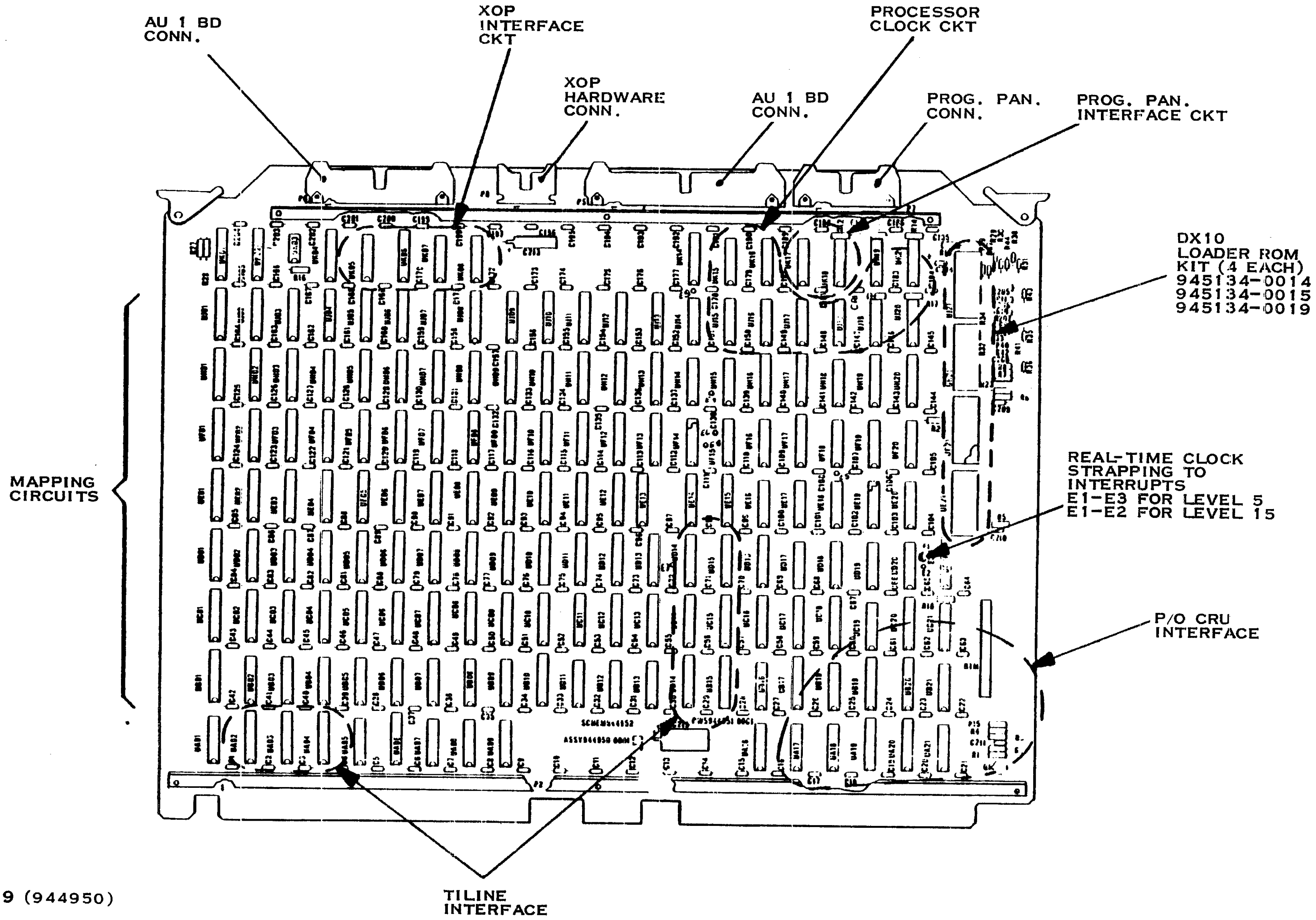


Figure 1-2. 990/10 SMI/M Interface Circuit Board

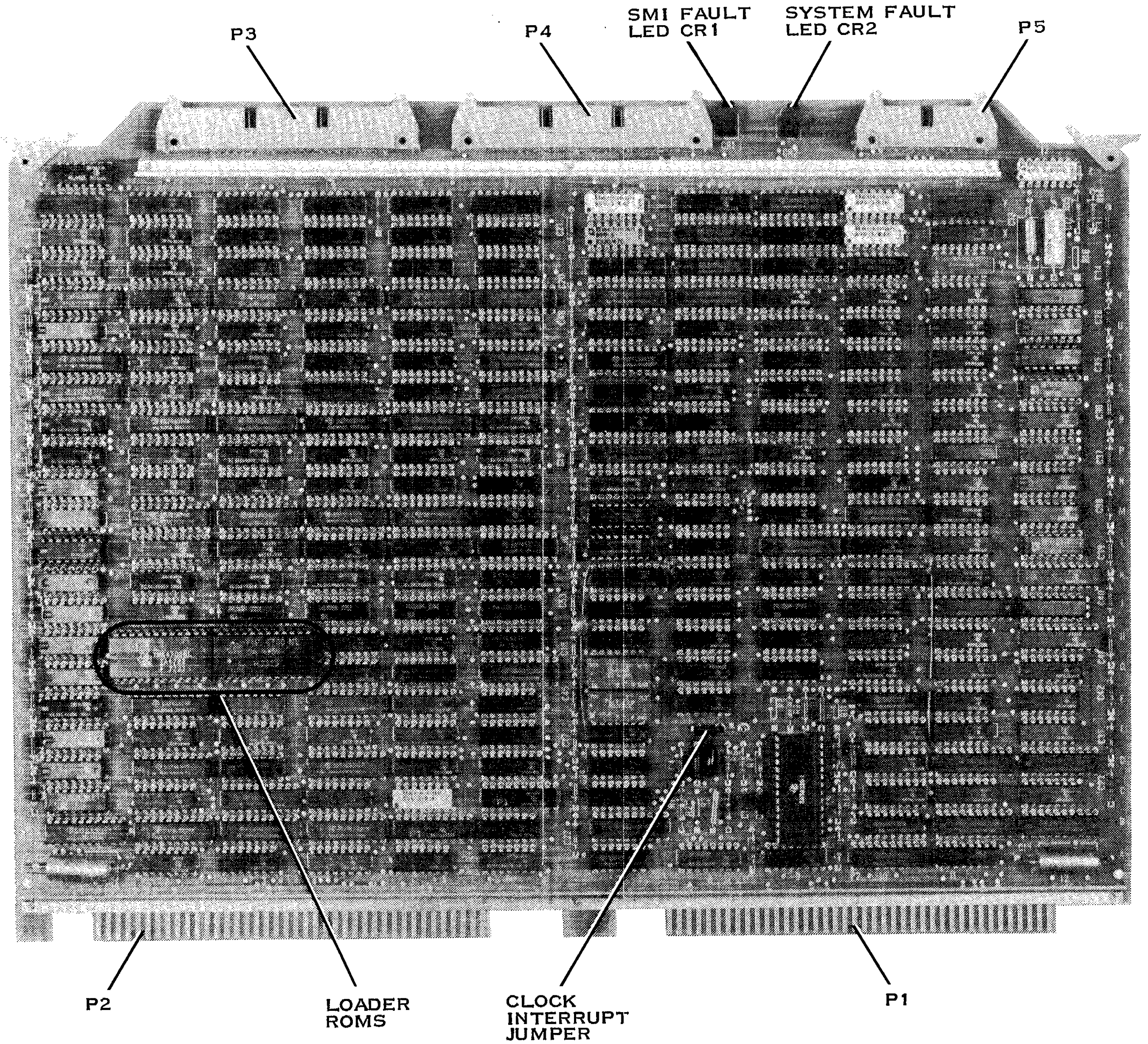


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Figure 1-3.   990/12 Computer SMI/M Board

1.5 FIELD-REPLACEABLE COMPONENTS, DS990 COMPUTERS

The field-replaceable components for the 990/5 computer, 990/10 computer and 990/12 computer are as follows:

990/5 Computer Field-Replaceable Components

990/5 Board with 32KB Memory	2261930-0001
990/5 Board with 64KB Memory	2261930-0002
ROM Loader Kit	2261949-0001
Motion/Cars ROM Loader Kit	0945110-0014
Holidex II ROM Loader Kit	2266614-0001
RTC ROM Loader Kit	2260867-0001
TMS 9903 IC, Synchronous Controller	2210243-0001
TMS 9902 IC, Asynchronous Controller	2210238-0001
16KB Dynamic RAM Chip (TMS 4116)	0996680-0001

990/10 Computer Field-Replaceable Components

990/10 SMI/M Board	0944950-0001
990/10 AU Board	0944930-0001
ROMs listed in paragraph 1.3.1	

990/12 Computer Field-Replaceable Components

990/12 SMI Board	2261975-0001
990/12 AU Board	2261970-0001
ROMs listed in paragraph 1.4.1	

2

Computer Memory Boards

2.1 GENERAL

This section of the manual describes the memory arrays and memory controllers used with the 990 family of computers. Included are processor memory allocations, memory error mapping, and selectable options on the memory boards.

All 990 computers have certain areas of memory reserved for specific functions. The reserved memory areas are the same for any model of the 990 family that has the functions implemented. All 990 computers will address only 64 kilobytes (64KB) without a memory mapping scheme that is available with 990/10 and 990/12 computers.

Figure 2-1 shows the processor memory allocation for the first 64KB of memory. The first 32 memory words are dedicated for interrupt trap vectors and include two words for each of the 16 interrupts of the computer. The first word in each interrupt trap is used to store the WP and the second word is used to store the PC, pointing to a software routine to be executed when an interrupt occurs (memory addresses >0 through >3E). Each time an interrupt occurs the AU causes the WP and PC to be loaded from a corresponding memory trap location assigned to the interrupt.

The second 32 memory words are dedicated for software XOP trap vectors. The first word in each trap is used to load the WP and the second is used to load the PC when an XOP occurs (memory addresses >40 through >7E), if the XOP at that level is not implemented in customer-supplied auxiliary equipment.

All standard loader ROMs use memory from >80 to >9E for workspace register space. General memory for program, data, and workspace registers reside between addresses >00A0 and >F7FE. Other general memory must be addressed by a memory mapping scheme. Addresses between >F800 and >FBFE are reserved for TILINE devices and CPU self-test functions. Addresses between >FC00 and >FFFE are reserved for ROM loader functions.

2.2 990/5 MEMORY

The 990/5 computer can address up to 64KB of memory. A memory word includes 16 bits plus a parity bit. The 990/5 CPU board may have either 32KB or 64KB of TMS 4116 dynamic RAM. Refer to Figure 2-1 for the memory RAM and ROM layout on the 990/5 CPU board.

The ROM for the 990/5 includes two TMS 4700 chips preprogrammed with self-test and loader software. One ROM contains eight upper-order bits and the other ROM contains the eight lower-order bits. Together they provide for storage of 1024 words of 16 bits, 512 words for self-test and 512 words of ROM loader programs. The ROM can be addressed only by the TMS 9900 processor and not via the TILINE.

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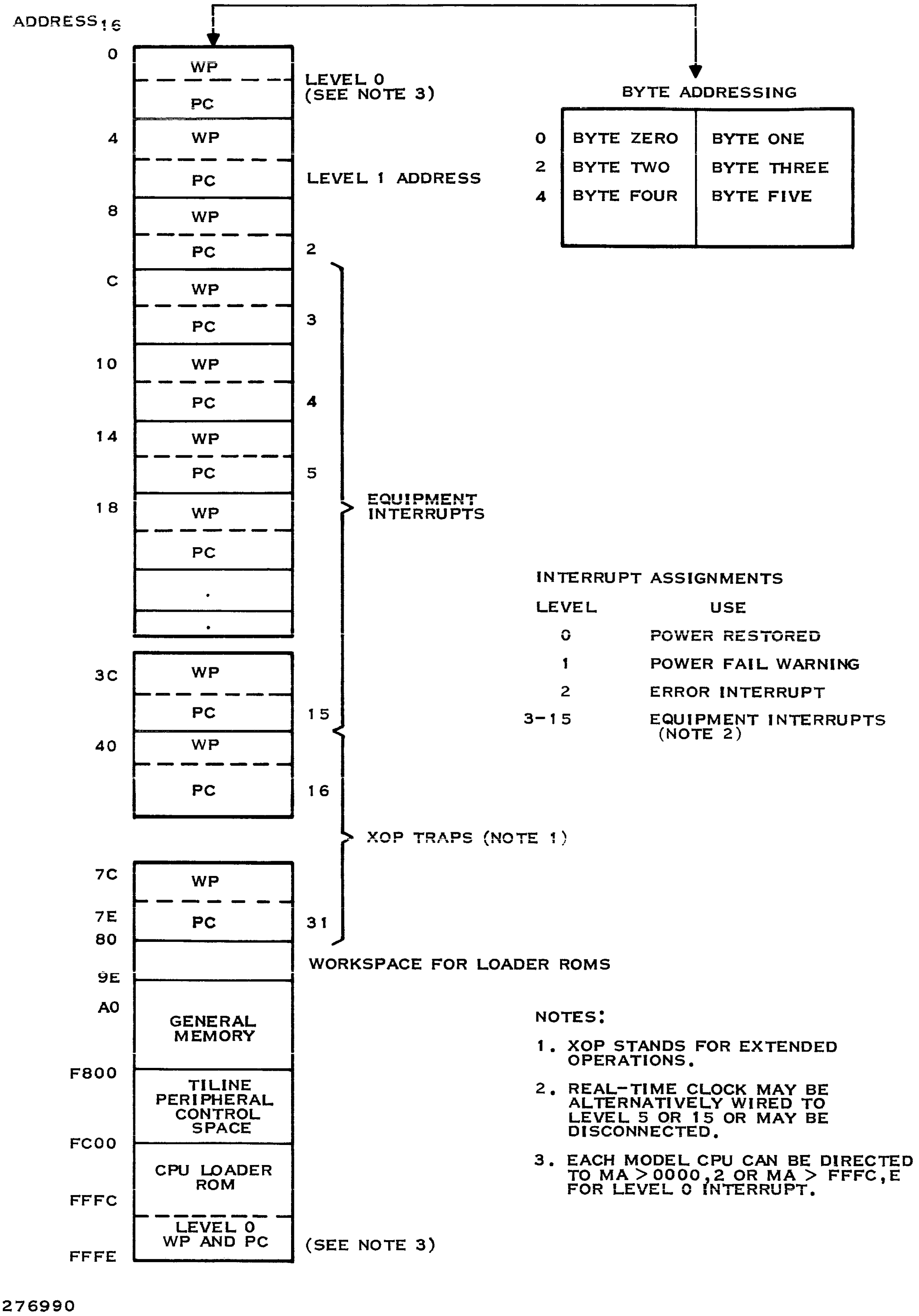

INTERRUPT ASSIGNMENTS

LEVEL	USE
0	POWER RESTORED
1	POWER FAIL WARNING
2	ERROR INTERRUPT
3-15	EQUIPMENT INTERRUPTS (NOTE 2)

NOTES:

1. XOP STANDS FOR EXTENDED OPERATIONS.
2. REAL-TIME CLOCK MAY BE ALTERNATIVELY WIRED TO LEVEL 5 OR 15 OR MAY BE DISCONNECTED.
3. EACH MODEL CPU CAN BE DIRECTED TO MA >0000,2 OR MA > FFFC,E FOR LEVEL 0 INTERRUPT.

Figure 2-1. 990 Processor Memory Map

The self-test function uses the TPCS addresses. This is controlled by executing a CRU set-bit-to-one (SBO) instruction at CRU address >17F8 that determines the state of Enable ROM at address >F800 (ENROMAF800). The self-test function is disabled and TPCS is enabled using the set-bit-to-zero (SBZ) instruction at location >17F8. The self-test function is always disabled when the 990/5 is in the run mode.

The 990/5 on-board memory may be accessed by external master controllers via the TILINE. The beginning TILINE address for the memory is set on an eight-position dual in-line package (DIP) switch on the 990/5 board. This sets the TILINE address for the memory and does not affect the fixed addresses (>7000 through >7FFE or >0000 through >FFFE) that the 990/5 processor uses to access RAM.

2.3 990 TILINE 4K-BIT RAM ECC MEMORY AND EXPANSION

The TILINE 4K-bit RAM, 16KB ECC memory controller consists of two rows of TMS 4060 dynamic RAM. Each row consists of 22 bits or devices, 16-bit words with 6 error correction bits. Figure 2-2 shows the layout of the 16KB ECC memory controller. This controller does not have the TPCS for diagnostic purposes such as the 96KB controller and cache controller have.

This controller has the capability of interfacing one add-on memory array board with a maximum of 48KB of TMS 4060 dynamic RAM memory. All of the interfacing is done through two top-edge connectors. The array board receives power only from the backpanel connectors. Figure 2-3 shows the layout of the 48KB memory array board.

The starting address is selected by the switches designated S1 on the controller, with switch one being the MSB. ECC Enable is a manual function that requires switches 1 and 2 of S2 to be in the on position.

There are two error LED indicators on the controller. The LED next to the ejector tab (CR5) indicates a one-bit correctable error when lit. The other LED (CR4) indicates a multiple-bit uncorrectable error when lit.

There are also two error LED indicators on the memory array board. The LED next to the ejector tab (CR6) indicates a multiple-bit uncorrectable error when lit. The other LED (CR7) indicates a one-bit correctable error.

2.4 990 TILINE 16K RAM 96KB ECC MEMORY CONTROLLER

2.4.1 General

The TILINE 96KB memory controller may have either 96KB or 64KB of 16K RAM memory installed. It also has six error-correction memory chips for each row of 16K RAM chips. The error-correction logic is turned on or off by software. Figure 2-4 shows the layout of the 96KB memory controller board.

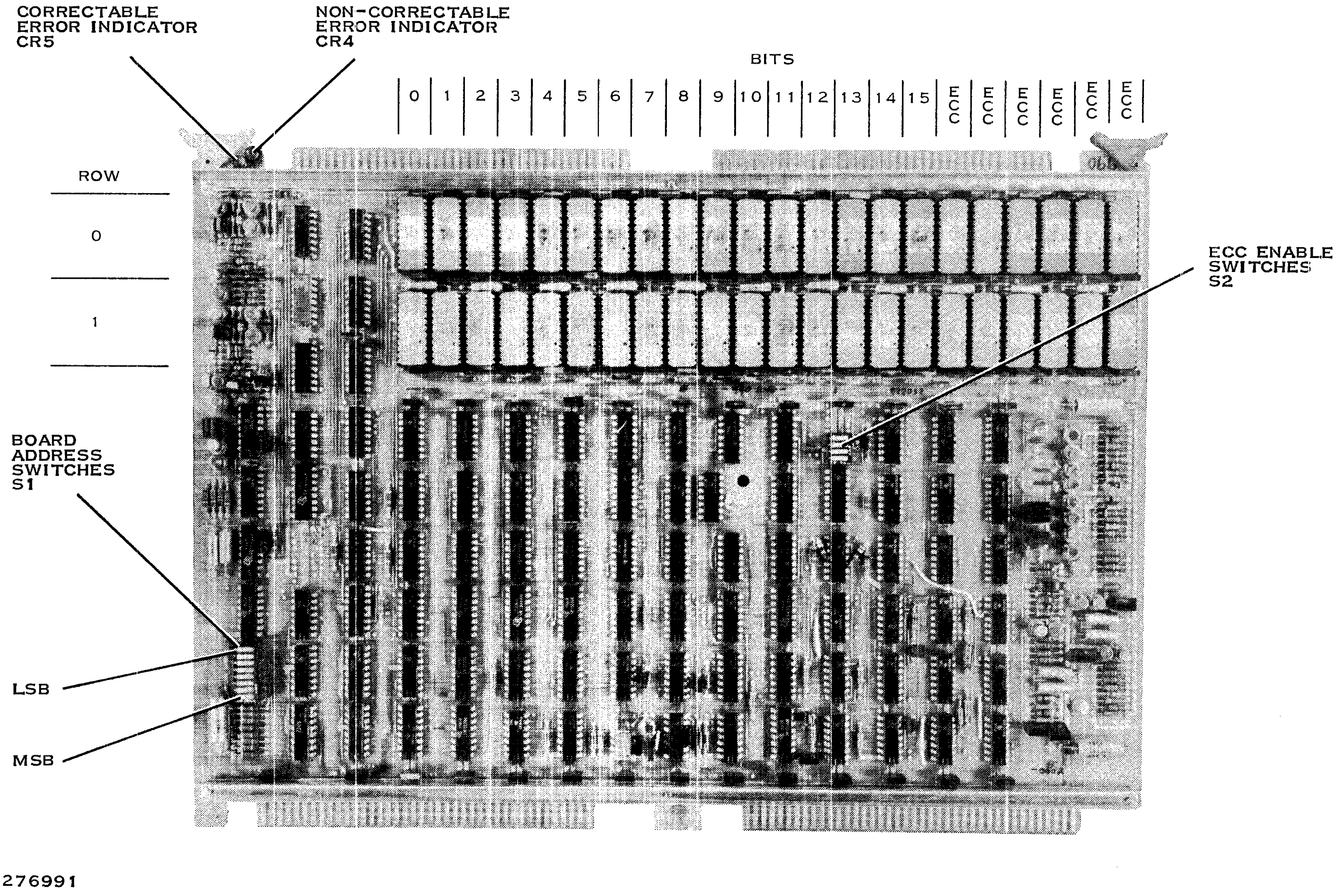

Figure 2-2. 16KB ECC Controller

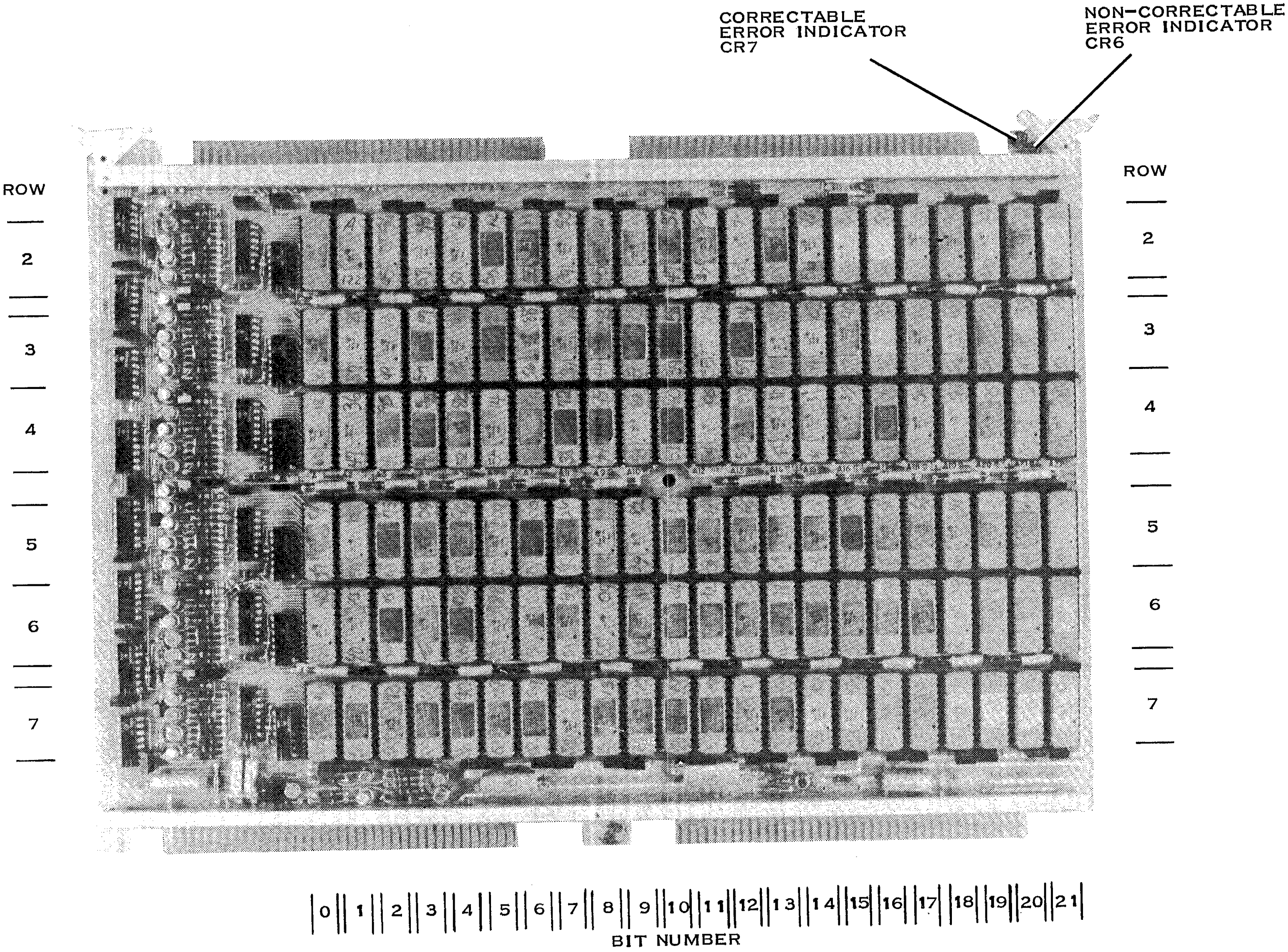

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Figure 2-3. 48KB ECC Memory Array Board

2.4.2 96KB Memory Controller Failure and Error Indicators

The controller includes two LED error indicators, 11 LED chip failure indicators, and two DIP switches. The one-bit correctable error LED CR2 will stay lit when a correctable error has been detected. The multibit LED CR1 (nearest to the ejector tab) will stay lit when an uncorrectable memory error has been detected. The 11 LED chip failure indicators are divided into two groups and pinpoint the memory chip that caused the first single-bit error. A group of five indicators form a binary code that identifies the bit that failed. The remaining six LEDs form a binary code that identifies the row that contains the failing chip. A bit pattern on the row and bit LEDs will remain lit indicating the first single-bit error encountered. The bad chip may be replaced with respect to this bit pattern code.

Table 2-1 shows this code converted to decimal and hexadecimal. All LED indicators will be turned off when a reset occurs.

2.4.3 96KB Memory Controller TILINE Address and TPCS Switches

The memory controller interfaces with the TILINE and decodes controller addresses, and reads or writes data to all memory locations on the controller and arrays attached to it. The controller does not decode the array addresses, but receives a select signal from the array when it is addressed. The TILINE address switches shown in Figure 2-4 select the first address of the controller. Refer to Table 2-2 for address switch positions. The switch location is C07 on the controller board.

The TPCS address switches shown in Figure 2-4 set the first address of the TPCS. This address is used for diagnostic mode operation. The switch location is B09 on the controller board. The switch selections for three controllers are as follows:

Controller Number	Address (Hexadecimal)	Switch Selections (B09)
1	FB00	1 and 2 ON
2	FB04	1, 2, and 8 ON
3	FB08	1, 2, and 7 ON

Table 2-1. ECC Memory Error Bit Map

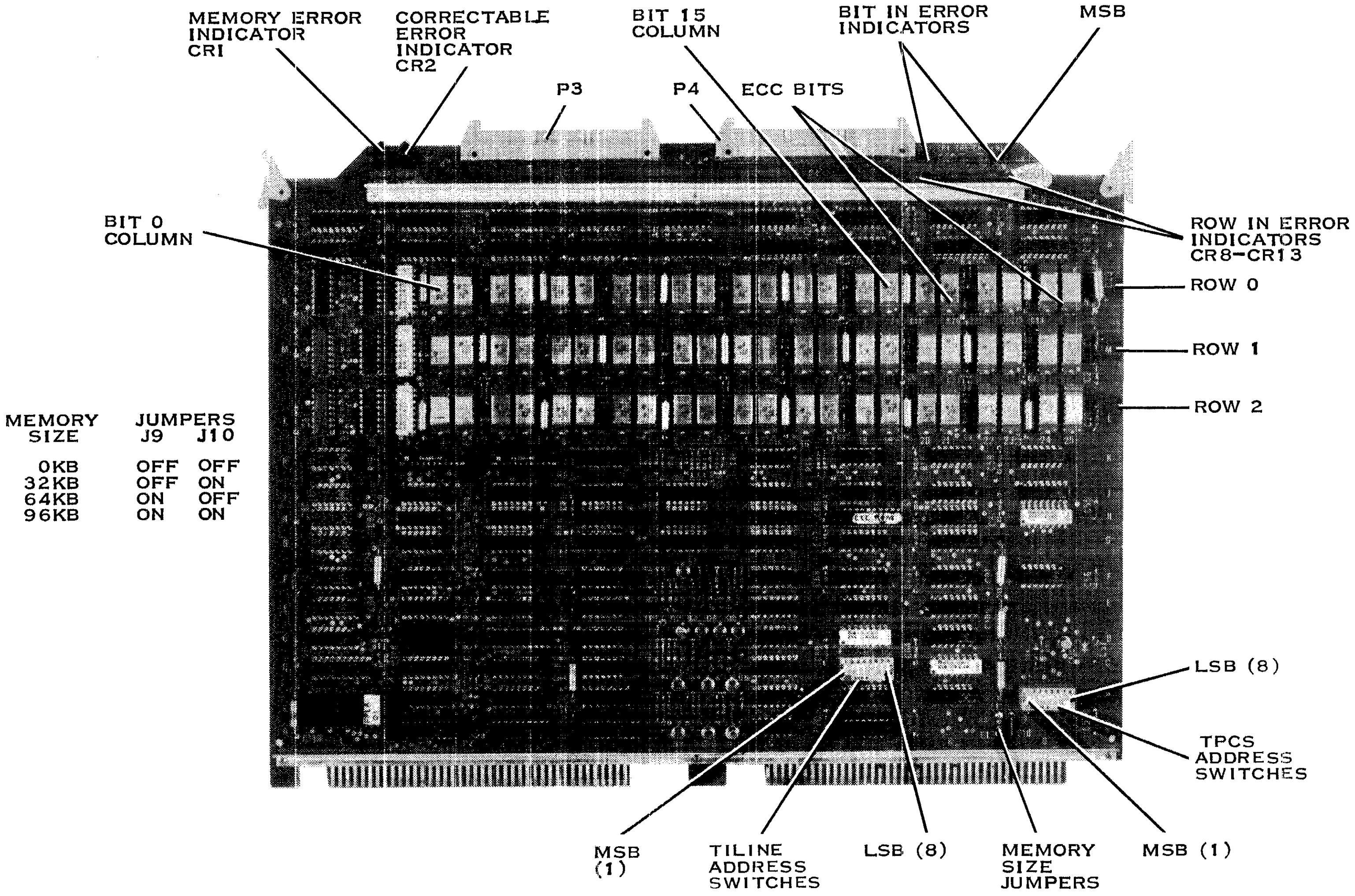
Binary Equivalent In		Row in Error (Binary)						Bit in Error (Binary)				
DEC	HEX	MSB					LSB	MSB				LSB
00	00	0	0	0	0	0	0	0	0	0	0	0
01	01	0	0	0	0	0	1	0	0	0	0	1
02	02	0	0	0	0	1	0	0	0	0	1	0
03	03	0	0	0	0	1	1	0	0	0	1	1
04	04	0	0	0	1	0	0	0	0	1	0	0
05	05	0	0	0	1	0	1	0	0	1	0	1
06	06	0	0	0	1	1	0	0	0	1	1	0
07	07	0	0	0	1	1	1	0	0	1	1	1
08	08	0	0	1	0	0	0	0	1	0	0	0
09	09	0	0	1	0	0	1	0	1	0	0	1
10	0A	0	0	1	0	1	0	0	1	0	1	0
11	0B	0	0	1	0	1	1	0	1	0	1	1
12	0C	0	0	1	1	0	0	0	1	1	0	0
13	0D	0	0	1	1	0	1	0	1	1	0	1
14	0E	0	0	1	1	1	0	0	1	1	1	0
15	0F	0	0	1	1	1	1	0	1	1	1	1
16	10	0	1	0	0	0	0	1	0	0	0	0
17	11	0	1	0	0	0	1	1	0	0	0	1
18	12	0	1	0	0	1	0	1	0	0	1	0
19	13	0	1	0	0	1	1	1	0	0	1	1
20	14	0	1	0	1	0	0	1	0	1	0	0
21	15	0	1	0	1	0	1	1	0	1	0	1
22	16	0	1	0	1	1	0					
23	17	0	1	0	1	1	1					
24	18	0	1	1	0	0	0					
25	19	0	1	1	0	0	1					
26	1A	0	1	1	0	1	0					
27	1B	0	1	1	0	1	1					
28	1C	0	1	1	1	0	0					
29	1D	0	1	1	1	0	1					
30	1E	0	1	1	1	1	0					
31	1F	0	1	1	1	1	1					
32	20	1	0	0	0	0	0					
33	21	1	0	0	0	0	1					
34	22	1	0	0	0	1	0					

Notes:

1. Row and bit in error, LED ON = 1. When an operating system is running, these LEDs may be blinking. When an error is detected, they will latch and remain latched (will not change) indicating the row and bit error until reset by an I/O reset.

2. Memory error, LED ON = 1 (more than one bad bit in the row that is uncorrectable). When this LED is ON, the problem may be more than a memory chip. It may be a bad driver or other problem with the board. (The row and bit LED information is not valid for this error condition).

3. Correctable memory error, LED ON = 1 (one bit correctable). The bad chip should be replaced to correct the problem.



MEMORY SIZE	JUMPERS J9	J10
0KB	OFF	OFF
32KB	OFF	ON
64KB	ON	OFF
96KB	ON	ON

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Figure 2-4. 96KB Memory Controller Components Layout

Table 2-2. Address Switch Positions

4K/16K RAM Slot/Size Addressing
the Switch Addresses in 4K Increments

Previous Qty Rows (4K Chip)	Previous Qty Rows (16K Chip)	Previous K Words	0 = OFF, 1 = ON Switch S1/C07/U601 Address								
			1	2	3	4	5	6	7	8	(Kilobytes)
0	0	0	0	0	0	0	0	0	0	0	0
4	1	16	0	0	0	0	0	1	0	0	32
8	2	32	0	0	0	0	1	0	0	0	64
12	3	48	0	0	0	0	1	1	0	0	96
16	4	64	0	0	0	1	0	0	0	0	128
20	5	80	0	0	0	1	0	1	0	0	160
24	6	96	0	0	0	1	1	0	0	0	192
28	7	112	0	0	0	1	1	1	0	0	224
32	8	128	0	0	1	0	0	0	0	0	256
36	9	144	0	0	1	0	0	1	0	0	288
40	10	160	0	0	1	0	1	0	0	0	320
44	11	176	0	0	1	0	1	1	0	0	352
48	12	192	0	0	1	1	0	0	0	0	384
52	13	208	0	0	1	1	0	1	0	0	416
56	14	224	0	0	1	1	1	0	0	0	448
60	15	240	0	0	1	1	1	1	0	0	480
64	16	256	0	1	0	0	0	0	0	0	512
68	17	272	0	1	0	0	0	1	0	0	544
72	18	288	0	1	0	0	1	0	0	0	576
76	19	304	0	1	0	0	1	1	0	0	608
80	20	320	0	1	0	1	0	0	0	0	640
84	21	336	0	1	0	1	0	1	0	0	672
88	22	352	0	1	0	1	1	0	0	0	704
92	23	368	0	1	0	1	1	1	0	0	736
96	24	384	0	1	1	0	0	0	0	0	768
100	25	400	0	1	1	0	0	1	0	0	800
104	26	416	0	1	1	0	1	0	0	0	832
108	27	432	0	1	1	0	1	1	0	0	864

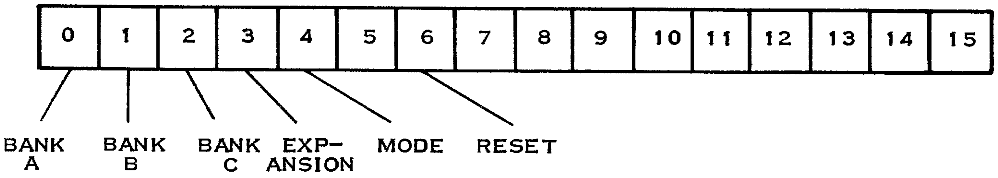
Note:

This table applies to:
8K ECC controller, part number 946655
16KR ECC controller, part number 2261980
128K Add-on memory, part number 948955

2.4.4 Software Diagnostic Features

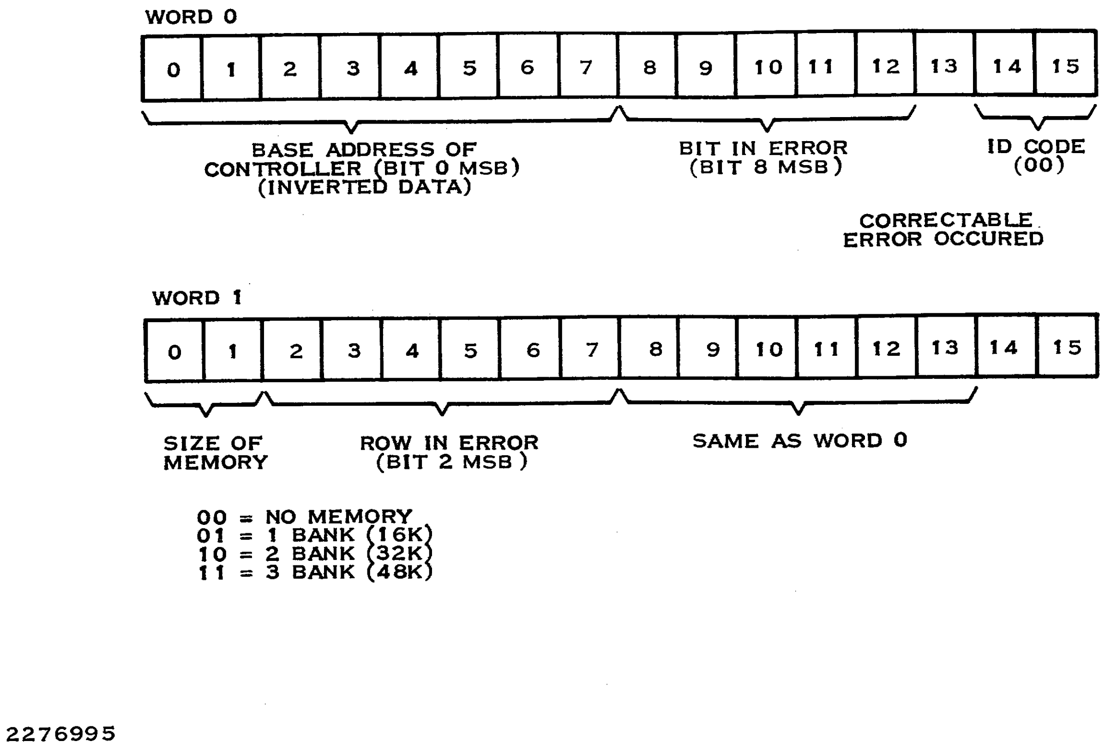
The memory controller may be placed in a diagnostic mode under program control through TPCS. The diagnostic mode is controlled by the data word written into the TPCS address. Information from the controller is obtained by a memory read operation from the same TPCS address. Each controller contains two contiguous TPCS address words.

The output bit assignments for a word written into the TPCS are as follows:



- Bit 0 — When set to one, this bit modifies access to Bank A. Bank A consists of addresses from the base address to the base address plus 16K. The mode is determined by bit 4.
- Bit 1 — When set to one, this bit modifies access to Bank B. (Base address plus 16K to base address plus 32K.)
- Bit 2 — When set to one, this bit modifies access to Bank C. (Base address plus 32K to base address plus 48K.)
- Bit 3 — When set to one, this bit modifies access to all expansion memory attached to this controller.
- Bit 4 — When set to zero, this bit disables error detection and correction in the banks selected by bits 0 to 3. When set to one, this bit swaps the most significant data bits with the error correction bits in banks selected by bits 0 to 3.
- Bit 7 — When set to one, this bit clears the error latches and error LEDs. This bit must be set to zero to reenable the error latches and LEDs.

The input bit assignments for a word read from the TPCS are as follows:



2.5 990 TILINE 16K RAM ECC CACHE MEMORY CONTROLLER

2.5.1 General

The TILINE cache memory controller contains all memory logic as well as the storage elements for 64KB of primary memory and 2KB of cache memory. The cache controller circuits, including the ECC circuits, are implemented in the lower half of the board as shown in Figure 2-5. The 64KB of on-board primary memory consist of two rows of TMS 4116 devices across the top of the board. Each row includes the 22 devices required for the storage of 16 data bits and 6 error correction bits. The 2KB of cache memory consists of two banks of memory devices grouped in the center of the lower edge of the board. Each bank includes the 14 devices required for the storage of 16 data bits, two data parity bits, one data error bit, 11 address bits, two address parity bits, and one validity bit. The error correction circuits can be turned on and off by software.

The cache controller includes three LED error indicators, 11 LED chip failure indicators, and one LED HIT indicator. The three error-indicating LEDs are dedicated to the following functions:

- To indicate that a single-bit, correctable primary memory error has been detected and corrected (CERR).
- To indicate that a multibit, uncorrectable primary memory error has been detected and placed on the data bus unmodified (MERR).
- To indicate that a parity error has occurred in either the cache data or the cache data address. No change is made to the data when this type of error occurs (CAER).

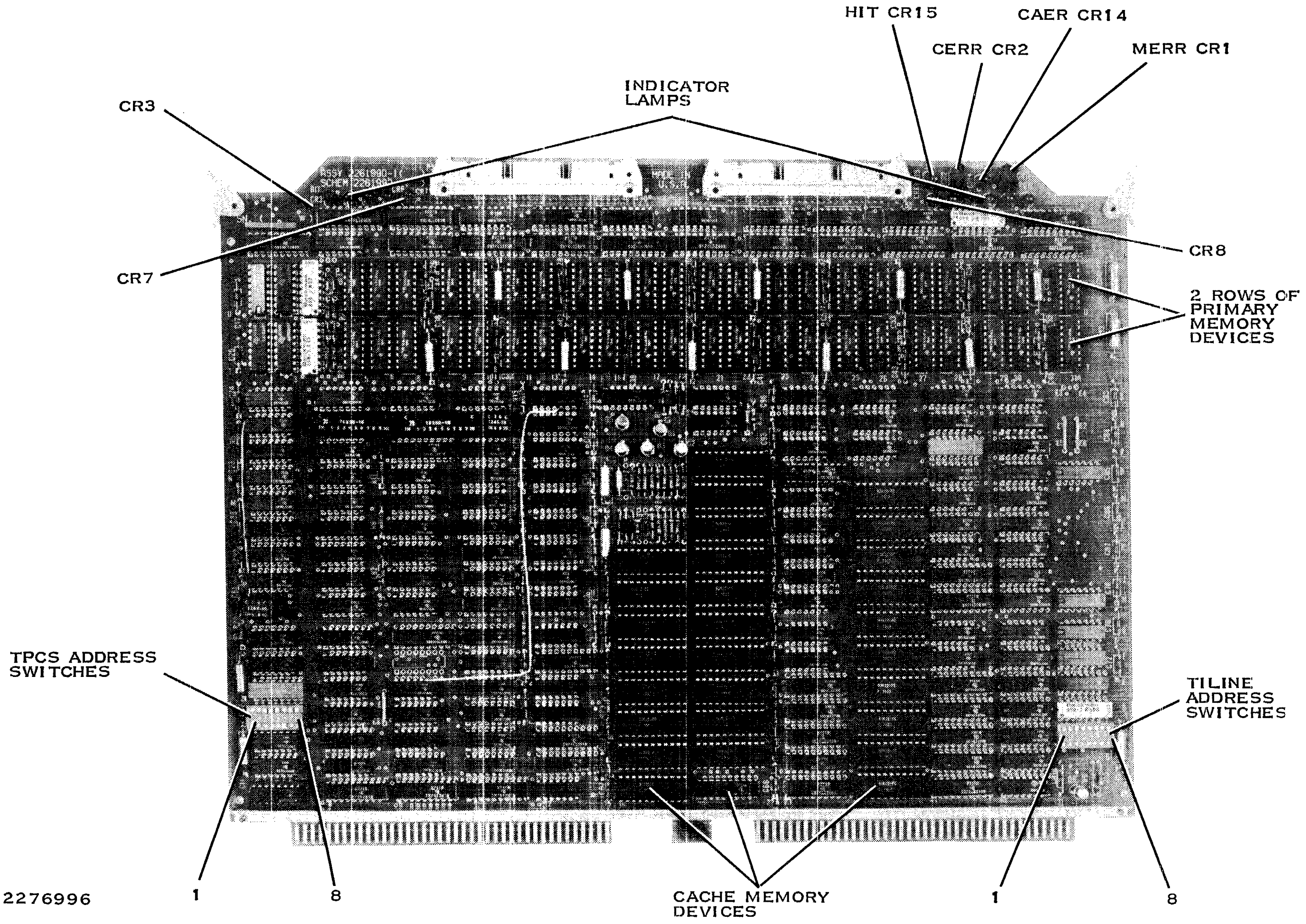


Figure 2-5. Cache Controller

The 11 LED chip failure indicators pinpoint the memory chip that caused the first single-bit error and are divided into two groups as shown in Figure 2-6. A group of five indicators form a binary code that identifies the bit that failed. The remaining six LEDs form a binary code that identifies the row that contains the failing chip. A bit pattern will remain lit on the row and bit LEDs that will indicate the first single-bit error encountered, and the bad chip may be located and replaced using this code. Table 2-1 shows this binary code converted to decimal and hexadecimal. All LED indicators will be turned off when a reset occurs.

The HIT indicator lights whenever the addressed word in a memory read or write operation resides in cache memory.

The cache memory controller board interfaces with the TILINE and decodes controller addresses, and reads or writes data to all memory locations on the controller and arrays attached to it. It does not decode the array addresses, but receives a select signal from it when the array is addressed.

The TILINE address switches shown in Figure 2-5 select the first address of the controller. Refer to Table 2-2 for address switch positions. Operation of these address switches is identical to that of the 96KB memory controller. The required switch settings for the cache controller are the same as those for the 96KB memory controller.

The TPCS switches shown in Figure 2-5 set the first address of the TPCS. This address is used to operate the controller in the diagnostic mode and is used by DX10 release 3.3 and later to log single-bit error locations. Switch 1 is the MSB of the address, and switch 8 is the LSB. The recommended TPCS addresses for cache controllers are as follows:

Controller Number	CPU Address (Hexadecimal)	TILINE Address (Hexadecimal)	Switch Positions (D01)
1	FB10	FFD88	1, 2, and 6 ON
2	FB14	FFD8A	1, 2, 6, and 8 ON
3	FB18	FFD8C	1, 2, 6, and 7 ON

2.5.2 Software Diagnostic Features

The memory controller may be placed in a diagnostic mode under program control through the TPCS. The diagnostic mode is controlled by the data word written into the TPCS address (Figure 2-7). Information from the controller is obtained by a memory read operation from the same TPCS address (Figure 2-8). Each controller contains two contiguous TPCS address words.

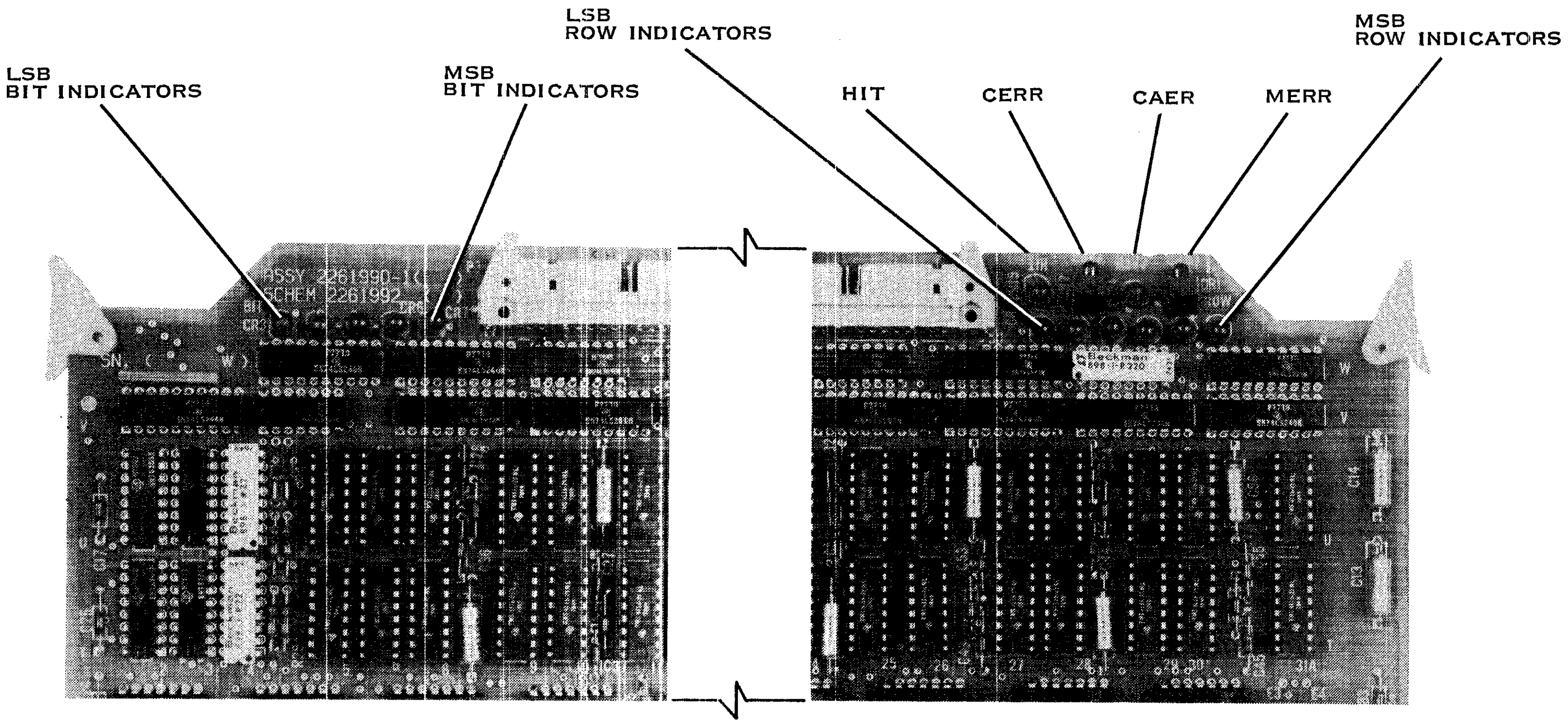


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Figure 2-6. Cache Controller Indicators

CACHE CONTROLLER TPCS WRITE WORD

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

BIT	MEANING
0	FIRST 64K BYTES PRIMARY MEMORY TEST
1-2	UNUSED
3	EXPANSION MEMORY TEST
4	MODE
5	LRU INPUT
6	LRU TEST ENABLE
7	CLEAR
8	UNUSED
9	CACHE DISABLE
10	CACHE INITIALIZE
11	SEGMENT CACHE
12	CACHE ABORT DISABLE
13-15	UNUSED

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Figure 2-7. TPCS Output Word

CACHE MEMORY DIAGNOSTIC WORD 0

WORD 0

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

BIT	MEANING
0-7	BASE ADDRESS OF CONTROLLER
8	MODE BIT
9	CACHE ENABLED
10	CACHE SEGMENTED
11	LRU TEST DISABLED
12	CACHE ERROR OCCURRED
13	CORRECTABLE ERROR OCCURRED
14-15	ID CODE (01) FOR CACHE CONTROLLER

CACHE MEMORY DIAGNOSTIC WORD 1

WORD 1

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

BIT	MEANING
0	UNASSIGNED
1	BANK B ADDRESS HIT
2-7	ROW IN ERROR
8-12	BIT IN ERROR
13	BANK A PARITY OK
14	BANK B PARITY OK
15	EVEN WORD SELECTED

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Figure 2-8. TPCS Input Word

2.6 256KB ADD-ON MEMORY ARRAY

The 256KB add-on memory array board contains the storage elements, address decoding logic, and control and data buffers for up to 256KB of MOS RAM. The board is used in conjunction with the 96KB memory controller or the cache controller to provide high-density main memory for the 990/10 and 990/12 computers. Up to four of the 256KB add-on memory array boards may be under the control of one memory controller. The 256KB add-on memory array board interface to the TILINE consists of TILINE address lines and power lines and is made through two 80-pin connectors at the bottom edge of the board that installs in the computer chassis. Two 50-pin connectors at the top edge of the board provide the data path and control signals interface to the 96KB memory controller or cache controller.

As shown in Figure 2-9, the address decoding logic and control and data buffers for the 256KB add-on memory array board are implemented in a TTL device located on one side of the board. The eight rows (or four banks) of the TMS 4116 MOS memory devices extend across the rest of the board, with row and bank designations as shown in Figure 2-9.

Also installed on the board are two LED error indicators and the DIP switch used to set the starting address of the board. The two error-indicating LEDs indicate that a one-bit (correctable) error or a multibit (uncorrectable) error has occurred on this board. These indicators are set on the first occurrence of the respective error stimulant and remain set until the system is powered down or until an I/O Reset instruction is issued.

The DIP switch consists of eight single-pole, single-throw switches. These address switches correspond to the eight MSBs of the 20-bit TILINE address and permit board starting address selection in 8KB increments. Switch 1 is the MSB of the address, and switch 8 is the LSB. To set the starting address for the 256KB add-on board, use the switch settings provided for the 96KB memory controller (Table 2-2). The memory capacity may be set in increments of from one to four banks of memory. Since each bank of memory represents 64KB of memory, the memory capacity available is either 64KB, 128KB, 192KB, or 256KB. Memory size is set by connecting jumpers across the terminals of E9 and E10.

In the case of a single-bit error on the array board, the 11 chip failure LEDs on the controller board for the array will pinpoint the chip that caused the error by giving row and bit information. The decoding of these LEDs is described in paragraph 2.4.2 for the 96KB controller and paragraph 2.5.1 for the cache controller. The array boards are extensions of the controller board so that the row count starts on the controller board and continues through the array boards connected to the controller. The row count would start on row 0 on the controller and continue to a maximum of row 34 on the last array board.

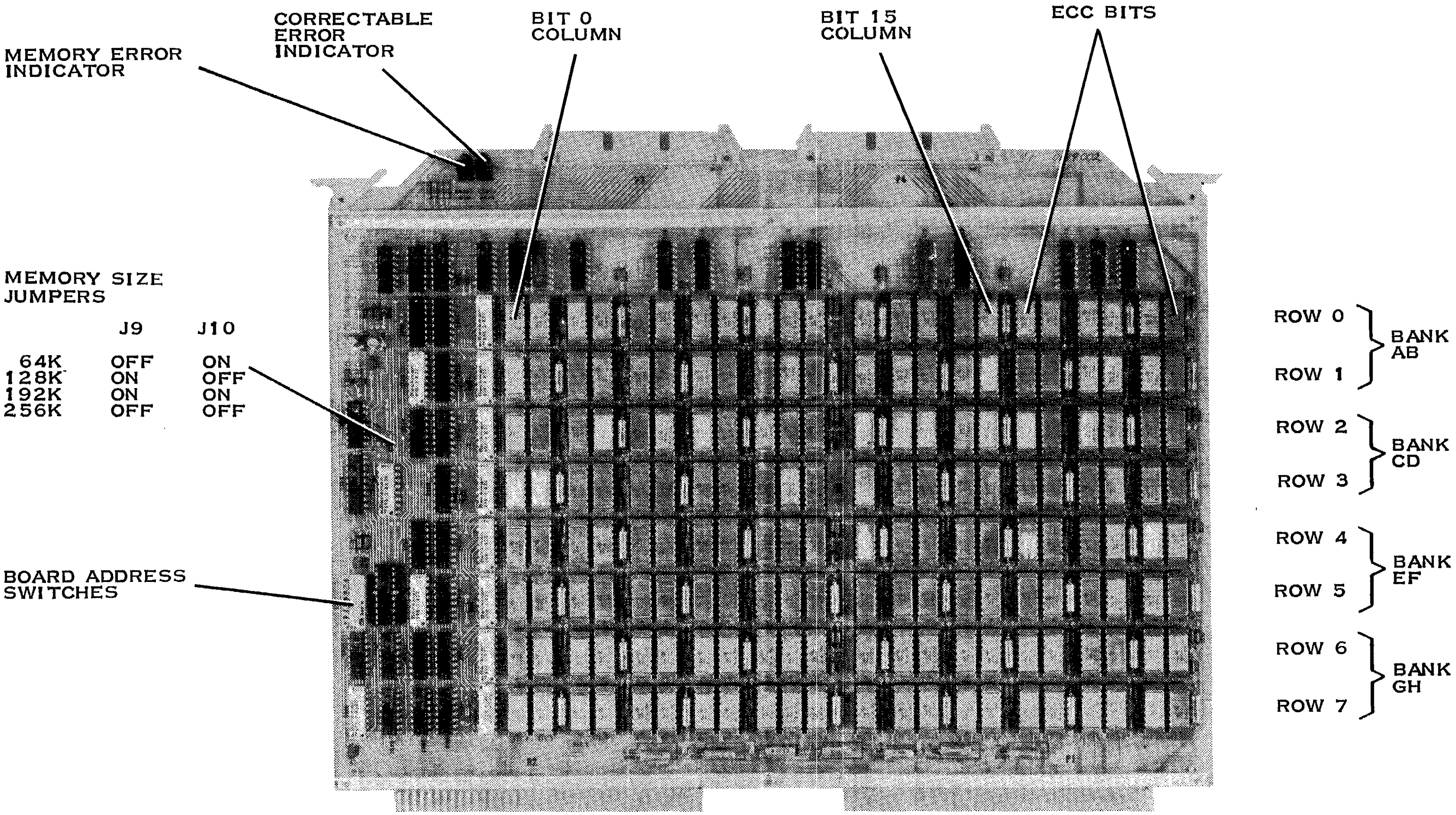

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Figure 2-9. 256KB Add-On Memory Array Board Components Locations

2.7 FIELD-REPLACEABLE COMPONENTS FOR COMPUTER MEMORY BOARDS

The field-replaceable components for 990 memories are as follows:

Item	TI Part Number
990/5 Memory	
16K RAM Chip TMS 4116	0996680-0001
ROM TMS 4700	2261949-0007
ROM TMS 4700	2261949-0008
16KB Memory Controller	
4K RAM ECC Controller	0946655-0002
4K RAM 16KB Array	0975155-0002
4K RAM 32KB Array	0975155-0004
4K RAM 48KB Array	0975155-0006
4K RAM Chip TMS 4060	0974679-0001
96KB Memory Controller	
16K RAM ECC MC with 64KB	2261980-0003
16K RAM ECC MC with 96KB	2261980-0004
16K RAM Chip TMS 4116	0996680-0001
Cache Memory Controller	
Cache Memory Controller	2261990-0001
16K RAM Chip TMS 4116	0996680-0001
16K RAM ECC Memory Array	
16K RAM ECC Array 64KB	0948955-0001
16K RAM ECC Array 128KB	0948955-0002
16K RAM ECC Array 192KB	0948955-0003
16K RAM ECC Array 256KB	0948955-0004
16K RAM Chip TMS 4116	0996680-0001

Contents

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CC — Computer Chassis

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5 — 17-Slot Computer Chassis

6 — CRU Expansion Chassis

7 — TILINE Expansion Chassis

Illustrations

Figure **Title** **Page**

CC — Computer Chassis

Tables

1

6-Slot 990/5 and 990/10 Computer Chassis

1.1 GENERAL

This section shows the configurations for the 6-slot computer chassis used with the following:

- 6-slot 990/5 computer chassis used with the DS990 Model 2 system
- 6-slot 990/10 computer chassis used with the DS990 Model 3 system

1.2 6-SLOT 990/5 COMPUTER CHASSIS

The 6-slot 990/5 computer chassis configuration for the DS990 Model 2 system is shown in Table 1-1.

Table 1-1. 6-Slot 990/5 Computer Chassis Configuration

P1 (CHASSIS FRONT)					P2 (CHASSIS REAR)				
SLOT	CRU ADDRESS	TL ADD	DEVICE	INTERRUPT LEVEL	CRU ADDRESS	TL ADD	DEVICE	INTERRUPT LEVEL	NOTES
1	N/A		990/5	N/A	N/A		990/5	N/A	
2	0120		SPARE	3	0100		SPARE	4	1
3	00E0		911 # 2	11	00C0		911 # 1	11	
4	00A0	F800	FD1000	7	0080	F800	FD1000	7	2
5	0060		SPARE	9	0040		SPARE	9	1
6	0020		SPARE	12	0000		SPARE	13	1

NOTES:

1. FULL-SIZE OR HALF-SIZE BOARDS MAY OCCUPY SLOTS 2,5 AND 6.
2. WHERE A TILINE MASTER DEVICE IS USED, TILINE ACCESS GRANTED (TLAG) JUMPER MUST BE REMOVED.

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1.2.1 990/5 Update to Support Synchronous Communications

Updating the 990/5 (part number 2261930-0002) to support synchronous communications requires replacing the loader ROMs and installing a TMS 9903 in the empty socket at location UV05. The part number of the update kit is 2261949-0001. The part numbers for each device are as follows:

- 2261929-0003 ROM, loader with self-test, standard #1, with TMS 9903, location UNP07.
- 2261929-0004 ROM, loader with self-test, standard #2, with TMS 9903, location UNP06.
- 2210243-0001 IC, synchronous receiver/transmitter, 4 MHz, TMS 9903-40.

CAUTION

Proper Orientation of IC devices is essential. If they are installed backwards and power is applied, they may be destroyed.

1.2.1.1 Testing the Modified 990/5. Install the 990/5 and power up the chassis. Execute the LOAD function of the computer and verify that the self-test passes. Load the AU05 diagnostic and verify that it passes. The last part of the diagnostic tests the TMS 9903-40.

1.3 6-Slot 990/10 COMPUTER CHASSIS

The 6-slot 990/10 computer chassis configuration for the DS990 Model 3 system is shown in table 1-2.

Table 1-2. 6-Slot 990/10 Computer Chassis Configuration

P1 (CHASSIS FRONT)					P2 (CHASSIS REAR)			
SLOT	CRU ADDRESS	TL ADD	DEVICE	INTERRUPT LEVEL	CRU ADDRESS	TL ADD	DEVICE	INTERRUPT LEVEL
1	N/A		990/10 SMI	N/A	N/A		990/10 SMI	N/A
2	0120		990/10 AU	8	0100		990/10 AU	10
3	00E0		911 NO. 2	12	00C0		911 NO. 1	11
4	00A0	F800	SYSTEM DISK	9	0080	F800	SYSTEM DISK	13
5	0060		PRINTER	14	0040		COMM IF	4
6	0020	FB00	MEMORY CONT	15	0000	FB00	MEMORY CONT	6

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1.3.1 Interrupts, 6-Slot Chassis

Location of the interrupt jumper plugs for the 6-slot chassis is shown in Figure 1-1. Installation of the jumpers in the plugs is shown in Figure 1-2.

1.3.2 TLAG Jumpers, 6-Slot Chassis

Locations of the TLAG jumpers for the 6-slot chassis are shown in Figure 1-3.

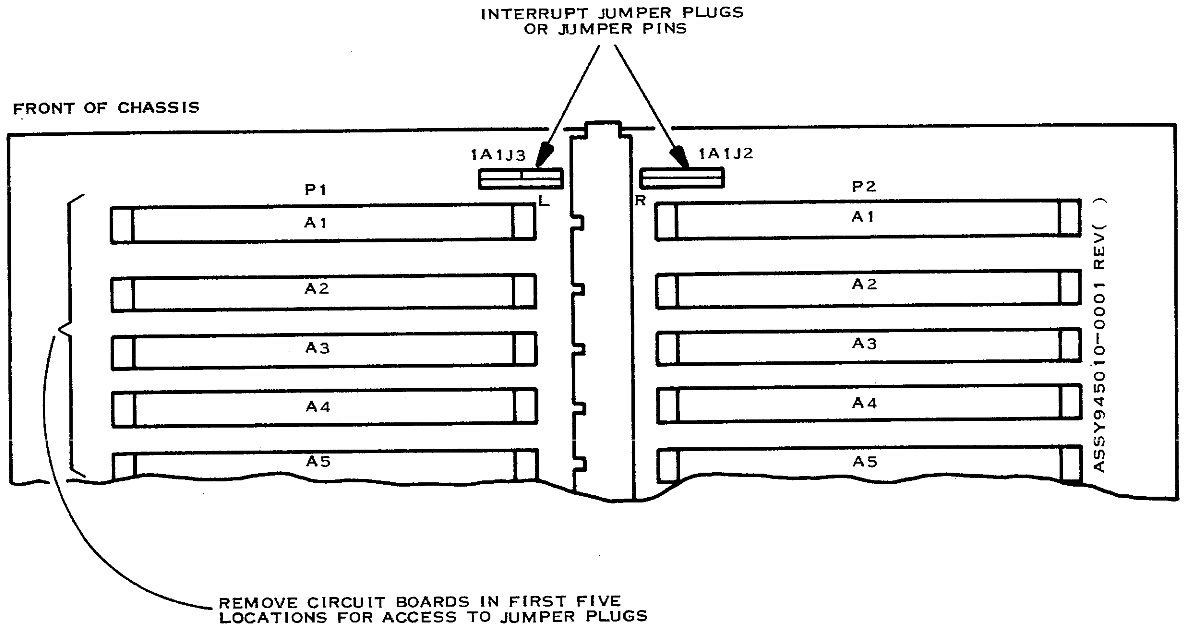

Figure 1-1. Location of Interrupt Jumpers, 6-Slot Chassis

CC — Computer Chassis

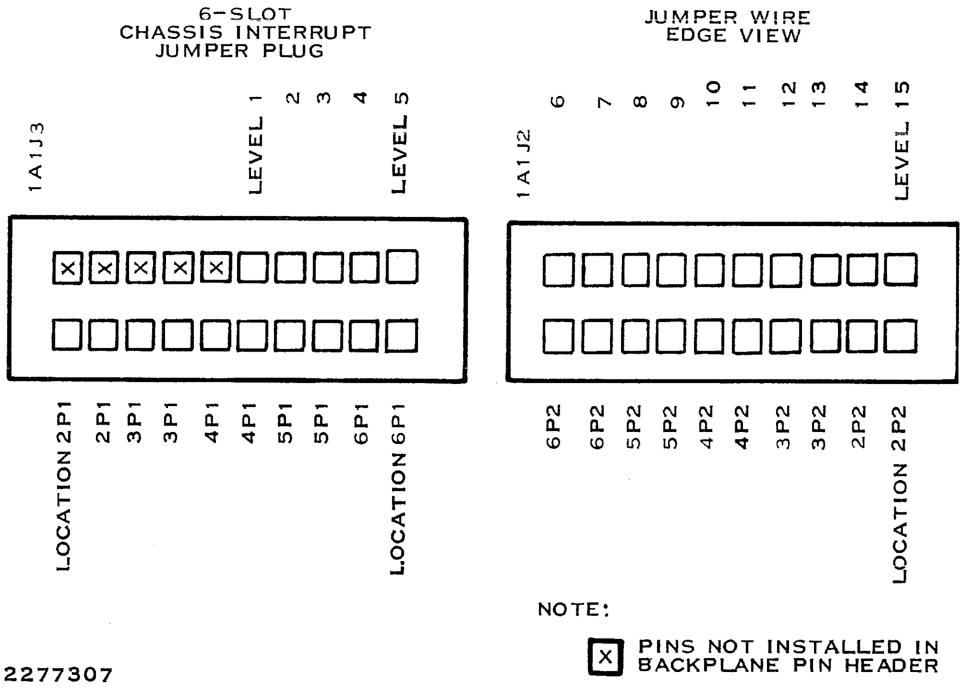

Figure 1-2. 6-Slot Chassis Interrupt Jumper Plugs

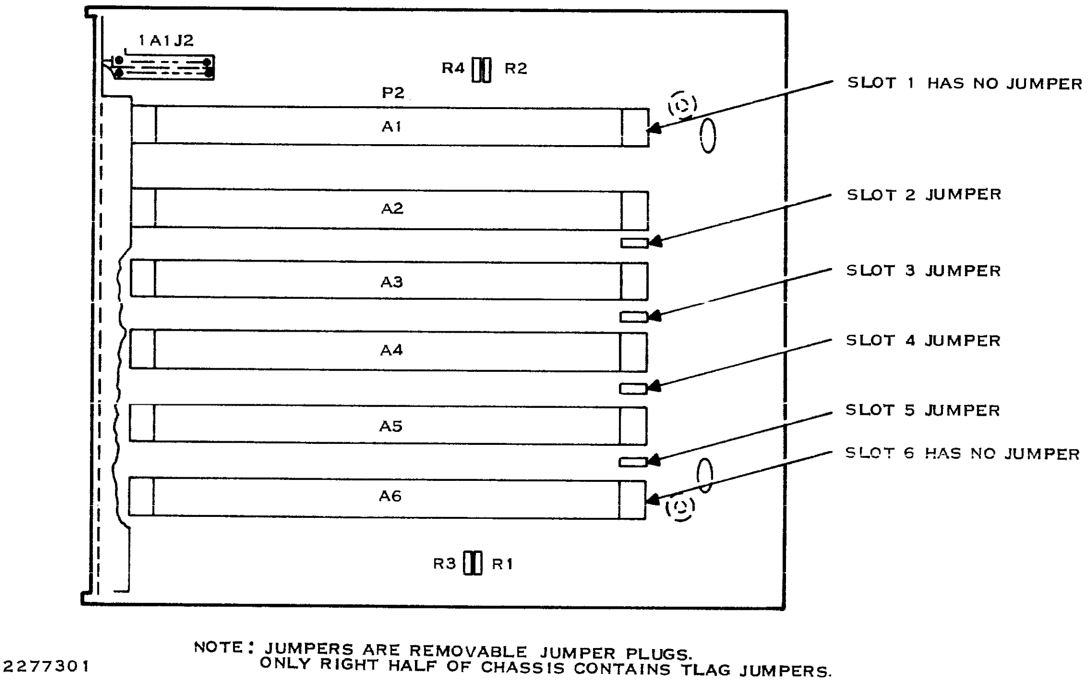

Figure 1-3. TLAG Jumpers for the 6-Slot Chassis

1.3.3 Field-Replaceable Components, 6-Slot Chassis

Field-replaceable components for the 6-slot computer chassis are as follows:

Item	TI Part Number
6-Slot Chassis	0944960-0001,0002
6-Slot Chassis (Model 3 only)	0944960-0003
20 A Power Supply	0944970-0001
23 A Power Supply (Model 3 only)	0944970-0002
Fan Assembly	0947512-0002
Programmer Front Panel Assembly	0945020-0001
Operator Front Panel Assembly	0945030-0001
AC Power Converter	0946650-0001
Standby Power Supply	0944990-0001
Air Filter (6-Slot Chassis)	0945152-0001
5 A 250 V Fuses	0416434-0503
3 A 250 V Fuses	0416434-0303
1700 uF 250 V Capacitor	0972930-0068
4200 uF 250 V Capacitor	0972930-0069
Interrupt Jumper Assembly, 6-Slot	2261945-0001
Center Card Guide Kit (includes Dummy Board, P/N 2265460-1)	0940045-0001
Fuseholder	0972690-0001
Standby Replacement Plug	0946739-0001
Terminal Block (1TB1)	0975270-0005
Surge Voltage Protector	0974805-0007
AC Line Filter (1FL1)	0972838-0005
Transformer, International Volt, 6-Slot	0946746-0005
Battery, Lead Acid, 6 V, 5 A	0946745-0001
Toggle Switch (ac-rated)	0972165-0001

2

13-Slot 990/5 Computer Chassis

2.1 13-SLOT 990/5 COMPUTER CHASSIS

The chassis configuration for the 13-slot 990/5 computer chassis for the Model 2 system is shown in Table 2-1.

Table 2-1. 13-Slot 990/5 Computer Chassis Configuration

P1 (CHASSIS FRONT)					P2 (CHASSIS REAR)				
SLOT	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL	NOTES
1	N/A		990/5	N/A	N/A		990/5	N/A	
2	02E0		SPARE	3	02C0		SPARE	4	1
3	02A0		SPARE	N/A	0280		SPARE	N/A	1
4	0260		SPARE	15	0240		SPARE	15	1
5	0220		SPARE	15	0200		SPARE	15	1
6	01E0		SPARE	10	01C0		SPARE	10	1
7	01A0		SPARE	13	0180		SPARE	13	1
8	0160		SPARE	12	0140		SPARE	12	1
9	0120		SPARE	10	0100		SPARE	10	1
10	00E0		911 # 2	11	00C0		911 # 1	11	
11	00A0	>F800	FD1000	7	0080	>F800	FD1000	7	2
12	0060		SPARE	9	0040		SPARE	9	1
13	0020		SPARE	15	0000		SPARE	15	1

NOTES:

1. FULL-SIZE OR HALF-SIZE BOARDS MAY OCCUPY SLOTS 2, 3, 4, 5, 6, 7, 8, 9, 12 AND 13.
2. WHERE A TILINE MASTER DEVICE IS USED, TLAG JUMPER MUST BE REMOVED.

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CC — Computer Chassis

2.1.1 Interrupts, 13-Slot Chassis

Interrupt jumper plugs for the 13-slot 990/5 computer chassis are shown in Figure 2-1.

2.1.2 TLAG 13-Slot Chassis

The TLAG jumper locations for the 13-slot chassis are shown in Figure 2-2.

2.1.3 Field-Replaceable Components, 13-Slot Computer Chassis

Field-replaceable components for the 13-slot computer chassis are as follows:

Item	TI Part Number
13-slot chassis	0945050-0024,0030
40 A Power Supply	0944980-0001
Fan Assembly	0947512-0003
Programmer Front Panel Assembly	0945020-0001
Operator Front Panel Assembly	0945030-0001
AC Power Converter	0946650-0001
Standby Power Supply	0944990-0001
Air Filter (13-Slot Chassis)	0945152-0002
5 A 250 V Fuses	0416434-0503
10 A 125 V Fuses	0416434-0005
4200 uF 250 V Capacitor	0972930-0069
Interrupt Jumper	2261946-0001
Fuseholder	0232092-0003
Standby Replacement Plug	0946739-0001
Terminal Block (1TB1)	0975270-0005
Surge Voltage Protector	0974805-0007
AC Line Filter	2210920-0001
Transformer, International Volt, 13-Slot	0946746-0006
Battery, Lead Acid, 6 V, 5 A	0946745-0001
Toggle Switch (ac-rated)	0972165-0001
Fuse 3-A 250 V, 3AG	0316434-0303

CC — Computer Chassis

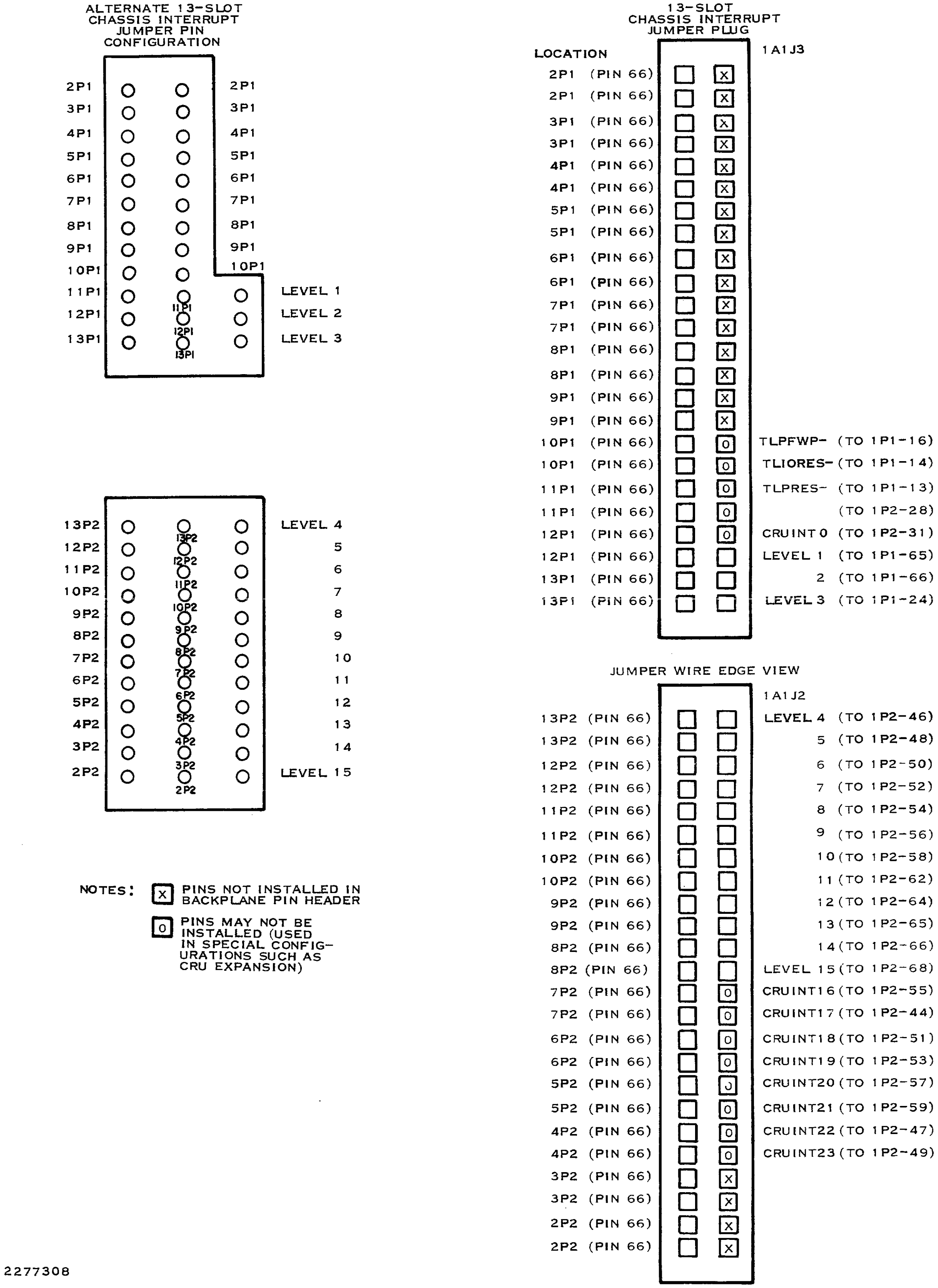

Figure 2-1. 13-Slot Chassis Interrupt Jumper Plugs

CC — Computer Chassis

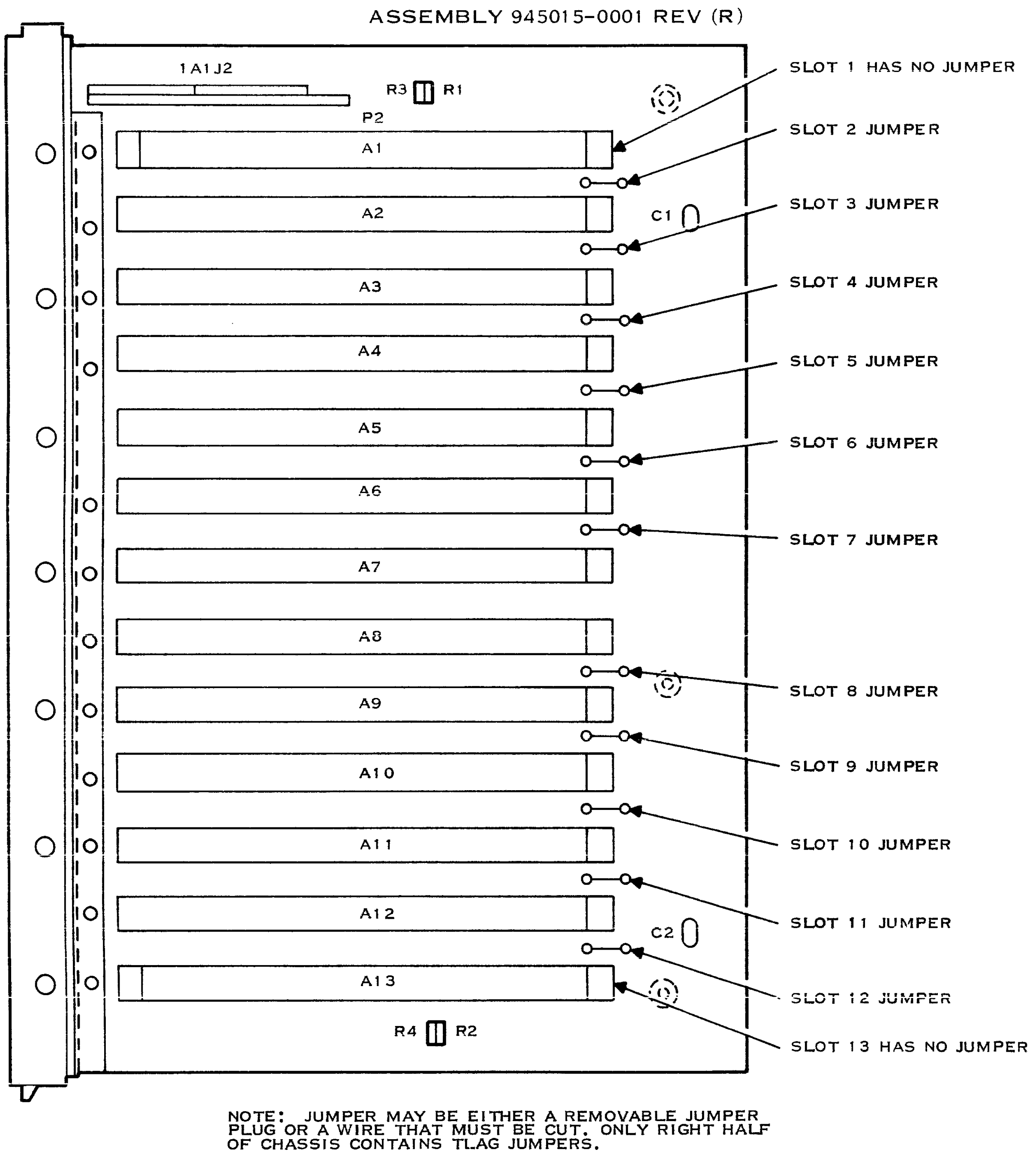

Figure 2-2. TLAG Jumper Locations for 13-Slot Chassis

3

13-Slot 990/10 Computer Chassis

3.1 13-Slot 990/10 Computer Chassis

This section contains computer chassis information on the following:

- 13-slot 990/10 computer chassis used with DS990 Models 4 through 30
- 13-slot 990/10 computer chassis used with DS990 Model 3

The 990/10 computer chassis configuration for DS990 Models 4 through 30 is shown in Table 3-1.

CC — Computer Chassis

Table 3-1. 13-Slot 990/10 Computer Chassis Configuration, Models 4 Through 30

P1 (CHASSIS FRONT)					P2 (CHASSIS REAR)				
SLOT	CRU ADDRESS	TL ADD	DEVICE	INTERRUPT LEVEL	CRU ADDRESS	TL ADD	DEVICE	INTERRUPT LEVEL	NOTES
1	N/A		990/10SMI	N/A	N/A		990/10SMI	N/A	
2	02E0		990/10 AU	N/A	02C0		990/10 AU	N/A	10
3	02A0		MEM CONT	N/A	0280	FB00 OR FB10	MEM CONT	N/A	3
4	0260		MEMORY	N/A	0240		MEMORY	N/A	3
5	0220		MEMORY 2ND MODEM	N/A	0200		MEMORY 2ND MODEM	N/A	3
6	01E0		MEMORY 2ND ACU 2ND MODEM	N/A	01C0		MEMORY 2ND ACU 2ND MODEM	N/A	3
7	01A0	F800	SYS DISK	13	0180	F800	SYS DISK	13	3
8	0160	F880	979A TL CPLR TL DISK	9	0140	F880	979A TL CPLR TL DISK	9	3,4 3,4,5,7 2,3,4
9	0120		911 # 2	8	0100		911 # 1	10	6
10	00E0		CRU EXP TL DEVICE 911 VDT	12	00C0		CRU EXP TL DEVICE 911 VDT	11	3 2,3,4 6
11	00A0		TL DEVICE FD800 2ND COMM	3	0080		TL DEVICE FD800	7	1,2,3,4 1,3
12	0060		LP OR 820	14	0040		COMM I/F CARD RDR TL DEVICE	4	1,3 1 1,2,3,4
13	0020		PROM PROG AUTO CALL	15	0000		TL DEVICE MODEM 733 ASR 743 KSR	6	1,2,3,4 1,3 1,3

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Table 3-1. 13-Slot 990/10 Computer Chassis Configuration, Models 4 through 30 (Continued)

NOTES:

1. 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.

2. WHERE MORE THAN ONE TILINE DISK INTERFACE IS USED, THE PRIORITY IS AS FOLLOWS. 1. DS31/32. 2. DS10. 3. DS25/50/200. THE HIGHEST PRIORITY DEVICE SHALL BE PLACED IN A HIGHER NUMBERED SLOT THAN THE NEXT HIGHEST PRIORITY DEVICE.

   NOTE:

   THE DS31/32 IS NO LONGER SUPPORTED, BUT IF USED, IT MUST HAVE PRIORITY.

3. REFER TO THE SECTION FOR THE PARTICULAR PERIPHERAL DEVICE FOR JUMPER AND SWITCH CONFIGURATIONS.

4. WHERE A TILINE COUPLER OR OTHER TILINE DEVICE IS USED, THE TLAG JUMPER MUST BE REMOVED. TILINE COUPLER JUMPERS ARE INSTALLED IN J2, J5, AND J6.

   A. J2 ALLOWS DIRECT NONMASKABLE INTERRUPTS IN FROM THE REMOTE CHASSIS.

   B. J5 ALLOWS TILINE RESET OR POWER RESET TO RESET THE EXPANSION CHASSIS.

   C. J6 ENABLES WRITE MEMORY CYCLES TO THE EXPANSION CHASSIS.

   THE TILINE CABLE THAT IS INSTALLED BETWEEN THE MAIN CHASSIS AND THE EXPANSION IS VECTORED TOWARD THE EXPANSION CHASSIS. (REFER TO FIGURE 7-2). J7 SHOULD ALSO BE INSTALLED IF THE EXPANSION CHASSIS WILL CONTAIN MEMORY ONLY. J7 DISABLES DECODES OF TPCS ADDRESSES.

TILINE COUPLER NOTE.

5. CRU MASKABLE INTERRUPT CRU BASE ADDRESS IS SELECTED BY J8. POSITION 1 IS STANDARD.

J8 JUMPER POSITIONS	CRU BASE ADDRESS (HEXADECIMAL)
1	1F40
2	1F44
3	1F48
4	1F4C
5	1F50
6	1F54
7	1F58
8	1F5C

6. 911 VDT SHOULD BE INSTALLED IN SLOT 9. ADDITIONAL LOCATIONS ARE OPTIONAL.

7. MAIN CHASSIS TILINE COUPLER ADDRESSING IF ALL MEMORY IS IN THE MAIN CHASSIS. BIAS =ALL ON, LOWER BOUND = ALL OFF, UPPER BOUND = ALL ON.

8. MAIN CHASSIS TILINE COUPLER ADDRESSING IF MEMORY IS INSTALLED IN THE EXPANSION CHASSIS. BIAS = ALL ON, LOWER BOUND AND UPPER BOUND REFER TO THE ADDRESSING CHARTS FOR THESE SWITCHES IN THE TILINE COUPLER SECTION, SECTION 7.

9. WHEN INTERNAL MODEM AND AUTO-CALL ARE USED, THEY MAY BE INSTALLED IN ANY EMPTY ADJACENT SLOTS.

10. JUMPER E1 TO E2 ON 990/10 AU MUST BE INSTALLED. WHEN REMOVED THE SYSTEM WILL BOOT ON POWER-UP (UNLESS A PROGRAMMER PANEL IS INSTALLED).

11. FOR SLOTS THAT SHARE INTERRUPTS WITH 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.

12. THE MODEL 4PP CONFIGURATION IS IDENTICAL TO THE MODEL 4 EXCEPT THE MEMORY CONTROLLER INSTALLED IN SLOT 3 IS THE CACHE CONTROLLER.

13. AUTO-CALL SOFTWARE DOES NOT USE INTERRUPTS. IF CUSTOMER APPLICATION DOES USE INTERRUPTS, THEN SLOT 6 MAY NOT BE USED.

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CC — Computer Chassis

The configuration of the 13-slot 990/10 computer chassis used with DS990 Model 3 is shown in Table 3-2.

Table 3-2. 13-Slot 990/10 Computer Chassis Configuration, DS990 Model 3 System

	P1 (CHASSIS FRONT)				P2 (CHASSIS REAR)			
SLOT	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL
1	N/A		990/10 SMI	N/A	N/A		990/10 SMI	N/A
2	02E0		990/10 AU	N/A	02C0		990/10 AU	N/A
3	02A0	FB00 OR FB10	MEMORY CONT	N/A	0280	FB00 OR FB10	MEMORY CONT	N/A
4	0260		MEMORY	N/A	0240		MEMORY	N/A
5	0220				0200			
6	01E0				01C0			
7	01A0	F820	SYS DISK	9	0180	F800	SYS DISK	13
8	0160			9	0140			9
9	0120		911 NO. 4	8	0100		911 NO. 3	10
10	00E0		911 NO. 2	12	00C0		911 NO. 1	11
11	00A0			3	0080			7
12	0060		PRINTER	14	0040		COMM I/F	4
13	0020			15	0000		MODEM	6

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3.1.1 13-Slot Chassis Interrupts and TLAG

The interrupt jumpers and TLAG jumpers for the 13-slot computer chassis are shown in Section 2, Figures 2-1 and 2-2, respectively.

3.1.2 Field-Replaceable Components, 13-Slot 990/10 Computer

The field-replaceable components for the 13-slot 990/10 computer chassis are the same as for the 13-slot 990/5 computer chassis with the exception of the interrupt jumper, which is part number 949970-0005. For field-replaceable components, refer to Section 2.

4

13-Slot Computer Expansion Chassis

4.1 13-SLOT COMPUTER EXPANSION CHASSIS

The 13-slot expansion chassis configuration is shown in Table 4-1.

4.1.1 13-Slot Interrupt and TLAG Jumpers

For 13-slot chassis interrupt and TLAG jumpers, refer to Figures 2-2 and 2-3, respectively.

4.1.2 Field-Replaceable Components, 13-Slot 990 Expansion Chassis

The field-replaceable components for the 13-slot expansion chassis are the same as for the 13-slot 990/5 chassis, with the exception of the interrupt jumper, which is part number 949970-0003. For field-replaceable components, refer to Section 2.

CC — Computer Chassis

Table 4-1. 13-Slot Expansion Chassis Configuration

	P1 (CHASSIS FRONT)				P2 (CHASSIS REAR)				
SLOT	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL	NOTES
1	N/A		CRU BUFFER	N/A	N/A		CRU BUFFER	N/A	4,5
2	06E0		TILINE COUPLER	N/A	06C0		TILINE COUPLER	N/A	2,4,5
3	06A0			N/A	0680			N/A	
4	0660			N/A	0640			N/A	
5	0620			N/A	0600			N/A	
6	05E0			N/A	05C0			N/A	
7	05A0	F820	TL DISK	13	0580	F820	TL DISK	13	2,5
8	0560	F880 F830	TL TAPE TL DISK	9	0540	F880	TL TAPE TL DISK	9	1,2,5 2,5
9	0520		911 VDT	8	0500		911 VDT	10	
10	04E0		911 VDT	12	04C0		911 VDT	11	
11	04A0	F850	FD800 TL DISK	3	0480	F850	FD800 TL DISK	7	3,5 2,5
12	0460			14	0440			4	
13	0420			15	0400			6	

NOTES:

1. FOR MAGNETIC TAPE INSTALLATION, REWIRE THE INTERRUPT JUMPER ASSEMBLY AS FOLLOWS. (THIS ALLOWS DIRECT INTERRUPT THE TILINE COUPLER.) CHANGE FROM: START 8P2--19 FINISH

   TO: START 8P2--2P2 FINISH

2. WHERE A TILINE COUPLER OR OTHER TILINE MASTER DEVICE IS USED, TLAG JUMPER MUST BE REMOVED.
   TILINE COUPLER JUMPERS ARE INSTALLED IN J1,J6,J7. (J1 ALLOWS DIRECT NONMASKABLE INTERRUPT OUT TO THE MAINCHASSIS; J6 ALLOWS WRITE MEMORY CYCLES TO THE EXPANSION CHASSIS; J7 DISABLES AUTOMATIC DECODING OF TPCS ADDRESSES.)

3. IF THE SLOT IS NOT OCCUPIED BY THE INDICATED DEVICE, FULL-SIZE OR HALF-SIZE CRU BOARDS MAY BE PLACED IN THE SLOT.

4. 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.

5. REFER TO THE SECTION FOR THE PERIPHERAL DEVICE FOR JUMPER AND SWITCH CONFIGURATIONS.

6. WHEN MORE THAN ONE TILINE MASTER CONTROLLER IS INSTALLED, ONLY ONE MAY USE THE DIRECT TILINE COUPLER INTERRUPT; ALL OTHER MUST USE THE CRU EXPANDER INTERRUPT WITH SLOT (INTERRUPT) POSITIONING.

7. TILINE COUPLER

   A. J8, CRU MASKABLE INTERRUPT IS IN THE CRU ADDRESS RANGE OF >1F40 TO >1F5C WITH POSITION 1 STANDARD.

   B. J7 INSTALLED DISABLES THE PASSING OF TPCS ADDRESSES.

8. CRU CHASSIS CONFIGURATION SHOWN IN THIS TABLE IS FOR CHASSIS NUMBER ONE.

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5

17-Slot Computer Chassis

5.1 17-SLOT COMPUTER CHASSIS

The 17-slot computer chassis configuration is shown in Table 5-1.

5.1.1 990/10 17-Slot Main Chassis Configuration for DS990 Model 8PP

The chassis configuration for the model 8PP is identical to the one shown in Table 5-1, except in place of the 990/12 AU and SMI the 990/10 AU and SMI is used. Otherwise, all other configuration notes for the 990/12 chassis apply to the 990/10 17-slot chassis configuration.

CC — Computer Chassis

Table 5-1. 17-Slot Computer Chassis Configuration

P1 (CHASSIS UPPER)					P2 (CHASSIS LOWER)				
SLOT	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL	CRU ADDRESS	TL ADD	DEVICE	INTER-RUPT LEVEL	NOTES
1	N/A		990/12 SMI OR 990/10 SMI/M	N/A	N/A		990/12 SMI OR 990/10 SMI/M	N/A	
2	N/A		990/12 AU OR 990/10 AU1	N/A	N/A		990/12 AU OR 990/10 AU1	N/A	11
3	N/A		MEM CONT	N/A	N/A	FB00 OR FB10	MEM CONT	N/A	3, 4, 8, 9
4	N/A		MEMORY	N/A	N/A		MEMORY	N/A	3, 4, 8
5	N/A		MEMORY 2ND MODEM	11	N/A		MEMORY 2ND MODEM	11	3, 4, 7, 8
6	02E0		MEMORY CRU DEVICE 2ND ACU	10	02C0		MEMORY CRU DEVICE 2ND ACU	10	1,3, 4, 7 4
7	02A0		MEMORY TL DEVICE CRU DEVICE	15	0280		MEMORY TL DEVICE CRU DEVICE	15	1, 3, 4 1, 2, 5, 9 4
8	0260		MEM CONT TL DEVICE CRU DEVICE	12	0240		MEM CONT TL DEVICE CRU DEVICE	12	1, 3, 4, 9 1, 2, 5, 9 4
9	0220		MEMORY TL DEVICE CRU DEVICE	8	0200		MEMORY TL DEVICE CRU DEVICE	8	1, 3, 4 1, 2, 5, 9 4
10	01E0		MEMORY 2ND COMM TL DEVICE	3	01C0		MEMORY 2ND COMM TL DEVICE	3	1, 3, 4 1, 3, 4 1, 2, 5, 9
11	01A0	F800	TILINE SYS DISK	13	0180	F800	TILINE SYS DISK	13	5
12	0160	F880	MAG TAPE TL DEVICE	9	0140	F880	MAG TAPE TL DEVICE	9	1, 2, 5 1, 2, 5, 9
13	0120		911 # 2	10	0100		911 # 1	10	6, 7
14	00E0		CRU EXP 911 VDT	11	00C0		CRU EXP 911 VDT	11	1, 4, 7 1, 7
15	00A0		FD1000 TL DEVICE TL COUPLER	7	0080		FD1000 TL DEVICE TL COUPLER	7	1, 4 1, 2, 5, 9 1, 5, 9
16	0060		LINE PTR	14	0040		1ST COMM CARD RDR	4	1, 4 1, 4
17	0020		ACU	6	0000		MODEM EIA TERM TL DEVICE	6	1, 4 1, 4 1, 2, 5, 9

NOTE:

THE 17-SLOT CHASSIS MUST HAVE ALL POSITIONS FILLED FOR PROPER AIR FLOW AND COOLING. PART NUMBERS FOR HALF-SIZE AND FULL-SIZE DUMMY BOARDS ARE LISTED IN PARAGRAPH 5.6.4.

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Table 5-1. 17-Slot Computer Chassis Configuration (Continued)

NOTES:

THE DEVICES SHOWN IN TABLE 5-5 ARE THE STANDARD LOCATIONS; THE FOLLOWING RULES SHOULD BE USED FOR THE VARIOUS CONFIGURATIONS POSSIBLE.

THESE SLOTS ARE DEDICATED TO THE INDICATED DEVICES. WHERE MORE THAN ONE DEVICE IS SHOWN FOR A SLOT, THEY ARE LISTED IN ORDER OF PREFERENCE. 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 THE 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 CRU BUT ONLY POWER SUCH AS A MODEM. RECOMMENDED SECOND LINE PRINTER LOCATION IS 16(P2) IF A CARD READER OR COMMUNICATION INTERFACE IS ABSENT. IF CARD READER OR COMMUNICATION INTERFACE IS PRESENT, SLOTS SHALL BE USED IN THE PRIORITY 17(P1), 17(P2), AND THEN 12(P1) OF THE EXPANSION CHASSIS.
2. WHERE MORE THAN ONE TILINE DISK INTERFACE IS USED, THE PRIORITY IS AS FOLLOWS: 1. DS31/32. 2. DS10. 3. D25,50,200. THE HIGHEST PRIORITY DEVICE SHALL BE PLACED IN A HIGHER NUMBERED SLOT THAN THE NEXT HIGHEST PRIORITY DEVICE.

   NOTE.

   THE DS31/32 IS NO LONGER SUPPORTED, BUT IF USED, IT MUST HAVE PRIORITY.
3. 16K RAM OR 4K RAM MEMORY MAY BE USED, BUT 4K RAM DECREASES THE PERFORMANCE OF THE SYSTEM DUE TO ITS SLOWER SPEED.
4. REFER TO THE SECTION FOR THE PERIPHERAL DEVICE FOR JUMPER AND SWITCH CONFIGURATIONS.
5. A MAXIMUM OF TEN TILINE DEVICE CONTROLLERS MAY BE INSTALLED IN THE 17-SLOT CHASSIS EXCLUDING MEMORY AND AU. THE TLAG SWITCHES ARE LOCATED ON THE BACK OF THE BACKPANEL BELOW THE POWER SUPPLIES. FIGURE 5-1 SHOWS THE LOCATION OF THESE SWITCHES. IF A TILINE MASTER DEVICE IS INSTALLED, THEN THE SWITCH FOR THAT SLOT MUST BE OFF.

   NOTE:

   S1 AND S2 EACH CONSIST OF 8 PENCIL SWITCHES

SWITCH S2 (LEFT)	SLOT	SWITCH S1 (RIGHT)	SLOT
1	2	1	10
2	3	2	11
3	4	3	12
4	5	4	13
5	6	5	14
6	7	6	15
7	8	7	16
8	9	8	NC

6. THE FIRST 911 VDT CONTROLLER SHOULD BE INSTALLED IN SLOT 13. ADDITIONAL LOCATIONS ARE OPTIONAL.
7. FOR SLOTS THAT SHARE INTERRUPTS BETWEEN EACH OTHER (INTRA-SLOT INTERRUPT SHARING) THE FOLLOWING RULE APPLIES:

   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.
8. THESE SLOTS CANNOT BE USED FOR CRU DEVICES.
9. TPCS CONTROLLER ADDRESSES.

ADDRESS	DEVICE
>F800	TILINE PRIMARY DISK
>F810	TILINE DISK
>F820	TILINE DISK
>F830	TILINE DISK
>F840	TILINE DISK
>F880	TILINE MAGNETIC TAPE
>F900	1ST FOUR CHANNEL COMMUNICATION CONTROLLER
>F910	2ND FOUR CHANNEL COMMUNICATION CONTROLLER
>F920	3RD FOUR CHANNEL COMMUNICATION CONTROLLER
>F930	4TH FOUR CHANNEL COMMUNICATION CONTROLLER
>F940	5TH FOUR CHANNEL COMMUNICATION CONTROLLER
>F950	6TH FOUR CHANNEL COMMUNICATION CONTROLLER
>FB00	1ST 16K RAM MEMORY CONTROLLER
>FB04	2ND 16K RAM MEMORY CONTROLLER
>FB10	1ST CACHE MEMORY CONTROLLER
>FB14	2ND CACHE MEMORY CONTROLLER

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Table 5-1. 17-Slot Computer Chassis Configuration (Continued)

TILINE COUPLER NOTES:

10. WHEN POSSIBLE, ALL TILINE DEVICES SHOULD BE LOCATED IN THE MAIN CHASSIS. IF THIS IS NOT POSSIBLE, THEN TILINE EXPANSION MAY BE USED. MAIN CHASSIS TILINE COUPLER SETTINGS IF ALL MEMORY IS INSTALLED IN THE MAIN CHASSIS ARE AS FOLLOWS:

    A. JUMPERS INSTALLED: J2, J5, J6
    B. BIAS: SWITCHES 1 THROUGH 8 ON
    C. LOWER BOUND: SWITCHES 1 THROUGH 8 OFF
    D. UPPER BOUND: SWITCHES 1 THROUGH 8 ON
    E. CABLE VECTOR TO EXPANSION CHASSIS.

    MAIN CHASSIS TILINE COUPLER SETTINGS IF MEMORY IS INSTALLED IN THE EXPANSION CHASSIS ARE AS FOLLOWS:

    A. JUMPERS INSTALLED: J2, J5, J6
    B. BIAS: SWITCHES 1 THROUGH 8 ON
    C. LOWER BOUND: LOWEST ADDRESS OF MEMORY IN THE EXPANSION CHASSIS.
    D. UPPER BOUND: HIGHEST ADDRESS OF MEMORY IN THE EXPANSION CHASSIS.
    E. REFER TO THE TILINE COUPLER SECTION FOR SWITCH CONFIGURATIONS.

11. JUMPER E1 TO E2 ON 990/12 AU MUST BE INSTALLED. WHEN REMOVED THE SYSTEM WILL BOOT ON POWER-UP (UNLESS A PROGRAMMER S PANEL IS INSTALLED).

TILINE MASTERS NOTES:

12. THE TILINE ACCESS DELAY ON SEVERAL CONTROLLERS IS INSUFFICIENT IN THE 17-SLOT CHASSIS DUE TO THE INCREASED NUMBER OF SLOTS, INCREASED LENGTH OF ETCH RUNS, AND PROBABILITY OF INCREASED NUMBERS OF CONTROLLERS ON THE TILINE.

    VERIFY THAT MASTER CONTROLLER BOARDS ARE ABOVE THE FOLLOWING REVISION LEVELS. THE FOLLOWING CHANGES MUST BE INCLUDED ON TILINE MASTER CONTROLLERS WHEN MULTIPLE CONTROLLERS ARE INSTALLED IN THE 17-SLOT CHASSIS. CAPACITORS INCLUDED IN THE KIT PART NUMBER 2265484-0001 ARE FOR THE FOLLOWING CONTROLLERS. REPLACE THE APPROPRIATE CAPACITOR INDICATED WITH THE REQUIRED REPLACEMENT. EXTRA CAPACITORS ARE INCLUDED. THESE CHANGES CAN ALL BE MADE AT THE CUSTOMER'S SITE.

	REV. LEV.* BEFORE CHANGE	REPLACE CAPACITOR		
DS10 CONTROLLER PN 937505 LOCATION ON BOARD-UH07	Y	C05	510pf	WITH 1200pf
DS25/50/200 CONTROLLER PN 940065 LOCATION ON BOARD-C11 8 TO 9	J	C19	510pf	WITH 1500pf
DS25/50/200 CONTROLLER PN 947525 LOCATION ON BOARD-C11 8 TO 9	R	C19	510pf	WITH 1500pf
TILINE COUPLER PN 945085 LOCATION ON BOARD-NEXT TO U59	AD	C29	750pf	WITH 1500pf

*ALL CONTROLLERS UP TO AND INCLUDING THIS LEVEL REQUIRE MODIFICATION

THE FOLLOWING 979A CONTROLLERS REQUIRE FACTORY MODIFICATION.

PN 2261635 (PE/NRZI PWB) UP TO AND INCLUDING REV H
PN 2261630 (PE/NRZI PWB) UP TO AND INCLUDING REV J
PN 0948990 (PE/NRZI MULTIWIRE) UP TO AND INCLUDING REV N
PN 0947555 (PE/NRZI MULTIWIRE) UP TO AND INCLUDING REV V

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5.1.2 17-Slot Chassis Interrupt Jumpers

The interrupt jumper plug connections for the 17-slot chassis are listed in Table 5-2.

Table 5-2. 17-Slot Chassis Interrupt Jumper Plugs

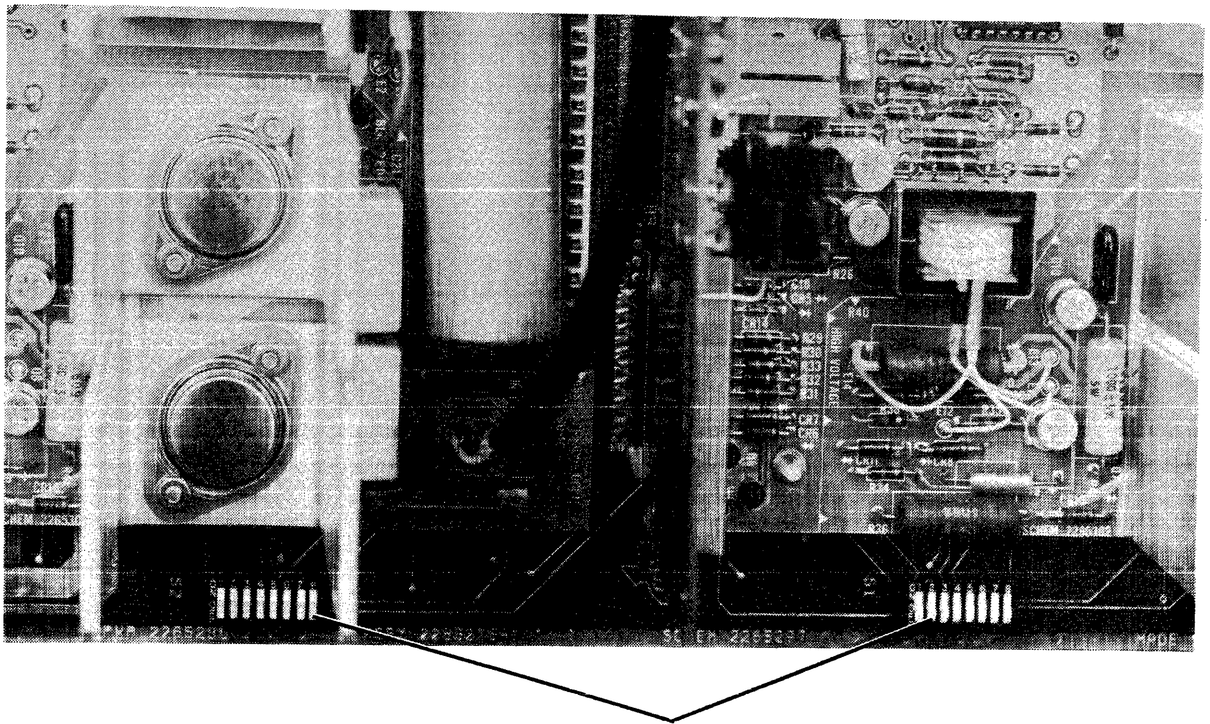
Signal Source	Name	Interrupt Connector A23 Pin Number		Name
		70	69	TLIORES-
		68	67	TLPRES-
		66	65	RESTART-
A2P2-66	2P2	64	63	
A2P1-66	2P1	62	61	
A3P2-66	3P2	60	59	
A3P1-66	3P1	58	57	INT3
A4P2-66	4P2	56	55	INT4
A4P1-66	4P1	54	53	INT5
A5P2-66	5P2	52	51	INT6
A5P1-66	5P1	50	49	INT7
A6P2-66	6P2	48	47	INT8
A6P1-66	6P1	46	45	INT9
A7P2-66	7P2	44	43	INT10
A7P1-66	7P1	42	41	INT11
A8P2-66	8P2	40	39	INT12
A8P1-66	8P1	38	37	INT13
A9P2-66	9P2	36	35	INT14
A9P1-66	9P1	34	33	INT15
A10P2-66	10P2	32	31	
A10P1-66	10P1	30	29	
A11P2-66	11P2	28	27	
A11P1-66	11P1	26	25	
A12P2-66	12P2	24	23	
A12P1-66	12P1	22	21	
A13P2-66	13P2	20	19	
A13P1-66	13P1	18	17	
A14P2-66	14P2	16	15	
A14P1-66	14P1	14	13	
A15P2-66	15P2	12	11	
A15P1-66	15P1	10	9	
A16P2-66	16P2	8	7	
A16P1-66	16P1	6	5	
A17P2-66	17P2	4	3	
A17P1-66	17P1	2	1	

Note:

Refer to Table 5-1 (17-Slot Chassis Configuration) for the standard configuration interrupt levels.

5.1.3 17-Slot Chassis TLAG Switches

The TLAG jumper switch locations for the 17-slot chassis are shown in Figure 5-1, and the TLAG switch positions are shown in Figure 5-2.



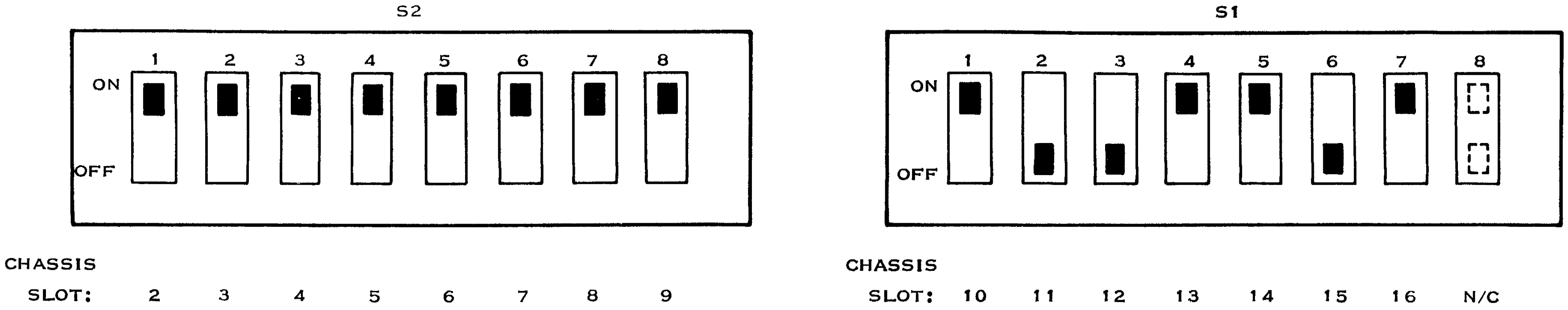
NOTE:

FOR COMPLETE REAR VIEW OF 17-SLOT CHASSIS REFER TO FIGURE 1-6 IN THE TR-TROUBLESHOOTING SECTION.

Figure 5-1. 17-Slot Chassis TLAG Jumper Switches Locations

ON = TLAG JUMPERED ACROSS SLOT (P2-6 TO P2-5)

OFF = TLAG NOT JUMPERED - CONTINUITY REQUIRES TILINE CONTROLLER



NOTES: 1. SWITCHES ARE SHOWN SET FOR:

SYSTEM DISK CONTROLLER	- SLOT 11
979A TILINE MAGNETIC TAPE CONTROLLER	- SLOT 12
FD1000 TILINE FLEXIBLE DISK CONTROLLER	- SLOT 15

2. EACH SWITCH SECTION MUST BE ON UNLESS A TILINE MASTER CONTROLLER IS INSTALLED IN THE CORRESPONDING CHASSIS SLOT. TILINE PRIORITY SYSTEM WILL NOT WORK IF SWITCHES ARE SET INCORRECTLY.

3. SLOT 17 DOES NOT REQUIRE A SWITCH.

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Figure 5-2. 17-Slot Chassis TLAG Jumper Switches Positions

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5.1.4 Field-Replaceable Components, 17-Slot Chassis

The field-replaceable components for the 17-slot computer chassis are as follows:

Item	Part Number
Programmer Panel Assembly	2265270-0001
+5 V Main Power Supply	2265300-0001
±12 V Power Supply	2265335-0001
Control Board	2265315-0001
Converter Board	2265320-0001
Backpanel Assembly	2265295-0001
Encoder Card, Low Voltage (100 V)	2265325-0001
Encoder Card, High Voltage (200 V)	2265330-0001
Fan Chassis Assembly	2265268-0001
Power Module Assembly	2265267-0001
European Power Cord	2210409-0001
U. S. Power Cord (208 Vac Chassis)	2265443-0001
Fan Motor Assembly	2265375-0001
Impeller Assembly	2265535-0001, or 2265535-0002
Fan Belt, w/Teeth	2265499-0005
Air Filter	2265283-0001
Fan Chassis Air Filter	2265294-0001
TLAG Switch S1 or S2	0972594-0005
Key-Lock Switch, Programmer Panel	2265372-0001
One-Quarter-Turn Fasteners	2210405-0005
Auxiliary Transformer with Harness	2265438-0001
EMI Line Filter	2265437-0001
Capacitor, Filter C1 or C2	0972930-0069
Rectifier, Full Wave Bridge	2210328-0001
Interrupt Plug, Standard (PWB)	2265440-0001
Interrupt Plug, Patchcord (opt to std)	2265442-0001
Interrupt Plug, Patchcord (cust opt)	2265457-0001
Fuse, 10 A (-4 Encoder Card)	0054186-0001
Fuse, 10 A (-1,-2,-3, Encoder Card)	2210403-0026
Dummy Card, Full Size	2265439-0001
Dummy Card, Half Size	2265460-0001
Cable Assemblies:	
(a) Secondary Voltage Cable (Interconnects J4 of converter board to J2 of backpanel)	2265406-0001
(b) Converter Board Cable (Interconnects J1 of converter board to bridge rectifier and filter caps)	2265403-0001
(c) Converter Board to Power Supply Cable (Interconnects J3 of converter board to J1 of power supply modules)	2265404-0001
(d) Converter Board Power Cable (Interconnects J2 of encoder card to J2 of converter card)	2265405-0001
(e) Fan Motor Cable (Interconnects J5 of Encoder Card to fan motor)	2265381-0001

6

CRU Expansion Chassis

6.1 990 CRU Expansion Chassis

CRU expansion is required when a system consists of more CRU interface controllers than can be installed in the main chassis, or when more than one TILINE master device requiring interrupts is installed in an expansion chassis. The interface consists of a CRU expansion board installed in the computer chassis, a CRU buffer board installed in the expansion chassis, and an interconnecting cable between the two.

Up to seven CRU expansion chassis may be connected to the main chassis when configuring large systems. The limit is two CRU expansion chassis if early production expansion hardware is used. The electrical interconnection between the main chassis backpanel and the expansion chassis is accomplished via the CRU expansion board (which is installed in an unused slot in the main chassis), and a CRU buffer board (which is installed in slot 1 of each expansion chassis).

The CRU expansion board contains seven top-edge connectors designated P3 through P9. Each connector contains all the necessary data, address, interrupt, and interrupt identification lines required to link an external expansion chassis to the main chassis through an interconnecting cable to the CRU buffer board. Interconnections for a typical CRU expansion system are shown in Figure 6-1. Chassis select assignments are listed in Table 6-1.

6.1.1 Old and New CRU Expansion Systems

There are two models of 990 CRU expansion systems in the field, the previous production (old) system and the current production (new) system.

CAUTION

Components of the new system and the old system cannot be mixed. Only two expansion chassis may be used with the 945005-1 assembly: one chassis on the 1-4 chassis select group, and one chassis on the 5-7 chassis select group. Refer to Table 6-1.

Part numbers for the two different systems are as follows:

Item	Old System	New System
CRU Buffer Board	944905-0001	2262075-0001
CRU Expansion Board	945005-0001	2262080-0001
CRU Expansion Cable	945001-0001	2262085-0001

6.1.2 CRU Expansion Board

The CRU expansion board is normally installed in slot 10 of the 13-slot main chassis, and slot 14 of the 17-slot main chassis; but it can be installed in any slot that has a CRU base address and an interrupt available.

Table 6-1. CRU Expansion Selections

	Expansion Chassis (CRU Buffer Board)			Main Chassis (CRU Expander Board)	
Chassis Select	CPU Address	Buffer Jumper (U15)	Interface Connector	CRU Module Select	Board Side Interrupt Pickup
1	0400	1 - 14	P3	0	A P2-66
2	0800	2 - 13	P4[2]	0	A P2-66
3[1]	0C00	3 - 12	P5	0	A P2-66
4[1]	1000	4 - 11	P6	0	A P2-66
5[1]	1400	5 - 10	P7	1	B P1-66
6[1]	1800	6 - 9	P8	1	B P1-66
7[1]	1C00	7 - 8	P9	1	B P1-66

Notes:

[1] Expansion chassis 3 - 7 not used on the old system.

[2] The old system supports only two expansion chassis: one chassis on the 1 - 4 select, and one chassis on the 5 - 7 select. Therefore, use P7 on the old system for the second expansion chassis.

6.1.2.1 CRU Expansion Board Jumper Options. The jumper options on the CRU expansion board are illustrated in Figure 6-2 for the early production models (945005 assembly) and Figure 6-3 for the current production models (2262080 assembly). Standard jumper configuration is E3 - E4, E5 - E6, and E7 - E8. Jumper options, summarized in Table 6-2, include:

- Jumper-wire selection of either power-up reset (TLPRES-) from the power supply or I/O reset (IORES-) from the CPU board in the main chassis. Typically, the IORES- signal is used. IORES- includes an OR of the main chassis power supply-on reset and the software reset (RSET) instruction. This jumper is connected between E3 and E4; E1 and E2 are open.
- Interrupt enabled option. E5 - E6 and E7 - E8 are connected in standard configurations using the 945005 assembly. E5 - E6 and E7 - E8 are implemented in etch on the 2262080 assembly. These jumpers enable both interrupt sections A and B (chassis 1 through 4 and chassis 5 through 7, respectively). Also on the 2262080 assembly are E9, E10, E11, and E12 that normally are not connected. These jumpers affect the interrupt scanning and are used only for testing.

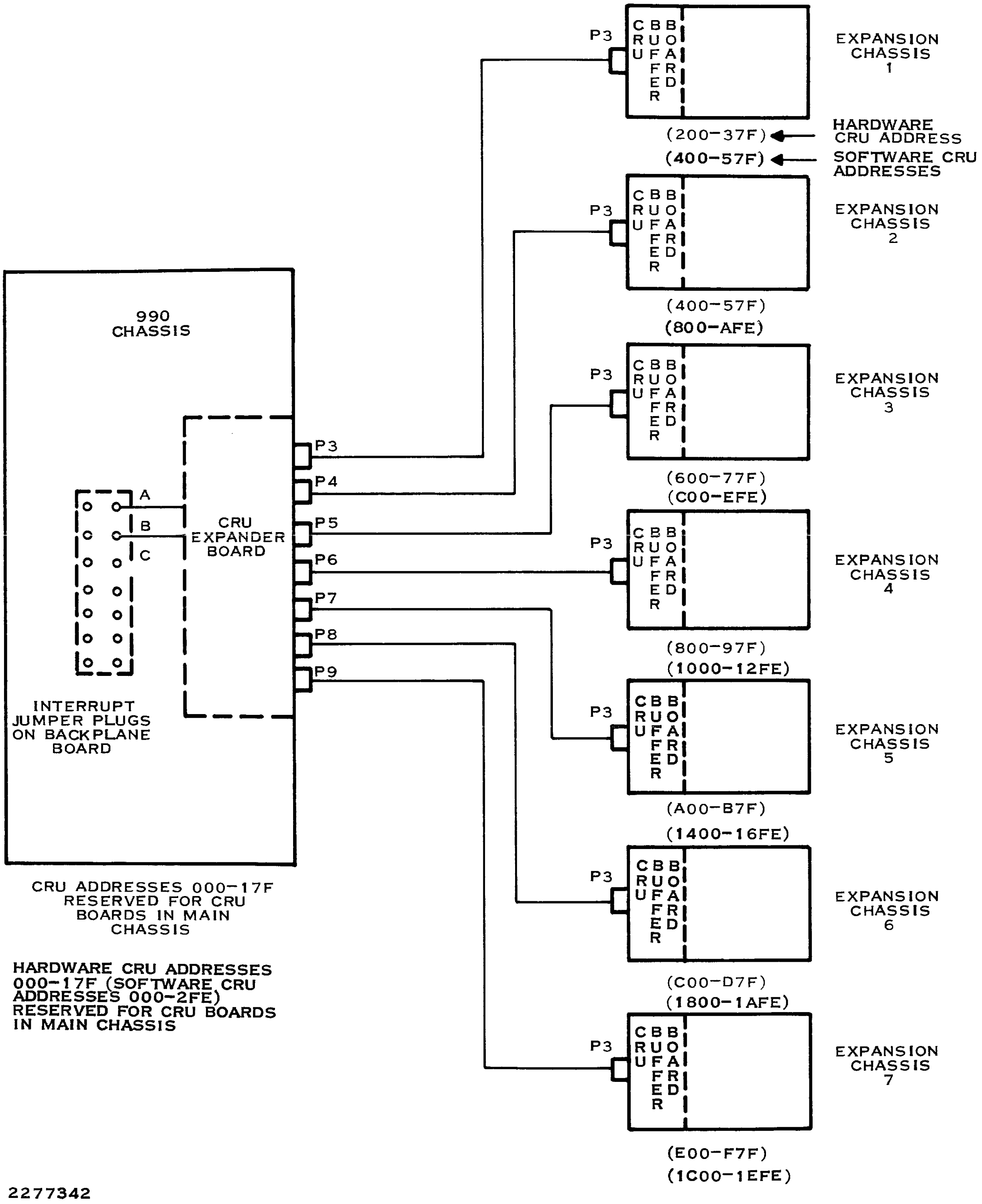

Figure 6-1. CRU Expansion Block Diagram

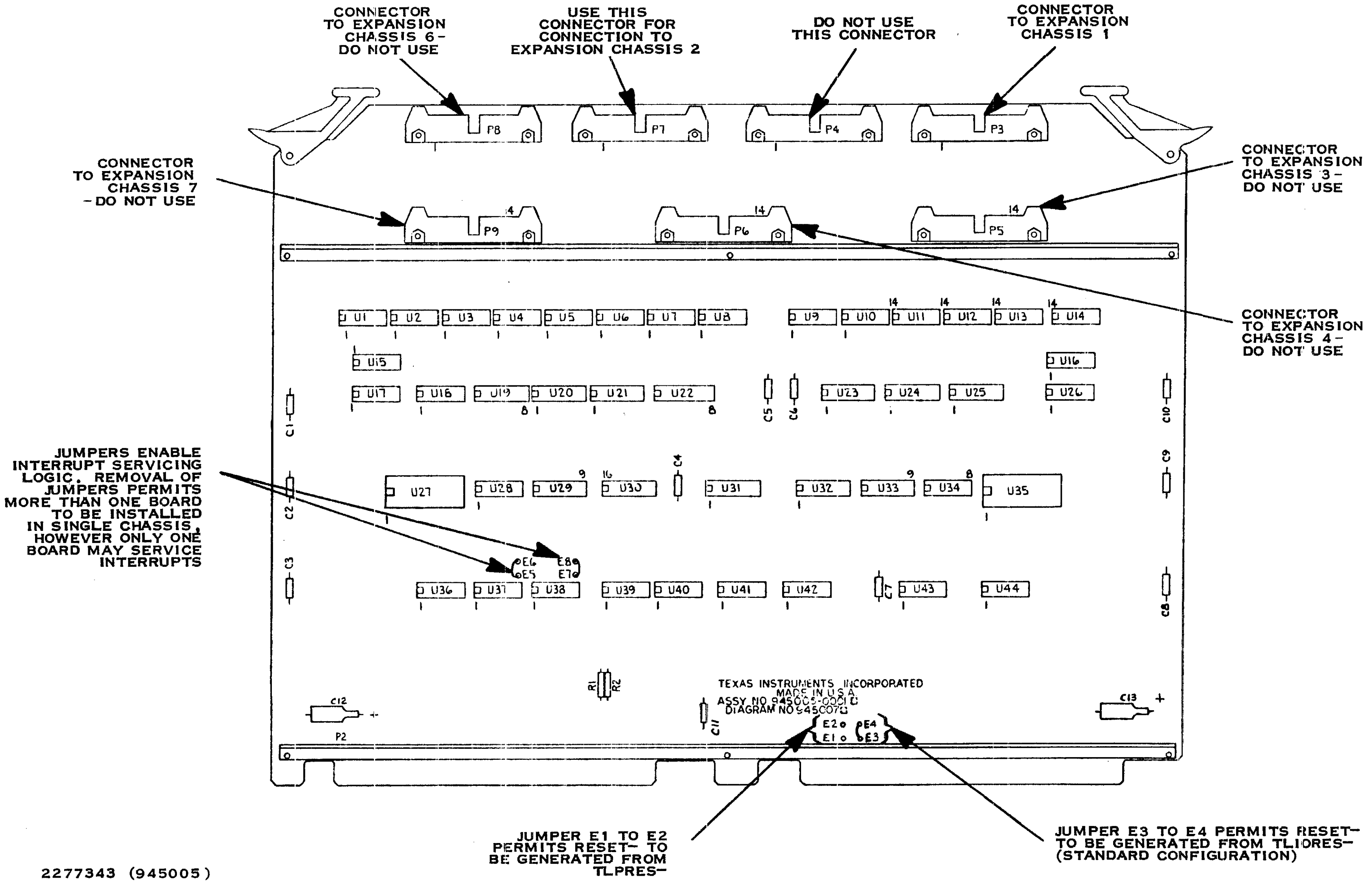

Figure 6-2. CRU Expansion Board Options, Previous Production

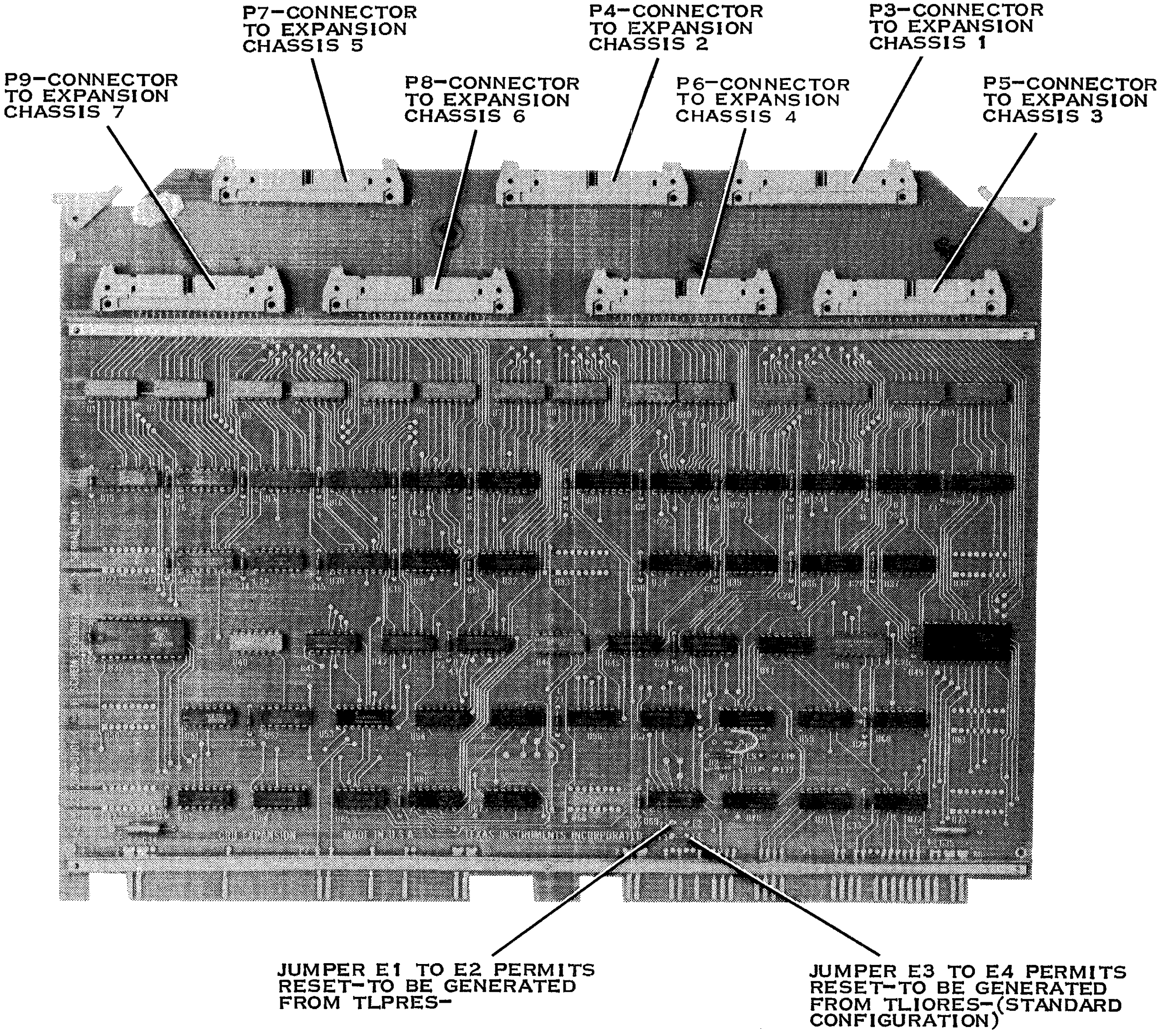

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Figure 6-3. CRU Expansion Board Options, Current Production

CC — Computer Chassis

Table 6-2. CRU Expansion Board Jumper Options

Reset Source	Jumper Options
IORES-	Jumper E3 to E4; open E1 to E2 (standard)
TLPRES-	Jumper E1 to E2; open E3 to E4
Interrupt section enabled	Jumper required (945005 only)
Section A (1-4)	Jumper E5 to E6 (standard)
Section B (5-7)	Jumper E7 to E8 (standard)

6.1.3 CRU Buffer Board

The CRU buffer board must be installed in slot 1 of each CRU expansion chassis. The previous production CRU buffer board (assembly 944905) is shown in Figure 6-4, and the current production CRU buffer board (assembly 2262075) is shown in Figure 6-5. The CRU buffer board in each expansion chassis must be programmed with the proper chassis ID, as shown in Table 6-3.

In the standard configuration, the chassis that is cabled to P3 on the CRU expansion board in the main chassis is designated chassis 1; the expansion chassis connected to J9 on the CRU expansion board is designated chassis 7; and the chassis between 1 and 7 are designated in ascending order. The chassis ID then must be programmed on the CRU buffer board that is installed in slot 1 of each expansion chassis. The chassis ID is set up by installing jumper plug P4 in the selected position, 1 through 7.

The CRU buffer board also contains provisions for bypassing the interrupt scanner for interrupt level 1 when a peripheral requiring fast interrupt response time is implemented in an expansion chassis. In this case, J1 is installed in DI1 and DI2. For normal interrupt scanner processing of level 1, J1 is installed in DI3 and DI4.

For normal operation, the internal clock disable jumper must be removed between terminals E1 and E2. For maintenance purposes, the interal clock can be disabled by installing this jumper. An external clock may be connected to the board via terminal E3, and the scan counter may be reset by momentarily applying a ground to terminal E4. The CRU buffer board options are summarized in Table 6-3.

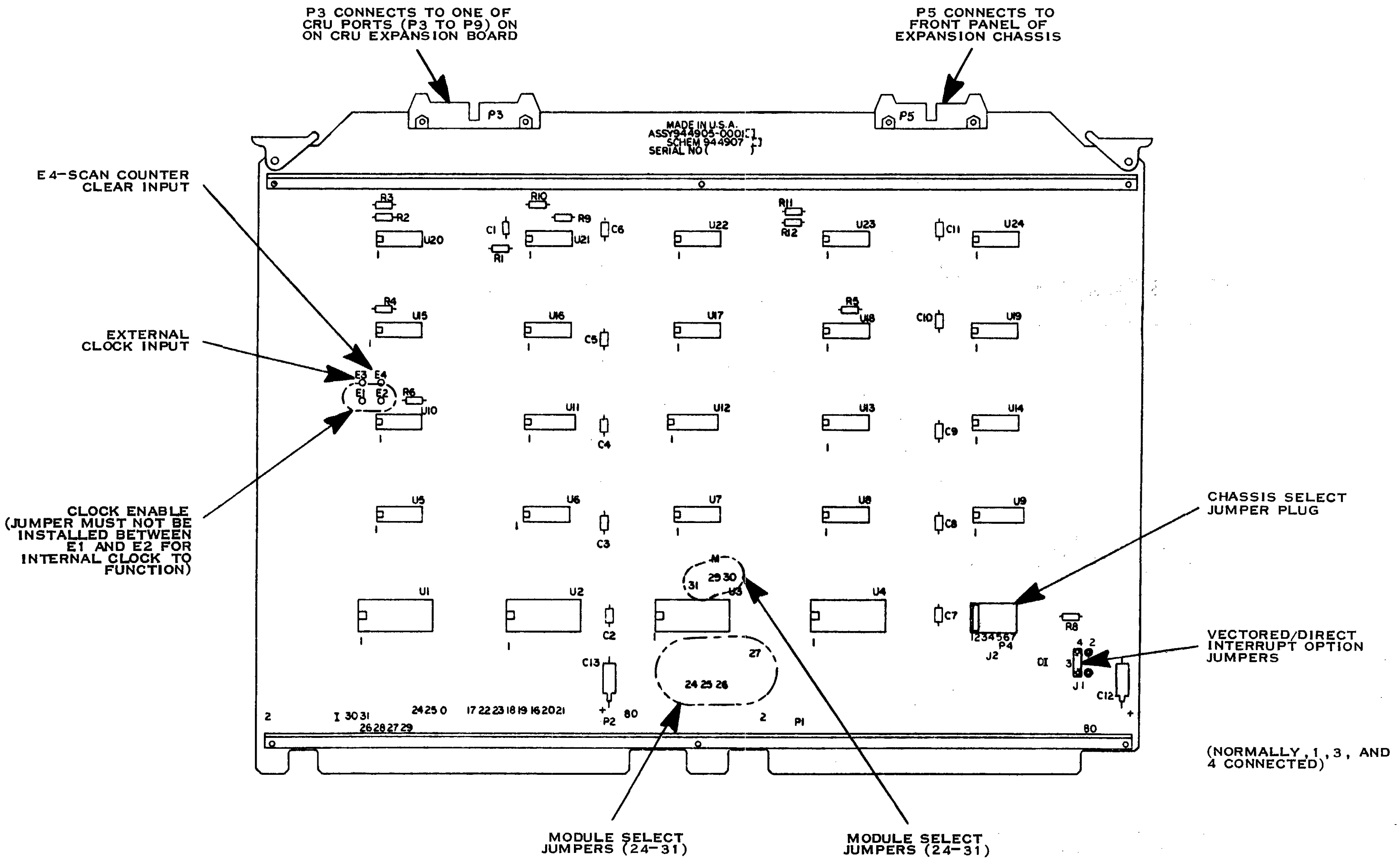

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Figure 6-4. CRU Buffer Board Options, Previous Production

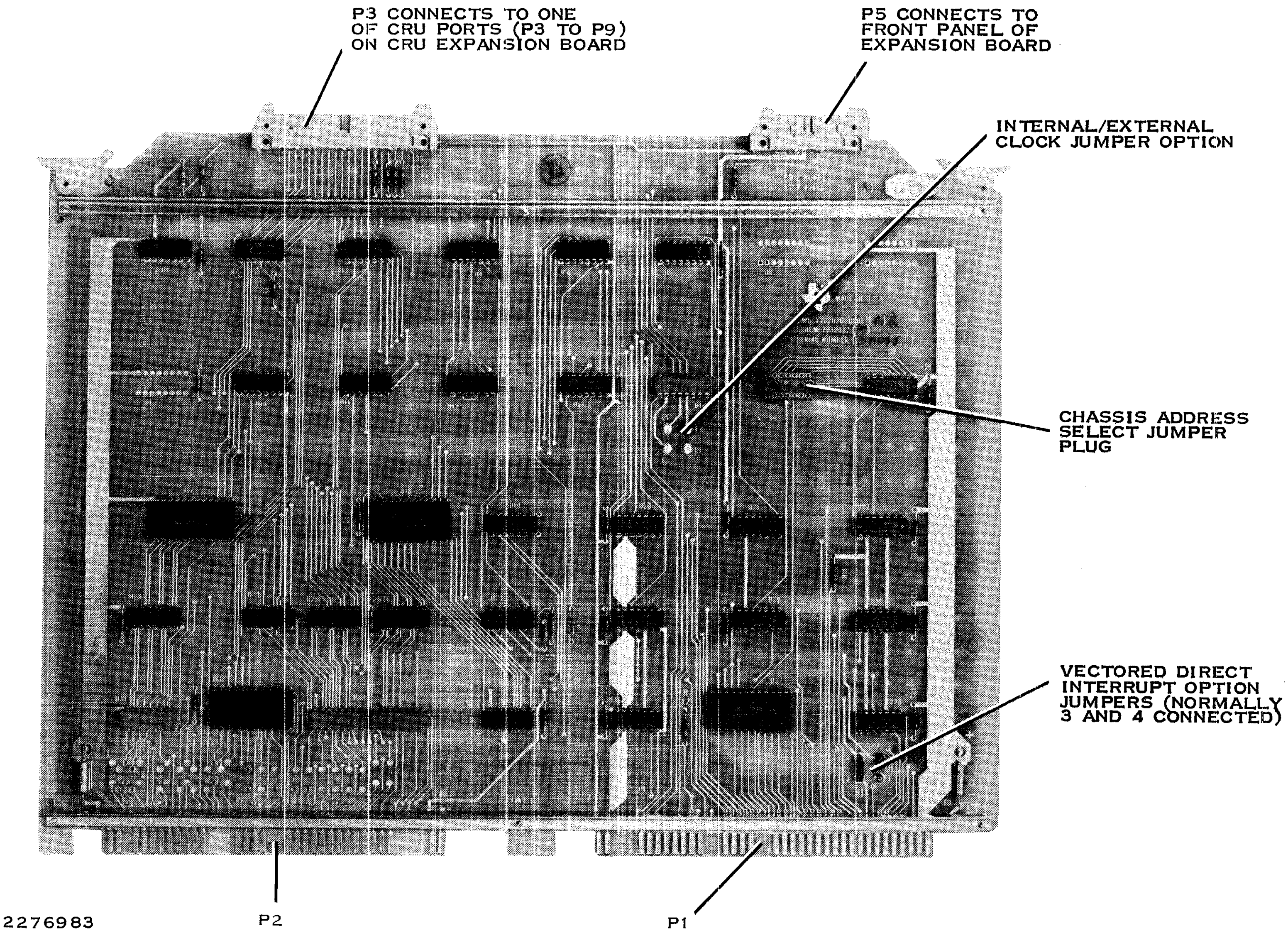


Figure 6-5. CRU Buffer Board Options, Current Production

Table 6-3. CRU Buffer Board Jumper Options

Chassis ID Select	CRU Software Base Address (Hexadecimal)	P4 Jumper Location
1	0400	Position 1 of J2
2	0800	Position 2 of J2
3	0C00	Position 3 of J2
4	1000	Position 4 of J2
5	1400	Position 5 of J2
6	1800	Position 6 of J2
7	1C00	Position 7 of J2

Notes:

Internal Clock Option:	Jumper Required:
Normal operating system	E1 to E2 open (standard)
Clock disabled	E1 to E2 jumpered
Vectored,Direct Int. Option:	Jumper Required:
Level 1 vectored	J1 in DI3 and DI4 (standard)
Level 1 direct	J1 in DI1 and DI2

6.1.4 CRU Expansion Field-Replaceable Components

The field-replaceable components for the 990 CRU expansion chassis consist of the following:

Item	TI Part Number
CRU Buffer Board	0944905-0001
CRU Expansion Board	0945005-0001
CRU Buffer Board	2262075-0001
CRU Expansion Board	2262080-0001
CRU Expansion Cable	2262085-0001

7

TILINE Expansion Chassis

7.1 990 TILINE EXPANSION

990 TILINE expansion is accomplished by installation of a TILINE coupler in the main computer chassis and a TILINE coupler in the 990 expansion chassis. TILINE expansion is required only when a TILINE controller such as a master-slave disk or slave memory controller is installed in the expansion chassis.

TILINE coupling is identical for all DS990 computer systems in respect to system hardware. The major difference between various configurations is the way the switches and jumpers are configured on the TILINE coupler boards. The TILINE coupler circuit board is shown in Figure 7-1.

Normally, when both CRU and TILINE devices or when multiple TILINE master devices are installed in the expansion chassis, all interrupts of these CRU and/or TILINE devices are routed to the main chassis through the CRU expansion boards. The TILINE coupler interrupt handling is usually used only if there is only one master device in the chassis, and only if CRU expansion is not used.

There are two cables required between the two couplers, a 40-pin ribbon cable, part number 946756, and a 20-pin ribbon cable, part number 945089. The P1 connector of both cables connects to the coupler in the expansion chassis, and the P2 connector of the cables connects to the coupler in the main chassis. The cabling configuration is shown in Figure 7-2.

What a TILINE coupler is installed in a chassis slot, the TLAG jumper for that slot must be removed. However. this jumper must be installed for all slots when TILINE master devices are not installed to preserve the continuity of this line between the CPU and the highest priority master device. TILINE access granted allows positional priority on any TILINE bus. This priority scheme gives the highest numbered slot the highest device priority on the TILINE. This is especially important when device controllers have very little or no buffering and when device speed must be considered.

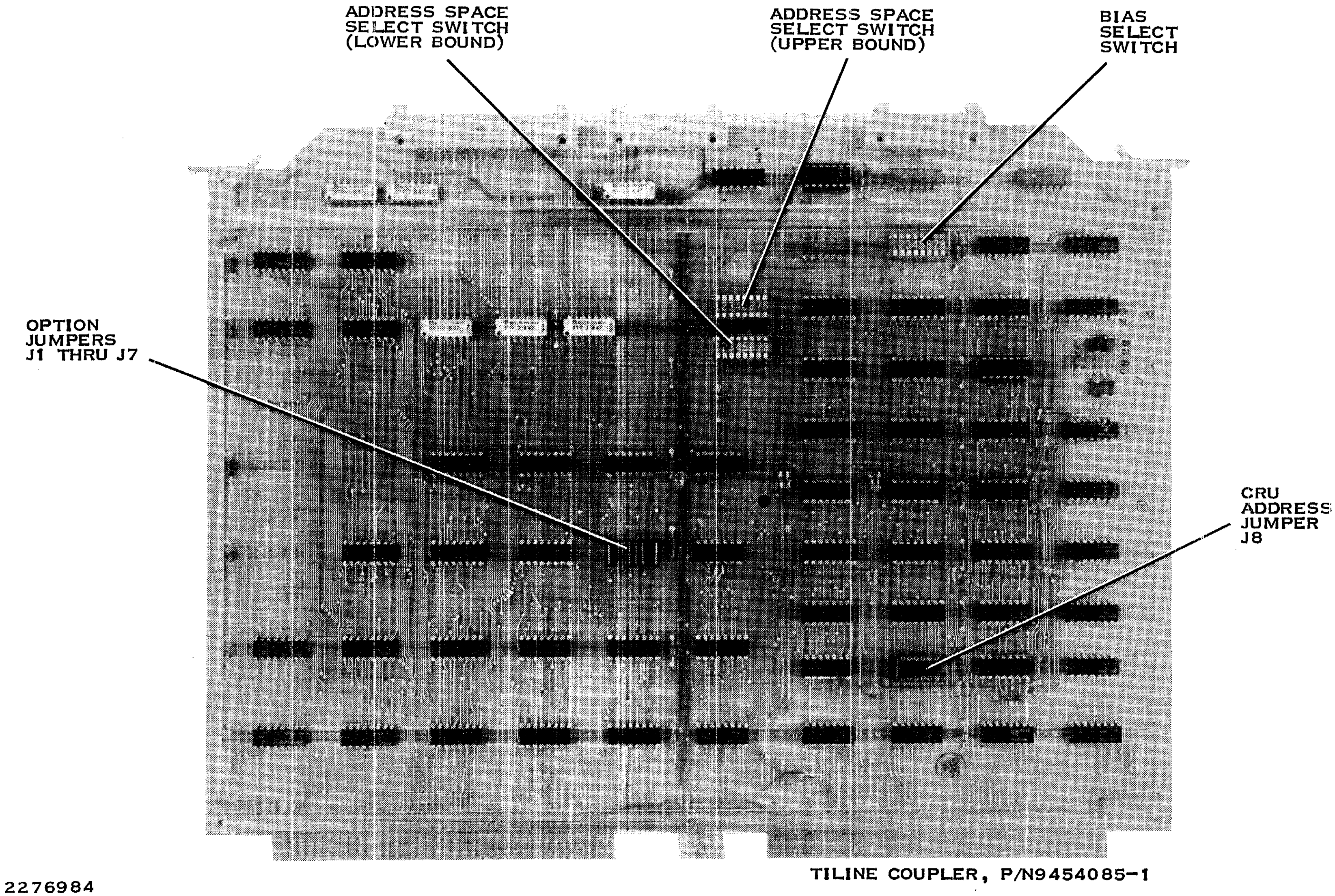
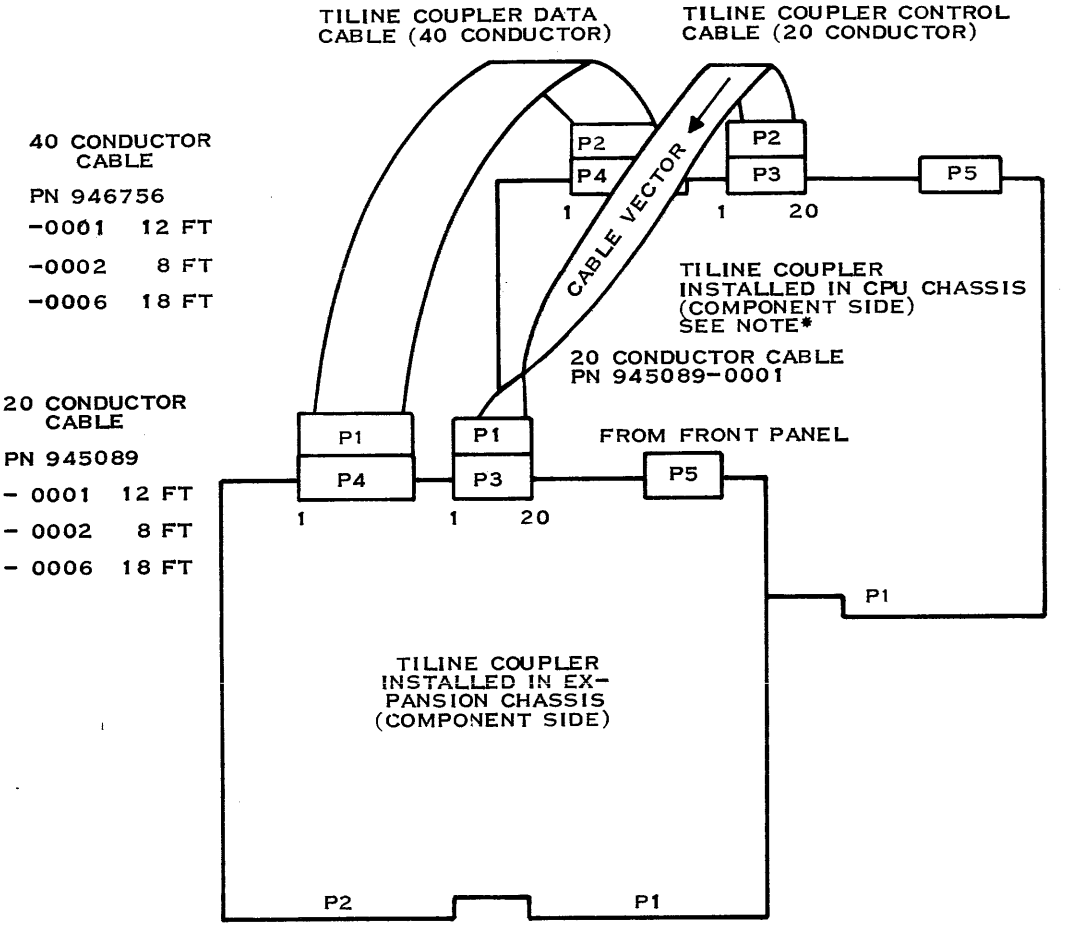


Figure 7-1. TILINE Coupler Options



*NOTE: P2 CONNECTOR ON CABLES SHOULD BE INSTALLED IN CPU CHASSIS. P1 CONNECTOR SHOULD BE INSTALLED IN EXPANSION CHASSIS. (P1 OF THE CONTROL CABLE WILL HAVE PIN 11 MISSING.) FOR PROPER INSTALLATION, CONTROL CABLE REQUIRES A HALF TWIST AS SHOWN. CABLE VECTOR MUST POINT AWAY FROM CPU CHASSIS. INSTALL JUMPER J5 ON TILINE COUPLER IN CPU CHASSIS ONLY.

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Figure 7-2. TILINE Expansion Cabling

7.1.1 TILINE Coupler Jumper Options

Each TILINE coupler includes a CRU interface for a maskable interrupt feature (Table 7-1), and a direct nonmaskable interrupt that may be jumper-selected as an incoming or outgoing interrupt. If the TILINE coupler is used with CRU expansion boards, the expansion chassis TILINE controller interrupt may be passed to the main chassis via the CRU expansion.

7.1.1.1 CRU Dedicated Start Address Option. The CRU section of the TILINE coupler may be assigned a dedicated start address beginning at one of eight different addresses controlled by the position of jumper J8, as illustrated in Table 7-1.

CC — Computer Chassis

7.1.1.2 Optional Interrupt Configurations. In addition to the CRU starting address jumper, four other jumpers (J1-J4) may be used to set up a wide variety of interrupt configurations. These jumpers are defined in Table 7-1 and shown in Figure 7-3. The TILINE coupler is capable of handling a single interrupt. When this interrupt is used for a TILINE device in the expansion chassis, it cannot be used for any other device.

Table 7-1. TILINE Coupler Jumper Options

Jumper	Option
J1	When installed, sends out a direct nonmaskable interrupt.
J2	When installed, brings in a direct nonmaskable interrupt.
J3	When installed, sends out a CRU maskable CRU-sourced interrupt.
J4	When installed, sends out a CRU maskable CRU-sourced interrupt.
J5	When inserted in the local TILINE coupler, allows TILINE IORES- to be sent to the remote chassis.
J6	When inserted in the local TILINE coupler, enables the remote chassis to be written to. Remove J6 for read only.
J7	When inserted, disables TPCS addresses to the remote TILINE coupler chassis (unless the addresses are allowed by lower bound and upper bound switch settings). Remove J7 to enable TPCS addresses.
J8	Selects the CRU maskable interrupt CRU base address. Position 1 is standard.

Notes:

1. J5 should be installed only in one coupler of a pair.
2. J3 and J4 can be left out if no remote CPU is used. Only one of these jumpers should be selected.
3. Either J1 or J2 must be installed.
4. J8 — The CRU maskable interrupt base address is in the range of >1F40 to >1F5C, and is selected as follows:

J8 Jumper Positions	CRU Base Address (hexadecimal)
1	1F40
2	1F44
3	1F48
4	1F4C
5	1F50
6	1F54
7	1F58
8	1F5C

7.1.1.3 IORESET Jumper Option. IORESET may be propagated to the remote chassis by inserting jumper J5. Propagation of IORESET is disabled by removing jumper J5 at the originating coupler.

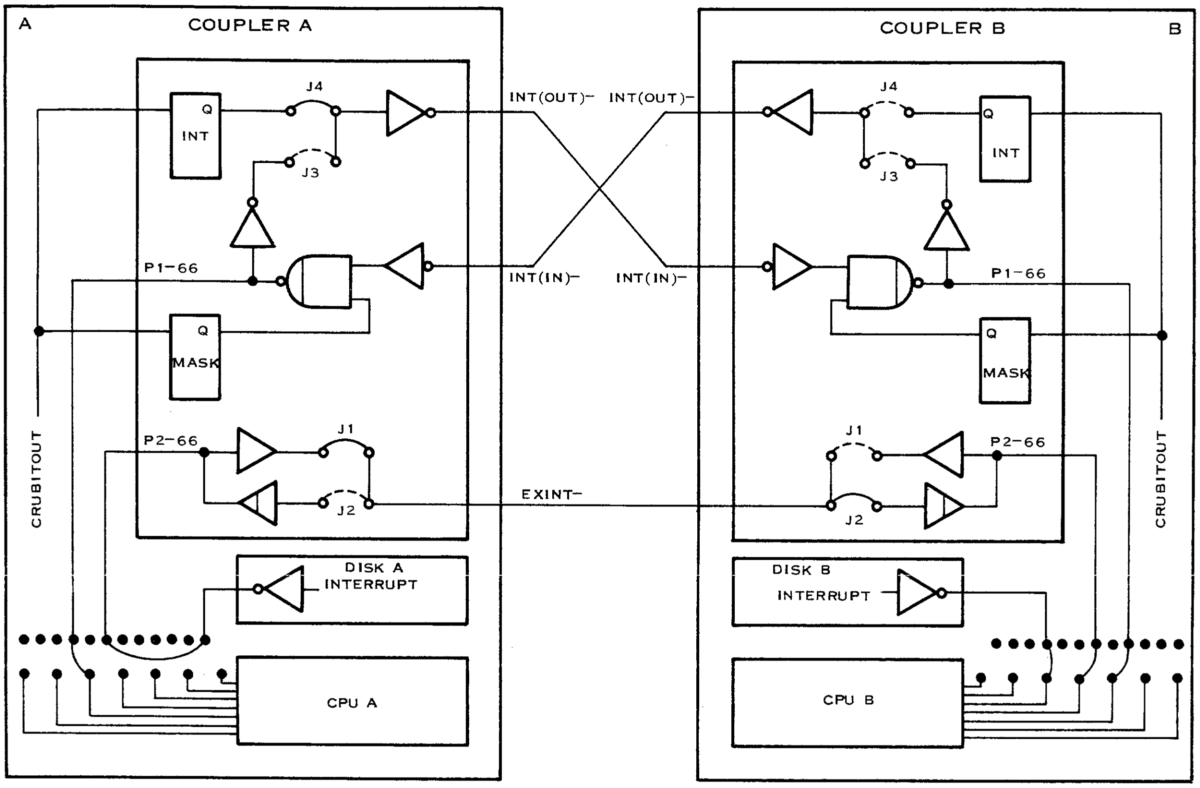

Figure 7-3. TILINE Coupler Interrupt Circuitry, Block Diagram

7.1.2 TILINE Coupler Configurations

In summary, the following are standard TILINE coupler configurations:

1. Main chassis TILINE coupler configuration:
   a. Jumpers installed: J2, J5, J6 (J7 if expansion chassis contains memory only)
   b. Jumper location J8: Position 1 is standard
   c. Addressing with all memory installed in the main chassis:
      (1) Bias switches: All ON
      (2) Lower bound switches: All OFF
      (3) Upper bound switches: All ON
   d. Addressing with memory installed in the expansion chassis
      (1) Bias switches: All ON
      (2) Lower bound switches: Refer to addressing chart, Table 7-2
      (3) Upper bound switches: Refer to addressing chart, Table 7-3
2. Expansion chassis TILINE coupler configuration:
   a. Jumpers installed: J1, J6
   b. Jumper location J8: Position 1 is standard
   c. Bias switches: All ON
   d. Lower bound switches: Refer to addressing chart, Table 7-2
   e. Upper bound switches: Refer to addressing chart, Table 7-3

Table 7-2. TILINE Coupler Switch Addressing, Lower Bounds

NOTE

TILINE coupler, part number 0945085, switch addressing 0 - 512K words (number of rows means the quantity of rows that are addressed below the target location). The switch addresses in 4K increments.

	Number of Rows			(1 = OFF, 0 = ON)							
K Words	**4K**	**16K**	**64K**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0	0	0	0	0	0	0	0	0	0	0	0
4	1	–	–	0	0	0	0	0	0	0	1
16	4	1	–	0	0	0	0	0	1	0	0
32	8	2	–	0	0	0	0	1	0	0	0
48	12	3	–	0	0	0	0	1	1	0	0
64	16	4	1	0	0	0	1	0	0	0	0
80	20	5	–	0	0	0	1	0	1	0	0
96	24	6	–	0	0	0	1	1	0	0	0
112	28	7	–	0	0	0	1	1	1	0	0
128	32	8	2	0	0	1	0	0	0	0	0
144	36	9	–	0	0	1	0	0	1	0	0
160	40	10	–	0	0	1	0	1	0	0	0
176	44	11	–	0	0	1	0	1	1	0	0
192	48	12	3	0	0	1	1	0	0	0	0
208	52	13	–	0	0	1	1	0	1	0	0
224	56	14	–	0	0	1	1	1	0	0	0
240	60	15	–	0	0	1	1	1	1	0	0
256	64	16	4	0	1	0	0	0	0	0	0
272	68	17	–	0	1	0	0	0	1	0	0
288	72	18	–	0	1	0	0	1	0	0	0
304	76	19	–	0	1	0	0	1	1	0	0
320	80	20	5	0	1	0	1	0	0	0	0
336	84	21	–	0	1	0	1	0	1	0	0
352	88	22	–	0	1	0	1	1	0	0	0
368	92	23	–	0	1	0	1	1	1	0	0
384	96	24	6	0	1	1	0	0	0	0	0
400	100	25	–	0	1	1	0	0	1	0	0
416	104	26	–	0	1	1	0	1	0	0	0
432	108	27	–	0	1	1	0	1	1	0	0
448	112	28	7	0	1	1	1	0	0	0	0
464	116	29	–	0	1	1	1	0	1	0	0
480	120	30	–	0	1	1	1	1	0	0	0
496	124	31	–	0	1	1	1	1	1	0	0
512	128	32	8	1	0	0	0	0	0	0	0

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Table 7-3. TILINE Coupler Switch Addressing, Upper Bounds

NOTE

1. TILINE coupler, part number 0945085, upper bound switch addressing 0 - 512K words (number of rows means the number of rows from address zero to the highest number address desired). The switch addresses in 4K increments.

2. The TILINE coupler bias switches should all be on.

	Number of Rows			(1 = OFF, 0 = ON)							
K Words	**4K**	**16K**	**64K**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
4	1	-	-	0	0	0	0	0	0	0	0
16	4	1	-	0	0	0	0	0	0	1	1
32	8	2	-	0	0	0	0	0	1	1	1
48	12	3	-	0	0	0	0	1	0	1	1
64	16	4	1	0	0	0	0	1	1	1	1
80	20	5	-	0	0	0	1	0	0	1	1
96	24	6	-	0	0	0	1	0	1	1	1
112	28	7	-	0	0	0	1	1	0	1	1
128	32	8	2	0	0	0	1	1	1	1	1
144	36	9	-	0	0	1	0	0	0	1	1
160	40	10	-	0	0	1	0	0	1	1	1
176	44	11	-	0	0	1	0	1	0	1	1
192	48	12	3	0	0	1	0	1	1	1	1
208	52	13	-	0	0	1	1	0	0	1	1
224	56	14	-	0	0	1	1	0	1	1	1
240	60	15	-	0	0	1	1	1	0	1	1
256	64	16	4	0	0	1	1	1	1	1	1
272	68	17	-	0	1	0	0	0	0	1	1
288	72	18	-	0	1	0	0	0	1	1	1
304	76	19	-	0	1	0	0	1	0	1	1
320	80	20	5	0	1	0	0	1	1	1	1
336	84	21	-	0	1	0	1	0	0	1	1
352	88	22	-	0	1	0	1	0	1	1	1
368	92	23	-	0	1	0	1	1	0	1	1
384	96	24	6	0	1	0	1	1	1	1	1
400	100	25	-	0	1	1	0	0	0	1	1
416	104	26	-	0	1	1	0	0	1	1	1
432	108	27	-	0	1	1	0	1	0	1	1
448	112	28	7	0	1	1	0	1	1	1	1
464	116	29	-	0	1	1	1	0	0	1	1
480	120	30	-	0	1	1	1	0	1	1	1
496	124	31	-	0	1	1	1	1	0	1	1
512	128	32	8	0	1	1	1	1	1	1	1

7.1.3 TILINE Expansion Replaceable Components

The TILINE expansion replaceable components are as follows:

Item	Part Number
TILINE Coupler Circuit Board	0945085-0001
40-Pin Data Cable, 3.66-meter (12-foot)	0946756-0001
40-Pin Data Cable, 5.48-meter (18-foot)	0946756-0006
40-Pin Data Cable, 2.4-meter (8-foot)	0946756-0002
20-Pin Control Cable, 3.66-meter (12-foot)	0945089-0001
20-Pin Control Cable, 5.48-meter (18-foot)	0945089-0006
20-Pin Control Cable, 2.4-meter (8-foot)	0945089-0002

Contents

DT — Data Terminals

Paragraph Title Page

1 — 911 Video Display Terminal

2 — 733 ASR/KSR Data Terminal

3 — 743 KSR Data Terminal

4 — 820 KSR Data Terminal

DT — Data Terminals

Illustrations

DT — Data Terminals

Tables

1

911 Video Display Terminal

1.1 911 VIDEO DISPLAY TERMINAL (VDT)

The Model 911 VDT (Figure 1-1) is a data entry/retrieval terminal for use on the CRU interface of the 990 computer.

Reference manuals for use with the 911 VDT are as follows:

- *Model 990 Computer Model 911 Video Display Terminal, Installation and Operation*, part number 945423-9701.
- *Model 990 Computer DS990 Peripheral Equipment Field Maintenance Manual*, part number 945419-9701.
- *Model 990 Computer Model 911 Video Display Terminal Depot Maintenance Manual*, part number 945424-9701.

1.2 GENERAL INFORMATION

The 911 VDT contains the following parts:

- CRT monitor
- PWB with interface electronics and power supply
- Control/adjustment circuit board
- Audio loudspeaker
- Keyboard assembly

Operator adjustments for display BRIGHTNESS, power ON/OFF, and audio VOLUME are provided on the right side of the unit housing. A row of LEDs on the rear of the unit allow monitoring of the data being generated on the keyboard. The operator controls are shown in Figure 1-2, and the data indicators are shown in Figures 1-3 and 1-4.

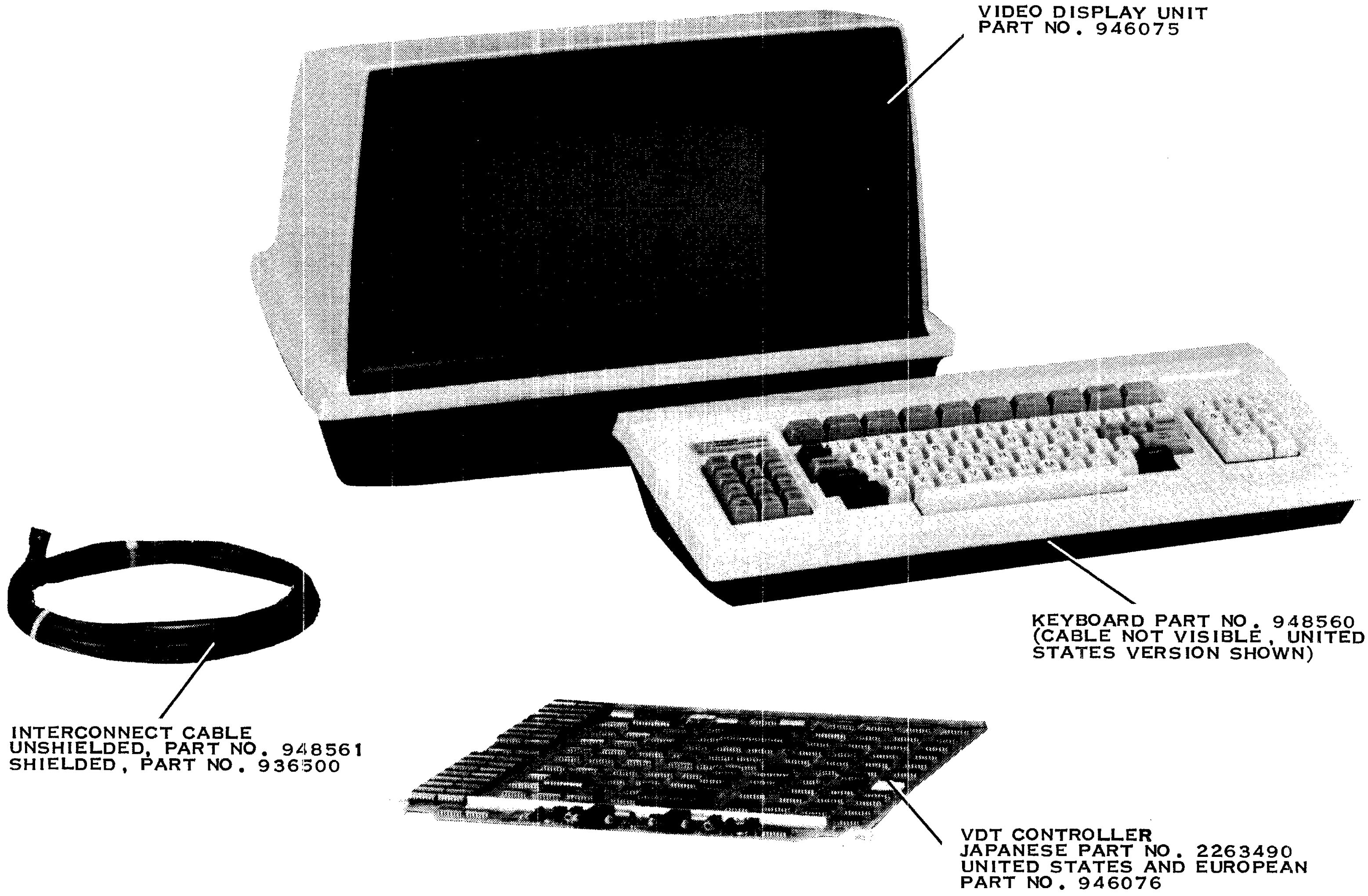


Figure 1-1. Basic 911 VDT Kit

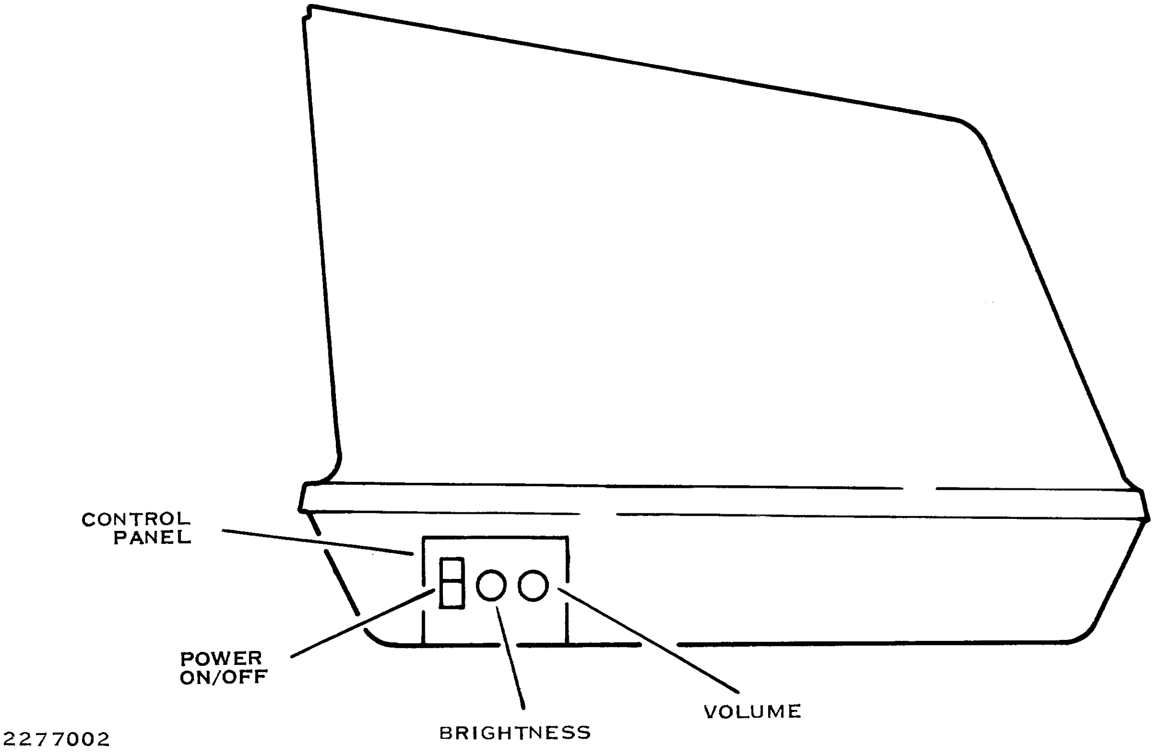


Figure 1-2. Monitor Unit Control Panel

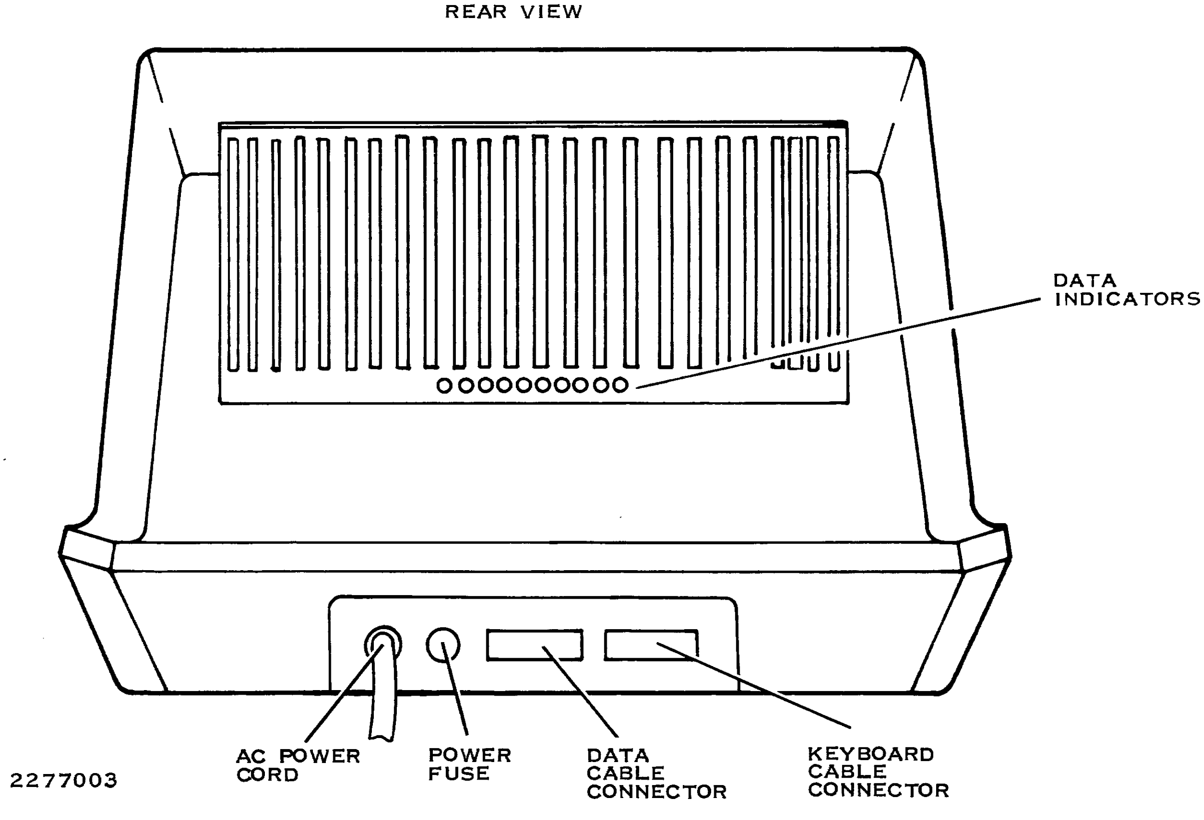


Figure 1-3. Data Indicators Location

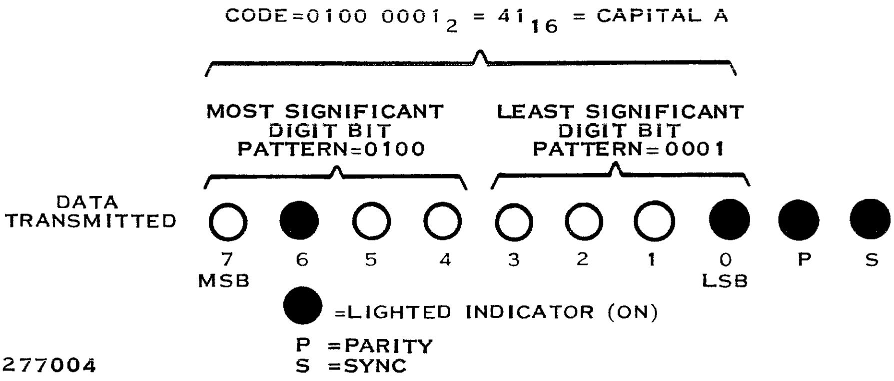


Figure 1-4. Data Indicators Sample Pattern

1.3 DATA INDICATORS

The data indicator LEDs along with a sample pattern are shown in Figure 1-4.

NOTE

> Data indicators on a few 911 VDT units in the field are deliberately disabled because of a lack of driving capability. If all LEDs are extinguished, they may be disabled.

When lit, the synchronization indicator (S) shows that the video sync pulse is being received from the 911 VDT controller. This indicator should always be lit if computer interface cables are properly installed, computer and VDT power are on, and the VDT controller is inserted in the chassis and is working properly.

When lit, the parity indicator (P) shows that the parity bit sent to the VDT 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 VDT controller.

The remaining indicators display the code of the character last entered on the keyboard. The indicators light to display a logic 1 bit, and remain dark to display a logic 0 bit. Figure 1-4 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.

1.4 INTERNAL COMPONENTS AND FIELD ADJUSTMENTS

The internal components of the 911 VDT are shown in Figures 1-5 and 1-6. The components that are field-replaceable are listed in Paragraph 1.9. A typical decal installed inside of the top cover (Figure 1-7) shows the adjustments that are available for three different models: Motorola, Ball, and Zenith. When making adjustments, be sure to use that portion of the decal that applies to the manufacturer of the VDT. Field adjustments are as follows:

- Vertical hold
- Vertical height
- Focus
- Brightness
- Width

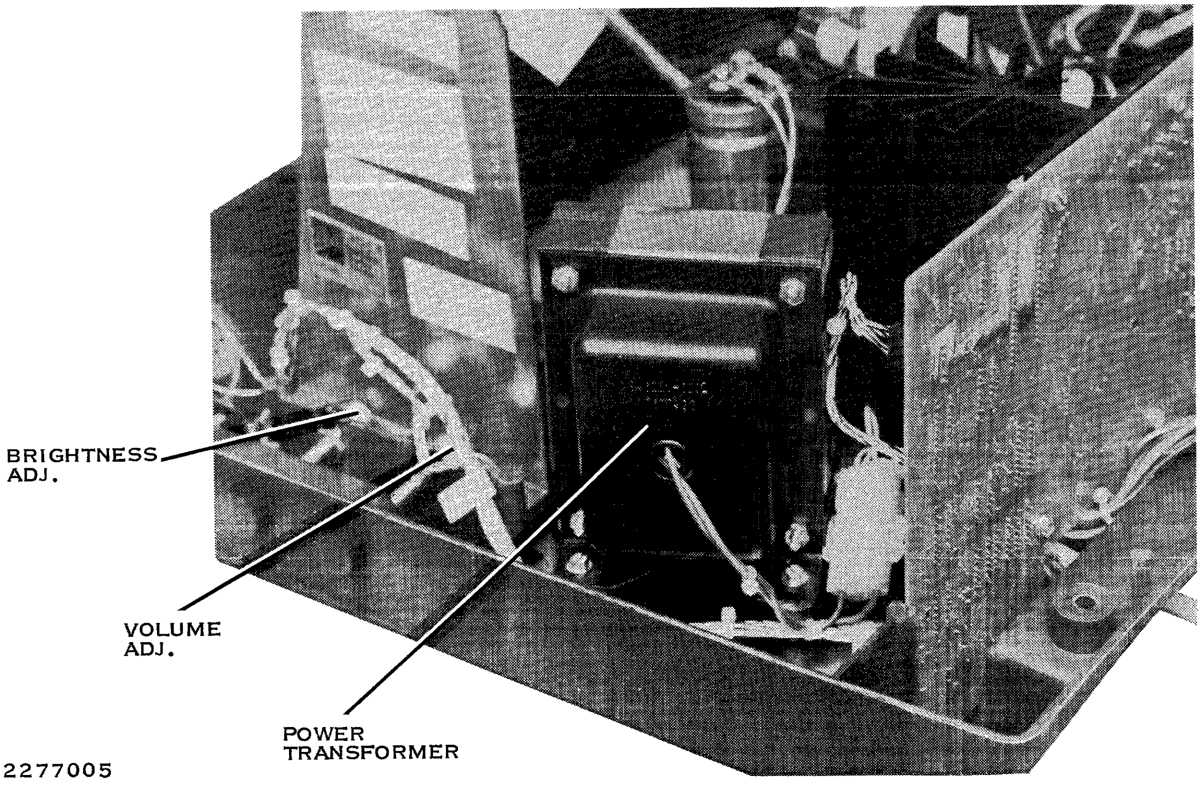


Figure 1-5. 911 VDT Internal Components, Right-Hand View

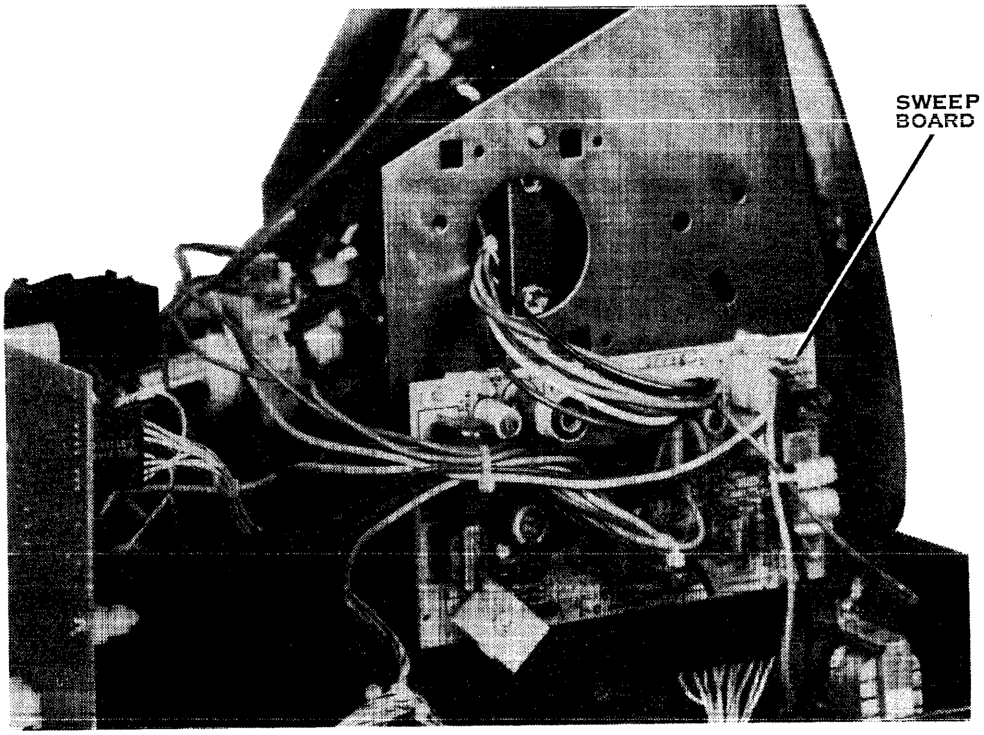
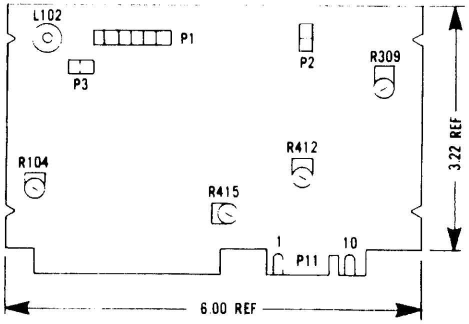


Figure 1-6. 911 VDT Internal Components, Left-Hand View

1.5 911 VDT KEYBOARD

The keyboard consists of 88 keyswitches mounted on a PWB in the keyboard housing. The keyboard has a typewriter key cluster, a numeric pad, a cursor control pad, and a function key array. Figure 1-8 illustrates the standard keyboard arrangement. All keys are designated either data keys or mode keys. The three mode keys, SHIFT(2), CONTROL, and UPPERCASE LOCK select four keyboard modes (lowercase, uppercase, control, and shift); and the REPEAT key initiates the repeat function. The 83 data keys produce 8-bit ASCII codes. Table 1-1 lists the functions of the 911 keys supported by DX10.



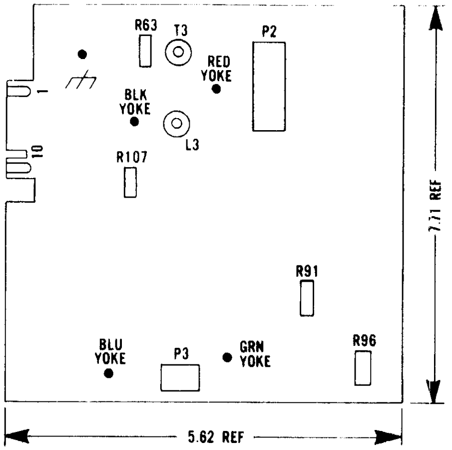
ZENITH CRT SWEEP BOARD

INTERCONNECTIONS		
CONNECTOR TO BOARD	WIRES ATTACHED TO CONNECTOR	DESTINATION
P1 6 PIN CONN	YEL; BLK; RED; BLU; VIO	FLYBACK
P2 2 PIN CONN	BLU; RED	VERTICAL YOLK
P3 2 PIN CONN	BLK; YEL	HORIZ YOLK

ADJUSTMENTS	
COMPONENT	FUNCTION
R104	VIDEO-HORIZ PHASE/CENTERING
R309	VERTICAL SIZE
R412	BRIGHTNESS
R415	FOCUS
L102	HORIZ WIDTH

NOTE: TWO OTHER CONNECTIONS ARE MADE TO THIS BOARD:
1.) 10 POSITION EDGE BOARD CONNECTOR (P11) OF WIRING HARNESS
2.) CRT CONNECTOR AT END OF WIRES SOLDERED TO CRT SWEEP BOARD

ZENITH INTERCONNECT AND ADJUSTMENT INFORMATION



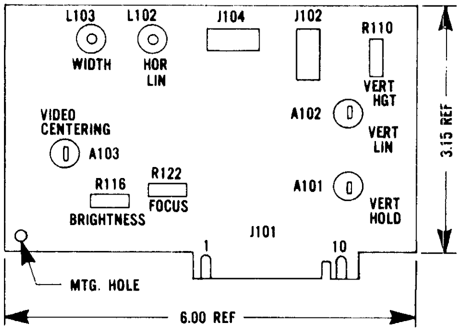
MOTOROLA CRT SWEEP BOARD

INTERCONNECTIONS		
CONNECTOR TO BOARD	WIRES ATTACHED TO CONNECTOR	DESTINATION
P2 6 PIN MOLEX	BLK; GRA. RED; YEL. WHT	FLYBACK
P3 2 PIN MOLEX	GRN. GRA	VERTICAL INDUCTOR
GRN YOKE 1 SOCKET	BLUE	YOKE
BLU YOKE 1 SOCKET	GRN	YOKE
RED YOKE 1 SOCKET	RED	YOKE
BLK YOKE 1 SOCKET	BLK	YOKE
⏚ 1 SOCKET	BLK	FLYBACK MTG. STUD

ADJUSTMENTS	
COMPONENT	FUNCTION
R63	FOCUS
R91	HEIGHT
R96	VERTICAL LINEARITY
R107	MASTER BRIGHTNESS
T3	"S" SHAPING
L3	WIDTH COIL

NOTE: TWO OTHER CONNECTIONS ARE MADE TO THIS BOARD:
1.) 10 POSITION EDGE BOARD CONNECTOR (P11) OF WIRING HARNESS
2.) CRT CONNECTOR AT END OF WIRES SOLDERED TO CRT SWEEP BOARD

MOTOROLA INTERCONNECT AND ADJUSTMENT INFORMATION



BALL CRT SWEEP BOARD

INTERCONNECTIONS		
CONNECTOR TO BOARD	WIRES ATTACHED TO CONNECTOR	DESTINATION
J104 7 PIN CONN	RED; ORN; BLU; YEL; BLK; WHT; BRN	FLYBACK
SOLDER	RED	YOKE-2
SOLDER	(NOTE 3) BLU	YOKE-3
J102	(NOTE 3) YEL	YOKE-1
J102	BRN	YOKE-4
J102	BLK; YEL	VERTICAL INDUCTOR
MTG. HOLE	MTG. HARDWARE	SHEET METAL

ADJUSTMENTS	
COMPONENT	FUNCTION
A101	VERTICAL HOLD
A102	VERTICAL LINEARITY
R110	VERTICAL HEIGHT
R116	BRIGHTNESS
R122	FOCUS
A103	VIDEO CENTERING
L102	HORIZ LINEARITY
L103	WIDTH COIL

NOTE: TWO OTHER CONNECTIONS ARE MADE TO THIS BOARD:
1.) 10 POSITION EDGE BOARD CONNECTOR (P11) OF WIRING HARNESS
2.) CRT CONNECTOR AT END OF WIRES SOLDERED TO CRT SWEEP BOARD
3.) YOKE WIRES MAY BE WHITE WITH COLORED STRIPES

BALL INTERCONNECT AND ADJUSTMENT INFORMATION

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Figure 1-7. 911 VDT Decal Showing Internal Adjustments

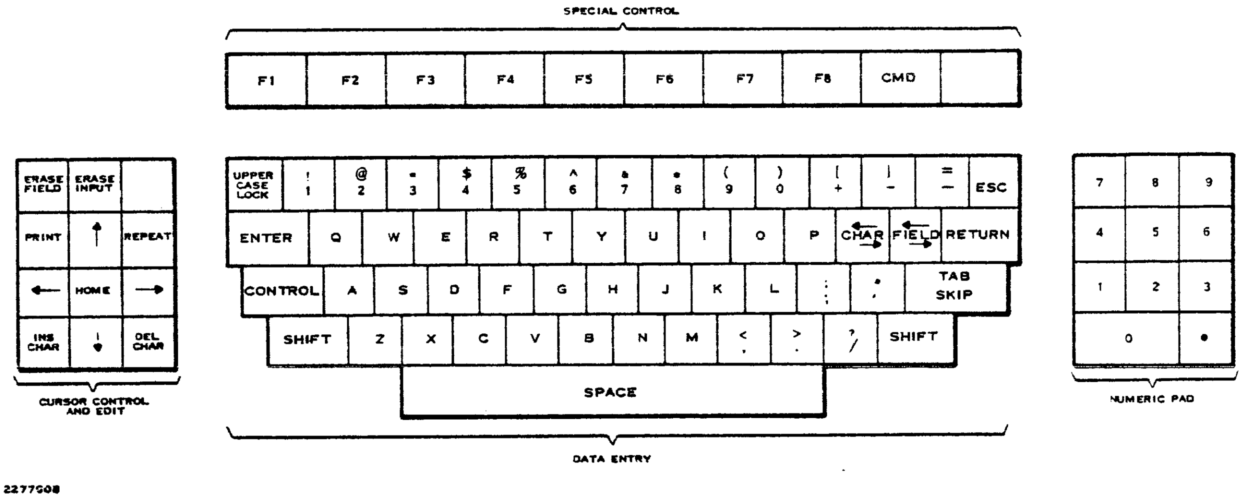

Figure 1-8. Standard 911 VDT Keyboard

Table 1-1. Function of 911 VDT Keys Supported by DX10

Key	Function
Alphanumeric	Press the alphabetical, numeric, or special character keys to enter information such as commands, parameters, and responses to requests for information.
Arrow keys	Right (——→) and left (←——) arrow keys move the cursor right or left one character position on the display screen in the direction shown by the arrow. Up (↑) and down (↓) arrow keys increment or decrement the cursor one line.
CONTROL	Holding the CONTROL key down and pressing a character key causes the character key to be a control character.
DEL CHAR	This key deletes the character over which the cursor is positioned. Any character or character string to the right of the cursor 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, 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 while pressing a data entry key causes the computer to repeat the character specified by the data entry key or space bar. The character repeats until the REPEAT key is released.

Table 1-1. Function of 911 VDT Keys Supported by DX10 (Continued)

Key	Function
RETURN	Pressing this key terminates entry of data into a field and submits the data entered to the computer for processing.
UPPERCASE LOCK	This key locks the terminal in the uppercase mode until the key is pressed a second time. This key affects only the alphabetic keys and does not affect the control keys or the numeric keys.
HOME	Pressing the HOME key positions the cursor to column 1, line 1 in the upper left-hand corner of the screen (the first unprotected character position).
ERASE INPUT	Pressing this key deletes the line the cursor is on and moves all following text up one line.
Blank Grey Key *	Pressing this key inserts a blank line where the cursor is resting and moves all following text down one line.
CHAR	Each time this key alone is pressed, the cursor moves to the left one character position (unless the cursor is at position 1). Each time this key is pressed while the SHIFT key is held down, the cursor moves to the right one character position.
FIELD	If the FIELD key is pressed while the SHIFT key is held down, the cursor moves to column 80. If the SHIFT key alone is pressed when the cursor is at column 1, the cursor moves to the highest numbered tab setting. Each subsequent actuation of the FIELD key moves the cursor to the left to the next tab setting.
TAB SKIP	If the TAB SKIP key alone is pressed, all characters to the right of the cursor are deleted. If the TAB SKIP key is pressed while the SHIFT key is held down, the cursor moves to the right to the next tab setting.
CMD	Aborts the command currently accepting user responses and allows the user to enter another command.
Blank Orange	Temporarily stops output at a terminal. Pressing any alphabetic or numeric key continues output.
F1 (Scroll Up) *	Causes the display to be repositioned forward the number of lines specified by the roll parameter. The roll parameter may be changed by the MR command. The initial roll value is 12 lines.
F2 (Scroll Down) *	Causes the display to be repositioned back the number of records specified by the roll parameter. The roll parameter may be changed by the MR command. The initial roll value is 12 lines.
F4 (Duplicate to Tab) *	Causes duplication of the corresponding field from the previous line. This key does not cause field termination. The user may accept the duplicate field by pressing the RETURN key or may modify the duplicated field before accepting it.

Table 1-1. Function of 911 VDT Keys Supported by DX10 (Continued)

Key	Function
F5 (Delete to Tab) *	Causes the data from the current cursor position to the next tab stop or end of record position to be cleared.
F6 (Line Numbers) *	This key causes the display of or suppression of line numbers on the display. Successive depressions of the key cause the line numbers to be displayed, suppressed, displayed, and so on.
F7 (Edit/Compose) *	Successive depressions of this key causes the mode to switch from edit, to compose, to edit, and so on. The compose mode is used to enter a large volume of data into a file being edited or to create a new file. The edit mode is used to modify existing records in the current file, to delete records, or to insert relatively few records at the current position in the file.
F3, F8	Not supported by DX10.

Note:

* These keys are software programmable and their function may vary depending on the operating system.

NOTE

All commands and responses to commands must be entered in the uppercase mode.

1.6 911 VDT CONTROLLER

The 911 VDT controller is shown in Figure 1-9. The controller (labeled CRT) occupies a full chassis slot in either a main or expansion computer chassis. The controller contains the logic to support at least one (optionally two) keyboard/display combinations.

The LED on the controller lights whenever the computer performs an SBO (set CRU bit to logic 1) instruction to bit 9 or 19 to select either display section of the controller for self-test mode. The indicator may be lit as a flag in a multicontroller system to identify an inoperative controller. If either controller in a multicontroller system is in the self-test mode, the LED will be lit.

The various configurations of the 911 VDT controller are shown in Tables 1-2, 1-3, and 1-4.

1.7 CABLING CONFIGURATIONS

The cabling interconnections for the 911 VDT subsystem are shown in Figure 1-10. For interconnecting information, refer to the installation and operation manual.

1.8 FIELD-REPLACEABLE COMPONENTS, 911 VDT

The field-replaceable components for the 911 VDT are as follows:

Item	TI Part Number
911 Domestic Power Supply	0946084-0001
911 International Power Supply	0946084-0002
911 Keyboard Assembly (U.S.)	0948560-0001
911 Keyboard Assembly (Japan)	0948560-0002
911 Keyboard Assembly (Great Britain)	0948560-0003
911 Keyboard Assembly (France)	0948560-0004
911 Keyboard Assembly (Germany)	0948560-0005
911 Keyboard Assembly (Sweden/Finland)	0948560-0006
911 Keyboard Assembly (Denmark/Norway)	0948560-0007
911 Monitor	0948572-0002
911 Display Assembly (115 V, 60 Hz,1920 char)	0946075-0001
911 Display Assembly (110 V, 50 Hz,1920 char)	0946075-0002
911 Display Assembly (220 V, 50 Hz,1920 char)	0946075-0003
911 Display Assembly (240 V, 50 Hz,1920 char)	0946075-0004
911 Display Assembly (100 V, 60 Hz,1920 char)	0946075-0005
911 Controller Assembly (Japan 60 Hz)	2263490-0003
911 Controller Assembly (Japan 50 Hz)	2263490-0007
911 Controller Assembly, 60 Hz (U.S.)	0946076-0005
911 Controller Assembly, 50 Hz (European)	0946076-0011
911 Sweep Board	0943847-0001
Switch, Rocker, dpst 15 A 250 V	0972248-0002
Fuse, 1 A Slow Blow 250 V	0410822-0019
Fuse, 5 A Slow Blow 250 V	0410822-0014
Cable, Keyboard to Display	0948589-0001
Cable, Display to Controller	0948561-0001
Cable, Power Cord (100 V, 115 V)	0975522-0003
Cable, Power Cord (220 V, 240 V European)	2262122-0003
Capacitor, 16000 μF 30 V	0972050-0003
Capacitor, 6000 μF 20 V	0230972-9001
Capacitor, 2400 μF 50 V	0230964-5001
Power Transformer, Domestic 115 V	0946081-0002
Power Transformer, 100/200 V, 120/240 V	0946082-0002

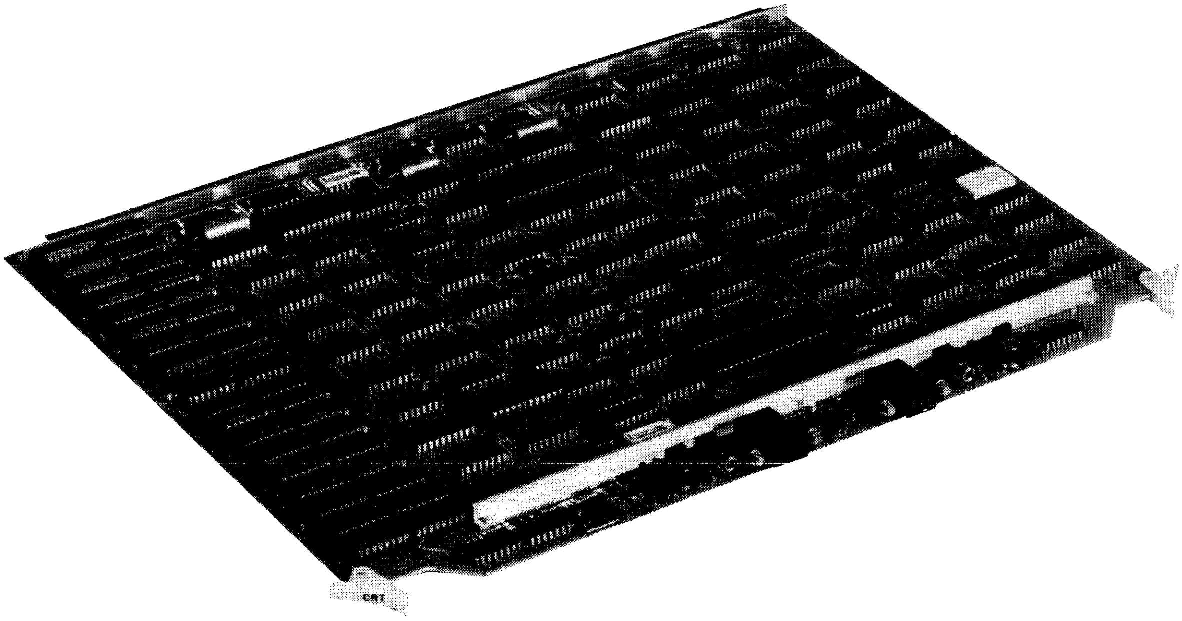

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Figure 1-9. Typical 911 VDT Controller Board

CONTROLLER ASSEMBLY PN946076 DASH NO.	TIMER ROMS PN948554			LINE COUNTER DEVICE TYPE U41	GRAPHIC ROM OPTION NETWORK LOCATIONS		GRAPHICS OPTION JUMPER PLUG P9	CURSOR ADDRESS JUMPER PLUGS	REQUIREMENT FOR SINGLE CONTROLLER HARDWARE JUMPERS U22 PIN 10 TO 16 U33 PIN 7 TO 16 U32 PIN 4 TO 16 U30 PIN 9 TO 8	REQUIRED MEMORY NETWORKS	DESCRIPTION D/S=DUAL/SNG F/H=1920/960 50/60 HZ G=GRAPHICS
	CHARACTER DECODER ROM DASH NO. U51	ROW DECODER ROM DASH NO. U52	SYNC DECODER ROM DASH NO. U42		LINE 8 PN972923-1	LINE 9 PN972923-2					
-1	-1	-2	-3	SN74162N			NONE	P6,P8, P10	NONE	U117 THRU U132 U137 THRU U152	D,F,60
-2	-1	-2	-3	SN74162N			NONE	P8,P10	YES	U137 THRU U152	S,F,60
-3	-1	-4	-5	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,60
-4	-1	-4	-5	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U138 THRU U152	S,H,60
-5	-1	-2	-3	SN74162N	U94,U24	U85,U23	YES	P6,P8, P10	NONE	U117 THRU U132 U137 THRU U152	D,F,60,G
-6	-1	-2	-3	SN74162N	U94	U85	YES	P8,P10	YES	U137 THRU U152	S,F,60,G
-7	-1	-6	-7	SN74162N			NONE	P6,P8, P10	NONE	U117 THRU U132 U137 THRU U152	D,F,50
-8	-1	-6	-7	SN74162N			NONE	P8,P10	YES	U137 THRU U152	S,F,50
-9	-1	-8	-9	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,50
-10	-1	-8	-9	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U138 THRU U152	S,H,50
-11	-1	-6	-7	SN74162N	U94,U24	U85,U23	YES	P6,P8, P10	NONE	U117 THRU U132 U138 THRU U152	D,F,50,G
-12	-1	-6	-7	SN74162N	U94,	U85	YES	P8,P10	YES	U137 THRU U152	S,F,50,G

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	-LOCATION		COUNTRY
	U35 NETWORK PART NO.	U105 NETWORK PART NO.	
-1	972894-1	972894-1	UNITED STATES
-2		972894-1	UNITED STATES
-3	972894-1	972894-1	UNITED STATES
-4		972894-1	UNITED STATES
-5	972894-1	972894-1	UNITED STATES
-6		972894-1	UNITED STATES
-7	972894-1	972894-1	UNITED STATES
-8		972894-1	UNITED STATES
-9	972894-1	972894-1	FRANCE
-10		972894-1	FRANCE
-11	972894-1	972894-1	FRANCE
-12		972894-1	FRANCE

Table 1-2. 911 VDT Controller Standard Configurations

CONTROLLER ASSEMBLY P/N946076 DASH NO.	TIMER ROMS PN948554			LINE COUNTER DEVICE TYPE U41	GRAPHIC ROM OPTION NETWORK LOCATIONS		GRAPHICS OPTION JUMPER PLUG P9	CURSOR ADDRESS JUMPER PLUGS	REQUIREMENTS FOR SINGLE CONTROLLER HARDWARE JUMPERS U22 PIN 10 TO 16 U33 PIN 7 TO 16 U32 PIN 4 TO 16 U30 PIN 9 TO 8	REQUIRED MEMORY NETWORKS	DESCRIPTION D/S=DUAL/ SNG F/H=1920/ 960 50/60HZ G=GRAPHICS
	CHARACTER DECODE ROM DASH NO. U51	ROW DECODER ROM DASH NO. U52	SYNC DECODER ROM DASH NO. U42		LINE 8 PN972923-1	LINE 9 PN972923-2					
-109	-1	-8	-9	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,50
-110	-1	-8	-9	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U138 THRU U152	D,H,50
-111	-1	-6	-7	SN74162N	U94,U24	U85,U23	YES	P6,P8, P10	NONE	U117 THRU U132 U138 THRU U152	D,F,50,G
-112	-1	-6	-7	SN74162N	U94	U85	YES	P5,P10	YES	U137 THRU U152	S,F,50,G
-209	-1	-8	-9	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,50
-210	-1	-8	-9	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U138 THRU U152	S,H,50
-211	-1	-7	-7	SN74162N	U94,U24	U85,U23	YES	P6,P8, P10	NONE	U117 THRU U132 U138 THRU U152	D,F,50,G
-212	-1	-6	-7	SN74162N	U94	U85	YES	P8,P10	YES	U137 THRU U152	S,F,50,G
-309	-1	-8	-9	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,50
-310	-1	-8	-9	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U138 THRU U152	S,H,50
-311	-1	-6	-7	SN74162N	U94,U24	U85,U23	YES	P6,P8, P10	NONE	U117 THRU U132 U138 THRU U152	D,F,50,G
-312	-1	-6	-7	SN74162N	U94	U85	YES	P8,P10	YES	U137 THRU U152	S,F,50,G

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	LOCATION		COUNTRY
	U35 NETWORK PART NO.	U105 NETWORK PART NO.	
-109	2263592-1	2263592-1	GREAT BRITAIN
-110		2263592-1	GREAT BRITAIN
-111	2263592 1	2263592-1	GREAT BRITAIN
-112		2263592-1	GREAT BRITAIN
-209	2263592-3	2263592-2	GERMANY
-210		2263592-2	GERMANY
-211	2263592-3	2263592-2	GERMANY
-212		2263592-2	GERMANY
-309	2263592-3	2263592-3	DENMARK NORWAY
-310		2263592-3	DENMARK NORWAY
-311	2263592-3	2263592-3	DENMARK NORWAY
-312		2263592-3	DENMARK NORWAY

Table 1-3. 911 VDT Controller International Configurations (Sheet 1 of 2)

CONTROLLER ASSEMBLY PN946076 DASH NO.	TIMER ROMS PN948554			LINE COUNTER DEVICE TYPE U41	GRAPHIC ROM OPTION NETWORK LOCATIONS		GRAPHICS OPTION JUMPER PLUG P9	CURSOR ADDRESS JUMPER PLUGS	REQUIREMENTS FOR SINGLE CONTROLLER HARDWARE JUMPERS U22 PIN 10 TO 16 U33 PIN 7 TO 16 U32 PIN 4 TO 16 U30 PIN 9 TO 8	REQUIRED MEMORY NETWORKS	DESCRIPTION D/S=DUAL/SNG F/H=1920/960 50/60HZ G=GRAPHICS	LOCATION		COUNTRY
	CHARACTER DECODE ROM DASH NO. U51	ROW DECODER ROM DASH NO. U52	SYNC DECODER ROM DASH NO. U42		LINE 8 PN972923-1	LINE 9 PN972923-2						U35 NETWORK PART NO.	U105 NETWORK PART NO.	
-409	-1	-8	-9	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,50	2263592-4	2263592-4	FINLAND SWEDEN
-410	-1	-8	-9	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U138 THRU U152	S,H,50		2263592-4	FINLAND SWEDEN
-411	-1	-6	-7	SN74162N	U94,U24	U85,U23	YES	P6,P8 P10	NONE	U117 THRU U132 U138 THRU U152	D,F,50,G	2263592-4	2263592-4	FINLAND SWEDEN
-412	-1	-6	-7	SN74162N	U94	U85	YES	P8,P10	YES	U137 THRU U152	S,F,50,G		2263592-4	FINLAND SWEDEN

2277012 (2/2)

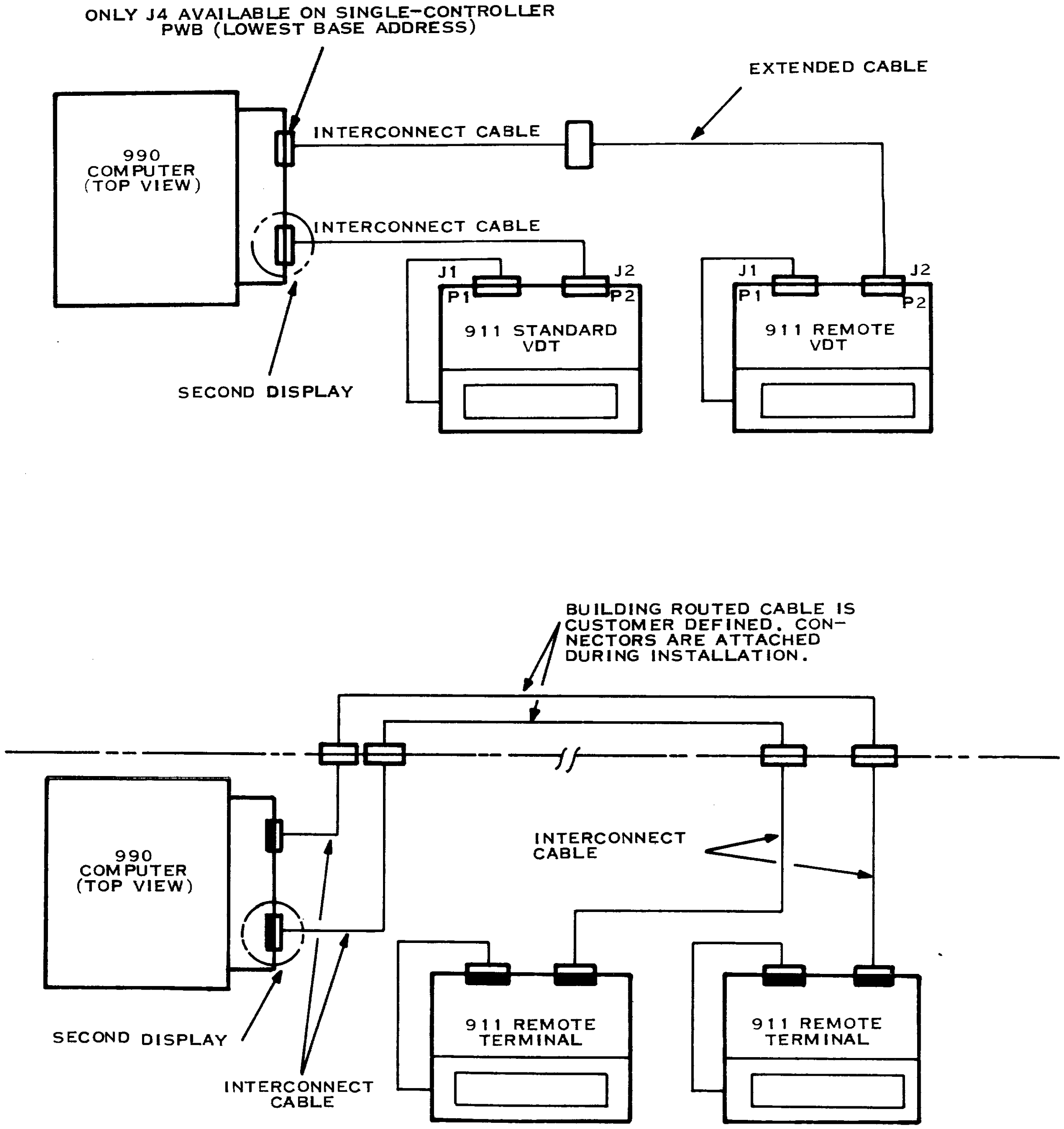
Table 1-3. 911 VDT Controller International Configurations, Sheet 2 of 2

CONTROLLER ASSEMBLY P/N2263490 DASH NO.	TIMER ROMS PN948554			LINE COUNTER DEVICE TYPE U41	GRAPHIC ROM OPTION NETWORK LOCATIONS		GRAPHICS OPTION JUMPER PLUG P9	CURSOR ADDRESS JUMPER PLUGS	REQUIREMENTS FOR SINGLE CONTROLLER HARDWARE JUMPERS U22 PIN 10 TO 16 U33 PIN 7 TO 16 U32 PIN 4 TO 16 U30 PIN 9 TO 8	REQUIRED MEMORY NETWORKS	DESCRIPTION D/S=DIAL/SNG F/H=1920/960 50/60 HZ G=GRAPHICS
	CHARACTER DECODE ROM DASH NO. D51	ROW DECODER ROM DASH NO. U52	SYNC DECODER ROM DASH NO. U42		LINE 8 PN972923-1	LINE 9 PN972923-2					
-1	-1	-4	-5	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,60
-2	-1	-4	-5	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U138 THRU U152	S,H,60
-3	-1	-2	-3	SN74162N	U24,U94	U23,U85	YES	P6,P8, P9,P10	NONE	U117 THRU U132 U138 THRU U152	D,F,60,G
-4	-1	-2	-3	SN74162N	U94	U85	YES	P8,P9, P10	YES	U137 THRU U152	S,F,60,G
-5	-1	-8	-9	SN74163N			NONE	P5,P7, P11	NONE	EVEN NUMBERED NETWORKS U118 THRU U132,U138 THRU U152	D,H,50
-6	-1	-8	-9	SN74163N			NONE	P7,P11	YES	EVEN NUMBERED NETWORKS U135 THRU U152	S,H,50
-7	-1	-6	-7	SN74162N	U24,U94	U23,U85	YES	P6,P8, P9,P10	NONE	U117 THRU U132 U138 THRU U152	D,F,50,G
-8	-1	-6	-7	SN74162N	U94	U85	YES	P8,P9, P10	YES	U137 THRU U152	S,F,50,G

	LOCATION		COUNTRY
	U35 NETWORK PART NO.	U105 NETWORK PART NO.	
-1	2263492-1	2263492-1	JAPAN
-2		2263492-1	JAPAN
-3	2263492-1	2263492-1	JAPAN
-4		2263492-1	JAPAN
-5	2263492-1	2263492-1	JAPAN
-6		2263492-1	JAPAN
-7	2263492-1	2263492-1	JAPAN
-8		2263492-1	JAPAN

2277013

Table 1-4. 911 VDT Controller, Japanese Configuration



NOTE: SHIELDED INTERCONNECT CABLE PART NO. 936500 AFFORDS SHIELDED TERMINATION BY CONNECTING THE CABLE PIGTAIL TO THE FAST-ON CONNECTOR ON THE COMPUTER CHASSIS. THE FAST-ON CONNECTOR IS WALL-MOUNTED IN REMOTE LOCATIONS.

2277010

Figure 1-10. 911 VDT Kit Cabling Configurations

2

733 ASR/KSR Data Terminal

2.1 733 ASR/KSR DATA TERMINAL

The 733 ASR data terminal is an automatic send-receive terminal with a keyboard for manual input, a printer for hard-copy output, and two magnetic tape cassette units for automatic input and output of data. The 733 KSR consists of a keyboard and printer only. These units are shown in Figures 2-1 and 2-2. Internal components of the data terminal are shown in Figure 2-3.

Reference manuals for use with the 733 ASR/KSR are as follows:

- *Model 990 Computer Model 733 ASR/KSR Data Terminal Installation and Operation Manual*, part number 945259-9701.
- *Silent 700 Electronic Data Terminal Model 732/733 ASR/KSR Maintenance Manual*, part number 960129-9701.

2.2 733 ASR/KSR CONTROLS AND INDICATORS

The standard keyboard of the data terminal is shown in Figure 2-4, and upper switch panel controls and indicators are shown in Figure 2-5. These are described in Table 2-1.

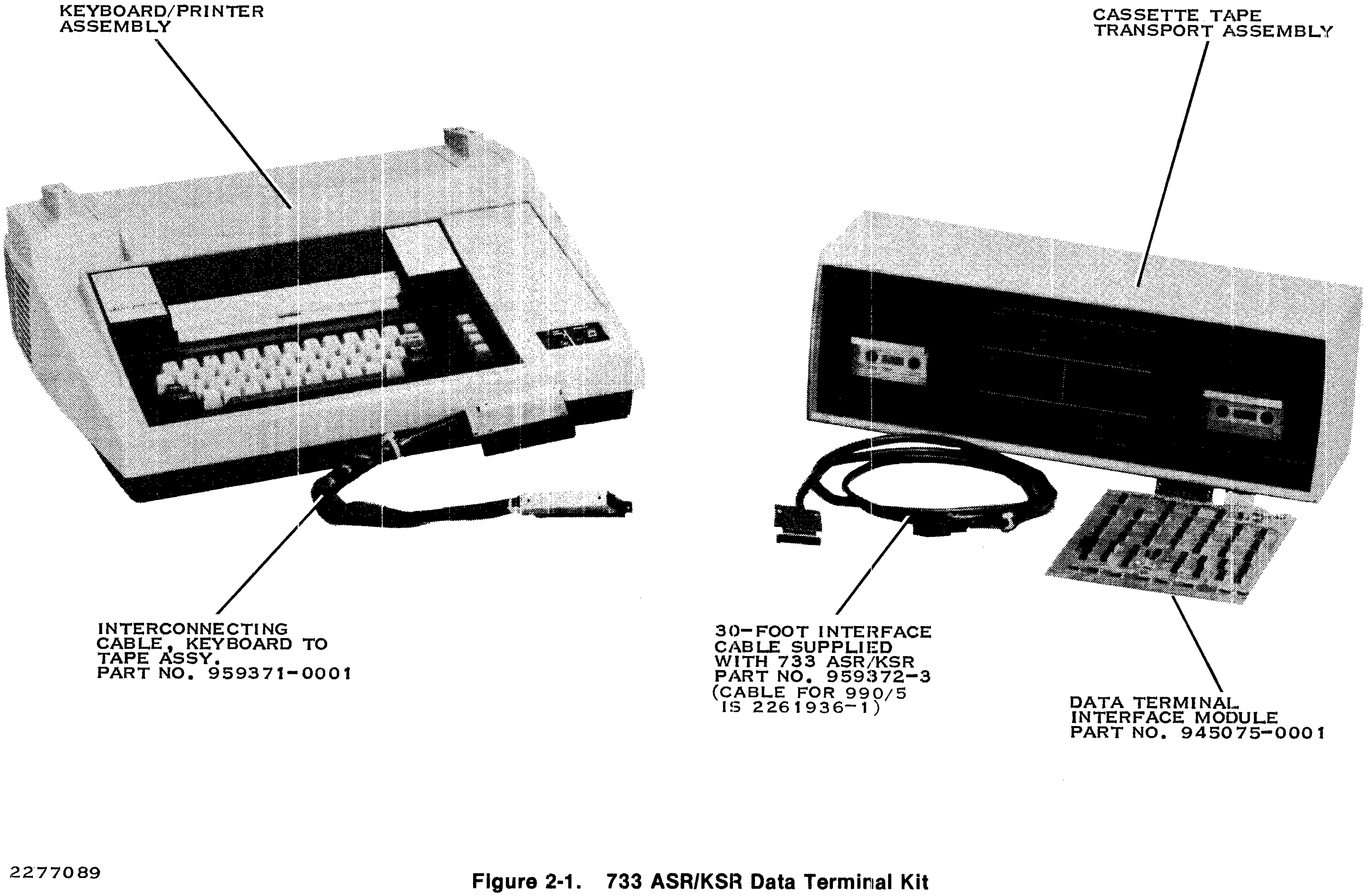
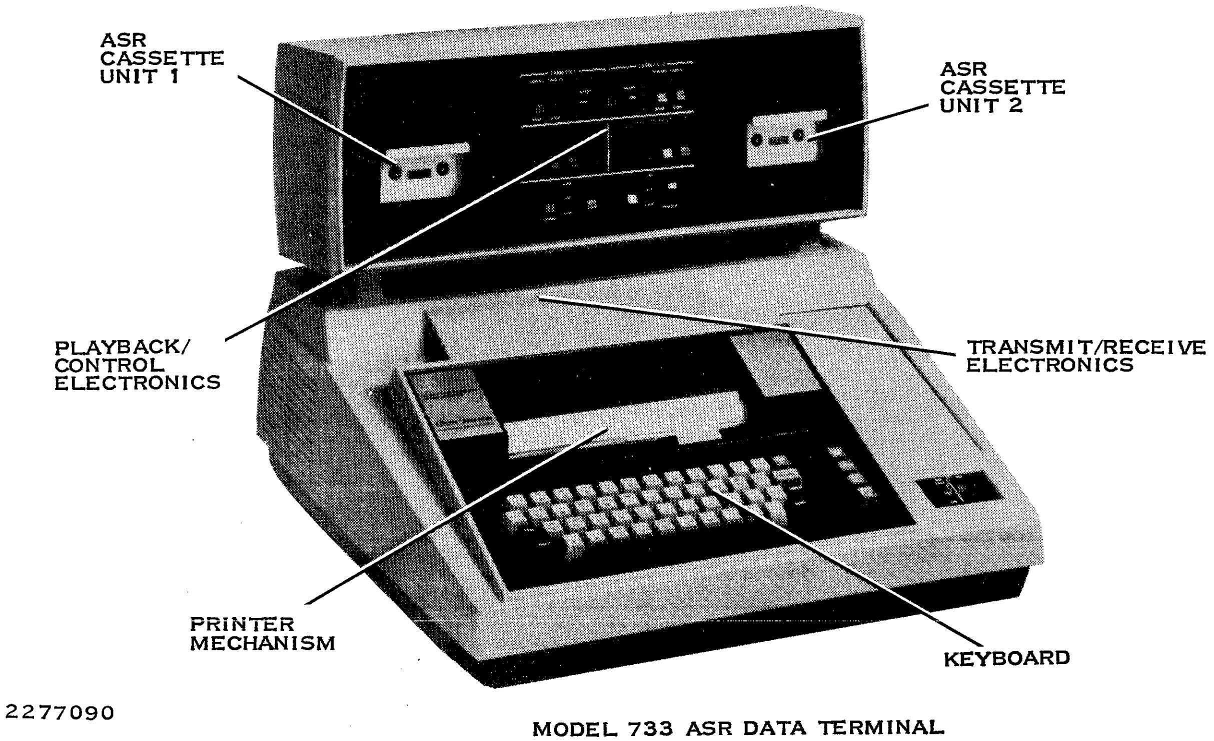


Figure 2-1. 733 ASR/KSR Data Terminal Kit



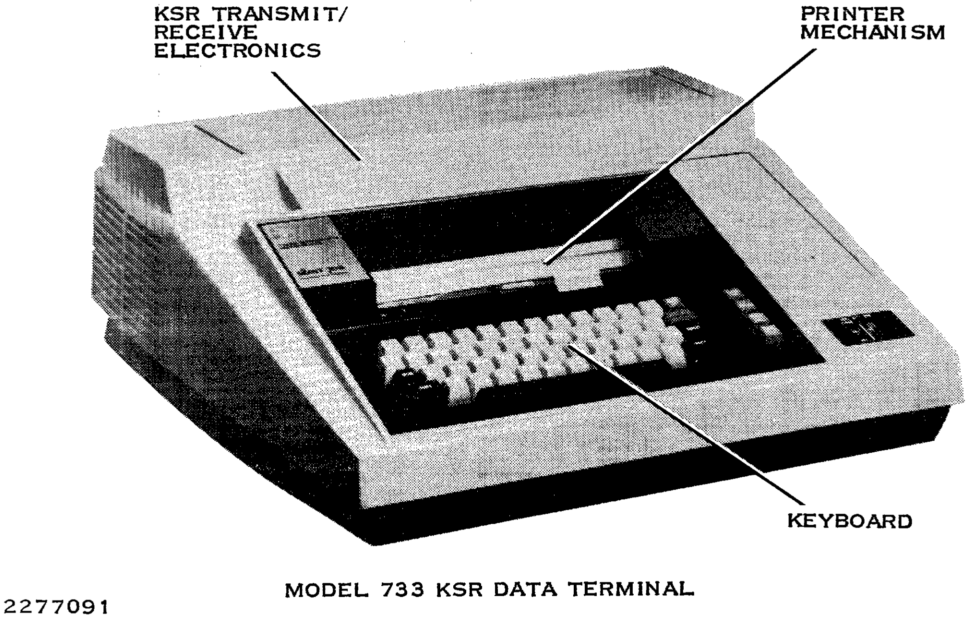


Figure 2-2. 733 ASR/KSR Data Terminals

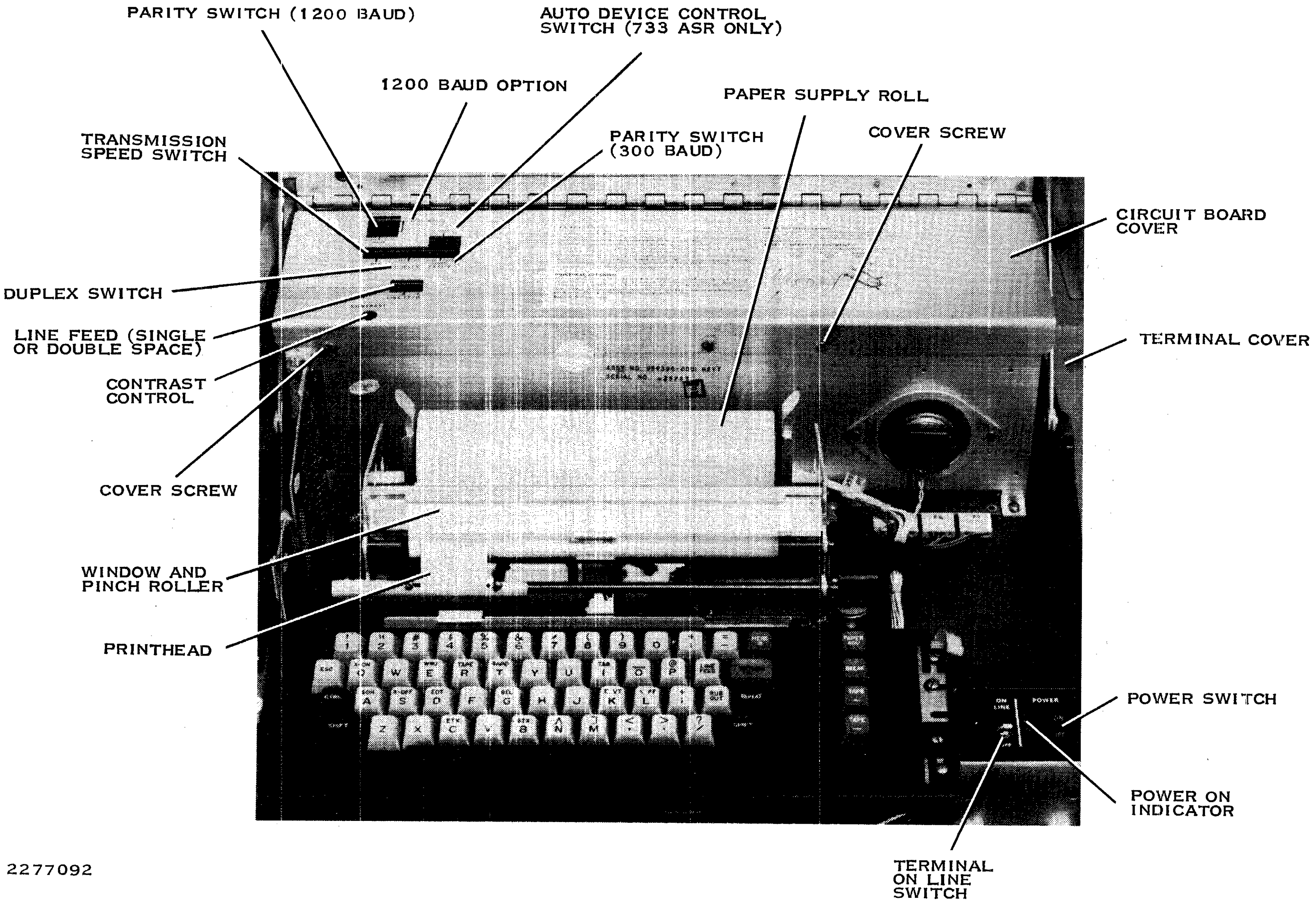


Figure 2-3. Data Terminal with Cover Open

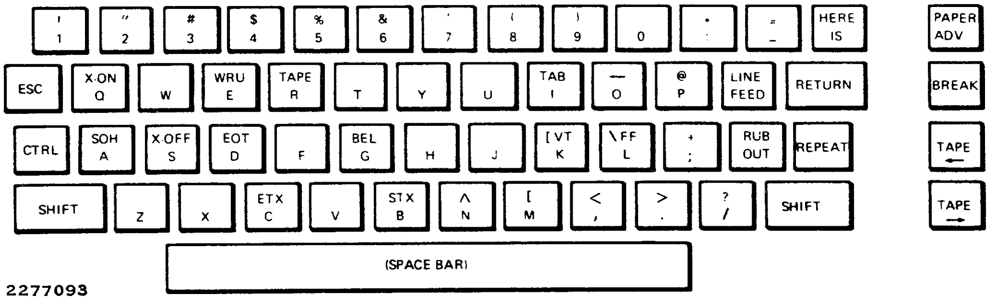
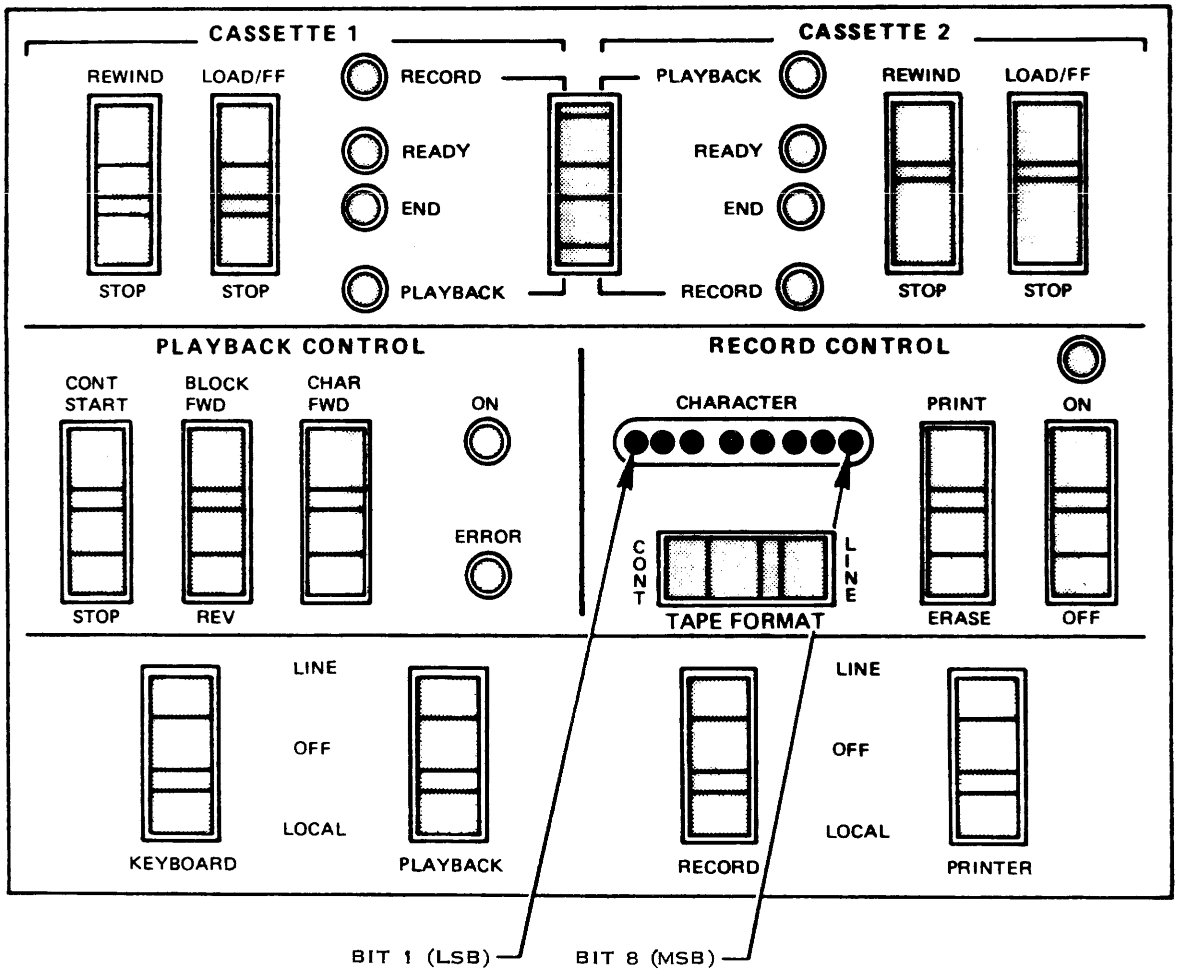


Figure 2-4. 733 ASR/KSR Standard Keyboard Layout



NOTE. CHARACTER BIT NUMBERS REFER TO ASCII CHARACTER CODE

2277094

Figure 2-5. 733 ASR Upper Switch Panel Controls and Indicators

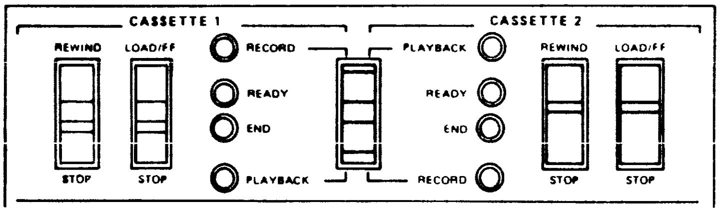
Table 2-1. Cassette Tape Control Switches and Indicators

Switch/ Indicator	Function
REWIND/STOP switch	REWIND causes the tape to wind toward the beginning of tape (BOT); it continues until clear leader is sensed or STOP is pressed.
LOAD/FF/STOP switch	After rewinding to tape beginning, the cassette is loaded by pressing LOAD/FF. Tape moves forward to the beginning of tape marker, then stops. Pressing LOAD/FF again causes the tape to wind forward at high speed to the end of tape (EOT) or until STOP is pressed. Fast forward is useful in advancing the tape to the opposite end or for performing a local tape search for editing purposes.

NOTE

REWIND and LOAD/FF are inoperative when RECORD CONTROL or PLAYBACK CONTROL (second row of switches) are ON.

PLAYBACK/RECORD Switch	Selects which cassette is in playback mode or record mode (cassette 1 or 2); cassettes automatically switch to opposite modes.
PLAYBACK/RECORD INDICATOR Lamp	Indicates which cassette is in playback and record mode.
END Indicator Lamps	Light when clear leader is sensed at either end of tape.
READY Indicator Lamps	Light when cassette is ready for applicable record or playback operation.



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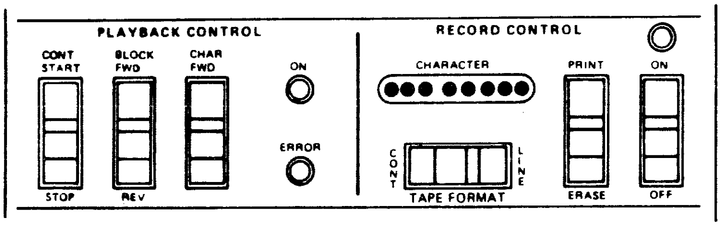
CONT START/STOP	Momentarily pressing CONT START begins continuous playback of the cassette designated by the illuminate PLAYBACK light. Tape stops when clear leader is sensed or STOP is momentarily pressed.
BLOCK/FWD/REV	Momentarily pressing BLOCK FWD causes the next block on tape to be read and played back, or the remainder of a block to be stopped in the middle. Momentarily pressing REV causes the tape to back up one block and stop (used in block locating).

Table 2-1. Cassette Tape Control Switches and Indicators (Continued)

Switch/ Indicator	Function
CHAR FWD	Momentarily pressing CHAR FWD allows reading out the playback buffer one character at a time. If the buffer is empty, the next block is entered in the buffer from the tape, and the first character is read. A character can be read on the CHARACTER display (if duplicating a tape) or on the printer.
ON Indicator Lamp	Lights when PLAYBACK CONTROL is in use.
ERROR Indicator Lamps	Light when parity error (missing flux reversal) on the tape is found during playback. (Can be caused by a dirty head).
CHARACTER Indicator Lamps	Shows seven-bit ASCII code of the character being addressed in record buffer. Bits 0 to 7 read from left to right. Bit 7 is used internally by the terminal.
LINE/CONT (TAPE FORMAT Switch)	This two-position switch controls the tape format. When the switch is in LINE position, recording of data on tape is initiated by the ASCII carriage return character or the 86th character of each block. Therefore, each block of data normally corresponds to one line of printout on the printer. This format is especially helpful when preparing and/or editing a tape on the recorder. With TAPE FORMAT switch in the CONT position, recording of data on tape is initiated only by the 86th character of each block. Therefore, each block of data on tape can contain several lines of printout on the printer. This format is especially useful when maximum tape storage is desired. Tapes recorded in one format may be easily converted to the other format through the tape duplicating process.
PRINT/ERASE	This switch is used to check record buffer contents during editing. The PRINTER and RECORD switches must be set to LOCAL. Content of the record buffer is printed out (but not recorded on tape) when PRINT is pressed and the buffer content is not affected. Pressing ERASE erases the record buffer contents but does not affect data recorded on the tape.
ON/OFF	This switch turns on the recorder and RECORD CONTROLLER allowing receipt of data into the record buffer and transferring the contents of the record buffer (if any) to tape. If ERASE is pressed before or during actuation of OFF, and OFF is released first, tape erase is initiated and continues until OFF is pressed again.

Table 2-1. Cassette Tape Control Switches and Indicators (Continued)

Switch/ Indicator	Function
ON Indicator Lamp	Lights when RECORD CONTROL is in use.
KEYBOARD, PLAYBACK, RECORD, PRINTER	These switches may be operated to any of the following positions: LINE/OFF/LOCAL. To connect the keyboard, the playback cassette, the record cassette, or the printer to the computer system, set the corresponding switch to the LINE position. Those switches not needed for line operation should be set to either OFF or LOCAL. When any of these switches are set to LOCAL, the associated functions are interconnected. For example, by placing the KEYBOARD and PRINTER switches to LINE, the user may communicate with the computer from the keyboard and the printer. At the same time, by placing the RECORD and PLAYBACK switches in the LOCAL position, a cassette tape may be copied offline. Devices set to OFF are disconnected from both the line and local loops.



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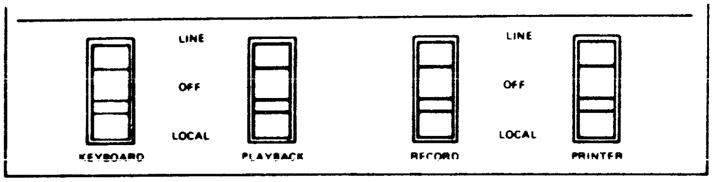

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2.3 INTERNAL SWITCH CONFIGURATIONS

Internal switch configurations for the 733 ASR/KSR are as follows:

Switch	Position
PARITY	EVEN
ADC/RDC	ON
SPEED	HI
DUPLEX	FULL
LINE FEED	1 (one)
LINE	ON

To check the RDC switch settings, proceed as follows:

1. Be sure terminal power is off.
2. Lift terminal cover.
3. Loosen screws holding card cage cover and remove cover.
4. Remove RDC card (5A2A6) for card cage by inserting thumbs under card extractor and lifting card from slot.
5. Check that DIP switches (S2) are set as follows:

S2 Position	Normal State
1	ON
2	ON
3	ON
4	ON
5	ON
6	OFF
7	OFF

6. Reinsert RDC card into slot 5A2A6.
7. Replace cover on card cage and close terminal cover. Restore power.

2.4 INTERFACE CONTROLLER

The 733 ASR/KSR uses the TTY/EIA interface module (Figure 2-6) as the controller. This is the same interface used by the 743 KSR, the 810 printer, and the 820 KSR. The only difference is in the jumper schedule. These jumpers are listed in Table 2-2.

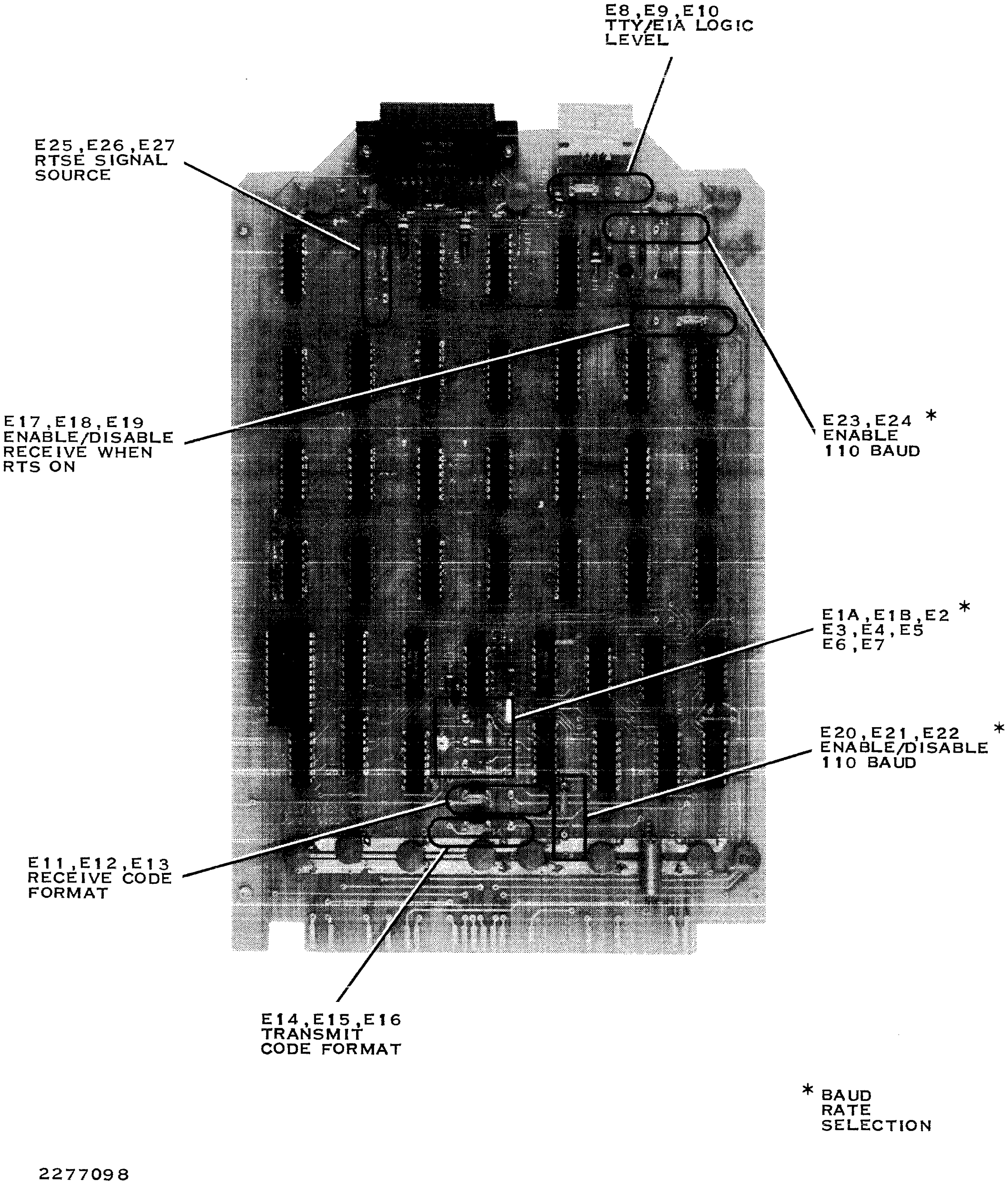


Figure 2-6. TTY/EIA Interface Module

Table 2-2. TTY/EIA Interface Module Jumper Schedule

Option	Jumper	733 ASR	733/743 KSR	810 PTR	820 KSR
Baud Rate = 75	E1A to E2				
Baud Rate = 110	E1A to E2				
Baud Rate = 300	E1A to E3		x		
Baud Rate = 1200	E1B to E4	x			
Baud Rate = 2400	E1B to E5				
Baud Rate = 4800	E1B to E6			x	x
Baud Rate = 9600	E1A to E7				
Logic Level = EIA	E8 to E9	x	x	x	x
Logic Level = TTY	E9 to E10				
Code Format = 10 Bit	E11 to E12	x	x	x	x
(Receive) = 11 Bit	E12 to E13				
Code Format = 10 Bit	E14 to E15	x	x	x	x
(Transmit) = 11 Bit	E15 to E16				
Enable Rec during RTS	E17 to E18	x	x	x	x
Disable 110 Baud	E20 to E21	x	x	x	x
Enable 110 Baud	E21 to E22				
Enable 110 Baud	E23 to E24				
RTSE = RTSE	E25 to E26	x	x		x
RTSE = DSRE	E26 to E27			x	

DT — Data Terminals

2.5 733 ASR/KSR SYSTEM CABLING

Cabling for the data terminal is shown in Figure 2-7. Interconnection data is presented in Table 2-3.

Table 2-3. Interconnection Data

Pin	Mnemonic	Signal Flow*	Voltage	Remarks
2	RCVDE	Input	High Level = +3 to +25 Vdc Low Level = -3 to -25 Vdc	Receiver: TI 75154
3	XMTDE	Output	High Level = +5 to +11 Vdc Low Level = -5 to -11 Vdc	Driver: TI 75150
5	PCTS	Output	+5 Vdc	390 ohm pullup
6	DTRE	Output	Same as pin 3	
7				Signal ground
8	RTSE	Output	Same as pin 3	
14	RCRE	Input	Same as pin 2	
16	RCTE	Output	Same as pin 3	
18	DCDE	Input	Same as pin 2	
20	DSRE	Input	Same as pin 2	
21	PDCD	Output	Same as pin 5	

Note:

* Signal flow input is into the module on the EIA interface and output is out of the interface connector P2.

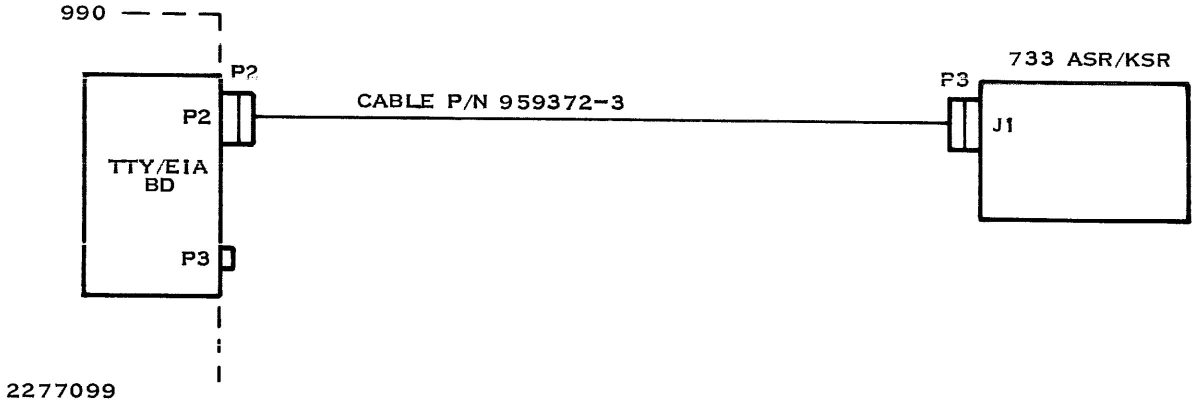


Figure 2-7. 733 ASR/KSR Interconnecting Cabling

2.6 FIELD-REPLACEABLE COMPONENTS, 733 ASR/KSR DATA TERMINAL

The field-replaceable components for the 733 ASR/KSR data terminal are as follows:

Item	TI Part Number
Drive Mechanism Assembly	0959391-0001
Power Module Assembly	0959390-0001
Printer Control Board	0981313-0001
14 A Regulator/Amplifier	0971443-0001
14 A Control/Regulator	0971450-0001
Printhead Interface	0959141-0001
Limited ASCII Keyboard	0959327-0001
Display Panel	0959155-0001
ASCII Printer Code	0959137-0001
ASR Terminal Control	0981310-0001
1200 Baud Receiver	0973907-0001
RDC 1200, Computer Option	0973901-0006
1200 Baud Transmit	0962293-0001
Tape Transport	0986461-0001
Controller	0945075-0001
Speaker Assembly	0959378-0001
Red Lamp	0772811-0005
SPST Switch	0772812-0001
Printhead Assembly	0959422-0001
Panel, Power Switch	0960113-0001
Switch, Online Assembly	0960119-0001
Cable, Terminal to Controller	0959372-0001
Cable, 990/5 to Terminal	2261936-0001
Cover Assembly, Interior	0954774-0001
Switch Assembly, Power Light Attach	0958864-0001
ASCII Transmit and Receive	0959135-0001
Power Module Backpanel	0959157-0001
TTY Interface, Polar	0959171-0001
TTY Interface, Neutral	0959171-0002
Board Assembly, Terminal Control	0959173-0001
Keyboard, Full ASCII Encoded	0959326-0001
Cable Assembly, Keyboard	0959370-0001
Cable Assembly, Cassette	0959371-0001
Cable Assembly, EIA Interface, 1200	0959372-0002
Cable Assembly, TTY Interface	0959384-0001
Cover, Cassette	0960010-0001
Base Assembly, Cassette	0960102-0001
Cover, Printer	0960105-0001
Switch Assembly, Speed	0960120-0001
Top Access Connector	0960160-0001
Answerback Memory	0960881-0001
Auto Answer Control, Modem	0960885-0001
Auto Answer Control, EIA	0960885-0002
Modem, ATL	0960887-0001
Modem, ATH	0960887-0003

DT — Data Terminals

Item	TI Part Number
Remote Answer Control	0960901-0001
Record Control	0960909-0001
Dual Format Record Buffer	0962285-0001
Dual Format Tape Read/Write	0969451-0001
Automatic Device Control, 300 Baud	0971481-0001
Automatic Device Control, 1200 Baud	0971481-0002
Backpanel Access	0971491-0001
Backpanel Access	0971491-0002
256-Bit PROM, RDC	0971521-0001
256-Bit PROM, ADC	0971521-0002
Cable Assembly, 300 Baud Auto Answer	0971555-0001
Cable Assembly, 300 Baud Auto Answer	0971557-0001
Cable Assembly, Bell 113A Interface	0971558-0001
Bearing, Sleeve, Oil-Impregnated	0972405-0199
Fan, 115 V, 50/60 Hz	0972479-0001
Connector Assembly Acoustic Coupler	0973258-0001
1200 Dual Format Transmit/Receive	0973905-0001
Base Printer	0981320-0001
Cassette Fan Assembly	0981323-0001
Motion Control Assembly	0986457-0001
ASR Terminal Control Assembly	0986458-0001
Printer Control Assembly	0986459-0001
Auto Search Control Assembly	0986460-0001
733 Acoustic Coupler PCB Assembly	0986462-0001
733 Acoustic Coupler Muff Assembly	0986463-0001
Remote Device Control	0986464-0001
Dual Format Playback Control Assembly	0986466-0001

3

743 KSR Data Terminal

3.1 743 KSR DATA TERMINAL

The 743 data terminal (Figure 3-1) is a data entry/inquiry terminal that provides direct half-duplex or full-duplex communication with a computer.

Reference manuals for use with the 743 KSR are as follows:

- *Model 990 Computer Model 743 KSR Data Terminal Installation and Operation Manual*, part number 943462-9701.
- *Silent 700 Electronic Data Terminals Model 743 KSR Model 745 Portable Maintenance Manual*, part number 984025-9701.

3.2 743 KSR CONTROLS AND INDICATORS

The controls and indicators of the 743 KSR data terminal are shown in Figure 3-2. These are as follows:

- AC power switch — The ac power switch is located on the top right rear corner of the unit.
- Print contrast adjustment — The CONTRAST control is a potentiometer accessible through a hole on the right side of the unit. A slot screwdriver will adjust for darker printing (clockwise) or lighter printing (counterclockwise). Blurred print usually indicates a need for a lighter setting.
- Transmit level adjustment — The TRANSMIT LEVEL control is not used with the 990 computer.
- Keyboard controls — In addition to the standard typewriter keys, the keyboard has ten control keys as follows:
  - PAPER ADV key — Pressing and holding this key returns the printhead to the left margin and continuously feeds paper until the key is released. No code is generated.
  - BREAK key — Pressing this key transmits a continuous ASCII space code over the communications line as long as the key is held down, if the terminal is online. Generally, the BREAK key is used in full-duplex communications networks to interrupt transmission from the remote equipment.

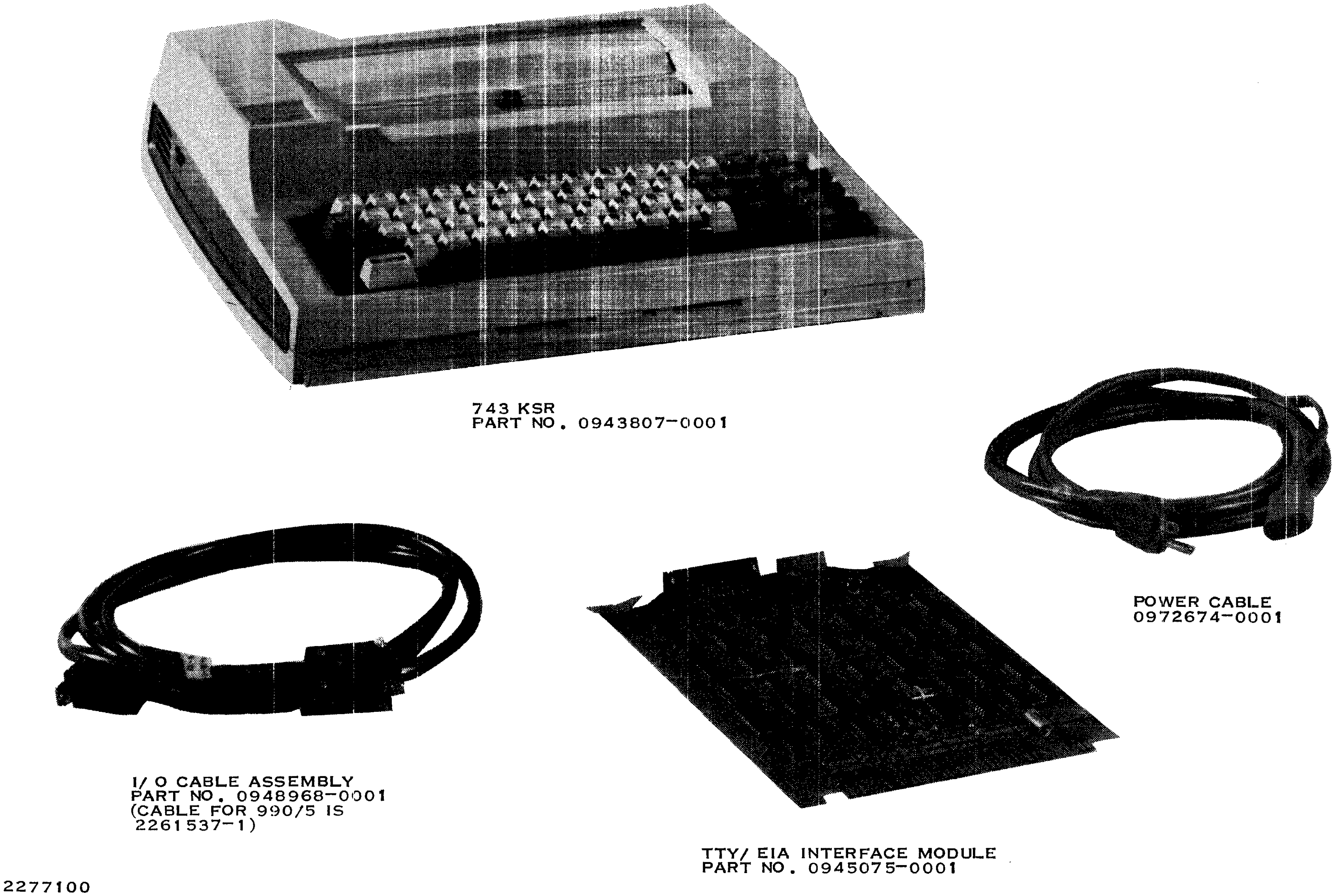
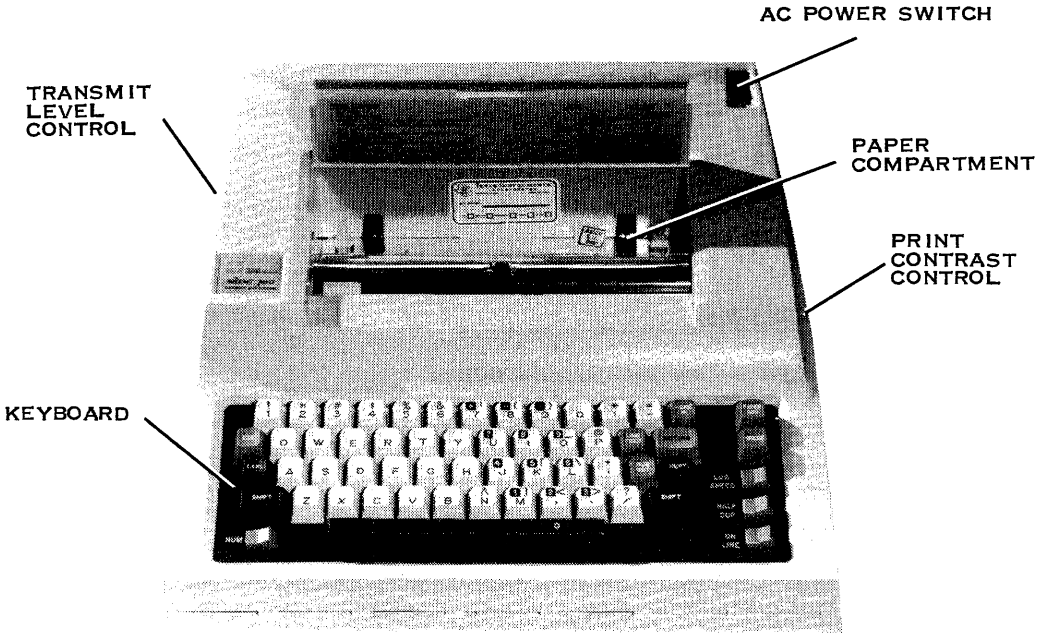


Figure 3-1. Model 743 KSR Data Terminal Kit, Part Number 948977-0001



2277101

Figure 3-2. Model 743 KSR Data Terminal

- LOW SPEED rocker switch — Actuating this switch to the LOW SPEED position sets the data transmission and reception to ten characters per second; actuating the switch away from the LOW SPEED position sets the transmission and reception speeds to 30 characters per second.
- HALF DUP rocker switch — Actuating this switch to the HALF DUP position sets the operating mode to half-duplex. Actuating the switch away from the HALF DUP position sets the operating mode to full-duplex.

NOTE

Set the key to full-duplex to disable local printout of transmitted data; set to half-duplex to enable local printout of transmitted data.

- ON LINE rocker switch — Actuating this switch to the ON LINE position connects the terminal to the communication line (online mode); actuating the switch away from the ON LINE position disconnects the terminal from the communication line (local mode).

- HERE IS key — Pressing this key transmits the contents of the optional answerback memory (if installed) to the communications line.

NOTE

The answerback memory (ABM) option is implemented by a PROM inserted into a socket located on the PWB inside the 743. The ABM option transmits any programmed sequence of one to 21 characters to serve as station identification. The message sequence is activated by pressing the HERE IS key or by receipt of an ENQ character if the terminal is online.

- LINE FEED key — Pressing this key advances the paper one line. The printhead does not move.
- RETURN key — Pressing this key returns the printhead to the left margin. The paper is not advanced.

NOTE

Both LINE FEED and RETURN must be pressed to obtain the equivalent of a conventional typewriter carriage return.

- REPT key — Pressing and holding this key while momentarily pressing another character key repeats that character until either the REPT key is released or another character key is pressed.
- NUM key — When this key is pressed, the nine keys on the right side of the keyboard with numbers on a black background become a numeric entry pad, using the space bar to enter a zero.

- Indicators — The 743 KSR provides one visible and one audible indicator as follows:
  - Carrier detect indicator — When illuminated, this green lamp indicates the presence of the receive-data carrier frequency.
  - Bell indicator — An audible sound is emitted when the BEL code is received from the keyboard or communication line.

3.3 743 KSR INTERFACE CONTROLLER

The 743 KSR data terminal uses the same TTY/EIA interface module, same as the 733 ASR/KSR data terminal. This controller is shown in Figure 2-6. Standard jumper schedule for the 743 KSR data terminal is as follows:

Option	Jumper
Baud rate = 300	E1A to E3
Logic level = EIA	E8 to E9
Code format = 10-bit (receive)	E11 to E12
Code format = 10-bit (transmit)	E14 to E15
Enable receive during RTS	E17 to E18
Disable 110 baud	E20 to E21
RTSE = RTSE	E25 to E26

3.4 743 KSR CABLING

A cabling diagram for the 743 KSR is shown in Figure 3-3.

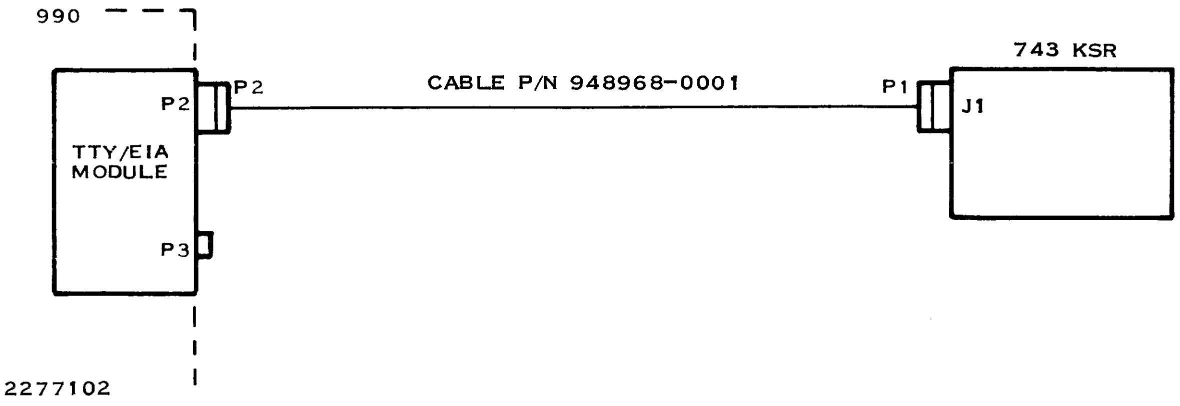


Figure 3-3. 743 KSR Interface Cabling Interconnection

3.5 FIELD-REPLACEABLE COMPONENTS, 743 KSR DATA TERMINAL

Field-replaceable components for the 743 KSR are as follows:

Item	TI Part Number
Terminal Electronics	0983841-0002
Drive Mechanism (with solenoid line feed)	0983811-0001
Drive Mechanism (with stepping motor line feed)	0999257-0001
PWB Backpanel	0937299
Controller	0945075-0001
Fan Assembly	0983825-0001
Printhead Assembly (for drive mechanism with solenoid line feed)	0983929-0001
Printhead Assembly (for drive mechanism with stepping motor line feed)	0983829-0001
Keyboard Kit, Limited ASCII	0984037-0001
Cable, Terminal to Controller	0948968-0001
Cable, 990/5 to Terminal	2261937-0001

4

820 KSR Data Terminal

4.1 820 KSR DATA TERMINAL

The Model 820 KSR Data Terminal (Figure 4-1) is a send/receive, forms-programmable terminal with an impact printer.

Reference manuals for use with the 820 KSR are as follows:

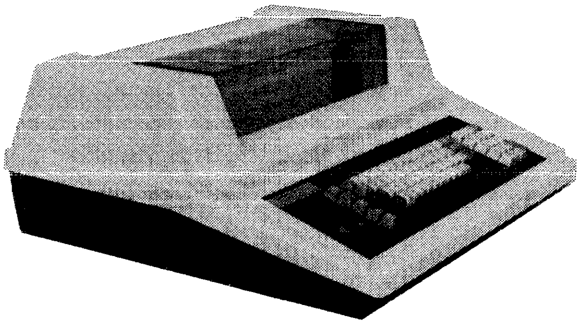
- *Model 990 Computer Model 820 KSR Data Terminal Installation and Operation Manual*, part number 2250454-9701.
- *Model 820 KSR Maintenance Manual*, part number 999853-9701

4.2 820 KSR CONTROLS AND INDICATORS

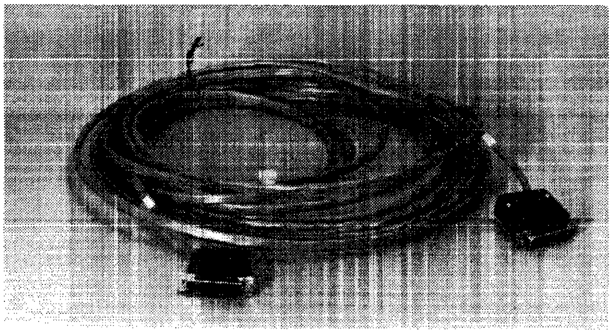
The operator controls consist of a control panel, typewriter keyboard, and numeric pad, shown in Figure 4-2. The control panel (Figure 4-3) provides status indicators; controls for LINE, STANDBY, or LOCAL operation; last character visibility; controls for BREAK and RESET; and form alignment. These controls are as follows:

- LINE/./LCL — This three-position switch will select one of the three normal operating modes of the 820 KSR as follows:
  - LINE — In the LINE position, the keyboard and printer operate in conjunction with the communications interface as defined by terminal configuration.
  - Standby — When the switch is in the center position (standby), the 820 printer and keyboard are disconnected from the communications interface. This position is used primarily to change ribbon and paper.
  - LCL — When the switch is down (local mode), the 820 KSR operates in the same manner as a typewriter with the keyboard connected to the printer. Also in this switch position, the terminal can be operated in the configure mode using the CONFIGURE/OPERATE switch.
- VIEW/OFF — This two-position switch controls the initialization of the print visibility feature. In the VIEW position, when no printable or control characters have been received for more than one second, the printhead moves to the right to permit the last character printed to be viewed. In the OFF position, the printhead advances to the right as printable characters are received, and the last character printed remains obscured by the printhead.

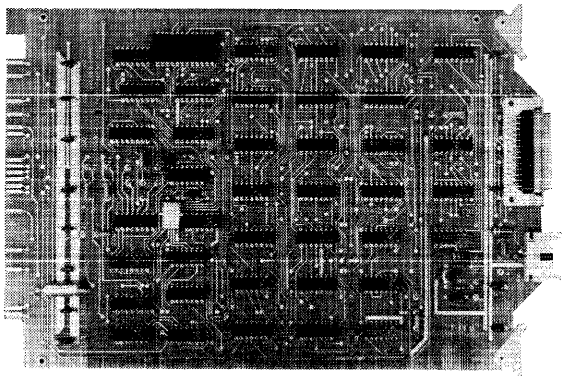
DT — Data Terminals



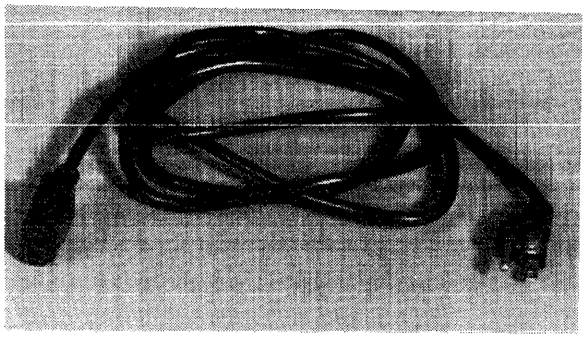
MODEL 820 KSR DATA TERMINAL
PART NO. 2262091-0001



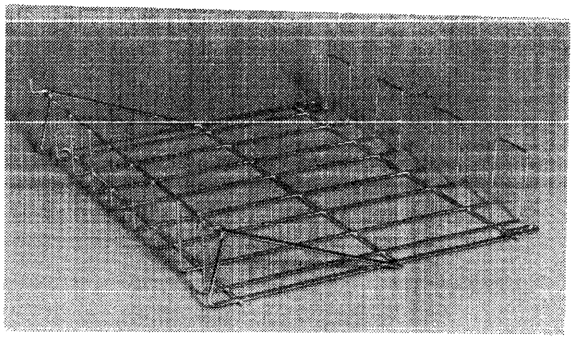
I/O CABLE ASSEMBLY
PART NO. 2262093-0001 (TTY/EIA)
PART NO. 2262096-0001 (990/5 EIA)



TTY/EIA INTERFACE MODULE
PART NO. 945075-0001
(NOT USED WHEN KSR IS
INTERFACED DIRECTLY TO
990/5 PORT 1 OR PORT 2)



POWER CABLE - 115 VAC
PART NO. 996289-0001



PAPER - CATCH TRAY
PART NO. 999838-0001

2277103

Figure 4-1. Model 820 KSR Data Terminal Kit

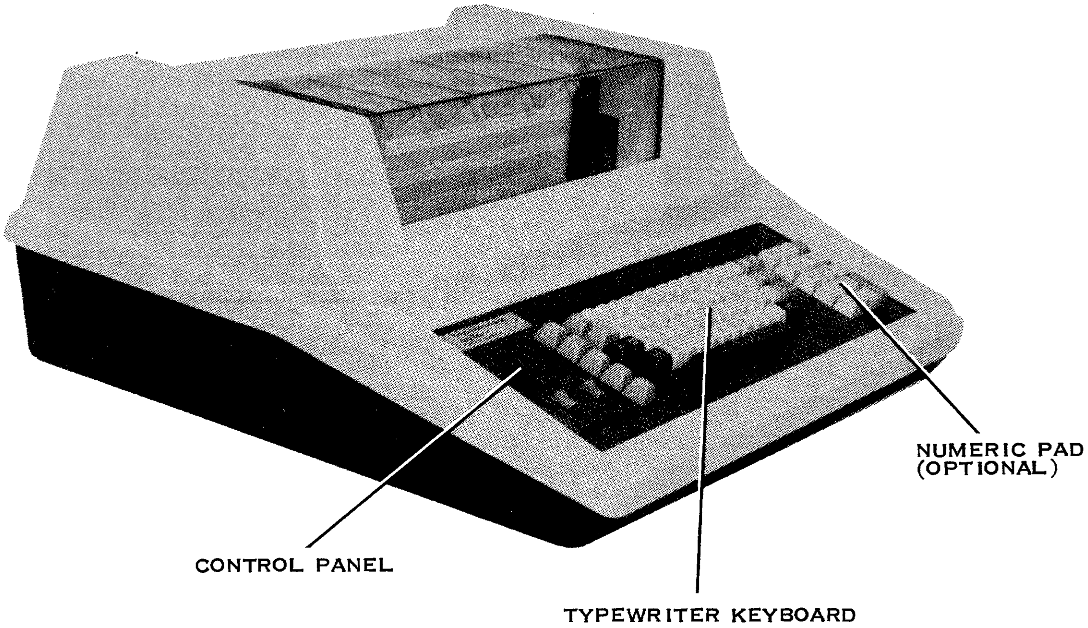


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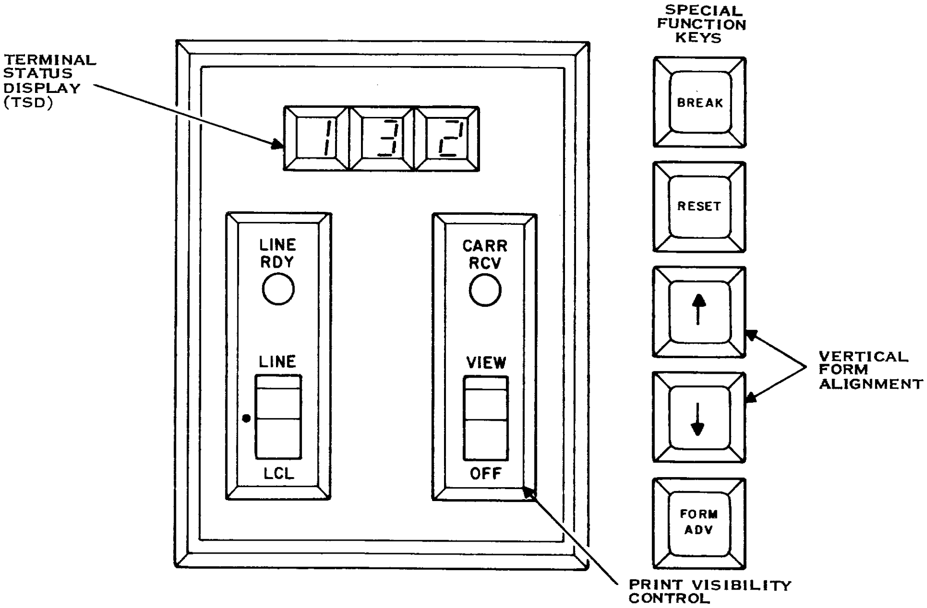
Figure 4-2. Operator Controls



2277105

Figure 4-3. 820 KSR Control Panel

- LINE RDY and CARR RCV — These indicators provide status information for the LINE/./LCL switch when it is set to either LINE or the standby position. In the full duplex communication mode of operation, these indicators have the following meanings:
  - CARR RCV: ON, ready to receive; OFF, receive not ready, no carrier.
  - LINE RDY: ON, communication line ready; OFF, communication line not connected; flashing, terminal in standby or communication line not connected.

4.2.1 Terminal Status Display (TSD)

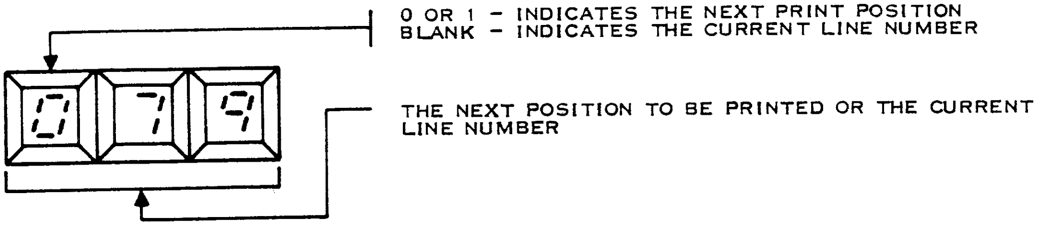
The TSD is a three-digit numeric indicator normally used to display the number of the next print column. The TSD also displays information such as error status and line numbers. Refer to Figure 4-4 for information on interpreting the TSD. When the TSD is flashing, an abnormal condition exists. The specific condition is indicated by the displayed code. These codes are prioritized in an ascending numeric sequence. When multiple conditions exist, the code with the highest priority is displayed first. The first displayed code is cleared by the next higher priority and so on until all conditions are displayed and cleared. Table 4-1 lists the status codes and the recommended actions to be taken by the operator.

4.2.2 Special Function Keys

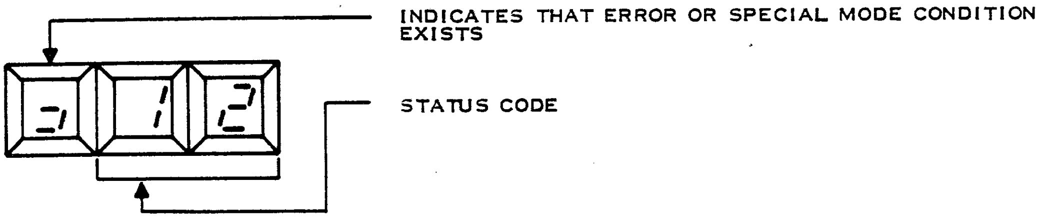
The 820 KSR control panel also contains five momentary pushbutton keys located to the right of the VIEW/OFF switch. These include three special function keys (BREAK, RESET, and FORM ADV) and two paper alignment keys. When the BREAK key is momentarily pressed and released, the 820 KSR responds by generating a 256-millisecond spacing signal. This signal turns off the reverse channel transmitter for 256 milliseconds when data is received in half-duplex and for a longer period if the key is held down. When the RESET key is momentarily pressed, the 820 KSR returns to normal operation after correction of an abnormal status condition, indicated by a diagnostic code display of the TSD. When pressed and released, the FORM ADV key advances the paper one line. If held depressed for longer than one-quarter second, this key advances the paper to the top left margin of the next form.

The UP key is used for upward vertical forms alignment. Each single actuation advances the paper one-eighth of a line space. Continuously pressing this key causes an upward one-eighth-line spacing at an increased rate. The DOWN key is used for downward vertical forms alignment. Each single actuation moves the paper downward one-eighth of a line space. Continuously pressing this key causes continuous reverse line feeds, one-eighth-line space each.

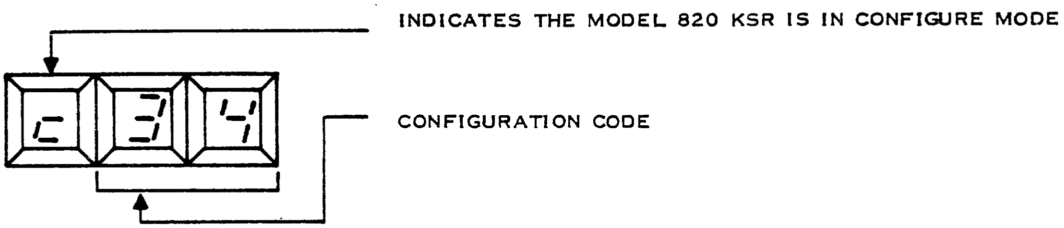
a. **Print Column/Current Line Indicator**



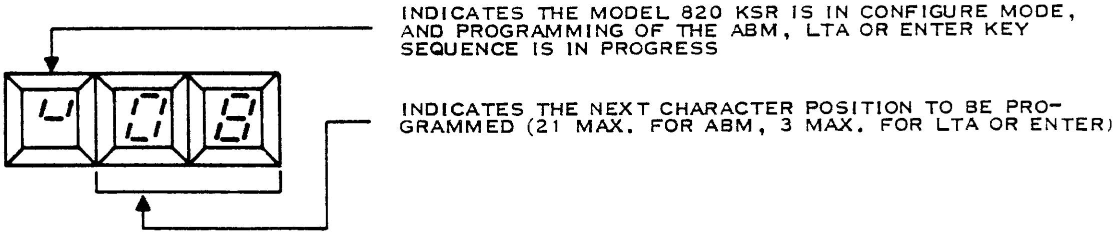
b. **Status (Display Flashing)**



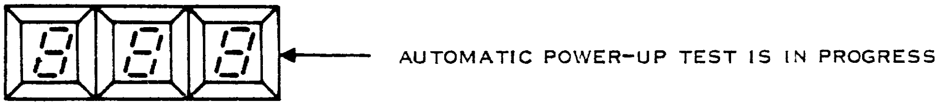
c. **CONFIGURE Mode**



d. **Program Answerback Memory (ABM), Line Turnaround (LTA) Character(s), or ENTER Key Sequence**



e. **Indicator Test**



2277106

Figure 4-4. Interpreting TSD Functions

DT — Data Terminals

Table 4-1. TSD Status Codes

Type	Code	Definition	Action Required
I (Permanent terminal failures)			
	00	RAM memory	Equipment problem: cycle power. If condition repeats, service is required. Errors in this category require that the 820 KSR be reconfigured.
	01	ROM memory I	
	02	ROM memory II	
	03	Nonvolatile memory	
II (Operator-correctable failures)			
	10	Leaving configure mode with half-duplex set but no line turnaround (LTA) specified	Go to CONFIGURE mode and specify LTA character or set full-duplex operation.
	11	Carriage jam	Clear jam and reset.
	12	Paper out	Load paper and reset.
III (Abnormal communication)			
	20	Clear-to-send time out	Reset[1]
	21	Loss-of-carrier time out	Reset[1]
	22	Wrong number time-out	Reset[1]
	23	Receive buffer overflow	Reset[2]
	24	Parity error	Reset/change parity[3]
	25	Transmit buffer overflow	Reset[2]
	29	Invalid ESC sequence from communication line[4]	
IV (Special operating mode)			
	30	Keyboard locked	From line or reset
	31	Printer off	From line or reset
	39	Test in progress	Reset
V (Operator error)			
	ccc	Invalid ESC sequence from keyboard	Reset and type valid command sequence

Notes:

[1] Automatically reset when EIA DSR turns on. If problem persists after resetting the terminal, troubleshooting may be required.

[2] Automatically reset when the status report is transmitted per a request from the line.

[3] If resetting the 820 KSR does not solve the parity error, refer to the installation and operation manual for the correct parity selections procedure.

[4] This code is not displayed, but it is transmitted as part of the status report.

4.2.3 Typewriter Keyboard

The 820 KSR standard typewriter keyboard is shown in Figure 4-5. Except for the eight special control keys, most functions of the keyboard are the same as those of a typewriter. Special control keys are as follows:

- CTRL — The control key is used primarily in communications operations. It is also used in some of the self-test features of the 820 KSR.
- ESC — The escape key depends on the operating mode of the 820 KSR (line, standby, local). The ESC key is used in the local mode to initiate the various commands when using the device/forms control (DFC) feature.
- TAB — The TAB key is used in the LCL mode to initiate special sequences that cause the printhead to advance to predetermined stops.
- BACKSPACE — The BACKSPACE key, when used in the local or standby mode, causes the printhead to move one character space to the left. In the line mode, the action of this key depends on computer software.
- HERE IS — This key is used in the line mode to initiate the transmission of a predefined ABM message.

NOTE

The ABM message (code 70) is programmable from the 820 keyboard. When the HERE IS key is pressed, it causes the 820 to transmit the ABM message if the ABM is programmed. HERE IS is ignored if the ABM is not programmed. If the LINE/./LCL switch is in the LCL position and code 72 is enabled, the ABM will be printed. Refer to Section 4 of the 820 KSR installation and operation manual for ABM programming instructions.

- LINE FEED — Used in the local or standby modes to advance the paper one line space when pressed and released. If the key is held depressed, the printer continues to advance the paper at an increasing rate until the key is released.
- DEL — The delete key is used in the line or configure modes. In the line mode, the function of the key is determined by computer software. In the configure mode, the key is used to eliminate and change the line control, transmission control, and terminal control configurations.
- RETURN — If the 820 KSR is operated in the local or standby modes, this key is used to move the printhead back to the left margin. If the 820 KSR is in the configure mode, this key must be pressed after an instruction is given to the terminal. In the line mode of operation, the function of this key is determined by computer software.

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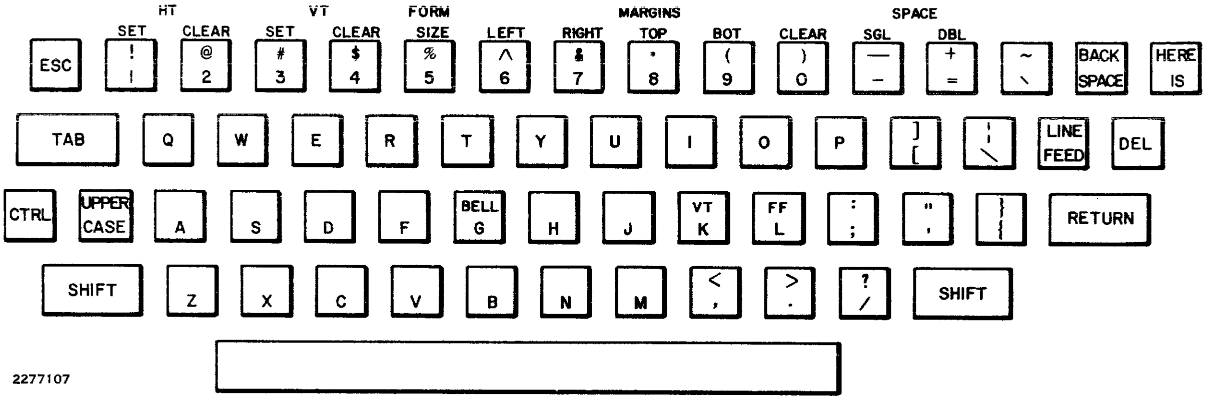

Figure 4-5. 820 KSR Typewriter Keyboard

4.2.4 820 KSR Internal Controls

The internal controls for the terminal, shown in Figure 4-6, are as follows:

- CONFIGURE/OPERATE switch — Terminal operating parameters can be changed when this switch is placed in the CONFIGURE position. The LINE/./LCL switch must be in the LCL (local) position and the CONFIGURE/OPERATE switch must be in the CONFIGURE position (moved toward the operator) to place the terminal in the configure mode.
- Forms width adjustment — The printer forms width adjustment can be adjusted to accept paper width from 76 millimeters (3.0 inches) to 378 millimeters (14.9 inches). Forms width adjustment is done by repositioning the right and/or left tractor mechanisms that move the form by engaging the sprocket holes on the paper.
- Forms thickness adjustment — The forms thickness adjustment allows the terminal to accept various thicknesses of forms up to an original and five copies.

4.2.5 Sets of Operating Parameters

Two sets of operating parameters are available for the 820 KSR: a factory default parameter set and a special 990 computer parameter set. The factory default parameter set is stored in permanent ROM memory but is not used in 990 computer operation. The special 990 computer parameters are stored in nonvolatile read/write memory. Both the standard default parameters and the 990 computer parameters are categorized by two-digit codes. The codes themselves are categorized by the type of parameter they identify. Table 4-2 lists the parameter codes and briefly describes each.

When the 820 KSR terminal's power is switched on, the terminal is ready for operation as part of the 990 computer system with no changes necessary. If an error code is displayed in the TSD upon initial power-up, the terminal automatically loads the factory default parameters. It is then necessary to reconfigure the 820 KSR terminal by using the 990 computer parameters before resuming operation with the 990 computer. For reconfiguring instructions, refer to Section 4 of the 820 KSR installation and operation manual.

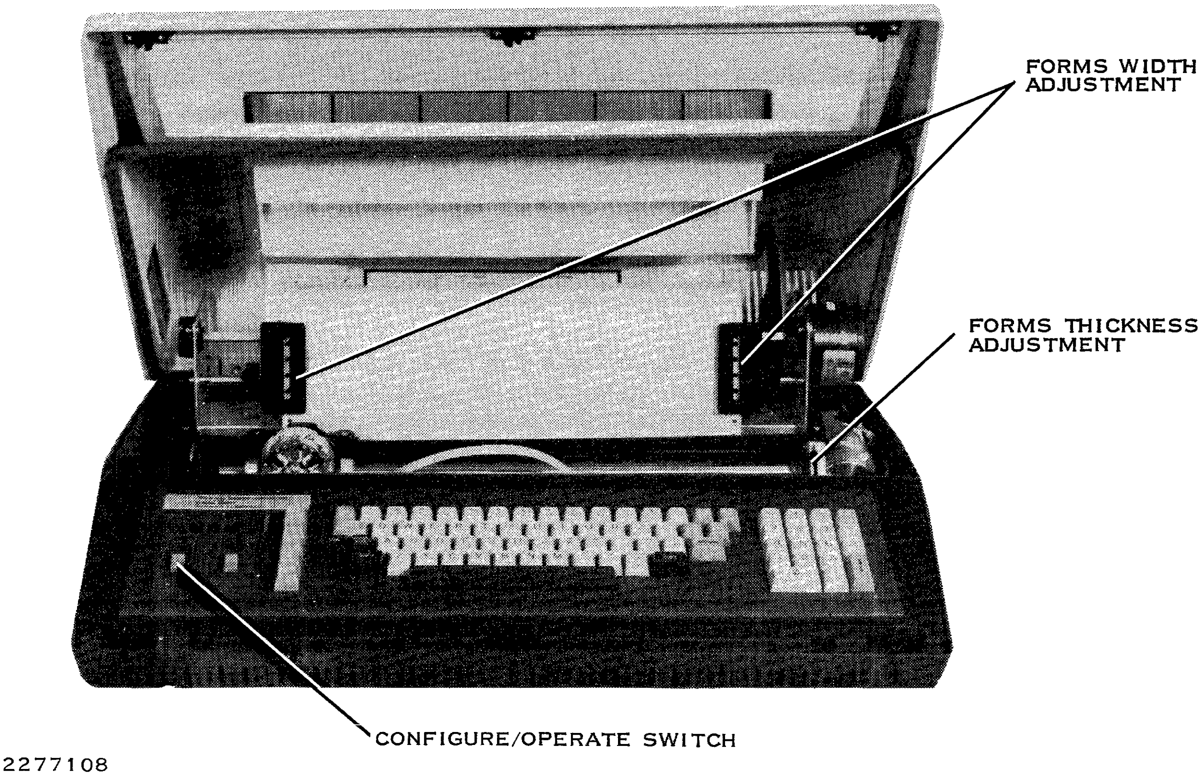

Figure 4-6. 820 KSR Internal Control Locations

Table 4-2. Operating Code Parameter Set

Code	Meaning
Predefined Configuration Selection (One Only)	
01 to 08	Select corresponding predefined configuration set
09[1] and 10[2]	Select factory default configuration set (factory and 990 version)
Communications Mode Selection (One Only)	
11	Half-duplex (for uses with type 202 data set)
12	Half-duplex and reverse channel (for use with type 202 data set)
13[1]	Full-duplex (for type 103, 113, and 212 data sets)
14[2]	Full-duplex and reverse channel ON for ready (for use as a console)
15	Full-duplex and reverse channel OFF for ready (for use as a console)
Transmission Rate Selection (One Only)	
21	110 baud
22	200 baud
23	300 baud
24	600 baud

Table 4-2. Operating Code Parameter Set (Continued)

Code	Meaning
25	1200 baud
26	2400 baud
27[2]	4800 baud
28	9600 baud
29[1]	300/1200 baud (for use with type 212 data set with speed-select option)
Parity Selection (One Only)	
31	Odd parity, no parity check
32[1]	Even parity, no parity check
33	Odd parity, indication on error
34	Even parity, indication on error
35	Odd parity, indication plus printed symbol on error
36	Even parity, indication plus printed symbol on error
37[2]	Parity bit mark, no parity check
38	Parity bit space, no parity check
Line Control Parameters (No Limit)	
60	Program line turnaround (LTA) characters for half-duplex (202)
61	Enable fail-safe disconnect
62	Disconnect on receipt of EOT
63	Disconnect on receipt of DLE EOT
64[2]	Disconnect on paper-out or carriage jam
Transmission Control Parameters (No Limit)	
70	Program ABM
71	Auto-trigger ABM on connection
72[2]	Enable print of ABM contents (local HERE IS or code 82 set)
Terminal Control Parameters (No Limit)	
80	Program ENTER key on numeric pad
81[2]	Enable DFC from the communication line
82	Enable local copy of transmitted data
83	Transmit DC2 or BREAK on printer-busy DC1 or LTA on ready
84	Perform a NEW LINE on receipt of LF
85	Perform a NEW LINE on receipt of CR
86	Transmit CR LF when RETURN key is pressed
87	Print all control characters
88	Set compressed print (16.5 characters per inch) only
89[2]	Set absolute right margin at column 80
	Invalid configuration code has been entered

Notes:

[1] Factory default parameter set

[2] Standard 990 parameter configuration set

4.3 820 KSR PAPER REQUIREMENTS

The 820 KSR terminal uses continuous form paper with standard perforations on each edge. Paper widths from 76 to 378 millimeters (3 to 14.9 inches) can be accommodated. Using either the rear chute or the bottom chute, single-part or multiple-part forms (one original and up to five copies) can be printed on paper with the following weight specifications:

- Single-part forms:
  6.8-kg (15-lb) stock, minimum
- Multiple-part forms:
  Original — 5.4-kg (12-lb) stock, maximum
  Copies — 5.4-kg (12-lb) stock, maximum
  Carbon paper — 3.4-kg (7.5-lb) stock, maximum

Cardstock of up to 0.254 millimeters (0.010 inches) thick can be used for either single-part forms or last-copy-only using the bottom chute. In any case, the total form thickness should not exceed 0.533 millimeters (0.021 inches).

It is not necessary to turn the power off when loading paper. Before loading, raise the cover of the 820 KSR terminal and note that the paper-loading instructions are located inside the terminal cover.

4.4 820 KSR INTERFACE CONTROLLER

The 820 KSR data terminal uses the same TTY/EIA interface as the 733 ASR/KSR data terminal. The controller is shown in Figure 2-6. The standard jumper schedule for the 820 KSR data terminal is as follows:

Option	Jumper
Baud rate = 4800	E1B to E6
Logic level = EIA	E8 to E9
Code format = 10-bit (receive)	E11 to E12
Code format = 10-bit (transmit)	E14 to E15
Enable receive during RTS	E17 to E18
Disable 110 baud	E20 to E21
RTSE = RTSE	E25 to E26

4.5 820 KSR INTERCONNECTING CABLING

The cabling configuration for the 820 KSR data terminal is shown in Figure 4-7.

DT — Data Terminals

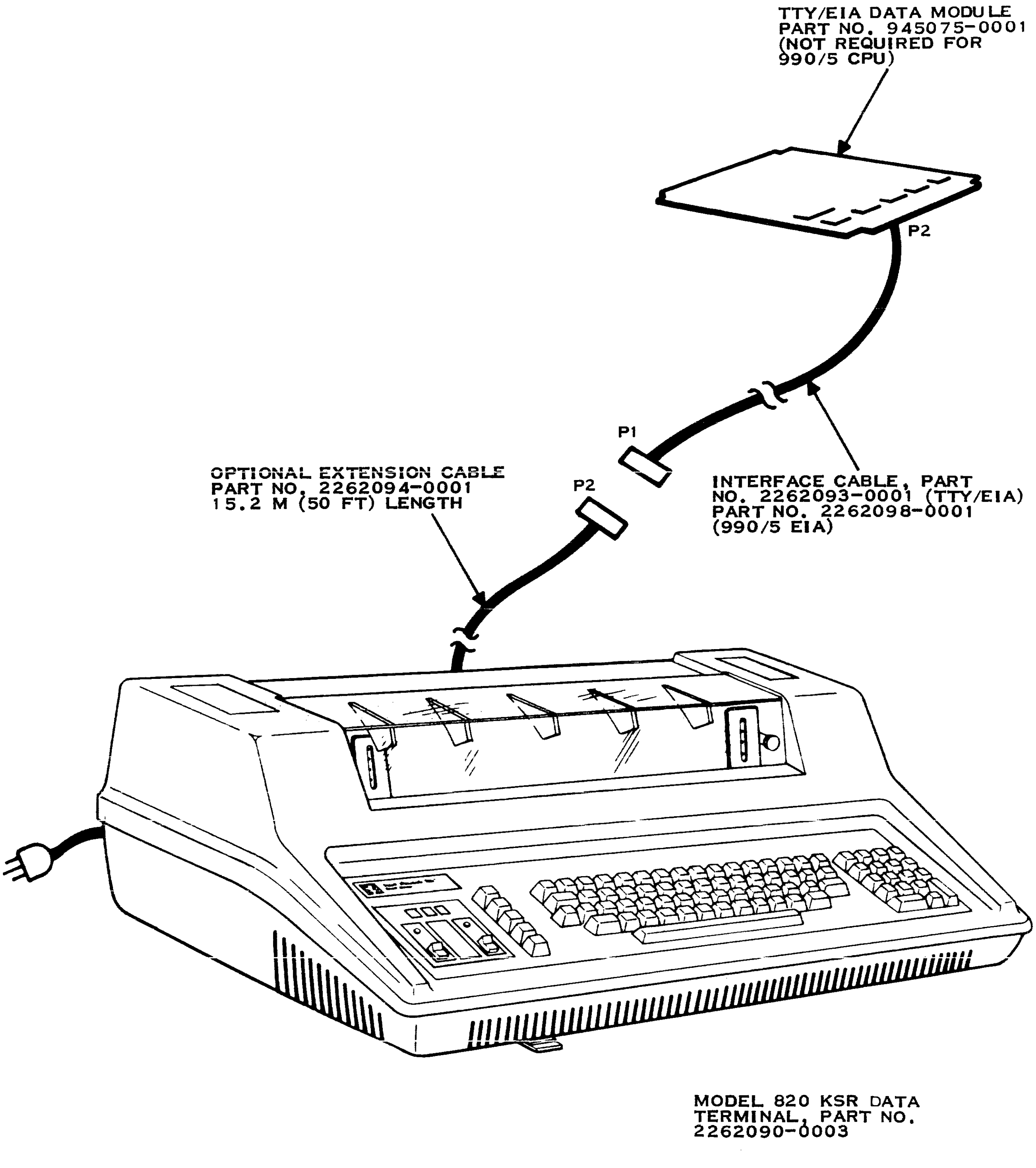

Figure 4-7. 820 KSR Interconnecting Cabling Diagram

4.6 FIELD-REPLACEABLE COMPONENTS, 820 KSR DATA TERMINAL

The field-replaceable components for the 820 KSR are as follows:

Item	TI Part Number
Controller (TTY/EIA Board)	0945075-0001
Keyboard Assembly, Full ASCII with Numeric Pad	0999691-0102
Keyboard Kit, Katakana	0999858-0001
Keyboard Kit, Katakana with Numeric Pad	0999858-0002
Printer Control Option Kit, MFG	
Device Forms Control Kit	0999845-0001
Device Forms Control (Katakana)	0999906-0001
Carriage Drive Assembly	0994238-0001
Terminal Electronics with Ground Plane	0999974-0101
Cable, I/F (TTY/EIA)	2262093-0001
Cable, I/F (990/5 EIA)	2262096-0001
Cable, Power, Domestic (115 Vac)	0996289-0001
Cable, Power, Western Europe	0996290-0001
Cable, Power, Australian	0996688-0001
Cable, Optional Extension (50-foot)	2262094-0001
Kit, Character Set, UK ASCII	0999849-0001
Kit, Character Set, DEN/NOR Full ASCII	0999850-0001
Kit, Character Set, SWE/FIN Full ASCII with Numeric Pad	0999851-0001
Kit, Character Set, France ASCII	0999852-0001
Kit, Character Set, Germany Full ASCII	0999866-0001
Cover Assembly	0999918-0001
Print Head 30 V	0999732-0001
Fan Assembly	0999819-0001
Switch, Power	0996656-0001
Test Plug	0999925-0001
Cable Assembly, 202/212 Data Set	0993205-0001
Cable Assembly, Data Terminal	0993210-0001
Drive Shaft, Tractor	0994172-0001
Bushing, Guide Rod	0994197-0001
Wire Rope, Drive Mechanism	0994233-0001
Carriage Drive Motor Assembly, 10C	0994238-0003
Carriage Drive Motor Assembly, 10 + 16.5	0994238-0004
Guide Rod, Upper	0994490-0001
Tractor, Paper Precision	0996158-0003
Switch, Sensitive	0996169-0001
Cord Set, 3-Pin Power, Domestic	0996289-0001
Cable, Electrical, Flexible	0996774-0002
Ribbon Drive	0999687-0001
Guide Rod, Lower	0999705-0001
Cover, Terminal	0999707-0001
Keyboard, Standard ASCII	0999712-0101
Keyboard, Standard ASCII	0999712-0102
Window, Terminal	0999713-0001
Printhead Assembly, 30 V	0999732-0001

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Item	TI Part Number
Cover, Paper Chute	0999739-0001
Cable Assembly, EIA	0999742-0001
Stay, External	0999749-0001
Stay, Internal	0999750-0001
Strike Cover	0999756-0001
Catch Cover	0999757-0001
Gear Assembly, Paper Advance	0999780-0001
Fan Assembly	0999819-0001
Motor Assembly	0999829-0001
Cable Assembly, Power Distribution	0999835-0001
APL Keyboard	0999868-0201
APL Keyboard	0999868-0202
Battery Pack	0999880-0001
Carriage Assembly, Printhead	0999913-0001
Cover Assembly	0999918-0001
Terminal, Electrical with Ground	0999974-0101
Current Loop	2206532-0001
Shorting Plug	2206534-0001
IC 8K X 8 ROM	2207625-0007
IC 8K X 8 ROM	2207625-0008
IC 4096 X 8 PROM, TMS 4732	2207626-0001
IC TIL32 Digital Display	0996698-0001
Control Panel Assembly	0999972-0001
1-Bit ROM	2261105-0001

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2 — DS25/50 Disk Drive System

3 — DS200 Disk Drive System

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Illustrations

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DD — Disk Drives

Tables

1

DS10 Disk Drive System

1.1 DS10 TILINE DISK DRIVE

The Model DS10 Cartridge Disk System (Figure 1-1) is a moving-head magnetic disk system that stores approximately ten megabytes of data: five megabytes on a removable 5440-type cartridge and five megabytes on a fixed disk. A pedestal mount model is shown in Figure 1-2. A rackmount model showing cable routing is shown in Figure 1-3.

Reference manuals for use with the DS10 disk are as follows:

- *Model 990 Computer Model DS10 Cartridge Disk System Installation and Operation Manual*, part number 946261-9701
- *Model 990 Computer Model DS10 Cartridge Disk System Field Maintenance Manual*, part number 945419-9702
- *Model 990 Computer DS10 Cartridge Disk Controller Depot Maintenance Manual*, part number 946262-9701,

Disk system features include:

- Single controller capable of supporting two disk drives
- 312KB per second transfer rate
- Fixed and removable disks
- Automatic track switching across head and cylinder boundaries
- Efficient disk formatting and double-frequency recording for high percentage storage use
- Controller self-test capability

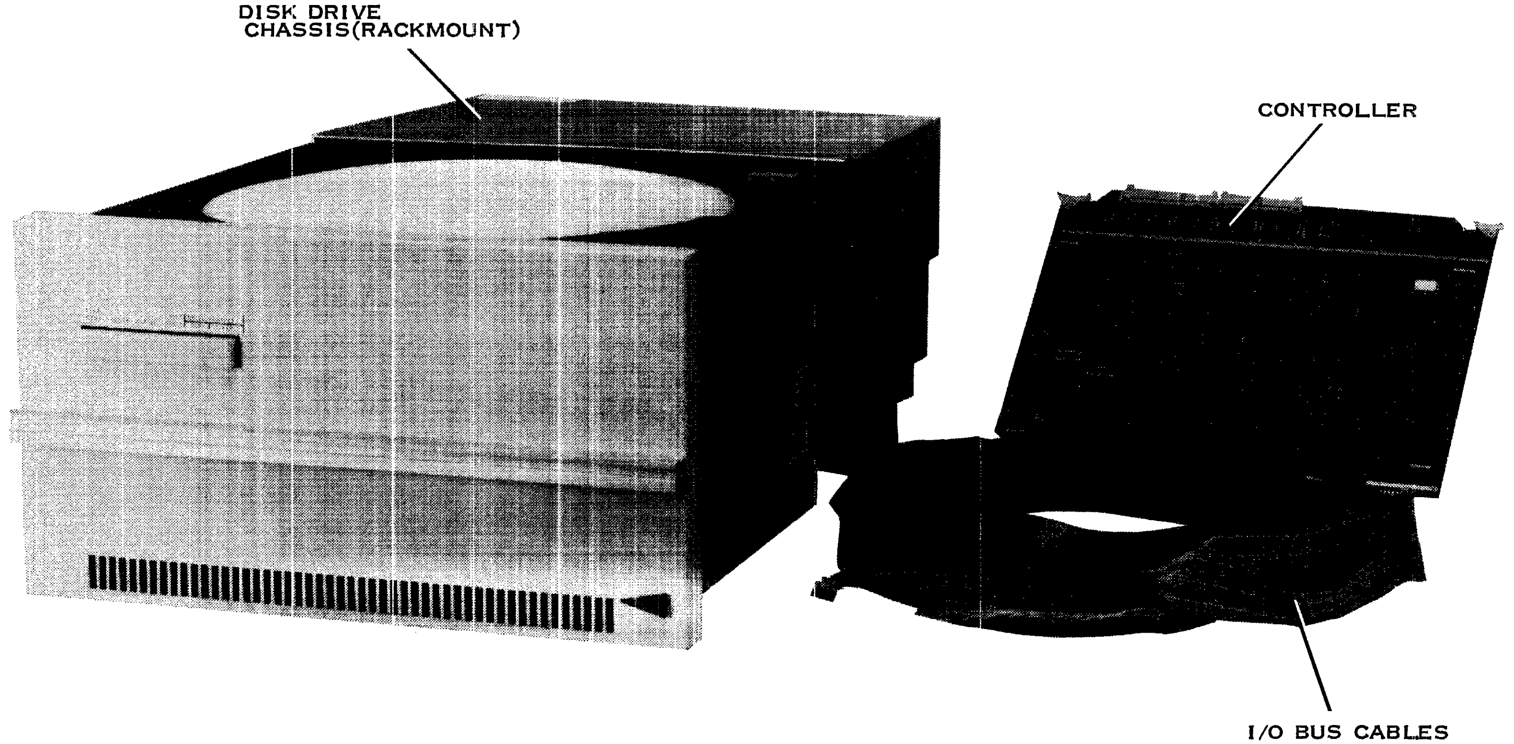

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Figure 1-1. Components of DS10 Disk System, Rackmount

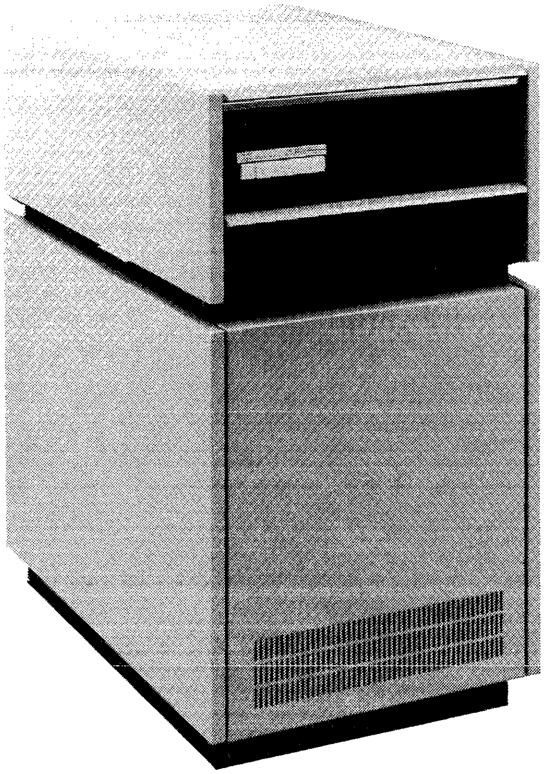

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Figure 1-2. Model DS10 Cartridge Disk Drive, Pedestal Mount

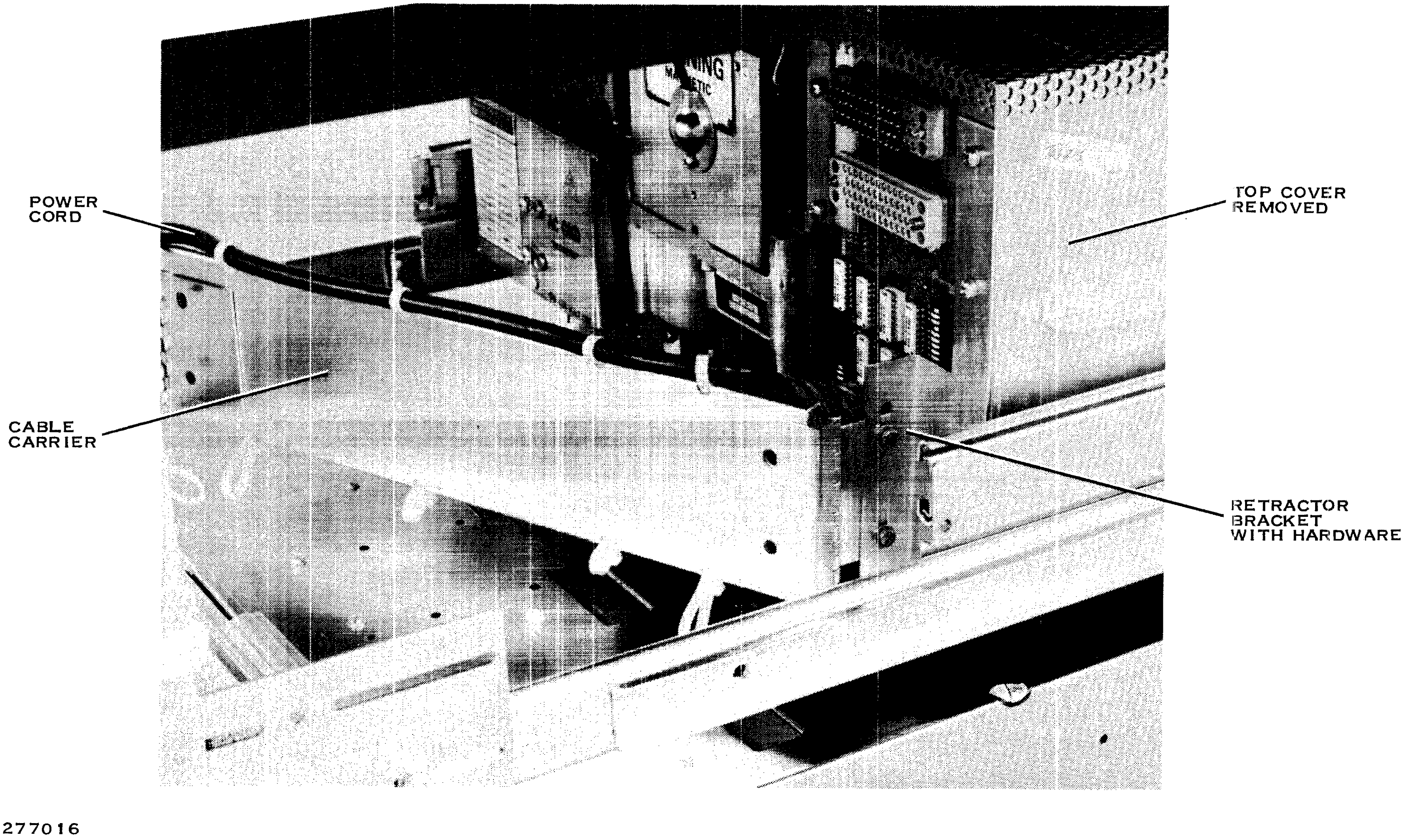

Figure 1-3. Rackmount DS10 Showing Cable Carrier and Cable Retractor Bracket

1.2 CONTROLS AND INDICATORS

The DS10 disk drive controls and indicators are shown in Figure 1-4 and Figure 1-5. These are described in Table 1-1.

Table 1-1. DS10 Disk Controls and Indicators

Control/Indicator	Function
DC Circuit Breaker (CB2)	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, this breaker is set during installation and checkout of the disk and is left on.

CAUTION

The dc circuit breaker must be set before the ac breaker is set to apply power to the disk drive. Otherwise, the power-up logic will not be energized correctly.

Control/Indicator	Function
AC Circuit Breaker (CB1)	The ac circuit breaker (labeled MAIN) on the rear of the disk drive protects the disk power supply, spindle motor, and fan motor from damage due to overload conditions. The ac circuit breaker may be remotely tripped by potentially damaging faults in the servo-system or in the power supply. The ac circuit is used as the main power switch for the disk drive unit.
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 if the following conditions exist: • Circuit breaker closed • Disk cartridge dust cover properly installed • Cartridge hold-down arms properly positioned • Reverse stop switch energized When the spindle motor is energized, the START/STOP indicator is lighted and remains lit until the spindle motor stops in response to START/STOP switch operation. Pressing the START/STOP switch while the indicator is lit (spindle motor energized) deenergizes the spindle motor. When the START/STOP switch is pressed to deenergize the spindle motor, the indicator remains lit until the following occurs: • Disk rotation stops • Interlock solenoids energize to release the disk cartridge

DD — Disk Drives

Table 1-1. DS10 Disk Controls and Indicators (Continued)

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.

Control/Indicator	Function
READY Indicator	This indicator is lighted when the spindle motor has reached operating speed, the heads are loaded, and the disk drive is ready for use. The indicator is extinguished during any fault, emergency retract, or stop operation.
ACTIVE Indicator	This lights to indicate that the disk drive is actively engaged in seeking and writing or reading data.
FAULT RESET Indicator/Switch	This lights to indicate any fault except ac power failure. If a momentary ac power drop occurs, the heads automatically go into emergency retract and the disk drive stops. The disk drive automatically starts when ac power returns to normal. This lights to indicate the occurrence of a nondamaging fault, i.e., more than one head selected, simultaneous read and write instructions, etc. The indicator is extinguished by a return-to-zero cylinder seek (Restore) command. If a momentary nondamaging fault occurs, pressing the FAULT RESET switch clears the fault logic and extinguishes the indicator. The FAULT RESET switch cannot be used to clear a persistent fault or one that causes an emergency head carriage retraction.
WRITE PROTECT CART Indicator/ Switch	This is an alternate-action lighted pushbutton switch. Pressing the switch when the indicator is not lit inhibits writing and erasing of data on the removable disk and lights the indicator. When the indicator is lit, the pushbutton remains partially depressed. Pressing the pushbutton when the indicator is lit removes the protect condition and extinguishes the indicator.
WRITE PROTECT FIXED Indicator/ Switch	This is an alternate-action lighted pushbutton switch. Pressing the switch when the indicator is not lit inhibits writing and erasing of data on the fixed disk and lights the indicator. When the indicator is lit, the pushbutton remains partially depressed. Pressing the pushbutton when the indicator is lit removes the protect condition and extinguishes the indicator.
Pack Locks	The pack locks may be considered controls in the sense that the drive will not reach the READY condition unless the pack locks are properly secured.

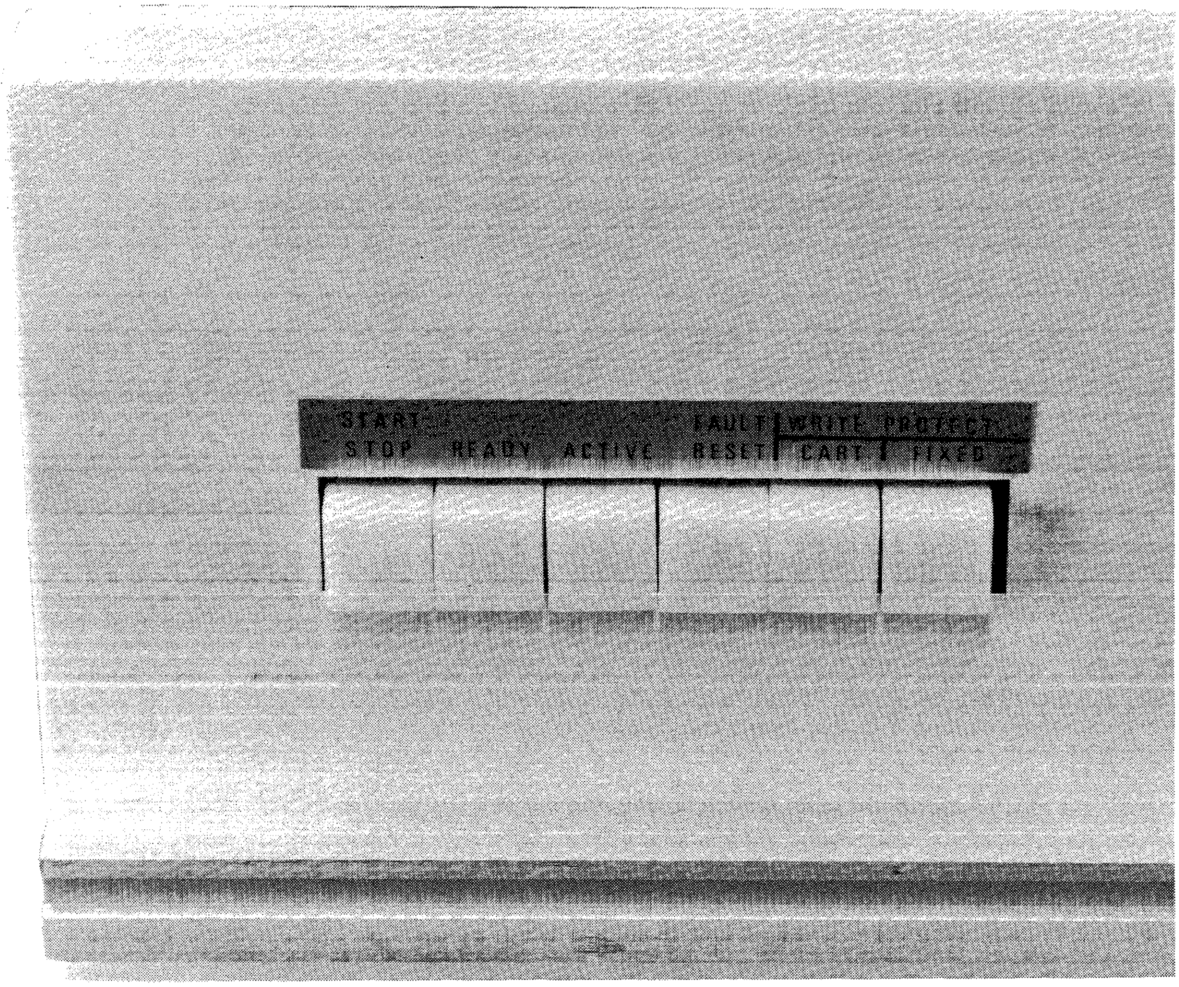

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Figure 1-4. Disk Drive Controls and Indicators

DD — Disk Drives

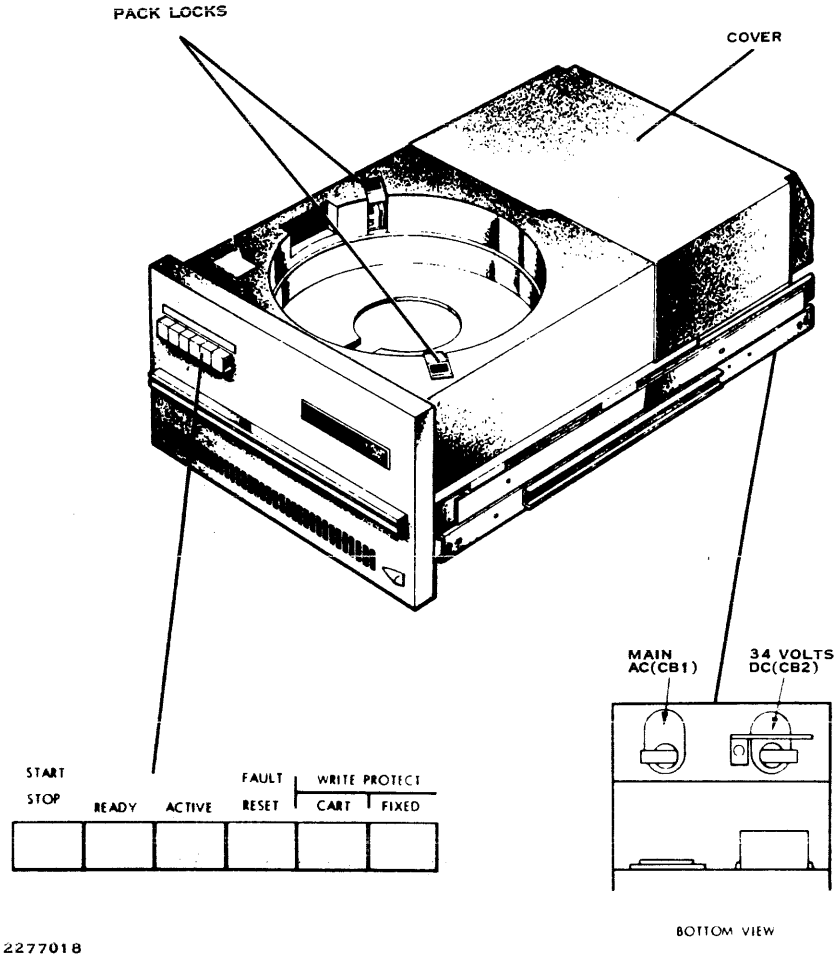

Figure 1-5. DS10 Disk Drive Control and Indicator Locations

1.3 VOLTAGE CONVERSION PROCEDURE

The following procedures and Table 1-2 detail the changes necessary to convert the DS10 disk drive to various operating voltages.

1. Remove the voltage adapter assembly (Figure 1-6) 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) and should not be removed.

2. Refer to Table 1-2 for proper jumper connections for desired voltage.

3. Pull movable end of jumper(s) out of the plug and reinsert into the location indicated by Table 1-2.

4. Install the jumper plug into the connector.

5. If necessary, remove the existing line cord plug and replace with a new one (customer-supplied) to provide proper mating of line cord with power outlet.

6. Alter voltage designation on the ID plate at the rear of the disk drive to reflect the new operating voltage.

Table 1-2. Disk Drive Input Voltage Jumper Connections

		Jumper No. 1		Jumper No. 2	
Voltage	Amperes	Fixed Pin	Movable Pin	Fixed Pin	Movable Pin
100	5.6	14	4	15	7
110	5.0	14	3	15	7
120	4.6	14	2	15	7
130	4.3	14	1	15	7
140	4.0	14	6	15	8
150	3.8	14	5	15	8
160	3.6	14	4	15	8
170	3.3	14	3	15	8
180	3.2	14	2	15	8
190	3.0	14	1	15	8
200	2.9	14	6	15	9
210	2.7	14	5	15	9
220	2.6	14	4	15	9
230	2.5	14	3	15	9
240	2.4	14	2	15	9
250	2.3	14	1	15	9

DD — Disk Drives

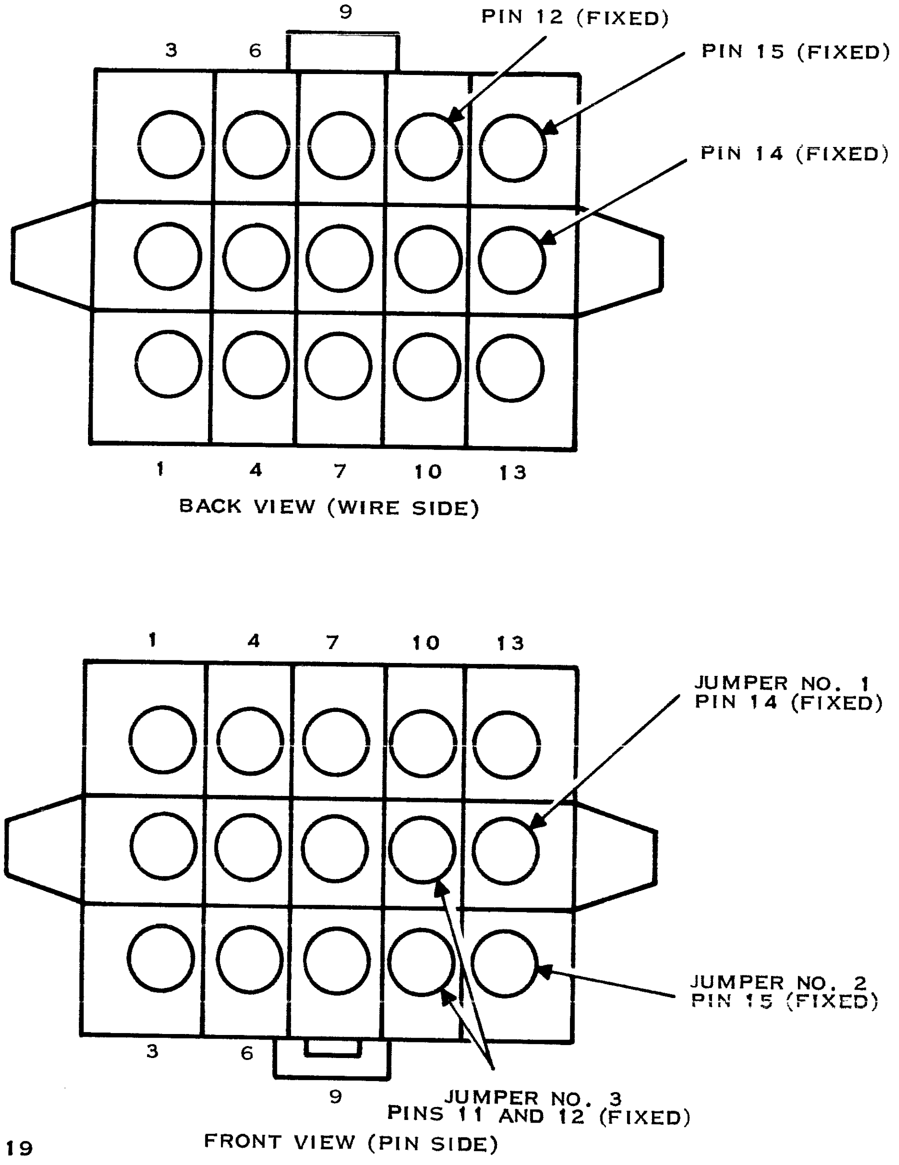

Figure 1-6. Voltage Jumper Plug and Connector

1.4 DS10 PURGE PROCEDURE

Prior to installing the disk drive in the system, it is necessary to purge the air-filtering system of contaminants. This can be accomplished by performing the following steps:

1. Set the MAIN circuit breaker to OFF.
2. Remove the back cover.

3. Unplug A1P2 (Figure 1-7) on the actuator visible at top center of the drive.
4. Set the MAIN circuit breaker to ON.
5. Install a scratch cartridge.
6. Press the START/STOP button to START.
7. Allow the disk drive to spin up and run with the heads retracted for 30 minutes.
8. Press the START/STOP button to STOP.
9. Set the MAIN circuit breaker to OFF.
10. Reconnect A1P2.
11. Set the MAIN circuit breaker to ON.
12. Remove the scratch cartridge.

1.5 DS10 DISK INTERNAL PWBS AND SWITCH SETTINGS

Figure 1-7 shows the disk drive with the card cage cover and cover clamp removed. Callouts show the circuit board mounting locations within the card cage. The disk drive circuit boards feature a number of switch-selected options. A label on the power supply cover shows the locations and the mandatory positions of these switches. Figure 1-8 is a copy of the switch setting label.

1.6 DS10 DISK CONTROLLER AND ASSOCIATED OPTIONS

The disk controller is shown in Figure 1-9. The TILINE base address for the controller is determined by the setting of DIP switches at the lower left of the circuit board. Figure 1-10 shows the switch sections and settings for TILINE addresses. Note that the switch sections are not physically arranged in binary order.

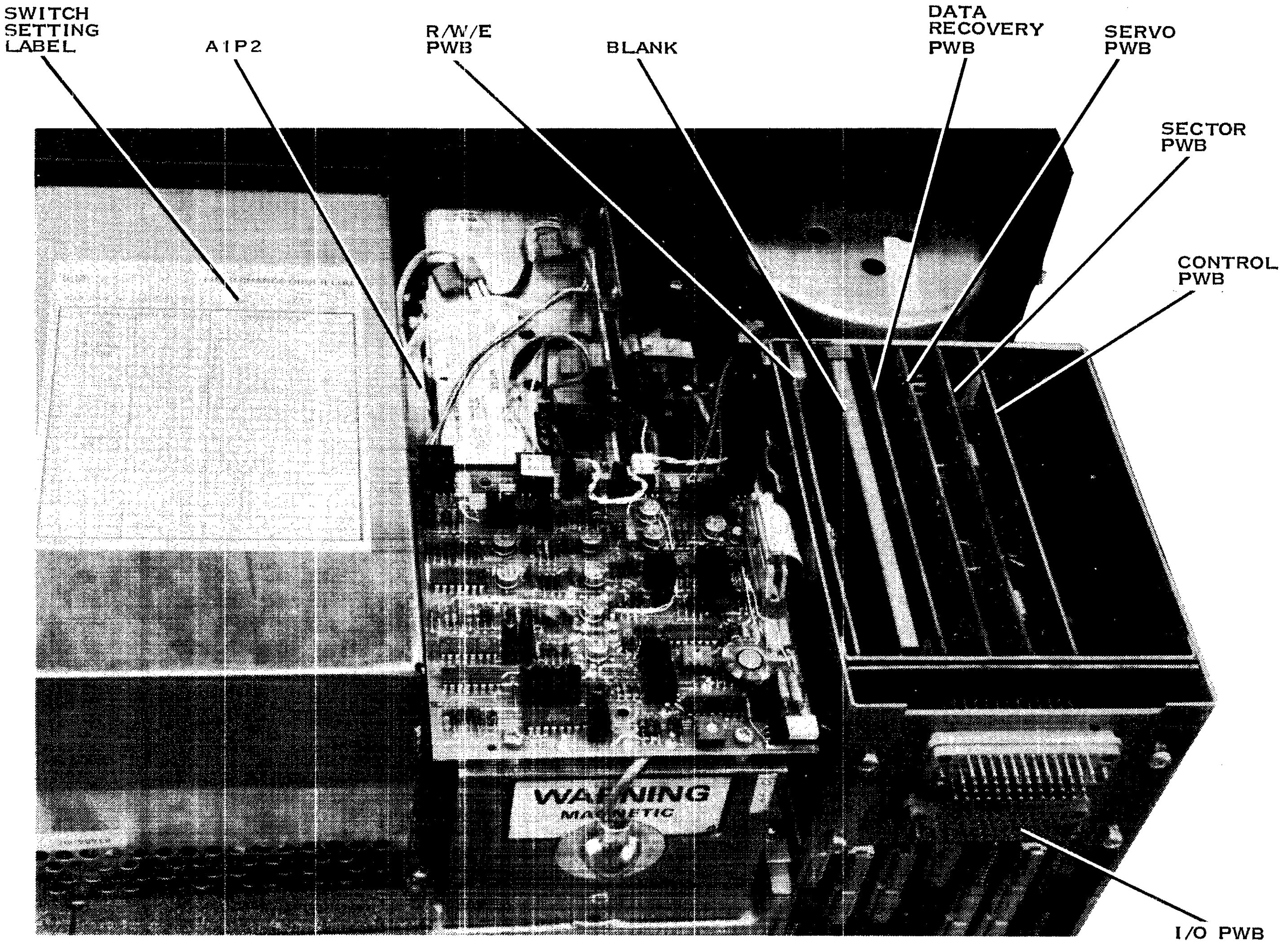

Figure 1-7. Disk Drive Internal Circuit Board Locations

DD — Disk Drives

SWITCH DESIGNATOR	CONTROL BOARD	SERVO BOARD			DATA RCVRY BOARD ****				SECTOR BOARD				I/O BOARD				
*** SWITCH POSITION	S1	S1	S2	S3	S1	S2	S3	S4	S1	S2	S3	S4	* S1	* S2	S3	S4	S5
1	0	1	0	** 0	0	0	1	0	1	1	0	0	UN1	INT1	0	0	0
2	1	1	0	** 1	1	0	0	0	1	0	0	0	UN2	INT2	1	1	0
3	1	1	0	1	0	1	0	1	0	0	0	0	UN3	INT3	0	** 1	0
4	0	1	0	1	0	** 0	1	1	1	0	1	0	UN4	INT4	0	1	0
5	0	1	0		** 0	** 1	1	0		0	1	0	0	** 0		0	0
6	0	1	0		** 0	** 0	0	0		0	0	1		0		0	0
7	1	1	0		1	** 1	1	1		1	0	1		1		0	0
8	0	1	0							0	1	0		0		1	0
9		1	0											0			
10		0	1											1			

* S1 AND S2 - UN AND INT SWITCHES MUST HAVE SAME UNIT SELECTED
** SWITCHES ARE REVERSED FOR 960/980 APPLICATIONS
*** 1=ON, 0=OFF
**** CDC PN 75886537 OR 75297105 FOR 990, CDC PN 75881050 FOR 960/980

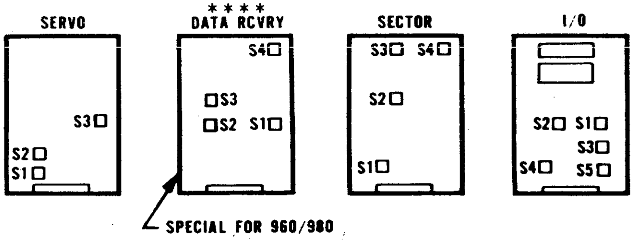

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Figure 1-8. Disk Drive Switch Setting Label

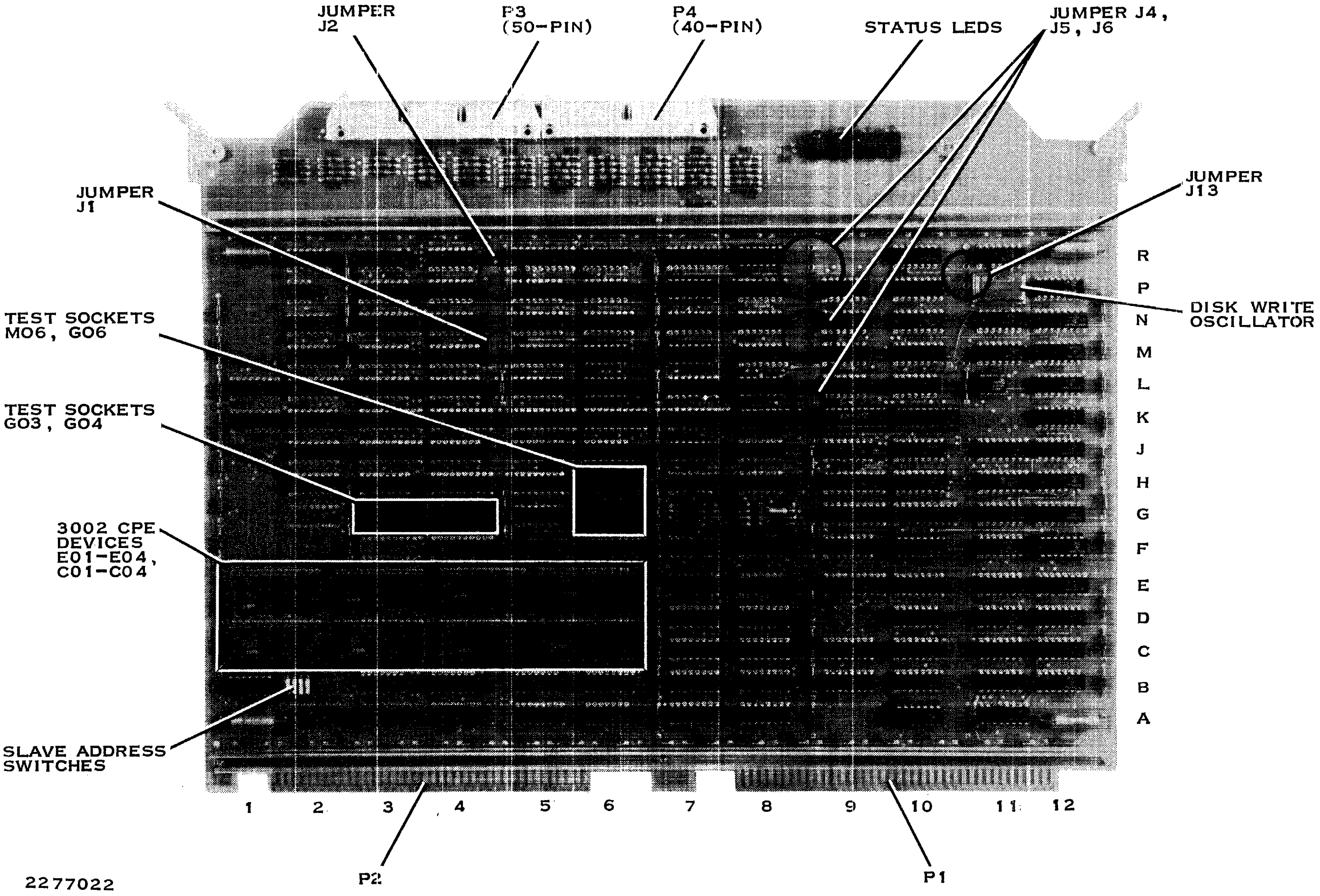
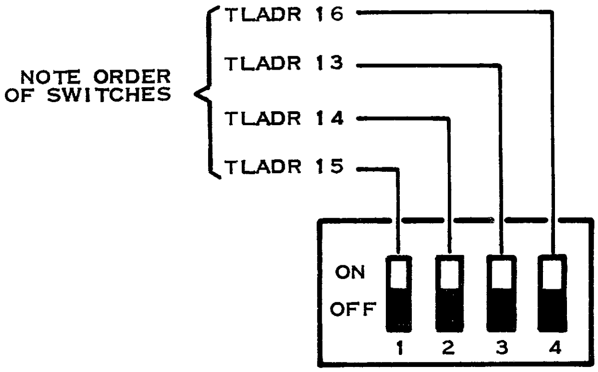


Figure 1-9. DS10 Disk Controller



TILINE ADDRESS (HEX)	CPU ADDRESS (HEX)	SWITCHES 1	 2	 3	 4
FFC00	F800	OFF	OFF	OFF	OFF
FFC08	F810	OFF	OFF	OFF	ON
FFC10	F820	ON	OFF	OFF	OFF
FFC18	F830	ON	OFF	OFF	ON
FFC20	F840	OFF	ON	OFF	OFF
FFC28	F850	OFF	ON	OFF	ON
FFC30	F860	ON	ON	OFF	OFF
FFC38	F870	ON	ON	OFF	ON
FFC40	F880	OFF	OFF	ON	OFF
FFC48	F890	OFF	OFF	ON	ON
FFC50	F8A0	ON	OFF	ON	OFF
FFC58	F8B0	ON	OFF	ON	ON
FFC60	F8C0	OFF	ON	ON	OFF
FFC68	F8D0	OFF	ON	ON	ON
FFC70	F8E0	ON	ON	ON	OFF
FFC78	F8F0	ON	ON	ON	ON

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Figure 1-10. DS10 Disk Controller TILINE Switches and Settings

Figure 1-11 shows the standard on-board jumper positions for the controller. The disk controller photograph shows the locations of these jumpers.

DD — Disk Drives

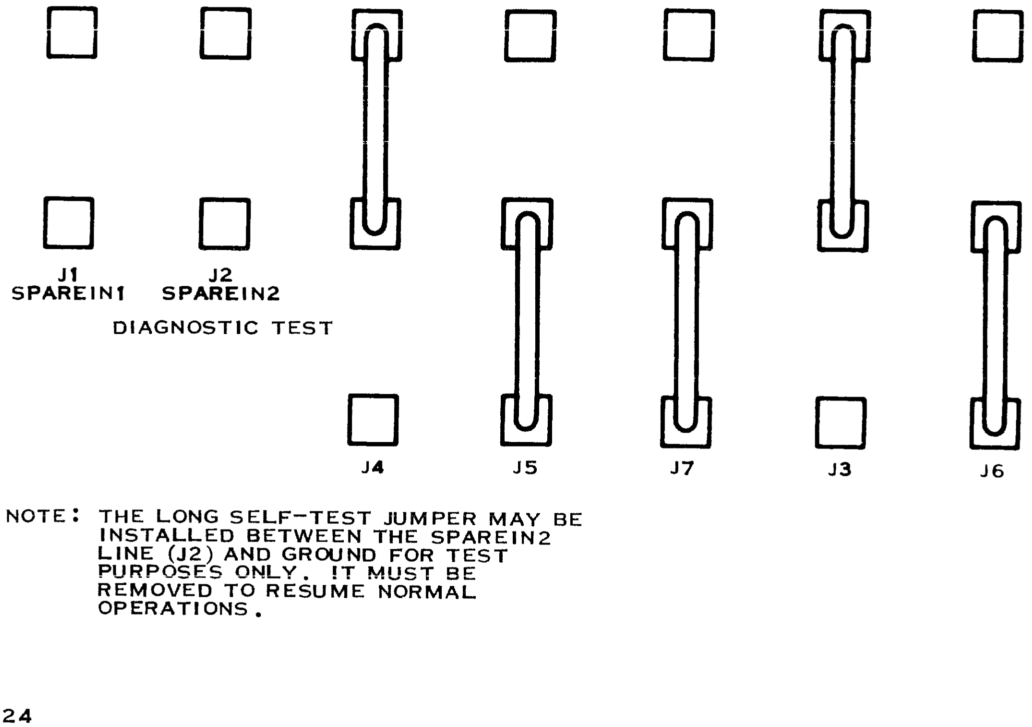

Figure 1-11. Disk Controller Standard Jumpers

Figure 1-12 shows the four LEDs located on the top right-hand corner of the controller. These indicators can be used when troubleshooting the controller to gain some idea of what may be wrong. Three of the LEDs are green and one is red. These are described as follows:

- FAULT — The FAULT LED is used to display two different conditions. This light will be turned on by the command timer when it reaches the maximum count. When this happens, the FAULT LED (red) will be illuminated and will remain on until cleared by the proper sequencing through the microcode terminate routine. This indicator is also set (illuminated) at the beginning of the self-test diagnostic and cleared (turned off) at the successful completion of the diagnostic test.

- CLK — Operation of the clock LED is as follows:

  — Indicator not lit — Controller not running. Possible TLAG problem.

  — Indicator lit but not bright — Clock running normally.

  — Indicator brightly lit — Clock always on. Possible faulty clock circuit.

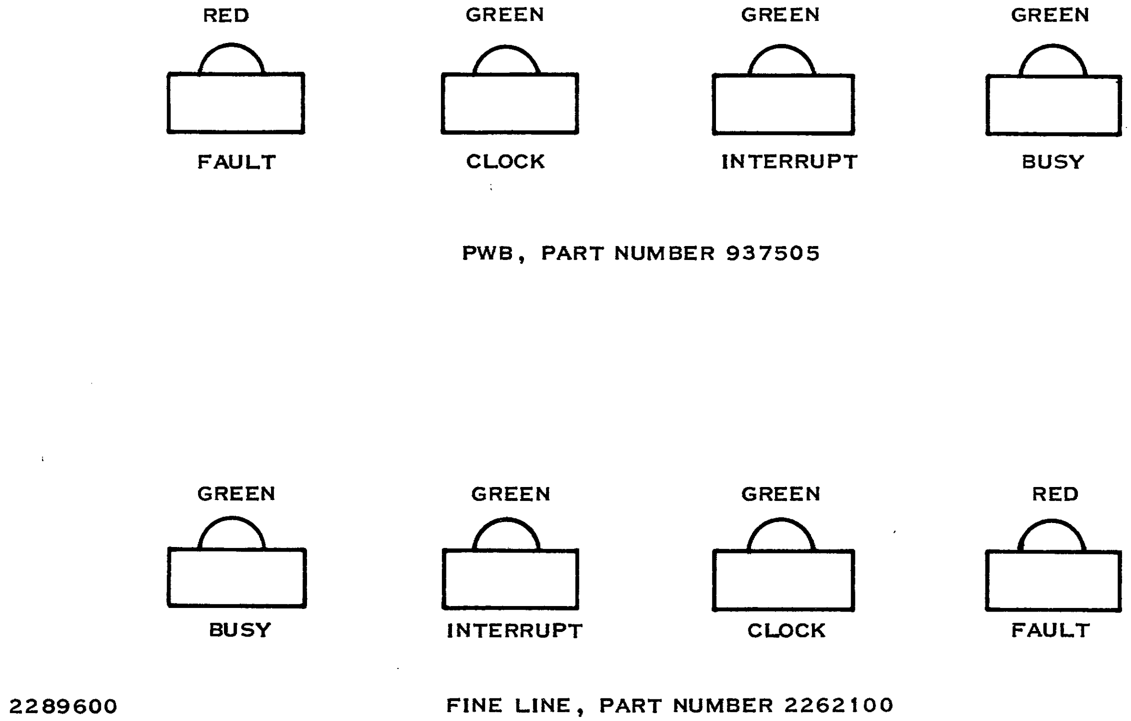

Figure 1-12. Disk Controller Status LEDs

- BUSY — When lit, the BUSY LED indicates that the controller is servicing a TILINE I/O reset or executing a command, a master power reset, or a power failure warning. When the BUSY indicator is lit, the controller cannot accept any commands.
- INT — The interrupt indicator is used to display the state of the interrupt line from the controller to the computer. When this indicator is lit, the controller has issued an interrupt to the computer. This light will stay on until the interrupt condition is reset by the computer.

1.7 CONTROL WORD FORMATS

The controller is initiated and interrogated by a TILINE master via a set of control words. These eight control words and their corresponding TILINE addresses are shown in Figure 1-13. The control word contents and formats are described in detail in the DS10 installation and operation manual.

DD — Disk Drives

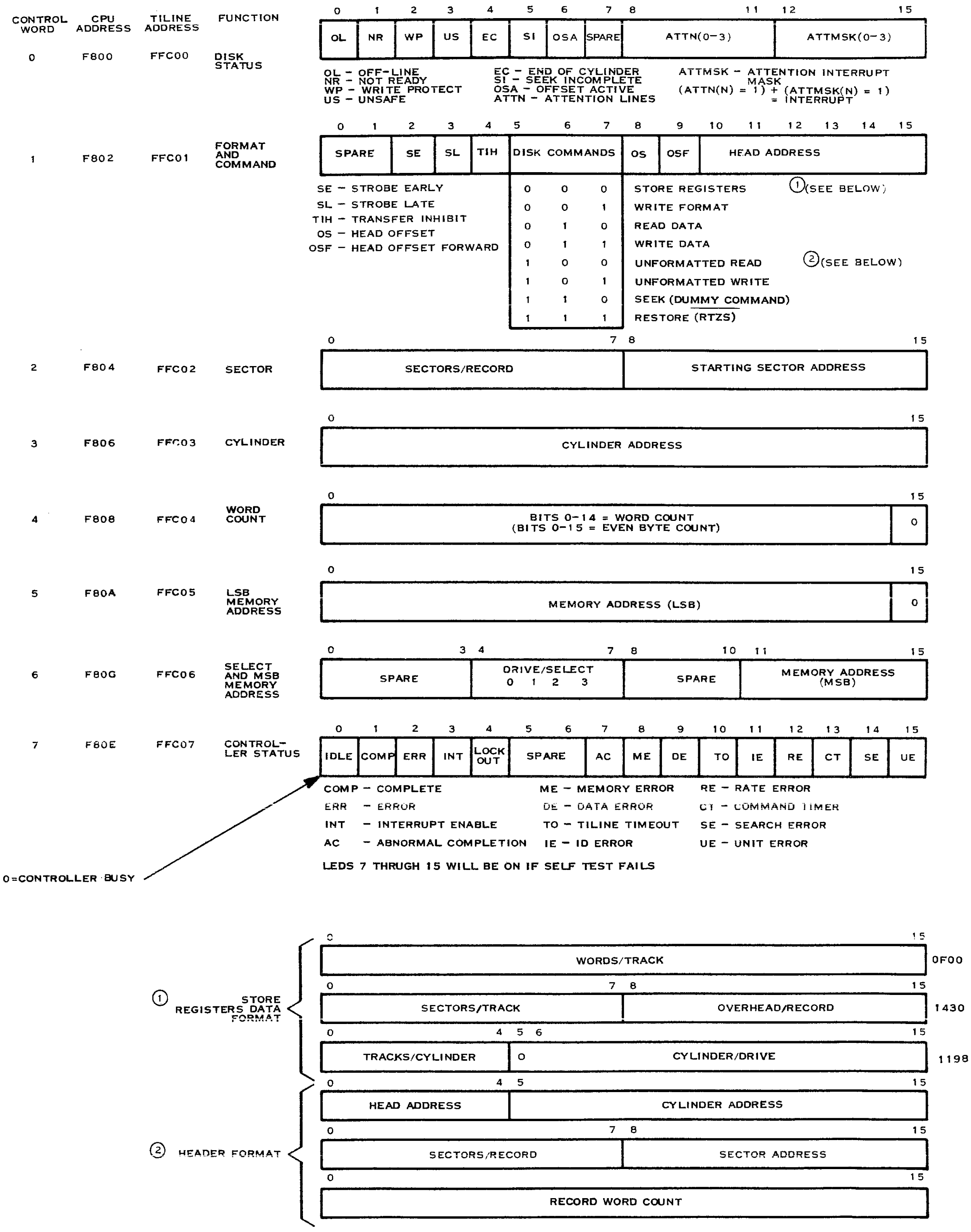

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Figure 1-13. DS10 Disk System Control Word Formats

1.8 DS10 DISK SYSTEM CABLING

Figure 1-14 shows the cabling configuration for a disk system with a single rackmount disk drive. Note that the cable adapter mounts directly on the I/O board of the rackmount drive. Also, note that the resistive terminator networks must be installed in sockets XRM1 through XRM12 on the I/O board. (Refer to Figure 1-15.) Figure 1-16 shows the cabling configuration for a disk system with dual rackmount disk drives.

Note that the resistive terminators are removed from the disk drive in the center of the daisy chain, leaving one set of terminators at the end of the chain. Also, two 220 picofarad capacitors must be installed on the disk drive that does not have terminating resistors. Install the capacitors on XRM8 pins 1 to 16 and 2 to 15. Trim the capacitor leads to a length of approximately 3/8 inch.

Cabling configurations for the pedestal-mounted drives are similar except for the physical location of the cable adapter in the lower bay of the pedestal.

Figure 1-17 shows the cable adapter with 50-pin connectors on top and 40-pin connectors on the bottom. It makes no difference which of the connectors are used as long as there is a pin-to-pin correspondence between the connector and the cable adapter and the connectors are properly aligned. At the lower right of the cable adapter are the pins for the unit select jumper option. These jumpers are shown in Figure 1-18. The jumpers use the conventions specified in the illustration.

The AGC servo preamp board for the DS10 is shown in Figure 1-19.

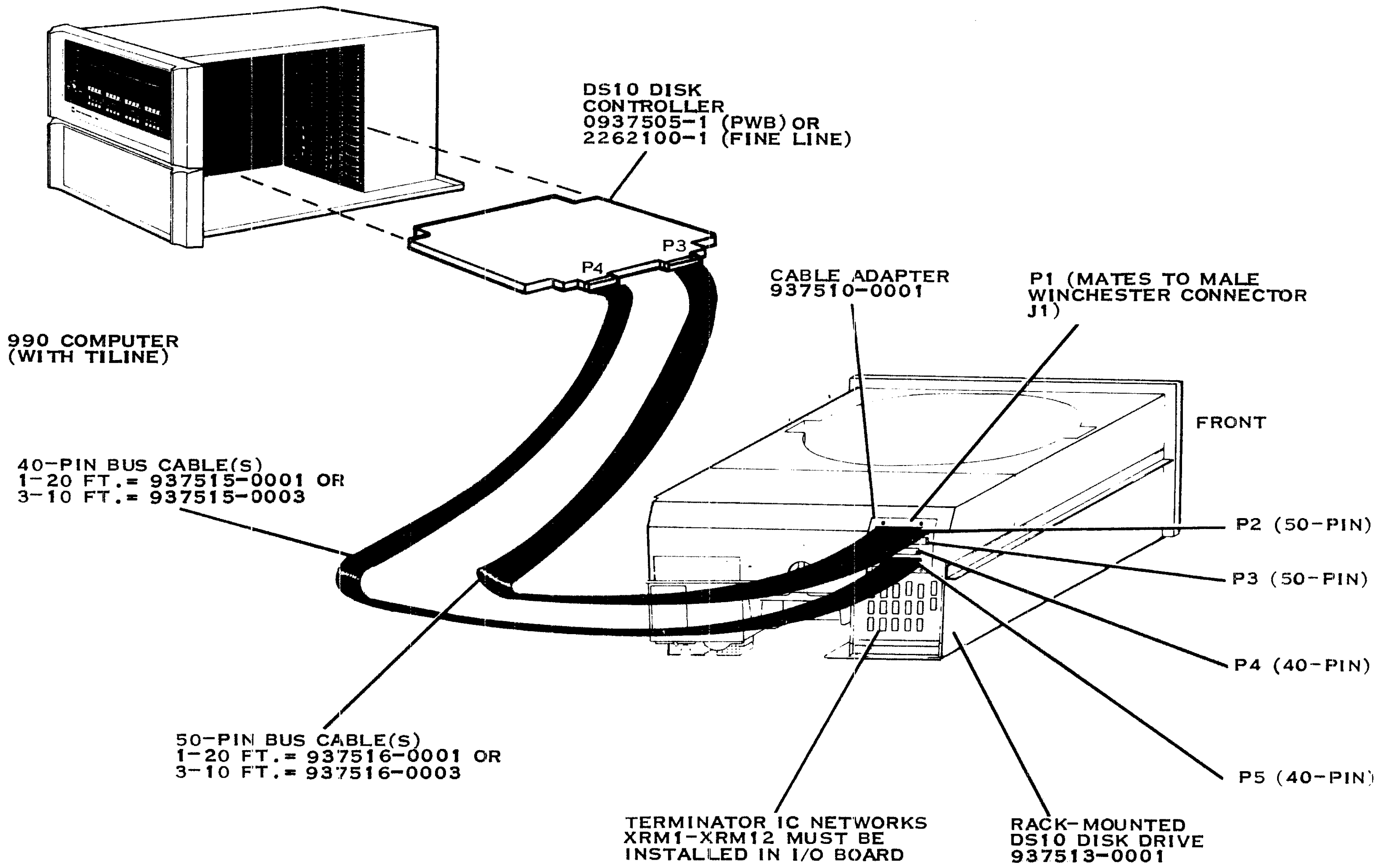


Figure 1-14. DS10 System Interconnections — Single Drive

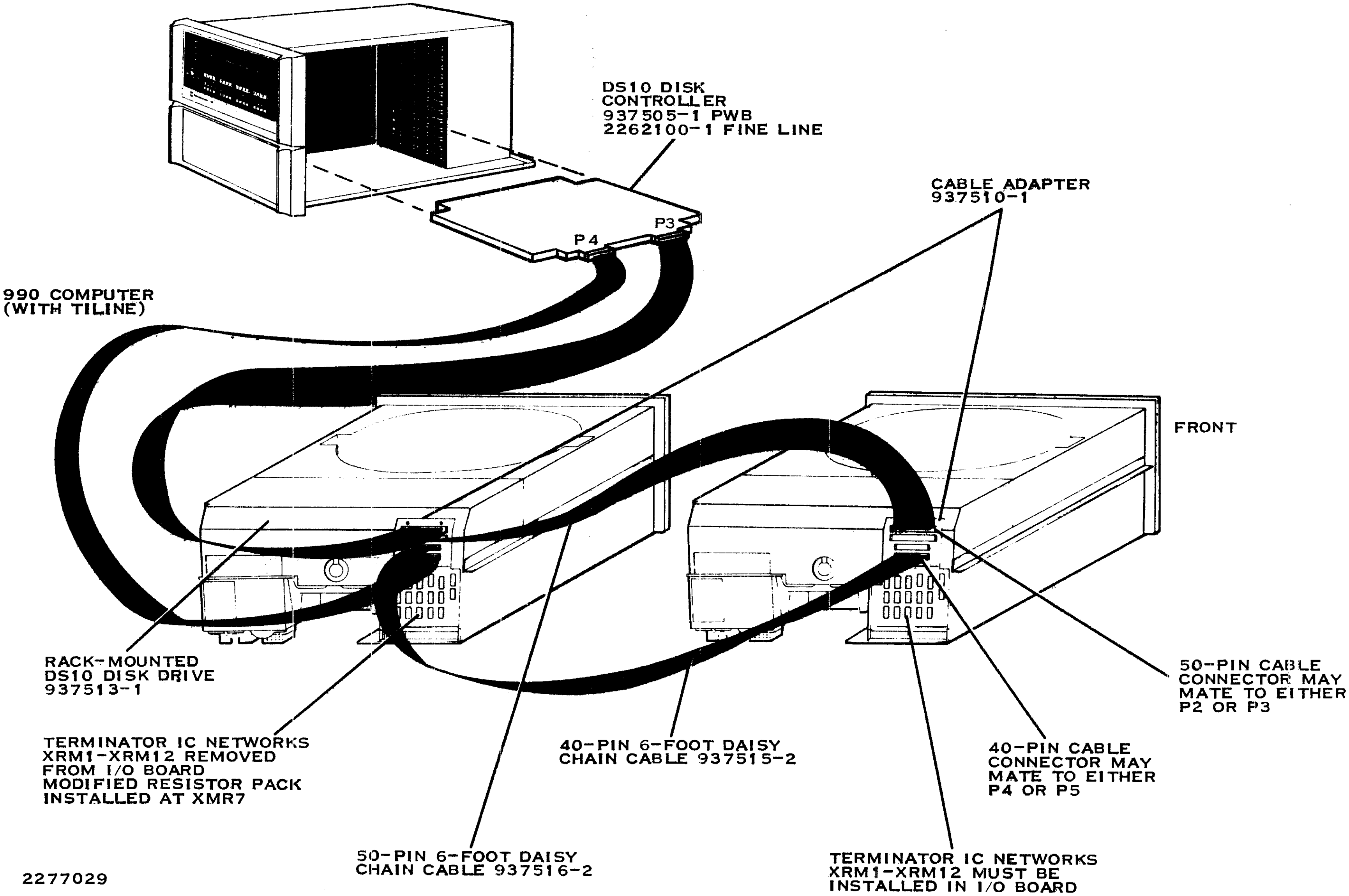


Figure 1-16. DS10 System Interconnections — Two Drives

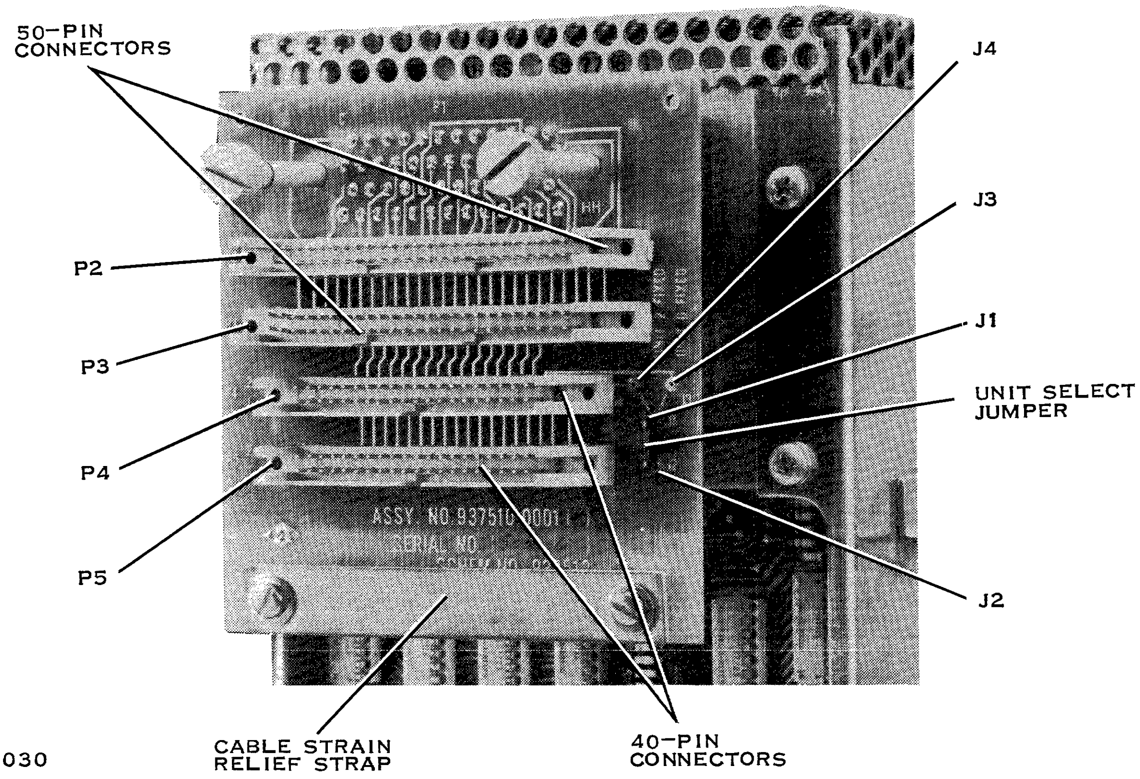
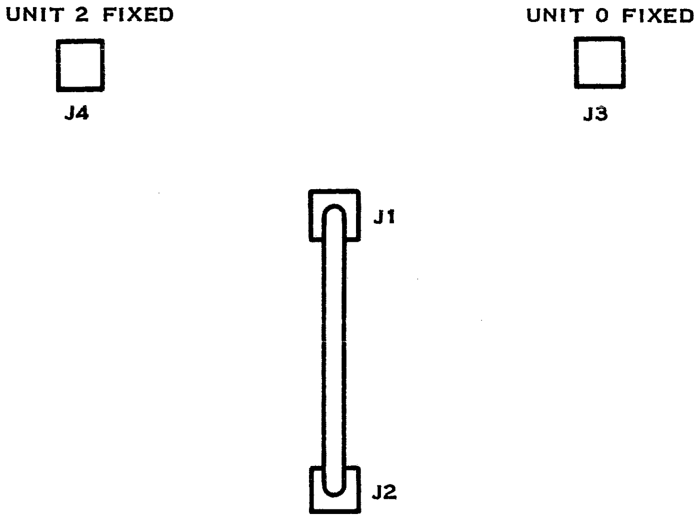


Figure 1-17. DS10 Disk Cable Adapter

DD — Disk Drives



DS10 ADAPTER (937510-1) AND JUMPER PLUG CONFIGURATION

1. PRIMARY DRIVE LOGICAL UNIT ASSIGNMENT: FIXED = UNIT 0, REMOVABLE = UNIT 1.
2. SECONDARY DRIVE LOGICAL UNIT ASSIGNMENT: FIXED = UNIT 2, REMOVABLE = UNIT 3.
3. J1 TO J2 DOES NOT ALTER UNIT ASSIGNMENT ABOVE.
4. J1 TO J3 REVERSES SELECTION ON PRIMARY DRIVE.
5. J1 TO J4 REVERSES SELECTION ON SECONDARY DRIVE.

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Figure 1-18. DS10 Disk Designation Reversing Jumper on Cable Adapter

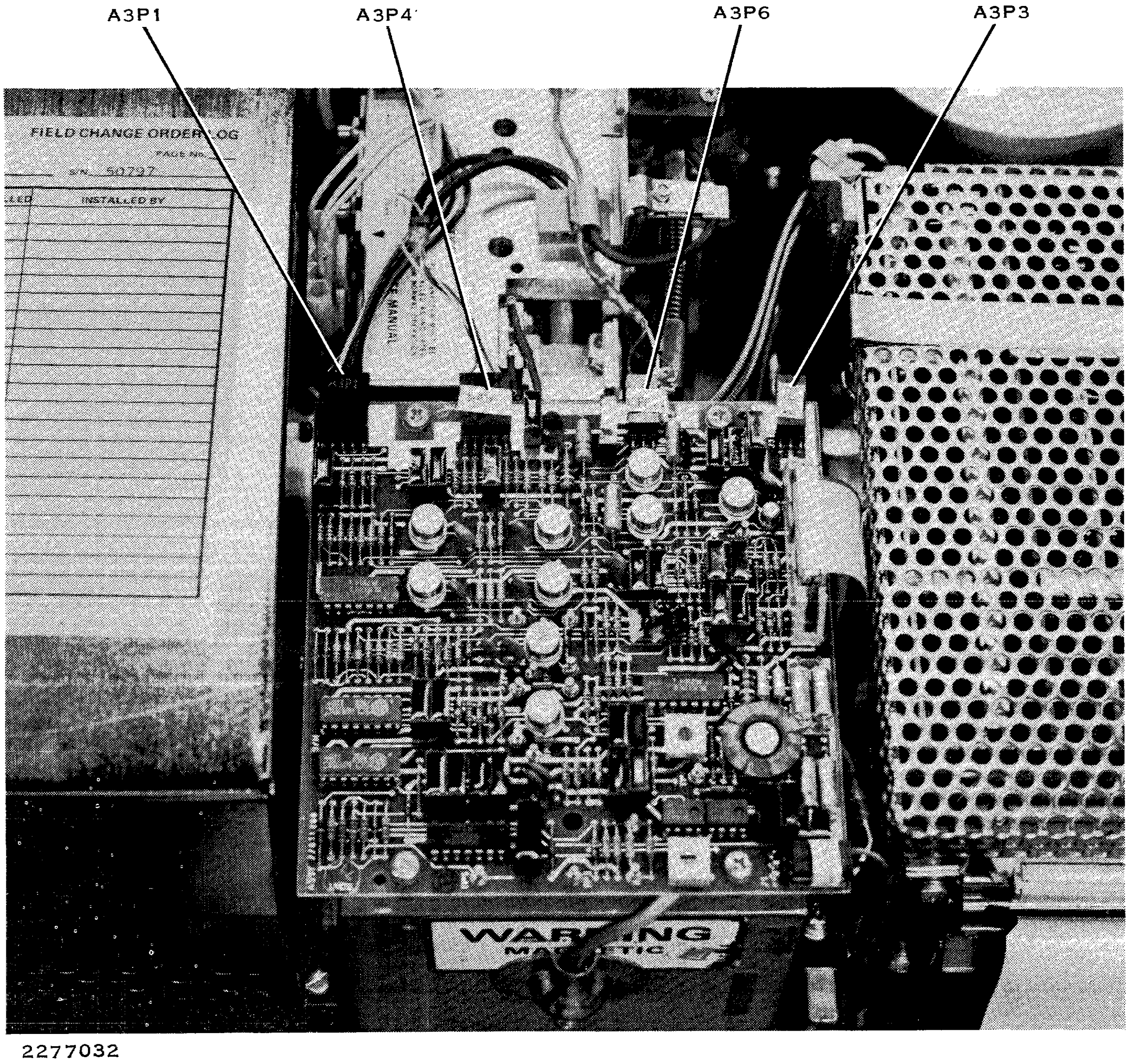


Figure 1-19. DS10 AGC Servo Preamp Board Showing Connector Locations

DD — Disk Drives

1.9 FIELD-REPLACEABLE COMPONENTS, DS10 DISK

The field-replaceable components for the DS10 disk drive system are as follows:

Item	TI Part Number	Vendor Part Number
Control Card	943848-0003	
Servo AGC Card	943848-0004	
PWR Piggyback Card	943848-0005	
R/W/E Card*	943848-0008	
Servo Card	943848-0009	
Sector Card	943848-0010	
I/O 3M Rack Card	943848-0011	
I/O Winch. Rack	943848-0012	
Brake Card	943848-0013	
Motherboard Card	943848-0020	75870203
Transducer Scale PWB Assembly	943848-0027	75315404
Blower	943848-0041	83457100
Motor and Brake Assembly	943848-0047	83467401
Power Supply Board	943848-0051	83475106
Position Transducer SL-CC	None	83475401
CR Ball Bearing	None	92054227
Transformer	None	75305002
End Travel Card	None	75318901
Controller, PWB	937505-0001	None
Controller, Fine Line	2262100-0001	None
Resistor Module	943848-0019	75300200
Lamp	943848-0021	77832393
Capacitor	943848-0023	75774466
Supply/Divert Gasket	943848-0035	75794902
Static Guard Spring	943848-0037	40054700
Idler Spring	943848-0038	70308502
Snubber Clutch	943848-0039	83443301
Solenoid	943848-0042	94357803
Blower Gasket	943848-0043	77499600
Motor Capacitor	943848-0046	94255105
Bridge Rectifier	943848-0048	95582004
Air Filter Cab	943848-0049	75805800
Prefilter Filter	943848-0053	77604000
Drive Belt	943848-0054	75722930
Resistor Module	943848-0055	75738604
Resistor Module	943848-0056	75738607
Capacitor	None	75774466
Spring	None	75779867
Resistor Module	None	75300200
Switch Subminiature	None	92549007
Switch Subminiature	None	77598501
Switch Pivot Lever 1	None	36159806

DD — Disk Drives

Item	TI Part Number	Vendor Part Number
Capacitor	None	75774406
Static Guard Spring	None	40054700
Relay	943848-0006	22940804
Head, ASM 200/SE/24	943848-0014	75037504
Head, ASM 200/SE/24	943848-0015	75037505
EOT Detector	943848-0017	83447301
Solid State Switch, 600 V	943848-0018	75885250
Upper Sensor Cable	943848-0030	75793802
Motor Brush Assembly	943848-0031	75740701
Disk Brush	943848-0032	40024501
Disk Brush	943848-0033	40024502
Air Filter	943848-0034	83437400
Lower Sensor Cable	943848-0044	75793803
ASM Switch	943848-0052	75299103
Disk, Fixed Recording	943848-0007	
Card, Data Recording	943848-0016	
Switch, Solid State	943848-0018	
Idler Assembly	943848-0040	
Head Alignment Tool	943848-0057	
Card Extractor	943848-0059	
Pack Locks	943848-0063	
Position Transducer SL-CC	943848-0064	
Cable Assembly SW, BD	943848-0073	
Data Recovery BD, 10 MB	943848-0075	
Armature Plate Shim	943848-0060	
Card Extender	943848-0058	
Fault Board	943848-0050	

Note:

* The R/W/E card has two resistor networks mounted on it, RM1 and RM2. These resistor networks must be transferred from the old card to the new card when changing out the board with special attention to the locations of pin 1.

2

DS25/50 Disk Drive System

2.1 DS25/50 TILINE DISK DRIVE

DS25/50 disk drives are random-access, data storage, moving-head devices that provide mass-storage memory for the computer. The DS25/50 disks use a magnetic high-density disk pack and flying heads that move laterally over the disk surfaces to select different cylinders. The components of a typical DS25/50 disk drive kit are shown in Figure 2-1.

Reference manuals for use with the DS25/50 disk drives are as follows:

- *Model 990 Computer Model DS25/50 Disk Systems Installation and Operation*, part number 946231-9701
- *Century Data T25/50 Disk Drive Maintenance Manual*, vendor number 76205-302
- *Model 990 Computer DS25/50 Disk Controller Depot Maintenance Manual*, part number 946238-9701

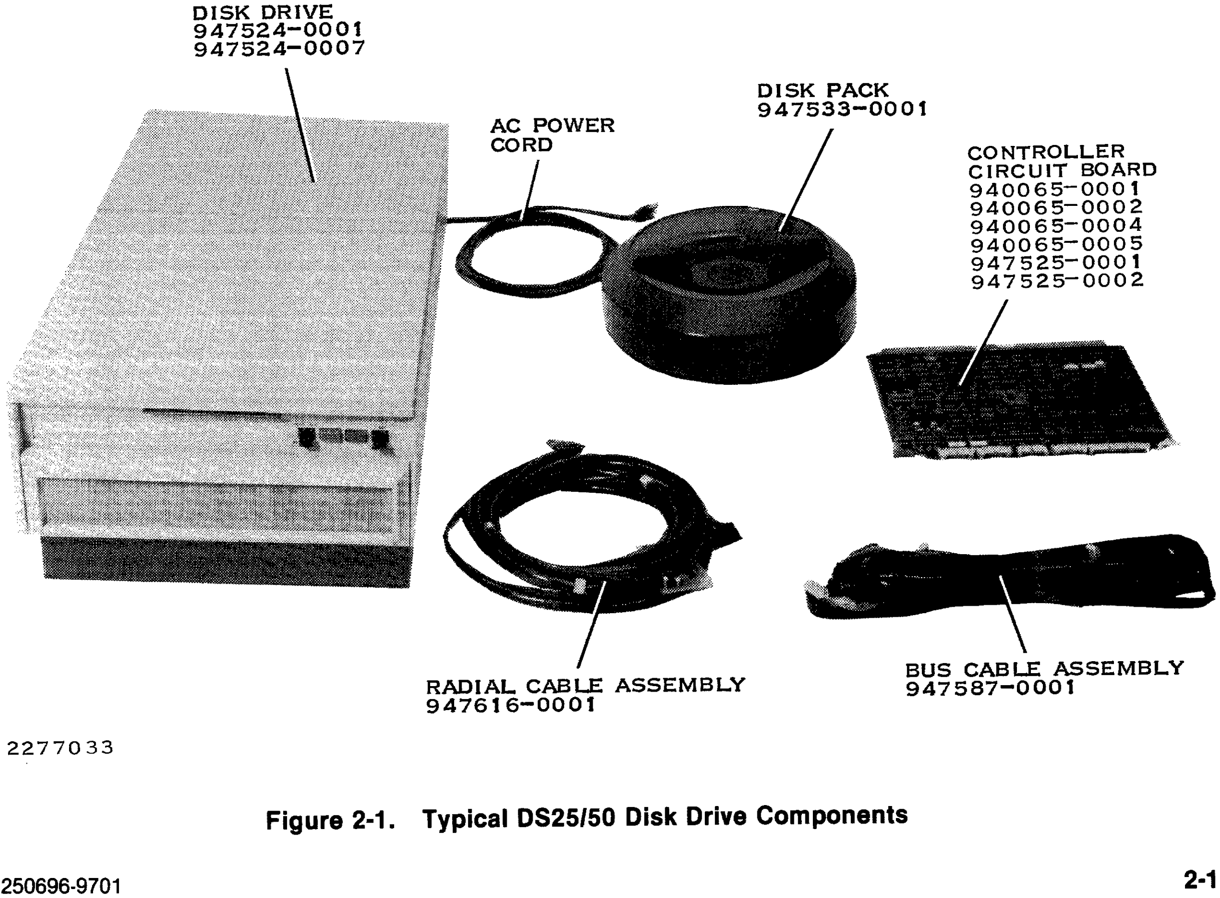


Figure 2-1. Typical DS25/50 Disk Drive Components

2.2 DS25/50 FRONT PANEL CONTROLS AND INDICATORS

The front panel controls and indicators are shown in Figure 2-2. These are described in Table 2-1.

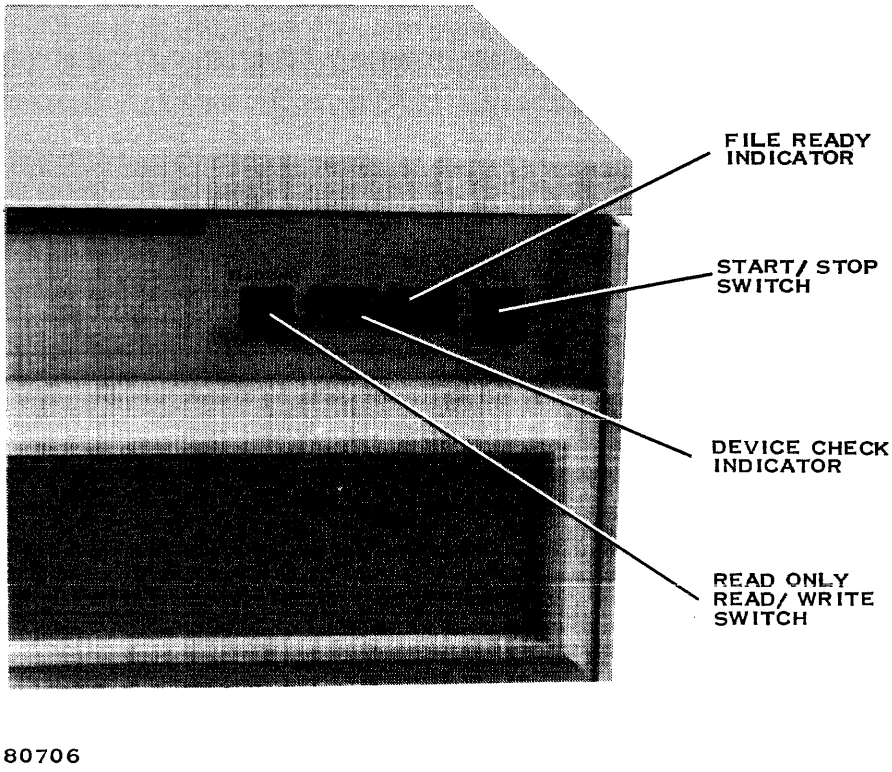


Figure 2-2. DS25/50 Front Panel Controls and Indicators

Table 2-1. DS25/50 Front Panel 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 drive is selected by the controller to prevent the operator from interrupting a disk write operation. The disk drive may be deselected by performing an I/O reset, by selecting another drive, or by toggling the START/STOP switch.
DEVICE CHECK Indicator	This indicator lights when a device check error has been detected by the disk drive and remains lit until the controller resets the device check error detector or until the disk drive is powered down.

Table 2-1. DS25/50 Front Panel Controls and Indicators (Continued)

Control	Description
File Ready Indicator	This indicator flashes during power-up and power-down sequencing. The disk drive is in the ready condition (powered up and heads loaded) when the indicator stays lit.
START/STOP Switch	This two-position toggle switch permits manual power-up and power-down sequencing. START position turns on the spindle drive motor, initiates a brush cycle (on newer drives brushes are not used), and loads the heads. (Heads will not load and seek incomplete will result 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 dynamic brake to stop the disk pack.

2.3 DISK CONTROLLER STATUS INDICATORS

There are four status indicators located on the controller (Figure 2-6). These indicators are as follows:

- FAULT — When the FAULT indicator lights, a microprogram type of failure has occurred and the controller must be repaired. Under normal conditions, the FAULT indicator is not lit; it lights if the command timer on the controller times out, indicating that the controller-initiated operation was not completed within the prescribed 100 milliseconds. Faulty components such as ROMs or 3002 CPE elements can cause the FAULT indicator to light.

- CLK — The clock indicator is always lit under normal operating conditions to indicate that the microprocessor clock is running. If this LED is extinguished, it means the controller cannot get access to the TILINE or is hung in a master cycle. A possible fault condition indicated by an inoperative CLK LED could be improper wiring of the access granted signal line, since the controller's clock is stopped during a TILINE master cycle.

- BUSY — When the BUSY indicator is lit, the controller is in the process of executing a command, servicing a TILINE I/O reset, master power reset, or power failure warning, or is in a sequence routine. When the indicator is lit, the disk drive system cannot accept any commands. The controller is busy for 20 seconds following power-up to allow voltage to stabilize before sequencing up the drive.

- INT — When the interrupt indicator is lit, the controller is issuing a TILINE interrupt. The INT indicator lights when the controller's master interrupt is active. This indicator is useful in analyzing system interrupt problems, or for displaying the interrupt activity and the response of the controller. The external interrupt signal can be activated and the INT indicator lit in two ways:

- When the interrupt enable bit and either the complete bit or error bit are set, the controller can set the interrupt flip-flop. This lights the INT indicator and sends an external interrupt signal to the TILINE.
- When the disk drive responds with an attention signal that compares to the preset attention mask, the resulting signal is ANDed with a busy signal, and an interrupt is sent to the TILINE and the INT indicator is lit.

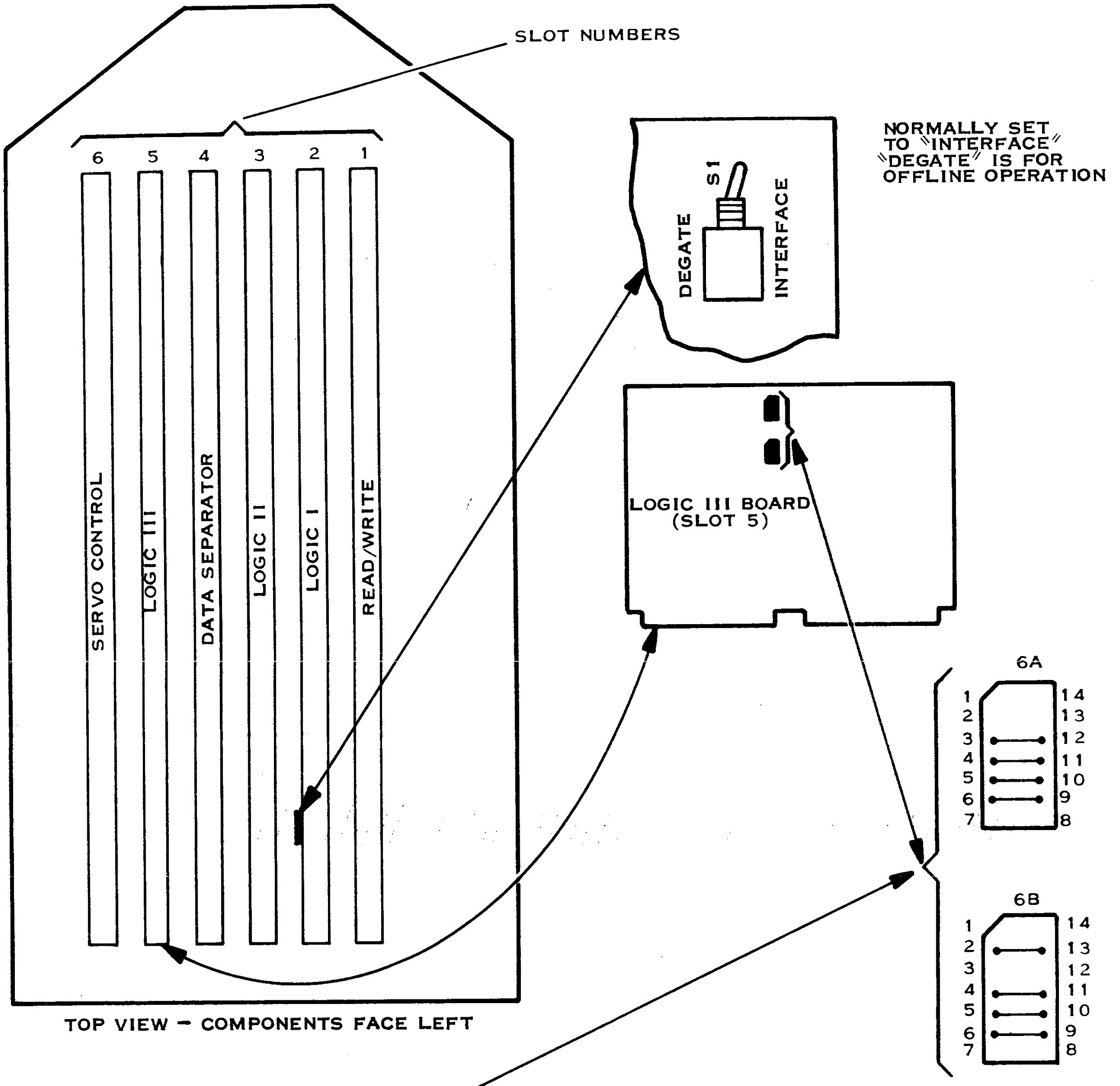
2.4 MAINTENANCE SWITCHES

The maintenance switches consist of an INTERFACE/DEGATE switch (Figure 2-3) on the logic I card, and the power ON/OFF switch (Figure 2-4) located on the rear of the disk drive unit. Figure 2-5 is an illustration of the logic-ground/power-ground jumper and the input voltage selector. The maintenance switches are as follows:

- INTERFACE/DEGATE Switch — This two-position toggle switch is located on the top edge of the logic I card (Figure 2-3). (The switch is accessible only when the rear cover is off.) The INTERFACE position enables normal online operation, permitting the disk drive to be selected by the controller. The DEGATE position disconnects the disk drive from the controller and enables the T2000A exerciser inputs for offline maintenance operation of the device.
- Power ON/OFF Switch — This two-position toggle switch controls ac power to the dc power supply of the disk drive. This switch should be set to OFF before any circuit board is removed or when disk drive assemblies or components are replaced.

WARNING

AC power is still present at the ac input control assembly when this switch is OFF and poses a shock hazard if the terminal board cover is removed.



ADD JUMPERS

SOCKET	JUMPER PINS
6A	3 – 12 4 – 11 5 – 10 6 – 9
6B	2 – 13 4 – 11 5 – 10 6 – 9

REMOVE JUMPERS (IF ANY)

SOCKET	PINS
6A	2 – 13 7 – 8
6B	1 – 14 3 – 12

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Figure 2-3. Switch and Jumper Configuration on Disk Drive Logic Boards

DD — Disk Drives

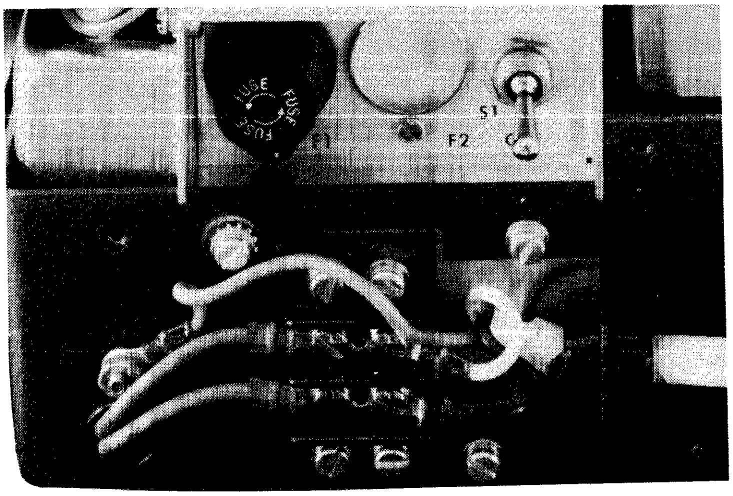

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Figure 2-4. Power Cable Terminal Board TB1

2.5 DISK CONTROLLER AND TILINE ADDRESS SWITCHES

The disk controller is shown in Figure 2-6 and the TILINE address configuration is shown in Figure 2-7. The movable jumper configuration on the controller is shown in Figure 2-8.

2.6 COMMAND CONTROL

The disk controller is initiated and interrogated by a TILINE master (normally the CPU) via a set of control words. These eight control words and their corresponding TILINE addresses are shown in Figure 2-9.

2.7 DS25/50 DISK SYSTEM CABLING

Cabling for a single disk drive unit is shown in Figure 2-10, and multiple disk system cabling is shown in Figure 2-11. The terminator is installed in J02 of the last disk drive in the series.

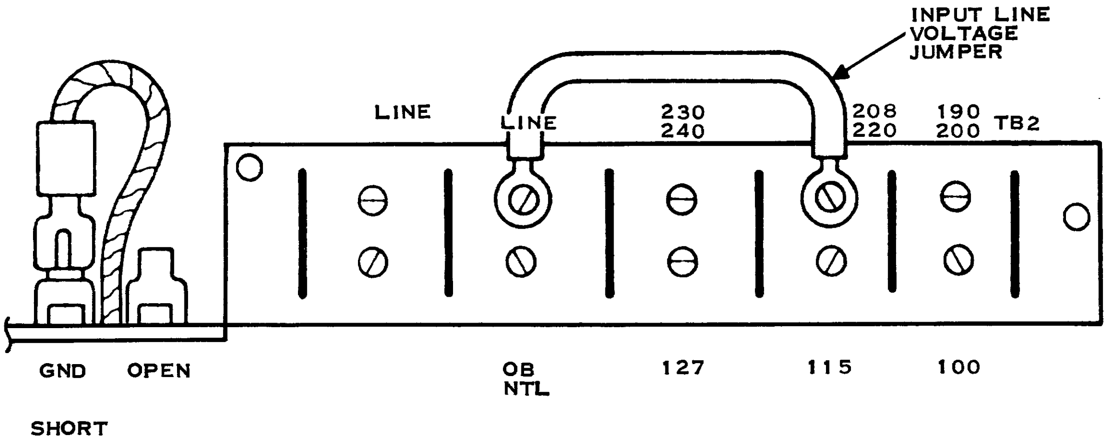

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Figure 2-5. Ground Short and Voltage Select Jumpers

2.8 CONFIGURATION OF DS25/50/200 MULTIWIRE CONTROLLER

The location of the ROMs used on the multiwire controller board (part number 947525) for the DS25/50/200 disk drives is K11. The part numbers of these ROMs are as follows:

Disk Drive	ROM Part Numbers
DS50	947581-18 or -23
DS25	947581-19 or -24

The storage location for these ROMs is UT05 and UT07.

The D02 location and configuration of the address switches for the multiwire controller is the same as the PWB version of the controller (part number 940065) as shown in Figure 2-7.

The location of the movable jumpers on the multiwire controller is at D01. The configuration of these jumpers is as follows:

Jumper Configuration	Computer
6 to 11	990/5, 990/10, 990/12
7 to 10	990/5, 990/10, 990/12

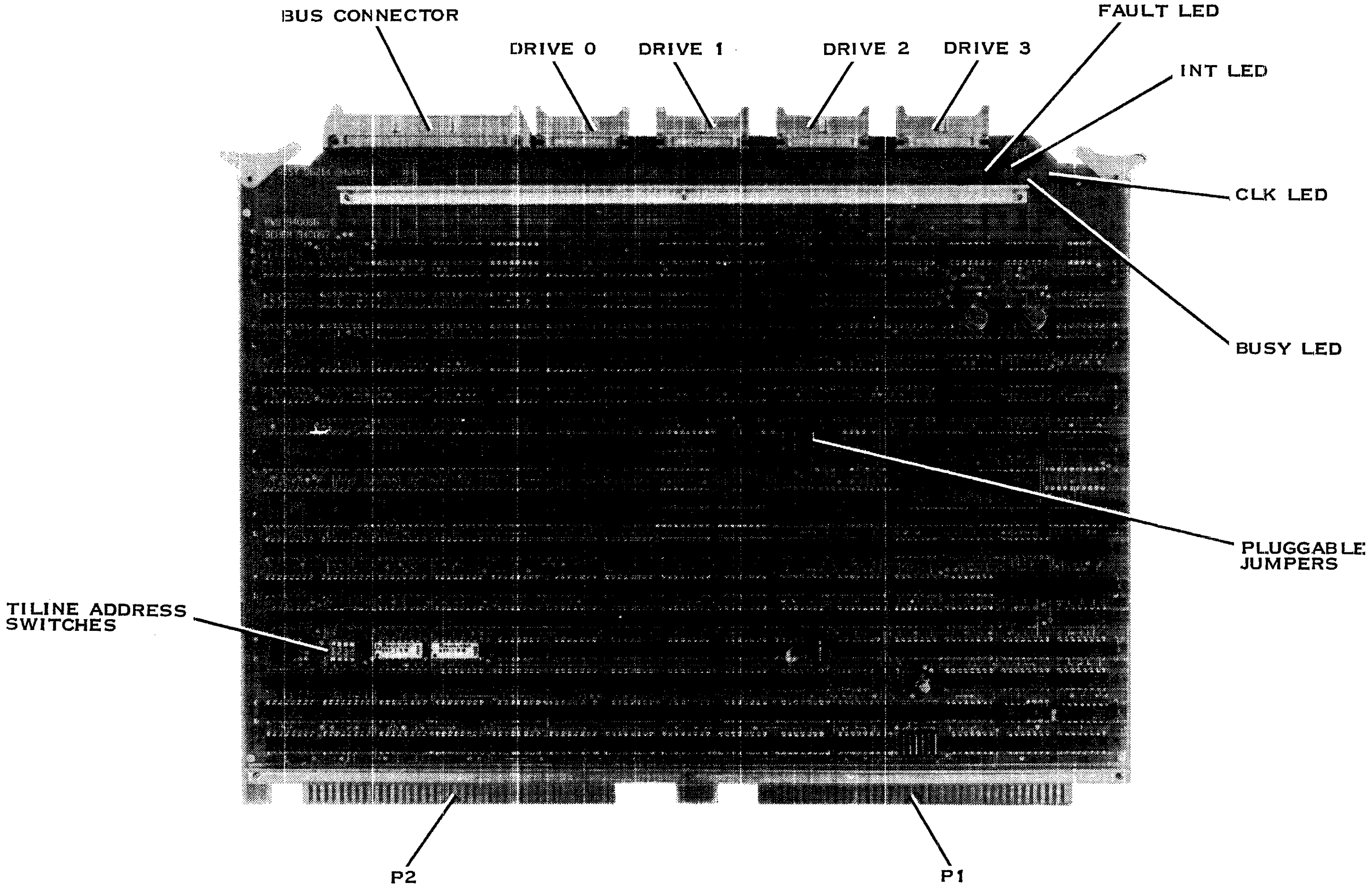
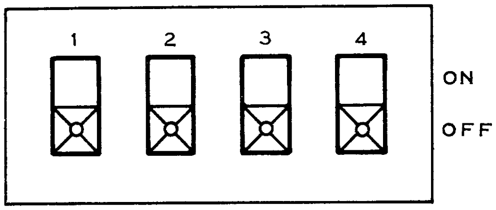


Figure 2-6. DS25/50 Disk Controller

TILINE WORD ADDRESS (HEXADECIMAL)	CPU BYTE ADDRESS (HEXADECIMAL)	DEVICE
FFC00 – FFC07	F800 – F80E	1ST DISK CONTROLLER
FFC10 – FFC17	F820 – F82E	2ND DISK CONTROLLER
FFC20 – FFC27	F840 – F84E	3RD DISK CONTROLLER
FFC30 – FFC37	F860 – F86E	4TH DISK CONTROLLER
FFC40 – FFC47	F880 – F88E	1ST TAPE CONTROLLER
FFC48 – FFC4F	F890 – F89E	2ND TAPE CONTROLLER



SWITCHES AT LOCATION D02, SHOWN SET AT CPU ADDRESS> F800

TILINE ADDRESS (HEXADECIMAL)	CPU ADDRESS (HEXADECIMAL)	SWITCHES				
		1	2	3	4	
FFC00	F800	OFF	OFF	OFF	OFF	DISK CONTROLLERS
FFC08	F810	OFF	OFF	OFF	ON	
FFC10	F820	OFF	OFF	ON	OFF	
FFC18	F830	OFF	OFF	ON	ON	
FFC20	F840	OFF	ON	OFF	OFF	
FFC28	F850	OFF	ON	OFF	ON	
FFC30	F860	OFF	ON	ON	OFF	
FFC38	F870	OFF	ON	ON	ON	
FFC40	F880	ON	OFF	OFF	OFF	OTHER TILINE SLAVES
FFC48	F890	ON	OFF	OFF	ON	
FFC50	F8A0	ON	OFF	ON	OFF	
FFC58	F8B0	ON	OFF	ON	ON	
FFC60	F8C0	ON	ON	OFF	OFF	
FFC68	F8D0	ON	ON	OFF	ON	
FFC70	F8E0	ON	ON	ON	OFF	
FFC78	F8F0	ON	ON	ON	ON	

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Figure 2-7. TILINE Address Switch Configurations

DD — Disk Drives

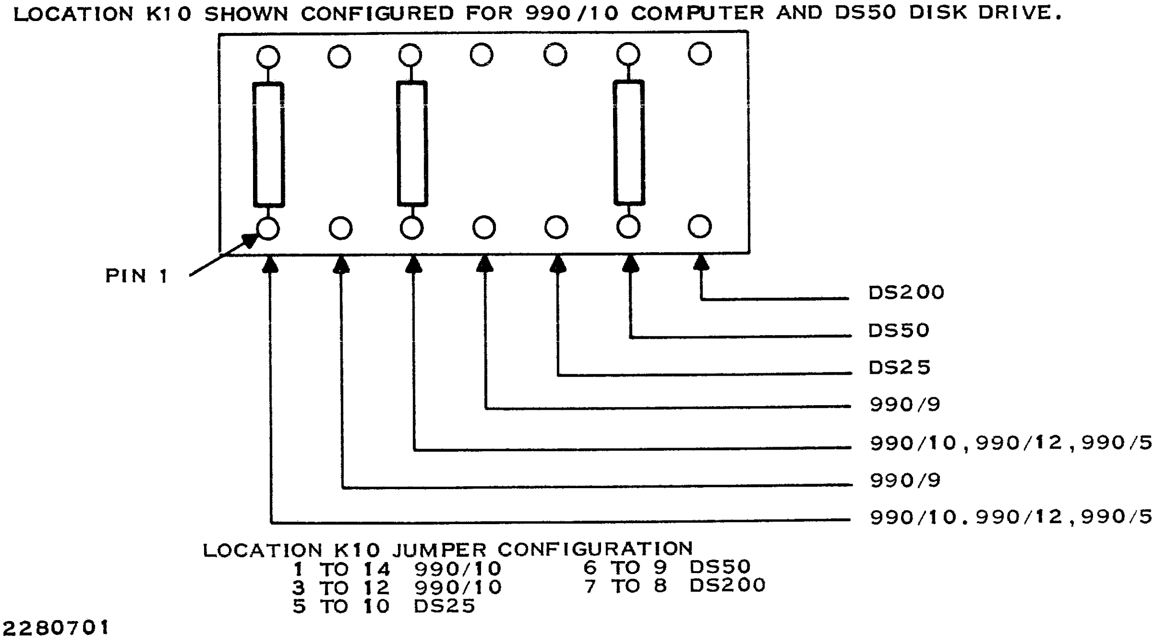


Figure 2-8. Movable Jumper Configuration, DS25/50 Controller, 940065

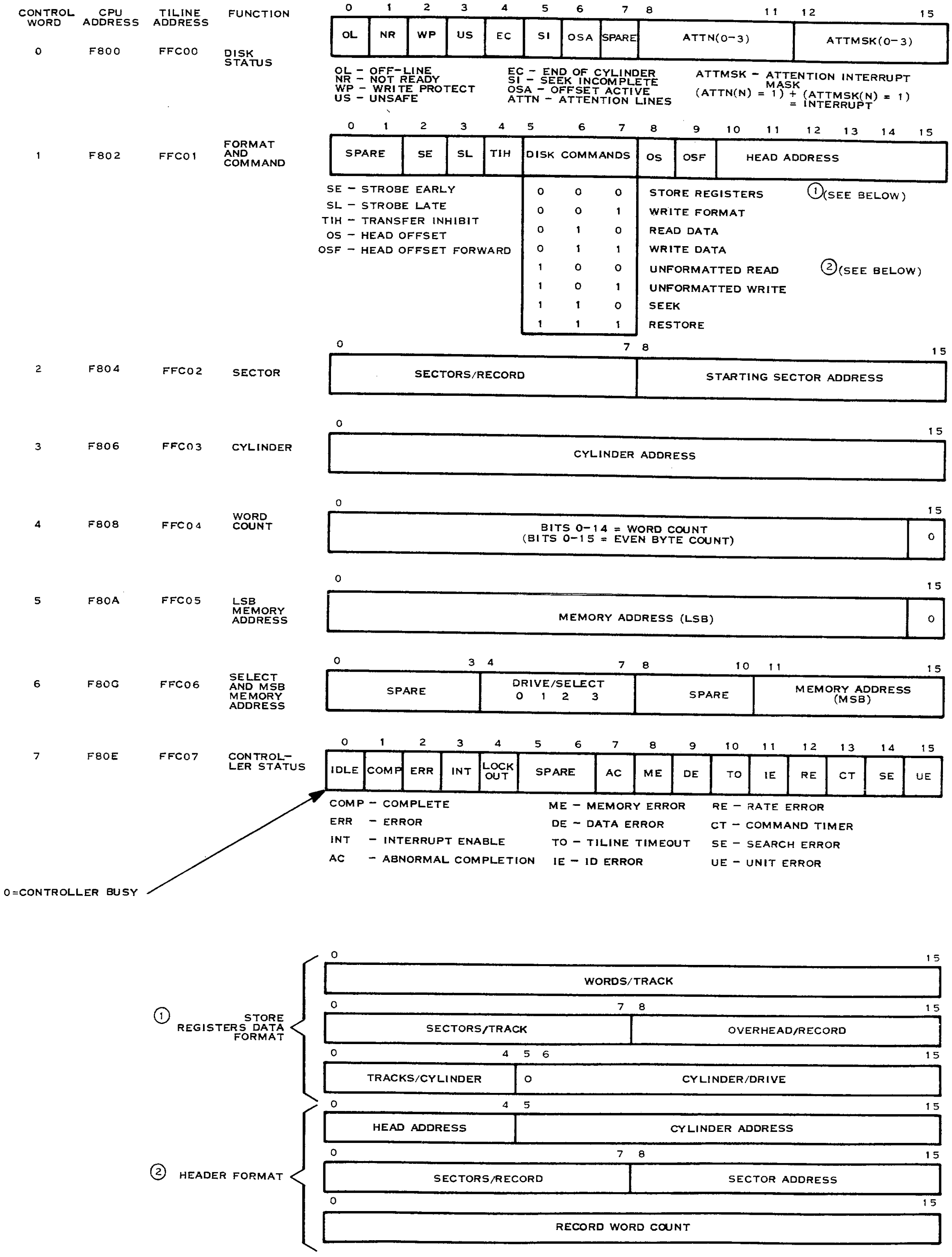
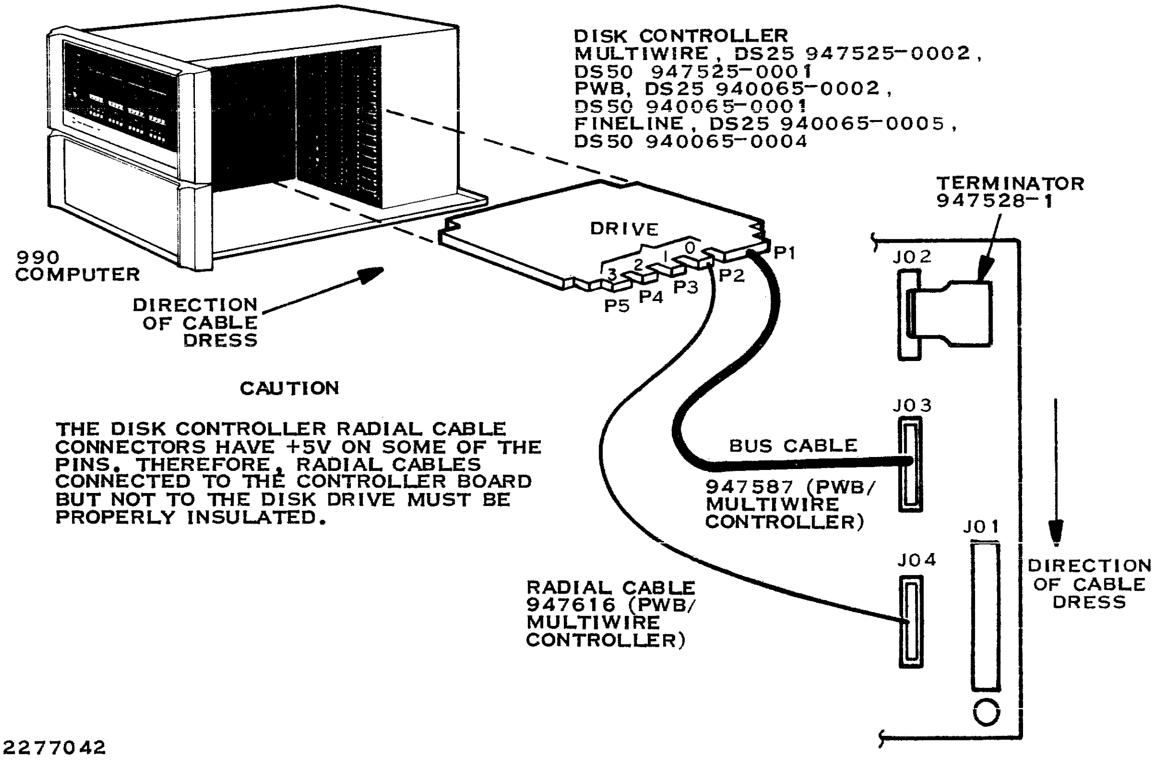


Figure 2-9. DS25/50 Disk Formats of Control Words

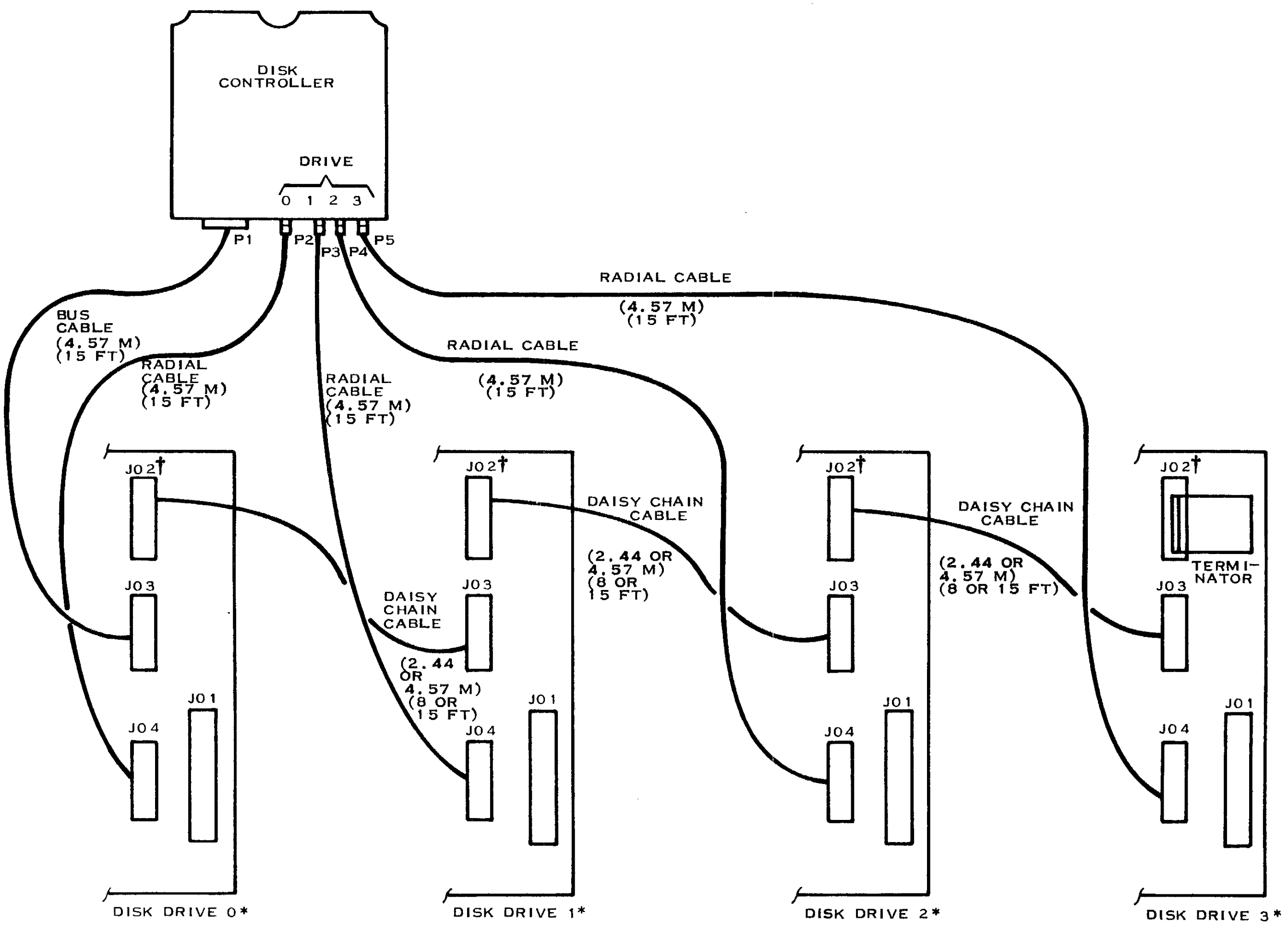
DD — Disk Drives



CAUTION

THE DISK CONTROLLER RADIAL CABLE CONNECTORS HAVE +5V ON SOME OF THE PINS. THEREFORE, RADIAL CABLES CONNECTED TO THE CONTROLLER BOARD BUT NOT TO THE DISK DRIVE MUST BE PROPERLY INSULATED.

Figure 2-10. Single Disk Drive Cabling



NOTES:

*MULTIPLE DISK DRIVES MUST BE EITHER ALL DS25 OR ALL DS50

†FOR SINGLE DISK DRIVE SYSTEMS, THE TERMINATOR CONNECTS TO J02 OF DISK DRIVE 0 AND NO DAISY-CHAIN CABLE IS REQUIRED. FOR MULTIPLE DISK DRIVE SYSTEMS, THE TERMINATOR CONNECTS TO J02 OF THE HIGHEST NUMBERED DISK DRIVE.

BOTTOM (OR BACK) VIEW OF CONTROLLER SHOWN.

2277043

Figure 2-11. Interconnections for Multiple Disk Drive System

DD — Disk Drives

2.9 DS50 PURGE PROCEDURE

Prior to installing the DS50 disk drive on the system it is necessary to purge the air-filtering system. This can be accomplished by performing the following steps:

1. Set the ac power switch to OFF.
2. Remove the emergency retract relay on the power supply module.
3. Install a scratch pack.
4. Set the ac power switch to ON.
5. Press the START/STOP switch to START.
6. Allow the disk to spin up and run with the heads retracted for 30 minutes.
7. Press the START/STOP switch to STOP and allow the disk pack to come to a complete stop.
8. Set the ac power switch to OFF.
9. Reinstall the emergency retract relay.

2.10 FIELD-REPLACEABLE COMPONENTS, DS25/50 DISK

Field-replaceable components for the DS25/50 disk are as follows:

Item	TI Part Number	Vendor Part Number
DS25/50 Power Supply Assembly, 230 V	0943841-0148	12449-001
DS25/50 Power Supply Assembly, 115 V	0943841-0147	12449-002
DS25/50 Board Assembly, Servo PA, VR61	0943841-0002	14912-001
DS25 Board Assembly, R/W Matrix, VR75	0943841-0070	18406-001
DS50 Board Assembly, R/W Matrix, Servo	0943841-0008	15141-001
DS25/50 Board Assembly, Data Separator, GR13	0943841-0003	14440-001
DS25 Board Assembly, R/W, AB1, GR28	0943841-0071	18465-001
DS50 Board Assembly, R/W, AB1, GR10	0943841-0001	12336-001
DS25 Board Assembly, Logic I, AB2, GL18	0943841-0069	18099-001
DS50 Board Assembly, Logic I, AB2, GL10	0943841-0004	12342-001
DS25/50 Board Assembly, Logic II, AB3, GL17	0943841-0059	15847-001
DS25/50 Board Assembly, Logic III, AB5, GL12	0943841-0006	12348-001
DS25/50 Board Assembly, Servo-Control	0943841-0007	14556-001
DS25 Controller	0940065-0002,-0005	

DD — Disk Drives

Item	TI Part Number	Vendor Part Number
DS50 Controller	0940065-0001,-0004	
PWB Signal Terminator	0947528-0001	19318-001
DS25/50 Fuse, Normal Blow, 6 A	0943841-0045	90437-006
DS25/50 Fuse, Normal Blow, 1 A	0943841-0076	90437-001
DS25/50 Fuse, 1 A	0943841-0077	92268-100
DS25/50 Fuse, Slow Blow, 15 A	0943841-0078	93142-015
DS25/50 Lamp, Bulb Indicator	0943841-0021	90922-001
DS25 Head, R/W 01, 04	0943841-0056	18504-003
DS25 Head, R/W 00, 03	0943841-0057	18504-004
DS25 Head, R/W 02	0943841-0058	18506-006
DS50 Head, R/W 01, 04	0943841-0065	13499-001
DS50 Head, R/W 02	0943841-0067	13501-001
DS50 Head, Servo	0943841-0068	13502-001
DS25/50 Filter Air	0943841-0038	12560-001
DS25/50 Filter Absolute Air	0943841-0041	13367-001
DS25/50 Seal, Absolute Air Filter	0943841-0087	13415-001
DS25/50 Cable, Bus	0947587-0001	
DS25/50 Cable, Radial	0947616-0001	
DS25/50 Cable, Daisy Chain, 8 ft	0947589-0001	
DS25/50 Cable, Daisy Chain, 15 ft	0947589-0002	
Brush, Drive Motor	0943841-0009	
Head, Servo	0943841-0020	
Transducer, Velocity	0943841-0023	
Relay, Solid State	0943841-0024	
Relay, Solid State	0943841-0025	
Relay, Power Sequence	0943841-0026	
Transistor	0943841-0043	
PWB, Logic I	0943841-0069	
Relay, Solid State (115 V)	0943841-0082	
Relay, Solid State (208/220 V)	0943841-0083	
Transistor, Power (115 V)	0943841-0088	
Velocity Transducer Rod	0943841-0096	
Logic IIi	0943841-0150	
Motor, Bobbin Assembly	0943841-0157	
Motor Assembly, Linear	0943841-0159	
Motor Assembly, Drive (220 V)	0943841-0160	
Relay Sequence Assembly (208/220 V)	0943841-0172	
Relay Sequence Assembly (115 V)	0943841-0184	
Blower Assembly (115 V)	0943841-0193	
Transformer (115 V)	0943841-0194	
Cord Assembly, Module	0943841-0199	
Head, R/W 00,03	0943841-0066	

3

DS200 Disk Drive System

3.1 DS200 TILINE DISK DRIVE

The DS200 disk drive (Figure 3-1) is a high-speed, random-access memory device used for mass data storage. The disk drive uses a removable disk pack that is installed or removed via an access door at the top front of the unit.

Reference manuals for use with the DS200 disk are as follows:

- *Model 990 Computer Model DS200 Disk System Installation and Operation,* part number 949615-9701
- *Model 990 Computer Models DS25/DS50/DS200 Disk Controller Depot Maintenance Manual,* part number 946238-9701
- *Disk Drive Model T200 Maintenance*, Calcomp part number 10204-901-002-0

3.2 CHANGING OPERATING VOLTAGES

The following procedures describe the modifications required to convert the disk drive unit from 220/240-volt to 200/208-volt input power operation.

1. Set the START/STOP switch to STOP. The READY (green) indicator light will flash for about 20 seconds. Wait until the READY indicator is extinguished.
2. Remove the ac power cord from the wall outlet.

WARNING

Line voltages are present in the area of the drive motor even when the START/STOP switch is set to STOP. Failure to disconnect the main power source may result in injury to service personnel.

3. Lift off the top cover at the rear of the unit. Remove the backpanel by lifting it straight up and out of the retaining trough, pulling the top of the panel out and away from the magnetic latch.
4. Open the swing-out card cage door by pulling the two latches (located at the top and bottom of the door assembly) to the left, and pulling out on the door.
5. Unplug P14 located next to the power supply voltage adjustments in the lower left of the disk drive unit as viewed from the rear.

DD — Disk Drives

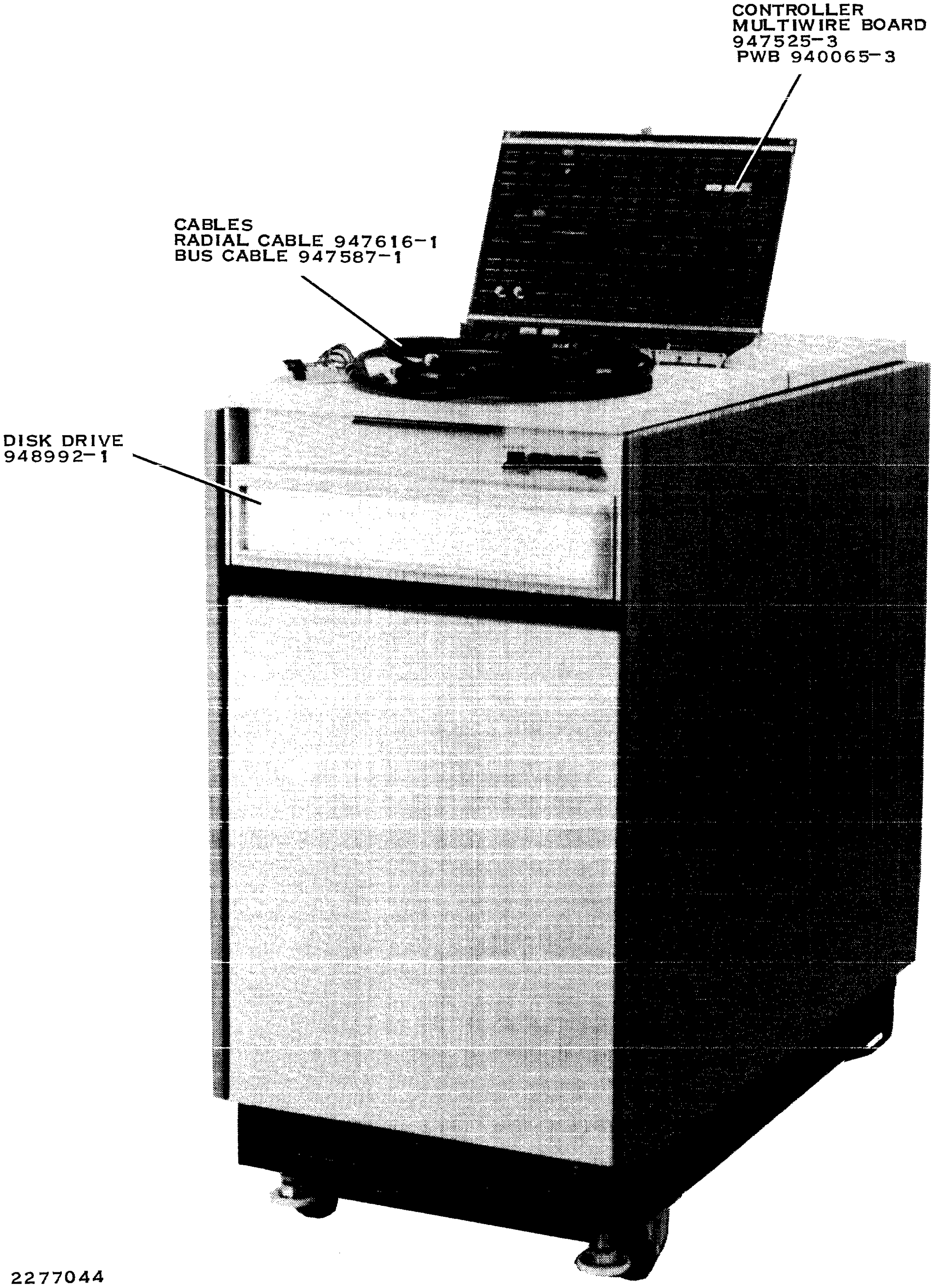
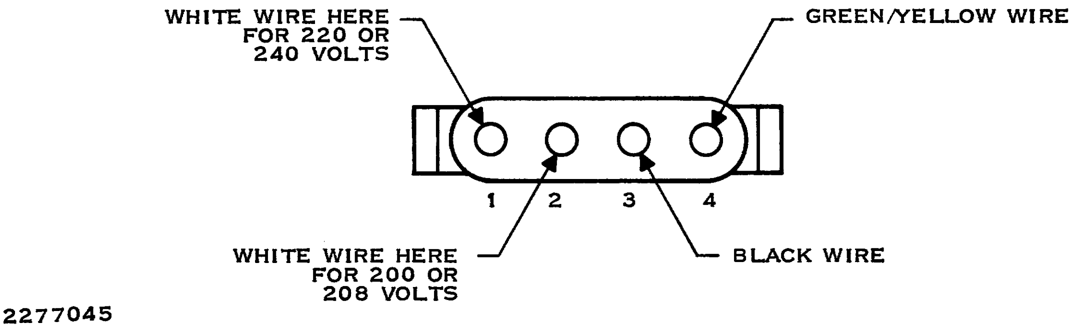


Figure 3-1. DS200 Disk Drive Master Kit, Part Number 938140-0001

6. Move the white wire to pin 1 of P14 for 220/240-volt operation, or move the white wire to pin 2 of P14 for 200/208-volt operation as shown in the following illustration. Do not attempt to remove the pin without using the AMP pin extractor 305183 (TI part number 943849-1016).



7. Label the proper operating voltage on the disk drive data plate at the rear bottom of the drive.

8. Reassemble the unit as follows:

   a. Reinstall P14.

   b. Close the card cage door.

   c. Reinstall the disk drive back panel.

   d. Reinstall the top cover.

   e. Reconnect the ac power cord.

3.3 DS200 FRONT PANEL CONTROLS AND INDICATORS

The front panel controls and indicators are shown in Figure 3-2 and described in Table 3-1.

Table 3-1. DS200 Front Panel Controls and Indicators

Control	Description
READ ONLY READ/WRITE Switch	This two-position toggle switch provides disk pack file protection. READ ONLY position inhibits write commands from writing on disk 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. The disk drive unit may be deselected by performing an I/O reset or by selecting another unit.

DD — Disk Drives

Table 3-1. DS200 Front Panel Controls and Indicators (Continued)

Control	Description
DEVICE CHECK Indicator	This indicator lights when a device check error has been detected by the unit and remains lit until the controller resets the device check error detector or until the unit is powered down.
File Ready Indicator	This indicator flashes during power-up and power-down sequencing. The drive is in ready condition (powered up and heads loaded) when the indicator stays lit.
START/ STOP Switch	This two-position toggle switch permits manual power-up and power-down sequencing. START position turns on the spindle drive motor, initiates a brush cycle, and loads the heads. (Heads will not load and a seek incomplete will result 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 dynamic brake to stop the disk pack.

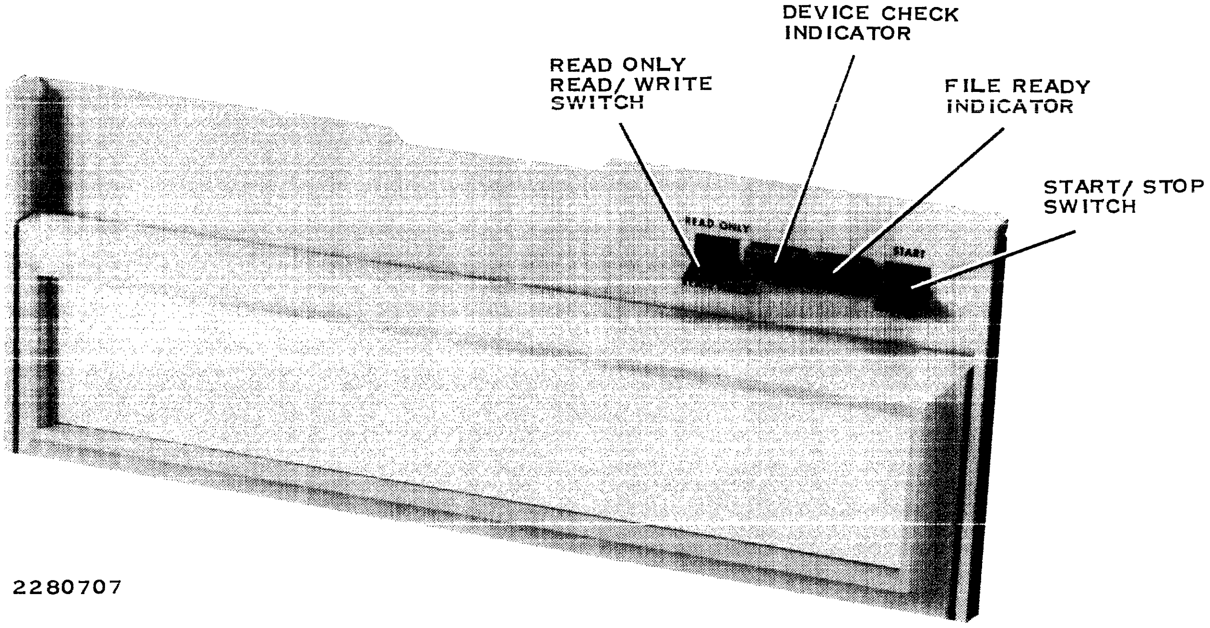


Figure 3-2. DS200 Disk Front Panel Controls and Indicators

3.4 DS200 DISK SUBSYSTEM CONFIGURATION

If the disk drive unit is received directly from the vendor, a plastic bag containing 12 jumpers should be taped to the outside of the card cage. These jumpers must be installed on the logic control I board as shown in Figure 3-3. Verify the presence of the jumpers shown in the illustration.

3.4.1 DS200 Disk Controller Configuration

The controller for the DS200 disk drive is shown in Figure 3-4. The TILINE address selection switches and the corresponding addresses are shown in Figure 3-5. The movable jumpers for this controller are shown in Figure 3-6.

3.5 FORMATS OF CONTROL WORDS

The disk controller is initiated and interrogated by a TILINE master (normally the computer CPU) via a set of control words. These eight control words and their corresponding TILINE bus addresses are shown in Figure 3-7. They are completely described in the installation and operation manual.

3.6 CONFIGURATION OF DS25/50/200 MULTIWIRE CONTROLLER

The location of the ROMs used on the multiwire controller board (part number 947525) for the drives is K11. The part numbers of these ROMs are as follows:

Disk Drive	ROM Part Numbers
DS50	947581-18 or -23
DS25	947581-19 or -24
DS200	947581-22 or -25

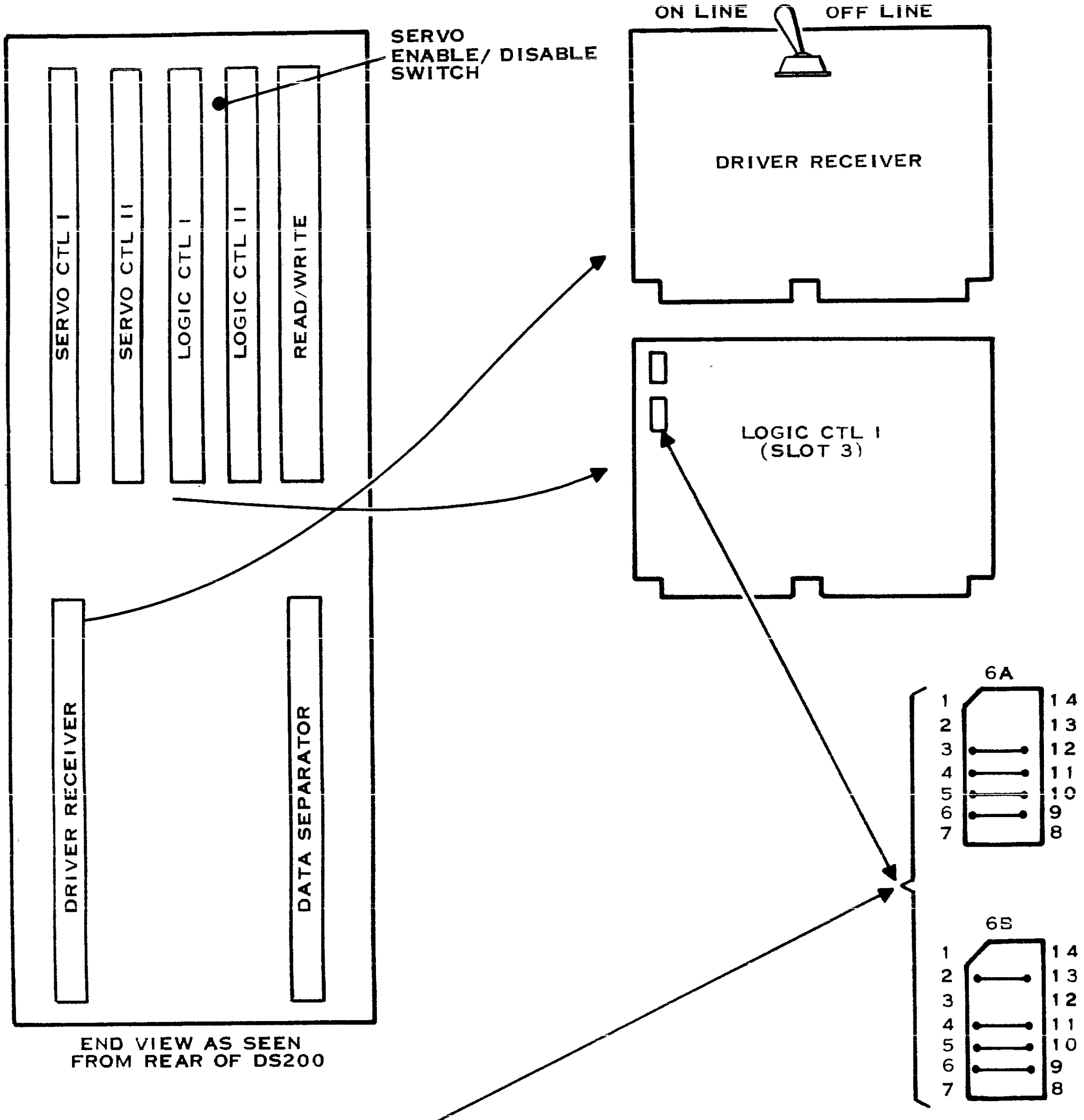
The storage location for these ROMs is UT05 and UT07.

The D02 location and configuration of the address switches for the multiwire controller (part number 947525) is the same as the PWB version of the controller (part number 940065), as shown in Figure 3-5.

The movable jumpers on the multiwire controller are located at D01. The configuration of these jumpers is as follows:

Jumper Configuration	Computer
6 to 11	990/5, 990/10, 990/12
7 to 10	990/5, 990/10, 990/12

DD — Disk Drives



ADD JUMPERS

SOCKET	JUMPER PINS
6A	3 - 12 4 - 11 5 - 10 6 - 9
6B	2 - 13 4 - 11 5 - 10 6 - 9

REMOVE JUMPERS (IF ANY)

SOCKET	PINS
6A	2 - 13 7 - 8
6B	1 - 14 3 - 12

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Figure 3-3. DS200 Disk Jumper Configuration Logic Control I Board

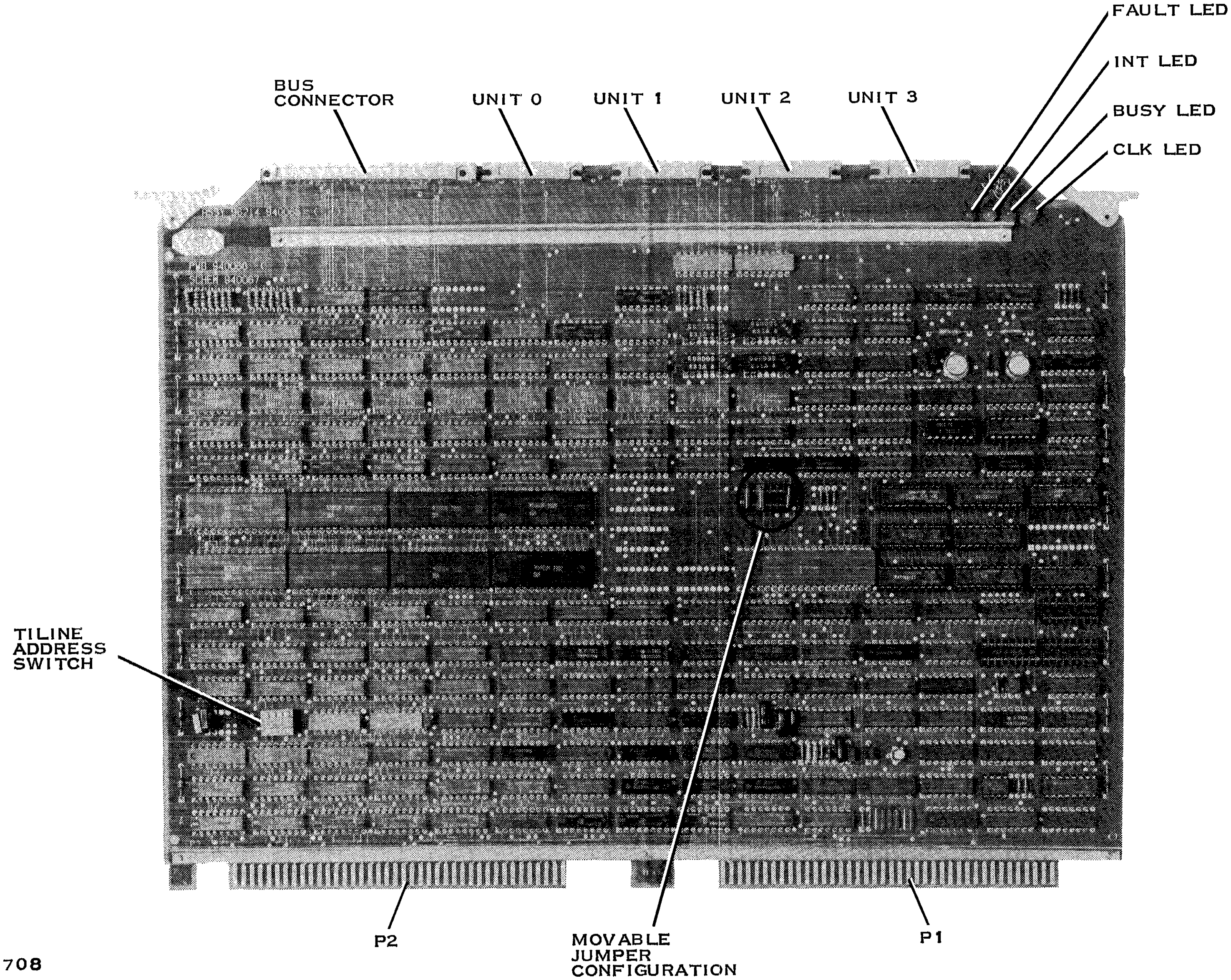
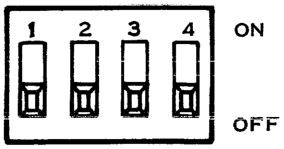


Figure 3-4. DS200 Disk Controller

DD — Disk Drives



SWITCHES AT LOCATION D02, SHOWN SET AT CPU ADDRESS > F800

TILINE ADDRESS (HEX)	CPU ADDRESS (HEX)	SWITCHES			
		1	2	3	4
FFC00	F800	OFF	OFF	OFF	OFF
FFC08	F810	OFF	OFF	OFF	ON
FFC10	F820	OFF	OFF	ON	OFF
FFC18	F830	OFF	OFF	ON	ON
FFC20	F840	OFF	ON	OFF	OFF
FFC28	F850	OFF	ON	OFF	ON
FFC30	F860	OFF	ON	ON	OFF
FFC38	F870	OFF	ON	ON	ON
FFC40	F880	ON	OFF	OFF	OFF
FFC48	F890	ON	OFF	OFF	ON
FFC50	F8A0	ON	OFF	ON	OFF
FFC58	F8B0	ON	OFF	ON	ON
FFC60	F8C0	ON	ON	OFF	OFF
FFC68	F8D0	ON	ON	OFF	ON
FFC70	F8E0	ON	ON	ON	OFF
FFC78	F8F0	ON	ON	ON	ON

DISK CONTROLLERS

OTHER TILINE SLAVES

TILINE WORD ADDRESSES	CPU BYTE ADDRESSES	DEVICE
FFC00$_{16}$ – FFC07$_{16}$	F800 – F80E	1ST DISK CONTROLLER
FFC10$_{16}$ – FFC17$_{16}$	F820 – F82E	2ND DISK CONTROLLER
FFC20$_{16}$ – FFC27$_{16}$	F840 – F84E	3RD DISK CONTROLLER
FFC30$_{16}$ – FFC37$_{16}$	F860 – F86E	4TH DISK CONTROLLER
FFC40$_{16}$ – FFC47$_{16}$	F880 – F88E	1ST TAPE CONTROLLER
FFC48$_{16}$ – FFC4F$_{16}$	F890 – F89E	2ND TAPE CONTROLLER

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Figure 3-5. DS200 Disk TILINE Address Switch Configuration

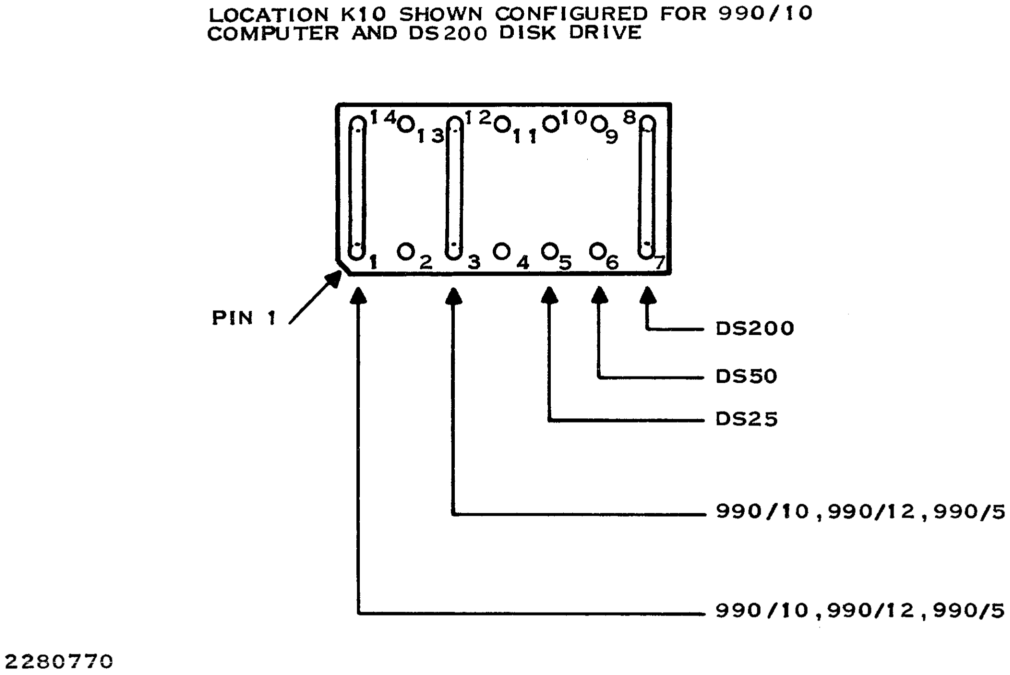
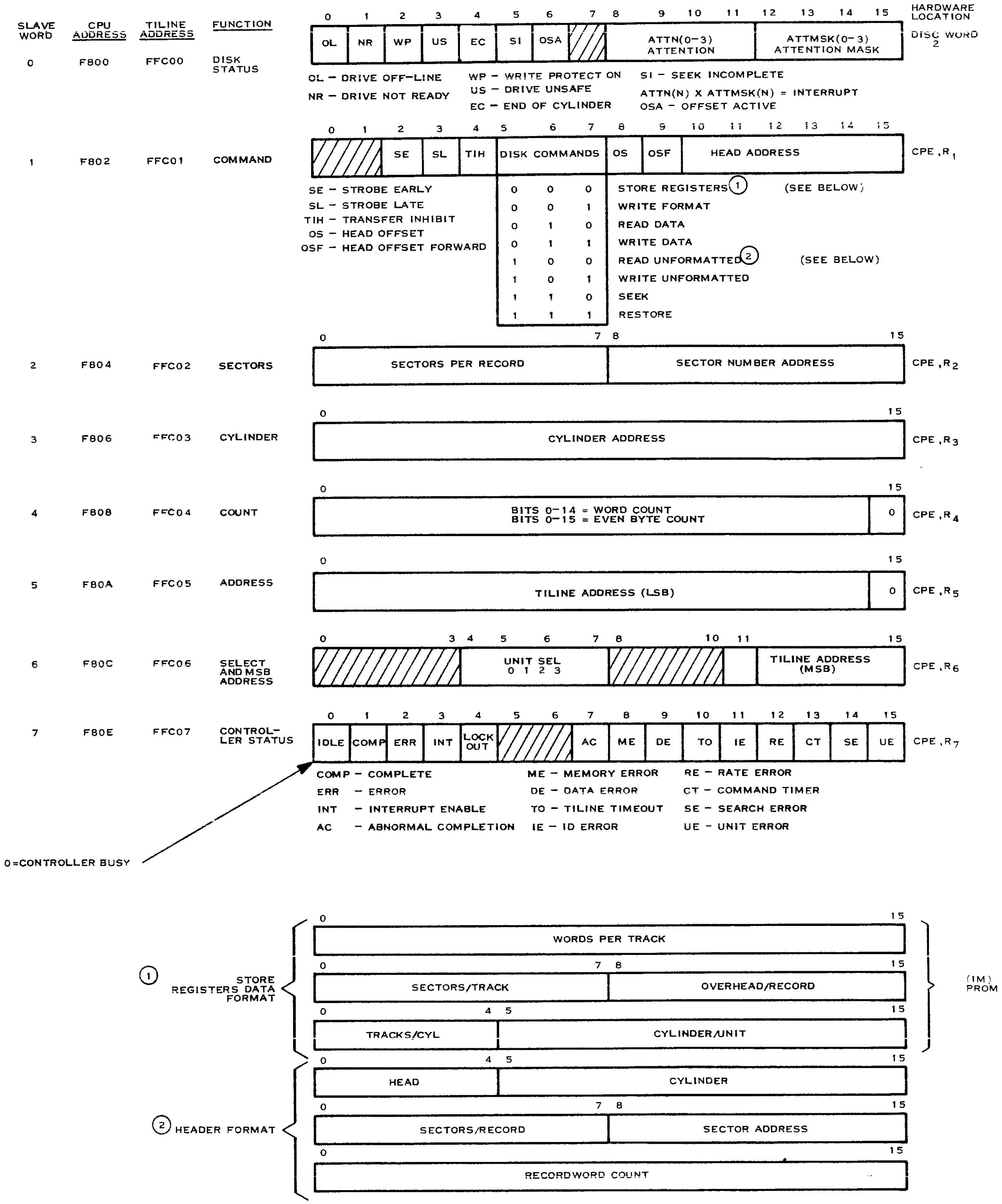


Figure 3-6. DS200 Disk Controller Movable Jumper Configuration

DD — Disk Drives



OL – DRIVE OFF–LINE
NR – DRIVE NOT READY
WP – WRITE PROTECT ON
US – DRIVE UNSAFE
EC – END OF CYLINDER
SI – SEEK INCOMPLETE
ATTN(N) X ATTMSK(N) = INTERRUPT
OSA – OFFSET ACTIVE

SE – STROBE EARLY
SL – STROBE LATE
TIH – TRANSFER INHIBIT
OS – HEAD OFFSET
OSF – HEAD OFFSET FORWARD

5	6	7	DISK COMMANDS	
0	0	0	STORE REGISTERS ①	(SEE BELOW)
0	0	1	WRITE FORMAT	
0	1	0	READ DATA	
0	1	1	WRITE DATA	
1	0	0	READ UNFORMATTED ②	(SEE BELOW)
1	0	1	WRITE UNFORMATTED	
1	1	0	SEEK	
1	1	1	RESTORE	

COMP – COMPLETE
ERR – ERROR
INT – INTERRUPT ENABLE
AC – ABNORMAL COMPLETION
ME – MEMORY ERROR
DE – DATA ERROR
TO – TILINE TIMEOUT
IE – ID ERROR
RE – RATE ERROR
CT – COMMAND TIMER
SE – SEARCH ERROR
UE – UNIT ERROR

Figure 3-7. DS200 Disk Formats of Control Words

3.7 DISK DRIVE SYSTEM INTERCONNECTING CABLES

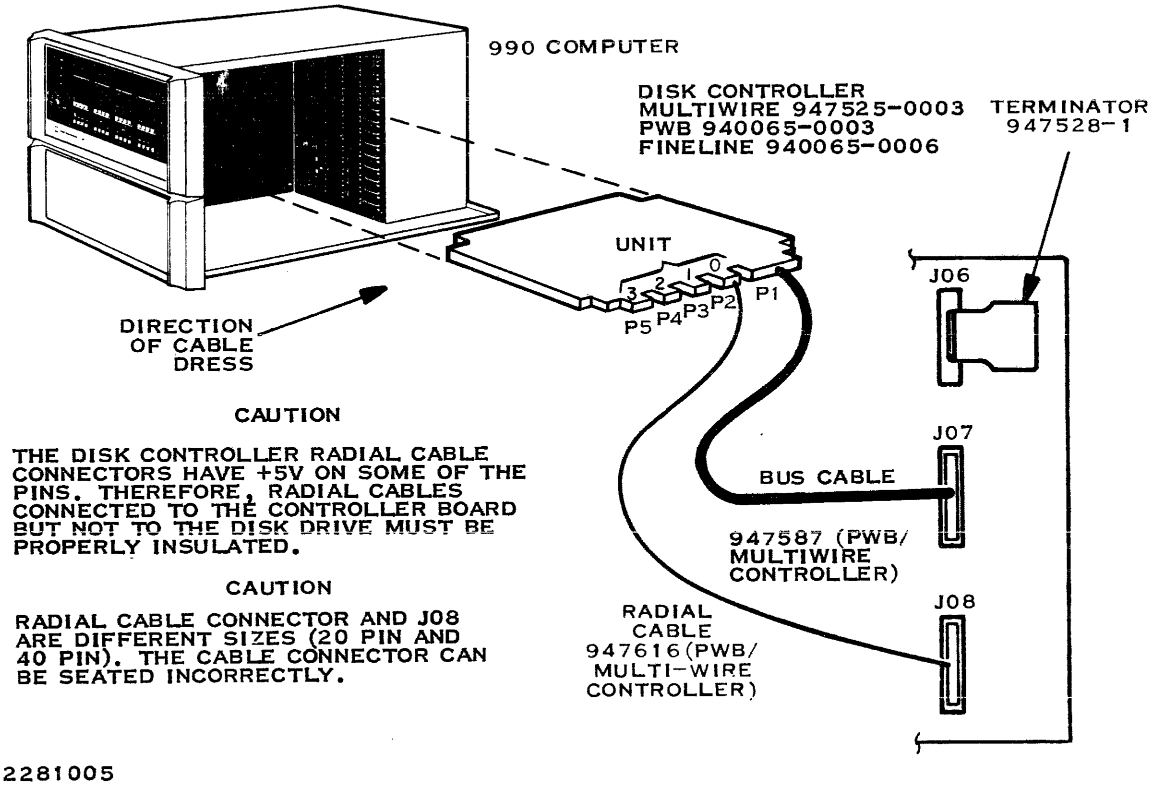
For a single disk drive unit, the interconnecting cables are installed as shown in Figure 3-8. Interconnections for multiple disk drive systems are shown in Figure 3-9. Note that the terminator is installed in the last disk drive in the series.

3.8 DS200 PURGE PROCEDURE

Prior to installing the disk drive on the system and following certain preventive maintenance procedures, it is necessary to purge the air-filtering system. This can be accomplished by performing the following steps:

1. Set the START/STOP switch to STOP and remove power from the disk drive unit.
2. Remove the disk drive backpanel.
3. Set the SERVO ENABLE/SERVO DISABLE switch located on the GL31 logic CTL II card (Figure 3-3) to SERVO DISABLE (down position).
4. Install a scratch pack.
5. Apply power to the disk drive and press the START/STOP switch to START.
6. Allow the disk to spin up and run with the heads retracted for 30 minutes.
7. Press the START/STOP switch to STOP and allow the disk pack to come to a complete stop.
8. Remove power from the disk drive unit.
9. Set the SERVO ENABLE/SERVO DISABLE to SERVO ENABLE.
10. Apply power to the disk drive, reinstall the backpanel, and restore the drive to normal operating configuration.

DD — Disk Drives



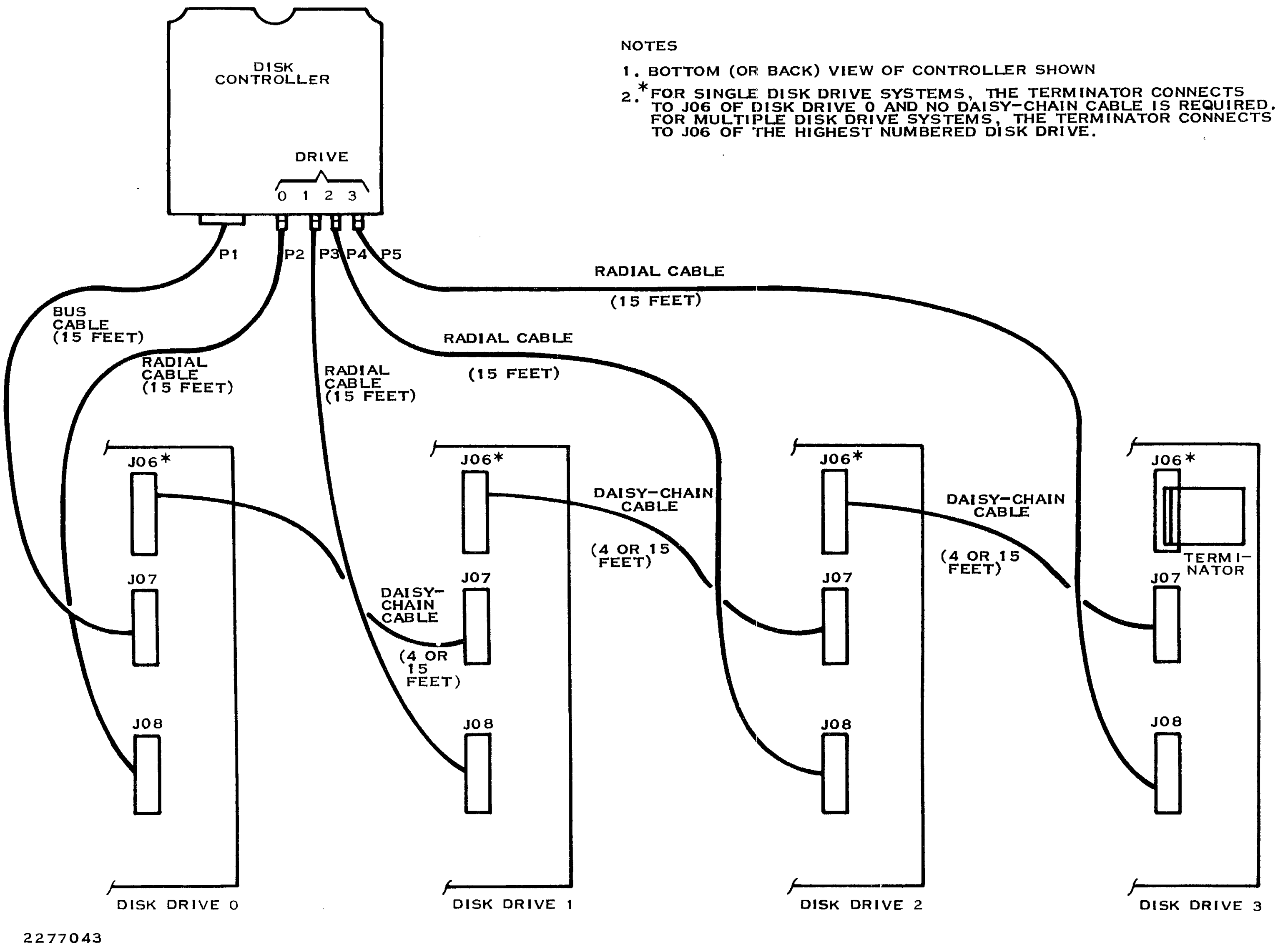
CAUTION

THE DISK CONTROLLER RADIAL CABLE CONNECTORS HAVE +5V ON SOME OF THE PINS. THEREFORE, RADIAL CABLES CONNECTED TO THE CONTROLLER BOARD BUT NOT TO THE DISK DRIVE MUST BE PROPERLY INSULATED.

CAUTION

RADIAL CABLE CONNECTOR AND J08 ARE DIFFERENT SIZES (20 PIN AND 40 PIN). THE CABLE CONNECTOR CAN BE SEATED INCORRECTLY.

Figure 3-8. Single Disk Drive Interconnections



NOTES

1. BOTTOM (OR BACK) VIEW OF CONTROLLER SHOWN
2. *FOR SINGLE DISK DRIVE SYSTEMS, THE TERMINATOR CONNECTS TO J06 OF DISK DRIVE 0 AND NO DAISY-CHAIN CABLE IS REQUIRED. FOR MULTIPLE DISK DRIVE SYSTEMS, THE TERMINATOR CONNECTS TO J06 OF THE HIGHEST NUMBERED DISK DRIVE.

Figure 3-9. Interconnections for Multiple Disk Drives

DD — Disk Drives

3.9 FIELD-REPLACEABLE COMPONENTS, DS200 DISK

Field-replaceable components for the DS200 disk drive system are as follows:

Item	TI Part Number	Vendor Part Number
Power Supply Assembly	0943841-0107	16360-001
Power Amplifier	0943841-0108	16336-001
PWB Terminator Assembly	0943841-0110	12421-001
PWB Signal CBL Terminator	0943841-0111	12424-001
PWB Data CBL Terminator	0943841-0112	12433-001
PWB Emergency Retract	0943841-0013	13794-001
PWB Control Logic II	0943841-0014	16687-001
PWB Drive/Receive	0943841-0015	16378-001
PWB GL 25	0943841-0018	16407-001
PWB Servo Control	0943841-0121	16461-001
PWB Drive/Receive	0943841-0122	16464-001
PWB Power Amplifier	0943841-0123	16529-001
PWB Data Separator	0943841-0124	19329-001
PWB Servo-Control I	0943841-0125	16467-001
PWB Read Limiter	0943841-0126	17686-001
PWB R/W Matrix (LH)	0943841-0127	16482-001
PWB R/W Matrix (RH)	0943841-0128	16485-001
PWB Servo HD Preamplifier	0943841-0129	19040-001
PWB Optical SW	0943841-0130	98455-001
PWB Power Supply	0943841-0137	14823-001
PWB Disk Controller (T200)	0940065-0003	None
PWB Signal Terminator	0948238-0001	19318-001
Blower Assembly (60 Hz)	0943841-0098	16444-001
Brake Diode Assembly	0943841-0099	99139-001
Brake Assembly	0943841-0100	95238-001
Head Assembly, Servo	0943841-0103	13500-001
Head Assembly, R/W	0943841-0104	18507-001
Head Assembly, R/W	0943841-0105	18507-002
Filter, Absolute	0943841-0141	16417-001
Linear Motor	0943841-0144	10413-001
Head Assembly R/W	None	18507-003
Head Assembly R/W	None	18507-004
Drive Belt, 60 Hz	0943841-0097	95304-015
Brush Spindle Ground	0943841-0101	91535-001
Light, Indicator	0943841-0106	92967-001
Bridge Rectifier	0943841-0131	92653-001
Switch	0943841-0133	17198-001
Lever Switch	0943841-0134	96997-002
Switch, Limit Micro	0943841-0135	90734-001
Switch, Lid Closed	0943841-0136	14906-001
Filter, Air	0943841-0138	16418-001
Fuse, 2 A	0943841-0142	90437-002
Fuse, 10 A	0943841-0143	90437-010
Brush, Spindle	0943841-0145	13628-001
Diode, Brake Assembly	0943841-0099	99139-001

DD — Disk Drives

Item	TI Part Number	Vendor Part Number
Rod Tach	None	19014-002
Housing Coil	None	19014-003
Brake, Disk Controller	None	96639-001
Spring, Compression	None	91446-010
Retainer, LVSYN	None	90402-001
Disk Brake	None	96639-001
Cable, Radial	0947616-0001	
Cable, Bus	0947587-0001	
Cable, Daisy-Chain (8-foot)	0947589-0001	
Cable, Daisy-Chain (15-foot)	0947589-0002	
Head Assembly, Upper	0943841-0062	
Head Assembly, Lower	0943841-0063	
Circuit Breaker	0943841-0102	
Servo Control I (Rev. E)	0943841-0154	
Servo Head Preamplifier (Rev. E)	0943841-0155	
Bobbin Assembly (DS200/300)	0943841-0166	
Bobbin Assembly (DS200/300)	0943841-0167	

4

CD1400 Disk Drive System

4.1 CD1400 TILINE DISK DRIVE

The Model CD1400 Cartridge Disk System (Figure 4-1) is a random-access, mass storage system that features a 16-megabyte removable front-loaded disk cartridge and fixed disk platters that provide an additional unformatted 16, 48, or 80 megabytes of online data storage.

NOTE

> The total unformatted data storage capacities for the three disk drives are 32MB, 64MB, and 96MB, respectively.

Reference manuals for use with the CD1400 disk are as follows:

- *Model CD1400 Disk System Installation and Operation Manual*, part number 2272081-9701.
- *Model CD1400 Disk System Field Maintenance Manual*, part number 945419-9706.
- *Model CD1400 Disk System Controller Depot Maintenance Manual*, part number 2272082-9701.

Disk system features include:

- Single circuit board disk controller
- Fixed disk platters and removable disk cartridge
- 9.67 megahertz transfer rate
- Independent manual write protection of fixed and/or removable media
- Extended fault isolation

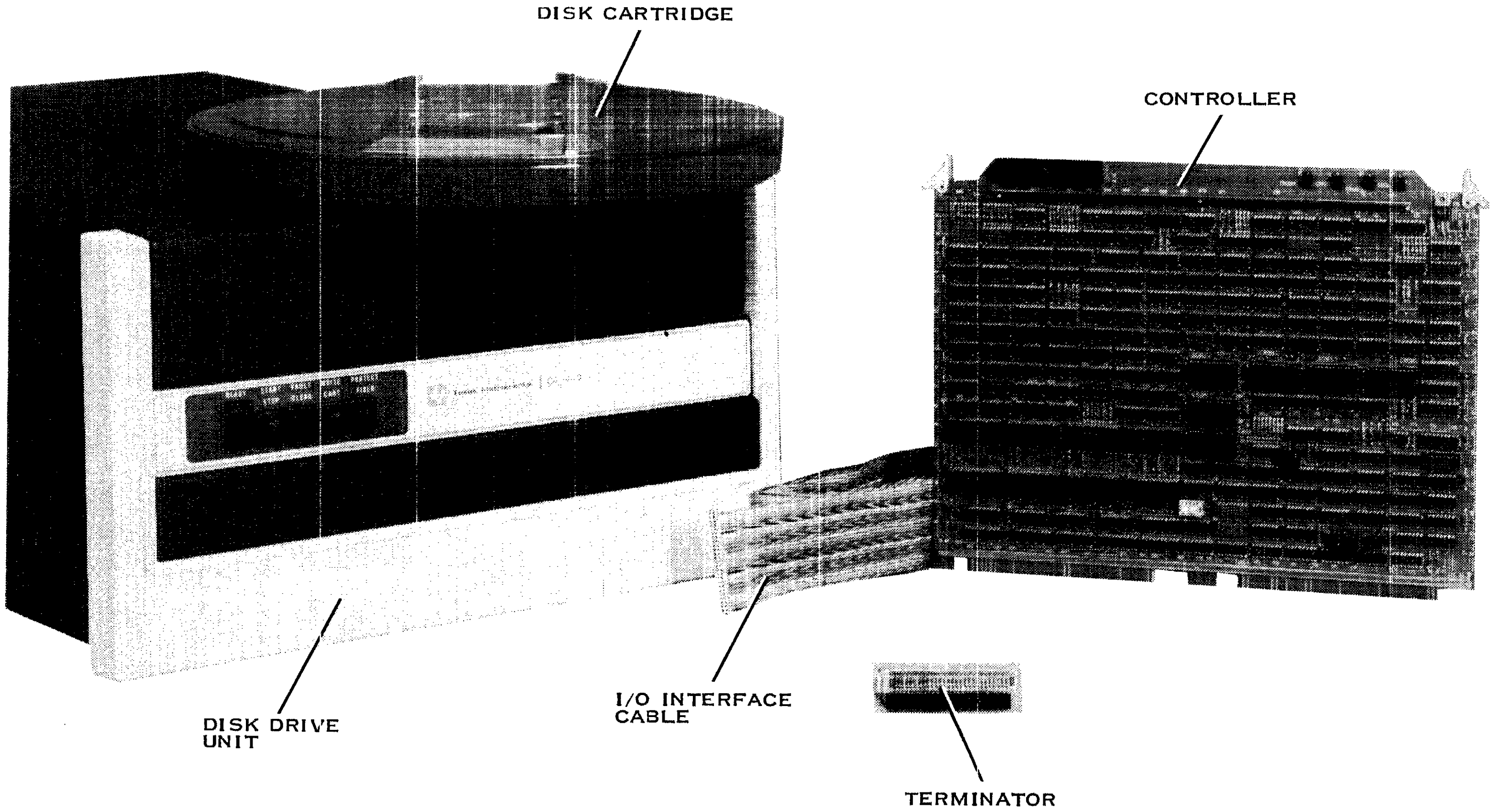


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Figure 4-1. Model CD1400 Disk Drive System Components

4.2 CONTROLS AND INDICATORS

The controls and indicators for the CD1400 disk drive are shown in Figure 4-2 and described in Table 4-1.

The following precautions must be observed to prevent damage to the disk drive unit:

CAUTION

1. **Do not remove ac power from the disk drive or switch the MAIN AC BREAKER to OFF until the disk platters have stopped rotating. If power is removed prematurely, unfiltered air will be drawn into the unit by the rotating disks.**
2. **Keep a removable disk cartridge in the disk drive unit at all times, whether it is operating or not. If a removable cartridge is not in place, the shroud area will not seal out atmospheric contaminants.**
3. **Keep the access door closed at all times to prevent entry of atmospheric contaminants.**
4. **To prevent cabinets from tipping over:**
    - a. **Never extend a disk drive unit on its slides unless all other cabinet-mounted components are fully retracted.**
    - b. **Never set any object such as test equipment on top of an extended disk drive.**
    - c. **Never lean on an extended drive.**
    - d. **Ensure that cabinet levelers are extended enough to raise the front wheels off the floor.**

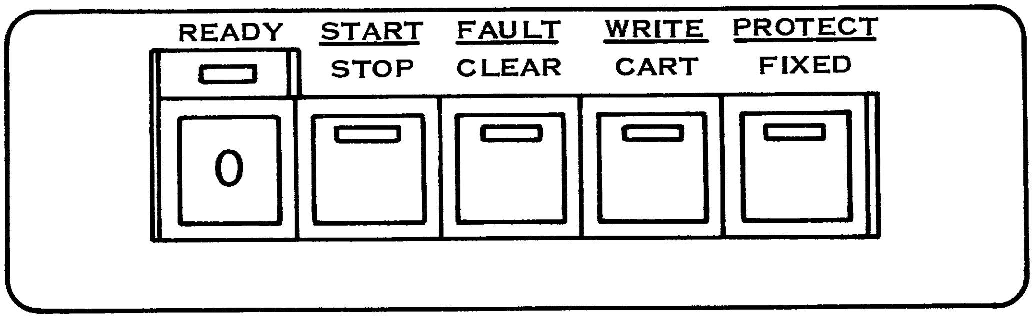

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Figure 4-2. CD1400 Disk Drive Front Panel Controls and Indicators

Table 4-1. CD1400 Controls and Indicators

Control or Indicator	Function
READY Indicator	Illuminates when the unit is up to speed, the heads are loaded, and no fault exists that requires manual intervention. The READY indicator blinks throughout the spindle start and stop procedure.
FAULT Switch	Clears certain disk drive faults when pressed.
FAULT Indicator	Lights to indicate a fault condition. If pressing the FAULT switch clears the fault, the indicator extinguishes.
WRITE PROTECT FIXED Switch	Alternate action switch. When actuated, data is prevented from being written on any fixed volumes.
WRITE PROTECT FIXED Indicator	Lights to indicate that the WRITE PROTECT FIXED switch is actuated.
WRITE PROTECT CART Switch	Alternate action switch. When actuated, data is prevented from being written on the removable cartridge.
WRITE PROTECT CART Indicator	Lights to indicate that the WRITE PROTECT CART switch is actuated.
MAIN AC BREAKER ON/OFF (located on rear panel)	Applies primary ac power to disk drive. Trips on overload.

4.3 CD1400 DISK INTERNAL PWBS AND SWITCH SETTINGS

Three internal printed wiring boards (PWBs) in the disk drive electronics module (Figure 4-3) contain option switches and jumpers that are preset at the factory. These are:

- I/O interface board (Figure 4-4)
- Servo-coarse board (Figure 4-5)
- Control/multiplexer board (Figure 4-6)

4.3.1 I/O Interface Board

The I/O interface board (Figure 4-4) contains two toggle switches (S1 and S2) and two DIP switches (S3 and S4). These switches are set as described in the following paragraphs.

4.3.1.1 LOC/REM Toggle Switch (S1). When the LOC/REM switch is set to REM (normal operating) position, initial power-on sequencing of the disk drive is controlled by the disk controller. In the LOC (local maintenance) position, power-on sequencing of the disk drive can be controlled only by the START/STOP switch on the disk drive front panel.

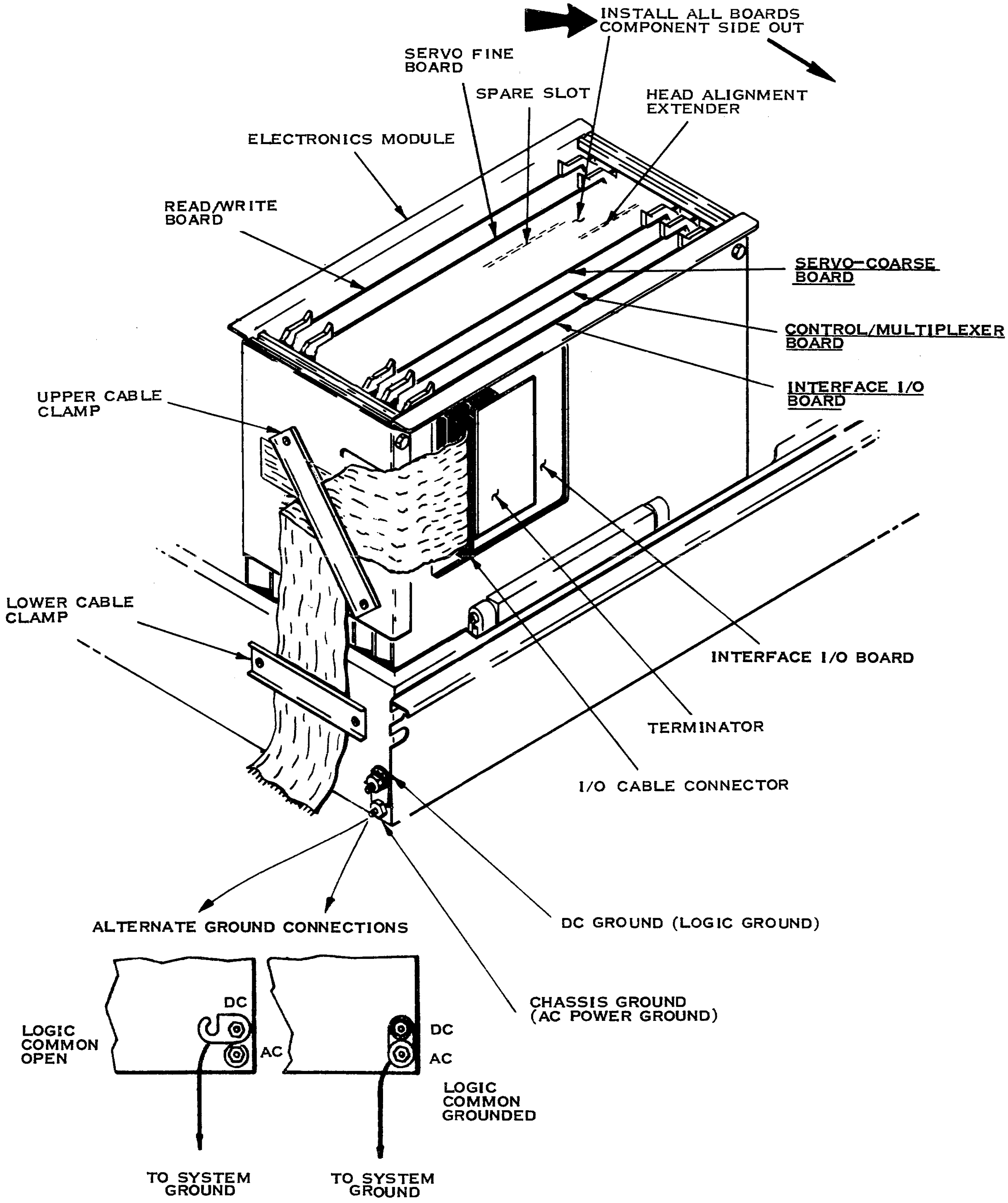

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Figure 4-3. CD1400 Disk Internal PWBs Locations

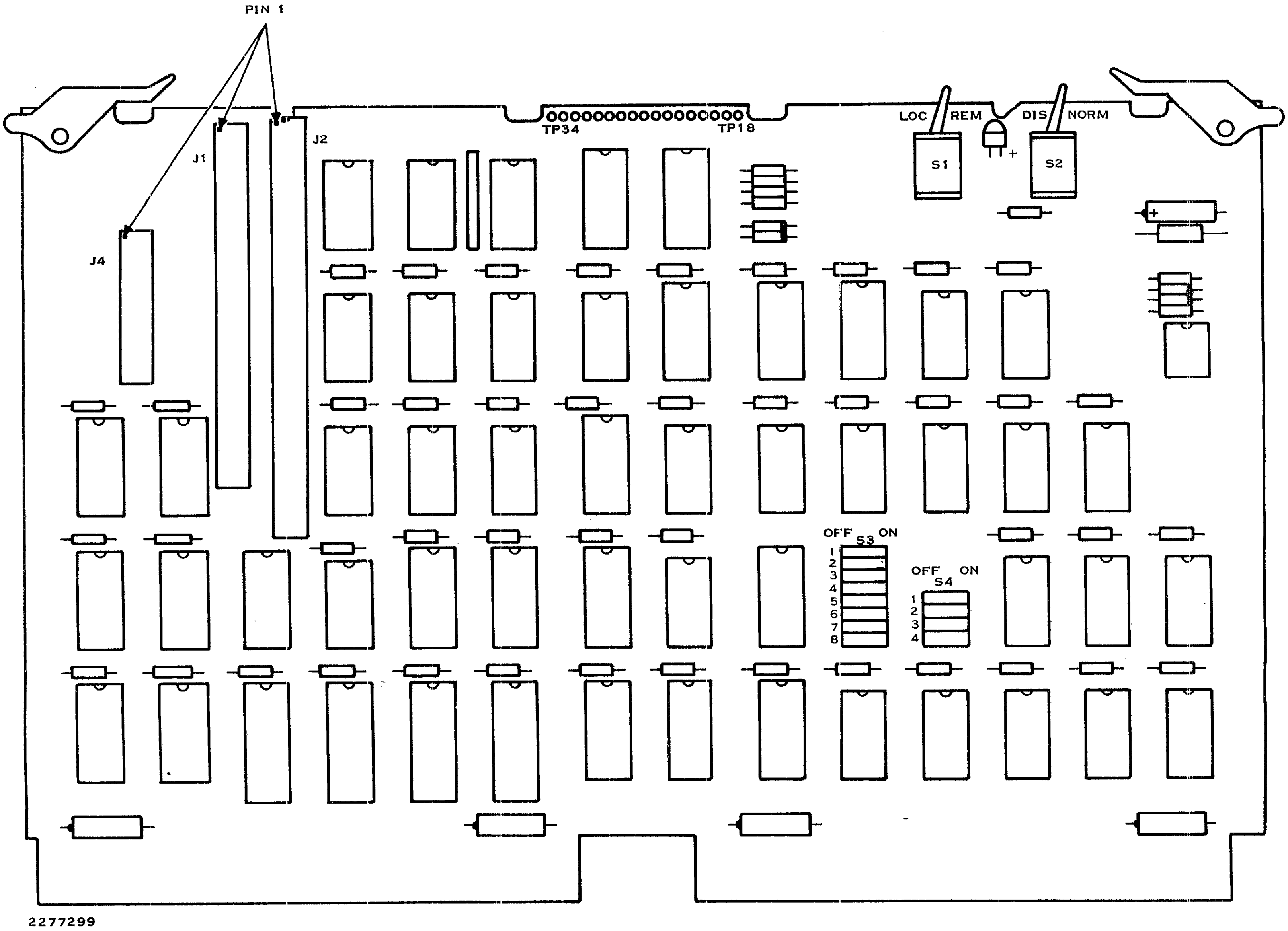


Figure 4-4. Disk Drive I/O Interface Board

4.3.1.2 DIS/NORM Toggle Switch (S2). In the NORM (normal operating) position of the DIS/NORM switch, the disk drive interface signals are enabled; in the DIS (local maintenance) position these interface signals are disabled.

4.3.1.3 Unit Select DIP Switch (S3). The unit select switch, S3, selects the disk drive unit numbers for the removable disk cartridge and fixed disk platters:

- Removable disk cartridge — Switch sections S3-1 through S3-4
- Fixed disk platters — Switch sections S3-5 through S3-8

To assign disk drive unit numbers for both the fixed and removable disks, set switch S3 as follows:

Disk Unit		Switch S3 Sections/Settings							
Fixed	**Removable**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0[1]	1	1	0	1	1	0	1	1	1
1	0	0	1	1	1	1	0	1	1
2[2]	3	1	1	1	0	1	1	0	1
3	2	1	1	0	1	1	1	1	0

Notes:
1 = ON; 0 = OFF
[1] Standard switch settings for primary drive: fixed = 0; removable = 1
[2] Standard switch settings for secondary drive: fixed = 2; removable = 3

4.3.1.4 Disk Drive Capacity DIP Switch (S4). Switch S4 is used to set the capacity of the fixed media in the disk drive unit. Only two switch sections, S4-1 and S4-2, are used. The switches are set as follows:

	S4 Section	Number/Position
Disk Capacity	**1**	**2**
32MB (16MB fixed)	ON	ON
64MB (48MB fixed)	OFF	ON
96MB (80MB fixed)	ON	OFF

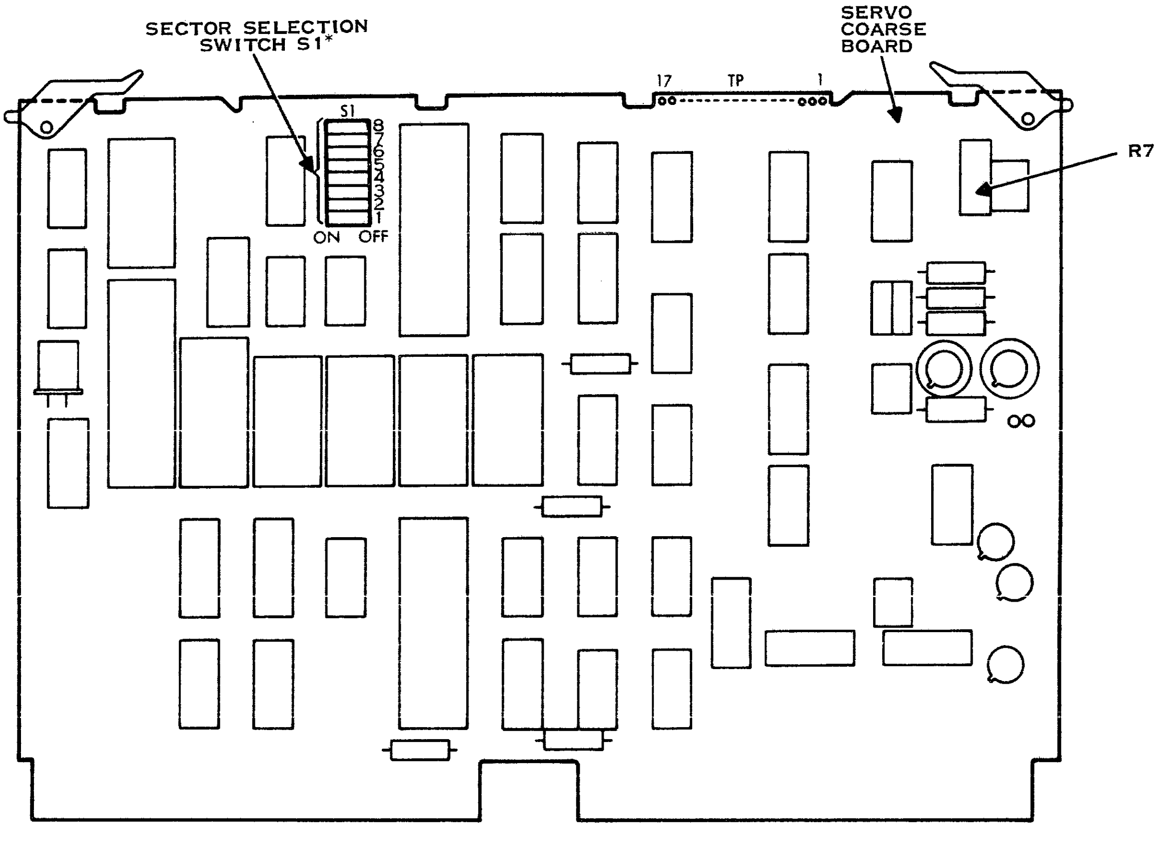
4.3.2 Servo-Coarse Board

The servo-coarse board (Figure 4-5) contains an eight-section DIP sector selection switch (S1). Seven of these switch sections (S1-1 through S1-7) set the number of sector pulses per revolution (which is 64). The eighth section (S1-8) is used for maintenance. S1 must be set to the positions shown in Figure 4-5.

NOTE

S1-8 is used in conjunction with R7 for velocity gain adjustment, as explained in paragraph 4.10.2.5.

SECTOR SELECTION SWITCH SECTIONS	1	2	3	4	5	6	7	8
POSITION	ON	ON	ON	ON	ON	ON	OFF	ON



*PUSH IN LEFT SIDE FOR ON , PUSH IN RIGHT SIDE FOR OFF .

Figure 4-5. Disk Drive Servo-Coarse Board

4.3.3 Control/Multiplexer Board

The control/multiplexer board (Figure 4-6) contains a jumper package that must reflect the capacity of the disk drive: either 32MB, 64MB, or 96MB. This jumper package resembles a standard DIP switch and plugs into a standard DIP socket. Jumpers are exposed along the top of the package, and can be broken by scratching across the jumper with a sharp tool until the connection is severed.

This jumper package is set at the factory before shipment, but must be configured properly at the following times:

- When swapping the control/multiplexer board between disk drives.
- When replacing the control/multiplexer board.
- When upgrading a disk drive to a higher data storage capacity.

Table 4-2 shows the jumper configuration for each capacity disk drive. Note that only the bottom three jumpers are used. A logic 1 in the table means that the jumper is broken; a logic 0 means that the jumper must remain intact.

Table 4-2. Control/Multiplexer Board Jumper Configuration

	Jumper Number		
Capacity	**0**	**1**	**2**
32MB	0	0	1
64MB	0	1	1
96MB	1	0	1

Note:

1 means jumper is broken

0 means jumper remains intact.

DD — Disk Drives

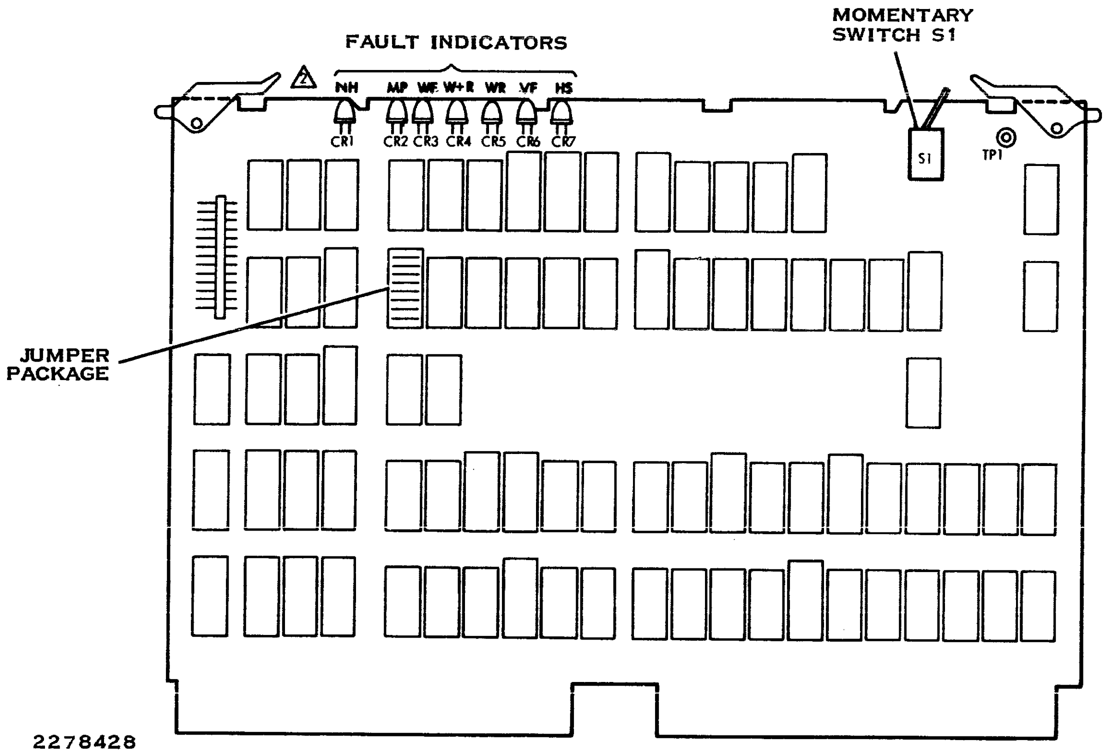


Figure 4-6. Control/Multiplexer Board

4.4 DISK CONTROLLER

Switches on the disk controller (Figure 4-7) select the TILINE base memory address. These switches, which are preset at the factory, should be verified when a controller board is removed or replaced. Figure 4-8 lists the TILINE addresses, CPU byte addresses, and corresponding switch positions for each address.

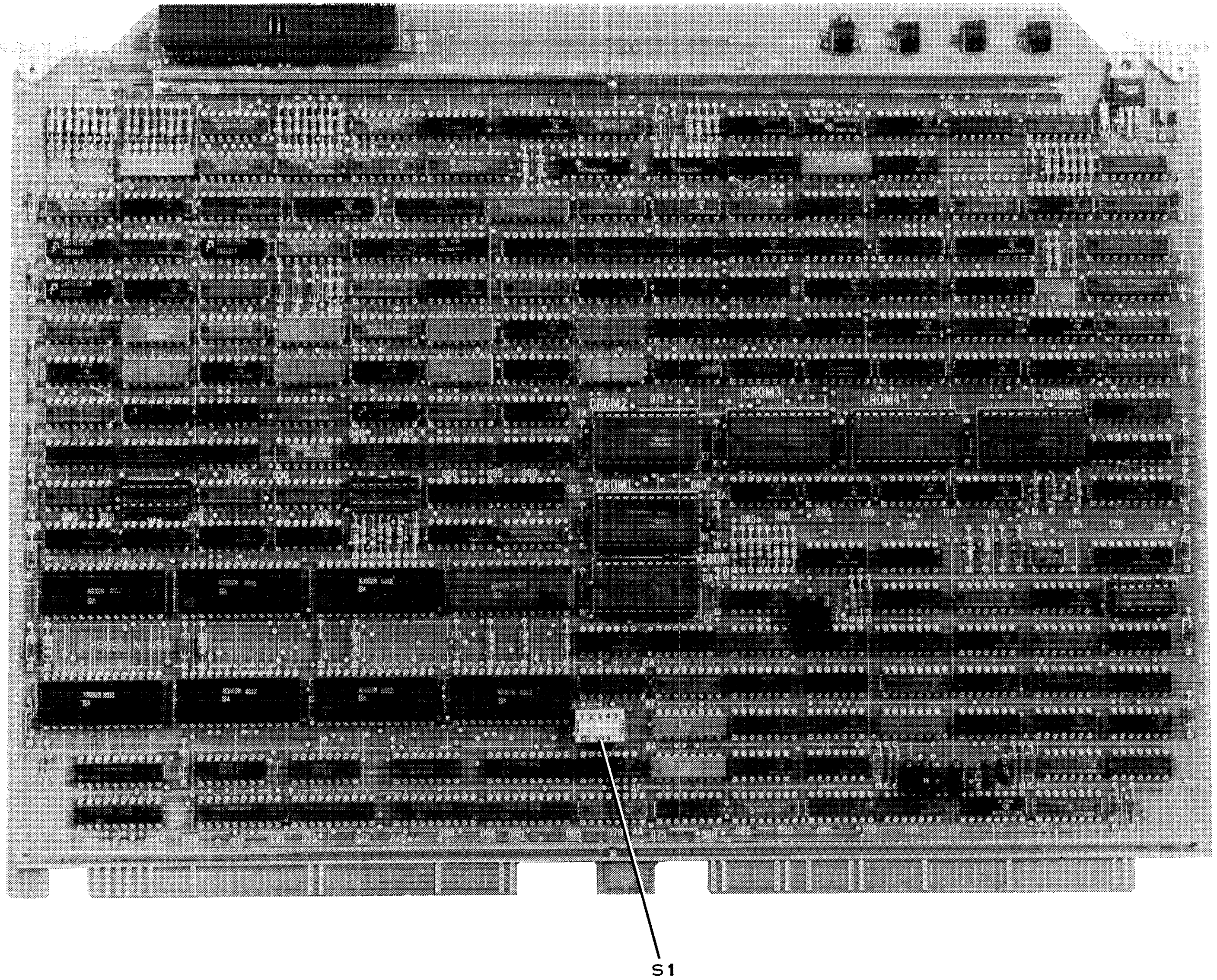
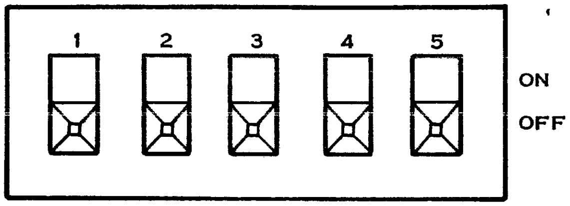


Figure 4-7. CD1400 Disk Controller

DD — Disk Drives



SWITCHES SHOWN SET AT CPU BYTE ADDRESS> F800

TILINE WORD ADDRESS (HEXA-DECIMAL)	CPU BYTE ADDRESS (HEXA-DECIMAL)	SWITCHES					
		1	2	3	4	5	
FFC00	F800	OFF	OFF	OFF	OFF	OFF	DISK CONTROLLERS
FFC08	F810	OFF	OFF	OFF	OFF	ON	
FFC10	F820	OFF	OFF	OFF	ON	OFF	
FFC18	F830	OFF	OFF	OFF	ON	ON	
FFC20	F840	OFF	OFF	ON	OFF	OFF	
FFC28	F850	OFF	OFF	ON	OFF	ON	
FFC30	F860	OFF	OFF	ON	ON	OFF	
FFC38	F870	OFF	OFF	ON	ON	ON	
FFC40	F880	OFF	ON	OFF	OFF	OFF	OTHER TILINE SLAVES
FFC48	F890	OFF	ON	OFF	OFF	ON	
FFC50	F8A0	OFF	ON	OFF	ON	OFF	
FFC58	F8B0	OFF	ON	OFF	ON	ON	
FFC60	F8C0	OFF	ON	ON	OFF	OFF	
FFC68	F8D0	OFF	ON	ON	OFF	ON	
FFC70	F8E0	OFF	ON	ON	ON	OFF	
FFC78	F8F0	OFF	ON	ON	ON	ON	

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Figure 4-8. Controller TILINE Address Switch Configurations

4.5 FORMATS OF CONTROL WORDS

The disk controller is initiated and interrogated by a TILINE master (normally the computer CPU) via a set of control words. These eight control words and their corresponding TILINE bus addresses are shown in Figure 4-9. They are completely described in the disk drive installation and operation manual.

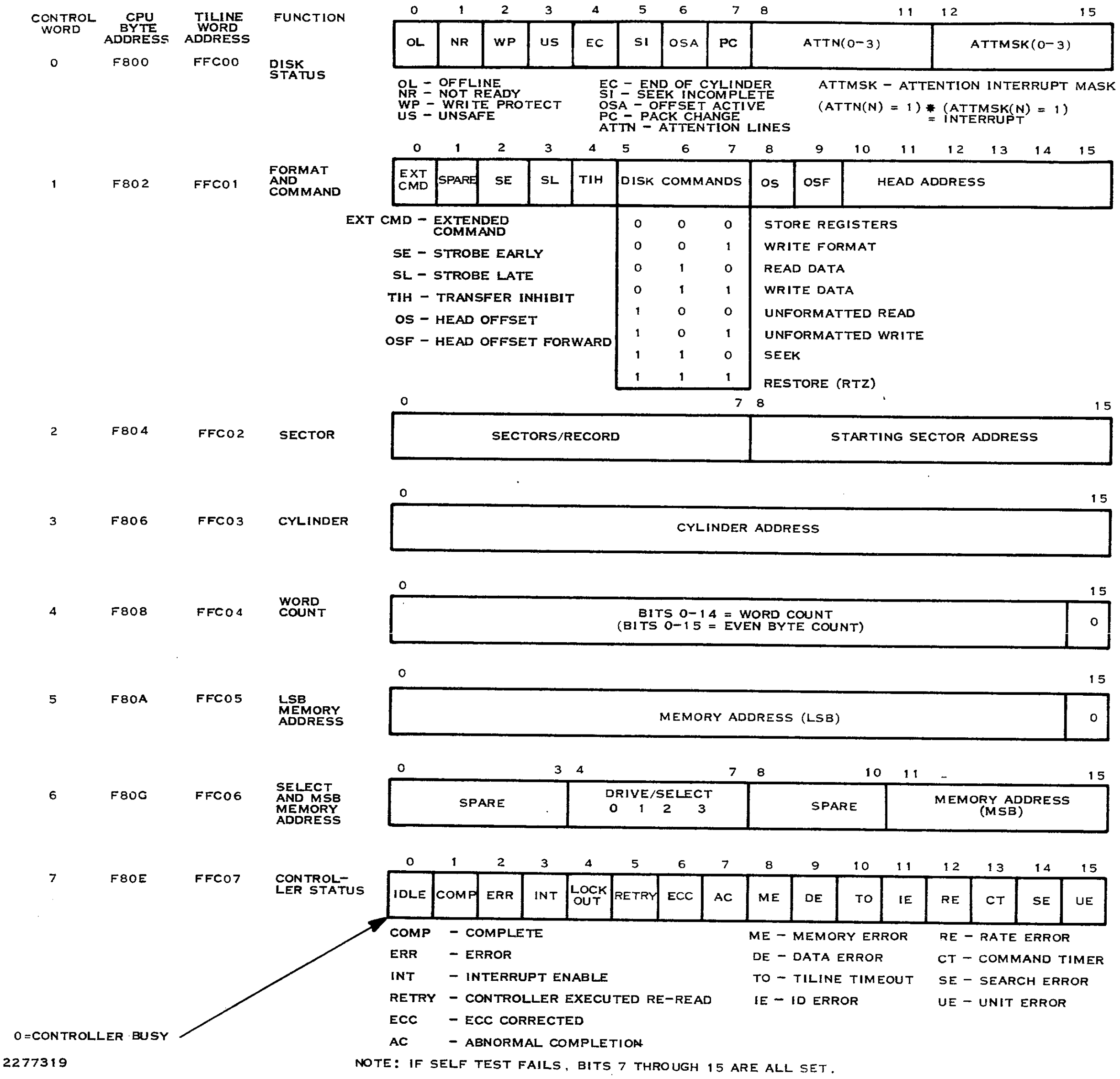

Figure 4-9. CD1400 Disk Control and Status Word Formats

4.6 CD1400 DISK CARTRIDGE

All removable disk cartridges used with the CD1400 disk drive must meet the following critical specifications:

1. Tracks 0, 1, and 822 must be error-free.
2. Unmapped track errors must not exceed seven bits in length.

3. An error map must accompany the disk cartridge.
4. A superior platter surface finish is required to minimize the probability of head crashing.

CAUTION

The TI-supplied disk cartridge, part number 2269886-0001, meets these specifications. If a disk cartridge from another supplier is used, it must be certified to these requirements.

The top dust cover is permanently affixed to the disk cartridge. Remove the bottom dust cover before inserting the cartridge into the disk drive. Refer to Figure 4-10 for an illustration of cartridge removal/installation. Observe the following special precautions in handling the disk cartridges:

CAUTION

1. **Always install the bottom dust cover on the cartridge when it is not inserted in the disk drive.**
2. **Store cartridges flat; avoid stacking.**
3. **Never touch the disk recording surface.**
4. **Always lift the cartridge by the handle of the top dust cover.**

4.7 CD1400 DISK SYSTEM CABLING

One or two disk drives may be connected to a single disk controller as shown in Figure 4-11. If only one disk drive is connected to the disk controller in the computer chassis, the I/O interface cable is connected between J3 at the controller and J1 on the interface board in the disk drive; a terminator board is installed in J2 of the interface board.

If two disk drives are connected in the system, an additional I/O cable is connected between the interface boards of the first and second disk drives. The terminator board is always installed in J2 of the last drive in the chain.

NOTE

Disk drive unit selection is not determined by cable routing or connections, but by switch settings on the disk drive I/O interface board. Refer to paragraph 4.3.1.3.

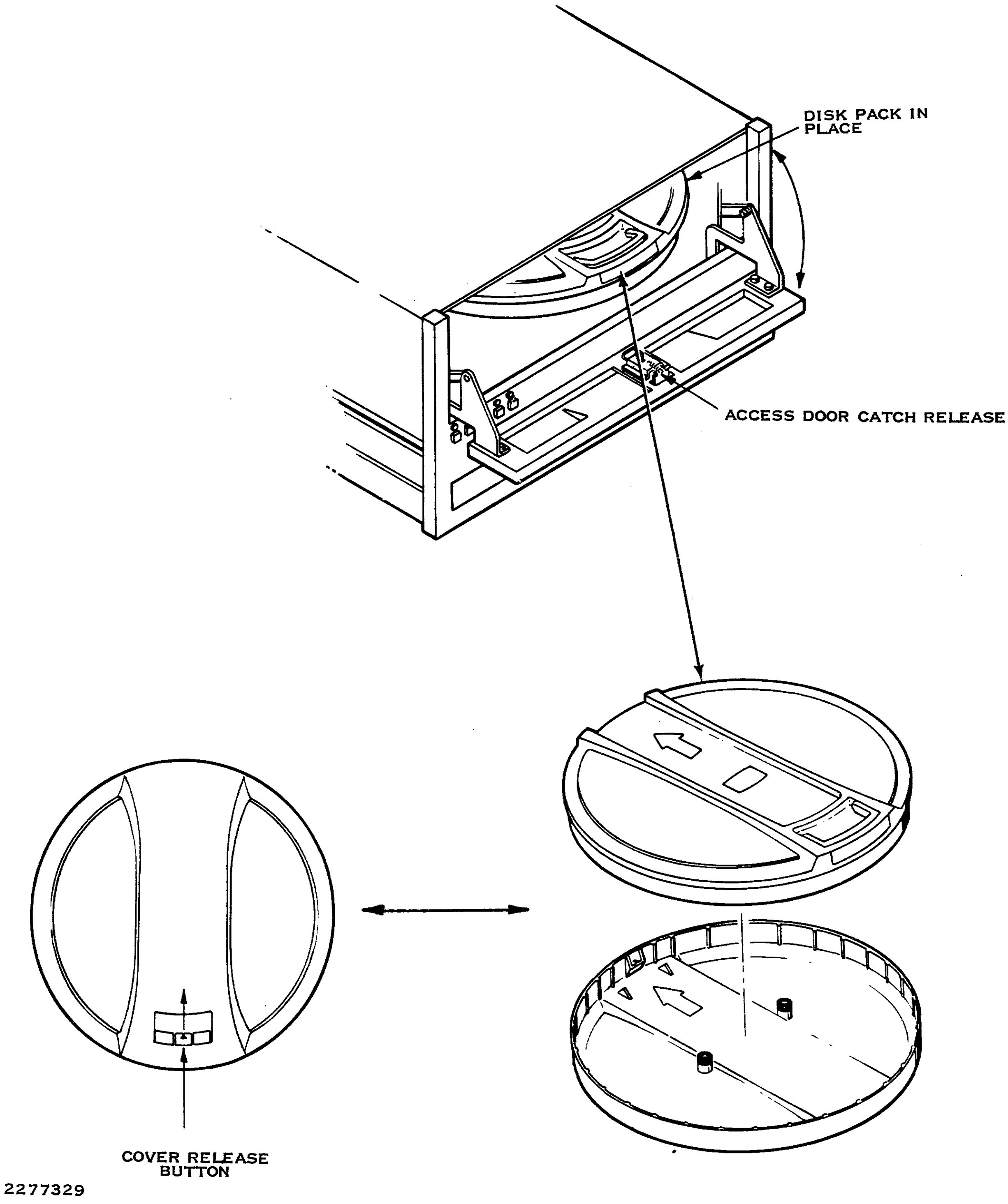

Figure 4-10. CD1400 Disk Cartridge Removal/Installation

DD — Disk Drives

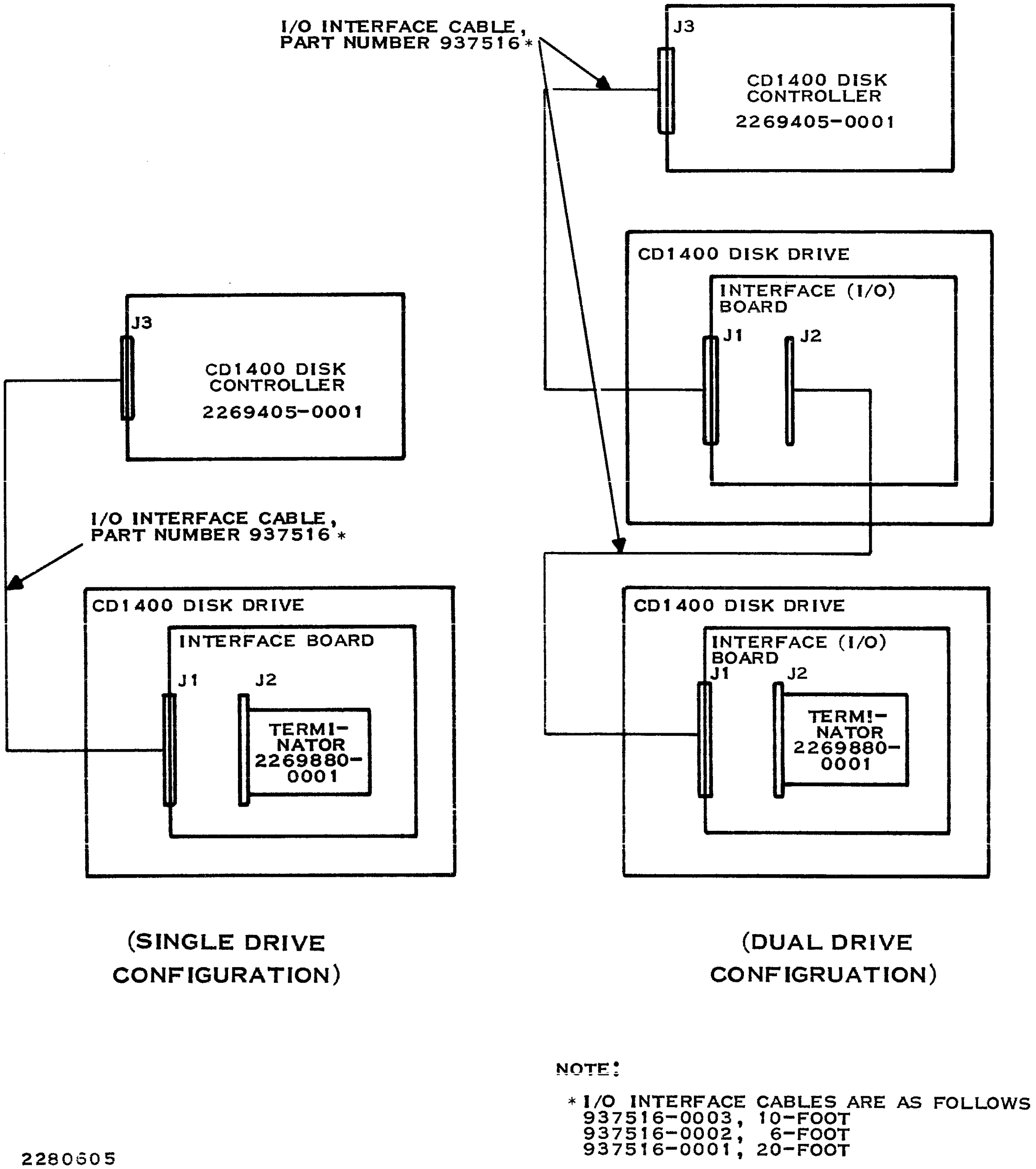

Figure 4-11. CD1400 Disk Drive System Cabling Interconnections

4.7.1 Disk Drive System Grounding

The disk drive logic common circuitry (dc ground) is grounded separately from the chassis (ac power) ground. These two grounds may be connected together at the external ground studs on the rear base pan of the disk drive as shown in Figure 4-3. These grounds are isolated by disconnecting the metal grounding strap between the two studs.

The following general guidelines should be followed when grounding the system.

1. The DS990 system should have a single point ground.
2. If another device in the system is grounded, do not ground the CD1400 disk drive.
3. If no other device in the system is grounded, ground the last disk drive in the chain.
4. Refer to Appendix E in this manual for single point grounding information.

4.8 PURGING THE CD1400 DISK DRIVE

For initial operation, purge the air-filtering system to ensure that the disk cavity is free of foreign matter before placing the disk drive online to the system. To purge the disk drive, perform the following steps.

1. If not already done, remove the disk drive top cover.
2. With the MAIN AC BREAKER on the disk drive rear panel set to OFF, disconnect the electrical connector A1P1 located in front of the voice coil assembly, Figure 4-12. This will prevent the heads from loading during purge procedures.
3. Set the LOC/REM power sequencing switch on the I/O board to LOC, Figure 4-12.
4. Verify that the START/STOP switch on the disk drive front panel is set to STOP (out).
5. Connect the equipment cabinet to the appropriate power source and turn on the cabinet circuit breaker.
6. Set the MAIN AC BREAKER on the disk drive rear panel to ON.
7. Install a scratch cartridge in the disk drive unit.
8. Start the disk drive by pressing the START/STOP switch to START. The READY light will flash until the disk drive is up to speed.
9. Operate the disk drive in this purge mode for at least 20 minutes.
10. Stop the disk drive. Remove the scratch cartridge.

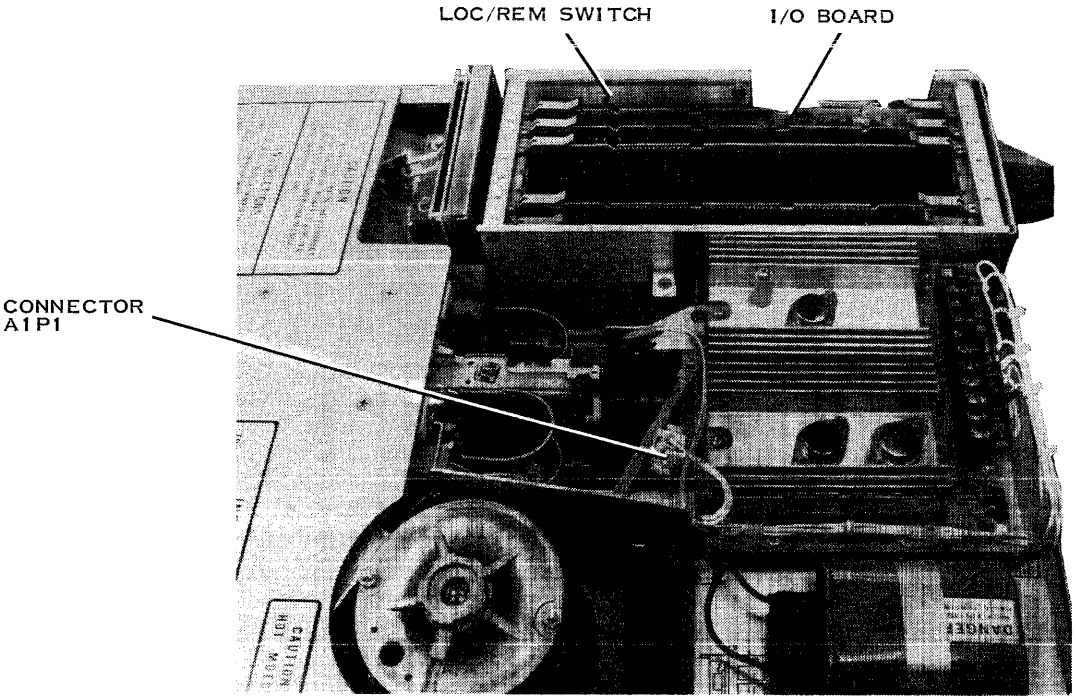

Figure 4-12. CD1400 Showing LOC/REM Switch and A1P1 Connector

11. Turn off the ac circuit breaker in the equipment cabinet.
12. Reconnect the electrical connector A1P1 disconnected in step 2.
13. On the I/O board, set the LOC/REM power sequencing switch to REM.

This completes the purge procedure.

4.9 DISK DRIVES POWER-ON SEQUENCING

In a multiple disk drive installation, the disk controller normally applies power to start up the disk drives one at a time. After the initial power-on sequencing is complete, any disk drive will start immediately upon pressing the START/STOP switch. For initial automatic power-on sequencing by the controller, perform the following steps:

1. Remove power from the computer.
2. On the rear panel verify that the MAIN AC BREAKER is ON for all disk drives.
3. Install disk cartridges in all disk drives.

4. Actuate the START/STOP switch to START on all disk drives.

5. Apply power to the computer. The controller will automatically sequence power to all disk drives in the system.

4.9.1 Manual Power-On Sequencing

For manual sequencing in a multiple drive installation, perform the following steps:

1. Verify that the computer is powered up and online.

2. Ensure the START/STOP switch is set to STOP (switch out and indicator extinguished) on all disk drives.

3. On rear panel of all disk drives set the MAIN AC BREAKER to ON.

4. Install disk cartridges in all drives.

5. On the first drive actuate the START/STOP switch and verify that the indicator is lit.

6. Observe the READY indicator until it ceases blinking and remains lit (approximately 60 seconds). This indicates the drive is up to speed and the heads loaded.

7. Verify that the FAULT indicator is extinguished.

8. Repeat this procedure for each drive in the system.

4.9.2 Correcting a Fault Indication

If the FAULT indicator lights, proceed as follows:

1. Press the FAULT switch. If the FAULT indicator goes out, resume normal operations.

2. If the FAULT indicator does not go out when pressed, press the START/STOP switch to STOP and observe that the READY indicator extinguishes.

3. Then press the START/STOP switch to START. If the FAULT indicator extinguishes, resume normal operations.

4. If the FAULT indicator remains lit, power down the equipment, then power up again. If the FAULT indicator remains lit, troubleshooting of the disk drive system is required.

4.10 CD1400 DISK SYSTEM TROUBLESHOOTING

Since a failure in an associated unit of the DS990 system can appear to originate with the disk drive system, verify proper operation of other equipment in the system, as far as possible, before assuming a disk system fault.

DD — Disk Drives

4.10.1 Disk Controller Self-Test Functions

Problem isolation to a major functional unit is generally a primary concern when confronted with a disk system failure. The controller can execute extensive self-tests that provide a highly reliable indication of controller integrity as well as diagnose certain disk drive failures, particularly in the interface circuits. Several of these self-tests are automatically executed upon controller power-up, and additional self-tests can be executed by entering an extended mode command using the CPU programmer panel or other input device. Also, the DOCS diagnostics can be used to run these self-tests.

Since a failure of the self-tests upon power-up can be caused by either the controller, I/O cabling, or the disk drive, the power-up sequence should first be accomplished with the system fully connected. Observe the following indications:

- If the FAULT indicator on the controller lights only briefly (while the self-tests are being executed) and goes out, the controller can be considered fully operational.
- If the FAULT indicator remains on, disconnect the I/O cable from the controller and repeat the power-up sequence.
- If the FAULT light goes out after the self-test, the problem lies within the disk drive or I/O cable. The power-up sequence can be repeated with the I/O cable connected to the controller but disconnected from the disk drive, which will check a portion, but not all, of the I/O cable for shorts.
- If the FAULT indicator remains on when the I/O cable is disconnected from the controller, the controller has detected a fault which could be one of the following:
  - — Controller failure.
  - — TLAG jumpers installed incorrectly.
  - — Faulty connections in the backplane or other interface to the TILINE.
  - — TILINE address switches set wrong.
  - — Two controllers set to the same TILINE address.
  - — Other TILINE device is preventing the controller from accessing the TILINE.

Additional self-tests, described in the following paragraphs, can provide some indication of selected disk drive faults as well as further check operation of the controller. If the self-tests of the previous paragraph indicate a good controller and I/O cable but a faulty disk drive, perform the self-test procedures as follows:

1. Connect the I/O cable to the disk drive and controller.
2. Power up the system using normal procedures.
3. Using the CPU front panel or other I/O device, enter >8700 into the controller TILINE register 1 (W1; e.g. >F802). This enters the self-test command (extended mode) into the controller register.

4. Enter >0B00 into W3 (e.g. >F806), which specifies execution of test B.

5. Enter a valid unit number into W6 (e.g. >F80C). Unit designation codes are as follows:

Unit Number	**W6 Bit Number** **4**	**5**	**6**	**7**	**TILINE Register 6 (e.g. >F80C)**
0	1	0	0	0	>0800
1	0	1	0	0	>0400
2	0	0	1	0	>0200
3	0	0	0	1	>0100

6. Enter >0000 for all other register locations except W7. W7 must be entered last.

7. Enter >0000 into W7 (e.g. >F80E) to initiate the self test.

8. After test execution, read W7 to determine test result. >C000 (or >C800 if lockout bit is set) is returned if the system passes the self-test. >A0FF (or >A8FF with lockout) is returned if a failure is detected.

9. If a self-test has failed, W2 (e.g. >F804) will contain an error code that indicates the type of malfunction that caused the test to fail. Read W2 and refer to Table 4-3 for a description of the failure associated with the error code.

10. Select a different unit number as in step 5, and repeat steps 6-9. Repeat for each unit connected to the controller.

11. Enter >0C00 into W3 (e.g. F806) to specify execution of test C.

12. Repeat steps 6-9. Unit numbers are not necessary for test C.

DD — Disk Drives

Table 4-3. Self-Test Failure Codes

Error Code (From W2 - >F804)	Description
Test B, Interface and Cable Test:	
>FFFF	Controller failure
>490B	Terminator fault, drive power fault, or I/O cable fault
>480B	Multiple units selected
>470B	Drive not ready or offline or unit select fault
>460B	Drive loopback failure: controller fault, I/O cable fault, I/O driver fault
>450B	Controller fault or I/O driver fault
>440B	Controller fault or I/O driver fault
>430B	Controller fault or I/O driver fault
>420B	No index pulse flag: I/O drivers, cable or drive fault
>410B	Sector counter on drive I/O PWB failure
>400B	Sector counter fault
>010B	Sector counter fault
>FF0B	Sector counter fault
>000B	No failure in test B
Test C, Bibus* and Sector Counter Test	
>FFFF	Controller failure
>FF0C	Controller failure
>880C	Cable or drive failure
>870C	Bibus failure: cable or I/O fault
>860C	Address set failure: cable or I/O fault
>850C	Address set failure: cable or I/O fault
>840C	Address set failure: cable or I/O fault
>830C	Controller fault
>820C	Controller fault
>810C	Controller fault
>800C	Controller fault
>7F0C	Controller fault
>010C	Controller fault
>000C	No failure in test C

Note:

* Bidirectional bus

4.10.2 Disk Drive Self-Test Functions

The disk drive also incorporates extensive self-test routines that can aid the field engineer in locating malfunctions. Maintenance switches and indicators located on the disk drive are listed with a brief functional description in Table 4-4. These switches and associated maintenance indicators are located on the control/multiplexer, I/O interface, servo-coarse, and servo-fine PWBs in the electronics module.

The seven LED indicators (CR1-CR7) on the control/multiplexer PWB (Figure 4-6) display both microprocessor and nonmicroprocessor detected faults; display the present cylinder address held in the microprocessor; or display velocity gain information. The particular information displayed (display mode) is dependent upon setting of servo-coarse PWB switch S1-8 (Figure 4-5) and control/multiplexer PWB switch S1 (Figure 4-6).

Table 4-4. Maintenance Switches and Functions

Switch	Name	Location	Function
S1[1]	Fault Clear	Control/ Multiplexer PWB (EM slot 2)	Momentary toggle switch that performs the following functions in conjunction with maintenance display indicators CR1-CR7: 1. Resets the fault latches when in the nonmicroprocessor fault display mode[2]. 2. Initiates the present cylinder address display mode. Switch actuations while in this mode cause the display to sequence through the three display states. Each display state places a portion of the coded current cylinder address on indicators CR1-CR7. 3. Actuating S1 after the current cylinder address initiates a separator state. 4. After the separator state, S1 actuation initiates the microprocessor-detected fault mode. Each subsequent switch actuation displays a different fault code until all fault codes have been displayed. 5. When CR3-CR7 are used to aid velocity gain adjustment, actuation of S1 causes the drive to execute a seek to cylinder 822 and a velocity code is displayed.
S1	Remote/Local	I/O PWB (EM Slot 1)	Allows control of main power at the disk drive front panel (local) or at the controller (remote). Used to sequence power application in multiple drive systems.
S2	Online/Offline	I/O PWB	When in offline position, inhibits drive-transmitted signals except for read/write clocks and data signals.

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Table 4-4. Maintenance Switches and Functions (Continued)

Switch	Name	Location	Function
S1	Data/Servo Select	Servo-Fine PWB (EM Slot 6)	Used when aligning heads. Selects either read data or servo data pattern for use in aligning the read/write or servo heads. This switch has no effect unless head alignment extender PWB is being used. Refer to the disk field maintenance manual for alignment instructions.
S1-8	Velocity Gain Adjustment	Servo-Coarse PWB (EM Slot 3)	When S1-8 is in the OFF position, the fault indicators CR3-CR7 display velocity gain information. Note that switches S1-1 through S1-8 on the control/multiplexer board are OFF when pressed down on the right side of the switch. When S1-8 is in the ON position, the fault display modes are enabled. Refer to the disk field maintenance manual for details on velocity gain tests and adjustments.
S1-1 thru S1-7[3]	Sector Number Select	Servo-Coarse PWB	Selects sector pulses per revolution. Since the CD1400 disk system is programmed for 64 sectors per revolution, this switch must be set for this number. Refer to paragraph 4.3.2 and Figure 4-5 for information concerning these switch settings.

Notes:

[1] See paragraphs 4.10.2.1 through 4.10.2.4 for additional details concerning switch use.

[2] The display modes of the CR1-CR7 indicators are explained in Table 4-5 and paragraphs 4.10.2.1 through 4.10.2.4.

[3] Not used normally for maintenance, but mentioned here to complete the description of switch S1 on the servo coarse PWB.

NOTE

Information from each display should be recorded before each actuation of control/multiplexer switch S1, since information cannot be repeated once it has been displayed.

4.10.2.1 Display Mode 1 — Nonmicroprocessor-Fault Display. During normal operation, when servo-coarse PWB switch S1-8 is ON and control/multiplexer PWB switch S1 is OFF, the fault indicators display nonmicroprocessor faults as they occur. Refer to Table 4-5 for the interpretation of these fault indications. The fault latches are reset when master power to the disk drive is cycled or when a different display mode is entered. Actuating control/multiplexer switch S1 shifts the display mode to either mode 2 or mode 4.

In most cases, the display shifts to mode 2 upon the first actuation of control/multiplexer switch S1, and cylinder address information is displayed. However, in some cases, the cylinder address latches are clear, and the display enters mode 4 and displays microprocessor-detected faults. Since there is no way to ascertain whether the fault indicator is currently in mode 2 or mode 4, the LED indications must be recorded during the next three states (actuations of S1). On the fourth actuation, either the separator state will be displayed (mode 3, shown in Table 4-5), or a fault indication from mode 4 will be displayed. If mode three (separator state) is displayed, the three previously recorded display codes were mode 2 (cylinder address) indications. If mode three is not displayed, the previously recorded display codes were mode 4 (microprocessor-detected fault) indications.

4.10.2.2 Display Mode 2 — Current Cylinder Address. When control/multiplexer switch S1 is actuated and the fault display enters mode 2, the fault latches are reset, indicator CR2 is turned ON, and indicators CR6 and CR7 display the highest-order two bits of the present cylinder address (the address used by the drive in performing the last seek operation). S1 need only be actuated momentarily. When S1 is actuated a second time, the information displayed by CR6 and CR7 is cleared, and CR4-CR7 then displays the next four high-order bits of the present cylinder address. The third actuation of S1 changes the information displayed on CR4-CR7 to the low-order four bits of the present cylinder address. CR3 is always off except when the cylinder address digit displayed on CR4-CR7 is zero. The 10 bits displayed as described above are the three hexadecimal numbers representing the address of the last seek performed by the drive. As cylinder address bits are displayed, the address latch is cleared, so that another seek operation must be performed before a cylinder address can again be displayed.

4.10.2.3 Display Mode 3 — Separator State. The next (fourth) actuation of switch S1, after the three actuations of display mode 2, turns off CR3-CR7, leaving only CR2 ON. This is a separator state between display mode 2 and display mode 4. Note that if this separator state does not occur, the last three indications were mode 4 indications.

4.10.2.4 Display Mode 4 — Microprocessor-Detected Faults. Assuming that display modes 2 and 3 occurred first, the fifth actuation of S1 places operation in display mode 4, the microprocessor-detected fault mode. Each error detected by the microprocessor is stored and can be read on the LED indicators by successive actuations of control/multiplexer switch S1.

Subsequent actuations of S1 display all error codes stored. Table 4-6 lists all these error codes and code interpretations. The next S1 actuation after the last error code has been displayed displays all ones on CR2-CR7 (all lights ON). The next actuation after all ones displays all zeros (all lights OFF but CR2). Subsequent actuations of S1 switches the display between ones and zeros on CR2-CR7 until the drive performs an operation (i.e., seek, read or write, RTZ, etc.). After the drive completes an operation and enters the idle mode, the fault display reverts to mode 1.

If the fault readout process is somewhere in mode 4 when a seek is performed, operation returns to mode 1. Any mode 4 error codes that were not displayed before the seek operation remain stored and can be read normally. New fault indications, if any, will be added to the accumulated fault codes.

4.10.2.5 Display Mode 5 — Velocity Gain Display. When S1-8 on the servo coarse PWB is placed in the OFF position (right side of switch depressed when facing switch from component side of PWB), servo system velocity gain information can be displayed on CR3-CR7.

NOTE

CR2 is normally on.

To set velocity gain, set S1-8 OFF and adjust R7 (Figure 4-5) to obtain the following indications:

CR No.	Interpretation	R7 Adjustment
3	Velocity gain very low	Turn clockwise
4	Velocity gain low	Turn clockwise
5	Velocity gain correct	No adjustment
6	Velocity gain high	Turn counterclockwise
7	Velocity gain very high	Turn counterclockwise

To test the velocity gain, toggle S1 on the control/multiplexer board 10 times. CR5 should be lit no less than 9 times out of 10. After the test is satisfactory, set S1-8 back to ON. All of S1 switch sections should remain ON except S1-7, which remains OFF.

Table 4-5. Fault Display Indicator Interpretation

Mode	S1	CR1	CR2	CR3	CR4	CR5	CR6	CR7	Description
1		ON	*	*	*	*	*	*	No head-select fault. When CR1 is on, an attempt has been made to select a nonexistent head.
1		*	ON	*	*	*	*	*	Microprocessor active. CR2 is on whenever the microprocessor is active.
1		*	*	ON	*	*	*	*	Write fault. CR3 is on when ac or dc write current is lost.
1		*	*	*	ON	*	*	*	Write or read off cylinder. CR4 is on when an attempt is made to read or write during a seek, RTZ, or volume change.
1		*	*	*	*	ON	*	*	Write and read fault. CR5 is on when an attempt has been made to write and read at the same time.
1		*	*	*	*	*	ON	*	Voltage fault. CR6 is on when a below-normal voltage has been sensed.
		*	*	*	*	*	*	ON	Head-select fault. CR7 is on when more than one head has been selected.

Table 4-5. Fault Display Indicator Interpretation (Continued)

Mode	S1	CR1	CR2	CR3	CR4	CR5	CR6	CR7	Description
2	1A**	OFF	ON	***	OFF	OFF	C9	C8	The two highest-order bits of the present cylinder address.
2	2A**	OFF	ON	***	C7	C6	C5	C4	The next four bits of the present cylinder address.
2	3A**	OFF	ON	***	C3	C2	C1	C0	The four lowest-order bits of the present cylinder address.
3	4A**	OFF	ON	OFF	OFF	OFF	OFF	OFF	Separator state. Nonindicating state between modes 2 and 4.
4	A**	OFF	ON	M4	M3	M2	M1	M0	A hexadecimally-coded binary number (M0-M4) that indicates a particular microprocessor-detected fault condition. Fault codes are described in the following table. Each actuation of switch S1 sequences to the next fault code display until all fault codes have been displayed. Further actuation alternates the display between all indicators on and all indicators off.

Notes:

* More than one indicator in this mode can be on simultaneously, indicating multiple faults.

** The letter A indicates a momentary actuation of this switch. 1A indicates the first actuation during this mode, 2A indicates the second actuation, etc.

*** Off whenever the cylinder address is not zero. On whenever the cylinder address is zero.

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Table 4-6. Microprocessor Fault Codes and Meanings

Codes 01 through 0C represent the 12 phases of operation that are checked by the microprocessor. Codes 0F through 1E represent the fault types that could have occurred in one of the phases. In display mode 4 the phase codes are read out in order first and then the fault codes in order. Code >1F is read after the last fault code is read out.

Hex Code	Binary Code* CR3 - CR7	Phase of Operation
01	00001	Return to track center
02	00010	Wait for coarse seek completion
03	00011	Seek settling complete
04	00100	Idle loop
05	00101	Return to zero motion
06	00110	End of velocity table
07	00111	Head load
08	01000	Await AGC during head load
09	01001	Await track center load or return to zero
0A	01010	Settling load or return to zero
0B	01011	Offset active
0C	01100	Clear offset settling
0D	01101	Resume settling after false termination
		Fault Type
0F	01111	Spindle did not start or stop in 2 minutes
10	10000	Spindle start greater than 70 seconds
11	10001	No spindle movement detected
12	10010	No drive to solid state relay
13	10011	Solid state relay failure
14	10100	Stop timeout
15	10101	Emergency retract failure
16	10110	Normal retract failure
17	10111	Cylinder address greater than 822
18	11000	Off-track greater than 1200 μs
19	11001	Unexpected AGC in head load
1A	11010	Lost AGC
1B	11011	Rpm fault
1C	11100	Lost speed pulses
1D	11101	Allowed time expired
1E	11110	No track lock in settling
1F	11111	Microprocessor fault code summary readout is complete

Note:

* CR3-CR7: 1 = light on; 0 = light off

4.11 CD1400 DISK SYSTEM FIELD-REPLACEABLE COMPONENTS

Field-replaceable components for the CD1400 disk drive system are as follows:

Item	TI Part Number	Vendor Part Number
System Components		
CD1400 Disk Drive System	2269887-00XX	
CD1400 Disk System (Rackmount)	2269909-00XX	
CD1400 Disk System (Pedestal Mount)	2269906-00XX	
CD1400 Disk Drive	2269885-00XX	
Disk Controller	2269405-0001	
Terminator	2269880-0001	
I/O Interface Cable	0937516-0001	
Removable Disk Cartridge	2269886-0001	
Disk Drive Components		
Data Cartridge	2213589-0013	
Power Supply, 115 Vac, 60 Hz	2213589-0010	77610705
Power Supply, International (100, 230, 240, 270 Vac, 50 Hz)	2213589-0049	77610707
Read/Write Preamplifier	2213589-0006	75885752
Servo Preamplifier	2213589-0007	75885800
Relay Control, PWA	2213589-0008	77633300
Relay Control, PWA, International	2213589-0055	77634450
Operator Control, PWA	2213589-0009	75895150
Power Amplifier, PWA	2213589-0011	75885950
Fixed Disk Package	2213589-0014	76204650
Data Head Assembly, Lower Surface	2213589-0017	75010102
Data Head Assembly, Upper Surface	2213589-0018	75010103
Servo Head Assembly	2213589-0019	75010105
Door Locked Switch	2213589-0030	94364401
Cartridge-In Switch	2213589-0031	75010140
Door Solenoid	2213589-0036	75883056
Inner Air Prefilter	2213589-0042	94364903
Front Panel Air Prefilter	2213589-0056	77604002
I/O Interface Board	2213589-0001	77680600
Control/Multiplexer Board	2213589-0002	77662133
Servo Coarse Board	2213589-0003	77666800
Servo Fine Board	2213589-0004	75886300
Read/Write Board	2213589-0005	75886350
Spindle	2213589-0012	75886281
Spindle Drive Motor	2213589-0016	75880125
Spin Speed Sensor Disk	2213589-0020	75880045
Static Ground Spring	2213589-0021	75887871
Velocity Transducer	2213589-0022	75894102
Magnet Assembly	2213589-0023	75886512
Carriage/Coil Assembly	2213589-0024	75880135

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Item	TI Part Number	Vendor Part Number
Spindle Drive Belt	2213589-0025	92314113
Spindle Drive Belt, International	2213589-0050	92314127
Solid State Relay (SSR)	2213589-0027	77610050
Spin Speed Sensor	2213589-0029	75885407
Heads Loaded Switch	2213589-0031	77610149
Retract Capacitor, C3	2213589-0040	75774471
Blower Motor Assembly	2213589-0015	75887510
Blower Motor Assembly, International	2213589-0053	75880126
Circuit Breaker, CB1	2213589-0026	15165895
RFI Filter	2213589-0028	75893326
RFI Filter, International	2213589-0054	75893325
Deck Down Switch	2213589-0032	77610143
Resistor, Wire Wound, R1	2213589-0034	75888775
Resistor, Wire Wound, R2-R4	2213589-0035	75888776
Capacitor C2	2213589-0037	95645628
Capacitor C4, Blower Motor Run	2213589-0038	76878900
Capacitor C5, Spindle Motor Run	2213589-0051	75738414
Capacitor C5, Spindle Motor Run, International	2213589-0052	76879006
Varistor	2213589-0039	75883006
Filter, Absolute	2213589-0041	75885996
Relay, K1	2213589-0043	77612660
Relay, K2	2213589-0044	22940808
Fuse, 10 A, 32 V	2213589-0045	24536203
Fuse, 6 A, 32 V	2213589-0046	24512930
Fuse, 1.25 A	2213589-0047	24512921

5

FD800 Flexible Disk Drive System

5.1 FD800 CRU FLEXIBLE DISK DRIVE

The FD800 flexible disk (Figure 5-1) is contained in a single or dual configuration that mounts in a standard EIA panel. Rackmount kits provide a pair of slides and accessory hardware for mounting the chassis in a standard 483-millimeter (19-inch) equipment cabinet or desk. Each chassis unit consists of a chassis with power supply that accommodates one or two drives. Up to four disk units can be operated from one FD800 controller.

There are two configurations of the FD800 flexible disk in the field, the previous production chassis and the new international chassis (sometimes referred to as the VDE chassis). A previous production FD800 chassis and an international chassis cannot be tied together with cables because the cables will not fit. The FD800 still uses a flat cable that cannot be extended.

Reference manuals for use with the FD800 are as follows:

- *Model 990 Computer Model FD800 Floppy Disk System Installation and Operation Manual* (previous production chassis), part number 945253-9701.
- *Model 990 Computer Model FD800 Floppy Disk System with International Chassis Installation and Operation Manual,* part number 2250697-9701.
- *Model 990 Computer Model FD800 Floppy Disk Controller Depot Maintenance Manual,* part number 945418-9701.
- *Shugart Floppy Disk SA800/801*, vendor number 50575-2.

5.2 FLEXIBLE DISK SYSTEM COMPONENTS

Components for the FD800 previous production chassis flexible disk system are listed in Table 5-1. Components for the FD800 international chassis flexible disk system are listed in Table 5-2.

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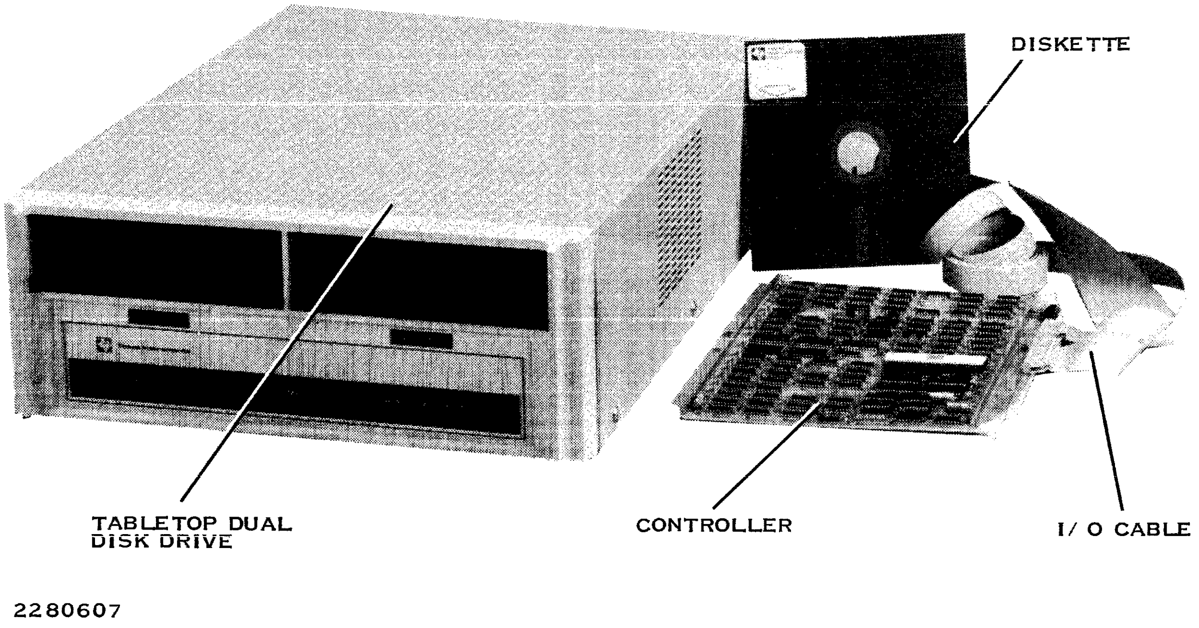

Figure 5-1. FD800 Disk System Components

Table 5-1. FD800 Flexible Disk System Components, Previous Production

Item	Part Number
FD Controller Assembly	945940-0001
Dual Chassis Cable Assembly	945951-0001
Quad Chassis Cable Assembly	945952-0001
Status Cable Assembly	945958-0001
Chassis Assembly (with Two Disk Drives):	
115 V, 60 Hz	945989-0002
230 V, 50 Hz	945989-0004
100 V, 50 Hz	945989-0006
Chassis Assembly (with One Disk Drive):	
115 V, 60 Hz	945989-0001
230 V, 50 Hz	945989-0003
100 V, 50 Hz	945989-0005
Tabletop Kit	945991-0001
Rackmount Kit:	
with Brackets	945996-0001
with Slides	945995-0002

Table 5-2. FD800 Flexible Disk System Components, International Chassis

Item	Part Number
FD Controller Assembly	945940-0001
Single Chassis Cable	2267294-0001
Dual Chassis Cable	2269928-0001
Tabletop Chassis Assembly:	
with One Drive	2267292-0001
with Two Drives	2267292-0002
Rackmount Chassis Assembly:	
with One Drive	2267291-0001
with Two Drives	2267291-0002

5.3 CARE OF FLEXIBLE DISKETTES

The flexible diskettes are made from flexible mylar. For an illustration of a diskette, refer to Section 6. When the diskette is not being used in the disk drive, it must be stored in its protective envelope. To protect the diskette, the same care and handling procedures specified for magnetic tape apply. These precautionary procedures are as follows:

- Return the diskette to its storage envelope when it is removed from the disk drive.
- Storage envelopes are designed to protect the disk. Replace envelopes when they become worn, cracked, or distorted.
- Do not touch the recording surface or attempt to clean it. Abrasions may cause the loss of stored data.
- Do not smoke while handling diskette. Head and disk contamination from a carelessly dropped ash can damage the diskette.
- Do not bend diskette or apply paper clips to edges.
- Do not expose diskettes to extreme heat, direct sunlight, or magnetic fields.
- Do not place diskettes on top of electrical equipment.
- Do not write on the plastic jacket with a lead pencil or ball point pen. Use a felt-tip pen.
- Diskettes required for immediate use should be stored in the operating environment.

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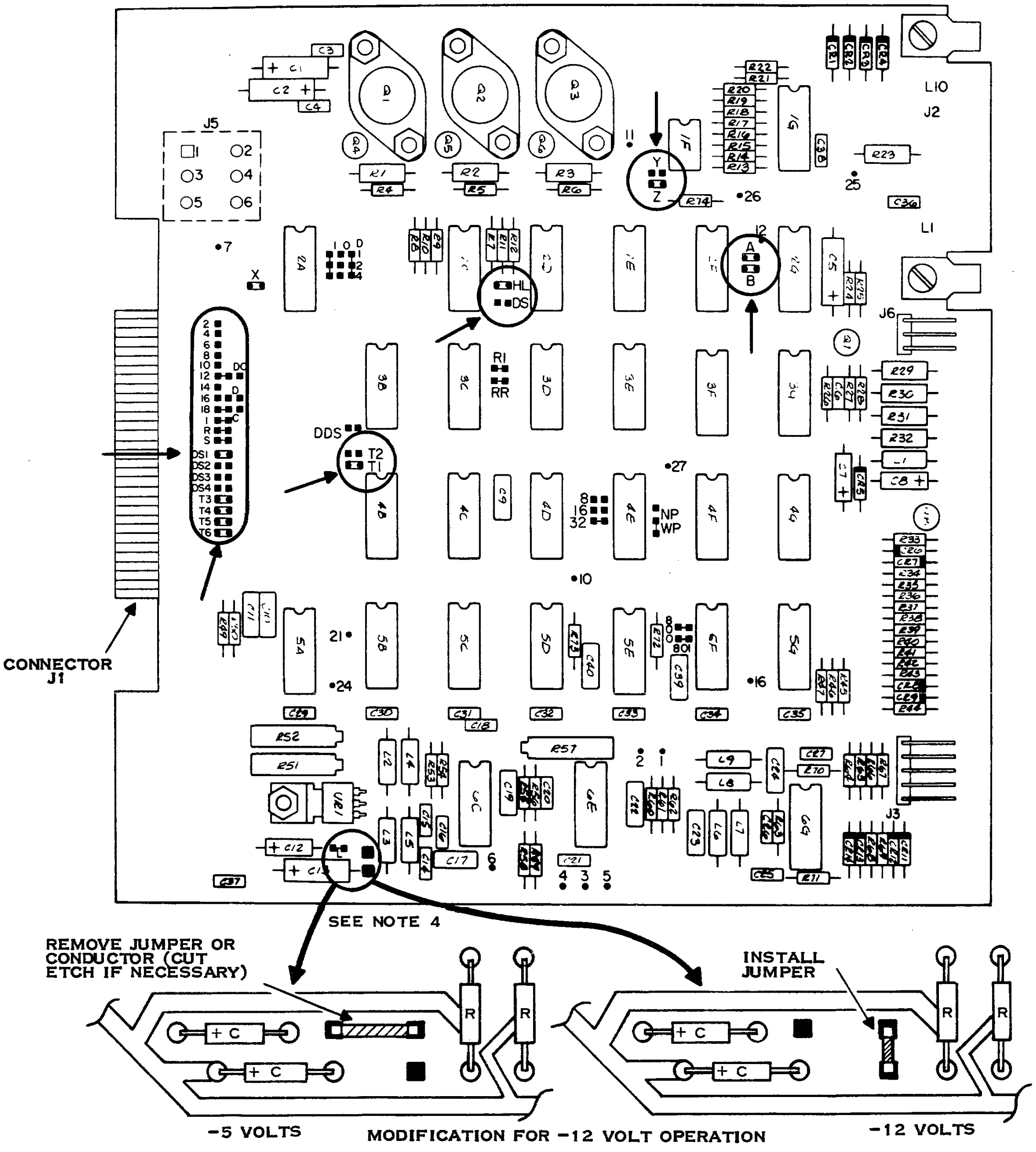
5.4 DISKETTE WRITE PROTECT NOTCH

A flexible diskette can be write-protected by means of a notch in the diskette jacket. The notch is located near the read/write access slot. When the notch is open, the diskette is protected from being written upon. When the notch is covered, writing is allowed. To allow writing, the hole is closed by placing a tab (tape) over the front of the notch. The tab is then folded over the edge of the diskette to cover the rear of the hole. The diskette can be write-protected by removing the tab.

5.5 FD800 DISK CONFIGURATION

The jumper configuration on the printed circuit board underneath the disk drive units is preset at the factory; alteration of the jumpers should not be necessary. However, if a disk drive is replaced, all jumpers on the new unit must be configured the same as the old one. Jumper plug configurations for the SSI version of the circuit card are shown in Figure 5-2. The installation of terminator plugs T1 through T6 and jumper plugs DS1 through DS4 is identical for both the SSI and LSI versions of the circuit card. The location of terminator plugs T1 and T2 is different for the LSI version of the circuit card. Figure 5-3 shows the location of the jumper and terminator plugs for the LSI version of the circuit card.



NOTES:

1. THE FOLLOWING JUMPERS ARE INSTALLED ON ALL DISK DRIVE UNITS:

   T2, A, B, C, DS, Z.

2. THE FOLLOWING TERMINATING JUMPERS ARE INSTALLED IN THE LAST DISK DRIVE UNIT IN THE DAISY-CHAIN SEQUENCE:

   T1, T3, T4, T5, T6.

3. ONE, AND ONLY ONE, DISK SELECT JUMPER, DS1 THROUGH DS4, IS INSTALLED TO IDENTIFY THE ASSIGNED NUMBER OF EACH DISK DRIVE IN THE SEQUENCE:

   DS1 - DISK DRIVE UNIT #1
   DS2 - DISK DRIVE UNIT #2
   DS3 - DISK DRIVE UNIT #3
   DS4 - DISK DRIVE UNIT #4

4. DISK DRIVE UNITS WITHIN CABINET ARE SUPPLIED WITH -12 VOLTS. DISK DRIVE UNITS IN TABLETOP CHASSIS ARE SUPPLIED WITH -5 VOLTS. VERIFY CORRECT JUMPER CONFIGURATION AS SHOWN ABOVE. ALL INTERNATIONAL CHASSIS USE-12V

2277055

Figure 5-2. Jumper Configuration for Disk Drive Units

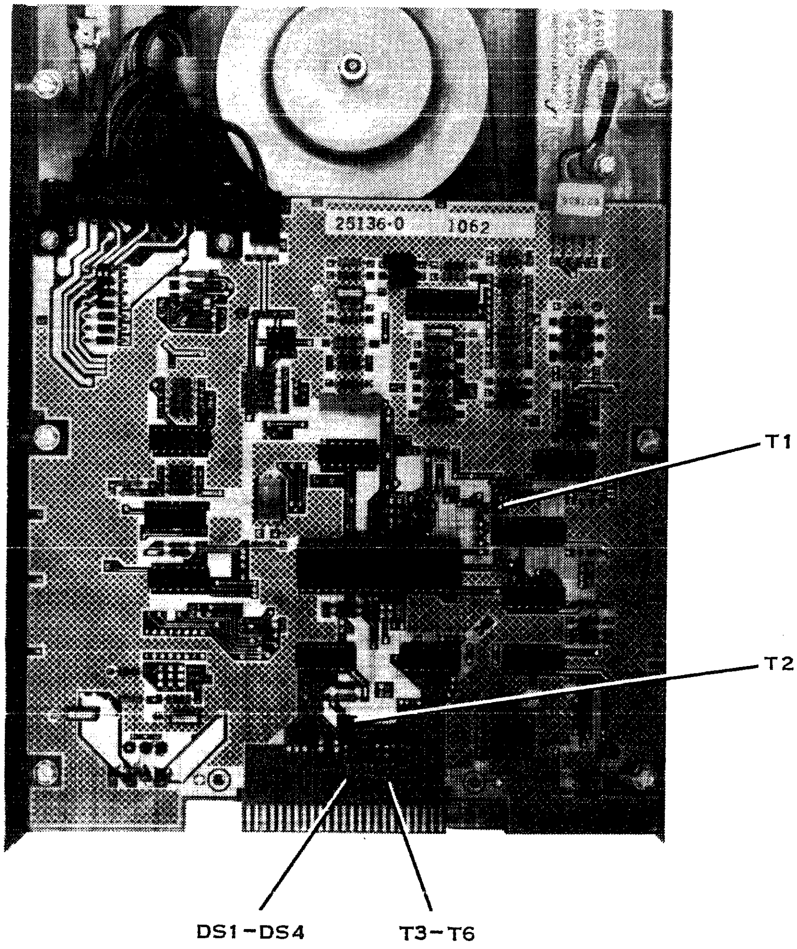


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Figure 5-3. Terminator and Jumper Plug Locations for LSI Circuit Card

5.6 FD800 DISK CONTROLLER CONFIGURATION AND SELF-TEST

The disk controller has a diagnostic self-test program. These diagnostics are initiated by any one of four actions:

- Initial power-up.
- Pressing the computer front panel RESET.
- Software initiation of the Reset command.
- Software power-up simulation.

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When the diagnostic tests are satisfied, the green LED lights. Any failure of the self-test will halt the test and display the failure mode on the red controller LEDs. The controller LEDs are shown in Figure 5-4.

Prior to troubleshooting, perform the following steps:

1. On the disk controller, verify that the jumpers are properly installed as follows:

   E1 - E2

   E3 - E4

   E5 - E6

2. Verify that jumper E11 - E12 is removed.
3. Check disk drive jumpers, Figure 5-2 or 5-3.
4. Install the controller on an extender board in the normal chassis slot and connect the interface cables.
5. Apply power to all equipment.
6. Verify that the green LED is lit after power-up.
7. Verify that the programmer panel is operative by pressing HALT, RESET, CLR and observing that the RUN and FAULT LEDs on the programmer panel extinguish. The green LED on the disk controller should flicker but remain on when the RESET switch is pressed.

On a routine basis or when the need arises, run the disk diagnostic program. The diagnostic can be executed without retries. This will allow the user to detect any degrading performance that would normally be corrected by retries in the controller firmware. The diagnostic can also perform a read-only test that allows the user to maintain a master written diskette for a standard reference.

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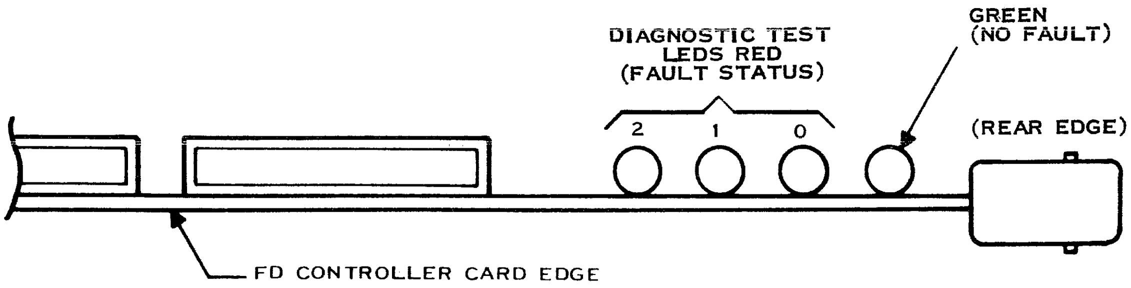

RED LED NO.			GREEN LED	FAULT STATUS
2	1	0		
OFF	OFF	OFF	OFF	BOARD POWER ,CLOCK ,ROM OR OTHER FAULT
OFF	OFF	OFF	ON	NO FAULT
OFF	OFF	ON	OFF	RAM FAILURE
OFF	ON	OFF	OFF	I/O CONTROL FAILURE
OFF	ON	ON	OFF	CRC DEVICE FAILURE
ON	OFF	OFF	OFF	BAD CRC ON WRITE
ON	OFF	ON	OFF	MARK DETECTION FAILURE
ON	ON	OFF	OFF	WRITE CIRCUIT FAILURE
ON	ON	ON	OFF	STATUS PORT OR MPU FAILURE

2277057

Figure 5-4. FD800 Controller Test Indicators

5.7 FLEXIBLE DISK SYSTEM CABLING INTERCONNECTIONS

Cabling for a dual disk drive system for the previous production chassis is shown in Figure 5-5. Cabling for a single or dual disk drive in an international chassis is shown in Figure 5-6. Cabling for four disk drives in international chassis is shown in Figure 5-7.

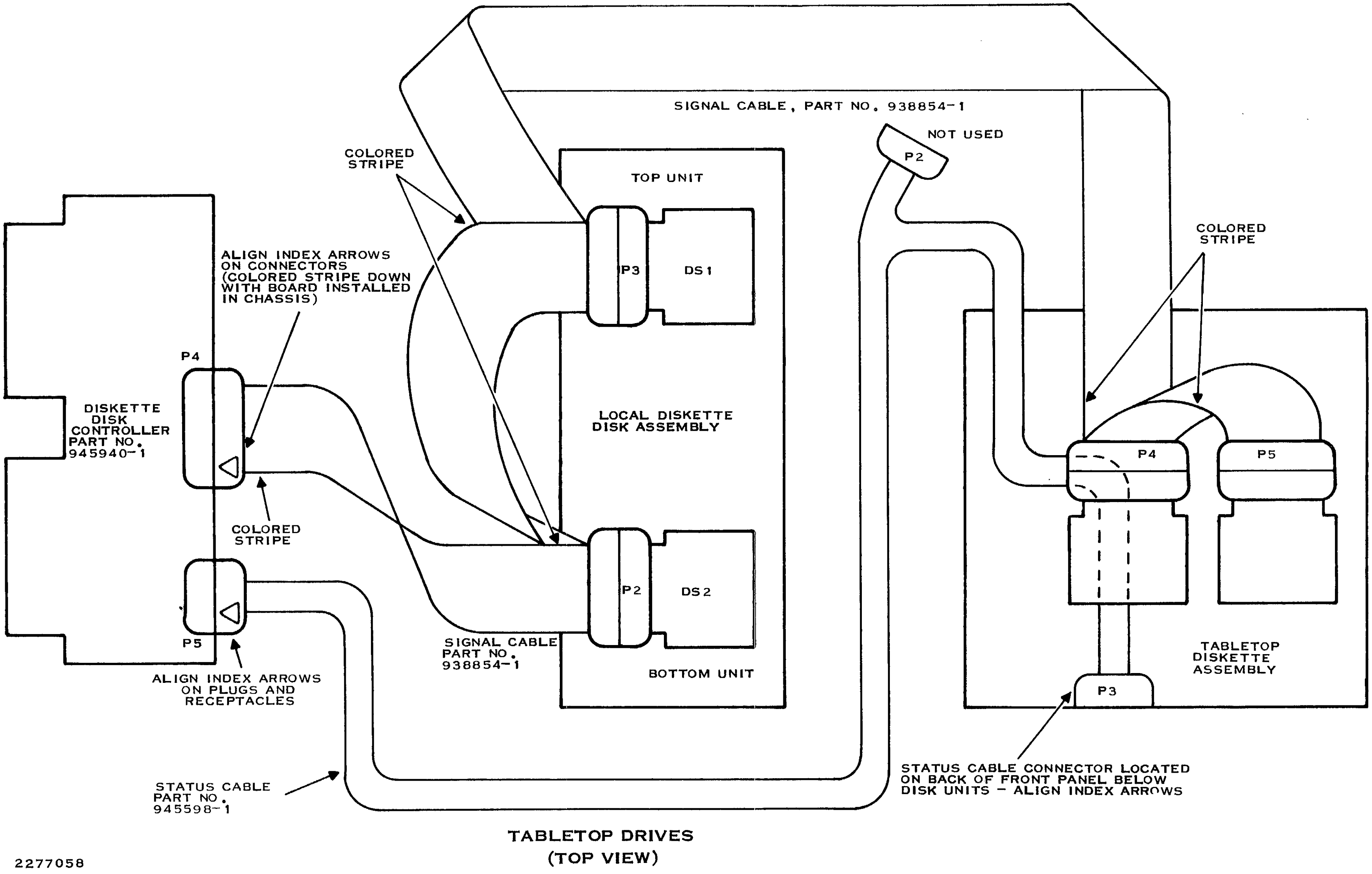

Figure 5-5. FD800 Previous Production Chassis Cabling

DD — Disk Drives

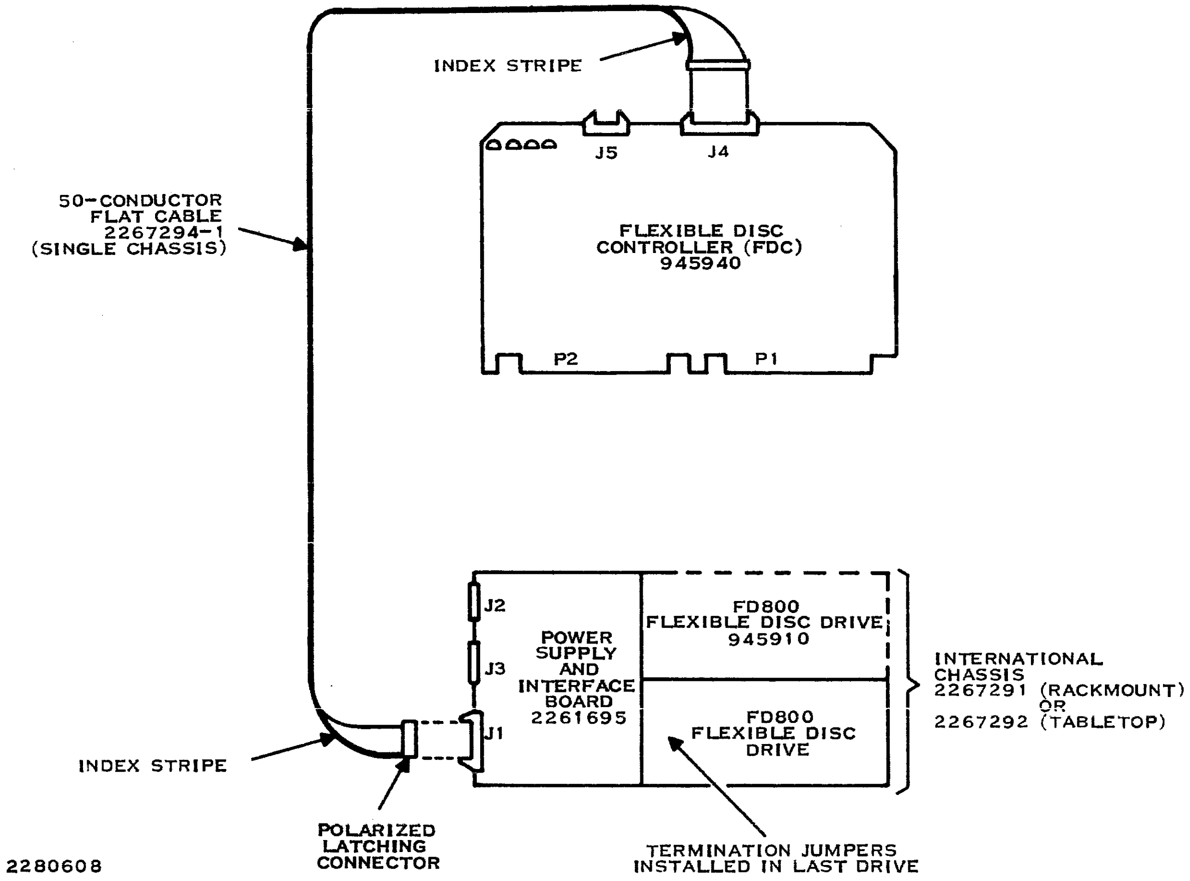

Figure 5-6. FD800 International Chassis Single or Dual Drive Cabling

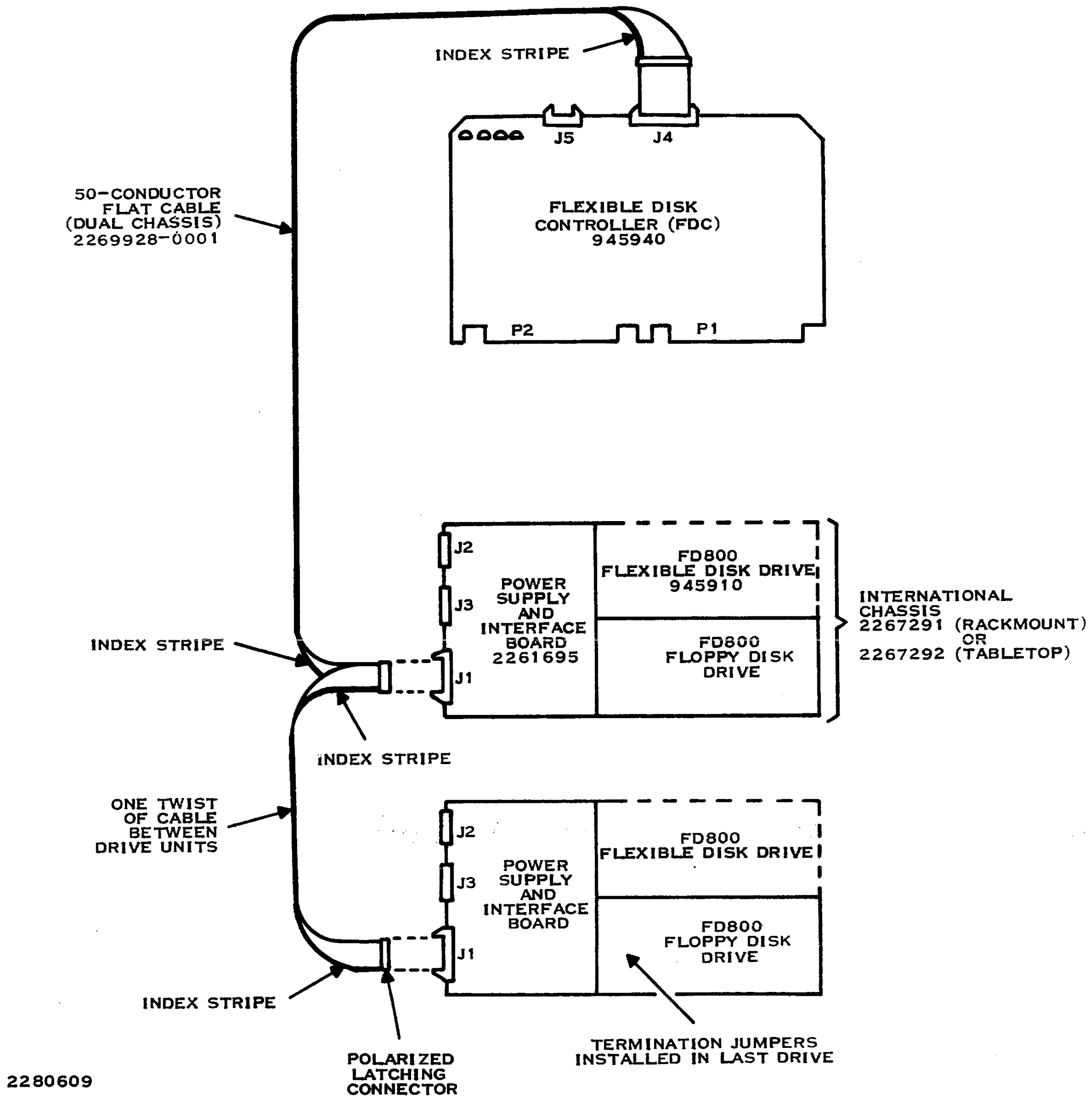

Figure 5-7. FD800 International Chassis, Four Drives Cabling

5.8 FIELD-REPLACEABLE COMPONENTS, FD800 FLEXIBLE DISK SYSTEM

The field-replaceable components are as follows:

Item	TI Part Number
Previous Production Chassis	
Controller PWB	0945940-0001
Power Supply Assembly	0945915-0004
Electronics PWB	0943842-0006
Status Panel PWB	0945986-0001
Flexible Disk Drive	0945910-0001
R/W Head Load Button	0943842-0028
Write Protect Detector	0943842-0027
Sector/Index LED Assembly	0943842-0014
Index/Sector Phototransistor Assembly	0943842-0017
Track 0 Detector Assembly	0943842-0001
Activity Light Assembly	0943842-0019
Door Closed Switch Assembly	0943842-0005
Belt (60 Hz)	0943842-0026
Cable, Dual Drive Assembly	0945951-0001
Cable, Quad Drive Assembly	0945952-0001
Cable, Status	0945958-0001
Power Cord	0975522-0001
Switch	0539760-0002
Fuse, 1/2 A	0410822-0014
Fuse, 20 A	0411787-0017
Fuse, 40 A	0411787-0019
International Chassis	
FD800 Flexible Disk Drive	0945910-0001
FD800 Controller PWB	0945940-0001
Power Supply	2261695-0001
Electronics PWB	0943742-0006
Air Filter	2265041-0001
Transformer	2267250-0001
Fan	2265012-0001
LED Power Indicator	0972479-0001
Cable, Single Chassis	2267294-0001
Cable, Dual Chassis	2269928-0001
Fuse, 3 A	0411787-0012
Programming Plug	2265046-0001
Power Cord	0996289-0001
Line Filter Assembly	2267252-0001
LED Indicator	2210461-0001

6

FD1000 Flexible Disk Drive System

6.1 FD1000 TILINE FLEXIBLE DSDD DISK DRIVE

The FD1000 flexible disk system (Figure 6-1) provides mass data storage for 990 computers with TILINE buses. FD1000 flexible disks operate with either double-sided, double-density (DSDD) diskettes or with IBM-compatible, single-sided, single-density (SSSD) diskettes. Single-sided diskettes are directly interchangeable between the FD1000 and FD800. The DSDD diskette stores 1.1 megabytes of data formatted in 288-byte sectors, 26 sectors per track, and 77 tracks per diskette.

There are two configurations of the FD1000 flexible disk system in the field, the previous production chassis and the new international chassis (sometimes referred to as the VDE chassis). The new FD1000 uses a round cable that can be extended to 300 feet. A previous production FD1000 chassis can be expanded with an international chassis for the third and fourth drives because both chassis connect directly to the controller. The old chassis would be connected by a flat cable and the international chassis by a round cable that can be extended. Reference manuals for use with the FD1000 are as follows:

- *Model 990 Computer Model FD1000 Flexible Disk System Installation and Operation Manual,* part number 2261886-9701.
- Model 990 Computer Model *FD1000 Flexible Disk System with International Chassis Installation and Operation Manual,* part number 2250698-9701.
- *Model 990 Computer Model FD1000 Flexible Disk System Field Maintenance Manual*, part number 945419-9703.
- *Model 990 Computer Model FD1000 Flexible Disk Controller Depot Maintenance Manual*, part number 2261885-9701.
- *Qume Data Trak 8 Product Specification*, vendor number 30006.

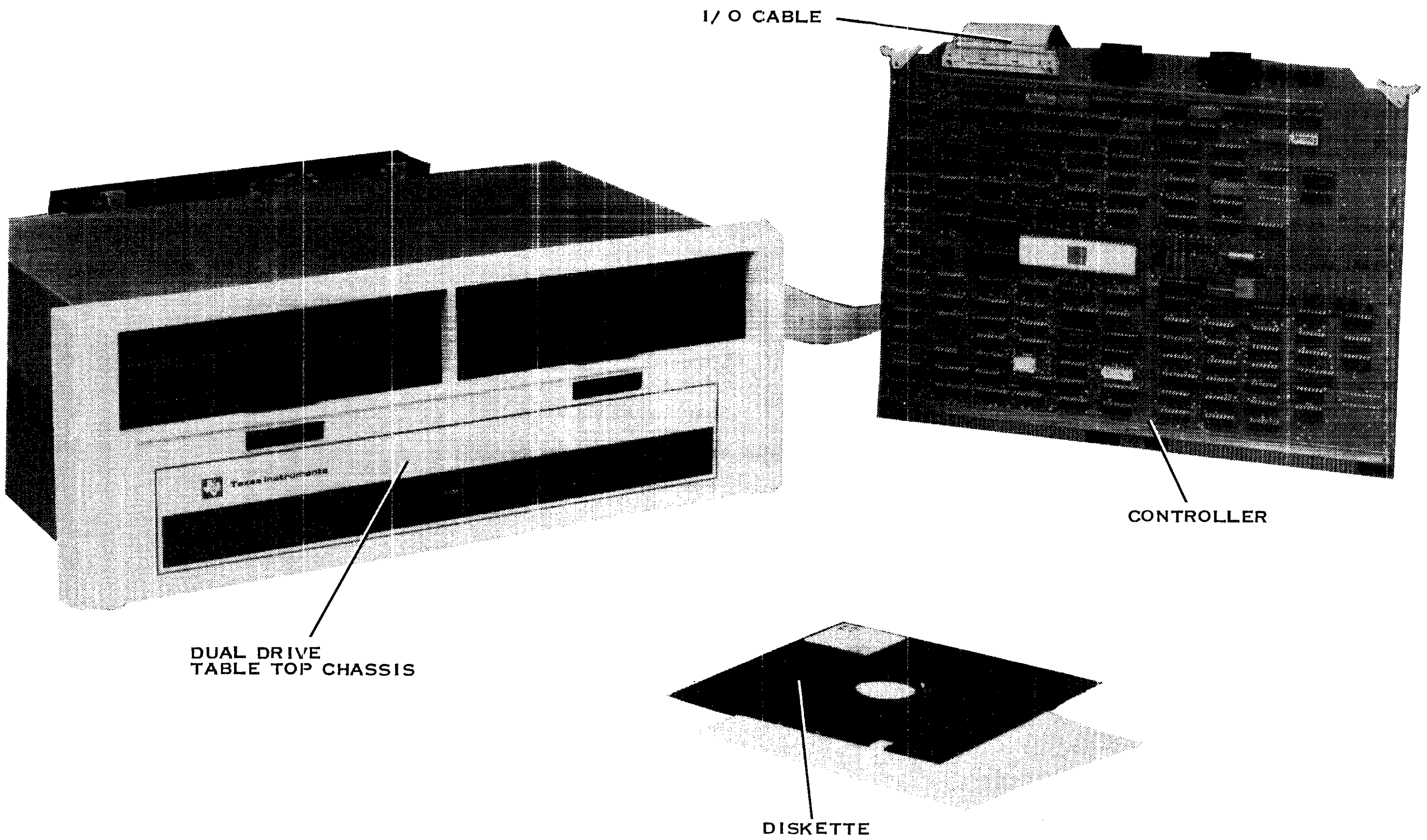

Figure 6-1. Model FD1000 Flexible Disk System

6.2 RECORDING MEDIA

The recording media is a 200-millimeter (7.88-inch) diameter flexible plastic disk (Figure 6-2) that is coated on one or both surfaces with a thin magnetic oxide coating. The disk is permanently encased in a 203-millimeter (8-inch) square plastic protective jacket. Inner surface coating in the jacket wipes the disk clean of dust as it rotates within the jacket. A large central cutout in the jacket allows the drive spindle to clamp the disk for rotation.

A manufacturer's tag identifies the top of the diskette, and is used to select the correct orientation for installing the diskette. Oval top and bottom cutouts allow the read/write heads access to the recording surface. The recording surface of an SSSD diskette, surface 0, is the bottom surface of the rotating disk. On a DSDD the lower surface is called surface 0 (to be consistent with the single-sided diskette) and the upper surface is surface 1.

A round cutout in the diskette jacket allows an optical transducer in the drive to generate a pulse when a smaller hole in the disk rotates past the cutout. This index pulse occurs once per revolution. It is used to verify that the disk is rotating, and it serves as a reference for formatting soft sectors on the disk.

The position of the index hole cutout in the diskette jacket identifies the type of diskette. As shown in Figure 6-2, the index hole cutout of an SSSD diskette is very close to the imaginary diskette center line that runs through the center of the oval recording cutout and the spindle center point. The cutout is displaced about 16 millimeters (5/8 inch) to the right of the center line for a DSDD diskette.

The FD1000 disk drive has index sensors at both positions. When the disk is spinning, these index sensors detect which index hole is present and determine the type of diskette being used. A diskette-type status signal from the disk drive to the controller selects the correct recording format.

A diskette can be write-protected using the notch or hole in the diskette jacket 57 millimeters (2.25 inches) from the read/write head access slot. If the hole is open, the disk is write-protected, and may not be written upon. A small tab (supplied with a pack of diskettes) may be taped over the hole or notch to enable writing on the diskette.

6.2.1 Care of Flexible Diskettes

The diskettes are made from flexible mylar. For an illustration of a diskette, refer to Figure 6-2. When the diskette is not being used in the disk drive, it must be stored in its protective envelope. To protect the diskette, use the same care and handling procedures specified for magnetic tape. These precautionary procedures are as follows:

- Return the diskette to its storage envelope when it is removed from the disk drive.
- Storage envelopes are designed to protect the disk. Replace envelopes when they become worn, cracked, or distorted.
- Do not touch the recording surface or attempt to clean it. Abrasions may cause the loss of stored data.

DD — Disk Drives

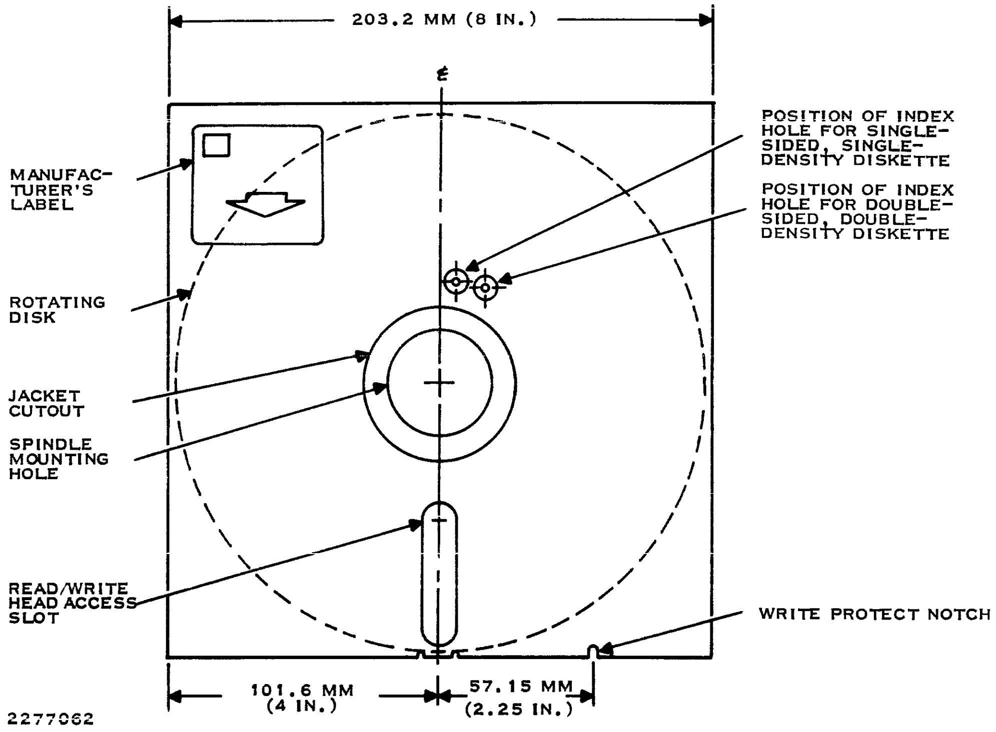

Figure 6-2. Single-Sided and Double-Sided Diskettes

- Do not smoke while handling diskettes. Head and disk contamination from a carelessly dropped ash can damage the diskette.
- Do not bend diskettes or apply paper clips to edges.
- Do not expose diskettes to extreme heat, direct sunlight, or magnetic fields.
- Do not place diskettes on top of electrical equipment.
- Do not write on diskette plastic jackets with a lead pencil or ball point pen. Use a felt tip pen.
- Diskettes required for immediate use should be stored in the operating environment.

6.3 DISK DRIVE CONFIGURATION

Figure 6-3 is a bottom view of the FD1000 (Qume DT/8) disk drive unit with the electronics board in place. The drive select jumper position and the presence or absence of the line terminators (Figure 6-4) are the options that commonly require checking or altering in the field. There are two versions of the Qume DT/8 drive electronics board. The early production version is shown in Figure 6-5, and the current production version (identified by the word "QUME") is shown in Figure 6-6. Following is a list of jumper options required for use in a Texas Instruments FD1000 system:

Push-On or Wire-Wrap Jumpers Added

DL = Door Lock

2S = Two-Sided

DC = Disk Change

DS1 = Drive Select 1 (or DS2, DS3, or DS4 jumpers, as specified)

J1-18 to adjacent unlabeled header pin toward D = Head Load to In Use (current production)

Soldered-In Jumpers Added

Jumper W = Head Load Latch (current production)

IC 2G pin 8 to IC 1D pin 5 = Head Load Latch (early production)

J1-18 (square pad between jumper C and J1-18) to IC 1D pin 3 = Head Load to In Use (early production)

IC 3F pin 10 to IC 3F pin 7 = Ready 1 always true (early production)

Jumper S1 = Side Select controlled by Direction

Traces Cut

S2 = Side Select

SS = Ready 1 always true (current production)

B = Head-Load Option (part of plug-in jumper module)

HL = Head Load (part of plug-in jumper module)

C = Head-Load Option (between square pad and jumper C, early production)

DD — Disk Drives

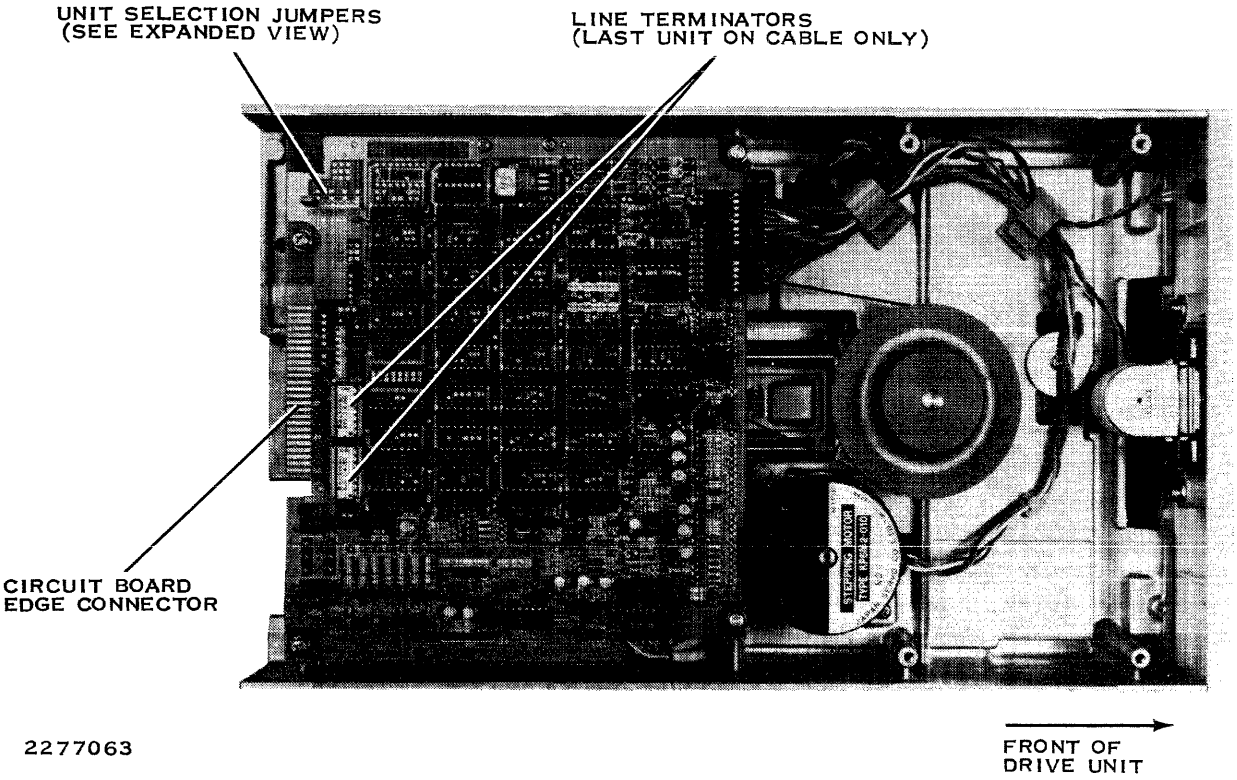

Figure 6-3. Disk Drive Unit, Bottom View

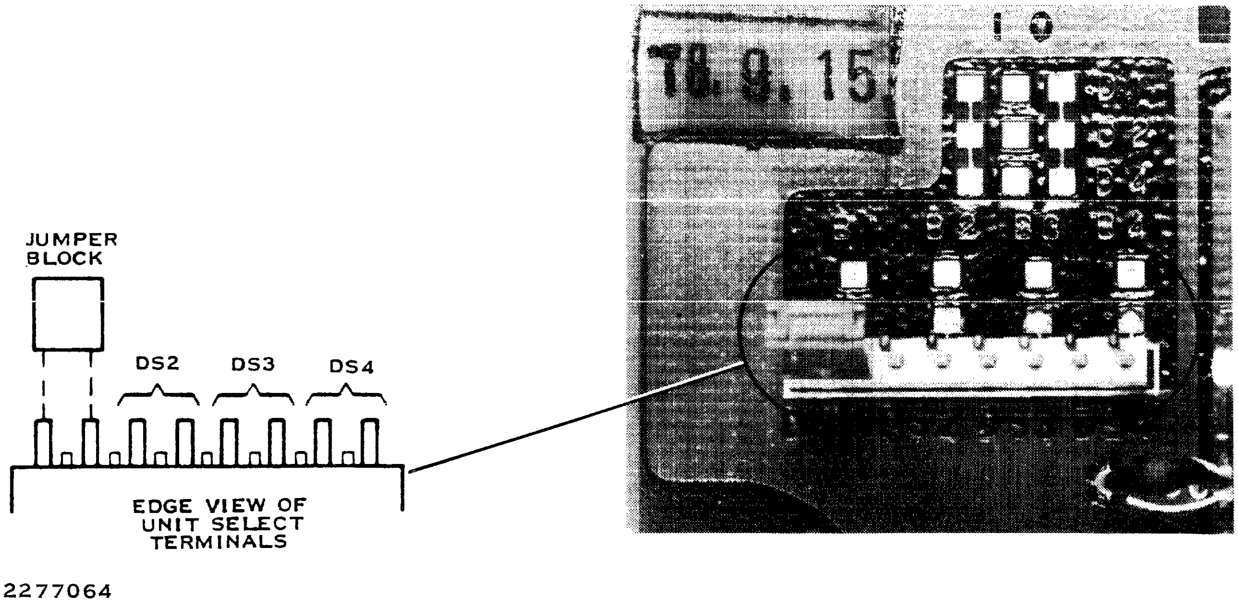

Figure 6-4. Disk Select Jumpers, Disk Circuit Board

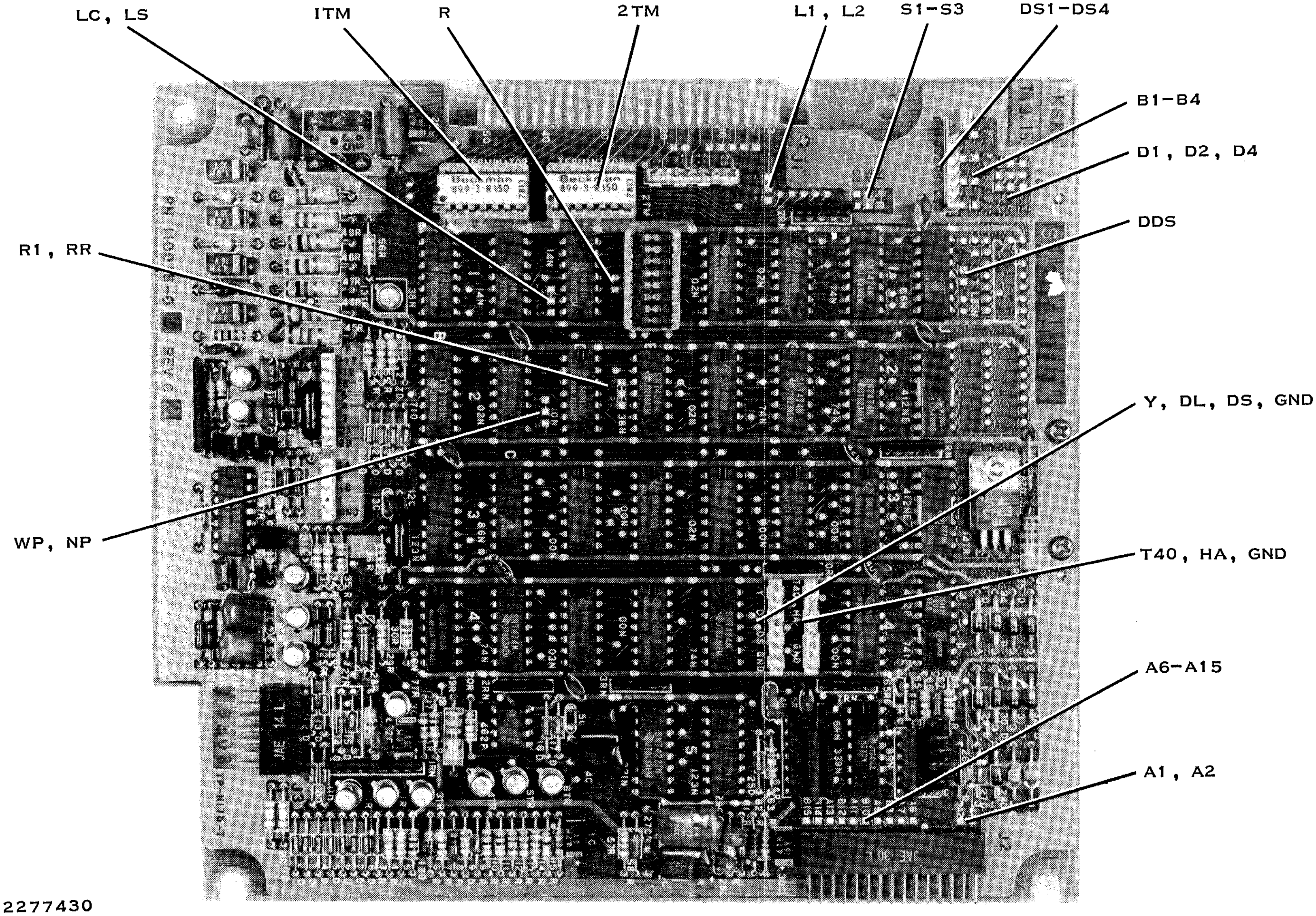

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Figure 6-5. FD1000 Disk Circuit Board (Early Production)

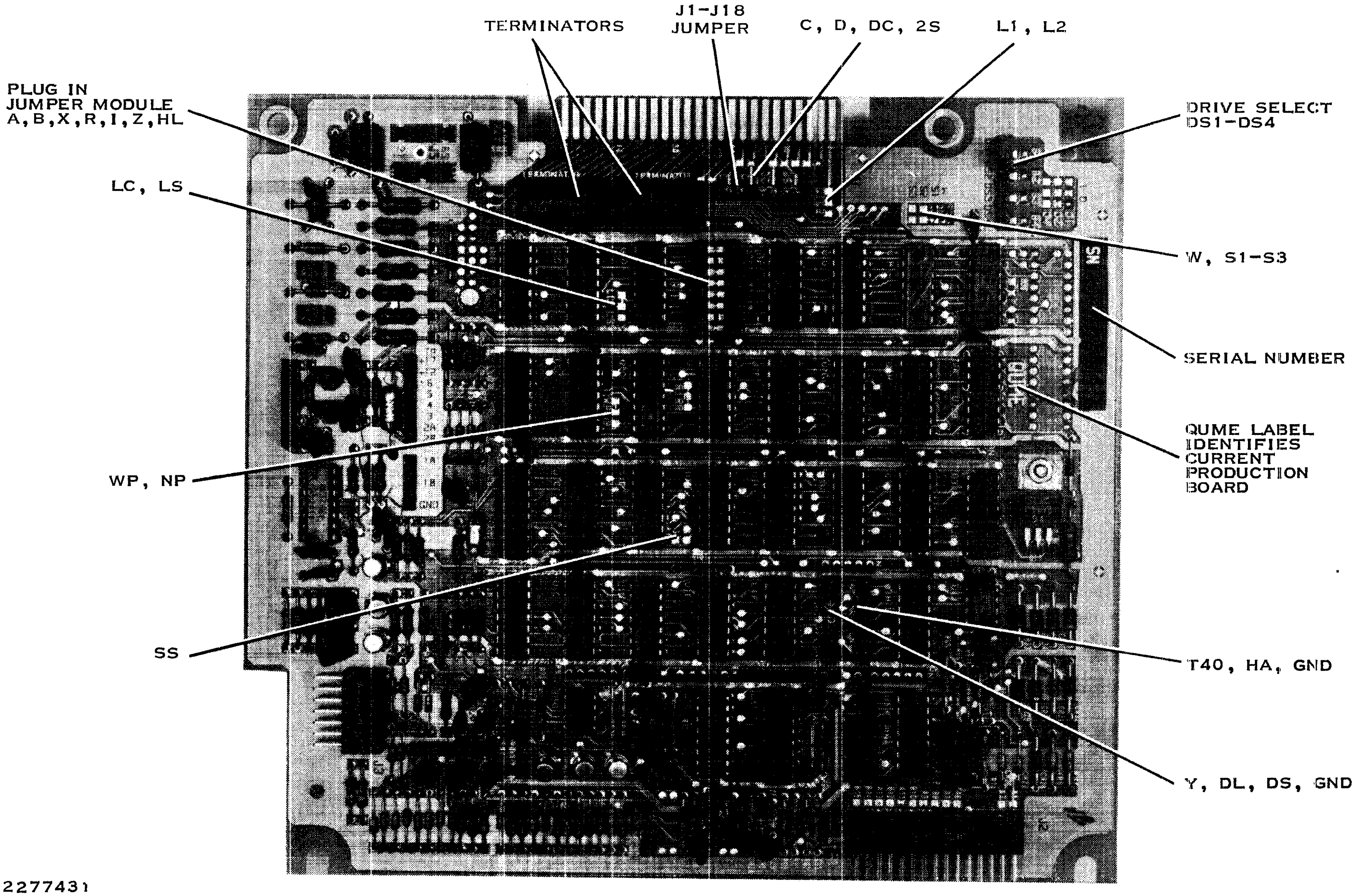


Figure 6-6. FD1000 Disk Circuit Board (Current Production)

6.4 DISK CONTROLLER CHARACTERISTICS

The disk controller (Figure 6-7) has a row of LEDs on the upper right edge of the circuit board that provides a quick method of determining controller status. In general, these indications apply only to the internal operating state of the controller; they do not provide information about the condition of the drive units. The LEDs are as follows:

- FAULT — This LED is turned on at the beginning of the controller self-test and remains on until cleared by successful completion of the test. This is a matter of one or two seconds. Failure of the self-test leaves the FAULT indicator lit and inhibits any operation that involves reading from or writing to the disk unit. An I/O reset or power-up reset initiates the self-test. If the self-test fails, the hardware interface or controller could be at fault.

- INT — The interrupt LED is used to display the state of the interrupt line from the disk controller to the 990 computer. When this indicator is lit (green), the controller has issued an interrupt and the computer has not yet responded. Interrupts are issued and answered so fast that the eye cannot detect the indicator flash. If the indicator is brightly lit, an error has occurred, leaving the controller hung in the interrupt-active condition.

- BUSY — The BUSY LED is used to tell when the controller is executing a command. When the light is extinguished, the controller is not executing any commands and is cycling on its internal idle loop. When the controller is executing a command, the BUSY light will illuminate and stay on until the command is complete. The apparent brightness of this indicator is quite variable depending on the type of operation being performed.

- CLK — The clock indicator remains lit at all times except when the TILINE master access logic of the controller is controlling a TILINE data transfer. This indicator is not affected by the transfer of the eight control words to the controller or by TILINE traffic not involving the controller.

6.4.1 TILINE Base Address Switch Settings

The TILINE base address for the disk controller is determined by the setting of a 5-section DIP switch at the lower left of the circuit board. Figure 6-8 is a drawing of the switch and a table that shows the 20-bit TILINE address and the corresponding CPU byte address for each switch setting.

NOTE

> Before issuing any commands to the FD1000, particularly after a power-up or I/O reset has occurred, a store registers command should be performed so that the controller will interrogate the index sensor to identify the type of diskette in the drive.

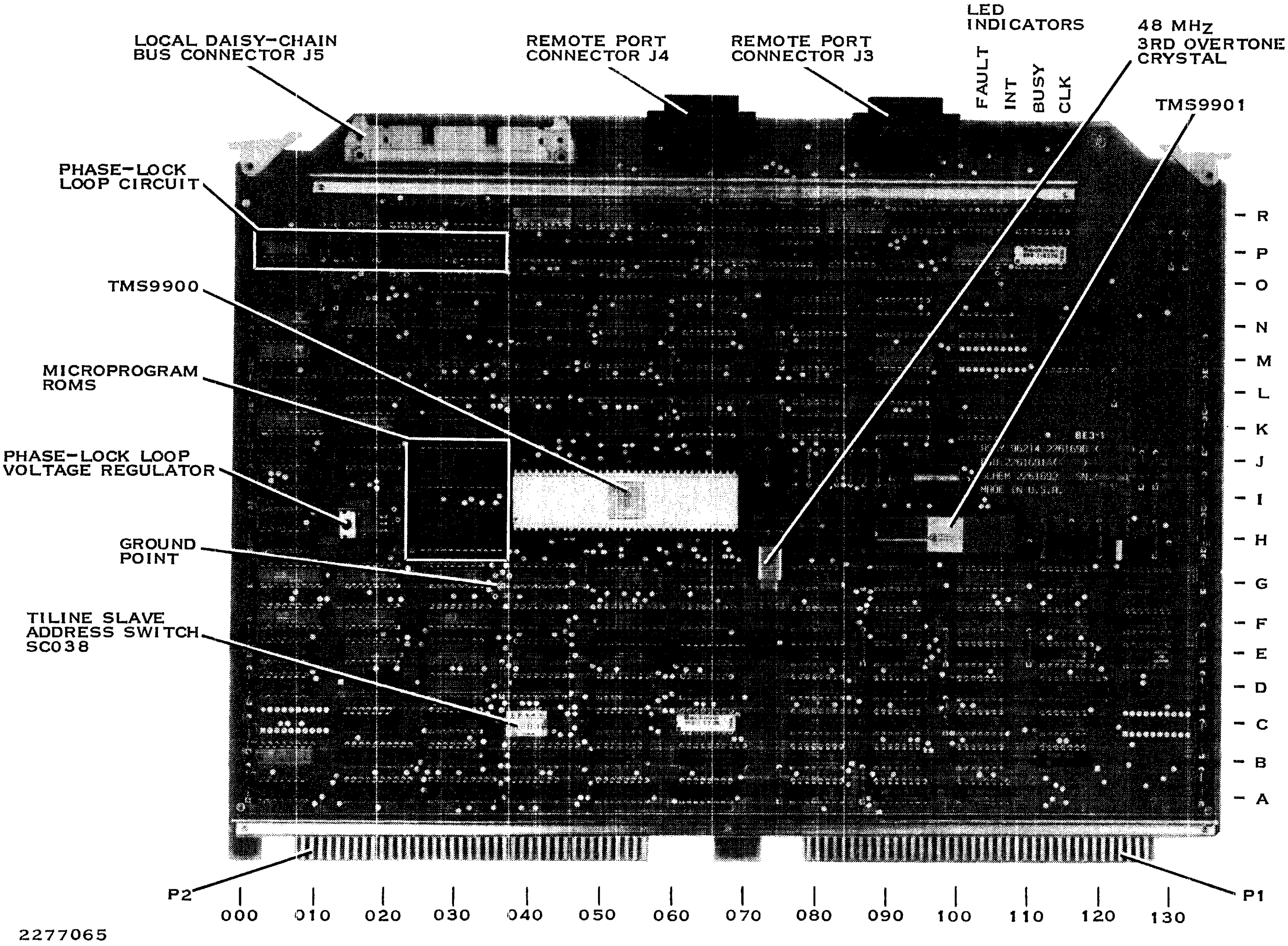
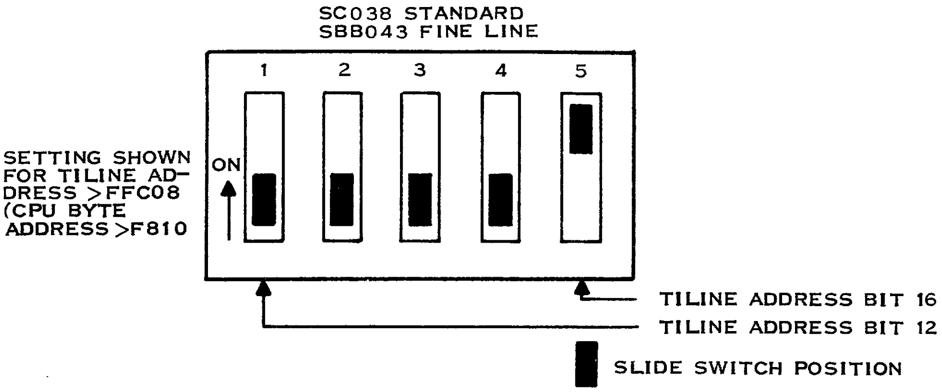


Figure 6-7. FD1000 TILINE Flexible Disk Controller (TFDC) Board



HEXADECIMAL ADDRESS		TILINE ADDRESS SWITCHES				
TILINE	CPU BYTE	1	2	3	4	5
FFC00	F800	OFF	OFF	OFF	OFF	OFF
FFC08	F810	OFF	OFF	OFF	OFF	ON
FFC10	F820	OFF	OFF	OFF	ON	OFF
FFC18	F830	OFF	OFF	OFF	ON	ON
FFC20	F840	OFF	OFF	ON	OFF	OFF
INCREMENTS OF >08	INCREMENTS OF >10			STRAIGHT BINARY SEQUENCE		
FFCF0	F9E0	ON	ON	ON	ON	OFF
FFCF8	F9F0	ON	ON	ON	ON	ON

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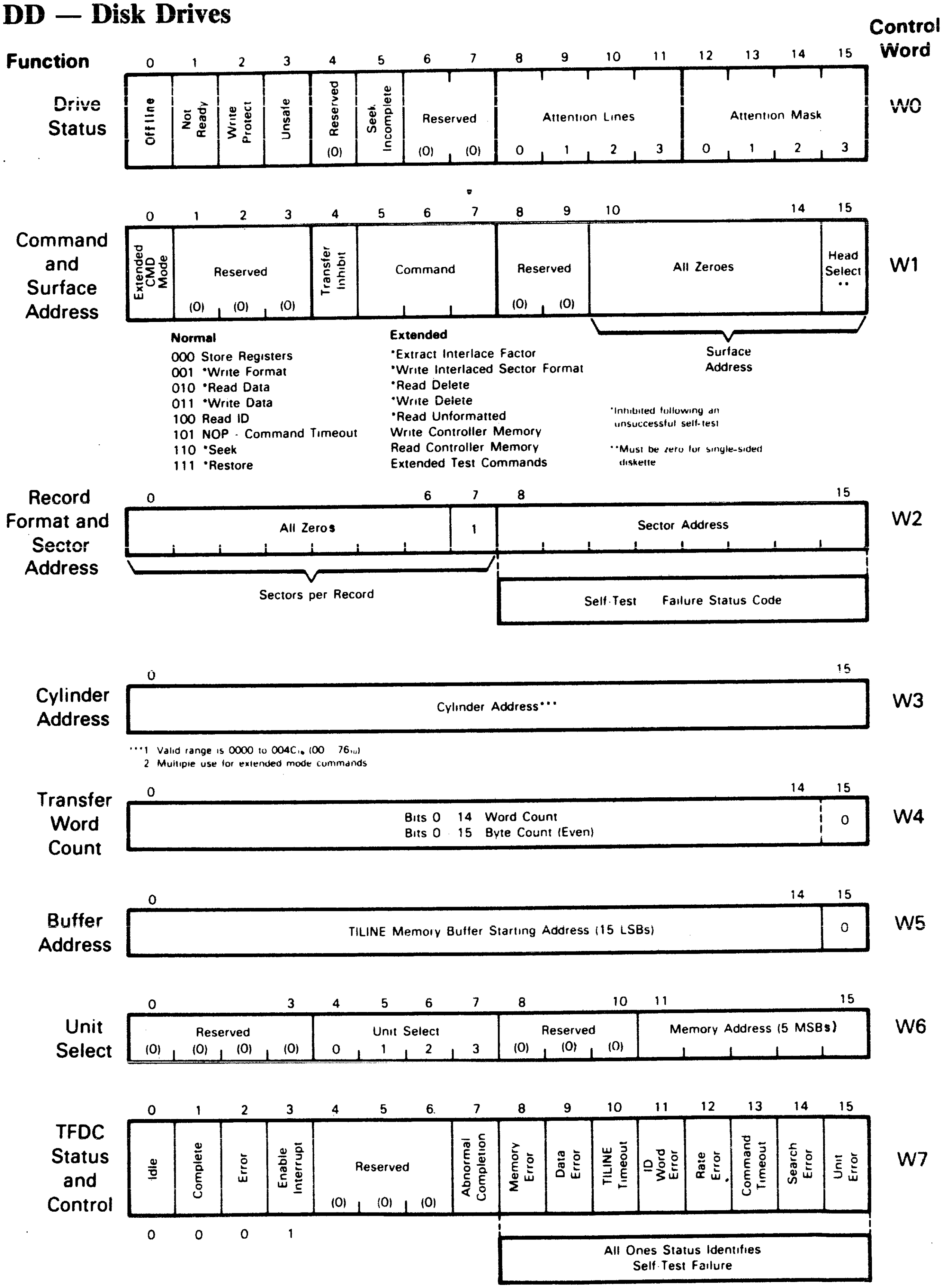
Figure 6-8. TILINE Base Address Switch Settings for the FD1000 Controller

6.5 CONTROL AND STATUS WORDS

Figure 6-9 shows the formats of the control and status words. The control words initially supplied to the controller are modified during the course of the operation. At the completion of the operation, the control words contain status information that may be read by the 990 CPU to determine if the operation completed normally. If an error occurred during the operation, the status words help identify the cause of the error.

DD — Disk Drives



Normal

000 Store Registers
001 *Write Format
010 *Read Data
011 *Write Data
100 Read ID
101 NOP - Command Timeout
110 *Seek
111 *Restore

Extended

*Extract Interlace Factor
*Write Interlaced Sector Format
*Read Delete
*Write Delete
*Read Unformatted
Write Controller Memory
Read Controller Memory
Extended Test Commands

*Inhibited following an unsuccessful self-test

**Must be zero for single-sided diskette

***1 Valid range is 0000 to 004C$_{16}$ (00 76$_{10}$)
2 Multiple use for extended mode commands

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Figure 6-9. FD1000 Controller Control and Status Words

6.6 DISK SYSTEM CABLING CONFIGURATIONS

There is one local (daisy-chain) input/output connector and two remote (radial) input/output connectors on the upper edge of the controller board. A number of different system configurations are supported. The cabling conventions for the previous production chassis systems are shown in Figures 6-10, 6-11, and 6-12. Cabling conventions for the FD1000 international chassis systems are shown in Figures 6-13 and 6-14.

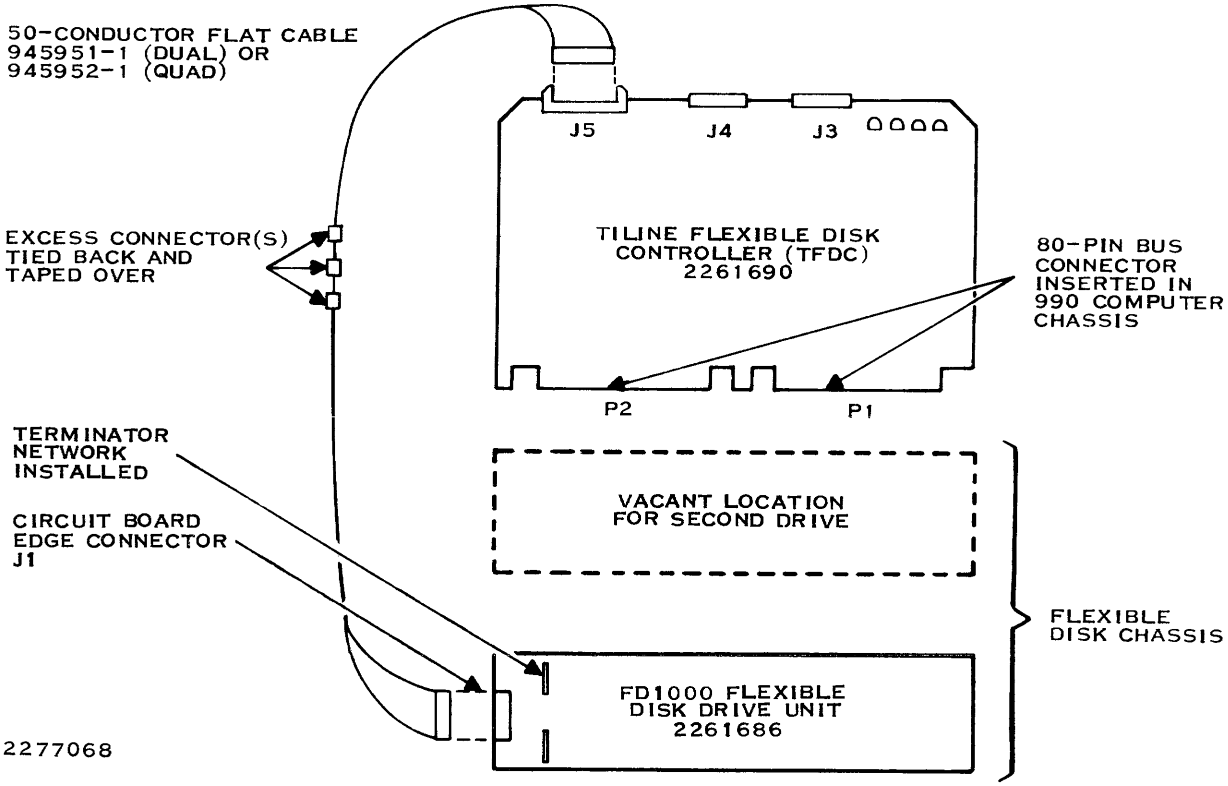

Figure 6-10. FD1000 Previous Production System Cabling, Single Drive

DD — Disk Drives

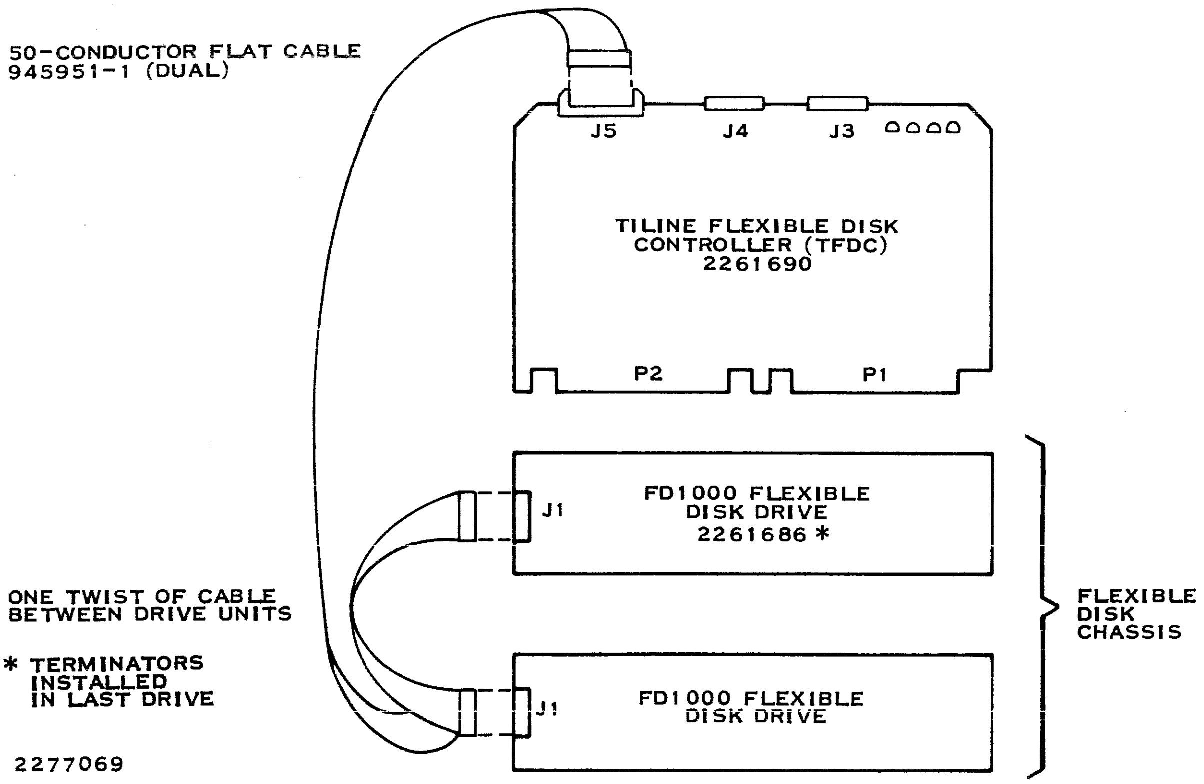

Figure 6-11. FD1000 Previous Production System Cabling, Dual Drives

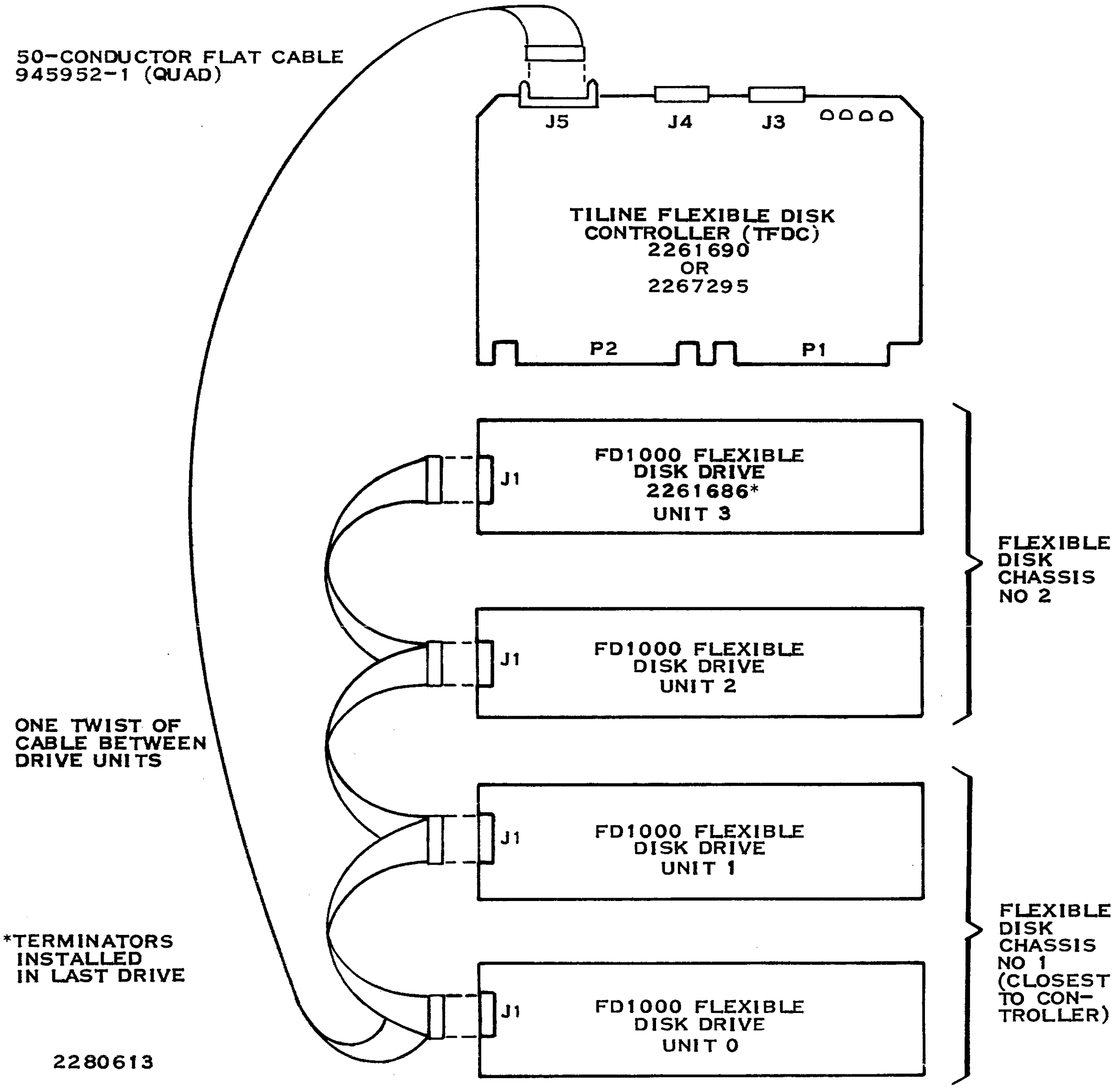

Figure 6-12. FD1000 Previous Production System Cabling, Four Drives

DD — Disk Drives

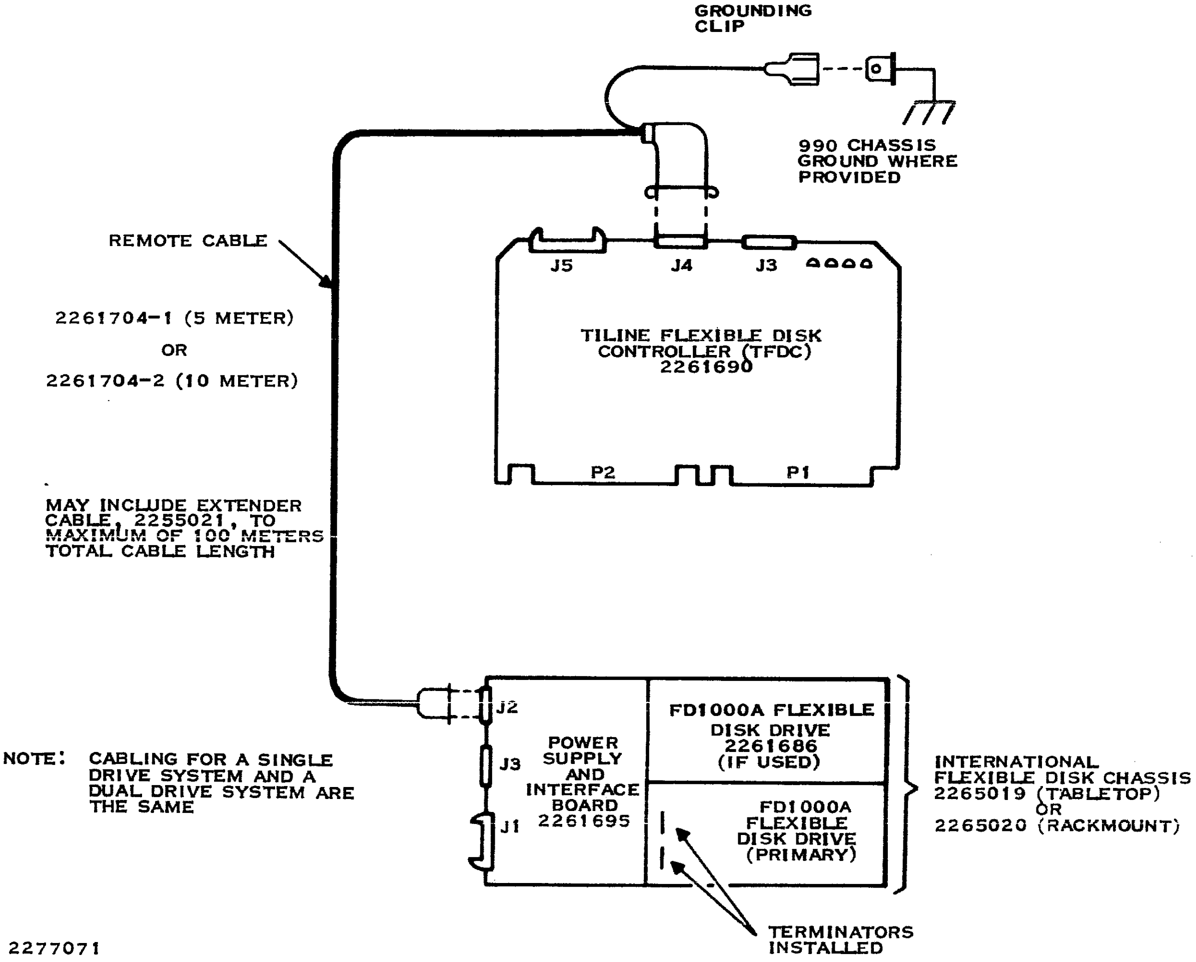

Figure 6-13. FD1000 International System Cabling, Single or Dual Drives

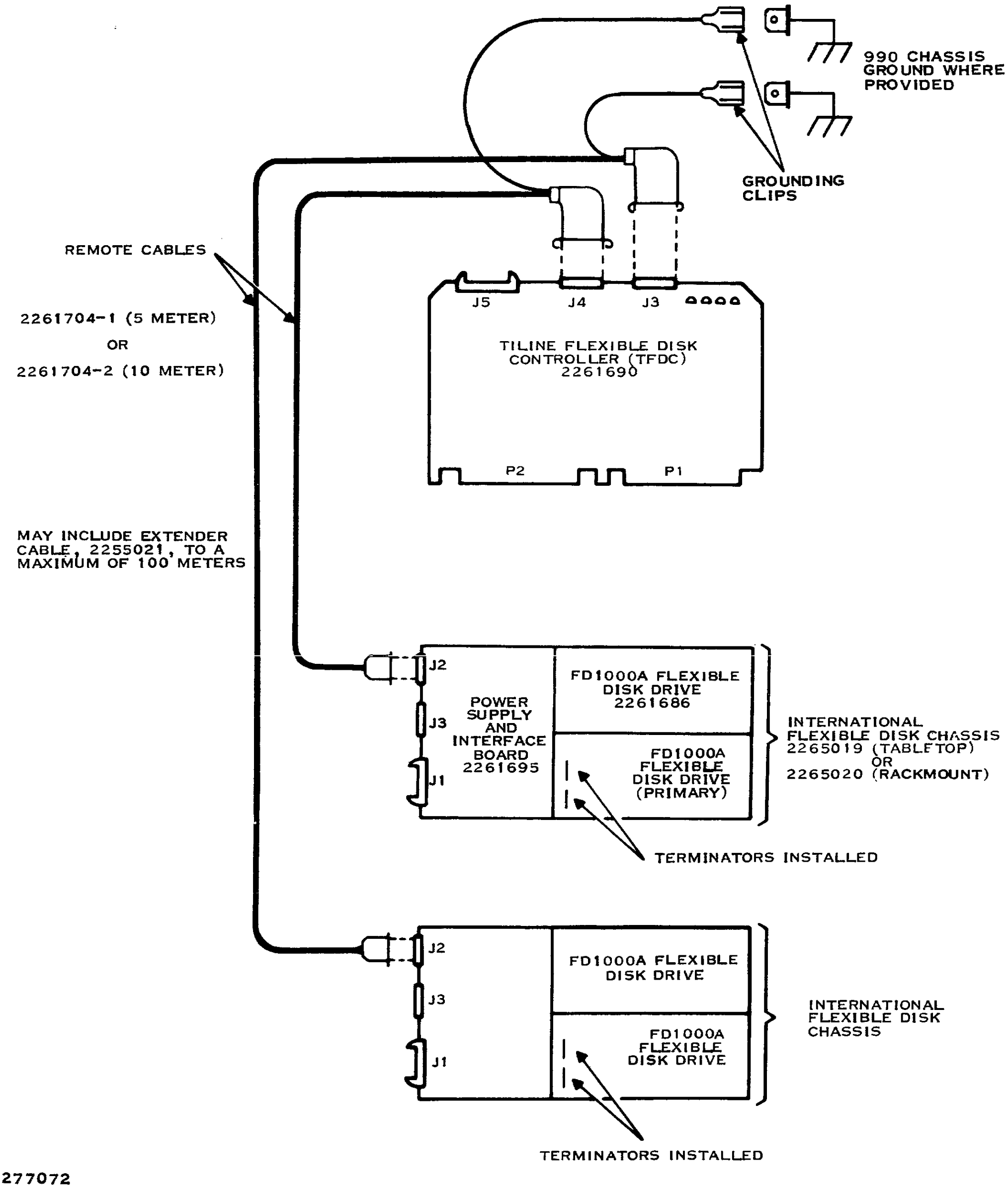

Figure 6-14. FD1000 International System Cabling, Four Drives

DD — Disk Drives

6.7 FIELD-REPLACEABLE COMPONENTS, FD1000 FLEXIBLE DISK

The field-replaceable components for the FD1000 disk drive system are as follows:

Item	TI Part Number
FD1000 with Previous Production Chassis	
FD1000 Disk Drive	
100 V, 60 Hz	2261686-0004
100 V, 50 Hz	2261686-0005
115 V, 60 Hz	2261686-0006
220/240 V, 50 Hz	2261686-0007
115 V, 50 Hz	2261686-0008
Controller Board (TFDC)	2261690-0001
Power Supply	
115 V, 60 Hz	0945915-0004
230 V, 50 Hz	0945915-0005
100 V, 50/60 Hz	0945915-0006
Cooling Fan	0947512-0003
Interface Cable	
Dual Drive	0945951-0001
Quad Drive	0945952-0001
Diskette	
DSDD	2261687-0001
SSSD	0945965-0001
Line Fuse	
100/115 V Units	0411787-0017
220/240 V Units	0410822-0019
FD1000 with International Chassis	
FD1000 Disk Drive	
100 V, 60 Hz	2261686-0004
100 V, 50 Hz	2261686-0005
115 V, 60 Hz	2261686-0006
220/240 V, 50 Hz	2261686-0007
115 V, 50 Hz	2261686-0008
Controller Board (TFDC)	2261690-0001
Power Supply/Interface	2261695-0001
Transformer	2267250-0001
AC Power Module Assembly	2265040-0001
Line Filter Assembly	2267252-0001
Cooling Fan, 50/60 Hz	0972479-0001
Interface Cable	
5 Meter	2261604-0001
10 Meter	2261604-0002

DD — Disk Drives

Item	TI Part Number
Extender Cable	
8 Meter	2265021-0001
15 Meter	2265021-0002
30 Meter	2265021-0003
60 Meter	2265021-0004
90 Meter	2265021-0005
Diskette	
DSDD	2261687-0001
SSSD	0945965-0001
Line Fuse	
110/115 V (3 A)	0411787-0012
220/240 V (1.5 A)	0411787-0015
LED Power Indicator	2210461-0001
Air Filter	2265041-0001
Programming Plug	2265046-0001

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979A Magnetic Tape Transport

1.1 979A MAGNETIC TAPE SYSTEM

The 979 magnetic tape system (Figure 1-1) provides facilities for serial-access mass data storage for 990 computers. The system consists of a controller, up to four 979A tape transports, a terminator, and interconnecting cables.

Reference manuals for use with the 979A magnetic tape system are as follows:

- *Model 990 Computer Model 979A Magnetic Tape System Installation and Operation Manual*, part number 946229-9701.
- *979A Tape Transport Subsystem Maintenance Manual*, part number 949613-9701.
- *Model 979A Tape Transport Installation and Operation Manual*, part number 949612-9701.
- *Model 990 Computer Peripheral Equipment Field Maintenance Manual*, part number 945419-9701
- *Model 990 Computer Model 979A Tape Controller Depot Maintenance Manual*, part number 946237-9701.

1.2 TAPE TRANSPORT CONTROLS AND INDICATORS

The control panel for the tape transport is shown in Figure 1-2. Controls and indicators are defined in Table 1-1.

MT — Magnetic Tape

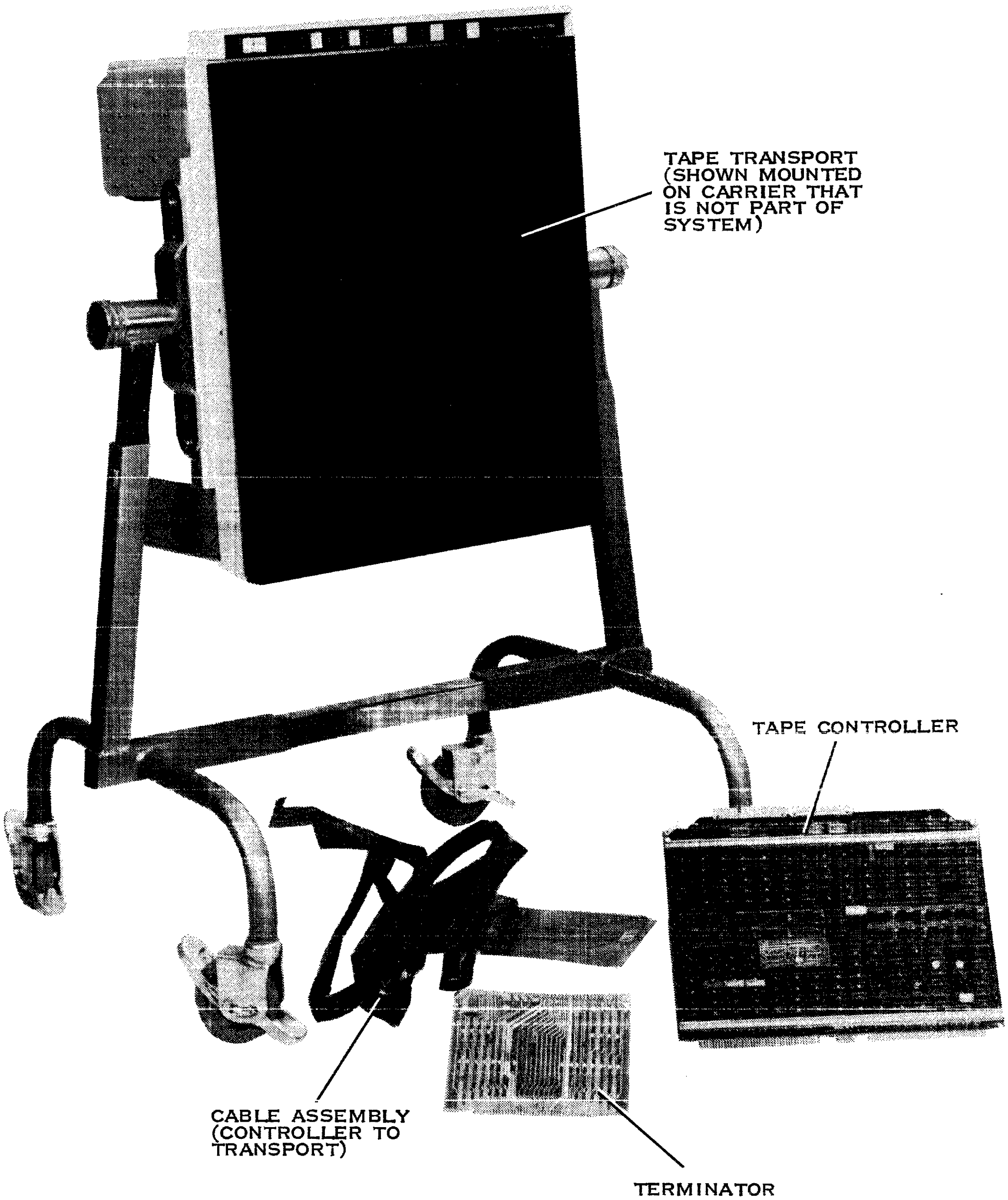

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Figure 1-1. 979A Magnetic Tape System Components

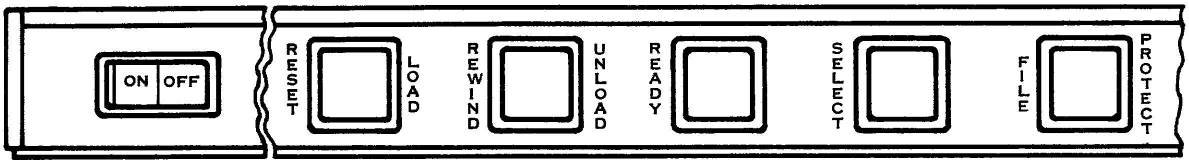

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Figure 1-2. 979A Tape Transport Control Panel

Table 1-1. 979A Controls and Indicators

Control	Function
ON/OFF	This switch turns ac power on and off to the tape transport.
RESET/LOAD	The RESET switch stops tape motion, takes the transport out of the remote mode (offline), and enables local control. After tape reels are installed and tape is threaded, the LOAD switch initiates the automatic loading action. Tape is pulled into the vacuum column, and the transport drive automatically searches and positions the tape at the beginning of tape (BOT) marker. If the BOT marker is positioned too near the BOT sensor to permit sufficient tape to load the lower vacuum loop, BOT sensing will precede vacuum column sensing and the tape electronics will lock out further tape motion. To recover, press RESET switch, move tape forward so that the BOT marker is on the take-up reel side of the BOT sensor, and reinitiate the LOAD sequence. If the tape is loaded, the LOAD switch will reestablish remote mode. While the transport is in the unload mode, the RESET/LOAD switch will not stop the unload operation after the BOT marker has been sensed.
REWIND/ UNLOAD	The REWIND switch initiates a high-speed (3.81 meters, 150.0 inches per second) tape rewind onto the supply reel. Rewind is terminated by sensing and automatically positioning the BOT marker in the same location as the load sequence. The UNLOAD switch initiates high-speed rewind until the BOT marker is sensed. At BOT, vacuum decays while tape is rewound slowly onto the supply reel until the capstan stops being moved by the tape.
READY	The READY lamp indicates that the tape transport is in the remote mode and is not rewinding.
SELECT	The SELECT lamp indicates that the particular transport is selected by the control unit.
FILE PROTECT	The FILE PROTECT lamp indicates that the transport is inhibited from writing because the write-enable ring is not on the supply reel.

MT — Magnetic Tape

1.3 TAPE LOADING

A tape loading diagram is shown in Figure 1-3. Tape loading and threading is performed in the following manner:

NOTE

> If power is turned off, wait five seconds before reapplying power to establish proper preset operation.

1. Turn power ON/OFF switch ON.
2. If it is not present, install a take-up reel on the lower hub, seating it firmly against the hub lip and locking it in place.
3. If file protection is required, verify that the write-enable ring is not on the supply reel before installing the reel. Place the file reel onto the upper hub, seating it firmly against the hub lip and locking it in place.

NOTE

> If data is to be written on tape, the write-enable ring must be installed on the supply reel to enable the write electronics. This ring is placed in the grooved backside of the reel just around the hub opening. When the reel is installed, the ring should engage the write-enable sensor pin. The FILE PROTECT lamp will not extinguish until the tape is loaded.

4. Thread the tape from the supply reel to the take-up reel over the guide rollers, head, and capstan and onto the take-up reel so that clockwise rotation will wind the tape onto the take-up reel. The cross talk-shield is spring-loaded against the heads and should be swung away from the head while threading the tape through the opening. Wrap three to five turns of tape around the take-up reel. When tape is first loaded, pull it free of slack so that the tape lies straight across the top and bottom roller guides of the vacuum column.

NOTE

> To ensure that sufficient tape is provided to establish the lower loop in the vacuum chamber, verify that the BOT marker does not fall between the upper guide roller and the BOT sensor. BOT sensing prior to lower loop vacuum column sensing will lock out the tape drive electronics.

5. Press the LOAD switch. After a brief delay to pull vacuum, tape loops will form in the vacuum column, tape will be wound on the take-up reel, and the transport drive will position the tape at the BOT marker. If the BOT marker is placed beyond the BOT sensor during threading, forward search will cease after 11 seconds and reverse search for the BOT marker will automatically be initiated.

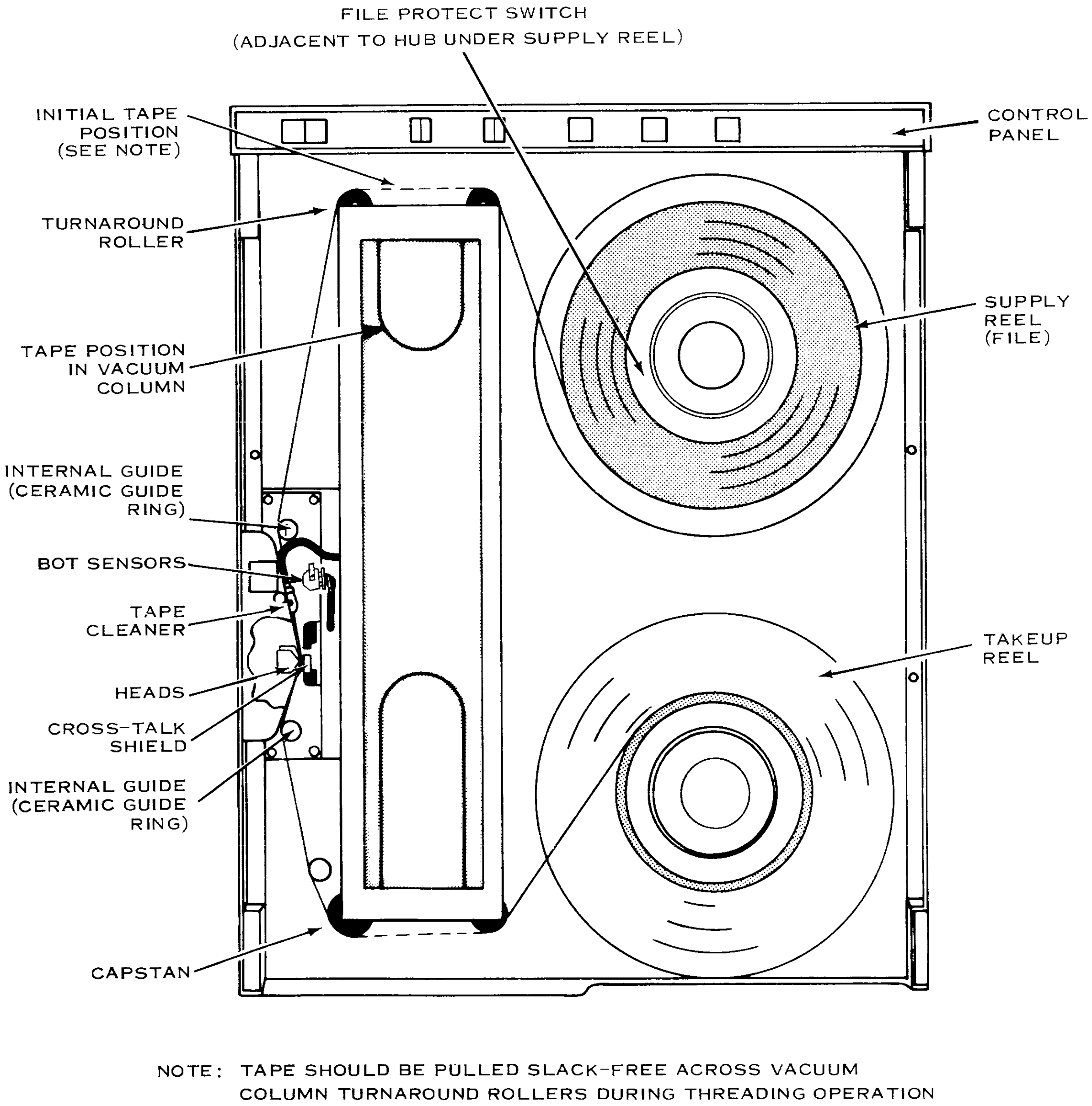

Figure 1-3. 979A Tape Loading Diagram

MT — Magnetic Tape

1.4 MAGNETIC TAPE CONTROLLER CONFIGURATIONS

Two versions of the tape controller are used, the nonreturn to zero inverted (NRZI) controller and the phase encoded/ nonreturn to zero inverted (PE/NRZI) controller. In both cases, there are PWB and multiwire configurations in the field. All four versions are illustrated on the following pages.

1.4.1 NRZI Controller

The NRZI controller, part number 2262630-0001, is capable of controlling up to four 800-bits per inch (bpi) NRZI tape transports. The PWB version of the NRZI tape controller is shown in Figure 1-4. This controller has a DIP switch module for selecting the model of computer in the system and for selecting the TILINE base address. This switch module, located at H03 on the PWB, is shown in Figure 1-5. The NRZI PWB tape controller also has movable jumpers located at K07 and N07. These jumpers and a description of each are shown in Figure 1-6.

The multiwire version of the NRZI tape controller, part number 947555-1, is shown in Figure 1-7. There are two DIP switch modules, K06 and K07, on the NRZI multiwire tape controller. Each switch module contains eight slide switches, as shown in Figure 1-8. The K06 switch module selects the beginning TILINE base address, and the K07 switch module selects the tape transport characteristics.

NOTE

> Since this circuit board can run only NRZI tape transports, selection of PE (1600 bpi) is meaningless. Therefore, the switches at location K07 should always be set to 800 bpi (OFF).

If the tape controller is removed from the chassis, switch positions should be checked before reinstallation.

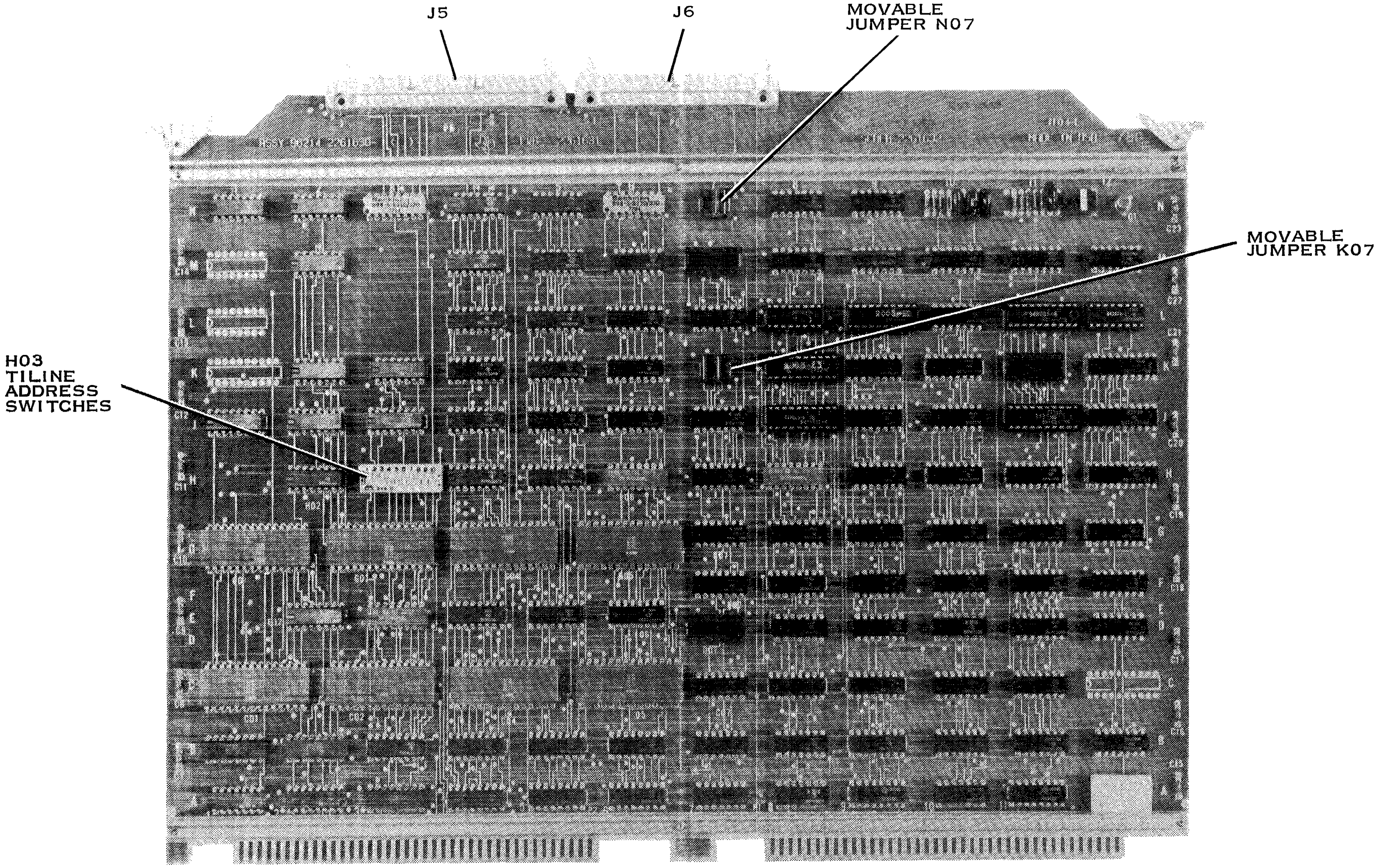

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Figure 1-4. NRZI PWB Tape Controller

MT — Magnetic Tape

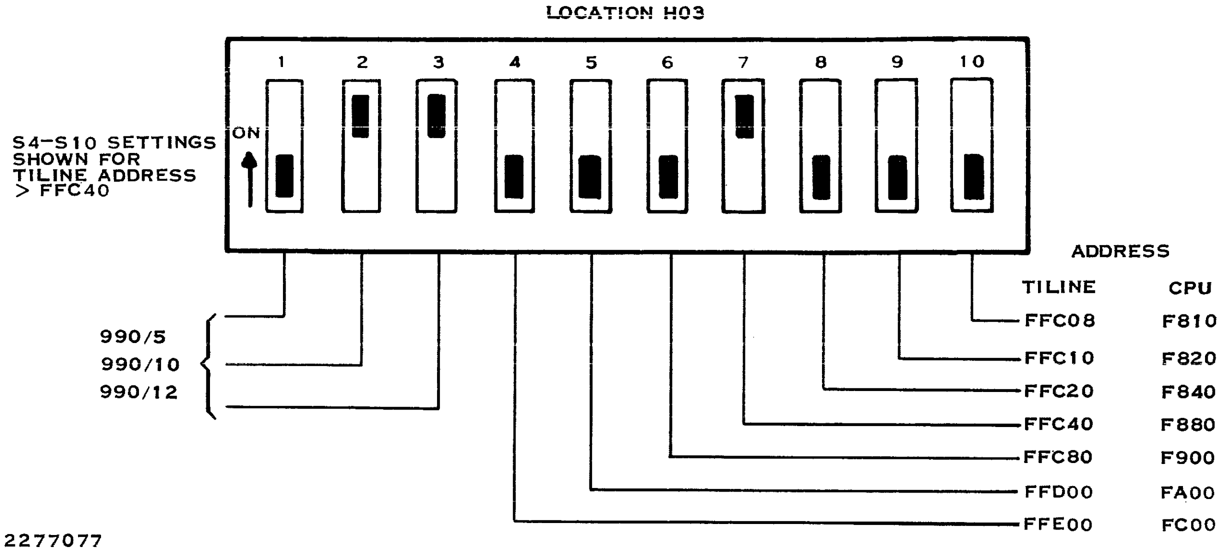

Figure 1-5. NRZI PWB Tape Controller Switch Settings

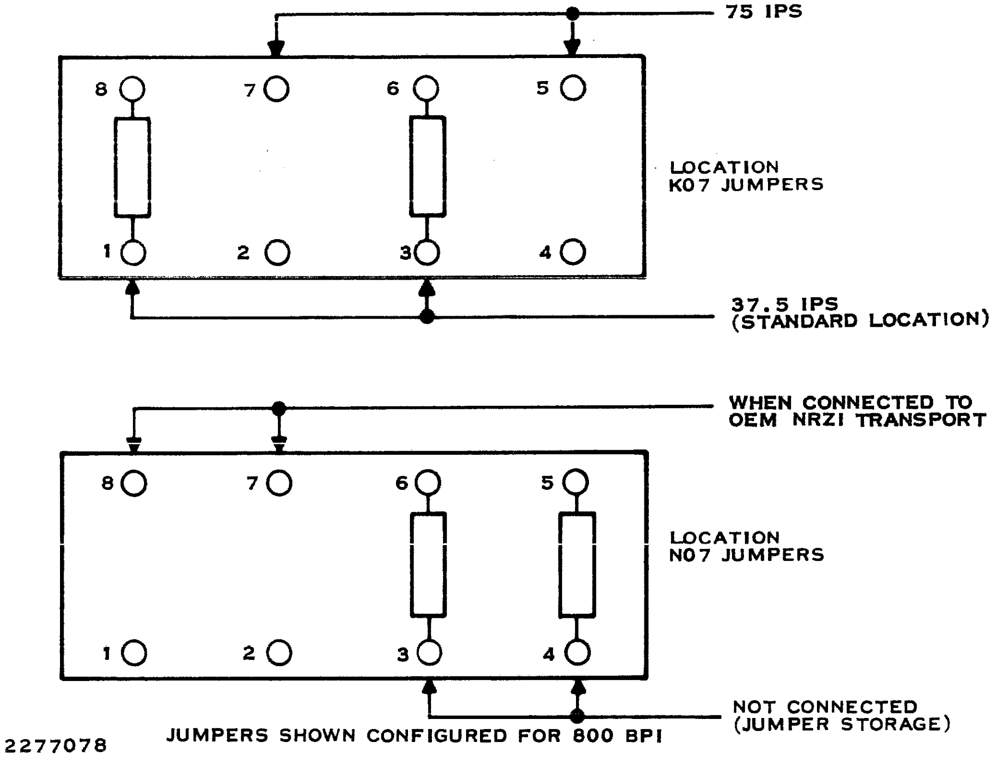

Figure 1-6. NRZI PWB Tape Controller Movable Jumpers

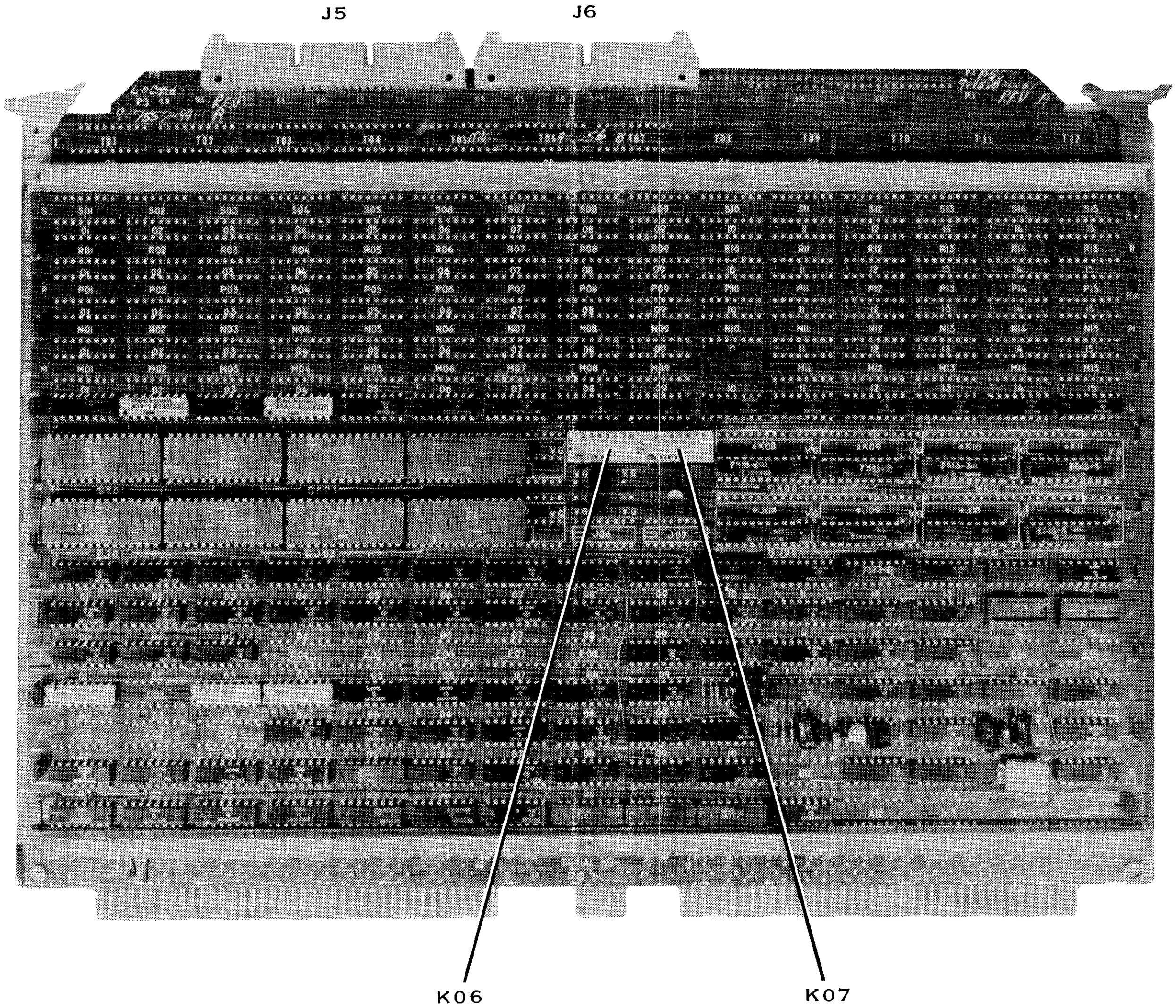

Figure 1-7. NRZI Multiwire Tape Controller

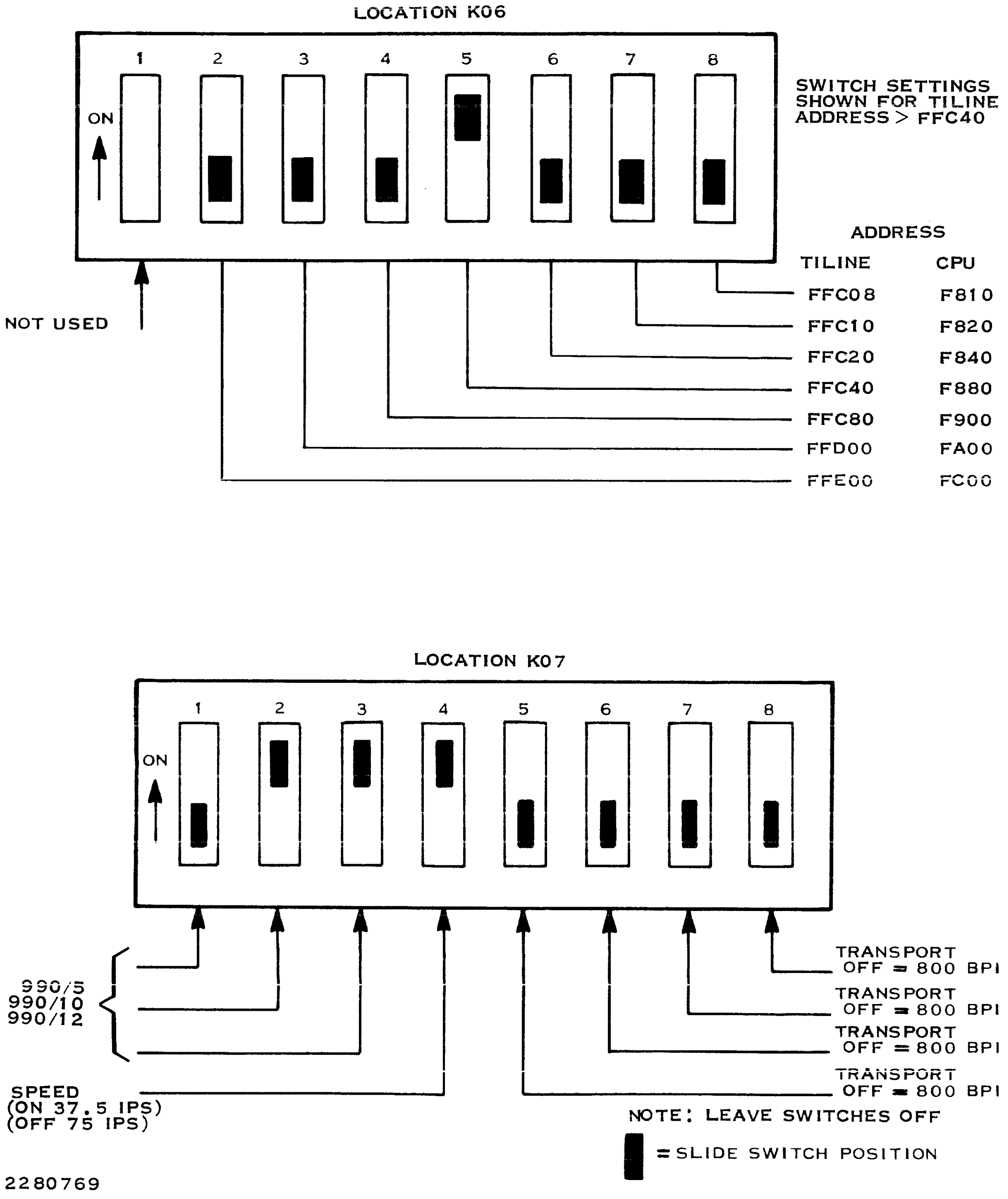

Figure 1-8. NRZI Multiwire Tape Controller Switch Settings

1.4.2 PE/NRZI Controller

The PE/NRZI controller is capable of controlling 1600 bpi phase-encoded tape transports in addition to 800 bpi tape transports. The PE/NRZI controller has nearly twice the amount of logic circuitry as the NRZI controller. The PE/NRZI PWB tape controller is shown in Figure 1-9, and the PE/NRZI multiwire tape controller is shown in Figure 1-10.

There is a single DIP switch module on both versions of the PE/NRZI controller, as shown in Figure 1-11. This switch module is located at K08 on the PWB version and at K07 on the multiwire version. The first three switches select the model of computer to adapt the controller to 990 timing, and the last four switches select the speed of one to four tape transports.

1.5 CONTROL AND STATUS WORD FORMATS

Figure 1-12 shows the formats of the controller and status words.

1.6 MAGNETIC TAPE CARD CAGE ASSEMBLIES

Location of assemblies installed in the magnetic tape unit card cage are shown in Figure 1-13.

1.7 SYSTEM CABLING

Cabling for a single transport system is shown in Figure 1-14, and multiple-transport system cabling is shown in Figure 1-15. Cabling configurations for the PE/NRI are the same as the NRZI. The 800 bpi and 1600 bpi tape transports may be cabled in any combination up to a total of four units.

The following notes apply to 979A tape transport cabling:

- Cable, part number 949003-1, connects J4 to tape transport number 1.
- Daisy-chain cable, part number 948218-2, or terminator, part number 948238-1, connect to J5.
- Both types of tape transports may be daisy-chained on the PE/NRZI controller as long as the unit switches are set properly.
- The total cable length from the controller to the last drive should be no more than 60 feet.

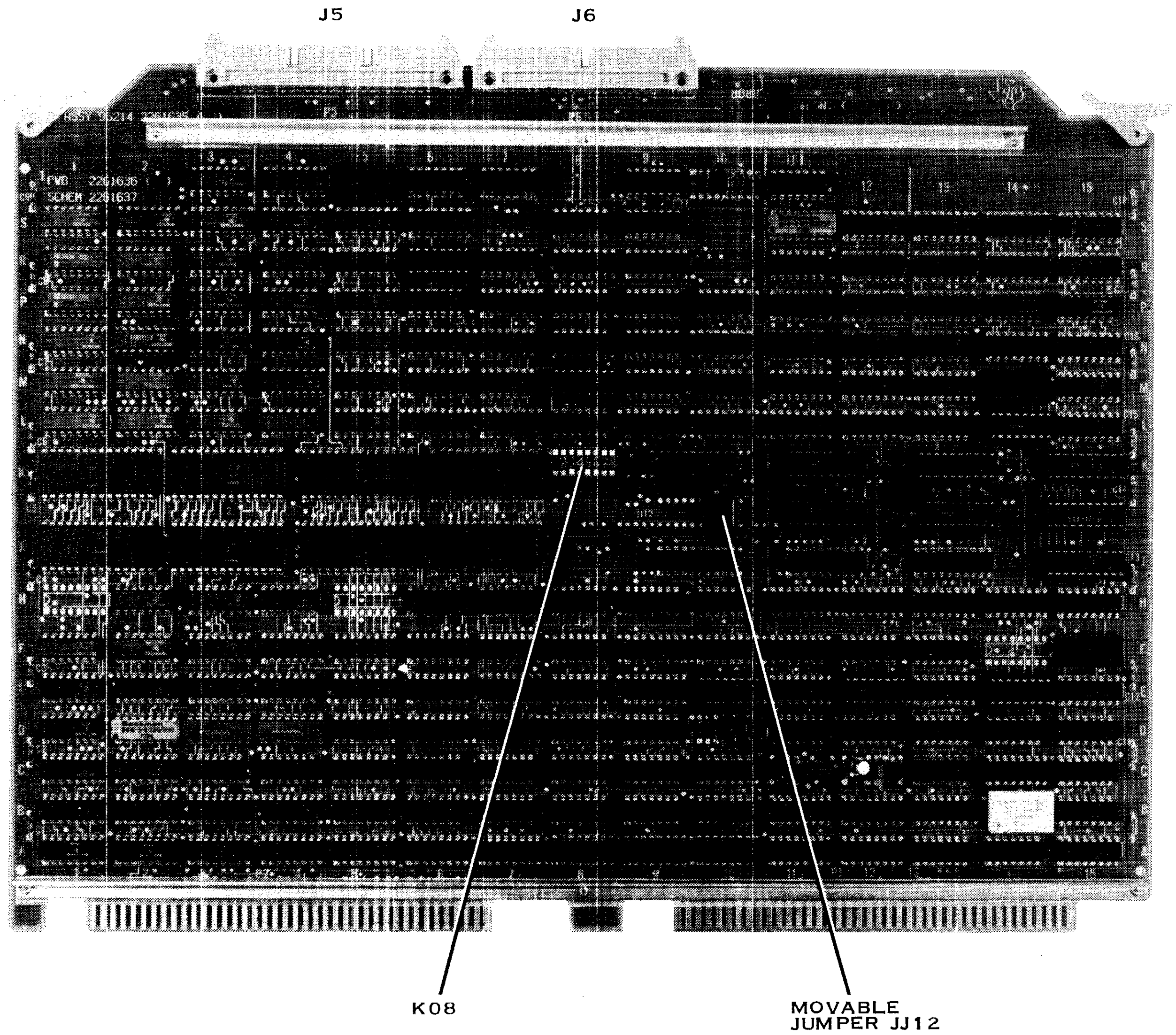

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Figure 1-9. PE/NRZI PWB Tape Controller

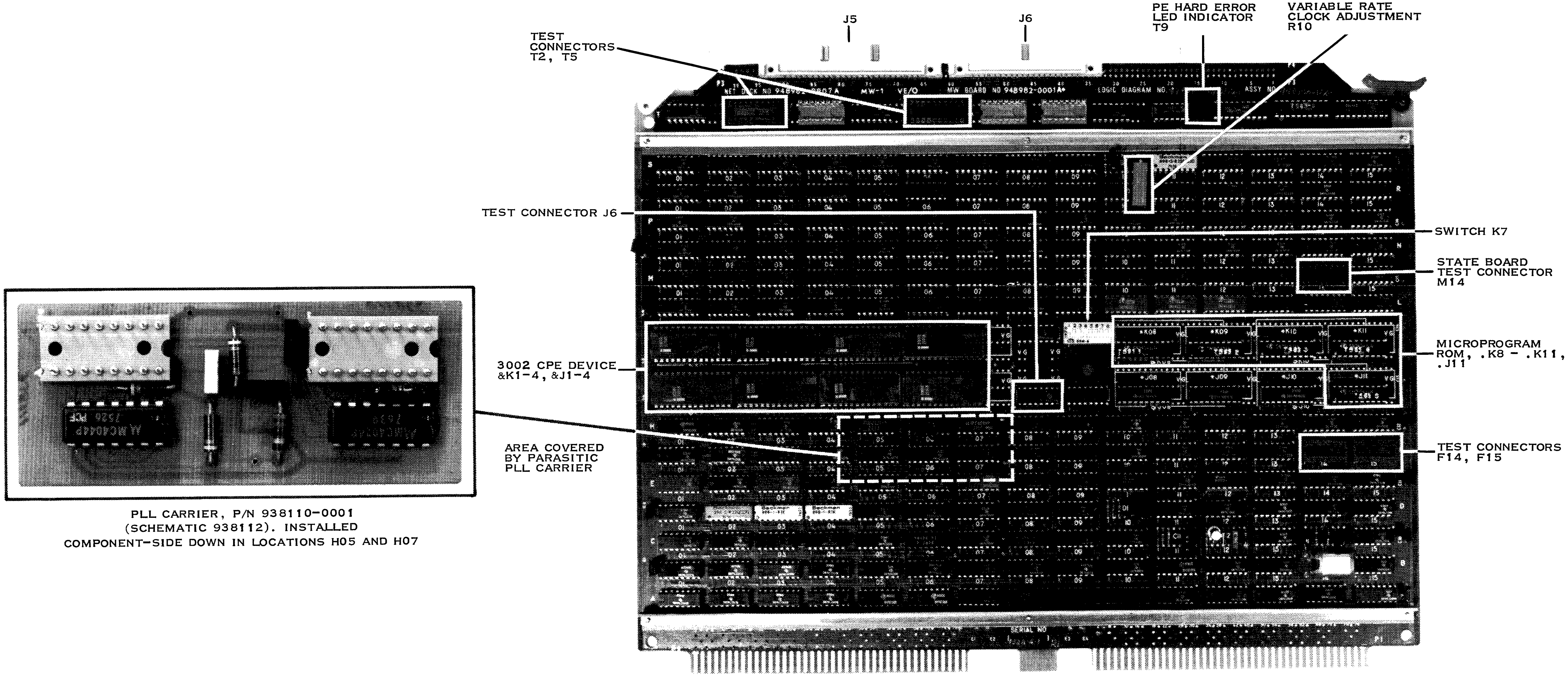

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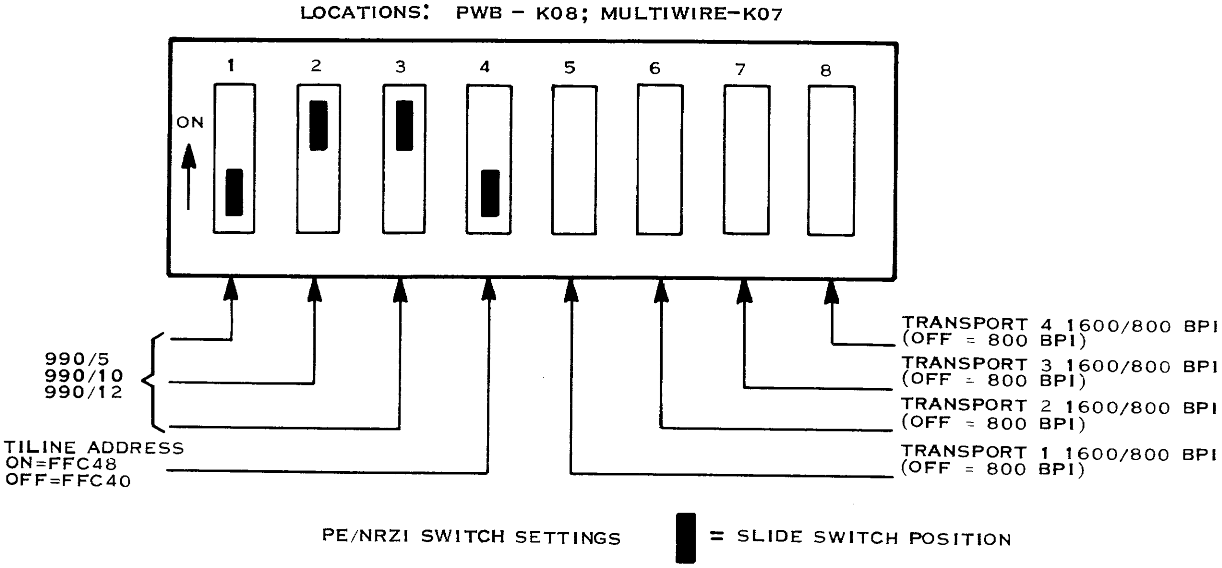
Figure 1-10. PE/NRZI Multiwire Tape Controller



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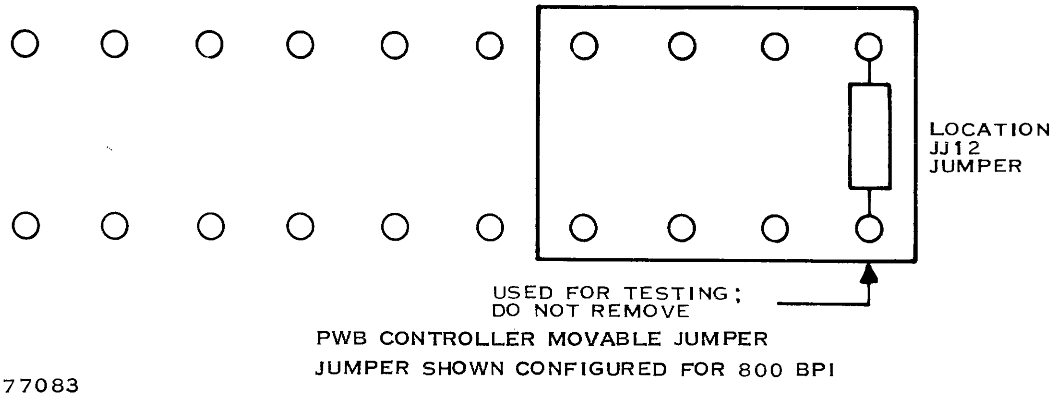

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Figure 1-11. PE/NRZI Tape Controller Switch and Jumper Configurations

CPU BYTE ADDRESS	TILINE ADDRESS	FUNCTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	CONTROL WORD
F880	FFC40	TAPE TRANSPORT STATUS	OFFLINE	BOT	EOR	EOF	EOT	WRITE RING	TAPE REWINDING	COMMAND TIMEOUT	TRANSPORT REWINDING 1	2	3	4	REWIND MASK 1	2	3	4	W0
F882	FFC41	READ OVERFLOW COUNT	READ OVERFLOW STATUS COUNT (16 LSB'S)																W1
F884	FFC42	READ OVERFLOW COUNT	READ OVERFLOW STATUS COUNT (8 MSB'S)								RESERVED FOR CONTROLLER SCRATCHPAD								W2
F886	FFC43	READ OFFSET	READ OFFSET (NO. OF CHARACTERS TO READ BEFORE STARTING XFER TO MEMORY)																W3
F888	FFC44		R/W CHARACTER COUNT, SKIP RECORD COUNT, OR ERASE LENGTH*																W4
F88A	FFC45	BUFFER ADDRESS	TILINE MEMORY BUFFER STARTING ADDRESS (15 LSB'S)														LSB	0	W5
F88C	FFC46	COMMAND AND TRANSPORT SELECT	UNIT SELECT 1	2	3	4	COMMAND				WRITE DIAG.	X	X	MEMORY ADDRESS (5 MSB'S)					W6
F88E	FFC47	TMTC STATUS AND CONTROL	IDLE	OP COMPL.	ERROR	INT ENBL	LOCK-OUT	X	PE FORMAT	ABNORM. COMP.	VRC ERROR	LRC ERROR	CRC ERROR	MEMORY PARITY ERROR	DATA TIMING ERROR	TILINE TIMEOUT ERROR	FORMAT ERROR	TAPE ERROR	W7

W0, bits 0–7: ANY OF THESE CONDITIONS WILL SET THE TAPE ERROR STATUS BIT IN WORD NO. 7

W4: *FUNCTION DEPENDS ON COMMAND CODE IN R7

W6, bits 9 and 10: SHOULD BE ZEROS (RESERVED FOR DIAGNOSTICS)

W6, bits 4–7: COMMAND CODES

0000 NOP
0001 NOP
0010 WRITE EOF
0011 RECORD SKIP REVERSE
0100 READ BINARY
0101 RECORD SKIP FORWARD
0110 WRITE BINARY
0111 ERASE
1000 READ TRANSPORT STATUS
1001 READ TRANSPORT STATUS
1010 REWIND
1011 REWIND AND UNLOAD
1100 NOP
1101 NOP
1110 NOP
1111 NOP

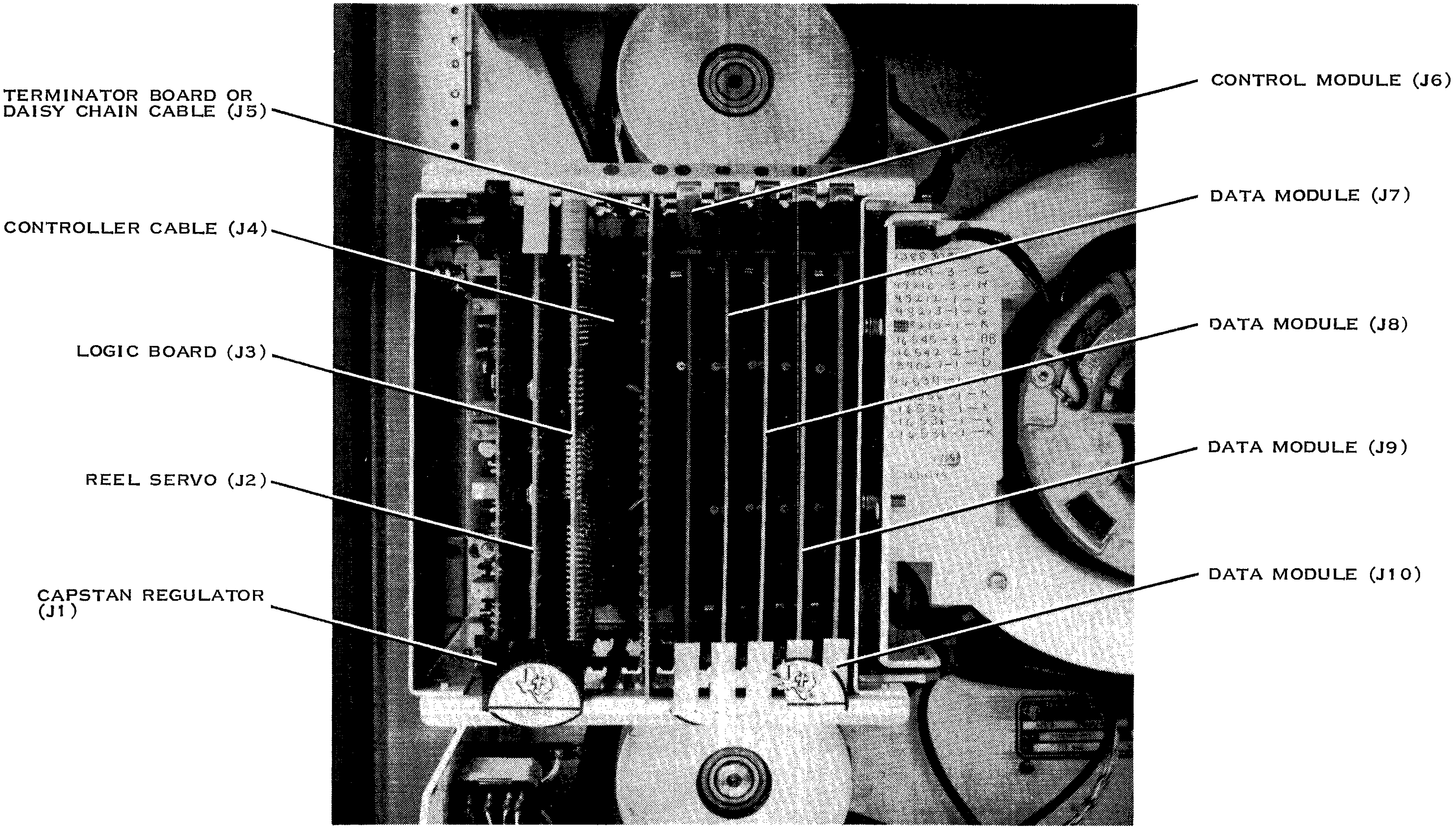
W7, bit 5: (RESERVED FOR DIAGNOSTICS)

W7, bit 10: PE HARD ERROR (PE TRANSPORT)

W7, bit 9: ERROR CORRECTION ENBLED (PE TRANSPORT)

2280772

Figure 1-12. Controller Control and Status Word Formats



BOARD	REF.	NRZI	PE/NRZI
CAPSTAN REGULATOR	J1	216545-3	216545-3
REEL SERVO	J2	216542-2	216542-2
LOGIC BOARD	J3	937027-1	937027-1
CONTROL MODULE	J6	948235-1	216539-1
DATA MODULE	J7-J10	948232-1	216536-1

2277086

Figure 1-13. Location of Boards in the Magnetic Tape Card Cage

MT — Magnetic Tape

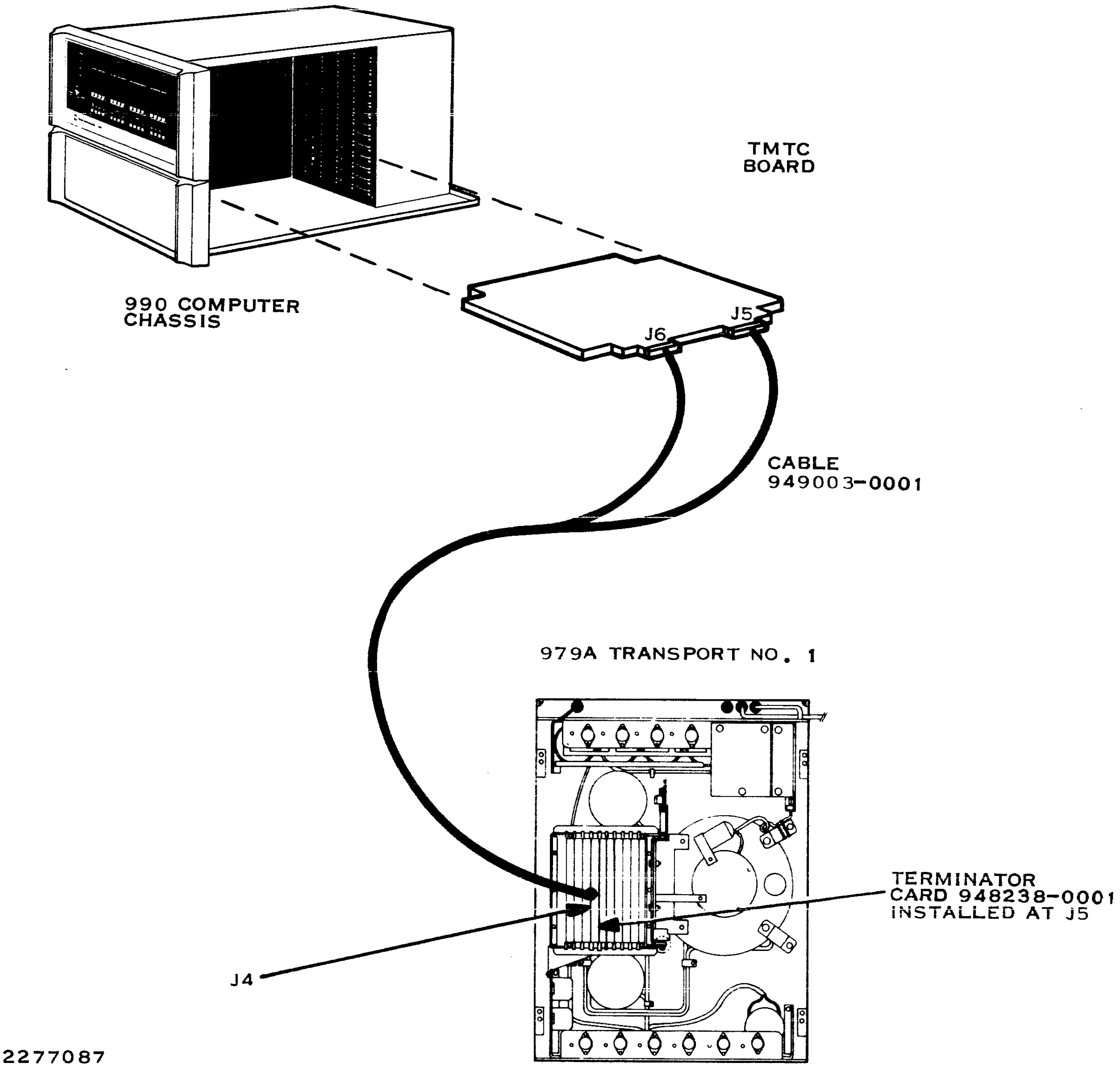


Figure 1-14. Single Tape Transport System Cabling

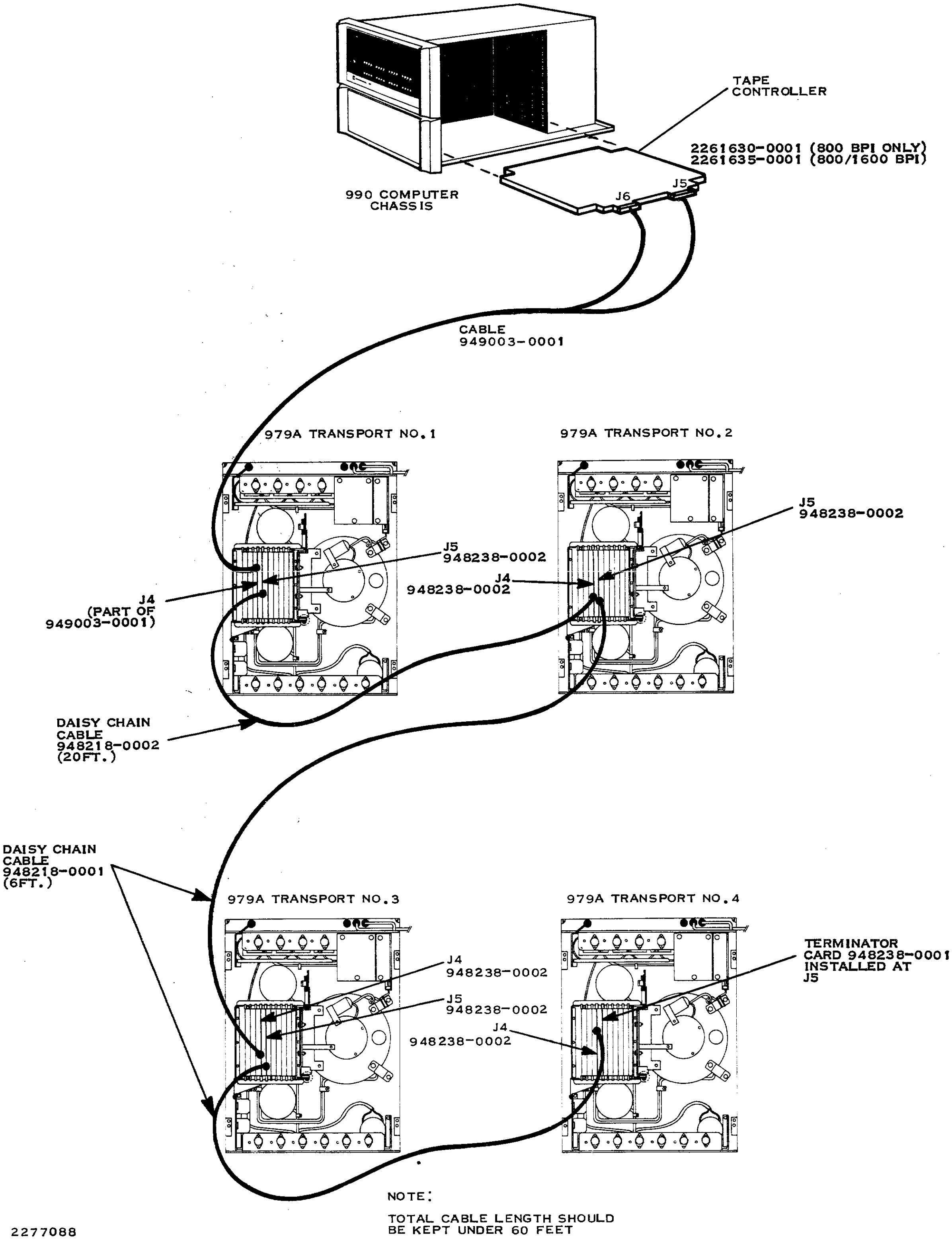


Figure 1-15. Multiple Tape Transport System Cabling

1.8 FIELD-REPLACEABLE COMPONENTS, 979A TAPE TRANSPORT

The field-replaceable components for the 979A tape transport are as follows:

Item	TI Part Number
Control Panel Assembly	0948215-0001
Capstan Regulator Card Assembly (NRZI/PE)	0216545-0003
Reel Servo Card Assembly (NRZI/PE)	0216542-0002
Logic Board, 979A (NRZI/PE)	0937027-0001
Control Module Assembly (NRZI)	0948235-0001
Control Module Assembly (PE)	0216539-0001
Data Module Assembly (NRZI)	0948232-0001
Data Module Assembly (PE)	0216536-0001
Blower, Five Stage (60 Hz)	0948248-0001
Blower, Seven Stage (50 Hz)	0948248-0002
Head Plate Assembly	0948216-0001
I/R LED Assembly, Vacuum Column (A1A1A2)	0948197-0001
I/R LED Assembly, Vacuum Column (A1A1A3)	0948249-0001
Servo Motor, DC-Capstan	0216295-0001
Motor, Reel Drive	0948247-0001
Signal Terminator Assembly	0948238-0001
979A Controller (NRZI)	
PWB	2261630-0001
Multiwire	0947555-0001
979A Controller (PE/NRZI)	
PWB	2261635-0001
Multiwire	0948990-0001
Lamp, Incandescent, Type T-1-3/4	0948240-0002
Fuse, 5 A Slow Blow	0411787-0020
Transistor, 2N3055	0972959-0001
Relay, 12 V, 10 A, 3pdt	0233015-0050
Diode, 1N4003	0539468-0003
Diode, 1N4719	0231768-0003
Rectifier, Bridge	0232933-0000
Fuse, 10 A, 250 V (Lit 314010)	0054186-0001
Fuse, 3 A, 250 V (Lit 312003)	0416434-0303
Fuse, 1 A, 250 V (Lit 312001)	0416434-0103
Fuse, 5 A, 250 V (Lit 312005)	0416434-0503
Fuse, 2 A, 250 V (Lit 312002)	0416434-0203
Photo Sensor Assembly, BOT/EOT	0948257-0001
File Protect Switch	0948230-0001
Compression Ring, Rubber	0216303-0001
Cable, Primary	0949003-0001
Cable, Daisy Chain (6-foot)	0948218-0001
Cable, Daisy Chain (20-foot)	0948218-0002
Hub Assembly, Reel Mounting	0216369-0001
Capstan, 312 ID	0216484-0002
Cord Assembly, Logic 245-451 PSSY	0216548-0000
Transport Interface Unit, 37.51PS-9	0240097-0002

MT — Magnetic Tape

Item	TI Part Number
Door Assembly	0948132-0001
Front Plate Vacuum Column	0948143-0001
Door, 979A Tape Transport	0948202-0001
Power Supply Assembly	0948212-0001
Servo Amplifier Assembly	0948213-0001
Logic Module Assembly	0948214-0001
Signal Terminator Assembly, Daisy Chain	0948238-0001
Cable Assembly, 979A Tape Transport (DMAC)	0948263-0001
Cable Assembly, Daisy Chain, 979A (979 to 979A)	0948267-0001

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Tables

1

810 Printer

1.1 MODEL 810 CRU SERIAL LINE PRINTER

The Model 810 Line Printer (Figure 1-1) is a receive-only, forms-programmable impact printer that features an internal microprocessor.

Reference manuals for use with the 810 printer are as follows:

- *Model 990 Computer Model 810 Printer Installation and Operation Manual,* part number 939460-9701
- *Omni 800 Electronic Data Terminals Maintenance Manual for Model 810 Printer,* part number 994386-9701

1.2 OPERATOR CONTROLS AND INDICATORS

There are two control panels for operator use: the main control panel, and the auxiliary control panel that is located under the access door. The locations of these panels are shown in Figure 1-2. The main operator control panel is shown in Figure 1-3, and the auxiliary control panel is shown in Figure 1-4. Five switches on the operator control panel have alternate functions (marked in red). These alternate functions are active only when the NORMAL/TEST/VFC switch on the auxiliary control panel is set to TEST/VFC. Normal functions are as follows:

- PAPER OUT indicator — This indicator lights when the PAPER OUT switch is activated. The audible tone (bell) beeps five times. The indicator is cleared when the paper is loaded and the RESET switch is pressed.
- ERROR indicator — The ERROR indicator has two functions:
  - The indicator lights steadily when a parity error is detected.
  - The indicator blinks if the printhead carriage runs into an obstacle or if the microprocessor loses tachometer pulses. When this happens, power to the printhead carriage motor is turned off and the audible tone beeps five times.

PR — Printers

- ON LINE switch and indicator — Pressing this pushbutton switch places the printer in the online condition and lights the indicator. The online condition allows the printer to receive data from an external source. Pressing the switch a second time places the printer in an offline condition. The offline condition causes the interface to go busy; partial lines remain in the buffer.

- TAB/RESET switch — The normal RESET function of this pushbutton switch clears the paper-out condition or either of two error conditions. The printhead realigns after clearing a carriage fault condition. The alternate TAB function of this switch is active only in the vertical format control (VFC) mode. When this switch is active, pressing the switch advances the paper to the next vertical tab.

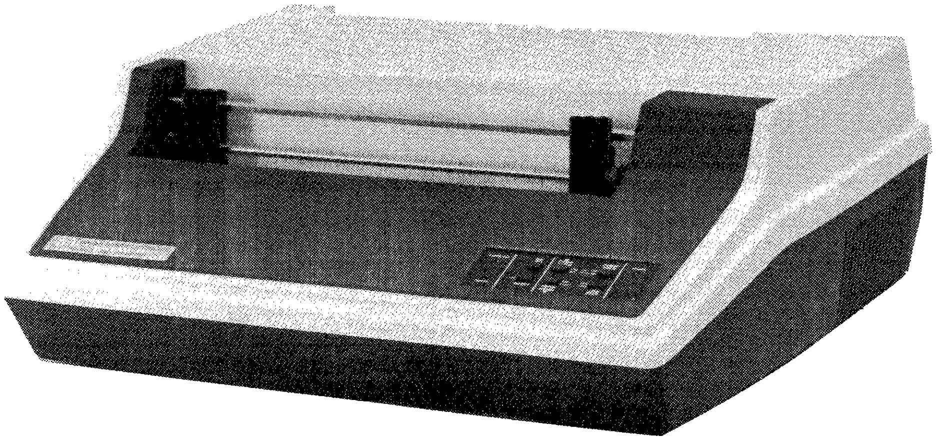
- FORM ALIGN (up)/TAB SET switch — The normal FORM ALIGN (up) function of this pushbutton switch causes the paper to move up 0.356 millimeter (0.014 inch). If the switch is held down, three small steps are taken and then full line feeds are executed to accelerate paper movement. This switch is active both offline and online. The alternate TAB SET function of this switch is active only in the VFC mode. When this switch is active, pressing the switch sets a vertical tab at the present line.

- FORM ALIGN (down)/TAB CLEAR switch — The normal FORM ALIGN (down) function of this pushbutton switch causes the paper to move down 0.356 millimeter (0.014 inch). If the switch is held down, paper continues to move in small increments. This switch is active both offline and online. The alternate TAB CLEAR function of this switch is active only in the VFC mode. When this switch is active, pressing the switch clears the vertical tab at the present line.

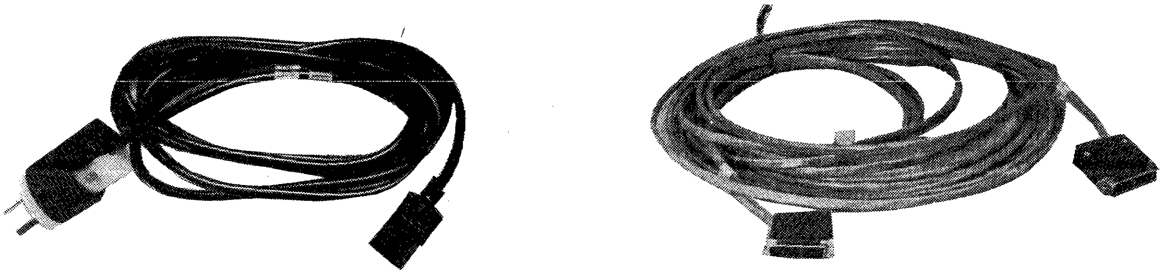
- FORM FEED/SET TOP OF FORM switch — The normal FORM FEED function of this pushbutton switch causes the paper to move to the top of the next form. Contents of the line buffer are printed before paper motion occurs. This switch is active both offline and online. The alternate SET TOP OF FORM function of this switch is active only in the VFC mode. When this switch is active, pressing the switch sets the top of form or reads the FORM LENGTH switch setting.

- LINE FEED/LINE FEED switch — Each time this pushbutton switch is pressed, the paper moves up one line (12 steps for 6 lines per inch and 9 steps for 8 lines per inch). If the line buffer is not empty, its contents are printed before paper motion occurs. This switch is active only when in offline. The normal and alternate functions of this switch are the same.

- POWER indicator — This indicator lights when power is applied to the printer.

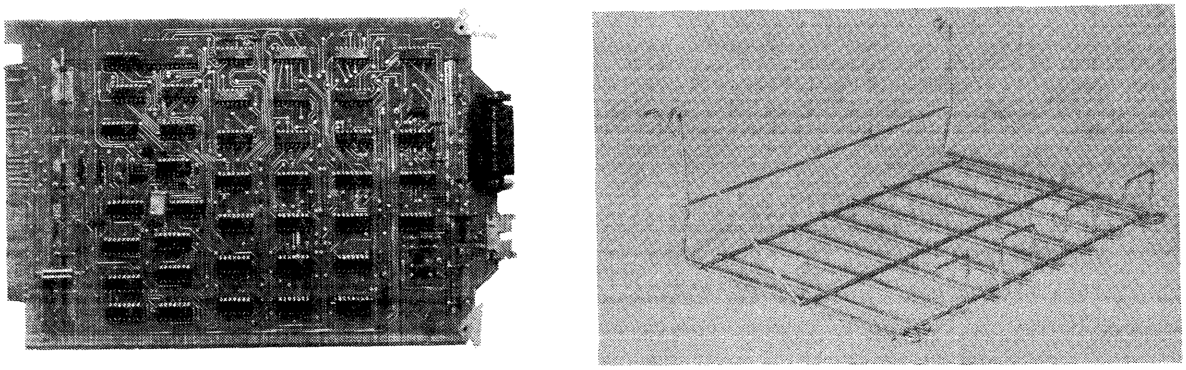


MODEL 810 PRINTER,
PART NO. 938152-1 THRU -13



POWER CABLE,
PART NO. 996289-1 DOMESTIC
996290-1 WESTERN EUROPE

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



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

PAPER BASKET,
PART NO. 994176-0001

2277110

Figure 1-1. Model 810 Line Printer Kit, Part Number 938120-0001

PR — Printers

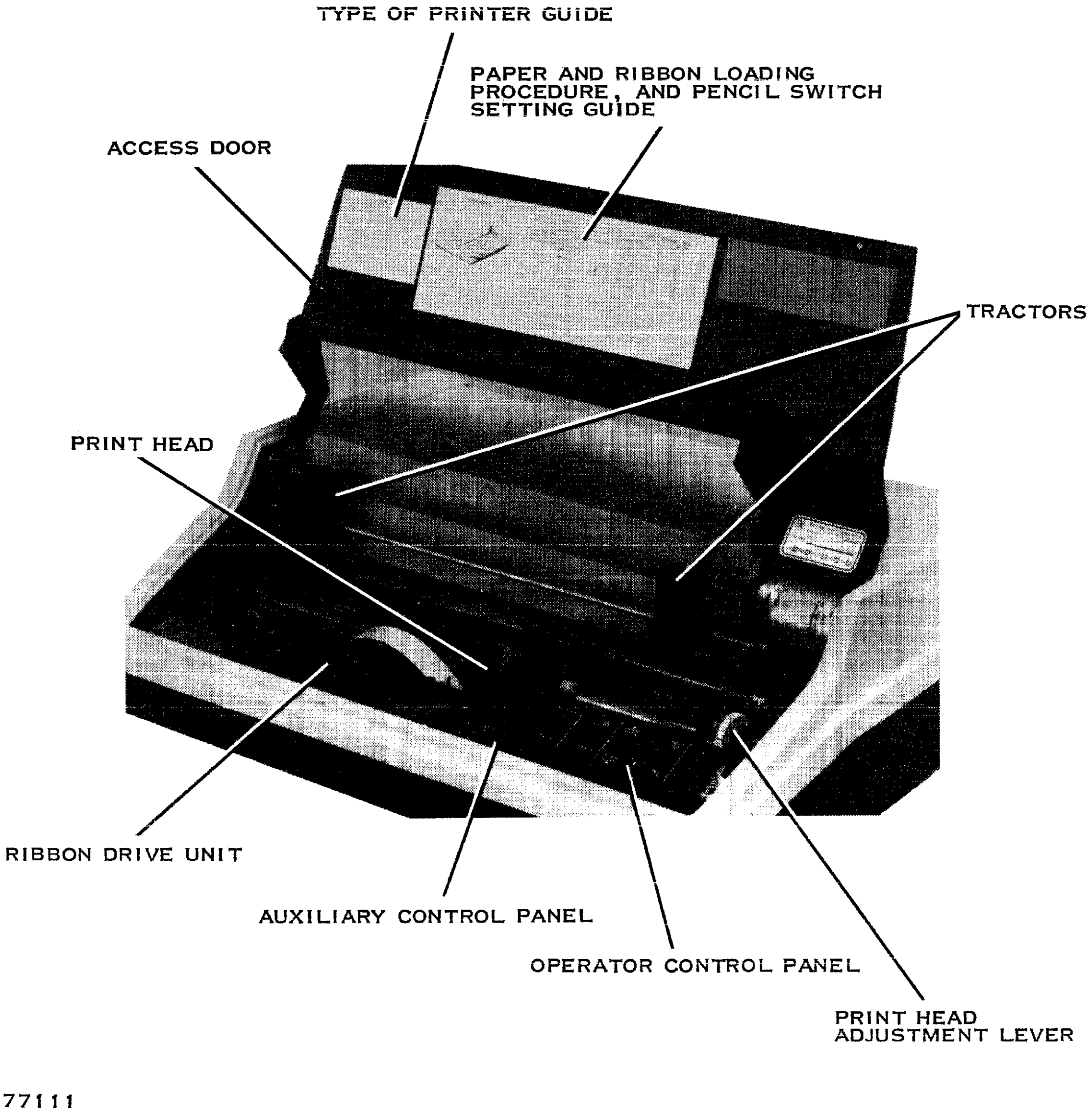


Figure 1-2. 810 Printer Controls and Indicators

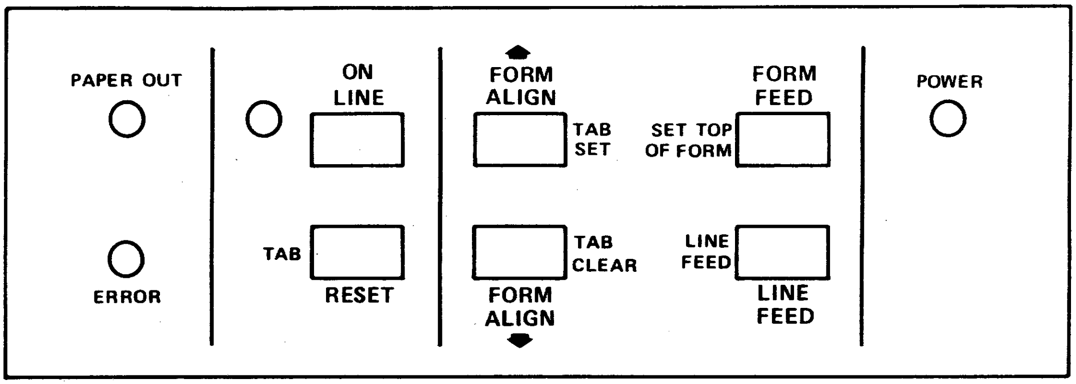


Figure 1-3. 810 Printer Operator Control Panel

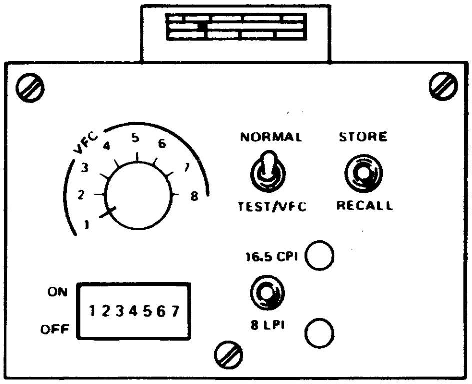


Figure 1-4. 810 Printer Auxiliary Control Panel

PR — Printers

The auxiliary control panel (Figure 1-4) is the vertical format control and compressed print (VCO) type. Controls and indicators for the auxiliary control panel are as follows:

- NORMAL/TEST/VFC — In the NORMAL position, this switch enables normal operation of the printer. With this switch in the TEST/VFC position, pressing the ON LINE switch initiates a rotating character test pattern (barber pole). With this switch in the TEST/VFC position (and as long as the ON LINE indicator is off), the alternate function switches TAB, TAB SET, TAB CLEAR, SET TOP OF FORM and LINE FEED are enabled for VFC programming.

- Pencil switches — All auxiliary control panels have seven pencil switches. Switches 1, 2 ,and 3 are used to select baud rates of 110, 150, 300, 1200, 4800, or 9600. Switches 4 and 5 are used to select odd, even, or ignore parity. Switch 6 activates the automatic line feed. Switch 7 activates the top of form automatic perforation skip. The automatic perforation skip causes the printer to skip three lines before printing the first line of the next form. Changes in pencil switch settings take effect when the printer goes online.

- VFC switch — The 8-position VFC channel rotary switch selects one of eight nonvolatile vertical format programs. These eight channels are also software-programmable through the communications interface.

- STORE/RECALL switch — In the STORE position, this switch stores manually programmed vertical tabs, the form length, and the LPI spacing in the selected VFC channel. In the RECALL position, the format program stored in the selected VFC channel is recalled into working memory. STORE and RECALL are active only in the VFC mode, and both are software-programmable through the communications interface. In the center position, this switch is off.

- 16.5 CPI/8 LPI switch and indicators — In the 16.5 CPI (16.5 characters per inch) position, this switch selects the compressed print mode. This mode is also software-programmable through the communications interface. The 16.5 CPI indicator lights when the printer is in the compressed print mode. Setting this switch to the 16.5 CPI position a second time returns the printer to the standard 10 characters per inch print mode. The printhead initializes to the left margin each time a change is made between 10 and 16.5 characters per inch. In the 8 LPI (eight lines per inch) position, this switch selects the eight lines per inch print mode. In this mode the 8 LPI indicator lights. This mode is also software-programmable through the communications interface. Setting this switch to the 8 LPI position a second time returns the printer to the six lines per inch mode. This switch is off in the center position.

1.3 810 PRINTER PAPER REQUIREMENTS

The printer uses continuous form paper with standard feed holes on each edge. Paper width from 76.2 to 381 millimeters (3 to 15 inches) can be accommodated. Using either the rear or bottom chute, multiple part forms (one original and up to five copies) can be printed on paper with the following weight specifications:

Type of Form	Weight
Single-part forms	6.8 to 9.07 kg (15 to 20 lbs)
Multiple-part forms	Original — 5.44 to 6.8 kg (12 to 15 lbs) Copies — 4.08 to 5.44 kg (9 to 12 lbs) Last copy — 6.8 kg (15 lbs)

Cardstock up to 0.178 millimeter (0.007 inch) thick can be used as a single-part form or a last copy only when using the bottom chute. In any case, it is recommended that total form thickness not exceed 0.533 millimeter (0.021 inch).

1.4 810 PRINTER INTERFACE CONTROLLER

The 810 printer uses the TTY/EIA interface module, same as the 733 ASR/KSR data terminal (Section 2 of the DT — Data Terminals section). Standard jumper schedule for the 810 printer is as follows:

Option	Jumper
Baud rate = 4800	E1B to E6
Logic level = EIA	E8 to E9
Code format = 10-bit (receive)	E11 to E12
Code format = 10-bit (transmit)	E14 to E15
Enable receive during RTS	E17 to E18
Disable 110 baud	E20 to E21
RTSE = DSRE	E26 to E27

1.5 810 PRINTER INTERCONNECTING CABLING

The communications interface connector (or connectors) is located at the left rear of the printer as shown in Figure 1-5. All printers have an EIA standard RS-232C interface connector for serial input.

Interconnecting cabling for the printer is shown in Figure 1-6.

PR — Printers

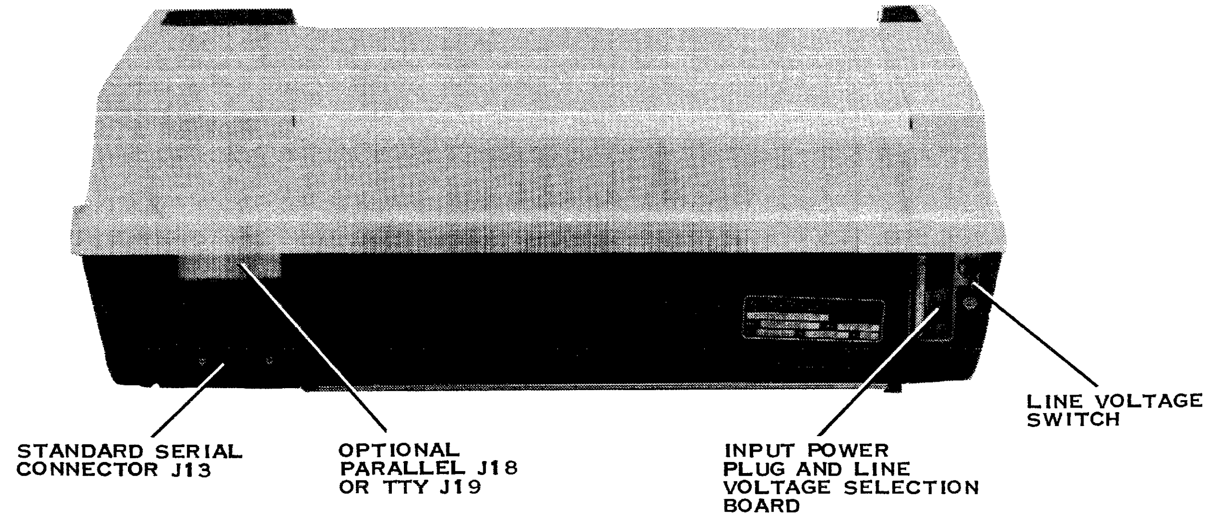


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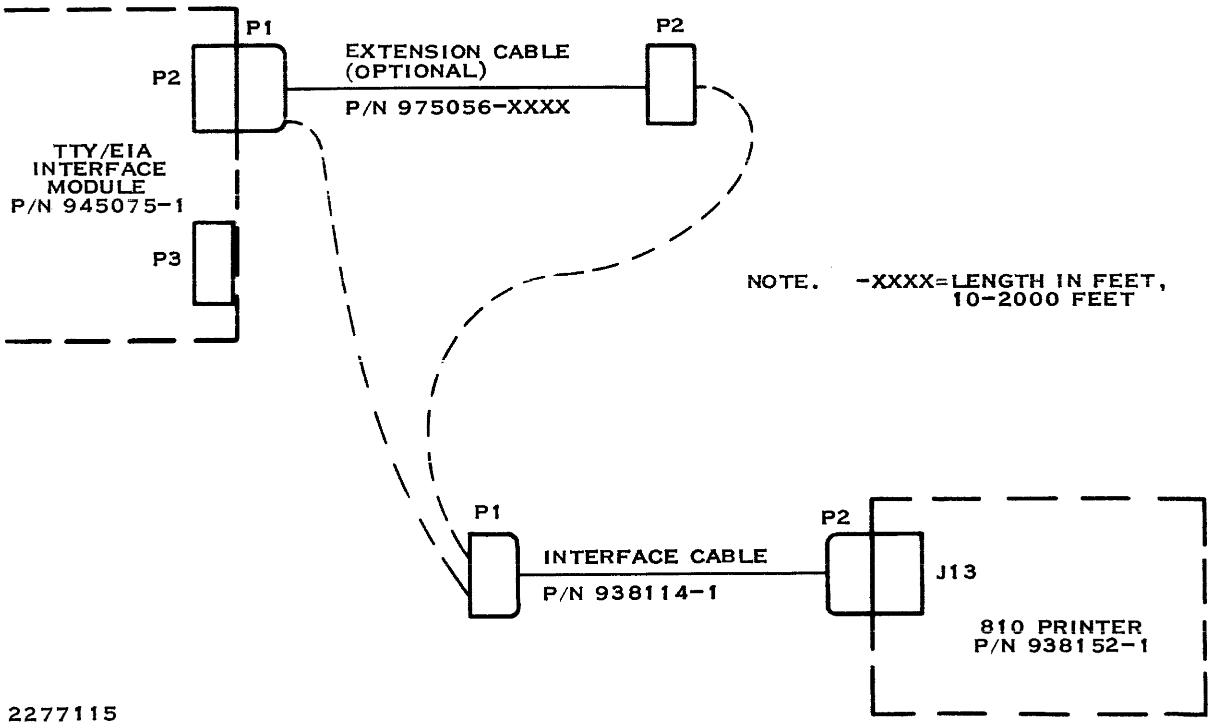
Figure 1-5. Rear View of Printer



2277115

Figure 1-6. 810 Printer Interconnection Diagram

1.6 FIELD-REPLACEABLE COMPONENTS, 810 LINE PRINTER

Field-replaceable components for the 810 printer are as follows:

Item	TI Part Number
AC Module	0994373-0001
Power Supply Board	0994394-0001
Driver Board (PCB Power Supply)	0994322-0001
Processor Board	0994244-0001
Backpanel	0994330-0001
Motor Carriage Drive	0994238-0001
Control Panel	0994251-0001
Auxiliary Control Panel	0994257-0001
Ribbon Drive Assembly	0994215-0001
Controller (TTY/EIA Board)	0945075-0001
PCB Interface (optional)	0994305-0001
Carriage and Paper Drive Assembly	0994183-0001
Printhead	0994258-0001
Paper Feed Motor	0994207-0001
Paper Feed Tractor, left	0946158-0001
Paper Feed Tractor, Right	0946158-0002
Fan Assembly	0996275-0001
Fuse, 1 A, 250 V	0416434-0103
Fuse, 1.5 A, 250 V	0416434-0150
Fuse, 2.5 A, 250 V	0416434-0004
Fuse, 3 A, 250 V	0941787-0012
Fuse, 5 A, 250 V	0416434-0503
Cable, TTY/EIA to 810	0938114-0001
Gear, Paper Advance	0994493-0001
Spring, Wire Rope Tension	0994263-0001
Battery	0996371-0001
Switch	0996169-0001
Latch, Spring Extension	0994314-0001
Switch, Miniature Precision	0996168-0001
Spring, External Ribbon Take-up	0944355-0001
Terminal Block	0996368-0001
Knob, Plastic	0411123-0107
Spring, Armature	0994277-0001
Spring, Needle	0994278-0001
Plug, Jumper	0972713-0001
Capstan Motor	0994177-0001
Clip, Fuse	0772635-0001
Strap, Tie-Down	0418212-0001
Cable, Extension (optional)	0975056-xxxx
Resistor Network, 47 Ohm	0972037-1470
AC Power Module Assembly	0986467-0001
Driver and Printhead	0987926-0001
Power Supply Assembly	0987927-0001
Cable Assembly, 202/212 Data Set	0993205-0001
Cable Assembly, Data Terminal	0993210-0001

PR — Printers

Item	TI Part Number
Drive Shaft, Tractor	0994172-0001
Gear, Paper Advance	0994174-0001
Base	0994179-0001
Cover	0994180-0001
Door, Access	0994181-0001
Rod, Lower Guide	0994189-0001
Lever, Printhead Adjust	0994198-0001
Rod, Tractor Support	0994209-0001
Plate, Bottom Paper Chute	0994213-0001
Wire Rope, Drive Mechanism	0994233-0001
Motor Assembly, Carriage Drive	0994238-0002
Pulley Assembly, Idler	0994241-0001
Processor	0994244-0002
Control and Indicator Assembly	0994251-0001
Auxiliary Control and Indicator Assembly (STD)	0994257-0001
Auxiliary Control and Indicator Assembly (FOR)	0994257-0002
Auxiliary Control and Indicator Assembly (FOR)	0994257-0003
Auxiliary Control and Indicator Assembly (VFC)	0994257-0004
Auxiliary Control and Indicator Assembly (DEL)	0994257-0005
Printhead Assembly, 9 Copy	0994258-0002
Cable Assembly, Paper Out	0994259-0001
Interface Option, Current Loop	0994305-0001
Cover, Electronics	0994340-0001
Cable Assembly, Flex	0994349-0001
Cable Assembly, Parallel Interface	0994359-0001
Cable Assembly, Parallel Interface	0994359-0002
Retainer, Battery	0994379-0001
Strap, Battery	0994380-0001
PROM, U.S. Limited ASCII	0994434-0008
PROM, U.S. Full ASCII	0994434-0019
PROM, U.S. Full ASCII	0994434-0100
PROM, Expanded Character, Limited ASCII	0994434-0108
PROM, U.S. Full ASCII	0994434-0119
Gear Assembly, Paper Advance	0994453-0001
Switch Assembly	0994463-0001
Window	0994476-0001
Guide Rod, Upper	0994490-0001
Carriage Assembly, Printhead	0994492-0001
Door Assembly	0994500-0001
Line Buffer, Parallel Interface	0994503-0001
Line Buffer, Serial Interface	0994503-0002
Backpanel	0994531-0001
Paper Tractor, Left and Right	0996158-0003
1024-Bit IC, 5101L	0996203-0001
Fan, 28 Vac	0996275-0002
2048 X 8 Bit IC, MK34071	0996279-0005

Item	TI Part Number
Cord Set, 3-Pin Power, Domestic	0996289-0001
Capacitor, 12,000 uF, 50 V	0996325-0001
Toggle Switch	0996656-0001
Tag, Bearing	2360001-0001

2

LP300/LP600 Line Printers

2.1 MODEL LP300/LP600 CRU PARALLEL LINE PRINTERS

The Models LP300 and LP600 Line Printers (Figure 2-1) are medium-speed, dot matrix, impact printers.

Reference manuals for use with the LP300/600 printers are as follows:

- *Model 990 Computer Model LP300 and LP600 Line Printers Installation and Operation Manual*, part number 2250364-9701
- *Model 990 Computer Model LP300 and LP600 Line Printers Maintenance Manual*, part number 945419-9704

2.2 LP300/600 PRINTER CONTROLS AND INDICATORS

Figure 2-2 shows the LP300/LP600 printer operator panel. The following paragraphs describe the controls and indicators contained on this panel. Also described are the printer internal controls and indicators.

2.2.1 POWER INDICATOR

The POWER INDICATOR illuminates when power is applied to the printer and the ac power switch is set to ON.

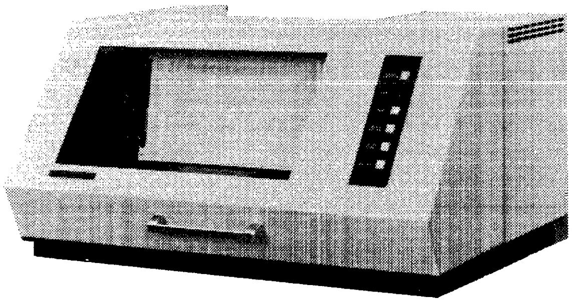
2.2.2 CHECK Pushbutton/Indicator

The CHECK pushbutton/indicator is a control switch and status indicator. When used as a control switch, it is depressed and released to reset the printer after a fault condition is cleared. If the CHECK indicator remains illuminated, an additional fault condition exists. All fault conditions must be cleared before the printer will become operational.

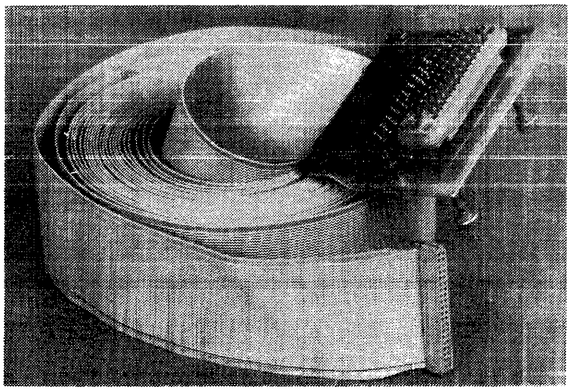
When used as an indicator, CHECK provides status information about certain printer functions and will illuminate for one or more of the following reasons:

- Form thickness adjustment lever is in load position.
- Paper has run out.
- There is no paper motion when the printer is operating.
- Internal voltage is abnormal.

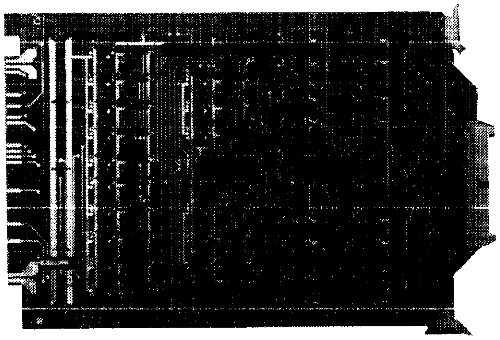
PR — Printers



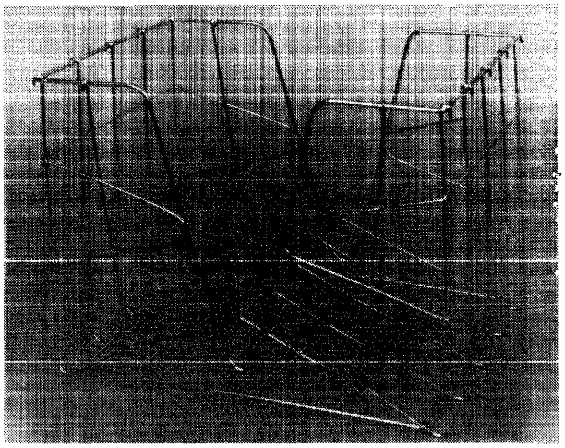
LP300/LP600 PRINTER
2271814-0001 THROUGH - 0014 (LP300)
2271815-0001 THROUGH - 0014 (LP600)



LP300/LP600 PRINTER CABLE ASSEMBLY
PART NO. 937490-2



TTL DATA MODULE
PART NO. 0945145-0006



LP300/LP600 PRINTER PAPER CATCHER
PART NO. 2271799-0001

2277167

Figure 2-1. LP300/LP600 Printer Subsystem

NOTE

> If the CHECK pushbutton/indicator remains lighted after all noticeable faults have been corrected, troubleshooting may be necessary. Refer to the printer field maintenance manual.

2.2.3 8LPI Pushbutton/Indicator

The 8LPI pushbutton/indicator is an indicator and a momentary action switch that selects line spacing of either eight lines-per-inch (lighted) or six lines-per-inch (unlighted). This pushbutton indicator is operational only when the printer is offline.

2.2.4 PAPER ADVANCE Pushbutton

When the PAPER ADVANCE pushbutton is held down, it causes the printer paper to advance.

2.2.5 TOP OF FORM Pushbutton/Indicator

The TOP OF FORM pushbutton/indicator is a status indicator and a momentary action switch. When depressed, it causes the paper to advance to the top of the next form. When lighted, the indicator indicates the electronic vertical format unit (EVFU) is loaded. This pushbutton/indicator is operational only when the printer is offline.

2.2.6 ON LINE Pushbutton/Indicator

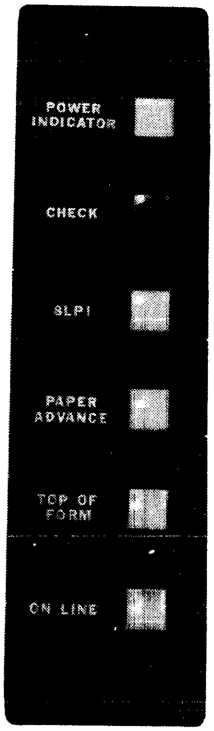
The ON LINE pushbutton/indicator is an indicator and a momentary action switch. When depressed (lighted), it places the printer online. When this indicator is not lighted, the printer is offline and cannot receive data from the computer.

2.3 OTHER LP300/LP600 PRINTER CONTROLS

Four printer controls not located on the printer operator panel are:

- Power ON/OFF switch
- Form width adjustment
- Form thickness adjustment
- Vertical positioning adjustment

Figure 2-3 shows the location of the form width and thickness adjustments and the vertical positioning adjustment.



2277168

Figure 2-2. LP300/LP600 Printer Operator Panel

2.3.1 Power ON/OFF Switch

A toggle switch on the left side of the printer controls ac power. When this switch is set to ON and power is applied to the printer, the POWER INDICATOR lights on the operator control panel.

2.3.2 Form Width Adjustment

The printer may be adjusted for form width in two ways. First, the printer mechanism may be adjusted to accept paper forms from 100 to 400 millimeters (4 to 16 inches) wide, by unlocking and repositioning the tractor knobs and repositioning the tractors that engage the holes in the paper (Figure 2-3). Once the tractor knobs are unlocked, the right-hand tractor may be moved the full width of the hammer bank. However, the left-hand tractor may be moved only 28 millimeters (1.1 inches) outward (left) from print column one. This tractor also has a mark for use in setting the top of form (TOF). In the second method of form width adjustment, the horizontal vernier adjustment knob allows both tractors to be moved simultaneously a maximum distance of two columns in either direction.

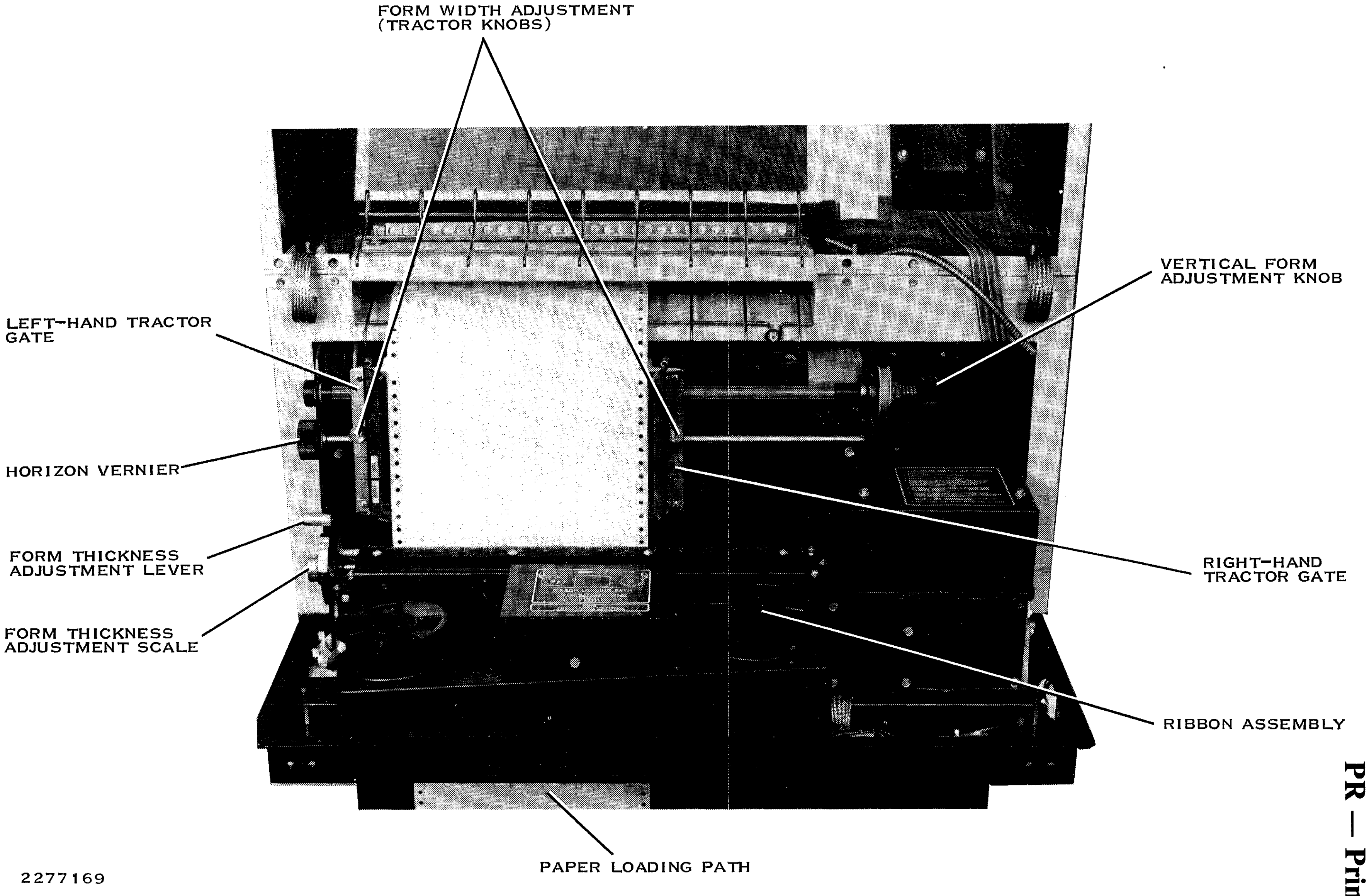


Figure 2-3. LP300/LP600 Printer Internal View

2.3.3 Form Thickness Adjustment

The form thickness adjustment lever is located on the left-hand side of the printer mechanism (Figure 2-3). The lever scale is marked with approximate locations (Figure 2-4) for various thicknesses of forms. The actual thickness of form will determine the proper lever setting.

To position the lever satisfactorily, initialize the self-test described in the installation and operation manual and observe the results. If the printed characters are too light, move the lever toward the rear of the printer. If the printed characters are too dark, move the lever toward the front of the printer.

2.3.4 Vertical Positioning Adjustment Knob

The vertical positioning adjustment knob (Figure 2-4) moves the paper up or down. It is used primarily in conjunction with the TOF tractor marks to set the TOF.

2.4 LP300/LP600 PRINTER INTERFACE CONTROLLER

The LP300/LP600 printers use the 16 I/O TTL data module, part number 945145-0006, shown in Figure 2-1 as the interface controller. The jumper schedule for this controller is as follows:

Configuration	Jumpers
One low-to-high interrupt	E5 to E20 E9 to E10 E11 to E12 E7 to E13 E16 to E18 E17 to E19

2.5 LP300/LP600 INTERCONNECTING CABLING

Figure 2-5 shows the interconnecting cabling for the printers.

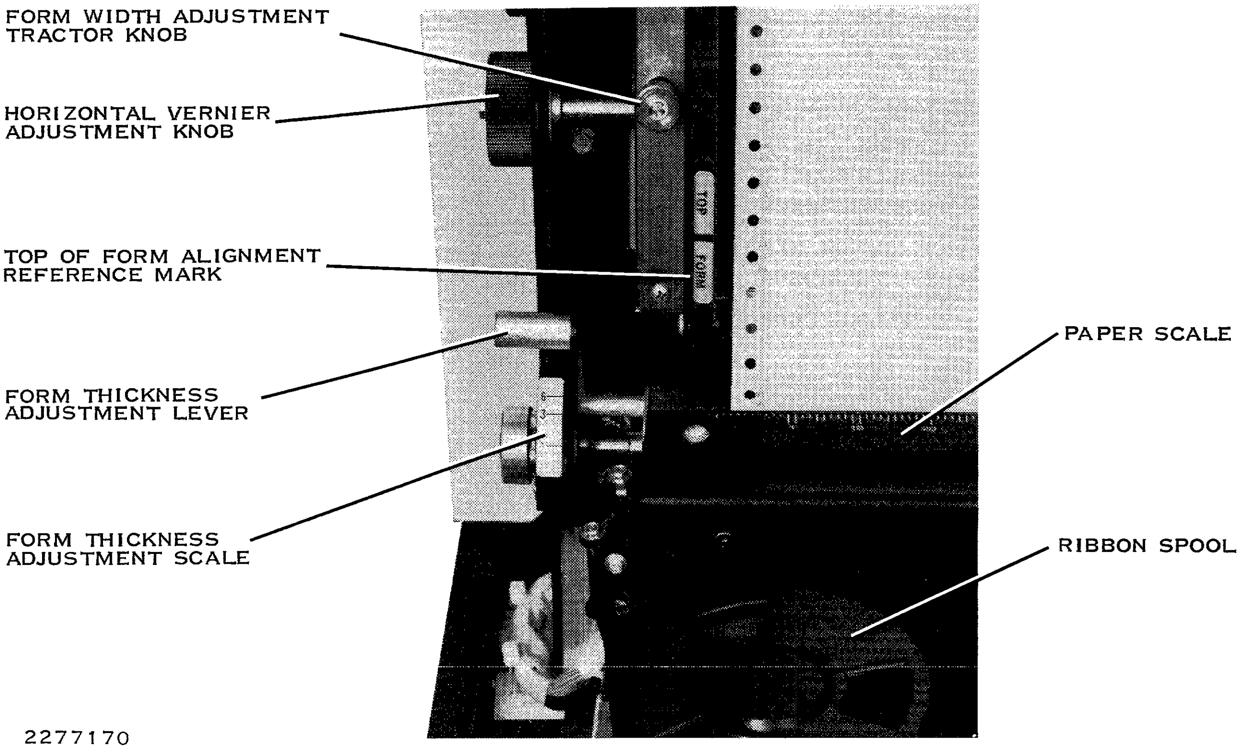


Figure 2-4. Form Thickness Adjustment Control

PR — Printers

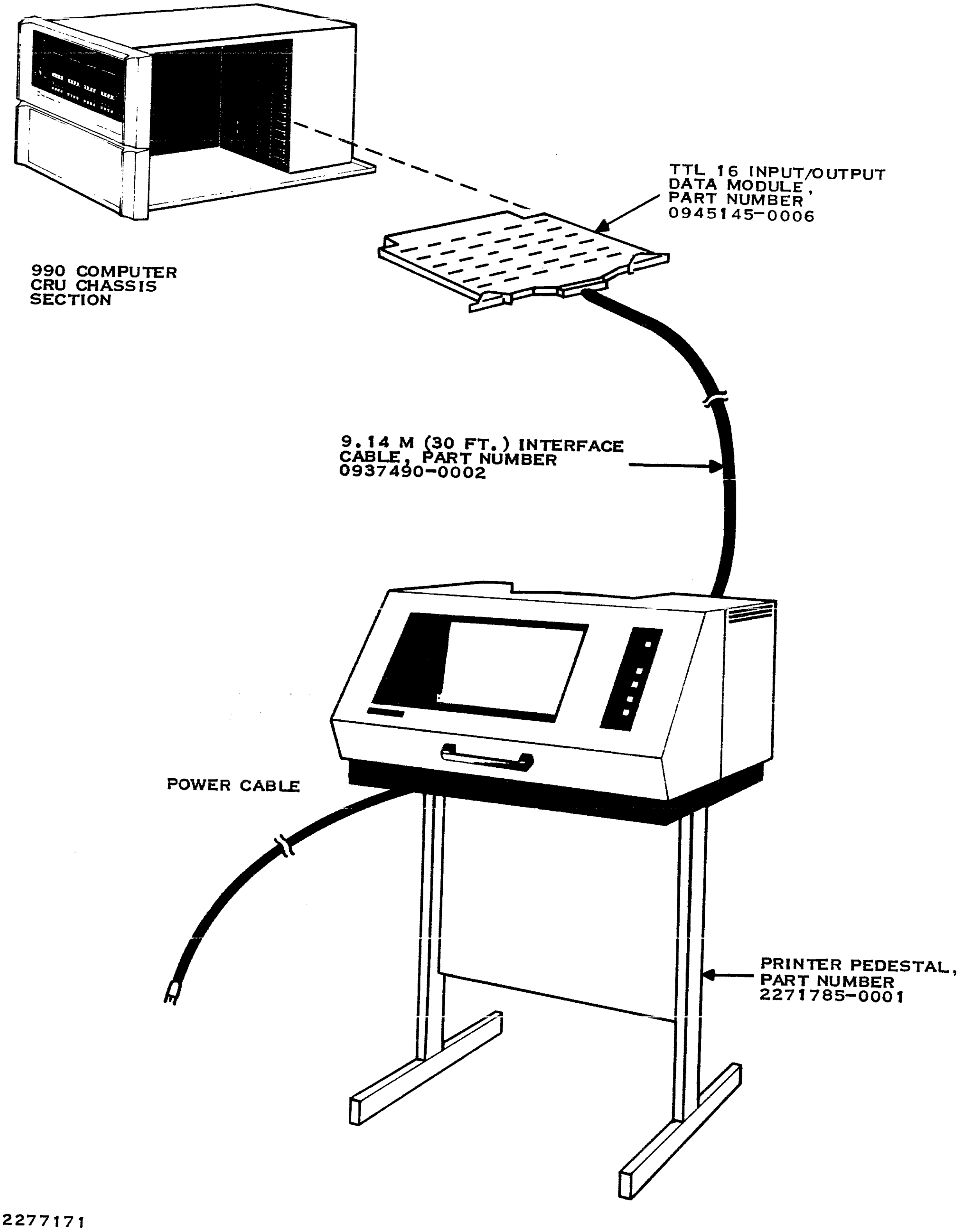


Figure 2-5. LP300/LP600 Printer Subsystem Interconnection Diagram

2.6 LP300/LP600 PRINTER FIELD-REPLACEABLE COMPONENTS

The field-replaceable components for the LP300/600 printers are as follows:

Item	TI Part Number	Vendor Part Number
Model LP300 Printer Only		
Timing Belt	2213548-0001	101768-001
Hammer Spring Assembly	2213548-0002	101127-001
Shuttle Spring	2213548-0003	101162-001
Hammer Drive PCB Assembly	2213548-0004	101200-001
Shuttle Assembly	2213548-0005	101458-001
Motor, Shuttle Assembly	2213548-0006	101485-001
Hammer Coil Assembly	2213548-0007	101711-001
Counter-Balance Assembly	2213548-0008	102064-001
Power Supply	2213548-0009	102160-001
Shuttle Cam Assembly	2213548-0010	102169-001
Power Supply	2213548-0011	102239-901
Ribbon Mask Assembly	2213548-0012	104086-002
Model LP600 Printer Only		
Fuse, 3 A	2213548-0014	101386-030
Fuse, 6 A	2213548-0015	101386-060
Power Supply Fan	2213548-0016	101388-001
Paper Forward Motor	2213548-0017	101474-901
Indicator Lamp	2213548-0018	101476-001
Switch Indicator (white)	2213548-0019	101487-001
Magnetic Pick-Up Assembly	2213548-0020	101494-901
Power Supply Cable	2213548-0021	101495-002
Cable — Logic A, Logic B	2213548-0022	101497-001
Cable — I/O	2213548-0023	101500-001
Tractor Assembly, Right	2213548-0024	101545-001
Tractor Assembly, Left	2213548-0025	101545-003
Blower Motor Assembly	2213548-0026	101624-001
Sensor, Paper Motion	2213548-0027	102057-001
Cable, PMD	2213548-0028	102071-001
Ribbon Control PCB Assembly	2213548-0029	102140-901
Ribbon Deck Drive Assembly	2213548-0030	102180-901
Ribbon Drive Motor	2213548-0031	102287-901
Paper Out Switch	2213548-0032	102634-001
Hammer Spring Assembly	2213548-0033	103013-901
Hammer Drive PCB Assembly	2213548-0034	103240-901
Power Supply Assembly	2213548-0035	103250-901
Shuttle Assembly	2213548-0036	103300-901
Hammer Coil Assembly	2213548-0037	103304-901
Shuttle Spring	2213548-0038	103036-001
Cable, Hammer Bank	2213548-0039	103311-011
Power Supply Assembly	2213548-0040	103313-901

PR — Printers

Item	TI Part Number	Vendor Part Number
Motor, Shuttle Assembly	2213548-0041	103315-001
Shuttle, Cam Assembly	2213548-0042	103326-001
Counterweight Spring	2213548-0043	103347-001
Both Models LP300 and LP600 Printers		
Logic A4 PCB Assembly	2213548-0044	103831-901
Logic B7 PCB Assembly	2213548-0045	103830-901

3

LQ45 Letter Quality Printer

3.1 MODEL LQ45 CRU SERIAL LINE PRINTER

The Model LQ45 Letter Quality Printer (Figure 3-1) is a receive-only, forms-programmable, impact printer that features an internal microprocessor.

Reference manuals for use with the LQ45 printer are as follows:

- *Model 990 Computer Model LQ45 Letter Quality Printer Installation and Operation Manual*, part number 2268695-9701.
- *Model 990 Computer Model LQ45 Letter Quality Printer Field Maintenance Manual*, part number 945419-9705.

3.2 FUNCTIONS OF PRINTER MECHANISMS

Figure 3-2 labels the parts of the printer mechanism that are important in the proper operation of the printer. A brief functional description of each of the items is provided in the following subparagraphs. Not shown in Figure 3-2, but described in the paragraphs that follow, are the column scale, the column scale indicator, and the ribbon advance switch.

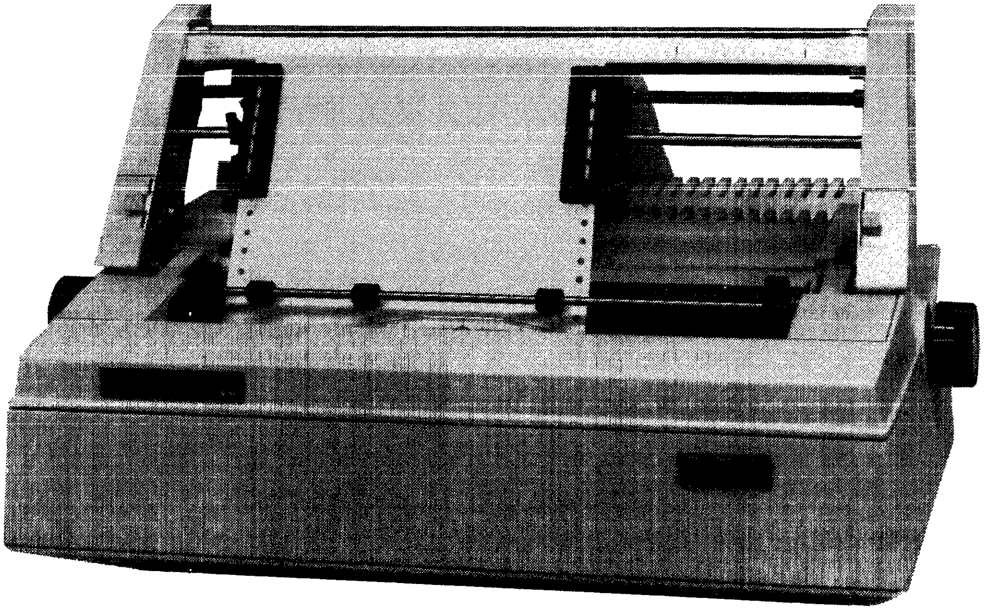
3.2.1 Platen

The platen holds the paper or form in printing position. The cushion face on the platen presents the proper backing for best print quality and quiet operation.

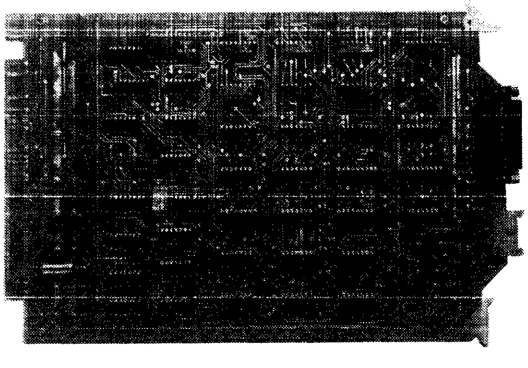
3.2.2 Platen Knobs

The platen knobs are used as they are on a typewriter, to move the paper or form vertically during paper loading or unloading. The platen knob to the operator's right can be pressed inward for fine vertical paper adjustments.

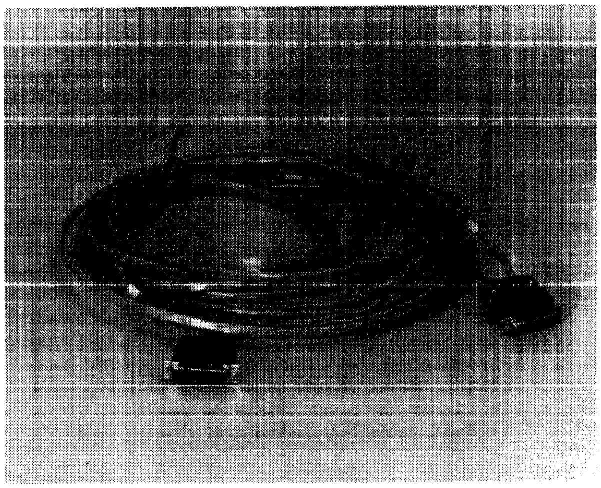
PR — Printer



LQ45 LETTER QUALITY PRINTER
(SHOWN WITH OPTIONAL TRACTOR FORM),
PART NO. 2262224-0001, 115 VAC OR
PART NO. 2262224-0002, 220 VAC



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



INTERFACE CABLE ASSEMBLY
PART NO. 975056-0030
(USED WITH TTY/EIA
INTERFACE MODULE) OR
PART NO. 2271821-0001
(NOT SHOWN, USED WITH
MODEL 990/5 COMPUTER)

2277160

Figure 3-1. Model LQ45 Letter Quality Printer Subsystem

3.2.3 Paper Bail

The paper bail holds the paper or form against the platen to prevent character smearing and for quiet operation. The paper bail is spring-loaded against the platen during normal operation and can be pulled forward by the operator while paper is being loaded.

3.2.4 Paper Release Lever

When the paper release lever is pulled forward (toward the operator), the tension between the feed rollers (below the platen) and the platen is removed. This allows the operator to adjust the paper or form freely in any direction. The normal operating position is to the rear.

3.2.5 Multicopy Select Lever

The multicopy select lever adjusts the spacing between the printing mechanism and the platen. For single-part forms or ordinary paper, the lever should be in the forward released position (toward the operator). For multipart forms or extremely thick stock paper, the lever can be moved one or more notches to the rear for better print quality.

3.2.6 Paper Centering Scale

The paper centering scale is similar to scales found on most typewriters. This scale aids the operator in positioning paper in the printer.

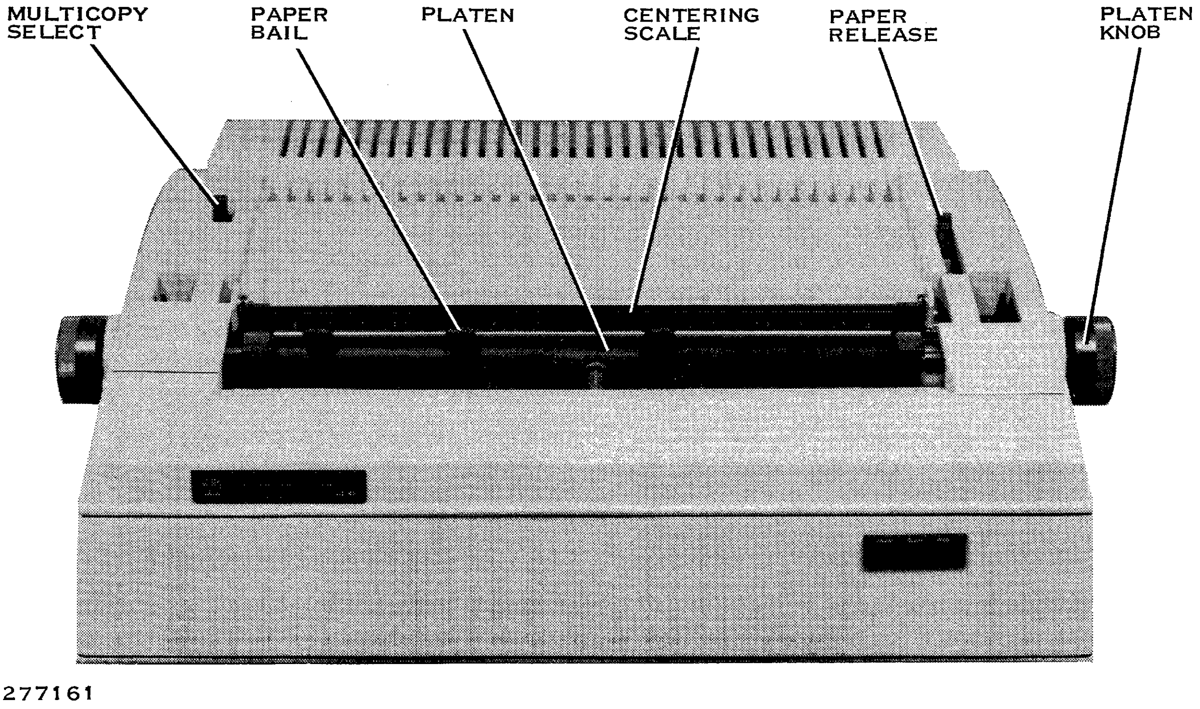


Figure 3-2. Printer Mechanism Parts Locations

3.2.7 Column Scale and Column Scale Indicator

The column scale (Figure 3-3) is a general guide to the column position of printed characters and the print mechanism. The scale is graduated for both 10 and 12 column spacings per inch. The operator should be aware that the printer can be commanded to operate with column spacings other than 10 or 12 per inch. Hence, the column scale will not accurately show the numeric column position.

The column indicator, a marker above the printhammer, shows the present printing position. When it is used in conjunction with the column scale, the column number can be easily determined.

3.2.8 Ribbon Advance Switch

The ribbon advance switch (Figure 3-4) is located inside the right front corner of the printer. The ribbon advance switch is used to remove slack in the ribbon and to advance the ribbon when installing a new ribbon cartridge.

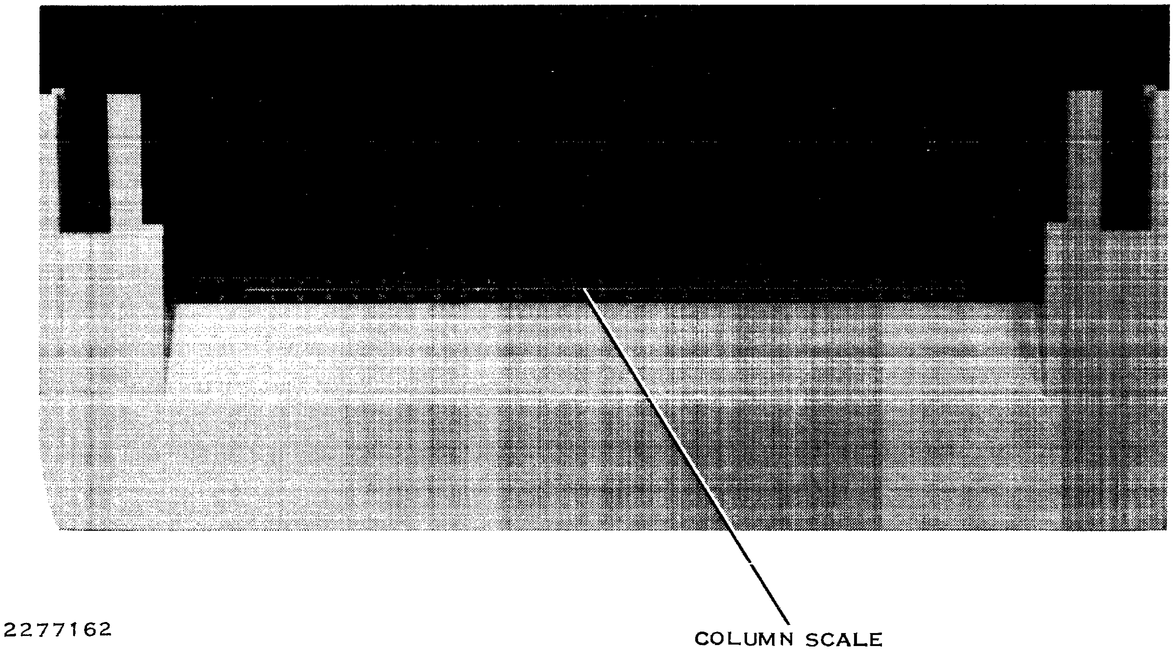


Figure 3-3. Column Print Position Indicator

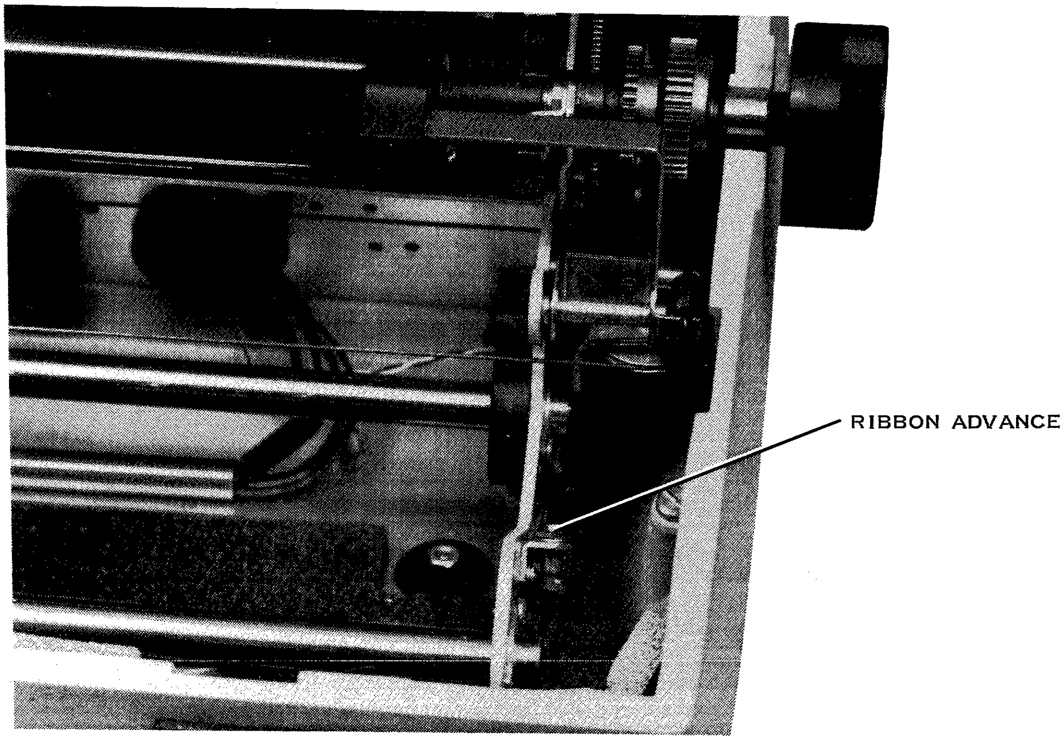


Figure 3-4. Ribbon Advance Control

3.3 CONTROLS AND INDICATORS

The printer controls and indicators consist of three front panel indicator lamps and a power on/off switch. The indicator lamps as shown in Figure 3-5 and described in Table 3-1 are located at the top right of the printer front panel. The power on/off switch as shown in Figure 3-6 is located at the right rear corner of the printer. For the low-voltage configuration (part number 2262224-0001), the power switch is an alternate-action switch. Pressing the switch once will toggle the switch to the opposite state. Pushing the switch a second time returns the switch to the first state. If power is not on as indicated by the POWER lamp when the power cord is connected to the source outlet, press the switch once to turn on the power supply. For the high-voltage configuration (part number 2262224-0002), the power switch is a conventional on/off toggle switch.

PR — Printer

Table 3-1. Printer Indicator Lamps

Indicator	Function
POWER lamp	When lit, indicates that the printer power is on.
READY lamp	When lit, indicates that all printer internal systems are ready to operate and that the printer top cover is in place.
RIBBON lamp	When lit, indicates that the printer has ribbon. The lamp extinguishes when the printer is out of ribbon.

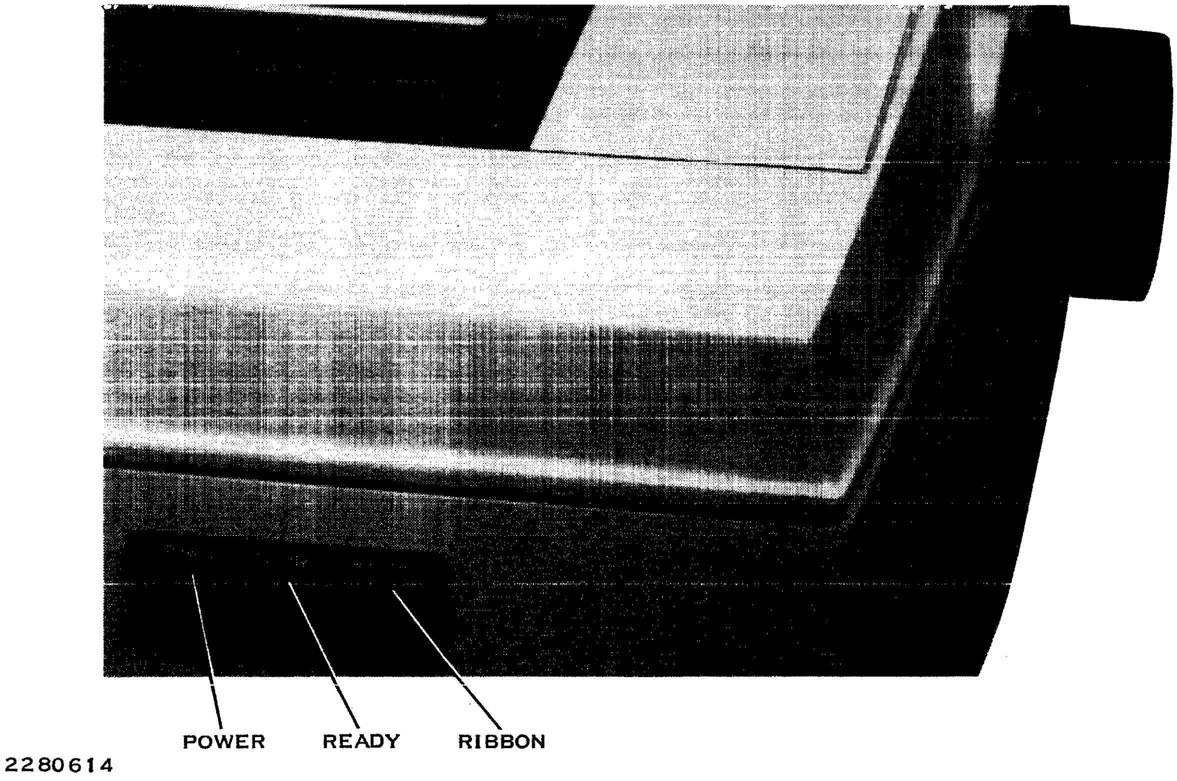


Figure 3-5. Printer Indicator Lamps

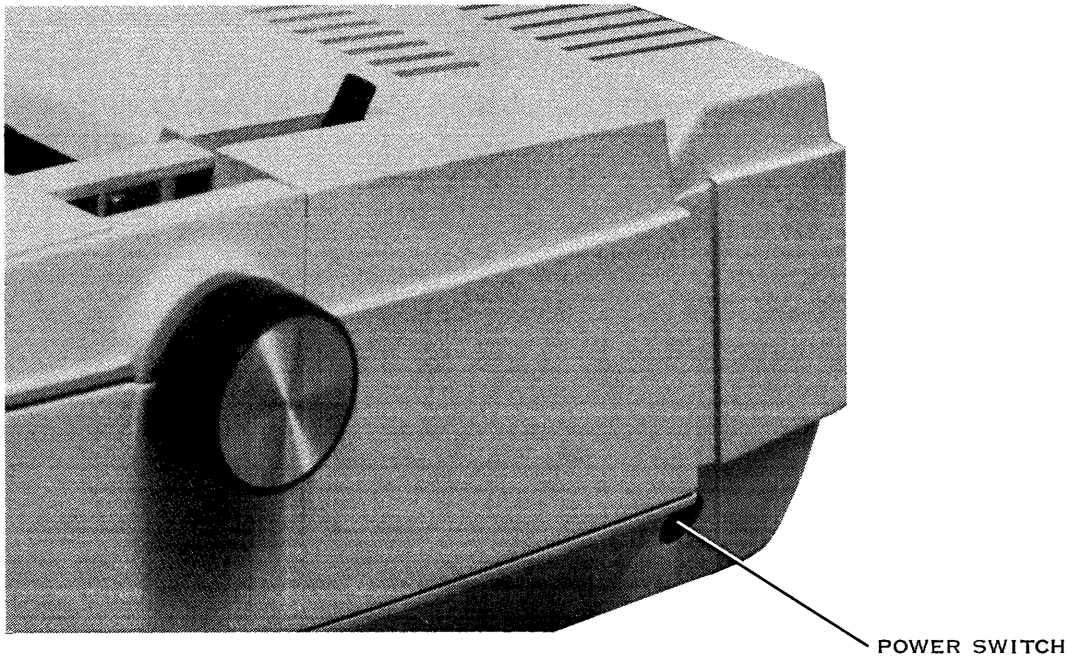


Figure 3-6. Printer Power Switch Location

3.4 TURN-ON PROCEDURES

To turn the LQ45 printer on, proceed as follows:

CAUTION

To prevent possible damage to the printwheel, do not print without a ribbon or with paper that is too narrow for the printed line width. If the full column width is used, the paper must be at least 14 7/8 inches wide.

1. Check that ribbon and paper are properly installed.
2. Apply power to the printer with the power on/off switch at the right rear of the printer.
3. The printer performs a self-test. If conditions are judged to be normal by the self-test, the READY indicator lights.

At this time, the initial conditions set for the printer are as follows:

1. The form length is set for 11 inches.
2. Line spacing is set to six lines per inch.
3. Character spacing is set to 12 characters per inch.
4. The printer is set for 1200 baud reception.
5. Left margin is set to column 0 and right margin is set to rightmost column; no horizontal tabs are set; the ribbon is set for automatic feed; the printer is set for forward print direction; and no special modes are set.

This completes the turn-on procedures if no changes to the above initial conditions are desired.

3.5 TURN-OFF PROCEDURES

Use the power on/off switch at the right rear of the printer to remove power from the printer. Note that when power is again applied to the printer, the printer returns to those initial conditions described in the turn-on procedures. If conditions other than the initial conditions are desired at next turn-on of the printer, the conditions must be noted and reentered into the printer after power is again applied.

3.6 SELF-HELP PROCEDURES

Proper operation of the printer depends not only upon the printer itself but also upon the proper operation of the host computer and the TTY/EIA interface module, the interface cable, and the ac power source for the printer. This paragraph provides a suggested list of corrective measures. If these measures do not correct the problem, refer to the *Model LQ45 Letter Quality Printer System Field Maintenance Manual* for troubleshooting procedures. The following is a list of corrective measures that may be taken by the operator:

1. Does the printer have power? At least the POWER lamp on the front panel should be lit. If the lamp is not lit, check the ac line cord connections and the printer power switch. Try another electrical appliance in the same receptacle to verify that ac power is present at the receptacle.
2. Is the top cover off or not seated properly? The printer is disabled by the interlock and the READY lamp is extinguished when the top cover is not properly installed. Check the cover; remove and reinstall it if there is doubt.
3. Is the ribbon cartridge empty? For printers that are equipped with the out-of-ribbon detect, the printer is usually disabled and the RIBBON lamp is extinguished when there is no ribbon.
4. Is the READY lamp lit? Except for limited situations, the READY lamp must be lit for the printer to operate properly.

5. Cycle power off and on to the printer. This resets the internal portions of the printer. If this must be done often, it indicates possible programming problems or difficulties within the printer.
6. Be sure that the printwheel is firmly and squarely in place.
7. Be sure that the printwheel motor mechanism is locked into place by firmly depressing the button marked C near the printwheel.
8. Make sure all cables are properly attached and have not been damaged.
9. If print quality is poor, examine the printwheel for dirt or wear. Replace the printwheel if necessary. Also check that the ribbon is threaded properly and is advancing as it should.
10. Command a self-test from the central processor of the associated computer. If the test completes satisfactorily but problems still exist with printer operation, call the service representative.

3.7 LQ45 PRINTER INTERFACE CONTROLLER

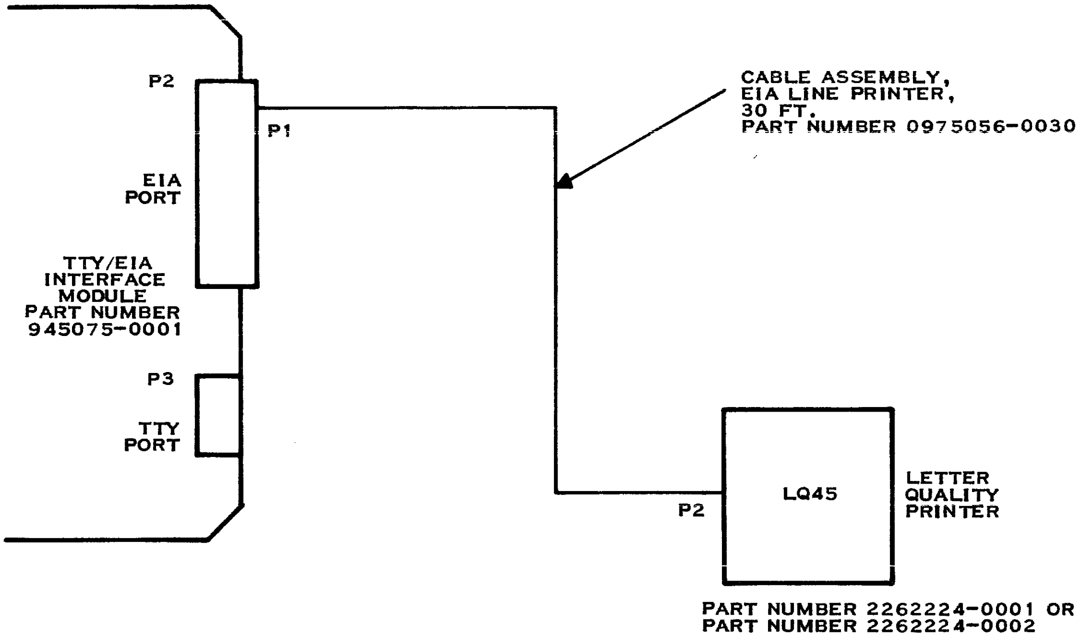
The LQ45 printer uses the same TTY/EIA interface module (part number 945075-0001) as the 733 ASR/KSR terminal. The standard jumper schedule for the LQ45 printer interface module is as follows:

Option	Jumper
Baud rate = 1200	EIB to E4
Logic level = EIA	E8 to E9
Code format = 10-bit (receive)	E11 to E12
Code format = 10-bit (transmit)	E14 to E15
Enable receive during RTS	E17 to E18
Disable 110 baud	E20 to E21
RTSE = DSRE	E26 to E27

3.8 LQ45 PRINTER INTERCONNECTING CABLING

The interface connector is located at the right rear of the printer. All printers have an EIA standard RS-232C interface connector for serial input. Interconnecting cabling for the printer is shown in Figure 3-7. The 990/5 computer uses I/O interface cable, part number 2271821-0001, while all other configurations use part number 975056-0030.

PR — Printer



NOTE:

990/5 CABLE PART NUMBER IS 2271821-0001. THE CABLE (P1 CONNECTOR) CONNECTS TO PORT 1 (P4) OR PORT 2 (P5) ON THE 990/5 COMPUTER.

2280615

Figure 3-7. LQ45 Printer Interconnecting Cabling

3.9 FIELD-REPLACEABLE COMPONENTS

The field-replaceable components for the LQ45 printer are as follows:

Item	TI Part Number	Vendor Part Number
Motor Carriage	2213524-0001	180023-01
Carriage Assembly	2213524-0002	180028-15
Paper Feed Motor	2213524-0008	180046-02
Arm Assembly	2213524-0024	180369-02
Power Supply Module	2213524-0033	180750-01
Fan Assembly	2213524-0035	181847-01
PCB Number 1	2213524-0044	190612-01
PCB Number 2	2213524-0045	190722-00
PCB Number 3	2213524-0046	190632-01
PCB Number 4	2213524-0047	190742-01
Backpanel	2213524-0043	190712-02
Heatsink	2213524-0042	190092-02
Heatsink	2213524-0030	180712-01
Tractor, Right	2213524-0040	185212-02

PR — Printer

Item	TI Part Number	Vendor Part Number
Tractor, Left	2213524-0039	185212-01
Cradle Assembly	2213524-0005	180032-03
Forward Roller Bail	2213524-0010	180142
Front Shaft Assembly	2213524-0011	180153
Rear Shaft	2213524-0012	180154
Left Bail Assembly	2213524-0034	180819
Stop Pad	2213524-0025	180374-01
Guide Link Assembly	2213524-0022	180358
Clutch Assembly	2213524-0009	180057-01
Gear Assembly 36T	2213524-0023	180367
Idler Gear	2213524-0019	180218
Knob Assembly	2213524-0007	180045
Resistor	2213524-0026	180610-01
Paper Feed Motor	2213524-0008	180046-02
Transistor	2213524-0052	197028-01
Transistor	2213524-0053	197029-01
Platen Lever	2213524-0020	180320-01
Roller Assembly	2213524-0021	180329
Pulley Assembly	2213524-0006	180037
Cabinet Fan	2213524-0035	181847-01
Photo Sensor	2213524-0003	180030-01
Photo Sensor	2213524-0004	180031-01
Impression Lever	2213524-0016	180186
Idler Gear	2213524-0017	180202
Ham Guides	2213524-0029	180687-03
Ham Spring	2213524-0031	180713
Carriage Spring	2213524-0028	180614
Inner Carriage Spring	2213524-0027	180613
Cable Carrier	2213524-0038	185127-01
Stepper Motor	2213524-0018	180207
Ribbon Tension	2213525-0037	181975
Tractor Gear	2213524-0014	180175
Platen Gear	2213524-0015	180177
Rear Sensor	2213524-0041	188932
Forward Level	2213524-0013	180160
Lift Coil Ribbon	2213524-0036	181924
Ham Assembly	2213524-0032	180714-07
Fuse, Dico	2213524-0048	194218-04
Fuse, Dico	2213524-0049	194218-05
Trans Print Wheel	2213524-0050	197026-01
Trans Print Wheel	2213524-0051	197027-01

4

2230/2260 Line Printers

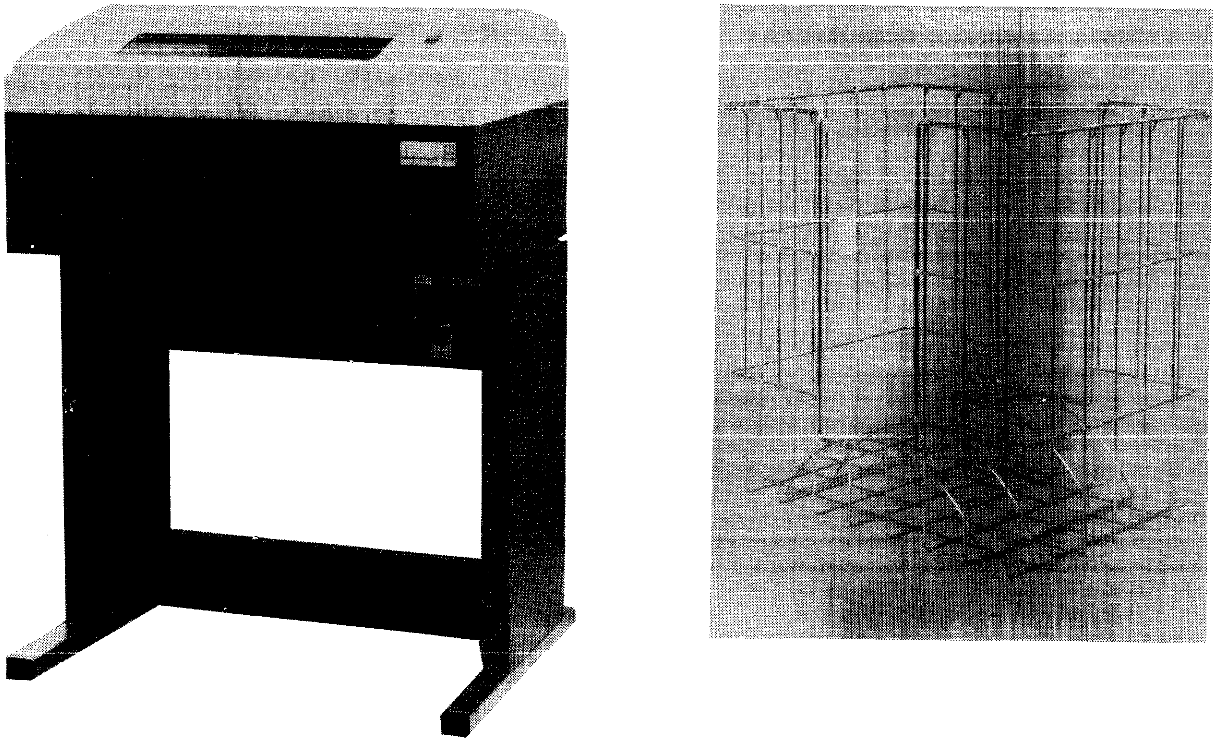
4.1 MODEL 2230/2260 CRU PARALLEL LINE PRINTERS

The Models 2230 and 2260 Line Printers (Figure 4-1) are medium-speed, drum-type impact printers.

Reference manuals for use with the 2230/2260 printers are as follows:

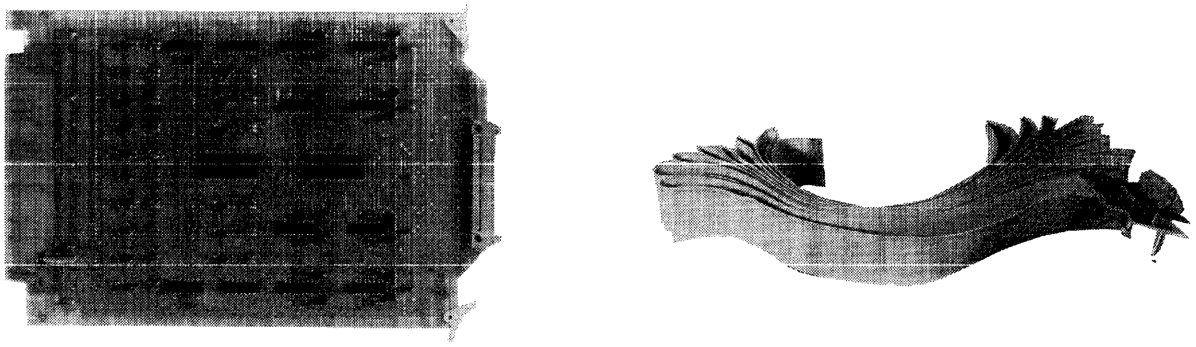
- *Model 990 Computer Model 2230/2260 Line Printer Installation and Operation Manual,* part number 946256-9701.
- *Model 2230 Line Printer Maintenance Manual*, Data Products part number DPC 241735H; TI part number 2272145-9701 (Volume I), TI part number 2272145-9702 (Volume II)
- *Model 2260 Line Printer Maintenance Manual*, Data Products part number DPC 239541G; TI part number 2272146-9701 (Volume I), TI part number 2272146-9702 (Volume II)

PR — Printers



MODEL 2230 OR 2260 LINE PRINTER
PART NO. 841039

PAPER RECEPTACLE



16 I/O TTL DATA MODULE
PART NO. 945145-3

CABLE ASSEMBLY
PART NO. 937490-1

2277116

Figure 4-1. Components of 2230/2260 Line Printer Kit

4.2 2230/2260 PRINTER CONTROLS AND INDICATORS

The operator and maintenance controls for the 2230/2260 printers are shown in Figure 4-2. The operator control panel is shown in Figure 4-3. Operator and maintenance controls are as follows:

Control/Indicator	Function
MAIN POWER circuit breaker (located below print station)	Controls application of ac power to the printer.
COARSE VERTICAL FORM ADJUSTMENT	Permits operator to vertically position the form in predetermined increments. (To make a coarse adjustment, the FORMS RESET switch must be held down to prevent a format error.)
FINE VERTICAL FORM ADJUSTMENT	Permits the operator to vertically fine position the form between the predetermined incremental range of the coarse vertical form adjustment. This adjustment may be made when the printer is operating. To make a fine adjustment, the FORMS RESET switch must be up.
HORIZONTAL FORM ADJUSTMENT	Moves both tractors simultaneously to permit fine horizontal positioning of form.
NUMBER OF COPIES	Permits the operator to adjust the spacing between the character drum and the hammer bank (the paper moves between them during printing) and is used to compensate for thickness of multiple forms.
Tractor locks	Permits the operator to align the tractors with the paper edge-punched holes and permits coarse horizontal form adjustments.
PHASE (phasing control)	Allows the operator to adjust the print hammer firing to maintain equal print density at top and bottom of character.
PRINT INHIBIT switch	When set to ON, permits the operator to inhibit the print hammer driver circuits for test purposes. For normal printing, this switch is set to off position (away from the connector edge of the control logic card).

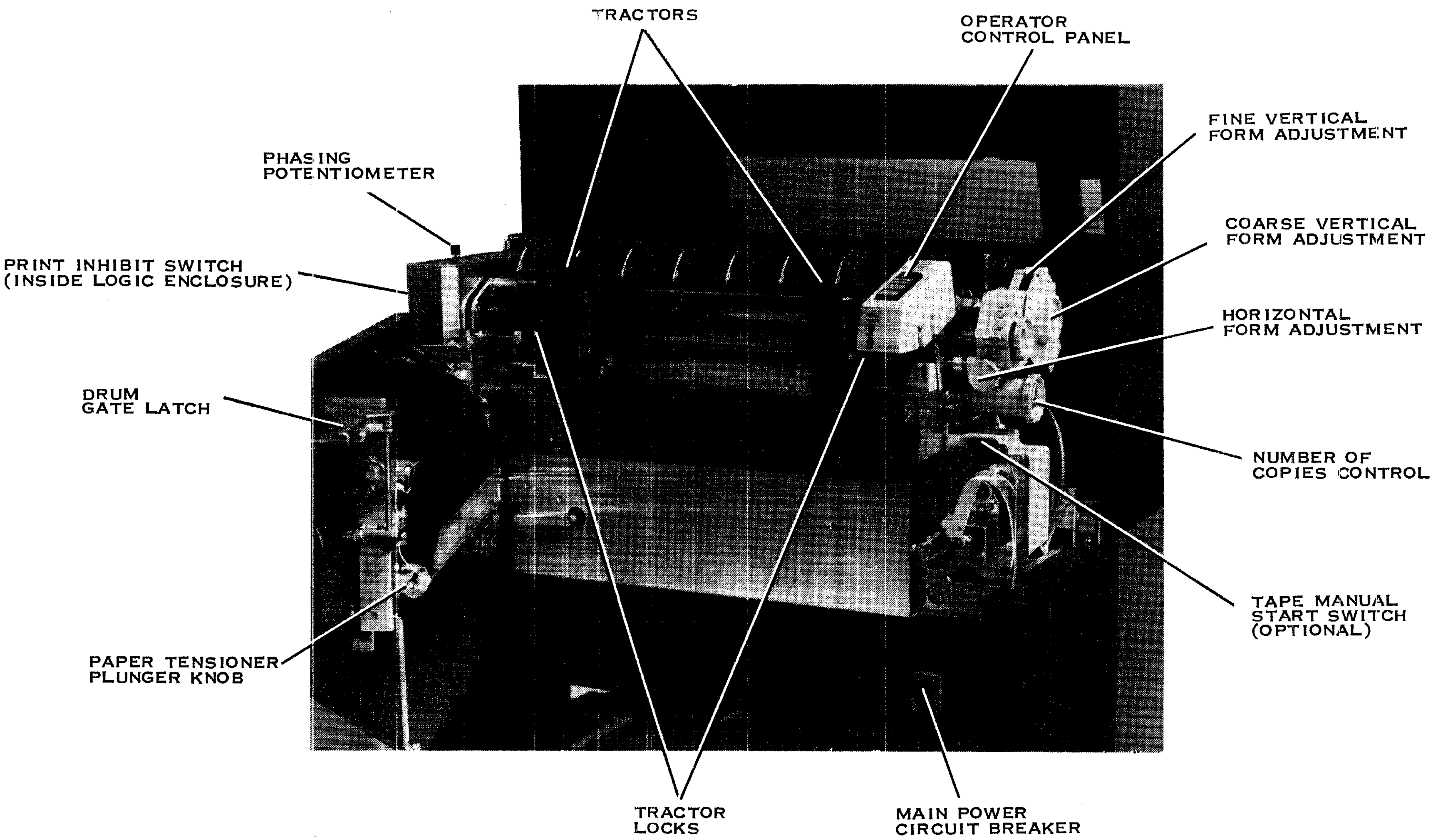


Figure 4-2. Operator and Maintenance Controls

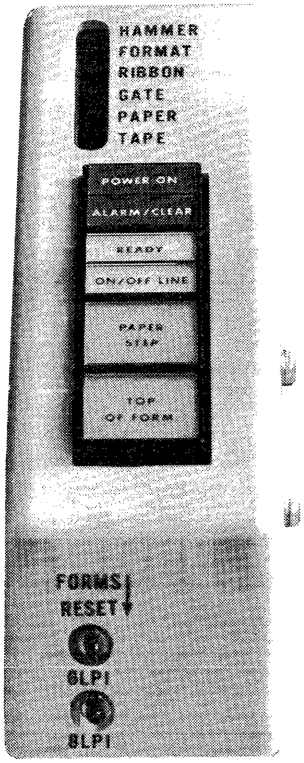


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Figure 4-3. 2230/2260 Operator Control Panel

The operator control panel is shown in Figure 4-3. The indicators and controls on this panel are as follows:

Control/Indicator	Function
POWER ON — ALARM/CLEAR, POWER ON	1. Illumination indicates all dc indicator voltages are within tolerances and the initial power-up delay (four seconds) has been completed. 2. Off (with MAIN POWER breaker ON,) the indication is that the voltage delay signal (VDEL) is active. During initial power on, VDEL is active for four seconds while dc levels are stabilizing. When dc levels have stabilized, VDEL goes inactive and POWER ON indicator lights. If VDEL again becomes active, this indicates one of the dc voltages has dropped, indicating power supply fault. If VDEL becomes active during a print cycle, the print cycle in progress will not be completed.

PR — Printers

Control/Indicator	Function
ALARM indicator	1. On indicates fault. A fault condition will take the printer offline. If the specific fault condition has an associated indicator, that indicator will also be lit. 2. This indicator illuminates when the character drum is not rotating at its proper speed (drum speed fault). 3. This indicator illuminates when the PRINT INHIBIT switch is in the on position and the READY indicator is lit.
Fault indicators	Illumination indicates the occurrence of a printer fault condition that will cause the printer to go offline upon completion of the print cycle in progress. These indicators light in conjunction with the ALARM indicator.
HAMMER fault indicator	Illumination indicates that hammer current is flowing when a hammer should not be firing, or that no hammer fired although at least one was addressed. This indicator does not light when the PRINT INHIBIT switch is ON.
FORMAT fault indicator	Illumination indicates that the line strobes generated in the control logic are not comparing with the strobes generated by the line count track (6 or 8) on the position encoder disk. A format fault is cleared by actuating the FORMS RESET switch.
RIBBON fault indicator	Illumination indicates that ribbon direction has failed to reverse at end of spool, a ribbon motor is open or shorted, or ribbon snag has developed.
PAPER fault indicator	Illumination indicates that the printer is out of paper, the paper is torn, or paper runaway has occurred. A paper runaway is a failure of the paper feed system to come to a stop within three seconds. A paper fault is cleared when the printer is master-cleared. Press and release CLEAR switch to clear the paper fault indication.
TAPE fault indicator	Illumination indicates a parity error has been detected in the VFU memory, or a tape channel command has been issued for which no hole has been punched.

Control/Indicator	Function
GATE fault indicator	Illumination indicates that the drum gate is open or that the gate latch is not latched. The GATE fault is cleared when the drum gate is closed.
CLEAR switch	Pressing the CLEAR switch will master-clear (initially) printer logic.
READY ON/OFF LINE READY indicator	Illumination indicates that all interlocks are satisfied, there is no fault condition, and the printer is ready to be placed online.
ON/OFF LINE indicator	Illumination indicates that the printer is online and controlled by the user system. At initial power-up, the indicator will be off.
ON/OFF LINE switch	Pressing this switch alternately places the printer online and offline. At initial power-up, the printer will be in the offline mode.
PAPER STEP switch	Pressing this switch advances paper to the next line. The switch is disabled when the printer is online and during a tape loading operation of the tape VFU option.
TOP OF FORM switch	Pressing this switch advances paper to the next line. The switch is disabled when the printer is online and during a tape loading operation of the tape VFU option.
FORMS RESET switch	When held down, the FORMS RESET switch allows manual override of the paper feed servo system so that paper may be repositioned during the time power is on. (Refer to COARSE and FINE VERTICAL FORM ADJUSTMENT controls for the direct application of this switch.)
6LPI/8LPI switch	This switch permits the operator to select either six or eight lines per inch vertical spacing.

4.3 VFU LOADING AND PROGRAMMING INSTRUCTIONS

The tape VFU is an option that serves as a paper advance controller for the printer by monitoring input data from the user system. The tape VFU consists of a tape reader (mounted to the right of the print station) and a tape VFU logic circuit card in the logic enclosure.

The following steps describe operator procedures for initial or concurrent tape load, and guidelines to be used when preparing punched tape and programming the user system. (Refer to Figure 4-4.)

To load the punched tape on the tape reader initially, proceed as follows:

1. With printer power off, raise the printer cover, and open the drum gate.
2. Open the tape reader cover, and place the punched tape sprocket holes on the sprocket drive with tape channel 1 oriented toward the front of the printer.
3. Close the tape reader cover, close the drum gate, lower the printer cover, and turn the power on. The tape will load automatically after the power stabilizes.
4. When the tape is loaded, the READY indicator on the operator control panel will light.

To load the punched tape on the tape reader during printer operation, proceed as follows:

1. Raise the printer cover and open the drum gate.

CAUTION

Wait for the character drum to stop rotating before proceeding to the next step.

2. Open the tape reader cover and place the punched tape sprocket holes on the sprocket drive with tape channel 1 oriented toward the front of the printer.
3. Close the tape reader cover, close the drum gate, press the Tape Manual Start switch, and lower the printer cover. The tape will load.
4. When the tape is loaded, the READY indicator on the operator control panel will light.

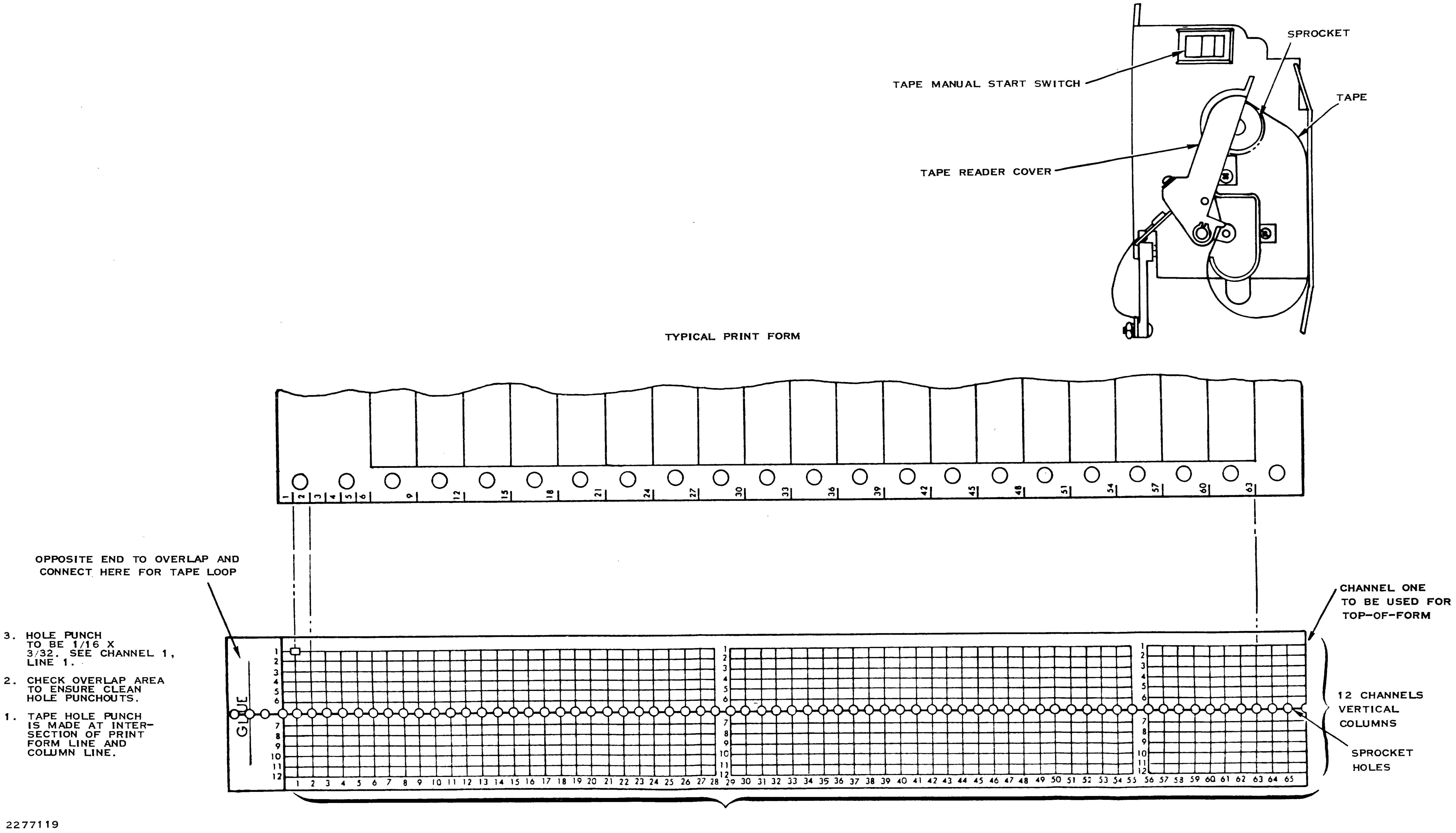

Figure 4-4. VFU Tape Loading and Punching

The following notes are provided as guidelines for preparing punched tape:

1. The tape reader is designed for standard IBM 12-channel tape only.
2. Each sprocket hole corresponds to one line of print. Refer to Figure 4-4.
3. Since tape channel 1 is used for top-of-form sensing, the tape should be punched with only one hole in channel 1.
4. Since the tape VFU logic counts lines (not lines per inch), the tape length should be as long as, or have as many sprocket holes as the length of the form times the lines per inch. For example, on an 11-inch form used at eight lines per inch, the tape will be 88 lines long or have a total of 88 sprocket holes. At six lines per inch using the same form, the tape will be 66 lines long.
5. Channels 2 through 11 can be punched in any manner to meet specific formatting needs.
6. Channel 12 is used for bottom-of-form sensing. Detection of this hole indicates to the printer control logic that the bottom of the form has been reached; if a paper-out condition exists, the printer will go offline. If the skip-over optional feature is installed on the VFU logic circuit card, detection of the hole will move the paper to the top of the next form if no paper-out condition was sensed.

4.4 2230/2260 PRINTER INTERFACE CONTROLLER

The 2230/2260 line printers use the 16 I/O TTL data module, part number 945145, shown in Figure 4-1, as the interface controller. The part numbers and the corresponding jumper schedule for this controller are as follows:

		Jumpers	
Part Number	**Configuration**	**-0003**	**-0006**
945145	One low-to-high interrupt	E1 to E3 E2 to E4 E5 to E8 E9 to E10 E11 to E12 E16 to E18 E7 to E13 E17 to E19	E5 to E20 E9 to E10 E11 to E12 E7 to E13 E16 to E18 E17 to E19

4.5 2230/2260 INTERCONNECTING CABLING

Figure 4-5 shows the interconnecting cabling for the printers.

PR — Printers

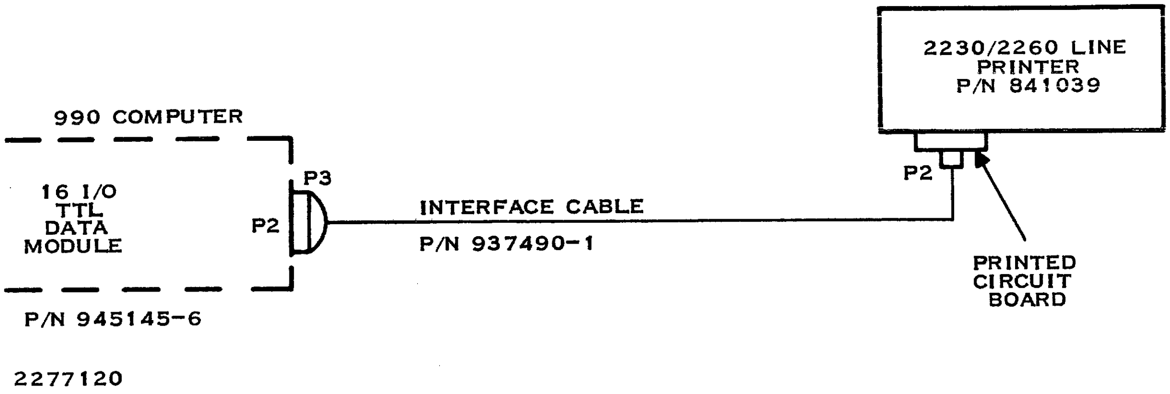

Figure 4-5. 2230/2260 Interconnecting Cabling

4.6 FIELD-REPLACEABLE COMPONENTS, 2230/2260 LINE PRINTERS

Field-replaceable components for the printers are as follows:

Item	TI Part Number	Vendor Part Number
PCB, Logic (2260)	0943831-0002	224706-001
PCB, Hammer Bank Supply (2260)	0943831-0003	237865-001
PCB, Vertical Format (2260)	0943831-0004	238044-003
PCB, Hammer Drive (2230/2260)	0943831-0006	238005-001
PCB, Regulator (2230)	0943831-0007	238030-001
Tape Reader (2230)	0943831-0010	240125-001
PCB, Logic (2230/2260)	0943831-0011	244708-803
PCB, I/O (2230/2260)	0943831-0020	244535-003
PCB, Regulator (2260)	0943831-0023	237480-001
PCB, Servo (2260)	0943831-0024	237880-001
PCB, VFU (2230/2260)	0943831-0025	238044-001
PCB, Self-Test (2230)	0943831-0026	244446-001
PCB, Self-Test (2260)	0943831-0027	244446-002
PCB, Logic (2230)	0943831-0195	247409-001
PCB, I/O (2230)	0943831-0196	243470-001
PCB, Servo (2230)	0943831-0197	235645-001
PCB, VFU (2230)	0943831-0193	244706-803
(Sub for 238045-001)		
PCB, Self-Test (2230/2260)	0943831-0199	244455-001
CCA Control Panel	0943831-0200	241523-001
Tape Reader (2260)	0943831-0225	240125-002
Controller	0945145-0006	None
Tractor Assembly (2230/2260)	0943831-0008	243365-001
Tractor Assembly (2230/2260)	0943831-0009	243365-002
Motor, Paper Feed (2230)	0943831-0016	801040-001
Motor, Paper Feed (2260)	0943831-0017	801325-002
Motor, Paper Feed Assembly (2260)	0943831-0028	238012-001

PR — Printers

Item	TI Part Number	Vendor Part Number
Capacitor Pack (2260)	0943831-0031	242060-001
Sensor, Paper Feed (2260)	0943831-0032	237835-001
Emitter, Paper Feed (2260)	0943831-0033	237640-001
Static Bar (2260)	0943831-0038	801680-001
Motor, Drum (2230)	0943831-0175	800954-001
Switch, Lower Paper-Out (2230)	0943831-0190	237403-001
Motor, Ribbon (2230/2260)	0943831-0191	801148-001
Motor, Paper Feed Assembly (2230)	0943831-0192	240064-001
Transducer (2230/2260)	0943831-0193	801619-001
Hammer, Mark IV B (2230/2260)	0943831-0201	127855-171
Blower, SN 5999 Down (2230/2260)	0943831-0209	801117-001
Blower, SN 6000 UP (2230/2260)		801346-001
Blower (2230/2260)	0943831-0210	800875-001
CKT Breaker (2230/2260)	0943831-0214	800797-001
Cap Pack Assembly (2230)	0943831-0215	253035-001
Coil Assembly (2230/2260)	0943831-0216	240780-001
Spring Assembly (2230/2260)	0943831-0217	238039-001
Sensor, Hammer Bank (2230/2260)	0943831-0218	235664-001
Emitter, Hammer Bank (2230/2260)	0943831-0219	235661-001
Sensor, Paper Feed Assembly (2230)	0943831-0220	235146-001
Sensor, Paper Feed Assembly (2260)	0943831-0221	235580-001
Transformer S/N 185 (2230/2260)	0943831-0222	800942-001
Transformer S/N 186 (2230/2260)	0943831-0223	800942-002
Relay, 12 V (2230/2260)	0943831-0224	801010-001
Reader Tape (2260)	0943831-0225	240125-002
Interface Cable	0937490-0001	None
Static Bar (2230)	0943831-0038	
PWB, Control Logic (2230)	0943831-0198	
Paper Feed Sense Assembly(2230)	0943831-0221	
Tape Reader (2230)	0943831-0225	
Transformer, Static Neutral (2230)	0943831-0249	
Tape Reader (2260)	0943831-0010	
Motor Drum (2260)	0943831-0175	
Transformer (2260)	0943831-0253	
AP 33 (2260)	0943831-0254	

1

Communications

Previous issues of this field maintenance manual contained information on operation and troubleshooting of the communications systems compatible with the TI DS990 Systems. However, the communications information is omitted in this issue in deference to a new publication that is more elaborate and detailed.

Field level maintenance information on the communications systems is contained in the *990 Family Communications Systems Field Reference Manual*, part number 2276579-9701, due to be published about 1 March 1982. This manual contains detailed information on the following major subjects:

- Introduction to Data Communications
- TI Communication Hardware
- TI Communication Software
- Communications Troubleshooting
- Test Equipment
- Communication Test Center

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Appendix A

DX10 System Crash Error Reporting

A.1 SYSTEM CRASH ERRORS

DX10 contains many internal consistency checks. If an error is detected within the system by one of these checks, the system will crash. A system crash has occurred if all terminals are locked out and both the FAULT and IDLE indicators on the front panel are lit. The pattern in the data lights on the front panel at this point represents a hexadecimal crash code. The system must be rebooted to continue.

System crashes usually occur as the result of a critical hardware error or a bug in the system software. Since these crashes arise from unexpected or unforeseen circumstances, it is difficult to describe beforehand any action the user could take to correct the problem beyond identifying (if possible) and avoiding the sequence of events that preceded the crash. A crash dump should be taken (paragraph A.1.1) and analyzed to determine the cause of the system crash. The dump may also be sent to TI with a copy of the system link map and a description of what was happening on the system at the time of the crash.

Table A-1 lists the system crash codes and a description of their causes. Auxiliary information is listed with those codes for which a possibility of user correction exists.

When the system crashes, all terminals in the system are inoperative and DX10 displays the following information on the front panel of the computer:

- The CPU data lights on the front panel of the computer display one of the system crash error codes described in Table A-1.
- The POWER, FAULT, IDLE, and RUN indicator lights of the computer are lit as shown in Figure A-1.

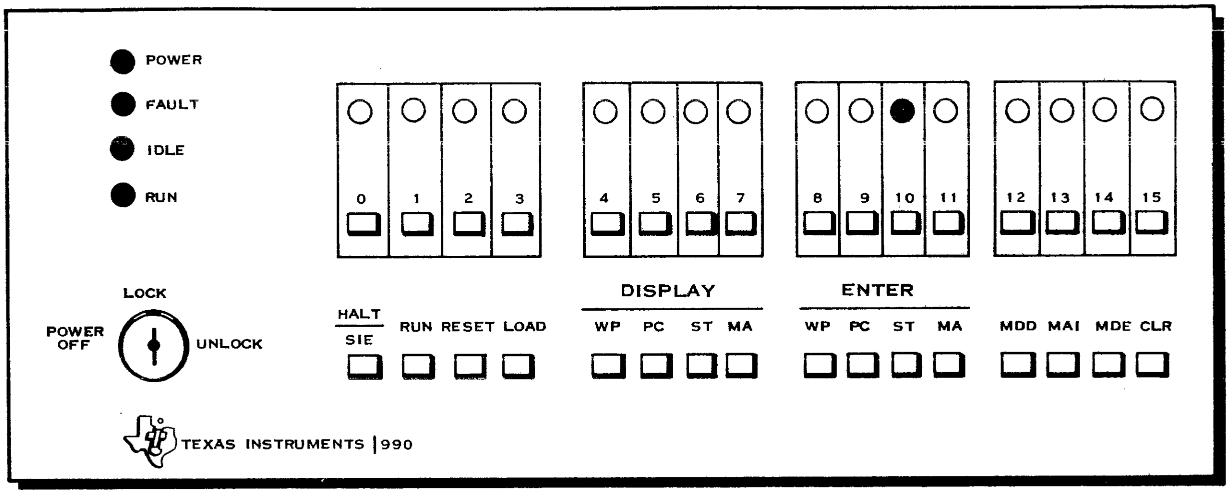


Figure A-1. Computer Front Panel When System Has Crashed

Table A-1. System Crash Codes

Crash Code	Message	Cause
10-1F	ILLEGAL INTERRUPT	An interrupt occurred at a level for which no device was sysgened. The interrupt is the crash code minus >10.
20	ILLEGAL INTERRUPT (1—D$DATA.2—TM$INT)	One of two things has happened: 1. An interrupt occurred at a level for which no device was sysgened. 2. An error interrupt (illegal opcode, memory parity, etc.) occurred within the system. Check for proper sysgen of system. Check for memory parity problems.
21	MEMORY LIST INCONSISTENCY—USER AREA (MM$MGR)	The integrity of the available list of blocks in user area memory has been compromised. Indicates a bug in the system software.
22	MEMORY LIST INCONSISTENCY—SYSTEM TABLE AREA (MM$MGR)	The integrity of the available list of blocks in the system table area has been compromised. Indicates a bug in the system software.
23	QUEUEING ERROR (SEVERAL)	Generally, an unexpected or undefined error return was taken by a system queueing routine.

Table A-1. System Crash Codes (Continued)

Crash Code	Message	Cause
24	SVC BUFFERING ERROR (SVCBUF)	Error return taken by call subroutine that has no error defined.
26	ERROR IN BIDDING QUEUE SERVER (TM$QUE)	Error return was taken while attempting to activate a queue server task. Possibly due to exhaustion of system table area.
27	TM$EXT NON-ZERO AFTER ERROR INTERRUPT (TM$INT)	A system task has encountered an error interrupt during a critical section of processing. Check for memory parity problems.
28	SVC BUFFERING ERROR (SVCBUF)	Internal supervisor call (SVC) buffering tables have been destroyed.
2A	MAPPING ERROR (TMIMAG)	Error return was taken when attempting to map in area for task/procedure load. This error will occur if the system size is greater than >FFCO bytes.
2C	TM$EXT LESS THAN ZERO IN TMS$RTN	The scheduler inhibit switch (TM$EXT) has been decremented more often than it has been incremented. This indicates that an unexpected path was taken through system software. There is a possible stack overflow.
2D	TM$LDR END ACTION TAKEN (TM$LDR)	The task loader (TM$LDR) has encountered an error interrupt. Check for memory parity errors.
2E	UNDEFINED ERROR RETURN (SO$CPR)	A call to the system queueing routine, which has no error defined, took an error return.
2F	I/O ERROR IN READING SYSTEM OVERLAY (SOLVLDR)	The system overlay loader (SOLVLDR) could not load an overlay.
30	SYSTEM TABLE AREA UNDERSIZED	During the sysgen process, the amount of system table area defined is too small to handle the current requirements.
31	TIME ORDERED LIST ERROR (BM$REL)	Linkage on the time-ordered list points to a block that is not in the user area of memory, resulting in an error return when an attempt is made to release it.
32	MAPPING ERROR (BM$REL)	Attempt to map in blocking buffer resulted in an error return. This error will occur if the system size exceeds >FFC0 bytes.
33	TIME-ORDERED LIST ERROR (BM$W)	See crash code 31.

Table A-1. System Crash Codes (Continued)

Crash Code	Message	Cause
34	UNDEFINED ERROR RETURN (BM$CLO)	The time-ordered list linkage routine, that has no error defined, returned an error.
35	TIME-ORDERED LIST ERROR (BM$CLO)	See crash code 31.
36	UNDEFINED ERROR RETURN (BM$CLO)	See crash code 34.
40	UNDEFINED ERROR RETURN (BM$BID)	One of many routines called by the task bidder (TM$BID) returned an error when no error was defined.
41	SYSTEM TABLE AREA ERROR (TM$DGN)	An error was returned to the termination task (TM$DGN) when it attempted to release task status block (TSB) memory in the system table area.
42	END ACTION TAKEN (TM$DGN)	The termination task (TM$DGN) encountered an error interrupt. Check for memory parity errors.
43	TSB/PSB NOT FOUND (MM$TSK)	A TSB/PSB (procedure status block) that exists in the system cannot be found on the TSB/PSB lists.
44	SYSTEM TABLE AREA ERROR (MM$TSK)	A structure was found on the TSB/PSB lists that is not in the system table area, resulting in an error when an attempt was made to release it. Indicates that an unexpected path was taken through system software. There is a possible stack overflow.
45	SVC BUFFERING ERROR (TM$SBD)	The scheduled bid task processor (TM$SBD) encountered an error attempting to release the buffered SVC block, indicating that it was buffered outside the system table area.
50	ERROR ON REQUEUE OF INSTALL REQUEST	Error encountered when putting install request back on queue in order to perform time delay (PF and CMN).
51	INCONSISTENT LDT POINTER FOR PROGRAM	Error locating logical device table (LDT) for program file in executing task LDT list (PF$).
80	END ACTION TAKEN (DM$TSK)	The disk management task (DM$TSK) encountered an error interrupt. Check for memory parity errors.
81	UNEXPECTED ERROR RETURN (DM$TSK)	A called routine took an error return when none was anticipated.

Table A-1. System Crash Codes (Continued)

Crash Code	Message	Cause
82	UNDEFINED SUB-OPCODE (DM$TSK)	The SVC block specifies an operation that is undefined to the disk manager. This generally indicates that the system table area is being destroyed.
83	PARTIAL BIT MAP INCONSISTENCY (DM$TSK)	The disk manager has encountered an inconsistency in the allocation tables. A region marked available in the bit map tables is marked allocated in the partial bit map itself. If the crash occurs only once, the problem may have been due to destruction of system table area. If it occurs consistently, the error exists on the disk. This error can be a side effect of an earlier crash that occurred while the allocation tables were being updated.
84	ERROR IN ALLOCATION TABLES (DM$TSK)	The disk allocation tables indicate an available allocatable disk unit (ADU) that is beyond the range of the disk.
85	ATTEMPTED ACCESS ON NONEXISTENT PARTIAL BIT MAP (DM$TSK)	Generally indicates that an attempt was made to release an ADU that is beyond the range of the disk. Probably due to a modified file descriptor record (FDR).
86	PARTIAL BIT MAP HAS BEEN STEPPED ON	The disk manager has determined that the bit map has been altered while in memory.
87	A BAD WRITE TO DISK PARTIAL BIT MAP	The partial bit map (PBM) was not written properly to disk. Check the hardware. The disk PBM is incorrect. The correct PBM is in XANAL.
88	WRITING ROLL # FILE (TM$LDR)	This error occurs during access to the ROLL$FILE. Boot a backup disk and install the bad system disk as a secondary disk. Create new system files on the secondary volume.
89	(SOVLDR) TAKEN	An internal error interrupt occurred. Check for memory parity error.
A0	END ACTION TAKEN (FILMGR)	The file manager encountered an error interrupt. Check for memory parity errors.
A1	UNEXPECTED ERROR RETURN (FILMGR)	An error return was taken that was undefined or unanticipated.
A2	SYSTEM TABLE AREA ERROR (FILMGR)	An attempt to release a structure in the system table area resulted in an error. Generally due to destroyed pointers.

Table A-1. System Crash Codes (Continued)

Crash Code	Message	Cause
A3	SYSTEM TABLE REQUEST ERROR (FILMGR)	An error code was returned on a system table area request that indicates that the table area header has been destroyed.
A4	KEY-INDEXED FILE CRASH CONDITION (KIF)	An internal inconsistency has been discovered during key-indexed file processing.
AF	NONEXISTENT ENTRY IN FILE MANAGER (FILMGR)	Attempt to call file manager routines with illegal entry.
E0	END ACTION TAKEN (DDT)	The device driver task (DDT) has encountered an error interrupt. Check for memory parity errors.
E1	QUEUEING ERROR (DDT)	An attempt to dequeue a structure known to be on the queue was unsuccessful.
E3	UNDEFINED ERROR RETURN (DDT)	An error return was taken from a routine that has no error defined.
E4	SYSTEM TABLE AREA ERROR (DDT)	An error was returned on the attempt to release the buffer after an I/O call. Indicates that the system table area is being destroyed.
E5	SYSTEM TABLE AREA ERROR (DDT)	An error was returned on the attempt to release the buffered SVC block after an I/O call. Indicates that system table area is being destroyed.
100	END ACTION TAKEN (FUTIL)	Check for memory parity errors.
101	FILE UPDATE ERROR (FUTIL)	A disk error occurred on an attempt to update a blocking buffer to disk during a release LUNO process.
102	LINKAGE ERROR (FUTIL)	An attempt to delink a structure known to be in the list was unsuccessful. This indicates that system table area is being destroyed.
103	INCONSISTENT LDT/FCB LINKAGE (FUTIL)	An LDT assigned to a specific file control block (FCB) could not be found on that FCB's list. Indicates that system table area is being destroyed.
104	SYSTEM TABLE AREA ERROR (FUTIL)	An attempt to release an LDT resulted in an error return.
105	UNEXPECTED ERROR RETURN (FUTIL)	An error return was taken from a routine that is not defined or anticipated.

Table A-1. System Crash Codes (Continued)

Crash Code	Message	Cause
106	SYSTEM TABLE AREA ERROR (FUTIL)	An attempt to release an FCB resulted in an error return.
107	FILE LDT LIST INCONSISTENCY (FUTIL)	The FCB indicates that there are no LUNOs assigned to the file, and yet the file LDT list is not empty.
108	BAD DIRECTORY (FUTIL)	This error generally indicates that the directory has been at least partially destroyed. The nature and extent of the destruction can be determined by using the Show Relative to File (SRF) command to look at the directory directly.
109	SYSTEM TABLE REQUEST ERROR (FUTIL)	This type of error indicates that the system table area header has been destroyed.
10A	DISK MANAGEMENT ERROR (FUTIL)	During error recovery processing an attempt was made to release disk space that has just been allocated. This attempt resulted in an error return from the disk manager.
10B	INCONSISTENT DIRECTORY OVERHEAD RECORD (FUTIL)	The directory overhead indicates that there is an available hole in the directory, but none can be found.
10C	FAILURE ALLOCATING INTERNAL LDT (FUTIL)	After 65,000 attempts, FUTIL was unable to allocate system table for use as an internal LDT. There is small possibility that this is due to an insufficiently sized system table area.
10D	FAILURE RELEASING INTERNAL LDT (FUTIL)	The error return on the attempt to release system table area indicates that the address specified was not in the table area. An internal pointer in FUTIL has been destroyed.
10E	FILE ADU COUNT OVERFLOW (FUTIL)	While building an FCB for the file, the total number of allocated ADUs was found to be greater than 65,535, which is an impossible condition. This indicates that part of the file descriptor has been destroyed.
120	UNABLE TO DELETE TEMP FILE (SYSRST)	The system restart task encountered an error while attempting to delete left-over temporary files. Ensure that the disk is not write-protected.
121	UNABLE TO INITIALIZE SYSTEM FILES (SYSRST)	The system restart task encountered an error while attempting to create system files or to assign system LUNOs. Ensure that the disk is not write-protected.

Table A-1. System Crash Codes (Continued)

Crash Code	Message	Cause
122	END ACTION TAKEN (SYSRST)	The system restart task has encountered an error severe enough to cause end action to be taken.
130	BAD OPCODE IN SVC BLOCK (INSTAL)	The opcode in the buffered SVC block is not one that is processed by the install task (install volume, unload volume, initialize new disk).
131	UNDEFINED ERROR RETURN (INSTAL)	A call to the system queueing routine, for which no error is defined, returned an error.
132	END ACTION TAKEN (INSTAL)	An error interrupt was encountered by INSTAL. Check for memory parity errors.
133	UNEXPECTED ERROR RETURN (INSTAL)	A call to a system routine returned an error where none was defined or anticipated.
134	DISK LUNO UNDEFINED (INSTAL)	The predefined disk LDT was not found in the system LDT list.
135	ERROR RELEASING LUNO (INSTAL)	An attempt to release a LUNO assigned to a volume being unloaded resulted in a release system memory error. It may be caused by the system table being too full to buffer the release LUNO call.
136	ERROR RELEASING FCB (INSTAL)	An attempt to release a LUNO assigned to a volume resulted in a release system memory error.
137	SYSTEM TABLE REQUEST ERROR (INSTAL)	This error indicates that the system table area header has been destroyed.
138	ERROR RETURN FROM DM$TBL (INSTAL)	An attempt to initialize the disk allocation tables for a volume being installed resulted in an error.
139	DISK ALLOCATION FAILURE (INSTAL)	An attempt to allocate a previously allocated ADU has been performed. This represents an inconsistency.
13A	INVALID BIT MAP NUMBER (INSTAL)	An attempt was made to read a nonexistent partial bit map from the disk being initialized.
13B	BAD ADU LIST RANGES OVERLAP (INSTAL)	In an initialize disk operation the bad track list input contains overlapping ADUs.

Table A-1. System Crash Codes (Continued)

Crash Code	Message	Cause
140	SYSTEM LOG MESSAGE FORMATTING ERROR	An error occurred when the system log returned memory to the system table area; or an error occurred when the system log was delinking its internal system queue.
177	DS01 USED AS COPY DEVICE IN DCOPY. IPL REQUIRED.	During the process of copying, DS01 has been used for the copy device. To ensure the structures in memory reflect the data on the new system disk, an IPL is required.

A.1.1 Dumping the Contents of Memory

When a system crash occurs, the system idles waiting for some user action to be taken. In order to analyze the cause of the system crash, it is advisable to take a crash dump at this point. This is accomplished by pressing the HALT and then the RUN switches on the front panel. This action causes the contents of memory to be written to the file .S$CRASH on the system disk. When the dump is completed, the idle light is turned on again (the dump takes about one second). After the dump is completed, the system may be rebooted, and the crash dump may be examined with the ANALZ utility.

If immediate analysis of the crash dump is not possible, the contents of the file .S$CRASH may be copied to a file in another directory using the Copy Directory (CD) command, as soon as is practical after the system is restarted (probably right after the system log is initialized). This allows the user to take another dump if necessary, without destroying the earlier one.

A.1.2 System Restart Procedure

After the user has dumped memory after a system crash, the system can be restarted by taking the following steps:

1. Press the HALT/SIE switch on the front panel of the computer.
2. Press the LOAD switch. DX10 is now loaded into memory.
3. Enter an IS command at a terminal to initialize the system date and time.
4. If desired, copy the system log files (.S$SYSLG1 and .S$SYSLG2) to save log information about the crash.
5. If desired, copy the system crash file (.S$CRASH) to another file by means of a CD (Copy Directory) command.

A.1.3 Forcing a System Crash

A problem may occur in the system that does not result in a system crash, but prevents useful work on the system (e.g., the system is malfunctioning but the FAULT light on the programmer panel is not lit). For example, a system routine may be hung in a tight loop if system table area is being destroyed, or an unforeseen deadlock condition may arise. In such cases, it is desirable to force a system crash in order to obtain the crash dump for analysis. To force a system crash:

1. Press the HALT switch twice. This forces the system into the clock handler, where it is in a known state.
2. Press the following switches in sequence:
   a. PC DISPLAY
   b. MA ENTER
   c. CLR
   d. MDE
   e. RUN
3. The system should now crash with a crash code of 20.
4. Take the crash dump by pressing HALT and then RUN.
5. The system may now be rebooted. (See System Restart Procedure, paragraph A.1.2).

Appendix B

TILINE and CRU I/O Pinouts

This appendix contains listings of signal lines and the pin numbers of associated connectors. Included are computer TILINE and CRU pinouts, as well as TILINE peripheral devices. This appendix contains the following:

AP — Appendixes

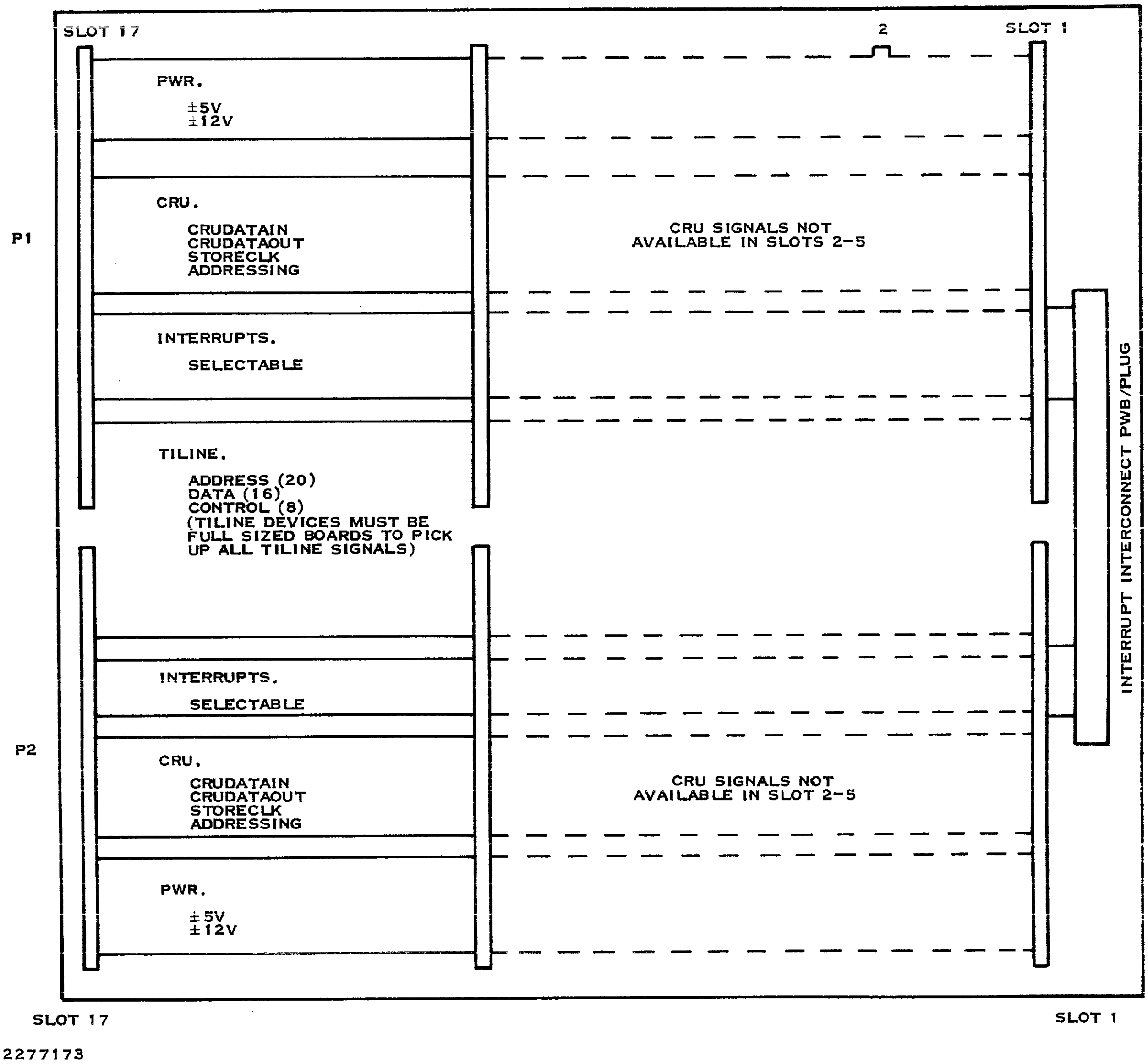
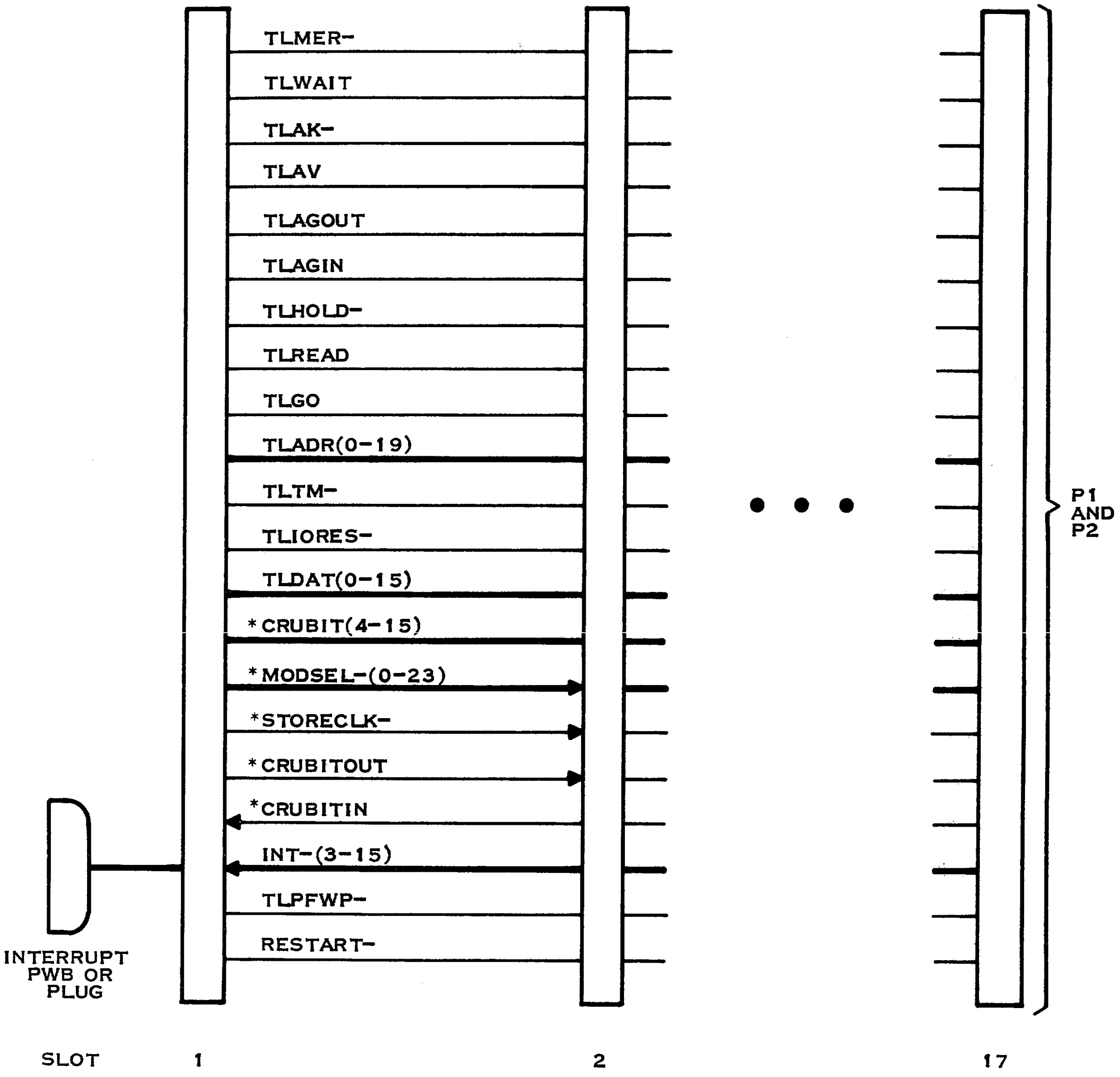


Figure B-1. Diagrammatical Representation of Computer Backpanel Signals



NOTE:

* MODSEL24–THROUGH MODSEL31– AND INT16– THROUGH INT31– ARE NOT IMPLEMENTED ON THE SMI BOARD CONNECTOR. PINS FOR THESE SIGNALS ARE ASSIGNED TO TILINE DATA SIGNALS 4 THROUGH 11 AND TILINE ADDRESS SIGNALS 0 THROUGH 15 ON THE SMI BOARD. IF THESE SIGNALS ARE IMPLEMENTED IN CRU EXPANSION, THEN TILINE EXPANSION CANNOT BE USED IN THE SAME CHASSIS

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Figure B-2. CRU and TILINE Interface Signals

Table B-1. TILINE Signal Definitions

Signature	Pin No.	Definition
TLGO-	P1-25	TILINE Go: Initiates all data transfers when transition from high (3.0 V) to low (1.0 V) occurs.[1]
TLREAD	P1-11	TILINE Read: When high (3.0 V), designates a read from slave operation; when low (1.0 V), designates a write to slave operation.[1]
TLADR00-	P2-55	TILINE address to define the location of data during a fetch or store operation. When high (>2.0 V), the corresponding address bit is a zero; when low (<0.8 V), the corresponding bit P2-57 is a one.[2]
01-	P2-44	
02-	P2-51	
03-	P2-53	
05-	P2-59	
06-	P2-47	
07-	P2-49	
08-	P2-17	
09-	P2-19	
10-	P2-10	
11-	P2-12	
12-	P2-11	
13-	P2-15	
14-	P2-8	
15-	P2-9	
16-	P2-29	
17-	P2-27	
18-	P2-25	
TLADR19-	P2-31	
TLDAT00-	P2-67	TILINE Data: Bidirectional data lines that when high (>2.0 V), represent zero data bits, and when low (<0.8 V), represent one data bit.[2]
01-	P2-69	
02-	P2-35	
03-	P2-37	
04-	P2-61	
05-	P2-63	
06-	P2-43	
07-	P2-45	
08-	P2-21	
09-	P2-33	
10-	P2-23	
11-	P2-20	
12-	P2-27	
13-	P2-28	
14-	P2-30	
TLDAT15-	P2-31	

Notes:

[1] Received by SN75138; driven by 36-milliampere, minimum, open-collector driver.

[2] Received by one, maximum, standard SN74- load per card slot; driven by SN74LS367/8.

Table B-1. TILINE Signal Definitions (Continued)

Signature	Pin No.	Definition
TLTM-	P1-20	TILINE Terminate: When low (1.0 V), indicates that the slave device has completed the requested operation.[1]
TLMER-	P1-55	TILINE Memory Error: When low (<0.8 V), indicates that a nonrecoverable error has occurred during a memory read operation.[2]
TLAG(in)	P2-6	TILINE Access Granted: When high (>2.0 V), this signal indicates that no higher priority device has requested use of the TILINE. When low (<0.8 V), this signal prevents the receiving device from gaining access to the TILINE bus.
TLAG(out)	P2-5	TILINE Access Granted: When high (>2.0 V), this signal indicates that neither the sending device nor any higher priority device is requesting use of the TILINE. When low (<0.8 V), this signal indicates that either the sending device or some higher priority device is requesting use of the TILINE bus and prevents all lower priority devices from gaining access to the bus.
TLAK-	P1-71	TILINE Acknowledge: When high (3.0 V), this signal indicates that no TILINE device has been recognized as the next device to use the TILINE. When low (1.0 V), this signal indicates that some TILINE device has requested access, has been recognized, and is waiting for the bus to become available.[1]
TLAV	P1-58	TILINE Available: When high (3.0 V), this signal indicates that no TILINE device is using the bus. When low (1.0 V), this signal indicates that the TILINE is busy.[1]
TLWAIT-	P1-63	TILINE Wait: A normally high (3.0 V) signal that when low (1.0 V), temporarily suspends all TILINE master devices from using the TILINE bus. This signal is generated by bus couplers to allow them to use the bus as the highest priority user.[1]

Notes:

[1] Received by SN75138; driven by 36-milliampere, minimum, open-collector driver.

[2] Received by one, maximum, standard SN74- load per card slot; driven by SN74LS367/8.

Table B-1. TILINE Signal Definitions (Continued)

Signature	Pin No.	Definition
TLIORES-	P1-14 P2-14	TILINE I/O Reset: A normally high (>2.0 V) signal that when low (<0.8 V), halts and resets all TILINE I/O devices. This signal is a 100- to 500-nanosecond pulse generated by the RESET on the control panel or by the execution of a Reset (RSET) instruction by a CPU. Driven by SN7437; received by two, maximum, standard SN74- loads per slot.
TLPRES-	P1-13 P2-13	TILINE Power Reset: A normally high (>2.0 V) signal that goes low (<0.8 V) to reset all TILINE devices and inhibit critical lines to external equipment. The signal is generated by the power supply at least 10 microseconds before dc voltages are stable during power-up. Driven by 80 mA, open-collector driver (160 mA with 40 A power supply).
TLPFWP-	P1-16 P2-16	TILINE Power Failure Warning Pulse: A 7.0 millisecond pulse preceding TLPRES-. When low (<0.8 V), this signal indicates that a power-down sequence is in progress, allowing the CPU to perform its power failure interrupt subroutine. Driven by SN7437; received by two, maximum, standard SN74- loads per card slot.

Notes:

[1] Received by SN75138; driven by 36-milliampere, minimum, open-collector driver.

[2] Received by one, maximum, standard SN74- load per card slot; driven by SN74LS367/8.

Table B-2. CRU Interface Signals, 13-Slot Chassis

Signature	990/4,990/5, 990/10,990/12 Circuit Board Pin Number	13-Slot Main, Expansion Chassis Backpanel Pin Number	Function
MODSEL0-	P1-23	Slot 13, P2-48	Module select signals generated by the microprocessor from address bits 7 - 11 (CRUBITS 8 - 11) for use within the main or an expansion chassis. Note that P1 in each slot of the backpanel receives one module select signal whereas P2
MODSEL1-	P1-35	Slot 13, P1-48 and P2-46	
MODSEL2-	P1-37	Slot 12, P2-48	
MODSEL3-	P1-43	Slot 12, P1-48 and P2-46	
MODSEL4-	P1-44	Slot 11, P2-48	

Table B-2. CRU Interface Signals, 13-Slot Chassis (Continued)

Signature	990/4,990/5, 990/10,990/12 Circuit Board Pin Number	13-Slot Main, Expansion Chassis Backpanel Pin Number	Function
MODSEL5-	P1-45	Slot 11, P1-48 and P2-46	receives two module select signals. This configuration permits P2 to use 32 bits of the CRU. Note that pin 48 of successive P2 connectors in the chassis slots are connected to even-numbered module select signals and at the CRU circuit board level carries a MODSELA- signature. Pin 46 of successive P2 connectors in the chassis slots are connected to pin 48 of P1 of that slot and then to an odd-numbered module select signal and carries a signature of MODSELB-. Pin P1-48 is not used when a full-sized CRU circuit board is implemented in a chassis slot. MODSEL signal lines will drive 10 TTL loads.
MODSEL6-	P1-46	Slot 10, P2-48	
MODSEL7-	P1-47	Slot 10, P1-48 and P2-46	
MODSEL8-	P1-48	Slot 9, P2-48	
MODSEL9-	P1-49	Slot 9, P1-48 and P2-46	
MODSEL10-	P1-51	Slot 8, P2-48	
MODSEL11-	P1-53	Slot 8, P1-48 and P2-46	
MODSEL12-	P1-61	Slot 7, P2-48	
MODSEL13-	P1-67	Slot 7, P1-48 and P2-46	
MODSEL14-	P1-69	Slot 6, P2-48	
MODSEL15-	P1-76	Slot 6, P1-48 and P2-46	
MODSEL16-	P2-38	Slot 5, P2-48	
MODSEL17-	P2-36	Slot 5, P1-48 and P2-46	
MODSEL18-	P2-34	Slot 4, P2-48	
MODSEL19-	P2-32	Slot 4, P1-48 and P2-46	
MODSEL20-	P2-22	Slot 3, P2-48	
MODSEL21-	P2-18	Slot 3, P1-48 and P2-46	
MODSEL22-	P2-16	Slot 2, P2-48	
MODSEL23-	P2-13	Slot 3, P1-48 and P2-46	
CRUBIT4	P1-56	P1-56	Address bit generated by the microprocessor to select a particular chassis (bits 4 - 6), a 16-bit module within that chassis (bits 7 - 11), and a particular bit from that module (bits 12 - 15). CRUBITS 4 - 11 are capable of driving at least 12 normalized TTL loads; CRUBITS 12 - 15 are capable of driving 30 normalized TTL loads.
CRUBIT5	P1-54	P1-54	
CRUBIT6	P1-52	P1-52	
CRUBIT7	P1-50	P1-50	
CRUBIT8	P1-62	P1-62	
CRUBIT9	P1-64	P1-64	
CRUBIT10	P1-68	P1-68	
CRUBIT11	P1-70	P1-70	
CRUBIT12	P1-36	P1-36, P2-36	
CRUBIT13	P1-32	P1-32, P2-32	
CRUBIT14	P1-38	P1-38, P2-38	
CRUBIT15	P1-34	P1-34, P2-34	

Table B-2. CRU Interface Signals, 13-Slot Chassis (Continued)

Signature	990/4,990/5, 990/10,990/12 Circuit Board Pin Number	13-Slot Main, Expansion Chassis Backpanel Pin Number	Function
CRUBITOUT	P1-18	P1-18, P2-18	Serial data line for transfer of data from the microprocessor to the addressed CRU bit(s). This line is active only when STORECLK- goes low. (This line will drive 30 normalized TTL loads).
CRUBITIN	P1-60	P1-60 P2-60	Serial data line for transfer of data from the addressed CRU bit(s) to the microprocessor. This line must be driven by an open collector gate and only when the module is selected. A 470-ohm pull-up resistor is mounted on the circuit board for this line.
STORECLK-	P1-22	P1-22, P2-22	An active-low pulse that indicates to the selected CRU module that the operation is a write (Set Bit or LDCR) operation. This pulse transfers the data on the CRUBITOUT line into a holding flip-flop that is the CRU bit. Will drive 30 TTL loads.
TLIORES-	P1-14	P1-14, P2-14	I/O Reset: A normally high signal that when low, resets all connected devices. This signal is a minimum 250-nanosecond pulse that is generated by a RSET instruction in the microprocessor. This signal is also low until dc power is up and stable. Will drive 30 TTL loads.
TLPFWP-	P1-16	P1-16, P2-16	Power Failure Warning Pulse: A low signal of at least 7.0 milliseconds duration that indicates that a power failure is imminent. Will drive 30 TTL loads.
TLPRES-	P1-13	P1-13, P2-13	Power Reset: A normally high signal that goes low to reset connected devices at least 10 microseconds before dc voltages begin to fail during power-down.

Table B-2. CRU Interface Signals, 13-Slot Chassis (Continued)

Signature	990/4,990/5, 990/10,990/12 Circuit Board Pin Number	13-Slot Main, Expansion Chassis Backpanel Pin Number	Function
INT1-*	P1-65		Each side of each full-sized chassis slot is furnished a pin (P1-66 and P2-66) through which a CRU circuit board may interrupt the processor. These pins are connected to interrupt levels by jumpers in accordance with assigned priorities. These pin numbers are those for slot 1 so the processor can pick them up.
INT2-*	P1-54		
INT3-	P2-24		
INT4-	P2-46		
INT5-	P2-48		
INT6-	P2-50		
INT7-	P2-52		
INT8-	P2-54		
INT9-	P2-56		
INT10-	P2-58		
INT11-	P2-62		
INT12-	P2-64		
INT13-	P2-65		
INT14-	P2-66		
INT15-	P2-67		

Note:

*INT1- and INT2- are sometimes implemented on the processor board and are not available for CRU use.

Table B-3. CRU Interface Signals, 17-Slot Chassis

Signature	SMI/CRU Expansion Circuit Board Pin Number	Backpanel Pin Number	Function

NOTE

Circuit board pin numbers shown are valid for the SMI and CRU expansion board except for signals MODSEL24- through MODSEL31- and INT16- through INT31-. These signals are not implemented on the SMI board, and these pin numbers are assigned to TILINE data signals 4 through 11 and TILINE address signals 0 through 15 on that board. If these signals are implemented in CRU expansion, TILINE expansion cannot be used in the same chassis.

Table B-3. CRU Interface Signals, 17-Slot Chassis (Continued)

Signature	SMI/CRU Expansion Circuit Board Pin Number	Backpanel Pin Number	Function
CRUBIT4	P1-56	P1-56	Address bits generated by the processor to select a particular chassis (bits 4 - 6), a 16-bit module within that chassis (bits 7 - 11) and a particular bit from that module (bits 12 - 15). CRUBITS 4 - 11 are capable of driving at least 12 normalized TTL loads; CRUBITS 12 - 15 are capable of driving 30 normalized TTL loads.
CRUBIT5	P1-54	P1-54	
CRUBIT6	P1-52	P1-52	
CRUBIT7	P1-50	P1-50	
CRUBIT8	P1-62	P1-62	
CRUBIT9	P1-64	P1-64	
CRUBIT10	P1-68	P1-68	
CRUBIT11	P1-70	P1-70	
CRUBIT12	P1-36	P1-36, P2-36	
CRUBIT13	P1-32	P1-32, P2-32	
CRUBIT14	P1-38	P1-38, P2-38	
CRUBIT15	P1-34	P1-34, P2-34	
CRUBITOUT	P1-18	P1-18, P2-18	Serial data line for transfer of data from the processor to the addressed CRU bit(s). This line is active only when STORECLK- goes low. This line will drive 30 normalized TTL loads.
CRUBITIN	P1-60	P1-60, P2-60	Serial data line for transfer of data from the addressed CRU bit(s) to the processor. This line must be driven by an open collector gate and only when the module is selected. A 470-ohm pull-up resistor is mounted on the SMI circuit board for this line.
STORECLK-	P1-22	P1-22, P2-22	An active-low pulse that indicates to the selected CRU module that the operation is a write (Set Bit or LDCR) operation. This pulse transfers the data on the CRUBITOUT line into a holding flip-flop that is the CRU bit. Will drive 30 TTL loads.
TLIORES-	P1-14	P1-14, P2-14	I/O Reset: A normally high signal that, when low, resets all connected devices. This signal is a minimum 250-ns pulse that is generated by a RSET instruction in the processor. This signal is also low

Table B-3. CRU Interface Signals, 17-Slot Chassis (Continued)

Signature	SMI/CRU Expansion Circuit Board Pin Number	Backpanel Pin Number	Function
			until dc power is up and stable. Will drive 30 TTL loads.
TLPFWP-	P1-16	P1-16, P2-16	Power Failure Warning Pulse: A low signal of at least 2 ms duration that indicates that a power failure is imminent. Will drive 30 TTL loads.
TLPRES-	P1-13	P1-13, P2-13	Power Reset: A normally high signal that goes low to reset connected devices at least 10 microseconds before dc voltages begin to fail during power-down. During power-up, this signal is low until all voltages are stable.
MODSEL0-	P1-23	Slot 17, P2-48	Module select signals generated by the processor from address bits 6 - 10 (CRUBITS 7 - 11) for use within the main or expansion chassis. Note that P1 in each slot of the backpanel receives one module select signal, whereas P2 receives two module select signals. This configuration permits P2 to use 32 bits of the CRU. Note that pins 48 of successive P2 connectors in the chassis slots are connected to even-numbered module select signals and at the CRU circuit board level carry a MODSELA-signature. Pins 46 of successive P2 connectors in the chassis slots are connected to pin 48 of P1 of that slot and then to an odd-numbered module select signal and carry a signature of MODSELB-. Pin P1-48 is not used when a full-sized CRU circuit board is implemented in a chassis slot. MODSEL signal lines will drive 10 TTL loads. Pin numbers
MODSEL1-	P1-35	Slot 17, P1-48 and P2-46	
MODSEL2-	P1-37	Slot 16, P2-48	
MODSEL3-	P1-43	Slot 16, P1-48 and P2-46	
MODSEL4-	P1-44	Slot 15, P2-48	
MODSEL5-	P1-45	Slot 15, P1-48 and P2-46	
MODSEL6-	P1-46	Slot 14, P2-48	
MODSEL7-	P1-47	Slot 14, P1-48 and P2-46	
MODSEL8-	P1-48	Slot 13, P2-48	
MODSEL9-	P1-49	Slot 13, P1-48 and P2-46	
MODSEL10-	P1-51	Slot 12, P2-48	
MODSEL11-	P1-53	Slot 12, P1-48 and P2-46	
MODSEL12-	P1-61	Slot 11, P2-48	
MODSEL13-	P1-67	Slot 11, P1-48 and P2-46	
MODSEL14-	P1-69	Slot 10, P2-48	
MODSEL15-	P1-71	Slot 10, P1-48 and P2-46	
MODSEL16-	P2-38	Slot 9, P2-48	
MODSEL17-	P2-36	Slot 9, P1-48 and P2-46	
MODSEL18-	P2-34	Slot 8, P2-48	
MODSEL19-	P2-32	Slot 8, P1-48 and P2-46	

Table B-3. CRU Interface Signals, 17-Slot Chassis (Continued)

Signature	SMI/CRU Expansion Circuit Board Pin Number*	Backpanel Pin Number	Function
MODSEL20-	P2-22	Slot 7, P2-48	shown for module select signals 24 through 31 are valid for the CRU expansion board only (i.e., module select signals in slots 2 through 5 apply only to expansion chassis).
MODSEL21-	P2-18	Slot 7, P1-48 and P2-46	
MODSEL22-	P2-16	Slot 6, P2-48	
MODSEL23-	P2-13	Slot 6, P1-48 and P2-46	
MODSEL24-	P2-61	Slot 5, P2-48	
MODSEL25-	P2-63	Slot 5, P1-48 and P2-46	
MODSEL26-	P2-43	Slot 4, P2-48	
MODSEL27	P2-45	Slot 4, P1-48 and P2-46	
MODSEL28-	P2-21	Slot 3, P2-48	
MODSEL29-	P2-33	Slot 3, P1-48 and P2-46	
MODSEL30-	P2-23	Slot 2, P2-48	
MODSEL31-	P2-20	Slot 2, P1-48 and P2-46	
INT3-			Each side of full-sized chassis slot is furnished with a pin (P1-66 and P2-66) through which a CRU circuit board may interrupt the processor. These pins are connected to interrupt levels in accordance with assigned priorities.
INT4-			
INT5-			
INT6-			
INT7-			
INT8-			
INT9-			
INT10-			
INT11-			
INT12-			
INT13-			
INT14-			
INT15-			
INT16-			
INT17-			
INT18-			
INT19-			
INT20-			
INT21-			
INT22-			
INT23-			
INT24-			
INT25-			
INT26-			
INT27-			
INT28-			
INT29-			
INT30-			
INT31-			

Table B-4. DS10 Disk Controller I/O Pins

50-Pin Cable

P1 (Mates to Controller P3)	Signal	P2 (Mates to Disk P2 or P3)*
C	RD-	2
A	RCLK-	4
E	RG-	6
B	WDNCLK-	8
J	AD004	10
K	EG-	12
L	UNITSEL1-	14
T	ADD032-	16
U	FILERDY-	18
V	UNITSEL3-	20
a	HDSEL-	22
b	ADD064-	24
c	WG-	26
j	SECTORB02-	28
m	ADD256-	30
k	SECTORB04-	32
u	SKIC-	34
t	ADDSTB-	36
w	RESTORE-	38
CC	ATTN1-	40
X	ADD008-	42
EE	ATTN3-	44
BB	ADD128-	46
FF	ATTN4-	48
DD	ATTN2-	50

Note:

* P2 connected to P3, pin-to-pin at disk cable adapter (reference Figures 9-16 and 9-17). All odd-numbered P3 pins are connected to ground.

Table B-4. DS10 Disk Controller I/O Pins (Continued)

40-Pin Cable

P1 (Mates to Controller P4)	Signal	P4 (Mates to Disk at P4 or P5)*
H	OFFSET-	4
F	RDYSRW-	6
N	ADD001-	8
P	WP-	10
R	UNITSEL2-	12
W	SECMRK-	14
Y	INDMRK-	16
Z	UNITSEL4-	18
c	SECTORB01	20
f	ADD016	22
h	WCHK-	24
p	ADDACK-	26
n	SECTORB08	28
s	ADD002-	30
y	LADDINTR	32
v	SECTORB16	34
AA	DISKSEL-	36

Note:

* P4 is connected to P5, pin-to-pin, at disk cable adapter (reference Figures 9-16 and 9-17). All odd-numbered pins on P4 and P5 are connected to ground.

Table B-5. DS25/50/200 Disk Controller Cable Pins

P3 (Mates with Controller P1)	Signal	P1	P2 (Mates with Disk: J03 — DS25/50 J07 — DS200)
3	ISECTOR-	3	1
5	IEOC-	5	2
7	IOFFSET-	7	4
9	INDEX-	9	6
11	IRDY-	11	8
13	IRDONLY-	13	10
15	IDEVCK-	15	12
17	IONLINE-	17	14
19	ISKINC-	19	16
21	IBUS0-	21	20
23	IBUS1-	23	22
25	IBUS2-	25	24
27	IBUS3-	27	26
29	IBUS4-	29	28
31	IBUS5-	31	30
33	IBUS6-	33	32
35	IBUS7-	35	34
37	IBUS8-	37	36
39	ICONTROLTAG-	39	37
41	IBUS9-	41	38
43	ISETCYLTAG-	43	39
45	ISETDHTAG-	45	40
49	ITERMINATORIN-	49	35

Notes:

1. Bus cable part number 947587-1.
2. Unlisted pins are connected to ground.
3. Reference Figures 10-11 and 11-9.

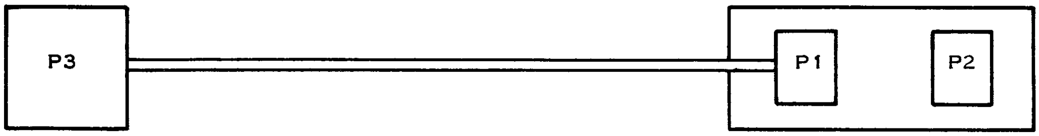

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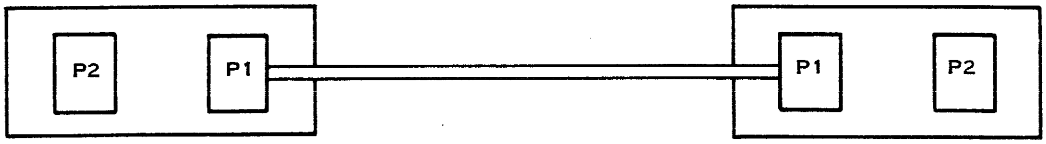
Table B-6. DS25/50/200 Disk Daisy-Chain Cable Pins

P2 (Mates with Disk J06 or J07)	Signal	P1
1	ISECTOR-	3
2	IEOC-	5
4	IOFFSET-	7
6	INDEX-	9
8	IRDY-	11
10	IRDONLY-	13
12	IDEVCK-	15
14	IONLINE-	17
16	ISKINC-	19
20	IBUS0-	21
22	IBUS1-	23
24	IBUS2-	25
26	IBUS3-	27
28	IBUS4-	29
30	IBUS5-	31
32	IBUS6-	33
34	IBUS7-	35
36	IBUS8-	37
37	ICONTROLTAG-	39
38	IBUS9-	41
39	ISETCYLTAG-	43
40	ISETHDTAG-	45
35	TERMINATORIN-	49

Notes:

1. Daisy-chain cable part number 947589.
2. Unlisted pins are connected to ground.



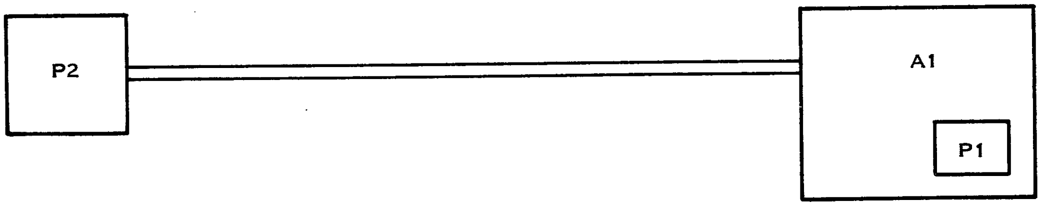
2277176

Table B-7. DS25/50/200 Disk Radial Cable Pins

P2 (Mates with Controller P2/P3/P4/P5)	Signal	A1 (PWB)	P1 (Mates with Disk: J04 — DS25/50 J08 — DS200)
1	TERMINATOR + 5	15	1
2	TERMINATOR + 5	16	2
3	R/WDATAP	4	14
5	R/WDATAM	3	16
7	ATTEN-	11	6
9	ISELECT-	5	12
11	SEQ-	7	10
13	SELECTED-	9	8
15	R/WCLOCKP	2	18
17	R/WCLOCKM	1	20

Note:

Radial cable part number 947616.



2277177

Table B-8. FD800 Flexible Disk Controller I/O Pins (Previous Production)

Control and Data Cable

P4 (Mates with Controller J4)	Signal	P4 (Mates with Disk)
14	TR43HDS-	14
18	LD-	18
20	INDEX-	20
22	RDY1-	22
26	SEL1-	26
28	SEL2-	28
30	SEL3-	30
32	SEL4-	32
34	DIR-	34
36	STP-	36
38	DAT-	38
40	WREN-	40
42	TR00-	42
44	WLO-	44
46	COMPDAT-	46

Status Cable

P5 (Mates with Controller J4)	Signal	P5 (Mates with Disk)
1	SEL1-	1
2	SEL2-	2
3	GND	3
4	LD-	4
6	WLO-	6
8	RDY-	8
10	STB-	10
11	SEL3-	11
12	SEL4-	12
14	LD-	14
16	WLO-	16
18	RDY-	18
20	STB-	20

Table B-9. FD1000 Flexible Disk I/O Pins (Previous Production)

Controller J5	Signal	Disk J1	Function
38	LWRDAT-	38	Write
40	LWRTEN-	40	
2	TR4DYE-	2	
46	LRDAT-	46	Read
34	LDIR-	34	Access Control
36	LSTEP-	36	
18	LLOAD-	18	
26	LSEL0-	26	
28	LSEL1-	28	
30	LSEL2-	30	
32	LSEL3-	32	
20	LINDEX-	20	Rotational Position
44	LWP-	44	Status
42	LTR00-	42	
22	LRDY-	22	
12	LDC-	12	
10	LTS-	10	

Notes:

1. All connections are parallel connections to other drive units on local daisy-chained bus.

2. Cable part number 945951.

Table B-10. FD1000 Flexible Disk I/O Pins (Present Production)

P4 (Mates with Controller J4)	Signal	P2 (Mates with Drive J2)
2	YCLK1- (Encoding/decoding clock)	2
1	YCLK1	1
4	YCNTL1- (Encoded control)	4
3	YCNTL1	3
5	YWEN1- (Write gate)	5
6	YWEN1	6
7	YWDT1- (Write data and clock)	7
8	YWDT1	8
9	YRDAT1- (Read data and clock)	9
10	YRDAT1	10
11	YSTAT1- (Encoded status)	11
12	YSTAT1	12
	(Remote enable, jumpered in cable connector)	13 14

Note:

Cable part number 2261704.

Table B-11. NRZI and PE/NRZI Magnetic Tape Controller I/O Pins

P5 (Mates with J5 on Controller)	Signal	P1 (Mates with J4 on Magnetic Tape Drive)
1	REMOTE FWD-	B
2	REMOTE REW-	C
3	RD DATA 4-	2
5	WRT DATA 4-	3
7	REMOTE GO-	E
8	RDY STAT-	K
9	RD DATA 2-	5
11	WRT DATA 2-	6
13	RD DATA 8-	8
15	RD DATA 1-	9
17	REMOTE UNLD-	L
19	RD DATA 6-	10
21	BOT STAT-	N
23	WRT DATA 1-	11
25	WRT DATA 8-	12
27	WRT DATA 6-	13
29	SELECT 1-	15
30	REW STAT 1-	S
31	REW STAT 2-	T

Table B-11. NRZI and PE/NRZI Magnetic Tape Controller I/O Pins (Continued)

P5 (Mates with J5 on Controller)	Signal	P1 (Mates with J4 on Magnetic Tape Drive)
32	SELECT 2-	16
33	SELECT 3-	17
34	REW STAT 3-	U
35	SELECT 4-	18
36	REW STAT 4-	V
37,38,39,40	+5 V CONTROL	4,2,x
41	RD CLK-	26
43	RD DATA 7-	30
45	WRT DATA 7-	28
47	WRT DATA 5-	33
49	RD DATA 5-	n
4,6	GND	1,4

P6 (Mates with J6 on Controller)	Signal	P1 (Mates with J4 on Magnetic Tape Drive)
1	WRT DATA 9-	34
3	RD DATA 9-	36
5	SET WRT-	r
7	WRITE CLK-	37
9	SET RD-	s
11	WRT RESET-	38
13	FPT STAT-	39
15	WRT DATA 3-	40
17	RD DATA 3-	v
19	EOT STAT-	w
2,4	GND	e,f
37,38	CHASSIS GND	14,R

Appendix C

Standard System Cabinet Configurations and AC Power Wiring

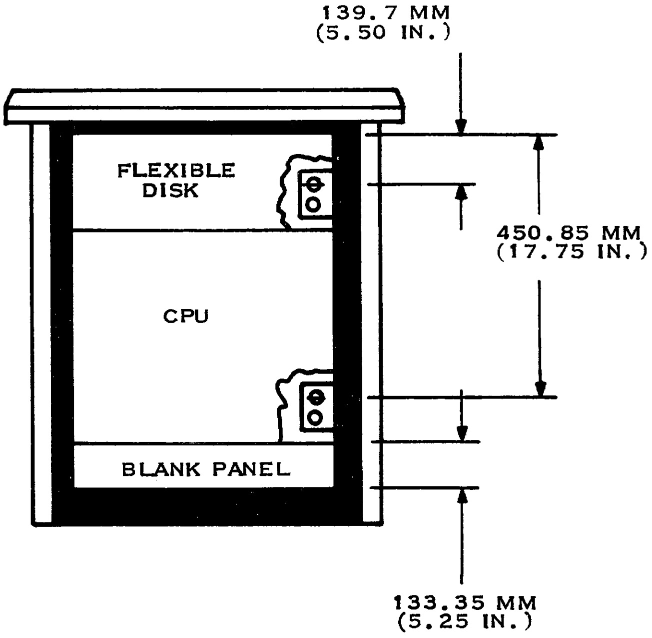
This appendix contains illustrations that show the configuration of desks and cabinets used in standard systems and the ac power wiring and outlets for the various cabinets. These configurations have been developed as standards for DS990 systems. Even though many more combinations could have been chosen, the ones presented in this appendix were selected because of system engineering constraints. These constraints include the following:

- Heat flow and cooling of devices
- Cable lengths and routing
- Front panel size
- Weight balance
- Configurations submitted for approval by UL (Underwriters Laboratories)
- User access to device
- Service access to device
- Power surges and consumption, including circuit breaker ratings
- Maximum flexibility with minimum configurations for manufacturing purposes

In the event that system upgrades, reconfigurations, or equipment expansions require modifying a configuration, one of the standard configurations described in this appendix should be used. Otherwise, the above list of constraints needs to be carefully reviewed.

Illustrations in this appendix for the standard cabinet configurations are as follows:

Illustrations that show the ac power wiring and outlets are as follows:



2280702

Figure C-1. Models 2, 3, 6, and 8 Single-Bay Desk or Pedestal

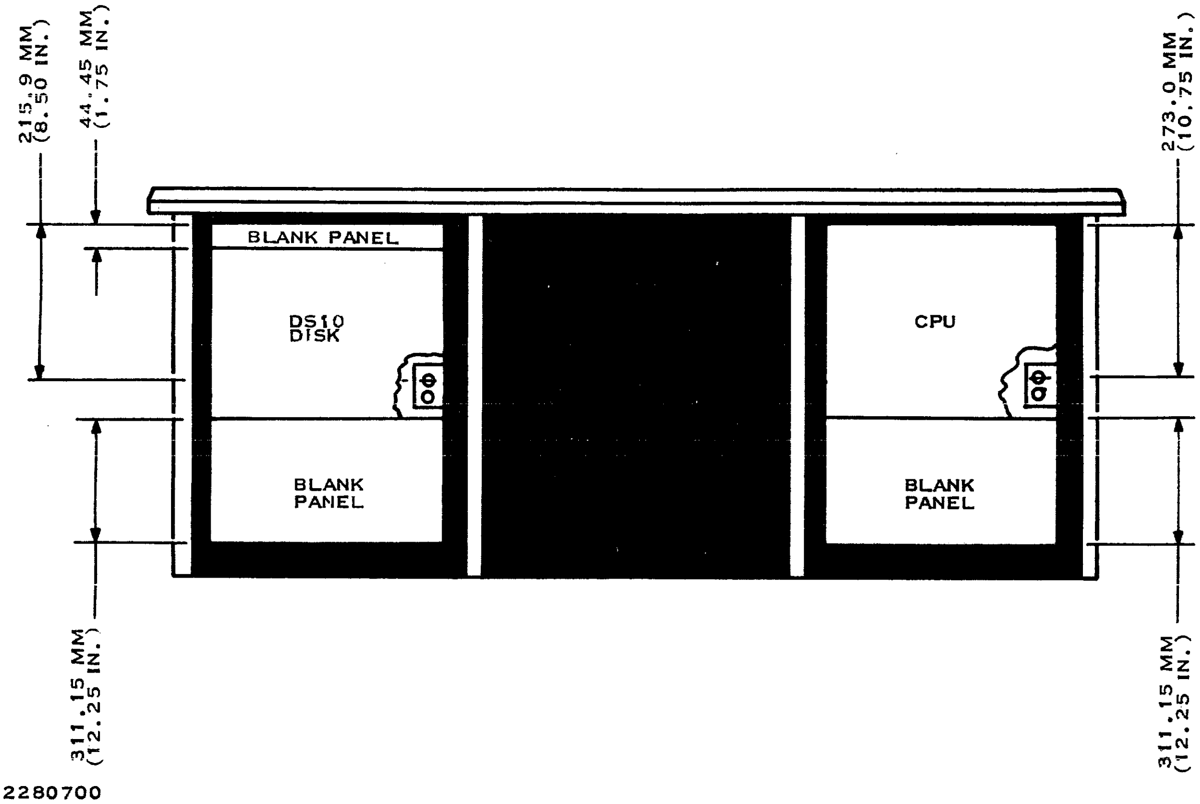


Figure C-2. Model 4 Double-Bay Desk

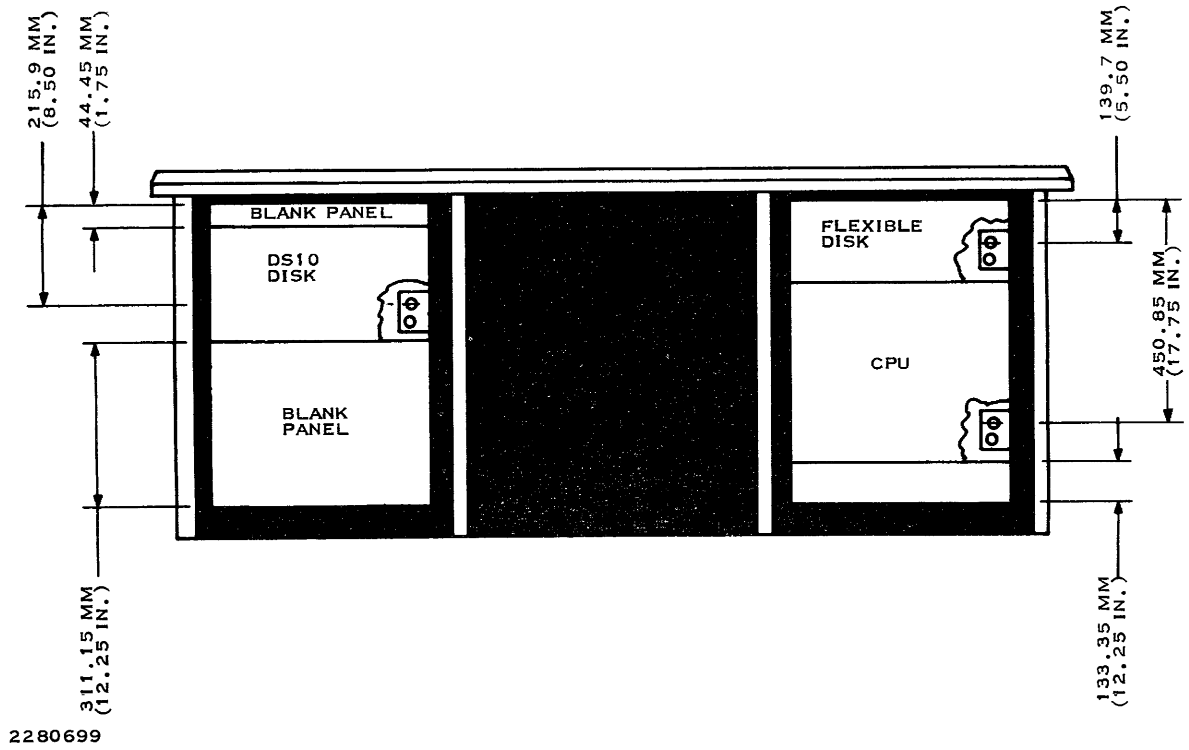
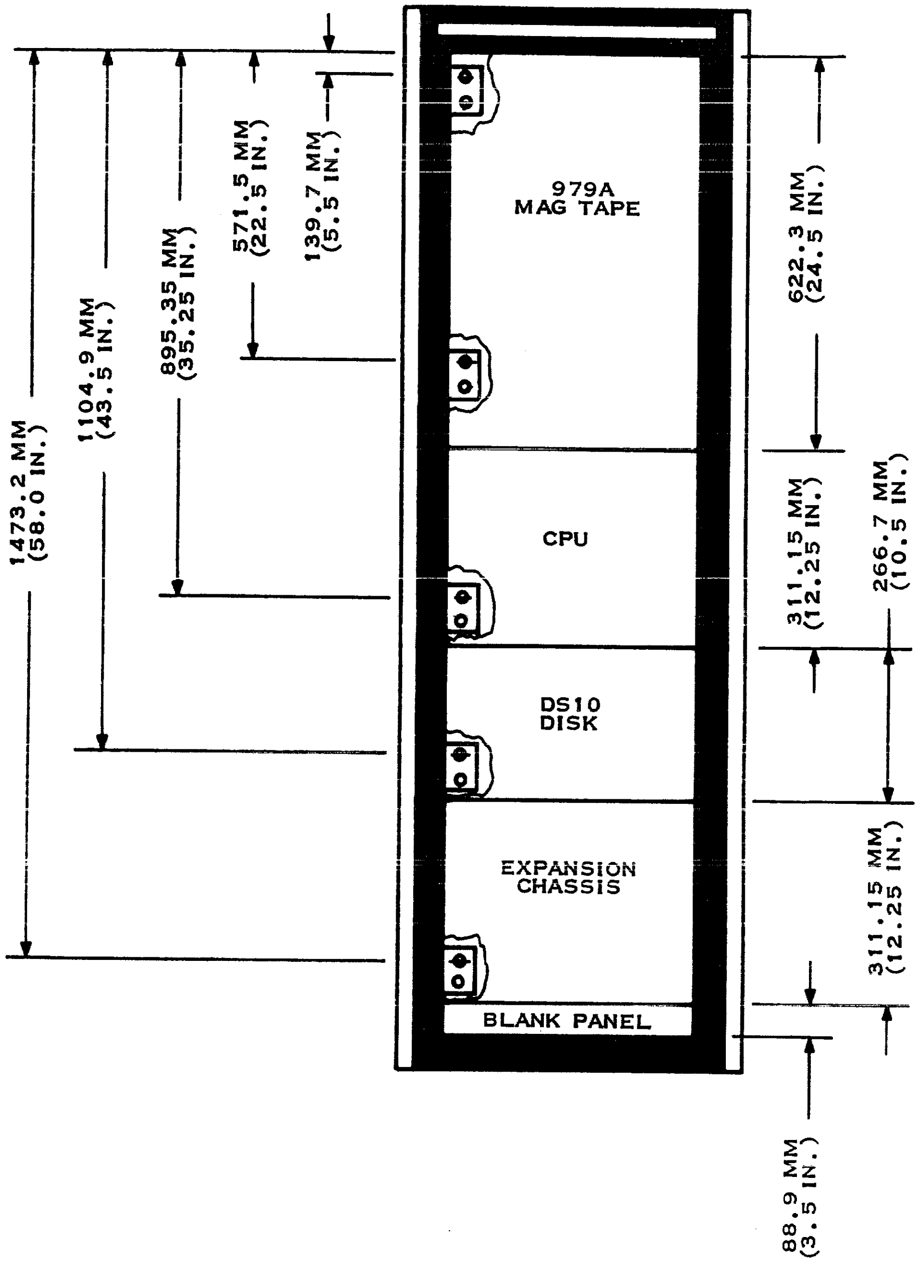
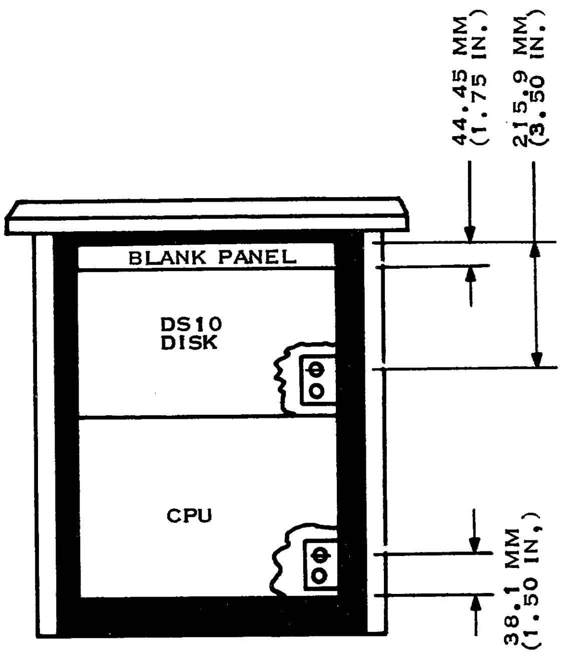


Figure C-3. Model 4 Optional Double-Bay Desk



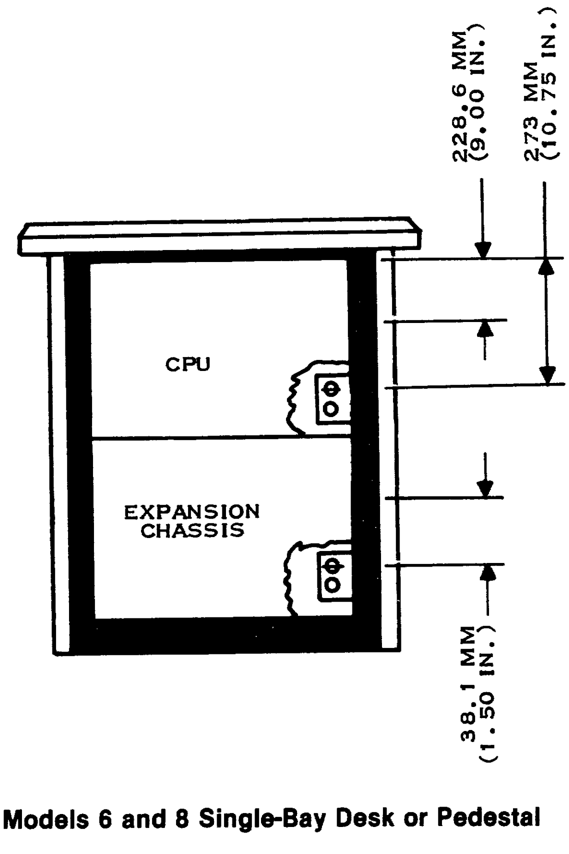
2277181

Figure C-4. Models 4, 6, and 8 1.78-Meter (70-Inch) Cabinet



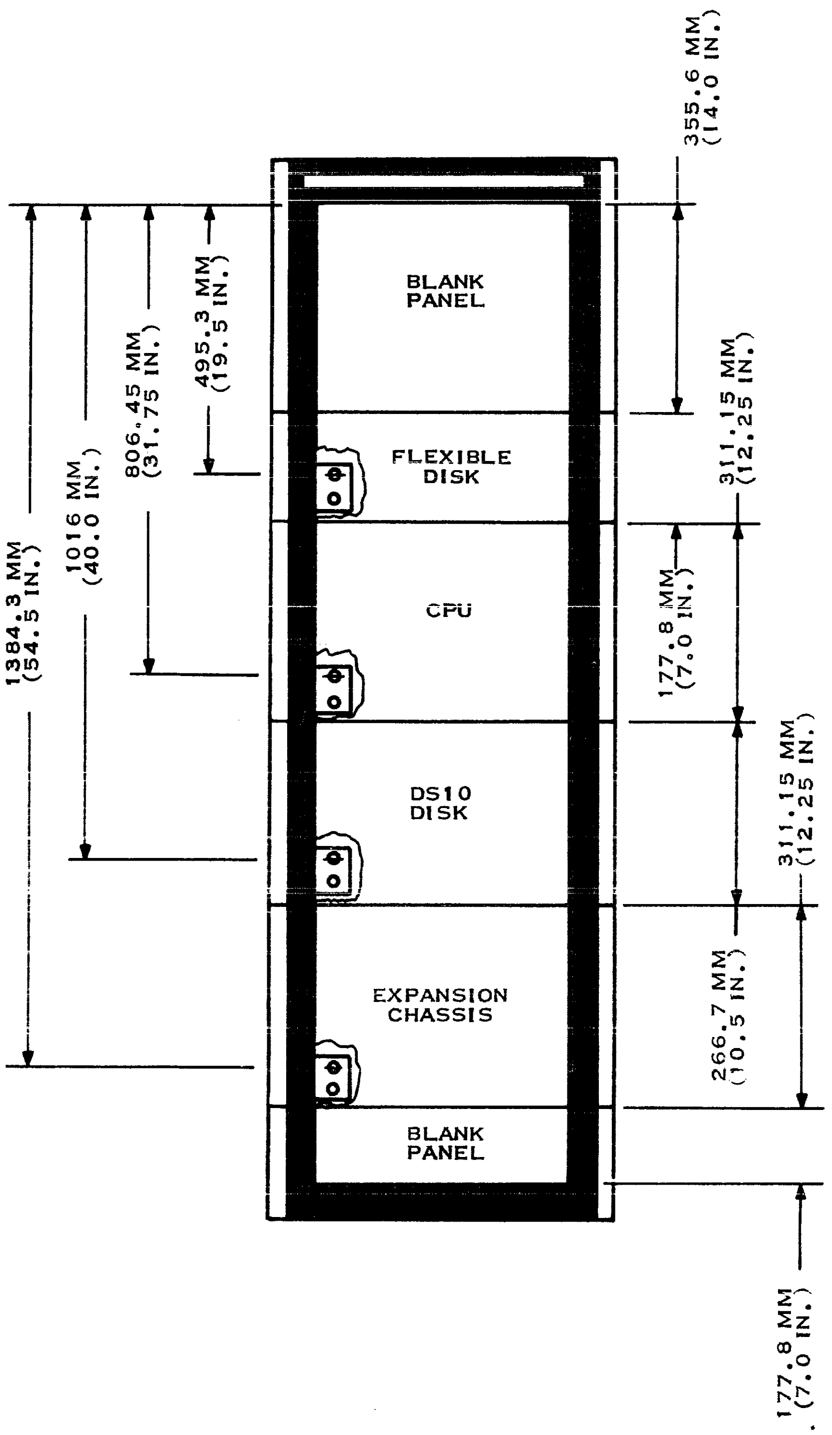
2280703

Figure C-5. Model 4 Single-Bay Desk or Pedestal



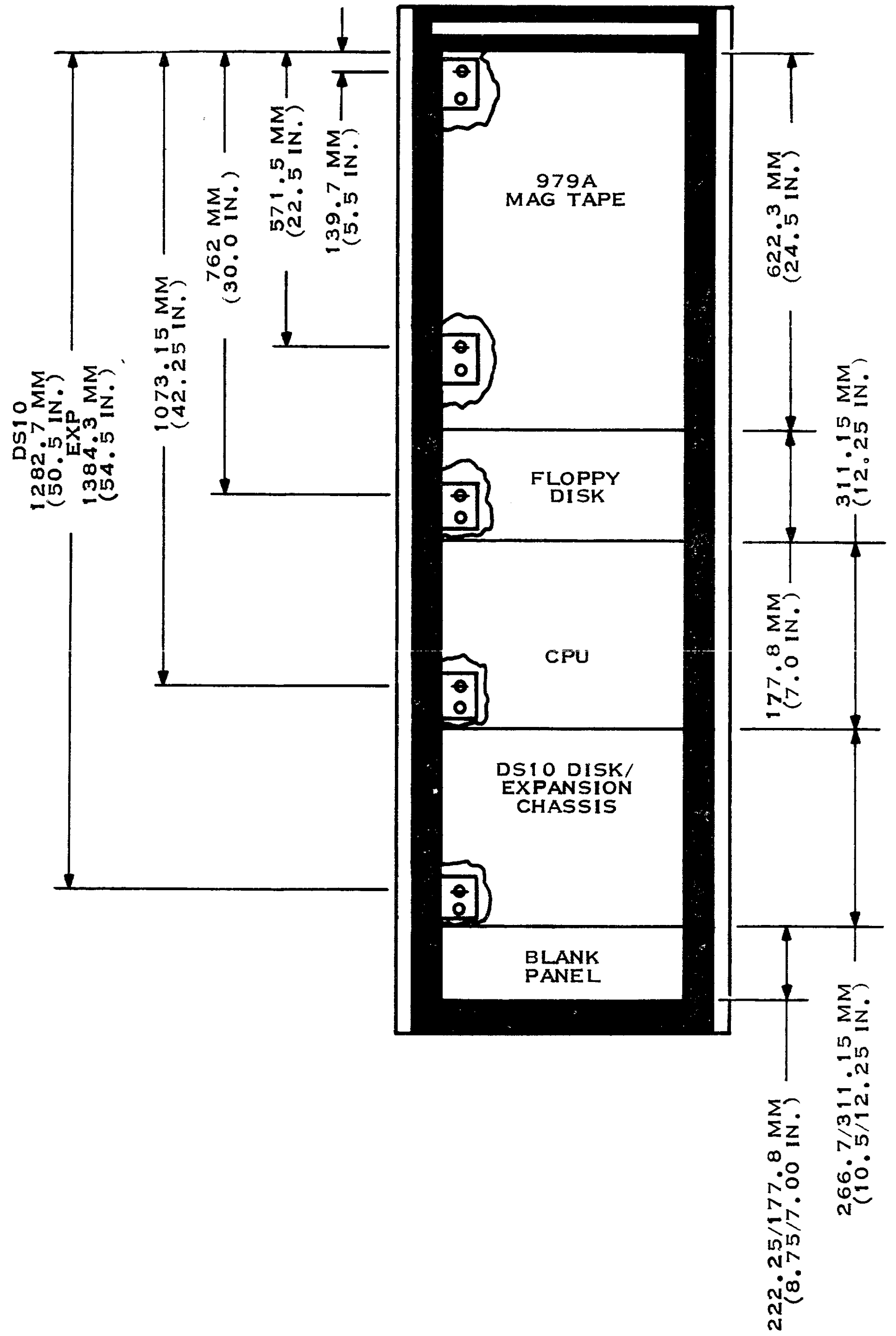
2277183

Figure C-6. Models 6 and 8 Single-Bay Desk or Pedestal



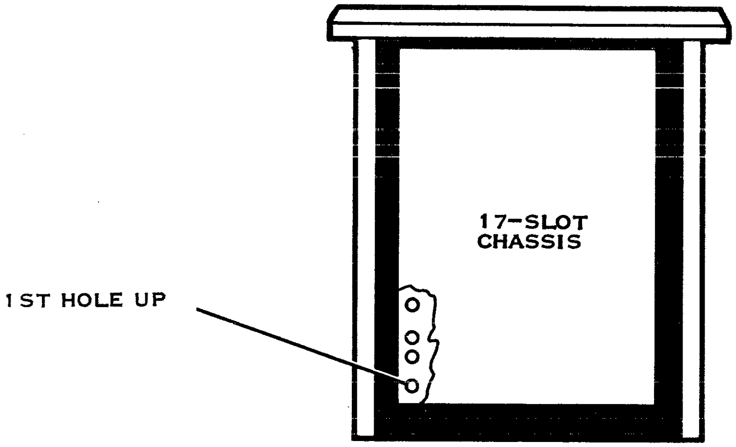
2277184

Figure C-7. Model 4 1.78-Meter (70-inch) Cabinet



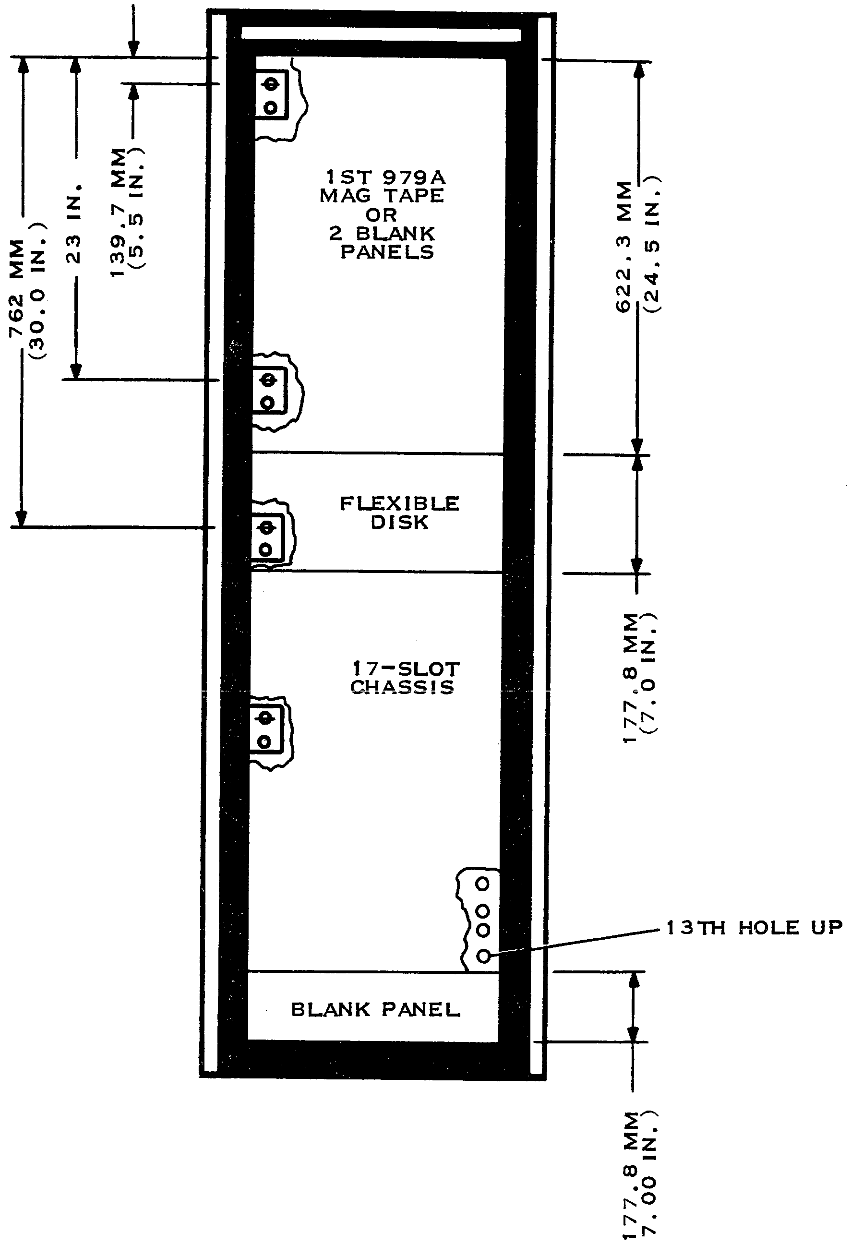
2277185

Figure C-8. Models 4, 6, and 8 1.78-Meter (70-Inch) Cabinet



2280568

Figure C-9. Model 8PP 762-Millimeter (30-Inch) Cabinet



2280569

Figure C-10. Models 8PP, 20, and 30 Primary Enclosure

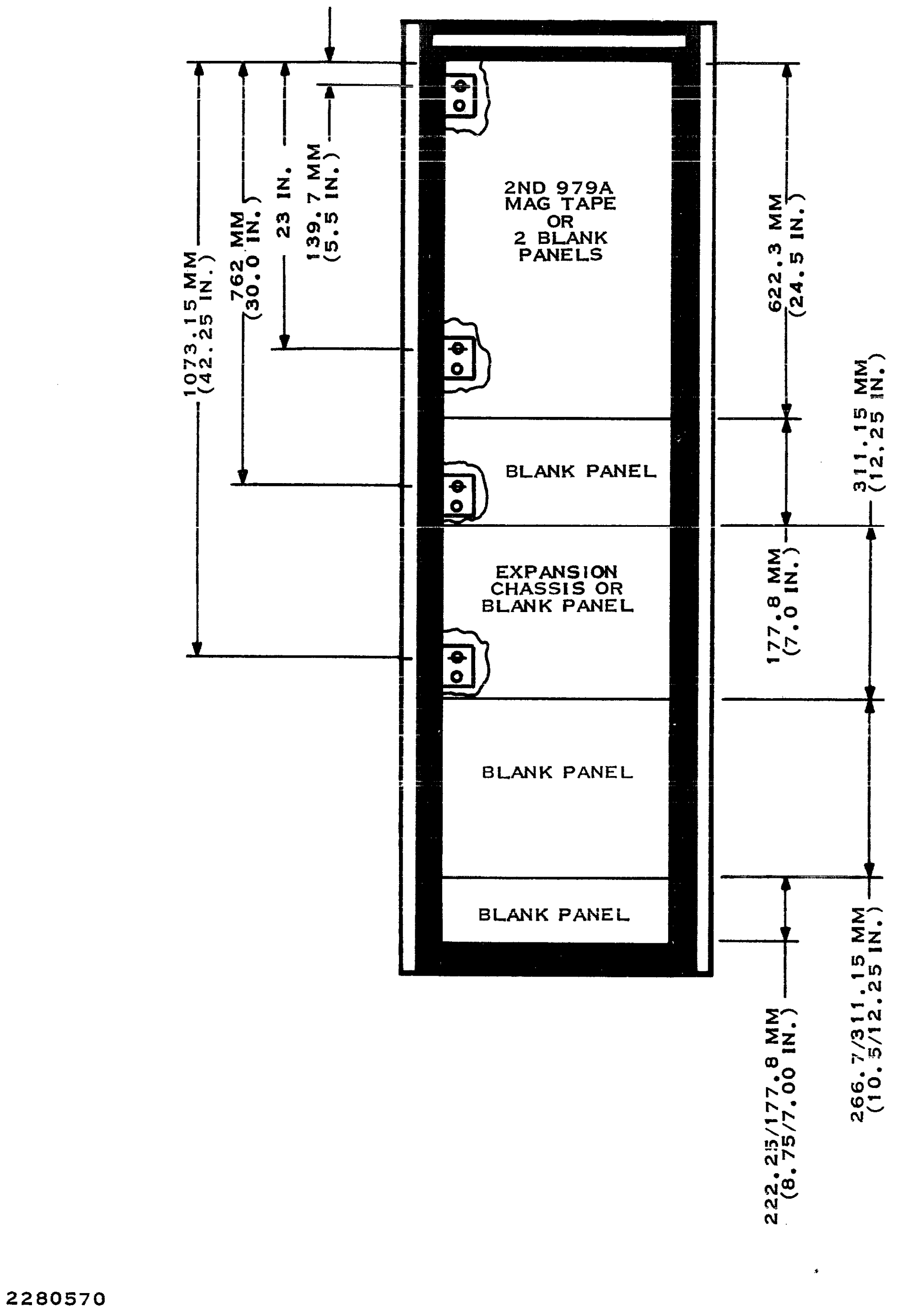
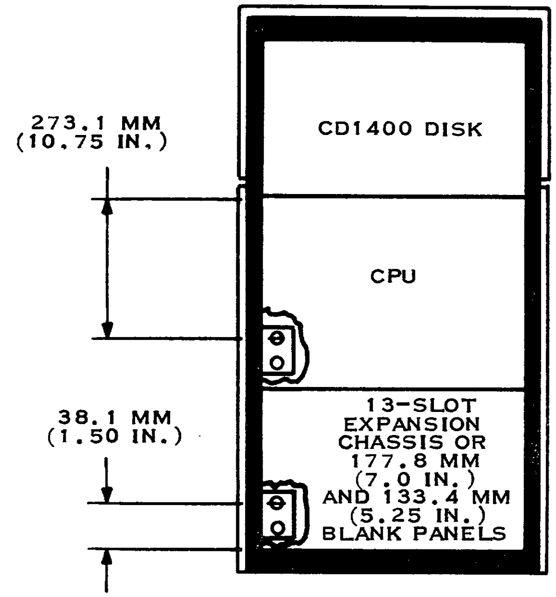
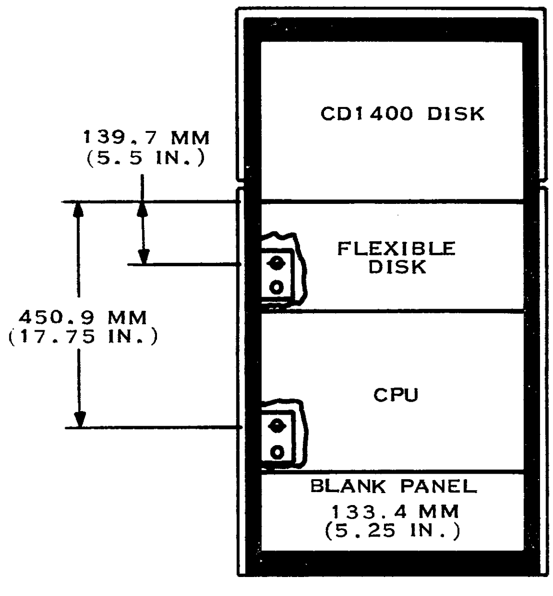


Figure C-11. Models 8PP, 20, and 30 Optional Enclosure



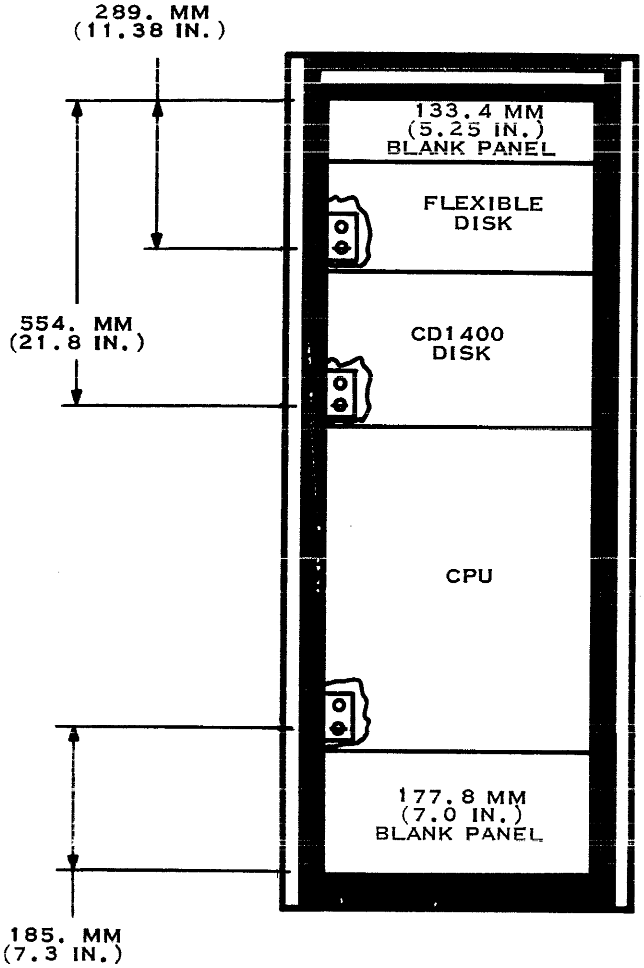
2280571

Figure C-12. Models 7 and 9 1.12-Meter (44-Inch) Pedestal



2280572

Figure C-13. Models 7 and 9 1.12-Meter (44-Inch) Pedestal with Optional Flexible Disk



2280573

Figure C-14. Model 29 1.52-Meter (60-Inch) Cabinet

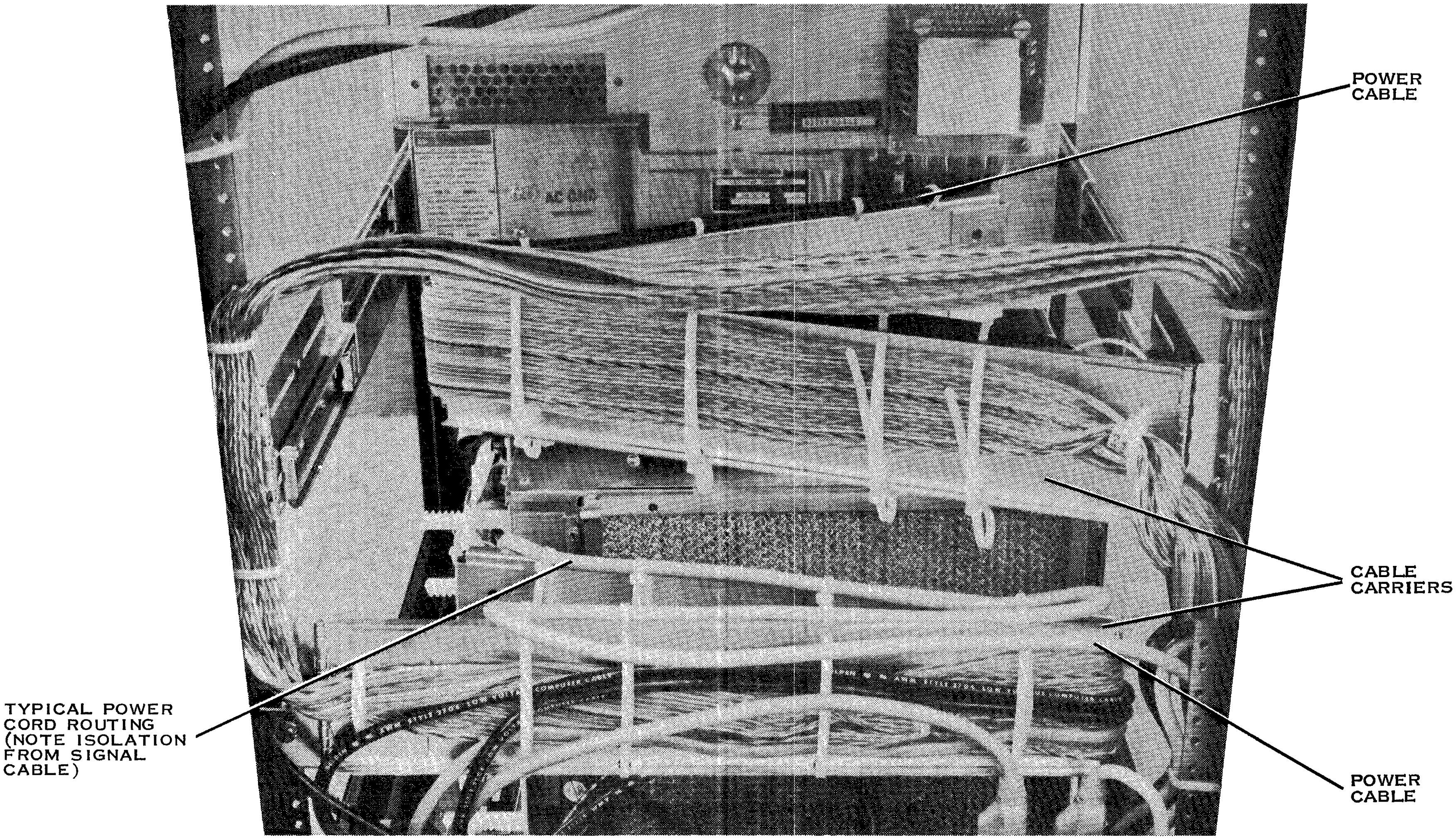


Figure C-15. DS990 Sample Cable Dressing Depicting Power Cord Isolation

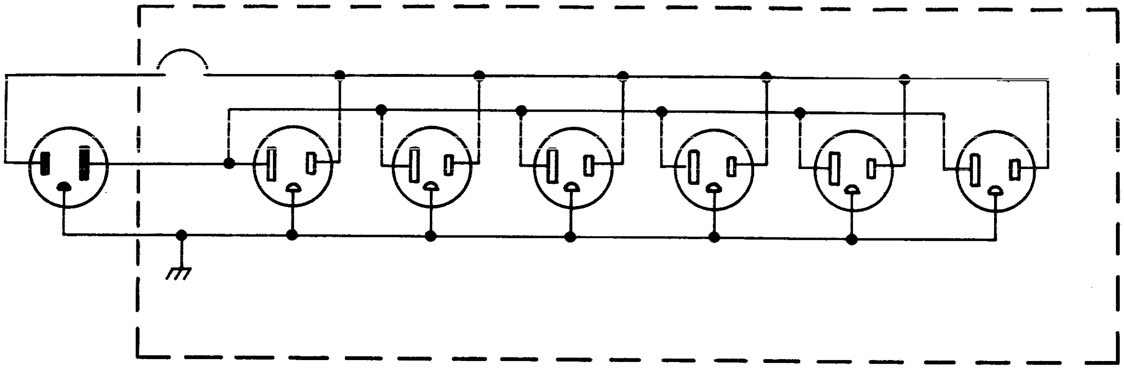


Figure C-16. Previous Production 100 V/120 V Desk or Pedestal

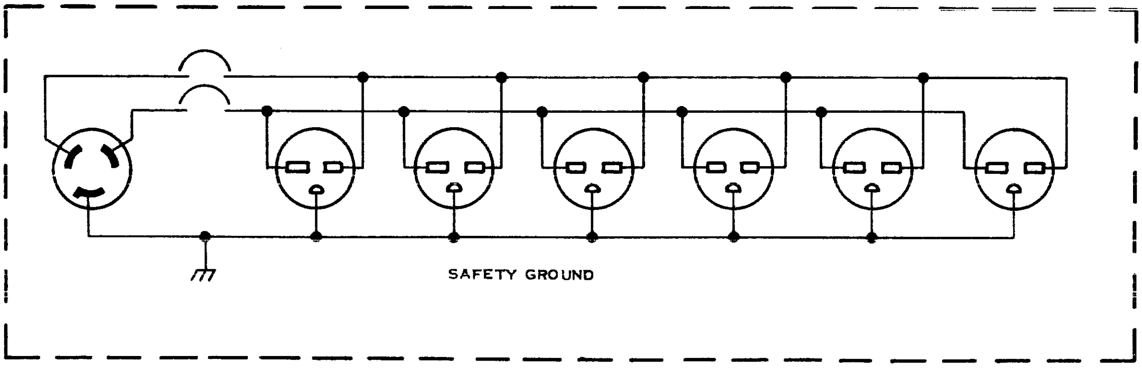


Figure C-17. Previous Production 230 V Desk or Pedestal

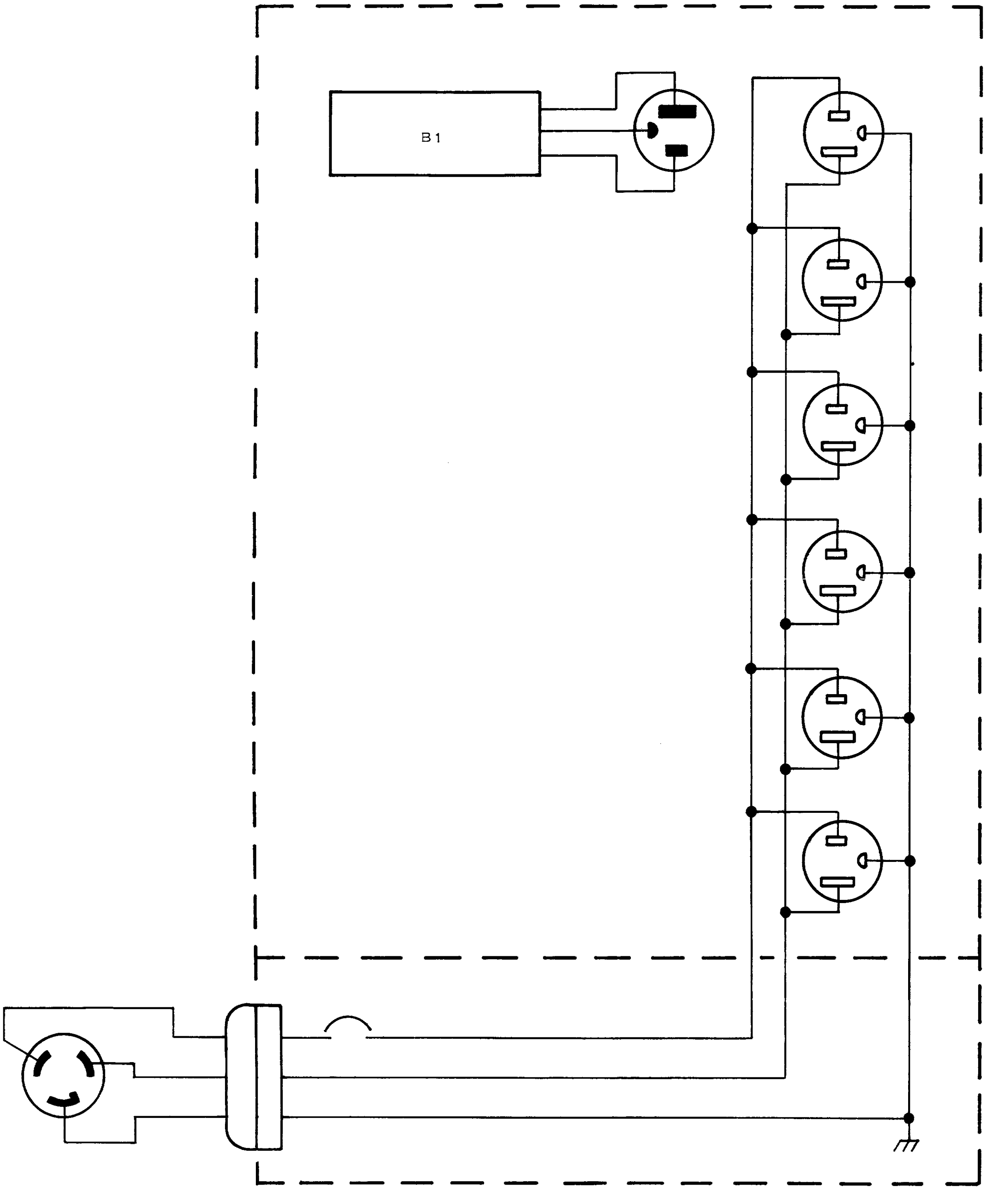


Figure C-18. Previous Production 100 V/120 V Cabinet

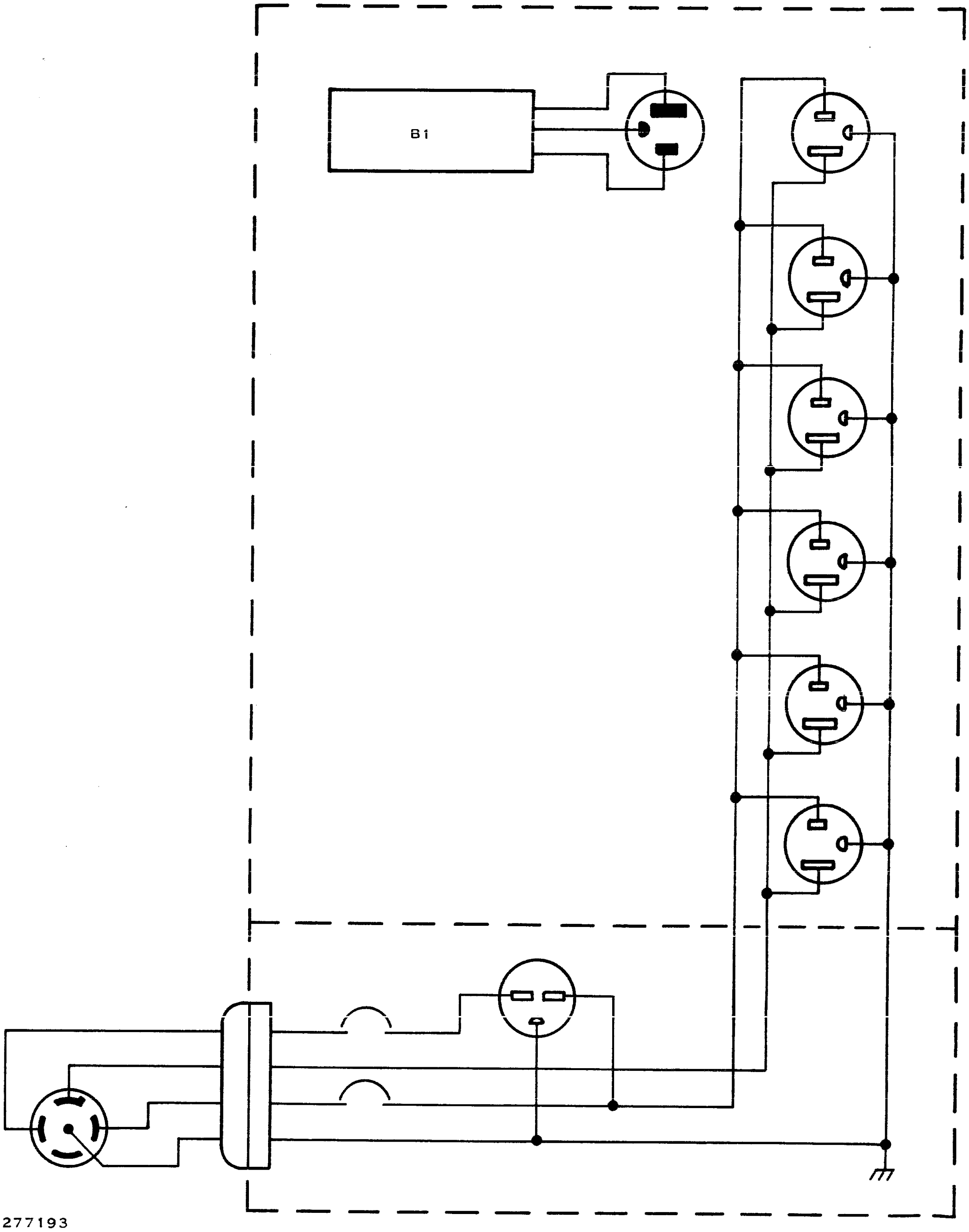


Figure C-19. Previous Production 100 V/200 V, 115 V/208 V Cabinet

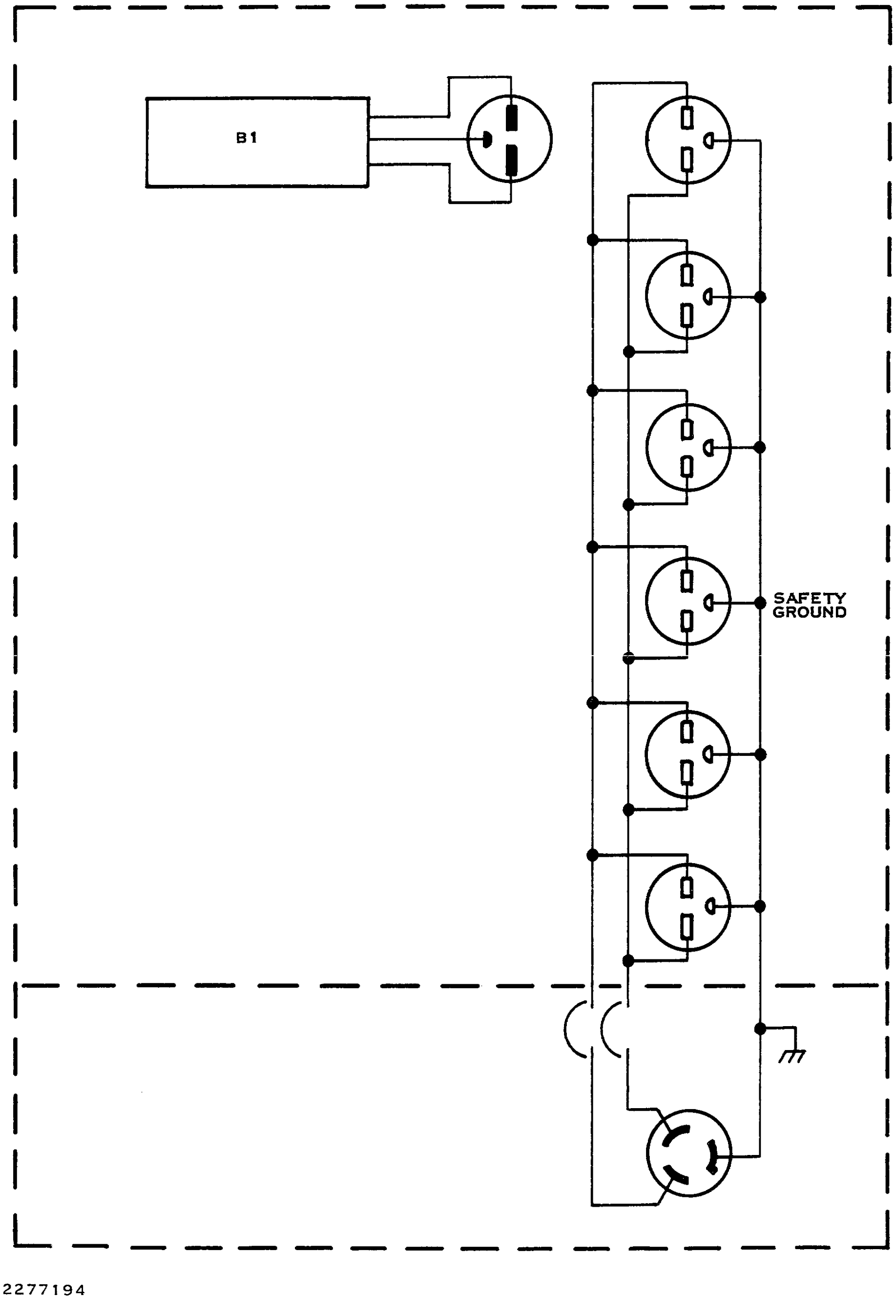


Figure C-20. Previous Production 230 V Cabinet

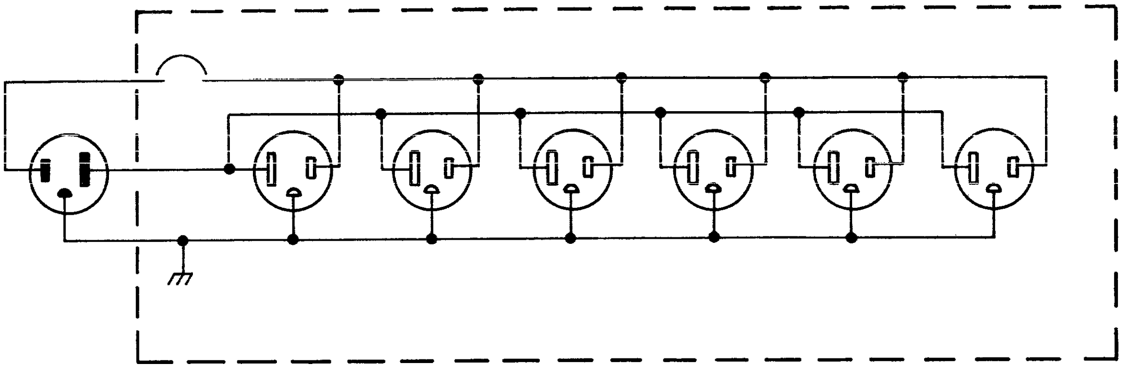


Figure C-21. Current Production 100 V/120 V Desk or Pedestal

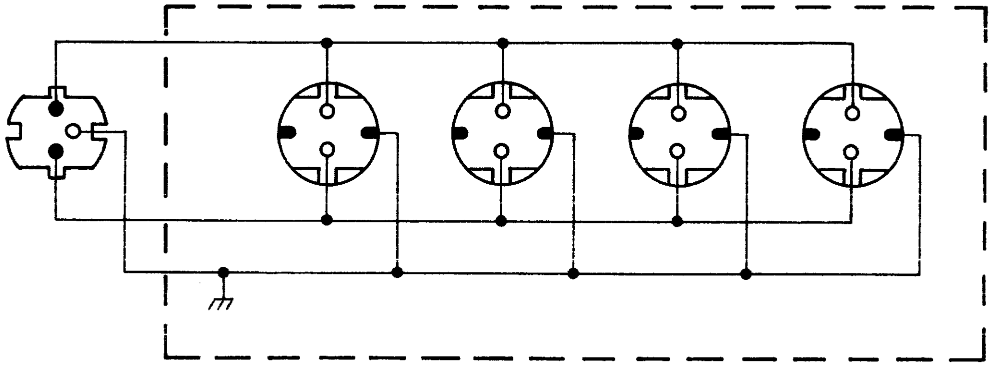


Figure C-22. Current Production 220 V, 10 A Desk or Pedestal

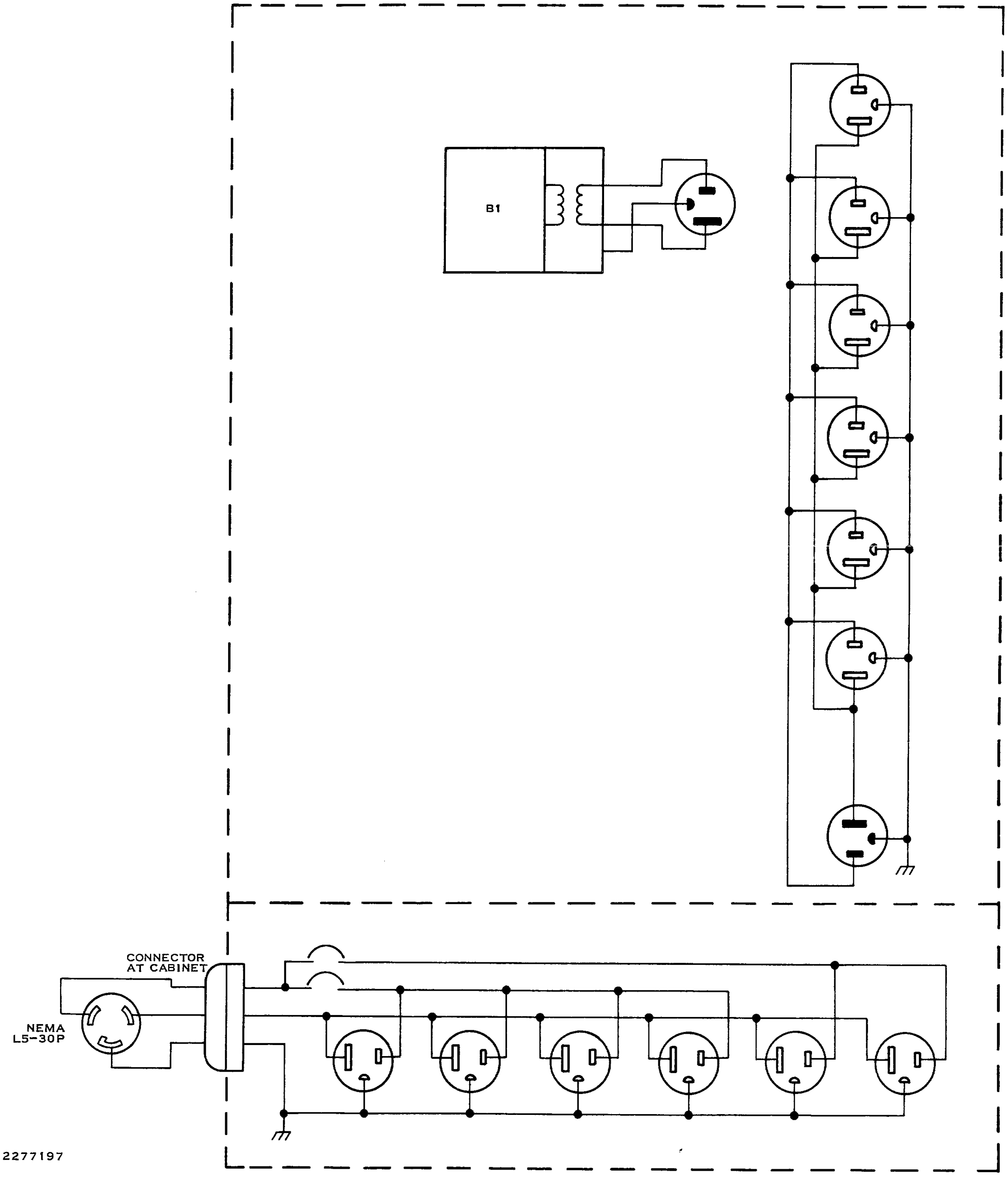
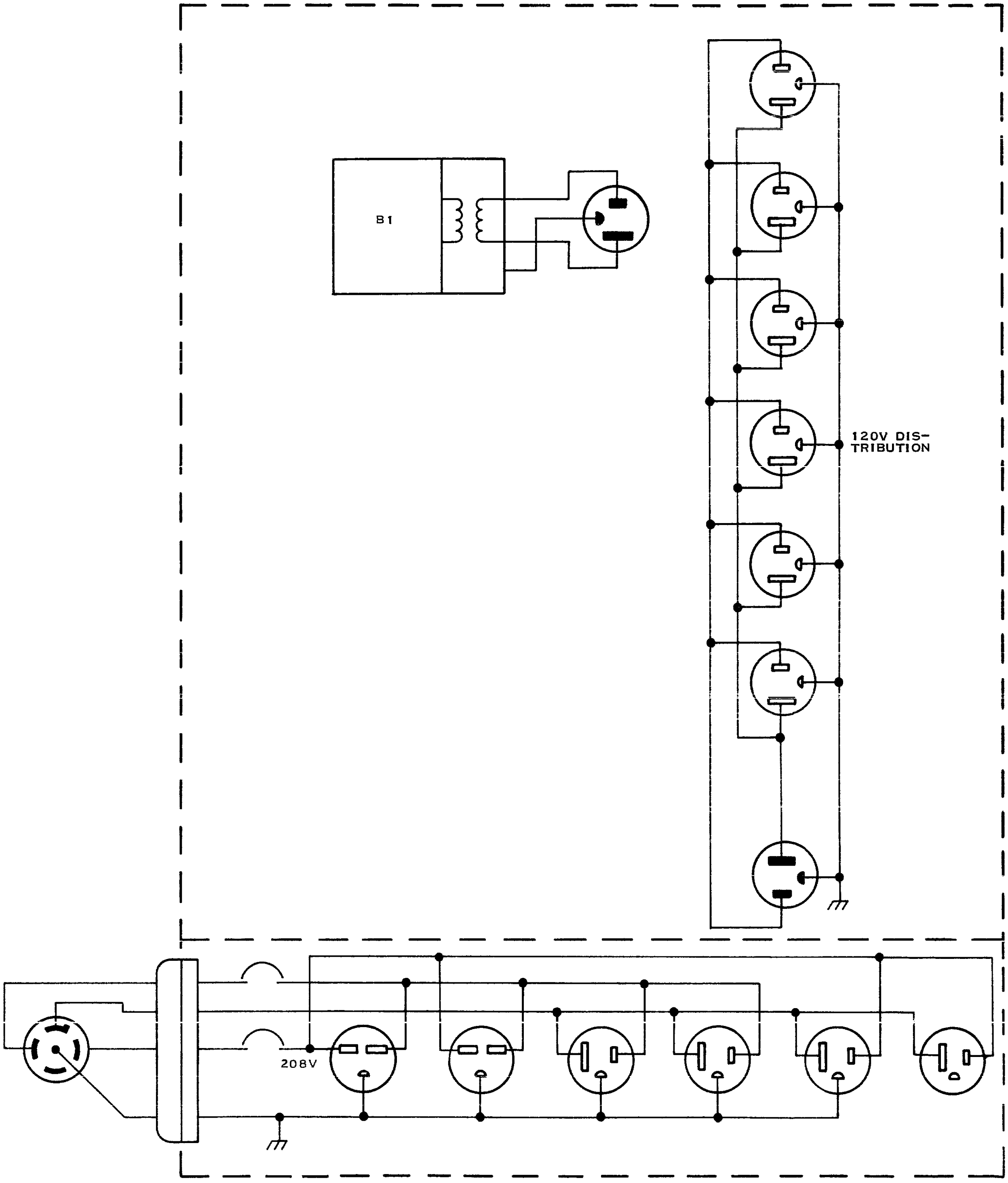


Figure C-23. Current Production 100 V/120 V, 30 A Cabinet



2277198

Figure C-24. Current Production 100 V/200 V, 120 V/208 V Cabinet

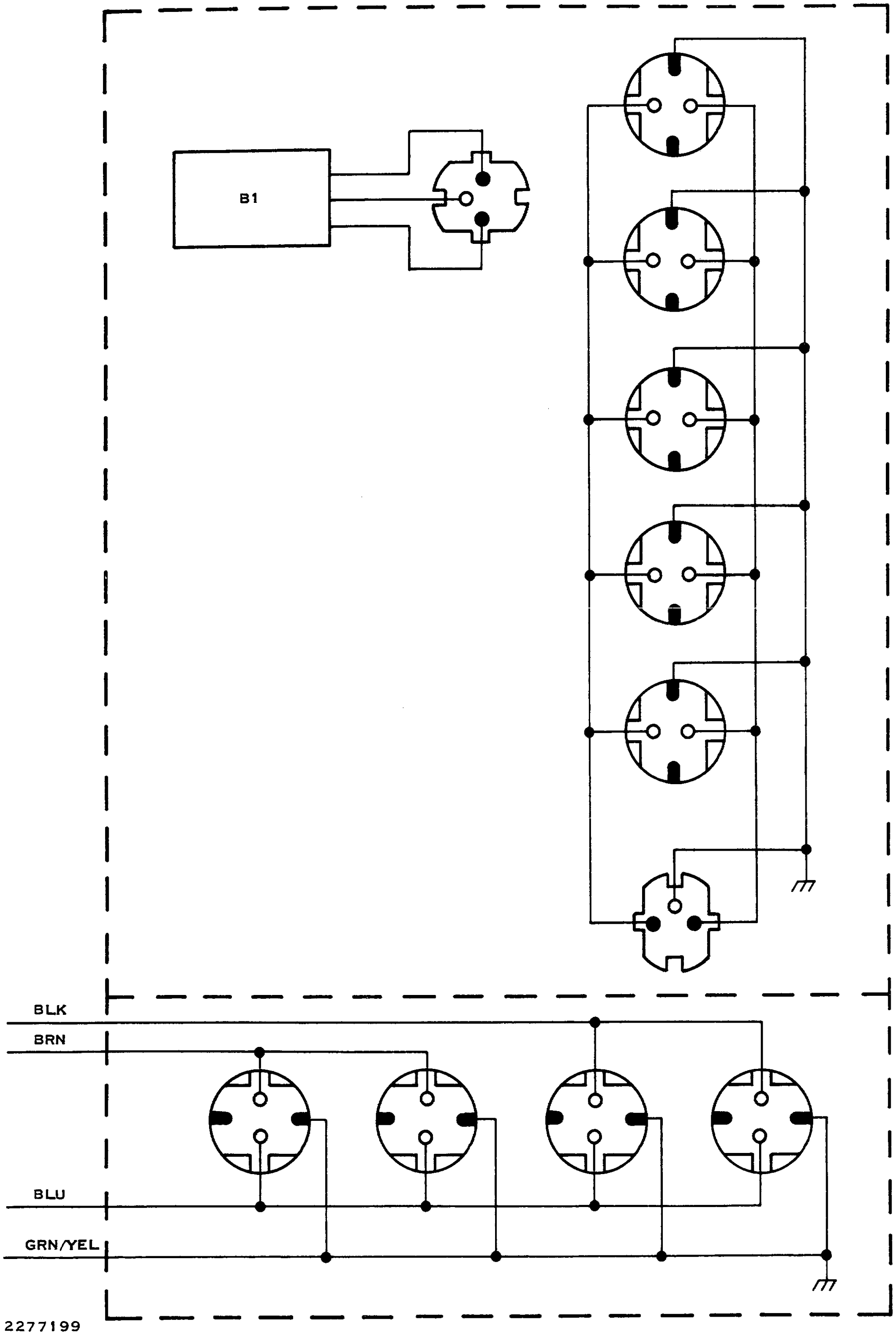


Figure C-25. Current Production 220 V, 16 A Cabinet

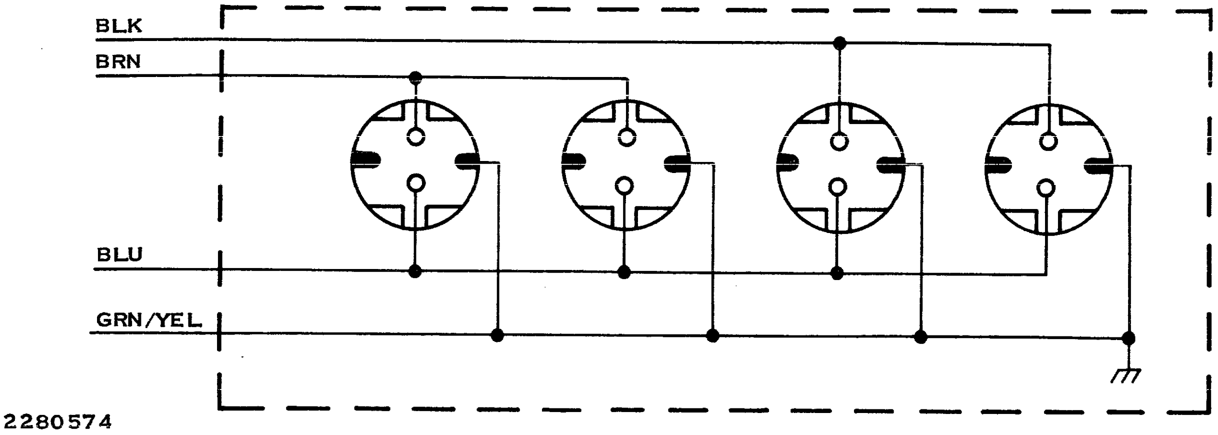


Figure C-26. Current Production 220 V, 16 A Pedestal

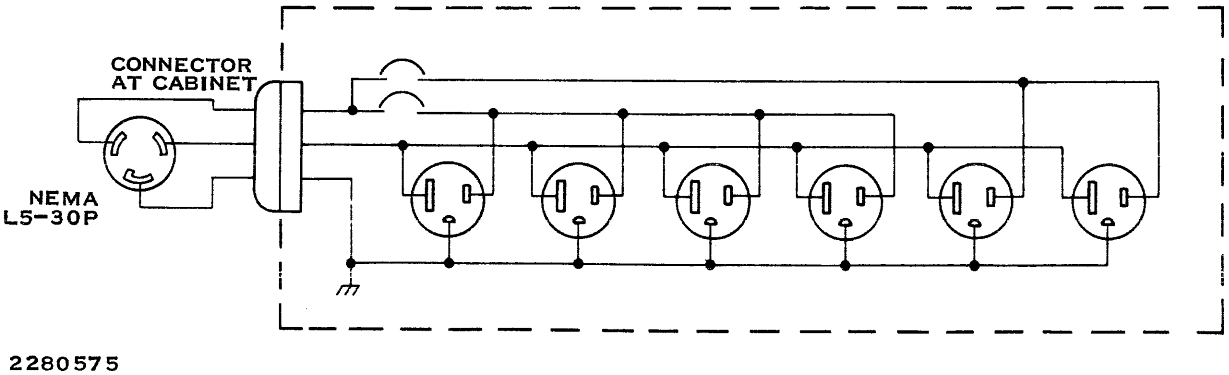


Figure C-27. Current Production 100 V/120 V, 30 A Pedestal

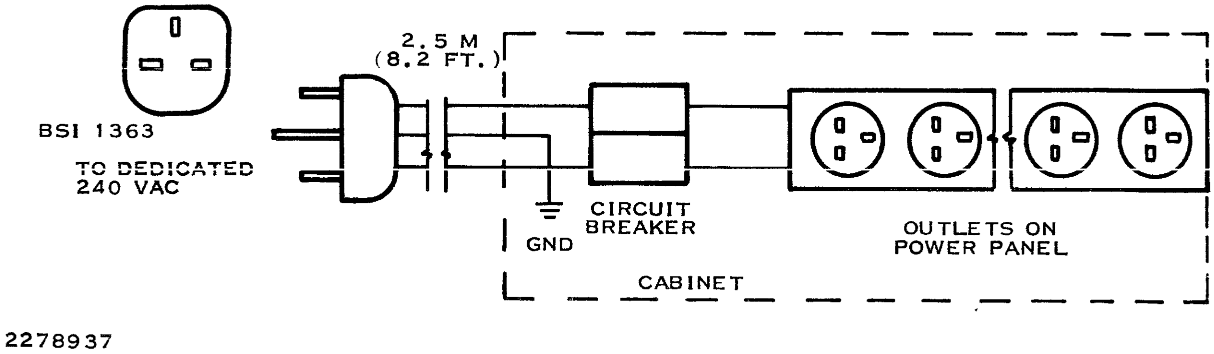


Figure C-28. International 240 Vac 762-Millimeter (30-Inch), 1.12-Meter (44-Inch), 1.52-Meter (60-Inch), and 1.78-Meter (70-Inch) Cabinet

Appendix D

CRU Bit Assignments

D.1 GENERAL

This appendix contains CRU bit information on the DS990 system interface boards and controllers that interface with the computer through the CRU. Tables and illustrations define the meaning of CRU input and output bits as they pertain to each interface board or controller. If further information of this type is desired, consult the installation and operation manual for the module, controller, or peripheral system.

D.2 911 VDT CONTROLLER

D.2.1 CRU Input Interface from 911 VDT

The addressable input data to the computer CRU from the 911 VDT controller includes:

- Display and memory read character
- Character intensity bit
- Keyboard character data
- Cursor address
- Status and error signals

The input interface signals are illustrated in Figures D-1 and D-2 for typical terminals 0 and 1, respectively. These signals are defined in Table D-1.

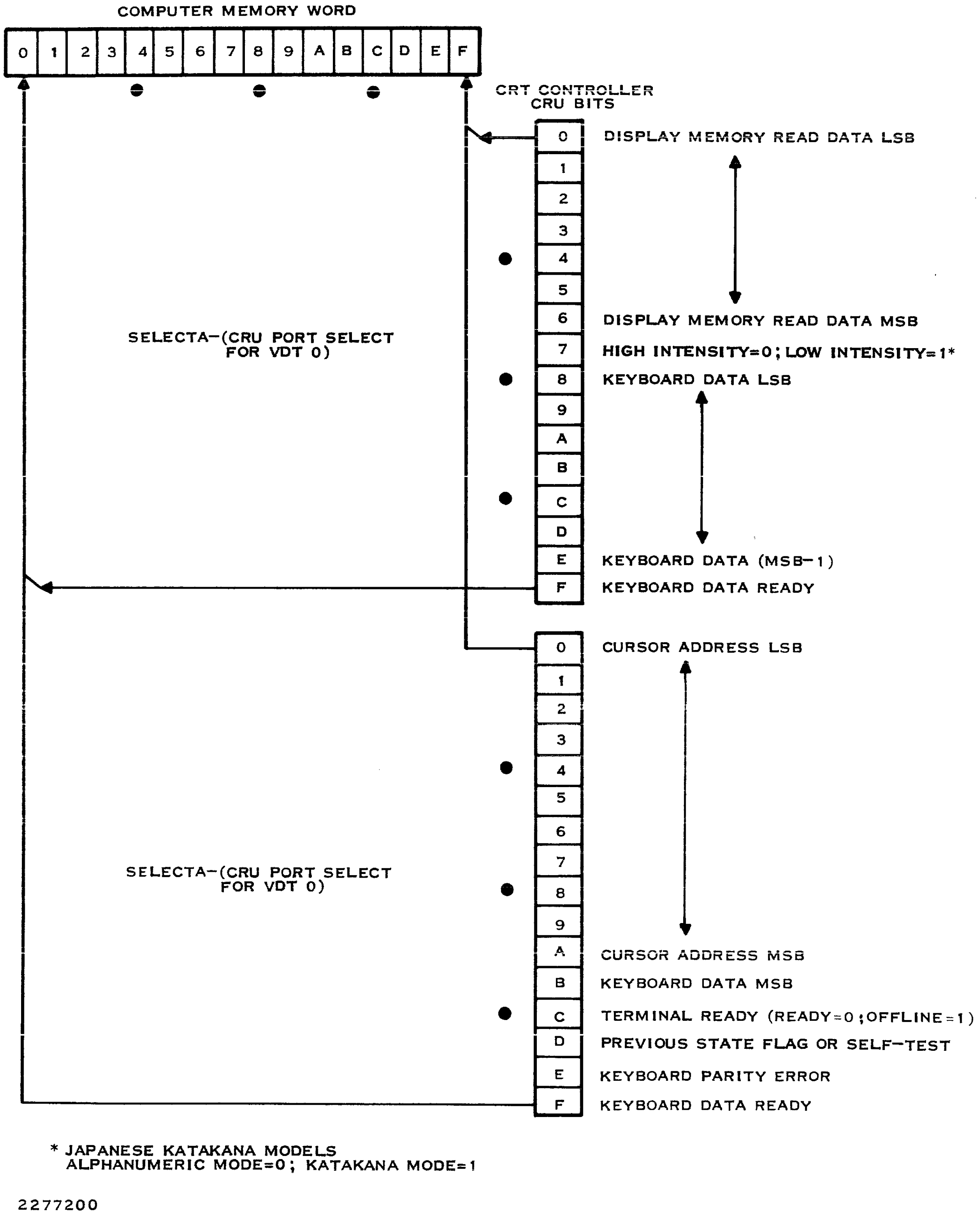
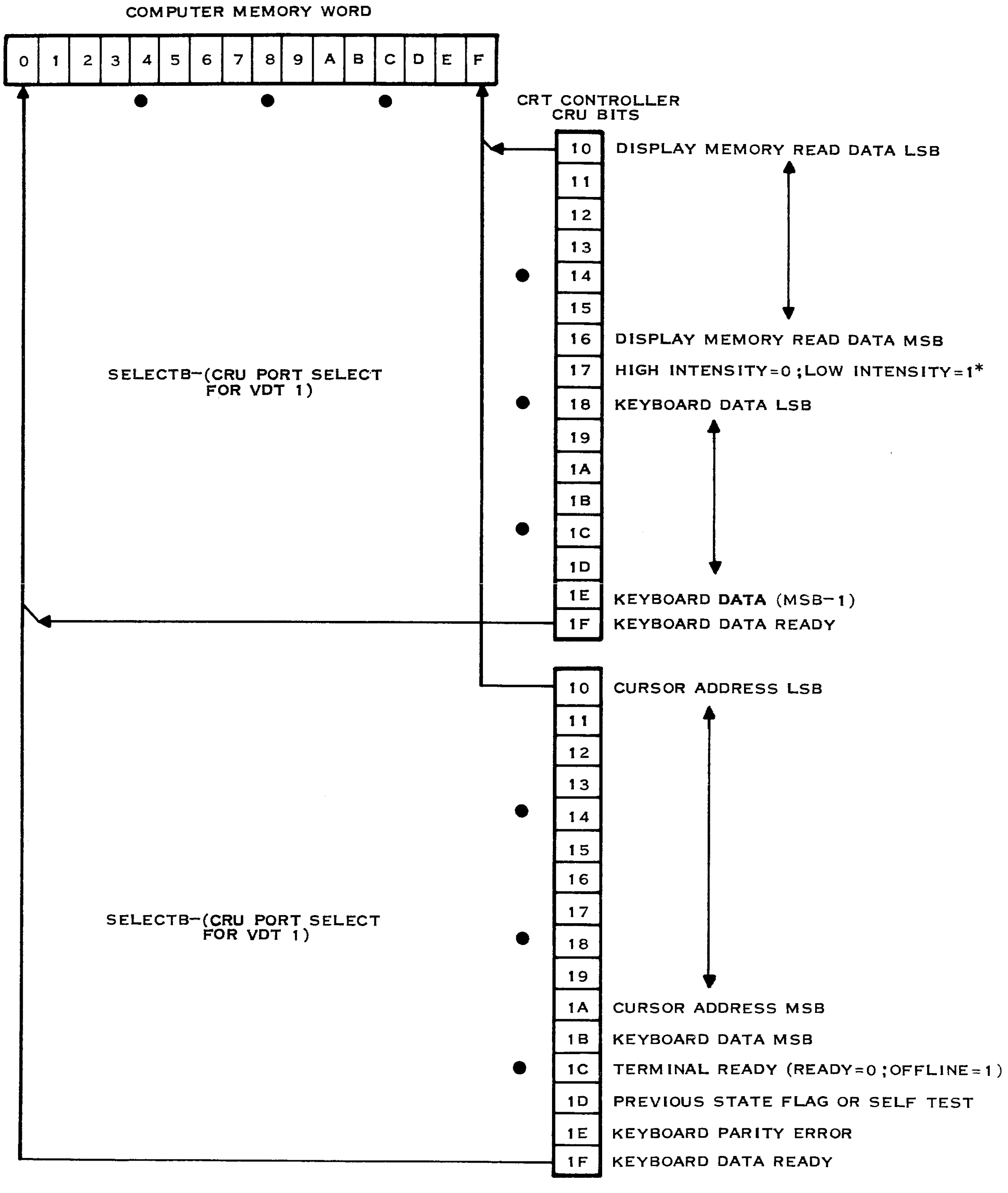


Figure D-1. CRU Input Bit Assignments from 911 VDT Controller for Terminal 0



* JAPANESE KATAKANA MODEL
ALPHANUMERIC MODE=0; KATAKANA MODE=1

2277201

Figure D-2. CRU Input Bit Assignments from 911 VDT Controller for Terminal 1

Table D-1. CRU Addressable Input Bits from 911 VDT

Bit Number (Hexadecimal)	Description

NOTE

Select Word (bit >F or >1F) must be set to 0 for the following bit definitions.

0 - 6, 10 - 16	Display Memory Read Data. 911 VDT memory data is read from the memory address defined by the current cursor location. Following a power-up sequence, a write operation or cursor address change must occur before the read data is ready for access.
7 - 17	Dual Density. Selects the intensity level for the monitor display. Logic 0 selects the high level of intensity; logic 1 selects the low level of intensity when the dual mode is an active feature. On Japanese 911s, all characters are displayed at high intensity; bits 7 and 17 are used to select Katakana (logic 1) or alphanumeric (logic 0).
8 - E, 18 - 1E	Keyboard Data. Least significant seven bits of keyboard character received from the 911 VDT keyboard. An 8-bit character is required to accommodate the full ASCII character set (128 characters) and additional special function keys. The keyboard control bit is in word select 1, CRU bit >B.
F - 1F	Keyboard Data Ready. Logic 1 indicates a character has been input at the display keyboard and is available to be read by the CPU. This signal is reset to logic 0 by an output of keyboard acknowledge. Keyboard data ready may be read independent of the word-select control bit.

NOTE

The 911 VDT controller may generate two CRU interrupts, one for each display. An interrupt signal occurs as a result of the keyboard ready signal, if the keyboard interrupt and enable control associated with a display is set to logic 1.

NOTE

Select Word (bit >F or >1F) must be set to logic 1 for the following bit definitions.

Table D-1. CRU Addressable Input Bits from 911 VDT (Continued)

Bit Number (Hexadecimal)	Description
0 - A, 10 - 1A	Cursor Address. Indicates the position of the cursor on the screen. The cursor indicates the position of the next character to be placed on the display screen. The number of address bits used is determined by the total number of character positions on the screen. Ten address bits are used with 960-character displays; 11 address bits are used with 1920-character displays. An unused address bit is always read as zero. The range of addresses for the 960- and 1920-character displays is shown in Figure D-3. Note that the display memory address range exceeds the range of the screen display. Memory beyond the screen display address range is program-accessible, but is not displayed.
B or 1B	Keyboard Data Control Bit. MSB of keyboard character.
C or 1C	Terminal Ready. Normally indicates the status of the associated terminal. A logic 0 indicates the terminal is connected and available. A logic 1 indicates the terminal is turned off or disconnected. Also, when self-test mode is selected, terminal ready is set to logic 1.
D or 1D	Previous State Flag or Self-Test Signal. Indicates the state of the word-select logic before the last transfer to word 1. Logic 0 indicates word 0 was selected, and logic 1 indicates word 1 was selected. If self-test mode is selected, this signal provides one of four test inputs. The previous state flag permits interrupt-driven software to determine the controller state prior to a keyboard interrupt. This permits the controller to process the interrupt and restore previous conditions. When test mode is selected, this bit has another function. In test mode the signal read is determined by two display memory write data bits: CRU output bits 0 and 1 of word 0, VDT 0; and CRU outputs 10 and 11 of word 0, VDT 1. The signals read during test mode are video, audio beep, horizontal sync, and vertical sync. The signals and their characteristics are summarized in Table D-2.
E or 1E	Keyboard Parity Error. A logic 1 on this input indicates that a parity error occurred on the previous keyboard data transmission. The error indication is reset by the output signal, keyboard acknowledge. A logic 0 indicates the transmission had valid parity.

Table D-1. CRU Addressable Input Bits from 911 VDT (Continued)

Bit Number (Hexadecimal)	Description
F or 1F	Keyboard Data Ready. Logic 1 indicates a character has been input at the 911 VDT keyboard and is available to be read by the CPU. This signal is reset to logic 0 by an output of keyboard acknowledge.

NOTE

The 911 VDT controller may generate two CRU interrupts. An interrupt signal occurs as a result of the keyboard data ready signal from VDT terminal 0 or terminal 1 if respective keyboard interrupt enable control signal is set to logic 1.

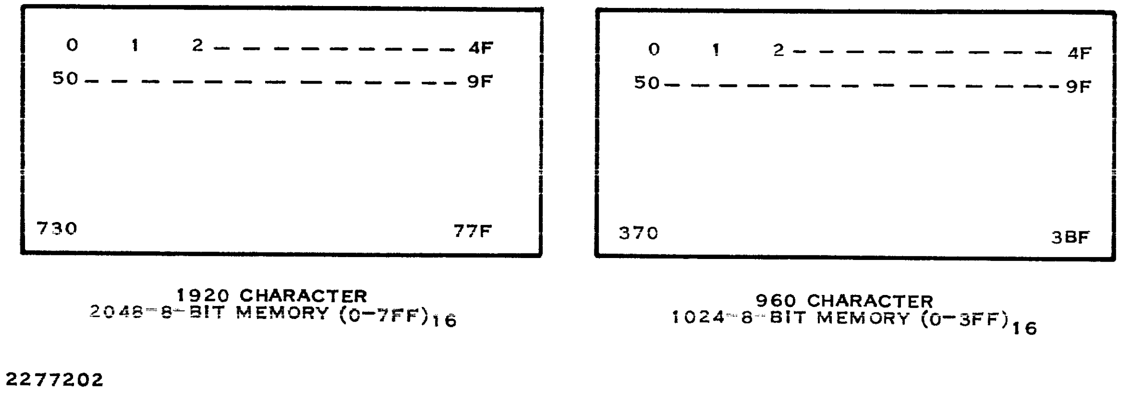


Figure D-3. Displayed Character Positions

Table D-2. Built-In Test Input Signals

Input Signal	Test Mode	Word 0 CRU Bit 1 or 10*	CRU Bit 1 or 11*	Signal Characteristics
Video	1	0	0	0 = All memory locations contain space character >20. 1 = All memory locations contain EM character >19.
Horizontal Sync	1	0	1	0 = 52-microsecond duration pulse. 1 = 12-microsecond duration pulse.
Vertical Sync	1	1	0	0 = 16.4-millisecond duration pulse at 60 Hz or 19.8-millisecond pulse at 50 Hz. 1 = 192-millisecond duration pulse.
Audio Alarm	1	1	1	0 = Beep off. 1 = Beep on; each pulse 0.3 second duration.

Note:

* CRU bits 0 and 1, word 0, selects the test signal for VDT terminal 0. CRU bits 10 and 11, word 0, selects the test signal for VDT terminal 1.

D.2.2 CRU Output Interface to 911 VDT

The addressable output data from the computer CRU includes:

- Display memory write data
- Test control bits
- Character intensity bit
- Write data strobe
- Cursor controls
- Interrupt enables
- Word select bit
- Cursor address

Figures D-4 and D-5 illustrate CRU output bit assignments for 911 VDT terminal 0 and terminal 1, respectively. Table D-3 defines this output interface.

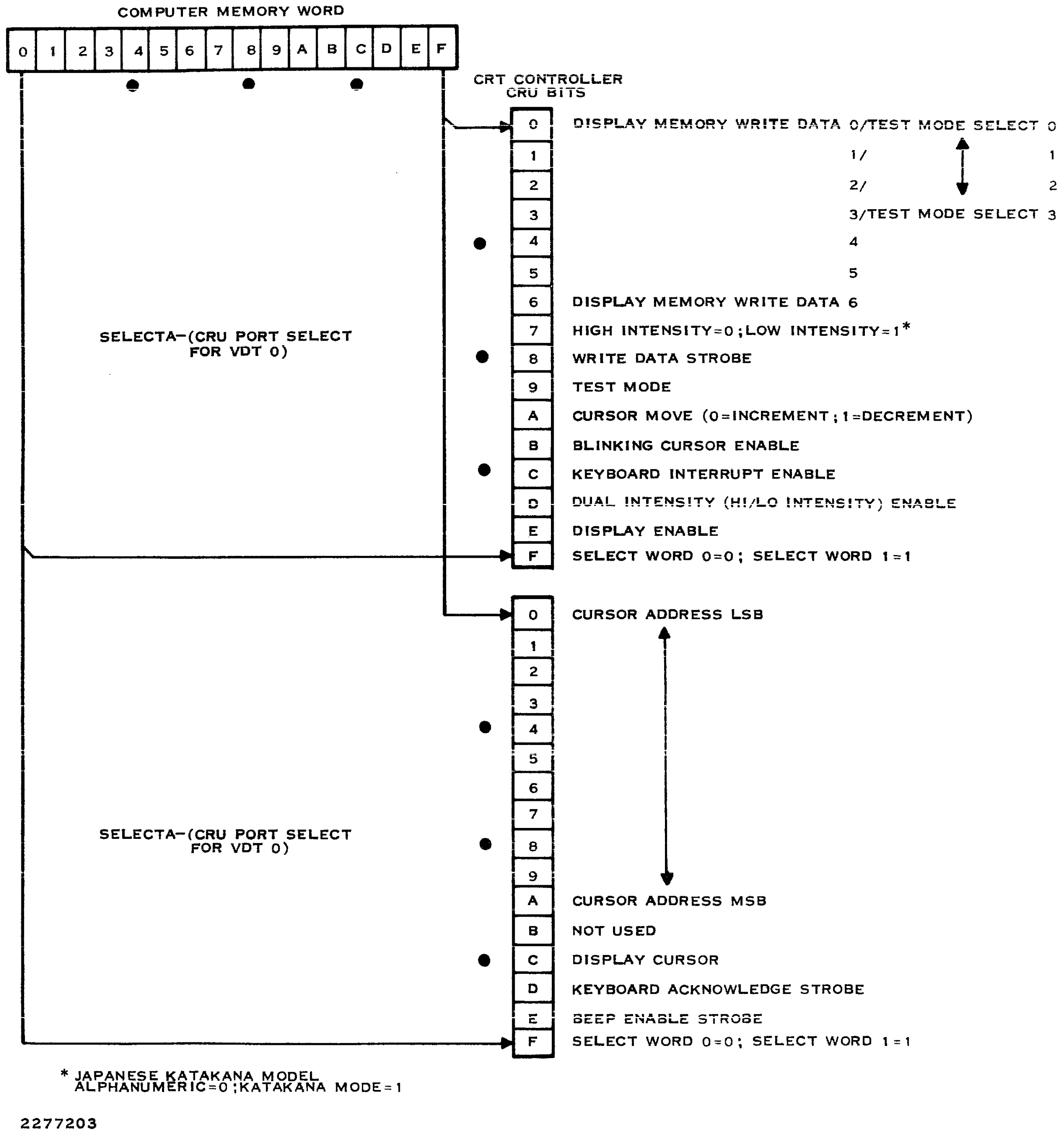


Figure D-4. CRU to 911 VDT Controller Output Bit Assignments for Terminal 0

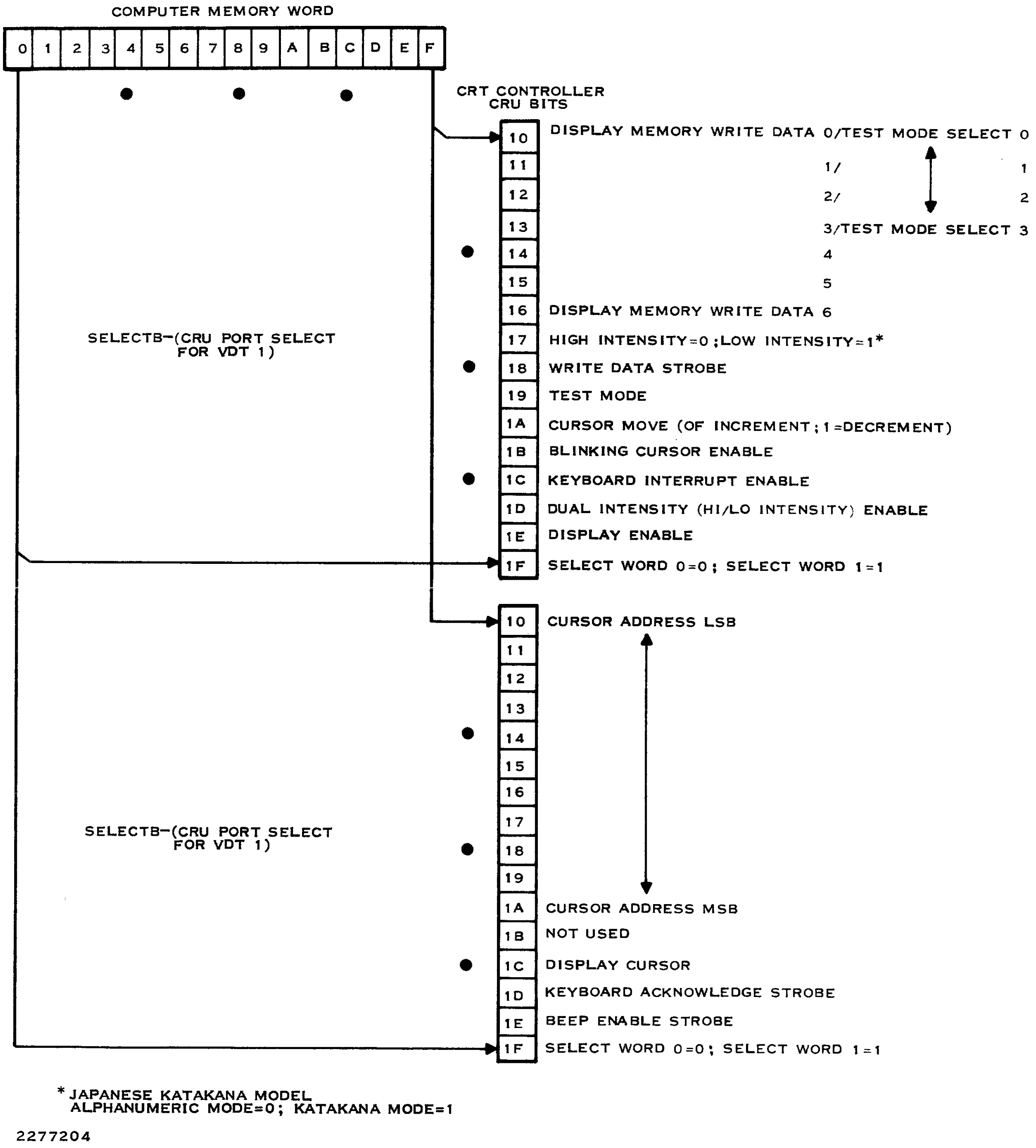


Figure D-5. CRU to 911 VDT Controller Output Bit Assignments for Terminal 1

Table D-3. 911 VDT Controller Addressable Output Bits

NOTE

The following descriptions of the CRU bit functions assume that word select has been set to logic 0.

Bit Number (Hexadecimal)	Description
0 - 6, 10 - 16	Display Memory Write Data. Represent an ASCII character that is to be written into the screen refresh memory. The destination of the character is determined by the contents of the cursor address register. Bit 0 is the LSB, and bit 6 is the MSB of the character. The 7-bit character and the high/low intensity bit are written into the cursor address when the write data strobe is output. The four LSBs of memory write data (CRU bits 0 - 3 for VDT terminal 0 and CRU bits 10 - 13 for VDT terminal 1) have special significance when self-test mode is activated. Bits 0 and 1 (or bits 10 and 11) select one to four test inputs. The selected input is read as CRU input signal previous state flag or self-test signal. Table D-2 shows the characteristics of the test inputs. Bits 2 and 3 (or bits 12 and 13) program the input to the keyboard test transmitter. The transmitter output feeds the keyboard input circuit to simulate keyboard data. Table D-4 relates the state of the control bits to the character generated by the transmitter.
7 or 17	Dual Intensity. Selects the high or low intensity level for 911 VDT display. Logic 0 selects high intensity logic display; logic 1 selects low intensity display when the dual intensity feature is active. On the Japanese model, this bit selects either the alphanumeric or the Katakana mode. A logic 0 selects alphanumeric; logic 1 selects Katakana. All characters are displayed at high intensity.
8 or 18	Write Data Strobe. Causes the contents of the display memory write data register and the dual intensity bit to be written into memory at the location specified by the cursor address register.
	Test Mode. Logic 1 selects test mode. A logic 0 output returns the control unit to the normal operation mode. Activating test mode does the following: • Turns on the test mode indicator

Table D-3. 911 VDT Controller Addressable Output Bits (Continued)

Bit Number (Hexadecimal)	Description
	• Tests the keyboard receiver with a serial test pattern • Selects one of four key controller signals for input on the previous state/self-test input line Keyboard data test patterns are selected by decoding write data bits 2 and 3 (or 12 and 13). Table D-4 correlates keyboard data test patterns with select bits. As shown in Table D-2, write data bits 0 and 1 (or 10 and 11) select one of the following signals: • Video • Horizontal sync • Vertical sync • Audio alarm
A or 1A	Cursor Mode. Permits the cursor address register to be incremented or decremented with a single-bit transfer instruction. A logic 0 output causes the cursor address to increment. A logic 1 output decrements the cursor address.

NOTE

Do not send write data strobe and cursor move within a single LDCR operation. The issue of separate commands assures completion of the write operation before the cursor address changes.

The cursor address register range is between >0 and >3BF for a 960-character display and >780 and >77F for a 1920-character display.

Note that location >3C0 to >3FF on the 960-character display and >780 to >7FF on the 1920-character display are not displayable. These locations may be accessed by software. Software must detect when an increment or decrement of the cursor address register will move the cursor into the nondisplayed region.

Bit Number (Hexadecimal)	Description
B or 1B	Blinking Cursor Enable. Controls the blinking of the cursor. If the cursor is displayed, a logic 1 on this bit causes the cursor to blink at a 2-Hz rate. A logic 0 disables the blinking cursor. Blinking results from alternately displaying the cursor position character in normal and reverse video.

Table D-3. 911 VDT Controller Addressable Output Bits (Continued)

Bit Number (Hexadecimal)	Description
C or 1C	Keyboard Interrupt Enable. Controls whether a keyboard data ready signal generates a CRU interrupt. Logic 1 enables an interrupt, while logic 0 masks the data ready interrupt. Only the selected VDT keyboard logic is affected.
D or 1D	Dual Intensity Enable. Controls dual intensity on VDT display screen. Logic 0 selects high intensity for the entire screen. Logic 1 selects high intensity for all words with bit 7 set. On the Japanese model, dual intensity is disabled by this bit being set to logic 1.
E or 1E	Display Enable. Logic 1 enables data to be displayed on the VDT screen. A logic 0 blanks the screen. A master reset automatically sets display enable to logic 0.
F or 1F	Select Word. The function of any CRU interface line is determined by the type of operation (input or output) and the select word signal level. Figures D-1 through D-5 show the two functions assigned to each input and output bit. The 32 input and 32 output lines on the CRU interface associated with each VDT are grouped into 16-bit words. The first set of inputs or outputs is selected when select word = 0, and the second set of interface signals is selected when select word = 1.

NOTE

The following descriptions of the CRU bit functions assume that word select has been set to logic 1.

Bit Number (Hexadecimal)	Description
0 - A, 10 - 1A	Cursor Address. Provides the cursor address for the display memory. Bit 0 or 10 is the LSB position, while bit A or 1A is the MSB position. Bits B and 1B are reserved for address expansion. When the cursor address is altered, data in the new address is read by the controller into the read data register. Cursor address changes are detected when CRU bit A (or 1A) is written. Consequently, this bit must be output regardless of the number of address bits transferred. Note that the most significant cursor bit is bit 9 for 960-character displays. Bit A, always zero, must still be output.

Table D-3. 911 VDT Controller Addressable Output Bits (Continued)

Bit Number (Hexadecimal)	Description
	Only cursor addresses between 0 and 3BF are displayed on the 960-character screen. Cursor addresses between >0 and >77F are displayed on the 1920-character screen. The nondisplayed locations may be used by the programmer or in the program. If the cursor address points to a nondisplayed location, the cursor will disappear from the screen.
B or 1B	Not used.
C or 1C	Display Cursor. Controls the indication of a cursor on the screen. Turning the cursor off permits it to be moved on the screen without annoying flashes from momentary cursor positions. A logic 1 enables a cursor indication, while a logic 0 blanks the cursor. An I/O reset instruction or a power-up reset set display cursor to logic 0.
D or 1D	Keyboard Acknowledge. Resets the keyboard data ready flag, keyboard interrupt (if enabled), and the keyboard parity error flag. This output causes a strobe when addressed and is independent of the data value output. Data may be logic 0 or 1. An I/O reset instruction on power-up reset condition effectively forces a keyboard acknowledge strobe.
E or 1E	Beep Enable Strobe. Causes an audible beep at the VDT. Addressing this bit with logic 0 or 1 data bit results in the generation of a 0.3 second tone at 2000 Hz.
F or 1F	Select Word. The function of any CRU interface bit is determined by the type of operation (input or output) and the select word state (logic 0 or 1). Figures D-1 through D-5 show the two functions assigned to each input and output bit. The 32 input and 32 output bits on the CRU interface associated with each video display terminal are grouped into 16-bit words. The first set of inputs or outputs is selected by select word = 1.

D.3 FD800 FLEXIBLE DISK

The CRU bit description for the FD800 flexible disk controller is shown in Figures D-6 and D-7. A description of each CRU bit is given in Tables D-4 and D-5. For more detailed information, refer to the FD800 installation and operation manual.

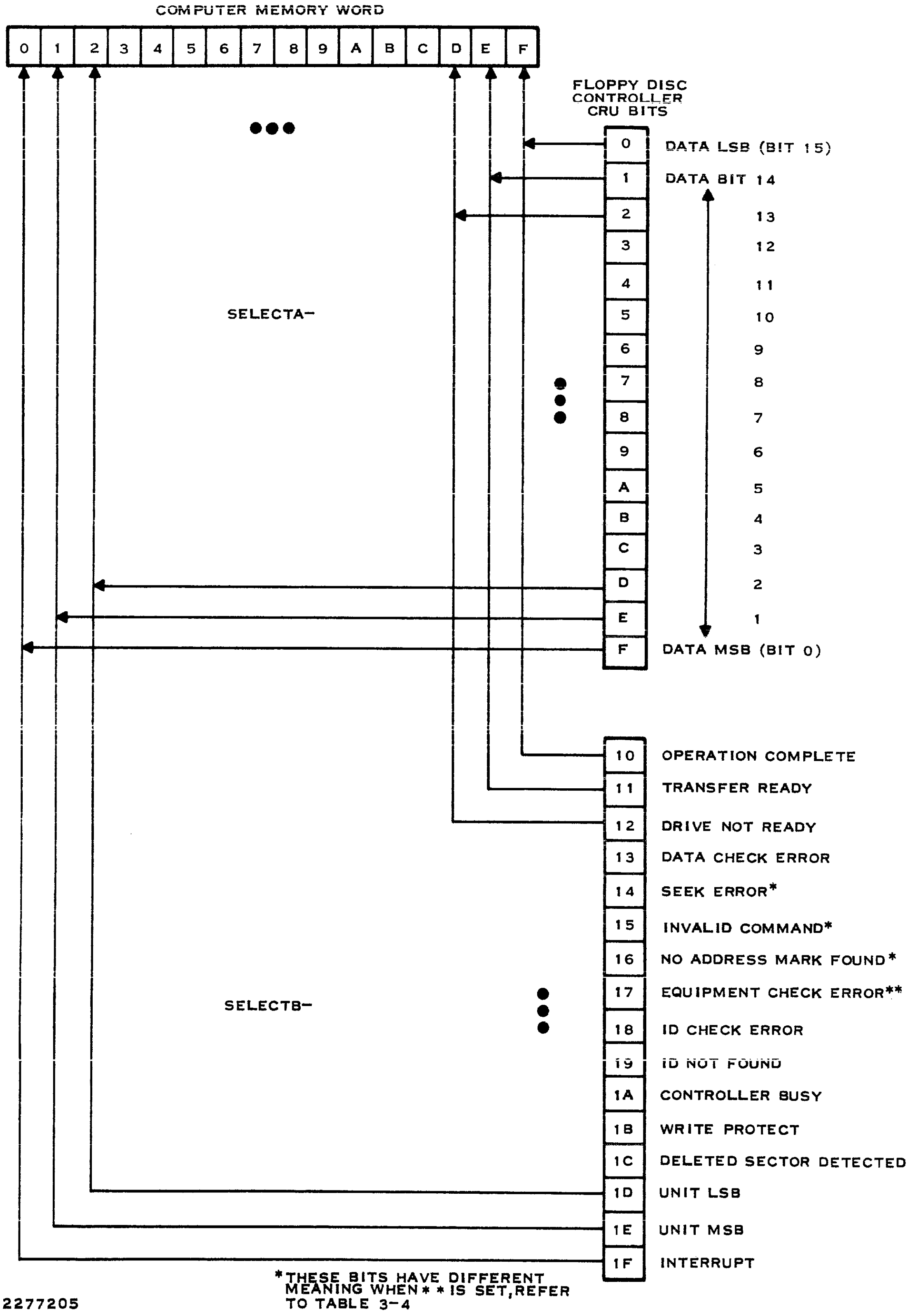


Figure D-6. Computer CRU Input Bit Assignments from FD800 Controller

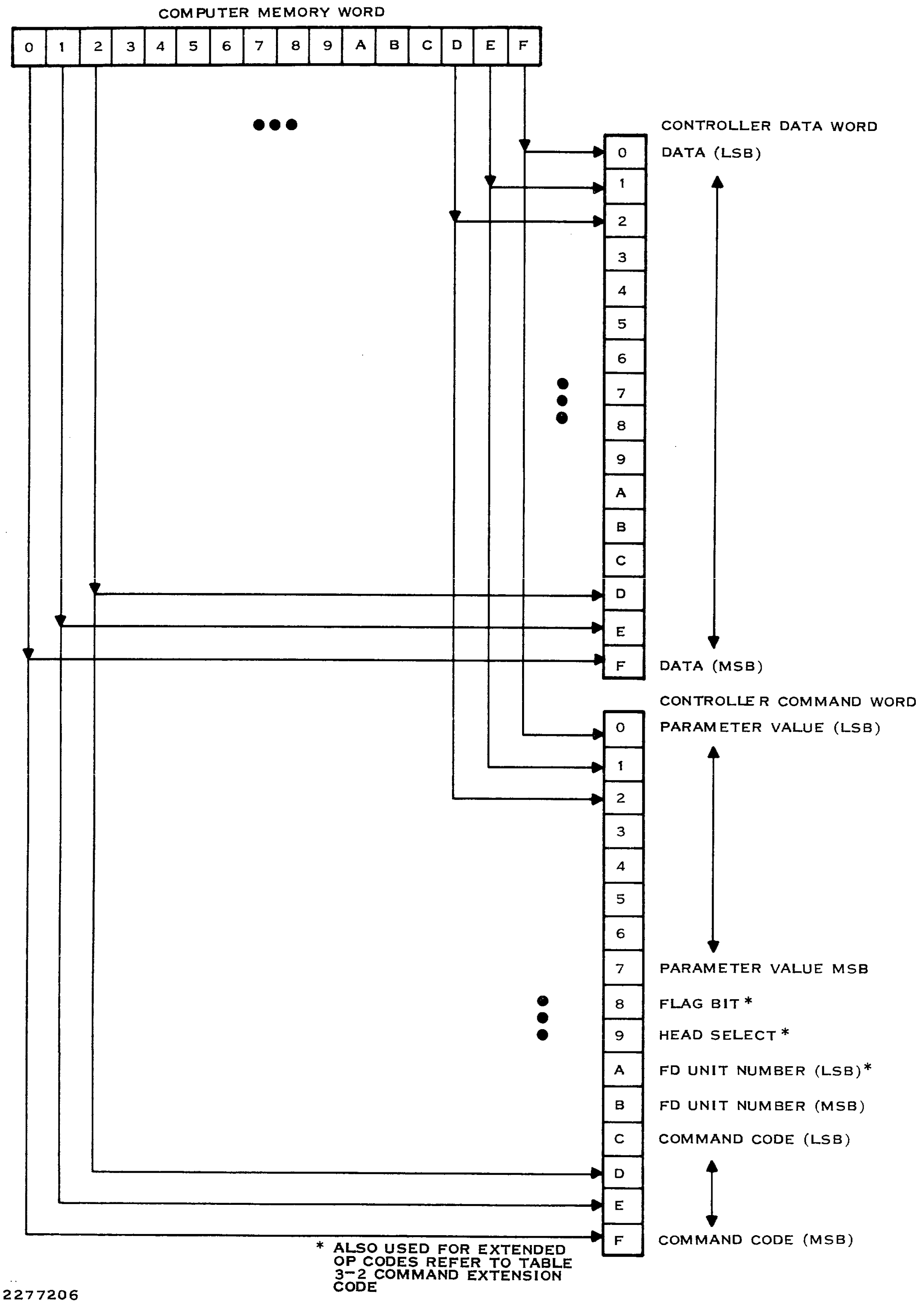


Figure D-7. Computer CRU Output Bit Assignments to FD800 Controller

Table D-4. CRU Addressable Input Bits from FD800 Controller

Input Format Bit Number			
Base Sel.	CRU	Memory	Description
A A	0 F	F 0	Data (LSB) through Data (MSB) inclusive
B	10	F	Operation Complete. This bit indicates a successful completion of any disk activity except for the Clear Status Port command. It is coincident with Interrupt.
B	11	E	Transfer Ready. During all data transfer operations, this bit indicates that the controller is prepared to transfer a data word. It is coincident with Interrupt. A data or strobe command (LDCR/SBO/SBZ that affects bit F of base A or B) clears this bit.
B	12	D	Drive Not Ready. This bit is present if the selected drive is not ready for any reason. It is coincident with Interrupt.
B	13	C	Data Check Error. Presence of this bit indicates that the CRC check failed on the data field. It is coincident with Interrupt.
B	14	B	Seek Error. This bit indicates that the track number could not be found during a seek or track switch operation. It is coincident with Interrupt.
B	15	A	Invalid Command. The controller sets this bit to indicate that it has received an invalid operation code. It is coincident with Interrupt.
B	16	9	Address Mark Not Found. The presence of this bit indicates that one of three types of address marks was not found (ID, Delete Data, or Data). It is coincident with Interrupt.
B	17	8	Equipment Check Error. This bit indicates that the controller's microprocessor has detected a controller error while running diagnostics or during command execution. It is coincident with Interrupt.
B	18	7	ID Check Error. This bit indicates that a CRC check failed in the identification field or a valid ID was not found during an ID check. It is coincident with Interrupt.
B	19	6	ID Not Found. An unsuccessful ID search after two revolutions is indicated by this bit. It is coincident with Interrupt.

Table D-4. CRU Addressable Input Bits from FD800 Controller (Continued)

Input Format Bit Number			
Base Sel.	**CRU**	**Memory**	**Description**
B	1A	5	Controller Busy. This bit is set when any command is issued to the controller. It is reset immediately upon completion of all commands. A command issued when Busy is present will terminate the previous command only when Read or Write is the previous command.
B	1B	4	Write Protect. This bit indicates that commanded Write, Format Track, or Write Deleted cannot be performed because the disk is write-protected. It is coincident with Interrupt.
B	1C	3	Deleted Sector Detected. This bit indicates that the last sector access in a Read or IPL command was found to contain a deleted sector data mark. If the sector occurs within a multiple sector call, data transfer is not completed. Interrupt is coincident with this indication.
B B	1D 1E	2 1	FD800 Disk Unit Number (LSB) through FD800 Disk Unit Number (MSB) inclusive. The disk unit number whose status is being reported is expanded in binary format.
B	1F	0	Interrupt. This bit indicates that an interrupt request exists in the FD800 disk controller. It is set during data transfer operations to indicate that data is ready for transfer by the computer. It is also set at the termination (completion or error) of any command activity except Clear Status Port. It is reset by the issue of any controller command. This status bit is operational regardless of the state of the hardware interrupt mask flip-flop.

D.4 TTY/EIA INTERFACE MODULE

The TTY/EIA interface module is used to interface several different peripherals to the computer. The CRU bit information given in the following paragraphs is for the interface module in general. In practice the peripheral may not use all the CRU bits available. The installation and operation manual for the peripheral in question should be consulted for a detailed description of the bits used.

Table D-5. CRU Output Bit Assignments to FD800 Controller

Output Format Bit Number			
Base Sel.	CRU	Memory	Description
A A	0 F	F 0	Data (LSB) through Data (MSB) inclusive. This 16-bit field is the full-word data transfer.
B B	10 17	F 0	Parameter Value (LSB) through Parameter Value (MSB) inclusive. This 8-bit field conveys parameters for the various commands.
B	18	7	This bit is used to specify nonsequential sector operations for Read and IPL commands and to specify Verify Only operation in the Format command.
B	19	6	This bit is used to specify the head to be used on double head disk drives for data transfer commands and Seek and Format operations.
B B	1A 1B	5 4	FD800 Drive Unit Number (LSB) FD800 Drive Unit Number (MSB) These two bits select the FD800 disk drive unit for any command except Reset and Clear Status Port.
B B	1B 1B	7 4	Command Extension Code (LSB) through Command Extension Code (MSB) inclusive. This field is used for command opcode extension during the Reset primary opcode.
B B	1C 1F	3 0	Command Code (MSB) through Command Code (LSB) inclusive. Sixteen commands are coded by these four bits. Seven additional opcodes are developed using bits >18 through >1B only during the primary opcode value, binary 1101.

D.4.1 CRU Input Interface from TTY/EIA Interface Module

The CRU input bit assignments are shown in Figure D-8. A description of these is contained in Table D-6.

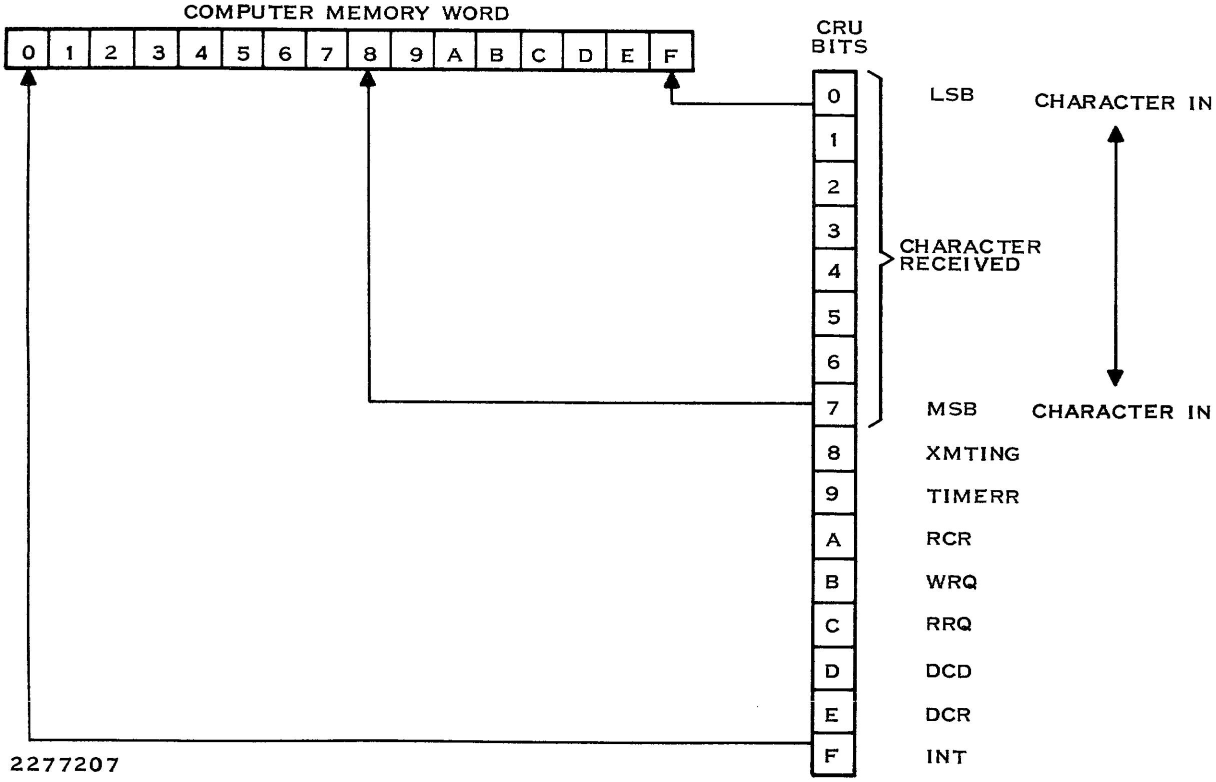


Figure D-8. CRU Input Bit Assignments from TTY/EIA Interface Module

Table D-6. CRU Addressable Input Bits from TTY/EIA Module

Bit	Signal	Description
0 7	Character IN Character OUT	Data (LSB) through Data (MSB) inclusive
8	XMTING	Transmit in progress, logic 1 active
9	TIMERR	Timing Error, logic 1 active
A	RCR	Reverse Channel Receive, logic 1 active
B	WRQ	Write Request, logic 1 active
C	RRQ	Read Request, logic 1 active
D	DCD	Data Carrier Detect, logic 1 active
E	DSR	Data Set Ready, logic 1 active
F	INT	Interrrupt, logic 1 active

D.4.2 CRU Output Interface to TTY/EIA Interface Module

The CRU output bit assignments are shown in Figure D-9. A description of these bits is contained in Table D-7.

The TTY/EIA module has the capability of logically gating the EIA outputs back into the EIA inputs. This capability is enabled by turning on the diagnostic mode latch. In the diagnostic mode the following outputs are gated to the following inputs:

Output Signal	Gated to Input Signal
DTR	DSR
RTS	DCD
XMTD	RCVD
RTS	RCR

In the diagnostic mode, the above output signals are also forced low to the RS-232C connector.

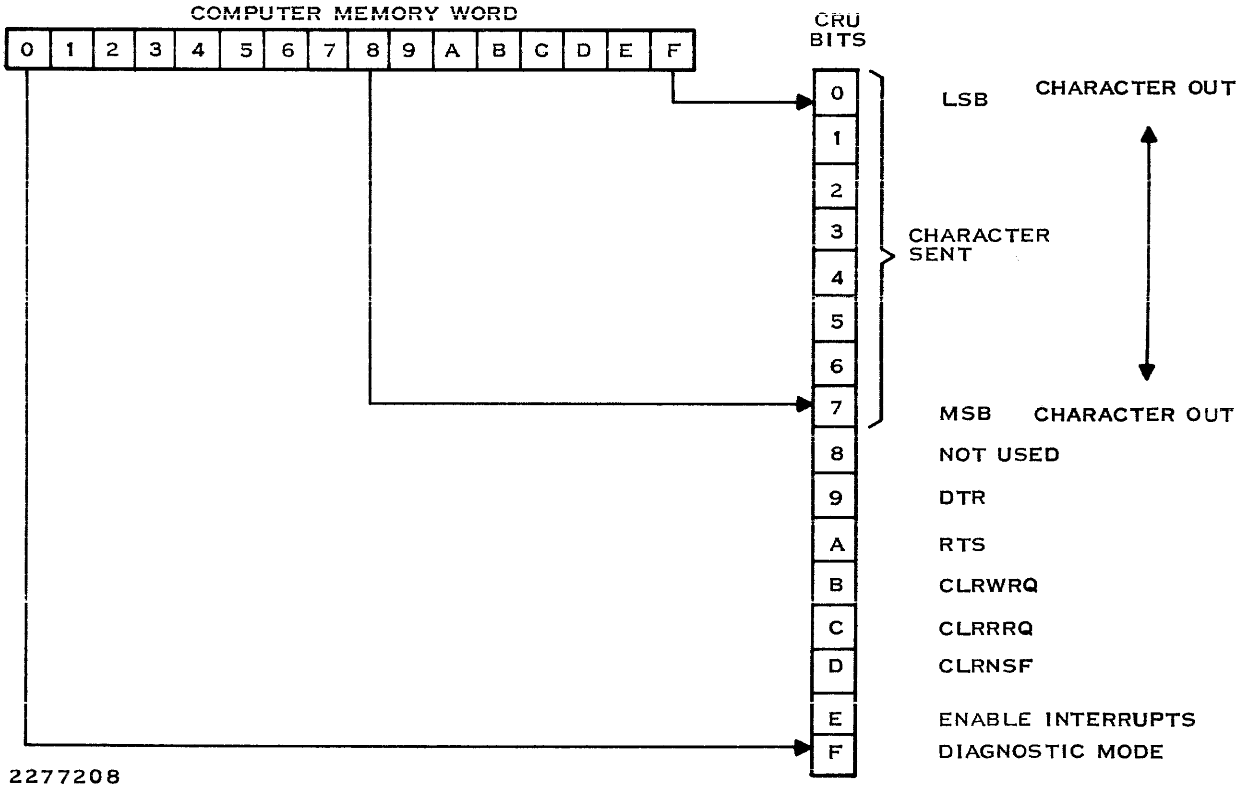


Figure D-9. CRU Output Bit Assignments to TTY/EIA Interface Module

Table D-7. CRU Addressable Output Bits to TTY/EIA Module

Bit	Signal	Description
0 7	Character OUT Character OUT	Data (LSB) through Data (MSB) inclusive. The first eight bits of information are data bits transmitted from the computer CRU to the peripheral device.
8		Not used.
9	DTR	Data Terminal Ready. Logic 1 sets the data terminal ready latch.
A	RTS	Request To Send. Logic 1 sets the request to send latch.
B	CLRWRQ	Clear Write Request. Logic 0 or 1 resets write request flag.
C	CLRRRQ	Clear Read Request. Logic 0 or 1 resets read request interrupt logic.
D	CLRNSF	Clear New Status Flag. Logic 0 or 1 resets new status flag.
E	INT	Enable Interrupts. Logic 1 sets interrupt mask latch.
F	DIAG	Diagnostic Mode. Logic 1 sets diagnostic mode latch.

D.5 AUTO CALL UNIT (ACU)

The CRU bit assignments for the ACU are summarized in Figures D-10 (CRU input) and D-11 (CRU output). These bit assignments are described in detail in Tables D-8 and D-9.

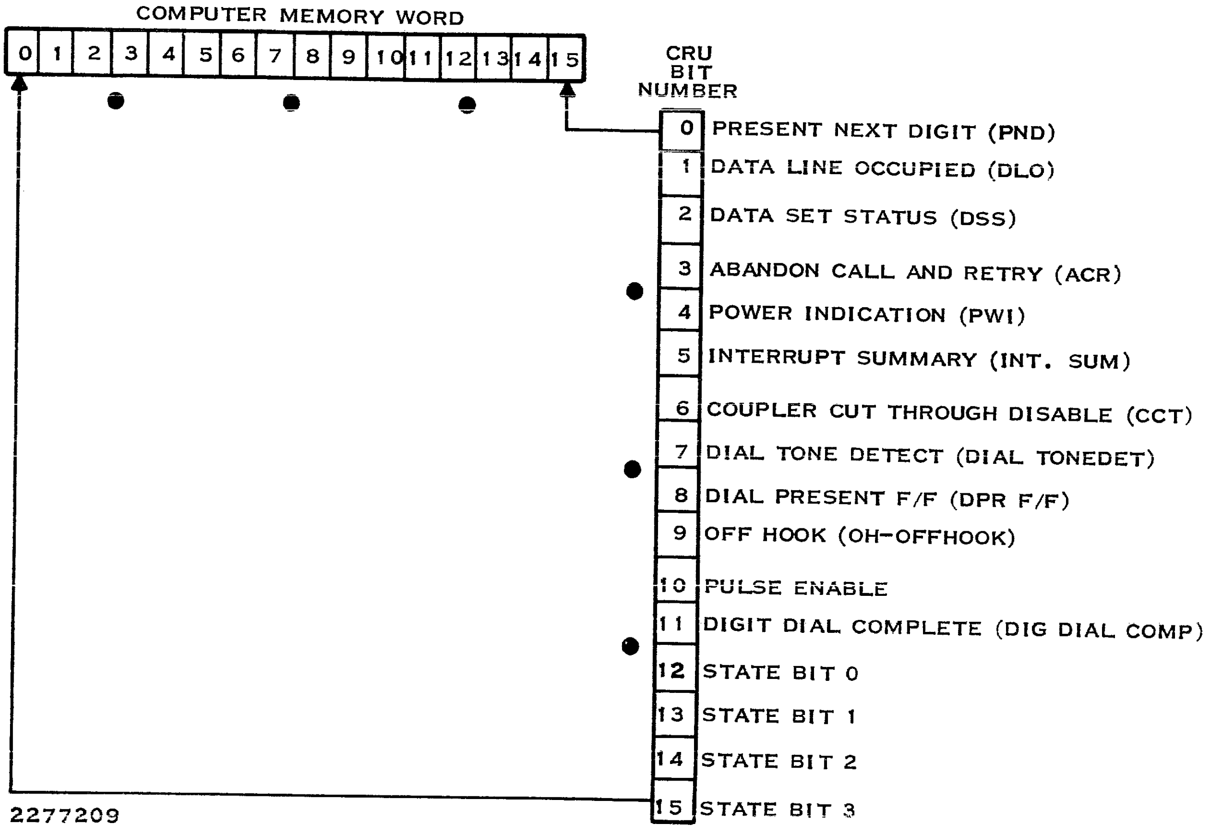


Figure D-10. Computer CRU Input Bit Assignments from ACU

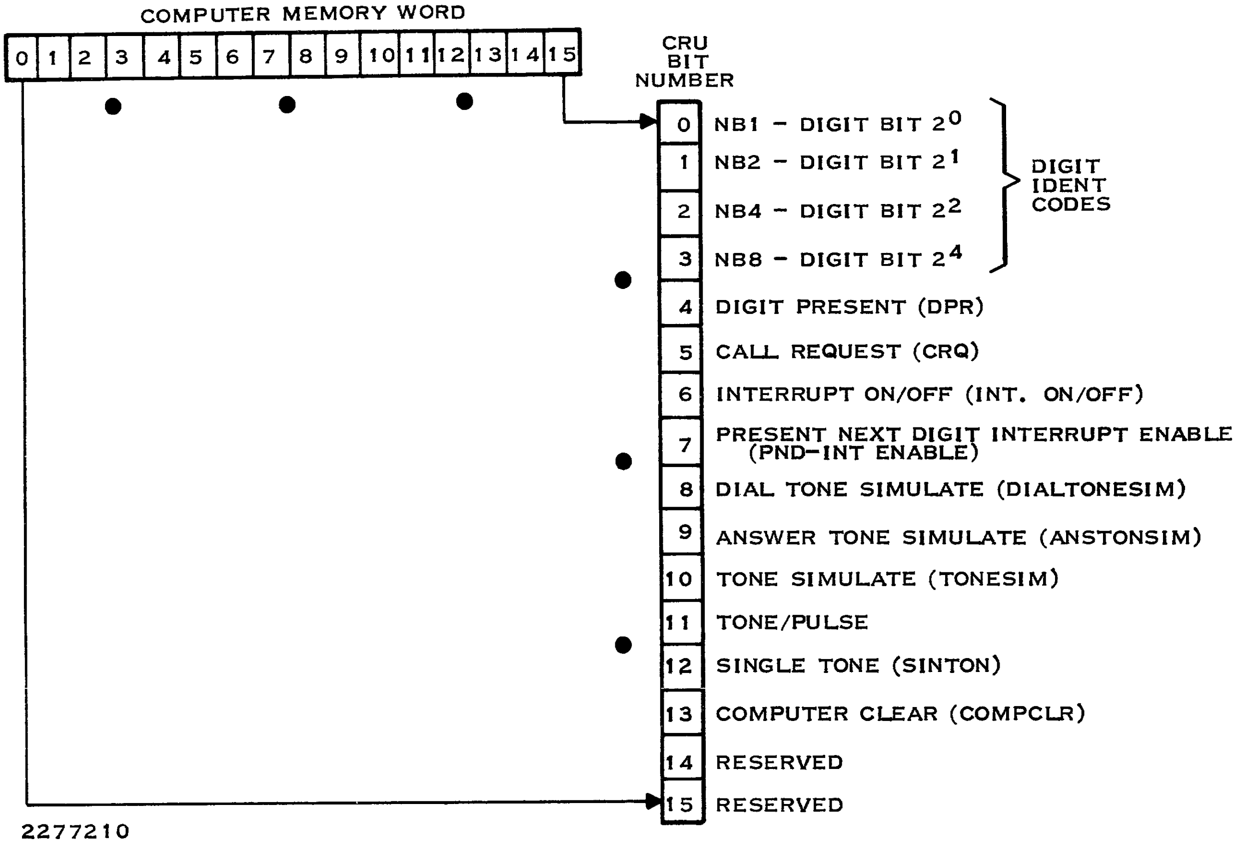


Figure D-11. CRU Output Bit Assignments to ACU

Table D-8. CRU Addressable Input Bits from ACU

Bit	Identification	Description
0	PND	A logic 1 in PND (Present Next Digit) indicates the ACU is ready to accept the digit identification codes (NB1, NB2, NB4, and NB8 defined in Table D-9). PND interrupts the CRU bus if PND INT ENABLE is set.
1	DLO	DLO (Data Line Occupied), set to logic 1, indicates the communication channel is in use.
2	DSS	A logic 1 in DSS (Data Set Status) indicates the telephone line is connected to the modem. DSS interrupts the CRU bus if INT ON/OFF is enabled.
3	ACR	A logic 1 in ACR (Abandon Call and Retry) indicates 40 seconds have elapsed since the last change of PND.
4	PWI	A logic 1 in PWI (Power Indication) indicates power is present in the ACU.
5	INT SUM	A logic 1 in INT SUM (Interrupt Summary) indicates the ACU has interrupted the CRU bus. ACR timing out, PND, or DSS will input a logic 1 in bit 5, if enabled.
6	CCT DISABLE	A logic 1 in CCT DISABLE (Coupler Cut Through Disable) indicates that the internal modem is disabled and the ACU has control of the phone lines.
7	DIALTONE DET	A logic 1 in DIALTONE DET (Dial Tone Detect) indicates that a dial tone has been detected.
8	DPR F/F	A logic 1 in DPR F/F (Dial Present Flip-Flop) indicates that the flip-flop has been set, verifying receiving a digit from the CRU bus.
9	OFF/HOOK	A logic 1 in OH (Off Hook) indicates the OH signal to the modem has been activated. Pulses equivalent to the digit are transmitted on the OH line during pulse dialing.
10	PULSE ENABLE	A logic 1 in Pulse Enable indicates the pulse enable line has been activated. Pulse Enable remains high during output of the digit to the internal modem.
11	DIG DIAL COMP	A logic 1 in Digit Dial Complete indicates the digit has been dialed. This bit should not be used to indicate PND.

Table D-8. CRU Addressable Input Bits from ACU (Continued)

Bit	Identification	Description
12	STATE BIT 0	These bits indicate the states of the ACU microcontroller.
13	STATE BIT 1	
14	STATE BIT 2	
15	STATE BIT 3	

Note:

ACU interrupt, if enabled, will be generated by PND, ACR, and DSS. After the interrupt is read, it may be reset by resetting the interrupt enable or by generating a clear to the ACU. The clear is generated by a RSET instruction or by setting the COMPCLR (Computer Clear) bit to logic 1 and then to logic 0. Interrupts will not be generated if CRQ (Call Request) is set to logic 0 because the ACU is inactive. Setting CRQ to logic 0 clears all interrupts at the end of a dialing sequence, provided the dialing sequence was successfully completed.

Table D-9. CRU Addressable Output Bits to ACU

Bit	Identification	Description
0,1,2,3	NB1, NB2, NB4, NB8	Digit Identification Codes

	Digit Identification Codes				Digit Value
	NB8	NB4	NB2	NB1	
CRU bit:	3	2	1	0	
	0	0	0	0	0
	0	0	0	1	1
	0	0	1	0	2
	0	0	1	0	3
	0	1	0	0	4
	0	1	0	1	5
	0	1	1	0	6
	0	1	1	1	7
	1	0	0	0	8
	1	0	0	1	9
	1	0	1	0	*
	1	0	1	1	#
	1	1	0	0	EON[1]
	1	1	0	1	WDT[2]
	1	1	1	0	
	1	1	1	1	

[1] End of Number (EON) is used as one method of terminating a call.

[2] Wait for Dial Tone (WDT) is used for tandem dialing.

Bit	Identification	Description
4	DPR	DPR (Digit Present), set to logic 1, indicates a valid digit is available for dialing. DPR must be set to logic 1 after PND goes to logic 1.

Table D-9. CRU Addressable Output Bits to ACU (Continued)

Bit	Identification	Description
5	CRQ	CRQ (Call Request) must be set to logic 1 during the complete call origination period. It must not be reset until after the DSS bit is set to logic 1. Setting CRQ to logic 0 resets the ACU, provided the call was successfully completed.
6	INT ON/OFF	A logic 1 in the Interrupt On/Off bit enables DSS and the ACR timer to interrupt the CRU bus. INT SUM and status bit, identifying which signal caused the interrupt, will also go to logic 1. A logic 0 in bit 6 clears and disables the interrupt function of DSS and ACR.
7	PND INT ENABLE	Present Next Digit Interrupt Enable, set to logic 1, allows PND to interrupt the CRU bus. This occurs only when PND comes on and does not occur when PND is reset. INT SUM and PND status bits are set when bit 7 is enabled and PND occurs.
8	DIAL TONE SIM	A logic 1 in Dial Tone Simulate releases the ACU from WDT.
9	ANSTONSIM	A logic 1 in Answer Tone Simulate releases the ACU from a wait for answer tone state.
10	TONE SIM	Tone Simulate, set to logic 1, causes the tone generator to generate single tones for test only.
11	TONE/PULSE	A logic 1 in Tone Pulse causes the ACU to pulse dial. Tone Pulse automatically assumes a logic 0 state for tone dialing when cleared by a RSET instruction or power-up clear.
12	SINTON	A logic 1, set in Single Tone, allows the tone generator to generate single tones for test purposes.
13	COMPCLR	Computer Clear, set to logic 1 and then to logic 0, causes the ACU microcontroller to be reset.
14,15		Reserved.

D.5.1 CRU Bit Assignments for EACUI

The CRU bit assignments for the EACUI are summarized in Figures D-12 (CRU input) and D-13 (CRU output). These bits are defined in Tables D-10 and D-11. The bits normally used in operation (as opposed to those used for test purposes) have the same definitions in both the ACU and the EACUI. This allows the same software to be used with either module.

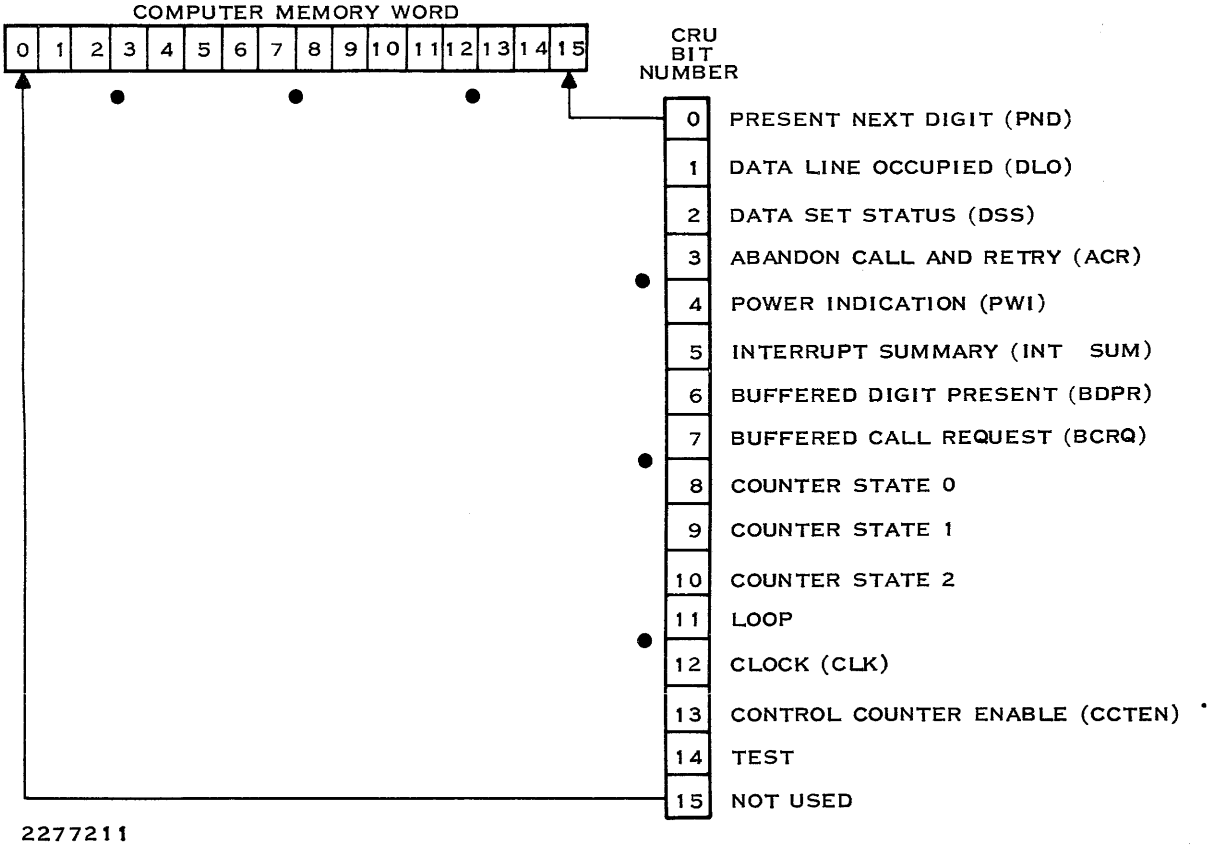


Figure D-12. Computer CRU Input Bit Assignments from EACUI

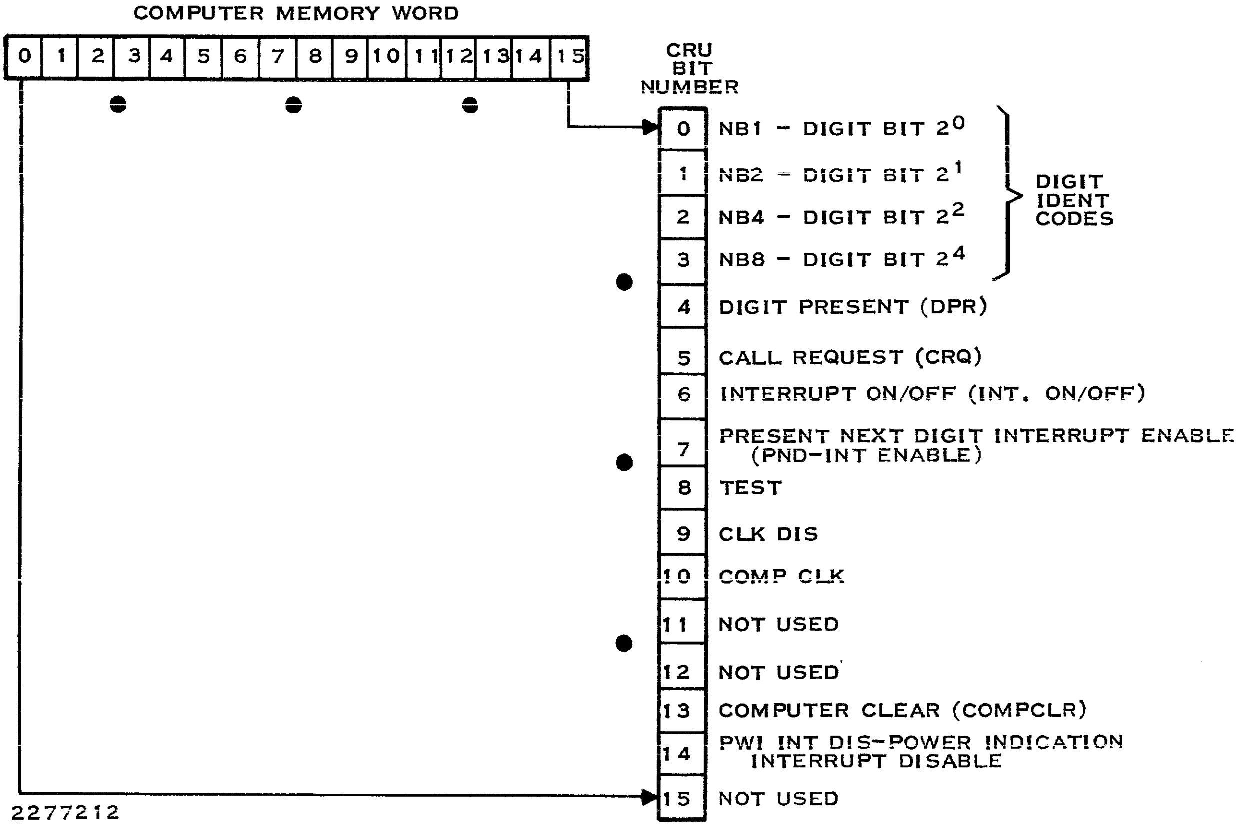


Figure D-13. Computer CRU Output Bit Assignments to EACUI

Table D-10. CRU Addressable Input Bits from EACUI

Bit	Identification	Description
0	PND	A logic 1 in PND (Present Next Digit) indicates that the EACU is ready to accept the next digit. PND interrupts the CRU bus if set to a logic 1 and if the PND INT bit is also high (logic 1). The computer, in polling PND for the time to present the next digit, must wait 8 microseconds after setting DPR to logic 1.
1	DLO	Setting DLO (Data Line Occupied) to logic 1 indicates that the communication channel is in use.
2	DSS	A logic 1 in DSS (Data Set Status) indicates that the telephone line is connected to the data set (modem). A zero-to-one transition in DSS interrupts the CRU bus as long as INT ON/OFF is high.
3	ACR	A logic 1 in ACR (Abandon Call and Retry) indicates that a time period has elapsed without an expected event occurring in the dialing sequence. The EACU makes this timing check. The ACR zero-to-one transition interrupts the CRU bus as long as INT ON/OFF is high.
4	PWI	A logic 1 in PWI (Power Indication) indicates that power is present in the EACU. Any transition of PWI will interrupt the CRU bus.
5	INT SUM	A logic 1 in INT SUM (Interrupt Summary) indicates that an interrupt that has been enabled has interrupted the CRU bus. Setting ACR, PND, PWI, or DSS to logic 1 generates a logic 1 in the interrupt summary bit, if enabled.
6	BDPR	BDPR (Buffered Digit Present) is used to indicate the status of DPR at the EACU. A logic 1 in BDPR indicates that DPR is set.
7	BCRQ	BCRQ (Buffered Call Request) is used to indicate the status of CRQ at the EACU. A logic 1 in BCRQ indicates that CRQ is set.
8 9 10	COUNTER STATE 0 COUNTER STATE 1 COUNTER STATE 1	These three bits are the count states of the state sequencer's control counter (U6) on the EACUI board.
11	LOOP	This bit is used in conjunction with a loopback connector to verify operation of the EIA drivers and receivers on the EACUI board.

Table D-10. CRU Addressable Input Bits from EACUI (Continued)

Bit	Identification	Description
12	CLK	The CLK (Clock) bit is the EACUI clock and is used for testing the clock circuits.
13	CCTEN	When the CCTEN (Control Counter Enable) bit is logic 1, the control counter is enabled.
14	TEST	This bit indicates that the test bit is set in the CRUBITOUT word.
15		Not used.

Table D-11. CRU Addressable Output Bits to EACUI

Bit	Identification	Description					
0,1,2,3	NB1, NB2, NB4, NB8		Digit Identification Codes				Digit Value
			NB8	NB4	NB2	NB1	
		CRU bit:	3	2	1	0	
			0	0	0	0	0
			0	0	0	1	1
			0	0	1	0	2
			0	0	1	1	3
			0	1	0	0	4
			0	1	0	1	5
			0	1	1	0	6
			0	1	1	1	7
			1	0	0	0	8
			1	0	0	1	9
			1	0	1	0	*
			1	0	1	1	#
			1	1	0	0	EON
			1	1	0	1	WDT
			1	1	1	0	
			1	1	1	1	
4	DRP	A logic 1 in DPR (Digit Present) indicates a valid digit is available for dialing. DPR must be turned on (logic 1) by the computer after the status bit PND is turned on (logic 1) by the EACU. Setting DPR to logic 1 resets the PND interrupt. DPR is reset automatically when PND is turned off (logic 0) by the EACU. It remains off for 130 ms or until PND is cycled back to logic 1 within 130 ms.					

Table D-11. CRU Addressable Output Bits to EACUI (Continued)

Bit	Identification	Description
5	CRQ	A logic 1 must be present at CRQ (Call Request) to originate a call. Depending on the option chosen for the EACU, CRQ must either remain logic 1 during the call origination period, or must remain high until DSS is set to logic 1. Setting CRQ to logic 0 resets the ACU and the EACUI.
6	INT ON/OFF	When the CRU bus sets Interrupt On/Off to logic 1, this bit enables DSS and ACR to interrupt the CRU bus. PWI (Power Indication) is enabled to interrupt the CRU bus if both bit 6 and bit 12 are high (logic 1). An Interrupt Summary (INT SUM) bit and a status bit identifying which signal, DSS, PWI, or ACR, caused the interrupt will also be set high. Setting bit 6 to logic 0 clears and disables further interrupts by DSS, PWI, or ACR.
7	PND INT ENABLE	When set to logic 1, Present Next Digit Interrupt Enable will allow the PND signal to interrupt the CRU bus. The interrupt occurs only when PND goes high and will not occur when PND is reset. Interrupt Summary and status bits are set when PND-INT is enabled. Setting bit 7 to logic 0 clears and disables PND-INT.
8	TEST	With the Test bit set to logic 1, the NB1 - NB8 bits may be used in testing the status flip-flops, interrupt flip-flops, and the data path to the input of the EIA devices.
9	CKDIS	With the CKDIS (Clock Disable) bit set to logic 1, the internal clock is disabled and the testing computer generates a clock pulse via bit 10, Computer Clock. This bit (bit 9) is used for testing only.
10	COMPCLK	With COMPCLK (Computer Clock) set to logic 1 and then to logic 0, this bit generates a clock in the EACU. This bit (bit 10) is used for testing only.
11		Not used.
12		Not used.
13	COMPCLR	With Computer Clear set to logic 1 and then to logic 0, the EACU controller is reset. The EACU is ready for dialing 8 microseconds after this bit is toggled. This bit should be used when an error is made in dialing a telephone number. The EACU to CRU control bits are not cleared by this bit and should be reset via a CRU bit addressing or by a RSET instruction.

Table D-11. CRU Addressable Output Bits to EACUI

Bit	Identification	Description
14	PWIINTDIS	When set to logic 1, Power Indication Interrupt Disable allows PWI to interrupt the CRU bus if bit 6 (INT ON/OFF) is also high. Setting this bit (bit 14) to logic 0 inhibits the PWI from interrupting the CRU bus.
15		Not used.

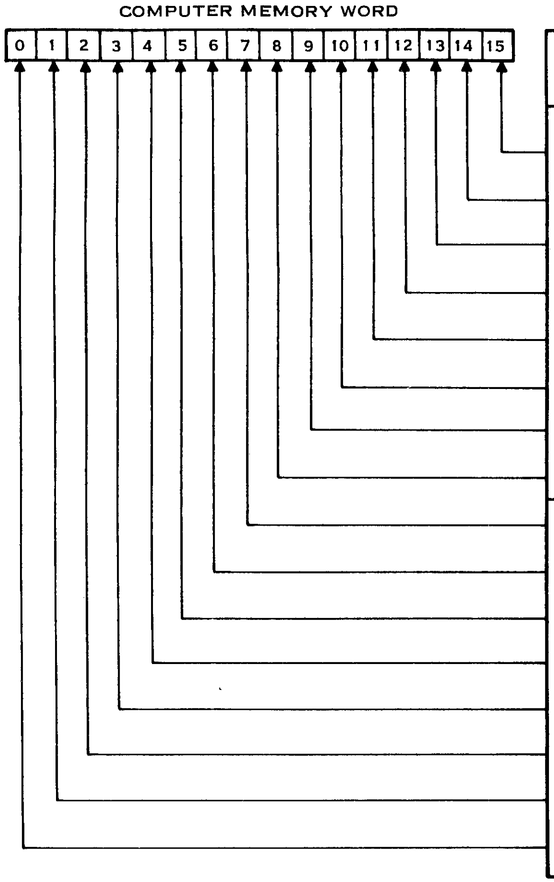
D.6 COMMUNICATIONS INTERFACE MODULE (CIM)

This paragraph and the associated illustrations contain information about the communications interface module (CIM) and the interface to the computer CRU. The interface between the CRU and the CIM consists of 16 addressable input bits and 16 addressable output bits.

D.6.1 Computer CRU from CIM Input Interface

The addressable input data to the CRU from the CIM includes the character received from the modem and all necessary control and status signals to inform the computer when data is present, and the status of the modem and telephone lines.

Information on the input interface is contained in five CRU words, addressed one at a time by a three-bit CRU addressing scheme. Figure D-14 illustrates the input interface for both synchronous and asynchronous data transmission to the computer. Table D-12 defines the interface signals.



ASYNC/SYNC CRU INTERFACE*
INPUT

CRU BIT NO.	INPUT WORD 0 ADDR 2-0=000 STROBE=1	INPUT WORD 1 ADDR 2-0=000 STROBE =0	INPUT WORD 2 ADDR 2-0=001 STROBE=1	INPUT WORD 3 ADDR 2-0=100 STROBE=1	INPUT WORD 4 ADDR 2-0=110 STROBE=0
0	RCV DATA 0	DSR	DTR	CLOCK SEL A0$_1$	MODEM ID 0
1	1	CTS	RTS	CLOCK SEL A1$_1$	1
2	2	SDCD$_1$	EN RRQ	CLOCK SEL A2	2
3	3	RES MODEM LD OUT	EN PARITY	ALT CLK STRIP SYNC$_3$	3
4	4	RING	ECHO/DLE STRIP$_3$	ODD PARITY	4
5	5	DCD	SBS/XMIT PARITY /FORCE DLE$_4$	SYNC MODE	5
6	6	UNUSED	BREAK/TRNSPRNT$_3$	CHAR LEN 0	MODEM ID 6
7	RCV DATA 7	UNUSED	$\overline{\text{SELF-TEST}}$	CHAR LEN 1	GND (UNUSED)
8	UNUSED	RRQ			
9	SYNC MODE	SYNC MODE			
10	UNUSED	UNDER-RUN$_2$			
11	R/W BUSY	R-W BUSY			
12	PE/DLE DETECT$_3$	NSF			
13	FE/SYNC DETECT	TIMER EXP			
14	OVER-RUN	INTR SUM			
15	RCV ERROR SUM	WRQ			

*ALL BIT DEFINITIONS ARE IN THE POSITIVE LOGIC SENSE (EXCEPT SELF-TEST):

LOGIC 0 = NOT ASSERTED OR INACTIVE
LOGIC 1 = ASSERTED OR ACTIVE
EXCEPT SELF-TEST (REFER TO PARA. 3.5)

1. THIS BIT DEFINED FOR ASYNCHRONOUS MODE COMMUNICATION ONLY
2. THIS BIT DEFINED FOR SYNCHRONOUS MODE COMMUNICATION ONLY
3. THIS BIT DEFINED FOR ASYNCHRONOUS/SYNCHRONOUS MODE COMMUNICATION AS INDICATED.
4. SBS IS DEFINED FOR ASYNCHRONOUS MODE ONLY. XMIT PARITY AND FORCE DLE ARE DEFINED FOR SYNCHRONOUS MODE ONLY.

Figure D-14. Computer CRU Input Bit Assignments from the CIM

Table D-12. CRU Addressable Input Bits from the CIM

Word	Bit	Signal	Description
0	0 - 7	RCV DATA	Receive Data Word. These three bits contain the byte input from the asynchronous/ synchronous receiver transmitter device to the CRU in response to an SBO Strobe, with ADD(0-2) = 000. Bit 0 is the LSB, and bit 7 is the MSB. If a character length of less than eight bits has been selected (Output Word 3, bits 6, 7), the character is justified to the LSB with zero-fill.
0	8		Not used.
0	9	SYNC MODE	Synchronous Mode Transmission. This bit indicates the contents of the Sync Mode bit (Output Word 3, bit 5).
0	10		Not used.
0	11	RW BUSY	Read/Write Busy. When set, this bit indicates that the module is busy processing a software-given read or write command, and neither the address bits nor the data bits 0 - 7 can be modified. Normal read/write referencing can resume when this bit is reset.
0	12	PE/DLE DETECT	Parity Error/Data Link Escape Detect. PE is a component of Receive Error Summary (Input Word 0, bit 15), and is set when a parity error (Output Word 2, bit 3) has been detected in the last character received in the receiver. PE is valid after the access of Input Word 0, while Strobe (Output Word 0, bit 11) is set; when Strobe is reset, PE is cleared. In synchronous communications, when Strip DLE (Output Word 2, bit 4) is enabled, the receiver parity check is disabled, and this bit (bit 12) is set if the character previous to the character presently in Receive Data Word matched the contents of the DLE register.
0	13	FE/SYNC-DETECT	Framing Error/Sync Detect. In asynchronous communications, this error condition is set when the transmitter detects a logic 0 stop bit (which should be logic 1). This bit (bit 13) is a component of Receive Error Summary (Input Word 1, bit 15). It is valid after the access of Input Word 0, while Strobe (Output Word 0, bit 11) is set; it is cleared when Strobe is reset.

Table D-12. CRU Addressable Input Bits from the CIM (Continued)

Word	Bit	Signal	Description
			In synchronous communications, this bit (bit 13) is set if the contents of the receiver register match the contents of the sync register. This bit is set and cleared as described above. In both modes, this bit is cleared by disabling the receiver.
0	14	OVER-RUN	Over-Run. This error condition is set during reception when a new data character is transferred into the receiver holding register before the previous character is read by the CRU. The previous character in the receiver will have been lost. Over-Run is cleared by the next Status Scan cycle or by disabling the receiver.
0	15	RCV ERROR-SUM	Receiver Error Summary. This bit is set when at least one of the following receiver status bits is asserted: 1. PE/DLE DETECT (unless in SYNC/TRANSPARENT mode). 2. FE/SYNC DETECT (unless in SYNC mode). OVER-RUN. This bit is cleared by executing SBZ Strobe, as above.
1	0	DSR	Data Set Ready. DSR indicates the state of the CC data set lead from the modem (DSR) on pin 6 of the EIA interface. A change in logic state of this modem lead is indicated as a component of New Status Flag (Input Word 1, bit 12) if DTR (Output Word 2, bit 0) is active.
1	1	CTS	Clear To Send. CTS indicates the state of the CB data set lead from the modem (CTS). When CTS is asserted, the transmitted section of the CIM is ready for transmission.
1	2	SDCD	Secondary Data Carrier Detect. This bit is defined for asynchronous mode communication only. SDCD indicates the condition of the data set lead SCF on pin 12 of the EIA interface. A change in state of this modem lead is indicated as a component of New Status Flag (Input Word 1, bit 12), if DTR (Output Word 2, bit 0) is active.
1	3	RES MODEM-LD OUT	Reserved Modem Lead Output. This bit indicates the contents of Output Word 4, bit 3.

Table D-12. CRU Addressable Input Bits from the CIM (Continued)

Word	Bit	Signal	Description
1	4	RING	Ring. Indicates the state of the Ring line from the modem (CE). A change in state from inactive to active of Ring is indicated as a component of NSF (Input Word 1, bit 12).
1	5	DCD	Data Carrier Detect. DCD indicates the state of the modem lead (CF). A change in state of DCD is indicated by NSF (Input Word 1, bit 12) if DTR (Output Word 2, bit 0) is set.
1	6, 7		Not used.
1	8	RRQ	Read Request. This bit is set when a receive character is available and EN RRQ (Output Word 2, bit 2) is active. RRQ is cleared when RCV Data Word (Input Word 0, bits 0 - 7) is read. RRQ is a component of Interrupt Summary (Input Word 1, bit 14).
1	9	SYNC MODE	Synchronous Mode. This bit indicates the contents of the Sync Mode bit (Output Word 3, bit 5).
1	10	UNDER-RUN	Under-Run. This bit is defined for synchronous mode communication only. When the transmitter is enabled, the Under-Run error bit is set if the transmitter holding register has remained empty for at least one character time (the time required to transmit one character serially), so that the transmitter has to insert fill characters into the transmitted data stream. The inserted fill characters are Sync characters if Transparent is not set. If Transparent is set, fill characters are DLE-SYNC. Once asserted, Under-Run remains asserted until cleared by resetting EN WRQ (Output Word 0, bit 15). Under-Run is defined for 8-bit character lengths, including parity.
1	11	R/W BUSY	Read/Write Busy. When set, this bit indicates that the CIM is busy processing a software-given read or write command, and neither of the address bits nor the data bits 0 - 7 can be defined. Normal read/write referencing can resume when this bit is reset.

Table D-12. CRU Addressable Input Bits from the CIM (Continued)

Word	Bit	Signal	Description
1	12	NSF	New Status Flag. This interrupt condition is set when CLR EN NSF (Output Word 0, bit 12) is set and any of the following modem lines changes state: DSR 1 to 0 or 0 to 1 SDCD 1 to 0 or 0 to 1 DCD 1 to 0 or 0 to 1 RING 0 to 1 NSF is a component of Interrupt Summary (Input Word 1, bit 14), and is cleared by referencing CLR EN NSF with either SBZ or SBO.
1	13	TIMER EXP	Timer Expired. This interrupt condition is set when the most recent 250-ms time period, started by the (software) assertion of CLR SET EN TIMER (Output Word 0, bit 13), expires. This bit is cleared by setting or resetting CLR SET EN TIMER. This bit is a component of Interrupt Summary (Input Word 1, bit 14), and can be set only when CLR SET EN TIMER is active.
1	14	INT SUM	Interrupt Summary. When set, this bit indicates that at least one of the following interrupt bits is set: RRQ (Input Word 1, bit 8) WRQ (Input Word 1, bit 15) TIMER EXPIRED (Input Word 1, bit 13) NSF (Input Word 1, bit 12) This bit will remain set until all interrupting conditions have been cleared, and the setting of this bit will interrupt the processor if Enable Interrupt (Output Word 0, bit 14) is active.
1	15	WRQ	Write Request. This interrupt condition occurs when the transmitter holding register becomes empty while EN WRQ (Output Word 0, bit 15), RTS (Output Word 2, bit 1), and CTS (Input Word 1, bit 1) are active. WRQ is cleared when a data character is written to the transmitter holding register, or when the transmitter is disabled (RTS reset). This bit is a component of Interrupt Summary (Input Word 1, bit 14).

Table D-12. CRU Addressable Input Bits from the CIM (Continued)

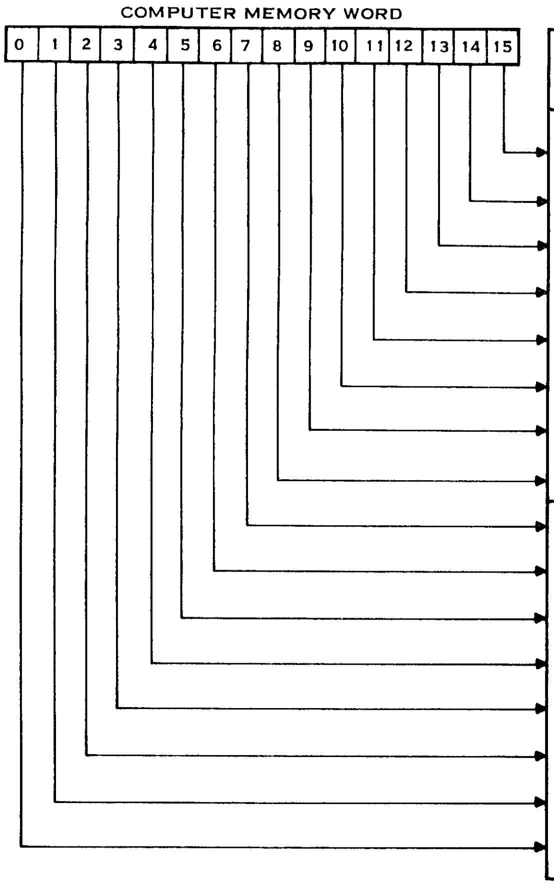
Word	Bit	Signal	Description
2	0 - 7	DTR RTS EN RRQ ECHO/DLE STRIP SBS/XMIT/PARITY/ FORCE DLE BREAK/TRANSPARENT SELF-TEST	This word indicates the current contents of Output Word 2. Note: The logic sense of the self-test bit is inverted in the output register.
3	0 - 7	CLOCKSEL ALT CLK/STRIP SYNC ODD PARITY SYNC MODE CHAR LEN	This word indicates the current contents of Output Word 3.
4	0 - 6	MODULE ID	These bits contain the Module ID code as set by the low-order seven bits of the DIP switch. Bit 0 (switch 1) is the LSB and bit 6 (switch 7) is the MSB.
4	7	GROUND	Bit 7 is tied to ground and will always read as logic 0.

D.6.2 Computer CRU to CIM Output Interface

The addressable output data from the computer CRU to the CIM includes the character to be transmitted and all the necessary control signals to ensure that the character is transmitted in the proper mode (synchronous or asynchronous) and at the proper baud rate. Also included are all the control signals necessary to direct and control the actual transmission of information over the telephone lines by the modem.

Information on the output interface to the CIM is contained in five module registers, addressed one at a time by a three-bit CRU addressing scheme. Bits 8, 9, and 10 of the 16-bit CRU output register constitute the module register number. Figure D-15 illustrates the output interface for both synchronous and asynchronous data transmission to the CIM. Table D-13 defines the output interface signals.

The interface definition for CRU output (write) operations is as follows: An output (write) operation addresses one of five output words as the eight LSBs bits of the 16-bit output word. The eight MSBs always refer to Output Word 0, which contains the address of the lower character.



ASYNC/SYNC CRU INTERFACE *
OUTPUT

CRU BIT NO.	OUTPUT WORD 0 ADDR 2-0=000 STROBE=0	OUTPUT WORD 1 ADDR 2-0=010 STROBE=1/1	OUTPUT WORD 2 ADDR 2-0=001 STROBE=0	OUTPUT WORD 3 ADDR 2-0=100 STROBE=0	OUTPUT WORD 4 ADDR 2-0=101
0	XMIT DATA 0	SYNC/DLE CHAR 0_2	DTR	CLOCK SEL A0	CLOCK SEL B0
1	1	CHAR 1_2	RTS	CLOCK SEL $A1_1$	CLOCK SEL $B1_1$
2	2	CHAR 2_2	EN RRQ	CLOCK SEL A2	$SRTS_1$
3	3	CHAR 3_2	EN PARITY	ALT CLK/STRIP $SYNC_3$	RES MODEM LD OUT
4	4	CHAR 4_2	ECHO/DLE $STRIP_3$	ODD PARITY	PULSED MODEM LD
5	5	CHAR 5_2	SBS/XMIT PARITY FORCE DLE_4	SYNC MODE	MASTER RESET
6	6	CHAR 6_2 SYNC/DLE	BREAK/$TRNSPRNT_3$	CHAR LENGTH 0	HALF-DUPLEX
7	XMIT DATA 7	CHAR 7_2	$\overline{\text{SELF-TEST}}$	CHAR LENGTH 1	AN L-B REM TEST
8	ADDR 0				
9	ADDR 1				
10	ADDR 2				
11	STROBE				
12	CLR-EN NSF				
13	CLR SET EN TIMER				
14	EN INTERRUPT				
15	EN WRQ				

*ALL BIT DEFINITIONS ARE IN THE POSITIVE LOGIC SENSE:

LOGIC 0 = NOT ASSERTED OR INACTIVE
LOGIC 1 = ASSERTED OR ACTIVE

1. THIS BIT DEFINED FOR ASYNCHRONOUS MODE COMMUNICATION ONLY.
2. THIS BIT DEFINED FOR SYNCHRONOUS MODE COMMUNICATION ONLY.
3. THIS BIT DEFINED FOR ASYNCHRONOUS/SYNCHRONOUS MODE COMMUNICATION AS INDICATED.
4. SBS DEFINED FOR ASYNCHRONOUS MODE ONLY. XMIT PARITY AND FORCE DLE ARE DEFINED FOR SYNCHRONOUS MODE ONLY.

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Figure D-15. Computer CRU Output Bit Assignments to the CIM

Table D-13. CRU Addressable Output Bits to CIM

Word	Bit	Signal	Description
0	0 - 7	XMIT DATA	Write Data Word. These eight bits represent the next data character that will be written to the transmitter holding register. Bit 0 is the LSB, and bit 7 is the MSB. All characters are justified to the LSB with zero-fill.
0	8 - 10	ADDR(0-2)	Address Bits 0 - 2. These three address bits represent the address of the CRU interface word being referenced by a read or write operation as described by Strobe (bit 11).
0	11	STROBE	The usage of Strobe is defined by the following:

ADDR 210[1]	Strobe Referenced	Interface Word Referenced
000	None	Input Word 1[2] (modem leads, etc)
	SBO	Input Word 0 (RCV Data, errors)
001	SBO	Input Word 2
011	SBO	Input Word 1 + Input Word 0 (Status Register, etc.)[3]
100	SBO	Input Word 3
110	None	Input Word 4 (CIM ID)
000	SBZ	Output Word 0 (Transmit Data)
001	SBZ	Output Word 2
010	SBZ	Output Word 1 (Sync)
	SBO	Output Word 1 (DLE). First reference to Output Word 1 with SBZ or SBO Strobe loads Sync. If DLE is to be loaded, the first reference must be SBO Strobe. The second reference with SBO loads DLE. SBZ Strobe releases the scanner.
100	SBZ	Output Word 3
101	None	Output Word 4 (Aux. Register)

Notes:

[1] The CIM resets ADDR(2-0) to 000 following each access to Strobe, i.e., SBZ or SBO Strobe.

[2] Input Word 1 is periodically (1 microsecond) updated by the CIM whenever a read/write operation is not being executed by software.

[3] SBO Strobe to ADDR(2-0) = 011 has the effect of forcing a Status Scan Cycle.

Word	Bit	Signal	Description
0	12	CLR EN NSF	Clear Enable New Status Flag. When referenced (SBO or SBZ), this bit clears NSF (Input Word 1, bit 12). When set by SBO, this bit enables NSF to be set upon occurrence of a new status condition from the modem. This bit remains set until reset by software.

Table D-13. CRU Addressable Output Bits to CIM (Continued)

Word	Bit	Signal	Description
0	13	CLR SET EN TIMER	Clear Set Enable Timer. Setting this bit initiates a 250-ms time quantum and enables TIMER EXP (Input Word 1, bit 13) to be set when the period has expired. A SBZ, SBO reference to this bit preempts an executing quantum and restarts a new one. If the reference is SBZ, no new time quantum is initiated. Once set, this bit remains set until reset by software.
0	14	EN INT	Enable Interrupt. This bit enables Interrupt Summary (Input Word 1, bit 14) to interrupt the processor. Interrupts can occur only when this bit is set.
0	15	EN WRQ	Enable Write Request. This bit, when set, enables WRQ (Input Word 1, bit 15) to be set. This bit remains set until reset by software.
1	0 - 7	SYNC/DLE	Synchronous Data Link Escape Character. In synchronous mode communication, this byte contains the SYNC or DLE character to be loaded into the SYNC/DLE register as determined by the following sequence of events: The initial write to address 010 loads the Sync character register and is executed with the instruction SBO Strobe (if DLE is to be loaded) or SBZ Strobe (if DLE is not to be loaded) (Output Word 0, bit 11). If the DLE character is also to be loaded to the CIM, it must be written by the next command cycle by SBO Strobe with ADDR(2-0) = 010. If only the Sync character is to be loaded, ADDR(2-0) need not be set = 010 for the next Strobe reference. However, the DLE character cannot be loaded without the preceding Sync character load. In order to return Strobe to the normal idle state of zero, an SBZ Strobe may be used now to close the SYNC/DLE write sequence.
2	0	DTR	Data Terminal Ready. DTR directly drives the CD data set lead (DTR) on pin 20 of the EIA interface, and also enables DSR, DCD, and SDCD changes to be flagged by New Status Flag.
2	1	RTS	Request To Send. RTS controls the CA data set lead (RTS) on pin 4 of the EIA interface. Setting RTS combined with CTS ON (Input Word 1, bit 1) enables the transmitter. When RTS is reset, any character in the transmitter register will be completely transmitted before the transmitter is turned off and the CA data set lead is deactivated.

Table D-13. CRU Addressable Output Bits to CIM (Continued)

Word	Bit	Signal	Description
2	2	EN RRQ	Enable Read Request. When set, this bit enables RRQ (Input Word 1, bit 8) to be set, and enables the receiver section of the CIM. Once set, this bit remains active until deactivated by software. Resynchronization of the receiver is affected by first resetting and then setting EN RRQ (requires Strobe). Additionally, resetting EN RRQ resets the error bits in Input Word 0, bits 12-15, and resets RRQ (Input Word 1, bit 8).
2	3	EN PARITY	Enable Parity. For asynchronous communication, setting this bit enables the CIM for parity checking/generation. For synchronous communication, setting this bit enables parity checking only. When this bit is set, the state of Odd Parity Select (Output Word 3, bit 4) determines whether odd or even parity is in effect. If Character Length 0,1 (Output Word 3, bits 6, 7) is selected to be eight bits, the parity bit will replace the MSB of the data character.
2	4	ECHO/DLE STRIP	Echo/Data Link Escape Strip. In asynchronous communications, setting this bit enables the automatic echo mode, wherein assembled received characters are presented to the transmit data output (data set lead BA) in place of normal transmission through the transmitter register. To allow this echo to occur, the receiver must be enabled by setting EN RRQ (Output Word 2, bit 2). Echo will not start until the transmitter is idle. In synchronous communication, setting this bit does not allow assembled receiver register data matching the contents of the DLE register to be transferred to the receiver holding register. Also, parity checking is disabled.
2	5	SBS/XMIT PARITY/ FORCE DLE	Stop Bit Select/Synchronous Transmit Parity/ Force Data Link Escape. In asynchronous communications, setting this bit causes 1 stop bit to be transmitted at the end of each character. Resetting SBS causes 1.5 or 2 stop bits to be transmitted, depending upon the character length specified. For 5-bit codes (Character Length 0,1 = 11), 1.5 stop bits will be transmitted, and for 6, 7, or 8-bit codes, 2 stop bits will be selected. In the synchronous mode, setting this bit (bit 5) combined with logic 0 on bit 6 of Output Word 2 enables Transmit Parity; otherwise, no parity is generated. When set, with bit 6 also set, the contents of the DLE register is transmitted prior to the next character loaded in the transmitter holding register.

Table D-13. CRU Addressable Output Bits to CIM (Continued)

Word	Bit	Signal	Description
2	6	BREAK/TRANSPARENT	Break/Transparent. In asynchronous communications, setting this bit while the transmitter is enabled holds the transmitted data set lead BA in spacing condition, starting at the end of any current transmitted character. Normal transmitter timing continues so that this break condition can be timed-out by software responding to WRQ interrupts. Character framing is thus maintained during break, and the break condition will be an integral number of character frames long. In synchronous communications, setting this bit conditions the transmitter to transparent transmission. In this mode, a DLE-SYN character sequence will comprise the idle fill, and DLE may be force-transmitted ahead of any character by setting the preceding bit, Output Word 2, bit 5. Note: When entering the transparent mode, the Force DLE bit (Output Word 2, bit 5) must be be set as well as this bit. Thereafter, the Force DLE bit will function as described at bit 5. The use of transparent requires a half-duplex protocol. If used in a full-duplex mode, unexpected results may occur.
2	7	SELF-TEST	Self-Test. Setting this bit causes the CIM to enter self-test (digital loopback) mode. In this mode, the following logical connections are made with respect to the modem leads. Note: The connection of the modem leads on the output is controlled with REMTEST (Remote Test) bit 7 = Output Word 4, in conjunction with this self-test bit.

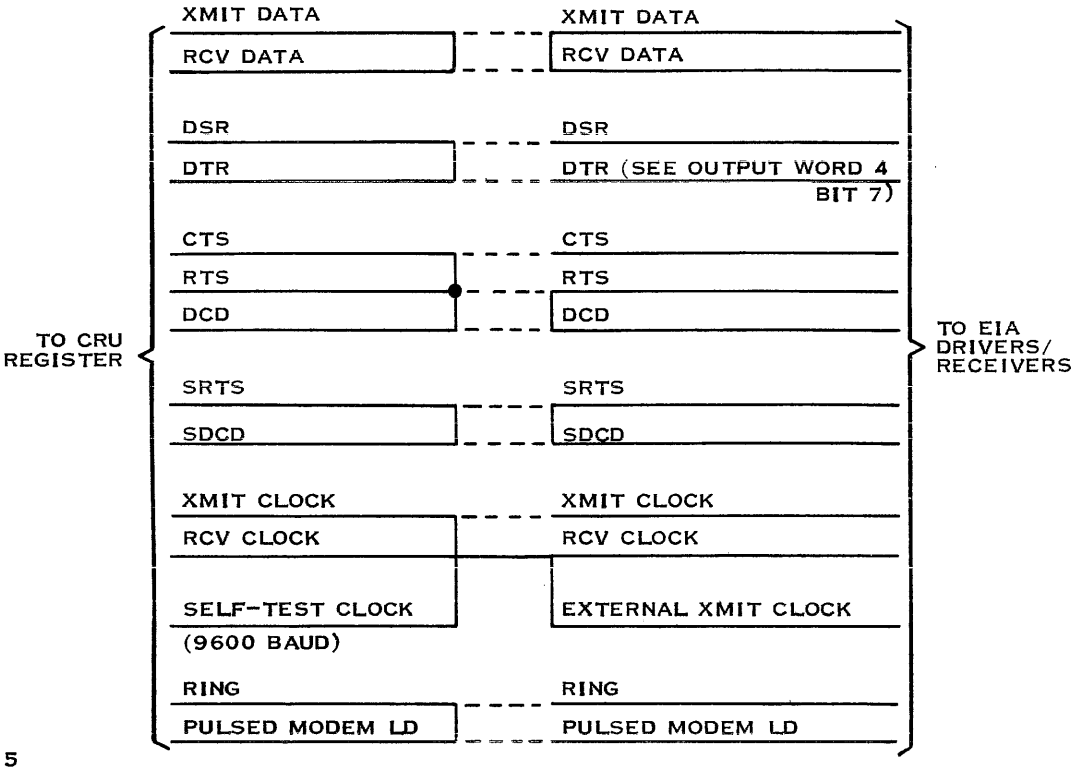

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Table D-13. CRU Addressable Output Bits to CIM (Continued)

Word	Bit	Signal	Description

CAUTION

The following word (Output Word 3) should be written to the asynchronous/synchronous receiver/transmitter only while the receiver and transmitter are idle.

Word	Bit	Signal	Description
3	0 - 2	CLOCKSEL	Clock Select A(0-2). These three bits select the transmit and receiver clocks. The input clock may be selected as shown:

CLOCKSEL A(0-2)	Clock	
000	1X clock for transmit and receive (normal state for synchronous mode)	
100	32X Async clock input ÷ 1	(normal state for asynchronous mode)
101	32X Async clock input ÷ 2	
110	32X Async clock input ÷ 3	
111	32X Async clock input ÷ 4	

Table D-13. CRU Addressable Output Bits to CIM (Continued)

Word	Bit	Signal	Description
			The 1X clock is the synchronous baud clock supplied by the data set, except in self-test mode when it is switched to the 9600 Hz self-test clock. The 32X asynchronous clock is one of four asynchronous baud clocks selected by CLOCKSEL B(0,1), reference Output Word 4, bits 0,1.
3	3	ALTCLK/ STRIP SYNC	Alternate Clock/Strip Synchronous. In synchronous mode communication, setting this bit will cause Sync characters (Output Word 1) to be stripped (deleted) from the received, or input, data stream. In asynchronous mode communication, this bit must be set.
3	4	ODD PARITY	Odd Parity Select. The state of this bit selects either even or odd parity to be checked/sent in the received/transmitted data stream. If this bit is not set, even parity is selected. Setting this bit selects odd parity. Parity must be enabled for this bit to have any effect.
3	5	SYNC MODE	Synchronous Mode Select. This bit, when set selects the synchronous transmission mode; when reset, the asynchronous mode is selected.
3	6, 7	CHAR LEN	Character Length Select 0,1. These two bits select the character length for communication as follows:

Bit 7	6	Character Length (including parity, if enabled)
0	0	8-bit characters
0	1	7-bit characters
1	0	6-bit characters
1	1	5-bit characters

Word	Bit	Signal	Description
4	0 - 1	CLOCKSEL	Clock Select B(0–1). These bits select one of four 32X clock baud rate ranges, as specified in the following. The bits allow specification of one of 16 baud rates via selection of CLOCKSEL A(0–1).

CLOCKSEL B(0–1)	Baud Rate Range	Baud Rates (÷ 1,2,4,8)
00	200	200,100,50,25
01	600	600,200,150,75
10	880	880,440,220,110
11	9600	9600,4800,2400,1200

Table D-13. CRU Addressable Output Bits to CIM (Continued)

Word	Bit	Signal	Description
			Note: CIM part number 948625-0001 has 134.5 baud rate in place of 200.
			The baud rate select from the list above may be divided by 1, 2, 4, or 8 as shown in the column on the right to accommodate a wide range of rates. When the 1X clock is selected (Output Word 2, bits 0, 2 = 000), these bits have no effect.
4	2	SRTS	Secondary Request To Send. This bit directly drives the SCA data set lead in pin 19.
4	3	RES MODEM LD OUT	Reserved Modem Lead Out. This bit is reserved for customer modem output signal and directly controls the data set lead on pin 18 of the EIA interface. When a TI internal modem is employed, this lead has the effect of controlling the audio monitor for use in troubleshooting and/or system assurance.
4	4	PULSED MODEM LD	Pulsed Model Lead. Setting this bit initiates a millisecond signal onto data set leads NS and CRD (pins 14 and 25) of the EIA interface. With a synchronous modem connected to the CIM, this bit will directly control the NS (New Sync) data set lead. With an asynchronous modem connected, this bit will control the CDR (Carrier Detect Reset) data set lead.

CAUTION

If an external modem type 208 is employed, the CDR data set lead should be disconnected. Cable part number 946117 does not have CDR connected.

Word	Bit	Signal	Description
4	5	MR	Master Reset. When set, MR clears all status and control (except input modem leads) to the reset (inactive) state. MR is a pulse and is automatically returned to the reset state by the CIM.
4	6	HALF-DUPLEX	Half-Duplex Mode. When transmitting in the half-duplex mode, setting this bit masks the serial receive data line to the CIM to logic 1, disabling the reception of the transmit data echo (called local copy) provided by many half-duplex (two-wire) modems.

Table D-13. CRU Addressable Output Bits to CIM (Continued)

<table>
<tr><th>Word</th><th>Bit</th><th>Signal</th><th>Description</th></tr>
<tr><td>4</td><td>7</td><td>ANALOG LB-REM TEST</td><td>Analog Loopback Remote Test. This bit is combined with Self-Test (Output Word 2, bit 7) to affect the loopback configuration given by the following table:
<table>
<tr><th>Self Test</th><th>Analog LB-REM Test</th><th>Loopback Configuration</th></tr>
<tr><td>0</td><td>0</td><td>None (normal communication)</td></tr>
<tr><td>0</td><td>1</td><td>Analog loopback only</td></tr>
<tr><td>1</td><td>0</td><td>Self-Test only (DTR off)</td></tr>
<tr><td>1</td><td>1</td><td>Self-Test, Remote Test (DTR on)</td></tr>
</table>
A manually-selected override switch is provided on the CIM. When the switch is in the closed position, the remote test mode is selected, regardless of the state of the Analog Loopback/Remote Test or Self-Test bits. When the switch is in the open position, the state of these bits prevails.</td></tr>
</table>

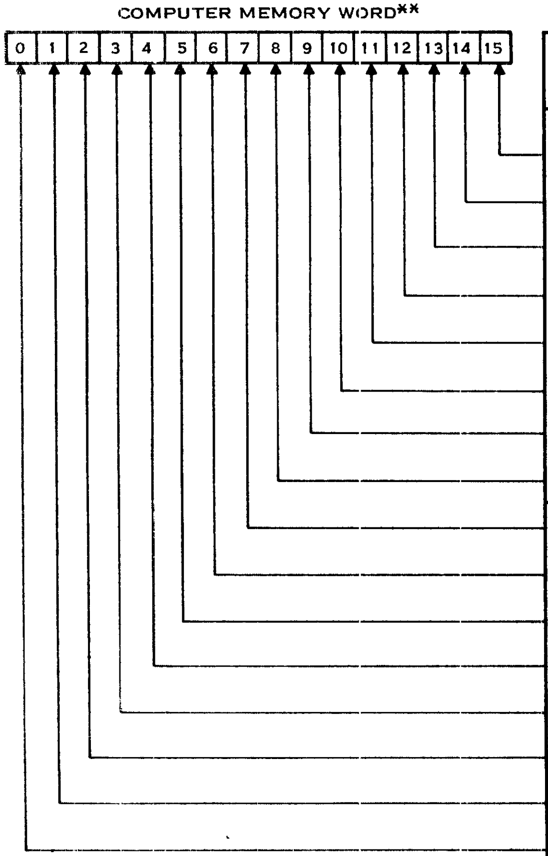
D.7 LOCAL LINE MULTIDROP MODULE

This paragraph contains information about the interface between the computer CRU and the local line multidrop module. The interface between the computer and the local line multidrop module consists of 16 addressable input bits and 16 addressable output bits.

D.7.1 Input Interface

The addressable input from the local line multidrop module to the CRU includes the character received and all the necessary control and status signals to inform the computer when data is present and to report on the status of the module.

Information on the input interface from the module to the CRU is contained in five module registers, addressed one at a time by the same three-bit CRU address scheme (bits 8 to 10 of Output Word 0) used by the output interface. Figure D-16 illustrates the input interface for synchronous data transmission to the computer. Table D-14 defines the input bits. A CRU input operation accesses one of five input words selected by specifying the value of ADDR(2–0) and the setting to logic 1 or logic 0 of STROBE.



CRU INTERFACE* INPUT

BIT NO.	INPUT WORD 0 ADDR 2–0=000 STROBE=1	INPUT WORD 1 ADDR 2–0=000 STROBE =0	INPUT WORD 2 ADDR 2–0=001 STROBE=1	INPUT WORD 3 ADDR 2–0=100 STROBE=1	INPUT WORD 4 ADDR 2–0=110 STROBE=0
0	RCV DATA 0	DSR	DTR	CLOCK SEL A0	ID SWITCH 0
1	1	CTS	RTS	CLOCK SEL A1	1
2	2	NOT USED	EN RRQ	CLOCK SEL A2	2
3	3	NOT USED	EN PARITY	ALT CLK	3
4	4	NOT USED	NOT USED	PARITY SELECT	4
5	5	DCD	SBS	NOT USED	5
6	6	NOT USED	NOT USED	CHAR LEN 0	ID SWITCH 7
7	RCV DATA 7	NOT USED	SELF-TEST	CHAR LEN 1	
8	NOT USED	RRQ			
9	NOT USED	NOT USED			
10	NOT USED	NOT USED			
11	R/W BUSY	R-W BUSY			
12	PE	NSF			
13	FE	TIMER EXP			
14	OVER-RUN	INTR SUM			
15	RCV ERROR SUM	WRQ			

*ALL BIT DEFINITIONS ARE IN THE POSITIVE LOGIC SENSE (EXCEPT SELF-TEST):

LOGIC 0 = NOT ASSERTED OR INACTIVE
LOGIC 1 = ASSERTED OR ACTIVE
EXCEPT SELF-TEST

**DATA TRANSFER SHOWN FOR FULL WORD (NOT BYTE) TRANSFER.

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Figure D-16. CRU Input Bit Assignments from Local Line Multidrop Module

Table D-14. CRU Addressable Input Bits from Local Line Multidrop Module

Word	Bit	Signal	Description
0	0 - 7	RCV DATA	Receive Data. The receive data bits contain the data byte input to the CRU in response to an SBO Strobe followed by an STCR instruction. Bit 0 is the LSB and bit 7 is the MSB. If a character length of less than eight bits has been selected (Output Word 3, bits 6 - 7), the character is justified to the LSB and zero-filled to the MSB.
0	8		Not used.
0	9		Not used.
0	10		Not used.
0	11	R/W BUSY	Read/Write Busy. When active, this bit indicates that the module is busy processing a software-given read or write command; therefore only TB (Test Bit for a CRU input line) can be executed. Normal read/write referencing can resume when this bit is inactive. This bit should be tested after any Strobe reference to ensure that the read or write cycle has been completed before processing continues.
0	12	PE	Parity Error. PE is a component of RCV Error Sum (Input Word 0, bit 15) and is set when Parity Enable (Output Word 2, bit 3) is set and a parity error is detected in the last character received in the receiver register. PE is valid after the access of Input Word 0, while Strobe (Output Word 0, bit 11) is set; when Strobe is reset, PE is cleared.
0	13	FE	Framing Error. The Framing Error condition is asserted when the transmitter detects a logic 0 stop bit (which should normally be a logic 1). This bit, a component of RCV Error Sum (Input Word 0, bit 15), is valid after the access of input word 0, while Strobe (Output Word 0, bit 11) is set. This bit (bit 13) is cleared when Strobe is reset, or by disabling the receiver.
0	14	OVER-RUN	Over-Run. This error condition is set during reception when a new data character is transferred into the receiver holding register before the previous character is read by the CRU. The character in the receiver holding register will have been lost. Over-Run is cleared by the next Status Scan cycle (SBO Strobe, ADDR = 011) or by disabling the receiver. This bit is a component of RCV Error Sum (Input Word 0, bit 15).

Table D-14. CRU Addressable Input Bits from Local Line Multidrop Module (Continued)

Word	Bit	Signal	Description
0	15	RCV ERROR SUM	Receive Error Summary. This bit is set when at least one of the following receiver status bits is set: Parity Error Framing Error Over-Run The bit is cleared by SBZ Strobe.
1	0	DSR	Data Set Ready. This bit indicates the state of Data Terminal Ready (DTR). A change in state of this lead is indicated as a component of New Status Flag (Input Word 1, bit 12).
1	1	CTS	Clear To Send. This bit is RTS with an 8-millisecond delay at the start. A 10-second timer resets CTS if RTS is held that length of time. CTS enables the transmitter.
1	2		Not used.
1	3		Not used.
1	4		Not used.
1	5	DCD	Data Carrier Detect. The DCD bit indicates the state of the RTS lead. A change in state of DCD is indicated by NSF (Input Word 1, bit 12), if DTR (Output Word 2, bit 0) is active.
1	6 - 7		Not used.
1	8	RRQ	Read Request. The RRQ interrupt condition occurs when a receive character is available and EN RRQ (Output Word 2, bit 2) is active. RRQ is cleared when RCV Data Word (Input Word 0, bits 0 - 7) is read. RRQ is a component of Interrupt Summary (Input Word 1, bit 14).
1	9		Not used.
1	10		Not used.
1	11	R/W BUSY	Read/Write Busy. This is the same as for R/W Busy (Input Word 0, bit 11).
1	12	NSF	New Status Flag. This interrupt condition is set when CLR-EN-NSF (Output Word 0, bit 12) is set, when DSR or DCD change state, and DTR is active. NSF is a component of Interrupt Summary (Input Word 1, bit 14) and is cleared by referencing CLR-EN-NSF with either SBZ or SBO.

Table D-14. CRU Addressable Input Bits from Local Line Multidrop Module (Continued)

Word	Bit	Signal	Description
1	13	TIMER EXP	Timer Expired. This interrupt condition is asserted when the most recent 250-millisecond time quantum started by the (software) assertion of CLR-SET-EN-TIMER (Output Word 0, bit 13) expires. This bit is cleared by setting or resetting CLR-SET-EN-TIMER. This bit is a component of Interrupt Summary (Input Word 1, bit 14) and can be set only when CLR-SET-EN-TIMER is active.
1	14	INTR SUM	Interrupt Summary. When set, this bit indicates that at least one of the following interrupt bits is set: RRQ (Input Word 1, bit 8) WRQ (Input Word 1, bit 15) Timer Expired (Input Word 1, bit 13) NSF (Input Word 1, bit 12) This bit will remain set until all interrupting conditions have been cleared. The setting of this bit will interrupt the processor if Enable Interrupt (Output Word 0, bit 14) is active.
1	15	WRQ	Write Request. This interrupt condition occurs when the transmitter holding register becomes empty while EN WRQ (Output Word 0, bit 15), RTS (Output Word 2, bit 1), and CTS (Input Word 2, bit 1) are active. WRQ is cleared when a data character is written to the transmitter holding register or when the transmitter is disabled (RTS set). This bit (bit 15) is a component of Interrupt Summary (Input Word 1, bit 14).
2	1	DTR	Input Word 2 indicates the current contents of register C1, as set by the most recent write to Output Word 2. NOTE The logical sense of the SELF-TEST bit is inverted between the output register and input register.
2	2	RTS	
2	3	EN RRQ	
2	4	EN PARITY	
2	5	Not used	
2	6	SBS	
2	7	Not used	
2	8	SELF-TEST	
3	0	CLOCK SEL A0	Input Word 3 indicates the current contents of register C2, as set by the most recent write to Output Word 3.
3	1	CLOCK SEL A1	
3	2	CLOCK SEL A2	
3	3	ALT CLK	
3	4	PARITY SELECT	
3	5	Not used	
3	6	CHAR LEN 0	
3	7	CHAR LEN 1	

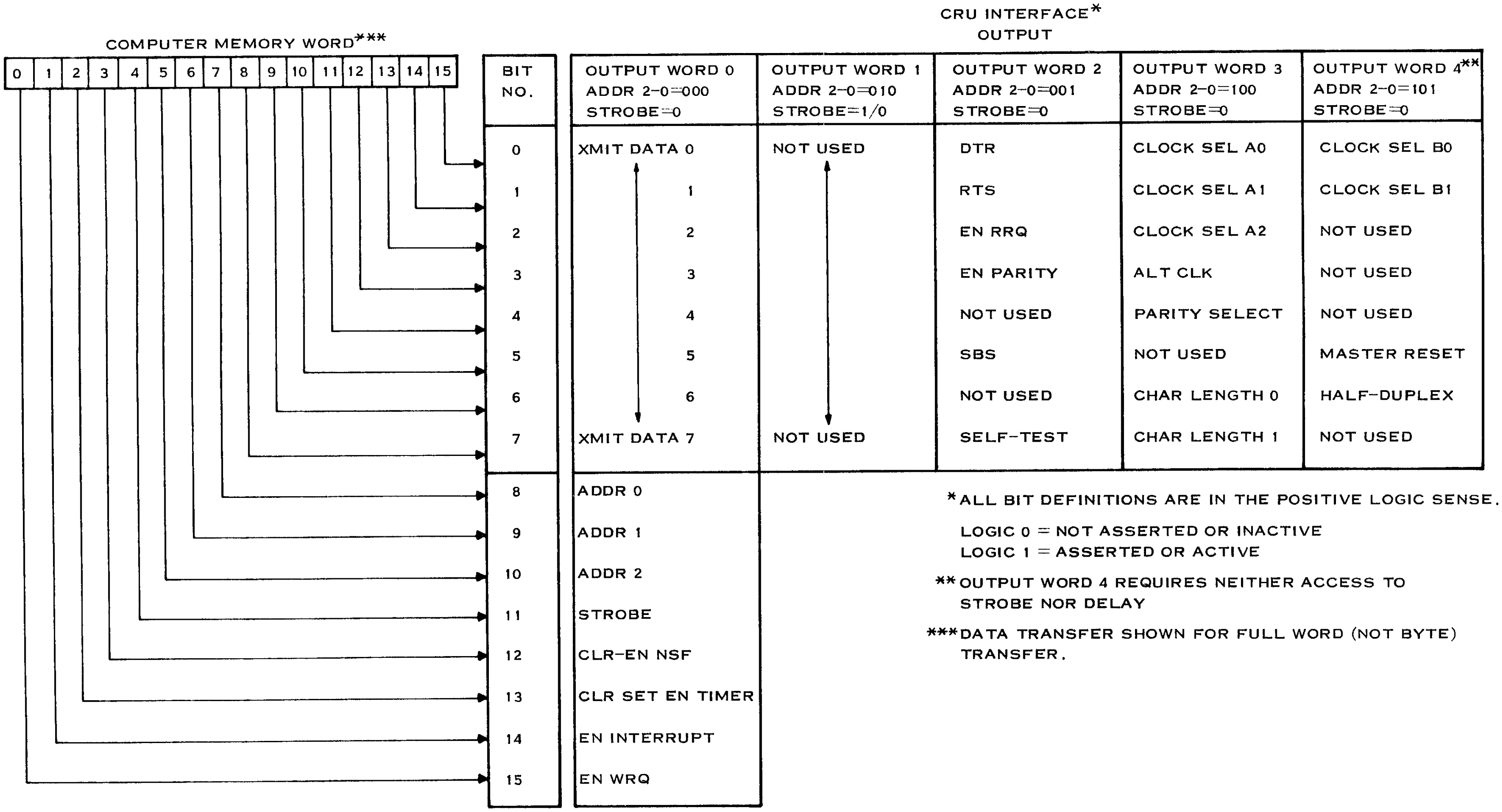
Table D-14. CRU Addressable Input Bits from Local Line Multidrop Module (Continued)

Word	Bit	Signal	Description
4	0 - 7	ID SWITCH	These bits contain the module ID code as was set by 8 bits of the module DIP switch. Bit 0 (switch 1) is the LSB and bit 7 (switch 8) is the MSB. Setting of this switch is explained in Section 20. **NOTE** No Strobe reference is required to read Input Word 4; therefore, the ADDR(2–0) bits are not automatically reset. These should be reset by software.

D.7.2 OUTPUT INTERFACE

The addressable output data from the computer to the local line multidrop module includes the character to be transmitted and all the necessary control signals to ensure that the character is transmitted at the proper baud rate. Also included are all the control signals necessary to direct and control the actual transmission of data.

Information on the output interface is contained in five module registers, addressed one at a time by a 3-bit CRU addressing scheme: bits 8, 9, and 10 of the 16-bit CRU output register constitute the module register number. Figure D-17 illustrates the output interface for asynchronous data transmission to the local line multidrop module. Table D-15 defines these output bits. An output (write) operation addresses one of five output words as the least significant eight bits of a 16-bit output word. The most significant eight bits always refer to bits 8 to 15 of Output Word 0.



BIT NO.	OUTPUT WORD 0 ADDR 2-0=000 STROBE=0	OUTPUT WORD 1 ADDR 2-0=010 STROBE=1/0	OUTPUT WORD 2 ADDR 2-0=001 STROBE=0	OUTPUT WORD 3 ADDR 2-0=100 STROBE=0	OUTPUT WORD 4** ADDR 2-0=101 STROBE=0
0	XMIT DATA 0	NOT USED	DTR	CLOCK SEL A0	CLOCK SEL B0
1	1		RTS	CLOCK SEL A1	CLOCK SEL B1
2	2		EN RRQ	CLOCK SEL A2	NOT USED
3	3		EN PARITY	ALT CLK	NOT USED
4	4		NOT USED	PARITY SELECT	NOT USED
5	5		SBS	NOT USED	MASTER RESET
6	6		NOT USED	CHAR LENGTH 0	HALF-DUPLEX
7	XMIT DATA 7	NOT USED	SELF-TEST	CHAR LENGTH 1	NOT USED
8	ADDR 0				
9	ADDR 1				
10	ADDR 2				
11	STROBE				
12	CLR-EN NSF				
13	CLR SET EN TIMER				
14	EN INTERRUPT				
15	EN WRQ				

*ALL BIT DEFINITIONS ARE IN THE POSITIVE LOGIC SENSE.

LOGIC 0 = NOT ASSERTED OR INACTIVE
LOGIC 1 = ASSERTED OR ACTIVE

**OUTPUT WORD 4 REQUIRES NEITHER ACCESS TO STROBE NOR DELAY

***DATA TRANSFER SHOWN FOR FULL WORD (NOT BYTE) TRANSFER.

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Figure D-17. CRU Output Bit Assignments to Local Line Multidrop Module

Table D-15. CRU Addressable Output Bits to Local Line Multidrop Module

<table>
<tr><th>Word</th><th>Bit</th><th>Signal</th><th>Description</th></tr>
<tr><td>0</td><td>0 - 7</td><td>XMIT DATA</td><td>These eight bits represent the next data character brought to the CRU by the LDCR instruction that will be written into the transmitter holding register. Bit 0 is the LSB and bit 7 is the MSB. All characters are justified to the LSB and zero-filled to the MSB.</td></tr>
<tr><td>0</td><td>8 - 10</td><td>ADDR(0-2)</td><td>These three bits represent the address of the CRU interface word being referenced by a read or write operation as described for the STROBE bit in the following.</td></tr>
<tr><td>0</td><td>11</td><td>STROBE</td><td>The usage of STROBE is defined by the following table.
<table>
<tr><th>ADDR 210[1]</th><th>Access to STROBE</th><th>Interface Word Referenced</th></tr>
<tr><td></td><td>SBZ</td><td>Output Word 0</td></tr>
<tr><td>000</td><td>None</td><td>Input Word 1[2]</td></tr>
<tr><td></td><td>SBO</td><td>Input Word 0</td></tr>
<tr><td>001</td><td>SBZ</td><td>Output Word 2</td></tr>
<tr><td></td><td>SBO</td><td>Input Word 2</td></tr>
<tr><td>010</td><td>SBZ</td><td>Output Word 1 (not used)</td></tr>
<tr><td></td><td>SBO</td><td>Output Word 1 (not used)</td></tr>
<tr><td>011</td><td>SBO</td><td>Input Word 1 + Input Word 0[3]</td></tr>
<tr><td>100</td><td>SBZ</td><td>Output Word 3</td></tr>
<tr><td></td><td>SBO</td><td>Input Word 3</td></tr>
<tr><td>101</td><td>None</td><td>Output Word 4</td></tr>
<tr><td>110</td><td>None</td><td>Input Word 4</td></tr>
</table></td></tr>
<tr><td>0</td><td>12</td><td>CLR-EN NSF</td><td>Clear Enable New Status Flag. When referenced (SBO or SBZ), this bit clears NSF (Input Word 1, bit 12). When set, this bit allows NSF to be set when a new status condition occurs for DSR or DCD while DTR is set. This bit remains set until reset by software.</td></tr>
</table>

Notes:

[1] The module resets ADDR(2-0) to 000 following access to the STROBE bit (SBZ or SBO STROBE).

[2] Input Word 1 is periodically (1 microsecond) updated by the module whenever a read/write operation is not being executed by software. This is the module Status Scan State.

[3] SBO STROBE with ADDR(2-0) = 011 has the effect of forcing a Status Scan Cycle.

Table D-15. CRU Addressable Output Bits to Local Line Multidrop Module (Continued)

Word	Bit	Signal	Description
0	13	CLR-SET EN TIMER	When this bit is set, it causes the TIMER EXP bit (Input Word 1, bit 13) to be reset for 250 milliseconds and then set again at the end of the time period. An SBZ followed by an SBO to this bit will preempt an executing time quantum and restart a new one. An SBZ to this bit will not start a new time quantum. Once set, this bit remains set until reset by software.
0	14	EN INTERRUPT	Enable Interrupt. When this bit is set, it enables Interrupt Summary (Input Word 1, bit 14) to interrupt the processor. Interrupts can occur only when this bit is set.
0	15	EN WRQ	Enable Write Request. When set, this bit allows Write Request Input Word 1, bit 14) to be set. Once set this bit remains set until reset by software.
1			Output Word 1 is not used.
2	0	DTR	Data Terminal Ready. Setting DTR enables changes to DSR and DCD to be flagged by NSF.
2	1	RTS	Request To Send. This bit, delayed by eight milliseconds, drives CTS and RTS enables the transmitter. Setting RTS for longer than 10 seconds will cause a timeout and reset CTS. When RTS is reset, the transmitter will complete transmission of any character before resetting lead CA.
2	2	EN RRQ	Enable Read Request. When set this bit enables RRQ (Input Word 1, bit 8) to be set and enables the receiver section of the module. Once set, this bit remains active until deactivated by software. The receiver is resynchronized by first resetting and then setting this bit. Additionally, resetting this bit resets the error bits in Input Word 0, bits 12 - 15, and reset RRQ (Input Word 1, bit 8).
2	3	EN PARITY	Enable Parity. Setting this bit enables the module for parity checking/generation. If Character Length 0,1 (Output Word 2, bits 6 - 7) is selected to be 8 bits, the MSB of the data character will be a parity bit.
2	4		Not used.

Table D-15. CRU Addressable Output Bits to Local Line Multidrop Module (Continued)

Word	Bit	Signal	Description
2	5	SBS	Stop Bit Select is always set and causes 1 stop bit to be transmitted at the end of each character.
2	6		Not used.
2	7	SELF-TEST	Setting this bit causes the module to enter self-test (digital loopback) mode. In this mode, the XMIT data lead drives the RCV DATA lead. In the self-test mode, the following logical connections are made with respect to the modem leads:

CAUTION

This word should be written only while both the receiver and transmitter are idle.

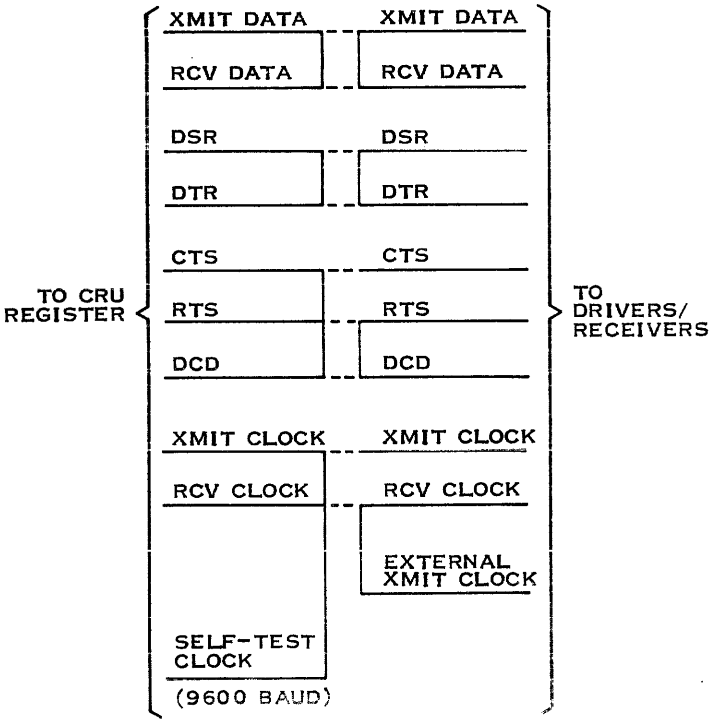

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Table D-15. CRU Addressable Output Bits to Local Line Multidrop Module (Continued)

<table>
<tr><th>Word</th><th>Bit</th><th>Signal</th><th>Description</th></tr>
<tr><td>3</td><td>0 - 2</td><td>CLOCK SEL</td><td>Clock Select A(0–2) bits select the transmit and receive clocks. The input clock selected by Clock Select B(0–1) (Output Word 4, bits 0-1) may be divided to form the 32X clock as shown:
<table>
<tr><th colspan="3">Clock Select</th><th>Clock</th></tr>
<tr><th>A2</th><th>A1</th><th>A0</th><th></th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1X clock for transmit and receive (pins 35 and 34 of ASTRO — not used)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>32X clock ÷ 1</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>32X clock ÷ 2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>32X clock ÷ 4</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>32X clock ÷ 8</td></tr>
</table>
The clock input is one of four baud rates selected by Clock Select B(0–1) (Output Word 4, bits 0 and 1).</td></tr>
<tr><td>3</td><td>3</td><td>ALT CLK</td><td>When the Alternate Clock bit is set, the same clock is selected for both transmit and receive data.</td></tr>
<tr><td>3</td><td>4</td><td>EN PARITY</td><td>When Enable Parity is set, odd parity is selected to be checked/sent in the received/transmitted data stream. When reset, even parity is selected. Parity must be enabled by Enable Interrupt bit (Output Word 0, bit 14) for this bit to have any effect.</td></tr>
<tr><td>3</td><td>5</td><td></td><td>Not used.</td></tr>
<tr><td>3</td><td>6 - 7</td><td>CHAR LEN</td><td>These two bits select the character length. Note they are not set for an eight-bit character length.
<table>
<tr><th>Bit 7,6</th><th>Character Length (including parity, if enabled)</th></tr>
<tr><td>0 0</td><td>8 bits</td></tr>
<tr><td>0 1</td><td>7 bits</td></tr>
<tr><td>1 0</td><td>6 bits</td></tr>
<tr><td>1 1</td><td>5 bits</td></tr>
</table></td></tr>
</table>

Table D-15. CRU Addressable Output Bits to Local Line Multidrop Module (Continued)

Word	Bit	Signal	Description
4	0 - 1	CLOCK SEL B0 - B1	Clock Select B(0-1). The clock select bits select one of four baud rate ranges, as specified below, and allow (via selection of Clock Select A(0-2)) a selection of one of 16 baud rates.

Clock Select B1 B0	Baud Rate Range
0 0	200
0 1	600
1 0	880
1 1	9600

The baud rate selected from the list above may be divided by 1, 2, 4, or 8 as set by Clock Select A(2-0) (Output Word 3, bits 0 - 2).

The following table summarizes the baud rates that result from settings of the two Clock Select bit combinations of A2 - A0 (Output Word 3, bits 0 - 2) and B1 - B0 (Output Word 4, bits 0 - 1).

		00	01	10	11	
CLOCK SEL BIT SETTINGS (A2/A1/A0)	100	200	600	880	9600	RESULTING BAUD RATES FOR EACH COMBINATION OF CLOCK SEL SETTINGS
	101	100	300	440	4800	
	110	50	150	220	2400	
	111	25	75	110	1200	

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Word	Bit	Signal	Description
4	2		Not used.
4	3		Not used.
4	4		Not used.
4	5	MASTER RESET	When set, Master Reset clears all status and control to the inactive (reset) state. Master Reset is a pulse and is automatically returned to the reset state by the module.
4	6	HALF-DUPLEX	When transmitting in half-duplex mode, setting this bit masks the serial receive data line from the module to logic 0, disabling the transmit data echo (called local copy) provided by most half-duplex (two-wire) systems. Do not set this bit to allow self-testing using a loopback mode.
4	7		Not used.

D.8 CRU EXPANSION BOARD

The CRU expansion board primarily expands the CRU interface in the main chassis to drive as many as seven additional 990 computer expansion chassis. The expansion board monitors for interrupts from the seven chassis using two independent interrupt recognition sections, A and B. If an interrupt occurs in chassis 1 through 4, the expansion board generates an INTA- (interrupt A). If the interrupt occurs in chassis 5 through 7, the expander board generates an INTB- (interrupt B). The expansion board then enables the interrupt ID lines from the highest priority chassis (chassis 1 highest priority, chassis 4 lowest priority in interrupt Section A).

The 990 software may then determine the source of the interrupt by executing an STCR instruction at address >F80 (interrupt vector for Section A) or >F90 (interrupt vector for Section B). As a result of the instruction, the CRU expansion board serially transfers a 16-bit vector in the format shown in Figure D-18. As indicated in the figure, the interrupt vector identifies the chassis and the unit within the chassis which issued the interrupt. The vector also indicates the online status of each expansion chassis that issued the interrupt. The vector also indicates the online status of each expansion chassis that reports to this interrupt monitoring section (chassis 1 through 4 for Section A; chassis 5 through 7 for Section B).

The CRU expansion board also contains provisions for fanning-in direct interrupts (IREQ-) from each of the seven chassis and issuing an INTC- to the CPU if a direct interrupt is received from any chassis. The direct interrupt scheme is used with peripherals requiring faster interrupt service than is available with the interrupt scanning system.

A CRU address map for the standard, fully-expanded 990 computer system is shown in Figure D-19. As shown in this illustration, each chassis is assigned a band of location-dependent CRU addresses that are used to address the CRU interface board implemented within a given chassis. The chassis number (1 through 7) that is assigned to each chassis is determined by an ID plug on the CRU buffer board.

In addition to the location-dependent address blocks, several bands of addresses are assigned as dedicated or location-independent addresses. In order to implement the dedicated CRU addresses, the board associated with these address functions contains decoding logic that permits the board to respond to its dedicated address regardless of location. For example, the two interrupt servicing sections on the CRU expansion board are assigned dedicated addresses >F80 and >F90, respectively. The interrupt servicing logic on the expander board will respond to these CRU addresses regardless of physical placement of the CRU expansion board.

The CRU buffer board contains fan-out and fan-in circuits for the CRU interface signals, including CRUBITIN, CRUBITOUT, CRUCLK, and CRU address lines. The board also contains an interrupt scanner circuit that monitors the interrupt lines from the various CRU interface boards within the chassis and issues an interrupt to the CRU expander board in the main chassis any time an interrupt is detected. When the interrupt is acknowledged by means of an ID enable signal, the CRU buffer board sends back the ID code corresponding to the originating interrupt level (1 through 15). The interrupt scanner then halts until software clears the interrupt on the originating board.

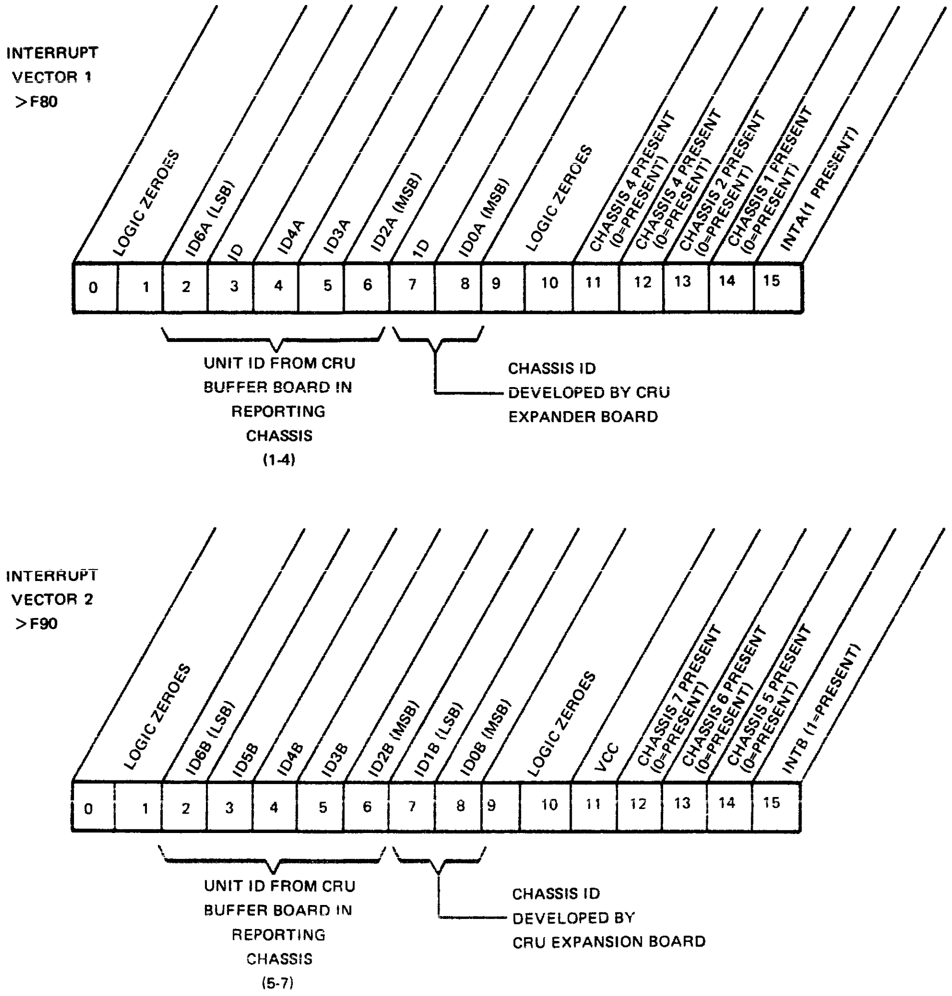

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Figure D-18. Expansion Interrupt Vector Format

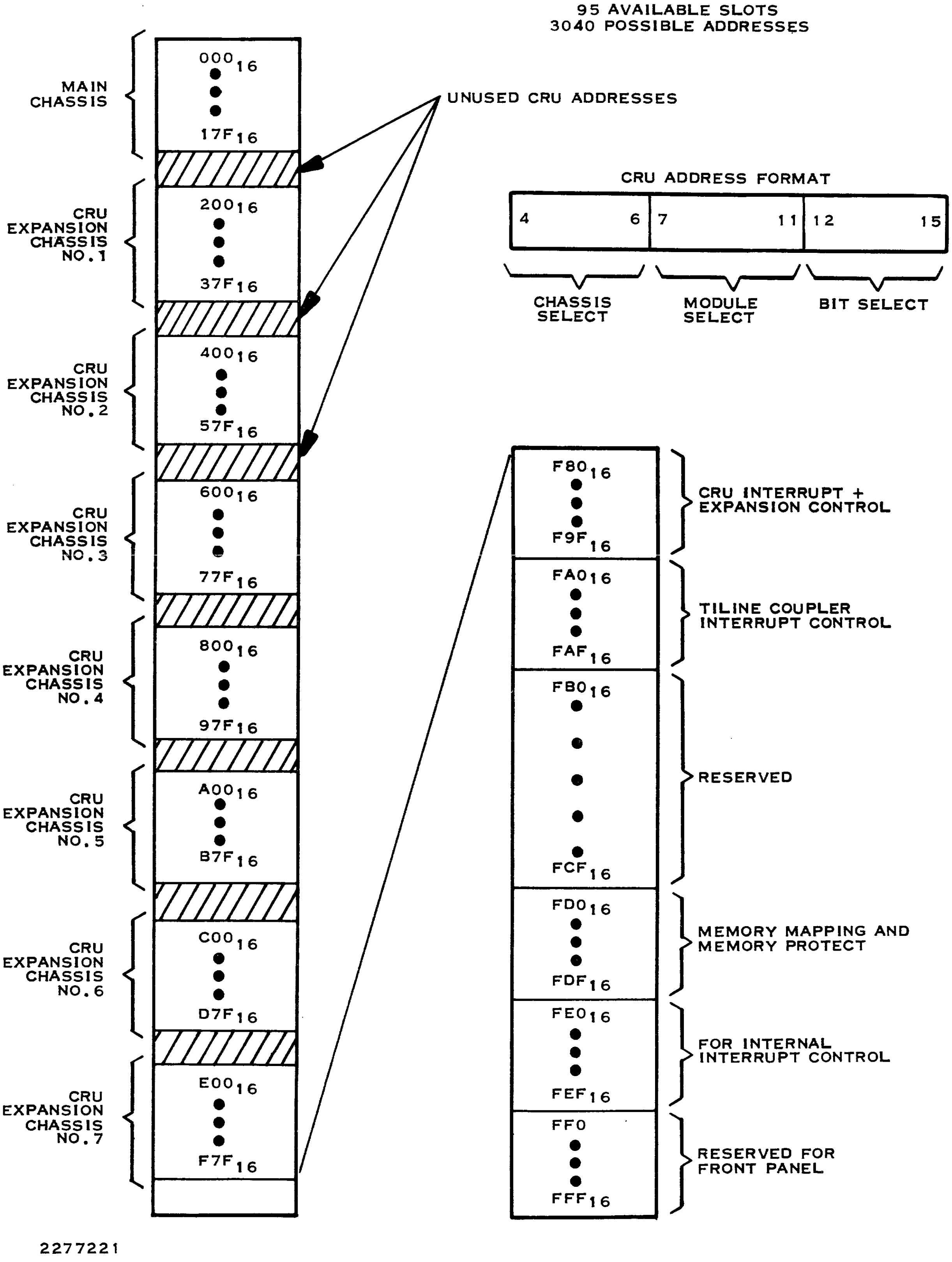

Figure D-19. CRU Address Map for Standard Expansion Implementation

Appendix E

DS990 Computer Systems Logic Common Grounding

E.1 INTRODUCTION

This appendix describes the methods for isolating and interconnecting signal grounds (logic grounds) and power grounds (frame or chassis grounds) in standard equipment of DS990 computer systems. Texas Instruments recommends that each system be grounded at one single predefined point whenever possible. This means that the logic common circuitry (signal ground) is tied to the chassis frame ground (power ground) at a prescribed location in a standard peripheral device. The device that will contain the single-point ground is selected by hierarchical priority; that is, the device is chosen from a preferential list. Ideally, the logic common is isolated from chassis ground, and the logic common circuitry floats in all devices in the system except the device that contains the single-point ground.

When all the devices are interconnected as a system, the logic common circuits from all devices are connected together. Hence, the system logic common makes connection to earth ground (i.e., is connected to chassis) through only one device, thus eliminating the potential for ground loops.

Also, the connection of the ac power distribution ground (safety ground wire) to earth ground is very important. Normally, this safety ground wire carries no current but is used only as an operator's safety return path for chassis and equipment. However, in the DS990 systems, a proper earth ground (also referred to as an isolated single-point earth ground) must be installed since it becomes a reference for the logic common circuitry in the computer system. The safety ground wire is also connected to the system equipment cabinets and chassis, and thus helps to shield microelectronic circuits from environmental electrical noise.

NOTE

> To avoid ground loops, all devices in a system must have the same common ac power ground circuit.

Connection of the safety ground wire to earth ground is not discussed here, but is specified in drawings contained in the DS990 site preparation manuals. However, the problems that can arise when the safety ground wire is not properly installed are similar to the problems that occur when the logic common and chassis ground in the computer system are not properly connected. The following paragraph lists these problems.

AP — Appendixes

E.2 BACKGROUND INFORMATION

Problems that sometimes arise in computer systems can be resolved by incorporating a system single-point grounding scheme. Some of these problems are:

- Intermittents (recurring, unexplainable system failures)
- Parity errors
- Data errors
- Static-induced noise (high static electricity susceptability)
- Ground loops
- Disk drive going not-ready (unexplainable not-ready conditions on disk drives)

In addition to eliminating these problems, grounding at a single point in the system also assures a uniform ground path that can simplify service calls and facilitate system upgrade modifications.

E.3 LOCATING, ISOLATING, AND VERIFYING SINGLE-POINT GROUND

The following subparagraphs describe:

- The procedure for determining which device in the system will contain the single-point ground.
- The method for disconnecting and isolating the logic common to chassis ground connection in each standard device.
- The procedure for verifying the absence or presence of a single-point ground in the system.

If nonstandard TI devices or customer-supplied devices are to be installed with a system, the customer's service representative in charge of installing the device(s) will be responsible for determining the best overall grounding scheme.

E.3.1 Selecting the Device for Single-Point Ground Location

To determine the preferred location and the method used to make the system single-point ground connection, refer to Table E-1 and the following discussion. Table E-1 lists standard TI peripheral devices in the order of priority for establishing the location of a system single-point ground. In the first four priority devices in the list, logic common is connected to the chassis internally by design and cannot be isolated. To determine the device where the single-point ground will be located, go down the list of Table E-1 in the order of priority to the first device encountered that is installed in the system. This is the device where the single-point ground connection should be made. All other logic common to chassis ground connections in the system should be removed, if possible.

Table E-1. Device Priority List for Single-Point Ground

Priority	Device	Remarks
1	DS31 Disk*	Logic common connected to chassis ground by design.
2	DS10 Disk*	Dynamic brake requires the logic common/chassis ground connection to be in any and all of these drives in a system.
3	FD800 Disk* (new chassis)	Logic common to chassis ground connection required.
4	FD800 Disk* (old chassis)	Logic common to chassis ground connection required, J1-6 to E2.
5	DS25/DS50 Disk	Jumper (spade lug)
6	DS200 Disk	Switch
7	CD1400 Disk	Shorting bar on back of chassis.
8	FD1000 Disk (new chassis)	Jumper plug
9	FD1000 Disk (old chassis)	Jumper wire
10	17-slot chassis	Screw in backpanel
11	2230/2260 Printer	Jumper wire
12	LP300/LP600 Printer	Wire on ground stud to capacitor
13	LQ45 Printer	Grounding etch on two boards; blower fan ground wire; add ground jumper
14	733 ASR	Jumper wire
15	743 KSR	Jumper plug
16	810 printer (if I/O cable less than 30 ft)	Jumper

Table E-1. Device Priority List for Single-Point Ground (Continued)

Priority	Device	Remarks
17	820 KSR (if I/O cable less than 30 ft)	Jumper wire
18	804 card reader	Coupled to ground through 0.1 microfarad capacitor installed at factory. Do not remove.

Note:

*These grounds are required by design.

After deciding what device will contain the single-point ground for the system in accordance with Table E-1, refer to Table E-2 and the associated illustrations to check for the absence or presence of logic common to chassis ground connections. The procedure for verifying the existence of a single-point ground in the system is given in paragraph E.3.3.

Table E-2. Device Grounding Locations

Device	Figure	Remarks
DS25/50 Disk Drive	E-1	Jumper spade lug connected in either OPEN or AC/DC GROUND SHORT position. Connect spade lug to OPEN to isolate grounds.
DS200 Disk Drive	E-2	Ground shorting switch (ON LINE — OFF LINE) located adjacent to CB1. Set switch to ON LINE to isolate grounds.
FD1000 Flexible Disk (new chassis)	E-3	Jumper plug on power supply. Remove jumper plug to isolate grounds.
FD1000 Flexible Disk (old chassis)	E-4	Ground shorting jumper wire installed J1-16 to chassis terminal E2. Remove jumper wire to isolate grounds.
FD800 Flexible Disk (new chassis)	E-3	Logic common to chassis ground connection required.
FD800 Flexible Disk (old chassis)	E-4	Ground shorting jumper wire J1-6 to chassis terminal E2. Do not remove; ground connection is required.
2230 Printer	E-5	Ground shorting jumper wire E16 to E18 on regulator card assembly. Remove jumper wire to isolate grounds.

Table E-2. Device Grounding Locations (Continued)

Device	Figure	Remarks
2260 Printer	E-6	Ground shorting jumper wire E4 to E5 on regulator card assembly. Remove jumper wire to isolate grounds.
733 ASR Terminal	E-7	Ground jumper wire E15 to E16 on ac power assembly. Remove jumper wire to isolate grounds.
743 KSR Terminal	E-8	Ground shorting jumper plug on regulator assembly. To isolate ground (standard), connect jumper E366 to E367. (For shorting grounds together, the jumper wire is connected E365 to E366.)
810 Printer	E-9	Ground jumper E6 to E7 installed on card cage backpanel between XA1P2 (driver) and XA2P2 (processor) connectors. Cut jumper to isolate grounds.
820 KSR Terminal	E-10	Ground shorting jumper wire on terminal electronics assembly. To isolate ground, (standard) connect jumper wire E221 to E222. (For shorting grounds together, the jumper wire is installed E222 to E223.)
LP300 Printer	E-11	Ground shorting wire from ground stud on heat sink to top of capacitor. Remove wire to isolate grounds.
LP600 Printer	E-12	Ground shorting wire from ground stud on heat sink to top of capacitor. Remove wire to isolate grounds.
CD1400 Disk Drive	E-13	Ground strap on terminals at rear of chassis. Remove strap to isolate grounds.
LQ45 Printer	E-14 through E-21	a. Remove etch on circuit board four. b. Remove etch at motherboard ground stud. c. Remove ground wire from fan. d. Add ground wire on toroid coil PWB.
6-slot chassis		Isolated by design.
13-slot chassis		Isolated by design.
17-slot chassis		Isolated normally during production. Screw installed in center of backpanel connects logic common to chassis ground
804 card reader		Isolated from ground through 0.1 microfarad capacitor in power supply installed at factory. Do not remove. Reference specification for 804, part number 974911-9901.
979A magnetic tape		Isolated by design. Reference specification for 979A, part number 948200-9901.

Table E-2. Device Grounding Locations (Continued)

Device	Figure	Remarks
911 VDT		isolated by design. Reference specification for 911, part number 946122-9901.
DS10 disk drive		The DS10 cannot be isolated because of the dynamic brake option which requires the ground connection.

E.3.2 Locating and Disconnecting Ground Connections

NOTE

After a system logic common to earth ground connection has been altered, a note should be entered in the system log identifying the device that contains the single-point ground and the date it was established.

As shown in Tables E-1 and E-2, the logic common to chassis ground circuit cannot be isolated in some devices because of the design. In this case, there may be multiple ground connections in the system. Therefore, it is imperative that all devices in the system be supplied by a common ac power circuit, with the same ground being supplied to each device otherwise, ground loops will occur. For details on system and device power requirements, refer to the following site preparation manuals:

Manual	TI Part Number
DS990 Model 2 System Site Preparation	2250359-9701
DS990 Models 4 and 6 Through 16 Systems Site Preparation	2260361-9701
DS990 Models 20 Through 36 Systems Site Preparation	2250692-9701

WARNING

Do not operate the DS25, DS50, and DS200 disk drives as stand-alone units without the ac and dc grounds being shorted together at the power supply. Otherwise, a potential of 60 volts or more can develop between the logic common and the chassis ground (machine frame). To connect the ac and dc grounds, refer to Table E-2 and Figures E-1 and E-2.

CAUTION

Be careful when disconnecting the logic common to chassis ground on the DS25, DS50, and DS200 disk drive units. Refer to Figures E-1 and E-2. Logic common to chassis ground must be connected at all times that the disk drive is not connected to the computer in order to prevent static discharge damage to the disk drive. If this ground is disconnected, do not connect or disconnect the disk interface cables at the disk drive or at the controller. To do so can also cause static discharge damage to the disk drive.

Table E-2 and Figures E-1 through E-21 show how and where to connect or disconnect the logic common to chassis ground connection in each type of device. For establishing the location of a single-point ground, the following special cases apply:

NOTE

In the following, a chain is defined as one or more TILINE devices connected to the same controller.

1. If the system contains more than one device of the same type and that device is selected by Table E-1, use the last device in the chain for the single-point ground connection.
2. If there are multiple controllers in a system for the same type of device and the device is selected by Table E-1, use the chain with the most devices on it.
3. If the chains in a system for the same type of device have an equal number of devices, and the device is selected by Table E-1, use the chain that has its controller in the lowest-numbered chassis slot.

NOTE

If more than one DS10 disk drive is in a chain, the logic common will be connected to chassis ground in all DS10 disk drives. This is required by design.

E.3.2.1 Isolating Grounds in LQ45 Printer. To isolate logic common ground from power ground in the LQ45 printer it is necessary to isolate three ground points and add one jumper, as follows:

- On circuit board number four, cut the etch at JP1.
- On the motherboard, cut the etch run at the ground point.
- Remove the ground wire from the fan motor.
- Add a ground jumper wire on the toroid coil PWB.

These steps are described in detail in the following paragraphs.

In order to gain access to the ground points, it is necessary to partially disassemble the printer. Proceed as follows:

1. Switch off the power on/off switch at the right rear of the printer.
2. Unplug the ac power cord from the wall outlet.
3. If present, remove the bidirectional forms tractor. (For installation/removal procedures, refer to the LQ45 printer installation/operation manual).
4. Remove the top cover (Figure E-14) by grasping the front edge and lifting upward and forward.
5. Pull the feed roll release lever and the paper bail forward.
6. Depress the platen release levers at each end of the platen and lift the platen up and out of the printer.
7. To remove the intermediate cover, remove the five screws that secure the intermediate cover to the bottom cover. Also, remove the two screws at the lower rear corners of the printer. Lift up the top of the intermediate cover, swing it to the left and set it in an inverted position next to the printer. Note that the intermediate cover and the lower part of the housing will still be connected by two wires.
8. Remove the plastic board holder from its position on top of the circuit boards by loosening the retaining screw.
9. Remove circuit board number four shown in Figure E-15 (TI part number 2213524-0047, Qume part number 90742-01; the board that is nearest to the front of the printer) by releasing the upper left corner of the board from the copper clip that secures it, and pulling the board upward.
10. Disconnect the connector plug on the upper left side of circuit board number four and remove the board from the printer.

11. Refer to Figure E-16 and cut the etch and/or jumper wire at JP1, located at the top left side of circuit board number four.

NOTE

> In all cases when removing ground connections in the LQ45 printer, if there is an etch run in the circuit board in addition to the ground jumper wire, be sure to cut the etch as well as the jumper.

12. Check resistance between points A and B shown in Figure E-16. There should be an open circuit.
13. Remove the remaining three circuit boards from the printer (Figure E-15).
14. Locate the ground point in the motherboard (TI part number 2213524-0043, Qume part number 90712-02) shown in Figure E-17. Cut the etch and/or jumper wire.
15. Check resistance between point C in Figure E-17 and any exposed point on the printer frame. There should be an open circuit.
16. Disconnect the fan connector J4 (Figure E-18) at the motherboard.
17. Refer to View A of Figure E-18. Push down on the tab with a scribe and pull the wire out of pin 3 while holding the tab down. Cut off this wire as close to the insulating sleeve as possible and discard.
18. Reinstall connector J4 in its socket.

NOTE

> This concludes the procedures for isolating logic common ground from power ground in the printer. However, it is necessary to add a ground jumper wire on the toroid coil PWB to provide continuity in the grounding circuits.

19. Gain access to the toroid coil PWB by performing the following steps:
    a. Remove the four screws that secure the heatsink assembly to the printer frame (Figure E-18) and move it out of the way to the left.
    b. Remove the paper feed rollers (Figure E-19).
    c. Lift out the paper pan and place it over the back of the printer. Do not disconnect the two springs from the paper pan.
    d. Remove the three screws that secure the metal plate below the paper feed rollers (Figure E-20) to the frame.

CAUTION

Be sure the nut and washer for each screw do not fall down into the printer when the screws are removed. Loose hardware remaining inside the printer can cause catastrophic failures. Any loose metal object inside the printer can become attached to the carriage motor magnets.

e. Remove the two screws that secure the toroid coil PWB to the printer frame. Be sure the nut and star washer for each screw do not fall into the printer.

f. Detach the two connectors from the toroid coil PWB and remove the PWB from the printer.

20. Solder a 1/2-inch jumper wire to the back of the toroid coil PWB as shown in figure E-21.

21. Reconnect the two connector plugs to their respective headers on the toroid coil PWB. Be sure to observe polarity of the plugs. The red connector should have its brown wire toward the top of the PWB. The black connector should have the white print facing away from the PWB.

22. Secure the toroid coil PWB to the printer frame with the two screws, nuts, and washers. The sequence should be: screwhead, lock washer, printer frame, nut.

23. Reassemble the printer in the reverse of the removal steps as follows:

    a. Return the paper pan to its proper position, making sure the slots in the pan seat into the pins on the frame.

    b. Reinstall the paper feed rollers.

    c. Replace the heatsink assembly.

    d. Reinstall the connector plug into its header on the upper left of circuit board number four. Be sure to observe polarity of the plug. The white lettering on the connector should face away from the board.

    e. Reinstall the four circuit boards in the printer. The connector sockets are arranged so that the boards cannot be installed incorrectly. Be sure all boards are firmly seated in their sockets.

    f. Clip the copper bracket onto the corner of circuit board four.

    g. Reinstall the circuit board holder in its proper position and tighten the screw, making sure the boards are inserted into the correct slots on the holder.

24. Check resistance between pin 1 (power ground) of the RS232C cable and any exposed point on the frame. There should be a short circuit.

25. Reattach the intermediate cover to the bottom cover, making sure the wires to the RS232C cable are not caught between the parts. Reinstall seven screws and tighten.

26. Reconnect the ground wire clip to the front panel. (The wire grounds the front panel to the printer frame.)

27. Check resistance between pin 7 (logic common ground) and pin 1 (power ground) of the RS232C cable. There should be an open circuit.

28. Reconnect the printer and apply power.

29. Perform an operational checkout or diagnostic of the printer subsystem.

E.3.2.2 Illustrations for Locating Device Ground Points. The illustrations referenced in Table E-2 appear on the following pages:

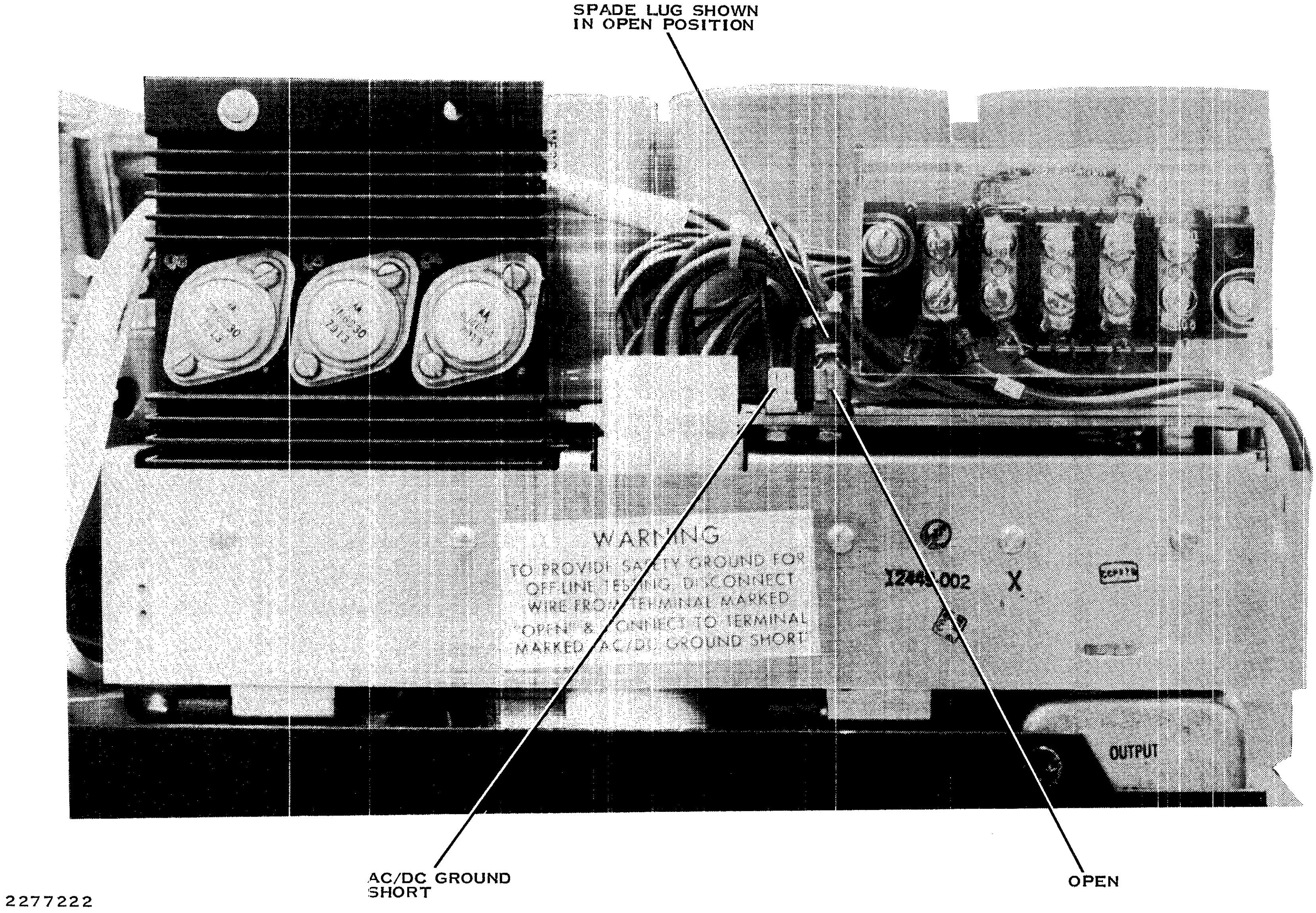

Figure E-1. DS25/50 Disk Drive Ground Shorting Spade Lug

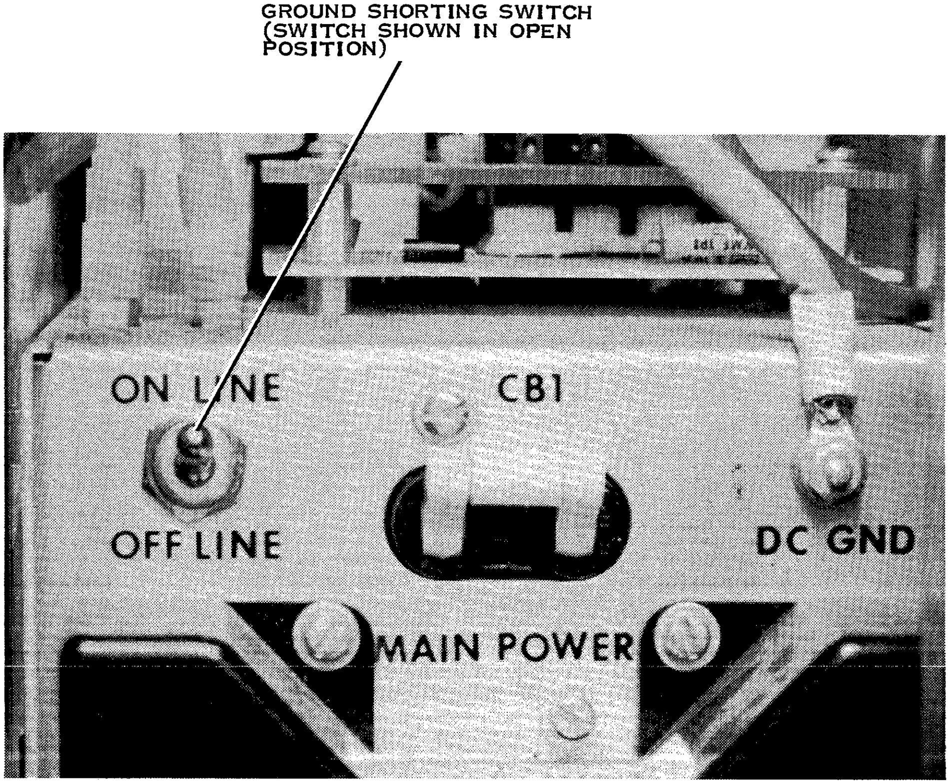

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Figure E-2. DS200 Disk Drive Ground Shorting Switch (ON LINE — OFF LINE)

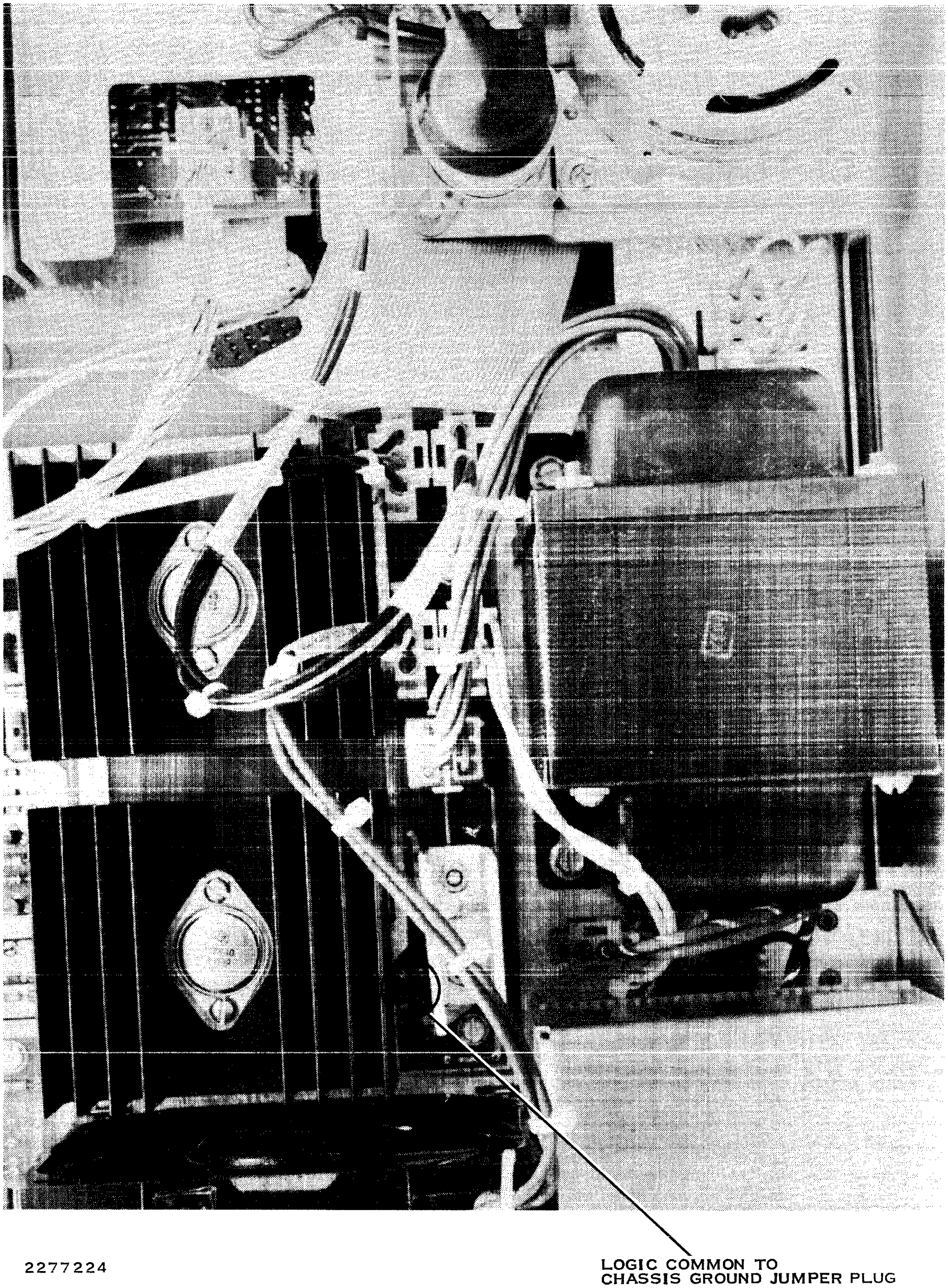

Figure E-3. FD800/FD1000 (New Chassis) Ground Shorting Jumper Plug

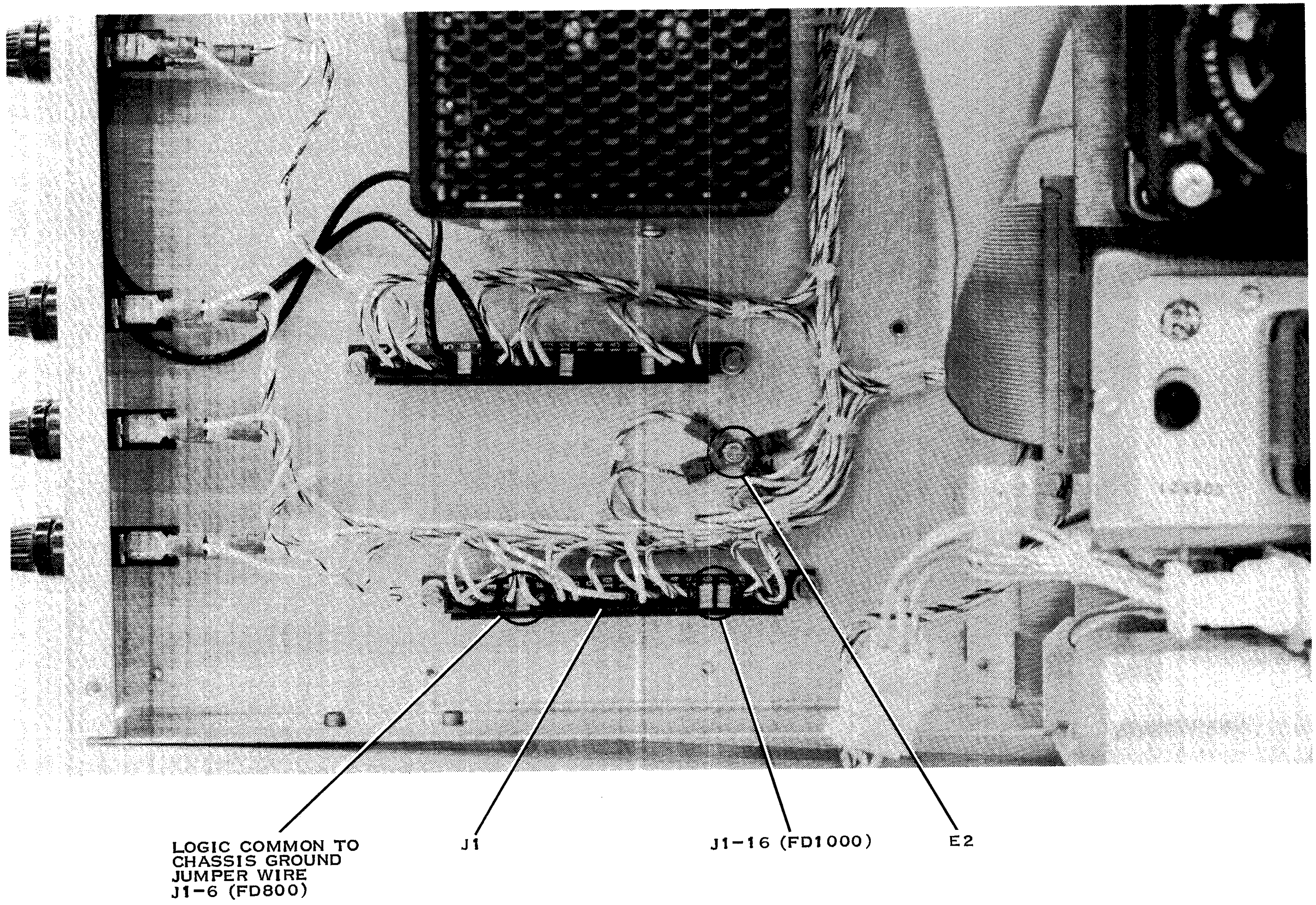

Figure E-4. FD800/FD1000 (Old Chassis) Ground Shorting Jumper Wire

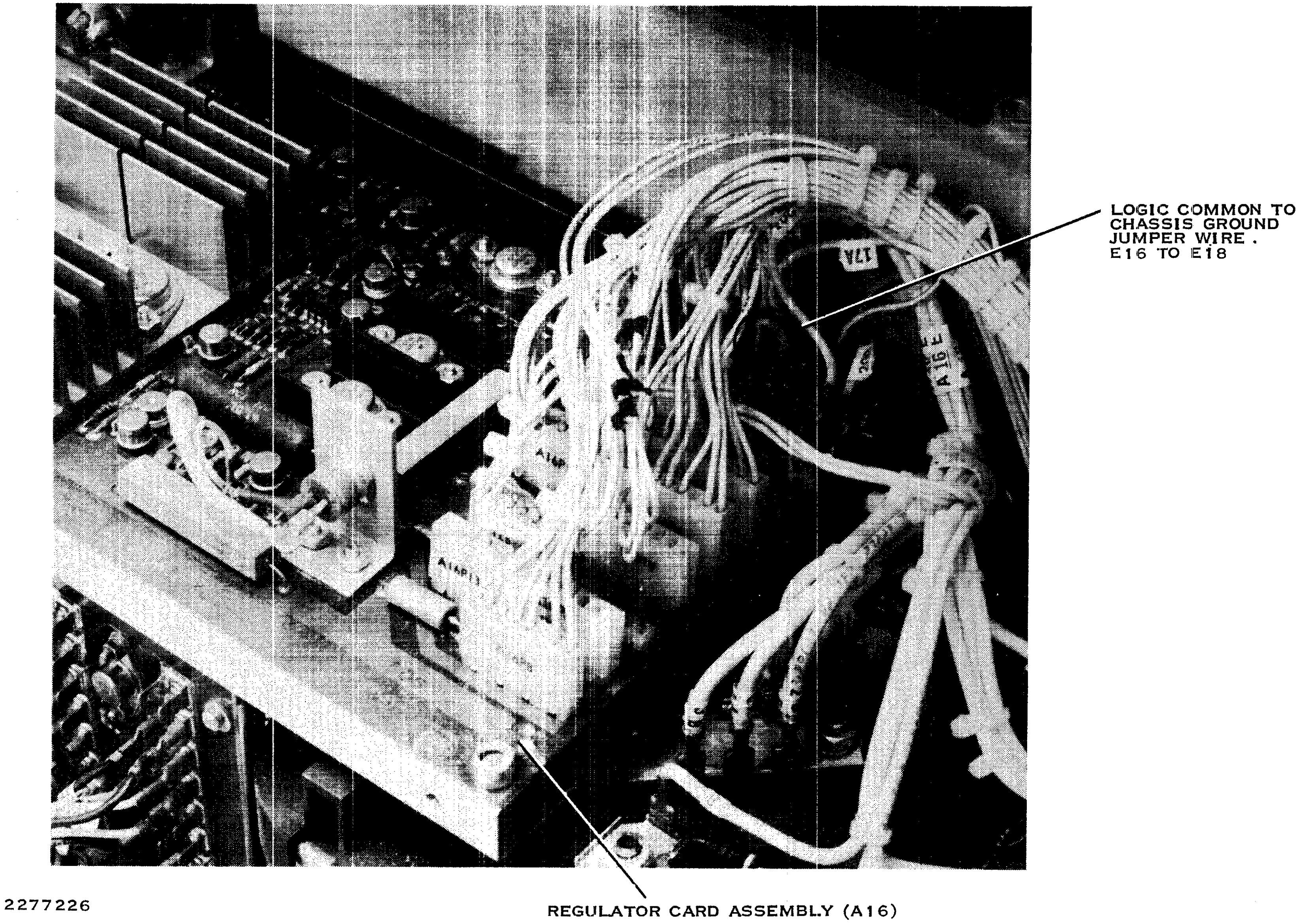

Figure E-5. 2230 Line Printer Ground Shorting Jumper Wire

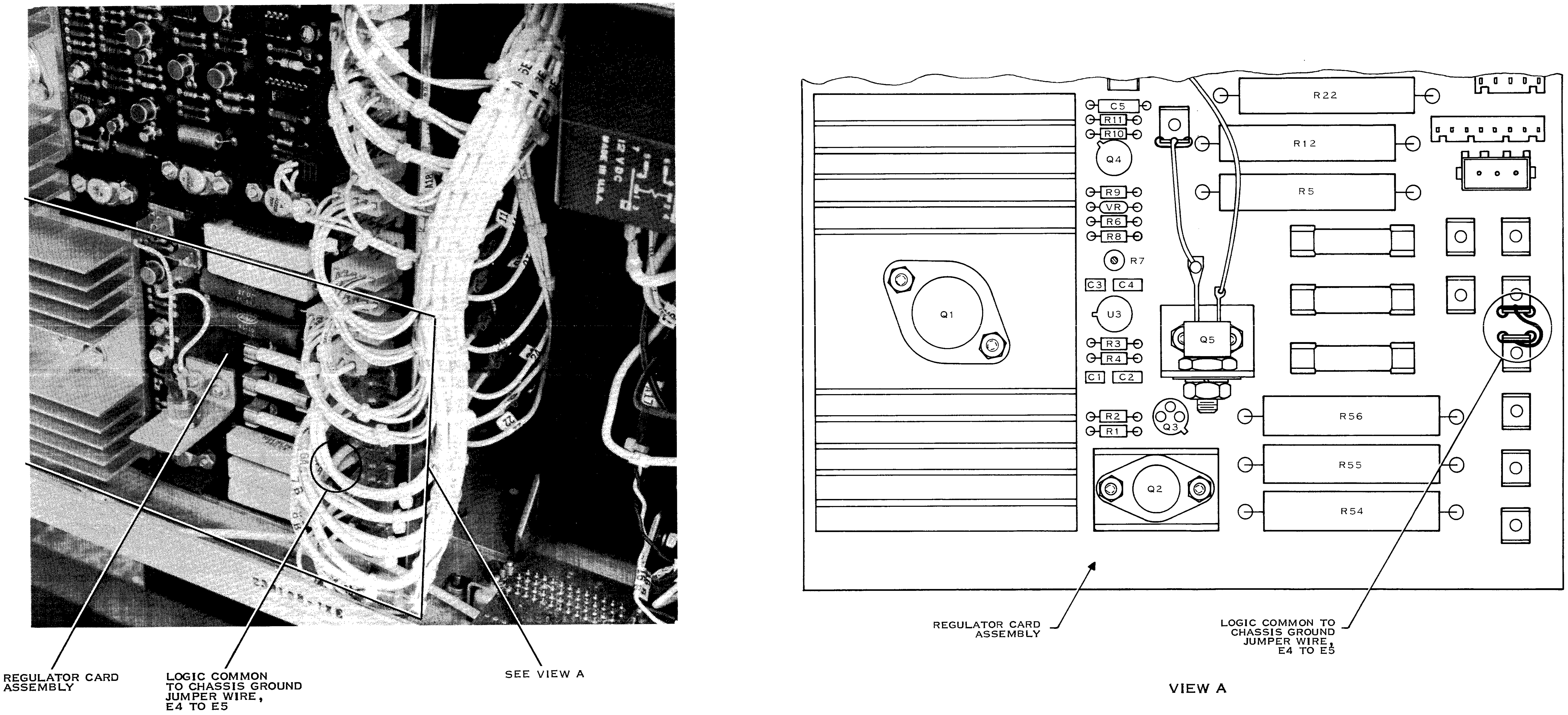

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Figure E-6. 2260 Line Printer Ground Shorting Jumper Wire

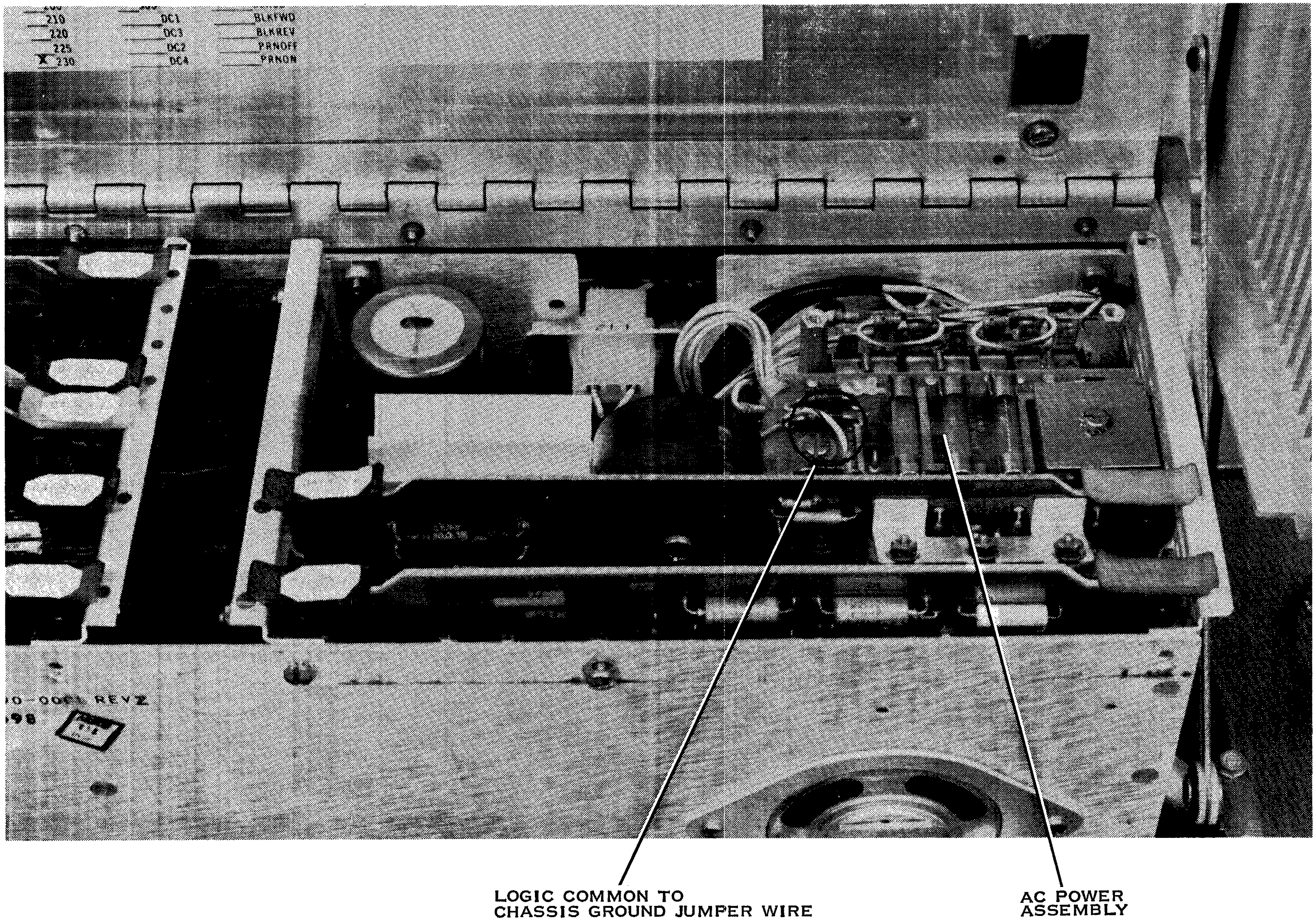

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Figure E-7. 733 ASR Ground Shorting Jumper Wire

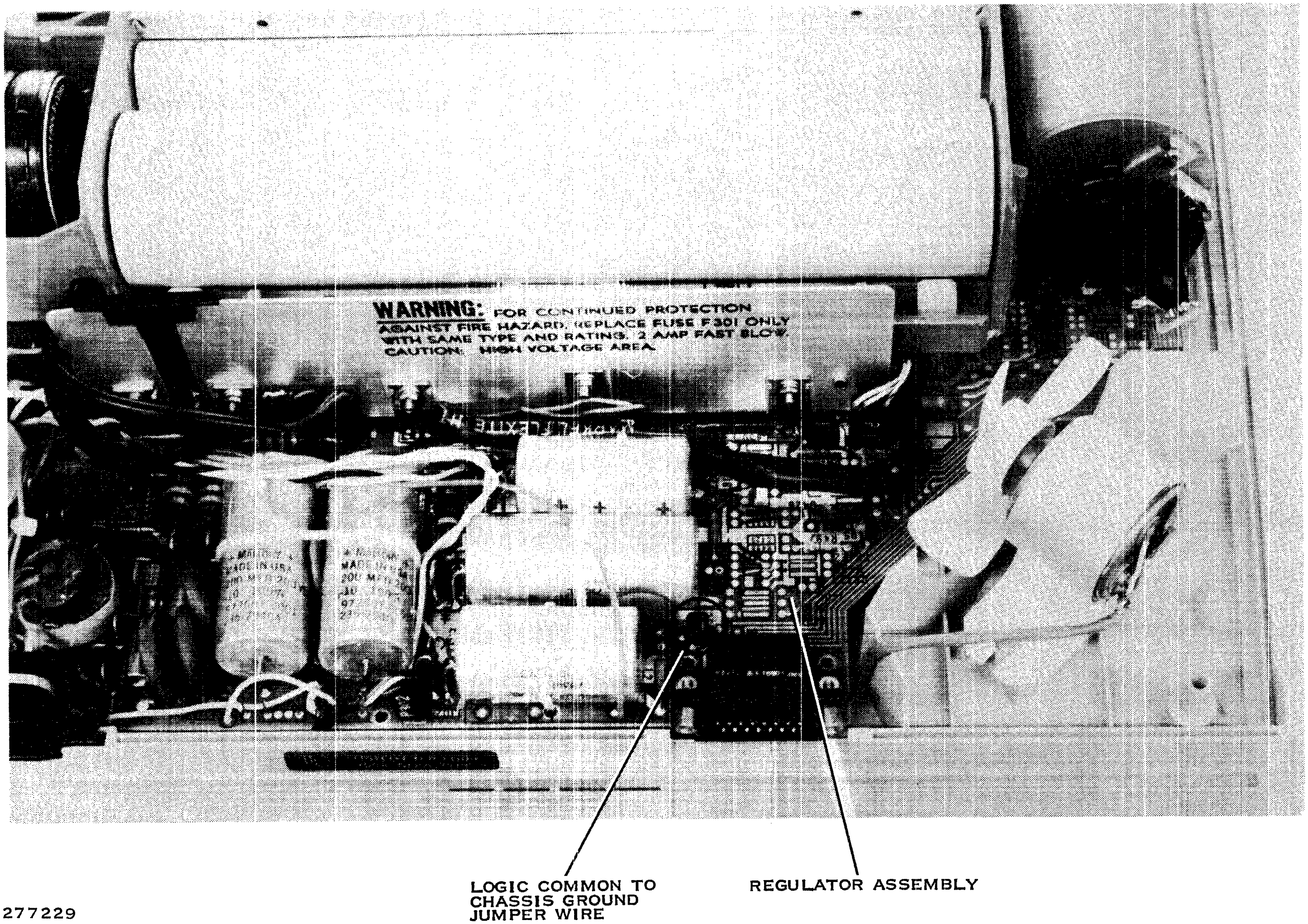
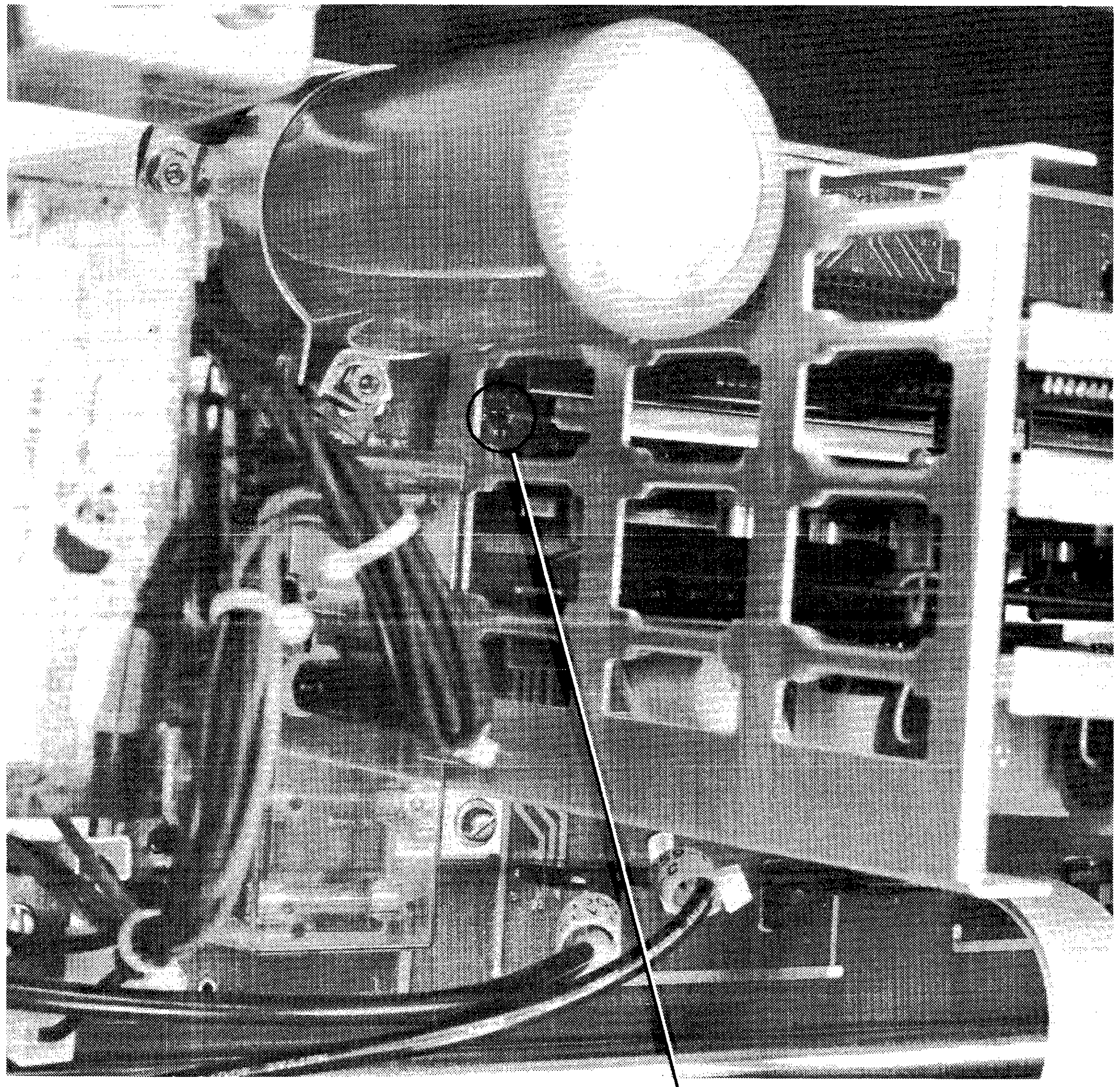
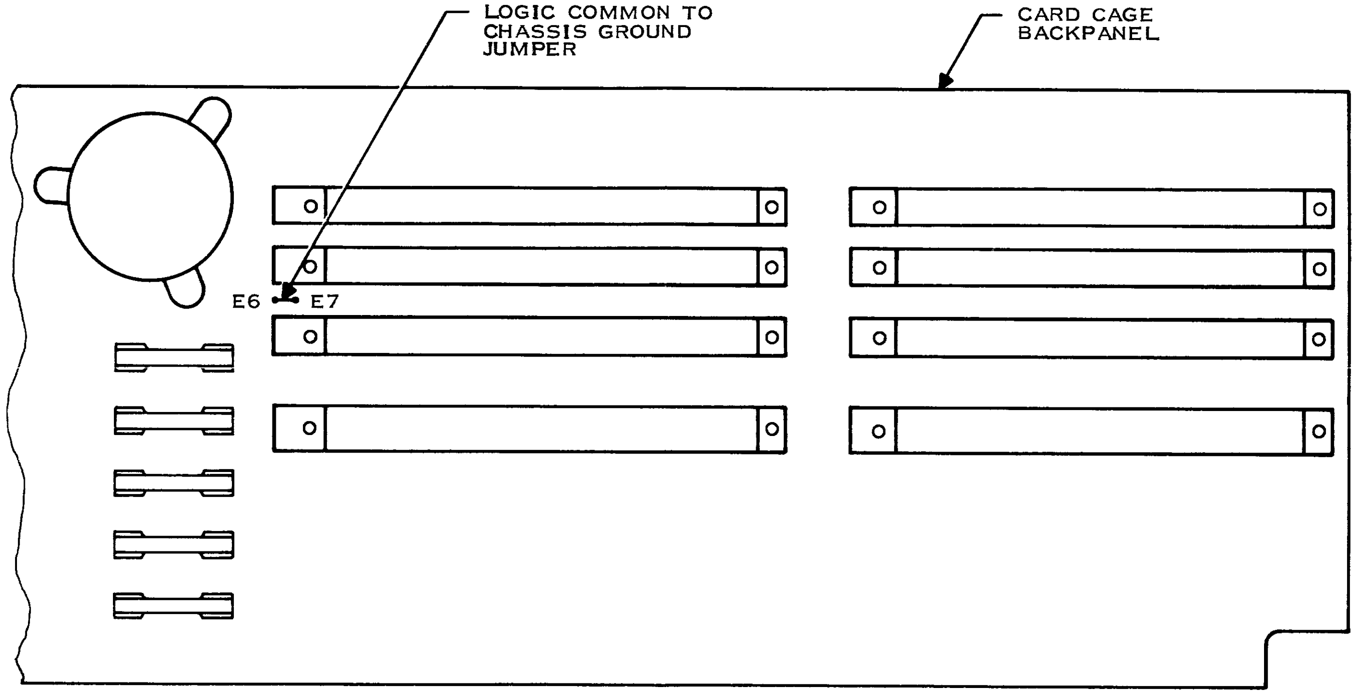


Figure E-8. 743 KSR Ground Shorting Jumper Plug





VIEW A

Figure E-9. 810 Printer Ground Shorting Jumper

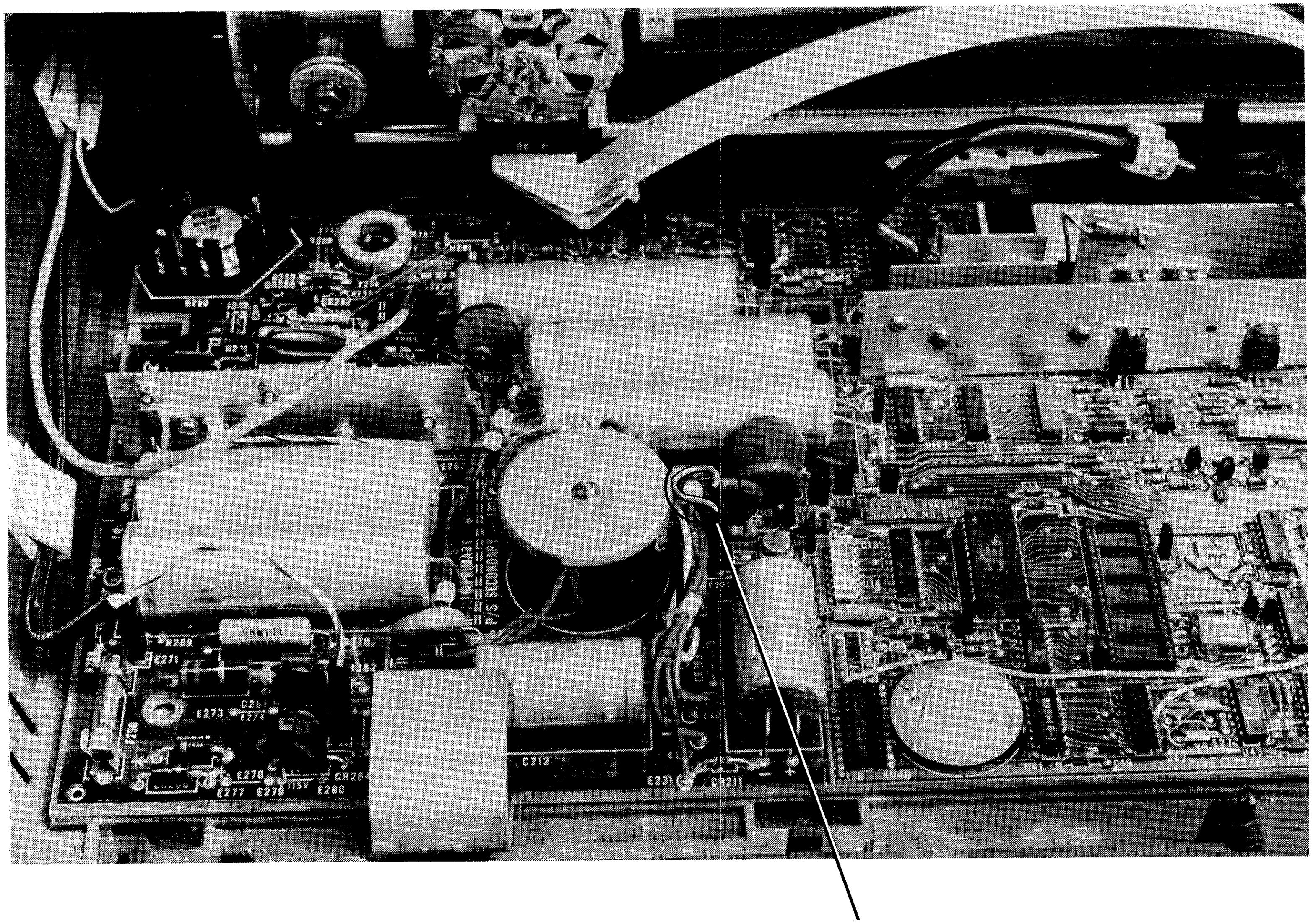


Figure E-10. 820 KSR Ground Shorting Jumper Wire

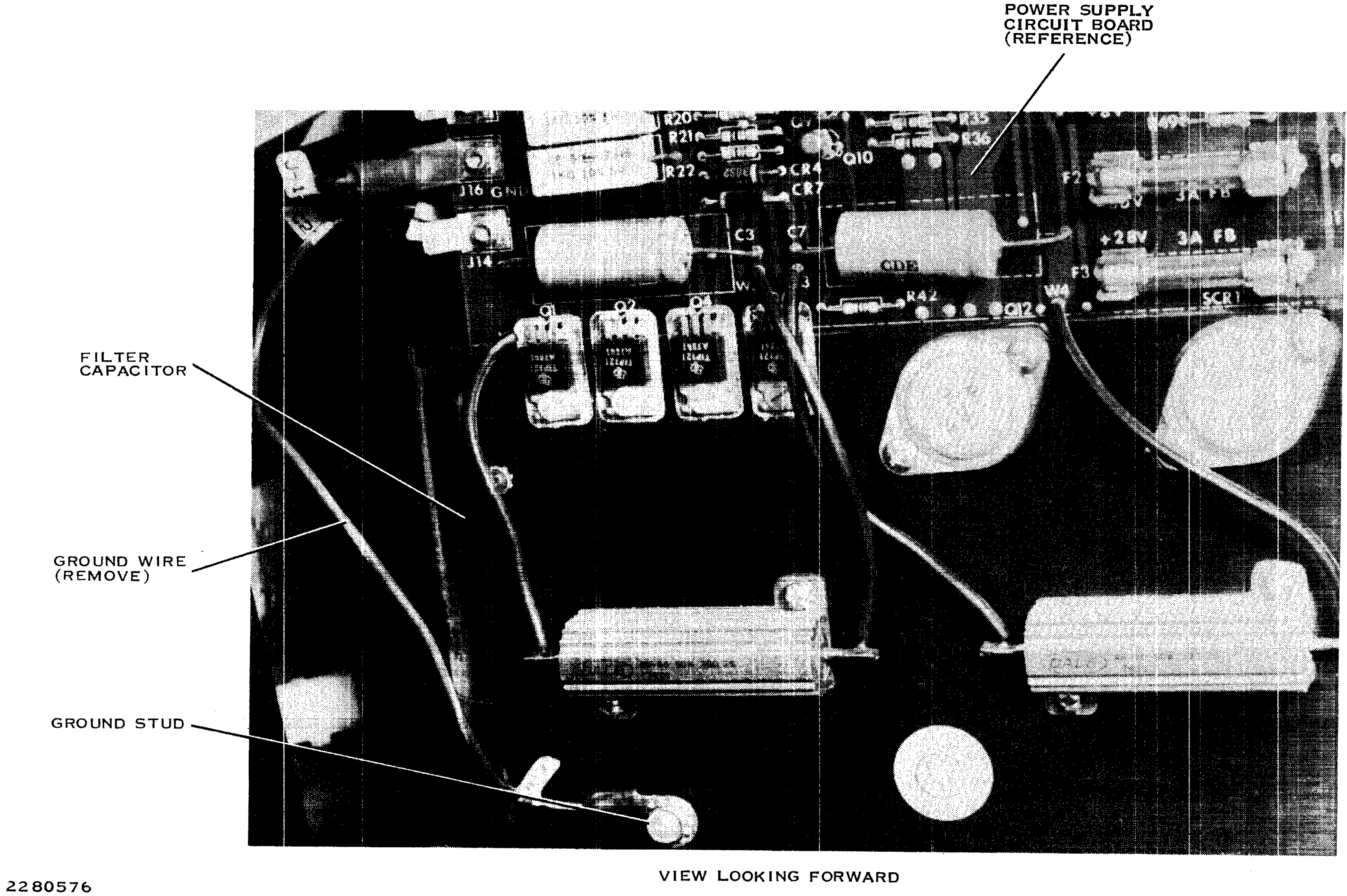
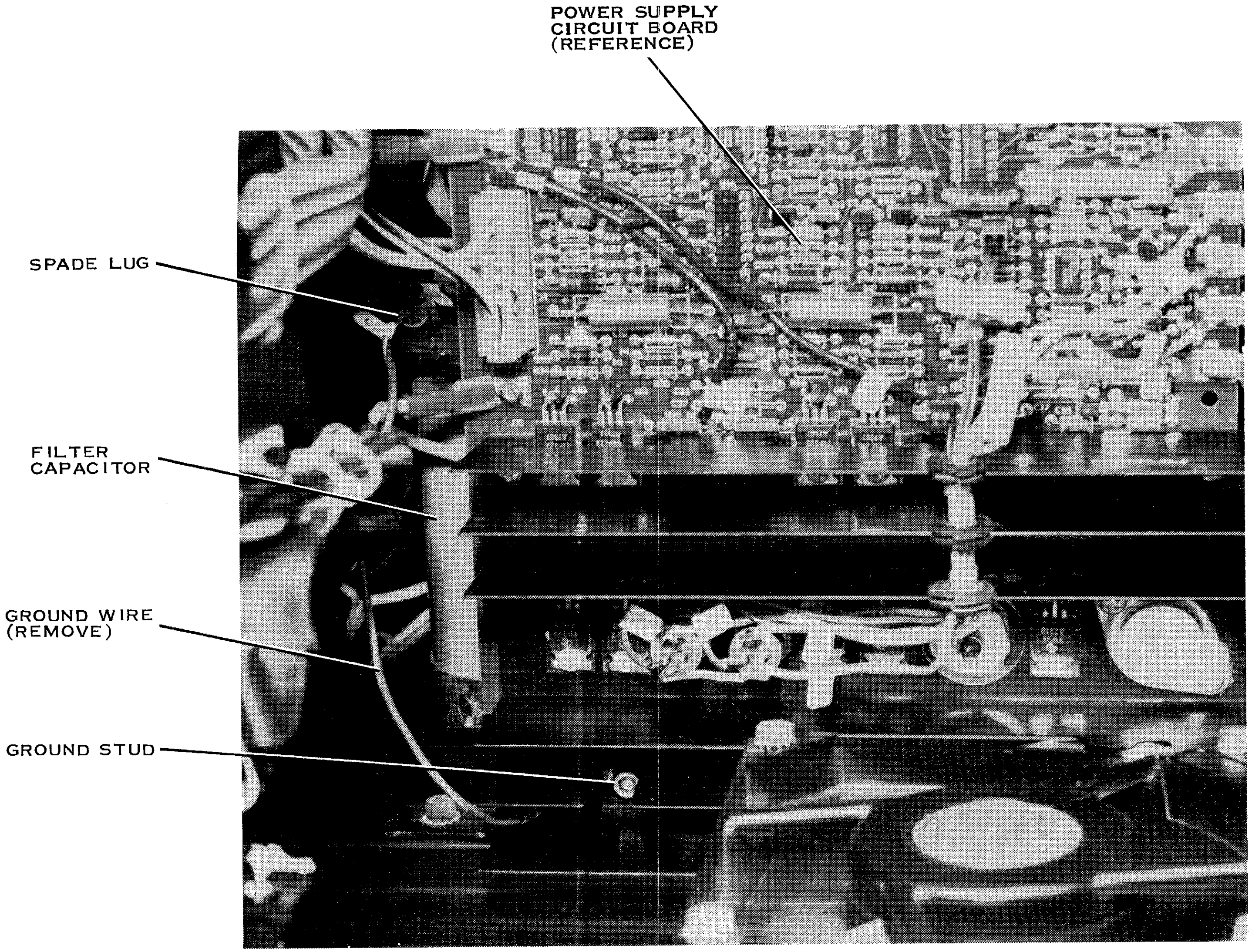


Figure E-11. Location of Ground Wire in LP300 Printer



VIEW LOOKING FORWARD WITH CARD CAGE SWUNG OPEN

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Figure E-12. Location of Ground Wire in LP600 Printer

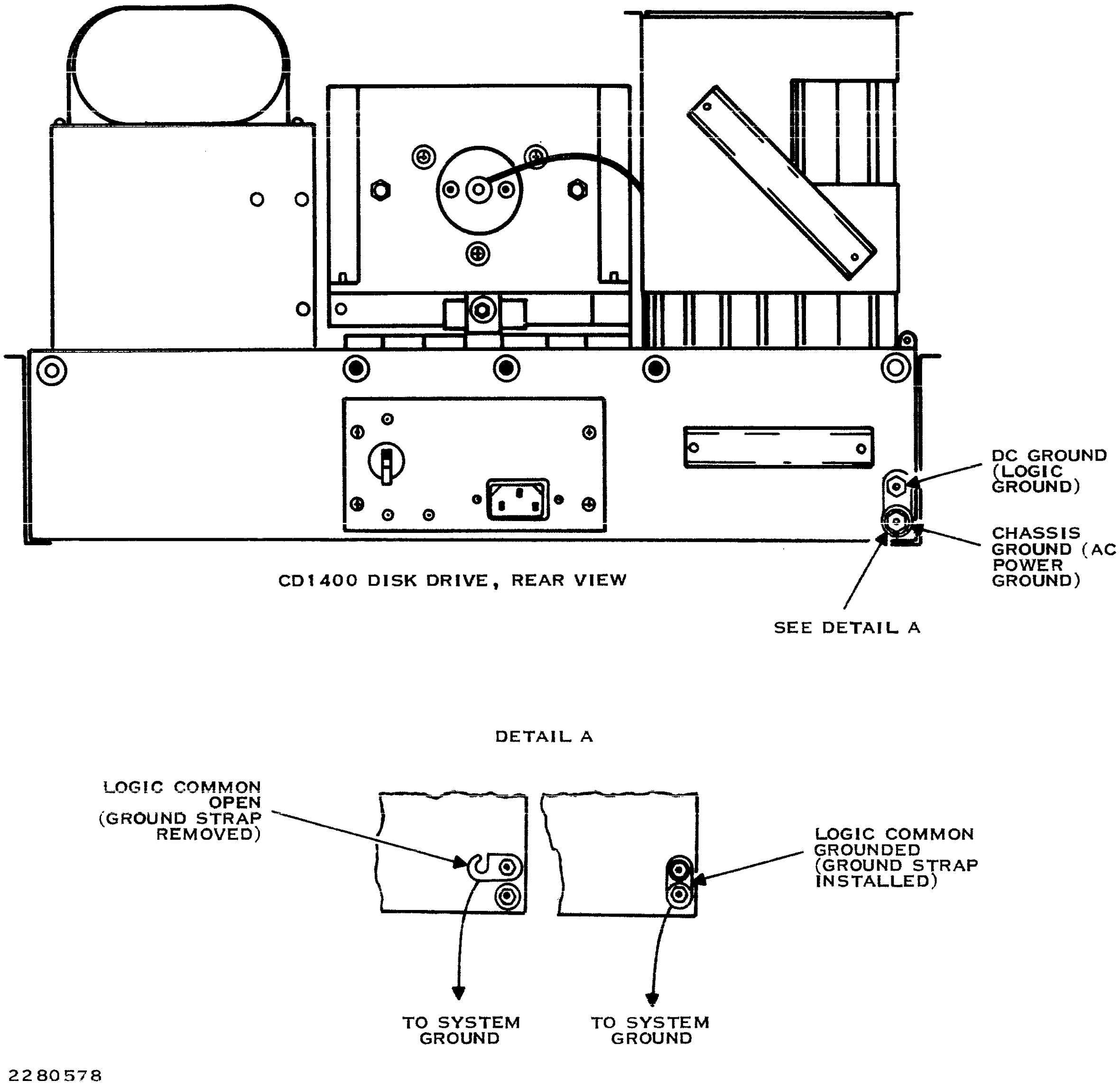

Figure E-13. CD1400 Disk Ground Strap

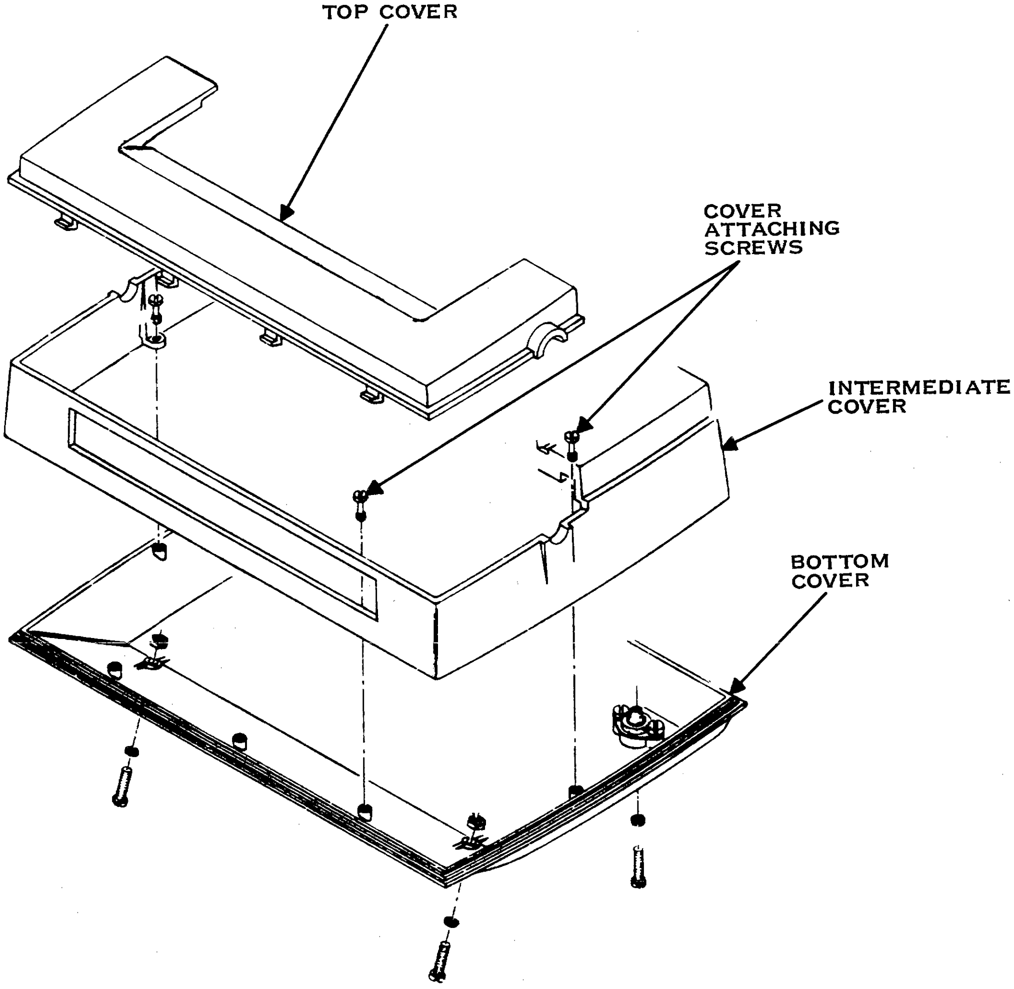

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Figure E-14. LQ45 Printer Covers

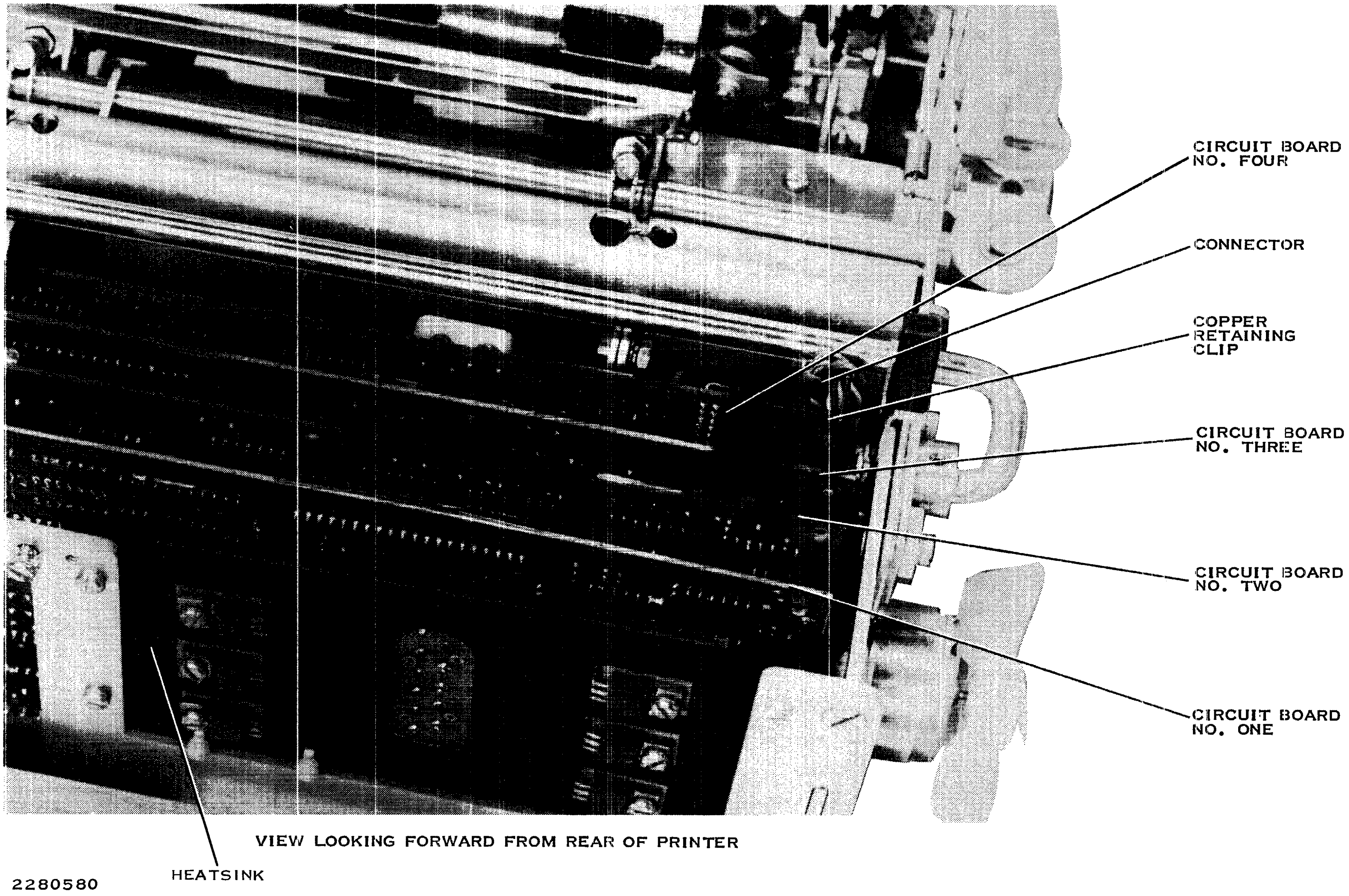

Figure E-15. Location of Circuit Boards in LQ45 Printer

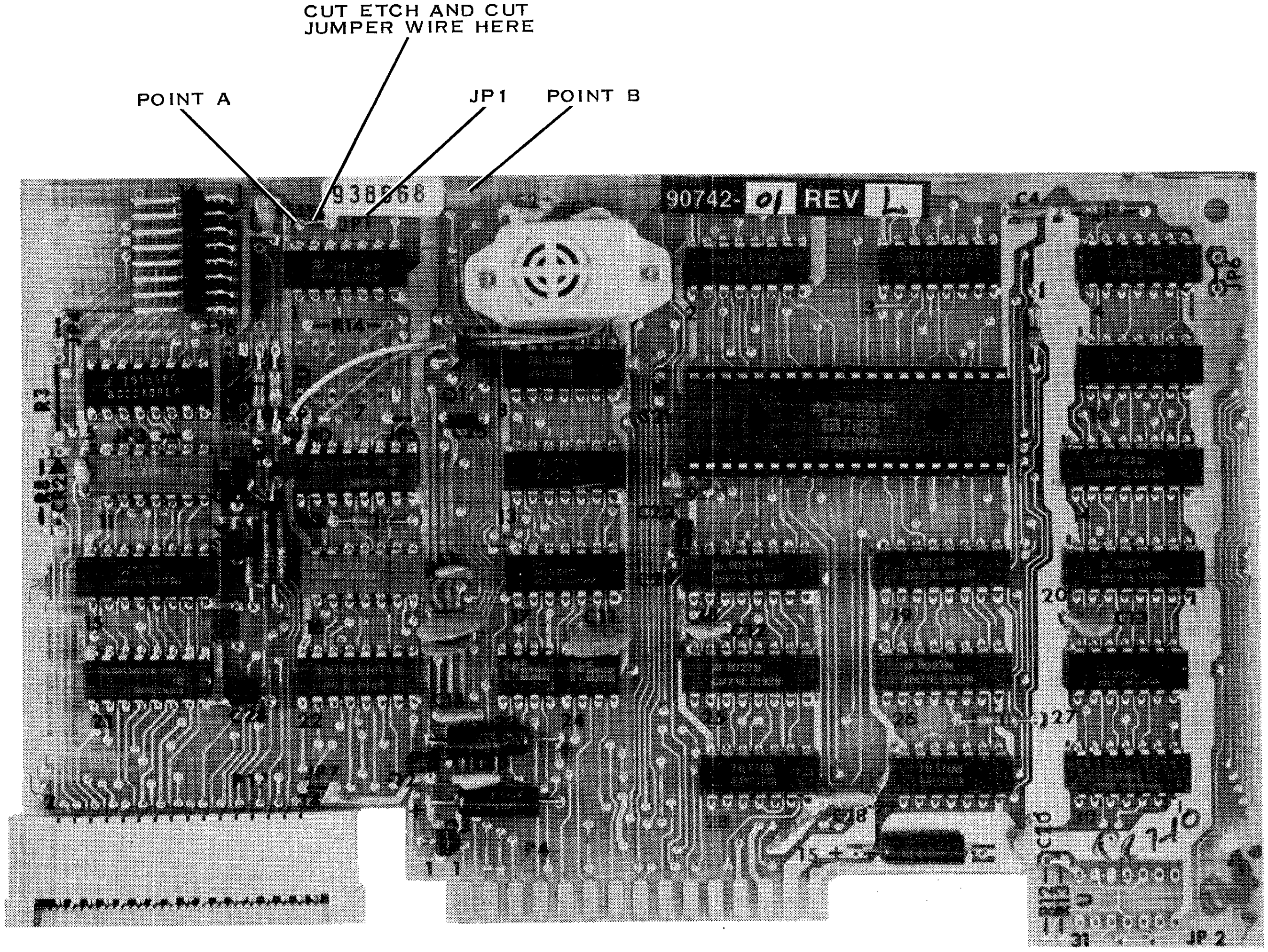

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Figure E-16. Circuit Board Number Four, LQ45 Printer

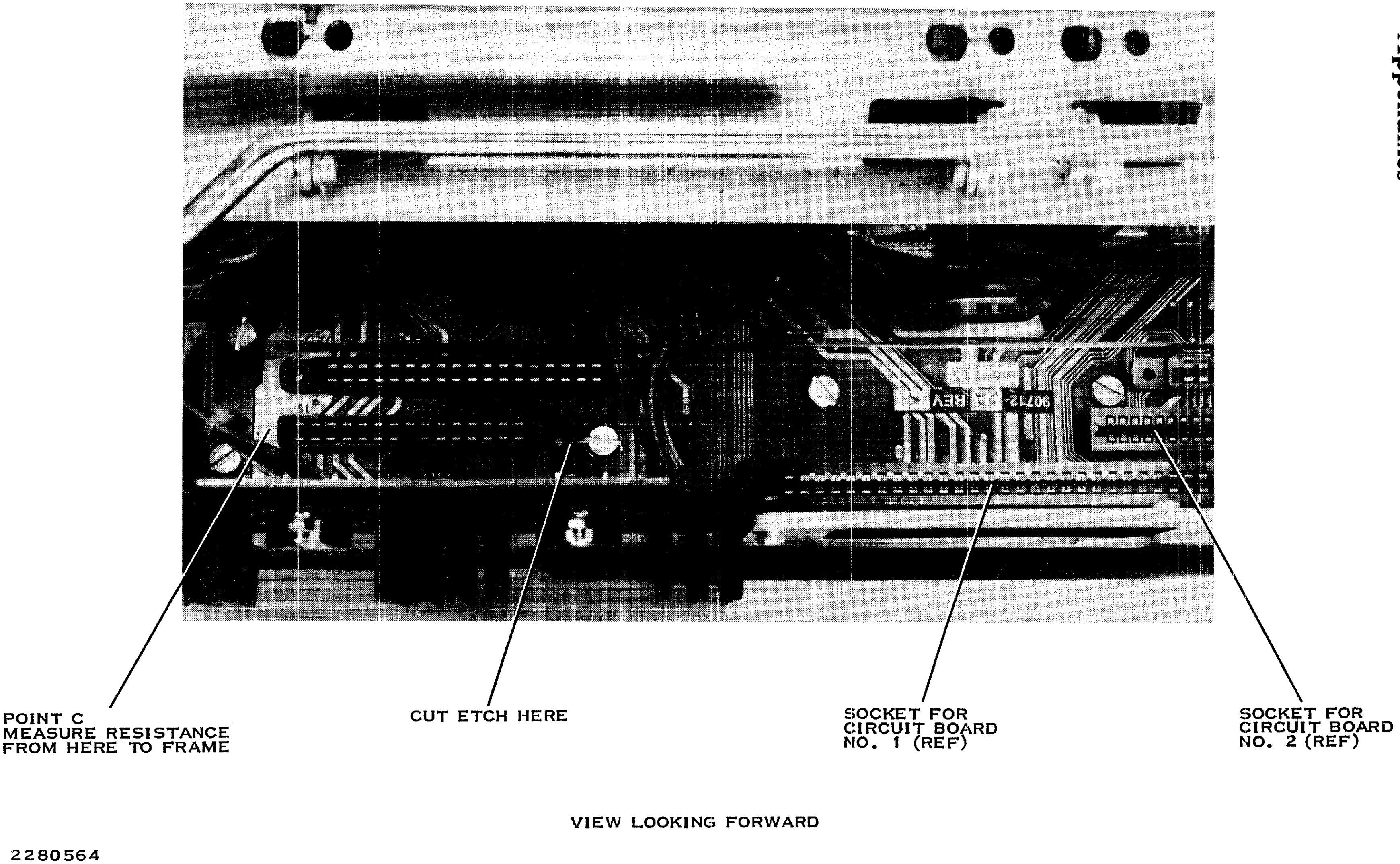


Figure E-17. Motherboard Grounding Point, LQ45 Printer

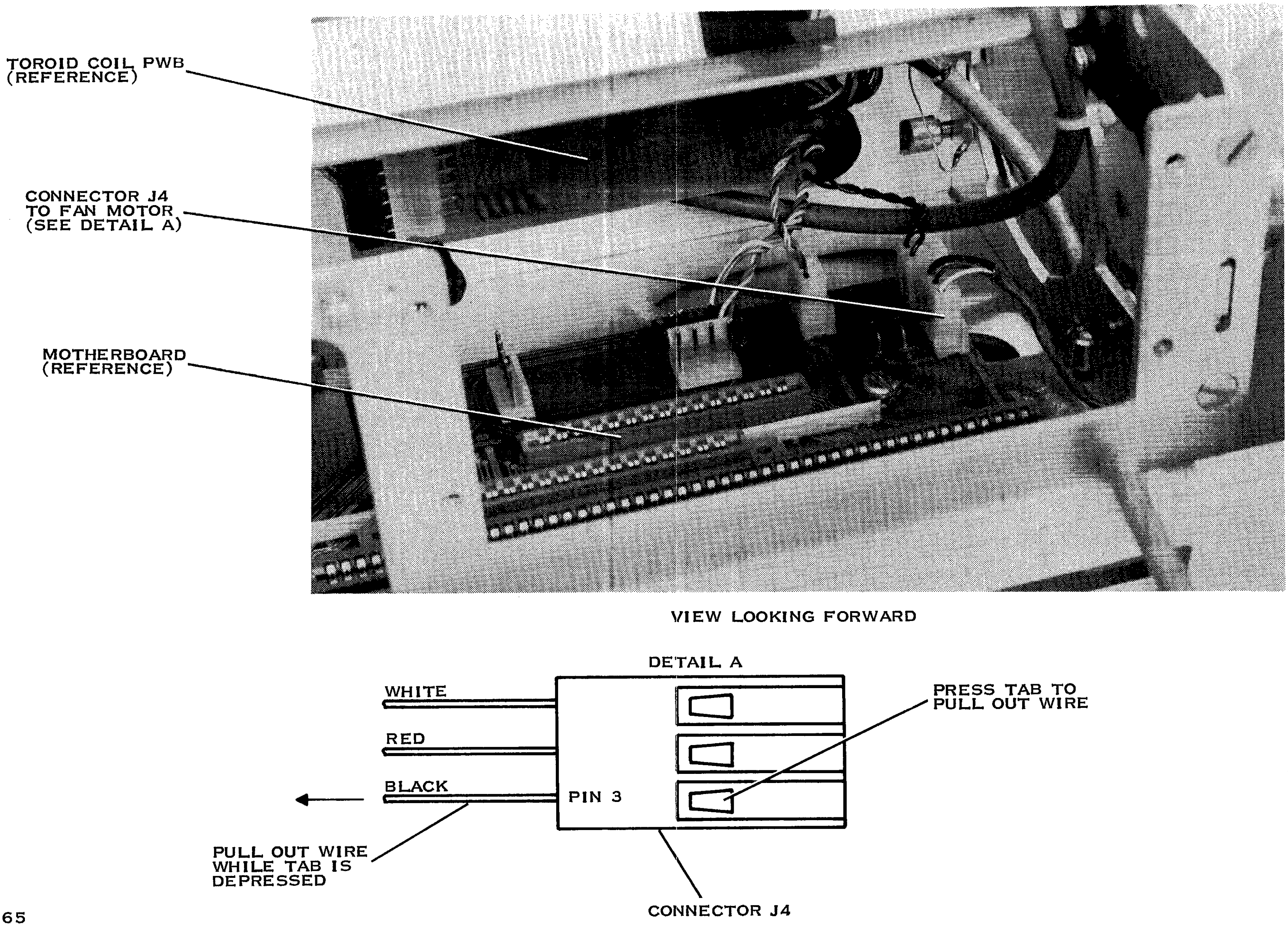


Figure E-18. Removing Ground Wire from J4 to Fan, LQ45 Printer

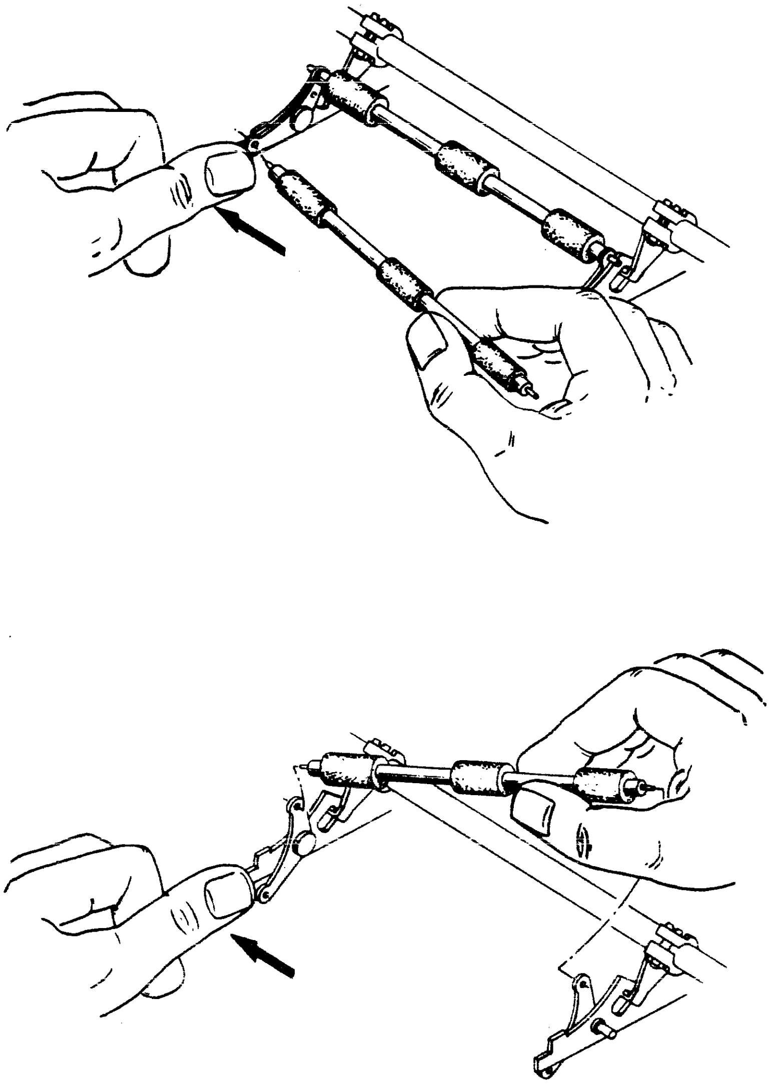


Figure E-19. Removal of Paper Feed Rollers, LQ45 Printer

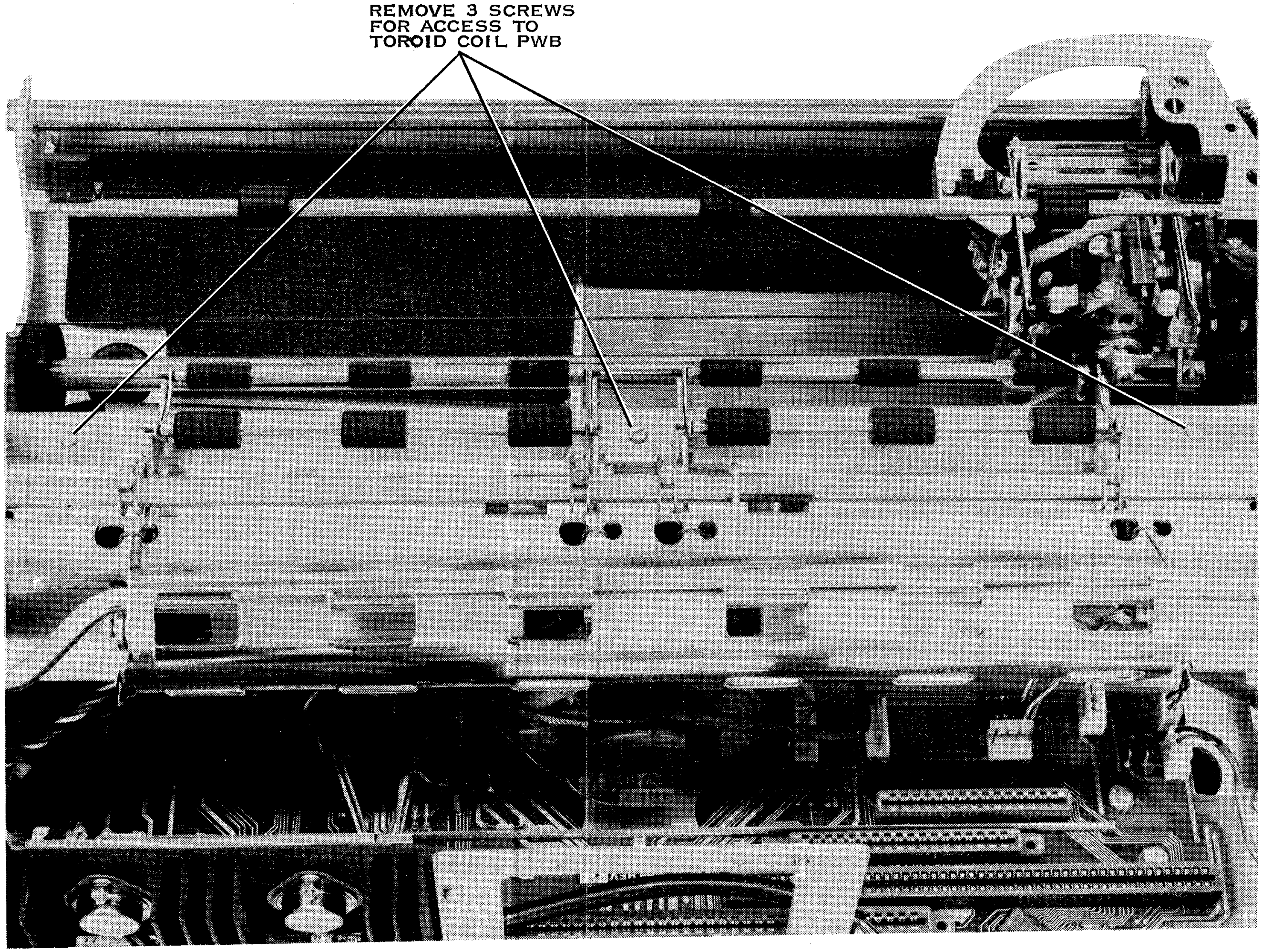


Figure E-20. Location of Screws for Plate below Feed Rollers, LQ45 Printer

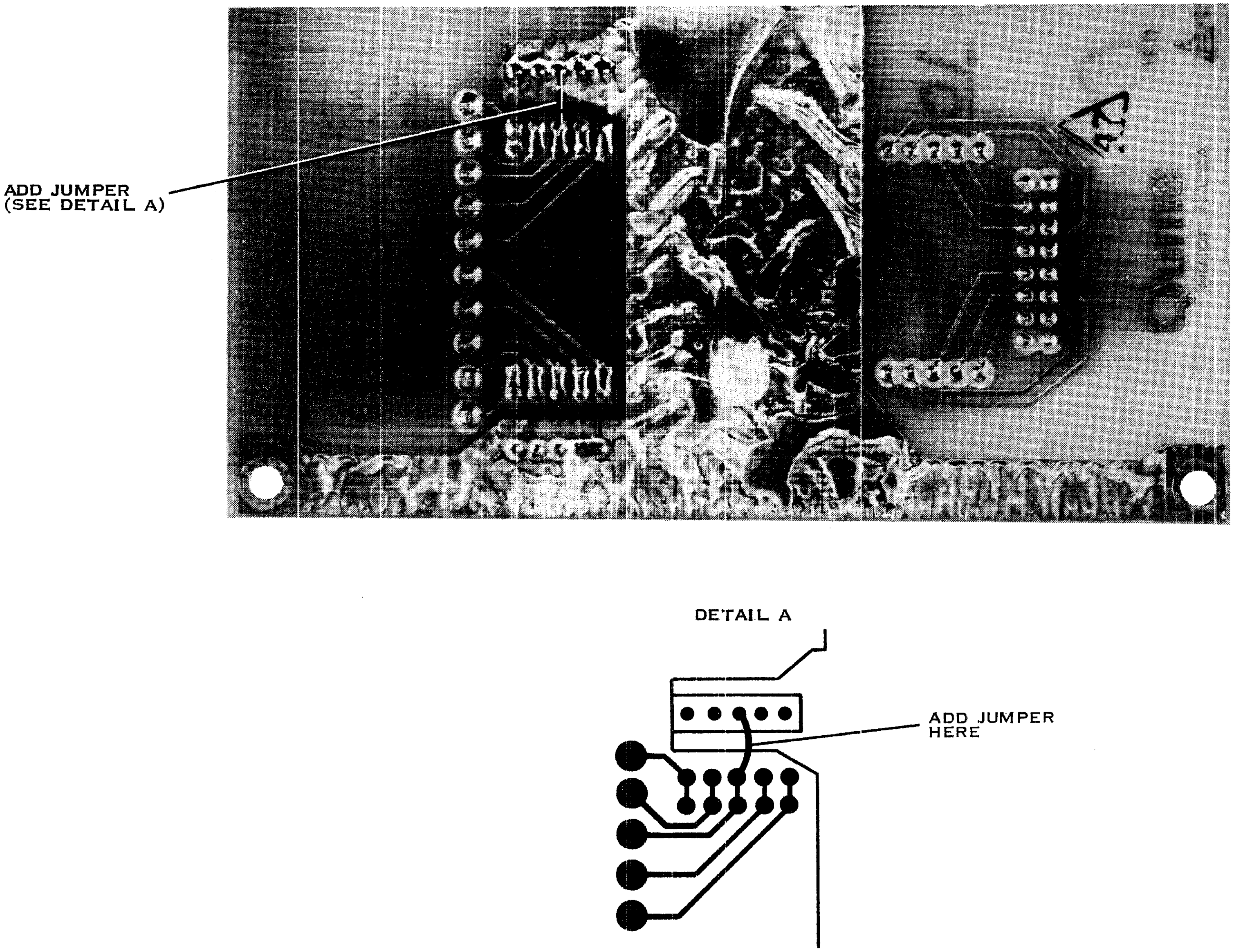


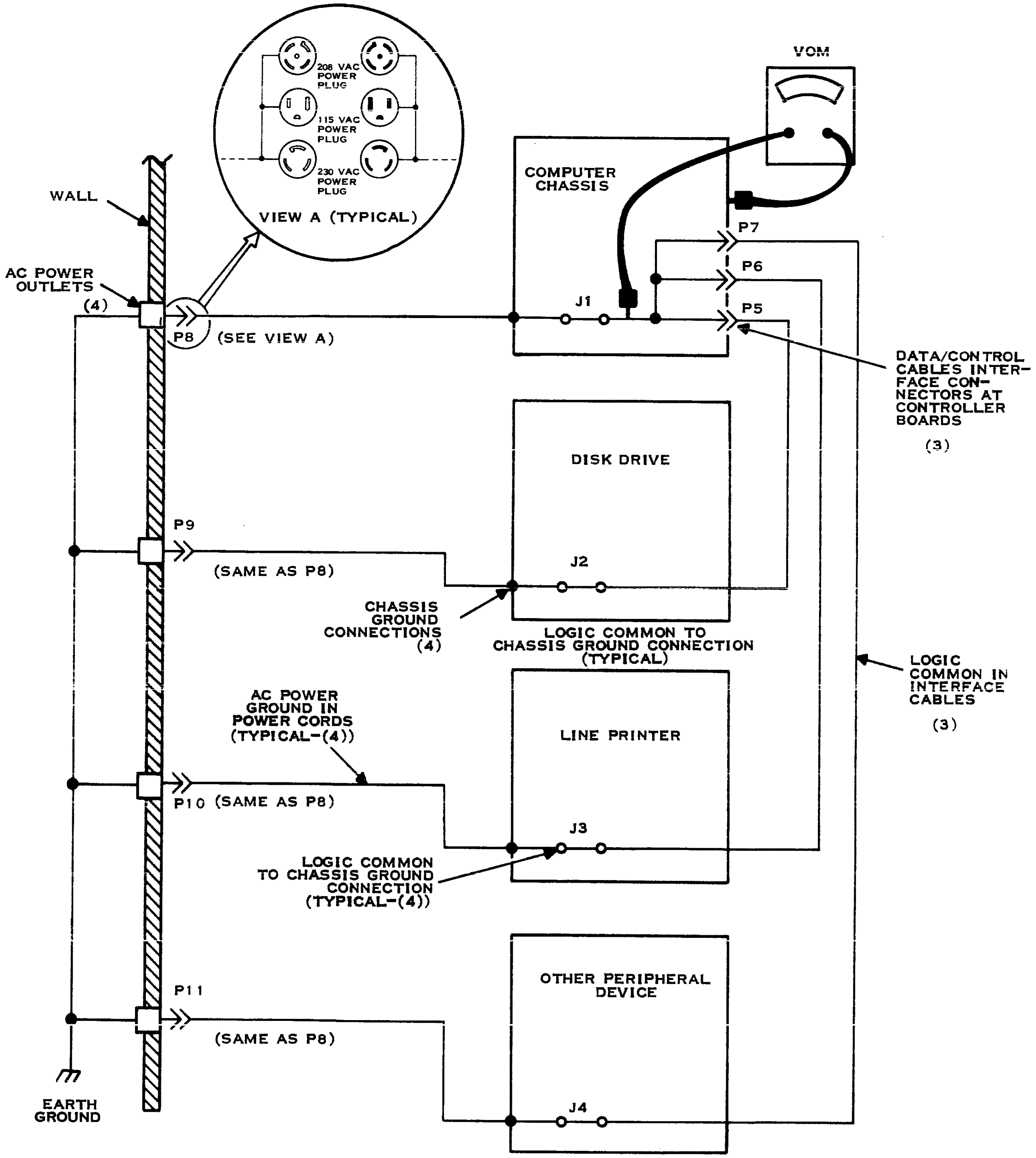
Figure E-21. Installation of Jumper Wire on Toroid Coil PWB, LQ45 Printer

E.3.3 Verification of System Single-Point Ground

Verification of the single-point ground in a computer system requires that the single-point ground connection be located, identified, and temporarily opened. All other devices in the system are then checked to ensure that their logic common to chassis ground connections are also open. If not, these grounds must be located and opened. The single-point system ground is then reconnected.

E.3.3.1 Typical Computer System Grounding Scheme. Figure E-22 shows a simplified diagram for the grounding in a typical computer system. The figure is used in conjunction with the following text to illustrate a method of locating the device that contains the logic common to chassis ground connection in a system. Important features of the diagram are as follows:

1. Each device has a connection to its chassis from earth ground through its ac power cable. The power plug chassis ground to earth ground connections are shown symbolically in Figure E-22 as follows:
   a. P8 for the computer chassis
   b. P9 for the disk drive unit
   c. P10 for the line printer
   d. P11 for another peripheral device
2. The system logic common is distributed through the computer chassis to all other devices by the data/control interface cables. P5, P6, and P7 show the logic common connections that are made when the interface cables are connected to the device controllers and the controllers are inserted in their computer chassis slots. Data/control interface cable connections at the computer are shown symbolically in Figure E-22 as follows:
   a. P5 for the disk drive
   b. P6 for the line printer
   c. P7 for some other peripheral device
3. The logic common to chassis ground connections for the different devices (identified in Table E-2 and the associated illustrations) are shown symbolically as follows:
   a. J1 for the computer chassis
   b. J2 for the disk drive unit
   c. J3 for the line printer
   d. J4 for another peripheral device



NOTES:

1. P8–P11 CHASSIS GROUND TO EARTH GROUND CONNECTION THROUGH AC POWER PLUG.
2. J1–J4. LOGIC COMMON TO CHASSIS GROUND CONNECTION IN DEVICES.
3. P5–P7. DATA/CONTROL INTERFACE CABLE CONNECTORS AT CONTROLLER BOARDS.

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Figure E-22. Typical Logic Common to Chassis Ground Connection Scheme

E.3.3.2 Procedure for Locating Grounded Devices.

NOTE

In performing the steps in this paragraph, keep a current list of all connections opened, wires changed or removed, connectors unplugged, boards unseated, etc., so the system can be returned to the desired (or original) configuration upon completion of the procedures.

The steps necessary to determine what devices have their logic common circuitry grounded (Figure E-22) are as follows:

CAUTION

Before making any resistance readings, always set the VOM to an appropriate ac voltage scale and take a voltage reading to avoid damaging the meter on the resistance scale. For example, the ac power outlet could be miswired and the full ac line voltage would be placed between logic ground and power ground.

1. Power down the system.
2. Set the on/off switches on all equipment to off.
3. Verify that the power cords for all system equipment are connected to the ac power outlets. This effectively closes P8, P9, P10, and P11.
4. Unplug the data/control interface cables from the controllers for all peripheral devices (including the expansion chassis, if any) at the computer chassis. Alternatively, the controller boards may be unseated. This effectively opens the logic common connections shown at P5, P6, and P7.
5. Measure the resistance between the computer chassis and logic common. Logic common is accessible at the following points in the computer chassis:
    a. 990/4 AU — Negative side of C4 (a large tantalum capacitor in the center of the board).
    b. 990/5 AU — Negative side of CZ12 (a large tantalum capacitor on the left-hand side of the board at the outside edge).
    c. 990/10 SMI board — Negative side of C213 (a large tantalum capacitor in the center of the board at the outside edge).
    d. 990/12 AU — Jumper E1 on the left-hand side of the board near the outside edge. The terminal nearest the computer backpanel is logic ground.

6. If the measurement in step 5 indicates an open circuit, there is no ground connection in the computer chassis (J1 is open). However, if the measurement indicates a short circuit, logic common is connected to chassis ground in the computer chassis. Locate and remove this connection (open J1).

7. While leaving the meter connected as in step 5, plug in the device data/control interface cables (or reseat the controllers) one at a time. If a device indicates that logic common and chassis ground are connected, leave that device unplugged until all other devices are checked.

NOTE

> The 911 VDTs have a one-megohm resistor between logic common and chassis ground. Therefore, the resistors for all VDTs are in parallel when all interface cables are plugged in. A reading of 100K ohms for 10 VDT terminals would be normal.

8. When all of the devices have been checked, refer to Table E-2 and isolate the logic common to chassis ground in all devices except the device that contains the single-point ground per Table E-1.

9. Reinstall cables and reseat circuit boards that were unplugged during this verification. Power up the system and verify normal operation.

10. Enter in the system log the device that has the single-point ground and the date it was installed.

NOTE

> If additional information is needed in order to connect logic common and chassis ground at a single point properly, call Hot Line (package engineering for System Integration Center (SIC)).

Alphabetical Index

Introduction

HOW TO USE INDEX

The index, table of contents, list of illustrations, and list of tables are used in conjunction to obtain the location of the desired subject. Once the subject or topic has been located in the index, use the appropriate paragraph number, figure number, or table number to obtain the corresponding page number from the table of contents, list of illustrations, or list of tables.

INDEX ENTRIES

The following index lists key words and concepts from the subject material of the manual together with the area(s) in the manual that supply major coverage of the listed concept. The numbers along the right side of the listing reference the following manual areas:

- 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.
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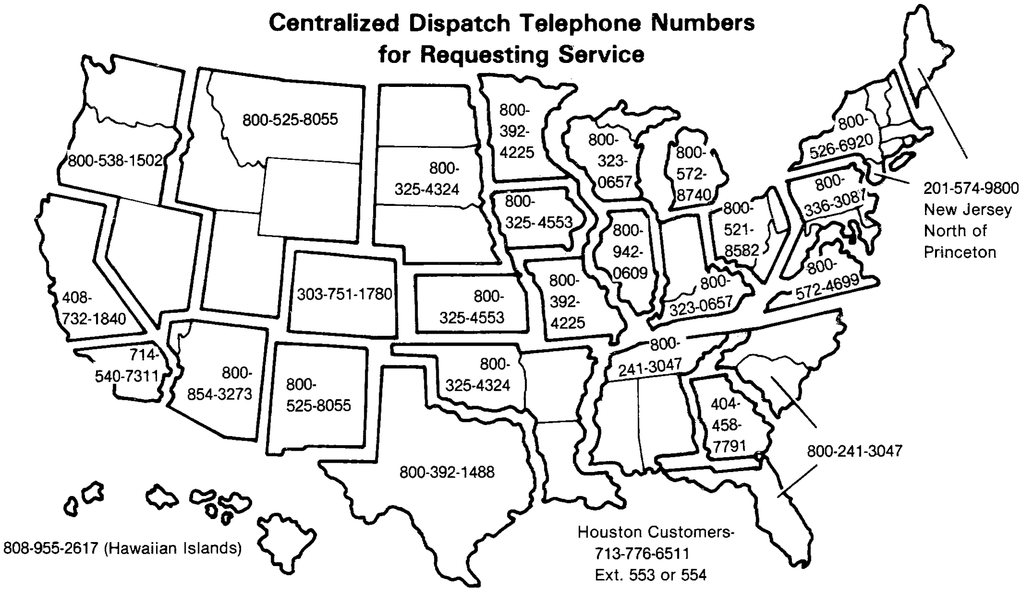

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