HEWLETT PACKARD

SERVICE MANUAL

7908
DISC/TAPE DRIVE

Manual part no. 07908-90903
Microfiche part no. 07908-90803

Printed: MAY 1983 07908-90903
Printed in U.S.A. E0583

MODELS COVERED

This manual covers the HP 7908P and HP 7908R Disc/Tape Drives.

OPTIONS COVERED

This manual covers option 015 and option 140 as well as the standard HP 7908 Disc/Tape Drive.

DESIGNED FOR HP-IB SYSTEMS

HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a computation system.

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PRINTING HISTORY

New editions incorporate all update material since the previous edition. Updating Supplements, which are issued between editions, contain additional and revised information to be incorporated into the manual by the user. The date on the title page changes only when a new edition is published.

Original ..... DEC 1981
Second printing ..... MAY 1982
Third printing ..... MAY 1983

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SAFETY CONSIDERATIONS

KEEP WITH MANUAL

GENERAL - This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND - This is a safety class I product and is provided with a protective earthing terminal. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER - Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the main power source.

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by service-trained personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

To install or remove a fuse, first disconnect the power cord from the device. Then, using a small screwdriver, turn the fuseholder cap counterclockwise until the cap releases. Install the proper fuse in the cap — either end of the fuse can be installed in the cap. Next, install the fuse and fuseholder cap in the fuseholder by pressing the cap inwards and then turning it clockwise until it locks in place.

GENERAL INFORMATION

SECTION I

1-1. INTRODUCTION

The HP 7908 Disc/Tape Drive is a 16 megabyte storage product incorporating Winchester disc technology and tape cartridge backup within the same device. Modular replacement philosophy is implemented to reduce on-site repair time.

This manual contains service information for the HP 7908 Disc/Tape Drive, which comes in two configurations: the HP 7908P is a stand-alone cabinet model with casters, intended for use on any stable floor surface; the HP 7908R is a rackmount model, intended to be installed in a system rack. Unless otherwise specified, this manual refers to both product configurations as the HP 7908.

The standard HP 7908 includes the tape system and comes wired for 100/110/120 Vac. Option 140 is the HP 7908 without the tape system. Option 015 is the HP 7908 wired for 208/220/240 Vac.

1-2. SCOPE OF MANUAL

This manual is organized as follows:

a. Section I is a general description of the HP 7908.

b. Section II contains information about the CS/80 Instruction Set and Hewlett-Packard Interface Bus (HP-IB).*

c. Section III is a description of the functional operation of the HP 7908.

d. Section IV contains service information including diagnostic information and functional block diagrams of all major assemblies.

e. Section V contains step-by-step removal and replacement procedures for all field-replaceable parts.

f. Section VI contains tables and figures for all field-replaceable parts as well as ordering information.

g. Appendix A contains backdating information about removal and replacement and replaceable parts for the HP 7908R and HP 7908P Disc/Tape Drives with serial numbers prefixed 2142 and prior.

h. Appendix B contains all applicable service notes as of the last printing of this manual.

1-3. DOCUMENTATION AVAILABLE

For operating information, refer to the *HP 7908 Disc/Tape Drive Operator Instructions*, part no. 07908-90901. For installation instructions, refer to the *HP 7908 Disc/Tape Drive Operating and Installation Manual*, part no. 07908-90902, and the *Site Environmental Requirements Manual for Disc/Tape Drives*, part no. 5955-3456. For instruction set information, refer to the *CS/80 Instruction Set Programming Manual*, part no. 5955-3442. For additional troubleshooting information, refer to the *CS/80 External Exerciser Reference Manual*, part no. 5955-3462.

**HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a computation system.*

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CHANNEL INTERFACE

SECTION II

2-1. INTRODUCTION

Interface to the HP 7908 is accomplished through Hewlett-Packard Interface Bus (HP-IB) hardware and the CS/80 Instruction Set, a set of commands formulated for mass storage devices. The following paragraphs discuss the types of CS/80 commands. Also provided is an overview of HP-IB. For full details of CS/80, refer to the *CS/80 Instruction Set Programming Manual*, part no. 5955-3442.

2-2. CS/80 INSTRUCTION SET

The increase in capabilities of both host computers and mass storage devices has emphasized the need for efficient channel communication. The CS/80 Instruction Set increases the efficiency and speed of channel operations between disc memories and their associated host computers. Table 2-1 is a summary of all CS/80 instructions. The CS/80 Instruction Set allows a host computer to access special utilities within the HP 7908. Utilities are routines stored in firmware which allow error rate tests to be performed and the results of such tests to be examined or logged. Utilities are listed in table 2-2.

2-3. TRANSACTION STRUCTURE

A transaction is a logically complete operation between a system host computer and a peripheral device (the HP 7908) over a given channel (HP-IB). Three phases may occur during each transaction: command, execute, and report. A transaction begins when a command is received by the HP 7908, and ends when a reporting message indicating the status of the transaction is accepted by the host. Figure 2-1 illustrates the transaction structure, and shows the relationship between the HP 7908 operating states and the channel activity relative to each phase.

A unit is a separately addressable entity within a device (HP 7908). The HP 7908 contains three units: the controller unit, a disc unit, and a tape unit. A volume is a separately addressable portion of the storage media within a given unit. Each unit in the HP 7908 has one volume: the disc unit contains fixed disc media; the tape unit utilizes removable tape media. The controller unit is addressed during diagnostic routines.

2-4. REAL TIME COMMANDS

Real time commands are optimized for execution time. These commands are used most often in host/device transactions. One or more complementary commands may precede a real time command in order to modify the operation of that command. Real time commands include: locate and read, locate and write, cold load read, and write file mark.

2-5. COMPLEMENTARY COMMANDS

Complementary commands are used to set or update programmable states in the HP 7908. The programmable states define characteristics such as: set unit, set volume, set address, set block displacement, set return addressing mode, set length, set burst mode, set retry time, set options, set release, set status mask, and set Rotational Position Sensing (RPS) window size. These commands may be included within Real Time, General Purpose, or Diagnostic command messages, or they may stand alone.

When a complementary command (or commands) is embedded within another command, the parameters or conditions established by that complementary command(s) are altered only for the duration of the current command. A stand-alone complementary command, however, sets the parameters or conditions until the same stand-alone complementary command alters the set value or until power-on occurs. Power-on resets all complementary commands to their default values. Therefore, at power-on, length is defaulted to equal the entire volume. A stand-alone "set length" command may give it a "set" value of 1 kbyte to be used for an entire sequence of transactions; although some special case commands could temporarily override this value with an embedded complementary command to a "current" value of 256 bytes (1 sector).

2-6. GENERAL PURPOSE COMMANDS

This command group includes commands which allow the host to determine device type and operating characteristics or ascertain storage media integrity. These commands are not considered "real time" commands and therefore should not be issued by the host unless it is willing to relinquish control of the device for a varying period of time. General purpose commands are: locate and verify, copy data, spare block, release, release denied, describe, initialize media, and unload.

2-7. DIAGNOSTIC COMMANDS

Diagnostic commands are intended to assist the host in isolating problems in the device to the replaceable assembly level. Some commands allow protected access variables or data maintained by the device (such as error information), while others cause tests to be

Table 2-1. CS/80 Command Summary

COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
LOCATE AND READ (REAL TIME)	[00000000]	00	000	NULL	0	NO VARIABLES OR PARAMETERS	LOCATES DATA INDICATED BY TARGET ADDRESS AND TRANSMITS DATA TO HOST.
LOCATE AND WRITE (REAL TIME)	[00000010]	02	002	STX	2	NO VARIABLES OR PARAMETERS	TRANSFERS DATA FROM HOST TO STORAGE AREA BEGINNING AT ADDRESS SPECIFIED BY TARGET ADDRESS.
LOCATE AND VERIFY (GENERAL PURPOSE)	[00000100]	04	004	EOT	4	NO VARIABLES OR PARAMETERS	INSTRUCTS DEVICE TO PERFORM AN INTERNAL VERIFICATION OF A SECTION OF DATA TO ENSURE THAT IT CAN BE READ.
SPARE BLOCK (GENERAL PURPOSE)	[00000110]	06	006	ACK	6	[00000110] [00000S0T] S = 0 SKIP SPARE S = 1 JUMP SPARE T = 0 RETAIN DATA T = 1 DO NOT RETAIN DATA T MUST EQUAL 1 FOR TAPE OPERATION S MUST EQUAL 0 FOR DISC OPERATION	ALLOWS HOST TO GIVE DEVICE PERMISSION TO BECOME TEMPORARILY BUSY WHILE SPARING BLOCK INDICATED BY TARGET ADDRESS.
COPY DATA (GENERAL PURPOSE)	[00001000]	08	010	BS	8	[00001000] [0VVV0UUU] [0001000T] [P1] - - - - - - - - [P6] SET ADDRESS / 6-BYTE PARAMETER ADDRESS OF DATA SOURCE [0XXX0WWW] [0001000T] [P1] - - - - - - - - [P6] SET ADDRESS / 6-BYTE PARAMETER ADDRESS OF DATA DESTINATION VVV = VOLUME NUMBER ON UUU FROM WHICH DATA IS COPIED UUU = UNIT NUMBER OF DATA SOURCE T = ADDRESS MODE (0 = SINGLE VECTOR, 1 = 3-VECTOR) XXX = VOLUME NUMBER ON WWW TO WHICH IS COPIED WWW = UNIT NUMBER OF DATA DESTINATION T = ADDRESS MODE (0 = SINGLE VECTOR, 1 = 3-VECTOR)	COPIES AMOUNT OF DATA SPECIFIED BY LENGTH (DEFAULT VALUE, OR COMPLEMENTARY COMMAND VALUE) FROM THE SPECIFIED UNIT AND VOLUME TO A SELECTED UNIT AND VOLUME. FOR THE TAPE, AN UNWRITTEN BLOCK OR BAD KEY CAUSES THE COPY DATA TO TERMINATE.
COLD LOAD READ (REAL TIME)	[00001010]	0A	012	LF	10	NO VARIABLES OR PARAMETERS	USED BY HOST SYSTEM TO BOOTSTRAP ITSELF INTO A HIGHER OPERATING ENVIRONMENT FROM A MORE PRIMITIVE STATE.
REQUEST STATUS (DIAGNOSTIC)	[00001101]	0D	015	CR	13	NO VARIABLES OR PARAMETERS	INSTRUCTS DEVICE TO RETURN (IN AN EXECUTION MESSAGE) THE STATUS OF THE LAST TRANSACTION.

Table 2-1. CS/80 Command Summary (continued)

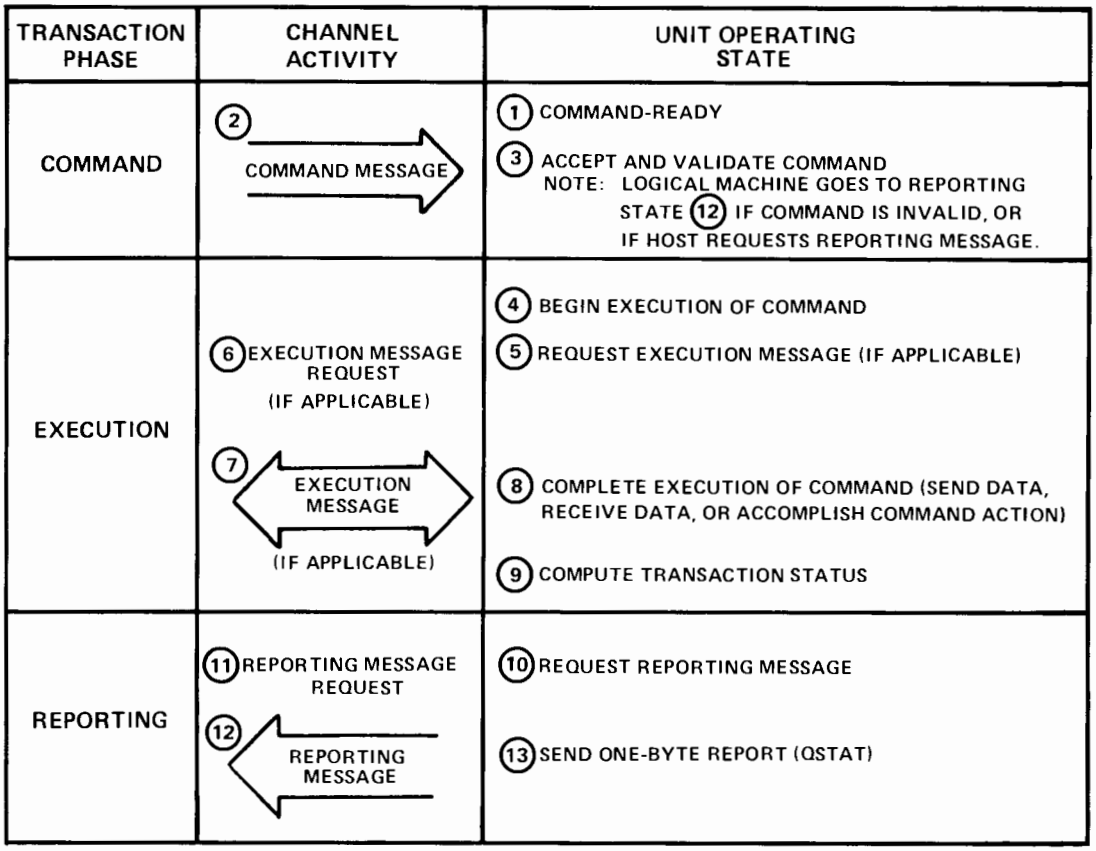
COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
RELEASE (GENERAL PURPOSE)	[00001110]	0E	016	SO	14	NO VARIABLES OR PARAMETERS	USED TO RELEASE DEVICE FOR A PERIOD OF TIME.
RELEASE DENIED (GENERAL PURPOSE)	[00001111]	0F	017	SI	15	NO VARIABLES OR PARAMETERS	PROHIBITS DEVICE FROM RELEASING ITSELF.
SET ADDRESS (COMPLEMENTARY)	[00010000] [00010001]	10 11	020 021	DLE DC1	16 17	[0001000T] [P1] - - - - - - - - [P6] 6-BYTE PARAMETER T = ADDRESS MODE: 0 = SINGLE VECTOR, 1 = 3-VECTOR SINGLE VECTOR FORMAT: 6-BYTE BINARY NUMBER 3-VECTOR FORMAT: P1 - P3 = CYLINDER ADDRESS P4 = HEAD ADDRESS P5 - P6 = SECTOR ADDRESS	USED TO SET VALUE OF TARGET ADDRESS, SPECIFIES SINGLE-OR THREE-VECTOR ADDRESS MODE. UPON COMPLETION OF AN INSTRUCTION WHICH UTILIZES A TARGET ADDRESS, THE TARGET ADDRESS IS AUTOMATICALLY INCREMENTED.
SET BLOCK DISPLACEMENT (COMPLEMENTARY)	[00010010]	12	022	DC2	18	[00010010] [P1] - - - - - - - - [P6] 6-BYTE PARAMETER PARAMETER FORMAT: 6-BYTE, SIGNED, TWO'S COMPLEMENT, BINARY NUMBER	ADJUSTS TARGET ADDRESS BY NUMBER OF BLOCKS INDICATED BY PARAMETER FIELD. ESPECIALLY USEFUL IN TAPE OPERATIONS.
SET LENGTH (COMPLEMENTARY)	[00011000]	18	030	CAN	24	[00011000] [P1] - - - - - - - - [P4] 4-BYTE PARAMETER PARAMETER FORMAT: 4-BYTE, UNSIGNED BINARY NUMBER	DEFINES THE NUMBER OF BYTES IN A DATA TRANSFER.
SET UNIT (COMPLEMENTARY)	[00100000] [00100001] [00101111]	20 21 2F	040 041 057	space ! /	32 33 47	[0010YYYY] (0000 = DISC, 0001 = TAPE) YYYY = UNIT NUMBER (1111 = DEVICE CONTROLLER) UNIT NUMBER MUST BE FIRST BYTE IN A COMMAND	USED TO SPECIFY A SPECIFIC UNIT NUMBER WITHIN A MASS STORAGE DEVICE.
INITIATE UTILITY (DIAGNOSTIC)	[00110000] [00110001] [00110010]	30 31 32	060 061 062	0 1 2	48 49 50	[001100XX] [P1] [P2] - - - - - - - - [P9] UP TO 8-BYTE PARAMETER XX = EXECUTION MESSAGE QUALIFIER 00 = NO EXECUTION MESSAGE 01 = DEVICE WILL RECEIVE EXECUTION MESSAGE TEXT 10 = DEVICE WILL SEND EXECUTION MESSAGE TEXT P1 = UTILITY NUMBER (SEE TABLE 2-2) PARAMETER QUANTITY AND CONTENT IS FUNCTION OF P1.	DIRECTS DEVICE TO PERFORM ONE UTILITY ROUTINE. SEE SECTION IV.

Table 2-1. CS/80 Command Summary (continued)

COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
INITIATE DIAGNOSTIC (DIAGNOSTIC)	[00110011]	33	063	3	51	[00110011] [P1] - - - - - - - - [P3] 3-BYTE PARAMETER	DIRECTS DEVICE TO PERFORM ONE INTERNALLY DEFINED DIAGNOSTIC ROUTINE. SEE SECTION IV.
NO OP (COMPLEMENTARY)	[00110100]	34	064	4	52	NO VARIABLES OR PARAMETERS	CAUSES DEVICE TO DISREGARD MESSAGE BYTE.
DESCRIBE (GENERAL PURPOSE)	[00110101]	35	065	5	53	NO VARIABLES OR PARAMETERS	DEVICE RETURNS 256 BYTES OF INFORMATION WHICH GIVES ALL DEVICE CHARACTERISTICS (SEE CS/80 INSTRUCTION SET MANUAL).
INITIALIZE MEDIA (GENERAL PURPOSE)	[00110111]	37	067	7	55	[00110111] [00000CWZ] [P2] CWZ FOR TAPE UNIT: Z = 0: REWRITE SPARING TABLE WITH NO JUMP SPARES. Z = 1: RESET SPARING TABLE TO INITIAL SPARES. W = 0: INITIAL SPARES ARE EVERY 512TH BLOCK WITH TRACK OFFSET. W = 1: INITIAL SPARES ARE NO SPARES. C = 0: RUNS CERTIFICATION UTILITY ON TAPE. C = 1: INHIBITS CERTIFY TEST. MEDIA REMAINS UNINITIALIZED. CWZ FOR DISC UNIT: 000 = RETAIN BOTH FACTORY (PRIMARY) AND FIELD (SECONDARY) SPARES. 001 = RETAIN FACTORY SPARES ONLY. 010 = RETAIN NO SPARES (CE USE ONLY). P2 = BLOCK INTERLEAVE BYTE (BINARY NUMBER). MUST BE 00 FOR TAPE.	USED TO INITIALIZE ALL OF THE DATA FIELDS OF THE UNDEFINED MEDIA AREA (CURRENT UNIT NUMBER AND VOLUME). FACTORY SPARES SHOULD ALWAYS BE RETAINED
SET OPTIONS (COMPLEMENTARY)	[00111000]	38	070	8	56	[00111000] [00000VYZ] V = 0 DISABLE AUTO SPARING V = 1 ENABLE AUTO SPARING Y = 0 JUMP SPARE Y = 1 SKIP SPARE Z = 0 DISABLE CHARACTER COUNT Z = 1 ENABLE CHARACTER COUNT	USED TO SPECIFY SPARING TECHNIQUE AND CHARACTER COUNT CAPABILITY FOR THE TAPE MODULE.
SET RPS (COMPLEMENTARY)	[00111001]	39	071	9	57	[00111001] [TIME 1] [TIME 2] TIME 1 = TIME-TO-TARGET IN HUNDREDS OF MICROSECONDS TIME 2 = WINDOW SIZE IN HUNDREDS OF MICROSECONDS IF TIME 1 = 0, RPS IS DISABLED	SETS TIME-TO-TARGET AND WINDOW-SIZE TIME INTERVALS FOR RPS DATA TRANSFERS. (RPS = ROTATIONAL POSITION SENSING)

Table 2-1. CS/80 Command Summary (continued)

COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
SET RETRY TIME (COMPLEMENTARY)	[00111010]	3A	072	:	58	[00111010] [P1] [P2] P1 - P2 RETRY TIME IN TENS OF MILLISECONDS (16 BIT BINARY NUMBER)	USED TO SET AMOUNT OF TIME AVAILABLE FOR READ AND SEEK RETRIES.
SET RELEASE (COMPLEMENTARY)	[00111011]	3B	073	;	59	[00111011] [TZ000000] T 1: SUPPRESS RELEASE TIME-OUT Z 1: RELEASE AUTOMATICALLY DURING IDLE TIME	USED TO SUPPRESS RELEASE TIME-OUT AND TO ENABLE AUTOMATIC RELEASE.
SET BURST (COMPLEMENTARY)	[00111100] [00111101]	3C 3D	074 075	< =	60 61	[0011110T] [P1] T 0 INDICATES THAT LAST BURST ONLY IS TAGGED WITH A MESSAGE TERMINATOR (EOI ON HP-IB). T 1 INDICATES THAT ALL BURSTS ARE TAGGED WITH A MESSAGE TERMINATOR. P1 NUMBER OF 256 BYTE SEGMENTS IN EACH BURST (IF P1 ALL ZEROS, BURST MODE IS DEACTIVATED).	ACTIVATES (AND DEACTIVATES) BURST MODE.
SET STATUS MASK (COMPLEMENTARY)	[00111110]	3E	076	>	62	[00111110] [P1] - - - - - - - - [P8] 8-BYTE PARAMETER PARAMETER FORMAT: BIT POSITIONS IN PARAMETER BYTES CORRESPOND TO STATUS REPORT ERROR BIT POSITIONS. REFER TO CS/80 INSTRUCTION SET MANUAL. 1 MASKED ERROR	ALLOWS MASKING OF ERROR CONDITIONS REPORTED BY REQUEST STATUS (DIAGNOSTIC) COMMAND.
SET RETURN ADDRESSING MODE (COMPLEMENTARY)	[01001000]	48	110	H	72	[01001000] [00000TTT] TTT ADDRESSING MODE 000 SINGLE VECTOR 001 3-VECTOR	USED BY HOST TO SPECIFY TYPE OF ADDRESS (SINGLE OR 3-VECTOR) TO BE RETURNED IN REQUEST STATUS EXECUTION MESSAGE.
WRITE FILE MARK (REAL TIME)	[01001001]	49	111	I	73	NO VARIABLES OR PARAMETERS	WRITES A FILE MARK AT THE CURRENT POSITION OF THE TAPE.
UNLOAD (GENERAL PURPOSE)	[01001010]	4A	112	J	74	NO VARIABLES OR PARAMETERS	UNLOADS THE TAPE.



(1) Logical Machine idle in command-ready state.

(2) Host sends command message.

(3) Logical Machine accepts and verifies command. If command is valid, Logical Machine moves to execution state. If not, Logical Machine moves to reporting state.

(4) Unit begins execution of command.

(5), (6) If command involves data transfer, Logical Machine requests an execution message. If not, unit completes execution (8).

(7) Execution message is established if command involves a data transfer.

(8) Unit completes execution of command. If command involves data transfer, unit sends or receives data through channel module. If not, unit completes action called for in command message.

(9) Logical Machine computes completion status of transaction. Pass/Fail status is set into QSTAT, complete status set into request status.

(10), (11) Logical Machine requests reporting message.

(12) Reporting message is established.

(13) Logical Machine sends one-byte reporting message (QSTAT) indicating Pass/Fail status of transaction. Host must send request status command for complete status report (20 bytes).

5955-2

Figure 2-1. Transaction Structure

Table 2-2. HP 7908 Disc/Tape Drive Utilities

UTILITY OPCODE(S) ALLOWED(*) (hex)	MICRO OPCODE (hex)	UTILITY PERFORMED BY THE HP 7908
32	C1	Read Error Summary
32	C3	Read Revision Numbers
32	C4	Read Drive Tables
32	C5	Read Run Time Data Error Log
32	C6	Read Error Rate Test Data Error Log
32	C7	Read Fault Log (disc) or Use Log (tape)
30, 32	C8	Initiate Write-Then-Read Error Rate Test
30, 32	C9	Initiate Read Only Error Rate Test
30, 32	CA	Initiate Short Error Rate Test
30, 32	CB	Initiate Random Error Rate Test
30, 32	CC	Initiate Random Read Only Error Rate Test
30	CD	Clear Logs
30	CE	Preset Drive
31	D1	Receive User Pattern

*Opcode 30 executes Utility With No Message
Opcode 31 executes Utility Receive Message
Opcode 32 executes Utility Send Message

performed within the device, or on a specific area of the storage media. Diagnostic commands may be modified by complementary commands. Initiate diagnostic, initiate utility, and request status are all diagnostic commands.

2-8. TRANSPARENT COMMANDS

Transparent commands compensate for different types of channels and differences in operating environments. Transparent commands are intercepted by the device firmware and modify the normal command-execution-reporting transaction sequence. Transparent commands are explained in the *CS/80 Instruction Set Programming Manual*, part no. 5955-3442.

2-9. HEWLETT-PACKARD INTERFACE BUS

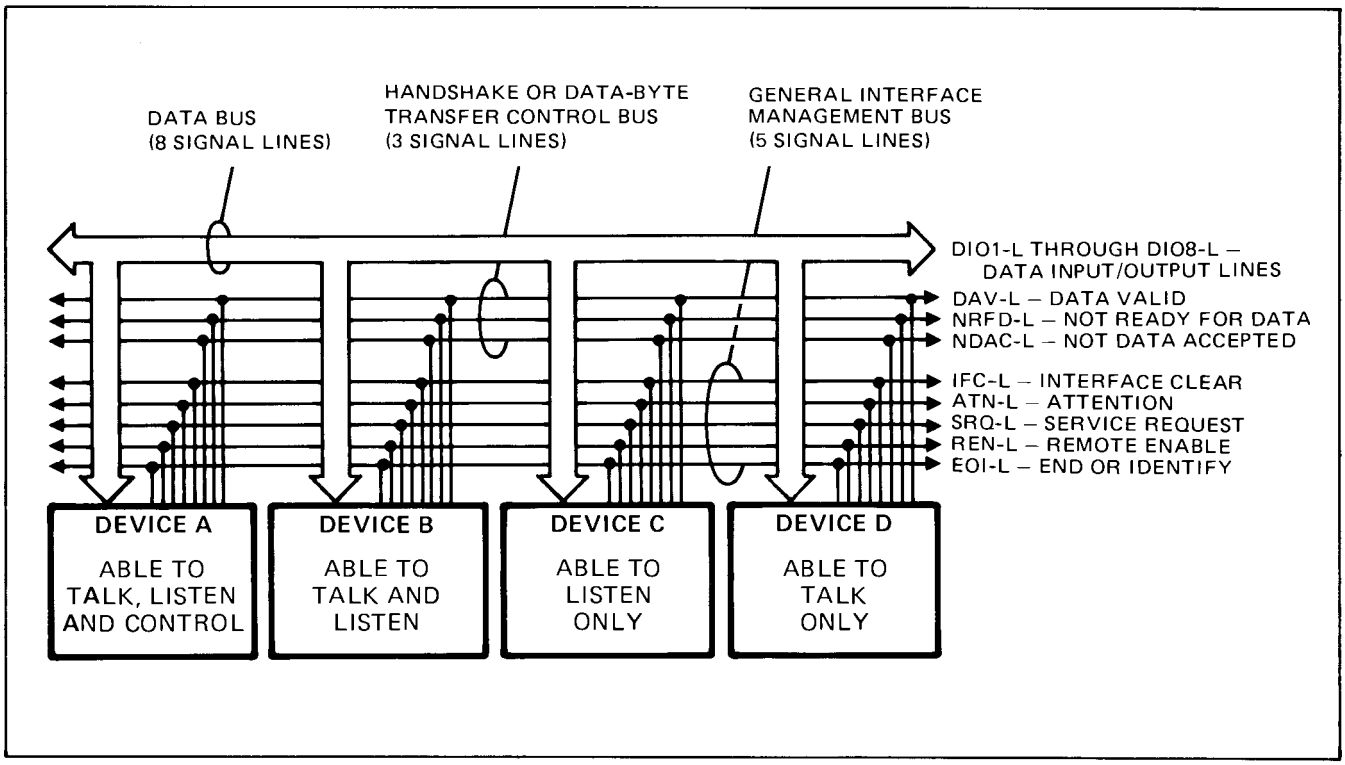
The Hewlett-Packard Interface Bus (HP-IB) provides a standardized method of connecting separate devices. (See figure 2-2.) The HP-IB permits transfer of commands and data between the components of a system on 16 signal lines. The interface functions for each system component are performed within the component so only passive cabling is needed to connect the system. The cable connects all controllers and other devices of the system in parallel.

The Hewlett-Packard Interface Bus (HP-IB) has certain rules which must be followed for successful installation of the HP 7908. Cabling is limited to 1 metre per HP-IB load. Typically the Central Processing Unit (CPU) is 7 equivalent loads and the HP 7908 is 1 equivalent load.

The CPU adheres to an HP standard which allows 7 metres of HP-IB cable between the CPU and the nearest device connected to it and 1 metre of cable between each additional device. The maximum configuration is eight devices (not including CPU) per HP-IB channel or a maximum of 15 metres or 15 equivalent loads.

The eight data I/O lines are reserved for the transfer of commands, data, and other messages in a byte-serial, bit-parallel manner. Data and message transfers are asynchronous, coordinated by three handshake lines: Data Valid (DAV-L), Not Ready For Data (NRFD-L), and Not Data Accepted (NDAC-L). The other five lines are for bus management.

Information is transmitted on the data lines under sequential control of the three handshake lines (DAV-L, NRFD-L and NDAC-L). No step in the sequence can be initiated until the previous step has been completed. Information transfer can proceed as fast as devices can respond, but no faster than allowed by the slowest



5955-3A

Figure 2-2. HP-IB Signal Lines

device presently addressed. This permits several devices to receive the same message byte concurrently.

Devices connected to the bus may be talkers, listeners, or controllers (refer to table 2-3). The Controller-In-Charge (CIC) dictates the role of each of the other devices by setting the Attention (ATN-L) line low and sending talk or listen addresses on the data lines. Addresses are set for each device at the time of system configuration. While the ATN-L line is low, all devices must listen to the data lines. When the ATN-L line is high, devices that have been addressed will send or receive data; all others ignore the data lines. Several listeners can be active simultaneously but only one talker can be active at a time. Whenever a talk address is put on the data lines (while ATN-L is low), all other talkers will be automatically unaddressed.

The Interface Clear (IFC-L) line places the interface system in a known quiescent state. The Remote Enable (REN-L) line is used to select between two alternate sources of device programming data such as the front panel or the HP-IB. The End Or Identify (EOI-L) line is used to indicate the end of a multiple-byte transfer sequence. In addition, when a controller-in-charge sets both the ATN-L and EOI-L lines low, each device capable of a parallel poll responds on the DIO line assigned to it.

2-10. HP-IB COMMUNICATIONS

This section describes the formats and sequences for the HP-IB commands, messages, and transactions that occur between the Controller-In-Charge (CIC) and the HP 7908. The following list explains the terms used in this section.

COMMAND — A parcel of information transmitted over the channel (HP-IB) relating to a specific operation. Channel commands (usually a single byte) are used to manage operations on the interface channel. Device commands (usually more than one byte) are used to control the operation and are contained within the text of a command message.

UNIVERSAL COMMAND — A channel command that causes all devices on the bus to perform a predetermined interface function. Refer to table 2-4.

PRIMARY COMMAND — The primary I command is a channel command that begins the message sequence. It contains the command to listen or talk and the address of a particular device. The primary II command terminates the message with an unlisten or untalk command.

SECONDARY COMMAND — The secondary command sets up the action required of the HP 7908 in the text of the message.

TEXT — The text of the message can be 1 to n bytes depending on the required action. The required action can be to receive further qualifying information or instructions (such as a device command), to receive write data, to send read or status data, or to perform a specific operation such as a CLEAR.

MESSAGE — A unique sequence of command and text bytes transmitted over the channel during which the communication link between the devices (e.g., CIC and the HP 7908) remains unbroken.

Table 2-3. HP-IB Definitions

HP-IB TERM	DEFINITION	CONSIDERATIONS
TALKER	Any device which sends information over the HP-IB.	There can be only one TALKER sending information over the HP-IB at a time.
LISTENER	Any device which receives information over the HP-IB. Some devices can function as LISTENERS or TALKERS.	In a parallel poll system, there can be up to 8 LISTENERS receiving information over the HP-IB at the same time.
CONTROLLER	Any device that has been programmed to manage data flow between the TALKER and the LISTENER(s) in addition to being a TALKER and a LISTENER.	The CONTROLLER manages data flow by addressing one device as a TALKER and one or more devices as LISTENERS. There can be only one active CONTROLLER on the HP-IB at any time. The active CONTROLLER is called the CONTROLLER-IN-CHARGE (CIC).
SYSTEM CONTROLLER	Any device that functions as a CONTROLLER and is able to gain absolute control of the HP-IB with the Interface Clear (IFC) signal.	There can be only one SYSTEM CONTROLLER connected to the HP-IB.

COMMAND MESSAGE — A single message containing all the information required to address a device and initiate an operation, set up a programmable parameter, or set up an operation to be executed by an execution message.

EXECUTION MESSAGE — A single message containing all the information required to carry out an operation previously set up by a command message.

TRANSACTION — A complete process or operation carried out over the channel. Some transactions are completed with only a command/report message, and some require a command, execution and a reporting message.

2-11. CHANNEL MANAGEMENT

The following techniques are used by the CIC to manage the HP-IB: Parallel Poll and Universal Device Clear.

2-12. PARALLEL POLL. The CIC conducts a parallel poll on the HP-IB by asserting ATN-L and EOI-L simultaneously. Each device requiring service can then respond by asserting the DIO line corresponding to its address. The CIC then addresses only the device requiring service. If more than one device requires service, the CIC addresses the device with the highest priority (lowest address) first. Parallel Poll Enable (PPE) and Parallel Poll Disable (PPD) are internal states of the HP 7908 controller. PPE occurs when the HP 7908 requires service from the CIC. PPD is the opposite state and occurs whenever the HP 7908 is active (e.g., busy executing a command) or idle. A Parallel Poll Response (PPR) from the HP 7908 will occur if the CIC asserts both ATN-L and EOI-L and if the HP 7908 is in the PPE state.

Table 2-4. Universal Command Formats

UNIVERSAL COMMAND	UNIVERSAL DEVICE CLEAR
ATN ⟨P001CCCC⟩ P = Parity Bit CCCC = Command Code	ATN ⟨P0010100⟩ P = Parity Bit

2-13. UNIVERSAL DEVICE CLEAR. A universal command is a channel command that causes all devices on the HP-IB to perform a pre-determined interface function. Universal Device Clear erases information stored in the HP 7908 controller and places the HP 7908 in a known reset state. The universal device clear format is shown in table 2-4.

2-14. MESSAGE STRUCTURE

Each message contains the following components (refer to table 2-5).

— Primary I Command
(unidirectional from CIC to device)

— Secondary Command
(unidirectional from CIC to device)

— Text (bidirectional)

— Primary II Command
(unidirectional from CIC to device)

The CIC asserts ATN-L during primary and secondary commands to distinguish them from text information. The HP 7908 decodes the information contained in both the primary I and secondary commands to prepare for action specified in the text.

Table 2-5. HP-IB Message Structure

HEADER		TEXT	TRAILER
PRIMARY I	SECONDARY	DEVICE COMMAND OR DATA	PRIMARY II
(ATN) ⟨ONE BYTE⟩ – UNIDIRECTIONAL • CIC TO DEVICE – BEGINS MESSAGE • ADDRESSES DEVICE TO LISTEN OR TALK • UNIVERSAL	(ATN) ⟨ONE BYTE⟩ – UNIDIRECTIONAL • CIC TO DEVICE – SET UP DEVICE FOR FURTHER ACTION	⟨ONE TO n BYTES⟩ – BIDIRECTIONAL – QUALIFYING INSTRUCTIONS TO DEVICE – WRITE DATA TO DEVICE – READ DATA TO CIC – STATUS DATA TO CIC	(ATN) ⟨ONE BYTE⟩ – UNIDIRECTIONAL • CIC TO DEVICE – TERMINATES MESSAGE – UNADDRESSES DEVICE • UNLISTEN • UNTALK

FUNCTIONAL OPERATION

SECTION III

3-1. INTRODUCTION

This section provides a detailed discussion of the functional operation of the HP 7908. The HP 7908 consists of five separate systems: the controller system, disc system, tape system, power system, and air circulation system. A functional block diagram of each major system is provided at the end of section IV. Figure 3-1 is a general block diagram of the HP 7908.

3-2. CONTROLLER SYSTEM

The controller system consists of the Microprocessor PCA-A5 (MPU) and the Disc Memory Access PCA-A4 (DMA), as shown in the Controller System functional diagram, figure 4-9. The controller system: governs head positioning, which involves seek and track following operations; provides storage space for all internal programs and algorithms; connects the HP-IB channel to either the disc or tape system during a read or write operation; and allows data to be transferred between the disc and tape memories.

3-3. MICROPROCESSOR PCA-A5

The Microprocessor PCA-A5 (MPU) controls all head positioning and data transfer operations within the HP 7908. The MPU also contains adequate memory space for storage of internal diagnostics and utilities which provide thorough device verification and extensive fault analysis.

3-4. CENTRAL PROCESSING UNIT. The Central Processing Unit (CPU) is a Z80A with its clock frequency set at 3.75 MHz. The Z80A is controlled by a predefined instruction set which allows manipulation of binary data. The Z80A utilizes an address bus to point to the location of the next instruction or data. The instruction or data is always transferred over the data bus to or from the CPU. The data on the CPU's data bus can be an instruction, a variable, or an address byte and should not be confused with user data to be stored on the disc as the two are completely independent of one another. The CPU's 16-bit address bus is connected directly to Read Only Memory (ROM). The address bus is buffered once and connected to Random Access Memory (RAM), and buffered again forming the 12-bit address bus on the Mother PCA-A7. The CPU's 8-bit data bus connects to three separate bidirectional buffers in order to form the memory data bus, the process data bus, and the Mother PCA-A7 data bus. The control logic circuitry converts the CPU's control signals into two enable signals, Read (RD-L) and Write (WR-L). When RD-L is asserted (low), it permits the data bus to "listen" to the area within the HP 7908 which is presently addressed by the address bus. When WR-L is asserted, it permits the data bus to "talk" to the area within the HP 7908 which is presently addressed by the address bus. The MPU's read and write signals should not be confused with read and write data operations performed on the disc.

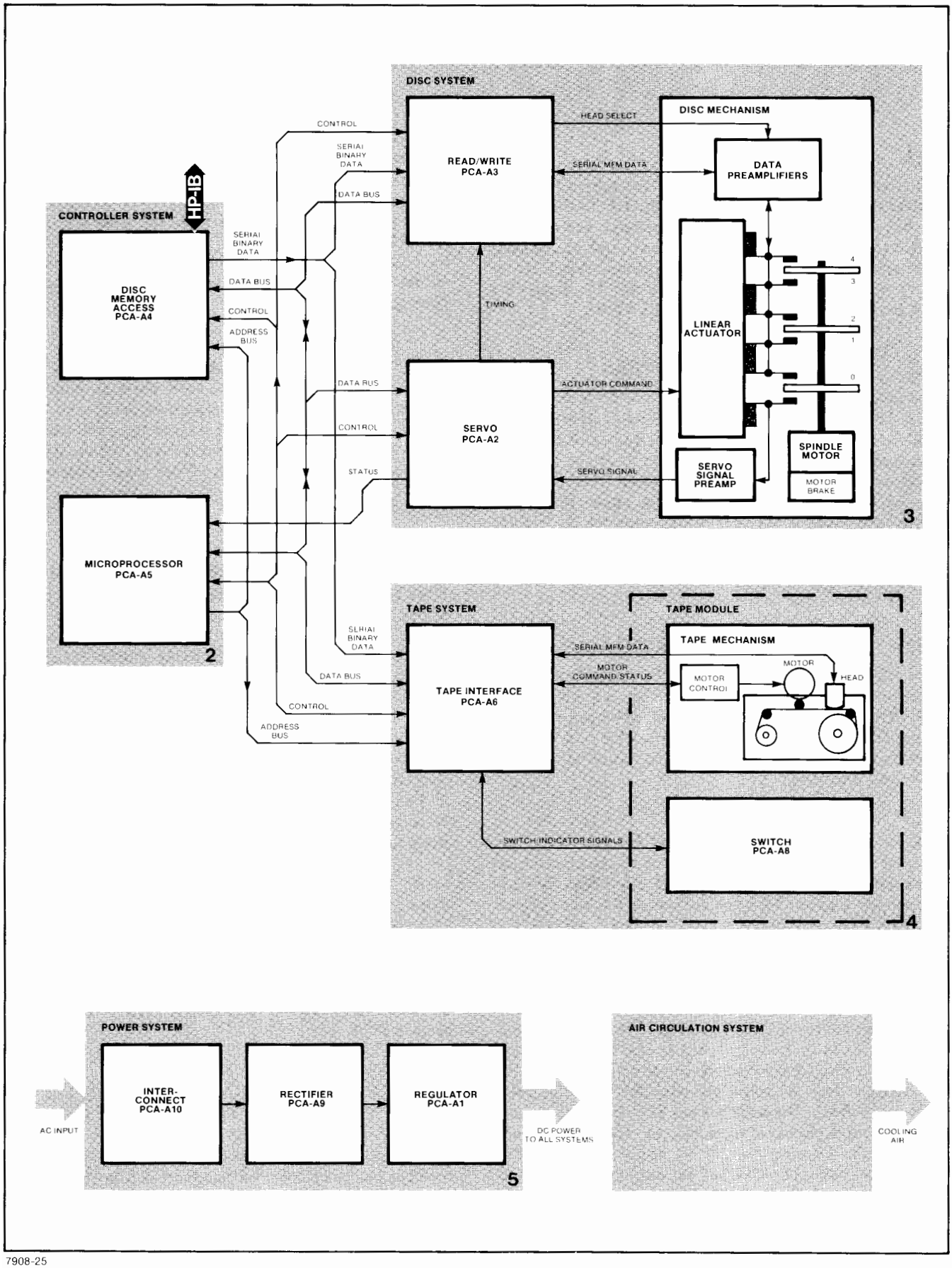
3-5. READ ONLY MEMORY. Read Only Memory (ROM) contains the firmware which provides permanent storage for preprogrammed sequences (algorithms) that govern head positioning, data transfer, and internal diagnostics and utilities. When ROM is addressed by the CPU's address bus, information stored in ROM is sent over the data bus to the CPU. There are 40 kbytes of ROM.

3-6. ERASABLE PROGRAMMABLE READ ONLY MEMORY (EPROM). EPROM allows patching of firmware in 512 byte segments. Patching alters the addressing scheme by directing the data bus to read from EPROM for certain ROM address locations.

3-7. RANDOM ACCESS MEMORY. Random Access Memory (RAM) provides temporary storage for program variables generated during various device operations. When RAM is addressed by the CPU's address bus, the CPU can read or write information from/to RAM over the data bus. There are 2 kbytes of RAM available on the MPU.

3-8. DECODE LOGIC AND BUS CONTROL. The decode logic and bus control circuitry allow the address bus to assert select signals and determine which segment of the data bus is connected to the CPU. The address bus is decoded to form nine select signals which enable different groups of circuits on certain PCA's.

3-9. COUNTER TIMER CIRCUIT. The Counter Timer Circuit (CTC) provides the CPU with four independently programmable 8-bit counter/timers (channel 0 - 3), each capable of sending an interrupt to the CPU. An interrupt is a branch in the normal sequence of operations within the CPU caused by an external event. When any of the 4 counters in the CTC reaches zero, an interrupt is generated and sent to the CPU. Channel 0 and channel 1 are cascaded to produce a 16-bit counter used by the firmware



7908-25

Figure 3-1. HP 7908 Disc/Tape Drive Block Diagram

for program control. Channel 0 is also used to control seek operations (discussed later in this section). Channel 2 is cascaded with the 4-bit tape counter and is used to control seeks for the tape system. Channel 3 of the CTC is preloaded by the CPU with the number of sectors (36) on the discs, then clocked down by the Sector Timing Pulse (STP-L) which comes from the disc system.

3-10. TAPE COUNTER. The tape counter is a 4-bit down counter which is loaded with the tape block address, and clocked by the Counter Timer Circuit Trigger (CTCT-H). The tape counter is cascaded with channel 2 of the CTC.

3-11. MULTIPLEXER. The multiplexer looks at either eight status signals coming from the disc system or the two switches on the MPU which initiate self test or diagnostic routines.

3-12. STATUS READOUT. The status readout is a 7-segment hexadecimal LED display which indicates error conditions and codes during self test or diagnostics. The status readout displays from 0 through F (hexadecimal); A, C, E and F will appear in capital letters and b and d will appear in small letters.

3-13. CONTROL LOGIC. The control logic is responsible for converting the CPU's control signals into Read (RD-L) and Write (WR-L) signals. RD-L and WR-L connect the data bus to either "listen" (read) or "talk" (write) to the circuitry within the device presently addressed by the CPU.

3-14. DISC MEMORY ACCESS PCA-A4

The Disc Memory Access PCA-A4 (DMA) connects the external parallel data port (HP-IB) to the controller system. Serial/Parallel conversion takes place on the DMA and a Cyclic Redundancy Check (CRC) is implemented.

3-15. DMA MICROPROCESSOR INTERFACE. The DMA microprocessor interface connects the CPU's address bus, data bus, and control and select signals to the DMA. The three select signals allow the CPU to access either the data RAM buffer (BUFS-L), the Processor-to-HP-IB (PHI) chip (IOS-L), or the DMA byte control/status circuitry (DMAS-L).

3-16. PROCESSOR-TO-HP-IB. The Processor-to-HP-IB (PHI) is a bank of eight 10-bit addressable registers. All interaction with the HP-IB is performed by reading or writing to these registers. This allows the HP 7908 to interface through HP-IB using an independent instruction set (CS/80) issued from a remote source (computer, calculator, etc.). The PHI normally is set up by the CPU to transfer parallel data either into the DMA data RAM (write) or out of the DMA data RAM (read).

3-17. HEADER RAM. The header RAM consists of 16 bytes of very fast (35 ns) read/write memory. The header RAM contains the header information for each disc or tape write operation. The header RAM provides all of the addressing information during a write, and recovers the same information back during a read. The DMA counter allows the header RAM to selectively strip off only the header information during a disc or tape read operation.

3-18. DATA RAM. The data RAM is a 4-kbyte buffer capable of buffering 16 sectors of data at a time, since each sector contains 256 bytes of data. The data RAM is effectively converted into a two-port RAM by multiplexing the DMA counters during a data transfer operation. The data RAM can be addressed from three sources: the CPU, the disc address counter, or the I/O address counter.

3-19. BYTE CONTROLLER. Two ROM-based state machines, a sector counter, and other combinational logic permit the byte controller to oversee all data byte movement within the DMA. One state machine controls data transfer from the serializer/deserializer (SERDES) through the data RAM, and into the PHI. The other state machine controls data transfer within the PHI. The sector counter is a 5-bit up/down counter which prevents data from overflowing the 4-kbyte data RAM space.

3-20. DISC ADDRESS COUNTER. The disc address counter addresses the header RAM and data RAM during a data transfer. The disc address counter is preloaded prior to the start of each sector, and during a sector transfer the counter is incremented for each byte.

3-21. I/O ADDRESS COUNTER. The I/O address counter addresses the data RAM during data transfers between the data RAM and the PHI. The I/O address counter can be accessed by the CPU.

3-22. I/O BYTE COUNTER. The I/O byte counter is a 12-bit down counter which allows data transfers over HP-IB to stop at a predetermined byte count. Before a data transfer operation is started, the host computer specifies the number of bytes in the transfer. The number of bytes specified is divided by 4k (4096); the remainder is stored in the I/O byte counter. Now the counter contains only the number of bytes to be written in the last 16 sectors; the integer

portion of the division performed is the number of times the I/O byte counter will be allowed to wrap around, back to the remainder number to which it was loaded. The I/O byte counter is then enabled and it proceeds to count down until the last byte is processed. When the count reaches zero, the data transfer halts.

3-23. SERIALIZER/DESERIALIZER. The serializer/deserializer (SERDES) consists of an 8-bit holding register and an 8-bit shift register. During a write operation, one byte is transferred from the PHI through the DMA data RAM to the holding register. Then the shift register is loaded with the byte from the holding register and it proceeds to shift the byte out in serial form to the disc/tape interface. During a read operation, the serial data from the read/write PCA-A3 or tape interface PCA-A6 is transferred through the disc/tape interface into the shift register one bit at a time. When the shift register is full, the byte is transferred to the holding register. The byte goes from the holding register through the data RAM to the PHI in parallel form.

3-24. CYCLIC REDUNDANCY CHECK. The Cyclic Redundancy Check (CRC) circuit implements the CRC-16 polynomial. The CRC-16 polynomial is a very powerful error detecting scheme utilizing a sixteenth order mathematical function generated logically by a shift register and exclusive-or gates. The resultant 4-term function (polynomial) is therefore referred to as cyclic. CRC-16 can detect virtually all errors that may occur as compared to simple parity checking which can detect only odd numbers of error bits. During a write operation, each sector of data propagates through the CRC, and a unique 2-byte signature is generated by the data and appended to that sector. During a read, the CRC information is regenerated in the same fashion by the data, and compared with the CRC which was appended to the sector when it was previously written. If the CRC previously written agrees with that which is regenerated during the read operation, the data is assumed correct.

3-25. DISC/TAPE INTERFACE. The disc/tape interface provides the serial data path interface between either the DMA and disc system or DMA and tape system. When Start Of Sector (SOS-L) is asserted (low), the DMA prepares to transfer a sector of data (256 bytes). Start of Data (SOD-L) is asserted which tells the DMA that the serial data stream will start on the next Read/Write Clock (RWC-L) edge. Serial data is clocked into or out of the DMA disc/tape interface over the DMA Out (DOUT-H) or DMA in (DIN-H) line, until the end of the sector is reached. Now SOS-L for the next sector is received which either continues the data transfer or resets the DMA.

3-26. DISC SYSTEM

The disc system consists of the disc mechanism, the servo PCA-A2, and the read/write PCA-A3, as shown in the Disc System functional diagram, figure 4-12. The disc system provides disc memory storage space for more than 16.5 megabytes of data, and permits random access of all data on a sector by sector basis. Serial binary data is transferred from the control system to the disc system during a write operation, and from the disc system to the controller system during a read operation.

The disc mechanism contains three discs which provide five data surfaces (0 - 4) and one servo surface. Data is accessed on the five data surfaces through five read/write heads. Data preamplifiers within the disc mechanism route data between the selected data head and the read/write PCA-A3. Head positioning information is obtained through a read only servo head, which reads permanent prerecorded code from the servo surface. The servo code is preamplified within the disc mechanism by the servo preamplifier and sent to the servo PCA-A2. Commands are sent by the servo system to control movement of the linear actuator which moves the heads.

When the HP 7908 is powered on, the spindle motor and spindle motor brake receive power, and the brake disengages. As the spindle motor begins to rotate, the discs rotate, and the heads, which were resting on the surface of the discs, begin to lift on a cushion of air.

All parts inside the disc mechanism, including the discs, heads, preamplifiers, linear actuator, spindle motor and brake are part of a sealed enclosure which should never be opened, except in a factory clean room.

3-27. SERVO PCA-A2

The disc mechanism within the HP 7908 has a dedicated servo surface on the underside of the lowest disc. The servo surface is preformatted at the factory. The heads can be moved from one track to another by performing a seek operation to find the track, and continuing with a track following operation to remain on track. The track following operation, performed by the servo PCA-A2, automatically keeps the data heads positioned directly over a track.

3-28. SERVO MICROPROCESSOR INTERFACE. The servo microprocessor interface latches commands from the data bus and links two select signals (SA-L and SB-L) to the servo PCA-A2. The data bus allows the CPU on the MPU to either program the configuration of the servo or send current acceleration commands to the Digital-to-Analog Converter (DAC). Position Mode (PMD-L) signals the read/write PCA-A3 when the track follow mode is enabled. The cylinder (CYL-L) signal is low for even cylinders; high for odd cylinders.

3-29. DIGITAL-TO-ANALOG CONVERTER. The Digital-to-Analog Converter (DAC) converts the digital pulses from the data bus into an analog command current. A gain adjust, controlled by the CPU, sets the gain of the DAC which allows compensation for slightly different linear actuator constants.

3-30. DIRECTION SWITCH. The direction switch receives a direction signal from the microprocessor interface which determines the polarity of the actuator command signal going to the power amplifier.

3-31. POWER AMPLIFIER. The power amplifier receives the low current actuator command and amplifies it into two high current signals (LMA and LMB). The two signals drive the linear actuator within the disc mechanism.

3-32. CARRIER AMPLIFIER. Two differential Servo Signals (SS1 and SS2) coming from the disc mechanism are amplified by the carrier amplifier. The Carrier Amplifier output (CA) goes to the peak detector circuit and also to the servo pattern detector. The amplified signal contains two positive peaks. The voltage level of the two peaks is summed and forced to a constant level via AGC feedback to the carrier amplifier.

3-33. PEAK DETECTOR. The two positive peaks in the Carrier Amplifier's output (CA) are detected and held by the peak detector. The voltage difference between the two peaks generates Position Error Signals (PES1 and PES2) which are proportional to the servo head distance from track center. When the servo head is on track, PES1 and PES2 will be near zero volts.

3-34. SERVO PATTERN DETECTOR. The servo pattern detector locks onto the carrier amplifier fundamental frequency of 324 kHz, and multiplies this signal by 16. The 8-times signal (P8-L) and the 2-times signal (P2-L) are used by the read/write PCA-A3 for synchronization.

The once-around index pattern from the servo head is detected by the servo pattern detector and sent to the read/write PCA-A3 (IDX-L). The read/write PCA-A3 slightly delays IDX-L and sends it to the microprocessor PCA-A5 (INDX-L). If the servo head enters the inner or outer guard band area, the servo pattern detector on the servo PCA-A2 will assert either an Inner Guard Band (IGB-L) or an Outer Guard Band (OGB-L) signal which is sent to the microprocessor PCA-A5. The microprocessor returns the proper seek command over the data bus to get the servo head out of the guard area.

3-35. SERVO COMPARATORS. The position error signals are fed to the comparator circuitry to obtain a Track Cross pulse (TKX-H), an ON track signal (ON-H), and an OFF track signal (OF-H). Each time the servo head crosses a track, the position error signals cross through zero volts. The comparator derives the Track Cross pulse (TKX-H) from this zero crossing. When the servo head remains on track center, PES1 and PES2 voltage is low enough to allow the comparator to assert the ON track signal (ON-H). If the servo head is not on track, PES1 and PES2 voltage goes up and causes the comparator to assert the Off Track signal (OF-H). The Differential Signal (DIF-H) derives the phase of the position error signals for odd or even tracks. TKX-H, DIF-H, ON-H, and OF-H are all used by the microprocessor PCA-A5 for head positioning information.

3-36. ACTUATOR LOCK. If power fails in the HP 7908, the actuator lock control circuit on the servo PCA-A2 asserts the solenoid lock signals SP and SM. The retract circuitry brings the heads to the outer guard band and the solenoid locks the actuator arm so that the heads land in a safe area.

3-37. DIAGNOSTIC SIGNAL INJECTOR. The servo PCA-A2 is diagnosed by causing a known signal (OTS) to be injected into the carrier amplifier instead of the servo head signal. If the servo PCA-A2 is working properly, the servo pattern detector will lock onto the diagnostic signal and the comparators will send the proper status information to the microprocessor PCA-A5.

3-38. VOLTAGE REFERENCE. The voltage reference circuitry provides -8.2V and ground for the servo preamplifier within the disc mechanism.

3-39. READ/WRITE PCA-A3

The read/write PCA-A3 formats (encodes) and separates (decodes) serial data. During a write operation, serial binary data from the DMA (DOUT-H) is formatted with the Read/Write Clock (RWC-L) signal. During a read operation, data from the disc mechanism is separated back into serial binary data and sent to the DMA (DIN-H).

3-40. READ/WRITE MICROPROCESSOR INTERFACE AND FAULT LATCH. The microprocessor interface and fault latch connect the MPU to the read/write PCA-A3. The Formatter-Separator Select (FSS-L) signal enables read and write operations. The fault latch can be read by the data bus when Fault Latch Select (FLS-L) is asserted. The fault latch monitors servo Phase Lock Error (PLE-L), Drive Write Fault (DWF-L) and other vital signals. The CPU ascertains disc system status by reading the fault latch over the data bus.

3-41. WRITE GATE GENERATOR. The write gate generator determines when data should be recorded on the disc and when data should not be recorded on the disc. Timing information as well as control signals from the CPU allow the write gate generator to enable the Write Gate (WG-L) signal for a one-sector interval during a write operation.

3-42. SECTOR TIMING LOGIC. The sector timing logic receives an Index Pulse (IDX-L) and a clock signal (P2-L) from the servo PCA-A2, and generates timing signals which control the overall operation of the read/write PCA-A3. The sector timing logic is a state machine which determines when particular operations must be performed.

3-43. DATA FORMATTER. The data formatter accepts the serial data DMA output (DOUT-H) and encodes this data into a Modified Frequency Modulation (MFM) signal. The MFM signal has cell boundaries or windows in which a transition is written for a digital "1", and no transition written for a "0". When two "zeros" occur successively, a transition is written at the cell boundary. The data formatter also generates the sync field and the start bit information during a write operation.

Serial binary data contains a bandwidth (in hertz) from zero (all ones or all zeros) to "f" (alternating ones and zeros), where "f" is the number of transitions per second. Therefore, the circuitry required to write and read normal serial binary data would have to provide a bandwidth equal to the frequency of the data. A more serious problem arises: The data head cannot detect a steady-state signal or bit; transitions are the only means of transferring informaiton. Specifically, the magnetic flux (which causes a bit to be written) is proportional to the change in current per second within the data head. Using the rules for MFM generation, all ones or all zeros produce the maximum frequency of "f", which is the number of transitions per second. Alternating ones and zeros, however, produce the minimum frequency of one-half "f". The bandwidth has been cut in half, and furthermore, a transition represents logical "1"; an absence of a transition (within the bit cell) represents logical "0". Therefore, MFM encoding allows high bit densities to be achieved on a magnetic recording surface using the least bandwidth.

3-44. WRITE DRIVERS. The write drivers provide the current transitions required for the disc's read/write heads to write data properly.

3-45. SIGNAL PROCESSING CIRCUIT. The signal processing circuit performs analog signal processing on the differential data inputs (DX and DY) coming from the disc mechanism. The signal processing circuit suppresses noise, differentiates the signals, detects using a zero cross detector, and provides an AGC loop. The single ended output, Read Data (RDA) goes to the timing recovery circuit.

3-46. TIMING RECOVERY. The timing recovery circuit allows the timing information from the servo PCA-A2 to clock the data during a write operation. During a read operation, the timing recovery circuit recovers clock information from the data as it is read from the disc mechanism. The timing recovery circuit contains a phase-lock-loop which outputs voltage pulses (VCO-H). The VCO-H pulse width is proportional to the time difference between transitions in the MFM-L signal.

3-47. DATA SEPARATOR. The data separator accepts MFM formatted data from the timing recovery circuit and converts it back into a serial binary data stream. The data separator also removes the sync field and start bits which allow only header, data, and error detection information to be sent to the DMA input (DIN-H).

3-48. DISC MECHANISM INTERFACE. The disc mechanism interface converts the control signals from the microprocessor interface to select signals needed by the disc mechanism. Chip Selects (CS0-L and CS1-L) and Head Selects (H1-L and H2-L) are decoded within the disc mechanism to enable one of five read/write heads. The voltages needed to operate the data preamplifiers within the disc mechanism (+6V and -4V) are also provided by the disc mechanism interface. The Write Select (WSE-L) and Write Current (WRMA-H) signals are generated in the disc mechanism interface, and a safe-to-write signal (PSAF-H) is returned by the disc mechanism.

3-49. DISC MECHANISM

The HP 7908 utilizes Winchester technology. Heads are designed to fly very close (approximately 17 microinches) to the surface of the disc. These heads are also designed to take off and land on the disc surfaces. After the discs begin to rotate, the heads rise above the surface of the discs on cushions of air and remain above the surfaces of the discs while they are turning. When the discs begin to slow down, the heads land in the landing zone on each surface. The spindle motor brake prevents prolonged dragging of the heads on the surface of the disc. The braking action begins whenever power is absent from the brake, and the braking action disengages when power is applied to the brake.

3-50. ADDRESSING STRUCTURE. Each data surface is divided into 380 concentric circles called tracks. When a data head is directly over a

track, it can access (read or write) data on that track. A cylinder consists of five separate data tracks, each one equidistant from the center of the disc. Therefore, five tracks can be accessed concurrently, without causing the linear actuator to move (seek). The 380 physical cylinders allow each surface to have 370 ensured logical track addresses available for data storage, 6 tracks for spares, and 4 tracks for system maintenance. Tracks are addressed when both cylinder and head numbers are specified. Each data track is divided into 36 physical data sectors; 35 ensured logical sector addresses available for data storage and one for a spare. Sectors are addressed when both head and sector addresses are specified for a given cylinder. Head addresses range from zero to four and sector addresses range from zero to 35.

3-51. DISC SECTOR FORMAT. A sector (see figure 3-2) is the smallest addressable data storage area on the surface of a disc. Each sector contains a 26-byte preamble, a 256-byte data field, and a 17-byte postamble.

The 26-byte preamble contains synchronization and addressing information. The 20-byte sync field allows the read/write PCA-A3 to lock onto the data before a read operation begins. The start bits mark the beginning of information to come for each sector and tell the read/write PCA-A3 to get ready to access data. The 6-byte header contains status and addressing information. The status byte labels the type of track as logical, spare, defective, or maintenance. The next byte (sector) provides the microprocessor PCA-A5 with the sector's physical address. The head byte provides the physical head number. The next 2 bytes (cylinder), contain the cylinder's physical address. The spare byte contains the number of the defective sector when the spare is needed; when the spare sector is not being used, the spare byte contains the number of the available spare or 35.

The data field contains 256 bytes of available storage space. This data field is the only part of any sector which is transferred to and from the host computer; the preamble and postamble are generated and checked internally.

The 17-byte postamble consists of 2 bytes of Cyclic Redundancy Check (CRC) information, 5 bytes reserved, and a 10-byte gap. The HP 7908 generates the 2 bytes of CRC during a write operation and appends it to the sector. During a read operation, the CRC information is regenerated and compared with the previously generated pattern in exclusive-or fashion which detects any errors.

3-52. SECTOR INTERLEAVING. Sector interleaving (figure 3-3) allows the transfer rate of a device to be matched most efficiently with that of the host computer connected to it. A host computer cannot always process sectors of data as fast as they are presented by the disc. Often, by the time the host computer is ready for another sector, the data head has already passed that particular sector on the disc, and a time delay or latency equal to as much as one revolution of the disc is incurred. Sector interleaving allows the data to be staggered or interleaved by one or more sectors; access time is delayed only enough to equal that of the host computer. Sector interleaving, therefore, eliminates inherent latencies which are characteristic of all disc drive memories. The host specifies the interleave with the "Initialize Media" command.

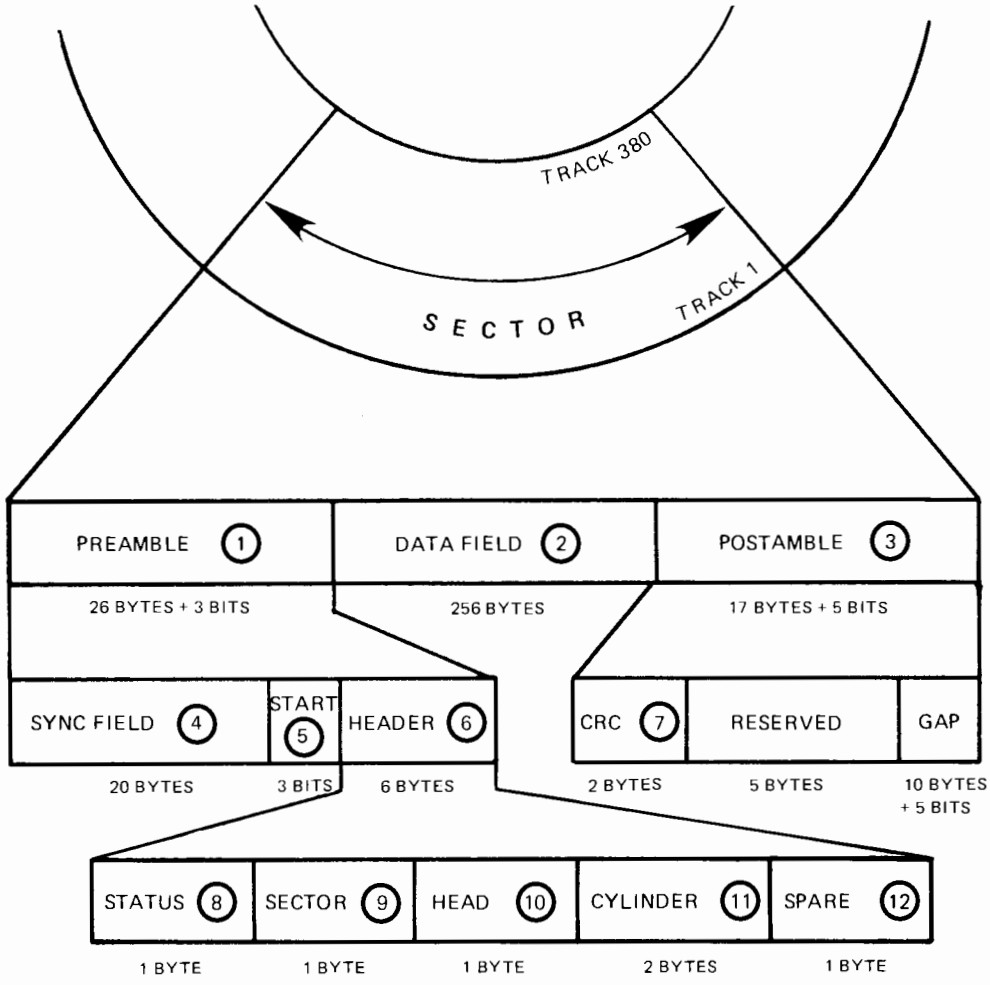
3-53. SPARE TRACKS AND SPARE SECTORS. When a defective track is first discovered (via a persistent disc CRC error detected on the DMA) the controller system must assign a spare track and initialize the bad track as defective. If this is done properly, the device can forget about the spare track; subsequent calls to the defective track will cause the HP 7908 to automatically seek to the spare track whose logical address is now that of the defective track. Four maintenance tracks on each disc surface are in charge of storing spare track information.

When a persistent CRC error is detected, the host can send a "Spare Block" command. This command allows the device to use its sparing algorithm resident in the MPU PCA-A5. If the present track already has its one spare sector being used, the track sparing algorithm is automatically initiated. The logical address of a spared sector or track is kept in a fast look-up table in microprocessor RAM and is also stored on a system maintenance track. Both sparing techniques are transparent to the host once "Spare Block" is initiated.

3-54. SPINDLE MOTOR. The spindle motor within the disc mechanism is a direct drive dc motor, driven directly by the +12V and -12V regulated supplies and therefore comes on whenever the device is powered on.

3-55. SPINDLE MOTOR BRAKE. The spindle motor brake, located near the bottom of the spindle motor, is used to stop the discs quickly when power is removed from the HP 7908. The brake prevents prolonged dragging of the heads on the disc surfaces. Braking action occurs whenever power is absent from the spindle motor; the brake disengages when power is applied.

3-56. LINEAR ACTUATOR. The linear actuator moves the heads to the proper location (cylinder) over the discs. The actuator is a linear dc motor coil attached to four actuator arms, which hold the heads. The linear dc motor coil in the actuator directly drives the actuator arms. The actuator rides smoothly on six precision bearings along two parallel rails.



1. PREAMBLE – 26 BYTES + 3 BITS FOR SYNCHRONIZATION AND ADDRESSING
2. DATA FIELD – 256 BYTES OF AVAILABLE USER DATA
3. POSTAMBLE – 17 BYTES + 5 BITS OF DATA CHECKING
4. SYNC FIELD – 20 BYTES TO ACHIEVE PHASE LOCK
5. START– 3 BITS SIGNAL THE START OF INFORMATION TO FOLLOW
6. HEADER – 6 BYTES FOR STATUS AND ADDRESSING INFORMATION
7. CRC – 2 BYTES FOR CYCLIC REDUNDANCY CHECK
8. STATUS – 1 BYTE FOR TRACK STATUS INFORMATION
9. SECTOR – 1 BYTE FOR SECTOR ADDRESS
10. HEAD – 1 BYTE FOR HEAD NUMBER
11. CYLINDER – 2 BYTES FOR CYLINDER ADDRESS
12. SPARE – 1 BYTE FOR LOGICAL SPARE NUMBER

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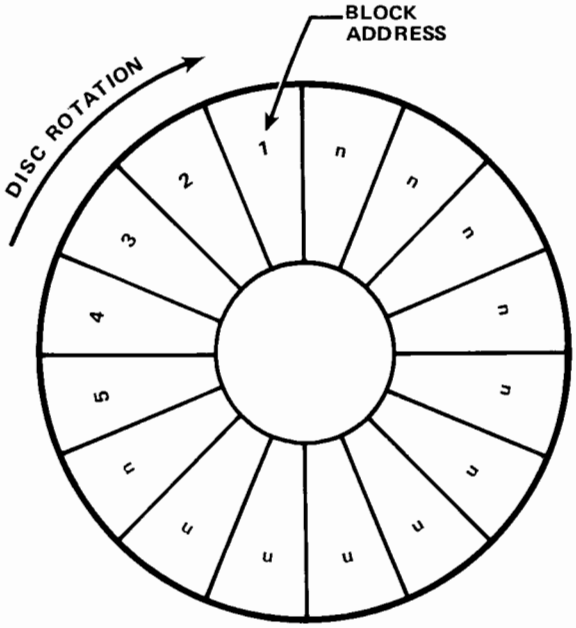
Figure 3-2. Disc Sector Format

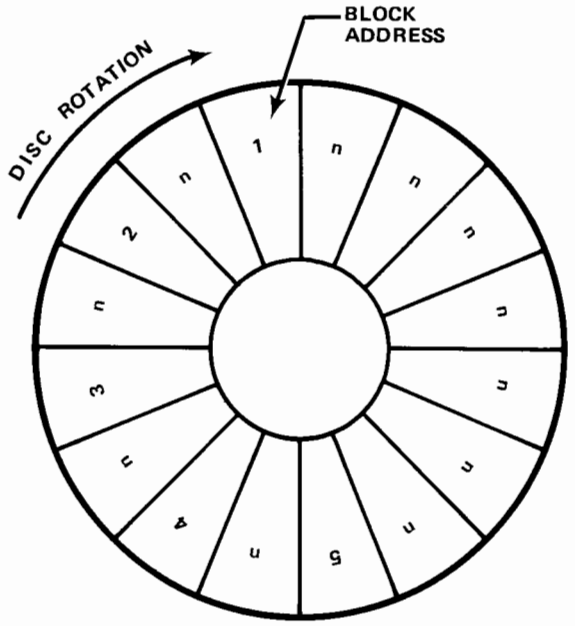


CASE 1

INTERLEAVE = 1

DATA TRANSFER SEQUENCE (BLOCKS 1 - n)

1. The disc drive reads and transmits block 1.
2. The disc drive head is now at block 2 but, because the host is still busy with the first transfer, the drive can not read and transmit the second block.
3. The host finishes accepting block 1 and readies itself for block 2. By this time the drive head has passed the beginning of block 2 and the host will now have to wait for the disc to make a complete revolution back to this block. This induces a latency and degrades system throughput.



CASE 2

INTERLEAVE = 2

DATA TRANSFER SEQUENCE (BLOCKS 1 - n)

1. The disc drive reads and transmits block 1.
2. The host finishes accepting block 1 and readies itself for block 2. Because the blocks are interleaved, the disc drive head is over the intervening block and is approaching block 2.
3. The disc drive head arrives at block 2, and reads and transmits it to the waiting host. By using block interleave to alternate the data blocks, latencies have been reduced and system throughput has been enhanced.

5955-16A

Figure 3-3. Sector Interleaving

3-57. SERVO PREAMPLIFIER. The servo preamplifier gets a signal from the read-only servo head which reads the tri-bit servo code (figure 3-4) from the underside of the lowest disc. The output of the servo preamplifier is a differential Servo Signal (SS1 and SS2) and is sent to the servo PCA-A2.

3-58. DATA PREAMPLIFIERS. Two data preamplifiers are needed to provide the disc mechanism with the capability of addressing the five data surfaces. The Chip select (CS0-L and CS1-L) and Head select (H1-L and H2-L) signals decide which head is to be selected. The bidirectional differential data signals (DX and DY) are connected to the data preamplifiers which allow read data or write data to be amplified.

3-59. TAPE SYSTEM

The tape system consists of the Tape Interface Board (TIB) PCA-A6, and the tape module, as shown in the Tape System functional diagram, figure 4-14. The tape module is comprised of the tape mechanism and the switch PCA-A8 which is attached to the front of the tape mechanism. The tape system provides tape backup storage space for all of the data stored on the disc. Serial binary data is transferred from disc memory via the controller system to tape memory, or from tape memory also via the controller system back to disc memory, as specified by the "Copy Data" instruction.

3-60. TAPE INTERFACE BOARD PCA-A6

The Tape Interface Board (TIB) PCA-A6 uses a state machine to control the data flow to and from the tape mechanism. Data is passed between the TIB data RAM and the DMA PCA-A4 under control of the TIB state machine. The TIB state machine controls the data to be written from the DMA PCA-A4 (DOUT-H), or the data to be read by the DMA PCA-A4 (DIN-H). Channel 2 on the Counter Timer Circuit (CTC) on the microprocessor PCA-A5 is clocked by the Counter Timer Circuit Trigger (CTCT-H) which comes from the TIB state machine. The output of this counter (CTCO-H) is sent back to the TIB state machine and signals the end of a transfer. When a data transfer begins, Start Of Sector (SOS-L) is asserted by being brought low. This tells the DMA PCA-A4 to get ready for a sector transfer. Start Of Data (SOD-L) is asserted or brought low which tells the DMA PCA-A4 that the serial data stream will start on the next Read/Write Clock (RWC-L) edge. Serial data is clocked into or out of the DMA PCA-A4 until the end of the sector is reached. The TIB PCA-A6 encodes the serial binary data with a clock signal to form an MFM data signal during a write (save) operation to the tape; during a read (restore) operation, the MFM encoded signal coming from the tape system is decoded back into serial binary data.

3-61. TIB MICROPROCESSOR INTERFACE. The microprocessor interface connects the MPU PCA-A5 to the tape system. The microprocessor interface on the TIB PCA-A6 connects the CPU'S data bus and enable signals to the tape mechanism and the switch PCA-A8. The data bus is split into two separate buses, the command bus and the status bus. The command bus (CMD 00 - 07) connects the data bus to the tape mechanism while Write (WR-L) is active, and the status bus (ST 00 - 07) connects the tape mechanism to the data bus while Read (RD-L) is active. The command/status bus sequences information back and forth under control of Command Strobe (CSTROB-H), Command Acknowledge (CACKN-H), Status Strobe (SSTROB-H) and Status Acknowledge (SACKN-H). The tape mechanism receives command signals and sends back status signals to the microprocessor PCA-A5. The reset signal (RESET-H) is asserted when the microprocessor PCA-A5 initiates the tape autoload sequence during power-on. Select signals (SELO-H and SEL1-H) are both fixed "low"; this allows the TIB to always address the tape mechanism.

Information written from disc to tape (WRDATA-H) or read from tape to disc (RDDATA-H) is enabled by the READ/WRITE enable line (RNWEN-H). The data is buffered in the TIB data RAM on the TIB PCA-A6.

3-62. TIB DMA INTERFACE AND SERDES. The TIB DMA interface, under control of the TIB state machine, passes serial data to and from the DMA PCA-A4 (DIN-H and DOUT-H). During a write operation, the DMA interface connects the DMA output (DOUT-H) to the TIB data RAM. The serializer/deserializer (SERDES) converts the serial binary data on DOUT-H to parallel binary data for the TIB data RAM. During a read operation, the parallel binary data from the TIB data RAM is converted to serial binary data by the SERDES, and sent to the DMA input (DIN-H).

3-63. TIB DATA RAM. The TIB data RAM provides a buffer for the data on the TIB. Data is converted from serial to bit-parallel and propagated through the TIB data RAM.

3-64. FORMATTER/SEPARATOR. The formatter/separator circuitry changes serial binary data into MFM data for a write to the tape, and MFM data to serial binary data for a read from the tape, under control of the state machine.

3-65. TAPE CYCLIC REDUNDANCY CHECK. The tape Cyclic Redundancy Check (CRC) permits the TIB to perform an integrity check on the data going to or from the tape system. The tape CRC works in a similar fashion to the CRC on the DMA.

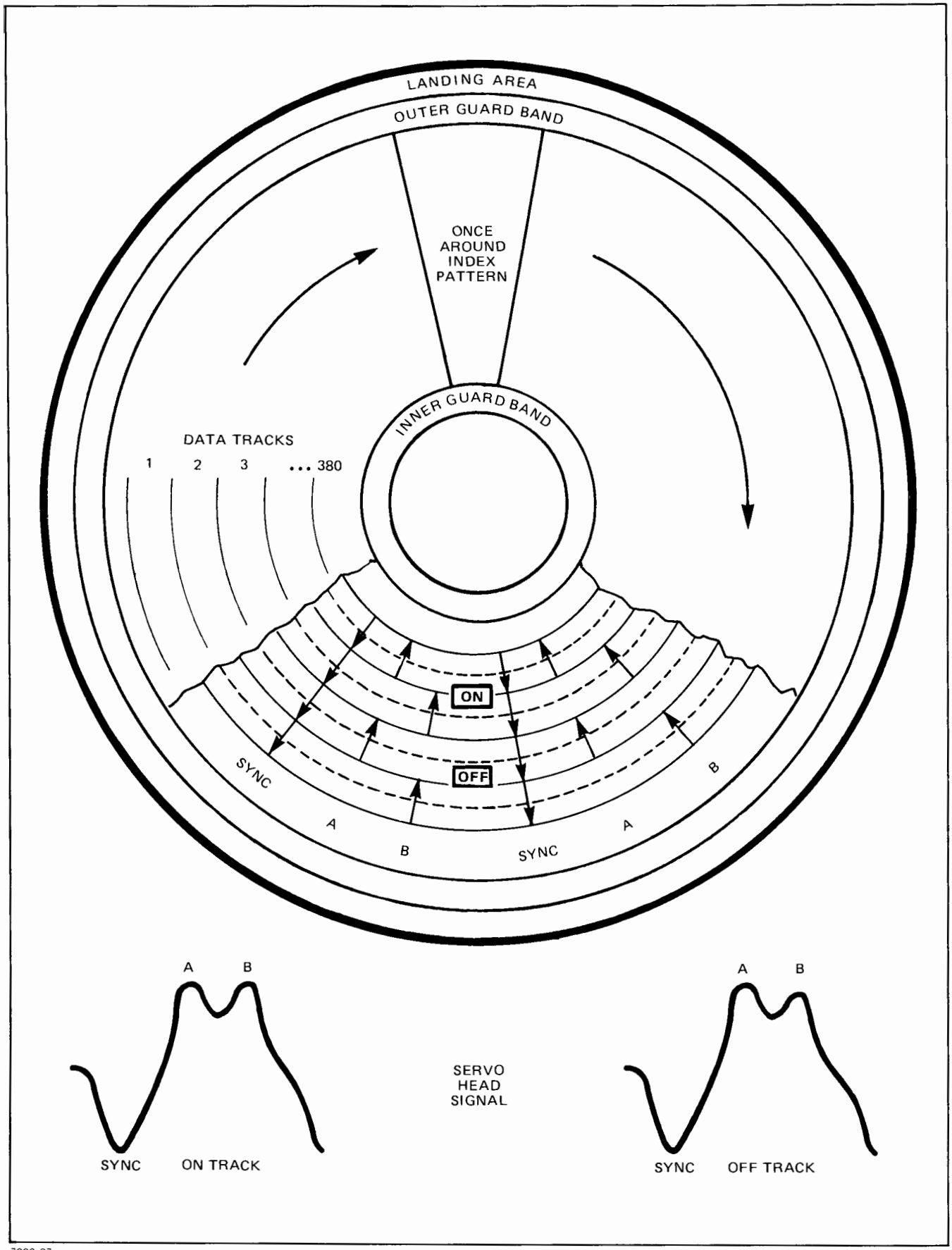


Figure 3-4. Tri-bit Servo Code

3-66. ERROR CORRECTION CIRCUIT. The Error Correction Circuit (ECC) allows data to be reconstructed when its validity is questionable. When data is written to the tape, six frames are transmitted for each block. Frames 1 and 3 are combined in exclusive-or fashion to form frame 5; correspondingly, frames 2 and 4 are combined in exclusive-or fashion to form frame 6. Frames 1 through 4 are data; frames 5 and 6 are error correction information. If an error is suspected in frame 1, frame 3, when exclusive-ored with frame 5, will regenerate frame 1. In this way, any of the four data frames may be reconstructed by combining the appropriate frames.

3-67. TIB STATE MACHINE. The TIB state machine governs all data transfers within the TIB. The Counter Timer Circuit Trigger (CTCT-H) is generated by the TIB state machine and the Counter Timer Circuit Output (CTCO-H) is monitored by the TIB state machine. Control signals are distributed within the TIB to allow data transfers to be sequenced properly.

3-68. CLOCK. The clock is required by the TIB state machine as a reference in order to allow sequential processes to be performed at the proper time.

3-69. TAPE MECHANISM

The tape mechanism has its own microprocessor-based controller which controls the operation of the capstan motor and the head stepper motor. The tape mechanism also contains the signal processing circuitry needed to convert the tape head signal into an MFM encoded TTL signal.

3-70. TAPE MECHANISM CONTROLLER. The tape mechanism controller receives commands from the CPU over the Command Bus (CMD 00 - 07) and sends back status over the Status Bus (ST 00 - 07). The tape mechanism controller adjusts the position of the stepper motor and the gain of the tape signal processor, and provides control for the capstan motor.

3-71. TAPE CARTRIDGE. The tape cartridge is preformatted (see figure 3-5) with a full width recording device which writes keys across the one-quarter inch width of the tape. A key contains a unique number which identifies the location along the length of the tape. The 150-foot tape has a capacity of 16.7 megabytes of user data achieved by recording 1022 blocks on each of 16 tracks; the 600-foot tape has a capacity of 67 megabytes of user data achieved by recording 4088 blocks on each of 16 tracks. In either tape, each block contains 1024 bytes of data, plus synchronization, header, and error correcton information. The 16 separate tracks are obtained by utilizing a movable single track read/write head. Blocks are accessed in the forward direction for even tracks and in the reverse direction for odd tracks; this minimizes rewind time. Keys can be read in both directions. A mechanical "write protect" is built into the cartridge also.

Tape history information is stored on a use log. During the unload sequence, the use log is updated with two entries: auto-load count and total number of blocks accessed. The auto-load count is the number of times the cartridge has been inserted into the tape mechanism.

The tape has one out of 512 blocks set aside as a spare. A block may be skip spared or jump spared. Skip sparing involves changing a bad block's address and utilizing the next available spare as determined by a look-up table. Skip sparing results in minimal latency but requires addresses to be altered. Jump sparing, however, replaces the bad block with the closest available spare according to seek time. Any future reference to the jump spared block generates a seek directly to the spare.

3-72. TAPE HEAD. The tape head writes or reads on any of the 16 available tracks on the tape cartridge. A stepper motor controlled by the tape mechanism controller drives the tape head up or down across the width of the tape.

3-73. CAPSTAN MOTOR. The capstan is a small cylindrical drive wheel used to drive the tape cartridge. The capstan motor is driven by the tape mechanism controller in either direction so that data can be written back and forth across the tape.

3-74. STEPPER MOTOR. The stepper motor, driven by the tape mechanism controller, drives the single track tape head up or down to allow accessing of data on 16 separate tracks.

3-75. TAPE SIGNAL PROCESSOR. The signal processor circuit connects the proper line to the tape head during a data transfer. For a read, the MFM read signal (RDDATA-H) is connected; for a write, the MFM write signal (WRDATA-H) is connected. The read/write enable line (RNWEN-H) comes from the microprocessor interface on the TIB PCA-A6. The signal processor can also provide gain for the RDDATA-H or WRDATA-H signal.

3-76. SWITCH PCA-A8

The switch PCA-A8 provides the outside interface for the tape system. Three switches and two indicator lights are located on the switch PCA-A8; two of the

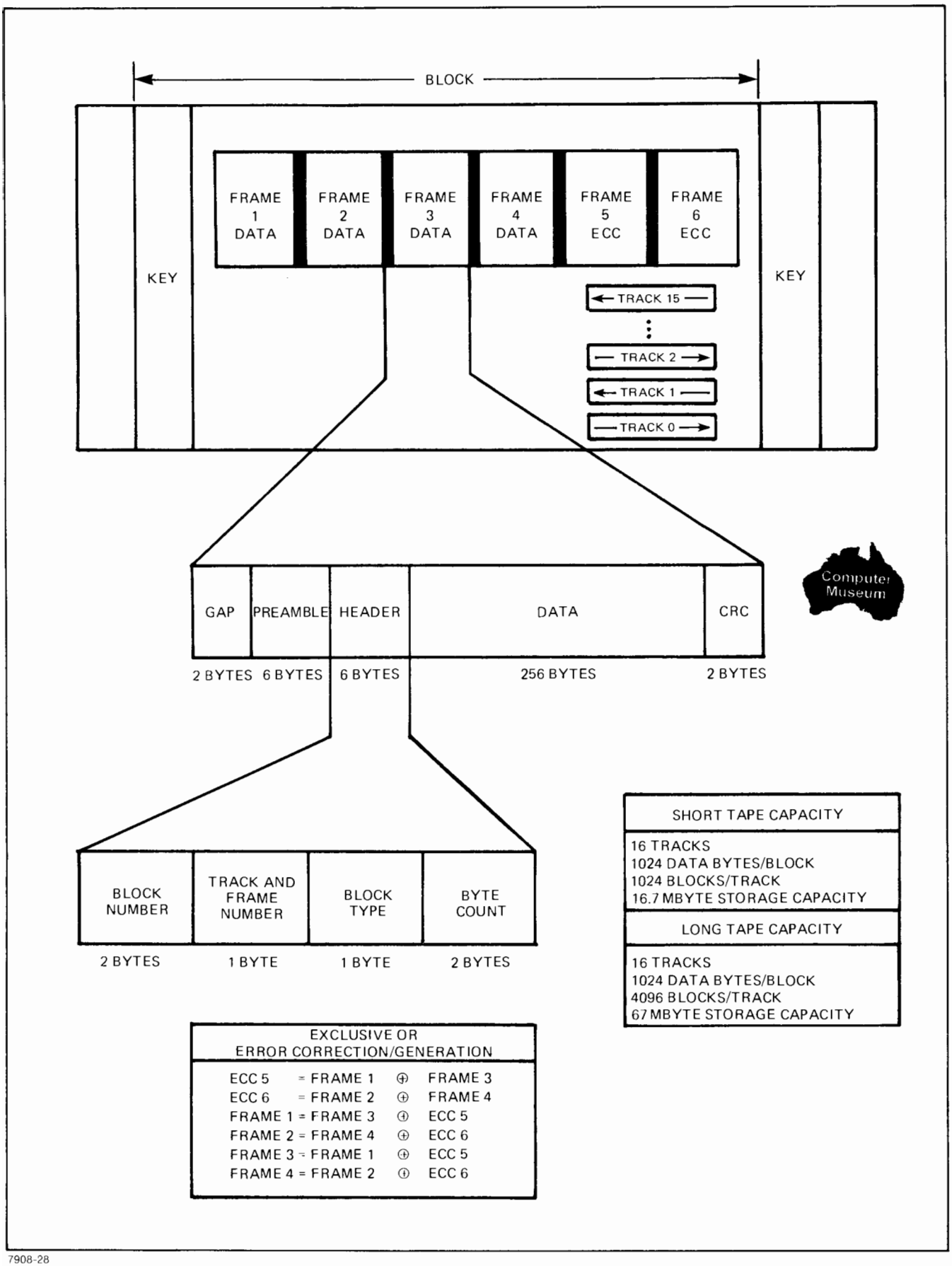


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Figure 3-5. Tape Block Format

switches, SAVE and RESTORE, offer an image back-up capability when the host computer is not able to do this using the HP-IB channel. Image backup stores a virtual copy of the disc's contents to the tape cartridge.

CAUTION

Before a DC 600 tape cartridge is used, it must be certified. Tapes are certified by any host system which supports CS/80 devices.

3-77. SAVE. A full volume (the entire disc) can be copied to the tape cartridge by using the SAVE switch, located on the front of the switch PCA. Save (SW1-L) can be done only when the tape system BUSY light (LAMP1) is off. The save operation does not require any host intervention, therefore it can be performed while the disc/tape drive is on or off line; however, when on line, the disc/tape must request release from the host to perform a save. To initiate a full volume (image) back-up of the disc, press the SAVE switch once; the BUSY light should begin to flicker (eight times per second). While the light is flickering, press the BUSY switch again to begin the back-up. If a save is attempted while the disc/tape drive is on line, the BUSY light may not flicker indicating that the host has not granted release and that the save operation will not be performed. If this occurs, the save operation should be retried by pressing the SAVE switch again.

The transfer will start from logical block 0 on the disc and tape, and proceed until the disc volume has been completely transferred, or end of volume occurs on the tape. After the last block is written, a file mark is added. When SAVE is successfully completed, the cartridge is unloaded. If a data error is encountered on the disc, the best guess is sent to the tape, and the save operation continues to completion. However, the tape is not unloaded and the flashing BUSY light (once per second) indicates a fault. Pushing the UNLOAD switch at this time unloads the cartridge and clears the fault conditions. Unreadable keys on the tape are marked in the spare table and skipped. The save operation continues to conclusion with no fault indicated, and the cartridge is unloaded. If a hardware fault interrupts the save, the BUSY light flashes (if possible) and the tape is stopped. The subsystem returns from release with the appropriate failure status.

3-78. RESTORE. The RESTORE switch, located on the front of the switch PCA, performs the same function as the SAVE switch but in reverse: the entire contents of the tape are copied to the disc. In all other aspects the operation of the RESTORE switch is identical to the operation of the SAVE switch.

3-79. UNLOAD. Pressing this front panel mounted button, following a request release sequence with the host system, updates the error logs near the beginning-of-tape (if necessary), rewinds the tape to End-of-Tape (EOT) area, updates the use log, and unlocks the cartridge with an audible buzz. If the UNLOAD button (SW3-H) is pushed during a save or restore operation, those operations will temporarily stop. If it is then pushed a second time and while the BUSY light is flickering, an unload will occur. If it is not pushed within 5 seconds, the save or restore operation will resume. Pushing the UNLOAD button during any other active operation initates a request release sequence to the host before unloading the tape (thus the host has control of this). The unload sequence can also be executed from the system via an unload command.

3-80. EJECT. This slide lever ejects the cartridge out of the tape mechanism. A mechanical interlock prevents its actuation unless the cartridge has unloaded as described in paragraph 3-79.

3-81. BUSY INDICATOR. The BUSY indicator, when lit, indicates that a tape operation is in progress. A 'flickering' light (8 times per second) is used in the save and restore sequences, and a flashing light (1 time per second) indicates a fault during save or restore.

3-82. PROTECT INDICATOR. The PROTECT indicator indicates that the present cartridge installed in the tape mechanism is protected against a write operation (SAVE).

3-83. POWER SYSTEM

The power system consists of the rectifier assembly and the Regulator PCA-A1, as shown in the Power System functional diagram, figure 4-16. The power system develops the various dc supply voltages from the ac input power, regulates each supply, and distributes these voltages to the appropriate area.

3-84. RECTIFIER ASSEMBLY

The rectifier assembly consists of the line filter, main fuse, power switch, interconnect PCA-A10, transformer, rectifier diodes, rectifier PCA-A9, and the saturable inductors. The rectifier assembly provides unregulated power to the regulator PCA-A1 within the card cage via the rectifier/regulator cable.

3-85. LINE FILTER. The line filter is a low pass, bilateral network that attenuates common-mode noise and minimizes the susceptibility of the device to conducted RF energy present on the ac input line.

3-86. MAIN FUSE. The main fuse provides protection for the primary winding of the main transformer in the rectifier assembly.

3-87. POWER SWITCH. The power switch applies power to the HP 7908 when placed in the "1" position.

3-88. INTERCONNECT PCA-A10. The interconnect PCA-A10 provides the strapping capability to operate from 88 to 127 Vac (voltage strap, part no. 07908-60026) or from 180 to 253 Vac (voltage strap, part no. 07908-60027). Option 015 is the 180 to 253 Vac model. The *HP 7908 Operating and Installation Manual,* part no. 07908-90902, provides information on the strapping options.

3-89. TRANSFORMER. Transformer T1 steps down the ac line voltage and also helps attenuate high voltage common-mode noise. The Faraday shield on T1 offers noise a low resistance path to ground. The varistors (RV1 and RV2) across the line, hot to neutral, protect the device electronics from high voltage normal-mode transients. One secondary winding of T1 is used to provide 115V to the fan. This circuit is protected by F255.

3-90. RECTIFIER DIODES. The two rectifier diodes, CR1 and CR2, provide full wave rectification for the +5V, +12V, and -12V unregulated supplies.

3-91. SATURABLE INDUCTORS. All three supplies are sampled and coupled back via the feedback network. The voltages are compared against a reference; the output of the feedback network drives the saturable inductors L1 and L2.

When the sampled voltage is too low, the feedback network drives the inductors into saturation. This minimizes the voltage drop across the inductors which increases the voltage on the primary of T1. The increase in voltage on the primary of T1 increases the voltage on the secondaries, and thus increases the unregulated output voltage.

When the sampled voltage is too high, the feedback network drives the inductors out of saturation to a point where more input voltage is dropped across the inductors. The reduced voltage on T1 decreases the unregulated voltage output.

3-92. RECTIFIER PCA-A9. The rectified voltages are applied to the rectifier PCA-A9 which consists of: filter networks for +5V unregulated, +12V unregulated, and -12V unregulated; a feedback network for voltage stabilization; voltage to drive the cooling fan; and fuse protection for all circuits.

The +5V unregulated is filtered by C320 and C350. DS172 (red) indicates that C320 and C350 are charged. DS173 (green) indicates the +5V unregulated circuit is active and F291 is not open.

The +12V unregulated supply is filtered by C370. DS174 (red) indicates that C320 is charged. DS175 (green) indicates the +12V unregulated circuit is active and F290 is not open.

The -12V unregulated supply is filtered by C390. DS170 (red) indicates that C390 is charged. DS171 (green) indicates the -12V unregulated circuit is active and F195 is not open.

3-93. REGULATOR PCA-A1

The Regulator PCA-A1 provides six regulated voltages to operate the device and also generates Master Reset (MRST-L) and Power Fail (PFAIL-L) signals.

The six regulator circuits are designed to maximize the operating range of the circuit while minimizing the circuit power dissipation.

At power-on, the voltage regulators are sequenced on. The +12V, +12L, -12L, and -12V regulators turn on first. The +5V regulator turns on next followed by the +12VT regulator. The +12VT regulator will not turn on until the +5V regulator reaches operational value. There is no specified time delay between the turn-on of each circuit.

Each regulator uses feedback to maintain the regulated output at a constant level. Each regulator is provided with over-voltage protection which is triggered at approximately 15 percent over rated voltage. When the protection circuit is triggered, the appropriate fuse on the rectifier PCA-A9 will open.

The regulator PCA-A1 also contains over-temperature protection. If the regulator circuit exceeds 93°C (200°F) a thermal switch shorts the reference voltage, removing power from the device.

The PFAIL-L line is used to prepare the device for impending loss of power. When power is lost the PFAIL-L goes low. After approximately 700 μs the MRST-L line goes low. This active low line makes the HP 7908 nonoperational.

3-94. AIR CIRCULATION SYSTEM

The air circulation and filtration system in the HP 7908 consists of three separate systems. Air is circulated and filtered in a closed system within the sealed portion of the disc mechanism. The second system consists of the cooling air which is cycled over the PCA's and out the rear of the device by an internal fan. The third system, a fan on the spindle, cools the spindle motor and the rectifier assembly.

3-95. HP 7908 DEVICE OPERATION

Device operation consists of power-on characteristics, head positioning, data transfer operations, and power-off characteristics.

3-96. POWER-ON SEQUENCE

When the HP 7908 is first powered on, a power-on routine is initiated in which many hardware checks are implemented. The power-on routine performs a complete device verification in a minimum amount of time. While the spindle motor is accelerating to normal speed, several micro-diagnostics are implemented on each PCA. Once the spindle has reached operating speed (3,600 rpm), higher level macro-diagnostics such as seeks, reads, and writes are performed. When the tests have completed, the device comes on-line and can be accessed by the host computer.

3-97. DISC HEAD POSITIONING

Disc head positioning involves moving the heads to any available data track (seeking) and keeping the heads placed directly over that track (track following). Seeks are initiated from the MPU as determined by an algorithm resident in MPU ROM; track following is done entirely with hardware located on the servo PCA-A2.

3-98. SEEK. A seek can be movement of heads from one track to another or simply a head switch. Seeks are completely under firmware control. A seek is performed when a full track has been accessed or when a command is received which requires a new target address. A head switch is a zero track seek initiated by the MPU. Track-to-track seeks are accomplished in the following manner: the microprocessor PCA-A5, through the use of a stored algorithm, adjusts the duration and amount of current applied to the linear actuator within the disc mechanism. The CPU sends a command over the data bus which is received by the microprocessor interface on the servo PCA-A2, and sent to the Digital-to-Analog Converter (DAC). An analog acceleration signal is sent from the DAC to the power amplifier during a seek. The power amplifier's output signals (LMA and LMB) drive the actuator. Forward or reverse accelerations are determined by the microprocessor and a reverse direction signal (one bit of the CPU's data bus) is used to control the direction switch on the servo PCA-A2.

When the stored algorithm in microprocessor ROM determines the actuator position to be about halfway between the desired and initial cyclinders, the CPU sends a command over the data bus which reverses the current in the actuator; this begins deceleration of the actuator arms and heads. Deceleration is constantly adjusted by comparing the actuator velocity obtained from the Track Cross (TKX-H) signal as a function of position to the stored algorithm. This algorithm compares where the actuator is and where it should be and adjusts the reverse current to control the actuator velocity. Once the microprocessor determines that the actuator is at the desired cylinder it switches control to the track following circuitry on the servo PCA-A2.

3-99. TRACK FOLLOWING. A tri-bit signal is pre-formatted all the way around the servo surface except for a once-around index pattern. The index pattern is used by the servo pattern detector to generate an Index signal (IDX-L) which controls the positioning of data sectors. Inner and outer guard bands on the boundaries of the servo surface are coded with special patterns indicating to the servo PCA-A2 that the heads are not in the proper area of the disc.

The servo information is picked up by the servo head and sent to the servo signal preamplifier within the disc mechanism. A voltage reference circuit on the servo PCA-A2 provides power for the servo head preamplifier within the disc mechanism. Two differential servo signals (SS1 and SS2) come from the servo signal preamplifier and are amplified by the carrier amplifier on the servo PCA-A2. The Carrier Amplifier output (CA) drives the peak detector circuit and also sends a sync pulse to the servo pattern detector. The amplified tri-bit signal contains two positive peaks, which are detected and held by the peak detector circuit. The voltage level of the two peaks is summed and forced to a constant level via AGC feedback to the carrier amplifier. The voltage difference of the two peaks generates Position Error signals (PES1 and PES2), which are proportional to servo head distance from track center. When the servo head is on track, the position error signals will be near zero volts.

3-100. DATA TRANSFER

All data coming from or going to the HP 7908 goes through the DMA PCA-A4. The MPU enables each sector transfer individually while constantly monitoring DMA status to prevent overrun in the DMA data RAM. The DMA controls HP-IB data overrun without MPU intervention.

The device begins a read, write, or copy data operation by seeking to the specified track. After the head is over the center of the track, the device reads or writes the track of information. When the HP 7908 has finished reading or writing the first surface's track, the HP 7908 switches to the next head. After the host has finished with this surface's track, it selects the next head. This process repeats until all five data surfaces have been accessed. Now a seek is performed to the next consecutive cylinder. This process continues until there is no more data or no more storage space available.

3-101. WRITING DATA. The sequence of events which allows the HP 7908 to write data begins with the assertion of the locate and write command from the host. The sector timing logic on the read/write PCA-A3 is a state machine which determines the location of sectors on the disc. A write gate generator enables the write drivers for one sector each time a write is initiated. The microprocessor and servo circuitry begin a seek operation to move the head over the desired track. (Refer to paragraph 3-98.) After the seek operation has completed, the track following operation is used to keep the head over the center of the track. (Refer to paragraph 3-99.) Data comes over the HP-IB in parallel form, one byte at a time, and it is sent to the data formatter on the read/write PCA-A3 in serial form (DOUT-H). The data formatter formats the data with the clock signal which forms an MFM data stream. The write drivers amplify the formatted MFM serial data and the differential outputs (DX and DY) are sent to the preamplifiers within the disc mechanism. The microprocessor determines the head to be selected and the microprocessor interface on the read/write PCA-A3 sends this information to the disc mechanism interface.

The heads fly over the surface of the disc on a cushion of air. When a head is near the outer edge of the disc (cylinder 1) it flies at a greater distance above the surface of the disc than at cylinder 380. This difference in the flying height is adjusted for by varying the amount of write current to the head depending on cylinder location. The controller system always keeps track of the current head, cylinder, and sector being accessed.

3-102. READING DATA. The sequence of events which allows the HP 7908 to read data begins with the assertion of the locate and read command from the host. The microprocessor PCA-A5 and the servo PCA-A2 begin a seek operation in order to move the head over the desired track. After the seek operation is completed, the track following operation is used to position the head over the center of the track. The signal processing circuitry on the read/write PCA-A3 accepts data from the data preamplifier. This signal is processed and sent to the timing recovery circuit. The timing recovery circuit recovers the clock signal from the MFM encoded signal from the disc. The data separator decodes the MFM signal into a binary bit stream, and generates the Data Timing Pulse (DTP-L). The binary bit stream is sent in serial form to the DMA circuitry on PCA-A4 (DIN-H). The DMA PCA-A4 shifts the information out in parallel form one byte at a time over the HP-IB.

3-103. COPY DATA. Copy Data is a CS/80 instruction which provides a method of transferring data from one unit to another. In the HP 7908, this instruction allows data to be copied from disc to tape or from tape to disc. Any errors found in the source during a copy will be noted in the status report returned following the copy data operation, along with the address of the first error. The transaction will terminate during a copy data from disc to tape if a bad key is detected, unless auto sparing is enabled. For more details on the copy data instruction, see the *CS/80 Instruction Set Manual*, part no. 5955-3442.

3-104. POWER-OFF SEQUENCE

When power is removed from the HP 7908, the sequence of events is the same regardless of whether it is due to a power failure or a desired shutdown of the device.

The spindle motor begins to slow down as soon as power is removed from the device. The Power Fail (PFAIL-L) signal coming from the regulator PCA-A1 goes low when power is removed. When PFAIL-L is sensed low by the read/write PCA-A3, the present write operation is completed and the write circuitry is then disabled by the software resident in MPU ROM. As the supply voltage approaches zero, the spindle motor brake is engaged. The retract circuitry on the servo PCA-A2 moves the head to the landing area at the outside edge of the disc. The actuator lock circuit on the servo PCA-A2 automatically locks the actuator in place. After the spindle motor brake is applied, the heads land on the surface of the discs and the discs stop rotating.

SERVICE INFORMATION

SECTION IV

4-1. TROUBLESHOOTING THE HP 7908

WARNING

The HP 7908 does not contain operator-serviceable parts. To prevent shock, refer all maintenance activities to service-trained personnel.

Note: The HP 7908P and HP 7908R require no preventive maintenance.

This section contains information useful for troubleshooting the HP 7908 Disc/Tape Drive. Included are functional diagrams, troubleshooting flowcharts and wiring diagrams. Figure 4-1 shows the diagnostics which are performed at power-on. Figure 4-2 gives the location of the controls and switches used to isolate malfunctions.

4-2. SERVICE TOOLS

Special tools and service aids needed to service the HP 7908 are listed in table 4-1.

4-3. FLOWCHARTS AND STATE DIAGRAM SYMBOLS

Figure 4-3 illustrates the symbols used on the troubleshooting flowcharts and state diagram. The state diagram in figure 4-5 is a representation of the self-test sequence using the rear panel switches. Refer to tables 4-4 and 4-5 for a complete list of error codes. The flowcharts in figure 4-4 provide instructions necessary to isolate a malfunction to a specific printed circuit assembly (PCA) or module. If a malfunction cannot be isolated to a particular item using this procedure, refer to the *CS/80 External Exerciser Reference Manual,* part no. 5955-3462.

4-4. SYSTEM FUNCTIONAL DIAGRAMS

Figures 4-6 through 4-16 are functional diagrams and PCA layouts for the HP 7908. Each functional diagram is labeled with a bold number. This number is used to direct the user from diagram to diagram. These include the Interconnect Diagram (1), Controller System (2), Disc System (3), Tape System (4), and Power System (5). Each of the systems is discussed in detail in Section III, Functional Operation. When a TTL digital signal is specified, a hyphen (-) and an "H" or "L" follows a mnemonic. "H" signifies an active high signal, and "L" signifies an active low signal. Signals without a hyphen and an "H" or "L" are analog signals.

Table 4-1. Tools and Service Aids

Description	HP Part No.
Mother PCA-A7 Removal Tool	09815-20602
Pozidriv Screwdriver	8710-0899
Pozidriv Screwdriver	8710-0900
Tape Head and Capstan Cleaning Tool	9300-0767
Tape Head Cleaning Solution (see WARNING below)	8500-1251
Torque Driver	1535-2653
Pozidriv Bit	8710-0903
IC Inserter	8710-1213
Allen Wrench	8720-0020
Thermal Grease	6040-0239
TORX® Driver Kit (includes the following items)	8710-1426
Bit, T6	8710-1424
Bit, T7	8710-1423
Bit, T8	8710-1422
Bit, T9	8710-1421
Bit, T10	8710-1418
Bit, T15	8710-1415
Bit, T20	8710-1416
Bit, T25	8710-1417
Bit, T27	8710-1420
Bit, T30	8710-1419
Driver Handle	8710-1413
Extension	8710-1425
Pouch	8710-1412

TORX® is a registered trademark of Camcar Division of Textron, Inc.

WARNING

All products which utilize tape head cleaner are shipped with a Material Safety Data Sheet (MSDS). Follow all applicable safety precautions when using the tape head cleaner.

4-5. DIAGNOSTICS

4-6. INTERNAL DIAGNOSTICS

The HP 7908 is capable of locally executing three troubleshooting routines which have been programmed into the microprocessor ROM. All routines exe-

cute thorough hardware checks. The self-test routine performs a short error rate test. The diagnostic routine performs an extensive seek and verify test. The power-on routine performs a hard reset and delays for the spindle to reach speed.

The HP 7908 has two switches and a seven-segment hexadecimal display located on the edge of the microprocessor PCA-A5. When first powered on, the device enters normal mode. In normal mode, momentarily pressing the self-test switch will run self test, and momentarily pressing the diagnostic switch will run diagnostics. Self test takes about 15 seconds; diagnostics take about 90 seconds (with tape installed). Pressing both switches momentarily will cause a power-on to occur and is equivalent to turning the HP 7908 power switch to "0" and then to "1" again.

The period on the status readout indicates that the device has finished execution of a test or has processed an input from one of the switches. When in normal mode, holding either switch depressed until the display flashes causes the HP 7908 to enter supplemental mode. Supplemental mode should only be used for troubleshooting the HP 7908. Once in supplemental mode, a number or the letter "*P.*" appears on the display. "*P.*" means the HP 7908 passed all tests which were run. If a number appears, this indicates a suspect condition. Press the self-test switch momentarily to see a two-digit error code (displayed one digit at a time) associated with the suspect condition which was displayed. The two digits represent a test error (TERROR) code as shown in table 4-4. Pressing the diagnostic switch momentarily will show the next suspect condition, if any. Any time "-." appears on the display, the last suspect condition or last error code has been displayed.

At any time, either switch can be held until the display flashes, and the results of the test which was run can be displayed again. To exit supplemental mode and return to normal mode, press both switches momentarily.

Once the first CS/80 instruction is received by the HP 7908, background diagnostics are enabled. This permits the HP 7908, when idle, to check itself at approximately two-second intervals. Background diagnostics monitor the controller system and the fault latch for vital information during idle states. An idle state occurs when the host CPU has not conversed with the HP 7908 for one second or more. Each time background diagnostics are completed, a "*P.*" is displayed on the status readout; therefore, during idle states the status readout will display a flashing "*P.*" at two-second intervals.

4-7. EXTERNAL EXERCISER

The CS/80 external exerciser is an interpreter which links the vast set of internal diagnostics and utilities within the HP 7908 to a service-trained person. The *CS/80 External Exerciser Reference Manual*, part no. 5955-3462, illustrates in detail how the exerciser interfaces to any CS/80 device; included here is specific information for the HP 7908. Table 4-3 is a list of all external exerciser commands which are recognized by the HP 7908.

Table 4-5 lists the drive error (DERROR) codes which can be passed to the CS/80 external exerciser. Following are definitions for each command and a breakdown of any special attributes for that particular command.

4-8. INTERNAL DIAGNOSTIC TEST (DIAG). This test initiates any of the internal micro- or macro-diagnostics (see figure 4-1) within the HP 7908. When the exerciser prompts for the diagnostic number, the numbers in table 4-2 are valid entries.

4-9. READ REVISION NUMBER UTILITY (REV). This utility reads the revision numbers of the firmware installed within the HP 7908. The external exerciser will display part numbers and their current revision numbers.

4-10. READ DRIVE TABLES UTILITY (TABLES). This utility returns values stored in special tables within the HP 7908. A list of the tables is as follows:

Table Number	Description
1	Disc Spare Track Table
5	Servo Adaptation Table
10	Manufacturer's Tape Block Table
11	Tape Spare Block Table

The disc spare track table lists the logical tracks which have been spared for each head, and which sequential spare (scalar) was used to replace the defective track. The corresponding physical cylinder address for each scalar is as follows:

Scalar Number	Physical Cylinder Address
0 - 4	32
5 - 9	96
10 - 14	160
15 - 19	224
20 - 24	288
25 - 29	352

The servo adaptation table shows the forward and reverse DAC gain, DC force offset, and nonuniform track spacing values. The manufacturer's tape block table identifies the origin and size of the tape cartridge. The tape spare block table contains the physical addresses of tape blocks which are spared.

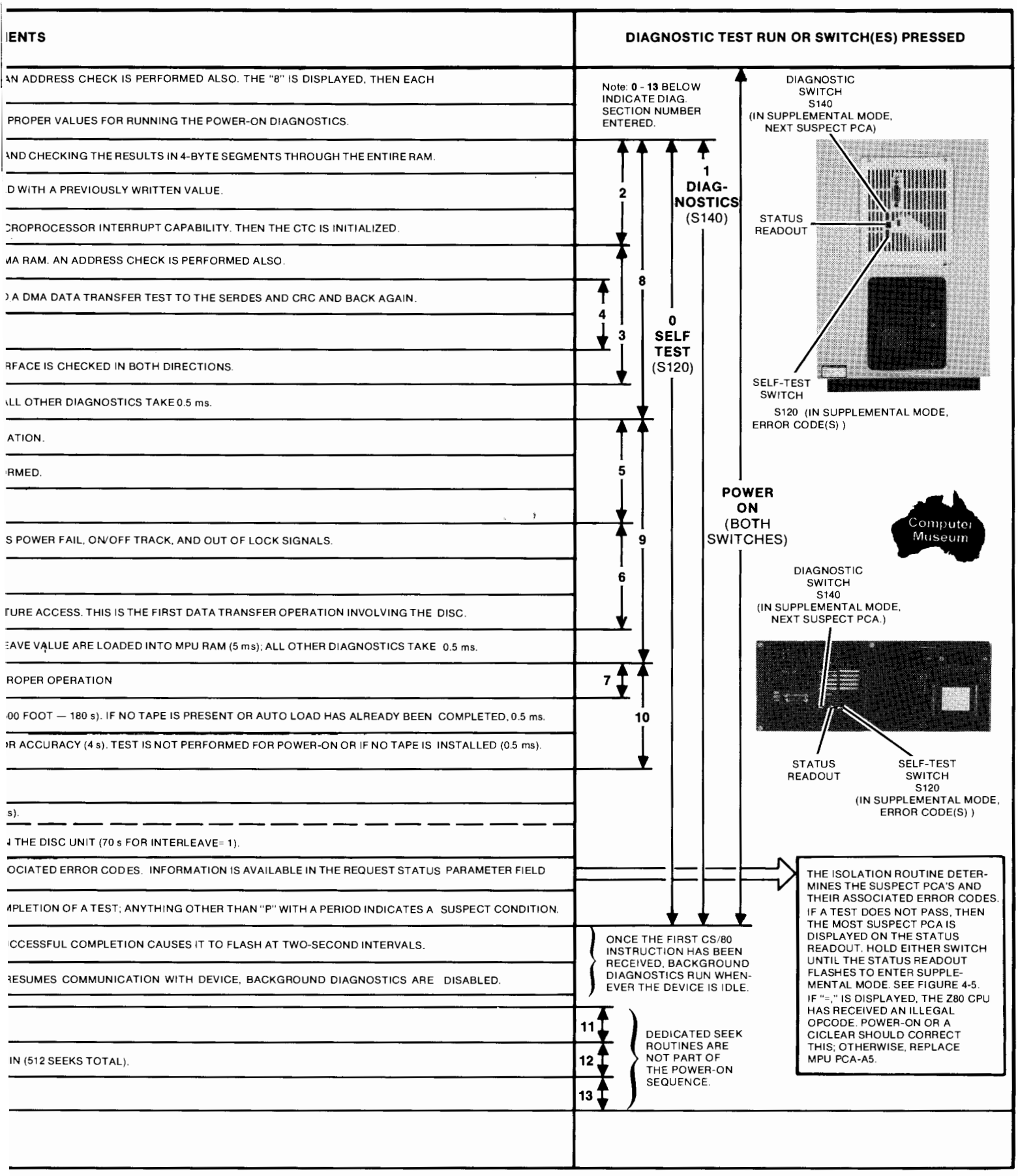

Figure 4-1. Micro- and Macro-diagnostics

TIME (APPROX)	STATUS READOUT	OPERATION PERFORMED	COMM
4 s	18	DESTRUCTIVE MPU RAM TEST	THE MPU RAM IS CLEARED, THEN SPECIFIC PATTERNS ARE MARCHED THROUGH THE RAM. SEGMENT LIGHTS SEPARATELY TO ENSURE LED OPERATION.
7 ms	10	INITIALIZE SOFTWARE TABLES	THE CPU REGISTERS ARE CLEARED, AND THE STATE VARIABLES IN MPU RAM ARE SET TO THE
0.1 s	5	TEST MPU RAM	THIS NON-VOLATILE TEST INVOLVES DOUBLE-COMPLEMENTING EACH ADDRESS IN MPU RAM
0.5 s	6	MPU ROM CHECKSUM	A CHECKSUM VALUE IS OBTAINED FROM EACH 4-KBYTE SEGMENT OF MPU ROM AND CHECKE
4 ms	3	MPU CTC TEST	EACH OF THE 4 COUNTERS WITHIN THE CTC IS CHECKED FOR COUNTING ACCURACY AND MI
0.2 s	7	TEST DMA RAM	FIRST THE DMA RAM IS CLEARED, THEN SPECIFIC PATTERNS ARE MARCHED THROUGH THE DI
3 s	17	TEST DMA PCA	COMPLETE MPU-TO-DMA INTERFACE TEST INCLUDING DMA DATA RAM AND HEADER RAM, ANI
0.5 ms	19	ECC TEST (NOT INSTALLED IN 7908)	ERROR CORRECTION CHIP (ECC) IS CHECKED USING A KNOWN ERROR PATTERN.
10 ms	4	PHI TEST	THE DATA PATH BETWEEN THE HP-IB AND THE DMA DATA RAM INCLUDING THE MPU-PHI INTE
SEE COMMENT	2	SPINUP DELAY	THE POWER-ON TEST REQUIRES A 15 SECOND DELAY FOR THE SPINDLE TO REACH 3600 RPM;
0.5 s	C	TEST SERVO PCA	THE SERVO CIRCUITRY INVOLVED WITH SEEKS IS TESTED AND CHECKED FOR CORRECT OPEF
4 s	21	DYNAMIC SERVO TEST	ADJUSTMENT TABLES FOR FUTURE SEEKS ARE DERIVED AND A DYNAMIC SEEK TEST IS PERFC
30 ms	1A	SERVO - READ/WRITE INTERFACE TEST	THE INTERFACE BETWEEN THE SERVO AND READ/WRITE PCA'S IS CHECKED.
0.5 ms	E	READ FAULT LATCH	THE FAULT LATCH (ON THE READ/WRITE PCA) GATHERS VITAL STATUS INFORMATION SUCH A
0.2 s	F	READ/WRITE - DMA INTERFACE TEST	THE INTERFACE BETWEEN THE READ/WRITE AND DMA PCA'S IS CHECKED.
1 s	1b	ACCESS MAINTENANCE TRACKS	THE CONTENTS OF THE MAINTENANCE TRACKS IS TRANSFERRED TO MPU RAM FOR QUICK FU
SEE COMMENT	1A	READ SPARE TABLE	DURING A POWER-ON TEST, THE CONTENTS OF THE SPARE TABLE AND THE CURRENT INTERLI
1 s	1J	TIB - DMA LOOPBACK TEST	DATA PATTERNS ARE LOOPED BETWEEN THE DMA AND TIB PCA'S AND CHECKED TO ENSURE F
SEE COMMENT	L	TAPE AUTOLOAD	IF A TAPE IS PRESENT, THE TAPE IS POSITIONED TO LOGICAL BLOCK ZERO (150 FOOT — 70 s;
SEE COMMENT	1H	TAPE PATTERN TEST	DATA IS WRITTEN TO A SPECIFIC TEST AREA ON THE TAPE, THEN READ BACK AND CHECKED FC ALSO, THE TAPE MANUFACTURER'S BLOCK IS READ.
0.5 ms	1C	TEST TAPE COUNTER	ALL 4 BITS ARE FIRST CLEARED TO ZERO, THEN SET TO ONE, AND CHECKED.
2 s	1	SEEK AND VERIFY TEST	FOR SELF TEST OR POWER-ON, A SEEK AND VERIFY TEST IS PERFORMED ON THE DISC UNIT (2
70 s		ERROR RATE TEST	FOR DIAGNOSTICS, AN EXTENSIVE ERROR RATE TEST (THE ENTIRE VOLUME) IS PERFORMED O
0.5 s	OFF	FINISH ISOLATION ROUTINE	ISOLATION ROUTINE WEIGHS ANY ERRORS AND DETERMINES SUSPECT CONDITIONS AND ASS OR VIA THE MPU SWITCHES.
UNTIL CS/80 INSTRUCTION RECEIVED	P.	TEST RUN HAS PASSED	"P." IS DISPLAYED WHEN THE TEST WHICH WAS RUN HAS PASSED. THE PERIOD INDICATES CO
0.5 s	OFF	RUN BACKGROUND DIAGNOSTICS (SEE HIGHLIGHTED AREAS ABOVE)	THE STATUS READOUT IS BLANKED AS PART OF THE BACKGROUND DIAGNOSTICS SO THAT SU
1.5 s	P.	BACKGROUND DIAGNOSTICS SUCCESSFUL **(FLASHING)**	BACKGROUND DIAGNOSTICS ENSURE DEVICE INTEGRITY DURING IDLE TIME. WHEN HOST
11 s	20	256 RANDOM SEEKS	THE DISC READS AND VERIFIES 256 DIFFERENT RANDOM ADDRESS LOCATIONS.
35 s	2-	256 RULL STROKE SEEKS	THE DISC SEEKS FROM PHYSICAL CYLINDER ZERO TO PHYSICAL CYLINDER 379 AND BACK AGA
6 s	3-	FULL LOGICAL VOLUME INCREMENTAL SEEKS	ALL LOGICAL CYLINDERS (0-369) ARE ACCESSED AND VERIFIED.

THESE TESTS ARE EXECUTED DURING BACKGROUND DIAGNOSTICS.

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option of retaining or not retaining data from the spared block. Since each track on the HP 7908 has one available spare sector, trying to spare more than one sector on the same track causes the entire track to be spared.

4-22. INITIALIZE MEDIA UTILITY (INIT MEDIA). This utility is used to format the media (disc or tape). For the disc, the utility erases all current data, and allows spares to be retained or not retained. For the tape, the utility will initialize the tape media.

4-23. EXIT EXTERNAL EXERCISER (EXIT). This command causes the CS/80 external exerciser program to exit.

4-24. ENTER CS/80 OPERATOR DESIGN ROUTINE (OPER). The OPER command allows CS/80 operations to be performed by the HP 7908.

4-25. DISPLAY HELP INFORMATION (HELP). HELP lists the utilities and diagnostics available in the CS/80 external exerciser.

4-26. CHANNEL INDEPENDENT CLEAR (CICLEAR). This command causes the HP 7908 to be cleared.

4-27. SELECTED DEVICE CLEAR (SDCLEAR). This command allows any particular device on the HP-IB to be cleared.

4-28. REQUEST STATUS (REQSTAT). This command causes the HP 7908 to return a status report which indicates the status for all transactions since the last request status or clear command.

4-29. CERTIFY TAPE (CERT). This utility performs a complete write-then-read verification of the tape.

4-30. CANCEL (CANCEL). This command cancels the CS/80 transaction sequence.

4-31. READ TAPE USE LOG (USE LOG). This command accesses the tape's use log.

4-32. WRITE FILE MARK (WRITE FM). This command writes a file mark at the current tape position.

4-33. UNLOAD TAPE (UNLOAD). This command allows the external exerciser to unload the tape cartridge in the same manner as pressing the unload button on the front panel.

4-34. POWER DISTRIBUTION

The troubleshooting procedures in this section assume all power sources in the device are within tolerance. Each power supply circuit is protected by a crowbar over-voltage circuit and an over-temperature shutdown circuit. The Power System functional diagram, figure 4-16, and the Interconnect Diagram, figure 4-6, can be used to isolate power source malfunctions. Tables 4-6 through 4-15 show all connections within the mother PCA-A7 and all cables in the HP 7908. Table 4-16 gives the visual indications of power system status. To check the voltages, proceed as follows:

WARNING

The following procedure is performed with power supplied to the device, and protective covers removed. This troubleshooting should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

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4-35. HP 7908P

If applicable, remove the tape cartridge from the tape mechanism.

a. Remove ac power cord from the ac mains power.

b. Remove the following:

(1) Lower front panel as stated in paragraph 5-4.

(2) Upper front panel as stated in paragraph 5-5.

(3) Rear door as stated in paragraph 5-8.

(4) Flip top assembly as stated in paragraph 5-10.

(5) Top cover as stated in paragraph 5-13.

c. Apply power to the device and check voltages shown below:

(1) +5V unregulated = 7 Vdc with 1V p-p ripple at TP-187

(2) +12V unregulated = 16 Vdc with 2V p-p ripple at TP-185

(3) -12V unregulated = -16 Vdc with 2V p-p ripple at TP-189

4-36. HP 7908R

If applicable, remove the tape cartridge from the tape mechanism.

a. Remove ac power cord from the ac mains power.

b. Remove the top cover as stated in paragraph 5-27.

c. Apply power to the device and check voltages as shown below:

(1) +5V unregulated = 7 Vdc with 1V p-p ripple at TP-187

(2) +12V unregulated = 16 Vdc with 2V p-p ripple at TP-185

(3) -12V unregulated = -16 Vdc with 2V p-p ripple at TP-189

4-37. TAPE SYSTEM

The tape mechanism cannot be serviced. It is replaced as an entire unit. Use table 4-17 for troubleshooting the tape mechanism. This should isolate tape problems to the tape mechanism or tape cartridge.

CAUTION

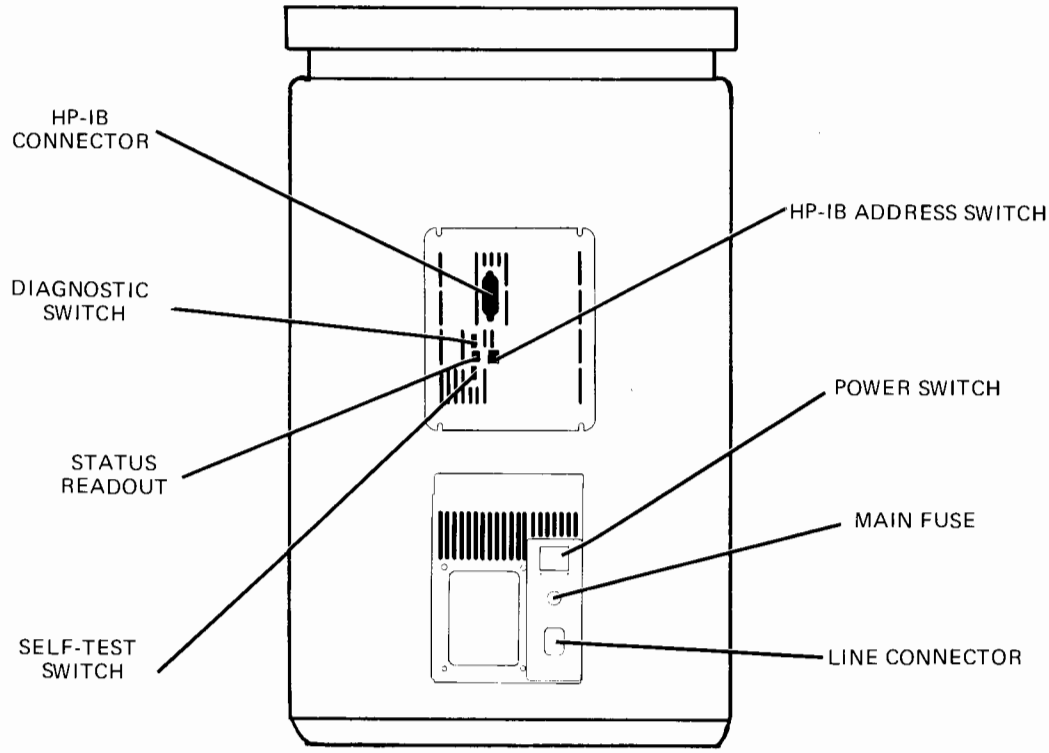
A power loss during a tape read operation could cause an unwanted write to occur. A tape should be "write-protected" by turning the screw on the cartridge to the "SAFE" position when the tape is not to be written to.

Table 4-3. External Exerciser Commands

COMMAND*	OPERATION PERFORMED	COMMAND*	OPERATION PERFORMED
DIAG	Internal Diagnostic Test	SPARE	Spare Block Utility
REV	Read Revision Number Utility	INIT MEDIA	Initialize Selected Media
TABLES	Read Drive Table Utility	EXIT	Exit External Exerciser
RUN LOG	Read Run Log Utility	OPER	Enter CS/80 Operations Routine
ERT LOG	Read Error Rate Log Utility	HELP	Display Help Information
FAULT LOG	Read Fault Log Utility	CICLEAR	Channel Independent Clear
ERRSUM	Read Error Summary Utility	SDCLEAR	Selected Device Clear
RO ERT	Read Only Error Rate Test	REQSTAT	Request Status
WTR ERT	Write-Then-Read Error Rate Test	CERT	Certify Tape Cartridge
PRESET	Preset Drive Utility	CANCEL	Cancel Transaction Sequence
CLEAR LOGS	Clear Logs Utility	USE LOG	Read Tape Use Log
CHANNEL	Channel Test Utility	WRITE FM	Write File Mark On Tape
UNIT	Set Unit Number Utility	UNLOAD	Unload Tape

*Some commands must be followed by an address; valid logical addresses in the HP 7908 are as follows:

HEAD	0 - 4
CYLINDER	0 - 369
SECTOR	0 - 34



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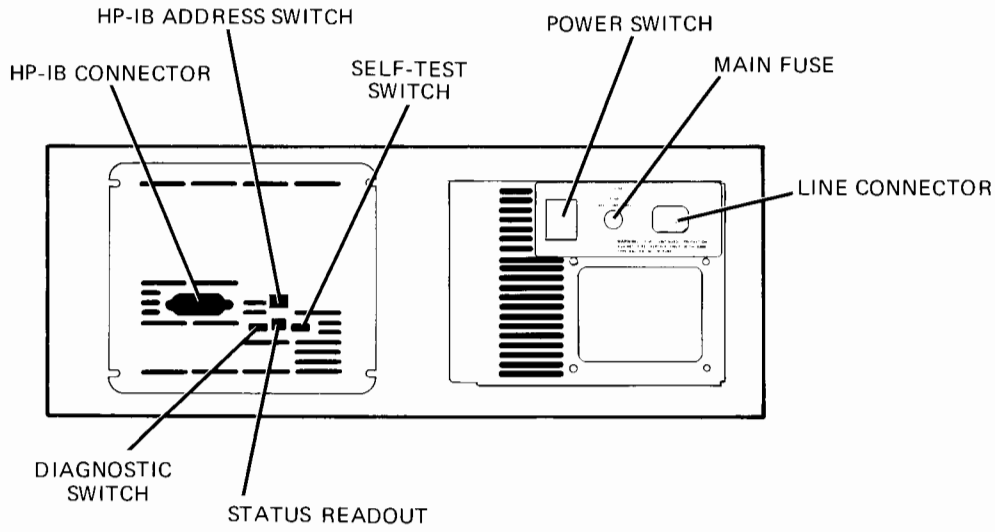

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7908-29

Figure 4-2. Rear Panels

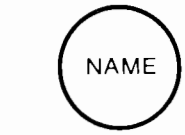
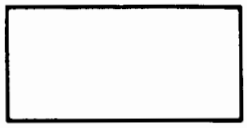
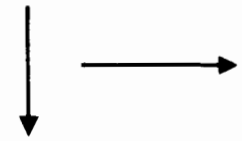
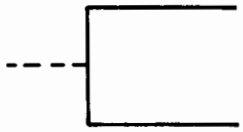
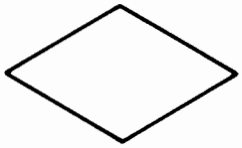
SYMBOL	DESCRIPTION
	**A. State Diagram Symbols** STATE SYMBOL. This symbol indicates the current condition a device is in. The symbol contains the name of the state.
	INPUT. Information read from an external source (such as a switch) which causes a response. RESPONSE. The output caused by a certain input while in a certain state. TRANSITION. The path from one state to another or from one state to itself.
	B. Flowchart Symbols
	TERMINAL SYMBOL. This symbol indicates the start or end of the operations named by the title of the flowchart.
	PROCESS SYMBOL. This symbol indicates the execution of a defined operation.
	FLOWLINE SYMBOL. This symbol indicates the logical path to follow in the flowchart.
	ANNOTATION SYMBOL. This symbol is used for descriptive comment in the flowchart.
	DECISION SYMBOL. This symbol requires a choice of logical paths. This choice of paths depends on the answer to the question contained in the symbol.
	ON-PAGE CONNECTOR. This symbol indicates that the flow line is continued at another such symbol elsewhere on the sheet.
	OFF-PAGE CONNECTOR. This symbol designates entry or exit from a page. EXIT from a page 2 A Go to sheet 2, block A. ENTRY from a page 1, 2 A Continued from sheet 1 or 2. Block A

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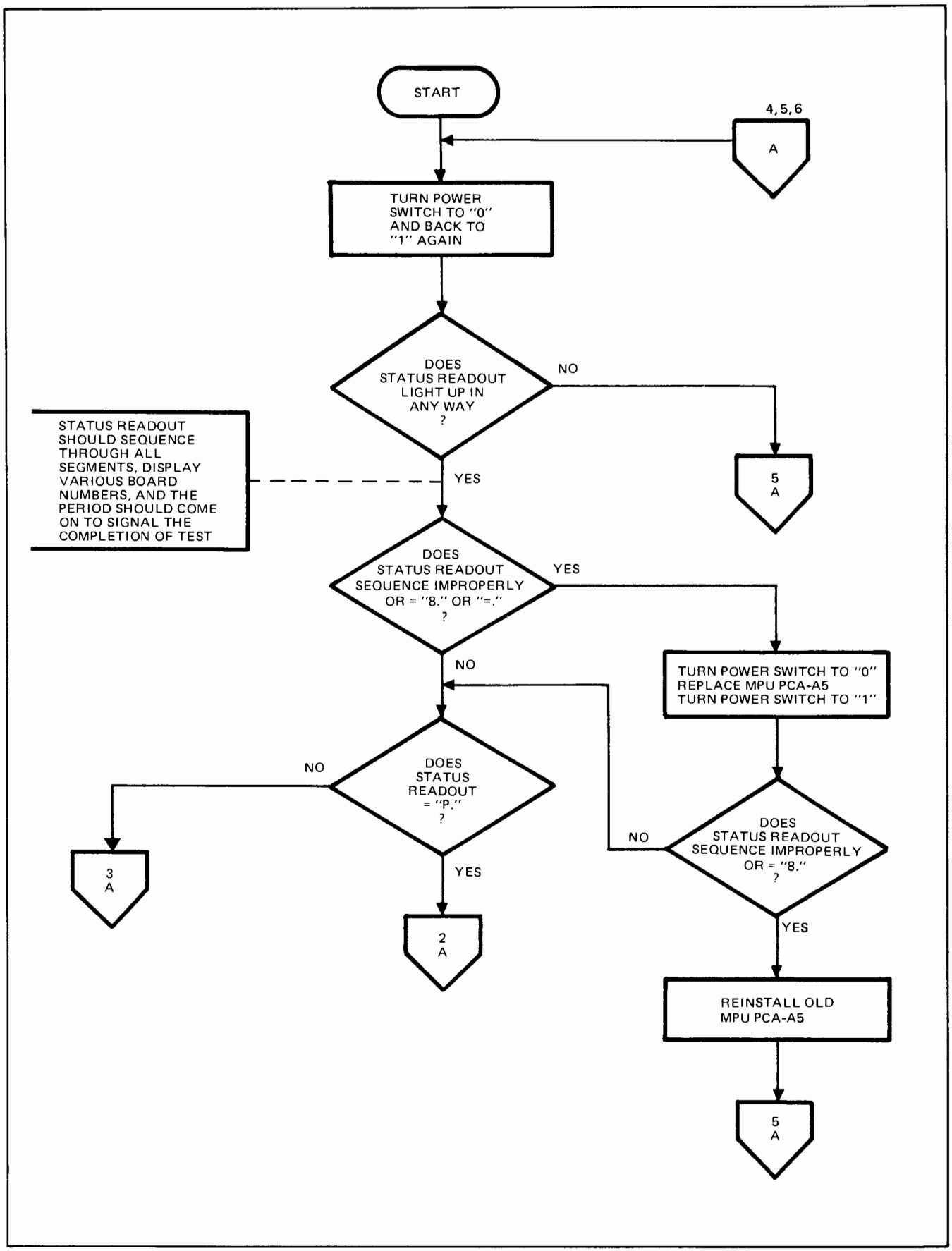
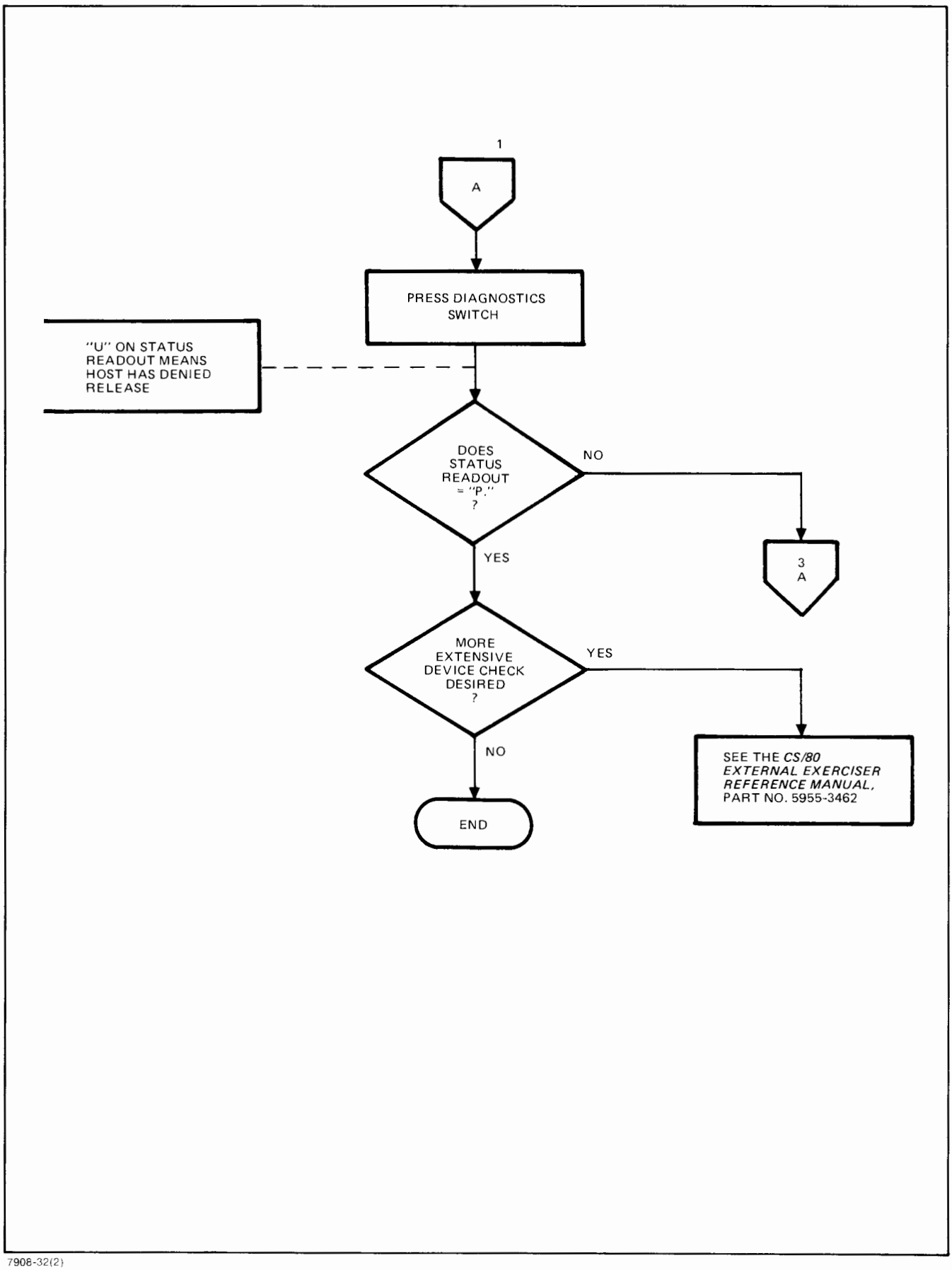
Figure 4-3. Symbols Used in This Section



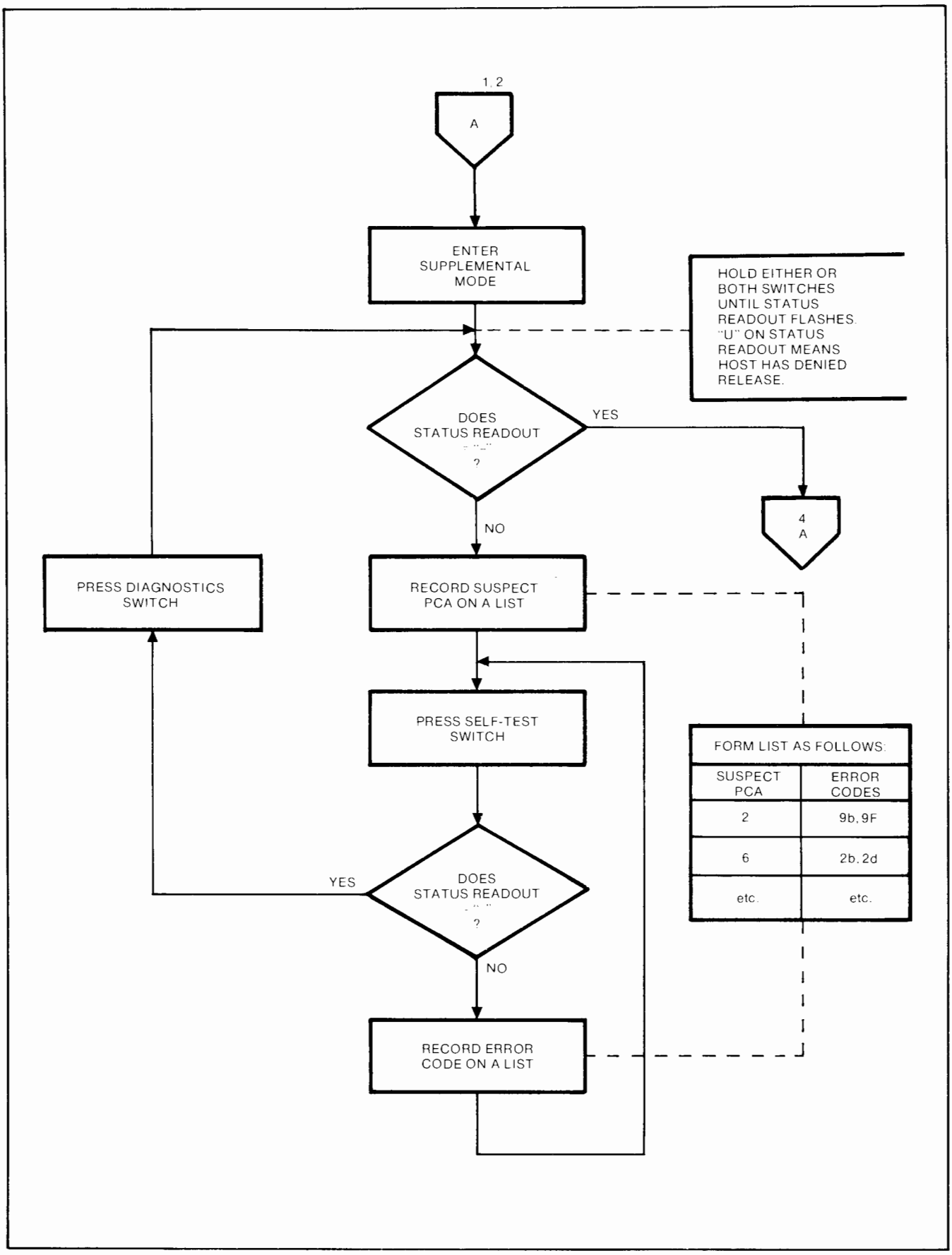
7908-32(1)A

Figure 4-4. Troubleshooting Flowchart (Sheet 1 of 6)



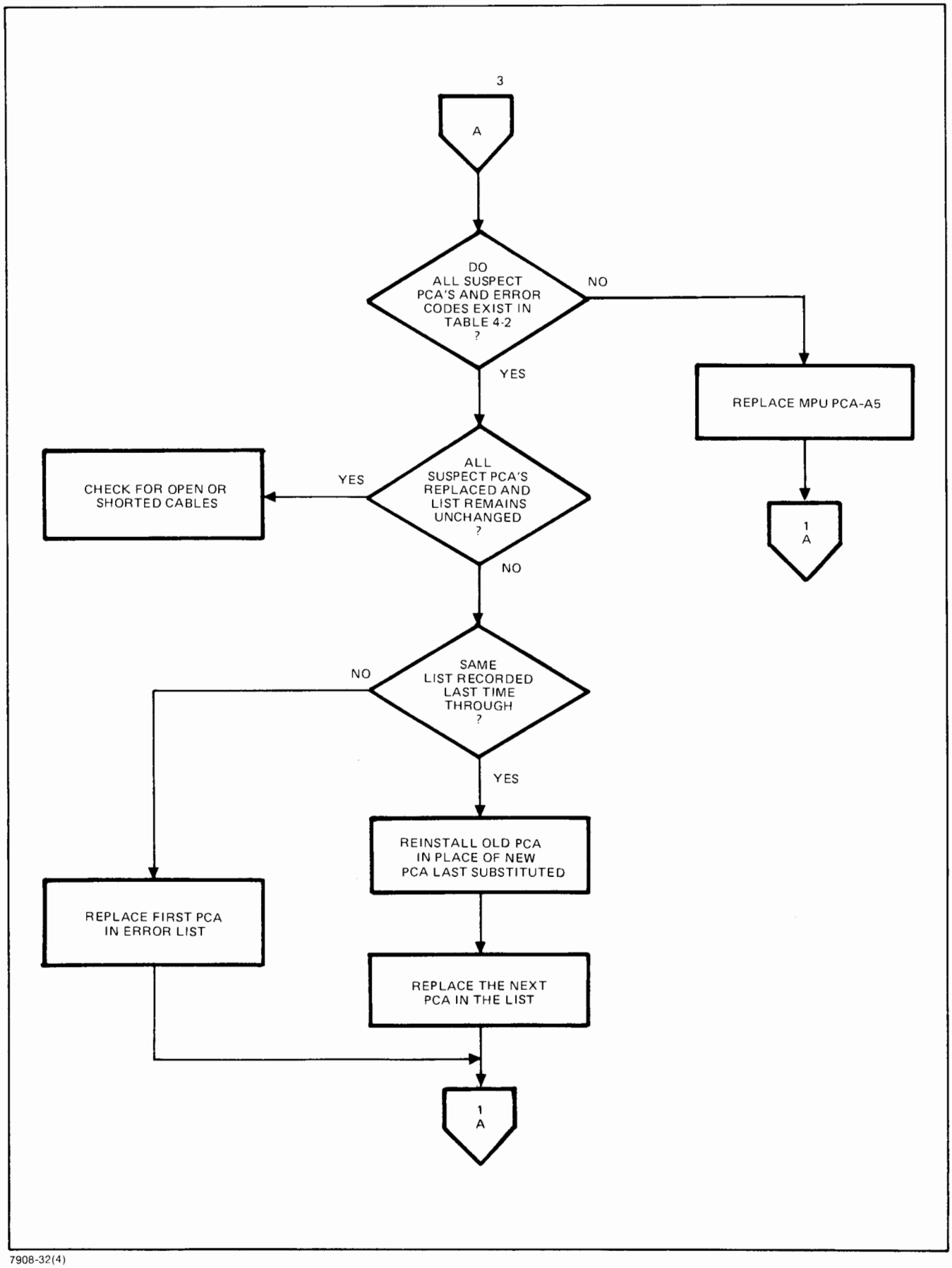
7908-32(2)

Figure 4-4. Troubleshooting Flowchart (Sheet 2 of 6)



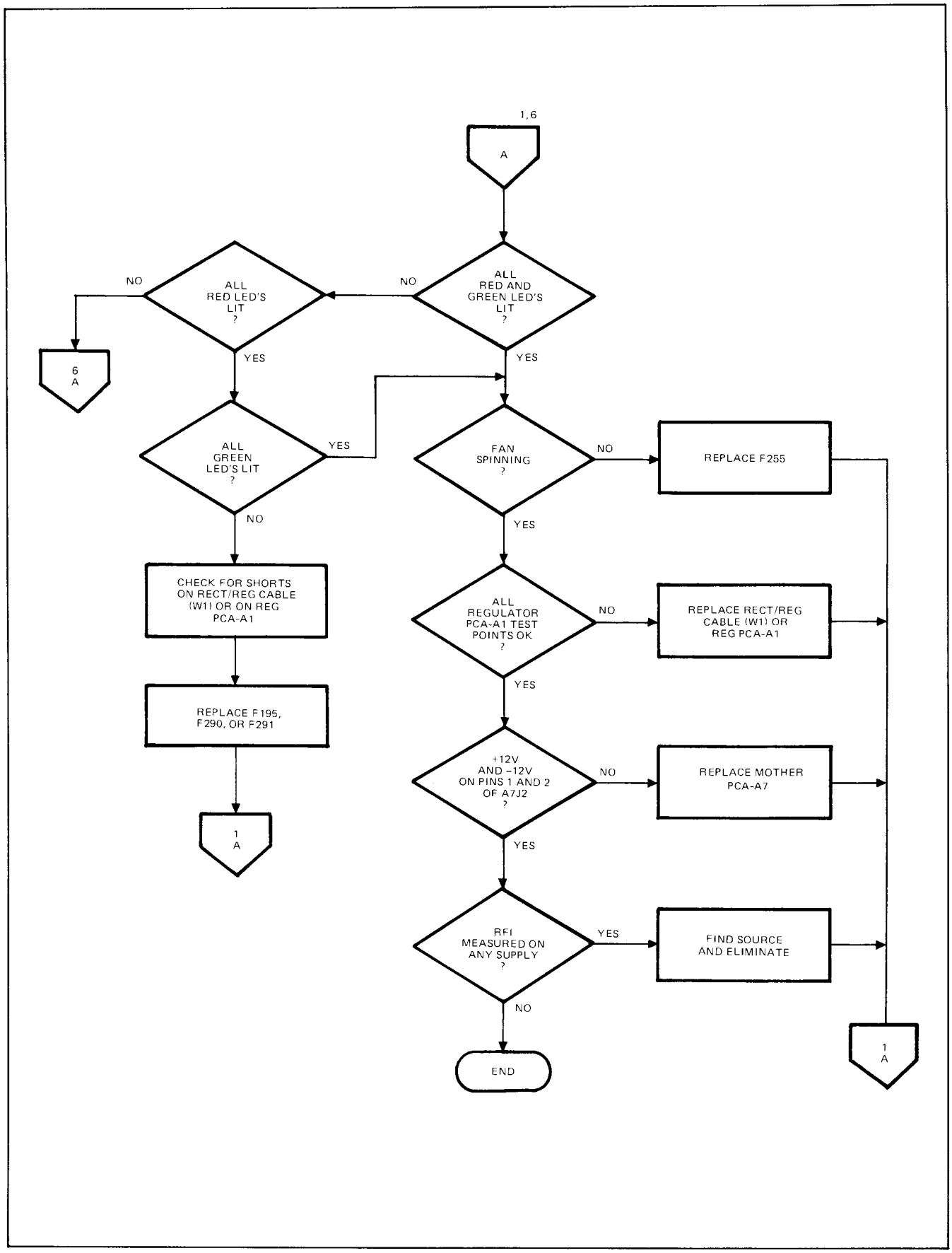
7908-32(3)A

Figure 4-4. Troubleshooting Flowchart (Sheet 3 of 6)



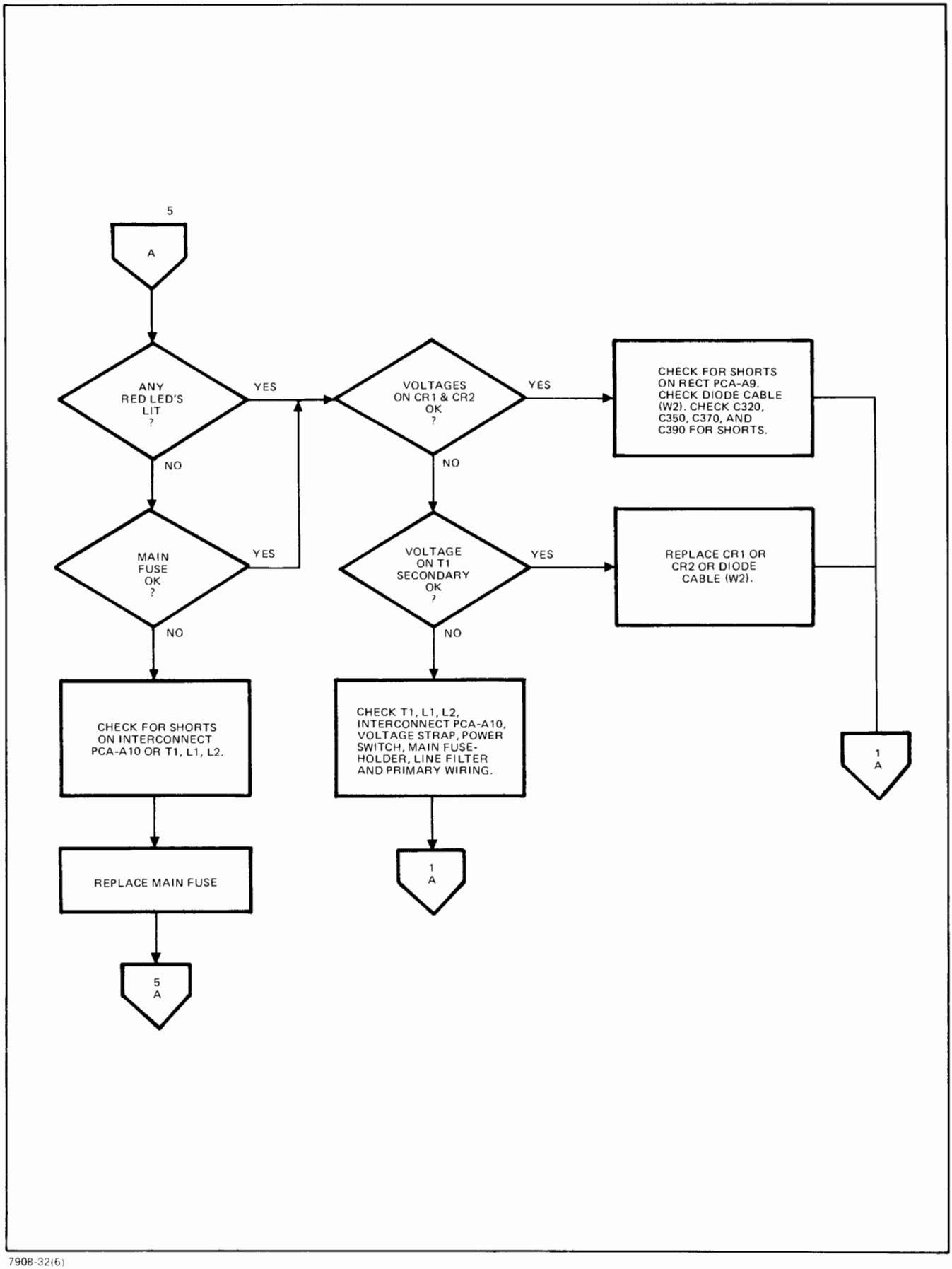
7908-32(4)

Figure 4-4. Troubleshooting Flowchart (Sheet 4 of 6)



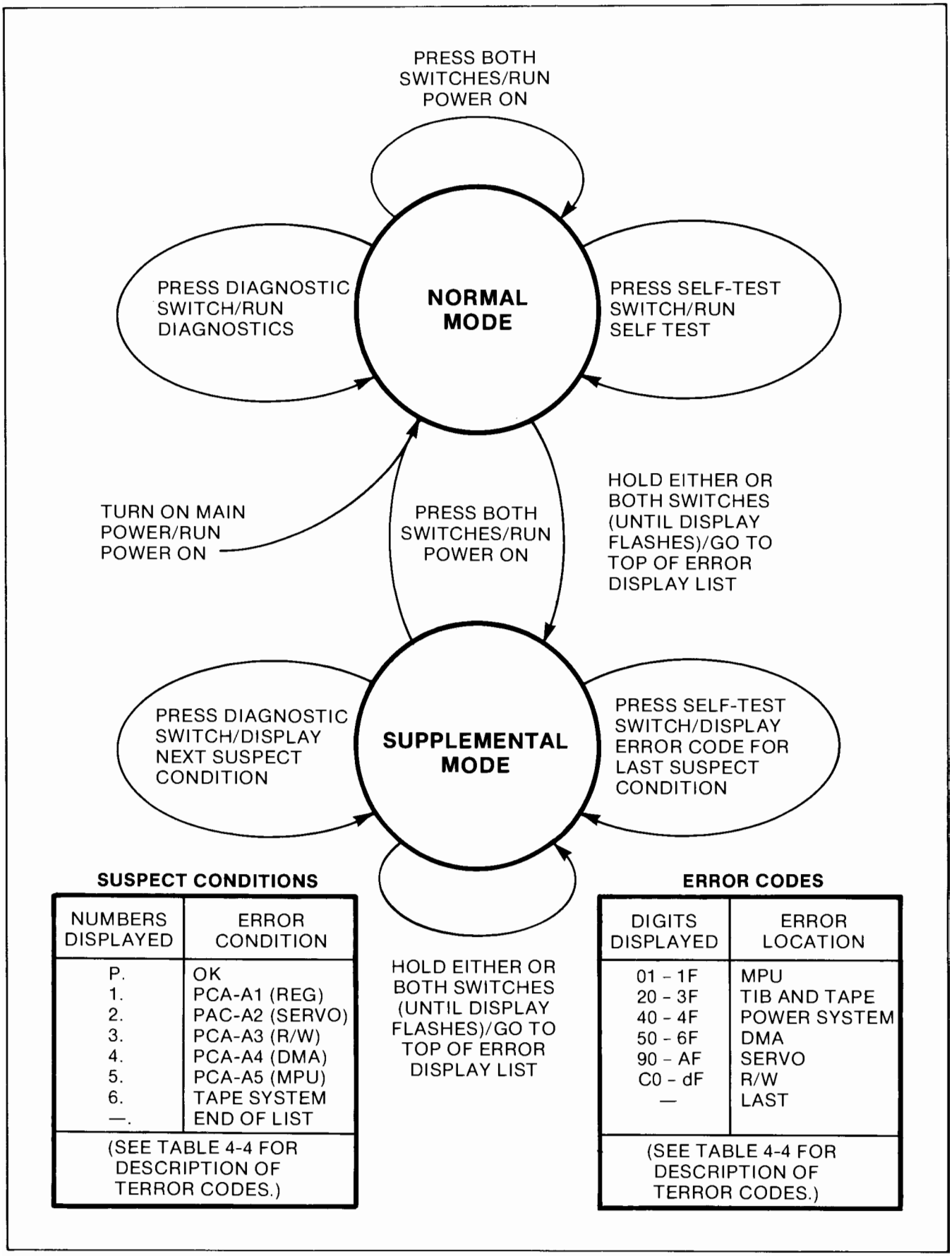
7908-32(5)

Figure 4-4. Troubleshooting Flowchart (Sheet 5 of 6)



7908-32(6)

Figure 4-4. Troubleshooting Flowchart (Sheet 6 of 6)



SUSPECT CONDITIONS

NUMBERS DISPLAYED	ERROR CONDITION
P.	OK
1.	PCA-A1 (REG)
2.	PAC-A2 (SERVO)
3.	PCA-A3 (R/W)
4.	PCA-A4 (DMA)
5.	PCA-A5 (MPU)
6.	TAPE SYSTEM
—.	END OF LIST
(SEE TABLE 4-4 FOR DESCRIPTION OF TERROR CODES.)	

ERROR CODES

DIGITS DISPLAYED	ERROR LOCATION
01 - 1F	MPU
20 - 3F	TIB AND TAPE
40 - 4F	POWER SYSTEM
50 - 6F	DMA
90 - AF	SERVO
C0 - dF	R/W
—	LAST
(SEE TABLE 4-4 FOR DESCRIPTION OF TERROR CODES.)	

7908-31A

Figure 4-5. Internal Diagnostic States

TERRORS

Table 4-4. Test Errors

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
1	01	MPU RAM data miscompare error during self-test.	1) MPU PCA (RAM, Z-80, or Data/Address bus)
2	02	Incorrect MPU ROM checksum found during self-test.	1) MPU PCA (EPROM, ROM, Data/Address bus or Z-80) 2) Another PCA is corrupting the common data bus
3	03	CTC self-test or diagnostic failure of any of 5 diagnostic tests for the counter timer circuit.	1) MPU PCA (CTC, Z-80 interrupt circuit, or data/address bus)
4	04	Cannot write to the 4-bit tape counter during a diagnostic. A write/read check of the tape 4-bit counter failed.	1) MPU PCA (tape counter) 2) TIB PCA (tape counter control circuitry CTCT-H)
5	05	Addressing problems found during self-test. Any of the controller or interface PCAs may be responding to an illegal address.	1) MPU PCA (addressing circuits) 2) Any PCA which shares the address bus (DMA, read/write, servo)
6	06	Bus corruption found during self test. Data bus failure on the common MPU bus.	1) MPU PCA (data bus latches) 2) Any PCA which shares the common data bus (DMA, read/write, servo)
7	07	Bad response to bus select during self-test. DMA, read/write, or servo PCA decode failure.	1) MPU PCA 2) Any of the selected PCAs (DMA, read/write, servo)
8	08	MPU RAM failure found during self-test or background tests.	1) MPU PCA (RAM) 2) Data or address bus

TERRORS

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
9	09	The Z-80 did not respond to the NMI-L generated by the PHI during a self-test. NMI-L circuitry is not operational.	1) MPU PCA (NMI-L to Z-80 circuit) 2) DMA PCA (PHI interrupt circuit)
10	0A	The controller did not detect either a disc or tape unit. The TIB, read/write, and/or servo PCA is not connected to the MPU bus.	1) Read/write, servo, or TIB not plugged into motherboard
11	0b	Either or both of the MPU self-test switches is continuously active for more than 30 seconds. MPU switches register active for too long.	1) MPU PCA (self-test switches may be stuck in the active state)
12	0C	The CPU trapped an illegal opcode. An illegal instruction was encountered.	1) MPU PCA (Z-80 or ROM)
15	0F	One of the previously mentioned errors has occured (01-0C hex). This error is an "or" of the RAM, ROM, CTC, and tape counter errors, and is used by the isolation routine as one place to look for general MPU health. See the descriptions for the TERRORS "01-0C" hex.	1) MPU PCA
16	10	The sector pulse is not incrementing the CTC circuit during a read/write self-test. The counter timer circuit is not operational.	1) MPU PCA (CTC or Z-80 interrupt) 2) Disc or read/write PCA not providing sector pulse
32	20	Cartridge not inserted.	1) No tape cartridge present 2) Tape mechanism (does not see the tape)
33	21	Tape did not meet the requirements for loading (tension, key readability, etc.).	1) Tape media (cartridge) 2) Tape mechanism

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Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
34	22	Upon completion of reset or autoload of tape, a register shows bad status with TIB connected.	1) TIB PCA 2) Tape mechanism 3) MPU PCA (TIB interface)
35	23	CRC circuitry on the TIB is not correcting errors.	1) TIB PCA (buffers/state machine)
37	25	The first frame (manufacturer's block) of the first block is both unreadable and uncorrectable. The tape may be of the wrong type.	1) Tape media (cartridge) 2) Tape mechanism 3) TIB PCA
38	26	The sector toggle flip-flop cannot be made to function from the TIB PCA. Tape/DMA interface circuits are not functioning properly.	1) TIB PCA 2) DMA PCA
39	27	The DMA to TIB loopback failed, and the TIB's ability to source a known pattern failed. Therefore, read and write to the TIB buffers has failed.	1) TIB PCA 2) DMA PCA (SERDES I/O)
40	28	The DMA-TIB loopback test failed but the test where the TIB sources a pattern to the DMA has passed (can't write, but can read).	1) TIB PCA 2) DMA PCA (SERDES I/O)
41	29	The address counter did not increment by four sectors when the TIB sent one block (1k) to the DMA. TIB/DMA interface circuits failed.	1) TIB PCA 2) DMA PCA (address-increment hardware, state machine)
42	2A	The TIB is failing to sequence the four frames within the 1k block.	1) TIB PCA (state machine)
43	2b	Timeout error for TIB sourcing the known pattern to the DMA. The TIB is not responding to self-test mode control, by sending a known buffer of data.	1) TIB PCA 2) DMA PCA

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
44	2C	Unable to write to self-test system blocks and cannot read keys.	1) Tape media (cartridge) 2) Tape mechanism 3) TIB PCA
45	2d	Could not read from the system test blocks during self-test. Tape unreadable at the system block area. Could not read keys or frame headers.	1) Tape media (cartridge) 2) Tape mechanism 3) TIB PCA
46	2E	In the loopback test (DMA-TIB), the data written was not the data read.	1) TIB PCA 2) Tape mechanism
64	40	The fault latch bit which indicates a possible power fail is set. This bit is tested during the read/write diagnostic. If the fault register is bad, TERROR "db" hex (fault latch shows conflicting results) should also be reported.	1) Rectifier PCA 2) Regulator PCA 2) Read/write PCA (Drive fault register)
80	50	DMA self-test control and status registers cannot be properly read.	1) DMA or MPU PCA (DMA/MPU interface)
81	51	During DMA self-test, the MPU could not read and write to every location in the 16-byte header.	1) DMA PCA (header RAM) 2) MPU PCA (interface/data bus)
82	52	The MPU can't read and write to every location in the 4k DMA data RAM.	1) DMA PCA (data RAM) 2) MPU (interface/data bus)
83	53	The data field bit is incorrect or the disc address counter points to the wrong area.	1) DMA PCA (disc interface) 2) Read/write PCA
84	54	Data compare error during a disc read (occurs if header, data, CRC, byte is wrong).	1) DMA PCA (disc interface) 2) Read/write PCA

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
85	55	The CRC error bit is set during a read of a good sector, or is not set during a read of a bad sector.	1) DMA PCA (CRC circuit)
86	56	The sector counter did not increment after the read of a good sector or the sector counter did not decrement after a sector had been written to the disc.	1) DMA PCA (sector counter circuits)
87	57	DMA self-test data compare error of any sector byte during a disc write.	1) DMA PCA (disc interface) 2) Read/write PCA
88	58	Unused signal line(s) are being pulled low by another PCA.	1) Read/write PCA (DMA interface)
89	59	The disc address counter didn't increment after a sector was read from the disc.	1) DMA PCA (disc address counter) 2) Read/write to DMA interface
96	60	Improper PHI interrupt bits are set during the PHI diagnostic.	1) DMA PCA (PHI) 2) MPU PCA (PHI to Z-80 interface)
97	61	The PHI self-test microdiagnostic had a FIFO wrap-around data miscompare.	1) DMA PCA (PHI)
98	62	PHI self-test identify bytes were not the same as those loaded.	1) DMA PCA (PHI) 2) MPU PCA
99	63	The byte counter failed during a write operation.	1) DMA PCA (security circuit)
100	64	No EOI was received during a write operation.	1) DMA PCA (PHI) 2) MPU PCA

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
101	65	A secondary command was not detected during a disc write.	1) DMA PCA (PHI) 2) MPU PCA
102	66	PHI to data RAM data miscompare or data overrun has occurred.	1) DMA PCA (I/O circuits)
103	67	Left-over bytes were not in the inbound FIFO after the buffer became full or the byte count expired during an I/O write (possible overrun).	1) DMA PCA (I/O circuits)
104	68	Transfer stopped in the wrong place during an I/O read (possibly did not stop after sending EOI).	1) DMA PCA (I/O circuits)
105	69	The sector didn't increment at the sector boundry on an I/O write.	1) DMA PCA (sector or I/O address counter)
106	6A	The sector counter didn't decrement at the sector boundry during an I/O read.	1) DMA PCA (sector counter or I/O address counter)
107	6b	Sector overrun or security circuit malfunction has occurred.	1) DMA PCA (security circuit)
108	6C	A data compare error occurred after an I/O read.	1) DMA PCA (I/O circuits)
109	6d	The DMA I/O counter stopped early.	1) DMA PCA (I/O circuits)
110	6E	The status register bits on the DMA PCA make no sense.	1) DMA PCA
111	6F	The DMA RAM failed the nondestructive RAM test during either the power-on or background test.	1) DMA PCA (RAM)

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
144	90	The fault register bit which indicates a servo phaselock fault was set when read. If the fault register on the read/write PCA is bad, then TERROR "db" hex (fault latch has conflicting results) should also have been logged.	1) Servo PCA (servo phaselock hardware) 2) Read/write PCA (fault register)
145	91	The offtrack bit of the fault register indicated a servo offtrack condition when read. The fault register may be bad. A "db" hex (fault register indicates conflicting results) should also be logged if the fault register is bad.	1) Servo PCA (track-following hardware) 2) Read/write PCA (fault register)
146	92	A track compare error has occurred during a read/write diagnostic. A header may be incorrect or unreadable, or the servo may have "jumped the track".	1) Servo PCA (track-following hardware) 2) Read/write PCA
147	93	The servo PROM diagnostic did not give the expected results. The Servo PROM may be defective, or the data and/or address lines used to read its contents may be bad.	1) Servo PCA (Servo PROM) 2) Data and/or address lines used to read PROM
149	95	The servo linear motor voltage indicator bit disagrees with the expected value during the servo diagnostic. The linear motor voltage is not responding to current commands, or the linear motor voltage indicator is bad.	1) Servo PCA (linear motor control circuitry) 2) Servo-Read/write cable 3) Disc mechanism (linear motor)
150	96	Track crossings are not indicated when expected. Track crossing detection is faulty or the device is not crossing tracks. Servo head may be in a zone where servo code is invalid or missing.	1) Servo PCA 2) Servo-Read/write cable 3) Disc mechanism 4) MPU (counter timer chip)
151	97	The disc doesn't reach or maintain its minimum specified speed within a reasonable interval.	1) Servo PCA (control circuits) 2) Read/write PCA (fault register) 4) Servo-Read/write cable

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
154	9A	The number of allowable offtracks was exceeded during a verify operation. Too many offtracks occurred.	1) Servo PCA 2) Disc mechanism (motor constant too weak or servo resonance)
155	9b	Too many verifies during a verify operation. Verify operation is failing.	1) Read/write PCA 2) Servo PCA 3) Disc mechanism (motor constant too weak or servo resonance)
157	9d	Servo ontrack indicator disagrees with expected state. Inability to lock on servo test signal or ontrack indicator is faulty.	1) Servo PCA (phase-locked loop, AGC circuitry, test signal generator, or track crossing and offtrack detection)
160	A0	A bit set on a servo PCA register is clear on the microprocessor register used to read that bit. The servo-microprocessor interface is bad.	1) Servo PCA 2) MPU PCA 3) Motherboard
162	A2	The servo phase-locked loop is unable to lock up on the servo-generated test signal. The servo PCA phase-locked loop, AGC, or test-signal generation is defective.	1) Servo PCA (phase-locked loop, AGC or test signal circuitry)
168	A8	The servo diagnostic does not detect a guard band signal when it expects to. Servo pattern detection or the servo phase-lock function are suspect.	1) Servo PCA (servo PROM for tri-bit pattern decoding) 2) Disc mechanism (servo information incorrectly encoded)
169	A9	Servo phase-locked loop is unable to attain phaselock on the disc signal during the servo diagnostic.	1) Disc mechanism (servo code or disc velocity) 2) Servo-Read/write cable 3) Servo PCA (phase-locked loop)

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
170	AA	The servo adaptation routine failed due to a dc force problem -e.g., too much drive tilt, the servo gain can't make up for weak motor constant, or the track spacing irregularities are too great.	1) Servo PCA (current drivers) 2) Disc mechanism
171	Ab	The recalibrate terminated with an error.	1) Servo PCA 2) Disc mechanism
172	AC	The device has attempted to force an offtrack condition by sending a very large offset command to the servo. No offtrack was indicated on the servo PCA. The device may not be over servo code, the servo offset circuitry may be defective, or the offset detection circuitry may be failing.	1) Servo PCA (track follower offtrack detection)
173	Ad	The interval between index pulses detected was too long or too short, or no pulse was detected. The servo head may not be over a zone where index pulse code exists, the index detection circuitry (e.g, the servo PROM) may be bad, or the index pulse code may be missing or incorrectly written on the disc.	1) Servo PCA (index detection circuitry) 2) MPU PCA (seek electronics - ROM) 3) Disc mechanism (index pulse code) 4) Servo PCA (data or address lines)
192	C0	The DWF-L (Destructive Write Fault) bit of the fault register indicated a fault when the fault register was read. A destructive write fault may have occurred. If the fault register is defective, TERROR "db" hex should also have been logged.	1) Read/write PCA (fault register) 2) Disc mechanism (preamplifier)
193	C1	The WOT-L (Write-and-Offtrack) bit of the fault register indicated a fault when read. An offtrack may have occurred during a write. If the fault register is bad, TERROR "db" hex should also have been logged.	1) Read/write PCA (write control circuits or fault register) 2) Servo PCA (track-follower)

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
194	C2	The bit indicating a read/write PCA phase-locked loop error (real-time) was set when the fault register was read. The read/write PCA phase-locked loop is out-of-lock, or the fault register is defective (look for TERROR "db" hex).	1) Read/write PCA (phase-locked loop or fault register)
195	C3	DPO-L (read/write phase-locked loop dropped out of lock) bit of the fault register indicated a fault. The read/write phase-locked loop dropped out of lock since the last time the fault latch was cleared. This is a latched, not a real-time, signal. Look for TERROR "db" hex to see whether the fault register is healthy.	1) Read/write PCA (phase-locked loop or fault register)
196	C4	No useable maintenance track could be found for the head indicated. This TERROR should always be accompanied by the head that was used to look for a good maintenance track. Possibly could not read even one of the the maintenance track sectors, using the head specified. Look at the head numbers (TERRORS "d0" to "d4" hex) that were also logged. TERRORS logged by servo tests will prevent the read/write diagnostic from running. If all the heads are included, then the hardware to suspect is most likely common to all the heads, such as the read/write PCA or the disc media. If only some of the heads were logged, most likely causes include the read/write select circuitry or the disc mechanism preamplifier(s).	1) Read/write PCA (read chain, control or select circuitry) 2) Disc media 3) Disc mechanism (preamplifier)
197	C5	When the correctable sector of the maintenance track was read, no CRC error was rereported. May have read the wrong sector, error detection may be defective, or reads are marginal. The DMA PCA is listed as second most suspect because any serious DMA errors would have blocked the execution of the read/write diagnostic.	1) Read/write PCA (sector counters, formatter/separator, and analog read chain) 2) DMA PCA (CRC circuitry)

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
198	C6	Write/read tests on maintenance track write test areas failed for the head(s) indicated by TERRORS "d0" to "d4" hex. Read or write faults, or sector addressing problems. Error detection circuitry (CRC, ECC) could be reporting problems where none exist, but since this circuitry has been tested prior to the read/write diagnostic, this is less likely.	1) Read/write PCA (formatter/separator read chain, read/write control) 2) DMA PCA (CRC circuitry)
199	C7	The data that was read from a write test sector of the maintenance track differs from the data that should have been written to that sector. This error implies a data miscompare between a disc write to and a disc read from the same sector. This could mean that that the ability to write to the disc media has been lost, although reads can still be performed. Such an error would not be detected by the CRC, as long as the last write to that sector left a CRC consistent with the rest of the sector data. Normally, this error will occur with a write/read TERROR "C6" hex. Look at the pattern of head failures for this error for clues to the problem.	1) Read/write PCA (write control and write path) 2) DMA PCA 3) Disc mechanism (preamplifier) 4) Disc media
201	C9	A sector compare error was detected after a disc read operation. This error is detected exactly as it would be during run-time reads. If no other read errors were reported, then this error probably points to sector counting problems rather than problems reading/writing sector headers. Three PCAs are involved in sector counting: the servo, read/write, and MPU PCAs. The servo PCA generates a byte clock, which the read/write PCA uses to produce sector pulses. The CTC (counter timer chip) on the MPU PCA counts sector pulses to determine which sector is currently addressed. At this point, the CTC and servo have passed their crucial diagnostic tests (or the read/write test would have been blocked).	1) Read/write PCA (sector timing and counting) 2) MPU PCA (counter timer chip) 3) Servo PCA (byte clock generation)
202	CA	The read/write-to-DMA tri-state buffer did not tri-state when commanded to do so. The control circuitry for the read/write-DMA buffer failed.	1) Read/write PCA (DMA tri-state buffer control)

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
204	CC	During the servo adaptation test, no index was detected by the MPU, although the servo PROM that detects disc index pulse code appears to be good. The MPU did not see an index pulse within a reasonable interval. The index pulse is detected by the servo PCA, passed to the read/write PCA for processing, and then sent to the MPU's CTC (counter timer chip). If the servo PROM passed self-test and correctly decoded inner or outer guardbands, then the index signal was probably good as it left the servo PCA. Since the CTC likely also passed self-test, the diagnostic finger points to the read/write PCA.	1) Read/write PCA (index pulse circuitry and sector timing) 2) Servo PCA (index pulse detection) 3) MPU PCA (CTC) 4) Disc media (index pulse locations)
208-212	d0-d4	Whenever TERRORS "C4", "C5", "C6", or "C7" hex are logged, the heads on which they occurred are also logged. The head(s) reported were being used when one of the above-mentioned errors occurred. The number which follows the "d" is the number of the head involved. Refer to TERRORS C4-C7 hex for the hardware to suspect. The pattern of head errors should provide additional clues to the problem. For example, heads 0 and 1 are on one preamplifier chip, while heads 2, 3 and 4 are on another. Select circuitry problems may result in only one head or chip being selected. If all heads are reported, the problem is probably common to all the heads.	1) Disc mechanism (preamplifier) 2) Read/write PCA (head select)
216	d8	No sector timing pulse was detected by the MPU CTC (counter timer chip) within a reasonable period. The sector timing pulse is either not being generated by the servo and read/write PCAs, or it is not being detected by the MPU CTC.	1) Read/write PCA (check for other TERRORS) 2) Servo PCA (check for other TERRORS) 3) MPU PCA (counter timer chip)
217	d9	The DMA detected the wrong level for the Start-Of-Data (SOD-L) signal from the read/write PCA during a sector read. The read/write PCA is not generating Start-Of-Data (SOD-L) signals, or the DMA is not detecting them.	1) Read/write PCA (SOD-L circuitry) 2) DMA PCA (disc interface)

Table 4-4. Test Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
218	dA	The device was unable to read the spare table on the maintenance track. Reads from or writes to the maintenance track are failing or inconsistent, or the maintenance track spare table cannot be located.	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) Disc media (data surface and mechanism interface)
219	db	The fault register does not report a fault when a fault condition is generated. The fault register is defective, or the fault condition (an offtrack) was not successfully generated. The device may be in a disc area (park zone) where offtracks will not be detected.	1) Read/write PCA (fault register) 2) Servo PCA (track-following and offtrack detection circuitry)
220	dC	A logical seek failed during a verify operation. The device cannot read/write well enough to verify, or the seek failed.	1) Read/write PCA 2) DMA PCA 3) Servo PCA
221	dd	The diagnostic error-rate test found an unreadable sector. Reads/writes are marginal or inconsistent, or the media is defective.	1) Read/write PCA 2) DMA PCA 3) Disc Media
222	dE	Can't read interleave table on maintenance track. Reads are not working, previous write to interleave table was bad, or we cannot locate the interleave table (track or sector).	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) Disc media

DERRORS

Table 4-5. Run-Time Drive Errors

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
4	04	During a read operation, the DMA hardware reported a data CRC error. This is the standard reporting error for a data CRC error.	None
5	05	The CRC caught a read data error and the fault register indicates off-track status. The off-track condition might easily have caused the read data error. Therefore, the servo system is more suspect than the read/write chain. A full test of the servo system should be performed. If that is successful, then a read/write test should be performed.	1) Servo PCA 2) Read/write PCA
6	06	During a drive operation that was receiving data from the host, the drive received an end of transfer before the number of bytes expected to be sent to the drive were received. In some cases (receiving a command) the early EOI status is expected and is not an error.	The internal diagnostic should be able to find any errors associated with the EOI status. The DMA PCA controls this status message.
7	07	During a receive or a receive and write operation, the number of bytes expected from the host was received but the last byte was not tagged with EOI. Under normal conditions, this is a reporting error.	If this error is associated with some possible hardware problem, the DMA PCA is suspect.
8	08	During a receive or receive and write operation, a secondary was received while expecting data or commands. If this error is associated with a drive problem, the DMA PCA could have problems. This error is a reporting error and does not mean that there are any hardware problems.	If a drive problem seems to exist, the DMA PCA is suspect.
9	09	An incremental seek was requested that would extend beyond the last track of the device. RAM/ROM failure or a request by the host for a transfer that would extend past the end of the volume.	1) MPU PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
14	0E	When a check was made of the header read from the disc, the first byte (status) had the most significant bit clear. This bit should always be set. The read/write PCA is suspect. A full self-test should be performed on the read/write chain.	1) Read/write PCA 2) DMA PCA
15	0F	When a check was made of the sector header read from the disc, the head number was not the one expected. The read/write chain is suspect. A full self-test on the read/write chain should be performed.	1) Read/write PCA (head select) 2) DMA PCA
16	10	When a check was made of the sector header read from the disc, the sector number was not a legal one for this device. The read/write chain is suspect. A full self-test on the read/write chain should be performed.	1) Read/write PCA 2) DMA PCA
17	11	When a check was made of the sector header read from the disc, the cylinder number was not the one expected. The read/write chain and the servo system are suspect. A full self-test should be performed on both the read/write chain and the servo system.	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) Disc media
18	12	DMA status indicates that the DMA buffer is full of data. The DMA buffer is held clear during this operation, so the DMA should not report a full buffer. The firmware holds the buffer not full on internal disc read operations (buffer reads).	1) DMA PCA
21	15	During a DMA buffer write to the disc DMA a rotational latency was incurred. During a buffered write, all the data is already in the DMA RAM so this error would indicate that the DMA PCA is faulty.	1) DMA PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER DEC	NUMBER HEX	CAUSE	SUSPECT HARDWARE
23	17	All maintenance copies were searched without finding a valid one during an access of the system maintenance area. Note that this error will require either new media or a primary initialization of current media if the error was caused by a read/write problem but that it is possibly recoverable if caused by a servo system failure. The drive has been unable to access a valid copy of a system maintenance file. This could be because seeks to the various copies were unable to be completed or that the read/write chain encountered errors that caused the drive to spare out all its possible copies of the maintenance file. Note that maintenance track sparing is not related to the CS/80 spare command and proceeds without host intervention. A full self-test should be performed on the read/write system and then the servo system.	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) MPU PCA 5) Disc media
24	18	During an access to a system maintenance area, a maintenance file was read that had an invalid checkword. Note that this error can occur during an access to the spare track table file; the spare table will be zero'ed and the drive will seek to the original physical track on an access to a previously spared track. The drive read in a file that had an invalid checkword at the end of a maintenance file. This had to be caused by a read/write failure or an uncorrectable failure or an uncorrectable read error or bad media. A full self-test should be performed on the read/write chain. If the read/write chain is found to be satisfactory, it must be assumed that a faulty write occurred and the current media must have a primary initialization or be replaced.	1) Read/write PCA 2) DMA PCA 3) Disc media 4) MPU PCA
25	19	An access of the system maintenance area was made and all the copies of the files contained the pattern of an unitialized disc. The disc media has not been properly initialized for use.	1) The disc media needs initializing

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
27	1B	A seek was unable to successfully reach the target track. The actual reason for the failure will be recorded in immediately previous logged DERRORs if logging is enabled (other than a drive system seek). Note: If this error has occurred, then the heads are currently over physical cylinder zero. Since an inability to successfully read from the target track in order to verify position can also trigger this fault, both the servo system and the read/write chain are suspect. A full self-test should be performed on both the servo system and the read/write chain.	1) Servo PCA (track follower or actuator driver) 2) Read/write PCA 3) DMA PCA
28	1C	The sector interleave value could not be read from the disc. This means that the firmware will default to an interleave of one (no interleave).	None
29	1D	A physical head position recalibration operation was unable to successfully attain the normal recal position. This error will prompt a head unload operation. Immediately prior DERRORs will elaborate on the cause of the failure if fault logging is enabled (if the recalibration is not part of a internal drive system operation). The servo system is suspect. A full self-test should be performed on the servo system.	1) Servo PCA
30	1E	A head unload operation failed to detect that the heads were retracted and the drive was forced to perform an emergency retract (if the drive has that ability). The servo system is suspect. A full servo system test should be performed.	1) Servo PCA 2) Disc mechanism 3) Disc media
32	20	At the end of a read operation, no data errors were indicated by the hardware, but at some time since the last seek operation, the drive has gone off track. The data read is considered to be valid. This error is an information error only.	If there are hardware problems associated with this error, the servo electronics should be checked out.

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
33	21	During a disc read or write operation, the target sector was passed because there was either no room in the DMA buffer for the sector to be read or there was not a sector's worth of information in the DMA buffer to be written to the disc. With RPS enabled on a write operation, the error could mean that the RPS window was missed. Otherwise, during a write operation, at least one sector was written to the disc and the latency was induced by a subsequent sector write.	None
35	23	The error log on the disc is full (it contains 101 entries). This may be an indication of an increasing error rate.	1) Read/write PCA 2) Disc media
36	24	The disc fault log is full (contains 65 entries). This might be an indication of degrading drive performance. A full internal diagnostic should be performed as the state of the drive is perhaps suspect. The severity of the impact of this error bears on the length of time since the fault log was last cleared.	None

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
64	40	During a disc read or write operation the drive detected an unexpected hardware fault register bit set. This means that some hardware was indicating to the MPU that a hardware fault had occurred. After this entry in the fault log, the contents of the fault register that prompted this error is recorded. The contents of that byte should indicate which assembly is in error. The fault register in the following parameter byte of the status message as well as in the fault log will have all negative true (negative fault) signals complemented. This means the condition causing the fault to be reported will be set high true in the information byte regardless of the logic level of that bit. Suspected hardware is indicated in the contents of the hardware fault register.	1) Indicated assembly due to the hardware fault register 2) MPU PCA Bit 0 = DWF-L Destructive Write Fault Bit 1 = PLE-L Servo PLL lost lock Bit 2 = PFAIL-L Power fail warning Bit 3 = ONT-H On Track Bit 4 = WOT-L Off Track during write Bit 5 = SOK-L Speed OK (always high) Bit 6 = OTL-L Out Of Lock Bit 7 = WAB-L Out of lock latched
65	41	Servo PCA is/was not phase-locked to the disc servo code.	1) Servo PCA 2) Disc mechanism
66	42	Timeout while waiting for an event that doesn't involve the CTC. Seek failure caused by servo electronics, disc mechanism or shock.	1) Servo PCA 2) Disc Mechanism
67	43	Timeout while waiting for a track crossing interrupt from the CTC. The CTC messed up, the servo PLL out of lock or a seek failure occurred.	1) MPU PCA (CTC chip) 2) Servo PCA 3) Disc mechanism
68	44	Timeout while waiting for ON-H (ontrack) at target track.	1) Servo PCA 2) Disc mechanism

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
69	45	Illegal head selected by software.	1) MPU PCA (EPROM or RAM)
70	46	Recalibrate failed because the heads failed to settle. This error is logged after 2 retries of the recalibrate failed.	1) Servo PCA 2) Disc media 3) Disc mechanism
71	47	Timeout occurred while waiting for an offtrack at the beginning of a seek.	1) Servo PCA 2) Disc mechanism 3) MPU PCA (EPROM)
72	48	Timed out waiting for index after a recalibrate. Recalibrate would have failed 2 retries already. Servo can't detect index pulses; read/write sector timer is bad.	1) Servo PCA 2) Read/write PCA 3) Disc mechanism 4) MPU PCA
73	49	The inner guard band was detected after a seek completed. Seek or servo pattern detection failed.	1) Servo PCA 2) Disc mechanism
74	4A	Outer guard band detected after seek complete. Seek failure or servo pattern detection failed.	1) Servo PCA 2) Disc mechanism
75	4B	Outer guard band wasn't detected during a recalibrate. No retries were attempted. Servo pattern detection failed; carriage lock is engaged.	1) Servo PCA 2) Disc mechanism
78	4E	Seek aborted due to servo PLL out of lock or because seek-blocking bit set. Recalibrate aborted due to seek-blocking bit set.	1) Servo PCA 2) Disc mechanism

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
80	50	The DMA electronics will indicate to the firmware that the header information in the DMA header buffer was transfered to the disc (disc write operation) and the data in the DMA data buffer is now being transfered. This status bit will remain set for a long enough period for the firmware to test its validity and expect it to be set (if tested at the correct time). If this bit is not set when the firmware expects it to be set, this error is reported. This is an indication that maybe the DMA electronics is not transfering data to the read/write PCA because the DMA is not receiving the control signals from the read/write electronics or there is a component failure on the DMA PCA.	1) Read write PCA 2) DMA PCA
90	5A	A spare operation retaining data was unable to seek to the target track. It is advised that a full internal diagnostic be performed before any sparing operation to ensure that we haven't lost our ability to seek and read/write. This error may be the reason why sparing was invoked originally.	1) Servo PCA 2) Read/write PCA
91	5B	A spare operation retaining data was unable to read all of the data from the target track. It is advised that a full internal diagnostic be performed before any sparing operation to ensure that we haven't lost our ability to read/write. This error may be the reason the sparing operation was invoked originally.	1) Read/write PCA
92	5C	A sparing operation was unable to seek to either of the two closest available spare tracks to be used in that operation. A full internal diagnostic is recommended before any sparing operation. This error would seem to indicate that perhaps a full cylinder of available spare tracks are defective or that the drive can no longer seek.	1) Servo PCA 2) Read/write PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
93	5D	A sparing operation was unable to write the available spare track and successfully verify it. A full internal diagnostic is recommended before any sparing operation. This error would seem to indicate that either a full cylinder of available spare tracks were defective or that the drive can no longer read/write.	1) Read/write PCA
94	5E	An error was detected in the logical head load routine from the physical head load driver. The specific DERROR from the physical driver should be the next DERROR.	1) Servo PCA
96	60	The CTC did not decrement or reload after the time for one sector. This problem can originate anywhere along the sector timing pulse data path.	1) MPU PCA
97	61	When the firmware has decided that a non-burst disc write operation is complete, it checks the DMA as it should stop in parallel with the firmware. This error is declared if the firmware and the DMA do not agree. This error is not possible in a burst mode write since the DMA is not currently receiving data from the channel during such a write.	1) DMA (channel circuitry)
98	62	A fault bit was detected on the DMA that should never be set for this device. The DMA PCA is highly suspect and the DMA internal diagnostic should be performed.	1) DMA PCA 2) MPU PCA
102	66	The DMA electronics set a bit that indicates the end of a transfer before the expected termination of the transfer. Either the DMA PCA's circuitry that monitors for the end of a transfer is faulty or the MPU's ability to sense these bits is faulty. A full internal diagnostic should be performed.	1) DMA PCA 2) MPU PCA

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Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
103	67	During a disc read or write, the target sector for an operation is determined by comparing the controller's target sector number and the sector counter found in the MPU PCA counter-timer chip (CTC). This error indicates that the desired sector number did not appear from the CTC within a full disc rotation. Either the CTC isn't counting (perhaps due to either the CTC circuitry being in fault or the sector timing circuitry that generates the sector pulses is failing) or that has been a controller fault that caused us to be looking for an illegal sector number. A full internal diagnostic of the drive should be performed.	1) MPU PCA 2) Servo PCA (sector timing circuitry)
107	6B	Inconsistent internal error code(s) encountered by error reporting routine.	1) MPU PCA
108	6C	While waiting for the sector counter (STP register) to reach an expected value, it was noted that the STP was counting at a faster rate than is legally possible. The STP circuitry (it is a channel of the counter-timer chip (CTC) on the MPU PCA) or the circuitry generating sector timing pulses (track follower) is bad. A full self test should be performed on the servo system and the MPU PCA.	1) MPU PCA 2) Servo PCA (STP pulse generating circuitry)
111	6F	A microdiagnostic failed that refers to the controller unit as opposed as to one of the mass storage units.	As the associated TERROR desribes
114	72	A channel parity error has been detected by the channel interface or an illegal channel interface state (caused by receiving bus control, DMA handshake error with channel) or channel loopback failure has occurred. The error could be caused by a faulty channel or a fault in the DMA channel interface. This error could also be caused by faulty system configuration or operation.	1) DMA PCA 2) Host system channel cabling, configuration, or interface

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
115	73	The device received a message type which conflicted with its current state. Assuming host computer is operational, there could be a problem with the DMA hardware.	1) HP-IB cable(s) 2) DMA PCA
118	76	Channel activity has placed the device interface in an illegal state. Host software placed the device in an illegal state, or DMA hardware is improperly communicating with the interface chip (PHI).	1) DMA PCA 2) System configuration
119	77	The received length (in bytes) of an HP-IB message conflicted with the expected length. This is an internal error or possibly an interface problem.	1) HP-IB configuration 2) DMA PCA
121	79	An HP-IB message was abnormally terminated. This is an internal error or possibly an interface problem.	1) DMA PCA 2) Channel configuration
128	80	The CPU sent an illegal opcode to the device. This is an internal error or possibly a transmission problem.	1) HP-IB cables 2) DMA PCA
129	81	The CPU sent a unit or volume number which was out of bounds for this device. This is an internal error or possibly a transmission problem.	1) HP-IB cable 2) DMA PCA
130	82	The CPU sent a command which did not have the correct number of parameter bytes for the opcode(s) included. This is an internal error or possibly a transmission problem.	1) HP-IB cables 2) DMA PCA
136	88	An internal diagnostic failed. Look at TERROR to ascertain which one failed.	Determined by TERROR
139	8B	PHI parallel poll synchronization problem was experienced by the CPU or the CPU tried to talk to the drive while it was automatically released.	1) DMA PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
146	92	No more spares are available for a requested sparing operation. Disc media is getting too old, has been damaged, or read/write electronics has problems.	1) Disc media 2) Read/write PCA
148	94	Retry attempts have failed to rectify a data error during a read operation.	1) Read/write PCA
177	B1	One of the first four data frames in a block had a CRC error. The TIB PCA performed a correction and the data was recovered.	None
178	B2	A CRC error was detected in one of the ECC frames (frame 5 or 6).	None
179	B3	Two nonadjacient frames on the tape had CRC errors. This combination of frames with CRC errors makes the block uncorrectable.	None
180	B4	The frame number returned in the DMA buffer after a transfer of data from the TIB PCA to the DMA buffer is not one of the expected values. This error is usually an indication that the TIB PCA skipped a frame while reading the data from a block into its internal buffer. If the TIB PCA appears free of any hardware problems, there could be a media defect at that block which forces the skew error on the tape. If it appears to be related to a particular address on the tape, that address should be spared.	1) Disc media
182	B6	When attempting to write a block of data to the tape, the key which the firmware believes to be the target key is unreadable. When attempting to read a block of data from the tape, the target key and the first 3 frames within that block have CRC errors (the TIB PCA will attempt to retreive the key address from the first three data frames of the block).	None

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
183	B7	During a tape verify operation where the TIB PCA is performing an 'n' block verify operation, a key with a CRC error was encountered. This part of the hardware verify operation will be implemented only for products which support parallel operations.	None
184	B8	Too many blocks in a row with a key CRC error (see DERROR "B6" hex). The count is set to 20 keys in a row with CRC errors.	1) Tape media (cartridge)
185	B9	This error is set after multiple attempts to seek and locate the target key. If auto sparing is on and this is a write operation, the block will be automatically spared.	None
186	BA	Eight-tenths of a second passed and the TIB PCA did not report finding a key. The tape has an area in which the keys have been destroyed. Use caution in putting tapes with valuable data in this mechanism until the problem is found. Possibly some keys could be erased.	1) Tape media (erasure) 2) TIB PCA 3) Tape mechanism
188	BC	If during a tape read and transmit operation, the host computer is slow receiving the data being sent to it, the tape may need to stop to allow the host to catch up. If the TIB PCA has data to be transfered to the DMA and a key is read on the tape, the TIB will stop the tape and report the situation to the firmware. The firmware will reposition the tape for the next data block. The tape mechanism is not designed to tollerate an excessive amount of stopping and starting. Any use of the tape which might cause the tape to stop and start an excessive amount should be avoided.	None

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
189	BD	This error is the same as the "BC" hex except that a key was read on the tape before a block of data was received from the host computer to be written to the tape. Another case where this error may appear is when a copy data from the disc to the tape is being performed and disc read retries are necessary, which forces a data overrun on the tape.	None
191	BF	This error indicates that the target block is behind the current block or the target block is too far in front of the current block to attempt to get there from here at 60 inches per second. If retries are allowed and not exhausted, a 90 inch-per-second seek be performed, otherwise, the user will get an unrecoverable data error. This error is also generated when the tape encounters a jump spare on the tape since the new block is too far away from the spared block. In most cases, this error is just information for the user indicating more than one seek was necessary in order to locate the target block. If an excessive number of these errors appear, the TIB PCA could be in error or the tape could have some defected areas causing the hardware to missposition.	1) TIB PCA 2) Tape media (cartridge)
192	C0	During any tape operation (seek, read, verify or write), the TIB PCA indicates that it has useful information in the completion code register by setting a bit in another status register. Upon reading the completion code register, the drive firmware can't find any bits set which mean anything for the operation which the TIB PCA should be performing.	1) TIB PCA 2) MPU PCA
194	C2	A command was strobed to the tape device and the tape drive did not acknowledge the command within two seconds.	1) TIB PCA 2) Tape mechanism 3) Tape data cable

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
196	C4	The command strobe procedure was called to strobe a command to the tape drive. This procedure will wait two seconds for the tape to go "not busy", in the case where the tape drive was busy before the procedure strobed the command. If the tape drive is busy and stays busy for the time limit, this error is reported.	1) TIB PCA 2) Tape mechanism
197	C5	A stop command was strobed to the tape drive. The tape drive set busy status indicating it is busy stopping the tape but the busy status does not go away.	1) Tape mechanism 2) TIB PCA
200	C8	A motion command was strobed to the tape drive. The line indicating the drive is busy is asserted by the tape drive but this line never goes false.	1) Tape mechanism 2) TIB PCA
201	C9	A command was sent to the tape tape drive to start the tape in motion. The tape drive acknowledged the command and supposedly started the tape without any problems, but when the tape status register was read, the "at speed" bit was not set.	1) TIB PCA 2) Tape mechanism
202	CA	Since there is no sector signal when transferring data between the TIB and DMA, the TIB toggles a flip flop for each block (256 bytes) transfered between the DMA and TIB. If the TIB does not toggle the flip flop, this error is reported.	1) TIB PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
203	CB	Status byte from tape drive has most significant bit (bit 7) set which indicates secondary status. This secondary status byte from the tape is also reported in the byte following the error byte. This error signals problems in the tape drive. These problems may be related to the tape cartridge or the tape mechanism. If the secondary is persistent and points to the tape mechanism, the tape drive may have problems. If the problem is an off-tape error, the tape may have passed beyond the BOT/EOT field on the tape and need to be respooled. Otherwise, the tape may have a damaged area.	(High true) Bit 0 = Read amplifier or electronics Bit 1 = Off tape Bit 2 = Stepper motor error Bit 3 = ROM checksum or RAM error Bit 4 = Abnormal tachometer feedback Bit 5 = Abnormal drive motor load Bit 6 = Illegal command Bit 7 = Always high (1)
204	CC	This error will occur if, during a write operation, the TIB PCA does not pulse the four-bit down counter on the MPU PCA in 23 milliseconds. Or, if during a read operation, the TIB PCA does not indicate the completion of the operation in approximately the same time.	1) TIB PCA
205	CD	This error is set when the host attempts to perform a tape operation before the tape has completed the autoload, read the spare table and manufacturer's block on the tape. If the "not ready" status is reported even after the tape has completed the autoload and the autoload did not fail.	1) TIB PCA 2) Tape mechanism
207	CF	After reseting the tape drive or after acknowledging the secondary status sent from the tape drive, the most significant bit of the tape drive status register did not return to zero after a specified time.	1) Tape mechanism (controller) 2) TIB PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
208	D0	When the data is transfered to the TIB PCA from the DMA PCA or to the DMA PCA from the TIB PCA, the upper nibble of the disc address counter (on the DMA PCA) will increment by one for each 256 bytes transfered. Since 1k bytes are transfered on tape transfers, this register is a good indication of whether 4 times 256 bytes transfered between the DMA and TIB. If this value does not change by 4, this error is reported.	1) TIB PCA 2) DMA PCA
209	D1	In a tape certification or a write-then-read error rate test, the firmware compares the data read with what it wrote. If they don't compare this error is reported.	1) TIB PCA 2) DMA PCA
211	D3	The firmware was waiting for the CTC to interrupt which indicates that the CTC pulsed the TIB PCA. The CTC interrupt never came.	1) MPU PCA
211	D3	When the target key is located, the TIB PCA pulses the counter timer chip on the MPU. This timer will time the delay to the initial erase and time the length of the initial erase (erase before first frame). If the CTC does not start counting after the target key is located during a write operation, this error is reported.	1) TIB PCA 2) MPU PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
213	D5	The firmware controls the gathering of a block of data from the host computer and then starts a write of that data to a block on the tape. While the TIB PCA is sequencing through the write operation, the firmware gathers another block from the host computer. Once the data for the next block is received from the host, the firmware will "hold hands" with the TIB as a form of redundant protection against writing over keys on the tape. This is done by allowing 23 msec for the TIB to indicate that the six frames were written on the tape (4-bit counter on MPU is pulsed). Once the 4-bit counter is pulsed, the counter is tested to be sure it decremented by only one count. The 4 bit counter decrementing is an indication that the TIB is in final erase (erase frame). This final erase will not last more than about 3.4 milliseconds at which time the TIB will indicate successful completion.	1) TIB PCA 2) MPU PCA (4-bit tape counter)
216	D8	The tape drive reported that a tape was in the mechanism, there was no autoload in progress and the not ready staus bit indicated that the tape was ready for use. This indicates to the firmware that the tape is ready for use. Some time later, the firmware wanted to strobe a command byte to the tape drive but the status now indicates it is not ready for use.	1) TIB PCA 2) Tape mechanism 3) MPU PCA
217	D9	This error is used by the firmware to force the unrecoverable error bit to be set in the staus field returned to the host computer. It means retries expired for a media related error.	1) Tape media (cartridge)
218	DA	The firmware was unable to recover from a non media related problem (possibly through retries). When doing an internal tape write/read test, the firmware will use this error to report that a situation encountered could not be recovered through retries or could not recover and retries are not allowed.	1) Tape media (cartridge)

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
219	DB	An attempt was made to read from a tape which was never written to.	1) TIB PCA 2) Tape mechanism
220	DC	The host attempted to access beyond the logical end of volume.	Host computer addressing
222	DE	During an internal tape error rate test (ERT), the ERT log overflowed. This means that the ERT test needs to log a new block with a permanent error but the log currently has the maxumum number of entries in it (255 entries). If this error occurs during a tape certify operation, and the firmware is able to update the ERT log on the tape, any blocks that need to be spared on the tape that are in the ERT log will be spared. This does not mean that the tape is safe to use since the certify did not complete.	1) Tape media (cartridge) 2) Dirty tape head
223	DF	An attempt was made to write to a tape which is write protected.	None
225	E1	A parameter bounds error occurred in a set address command.	1) HP-IB cables 2) DMA PCA
226	E2	A parameter bounds error occurred in a command other than unit, volume, or address.	1) HP-IB cables 2) DMA PCA
228	E4	At the end of any disc disc read operation, the firmware will compare the header information that was read from the last sector of the disc to the expected values for that sector address. If this address is incorrect, this error is reported. This fault is an indication of a possible DMA data RAM failure.	1) DMA PCA

Table 4-5. Run-Time Drive Errors (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
229	E5	At the end of any disc read operation, the header information from the last sector read is compared to the expected sector number. If the values differ, this error is reported. There are a number of possible reasons why this situation could occur. The DMA header RAM could be failing, the CTC could be failing, the read/write electronics could have problems or the servo electronics could be dropping sector timing pulses which go to the CTC on the MPU PCA. Also, if the media has a defect which causes the servo PCA to miss a start of sector signal in the servo code this error could be reported.	1) DMA PCA 2) Read/write PCA 3) Servo PCA 4) MPU PCA 5) Disc mechanism
230	E6	The device was not in proper position to access the media when the CPU commanded a media access. Media not inserted, head loading or diagnostic failure, or a drive fault during real time access may have occurred.	1) Servo PCA 2) Read/write PCA

Table 4-6. Power Within the Mother PCA-A7

SUPPLY	REGULATOR PCA-A1		SERVO PCA-A2		R/W PCA-A3		DMA PCA-A4		MPU PCA-A5		TIB PCA-A6		MOTHER PCA-A7	
	A1P1	A1P2	A2P1	A2P2	A3P1	A3P2	A4P1	A4P2	A5P1	A5P2	A6P1	A6P2	A7J1	A7J2
													TAPE	DISC
+5V Regulated	37 thru 50	1 thru 14	47, 48	3, 4	47, 48	3, 4	47, 48	3, 4	47, 48	3, 4	47, 48	3, 4	+5	
+12V Regulated (Spindle)		19 thru 26		29, 30										+12
+12VL Regulated (Logic)		34		1, 2		1, 2		1, 2		1, 2		1, 2		
+12VT Regulated (Tape)		27 thru 32											+12	
-12V Regulated (Spindle)	19 thru 32		21, 22											-12
-12VL Regulated (Logic)		33	49, 50		49, 50		49, 50		49, 50		49, 50			
Ground	1 thru 18	35 thru 42 45 thru 50	1, 2, 25, 26, 45, 46	5, 6, 7, 8, 25, 26, 47, 48, 49, 50	1, 2, 25, 26, 45, 46	7, 8, 25, 26, 47, 48, 49, 50	1, 2, 25, 26, 45, 46	7, 8, 25, 26, 47, 48, 49, 50	1, 2, 25, 26, 45, 46	7, 8, 25, 26, 47, 48, 49, 50	1, 2, 25, 26, 45, 46	7, 8, 25, 26, 49, 50	GND	

Denotes Source

Table 4-7. Signals Within the Mother PCA-A7

MNEMONIC	DEFINITION	SERVO PCA-A2		R/W PCA-A3		DMA PCA-A4		PROCESSOR PCA-A5		TIB PCA-A6	
		A2P1	A2P2	A3P1	A3P2	A4P1	A4P2	A5P1	A5P2	A6P1	A6P2
A0-H	ADDRESS BIT 0					13		13		13	
A1-H	ADDRESS BIT 1					14		14		14	
A2-H	ADDRESS BIT 2					15		15		15	
A3-H	ADDRESS BIT 3					16		16		16	
A4-H	ADDRESS BIT 4					17		17			
A5-H	ADDRESS BIT 5					18		18			
A6-H	ADDRESS BIT 6					19		19			
A7-H	ADDRESS BIT 7					20		20			
A8-H	ADDRESS BIT 8					21		21			
A9-H	ADDRESS BIT 9					22		22			
A10-H	ADDRESS BIT 10					23		23			
A11-H	ADDRESS BIT 11					24		24			
BUFS-L	BUFFER SELECT					28		28			
CTCMO-H	COUNTER OUTPUT							44		44	
CTCT-H	COUNTER TRIGGER							41		41	
CYL-L	CYLINDER ADDRESS		11						11		
D0-H	DATA BIT 0	3		3		3		3		3	
D1-H	DATA BIT 1	4		4		4		4		4	
D2-H	DATA BIT 2	5		5		5		5		5	
D3-H	DATA BIT 3	6		6		6		6		6	
D4-H	DATA BIT 4	7		7		7		7		7	
D5-H	DATA BIT 5	8		8		8		8		8	
D6-H	DATA BIT 6	9		9		9		9		9	
D7-H	DATA BIT 7	10		10		10		10		10	
DIF-H	DIFFERENTIAL POSITION		21						21		
DIN-H	READ DATA			37		37					
DMAS-L	DMA SELECT					30		30			
DOUT-H	WRITE DATA			33		33				35	
FLS-L	FAULT LATCH SELECT			36				36			
FSS-L	FORMATTER/SEPARATOR SELECT			34				34			
IDX-L	INDEX PULSE		14		14						
IGB-L	INNER GUARD BAND		22						22		
INDX-L	MODIFIED INDEX PULSE				11				14		
IOS-L	I/O SELECT					32		32			
MRST-L	MASTER RESET		16		16		16		16	32	
NMI-L	NON-MASK INTERRUPT						5		5		
OF-H	OFF TRACK		23						23		
OGB-L	OUTER GUARD BAND		24						24		
ON-H	ON TRACK		17		17				17		
PLE-L	PHASE LOCK ERROR		45		45						
P2-L	CLOCK (648 kHz)		13		13						
P8-L	CLOCK (2.6 MHz)		9		9						
PFAIL-L	POWER FAIL (from Regulator PCA-A1)				44						
PMD-L	POSITION MODE		12		12						
RD-L	READ ENABLE	11		11		11		11		11	
RWC-L	READ/WRITE CLOCK			42		42				42	
RWS-L	READ/WRITE SELECT			31				31			
SA-L	SERVO ENABLE (DATA)	27						27			
SB-L	SERVO ENABLE (COMMAND)	29						29			
SOD-L	START OF DATA				20		20			36	
SOS-L	START OF SECTOR				15		15			39	
STP-L	SECTOR TIMING PULSE				37				41		
TC-H	TRACK CROSS		18						18		
TIBS-L	TIB SELECT							33		33	
TKX-H	TRACK CROSS	40						40			
WR-L	WRITE ENABLE	12		12		12		12		12	

Denotes Source(s)

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Table 4-8. W1 Rectifier-Regulator Cable Wiring

VOLTAGE	DESCRIPTION	RECTIFIER PCA-A9 (J1)	REGULATOR PCA-A1 (J1)
115 Vac	Fan Power	11	To Fan
115 Vac	Fan Power	12	To Fan
+5V UNRGLTD	Unregulated +5V Supply	3, 6	3, 8
+12V UNRGLTD	Unregulated +12V Supply	2, 5	4, 7
-12V UNRGLTD	Unregulated -12V Supply	9	5, 6
GND	Common Ground	4, 7, 8, 10	1, 2, 9, 10
Chassis	Chassis Ground	1	To Chassis

Table 4-9. W2 Diode Cable Wiring

VOLTAGE	DESCRIPTION	DIODE	RECTIFIER PCA-A9 (J5)
+5V	CR1 (+) Output	CR1 (+)	1, 2
+12V	CR2 (+) Output	CR2 (+)	4
-12V	CR2 (-) Output	CR2 (-)	3

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Table 4-10. W4 Tape Power Cable Wiring

VOLTAGE	DESCRIPTION	MOTHER PCA-A7 (J1)	TAPE MECHANISM
+5V RGLTD	+5V Regulated Supply	3	4
+12VT RGLTD	+12VT Regulated Supply	1	1
GND	Common Ground	2	2

Table 4-11. W7 Interconnect Cable Wiring

VOLTAGE	DESCRIPTION	POWER SWITCH	INTERCONNECT PCA-A10 (J5)
120 Vac (240 Vac Opt 015)	AC Line Voltage	2	4
120 Vac (240 Vac Opt 015)	AC Line Voltage	5	1

Table 4-12. W3 Read/Write-Servo Cable Wiring

MNEMONIC	DESCRIPTION	READ/WRITE PCA-A3 (J2)	SERVO PCA-A2 (J2)	DISC MECHANISM
CS0-L	Chip Select 0	6		30
CS1-L	Chip Select 1	5		29
DX	Differential Data	33		1
DY	Differential Data	32		4
H1-L	Head Select 1	26		10
H2-L	Head Select 2	27		7
PSAF-H	Write Safe	24		12
-4V	-4V Supply	23		11
+6V	+6V Supply	21		13
GND	Common Ground	17, 31, 34		2, 3, 17
WRMA-H	Write Current	25		9
WSE-L	Write Select	22		14
LMA	Linear Motor Current		9, 10	25, 26
LMB	Linear Motor Current		11, 12	23, 24
SM	Solenoid Lock Minus		8	28
SP	Solenoid Lock Plus		7	27
SS1	Servo Signal		15	19
SS2	Servo Signal		14	22
-8.2V	-8.2V Supply		13	21
GND	Common Ground		16	20

Table 4-13. HP-IB Cable Wiring

MNEMONIC	DESCRIPTION	DMA PCA-A4 (J1)
EOI-L	End Or Identify	16
REN-L	Remote Enable	15
SRQ-L	Service Request	6
ATN-L	Attention	4
IFC-L	Interface Clear	8
NDAC-L	Not Data Accepted	10
NRFD-L	Not Ready For Data	12
DAV-L	Data Valid	14
DIO1-L	Data I/O Line 1	24
DIO2-L	Data I/O Line 2	22
DIO3-L	Data I/O Line 3	20
DIO4-L	Data I/O Line 4	18
DIO5-L	Data I/O Line 5	23
DIO6-L	Data I/O Line 6	21
DIO7-L	Data I/O Line 7	19
DIO8-L	Data I/O Line 8	17
GND	Ground	1, 3, 5, 7, 9, 11, 13
SHIELD	Shield	2

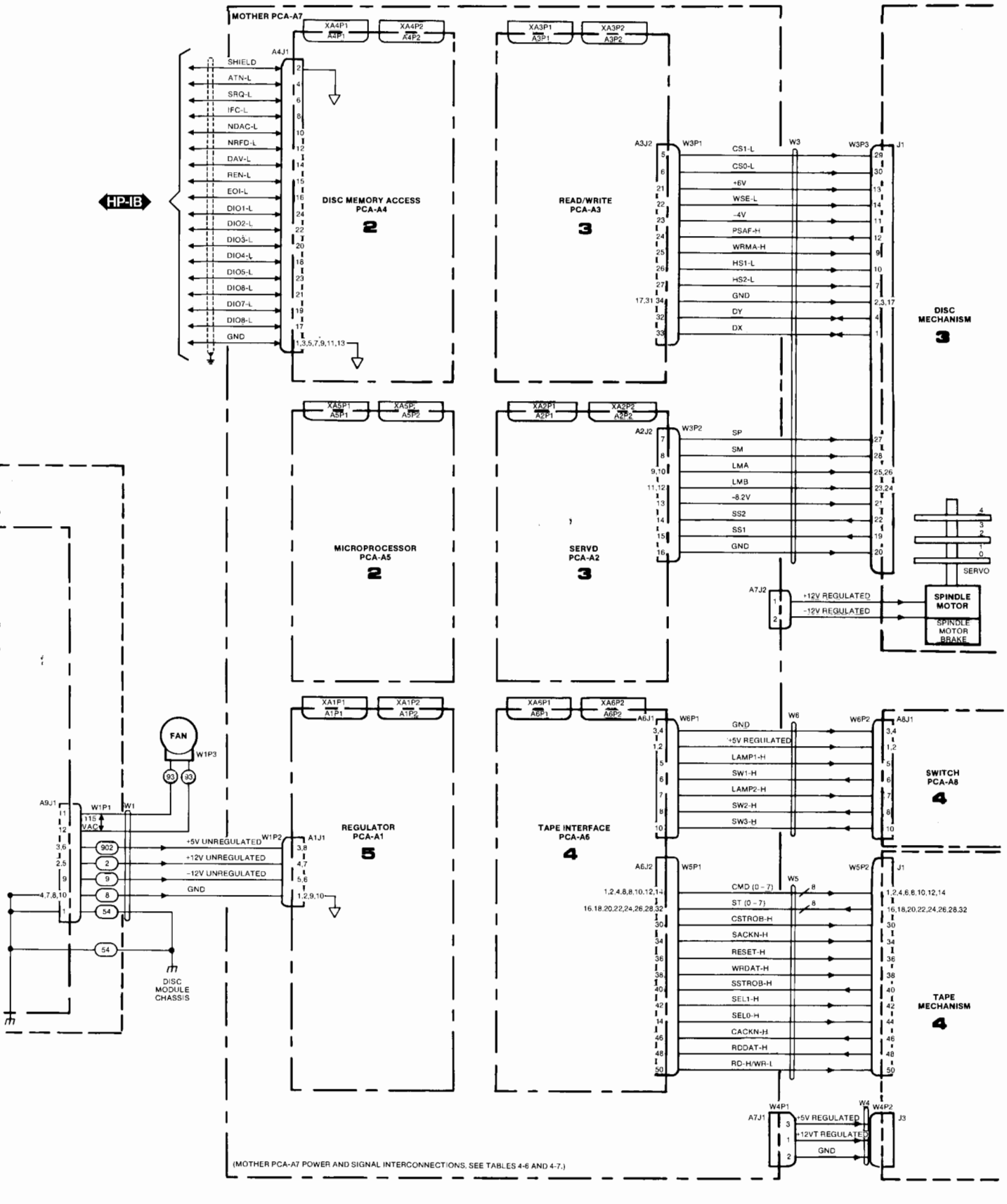
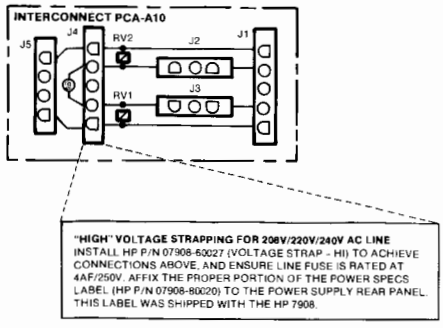


Figure 4-6. Interconnection Diagram


INTERCONNECT PCA-A10
J5
J4
RV2
J2
J1
RV1
J3
"HIGH" VOLTAGE STRAPPING FOR 208V/220V/240V AC LINE
INSTALL HP P/N 07908-60027 (VOLTAGE STRAP - HI) TO ACHIEVE CONNECTIONS ABOVE, AND ENSURE LINE FUSE IS RATED AT 4AF/250V. AFFIX THE PROPER PORTION OF THE POWER SPECS LABEL (HP P/N 07908-80020) TO THE POWER SUPPLY REAR PANEL. THIS LABEL WAS SHIPPED WITH THE HP 7908.

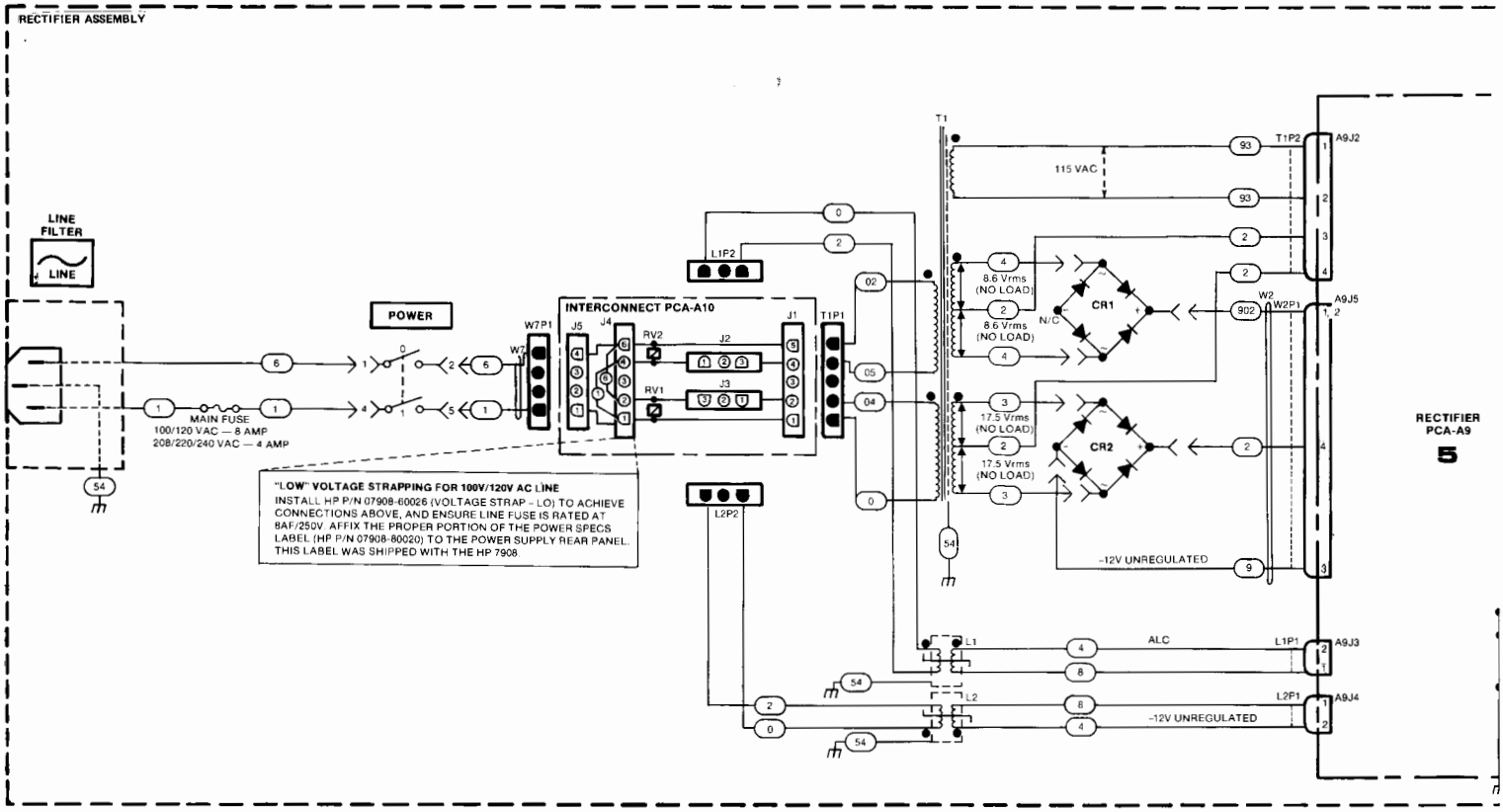

RECTIFIER ASSEMBLY
LINE FILTER
LINE
POWER
MAIN FUSE
100/120 VAC — 8 AMP
208/220/240 VAC — 4 AMP
W7P1
INTERCONNECT PCA-A10
J5
J4
RV2
J2
J1
RV1
J3
T1P1
L1P2
L2P2
T1
115 VAC
8.6 Vrms (NO LOAD)
17.5 Vrms (NO LOAD)
CR1
CR2
N/C
W2
W2P1
T1P2
A9J2
A9J5
A9J3
A9J4
L1P1
L2P1
L1
L2
ALC
-12V UNREGULATED
RECTIFIER PCA-A9
5
"LOW" VOLTAGE STRAPPING FOR 100V/120V AC LINE
INSTALL HP P/N 07908-60026 (VOLTAGE STRAP - LO) TO ACHIEVE CONNECTIONS ABOVE, AND ENSURE LINE FUSE IS RATED AT 8AF/250V. AFFIX THE PROPER PORTION OF THE POWER SPECS LABEL (HP P/N 07908-80020) TO THE POWER SUPPLY REAR PANEL. THIS LABEL WAS SHIPPED WITH THE HP 7908.

Table 4-14. W5 Tape Data Cable Wiring

MNEMONIC	DESCRIPTION	TIB PCA-A6 (J2)	TAPE MECHANISM
CACKN-H	Command Acknowledge	46	46
CMD (0-7)	Command Bus	1, 2, 4, 6, 8, 10, 12, 14	1, 2, 4, 6, 8, 10, 12, 14
CSTROB-H	Command Strob	30	30
RDDAT-H	Read Data	48	48
RD-H/WR-L	Read Enable/Disable	50	50
RESET-H	Reset	36	36
SACKN-H	Status Acknowledge	34	34
SEL0-H	Select	44	44
SEL1-H	Select	42	42
SSTROB-H	Status Strobe	40	40
ST (0-7)	Status Bus	16, 18, 20, 22, 24, 26, 28, 32	16, 18, 20, 22, 24, 26, 28, 32
WRDAT-H	Write Data	38	38

Table 4-15. W6 Switch Cable Wiring

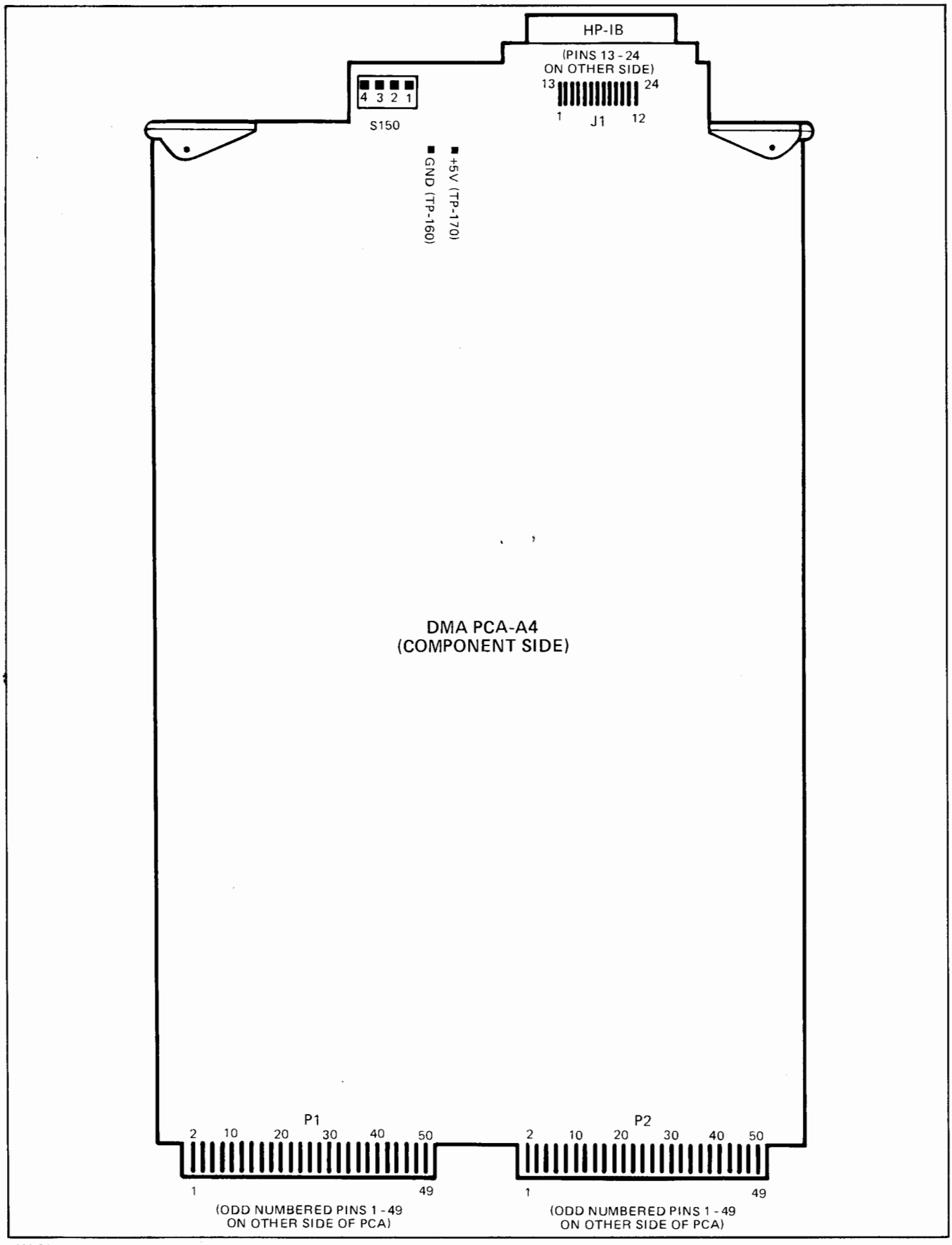
MNEMONIC	DESCRIPTION	TIB PCA-A6 (J1)	SWITCH PCA-A8 (J1)
LAMP1-L	Busy Indicator	5	5
LAMP2-L	Protect Indicator	7	7
SW1-H	Save Key	6	6
SW2-H	Restore Key	8	8
SW3-H	Unload Key	10	10
+5V RGLTD	+5V Regulated Supply	1, 2	1, 2
GND	Common Ground	3, 4	3, 4

Table 4-16. Rectifier Assembly LED's

UNREGULATED SUPPLY	LED'S EXTINGUISHED	SUSPECT COMPONENT
+5V	DS 172 (RED) and DS 173 (GREEN)	CR1
+5V	DS 173 (GREEN)	F 291
+12V	DS 174 (RED) and DS 175 (GREEN)	CR2
+12V	DS 175 (GREEN)	F 290
-12V	DS 170 (RED) and DS 171 (GREEN)	CR2
-12V	DS 171 (GREEN)	F 195
ALL	All LED's extinguished	Main Fuse

Table 4-17. Tape Mechanism Status LED's

DRIVE FAILURE LAMP (Right Lamp)	CARTRIDGE FAILURE LAMP (Left Lamp)	CAUSE
OFF	OFF	Normal
OFF	ON	Bad or Improper Cartridge
ON	OFF	Replace Tape Mechanism
ON	ON	Could be Tape Mechanism or Cartridge



7908-34

Figure 4-7. DMA PCA-A4 Layout

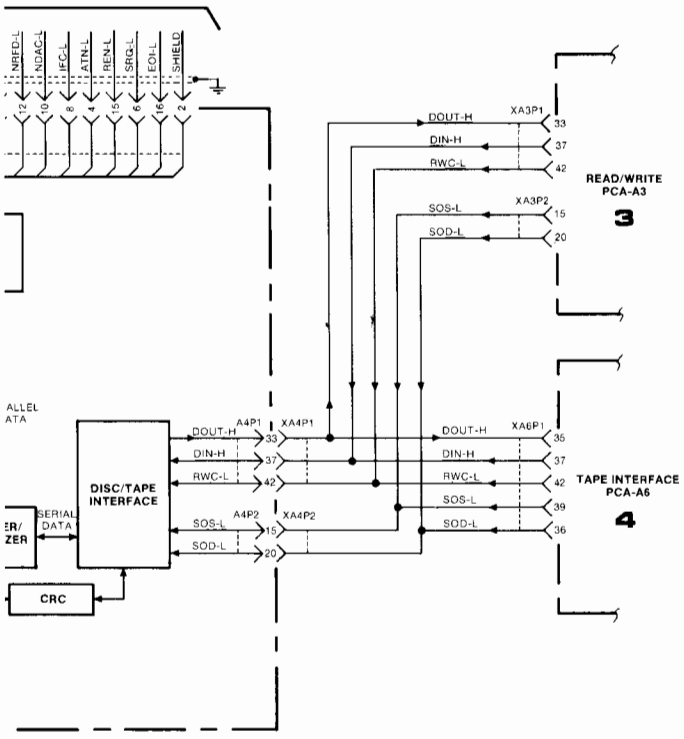
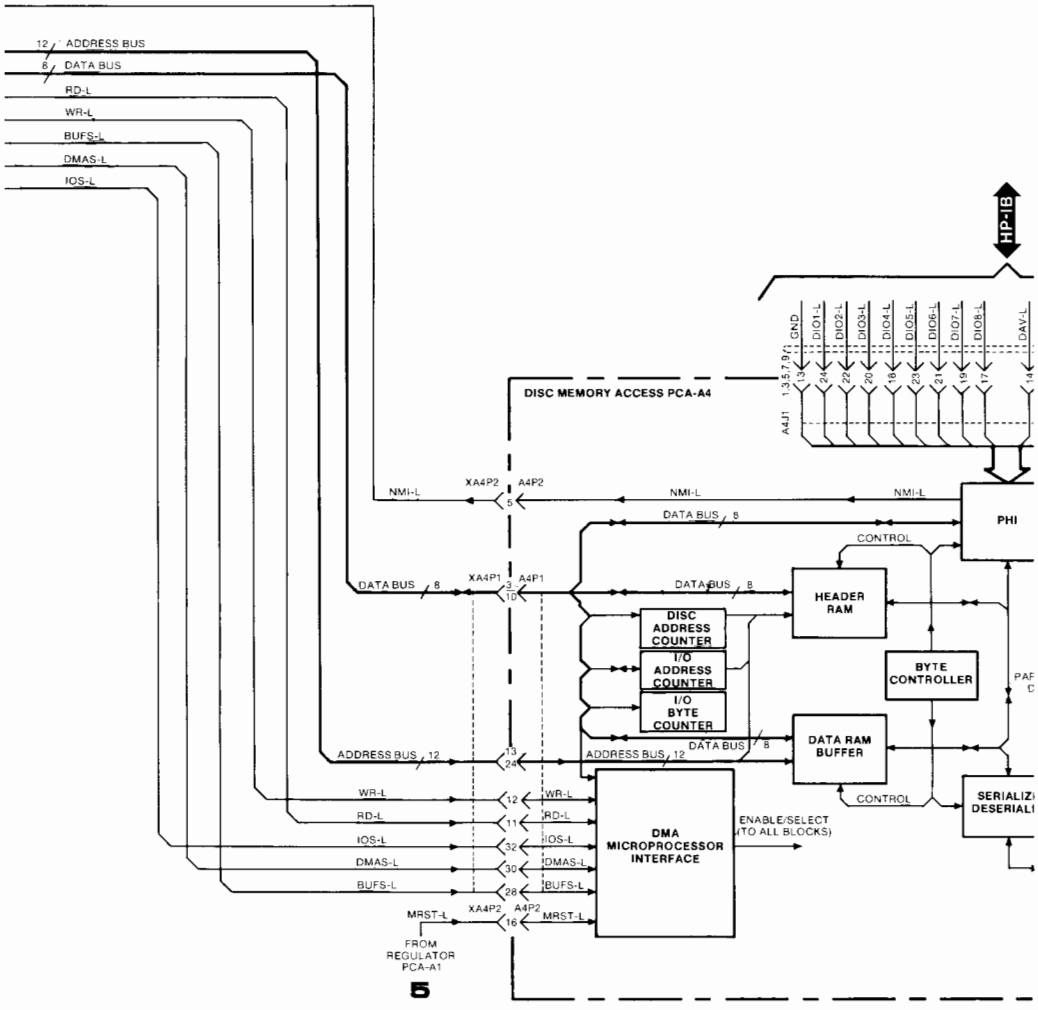
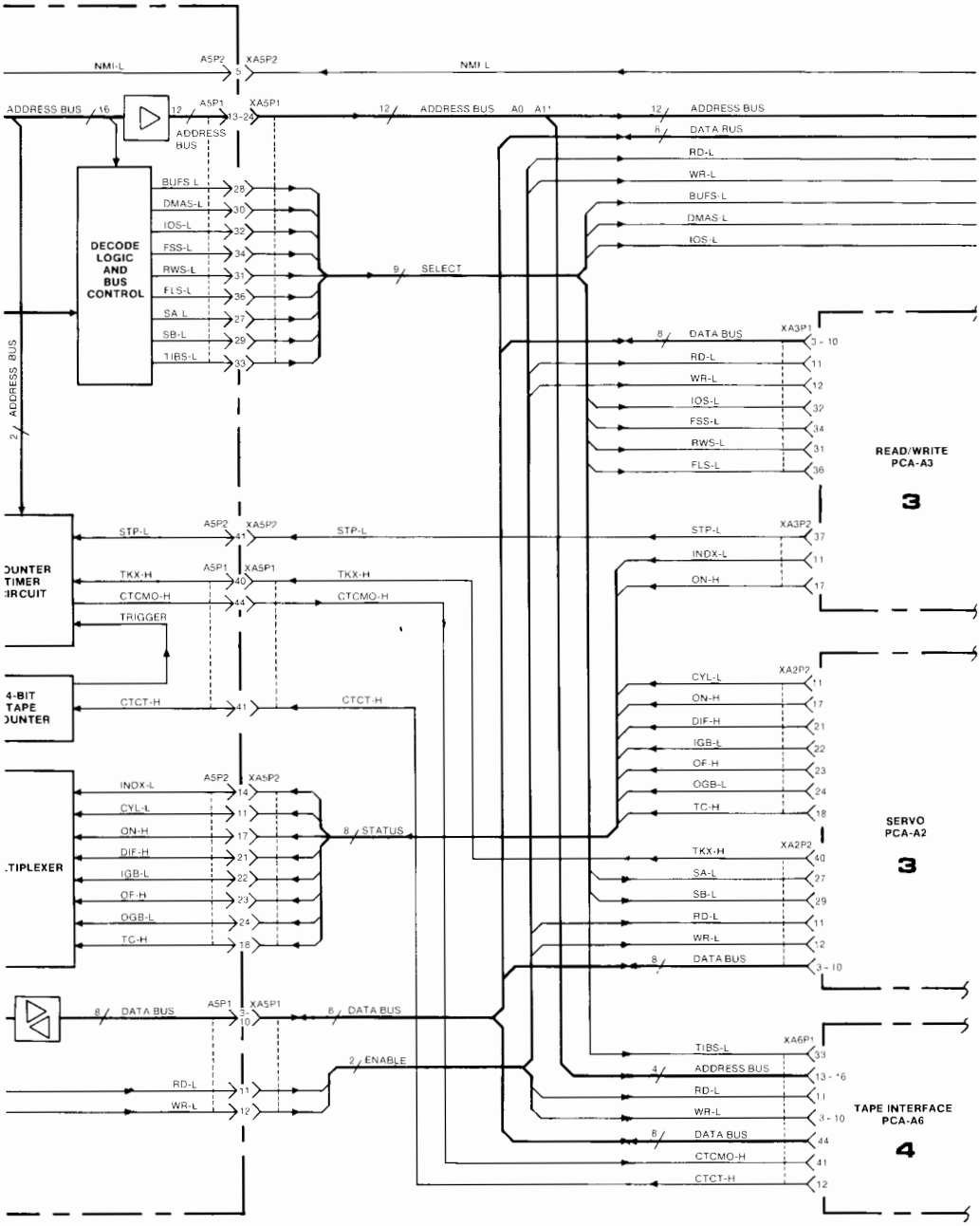
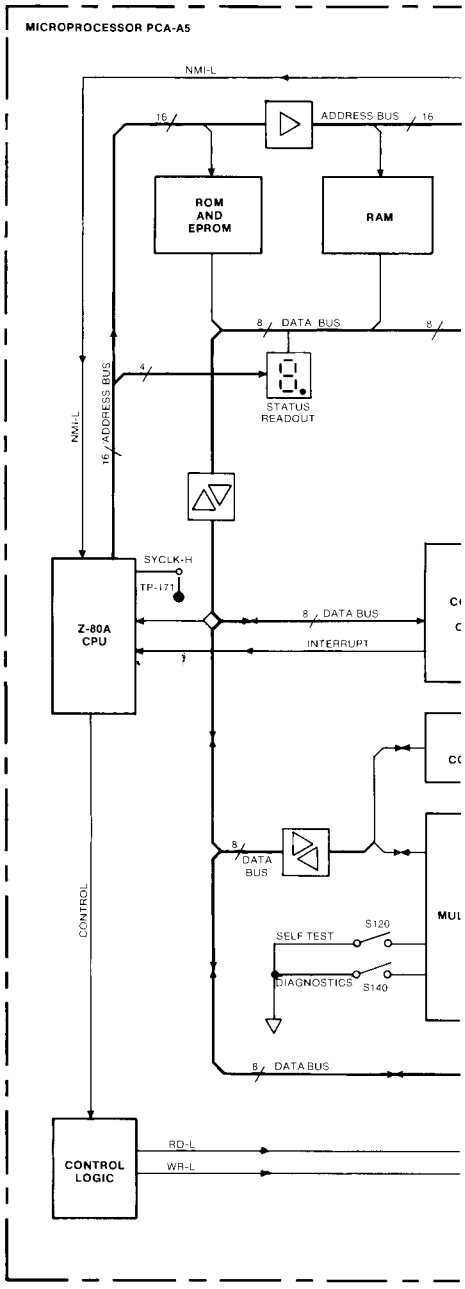
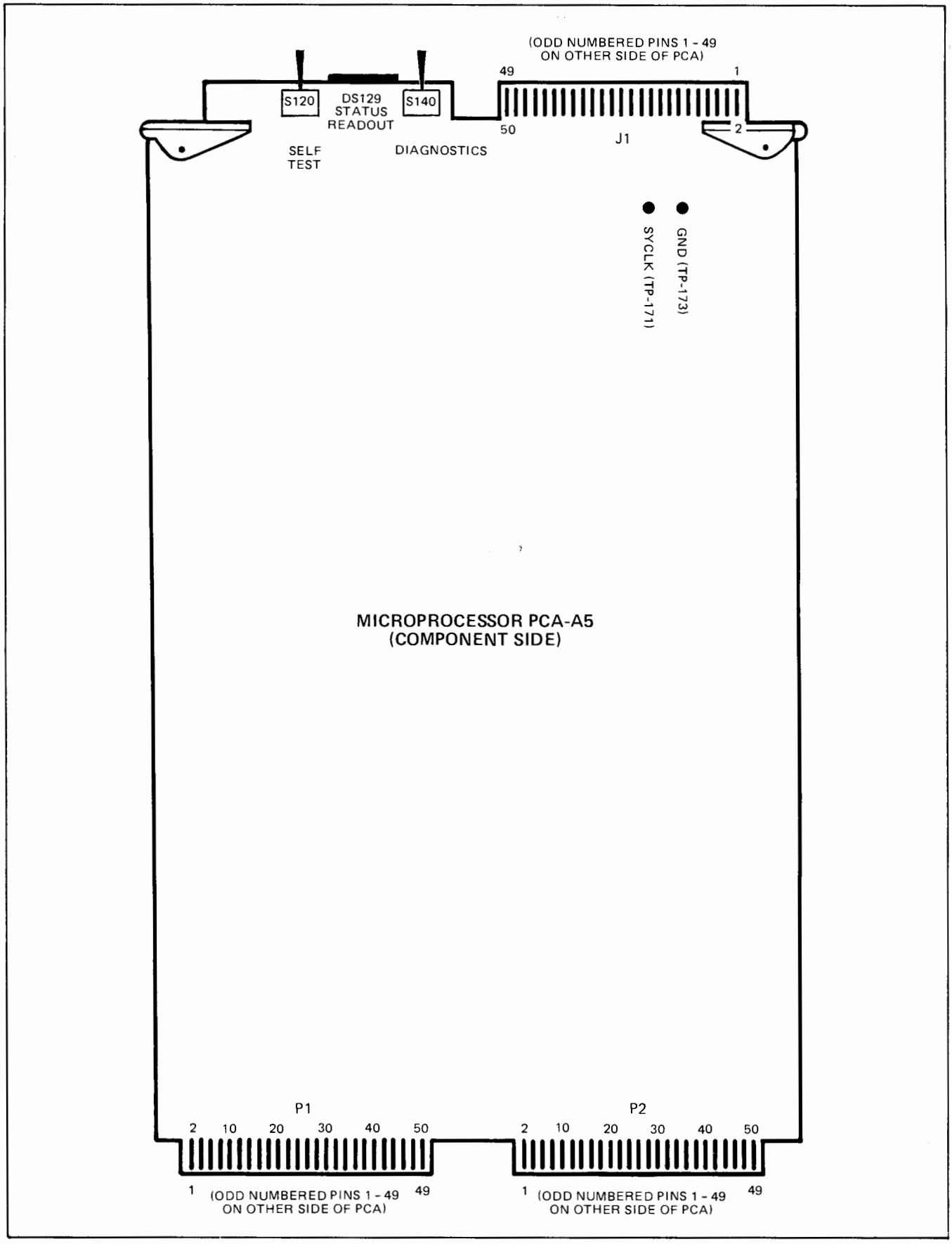


Figure 4-9. Controller System Functional Diagram


12 ADDRESS BUS
8 DATA BUS
RD-L
WR-L
BUFS-L
DMAS-L
IOS-L
HP-IB
GND
DIO1-L
DIO2-L
DIO3-L
DIO4-L
DIO5-L
DIO6-L
DIO7-L
DIO8-L
DAV-L
A4J1
DISC MEMORY ACCESS PCA-A4
NMI-L
XA4P2
A4P2
PHI
DATA BUS 8
CONTROL
XA4P1
A4P1
HEADER RAM
DISC ADDRESS COUNTER
I/O ADDRESS COUNTER
I/O BYTE COUNTER
BYTE CONTROLLER
DATA RAM BUFFER
ADDRESS BUS 12
DMA MICROPROCESSOR INTERFACE
ENABLE/SELECT
MRST-L
FROM REGULATOR PCA-A1
5

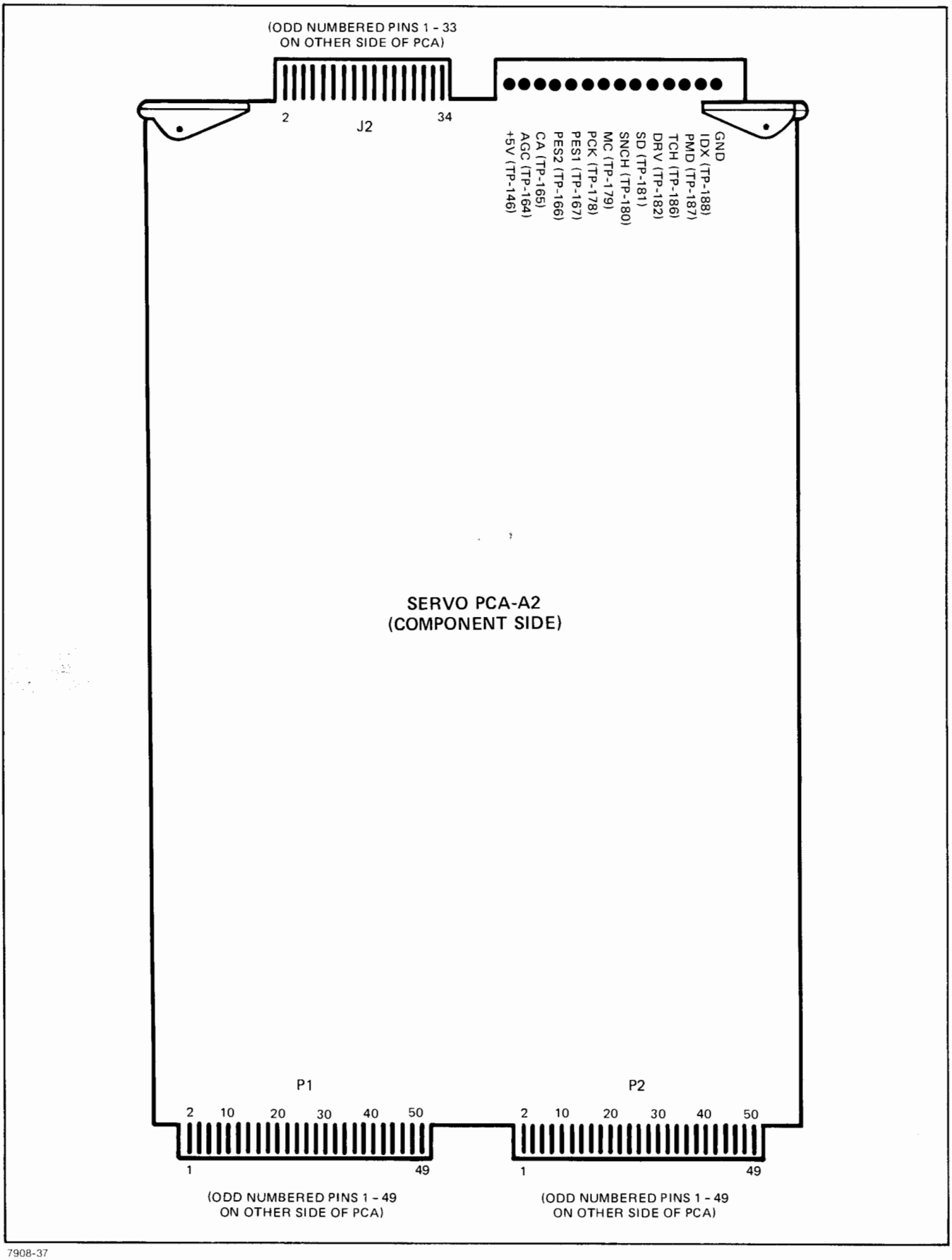

NMI-L
A5P2
XA5P2
5
NMI-L
ADDRESS BUS
16
12
A5P1
13-24
XA5P1
ADDRESS BUS
12
ADDRESS BUS
A0
A1
12
ADDRESS BUS
8
DATA BUS
RD-L
WR-L
BUFS-L
DMAS-L
IOS-L
DECODE LOGIC AND BUS CONTROL
BUFS-L
28
DMAS-L
30
IOS-L
32
FSS-L
34
RWS-L
31
FLS-L
36
SA-L
27
SB-L
29
TIBS-L
33
8
SELECT
2
ADDRESS BUS
8
DATA BUS
XA3P1
3 - 10
RD-L
11
WR-L
12
IOS-L
32
FSS-L
34
RWS-L
31
FLS-L
36
READ/WRITE PCA-A3
3
STP-L
A5P2
41
XA5P2
STP-L
STP-L
XA3P2
37
INDX-L
11
ON-H
17
TKX-H
A5P1
40
XA5P1
TKX-H
CTCMO-H
44
CTCMO-H
TRIGGER
CTCT-H
41
CTCT-H
CYL-L
XA2P2
11
ON-H
17
DIF-H
21
IGB-L
22
OF-H
23
OGB-L
24
TC-H
18
INDX-L
A5P2
14
XA5P2
CYL-L
11
ON-H
17
DIF-H
21
IGB-L
22
OF-H
23
OGB-L
24
TC-H
18
8
STATUS
SERVO PCA-A2
3
TKX-H
XA2P2
40
SA-L
27
SB-L
29
RD-L
11
WR-L
12
8
DATA BUS
3 - 10
8
DATA BUS
A5P1
9
XA5P1
10
8
DATA BUS
2
ENABLE
RD-L
11
WR-L
12
TIBS-L
XA6P1
33
4
ADDRESS BUS
13 - 16
RD-L
11
WR-L
3 - 10
8
DATA BUS
44
CTCMO-H
41
CTCT-H
12
TAPE INTERFACE PCA-A6
4


MICROPROCESSOR PCA-A5
NMI-L
16
ADDRESS BUS
16
ROM AND EPROM
RAM
8
DATA BUS
8
4
STATUS READOUT
NMI-L
16
ADDRESS BUS
SYCLK-H
TP-171
Z-80A CPU
8
DATA BUS
INTERRUPT
8
DATA BUS
CONTROL
SELF TEST
S120
DIAGNOSTICS
S140
8
DATA BUS
CONTROL LOGIC
RD-L
WR-L



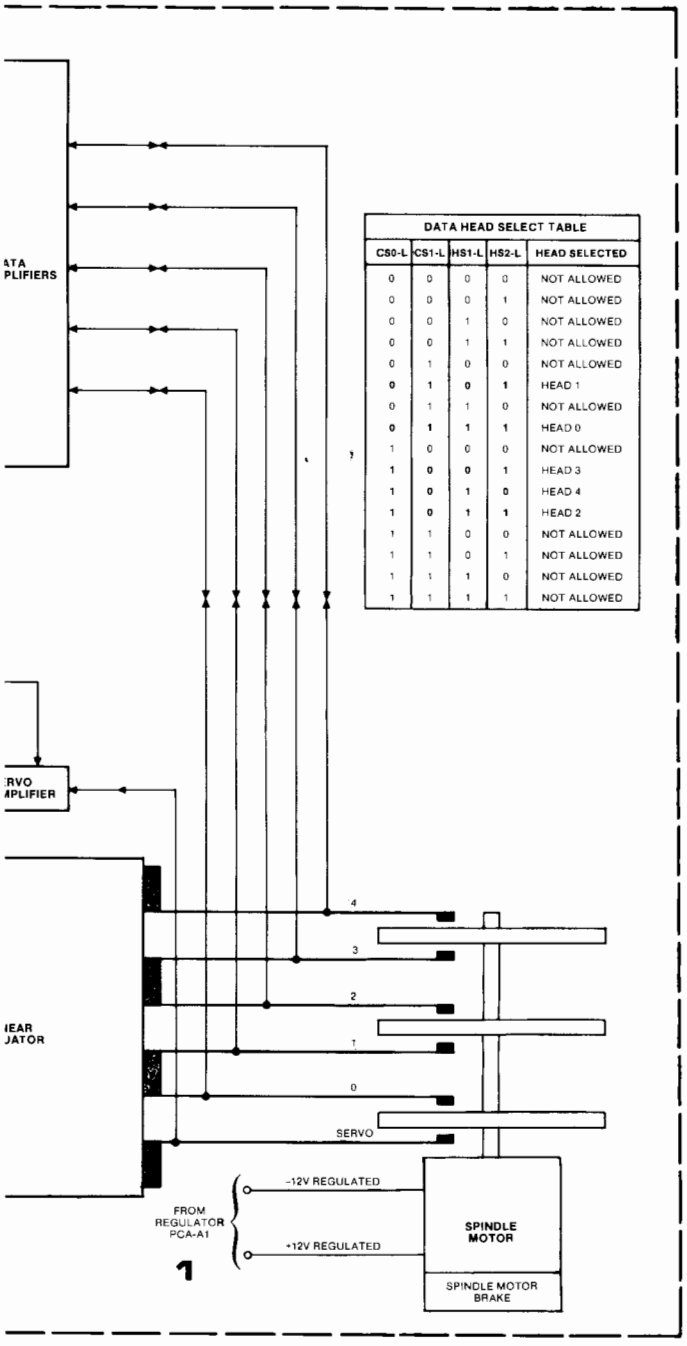
7908-35

Figure 4-8. MPU PCA-A5 Layout



7908-37

Figure 4-10. Servo PCA-A2 Layout

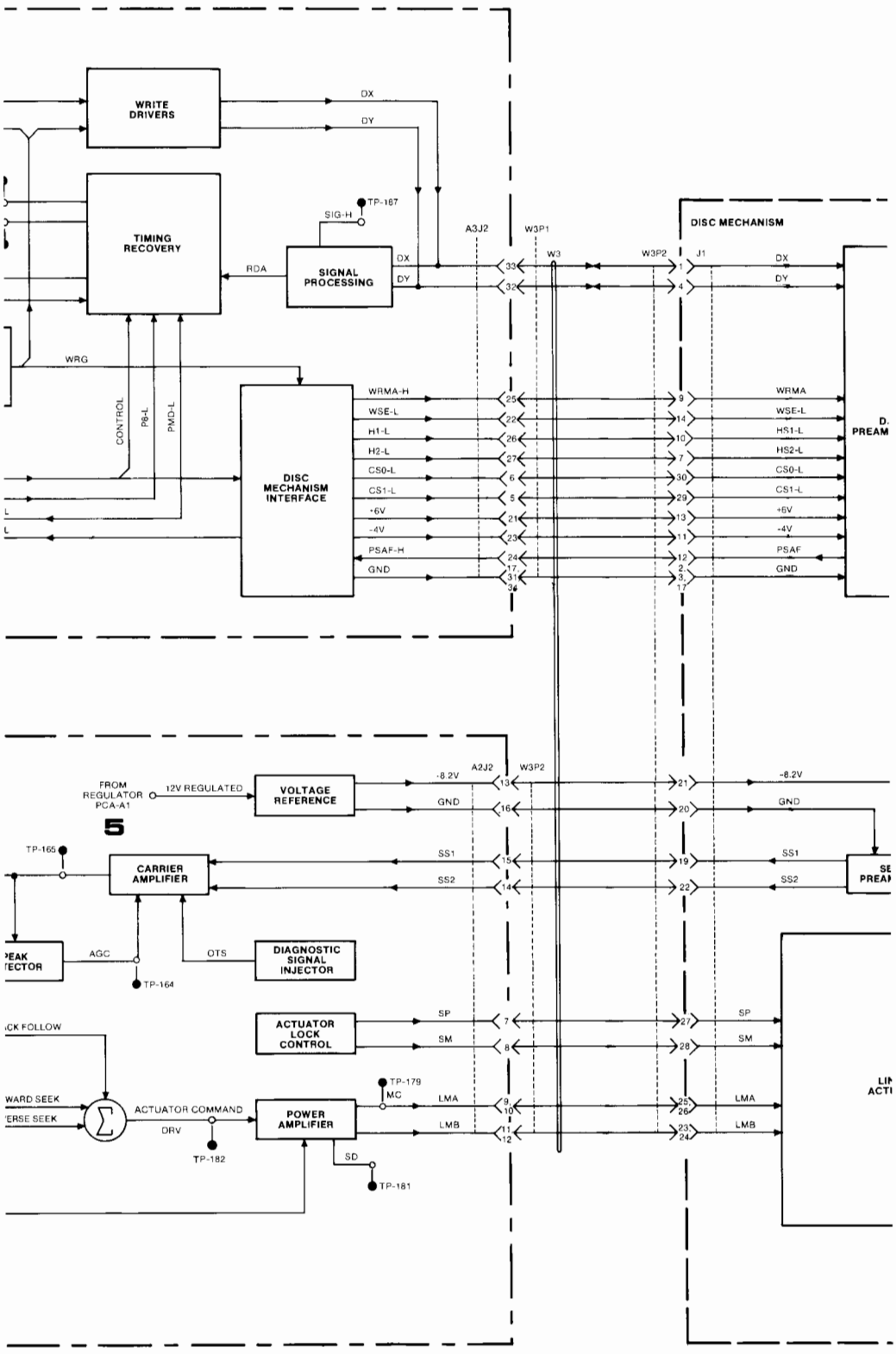


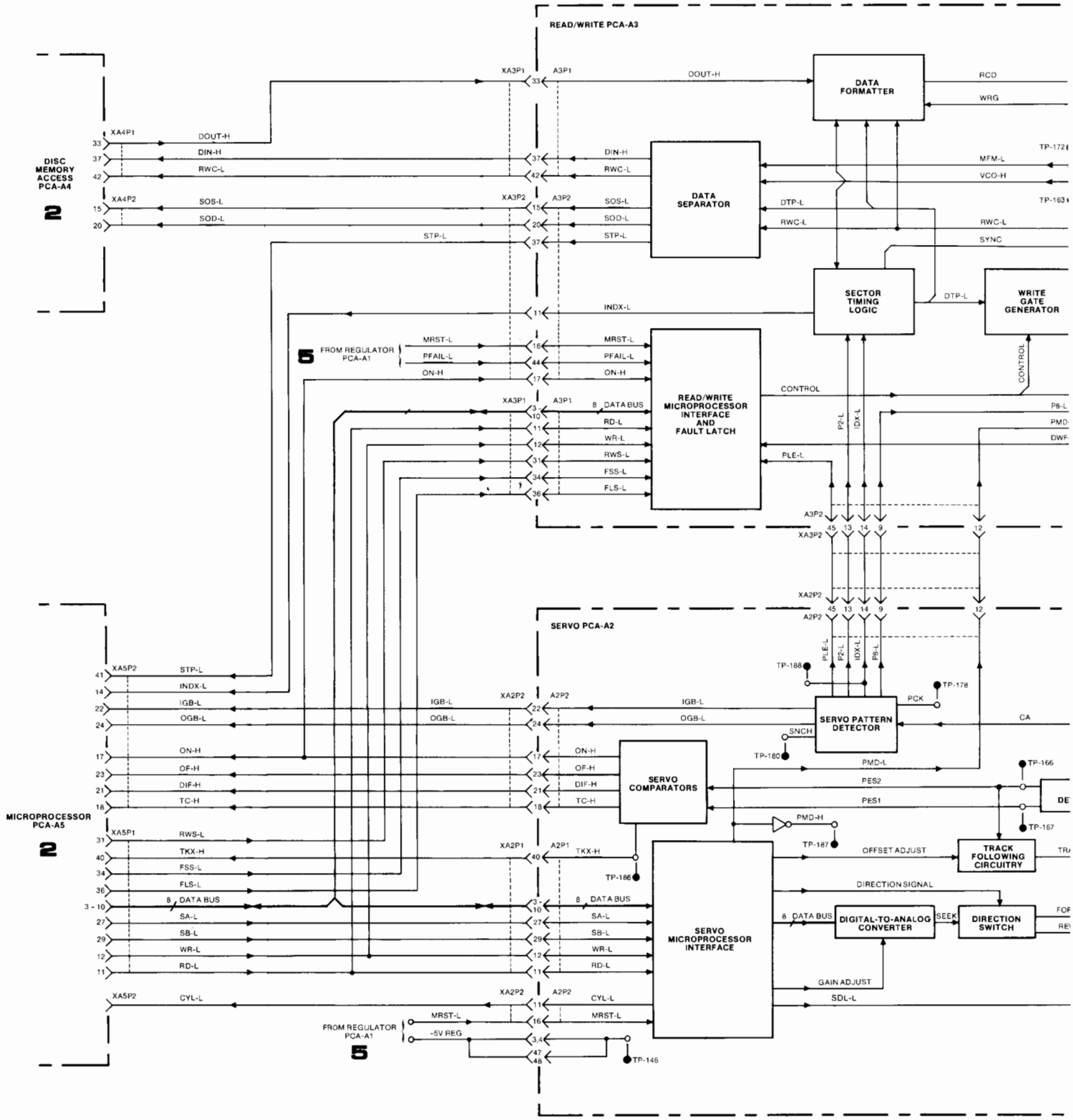
DATA HEAD SELECT TABLE

CS0-L	CS1-L	HS1-L	HS2-L	HEAD SELECTED
0	0	0	0	NOT ALLOWED
0	0	0	1	NOT ALLOWED
0	0	1	0	NOT ALLOWED
0	0	1	1	NOT ALLOWED
0	1	0	0	NOT ALLOWED
0	**1**	**0**	**1**	HEAD 1
0	1	1	0	NOT ALLOWED
0	**1**	**1**	**1**	HEAD 0
1	0	0	0	NOT ALLOWED
1	**0**	**0**	**1**	HEAD 3
1	**0**	**1**	**0**	HEAD 4
1	**0**	**1**	**1**	HEAD 2
1	1	0	0	NOT ALLOWED
1	1	0	1	NOT ALLOWED
1	1	1	0	NOT ALLOWED
1	1	1	1	NOT ALLOWED

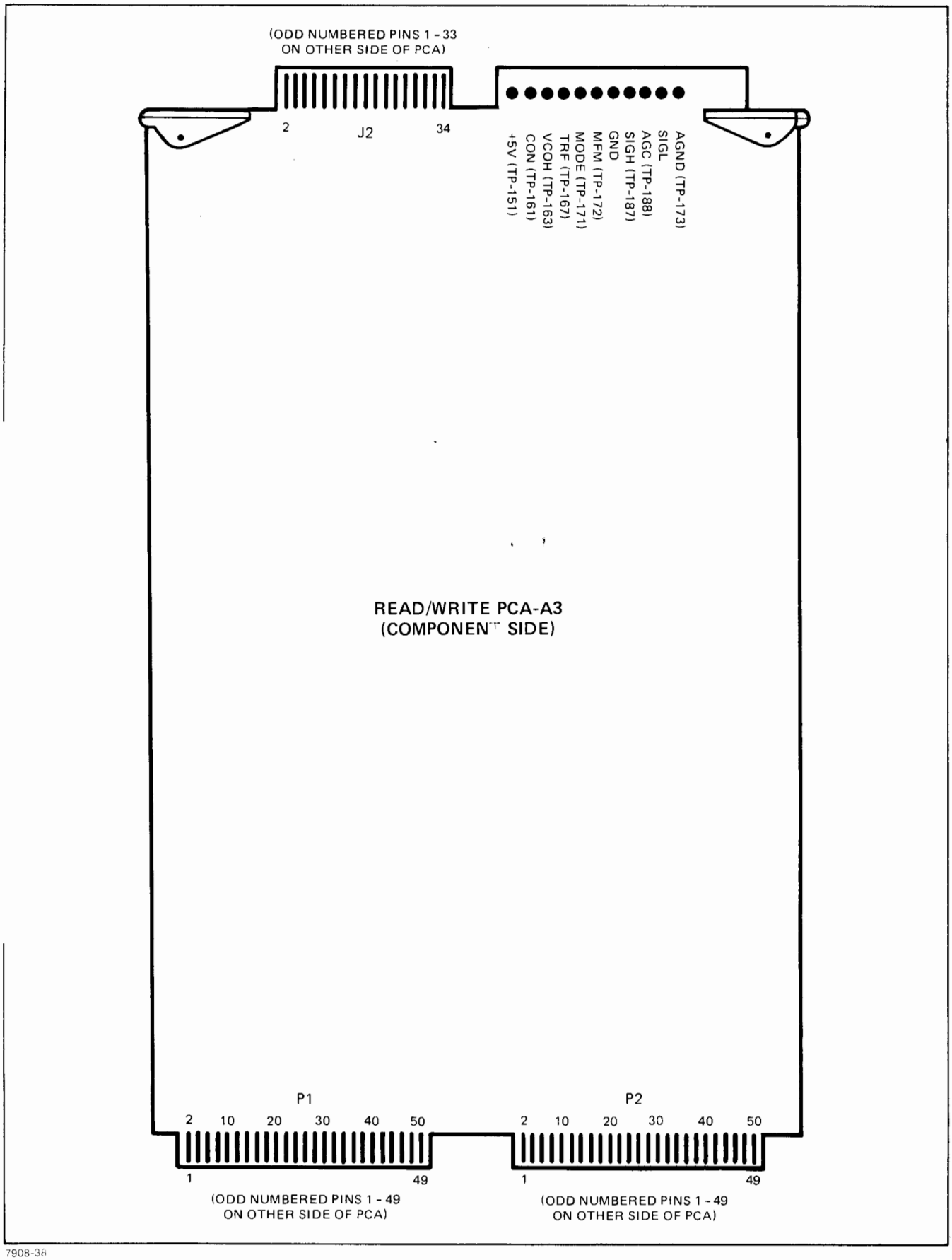
Computer Museum

Figure 4-12. Disc System Functional Diagram


WRITE DRIVERS
DX
DY
TIMING RECOVERY
SIG-H
TP-187
RDA
SIGNAL PROCESSING
DX
DY
A3J2
W3P1
W3
W3P2
J1
DISC MECHANISM
WRG
CONTROL
P8-L
PWD-L
DISC MECHANISM INTERFACE
WRMA-H
WSE-L
H1-L
H2-L
CS0-L
CS1-L
+6V
-4V
PSAF-H
GND
WRMA
WSE-L
HS1-L
HS2-L
CS0-L
CS1-L
+6V
-4V
PSAF
GND
FROM REGULATOR PCA-A1
12V REGULATED
VOLTAGE REFERENCE
-8.2V
GND
A2J2
W3P2
5
TP-165
CARRIER AMPLIFIER
SS1
SS2
AGC
OTS
DIAGNOSTIC SIGNAL INJECTOR
TP-164
ACTUATOR LOCK CONTROL
SP
SM
TP-179
MC
ACTUATOR COMMAND
DRV
TP-182
POWER AMPLIFIER
LMA
LMB
SD
TP-181

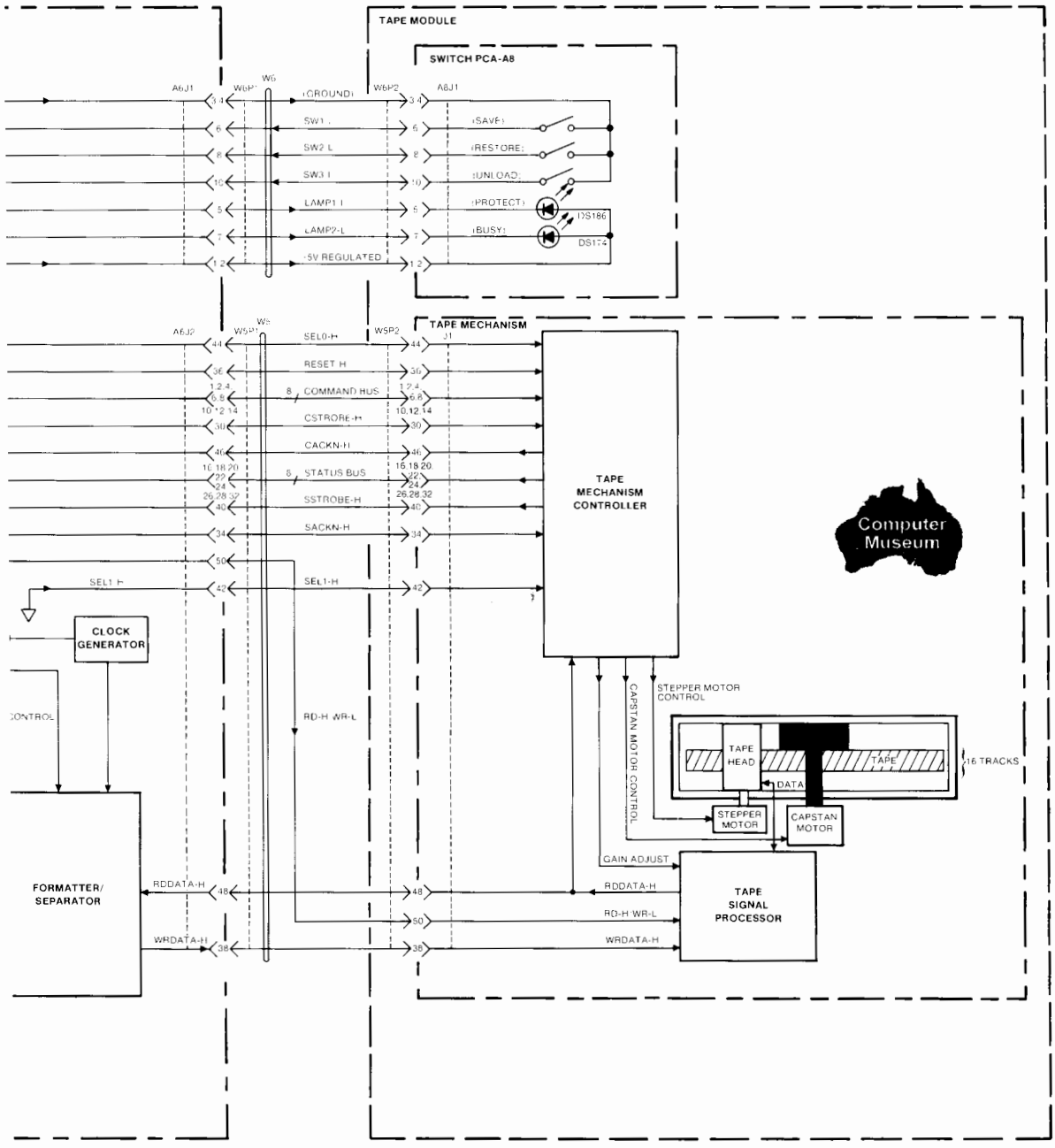

READ/WRITE PCA-A3
DISC MEMORY ACCESS PCA-A4
2
XA4P1
XA4P2
XA3P1
XA3P2
A3P1
A3P2
DOUT-H
DIN-H
RWC-L
SOS-L
SOD-L
STP-L
INDX-L
MRST-L
PFAIL-L
ON-H
DATA BUS
RD-L
WR-L
RWS-L
FSS-L
FLS-L
PLE-L
DATA FORMATTER
DATA SEPARATOR
SECTOR TIMING LOGIC
WRITE GATE GENERATOR
READ/WRITE MICROPROCESSOR INTERFACE AND FAULT LATCH
FROM REGULATOR PCA-A1
5
RCD
WRG
MFM-L
VCO-H
DTP-L
SYNC
CONTROL
P2-L
IDX-L
P8-L
PMD-L
DWF-L
SERVO PCA-A2
XA2P2
A2P2
XA2P1
A2P1
IGB-L
OGB-L
SERVO PATTERN DETECTOR
PCK
SNCH
CA
TP-188
TP-178
TP-180
SERVO COMPARATORS
ON-H
OF-H
DIF-H
TC-H
PMD-L
PES2
PES1
PMD-H
TP-166
TP-167
TP-187
TRACK FOLLOWING CIRCUITRY
OFFSET ADJUST
DIRECTION SIGNAL
DIGITAL-TO-ANALOG CONVERTER
SEEK
DIRECTION SWITCH
GAIN ADJUST
SDL-L
TKX-H
TP-186
SERVO MICROPROCESSOR INTERFACE
MICROPROCESSOR PCA-A5
2
XA5P1
XA5P2
RWS-L
TKX-H
FSS-L
FLS-L
DATA BUS
SA-L
SB-L
WR-L
RD-L
CYL-L
FROM REGULATOR PCA-A1
5
MRST-L
-5V REG
TP-146

7908-39B



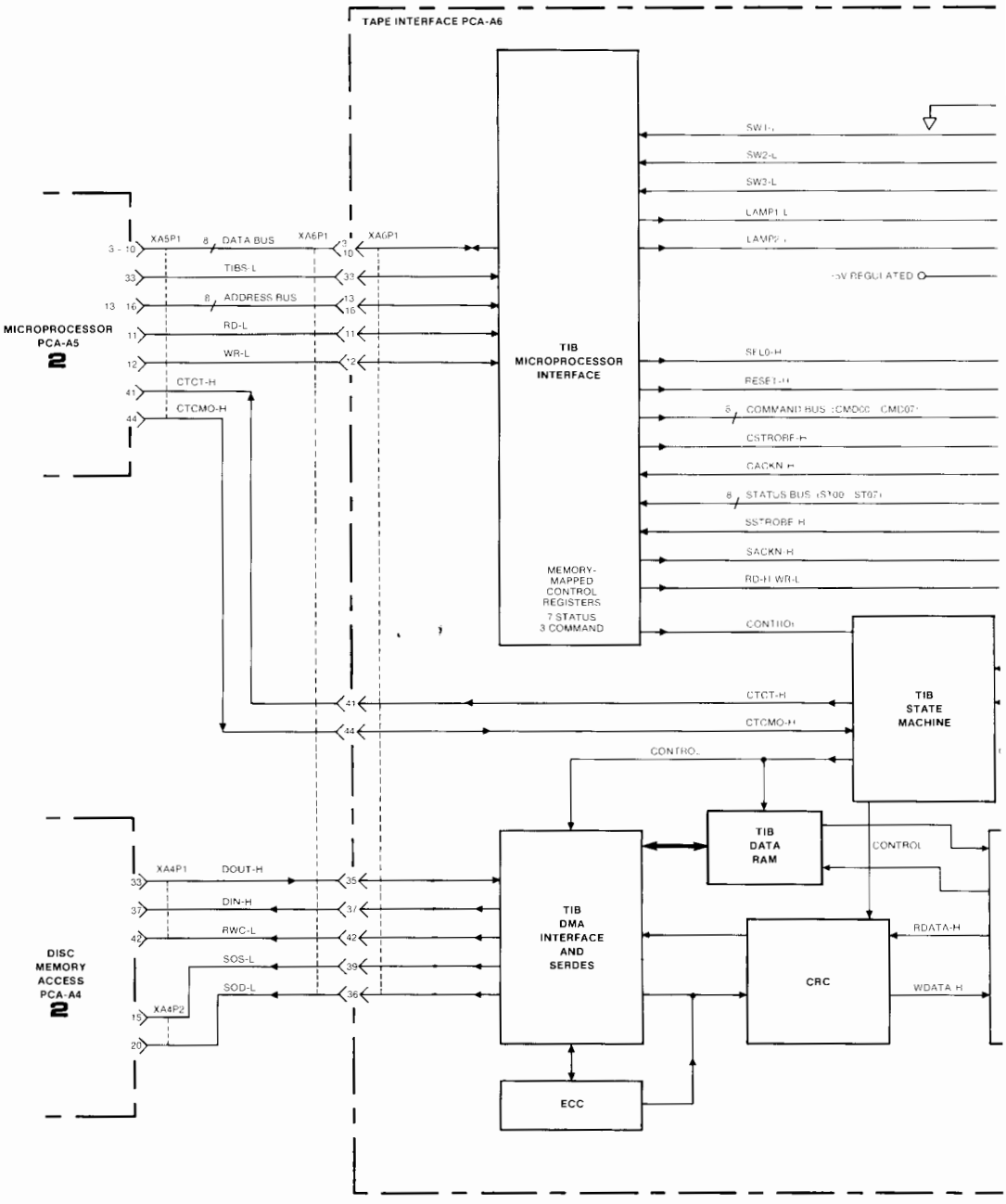
7908-38

Figure 4-11. Read/Write PCA-A3 Layout

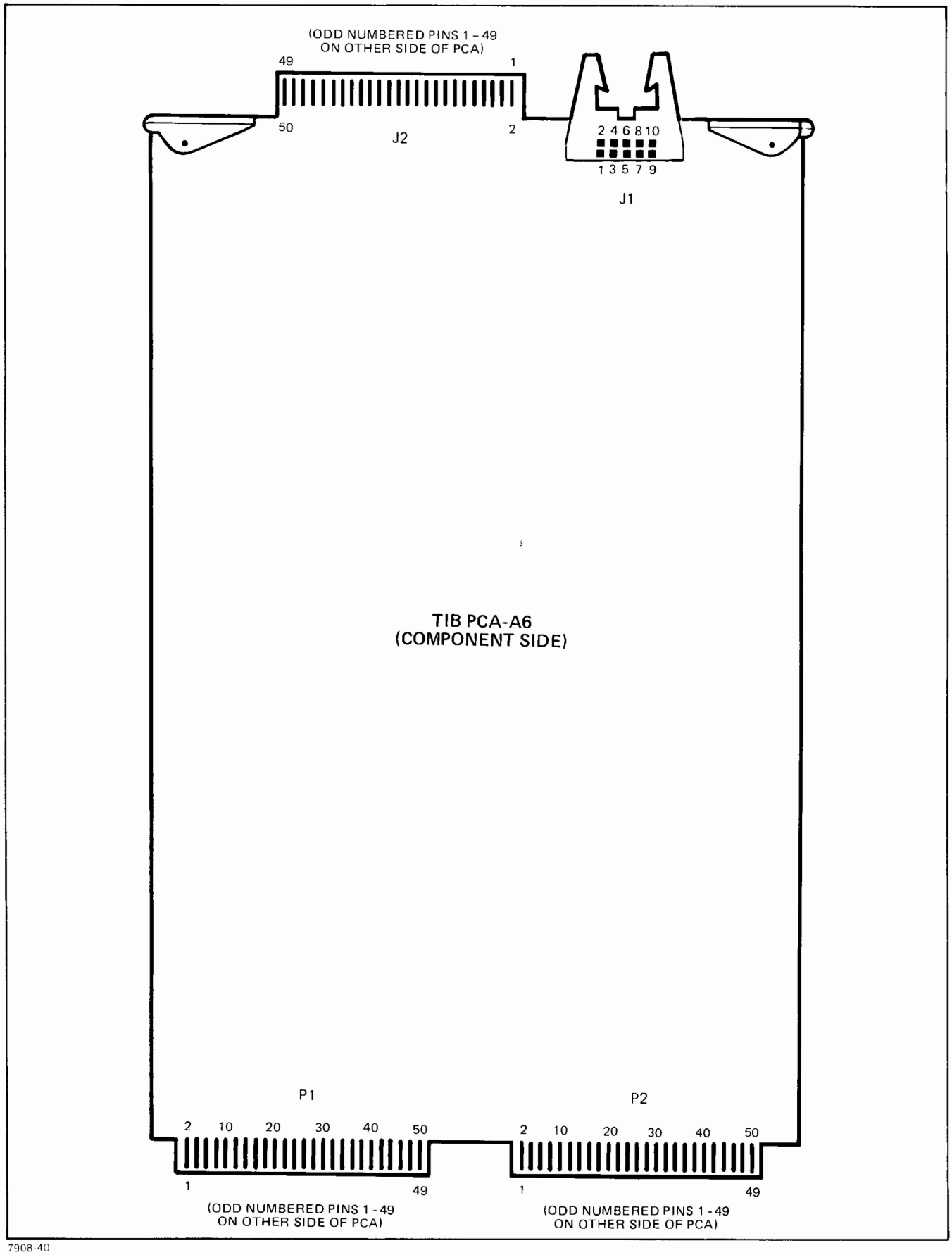


7908-40

Figure 4-14. Tape System Functional Diagram


TAPE INTERFACE PCA-A6
MICROPROCESSOR PCA-A5
2
XA5P1
8 DATA BUS
XA6P1
XA6P1
TIBS-L
8 ADDRESS BUS
RD-L
WR-L
CTCT-H
CTCMO-H
TIB MICROPROCESSOR INTERFACE
MEMORY-MAPPED CONTROL REGISTERS
7 STATUS
3 COMMAND
SW1-L
SW2-L
SW3-L
LAMP1-L
LAMP2-L
+5V REGULATED
SEL0-H
RESET-H
8 COMMAND BUS (CMD00 - CMD07)
CSTROBE-H
CACKN-H
8 STATUS BUS (ST00 - ST07)
SSTROBE-H
SACKN-H
RD-H/WR-L
CONTROL
TIB STATE MACHINE
CTCT-H
CTCMO-H
CONTROL
TIB DATA RAM
CONTROL
DISC MEMORY ACCESS PCA-A4
2
XA4P1
DOUT-H
DIN-H
RWC-L
SOS-L
SOD-L
XA4P2
TIB DMA INTERFACE AND SERDES
RDATA-H
WDATA-H
CRC
ECC

7908-41



7908-40

Figure 4-13. TIB PCA-A6 Layout

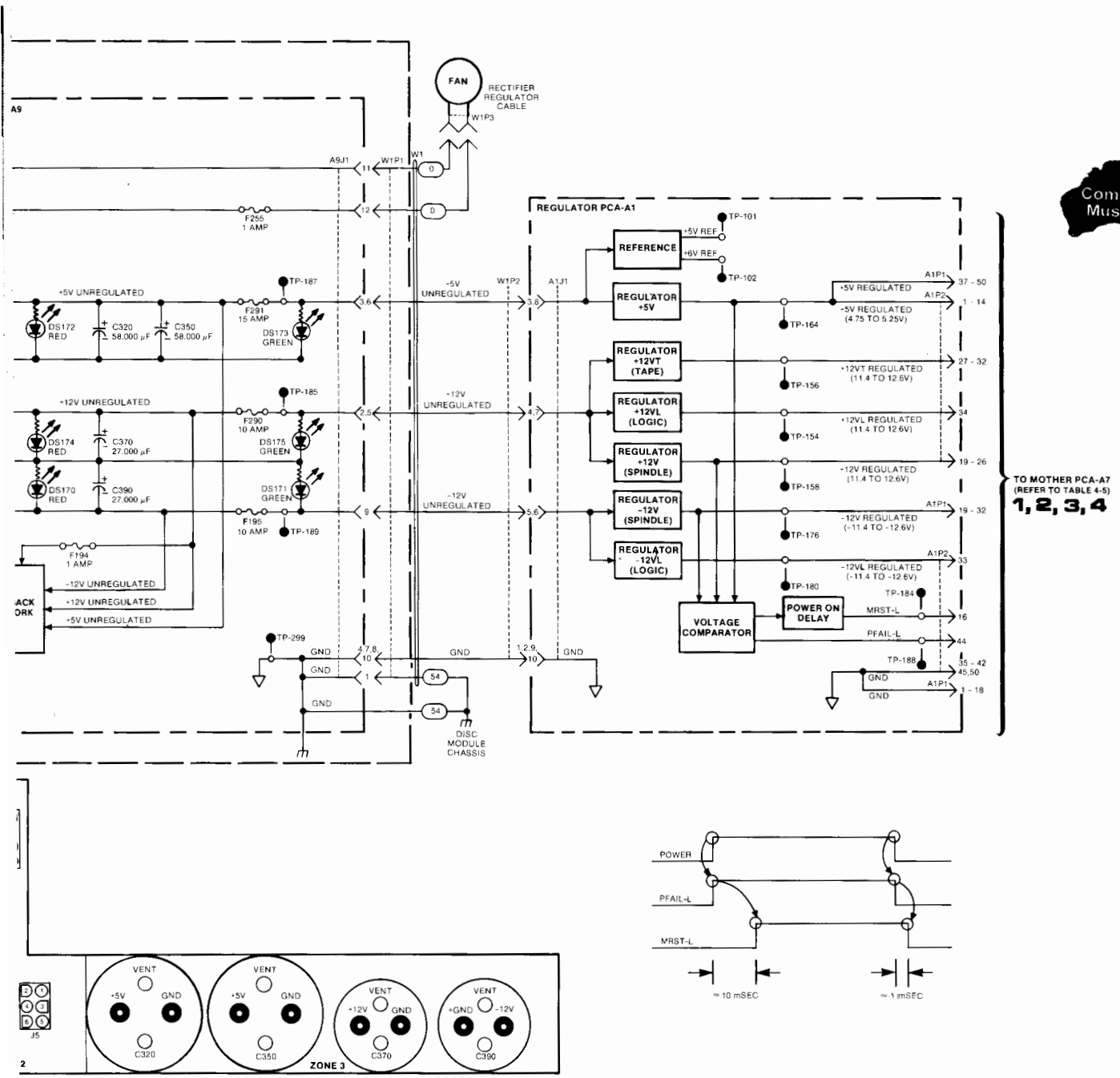
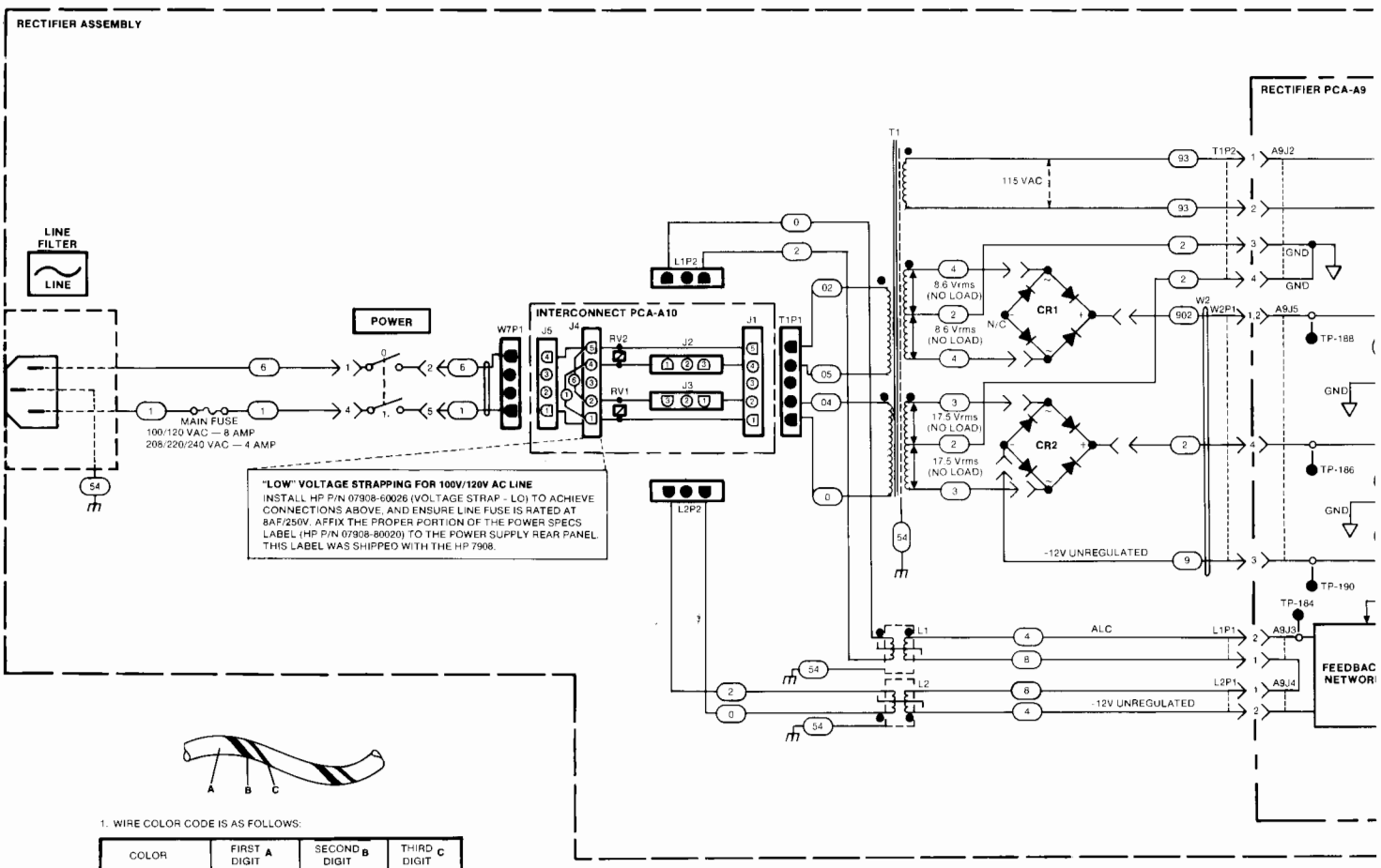


Figure 4-16. Power System Functional Diagram

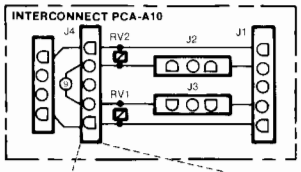


1. WIRE COLOR CODE IS AS FOLLOWS:

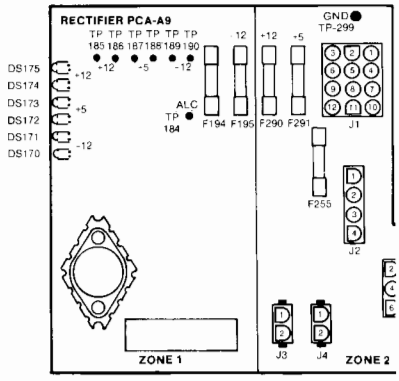
COLOR	FIRST A DIGIT	SECOND B DIGIT	THIRD C DIGIT
BLACK	0	0	0
BROWN	1	1	1
RED	2	2	2
ORANGE	3	3	3
YELLOW	4	4	4
GREEN	5	5	5
BLUE	6	6	6
VIOLET	7	7	7
GRAY	8	8	8
WHITE	9	9	9

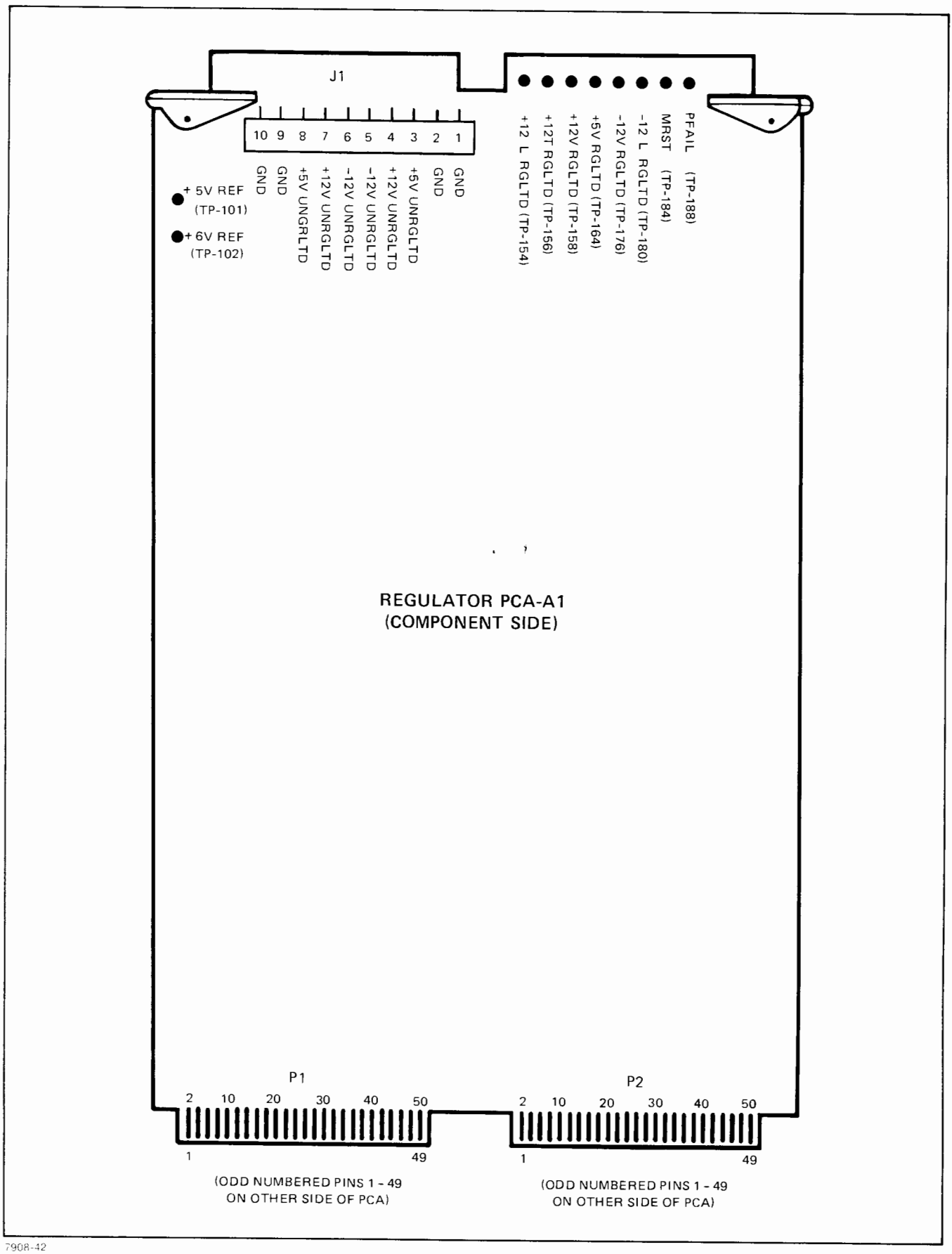
2. NOMINAL VOLTAGES:

TEST POINT	LOADED		NO LOAD		LOADED
	DC	AC	DC	AC	MINIMUM (DC) OPERATING
TP-187	7V	1V p-p	12V	1.5V p-p	6V
TP-185	16V	2V p-p	22V	3V p-p	13V
TP-189	-16V	2V p-p	-22V	3V p-p	-13V



"HIGH" VOLTAGE STRAPPING FOR 208V/220V/240V AC LINE
INSTALL HP P/N 07908-60027 (VOLTAGE STRAP - HI) TO ACHIEVE CONNECTIONS ABOVE, AND ENSURE LINE FUSE IS RATED AT 4AF/250V. AFFIX THE PROPER PORTION OF THE POWER SPECS LABEL (HP P/N 07908-80020) TO THE POWER SUPPLY REAR PANEL. THIS LABEL WAS SHIPPED WITH THE HP 7908.





7908-42

Figure 4-15. Regulator PCA-A1 Layout

REMOVAL AND REPLACEMENT

SECTION V

(For HP 7908 disc/tape drives with serial numbers prefixed 2143 and later.)

5-1. INTRODUCTION

This section provides removal and replacement procedures for field replaceable HP 7908 assemblies and parts. Procedures are given in order in which disassembly normally occurs. Each assembly or part which must be removed before access can be gained to another assembly or part is presented first, followed by the next assembly that can be removed. Figures 5-1 and 5-2 show the disassembly structures for the HP 7908P and HP 7908R, respectively.

TORX® hardware is used in the assembly of the disc/tape drive. This hardware requires the use of special drivers (refer to table 4-1). In this manual, any reference to this type of hardware will be accompanied by the appropriate driver size (for example, T15).

WARNING

The HP 7908 does not contain any operator-serviceable parts. To prevent electrical shock, refer all service activities to service-trained personnel.

CAUTION

For U.S.A. operation, use only a UL listed, detachable power cord with type SJT flexible cord, suitable for rated voltage and current. Check the input ac voltage, main fuse rating, and voltage select plug before connecting the power cord. The HP 7908 is shipped with an appropriate power cord.

CAUTION

Do not attempt to operate an HP 7908 configured for 100/120 Vac on 220/240 Vac or vice-versa. Damage to the HP 7908 may result.

To attach a power cord, proceed as follows:

a. Set the POWER switch on the rear panel to "0".

b. Plug the female end of the power cord into the HP 7908.

5-2. PREPARATION PROCEDURES

WARNING

To avoid dangerous electrical shock, do not perform any removal/replacement operation until the ac mains power is removed from the HP 7908.

CAUTION

Do not power-up or power-down the HP 7908 when the system bus is in an active state.

CAUTION

Do not connect or disconnect the HP-IB cable(s) from the HP 7908 when the system bus is in an active state.

All service procedures require the power cord and the HP-IB cable to be disconnected as follows:

a. Set the POWER switch on the rear panel to the "0" position.

b. Disconnect the ac power cord from the wall outlet and from the receptacle on the rear of the HP 7908.

c. Loosen the two thumb screws which hold the HP-IB connector in place.

d. Disconnect the HP-IB cable.

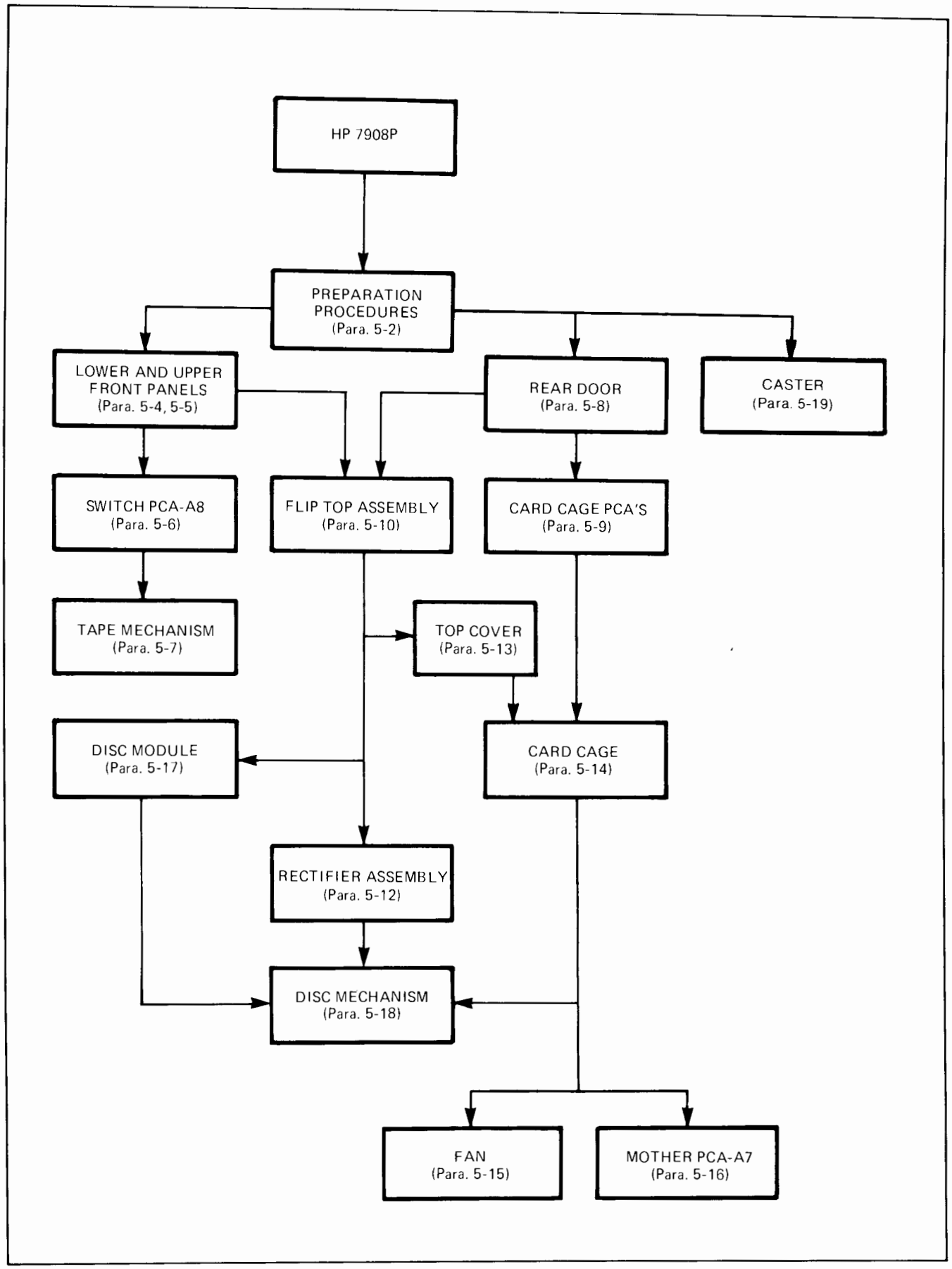
To reconnect the HP-IB cable, plug the HP-IB cable into its receptacle and tighten the two thumb screws.

5-3. REMOVAL AND REPLACEMENT (HP 7908P)

5-4. LOWER FRONT PANEL (1, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.



7908-44A

Figure 5-1. HP 7908P Disassembly Aid

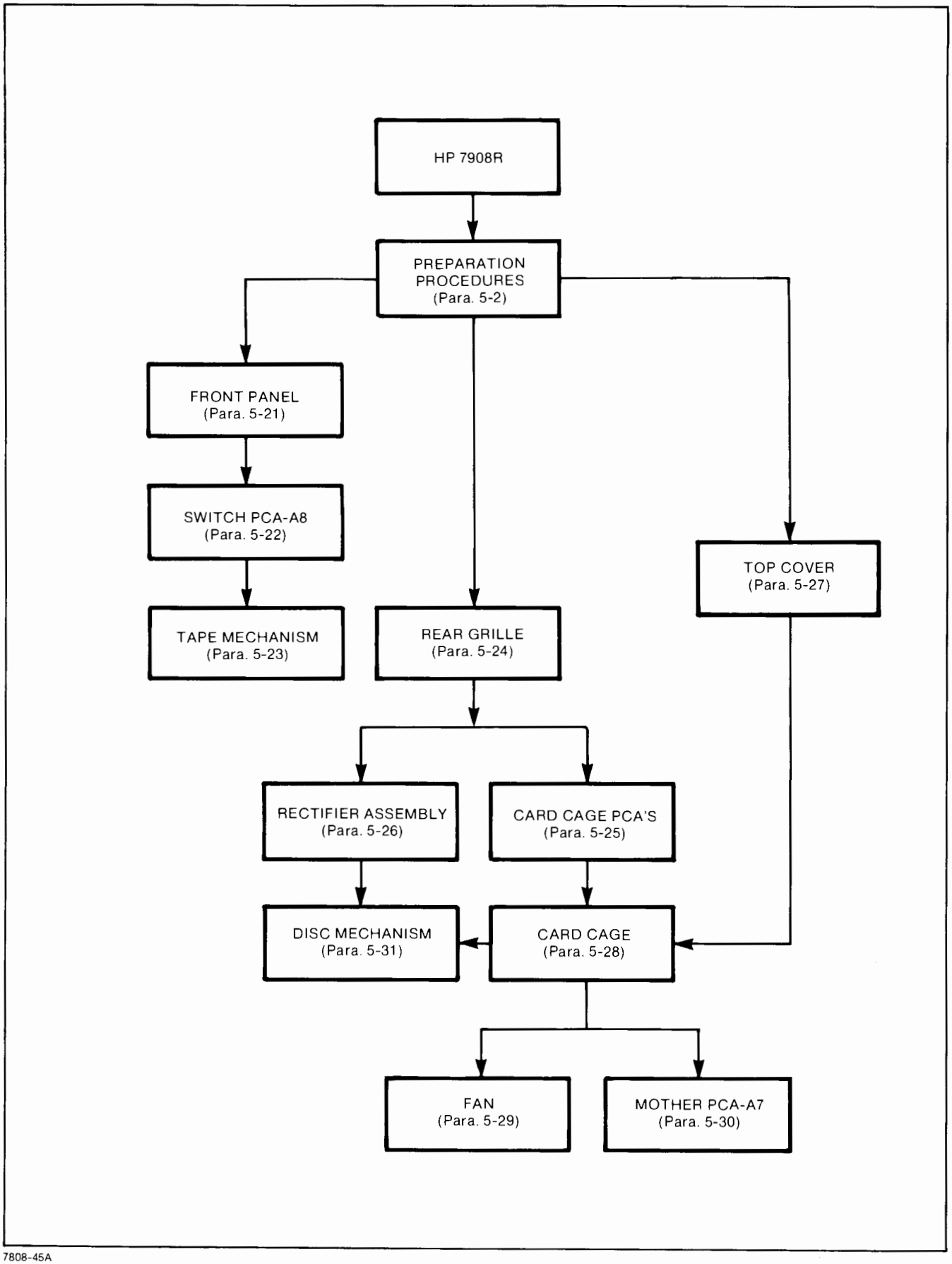


Figure 5-2. HP 7908R Disassembly Aid

c. The lower front panel is removed by pulling the top of it forward and sliding it up and out of the base assembly.

To replace, slide the lower front panel into the base assembly and push the top into place.

5-5. UPPER FRONT PANEL (2, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. The upper front panel on the standard HP 7908 is removed by pulling it forward. The upper front filler panel (3, Opt. 140) is held on by one T15 screw (4) located beneath the panel.

To replace, reverse the procedure.

If either of the front panels does not fit properly in place, one or more stud retainers may need replacement. The defective stud retainer must be drilled out with a 0.125 inch bit (3.2 mm) from the front of the base assembly. The new stud retainer is held in place by two T9 screws as shown in figure 6-1.

5-6. SWITCH PCA-A8 (8, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the upper front panel. (Refer to paragraph 5-5.)

d. Remove the two T15 screws (5) which hold the electrostatic discharge shield (6) and the switch PCA-A8 to the tape mechanism (16).

e. Disconnect the switch cable (7) from the switch PCA-A8.

f. Remove the switch PCA-A8.

To replace, reverse the procedure.

5-7. TAPE MECHANISM (16, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the switch PCA-A8. (Refer to paragraph 5-6.)

f. Remove the five T15 screws (9) which hold the tape mechanism brackets (10 and 12) to the base assembly (33).

g. Pull the tape mechanism forward.

h. Remove the tape power cable (15) and tape data cable (14) from the rear of the tape mechanism.

i. Remove the tape mechanism.

Note: If a new tape mechanism is to be installed, the brackets on the defective tape mechanism must be removed and installed on the new tape mechanism.

To replace, reverse the procedure.

5-8. REAR DOOR (21, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the five T25 screws (19 and 20) which hold the rear door in place.

d. Remove the rear door.

To replace, reverse the procedure.

5-9. CARD CAGE PCA'S (1 through 6, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear door. (Refer to paragraph 5-8.)

d. Remove any cables from the PCA to be replaced.

e. Remove the PCA.

CAUTION

Ensure that the correct PCA is inserted into the proper card slot as shown in figure 5-3, otherwise damage to the PCA will result. Also, ensure that the cables are connected to the proper PCA's.

To replace, reverse the procedure.

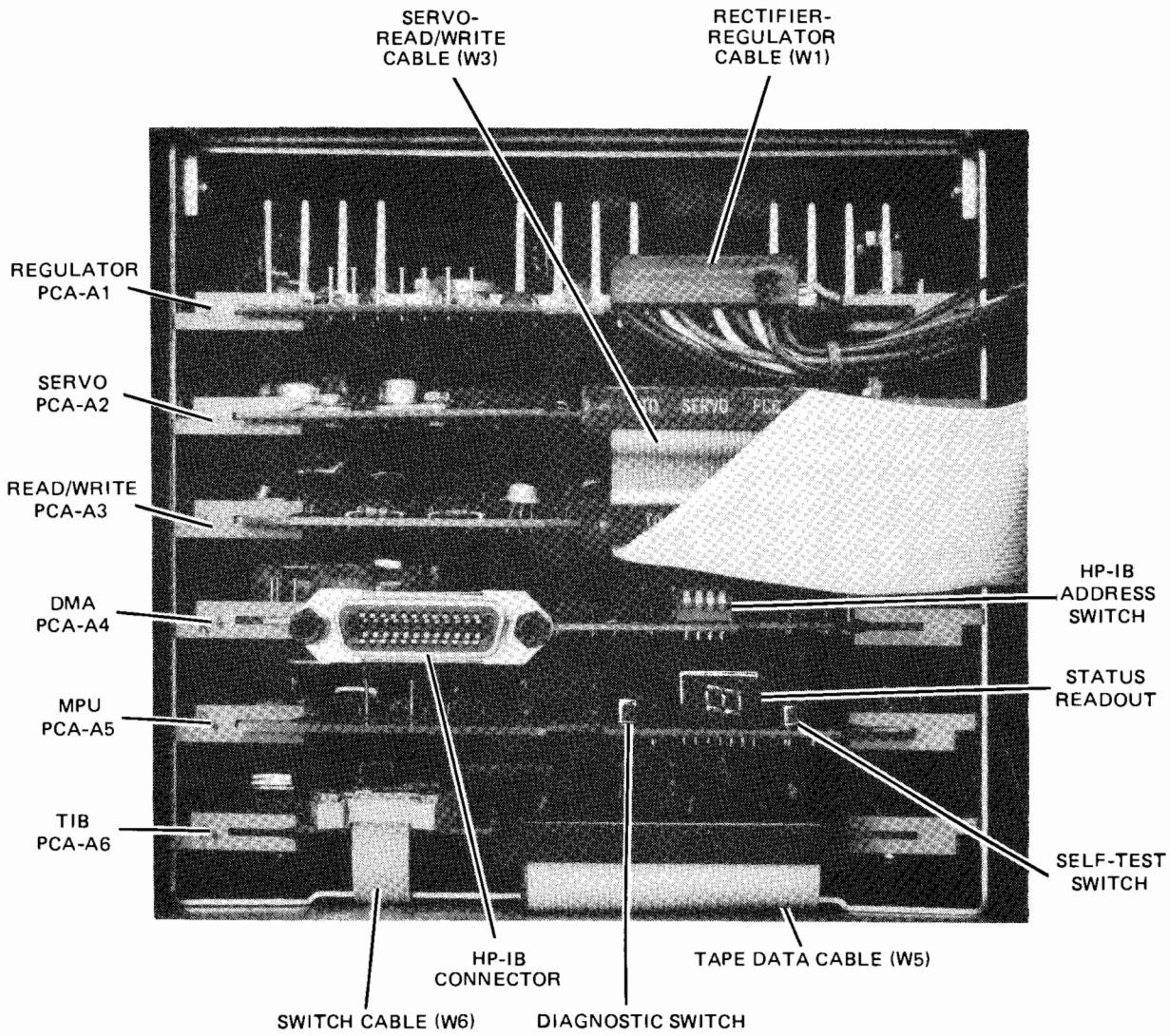


Figure 5-3. Card Cage PCA Locator

5-10. FLIP TOP (22, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-4.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the four T15 screws (23) which hold the flop top to the front of the base assembly (33).

g. Lift the front of the flip top up and back until it faces up.

h. Lift the flip top up and off of the base assembly.

To replace, reverse the procedure.

5-11. STORAGE BOX (24, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the three T15 screws (25) which hold the storage box to the front of the base assembly (33).

h. Remove the storage box.

To replace, reverse the procedure.

5-12. RECTIFIER ASSEMBLY (9, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Lay the base assembly on its side so that the top cover of the disc module faces up.

WARNING

If any of the red or green LED's on the rectifier PCA-A9 are lit, a dangerous voltage exists on the filter capacitors.

h. Remove the two T30 cap screws (8) located to the right of the transformer cover plate.

i. Remove the one T15 top cover screw (7) which holds the rectifier assembly to the edge of the disc module.

j. Pull the rectifier assembly out part way.

k. Disconnect the green/yellow ground wire (16) from the side of the rectifier assembly.

l. Disconnect the rectifier-regulator cable (30) from the rectifier PCA-A9.

m. Slide the rectifier assembly out slowly. (Refer to paragraph 5-32 for rectifier disassembly.)

To replace, reverse the procedure.

5-13. TOP COVER (11, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the eight T15 screws (10) which hold the top cover in place.

h. Remove the top cover.

To replace, reverse the procedure.

5-14. CARD CAGE ASSEMBLY
(19, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the top cover. (Refer to paragraph 5-13.)

h. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

i. Disconnect the disc power cable from the mother PCA-A7.

j. Disconnect the rectifier-regulator cable (30) from the fan (21).

k. Disconnect the tape power cable from the mother PCA-A7.

l. Remove the two T15 screws (20) which hold the card cage assembly in place.

m. Remove the card cage assembly.

To replace, first ensure that the tape data cable, switch cable, fan cable, tape power cable and disc power cable are in place, then reverse the procedure.

5-15. FAN (21, figure 6-3).

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the top cover. (Refer to paragraph 5-13.)

h. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

i. Remove the card cage assembly. (Refer to paragraph 5-14.)

Note: Notice the position of the fan with respect to the cable plug and the direction of airflow (air flows into the card cage and out through the rear door). Also, do not lose the four spacers.

j. Remove the four T15 screws (22) which hold the fan to the fan mounting chassis (27).

k. Remove the fan.

Note: One of the screws which holds the fan to the mounting chassis must have a lock washer inserted between the fan grille and the fan body (as shown in figure 6-3). This ensures proper grounding of the fan.

To replace, reverse the procedure.

5-16. MOTHER PCA-A7 (26, figure 6-3).

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the top cover. (Refer to paragraph 5-13.)

h. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

i. Remove the card cage assembly. (Refer to paragraph 5-14.)

j. Remove the four T15 screws (25) which hold the fan mounting chassis (27) to the card cage.

k. Remove the fan mounting chassis.

l. Remove the mother PCA-A7 using the removal tool (part no. 09815-20602). The removal tool slides over the studs which hold the mother PCA-A7 to

the fan mounting chassis. By pushing the tool downward, the locking studs are cancelled and the mother PCA-A7 may be removed.

To replace the mother PCA-A7, push it onto the studs on the fan mounting chassis, then reverse the procedure.

5-17. DISC MODULE (30, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the two T15 screws (27) located on the support bracket (31).

h. Remove the two T15 screws (26) located on the lower edge of the disc module.

i. Remove the three cables connected to the tape mechanism (16).

j. Lift the disc module off of the base assembly (33).

To replace, reverse the procedure.

5-18. DISC MECHANISM (41, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the disc module. (Refer to paragraph 5-17.)

h. Remove the top cover. (Refer to paragraph 5-13.)

i. Remove the rectifier assembly. (Refer to paragraph 5-12.)

j. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

k. Remove the card cage assembly. (Refer to paragraph 5-14.)

CAUTION

The disc mechanism is very prone to damage if not handled with extreme care.

l. While supporting the disc mechanism, remove the three T15 screws (34, 36); one from the center of each shockmount.

m. Disconnect the green/yellow electrostatic discharge strap (40) from the disc module chassis (51).

n. Remove the disc mechanism.

CAUTION

The disc mechanism is not field serviceable.

o. From the shockmount bracket (38), remove the T15 screw (43) which secures the cable tie (44). Cut the cable tie. When installing the new disc mechanism, use the new cable tie provided (attached to the disc mechanism) and route the disc mechanism power cable and the electrostatic discharge strap through the new cable tie.

p. Remove the three T15 screws (39) which hold the disc mechanism bracket (38) to the side of the disc mechanism. The bracket must be retained for installing the new disc mechanism.

To replace, reverse the procedure. Torque the T15 screws removed in steps l and p to 10 inch-pounds.

5-19. CASTER (41, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Place the disc drive on its right side (the storage box toward the floor).

d. Pry the defective caster away from its mounting bracket. The plastic washer which fits between the caster wheel and the bracket must be reused.

e. Tap the new caster into place using the palm of the hand.

5-20. REMOVAL AND REPLACEMENT (HP 7908R)

5-21. FRONT PANEL (1, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. The front panel (1) or front filler panel (2, Opt. 140) is removed by pulling it forward.

To replace, push the panel into place.

If the front panel does not fit properly in place, one or more stud retainers may need replacement. The defective stud retainer must be drilled out with a 0.125 inch bit (3.2 mm) from the front of the disc module. The new stud retainer is held in place by two T9 screws as shown in figure 6-2.

5-22. SWITCH PCA-A8 (6, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel (Refer to paragraph 5-21.)

d. Remove the two T15 screws (3) which hold the electrostatic discharge shield (4) and the switch PCA-A8 to the tape mechanism (10).

e. Remove the switch cable (5) from the switch PCA-A8.

f. Remove the switch PCA-A8.

To replace, reverse the procedure.

5-23. TAPE MECHANISM (10, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel. (Refer to paragraph 5-21.)

d. Remove the switch PCA-A8. (Refer to paragraph 5-22.)

e. Remove the three T15 screws (9) which hold the tape mechanism to the top of the disc module (19) chassis.

f. Pull the tape mechanism forward.

g. Remove the tape power cable (8) and tape data cable (7) from the rear of the tape mechanism.

h. Remove the tape mechanism.

To replace, reverse the procedure.

5-24. REAR GRILLE (14, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the five T15 screws (13) which hold the rear grille in place.

d. Remove the rear grille.

To replace, reverse the procedure.

Computer Museum

5-25. CARD CAGE PCA'S (1 through 6, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-24.)

d. Remove any cables from the PCA to be replaced.

e. Remove the PCA.

CAUTION

Ensure that the correct PCA is inserted into the proper card slot as shown in figure 5-3, otherwise damage to the PCA will result. Also, ensure that the cables are connected to the proper PCA's.

To replace, reverse the procedure.

5-26. RECTIFIER ASSEMBLY (9, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-24.)

WARNING

If any of the red or green LED's on the rectifier PCA-A9 are lit, a dangerous voltage exists on the filter capacitors.

d. Remove the two T30 cap screws (8) located on the right of the transformer cover plate.

e. Remove the one T15 top cover screw (7) which holds the rectifier assembly to the edge of the disc module.

f. Pull the rectifier assembly out part way.

g. Disconnect the green/yellow ground wire (16) which connects to the rectifier assembly.

h. Disconnect the rectifier-regulator cable (30) from the rectifier PCA-A9.

i. Slide the rectifier assembly out slowly. (Refer to paragraph 5-32 for a rectifier disassembly.)

To replace, reverse the procedure.

5-27. TOP COVER (11, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the eight T15 screws (10) which hold the top cover in place.

d. Remove the top cover.

To replace, reverse the procedure.

5-28. CARD CAGE ASSEMBLY (19, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-24.)

d. Remove the top cover. (Refer to paragraph 5-27.)

e. Remove all PCA's from the card cage. (Refer to paragraph 5-25.)

f. Disconnect the disc power cable from the mother PCA-A7 (26).

g. Disconnect the rectifier-regulator cable (30) from the fan (21).

h. Disconnect the tape power cable from the mother PCA-A7.

i. Remove the two T15 screws (20) which hold the card cage assembly to the disc module chassis.

j. Remove the card cage assembly.

To replace, reverse the procedure.

5-29. FAN (21, figure 6-3).

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-24.)

d. Remove the top cover. (Refer to paragraph 5-27.)

e. Remove all PCA's from the card cage. (Refer to paragraph 5-25.)

f. Remove the card cage assembly. (Refer to paragraph 5-28.)

Note: Notice the position of the fan with respect to the cable plug and the direction of airflow (air flows into the card cage and out through the rear grille). Also, do not lose the four spacers.

g. Remove the four T15 screws (22) which hold the fan to the fan mounting chassis (27).

h. Remove the fan.

Note: One of the screws which holds the fan to the mounting chassis must have a lock washer inserted between the fan grille and the fan body (as shown in figure 6-3). This ensures proper grounding of the fan.

To replace, reverse the procedure.

5-30. MOTHER PCA-A7 (26, figure 6-3).

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-24.)

d. Remove the top cover. (Refer to paragraph 5-27.)

e. Remove all PCA's from the card cage. (Refer to paragraph 5-25.)

f. Remove the card cage assembly. (Refer to paragraph 5-28.)

g. Remove the four T15 screws (22) which hold the fan mounting chassis (27) to the card cage assembly (19).

h. Remove the fan mounting chassis.

i. Remove the mother PCA-A7 using the removal tool (part no. 09815-20602). The removal tool slides over the studs which hold the mother PCA-A7 to the fan mounting chassis. By pushing the tool downward, the locking studs are cancelled and the mother PCA-A7 may be removed.

To replace the mother PCA-A7, push it onto the studs on the fan mounting chassis, then reverse the procedure.

5-31. DISC MECHANISM (41, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-24.)

d. Remove the top cover. (Refer to paragraph 5-27.)

e. Remove the rectifier assembly. (Refer to paragraph 5-26.)

f. Remove all PCA's from the card cage. (Refer to paragraph 5-25.)

g. Remove the card cage assembly. (Refer to paragraph 5-28.)

CAUTION

The disc mechanism is very prone to damage if not handled with extreme care.

h. While supporting the disc mechanism, remove the three T15 screws (34, 36); one from the center of each shockmount.

i. Disconnect the green/yellow electrostatic discharge strap (40) from the disc module chassis (51).

CAUTION

The disc mechanism is not field serviceable.

j. Remove the disc mechanism.

k. From the shockmount bracket (38), remove the T15 screw (43) which secures the cable tie (44). Cut the cable tie. When installing the new disc mechanism, use the new cable tie provided (attached to the disc mechanism) and route the disc mechanism power cable and the electrostatic discharge strap through the new cable tie.

l. Remove the three T15 screws (39) which hold the disc mechanism bracket (38) to the side of the disc mechanism. The bracket must be retained for installing the new disc mechanism.

To replace, reverse the procedure. Torque the T15 screws removed in steps h and l to 10 inch-pounds.

5-32. RECTIFIER DISASSEMBLY

WARNING

If any of the red or green LED'S on the top edge of the rectifier PCA are lit, a dangerous voltage still exists on the filter capacitors.

5-33. RECTIFIER PCA-A9 (5, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-26 for HP 7908R.)

d. Remove all plug connectors from the rectifier PCA-A9.

e. Remove the ten T15 screws (6) which hold the rectifier PCA-A9 in place.

f. Remove the rectifier PCA-A9.

To replace, reverse the procedure.

5-34. FILTER CAPACITORS (1, 3, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-26 for HP 7908R.)

d. Remove the two T25 screws from the defective capacitor.

e. Remove the capacitor.

CAUTION

Check the polarity before installing the new capacitor.

To replace, reverse the procedure.

5-35. BRIDGE RECTIFIER DIODES

(20, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-26 for HP 7908R.)

d. Remove the quick connect plugs from the defective diode bridge.

e. Remove the T15 screw (21) which holds the diode to the power bracket (32).

CAUTION

Check the color code information (figure 4-16) before installing the wires.

Before installing a new rectifier diode, coat the metal side of the diode with thermal grease (part no. 6040-0239). Use just enough thermal grease to cover the metal plate on the diode.

5-36. INTERCONNECT PCA-A10

(29, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-26 for HP 7908R.)

d. Remove all plugs from the interconnect PCA-A10.

e. Remove the four T15 screws (30) which hold the interconnect PCA-A10 in place.

To replace, reverse the procedure.

5-37. POWER SWITCH (14, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-26 for HP 7908R.)

d. Remove the four wires from the switch.

e. Break off the switch mounting tabs on the old switch.

f. Remove the switch.

To replace, push the new switch into place and reconnect the four wires. (See color code information in figure 4-16.)

REPLACEABLE PARTS

SECTION VI

(For HP 7908 disc/tape drives with serial numbers prefixed 2143 and later.)

6-1. INTRODUCTION

This section provides a listing of all field-replaceable parts and an illustrated parts breakdown for the HP 7908, as well as replaceable part ordering information.

Replaceable parts for the HP 7908 are listed in order of disassembly in tables 6-1 through 6-4 and illustrated in figures 6-1 through 6-4. In each listing, attaching parts are listed immediately after the item they attach. Items in the DESCRIPTION column are indented to indicate relationship to the next higher assembly. In addition, the symbol "— — — x — — —" follows the last attaching part for that item. Identification of the items and the labels is as follows:

Major Assembly
*Replaceable Assembly
*Attaching Part for Replaceable Assembly
**Subassembly or Component Part
**Attaching Parts for Subassembly or Component Part

The replaceable parts listing provides the following information for each part:

a. FIG & INDEX NO. The figure and index number which indicates where the replaceable part is illustrated.

b. HP PART NO. The Hewlett-Packard Part number for each replaceable part.

c. DESCRIPTION. The description of each replaceable part. Refer to Table 6-5 for an explanation of abbreviations used in the DESCRIPTION column. TORX® drive screws are used extensively within the HP 7908 disc/tape drive. These screws require the use of special drivers (refer to table 4-1). These screws are identified by the letter "T" followed by a number that indicates the drive bit size needed for removal and replacement.

d. MFR CODE. The 5-digit code that denotes a typical manufacturer of a part. Refer to table 6-6 for a listing of manufacturers that corresponds to the codes.

e. MFR PART NO. The manufacturer's part number of each replaceable part.

f. UNITS PER ASSEMBLY. The total quantity of each part used in the major assembly.

g. The MFR CODE and MFR PART NO. for common hardware items are listed as 00000 and OBD (Order By Description), respectively, because these items can usually be purchased locally.

6-2. ORDERING INFORMATION

To order replaceable parts for the HP 7908, address the order to your local Hewlett-Packard Sales and Support Office. Sales and Support Offices are listed at the back of this manual. Specify the following information for each order:

a. Model and full serial number.

b. Hewlett-Packard part number.

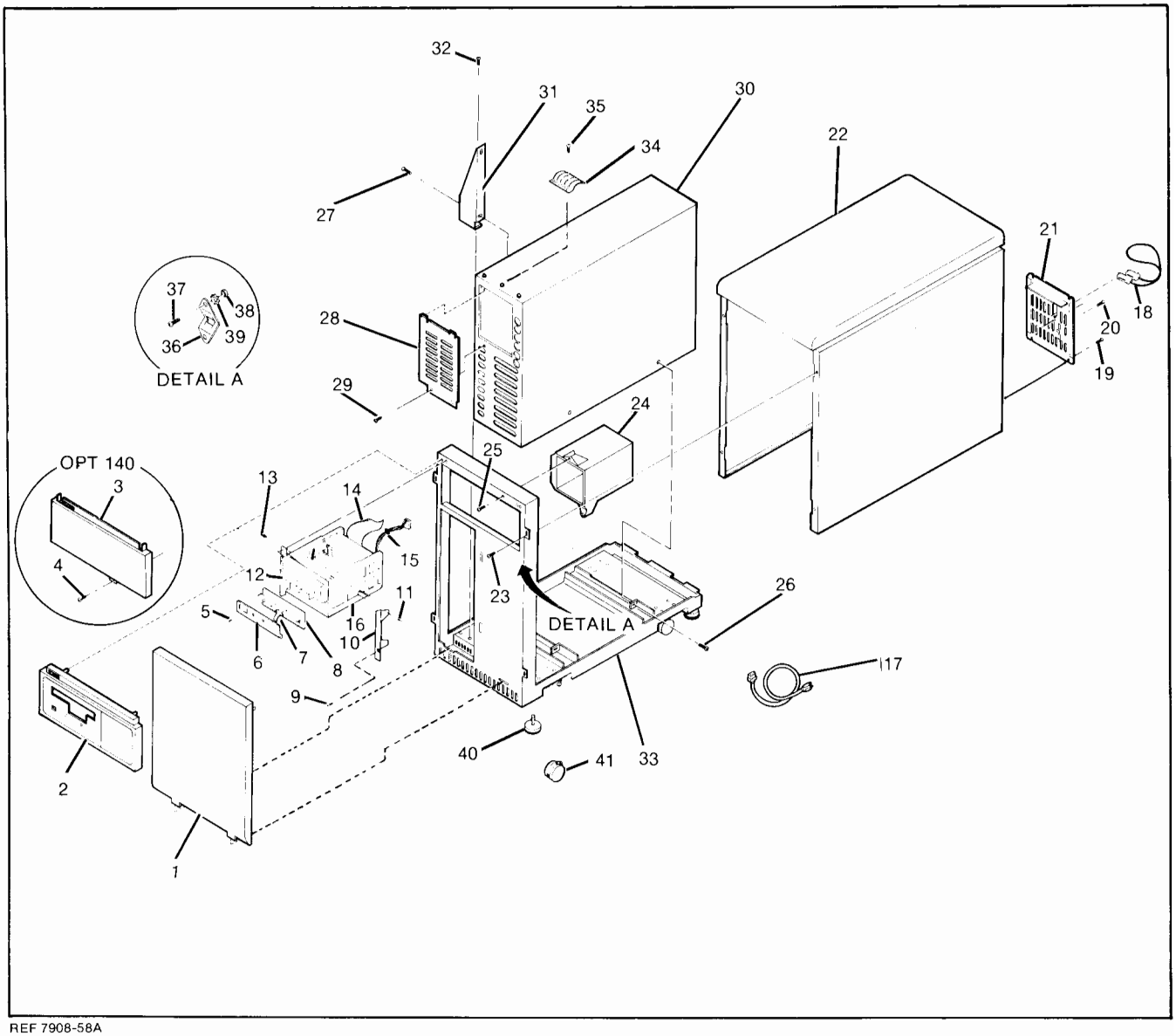
c. Complete description for each part as provided in the replaceable parts listings.

Table 6-1. HP 7908P Disc/Tape Drive, Replaceable Parts
(For HP 7908 disc/tape drives with serial numbers prefixed 2143 and later.)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1-	7908P	DISC/TAPE DRIVE	28480	7908P	
1	07908-60034	*PANEL, lower front	28480	07908-60034	1
2	07908-60032	*PANEL, upper front (Standard)	28480	07908-60032	1
3	07908-60033	*FILLER PANEL, upper front (Option 140)	28480	07908-60033	REF
		(Attaching Parts)			
4	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long — — — x — — —	00000	OBD	1
5	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	2
6	07908-00047	*ELECTROSTATIC DISCHARGE SHIELD	28480	07908-00047	1
7	07908-60144	*CABLE, switch (W6)	28480	07908-60144	1
8	07908-60142	*SWITCH PCA-A8	28480	07908-60142	1
9	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	5
10	07908-00036	*BRACKET, right	28480	07908-00036	1
		(Attaching Parts)			
11	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long — — — x — — —	00000	OBD	2
12	07908-00035	*BRACKET, left	28480	07908-00035	1
		(Attaching Parts)			
13	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long — — — x — — —	00000	OBD	2
14	07908-60143	*CABLE, tape data (W5)	28480	07908-60143	1
15	07908-60145	*CABLE, tape power (W4)	28480	07908-60145	1
16	07908-60340	*TAPE MECHANISM	28480	07908-60340	1
17	8120-2371	*POWER CORD, 16 AWG	28480	8120-2371	1
	8120-1351	*POWER CORD, BS1363/CEE	28480	8120-1351	REF
	8120-1369	*POWER CORD, ASC112/CEE	28480	8120-1369	REF
	8120-1689	*POWER CORD, GMBH/CEE	28480	8120-1689	REF
	8120-1860	*POWER CORD, CEE/CEE	28480	8120-1860	REF
	8120-2104	*POWER CORD, SEV/CEE	28480	8120-2104	REF
	8120-2956	*POWER CORD, MDPP/CEE	28480	8120-2956	REF
18	8120-3446	*CABLE, HP-IB, 2 metre	28480	8120-3446	1
19	0515-0383	*SCREW, machine, pnh, T15, M4-0.7, 16 mm long	00000	OBD	4
20	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 6 mm long	00000	OBD	1
21	07908-00034	*DOOR, rear	28480	07908-00034	1
22	07908-60030	*FLIP TOP	28480	07908-60030	1
		(Attaching Parts)			
23	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long — — — x — — —	00000	OBD	4
24	07908-40004	*STORAGE BOX	28480	07908-40004	1
		(Attaching Parts)			
25	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long — — — x — — —	00000	OBD	3
26	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	2
27	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	2
28	07908-00032	*GUARD PANEL	28480	07908-00032	1
		(Attaching Parts)			
29	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 6 mm long — — — x — — —	00000	OBD	1
30	No Number	*DISC MODULE (See figure 6-3)	28480	No Number	1
31	07908-00025	*BRACKET, support	28480	07908-00025	1
		(Attaching Parts)			
32	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long — — — x — — —	00000	OBD	2
33	07908-60031	*BASE ASSEMBLY	28480	07908-60031	1
34	8160-0416	**RFI GROUND STRIP	28480	8160-0416	1
		(Attaching Parts)			
35	0515-0433	**SCREW, machine, pnh, T15, M4-0.7, 8 mm long — — — x — — —	00000	OBD	2

Table 6-1. HP 7908P Disc/Tape Drive, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1					
36	1390-0036	**STUD RETAINER	28480	1390-0036	5
		(Attaching Parts)			
37	2200-0598	**SCREW, machine, pnh, T9, 4-40, 0.25 in. long	00000	OBD	2
38	2260-0001	**NUT, hex, 4-40	00000	OBD	2
39	2190-0411	**WASHER, no. 4, lock, ext-tooth	00000	OBD	2
		— — — x — — —			
40	0403-0412	**LEVELING PAD	28480	0403-0412	4
41	1492-0083	**CASTER	28480	1492-0083	4
		ACCESSORIES (not shown on figure 6-1)			
	9164-0156	*TAPE CARTRIDGE, 150-foot	28480	9164-0156	1
	8500-3440	*CLEANING FLUID	28480	8500-3440	1
	9300-0767	*CLEANING SWABS	28480	9300-0767	1
	07908-90901	*HP 7908 OPERATOR INSTRUCTIONS MANUAL	28480	07908-90901	1
	07908-90902	*HP 7908 OPERATING AND INSTALLATION MANUAL	28480	07908-90902	1
	5955-3456	*SITE ENVIRONMENTAL REQUIREMENTS MANUAL	28480	5955-3456	1

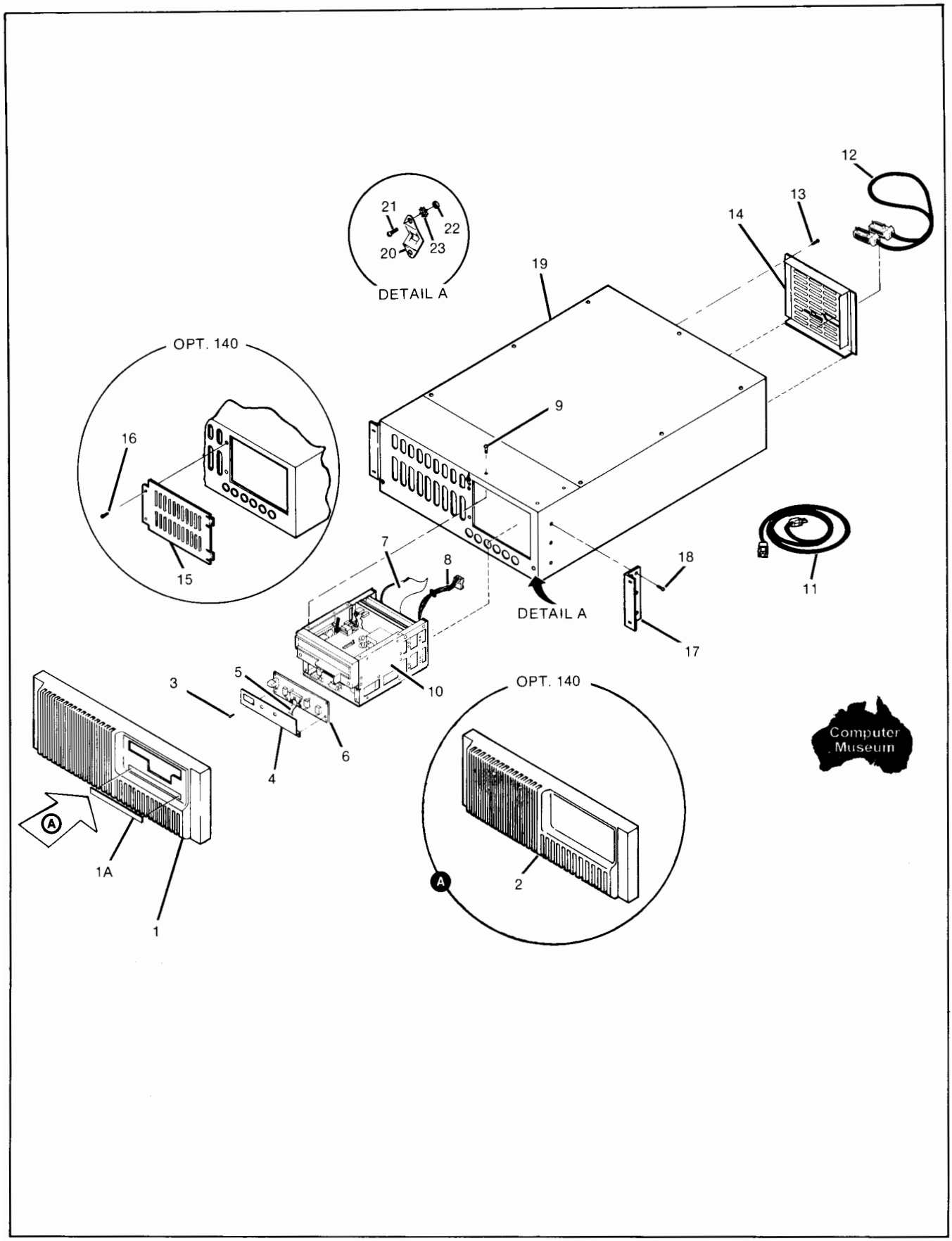


REF 7908-58A

Figure 6-1. HP 7908P Disc/Tape Drive, Exploded View (with serial numbers prefixed 2143 and later)

Table 6-2. HP 7908R Disc/Tape Drive, Replaceable Parts
(For HP 7908 disc/tape drives with serial numbers prefixed 2143 and later.)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-2-	7908R	DISC/TAPE DRIVE	28480	7908R	
1	07908-60016	*PANEL, front (Standard)	28480	07908-60016	1
1A	07908-00039	**LABEL, for front panel	28480	07908-00039	1
2	07908-60028	*FILLER PANEL, front (Option 140)	28480	07908-60028	REF
3	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	2
4	07908-00047	*ELECTROSTATIC DISCHARGE SHIELD	28480	07908-00047	1
5	07908-60144	*CABLE, switch (W6)	28480	07908-60144	1
6	07908-60142	*SWITCH PCA-A8	28480	07908-60142	1
7	07908-60143	*CABLE, tape data (W5)	28480	07908-60143	1
8	07908-60145	*CABLE, tape power (W4)	28480	07908-60145	1
9	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	3
10	07908-60340	*TAPE MECHANISM	28480	07908-60340	1
11	8120-1378	*POWER CORD, NEMA5/CEE	28480	8120-1378	1
	8120-1351	*POWER CORD, BS1363/CEE	28480	8120-1351	REF
	8120-1369	*POWER CORD, ASC112/CEE	28480	8120-1369	REF
	8120-1689	*POWER CORD, GMBH/CEE	28480	8120-1689	REF
	8120-1860	*POWER CORD, CEE/CEE	28480	8120-1860	REF
	8120-2104	*POWER CORD, SEV/CEE	28480	8120-2104	REF
	8120-2956	*POWER CORD, MDPP/CEE	28480	8120-2956	REF
12	8120-3446	*CABLE, HP-IB, 2 metre	28480	8120-3446	1
13	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	5
14	07908-00019	*GRILLE, rear	28480	07908-00019	1
15	07908-00032	*GUARD PANEL (Option 140)	28480	07908-00032	1
		(Attaching Parts)			
16	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	2
		— — — x — — —			
17	07908-00023	*RACKMOUNT EAR	28480	07908-00023	2
		(Attaching Parts)			
18	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	3
		— — — x — — —			
19	No Number	*DISC MODULE (See figure 6-3)	28480	No Number	1
20	1390-0036	**STUD RETAINER	28480	1390-0036	3
		(Attaching Parts)			
21	2200-0598	**SCREW, machine, pnh, T9, 4-40, 0.25 in. long	00000	OBD	2
22	2260-0001	**NUT, hex, 4-40	00000	OBD	2
23	2190-0411	**WASHER, no. 4, lock, ext-tooth	00000	OBD	2
		— — — x — — —			
		ACCESSORIES (not shown on figure 6-2)			
	9164-0156	*TAPE CARTRIDGE, 150-foot	28480	9164-0156	1
	8500-3440	*CLEANING FLUID	28480	8500-3440	1
	9300-0767	*CLEANING SWABS	28480	9300-0767	1
	07908-90901	*HP 7908 OPERATOR INSTRUCTIONS MANUAL	28480	07908-90901	1
	07908-90902	*HP 7908 OPERATING AND INSTALLATION MANUAL	28480	07908-90902	1
	5955-3456	*SITE ENVIRONMENTAL REQUIREMENTS MANUAL	28480	5955-3456	1



REF 7908-59A

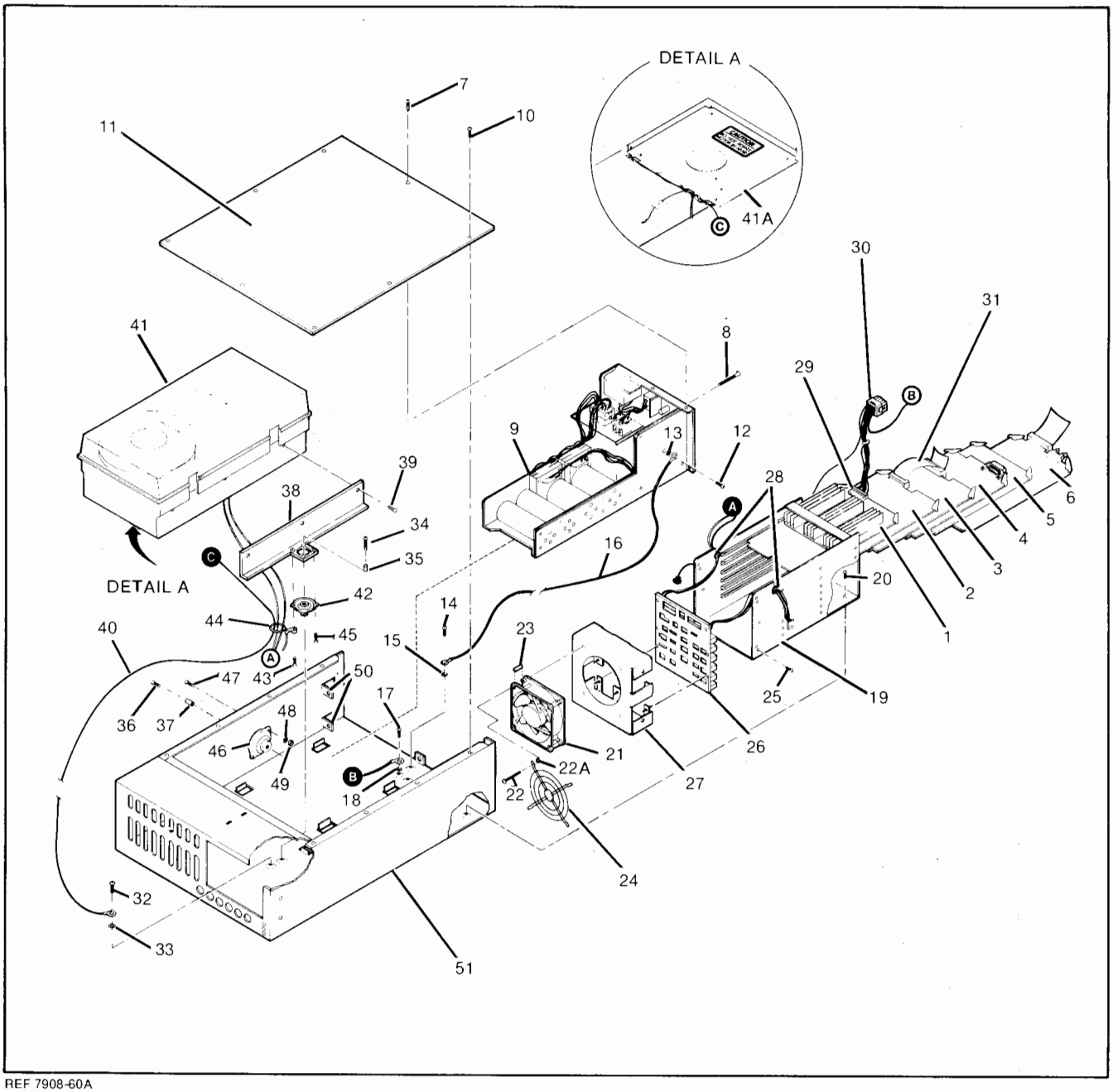
Figure 6-2. HP 7908R Disc/Tape Drive, Exploded View (with serial numbers prefixed 2143 and later)

Table 6-3. Disc Module, Replaceable Parts
(For HP 7908 disc/tape drives with serial numbers prefixed 2143 and later.)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-	No Number	DISC MODULE (30, figure 6-1; 19, figure 6-2)	28480	No Number	
1	07908-60007	*REGULATOR PCA-A1	28480	07908-60007	1
2	07908-60006	*SERVO PCA-A2	28480	07908-60006	1
3	07908-60205	*READ/WRITE PCA-A3	28480	07908-60205	1
4	07908-60009	*DISC MEMORY ACCESS PCA-A4	28480	07908-60009	1
5	07908-60002	*MICROPROCESSOR PCA-A5	28480	07908-60002	1
	07908-11007	**EPROM KIT FOR MPU (not shown)	28480	07908-11007	1
6	07908-60241	*TAPE INTERFACE BOARD PCA-A6	28480	07908-60241	1
7	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	1
8	2940-0248	*CAP SCREW, T30, 1/4 x 20, 2.75 in. long	00000	OBD	2
9	No Number	*RECTIFIER ASSEMBLY (See figure 6-4)	28480	No Number	1
10	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	7
11	07908-00022	*TOP COVER	28480	07908-00022	1
12	2360-0462	*SCREW, machine, pnh, T15, 6-32, 0.250 in. long	00000	OBD	1
13	2190-0468	*WASHER, lock, intl-tooth, no. 6	00000	OBD	1
14	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	1
15	2190-0321	*WASHER, lock, intl-tooth, M4	00000	OBD	1
16	07908-60025	*GROUND WIRE	28480	07908-60025	1
17	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	1
18	2190-0321	*WASHER, lock, intl-tooth, M4	00000	OBD	1
19	07908-60010	*CARD CAGE ASSEMBLY	28480	07908-60010	1
		(Attaching Parts)			
20	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long — — — x — — —	00000	OBD	2
21	3160-0341	**FAN, 115 Vac	28875	BS2107F-510H	1
		(Attaching Parts)			
22	2360-0467	**SCREW, machine, pnh, T15, 6-32, 1.75 in. long	00000	OBD	4
22A	2190-0468	**WASHER, lock, intl-tooth, no. 6	00000	OBD	1
23	0380-0912	**SPACER, 0.72 in. long	28480	0380-0912	4
24	3160-0099	**GRILLE, fan — — — x — — —	28480	3160-0099	1
25	2360-0464	**SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	4
26	07908-60004	**MOTHER PCA-A7	28480	07908-60004	1
27	07908-00021	**CHASSIS, fan mounting	28480	07908-00021	1
28	0400-0062	**GROMMET	51533	8069	2
29	1251-7263	*COVER, cable	28480	1251-7263	1
30	07908-60024	*CABLE, rectifier-regulator (W1)	28480	07908-60024	1
31	07908-60020	*CABLE, servo-read/write (W3)	28480	07908-60020	1
32	0515-0433	*SCREW, machine, pnh, T15, M4-0.7, 8 mm long	00000	OBD	1
33	2190-0321	*WASHER, lock, intl-tooth, M4	00000	OBD	1
34	0515-0636	*SCREW, machine, pnh, T15, M4-0.7, 25 mm long	00000	OBD	1
35	07908-20001	*BUSHING	28480	07908-20001	1
36	2360-0473	*SCREW, machine, pnh, T15, 6-32, 1.00 in. long	00000	OBD	2
37	07908-20001	*BUSHING	28480	07908-20001	2
38	07908-00018	*BRACKET, disc mechanism	28480	07908-00018	1
		(Attaching Parts)			
39	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long — — — x — — —	00000	OBD	3
40	07908-60023	*ELECTROSTATIC DISCHARGE STRAP	28480	07908-60023	1
41	07908-60100	*DISC MECHANISM (in transit case)	28480	07908-60100	1
41A	07908-60104	**BOTTOM PLATE KIT	28480	07908-60104	1
42	1520-0217	*SHOCKMOUNT, bracket (blue dot)	17569	7821-3A	1
		(Attaching Parts)			
43	2360-0469	*SCREW, machine, pnh, T15, 6-32, 0.750 in. long	00000	OBD	1
44	1400-0719	*CABLE TIE	04225	TY-34M-8	1
45	2360-0465	*SCREW, machine, pnh, T15, 6-32, 0.5 in. long — — — x — — —	00000	OBD	1

Table 6-3. Disc Module, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-					
46	1520-0216	*SHOCKMOUNT, chassis (orange dot)	17569	7821-1A	2
		(Attaching Parts)			
47	2360-0465	*SCREW, machine, pnh, T15, 6-32, 0.5 in. long	00000	OBD	2
48	3050-0407	*WASHER, flat, no. 6	00000	OBD	2
49	2420-0002	*NUT, 6-32	00000	OBD	2
		— — — x — — —			
50	0590-1338	*CLIP NUT	17875	C521-1420-4	2
51	07908-00012	*CHASSIS, disc module	28480	07908-00012	1



REF 7908-60A

Figure 6-3. Disc Module, Exploded View (for HP 7908 disc/tape drives with serial numbers prefixed 2143 and later)

Table 6-4. Rectifier Assembly, Replaceable Parts
(For HP 7908 disc/tape drives with serial numbers prefixed 2143 and later.)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-4-	No Number	RECTIFIER ASSEMBLY (9, figure 6-3)	28480	No Number	REF
1	0180-3095	*CAPACITOR, 27,000 μF, 30 Vdc rating	00853	500R273U030BF2A	2
		(Attaching Parts)			
2	2680-0286	*SCREW, machine, pnh, T25, 10-32, 0.375 in. long	00000	OBD	2
		— — — x — — —			
3	0180-3096	*CAPACITOR, 58,000 μF, 15 Vdc rating	00853	500R583U015CC2A	2
		(Attaching Parts)			
4	2680-0286	*SCREW, machine, pnh, T25, 10-32, 0.375 in. long	00000	OBD	2
		— — — x — — —			
5	07908-60013	*RECTIFIER PCA-A9	28480	07908-60013	1
		(Attaching Parts)			
6	2360-0464	*SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	10
		— — — x — — —			
7	2110-0048	**FUSE, 15 Amp, 32V rating (F291)	75915	311015	1
8	2110-0523	**FUSE, 10 Amp, 32V rating (F195, F290)	75915	311010	2
9	2110-0001	**FUSE, 1 Amp, 250V rating (F194, F255)	75915	312001	2
	07908-60018	*TRANSFORMER ASSEMBLY (See note on fig. 6-4)	28480	07908-60018	1
10	2110-0565	**CAP, fuseholder	06328	031.1666	1
11	2110-0342	**FUSE, main, 8 Amp, 250V rating	75915	314008	1
	2110-0055	**FUSE, main, 4 Amp, 250V rating (Option 015)	75915	312004	REF
12	2110-0566	**FUSEHOLDER	06328	031.1677	1
		(Attaching Parts)			
13	2110-0569	**NUT	06328	583.0016	1
		— — — x — — —			
14	3101-2399	**SWITCH, power	81716	566214180	1
15	9135-0107	**FILTER, line	23880	F14281	1
		(Attaching Parts)			
16	2360-0464	**SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	2
17	2190-0468	**WASHER, lock, intl-tooth, no. 6	00000	OBD	4
18	2420-0002	**NUT, hex, 6-32	00000	OBD	2
		— — — x — — —			
19	07908-60050	**CABLE, diode (W2)	28480	07908-60050	1
20	1906-0205	**BRIDGE RECTIFIER DIODE	53562	VK248	2
		(Attaching Parts)			
21	2360-0465	**SCREW, machine, pnh, T15, 6-32, 0.5 in. long	00000	OBD	1
		— — — x — — —			
22	1400-0719	**CABLE TIE CLIP, inductor wires	56501	TY-34M-8	1
		(Attaching Parts)			
23	2360-0465	**SCREW, machine, pnh, T15, 6-32, 0.50 in. long	00000	OBD	1
		— — — x — — —			
24	2360-0464	**SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	1
25	2190-0468	**WASHER, lock, intl-tooth, no. 6	00000	OBD	1
26	2420-0002	**NUT, hex, 6-32	00000	OBD	1
27	07908-60029	**CABLE, interconnect (W7)	28480	07908-60029	1
28	07908-60026	**VOLTAGE SELECT PLUG, 100/110/120 Vac	28480	07908-60026	1
	07908-60027	**VOLTAGE SELECT PLUG, 208/220/240 Vac (Option 015)	28480	07908-60027	REF
29	07908-60012	**INTERCONNECT PCA-A10	28480	07908-60012	1
		(Attaching Parts)			
30	2360-0464	**SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	4
		— — — x — — —			
31	2940-0248	**CAP SCREW, T30, 1/4 x 20, 2.75 in. long	00000	OBD	2
32	07908-00015	**BRACKET, power	28480	07908-00015	1
33	No Number	**TRANSFORMER (T1) (Order HP part no. 07908-60018)		NSR	1
34	2360-0464	**SCREW, machine, pnh, T15, 6-32, 0.375 in. long	00000	OBD	2
35	2190-0468	**WASHER, lock, intl-tooth, no. 6	00000	OBD	2

Table 6-4. Rectifier Assembly, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-4-					
36	No Number	**INDUCTOR, saturable (L1, L2) (Order HP part no. 07908-60018) (Attaching Parts)		NSR	2
37	2680-0280	**SCREW, machine, pnh, T25, 10-32, 1.5 in. long	00000	OBD	4
38	2190-0402	**WASHER, flat, no. 10	00000	OBD	4
	2740-0002	**NUT, hex, 10-32	00000	OBD	4
		— — — x — — —			
40	No Number	**RECTIFIER ASSEMBLY CHASSIS	28480	NSR	1

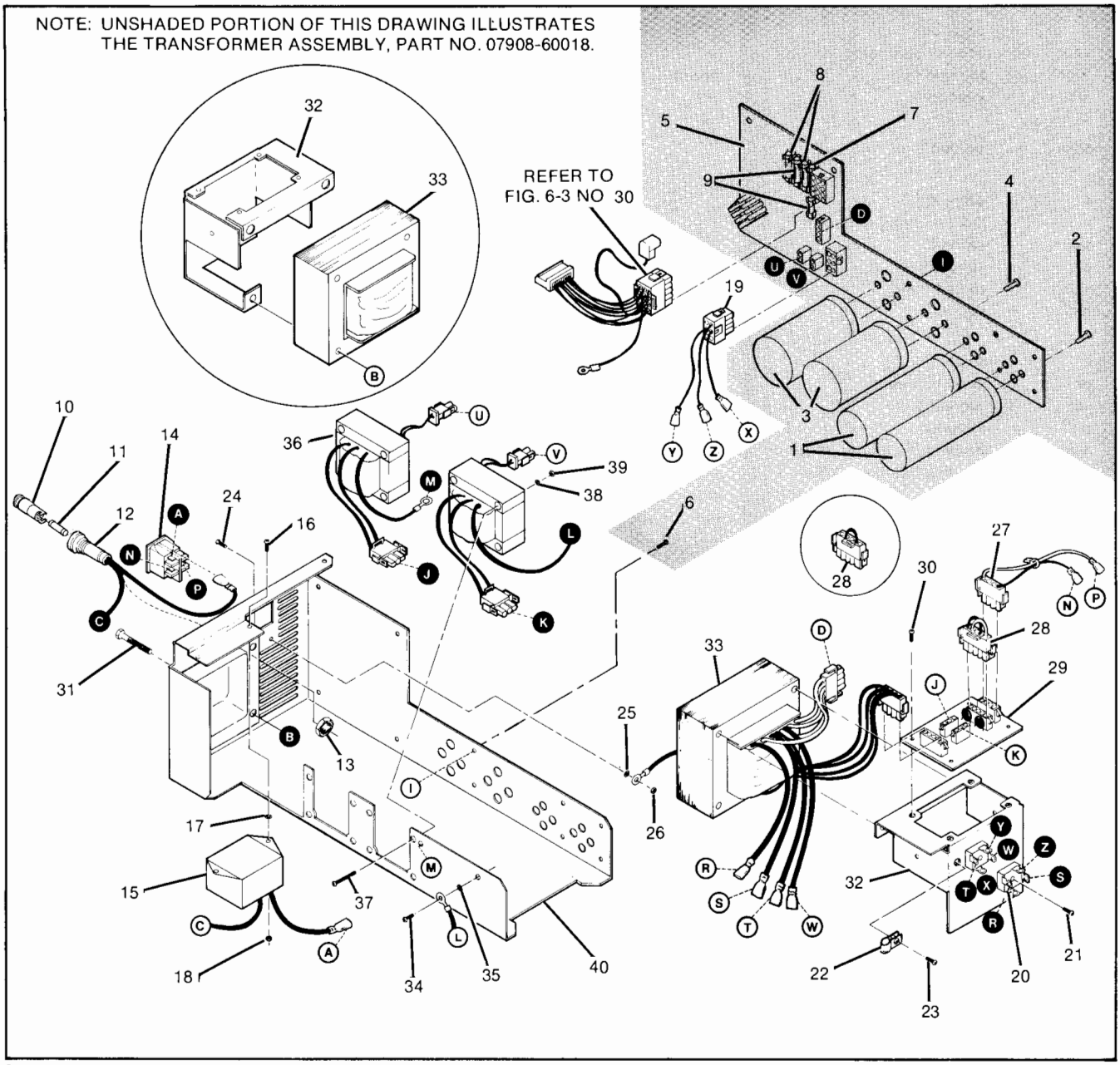


Figure 6-4. Rectifier Assembly, Exploded View (for HP 7908 disc/tape drives with serial numbers prefixed 2143 and later)

Table 6-5. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly	J = jack, receptacle connector	T = transformer
B = blower, fan, motor, synchro	K = relay	TB = terminal board
C = capacitor	L = inductor	TP = test point
CB = circuit breaker	M = meter	U = integrated circuit, non-repairable assembly
CR = diode	MP = mechanical part	
DS = indicator lamp	P = plug connector	VR = voltage retulator
E = contact, miscellaneous electrical part	Q = semiconductor device other than diode or integrated circuit	W = cable assembly (with connectors), wire
F = fuse	R = resistor	X = socket
FL = filter	RT = thermistor	Y = crystal unit
H = hardware	S = switch	Z = network, tuned circuit

ABBREVIATIONS

A = ampere(s)	ID = inside diameter	qty = quantity
ac = alternating current	in. = inch, inches	
AR = as required	incand = incandescent	rdh = round head
assy = assembly	incl = include(s)	rect = rectifier
	intl = internal	ref = reference
brkt = bracket	I/O = input/output	rf = radio frequency
		rfi = radio frequency interference
c = centi(10^{-2})	k = kilo (10^{3}), kilohm	rh = right hand
C = Celsius, centigrade	kg = kilogram	rpm = revolutions per minute
cer = ceramic		rwv = reverse working voltage
cm = centimetre	lb = pound	
comp = composition	LED = light-emitting diode	sb = slow blow
conn = connector	lh = left hand	SCR = semiconductor-controlled rectifier
	M = mega (10^{6}), megohm	scw = square cone washer
d = deci(10^{-1})	m = milli (10^{-3})	Se = selenium
dc = direct current	mach = machine	Si = silicon
deg = degree(s)	mb = medium blow	slftpg = self-tapping
dia = diameter	met oxd = metal oxide	spdt = single-pole, double throw
dpdt = double-pole, double-throw	mfr = manufacturer	spst = single-pole, single throw
dpst = double-pole, single-throw	misc = miscellaneous	sst = stainless steel
	mm = millimetre	stl = steel
elctlt = electrolytic	mtg = mounting	sw = switch
encap = encapsulated	My = Mylar	
ext = external		T = TORX® screw
	n = nano (10^{-9})	Ta = tantalum
F = Fahrenheit, farad	n.c. = normally closed	tgl = toggle
fb = fast blow	no. = number	thd = thread
fh = flat head	n.o. = normally open	Ti = titanium
fig. = figure	NSR = not separately replaceable	tol = tolerance
filh = fillister head	ntd = no time delay	
flm = film		U (μ) = micro (10^{-6})
fw = full wave	OBD = order by description	
fxd = fixed	OD = outside diameter	V = volt(s)
	ovh = oval head	var = variable
G = giga(10^{9})	oxd = oxide	Vdcw = direct current working volts
Ge = germanium		
	p = pico (10^{-12})	W = watt(s)
H = henry, henries	PCA = printed-circuit assembly	w/ = with
hd = head	phh = phillips head	WIV = inverse working volts
hex = hexagon, hexagonal	pnh = pan head	ww = wire-wound
hlcl = helical	P/O = part of	
Hz = Hertz	pot = potentiometer	
	pozi = Pozidriv	

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Table 6-6. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS
00853	Sangamo Elec. Co.	Pickens, SC	28480	Hewlett-Packard Co.	Palo Alto, CA
02768	Illinois Tool Works, Inc.	Des Plaines, IL	28875	IMC Magnetics Corp.	Rochester, NH
06328	Schurter Agh.	Luzern, Switz.	51533	Fluorocarbon Co.	Sunnyvale, CA
06915	Richco Plastic Co.	Chicago, IL	53562	Varo Semiconductor Corp.	Garland, TX
17569	Barry Wright Corp.	Watertown, MA	56501	Thomas and Betts Co.	Elizabeth, NJ
17875	Eaton Corp.	Cleveland, OH	75915	Littelfuse, Inc.	Des Plaines, IL
23880	Stanford Applied Eng. Co.	Santa Clara, CA	81716	Oak Ind., Inc.	Crystal Lake, IL

APPENDIX A
BACKDATING INFORMATION

This backdating appendix provides removal and replacement and replaceable parts information for HP 7908P and HP 7908R Disc/Tape Drives with serial numbers prefixed 2142 and prior. These disc/tape drives utilize Pozidriv® screws throughout.

CHANGE	DESCRIPTION
1	Sections V and VI in this backdating section should be used in place of sections V and VI in the main manual for HP 7908P and HP 7908R Disc/Tape Drives with serial numbers prefixed 2142 and prior.

REMOVAL AND REPLACEMENT

SECTION V

5-1. INTRODUCTION

This section provides removal and replacement procedures for field replaceable HP 7908 assemblies and parts. Procedures are given in order in which disassembly normally occurs. Each assembly or part which must be removed before access can be gained to another assembly or part is presented first, followed by the next assembly that can be removed. References are made to illustrations and parts lists contained in Section VI, Replaceable Parts, to aid in identifying and locating parts. Each heading includes the applicable figure number to aid disassembly; the numbers in the removal procedures refer to items in that figure. Figures 5-1 and 5-2 show the disassembly structures for the HP 7908P and HP 7908R respectively.

WARNING

The HP 7908 does not contain any operator-serviceable parts. To prevent electrical shock, refer all service activities to service-trained personnel.

CAUTION

For U.S.A. operation, use only a UL listed, detachable power cord with type SJT flexible cord, suitable for rated voltage and current. Check the input ac voltage, main fuse rating, and voltage select plug before connecting the power cord. The HP 7908 is shipped with an appropriate power cord.

CAUTION

Do not attempt to operate an HP 7908 configured for 100/120 Vac on 220/240 Vac or vice-versa. Damage to the HP 7908 may result.

To attach a power cord, proceed as follows:

a. Set the POWER switch on the rear panel to "0".

b. Plug the female end of the power cord into the HP 7908.

5-2. PREPARATION PROCEDURES

WARNING

To avoid dangerous electrical shock, do not perform any removal/replacement operation until the ac mains power is removed from the HP 7908.

CAUTION

Do not power-up or power-down the HP 7908 when the system bus is in an active state.

CAUTION

Do not connect or disconnect the HP-IB cable(s) from the HP 7908 when the system bus is in an active state.

All service procedures require the power cord to be disconnected. To remove the power cord, proceed as follows:

a. Set the POWER switch on the rear panel to the "0" position.

b. Disconnect the ac power cord from the wall outlet and from the receptacle on the rear of the HP 7908.

All service procedures require the HP-IB cable to be disconnected as follows:

a. Loosen the two thumb screws which hold the HP-IB connector in place.

b. Disconnect the HP-IB cable.

To reconnect the HP-IB cable, plug the HP-IB cable into its receptacle and tighten the two thumb screws.

5-3. REMOVAL AND REPLACEMENT (HP 7908P)

5-4. LOWER FRONT PANEL (1, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

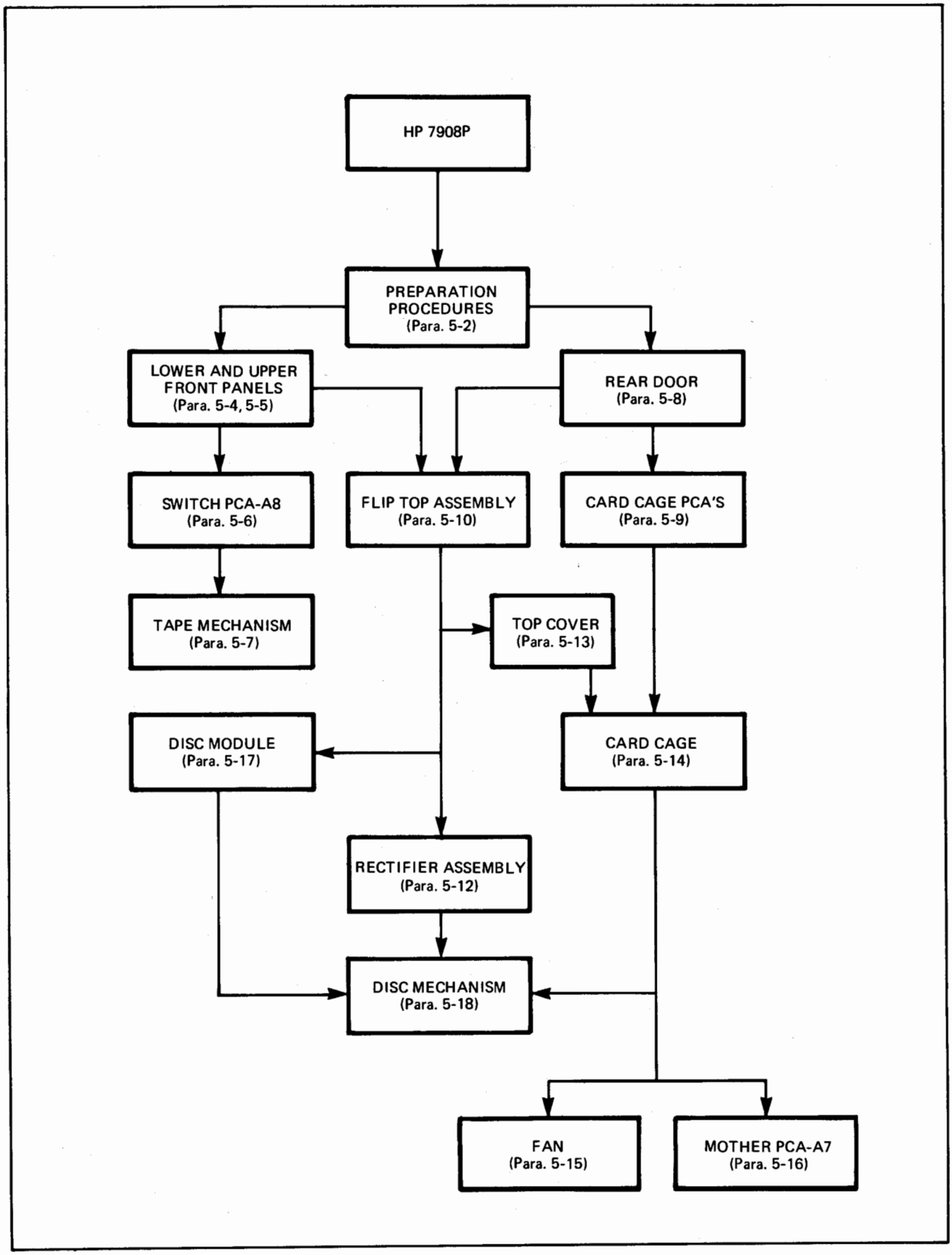

Figure 5-1. HP 7908P Disc/Tape Drive Disassembly Aid

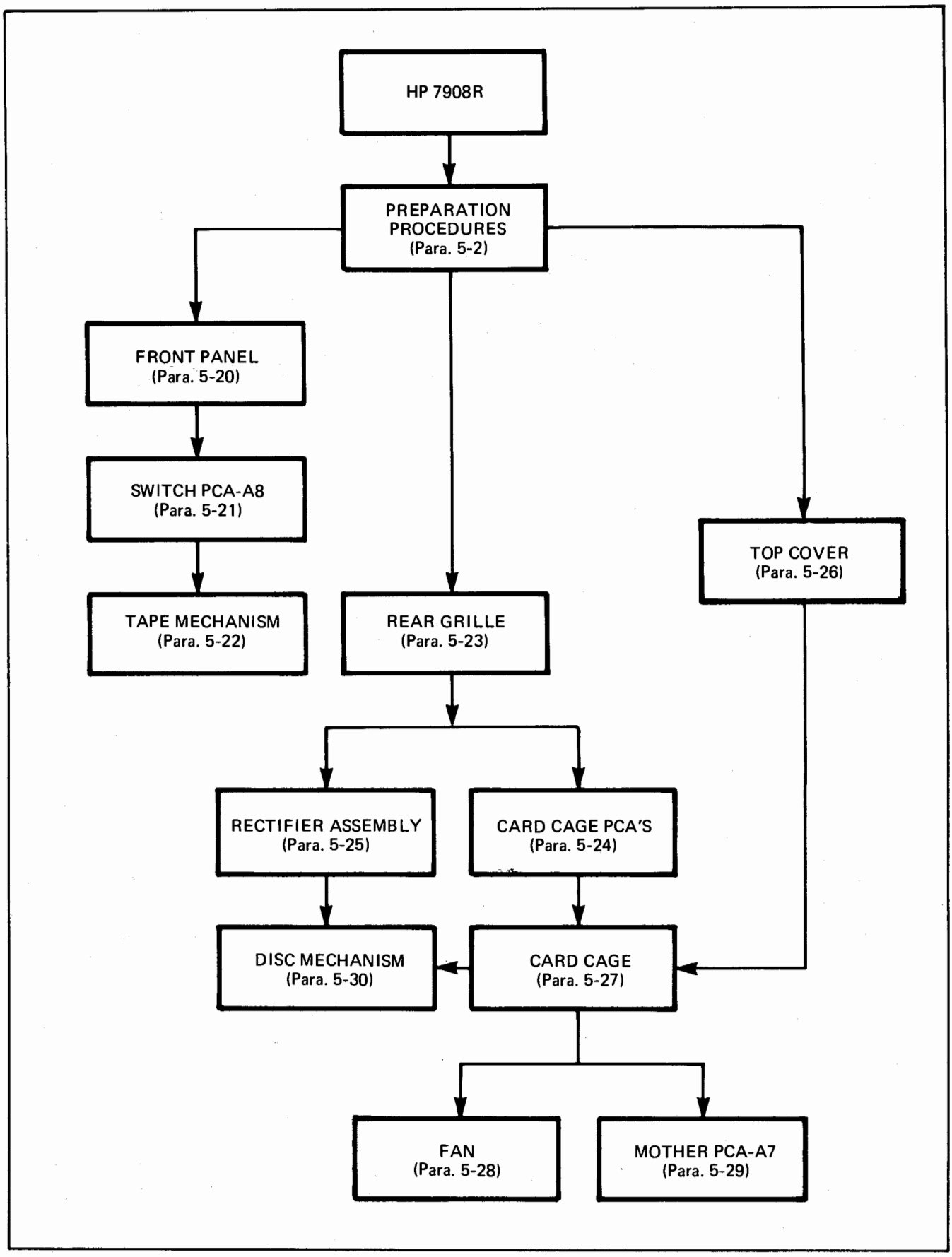

Figure 5-2. HP 7908R Disc/Tape Drive Disassembly Aid

c. The lower front panel is removed by pulling the top of it forward and sliding it up and out of the base assembly.

To replace, slide the lower front panel into the base assembly and push the top into place.

5-5. UPPER FRONT PANEL (2, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. The upper front panel on the standard HP 7908 is removed by pulling it forward. The upper front filler panel (3, Opt. 140) is held on by one screw (4) located beneath the panel.

To replace, reverse the procedure.

5-6. SWITCH PCA-A8 (11, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the upper front panel. (Refer to paragraph 5-5.)

d. Remove the two screws (7) which hold the electrostatic discharge shield (9) and the switch PCA-A8 to the tape mechanism (22).

e. Disconnect the switch cable (10) from the switch PCA-A8.

f. Remove the switch PCA-A8.

To replace, reverse the procedure.

5-7. TAPE MECHANISM (20, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the switch PCA-A8. (Refer to paragraph 5-6.)

f. Remove the five screws (12) which hold the tape mechanism brackets (14 and 17) to the base assembly (46).

g. Pull the tape mechanism forward.

h. Remove the tape power cable (21) and tape data cable (20) from the rear of the tape mechanism.

i. Remove the tape mechanism.

Note: If a new tape mechanism is to be installed, the brackets on the defective tape mechanism must be removed and installed on the new tape mechanism.

To replace, reverse the procedure.

5-8. REAR DOOR (27, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the five screws (25) which hold the rear door in place.

d. Remove the rear door.

To replace, reverse the procedure.

5-9. CARD CAGE PCA'S (1 through 6, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear door. (Refer to paragraph 5-8.)

d. Remove any cables from the PCA to be replaced.

e. Remove the PCA.

CAUTION

Ensure that the correct PCA is inserted into the proper card slot as shown in figure 5-3, otherwise damage to the PCA will result. Also, ensure that the cables are connected to the proper PCA's.

To replace, reverse the procedure.

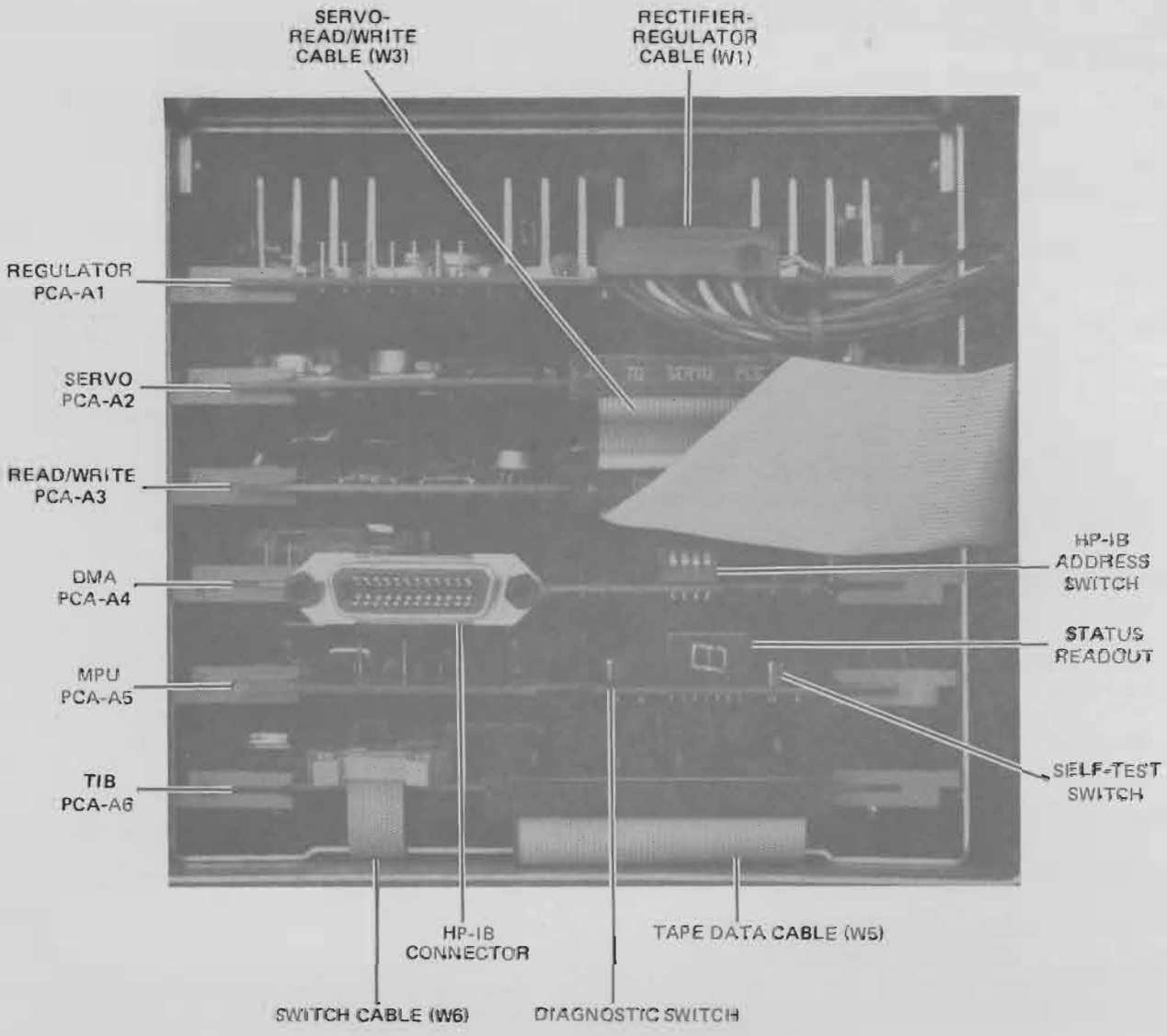

Figure 5-3. Card Cage PCA Locator

5-10. FLIP TOP (28, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the four screws (29) which hold the flip top to the front of the base assembly (46).

g. Lift the front of the flip top up and back until it faces up.

h. Lift the flip top up and off of the base assembly.

To replace, reverse the procedure.

5-11. STORAGE BOX (30, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the three screws (31) which hold the storage box to the front of the base assembly (46).

h. Remove the storage box.

To replace, reverse the procedure.

5-12. RECTIFIER ASSEMBLY (11, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Lay the base assembly on its side so that the top cover of the disc module faces up.

WARNING

If any of the red or green LED's on the rectifier PCA-A9 are lit, a dangerous voltage exists on the filter capacitors.

h. Remove the two cap screws (8) located to the right of the transformer cover plate.

i. Remove the one top cover screw (7) which holds the rectifier assembly to the edge of the disc module.

j. Pull the rectifier assembly out part way.

k. Disconnect the green/yellow ground wire (18) from the side of the rectifier assembly.

l. Disconnect the rectifier-regulator cable (36) from the rectifier PCA-A9.

m. Slide the rectifier assembly out slowly. (Refer to paragraph 5-31 for rectifier disassembly.)

To replace, reverse the procedure.

5-13. TOP COVER (13, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the eight screws (12) which hold the top cover in place.

h. Remove the top cover.

To replace, reverse the procedure.

5-14. CARD CAGE ASSEMBLY
(21, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the top cover. (Refer to paragraph 5-13.)

h. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

i. Disconnect the disc power cable from the mother PCA-A7.

j. Disconnect the rectifier-regulator cable (36) from the fan (24).

k. Disconnect the tape power cable from the mother PCA-A7.

l. Remove the two screws (22) which hold the card cage assembly in place.

m. Remove the card cage assembly.

To replace, first ensure that the tape data cable, switch cable, fan cable, tape power cable and disc power cable are in place, then reverse the procedure.

5-15. FAN (24, figure 6-3). Proceed as follows:

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the top cover. (Refer to paragraph 5-13.)

h. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

i. Remove the card cage assembly. (Refer to paragraph 5-14.)

Note: Notice the position of the fan with respect to the cable plug and the direction of airflow (air flows into the card cage and out through the rear door). Also, do not lose the four spacers.

j. Remove the four screws (25) which hold the fan to the fan mounting chassis (33).

k. Remove the fan.

To replace, reverse the procedure.

5-16. MOTHER PCA-A7 (32, figure 6-3). Proceed as follows:

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door. (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the top cover. (Refer to paragraph 5-13.)

h. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

i. Remove the card cage assembly. (Refer to paragraph 5-14.)

j. Remove the four screws (29) which hold the fan mounting chassis (33) to the card cage.

k. Remove the fan mounting chassis.

l. Remove the mother PCA-A7 using the removal tool (part no. 09815-20602).

To replace the mother PCA-A7, push it onto the studs on the fan mounting chassis, then reverse the procedure.

5-17. DISC MODULE (41, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the two screws (36) located on the support bracket (42).

h. Remove the two screws (33) located on the lower edge of the disc module.

i. Remove the three cables connected to the tape mechanism (20).

j. Lift the disc module off of the base assembly (46).

To replace, reverse the procedure.

5-18. DISC MECHANISM (52, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel. (Refer to paragraph 5-4.)

d. Remove the upper front panel. (Refer to paragraph 5-5.)

e. Remove the rear door (Refer to paragraph 5-8.)

f. Remove the flip top. (Refer to paragraph 5-10.)

g. Remove the disc module. (Refer to paragraph 5-17.)

h. Remove the top cover. (Refer to paragraph 5-13.)

i. Remove the rectifier assembly. (Refer to paragraph 5-12.)

j. Remove all PCA'S from the card cage. (Refer to paragraph 5-9.)

k. Remove the card cage assembly. (Refer to paragraph 5-14.)

CAUTION

The disc mechanism is very prone to damage if not handled with extreme care.

l. While supporting the disc mechanism, remove the three screws (40, 44); one from the center of each shockmount.

m. Disconnect the green/yellow electrostatic discharge strap (51) from the disc module chassis (67).

n. Remove the disc mechanism.

CAUTION

The disc mechanism is not field serviceable.

o. From the bracket shockmount (53), remove the screw (54) which secures the cable tie (55).

p. Remove the three screws (49) which hold the disc mechanism bracket (48) to the side of the the disc mechanism. The bracket must be retained for installing the new disc mechanism.

To replace, reverse the procedure.

5-19. REMOVAL AND REPLACEMENT (HP 7908R)

5-20. FRONT PANEL (1, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. The front panel (1) or front filler panel (2, Opt. 140) is removed by pulling it forward.

To replace, push the panel into place.

5-21. SWITCH PCA-A8 (7, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel. (Refer to paragraph 5-20.)

d. Remove the two screws (3) which hold the electrostatic discharge shield (5) and the switch PCA-A8 to the tape mechanism (12).

e. Remove the switch cable (6) from the switch PCA-A8.

f. Remove the switch PCA-A8.

To replace, reverse the procedure.

5-22. TAPE MECHANISM (12, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel. (Refer to paragraph 5-20.)

d. Remove the switch PCA-A8. (Refer to paragraph 5-21.)

e. Remove the three screws (10) which hold the tape mechanism to the top of the disc module (23) chassis.

f. Pull the tape mechanism forward.

g. Remove the tape power cable (9) and tape data cable (8) from the rear of the tape mechanism.

h. Remove the tape mechanism.

To replace, reverse the procedure.

5-23. REAR GRILLE (17, figure 6-2)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the five screws (15) which hold the rear grille in place.

d. Remove the rear grille.

To replace, reverse the procedure.

5-24. CARD CAGE PCA'S (1 through 6, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-23.)

d. Remove any cables from the PCA to be replaced.

e. Remove the PCA.

CAUTION

Ensure that the correct PCA is inserted into the proper card slot as shown in figure 5-3, otherwise damage to the PCA will result. Also, ensure that the cables are connected to the proper PCA's.

To replace, reverse the procedure.

5-25. RECTIFIER ASSEMBLY (11, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-23.)

WARNING

If any of the red or green LED's on the rectifier PCA-A9 are lit, a dangerous voltage exists on the filter capacitors.

d. Remove the two cap screws (8) located on the right of the transformer cover plate.

e. Remove the one top cover screw (7) which holds the rectifier assembly to the edge of the disc module.

f. Pull the rectifier assembly out part way.

g. Disconnect the green/yellow ground wire (18) which connects to the rectifier assembly.

h. Disconnect the rectifier-regulator cable (36) from the rectifier PCA-A9.

i. Slide the rectifier assembly out slowly. (Refer to paragraph 5-31 for rectifier disassembly.)

To replace, reverse the procedure.

5-26. TOP COVER (13, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the eight screws (12) which hold the top cover in place.

d. Remove the top cover.

To replace, reverse the procedure.

5-27. CARD CAGE ASSEMBLY (21, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-23.)

d. Remove the top cover. (Refer to paragraph 5-26.)

e. Remove all PCA'S from the card cage. (Refer to paragraph 5-24.)

f. Disconnect the disc power cable from the mother PCA-A7 (33).

g. Disconnect the rectifier-regulator cable (36) from the fan (24).

h. Disconnect the tape power cable from the mother PCA-A7.

i. Remove the two screws (22) which hold the card cage assembly to the disc module chassis.

j. Remove the card cage assembly.

To replace, reverse the procedure.

5-28. FAN (24, figure 6-3). Proceed as follows:

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-23.)

d. Remove the top cover. (Refer to paragraph 5-26.)

e. Remove all PCA'S from the card cage. (Refer to paragraph 5-24.)

f. Remove the card cage assembly. (Refer to paragraph 5-27.)

Note: Notice the position of the fan with respect to the cable plug and the direction of airflow (air flows into the card cage and out through the rear grille). Also, do not lose the four spacers.

g. Remove the four screws (25) which hold the fan to the fan mounting chassis (33).

h. Remove the fan.

To replace, reverse the procedure.

5-29. MOTHER PCA-A7 (32, figure 6-3). Proceed as follows:

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (Refer to paragraph 5-23.)

d. Remove the top cover. (Refer to paragraph 5-26.)

e. Remove all PCA'S from the card cage. (Refer to paragraph 5-24.)

f. Remove the card cage assembly. (Refer to paragraph 5-27.)

g. Remove the four screws (29) which hold the fan mounting chassis (33) to the card cage assembly (21).

h. Remove the mounting chassis.

i. Remove the mother PCA-A7 using the removal tool (part no. 09815-20602).

To replace the mother PCA-A7, push it onto the studs on the fan mounting chassis, then reverse the procedure.

5-30. DISC MECHANISM (52, figure 6-3)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rear grille. (refer to paragraph 5-23.)

d. Remove the top cover. (Refer to paragraph 5-26.)

e. Remove the rectifier assembly. (Refer to paragraph 5-25.)

f. Remove all PCA'S from the card cage. (Refer to paragraph 5-24.)

g. Remove the card cage assembly. (refer to paragraph 5-27.)

CAUTION

The disc mechanism is very prone to damage if not handled with extreme care.

h. While supporting the disc mechanism, remove the three screws (40, 44); one from the center of each shockmount.

i. Remove the green/yellow electrostatic discharge strap (51) from the disc module chassis.

CAUTION

The disc mechanism is not field serviceable.

j. Remove the disc mechanism.

k. From the shockmount bracket (53), remove the screw (54) which secures the cable tie (55).

l. Remove the three screws (49) which hold the disc mechanism bracket (48) to the side of the the disc mechanism. The bracket must be retained for installing the new disc mechanism.

To replace, reverse the procedure.

5-31. RECTIFIER DISASSEMBLY

WARNING

If any of the red or green LED'S on the top edge of the rectifier PCA are lit, a dangerous voltage still exists on the filter capacitors.

5-32. RECTIFIER PCA-A9

(7, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-25 for HP 7908R.)

d. Remove all plug connectors from the rectifer PCA-A9.

e. Remove the ten screws (8) which hold the rectifier PCA-A9 in place.

f. Remove the rectifier PCA-A9.

To replace, reverse the procedure.

5-33. FILTER CAPACITORS

(1, 4, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-25 for HP 7908R.)

d. Remove the two screws from the defective capacitor.

e. Remove the capacitor.

CAUTION

Check the polarity before installing the new capacitor.

To replace, reverse the procedure.

5-34. BRIDGE RECTIFIER DIODES

(23, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-25 for HP 7908R.)

d. Remove the quick connect plugs from the defective diode.

e. Remove the screw (24) which holds the diode to the power bracket (41).

CAUTION

Check the color code information (figure 4-15) before installing the wires.

Before installing a new rectifier diode, coat the metal side of the diode with thermal grease (part no. 6040-0239). Use just enough thermal grease to cover the metal plate on the diode.

5-35. INTERCONNECT PCA-A10

(35, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-25 for HP 7908R.)

d. Remove all plugs from the interconnect PCA-A10.

e. Remove the four screws (36) which hold the interconnect PCA-A10 in place.

To replace, reverse the procedure.

5-36. POWER SWITCH (17, figure 6-4)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the rectifier assembly. (Refer to paragraph 5-12 for HP 7908P; refer to paragraph 5-25 for HP 7908R.)

d. Remove the four wires from the switch.

e. Break off the switch mounting tabs on the old switch.

f. Remove the switch.

To replace, push the new switch into place and reconnect the four wires. (See color code information in figure 4-16.)

REPLACEABLE PARTS

SECTION VI

6-1. INTRODUCTION

This section provides a listing of all field-replaceable parts and an illustrated parts breakdown for the HP 7908, as well as replaceable part ordering information.

Replaceable parts for the HP 7908 are listed in order of disassembly in tables 6-1 through 6-4 and illustrated in figures 6-1 through 6-4. In each listing, attaching parts are listed immediately after the item they attach. Items in the DESCRIPTION column are indented to indicate relationship to the next higher assembly. In addition, the symbol "— — — x — — —" follows the last attaching part for that item. Identification of the items and the labels is as follows:

Major Assembly
*Replaceable Assembly
*Attaching Parts for Replaceable Assembly
**Subassembly or Component Part
**Attaching Parts for Subassembly or Component Part

The replaceable parts listing provides the following information for each part:

a. FIG. & INDEX NO. The figure and index number which indicates where the replaceable part is illustrated.

b. HP PART NO. The Hewlett-Packard part number for each replaceable part.

c. DESCRIPTION. The description of each replaceable part. Refer to table 6-5 for an explanation of abbreviations used in the DESCRIPTION column.

d. MFR CODE. The 5-digit code that denotes a typical manufacturer of a part. Refer to table 6-6 for a listing of manufacturers that corresponds to the codes.

e. MFR PART NO. The manufacturer's part number of each replaceable part.

f. UNITS PER ASSEMBLY. The total quantity of each part used in the major assembly.

g. The MFR CODE and MFR PART NO. for common hardware items are listed as 00000 and OBD (Order By Description), respectively, because these items can usually be purchased locally.

6-2. ORDERING INFORMATION

To order replaceable parts for the HP 7908, address the order to your local Hewlett-Packard Sales and Support Office. Sales and Support Offices are listed at the back of this manual. Specify the following information for each order:

a. Model and full serial number.

b. Hewlett-Packard part number.

c. Complete description for each part as provided in the replaceable parts listings.

Table 6-1. HP 7908P Disc/Tape Drive, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1-	7908P	DISC/TAPE DRIVE	28480	7908P	
1	07908-60034	*PANEL, lower front	28480	07908-60034	1
2	07908-60032	*PANEL, upper front (Standard)	28480	07908-60032	1
3	07908-60033	*FILLER PANEL, upper front (Option 140)	28480	07908-60033	REF
		(Attaching Parts)			
4	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	1
5	2190-0464	*WASHER, flat, no. 6	00000	OBD	1
6	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	1
		— — — x — — —			
7	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	2
8	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	2
9	07908-00047	*ELECTROSTATIC DISCHARGE SHIELD	28480	07908-00047	1
10	07908-60144	*CABLE, switch (W6)	28480	07908-60144	1
11	07908-60142	*SWITCH PCA-A8	28480	07908-60142	1
12	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	5
13	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	5
14	07908-00036	*BRACKET, right	28480	07908-00036	1
		(Attaching Parts)			
15	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	2
16	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	2
		— — — x — — —			
17	07908-00035	*BRACKET, left	28480	07908-00035	1
		(Attaching Parts)			
18	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	2
19	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	2
		— — — x — — —			
20	07908-60143	*CABLE, tape data (W5)	28480	07908-60143	1
21	07908-60145	*CABLE, tape power (W4)	28480	07908-60145	1
22	07908-60340	*TAPE MECHANISM	28480	07908-60340	1
23	8120-2371	*POWER CORD, 16 AWG	28480	8120-2371	1
	8120-1351	*POWER CORD, BS1363/CEE	28480	8120-1351	REF
	8120-1369	*POWER CORD, ASC112/CEE	28480	8120-1369	REF
	8120-1689	*POWER CORD, GMBH/CEE	28480	8120-1689	REF
	8120-1860	*POWER CORD, CEE/CEE	28480	8120-1860	REF
	8120-2104	*POWER CORD, SEV/CEE	28480	8120-2104	REF
	8120-2956	*POWER CORD, MDPP/CEE	28480	8120-2956	REF
24	8120-3446	*CABLE, HP-IB, 2 metre	28480	8120-3446	1
25	0515-0071	*SCREW, machine, pnh, pozi, M4-0.7, 16 mm long	00000	OBD	5
26	3050-0893	*WASHER, flat, M4	00000	OBD	5
27	07908-00034	*DOOR, rear	28480	07908-00034	1
28	07908-60030	*FLIP TOP	28480	07908-60030	1
		(Attaching Parts)			
29	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	4
		— — — x — — —			
30	07908-40004	*STORAGE BOX	28480	07908-40004	1
		(Attaching Parts)			
31	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	3
32	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	3
		— — — x — — —			
33	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	2
34	3050-0893	*WASHER, flat, M4	00000	OBD	2
35	2190-0586	*WASHER, lock, helical, M4	00000	OBD	2
36	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 8 mm long	00000	OBD	2
37	3050-0893	*WASHER, flat, M4	00000	OBD	2
38	2190-0586	*WASHER, lock, helical, M4	00000	OBD	2
39	07908-00032	*GUARD PANEL	28480	07908-00032	1
		(Attaching Parts)			
40	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	1
		— — — x — — —			
41	No Number	*DISC MODULE (See figure 6-3)	28480	No Number	1

Table 6-1. HP 7908P Disc/Tape Drive, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1-					
42	07908-00025	*BRACKET, support	28480	07908-00025	1
		(Attaching Parts)			
43	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	2
44	3050-0893	*WASHER, flat, M4	00000	OBD	2
45	2190-0586	*WASHER, lock, helical, M4	00000	OBD	2
		— — — x — — —			
46	07908-60031	*BASE ASSEMBLY	28480	07908-60031	1
47	1390-0036	**STUD RETAINER	28480	1390-0036	5
		(Attaching Parts)			
48	2200-0598	**SCREW, machine, pnh, T9, 4-40, 0.25 in. long	00000	OBD	2
49	2260-0001	**NUT, hex, 4-40	00000	OBD	2
50	2190-0411	**WASHER, no. 4, lock, ext-tooth	00000	OBD	2
		— — — x — — —			
51	0403-0412	**LEVELING PAD	28480	0403-0412	4
52	1492-0083	**CASTER	28480	1492-0083	4
		ACCESSORIES (not shown on figure 6-1)			
	9164-0156	*TAPE CARTRIDGE, 150-foot	28480	9164-0156	1
	8500-3440	*CLEANING FLUID	28480	8500-3440	1
	9300-0767	*CLEANING SWABS	28480	9300-0767	1
	07908-90901	*HP 7908 OPERATOR INSTRUCTIONS MANUAL	28480	07908-90901	1
	07908-90902	*HP 7908 OPERATING AND INSTALLATION MANUAL	28480	07908-90901	1
	5955-3456	*SITE ENVIRONMENTAL REQUIREMENTS MANUAL	28480	5955-3456	1

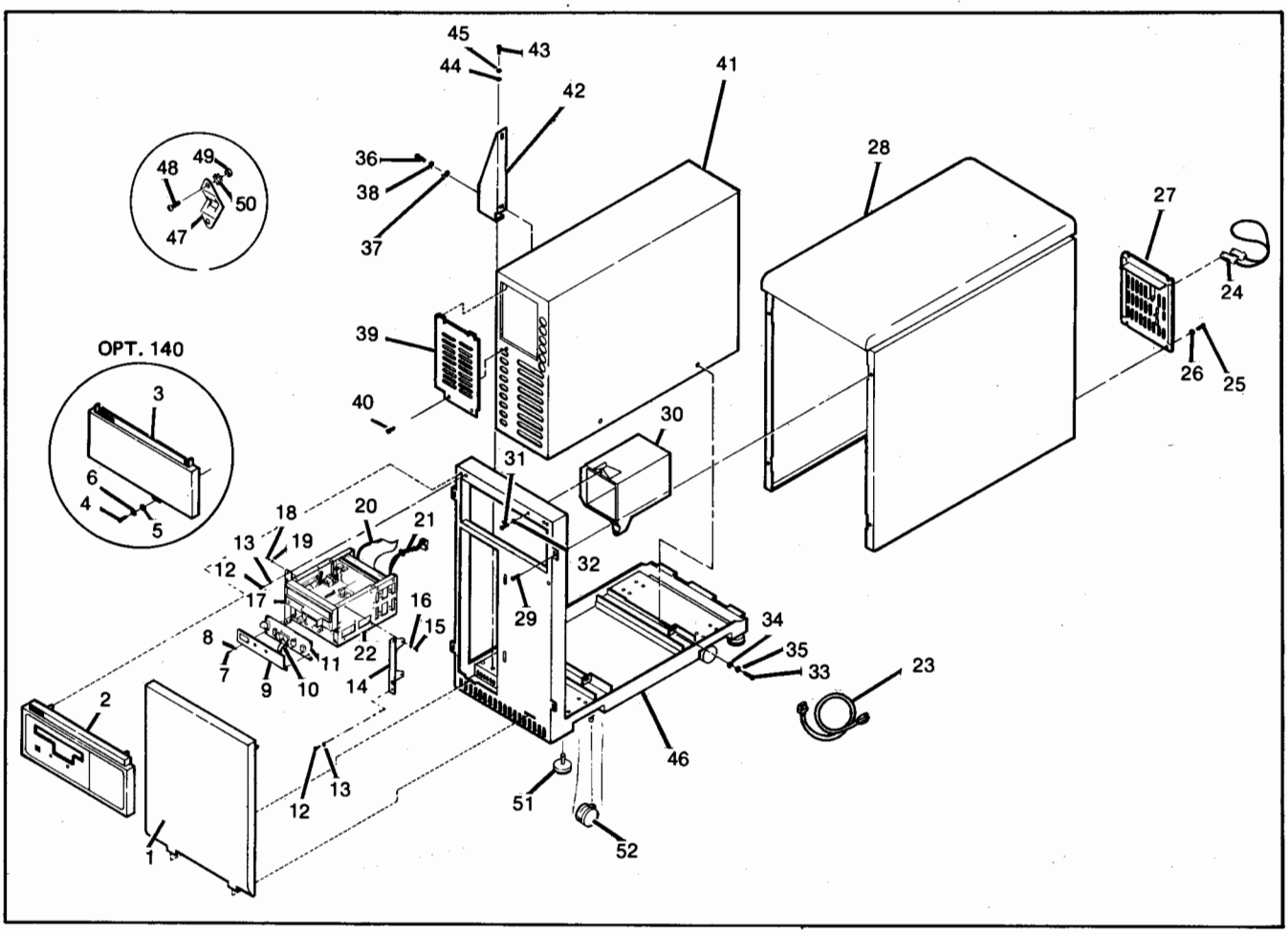

Figure 6-1. HP 7908P Disc/Tape Drive, Exploded View

Table 6-2. HP 7908R Disc/Tape Drive, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-2-	7908R	DISC/TAPE DRIVE	28480	7908R	
1	07908-60016	*PANEL, front (Standard)	28480	07908-60016	1
1A	07908-00039	**LABEL, for front panel (not shown)	28480	07908-00039	1
2	07908-60028	*FILLER PANEL, front (Option 140)	28480	07908-60028	REF
3	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	2
4	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	2
5	07908-00047	*ELECTROSTATIC DISCHARGE SHIELD	28480	07908-00047	1
6	07908-60144	*CABLE, switch (W6)	28480	07908-60144	1
7	07908-60142	*SWITCH PCA-A8	28480	07908-60142	1
8	07908-60143	*CABLE, tape data (W5)	28480	07908-60143	1
9	07908-60145	*CABLE, tape power (W4)	28480	07908-60145	1
10	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	3
11	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	3
12	07908-60340	*TAPE MECHANISM	28480	07908-60340	1
13	8120-1378	*POWER CORD, NEMA5/CEE	28480	8120-1378	1
	8120-1351	*POWER CORD, BS1363/CEE	28480	8120-1351	REF
	8120-1369	*POWER CORD, ASC112/CEE	28480	8120-1369	REF
	8120-1689	*POWER CORD, GMBH/CEE	28480	8120-1689	REF
	8120-1860	*POWER CORD, CEE/CEE	28480	8120-1860	REF
	8120-2104	*POWER CORD, SEV/CEE	28480	8120-2104	REF
	8120-2956	*POWER CORD, MDPP/CEE	28480	8120-2956	REF
14	8120-3446	*CABLE, HP-IB, 2 metre	28480	8120-3446	1
15	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	5
16	3050-0893	*WASHER, flat, M4	00000	OBD	5
17	07908-00019	*GRILLE, rear	28480	07908-00019	1
18	07908-00032	*GUARD PANEL (Option 140)	28480	07908-00032	1
		(Attaching Parts)			
19	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	2
		— — — x — — —			
20	07908-00023	*RACKMOUNT EAR	28480	07908-00023	2
		(Attaching Parts)			
21	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	3
22	3050-0893	*WASHER, flat, M4	00000	OBD	3
		— — — x — — —			
23	No Number	*DISC MODULE (See figure 6-3)	28480	No Number	1
24	1390-0036	**STUD RETAINER	28480	1390-0036	3
		(Attaching Parts)			
25	2200-0598	**SCREW, machine, pnh, T9, 4-40, 0.25 in. long	00000	OBD	2
26	2260-0001	**NUT, hex, 4-40	00000	OBD	2
27	2190-0411	**WASHER, no. 4, lock, ext-tooth	00000	OBD	2
		— — — x — — —			
		ACCESSORIES (not shown on figure 6-2)			
	9164-0156	*TAPE CARTRIDGE, 150-foot	28480	9164-0156	1
	8500-3440	*CLEANING FLUID	28480	8500-3440	1
	9300-0767	*CLEANING SWABS	28480	9300-0767	1
	07908-90901	*HP 7908 OPERATOR INSTRUCTIONS MANUAL	28480	07908-90901	1
	07908-90902	*HP 7908 OPERATING AND INSTALLATION MANUAL	28480	07908-90902	1
	5955-3456	*SITE ENVIRONMENTAL REQUIREMENTS MANUAL	28480	5955-3456	1

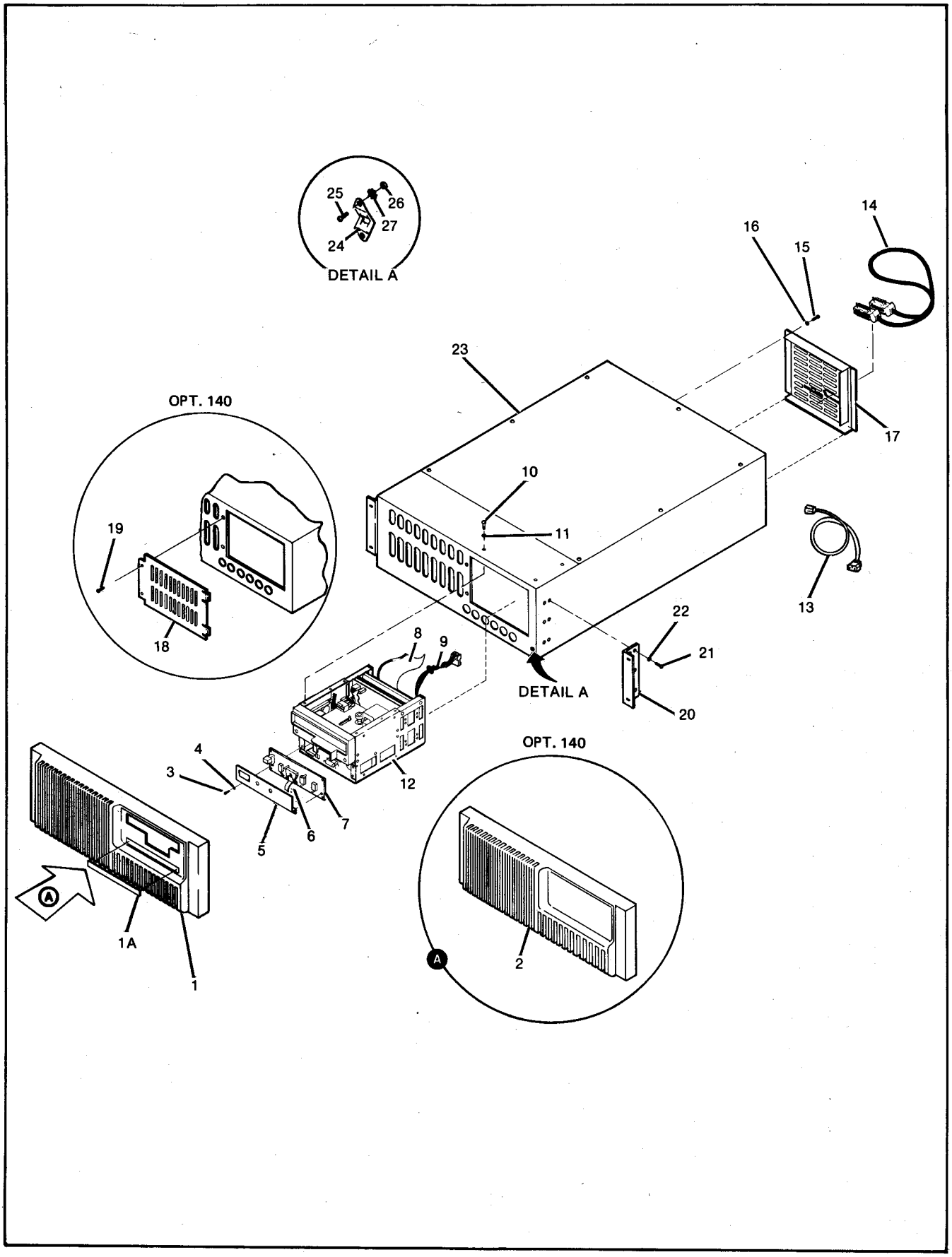

Figure 6-2. HP 7908R Disc/Tape Drive, Exploded View

Table 6-3. Disc Module, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-	No Number	DISC MODULE (41, figure 6-1; 23, figure 6-2)	28480	No Number	
1	07908-60007	*REGULATOR PCA-A1	28480	07908-60007	1
2	07908-60006	*SERVO PCA-A2	28480	07908-60006	1
3	07908-60205	*READ/WRITE PCA-A3	28480	07908-60205	1
4	07908-60009	*DISC MEMORY ACCESS PCA-A4	28480	07908-60009	1
5	07908-60002	*MICROPROCESSOR PCA-A5	28480	07908-60002	1
	07908-11007	**EPROM KIT FOR MPU (not shown)	28480	07908-11007	1
6	07908-60241	*TAPE INTERFACE BOARD PCA-A6	28480	07908-60241	1
7	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	1
8	T-18532	*CAP SCREW, 1/4 x 20, 3.0 in. long	00000	OBD	2
9	2190-0859	*WASHER, flat, 1/4 in.	00000	OBD	2
10	2190-0740	*WASHER, lock, helical, 1/4 in.	00000	OBD	2
11	No Number	*RECTIFIER ASSEMBLY (See figure 6-4)	28480	No Number	1
12	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	7
13	07908-00022	*TOP COVER	28480	07908-00022	1
14	2360-0193	*SCREW, machine, pnh, pozi, 6-32, 0.250 in. long	00000	OBD	1
15	2190-0468	*WASHER, lock, intl-tooth, no. 6	00000	OBD	1
16	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	1
17	2190-0321	*WASHER, lock, intl-tooth, M4	00000	OBD	1
18	07908-60025	*GROUND WIRE	28480	07908-60025	1
19	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	1
20	2190-0321	*WASHER, lock, intl-tooth, M4	00000	OBD	1
21	07908-60010	*CARD CAGE ASSEMBLY	28480	07908-60010	1
		(Attaching Parts)			
22	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	2
23	2190-0586	*WASHER, lock, helical, M4	00000	OBD	2
		— — — x — — —			
24	3160-0341	**FAN, 115 Vac	28875	BS2107F-510H	1
		(Attaching Parts)			
25	2360-0137	**SCREW, machine, pnh, pozi, 6-32, 1.75 in. long	00000	OBD	4
26	2190-0464	**WASHER, flat, no. 6	00000	OBD	4
27	2190-0851	**WASHER, lock, helical, no. 6	00000	OBD	4
28	0380-0912	**SPACER, 0.72 in. long	28480	0380-0912	4
		— — — x — — —			
29	2360-0197	**SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	4
30	2190-0464	**WASHER, flat, no. 6	00000	OBD	4
31	2190-0851	**WASHER, lock, helical, no. 6	00000	OBD	4
32	07908-60004	**MOTHER PCA-A7	28480	07908-60004	1
33	07908-00021	**CHASSIS, fan mounting	28480	07908-00021	1
34	0400-0062	**GROMMET	51533	8069	2
35	1251-7263	*COVER, cable	28480	1251-7263	1
36	07908-60024	*CABLE, rectifier-regulator (W1)	28480	07908-60024	1
37	07908-60020	*CABLE, servo-read/write (W3)	28480	07908-60020	1
38	0515-0070	*SCREW, machine, pnh, pozi, M4-0.7, 6 mm long	00000	OBD	1
39	2190-0321	*WASHER, lock, intl-tooth, M4	00000	OBD	1
40	0515-0072	*SCREW, machine, pnh, pozi, M4-0.7, 25 mm long	00000	OBD	1
41	3050-0893	*WASHER, flat, M4	00000	OBD	1
42	2190-0586	*WASHER, lock, helical, M4	00000	OBD	1
43	07908-20001	*BUSHING	28480	07908-20001	1
44	2360-0209	*SCREW, machine, pnh, pozi, 6-32, 1.00 in. long	00000	OBD	2
45	2190-0464	*WASHER, flat, no. 6	00000	OBD	2
46	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	2
47	07908-20001	*BUSHING	28480	07908-20001	2
48	07908-00018	*BRACKET, disc mechanism	28480	07908-00018	1
		(Attaching Parts)			
49	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	3
50	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	3
		— — — x — — —			
51	07908-60023	*ELECTROSTATIC DISCHARGE STRAP	28480	07908-60023	1
52	07908-60100	*DISC MECHANISM (in transit case)	28480	07908-60100	1
52A	07908-60104	**BOTTOM PLATE KIT	28480	07908-60104	1

Table 6-3. Disc Module, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-					
53	1520-0217	*SHOCKMOUNT, bracket (blue dot)	17569	7821-3A	1
		(Attaching Parts)			
54	2360-0203	*SCREW, machine, pnh, pozi, 6-32, 0.625 in. long	00000	OBD	1
55	1400-0719	*CABLE TIE	56501	TY-34M-8	1
56	3050-0407	*WASHER, flat, no. 6	00000	OBD	1
57	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	1
58	2360-0201	*SCREW, machine, pnh, pozi, 6-32, 0.5 in. long	00000	OBD	1
59	3050-0407	*WASHER, flat, no. 6	00000	OBD	1
60	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	1
		— — — x — — —			
61	1520-0216	*SHOCKMOUNT, chassis (orange dot)	17569	7821-1A	2
		(Attaching Parts)			
62	2360-0201	*SCREW, machine, pnh, pozi, 6-32, 0.5 in. long	00000	OBD	2
63	3050-0407	*WASHER, flat, no. 6	00000	OBD	2
64	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	2
65	2420-0002	*NUT, 6-32	00000	OBD	2
		— — — x — — —			
66	0590-1338	*CLIP NUT	17875	C521-1420-4	2
67	07908-00012	*CHASSIS, disc module	28480	07908-00012	1

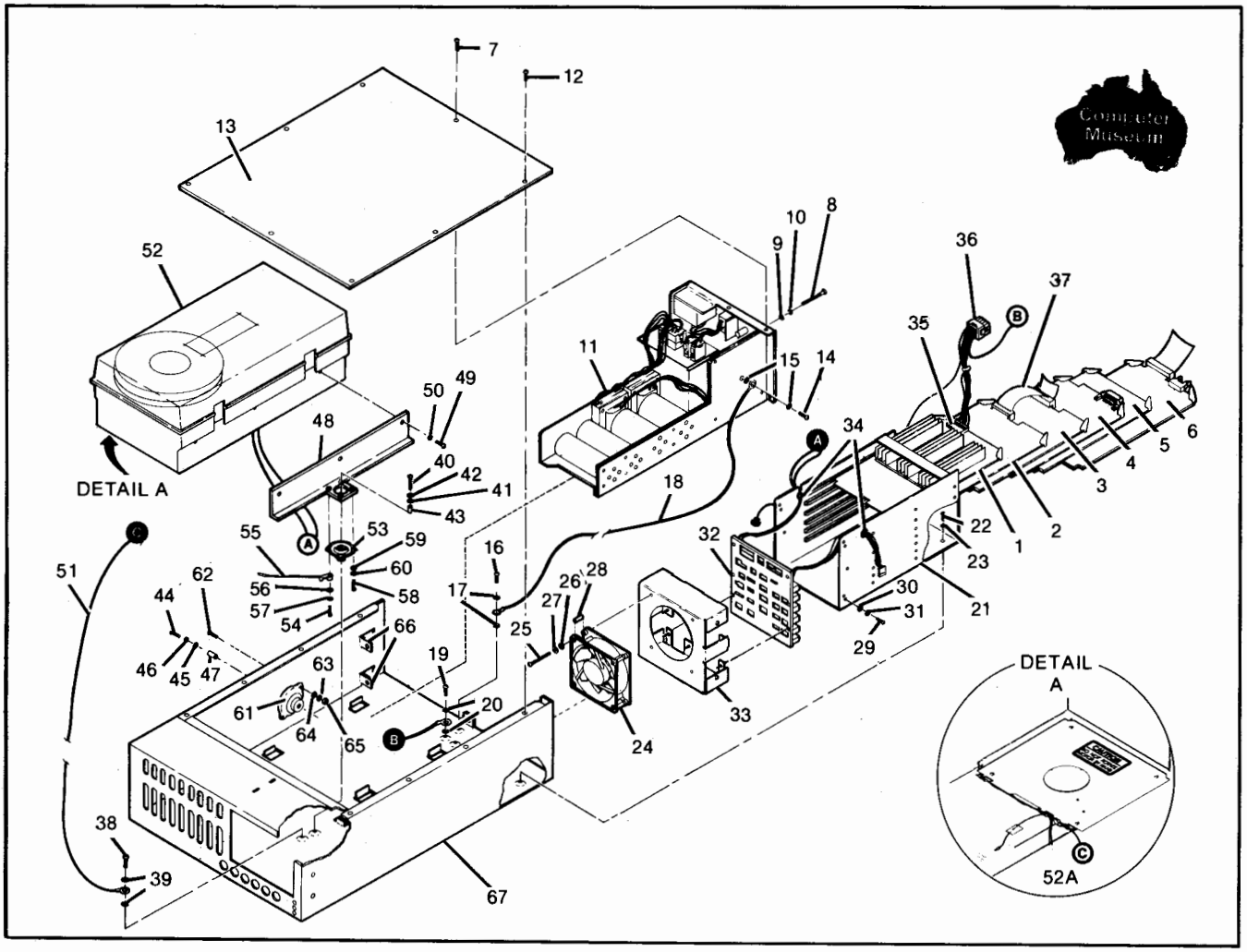

Figure 6-3. Disc Module, Exploded View

Table 6-4. Rectifier Assembly, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-4-	No Number	RECTIFIER ASSEMBLY (11, figure 6-3)	28480	No Number	REF
1	0180-3095	*CAPACITOR, 27,000 μF, 30 Vdc rating	00853	500R273U030BF2A	2
		(Attaching Parts)			
2	2680-0099	*SCREW, machine, pnh, pozi, 10-32, 0.375 in. long	00000	OBD	2
3	2190-0074	*WASHER, lock, helical, no. 10	00000	OBD	2
		— — — x — — —			
4	0180-3096	*CAPACITOR, 58,000 μF, 15 Vdc rating	00853	500R583U015CC2A	2
		(Attaching Parts)			
5	2680-0099	*SCREW, machine, pnh, pozi, 10-32, 0.375 in. long	00000	OBD	2
6	2190-0074	*WASHER, lock, helical, no. 10	00000	OBD	2
		— — — x — — —			
7	07908-60013	*RECTIFIER PCA-A9	28480	07908-60013	1
		(Attaching Parts)			
8	2360-0197	*SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	10
9	2190-0851	*WASHER, lock, helical, no. 6	00000	OBD	10
		— — — x — — —			
10	2110-0048	**FUSE, 15 Amp, 32V rating (F291)	75915	311015	1
11	2110-0523	**FUSE, 10 Amp, 32V rating (F195, F290)	75915	311010	2
12	2110-0001	**FUSE, 1 Amp, 250V rating (F194, F255)	75915	312001	2
	07908-60018	*TRANSFORMER ASSEMBLY	28480	07908-60018	1
13	2110-0565	**CAP, fuseholder	06328	031.1666	1
14	2110-0342	**FUSE, main, 8 Amp, 250V rating	75915	314008	1
	2110-0055	**FUSE, main, 4 Amp, 250V rating (Option 015)	75915	312004	REF
15	2110-0566	**FUSEHOLDER	06328	031.1677	1
		(Attaching Parts)			
16	2110-0569	**NUT	06328	583.0016	1
		— — — x — — —			
17	3101-2399	**SWITCH, power	81716	566214180	1
18	9135-0107	**FILTER, line	23880	F14281	1
		(Attaching Parts)			
19	2360-0197	**SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	2
20	2190-0468	**WASHER, lock, intl-tooth, no. 6	00000	OBD	4
21	2420-0002	**NUT, hex, 6-32	00000	OBD	2
		— — — x — — —			
22	07908-60050	**CABLE, diode (W2)	28480	07908-60050	1
23	1906-0205	**BRIDGE RECTIFIER DIODE	53562	VK248	2
		(Attaching Parts)			
24	2360-0201	**SCREW, machine, pnh, pozi, 6-32, 0.5 in. long	00000	OBD	1
25	2190-0851	**WASHER, lock, helical, no. 6	00000	OBD	1
		— — — x — — —			
26	1400-0719	**CABLE TIE CLIP, inductor wires	56501	TY-34M-8	1
		(Attaching Parts)			
27	2360-0197	**SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	1
28	2190-0464	**WASHER, flat, no. 6	00000	OBD	1
29	2190-0851	**WASHER, lock, helical, no. 6	00000	OBD	1
		— — — x — — —			
30	2360-0197	**SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	1
31	2190-0468	**WASHER, lock, intl-tooth, no. 6	00000	OBD	2
32	2420-0002	**NUT, hex, 6-32	00000	OBD	1
33	07908-60029	**CABLE, interconnect (W7)	28480	07908-60029	1
34	07908-60026	**VOLTAGE SELECT PLUG, 100/110/120 Vac	28480	07908-60026	1
	07908-60027	**VOLTAGE SELECT PLUG, 208/220/240 Vac (Option 015)	28480	07908-60027	REF
35	07908-60012	**INTERCONNECT PCA-A10	28480	07908-60012	1
		(Attaching Parts)			
36	2360-0197	**SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	4
37	2190-0851	**WASHER, lock, helical, no. 6	00000	OBD	4
		— — — x — — —			
38	T-18532	**CAP SCREW, 1/4 x 20, 3.0 in. long	00000	OBD	2
39	2190-0859	**WASHER, flat, 1/4 in.	00000	OBD	2
40	2190-0740	**WASHER, lock, helical, 1/4 in.	00000	OBD	2

Table 6-4. Rectifier Assembly, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-4-					
41	07908-00015	**BRACKET, power	28480	07908-00015	1
42	No Number	**TRANSFORMER (T1)(Order HP part no. 07908-60018)		NSR	1
43	2360-0197	**SCREW, machine, pnh, pozi, 6-32, 0.375 in. long	00000	OBD	2
44	2190-0468	**WASHER, lock, intl-tooth, no. 6	00000	OBD	4
45	No Number	**INDUCTOR, saturable (L1, L2)(Order HP part no. 07908-60018)		NSR	2
		(Attaching Parts)			
46	2680-0069	**SCREW, machine, pnh, pozi, 10-32, 1.5 in. long	00000	OBD	4
47	2190-0402	**WASHER, flat, no. 10	00000	OBD	4
48	2190-0074	**WASHER, lock, helical, no. 10	00000	OBD	4
49	2740-0002	**NUT, hex, 10-32	00000	OBD	4
		— — — x — — —			
50	No Number	**RECTIFIER ASSEMBLY CHASSIS	28480	No Number	1

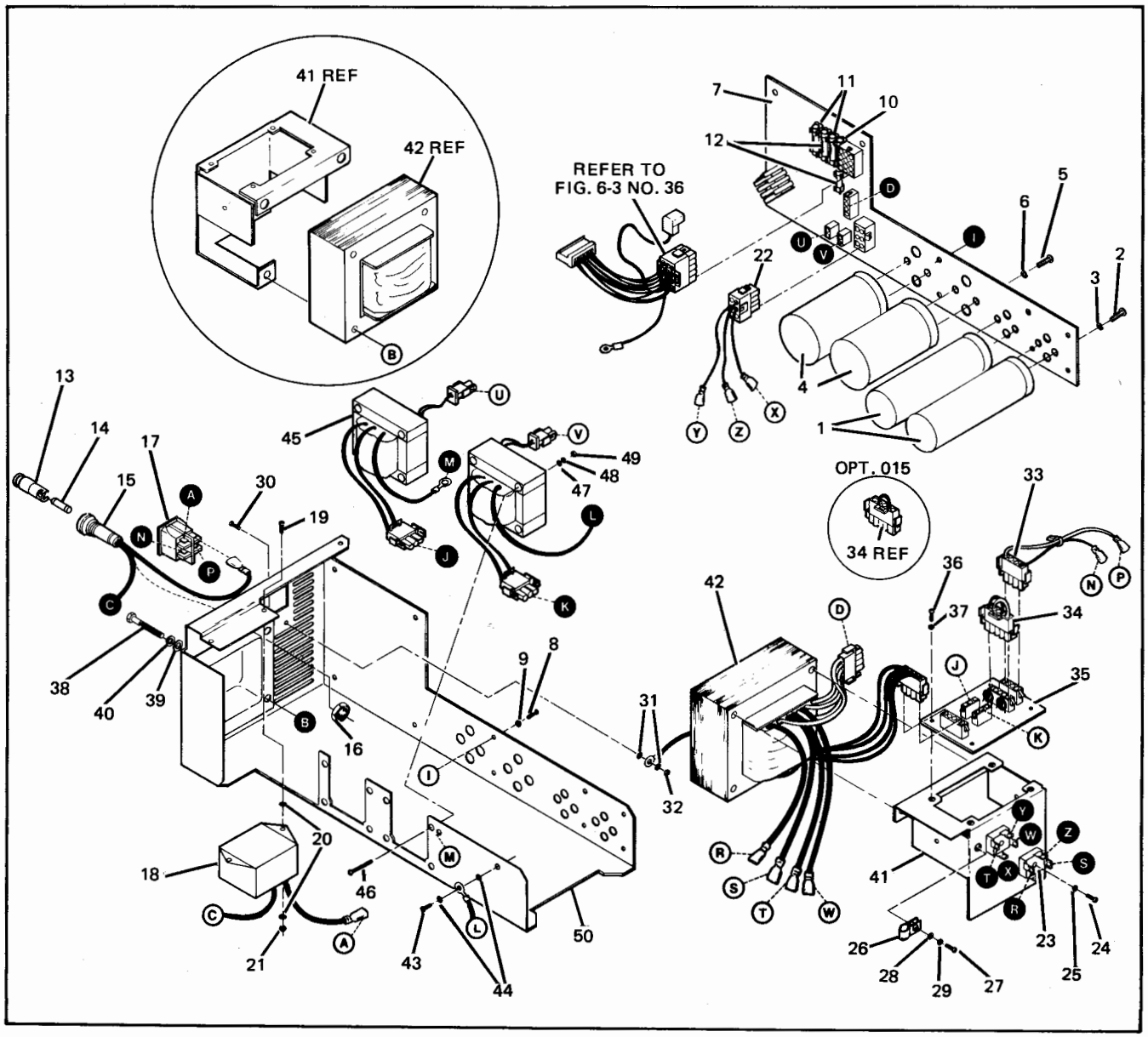

Figure 6-4. Rectifier Assembly, Exploded View

Table 6-5. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly	J = jack, receptacle connector	T = transformer
B = blower, fan, motor, synchro	K = relay	TB = terminal board
C = capacitor	L = inductor	TP = test point
CB = circuit breaker	M = meter	U = integrated circuit, non-repairable assembly
CR = diode	MP = mechanical part	
DS = indicator lamp	P = plug connector	VR = voltage retulator
E = contact, miscellaneous electrical part	Q = semiconductor device other than diode or integrated circuit	W = cable assembly (with connectors), wire
F = fuse	R = resistor	X = socket
FL = filter	RT = thermistor	Y = crystal unit
H = hardware	S = switch	Z = network, tuned circuit

ABBREVIATIONS

A = ampere(s)	ID = inside diameter	qty = quantity
ac = alternating current	in. = inch, inches	
AR = as required	incand = incandescent	rdh = round head
assy = assembly	incl = include(s)	rect = rectifier
	intl = internal	ref = reference
brkt = bracket	I/O = input/output	rf = radio frequency
		rfi = radio frequency interference
c = centi(10^{-2})	k = kilo (10^{3}), kilohm	rh = right hand
C = Celsius, centigrade	kg = kilogram	rpm = revolutions per minute
cer = ceramic		rwv = reverse working voltage
cm = centimetre	lb = pound	
comp = composition	LED = light-emitting diode	
conn = connector	lh = left hand	sb = slow blow
		SCR = semiconductor-controlled rectifier
d = deci(10^{-1})	M = mega (10^{6}), megohm	
dc = direct current	m = milli (10^{-3})	scw = square cone washer
deg = degree(s)	mach = machine	Se = selenium
dia = diameter	mb = medium blow	Si = silicon
dpdt = double-pole, double-throw	met oxd = metal oxide	slftpg = self-tapping
dpst = double-pole, single-throw	mfr = manufacturer	spdt = single-pole, double throw
	misc = miscellaneous	spst = single-pole, single throw
elctlt = electrolytic	mm = millimetre	sst = stainless steel
encap = encapsulated	mtg = mounting	stl = steel
ext = external	My = Mylar	sw = switch
	n = nano (10^{-9})	
F = Fahrenheit, farad	n.c. = normally closed	T = TORX® screw
fb = fast blow	no. = number	Ta = tantalum
fh = flat head	n.o. = normally open	tgl = toggle
fig. = figure	NSR = not separately replaceable	thd = thread
filh = fillister head	ntd = no time delay	Ti = titanium
flm = film		tol = tolerance
fw = full wave	OBD = order by description	
fxd = fixed	OD = outside diameter	U (μ) = micro (10^{-6})
	ovh = oval head	
G = giga(10^{9})	oxd = oxide	V = volt(s)
Ge = germanium		var = variable
	p = pico (10^{-12})	Vdcw = direct current working volts
H = henry, henries	PCA = printed-circuit assembly	
hd = head	phh = phillips head	W = watt(s)
hex = hexagon, hexagonal	pnh = pan head	w/ = with
hlcl = helical	P/O = part of	WIV = inverse working volts
Hz = Hertz	pot = potentiometer	ww = wire-wound
	pozi = Pozidriv	

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5/83

Table 6-6. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS
00853	Sangamo Elec. Co.	Pickens, SC	28480	Hewlett-Packard Co.	Palo Alto, CA
02768	Illinois Tool Works, Inc.	Des Plaines, IL	28875	IMC Magnetics Corp.	Rochester, NH
06328	Schurter Agh.	Luzern, Switz.	51533	Fluorocarbon Co.	Sunnyvale, CA
06915	Richco Plastic Co.	Chicago, IL	53562	Varo Semiconductor Corp.	Garland, TX
17569	Barry Wright Corp.	Watertown, MA	56501	Thomas and Betts Co.	Elizabeth, NJ
17875	Eaton Corp.	Cleveland, OH	75915	Littelfuse, Inc.	Des Plaines, IL
23880	Stanford Applied Eng. Co.	Santa Clara, CA	81716	Oak Ind., Inc.	Crystal Lake, IL

APPENDIX B
SERVICE NOTES

CONTENTS

7908-01A	Disc Backup Tape Cartridges	B-3
7908P/R-02A	MPU Firmware Update	B-5
7908P/R-03	Cartridge Tape Read or Certify Errors	B-7
7908P/R-04	Special TIB PCA Update	B-9
7908P/R-05	Disc Write Faults	B-11
7908P/R-06	Strain Relief of Disc Mechanism Grounding Cable	B-13
7908P/R-07	Noisy Disc Mechanism	B-15
7908P/R-08	Destructive Write Faults (DWF-L)	B-17
7908P/R-09	MPU Mandatory Firmware Update	B-19
7908P/R-10	Tape Mechanism Failures	B-21
7908P/R-11	Spindle Ground Strap Removal	B-25
7908P/R-12	Fan Grounding Update	B-27

7908-01 A
7911-01 A
7912-01 A

SERVICE NOTE

Supersedes: 7908-01, 7911-01
7912-01

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐ On Failure	At PM/Normal Call ☐ Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:		X	
PARTS:		X	
TRAVEL:		X	

SERVICE INVENTORY	Return for update ☐ Return for salvage ☐	Use as is ☐ See text ☒

WARRANTY EXTENDED UNTIL:

MODELS AFFECTED: 88140S, 88140L

DATE CODES INVOLVED: 2XX41-XXXX
through 2XX49-XXXX
(88140S)

5XX41-XXXX
through 5XX48-XXXX
(88140L)

7908/11/12 DISC BACKUP TAPE CARTRIDGES

SYMPTOMS: The most noticable symptoms are:

1. Tape fails initialization with a "unit fault" or an "uninitialized media status."
2. Initialization takes much longer than normal.*
3. There are a high number of spares used during initialization.*
4. Heads have vertical brown streak (oxide debris) in the white portion of the head.

CAUSE: Some tapes produced in November and December of 1981 are dirty and have a tendency to clog heads faster than normal. In most cases, the tapes are usable, but do require head cleaning more often for the first two or three times they are used. Remember writing tapes with a dirty head will cause data to be written with a high data error rate.

ACTION: The tape should be usable if the following is done:

1. CLEAN the heads!
2. Re-Certify the tape.
3. Read the ERT LOG and the Spare Table.

4. If the number of errors or spares is less than the table below shows, then the tape will be usable under standard usage.

* Table of values for misc tape drive characteristics on following page:

BF/sg

(continued on reverse)

12/81-48

HEWLETT PACKARD

	88140S	88140L
Number of Permanent error on one pass of certify or error rate test. (worst case)	64	256
Number of Transient errors after one pass of certify or error rate test. (worst case)	128	512
Number of spares used. (worst case)	5	20
Number of spares available.	32	128
Time to initialize	18 min	64 min

(2 of 2)

7908P/R-02A

SERVICE NOTE

Supersedes: 7908P/R-02

7908P/R Disc/Tape Drive

All Units With Serial Number Prefix 2205A and Below

Mandatory MPU Firmware Update

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call X
	On Failure ☐		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	. 3 hrs		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update X		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '83		

SYMPTOM: Mandatory next site visit update of MPU firmware in all 7908P/R disc drives with a serial number prefix of 2205A and below.

CAUSE: The latest revision MPU firmware contains fixes for many low level bugs. In addition to these fixes, the new TIB PCA (07908-6X241) requires updated firmware (see service note 7908P/R-03). A mandatory update is being implemented because of the wide number of symptoms. No single symptom, however, requires a mandatory update.

SOLUTION: On the next visit to the customer's site the CE should update the MPU firmware by installing a 07908-19006 Exchange EPROM Kit. The revision level of MPU firmware can be checked by noting the last two digits of the individual EPROM's part numbers. The 07908-19006 level MPU firmware will have the following numbers (EPROMs with lower part numbers represent old revision firmware):

U241 - 57
U261 - 58
U271 - 59
U291 - 60
U2101 - 61
U121 - 62

Note: These EPROM's are not individually replaceable. The EPROM kit (which includes all six EPROMS) must always be ordered.

MA/sg

(continued)

4/82-48

HEWLETT PACKARD

The MPU EPROM Kit is now supplied through the Corporate Parts Center's (CPC, or Div. 15) Blue Stripe Exchange program. The Exchange EPROM Kit part number is 07908-19006. Defective exchange kits should be returned to CPC/PCE (Div. 15) and NOT to CSD (Div. 50). All service kits must be updated with the 07908-19006 revision firmware.

Note: As prevously stated, the 07908-69241 TIB PCA requires 07908-19006 revision MPU firmware. However, the old revision TIB PCA (07908-69141) will work correctly with the new revision firmware. It not necessary to update the TIB PCA when new firmware is installed.

DMD will accept extended warranty (02G) as follows:

Parts - 07908-19006 Exchange EPROM Kit. DMD will not accept warranty billings for new EPROM kits (07908-10006). Only the exchange kit will be accepted.

Labor - .3 hours

Travel - None - update should be done during the CE's next site visit.

****
* NOTE: When completing the Customer Support Order (CSO) form *
* the service code block should be filled in with: "0002" *
* This code will allow DMD to monitor the implementation *
* of this service note and prevent rejection of warranty *
* billing. *
****

7908P/R-03

SERVICE NOTE

Supersedes:

7908P/R Disc/Tape Drive

All Units With Serial Number Prefix 2205A and Below

Cartridge Tape Read or Certify Errors

APPLIES TO:	All Units X	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure X	Information Only ☐

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	.7		
PARTS:	X		
TRAVEL:	X		

SERVICE INVENTORY	Return for update X	Use as is ☐
	Return for salvage ☐	See text ☐

WARRANTY EXTENDED UNTIL: 15 April '83

SYMPTOM: Falsely reported uncorrectable tape data errors may occur during a tape read, initialize, or certify. In some cases an uncorrectable tape data error will be followed by an unlocatable block. Although the error is not uncorrectable, the tape subsystem will report it as such.

CAUSE: Tape media defects (dropouts) are normally corrected by the drive's error correction circuitry (ECC). If the ECC cannot correct the error caused by a dropout the defective block will be spared during the tape certify. However, marginal areas on the tape are not always identified by the certify operation. When a read was attempted in an area with a defect, the block would be seen as uncorrectable. Recovery from the error would not occur until well into the next block, rendering that block unlocatable. If the error was detected during normal operation, the location will be in the RUN LOG.

MA/sg (continued) 3/82-48

HEWLETT PACKARD

The Tape Interface Board (TIB) and the Microprocessor PCA's firmware (MPU EPROM Kit) have been modified to prevent the false detection of uncorrectable data. In most cases these modifications will allow recovery of previously written customer data.

SOLUTION: When an uncorrectable tape read error occurs, the CE must update the following assembly:

Tape Interface Board (TIB)
****07908-69241****

The 07908-69241 replaces the 07908-69141. All 07908-69141 TIB PCA's currently in field service inventory (FSI) must be returned to CSD for update.

Important Note:
The 07908-69241 TIB PCA requires the drive to have 07908-19006 (or above) revision MPU firmware. The MPU firmware update is being implemented on all drives with a serial number prefix of 2205A and below. Refer to service note 7908P/R-02 (Mandatory MPU Firmware Update) for details on identifying updated firmware.

DMD will accept warranty as follows:

Parts - 07908-69241 exchange TIB PCA

Labor - .7 hours

Travel - Yes

This service note should be implemented only on failure.

****
* NOTE: When completing the Customer Support Order (CSO) form *
* the service code block should be filled in with: "0003" *
* This code will allow DMD to monitor the implementation *
* of this service note and prevent rejection of warranty *
* billing. *
****

7908P/R-04

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure X		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	.7 hrs.		
PARTS:	X		
TRAVEL:	X		
SERVICE	Return for update X		Use as is ☐
INVENTORY	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '83		

7908P/R Disc/Tape Drive

Special TIB PCA Update

Drive Serial Numbers:
7908P - 2206A00716 through 2208A00901
7908R - 2207A00187 through 2208A00211

Parts Affected: 07908-60241
date code E-2206 only.

SYMPTOMS: 1. Test errors C0 (destructive write fault on fault latch) or DA (cannot read spares table on maintenance tracks) may occur during a tape rate test or certify.

2. Test error 28 (TIB to DMA write path error) incorrectly reported by self-test.

3. When performing a tape read, the TIB state machine may jump into an infinite loop and cause a time-out to be returned.

CAUSE: The symptoms described above were created on the first implementation of the 7908-60241 TIB PCA (date code E-2206). None of these symptoms occur on the 07908-60141 TIB. Because this design error was discovered soon after the 07908-60241 was introduced to production, only approximately 200 7908P/R disc drives are affected by this service note. It is estimated that less than 10% of these 200 drives will show the symptoms described above.

MA/sg (continued) 3/82-48

HEWLETT PACKARD

SOLUTION: The part number of the TIB PCA will remain 07908-69241. The previously described changes will be indicated by a TIB date code of E-2210. All field service inventory will be updated to date code E-2210.

Should one of the symptoms described above occur and the drive serial number prefix is 2206A through 2208A, the CE should replace the TIB PCA. This service note should be implemented only on failure.

DMD will accept extended warranty (02G) as follows:

Parts: 07908-69241

Labor: .7 hours

Travel: Yes

Important Note:
None of the three sytmptoms described in this service note apply to the 07908-69141 TIB PCA. Refer to service note 7908P/R-03 for information on the 69141 revision TIB.

```
**********************************************************************
* NOTE: When completing the Customer Support Order (CSO) form       *
*       the service code block should be filled in with: "0004"      *
*       This code will allow DMD to monitor the implementation       *
*       of this service note and prevent rejection of warranty       *
*       billing.                                                     *
**********************************************************************
```

7908P/R-05

SERVICE NOTE

Supersedes: None

7908P/R Disc/Tape Drive

All Units With Serial Number Prefix 2208A and Below

Disc Write Faults

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	0.5 hr.		
PARTS:	Yes		
TRAVEL:	See text		
SERVICE INVENTORY	Return for update ☒		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	15 May '83		

SYMPTOM: The following two symptoms may intermittently occur on 7908P/R disc drives with serial number prefixes of 2208A and below:

1. An off track condition may go undetected during a write which will result in errors when the data is read back.

2. A Destructive Write Fault - Low (DWF-L) may be falsly detected. A DWF-L fault will be logged in the fault log and will be seen as a DERROR=64 with the microprocessor fault register= 00000001.

CAUSE: For Symptom 1:
A race condition on the R/W PCA prevents the Write Off Track-Low (WOT-L) latch from being properly set. The WOT-L latch is normally set when an off-track is detected during a write operation.

For Symptom 2:
When performing a write the drive will always verify the sector previous to where the write will begin. However, the current R/W board does not allow sufficient settling time before beginning this verify. This may result in a DWF-L unit fault.

SOLUTION: Modifications to correct the above symptoms are incorporated on a new R/W PCA. To reflect these modifications, the part number of the R/W PCA will be changed from 07908-6X005 to 07908-6X105.

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HEWLETT PACKARD

Because the two symptoms described above occur as a result of subtle timing errors, it is unlikely that either symptom will occur on affected drive in their current configuration. However, should the Disc Mechanism (07908-69100) or the Servo PCA (07908-69006) require replacement, the chance of an error greatly increases. Therefore, the following must be done:

1. The R/W PCA should be updated to 07908-69105 when symptoms one or two occur.

2. When replacing the disc mechanism or the servo PCA for ANY reason, the R/W PCA must be updated. Failure to update the R/W PCA when replacing the mechanism or servo PCA may result in loss of customer data.

DMD will accept extended warranty (02G) as follows:

Parts - 07908-69105 R/W PCA
Labor - .5 hours
Travel - Travel will be accepted only when a failure has occurred. Travel should NOT be billed to extended warranty when the R/W PCA is updated because of a mechanism or servo PCA failure.

****
* NOTE: When completing the Customer Support Order (CSO) form *
* the service code block should be filled in with: "0805" *
* This code will allow DMD to monitor the implementation *
* of this service note and prevent rejection of warranty *
* billing. *
****

7908P/R-06

SERVICE NOTE

Supersedes: None

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X

SERVICE INVENTORY	n/a	Return for update ☐	Use as is ☐
		Return for salvage ☐	See text ☐

WARRANTY EXTENDED UNTIL: n/a

7908P/R Disc/Tape Drive

All Units

Strain Relief of Disc Mechanism Grounding Cable

Symptom: Improper removal of the 7908P/R Disc Mechanism (07908-69100) may cause damage to the electrostatic discharge cable (07908-60023) or the spindle ground cable on the mechanism.

Cause: If the mechanism is removed from the chassis before the electrostatic discharge cable is removed, damage may result.

Solution: To prevent damage to the disc mechanisms of 7908P/R disc drives, a strain relief cable tie must be installed on the electrostatic discharge cable. When replacing the 7908 drive mechanism, the CE must cut and remove the old cable tie and re-cable tie both the electrostatic discharge cable and the spindle motor power cable. (See Fig. 1.) Currently, only the spindle motor power cable is cable tied. Henceforth, a cable tie will be factory installed in this configuration; and a cable tie (P/N 1400-0719) to be used for this procedure will be included with each replacement mechanism. Because disc mechanisms currently in FSI do not include cable ties, the CE should be prepared to provide a cable tie to secure the two cables.

This service note is informational only and, therefore, no warranty is implied.

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HEWLETT PACKARD

SN 7908P/R-06 cont.

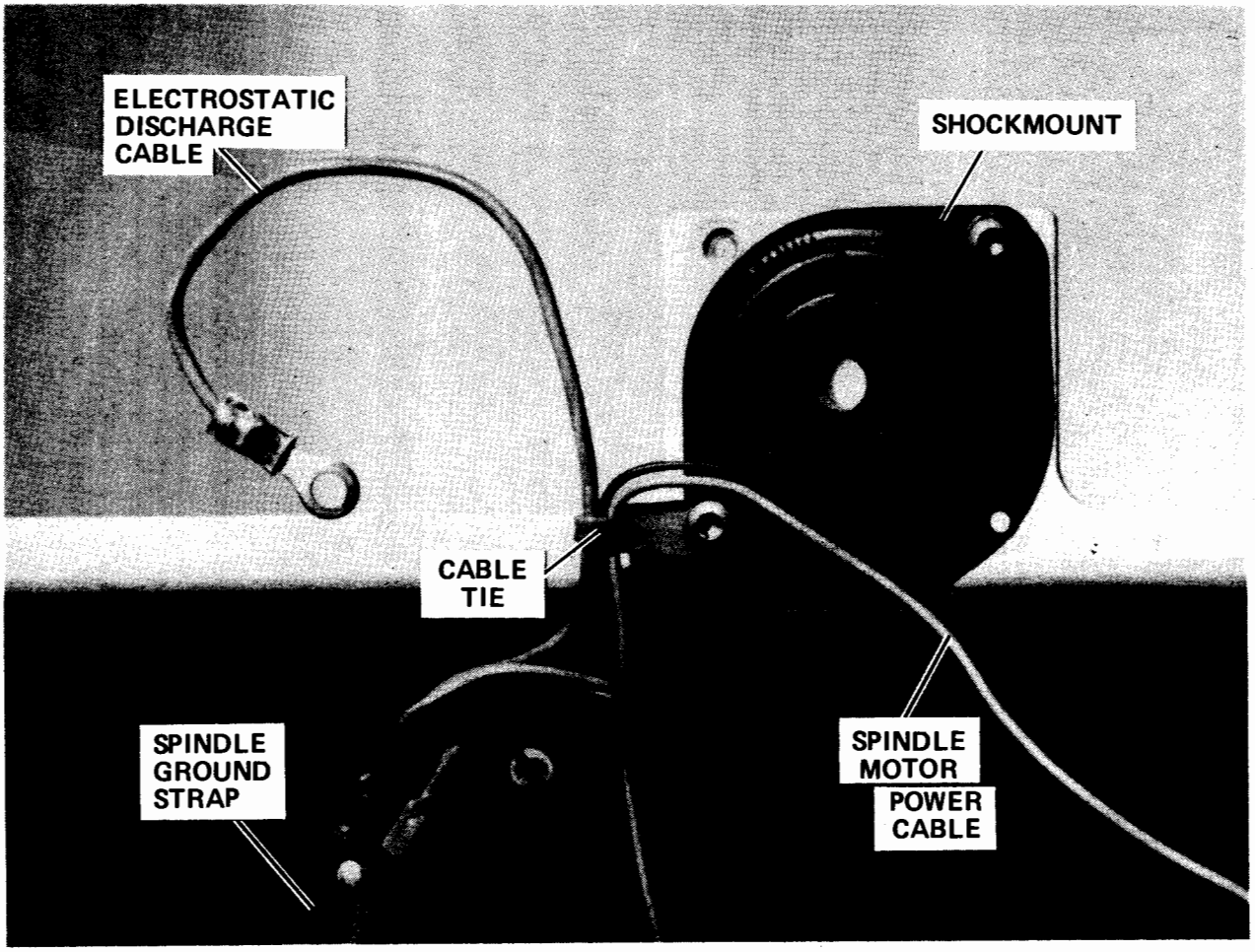

FIGURE 1

MA/sg

7908P/R-07

SERVICE NOTE

Supersedes:

7908P/R Disc/Tape Drive

7908P-Serial Numbers XXXXA01699 and below

7908R-Serial Numbers XXXXA00299 and below

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	.8hr.		
PARTS:	yes		
TRAVEL:	yes		
SERVICE INVENTORY	Return for update ☐ / Return for salvage ☐	n/a	Use as is ☐ / See text ☐
WARRANTY EXTENDED UNTIL:	15 August, 1983		

Noisy Disc Mechanism

Symptom: Excessive acoustical noise generated by the disc mechanism. This noise is in the medium to high audio frequency range (400HZ to 10000HZ). This noise will not affect drive performance, reliability or error rates.

Cause: Excessive acoustical noise may be produced if the spindle ground strap vibrates. The spindle ground strap, located on the underside of the disc mechanism, may vibrate anytime the disc is powered on. This noise may develop after product installation.

Solution: The CE should quiet noisy ground straps by applying a strip of dampening material to the back of the spindle ground strap. This dampening material, orderable from CPC/PCE under part number 07908-00056, should be applied as shown in Figure 1. Ordering 07908-00056 will provide enough dampening material to repair one drive.

DMD will accept warranty as follows:

Parts: 07908-00056
Labor: 0.8 hours
Travel: Yes

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HEWLETT PACKARD

Note: All product support packages should contain this dampening material. The recommended stocking is five parts per PSP.

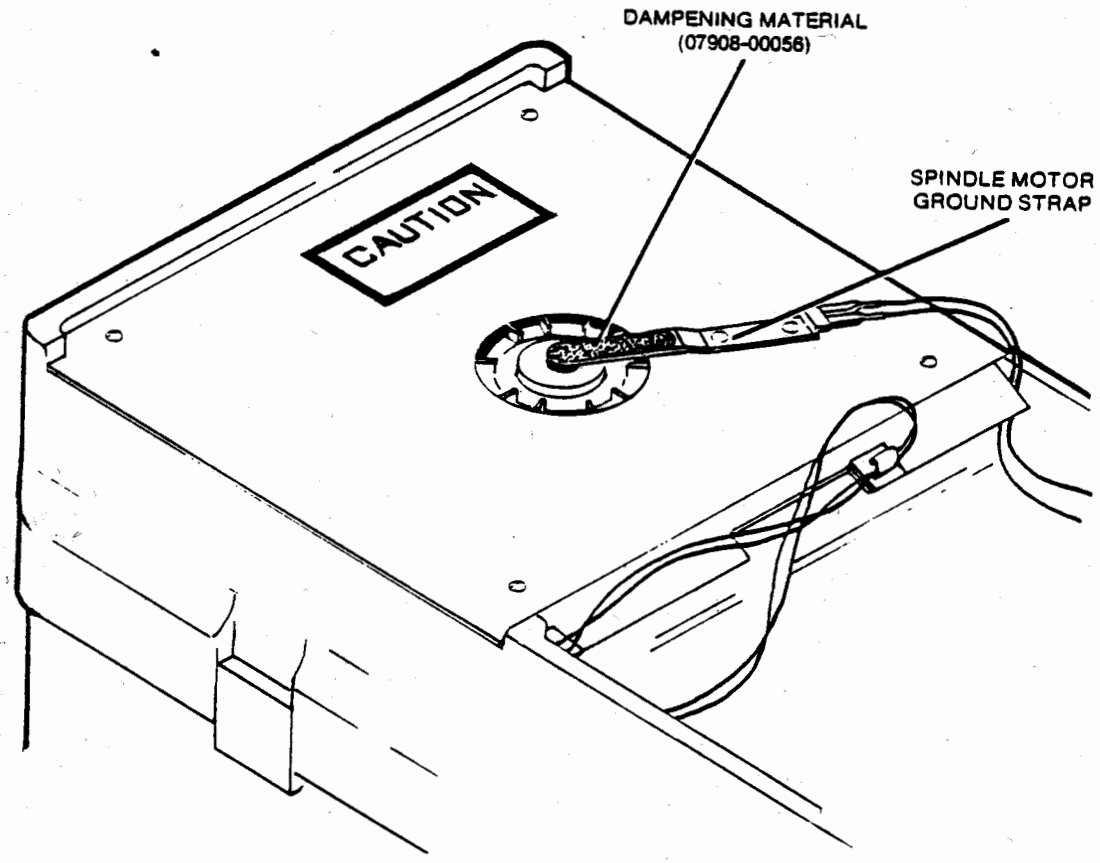

Figure 1

```
**************************************************************************
* NOTE: When completing the Customer Support Order (CSO) form           *
*       the service code block should be filled in with: "0007"          *
*       This code will allow DMD to monitor the implementation           *
*       of this service note and prevent rejection of warranty           *
*       billing.                                                         *
**************************************************************************
```

7908P/R-08

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure ☒	Information Only ☐

WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	1.0hr		
PARTS:	yes		
TRAVEL:	yes		

SERVICE	Return for update ☒	Use as is ☐
INVENTORY	Return for salvage ☐	See text ☐

WARRANTY EXTENDED UNTIL: 15 August, 1983

7908P/R Disc/Tape Drive

All Units With Serial Number Prefix 2224A and Below

Destructive Write Faults (DWF-L)

Symptom: A Destructive Write Fault-Low (DWF-L) condition may be falsely detected during write operation. A DWF-L will be reported as unit fault to the host. The error will be logged in the fault log as a DERROR 64 with the microprocessor fault register equal to 00000001. A destructive write fault can also be detected by the self tests and will be reported as a Test Error (TERROR) CO.

This service note replaces symptom two of service note 7908P/R-05 (Disc Write Faults). Symptom one of service note 7908P/R-05 is not affected by this service note. A destructive write fault will not cause the loss of customer data.

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HEWLETT PACKARD

Cause: Timing descrepencies between the R/W PCA and the disc mechanism may cause a destructive write/fault to be falsely reported. The solution for symptom two of service note 7908P/R-05 provided a partial solution for this problem. The updated R/W PCA (07908-60205) will allow additional timing margins.

Solution: Modifications to prevent falsely reported destructive write faults are incorporated on a new R/W PCA. The part number of the R/W PCA will be changed from 07908-6X105 to 07908-6X205.

When a destructive write fault occurs on any drive with serial number prefix 2224A and below, the CE should update the R/W PCA to a 07908-69205. The board being replaced may be a 07908-6X005 or a 07908-6X105.

DMD will accept extended warranty (02G) as follows:

Parts - 07908-69205 R/W PCA
Labor - 1.0 hours
Travel - Yes

****
* NOTE: When completing the Customer Support Order (CSO) form *
* the service code block should be filled in with: "0008" *
* This code will allow DMD to monitor the implementation *
* of this service note and prevent rejection of warranty *
* billing. *
****

7908P/R-09

SERVICE NOTE

Supersedes: 7908P/R-02A

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call X
	On Failure ☐		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	0.5hr		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update X		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	August, 1983		

7908 P/R Disc/Tape Drive

All units with serial number prefix below 2229

MPU Mandatory Firmware Update

SYMPTOM: Mandatory next site visit MPU firmware update of all 7908P/R discs with serial number prefix below 2229.

CAUSE: The predominant reason for this firmware update has been tape certification failures due to a "no data found" error. On many systems this error is not reported, but the system indicates "uninitialized media" when the tape initialization (format/certify) aborts.

This firmware revision also forces the ERT log to be updated at tape certification termination. This occurs whether the termination is normal or not.

This new firmware revision also corrects many low-level bugs that are transparent to the user.

SOLUTION: On the next customer site visit, update the firmware by replacing the 6 EPROMS with the new exchange EPROM kit. The part number of the new exchange kit is 07908-19007. This kit is available from CPC/PCE on the Blue Stripe Program. Old EPROMS should be returned for credit to CPC/PCE (Div. 15).

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HEWLETT PACKARD

Following is a list of part numbers of individual EPROMS and the "U" number corresponding to their location on the MPU board (07908-60002). Enclosed with each kit is a label to signify the drive has been updated. Place this label next to the serial number tag.

NOTE: These individual parts are NOT available. The entire kit must be ordered from CPC, p/n 07908-19007.

07908-89066	U241
07908-89067	U261
07908-89068	U271
07908-89069	U291
07908-89070	U2101
07908-89071	U121

NOTE: This service note supersedes S/N 7908P/R-02A.

NOTE: The 7911/12 EPROM kit cannot be used in the 7908.

DMD will accept extended warranty (02G) as follows:

Parts - 07908-19007 Eprom Exchange Kit
Labor - .5 hours
Travel - no travel will be accepted

DMD will not accept extended warranty for NEW EPROM kits.

****
*NOTE: When completing the customer support order (CSO) *
* form the service code block should be filled in *
* with: "0009". This code will allow DMD to monitor*
* the implementation of this service note and pre *
* vent rejection of warranty billing. *
****

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7908P/R-10

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure X		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	1.5 hr		
PARTS:	no		
TRAVEL:	1.3 hr		
SERVICE INVENTORY	Return for update X		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	November, 1983		

MODELS AFFECTED: 7908P/R

SERIAL PREFIXES INVOLVED:

7908P/R 2241 AND BELOW

PART NUMBERS INVOLVED:

07908-6X140 TAPE MECHANISM
07908-69340 TAPE MECHANISM

TAPE MECHANISM FAILURES

SYMPTOMS:

1. TAPE CERTIFY/INITIALIZE/FORMAT FAILURES

   THE TAPE INITIALIZATION ROUTINE IS A WRITE THEN READ ERROR RATE TEST, WITH SPARING FOR UNCORRECTABLE AND UNLOCATABLE ERRORS. THIS PROCESS CAN BE TERMINATED IF:
   A. ALL SPARES ARE USED.
   B. THE MAINTENANCE TRACK OVERLOWS WITH PERMANENT ERRORS.

   THESE FAILURES INDICATE THAT THE TAPE DRIVE HEAD IS NOT WRITING OR READING THE DATA CORRECTLY. ONLY OCCASIONALLY WILL THE TAPE CARTRIDGE BE THE CAUSE OF THESE FAILURES.

   IF THE INITIALIZATION PROCESS TERMINATES IN ERROR ALL SYSTEMS WILL REPORT "UNINITIALIZED MEDIA". ADDITIONAL INFORMATION ON THE FAILURE WILL BE DISPLAYED ON SOME SYSTEMS.

HEWLETT PACKARD

2. UNRECOVERABLE DATA ERRORS REPORTED ON TAPE UNIT.

UNRECOVERABLE DATA ERRORS WILL BE REPORTED BY THE SYSTEM DRIVER OR THE SYSTEM UTILITY, FROM THE CS80 STATUS WORDS:

3000(MPE) SYSTEMS - LISTLOG2 WILL HAVE AN UNRECOVERABLE ERROR BIT SET IN THE FOURTH FIELD OF THE DEVICE STATUS WORDS.

1000(RTE) SYSTEMS - AN UNRECOVERABLE DATA ERROR WILL BE REPORTED TO THE TERMINAL, WHEN IT OCCURS.

250 SYSTEMS - AN UNRECOVERABLE ERROR BIT WILL BE SET IN THE DISC STATUS RETURNS.

THE TAPE RUN LOG WILL ALSO CONTAIN INFORMATION ABOUT UNRECOVERABLE DATA ERRORS. THE RUN LOG WILL GIVE THE COUNT OF BOTH UNLOCATABLE OR UNCORRECTABLE DATA ERRORS. THESE TWO ERROR TYPES ARE THE SUBSETS OF UNRECOVERABLE ERRORS.

CAUSE: TAPE DRIVES WITH FAULTY READ/WRITE HEADS OR R/W ELECTRONICS, CANNOT RECOVER DATA PROPERLY.

ACTION: IF TAPE INITIALIZATION FAILS OR UNRECOVERABLE ERRORS ARE REPORTED FREQUENTLY, REPLACE THE TAPE DRIVE WITH A TAPE DRIVE WITH A NEW PART NUMBER. A 07908-6X340 WILL HAVE AN IMPROVED READ/WRITE HEAD CONTOUR AND R/W ELECTRONICS. UPON FAILURE REPLACE 07908-6X140 WITH 07908-69340.

****

CAUTION: TAPE INITIALIZATION FAILURES REQUIRE REV. F FIRMWARE BE INSTALLED IN THE DISC. SEE SERVICE NOTE:

7908P/R-09

NOTE: ANY INITIALIZATION FAILURES REQUIRE UPGRADE OF THE TAPE MECHANISM. IF REV.F, p/n07908-19007, HAS NOT BEEN INSTALLED, THIS IS IMMATERIAL. REPLACE THE TAPE MECHANISM AND UPGRADE THE FIRMWARE.

****

7908P/R-10

DMD WILL ACCEPT EXTENDED WARRANTY (02G) AS FOLLOWS:

PARTS - NO
LABOR - 1.5 HOURS
TRAVEL - YES

DMD WILL NOT ACCEPT EXTENDED WARRANTY FOR TAPE MECHANISMS. ANY MECHANISMS REPLACED FOR THE FAILURES DETAILED IN THIS NOTE SHOULD BE RETURNED TO CSD FOR CREDIT. ORDER A REPLACEMENT AS FSI INCREASE, WITH THE COMMENT "!UPDATE". RETURN 07908-6X140 AS A FSI DECREASE. IT WILL BE CROSSREFERENCED TO A 07908-69340.

NOTE: WHEN COMPLETING THE CUSTOMER SUPPORT ORDER (CSO) FORM THE SERVICE CODE BLOCK SHOULD BE FILLED IN WITH: "0010"

THIS CODE WILL ALLOW DMD TO MONITOR THE IMPLEMENTATION OF THIS SERVICE NOTE AND PREVENT REJECTION OF WARRANTY BILLING.

Computer Museum

7908-11

SERVICE NOTE

Supersedes: None

7908 P/R DISC/TAPE Drive

All Units

SPINDLE GROUND STRAP
REMOVAL/ MECHANISM BOTTOM
PLATE REPLACEMENT KIT

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:			X
PARTS:			X
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	N/A		

SYMPTOM: Damage could occur to the spindle ground strap which is attached to the bottom plate of the 7908 disc mechanism.

CAUSE: During mechanism removal and replacement, the ground strap could be broken or bent if the mechanism is handled improperly.

SOLUTION: Testing has shown that adequate grounding of the spindle is achieved without a spindle ground strap. Therefore, if the spindle ground strap has been damaged, it need not be removed unless 1) it causes mechanical interference with the fan, 2) one of the ground straps tabs has been broken causing disruption of the mechanism ground path, or 3) the broken ground strap creates a sharp edge which presents a potential safety hazard to the CE.

If the spindle ground strap must be removed, the bottom plate--to which it is attached--must also be removed. The CE should order the bottom plate replacement kit (07908-60104) which has been set up at CPC. Note that this bottom plate has no spindle ground strap. Installation instructions are included in the kit.

DMD will continue to ship disc mechanisms with spindle ground straps until the stock of bottom plates with spindle ground straps is depleted.

** Important: If the spindle ground strap vibrates, apply the damping material as explained in service note # 7908 P/R-08. There is no need to remove the ground strap.

PS/sg

12/82-48

HEWLETT PACKARD

PRODUCT SAFETY SERVICE NOTE

7908P/R-12 Supersedes: None

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM Normal Call ☐
	On Failure ☐		Information Only X
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text X
WARRANTY EXTENDED UNTIL:	N/A		

7908P/R Disc/Tape Drive

Units with serial prefixes greater than 2205 and less than 2243

FAN GROUNDING UPDATE

SYMPTOM: After the occurrence of several unlikely events, the CE could experience an electrical shock when he/she touches the 7908 card cage fan. This is a potential safety hazard to service personnel. Note that the card cage fan is not accessible to the customer/user.

CAUSE: A fan grille was added to the 7908 fan assembly (serial number prefix 2205 for both the 7908P and 7908R.) The grille obstructs contact between the cone washer (on the TORX (r) screw) and the painted fan body, and leaves no sure grounding path from the fan to the chassis. IF a short occurs in the fan, AND IF the fan fuse (F255) does not blow, AND IF the CE removes the flip top assembly and the module top cover and powers on the drive, AND IF the CE touches the fan body WHILE ALSO touching another live part of the circuit (the fuse holder or another short in the circuit), AND IF the screw threads have not provided a ground path between the fan and the chassis, the CE could experience a shock.

SOLUTION: Proper grounding of the 7908 fan can be accomplished by inserting a star lock washer in-between the fan grille and the fan body as prescribed by the procedure in this service note. The star lock washer bites through the painted fan body and provides a ground path.

Since the fan is not exposed, the 7908P/R fan should only be udpated when the CE is servicing an assembly near the fan assembly. The 7908P should be updated when the disc module top cover has been removed to service an assembly contained therein. The fan is then accessible. The 7908R should be updated when performing a service operation that requires removal of the disc module top cover and the tape mechanism.

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9320-5190 (1/83)

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7908P/R-12

7908 FAN GROUNDING UPDATE PROCEDURE

To perform this update, you will need to supply one #6 star lock washer. Either of the following is acceptable:

HP part number 2190-0468 #6 internal tooth lock washer
HP part number 2190-0414 #6 external tooth lock washer

The tools required to perform this update are:

1/4 inch Xcelite (r) nut driver
TORX (r) bit T15 (8710-1399)

Use the nut driver handle instead of the TORX driver handle because it is shorter than the standard size TORX (r) driver handle, and it fits better into the available work space. Some CE's have non standard TORX (r) drivers that may be short enough for this application.

*** * * * W A R N I N G * * * ***

To avoid dangerous electrical shock, disconnect the ac power cord from the wall outlet and from the receptacle on the rear of the 7908.

1. Check all four fan mounting screws to see if a star lock washer has already been installed on one of the screws between the fan grille and the fan. If one screw has a star lock washer, this update does not need to be performed. If none of the screws has a star lock washer, perform steps 2, 3 and 4.

2. Refer to the drawing in this service note and figure 6-3 in the 7908 service manual or figure 8-1 in the 7908 section of the CE Handbook.

   Locate the side of the fan that faces you when you remove the top cover. The card cage assembly need not be removed. Use the nut driver (or TORX (r) driver) and bit to remove the screw on the corner closest to the disc mechanism. The attached figure shows the orientation of the fan as you will see it.

3. As shown, insert the star lock washer between the fan grille and fan body.

4. Replace and tighten the screw.

No further modification or testing is needed. Since this modification involves the insertion of only one lock washer, it will take less time to perform than it did to read this service note. Therefore, this update should not interfere with the service operation in progress.

(TORX (r) and Xcelite (r) are registered trademarks.)

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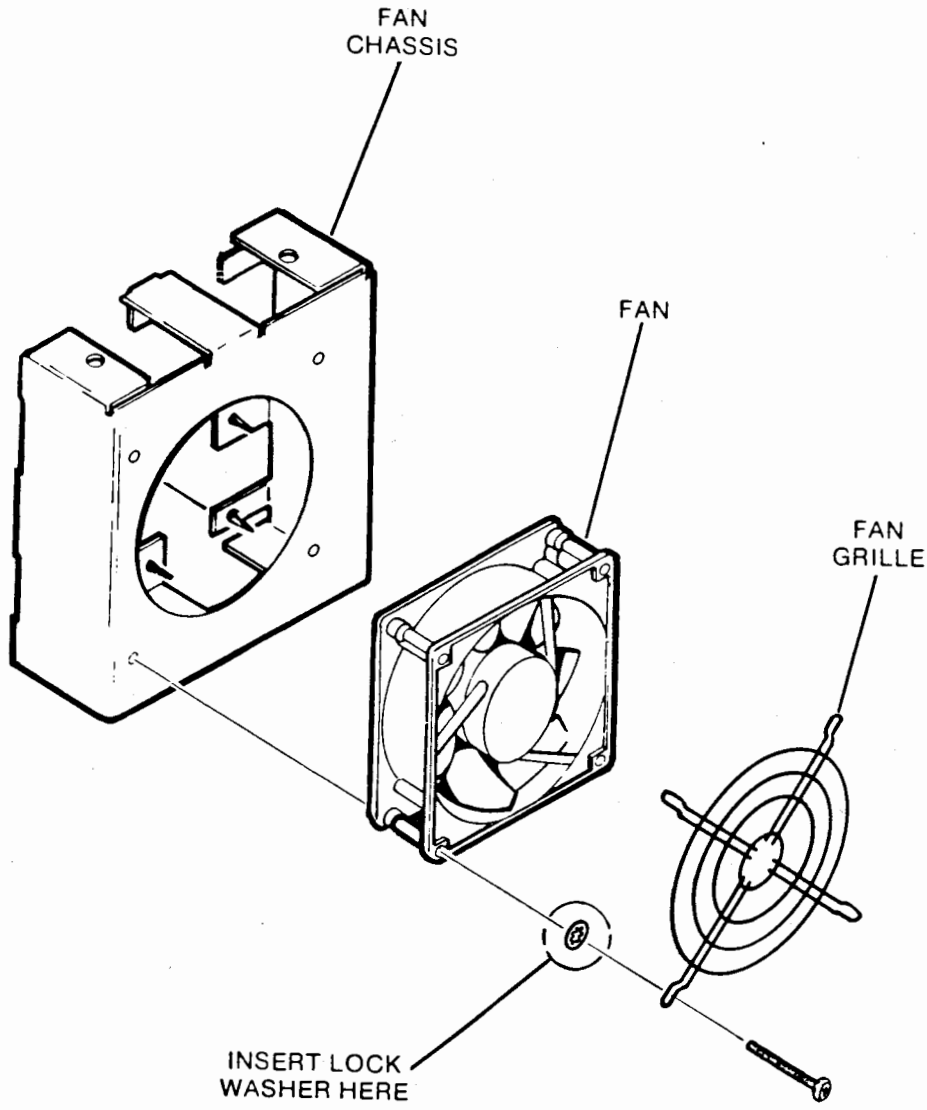

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