



# **5.25-inch Hard Disk Drive Service Manual**

**Models 97556, 97560**



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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.

Edition 1

October 1991



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## Typographical Conventions

The following safety symbols and typographical conventions are used in this manual:

- *Italic* is used for emphasis or titles of manuals.

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**Note** Notes contain important information.



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**Caution** Caution messages appear before procedures which, if not observed, could result in damage to equipment or loss of data.



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## Drive Information

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The 5.25-inch hard disk drive uses sputtered thin-film 5.25-inch disks as storage media. It includes a hybrid servo system that combines the performance of a dedicated servo system and the dynamic head alignment of an embedded servo system. The actuator features high performance and low power consumption.

The drive includes an embedded SCSI controller PCA with internal diagnostic routines. The electrical interface is compatible with the industry standard Small Computer System Interface Version 2 (SCSI-2).

## Drive Models

The drive models included in this manual are listed in Table 1-1. The model number is found on the HP label located on top of the disk mechanism.

### Note



Refer to the table titled “Mass Storage Devices/Storage System Support” in the front of the *HP Storage System Service Information Package* to correlate these drive models with the storage systems they are used in.

**Table 1-1. Drive Models**

Model Number <sup>1</sup>	Capacity (Mbytes)	Form Factor	Interface Type <sup>2</sup>
97556-60062	677	5.25-inch	SCSI SE
97560-60062	1355	5.25-inch	SCSI SE
97556-60063	677	5.25-inch	SCSI DIFF
97560-60063	1355	5.25-inch	SCSI DIFF
<sup>1</sup> Only the five-digit prefix is used on the title page of this manual. <sup>2</sup> SE= single-ended; DIFF= differential			

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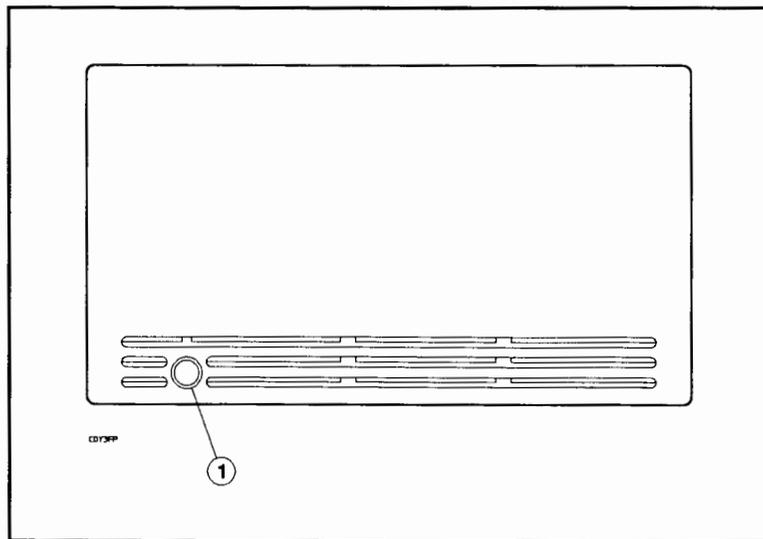
## Technical Specifications/Environmental Requirements

Refer to the drive user's manual for technical specifications and environmental requirements.

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## Controls and Indicators

Figure 1-1 shows the location of the drive status light. Refer to Table 4-1 for drive status light indications.



**Figure 1-1. Drive Front Panel**

1. Drive Status Light

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## Service Kit

Table 1-2 lists the recommended contents of the service kit.

**Table 1-2. Service Kit**

<b>Part No.</b>	<b>Description</b>
8710-1426	TORX* Field Kit
9300-1155	Anti-static Workstation
8710-1982	ROM Extraction Tool
<i>*TORX is a product of Camcar Division, Textron, Inc.</i>	

## Installation and Configuration

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### Installation

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**Note**

Refer to the *Storage System Hardware Installation Manual* for information on installing the drive into the storage system cabinet.

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### Configuration

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**Caution**

The drive configuration is set for the storage system it is installed in. Changing the configuration may cause the drive to malfunction. Refer to the installation details in the *Storage System Hardware Installation Manual* for information on the drive configuration.

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## Options

The drive configuration is set with jumpers on option connectors 1 and 2 (see Figure 2-1 and Figure 2-2). A pin-set is shorted with a jumper installed, or open without a jumper. Table 2-1 lists pin-set functions for option connector 1, and Table 2-2 lists pin-set functions for option connector 2.

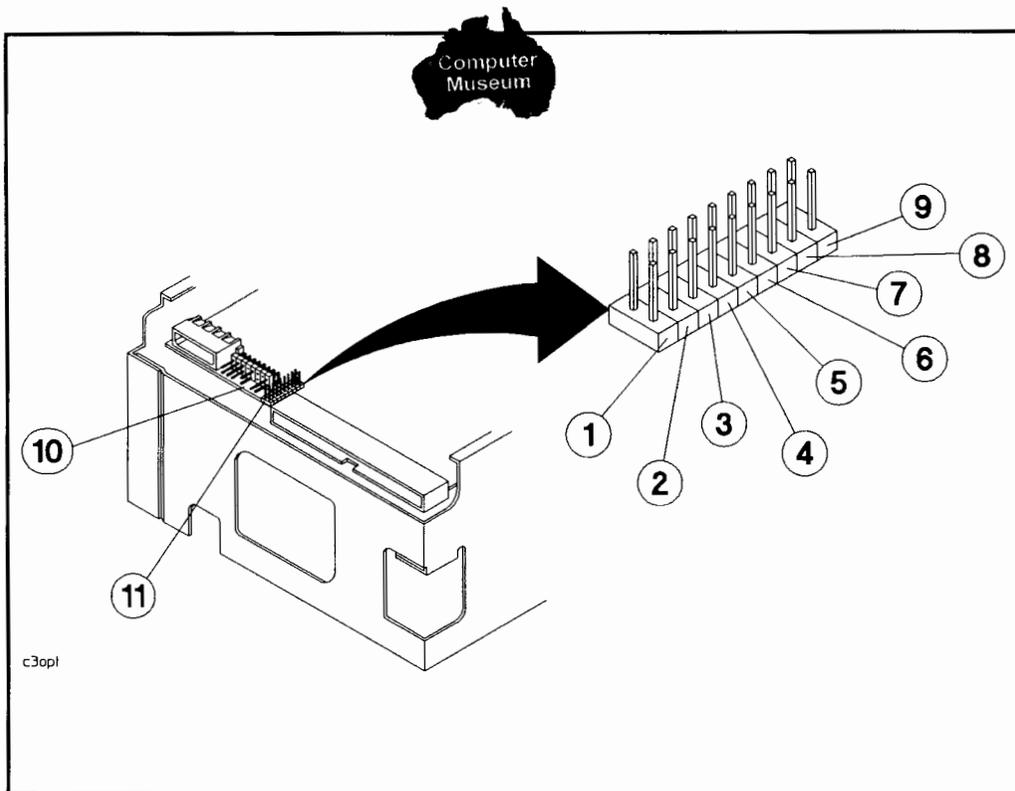
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### Caution



The jumpers for option connector 1 and option connector 2 are not interchangeable. Interchanging the jumpers may damage the connectors.

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**Figure 2-1. Option Connector 1 Pin-sets**

- |   |                             |
|---|-----------------------------|
| 1. Pin-set 1 (Reset Enable)                     | 8. Pin-set 8 (Parity)       |
| 2,3. Pin-sets 2,3 (Sync Spindle Signal Routing) | 9. Pin-set 9 (Auto Spin-up) |
| 4,5. Pin-sets 4,5 (Terminator Power)            | 10. Option Connector 2      |
| 6. Pin-set 6 (Unit Attention)                   | 11. Option Connector 1      |
| 7. Pin-set 7 (SDTR <sup>1</sup> )               |                             |

<sup>1</sup>Synchronous Data Transfer Request

Table 2-1. Option Connector 1 Functions

**Pin-set 1 (Reset Enable):**

1 = shorted Reset enabled. Used in multiuser systems to provide fault tolerance. A Reset signal from the power supply is routed to the drive microprocessor to warn of impending power loss (see Figure 2-2, pin 4); the drive finishes writing the current sector, then stops writing to prevent data loss.

1 = open Reset disabled.

**Pin-sets 2,3 (Sync Spindle Signal Routing):**

2 = shorted Pin 29 of SCSI connector connected to ground. Note: when  
3 = open pin-set 3 is open, pin-set 2 *must* be shorted to connect pin 29 to ground.

2 = open Synchronized spindle sync signal routed to pin 29 of SCSI  
3 = shorted connector. Note: when pin-set 3 is shorted, pin-set 2 *must* be open.

**Pin-sets 4,5 (Terminator Power):**

4 = open **All Drives:** Drive +5 V not connected to terminator resistors;  
5 = open initiator supplied +5 V not connected to terminator resistors.

4 = shorted **All Drives:** Drive +5 V connected to terminator resistors but  
5 = open not to SCSI connector pins.

4 = open **Single-ended Drives:** Initiator supplies +5 V input to SCSI  
5 = shorted connector pin 26.

**Differential Drives:** Initiator supplies +5 V input to SCSI connector pins 25 and 26.

4 = shorted **Single-ended Drives:** Drive +5 V connected to terminator  
5 = shorted resistors and to SCSI connector pin 26.

**Differential Drives:** Drive +5 V supplied to terminator resistors and to SCSI connector pins 25 and 26.

Table 2-1. Option Connector 1 Functions (continued)

**Pin-set 6 (Unit Attention):**

- 6 = open      Enable Unit Attention
- 6 = shorted    Inhibit Unit Attention

**Pin-set 7 (SDTR):**

- 7 = open      Inhibit drive initiation of SDTR message
- 7 = shorted    Enable drive initiation of SDTR message at Power-On and Reset

**Pin-set 8 (Parity):**

- 8 = open      Inhibit parity checking
- 8 = shorted    Enable parity checking

**Pin-set 9 (Auto Spin-up):**

- 9 = open      Drive spins up when Initiator sends Start Unit command
- 9 = shorted    Drive will spin up automatically at Power-on

## SCSI Address

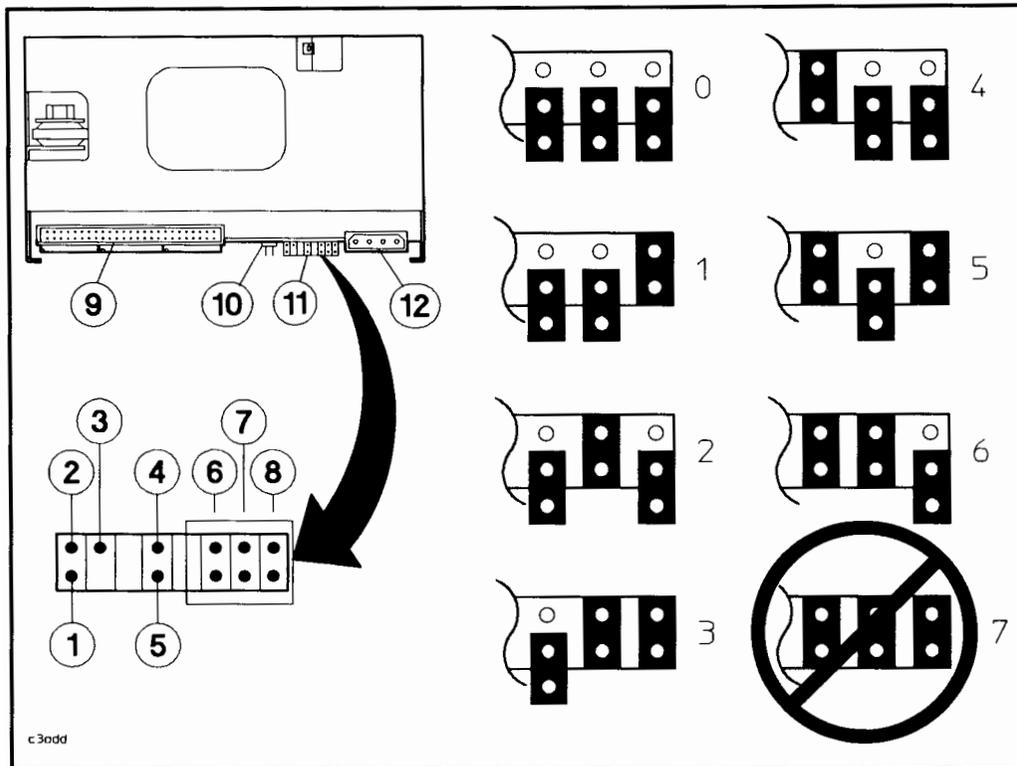
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**Note**

Some drives include an address cable that is connected only to the SCSI Address pin-sets, or is connected to the SCSI Address pin-sets and to the Reset pin. Refer to the *Storage System Hardware Installation Manual* for information on setting the SCSI address with the storage system address switches. Refer to Table 2-2 for information on the function of the Reset pin.

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On drives that do not include an address cable, the SCSI address is set using jumpers. Figure 2-2 shows jumper settings for SCSI address 0 through 7. Avoid using address 7; it is usually reserved for the host bus adapter (HBA).



**Figure 2-2. Option Connector 2 Pins and Pin-sets**

- |                                |                                      |
|--------------------------------|--------------------------------------|
| 1. Pin 1 (Sync Spindle Ground) | 6,7,8. Pin-sets 6,7,8 (SCSI Address) |
| 2. Pin 2 (Slave)               | 9. SCSI Connector                    |
| 3. Pin 3 (Master)              | 10. Option Connector 1               |
| 4. Pin 4 (Reset)               | 11. Option Connector 2               |
| 5. Pin 5 (NOT USED)            | 12. DC Power Connector               |

**Table 2-2. Option Connector 2 Functions**

**Pin 1 (Sync Spindle Ground):** Provides a dedicated ground for synchronized spindle modes.

**Pin 2 (Slave):** Used as an input or output for synchronized spindle modes.

**Pin 3 (Master):** Used as an input or output for synchronized spindle modes.

**Pin 4 (Reset):** Used in multiuser systems to provide fault tolerance. A Reset signal from the power supply is routed to this pin, via a wire from the address cable, to warn of impending power loss.

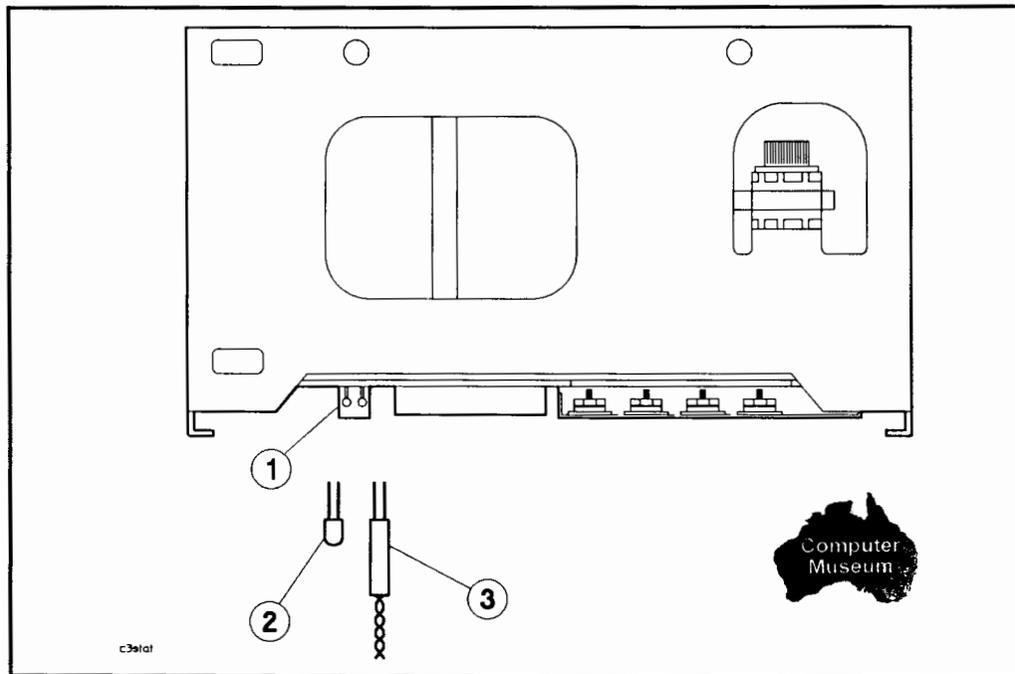
**Pin 5 (NOT USED):** No connection to this pin.

**Pin-sets 6,7,8 (SCSI Address):** See Figure 2-2 for address settings.

### Status Indicator Connector

Figure 2-3 shows two configurations for the status indicator connector:

- If the drive is installed in a minitower cabinet, connect the status LED, with the cathode side of the LED facing the left edge of the PCA, to the status indicator connector.
- If the drive is installed in a rack cabinet, connect the status cable, white dot on the status cable connector facing downward, to the status indicator connector. The status cable routes the status signal to the cabinet front panel.



**Figure 2-3. Status Indicator Connector Configurations**

- 1. Status Indicator Connector
- 2. Status LED
- 3. Status Cable



## **Preventive Maintenance**

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This drive requires no preventive maintenance.



## Troubleshooting and Diagnostics

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This chapter describes how to troubleshoot and repair the hard disk drive. Diagnostic information is also included.

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### Troubleshooting

The hard disk drive includes two replaceable subassemblies: the disk mechanism and the SCSI controller PCA. The firmware ROM on the SCSI controller PCA is also replaceable.

If the problem is isolated to the SCSI controller PCA, it can be replaced separately in order to preserve the data in the disk mechanism. If the disk mechanism is faulty, the disk mechanism must be replaced, and the data must be restored to the new disk mechanism. Since restoring data is a time-consuming process, perform the following steps before replacing the disk mechanism (see Figure 4-1):

1. Switch off drive power and remove the drive from the cabinet.
2. Remove the SCSI controller PCA from the disk mechanism.
3. Install a known good SCSI controller PCA on the disk mechanism. Make sure the configuration jumpers on the good SCSI controller PCA assembly are set to the same positions as the jumpers on the suspect assembly.
4. Remove the firmware ROM from the faulty SCSI controller PCA, and install it on the replacement SCSI controller PCA.
5. Reinstall the disk drive.
6. Check system operation to see if the problem is solved.

If the problem persists, replace the disk mechanism.

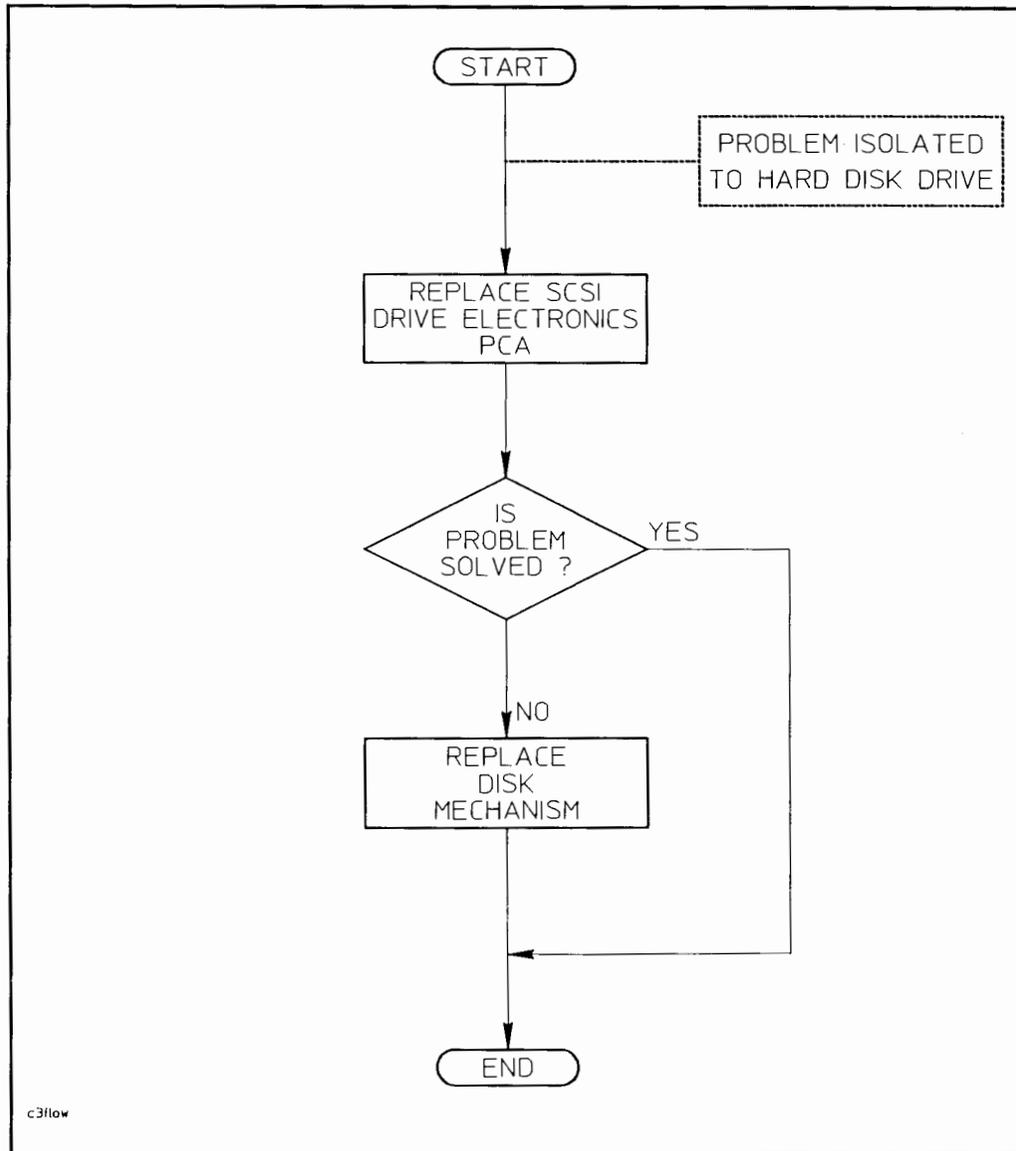


Figure 4-1. Hard Disk Drive Troubleshooting Flowchart

### Drive Status Light

Table 4-1 shows drive status light indications during normal operation and fault conditions.

**Table 4-1. Status Light Indications**

<b>Status</b>	<b>Explanation</b>
OFF	This is the normal indication when the hard disk drive is idle. This may also indicate that there is no power to the hard disk drive.
ON	If the status light remains on more than 20 seconds after the self-test begins, it indicates a self-test failure.
FLASHING (1 Hz)	If the status light continues flashing at a 1 Hz rate more than 20 seconds after the self-test begins, it indicates a self-test failure.
FLASHING (10 Hz)	This indicates that the hard disk drive is performing its internal self-test diagnostic. This pattern should only continue as long as the self-test is in progress.
RANDOM FLASHING	The status light flashes when the hard disk drive is accessed by the host. This indicates normal operation.

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## Diagnostic Information

The following paragraphs provide information on the hard disk drive internal status logs and the Extended Sense data returned by the hard disk drive in response to a REQUEST SENSE command.

The method of accessing this information depends on the diagnostic tool you are using. Refer to the appropriate diagnostic documentation for information on retrieving device information.

### Logs

There are three internal hard disk drive logs: the Usage Log, the Data Error Log, and the Hardware Error Log. These logs are maintained in two locations: on the disk media, and in SCSI controller RAM. The controller RAM is initialized from the disk at power-on or following a reset. During disk drive operation, the controller RAM is continually updated. The contents of the controller RAM are only posted to the disk media when an error entry is added.

### Usage Log

The Usage Log includes the following fields: Area, Access Count, Blocks Accessed, First Retry Count, Multiple Retry Count.

The Area field indicates which part of the hard disk media the Data Error Log is reporting on.

The Access Count field indicates the number of media accesses performed since the last hardware error occurred, or the log was cleared. When an entry is added to the Hardware Error Log, the contents of this field are included and this field is reset to zero. Thus, to determine the total number of media accesses, you must add the contents of this field to any Hardware Error Log Access Count entries. If there are no Hardware Error Log entries, this value represents the total media accesses. Table 4-2 lists the access count ranges corresponding to the values reported in this field.

The Blocks Accessed field indicates the number of blocks read from the hard disk drive.

The First Retry Count field indicates the number of times read retries were performed and data was recovered on the first retry.

The Multiple Retry Count field indicates the number of times data was not recovered on the first retry. This field is incremented only once per completed recovery.

**Table 4-2. Hard Disk Drive Access Count Range Values**

VALUE (HEX)	MINIMUM OF ACCESS RANGE	MAXIMUM OF ACCESS RANGE
0	No Accesses	No Accesses
1	1	1
2	2	10
3	11	100
4	101	1,000
5	1,001	10,000
6	10,001	100,000
7	100,001	500,000
8	500,001	1,000,000
9	1,000,001	5,000,000
A	5,000,001	10,000,000
B	10,000,001	50,000,000
C	50,000,001	100,000,000
D	100,000,001	500,000,000
E	500,000,001	1,000,000,000
F	1,000,000,001	>1,000,000,001

**Data Error Log**

The Data Error Log includes the following fields: Logical Block Address, Error Type, Count, and Error.

The Logical Block Address field contains the logical block address of a data block that encountered multiple read retries during one or more data error recovery attempts.

The Error Type field indicates the type of data error the block encountered (refer to Table 4-3).

The Count field is incremented each time a block is uncorrectable or requires multiple retries during a transaction. This field is incremented only once for each data recovery attempt.

The Error field contains encoded data error byte information as listed in Table 4-3.

**Table 4-3. Hard Disk Drive Error Type and Error Byte**

<b>Error type:</b>	
REC-E =	Recovered data with ECC
REC-R =	Recovered data with retrys
UNR =	Unrecoverable error
<b>Error byte:</b>	
1XXXXXXX =	Unclassifiable error
X1XXXXXX =	Error occurred in header field
XX1XXXXX =	Error occurred in data field
XXX1XXXX =	Unrecoverable data
XXXX1XXX =	Data recovered with ECC
XXXXX1XX =	Data recovered with retrys
XXXXXX1X =	Write fault
XXXXXXX1 =	Reserved

**Hardware Error Log**

The Hardware Error Log includes the following fields: Logical Block Address, Internal Drive Status, and Access Count.

The Logical Block Address field contains the logical block address of a data block that was being accessed when the error occurred.

The Internal Device Status field contains an error code corresponding to the Additional Sense Code field returned by the REQUEST SENSE command.

The Access Count field indicates the number of media accesses that had been performed when the hardware fault occurred. To determine the total number of media accesses, add these values to the Access Count field of the Usage Log. Table 4-2 lists the access count ranges corresponding to the values in this field.

**REQUEST SENSE Data Fields**

Table 4-4 shows the data format for the following data fields returned by the drive in response to a REQUEST SENSE command. Reserved fields always contain zeros.

**Table 4-4. REQUEST SENSE Data Format**

BYTE	BIT							
	7	6	5	4	3	2	1	0
00	Valid	Error Class			Reserved			Error Code
01	Segment Number = 0							
02	FM = 0	EOM = 0	ILI	Reserved	Sense Key			
03-06	(MSB-03) Information Bytes				(LSB-06)			
07	Additional Sense Length = 20							
08-11	Command Specific Information							
12	Additional Sense Code							
13	Additional Sense Code Qualifier = 0							
14	Field Replaceable Unit Code = 0							
15	SKSV = 0	Sense Key Specific						
16-17	Sense Key Specific							
18	Retry = 0	Reass = 0	HERR = 0	Reserved				
19-23	Reserved							
<b>Device Error Field: (Bytes 24-27)</b>								
24	Vendor Unique ESDI Status Code							
25	ESDI Status Byte							
26-27	SCSI Status Bytes							



## 5.25-inch Hard Disk Drive

## Service Manual

**Error Code.** A value of 0 specifies current error; a value of 1 specifies deferred error.

**Error Class.** Always set to 7.

**Valid.** A value of 1 indicates that the Information bytes contain valid information. The exact significance of the Information bytes depends on the status of the Sense Key field.

**Segment Number.** Always set to 0.

**FM (File Mark), EOM (End of Media), ILI (Incorrect Length Indicator).** All set to zero (0).

**Sense Key.** Indicates the type of error that has occurred, and the recovery action that should be taken by the initiator. Refer to Table 4-5.

**Additional Sense Code.** Provides additional information about the error condition reported in the Sense Key field. Refer to Table 4-6.

**Information.** Contains information relative to specific commands and specific devices.

**Additional Sense Length.** Specifies the number of Additional Sense bytes to follow. Always set to 20.

**Command Specific Information.** Contains information dependent on the command that was executed.

**Additional Sense Code Qualifier.** Always set to 0.

**Failed Field Replaceable Unit (FRU).** Always set to 0.

**SKSV (Sense Key Specific Valid).** Always set to 0.

**Device Error Field.** Indicates device unique error codes designed to aid service personnel in more detailed analysis of any drive faults. This field consists of four bytes:

Byte	Description
24	Vendor Unique ESDI Status Codes (refer to Table 4-7)
25	ESDI Status Byte (refer to Table 4-8)
26-27	SCSI Status Bytes (refer to Table 4-9)

Table 4-5. Sense Key Codes

Value (hex)	Description
0	<b>No Sense.</b> Indicates that there is no specific sense key information to be reported for the designated logical unit.
1	<b>Recovered Error.</b> Indicates that the last command completed successfully with some recovery action performed by the Target. Details may be determined by examining the additional sense bytes and the information bytes.
2	<b>Not Ready.</b> Indicates that the logical unit addressed cannot be accessed.
3	<b>Media Error.</b> Indicates that the command terminated with a nonrecovered error condition that was probably caused by a flaw in the media or an error in the recorded data.
4	<b>Hardware Error.</b> Indicates that the Target detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self test.
5	<b>Illegal Request.</b> Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands.
6	<b>Unit Attention.</b> Indicates that the Target has been reset or there has been a power on.
B	<b>Aborted Command.</b> Indicates that the Target aborted the command due to Initiator request/action.
E	<b>Miscompare.</b> Indicates data in buffer may have been corrupted between READ BUFFER and WRITE BUFFER commands, or a MISCOMPARE occurred during a VERIFY (with BYTCK enabled).

Table 4-6. Additional Sense Codes

Value (hex)	Description
00	No Additional Sense Information
01	No Index/Sector signal
02	No Seek Complete
03	Write Fault
04	Drive Not Ready
08	Logical Unit Communication Failure
09	Servo lost while track following
10	ID CRC or ECC error
11	Unrecovered Read error of data blocks
14	No record found
15	Seek Positioning error
17	Recovered Read data with Target's Read retries (not with ECC)
18	Recovered Read data with Target's ECC correction (not with retries)
19	Defect List error
1A	Parameter Overrun
1B	Synchronous Transfer error
1D	Compare error
20	Invalid Command Operation Code
21	Illegal Logical Block Address. Address greater than the maximum LBA returned by the READ CAPACITY data with PMI not set.
24	Illegal field in CDB
25	Invalid LUN
26	Invalid field in Parameter List
27	Write Protected
29	Power On or Reset or Bus Device Reset occurred
2A	Mode Select Parameters changed.
31	Media Format Corrupted
32	No Defect Spare Location Available
33	Spare Operation Failed
40	RAM failure
41	Data Path Diagnostic failure
42	Power-On Diagnostic Failure
43	Message Reject Error
44	Internal Controller Error
45	Select/Reselect failed
46	Unsuccessful Soft Reset
47	SCSI Interface Parity Error
48	Initiator Detected Error
49	Inappropriate/Illegal Message

Table 4-7. Vendor Unique ESDI Status Codes

Error Code Hex (Dec)	Description
00 (0)	Not an error condition.
02 (2)	EEPROM checksum failed.
03 (3)	Timed out waiting for DSP to complete Power On Self-Test.
04 (4)	After power-on, DSP became Command Ready without Finished being asserted.
05 (5)	DSP reported a revision value incompatible with this firmware version.
06 (6)	Power-On DSP RAM test failed.
07 (7)	Parity error on command received.
09 (9)	Timed out transferring data to ESDI controller.
0A (10)	Received illegal command.
0B (11)	Address of Seek command was outside legal address space.
0C (12)	An attempt was made to set an illegal EEPROM address.
0D (13)	An attempt was made to access the EEPROM while mechanism was spinning.
0E (14)	Timed out waiting for EEPROM write to complete.
0F (15)	DSP did not spinup after a spinup command was executed.
10 (16)	Timed out waiting for DSP to become ready for a short term command.
11 (17)	Timed out waiting for DSP to become ready for a long term command.
12 (18)	A Seek was attempted when the spindle was not spun up and locked.
13 (19)	The DSP did not end up in tracking mode after a Recalibrate command was executed.
14 (20)	Bounds test of Track Offset command failed.
15 (21)	A fault is still set after clearing Gate Array fault flip/flops.
16 (22)	Retries were exhausted while trying to verify position during a Recalibrate.
17 (23)	The DC bias adaptation failed to null NPES within the maximum iteration limit.
18 (24)	Maximum iteration limit reached during head alignment SPES null.
19 (25)	DSP sync lost during head alignment SPES measurement.
1A (26)	The drive has entered the Head Alignment Needed state.
1B (27)	The drive has entered the Head Alignment Critical state.
1C (28)	The maximum total (AC+DC) head alignment correction limit was exceeded.
1D (29)	Head alignment fault recovery failed.
1E (30)	DSP failed to complete a Read Track Number command in allotted time.
1F (31)	DSP failed to complete a Spin Down command in allotted time.
20 (32)	Reserved.
21 (33)	DSP failed to complete a Spin Up command in allotted time.
22 (34)	DSP failed to complete a Recalibrate command in allotted time.
23 (35)	DSP failed to complete an Introduce Tracking Offset command in allotted time.
24 (36)	DSP failed to complete a Seek command in allotted time.
25 (37)	DSP failed to complete a Measure Alignment Band command in allotted time.

Table 4-7. Vendor Unique ESDI Status Codes (continued)

Error Code Hex (Dec)	Description
26 (38) thru 31 (49)	Reserved.
32 (50)	The long term DSP command completed with Alert signal set in status register.
33 (51)	The DSP Alert signal was set when attempting to send a command to the DSP.
34 (52)	Request Status logged a Servo Fault from the fault register.
35 (53)	DSP failure code indicates other than Reset at power-on.
36 (54)	Reserved.
37 (55)	Reserved.
38 (56)	Maximum DC head alignment correction capability was exceeded.
39 (57)	Maximum AC head alignment correction capability was exceeded.
3A (58)	Maximum iteration limit was exceeded in calibrating the NPES gain.
3B (59) thru 3E (62)	Reserved.
3F (63)	That command requires a special test enable to be executed.
40 (64)	Unknown write fault.
41 (65)	Write during loss of servo timing sync.
42 (66)	Write during momentary spindle off-speed indication.
43 (67)	Write during momentary actuator off-track indication.
44 (68)	Write during a seek operation.
45 (69)	Write after settle or tracking failure.
46 (70)	Reserved.
47 (71)	Reserved.
48 (72)	Write was attempted while ESDI attention was asserted.
49 (73)	Write was attempted while an illegal head was selected.
4A (74)	Write was attempted while a recalibrate was in process.
4B (75)	Write was attempted on a head that was in the head alignment critical state.
4C (76)	Write was attempted while a head alignment was in process.
4D (77)	Write was attempted after a fatal head alignment occurred.
4E (78)	Write was attempted while spun down or after a recalibrate failure.
80 (128)	No failure detected.
81 (129)	Unsupported command.
82 (130)	Illegal command sequence.
83 (131)	Servo heartbeat time out.

Table 4-7. Vendor Unique ESDI Status Codes (continued)

Error Code Hex (Dec)	Description
84 (132)	Spindle stuck.
85 (133)	Spindle could not reach full speed.
86 (134)	Servo PLL did not lock
87 (135)	Index pattern fault.
88 (136)	TMR2 Alignment failure
89 (137)	Servo PLL came unlocked.
8A (138)	Bad hard track number.
8B (139)	Settle failure.
8C (140)	Alignment Band AGC voltage not within legal range.
8D (141)	Heroics invoked during spin up.
8E (142)	DSP reset detected.
8F (143)	Minimum spindle speed could not be detected.
90 (144)	Tracking failure after a successful settle to a new setpoint.
91 (145) thru C0 (192)	Reserved.
C1 (193)	PLL came unlocked in Slow Acceleration Phase.
C2 (194)	Seek timed out in Slow Acceleration Phase.
C3 (195)	Velocity too high in Slow Acceleration Phase.
C4 (196) thru C8 (200)	Unassigned seek fault in Slow Acceleration Phase.
C9 (201)	PLL came unlocked in Fast Acceleration Phase.
CA (202)	Seek timed out in Fast Acceleration Phase.
CB (203)	Velocity too high in Fast Acceleration Phase.
CC (204) thru D0 (208)	Unassigned seek fault in Fast Acceleration Phase.
D1 (209)	PLL came unlocked in the Coasting Phase.
D2 (210)	Seek timed out in the Coasting Phase.
D3 (211)	Velocity too high in the Coasting Phase.
D4 (212) thru D8 (216)	Unassigned seek fault in the Coasting Phase.

## 4-14 Troubleshooting and Diagnostics

Table 4-7. Vendor Unique ESDI Status Codes (continued)

Error Code Hex (Dec)	Description
D9 (217)	PLL came unlocked in Fast Deceleration Phase.
DA (218)	Seek timed out in Fast Deceleration Phase.
DB (219)	Velocity too high in Fast Deceleration Phase.
DC (220) thru E0 (224)	Unassigned seek fault in Fast Deceleration Phase.
E1 (225)	PLL came unlocked in Slow Deceleration Phase
E2 (226)	Seek timed out in Slow Deceleration Phase
E3 (227)	Velocity too high in Slow Deceleration Phase
E4 (228) thru E8 (232)	Unassigned seek fault in Slow Deceleration Phase.
E9 (233)	PLL came unlocked in the Flare Phase.
EA (234)	Seek timed out in the Flare Phase.
EB (235)	Velocity too high in the Flare Phase.
EC (236) thru F0 (240)	Unassigned seek fault in the Flare Phase.
F1 (241)	PLL came unlocked in the Gross Settle Phase.
F2 (242)	Seek timed out in the Gross Settle Phase.
F3 (243)	Velocity too high in the Gross Settle Phase.
F4 (244) thru F9 (249)	Unassigned seek fault in the Gross Settle Phase.
FA (250)	Seek timed out in the Fine Settle Phase.
FB (251)	Velocity too high in the Fine Settle Phase.
FC (252) thru FF (255)	Unassigned seek fault in the Fine Settle Phase.

**Table 4-8.**  
**Device Error Codes**  
**ESDI Status Byte 25**

Bit	Description
7	Spindle motor stopped
6	Command data parity fault
5	Interface Fault
4	Invalid command fault
3	Seek fault
2	Write gate with track offset fault
1	Vendor Unique ESDI status available; SCSI (CCS)= byte 21, SCSI-2 = byte 27
0	Write fault

**Table 4-9.**  
**Device Error Codes**  
**SCSI Status Bytes 26, 27**

Bit	Description
<b>Byte 26</b>	
7	BPF: Buffer parity fault
6	UNF: FIFO underflow fault
5	OVF: FIFO overflow fault
4	SOS: Start-of-sector not detected
3	ATN: ESDI Attention bit
2	SIL: Reserved: internal use only
1	CTO: Command Timeout
0	EOS: Early end of sector
<b>Byte 27</b>	
7	FTL: Fatal fault: refer to previous byte, bits 0 thru 4
6	DE3: Data ECC, interleave 3, syndrome fault
5	DE1: Data ECC, interleave 1, syndrome fault
4	HE1: Header ECC, interleave 1, syndrome fault
3	DSF: Data sync field fault
2	HSF: Header sync field fault
1	HCP: Header compare failed
0	OTH: Other fault: refer to previous byte, bits 5 thru 7

## Removal and Replacement

---

This chapter describes the procedures for removal and replacement of the drive replaceable assemblies.

---

### Note



- Refer to the storage system service manual for instructions on removing the drive from, and installing the drive into the storage system cabinet.
  - New drives do not include mounting hardware. You must remove the mounting hardware from the old drive and install it on the new drive.
- 

---

### Replaceable Assemblies

The hard disk drive contains two replaceable assemblies: the hard disk mechanism and the SCSI controller PCA. The front panel may also be replaced as a subassembly.

Whenever a faulty SCSI controller PCA is replaced, the firmware ROM should be transferred from the old PCA to the new PCA. However, the firmware ROM may also be ordered separately.

## Disk Mechanism

### To remove the disk mechanism:

- Follow the procedure for removing the SCSI controller PCA to separate the disk mechanism from the SCSI controller PCA.

### To replace the disk mechanism:

- Follow the procedure for replacing the SCSI controller PCA.

## SCSI Controller PCA

---

### Caution



- The drive must be placed upside-down to remove the SCSI controller PCA. In this position, the drive is very susceptible to mechanical shock and vibration. Be extremely careful to avoid bumping or jarring the drive while it is upside-down. Place the drive on a padded surface while replacing the SCSI controller PCA.
  - Make sure you observe the proper ESD precautions when removing the SCSI controller PCA.
  - Make sure the configuration jumpers on the new PCA are in the same positions as those on the old PCA (refer to Table 2-1).
-

**To remove the SCSI controller PCA (see Figure 5-1):**

1. Remove the mounting bracket from the drive (refer to the storage system service manual).
2. Carefully place the drive upside-down on a padded surface.
3. Remove the four PCA mounting screws. One of the mounting screws is located on the side of the disk mechanism.
4. Carefully tilt the PCA from side to side while pulling up until it is free of the two connectors on the bottom of the disk mechanism.

**To replace the SCSI controller PCA (see Figure 5-1):****Note**

Before replacing the SCSI controller PCA, check the insulator sheets on the disk mechanism for any signs of damage. These sheets prevent the PCA from shorting out against the disk mechanism. If there are any holes or tears in the insulator sheets, they should be replaced.

1. Position the PCA on the disk mechanism so that the four mounting holes in the PCA are aligned with the mounting holes in the disk mechanism. This will align the connectors on the disk mechanism with the corresponding connectors on the PCA.
2. Press the PCA down firmly onto the disk mechanism connectors.

---

**Caution**

Failure to install the PCA mounting screws in the correct holes may damage the SCSI controller PCA.

---

3. Install the four PCA mounting screws. The screws are of three different types and must be installed in the proper mounting holes as follows:
  - The screw with the captive washer goes in the side mounting hole on the disk mechanism.
  - The screw with the unthreaded shoulder goes in the corner mounting hole of the PCA near the status LED.
  - The remaining two screws go in the other two mounting holes in the PCA.

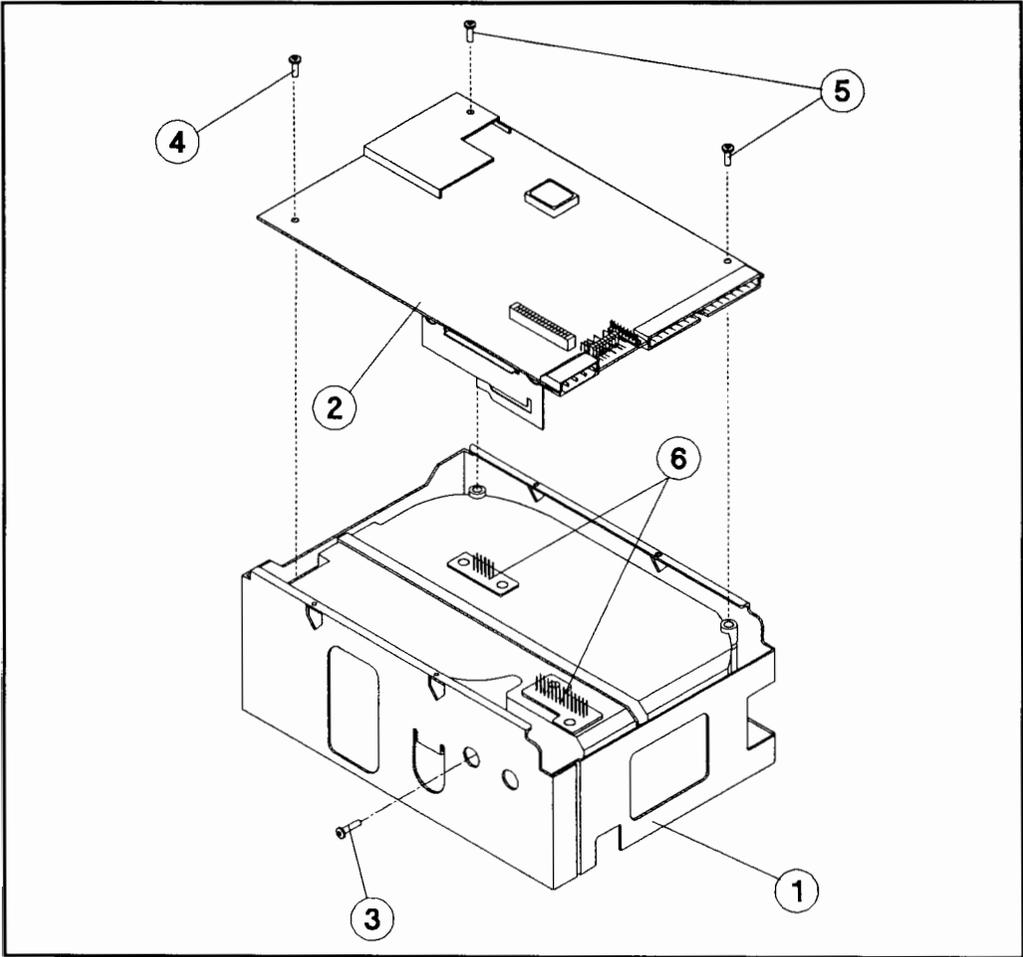


Figure 5-1. Replacing the SCSI Controller PCA

- 1. Disk Drive
- 2. SCSI Controller PCA
- 3. Mounting Screw (captive washer)
- 4. Mounting Screw (unth. shoulder)
- 5. Mounting Screws
- 6. PCA Connectors

**Firmware ROM****Note**

---

Whenever a faulty SCSI controller PCA is removed, the firmware ROM should be transferred from the faulty PCA to the replacement PCA.

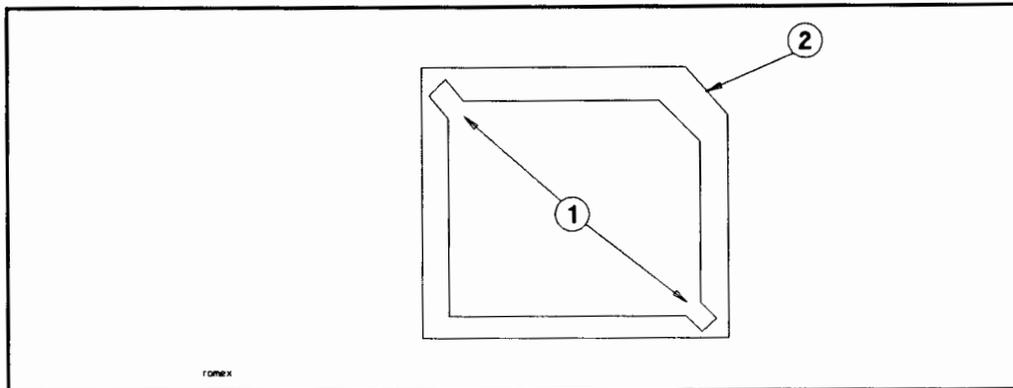
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**To remove the firmware ROM (see Figure 5-2):**

1. Insert the tapered end of the extraction tool, part no. 8710-1982, into one of the extraction slots in the socket.
2. Pry up on the corner of the chip.
3. Repeat steps 1 and 2 for the opposite corner of the chip.
4. Remove the firmware ROM.

**To replace the firmware ROM (see Figure 5-2):**

1. Match the beveled corner of the ROM with the locator key in the socket (see Figure 5-2).
2. Place the ROM on the socket.
3. Push the ROM gently into the socket.



**Figure 5-2. ROM Socket**

1. ROM Extraction Slots
2. ROM Locator Key

### **Front Panel**

**To remove the front panel (see Figure 5-3):**

1. Grasp the lower corners of the front panel and pull the plastic posts out of the post holes.
2. Repeat step 1 for the upper corners of the front panel.

**To replace the front panel:**

1. Place the front panel plastic posts over the post holes.
2. Press the posts into the holes until they snap into place.

## Field Stocking Inventory

Table 5-1 shows the new and exchange parts numbers for field stocking.

**Table 5-1. Field Stocking Inventory**

<b>NEW PART NO.</b>	<b>EXCHANGE PART NO.</b>	<b>DESCRIPTION</b>
97556-60162	97556-69162	DISK MECHANISM, 5.25-inch, 677-megabyte
97560-60162	97560-69162	DISK MECHANISM, 5.25-inch, 1355-megabyte
97560-60021	97560-69021	DRIVE CONTROLLER PCA, single-ended, without firmware ROM
97560-60020	97560-69020	DRIVE CONTROLLER PCA, differential, without firmware ROM
NS <sup>1</sup>	NS <sup>1</sup>	FIRMWARE ROM, for C2214B, C2216T, and C2217T products
NS <sup>1</sup>	NS <sup>1</sup>	FIRMWARE ROM, for C2461R/F and C2462R/F products
NS <sup>1</sup>	NS <sup>1</sup>	FIRMWARE ROM, for C2481A and C2482A products
<sup>1</sup> Not stocked; call factory for current part number and ordering instructions.		

## Replaceable Parts

Table 5-2 lists the major replaceable parts by product and model number. Table 5-3 is a complete list of the replaceable parts shown in Figure 5-3.

**Note** Refer to the storage system service manual for information on drive mounting hardware.



**Table 5-2. Replaceable Parts Product Matrix**

Product No.	Disk Mechanism	Drive Controller	Firmware ROM
C2214B	97560-60162	97560-60021	NS <sup>1</sup>
C2461R	97556-60162	97560-60021	NS <sup>1</sup>
C2462R	97560-60162	97560-60021	NS <sup>1</sup>
C2481A	97556-60162	97560-60020	NS <sup>1</sup>
C2482A	97560-60162	97560-60020	NS <sup>1</sup>
C2216T	97556-60162	97560-60021	NS <sup>1</sup>
C2217T	97560-60162	97560-60021	NS <sup>1</sup>
C2461F	97556-60162	97560-60021	NS <sup>1</sup>
C2462F	97560-60162	97560-60021	NS <sup>1</sup>

<sup>1</sup>Not stocked; call factory for current part number and ordering instructions.

Table 5-3. Drive Replaceable Parts

FIG.- INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY
5-3-1	97556-60162	DISK MECHANISM, 5.25-inch, 677-megabyte	1
	97560-60162	DISK MECHANISM, 5.25-inch, 1355-megabyte	REF
2	C2260-60049	FRONT PANEL, for Minitower products only	1
3	97560-80005	PCA INSULATOR	2
4	97560-60021	DRIVE CONTROLLER PCA, single-ended, without firmware ROM	1
	97560-60020	DRIVE CONTROLLER PCA, differential, without firmware ROM	REF
5 <sup>1</sup>	NS	FIRMWARE ROM, for C2214B, C2216T, and C2217T products	1
	NS	FIRMWARE ROM, for C2461R/F and C2462R/F products	REF
	NS	FIRMWARE ROM, for C2481A and C2482A products	REF
6 <sup>2</sup>	0515-1246	SCREW, T10, M3.0 x 0.50 x 6 mm long	2
7 <sup>2</sup>	97560-20046	SCREW, T10, M3.0 x 0.50 x 8 mm long, with unthreaded shoulder	1
8 <sup>2</sup>	0515-0430	SCREW, T10, M3.0 x 0.60 x 6 mm long, with captive washer	1
9	C2260-60041	ADDRESS CABLE, 4-wire, for C2214B, C2216T, C2217T, C2481A and C2482A products	1
	C2260-60042	ADDRESS CABLE, 5-wire, for C2461R/F and C2462R/F products	REF
<sup>1</sup> Not stocked; call factory for current part number and ordering instructions.			
<sup>2</sup> These parts may be obtained locally by their description.			

## 5-10 Removal and Replacement

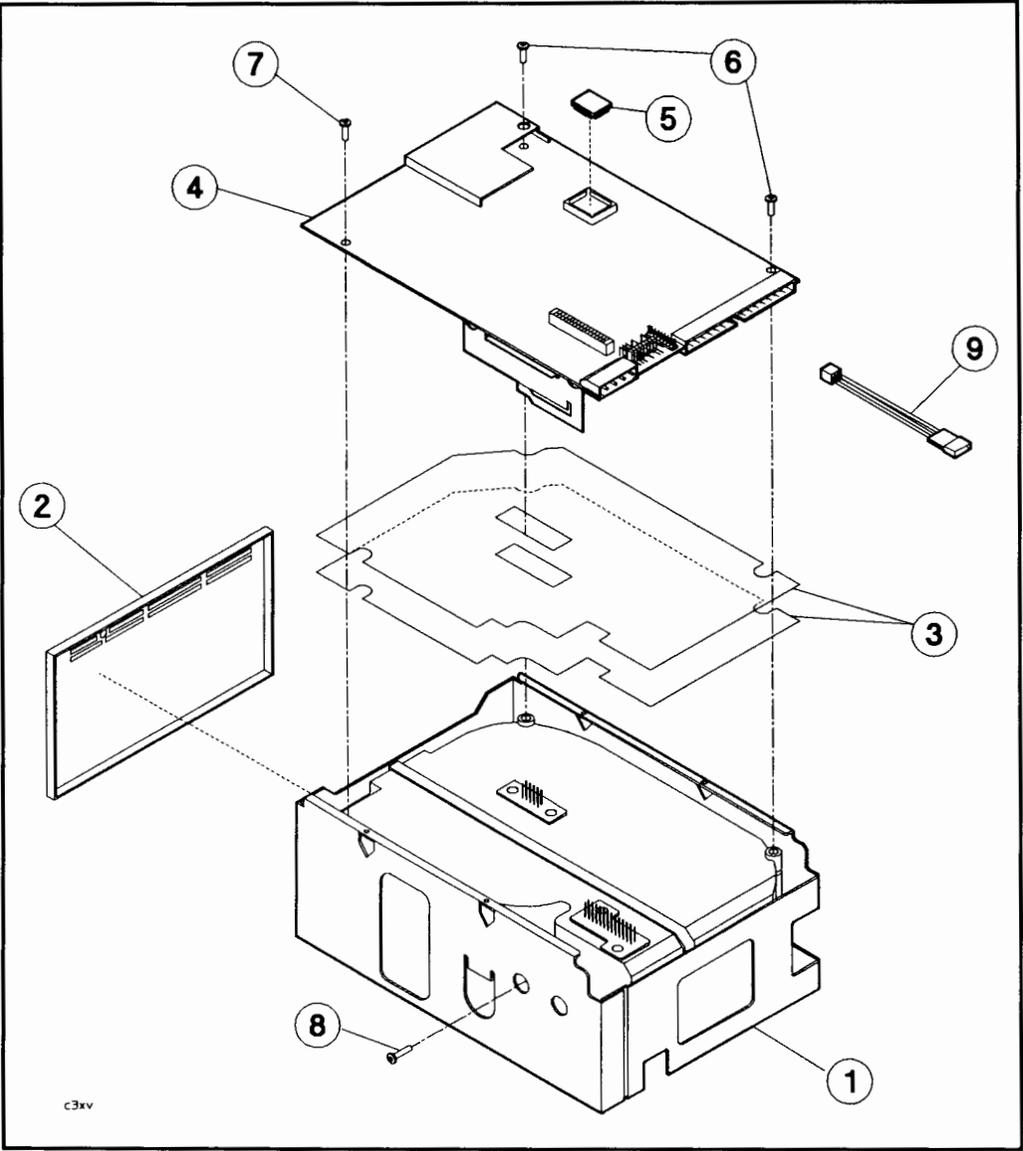


Figure 5-3. Drive Exploded View



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