HEWLETT PACKARD

This package contains a section of the

CE SERVICE HANDBOOK
FOR
79XX SERIES DISC DRIVES

and consists of the following document:

Insert this section into the handbook binder P/N 9282-0683 along with cover and tabset P/N 5957-4228.

P.O. Box 39, Boise, Idaho 83707-0039

Notice

The information contained in this document is subject to change without notice.

♦

FOR U.S.A. ONLY

The Federal Communications Commission (in 47 CFR 15.838) has specified that the following notice be brought to the attention of the users of this product.

FEDERAL COMMUNICATIONS COMMISSION
RADIO FREQUENCY INTERFERENCE
STATEMENT

Warning: This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: re-orient the receiving antenna; relocate the computer with respect to the receiver; move the computer away from the receiver; plug the computer into a different branch circuit. If necessary, the user should consult the dealer or authorized field service representative for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: "Interference Handbook." This booklet is available from the U.S. Government Printing Office, Washington, DC 20402. Stock No. 004-000-00450-7.

HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

Herstellerbescheinigung

Hiermit wird bescheinigt, daß das Gerät/System HP 7957B, 7958B and 7959B in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Manufacturer's Declaration

This is to certify that the product(s) HP 7957B, 7958B and 7959B is in accordance with the Radio Interference Requirements of Directive FTZ 1046/1984. The German Bundespost was notified that this equipment was put into circulation; the right to check the series for compliance with the requirements was granted.

Additional Information for Test and Measurement Equipment

If Test and Measurement Equipment is operated with unscreened cables and/or used for measurements on open setups, the user has to assure that under operating conditions the Radio Interference Limits are still met at the border of his premises.

For Japan

この装置は，第二種情報装置（住宅地域又はその隣接した地域において使用されるべき情報装置）で住宅地域での電波障害防止を目的とした情報処理装置等電波障害自主規制協議会（VCCI）基準に適合しております。

しかし，本装置をラジオ，テレビジョン受信機に近接してご使用になると，受信障害の原因となることがあります。

取扱説明書に従って正しい取り扱いをして下さい。

This apparatus is a class 2 ITE (information apparatus which may be used in residential and adjacent areas) which meets the VCCI standards to prevent radio interference in residential and adjacent areas. However, this apparatus may become a source of radio interference if used within close range of radio or television receivers. To ensure compliance, this apparatus must be operated according to instructions included with the product.

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Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page change only when a new edition or a new update is published. No information is incorporated into a reprinting unless it appears as a prior update; the edition does not change when an update is incorporated.

A software code may be printed before the date; this indicates the version level of the software product at the time the manual or update was issued. Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

Edition 1 .... MARCH 1988

d

Safety Considerations

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 or practice that, if not correctly performed or adhered to, could result in personal 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 or practice that, 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 according to the input power configuration instructions provided in this manual.

If this product is to be operated with an auto-transformer make sure that 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 after the product has been disconnected from the main power source.

To avoid a fire hazard, fuses with the proper current rating and of the specified type (normal blow, time delay, etc.) must be used for replacement. To install or remove a fuse, first disconnect the power cord from the device. Then, using a small flat-bladed screw driver, turn the fuseholder cap counterclockwise until the cap releases. Install either end of a properly rated fuse into the cap. Next, insert the fuse and fuseholder cap into the fuseholder by pressing the cap inward and then turning it clockwise until it locks in place.

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Adjustments **6-1**

Chapter 7 **Page**
Peripherals **7-1**

Chapter 8 **Page**
Replaceable Parts **8-1**

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Figures and Tables

1-1. Product Description

Features

- 81-megabyte capacity (formatted) – HP 7957B
- 152-megabyte capacity (formatted) – HP 7958B
- 304-megabyte capacity (formatted) – HP 7959B
- Hewlett-Packard Interface Bus (HP-IB)
- Rugged, sealed head-media design
- 5.12-inch thin-film media
- Thin-film heads
- 18.0 ms average seek time
- Integrated controller and power supply
- Built-in diagnostic capability
- Auto sparing
- Offline media maintenance

Unless otherwise specified, "disc drive" in this publication refers to all three models of the drive.

Physical Characteristics

Refer to the *Site Environmental Requirements Manual*, part no. 5955-3456, for details regarding the physical characteristics of the disc drive.

1-2. Options and Accessories

The following items are included with the standard drive:

```
07959-90901    HP 7957B, 7958B, and 7959B Owner's Manual
5955-3456      Site Environmental Requirements
               for Disc/Tape Drives Manual
8120-1378      Power Cord
2110-0003      Fuse (2 each)
```

The following options are available:

```
OPTION 015     Set for 230 Vac operation
OPTION 550     Delete HP-IB cable
```

The following accessories are available:

```
HP 92211R      Desk-height stand-alone cabinet
HP 19500B      Rack mounting kit for 19-inch rack
```

The following packaging items are required when repackaging the drive for shipment:

```
9211-4692       Shipping Carton
9222-1177       Plastic Bag
07941-80001     Foam Cushion (2)
```

1-3. Operating Specs and Characteristics

Operating specifications and characteristics for the drive are given in the *Site Environmental Requirements for Disc/Tape Drives Manual*, part no. 5955-3456. This publication is contained in a section of this handbook.

1-4. Service Kit

The following items are recommended as a Product Support Package for the drive.

```
┌─────────────┐
│    NOTE     │
└─────────────┘
```

Disc Memory Division does not supply this package.

```
5110-0566       HP 85 External Exerciser Tape 1 (Rev 2735 and up)
5110-0567       HP 85 External Exerciser Tape 2 (Rev 2735 and up)
5955-3462       CS/80 External Exerciser Reference Manual
8710-1426       TORX* Field Kit
9300-0794       Anti-static Work Station
07959-90905     7957B, 7958B and 7959B Disc Drives (insert for
                CE Handbook)
```

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

2-1. Environmental Requirements

Environmental specifications for the drive are given in the *Site Environmental Requirements for Disc/Tape Drives Manual*, part no. 5955-3456. This publication is contained in a section of this handbook.

2-2. Installation

First-time installation of the drive requires the use of the following manuals:

- *Site Environmental Requirements for Disc/Tape Drives Manual*, part number 5955-3456.

- *HP 7957B, 7958B, and 7959B Owner's Manual*, part number 07957-90901.

2-3. Installation Checklist

1) Verify input ac voltage, fuse rating, and VOLTAGE SELECTOR switch setting.

2) Connect HP-IB cable and set ADDRESS switch.

3) Power up and perform self-test (refer to chapter 4).

2-4. Handling

While the disc drive has been designed to withstand a certain shock, level it is still a delicate device. Care should be taken when handling or transporting the product. The following precautions should be observed when handling or transporting the disc drive. Failure to observe these handling precautions could result in loss of data or damage to the product.

Handling Precautions

- Avoid sharp shocks to the disc drive.

- Always repackage the disc drive in approved packaging (see figure 2-1) when transporting the product from one area to another.

2-5. Controls and Connectors

Figure 2-2 shows the location of the disc drive controls and indicators.

FOAM CUSHION*

DISC DRIVE

PLASTIC BAG.
PART NO. 9222-1177

FOAM CUSHION*

SHIPPING CARTON,
PART NO. 5180-0543

* PART NO. 07941-80001. INCLUDES TWO
IDENTICAL FOAM CUSHIONS.

W7987B02
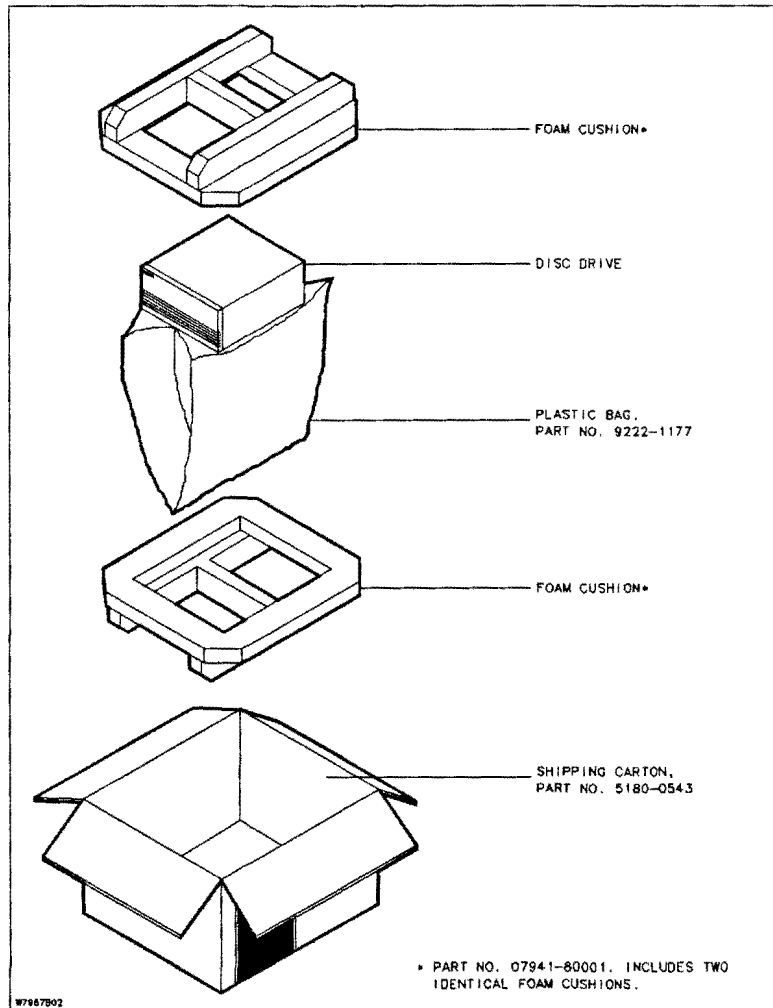
Figure 2-1. Packaging Details
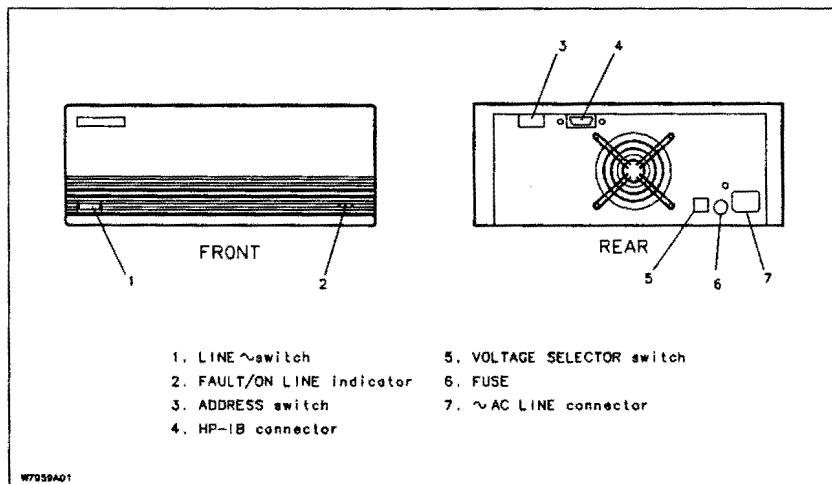
Figure 2-2. Controls and Connectors

2-6. AC Power: Voltage Selection/Fuse/Cords

Voltage Selection:

CAUTION

Disconnect the power cord from the disc drive ~AC LINE connector before changing the VOLTAGE SELECTOR.

Slide the VOLTAGE SELECTOR switch to the proper position (115V or 230V) for the voltage available.

Fuse:

WARNING

Remove the power cord from the disc drive before installing or replacing the fuse. Failure to do so may result in electrical shock hazard. Replace the fuse with one of the same type and rating.

The same fuse is used for 115V and 230V operation:

HP part no. 2110-0003   DESCRIPTION: 3A, 250V, non time-delay

Power Cords;

Refer to Appendix D in the *Site Environmental Requirements for Disc/Tape Drives Manual*, part no. 5955-3456, for power cord information.

2-7. HP-IB Interconnections

| CAUTION |

Do not connect or disconnect the HP-IB cable to the disc drive if the system is in an active state.

Do not power the disc drive down if the system bus is in an active state. Failure to observe this may result in damage to the disc drive.

A 1-metre HP-IB cable is supplied with the disc drive. Other HP-IB cables available from the Corporate Parts Center are listed below (lengths must be within load limits specified in next paragraph).

CABLE LENGTH (METRES)	PRODUCT NUMBER
0.5	10833D
1.0	10833A
2.0	10833B
4.0	10833C
6.0	8120-3448
8.0	8120-3449

Cabling is limited to one metre per HP-IB load. Typically, the host system is seven equivalent loads and a disc drive is one equivalent load. In multi-drive systems, the HP standard allows seven metres of cable between the host and the nearest device, and one metre between each additional device. The maximum configuration is eight devices (not including the CPU) per HP-IB channel or a maximum of 15 metres or 15 equivalent loads (see figure 2-3). Refer to the host *Configuration Guide* for any additional system limitations.

2-8. HP-IB Device Address

Set the HP-IB address on the ADDRESS switch. The location of the switch is shown in figure 2-2.

2-9. Preventive Maintenance

No regularly scheduled PM is required.
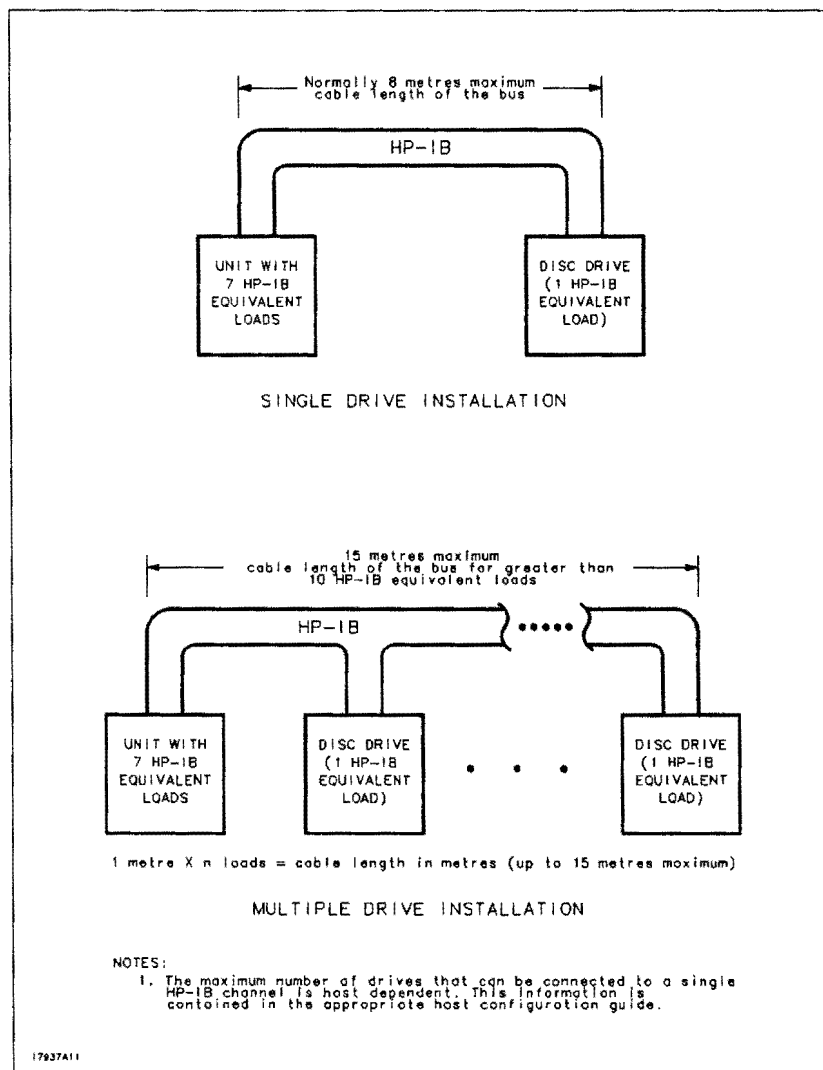
Figure 2-3. Maximum HP-IB Cable Length

Configuration 3

For system configuration, refer to the appropriate configuration section of the system manual.

The disc drive itself requires no configuration other than voltage selection and HP-IB address switch setting as described in the installation instructions in chapter 2.

Troubleshooting 4

4-1. Troubleshooting

When troubleshooting the disc drive, the first thing to do is to determine if the fault is repeatable or intermittent. A repeatable fault usually causes the same self-test fail result to be presented each time self-test is performed. An intermittent fault, on the other hand, occurs at random intervals, and may not always cause a self-test failure. Use the self-test repetition feature described in paragraph 4-8 to loop on self-test.

In the case of a repeatable fault, self-test will identify the failing field replaceable assembly (FRA) with a 95 percent certainty. In the event that more than one FRA is listed as the possible cause of the failure, replace the FRA's one at a time, in the order given in the self-test display.

```
NOTE
```

Cable faults (an open cable conductor, loose cable connector, etc.) may present a multiple FRA failure message. The FRA's listed will be the FRA's at either end of the defective cable. All cabling should therefore be checked before replacing any FRA's.

Ribbon cables W2, W3 and power cable W1 are sufficiently long to allow a substitute disc drive assembly A1 (FRA1) to be connected into the circuit adjacent to the disc drive cabinet. This permits the substitute A1 to be connected into the circuit without removing the disc drive assembly from the cabinet.

Attempt to isolate the fault to a specific FRA by running self-test following the replacement of each FRA.

There are two offline utilities that help isolate intermittent faults: repetitive self-test and media maintenance.

To perform repetitive self-test, do the following:

- Set the rear-panel ADDRESS switch to 9

- Turn on the disc drive power

- Set the ADDRESS switch to the normal HP-IB address (0-7) to terminate the test

To perform the media maintenance test, do the following:

CAUTION

The media maintenance test erases all data on the disc! If needed data is stored on the disc, make sure it has been saved on tape first.

- Set the ADDRESS switch to 8.

- While display flashes, set the ADDRESS switch to 9.

- The green LED will flash during media maintenance; this is normal.

- Set the ADDRESS switch to the normal HP-IB address (0-7) to terminate the test.

An internal auto-sparing routine helps keep the need for troubleshooting to a minimum. Since the auto-sparing routine moves sectors and tracks when necessary without being told to do so, the distinction between physical and logical addresses may be confusing.

4-2. Self-test Display

Results of the power-on self-test routines are presented on the red/green FAULT/ON LINE indicator on the front panel. See figure 4-1. Details of how to interpret this display are presented in the following paragraphs.

The FAULT/ON LINE indicator signals to the user the operating status of the disc drive. When line voltage is applied to the drive, the FAULT (red) and ON LINE (green) portions of the display are illuminated for two (2) seconds while the disc drive controller is tested and the disc drive mechanism spins up. If both the red and green indicators remain lit for longer than two seconds after power is applied, an error state exists caused by a failure in either the controller or the disc drive mechanism.

Following successful completion of the first part of the self-test routine, the red indicator is extinguished and the green indicator flashes for approximately 10 seconds (HP 7957B), 20 seconds (HP 7958B), or 30 seconds (HP 7959B) while a test of the disc drive mechanism takes place. If the disc drive mechanism passes this test, the green indicator changes from a flashing green to a solid green display. This indicates that the disc drive has successfully passed the entire self-test routine and is in a ready state.

Note: If at the completion of self-test, the red and green indicators flash together for 10 to 15 seconds and then remain lit, turn off the power to the drive and check the setting of the ADDRESS switch. It is probably set to 8 or 9.

If the disc drive mechanism fails self-test, the green indicator is extinguished and the red indicator is lit to signal the failure. However, at this time, the disc drive can still be accessed by the host CPU to run diagnostics.

After a successful completion of the entire power-on self-test routine, a solid green display indicates that the disc drive is idle and a flashing green display indicates that the disc drive is active. The action of the display at power-on and during normal operation of the drive is summarized in figure 4-1. Refer to chapter 5 for self-test subtests.

FAULT/ON LINE INDICATOR

RED	GREEN	
		SELF-TEST
ON	ON	On for 2 seconds at power on while controller runs self-test and disc mechanism spins up. If either controller self-test or mechanism spin up fails then both LED's remain on.
OFF	FLASHING	Executing self-test.
ON	OFF	Disc drive has failed mechanism self-test. Drive may still be accessed by the host CPU to run diagnostics.
		NOTE: If the display sequence differs from the one described above, check that the ADDRESS switch is set to a valid HP-IB address (0-7).
		NORMAL OPERATION (0-7)
OFF	ON	Disc drive is in a ready state.
OFF	FLASHING	Disc drive is active (i.e., reading ,writing, or processing a command).
		MEDIA MAINTENANCE (8,9)
FLASHING*	FLASHING	ADDRESS switch set to 8. Drive waiting for confirmation of desire to perform utility. (Set ADDRESS switch to 9 within 15 sec.)
ON	ON	Drive hung. ADDRESS switch not set to 9 within 15 sec.
OFF	FLASHING	ADDRESS switch set to 9 within 15 sec. Drive executing media maintenance utility.
ON	OFF	Drive failed media maintenance utility. Change to valid HP-IB address.
FLASHING	ON	ADDRESS switch changed. Set to desired HP-IB address.

*The LED's flash at a slower rate during selection and execution of the media maintenance utility.

C7969A03

Figure 4-1. FAULT/ON LINE Indicator

4-3. FRA Location and Layout

CAUTION

The field-replaceable assemblies (FRA's) in the disc drive are electrostatic-sensitive devices. Take appropriate precautions when removing the FRA's from the disc drive. Use of an anti-static pad and wrist strap is recommended. (These components are contained in the anti-static work station, part no. 9300-0749.) Immediately after removal, store the FRA's in anti-static, conductive plastic bags.

Figure 4-2 shows the location of the FRA's. Figures 4-3 through 4-5 show the layout and cable connections for each FRA. Figure 4-6 is an overall cabling diagram of the disc drive.

4-4. Power Supply Voltage

WARNING

With ac power applied, hazardous voltages are present on power supply PCA-A3.

All power supply voltages can be measured at test points on power supply PCA-A3. Figure 4-7 shows the locations of these test points and the values that should be measured at each one.

4-5. Offline Utilities

The firmware set for controller PCA-A2 includes features that allow the user to perform offline media maintenance and self-test repetition.

The purpose of the offline media maintenance routine is to allow the disc drive user to perform an offline media verification operation and assume that the disc is defect-free afterward. The utility is designed to augment and not replace the factory sparing that has been done on new disc mechanisms. It does however, attempt to use the same sparing and error evaluation criteria (to the extent that it is possible) that is used by the product final test. The test is based around a full volume, alternate data pattern, write/read pattern error rate test. This test runs as it would if initiated via an Execute Utility command with no execution message, but with a few important exceptions.

Normally, errors encountered during an error rate test are entered in the ERT log. However, during this test, each error is conditionally spared as it is encountered. That is, a call is made to the sparing routines allowing them to decide if sparing is appropriate. The sparing routine does a 7 loop, alternate data pattern, sector mode ERT to determine if there is a defect present in the sector. If any errors are detected during this process, the sector is spared. If no errors are detected, then the sector is not spared and that address is entered into the ERT log. (Note that the entry is made only if the sector is *not* spared). If that address is found to be present in the log already, it means that it had an error previously and was not spared. In this case, a call is made to the sparing routines indicating that sparing should be "forced" on that sector. Anytime a sparing operation is forced, the address of that sector is removed from the ERT log. That guarantees that if that logical address comes up again, it will get the same treatment that any other sector would get.

4-4

MAINFRAME

U0-A2
U2-A2
(CONTROLLER
PCA-A2)

POWER SUPPLY
PCA-A3

U0-A1
(DISC DRIVE
ASSEMBLY A1)

U (unit)	A (field replaceable assembly)
0-DISC DRIVE	1-DISC DRIVE ASSEMBLY A1
	2-CONTROLLER PCA-A2
2-CONTROLLER	2-CONTROLLER PCA-A2

57869A04
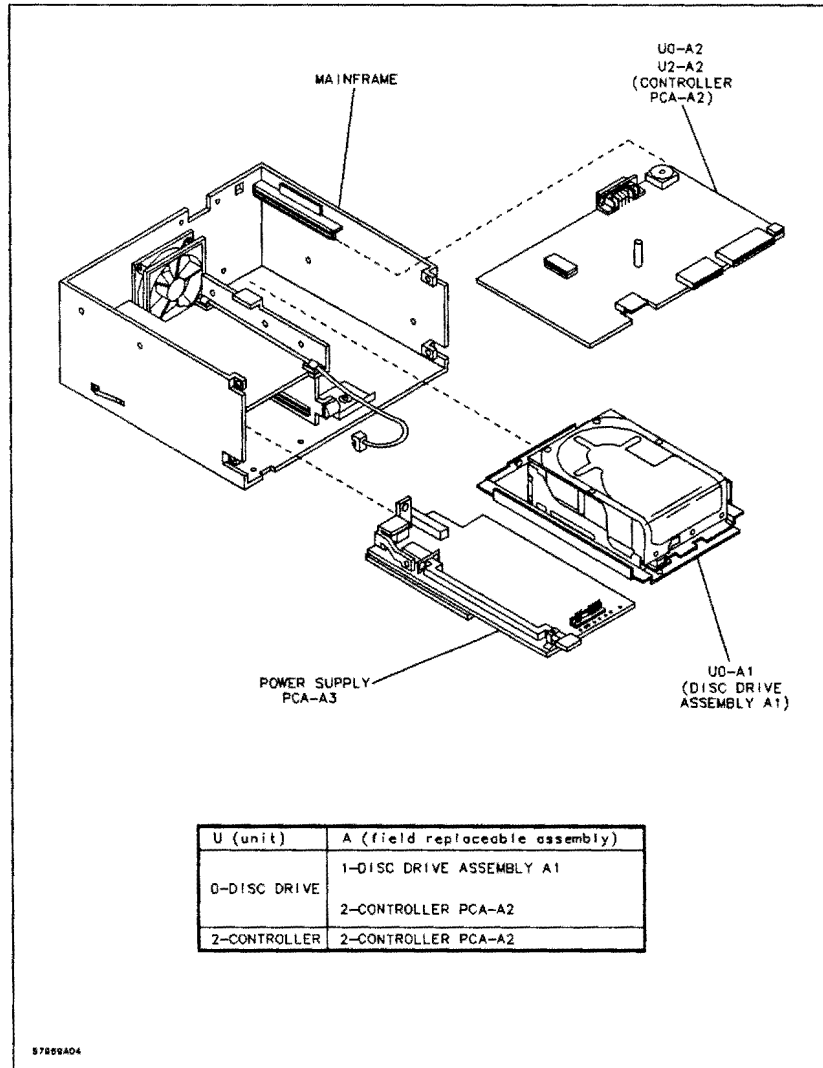
Figure 4-2. Field Replaceable Assembly (FRA) Locations

1. J1 PINS ARE NUMBERED 1 THRU 20.
   EVEN-NUMBERED PINS ARE ON SOLDER
   SIDE OF PCA. THERE IS A KEYSEAT
   BETWEEN PINS 4 AND 6.

2. J2 PINS ARE NUMBERED 1 THRU 34.
   EVEN-NUMBERED PINS ARE ON SOLDER
   SIDE OF PCA. THERE IS A KEYSEAT
   BETWEEN PINS 4 AND 6.

3. J3 IS NUMBERED AS SHOWN

TO CONTROLLER
PCA-A2

TO POWER SUPPLY
PCA-A3
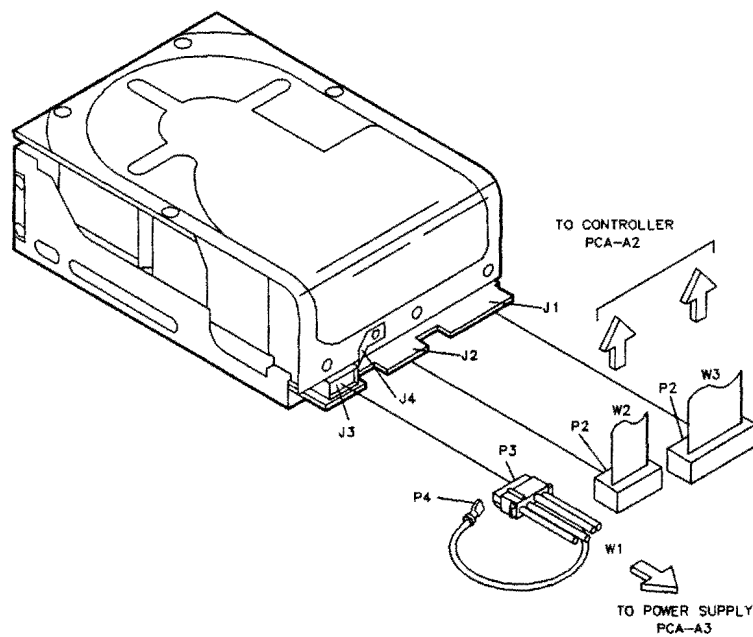
S7959A02

Figure 4-3. Disc Drive Assembly A1 (FRA1), Layout and Cable Connections
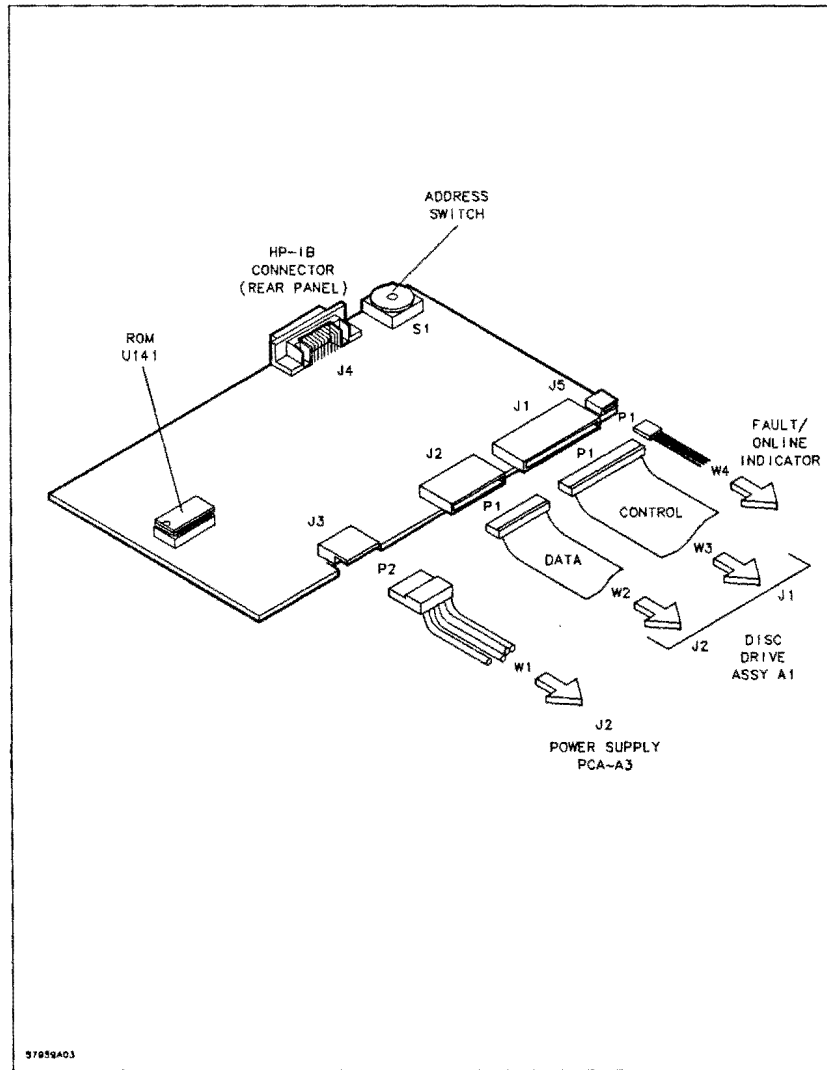
Figure 4-4. Controller PCA-A2 (FRA2), Layout and Cable Connections

FAN B1

B1P1

FUSE

P1

W1

W1

J3, J4
DISC DRIVE
ASSEMBLY A1

CONTROLLER
PCA-A2
J3

J2

S7989A07
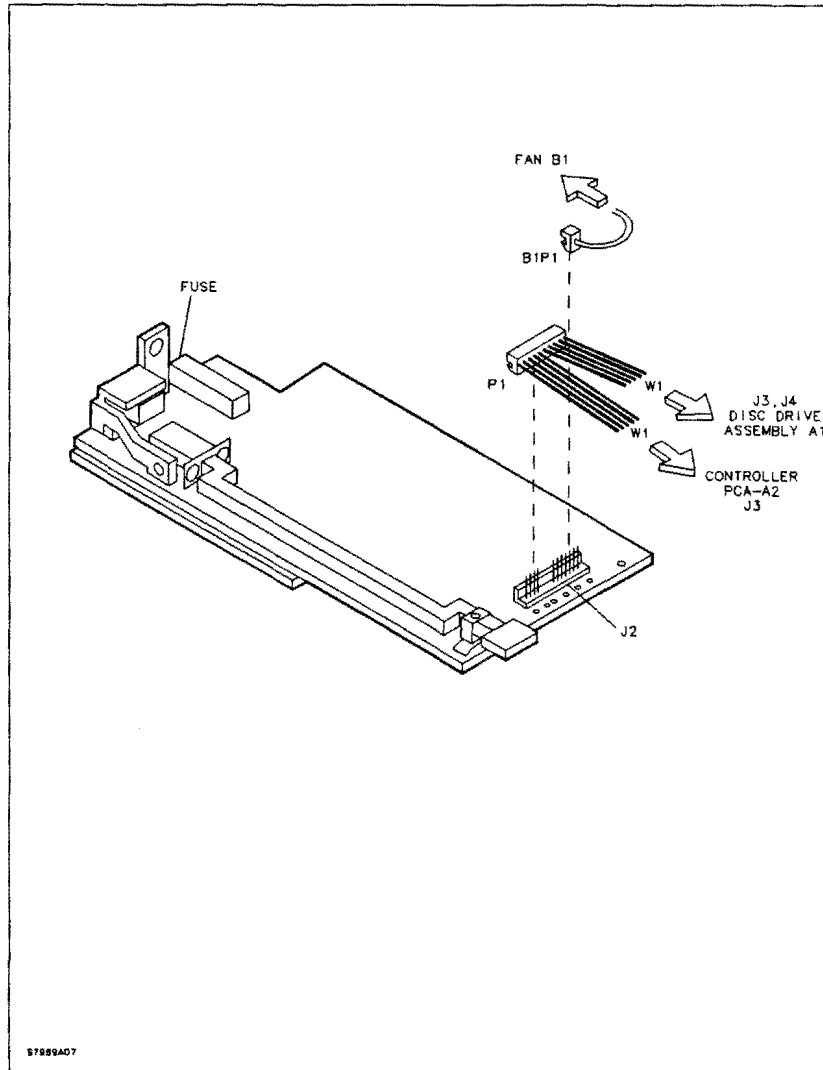
Figure 4-5. Power Supply PCA-A3, Layout and Cable Connections
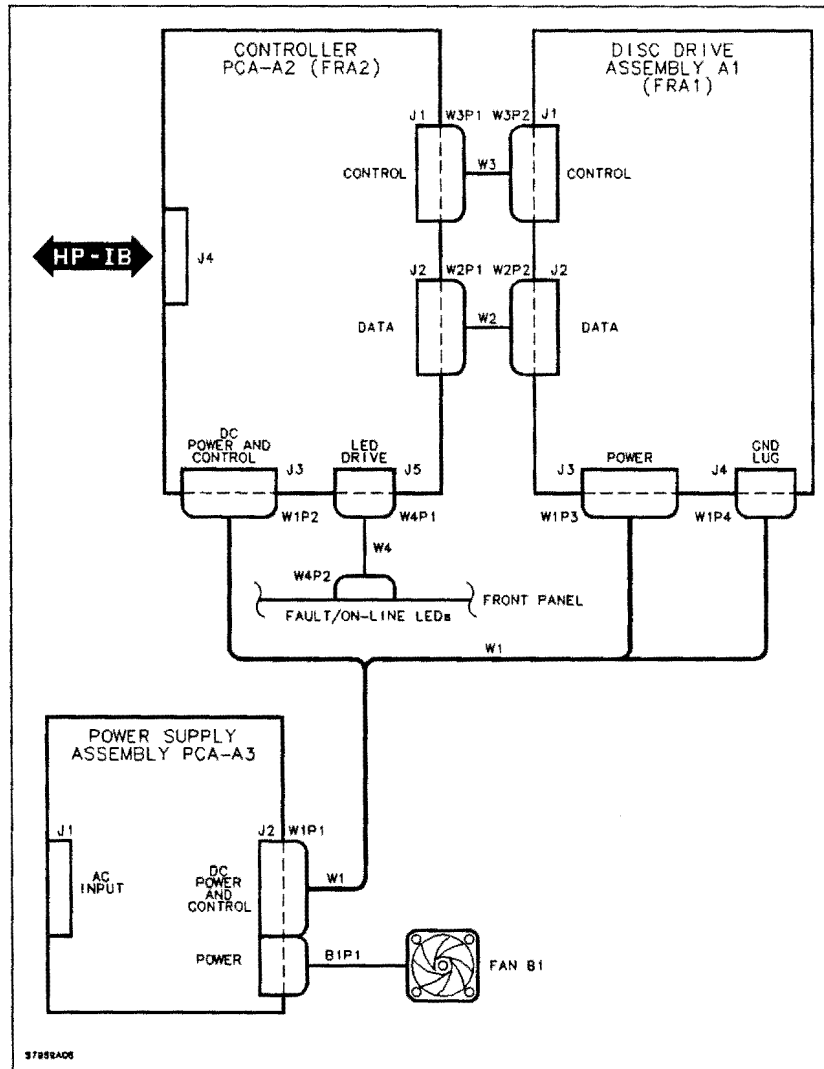
Figure 4-6. Cabling Diagram
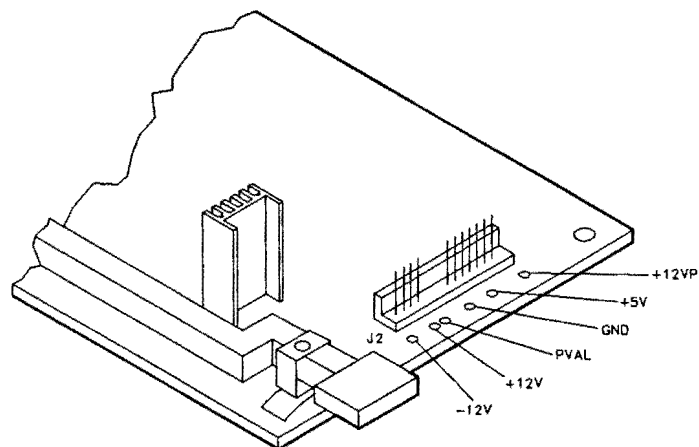
TEST POINT	VOLTAGE RANGE
−12V	−11.4 TO −12.6V
+12V	+11.64 TO +12.36V
PVAL	$\geq$ +2.4V (TYPICALLY 4.0V)
+5V	+4.85 TO 5.15V
+12VP	11.0 TO 13.0V

NOTE: 1. −12V IS NOT USED IN THE HP 7957B, HP 7958B AND HP 7959B.

2. USE GND TEST POINT FOR VOLTMETER RETURN.

3. THE OUTPUT VOLTAGES ARE NOT ADJUSTABLE.

4. MAXIMUM RIPPLE:
5V SUPPLY: <50 mV P−P
12V SUPPLIES: <100 mV P−P

S7959A08

Figure 4-7. Power Supply PCA-A3 Test Points and Voltages

The purpose of the repetitive self-test utility is to allow for extended testing of drives that have intermittent faults that may be detected by the drive self-test.

4-6. Utility Initiation

Both the media maintenance and the self-test repetition utilities are initiated using the ADDRESS switch on the rear panel of the disc drive. Since addresses 8 and 9 are not valid addresses for drives that implement the CS/80 instruction set, these numbers are used to initiate and terminate the utilities.

If the ADDRESS switch is set to 8 or 9 and self-test fails, the selected utility will not be executed. However, the drive cannot come on line since the address is not valid. Therefore, it is necessary to cycle power to the drive, set the ADDRESS switch to a valid address (0-7), and turn power on again. If self-test runs to the point that it will come on line, the fault log can be read to determine why it failed previously.

4-7. Media Maintenance

CAUTION

This utilty erases all data on the disc. If needed data is stored on the disc, make sure that it has been saved on tape first.

After the power-on self-test has completed and passed, the setting of the ADDRESS switch is checked. If it is in the range of 0 through 7, the drive will come on line. If the address is set to 8, the drive will go into a mode that allows the user to confirm that it is really desired to perform the utility. (*All data on the disc will be destroyed.*) During this time, the green and red LED's in the Fault/On Line indicator will flash together at a slow rate to indicate that the drive is waiting for that confirmation. See figure 4-1.

The user will have 15 seconds to either abort the utility or confirm its execution by changing the ADDRESS switch setting. If the ADDRESS switch is set to 9, the drive will wait until the address value is stable for 5 seconds to verify that the switch is not still turning, and then the utility will commence.

If, rather than being set to 9, the ADDRESS switch is set to a valid HP-IB address (0-7), the drive will execute another self-test and come on line as usual. If the 15-second period expires and the switch is not changed, the drive will hang with both LED's illuminated.

The utility performs the equivalent of a Pattern Write/Read Error Rate Test over the entire disc volume using the Pattern Table as the data source. It will continue to do write/read passes over the disc until a fault is encountered or the user terminates the test.

During the utility, the green LED will flash to indicate that the drive is active. Media defects are handled by the sparing routines as they are encountered and eventually even unspared discs will be cleaned up. However, data errors that cannot be verified as being media defects are stored in the ERT log which can hold 50 entries. If this log overflows during the utility, it will fail. Likewise, if any fatal faults are encountered, the utility will fail.

Normal termination of the utility is accomplished by setting the ADDRESS switch to a valid HP-IB address (0-7). After a 5-second switch verification, the drive will update the fault log, perform a power-on self-test, and come back on line. Note: Although the test will terminate when power is removed from the drive, using the ADDRESS switch is the preferred method. This is due to the fact that a sparing

operation could be performed at any time and power cycling in the middle of a sparing operation is not recommended.

If the utility fails, the green LED is turned off, and the red LED remains lit. At this point, the operator must change the ADDRESS switch to a valid HP-IB address (0-7). As soon as the switch is changed, the green LED will be illuminated and the red LED will start blinking. This indicates to the user that the desired address should be set. After a 5-second switch verification, the drive will execute a power-on self-test and will come on line. At this point, the fault log should contain a fault that indicates the reason for the failure.

4-8. Self-test Repetition

If, after self-test has completed and passed, the HP-IB address is found to be set to 9, the drive will immediately jump back and execute the self-test routine again. This looping will continue until either the self-test fails or an HP-IB address other than 9 is detected.

If the drive fails self-test, it is not possible to immediately come on line since the HP-IB address is set to 9 and the drive does not know which address to respond to. Therefore, if the failure condition is observed (either both the red and green LED's illuminated or the red LED on by itself), the drive must be power cycled. After turning the power off, and before turning it back on, the ADDRESS switch should be set to a valid HP-IB address. After power-on (pass or fail), the drive fault logs can be read and the cause of the previous failure can be determined. Note that a failure with both red and green LED's illuminated indicates a controller fault and hence no entries are made in the fault log.

If it is desired to terminate the test with the HP-IB address, it must be set to the desired state during the execution of the self-test. Since the user cannot know exactly when the switch will be read, it may be difficult to get the desired address set up in the internal hardware. The alternative is to terminate the test by power cycling the drive and setting the switch before the drive is powered back on. Note that the ADDRESS switch is read at the *end* of self-test. Consequently, changing the switch early in self-test (immediately after the red LED extinguishes) will usually allow sufficient time to set the desired address.

4-9. Errors

4-10. Error Definition

Recoverable errors are errors that are corrected on the first retry. Marginal errors are errors that are corrected after the first retry or by the error correction code (ECC). If an error is greater than 12 bits and/or there are two bad locations in a sector, ECC cannot correct this and the sector is considered unrecoverable.

4-11. Error Logs

The information in the logs is defined as follows:

```
    ERT LOG - Correctable (recoverable and marginal) errors
              Uncorrectable errors

RUN TIME LOG - Correctable (marginal) errors
               Uncorrectable errors
```

4-12

4-12. Error Detection and Correction

Error detection is implemented during run time and during diagnostics. Error correction is implemented only when errors are detected during run time and the error is not correctable during retries. The run time error detection and correction sequence is described as follows:

- An error is detected and read by the ECC circuits inside controller PCA-A2.

- Retries are initiated.

- On each retry, data is read and checked by the ECC circuits.

- The first retry is done on track center.

- The retry is then done once with a negative radial offset; then once with a positive radial offset.

- If the data is unreadable during each retry, the disc drive loops back with one retry on track, one retry with positive offset, one retry with negative offset; for a total of 36 retries.

- If a correct reading cannot be accomplished with the retries (a total of 36 retries for 800ms), ECC is invoked to correct up to 12 bits.

- If the error is greater than 12 bits and/or there are two bad locations in a sector, ECC cannot correct this and the sector is considered unrecoverable.

During WTR ERT testing a pattern is written to the track and then read back. If an error is detected, the retries are initiated as follows:

- The disc drive makes 12 retries on track center.

- If the data is not read correctly with the first 12 retries, more retries are made with a positive offset.

- If the data is not read correctly with the first two sets of retries, then 12 more retries are initiated with a negative offset.

If the data is not read correctly with the retries (36 retries for 800 ms), an error is recorded in the log.

4-13.   Auto-sparing

The auto-sparing function incorporated in the drive electronics is described in the following paragraphs.

4-14. Purpose

Media defects in the drive will make themselves apparent to the system by reporting a Marginal Data error or Unrecoverable Data error to the host during a read or write operation. When a data error occurs, the drive automatically performs a sparing operation without intervention of the CE.

It should be noted that while auto-sparing will not help recover data that is unrecoverable, it will move data such that rewriting the bad data will allow it to be rewritten on good media. If an error is marginal, then auto-sparing will move the data to good media before it becomes unrecoverable.

4-15. Description

An auto-sparing operation is invoked by the drive when a read operation has detected a data error and all of the data has been sent to the host (before the drive responds to PPOLL for the Report phase). The track with the erroneous data is moved to a new location (sparing may be sector sparing or track sparing) and any unrecoverable sectors will continue to report that status if read again. If the data is written by the host, subsequent reads will report no errors. If the data is read after the auto-sparing operation but before it is written, a previously marginal data error would not be reported but a sector with an unrecoverable error would still report the same error.

A data error in the sector header may be reported during a write operation. When this occurs, the controller will sink the remaining data from the host and then auto-sparing will be performed. If the host then retries the write operation, the data will be written out at the spared out location.

An auto-sparing operation will normally take one to two seconds. However, the time could be longer if extensive retries are needed to recover the data.

After the auto-sparing operation has completed, the auto-sparing invoked bit (bit number 55) will be set in the Information Errors Field of the status message. This means that the operation will complete with a QSTAT if 1 unless the host has masked out that status bit.

A disc error will cause a log entry, but it should only occur once before it is auto-spared. If an entry has an occurrence count greater than 1 then either there is a problem with the drive (for example, out of spares) or the auto-sparing feature has been turned off.

The default mode for the drive is auto-sparing on. Auto-sparing can be turned off via the Set Options command (set bit 2 of the parameter byte) and it will also be turned off in the event self-test fails. Auto-spared locations will be designated as Field spares.

A list of sectors intentionally written unrecoverable is kept to prevent auto-sparing from being attempted when it is known that the sector has already been auto-spared (it is reported as unrecoverable until it is rewritten). This implies that each write operation must check this list and delete entries as they are written, but most of the time the list will be empty.

4-16. Auto-sparing Details

When an error occurs during a read operation, that sector becomes a candidate for auto-sparing. When all of the data has been sent to the host (before PPOLL response is enabled for the Report message), auto-sparing is attempted as follows:

1. Check the list of intentionally written bad sectors for the candidate sector. If it is present do not attempt auto-sparing.

2. Locate a good track in the spare pool and format with the logical address of the track being spared.

3. Move the data from the bad track to the good track, moving the sectors with unrecoverable data errors with read and write full sector operations to maintain the unrecoverable status.

4. Verify the new track to assure that the proper sectors are unrecoverable. If there are unrecoverable sectors that were not written that way intentionally, the data for that sector is rewritten. If the unrecoverable error remains, there is an attempt to perform a sector spare on the location and the data is rewritten. If there is still an unexpected unrecoverable error, then the track is flagged as defective and

the auto-sparing operation terminates (if the original defect is hit again, another auto-sparing attempt is made with the data being moved to a different track).

5. Go back to the original track and test it for data errors. Sector sparing will be done if possible to make the track good, otherwise it will be considered to be a bad track and marked defective. If the old track is defective then the new track is left as a proper spare track and the auto-sparing is complete.

6. Since the original track is now an allegedly good track, move the data back to it, again retaining all un-recoverable sectors.

7. Verify the track to be sure the unrecoverable sectors map to the proper sectors and there should be no marginal sectors. If there is a marginal or unexpected unrecoverable sector, it is rewritten and checked. If it is still marginal or unrecoverable, sector sparing will be done if the spare sector is available, other-wise the track is flagged defective and the spare track is used. If they do map properly, go back to the new track and return it to the spare pool.

8. When the auto-sparing is completed, add any sectors that were written with unrecognizable data errors to the list of intentionally written bad sectors.

Diagnostics 5

5-1. CS/80 Implementation Information

The following information provides details of how various CS/80 commands are implemented in the disc drive. Refer to table 5-1 for a list of supported utilities.

5-2. Initialize Media Command

The following format options are available when using the Initialize Media command:

Format Option A - This option will write zeros (0's) over the logical tracks. Spare tracks and the spare table are not affected. This option does not write over the headers and is completed in a short time.

Format Option P - This option will de-allocate the field (secondary) spares and writes zeros (0's) over the logical tracks. This option takes approximately 5 minutes to complete.

Format Option R - This option reformats all tracks on the disc, but maintains sparing. The headers from the disc are read into the CEC buffers. These headers are used to reformat the tracks. All tracks are reformatted. Sector and track sparing are maintained. This option takes approximately 10 minutes to complete.

5-3. Initiate Diagnostics Command (DIAG)

The following options are available when using this command:

> 0 = initiates self-test
> 1 = initiates random seek test

For more information, refer to Self-test Subtests later in this chapter.

5-4. CS/80 Describe Command Response

In response to a CS/80 Describe command, controller PCA-A2 will respond with the following information:

```
CONTROLLER DESCRIPTION FIELD
INSTALLED UNIT <1 bit for each unit>:
****1000 0000 0000 0001****
MAXIMUM TRANSFER RATE: 1000 K-BYTES/SEC
CONTROLLER TYPE:  0
<INTEGRATED SINGLE-UNIT CONTROLLER>
```

UNIT 0 DESCRIPTION FIELD	7959B	7958B	7957B
GENERIC DEVICE TYPE: 0			
<FIXED DISC>			
HP PRODUCT NUMBER 079591		079581	079571
NUMBER OF BYTES PER BLOCK 256		256	256
NUMBER OF BLOCKS THAT CAN			
BE BUFFERED 64		64	64
RECOMMENDED BURST SIZE 0		0	0
BLOCK TIME (microseconds) 256		256	256
CONTINUOUS AVE TRANS RATE			
<KBYTES/SEC> 768		768	768
OPTIMAL RETRY TIME			
(tens of millisec).................................. 80		80	80
ACCESS TIME PARAMETER 500		500	500
MAXIMUM INTERLEAVE FACTOR 1		1	1
FIXED VOLUME BYTE <one bit per vol>:			
****0000 0001****			
REMOVABLE VOLUME BYTE <one bit per vol>:			
****0000 0000****			

VOLUME 0 DESCRIBE FIELD			
MAXIMUM CYLINDER ADDRESS 1571		1571	1268
MAXIMUM HEAD ADDRESS 11		5	3
MAXIMUM SECTOR ADDRESS 62		62	62
MAXIMUM SINGLE-VEC ADDRESS 1188431		594215	319787
CURRENT INTERLEAVE FACTOR 1		1	1

5-5. Request Status

If an Initiate Diagnostic command (DIAG) is issued to the disc drive and an execution message returns a QSTAT of 1, this means that a self-test error has occurred. A Request Status command (REQSTAT) should be issued to obtain the reason for the previous QSTAT of 1. When the Request Status command is executed, a 20-byte field is returned. This field is defined in the *CS/80 Instruction Set Programming Manual*, part no. 5955-3442. When self-test is executed and it fails, the Diagnostic Result Bit (bit 24) will be set in the Fault Error Field (sometimes referred to as the Error Fault Field) of the 20 bytes

returned from the Request Status command. When bit 24 is set, P1, P2, P3, P7, and P8 contain specific self-test results, as detailed below:

- P1 - Identifies the most suspect FRA:
    - 1 = FRA1 (disc drive assembly A1)
    - 2 = FRA2 (controller PCA-A2)

- P2 - Identifies the next most suspect FRA:
    - Same code as P1

- P3 - Failed disc drive (unit 0) self-test subtest.
    - Refer to table 5-2

- P7 - Failed disc drive error condition.
    - Refer to table 5-2

- P8 - Details of failed disc drive error condition.
    - Refer to table 5-2

The following example shows how to interpret P1, P2, P3, P7 and P8 returned for a Request Status command following a self-test failure.

P1 = 1
P2 = 2
P3 = 4EH (hex)
P7 = 4EH
P8 = 0000 0100

P1 indicates that the most suspect FRA is FRA1 (disc drive assembly A1 [HDA]). P2 indicates that the next most suspect FRA is FRA2 (controller PCA-A2 [controller]). P3 indicates that the failed self-test subtest is 4EH which is defined in table 5-2 as "Seek diagnostic failed". P7 contains the fault code 4EH and P8 contains the ESDI status with bit 2 set indicating a seek fault.

Note: P7 may contain a fault code other than 4EH if more detailed information on the cause of the failure is available.

5-6. Spare Block Command

In order to prevent double sparing, a Spare Block command will cause a sector to be spared only if there is truly a media defect at that location. If the host requests a sector to be spared and there is no defect at that location, the QSTAT will be zero (0) even though no sparing operation has been done. If the host specifies the spare retaining data option, the data from the defective sector will be retained as long as it is not unrecoverable (an unrecoverable sector will cause the format pattern to be placed in the defective sector's place).

If the host wishes to force the sparing operation, bit 3 of the Spare Block command's parameter byte will cause the block to be spared regardless of whether or not there is a media defect in the sector. This is useful when a media defect is such that it is very difficult to detect, but needs to be spared anyway.

It is desirable for the host to know what happened when the spare block command executes, so the sparing information available in the status message (immediately after the spare block command) will tell whether or not the sparing operation was performed. The length of the reformatted area (which indicates whether

sector or track sparing was done) is reported in parameter bytes 7 through 10. With this sparing implementation, parameter bytes 8, 9, and 10 will contain a one (1) if sector sparing was done, a 63 for track sparing and a zero (0) will be reported if the drive determines that the sector does not need to be spared. If the spare option is to retain data and the data from the defective sector is successfully read, then parameter byte 7 of the status message will be set to one (1). If the data is not successfully read or the sparing option is to not retain data, then parameter byte 7 will be zero (0).

5-7.   Utilities

Utilities are firmware routines which perform error rate tests, access error logs, access fault logs and access the spare table. Table 5-1 lists all supported utilities. The utilities are classified by the method through which they are invoked. The utilities may be initiated through the CS/80 command "Initiate Utility". The specific utility is selected by a 1-byte micro opcode which may be followed by up to eight bytes of input parameters.

The format for the "Initiate Utility" command is:

<INITIATE Utility> <Micro Opcode> <up to 8 parameter bytes>

Initiate utility = 001100**XX**
      Where **XX**: 00 = no execution message text
                  01 = device will receive execution message
                  10 = device will send execution message text

Table 5-1. Supported Utilities

CS/80 NO EXECUTION MESSAGE (no information is returned to host)

       Clear Logs
       Preset

CS/80 SEND EXECUTION MESSAGE (drive returns information to host)

       Read Fault Log
       Read Run Time Error Log
       Read Error (ERT) Log
       Read Spare Table
       Locate and Read Full Sector
       Servo Test
       Pattern Error Rate Test (ERT)*
       Random Pattern Error Rate Test (ERT)*
       Read Only Error Rate Test (ERT)*
       Random Read Only Error Rate Test (ERT)*
       Read Revision Number
       Read Defect List

*These utilities provide both a NO EXECUTION MESSAGE and a SEND EXECUTION MESSAGE depending upon the bits set in the "Initiate Utility" command. Refer to paragraph 5-7.

5-8. CS/80 No Execution Message Utilities

Error rate tests run with "no execution message" store error information in the ERT table and faults in the fault log. See paragraph 5-37 for a description of these logs.

5-9. Clear Logs

```
MICRO OPCODE : OCDH (205)
PARAMETERS   : 0 = clear all logs (run time/Fault log and ERT log)
               1 = clear ERT log only
               2 = clear disc-based logs (fault, run time data error)
```

Clearing the ERT log clears all ERT sectors read count. Clearing the disc-based logs clears the run time sectors read estimate.

5-10. Preset

```
MICRO OPCODE : OCEH   (206)
PARAMETERS   : none
```

This utility posts any data in the fault and runtime queues as well as the runtime sectors read count to the disc. It is usually not necessary since this posting takes place as necessary during the Report phase of the command.

5-11. CS/80 Send Execution Message Utilities

Details of the CS/80 Send Execution Message utilities listed in Table 5-1 are provided in the following paragraphs.

5-12. Read Fault Log

```
MICRO OPCODE : OC7H   (199)
PARAMETERS   : none
```

The utility reads the data from the disc-based fault log and returns the entries to the host in chronological order. That is, the first faults returned are the oldest, and the last one is the most recent.

Note: Performing an error rate test does not clear the fault log, so unless the log is specifically cleared before beginning a test, the faults which are returned may have occurred during previous tests or run time activities.

```
format:

header:
        # of entries            1 byte
(Max. number of entries:   46)
```

```
entry:   Current logical cylinder   2 bytes
         Current logical head       1 byte
         Logical sector             1 byte
         Target logical cylinder    2 bytes
         Target logical head        1 byte
         Logical sector             1 byte
         Fault code                 1 byte
         Status                     1 byte
         Status                     1 byte
```

Refer to paragraph 5-27 for a description of the contents of the status bytes and to paragraph 5-28 for a description of physical address reporting for faults.

Note: In the case where a read of the fault log fails, the QSTAT returned will be one (1), but the execution message will contain any fault information that was present in the queue.

Also, if the queue contains data when the fault log is read, that data is assumed to be new, relevant data and is appended to the disc-based information. As a result, the maximum number of faults that can be returned is 46 + 5, or 51.

5-13. Read Run Time Error Log

```
MICRO OPCODE : 0C5H   (197)
PARAMETERS   : head #   (1 byte)
```

The utility reads the disc-based error log and sorts outs these errors that pertain to the selected head. These errors are then returned to the host in chronological order.

Note: Since an entry contains an occurrence count, the total number of errors may exceed the number of entries.
format:

```
header:
         # of entries on the selected head   1 byte
         estimate sectors read by this head  5 bytes
         # of entries on the selected head   1 byte

entry: (selected head only)
         Current physical cylinder          2 bytes
         Current physical head              1 byte
         not used = 0                       1 byte
         Current logical cylinder           2 bytes
         Current logical head               1 byte
         Logical sector                     1 byte
         "Error byte"                       1 byte
         occurrence count                   1 byte
```

The error byte gives information about the location in the sector where the error occurred and the severity of the error (i.e., recoverable, nonrecoverable).

```
error byte format:
    bit 7 = byte sync (no data sync or sector overrun)
    bit 6 = error in header field
    bit 5 = error in data field
    bit 4 = unrecoverable data error
            (all retries exhausted)
    bit 3 = ECC marginal data error
    bit 2 = retry marginal data error
            (more than 1 retry required)
    bit 1 = recoverable on the first retry
    bit 0 = track offset invoked
```

5-14. Read Error (ERT) Log

```
MICRO OPCODE : OC6H   (198)
PARAMETERS   : head #    (1 byte)
```

This utility returns the data error information stored in the RAM-based ERT log to the host. Only those data errors which occurred on the specified head are sent to the host.

```
format:

header:
        # of entries on the selected head   1 byte
        # of sectors read by this head      5 bytes
        not used  = 0                       2 bytes
        # of entries on the selected head   1 byte

entry: (selected head only)
        current phys cyl                    2 bytes
        current phys head                   1 byte
        current phys sector                 1 byte
                  (logical sector)
        current log cyl                     2 bytes
        current log head                    1 byte
        current log sector                  1 byte
        "Error byte"                        1 byte
        occurrence count                    1 byte
```

The error byte gives information about the location in the sector where the error occurred and the severity of the error (i.e., recoverable, nonrecoverable).

```
error byte format:
    bit 7 = Byte sync (no data sync or sector overrun)
    bit 6 = error in header field
    bit 5 = error in data field
    bit 4 = unrecoverable data error
            (all retries exhausted)
    bit 3 = ECC marginal data error
    bit 2 = retry marginal data error
            (more than 1 retry required)
```

```
bit 1 = recoverable on the first retry
bit 0 = FIFO data lost or track offset invoked
```

If a data error occurs more than once at the same location (i.e., same physical cylinder, physical head, and logical sector) on the disc, the error byte is "OR"ed to give a cumulative report, and the occurrence count is incremented.

5-15. Read Spare Table


```
MICRO OPCODE : 0C4H  (196)
PARAMETERS   : Table = 1 (spare table)
```

The spare table is the only accessible table in this controller. Since the spare table is not stored on maintenance tracks, it must be built at power-on. This is done by going to the spare track area and seeing which have been allocated. The first time the spare table is read after power-on will take up to 2 minutes to execute because each track must be checked to count the number of sector spares. Subsequent reads do not require this step and will execute much faster.

HEADER

Head #	1 byte
# of spare operations	2 bytes (MSB first)
# of spare tracks used	1 byte
# of logical spared tracks	1 byte
	(MSB set indicates a
	factory spare track)

ENTRY

Cylinder High	1 byte
Cylinder low	1 byte
Scalar #	1 byte

The "head #" is the head address. There will be one header for each head in the drive.

The "# of spare operations" is the number of sectors on this head which have been allocated during field sparing operations.

The "# of spare tracks used" is the total number of spare tracks on this head that have been allocated for factory and field sparing operations.

The "# of logical spared tracks" is the number of tracks on this head which have been determined to be defective and were spared. The number of logical spared tracks will be equal to the number of entries.

The "scalar #" indicates which of the spare tracks on a surface were used when the defective track was spared. For example, if there are 6 (0 through 5) spare tracks per surface, and the second spare track was used by this entry, then the scalar # would be 1.

5-16. Locate And Read Full Sector

```
MICRO OPCODE : 0C0H  (192)
PARAMETERS   : physical cylinder    2 bytes
               physical head        1 byte
               physical sector      1 byte
               (logical sector)
```

The utility will read a physical sector and return the 256 data bytes from that sector and the 6 ECC bytes. The total execution message will be 262 bytes long. Faults will show up in the status, but data errors are neither detected nor reported.

Headers are not read by the read full sector command.

5-17. Servo Test

```
MICRO OPCODE : 0BFH  (191)
PARAMETERS   : Loop count
```

This utility will perform seeks to the following tracks: 0, 1, 2, 4, 8, 16, 32, . . . n, 0, n, n-1, n-2, n-4, n-8, n-16, n-32, . . . 0 (n = max logical track). This sequence of seeks is repeated once for each head.

A seek failure or a timeout will be reflected in the status as well as the first byte of the execution message. A seek error will only be reflected in the first byte of the execution message. A seek error results if the header is readable, and it shows the head is not on target track.

Servo test can be canceled or cleared for early termination.

The test will halt and return the execution message as soon as the first failure occurs.

```
execution message:
   byte 1:  0 = pass              QSTAT 0
            1 = seek failure      QSTAT 1
                (timeout, header read failed)
            2 = seek error        QSTAT 0

   byte 2, 3:  Number of seeks completed in the last loop.
```


5-18. Pattern Error Rate Test (ERT)

```
MICRO OPCODE : 0C8H  (200)
PARAMETERS   : LOOP    (0-255) 255 implies infinite loop
             : OFFSET  (XXXXXXXX)
             : REPORT  (XXXXXXXX)
             : TEST AREA       0 = SECTOR
                               1 = TRACK
                               2 = CYLINDER
                               3 = SURFACE
                               4 = VOLUME (the whole disc)
```

```
: PATTERN SELECT   0 = change pattern with
                       each loop
                       (includes random data)
                   1 = 39CE7H
                   2 = C30H
                   3 = 30E61CC3987H
                   4 = B8F32E3CCH
                   5 = CCH
                   6 = DB6H
                   7 = 33F94CFE5H
                   8 = random data
```

This utility will report data errors to the host immediately after they occur. The errors are not stored in the ERT log.

The sector count is updated for each head.

The first loop of the test begins at the target address which should be determined by the complementary command "Set Address". If the target address is in the middle of the test area, the first pass will consist of writing from the target address to the end of the test area. The first read operation will also be from the target address to the end of the test area. The second loop and each loop thereafter will be from the start of the test area to the end of the test area.

Each loop consists of writing and reading the test area. If the loop count is set to 255, the test will continue indefinitely until a Cancel or Clear command is sent from the host.

If a fault occurs, the test will halt; QSTAT is set; status will indicate the fault.

If a data error occurs, the execution message has the following format:

```
    (no header is sent)
    entry:
          current phys cyl              2 bytes
          current phys head             1 byte
          current physical sector       1 byte
          (equals logical sector)
          current logical cyl           2 bytes
          current logical head          1 byte
          current logical sector        1 byte
          error byte                    1 byte
          loop count when error occurred 1 byte

error byte format:
    bit 7 = byte sync (no data sync or sector overrun)
    bit 6 = error in header field
    bit 5 = error in data field
    bit 4 = unrecoverable data error
            (all retries exhausted)
    bit 3 = ECC marginal data error
    bit 2 = retry marginal data error
            (more than 1 retry required)
    bit 1 = recoverable on the first retry
    bit 0 = FIFO data lost or track offset invoked
```

The state of the test is saved when an error or fault occurs. After reporting the error/fault, the test may be continued by resending the ERT command sequence with the loop count set to zero.

At the end of the test (loop count exhausted), one byte (containing a zero) tagged with EOI will be sent to the host.

5-19. Random Pattern Error Rate Test

```
MICRO OPCODE : 0CBH   (203)
PARAMETERS   : LOOP      (0-255) 255 implies infinite loop
             : OFFSET    (XXXXXXXX)
             : REPORT    (XXXXXXXX)
             : PATTERN SELECT   0 = change pattern with
                                    each loop
                                    (includes random data)
                                1 = 39CE7H
                                2 = C30H
                                3 = 30E61CC3987H
                                4 = B8F32E3CCH
                                5 = CCH
                                6 = DB6H
                                7 = 33F94CFE5H
                                8 = random data
```

The Random Pattern ERT functions like the non-random Pattern ERT with the exception that the test area is randomly generated. This is done by generating a random starting address and then generating a random transfer length between 1 sector and 63 sectors. It is assumed that random error rate test is allowed to read and write anywhere in the logical data space of the disc.

One loop of the test is performed by writing 256 random test areas and then reading the same 256 random test areas. The random number generator is reinitialized to generate the same sequence of random test areas each time the Random Pattern Error Rate test command is received. (NOTE: A test may be continued after a data error has been reported. This is done by reissuing the command with the loop count set to zero. Continuing a test does not reinitialize the random number generator to the start of the sequence.)

The sector count is updated for each head.

Refer to paragraph 5-18 for details of the execution message.

5-20. Read Only Error Rate Test

```
MICRO OPCODE : 0C9H   (201)
PARAMETERS   : LOOP      (0-255) 255 implies infinite loop
             : OFFSET    (XXXXXXXX)
             : REPORT    (XXXXXXXX)
             : TEST AREA      0 = SECTOR
                              1 = TRACK
                              2 = CYLINDER
                              3 = SURFACE
                              4 = VOLUME (the whole disc)
```

This utility will report data errors to the host as soon as they occur. The sector count is updated for each head and is available by reading the ERT log. As the name implies, this test does not write data on the disc. Therefore, data written previous to calling this utility will not be destroyed.

The first loop of the test begins at the target address which should be determined by the complementary command "Set Address". If the target address is in the middle of the test area, the first pass will consist of reading from the target address to the end of the test area. Each loop thereafter will begin at the start of the test area.

If a fault occurs, the test will halt; QSTAT is set; status will indicate the fault.

If a data error occurs, the execution message has the following format:

```
     (no header is sent)
     entry:
             current phys cyl             2 bytes
             current phys head            1 byte
             current phys sector          1 byte
             (current logical sector)
             current logical cyl          2 bytes
             current logical head         1 byte
             current logical sector       1 byte
             error byte                   1 byte
             loop count when error occurred 1 byte

error byte format:
bit 7 = byte sync (no data sync or sector overrun)
bit 6 = error in header field
bit 5 = error in data field
bit 4 = unrecoverable data error
        (all retries exhausted)
bit 3 = ECC marginal data error
bit 2 = retry marginal data error
        (more than 1 retry required)
bit 1 = recoverable on the first retry
bit 0 = track offset invoked
```

The state of the test is saved when an error or fault occurs. After reporting the error/fault, the test may be continued by resending the ERT command sequence with the loop count set to zero.

At the end of the test (loop count exhausted), one byte (containing a one) tagged with EOI will be sent to the host.

5-21. Random Read Only Error Rate Test

```
MICRO OPCODE : OCCH   (204)
PARAMETERS   : LOOP      (0-255) 255 implies infinite loop
```

This routine functions like the Read Only Error Rate test. The one exception is that the test area is generated randomly. This is done by generating a random starting address and then generating a random length between 1 sector and 63 sectors.

Refer to paragraph 5-20 for details on the execution message.

5-22. Read Revision Numbers

```
MICRO OPCODE : 0C3H (195)
PARAMETERS   : none
```

This utility will read the firmware ROM revision numbers and return them in an execution message. The first byte specifies the number of revision number bytes that will follow.

```
byte #
0      number of bytes to follow
       (equals 1 since there is only one ROM)
1      revision # for ROM
```

The format for the revision byte is for the most significant nibble to contain the main revision number, and for the least significant nibble to contain a secondary revision number.

5-23. Read Defect List

```
MICRO OPCODE : 0D4H (212)
PARAMETERS   : 2 byte physical cylinder
               1 byte physical head
```

This routine attempts to read the ESDI defect list stored on the track selected by the input parameter. The disc controller chip is configured for the proper format and an ignore header – read data operation is performed. The CRC is used to check the integrity of the data. A QSTAT of 1 is returned if the hard disc controller chip detects any problems or a timeout occurred while waiting for the operation to complete. The QSTAT will also be set to 1 if the seek to the target track fails. No retries are attempted by this utility.

The execution message will always consist of 256 bytes. The execution message is initialized to 99H and is overwritten by the data as physical sector zero of the target track is read. The execution message data will be in the format specified by ESDI for the defect list data field.

This routine does input parameter checking and allows only three possible values for the cylinder address. Those values are the maximum cylinder (for that particular mechanism), maximum cylinder –8, of cylinder 4095 (a special ESDI provision for "hiding" another defect list). Any head between 0 and the maximum head for that mechanism is allowed.

5-24. Logs Internal to Controller

The Run Time (RT) Error Log and Fault Log contain data error information and fault information, respectively. These logs are stored in redundant copies on maintenance tracks in physical cylinder 0 of the disc.

The ERT log is RAM-based and contains information on data errors which occur during error rate testing.

5-25. Run Time and Fault Logs

During run time, marginal and recoverable data error information is placed in a RAM-based queue waiting to be posted to the disc-based logs. The same holds true for any drive faults that occur (i.e., there is a fault queue as an outline queue).

After the QSTAT byte has been sent during the report phase of a command, a logs update flag is checked. If there is information to be logged, all of the RAM-based queues are added to their counterpart logs on the disc. If any of the logs are full, the new entries are written over the oldest entries in the same logs, and that older information is lost. Due to the nature of the scheme, the maintenance tracks overflow bit in status will never be set.

This log update is transparent to the host and takes place in about 120 milliseconds. Consequently, the next host command will be held off for that period of time. The request release function is not used with logs.

5-26. Implementation

The RAM-based fault queue is 5 entries long and the runtime error queue is 3 entries long. The disc-based fault log can hold 46 entries, and the runtime error log can hold 50 entries.

Since the only time the queues get posted to the disc is during reporting phase, long execution time commands (such as error rate tests) run the risk of overflowing the queue. To lessen the effect of this, the queues are managed such that when they get full the last entry in the queue is overwritten with any new entries as they are posted.

After successful posting of queue information to the disc, the queues are cleared. if the data was not successfully posted, the queues remain intact but the log update flag is cleared. As a result, no more log posting attempts will be made until a new entry is added to one of the queues.

Run time data errors take the following format in the logs:

```
Current physical cylinder          2 bytes
Current physical head              1 byte
Current physical sector            1 bytes
Current logical cylinder           2 byte
Current logical head               1 byte
Current Logical sector             1 byte
Error Byte                         1 byte
Occurrence Count                   1 byte
```

Faults take the following format in the logs:

```
Current logical cylinder          2 bytes
Current logical head              1 byte
Current logical sector            2 bytes
Target logical cylinder           2 bytes
Target logical head               1 byte
Target Logical sector             1 byte
Fault Code                        1 byte
Status byte                       1 byte
Status byte                       1 byte
```

Note: These formats are the same as the formats in which the data is returned during the reading of the respective logs.

5-27. Fault Status Bytes

The contents of the two status bytes which are associated with a Fault entry depends on the Fault code of that entry. The range of all possible Fault codes (1-255) has been divided into subranges for the purpose of defining appropriate tontents for the status bytes (refer to table 5-2 for a listing of error codes).

```
 1-1FH     Faults not logged
20-3FH     Data errors NO fault log entry
40-4FH     Status 1 = compressed ESDI status
           Status 2 = vendor unique status
50-5FH     Status 1 = 0, Status 2 = 0
60-6FH     Status 1 =  8466 status reg
           Status 2 = 8466 error reg
70-8FH     Status 1 = 8466 status reg
           Status 2 = 8466 error reg
90-AFH     Status 1 = compressed ESDI status
           Status 2 = vendor unique status
80-DFH     Status 1 = 0, Status 2 = 0
E0-FFH     Status 1 = compressed ESDI status
           Status 2 = vendor unique status
```

Compressed ESDI status:

```
bit 0 = write fault
bit 1 = write gate with track offset
bit 2 = seek fault
bit 3 = invalid or unimplemented command
bit 4 = interface fault
bit 5 = command data parity fault
bit 6 = power-on conditions exist
bit 7 = spindle motor stopped
```

Vendor Unique status:

Only the least significant byte of the first word of vendor unique status is saved. Details on vendor unique status codes are not available to the field.

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5-28. Physical Address Reporting

Faults will normally be reported with a logical address as is shown in paragraph 5-12. If the seek preceding the occurrence of the fault was a physical seek then the current logical cylinder and target logical cylinder will be replaced by a current physical cylinder and a target physical cylinder. The exercisers and test systems are informed of the switch by setting the most significant bit of the cylinder address.

Note: The physical seek may be to an address which is within the logical address space, but the physical address will still be reported. It is assumed that any operation which performs a physical seek will be primarily interested in the physical address if a fail occurs.

5-29. Run Time Sectors Read Count

The controller PCA-A2 maintains an estimate of the number of sectors read during run time (i.e., not utility or diagnostic) commands. An estimate of the number of sectors read per head is returned to the host in the header of the read run time log execution message.

The disclaimer "estimate" is given to the count for several reasons. The count is not kept on an individual head basis as is the case for the ERT sectors read count. The run time sectors read count is a total for all heads, which is divided by the total number of heads, to give an estimate of the number of sectors read by an individual head. This compromise results in lower overhead associated with real time command operation, and also reduces the space in the logs that is required to store that information.

The count is also compromised by the fact that it is initially kept in RAM. The count is only moved to the disc-based logs when a run time marginal/unrecoverable data error occurs or the utility command Preset is issued. Therefore, if power is lost before the RAM-based count is added to the disc-based count, an inaccuracy equal to the RAM-based count occurs.

Note: Reading the run time error log also updates the disc-based count with the total of the RAM-based count and the disc-based count.

5-30. Error Rate Test (ERT) Log

The RAM-based ERT table will store data error information on a maximum of 50 locations.

The log is allocated in the following way:

```
        sectors read head 0       5 bytes
        sectors read head 1       5 bytes
                .                    .
                .                    .
                .                    .
        sectors read head 15      5 bytes
                              -----------
                              80 bytes


entry: physical cylinder       2 bytes
       physical head           1 byte (equals logical sector)
       logical cylinder        2 bytes
       logical head            1 byte
```

```
logical sector          1 byte
error byte              1 byte
occurrence count        1 byte
                     ----------
                       10 bytes

    50 entries ===> 500 bytes
```

If the error rate tests are initiated via CS/80 using the "send execution message" option, errors are report-
ed immediately to the host and are not logged to the ERT log.

Both "send execution" and "no execution" ERT utilities keep a count of the sectors successfully read by in-
dividual heads. The sectors read count is read by the host through the read ERT log command.

5-31. Error Byte Description

The error byte is used by error rate test utilities and by the run time log to report the location of a data
error and its severity to the host.

```
error byte format:
        bit 7 = byte sync (no data sync or sector overrun)
        bit 6 = error in header field
        bit 5 = error in data field
        bit 4 = unrecoverable data error
                (all retries exhausted)
        bit 3 = ECC marginal data error
        bit 2 = retry marginal data error
                (more than 1 retry required)
        bit 1 = recoverable on the first retry
        bit 0 = track offset invoked

bits 5-7 describe the location
bits 1-4 describe the severity
```

Bit 0 of the error byte is set when a radial track offset was used to recover data during the ERT. The
recovery algorithm includes doing 12 retries on track before an offset is attempted. As a result, the error
status must be at least marginal for bit 0 to be set. Consequently, bits 0 and 1 will never be set together.

5-32. Faults/Errors During Error Rate Testing

Faults: If a fault is encountered, the ERT is halted and the state of the machine is saved. QSTAT is set
and the status will indicate the fault. The host may continue the test by sending the ERT command se-
quence with the loop count set to zero.

Note that, due to the way the fault queue is maintained, if you execute a no execute message ERT, the
maximum number of log-only faults you will observe is 5. This is due to the fact that the queue only gets
posted to the disc during report phase, since the test executes for a long time without going to report
phase, the queue will fill up and the last entry will be continually overwritten.

A fault is generated during error rate testing if the ERT log overflows. The host is allowed to read the ERT log, send the clear ERT log command and then continue the error rate test by sending the ERT command sequence with the loop count set to zero.

Errors: If a data error occurs, it will be logged in the ERT log and the test will continue at the next block. QSTAT will be "pass" if only data errors occur.

Note: If no errors have occurred since the last restart of the test, then one byte (containing a zero) tagged with EOI will be returned to the host upon completion of the test.

5-33. Self-test Subtests

Self-test consists of the following subtests:

- Microprocessor Self-test
- RAM Self-test
- ROM Checksum Test
- HP-IB Interface IC Loopback Test
- Buffer Self-test
- Hardware/Firmware Initialization
- Select-A-Drive
- Command Complete
- ESDI Status Check
- Reset Attention
- Check for Drive Ready
- Request Configuration
- Mechanism Self-test
- Read/Write ECC Test
- Build Spares Table
- Seek with Verify Position
- Finish HP-IB Interface IC Initialization

These self-test routines are stored in the ROM on controller PCA-A2. The host can determine the details of self-test failures at the select-a-drive point by using the CS/80 Request Status command.

5-34. Microprocessor Self-test

Note: Hardware forces the red and green LED's in the FAULT/ON LINE indicator to light when a power-on reset condition occurs.

Limitations: This self-test is by no means intended to be a thorough test of the operation of the micro-processor or even a sufficient subset of the microprocessor's operation.

Process: The X and D registers are loaded with C355H. The Y and U registers are loaded with 3CAAH. The registers are compared against the loaded values and a mismatch in any register causes the firmware to loop forever at the point where the error was detected. The purpose of the infinite loop is to assure that the controller PCA-A2 will not attempt to come on line.

Fault Reporting: The only means of communicating a failure to the user is via the FAULT/ON LINE in-dicator. Both the red and green LED's will remain lit indefinitely.

Note: Without monitoring the address of the firmware loop, this fault will be indistinguishable from RAM self-test failure, ROM checksum failure, or a buffer self-test failure.

5-35. RAM Self-test

Limitations: This is a 2K RAM which the microprocessor uses for its stack and for variables. Each byte is tested for stuck at one (1) and stuck at zero (0).

Process: A 3-byte pattern (00H, A5H, C3H) is written to the RAM. The RAM is read to make certain each byte contains the correct value. The RAM is rewritten with another 3-byte pattern (FFH, 5AH, 3CH) such that each byte is written with the complement of the value it received on the first write pass. The RAM is read and each byte is compared against the value it should contain.

If a failure occurs, the firmware enters an infinite loop. The disc drive is not allowed to come on line.

Fault Reporting: The only means of communicating a failure to the user is via the FAULT/ON LINE in-dicator. Both the red and green LED's will remain lit indefinitely.

Note: Without monitoring the address of the firmware loop, this fault will be indistinguishable from a microprocessor self-test failure, ROM checksum failure, or a buffer self-test failure.

5-36. ROM Checksum Test

A checksum is calculated and compared to the ROM's checksum.

Process: If a failure occurs, the firmware enters an infinite loop. The drive is not allowed to come on line.

Fault Reporting: The only means of communicating a failure to the user is via the FAULT/ON LINE in-dicator. Both the red and green LED's will remain lit indefinitely.

Note: Without monitoring the address of the firmware loop, this fault will be indistinguishable from a microprocessor self-test failure, RAM self-test failure, or a buffer self-test failure.

5-37. HP-IB Interface IC Loopback Test

Limitations: Data patterns are written to the internal outbound FIFO and are read back through the inbound FIFO. A check is made to see that the last byte is tagged with EOI, as it should be. This test does not attempt to check functionality of most of the interrupts. It cannot verify the ability of the circuit to control lines over the HP-IB interface.

Process: If this test fails the firmware will loop indefinitely. The disc drive will not come on line.

Fault Reporting: The only means of communicating a failure to the user is via the FAULT/ON LINE indicator. Both the read and green LED's will remain lit indefinitely.

Note: Without monitoring the address of the firmware loop, this fault will be indistinguishable from a microprocessor self-test failure, a RAM self-test failure, or a buffer RAM self-test failure.

This test is not available through the diagnostics command option 0. It only occurs as part of the power-on sequence.

5-38. Buffer Test

Limitations: These are the two buffers (0 and 1) which the DMA uses to buffer data transfers between the host and the disc drive assembly A1. It is also used to receive commands from the host and to return reports and execution messages to the host. Each byte is tested for stuck at one (1) and stuck at zero (0).

Process: A 3-byte pattern (00H, A5H, C3H) is written to the buffers. The buffer is read to make certain each byte contains the correct value. The buffer is rewritten with another three byte pattern (FFH, 5AH, 3CH) such that each byte is written with the complement of the value it received on the first write pass. The buffer is read and each byte is compared against the value it should contain.

If a failure occurs, the firmware enters an infinite loop. The drive is not allowed to come on line. The self-test which is done as a result of an Initiate Diagnostic command also does a walking one (1) and a walking zero (0) test on each byte of the buffer.

Fault Reporting: The only means of communicating a failure to the user is via the FAULT/ON LINE indicator. Both the red and green LED's will remain lit indefinitely.

Note: Without monitoring the address of the firmware loop, this fault will be indistinguishable from a microprocessor self-test failure, ROM checksum failure, or a RAM self-test failure.

5-39. Hardware/Software Initialization

Process: Controller PCA-A2 is initialized and placed in a benign state. The HP-IB interface IC is initialized to a harmless state, but its initialization is not complete at this point. Certain status and global variables are initialized to their power-on values. The spare table is cleared and the error rate test table is initialized. The seek variables are initialized.

Fault Reporting: No self-test is associated with this step in the power-on process so no faults are detected.

The subtests described to this point take approximately one to two seconds to complete.

5-40. Select-A-Drive

Limitations: Controller PCA-A2 is designed to support only a single disc drive. Therefore, disc drive assembly A1 will always be selected by the firmware.

Process: The ESDI Drive Select line for disc drive assembly A1 is asserted. Up to 60 seconds is allowed for the disc drive to assert the Drive Selected line in response. If the Drive Selected line is not asserted within the timeout period, the mechanism self-test will terminate and the disc drive will not attempt to come on line. The disc drive is not allowed to come on line because the "drive not selected" condition may be the result of a disconnected ESDI data cable (W2). If this is the case, the Read Clock to the DDC IC would not be present, making DMA transfers to the host impossible.

Fault Reporting: In this case both LED's are illuminated. In the second case, the disc drive comes on line and reports self-test fault #69 in P7 and P3. The diagnostic result bit will be set. P1 contains the code for the first suspect FRA. It will be a one (1) indicating disc drive assembly A1. P2 contains the code for the second suspect FRA. A two (2) indicates controller PCA-A2. The ribbon cables between controller PCA-A2 and disc drive assembly A1 are also suspect but no FRA numbers exist for the cables.

Note: Disc drive assembly A1 must be deselected and reselected as part of the initialization. If the disc drive fails to respond with "drive selected", then the "Can't Select Drive" diagnostic fault is generated. The remainder of the self-test and initialization is skipped and the disc drive comes on line to report the fault.

Once the power-on sequence completes the select-a-drive subtest, the disc drive will always come on line and report the nature of the subsequent self-test failures using the CS/80 status bytes P1, P2, P3, P7, P8 and P9. This does not mean that the subsequent self-test failures are less critical or that the disc drive is operable. On the contrary, it strongly advisable for the host not to issue commands to the disc drive after any self-test failure. If the diagnostic bit is set during power-on self-test, any operation initiated by the host can have unpredictable results. The only reason that the disc drive is allowed to come on line is to report the nature of the self-test failure to the operator.

At this point in the power-on process, the red LED will be turned off and the green LED will blink.

5-41. Command Complete

Process: Controller PCA-A2 will wait up to 60 seconds for disc drive assembly A1 to assert the ESDI Command Complete line. If the Command Complete line is not asserted within the timeout period a fault will be generated. The remainder of the self-test and initialization is skipped and the disc drive comes on line to report the fault.

Fault Reporting: The disc drive comes on line and reports self-test fault #70 in P7 and P3. The diagnostic result bit will be set. P1 contains the code for the first suspect FRA. A one (1) indicates disc drive assembly A1. P2 contains the code for the second suspect FRA. A two (2) indicates controller PCA-A2. The ribbon cables between controller PCA-A2 and disc drive assembly A1 are also suspect but no FRA numbers exist for the cables.

Note: At this point it is strongly advisable for the host not to attempt any further operations with the disc drive. If the host attempts to run utilities or diagnostics, unpredictable results will occur. For example, diagnostics may return a status of pass without having done anything. This result comes from the fact that configuration was not executed.

5-42. ESDI Status Check

Process: This is the first time that controller PCA-A2 attempts to send a command over the ESDI Serial Communication line. More than one type of fault can arise.

An ESDI Request Status command is sent to disc drive assembly A1. The disc drive should respond with a 16-bit general status word. If the status is successfully received from disc drive assembly A1 the vendor unique status bit is checked. If the vendor unique status bit is set, the vendor unique status is requested from disc drive assembly A1, a fault is generated, and the fault number, ESDI status, and least significant byte of the vendor unique status are returned to the host. Information from the 16-bit word is compressed into the ESDI status word.

If the vendor unique status available bit is not set, then several of the other status bits are checked. If any of these bits are set, a fault is generated. The fault and ESDI status will be returned to the host.

```
Compressed ESDI status bits:
                        7 = SMS-spindle motor stopped
                        6 = PON-power-on conditions exist/
                            start spindle motor command may
                            be required
                        5 = CDP-command data parity fault
                        4 = IF-interface fault
                        3 = IC-invalid or unimplemented command
                        2 = SF-seek fault
                        1 = WG-write gate with track offset fault
                        0 = 1-write fault
```

Note: Bit 6 is expected to be set during a fault condition.

Note: Retry commands are transparent to the self-test procedure. If the ESDI communication fails but a retry is successful, the self-test will pass and none of the bits listed above should be set.

Fault Reporting: If the vendor unique status bit is set, fault #76 will be placed in P3. The first suspect (P1) is disc drive assembly A1. The second suspect (P2) is set to zero (0) which implies that the guilty party is known with sufficient confidence that no second suspect is necessary.

```
P7 = fault 76
P8 = compressed ESDI status
P9 = least significant byte of vendor unique status
```

If one of the ESDI status bits is set indicating that the disc drive assembly A1 is in an unexpected state then:

```
P1 = disc drive assembly A1
P2 = zero
P3 = fault 71
P7 = fault 71
P8 = compressed ESDI status
P9 = least significant byte of vendor unique status
```

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5-43. Reset Attention

Process: The ESDI Reset Attention command is sent to disc drive assembly A1. This command deasserts the Attention line and clears the status. A fault occurs if an ESDI communication timeout occurs and the retries are exhausted or if the Attention line is still asserted after the Reset Attention command is sent.

Fault Reporting: The disc drive comes on line and reports self-test fault #75 in P3. The diagnostic result bit will be set. P1 contains the code for the first suspect FRA. A one (1) indicates disc drive assembly A1. P2 contains the code for the second suspect FRA. A two (2) indicates controller PCA-A2. The ribbon cables between controller PCA-A2 and disc drive assembly A1 are also suspect but no FRA numbers exist for the cables.

P7 will contain either fault #75 if the Attention line was not reset or a fault number describing the ESDI communication problem if that condition occurred. P8 and P9 will contain the status associated with the fault number stored in P7.

Note: At this point it is strongly advisable for the host not to attempt any further operations with the disc drive. If the host attempts to run utilities or diagnostics, unpredictable results will occur. For example, diagnostics may return a status of pass without having done anything. This result comes from the fact that configuration was not executed.

5-44. Check for Drive Ready

Process: The firmware will read the ESDI Drive Ready line. If Drive Ready is not asserted a fault is generated.

Fault Reporting: The disc drive comes on line and reports self-test fault #72 in P3 and P7. The diagnostic result bit will be set. P1 contains the code for the first suspect FRA. A one (1) indicates disc drive assembly A1. P2 contains the code for the second suspect FRA. A two (2) indicates controller PCA-A2. The ribbon cables between controller PCA-A2 and disc drive assembly A1 are also suspect but no FRA numbers exist for the cables.

P8 and P9 will contain the compressed ESDI status and vendor unique status respectively.

Note: At this point it is strongly advisable for the host not to attempt any further operations with the disc drive. If the host attempts to run utilities or diagnostics, unpredictable results will occur. For example, diagnostics may return a status of pass without having done anything. This result comes from the fact that configuration was not executed.

5-45. Request Configuration

Process: The ESDI Request Configuration command is used to determine capacity and feature characteristics of the disc drive assembly A1. The information which disc drive assembly A1 returns is not bounds checked, but is assumed to be correct. The only faults which can result from this step in the initialization process are ESDI communication faults.

Note: The configuration process issues a set number of unformatted bytes per sector command. This command overrides the 63 sector configuration set by internal jumpers. Disc drive assembly A1 is now configured for 325 bytes per sector which results in 64 sectors per track.

Fault Reporting: The disc drive comes on line and reports self-test fault #73 in P3. The diagnostic result bit will be set. P1 contains the code for the first suspect FRA. A one (1) indicates disc drive assembly A1. P2 contains the code for the second suspect FRA. A two (2) indicates controller PCA-A2.

P7 will contain the fault number describing the ESDI communication problem. P8 and P9 will contain the status associated with the fault number stored in P7.

Note: At this point it is strongly advisable for the host not to attempt any further operations with the disc drive. If the host attempts to run utilities or diagnostics, unpredictable results will occur. For example, diagnostics may return a status of pass without having done anything. This result comes from the fact that configuration was not executed.

5-46. Disc Drive Assembly A1 Self-test

Limitations: Disc drive assembly A1 self-test is not intended to be exhaustive or to verify the product specifications. It does attempt to determine if minimal read, write, and seek capabilities exist.

Process: Disc drive assembly A1 self-test is broken down into four major subtests.

        1) seeks without position verify
        2) read, write and ECC tests
        3) build spare tables
        4) seeks on all heads with position verify after each seek

5-47. Seek Test Without Position Verify

Process: Logical seeks are performed with head 0 selected. The target tracks are 0, 1, 2, 4, 8 . . . max logical, 0, max logical, max logical -1, max logical -2, max logical -4, max logical -8 . . . 0. Faults occur if disc drive assembly A1 reports a seek fault or ESDI communication problems arise. No attempt is made to read a header to verify that a seek actually occurred.

Fault Reporting:
P1 = 1 (disc drive assembly A1)
P2 = 2 (controller PCA-A2)
P3 = 77 disc drive assembly A1 self-test failed
P7 = fault #
P8 = status associated with fault # in P7
P9 = status associated with fault # in P7

5-48. Read/Write ECC Test

Limitations: A sector may be found which can be read and written 10 times without an error yet still contain a slight media defect. The defect could cause some inconsistency in the ECC test results.

Process: There are two phases in the read/write ECC test. The first consists of finding a sector which can be written and read 10 times without a data error. This sector is then assumed to be free of major media defects and so it is used for the second phase which is the ECC portion of the test. The test begins with a physical seek to the outside-diameter (OD) self-test cylinder which is at physical cylinder 0. Starting on head 0, up to 5 sectors are tried in an attempt to find one which can be read and written 10 times

without an error. If five sectors are tried unsuccessfully, self-test fault #67 is generated to indicate that the read/write retry count was exhausted. If any other fault is detected during the read/write test it will be reported. As soon as a fault occurs testing stops.

When a sector is found that can be read and written without an error, the ECC test is performed. This consists of writing an uncorrectable data error on the sector. The sector is read and an uncorrectable error must be detected. A correctable error is written and it must be read back as a correctable error. The corrected data is checked to make certain that the errors were accurately corrected. The final step is to rewrite the sector with no error. An ECC test failure results in fault #68.

The tests outlined in the preceding two paragraphs are repeated for each head at the OD self-test cylinder and again for each head on the inside diameter (ID) self-test cylinder.

Each time a sector is read as part of the read/write test, the data is compared against that which was written. Any mismatch which was not detected by the ECC is flagged as a fault #66. Fault #66 is a self-test data compare error. The data is read into various locations in the buffer space in an attempt to guarantee the integrity of the buffer RAM addressing and the DMA.

Fault Reporting: The three most likely faults to be generated are:

```
66 = Self-test data compare failed
67 = Self-test read/write retry count exhausted
68 = ECC test failed
```

The errors would be reported in P3 and P7.

```
For Faults 66 and 68: P1 = 2 (controller PCA-A2)
                      P2 = 0 (no second suspect)
For Fault 67:         P1 = 1 (disc drive assembly A1)
                      P2 = 2 (controller PCA-A2)
```

5-49. Build Spare Tables

Since the spare table is not stored on a maintenance track, it must be built at power-on. A seek is done on each head and the sector header is read. If the flag byte indicates that there is a spare track in use, then the header cylinder value is entered in the table for the head being accessed. If the spare table cannot be built (due to data errors or faults), then no spares will be in the spare table. However, if an attempt is made to access a spared-out track, a Unit Fault will be reported.

5-50. Seek Test with Position Verify

Process: The following seek test is performed on each head. A header is read after each seek to verify that the head is over the target track. If the header does not match the target address then the seek is retried. If the header now matches the target then a fault 240 is entered in the fault log but no faults will be reported to the host and testing will continue.

Logical seeks are performed. The target tracks are 0, 1, 2, 4, 8 . . . max logical, 0, max logical, max logical -1, max logical -2, max logical -4, max logical -8 . . . 0

Fault Reporting: The following faults can be generated by the verify operation and are fatal:

```
149 = ATN set during read any heads
200 = Headers unreadable during verify position
201 = Header does not match logical target address (after retries)
```

Any fault associated with a seek timeout or an unrecoverable ESDI communication problem will be reported and considered fatal.

5-51. Finish HP-IB Interface IC Initialization

Process: No self-test faults can be generated by this step. The HP-IB interface IC initialization is completed. The green LED is lit (flashing ceases). The interrupts are enabled.

Table 5-2. Error Codes (1 of 6)

Miscellaneous errors. Miscellaneous errors caused by externally initiated operations. These errors do not cause a log entry to be generated. Only error 1C – 1FH will affect P7.

Oct	Dec	Hex	Description
010	01	01	End Of Volume
020	02	02	Channel Parity Error
050	05	05	Illegal Opcode
070	07	07	Address Bounds
100	08	08	Parameter Bounds
110	09	09	Illegal Parameter
120	10	0A	Message Sequence
140	12	0C	Message Length Error
170	15	0F	Auto-sparing spared a location
200	16	10	No spares available on this head.
210	17	11	Media wear – one or fewer spare tracks left on this head after this sparing operation.
220	18	12	Power-on initialization.

Data errors These are media-related data bit errors. In the Request Status parameter bytes, P7 will contain the error code. P8 will contain the number of retries used.

400	32	20	Marginal Data Field data error on a Read.
410	33	21	Marginal ECC corrected data field data error on a Read.
420	34	22	Unrecoverable data field data error on a Read.
430	35	23	Marginal Header Failed Although Sector Matched data error on a Read.
440	36	24	Unrecoverable Header Failed Although Sector Matched data error on a Read.
450	37	25	Marginal Sector Not Found data error on a Read.
460	38	26	Unrecoverable Sector Not Found data error on a Read.
470	39	27	Marginal No Data Sync data error on a Read.
500	40	28	Unrecoverable No Data Sync data error on a Read.
510	41	29	Marginal Sector Overrun data error on a Read.
520	42	2A	Unrecoverable Sector Overrun data error on a Read.
560	46	2E	A sector other than the target was bad during a sparing.
570	47	2F	Unrecoverable data error on a Write (header not readable).
630	51	33	Marginal Header Failed Although Sector Matched data error on a Write.
640	52	34	Unrecoverable Header Failed Although Sector Matched data error on a Write.
650	53	35	Marginal Sector Not Found data error on a Write.
660	54	36	Unrecoverable Sector Not Found data error on a Write.
670	55	37	Marginal No Data Sync data error on a Write.
700	56	38	Unrecoverable No Data Sync data error on a Write.
710	57	39	Marginal Sector Overrun error on a Write.
720	58	3A	Unrecoverable Sector Overrun error on a Write.

Table 5-2. Error Codes (2 of 6)

Self test errors. A fault entry will be generated. In the Request Status parameter bytes, P7 will contain the fault code, P8 will contain the ESDI status, P9 will contain the least-significant byte of Vendor Unique Status.

Oct	Dec	Hex	Description
1010	65	41	Buffer RAM test failed.
1020	66	42	Self-test data compare failed.
1030	67	43	Self-test R/W retry count exhausted.
1040	68	44	ECC test failed.
1060	70	46	Timed out waiting for Command Complete (power-on).
1070	71	47	Power-on ESDI status indicates a fault.
1100	72	48	Drive Ready not asserted during power-on.
1110	73	49	Auto configuration failed.
1130	75	4B	Reset attention command failed during power-on.
1140	76	4C	The start motor command was needed but failed.
1150	77	4D	Mechanism self-test has failed.
1160	78	4E	Seek diagnostic failed.

Controller Faults. A fault log entry will be generated. In the Request Status parameter bytes, P7 will contain the fault code.

1240	84	54	Offset recovery position unknown.
1250	85	55	Seek recovery position unknown.

COMPRESSED ESDI STATUS

(A status of FFH indicates that the Request Status command failed.
Same for VU status.)

```
0 = write fault
1 = write gate with track offset fault
2 = seek fault
3 = invalid/unimplemented command fault
4 = interface fault
5 = command data parity fault
6 = PON conditions exist/start spindle motor command may be required
7 = spindle motor stopped
```

Table 5-2. Error Codes (3 of 6)

Controller faults with Disc Data Controller IC status. A fault log entry will be generated and the fault log entry will include the Disc Data Controller IC status. In the Request Status parameter bytes, P7 will contain the fault code, P8 will contain the Disc Data Controller IC Status register, and P9 will contain the Disc Data Controller IC Error register.

Oct	Dec	Hex	Description
1400	96	60	Disc Data Controller IC timed out when trying to read sector headers (0-63).
1410	97	61	Error detected during Read Full Sector.
1420	98	62	Disc Data Controller IC indicates a fatal fault on a Read.
1430	99	63	Disc Data Controller IC indicates a fatal fault on a Write.
1440	100	64	Retries exhausted during Format Track.
1450	101	65	Retries exhausted during verify initialize. No header was readable on track.
1460	102	66	Retries exhausted during Read Header.
1470	103	67	This should not directly cause a bit in status to be set. It is used by Wait For INT or ATN (a low level routine) to call Save drive info and get the right information stored away.
1500	104	68	Disc Data Controller IC timeout when trying to read any header for sparing.
1510	105	69	Disc Data Controller IC timeout when formatting a track (deallocating spare track or returning temp spare.)
1520	106	6A	Disc Data Controller IC timeout while formatting a track to flag a sector defective.
1530	107	6B	Disc Data Controller IC timeout while formatting the spare track, before the data is written.
1540	108	6C	Retries exhausted during format track. Last problem was Disc Data Controller IC timeout.
1550	109	6D	Retries exhausted during Read Header operation. Last problem was Disc Data Controller IC timeout.
1560	110	6E	Retries exhausted when verifying initialize. Last problem was Disc Data Controller IC timeout.
1560	110	6E	Timed out while formatting a track to flag it defective.

Unit fault with Disc Data Controller IC status. A fault log entry will be generated and the fault log entry will include the Disc Data Controller IC status. In the Request Status parameter bytes, P7 will contain the fault code, P8 will contain the Disc Data Controller IC status, P9 will contain the Disc Data Controller IC error register.

Oct	Dec	Hex	Description
1610	113	71	Error Detected (ED) bit set in Disc Data Controller IC during read defect list.
1620	114	72	Failed due to Disc Data Controller IC error while formatting a track to flag a sector defective.
1630	115	73	Failed due to Disc Data Controller IC error while formatting the spare track for track sparing.
1640	116	74	Failed due to Disc Data Controller IC error while formatting a spare track to deallocate it.
1650	117	75	Failed due to Disc Data Controller IC error while formatting a track to flag it defective.
1660	118	76	Failed due to Disc Data Controller IC error while formatting a spare track to return it to the spare pool.

Table 5-2. Error Codes (4 of 6)

Oct	Dec	Hex	Description
1710	121	79	Disc Data Controller IC error during a spare track pool conversion.
1720	122	7A	Disc Data Controller IC timeout during spare track pool conversion.
1770	127	7F	Uncorrectable data error on a full sector operation.
2100	136	88	Illegal Disc Data Controller IC status detected in utilities.

Unit fault with Compressed ESDI status. A log entry will be generated and the fault entry will include the compressed ESDI status. In the Request Status parameter bytes, P7 will contain the fault code, P8 will contain the compressed ESDI status, P9 will contain the least-significant byte of Vendor Unique Status.

Oct	Dec	Hex	Description
2210	145	91	ESDI status indicates a fatal fault on a Read.
2220	146	92	ESDI status indicates a fatal fault on a Write.
2230	147	93	3rd Retry of Write Fault (offtrack on write) failed.
2250	149	95	ATN set during read any heads..
2260	150	96	Local write saw a non-retryable ESDI status.
2270	151	97	ATN set during Read Full Sector.
2300	152	98	ATN set during read defect list.
2310	153	99	ESDI command pass thru utility failed.
2320	154	9A	Retries exhausted during format track. Track probably did not get formatted.
2330	155	9B	Retries exhausted during verify initialize. No header readable on a track.
2340	156	9C	Retries exhausted during read headers operation.
2350	157	9D	Used by low level routine (wait for INT or ATN). Should not directly affect status. Used when calling save-drive-information to save the right information.
2370	159	9F	A seek to a cylinder outside of the address spare failed.
2400	160	A0	Failed due to ATN being set while formatting a track to flag a sector defective.
2410	161	A1	Failed due to ATN being set while formatting the spare track before the data is written on it.
2420	162	A2	Failed due to ATN being set while reading any header for sparing.
2430	163	A3	Failed due to ATN being set while formatting a track to deallocate a spare.
2440	164	A4	Failed due to ATN being set while formatting a track to flag it defective.
2450	165	A5	Failed due to ATN being set while formatting a track to return it to spare pool.
2460	166	A6	Too many ESDI Seek Faults seen in a utility.
2470	167	A7	ATN set during the spare track pool conversion.
2500	168	A8	Too many ESDI Write Faults seen during a Write.
2510	169	A9	A fatal fault was detected (probably on a seek).
2520	170	AA	Local read saw a non-retryable ESDI status.
2530	171	AB	A check for HDA ready saw it deasserted.
2540	172	AC	Seek fault bit set in ESDI Status, Recal, or Retry failed.
2550	173	AD	Same as above, except on a Write.
2570	175	AF	The power-on request suggested skew command failed.

Table 5-2. Error Codes (5 of 6)

Unit Faults. A log entry will be generated and the extra byte in the fault entry will be zero (0). In the Request Status parameter bytes, P7 will contain the fault code. P8 through P10 will be all zeroes (0's).

Oct	Dec	Hex	Description
2600	176	B0	Logical seek timeout.
2610	177	B1	Physical seek timeout.
2620	178	B2	Defective track reached when doing a logical seek (field spare deallocation).
2630	179	B3	When seeking back to defective track to flag it defective, header is not logical cylinder or head.
2640	180	B4	Headers bad when flagging a sector defective.
2650	181	B5	Defective sector header not found when sector sparing.
2660	182	B6	Headers on spare track bad after they tested good (when writing logical headers).
2670	183	B7	Headers are bad when a physical Read Full Sector is going to be attempted during sparing.
2700	184	B8	Looking for logical header of a sector for Read Full Sector during sparing and cannot find it.
2710	185	B9	All headers bad when setting up for Read Full Sector during sparing.
2720	186	BA	Header failed although sector matched without Header Fault - seek retried successfully - but retry of read not successful.
2730	187	BB	Header failed although sector matched without Header Fault - seek retried successfully - but retry of write not successful.
2740	188	BC	Seek retry count exhausted in utilities.
2750	189	BD	Headers bad when trying to sector spare (they were previously good).
2760	190	BE	No Disc Data Controller IC interrupt while reading the defect list.
2770	191	BF	No Disc Data Controller IC interrupt while reading full sector.
3000	192	C0	ERT log overflqw.
3010	193	C1	PON autospare used up all of the spare tracks.
3020	194	C2	That utility cannot be performed on this mechanism.
3030	195	C3	Verify position failed after initialize media - cylinder and head in header did not match as expected.
3040	196	C4	No copy of the reserved area was read without error.
3050	197	C5	The Disc Data Controller IC timed out during an ECC correction cycle.
3070	199	C7	All headers bad on a track during format option 2.
3100	200	C8	Headers unreadable during verify position.
3110	201	C9	Header does not match logical target address (after retries).
3120	202	CA	HDA did too many internal recalibrates in a utility.
3130	203	CB	Timeout waiting for ATN or Disc Data Controller IC completion status.
3140	204	CC	Two spare tracks in a row were bad when autosparing attempted (includes sector spares).
3150	205	CD	Two spare tracks in a row were bad when sparing attempted (includes section spares).
3160	206	CE	Unrecoverable errors in all log copies.

Table 5-2. Error Codes (6 of 6)

Oct	Dec	Hex	Description
3170	207	CF	No valid copy of the logs was found.
3200	208	D0	Transfer-acknowledged-set timed out after transfer request was set.
3210	209	D1	Transfer-acknowledged-reset timed out after transfer request was reset.
3220	210	D2	Timeout on command complete.
3230	211	D3	Too many retries of ATN set at the end of a seek.
3240	212	D4	Retries exhausted in attempting to recalibrate.
3260	214	D6	Reset Attention command failed.
3270	215	D7	Command complete timeout while waiting to send a command.
3300	216	D8	Timeout on HDA auto recalibrate during a read or write.
3320	218	DA	Header rewrites failed during spare track pool conversion.
3330	219	DB	Track spares exhausted during spare track pool conversion.
3340	220	DC	Command Complete signal dropout on a Read.
3350	221	DD	Command Complete signal dropout on a Read retry.
3360	222	DE	Command Complete signal dropout on a Write.
3370	223	DF	Command Complete signal dropout on a Write retry.

Unit fault that is logged only. A log entry will be generated and the fault log entry will contain the compressed ESDI status and the least-significant byte of the Vendor Unique Status. No bits will be set in the status message.

Oct	Dec	Hex	Description
3400	224	E0	A retryable fault occurred during a seek.
3420	226	E2	Bad parity detected on read data over ESDI.
3430	227	E3	Header failed although Sector Matched Without Header Fault. Seek retry OK - Read retry OK.
3440	228	E4	Header failed although Sector Matched Without Header Fault. Seek retry OK - Write retry OK.
3450	229	E5	2nd and 3rd retry of a Write Fault (offtrack successful).
3470	231	E7	Retry of seek fault bit set in ESDI status, on read, ok.
3500	232	E8	Same as above, on a Write.
3560	238	EE	Retries required during Format Track.
3570	239	EF	Retries required during Read Headers. Recovery was successful.
3600	240	F0	Header does not match target address.
3610	241	F1	No operation complete INT after resetting Disc Data Controller IC.
3700	248	F8	A seek was successfully tried on a Read.
3710	249	F9	A seek error was successfully retried on a Write.
3720	250	FA	An ESDI write fault was retried successfully.
3730	251	FB	HDA auto recal detected in utilities.
3740	252	FC	An ESDI fault was successfully retried on a Read.
3730	253	FD	An ESDI fault was successfully retried in a Write.

Adjustments

6

No operating or maintenance adjustments are required for these products.

.

Peripherals 7

This chapter is not applicable to these products.

Replaceable Parts 8

8-1. Replaceable Parts

Field replaceable assemblies and parts for the disc drive are shown in order of disassembly in figure 8-1 and listed in table 8-1. Figure 9-7 illustrates all the parts for the disc drive (see Diagrams chapter). In each listing, attaching parts are listed immediately after the item they attach. Items in the DESCRIPTION column are indented to indicate their relationship to the next higher assembly. In addition, the symbol "- - - X - - -" follows the last attaching part for the item. Identification of the items and the labels is as follows:

Major Assembly

*Replaceable Assembly

*Attaching Part for Replacement Assembly

**Subassembly or Component Part

**Attaching Part for Subassembly or Replacement Part

The replaceable parts listings provide the following information for each part:

a. FIGURE AND INDEX NO. The figure and index numbers which indicate where the replaceable part is illustrated.

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

c. DESCRIPTION. The description of the replaceable part. Refer to table 8-2 for an explanation of the abbreviations used in the DESCRIPTION column.

d. MFG. CODE. The 5-digit code that denotes a typical manufacturer of a part. Refer to table 8-3 for a listing of manufacturers that corresponds to the codes.

e. MFG. PART NO. The manufacturer's part number for each replaceable part.

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

g. The MFG CODE and MFG PART NO. for common hardware are listed as 00000 and OBD (order by description), respectively, because these items can be purchased locally.

NOTE

TORX* hardware is used in the disc drive. This hardware requires the use of special drivers. In this manual, any reference to this type of hardware will be accompanied by the required driver size (for example, "T15").

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

TOP
SHROUD

ROM

CONTROLLER
PCA-A2 (FRA2)

FRONT
PANEL

FAN

LED
CABLE

POWER
SUPPLY
PCA-A3

DISC
DRIVE
A1 (FRA1)

C7859A01
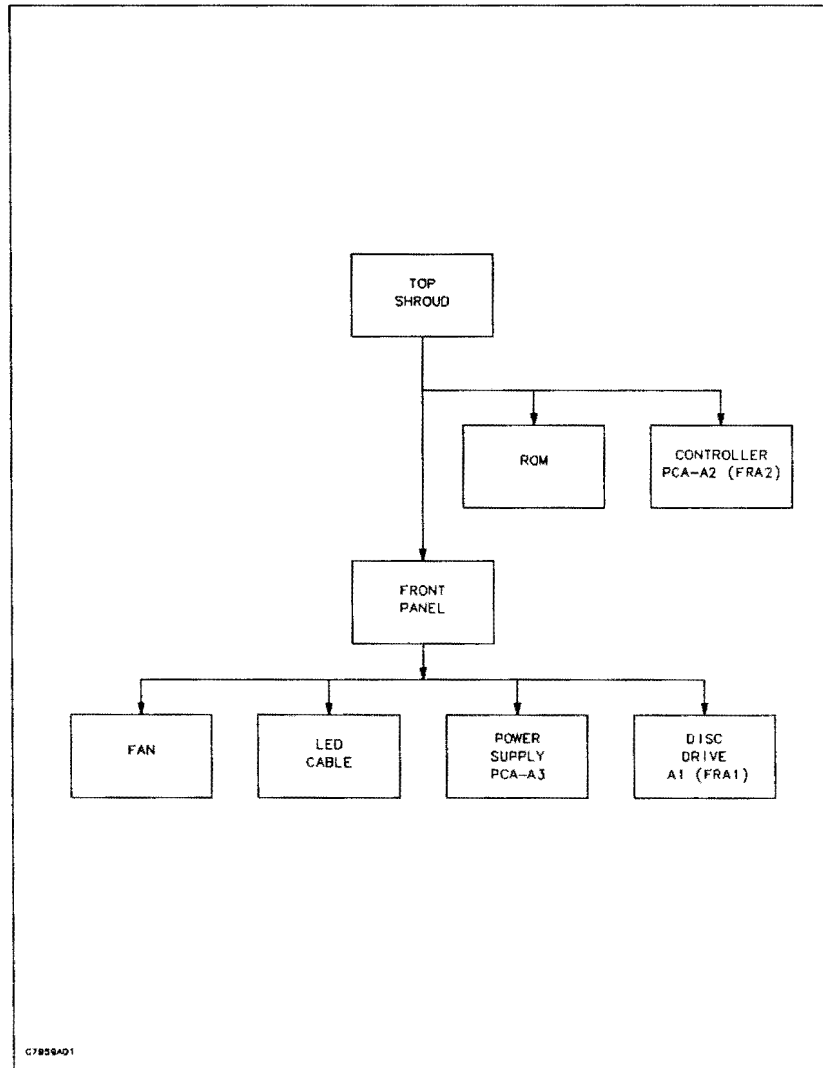
Figure 8-1. Order of Disassembly

8-2. Ordering Information

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

a . Model and full serial number.

b. Hewlett-Packard part number.

c . Complete description of each part as provided in the replaceable parts listing.

8-3. Disc Drive Assembly PCA-A1 Return

A defective disc drive assembly A1 being returned to the factory must be packaged and shipped in Hewlett-Packard shipping material or the warranty will be void.

8-4. Field Stocking Inventory

The following assemblies and parts comprise a recommended field stocking inventory for the drive.

PART NO.	QTY	DESCRIPTION
2110-0003	1	FUSE, 3A, 250V, non time-delay
3160-0528	1	FAN
07941-60003	1	CABLE, LED (W4)
07957-60008	1	CABLE, power (W1)
07957-60010	1	CONTROLLER PCA-A2
07957-60090	1	CABLE, data (W2)
07957-60091	1	CABLE, control (W3)
07961-10102	1	ROM, controller PCA-A2
07961-60051	1	DISC DRIVE ASSY A1 (81 Mbyte)
07962-60051	1	DISC DRIVE ASSY A1 (152 Mbyte)
07963-60051	1	DISC DRIVE ASSY A1 (304 Mbyte)
09133-67120	1	POWER SUPPLY ASSEMBLY PCA-A3

8-5. Removal and Replacement

Removal and replacement procedures for the field-replaceable assemblies and parts in the disc drive are given in the following paragraphs. The order of disassembly is shown in figure 8-1. To assist in the iden-tification of parts, references are made to the index numbers in table 8-1 and figure 9-7.

NOTE

All attaching hardware must be in place and the torque specifications given adhered to in order for the drive to meets its RFI specifications.

8-6. Top Shroud

To remove the top shroud (1):

a. Remove the three T10 screws (2) which secure the top shroud to the disc drive.

b. Raise the rear of the top shroud upward slightly and then move it backward and away from the disc drive.

c. Ground the frame of the disc drive to an anti-static pad.

Reinstallation is a reversal of the removal procedure.

8-7. ROM

To remove the ROM (11):

a. Remove the top shroud.

b. Remove the ROM (11) from its 28-pin socket (U141) on controller PCA-A2 (10). See figure 4-4 for the location of the ROM. Place the ROM on a piece of anti-static foam.

Reinstallation is a reversal of the removal procedure. Ensure that the ROM is installed in the socket with the index notch on the ROM in line with the notch on the socket.

8-8. Controller PCA-A2

To remove controller PCA-A2 (10):

a. Remove the top shroud.

b. Remove the two 6-32 hex standoffs (8) and lock washers (9) which secure the HP-IB connector on PCA-A2 to the rear panel of the disc drive.

c. Disconnect cable assemblies W1 (13), W2 (15), W3 (14), and W4 (7) from PCA-A2.

d. Slide PCA-A2 forward and out of the disc drive.

Reinstallation is a reversal of the removal procedure. Ensure that the cable connectors are firmly seated in their mating connectors.

8-9. Front Panel

To remove the front panel (4):

a. Remove the top shroud.

b. Remove the four T10 screws (3) which secure the front panel shield (6), with front panel (4) and LED

cable assembly W4 (7) attached, to the disc drive. Move the front panel forward and away from the disc drive.

c. Disconnect cable assembly W4 from controller PCA-A2.

Torque Specification: Tighten the four T10 screws removed in step b to 14 in./lbs.

Reinstallation is a reversal of the removal procedure. Check that the LINE¯ switch operates freely before tightening the four T10 screws which secure the front panel to the mainframe.

8-10. Fan

To remove the fan (16), proceed as follows:

a. Remove the top shroud and the front panel.

b. Remove the two 6-32 hex standoffs (8) and lock washers (9) which secure the HP-IB connector on controller PCA-A2 (10) to the rear panel of the mainframe assembly. Slide controller PCA-A2 forward to gain access to the fan.

c. Remove the four T20 screws (17) and grille (18) which secure the fan to the rear panel of the mainframe assembly (34).

d. Disconnect the fan power cable from power supply PCA-A3 (23).

e. Disengage the fan cable assembly from the two cable clamps (19) and remove the fan from the disc drive.

Reinstallation is a reversal of the removal procedure. Ensure that the fan is positioned with its power cable assembly in line with the cable clamps (19). Ensure also that the fan cable connector is firmly seated in its mating connector on power supply PCA-A3. Before returning the disc drive to service, check that the fan is operating correctly.

8-11. LED Cable W4

To remove LED cable assembly W4 (7):

a. Remove the top shroud and the front panel.

b. Remove the four T25 screws (5) that hold the front panel shield (6) to the front panel (4).

c. Lift the front panel shield from the front panel and remove LED cable assembly W4 from the front panel.

8-12. Power Supply PCA-A3

To remove power supply PCA-A3 (23):

a. Remove the top shroud and the front panel.

b. Disconnect cable W1 (13) and the fan cable from power supply PCA-A3.

c. Remove the T10 screw (20) and spacer (21) which secure PCA-A3 to the mainframe assembly.

d. Remove the two T15 screws (22) which secure PCA-A3 to the mainframe assembly.

e. Slide PCA-A3 forward and out of the disc drive.

WARNING

Power supply shield (26) must be in place and the captive T15 screw (22) on the left-hand side of the mainframe assembly (34) tightened before power is applied to the disc drive.

NOTE

The T10 screw (20) and spacer (21) must be in place for the disc drive to meet its RFI specifications. Also, the T10 screw (20) should be replaced each time it is removed from the disc drive.

Torque Specification: Tighten the T10 screw removed in step c to 10 in./lbs.

Reinstallation is a reversal of the removal procedure. Ensure that the T10 screw (20) and spacer (21) are properly installed. Ensure also that the two T15 screws (22) are in place. All of this attaching hardware is required to properly ground the power supply to the mainframe.

8-13. Disc Drive Assembly A1

CAUTION

A defective disc drive assembly A1 being returned to the factory must be packaged and shipped in the proper Hewlett-Packard shipping container. Failure to use the proper container will void the warranty.

To remove disc drive assembly A1 (32):

NOTE

Before removing disc drive assembly A1, refer to paragraph 4-1. This describes how a substitute drive assembly can be connected into circuit before the drive is removed from the mainframe.

a. Remove the top shroud and the front panel.

b. Disconnect cable assemblies W1 (13), W2 (15), and W3 (14) from A1.

c. Remove the four T15 screws (30) which secure tray (33), with A1 attached, to the mainframe assembly.

d. Carefully withdraw A1 from the mainframe assembly.

e. Remove the four T15 screws (31) which secure A1 to the tray.

Torque Specification: Tighten the four T15 screws removed in step c to 10 in./lbs and the four T15 screws removed in step e to 15 in./lbs.

Reinstallation is a reversal of the removal procedure.

Table 8-1. Disc Drive Replaceable Parts

FIG.& INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-7-	7957B	DISC DRIVE	28480	7957B	REF
	7958B	DISC DRIVE	28480	7958B	REF
	7959B	DISC DRIVE	28480	7959B	REF
1	07957-60015	* TOP SHROUD ASSEMBLY	28480	07957-60015	1
		(Attaching Parts)			
2	0515-0374	* SCREW,pnh,T10,M3.0 X 0.50, 10 mm long w/scw	00000	OBD	3
		- - - X - - -			
3	0515-0374	* SCREW,pnh,T10,M3.0 X 0.50, 10 mm long w/scw	00000	OBD	4
4	07957-60017	* FRONT PANEL ASSEMBLY, 7957B	28480	07957-60017	1
	07958-60017	* FRONT PANEL ASSEMBLY, 7958B	28480	07958-60017	REF
	07959-60017	* FRONT PANEL ASSEMBLY, 7959B	28480	07959-60017	REF
5	0624-0590	** SCREW, tapping, pnh, T25, 8-16, 0.312	00000	OBD	4
6	5001-3344	** FRONT PANEL SHIELD	28480	5001-3344	1
7	07941-60003	** LED Cable Assembly (W4)	28480	07941-60003	1
8	0380-1918	* STANDOFF, hex, 6-32, 0.255 in. long	28480	0380-1918	2
9	2190-0017	* WASHER, lock, helical, no. 8	00000	OBD	2
10	07957-60010	* CONTROLLER PCA-A2 (FRA2)	28480	07957-60010	1
11	07961-10104	** FIRMWARE ROM KIT	28480	07961-10104	1
12	0380-1656	** SPACER, SNAP-IN, 0.625 in. long, 0.280 in. OD, Nylon	00000	OBD	1
13	07957-60092	* POWER CABLE ASSEMBLY (W1)	28480	07957-60092	1
14	07957-60091	* CONTROL CABLE ASSEMBLY (W3)	28480	07957-60091	1
15	07957-60090	* DATA CABLE ASSEMBLY (W2)	28480	07957-60090	1
16	3160-0528	* FAN	28480	3160-0528	1
		(Attaching Parts)			
17	0624-0661	* SCREW, tapping, pnh, T20, 10-14, 0.625 in. long	00000	OBD	4
18	07941-00026	* GRILLE, fan	28480	07941-00026	1
19	1400-0510	* CLAMP, cable	02768	8511-28-00-99	2
		- - - X - - -			
20	0515-0665	* SCREW, machine, pnh, T10, M3.0 by 0.5, 14 mm long, w/scw	00000	OBD	1
21	5021-1534	* SPACER	28480	5021-1534	1
22	0515-0433	* SCREW, machine, pnh, T15, M4.0 by 0.7, 8 mm long, w/scw	00000	OBD	2
23	09133-67120	* POWER SUPPLY ASSEMBLY	28480	09133-67120	1
24	2110-0565	** CAP, fuseholder	28480	2110-0565	1
25	2110-0003	** FUSE, 3A, 250V, ntd, 1.25 by 0.25 in.	75915	312 003	1
26	09144-45404	** SHIELD, power supply	28480	09144-45404	1
27	09133-40202	** SHAFT, switch	28480	09133-40202	1
28	0380-1655	** HOLDER, shaft	28480	0380-1655	1
29	5041-1203	** CAP, switch	28480	5041-1203	1
30	0515-0433	* SCREW, machine, pnh, T15, M4.0 by 0.7, 8 mm long, w/scw	00000	OBD	4
31	2360-0464	* SCREW, pnh, T15, 0.375 in. long, 6-32 w/scw	00000	OBD	4
32	07961-60051	* DISC MECHANISM, 81 MEGABYTE	28480	07961-60051	1

Table 8-1. Disc Drive Replaceable Parts (continued)

FIG.& INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
	07962-60051	* DISC MECHANISM, 152 MEGABYTE	28480	07962-60051	REF
	07963-60051	* DISC MECHANISM, 304 MEGABYTE	28480	07963-60051	REF
33	5001-3341	* DISC TRAY	28480	5001-3341	1
34	5061-3145	* MAINFRAME ASSEMBLY	28480	5061-3145	1
35	09121-48303	** FOOT, plastic, molded	0BJK9	No number	2
36	0403-0427	** FOOT, rear	94959	SJ-5008	2
37	0403-0406	** GUIDE, PCA, 4.5 in. long	28480	0403-0406	2
38	0403-0379	** GUIDE, PCA, 9.9 in. long	28480	0403-0379	1
39	0403-0302	** GUIDE, PCA, 8 in. long	28480	0403-0302	1
40	8120-3445	* HP-IB CABLE ASSEMBLY, 1m, (Model 10833A)	28480	8120-3445	1
41	8120-0698	* POWER CORD, NEMA15A/CEE (option 904)	28480	8120-0698	1
	8120-1351	* POWER CORD, BS 1363/CEE (option 900)	28480	8120-1351	REF
	8120-1369	* POWER CORD, ASC 112/CEE (option 901)	28480	8120-1369	REF
	8120-2371	* POWER CORD, NEMA10A/CEE (option 903)	28480	8120-2371	REF
	8120-1689	* POWER CORD, GMBH/CEE (option 902)	28480	8120-1689	REF
	8120-1860	* POWER CORD, CEE/CEE, 1.5 m, (option 905)	28480	8120-1860	REF
	8120-2104	* POWER CORD, SEV/CEE (option 906)	28480	8120-2104	REF
	8120-2956	* POWER CORD, MDPP/CEE (option 912)	28480	8120-2956	REF
	8120-4211	* POWER CORD, SABS/CEE (option 917)	28480	8120-4211	REF
	8120-4753	* POWER CORD, NEMA12A/CEE (option 918)	28480	8120-4753	REF

Table 8-2. Abbreviations

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

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Table 8-3. Code List of Manufacturers

CODE NO.	MANUFACTURER	ADDRESS
OBJK9	Plastech	Monrovia, CA
28480	Hewlett-Packard Co.	Palo Alto, CA
2K658	Sony Corp.	Dallas, TX
61058	Panasonic Industrial Co.	Secaucus, NJ
75915	Littelfuse Tracor Inc.	Des Plaines, IL
94959	3M Co., Adhesives, Coating, and Sealers Div.	St. Paul, MN

Diagrams 9

9-1. Introduction

This chapter contains illustrations of the disc drive addressing structure, track allocation, sector format, functional blocks, cabling, signal distribution and parts location.

2 HEADS PER DISC

ACTUATOR

0
1
2
3
4
5
6
7
8
9
10
11

TRACK 0 1582

7957B
2 DISCS

7958B
3 DISCS

7959B
6 DISCS

1583 CYLINDERS

64 SECTORS PER TRACK

TRACK
0000

TRACK
1582

LANDING
ZONE

DIRECTION OF
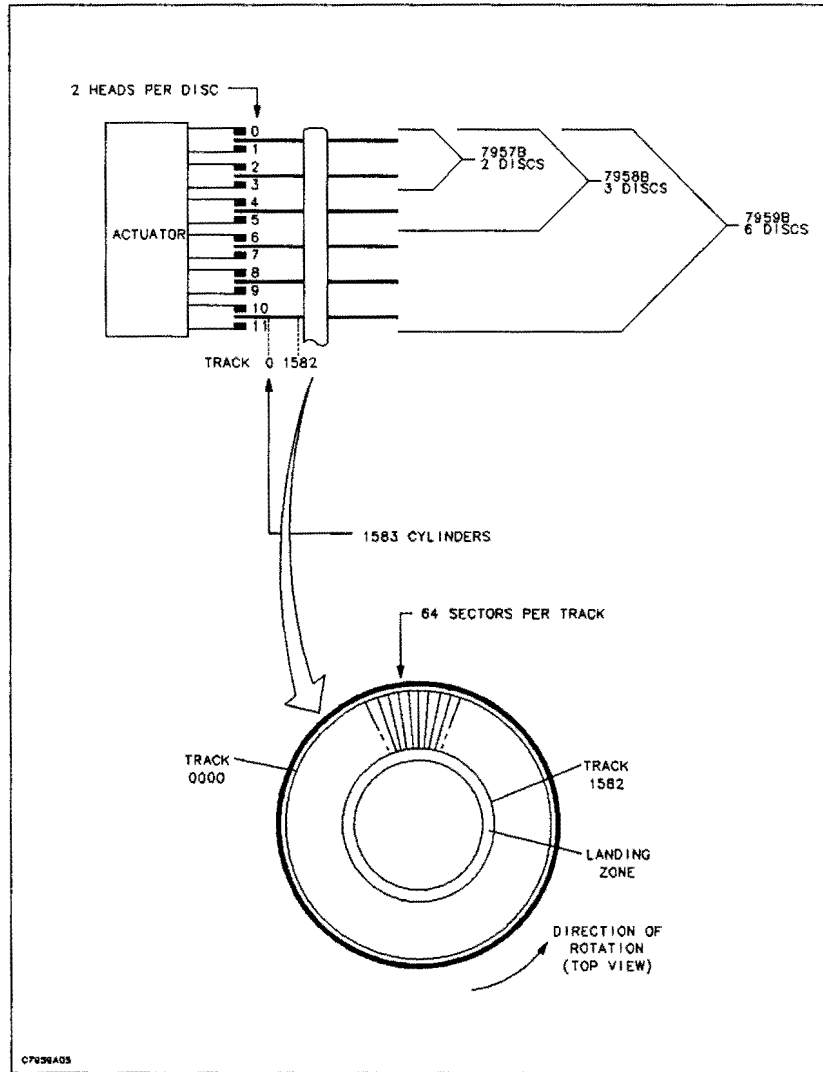ROTATION
(TOP VIEW)

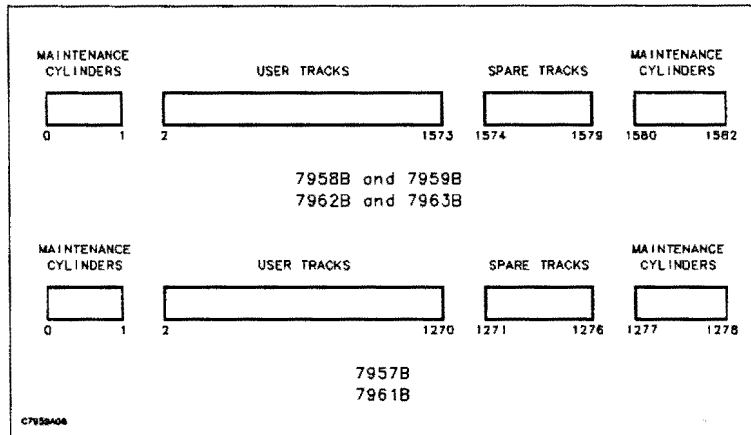C7959A05

Figure 9-1. Disc Mechanism Addressing Structure

Figure 9-2. Track Allocation
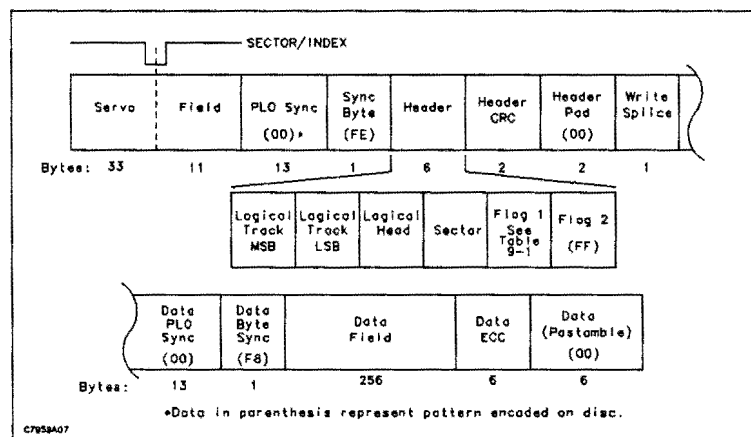
Figure 9-3. Physical Sector Format
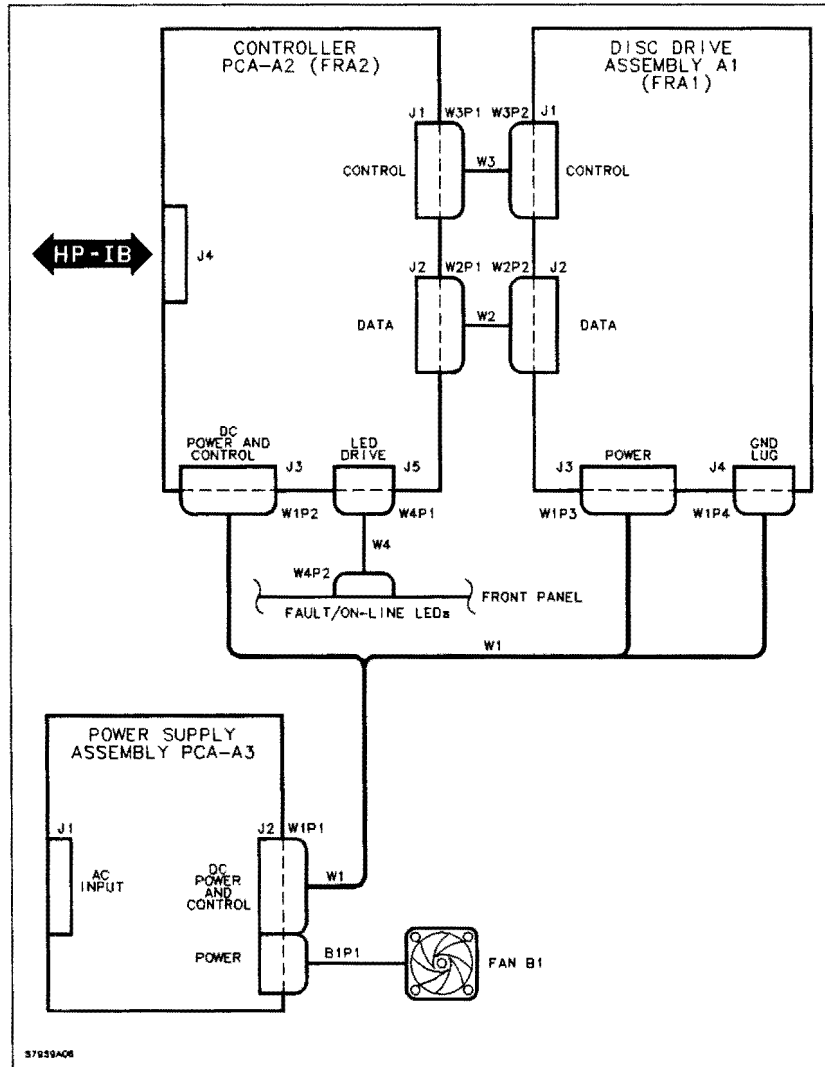
Figure 9-4. Cabling Diagram
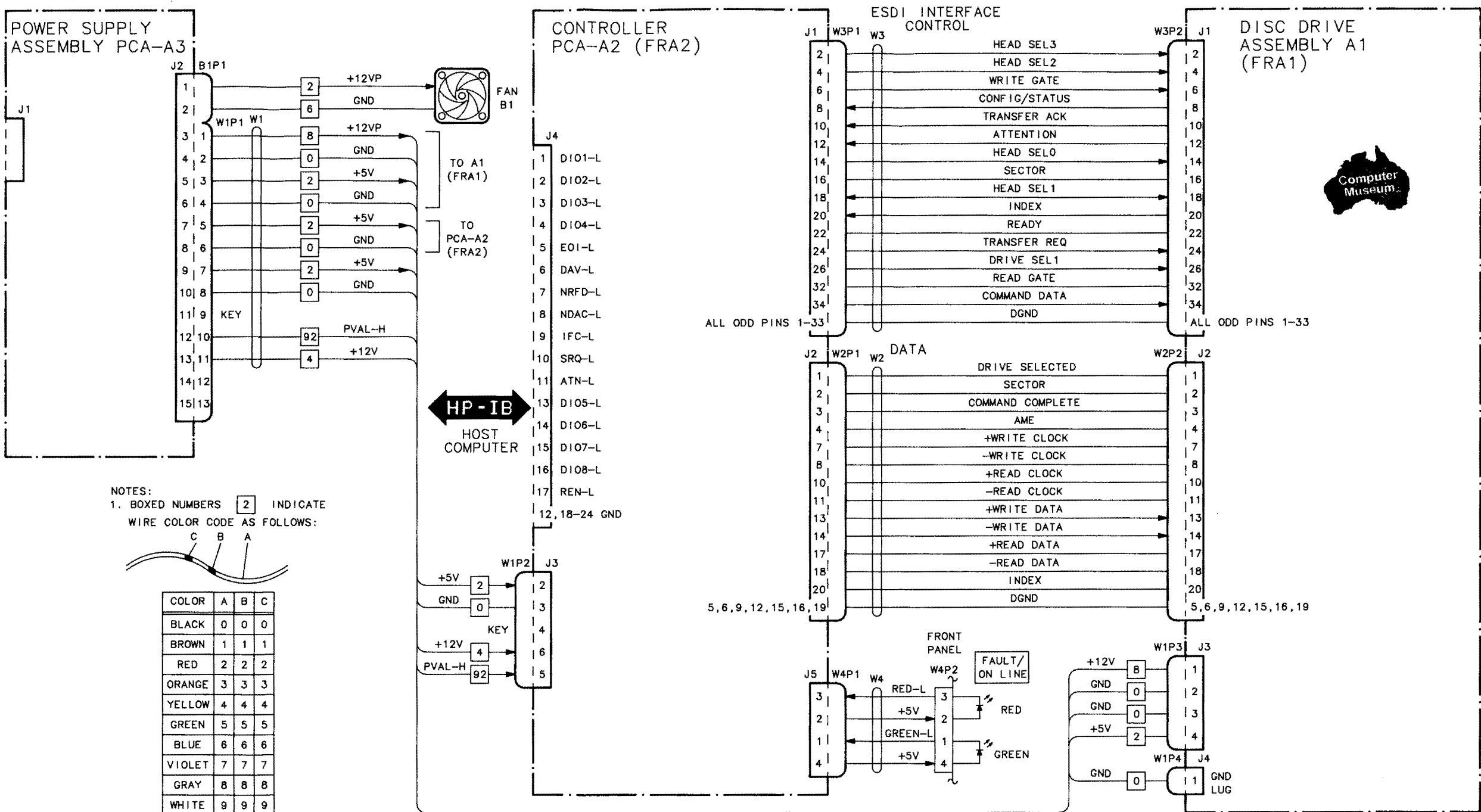
Figure 9-5. Signal Distribution

9-5/9-6

DISC DRIVE ASSEMBLY A1
(FRA1)

ESDI BUS   CONTROL
            DATA

ESDI
INTERFACE

NRZ READ/WRITE DATA

WIPER
GATE
ARRAY
IC

CONTROL/STATUS

DISC
CONTROLLER

READ/WRITE

SERVO

SERVO
DATA

SPINDLE
CONTROL

RLL
READ/WRITE
DATA

ACTUATOR
CONTROL

DIAPER
GATE
ARRAY
IC

SPINDLE
DRIVER

CONTROL

ACTUATOR
DRIVER

LED CONTROL

FRONT PANEL
FAULT/ON LINE
INDICATOR

HEAD
INTERFACE

MEDUSA
ADDRESS LINES
3

ACTUATOR

HP-IB
INTERFACE
(MEDUSA)
IC

SPINDLE
MOTOR

SEALED HEAD/
DISC ASSY

4

ADDRESS
SWITCH

POWER
SUPPLY
PCA-A3

AC INPUT

+5V
+12V
-12V
POWER-ON RESET
+12VP

Figure 9-6. Disc Drive
Functional Block Diagram

CONTROLLER PCA-A2 (FRA2)

ESDI DATA & CONTROL

CONTROL

CONTROL

µP CLOCKS

INPUT PORT (STATUS BYTE)

STATUS

ADDRESS DECODER

DEVICE SELECT

ROM 32K X 8

RAM 2K

12 MHz CLOCK

MICRO-PROCESSOR

ATTN

DATA BUS

8

ADDRESS BUS

16

CLOCKS

DMA ADDRESS BUFFERS

TRANSCEIVER

CONTROL

DISC DATA CONTROLLER (DDC) IC

WRITE DATA

LOWER DMA DATA BUS

8

TRANSCEIVER

READ DATA

UPPER DMA DATA BUS

8

RAM BUFFER 1 8K

RAM BUFFER 0 8K

ADDRESS STROBE

ADDRESS LATCH

DMA ADDRESS BUS

14

CONTROL

HP-IB

-IB

C7959A04

Figure 9-7. Disc Drive, Exploded View

9-9/9-10

S7059A01

Table 9-1. Flag Status Values

	ADDRESS BYTES			FLAG BYTE							
	NORMAL SECTOR CYLINDER HEAD SECTOR	SPARE SECTOR CYLINDER HEAD SECTOR	DEFECTIVE SECTOR CYLINDER HEAD SECTOR	AUX TRK	NOT USED	FACT TRK	FLD TRK	FACT SECT	FLD SECT	NOT USED	DEF TRK
DATA AREA											
NORMAL TRACK — NO SECTOR SPARED	LOG, LOG, 0-62	LOG, LOG, 0-63	NONE	0	0	0	0	0	0	0	0
TRACK WITH SPARED SECTOR											
FACTORY SPARED	LOG, LOG, 0-62	NONE	LOG, LOG, 255	0	0	0	0	1	0	0	0
FIELD SPARED	LOG, LOG, 0-62	NONE	LOG, LOG, 255	0	0	0	0	0	1	0	0
SPARED OUT (DEFECTIVE) TRACK											
FACTORY SPARED											
FACTORY SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	1	0	1	0	0	1
FIELD SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	1	0	0	1	0	1
FIELD SPARE											
FACTORY SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	0	1	1	0	0	1
FIELD SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	0	1	0	1	0	1
AUXILIARY AREA											
GUARD TRACKS	PHYS, PHYS, 0-63	NONE	NONE	1	0	0	0	0	0	0	0
SELFTEST TRACKS	PHYS, PHYS, 0-63	NONE	NONE	1	0	0	0	0	0	0	0
SPARE TRACKS											
NOT USED TRACKS											
NO SECTOR SPARED	PHYS, PHYS, 0-62	PHYS, PHYS, 0-63	NONE	1	0	0	0	0	0	0	0
SECTOR SPARED	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	1	0	0	0	1	0	0	0
IN USE TRACKS											
NO SPARED SECTOR	LOG, LOG, 0-62	LOG, LOG, 0-63	NONE	0	0	0	0	0	0	0	0
FACTORY SPARED SECTOR	LOG, LOG, 0-62	NONE	LOG, LOG, 255	0	0	0	0	1	0	0	0
FIELD SPARED SECTOR	LOG, LOG, 0-62	NONE	LOG, LOG, 255	0	0	0	0	0	1	0	0
DEFECTIVE TRACK											
FACTORY SPARED											
FACTORY SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	1	0	1	0	0	1
FIELD SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	1	0	0	1	0	1
FIELD SPARED											
FACTORY SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	0	1	1	0	0	1
FIELD SPARED SECTOR	PHYS, PHYS, 0-62	NONE	PHYS, PHYS, 255	0	0	0	1	0	1	0	1

NOTE:
1. LOG = LOGICAL
2. PHYS = PHYSICAL
3. ANY PHYSICAL CYLINDER ADDRESS WILL HAVE THE MSB SET.

S7957A11

Reference   10

10-1. Introduction

For more information regarding the disc drive, refer to the publications listed below:

5955-3456   *Site Environmental Requirements for Disc/Tape Drives*
07959-90901   *HP 7957B, 7958B, 7959B Owner's Manual*

Service Notes   11

11-1. Introduction

This chapter provides a listing of all released service notes for the disc drive. (No service notes have been published at the time of this printing.)

HEADQUARTER OFFICES
If there is no HP Sales Office in your area,
contact one of these headquarter offices.

UNITED STATES:
Hewlett-Packard Company
4 Choke Cherry Road
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Telephone: (301) 670-4300

Hewlett-Packard Company
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Rolling Meadows, IL 60008
Telephone: (312) 255-9800

Hewlett-Packard Company
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North Hollywood, CA 91601
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Hewlett-Packard Company
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Atlanta, GA 30339
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