HP 3000 Series 900 Computer Systems

HP 27115A
Fiber-Optic Link

Installation Manual

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E0490

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History

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General Information

Introduction

This manual contains installation and troubleshooting information for the HP 27115A Fiber-Optic Link (HP-FL) device adapter.

Product Description

The HP 27115A HP-FL device adapter provides the computer system with a high speed, serial connection to peripheral devices over a fiber-optic data link. Device specific data are converted to a format compatible with the CIO bus (CIB), and then passed to the host computer. The channel adapter controls the flow of traffic between the CIB and the memory/processor bus. See figure 1-1.

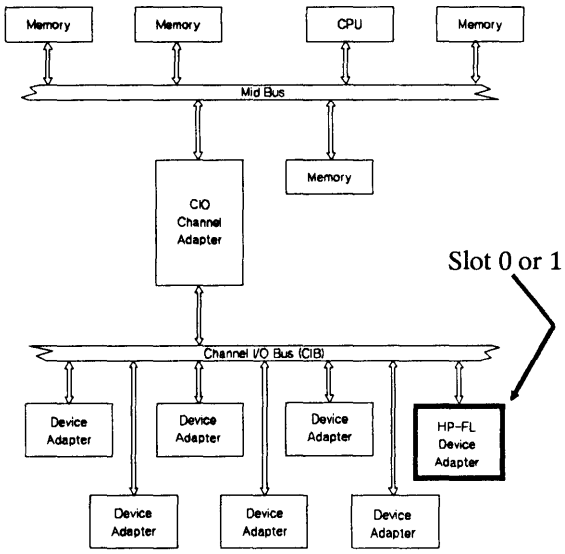

Figure 1-1. HP-FL Device Adapter in an HP 3000 Computer System

A duplex fiber-optic cable provided with the HP-FL connects it to supported peripherals. The cable consists of two graded index optical fibers with cladding and a polyurethane outer jacket, with four 905-type SMA optical connectors.

Peripherals that may be connected to the HP 27115A HP-FL include:

- HP 7936FL, 307-Mbyte disk drive with HP-FL controller
- HP 7937FL, 571-Mbyte disk drive with HP-FL controller
- HP C2201A, 670-Mbyte disk drive with HP-FL controller
- HP C2204A, 1340-Mbyte disk drive with HP-FL controller

Features

Table 1-1 summarizes key features of this product.

Table 1-1. Summary of HP 27115A Features

Disk clusters and I/O slot efficiency	HP-FL can connect the host with up to 8 disk drives in a cluster. This can result in a large number of disk drives attached to your system while lowering the number of I/O slots required. The drives use a "daisy-chain" connection called the "PBus" to move data to the fiber link.
Transfer rates	The HP-FL protocol can transfer up to 5 Mbytes per second. The overhead imposed by the HP-FL device adapter is less than 1 ms. (Additional overhead accrues from the software, the channel, and the disk controller.)
Offloading the host CPU	The HP-FL on-board microprocessor controls the HP-FL protocol. It manages PCA operations and data transfers with minimal host intervention. It also conducts a hardware self-test, and displays results of internal and external link status checks by means of 6 LEDs.
Optical fiber cable	Fiber-optic cable is thin, lightweight and flexible. It is not susceptible to electronic or magnetic noise and provides electrical isolation The cable may be up to 500 meters long, allowing greater flexibility in locating disk drives. (See "Cables, Test Equipment, and Tools", to order a cable other than 30 m long.)

Equipment Supplied

The following items are provided with the standard HP 27115A product:

- 27115-60001 HP-FL device adapter PCA
- 1005-0078 30 m, duplex fiber-optic cable with 905-type SMA connectors
- 5061-3151 PBus terminator (quantity = 2)
- 27115-90001 *HP 27115A Fiber-Optic Link Installation Manual*

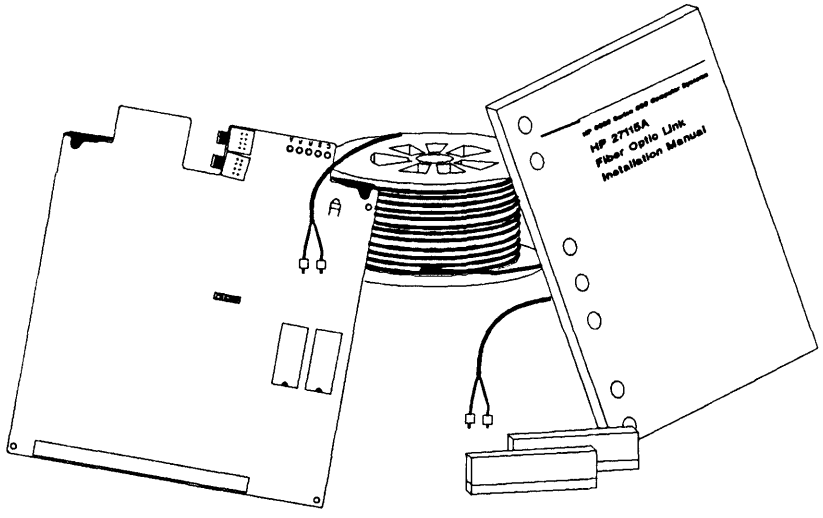

Figure 1-2. HP 27115A Fiber Optic Link

Options

Depending on the options below, the above items may have been modified:

#001 Deletes the standard 30-meter HP-FL cable. Cables in special lengths are available separately from Hewlett-Packard.

#002 Adds a 30-cm, single-fiber loopback cable, part number HFBR-3020.

If any item is missing or incorrect, or you would like to order additional hardware, contact your nearest HP Sales and Support Office.

Cables, Test Equipment and Tools

To order a special length cable from Hewlett-Packard, contact the HP Sales and Support Office. Order part number HFBR-AWQ*xxx*, with *xxx* replaced by the length (in meters) you want the cable to be. For example, HFBR-AWQ075 is the part number for a 75-meter cable. The following cable lengths (in meters) are available:

001	015	035	075	175	350
002	020	040	100	200	400
005	025	045	125	250	450
010	030	050	150	300	500

Note

Installation of the fiber-optic cable may require additional equipment to pull and protect the cable. Refer to the *Fiber-Optic Cable Installation Guide* (5954-8446), provided with the cable.

For cable specifications, see appendix A or the *Fiber-Optic Cable Installation Guide*.

Test Equipment

Test equipment may be required to test the fiber-optic cable, both before and after installation. This equipment must be able to connect with the 905-type SMA connectors on the cable ends. The following equipment can be used:

- *Optical power meter*, for example, Photodyne Model 11XE*
- *Optical power source*, for example, Photodyne Model 8XE-B*
- *905/906 series SMA adapter*, for example, Photodyne Model 2003*

Refer to your supplier's catalog for various options and accessories available.

A *single-fiber loopback cable* allows convenient troubleshooting of HP-FL subsystem components. Option #002 to the product provides a short, single-fiber cable for this purpose (this cable is available as part number HFBR-3020). Alternatively, one of the fibers on a duplex cable can be used for loopback testing if both ends of the fiber are available for connection to the HP 27115A PCA.

Tools

Installation or routing the cable may require assembly, disassembly, or adjustment of a strain-relief ferrule on the fiber-optic cable. Two screws secure the ferrule to the cable, and will require the use of a 0-point Pozidriv or Phillips screwdriver. See figure 2-5 and the accompanying text for details about the strain-relief ferrule.

Note

The decision to repair a fiber-optic cable depends on the availability and cost of a replacement cable. The repair will take a trained technician about two hours with the required tools and parts. Test the cable after the repair. See chapter 3 for details.

A fiber-optic tool kit (Amphenol part number 927-100-5905†) is available that has tools and minor parts for making these repairs. (Amphenol also offers a replenishment kit, part number 927-100-2039†, with replacements for those parts used in the repair process.) You must also have two, 905-type SMA connectors (HP part number HFBR-40001) to make the repair

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* Available from:
Photodyne Inc.
3760 Calle Tecate
Camarillo, California, U.S.A. 93010

† Available from:
Amphenol Fiber Optics
1938C University Lane
Lisle, Illinois, U.S.A. 60532

Installation Design

This section describes supported computer-to-disk connections.

Note

Connecting two or more computers to a single disk cluster is not supported. Although the hardware connection is possible, software for multiple computer disk sharing is not available.

Figure 1-3 shows two HP-FL device adapters and disk clusters. The number of HP-FL device adapters that can be installed depends on the particular computer system, number of HP CIO channels, and available I/O card slots. Consult your computer system installation and configuration manuals. If your installation requires more than one HP-FL link, be sure to divide them evenly among the available CIO buses.

Caution

No CIO bus may have more than two HP-FL PCAs More than two HP-FL device adapters will cause CIO channel contention and may overtax the power supply on your computer or extender. See table 1-2 for the power requirements for the HP-FL PCA.

Notice that, with a single drive attached to an HP-FL device adapter, two PBus terminators are installed on that drive. Where there are multiple drives, one terminator attaches to the drive where the fiber cable connects. A second terminator attaches to the last drive in the chain, and the PBus cables connect the controller (in the first drive) in series to the other drives. Your disk drive installation manual will have detailed instructions for installing the PBus terminators.

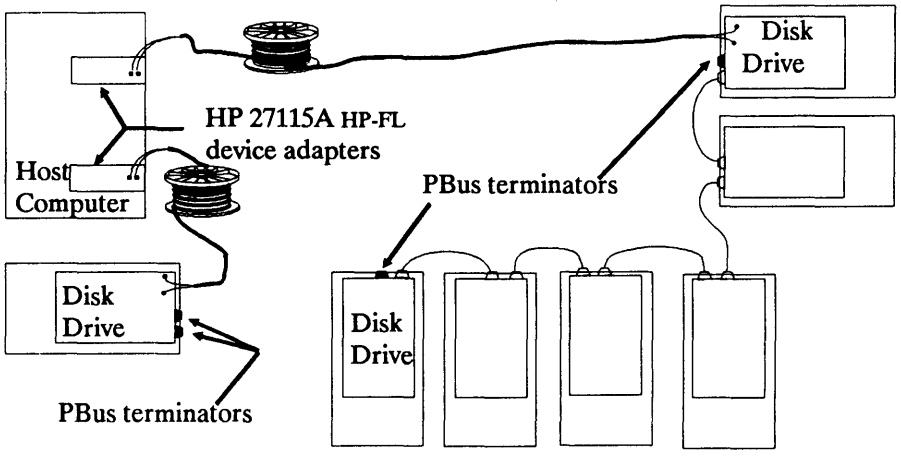

Figure 1-3. Connection to Disk Clusters

HP-FL Subsystem Considerations

There are various subsystem considerations associated with installing the HP-FL PCA that will affect system operation and performance.

Number of Disk Drives

The HP-FL software can control as many as eight disk drives through a single HP-FL PCA. However, your computer or installation may limit this number to six or fewer. See your system manuals for details.

CIO Slots

The total number of CIO slots available for general device adapters depends on the computer, and whether it supports additional CIB channel adapters or extenders. Depending on the system, each channel adapter supports from 5 to 14 CIO slots. However, you must install the HP-FL PCA in one of the eight lowest-numbered slots in any given CIB.

Note

Install the HP-FL PCA in one of the slots numbered from 0 to 7 in any CIO bus.

Channel Contention

As noted above, some systems have more than one CIB. With a host with multiple CIO buses and more than one HP-FL PCA, divide the PCAs among the CIO buses to minimize channel contention problems. For instance, with two HP-FL PCAs and two CIO buses, put one PCA on each bus.

Identification

The HP-FL PCA is identified on two labels affixed to the card. For example, the labels might look like this:

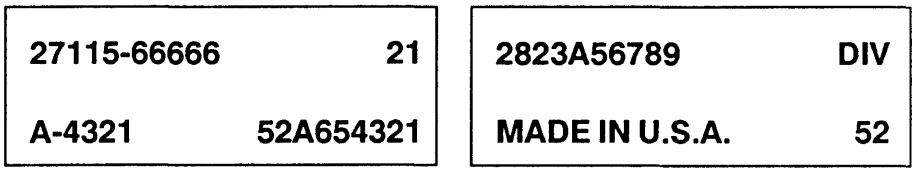

Figure 1-4. Example PCA Identification Stickers

Do not remove the labels. Record this information in a convenient place, such as your system logbook, for use when discussing the device adapter with HP factory and support personnel.

Specifications

Total the power requirement of all the adapters in the backplane and compare the sum to the rated output of the power supply to determine whether you can add the HP-FL to your computer system. The power figures are useful for determining the size of the required cooling system.

Table 1-2. Voltage Requirements and Power Dissipation

Voltage (± 5%)	Current				Power	
	typical	2σ	worst case			
+5 V dc	2.920 A	3.190 A	3.350 A		typical	14.9 W
+12 V dc	0.019 A	0.029 A	0.031 A		2σ	16.5 W
-12 V dc	0.015 A	0.017 A	0.017 A		worst case	18.2 W

Note

When using multiple HP-FL device adapters, the total number of disk drives supported on a system is system dependent. Consult your system specifications.

Table 1-3. HP-FL Environmental Limits

	Operating Environment	Storage Environment
Temperature	0°C–55°C	-40°C–70°C
Relative humidity	95% @40°C (noncondensing)	90% @65°C (noncondensing)
Altitude	4.6 km (15,000 feet)	15.2 km (50,000 feet)

Table 1-4. HP-FL Optical Specifications

	Transmitter	Receiver
Connector	Compatible with 905-type SMA connectors	Compatible with 905-type SMA connectors
Wavelength	820 nm	820 nm
Raw Bit Speed	80 Mbit/s	80 Mbit/s
Optical Power (using 100/140 μm cable with NA = 0.30)	-21 dBm (minimum) -9 dBm (maximum)	-27 dBm (minimum) -9 dBm (maximum)

2

Installation and Configuration

HP-FL Installation

Installation of the HP 27115A HP-FL device adapter takes five steps:

1. Configure the link into the operating system.
2. Verify the position of jumper J2.
3. Install the HP-FL PCA.
4. Connect the fiber-optic cable.
5. Verify the link operation.

The HP 27115A Fiber-Optic Link (HP-FL) printed circuit assembly (PCA) is susceptible to damage by electrostatic discharge (ESD). If possible, work in a static-free work area.

- Handle the PCA by its edges or extractor levers
- Avoid working on a carpet
- Reduce unnecessary movements.

These precautions will lessen the chances of ESD damage.

Caution

ESD can damage any electronic assembly. Failure to follow anti-ESD precautions can void your warranty.

If you do not have a static-free work area, we recommend a workstation kit, like the one provided as part number 9300-1155. It has a grounding wrist strap, a conductive work mat and other items to safely shunt any charge to ground. Instructions for its use come with the kit.

Configure the Link into the Operating System

To configure the HP-FL PCA and peripheral drives into the operating system, refer to your system administrator's manuals and the disk drive manuals. You may configure the operating system either before or after installation of the hardware.

Verify the Position of Jumper J2

The HP-FL PCA has a jumper labeled J2. The "M" position is undefined. For operation, the jumper must be in the "L" position, as shown in figure 2-1.

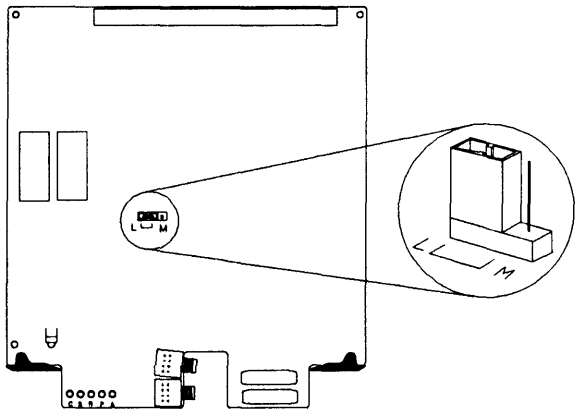

Figure 2-1. Jumper J2 Location and Position

Install the HP-FL PCA

Slot selection depends on how your system is configured. Review the section titled "HP-FL Subsystem Considerations" in chapter 1. Your system administrator's manual will identify those slots where the HP-FL PCA is allowed.

WARNING

Switch off the computer power when installing or removing a PCA. Before switching off the power, carefully follow the shutdown procedures explained in your system manuals.

Failure to follow the correct procedure may result in electrical shock and in data loss or corruption.

The HP-FL PCA must be installed into the CIO card cage of your computer or extender unit. Because this operation is system dependent, refer to the system hardware manuals supplied with your computer for details. You will:

1. Shut down the operating system.
2. Switch off the computer power.
3. Open the CIO card cage.
4. Insert the PCA into a CIO card cage slot. This step includes orienting the PCA correctly, and seating the PCA connector onto the backplane connector in the CIO bus. However, do not insert the PCA completely into the backplane connector. Leave about 5 cm (2 in.) protruding to allow installation of the fiber-optic cable.

Connect the Fiber-Optic Cable

Remove the protective caps on each connector of the cable and the PCA's ports. Attach the cable connector with the white sleeve to the light gray transmit port on the HP-FL PCA and the other connector to the darker gray receive port. This may be easier with the PCA slightly extended from the CIO card cage. See figures 2-2 and 2-3.

At the other end of the cable, attach the white-sleeved connector to the transmit port on the controlling drive and the sleeveless connector to the drive receive port.

Caution

When attaching the cable to the PCA, be careful not to overtighten the connectors. Use caution to avoid cross-threading the plastic port barrel. Make the connections by hand to avoid excessive torque. Do not use tools as they may damage the connectors.

The optical transmit port on the PCA must connect to the drive's receive port, and the PCA's receive port must connect to the drive's transmit port. The standard cable is marked to make this easier (see figure 2-2).

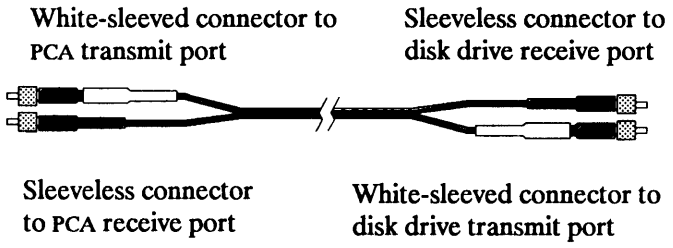

Figure 2-2. Identifying the Transmit and Receive Cable Connectors

If you connect the transmit ports to each other and the receive ports to each other, no damage will result, but the link will not work. (See the "Verify Link Operation" section later in this chapter. The red S and R LEDs will light.)

Cables from a Non-HP Source

Duplex fiber cables from other manufacturers will have a different scheme to help you identify a single fiber at each end of the cable. For example, one fiber may have a stripe along its length, while the other fiber does not. Connect the fiber with the stripe to the transmit port (light gray) and the unstriped connector to the receive port (dark gray) on the HP-FL PCA. At the disk drive end of the cable, connect the striped fiber to the disk drive's receive port and the unstriped fiber to the disk drive's transmit port.

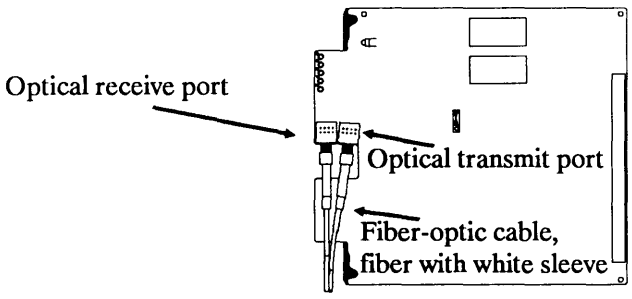

Figure 2-3. Fiber-Optic Cable Connection

Installing the PBus Terminators

Installing the PBus terminators has only two rules:

1. Every PBus socket must have either a terminator or a PBus cable connector attached.
2. The terminators must be reversed with respect to each other.

Since different disk drives have different socket arrangements, there are two terminator installation-indicator LEDs on the disk drive control boards near the PBus cable/terminator sockets. All of the indicators on the PBus must be off. If any is on, remove one of the terminators, invert it and re-install it. Figure 2-4 shows the disk-drive controller board for a single disk-drive installation and the first and last controller boards for a multiple disk-drive installation.

Note

Be sure the disk-drive power is on when you verify the LEDs. If you install the PBus terminators wrong, the HP-FL link will not work. See the disk drive manuals for more detail.

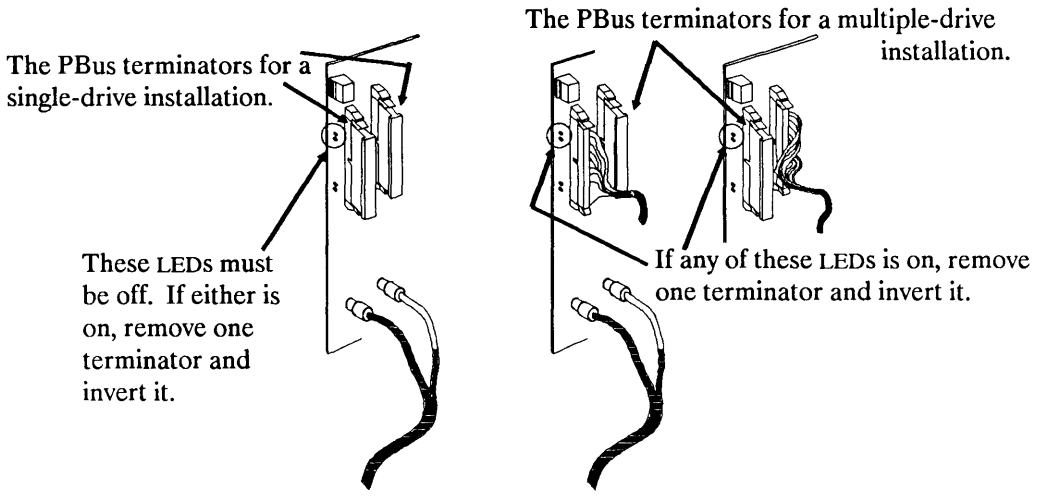

Figure 2-4. The Disk Drive Controllers Board Terminator LEDs

Attach and Adjust the Strain Relief Ferrule

Once the PCA, with the attached cable, is in the CIO card cage, you will need to install a strain-relief ferrule (unless it is already installed on the cable). When properly connected to the CIO grounding bus (part of the CIO card cage), it provides strain relief and guides the fiber-optic cable out of the card cage. The computer power should be switched off for this procedure. Figure 2-5 illustrates installing a strain relief ferrule.

Note

If the strain-relief ferrule is pre-assembled on the cable, you may still need to adjust it for proper distance from the cable end. Reverse the ferrule in the grounding bus (as in step 1) and proceed to step 2 below.

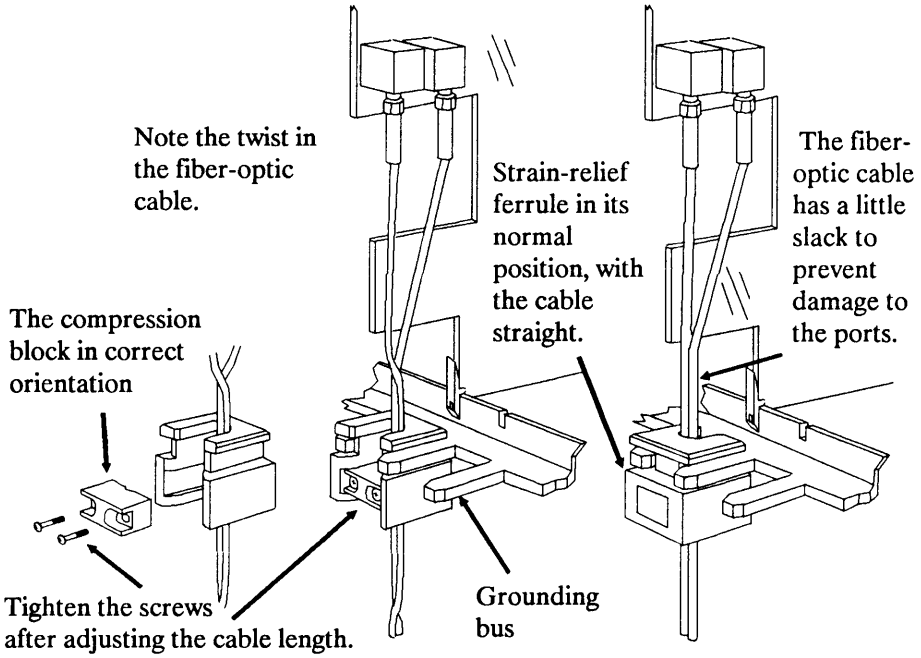

Figure 2-5. Fiber-Optic Cable Strain-Relief Ferrule

To install the strain-relief ferrule:

1. Place the ferrule into the "grounding bus" backwards – that is, with its open side exposed as shown in figure 2-5. As the figure illustrates, lay the fiber-optic cable into the ferrule with a half twist. (At the end of the installation process, you will take the twist out again. The cable will then be straight when the ferrule is in its normal position.) Be sure there is no tension on the PCA's optical ports.
2. As shown in the illustration, insert the compression block of the ferrule into its channel. Tighten the two screws enough to hold the cable in place for the next step. If the ferrule was pre-assembled on the cable, loosen the screws enough to slide the cable up or down for adjustment.

Caution

The compression block must be inserted with the notched side toward the cable, as in the figure. If it goes in backwards, it can damage the cable.

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3. Leave 0.5 cm (¼ in.) "play" as slack in the cable to prevent damage to the optical ports. Securely fasten the compression block to the ferrule body. The cable should no longer slip in the ferrule.
4. Pull the PCA slightly out (5 cm or 2 in.) from the card cage to provide working slack in the cable. Remove the ferrule from the grounding bus. Turn it around so the cable is straight and re-insert it into the grounding bus. Reseat the PCA.

Complete the Installation

With the HP-FL PCA fully inserted, both it and the strain-relief ferrule are now installed.

Verify the Link Operation

You should verify operation of the PCA and the HP-FL subsystem before transmitting any data across the link.

To verify operation of the HP-FL link, observe the results of the PCA self-test on the six LEDs on the front of the PCA. Figure 2-6 shows their locations.

WARNING

Operation of the computer with the CIO card cage open exposes personnel to hazardous electrical power.

For some systems, a safety interlock switches off the computer power when the card cage is open. Any attempt to defeat the interlock may also expose personnel to mechanical dangers.

Caution

The HP-FL PCA does not comply with mandatory electromagnetic radiation and interference (EMI and RFI) regulations when the card cage is open.

PCA Self-Test

The PCA self-test runs whenever the computer power is switched on or the computer is reset. If you are familiar with the operating system, you can reset the PCA programmatically. Some sections of the diagnostic program HPFLDIAG also reset the PCA. (See chapter 3, *Troubleshooting and Diagnostics*.)

PCA Self-Test Results

Your system may display the PCA self-test results in any of these ways:

- The System Status Display identifies any non-operational PCA in the host backplane. During the SPU self-test, general I/O self-tests also run. The host reports this information through the system status display (on a hexadecimal readout, on the system console, or by the system status LEDs). Refer to the hardware support manuals for your computer.
- HPFLDIAG displays its results on the system console or a user terminal.
- Most PCAs (including the HP-FL PCA) have LEDs that return the results of the PCA self-test. The LEDs on the HP-FL PCA are shown below.

PCA LEDs

Figure 2-6 shows the locations of the six LEDs on the HP-FL PCA. The self-test LED will go on for about five seconds during the self-test and then it must go off. If it remains on, or goes back on, the PCA is defective. Replace it.

If the self-test passes, the remaining LEDs indicate the link status. Table 2-2 shows common patterns that may occur after a successful self-test. (The "A" LED blinks irregularly and somewhat slowly, 10 to 60 time per minute.) For more information on self-test and LED interpretation, see chapter 3.

Table 2-2. Common LED Patterns After Self-Test Passes.

LED (color)	Pattern	Link Status
Self-test (red) C (red) S (red) R (red) P (green) A (green)	off off off off on/blinking blinking	The HP-FL device adapter and link are operational.
Self-test (red) S (red) R (red) P (green)	off on/blinking on on	Bad connection to the remote device: – the cable is not connected, – there is no power to the remote device, or – the remote device is faulty.
Self-test (red) P (green) A (green)	off on/blinking off	The HP-FL is not generating ID requests (replace the PCA)
Self-test (red) S (red) R (red)	off on on	Bad connection to remote device: the cable ends are reversed.
Self-test (red) C (red) P (green)	off on on/blinking	The PCA jumper J2 is in the "M" position (remove the PCA and place the jumper in the "L" position), or the disk drive is incompatible.

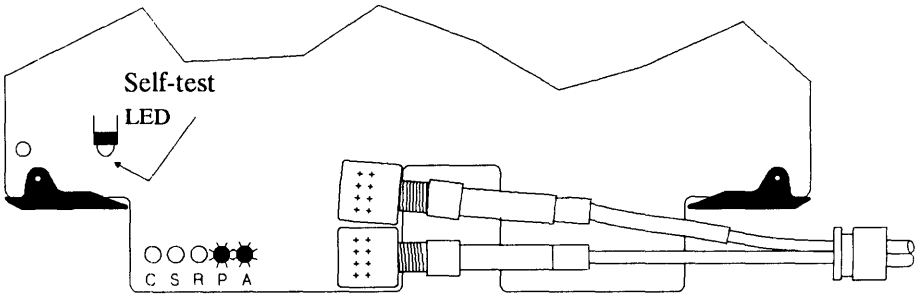

Figure 2-6. Self-Test and Status LEDs with Fiber-Optic Cable Installed

3

Troubleshooting and Diagnostics

Introduction

If the HP 27115A Fiber-Optic Link (HP-FL) hardware is not operating properly, this chapter will help you to identify the field replaceable unit (FRU) that is causing the problem. FRUs are the lowest level of assembly authorized for replacement. For the HP-FL, there are two primary FRUs: the PCA and the fiber-optic cable.

This chapter describes the following:

- Self-test and Status LEDs
- HP-FL Diagnostic Software, HPFLDIAG
- General Troubleshooting

For test equipment and special tools, refer to chapter 1.

Self-Test Failure and Status LEDs

The self-test failure and status LEDs on the PCA display results of the PCA self-test and the general status of PCA operation. To view the LEDs, you may need to open the CIO card cage.

WARNING

Operation of the computer with the I/O card cage open will expose personnel to hazardous electrical power. For some systems, power to the computer cannot be applied while the I/O card cage is open, due to a safety interlock feature. Any attempt to defeat the safety interlock and operate the computer will expose personnel to hazardous electrical power and mechanical devices (such as ventilation fans).

Caution

The product does not comply with mandatory electromagnetic radiation and interference (EMI and RFI) regulations when the I/O card cage is open.

Figure 3-1 shows the location of the six self-test failure and status LED indicators. The LED on the left is the "self-test failure LED". The remaining five are the status LEDs used to indicate the operational status of the fiber-optic link and the PCA.

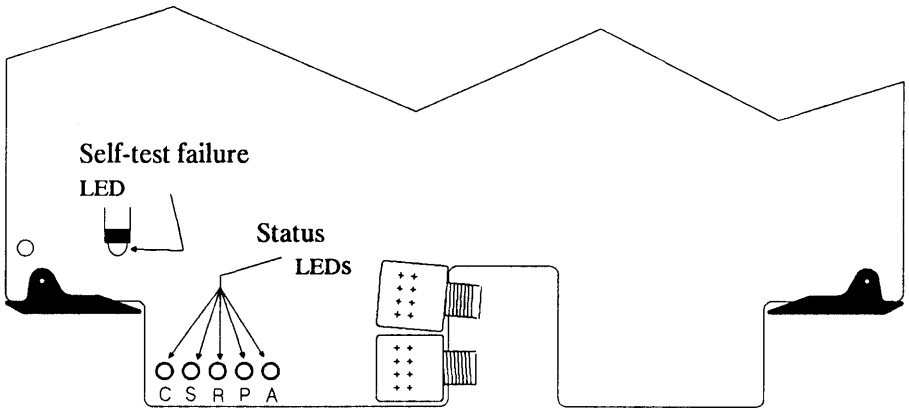

Figure 3-1. Locations of the Self-Test Failure and Status LEDs

Self-Test Failure LED

The self-test runs when the computer power is switched on or the PCA is reset. The self-test failure LED goes on during execution of the self-test (which takes less than five seconds), and will go off when the self-test passes. If the self-test fails, the self-test failure LED will remain on, and you must replace the PCA.

Operational Status LEDs

If the PCA self-test completes successfully, the self-test failure LED will turn off and remain off. Subsequently, under firmware control, the PCA will begin operation. In this mode, the interpretation of the LEDs is summarized in table 3-1 and described below.

Summary: Interpreting the LEDs

In table 3-1, the **bold type** in the status column shows the acceptable state(s) of the LED in question. Entries in normal-weight type designate a fault. The self-test failure LED must be off for this information to be accurate.

Table 3-1. LED Interpretation During Normal Operation

LED (color)	Status	Meaning
"C" Config (red)	**off**	PCA is set up correctly and the remote device is compatible.
	on	Jumper J2 is in the wrong position or the response from the remote device is incompatible with the HP-FL protocol.
"S" Signal (red)	**off**	The signal strength and quality are acceptable.
	flicker	The signal is marginal. The brighter the LED appears, the less likely it is that the signal strength will allow successful data transfers. See below.
	on	The signal is lacking or of unacceptable quality: – There are no transitions on the link. – The phase lock receiver cannot acquire the signal. – The link error rate exceeds acceptable tolerances.
"R" Remote (red)	**off**	The remote device has correctly identified itself.
	on	The remote device fails to respond or responds incorrectly to periodic identification requests.
"P" Passed (green)	**on**	The PCA self-test passed—the PCA is operational.
	blinking	The on-board firmware is waiting for an initial connect subchannel over the CIO bus backplane.
	off	The PCA is no longer functional.
"A" Activity (green)	**blinking**	The HP-FL is transmitting header fields in data frame.
	off	The HP-FL has detected protocol errors or the expected status information is lacking. The PCA is probably faulty.

Configuration LED: C (red, normally off)

When on, the Configuration LED can mean either of two things:

- The jumper J2 is in the wrong position. The HP-FL cannot communicate with the remote device.
- There is an incompatible response from the remote disk drive.

During troubleshooting, if a *single-fiber loopback cable* is installed, the C LED will also light with the jumper J2 in the correct position. With a loopback cable installed, this indication is normal.

Signal LED: S (red, normally off)

When on, the Signal LED indicates that the HP-FL is having difficulty extracting data from the received signal. Total absence of a signal will cause the LED to light at full intensity. The PCA updates the state of this LED periodically. The rate of updating may be thousands of Hertz and the LED may appear to blink or flicker.

Remote LED: R (red, normally off)

When on, the Remote LED indicates that the remote device fails to respond to periodic requests for identification. These requests are part of the proprietary HP-FL protocol.

Passed Self-Test LED: P (green, normally on or blinking)

This LED will light when the PCA has passed its self-test and is operational. It remains lit unless an error condition on the PCA causes the LED to turn off. Error conditions that will cause this are link protocol errors, link data parity errors, and data structure faults. (The system console may report an unexpected CIO event corresponding to these errors.)

Note that this LED will blink following any form of PCA reset until a "connect subchannel command" is received from the system processor unit via the CIO bus. A subchannel establishes a path from the CIO bus to the actual link data path, and is prerequisite to transferring data between the CIO bus and the HP-FL PCA.

Activity LED: A (green, normally blinking)

This LED is lit when message frames with proper HP-FL protocol headers are transmitted onto the link. This is an unpredictable event and depends on HP-FL requests for link access. Even when no HP-FL PCA requests are pending, the LED will light whenever the PCA transmits its periodic requests for identification to the remote device; hence, this LED blinks irregularly and somewhat slowly, 10 to 60 times per minute.

HP-FL Diagnostic Software (HPFLDIAG)

The HP 27115A HP-FL diagnostic software, HPFLDIAG, is part of the Online Diagnostic Subsystem and will detect HP-FL hardware faults. Use of the diagnostic is thoroughly described in the *SPU and Device I/O Diagnostics Manual* (09740-90020). The information below is a summary of its operation.

Note

The use of HPFLDIAG to troubleshoot a link failure may not be possible if the remote device is the boot disk, unless some other mechanism for loading HPFLDIAG is available.

HPFLDIAG Capabilities

HPFLDIAG does the following things:

- Identifies the PCA and the remote device.
- Reports the status of the PCA.
- Resets the PCA.
- Tests the majority of circuits on the PCA.
- Performs the loopback tests
  - to exercise the PCA connection to the CIO bus,
  - to exercise the PCA,
  - to check the PCA optical ports (using a loopback cable),
  - to check the connection to the remote peripheral.
- Troubleshoots the link and identify probable faulty hardware.

Running HPFLDIAG

HPFLDIAG is accessed via the Online Diagnostic Subsystem, SYSDIAG. The user's interface to SYSDIAG is a command interpreter program, Diagnostic User Interface (DUI). To run HPFLDIAG, you must execute SYSDIAG and enter an HPFLDIAG run string at the DUI prompt (DUI >).

Note

On HP MPE/XL systems, the DUI is normally called by entering "SYSDIAG".

The HPFLDIAG run string must include a physical device (PDEV) specifier of the PCA under test (consult your system manager). Also in the run string, you may specify the diagnostic "sections" to be executed. These "sections" are briefly described later. The example on the next page illustrates how to start HPFLDIAG. Note that user input is **bold**.

An online description of HPFLDIAG is available if you type "help hpfldiag" at the DUI > prompt. If you type "help hpfldiag section", a description of the HPFLDIAG sections is displayed.

Once running, HPFLDIAG provides an introductory header, then prompts you for a target device (0 through 7). If a cluster of devices is connected, the target device need not be the one attached directly to the HP-FL cable.

If you do not respond to the target device prompt – that is, you simply press the "return" or "enter" key – test steps that require a target device will default to the one directly attached to the HP-FL cable.

Some diagnostic sections involve destructive tests and may not be run unless the user has logged in with the required level of security. Consult your system manager.

Example

```
:SYSDIAG

**********************************************************************
*****                                                            ***
*****              ONLINE DIAGNOSTIC SUBSYSTEM                   ***
*****                                                            ***
*****          (C) Copyright Hewlett Packard Co. 1987            ***
*****                      All Rights Reserved                   ***
*****          DUI Version A.xx.yy  Monitor Version A.xx.yy      ***
*****                                                            ***
**********************************************************************

Type "HELP" for assistance

DUI > RUN HPFLDIAG PDEV=w/x.y
```

Note

"PDEV" is the physical device number. "w/" identifies the bus converter for Model 950 systems (usually "2/" or "6/"), and is normally not entered in the run string for non-950 systems. "x" is the system-dependent channel_address (e.g., Model 930 = 8, Model 925 = 4, etc.), and "y" is the CIO slot number.

If you do not specify a specific diagnostic section number in the "run string", section 10 (Verification Trouble Tree) and/or section 11 (Diagnostic Trouble Tree) will execute. Which one, or ones, does execute depends on whether HPFLDIAG is run in "Normal or Disruptive" mode, or "Destructive" mode. (Sections 10 and 11 do all the things the other sections do.) To specify other sections, you must add them to the HPFLDIAG run string like this:

```
DUI > RUN HPFLDIAG PDEV=8.0 SECTION=3,12
```

Section 12 (On-Site Trouble Tree) is the section most often used after the default sections. See the *Online Diagnostics Subsystem Manual, Vol 1*, for other run string entries. HPFLDIAG displays the following header:

```
*********************************************************************
*****                                                           ***
*****                    HP-FL DIAGNOSTIC                       ***
*****                                                           ***
*****          (C) Copyright Hewlett Packard Co. 1987           ***
*****                    All Rights Reserved                    ***
*****                    Version A.00.00                        ***
*****                                                           ***
*********************************************************************

Welcome, Today is MON, May 21, 1990, 9:03 AM

Please select target drive to test (<CR> for link drive) > > 0
```

Note

Be sure to select a number that corresponds to one of the physical addresses set on the disk drives.

If you press ENTER or RETURN here, the test will loopback to the disk drive directly connected to the HPFL PCA.

Summary of Diagnostic Sections

The main sections in HPFLDIAG are briefly presented here.

Section 2. CLEAR

This section clears or resets the target device controller or the HP-FL PCA. This will abort any data process on the link.

Section 3. IDENTIFY

"Identify" commands are sent to the target device controller or HP-FL PCA. Responses are decoded and displayed. This section is non-destructive.

Section 4. LOOPBACK

This section provides various forms of loopback test (some of which are destructive), including:

- HP-FL device adapter loopback: verifies data path between the CIO bus and the HP-FL PCA (this test is non-destructive),
- Link device loopback: verifies the data path between the HP-FL PCA RAM and the remote device controller directly connected to the HP-FL cable (this test is non-destructive),
- Target device loopback: verifies the data path between the PCA and the target device controller (e.g., over the PBus) (this test is non-destructive),
- HP-FL interface internal Loopback: verifies the data path completely internal to the HP-FL PCA (this test is destructive),
- HP-FL external loopback: verifies the data path internal and external to the HP-FL PCA (a loopback cable is required) (this test is destructive).

Section 6. STATUS

This non-destructive section reports the hardware status from the HP-FL PCA.

Section 10. VERIFICATION TROUBLE TREE

This non-destructive section proceeds through a series of tests to check the communication path from the host computer to the peripheral devices. See the summary below.

Section 11. DIAGNOSTIC TROUBLE TREE

Although similar to section 10, this section is more exhaustive and runs in destructive mode. See the summary below.

Summary of Trouble Trees Operation. Both trouble tree sections (10 and 11) run four separate tests sequentially:

1. Loopback on the PCA.
2. Loopback to the disk drive directly connected to the HP-FL PCA.
3. Loopback to a target disk (any one of the drives on the PBus).
4. Loopback through the buffer on the target drive.

The target drive is the drive you specify when running the diagnostic.

Note

If any of the tests fails, the section stops and reports it. Although it is possible for more than one error to exist on the HP-FL subsystem, it is unlikely.

If there is a problem, suspected causes are displayed in the order of likely occurrence. Table 3-2 shows an example. We ran a test of the diagnostic program by inducing faults into a fiber-optic link system. The table shows the results of this test. For each of the faults, it gives the number of suspected causes reported by the diagnostic, and the sequence number of the actual cause.

Table 3-2. Examples from Testing Sections 10 and 11

Drive configuration	Fault induced for the test	Number of causes reported	Actual cause of fault
Single	Drive power switched off	4	first
Single	Incorrect drive address	3	first
Single	PBus terminators missing	3	first
Single	Fiber-optic cable not connected	4	second
Single	Cable fibers connected backwards	4	second
Multiple	Power switched off on target drive	4	first
Multiple	Incorrect target drive address	4	third
Multiple	PBus terminators missing	4	first

Section 12. ON-SITE TROUBLE TREE

This section is instructional and guides you through a troubleshooting procedure using decision criteria. There is no interaction between the diagnostic and the subsystem hardware. However, by entering the appropriate responses to the queries provided, you will receive a list of possible hardware faults beginning with the HP-FL PCA and running completely through to the last drive on the PBus. This is the section to choose if the other trouble tree sections do not identify an error for you.

General Troubleshooting

To troubleshoot the fiber-optic link hardware, you can use the diagnostic, HPFLDIAG, described earlier in this chapter. Section 12 of the diagnostic provides detailed troubleshooting methods to isolate hardware faults. If HPFLDIAG is not available, or you choose a more direct approach, use the following procedures:

1. Perform the HP-FL PCA fault isolation tests.
2. Perform the fiber-optic cable fault isolation tests.
3. Perform fault isolation tests on the remote device.

These procedures are described in the remainder of this chapter.

PCA Fault Isolation

The PCA or its firmware PROMs may be faulty. PCA fault isolation testing consists of running the PCA self-test with a loopback cable attached, and observing the PCA LEDs.

If the self-test fails and the C, S, and R LEDs are on, the PROMs are defective. If possible, test the PROMs by moving them to a "known good" PCA and use the procedures below. If the test fails, the PROMs are the faulty element.

1. Disconnect the duplex cable from the PCA.
2. Connect the transmit port directly to the receive port using a single fiber. Use the fiber-optic loopback cable (HFBR-3020), if available.
3. Run the self-test: Reset the PCA by switching off the computer power, then switching it on. (Be sure to shut down the operating system first.)
4. Observe the LEDs and determine if the PCA is good. Figure 3-2 and table 3-3 show the pattern of the LEDs with a loopback cable installed for a good PCA. Any other pattern means the PCA has failed the self-test. You should replace it.

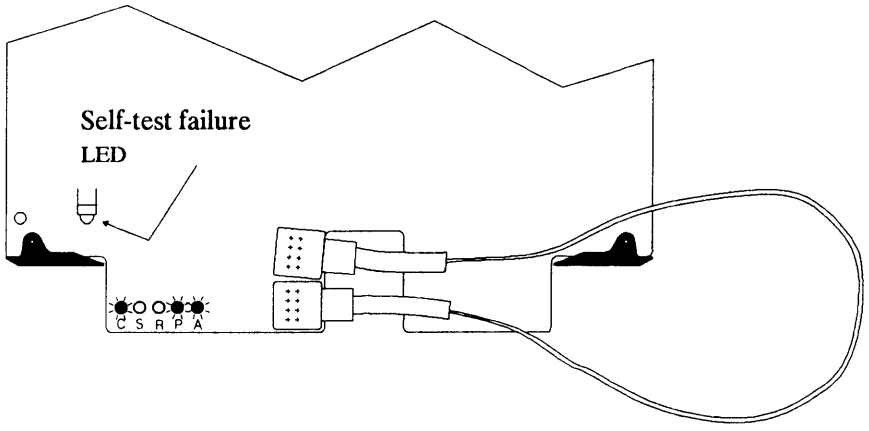

Figure 3-2. Testing the HP-FL PCA with a Loopback Cable

Table 3-3. LED Pattern on a Good PCA with a Loopback Cable Installed

LED (color)	Pattern	Meaning
Self-test (red)	off	On-board self-test passed
C (red) S (red) R (red) P (green) A (green)	on off off on/blinking blinking	Normal result of self-test with loopback cable installed. The PCA is operational. The PCA shows activity, requests remote ID value.

Note

Successful loopback fiber tests may not mean the PCA is good – a marginal transmitter or receiver may go undetected. See the "Fault Not Found" section later in this chapter.

Cable Fault Isolation

If the PCA passes the self-test using the loopback cable, check the installed duplex cable. You can check the duplex cable for damage in a variety of ways. The method you use depends on what tools are available to you.

Method 1: By Inference

The simplest method to test the duplex cable is by inference. If either device on the cable indicates a fault when connected (the S or R LED remains on after self-test), but both devices operate properly when individually tested with a loopback cable, then you can logically conclude the duplex cable is faulty. (However, this may not be true with a marginal optical transmitter or receiver on the PCA or remote device.)

- To test the HP-FL PCA, use the PCA fault isolation procedure – with the loopback cable – described above.
- To test the remote device's interface with a loopback cable, refer to the applicable device service manual.

Method 2: Loopback Test on Each Fiber of the Duplex Cable

The second method to test the cable can help to determine if a marginal transmitter or receiver on the PCA exists. It presupposes that the remote end of the duplex cable can be physically connected to the HP-FL PCA. This may not be possible depending on the location of the remote device, or the medium through which the duplex cable is run.

To conduct this test, do the following (we assume that you have already tested the HP-FL PCA using the instructions provided earlier):

1. Remove the duplex cable from the remote device. (Refer to the applicable device manual.)
2. Identify one of the duplex cable fibers, and its corresponding connectors at each end. Duplex fiber-optic cables are normally marked to allow easy identification of each fiber. (See the section in chapter 2 titled "Connect the Fiber-Optic Cable".)

   The remaining procedure assumes the hookup is correct.
3. Connect each end of the fiber to the HP-FL PCA (transmit port and receive port, respectively) so that the fiber acts as a loopback cable.
4. Run the PCA self-test (refer to "PCA Fault Isolation", above).
5. Observe the PCA LEDs. The self-test fail LED should turn off, indicating the PCA is good.

   If the S or R LED now turns on, the fiber is probably faulty, and the cable should be replaced. (Again, the PCA's transmitter/receiver may be marginal.)
6. If the S and R LEDs remain off, the fiber is good, and you should repeat the process on the other fiber (starting at step "3" above).
7. If both fibers pass the test, the duplex cable is not faulty, and the PCA's transmitter and receiver appear to be good. Test the remote device.

Method 3: Use Fiber-Optic Cable Test Equipment

Another method to test the duplex cable is to test each fiber using special test equipment (optical power source and meter). Refer to the "Cables, Test Equipment, and Tools" section in chapter 1.

The operation of fiber-optic test equipment varies. The equipment may require calibration. Consult the user manuals for your particular brand and models.

The basic test procedure is as follows:

1. Obtain a loopback cable like the one with part number HFBR-3020.
2. Connect the optical power source to one end of the test cable, and the optical meter to the other end. Use the optical meter to determine optical power received.
3. Remove the test cable and go to the installed duplex cable.
4. Identify both ends of a single fiber in the duplex cable.
5. Connect the optical power source to one end of the fiber, and the optical power meter to the other end.
6. Measure the optical power through the fiber. Compare this with the power measured with the test cable. The difference must not exceed 6 dB. If it is greater, replace the duplex cable.
7. If the loss is not excessive, repeat the process on the other fiber, starting with step 5 above.
8. If both fibers pass the test, the cable is not faulty. You should proceed with testing the remote device.

Remote Device Fault Isolation

To test the remote device, refer to the procedures provided in the applicable device service manuals.

Fault Not Found

If a link hardware problem persists, check for a marginal fiber-optic transmitter, receiver, or duplex cable using optical meter equipment. This takes two steps, the first of which is a direct measurement of the transmitter's output. The second measures the receiver's input and indirectly tests the receiver itself. Before proceeding, test the transmission of the 30-cm loopback cable. It should show no more than 2 dB loss.

1. Measure the output of the PCA's transmitter:

   a. First, using the 30-cm loopback cable, measure the transmitter's output. The received signal must be greater than -21 dBm (that is, closer to 0).

   b. Then, attach the duplex cable between the transmitter and meter. The received signal must now be greater than -27 dBm. If it is, both the duplex cable fiber and the transmitter are good. If not, either may be bad.

2. Depending on the outcome above, take one of the following actions:

   a. If both of the above readings failed, the PCA's transmitter is faulty. Replace the PCA.

   b. If the duplex cable reading failed, but the loopback cable reading passed, follow to the "Cable Fault Isolation" procedures provided earlier in this chapter.

   c. If both readings passed, check the strength of the signal from the external device using the same technique described above. If this reading is greater than -27 dBm (indicating the transmitter on the disk drive is good), replace the PCA, because its receiver is bad.

      If both the first readings were within tolerances, and this test showed that the disk drive's transmitter is good, then the disk drive's receiver is bad.

For difficult faults, other recommended actions include:

1. Replace the PCA PROMs.
2. Recheck the system hardware and software configurations.

Replaceable Parts

Field Replaceable Units

The general support strategy for the HP 27115A Fiber-Optic Link (HP-FL) is to replace faulty hardware at the lowest level of assembly authorized for replacement, known as field replaceable units (FRUs).

Exchange Assemblies

The HP-FL printed circuit assembly (PCA) is an FRU that may be replaced under the Hewlett-Packard exchange program for PCAs. See table 4-1.

Note

Before returning a PCA for exchange, remove and save the firmware PROMs. The exchange assembly will be supplied without the PROMs. Contact the HP Sales and Support Office for details.

Be sure to use anti-ESD precautions when removing or storing the PROMs.

PROMs currently provided with the product are listed in table 4-1. PROM firmware may be revised by Hewlett-Packard to correct errors, improve performance, enhance product features, or match operating system, or application revisions. Should you require replacement of the PROMs, consult with your Hewlett-Packard representative for the latest PROM version.

Table 4-1 lists FRUs associated with this product.

Table 4-1. FRUs for the HP-FL

HP part number	Description	Location
27115-60001	HP-FL printed circuit assembly (For the exchange program, use 5062-3308.)	
1005-0078	HP-FL duplex, fiber-optic cable (with strain-relief ferrule). (For lengths other than 30 m, see chapter 1.)	
5061-3151	PBus terminator (2 required)	Disk drive on PBus
27115-81001	PROM (Number may change as modifications occur)	Socket U29 on PCA
27115-81002	PROM (Number may change as modifications occur)	Socket U30 on PCA
1258-0141	Jumper plug	Jumper J2 on PCA

Removal and Replacement

This section explains removal and replacement of the HP 27115A HP-FL PCA. Typically, you will use this information if you suspect the PCA is faulty and need to replace it, or when you wish to modify the I/O slot configuration.

Caution

Switch off the power to both the computer system and the associated peripheral device before attempting to remove any PCA or cable from the system.

The HP-FL PCA is susceptible to damage by electrostatic discharge. When handling, removing, or installing the card, use a grounding wrist strap. Handle the card only by its edges or extractor levers. See the "Safety Considerations" section in the front of your system manual for additional information. If you do not have a static-free area available, use work station kit (9300-1155) to protect the HP-FL PCA from damage.

PCA Removal

To remove the PCA:

1. At the host computer, shut the operating system down and switch off the computer system power. Refer to the system administrator's and hardware manuals that apply to your system.
2. Open the CIO card cage where your HP 27115A HP-FL PCA is installed (refer to your computer or extender hardware's manuals). Simultaneously lift both extractor levers to pull the PCA from the CIO bus connector. After the PCA is unseated, grasp it by the levers and slowly guide the card partially out, about 10 cm (2 in.).
3. Disconnect the HP-FL cable from the HP 27115A PCA's optical ports and the grounding bus. Then remove the PCA completely from its slot.
4. Lay the PCA on a grounded surface to protect PCA components from electrostatic discharge. (If you are not wearing a grounding wrist strap, you will damage the HP-FL PCA. Always use anti-ESD precautions.)

Replacement

This section provides replacement procedures for the following parts:

- HP-FL PCA
- Fiber-optic cable
- PROMs on the HP-FL interface card

PCA

To replace the PCA:

1. Remove the existing PCA from the CIO card cage using the "PCA Removal" section above. (Remove PROMs and install them on the replacement PCA as required.)
2. Install the replacement PCA into the desired CIO slot and reconnect the HP-FL cable. To do this, you may need to refer to the installation section in chapter 2.

HP-FL Cable

To replace the HP-FL cable:

1. Switch off the peripheral device power. Refer to your device manuals.
2. At the host computer, shut the operating system down and switch off the computer system. Refer to your system administrator and hardware support manuals that apply to your system.
3. Disconnect the HP-FL cable from the computer system and the peripheral device. Consult your peripheral's manuals for information about access to the HP-FL cable connection at the peripheral. See your computer or extender hardware's manuals for information about access to the CIO card cage where the HP 27115A PCA is installed.
4. Remove any strain-relief ferrules assembled on the cable. Unscrew and remove the two screws that fasten the compression block, which, in turn, secures the ferrule to the cable. Be careful not to damage the fiber-optic cable. With the compression block gone, the cable is easily removed from the ferrule.
5. Install the replacement cable using the information provided in the *Fiber-Optic Cable Installation Guide* (5954-8446).
6. Connect the replacement cable to the peripheral device. Refer to your peripheral device's manuals for procedural information.
7. Connect the replacement cable to the HP 27115A PCA and install or adjust the strain-relief ferrule as described in chapter 2.

Firmware PROMs

Board exchanges, and revisions to card firmware, may require that the PROMs be removed and replaced. To remove and replace the PROMs:

1. Remove the PCA as described previously.
2. Locate the PROMs. Figure 4-1 shows the location designators and approximate positions of the PROMs on the PCA.
3. Remove each PROM from its socket, without damaging its socket. We recommend an integrated circuit removal tool ("chip extractor"); however, you can use a fine rigid device (like a very thin flat-bladed screwdriver) to initially loosen the PROM from its socket. Note that excessive prying and pressure can damage the socket and PROM. Use caution during removal.
4. Before installing the PROMs, identify the PROM part number and correct socket into which each PROM must be installed.
5. Note the half-circle notch located on one end of each PROM that identifies pin 1 on the PROM. Match it to a similar mark on the empty socket. Ensure that the contact pins of the PROM are aligned with the socket receptacles. It may be necessary to adjust the pins (bend them in or out) for proper alignment. Gently press the PROM into place to properly seat the pins. If pressure is not uniformly applied, the pins on one side or the other may fold and collapse without properly mating into their sockets. (If this occurs, remove the PROM, straighten the pins, and try again. If damage was extensive, you may need a new PROM.)

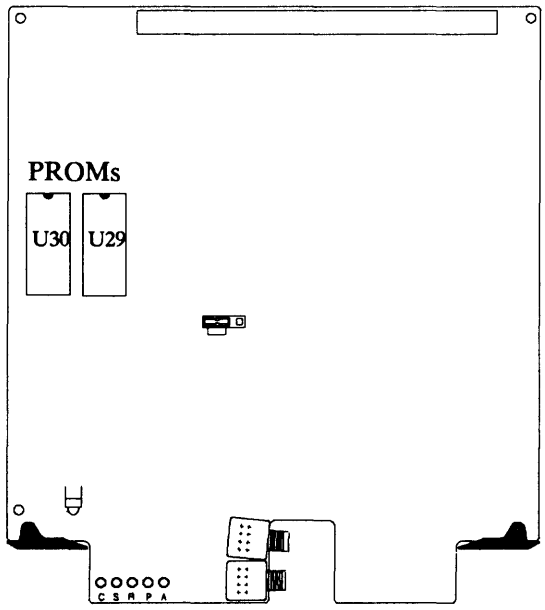

Figure 4-1. Location of PROMs

Cable Installation

This appendix gives very general guidance for cable installation. Additional information is available in the *Fiber-Optic Cable Installation Guide* (5954-8446). This manual focuses primarily on the HP-FL printed circuit assembly installation. We assume you have installed the cable according to your requirements. Assistance for planning and installing your cable is available from Hewlett-Packard (contact the nearest HP Sales and Support Office).

Cable Plan

Before laying the cable, we recommend that you prepare a cable plan and have it reviewed by your Hewlett-Packard Site Preparation Specialist. This plan should include the location of existing and planned equipment (systems and peripherals). The plan should also note cable paths through cable trays, conduits, ducts and junction boxes as well as paths under mats or raised floors.

WARNING

Neither the cable nor its storage is flame resistant. In case of fire, they will give off toxic gases. Do not roote the cable through air plenums or ventilation ducts. Do not store it in environmental air spaces.

For critical applications, the use of redundant cables may be desirable. The cable plan should include the route of redundant cables.

Installation

Cable replacement after installation may be costly. A cable verification test *before installation* is recommended to preclude installation of a faulty cable. Cable operation checks can be performed using optical power source and measurement equipment (see chapter 3 for methods to check cables).

The repair of fiber-optic cable requires trained personnel and special equipment – it is not a simple task. Preventing damage is the best practice. Ensure that there are adequate provisions to protect the cable from damage, especially in areas where there is personnel traffic or equipment movement. Excess cable may be placed behind, or in open spaces of, computer cabinets. Use cable spools when possible.

When installing the cable, follow the guidelines provided in the *Fiber-Optic Cable Installation Guide* (included with the standard product cable). Do not exceed maximum pull forces or the minimum bend radius (see table A-1 for specifications). Watch for sharp edges.

Caution

When routing the HP-FL fiber-optic cable, adhere to the bend radius and stress limits below. Failure to comply may damage the cable or affect the optical signals. The "bend radius" and "pull strength" specifications are provided for both short durations (1 hour) and longer periods. For long periods, bend radius must be more than 35 mm (1.38 in.) under no tensile force, and tensile force must not exceed 37 kg (81.5 lb) force with no bend (infinite radius).

Table A-1 shows the characteristics of the cable supplied by Hewlett-Packard. Table A-2 provides a check list for cable installation.

Table A-1. Fiber-Optic Cable Characteristics

Cable type:	Duplex
Cable length:	≤ 500 m
Markings:	"Transmit" has white sleeve.
Construction:	Graded-index glass fiber
Core/cladding diameter:	100 μm/140 μm
Connectors:	905 type SMA
Operating temperature: **Storage temperature:**	-20°C to 85°C -40°C to 85°C
Outer jacket:	Polyurethane (not suitable for air ducts or plenums)
Exit numerical aperture (NA):	0.3 (for fiber lengths greater than 300 m)
Attenuation:	≤ 8.0 dB/km
Maximum pull strength:	61 kg (@ 25 mm radius < 1 hr) 37 kg (@ ∞ radius > 1 hr)
Minimum bend radius:	25 mm (< 1 hr) 35 mm (@ 0 kg stress > 1 hr)
Optical Bandwidth • distance product:	> 50 MHz • km

Table A-2. Cable Installation Check List

Did a Hewlett-Packard representative review the completed fiber-optic cable plan?	
Did you do a pre- and post-installation cable check with an optical power source and meter?	
Did you check the cable for minimum bend radius and tension, during and after installation?	
Is the cable protected by conduit, cable trays, etc., over its entire length?	
Did the cable installation use approved pullheads and other devices?	
Were non–Hewlett-Packard cables approved by a Hewlett-Packard representative?	
Have all installation errors or violations been corrected?	

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Reader Comment Sheet

HP Fiber-Optic Link Installation Manual

27115-90001 April 1990

We welcome your evaluation of this manual. Your comments and suggestions help us to improve our publications. Please explain your answers under "Comments", below, and use additional pages if necessary.

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Are the illustrations and tables accurate and useful?	☐ Yes	☐ No
Are the concepts and wording easy to understand?	☐ Yes	☐ No
Is the format of the manual convenient in size, arrangement, and readability?	☐ Yes	☐ No

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