Installation and Verification Guide

HP 71450B/1B/2B Optical Spectrum Analyzers

HEWLETT PACKARD

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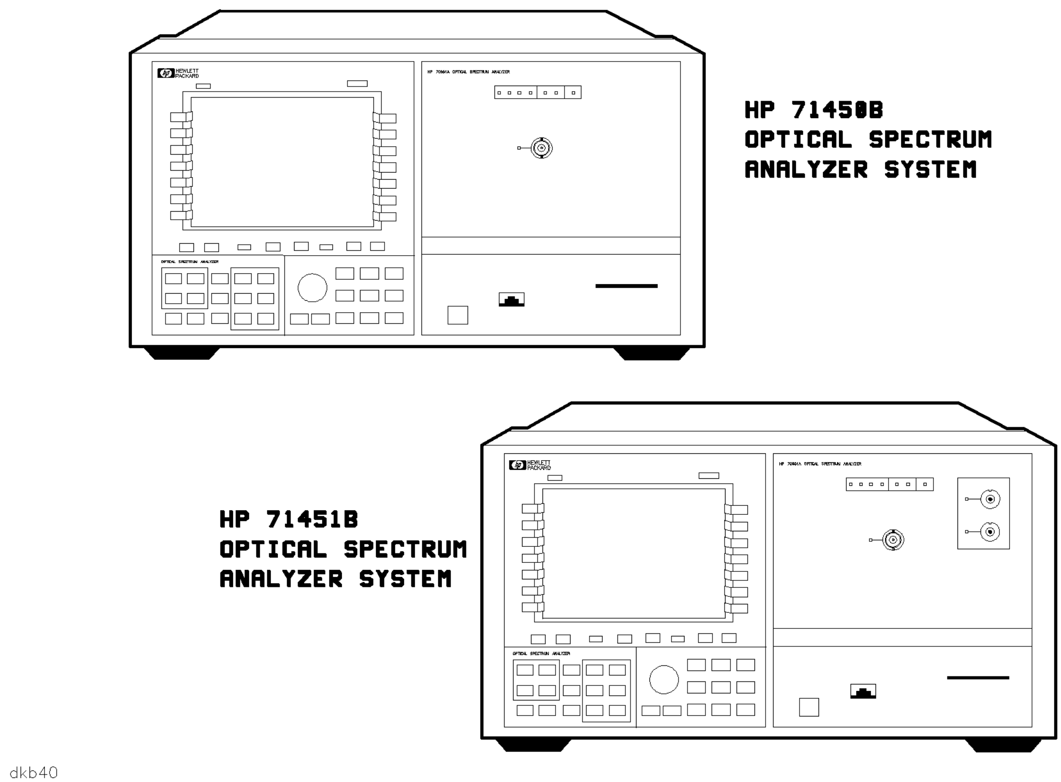
Installation and Operation Verification of the Optical Spectrum Analyzer

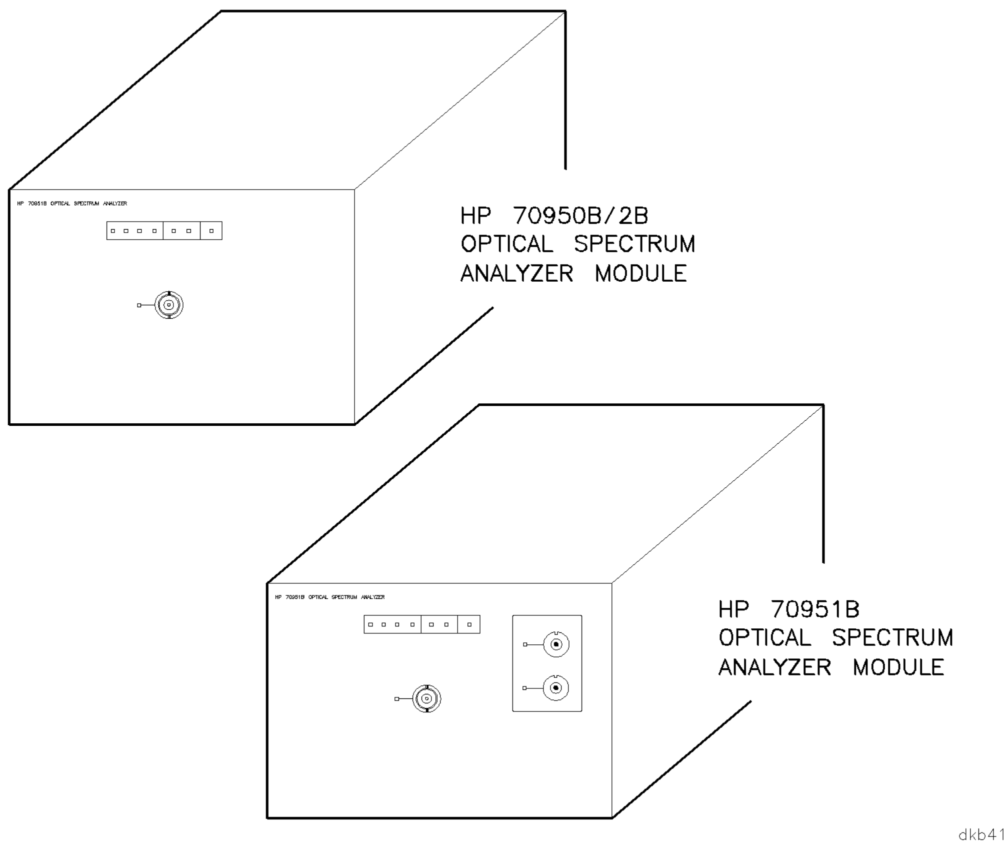
The HP 71450B/1B/2B Optical Spectrum Analyzer Systems

The HP 71450B/1B/2B are preconfigured systems that include either an HP 70950B, HP 70951B, or HP 70952B optical spectrum analyzer module, an HP 70004A, and an optical spectrum analyzer keypad. The HP 70950B/1B/2B optical spectrum analyzer modules may be installed either in an existing HP 70004A display or in an HP 70001A mainframe.



The HP 70950B/1B/2B Optical Spectrum Analyzer Modules

The HP 70950B, HP 70951B, and HP 70952B are 4/8-width modules that must be inserted into either an HP 70004A or an HP 70001A mainframe. An optical spectrum analyzer keypad is shipped with both the modules. If you are using a monochrome display (or no display at all), certain features (such as color) will not be available.



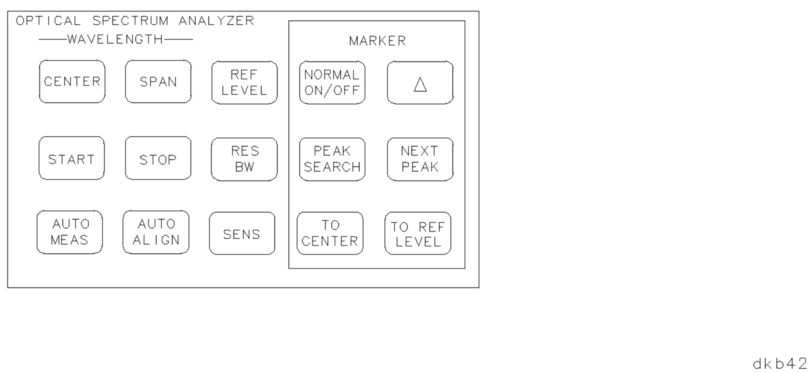
The Optical Spectrum Analyzer Keypad

The optical spectrum analyzer keypad provides front-panel keys that serve the same purpose as some of the softkeys. This allows you easy access to frequently-used functions without losing your position in a softkey menu and saves you steps when making measurements.

This keypad may only be used with the HP 70004A. However, even if this keypad is not installed, all of the optical spectrum analyzer's functions are accessible using the softkeys. The keypad is already installed when you receive an HP 70950B, HP 70951B, or HP 70952B. Installation instructions for the optical spectrum analyzer keypad are provided in Chapter 1.

The optical spectrum analyzer keypad is not the only keypad that will work with the optical spectrum analyzer. If you have a keypad from another product installed and press one of its keys, the optical spectrum analyzer will try to perform the task if it is a relevant task for the optical spectrum analyzer.

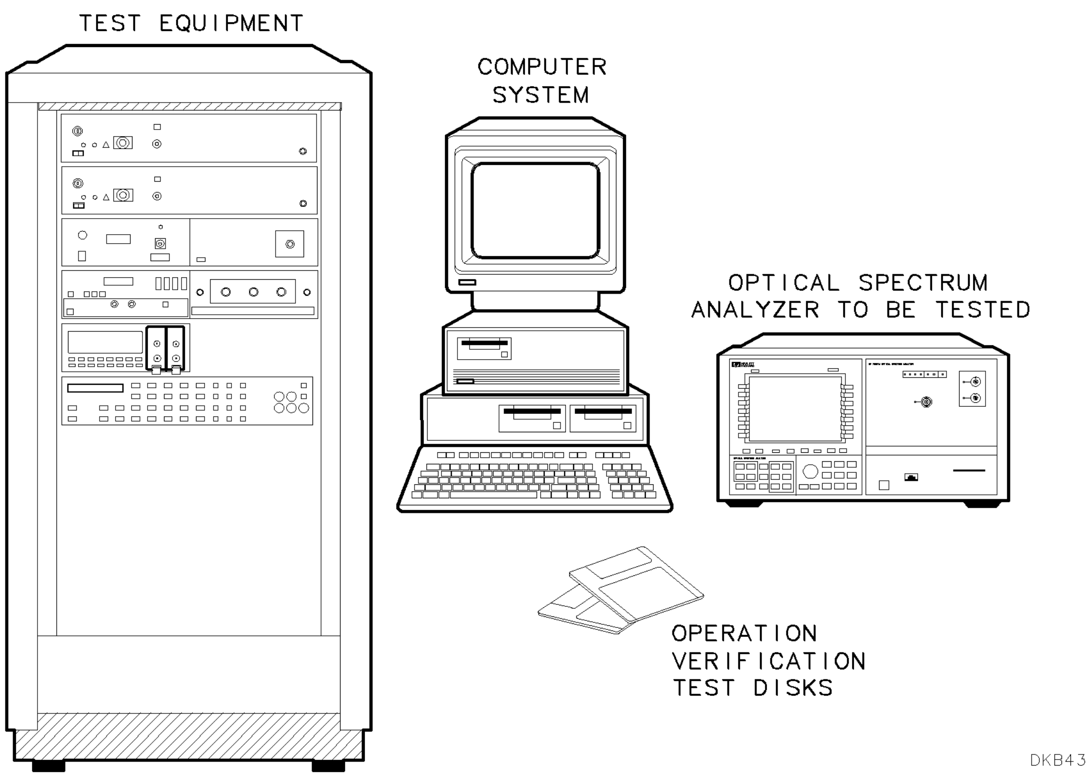
OPTICAL SPECTRUM
ANALYZER KEYPAD



The Operation Verification Tests

The operation verification tests are designed to give you a high level of confidence that the optical spectrum analyzer is operating correctly and meets its specifications. The operation verification tests consist of:

- Automated Tests - The operation verification test disks are shipped with the optical spectrum analyzer. You will need a computer system with the HP BASIC operating system and test equipment to perform the operation verification tests on the optical spectrum analyzer.
- Manual Operation and Verification Tests - These tests can be performed if you do not have the specific equipment required to perform the automated version.
- Manual Operational Checks - These tests verify the functionality of instrument modes on the HP 70951B optical spectrum analyzer module.



Note In this book, normal front-panel keys are indicated in (boxed) letters. Softkeys are indicated by `shaded` letters.

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1

Installation

Introduction

The installation instructions in this chapter show how to install the optical spectrum analyzer *system* and *module*. The instructions cover all model numbers dispite the figures showing HP 71451B systems and HP 70951B modules. The system is preassembled at the factory to minimize your setup time. This manual includes instructions for optional installation steps such as rack mounting the system, connecting the system to another display or mainframe, and setting the date and time.

Required installation steps:

- Preparing to install the optical spectrum analyzer module.
- Checking the module and system's HP-MSIB address.
- Installing the module in a display or a mainframe and attaching the handles.

Optional installation steps:

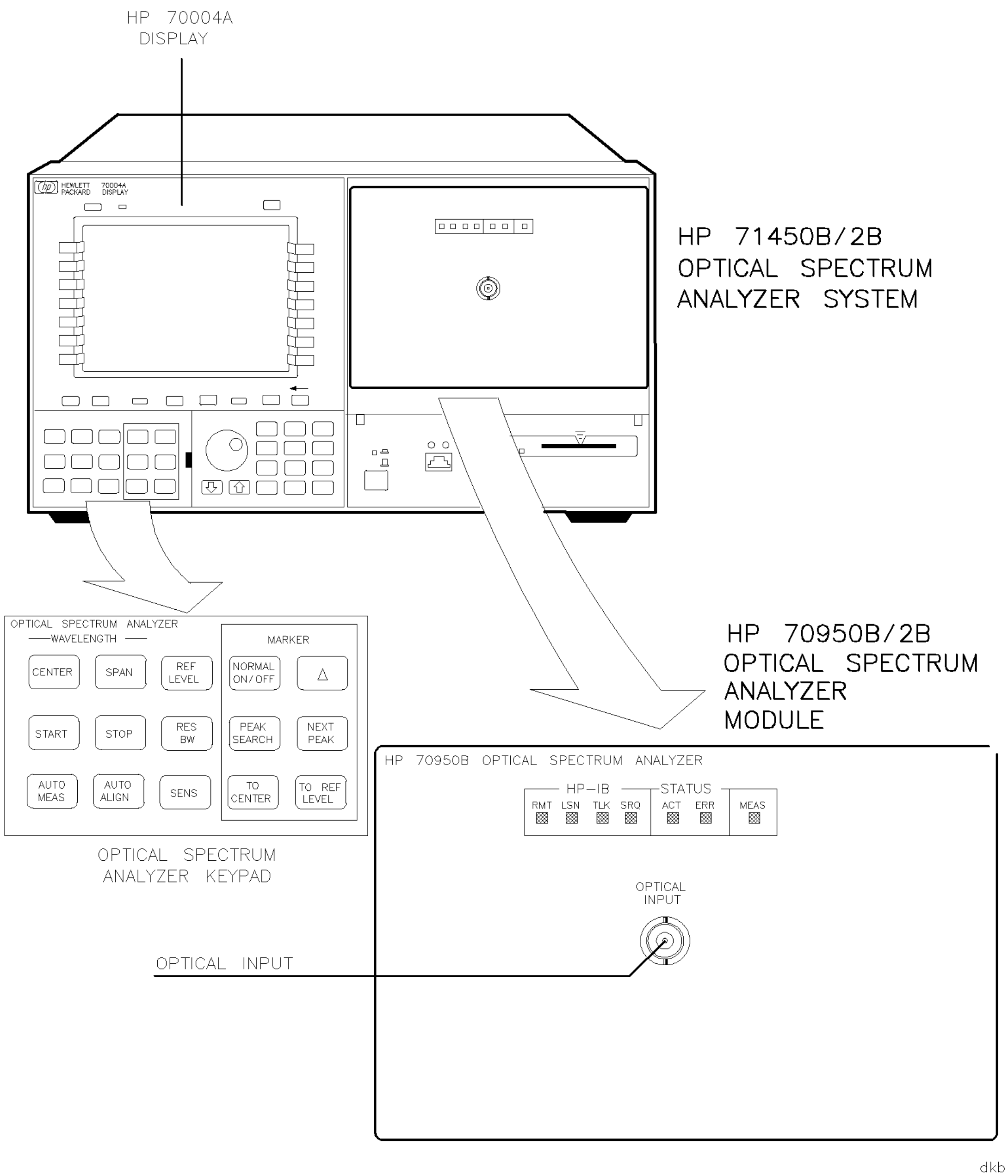
- Changing the HP-MSIB address of the optical spectrum analyzer module.
- Installing the optical spectrum analyzer's keypad in the display.
- Rack mounting the optical spectrum analyzer system.
- Connecting the optical spectrum analyzer system to another display or mainframe.
- Displaying and changing the time and date.

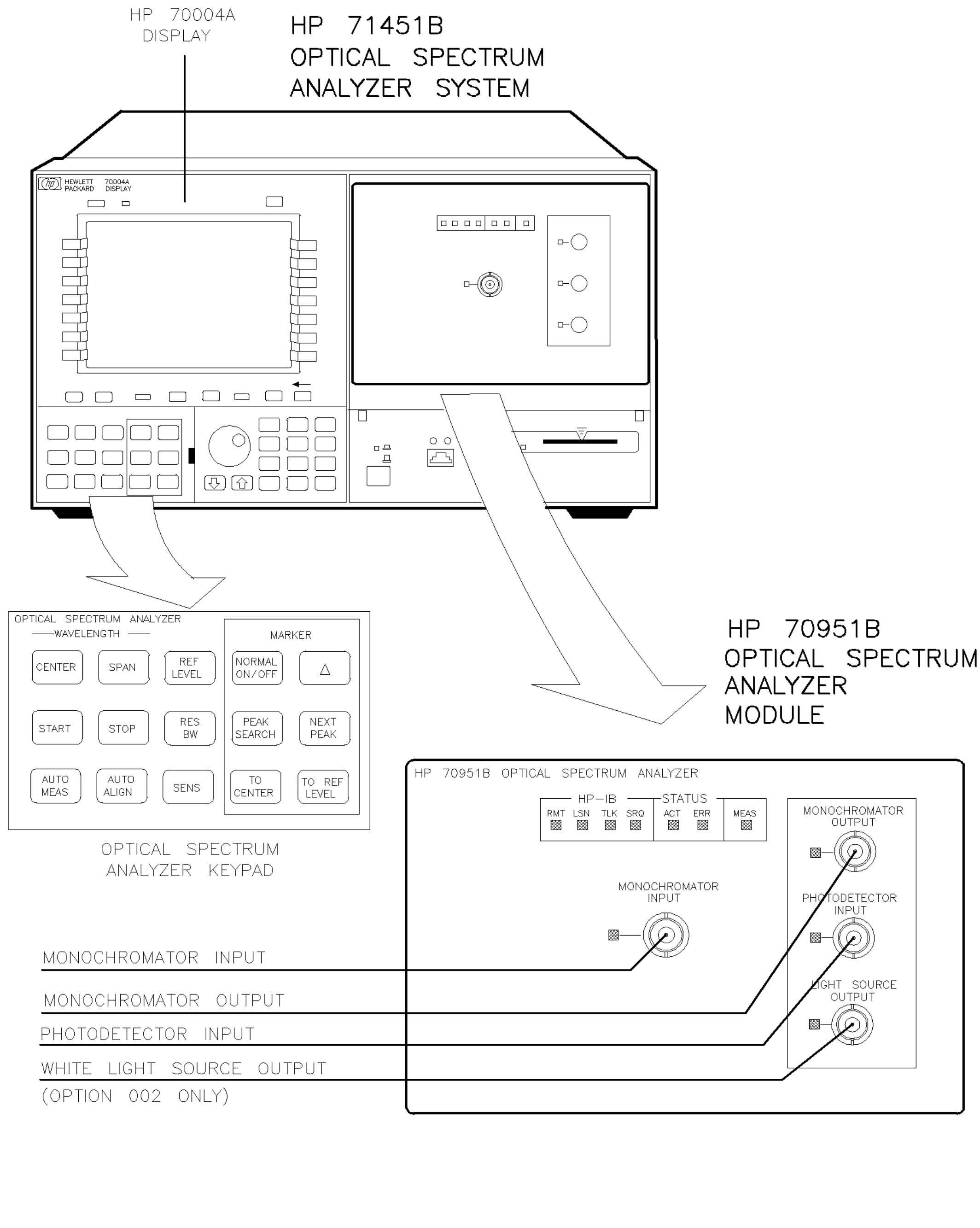
Tools you'll need:

Installing a module or performing the optional installation steps require these tools:

- An 8 mm hex-ball driver for installing and removing modules.
- A nonconductive stylus for setting address switches.
- A small pozidrive screwdriver for installing the optional interlock kit that connects the HP 70004A display to another display or mainframe.
- A large pozidrive screwdriver for installing handles and rack mount kits on the display or mainframe.

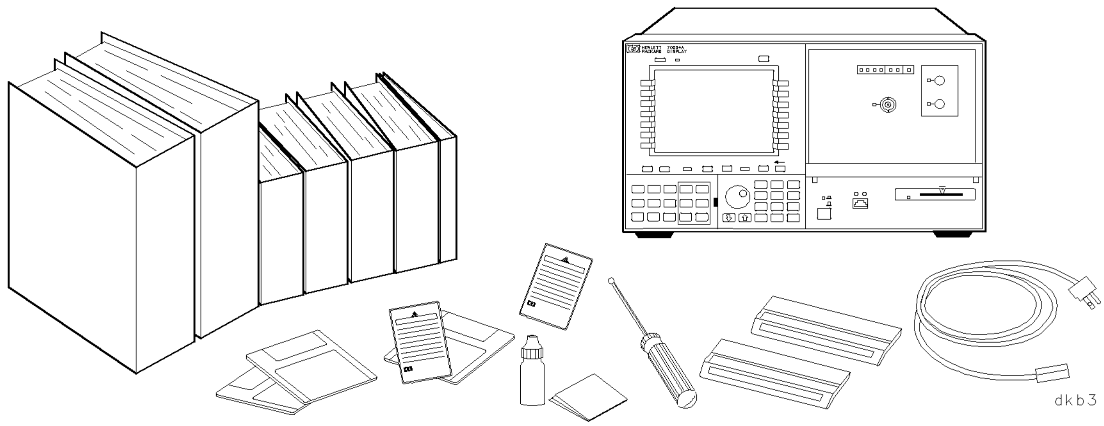
Installation at a Glance




HP 70004A
DISPLAY
HP 71451B
OPTICAL SPECTRUM
ANALYZER SYSTEM
OPTICAL SPECTRUM ANALYZER
WAVELENGTH
CENTER
SPAN
REF LEVEL
START
STOP
RES BW
AUTO MEAS
AUTO ALIGN
SENS
MARKER
NORMAL ON/OFF
△
PEAK SEARCH
NEXT PEAK
TO CENTER
TO REF LEVEL
OPTICAL SPECTRUM
ANALYZER KEYPAD
HP 70951B
OPTICAL SPECTRUM
ANALYZER
MODULE
HP 70951B OPTICAL SPECTRUM ANALYZER
HP-IB
STATUS
RMT LSN TLK SRQ
ACT ERR
MEAS
MONOCHROMATOR OUTPUT
MONOCHROMATOR INPUT
PHOTODETECTOR INPUT
LIGHT SOURCE OUTPUT
MONOCHROMATOR INPUT
MONOCHROMATOR OUTPUT
PHOTODETECTOR INPUT
WHITE LIGHT SOURCE OUTPUT
(OPTION 002 ONLY)
dkb2

Installing the HP 71450B/1B/2B Optical Spectrum Analyzer System

1 Unpack the optical spectrum analyzer system from its shipping containers. Inspect the system thoroughly for any damage received during shipment. Make sure that your shipment is complete. Note that these installation instructions show the installation of the HP 71451B system only. However, the HP 71450B/2B system uses the same set of installation instructions.



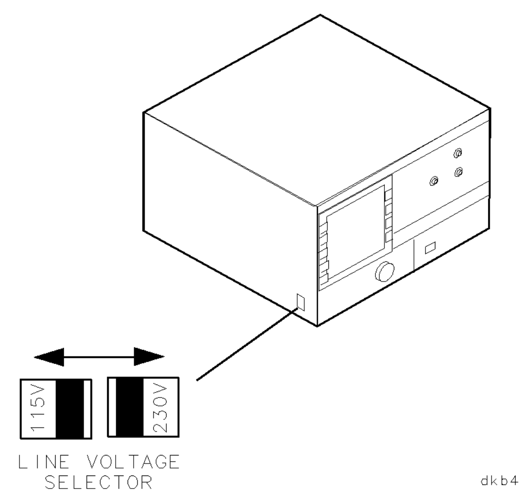
Caution

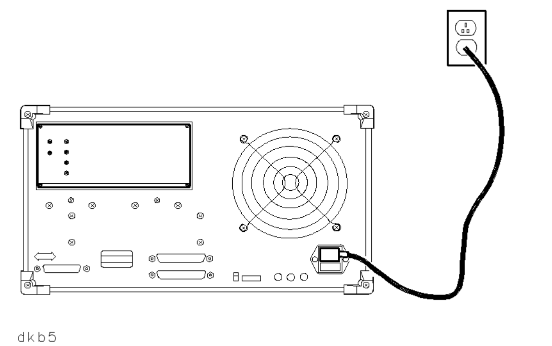
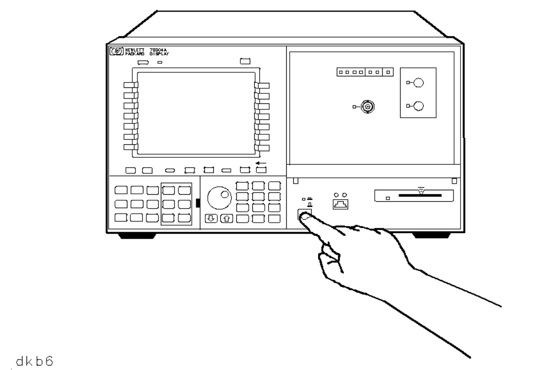
Before turning this instrument on, make sure the line voltage selector is set to the voltage of the ac power source:

115 V position for 90 to 132 V ac line input voltages at 50, 60, or 400 Hz

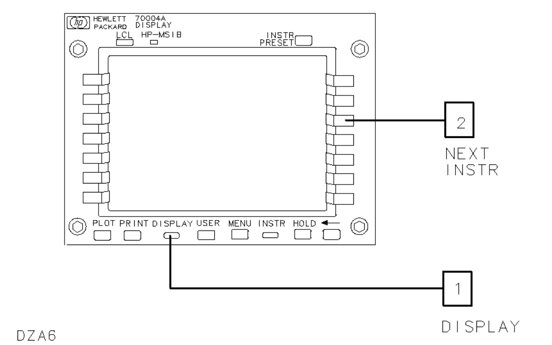
230 V position for 198 to 264 V ac line input voltages at 50 or 60 Hz

2 Set the line voltage selector to the voltage corresponding to the power source used. The line voltage selector is located on the left side of the optical spectrum analyzer, near the front.



3 Connect the ac power cord to the rear of the optical spectrum analyzer system. Then connect the other end of the ac power cord to the line voltage.	**4** Press the optical spectrum analyzer's front-panel **LINE** switch to turn the system on.
	

5 Press the (DISPLAY) key. Press the `NEXT INSTR` softkey.



If you want instructions for mounting the system in a rack, connecting the system to another display or mainframe, displaying the date and the time, or changing the date and the time, refer to the following optional installation steps:

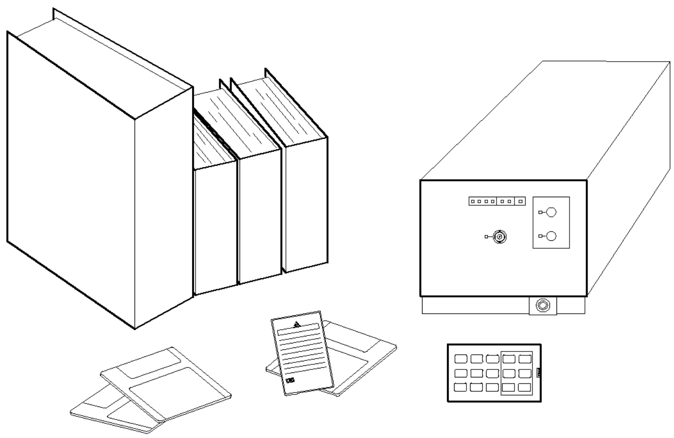
- "Optional: Mounting the System in a Rack".
- "Optional: Connecting the Optical Spectrum Analyzer System to Another Display or Mainframe".
- "Optional: Displaying the Time and the Date".
- "Optional: Changing the Time and the Date".

If you are ready to start making measurements, refer to the *HP 71450B/1B/2B Optical Spectrum Analyzer Quick Start Guide* to get started.

Installing an HP 70950B/1B/2B Optical Spectrum Analyzer Module

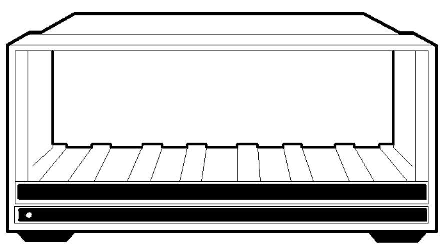
Step 1. Prepare to Install the Optical Spectrum Analyzer Module.

1 Unpack the optical spectrum analyzer module from its shipping containers. Inspect the module thoroughly for any damage received during shipment. Make sure that your shipment is complete. Note that these installation instructions only show the installation of the HP 70951B module. However, the HP 70950B/2B modules uses the same set of installation instructions.



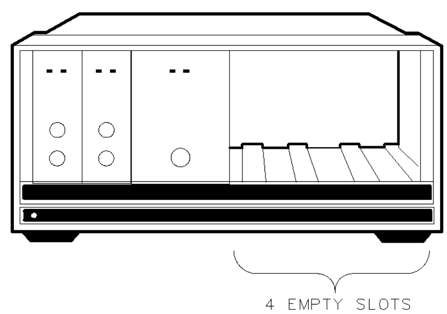
dkb7

2 Install the mainframe or the display that you will be using with the module. Refer to the appropriate installation manual for instructions.



DZA16

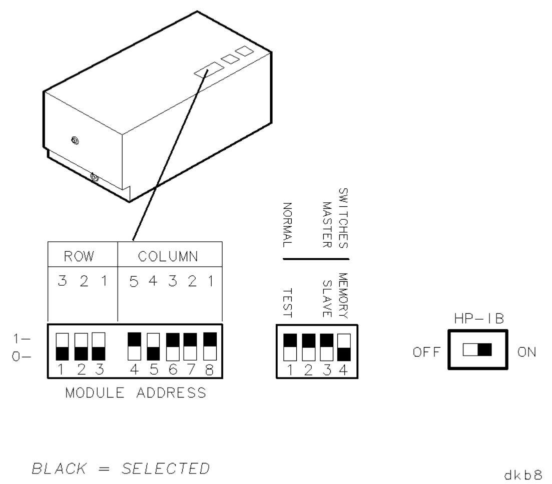
3 The HP 70950B/1B/2B are 4/8-width modules. They each require four adjacent, empty slots for installation. Remove or move previously installed modules from the display or mainframe to open the necessary slots.



DZA17

Step 2. Check the Address of the Optical Spectrum Analyzer Module.

1 Locate the eight address switches on the top of the module. These switches are factory preset to row address 0 and column address 23.

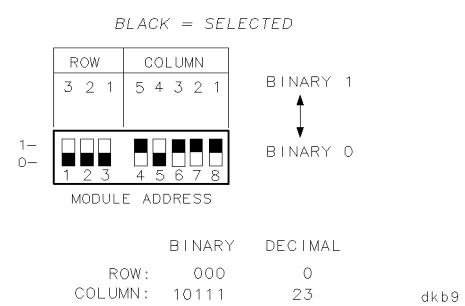


When using the HP 70950B/1B/2B optical spectrum analyzer module with other factory-preset modules, the factory-preset address of the HP 70950B/1B/2B does not need to be changed.

However, if two optical spectrum analyzers are in the system, you must change the address of one of them.

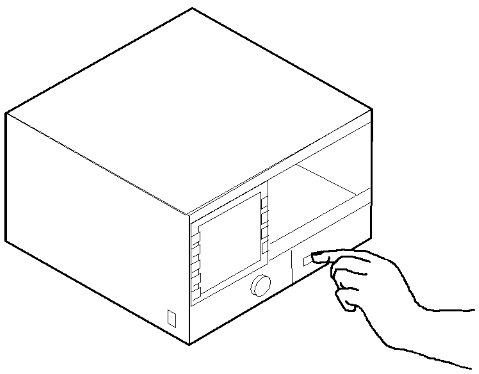
Each device that communicates over the HP-MSIB bus must have a unique 8-bit binary HP-MSIB address. This address is determined by the eight address switches. The three most significant bits (MSB) determine the row address. The five least significant bits (LSB) determine the column address. This manual refers to the decimal equivalent of the binary address.

2 Determine the module's address by looking at the address switches and calculating the decimal equivalent.



Step 3. Check the System's HP-MSIB Addresses.

1 Press the **LINE** switch to turn the mainframe or the display on.

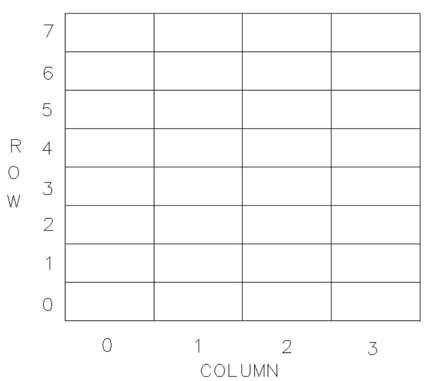


DZA20

When pressing the (DISPLAY) key and the `Address Map` softkey in step 2 below,

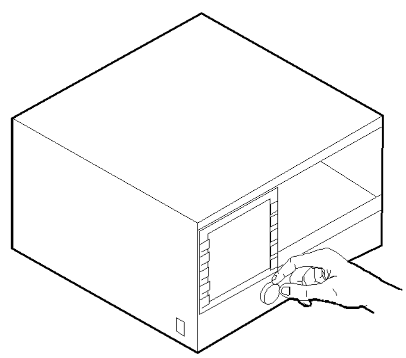
- If you have an HP 70205A graphics display:
  - use the (DSP) key instead of the (DISPLAY) key, and
  - use the `address map` softkey instead of the `Address Map` softkey.
- If you have an HP 70206A system graphics display:
  - use the `address map` softkey instead of the `Address Map` softkey.

2 Press the (DISPLAY) key. Press the `Address Map` softkey. This displays the system's HP-MSIB address map.



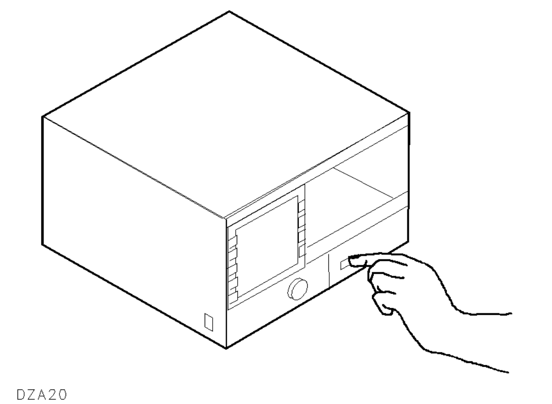
DZA21

3 Turn the front-panel knob of the display to see if any other module is set to the optical spectrum analyzer module's address, determined in "Step 2. Check the Address of the Optical Spectrum Analyzer Module." on the previous page.



DZA22

4 Press the **LINE** switch of the mainframe or the display to turn it off.

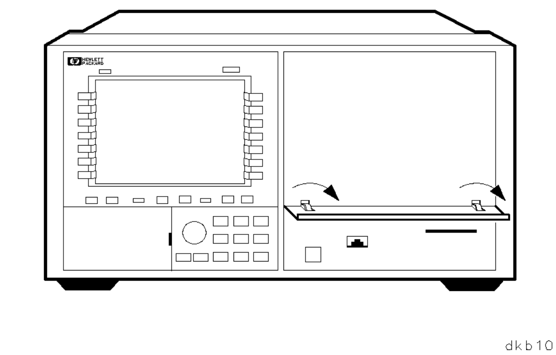
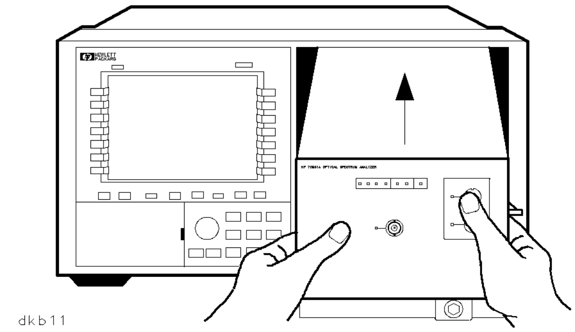
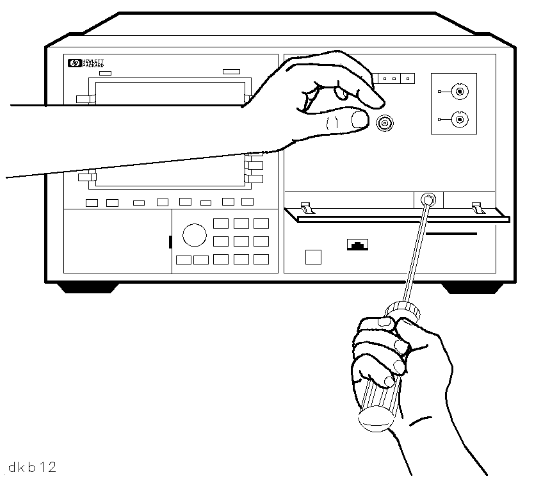
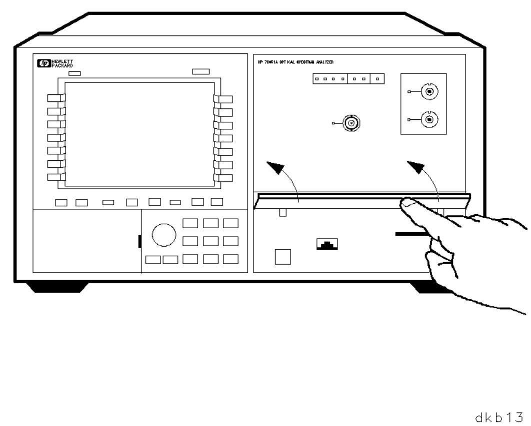


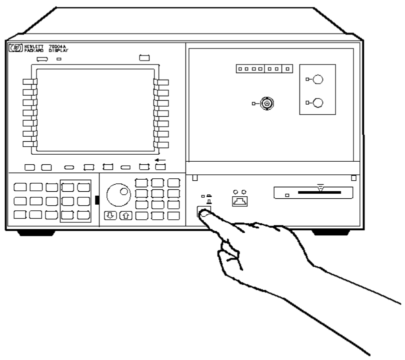
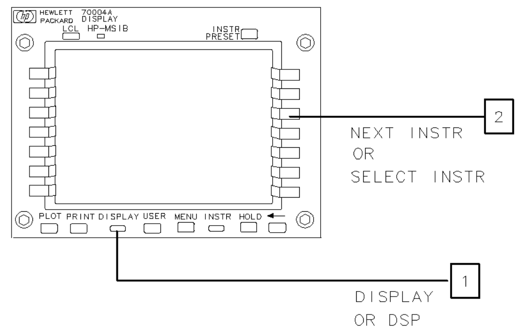
If no other module is set to the same HP-MSIB address as the optical spectrum analyzer module, continue at "Step 4. Install the Optical Spectrum Analyzer Module in the HP 70001A Mainframe or the HP 70004A Display." on the following page.

If there is another module at same the HP-MSIB address as the optical spectrum analyzer module, you can change the HP-MSIB address either of the optical spectrum analyzer module or of the other module assigned to that address.

- If you want to change the address of the optical spectrum analyzer module, continue at "Optional: Changing the HP-MSIB Address of the Optical Spectrum Analyzer Module".
- If you want to change the address of the other module, refer to the installation manual for that module. After the address of that module has been changed, continue at "Step 4. Install the Optical Spectrum Analyzer Module in the HP 70001A Mainframe or the HP 70004A Display." on the following page.

Step 4. Install the Optical Spectrum Analyzer Module in the HP 70001A Mainframe or the HP 70004A Display.

1 Open the front-panel door on the mainframe or the display.	**2** Slide the optical spectrum analyzer module into the mainframe or the display.
	
3 Press against the module front panel while tightening the hex-nut latch with the 8 mm hex-ball driver (HP part number 8710-1651).	**4** Close the front-panel door on the mainframe or the display.
	

5 Press the optical spectrum analyzer's front-panel **LINE** switch to turn the system on.	**6** Press the (DISPLAY) or the (DSP) key. Press the **NEXT INSTR** or the **SELECT INSTR** softkey. The key and softkey that you press depend on the display you are using.
 dkb6	 DZA27

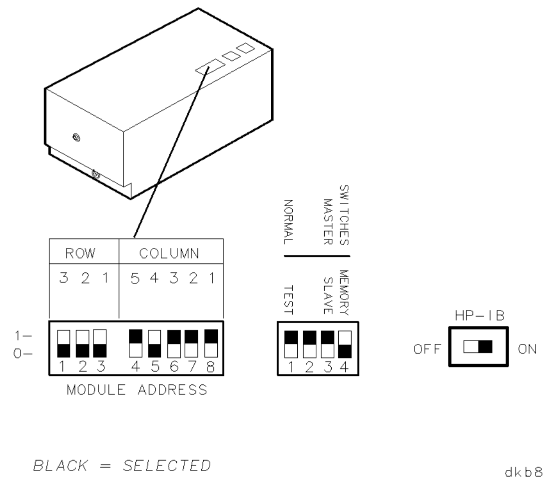
If you want instructions for installing the optical spectrum analyzer's keypad, for mounting the system in a rack, or for connecting the system to another display or mainframe, refer to the following optional installation steps:

- "Optional: Installing the Optical Spectrum Analyzer's Keypad in the Display".
- "Optional: Mounting the System in a Rack".
- "Optional: Connecting the Optical Spectrum Analyzer System to Another Display or Mainframe".
- "Optional: Displaying the Time and the Date".
- "Optional: Changing the Time and the Date".

If you are ready to start making measurements, refer to the *HP 71450B/1B/2B Optical Spectrum Analyzer Quick Start Guide* to get started.

Optional: Changing the HP-MSIB Address of the Optical Spectrum Analyzer Module

1 Locate the eight HP-MSIB address switches on top of the module. These switches are factory preset to row address 0 and column address 23.



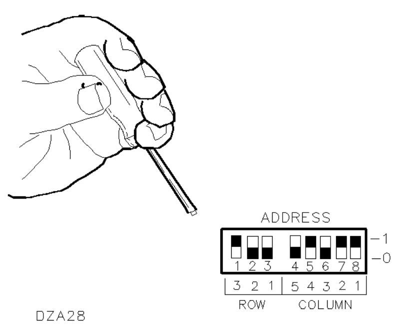
Each device that communicates over the HP-MSIB bus must have a unique 8-bit binary HP-MSIB address. This address is determined by the eight address switches. The three most significant bits (MSB) determine the row address. The five least significant bits (LSB) determine the column address. This manual refers to the decimal equivalent of the binary address.

Only the modules and the stand-alone instruments that have addresses in row 0 can communicate over the HP-IB bus.

Address 0, 31 is an illegal address. No device may be set to this address.

A thin, nonconductive stylus is useful for setting the address switches.

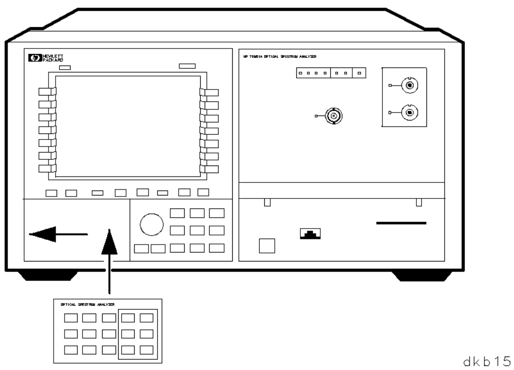
2 Set the address switches of the module to an HP-MSIB address in row 0 that does not have a module assigned to any row in that column.



Continue at "Step 4. Install the Optical Spectrum Analyzer Module in the HP 70001A Mainframe or the HP 70004A Display.".

Optional: Installing the Optical Spectrum Analyzer's Keypad in the Display

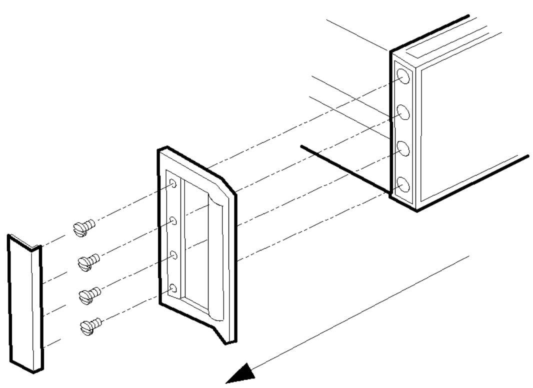
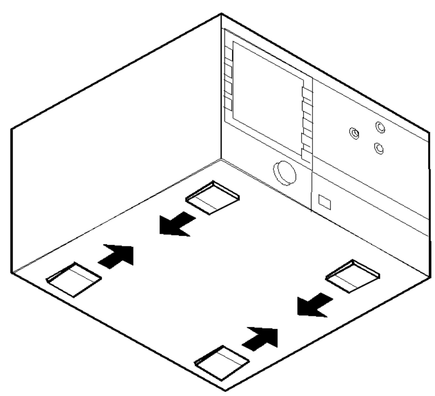
1 Install the optical spectrum analyzer's keypad by inserting the left side of the keypad into the display's front panel. Press the right side of the keypad in until it snaps into the front panel.



If you are ready to start making measurements, refer to the *HP 71450B/1B/2B Optical Spectrum Analyzer Quick Start Guide* to get started.

Optional: Mounting the System in a Rack

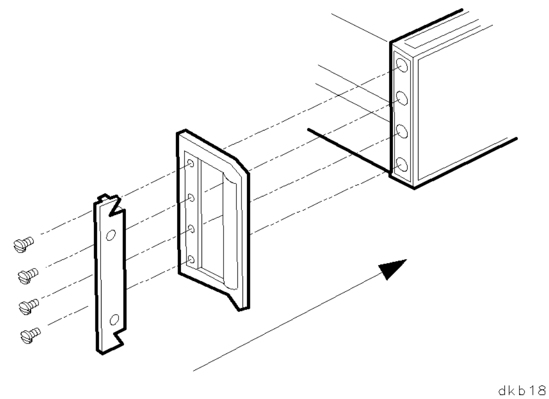
<table>
<tr>
<td>
Hardware kits are needed to rack-mount the system. Refer to the lists of the hardware kits, below, for the options, the descriptions, and the HP part numbers.
For HP 70004A display:
Option 810 rackmount slide kit
(HP part number 5062-7086)
Option 908 rack flange kit without handles
(HP part number 5062-3979)
Option 913 rack flange kit with handles
(HP part number 5062-4073)
For HP 70001A mainframe:
Option 810 rackmount slide kit
(HP part number 5062-0781)
Option 908 rack flange kit without handles
(HP part number 5062-3978)
Option 913 rack flange kit with handles
(HP part number 5062-4072)
</td>
<td>
Caution

Make sure that the rack that you are mounting the optical spectrum analyzer system in does not vibrate substantially. Excessive vibration may cause signal amplitude measurements to be inaccurate.
Do not rack-mount multiple displays or mainframes with a single rack-mount hardware kit. One rack-mount hardware kit must be ordered for each display or mainframe.
</td>
</tr>
<tr>
<td>1 If the handles are already installed, slide the plastic trim strip on each handle forward and remove them. Remove the screws securing each handle to the instrument.</td>
<td>2 Remove the feet and the tilt stand legs (if installed) from the bottom of the display or mainframe.</td>
</tr>
<tr>
<td>
dkb16</td>
<td>
dkb17</td>
</tr>
</table>

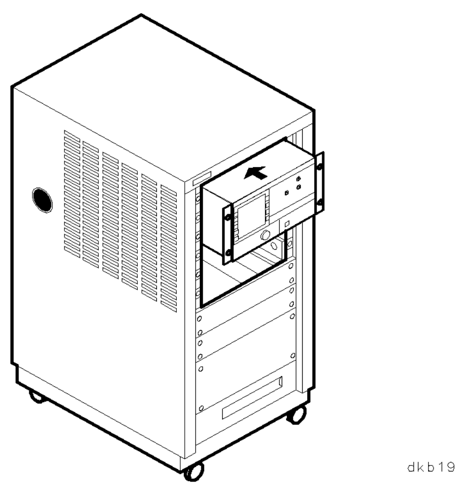
Caution

Be sure to use the correct hardware when replacing parts. Both metric and English hardware are used with these instruments. Using incorrect screw sizes may damage the instrument cabinet.

3 Install the rack-mount hardware kit on the display or mainframe. The installation instructions are included with each kit.



4 Slide the display or mainframe into the rack. Insert two screws through the holes in the rack flange on each side of the instrument and into the front of the rack. Tighten each screw.



If you are ready to start making measurements, refer to the *HP 71450B/1B/2B Optical Spectrum Analyzer Quick Start Guide* to get started.

Optional: Connecting the Optical Spectrum Analyzer System to Another Display or Mainframe

The optical spectrum analyzer system may be connected to another display or mainframe. The optical spectrum analyzer system may be left separate or physically configured in one of two ways.

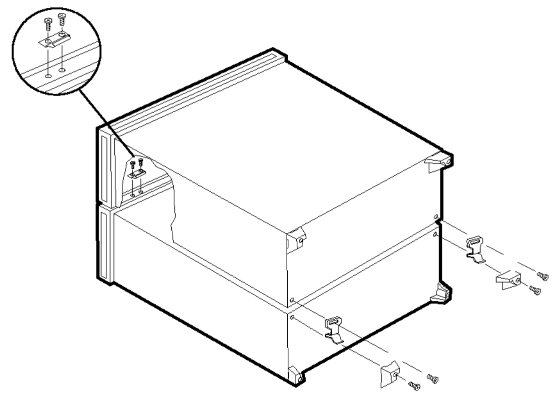
- Rack mounted
- Stacked and interlocked (with a mainframe only)

If you want to leave the optical spectrum analyzer system and the display or mainframe separate, refer only to step 2 below.

If you want to rack-mount the optical spectrum analyzer system and the display or mainframe, refer to "Optional: Mounting the System in a Rack", and to step 2 below.

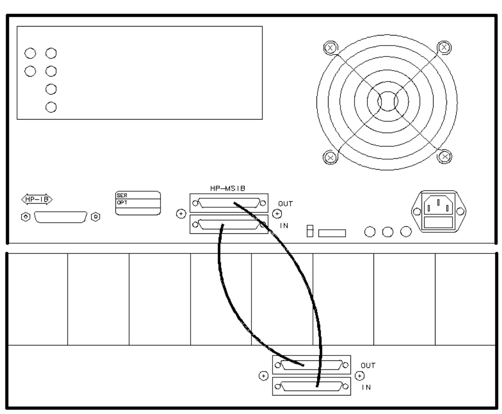
If you want to stack and interlock the optical spectrum analyzer system with the mainframe, continue at step 1 on this page.

1 Assemble the optical spectrum analyzer system and mainframe as shown below. Order interlock kit (HP part number 5061-9061) for hardware and instructions.



DZA41

2 Connect the HP-MSIB cables serially: coupling the input of one display or mainframe to the output of the next until the loop is completed. This shows the HP-MSIB cable connections between the optical spectrum analyzer system and the mainframe.



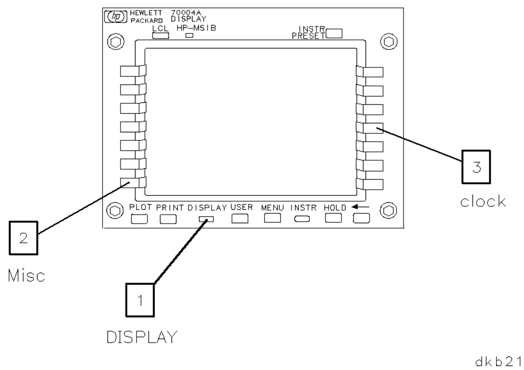
dkb20

Long HP-MSIB cables between the display and mainframe allow remote operation. Since the signals on the HP-MSIB are digital, measurement speed is only slightly degraded. Measurement accuracy is not affected by HP-MSIB cable length.

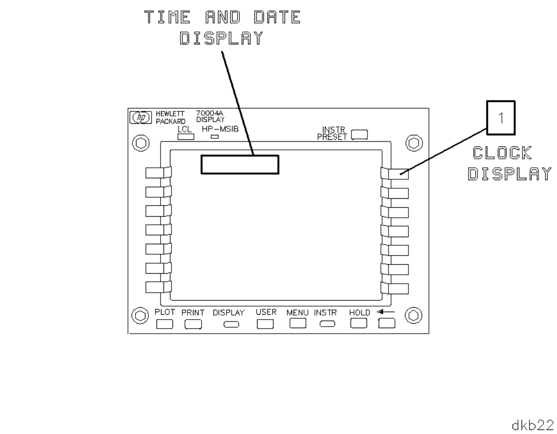
If you are ready to start making measurements, refer to the *HP 71450B/1B/2B Optical Spectrum Analyzer Quick Start Guide* to get started.

Optional: Displaying the Time and the Date

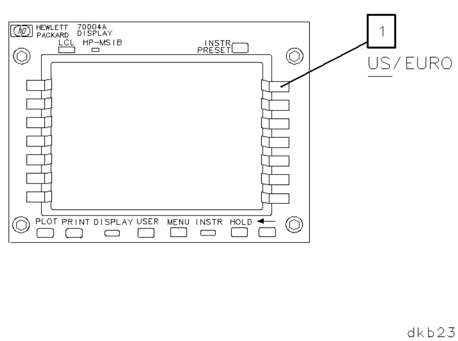
1 Press the DISPLAY key. Press the `Misc` softkey. Press the `clock` softkey.



2 Press the `CLOCK DISPLAY` softkey. Pressing this softkey toggles the time and date off and on.



3 Press the `US/EURO` softkey to toggle the date display format between US and EURO. For example, April 18th of 1991 is displayed as `APR 18, 1991` in US format and as `18.04.1991` in EURO format.



If you are ready to start making measurements, refer to the *HP 71450B/1B/2B Optical Spectrum Analyzer Quick Start Guide* to get started.

Optional: Changing the Time and the Date

<table>
<tr>
<td>

1 Display the time and the date. Refer to “Optional: Displaying the Time and the Date” on the previous page.

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2 With the `clock` softkeys displayed, press `set clock`.

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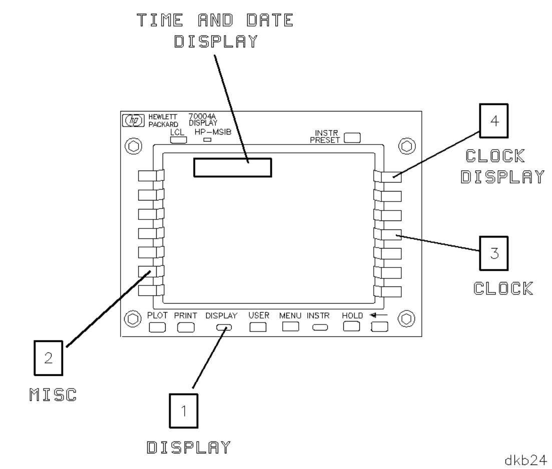

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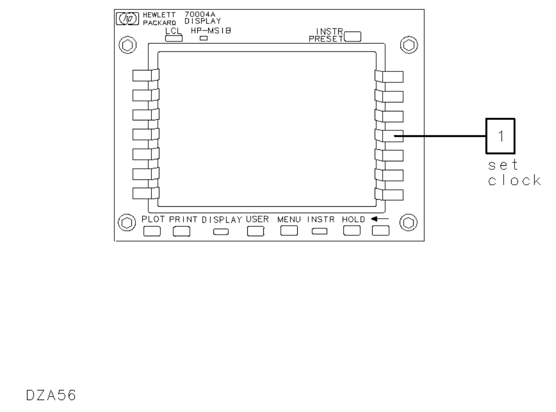

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3 Press the first time or date units softkey that you want to change. The units softkeys include `HOUR`, `MINUTE`, `SECOND`, `MONTH`, `DAY`, and `YEAR`.

</td>
<td>

4 If the time is being corrected, use the display’s numeric keypad to input the correct hours, minutes, or seconds. If the date is being corrected, use the numeric keypad to input the correct month, day, or year.

</td>
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<tr>
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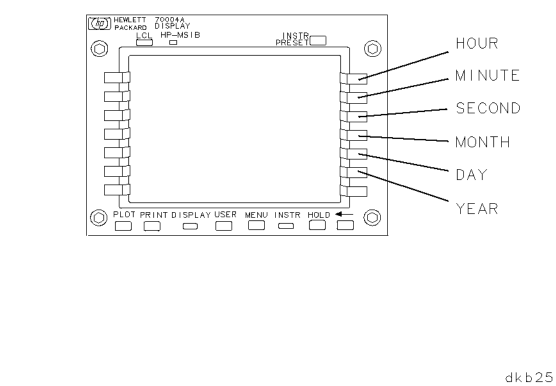

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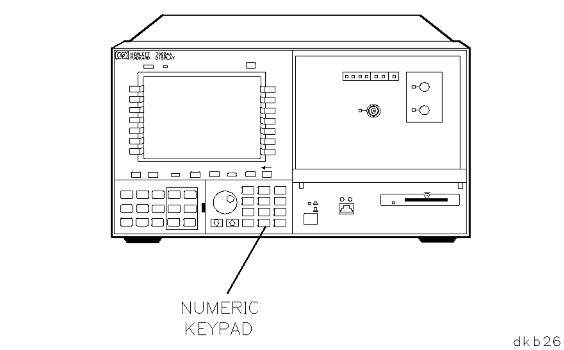

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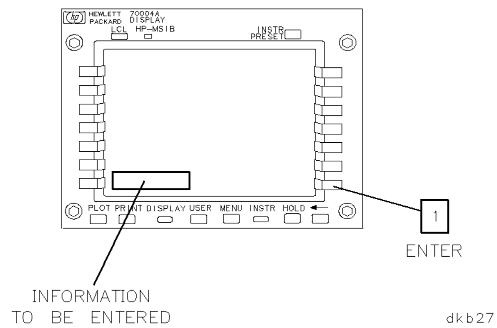
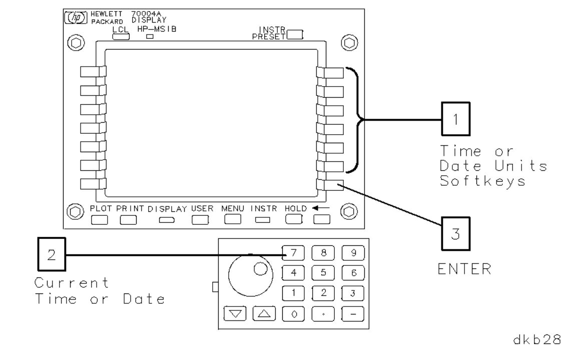
</table>

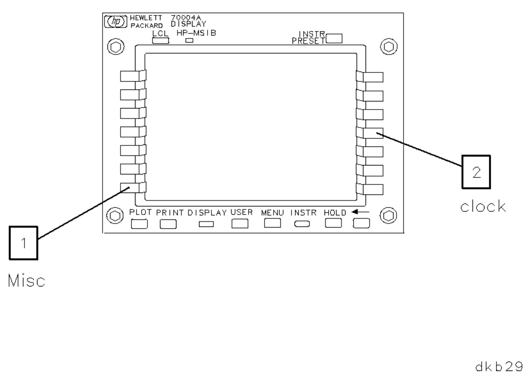
5 Press ENTER.



6 Repeat steps 3, 4, and 5 of this procedure until the current time and date is displayed.



7 To return to the `clock` softkeys, press `Misc` and then press `clock`.



If you are ready to start making measurements, refer to the *HP 71450B/1B/2B Optical Spectrum Analyzer Quick Start Guide* to get started.

2

If You Have a Problem During Installation

Introduction

This chapter will help you correct problems you may encounter during installation of the optical spectrum analyzer. The problem or symptom is listed at the top of each page. Most problems have a brief description or explanation, followed by a checklist of items that could be causing the problem. Using the checklist of possible solutions will help you correct the problem. If the problem is internal to the optical spectrum analyzer, the checklist will also help to identify the faulty module, display, or mainframe.

Refer to “What to Expect When You Turn on the Optical Spectrum Analyzer” in this chapter for information regarding the normal steps that occur when the instrument is first turned on.

Problems Requiring Additional Technical Resources

Problems that are internal to a module, a display, or a mainframe will require additional technical information. Refer to the service documentation for the faulty module, display, or mainframe or return the instrument to Hewlett-Packard for servicing. Instructions for returning the instrument are provided in “If the Optical Spectrum Analyzer Needs to be Returned for Service”.

What to Expect When You Turn on the Optical Spectrum Analyzer

Each time the optical spectrum analyzer is turned on, the following actions take place:

1. The module self-test procedure turns on all the LEDs, except the STATUS LEDs. The STATUS LEDs will turn on one second later. Refer to Figure 2-1.

   This description identifies the optical spectrum analyzer module LEDs that light. Depending on the display or mainframe used, their LEDs will also light during turn on.
2. After the preliminary self-test, all optical spectrum analyzer module front-panel LEDs are turned off.
3. The display's model number is briefly displayed on screen.
4. The system begins running an instrument INITIALIZING routine.
5. At the beginning of the INITIALIZING routine, the ACT LED lights and remains lit.
6. At the end of the INITIALIZING routine, the MEASURE LED lights as the optical spectrum analyzer sweeps across the display. If the module is an HP 70951B, the MONOCHROMATOR INPUT LED will also light.

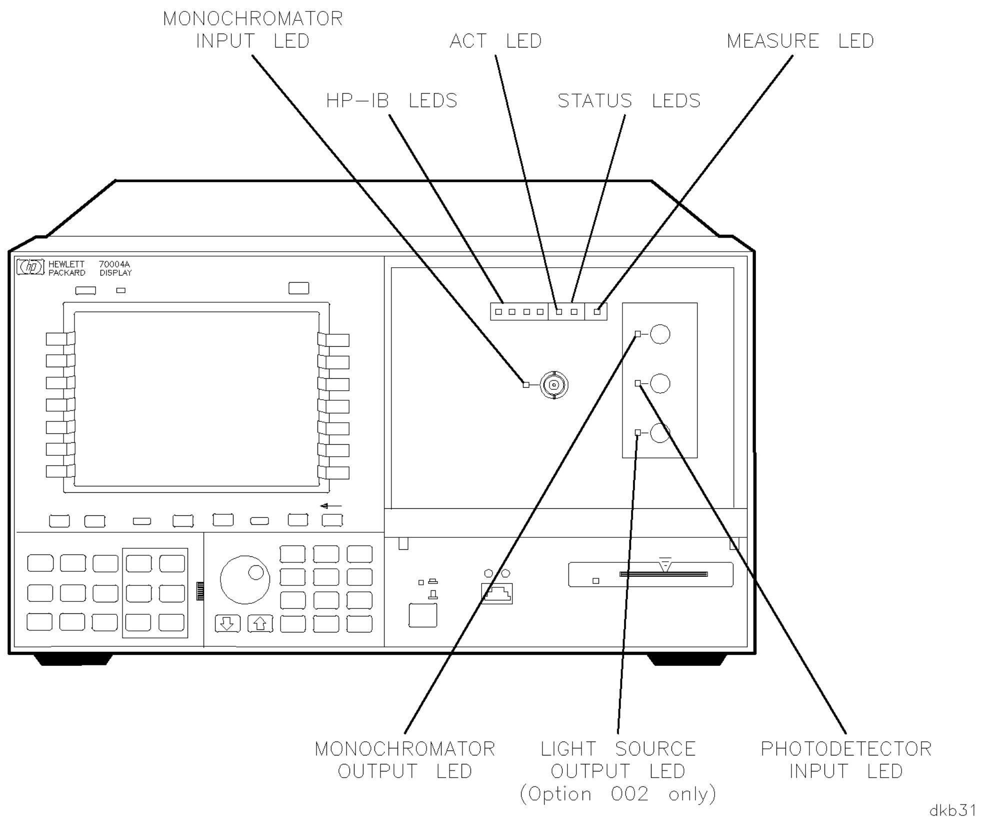


Figure 2-1.
Optical Spectrum Analyzer Front Panel
(HP 71451B Shown)

If the Optical Spectrum Analyzer Will Not Turn On

Pressing the LINE switch on the front panel of each display and mainframe in system should turn the system on. If there is a problem providing power to the system, these symptoms will occur:

- □ The display will remain blank.
- □ The LINE LED on the front panel of the display or mainframe will not light.
- □ The actions described in "What to Expect When You Turn on the Optical Spectrum Analyzer" will not occur.

If you press the LINE switch on the front panel of the display or the mainframe and the optical spectrum analyzer does not turn on, check the following items:

- Check that the optical spectrum analyzer is connected to the ac power source.
- Check that the line voltage selector switch is set to the correct voltage for the power source. The line voltage selector switch is located on the left side of the HP 70004A display, on the bottom of the HP 70001A mainframe, or on the rear panel of the HP 70206A system graphic display. See Figure 2-2.

Figure 2-2. Line Voltage Selector

- Check the line fuse on the display or the mainframe to ensure that it is not damaged.

  The line fuse for this instrument is located inside the power-cord receptacle housing on the rear of the display and mainframe. Also included in this housing is a spare fuse. The fuse is a 5 by 20 mm fuse rated at 6.3 A, 250 V (HP part number 2110-0703). This line fuse can be used with both 120 V and 230 V power sources. Refer to Figure 2-3.

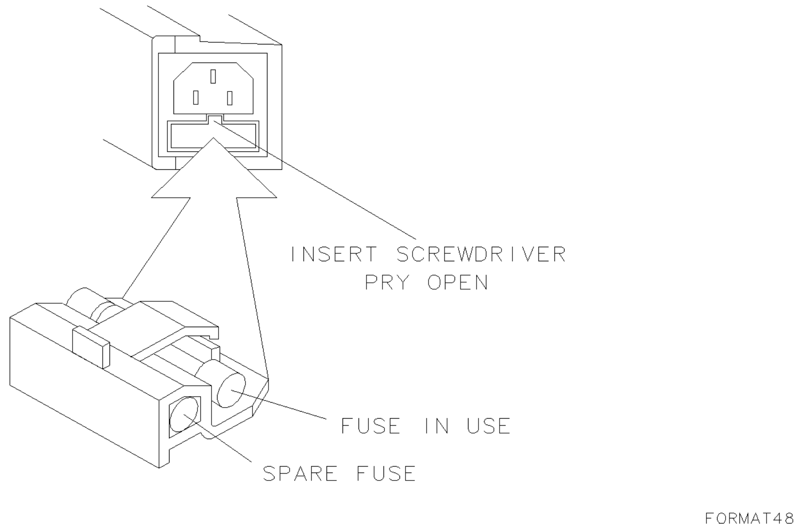


Figure 2-3. Line Fuse Removal and Replacement

If the Front-Panel LEDs Do Not Light When the Optical Spectrum Analyzer is Turned On

When the optical spectrum analyzer is turned on, the module self-test procedure turns on all the LEDs, except the STATUS LEDs. The STATUS LEDs will turn on one second later. After the self-test is complete, the MEASURE LED will start to blink. Refer to Figure 2-4.

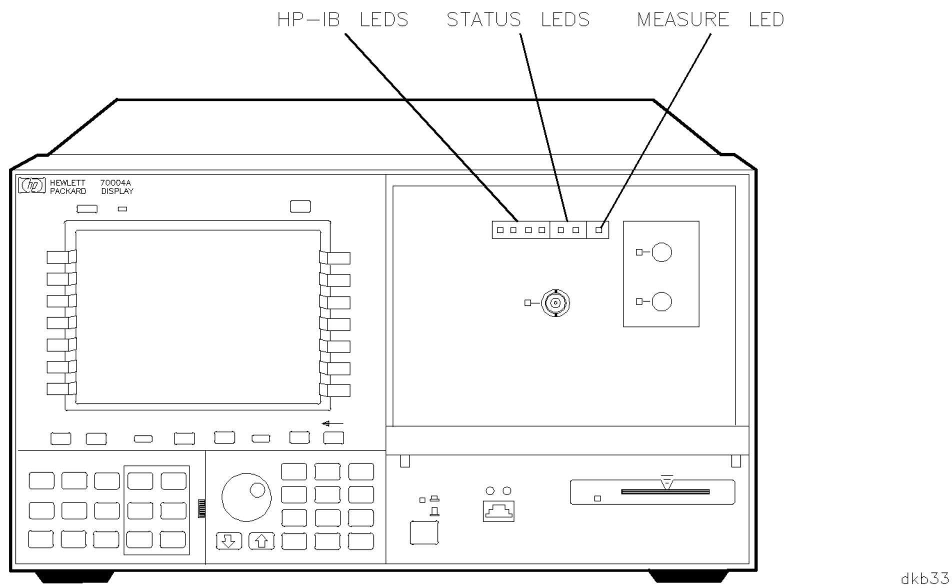


Figure 2-4. Optical Spectrum Analyzer Front Panel LEDs (HP 71451B Shown)

If the front-panel LEDs do not light when the optical spectrum analyzer is turned on:

- Ensure that the display or mainframe is operating properly.

  If the display or mainframe is not providing the correct power to the optical spectrum analyzer module, the optical spectrum analyzer will not operate correctly. The optical spectrum analyzer module may need to be removed to determine if the display or mainframe is operating properly. Refer to the display's or mainframe's installation manual for information regarding proper operation.

  - If the display or mainframe is operating properly, the optical spectrum analyzer module is probably faulty and additional technical resources are required. Refer to "Problems Requiring Additional Technical Resources".

- If other instruments are connected to the display or the mainframe via the HP-MSIB bus, check that they are turned on.

If the Optical Spectrum Analyzer Front-Panel ERR LED Remains Lit or Blinks after the Self-Test

The ERR LED is one of the two STATUS LEDs on the front panel of the optical spectrum analyzer module. The ERR LED should light during the optical spectrum analyzer's self-test. It is turned on and off so quickly during the self-test that you may not be able to see it light. Refer to Figure 2-5.

After the self-test, the ERR LED lights when an error (problem) is encountered. When it lights, it will either remain on continuously or it will blink.

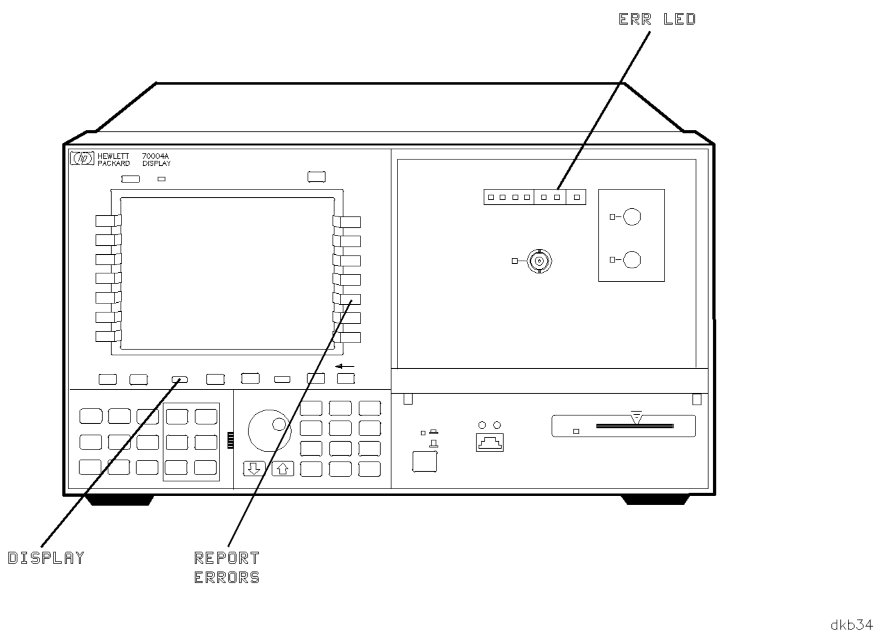


Figure 2-5. Optical Spectrum Analyzer Error Information (HP 71451B Shown)

If the ERR LED remains on continuously, it is indicating that there may be a problem with the optical spectrum analyzer. Perform the following steps:

1. Press (DISPLAY) or (DSP).
2. Press REPORT ERRORS.
3. Check the display for the reported error.
4. Refer to "If Errors Are Reported on the Display" for help correcting the error.

If the ERR LED blinks, it is indicating that there may be a problem with the HP-MSIB. Check the following items:

- If more than one mainframe is connected together, check that all HP-MSIB cables are securely connected and ensure that they are connected serially to form a loop.
- Check whether there are two modules in the system with the same HP-MSIB address. Refer to "Step 3. Check the System's HP-MSIB Addresses." in Chapter 1 for instructions.

If Errors Are Reported on the Display

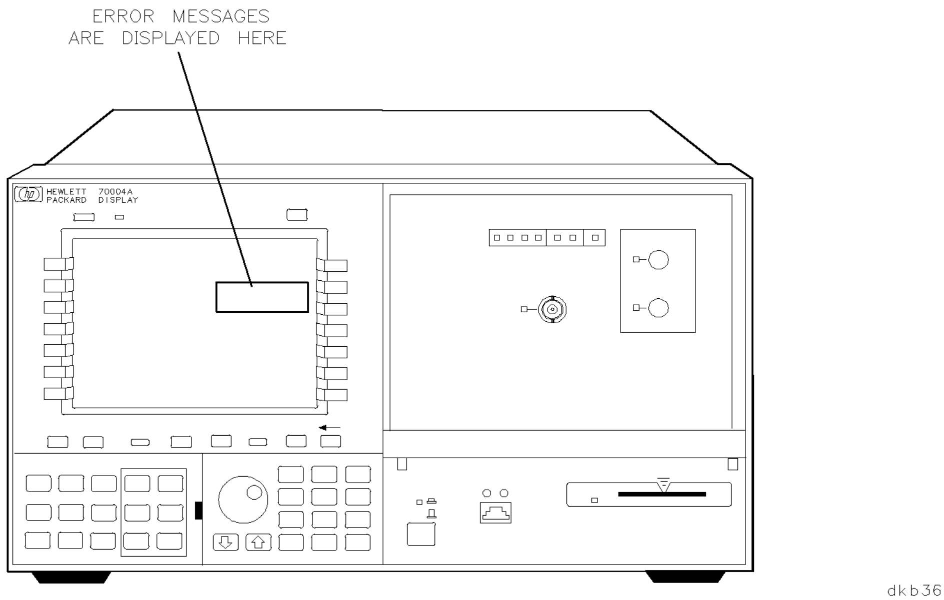


Figure 2-6.
Optical Spectrum Analyzer Displayed Errors
(HP 71451B Shown)

- Note the error number and the error message. The model number of the module detecting the error will be included in the error message. Refer to Figure 2-6 for the location of the displayed errors.

  If your display is an HP 70004A, the error displayed is in its default condition.

- If the error is detected by the optical spectrum analyzer, refer to the list of errors in the Reference manual. This book provides additional information about error messages.

If the Optical Spectrum Analyzer Front-Panel HP-IB LEDs Remain Lit after the Self-Test

The HP-IB LEDs on the front panel of the optical spectrum analyzer are turned on then off, one at a time, during the optical spectrum analyzer's self-test. The four HP-IB LEDs are: service request (SRQ), talk (TLK), listen (LSN), and remote (RMT). Refer to Figure 2-7 for the location of each of the HP-IB LEDs. The HP-IB LEDs reveal the status of the optical spectrum analyzer module when it is being controlled by a computer.

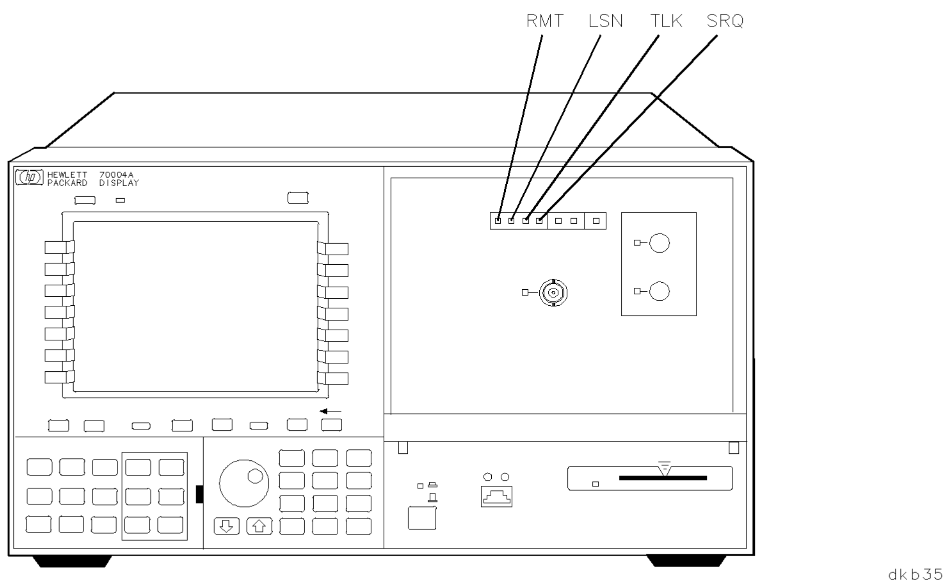


Figure 2-7. Optical Spectrum Analyzer HP-IB LEDs (HP 71451B Shown)

The following lists and describes the HP-IB LEDs, and suggests what to check if an LED remains on after the self-test.

LED	Solution
SRQ	The service request (SRQ) LED lights when the optical spectrum analyzer has requested computer service. Check for error messages on the display.
TLK LSN RMT	The talk (TLK) and listen (LSN) LEDs light when a controller has addressed the optical spectrum analyzer to talk or listen over the HP-IB. The remote (RMT) LED lights if the remote enable (REN) line is asserted and the optical spectrum analyzer is addressed by a controller.

If the TLK, LSN, or RMT LEDs remain on after the self-test:

- Check that no HP-IB address conflicts with other equipment on the HP-IB bus.

  Two instruments on the HP-IB bus that have the same HP-IB address will cause an error.

- Remove the HP-IB bus from the optical spectrum analyzer.
  - □ If the LED turns off, the problem is probably caused by the controller or another instrument on the HP-IB bus.

    Return the optical spectrum analyzer to the HP-IB bus. Remove other instruments from the bus to isolate the source of the problem.

  - □ If the LED remains on, the optical spectrum analyzer probably is the cause.
    - Turn the power off, then back on.
    - Check the LED to see if the problem remains.

      If the LED is still on, the optical spectrum analyzer module is probably faulty and additional technical resources are required. Refer to "Problems Requiring Additional Technical Resources".

If the Display HP-MSIB or the Mainframe I/O CHECK Indicator Light Remains Lit

The display HP-MSIB fault indicator light and the mainframe I/O CHECK status indicator light indicate the status of the HP-MSIB. If either of the lights are on, there is a problem with the HP-MSIB. Refer to Figure 2-8 for the location of the HP-MSIB indicator light on the display and the location of the I/O CHECK indicator light on the mainframe.

- Verify that the power to all mainframes and stand-alone display instruments is on.
- Check that all HP-MSIB cables are securely connected and ensure that they are connected serially to form a loop.
- Check for two modules in the system with the same HP-MSIB address. Refer to "Step 3. Check the System's HP-MSIB Addresses." in Chapter 1 for instructions.
- Check for a faulty mainframe or stand-alone display by removing all of the HP-MSIB cables and noting the state of the indicator light as each cable is removed.
  - ☐ If the indicator light is still on, that mainframe, display, or one of its modules is probably causing the HP-MSIB problem.
  - ☐ If the indicator light goes out, the problem is probably with some other part of the system.
  - ☐ If all displays and mainframes operate satisfactorily by themselves, check the HP-MSIB cables.

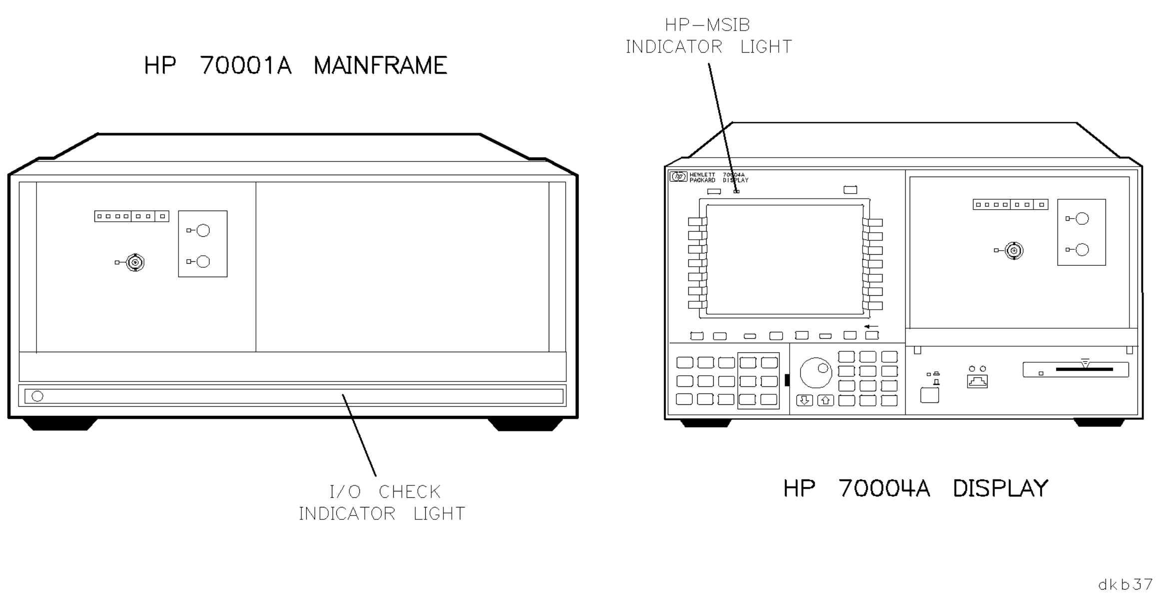


Figure 2-8. HP-MSIB and I/O CHECK Indicator Lights

If the Mainframe CURRENT Indicator Light Remains Lit

The CURRENT error indicator light turns on when the mainframe power supply senses a current overload. Refer to Figure 2-9 for the location of the CURRENT indicator light.

- Check to see which module is causing the current overloading condition.
  - □ Turn the power off.
  - □ Remove one module from the mainframe.
  - □ Turn the power on.
    - If the indicator light is off, the optical spectrum analyzer module is probably faulty and additional technical resources are required. Refer to "Problems Requiring Additional Technical Resources".
    - If the indicator light is still on, continue removing modules, one at a time, until the module causing the indicator light is identified. If removing a module causes the indicator light to turn off, refer to the service manual for that module for help correcting the problem.
    - If the indicator light remains on after all modules have been removed, the mainframe is probably faulty. Refer to the *HP 70001A Mainframe Service Manual* for assistance.

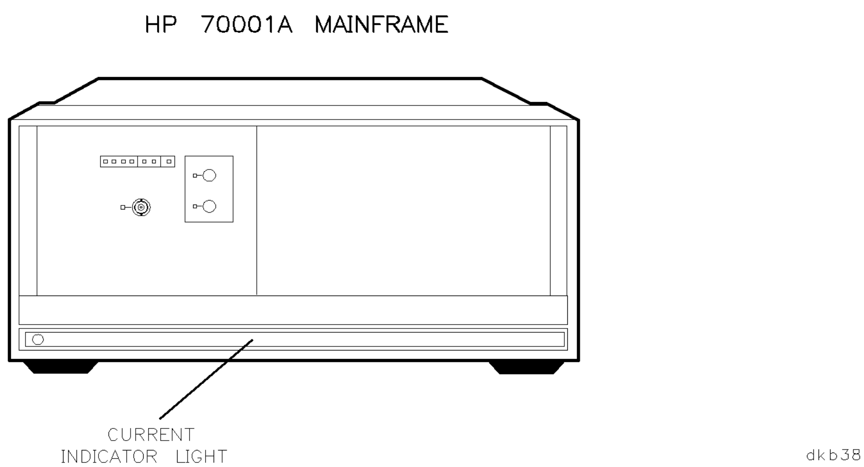


Figure 2-9. Current Indicator Light

If the Optical Spectrum Analyzer Needs to be Returned for Service

When an instrument is returned to a Hewlett-Packard service office for servicing, it must be adequately packaged and have a complete description of the failure symptoms attached.

When describing the failure, please be as specific as possible about the nature of the problem. Include copies of additional failure information (such as instrument failure settings, data related to instrument failure, and error messages) along with the instrument being returned.

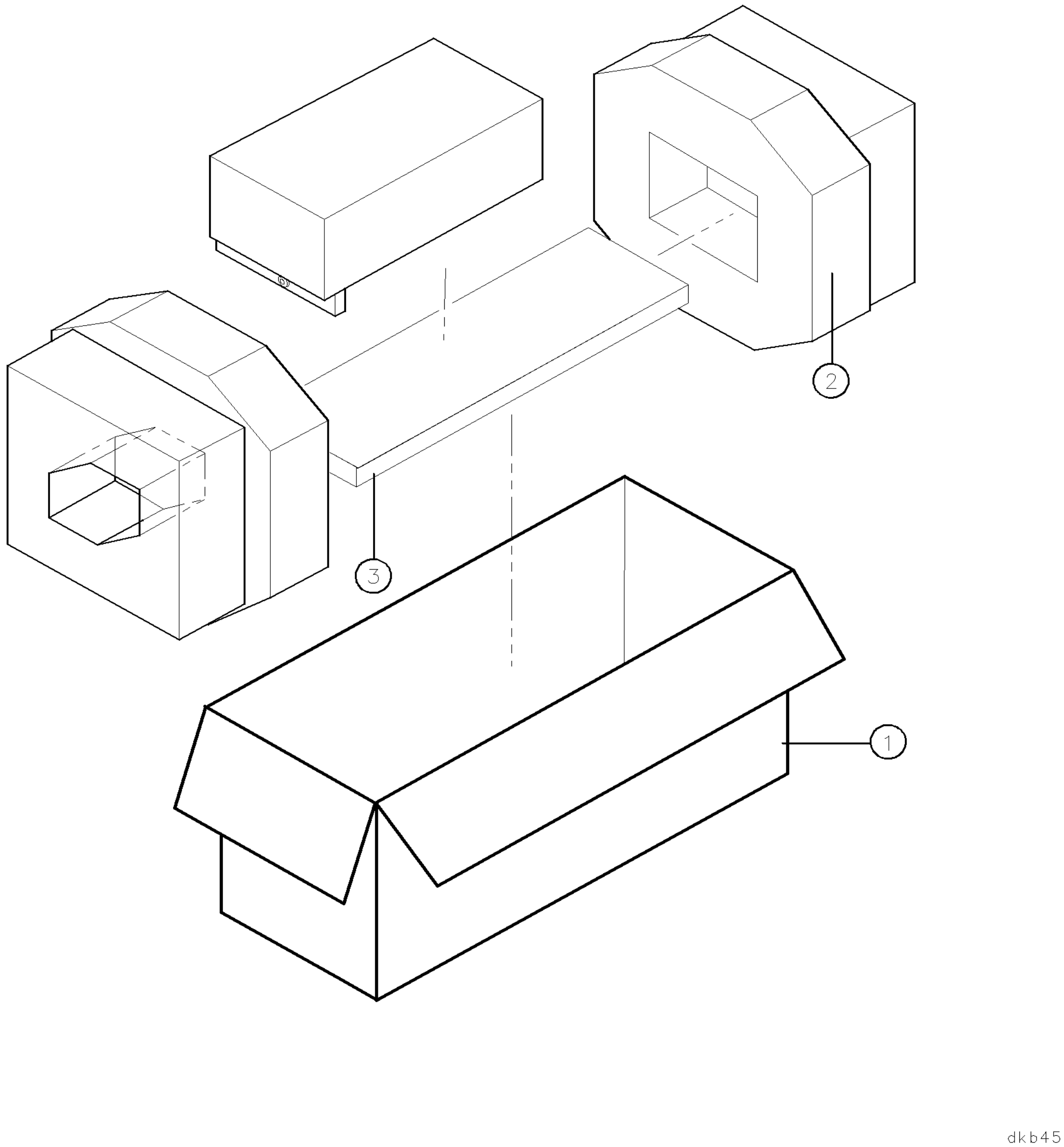
Please notify the service office before returning your instrument for service. Any special arrangements for the instrument can be discussed at this time. This will help the HP service office repair and return your instrument as quickly as possible.

Repackaging an instrument requires original shipping containers and materials or their equivalents. Hewlett-Packard offices can provide packaging materials identical to the original materials.

Caution Packaging materials not specified can result in instrument damage. Never use styrene pellets to package electronic instruments. The pellets do not adequately cushion the instrument, do not prevent all instrument movement, and can generate static electricity.

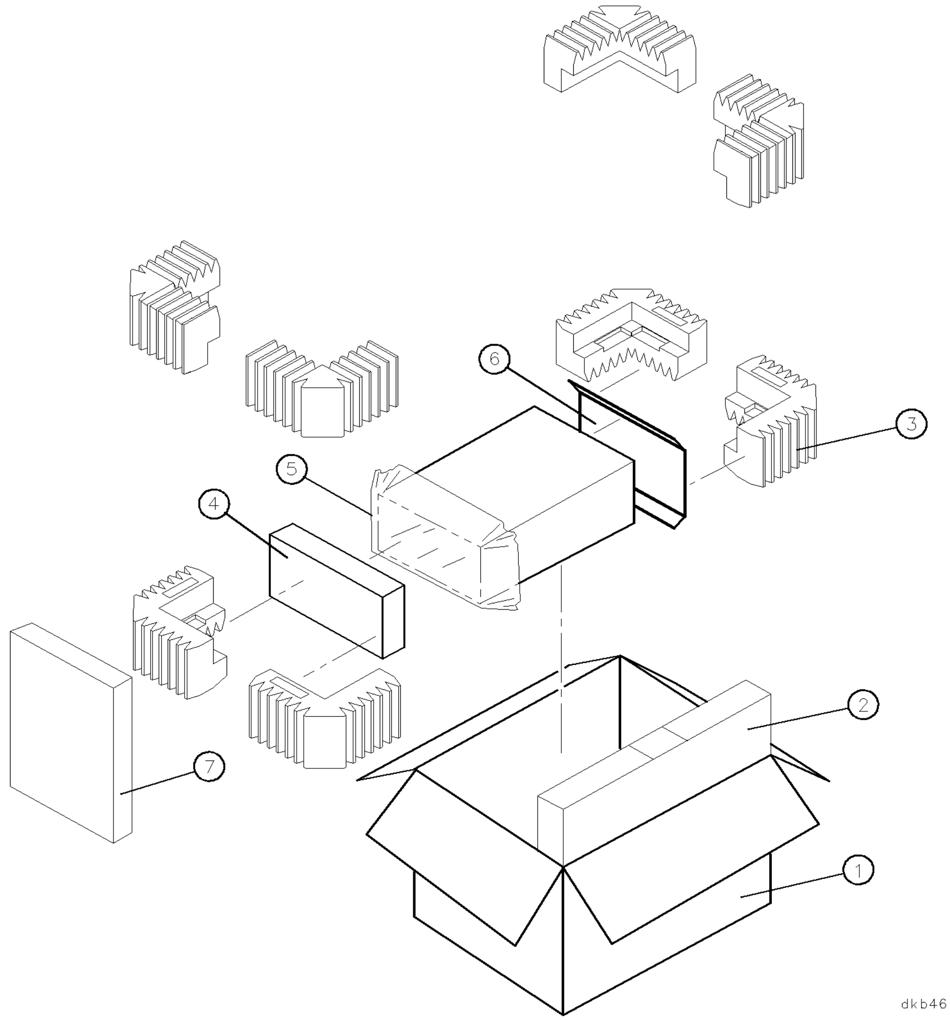
To return the instrument for service

1. Fill out the Service Repair Form (located at the end of this procedure), and place it in the box with the instrument. Send a copy of any noted error messages or other helpful performance data.
2. To help prevent damage during transit, pack the instrument in the factory packaging materials. Original shipping materials or equivalents are best; however, the following instructions result in acceptable packaging.
   a. Wrap the instrument in anti-static plastic to reduce the possibility of ESD damage.
   b. For instruments that weigh less than 54 kg (120 lb), use a double-walled, corrugated cardboard carton of 159 kg (350 lb) test strength. The carton must be both large enough and strong enough to accommodate the instrument. Allow at least three to four inches on all sides of the instrument for packing material.
   c. Surround the equipment with three to four inches of packing material to protect the module and to prevent movement in the carton. If packing foam is not available, the best alternative is S.D.-240 Air Cap™ from Sealed Air Corporation, Hayward, California 94545. Air Cap is plastic sheeting filled with 1-1/4 inch air bubbles. Use pink anti-static Air Cap. Wrapping the instrument several times in this material should provide sufficient protection and also prevent movement in the carton.
3. Seal the carton with strong nylon adhesive tape.
4. Mark the carton FRAGILE, HANDLE WITH CARE.
5. Retain copies of all shipping papers.



Item	HP Part Number	CD	Qty	Description
1	9211-6708	5	1	Carton
2	9220-4945	7	1	Foam End Cap (Set of 2)
3	9220-4946	8	1	Bottom Pad

Figure 2-10. Packaging Materials for HP 70950B/1B/2B Modules



Item	HP Part Number	CD	Qty	Description
1	9211-5311	4	1	carton, corrugated
2	9220-4384	8	2	side spacers, corrugated
3	5040-6967	1	8	corner pads, foam
4	5040-6973	9	1	front panel cover, plastic
5	9223-0636	1	1	antistatic sheeting (28 in. by 24 in.)
6	9220-4962	8	1	rear panel protector, corrugated
7	4208-1210	2	1	front space, foam

Figure 2-11. Packaging Materials for HP 71450B/1B/2B Systems

Service Repair Form

Date:	
Company:	______________________
Address:	______________________
	______________________
	______________________
	______________________
Technical contact person:	______________________
Phone:	______________________
Model number:	______________________
Serial number:	______________________
P.O. number:	______________________
Accessories returned with unit:	○ none ○ cables(s) ○ power cable ○ adapter(s)
Other: ______________________	
Service Needed:	○ calibration only ○ repair ○ repair and calibration
Other: ______________________	
Failure symptoms and special control settings:	
______________________	
______________________	
______________________	
______________________	
______________________	
If unit is part of system, list model number(s) of other interconnected instruments:	
______________________	
______________________	
______________________	

Sales and service offices

Hewlett-Packard has sales and service offices located around the world to provide complete support for Hewlett-Packard products. To obtain servicing information or to order replacement parts, contact your nearest Hewlett-Packard sales and service office. In any correspondence or telephone conversation, refer to the instrument by its model number, serial number, and option designation.

Hewlett-Packard Sales and Service Offices

U.S. FIELD OPERATIONS		
Headquarters Hewlett-Packard Company 19320 Pruneridge Avenue Cupertino, CA 95014 U.S.A. (800) 752-0900	**California, Northern** Hewlett-Packard Company 301 East Evelyn Mountain View, CA 94041 (415) 694-2000	**California, Southern** Hewlett-Packard Company 1421 South Manhatten Ave. Fullerton, CA 92631 (714) 999-6700
Colorado Hewlett-Packard Company 24 Inverness Place, East Englewood, CO 80112 (303) 649-5000	**Georgia** Hewlett-Packard Company 2000 South Park Place Atlanta, GA 30339 (404) 955-1500	**Illinois** Hewlett-Packard Company 5201 Tollview Drive Rolling Meadows, IL 60008 (708) 342-2000
New Jersey Hewlett-Packard Company 120 West Century Road Paramus, NJ 07653 (201) 586-5400	**Texas** Hewlett-Packard Company 930 East Campbell Road Richardson, TX 75081 (214) 231-6101	

EUROPEAN FIELD OPERATIONS		
Headquarters Hewlett-Packard S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/Geneva Switzerland (41 22) 780.8111	**France** Hewlett-Packard France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60	**Germany** Hewlett-Packard GmbH Hewlett-Packard Strasse 61352 Bad Homburg Germany (+49 6172) 16-0
Great Britain Hewlett-Packard Ltd. Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG11 5DZ		

Hewlett-Packard Sales and Service Offices (continued)

INTERCON FIELD OPERATIONS		
Headquarters Hewlett-Packard Company 3495 Deer Creek Rd. Palo Alto, California 94304-1316 (415) 857-5027	**Australia** Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 (61 3) 895-2895	**Canada** Hewlett-Packard Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232
China China Hewlett-Packard Company 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888	**Japan** Yokogawa-Hewlett-Packard Ltd. 1-27-15 Yabe, Sagamihara Kanagawa 229, Japan (81 427) 59-1311	**Singapore** Hewlett-Packard Singapore Ltd. Pte. Ltd. Alexandra P.O. Box 87 singapore 9115 (65) 271-9444
Taiwan Hewlett-Packard Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404		

3

Installation Reference

Introduction

This chapter includes:

- Part numbers and model numbers for cables, tools, and supplies that will be useful when installing the optical spectrum analyzer.
- A table showing and describing ac power cables.
- Information about serial number and option labels.
- Electrostatic discharge (ESD) information and accessories.

Optical Spectrum Analyzer Accessories

The following tables show the available accessories that maybe useful when installing your optical spectrum analyzer. Each accessory listed has a description and an HP model number or part number.

HP-MSIB Cables

HP-MSIB cables are used to interconnect mainframes and displays. For systems with multiple mainframes and displays, the number of HP-MSIB cables required is the number of mainframes and displays in the system.

HP Model Number	Description
HP 70800A	HP-MSIB cable, 0.5 m
HP 70800B	HP-MSIB cable, 1.0 m
HP 70800C	HP-MSIB cable, 2.0 m
HP 70800D	HP-MSIB cable, 6.0 m
HP 70800E	HP-MSIB cable, 30 m

Connector Interfaces

HP Model Number	Description
HP 81000AI	Diamond HMS-10 connector interface
HP 81000FI	FC/PC connector interface
HP 81000GI	D4 connector interface
HP 81000KI	SC connector interface
HP 81000SI	DIN 47256 connector interface
HP 81000VI	ST connector interface
HP 81000WI	Biconic connector interface
83410-20003	Diamond HMS-10 to HP universal adapter with panel mount flange
5022-0991	Diamond HMS-10 to HP universal adapter

Memory Cards

HP Part Number	Description
0950-1964	32 Kbyte RAM blank memory card (HP 85700A)
0950-2084	128 Kbyte RAM blank memory card
5010-1594	HP 71451B/1B/2B, DFB, FP, and LED Measurement Personality ROM Card

Tools

HP Part Number	Description
8710-1307	8 mm hex-ball driver, 6-1/2 inch shaft
8710-1651	8 mm hex-ball driver, 1-3/4 inch shaft

Miscellaneous Parts and Supplies

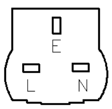
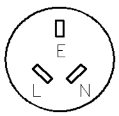
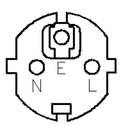
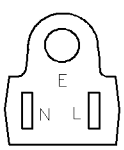
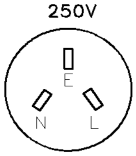
HP Part Number	Description
2110-0703	Fuse, 6.3 A, 250 V
5061-9006	Panel-mainframe front blank, 1/8 module width
8500-2163	Display cleaner, thin-film cleaner
85680-60093	Cable assembly, BNC (m) to SMB (f), 1 meter, may be used to make connections to the rear panel connectors
5086-7913	White light source lamp assembly replacement kit
5086-6913	Exchange white light source lamp assembly replacement kit

Power Cables

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When this cable is connected to a properly grounded power receptacle, the instrument cabinet is grounded.

A suitable cable for systems shipped to international customers is included with each system. If additional cables need to be ordered, refer to Table 3-1 for part numbers.

Table 3-1. Power Cables

PLUG TYPE **	CABLE HP PART NUMBER	PLUG DESCRIPTION	CABLE LENGTH CM (INCHES)	CABLE COLOR	FOR USE IN COUNTRY
250V 	8120-1351 8120-1703	Straight* BS1363A 90°	229 (90) 229 (90)	Mint Gray Mint Gray	Great Britain, Cyprus, Nigeria, Singapore, Zimbabwe
250V 	8120-1369 8120-0696	Straight* NZSS198/ASC112 90°	201 (79) 221 (87)	Gray Gray	Argentina, Australia, New Zealand, Mainland China
250V 	8120-1689 8120-1692	Straight* CEE7-Y11 90°	201 (79) 201 (79)	Mint Gray Mint Gray	East and West Europe, Central African Republic, United Arab Republic (unpolarized in many nations)
125V 	8120-1348 8120-1538	Straight* NEMA5-15P 90°	203 (80) 203 (80)	Black Black	United States Canada, Japan (100 V or 200 V), Brazil, Colombia, Mexico, Philippines, Saudia Arabia, Taiwan
	8120-1378 8120-4753 8120-1521 8120-4754	Straight* NEMA5-15P Straight 90° 90°	203 (80) 230 (90) 203 (80) 230 (90)	Jade Gray Jade Gray Jade Gray Jade Gray	
250V 	8120-5182 8120-5181	Straight* NEMA5-15P 90°	200 (78) 200 (78)	Jade Gray Jade Gray	Israel

* Part number for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable, including plug.

** E = Earth Ground; L = Line; N = Neutral.

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Serial Number and Option Labels

Serial Number Labels

A serial-number label is attached to the front frame of the optical spectrum analyzer module. The serial number is divided into two parts. The first four digits and letter are the serial-number prefix; the last five digits are the suffix. Refer to Figure 3-1.

The prefix is the same for all identical modules; the prefix changes only when a significant modification is made to the product. The suffix, however, is assigned sequentially and is different for each module.

Option Labels

If the optical spectrum analyzer module is ordered with an option, a label indicating the option will be attached to the front frame of the module. For example, if you have an optical spectrum analyzer module with a built-in current source, a label on the module's front frame will show "Option 001." Refer to Figure 3-1 for the location of the label.

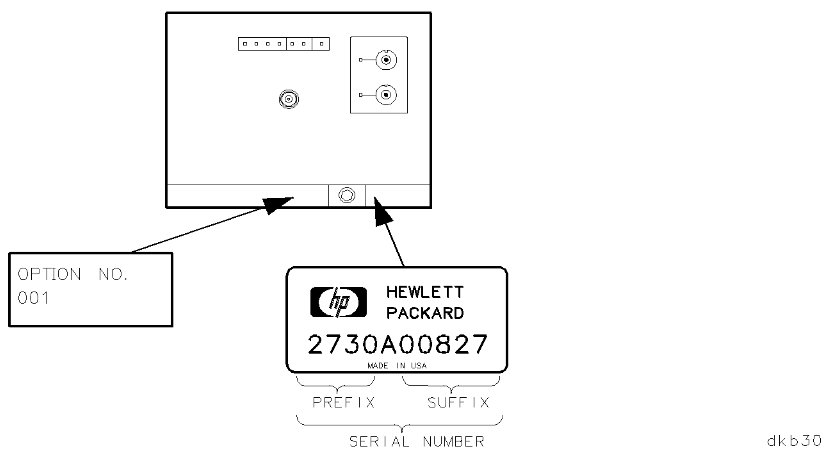

Figure 3-1. Module Serial-Number and Option Labels

ESD Information

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work performed on assemblies consisting of electronic components should be done at a static-safe workstation.

Figure 3-2 shows an example of a static-safe workstation. Two types of ESD protection are shown: the conductive table mat and wrist strap combination and the conductive floor mat and heel strap combination. The two types *must* be used together to ensure adequate ESD protection. Refer to Table 3-2 for a list of static-safe accessories and their part numbers.

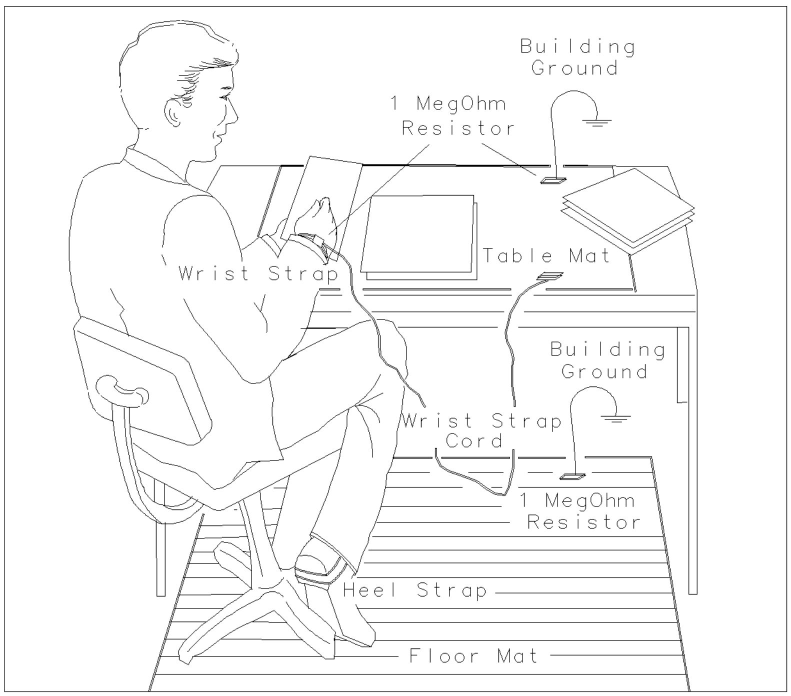

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Figure 3-2. Static-Safe Workstation

Reducing ESD Damage

Below are suggestions that may help reduce the amount of ESD damage that occurs during testing and servicing instruments.

PC Board Assemblies and Electronic Components

- Handle these items at a static-safe workstation.
- Store or transport these items in static-shielding containers.

Test Equipment

- Before connecting any coaxial cable to an instrument connector for the first time each day, *momentarily* short the center and outer conductors of the cable together.
- Personnel should be grounded with a resistor-isolated wrist strap before touching the center pin of any connector and before removing any assembly from the instrument.
- Be sure that all instruments are properly earth-grounded to prevent buildup of static charge.

Static-Safe Accessories

Table 3-2. Static-Safe Accessories

HP Part Number	Description
Order the following through any Hewlett-Packard Sales and Service Office	
9300-0797	Set includes: 3M static control mat 0.6 m × 1.2 m (2 ft × 4 ft) and 4.6 cm (15 ft) ground wire. (The wrist-strap and wrist-strap cord are not included. They must be ordered separately.)
9300-0980	Wrist-strap cord 1.5 m (5 ft)
9300-1383	Wrist-strap, color black, stainless steel, without cord, has four adjustable links and a 7 mm post-type connection.
9300-1169	ESD heel-strap (reusable 6 to 12 months).

4

Operation Verification Testing

Introduction

This chapter will help you install and perform the optical spectrum analyzer's operation verification tests. It contains required and optional step-by-step instructions for running the operation verification test software. The software is designed to provide a high level of confidence that the optical spectrum analyzer system meets its specifications without requiring excessive test equipment or test time.

Note

- Before starting the operation verification tests, make backup copies of the operation verification test disks to ensure that your original disks will not be altered. If the program data on one disk should become altered, it cannot be ordered separately. The set of disks must be ordered to replace any one disk.
- To perform all of the operation verification tests, you must have *all* of the test equipment listed in "Recommended Test Equipment" in Chapter 5 or the equivalent test equipment. The operation verification software was designed to support the recommended models of the test equipment. If you use other acceptable models of test equipment, you may have to modify the software.
- The operation verification tests allow for performance to be tested using both a 1300 nm DFB laser and a 1550 nm DFB laser. The 1300 nm DFB laser is required to perform the operation verification tests. The use of the 1550 nm DFB laser is optional for all tests.
- Unless otherwise specified, optical connections should be made with 9/125 μm patchcords using FC/PC connector interfaces. Clean all connectors and optical input fibers before beginning the operation verification tests.

- Manual versions of the wavelength accuracy test, the flatness test, and the dynamic range test are included; you may substitute these tests if you do not have the specific equipment required to perform the automated versions of these tests. Refer to Chapter 6 for these manual tests.
- There are manual operational checks, designed to verify the functionality of the HP 70951B optical spectrum analyzer module's additional instrument modes, included at the end of Chapter 6. These instrument modes are not verified by the test software.
- The keys that are referred to in this chapter are for the HP 46021A keyboard. Due to the various input devices (keyboard or mouse) supported, some minor text differences appear in the menus and softkeys displayed on screen. Refer to "Computer Keyboard Compatibility and Mouse Operation" in Chapter 5 for information regarding your keyboard or mouse.
- It takes about 1.5 hours to perform all of the automated operation verification tests.
- Chapter 6 describes each operation verification test in detail. Refer to that chapter for information regarding an individual test.

Step 1. Set up the Hardware for Operation Verification Testing

Operation verification software can run on HP 9000 Series 300 computers. The computer must have:

- A minimum of 2.5 to 4 megabytes of RAM (depending on the display configuration used).
- An HP-IB interface.
- A 3.5 inch double-sided flexible disk drive.
- A hard disk drive with 4 megabytes available space.

1. Connect the optical spectrum analyzer to the computer port.

   There are two possible configurations:

   - If the computer has an HP 98624A HP-IB interface:
     - □ Connect your optical spectrum analyzer to the port labeled HP-IB SELECT CODE 8.
     - □ Check that the address switch on the HP 98624A HP-IB interface matches the HP-IB controller device address.
     - □ If necessary, refer to the *HP 9000 Series 200/300 Peripheral Installation Guide, Volume 1.*
   - If the computer does not have an HP 98624A HP-IB interface:
     - □ Connect the optical spectrum analyzer to the port labeled HP-IB SELECT CODE 7.
2. Connect the HP-IB cables from the test equipment to the computer's HP-IB SELECT CODE 7 port.
3. Connect the external disk drive's HP-IB to the HP-IB SELECT CODE 7 port using a 0.5 meter HP-IB cable (HP 10833D, or similar cable).

   Occasionally disk drives exhibit unpredictable behavior when sharing the HP-IB with instruments. If you find that this occurs, connect the disk drive to a separate HP-IB interface.
4. Set the external test equipment and the optical spectrum analyzer line switches to ON. Allow the equipment to warm up as specified for the operation verification tests.
5. If the optical spectrum analyzer that you will be testing is an Option 001, refer to "Precision Resistor and RC Network" in Chapter 5 for instructions on constructing a precision resistor and RC network. This network is required to test the optical spectrum analyzer's current source option.
6. Turn the disk drive and the computer on.

Step 2. Install the Software on an SRM or HFS Hard Disk

Note

For best results, install the operation verification software on, and run the tests from, a hard disk drive. If you want to run the tests from a flexible disk drive, see "Optional: Running the Operation Verification Tests from a Flexible Disk Drive".

SRM is an acronym for shared resource manager; HFS is an acronym for hierarchical file structure. This step is a general procedure for installing the operation verification software on an SRM or HFS hard disk system. For detailed information on creating directories and copying files, refer to the appropriate SRM or HFS hard disk manuals.

Caution

Make backup copies of all write-protected disks. If the program data on an individual disk should become altered, it cannot be ordered separately. The entire set of disks must be ordered to replace any one. Before making backup copies of write-protected disks, initialize the backup disks:

For example:

```
INITIALIZE ":,700,0",2,3.
```

Note that you must use Format Option 3; however, the MSVS and interleave factor are specific to your system.

To load and run the operation verification test software, you must have a BASIC programming language and appropriate binary files loaded into the computer.

1. Load BASIC 5.13 or later, with the BIN files listed below into the HP 9000 Series 300 computer. If necessary, refer to an HP BASIC reference manual. Refer to Table 5-2 for a description of each file.

CLOCK	EDIT	KBD
COMPLEX	ERR	MAT
CRTA	GRAPH	MS
CRTB	GRAPHX	PDEV‡
CRTX	HFS*	SRM†
CS80	HPIB	TRANS
DCOMM †	IO	XREF‡
DISC		

*Optional: required only for HFS (hierarchical file system) environment.

†Optional: required only for SRM (shared resource management) environment.

‡Optional: required only for DEBUG.

2. Insert Disk 1 in the disk drive.
3. Assign the MSI (mass storage is) to the 3.5 inch double-sided flexible disk drive and press (Return).

   For example, assigning MSI to a hard disk drive with an address of 700 would look like this:

   ```
   MSI ":,700,0"
   ```

4. Type `LOAD "INSTALL",1` . Press (Return).
5. The program will prompt you to enter the MSVS (mass storage volume specifier) of your flexible disk drive. Enter the address and press (Return).

   For example:

   ```
   : ,700,1
   ```

6. The program will prompt you to enter the MSVS of your hard disk. Enter the address and press (RETURN).
7. The program will prompt you for the directory path where you want to install the operation verification test program. `/OPV9000/OSA/` is the default; if you want the test program installed in another directory, substitute that path for the default path shown on the display. Press (RETURN).

Note The default shows leading and trailing slashes. Be sure your directory path contains these slashes.

---

8. When prompted, remove Disk 1 and insert Disk 2. Press `Continue`.

   If you have an HP 46021A keyboard, and the `Continue` softkey does not appear on the display, press (Esc) (System). If you have an HP 98203C keyboard, refer to "Computer Keyboard Compatibility and Mouse Operation" in Chapter 5.

Step 3. Load the Software

To run the operation verification test software, you must have a BASIC programming language loaded into the computer. There are several binaries (BIN files) that must be loaded also.

1. Make sure that BASIC 5.13 or later (with the appropriate BIN files listed in "Step 2. Install the Software on an SRM or HFS Hard Disk") is loaded in the HP 9000 Series 300 computer. If necessary, refer to an HP BASIC reference manual.
2. Assign the MSI (mass storage is) to the directory path where the program is installed.

   For example:

   ```
   MSI "/OPV9000/OSA/"
   ```

3. Type `LOAD "OPV",1` and press (Return).
4. When the program prompts you to insert Disk 2, type `CONTINUE` and press (Return).

Step 4. Select the Optical Spectrum Analyzer's Model

This operation verification software supports the operation verification tests for the HP 70950B, HP 70951B, and HP 70952B optical spectrum analyzer modules. You will need to identify the model on which you are performing the operation verification tests.

If your optical spectrum analyzer is an Option 001, you will enter that information when you are performing the steps in "Step 5. Enter the Optical Spectrum Analyzer's Test Information".

```
= SPECIFIC MODEL? =
HP70950A
HP70951A
```

Figure 4-1.

1. With a display on your computer similar to the display shown in Figure 4-1, use the arrow keys (▼ and ▲) to highlight the model number to be tested.
   - If you have an HP 71450B (HP 70950B) instrument, select `HP70950A`.
   - If you have an HP 71451B (HP 70951B) instrument, select `HP70951A`.
   - If you have an HP 71452B (HP 70952B) instrument, select `HP70950A`.
2. Press Return.
3. The computer will display a title page for the optical spectrum analyzer's operation verification test.
4. To continue, press any key (except Stop) on the computer.

   The Stop key will not allow you to continue.

Step 5. Enter the Optical Spectrum Analyzer's Test Information

In order to ensure that test records are as complete as possible and that the correct tests are performed, you will need to enter complete information about the optical spectrum analyzer that you are testing.

```
============UUT: HP70951A============
SERIAL NUMBER
ADDRESS TYPE   HP-IB
ADDRESS        723
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
```

Figure 4-2.

1. With a display on your computer similar to the display shown in Figure 4-2, press (Select) to enter the serial number.
2. Type in the instrument's complete serial number and press (▼) (home key).

   Enter the module's complete ten-digit serial number. Refer to "Serial Number Labels" in Chapter 3 for additional information regarding the instrument's serial number.
3. Review the other items in the list to determine if the information needs to be changed.

   The address type and the controller items are not used for the optical spectrum analyzer. These categories do not need to be changed.
4. If any of these items need to be changed, use the arrow keys ((▼) and (▲)) to highlight the item.
5. Refer to the following list for instructions regarding the appropriate item.
   - "Optional: Selecting the Optical Spectrum Analyzer's Address"
   - "Optional: Adding Options"
   - "Optional: Modifying the Temperature Setting"
   - "Optional: Modifying the Humidity Setting"
   - "Optional: Selecting the Line Frequency"
6. If all of the test information is correct, press (▼) (home key).

Step 6. Select Where You Want to Output the Test Results

The test results may be printed on the computer's printer, displayed on the computer's CRT, or not displayed at all. You must choose how you want to output these test results.

```
Where should Test Reports be directed?   CRT
                                         PRINTER
                                         NO OUTPUT
```

Figure 4-3.

1. With a display on your computer similar to the display shown in Figure 4-3, use the arrow keys (▼ and ▲) to select whether you want the test reports displayed on the computer's CRT, printed on the printer, or not output at all.

   Only one output location may be chosen.

2. Press Select.

Step 7. Verify the Test Equipment

```
EQUIPMENT USED (MODEL/ADDRESS):
HP8157A      728
HP83425A
HP83424A
AQ4302
HP11894A
HP8153A      722
HP81532A
WHITE-LIGHT
HP70951A     718                  CONTINUE
HP3456A      724                  PRINT
```

Figure 4-4.

1. With a display on your computer similar to the display shown in Figure 4-4, verify the model numbers and the addresses match the equipment available for testing.

   The window lists the model number as `A` even though you are testing a `B` model. This does not indicate a problem.

Note

- The HP 3456A (on the last line of the equipment list) and its address will not be displayed unless you indicated in "Step 5. Enter the Optical Spectrum Analyzer's Test Information" that your optical spectrum analyzer is an Option 001.
- To minimize interconnection changes, the HP 8157A optical attenuator and the HP 11894A polarization controller are listed as standard equipment for all tests. However, they are included in a test setup illustration only when they are used by that test. If you have verified model numbers and addresses for the optical attenuator and polarization controller, the program will include them in the setup directions.

---

2. If the test equipment's model numbers and addresses displayed on your computer match your test equipment's model numbers and addresses, proceed to the operation verification test list.

   a. Use the arrow keys (▼ and ▲) to select `CONTINUE` on the display.

   b. Press Select.

   c. Continue at "Step 8. Verify the Accessories".

3. If the test equipment's model numbers and addresses displayed on your computer do not match your test equipment's model numbers and addresses, you must either:

- Change your test equipment and its addresses to match the displayed test equipment and addresses:

  a. Collect the equipment and change its the addresses to match the displayed test equipment and addresses.

  b. Use the arrow keys (▼ and ▲) to select CONTINUE on the display.

  c. Press (Select).

  d. Continue at "Step 8. Verify the Accessories".

- Change the default test equipment and addresses displayed to match your test equipment:

  a. Follow the instructions in "Optional: Changing the Default Equipment".

     Table 4-1 lists the test equipment, the default model number of the test equipment, and alternate model numbers that may be substituted for the default model number. Only test equipment that lists multiple model numbers may substitute another model for the default model.

Step 8. Verify the Accessories

```
ACCESSORIES USED:                  CONTINUE
Precision resistor and RC Network PRINT
```

Figure 4-5.

1. Verify that you have the precision resistor and RC network available for testing the current source option.

   If your optical spectrum analyzer is an Option 001 (the current source installed), and you have added that option as part of your system configuration, the screen will display the information shown in Figure 4-5. See "Optional: Adding Options".

2. If you have the precision resistor and RC network available, press (Select) to continue.

3. If you did not construct the precision resistor and RC network in "Step 1. Set up the Hardware for Operation Verification Testing", do one of the following steps:

   - Construct the precision resistor and RC network using the instructions provided in "Precision Resistor and RC Network" in Chapter 5 and press (Select) to continue, or
   - Press (Select) to continue, but do not select the current source test when running the operation verification tests.

Step 9. Run the Operation Verification Tests

```
===================TEST LIST===================
Wavelength Accuracy
Resolution Bandwidth Accuracy
Absolute Amplitude Accuracy
Scale Fidelity
Flatness
Sensitivity
Dynamic Range
Current Source (Opt 001)
White Light Output (Opt 002)
Polarization Dependent Loss (Opt 003)
```

Figure 4-6.

1. With a display on your computer similar to the display shown in Figure 4-6, use the arrow keys (▼ and ▲) to select the first test to be tested.

   The Current Source Accuracy test will not be displayed unless you have entered that your optical spectrum analyzer is an Option 001 when you were performing "Step 5. Enter the Optical Spectrum Analyzer's Test Information".

2. Press Select to begin running the test.

   When you select the first test, you will be asked to input the true wavelengths of the 1300 nm and the 1550 nm DFB lasers.

   - Enter the wavelength for each DFB laser to the nearest one-tenth of a nanometer.
   - If you do not have either a 1300 nm or a 1550 nm DFB laser or you do not know their wavelengths, enter zero (0000.0) for the wavelength.

3. Follow the on screen instructions to set up the test equipment for each test.

   Instructions and an illustration of the test setup for each test are also included in Chapter 6.

4. Repeat steps 1, 2 and 3 until all of the operation verification tests are completed.
5. When the tests are complete, exit the program by pressing ▼ (home key).

```
Quit the Test Executive Program?  YES
                                  NO
```

Figure 4-7.

6. Use the arrow keys to select either YES or NO.
7. Press Select.

Optional: Selecting the Optical Spectrum Analyzer's Address

If your optical spectrum analyzer's address is set to an address other than the factory preset address of 723, you may change this software to operate using your optical spectrum analyzer's current address.

```
============UUT: HP70951A============
SERIAL NUMBER  3141A00056
ADDRESS TYPE   HP-IB
ADDRESS         723
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
```

Figure 4-8.

1. With a display on your computer similar to the display shown in Figure 4-8, press (Select).

   The default address for the optical spectrum analyzer is 723.

2. Use the arrow keys ((◀), (▶), (▼) and (▲)) to change the address to the correct address number.

   Use the (◀) and the (▶) to move the cursor to the appropriate address digit.

   Use the (▼) and the (▲) to change the digit to match the correct address number.

3. Press (▼) (home key).
4. Return to step 3 of "Step 5. Enter the Optical Spectrum Analyzer's Test Information" to continue.

Optional: Adding Options

If your optical spectrum analyzer has an option installed, you will need to enter the option information to ensure that your optical spectrum analyzer is tested completely.

```
============UUT: HP70951A============
SERIAL NUMBER  3141A00056
ADDRESS TYPE   HP-IB
ADDRESS        723
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
```

Figure 4-9.

1. With a display on your computer similar to the display shown in Figure 4-9, press (Select).

```
============UUT: HP70951A============
SERIAL NUMBER  3141A00056
ADDRESS TYPE   HP-IB
ADDRESS        723
CONTROLLER
OPTIONS
 ==========UUT OPTIONS===========
 001      NO  Current Source added
   002     NO  White Light added
   003     NO  PDL added
LINE FREQUENCY 60 Hz
```

Figure 4-10.

2. Use the (▼) and the (▲) to highlight the installed options, one at a time.
3. With a display on your computer similar to the display shown in Figure 4-10, press (Select) to select either YES or NO.

   YES and NO are not shown on the display at the same time. Pressing (Select) toggles between YES and NO.
4. Press (▼) (home key).
5. Return to step 3 of "Step 5. Enter the Optical Spectrum Analyzer's Test Information" to continue.

Optional: Modifying the Temperature Setting

You may enter the ambient room temperature in which the optical spectrum analyzer is operating. This temperature becomes part of the test record.

```
============UUT: HP70951A============
SERIAL NUMBER  3141A00056
ADDRESS TYPE   HP-IB
ADDRESS        723
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
```

Figure 4-11.

1. With a display on your computer similar to the display shown in Figure 4-11, press (Select).

   The default temperature is 23.0 degrees Celsius. Only temperatures in degrees Celsius only.

2. Use the arrow keys ((◀), (▶), (▼) and (▲)) to change the temperature to the correct temperature.

   Use the (◀) and the (▶) to move the cursor to the appropriate temperature digit.

   Use the (▼) and the (▲) to change the digit to match the correct temperature number.

3. Press (▼) (home key).

4. Return to step 3 of "Step 5. Enter the Optical Spectrum Analyzer's Test Information" to continue.

Optional: Modifying the Humidity Setting

You may enter the humidity of the room in which the optical spectrum analyzer is operating. This humidity becomes part of the test record.

```
============UUT: HP70951A============
SERIAL NUMBER  3141A00056
ADDRESS TYPE   HP-IB
ADDRESS        723
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
```

Figure 4-12.

1. With a display on your computer similar to the display shown in Figure 4-12, press (Select).

   The default humidity is 50 percent.

2. Use the arrow keys ((◀), (▶), (▼) and (▲)) to change the humidity to the correct humidity.

   Use the (◀) and the (▶) to move the cursor to the appropriate humidity digit.

   Use the (▼) and the (▲) to change the digit to match the correct humidity number.

3. Press (▼) (home key).
4. Return to step 3 of "Step 5. Enter the Optical Spectrum Analyzer's Test Information" to continue.

Optional: Selecting the Line Frequency

You may enter the line frequency that the optical spectrum analyzer is using to operate. This line frequency is recorded with the test record.

```
============UUT: HP70951A============
SERIAL NUMBER  3141A00056
ADDRESS TYPE   HP-IB
ADDRESS        723
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
```

Figure 4-13.

1. With a display on your computer similar to the display shown in Figure 4-13, press (Select).

```
============UUT: HP70951A============
SERIAL NUMBER  3141A00056
ADDRESS TYPE   HP-IB
ADDRESS        723
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
  60 Hz
  50 Hz
  400 Hz
```

Figure 4-14.

2. With a display on your computer similar to the display shown in Figure 4-14, use the arrow keys ((▼) and (▲)) to select the line frequency that the optical spectrum analyzer is using.

   The default line frequency is 60 hertz.

3. Press (Select).
4. Return to step 3 of "Step 5. Enter the Optical Spectrum Analyzer's Test Information" to continue.

Optional: Changing the Default Equipment

Use the following procedure if your test equipment model numbers and addresses are different from the default test equipment that was displayed when you verified the test equipment. These instructions are a continuation from step 3 of "Step 7. Verify the Test Equipment". This software only supports the equipment shown in Table 4-1 on the next page. To perform this procedure, you must have BASIC 5.13 or above and the language extensions specified in "Step 2. Install the Software on an SRM or HFS Hard Disk" installed on your computer.

The **TSCRIPT_MS** file contains the model numbers and HP-IB addresses of the test equipment and the test equipment required for each operation verification test. In this procedure, you will edit, save, and run the TSCRIPT_MS file.

Step 1. Print the Default Equipment List

If you have a printer connected to your computer, you can print the default test equipment list when you are in the test equipment screen. Refer to Figure 4-4. To print the list:

1. Use the arrow keys (▼ and ▲) to select `PRINT` on the display.
2. Press [Select].

Step 2. Exit the Operation Verification Software

1. Use the arrow keys (▼ and ▲) to select `CONTINUE` on the display.
2. Press [Select].

   This displays the operation verification test menu.
3. Press ▼ (home key).

   You will be asked if you want to quit the test executive program. The default selection is yes.
4. Press [Select].

   This will exit the operation verification test software.

Step 3. Load the TSCRIPT_MS File

In this procedure, you will load the TSCRIPT_MS file.

1. Type `GET "TSCRIPT_MS"` and press [Return]. Wait for the asterisk in the lower right portion of the computer screen to disappear.
2. Type `EDIT` and press [Return]. Wait for the TSCRIPT_MS file to appear on the computer screen.

Step 4. Edit the Test Equipment and HP-IB Address Lists

In this procedure, you will edit the TSCRIPT_MS file's test equipment and HP-IB address lists.

If your test equipment model numbers and HP-IB addresses do not match the operation verification software's test equipment model numbers and HP-IB addresses, you will need to edit the lists in the TSCRIPT_MS file.

If you do not have an optical attenuator or a polarization controller available as part of your test equipment, refer to "Step 6. Select Where You Want to Output the Test Results".

1. Scroll to the `CALIBRATION_STANDARDS(` section of the file. This section of the TSCRIPT_MS file shows the default list of test equipment. The variable names with corresponding descriptions are shown in Table 4-1.

Table 4-1. Test Equipment Variable Names

Variable Name	Description	Default Model Number	Alternate Model Numbers
LW1	lightwave source 1	WHITE-LIGHT	AQ 4304
LW2	lightwave source 2	HP 83425A	HP 83420A Option 210, HP 83421A Option 210
LW3	lightwave source 3	HP 83424A	HP 83420A Option 220, HP 83421A Option 220
LW4	lightwave source 4	AQ 4302	
PM1	lightwave multimeter 1	HP 8153A	HP 8153B
ATTN	optical attenuator	HP 8157A	HP 8157B
DVM	digital voltage meter	HP 3456A	HP 3455A, HP 3458A
PL	polarization controller	HP 11894A	
SA1	optical spectrum analyzer	HP 70951B	

2. Edit the default list of test equipment as needed. Refer to Table 4-1 for a default model numbers and their alternate model numbers. Press (Return) to save the change.

   For example, if you wish to substitute the HP 3458A digital multimeter in place of the HP 3456A digital voltmeter, scroll down to the `DVM(HP3456A)` line. Then, position the cursor under the `6` and type `8` over the `6`. The result should be `DVM(HP3458A)`. Note that there is no space between `HP` and `3458A`.

3. Scroll to the `DEFAULT_ADDRESSES(` section of the file and edit the equipment addresses in a manner similar to the example in step 2 of this procedure.

   Valid addresses are 00 to 30. Valid select codes are 0 through 5 and 7 through 9. The default is 7. Do not set the equipment addresses to any addresses used by the unit under test.

Step 5. Edit the Required Test Equipment Lists

In this procedure, you will edit the TSCRIPT_MS file to delete optional equipment from operation verification tests.

If you do not have an optical attenuator or a polarization controller available as part of your test equipment, you can still perform the wavelength accuracy and the resolution bandwidth accuracy tests. The optical attenuator and the polarization controller are optional equipment for these two tests. This procedure will show you how to edit the TSCRIPT_MS file so that you may perform the wavelength accuracy and the resolution bandwidth accuracy tests without the optical attenuator and the polarization controller.

1. Move the cursor to the following line of the TSCRIPT_MS file:
   `TEST(TN(Wavelength Accuracy) TP(Wave_accy) TR(Report_gen)`
2. Move the cursor down one more line to the `"SETUP ALL1"` line of the test.
3. Use the (Delete line) key to delete all five lines of the `"SETUP ALL1"` section.
4. Move the cursor to the following line of the TSCRIPT_MS file:
   `TEST(TN(Resolution Bandwidth Accuracy) TP(Resolution) TR(Report_gen)`
5. Move the cursor down one more line to the `"SETUP ALL2"` line of the test.
6. Use the (Delete line) key to delete all four lines of the `"SETUP ALL2"` section.

Step 6. Save the TSCRIPT_MS File's Edits

In this procedure, you will save the edited TSCRIPT_MS file and restart the operation verification test software.

1. Press (Stop), type `RE-SAVE "TSCRIPT_MS"` , and press (Return) to save the edited TSCRIPT_MS file. Wait for the asterisk (*) in the lower right portion of the computer screen to turn off.
2. Type `LOAD "C_TSCRIPT_MS"` and press (Return). Wait for the asterisk (*) in the lower right portion of the computer screen to turn off.
3. Type `RUN` and press (Return).

   When `Done.` appears on the computer screen, the operation verification software is ready to load and run.
4. Continue at beginning of the operation verification software. Refer to "Step 4. Select the Optical Spectrum Analyzer's Model".

Optional: Running the Operation Verification Tests from a Flexible Disk Drive

To run the operation verification test software, you must have a BASIC programming language loaded into the computer. There are several binaries (BIN files) that must be loaded also.

1. Load BASIC 5.13 or later, with the appropriate BIN files, into the HP 9000 Series 300 computer. If necessary, refer to an HP BASIC reference manual.

   The BIN files that should be loaded are listed below. Refer to Table 5-2 for a description of each file.

CLOCK	EDIT	KBD
COMPLEX	ERR	MAT
CRTA	GRAPH	MS
CRTB	GRAPHX	PDEV‡
CRTX	HFS*	SRM†
CS80	HPIB	TRANS
DISC	IO	XREF‡

   *Optional: required only for HFS (hierarchical file system) environment.
   †Optional: required only for SRM (shared resource management) environment.
   ‡Optional: required only for DEBUG.

2. Insert Disk 1 in the disk drive.
3. Assign the MSI (mass storage is) to the drive you will use as the default drive.

   For example:

   ```
   MSI ":,700,0"
   ```

4. Type `LOAD "OPV",1` and press (Return).
5. When prompted, remove Disk 1 and insert Disk 2. Press `Continue`.

   If you have an HP 46021A keyboard, and the `Continue` softkey does not appear on the display, press (Esc) (System). If you have an HP 98203C keyboard, refer to "Computer Keyboard Compatibility and Mouse Operation" in Chapter 5.
6. Continue at "Step 4. Select the Optical Spectrum Analyzer's Model".

5

Operation Verification Test Reference

Introduction

The topics in this chapter supplement the information in Chapter 4. This chapter includes specific information regarding the computer system that is required to run the operation verification test software, detailed instructions on using the operation verification test software with different keyboards or a mouse, and a complete listing of the test equipment required to perform the operation verification tests. A description of a precision resistor and RC network is also included in this chapter. The precision resistor and RC network is required for the current source test.

System Requirements

The requirements for the computer system's hardware and software is described below. This computer system is required to run the optical spectrum analyzer's automated operation verification tests.

Computer Hardware

Table 5-1. Required Computer Hardware

HP 9000 Series 300 computer.
Minimum of 2.5 to 4 megabytes of RAM.*
HP-IB interface.
3.5 inch double-sided flexible disk drive.
hard disk drive with 4 megabytes available space.
* The minimum memory requirement depends on the display configuration used.

Operating System

The required operating system is BASIC 5.13 or later. Refer to Table 5-2 for the required language extensions.

Table 5-2. Required BASIC 5.13 Language Extensions

Binary Name	Description
GRAPH	provides graphics capability.
GRAPHX	extends “GRAPH” by providing graphics input, color plotting, and area-filling capabilities.
IO	increases Input/Output (I/O) capability.
TRANS	provides background Input/Output transfer capability and the use of BUFFERs.
MAT	increases array and matrix capabilities.
PDEV	increases program development capability.
XREF	provides a cross reference capability.
CLOCK	increases time and date capability.
MS	increases mass storage capability.
ERR	extends BASIC error messages to include an English explanation of the error.
DISC	provides the device driver for non-CS/80 external disk drives.
CS80	provides the device driver for CS/80 and SS/80 type disks.
DCOMM	provides a device driver for SRM interfaces.
HPIB	provides the interface driver for the internal HP-IB or the HP 98624 HP-IB interface.
CRTA	provides the device driver for non-bit-mapped displays.
COMPLEX	adds complex math functions, hyperbolic functions, and the complex data type.
CRTX	provides several CRT display “eXtended” capabilities.
EDIT	provides an editing environment for BASIC programs.
KBD	provides increased keyboard and softkey capability and HP-HIL access.
SRM	(IF NEEDED) provides a driver and statements for SRM (shared resource manager) systems.
CRTB	(IF NEEDED) provides the device driver for bit-mapped displays.
HFS	(IF NEEDED) provides a hierarchical file system and a few statements for managing files.

Computer Keyboard Compatibility and Mouse Operation

This section explains how to use different keyboards, and how to use a mouse with the software. The procedure in Chapter 4 was written for computers that use the HP 46021A keyboard. If you have an HP 98203C keyboard, use Table 5-3.

Table 5-3. Equivalent Keys for the Operation Verification Tests

HP 46021A Keyboard	HP 98203C Keyboard
▾ (home key)	ENTER or CONTINUE
Delete line	DEL LN
Return	ENTER
Select	ENTER
Stop	PAUSE
Continue	CONTINUE

Using an HP 46021A Keyboard with a Series 300 Computer

If you have an HP 46021A keyboard (ITF keyboard) in this configuration, the operation verification software will assume a mouse is connected.

The following keyboard strokes work whether a mouse is connected or not.

- To highlight your preference, press the ▲ or ▼ keys.
- To choose the highlighted item, press RETURN, SELECT, or ▾ (home key).
- To exit the menu, press QUIT or EXIT if they are displayed in a menu. If QUIT or EXIT are not displayed, press ▾ (home key) to exit.

Using an HP 98203C Keyboard with a Series 300 Computer

If you have HP 98203C keyboard (Nimitz keyboard) in this configuration, the operation verification software will assume a mouse is connected.

The following key strokes work whether a mouse is connected or not.

- To highlight an item in the menu, rotate the keyboard knob. You may also use the ▲ and ▼ keys to highlight the menu items.
- To choose the highlighted item, press ENTER, EXECUTE, or CONTINUE.
- To exit the menu, press QUIT or EXIT if they are displayed in a menu. If QUIT or EXIT are not displayed, press CONTINUE to exit.

Using a Mouse with a Series 300 Computer

The menus in the operation verification test software use a window format, displaying the choices available in that menu.

- To highlight your preference, slide the mouse up or down.
- To choose the highlighted item, press the left-hand button on the mouse, or slide the mouse to the right.
- To exit the menu, press `QUIT` or `EXIT` if they are displayed in a menu. If `QUIT` or `EXIT` are not displayed, slide the mouse to the left to exit.

Recommended Test Equipment

The test equipment required to perform the operation verification tests is listed in Table 5-4. If the recommended test equipment is not available, alternate equipment may be used if it meets the critical specifications in the table.

If the optical spectrum analyzer being tested is an Option 001 (current source option), a precision resistor and RC network is required to test the current source. The precision resistor and RC network is not listed in Table 5-4; however, instructions for constructing the precision resistor and RC network are included in "Precision Resistor and RC Network" in the following section.

A technical computer and its operating system is required to perform the automated operation verification tests but are not listed in Table 5-4. Refer to "System Requirements" at the beginning of this chapter.

Table 5-4. Recommended Test Equipment

Equipment Name	Critical Specifications		Recommended Equipment
Digital voltmeter	dc voltage accuracy 4 wire ohm accuracy	±0.05% ±0.05%	HP 3456A digital voltmeter
HeNe laser	Fiberized output Minimum power	9/125 μm −20 dBm	AQ 4302 He-Ne Laser
Lightwave multimeter	Compatible with power sensor		HP 8153A lightwave multimeter
Power sensor	Power range Wavelength range Total uncertainty Linearity	0 dBm to −110 dBm 1100 nm – 1650 nm ±5%, ±1.5 pW ±0.015 dB, ±1 pW	HP 81532A power sensor
1300 nm DFB laser	Wavelength stability Spectral width Minimum average power Amplitude stability (characterized with a lightwave multimeter) Wavelength accuracy (calibrated with a wavemeter)	±0.01 nm <0.01 nm ≥0 dBm ±0.05 dB ±0.1 nm	HP 83425A Option 012 lightwave CW source
1550 nm DFB laser	Wavelength stability Spectral width Minimum average power Amplitude stability (characterized with a lightwave multimeter) Wavelength accuracy (calibrated with a wavemeter)	±0.01 nm <0.01 nm ≥0 dBm ±0.05 dB ±0.1 nm	HP 83424A Option 012 lightwave CW source
Optical attenuator	Wavelength range Return loss Range Minimum step size Repeatability of settings	1100 nm – 1650 nm 45 dB 60 dB 0.01 db <±0.04 dB	HP 8157A Option 012 optical attenuator

Table 5-4. Recommended Test Equipment (continued)

Equipment Name	Critical Specifications		Recommended Equipment
Polarization controller	Wavelength	1250 nm – 1600 nm	HP 11894A Option 012 polarization controller
	Compatible fiber	9/125μm	
	Insertion loss variation with adjustment	<0.05 dB	
Monochromator/ Current source	Resolution bandwidth	5 nm	HP 70951B Option 001 optical spectrum analyzer
	Setability	0.05 nm	
	Absolute accuracy	$\pm$1 nm	
	Current range	0.0 mA to $-$10 mA	
	Current accuracy	2% $\pm$50 μA	
White light source	Output power stability	$\pm$0.05 dB	HP 70951B Option 002 optical spectrum analyzer
	Minimum power in a 5 nm bandwidth	$-$60 dBm	
	Wavelength range	1100 nm – 1650 nm	
	Fiberized output	62.5/125 μm	
	Rejection (at wavelengths $\leq$ 825 nm)	> 15 dB	
Display/Mainframe	Compatible with the HP 70000 family		HP 70004A display HP 70001A mainframe or HP 70004A from EUT
Optical coupler	Singlemode wavelength independent		Gould optical coupler 50-30335-01-13131
	Return loss	>30 dB	
	Insertion loss	< 6 dB	
	Coupling ratio	01/99	
	Port configuration	1x2	
	Directivity	$\geq$50 dB	

Precision Resistor and RC Network

If you have an optical spectrum analyzer with an Option 001 (the current source option) and you want to perform the current source operation verification test, you will need a precision resistor and RC network. The schematic diagram and parts list for building the network are provided. Test points are designated on the schematic diagram; these test points are referred to in the current source's operation verification test description in Chapter 6.

Table 5-5. Precision Resistor and RC Network Parts List

Part	Description	HP Part Number
C1	Capacitor, 0.63 μF 100V	0160-5558
R1	Resistor, 6.8 kΩ 1% .25W	0698-7256
R2	Resistor, 46.5 Ω 0.5% .3W 0 $\pm$5 ppm/DEG C	0699-1265
R3	Resistor, 46.5 Ω 0.5% .3W 0 $\pm$5 ppm/DEG C	0699-1265

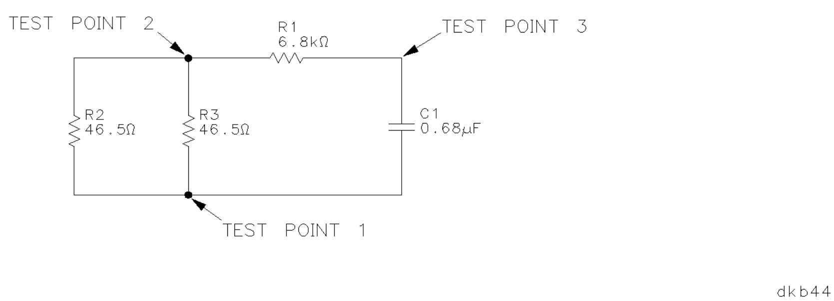

Figure 5-1. Precision Resistor and RC Network Schematic Diagram

6

Operation Verification Test Descriptions

Introduction

Operation verification tests are designed to give you a high confidence level that your optical spectrum analyzer is working properly. These tests are also designed to be completed in the least time possible.

All operation verification tests are automated and are designed to be controlled by a computer. However, three of the operation verification tests also have manual versions of the test. These manual operation verification tests are designed to be used if you do not have the specific test equipment required for the automated version of the test.

Two manual operational checks, designed to verify the functionality of the HP 70951B optical spectrum analyzer module's additional instrument modes, are included at the end of this chapter. These instrument modes are not verified by the automated tests.

The following is a list of the operation verification tests:

Automated Test Procedures
- Wavelength Accuracy (Automated)
- Resolution Bandwidth Accuracy
- Absolute Amplitude Accuracy
- Scale Fidelity
- Flatness Verification
- Sensitivity
- Dynamic Range (Automated)
- Current Source, Option 001
- White Light Output Power, Option 002
- PDL System Accuracy, Option 003

Manual Test Procedures
- Wavelength Accuracy (Manual)
- Dynamic Range (Manual)
- Flatness (Manual)

Manual Operational Checks for the HP 70951B optical spectrum analyzer module
- Transimpedance Input Check
- Monochromator Output/Photodetector Input Check

The operation verification test descriptions and procedures describe the operation verification tests for the HP 70950B/1B/2B. However, the input of the monochromator for the HP 70950B/2B and for the HP 70951B are labeled differently. In this chapter, the term **optical input** refers to both the HP 70950B/2B's OPTICAL INPUT and to the HP 70951B's MONOCHROMATOR INPUT.

Unless otherwise specified, optical connections should be made with 9/125 μm patchcords using FC/PC or Diamond HMS 10 physical contact connector interfaces. To prevent damage to your optical spectrum analyzer and ensure accurate measurements, clean all connectors and optical input fibers before beginning the operation verification tests.

Note To minimize interconnection changes, the HP 8157A optical attenuator and the HP 11896A polarization controller are listed as standard equipment for all tests. However, they are included in a test setup illustration only when they are required by that test. If you have verified model numbers and addresses for the optical attenuator and polarization controller in "Step 7. Verify the Test Equipment" in Chapter 4, the program will include them in the setup directions.

Automated Test Procedures

Each automated operation verification test in this section summarizes the purpose of the test, lists the equipment required to perform the test, explains how the equipment is set up, describes the test, and suggests the assemblies or items to check if the instrument fails the operation verification test.

The measured results of the automated operation verification tests are compared with the specifications for the optical spectrum analyzer. The operation verification software records whether the measured results of the test meets the specifications. Refer to "Specifications and Characteristics" in the Reference manual for the specifications.

A list of test equipment required to perform these operation verification tests is located in "Recommended Test Equipment" in Chapter 5 and in the equipment list of each test description. The computer and its peripheral equipment are not listed in "Recommended Test Equipment" in Chapter 5 or in the equipment list of each test. For details regarding the computer, refer to "Step 1. Set up the Hardware for Operation Verification Testing" in Chapter 4.

Some operation verification tests use the monochromator of an optical spectrum analyzer as a tunable optical filter to test the optical spectrum analyzer under test. The optical spectrum analyzer being tested is referred to as the "optical spectrum analyzer under test." The optical spectrum analyzer with the monochromator that is being used as part of the test equipment is referred to as the "test system's optical spectrum analyzer."

Wavelength Accuracy (Automated)

This test measures the wavelength accuracy of the optical spectrum analyzer under test at 632.8 nm, and the wavelengths of the DFB lasers selected for the operation verification tests.

Equipment

- HeNe laser
- 1300 nm DFB laser
- 1550 nm DFB laser (optional)

Equipment Setup

First, connect the HeNe laser's OUTPUT to the optical input of the optical spectrum analyzer under test. Refer to Figure 6-1.

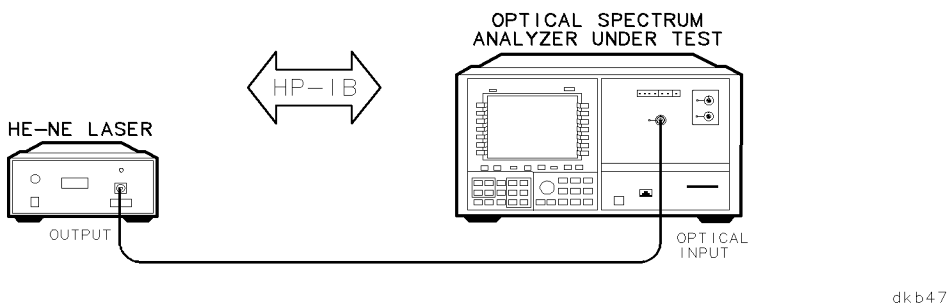

Figure 6-1. Wavelength Accuracy Test Setup 1

When the software prompts you, remove the connection from the HeNe laser and connect the 1300 nm DFB laser's OPTICAL OUTPUT to the optical input of the optical spectrum analyzer under test. Refer to Figure 6-2.

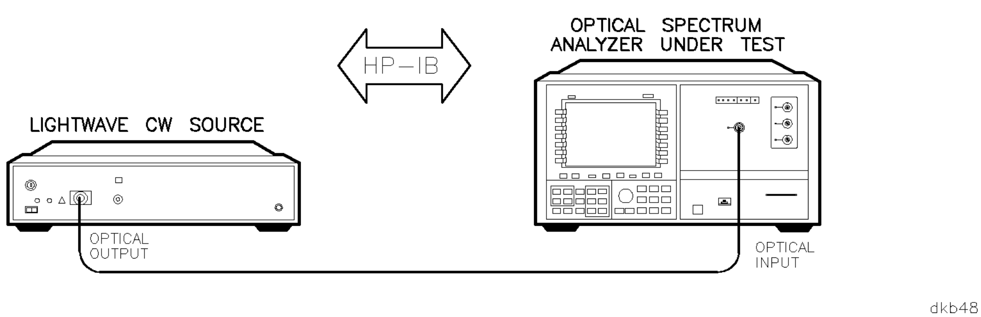

Figure 6-2. Wavelength Accuracy Test Setup 2

Description

The 1300 nm DFB laser and the 1550 nm DFB laser should have their wavelengths measured and calibrated by a wavemeter to the nearest tenth of a nanometer.

The wavelength measured on the optical spectrum analyzer in both first and second order operation is compared to the known wavelength of the HeNe laser (632.8 nm).

Then, with the 1300 nm DFB laser's OPTICAL OUTPUT connected to the optical input of the optical spectrum analyzer under test, the optical spectrum analyzer under test is set to automatic grating order. The center wavelength is set to the calibrated wavelength of the 1300 nm DFB laser. The difference between the measured wavelength and the calibrated wavelength of the 1300 nm DFB laser is compared to the specification.

If the 1550 nm DFB laser is selected, the test is repeated for this source.

In Case of Failure

If this test fails, the following assemblies may need repair:

- A4 monochromator
- A2 motor control board

Resolution Bandwidth Accuracy

This test measures the resolution bandwidth accuracy of the optical spectrum analyzer under test.

Equipment

- 1300 nm DFB laser
- 1550 nm DFB laser (optional)

Equipment Setup

Connect the 1300 nm DFB laser's OPTICAL OUTPUT to the optical input of the optical spectrum analyzer under test. Refer to Figure 6-3.

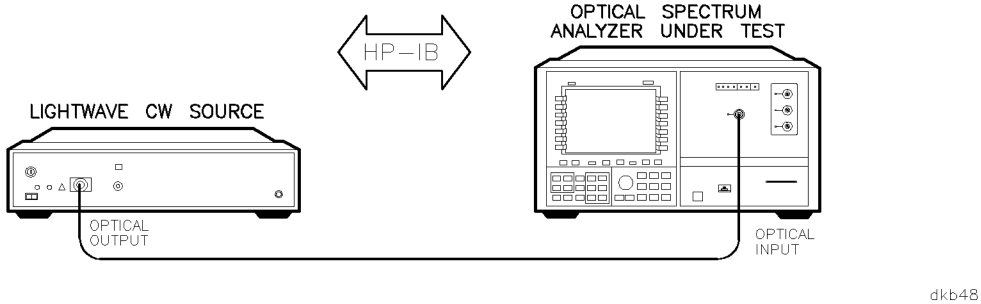

Figure 6-3. Resolution Bandwidth Accuracy Test Setup

Description

The optical spectrum analyzer under test is tuned to the calibrated wavelength of the 1300 nm DFB laser and an auto alignment is performed to ensure the optical spectrum analyzer under test is peaked on the signal. The resolution setting of the optical spectrum analyzer under test is set to 0.5 nm. Then a sweep is taken and the 3 dB bandwidth is determined. The 3 dB bandwidth is compared to the specification.

This procedure is repeated for four additional resolution bandwidths. The resolution bandwidths range from 0.5 nm to 10.0 nm.

If the 1550 nm DFB laser is selected, the test is repeated for this source.

In Case of Failure

If this test fails, check the following items:

- 9/125 μm fiber input patchcord
- A2 motor control board
- A4 monochromator

Absolute Amplitude Accuracy

This test measures the absolute amplitude accuracy and the polarization sensitivity of the optical spectrum analyzer under test.

Equipment

- Optical attenuator
- Polarization controller
- Lightwave multimeter
- Power sensor
- 1300 nm DFB laser
- 1550 nm DFB laser (optional)

Equipment Setup

Connect the OPTICAL OUTPUT of the 1300 nm DFB laser to the INPUT of the optical attenuator. Connect the OUTPUT of the optical attenuator to the OPTICAL INPUT of the polarization controller. Connect the OPTICAL OUTPUT of the polarization controller to the input of the lightwave multimeter's power sensor. Refer to Figure 6-4.

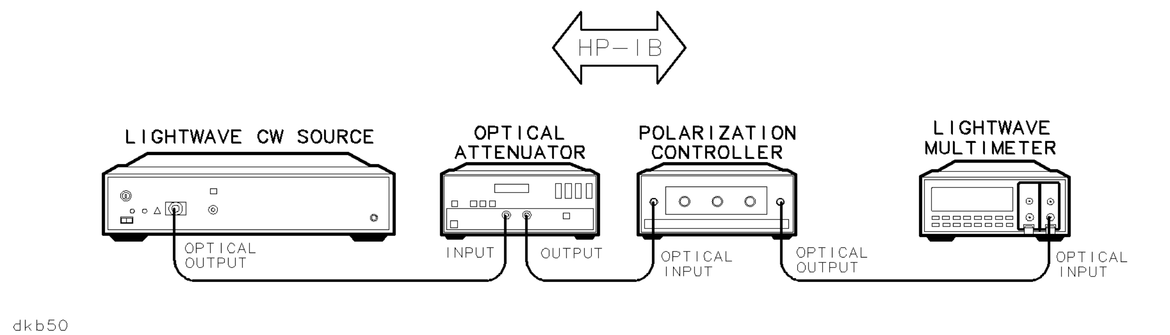

Figure 6-4. Absolute Amplitude Accuracy Calibration Setup

After the calibration is done, remove the optical cable from the lightwave multimeter. Connect the OPTICAL OUTPUT of the polarization controller to the optical input of the optical spectrum analyzer under test. Refer to Figure 6-5.

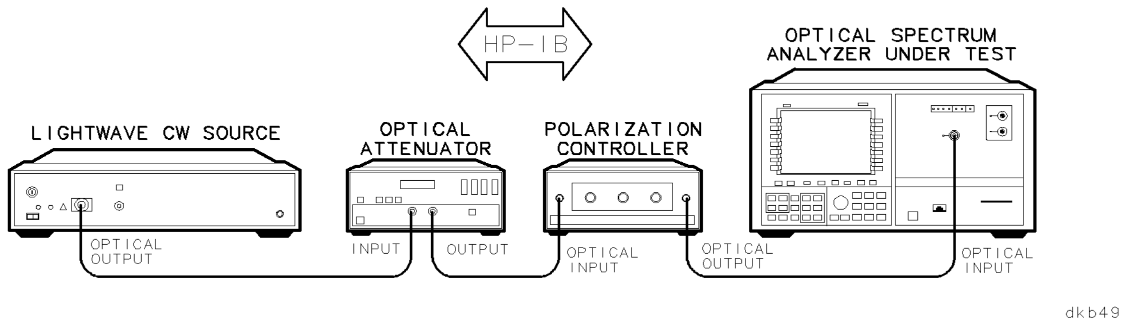

Figure 6-5. Absolute Amplitude Accuracy Test Setup

If the 1550 nm DFB laser is also selected, this equipment setup is repeated for this source.

Description

The optical attenuator is adjusted to set the power level measured by the lightwave multimeter to −30 dBm ± 0.03 dB. After the power is adjusted, you are prompted to connect the polarization controller's OPTICAL OUTPUT to the optical input of the optical spectrum analyzer under test. Trace A is set to MAX HOLD and trace B is set to MIN HOLD. Then you are prompted to adjust the polarization controller for a maximum signal deviation between trace A and trace B. Slowly turn each polarization controller knob until the maximum is displayed on trace A and the minimum is displayed on trace B. The polarization controller knobs are interactive.

When you see the maximum and minimum signal levels on the display, press CONTINUE; the computer reads the peak on trace A and on trace B. The average of these two readings is calculated, and the value is compared to the specification for absolute amplitude accuracy. The polarization sensitivity, the difference between the maximum and minimum signals, is also calculated and compared to the specification.

In Case of Failure

If this test fails, check the following items:

- Cleanliness of the optical input connector
- A2 motor control board
- A4 monochromator
- A7A1 data acquisition board

Scale Fidelity

This test measures the scale linearity and transimpedance step gain accuracy of the optical spectrum analyzer under test. It verifies that the optical spectrum analyzer meets the specification for scale fidelity.

Equipment

- Optical attenuator
- Lightwave multimeter
- Fiber optic coupler
- Power sensor
- 1300 nm DFB laser
- 1550 nm DFB laser (optional)

Equipment Setup

Connect the optical output of the 1300 nm DFB laser to the input of the optical attenuator . Connect the output of the optical attenuator to the input of the optical coupler. Connect the 1 dB output of the optical coupler to the optical input of the optical spectrum analyzer under test. Connect the -20 dB output of the optical coupler to the lightwave multimeter power sensor input. Refer to Figure 6-6.

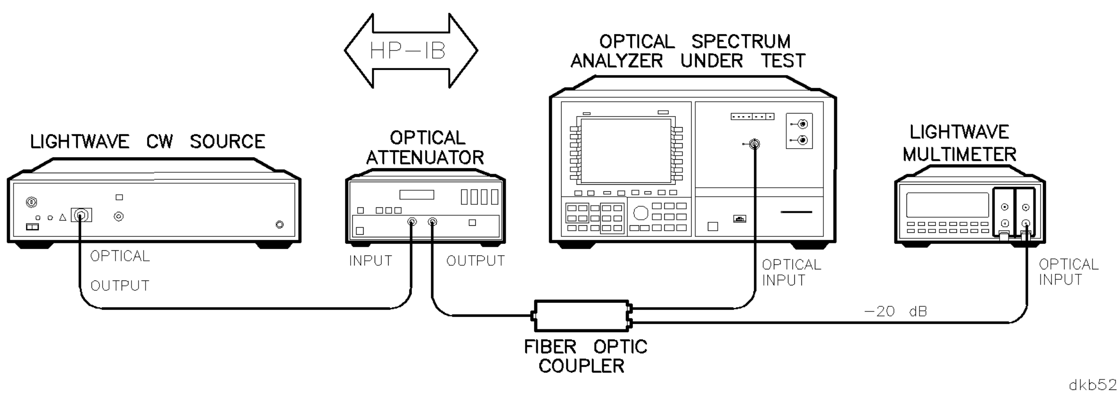

Figure 6-6. Scale Fidelity Test Setup

Note Be sure optical connections are clean and in good condition. Small reflections can cause this test to fail.

If the 1550 nm DFB laser is also selected, this equipment setup is repeated for this source.

Description

Scale fidelity is specified with autoranging on and autoranging off. With autoranging on, the optical spectrum analyzer automatically switches between stages of transimpedance gains. With autoranging off, transimpedance gain switching is not permitted.

The transimpedance gain switchpoints are determined by the optical spectrum analyzer firmware. The switchpoints vary between optical spectrum analyzers because the switchpoints are dependent on the monochromator's insertion loss and photodetector's responsivity.

The optical attenuator is set to a minimum attenuation level and the accuracy of the transimpedance gains is tested. The optical spectrum analyzer under test is set to the lowest transimpedance. A sweep is taken and the peak level recorded. The optical spectrum analyzer under test is then set to the next transimpedance and another peak level is recorded. If the transimpedances are perfect, the two power levels should be exactly the same because the firmware compensates for the 10 dB increase in gain. The difference in gain is recorded. The optical attenuator's attenuation is increased to prevent saturation of the transimpedance amplifier. A new level is measured and compared to the level measured with the next transimpedance step. The process of increasing the attenuation, measuring the power level in one transimpedance, and comparing the level of the signal in the next transimpedance is repeated until every transimpedance setting is checked. The maximum error due to transimpedance gain changes is calculated and is used as one component of scale fidelity with autoranging on.

The input signal is set to the reference level. The attenuation is stepped from the minimum attenuation level to the maximum attenuation level with the optical spectrum analyzer under test measuring each amplitude point. (At each point, the power meter measures the actual attenuation through the coupled arm.) The response of the spectrum analyzer is compared to the response of the power meter for each attenuation step. The results are the linearity error of the optical spectrum analyzer under test. This error is normalized to 0 at the reference point and compared to specifications for autoranging off. For autoranging on, the most negative transimpedance and linearity errors and the most positive transimpedance and linearity errors are combined and compared to the specifications.

In Case of Failure

If this test fails, the following assembly may need repair:

- Check optical connections for damage and cleanliness
- A7A1 data acquisition board

Flatness Verification

This test measures the amplitude flatness of the optical spectrum analyzer under test from 1200 nm to 1700 nm.

Equipment

- Monochromator (standard 62.5 μm input)
- Lightwave multimeter
- Power sensor
- White light source
- 62.5/125 μm fiber patchcord (1005-0220 semi-rigid cable for Option 002 white light source)

Equipment Setup

The optical spectrum analyzer being tested is referred to as the "optical spectrum analyzer under test;" the monochromator in the test system is referred to as the "test system's optical spectrum analyzer."

The white light source's optical output is connected to the MONOCHROMATOR INPUT of the test system's optical spectrum analyzer using a 62.5/125 μm fiber patchcord. The MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer is connected to the input of the lightwave multimeter's power sensor for calibration. Refer to Figure 6-7.

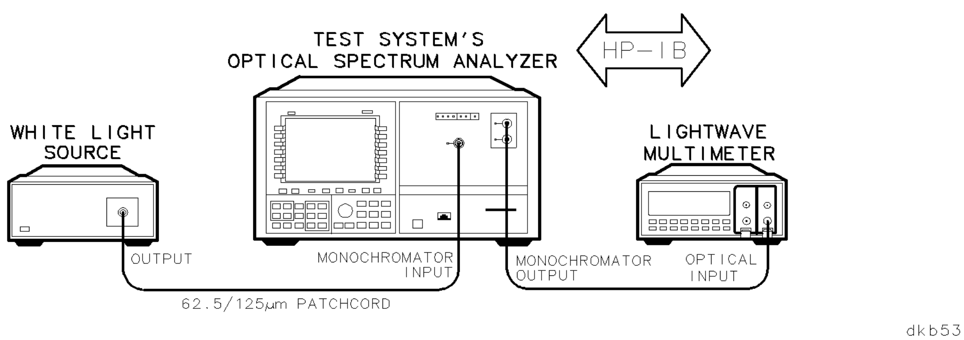

Figure 6-7. Flatness Calibration Setup

After the calibration is complete, remove the patchcord from the power sensor. Connect the MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer to the optical input of the optical spectrum analyzer under test. Refer to Figure 6-8.

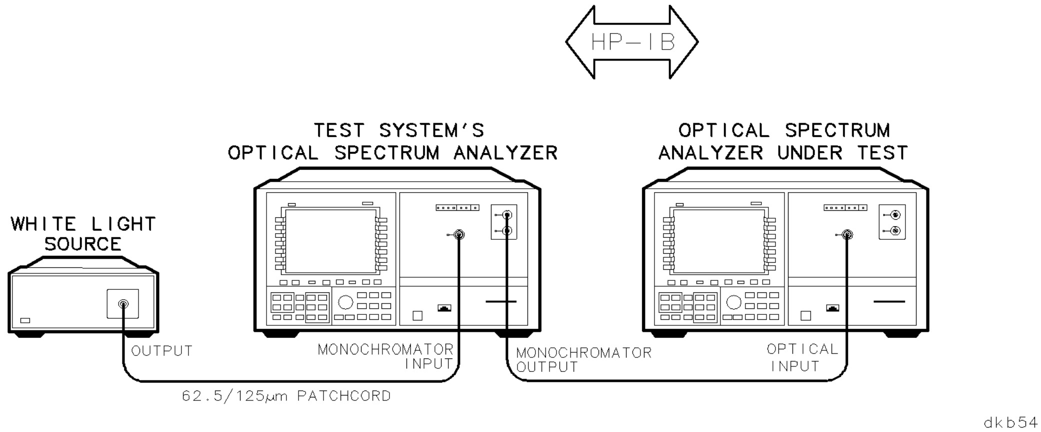

Figure 6-8. Flatness Test Setup

Description

This test uses the monochromator of an optical spectrum analyzer as a tunable optical filter for the white light source to form a tunable light source. Using a 62.5/125 μm fiber between the white light source and the test system's optical spectrum analyzer allows the use of a 9/125 μm fiber on the monochromator output because the white light source fully fills the 62.5 μm fiber making the output spot size 62.5 μm, so the output is not susceptible to vibration.

First, the test measures the white light output filtered through a 5 nm resolution bandwidth. With the MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer turned off, the lightwave multimeter is zeroed. After zeroing the lightwave multimeter, an automatic alignment is performed on the test system's optical spectrum analyzer to center the monochromator output spot. Then the test system's optical spectrum analyzer is set to Stimulus/Response mode, which connects the monochromator's output to the power sensor. The center wavelength of the test system's optical spectrum analyzer is stepped from 1250 nm to 1650 nm with the lightwave multimeter's power sensor measuring the power at each wavelength.

After the calibration is complete, connect the MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer to the optical input of the optical spectrum analyzer under test. The test system's optical spectrum analyzer is tuned to the 1250 nm and an automatic alignment is performed on the optical spectrum analyzer under test. The optical spectrum analyzer under test and the test system's optical spectrum analyzer are both stepped from 1250 nm to 1650 nm. The optical spectrum analyzer under test takes a sweep and measures the power at each wavelength. After completing the measurements, the power measured by the optical spectrum analyzer under test at each wavelength is compared to the power measured by the lightwave multimeter. The peak-to-peak value of the difference is compared to the specification.

Note Between 1350 nm and 1420 nm, absorption of light by atmospheric moisture affects flatness. At room temperature, total humidity effects should be less than 1 dB.

In Case of Failure

If this test fails, check the following items:

- Connector cleanliness and quality
- A4 monochromator
- A7A1 data acquisition board

Sensitivity

This test measures the optical sensitivity of the optical spectrum analyzer under test over the wavelength range of 600 nm to 1700 nm.

Equipment Setup

The optical input of the optical spectrum analyzer under test is covered with a cap to prevent stray light entering the monochromator. Refer to Figure 6-9.

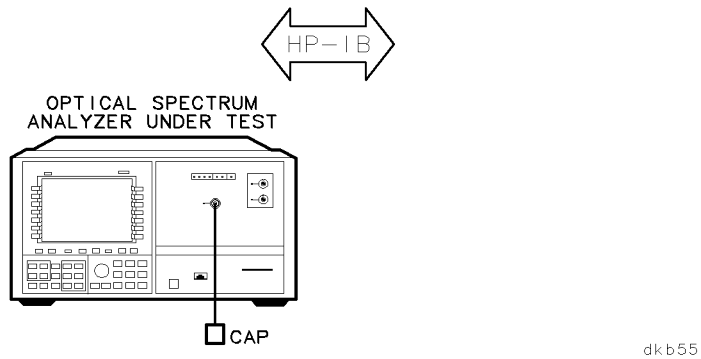

Figure 6-9. Sensitivity Test Setup

Description

The optical spectrum analyzer under test must be warmed up at least 30 minutes.

Sensitivity is measured at four wavelengths. The optical spectrum analyzer under test is zeroed at each wavelength before the measurement is taken to remove errors due to drift.

Sensitivity is defined as the minimum detectable signal level. This is taken to be six times the RMS value of the noise. The sensitivity function is used to set a noise level that allows the specified sensitivity to be measured. The noise level is measured and the sensitivity is calculated at each wavelength and compared to the specification.

In Case of Failure

If this test fails, the following assembly may need repair:

- A7A1 data acquisition board

Dynamic Range (Automated)

This test measures the dynamic range of the optical spectrum analyzer under test at either 1300 nm or 1550 nm.

Equipment

- Monochromator
- 1300 nm DFB laser
- 1550 nm DFB laser (optional)

Equipment Setup

The optical spectrum analyzer being tested is referred to as the "optical spectrum analyzer under test;" the monochromator in the test system is referred to as the "test system's optical spectrum analyzer."

The 1300 nm DFB laser is connected to the MONOCHROMATOR INPUT of the test system's optical spectrum analyzer. The MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer is connected to the PHOTODETECTOR INPUT of the test system's optical spectrum analyzer using a 9/125 μm patchcord for a test system alignment. Refer to Figure 6-10.

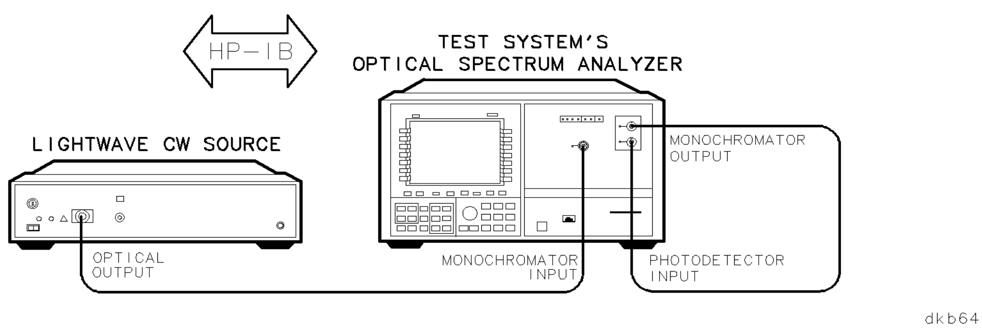

Figure 6-10. Dynamic Range Test System Alignment Setup

For the test, remove the patchcord from the PHOTODETECTOR INPUT of the test system's optical spectrum analyzer and connect the MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer to the optical input of the optical spectrum analyzer under test. Refer to Figure 6-11.

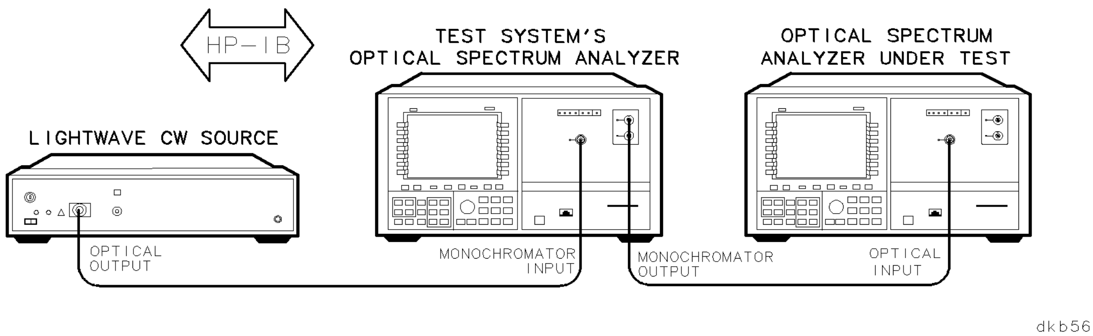

Figure 6-11. Dynamic Range Test Setup

If the 1550 nm DFB laser is also selected, this equipment setup is repeated for this source.

Description

The monochromator of the test system's optical spectrum analyzer is used as a preselector to filter the output of the 1300 nm DFB laser. This filtered output is used to test the optical spectrum analyzer under test.

With the MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer connected to the PHOTODETECTOR INPUT of the test system's optical spectrum analyzer, the software aligns the monochromator's output with the 9/125 μm patchcord. This alignment is critical. The test setup is sensitive to vibration or movement.

With the MONOCHROMATOR OUTPUT of the test system's optical spectrum analyzer connected to the optical spectrum analyzer under test, the peak level of the 1300 nm DFB laser's signal is measured. The level of the signal at $\pm$0.5 nm and $\pm$1.0 nm is then measured relative the peak level of the 1300 nm DFB laser's signal. These values are compared to the specifications.

In Case of Failure

If this test fails, check the following items:

- The alignment between the monochromator's output and the 9/125 μm fiber input patchcord
- A4 monochromator

Current Source, Option 001

This test measures the output current accuracy of the optical spectrum analyzer under test in the DC mode of operation. It verifies the maximum output voltage limit of this optical spectrum analyzer's current source. This test is performed on optical spectrum analyzers with Option 001 only.

Equipment

- Digital voltmeter
- Precision resistor and RC network
  (Refer to "Precision Resistor and RC Network" in Chapter 5 for additional information.)

Equipment Setup

First, measure the resistance of the current sense resistor in the precision resistor and RC network by connecting the digital voltmeter to the network for a four-wire ohm measurement. The digital voltmeter's LO inputs are connected to the precision resistor and RC network's test point 1. The digital voltmeter's HI inputs are connected to the precision resistor and RC network's test point 2. Refer to Figure 6-12.

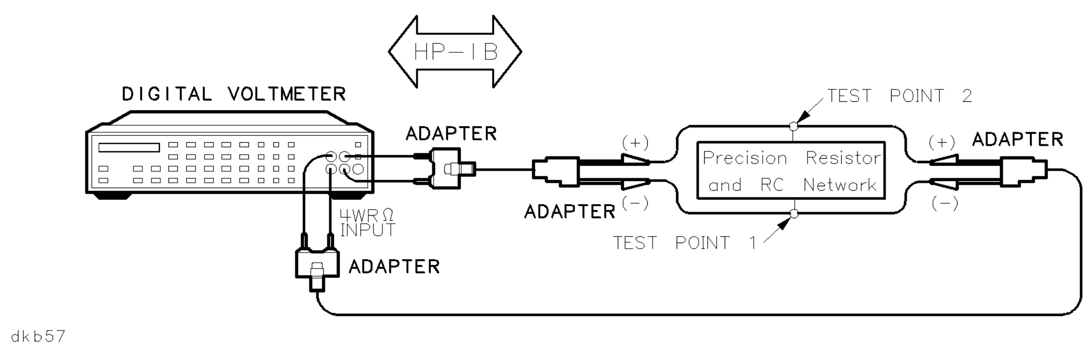

Figure 6-12. Current Source Calibration Setup

After the calibration is performed, connect the digital voltmeter across the capacitor of the precision resistor and RC network for a 2-wire voltage measurement. The digital voltmeter's LO input is connected to the precision resistor and RC network's test point 1. The digital voltmeter's HI input is connected to the precision resistor and RC network's test point 3. Connect the CURRENT SOURCE output of the optical spectrum analyzer under test across the current sense resistors of the precision resistor and RC network. The CURRENT SOURCE connector's center pin connects to the precision resistor and RC network's test point 2. The CURRENT SOURCE connector's outer connector connects to the precision resistor and RC network's test point 1. Refer to Figure 6-13.

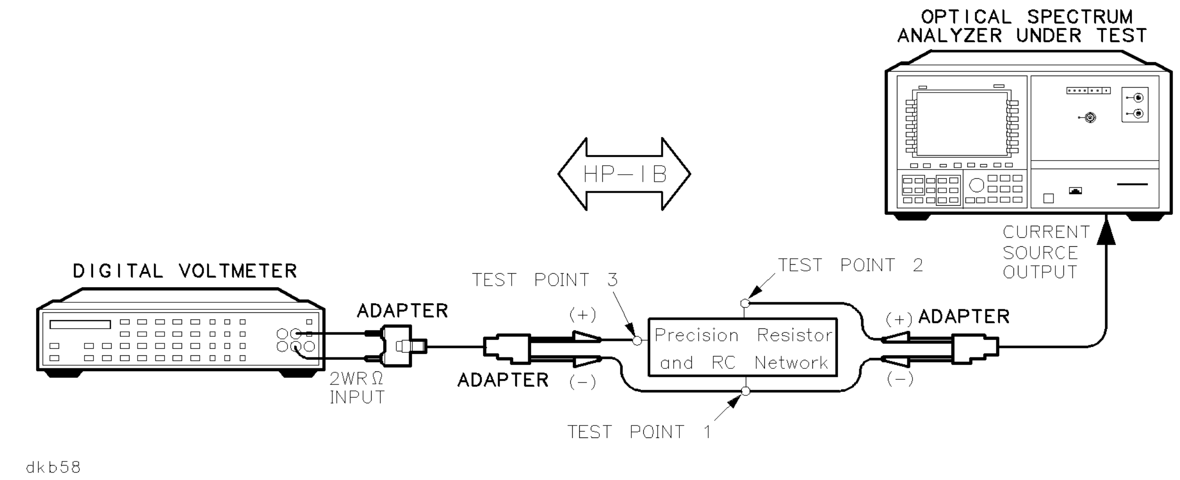

Figure 6-13. Current Source Test Setup

Description

To perform the calibration, the resistor value is measured using a four-wire ohm measurement. With the digital voltmeter's four-wire ohm inputs across the current sense resistors, the digital voltmeter is triggered and the resistance value is recorded.

To perform the measurement, the CURRENT SOURCE output of the optical spectrum analyzer under test is connected across the current sense resistors. The current source is turned on and set to the following current levels with the digital voltmeter measuring the voltage across the sense resistors.

Current Level	Calculated Voltage Level
±1.0 mA	±0.001 × Resistance
±10.0 mA	±0.01 × Resistance
±100.0 mA	±0.1 × Resistance
±200.0 mA	±Clamp Voltage

The current levels for the ±1.0 mA to ±100 mA settings are calculated from the voltage readings and compared to the specification. The clamp voltage at the 200 mA setting is compared to the specification.

In Case of Failure

If this test fails, the following assemblies may need repair:

- A3 X-Y controller board

White Light Output Power, Option 002

This test measures the power spectral density of the white light source across the wavelength range of 900 to 1700 nm, and at 799 nm. This test is performed on optical spectrum analyzers with Option 002 only.

Equipment

- 1300 nm or 1550 nm DFB laser
- 9 μm optical fiber cable

Equipment Setup

Connect the OPTICAL OUTPUT of the 1300 nm or 1550 nm DFB laser to the MONOCHROMATOR INPUT of the optical spectrum analyzer under test. Refer to Figure 6-14.

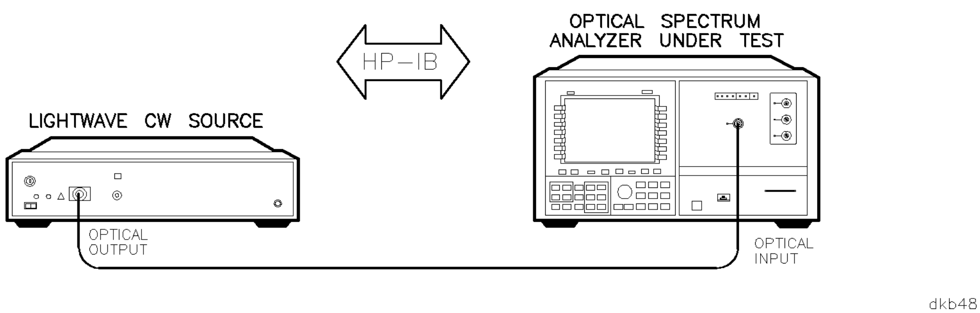

Figure 6-14. White Light Output Power Test Setup 1

When prompted: `Connect the WLS OUTPUT of the DUT to the OPTICAL INPUT of the DUT`, remove the connection from the OPTICAL OUTPUT of the 1300 nm or 1550 nm DFB laser and connect the LIGHT SOURCE OUTPUT to the MONOCHROMATOR INPUT of the optical spectrum analyzer under test using a 9 μm optical fiber cable. Refer to Figure 6-15.

Note The fiber should not be moved during the test and there should be minimum stress to the fiber.

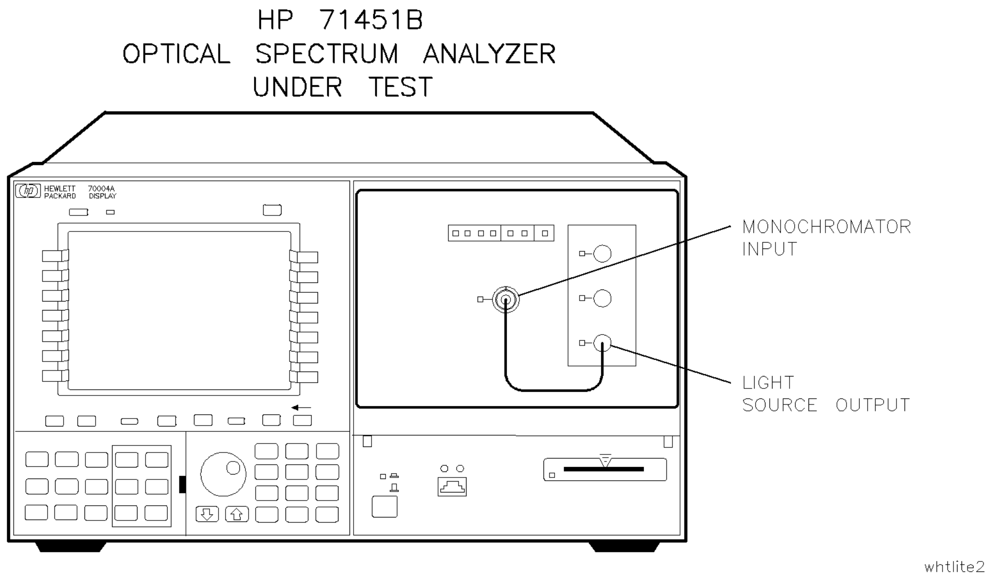

Figure 6-15. White Light Output Power Test Setup 2

Description

The optical spectrum analyzer under test is tuned to the DFB wavelength and an auto alignment is performed to ensure the xy positioner is properly peaked on the signal. A sweep is taken and the 3 dB bandwidth is determined. This number is used later as a parameter in the correction of the white light source output power spectral density.

Then, the optical spectrum analyzer under test will be set to measure the white light source power. A sweep will be taken and correction factors summed in. The white light source power spectral density will be determined and compared to specification.

Next, the output power below 800 nm is measured. An average of five sweeps will be taken at one wavelength only. This value will be corrected and the difference between the minimum power level from 900 to 1700 nm, and the power spectral density at 799 nm will be determined and compared to specifications for maximum out of band light.

In Case of Failure

If this test fails, check the following items:

- A3 X-Y controller board (drive circuitry)
- A11 white light source

Polarization Dependent Loss System Accuracy, Option 003

This test measures the residual polarization dependent loss (PDL) measured by the PDL system when only a patchcord is being tested. It verifies the system accuracy specification for optical-to-optical devices. This test is performed on optical spectrum analyzers with Option 003 only.

Equipment

- White light source (for optical spectrum analyzers without Option 002)

Equipment setup

The LIGHT SOURCE OUTPUT is connected to the HP 70951B MONOCHROMATOR INPUT using the curved semi-rigid multi-mode patchcord supplied with the PDL kit.

Note This patchcord is NOT symmetrical. One end of the cable is meant to connect to the LIGHT SOURCE OUTPUT and the other to the MONOCHROMATOR INPUT. Reversing the cable can result in damage to the cable.

The HP 70951B MONOCHROMATOR OUTPUT is connected to the POLARIZER INPUT. The POLARIZER OUTPUT is connected to the HP 11896A OPTICAL INPUT with a single-mode patchcord. The HP 11896A OPTICAL OUTPUT is connected to the EXTERNAL PHOTODIODE OPTICAL INPUT using the interface adapter supplied with the PDL kit. The EXTERNAL PHOTODIODE ELECTRICAL OUTPUT is connected to the HP 70951B's rear panel TRANS Z INPUT. Refer to Figure 6-16.

Note Movement of the optical fiber may cause the test to fail.

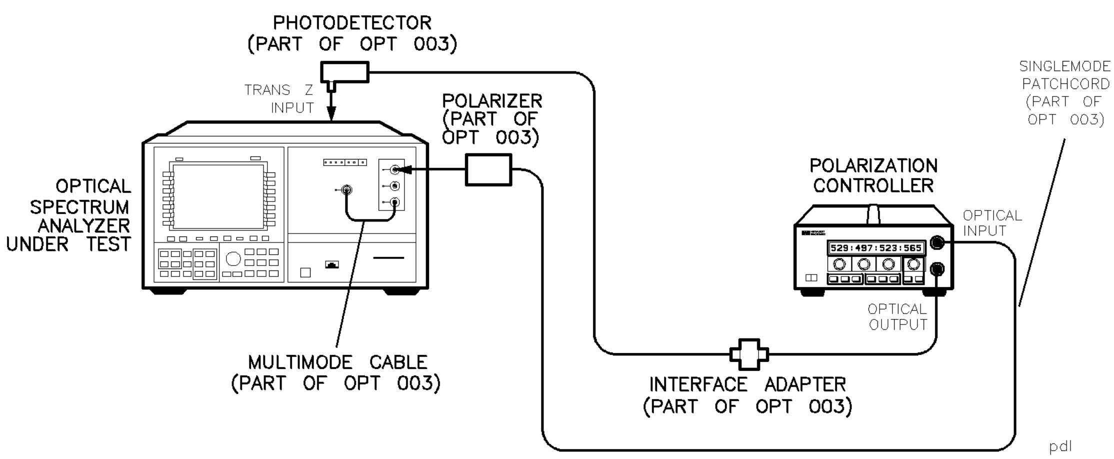

Figure 6-16. PDL System Accuracy Test Setup

Description

The operator is prompted to adjust the three knobs on the HP 11896A polarization controller for a maximum deviation on the screen between the maximum and minimum hold traces. To check a sufficient number of polarization states on the polarization controller, set all combinations of knob postistions (1, 5, 10, and 14) on the three knobs. Change only one knob position between each sweep. The recommended procedure is as follows:

- Set all three knobs on the polarization controller to 1 and allow a sweep to complete. The MEASURE LED on the optical spectrum analyzer turns off when the sweep is complete.
- Adjust the left-hand knob to it's next three settings (5, 10, and 14), and allow a complete sweep for each setting while the other two knobs remain unchanged.
- Now, set the center knob to 5. At the end of one sweep, adjust the left-hand knob to it's next three settings (10, 5, and 1), leaving the other two knobs unchanged completing one sweep for each setting.
- Continue this procedure until all possible combinations of 1, 5, 10, and 14 have been completed. (A total of 64 combinations.) Refer to Table 6-1 for a list of knob settings.

You will have approximately 10 minutes to adjust the polarization controller. When you are finished press Done, or if the test time has elapsed, the computer will calculate the difference between the maximum and minimum traces. These values are compared to specifications.

Table 6-1. Knob Settings for the Polarization Controller

Sweep #	Left-hand knob	Center knob	Right-hand knob	Sweep #	Left-hand knob	Center knob	Right-hand knob
1	1	1	1	9	1	10	1
2	5	1	1	10	5	10	1
3	10	1	1	11	10	10	1
4	14	1	1	12	14	10	1
5	14	5	1	13	14	14	1
6	10	5	1	14	10	14	1
7	5	5	1	15	5	14	1
8	1	5	1	16	1	14	1

Note

For sweeps 17-32, repeat knob settings for sweeps 16 through 1 with the right-hand knob set to 5.

For sweeps 33-48, repeat knob settings for sweeps 1 through 16 with the right-hand knob set to 10.

For sweeps 49-64, repeat knob settings for sweeps 16 through 1 with the right-hand knob set to 14.

In Case of Failure

If this test fails check the following item:

- Check optical connections for cleanliness or damage
- Remove the polarizer and verify insertion loss versus knob position of the HP 11896A polarization controller

Manual Test Procedures

There are three operation verification tests that have manual procedures in addition to their automated version. These manual test versions are designed to be used if you do not have the test equipment required for the automated versions.

Since these tests are manual, you will need to determine if the operation verification tests meet their specifications. Refer to “Specifications and Characteristics” in the Reference manual for the specifications.

Wavelength Accuracy (Manual)

This test measures the wavelength accuracy of the optical spectrum analyzer manually. This test does not use the same test equipment as the automated operation verification test.

Equipment

- Precision single-mode laser of a known wavelength between 600 and 1700 nm

  The wavelength of this laser must be known very accurately—ideally to 0.01 nm. The maximum acceptable error from the laser's actual wavelength is 0.1 nm.

- Additional single-mode source of a known wavelength between 600 and 1700 nm

  At least one source of a known wavelength is required.

Equipment Setup

Connect the output of the precision single-mode laser to the optical input of the optical spectrum analyzer under test. After the optical spectrum analyzer has been calibrated with the laser, connect the additional source's output to the optical spectrum analyzer under test's optical input. Refer to Figure 6-17.

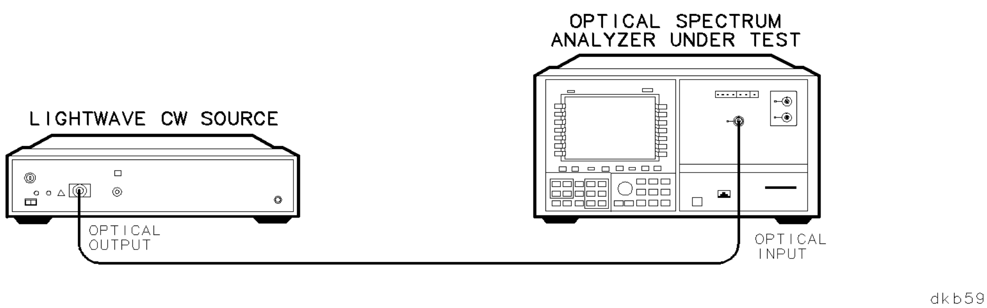

Figure 6-17. Manual Wavelength Accuracy Test Setup

Procedure

Calibrating the Optical Spectrum Analyzer's Wavelength

1. Display the response of a precision single-mode laser on the optical spectrum analyzer.
2. Press the left-side `Waveln` softkey.
3. Press the `MORE 1 of 2` softkey.
4. Press the `cal menu` softkey to enter the Calibration menu.
5. Press the `WAVELEN FOR CAL` softkey.
6. Use the numeric keypad to enter the laser's known wavelength.
7. Press the `POWER FOR CAL` softkey.
8. Use the numeric keypad to enter the laser's approximate power.
9. Press the `CAL WAVELEN` softkey to start the calibration routine.

   The calibration routine takes several seconds to complete.

Measuring the Wavelength Absolute Accuracy (after user cal)

1. Remove the precision laser and display the response of an additional single-mode optical source of a known wavelength.
2. Measure the response and wavelength of the additional single-mode laser with the optical spectrum analyzer under test by pressing the following keys:

   (AUTO MEAS)

   (RES BW) 0.1 nm

   (PEAK SEARCH)
3. Compare the displayed wavelength with the known wavelength to ensure that it meets the wavelength absolute accuracy (after user cal) specification.

Measuring the Wavelength Absolute Accuracy

1. Turn the optical spectrum analyzer's user calibration corrections off and remeasure the additional single-mode laser's signal by pressing the following keys and softkeys:

   `Waveln`

   `MORE 1 of 2`

   `cal menu`

   `WL CAL On Off` until Off is underlined

   (PEAK SEARCH)
2. Compare the displayed wavelength with the known wavelength to ensure that it meets the wavelength absolute accuracy specification.

Dynamic Range (Manual)

This test manually tests the dynamic range of the optical spectrum analyzer using a YAG or a filtered source. This test does not use the same test equipment as the automated operation verification test.

Equipment

- YAG or a source with a monochromator filter

  The noise sidebands for this source must be ≤ -60 dBc at ± 0.5 nm from the carrier.

Equipment Setup

If the source being used is a:

- YAG, connect the YAG's output to the optical input of the optical spectrum analyzer under test with a 9/125 μm patchcord.
- source with a monochromator, connect the source's output to the input of the monochromator. Connect the monochromator's output to the optical input of the optical spectrum analyzer under test with a 9/125 μm patchcord. Refer to Figure 6-18.

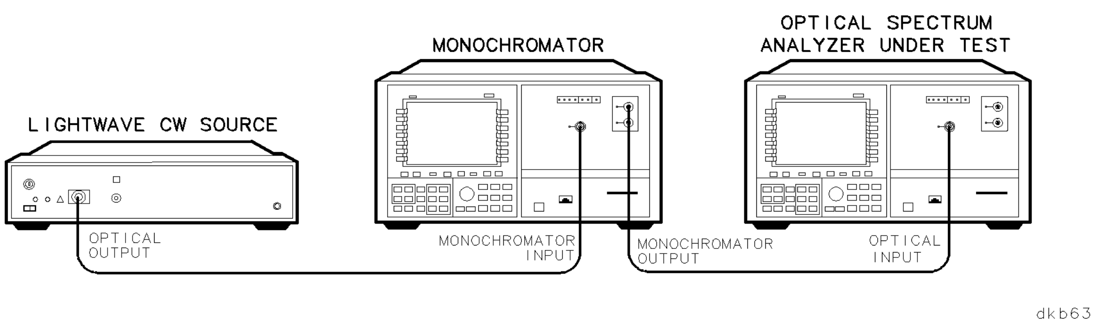

Figure 6-18. Manual Dynamic Range Test Setup

Procedure

1. If you are using a source with a monochromator, align the monochromator output on the patchcord after you have connected the source to the monochromator input.
2. Display the source's response on the optical spectrum analyzer under test.
3. Press the following keys on the optical spectrum analyzer under test:

   AUTO ALIGN

   AUTO MEAS

   SPAN 2.5 nm

4. Note the amplitude level of the measured signal and set the sensitivity to 65 dB below the signal's measured amplitude level by performing the following steps:

   Press `Amptd`

   Press `SENS AutoMan` until Man is underlined

   Enter a value 65 dB below the measured amplitude level

5. Check the power at each point, ± 0.5 db and ± 1 db depending on wavelength. Refer to the specifications.

Flatness (Manual)

This test manually measures the flatness of the optical spectrum analyzer. This test does not use the same test equipment as the automated operation verification test.

Equipment

- Two stable, narrowband sources

  The sources must be:
  - □ amplitude-stable. Do not use a Fabry-Perot laser.
  - □ $\leq$ 5 nm in a 3 dB bandwidth. A filtered LED source may be used.
- Power sensor
- Lightwave multimeter
- Polarization controller
- Optical attenuator (optional)

Equipment Setup

If you are using a filtered LED as your source, set the resolution bandwidth of the filter to 5 nm and the resolution bandwidth of the optical spectrum analyzer under test to 10 nm.

Connect the output of the source to the input of the polarization controller. Connect the output of the polarization controller to the power sensor. Refer to Figure 6-19.

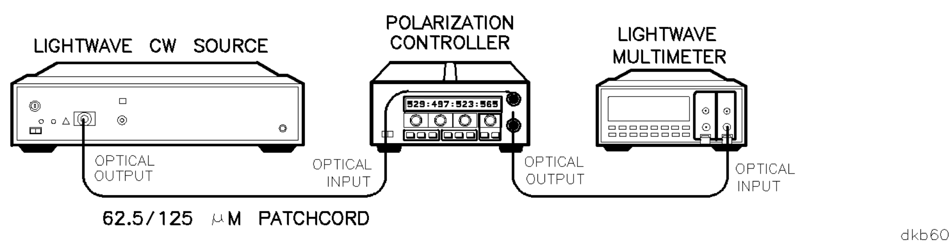

Figure 6-19. Manual Flatness Test Setup 1

Connect the output of the source to the input of the polarization controller. Connect the output of the polarization controller to the optical input of the optical spectrum analyzer under test. Refer to Figure 6-20.

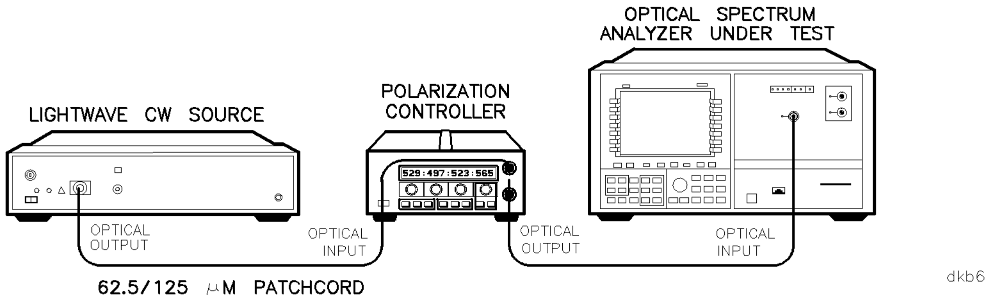

Figure 6-20. Manual Flatness Test Setup 2

Procedure

1. If an optional optical attenuator is available, adjust it for an approximate power meter reading of −25 dBm.
2. Record the power meter reading.
3. Remove the output of the polarization controller from the power sensor. Connect the polarization controller's output to the optical input of the optical spectrum analyzer under test.
4. Adjust the polarization controller for maximum response on the optical spectrum analyzer under test.
5. Record the maximum power reading.
6. Adjust the polarization controller for minimum response on the optical spectrum analyzer under test.
7. Record the minimum power reading.
8. Calculate the midpoint between the maximum power reading and the minimum power reading to remove error due to polarization sensitivity.
9. Subtract the midpoint power calculation from the power meter reading taken in step 2. This is the absolute error at this wavelength.
10. Remove the first source from the test setup and connect the second source to the test setup.
11. Repeat steps 1 through 9 for the second source.
12. Subtract the absolute error calculated for the second source from the absolute error calculated for the first source and divide this result by 2.
13. Compare this to the amplitude flatness specification.

Note Between 1350 nm and 1420 nm, absorption of light by atmospheric moisture affects flatness. At room temperature, total humidity effects should be less than 1 dB.

Manual Operational Checks for the HP 70951B Optical Spectrum Analyzer Module

The manual operational checks are designed to give you confidence that your HP 70951B optical spectrum analyzer modules's instrument modes operate properly.

Transimpedance Input Check

This check verifies the functionality of the transimpedance input on the HP 70951B optical spectrum analyzer module under test.

Equipment

- Current source

Equipment Setup

This manual operational check uses the current source output of an optical spectrum analyzer as a current source to test the optical spectrum analyzer under test. The optical spectrum analyzer being tested is referred to as the "optical spectrum analyzer under test." The optical spectrum analyzer with the current source that is being used as part of the test equipment is referred to as the "test system's optical spectrum analyzer."

The CURRENT SOURCE output of the test system's optical spectrum analyzer is connected to the TRANS-Z IN on the rear panel of the optical spectrum analyzer under test. Refer to Figure 6-21.

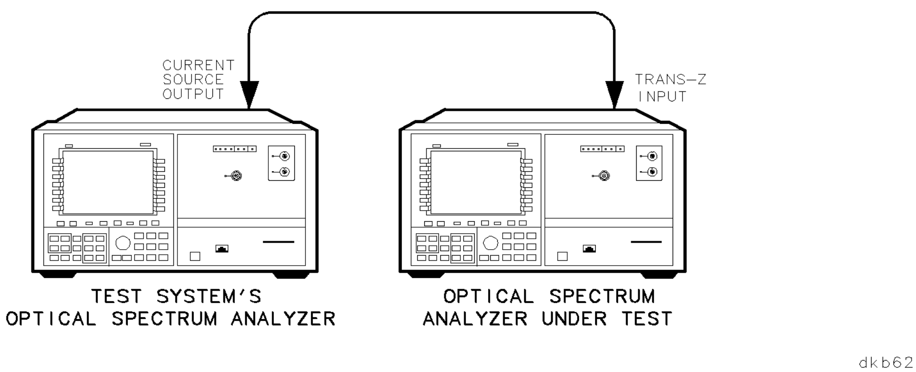

Figure 6-21. Transimpedance Input Check Setup

Procedure

1. Set the optical spectrum analyzer under test to the following settings:

   (INSTR PRESET)

   (CENTER) 1000 nm

   (SPAN) 1 nm

   (REF LEVEL) 10 dBm

   `Amptd`

   `MORE 1 of 4`

   `MORE 2 of 4`

   `AUTZERO On Off` until Off is underlined

2. Set the test system's optical spectrum analyzer to the following settings:

   INSTR PRESET

   `State`

   `current source`

   `IGEN LIMIT` 8 mA

   `IGEN On Off` until IGEN is highlighted

   −3 mA

Caution Damage to the transimpedance amplifier may result if the input current exceeds ±10 mA.

3. Set the optical spectrum analyzer under test into the photodiode test mode by pressing the following softkeys:

   `State`

   `instr modes`

   `photo diode`

   `PD MEAS On Off` until On is underlined

   `A-B ->A On Off` until Off is underlined

4. Turn on the current generator on the test system's optical spectrum analyzer by pressing the `IGEN On Off` softkey until On is underlined.
5. Confirm that the response of the current source of the test system's optical spectrum analyzer is displayed on the display of the optical spectrum analyzer under test.
6. Place a marker at the peak of the signal displayed on the optical spectrum analyzer under test by pressing the following keys:

   NORMAL ON/OFF until the marker is turned on

   PEAK SEARCH

   Δ

7. Change the current source current of the test system's optical spectrum analyzer from −3 mA to −6 mA by pressing the following softkeys and keys:

   `IGEN On Off` until On is underlined

   −6 mA

8. Check that the marker level on the optical spectrum analyzer under test increases by approximately 3 dB.

   The marker level should increase by approximately 3 dB when the current into the transimpedance input changes from −3 mA to −6 mA.

In Case of Failure

If this check fails, check the following items:

- A7A1 data acquisition board
- The cable between the transimpedance input (TRANS-Z IN) and the A7A1 data acquisition board

Monochromator Output/Photodetector Input Check

This check verifies the operation of the optical switch. The optical switch is essential to the operation of the power meter, preselector, and stimulus response modes of the HP 70951B optical spectrum analyzer module under test.

Equipment

- 1300 nm DFB laser
- 62.5/125 μm fiber patchcord

Equipment Setup

The 1300 nm DFB laser is connected to the MONOCHROMATOR INPUT of the optical spectrum analyzer under test. The MONOCHROMATOR OUTPUT of the optical spectrum analyzer under test is connected to the PHOTODETECTOR INPUT of the optical spectrum analyzer under test using a 62.5 μm patchcord. Refer to Figure 6-22.

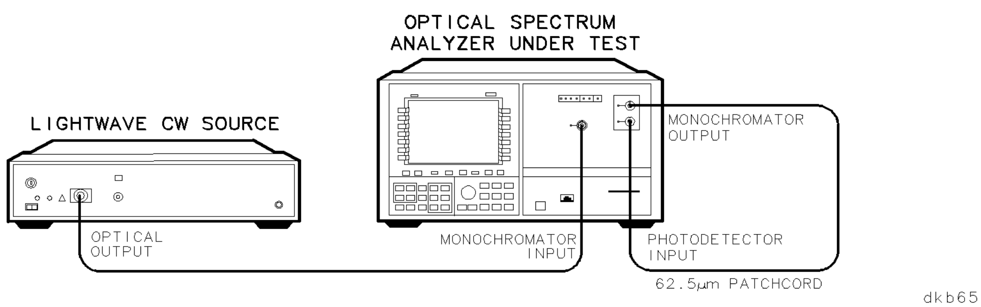

Figure 6-22. Monochromator Output/Photodetector Input Check Setup

Procedure

1. Perform the automatic alignment on the 1300 nm DFB laser's input to the optical spectrum analyzer under test by pressing the following keys:

   (INSTR PRESET)

   (AUTO MEAS)

   (AUTO ALIGN)

2. Place a marker on the peak of the signal by pressing the following keys:

   (PEAK SEARCH)

   (Δ)

3. Select the stimulus response mode to activate the monochromator output and the photodetector input of the optical spectrum analyzer under test by pressing the following softkeys:

   `State`

   `instr modes`

   `STM/ RESP`

4. When the optical switch switches, note the audible click and the change in the signal level and the noise floor.

   Pressing the `STM/ RESP` softkey switches the optical switch. The amplitude corrections for monochromator loss are subtracted from the display level. The signal level will drop by the monochromator loss (<7 dB at 1300 nm) plus the loss in the 62.5/124 μm patchcord (typically <1 dB). The noise level will also drop when the optical switch switches.

In Case of Failure

If this check fails, check the following items:

- Connector cleanliness
- 62.5/125 μm fiber input patchcord
- A7A1 data acquisition board
- A3 X-Y controller board

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