

User's Guide

HP E5972A LED Source

SERIAL NUMBERS

This manual applies to all instruments.



HP Part No. E5972-91011
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First Edition
E0295

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Printing History

New editions are complete revisions of the guide reflecting alterations in the functionality of the instrument. Updates are occasionally made to the guide between editions. The date on the title page changes when an updated guide is published. To find out the current revision of the guide, or to purchase an updated guide, contact your Hewlett-Packard representative.

Control Serial Number: Edition 1 applies directly to all instruments.
Edition 1 : 1st February 1995 : E5972-91011 : E0295

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Produced to ISO 9001 international quality system standard as part of our objective of continually increasing customer satisfaction through improved process control.

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

General This is a Safety Class III instrument and has been manufactured and tested according to international safety standards.

Operation - Before applying power Comply with the installation section. Additionally, the following shall be observed:

- Do not remove instrument covers when operating.
- Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Be aware that capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Safety Symbols



The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual to protect the apparatus against damage.



Caution, risk of electric shock.



Frame or chassis terminal.



Protective conductor terminal.



Hazardous laser radiation.

Warning

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

Caution

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

Introduction

This guide has two sections

- How to operate the instrument (chapter 1), and
- Supporting information, which is not required for the general operation of the instrument (appendices A to E).

Using the Source

This chapter describes the normal operation of the LED source.

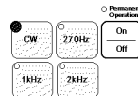
Switching the LED Source On

Note

Normally the LED source switches off automatically after a period of 20 minutes. If you need to use the source for a longer period, see “Switching the LED Source On Permanently”.

To switch the LED source on:

1. Press **On/Off**.



The LED Source at Power On

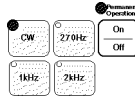
The CW indicator lights to show that the source is on. The source is active (radiating) as long as the instrument is switched on.

If the LED source does not switch on, check the battery (see “Changing the Batteries” in Appendix A for information on accessing, and changing, the battery).

Switching the LED Source On Permanently

To switch the LED source on for permanent operation:

1. Press and hold **On/Off**.
2. Wait until **Permanent Operation** indicator lights (approximately 2 seconds).



The LED Source at Power On for Permanent Operation

3. Release **On/Off**.

The CW indicator also lights. The source is active (radiating) as long as the instrument is switched on.

If the LED source does not switch on, check the battery (see “Changing the Batteries” in Appendix A for information on accessing, and changing, the battery).

Switching the LED Source Off

To switch the LED source off:

1. Press **On/Off**.

Modulating the Output of the Source

You can modulate the output of the LED source so that it outputs a square wave, with 50% duty cycle and 100% modulation. There are three modulating frequencies that you can select 270Hz, 1kHz, 2kHz.

- Press **270Hz** to select 270Hz modulation.
- Press **1kHz** to select 1kHz modulation.
- Press **2kHz** to select 2kHz modulation.
- Press **CW** to select continuous wave output (no modulation).

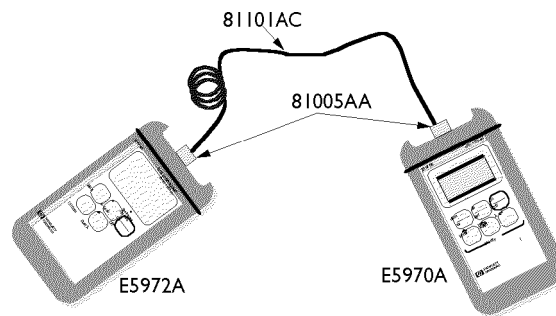
Example: Measuring Signal Power

In this example, we will measure the difference in power between the 1kHz modulated output and the unmodulated output from the source.

The example uses the following equipment:

- The HP E5970A Optical Power Meter with a HP 81005AA HMS-10 Adapter,
- A HP E5972A LED Source with a HP 81005AA HMS-10 Adapter,
- A HP 81101AC Diamond HMS-10/HP to HMS-10/HP Patchcord.

1. Set up the equipment as shown in the diagram:



Set Up for Signal Power Measurement Example

2. Switch on both the instruments.
3. If the power meter is not already measuring in dB, press **(dB/Ref)**, to set the power meter to measure relative power.
4. On the power meter, press **(Disp→Ref)** to take the continuous wave output power as the reference.
5. Press **(1kHz)** on the LED source. You can now read the value for the difference in output power on the meter.

A

Preparing for Operation

This section covers the information you need to know to set up your instrument.

Initial Inspection

Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically.

The Appendix D gives a procedure for checking the operation of the instrument. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Hewlett-Packard office.

Power Supply Requirements

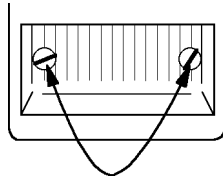
The instrument is powered by two 1.5V dry batteries (Mignon AA size), for an operating period of approximately 36 hours, or two 1.2V rechargeable batteries for an operating period of approximately 12 hours.

When the batteries are low, the indicator on the key that is currently active (**CW**, **270Hz**, **1kHz**, or **2kHz**) starts blinking. At this stage, there is approximately enough charge for another 30 minutes of use.

Changing the Batteries

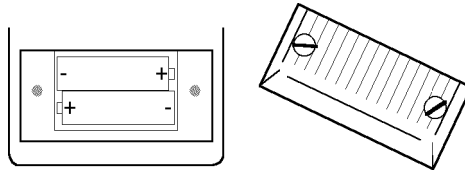
To change the batteries,

1. Loosen the thumbscrews on the rear of the instrument.



The Thumbscrews on the Rear of the Instrument.

2. Remove the cover.



Removing the Rear Cover.

3. Remove the batteries.
4. Making sure that the polarity is correct (it is shown on the bottom of the battery compartment), insert the new batteries.
5. Put the cover back on.
6. Tighten the thumbscrews with your fingers.

Operating and Storage Environment

The following summarizes the operating environment ranges. In order for the instrument to meet its specifications, the operating environment must be within these limits.

Warning **The instrument is water-protected. Do not submerge in water.**



Temperature

The instrument should be protected from temperature extremes and changes in temperature that may cause condensation within it.

The storage and operating temperatures are given below.

Operating Temperature Range: -10°C to +55°C
Storage Temperature Range: -40°C to +70°C

Humidity

The operating humidity for the instrument is $\leq 95\%$.

Optical Input

The connector adapters and accessories listed in “Connector Adapters” in Appendix B are used so that you can use the instrument with various optical connector types.

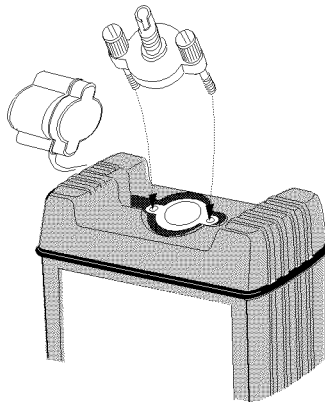
Attaching a Connector Adapter

Warning

Be careful not to touch the LED or its glass cover while attaching the adapter. Any contact with the LED could dirty or damage it.

To attach an adapter:

1. Pull the dust cap off the LED.



Attaching the Adapter

2. Carefully place the adapter onto the LED.
3. Tighten the thumbscrews with your fingers.

Removing a Connector Adapter

Warning

Be careful not to touch the LED or its glass cover while removing the adapter. Any contact with the LED could dirty or damage it.

To remove the adapter:

1. Loosen the thumbscrews.
2. Remove the adapter from the LED.
3. Cover the LED with the dust cap.
4. Put the adapter into its box.

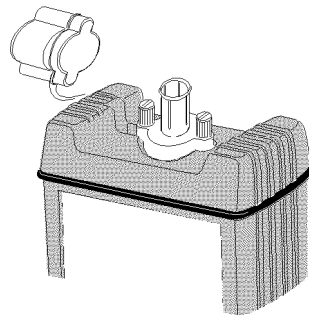
Connecting Bare Fibers

There are two parts to the bare fiber adapter.

- the connector adapter
- the bare fiber connector

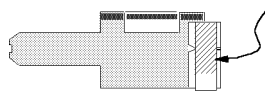
To connect a bare fiber,

1. Attach the adapter:
 - a. Pull the dust cap off the LED.
 - b. Carefully place the adapter onto the LED.



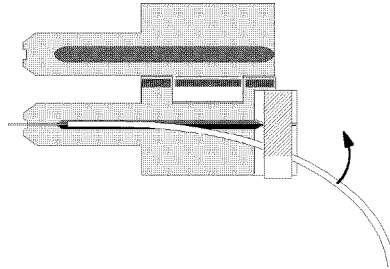
The Adapter on the LED

- c. Tighten the thumbscrews with your fingers.
 2. Insert the bare fiber into the connector
 - a. Remove approximately 10mm of the secondary coating of the fiber.
 - b. Strip away a few millimeters from the end of the fiber (using a fiber cleaver).
 - c. Use the adjusting screw to lift the clamping plate of the connector.



The Clamping Plate

- d. Open the connector.
 - e. Insert the fiber into the notch so that the secondary coating section lies in the large V-notch, and the bare fiber end lies in the small V-notch, protruding slightly out of the end of the connector.



Inserting the Bare Fiber

- f. Slide the fiber with secondary coating under the clamping plate, and undo the screw until the fiber is clamped.
 - g. Carefully close the connector, making sure that the fiber does not move.
 - h. Hold the connector closed, and gently pull back the end of the connector until it is even with the end of the connector.
3. Insert the connector into the adapter.

Note

Make sure the instrument does not move, or the fiber is not disturbed while you are measuring.

B

Ordering Information

This section covers the instruments and accessories in the handheld fiber-optic test range.

Instruments

Description	Product Number
Optical Power Meter 800 to 1600nm	HP E5970A
LED Source 1300nm	HP E5972A
Dual Laser Source 1310/1550nm	HP E5974A

Commercial Calibration Report Option UK6

AC Adapter (HP E5974A only)

Product Number	Option Number	Region
HP E5974A	001	U.S.
HP E5974A	002	Europe
HP E5974A	003	U.K.
HP E5974A	004	Australia

If an applicable AC adapter is not listed above, you can use an AC adapter which satisfies the following specifications:

Voltage	9±1V DC		
Current	≤150mA		
Plug tube jack	inside diameter	1.35mm	
	outside diameter	3.7mm	
	jack length	≥9mm	
	polarity	inner contact is positive	

Connector Adapters

Connector Adapters for the HP E5970A Optical Power Meter and HP E5972A LED Source

Description	Product Number
HMS-10 Adapter	HP 81005AA
FC/PC Adapter	HP 81005FA
DIN 47256 Adapter	HP 81005SA
ST Adapter	HP 81005VA
Biconic Adapter	HP 81005WA
SMA Adapter	HP 81005JA
Bare Fiber Adapter	HP 81005BA

Connector Adapters for the HP E5974A Dual Laser Source

Description	Product Number
HMS-10 Adapter	HP 81005AI
FC/PC Adapter	HP 81005FI
DIN 47256 Adapter	HP 81005SI
ST Adapter	HP 81005VI
Biconic Adapter	HP 81005WI

Specifications

Definitions

Output Power Level	In CW mode, the output power at the specified wavelength, measured at the end of a jumper cable.
Power Uncertainty / Repeatability	In CW mode, the uncertainty in generating a power level at the end of a 50/125 μ m multimode patchcord. The connector is included (assuming specified, HP connector-interfaces and patchcords; connectors and patchcords must be absolutely clean and undamaged).
Short / Long Term (Power) Stability	In CW mode, the uncertainty of the power level observed over the given time compared to the mean power during this time. Measured with average optical power meter and a 50/125 μ m multimode fiber, at constant temperature within a specified temperature window and with line voltage uninterrupted.
Center Wavelength	mean (3 dB), the average of the two wavelengths that are 3 dB (half-power) below the peak wavelength.
Spectral Bandwidth (FWHM)	FWHM (full width at half the maximum) the spectral width of the half-power (-3dB) points of the LED. The half-power points are those where the power-spectral density is one-half of the peak amplitude.

Specifications

Specifications describe the instrument's warranted performance over the -10°C to +55°C temperature range. Characteristics provide information about non-warranted performance. One of the interfaces specified for use with this instrument in "Connector Adapters" in Appendix B is assumed for all cases, except where stated otherwise.

Description	HP E5972A
Source Type	LED
Center Wavelength	1300±50nm
Bandwidth (FWHM)	150nm typical
Output Power Level (typical)	-38dBm (9/125μm fiber) -20dBm (50/125μm fiber) -15dBm (62.5/125μm fiber) -11dBm (100/140μm fiber)
Short Term Stability ^[1]	±0.01dB (±0.003dB typical)
Long Term Stability ^[2] (typical)	±0.1dB
Power Uncertainty/Repeatability ^[1] (including connector)	±2dB
Optical Output	Non-Contact, Removable Connector Adapters Single port, Open beam.
Applicable Fiber Type	Up to 100/140μm
Operating Time (typical)	36 hours (12 hours for rechargeable batteries)

^[1] 15 minutes, constant temperature (±1K), +20 to +26°C, constant within ±1K, fiber type 50/125μm.
^[2] 6 hours, constant temperature (±3K), -10 to +55°C, constant within ±3K, fiber type 50/125μm.

Supplementary Performance Characteristics

Instrument warm-up time is not required.

Internal modulation allows frequencies 270Hz, 1kHz, 2kHz. The signal form is square wave with a duty cycle of 50% and a modulation depth of 100% (average power is decreased by 3dB).

Dynamic Range with E5970A Optical Power Meter at 1300nm is >32dB for a 9/125μm fiber, and >50dB for a 50/125μm fiber.

C-2 Specifications

General Specifications

Power Supply

Dry Battery 2×AA 1.5V

Rechargeable NiCd Battery 2×AA 1.2V

Auto Off Time^[1] 20minutes (approx.)

Dimensions

95mmW×49mmH×195mmD

3.7"×1.9"×7.7"

Net Weight^[2]

500g (approx.)

Operating Temperature

-10 to +55°C

Storage Temperature

-40 to +70°C

Relative Humidity

non-condensing

Recommended Recalibration Period

2 years

Electromagnetic Compatibility according to EN 50 081-1, EN 50 082-1

^[1] The Auto Off mode can be disabled.

The time given is after power on.

^[2] Including batteries and connector adapter.

D

Performance Test

The procedures in this section test the optical performance of the instrument. The complete specifications to which the HP E5972A is tested are given in Appendix C. All tests can be performed without access to the interior of the instrument.

Required Test Equipment

The equipment required for the performance test is listed in the table below. Any equipment that satisfies the critical specifications of the equipment given in the table, may be substituted for the recommended models.

Instrument or Accessory	Quantity	Recommended Model
Lightwave Multimeter Meter	1	HP 8153A
Optical Power Sensor	1	HP 81532A
Patchcord HMS-10/HMS-10, 9/125 μ m	1	HP 81101AC
Patchcord HMS-10/HMS-10, 50/125 μ m	1	HP 81501AC
Patchcord HMS-10/HMS-10, 50/125 μ m	1	HP 81501FC
connector interface	1	HP 81000AI
connector adapter	1	HP 81005AA
connector adapter	1	HP 81005FA

Test Record

Results of the performance test may be tabulated on the Test Record provided after the test procedures. The Test Record can also be used as a permanent record and may be reproduced without written permission from Hewlett-Packard.

Performance Test

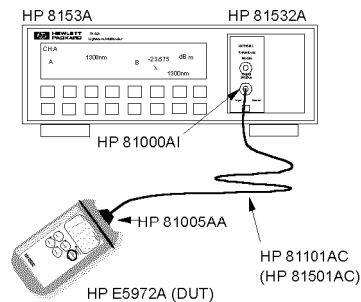
General

- Make sure all the equipment has warmed up and all connectors are clean.
- Make sure that all patchcords are fixed to the table so that they won't move during measurements.
- Make sure that the ambient conditions are in the following ranges:

temperature $23^{\circ}\text{C}\pm 3\text{K}$
relative humidity 45 to 75 %

Testing the Output Power Level (CW)

1. Connect the equipment as shown in the figure.



Set-Up for Testing the Output Power Level

2. Set the 8153A as follows:

dBm / W	dBm
wavelength	1300nm
averaging time	100ms
Range	AUTO

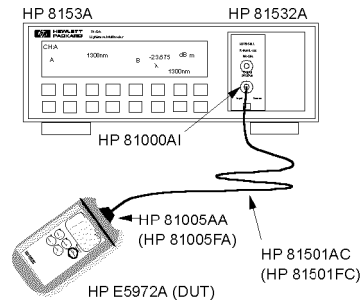
Before switching on the DUT, zero the power meter, that is, press **Zero**.

3. Switch on the DUT and allow it to settle.
4. Make sure that the frequency modulation on the DUT is set to CW.
5. Note the displayed power level on the 8153A in the test report
6. Repeat this measurement (list item 5) with the 50/125 μm fiber.

D-2 Performance Test

Repeatability / Uncertainty

1. Connect the equipment as shown in the figure.



Set-Up for Testing the Repeatability / Uncertainty

2. Set the 8153A as follows:

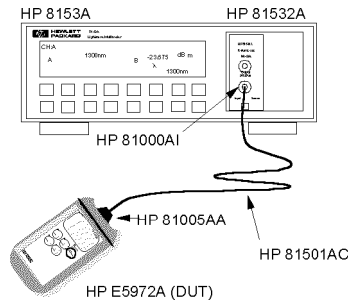
dBm / W	dBm
wavelength	1300nm
averaging time	100ms
Range	AUTO

Before switching on the DUT, zero the power meter, that is, press **Zero**.

3. Switch on the DUT and allow it to settle.
4. Make sure that the frequency modulation on the DUT is set to CW.
5. Note the displayed power level on the 8153A in the test report.
6. Remove the patchcord from the source and put it back.
7. Note the displayed power level in the test report.
8. Repeat list item 6 and list item 7 another 4 times.
9. replace the patchcord by the one having the FC connectors.
10. Repeat the list item 5 to list item 8 and note the displayed power levels in the test report.

Short Term Stability

1. Connect the equipment as shown in the figure.



Set-Up for Testing the Short Term Stability

2. Set 8153A:

wavelength 1300nm
 averaging time 100ms
 Range AUTO

Before switching on the DUT, zero the power meter, that is, press **Zero**.

3. Switch on the DUT and allow to settle
4. Make sure that the frequency modulation on the DUT is set to CW.
5. Set 8153A to datalogging
 - a. press **Mode** to change to the menu mode.
 - b. press **Record** to get the STABILTY application
 - c. press **Edit** to get T_TOTAL
 - d. set the total measurement time to 00:15:00 for a short term stability test using the Modify cursor keys
 - e. press **Edit** to get back to STABILTY.
 - f. press **Exec** to execute the application.

The display shows RUNNING, and the remaining time, counting down in seconds. The 8153A stops automatically when the logging time is over, then displays STABILITY.

6. Get measurement result:
 - a. press **More** to get SHOW.
 - b. press **Edit** to get MAXIMUM.
 - c. press **Next** twice to get DIFF.

Note the displayed value in your test record.

7. Reset to measure mode:
 - a. press **Edit** to get SHOW.
 - b. press **Record** until you get STABILITY.

D-4 Performance Test

- c. press **Mode** to get back to MEASURE Mode.

Optional Test: Center Wavelength and Spectral Bandwidth (FWHM)

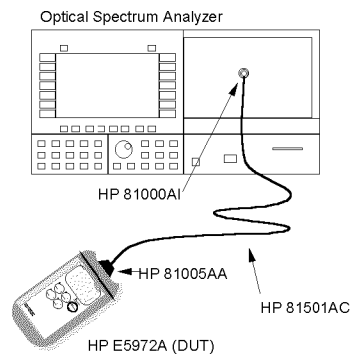
The LED has been tested, and the specifications include a theoretical drift of wavelength or bandwidth even if this is not likely. This test is not mandatory but optional.

Additional Test Equipment

Instrument or Accessory	Quantity	Recommended Model
Optical Spectrum Analyzer	1	HP 75450A #101

Testing the Center Wavelength and Spectral Bandwidth

1. Connect the test equipment as shown in the figure.



Set-Up for Testing the Wavelength and Spectral Bandwidth

2. Ensure that the OSA is switched on and has warmed up.
3. Enable the E5972A (DUT)
4. Set-up the OSA:
 - a. press **Instr Preset**.
 - b. press **Auto/Meas** and wait until End of Automeasure is displayed.

- c. choose **User** and then select the type of source to be measured (LED).
5. To show the display in linear mode:
 - a. press **Menu**.
 - b. select **Ampt** on the left side of the display.
 - c. press **Linear** on the right side of the display.
6. To ensure interference free reading of the display it is advisable to stop the repeating calculations.
 - a. select **User**.
 - b. press **Single Sweep**.

If the the curve on the display is not clear, you can change resolution by using the Span key.

7. From the displayed measurements check and note the values for Mean (3 dB) Wavelength and 3 dB Width.

Performance Test for the HP E5972A

Page 1 of 3

Test Facility:

_____ Report No. _____
_____ Date _____
_____ Customer _____
_____ Tested By _____

Model HP E5972A LED Source

Serial No. _____ Ambient temperature _____ °C

Options _____ Relative humidity _____ %

Firmware Rev. _____ Line frequency _____ Hz

Test Equipment Used:

Description	Model No.	Trace No.	Cal.	Due Date
1. Lightwave Multimeter	HP 8153A			
2. Optical Power Sensor	HP 81532A			
3. Patchcord HMS-10/HMS-10, 9/125 μ m	HP 81101AC			
4. Patchcord HMS-10/HMS-10, 50/125 μ m	HP 81501AC			
5. Patchcord HMS-10/HMS-10, 50/125 μ m	HP 81501FC			
6. Connector interface	HP 81000AI			
7. Connector adapter	HP 81005AA			
8. Connector adapter	HP 81005FA			

Performance Test for the HP E5972A

Model HP E5972A LED Source		No. _____	Date _____		
Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
I.	Output Power Level (CW)		dBm	dBm (typical)	_____dB
	fiber type				
	9/125 μ m Single Mode		_____	-38	
	50/125 μ m Multi Mode		_____	-20	
II.	Uncertainty/Repeatability				_____dB
	fiber type				
	50/125 μ m Multi Mode				
	connector type/patchcord connection	dBm	dBm	dBm	
	HMS-10/81501AC	1	-22.00	_____	-18.00
		2	-22.00	_____	-18.00
		3	-22.00	_____	-18.00
		4	-22.00	_____	-18.00
		5	-22.00	_____	-18.00
	FC/81501FC	1	-22.00	_____	-18.00
		2	-22.00	_____	-18.00
		3	-22.00	_____	-18.00
		4	-22.00	_____	-18.00
		5	-22.00	_____	-18.00

Performance Test for the HP E5972A

Page 3 of 3

Model HP E5972A LED Source No. _____ Date _____

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
III.	Short Term Stability		dBpp	dBpp	_____dB
	DIFF		_____	0.02	
	Level variation peak-to-peak			0.006 typical	

Optional Performance Test for Center Wavelength and Spectral Bandwidth

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
IV.	Center Wavelength and Spectral Bandwidth (FWHM)	nm	nm	nm	
	(Optional)				
	Wavelength	1250.00	_____	1350.00	_____
	Spectral Bandwidth		_____	150 (typical)	_____

Cleaning Procedures

The Cleaning Kit

A full cleaning kit contains the following items:

Isopropyl alcohol This is usually available from pharmaceutical suppliers or chemists.

If possible, use alcohol supplied for medical purposes, rather than impure alcohol or alcohol with additives.

Caution

Do not use other solvents as some can damage plastic materials and claddings. For example, Acetone dissolves the adhesives used in fiber optic devices.

Warning

Never drink this alcohol as this can lead to blindness or other serious damage to your health.

Cotton-swabs Use swabs such as Q-tips or other cotton-swabs. These are typically available from local distributors of medical or hygiene products (such as supermarkets or pharmacies).

Note If you are cleaning connector interfaces or adapters, the diameter of the cotton swab is important. Cotton swabs for babies normally have a smaller diameter.

Caution

- Do not use foam swabs, as these can leave filmy deposits on the surface you are cleaning.
- Store your cotton-swabs carefully and never reuse them. Dust and dirt from the air or from previous cleaning, can scratch or dirty your optical device.

Soft-tissues These are available from most stores and distributors of medical and hygiene products (such as supermarkets or pharmacies).

Use multi-layer tissues made from non-recycled cellulose. These are more absorbent and softer than other types and they do not scratch the surface of your device.

Caution

Store your soft-tissues carefully and never reuse them, as dust and dirt from the air or from previous cleaning can scratch and dirty your optical device.

Pipe-cleaner These are available from tobacco shops.
Ensure that the bristles of the pipe-cleaner are soft, so that they do not scratch your device during cleaning.

Caution

Store your pipe-cleaner carefully and never reuse them as dust and dirt from the air or from previous cleaning can scratch and dirty your optical device.

Compressed Air This is available from laboratory suppliers.

It is essential that your compressed air is free of dust, water and oil. Only use clean, dry air. If you do not, it can lead to filmy deposits or scratches.

When using compressed air from a can,

- Hold the can upright. A slant can cause propellant to escape with the compressed air and dirty your optical device.
- Spray the first couple of seconds into the air, as the first stream of compressed air can contain condensation or propellant. Any condensation produces a filmy deposit.

If you are using compressed air from a can, you should select one with a CFC-free propellant, for the sake of the environment.

Other Cleaning Tools

To examine devices you also require:

Microscope Select a microscope with a magnification range of between 50X and 300X. These should be available from photographic stores or laboratory suppliers.

Ensure that the light source of the microscope is flexible. This helps you to examine your device closely and from different angles.

A microscope allows you to determine the type of dirt on your device and its extent. Then you can choose the correct cleaning procedure and later to examine the results of cleaning. With a microscope you can also decide if your optical device is scratched.

Ultrasonic bath These are typically available from photographic stores or laboratory suppliers.

An ultrasonic bath very gently removes greasy and other stubborn dirt from optical devices.

Only use an ultrasonic bath with isopropyl alcohol, as other solvents can damage or dirty your optical device.

Premoistened cleaning wipes These are available from HP. The part number is HP 92193N (80 Wipes per box). These are tissues that are moistened with isopropyl alcohol.

E-2 Cleaning Procedures

Infrared sensor card	This is typically available from laboratory suppliers. With this card you can qualitatively check the uniformity of your emitted laser light, because when the laser light is projected onto the sensor card it becomes visible.
Lens Cleaning Paper	Some lens cleaning papers and cleaning kits available, for example, in photographic stores are not suitable for cleaning fiber optic devices. To be sure, please ask the salesperson or the manufacturer.

Preserving Connectors

Listed below are some hints on how best to keep your connectors in the best possible condition.

Making Connections	Before you make any connection you must ensure that all cables and connectors are clean. If they are dirty, use the appropriate cleaning procedure. When inserting the ferrule of a patchcord into a connector or an adapter, make sure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise you will rub the fiber end against an unsuitable surface, producing scratches and dirt deposits on the surface of your fiber.
Dust Caps and Shutter Caps	Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber as any dust in the cap can scratch or dirty your fiber surface. When you have finished cleaning, put the dust cap back on, or close the shutter cap if the equipment is not going to be used immediately. Keep the caps on the equipment always when it is not in use. All Hewlett-Packard's lightwave instruments and accessories are shipped with either laser shutter caps or dust caps. If you need additional or replacement dust caps, contact your Hewlett-Packard sales office.
Immersion Oil and Other Index Matching Compounds	Where it is possible, do not use immersion oil or other index matching compounds with your device. They are liable to impair and dirty the surface of the device. In addition, the characteristics of your device can be changed and your measurement results affected.

Cleaning Instrument Housings

Use a dry and very soft cotton tissue to clean the instrument housing and the keypad. Do not open the instruments as there is a danger of electric shock, or electrostatic discharge. Opening the instrument can cause damage to sensitive components, and in addition your warranty will be voided.

Cleaning Procedures

If you are unsure about the correct cleaning procedure for your device or if you are unsure whether the procedure given here is suitable for your device, check with the manufacturer or sales distributor, or try the procedure on a dummy or test device first.

Cleaning Cable Connectors

Cleaning connectors is difficult as the core diameter of a singlemode fiber is only about $9\mu\text{m}$. This generally means you cannot see streaks or scratches on the surface. To be certain of the condition of the surface of your connector and to check it after cleaning, you need a microscope.

For scratches, or dust that has been burnt onto the surface of the connector, you may have no option but to polish the connector. This depends on the degree of dirtiness, or the depth of the scratches. This is a difficult procedure and should only be done by skilled personal, and as a last resort as it wears out your connector.

Warning

Never look into the end of an optical cable that is connected to an active source.

To assess the projection of the emitted light beam you can use an infrared sensor card. Hold the card approximately 5 cm from the output of the connector. The invisible emitted light is project onto the card and becomes visible as a small circular spot.

Preferred Procedure

1. Clean the connector by rubbing a new, dry cotton-swab over the surface using a small circular movement.
2. Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the connector:

1. Moisten a new cotton-swab with isopropyl alcohol.
2. Clean the connector by rubbing the cotton-swab over the surface using a small circular movement.
3. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
4. Blow away any remaining lint with compressed air.

- An Alternative Procedure** The better, more gentle, but more expensive cleaning procedure is to use an ultrasonic bath with isopropyl alcohol.
1. Hold the tip of the connector in the bath for at least three minutes.
 2. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
 3. Blow away any remaining lint with compressed air.

Cleaning Connector Adapters

Caution

Some adapters have an anti-reflection coating on the back to reduce back reflection. This coating is extremely sensitive to solvents and mechanical abrasion. Extra care is needed when cleaning these adapters.

- Preferred Procedure**
1. Clean the adapter by rubbing a new, dry cotton-swab over the surface using a small circular movement.
 2. Blow away any remaining lint with compressed air.

- Procedure for Stubborn Dirt** Use this procedure particularly when there is greasy dirt on the adapter:
1. Moisten a new cotton-swab with isopropyl alcohol.
 2. Clean the adapter by rubbing the cotton-swab over the surface using a small circular movement.
 3. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
 4. Blow away any remaining lint with compressed air.

Cleaning Connector Interfaces

Caution

- Be careful when using pipe-cleaners, as the core and the bristles of the pipe-cleaner are hard and can damage the interface.
- Do not use pipe-cleaners on optical head adapters, as the hard core of normal pipe cleaners can damage the bottom of an adapter.

- Preferred Procedure**
1. Clean the interface by pushing and pulling a new, dry pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.
 2. Then clean the interface by rubbing a new, dry cotton-swab over the surface using a small circular movement.
 3. Blow away any remaining lint with compressed air.

**Procedure for
Stubborn Dirt**

Use this procedure particularly when there is greasy dirt on the interface:

1. Moisten a new pipe-cleaner with isopropyl alcohol.
2. Clean the interface by pushing and pulling the pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.
3. Moisten a new cotton-swab with isopropyl alcohol.
4. Clean the interface by rubbing the cotton-swab over the surface using a small circular movement.
5. Using a new, dry pipe-cleaner and a new, dry cotton-swab remove the alcohol, any dissolved sediment and dust.
6. Blow away any remaining lint with compressed air.

Cleaning Bare Fiber Adapters

Bare fiber adapters are difficult to clean. Protect from dust unless they are in use.

Caution

Never use any kind of solvent when cleaning a bare fiber adapter as

- Solvents can damage the foam inside some adapters.
- They can deposit dissolved dirt in the groove, which can then dirty the surface of an inserted fiber.

**Preferred
Procedure**

Blow away any dust or dirt with compressed air.

**Procedure for
Stubborn Dirt**

Use this procedure particularly when there is greasy dirt on the adapter:

Caution

Be careful when using pipe-cleaners, as the core and the bristles of the pipe-cleaner are hard and can damage the adapter.

1. Clean the adapter by pushing and pulling a new, dry pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.
2. Clean the adapter by rubbing a new, dry cotton-swab over the surface using a small circular movement.
3. Blow away any remaining lint with compressed air.

Cleaning Bare Fiber Ends

Bare fiber ends are often used for splices or, with other optical components, to create a parallel beam. The end of a fiber can often be scratched. You make a new cleave. To do this:

1. Strip off the cladding.
2. Take a new soft-tissue and moisten it with isopropyl alcohol.
3. Carefully clean the bare fiber with this tissue.
4. Make your cleave and immediately insert the fiber into your bare fiber adapter to protect the surface from dirt.

Cleaning Physical Contact Interfaces

Remove any connector interfaces from the optical output of the instrument before you start the cleaning procedure.

Cleaning interfaces is difficult as the core diameter of a singlemode fiber is only about $9\mu\text{m}$. This generally means you cannot see streaks or scratches on the surface. To be certain of the degree of pollution on the surface of your interface and to check whether it has been removed after cleaning, you need a microscope.

Warning

Never look into an optical output, because this can seriously damage your eye sight.

To assess the projection of the emitted light beam you can use an infrared sensor card. Hold the card approximately 5 cm from the interface. The invisible emitted light is project onto the card and becomes visible as a small circular spot.

- Preferred Procedure**
1. Clean the interface by rubbing a new, dry cotton-swab over the surface using a small circular movement.
 2. Blow away any remaining lint with compressed air.

- Procedure for Stubborn Dirt**
- Use this procedure particularly when there is greasy dirt on the interface:
1. Moisten a new cotton-swab with isopropyl alcohol.
 2. Clean the interface by rubbing the cotton-swab over the surface using a small circular movement.
 3. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
 4. Blow away any remaining lint with compressed air.

Cleaning Recessed Lens Interfaces

- Preferred Procedure**
1. Blow away any dust or dirt with compressed air.
- If this is not sufficient, then
1. Clean the interface by rubbing a new, dry cotton-swab over the surface using a small circular movement.
 2. Blow away any remaining lint with compressed air.

**Procedure for
Stubborn Dirt**

Use this procedure particularly when there is greasy dirt on the interface, and using the procedure for light dirt is not sufficient. Using isopropyl alcohol should be your last choice for recessed lens interfaces because of the difficulty of cleaning out any dirt that is washed to the edge of the interface:

1. Moisten a new cotton-swab with isopropyl alcohol.
2. Clean the interface by rubbing the cotton-swab over the surface using a small circular movement.
3. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
4. Blow away any remaining lint with compressed air.