

User's Guide

HP E5974A Dual Laser Source

SERIAL NUMBERS

This manual applies to all instruments.



HP Part No. E5974-91011
Printed in the Federal Republic of Germany

First Edition
E0696

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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 : E5974-91011 : E0696

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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 dual laser source.

Switching the Laser Source On

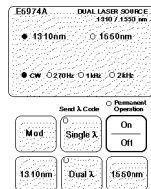
Note



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

To switch the laser source on:

1. Press **On/Off**.



The Laser Source at Power On

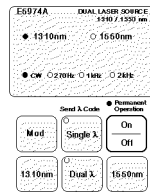
The CW and the 1310nm indicators light to show that the source is on. The source is active (radiating) as long as the instrument is switched on.

If the laser 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 Laser Source On Permanently

To switch the laser source on for permanent operation:

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



The Laser Source at Power On for Permanent Operation

3. Release **On/Off**.

The CW and 1310nm indicators also light. The source is active (radiating) as long as the instrument is switched on.

If the laser 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 Laser Source Off

To switch the laser source off:

1. Press **On/Off**.

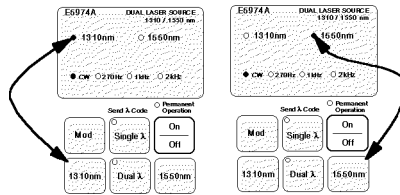
Setting the Wavelength

There are three possibilities for setting the wavelength:

- 1310nm,
- 1550nm,
- Alternating between 1310nm and 1550nm.

Selecting a Single Wavelength

To select a wavelength, press the button. The indicator lights.



Wavelength Buttons and Indicators

Sending the Wavelength to the Power Meter

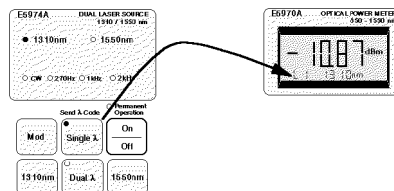
If you are using an HP E5970A Optical Power Meter, you can use the Send λ Code function to set the wavelength on the power meter automatically.

Note



Because the source uses amplitude modulation of the laser signal to tell the power meter the wavelength, the power output of the source is reduced by 3dBm when sending the λ code.

1. Connect your test system, with the dual laser source and the power meter.
2. Select the wavelength on the source by pressing **1310nm**, or **1550nm**.
3. Press **Single λ** on the source.



Sending the λ code (at 1310nm)

The power meter now shows the wavelength, and L1 for the modulation.

You can change the wavelength as usual by pressing **1310nm** or **1550nm**.

Switching Off the λ Code. To stop sending the λ code press **Mod** once.

The power meter will return to its original wavelength setting when the λ code is switched off.

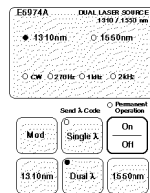
Outputting Both Wavelengths

Note



Because the source uses amplitude modulation of the laser signal to tell the power meter the wavelength, the power output of the source is reduced by 3dBm when using dual λ .

Press **(Dual λ)** to get the source to output both 1310nm and 1550nm alternately.



Dual λ

Each wavelength is output for approximately 2 seconds. Sending the λ code is automatically enabled, so if you are using the HP E5970A Optical Power Meter it will automatically follow the changes in wavelength.

Switching Off Dual λ

To switch off the dual λ output press either **(1310nm)** or **(1550nm)** once.

Modulating the Output of the Source

You can modulate the output of the laser 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 **(Mod)** repeatedly to select the modulation.

An indicator lights beside the selected modulation.

If you cannot change the modulation, check that Dual λ is off (press either **(1310nm)** or **(1550nm)** to switch it off).

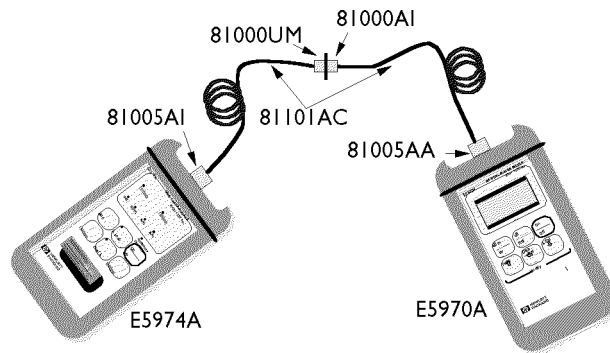
Example: Making a Loss Measurement at Two Wavelengths

This example describes how to measure the loss due to a badly made connection at both wavelengths.

In this example, we use

- The HP E5970A Optical Power Meter with a HP 81005AA HMS-10 Adapter,
- A HP E5974A Dual Laser Source with a HP 81005AI HMS-10 Adapter,
- Two HP 81101AC Diamond HMS-10/HP to HMS-10/HP Patchcords,
- HP 81000UM Universal Through Adapter with a HP 81000AI HMS-10 Adapter.

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



Set Up for Loss Measurement Example

- a. Switch on both the instruments.
- b. Press **(Dual λ)** on the laser source.
2. Measure the references:
 - a. Wait until the power meter is at 1310nm, then press **(Disp→Ref)**.
 - b. Wait until the power meter is at 1550nm, then press **(Disp→Ref)**.
3. Make the DUT.
 - a. Separate the two connectors in the through adapter (HP 81000UM).
4. Measure the loss:
 - a. Read the value for the loss on the display of the power meter at each of the wavelengths.

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 28 hours, or two 1.2V rechargeable batteries for an operating period of approximately 9 hours.

When the batteries are low, the indicator for Continuous Operation starts blinking. At this stage, there is approximately enough charge for another 30 minutes of use.

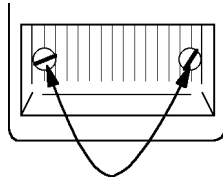
AC Adapter

The Laser source can also be powered by an AC Adapter (see “AC Adapter (HP E5974A only)” in Appendix B, for more information on the adapter).

Changing the Batteries

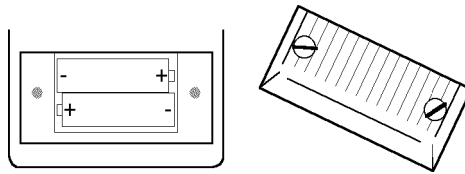
To change the batteries,

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



The Thumbscrews on the Rear of the Instrument.

2. Remove the cover.



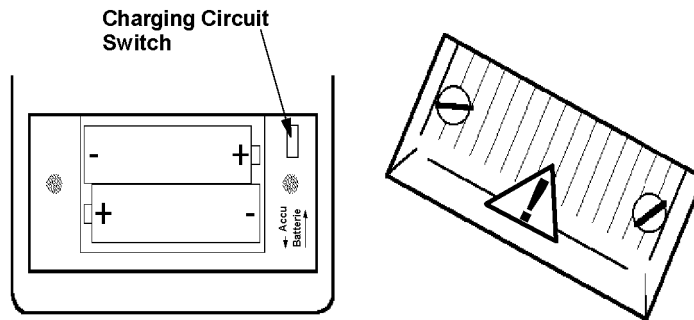
Removing the Rear Cover.

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.

Recharging the Batteries

If you have a model with a serial number 3504 G 00229 or higher, you can recharge your batteries.

When you remove the rear cover, you will see a switch next to 2 arrows, labeled **Accu** and **Batterie**. You can use this switch to activate the charging circuit.



The charging circuit switch

The switch has two positions:

- **Batterie:** no charging.
- **Accu:** charging is enabled for using rechargeable batteries.



If you are using normal (not rechargeable) batteries, be sure that the switch is in the **Batterie** position.

The charging time is 14 hours if the machine is switched off, longer if the machine is switched on. Charging is automatically activated when connected to the AC power supply.

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

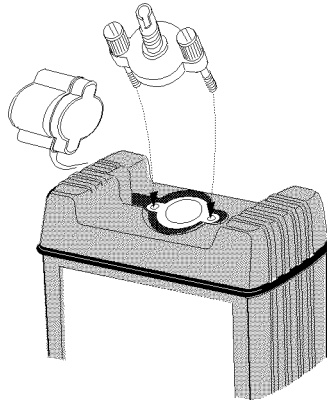
Warning



Be careful not to touch the ferrule while attaching the adapter. Any contact with the ferrule could dirty or damage it.

To attach an adapter:

1. Pull the dust cap off the ferrule.



Attaching the Adapter

2. Carefully place the adapter onto the ferrule.
3. Rotate the adapter until it is properly seated.
4. Tighten the sleeve with your fingers.

Removing a Connector Adapter

Warning



Be careful not to touch the ferrule while removing the adapter. Any contact with the ferrule could dirty or damage it.

To remove the adapter:

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

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.
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 9/125 μ m fiber, at constant temperature within a specified temperature window and with the line voltage uninterrupted.
Power Uncertainty / Repeatability	The uncertainty in generating a power level at the end of a 9/125 μ m patchcord. The connector is included (assuming specified HP connector-interfaces (HP/HMS-10, DIN 47256 or FC) and patchcords; connectors and patchcords must be absolutely clean and undamaged).
Center Wavelength	The wavelength representing the center of mass of the selected peaks. The power and wavelength of each spectral component are used in the calculation: $CenterWavelength = \bar{\lambda} = \sum \{P_i(\frac{\lambda_i}{P_0})\}$ <p>where P_i is the power of an individual peak, and P_0 is the total power, $\sum P_i$.</p>
Spectral Bandwidth (FWHM)	FWHM (full width at half the maximum) describes the spectral width of the half-power points of the laser, assuming a continuous, Gaussian distribution of power. The half-power points are those where the power-spectral density is one-half of the peak amplitude of the computed Gaussian curve. $FWHM = 2.355\sigma$ <p>where σ is an rms calculation of the spectral width of the laser based on a Gaussian distribution, using the power and wavelength of each spectral component</p> $\sigma = \sqrt{\sum \{P_i \frac{(\lambda_i - \bar{\lambda})^2}{P_0}\}}$

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 E5974A
Source Type	Fabry-Perot LD
Center Wavelength	1310±20nm 1550±20nm
Bandwidth (FWHM)	5nm typical
Output Power Level (typical)	-7dBm
Short Term Stability ^[1]	±0.1dB ±0.02dB typical
Long Term Stability ^[2]	±0.15dB typical
Temperature Coefficient	0.5nm/K typical
Power Uncertainty/Repeatability ^{[1][3]} Including connector	±1dB
Optical Output	Non-Contact, Removable Connector Adapters Single port, Straight contact.
Operating Time (typical)	28 hours 9 hours rechargeable

^[1] 15 minutes, constant temperature (±1K), +20 to +26°C, constant within ±1K, fiber type 9/125μm.
^[2] 8 hours, constant temperature (±3K), -10 to +50°C, constant within ±3K, fiber type 9/125μm.
^[3] With connectors HMS-10, DIN 47256, FC/PC.

C-2 Specifications

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%.

The automatic wavelength setting (Send λ Code) uses modulation frequencies of 350Hz and 550Hz.

Average power and dynamic range are decreased by 3dB with internal modulation on, dual wavelength mode, and in automatic wavelength setting mode.

Dynamic Range with E5970A Optical Power Meter at 1310nm is >63dB for a 9/125 μ m fiber.

Although not specified with angled connectors, the HP E5974A Dual Laser Source is compatible with most of them, e.g. APC and DIN 47256/4108. The expected output power reduction will be <10dB.

General Specifications

Power Supply

Dry Battery	2×AA 1.5V
Rechargeable NiCd Battery	2×AA 1.2V
AC Adapter ^[1] Auto Off Time ^[2]	20minutes (approx.)

Dimensions	95mmW×49mmH×195mmD 3.7"×1.9"×7.7"
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Net Weight ^[3]	500g (approx.)
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Operating Temperature	-10 to +55° C
Storage Temperature	-40 to +70° C
Relative Humidity	non-condensing

Recommended Recalibration Period	2 years
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Electromagnetic Compatibility according to EN 50 081-1, EN 50 082-1

^[1] see “AC Adapter (HP E5974A only)” in Appendix B

^[2] The Auto Off mode can be disabled.

The time given is after power on.

^[3] 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-HRL, 9/125 μ m	1	HP 81109AC
connector interface	1	HP 81000AI
connector adapter	1	HP 81005AI

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

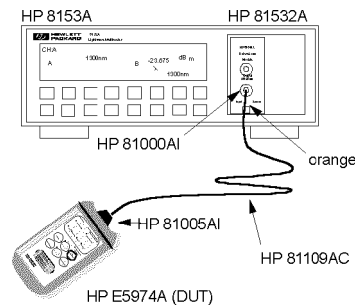
General

- 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	1310nm
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. Make sure that the wavelength on the DUT is set to 1310nm.
6. Note the displayed power level on the 8153A in the test report
7. Repeat this measurement (list item 6) with the DUT and the 8153A set to 1550nm.

D-2 Performance Test

- Note the displayed value in your test record.
8. Reset to measure mode:
 - a. press **Edit** to get SHOW.
 - b. press **Record** until you get STABILITY.
 - c. press **Mode** to get back to MEASURE Mode.
 9. Set the wavelength on the DUT and on the 8153A to 1550nm.
 10. Set 8153A to datalogging
 - a. press **Mode** to change to the menu mode.
 - b. press **Record** to get the STABILITY application
 - c. 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.

11. 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.

12. Reset to measure mode:
 - a. press **Edit** to get SHOW.
 - b. press **Record** until you get STABILITY.
 - c. press **Mode** to get back to MEASURE Mode.

Optional Test: Center Wavelength and Spectral Bandwidth (FWHM)

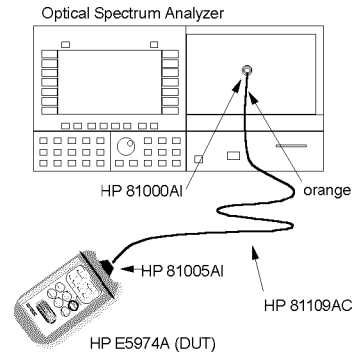
The laser has been tested, and the specifications include a theoretical drift of wavelength or bandwidth even if this is not likely. This test is not mandatory but optional.

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 E5974A (DUT)
4. Make sure the DUT is set to 1310nm.
5. 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 (FP for Fabry Perot laser).
6. To show the display in linear mode:
 - a. press **Menu**.
 - b. select **Amptd** on the left side of the display.
 - c. press **Linear** on the right side of the display.
7. 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.

8. From the displayed measurements check and note the values for mean waveln and FWHM.
9. Repeat the test with the DUT wavelength set to 1550nm.

Performance Test for the 4P E5972A

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-HRL, 9/125 μ m	HP 81109AC			
4. Connector interface	HP 81000AI			
5. Connector adapter	HP 81005AA			

Performance Test for the HP E5972A

Model HP E5972A LED Source No. _____ & sigspace; Date _____

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
I.	Output Power Level (CW) and Uncertainty fiber type 9/125 μ m Single Mode performed at 1310nm performed at 1550nm	-8.00 -8.00	dBm _____ _____	dBm -6.00 -6.00	_____ _____ _____ dB
II.	Short Term Stability performed at 1310nm DIFF Level variation peak-to-peak performed at 1550nm DIFF Level variation peak-to-peak		dBpp _____ _____	dBpp 0.2 0.04 typical 0.2 0.04 typical	_____ _____ _____ dB

Optional Performance Test for Center Wavelength and Spectral Bandwidth

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
III.	Center Wavelength and Spectral Bandwidth (FWHM) (Optional) performed at 1310nm Wavelength	nm	nm	nm	
		1290.00		1330.00	
				10	
				5 typical	
	performed at 1550nm Wavelength	1530.00		1570.00	
				10	
				5 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.