Errata

Title & Document Type: E5574A Optical Loss Analyzer User's Guide

Manual Part Number: E5574-91011

Revision Date: January 2000

HP References in this Manual

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Agilent Technologies

HP E5574A
Optical Loss Analyzer

User's Guide

Notices

Subject Matter

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Fourth Edition

January 2000

E5574-91011

E0100

(First Edition E0895)

(Second Edition E1096)

(Third Edition E0999)

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Herrenberger Str. 130
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HP E5574A Optical Loss Analyzer

User's Guide

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 1 instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

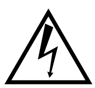
Operation – Before applying power Comply with the installation section. Additionally, the following shall be observed:

- Do not remove instrument covers when operating.
- Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers and devices connected to it should be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury.
- Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.
- Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.
- Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Be aware that energy at many points may, if contacted, result in personal injury.
- Any adjustments, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when unavoidable, should be carried out only by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present. Do not replace components with power cable connected.

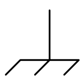
- Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Be aware that capacitors inside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

Safety Symbols

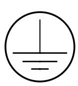
The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.



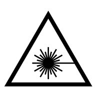
Caution, risk of electric shock.



Frame or chassis terminal.



Protective conductor terminal.



Hazardous laser radiation.

Electromagnetic interference (EMI)

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.

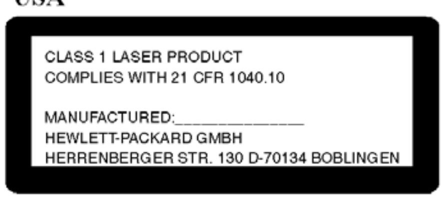
Initial Safety Information for Laser Source

The specifications for the laser source are as follows:

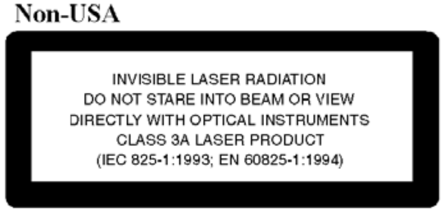
	E5574A
Laser Type	FP-Laser InGaAsP
Laser Class	
According to IEC 825 (Europe)	3A
According to 21 CFR 1040.10 (Canada, Japan, USA)	1
Output Power (CW)	less than 500 µW
Beam Waist Diameter	9 µm
Numerical Aperture	0.1
Wavelength	1310 ±20nm 1550 ±20nm

NOTE The laser safety warning labels are fixed on the front panel of the instrument.

USA



Non-USA



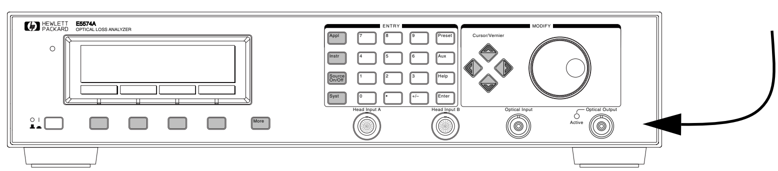
A sheet of laser safety warning labels is included with the laser module. You ***must*** stick the labels in the local language onto the outside of the instrument, in a position where they are clearly visible to anyone using the instrument.

NOTE

The Max. Output Power stated on the label located on the rear panel of the instrument are the maximum allowances for class 1 (USA) and class 3A (non-USA) laser products respectively.

The *real* output power of the built-in laser source(s) never exceeds 500 µW.

The recommended position for the laser safety warning label is the bottom right corner on the front of the instrument as shown by the arrow in the diagram below.



You ***must*** return instruments with malfunctioning laser modules to a HP Service Center for repair and calibration, or have the repair and calibration performed on-site by HP personnel.

The laser module has built in safety circuitry that disables the optical output in the case of a fault condition.

WARNING

Use of controls or adjustments or performance of procedures other than those specified for the laser source may result in hazardous radiation exposure.

WARNING

Refer Servicing only to qualified and authorized personnel.

WARNING

Do not enable the laser when there is no fiber attached to the optical output connector.
The optical output connector is at the bottom right corner of the

instrument's front panel.
The laser is enabled by pressing SOURCE ON/OFF. The laser is enabled when the green LED on the front panel of the laser module is lit.

WARNING **Under no circumstances look into the end of an optical cable attached to the optical output when the device is operational.**
The laser radiation is not visible to the human eye, but it can seriously damage your eyesight.

There is a safety circuit which monitors the average laser power output, and the power output of each laser pulse. If either the average or the pulse power is greater than the limit for the module, the laser will be disabled.

The Structure of this Manual

This manual is divided into four parts:

- General information and guidelines in chapter 1.
- The operating guide, describing how to use the instrument from the front panel, in chapters 2 to 7.
- The programming guide, describing how to operate the instrument remotely via the HP-IB, in chapter 8.
- Additional information not required for routinely day-to-day use in the appendix.

Conventions used in this Manual

- Quoted terms like “Pol. Depend. Loss” are menu items or applications, respectively.
- Small capitals are used to indicate front panel keys, e.g. PRESET.
- Grey text is used to indicate softkeys, e.g. SELECT.

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1 Introducing the HP E5574A Optical Loss Analyzer

2 Taking Polarization Dependent Measurements

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1

Introducing the HP E5574A Optical Loss Analyzer

Introducing the HP E5574A Optical Loss Analyzer

In this chapter you will find basic information about the HP E5574A Optical Loss Analyzer (OLA).

After reading this chapter you will know

- how the instrument works,
- which applications it supports,
- how it is operated.

1.1 The Components of the OLA

The HP E5574A Optical Loss Analyzer is a complete solution for the loss/gain characterization of active and passive optical components. The instrument has been optimized to measure the loss of optical fibers and components caused by different states of polarization.

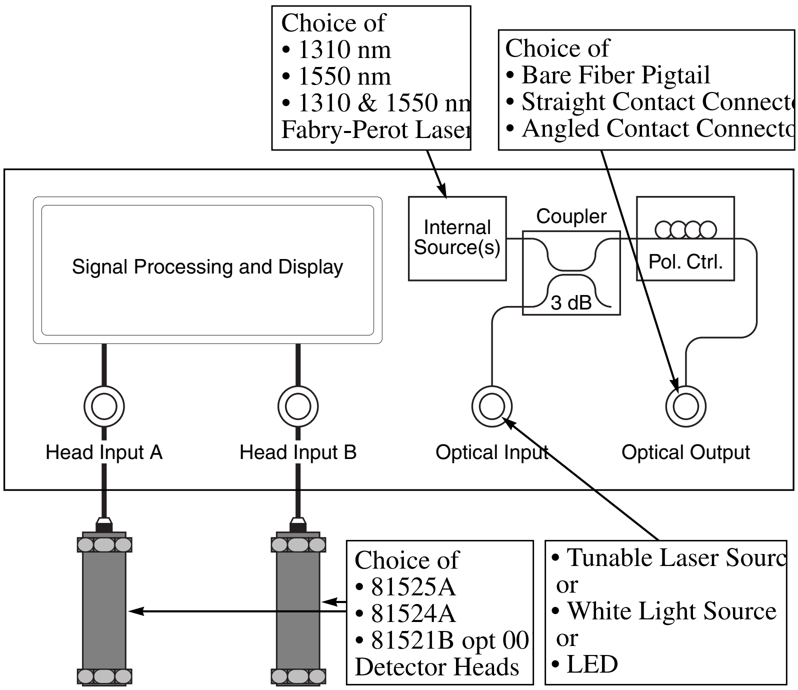


Figure 1-1 The OLA Components

The OLA consists of

- one or two built-in Fabry-Perot laser sources,
- a 3-dB optical coupler for the connection of an external source and for Return Loss measurements,
- a 4-paddle polarization controller for automatic sweep or manual setting of the polarization,
- an optical output with either a FC/PC terminated fiber pigtail, or a straight contact connector, or an angled contact connector,
- one or two optical heads, chosen to match wavelength and sensitivity requirements,
- the signal processing and display unit.

1.2 What You Can Do With the OLA

As one can see from Figure 1-1, the OLA has one output and three input ports. It therefore supports a variety of applications.

Operational Modes

You can set-up the OLA to perform as follows:

- It can serve as a highly stable source of linear polarized infra-red light with a wavelength of 1310 nm and/or 1550 nm.
- It can launch its own or any light from an external source to any optical device under test (DUT).
- It can circulate the optical output through all states of polarization or establish any desired state of polarization.
- Once the source power has been measured and stored, you can measure the Insertion Loss of any passive DUT, the output of which is connected to one of the optical heads.

- You can measure the optical power of any active optical device connected to one of the optical heads.
- You can measure two optical powers simultaneously (which is mandatory for comparing active or passive optical devices and for measuring optical couplers).
- You can measure the polarization dependent characteristics of the DUT, be that two-port devices or couplers.
- By connecting the sensor head to the optical input, you can measure the backreflection of a DUT, called Return Loss.

The OLA Applications

The OLA applications include the following measurements:

Insertion Loss (IL)

You measure the power loss of passive optical components.

Polarization Dependent Loss (PDL)

You measure the maximal power fluctuation caused by the DUT's sensitivity to changes in polarization.

Coupler Test

You measure the Coupling Ratio (CR), Splitting Ratio (SR), Insertion Loss (IL), Excess Loss (EL), and Directivity (DIR) of optical couplers.

Polarization Dependent Coupler Test

You measure the Polarization Dependent Coupling Ratio (PDCR), Splitting Ratio (PDSR), Loss (PDL), and Excess Loss (PDEL) of optical couplers.

PDL / Insertion Loss

You measure the Polarization Dependent Loss (PDL) and the averaged Insertion Loss (IL avg) simultaneously.

Return Loss (RL)

You measure the fraction of power which is scattered back to the source by a component.

Powermeter

You measure the absolute or relative power of one or two light sources in dBm or Watts.

1.3 The OLA Front Panel Keys

This paragraph deals with the operation of the OLA using the front panel keys and the rotary knob.

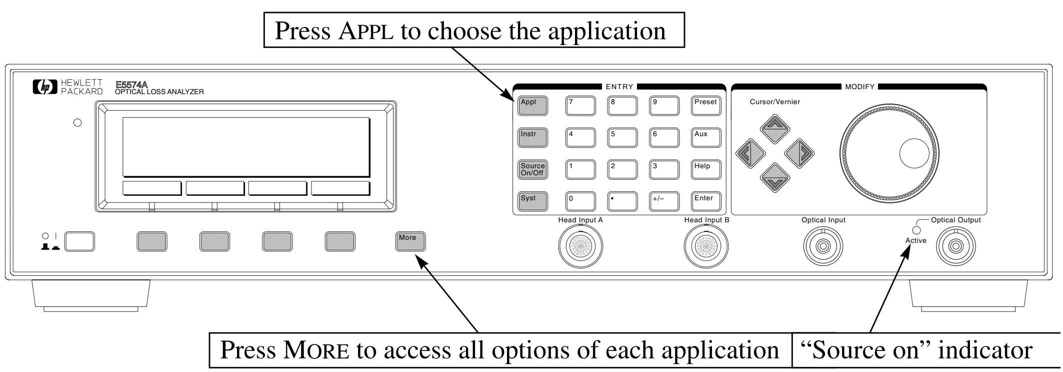


Figure 1-2 The OLA Front Panel

The OLA can also be operated remotely, controlled by a computer using the HP Interface Bus. See Chapter 8 “HP-IB Programming” for details.

The front panel shows (from left to right) the power on/off key, four keys below the display, the MORE key, a numerical keypad with additional function keys, four cursor control keys, and the rotary knob.

The Softkeys

The four keys below the display are softkeys (software controlled keys). Their meaning changes according to the instrument application you use.

The current function of each softkey is indicated in the corresponding box on the display.

The MORE Key

The key named MORE is used to activate and to display additional softkeys. An application can thus provide more than four softkeys.

After selecting an application, always press MORE to view any additional options provided by the application. Press MORE once again to return to the first screen.

The Keypad

The keypad comprises numerical keys as well as named keys.

The numerical keys can be used to enter numerical parameters.

The named keys can be pressed at any time. They are used as follows:

APPL Use this key to invoke the “Select Application” menu which shows the list of applications.

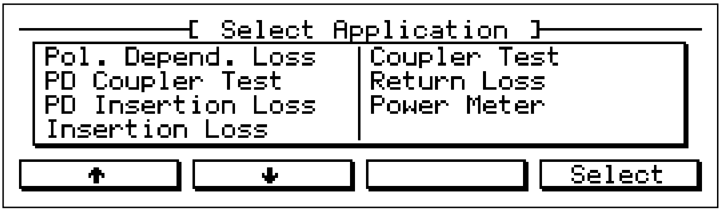


Figure 1-3 Select Application Display

With the softkeys, the cursor control keys, or the rotary knob you can choose any application. To start the highlighted application press SELECT or ENTER or APPL once more.

If you have started an application, you can directly access all relevant settings.

INSTR Use this key to invoke the “Select Instrument” menu. You can check or change the settings of the light source, the polarization controller, and the powermeter.

SOURCE ON/OFF Use this key to turn the internal laser light source on or off. The “Source on” indicator lamp shows the current state.

SYST Use this key to invoke the “System Configuration” screen. You can check and change the current HP-IB address of the instrument.

These settings apply to all the measurements you take.

PRESET Use this key to check and to change the general instrument settings for the measurement sensitivity and for the display of measured values.

ATTENTION Pressing this key does *not* reset the instrument to power-up defaults!

AUX Use this key to display the status of the software presently installed.

HELP Use this key to invoke the built-in help system.

ENTER Use this key to confirm the selection of a menu item or to terminate the manual input of a numerical parameter value.

The Cursor Control Keys

The use of the cursor control keys depends on the application.

↑ / ↓ Use these keys to either move the cursor on the display or to decrement/increment the highlighted parameter value.

→ / ← If the upper right-hand corner of the window frame on the display shows > or <, you use these keys to proceed to a second page or to return to the previous page.

When changing a numerical parameter, you can use these keys to move the cursor.

The Rotary Knob

The rotary knob performs like ↑ / ↓. It is especially useful if you want to increment or decrement a highlighted parameter value quickly and conveniently.

1.4 Operating the OLA

In general, the OLA is operated by means of the softkeys. Each application comes with its own set of softkeys.

For example:

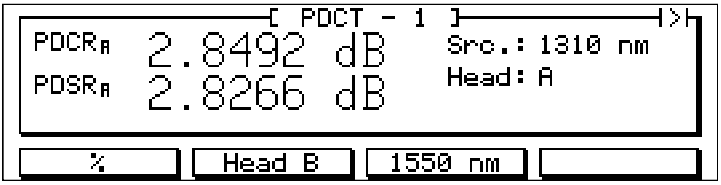


Figure 1-4 Example of an Application Display

The display shows not only the measured parameters and value(s), but also the current measurement conditions, which can be changed at the touch of a softkey.

If you want to measure the same parameters at head B or at another optical wavelength, simply press the corresponding softkey below the screen.

However, there are some exceptions to the rule.

Please note:

- The application may provide more options than are displayed. Press MORE to view any additional softkeys available.
- The > in the upper right-hand corner of the window frame indicates, that a second page exists. Press → to access this page. Press ← to return.
- If you chose a numerical parameter to be changed (by pressing the appropriate softkey), use the rotary knob, or ↑ / ↓, or the numerical keypad to set its new value.
- The named keys take precedence over the softkeys. If you press one of these keys, the current application will be suspended.

ATTENTION The display does not show the general instrument settings. These can only be accessed by pressing the PRESET key!

ATTENTION The display may burn in if it remains unchanged for longer than 24 hours. To avoid damaging the display:

- Change the appearance of the display occasionally.
- Turn off the OLA when it is not in use.

1.5 Help is Available

Whenever you are in doubt, press HELP.

You will get information about the current screen. If you need more information, press SEARCH.

You will then see an alphabetical list of related topics. This list covers the parameters displayed and all related softkeys, including those which are only available after pressing MORE. The list usually comprises several pages.

From this list, you can access help to any parameter and/or softkey.

1.6 Getting Started

This section is intended to give you general advice. Details can be found in chapters 2 to 7, depending on the application chosen.

Please follow these steps in the given order:

1. Power-on
2. General instrument settings
3. Zeroing the heads
4. Storing the reference power
5. Checking the stability

Power-On

The OLA has been designed to measure even very small changes of optical power.

How to Obtain the Highest Accuracy

1. After switching the instrument on and connecting the optical head(s), wait one hour before taking measurements.

After this warm-up time, the instrument will deliver measurement results within the specified measurement accuracy.

General Instrument Settings

The general instrument settings for display and sensitivity affect all subsequent measurements.

How to Check the General Instrument Settings

1 Press PRESET to check or change the general instrument settings.

You can change the number of digits to be displayed, the measurement and display mode, and the sensitivity.

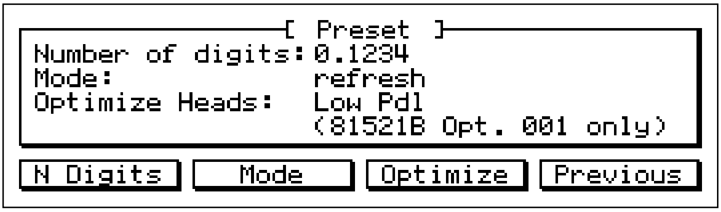


Figure 1-5 Preset Display

Number of Digits The standard setting is four digits. It may be desirable to reduce the number of digits, e.g. if the OLA is used for screening examinations of optical components.

To change the setting press N DIGITS.

Mode The measurement and display mode affects all polarization dependent measurements.

The standard setting is “refresh”: The display is updated continuously.

You may change this setting to “average”: The instrument measures one time interval, calculates the average and then stops. To repeat the measurement, the RESET softkey has to be pressed.

When measuring polarization dependent loss, please note: The PDL value is within the specified accuracy after the bargraph shown at the bottom of the display is filled.

In refresh mode, this value can change as the measuring window is a sliding window which is updated continuously. However, the accuracy of the PDL value will not improve over time.

In average mode, the measurement will continue and take an average over a second time window. After twice the time the PDL result is displayed and will not change any more. The display will blink during taking of the measurement and the average.

To change the setting press MODE.

Optimization of the Head(s) Standard setting is “Low PDL”: The power range is reduced to -64 dBm, but you get the highest possible polarization sensitivity (0.003 dBpp PDL). This setting is recommended for all polarization dependent measurements. It is only applicable if you use the optical heads HP 81521B opt. 001.

You can change the standard setting to “High sensitivity”: You get the maximal power range (-80 dBm), but less polarization sensitivity (0.012 dBpp PDL typical).

To change the setting press OPTIMIZE. Allow 20 s for switching between these modes.

To return to the last application or menu prior to pressing PRESET, press PREVIOUS.

Zeroing the Heads

Though it is not a must, it is recommended that the heads be zeroed once after the warm-up time. This ensures that the OLA will use the full sensitivity range of the heads.

Loss measurements are relative measurements, comparing the optical power transmitted to the device under test (DUT) with the power returned from the DUT.

Zeroing the heads is only necessary, if you wish to use the OLA to measure the absolute output power of optical devices. Zeroing is only required once after warm-up.

How to Zero the Heads

Most of the OLA applications provide the ZERO softkey.

1 Shield the optical head(s) from light.

  Do one of the following:

  - Screw the protection caps onto the heads.
  - Interrupt the signal path (e. g. by turning the source off).

2 Press APPL and activate “Powermeter”.

3 Press MORE to view the ZERO softkey.

4 Press ZERO.
  If there are two heads connected, both heads will be zeroed. The message “Light A” or “Light B” will be displayed, if one of the heads is still sensing a signal. In this case, zeroing is not possible. You can either disconnect the second head or repeat step one.

5 Wait some seconds until a power value is shown again.

6 Press APPL to terminate the “Powermeter” application.

After zeroing, the instrument is ready to measure absolute power values.

Note that the power range is independent of the source wavelength. Even if you change the wavelength, there is no need to zero the heads once again.

Storing the Reference Power

In order to measure the optical power loss of a device, you must first measure and store the power transmitted to the device. As long as you use one of the internal light sources and the same setup, this is required only once after warm-up (unless the room temperature changes drastically).

How to Measure the Reference Power

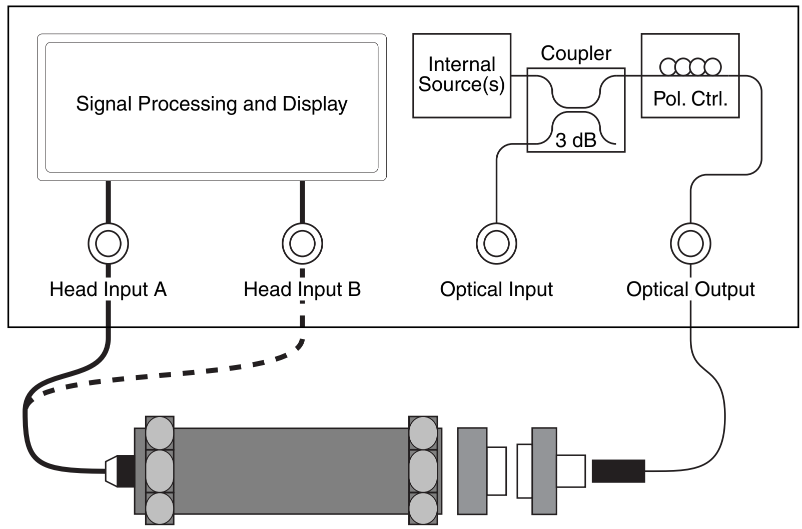


Figure 1-6 Setup for Measuring the Reference Power

1 Connect the optical output to the optical head you wish to use.

   Include all connectors and connector adaptors you are going to use for connection of your device under test.

2 Activate the optical output.

   If you decide to use the internal light source, press SOURCE ON/OFF to turn the source on. Watch the source indicator lamp.

   If you have connected an external light source to the optical input, press SOURCE ON/OFF to turn the internal source off.

WARNING **After connecting an external source to the optical input, light (eventually laser light) will emerge from the optical output even though the source indicator lamp is off! This happens even when the OLA is not connected to the mains or is switched off!**

3 Press APPL and activate "Powermeter".

4 Check the "Head" parameter on the display.

5 Press HEAD A or HEAD B, respectively, to activate the head to which you have connected the optical output.

6 Check the power output value on the display. For the internal source it should be around –7.5 dBm.

All of the OLA applications for loss measurements provide the DISP–>REF softkey.

7 Press DISP–>REF.

8 Press APPL to terminate the "Powermeter" application.

After storing the reference power, the instrument is ready to measure power loss.

ATTENTION If you change the interface adaptors or the source, you must measure and store the reference power anew.

Checking the Stability

Mechanical and electrical stability are vital issues in the measurement of optical characteristics.

After warm-up, the electrical stability of the OLA reaches or surpasses the values stated in its Technical Data sheet.

The mechanical stability depends on your setup.

After the first setup and after any change it is advisable to check the stability. Most of the OLA applications offer the STABILITY softkey.

How to Check the Stability

1 Press STABILITY to measure the variation of the optical power received by the head(s).
The instrument uses a sliding time window of 5 s and displays the difference between the highest and lowest power value

measured within that time. The display is automatically updated.

2 Observe the stability value.

If you leave your set-up untouched, it will reach a minimum.

You can decide whether the stability value supports your requirements or not. For example: If you are measuring a signal of 0.1 dB and only 10 % accuracy is required, a stability value of 0.01 dB may suffice.

However, in most cases a stability value below 0.002 dB can be achieved in a few seconds.

1.7 How to Obtain Exact Results

The accuracy and reproducibility of the measured results depend largely on your setup. It must be mechanically stable and you must attach adequate heads and connectors.

Mechanical Stability

The signal variations caused by polarization are usually rather small. Vibrations or movement of the optical cables will cause relatively large measurement errors.

The use of an optical workbench is therefore recommended. You should use adhesive tape or clamps to attach as much of the optical cables to the bench as possible.

Selection of the Optical Heads

See the HP E5574A Technical Data sheet for information on the optical heads.

Optical head HP 81521B opt. 001 is recommended for all polarization dependent measurements. It is the only head which has a specified polarization sensitivity of 0.003 dBpp for the measurement of polarization dependent power variations.

If you are using the optical heads HP 81524A or HP 81525A, respectively, please note that these heads are not suitable for polarization dependent measurements.

The Influence of the Output Connector

The fiber pigtail optical output provides polarization dependent loss measurements with the highest accuracy.

If your instrument is equipped with the straight or angled connector option, please remember:

Due to their construction, angled contact connectors usually exhibit a higher polarization dependent loss than straight contact connectors.

- Every connector or patchcord may induce measurement errors caused by polarization dependent loss of the connector or patchcord itself.
- It is important that you use high precision connectors with excellent physical glass-to-glass contact. Even the slightest gap within a connector pair will result in variable reflections, which can cause high errors and which may affect the laser source, too.
- Every connector between the source, the device under test, and the optical head reduces the overall sensitivity.

Taking Polarization Dependent Measurements

Taking Polarization Dependent Measurements

This chapter provides information on how to measure the loss of an optical component or the changes of the characteristics of an optical coupler caused by different states of polarization.

When you start one of the applications

- Pol. Depend. Loss,
- PD Coupler Test,
- PDL / Insert. Loss,

the built-in polarization controller begins to sweep. The light emerging from the optical output will pass through all states of polarization.

What you measure is basically the difference between the highest and lowest intensity caused by the continuously changing polarization and received by the optical head(s). The OLA uses a recursive algorithm which checks the PDL value and changes the measurement window (that is, the number of samples to be taken) so that the specified accuracy is achieved. The larger the PDL value is, the longer the measurement takes.

This chapter is divided into two sections:

- The measurement of the Polarization Dependent Loss of passive optical components.
- The measurement of the polarization dependent characteristics of optical couplers.

2.1 Measuring Polarization Dependent Loss

This section covers the use of the applications “Pol. Depend. Loss” and “PDL / Insert. Loss”. You can measure how the optical loss of passive components is affected by different states of polarization.

PDL Measurement Setup

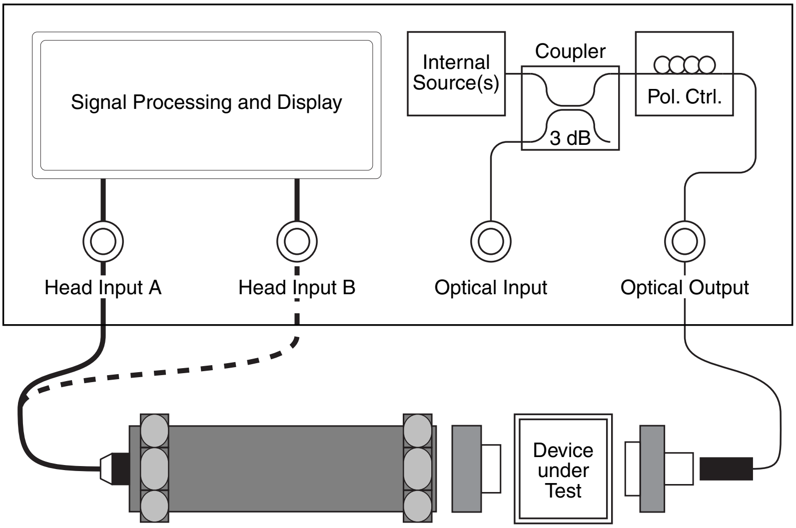


Figure 2-1 Setup for PDL Measurements

The same setup can be used to measure the Insertion Loss.

1 Connect the optical output to the input of the device under test (DUT).

2 Connect the optical head to the output of the DUT.

3 Activate the optical output.

If you use the internal light source, press SOURCE ON/OFF to turn the source on. The source indicator lamp must be lit.

If you have connected an external light source to the optical input, press SOURCE ON/OFF to turn the internal source off. The source indicator lamp must be off.

Starting the Measurement

1 Press APPL to activate the “Select Applications” menu.

2 Choose “Pol. Depend. Loss”.

3 Wait until the result is displayed.

The OLA immediately starts to measure. Depending on the PDL value, the instrument automatically chooses the right amount of samples to achieve the specified accuracy. The bargraph at the bottom of the display shows the measurement in progress. The larger the PDL value of the DUT is, the longer the measurement takes.

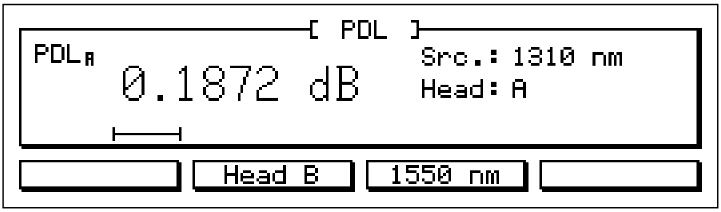


Figure 2-2 Polarization Dependent Loss Display

Checking the Measurement Conditions

1 If not already done, check the general instrument settings by pressing PRESET.

For highest resolution, the “Number of Digits” should read 0.1234 and “Low PDL” should be set. The “Mode” will affect the measuring method (see section 1.6 “Getting Started” on page 31). Press PREVIOUS to return to PDL.

2 Check the “Head” parameter on the display. If it does not show the head to which you connected the DUT, press HEAD A or HEAD B respectively.

Before you record the first PDL value on your test protocol, it is important to check the stability of your setup.

Checking the Stability of the Setup

1 Press MORE.

2 Press STABILITY.

3 Check the stability value. Refer to page 31 in section 1.6 “Getting Started” for information on the stability value.

4 Press PREVIOUS to return to the previous page and read the PDL.

Repeating the PDL Measurement

If the display is not updated continuously, because you are in average mode, you must restart the PDL measurement manually.

1 Press RESTART.

Measuring PDL and Insertion Loss Simultaneously

ATTENTION Before you measure Insertion Loss, you must at least measure and store the reference power P ref. If you have not yet stored the reference power, refer to page 31 in section 1.6 “Getting Started”.

1 Press APPL to activate the “Select Applications” menu.

2 Choose “PDL / Ins. Loss”.

The instrument immediately starts to measure. Wait until the values are displayed.

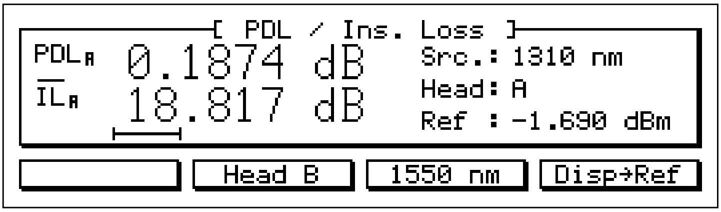


Figure 2-3 Polarization Dependent Loss / Insertion Loss Display

Explanation of the Results

The values are calculated according to the following formulas:

Polarization Dependent Loss

$$PDL = 10 \cdot \log \frac{P_{max}}{P_{min}}$$

$$PDL_{A/B}(dB) = 10 \cdot \log \frac{P_{A/B}\ max}{P_{A/B}\ min}$$

For most components (except polarizers) the PDL is much smaller than the Insertion Loss.

Averaged Insertion Loss

The Insertion Loss is defined as

$$IL_{A/B}(dB) = -10 \cdot \log\frac{P_{A/B}}{P\ ref}$$

You will notice a difference in readings for the insertion loss values measured with the applications “Insertion Loss” or “PDL / Ins. Loss” respectively.

The reason is that the average insertion loss measured with “PDL / Ins. Loss” represents a PDL independent insertion loss value.

$$IL_{A/B}\ avg = \frac{IL_{A/B}\ max + IL_{A/B}\ min}{2}$$

The value for Averaged Insertion Loss is the same as if measured with an unpolarized source such as an LED.

2.2 Measuring the Polarization Dependent Characteristics of Couplers

This section covers the use of the application “PD Coupler Test”. You can measure how the Coupling Ratio, the Splitting Ratio and other parameters change with polarization.

PD Coupler Test Measurement Setup

Two optical heads are required to measure the properties of optical couplers.

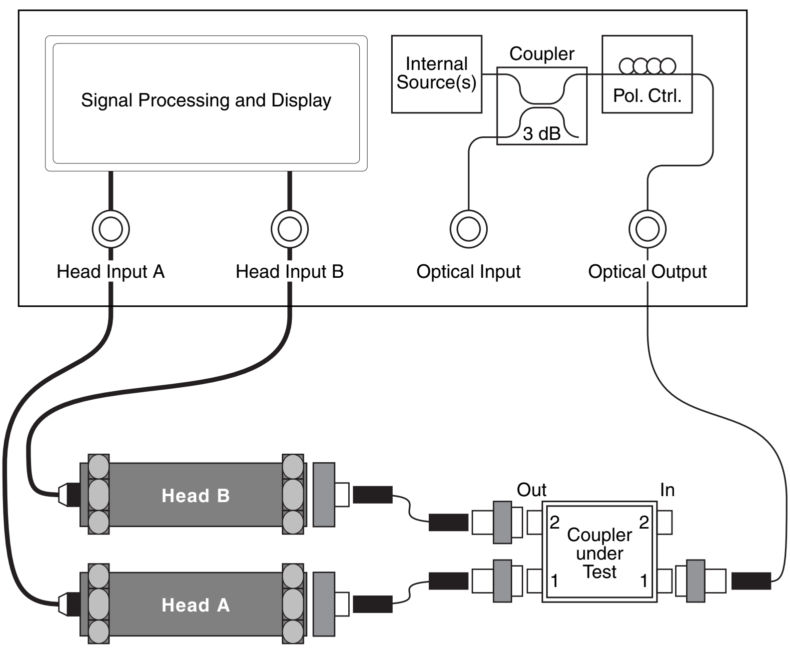


Figure 2-4 Setup for PD Coupler Test

Measuring the Polarization Dependent Characteristics of Couplers

The same setup can be used for the standard coupler test.

1 Connect the optical output to input no. 1 of the device under test (DUT).

2 Connect optical head A to output no. 1 of the DUT.

3 Connect optical head B to output no. 2 of the DUT.

4 Activate the optical output.

   If you use the internal light source, press SOURCE ON/OFF to turn the source on. The source indicator lamp must be lit.

   If you have connected an external light source to the optical input, press SOURCE ON/OFF to turn the internal source off. The source indicator lamp must be off.

Starting the Measurement

1 Press APPL to activate the “Select Applications” menu.

2 Choose “PD Coupler Test”.

   The first page of the polarization dependent coupler test is displayed.

3 Wait until the results are displayed.

The OLA immediately starts to measure. Depending on the PDL value, the instrument automatically chooses the right amount of samples to achieve the specified accuracy. The bargraph at the bottom of the display shows the measurement in progress. The larger the PDL value of the DUT is, the longer the measurement takes.

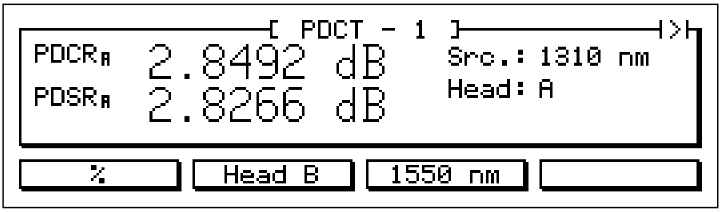


Figure 2-5 Polarization Dependent Coupler Test Display, Page 1

Measuring the Polarization Dependent Characteristics of Couplers

The display shows the measured values for the Polarization Dependent Coupling Ratio (PDCR) and the Polarization Dependent Splitting Ratio (PDSR).

Checking the Measurement Conditions

1 If not already done, check the general instrument settings by pressing PRESET.

For highest resolution, the “No. of Digits” should read 0.1234 and “Low PDL” should be set. The “Mode” will affect the measuring method (see section 1.6 “Getting Started” on page 31). Press PREVIOUS to return to the PD Coupler Test.

2 Check the “Head” parameter on the display. If you want to measure the other output of the coupler, press HEAD A or HEAD B respectively.

Before you record the values of the Polarization Dependent Coupling Ratio and the Polarization Dependent Splitting Ratio on your test protocol, it is important to check the stability of your setup.

Checking the Stability of the Setup

1 Press MORE.

2 Press STABILITY.

3 Check the stability value. Refer to page 31 in section 1.6 “Getting Started” for information on the stability value.

4 Press PREVIOUS to return to the previous page and read the PDL.

Continuing the Measurement

1 Press % to display the measured values in percent.

2 Press DB to change the measuring unit to dB.

3 Press → to view the second page of the application.

Page two shows the measured values for Polarization Dependent Loss (PDL) and Polarization Dependent Excess Loss (PDEL).

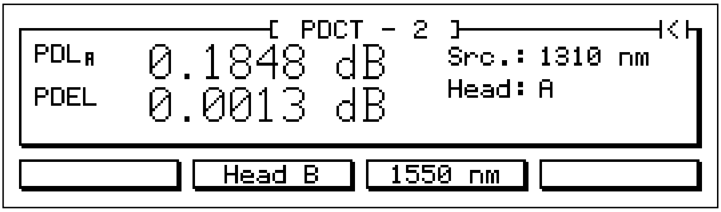


Figure 2-6 Polarisation Dependent Coupler Test Display, Page 2

4 Press ← to return to the first page.

Repeating the Measurement

If the display is not updated continuously, because you are in average mode, you must restart the PD Coupler Test manually.

1 Press RESTART.

Explanation of the Results

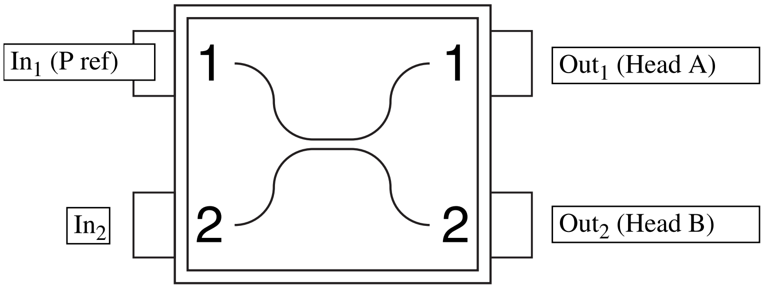


Figure 2-7 Connection Scheme for Optical Couplers

If this is your setup, you have measured the following parameters:

Polarization Dependent Coupling Ratio

$PDCR_{A/B} = CR_{A/B}$ max – $CR_{A/B}$ min

$CR_{A/B}$ max = $Out_{1/2}$ max / (Out_1 max + Out_2 max)

$CR_{A/B}$ min = $Out_{1/2}$ min / (Out_1 min + Out_2 min)

$PDCR_{A/B}$ (%) = $CR_{A/B}$ max (%) – $CR_{A/B}$ min (%)

Since you are measuring variations only, $PDCR_A$ (%) is equal to $PDCR_B$ (%).

$PDCR_{A/B}$ (dB) = – 10 log [$CR_{A/B}$ max / $CR_{A/B}$ min]

Note that $PDCR_A$ (dB) is not equal to $PDCR_B$ (dB).

Measuring the Polarization Dependent Characteristics of Couplers

Polarization Dependent Splitting Ratio

$PDSR_{A/B} = SR_{A/B}\ max - SR_{A/B}\ min$

$SR_{A/B}\ max = Out_{1/2}\ max\ /\ Out_{2/1}\ max$

$SR_{A/B}\ min = Out_{1/2}\ min\ /\ Out_{2/1}\ min$

$PDSR_{A/B}\ (\%) = SR_{A/B}\ max\ (\%) - SR_{A/B}\ min\ (\%)$

$PDSR_{A/B}\ (dB) = -10\ log\ [SR_{A/B}\ max\ /\ SR_{A/B}\ min]$

Note that $PDSR_A$ (%) is not equal to $PDSR_B$ (%), while $PDSR_A$ (dB) is equal to $PDSR_B$ (dB).

Polarization Dependent Loss

$PDL_{A/B}\ (dB) = 10\ log\ [Out_{1/2}\ max\ /\ Out_{1/2}\ min]$

Polarization Dependent Excess Loss

PDEL (dB) = EL max (dB) – EL min (dB)

$EL\ max\ (dB) = -10\ log\ [(Out_1\ max + Out_2\ max)\ /\ P\ ref]$

$EL\ min\ (dB) = -10\ log\ [(Out_1\ min + Out_2\ min)\ /\ P\ ref]$

$PDEL\ (dB) = -10\ log\ [(Out_1\ max + Out_2\ max)/(Out_1\ min + Out_2\ min)]$

Measuring the Polarization Dependent Characteristics of Couplers

Taking Standard Loss Measurements

Taking Standard Loss Measurements

This chapter provides information on how to measure the Insertion Loss and the Return Loss of passive optical components.

This chapter is divided into two sections:

- Measuring the Insertion Loss
- Measuring the Return Loss

3.1 Measuring the Insertion Loss

This section covers the use of the application “Insertion Loss” to measure the ratio of the optical power emerging from a device to the power launched into that device.

Note: The attenuation of polarized light usually differs from the attenuation of unpolarized light. However, you can measure the same averaged Insertion Loss as with an unpolarized source even with the internal source. This is accomplished by using the application “PDL / Ins. Loss” (see section 2.1 “Measuring Polarization Dependent Loss” on page 41).

ATTENTION Before you measure the Insertion Loss, you must at least measure and store the reference power P ref. If you have not yet stored the reference power, refer to page 31 in section 1.6 “Getting Started”.

Insertion Loss Measurement Setup

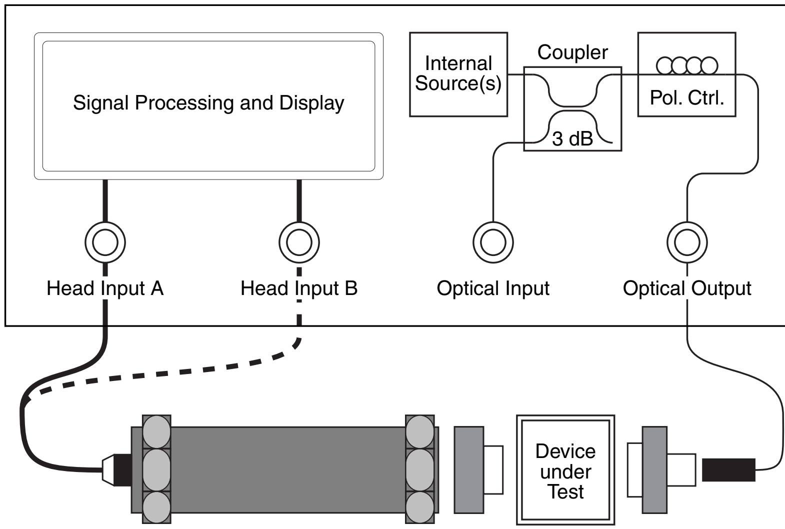


Figure 3-1 Setup for Insertion Loss Measurements

The same setup can be used to measure the Polarization Dependent Loss.

1 Connect the optical output to the input of the device under test (DUT).

2 Connect the optical head which was used to measure and store the reference power to the output of the DUT.

3 Activate the optical output.

If you wish to use the internal light source, press SOURCE ON/OFF to turn the source on. The source indicator lamp must be lit.

If you have connected an external light source to the optical input, press SOURCE ON/OFF to turn the internal source off. The source indicator lamp must be off.

Starting the Measurement

1 Press APPL to activate the “Select Applications” menu.

2 Choose “Insertion Loss”.

The OLA displays the Insertion Loss value almost immediately.

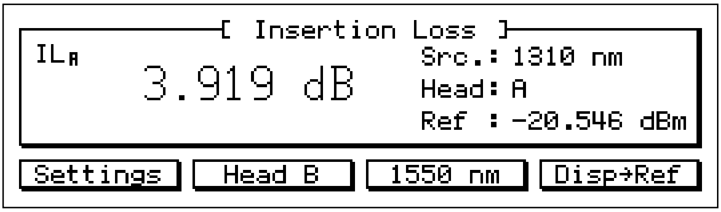


Figure 3-2 Insertion Loss Display

The value is updated automatically.

Checking the Measurement Conditions

1 If not already done, check the general instrument settings by pressing PRESET (see section 1.6 “Getting Started” on page 31). Press PREVIOUS to return to the IL measurement.

2 Check the “Head” parameter on the display. If it does not show the head to which you have connected the DUT, press HEAD A or HEAD B respectively.

Note that the same setting of “T avg” is used by the “Powermeter” application.

3 Press SETTINGS to view the time span “T avg” used for the measurement.

The power is integrated over a time window. The value displayed represents an average. You can change the size of this window by repeatedly pressing AVERAGE.

4 Press PREVIOUS to return to the measurement screen.

Before you record the Insertion Loss value on your test protocol, it is good practice to check the stability of your setup.

Checking the Stability of the Setup

1 Press MORE.

2 Press STABILITY.

3 Check the stability value. Refer to page 31 in section 1.6 "Getting Started" for information on the stability value.

4 Press PREVIOUS to return to the previous page and read the PDL.

Explanation of the Result

The IL value is calculated according to the following formula:

Insertion Loss

$IL_{A/B}$ (dB) = – 10 log [$P_{A/B}$ / P ref]

3.2 Measuring the Return Loss

This section explains how to measure the Return Loss, i. e. the ratio of the optical power launched into a device to the power reflected back to the source.

The Return Loss can only be measured by using the internal light source. Before you start measuring the Return Loss of a device under test (DUT), you need to calibrate your setup.

ATTENTION Before you calibrate the OLA for Return Loss, it is advisable to zero the optical head you are going to use. If you have not yet zeroed the head, refer to section 1.6 "Getting Started" on page 31.

Return Loss Calibration Setup

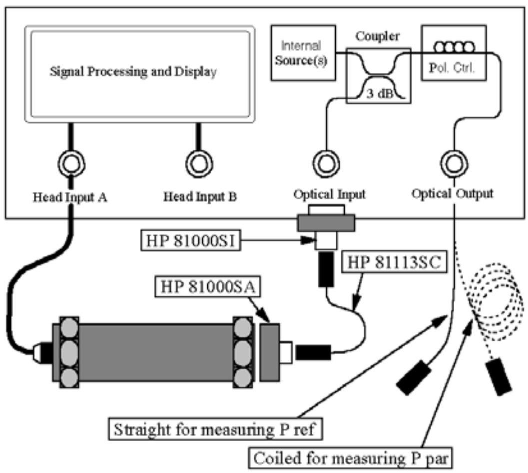


Figure 3-3 Setup for Return Loss Calibration

1. Connect the optical head A to the optical input of the OLA. For best performance, the connector adaptors HP 81000AI and HP 81000AA together with the patchcord HP 81102AC are recommended.

2. The measurement of a reference reflection is required for calibration.

   If your optical output is the fiber pigtail with FC/PC connector, leave it untouched and open-ended.

   If your instrument is equipped with one of the output connector options, attach the patchcord you are going to use for the device to it and leave the patchcord open-ended.

Calibrating for RL Measurements

Instead of measuring the power transmitted to the DUT, you can use the assumed backreflection of a glass-to-air transition as a reference.

To calibrate the instrument for Return Loss measurements you have to

- enter the assumed backreflection and
- measure and store the real backreflection and the power of parasitic reflections of your setup.

1 Press SOURCE ON/OFF to switch the source on. The source indicator lamp must be lit.

2 Press APPL to activate the “Select Applications” menu.

3 Choose “Return Loss”.

4 Check the “Head” parameter on the display. If it does not indicate the input to which you have connected the head, press HEAD A or HEAD B respectively.

5 Press SETTINGS.

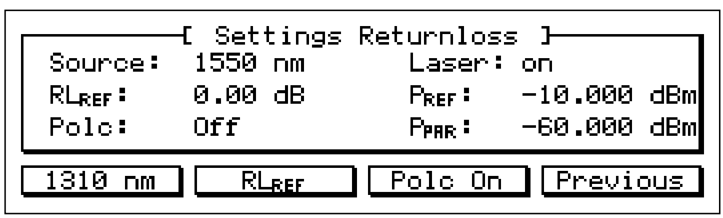


Figure 3-4 Return Loss Settings Display

If the refractive index of the fiber you are using differs largely from 1.458, you can set any adequate reference value.

6 Press RL REF.

Use the rotary knob to change the value. 14.7 dB is the usual backreflection of a well polished straight glass-to-air transition based on a fiber refractive index of 1.458. Store with ENTER or ENTER.

Note: Using the open-end reflection as a reference is simple and convenient. However, you can also use any other defined reflection, for instance a mirror.

7 Press PREVIOUS to return to the measurement screen.

8 Press CALIBRATE.

Figure 3-5 Return Loss Calibration Display

9 Press DISP–>P REF. The power reflected from the open end of the optical output and received by the optical head is stored as the reference power.

If there is no value displayed any more, the optical head has not been zeroed. Refer to page 31 in section 1.6 "Getting Started" to find out how to zero the head.

10 Wind the optical output fiber cable close to the open end in seven tight loops around a pen.

This almost eliminates the reflection from the open fiber end. The remaining optical power is caused by so-called parasitic reflections within the test setup. It should be as small as possible (below –50 dBm).

11 Press DISP–>P PAR. The current value is stored as the parasitic power.

12 Unwind the optical output fiber cable.

13 Press PREVIOUS to return to the measurement screen.

The display shows the open-end reflection.

You now are ready to attach your DUT.

Return Loss Measurement Setup

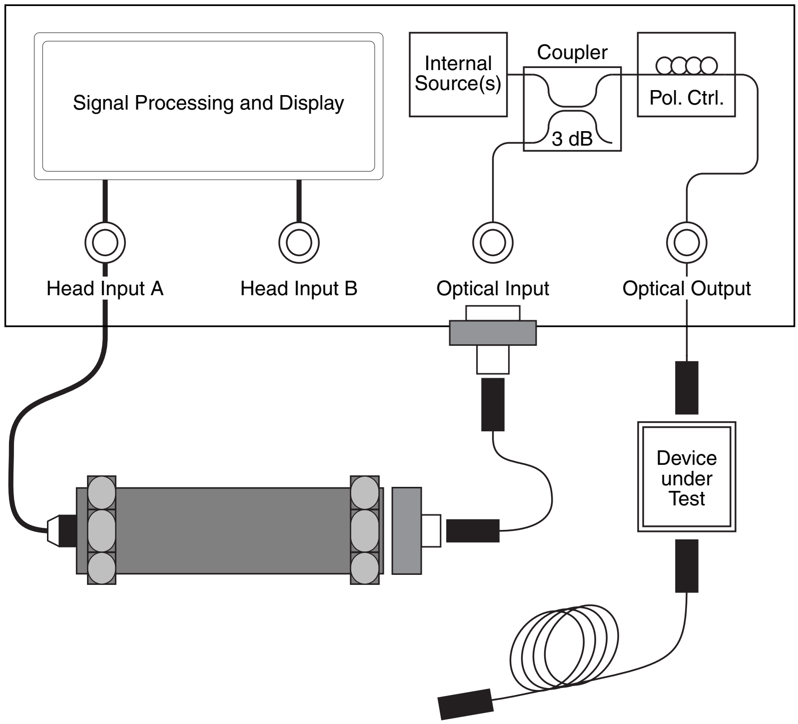


Figure 3-6 Setup for Return Loss Measurements

1. Connect the optical output to the input of the DUT.
2. If the DUT has no fiber output, attach a patchcord to its output.
3. Wind the fiber or patchcord close to its open end in seven tight loops around a pen.
   This will virtually eliminate the backreflection from the open end.

Starting the Measurement

The OLA measures the Return Loss automatically and continuously.

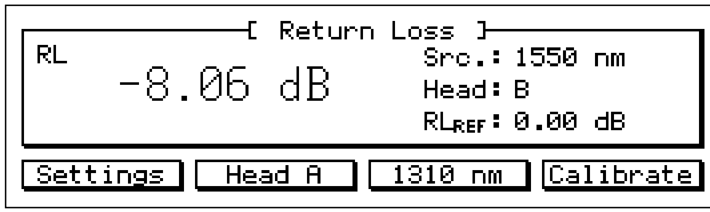


Figure 3-7 Return Loss Display

Before you record the value of the Return Loss on your test protocol, it is good practice to check the stability of your setup.

Checking the Stability of the Setup

1 Press MORE.

2 Press STABILITY.

3 Check the stability value. Refer to page 31 in section 1.6 “Getting Started” for information on the stability value.

4 Press PREVIOUS to return to the previous page and read the PDL.

Checking the Influence of Polarization

1 Press SETTINGS to view the current measurement conditions.

2 Press POLC ON if you want to sweep through all states of polarization (see also section 6.2 “Using the OLA as a Polarization Controller” on page 84).

3 Press PREVIOUS to return to the measurement screen. The polarization controller will begin to sweep.

To terminate the sweep you can either press APPL or press SETTINGS, followed by POLC OFF and PREVIOUS.

Explanation of the Result

The Return Loss is calculated according to the following formula:

Return Loss

$RL_{A/B}$ (dB) = – 10 log [($P_{A/B}$ – P par) / (P ref – P par)] + RL ref

Testing Optical Couplers

Testing Optical Couplers

This chapter provides information on how to measure the properties of optical couplers. It covers the application “Coupler Test”.

You can measure the following parameters:

- Coupling Ratio, which means the ratio of the power at one output to the total power of both outputs.
- Splitting Ratio, which means the ratio of the power at one output to the power at the other.
- Insertion Loss, which means the ratio of the power at one output to the input power.
- Excess Loss, which means the ratio of the total power of both outputs to the input power.
- Directivity, which means the ratio of the power at the secondary input to the input power.

ATTENTION Before you measure the characteristics of a coupler, you must at least measure and store the reference power P ref. If you have not yet stored the reference power, refer to page 31 in section 1.6 “Getting Started”.

4.1 Measuring Optical Coupler Characteristics

Coupler Test Measurement Setup

The same setup can be used for the polarization dependent coupler test.

Two optical heads are required to measure the properties of optical couplers.

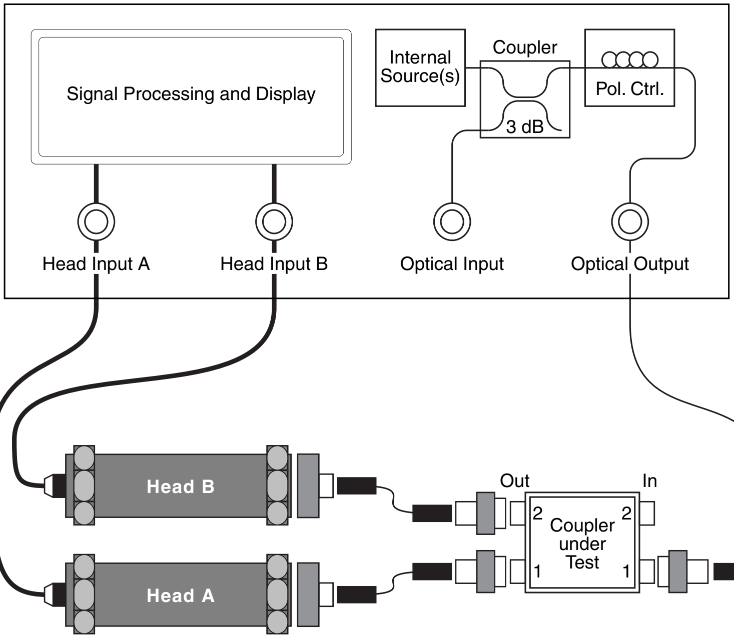


Figure 4-1 Setup for Coupler Test

1 Connect the optical output to input no. 1 of the device under test (DUT).

2 Connect optical head A to output no. 1 of the DUT.

3 Connect optical head B to output no. 2 of the DUT.

4 Activate the optical output.

If you want to use the internal light source, press SOURCE ON/OFF to turn the source on. The source indicator lamp must be lit.

If you have connected an external light source to the optical input, press SOURCE ON/OFF to turn the internal source off. The source indicator lamp must be off.

Starting the Measurement

1 Press APPL to activate the “Select Applications” menu.

2 Choose “Coupler Test”.

The first page of the coupler test is displayed.

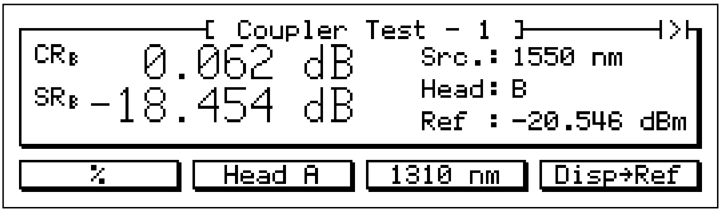


Figure 4-2 Coupler Test Display, Page 1

The display shows the measured values for the Coupling Ratio (CR) and the Splitting Ratio (SR).

Checking the Measurement Conditions

1 If not already done, check the general instrument settings by pressing PRESET (see section 1.6 “Getting Started” on page 31). Press PREVIOUS to return to the Coupler Test.

2 Check the “Head” parameter on the display. If you wish to measure the other output of the coupler, press HEAD B or HEAD A respectively.

3 Before recording the values of the Coupling Ratio and the Splitting Ratio on your test protocol, it is advisable to check the stability of your setup.

Checking the Stability of the Setup

1 Press MORE.

2 Press STABILITY.

3 Check the stability value. Refer to page 31 in section 1.6 “Getting Started” for information on the stability value.

4 Press PREVIOUS to return to the previous page and read the values.

Continuing the Coupler Test

1 Press % to display the measured values in percent.

2 Press DB to change the measuring unit to dB.

3 Press → to view the second page of the application.

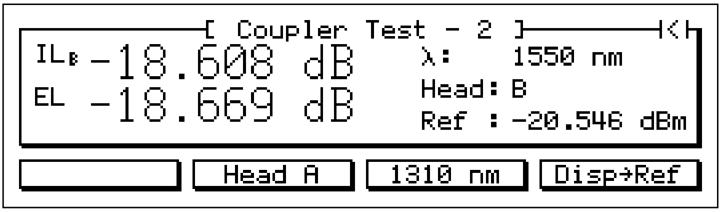


Figure 4-3 Coupler Test Display, Page 2

Page two shows the measured values for Insertion Loss (IL) and Excess Loss (EL).

4 Press ← to return to the first page.

Measuring the Directivity

The Directivity is a measure of the isolation between the two input ports of the coupler.

1 Connect one of the heads to the secondary input of the coupler.

2 Check the “Head” parameter on the display. If it does not show the head to which you have connected the secondary input, press HEAD B or HEAD A respectively.

3 Check the stability of your setup.

4 Press DIR.

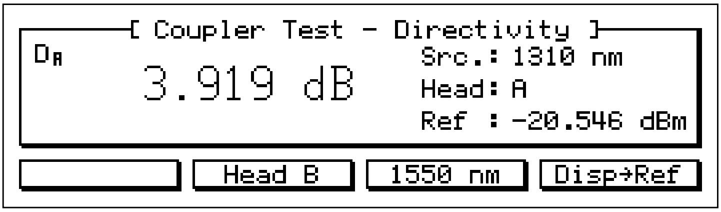


Figure 4-4 Coupler Test Directivity Display

5 Press MORE and COUP.TEST to return to the Coupler Test screen.

Explanation of the Results

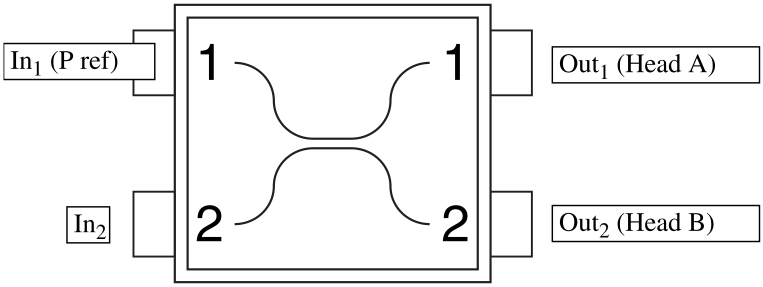


Figure 4-5 Connection Scheme for Optical Couplers

If this is your setup, you have measured the following parameters:

Coupling Ratio

$CR_{A/B}$ (%) = $Out_{1/2}$ / (Out_1 + Out_2)

$CR_{A/B}$ (dB) = – 10 Log [$Out_{1/2}$ / (Out_1 + Out_2)]

Splitting Ratio

$SR_{A/B}$ (%) = $Out_{1/2}$ / $Out_{2/1}$

$SR_{A/B}$ (dB) = – 10 Log [$Out_{1/2}$ / $Out_{2/1}$]

Insertion Loss

$IL_{A/B}$ (dB) = 10 log [$Out_{1/2}$ / P ref]

Excess Loss

EL (dB) = – 10 log [(Out_1 + Out_2) / P ref]

Directivity

$DIR_{A/B}$ (dB) = – 10 log [In_2 / P ref]

Measuring Power

Measuring Power

This chapter provides information on how to measure optical power, usually the power radiated by active optical devices. It covers the application “Powermeter”.

If you activate the built-in polarization controller, you can also measure the power at different states of polarization. This application is explained in *section 6.2 “Using the OLA as a Polarization Controller” on page 84.*

Using one optical head you can measure:

- The average power of a light source in dBm or W.
- The ratio of the power presently received to a power measured previously.
- The variation (fluctuation) of the power measured within a specified number of samples.

Using two optical heads you can measure:

- The average power and the power fluctuation of two light sources simultaneously.
- The ratio of the two powers presently received to a power measured previously.
- The ratio of one power to the other.

ATTENTION Before you measure optical power, it is necessary to zero the optical head(s). If you have not yet zeroed the head(s), refer to page 31 in section 1.6 “Getting Started”.

5.1 Measuring Absolute and Relative Power

Powermeter Measurement Setup

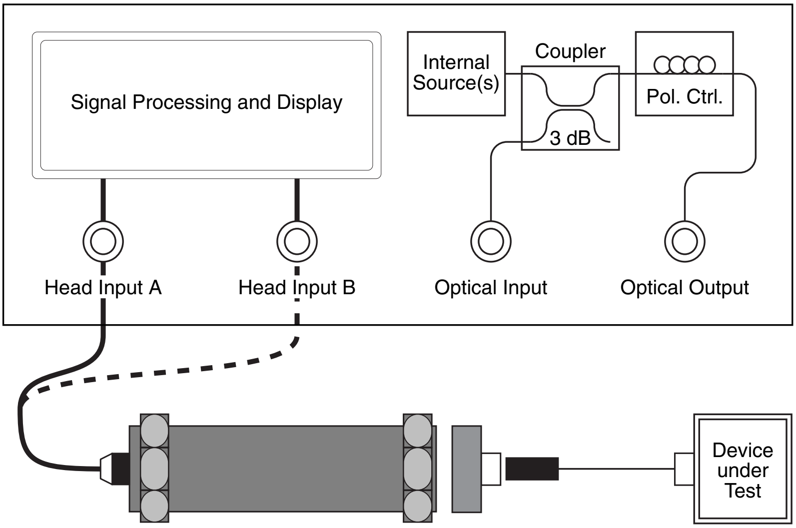


Figure 5-1 Powermeter Setup

1 Press SOURCE ON/OFF to turn the internal source off.

2 Attach the device(s) under test (DUT) to the optical head(s).

Starting the Measurement

1 Press APPL to activate the "Select Applications" menu.

2 Choose "Powermeter".

The OLA begins to measure the optical power received by the optical head(s).

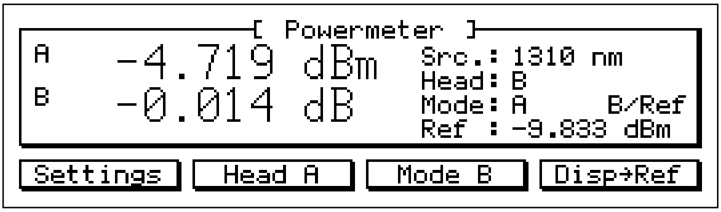


Figure 5-2 Powermeter Display

Checking the Measurement Conditions

1 If not already done, check the general instrument settings by pressing PRESET (see section 1.6 "Getting Started" on page 31). Press PREVIOUS to return to the Powermeter screen.

2 Press SETTINGS to check or change the measurement conditions.

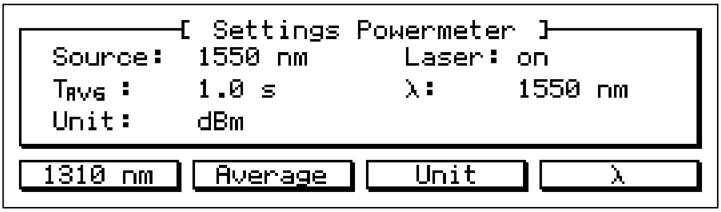


Figure 5-3 Powermeter Settings Display

The same setting of "T avg" is used by the "Insertion Loss" application.

Average Time The parameter "T avg" shows the length of the time interval during which the power value is averaged. You can change the size of this interval by repeatedly pressing AVERAGE.

Wavelength The parameter λ shows the wavelength setting for best performance of the optical head(s). It will change if you turn the internal laser on or if you activate the secondary internal laser source by pressing 1550 or 1310, respectively. It shows not the nominal, but the real source wavelength.

When measuring the absolute power of LEDs or laser diodes, you must change this setting because the sensors are wavelength-sensitive.

To change the wavelength press λ. Use the rotary knob to set the new value, press ENTER or ENTER to store.

Relative measurements are always displayed in dB.

Unit The "Unit" parameter shows the measuring unit for the optical power. By pressing UNIT you can toggle between dBm and W(atts).

3 Press MORE and PREVIOUS to return to the "Powermeter" screen.

Storing a Reference Value

You may want to store one of the two measured values displayed as a reference for future measurements.

1 The parameter "Head" indicates the "active" optical head. If it does not indicate the head whose value you want to store, press HEAD A or HEAD B respectively.

2 Press DISP–>REF to store the value. It is displayed as "Ref" on the screen.

Setting the Measurement Mode

The "Mode" parameter explains the measured values on the screen. It shows two settings:

- Left: The measurement mode of head A (the meaning of the A-value)
- Right: The measurement mode of head B (the meaning of the B-value)

The standard settings are: The A-value is the power measured at head A, the B-value is the power measured at head B. However, you can change these settings.

The A-value can be the power measured at head A, the power measured at head A divided by the power measured at head B, or the power measured at head A divided by the stored reference value.

The B-value can be the power measured at head B, the power measured at head B divided by the power measured at head A, or the power measured at head B divided by the stored reference value.

How to Change the Measurement Mode

If you want to change the measurement mode, proceed as follows:

1. The parameter "Head" indicates the active optical head. If it does not indicate the head whose mode you want to change, press HEAD A or HEAD B respectively. Note that the MODE softkey points to the active head, too.
2. Press MODE A or MODE B respectively.
3. Press the same key repeatedly to change the measurement mode from A/Ref to A/B to A as described above.

Measuring the Fluctuation of Optical Power

You can measure the fluctuation of the optical power even if it is rather small compared to the average power radiated.

You can specify the method of measurement and display and the number of samples to be taken into account.

1 Press MORE.

2 Press MIN/MAX.

3 Wait.

The instrument begins to measure. The bargraph at the bottom of the display window shows its progress.

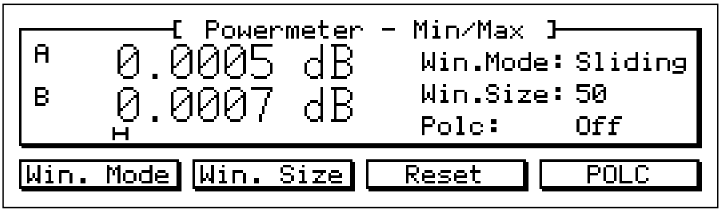


Figure 5-4 Powermeter Minimum/Maximum Display

The display shows the power variation, i.e. the difference between the highest and the lowest power value measured in a specified number of samples.

The "Win. Size" parameter is not available in continuous mode.

Win. Size The parameter "Win. Size" shows the number of samples used to determine the highest and lowest power value. By repeatedly pressing WIN. SIZE you can set the number of samples to be taken to 100, 500, 1000, or back to 50.

The samples constitute the time window represented by the bargraph.

Win. Mode The parameter "Win. Mode" shows the current measurement mode.

Standard setting is "Sliding": First, the instrument takes the number of samples defined by "Win. Size" and stores the measured values. After the window buffer is filled, the difference between the maximal and minimal value is displayed. The next sample replaces the oldest value stored and the difference is calculated anew. The display is thus updated from sample to sample.

By repeatedly pressing WIN. MODE you can set the measurement and display mode to

- "Refresh": The display is not updated from sample to sample. Instead, the instrument clears the window buffer and restarts. The next value displayed is based on a completely new set of samples.
- "Cont.": The window buffer is reduced to just two values. From sample to sample the difference between the present and the previous power value is calculated and updated continuously.

4 Press MORE.

5 Press PREVIOUS to return to the "Powermeter" screen.

Explanation of the Results

Depending on the "Mode" you have measured:

A-value

- the optical power received by head A
- the fractional power 10 log [P_A / P_B] = P_A (dBm) – P_B (dBm)
- the ratio 10 log [P_A / P ref] = P_A (dBm) – P ref (dBm)

B-value

- the optical power received by head B
- the fractional power 10 log [P_B / P_A] = P_B (dBm) – P_A (dBm)
- the ratio 10 log [P_B / P ref] = P_B (dBm) – P ref (dBm)

Using the OLA as a Laser Source and Polarization Controller

Using the OLA as a Laser Source and Polarization Controller

This chapter provides information on how to use the OLA as a laser light source or as a controller to sweep or set the polarization of an external laser source.

The chapter is divided into two sections:

1 How to use the OLA as a light source, and

2 How to use the OLA as a polarization controller.

6.1 Using the OLA as a Laser Source

You can use the OLA to launch laser light into any optical fiber or device.

Using the Internal Laser

Depending on how the OLA was ordered, the instrument will comprise one or two built-in Fabry-Perot lasers, that deliver linear polarized laser light at the optical output with a power of about -7.5 dBm.

The wavelength is either 1310 nm or 1550 nm. If the OLA is equipped with both lasers, you can switch between these two options.

How to Activate the Internal Laser

Pressing SOURCE ON/OFF will turn the internal laser on or off respectively. As long as the internal laser is on, the source indicator lamp at the front panel will be lit.

How to Switch the Wavelength

If there are two lasers installed, each of the OLA applications provides a softkey to switch from 1310 nm to 1550 nm or vice versa.

If you are not using any application, press INSTR and choose “Source”. The current wavelength will be displayed. To change the wavelength press 1550 or 1310 respectively.

Using an External Source

You can perform all measurements with an external laser source except the measurement of Return Loss.

You can connect an external LED, laser, or white light source to the optical input of the OLA. The built-in optical coupler will direct the external light to the OLA's optical output. It is attenuated by approximately 3 dB.

If you wish to use an external source, you must turn the internal source off by pressing SOURCE ON/OFF. The source indicator lamp at the front panel must not be lit.

WARNING **Although the source indicator lamp is off, light (eventually laser light) will emerge from the optical output! This happens even if the OLA is not connected to the mains or is switched off!**

6.2 Using the OLA as a Polarization Controller

The OLA comprises a 4-paddle polarization controller. Four fiber loops have been optimized to approximate four quarter-wave retarders over the polarization controller's specified wavelength range. Each paddle (loop) can rotate between 0 and 180°.

You can use the polarization controller

- to sweep through all states of polarization, or
- to set a reproducible state of polarization.

You can change the polarization of the internal source or an external polarized laser source as well.

Sweeping Through all States of Polarization

When you start one of the applications

- Pol. Depend. Loss,
- PD Coupler Test, or
- PDL / Insert. Loss,

the built-in polarization controller begins to sweep automatically. The light emerging from the optical output will pass through all states of polarization.

How to Manually Activate the Automatic Sweep

To start the automatic sweep of the polarization controller manually, do one of the following:

- If you are using the “Return Loss” application, press SETTINGS and POLC ON. The automatic sweep will start as soon as you return to the measurement screen.
- If you are using the “Powermeter” application, press POLC.
- If you have not started any application, press INSTR and choose “Pol. Controller”.

In the latter cases, you will see the “Pol. Controller” screen. You can activate the automatic sweep by pressing POLC ON.

Note: If you have called the “Pol. Controller” screen from the “Powermeter” application, the measured values are still displayed. After activating the automatic sweep you can measure the power variation due to the continuously changing polarization.

How to Change the Scan Rate

If the automatic sweep of the polarization controller is on, the “Pol. Controller” screen displays the current scan rate.

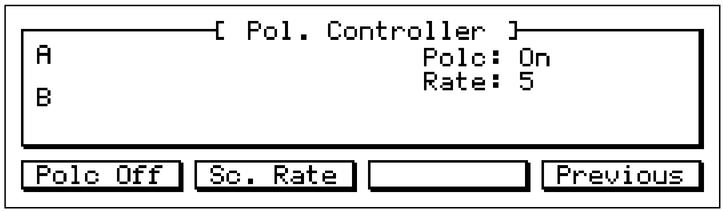


Figure 6-1 Polarization Controller Rate Settings Display

You can change the scan rate within a range of 2 to 6 sweeps per minute.

To change the scan rate press SC. RATE. Use the rotary knob or the keypad to set the new value and confirm with ENTER or ENTER.

How to Terminate the Automatic Sweep

To stop the sweep do one of the following:

- Suspend the current application, e. g. by pressing APPL.
- If you are using the “Return Loss” application, press SETTINGS and POLC OFF. The automatic sweep will stop as soon as you return to the measurement screen.
- If you are using the “Powermeter” application, press POLC to access the “Pol. Controller” screen and press POLC OFF.

Setting a Reproducible State of Polarization

If you have called the "Pol. Controller" screen from the "Powermeter" application, the measured values are still displayed. By varying the paddle positions, you can determine the settings of minimal or maximal power.

When the automatic sweep is off, the four paddles return to zero position (except the sweep was started automatically).

You can adjust each of the four paddles independently of each other to any angle desired. The angular range of each paddle has been divided into 1000 equal steps (0 to 999). This yields an adjustment resolution of 0.18°.

You can thus compare measurements taken under equal conditions.

How to set the Paddles

Setting the paddles individually is only possible when the automatic sweep is off.

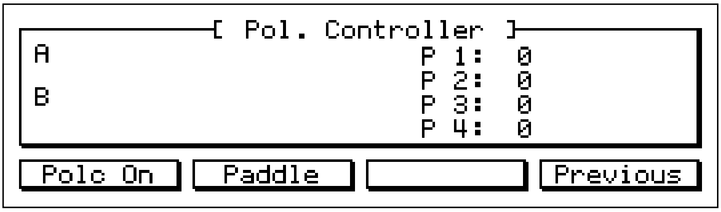


Figure 6-2 Polarization Controller Paddle Settings Display

1. Repeatedly press PADDLE or ↑ / ↓ to highlight any paddle.
2. Use the rotary knob to change the angle of the highlighted paddle.

Notice that your setting is stored. It is re-established after polarization dependent measurements. It is erased as soon as you start the automatic sweep of the polarization controller manually.

7

Instrument Settings and Software Status

Instrument Settings and Software Status

This chapter provides information on how to check or change the current system parameters and how to get information about the state of the software installed. It mainly covers the functions of the SYST key and the AUX key.

7.1 Checking the General Instrument Settings

The general instrument settings affect all subsequent measurements.

Press PRESET to check or change the general instrument settings.

You can change the number of digits to be displayed, the measurement and display mode, and the sensitivity.

For a detailed description see section 1.6 "Getting Started" on page 31.

7.2 Checking the System Configuration

The OLA can be operated remotely within a computerized measurement system using the HP Interface Bus.

Press SYST to access the "System Configuration" screen.

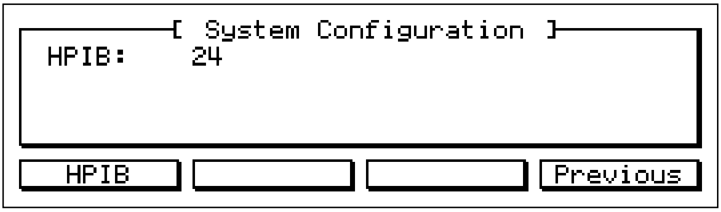


Figure 7-1 System Configuration Display

How to change the HP-IB address

1 You can change the instrument’s HP-IB address by pressing HPIB.

2 Use the rotary knob or the keypad to set the new address.

3 Press ENTER or ENTER to store the new value.

The special commands and procedures for operating the OLA in a computerized environment are described in chapter 8 “HP-IB Programming”.

7.3 Checking the Software Status

The OLA is software-driven. It can be upgraded by updating the software.

1 Press AUX to display the version number of the software installed.

   If you encounter any problem with the OLA, please contact your HP representative. He can tell you whether your problem can be solved by installing another software version.

   To facilitate updating of the software, the OLA is equipped with a PCMCIA slot which can be accessed from the rear.

2 Press PREVIOUS to return to the current application.

8

HP-IB Programming

HP-IB Programming

This chapter deals with the commands used for remote control of the Optical Loss Analyzer via the HP Interface Bus. It is assumed that you are already familiar with programming the HP-IB.

This chapter is divided into four main sections:

- Introduction,
- IEEE common commands,
- OLA specific commands, and
- Programming examples.

8.1 Introduction to Programming the OLA

The interface used for remote control of the OLA is the HP-IB, the Hewlett-Packard Interface Bus.

The HP Interface Bus

The Hewlett-Packard Interface Bus is the interface used for communication between a controller and an external device, such as the OLA. The HP-IB conforms to IEEE standard 488-1987, ANSI standard MC 1.1, and IEC recommendation 625-1.

If you are not familiar with the HP-IB, please refer to the following books:

- Hewlett-Packard Company: Publication 5952-0156, *Tutorial Description of Hewlett-Packard Interface Bus*.
- The Institute of Electrical and Electronic Engineers: IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.
- The Institute of Electrical and Electronic Engineers: IEEE Standard 488.2-1987, *IEEE Standard Codes, Formats, and Common Commands For Use with IEEE Standard 488.1-1987*.

To obtain a copy of these last two documents, write to:

The Institute of Electrical and Electronic Engineers, Inc.
345 East 47th Street
New York, NY 10017
USA.

In addition, the commands not from the IEEE 488.2 standard are defined according to the Standard Commands for Programmable Instruments (SCPI). For an introduction to SCPI and SCPI programming techniques, refer to the following documents:

- Hewlett-Packard Press (Addison-Wesley Publishing Company, Inc.): *A Beginners Guide to SCPI* by Barry Eppler, 1991.

- The SCPI Consortium: *Standard Commands for Programmable Instruments*, published periodically by various publishers. To obtain a copy of this manual, contact your Hewlett-Packard representative.

The OLA interfaces to the HP-IB as defined by the IEEE Standards 488.1 and 488.2. The table shows the interface functional subset that the OLA implements.

Table 8-1 HP-IB Capabilities

Mnemonic	Function
SH1	Complete source handshake capability
AH1	Complete acceptor handshake capability
T6	Basic talker; serial poll; unaddressed to talk if addressed to listen; no talk only
L4	Basic listener; unaddressed to listen if addressed to talk; no listen only
SR1	Complete service request capability
RL1	Complete remote/local capability
PP0	No parallel poll capability
DC1	Device clear capability
DT1	Device trigger capability (accepted but ignored)
C0	No controller capability

Setting the HP-IB Address

You can only set the HP-IB address from the front panel. See section 7.2 “Checking the System Configuration” on page 91.

The default HP-IB address is 24.

Modes of Operation

The OLA has three modes of operation:

Local Mode The instrument is operated using the front panel keys.

Remote After reception of the first command or query via the HP-IB, the instrument is put into remote state. The softkeys are erased. The right-hand softkey is replaced by LOCAL. This is the only active softkey. It can be pressed to reset the OLA manually to local mode.

To re-establish the local mode from the controller, you can send the HP-IB bus command “GTL”.

Remote with Lockout When the controller issues the HP-IB bus command “LLO”, the OLA is put into Remote with Lockout State (RWLS). In this mode, local operation is not possible. The RWLS mode can only be terminated by sending the “GTL” command.

OLA Specific Features

When operating the OLA remotely, please note:

- The display reacts on changes of the instrument mode triggered via the HP-IB.
- Starting an application via the HP-IB stops any other application (it acts like pressing the APPL key and then choosing an application).
- Starting “Stability” is only possible after starting an application. To leave the Stability application, one has to reactivate the original application.
- When leaving HP-IB remote control, the last local mode (prior to the first HP-IB command) will not be restored. Instead, the instrument remains in its current mode.
- The HP-IB commands will be accepted and executed in sequence, that is, a new HP-IB command will only be executed after any previous command has been serviced.
- The number of visible digits cannot be changed via the HP-IB.
- The syntax used for sweeping and moving the paddles is the same as for the HP 11896A.

How the OLA Processes HP-IB commands

The OLA maintains three queues for the communication with the HP-IB controller:

- the input queue,
- the output queue, and
- the error queue.

The Input Queue

Incoming data are stored in the input queue. The input queue can accept up to 1024 characters.

As soon as data has been received, the "parser" program tries to interpret the data as commands (or queries).

The parser is started upon the reception of a line feed character (LF), and when the input queue is full. It removes the data from the input queue and initiates either an error message or the command's execution. Only those commands which are described in this chapter can be executed.

Switching the power off causes all commands that are in the input queue to be lost.

The Output Queue

The output queue is a buffer which contains the response to the last query. It is 274 bytes long. It is cleared automatically as soon as a new command is inserted into the input queue.

To receive a response, the controller has to address the instrument as a "talker" (by issuing ENTER, READ, or another receive command).

Each response is terminated by a LF character, with EOI = "true". If the query has an error, the output queue remains empty.

Whenever there is data in the output queue, the Message Available bit (MAV, bit 4) is set in the Status Byte register. You can read the Status Byte register by issuing the "*STB?" query.

The Error Queue

If a command or query cannot be processed successfully, an error message is placed in the error queue. Error messages consist of the error code and the error text.

The error queue is a FIFO queue (first in - first out). It can hold up to 30 error messages. If the error queue is full, the message “-350 Queue overflow” is inserted as the last message.

To find out whether an error occurred, you can transmit the “*ESR?” query and check the bits 2 – 5 of the Event Status register.

To read the error queue, you have to issue the “:SYST:ERR?” query. You will receive the oldest error message stored in the queue. This message is automatically removed from the queue. Thus, you can clear the error queue by issuing the “:SYST:ERR?” query repeatedly.

Some Notes about Programming and Syntax Conventions

The following are a few points about the commands and queries sent to the OLA.

Sending Messages to the OLA

- You can use either upper-case or lower-case characters. The characters 00 to 09 and 0B to 1F (Hex) are converted to space characters (20 Hex). Two or more spaces are compressed to one.
- You can send several commands in a single message. Each command must be separated from the next one by a semicolon (;).
- You terminate a message with a line feed character (LF), or any character sent with End-Or-Identify (EOI). Upon detection of EOI, a LF is inserted into the input queue.
- You can use any valid number/unit configuration. For example: 1500nm, 1.5um and 1.5e-6m are all equivalent.

If you don’t specify a unit, the command’s default unit is assumed.

Command Syntax Used in this Manual

Please observe the following guidelines:

<...> The characters between angled brackets show the kind of data which you send with a command or which you receive upon a query. You do not enter the angled brackets. The most common kinds of data are:

- application: “Application” is an application name.
- boolean: This can be the literals ON or OFF, or a number: 0 means OFF, 1 or any non-zero number means ON.
- value: Values are numeric data in integer (e.g. 1500), decimal (1500.0) or exponential (1.5e3) format.
- wsp (=white space): The characters HT, CR, and space are treated as white space characters.

Others are described with the respective commands.

[...] The characters between brackets show optional information that you can include. You do not enter the brackets.

| The bar indicates an either-or choice. For instance, 1|2 means either 1 or 2, but never both.

The instrument accepts commands in short or long form.

In this manual upper and lower case characters are used to separate between the short and long form of the command, for example :SENSe[1|2]:POWer:ATIMe. In short form you can send this command as `:SENS1:POW:ATIM`. The first colon can be omitted for the first command or query in your message.

8.2 Command Summary

IEEE Common Commands

The following commands conform to the IEEE standard 488.2.

Table 8-2 EEE Common Commands

Command	Parameter/ Response Format	Min	Max	Function
*CLS				Clear Status Command
*ESE	<value>	0	255	Event Status Enable Command
*ESE?	<value>	0	255	Event Status Enable Query
*ESR?	<value>	0	255	Event Status Register Query
*IDN?	<string>			Identification Query
*OPC				Operation Complete Command
*OPC?	<value>			Operation Complete Query
*OPT?	<string>			Options Query
*RCL	<location>	0	9	Recall Instrument Setting
*RST				Reset Command
*SAV	<location>	1	9	Save Instrument Setting
*SRE	<value>	0	255	Service Request Enable Command
*SRE?	<value>	0	255	Service Request Enable Query
*STB?	<value>	0	255	Read Status Byte Query
*TRG				Trigger Command
*TST?	<value>	0	1	Self Test Query
*WAI				Wait Command

SCPI Standard STATUS Commands

The following commands control and reflect the status registers as defined by the IEEE standard 488 and the Standard Commands for Programmable Instruments (SCPI).

Table 8-3 SCPI Standard STATUS Commands

STAT:OPER?	Returns the OPERation EVENt register contents
STAT:OPER:COND?	Returns the OPERation CONDition register contents
STAT:OPER:ENA	Sets the OPERation ENAble register
STAT:OPER:ENA?	Returns the OPERation ENAble register contents
STAT:OPER:NTR	Sets the NTRansition register
STAT:OPER:NTR?	Returns the NTRansition register contents
STAT:OPER:PTR	Sets the PTRansition register
STAT:OPER:PTR?	Returns the PTRansition register contents
STAT:PRES	Presets all enable registers
STAT:QUES?	Returns the QUEStionable EVENt register contents
STAT:QUES:COND?	Returns the QUEStionable CONDition register contents
STAT:QUES:ENA	Sets the QUEStionable ENAble register
STAT:QUES:ENA?	Returns the QUEStionable ENAble register contents
STAT:QUES:NTR	Sets the NTRansition register
STAT:QUES:NTR?	Returns the NTRansition register contents
STAT:QUES:PTR	Sets the PTRansition register
STAT:QUES:PTR?	Returns the PTRansition register contents

OLA Specific Commands

Note: Commands marked with a "+" character exist with comparable behavior for the HP 8153A Lightwave Multimeter.

Table 8-4 Application Independent Commands

	SENS:POW:HEAD?	Returns information on a head
	SENS:FUNC	Starts an application
	SENS:FUNC?	Returns the current application
	SENS:FUNC:STAT?	Returns the status of an application
	SENS:POW:CALC:MODE	Sets the measurement mode
	SENS:POW:CALC:MODE?	Returns the measurement mode
	SENS:POW:OPT	Optimizes the heads
	SENS:POW:OPT?	Returns the optimization status
+	SOUR:POW:STAT	Switches the source on/off
+	SOUR:POW:STAT?	Returns the source status
+	SOUR:POW:WAV	Switches the wavelength
+	SOUR:POW:WAV?	Returns the wavelength setting
+	SYST:ERR?	Reads the error queue
	SYST:VERS?	Returns the SCPI software version

Table 8-5 PDCT Specific Commands

SENS:DATA? CR	Returns the PDCR value
SENS:DATA? SR	Returns the PDSR value
SENS:DATA? PDL	Returns the PDL value
SENS:DATA? EL	Returns the PDEL value
SENS:POW:UNIT	Sets the unit to dB or %
SENS:POW:UNIT?	Returns the unit

Table 8-6 IL Specific Commands

	SENS:DATA? IL	Returns the IL value
+	SENS:POW:REF:DISP	Stores the reference power
+	SENS:POW:REF:DISP?	Returns the stored reference power
	SENS:POW:REF:DISP:HEAD?	Returns the origin of the reference
+	SENS:POW:ATIM	Sets the average time
+	SENS:POW:ATIM?	Returns the average time

Table 8-7 PDL/IL Specific Commands

	SENS:DATA? PDL	Returns the PDL value
	SENS:DATA? IL	Returns the IL value
+	SENS:POW:REF:DISP	Stores the reference power
+	SENS:POW:REF:DISP?	Returns the stored reference power

Table 8-8 Coupler Test Specific Commands

	SENS:DATA? CR	Returns the CR value
	SENS:DATA? SR	Returns the SR value
	SENS:DATA? EL	Returns the EL value
	SENS:DATA? IL	Returns the IL value
	SENS:DATA? DIR	Returns the Directivity
	SENS:POW:UNIT	Sets the unit to dB or %
	SENS:POW:UNIT?	Returns the unit
+	SENS:POW:REF:DISP	Stores the reference power
+	SENS:POW:REF:DISP?	Returns the stored reference power

Table 8-9 Return Loss Specific Commands

ABOR	Stops the polarization controller
INIT	Starts the polarization controller
SENS:DATA? RL	Returns the Return Loss value
SENS:POW:REF	Sets RL ref
SENS:POW:REF?	Returns the RL ref setting
SENS:POW:REF:DISP:PREF	Stores P ref
SENS:POW:REF:DISP:PREF?	Returns P ref
SENS:POW:REF:DISP:PPAR	Stores the parasitic reflection
SENS:POW:REF:DISP:PPAR?	Returns the parasitic reflection

Table 8-10 Powermeter Specific Commands

	ABOR	Stops the polarization controller
	INIT	Starts the polarization controller
	PADD:POS	Sets a paddle position
	PADD:POS?	Returns a paddle position
	SCAN:RAT	Sets the sweep speed
	SCAN:RAT?	Returns the sweep speed
	SENS:DATA? POW	Returns the power value
	SENS:FUNC:MINM	Starts the Min/Max application
+	SENS:POW:ATIM	Sets the average time
+	SENS:POW:ATIM?	Returns the average time
+	SENS:POW:WAV	Sets the wavelength
+	SENS:POW:WAV?	Returns the wavelength
+	SENS:POW:UNIT	Sets the unit to dBm or W
+	SENS:POW:UNIT?	Returns the unit setting
+	SENS:POW:REF:DISP	Stores the reference power
+	SENS:POW:REF:DISP?	Returns the stored reference power
	SENS:POW:MEAS:MOD	Sets the measurement mode of a head
	SENS:POW:MEAS:MOD?	Returns the measurement mode of a head

Table 8-11 Min/Max Application Specific Commands

SENS:DATA? MINM	Returns the Min/Max value
SENS:POW:WIND:MOD	Sets the measurement window mode
SENS:POW:WIND:MOD?	Returns the measurement window mode
SENS:POW:WIND:SIZ	Sets the measurement window size
SENS:POW:WIND:SIZ?	Returns the measurement window size
SENS:POW:ATIM?	Returns the average time
SENS:FUNC POW	Restarts the Powermeter application

Table 8-12 Commands, which are Called from all Applications

+	SENS:CORR:COLL:ZER	Zeroes the heads
+	SENS:CORR:COLL:ZER?	Returns the last zero result
	SENS:FUNC STAB	Starts the Stability function
	SENS:DATA? STAB	Returns the stability value

These commands and queries are described in the following sections.

8.3 IEEE Common Commands

The IEEE 488.2 standard has a list of reserved commands, called common commands. Some of these commands must be implemented by any instrument using the standard, others are optional. The OLA implements all the necessary commands and some optional ones. This section describes the implemented commands.

General Remarks

Common Status Information

There are four registers for status information:

- Status Byte register (STB)
- Service Request Enable register (SRE)
- Event Status Register (ESR)
- Event Status Enable register (ESE)

Two of these are status-registers and two are enable-registers.

These registers conform to the IEEE Standard 488.2-1987. You can find further descriptions of these registers under *ESE, *ESR?, *SRE, and *STB?. The following figure shows how the registers are organized.

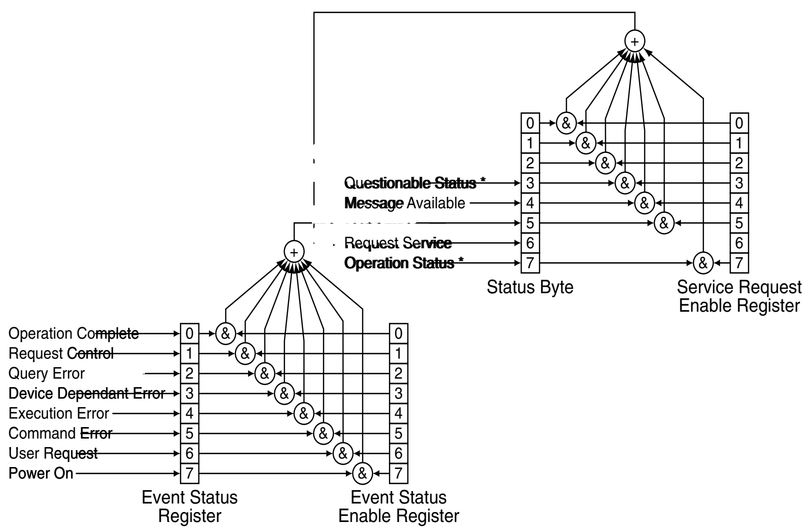


Figure 8-1 Common Status Registers

* The questionable and operation status commands are described in section 8.4 “Standard STATUS Commands” on page 118.

ATTENTION Unused bits in any of the registers return 0 when you read them.

The Request Service Bit in the Status Byte

A service request (SRQ) occurs when a bit in the Status Byte register goes from 0 to 1 AND the corresponding bit in the Service Request Enable Mask is set.

The Request Service (RQS) bit is set to 1 at the same time that the SRQ is caused. This bit can only be reset by reading it by a serial poll. The RQS bit is not affected by the condition that caused the SRQ. The serial poll command transfers the value of the Status Byte register to a variable.

Command Descriptions

command ***CLS**

syntax *CLS

description The CLear Status command *CLS clears the following:

- The error queue
- The standard Event Status Register (ESR)
- The STatus Byte (STB).

Neither the Event Status Enable register, nor the Service Request Enable register are affected by this command.

After the *CLS command the instrument is left in the idle state. The command does not alter the instrument setting. *OPC/*OPC? actions are cancelled.

example `OUTPUT 724;"*CLS"`

command	*ESE
syntax	*ESE<wsp><value>
description	The Event Status Enable command *ESE sets bits in the Event Status Enable register that enable the corresponding bit in the Event Status Register ESR. The register is cleared at power-on. The *RST and *CLS commands do not affect the register.
parameter	The bit value for the register: 0 ≤ value ≤ 255.

Bit	Mnemonic	Decimal Value
7 (MSB)	Power On	128
6	User Request	64
5	Command Error	32
4	Execution Error	16
3	Device Dependent Error	8
2	Query Error	4
1	Request Control	2
0 (LSB)	Operation Complete	1

related commands	*ESE?
example	`OUTPUT 724;*ESE 21`

command	*ESE?
syntax	*ESE?
description	The Event Status Enable query *ESE? returns the contents of the Event Status Enable register.
response	The bit value for the register: 0 ≤ value ≤ 255. See *ESE for information on this register.
related commands	*ESE
example	`OUTPUT 724;"*ESE"` `ENTER 724; A$`

command ***ESR?**

syntax *ESR?

description The Event Status Register query *ESR? returns the contents of the Event Status Register. The register is cleared after being read.

response The bit value for the register: $0 \leq$ value ≤ 255.

Bit	Mnemonic	Decimal Value
7 (MSB)	Power On	128
6	User Request	64
5	Command Error	32
4	Execution Error	16
3	Device Dependent Error	8
2	Query Error	4
1	Request Control	2
0 (LSB)	Operation Complete	1

example

```
OUTPUT 724;"*ESR?"
ENTER 724; A$
```

command ***IDN?**

syntax *IDN?

description The IDeNtification query *IDN? is used to obtain the instrument’s identification.

response The identification string:

“Hewlett-Packard, E5574A, xxxxxxxxxx, y.yy”

xxxxxxxxxx = Serial number (10 digits)
y.yy = Firmware revision (for instance: 1.00)

related commands *OPT?

example

```
DIM A$[80]
OUTPUT 724;"*IDN?"
ENTER 724; A$
```

command	***OPC**
syntax	*OPC
description	The OPeration Complete command *OPC parses and executes all commands and queries in the input queue. When the contents of the input queue have been processed, the Operation Complete bit in the Event Status Register ESR is set. This command can be used to avoid filling the input queue before the previous commands have finished executing. The following actions cancel the *OPC command: **1** Power-on **2** Setting the interface to Device Clear Active state **3** *CLS **4** *RST
related commands	*OPC?
example	`OUTPUT 724;"*OPC"`

command	***OPC?**
syntax	*OPC?
description	The OPeration Complete query *OPC? causes all program message units in the input queue to be executed. When the contents of the input queue have been processed, the operation complete bit in the Event Status Register ESR is set, and an ASCII "1" is placed in the output queue. The following actions cancel the *OPC? command: **1** Power-on **2** Setting the interface to Device Clear Active state **3** *CLS **4** *RST
response	After completion: 1

related commands *OPC, *WAI

example
```
OUTPUT 724;"*CLS;*ESE 1;*SRE 32"
OUTPUT 724;"*OPC?"
ENTER 724;A$
```

command ***OPT?**

syntax *OPT?

description The OPTions query *OPT? returns a string with the options installed in the OLA. There are two fields, separated by commas.

response The two fields are: <Laser>,<Connector>

Laser:	1310nm, 1550nm, or 1310nm/1550nm
Connector:	Bare Fiber, Straight Contact, or Angled Contact

related commands *IDN?

example
```
DIM A$[60]
OUTPUT 724;"*OPT?"
ENTER 724;A$
```

command ***RCL**

syntax *RCL<wsp><location>

description The ReCaLl instrument setting command *RCL changes the instrument setting to that stored at the internal RAM location specified.

Location 0 contains the default setting for the instrument. For information on the default setting, see *RST. For information on how to store individual settings at locations 1 to 9, see *SAV.

parameter The RAM location: $0 \leq location \leq 9$.

related commands *SAV

example
```
OUTPUT 724;"*RCL"
```

command ***RST**

syntax *RST

description The ReSeT command *RST sets the instrument to the default setting stored in ROM. Pending *OPC/*OPC? actions are cancelled.

The ReSeT command acts as follows:

- selects the default laser (1310 nm if installed, 1550 nm else)
- switches the laser off
- activates the “Select Application” menu
- sets the average time to 200 ms
- sets the reference power to -10 dBm
- sets RL ref to 14.7 dB
- sets the unit for power to Watt
- sets the unit for SR in CT and PDCT measurement to %
- stops the automatic sweep of the polarization controller
- sets the scan rate of the polarization controller to 5
- activates head A

The instrument is placed in the idle state waiting for a command. The *RST command clears the input queue.

The following are not changed:

- HP-IB (interface) state
- Instrument interface address
- Output queue
- Service Request Enable register (SRE)
- Standard Event Status Enable register (ESE)

example `OUTPUT 724;"*RST"`

command	***SAV**
syntax	*SAV<wsp><location
description	With the SAVe command *SAV the instrument setting is stored in RAM. You can store settings at locations 1 - 9. The scope of the saved setting is identical to the standard setting (see *RST).
parameter	The RAM location: 1 ≤ location ≤ 9.
related commands	*RCL
example	`OUTPUT 724;"*SAV 3"`

command ***SRE**

syntax *SRE<wsp><value>

description The Service Request Enable command *SRE sets bits in the Service Request Enable register.

Any logical ‘1’ in the enable register enables the corresponding bit in the Status register.

The register is cleared at power-on. The *RST and *CLS commands do not change the register.

parameter The bit value for the register: 0 ≤ value ≤ 255.

Bit	Mnemonic	Decimal Value
7 (MSB)	Operation Status	128
6	Request Status	64
5	Event Status Bit	32
4	Message Available	16
3	Questionable Status	8
2	Not used	0
1	Not used	0
0 (LSB)	Not used	0

Note: Bit 6 cannot be masked.

related commands *SRE?

example `OUTPUT 724;"*SRE 48"`

command ***SRE?**

syntax *SRE?

description The Service Request Enable query *SRE? returns the contents of the Service Request Enable register.

response The value stored in the register: 0 ≤ value ≤ 255. See *SRE for information on the Service Request Enable register.

related commands *SRE

example
```
OUTPUT 724;"*SRE?"
ENTER 724;A$
```

command ***STB?**

syntax *STB

description The STatus Byte query *STB? returns the contents of the Status Byte register. The register is programmed via the Service Request Enable mask. For setting this mask, see *SRE.

response The value stored in the register (0 ≤ value ≤ 255). See *SRE for information on the Status Byte register.

example
```
OUTPUT 724;"*STB?"
ENTER 724;A$
```

command ***TRG**

syntax *TRG

description The TRiGger command *TRG starts a power measurement.

example `OUTPUT 724;"*TRG"`

command ***TST?**

syntax *TST?

description The TeST query *TST? initiates a self-test and returns a result value.

The self-test

- switches the laser off
- stops the automatic sweep of the polarization controller
- activates the “Select Application” menu
- switches all pixels in the display on for ca. 5 sec.
- checks the polarization controller

No further commands are allowed while the test is running. After the self-test the instrument returns to the setting that was active at the time the self-test query was processed.

response A **boolean** value:

0 if the polarization controller test was successful
1 if the polarization controller test failed

example

```
OUTPUT 724;"*TST?"
ENTER 724;A$
```

command ***WAI**

syntax *WAI

description The WAIt command *WAI prevents the instrument from executing any further commands until the current command has finished executing. All pending operations are completed during the wait period.

related commands *OPC, *OPC?

example

```
OUTPUT 724;"*WAI"
```

8.4 Standard STATUS Commands

This section gives a list of the OLA-commands and queries used for determining the status of the instrument.

General Remarks

The OLA uses two “nodes” which describe the status of the instrument:

- The OPERation node shows things that can happen during normal operation.
- The QUEStionable node shows error conditions.

The Status Registers and Filters

Each node consists of five 16-bit-registers:

- The CONDition register, which contains the current status. This register is continuously updated.
- The EVENt register, which contains the filtered status of the CONDition register. This register is cleared when it is read.
- The PTRansition register is one of the two filters controlling the EVENt register: It puts, when enabled, a 1 into the EVENt register when the corresponding bit in the CONDition register changes from 0 to 1. At power-on, all bits of this register are enabled.
- The NTRansition register is the second of the filters controlling the EVENt register: It puts, when enabled, a 1 into the EVENt register when the corresponding bit in the CONDition register changes from 1 to 0. At power-on, all bits of this register are disabled.
- The ENABle register, which enables changes in the EVENt register to affect the Status Byte.

If the corresponding bits in the ENABle registers are set, changes in the OPERation EVENt register will change bit 7 of the Status Byte, changes in the QUEStionable EVENt register will change bit 3 (see Figure 8-1 on page 108).

What you can do

At both nodes you can:

- Query the CONDition, EVENt, NTRansition, PTRansition, and ENAble registers,
- Set the NTRansition, PTRansition, and ENAble registers.

The Bits Used by the OLA

The following bits are used in the OPERation node registers:

Bit	Status
8	Channel A is being zeroed
9	Channel B is being zeroed

The following bit is used in the QUEStionable node registers:

Bit	Status
9	Safety bit

The safety bit is set in the CONDition register, when the internal laser source has been switched off by the built-in power monitoring circuit.

Command Descriptions

command **:STATus:OPERation:CONDition?**

syntax :STATus:OPERation:CONDiton?

description This query reads the contents of the OPERation:CONDition register. Only two bits of the condition register are used.

Bit	Mnemonic	Bit Value
8	Zeroing A	256
9	Zeroing B	512

example
```
OUTPUT 724;":STAT:OPER:COND?"
ENTER 724;A$
```

command **:STATus:OPERation[:EVENt]?**

syntax :STATus:OPERation[:EVENt]?

description This query reads the contents of the OPERation:EVENt register. Only two bits of the event register are used (whether these bits contain information depends on the transition register configuration):.

Bit	Mnemonic	Bit Value
8	Zeroing A	256
9	Zeroing B	512

example
```
OUTPUT 724;":STAT:OPER?"
ENTER 724;A$
```

command **:STATus:OPERation:ENABle**

syntax :STATus:OPERation:ENABle<wsp><value>

description This command sets the bits in the ENABle register that enables the contents of the EVENt register to affect the Status Byte (STB). Setting a bit in this register to 1 enables the corresponding bit in the EVENt register to affect bit 7 of the Status Byte.

example

```
OUTPUT 724;":STAT:OPER:ENAB 768"
```

command **:STATus:OPERation:ENABle?**

syntax :STATus:OPERation:ENABle?

description This query returns the current contents of the OPERation:ENABle register.

example

```
OUTPUT 724;":STAT:OPER:ENAB?"
ENTER 724;E$
```

command **:STATus:OPERation:NTRansition**

syntax :STATus:OPERation:NTRansition<wsp><value>

description This command sets the bits in the NTRansition register. Setting a bit in this register enables a negative transition ($1 \rightarrow 0$) in the corresponding bit in the CONDition register to set the bit in the EVENt register.

example

```
OUTPUT 724;":STAT:OPER:NTR 768"
```

command **:STATus:OPERation:NTRansition?**

syntax :STATus:OPERation:NTRansition?

description This query returns the current contents of the OPERation:NTRansition register.

example

```
OUTPUT 724; STAT:OPER:NTR?"
ENTER 724;N$
```

command **:STATus:OPERation:PTRansition**

syntax :STATus:OPERation:PTRansition<wsp><value>

description This command sets the bits in the PTRansition register. Setting a bit in this register enables a positive transition ($0 \rightarrow 1$) in the corresponding bit in the CONDition register to set the bit in the EVENt register.

example

```
OUTPUT 724;":STAT:OPER:PTR 512"
```

command **:STATus:OPERation:PTRansition?**

syntax :STATus:OPERation:PTRansition?

description This query returns the current contents of the OPERation:PTRansition register.

example
```
OUTPUT 724;":STAT:OPER:PTR?"
ENTER 724;P$
```

command **:STATus:PRESet**

syntax :STATus:PRESet

description This command presets all the enable registers and transition filters for both the OPERation and QUEStionable nodes:

- All the bits in the ENABle registers are set to 0.
- All the bits in the PTRansition registers are set to 1.
- All the bits in the NTRansition registers are set to 0.

example
```
OUTPUT 724;":STAT:PRES"
```

command **STATus:QUEStionable:CONDition?**

syntax :STATus:QUEStionable:CONDition?

description This query reads the contents of the QUEStionable:CONDition register. Only one bit of the condition register is used:.

Bit	Mnemonic	Bit Value
9	Safety bit	512

example
```
OUTPUT 724;":STAT:QUES:COND?"
ENTER 724;A$
```

command **:STATus:QUEStionable[:EVENt]?**

syntax :STATus:QUEStionable[:EVENt]?

description This query reads the contents of the QUEStionable:EVENt register. Only one bit of the event register is used (whether this bit contains information depends on the transition register configuration):.

Bit	Mnemonic	Bit Value
9	Safety bit	512

example
```
OUTPUT 724;":STAT:QUES?"
ENTER 724;A$
```

command **:STATus:QUEStionable:ENABle**

syntax :STATus:QUEStionable:ENABle<wsp><value>

description This command sets the bits in the ENABle register that enable the contents of the EVENt register to affect the Status Byte (STB). Setting a bit in this register to 1 enables the corresponding bit in the EVENt register to affect bit 3 of the Status Byte.

example
```
OUTPUT 724;":STAT:QUES:ENAB 512"
```

command **STATus:QUEStionable:ENABle?**

syntax :STATus:QUEStionable:ENABle?

description This query returns the current contents of the QUEStionable:ENABle register.

example
```
OUTPUT 724;":STAT:QUES:ENAB?"
ENTER 724;E$
```

command	**:STATus:QUEStionable:NTRansition**
syntax	:STATus:QUEStionable:NTRansition XXXXXXXXXXX
description	This query returns the current contents of the QUEStionable:NTransition register.
example	`OUTPUT 724;":STAT:QUES:NTR 0"`

command	**:STATus:QUEStionable:NTRansition?**
syntax	:STATus:QUEStionable:NTRansition?
description	This query returns the current contents of the QUEStionable:NTransition register.
example	`OUTPUT 724;":STAT:QUES:NTR?"` `ENTER 724;N$`

command	**:STATus:QUEStionable:PTRansition**
syntax	:STATus:QUEStionable:PTRansition<wsp><value>
description	This command sets the bits in the PTRansition register. Setting a bit in this register enables a positive transition ($0 \rightarrow 1$) in the EVENt register.
example	`OUTPUT 724;":STAT:QUES:PTR 512"`

command	**:STATus:QUEStionable:PTRansition?**
syntax	:STATus:QUEStionable:PTRansition?
description	This query returns the current contents of the QUEStionable:PTRansition register.
example	`OUTPUT 724;":STAT:QUES:PTR?"` `ENTER 724;P$`

8.5 OLA Specific Commands

This section describes the commands used to operate the OLA remotely via its HP-IB interface.

The commands and queries appear in alphabetical order.

command **:ABORt**

syntax :ABORt

description The abort command stops the automatic sweep of the polarization controller. It is only applicable to the applications

- Powermeter,
- Powermeter Min/Max, and
- Return Loss.

errors The message “Wrong application for this command” is returned, if the present application is not Powermeter, Powermeter Min/Max, or Return Loss.

example `OUTPUT 724;":ABOR"`

command **:INITiate**

syntax :INITiate[:IMMediate]

description The initiate command starts the automatic sweep of the polarization controller. It is only applicable to the applications

- Powermeter,
- Powermeter Min/Max, and
- Return Loss.

extension **:IMM** The “:IMMediate” extension may be present, but is ignored.

errors The message “Wrong application for this command” is returned, if the present application is not Powermeter, Powermeter Min/Max, or Return Loss.

example `OUTPUT 724;":INIT"`

command **:PADDle:POSition**

syntax :PADDle[1|2|3|4]:POSition<wsp><value|MIN|MAX>

description The paddle positioning command sets the specified paddle (coil) of the polarization controller to the desired angle position. It is only applicable to the applications

- Powermeter,
- Powermeter Min/Max, and
- Return Loss.

Note: This command is only executed when the automatic sweep is off (see “:ABORt”).

parameters **1|2|3|4** The number of the paddle which is to be set.

Default is 1.

value The value for the angle: $0 \le$ value ≤ 999).

Value	Angle
0	0°
249	45°
499	90°
749	135°
999	179°

MIN|MAX Instead of a value you can enter the keyword MIN (= 0°) or MAX (= 180°) respectively.

errors The message “Wrong application for this command” is returned, if the present application is not Powermeter, Powermeter Min/Max, or Return Loss.

example `OUTPUT 724;"ABORT;:PADD2:POS 355"` command **:PADDle:POSition?**

syntax PADDle[1|2|3|4]:POSition?

description The paddle position query returns the present position of the specified paddle (coil) of the polarization controller. It is only applicable to the applications

- Powermeter,
- Powermeter Min/Max, and
- Return Loss.

Note: This command is only executed when the automatic sweep is off (see ":ABORt").

parameter **1|2|3|4** The number of the paddle the position of which is to be returned.

Default is 1.

response An integer number: 0 ≤ value ≤ 999. For an explanation of the value returned see ":PADDle:POSition".

errors The message "Wrong application for this command" is returned, if the present application is not Powermeter, Powermeter Min/Max, or Return Loss.

example
```
OUTPUT 724;":PADD3:POS?"
ENTER 724;A$
```

command **:SCAN:RATe**

syntax :SCAN:RATe<wsp><value|MIN|MAX>

description The scan rate command sets the sweep speed of the polarization controller to the desired value. It is only applicable to the applications

- Powermeter, and
- Powermeter Min/Max.

Note: This command is only executed when the automatic sweep is on (see “:INITiate”).

parameter — **Value** The value for the speed: 2 ≤ value ≤ 5. The default scan rate is 5, the slowest is 2.

MIN|MAX Instead of a value you can enter the keyword MIN (= 2) or MAX (= 5) respectively.

ATTENTION If you adjust the instrument from the user interface, you may set the scan rate to 6 sweeps per minute. See “How to Change the Scan Rate” on page 86.

related commands — :SCAN:RATe?

errors — The message “Wrong application for this command” is returned, if the present application is not Powermeter or Powermeter Min/Max.

example — `OUTPUT 724;":INIT;:SCAN:RAT MAX"`

command — **:SCAN:RATe?**

syntax — :SCAN:RATe?[<wsp>MIN|MAX]

description — The scan rate query returns either the present setting of the polarization controller’s sweep speed, or the minimum or maximum value which can be set. It is only applicable to the applications

- Powermeter, and
- Powermeter Min/Max.

Note: This command is only executed when the automatic sweep is on (see “:INITiate”).

parameter — **MIN|MAX** You can add the keyword MIN or MAX respectively, to obtain the minimum (= 2) or maximum value (= 5) which can be set.

response — An integer number: 2 ≤ value ≤ 5.

related commands — :SCAN:RATe

errors — The message “Wrong application for this command” is returned, if the present application is not Powermeter or Powermeter Min/Max.

example
```
OUTPUT 724;":SCAN:RAT?"
ENTER 724;A$
```

command **:SENSe:CORRection:COLLect:ZERo**

syntax :SENSe[1|2]:CORRection:COLLect:ZERo

description This command zeroes both optical heads (if attached). It is applicable to all applications.

Note: The laser has to be switched off. The polarization controller stops automatically. No other command will be executed until zeroing is finished.

parameter **1|2** The channel parameter 1 or 2 may be present, but is ignored.

errors The message “Wrong application for this command” is returned, if no application is active.

The message “No head connected” is returned, if there is no optical head attached to the instrument.

related commands :SENSe:CORRection:COLLect:ZERo?

example
```
OUTPUT 724;":SENS:CORR:COLL:ZER"
```

command **:SENSe:CORRection:COLLect:ZERo?**

syntax :SENSe[1|2]:CORRection:COLLect:ZERo?

description This query returns the status of the most recent zero command.

parameter **1|2** The channel parameter 1 or 2 may be present, but is ignored.

response A **boolean** value:

0 Success
1 Zeroing was not possible, one or both of the heads were sensing
light.

related commands :SENSe:CORRection:COLLect:ZERo

example
```
OUTPUT 724;":SENS:CORR:COLL:ZER?”
ENTER 724; A$
```

command **:SENSe:DATA? CR**

syntax :SENSe[1|2]:DATA?<wsp>CR

description This query returns either the Coupling Ratio CR or the Polarization Dependent Coupling Ratio PDCR, depending on the application currently active. It is only applicable to the applications

- Coupler Test, and
- Polarization Dependent Coupler Test.

parameter **1|2**
1 Reads head A
2 Reads head B
Default is 1.

response The measured value in dB or percent, depending on the current setting of the measurement unit (see “:SENSe:POWer:UNIT”).

errors The message “Wrong application for this command” is returned, if the present application is not Coupler Test or Polarization Dependent Coupler Test.

The message “No head connected” is returned, if there is only one or no optical head attached to the instrument.

The message “No valid result possible” is returned, if the value cannot be measured.

example
```
OUTPUT 724;":SENS2:DATA? CR"
ENTER 724;A$
```

command **:SENSe:DATA? DIR**

syntax :SENSe[1|2]:DATA?<wsp>DIR

description This query returns the Directivity value. It is only applicable to the Directivity application.

parameter **1|2**
1 Reads head A
2 Reads head B
Default is 1.

response The measured value in dB.

errors	The message “Wrong application for this command” is returned, if the present application is not Directivity. The message “No head connected” is returned, if there is only one or no optical head attached to the instrument. The message “No valid result possible” is returned, if the value cannot be measured.
example	`OUTPUT 724;":SENS1:DATA? DIR"` `ENTER 724;A$`

command	**:SENSe:DATA? EL**
syntax	:SENSe[1|2]:DATA?<wsp>EL
description	This query returns either the Excess Loss EL or the Polarization Dependent Excess Loss PDEL, depending on the application currently active. It is only applicable to the applications • Coupler Test, and • Polarization Dependent Coupler Test.
parameter	**1|2** 1 Reads head A 2 Reads head B Default is 1.
response	The measured value in dB or percent, depending on the current setting of the measurement unit (see “:SENSe:POWer:UNIT”).
errors	The message “Wrong application for this command” is returned, if the present application is not Coupler Test or Polarization Dependent Coupler Test. The message “No head connected” is returned, if there is only one or no optical head attached to the instrument. The message “No valid result possible” is returned, if the value cannot be measured.
example	`OUTPUT 724;":SENS[1|2]:DATA? EL"` `ENTER 724;A$`

command **:SENSe:DATA? IL**

syntax :SENSe[1|2]:DATA?<wsp>IL

description This query returns the Insertion Loss value. It is only applicable to the applications

- Insertion Loss,
- PDL/Insertion Loss, and
- Coupler Test.

parameter **1|2** 1 Reads head A
2 Reads head B
Default is 1.

response The measured IL value in dB.

errors The message “Wrong application for this command” is returned, if the present application is not one of those listed above.

The message “No head connected” is returned, if there is no optical head attached to the specified channel.

The message “No valid result possible” is returned, if the value cannot be measured.

example
```
OUTPUT 724;":SENS1:DATA? IL"
ENTER 724;A$
```

command **:SENSe:DATA? MINMax**

syntax :SENSe[1|2]:DATA?<wsp>MINMax

description This query returns the MIN/MAX value. It is only applicable to the MINMax application, which can only be started from the Powermeter application.

parameter **1|2** 1 Reads head A
2 Reads head B
Default is 1.

response	The measured value in dB.
	Note: The delay between sending the command and receiving a response depends on the Window Size, the Window Mode and the Average Time. Worst case:
	Window Mode "refresh" Window Size 1000 Average Time T avg 1 s
	In this case the measurement will take 1000 s or approximately 17 minutes.
errors	The message "Wrong application for this command" is returned, if the present application is not MINMax.
	The message "No head connected" is returned, if there is no optical head attached to the specified channel.
	The message "No valid result possible" is returned, if the value cannot be measured.
example	`OUTPUT 724;"SENS2:DATA? MINM"` `ENTER 724;A$`

command	**:SENSe:DATA? PDL**
syntax	:SENSe[1|2]:DATA?<wsp>PDL
description	This query returns the PDL value. It is only applicable to the applications • Polarization Dependent Loss, • PDL/Insertion Loss, and • Polarization Dependent Coupler Test.
parameter	**1|2** 1 Reads head A 2 Reads head B Default is 1.
response	The measured value in dB.

errors — The message “Wrong application for this command” is returned, if the present application is not one of those listed above.

The message “No head connected” is returned, if there is no optical head attached to the specified channel.

The message “No valid result possible” is returned, if the value could not be measured.

example

```
OUTPUT 724;":SENS2:DATA? PDL"
ENTER 724;A$
```

command — **:SENSe:DATA? POW**

syntax — :SENSe[1|2]:DATA?<wsp>POW

description — This query returns the power value measured by the specified head. It depends on the measurement mode, whether this value is absolute or relative. This query is only applicable to the Powermeter application.

parameter — **1|2**

1	Reads head A
2	Reads head B

Default is 1.

response — You receive one of the following values:

If you choose head A:	A, A/B, or A/Ref.
If you choose head B:	B, B/A, or B/Ref.

The unit for absolute measurements is dBm or Watt, depending on the current setting of the measurement unit (see “:SENSe:POWer:UNIT”). The unit for relative measurements is dB. The unit is not included in the response.

errors — The message “Wrong application for this command” is returned, if the present application is not Powermeter.

The message “No head connected” is returned, if there is no optical head attached to the specified channel.

The message “No valid result possible” is returned, if the value could not be measured.

related commands :SENSe:POWer:MEASuring:MODe, :SENSe:POWer:UNIT

example
```
OUTPUT 724;":SENS1:DATA? POW"
ENTER 724;A$
```

command **:SENSe:DATA? RL**

syntax :SENSe[1|2]:DATA?<wsp>RL

description This query returns the Return Loss value. It is only applicable to the Return Loss application.

parameter **1|2**
1 Reads head A
2 Reads head B
Default is 1.

response The measured value in dB.

errors The message “Wrong application for this command” is returned, if the present application is not Return Loss.

The message “No head connected” is returned, if there is no optical head attached to the specified channel.

The message “No valid result possible” is returned, if the value could not be measured.

example
```
OUTPUT 724;":SENS1:DATA? RL"
ENTER 724;A$
```

command **:SENSe:DATA? SR**

syntax :SENSe[1|2]:DATA? SR

description This query returns either the Splitting Ratio SR or the Polarization Dependent Splitting Ratio PDSR, depending on the application currently active. It is only applicable to the applications

- Coupler Test, and
- Polarization Dependent Coupler Test.

parameter **1|2** 1 Reads head A
2 Reads head B
Default is 1.

response The measured value in dB or percent, depending on the current setting of the measurement unit (see “:SENSe:POWer:UNIT”).

errors The message “Wrong application for this command” is returned, if the present application is not Coupler Test or Polarization Dependent Coupler Test.

The message “No head connected” is returned, if there is only one or no optical head attached to the instrument.

The message “No valid result possible” is returned, if the value could not be measured.

example
```
OUTPUT 724;":SENS1:DATA? SR"
ENTER 724;A$
```

command **:SENSe:DATA? STAB**

syntax :SENSe[1|2]:DATA?<wsp>STAB

description This query returns the stability value. It is only applicable to the Stability application, which can only be started if an application is active.

parameter **1|2** 1 Reads head A
2 Reads head B
Default is 1.

response The measured value in dB.

errors The message “Wrong application for this command” is returned, if the present application is not Stability.

The message “No head connected” is returned, if there is no optical head attached to the specified channel.

The message “No valid result possible” is returned, if the value cannot be measured.

example

```
OUTPUT 724;":SENS:FUNC PDL"
OUTPUT 724;":SENS:FUNC STAB"
OUTPUT 724;":SENS2:DATA? STAB"
ENTER 724;A$
OUTPUT 724;":SENS:FUNC PDL"
```

command **:SENSe:FUNCtion**

syntax :SENSe[1|2]:FUNCtion[:ON]<wsp><application|value>

description This command starts the specified application. It corresponds to pressing the APPL key and choosing an application from the “Select Application” menu. It can be used any time.

Note: If the specified application is already active, this command resets the database and restarts the measurement.

parameters **1|2** The channel parameter 1 or 2 may be present, but is ignored.

:ON The “:ON” extension may be present, but is ignored.

Application|value You can enter either the literal application mnemonic or the application number as an integer value.

Mnemonic	No.	Application
CT	0	Coupler Test
DIR	1	Directivity
IL	2	Insertion Loss
MAIN	3	“Select Application” menu
MINM	4	Powermeter Min/Max application
PDCT	5	Polarization Dependent Coupler Test
PDL	6	Polarization Dependent Loss
PI	7	PDL/Insertion Loss
POW	8	POWermeter
RL	9	Return Loss
STAB	10	STABility

Note:

- The Stability application cannot be started from the “Select Application” menu application, from the Powermeter application, or from the Powermeter Min/Max application.
- To return to the Powermeter application from the Min/Max application, you have to restart the Powermeter application by first sending the command :SENS:FUNC MAIN and then sending the command :SENS:FUNC POW.
- The command :SENS:FUNC MAIN stops any active application and returns to the “Select Application” menu.

errors: The message “Wrong application for this command” is returned, if you specify STAB and the present application is Powermeter, Powermeter Min/Max or none.

The same message is returned, if you specify MINM and the present application is not Powermeter.

related commands: :SENSe:FUNCtion?, :SENSe:FUNCtion:STATe?

example:
```
OUTPUT 724;":SENS:FUNC MAIN"
OUTPUT 724;":SENS:FUNC PDL"
```

command: **:SENSe:FUNCtion?**

syntax: :SENSe[1|2]:FUNCtion[:ON]?

description: This query returns the application currently active as a string. It can be used any time.

parameters: **1|2** The channel parameter 1 or 2 may be present, but is ignored.

:ON The “:ON” extension may be present, but is ignored.

response	A character string like “PDL”, “STAB” etc. For the meaning of the mnemonic see “:SENSe:FUNCtion”.
	Note: The response may also indicate “SYST” for System settings or “AUX” for Auxiliary Information, though these instrument functions cannot be activated or operated via the HP-IB.
related commands	:SENSe:FUNCtion, :SENSe:FUNCtion:STATe?

example	`DIM A$ [6]`
	`OUTPUT 724;":SENS:FUNC?"`
	`ENTER 724;A$`

command	**:SENSe:FUNCtion:STATe?**
syntax	:SENSe[1|2]:FUNCtion:STATe?<wsp><application|value>
description	This query returns the present status of the specified application. It can be used any time.
parameters	**1|2** The channel parameter 1 or 2 may be present, but is ignored.
	Application|value You can enter either the literal application mnemonic or the application number as an integer value.

Mnemonic	No.	Application
CT	0	Coupler Test
DIR	1	Directivity
IL	2	Insertion Loss
MAIN	3	“Select Application” menu
MINM	4	Powermeter Min/Max application
PDCT	5	Polarization Dependent Coupler Test
PDL	6	Polarization Dependent Loss
PI	7	PDL/Insertion Loss
POW	8	POWermeter
RL	9	Return Loss
STAB	10	STABility

response — A **boolean** value:
0 Application is inactive
1 Application is active

related commands — :SENSe:FUNCtion, :SENSe:FUNCtion?

example
```
OUTPUT 724;":SENS:FUNC:STAT? 3"
ENTER 724;A$
```

command — **:SENSe:POWer:ATIMe**

syntax — :SENSe[1|2]:POWer:ATIMe<wsp><value>[unit]

description — This command sets the time interval used for averaging power measurements. It is only applicable to the applications

- Powermeter, and
- Insertion Loss.

parameters — **1|2** The channel parameter 1 or 2 may be present, but is ignored. The setting affects both channels.

Unit s = seconds, ms = milliseconds. Default is s.

Value If unit is “s” or default: Choice of 0.02, 0.2, 1.
If unit is “ms”: Choice of 20, 200, 1000.
Default is 0.2 s. If you transmit a different value, it is rounded to one of the three values listed above.

errors — The message “Wrong application for this command” is returned, if the present application is not Powermeter or Insertion Loss.

related commands — :SENSe:POWer:ATIMe?

example
```
OUTPUT 724;":SENS:POW:ATIM 20ms"
```

command	**:SENSe:POWer:ATIMe?**
syntax	:SENSe[1|2]:POWer:ATIMe?
description	This query returns the current setting of the time interval used for averaging power measurements. It can be used any time.
parameter	**1|2** The channel parameter 1 or 2 may be present, but is ignored.
response	The average time is returned as a number in exponential format: 2E-2, 2E-1, or 1. The unit is seconds. The unit not included in the response.
related commands	:SENSe:POWer:ATIMe
example	`OUTPUT 724;":SENS:POW:ATIM?"` `ENTER 724;A$`

command	**:SENSe:POWer:CALCulate:MODe**
syntax	:SENSe[1|2]:POWer:CALCulate:MODe<wsp><mode>
description	This command sets the measurement and display mode for all polarization dependent measurements, as can be done manually with the PRESET key.
parameters	**1|2** The channel parameter 1 or 2 may be present, but is ignored. **Mode** REFResh|AVERage|0|1. You can enter either the mnemonic or the corresponding number: REFResh 0 Refresh AVERage 1 Average
related commands	:SENSe:POWer:CALC:MODE?

examples	The following examples yield the same instrument setting:
	
	`OUTPUT 724;":SENS:POW:CALC:MODE AVER"`
	`OUTPUT 724;":SENS:POW:CALC:MODE 1"`

command	**:SENSe:POWer:CALC:MODe?**
syntax	:SENSe[1|2]:POWer:CALC:MODe?
description	This query returns the current setting of the measurement and display mode for the polarization dependent applications. It can be used any time.
parameter	**1|2** The channel parameter 1 or 2 may be present, but is ignored.
response	A **boolean** value: 0 Refresh 1 Average
related commands	:SENSe:POWer:CALC:MODE
example	`OUTPUT 724;":SENS:POW:CALC:MOD?"` `ENTER 724;A$`

command	**:SENSe:POWer:HEAD?**
syntax	:SENSe[1|2]:POWer:HEAD?
description	This query returns information about the optical head connected to the specified channel. It can be used any time.
parameter	**1|2** 1 Reads head A 2 Reads head B Default is 1.
response	An **integer** number: 0 There is no head attached to the specified channel 1 There is a head attached to the specified channel 2 A low PDL head is attached to the specified channel 3 A low PDL head with temperature control is attached to the specified channel
example	`OUTPUT 724;":SENS2:POW:HEAD?` `ENTER 724;A$`

command **:SENSe:POWer:MEASuring:MODe**

syntax :SENSe[1|2]:POWer:MEASuring:MODe<wsp><mode>

description This command sets the power measurement mode for the specified channel. It is only applicable to the Powermeter application.

Note: The command which returns a result is :SENS:DATA? POW.

parameters **1|2** 1 Sets head A
2 Sets head B
Default is 1.

Mode ABS|REL1|REL2|0|1|2. You can enter either the mnemonic or the corresponding number.

If you choose head A:

ABS	0	Absolute power measurement
REL1	1	Relative measurement A/Ref
REL2	2	Relative measurement A/B

If you choose head B:

ABS	0	Absolute power measurement
REL1	1	Relative measurement B/Ref
REL2	2	Relative measurement B/A

errors The message “Wrong application for this command” is returned, if the current application is not Powermeter.

related commands :SENSe:POWer:MEASuring:MODe?, :SENS:DATA? POW

examples The following examples yield the same instrument setting:

```
OUTPUT 724;":SENS1:POW:MEAS:MOD ABS"
OUTPUT 724;":SENS1:POW:MEAS:MOD 0"
```

command	**:SENSe:POWer:MEASuring:MODe?**
syntax	:SENSe[1|2]:POWer:MEASuring:MODe?
description	This query returns the current measurement mode of the specified channel. It is only applicable to the Powermeter application.
parameters	**1|2** 1 Reads the mode of head A 2 Reads the mode of head B Default is 1.
response	An **integer** value: 0 Absolute power measurement 1 Relative measurement A/Ref or B/Ref respectively 2 Relative measurement A/B or B/A respectively
related commands	:SENSe:POWer:MEASuring:MODe
example	`OUTPUT 724;":SENS2:POW:MEAS:MOD?"` `ENTER 724;A$`

command	**:SENSe:POWer:OPTimize**
syntax	:SENSe[1|2]:POWer:OPTimize<wsp><mode>
description	This command optimizes the optical heads attached to the OLA for PDL measurement or for high sensitivity. *Note*: This command affects only the temperature controlled heads of type HP 81521B opt. 001.
parameters	**1|2** The channel parameter 1 or 2 may be present, but is ignored. **Mode** LPDL|HSENs|0|1. You can enter either the mnemonic or the corresponding number: LPDL 0 Low PDL for polarization dependent measurements HSENs 1 High sensitivity for low power measurements
related commands	:SENSe:POWer:OPTimize?

examples	The following examples yield the same instrument setting:
	`OUTPUT 724;":SENS1:POW:OPT HSEN"`
	`OUTPUT 724;":SENS1:POW:OPT 1"`

command **:SENSe:POWer:OPTimize?**

syntax :SENSe[1|2]:POWer:OPTimize?

parameters **1|2** The channel parameter 1 or 2 may be present, but is ignored.

description This query returns the current optimization status of the OLA.

Note: The optimization affects only the temperature controlled heads of type HP 81521B opt. 001.

response A **boolean** value:

0 The OLA is optimized for PDL measurement
1 The OLA is optimized for maximal sensitivity

related commands :SENSe:POWer:OPTimize

example
```
OUTPUT 724;":SENS:POW:OPT?"
ENTER 724;A$
```

command **:SENSe:POWer:REFerence**

syntax :SENSe[1|2]:POWer:REFerence<wsp><value>

description This command sets the reference reflection RL ref to the specified value. It is only applicable to the Return Loss application.

Note: This is the only reference, which is not measured.

parameters **1|2** The channel parameter 1 or 2 may be present, but is ignored.

Value The open end reflection in dB (usually 14.7).

related commands :SENSe:POWer:REFerence?, SENSe:POWer:REFerence:DISPlay:PPAR, :SENSe:POWer:REFerence:DISPlay:PREF

errors The message “Wrong application for this command” is returned, if the present application is not Return Loss.

example
```
OUTPUT 724;":SENS:POW:REF 14.7"
```

command **:SENSe:POWer:REFerence:DISPlay**

syntax :SENSe[1|2]:POWer:REFerence:DISPlay

description This command stores the value currently measured and displayed as the new reference value (usually the source power). It is only applicable to the applications

- Insertion Loss,
- PDL/Insertion Loss,
- Coupler Test,
- Directivity, and
- Powermeter.

Note: After starting the application wait ca. 2 s before issuing this command.

parameter **1|2** 1 Reads head A
2 Reads head B
Default is 1.

errors The message “Wrong application for this command” is returned, if the present application is not one of those listed above.

The message “No head connected” is returned, if there is no optical head attached to the specified channel.

related commands :SENSe:POWer:REFerence:DISPlay?,
:SENSe:POWer:REFerence:DISPlay:HEAD?

example `OUTPUT 724;":SENS1:POW:REF:DISP"` command **:SENSe:POWer:REFerence:DISPlay:HEAD?**

syntax :SENSe[1|2]:POWer:REFerence:DISPlay:HEAD?

description This query informs you whether the reference value has been taken with the specified head. It is only applicable to the applications

- Insertion Loss,
- PDL/Insertion Loss,
- Coupler Test,
- Directivity, and
- Powermeter.

parameter **1|2** 1 Checks head A
2 Checks head B
Default is 1.

response A **boolean** value:

0 The reference has been taken with the other head.
1 The reference has been taken with this head.

related commands :SENSe:POWer:REFerence:DISPlay,
:SENSe:POWer:REFerence:DISPlay?

example
```
OUTPUT 724;":SENS1:POW:REF:DISP:HEAD?"
ENTER 724;A$
```

command **SENSe:POWer:REFerence:DISPlay:PPAR**

syntax SENSe[1|2]:POWer:REFerence:DISPlay:PPAR

description This command stores the value currently measured and displayed as the power of parasitic reflections. It is only applicable to the Return Loss application.

parameter **1|2**
1 Reads head A
2 Reads head B
Default is 1.

errors The message “Wrong application for this command” is returned, if the present application is not Return Loss.

The message “No head connected” is returned, if there is no optical head attached to the specified channel.

related commands :SENSe:POWer:REFerence:DISPlay:PPAR?, :SENSe:POWer:REFerence, :SENSe:POWer:REFerence:DISPlay:PREF

example
```
OUTPUT 724;"SENS1:POW:REF:DISP:PPAR"
```

command **:SENSe:POWer:REFerence:DISPlay:PPAR?**

syntax :SENSe[1|2]:POWer:REFerence:DISPlay:PPAR?

description This query returns the stored value of the parasitic reflections. It is only applicable to the Return Loss application.

parameter **1|2** The channel parameter 1 or 2 may be present, but is ignored. P par is valid for both channels.

response The stored parasitic reflections value P par.

related commands :SENSe:POWer:REFerence:DISPlay:PPAR

errors The message “Wrong application for this command” is returned, if the present application is not Return Loss.

example
```
OUTPUT 724;":SENS:POW:REF:DISP:PPAR?"
ENTER 724;A$
```

command	**:SENSe:POWer:REFerence:DISPlay:PREF**
syntax	:SENSe[1|2]:POWer:REFerence:DISPlay:PREF
description	This command stores the value currently measured and displayed as the Return Loss reference power. It is only applicable to the Return Loss application.
parameter	**1|2** 1 Reads head A 2 Reads head B Default is 1.
errors	The message “Wrong application for this command” is returned, if the present application is not Return Loss. The message “No head connected” is returned, if there is no optical head attached to the specified channel.
related commands	:SENSe:POWer:REFerence:DISPlay:PREF?, :SENSe:POWer:REFerence, :SENSe:POWer:REFerence:DISPlay:PPAR
example	`OUTPUT 724;"SENS1:POW:REF:DISP:PREF"`

command	**:SENSe:POWer:REFerence:DISPlay:PREF?**
syntax	:SENSe[1|2]:POWer:REFerence:DISPlay:PREF?
description	This query returns the stored value of the power reference for Return Loss measurements. It is only applicable to the Return Loss application.
parameter	**1|2** The channel parameter 1 or 2 may be present, but is ignored. P ref is valid for both channels.
response	The stored power reference value P ref.
errors	The message “Wrong application for this command” is returned, if the present application is not Return Loss.
related commands	:SENSe:POWer:REFerence:DISPlay:PREF
example	`OUTPUT 724;":SENS:POW:REF:DISP:PREF?"`

command	**:SENSe:POWer:REFerence:DISPlay?**
syntax	:SENSe[1|2]:POWer:REFerence:DISPlay?
description	This query returns the stored reference value of the specified channel. It is only applicable to the applications • Insertion Loss, • PDL/Insertion Loss, • Coupler Test, • Directivity, and • Powermeter.
parameter	**1|2** 1 Checks head A 2 Checks head B Default is 1.
response	The reference value taken from the specified head in dBm.
errors	The message "Wrong application for this command" is returned, if the present application is not one of those listed above. The message "No head connected" is returned, if the reference was not taken from the specified head.
related commands	:SENSe:POWer:REFerence:DISPlay
example	`OUTPUT 724;":SENS1:POW:REF:DISP?"`

command	**:SENSe:POWer:REFerence?**
syntax	:SENSe[1|2]:POWer:REFerence?
description	This query returns the current Return Loss reference value for an open end reflection RL ref. It is only applicable to the Return Loss application.
parameter	**1|2** The channel parameter 1 or 2 may be present, but is ignored. P ref is valid for both channels.
response	A floating point number, indicating the current Return Loss reference value in dB.

related commands :SENSe:POWer:REFerence

errors The message “Wrong application for this command” is returned, if the present application is not Return Loss.

example

```
OUTPUT 724;":SENS:POW:REF?"
ENTER 724;A$
```

command **:SENSe:POWer:UNIT**

syntax :SENSe[1|2]:POWer:UNIT<wsp><unit>

description This command sets the specified measurement unit.

The units dBm and Watt are only applicable to the Powermeter application.

The units % and dB are only applicable to the applications

- Coupler Test, and
- Polarization Dependent Coupler Test.

parameters **1|2** The channel parameter 1 or 2 may be present, but is ignored. The unit is valid for both channels.

Unit When the Powermeter application is active: DBM|W|0|1. You can enter either the mnemonic or the corresponding number:

DBM	0	Measurement unit dBm
W	1	Measurement unit Watt (or mW)

Note: Switching between dBm and W affects only absolute power measurements. Relative measurements are always in dB.

When Coupler Test or PDCT is active: PERCent|DB|2|3.
You can enter either the mnemonic or the corresponding number:

PERCent	2	Measurement unit %
DB	3	Measurement unit dB

Note: Switching between percent and dB affects only the display of the Coupling Ratio (CR, PDCR) and the Splitting Ratio (SR, PDSR). All other coupler parameters are always measured in dB.

errors — The message “Wrong application for this command” is returned, if you send DBM|W|0|1 and the current application is not Powermeter.

The same message is returned, if you send PERCent|DB|2|3 and the current application is not Coupler Test or Polarization Dependent Coupler Test.

related commands — :SENSe:POWer:UNIT?, :SENSe:DATA? POW, :SENSe:DATA? CR, :SENSe:DATA? SR

example

```
OUTPUT 724;":SENS:FUNC POW"
OUTPUT 724;":SENS:POW:UNIT W"
```

command — **:SENSe:POWer:UNIT?**

syntax — :SENSe[1|2]:POWer:UNIT?

description — This query returns the current setting of the measurement unit. It is only applicable to the applications

- Coupler Test,
- Polarization Dependent Coupler Test, and
- Powermeter.

parameter — **1|2** When the Powermeter application is active:

1 Reads head A
2 Reads head B
Default is 1.

When the Coupler Test or PD Coupler Test application is active: The channel parameter 1 or 2 may be present, but is ignored.

response — An integer number. When the Powermeter application is active:

0 Measurement unit dBm
1 Measurement unit Watt (or mW)
3 Measurement unit dB (channel mode is set for relative measurements)

When the Coupler Test or PD Coupler Test application is active:

2	Measurement unit % for CR, PDCR, SR, and PDSR
3	Measurement unit dB for CR, PDCR, SR, and PDSR

related commands

:SENSe:POWer:UNIT, :SENSe:DATA? POW, :SENSe:DATA? CR, :SENSe:DATA? SR

example

```
OUTPUT 724;":SENS1:POW:UNIT?"
ENTER 724;A$
```

command **:SENSe:POWer:WAVelength**

syntax :SENSe[1|2]:POWer:WAVelength<wsp><value>[unit]

description This command sets the wavelength for the optical heads. It is only applicable to the Powermeter application.

parameter **1|2** The channel parameter 1 or 2 may be present, but is ignored. The setting affects both channels.

Unit		
	m	meter
	mm	millimeter
	um	micrometer
	nm	nanometer
	pm	picometer

Default is m.

Value 800 ≤ value ≤ 1700 nm. Any valid number/unit combination will be accepted, e.g. 1.55e-6.

errors The message “Wrong application for this command” is returned, if the present application is not Powermeter.

The message “Value out of range” is returned, if the value is outside the range specified for the OLA.

related commands :SENSe:POWer:WAVelength?

example

```
OUTPUT 724;":SENS:POW:WAV 1300nm"
```

command	**:SENSe:POWer:WAVelength?**
syntax	:SENSe[1|2]:POWer:WAVelength?
description	This query returns the current wavelength setting.
parameter	**1|2** The channel parameter 1 or 2 may be present, but is ignored. The wavelength is valid for both channels.
response	The wavelength is returned as a floating point number in exponential format, e.g. 1.3E-6. The unit is meter. The unit is not included in the response.
related commands	:SENSe:POWer:WAVelength
example	`OUTPUT 724;":SENS:POW:WAV?"` `ENTER 724;A$`

command	**:SENSe:POWer:WINDow:MODe**
syntax	:SENSe[1|2]:POWer:WINDow:MODe<wsp><mode>
description	This command sets the mode of the measurement window used for calculating the Min/Max value. It is only applicable to the Powermeter Min/Max application.
parameters	**1|2** The channel parameter 1 or 2 may be present, but is ignored. The setting affects both channels. **Mode** There are three modes available. You enter one of the following keywords: SLIDing — The window is filled once. After that, the Min/Max value is updated from sample to sample. REFResh — The Min/Max value is not updated until the window has been refilled completely. CONTinuous — The Min/Max value is calculated as the difference between the present and the previous value.
errors	The message “Wrong application for this command” is returned, if the present application is not Powermeter Min/Max.
related commands	:SENSe:POWer:WINDow:MODe?

example `OUTPUT 724;":SENS:POW:WIND:MOD REFR"`

command **:SENSe:POWer:WINDow:MODe?**

syntax :SENSe[1|2]:POWer:WINDow:MODe?

description This query returns the current mode of the window used for collecting the samples for the Min/Max determination. It is only applicable to the Powermeter Min/Max application.

parameter **1|2** The channel parameter 1 or 2 may be present, but is ignored. The setting affects both channels.

response An **integer** value:

0 Sliding window
1 Refresh mode
2 Continuous mode

errors The message “Wrong application for this command” is returned, if the present application is not MINMax.

related commands :SENSe:POWer:WINDow:MODe

example
```
OUTPUT 724;":SENS:POW:WIND:MOD?"
ENTER 724;A$
```

command **:SENSe:POWer:WINDow:SIZe**

syntax :SENSe[1|2]:POWer:WINDow:SIZe<wsp><value>

description This command specifies the dimension of the window used for collecting the samples for the Min/Max determination. It is only applicable to the Powermeter Min/Max application.

parameter **1|2** The channel parameter 1 or 2 may be present, but is ignored. The setting affects both channels.

Value The number of samples used to determine the minimum and maximum value: 50|100|500|1000.

Note: If you specify a number which is different from those listed above, the window is set to the size which comes closest. For instance, 74 sets 50, 75 sets 100 samples.

related commands :SENSe:POWer:WINDow:SIZe?

errors The message “Wrong application for this command” is returned, if the present application is not Powermeter Min/Max.

example `OUTPUT 724;":SENS:POW:WIND:SIZ 500"`

command **:SENSe:POWer:WINDow:SIZe?**

syntax :SENSe[1|2]:POWer:WINDow:SIZe?

description This query returns the dimension of the window used for collecting the samples for the Min/Max determination. It is only applicable to the Powermeter Min/Max application.

parameter **1|2** The channel parameter 1 or 2 may be present, but is ignored. The setting affects both channels.

response The number of samples which constitutes the window: 50, 100, 500, or 1000.

related commands :SENSe:POWer:WINDow:SIZe

example
```
OUTPUT 724;":SENS:POW:WIND:SIZ?"
ENTER 724;A$
```

command **:SOURce:POWer:STATe**

syntax :SOURce:POWer:STATe<wsp><boolean>

description This command switches the built-in laser source on or off. It is applicable any time.

parameter **Boolean** A **boolean** variable: OFF|ON|0|1. You can enter either the function literally or the corresponding number:

OFF 0 Switches the internal laser source off.
ON 1 Switches the internal laser source on.

Note: Any non-zero number switches the internal laser source on.

related commands :SOURce:POWer:STATe?

example `OUTPUT 724;":SOUR:POW:STAT ON"`

command	**:SOURce:POWer:STATe?**
syntax	:SOURce:POWer:STATe?
description	This query returns the current state of the internal laser source.
response	A **boolean** value: 0 The internal source is off. 1 The internal source is on.
related commands	:SOURce:POWer:STATe
example	`OUTPUT 724;":SOUR:POW:STAT?"` `ENTER 724;A$`

command	**:SOURce:POWer:WAVelength**
syntax	:SOURce:POWer:WAVelength<wsp><source>
description	This command switches the wavelength of the built-in laser source. It is only applicable to an instrument equipped with the dual source option. It can be used any time. It is ignored, if the OLA has only a single source.
parameter	**Source** You enter one of the following keywords: LOWer Switches to 1310 nm UPPer Switches to 1550 nm
related commands	:SOURce:POWer:WAVelength?
example	`OUTPUT 724;"SOUR:POW:WAV UPP"`

command	**:SOURce:POWer:WAVelength?**
syntax	:SOURce:POWer:WAVelength?
description	This query returns the current wavelength of the internal source.
response	The wavelength is returned as a floating point number in exponential format, e.g. 1.55E-6. The unit is meter. The unit is not included in the response.
related commands	:SOURce:POWer:WAVelength

example
```
OUTPUT 724;":SOUR:POW:WAV?"
ENTER 724;A$
```

command **:SYSTem:ERRor?**

syntax :SYSTem:ERRor?

description This query returns the oldest error message in the error queue. The error message returned is erased from the queue. To clear the error queue, you have to issue the query repeatedly.

response The response includes the error code number and the error text string, separated by a comma, e.g. -109, "Missing parameter".

Positive error numbers are device dependent. Negative error numbers are defined by the SCPI standard.

An error code of 0 indicates, that there are no errors in the queue. For a list of the error messages and error codes see Appendix F "Error Messages".

example
```
DIM A$[60]
OUTPUT 724;":SYST:ERR?"
ENTER 724;Errno,A$
```

command **:SYSTem:VERS?**

syntax :SYSTem:VERSion?

description This query returns the version of the SCPI command set currently installed.

response A number in the format yyyy.v, where yyyy is the year, and v is the version, e.g. 1995.0.

example
```
OUTPUT 724;":SYST:VERS?"
ENTER 724;A$
```

8.6 Programming Examples

This chapter gives some programming examples. The language used is the BASIC 5.1 Language System used on HP 9000 Series 200/300 computers.

These programming examples do not cover the full command set for the instrument. They are intended only as an introduction to the method of programming the instrument.

Example 1 - Checking the Communication

Function

This program sends two queries and displays the responses.

Listing

```
10   !-----------------------------------------------------------------
-----
20   !
30   ! HP E5574A OLA Programming Example 1
40   !
50   ! A Simple Communications Check
60   !
70   !-----------------------------------------------------------------
-----
80   !
90   ! Definitions and Initializations
100  !
110  OLA=724
120  !
130  ! The first 7 is to access the HP-IB card in the controller,
140  ! the 24 is the HP-IB address of the OLA.
150  !
160  !
170  DIM String$[60]
180  !
```

```
190   CLEAR SCREEN
200   PRINT TABXY(5,10);"Programming Example 1, Simple Communication"
210   !
220   ! Send an IDN query and print the identification
230   !
240   OUTPUT OLA;"*IDN?"
250   ENTER OLA;String$
260   PRINT TABXY(10,12);"Identification: ";String$
270   !
280   ! Send an OPT query and print the options installed
290   !
300   OUTPUT OLA;"*OPT?"
310   ENTER OLA;String$
320   PRINT TABXY(10,13);"Options:        ";String$
330   !
340   END
```

Example 2 - Reading Power and Storing the Reference

For this program to work, you need an optical head attached to input A. The optical output is to be connected to this head.

Function

This program measures and displays the source power and stores it as the reference power.

Listing

```
10   !---------------------------------------------------------------
-----
20   !
30   ! HP E5574A OLA Programming Example 2
40   !
50   ! Measuring Power and Storing the Reference
60   !
70   !---------------------------------------------------------------
-----
80   !
```

```
90   ! Definitions and Initializations
100  !
110  OLA=724
120  !
130  ! The first 7 is to access the HP-IB card in the controller,
140  ! the 24 is the HP-IB address of the OLA.
150  !
160  !
170  REAL Diff,Value1,Value2
180  !
190  CLEAR SCREEN
200  PRINT TABXY(5,10);"Programming Example 2, Measuring Power"
210  PRINT TABXY(5,13);"Value:              dBm"
220  !
230  ! Switch the source on
240  !
250  OUTPUT OLA;":SOURCE:POW:STAT ON"
260  !
270  ! Activate Powermeter; set measurement unit to dBm
280  !
290  OUTPUT OLA;":SENS:FUNC MAIN"
300  OUTPUT OLA;":SENS:FUNC POW"
310  OUTPUT OLA;":SENS:POW:UNIT DBM"
320  !
330  ! Take measurements until two consecutive results are identical
340  !
350  REPEAT
360       WAIT 1.0
370       OUTPUT OLA;":SENS1:DATA? POW"
380       ENTER OLA;Value2
390       PRINT TABXY(12,13);"       "
400       PRINT TABXY(12,13);Value2
410       Diff=Value2-Value1
420       Value1=Value2
430  UNTIL Diff=0
440  !
450  ! Store the present value as the reference power
460  !
```

```
470  OUTPUT OLA;":SENS1:POW:REF:DISP"
480  !
490  END
```

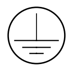
A

Installation and Maintenance

Installation and Maintenance

This appendix provides installation instructions for the E5574A. It also includes information about initial inspection and damage claims, preparation for use, packaging, storage, and shipment.

Safety Considerations



The E5574A is a Class 1 instrument (that is, an instrument with an exposed metal chassis directly connected to earth via the power supply cable). The shown symbol is used to indicate a protective earth terminal in the instrument.

Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

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.

CAUTION Take care of the yellow fiber when unpacking your E5574A #020.

The Appendix D “Performance Test” on page 193 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.

WARNING **To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).**

AC Line Power Supply Requirements

The HP E5574A can operate from any single-phase AC power source that supplies between 100V and 240V at a frequency in the range from 50 to 60Hz. The maximum power consumption is 100VA with all options installed.

Line Power Cable

According to international safety standards, this instrument has a three-wire power cable. When connected to an appropriate AC power receptacle, this cable earths the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure A-1 for the part numbers of the power cables available.

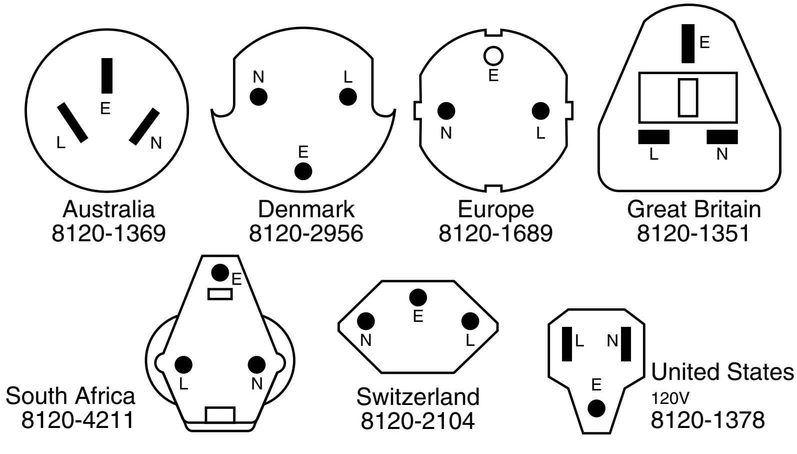


Figure A-1 Line Power Cables – Plug Identification

WARNING **To avoid the possibility of injury or death, you must observe the following precautions before switching on the instrument.**

- **If this instrument is to be energized via an autotransformer for voltage reduction, ensure that the Common terminal connects to the earth pole of the power source.**
- **Insert the power cable plug only into a socket outlet provided with a protective earth contact. Do not negate this protective action by the using an extension cord without a protective conductor.**
- **Before switching on the instrument, the protective earth terminal of the instrument must be connected to a protective conductor. You can do this by using the power cord supplied with the instrument.**
- **Do not interrupt the protective earth connection intentionally.**

The following work should be carried out by a qualified electrician. All local electrical codes must be strictly observed. If the plug on the cable does not fit the power outlet, or if the cable is to be attached to a terminal block, cut the cable at the plug end and rewire it.

The color coding used in the cable depends on the cable supplied. If you are connecting a new plug, it should meet the local safety requirements and include the following features:

- Adequate load-carrying capacity (see table of specifications).
- Ground connection.
- Cable clamp.

WARNING **To avoid the possibility of injury or death, please note that the HP E5574A does not have a floating earth.**
The HP E5574A is not designed for outdoor use. To prevent potential fire or shock hazard, do not expose the instrument to rain or other excessive moisture.

The AC power requirements are summarized on the rear panel of the instrument.

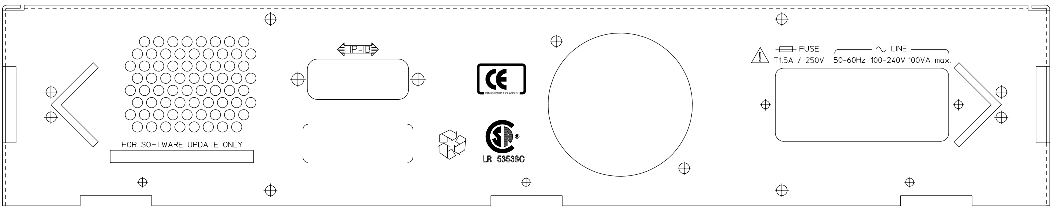


Figure A-2 Rear Panel Markings

Replacing the Fuse

There is one fuse in this instrument. This is a T1.5A/250V (time-lag) (HP Part No. 2110-0304). The fuse holder is at the rear of the instrument, beside the line power connector.

How to Replace the Fuse

1. Release the fuse holder: use the blade of a flat-headed screwdriver to depress the catch at the side of the holder and then pull the holder out a little.

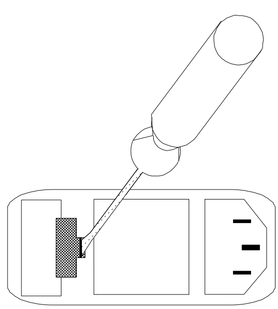


Figure A-3 Releasing the Fuse Holder

2 Pull the fuse holder out of the instrument.

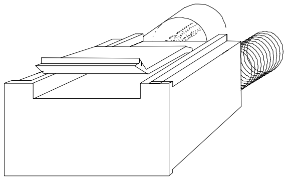


Figure A-4 The Fuse Holder

3 Check and replace the fuse as necessary making sure that the fuse is always in the top position of the fuse holder, and the bridge is in the bottom.

4 Place the fuse holder back in the instrument, and push it until the catch clicks back into place.

Replacing the Battery

This instrument contains a lithium battery. Replacing the battery should be carried out only by a qualified electrician or by HP service personnel.

There is a danger of explosion if the battery is incorrectly replaced. Replace only with the same or an equivalent type (HP part number 1420-0394). Discard used batteries according to local regulations.

Environmental Specifications

The following summarizes the HP E5574A operating environment ranges. In order for the instrument to meet specifications, the operating environment must be within these limits.

NOTE Protect the instrument from temperature extremes and changes in temperature that may cause condensation within it.

AC line Voltage Requirements	100-240 V, 50-60 Hz
Maximum Power Requirements	100 VA
Operating Temperature	10-40°C ambient
Relative Humidity	< 95% from 10°C to 40°C
Altitude	to 2000 m
Storage	-40°C to 70°C
Installation Category (IEC 664)	II
Pollution Degree (IEC 664)	2

Instrument Positioning and Cooling

Mount or position the instrument upright and horizontally so that air can circulate around it freely. When operating the E5574A, choose a location that provides at least 75mm (3 inches) of clearance at the rear, and at least 25mm (1 inch) of clearance at each side. Failure to provide adequate air clearance may result in excessive internal temperature, reducing instrument reliability.

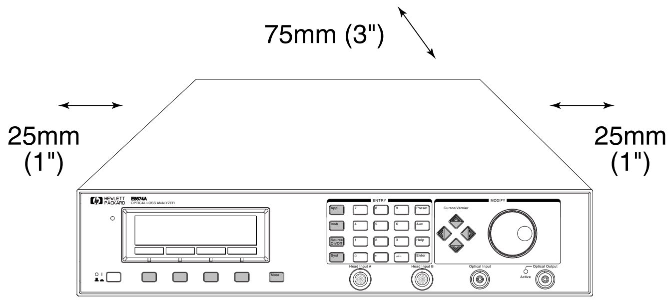


Figure A-5 Correct Positioning of the HP E5574A

Optical Output

CAUTION Make sure that you only use the correct cables with your chosen output.

HP-IB Interface

You can connect your HP-IB interface into a star network, a linear network, or a combination star and linear network. The limitations imposed on this network are as follows:

- The total cable length cannot exceed 20 meters
- The maximum cable length per device is 2 meters
- No more than 15 devices may be interconnected on one bus.

Connector

The following figure shows the connector and pin assignments (Connector Part Number: 1251-0293).

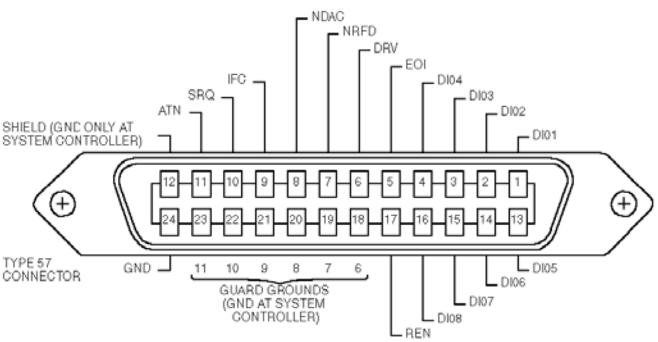


Figure A-6 The HP-IB Connector

CAUTION HP products delivered now are equipped with connectors having ISO metric-threaded lock screws and stud mounts (ISO M3.5 x 0.6) that are black in color. Earlier connectors may have lock screws and stud mounts with imperial-threaded lock screws and stud mounts (6-32 UNC) that have a shiny nickel finish.

CAUTION It is recommended that you do not stack more than three connectors, one on top of the other.
Hand-tighten the connector lock screws. Do not use a screwdriver.

HP-IB Logic Levels

The E5574A HP-IB lines use standard TTL logic, as follows:

- True = Low = digital ground or 0 Vdc to 0.4 Vdc
- False = High = open or 2.5 Vdc to 5 Vdc

All HP-IB lines have LOW assertion states. High states are held at 3.0Vdc by pull-ups within the instrument. When a line functions as an input, it requires approximately 3.2mA to pull it low through a closure to digital ground. When a line functions as an output, it can sink up to 48mA in the low state and approximately 0.6mA in the high state.

NOTE The HP-IB line screens are not isolated from ground.

Claims and Repackaging

If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Hewlett-Packard Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

Return Shipments to HP

If the instrument is to be shipped to a Hewlett-Packard Sales/ Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required. The original shipping carton and packing material may be reusable, but the Hewlett-Packard Sales/Service Office will provide information and recommendation on materials to be used if the original packing is no longer available or reusable. General instructions for repacking are as follows:

- Wrap instrument in heavy paper or plastic.
- Use strong shipping container. A double wall carton made of 350-pound test material is adequate.
- Use enough shock absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside container. Protect control panel with cardboard.
- Seal shipping container securely.
- Mark shipping container FRAGILE to encourage careful handling.
- In any correspondence, refer to instrument by model number and serial number.

B

Accessories

Accessories

The HP E5574A is a high performance optical loss analyzer for measurements on single-mode optical components. It is available in various configurations for the best possible match to the most common applications.

This appendix provides information on the available options and accessories.

Instrument and Options

Model No.	Description
HP E5574A	Optical Loss Analyzer including one HP 81521B #001 optical head
Option 013	Fabry Perot Laser Source 1310 nm
Option 015	Fabry Perot Laser Source 1550 nm
Option 135	Dual Wavelength Fabry Perot Laser Source 1310/1550 nm
Option 020	Pigtail optical output connector A 9/125 µm fiber pigtail with an FC/PC connector attached
Option 021	Straight contact optical output connector
Option 022	Angled contact optical output connector
Option 521	Second HP 81521B #001 optical head

ATTENTION The optical input always requires angled connectors.

Using any other connector:

- **will increase insertion loss and**
- **may damage the optical input.**

If using a different optical head, use one of the following:

Model No.	Description
HP 81521B	Ge, 5mm, 900-1700 nm, +3 to -80 dBm
HP 81524A	InGaAs, 5mm, 800-1650 nm, +3 to -90 dBm
HP 81525A	InGaAs, 5mm, 800-1650 nm, +27 to -70 dBm

HP-IB Cables and Adapters

The HP-IB connector is compatible with the connectors on the following cables and adapters.

Model No.	Description
HP 10833A	HP-IB Cable 1 m (3.3 ft.)
HP 10833B	HP-IB Cable 2 m (6.6 ft.)
HP 10833C	HP-IB Cable 4 m (13.2 ft.)
HP 10833D	HP-IB Cable 0.5 m (1.6 ft.)
HP 10834A	HP-IB Adapter 2.3 cm extender

Connector Interfaces and Other Accessories

The Optical Loss Analyzer is supplied with one of three output connector interface options:

- Fiber Pigtail output with an FC/PC connector
- Straight contact
- Angled contact

ATTENTION The optical input always requires angled connectors.

Using any other connectors:

- **will increase insertion loss and**
- **may damage the optical input.**

Pigtail Optical Output Connector

The fiber pigtail optical output consists of a 9/125 µm fiber pigtail with an FC/PC connector attached.

Straight Contact Connector

If you want to use straight contact connectors to connect to the instrument, you must

1. attach your connector interface (see list of connector interfaces below) to the interface adapter,
2. then connect your cable.

Model No.	Description
HP 81000AI	Diamond HMS-10
HP 81000FI	FC/PC/SPC

Model No.	Description
HP 81000GI	D4
HP 81000KI	SC
HP 81000SI	DIN 47256
HP 81000VI	ST
HP 81000WI	Biconic

Angled Contact Connector

If you want to use angled contact connectors to connect to the instrument, you must

1. attach your connector interface (see list of connector interfaces below) to the interface adapter,
2. then connect your cable.

Model No.	Description
HP 81000FI	FC/APC
HP 81000KI	SC/APC
HP 81000SI	DIN 4108

Connector Adapters for Optical Heads

You will need at least one connector adapter for each optical head.

Model No.	Description
HP 81000AA	Diamond HMS-10
HP 81000BA	Bare fiber (125 µm fiber cladding diameter)
HP 81000DA	Radiall VFO-DF
HP 81000EA	Radiall EC
HP 81000FA	FC/PC/SPC/APC

Model No.	Description
HP 81000GA	NEC D4
HP 81000KA	SC
HP 81000SA	DIN 47256/4108
HP 81000VA	ST
HP 81000WA	Biconic

Rack Mount Options

Model No.	Description
P/N 5062-3988	Front Handle Kit
P/N 5062-3974	Rack Mount Flange Kit

C

Specifications

Definitions of Terms

Output Power

The output power at the specified wavelength, measured at the end of the pigtail (#020) or at the end of a jumper cable (#021 and #022), assuming specified HP connector interfaces and patchcords. Connectors and patchcords must be absolutely clean and undamaged.

CW-Stability short term

The uncertainty of the power level observed over the given time relative to the mean power during this time.

Measured with average optical power meter and a 9/125 µm fiber, at constant temperature within the specified operating temperature and within a given time, line voltage uninterrupted.

Center Wavelength

The wavelength defined as wavelength in air and by the "center of gravity" of the spectral emission. The power and wavelength of each spectral component are used in the calculation of the Center Wavelength:

$$\bar{\lambda} = \Sigma\{P_i \times (\lambda_i / P_0)\}$$

where P_0 is total power ΣP_i
P_i is the power of an individual peak

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 power distribution.

When the power distribution is a spectrum of discrete lines, then the FWHM spectral bandwidth, w, is calculated from

$$w = 2.355 \times \sigma$$

where σ is the “RMS spectral width”, to be calculated with the help of the power and wavelength of each spectral component:

$$\sigma = \sqrt{\Sigma\{P_i \times [\lambda_i - \bar{\lambda}]^2 / P_{total}\}}$$

Nonlinearity

When changing the displayed power level from the reference level, D_0, to an arbitrary displayed level, D_1, the nonlinearity, N, is the relative difference between the displayed power ratio, D_1/D_0, and the true power ratio P_1/P_0 :

$$N = (D_1 / D_0) / (P_1 / P_0) - 1$$

Please note: A reference level between 10 and 20µW is chosen by international convention.

Absolute PDL/PDG uncertainty

PDL describes the relative difference between an optical component’s maximum and minimum transmission loss or gain assuming all states of polarization have been covered.

The PDL/PDG uncertainty includes all random and systematic uncertainties from the source, the polarization controller and the optical power meter.

PDL is measured by applying random polarization states to the test device.

Therefore, generating the polarization states which lead to min/max transmission includes a random component. As a result, the displayed PDL/PDG value tends to be smaller than the true PDL/ PDG value. Asymmetric uncertainty limits are specified to reflect this characteristic.

If the test device includes several PDL producing components then the overall PDL depends on the geometrical alignment of these components. Accordingly, the measured PDL/PDG value may change as a consequence of alignment changes within the test device.

Repeatability of PDL/PDG

The uncertainty in reproducing a PDL/PDG measurement result with unchanged conditions (without moving the fibres or disconnecting the connectors). The repeatability is half the span between the maximum and minimum value of all differences.

Absolute PDCR uncertainty

The PDCR uncertainty includes all random and systematic uncertainties from the source, the polarization controller and the optical power meter.

Repeatability of PDCR

The uncertainty in reproducing a PDCR measurement result under unchanged conditions (without moving the fibers or disconnecting the connectors).

Technical Data, Product Specifications and Characteristics

The HP E5574A Optical Loss Analyzer is produced to ISO 9001 international quality system standard as part of HP's commitment to continually increasing customer satisfaction through improved quality control.

Specifications describe the instrument's warranted performance. Supplementary Performance Characteristics describe the instrument's non-warranted typical performance.

The display may vary by ±1 count.

Notes for following table "Absolute Power Measurement Specifications":

[1] At the following reference conditions:
- Power level 10 µW (-20 dBm), continuous wave (CW).
- Parallel beam, 3mm spot diameter on detector.
- Ambient temperature 23°C ±5K.
- At day of calibration (add 0.3% for aging over one year, add 0.6% over two years).
- Spectral width of source <10nm.

[2] At the following operating conditions:
- Parallel beam, 3 mm spot diameter on detector or connectorized fiber with NA ≤0.2.
- Ambient temperature within operating temperature range, non-condensing.
- Within 1 year after calibration, add 0.3% for second year.

[3] Add ±0.007dB/dB between 10 and 27dBm.

[4] For single-mode fiber with NA ≤ 0.1, straight fiber end, 1250 – 1570 nm.

[5] with HP E5574A, setting optimized to DYNAMIC.

[6] with HP E5574A, setting optimized to PDL and with HP 8153A.

Absolute Power Measurement Specifications

Optical Head	81521B #001	81521B	81524A	81525A
Sensor element	Ge, 5 mm		InGaAs, 5 mm	
Wavelength range	900 – 1700 nm		800 – 1650 nm	
Power range	+3 to –80 dBm [5] +3 to –64 dBm [6]	+3 to –80 dBm	+3 to –90 dBm	+27 to –70 dBm (1250 – 1650 nm) +23 to –70 dBm (800 – 1650 nm)
Display resolution	0.001 dBm			
Applicable fiber type	parallel beam, 9/125 – 100/140µm, NA ≤ 0.3			
Uncertainty (accuracy) at reference cond. [1]	±2.2% (1000 –1650 nm)		±2.2% (1000 - 1600 nm)	±3.0% (900 - 1600 nm)
Total uncertainty [2]	±4% ±50 pW [5] ±4% ±600 pW [6] (1000 – 1650 nm)	±4% ±50 pW (1000 – 1650 nm)	±4% ±5 pW (1000 – 1600 nm)	±5% ±500 pW (900 – 1600 nm)
Linearity (power)	(0 to –60 dBm) [5] (0 to –44 dBm) [6]	(0 to –60 dBm)	(+3 to –70 dBm)	(+10 to –50 dBm) [3]
(18°C to 28°C, T=const)	±0.04 dB ±50 pW [5] ±0.04 dB ±600 pW [6]	±0.04 dB ±50 pW	±0.04 dB ±5 pW	±0.04 dB ±500 pW
(op. temp. range, T=const)	±0.15 dB ±50 pW [5] ±0.15 dB ±600 pW [6]	±0.15 dB ±50 pW	±0.15 dB ±5 pW	±0.15 dB±500 pW
Noise (peak-peak) averaging time 1 sec.	<50 pW [5] <600 pW [6] (1200 – 1600 nm)	<50 pW (1200 – 1600 nm)	<5 pW (1000 – 1600 nm)	<500 pW (900 –1600 nm)
Polarization sensitivity	0.003 dBpp [4]	–	–	–

Insertion Loss/Gain and Coupling Ratio Measurement Specifications

Laser Source	Option 013	Option 015	Option 135
Type	Fabry Perot Laser with built-in isolator		
Central wavelength	1310 ±20 nm	1550 ±20 nm	1310/1550 ±20 nm
Fiber type	single-mode, 9/125 µm		
Display resolution	0.001 dB		
Output power [1]	>-10 dBm (>-8 dBm typ)	>-10 dBm (>-8 dBm typ)	>-10 dBm (>-8 dBm typ)
CW-Stability (15 min, T=const)	±0.004 dB(typ)	±0.004 dB (typ)	±0.004 dB (typ)
Backreflection sensitivity (typ)	<0.001 dBpp @ 4% reflection		
Insertion loss/gain range	max. measurable gain [dB] : upper power limit of optical head [dBm] minus source output power [dBm] max. measurable insertion loss [dB] : output power of source [dBm] minus sensitivity of optical head [dBm]		
Coupling ratio/ directivity range	any value within power range of optical head		
Linearity [2]	(> -60 dBm at optical head)		
(18°C to 28°C, T=const) (op. temp. range, T=const)	±0.04 dB ±50 pW ±0.15 dB ±50 pW		

[1] Class 3A according to IEC 825-1 (1993), Class 1 according to FDA CFR 21 (1986).

[2] applies to HP 81521B #001. For other optical heads, check linearity specification on previous page.

Polarization Dependent Loss (PDL), Gain (PDG) and Coupling Ratio (PDCR) Measurement Specifications

Specifications are measured with internal source and optical head HP 81521B #001.

Central wavelength (with internal source)	1310 ±20 nm and/or 1550 ±2 0nm
Wavelength range (with external source)	1250 - 1600 nm
Display resolution	0.0001 dB
Absolute PDL/PDG uncertainty [1]	±0.005 dB +0/-2.5% of measured PDL (for PDL ≤ 0.2 dB) ±0.005 dB +0/-5% of measured PDL (for 0.2 dB < PDL ≤ 5 dB)
Absolute PDCR uncertainty	±0.01 dB +0/-5% of measured PDCR (for PDCR ≤ 0.2 dB) ±0.01 dB +0/-10% of measured PDCR (for 0.2 dB < PDCR ≤ 5 dB)
Repeatability for PDL/PDG	±0.001 dB ±2% of measured PDL
Repeatability for PDCR	±0.002 dB ±4% of measured PDCR
PDL/PDG/PDCR range [2]	0 - 5 dB
Max. insertion loss of DUT [3]	20 dB

[1] applies to output connector option 020 (pigtailed fiber port). For option 021 (straight contact output connector) and option 022 (angled contact output connector) the PDL of the individual connector or connection may by far exceed the specified accuracy.

[2] higher PDL/PDG/PDCR values may be measured with increased uncertainty.

[3] with higher insertion loss or source power <-10 dBm, PDL/PDG/PDCR values may be measured with increased uncertainty.

Supplementary Performance Characteristics

Return Loss Can be measured with internal source up to typically 55 dB with ±1 dB accuracy.

General Recalibration period: 2 years. Warm-up time to meet accuracy specifications: 60 min. for instrument, 5 min with laser on.

HP-IB Capability All modes and parameters can be programmed, SCPI command set, HP 8153A lightwave multimeter compliant command set where applicable.

HP-IB Interface Function Code SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0.

Environmental Storage temperature: –40°C to +70°C. Operating temperature: 10°C to +40°C (35°C for HP81525A). Humidity: < 95% R.H. within operating temperature range.

Power 100 – 240 Vrms, 100 VA max., 50 – 60 Hz.

Battery Back-up (for non-volatile memory) With instrument switched off all current modes and data will be maintained for at least 10 years after delivery.

Dimensions (WxHxD in cm): 42.6 × 8.9 × 44.5

Weight 9 kg

D

Performance Test

Performance Test

Use the Performance Test to verify the instruments warranted performance.

Required Test Equipment

Instrument or Accessories	Recommended Model	Required Characteristic	Quantity #20	Quantity #21	Quantity #22
Optical Spectrum Analyzer	HP 75450A #101		1	1	1
Standard Lightwave Multimeter Mainframe	HP 8153A		1	1	1
Standard Optical Head Interface Module	HP 81533B		1	1	1
Standard Optical Head	HP 81521B	Uncertainty ±1.5%	1	1	1
Lightwave Multimeter Mainframe	HP 8153A		1	1	1
Optical Head Interface Module	HP 81533B		1	1	1
Optical Head [1]	HP 81521B #001 as part of the DUT		1 (2)	1 (2)	1 (2)
Laser Source Modules	HP 81552SM 1310nm Laser Source Module and HP 81553SM 1550nm Laser Source Module **OR** HP 81554SM 1310/1550nm Laser Source Module.	Wavelength Uncertainty ±1.5 nm Wavelength Uncertainty ±1.5 nm	1 1 1	1 1 1	1 1 1
Optical Attenuator	HP 8156A Option 101 or equivalent	Insertion Loss < 4 dB Return Loss > 25 dB Attenuation Range > 50 dB	1	1	1
Protection Cap	81521-44101		1	1	1
Optical Interface	HP 81000AI		1	2	1
Optical Interface	HP 81000FI		1	-	-
Optical Interface	HP 81000SI		-	-	1
Optical Interface	depending on the connector option of your attenuator		2	2	2
Optical Adapter	HP 81000AA		1	1	1
Optical Adapter	HP 81000FA		1	-	-
Single Mode Fiber	straight – depending on the connector option of your attenuator.		2	2	2
Single Mode Fiber	HP 81101AC		-	1	-
Single Mode Fiber	HP 81102SC		-	-	1

[1] If 2 Optical Heads are part of the DUT the quantity for all options changes to 2.

General

Setup and Performing the Performance Test

- The performance test includes only tests with HP 81521B #001 Optical Head.
- Perform the tests for both Head Inputs (Head Input A and Head Input B).
  - The set-up figures show the measurement set-ups for tests with Head Input A.
  - If a second HP 81521B #001 Head is part of your OLA repeat tests “Test IV. Linearity and Accuracy” & “Test VII. Noise” using this head and HP 8153A and tests “Test V. PDL/PDG uncertainty (#020 only)” & “Test VI. Repeatability PDL/PDG” using this head and OLA, Head Input B.
  - If your OLA has only one HP 81521B #001 Head repeat tests “Test V. PDL/PDG uncertainty (#020 only)” & “Test VI. Repeatability PDL/PDG” using this head and OLA, Head Input B.
- Make sure that the cable connectors, lenses and detector windows are clean. Refer to the cleaning procedure.
- Make sure that all equipment has warmed up.
- Make sure that all patchcords are fixed to the table—where appropriate—so that they won’t move during measurements.
- Settling time for laser when switched from 1310 nm to 1550 nm or from 1550 nm to 1310 nm: 5 minutes.

Setting the Wavelength

Set the wavelength according to the laser option of your HP E5574A and perform the tests that you want to carry out. After setting the wavelength allow the laser to settle about 5 minutes.

How to Set the Wavelength

1. Press INSTR.
2. Select “Source”.
3. Press 1310 NM or 1550 NM to get the desired wavelength.
4. Press SOURCE ON/OFF to enable the source.

Wavelengths for the Different Laser Options:

013: set wavelength to $\lambda = 1310$ nm.

015: set wavelength to $\lambda = 1550$ nm.

135: set wavelength to $\lambda = 1310$ nm and perform the tests, then
set wavelength to $\lambda = 1550$ nm and perform the tests again.

Note the actual wavelength in the test record.

Test I. Center Wavelength

1 Set up and switch on the equipment:

a Connect the equipment as shown in Figure D-1.

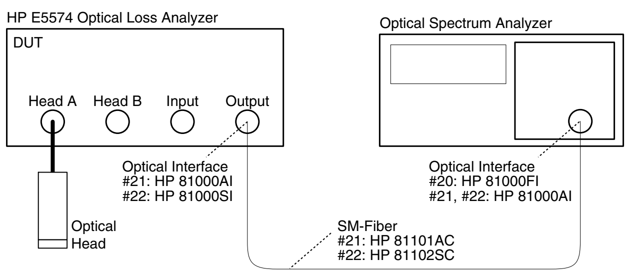


Figure D-1 Center Wavelength Test Setup

b Ensure that the instruments have warmed up and that the laser has settled.

2 Set-up the OSA:

a Press INSTR PRESET on the top of the display.

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).

3 To show the display on the OSA 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.

4 To ensure interference free reading of the display on the OSA it is advisable to stop the steady repeating calculations.

a Select USER.

b Press SINGLE SWEEP.

If the curve on the display is not clear, you can change resolution by using the SPAN key and the Vernier knob.

5 From the displayed measurements check and note the value for the **Mean Wavelength** in the test record.

Test II. Output Power

1 Set up and switch on the equipment:

a Connect the equipment as shown in Figure D-2.

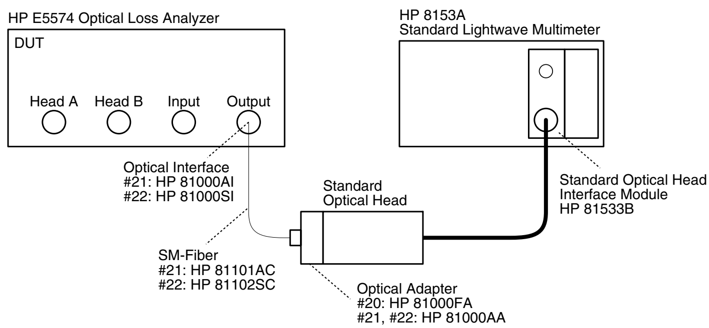


Figure D-2 Output Power Test Setup

b Ensure that the instruments have warmed up and that the laser has settled.

2 Zero the HP 8153A:

a Mount the protection cap on the head in order to keep the light out.

b Press MENU to change to Measure Mode.

c Press ZERO and wait while zeroing.

   d Unmount the protection cap and connect the equipment as shown in Figure D-3.

3 Set up the HP 8153A:

   a Select Auto Range: Press AUTO.

   b Select averaging time to 100ms:
   Press PARAM until the averaging time is displayed.
   Use the modify keys to change to 100ms.

   c Set display to show power in dBm:
   Press DBM/W until dBm is displayed.

   d Set actual wavelength (refer to “Test I. Center Wavelength”, Mean Wavelength):
   Press PARAM until the wavelength is displayed.
   Use modify keys to edit the wavelength.

4 Note the displayed power level in the test report.

Test III. CW-Stability Short Term

1 Set up and switch on the equipment:

   a Connect the equipment as shown in Figure D-3.

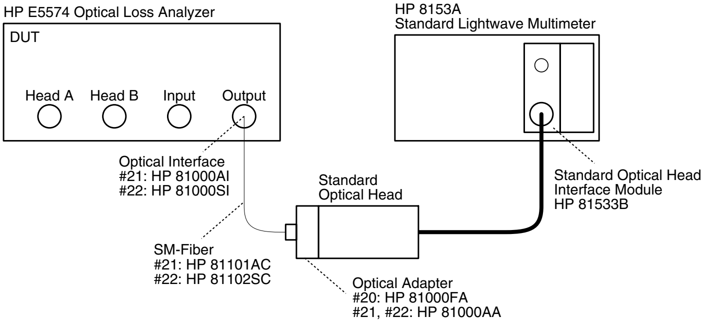


Figure D-3 CW-Stability Short Term Test Setup b Ensure that the instruments have warmed up and that the laser has settled.

2 Zero the HP 8153A:

a Mount the protection cap on the head in order to keep the light out.

b Press MENU to change to Measure Mode.

c Press ZERO and wait while zeroing.

d Unmount the protection cap and connect the equipment as shown in Figure D-3.

3 Set up the HP 8153A:

a Select Auto Range: Press AUTO.

b Select averaging time100ms:
Press PARAM until the averaging time is displayed.
Use the modify keys to change to 100ms.

c Select display in dB:
Press DB

d Set wavelength to the actual wavelength:
Press PARAM until the wavelength is displayed.
Use modify keys to edit the wavelength.

4 Set power meter to datalogging:

a Select STABILITY application:
Press MENU, press RECORD.

b Set the total measurement time to 00:15:00 for short term stability test of 15 minutes:
Press EDIT and set T_TOTAL to 00:15:00 using the modify cursor keys.

c Set AUTODUMP OFF:
Press NEXT and use modify cursor keys to set autodump to off.

5 Execute measurement:

a Press EDIT to get back to STABILITY.

b Press EXEC to execute datalogging.

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

6 Get measurement results, MIN/MAX readings:

a Press MORE to get SHOW.

b Press EDIT to get MAXIMUM.

c Press NEXT twice to get DIFF.

d Note the displayed value in your test record.

Test IV. Linearity and Accuracy

The following steps describe the procedure for performing the accuracy test for the HP E5574A / 81521B#001:

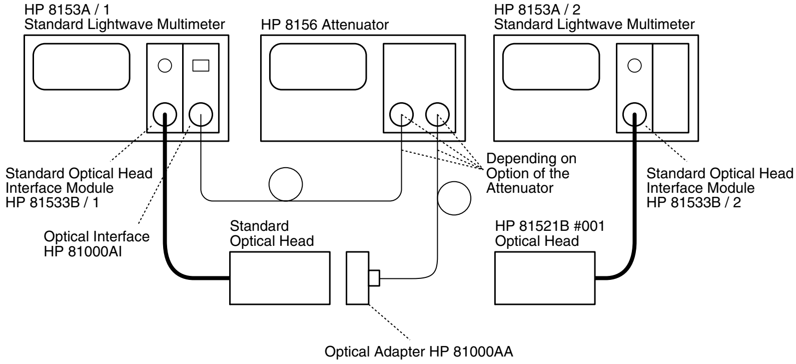


Figure D-4 Accuracy Test Setup

1. Make sure that the cable connectors, lenses and detector windows are clean.
   Refer to the cleaning procedure.
2. Connect the equipment as shown in Figure D-4.
   (If a second HP 81521B #001 Head is part of your OLA repeat the test with this Head).
   Ensure that the cables to and from the Attenuator are fixed on the table and both optical heads are close together so that minimum cable movement is achieved when connecting the cable to the Standard or to the DUT Head.
3. Turn the instruments on, enable the laser source, and allow the instruments to warm up for at least 20 minutes.
4. ZERO the power meters with the head connector adapters covered with plastic caps (P/N 5040-9361 or 5040-9351).
5. First set the wavelength of the Laser Source to 1310 nm. After performing the Linearity/Accuracy test set the wavelength to 1550 nm and perform the test again.
6. Set the CAL factor of both instruments to zero.
7. Set the WAVELENGTH of both instruments to the actual wavelength of the Laser Source and note the wavelength in the Test Record.
8. Set both instruments to MEASure, (display in µW), switch AUTOrange off and select the –20 dBm range.
9. Enable the HP 8156A output, and change the HP 8156A attenuation until the Power Meter Standard displays 10.00 µW.
10. Connect the attenuator output cable to the DUT and check that the DUT display is between 9.75 µW and 10.25 µW. Note the result in the Test Record.

The following steps describe the procedure to perform the linearity test for the HP E5574A / 81521B#001:

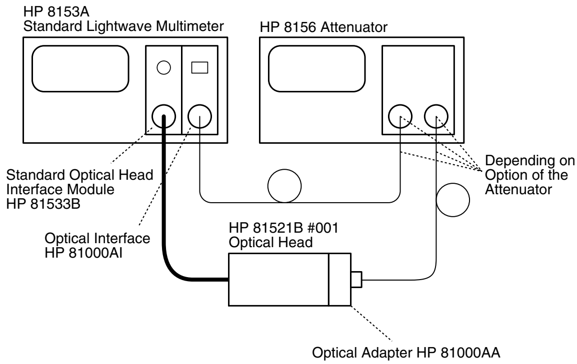


Figure D-5 Linearity Test Setup

1 Connect the equipment as shown in Figure D-5.
(If a second HP 81521B #001 Head is part of your OLA perform the test again with this Head).

2 ZERO the HP 8153A.

a Make sure that the HP 8156A output is disabled.

b Change to measure mode by pressing MODE.

c Press ZERO.

3 Ensure that the Laser Source is enabled and enable the HP 8156A output.

4 Set up the HP 8153A.

a Switch off autoranging:
Press AUTO.

b Select the –20 dBm range.
Use the UP and DOWN keys until –20 is displayed.

c Set the display to show results in dBm:
Press DBM.

5 Alter the attenuation until the HP 8153A displays –17.4dBm.

  a At the Attenuator:
  Press ATT and use the modify cursor keys to alter the attenuation.

6 On the HP 8153A:

  a Press DISP–>REF then DB.

  b Press UP to select the –10 dBm range.

7 Note the deviation, displayed in dB, as R1 in the test record.

8 In the –10 dBm range.

  a Set the display to show results in dBm.

  b Alter the attenuation until the DUT displays –7.4 dBm.

  c Press DISP–>REF, then DB.

  d Select the 0 dBm range.

  e Note the deviation, displayed in dB, as R2 on the test record.

9 Repeat the steps a. to e. at all ranges and level settings shown in the test record.

10 Calculate the non-linearity using the formula in the test record.

Test V. PDL/PDG uncertainty (#020 only)

The absolute PDL/PDG uncertainty is the maximum value of several PDL measurement when changing the alignment of the PDL generating components.

1 Set up and switch on the equipment:

a Connect the equipment as shown in Figure D-6.
(Set-up for performing the test with Head Input A. For performing the test with Head Input B connect the (second) HP 81521B#001 Head to Head Input B.)

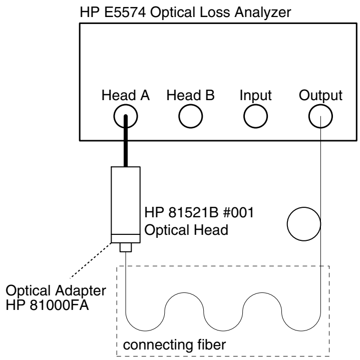


Figure D-6 PDL/PDG Uncertainty Test Setup

b Ensure that the instruments have warmed up and that the laser has settled.

2 Set up the OLA:

a Optimize the OLA for PDL measurement:
Press PRESET and then press OPTIMIZE to change to PDL.

b Select Polarization Dependent Loss Application:
Press APPL, select Pol Depend. Loss and then press SELECT.

3 Zero the OLA:

a Mount the protection cap on the head in order to keep the light out.

b Press MORE.

c Press ZERO and wait while zeroing.

d Unmount the protection cap and connect the equipment as shown in Figure D-6.

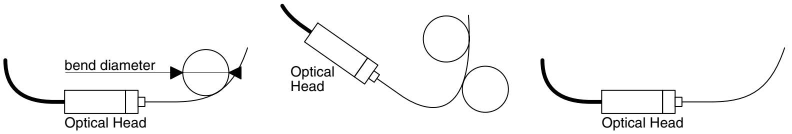
4 PDL Measurement:

Do not move the patchcord during measurement!

a Press RESET.

b Note the first stable value after the window full marker (|—|) is shown at the display in the test record.

5 Move the fiber and the optical head to another position (see Figure D-7 but don't move the equipment while measuring.



Note: Don't form the bend diameter smaller than 4 inches (10 cm) to prevent termi

Figure D-7 Example Drawings

6 Repeat steps 4 and 5 twenty times.

7 Calculate the PDL/PDG uncertainty as described in the test record.

Test VI. Repeatability PDL/PDG

1 Set up and switch on the equipment:

a Connect the equipment as shown in Figure D-8.
(Set-up for performing the test with Head Input A. For performing the test with Head Input B connect the (second) HP 81521B#001 Head to Head Input B.)

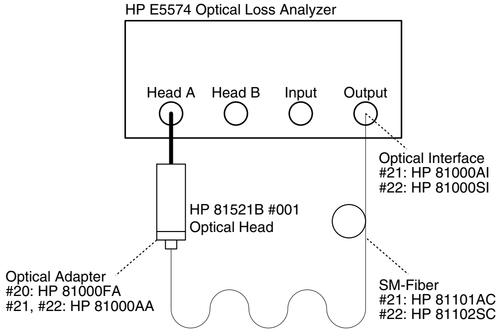


Figure D-8 Repeatability PDL/PDG Test Setup

b Ensure that the instruments have warmed up and that the laser has settled.

2 Set up the OLA:

a Optimize the OLA for PDL measurement:
Press PRESET and then press OPTIMIZE to change to PDL.

b Select Polarization Dependent Loss Application:
Press APPL, select Pol. Depend. Loss and then press SELECT.

3 Zero the OLA:

a Mount the protection cap on the head in order to keep the light out.

b Press MORE.

c Press ZERO and wait while zeroing.

d Unmount the protection cap and connect the equipment as shown in Figure D-8.

4 PDL Measurement:

a Press RESET.

b Note the first stable value after the window full marker (|—|) is shown at the display in the test record.

5 Repeat step 4 twenty times.

6 Calculate the Repeatability as described in the test record.

Test VII. Noise

This parameter ensures the dynamic range of PDL/PDG measurements, i.e. the Max. insertion loss of a DUT where the PDL specifications still apply.

1 Set up and switch on the equipment:

a Connect the equipment as shown in Figure D-9.
(If a second HP 81521B #001 Head is part of your OLA perform the test again with this Head).

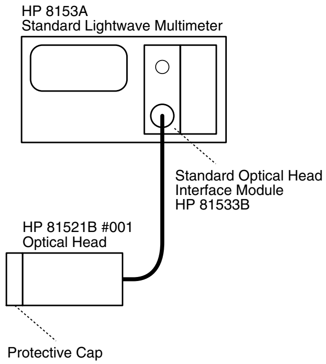


Figure D-9 Noise Test Setup

b Ensure that the instruments have warmed up.

c Mount the protection cap on the head in order to keep the light out.

2 Zero the HP 8153A:

a Press MENU to change to Measure Mode.

b Press ZERO and wait while zeroing.

3 Setup the HP 8153A:

a Select Auto Range:
Press AUTO.

b Select averaging time 1s:
Press PARAM until the averaging time is displayed.
Use the modify keys to change to 1s.

c Select display in W:
Press DBM/WATT

4 Set power meter to datalogging:

a Select STABILITY application:
Press MENU, press RECORD.

b Set the total measurement time to 00:00:30.
Press EDIT and set T_TOTAL to 00:00:30 using the modify cursor keys.

c Set AUTODUMP OFF:
Press NEXT and use modify cursor keys to set autodump to off.

5 Execute measurement:

a Press EDIT to get back to STABILITY.

b Press EXEC to execute datalogging.

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

6 Get measurement results, MIN/MAX readings:

a Press MORE to get SHOW.

b Press EDIT to get MAXIMUM.

c Press NEXT twice to get DIFF.

d Note the displayed value in your test record.

Absolute PDCR Uncertainty, Repeatability for PDCR

It is guaranteed by design that PDCR performance (uncertainty and repeatability) directly relates to the performance of the two optical sensors used in PDCR measurements.

Performance Test Form Sheets

Please use copies of the following 6 form sheets for your individual performance tests.

Performance Test for the HP 5574A **Page 1 of 6**

Test Facility:

______________________________	Report No.	______________________________
______________________________	Date	______________________________
______________________________	Customer	______________________________
______________________________	Tested by	______________________________

Model: HP E5574A Optical Loss Analyzer

Serial No. ______________________________

Options: ______________________________ Firmware Rev. ____________________

Model: HP 81521B #001 Optical Head

First Optical Head

Serial No. ______________________________

Second Optical Head

Serial No. ________________________

Ambient Temperature: ________________ ºC

Relative Humidity: ____________________ %

Line frequency: _______________________ Hz

Test equipment used:

Description:	Model No.	Trace No.	Cal. Due Date
1. Optical Spectrum Analyzer	______________	__________________	___ / ___ / ___
2. Attenuator	______________	__________________	___ / ___ / ___
3. Std. Lightwave Multimeter	______________	__________________	___ / ___ / ___
4. Std. Optical Head Interface	______________	__________________	___ / ___ / ___
5. Std. Optical Head	______________	__________________	___ / ___ / ___
6. Lightwave Multimeter	______________	__________________	___ / ___ / ___
7. Optical Head Interface	______________	__________________	___ / ___ / ___
8. Laser Source	______________	__________________	___ / ___ / ___
9. ____________________________	______________	__________________	___ / ___ / ___
10. ___________________________	______________	__________________	___ / ___ / ___
11. ___________________________	______________	__________________	___ / ___ / ___
12. ___________________________	______________	__________________	___ / ___ / ___

Performance Test for the HP 5574A **Page 2 of 6**

Model HP E5574A Optical Loss Analyzer No. ____________ Date ___ / ___ / ___

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
I.	**Central Wavelength**	nm	nm	nm	__________ nm
	performed at 1310 nm Wavelength	1290.00	_________	1330.00	
	performed at 1550 nm Wavelength	1530.00	_________	1570.00	
II.	**Output Power** fiber type 9/125 µm SM	dBm	dBm	dBm	_________ dBm
	performed at 1310 nm	-10.00 -8.00 typ	_________	n/a	
	performed at 1550 nm	-10.00 -8.00 typ	_________	n/a	
III.	**CW-Stability short term** fiber type 9/125 µm SM		dBpp	dBpp	__________ dB
	performed at 1310 nm 15 minutes, T = constant DIFF Level variation peak-to-peak		_________	0.02	
	performed at 1550 nm 15 minutes, T = constant DIFF Level variation peak-to-peak		_________	0.02	

Performance Test for the HP 5574A **Page 3 of 6**

Model HP E5574A Optical Loss Analyzer No. ____________ Date ___ / ___ / ___

Wavelength ____________ nm Optical Head ____________ (First / Second)

Test No.	Test Description			Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
IV.	**Accuracy/Linearity Test**						
	Accuracy			9.75 µW	_______ µW	10.25 µW	________ µW
	Linearity						
	Range	Power (dBm)			dB		
	-10 dBm -20 dBm	-17.4	Disp -> Ref		______ = R1		
	0 dBm -10 dBm	-7.4	Disp -> Ref		______ = R2		
	-20 dBm -30 dBm	-27.4	Disp -> Ref		______ = R3		
	-30 dBm -40 dBm	-37.4	Disp -> Ref		______ = R4		
	Non-Linearity						
	Range	Formula		dB	dB	dB	
	0 dBm	R1 + R2		-0.04	__________	+ 0.04	_______ dB
	-10 dBm	R1		-0.04	__________	+ 0.04	_______ dB
	-20 dBm				0.000		
	-30 dBm	R3		-0.04	__________	+ 0.04	_______ dB
	-40 dBm	R3 + R4		-0.04+	__________	+ 0.04	_______ dB

Performance Test for the HP 5574A **Page 4 of 6**

Model HP E5574A Optical Loss Analyzer No. ___________ Date ___ / ___ / ___

Wavelength ____________ nm Head Input ____________

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
V.	**Absolute PDL/PDG Test**		dB		
	1. measurement		_________		
	2. measurement		_________		
	3. measurement		_________		
	4. measurement		_________		
	5. measurement		_________		
	6. measurement		_________		
	7. measurement		_________		
	8. measurement		_________		
	9. measurement		_________		
	10. measurement		_________		
	11. measurement		_________		
	12. measurement		_________		
	13. measurement		_________		
	14. measurement		_________		
	15. measurement		_________		
	16. measurement		_________		
	17. measurement		_________		
	18. measurement		_________		
	19. measurement		_________		
	20. measurement		_________		
	Absolute PDL/PDG uncertainty		dB	dB	
	Maximum of all values		_________	0.005	________ dB

Performance Test for the HP 5574A **Page 5 of 6**

Model HP E5574A Optical Loss Analyzer No. ____________ Date ___ / ___ / ___

Wavelength _____________ nm Head Input _____________

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
VI.	**Test of Repeatability for PDL/PDG**		dB		
	1. measurement		__________		
	2. measurement		__________		
	3. measurement		__________		
	4. measurement		__________		
	5. measurement		__________		
	6. measurement		__________		
	7. measurement		__________		
	8. measurement		__________		
	9. measurement		__________		
	10. measurement		__________		
	11. measurement		__________		
	12. measurement		__________		
	13. measurement		__________		
	14. measurement		__________		
	15. measurement		__________		
	16. measurement		__________		
	17. measurement		__________		
	18. measurement		__________		
	19. measurement		__________		
	20. measurement		__________		
	Repeatability for PDL/PDG		dB	dBpp	
	Maximum of all values		__________		
	Minimum of all values		__________		
	Difference of Maximum - Minimum		__________	0.002	_________ dB

Performance Test for the HP 5574A					**Page 6 of 6**
Model HP E5574A Optical Loss Analyzer			No. ____________	Date ___ / ___ / ___	
Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
VII.	**Noise**		ρW		
	fiber type 9/125 µm SM				
	30 seconds, T = constant DIFF Level variation peak-to-peak		_________	600 ρW	__________
	Optional: Noise test with second HP 81521B #001 Head as part of the OLA:				
	30 second, T = constant DIFF Level variation peak-to-peak		_________	600 ρW	__________

E

Cleaning Procedure

Cleaning Procedure

In general, *whenever possible use physically contacting connectors, and dry connections*. Clean the connectors, interfaces and bushings carefully each time after use.

WARNING **Make sure to disable all sources when you are cleaning any optical interfaces.**
Under no circumstances look into the end of an optical cable attached to the optical output when the device is operational.
The laser radiation is not visible to the human eye, but it can seriously damage your eyesight.

WARNING **To prevent electrical shock, disconnect the HP model E5574A from the mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

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 determine 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.

Warm water and liquid soap

Use water only if you are sure that your optical device will not corrode or be damaged. Do not use hot water, as this can lead to mechanical stress that can damage your optical device. Ensure that your liquid soap has no abrasive properties or perfume in it, as these can scratch or damage your optical device. Do not use normal washing-up liquid, as it can leave behind an iridescent film.

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.

Polymer film

This is typically available from professional photographic stores or laboratory suppliers.

Polymer film is very gentle on optical surfaces and is particularly good for cleaning extremely sensitive devices such as mirrors.

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 of 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 9µm. 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.

In the case of scratches, or of 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 performed 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

1 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, together 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 in order to protect the surface from dirt.

Cleaning Lenses

Some lenses have special coatings that are sensitive to solvents, grease, liquid and mechanical abrasion. Take extra care when cleaning lenses with these coatings.

Lens assemblies consisting of several lenses are not normally sealed. Therefore, use as little alcohol as possible, as it can get between the lenses and in doing so can change the properties of projection.

Preferred Procedure

1. Clean the lens 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 lens:

1. Moisten a new cotton-swab with isopropyl alcohol.
2. Clean the lens by rubbing the cotton-swab over the surface using a small circular movement.
3. Using a new, dry cotton-swab remove the alcohol, any dissolved sediment and dust.

4 Blow away any remaining lint with compressed air.

Cleaning Large Area Lenses and Mirrors

CAUTION Some mirrors, as those from a monochromator, are very soft and sensitive. Therefore, never touch them and do not use cleaning tools such as compressed air or polymer film.
Some lenses have special coatings that are sensitive to solvents, grease, liquid and mechanical abrasion. Take extra care when cleaning lenses with these coatings.
Lens assemblies consisting of several lenses are not normally sealed. Therefore, use as little liquid as possible, as it can get between the lenses and in doing so can change the properties of projection.

Preferred Procedure

1 Blow away any dust or dirt with compressed air.

Procedure for Stubborn Dirt

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

CAUTION Only use water if you are sure that your device does not corrode.
Do not use hot water as this can lead to mechanical stress, which can damage your device.
Make sure that your liquid soap has no abrasive properties or perfume in it, because they can scratch and damage your device.
Do not use normal washing-up liquid as sometimes an iridescent film remains.

1 Moisten the lens or the mirror with water.

2 Put a little liquid soap on the surface and gently spread the liquid over the whole area.

3 Wash off the emulsion with water, being careful to remove it all, as any remaining streaks can impair measurement accuracy.

4 Take a new, dry soft-tissue and remove the water, by rubbing gently over the surface using a small circular movement.

5 Blow away remaining lint with compressed air.

Alternative Procedure A

To clean lenses that are extremely sensitive to mechanical stress or pressure you can also use an optical clean polymer film. This procedure is time-consuming, but you avoid scratching or destroying the surface.

1 Put the film on the surface and wait at least 30 minutes to make sure that the film has had enough time to dry.

2 Remove the film and any dirt with special adhesive tapes.

Alternative Procedure B

If your lens is sensitive to water then:

1 Moisten the lens or the mirror with isopropyl alcohol.

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 remaining lint with compressed air.

Cleaning Fixed Connector Interfaces

A few instruments, such as the HP 8158B, have fixed connector interfaces. Generally, avoid cleaning this kind of interface, because it is difficult to remove any used alcohol or lint from the input of the optical block. Keep the dust caps on the interfaces unless it is in use.

If there is dust on the interface, try cleaning it using compressed air.

If there is fluid or greasy dirt on the interface then contact Hewlett-Packard, where trained personnel can open the instrument and do the cleaning. Never open the instrument to clean the optical block yourself, because the optical components can be easily scratched or misaligned.

Cleaning Optical Glass Plates

Some instruments, for example, the optical heads from Hewlett-Packard have an optical glass plate to protect the sensor. Clean this glass plate in the same way as optical lenses (see "Cleaning Lenses" on page 233).

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 9µm. 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

2 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, 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.

Cleaning Fragile Optical Devices

Some optical devices, such as the HP 81000BR Reference Reflector, which has a gold plated surface, are very sensitive to mechanical stress or pressure. Do not use cotton-swabs, soft-tissues or other mechanical cleaning tools, as these can scratch or destroy the surface.

Preferred Procedure

1 Blow away any dust or dirt with compressed air.

Procedure for Stubborn Dirt

To clean devices that are extremely sensitive to mechanical stress or pressure you can also use an optical clean polymer film. This procedure is time-consuming, but you avoid scratching or destroying the surface.

1 Put the film on the surface and wait at least 30 minutes to make sure that the film has had enough time to dry.

2 Remove the film and any dirt with special adhesive tapes.

Alternative Procedure

For these types of optical devices you can often use an ultrasonic bath with isopropyl alcohol. Only use the ultrasonic bath if you are sure that it won't cause any damage anything to the device.

1 Put the device into the bath for at least three minutes.

2 Blow away any remaining liquid with compressed air.

If there are any streaks or drying stains on the surface, repeat the cleaning procedure.

Cleaning Metal Filters or Attenuator Gratings

This kind of device is extremely fragile. A misalignment of the grating leads to inaccurate measurements. Never touch the surface of the metal filter or attenuator grating. Be very careful when using or cleaning these devices. Do not use cotton-swabs or soft-tissues, as there is the danger that you cannot remove the lint and that the device will be destroyed by becoming mechanically distorted.

Preferred Procedure

1. Use compressed air at a distance and with low pressure to remove any dust or lint.

Procedure for Stubborn Dirt

Do not use an ultrasonic bath as this can damage your device.

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

1. Put the optical device into a bath of isopropyl alcohol, and wait at least 10 minutes.
2. Remove the fluid using compressed air at some distance and with low pressure. If there are any streaks or drying stains on the surface, repeat the whole cleaning procedure.

F

Error Messages

Error Messages

There are only a few situations when the OLA does not know what to do. If this occurs, the instrument will question you. This appendix provides information on these questions.

Display Messages

Light A?, Light B?, Light A & B?

An attempt was made to zero the optical heads without shielding them completely from light.

Do one of the following:

- Screw the protection caps onto the heads.
- Interrupt the signal path to the heads (e. g. by turning the source off).

After that press ZERO again.

No Head A, No Head B, No Heads

This message is displayed, if there is no head attached to the instrument. Or, if there is only one head attached to the instrument and you activate the non-existent head. It also appears, if only one head is connected and you start the applications Coupler Test or PD Coupler Test, respectively.

P < P par ?

You may encounter this message when measuring Return Loss. It appears whenever the optical power which is currently received remains under the stored value of the power of parasitic reflections.

Zero the heads.

Switch the source on. The source indicator lamp must be lit.

Follow the calibration procedure described in section 3.2 “Measuring the Return Loss” on page 58: First store the power reflected from the open end of the optical output as P ref. Then remove the reflection from the open fiber end and store the remaining power as P par. P par should be below –50 dBm.

After that attach your device under test.

HP-IB Messages

Instrument Specific Errors

These are error messages with positive numbers.

105 **No head connected.**

106 **Wrong application for this command.**

107 **Invalid channel selected.**

108 **DAC value out of range.**

109 **No valid result possible.**

110 **Value out of range.**

See the command descriptions for details.

Command Errors (-100 to -199)

These are error messages in the range -100 to -199. They show that a syntax error has been detected by the parser in a command, such as incorrect data, incorrect commands, or misspelled or mistyped commands.

A command error is signalled by the command error bit (bit 5) in the event status register.

-100 **Command error.**

This shows that the parser has found a command error but cannot be more specific.

-101 **Invalid character.**

The command contains an invalid or unrecognized character.

-102 **Syntax error.**

The command or data could not be recognized.

-103 **Invalid separator.**

The parser was expecting a separator (for example, a semicolon (;) between commands) but did not find one.

-104 **Data type error.**

The parser was expecting one data type, but found another (for example, was expecting a string, but received numeric data).

-105 **GET not allowed.**

A Group Execute Trigger was received within a program message (see IEEE 488.2, 7.7)

-108 **Parameter not allowed.**

More parameters were received for a command than were expected.

-109 **Missing parameter.**

Fewer parameters were received than the command requires.

-110 **Command header error.**

A command header is the mnemonic part of the command (the part not containing parameter information). This error shows that the parser has found an error in the command header but cannot be more specific.

-111 **Header separator error.**

A character that is not a valid separator was encountered.

-112 **Program mnemonic too long.**

The program mnemonic must be 12 characters or shorter.

-113 **Undefined header.**

This header is not defined for use with the instrument.

-114 **Header suffix out of range.**

The header contained an invalid character. This message sometimes occurs because the parser is trying to interpret a non-header as a header.

-120 **Numeric data error.**

This error shows that the parser has found an error in numeric data (including nondecimal numeric data) but cannot be more specific.

-121 **Invalid character in number.**

An invalid character was found in numeric data (note, this may include an alphabetic character in a decimal data, or a "9" in octal data).

-123 **Exponent too large.**

The exponent must be less than 32 000.

-124 **Too many digits.**

The mantissa of a decimal number can have a maximum of 255 digits (leading zeros are not counted).

-128 **Numeric data not allowed.**

Another data type was expected for this command.

-130 **Suffix error.**

The suffix is the unit and the unit multiplier for the data. This error shows that the parser has found an error in suffix but cannot be more specific.

-131 **Invalid suffix.**

This suffix is incorrect or inappropriate.

-134 **Suffix too long.**

A suffix can have a maximum of 12 characters.

-138 **Suffix not allowed.**

A suffix was found where none is allowed.

-140 **Character data error.**

This error shows that the parser has found an error in character data but cannot be more specific.

-141 **Invalid character data.**

The character data is incorrect or inappropriate.

-144 **Character data too long.**

Character data can have a maximum of 12 characters.

-148 **Character data not allowed.**

Character data was found where none is allowed.

-150 **String data error.**

This error shows that the parser has found an error in string data but cannot be more specific.

-151 **Invalid string data.**

The string data is incorrect (for example, an END message was received before the terminal quote character).

-158 **String data not allowed.**

String data was found where none is allowed.

-160 **Block data error.**

This error shows that the parser has found an error in block data but cannot be more specific.

-161 **Invalid block data.**

The block data is incorrect (for example, an END message was received before the length was satisfied).

-168 **Block data not allowed.**

Block data was found where none is allowed.

Execution Errors (-200 to -299)

These are error messages in the range -200 to -299. They show that an execution error has been detected by the execution control block.

An execution error is signalled by the execution error bit (bit 4) in the event status register.

-200 **Execution error.**

This shows that an execution error has occurred but the control block cannot be more specific.

-201 **Invalid while in local.**

This command is invalid because in conflicts with the configuration under local control.

-202 **Settings lost due to rtl.**

A local setting was lost when the instrument was changing from remote to local control, or from local to remote control.

-220 **Parameter error.**

This shows that a parameter error has occurred but the control block cannot be more specific.

-221 **Settings conflict.**

A valid parameter was received, but could not be used during execution because of a conflict with the current state of the instrument.

-222 **Data out of range.**

The data, though valid, was outside the range allowed by the instrument.

-223 **Too much data.**

The block, expression, or string data was too long for the instrument to handle.

-224 **Illegal parameter value.**

One value from a list of possible values was expected. The parameter received was not found in this list.

-240 **Hardware error.**

Shows that a command could not be executed due to a hardware error but the control block could not be more specific.

-241 **Hardware missing.**

Shows that a command could not be executed because of missing instrument hardware.

Device-Specific Errors (-300 to -399)

These are error messages in the range -300 to -399, or between 1 and 32767. They show that an error has been detected that is specific to the operation of the OLA.

A device-specific error is signalled by the device-specific error bit (bit 3) in the event status register.

-300 **Device-specific error.**

This shows that a device-specific error has occurred. No more specific information is available.

-310 **System error.**

An instrument system error has occurred.

-311 **Memory error.**

A memory error has been detected.

-314 **Save/recall memory lost.**

The nonvolatile data saved by the *SAV command has been lost.

-315 **Configuration memory lost.**

The nonvolatile configuration data saved by the instrument has been lost.

-330 **Self-test failed.**

Further information about the self-test failure is available by using *TST?.

-350 **Queue overflow.**

The error queue has overflown. This error is written to the last position in the queue, no further errors are recorded.

Query Errors (-400 to -499)

These are error messages in the range -400 to -499. They show that an error has been detected by the output queue control.

A query error is signalled by the query error bit (bit 2) in the event status register.

-400 **Query error.**

This shows that a query error has occurred. No more specific information is available.

-410 **Query interrupted.**

A condition occurred that interrupted the transmission of the response to a query (for example, a query followed by a DAB or a GET before the response was completely sent).

-420 **Query unterminated.**

A condition occurred that interrupted the reception of a query (for example, the instrument was addressed to talk and an incomplete program message was received).

-430 **Query deadlock.**

A condition causing a deadlock query has occurred (for example, both the input and the output buffer are full and the device cannot continue).

-440 **Query unterminated after indefinite response.**

Two queries were received in the same message. The error occurs on the second query if the first requests an indefinite response and was already executed.

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