Agilent 81618A/9A Optical Head Interface Modules and Agilent 81623A/4A/5A/5B Optical Heads

User's Guide

Agilent Technologies

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ISO 9001 Certification

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

Second Edition:
81623-90014 E1000

First Edition:
E0100: January 2000

Second Edition:
E1000: October 2000

Safety Considerations

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. Agilent Technologies Inc. assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and manual, including the red safety page, for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

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.

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.

Initial Inspection

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

The Performance Tests give procedures 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 Agilent Technologies Sales/Service 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.).

Line Power Requirements

The Agilent 81618A and Agilent 81619A Optical Head Interface Modules operate when installed in the Agilent 8163A Lightwave Multimeter, Agilent 8164A Lightwave Measurement System, and Agilent 8166A Lightwave Multichannel System.

Operating Environment

The safety information in the Agilent 8163A Lightwave Multimeter, Agilent 8164A Lightwave Measurement System, and Agilent 8166A Lightwave Multichannel System User's Guide summarizes the operating ranges for the Agilent 81618A and Agilent 81619A Optical Head Interface Modules. In order for these modules to meet specifications, the operating environment must be within the limits specified for the Agilent 8163A Lightwave Multimeter, Agilent 8164A Lightwave Measurement System, and Agilent 8166A Lightwave Multichannel System.

Storage and Shipment

This module can be stored or shipped at temperatures between –40°C and +70°C. Protect the module from temperature extremes that may cause condensation within it.

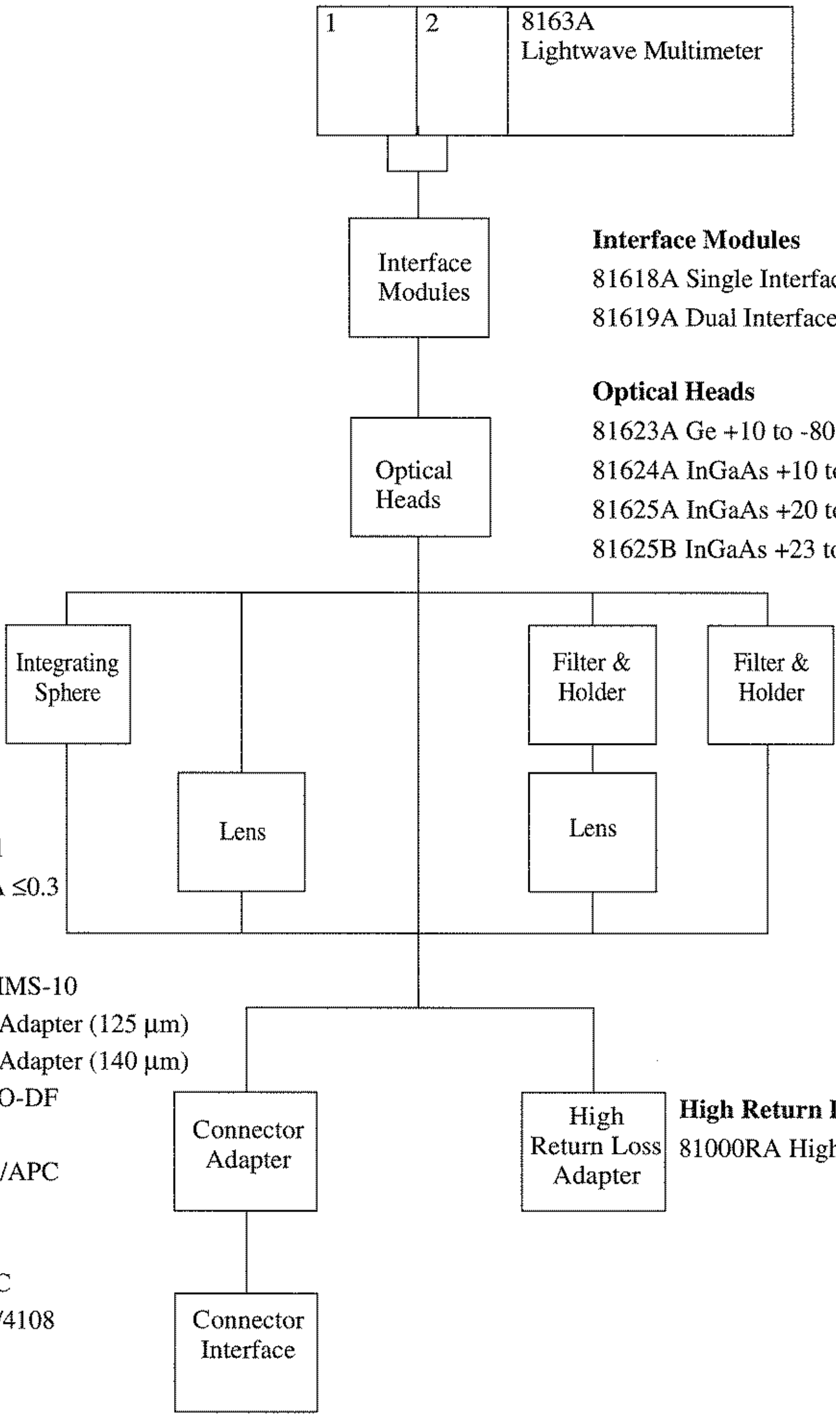
Table of Contents

Accessories

The Agilent 81618A/9A Optical Head Interface Modules and Agilent 81623A/4A/5A/5B Optical Heads are available in various configurations for the best possible match to the most common applications.

This chapter provides information on the available options and accessories.

Modules and Options



Interface Modules

81618A Single Interface Module

81619A Dual Interface Module

Optical Heads

81623A Ge +10 to -80 dBm

81624A InGaAs +10 to -90 dBm

81625A InGaAs +20 to -80 dBm

81625B InGaAs +23 to -70 dBm

Integrating Sphere

81002FF Integrating Sphere

Filter & Holder

81000A Filter Holder

81000F Filter 10 dB

Lens

81000BL for NA ≤0.1

81050BL for <0.1 NA ≤0.3

Connector Adapters

81000AA Diamond HMS-10

81000BA Bare Fiber Adapter (125 µm)

81000CA Bare Fiber Adapter (140 µm)

81000DA Radiall VFO-DF

81000EA Radiall-EC

81000FA FC/PC/SPC/APC

81000GA NEC D4

81000JA SMA

81000KA SC/PC/APC

81000SA DIN 47526/4108

81000VA ST

81000WA Biconic

High Return Loss Adapter

81000RA High Return Loss Adapter

Figure 1 Optical Head Accesories

Specifications

The Agilent 81618A/9A Optical Head Interface Modules and Agilent 81623A/4A/5A/5B Optical Heads are produced to the ISO 9001 international quality system standard as part of Agilent Technologies' commitment to continually increasing customer satisfaction through improved quality control.

Specifications describe the modules' and heads' warranted performance. Supplementary performance characteristics describe the modules' and heads' non-warranted typical performance.

Because of the modular nature of the instrument, these performance specifications apply to these modules and heads rather than the mainframe unit.

Definition of Terms

This section defines terms that are used both in this chapter and *"Performance Tests" on page 21.*

Generally, all specifications apply for the given environmental conditions and after warmup time.

Measurement principles are indicated. Alternative measurement principles of equal value are also acceptable.

Averaging Time

Time defining the period during which the power meter takes readings for averaging. At the end of the averaging time the average of the readings is available (display- or memory-update). Symbol T_{avg}.

Linearity

The linearity error is defined as the relative difference between the displayed power ratio, D_x/D_0, and the actual (true) power ratio P_x/P_0 caused by changing the displayed power level from the reference level, D_0, to an arbitrary displayed level, D_x. Symbol N.

if expressed in %

$$N = \left(\frac{D_x/D_0}{P_x/P_0} - 1\right)100$$

if expressed in dB

$$N_{dB} = 10\log\left(\frac{D_x/D_0}{P_x/P_0}\right)$$

Conditions: reference level 10 µW, displayed power levels within the specified range, zero less than specified time prior to measurement.

Note 1: ideally $E = 0$ %, respectively 0 dB.

Note 2: the power-dependent nonlinearity, $N(P_x)$, can alternatively be expressed by the following formula:

$$N(P_x) = \frac{r(P_x) - r(P_0)}{r(P_0)}$$

where $r(P)$ is the power-dependent responsivity (for a power meter, the responsivity is defined as the ratio of displayed power to actual input power).

Linewidth

FWHM spectral bandwidth. The 3 dB width of the optical spectrum, expressed in Hertz. Symbol: Δf.

Noise

The peak-to-peak change of displayed power level with zero input power level (dark).

Conditions: Zero prior to measurement, averaging time and observation time as specified, lowest power range selected and wavelength range as specified.

Measurement: the measurement result is obtained by:

$Noise = P_{max} - P_{min}$ expressed as peak-to-peak within the given time span. Any offset is automatically excluded this way.

Power range

The power range is defined from the highest specified input power level to the smallest input power level that causes a noticable change of displayed power level.

Conditions: wavelength, averaging time as specified.

Reference conditions

The specified conditions during the spectral responsivity calibration, or conditions which are extrapolated from the conditions during calibration.

Conditions: power level, beam diameter or fiber type, numerical aperture, wavelength, spectral width, ambient temperature as specified, at the day of calibration. →Noise and drift observed over a specified observation time, with a temperature change of not more than ±ΔT.

Relative uncertainty (spectral ripple) due to interference

Uncertainty of power reading when using a coherent source, due to a periodic change of the power meter's responsivity caused by optical interference[1] between reflective interfaces within the power meter's optical assembly.

Conditions: constant wavelength, constant power level, angled connector as specified, linewidth of source <100 MHz, temperature as specified.

Relative uncertainty due to polarization

Also termed polarization-dependent responsivity (PDR), the relative uncertainty due to polarization is the uncertainty of the displayed power level on the input polarization state, expressed as the difference between the highest and the lowest displayed power. Uncertainty figures are based upon a 95% confidence level.

Conditions: laser source with variable polarization state, generation of all possible polarization states (covering the entire Poincaré sphere), constant wavelength, constant power level, angled connector as specified, temperature as specified.

Return loss:

The ratio of the incident power to the reflected power expressed in dB. Symbol: *RL.*

$$RL = 10\log\left(\frac{P_{in}}{P_{back}}\right)$$

Conditions: the return loss excludes any reflections from the fiber end used as radiation source.

Spectral width of optical source

Full width at half maximum. The 3 dB width of the optical spectrum, expressed in nm. Symbol: *FWHM.*

Total uncertainty

The uncertainty for a specified set of operating conditions, including noise and drift.

Conditions: power level, beam diameter or fiber type, numerical aperture, wavelength, spectral width, ambient temperature, re-calibration period as specified. →Noise and drift observed over a specified observation time, with a temperature change of not more than ±ΔT.

Uncertainty at reference conditions

The uncertainty for the specified set of reference conditions, including all uncertainties in the calibration chain from the national laboratory to the test meter.

Wavelength range

The range of wavelengths for which the power meter is calibrated.

Note: Selectable wavelength setting of the power meter for useful power measurements (operating wavelength range).

Literature

[1]***Fiber optic test and measurement***, Hewlett Packard Professional Books, edited by Prentice Hall, ISBN 0-13-534330-5

Optical Head Specifications

All optical heads have to be operated with the single (Agilent 81618A) or dual (Agilent 81619A) Interface Modules.

Table 1 Optical Head Specifications

	Agilent 81623A	Agilent 81624A	Agilent 81625A	Agilent 81625B
Sensor Element	Ge, Ø 5 mm	InGaAs, Ø 5 mm		
Wavelength Range	750 - 1800 nm	800 - 1700 nm	850 - 1650 nm	850 - 1650 nm
Power Range	+10 to -80 dBm	+10 to -90 dBm	+20 to -80 dBm	+27 to -70 dBm (1250 - 1650 nm) +23 to -70 dBm (850 - 1650 nm)
Display Resolution	0.0001 dB / dBm, 0.001 pW to 1 pW (depending on power range)			
Applicable Fiber Type	Standard SM and MM max 100 µm core size, NA ≤ 0.3			
Open Beam	Parallel beam max Ø 5 mm			
Uncertainty at Reference Conditions [1]	±2.2% (1000 to 1650 nm)	±2.2% (1000 to 1630 nm)	±2.5% (950 to 1630 nm)	±3.0% (950 to 1630 nm)
Total Uncertainty [2]	±3.5% (1000 to 1650 nm)	±3.5% (1000 to 1630 nm)	±4.0% (950 to 1630 nm)	±5.0% (950 to 1630 nm)
Relative Uncertainty [7]				
- due to polarization [3]		± 0.005 dB (typ. ± 0.002 dB)	± 0.005 dB (typ. ± 0.002 dB)	± 0.005 dB (typ. ± 0.002 dB)
Spectral ripple (due to interference) [4]		± 0.005 dB (typ. ± 0.002 dB)	± 0.005 dB (typ. ± 0.002 dB)	± 0.005 dB (typ. ± 0.002 dB)
Linearity (power): [5]	(CW +10 to -60 dBm) (1000 - 1650 nm)	(CW +10 to -70 dBm) (1000 - 1630 nm)	(CW +20 to -60 dBm) (950 - 1630 nm)	(CW +27 to -50 dBm) (950 - 1630 nm)
-at 23°C ±5°C	<±0.02 dB ± 100 pW [9]	<±0.02 dB ± 5 pW	<±0.02 dB ± 100 pW [8]	<±0.04 dB ± 500 pW [11]
- at operating temp. range	<±0.05 dB ± 100 pW [9]	<±0.05 dB ± 5 pW	<±0.05 dB ± 100 pW [8]	<±0.15 dB ± 500 pW [11]
Return Loss [7]	> 45 dB	typ. 60 dB	> 60 dB	> 45 dB
Noise (peak to peak) [5, 6]	< 100 pW	< 5 pW	< 100 pW	< 500 pW
Averaging Time (minimal)	100 µs			
Dimensions (H x W x D)	75 mm × 32 mm × 335 mm (2.8" × 1.3" × 13.2")			
Weight	0.5 kg			
Recalibration Period	2 years			
Operating Temperature	0°C to +40°C		0°C to +35°C	0°C to +35°C [10]
Humidity	Non-condensing			
Warm-up time	40 minutes			

Table 1 Optical Head Specifications

	Agilent 81623A	Agilent 81624A	Agilent 81625A	Agilent 81625B

1 Reference Conditions:

- Power level 10 µW (-20 dBm), continuous wave (CW)
- Parallel beam, 3 mm spot diameter on the center of the detector
- Ambient temperature 23 °C ± 5 °C
- On day of calibration (add ± 0.3% for aging over one year; add ± 0.6% over two years)
- Spectral width of source < 10 nm (FWHM)
- Wavelength setting at power meter must correspond to source wavelength ± 0.4 nm

2 Total uncertainty includes: polarization, interference, linearity conditions:

- Parallel beam, 3mm spot diameter on the center of the detector or connectorized fiber with NA ≤ 0.2
- For NA > 0.2, add 1%
- Within one year after calibration, add 0.3% for second year

3 All states of polarization at constant wavelength (1550 nm ± 30 nm) and constant power, straight connector, T = 23°C ± 5°. For angled connector (8°) add 0.01 dB typ.

4 Conditions:
Wavelength 1550 nm ± 30 nm, fixed state of polarization, constant power, Temperature 23°C ± 5°C, Linewidth of source ≥ 100 MHz, angled connector 8°.

5 At constant temperature (ΔT = ± 1°C), zeroing required.

6 Averaging time 1s, T = 23°C ± 5°C, observation time 300 s. Wavelength range 1200 - 1630 nm.

7 Conditions

- Wavelengths 1550 nm ± 30 nm.
- Standard single-mode fiber, angled connector min 8°.

8 For input power >+10 mW add:
typ. ± 0.001 dB / mW without Agilent 81000AF, or add
± 0.02 dB / mW with Agilent 81000AF (direct coupled)

9 For input power > 2 mW, add ± 0.004 dB / mW

10 30°C for > +20 dBm input power

11 For input power >+10 mW add:
typ. ± 0.0016 dB / mW without Agilent 81000AF, or add
± 0.0008 dB / mW with Agilent 81000AF (direct coupled)

In the case of a negative power change >50 dB allow an addition recovery time of 3 minutes.

Performance Tests

The procedures in this section test the performance of the instrument. The complete specifications to which Agilent 81623A/4A/5A/5B Optical Heads are tested are given in *"Specifications" on page 13*. All tests can be performed without access to the interior of the instrument. The test equipment given corresponds to tests carried out with Diamond HMS - 10 connectors.

Equipment Required

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

Table 2 Equipment Required for Performance Test

Instrument/Accessory	Recommended Model	Interface		Optical Head				Required Characteristics	Alternative Models
		81618A	81619A	81623A	81624A	81625A	81625B		
Multimeter Mainframe	Agilent 8163A	1 ea	1 ea	2 ea	2 ea	2 ea	2 ea		Agilent 8164A
Interface Module	Agilent 81618A	–	–	x	x	x	x		Agilent 81619A
Optical Head	8162x	1 ea	2 ea	–	–	–	–		
CW Laser Module	Agilent 81656A	–	–	x	x	x	x		Agilent 81657A
CW Laser Module	HP 81554SM	–		x	x	x	x		Agilent 81657A
Power Meter Standard	HP 81533B Optical Head Interface Module with HP 81521B #C01 Working Standard Optical Head	–	–	x	x	x	x		
Power Sensor Module	HP 81532A	–	–	x	x	x	x		Agilent 81634A
Optical Attenuator	Agilent 8156A #221	–	–	x	x	x	x		
Optical Attenuator	Agilent 8156A #101	–	–	x	x	x	x		HP 8157A or HP 8158B #002
Backreflector Kit	Agilent 8156A #203	–	–	x	x	x	x		
Return Loss Module	HP 81534A	–	–	x	x	x	x		
Tunable Laser Source	Agilent 8164A and Agilent 81680A #022	–	–	–	o	o	o		HP 8168E/F #022
Polarization Controller	HP 11698A	–	–	–	o	o	o		
Wavelength Independent Coupler (3 dB)	Special Tool	–	–	–	o	o	o		
Best IF Adapter	Special Tool	–	–	–	o	o	o		
Worst IF Adapter	Special Tool	–	–	–	o	o	o		
Singlemode Fiber	Agilent 81101AC (2 ea)	–	–	x	x	x	x		
	Agilent 81102SC (1 ea)	–	–	x	x	x	x		
	Agilent 81113PC (3 ea)	–	–	x	x	x	x		
Legend : – not applicable; x necessary; o optional.									

Table 2 Equipment Required for Performance Test

Instrument/Accessory	Recommended Model	Interface		Optical Head				Required Characteristics	Alternative Models
		81618A	81619A	81623A	81624A	81625A	81625B		
	Agilent 81113SC (1 ea)	–	–	x	x	x	x		
Connector Adapters	Agilent 81000AA (2 ea)	–	–	x	x	x	x		
	Agilent 81000SA (1 ea)	–	–	x	x				
Connector Interfaces	Agilent 81000AI (5 ea)	–	–	x	x	x	x		
	Agilent 81000FI (3 ea)	–	–	x	x	x	x		
	Agilent 81000SI (4 ea)	–	–	x	x	x	x		
Plastic Cap	PN 5040-9351	–	–	x	x	x	x		
Legend : – not applicable; x necessary; o optional.									

Test Record

Results of the performance test may be tabulated on the Test Record provided at the end of the test procedures. It is recommended that you fill out the Test Record and refer to it while doing the test. Since the test limits and setup information are printed on the Test Record for easy reference, the record can also be used as an abbreviated test procedure (if you are already familiar with the test procedures). The Test Record can also be used as a permanent record and may be reproduced without written permission from Agilent Technologies.

Test Failure

If the Agilent 81618A/19A Interface module or Agilent 81623A/4A/5A/5B Optical Head fails any performance test, return the instrument to the nearest Agilent Technologies Sales / Service Office for repair.

Instrument Specification

Specifications are the performance characteristics of the instrument that is certified. These specifications, listed in *"Specifications" on page 13*, are the performance standards or limits against which the Agilent 81623A/4A/5A/5B Optical Head can be tested. *"Specifications" on page 13* also lists some supplemental characteristics of the Agilent 81623A/4A/5A/5B Optical Head. Supplemental characteristics should be considered as additional information.

Agilent 81618A/19A Interface Modules are tested for functionality only.

Any changes in the specifications due to manufacturing changes, design, or traceability to the National Institute of Standards and Technology (NIST), will be covered in a manual change supplement, or revised manual. Such specifications supercede any that were previously published.

Functional Test

This functional test applies to Agilent 81618A/19A Interface modules.

1 Set up the equipment as shown in Figure 2

If you are using an Agilent 81619A Interface module connect one optical head to channel 1 and the other to channel 2

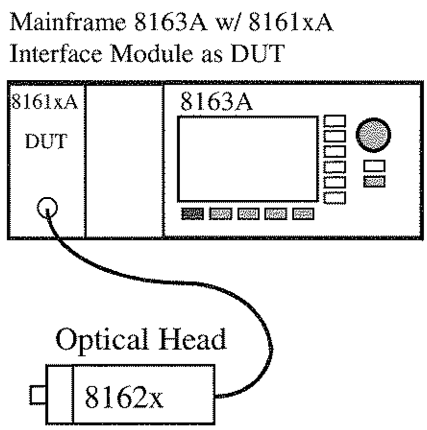


Figure 2 Functional Test Setup

2 Power up the mainframe.

If the Agilent 81618A/19A passes all self-tests, the module is considered fully functional.

Performance Tests

The performance tests given in this section includes the Accuracy Test, the Linearity Test, the Return Loss Test and the Noise Test. The performance tests for the Agilent 81623A/4A/5A/5B also include – as optional tests – the Relative Polarization Uncertainty and the Relative Interference Uncertainty Test. Perform each step in the order given, using the corresponding test equipment.

NOTE Make sure that all optical connections are dry and clean. DO NOT USE INDEX MATCHING OIL. For cleaning, use the cleaning instructions given in *"Cleaning Information" on page 63.*

Fix the optical cables that connect the laser source and Power Meter to the Agilent 8156A Attenuator. This ensures minimum cable movement during the tests.

Accuracy Test

This performance test applies to Agilent 81623A/4A/5A/5B Optical Heads.

NOTE The linearity test must only be performed at either 1310 nm or 1550 nm. The accuracy test must be performed in the -20 dBm range at 10.0 μW at both 1310 nm and 1550 nm.

Test Setup

1 Make sure that cable connector, detectors and adapters are clean.

2 Connect the equipment as shown in Figure 3.

Instead of an Agilent 81657A Fixed Laser Source (FLS) you can also use an 81554SM Laser Source.

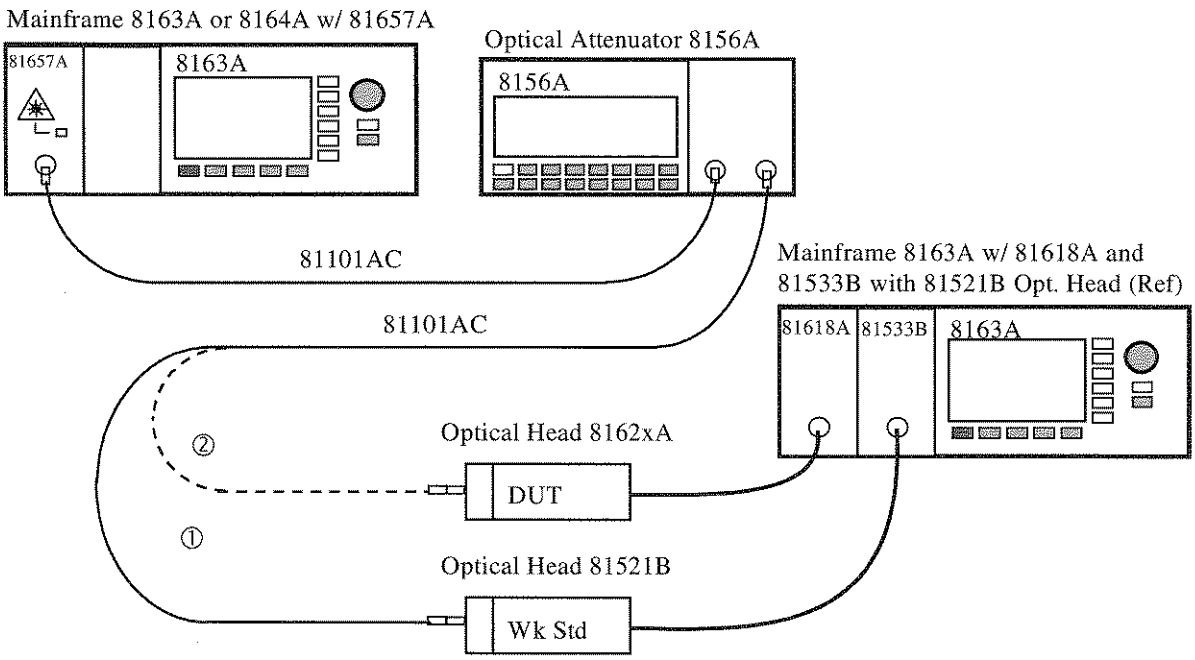


Figure 3 Accuracy Test Setup

NOTE Make sure that the cables to and from the attenuator are fixed on the table and that both the optical head and the DUT are close together so that minimum cable movement is required when connecting the cable to the head or to the DUT.

3 Move to the Laser Source channel, move to the wavelength parameter, [λ], press *Enter*, select the lower wavelength source, and press *Enter*.

4. If you are using an Agilent 81657A Laser Source make sure you initialize the Agilent 8156A Optical Attenuator with 30 dB attenuation.
5. Turn the instruments on, enable the laser source and allow the instruments to warm up for at least 40 minutes.
6. Perform the following sub-procedure for both Power Meters:
   a. Move to the Power Meter channel.
   b. Move to the wavelength parameter, [λ], press *Enter*, enter the wavelength of the laser source, and press *Enter*.
   c. Move to the calibration parameter, [*CAL*], press *Enter*, set the calibration parameter to zero, and press *Enter*.
   d. Move to the averaging time parameter, [*AvgTime*], press *Enter*, move to <*500 ms*>, and press *Enter*.
   e. Move to the power parameter, [*P*], press [Pwr unit], move to <*Watt*>, and press *Enter*.
7. Make sure the optical input of the Device Under Test (DUT), 8162xA/B, is not receiving any light by placing a plastic cap over the input. Move to the DUT Power Meter channel, press [Menu], move to <*Zero*>, press *Enter*.
8. Ensure that the Agilent 8156A output is disabled. Move to the reference Power Meter channel that uses the HP 81521B Optical Head and HP 81533B Optical Head Interface module, press [Menu], move to <*Zero*>, press *Enter*.
9. Enable the Agilent 8156A output and change the attenuation until the reference Power Meter displays 10.00 mW.
10. Connect the attenuator output cable to the DUT Power Meter. Note the power value returned from the DUT, [*P*], from the display and note the result in the test record.
11. Move to the Laser Source channel, move to the wavelength parameter, [λ], press *Enter*, select the longer wavelength source, and press *Enter*.
12. Repeat steps 4 to 10 at the second wavelength with the corresponding source.

Linearity Test

This performance test applies to Agilent 81623A/4A/5A/5B Optical Heads.

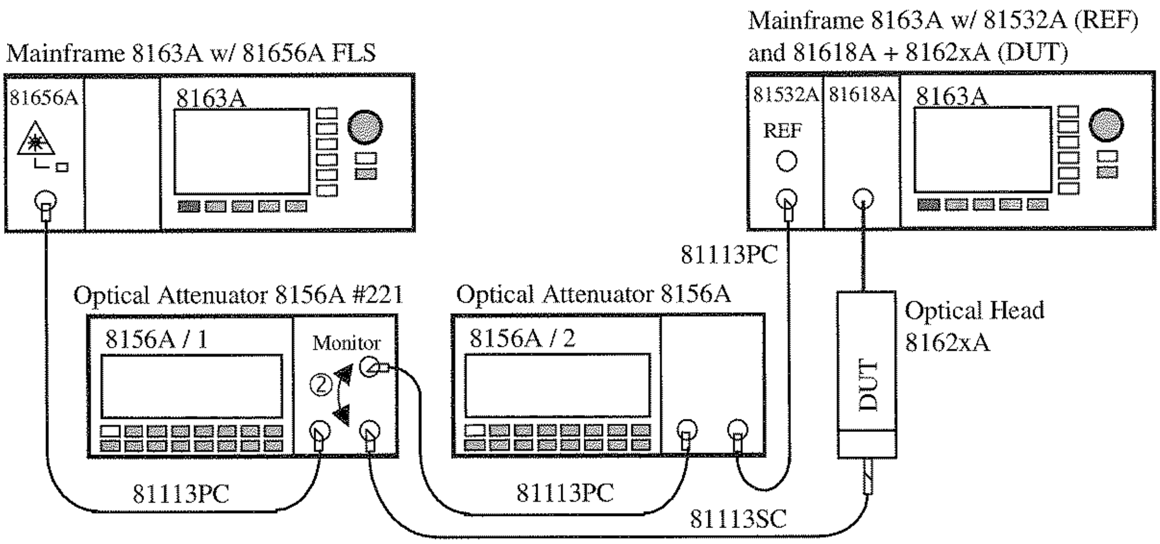


Figure 4 Measurement Setup for Power Linearity

NOTE

- Do not turn the laser off during the measurement!
- Clean all connectors carefully before you start with the measurement!

Test Setup

1 Make sure that cable connector, detectors and adapters are clean.

2 Make sure that you perform this test in a temperature-controlled environment with temperature fluctuations less than ±1°C.

3 Setup the equipment as shown in Figure 4. Disable both attenuators and enable the laser source, where the source wavelength is chosen to 1550 nm. If you are using the 81657A, move to the wavelength parameter, [λ], press *Enter*, select the longer wavelength source (1550 nm nominally), and press *Enter*.

4 Set the wavelength of both attenuators to the same wavelength as the laser source.

5 Perform the following sub-procedure for both Power Meters:

   a Move to the Power Meter channel.

Performance Tests

- **b** Move to the wavelength parameter, [λ], press *Enter*, enter the wavelength of the laser source, and press *Enter*.
- **c** Move to the calibration parameter, [*CAL*], press *Enter*, set the calibration parameter to zero, and press *Enter*.
- **d** Move to the averaging time parameter, [*AvgTime*], press *Enter*, move to <*100 ms*>, and press *Enter*.
- **e** Move to the power parameter, [*P*], press [Pwr unit], move to <*dBm*>, and press *Enter*.
- **f** Press the [Menu] softkey and move to <*Number of digits*>, press *Enter*, move to <*3*>, press *Enter* and press [Close].

NOTE Always include at least three digits after the decimal point when you note a power reading.

6 Initialize the two attenuators as follows:

- **a** Set the attenuation of the 8156A #221 with Monitor Output (referred to as Atty1) to 0 dB.
- **b** Set the attenuation of the other 8156A (referred to as Atty2) to 35 dB.

7 Wait at least 15 minutes until the laser source has stabilized.

8 Perform the following sub-procedure for the reference Power Meter, 81532A:

- **a** Press [Menu], move to <*Range mode*>, move to <*Manual*>, and press *Enter*.
- **b** Move to <*Range*>, press *Enter*, move to <*-40 dBm*>, press *Enter*, and press [Close].

9 Perform the following sub-procedure for the DUT, 8162xA/B:

- **a** Press [Menu], move to <*Range mode*>, move to <*Manual*>, and press *Enter*.
- **b** Move to <*Range*>, press *Enter*, move to <*10 dBm*>, and press *Enter*.
- **c** Zero both Power Meters. Move to <*Zero all*> and press *Enter*.

10 Enable both attenuators.

11 Adjust the attenuation of Atty2 in order to achieve -37.2 dBm on the reference Power Meter.

 Performance Tests

+10 dBm Range

12 Applies to the 81625B only:
Switch to the 30 dBm range and note both power readings as n=0 in the test record, which is given at the end of the test descriptions (#0, that is n=0). Switch back to the 10 dBm range.

13 Note both power readings as the first value in the test record, which is given at the end of the test descriptions (#1).

14 Increase the attenuation of Atty1 until the power reading of the DUT shows about +2.8 dBm.

15 Note the InRange-values in the test record (#2)

16 Perform the following sub-procedure for the DUT, 8162xA/B:

a Press [Menu], move to *<Range mode>*, move to *<Manual>*, and press *Enter*.

b Move to *<Range>*, press *Enter*, move to *<0 dBm>*, and press *Enter*.

17 If necessary, adjust the attenuation of Atty2 in order to be on the upper limit of the -40 dBm range (i.e. -37.2 dBm).

0 dBm Range

18 Disable Atty1.

19 Zero both Power Meters. On the 8163A with two installed power meters, press [Menu], move to *<Zero all>*, and press *Enter*.

20 Enable Atty1.

21 Switch one range up to the +10 dBm range.

22 Note both power readings (#3).

23 Switch down to the previous range (0 dBm) and note the values again (#4).

24 Increase Atty1 by 10 dB and note the results in the test record (#5).

25 Move to the channel of the DUT, 8162xA/B, press [Menu], move to *<Range>*, press *Enter*, move to *<-10 dBm>*, press *Enter*, and press [Close].

26 If necessary, adjust the attenuation of Atty1 in order to be on the upper limit of the range (i.e. -x7.y dBm).

27 Decrease the attenuation of Atty2 by 10 dB in order to be on the upper limit of the -40 dBm range.

-10 dBm Range

28 Disable Atty1

29 Zero both Power Meters. On the 8163A with two installed power meters, press [Menu], move to *<Zero all>*, and press *Enter*.

30 Enable Atty1.

31 Switch one range up to the 0 dBm range and note the power readings (#6).

32 Switch down to the previous range (-10 dBm) and note the values again (#7).

33 Increase the attenuation of Atty1 by 10 dB and note the results in the test record (#8).

34 On the DUT switch one range down to the -20 dBm range.

Change Setup

35 Disable Atty1 and switch the output with the monitor output.

36 Set the attenuation of Atty1 to 15 dB and of Atty2 to 35 dB.

37 Enable Atty1 again.

38 Adjust the attenuation of both attenuators in the following order:

a Atty1: DUT Power Meter shows a reading of -17.2 dBm and

b Atty2: the REF Power Meter shows a reading of -37.2 dBm.

-20 dBm to -50 dBm Range

39 Disable Atty1.

40 Zero both Power Meters. On the 8163A with two installed power meters, press [Menu], move to *<Zero all>*, and press *Enter*.

41 Enable Atty1.

42 Switch one range up and note both power readings.

43 Switch one range down and note the power readings again.

44 Increase the attenuation of Atty1 by 10 dB and note the results in the test record.

45 On the DUT switch one range down. Adjust the attenuation of Atty1, if necessary, so that the power displayed by the DUT is at the upper limit of the range, that is, -x7.y dBm.

46 Decrease the attenuation of Atty2 by 10 dB in order to be on the upper limit of the -40 dBm range.

Repeat step 39 to 46 until the power reading of the DUT shows -57.x dBm

[or, for the 81625B only, -47.x dBm].

Calculation

47 Calculate the non-linearity using the formulas given in the test record.

Example: Measurement Results

Information only				Your Entries		
n	Atty1 / #221 [dB]	Atty2 / #100 [dB]	DUT Range [dBm]	REF Power [dBm]	DUT Power [dBm]	Notes
1	0	24	10	-37,2968	8,4557	1. Value
2	6	24	10	-42,437	3,315	InRange
3	6	18	10	-37,2977	3,3136	RangeDisc / lower limit
4	6	18	0	-37,296	3,3137	RangeDisc / upper limit
5	16	18	0	-47,282	-6,6721	InRange
6	16	8	0	-37,2806	-6,6735	RangeDisc / lower limit
7	16	8	-10	-37,2787	-6,6721	RangeDisc / upper limit
8	26	8	-10	-47,2649	-16,6574	InRange
9	7,7	35,7	-10	-37,2996	-17,5518	RangeDisc / lower limit
10	7,7	35,7	-20	-37,2974	-17,5509	RangeDisc / upper limit
11	17,7	35,7	-20	-47,2954	-27,5483	InRange
12	17,7	25,7	-20	-37,2889	-27,5486	RangeDisc / lower limit
13	17,7	25,7	-30	-37,2869	-27,5456	RangeDisc / upper limit
14	27,7	25,7	-30	-47,2827	-37,5404	InRange
15	27,7	15,7	-30	-37,2786	-37,5389	RangeDisc / lower limit
16	27,7	15,7	-40	-37,2764	-37,5365	RangeDisc / upper limit
17	37,7	15,7	-40	-47,2734	-47,537	InRange
18	37,7	5,7	-40	-37,2655	-47,5296	RangeDisc / lower limit
19	37,7	5,7	-50	-37,2632	-47,5289	RangeDisc / upper limit
20	47,7	5,7	-50	-47,2626	-57,5435	InRange

Calculations

	Conversion [dBm] → [mW]		Calculation as given		Calculation as given
n	**Ref / R** [mW]	**DUT / D** [mW]	**Relation1 / A** $= R_{n+1}/R_n$	**Relation2 / B** $= D_n/D_{n+1}$	**Non-Linearity** $= A_n * B_n \ (NL_{n\pm1}+1) - 1$ ① [%]
1	1,86346E-04	7,00761E+00	3,06182E-01	3,26640E+00	-0,02
2	5,70558E-05	2,14536E+00			
3	1,86307E-04	2,14467E+00	1,00039E-00	9,99977E-01	-0,06
4	1,86380E-04	2,14472E+00	1,00323E-01	9,96736E+00	-0,05
5	1,86982E-05	2,15174E-01			
6	1,87042E-04	2,15105E-01	1,000437587E-01	9,99678E-01	-0,02
7	1,87124E-04	2,15174E-01	1,00318E-01	9,96621E+00	-0,01
8	1,87720E-05	2,15904E-02			
9	1,86266E-04	1,75720E-02	1,00051E-00	9,99793E-01	-0,03
10	1,86320E-04	1,75756E-02	**Reference Level**		**0,00**
11	1,86406E-05	1,75861E-03	9,99540E+00	1,00060E-01	-0,01
12	1,86685E-04	1,75849E-03			
13	1,86771E-04	1,75971E-03	9,99540E-01	1,00069E+00	0,04
14	1,86952E-05	1,76181E-04	9,99033E+00	1,00120E-01	-0,06
15	1,87129E-04	1,76242E-04			
16	1,87223E-04	1,76340E-04	9,99494E-01	1,00055E+00	0,06
17	1,87353E-05	1,76319E-05	9,99309E+00	9,99885E-02	0,02
18	1,87694E-04	1,76620E-05			
19	1,87993E-04	1,76649E-05	9,99471E-01	1,00016E+00	0,15
20	1,87819E-05	1,76056E-06	9,99862E+00	9,96644E-02	0,40

NOTE ①: The Nonlinearity is calculated recursively using n=10 as reference point. The formula is:

$$NL_n = \begin{cases} A_n / B_n \cdot (NL_{n+1} + 1) - 1 & for\ n \prec 10 \\ A_n / B_n \cdot (NL_{n-1} + 1) - 1 & for\ n \succ 10 \end{cases}$$

where NL_{n+1} or NL_{n-1} is the previously calculated non-linearity value. For n=1, 4, 7 the values are NL_{n+2} , while they are NL_{n-2} for n=13, 16, 19.

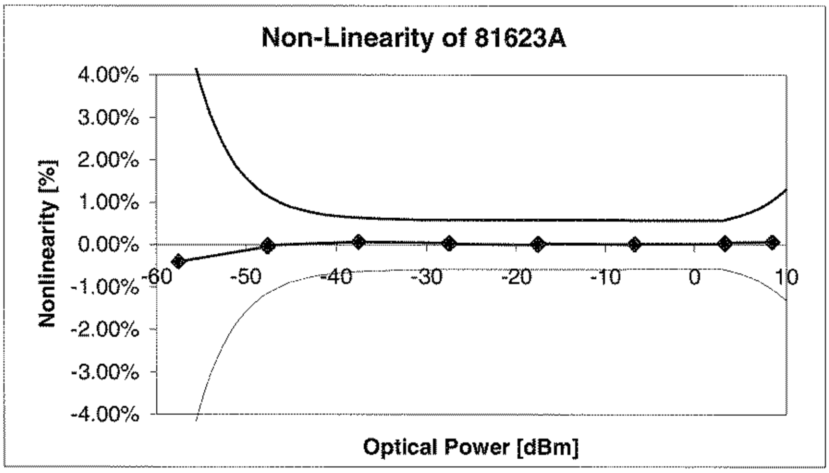


Figure 5 Example of Linearity Test Result.

Noise Test

This performance test applies to Agilent 81623A/4A/5A/5B Optical Heads.

NOTE You must insert a module or a blank panel in the second channel position of the Agilent 8163A Lightwave Multimeter before you perform the noise measurement.

1. Insert an Agilent 81618A or an Agilent 81619A Optical Head Interface module into one slot of the Agilent 8163A Lightwave Multimeter and connect the device under test, an 8162xA/B Optical Head, to the Optical Head Interface module.
2. Make sure the optical input of the Device Under Test (DUT), an 8162xA/B Optical Head, is not receiving any light by placing a plastic cap over the input adapter. Move to the DUT Power Meter channel, press [Menu], move to *<Zero>*, and press *Enter*.
3. Press *Appl*, move to *<Stability>*, and press *Enter*. The Stability Setup Screen appears.
4. Ensure that the correct channel is selected in the upcoming Module Selection box.
5. Press [Menu] to access the Logging application menu screen.
6. Move to *<Pwr unit>*, press *Enter*, move to *<W>*, and press *Enter*.
7. Move to *<AvgTime>*, press *Enter*, move to *<1 s>*, and press *Enter*.
8. Move to *<Range mode>*, press *Enter*, move to *<Auto>*, and press *Enter*, and press [Close].
9. Press the [Parameter] softkey, move to [*TotalTime*], press *Enter*, set the total time to 00:05:00, which is 5 minutes, and press *Enter*.
10. Press the [Measure] softkey to start the measurement.
11. After the stability application has finished, press the [Analysis] softkey, press the [more] softkey, and note [ΔP] as the noise value in the test record.

Performance Tests

Return Loss Test

This performance test applies to Agilent 81623A/4A/5A/5B Optical Heads.

1 Connect the equipment as shown in Figure 6/①. Alternatively, you can use a clean and undamaged straight fiber end as a reference reflector.

2 Move to the fixed wavelength Laser Source channel, select [Menu] and set the *<Modulation src 15xx.xnm>* to *<Coherence Ctrl>*. Ensure that you set the modulation of the upper wavelength source if you are using a Agilent 81657A Laser Source.

3 Set the attenuation of the Agilent 8156A optical attenuator to 10.0 dB at the wavelength given by the source module and enable the output of the attenuator.

4 Set the averaging time of the Return Loss Module to 1 second by pressing *Param* and set the wavelength to the wavelength of the Laser Source.

5 Zero the Return Loss Module.

6 Select the reference parameter, R, by pressing *Param* and set this to 0.18 dB (if you a using a straight fiber end as a reference reflector, set the reference to 14.7 dB).

7 Enable the source output and press *Disp→Ref* for the Return Loss Module.

8 Select the termination parameter T by pressing *Param.*

9 Disconnect the Agilent 81102SC and the Agilent 8156A #203 patchcords from each other.

10 Press *Disp→Ref* for the Return Loss Module.

11 Ensure that the termination parameter T at the Return Loss Module shows a reading of more than 50 dB.

12 Connect the DIN-connector of the 81102SC patchcord to the sensor module as shown in Figure 6/②.

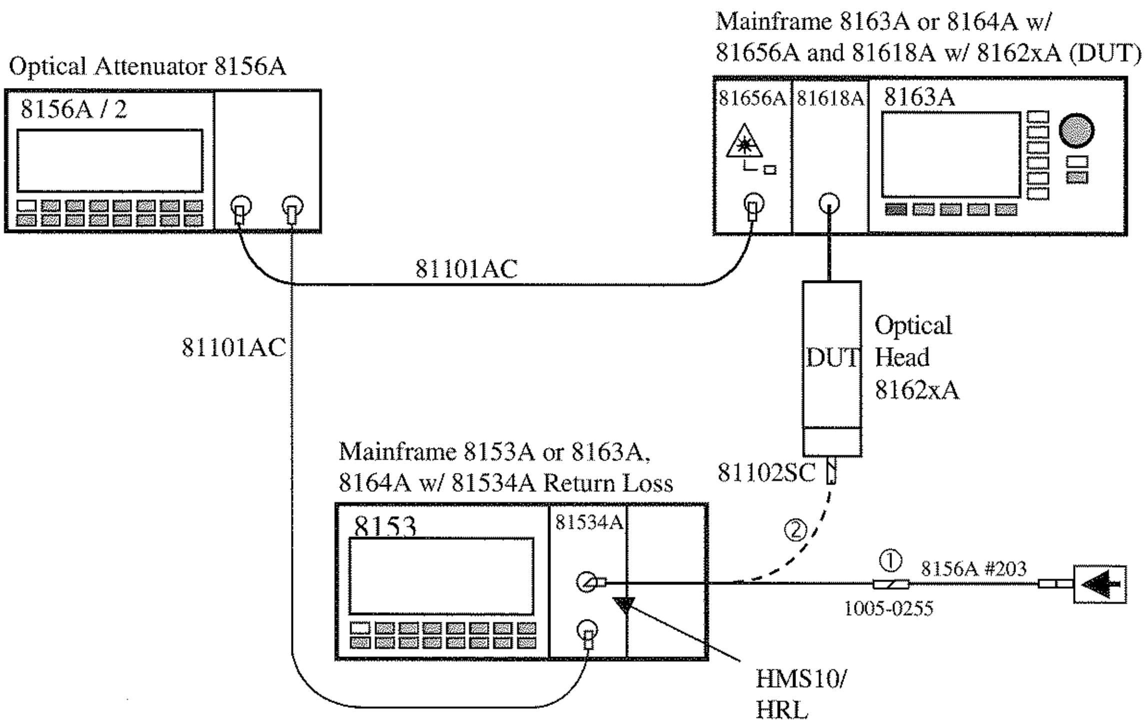


Figure 6 Return Loss Measurement Setup

13 Note the result as the return loss of the sensor module into the test record.

Relative Uncertainty due to Polarization (Optional Test)

NOTE The performance test "Relative Uncertainty due to Polarization" is optional, since the polarization is given with the production of the unit by mechanical and optical cavities and is unchanged by normal use of the sensor module.

Refer to Figure 7 for a setup to verify the relative uncertainty due to polarization of the sensor module.

Generally, during this measurement procedure the tunable laser source is swept through a predefined wavelength range. After every wavelength step, a single PDL-measurement is made, where the polarization controller generates all the different polarization states. The highest PDL value is taken as the "relative uncertainty due to polarization". The low output power path of the coupler is used to monitor the power stability of the setup.

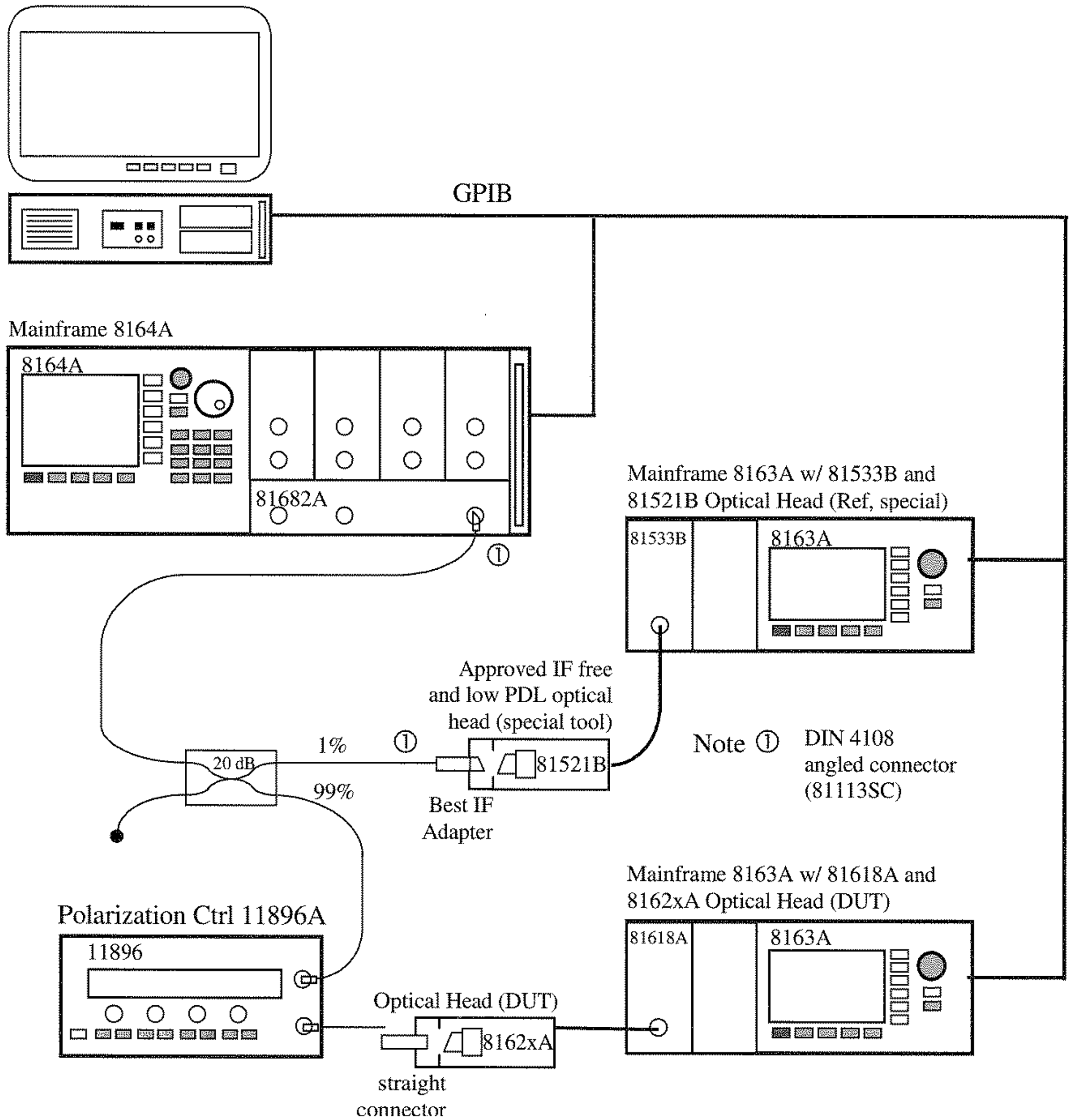


Figure 7 Measurement Setup for PDL Test

Relative Uncertainty due to Interference (Optional Test)

NOTE The performance test "Relative Uncertainty due to Interference" is optional, since the interference is given with the production of the unit by mechanical and optical cavities and is unchanged by normal use of the sensor module.

Refer to Figure 8 for a test setup to verify the relative uncertainty due to interference of the sensor module. In order to perform the relative uncertainty due to interference test, it is mandatory to use two mainframes, since the time difference between measurement A und B for a specific wavelength point has to be no greater than 2 ms. Due to this short measurement interval, the performance test of the relative uncertainty due to interference can only be performed using computer control.

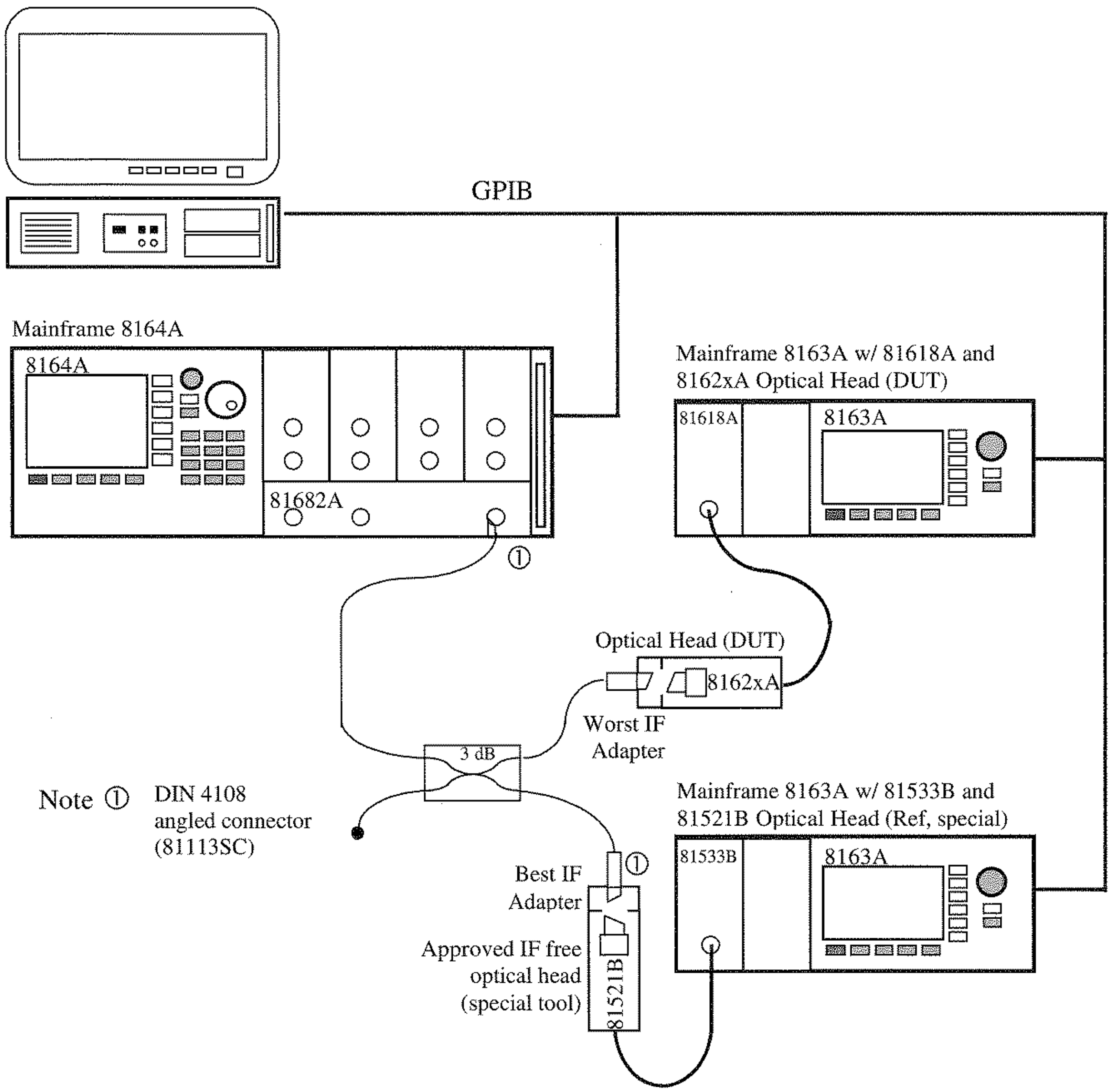


Figure 8 Setup for Relative Uncertainty due to Interference Measurement

Theoretically, both Power Meters are monitoring the power ratio over the variable wavelength in a predefined range as shown in Figure 9. Ensure that the tunable laser source is mode-hop free in the tested wavelength range.

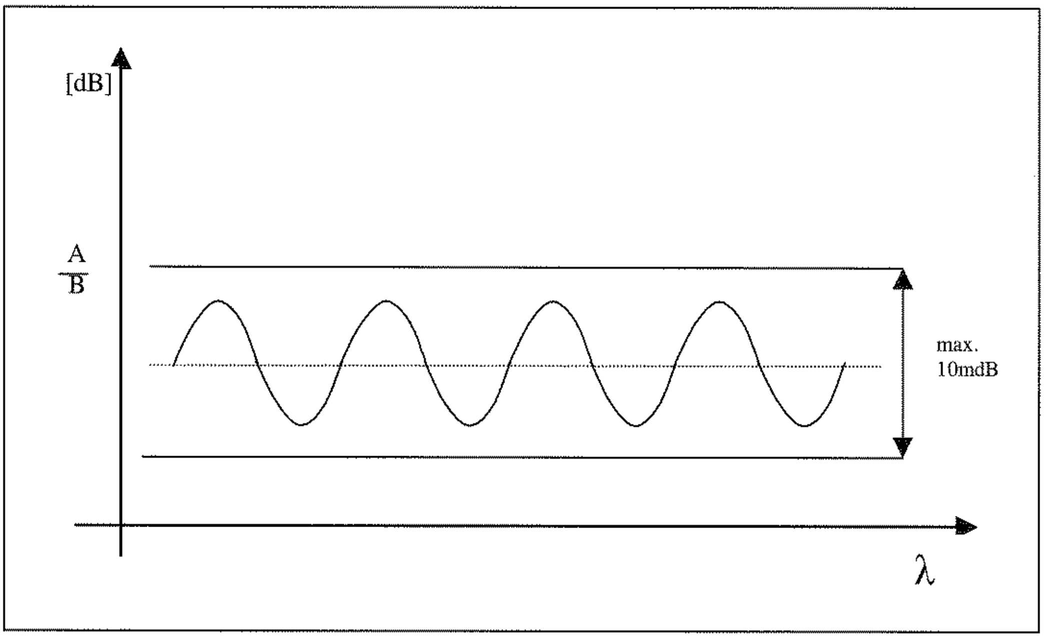


Figure 9 Interference Ripple

Performance Test for the Agilent 81623A

Page 1 of 3

Model	Agilent 81623A Optical Head_	Date	________
Serial No.	________	Ambient Temperature	________ °C
Options	________	Relative Humidity	________ %
Firmware Rev.	________	Line Frequency	________ Hz
Test Facility	________	Customer	________
Performed by	________	Report No	________

Special Notes ________

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Performance Test for the Agilent 81623A **Test Equipment Used**

Page 2 of 3

	Description	Model No.	Trace No	Cal. Due Date
1a1	Lightwave Multimeter (Std.)	Agilent 8163A	________	________
1a2	Lightwave Multimeter (DUT)	Agilent 8163A	________	________
1b	TLS Mainframe	Agilent 8164A	________	________
2a	Interface Module	Agilent 81618A	________	________
2b	Interface Module	Agilent 81619A	________	________
3a	CW High Power Laser Source	Agilent 81656A	________	________
3b	CW Dual High Power Laser Source	Agilent 81657A	________	________
4	CW Dual Laser Source	HP 81554SM	________	________
5a1	Opt. Head Interface Module	HP 81533B	________	________
5a2	Optical Head, Reference	HP 81521B	________	________
6	Sensor Module	HP 81532A	________	________
7	Optical Attenuator	Agilent 8156A #221	________	________
8a	Optical Attenuator	Agilent 8156A #101	________	________
8b	Optical Attenuator	HP 8157A	________	________
8c	Optical Attenuator	HP 8158B #002	________	________
9	Return Loss Module	HP 81534A	________	________
10	________	________	________	________
11	________	________	________	________
12	________	________	________	________

Accessories	#	Product	#	Product	#	Product
Singlemode Fibers	2	81101AC	1	81102SC	3	81113PC
	1	81113SC				
Connector Interfaces	5	81000AI	3	81000FI	4	81000SI
Connector Adapters	2	81000AA	1	81000SA		

Performance Test for the Agilent 81623A

Page 3 of 3

Model Agilent 81623A Sensor Module **Report No.**________ **Date** ________________

Test No.	Test Description	Min. Spec.	Result	Max. Spec.	Measurement Uncertainty
I	**Accuracy Test**		[μW]		
	measured at _______ nm (1310nm) Output Power	9.72 μW	______	10.28 μW	
	measured at _______ nm (1550nm) Output Power	9.72 μW	______	10.28 μW	

II Linearity Test For Calculations you may want to use the appropriate sheet

Range	P_{DUT} [dBm]	P_{DUT} [dBm]	Loss [%]	
+10	+9	_______	______	<± 1.13 %
+10	+3	_______	______	<± 0.58 %
0	+3	_______	______	<± 0.58 %
0	-7	_______	______	<± 0.58 %
-10	-7	_______	______	<± 0.58 %
-10	-17	_______	______	<± 0.58 %
-20*	-17*	Reference	**0.0**	<± 0.58 %
-20	-27	_______	______	<± 0.58 %
-30	-27	_______	______	<± 0.58 %
-30	-37	_______	______	<± 0.63 %
-40	-37	_______	______	<± 0.63 %
-40	-47	_______	______	<± 1.08 %
-50	-47	_______	______	<± 1.08%
-50	-57	_______	______	<± 5.59 %

Test No.	Test Description	Min. Spec.	Result	Max. Spec.
III	**Noise Test**		[pW]	
			______	< 100 pW
IV	**Return Loss Test**		[dB]	
		45 dB <	______	

Performance Test for the Agilent 81624A

Page 1 of 3

Model	Agilent 81624A Optical Head_	Date	____________
Serial No.	______________________	Ambient Temperature	____________°C
Options	______________________	Relative Humidity	____________ %
Firmware Rev.	______________________	Line Frequency	____________ Hz
Test Facility	______________________	Customer	______________________
Performed by	______________________	Report No	______________________

Special Notes ____

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Performance Test for the Agilent 81624A **Test Equipment Used**

Page 2 of 3

	Description	Model No.	Trace No	Cal. Due Date
1a1	Lightwave Multimeter (Std.)	Agilent 8163A	________	________
1a2	Lightwave Multimeter (DUT)	Agilent 8163A	________	________
1b	TLS Mainframe	Agilent 8164A	________	________
2a	Interface Module	Agilent 81618A	________	________
2b	Interface Module	Agilent 81619A	________	________
3a	CW High Power Laser Source	Agilent 81656A	________	________
3b	CW Dual High Power Laser Source	Agilent 81657A	________	________
4	CW Dual Laser Source	HP 81554SM	________	________
5a1	Opt. Head Interface Module	HP 81533B	________	________
5a2	Optical Head, Reference	HP 81521B	________	________
6	Sensor Module	HP 81532A	________	________
7	Optical Attenuator	Agilent 8156A #221	________	________
8a	Optical Attenuator	Agilent 8156A #101	________	________
8b	Optical Attenuator	HP 8157A	________	________
8c	Optical Attenuator	HP 8158B #002	________	________
9	Return Loss Module	HP 81534A	________	________
10	________________	________	________	________
11	________________	________	________	________
12	________________	________	________	________

Accessories	**#**	**Product**	**#**	**Product**	**#**	**Product**
Singlemode Fibers	2	81101AC	1	81102SC	3	81113PC
	1	81113SC				
Connector Interfaces	5	81000AI	3	81000FI	4	81000SI
Connector Adapters	2	81000AA	1	81000SA		

Performance Tests

Performance Test for the Agilent 81624A

Page 3 of 3

Model Agilent 81624A Sensor Module **Report No.________** **Date ________________**

Test No.	Test Description	Min. Spec.	Result	Max. Spec.	Measurement Uncertainty
I	**Accuracy Test**		[μW]		
	measured at _______ nm (1310nm) Output Power	9.72 μW	_______	10.28 μW	
	measured at _______ nm (1550nm) Output Power	9.72 μW	_______	10.28 μW	

II Linearity Test For Calculations you may want to use the appropriate sheet

Range	P_{DUT} [dBm]	P_{DUT} [dBm]	Loss [%]	
+10	+9	_______	_______	<± 0.46 %
+10	+3	_______	_______	<± 0.46 %
0	+3	_______	_______	<± 0.46 %
0	-7	_______	_______	<± 0.46 %
-10	-7	_______	_______	<± 0.46 %
-10	-17	_______	_______	<± 0.46 %
-20*	-17*	Reference	**0.0**	<± 0.46 %
-20	-27	_______	_______	<± 0.46 %
-30	-27	_______	_______	<± 0.46 %
-30	-37	_______	_______	<± 0.49 %
-40	-37	_______	_______	<± 0.49 %
-40	-47	_______	_______	<± 0.71 %
-50	-47	_______	_______	<± 0.71 %
-50	-57	_______	_______	<± 2.97 %

Test No.	Test Description	Min. Spec.	Result	Max. Spec.
III	**Noise Test**		[pW]	
			_______	< 5 pW
IV	**Return Loss Test**		[dB]	
		typ. 60 dB	_______	

Performance Test for the Agilent 81625A

Page 1 of 3

Model	Agilent 81625A Optical Head_	Date	________
Serial No.	____________________	Ambient Temperature	________°C
Options	____________________	Relative Humidity	________ %
Firmware Rev.	____________________	Line Frequency	________ Hz

Test Facility	____________________	Customer	____________________
Performed by	____________________	Report No	____________________

Special Notes ____

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Performance Test for the Agilent 81625A **Test Equipment Used**

Page 2 of 3

	Description	Model No.	Trace No	Cal. Due Date
1a1	Lightwave Multimeter (Std.)	Agilent 8163A	________	________
1a2	Lightwave Multimeter (DUT)	Agilent 8163A	________	________
1b	TLS Mainframe	Agilent 8164A	________	________
2a	Interface Module	Agilent 81618A	________	________
2b	Interface Module	Agilent 81619A	________	________
3a	CW High Power Laser Source	Agilent 81656A	________	________
3b	CW Dual High Power Laser Source	Agilent 81657A	________	________
4	CW Dual Laser Source	HP 81554SM	________	________
5a1	Opt. Head Interface Module	HP 81533B	________	________
5a2	Optical Head, Reference	HP 81521B	________	________
6	Sensor Module	HP 81532A	________	________
7	Optical Attenuator	Agilent 8156A #221	________	________
8a	Optical Attenuator	Agilent 8156A #101	________	________
8b	Optical Attenuator	HP 8157A	________	________
8c	Optical Attenuator	HP 8158B #002	________	________
9	Return Loss Module	HP 81534A	________	________
10	________	________	________	________
11	________	________	________	________
12	________	________	________	________

Accessories	#	Product	#	Product	#	Product
Singlemode Fibers	2	81101AC	1	81102SC	3	81113PC
	1	81113SC				
Connector Interfaces	5	81000AI	3	81000FI	4	81000SI
Connector Adapters	2	81000AA	1	81000SA		

Performance Test for the Agilent 81625A

Page 3 of 3

Model Agilent 81625A Sensor Module		**Report No.________**		**Date ________________**	
Test No.	**Test Description**	**Min. Spec.**	**Result**	**Max. Spec.**	**Measurement Uncertainty**
I	**Accuracy Test**		*[µW]*		
	measured at _______ nm (1310nm) Output Power	9.64 µW	_______	10.36 µW	
	measured at _______ nm (1550nm) Output Power	9.64 µW	_______	10.36 µW	

II **Linearity Test** For Calculations you may want to use the appropriate sheet

Range	**P_{DUT} [dBm]**	**P_{DUT} [dBm]**	**Loss [%]**	
+10	+9	________	_______	<± 0.46 %
+10	+3	________	_______	<± 0.46 %
0	+3	________	_______	<± 0.46 %
0	-7	________	_______	<± 0.46 %
-10	-7	________	_______	<± 0.46 %
-10	-17	________	_______	<± 0.46 %
-20*	-17*	Reference	**0.0**	<± 0.46 %
-20	-27	________	_______	<± 0.47 %
-30	-27	________	_______	<± 0.47 %
-30	-37	________	_______	<± 0.51 %
-40	-37	________	_______	<± 0.51 %
-40	-47	________	_______	<± 0.96 %
-50	-47	________	_______	<± 0.96 %
-50	-57	________	_______	<± 5.47 %

III	**Noise Test**		[pW]	
			_______	< 100 pW
IV	**Return Loss Test**		[dB]	
		60 dB <	_______	

Performance Test for the Agilent 81625B

Page 1 of 3

Model	Agilent 81625B Optical Head_	Date	____________
Serial No.	____________________	Ambient Temperature	____________°C
Options	____________________	Relative Humidity	____________%
Firmware Rev.	____________________	Line Frequency	____________Hz
Test Facility	____________________	Customer	____________________
Performed by	____________________	Report No	____________________

Special Notes ____

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Performance Test for the Agilent 81625B **Test Equipment Used**

Page 2 of 3

	Description	Model No.	Trace No	Cal. Due Date
1a1	Lightwave Multimeter (Std.)	Agilent 8163A	______	______
1a2	Lightwave Multimeter (DUT)	Agilent 8163A	______	______
1b	TLS Mainframe	Agilent 8164A	______	______
2a	Interface Module	Agilent 81618A	______	______
2b	Interface Module	Agilent 81619A	______	______
3a	CW High Power Laser Source	Agilent 81656A	______	______
3b	CW Dual High Power Laser Source	Agilent 81657A	______	______
4	CW Dual Laser Source	HP 81554SM	______	______
5a1	Opt. Head Interface Module	HP 81533B	______	______
5a2	Optical Head, Reference	HP 81521B	______	______
6	Sensor Module	HP 81532A	______	______
7	Optical Attenuator	Agilent 8156A #221	______	______
8a	Optical Attenuator	Agilent 8156A #101	______	______
8b	Optical Attenuator	HP 8157A	______	______
8c	Optical Attenuator	HP 8158B #002	______	______
9	Return Loss Module	HP 81534A	______	______
10	______	______	______	______
11	______	______	______	______
12	______	______	______	______

Accessories	#	Product	#	Product	#	Product
Singlemode Fibers	2	81101AC	1	81102SC	3	81113PC
	1	81113SC				
Connector Interfaces	5	81000AI	3	81000FI	4	81000SI
Connector Adapters	2	81000AA	1	81000SA		

Performance Test for the Agilent 81625B

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Model Agilent 81625B Sensor Module	**Report No.________**		**Date ________________**	
Test No. **Test Description**	**Min. Spec.**	**Result**	**Max. Spec.**	**Measurement Uncertainty**
I **Accuracy Test**		*[μW]*		
measured at _______ nm (1310nm) Output Power	9.64 μW	_______	10.36 μW	
measured at _______ nm (1550nm) Output Power	9.64 μW	_______	10.36 μW	

II **Linearity Test** For Calculations you may want to use the appropriate sheet

Range	P_{DUT} **[dBm]**	P_{DUT} **[dBm]**	**Loss [%]**	
+30	+9	_______	_______	<± 1.50% [1]
+10	+9	_______	_______	<± 0.93 %
+10	+3	_______	_______	<± 0.93 %
0	+3	_______	_______	<± 0.93 %
0	-7	_______	_______	<± 0.93 %
-10	-7	_______	_______	<± 0.93 %
-10	-17	_______	_______	<± 0.93 %
-20	-17	_______	_______	<± 0.93 %
-20*	-17*	Reference	**0.0**	<± 0.93 %
-20	-27	_______	_______	<± 0.95 %
-30	-27	_______	_______	<± 0.95 %
-30	-37	_______	_______	<± 1.18 %
-40	-37	_______	_______	<± 0.18 %
-40	-47	_______	_______	<± 3.43 %

III **Noise Test**		[pW]	
		_______	< 500 pW
IV **Return Loss Test**		[dB]	
	60 dB <	_______	

[1] The 30 dB range measurement is only performed to check the functionality of the current booster. The published specification does not apply because the attenuator is not in automode.

NOTE The nonlinearity of the 81625B is not usually tested to the specified power level of +27 dBm. Instead, limited testing up to +9 dBm is used to test the electronic circuitry of the 81625B. Above +9 dBm the largest contribution to nonlinearity is from the absorbing glass filter (which is tested on a sample basis) that does not change its linearity with time. Thus it is guaranteed by design that testing the 81625B up to +9 dBm ensures specification compliance to +27 dBm

Calculation Sheets

Table 3 Calculation Sheet for Linearity Measurement (81623A, 81624A, 8125A)

	Conversion [dBm] → [mW]		Calculation as given		Calculation as given
n	**Ref / R [mW]**	**DUT / D [mW]**	**Relation1 / A** $= R_{n+1}/R_n$	**Relation2 / B** $= D_n/D_{n+1}$	**Non-Linearity** $= A_n*B_n\ (NL_{n\pm1}+1) - 1$ ① [%]
1					
2					
3					
4					
5					
6					
7					
8					
9					
10			**Reference Level**		**0.00**
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Table 4 Calculation Sheet for Linearity Measurement (81625B)

	Conversion [dBm] → [mW]		Calculation as given		Calculation as given
n	**Ref / R** [mW]	**DUT / D** [mW]	**Relation1 / A** $= R_{n+1}/R_n$	**Relation2 / B** $= D_n/D_{n+1}$	**Non-Linearity** $= A_n{*}B_n\ (NL_{n\pm1}+1) - 1$ ① [%]
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10			**Reference Level**		**0,00**
11					
12					
13					
14					
15					
16					
17					

Cleaning Information

The following Cleaning Information contains some general safety precautions, which must be observed during all phases of cleaning. Consult your specific optical device manuals or guides for full information on safety matters.

Please try, whenever possible, to use physically contacting connectors, and dry connections. Clean the connectors, interfaces, and bushings carefully after use.

If you are unsure of the correct cleaning procedure for your optical device, we recommend that you first try cleaning a dummy or test device.

Agilent Technologies assume no liability for the customer's failure to comply with these requirements.

Cleaning Instructions for this Device

This Cleaning Information applies to a number of different types of Optical Equipment.

Sections of particularly relevance to the following devices are cross-referenced below.

81000xA Optical Head Adapters

When using optical head adapters, periodically inspect the optical head's front window (see *"How to clean connector adapters" on page 74* for cleaning procedures). Dust and metal particles can be propelled through the adapter's pinhole while inserting the connector ferrule into the receptacle. These dirt particles collect on the head's front window and, if not removed, can lead to incorrect measurement results.

8162xx Optical Power Heads

Periodically inspect the optical head's front window for dust and other particles (see *"How to clean instruments with an optical glass plate" on page 78* for cleaning procedures). These can be propelled through the optical head adapter's pinhole while inserting a connector ferrule into the receptacle. Particles on the optical head's front window can significantly impair measurement results.

Safety Precautions

Please follow the following safety rules:

- Do not remove instrument covers when operating.
- Ensure that the instrument is switched off throughout the cleaning procedures.
- Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.
- Make sure that you disable all sources when you are cleaning any optical interfaces.
- Under no circumstances look into the end of an optical device attached to optical outputs when the device is operational. The laser radiation is not visible to the human eye, but it can seriously damage your eyesight.
- To prevent electrical shock, disconnect the instrument 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.
- Do not install parts or perform any unauthorized modification to optical devices.
- Refer servicing only to qualified and authorized personnel.

Why is it important to clean optical devices?

In transmission links optical fiber cores are about 9 µm (0.00035") in diameter. Dust and other particles, however, can range from tenths to hundredths of microns in diameter. Their comparative size means that they can cover a part of the end of a fiber core, and as a result will reduce the performance of your system.

Furthermore, the power density may burn dust into the fiber and cause additional damage (for example, 0 dBm optical power in a single mode fiber causes a power density of approximately 16 million W/m^2). If this happens, measurements become inaccurate and non-repeatable.

Cleaning is, therefore, an essential yet difficult task. Unfortunately, when comparing most published cleaning recommendations, you will discover that they contain several inconsistencies. In this section, we want to suggest ways to help you clean your various optical devices, and thus significantly improve the accuracy and repeatability of your lightwave measurements.

What do I need for proper cleaning?

Some Standard Cleaning Equipment is necessary for cleaning your instrument. For certain cleaning procedures, you may also require certain Additional Cleaning Equipment.

Standard Cleaning Equipment

Before you can start your cleaning procedure you need the following standard equipment:

- Dust and shutter caps
- Isopropyl alcohol
- Cotton swabs
- Soft tissues
- Pipe cleaner
- Compressed air

Dust and shutter caps

All of Agilent Technologies' lightwave instruments are delivered with either laser shutter caps or dust caps on the lightwave adapter. Any cables come with covers to protect the cable ends from damage or contamination.

We suggest these protective coverings should be kept on the equipment at all times, except when your optical device is in use. Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber too hard, as any dust in the cap can scratch or pollute your fiber surface.

If you need further dust caps, please contact your nearest Agilent Technologies sales office.

Isopropyl alcohol

This solvent is usually available from any local pharmaceutical supplier or chemist's shop.

If you use isopropyl alcohol to clean your optical device, do not immediately dry the surface with compressed air (except when you are cleaning very sensitive optical devices). This is because the dust and the dirt is solved and will leave behind filmy deposits after the alcohol is evaporated. You should therefore first remove the alcohol and the dust with a soft tissue, and then use compressed air to blow away any remaining filaments.

If possible avoid using denatured alcohol containing additives. Instead, apply alcohol used for medical purposes.

Never drink this alcohol, as it may seriously damage to your health.

Do not use any other solvents, as some may damage plastic materials and claddings. Acetone, for example, will dissolve the epoxy used with fiber optic connectors. To avoid damage, only use isopropyl alcohol.

Cotton swabs

We recommend that you use swabs such as Q-tips or other cotton swabs normally available from local distributors of medical and hygiene products (for example, a supermarket or a chemist's shop). You may be able to obtain various sizes of swab. If this is the case, select the smallest size for your smallest devices.

Ensure that you use natural cotton swabs. Foam swabs will often leave behind filmy deposits after cleaning.

Use care when cleaning, and avoid pressing too hard onto your optical device with the swab. Too much pressure may scratch the surface, and could cause your device to become misaligned. It is advisable to rub gently over the surface using only a small circular movement.

Swabs should be used straight out of the packet, and never used twice. This is because dust and dirt in the atmosphere, or from a first cleaning, may collect on your swab and scratch the surface of your optical device.

Soft tissues

These are available from most stores and distributors of medical and hygiene products such as supermarkets or chemists' shops.

We recommend that you do not use normal cotton tissues, but multi-layered soft tissues made from non-recycled cellulose. Cellulose tissues are very absorbent and softer. Consequently, they will not scratch the surface of your device over time.

Use care when cleaning, and avoid pressing on your optical device with the tissue. Pressing too hard may lead to scratches on the surface or misalignment of your device. Just rub gently over the surface using a small circular movement.

Use only clean, fresh soft tissues and never apply them twice. Any dust and dirt from the air which collects on your tissue, or which has gathered after initial cleaning, may scratch and pollute your optical device.

Pipe cleaner

Pipe cleaners can be purchased from tobacconists, and come in various shapes and sizes.The most suitable one to select for cleaning purposes has soft bristles, which will not produces scratches.

There are many different kinds of pipe cleaner available from tobacco nists.

The best way to use a pipe cleaner is to push it in and out of the device opening (for example, when cleaning an interface). While you are cleaning, you should slowly rotate the pipe cleaner.

Only use pipe cleaners on connector interfaces or on feed through adapters. Do not use them on optical head adapters, as the center of a pipe cleaner is hard metal and can damage the bottom of the adapter.

Your pipe cleaner should be new when you use it. If it has collected any dust or dirt, this can scratch or contaminate your device.

The tip and center of the pipe cleaner are made of metal. Avoid accidentally pressing these metal parts against the inside of the device, as this can cause scratches.

Compressed air

Compressed air can be purchased from any laboratory supplier.

It is essential that your compressed air is free of dust, water and oil. Only use clean, dry air. If not, this can lead to filmy deposits or scratches on the surface of your connector. This will reduce the performance of your transmission system.

When spraying compressed air, hold the can upright. If the can is held at a slant, propellant could escape and dirty your optical device. First spray into the air, as the initial stream of compressed air could contain some condensation or propellant. Such condensation leaves behind a filmy deposit.

Please be friendly to your environment and use a CFC-free aerosol.

Additional Cleaning Equipment

Some Cleaning Procedures need the following equipment, which is not required to clean each instrument:

- Microscope with a magnification range about 50X up to 300X
- Ultrasonic bath
- Warm water and liquid soap
- Premoistened cleaning wipes
- Polymer film
- Infrared Sensor Card

Microscope with a magnification range about 50X up to 300X

A microscope can be found in most photography stores, or can be obtained through or specialist mail order companies. Special fiber-scopes are available from suppliers of splicing equipment.

Ideally, the light source on your microscope should be very flexible. This will allow you to examine your device closely and from different angles.

A microscope helps you to estimate the type and degree of dirt on your device. You can use a microscope to choose an appropriate cleaning method, and then to examine the results. You can also use your microscope to judge whether your optical device (such as a connector) is severely scratched and is, therefore, causing inaccurate measurements.

Ultrasonic bath

Ultrasonic baths are also available from photography or laboratory suppliers or specialist mail order companies.

An ultrasonic bath will gently remove fat and other stubborn dirt from your optical devices. This helps increase the life span of the optical devices.

Only use isopropyl alcohol in your ultrasonic bath, as other solvents may cause damage.

Warm water and liquid soap

Only use water if you are sure that there is no other way of cleaning your optical device without causing corrosion or damage. Do not use hot water, as this may cause mechanical stress, which can damage your optical device.

Ensure that your liquid soap has no abrasive properties or perfume in it. You should also avoid normal washing up liquid, as it can cover your device in an iridescent film after it has been air dried.

Some lenses and mirrors also have a special coating, which may be sensitive to mechanical stress, or to fat and liquids. For this reason we recommend you do not touch them.

If you are not sure how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor.

Premoistened cleaning wipes

Use pre-moistened cleaning wipes as described in each individual cleaning procedure. Cleaning wipes may be used in every instance where a moistened soft tissue or cotton swab is applied.

Polymer film

Polymer film is available from laboratory suppliers or specialist mail order companies.

Using polymer film is a gentle method of cleaning extremely sensitive devices, such as reference reflectors and mirrors.

Infrared Sensor Card

Infrared sensor cards are available from laboratory suppliers or specialist mail order companies.

With this card you are able to control the shape of laser light emitted. The invisible laser beam is projected onto the sensor card, then becomes visible to the normal eye as a round spot.

Take care never to look into the end of a fiber or any other optical component, when they are in use. This is because the laser can seriously damage your eyes.

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.

Always keep the caps on the equipment when it is not in use.

All of Agilent Technologies' lightwave instruments and accessories are shipped with either laser shutter caps or dust caps. If you need additional or replacement dust caps, contact your nearest Agilent Technologies Sales/Service Office.

Immersion Oil and Other Index Matching Compounds

Wherever 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.

Which Cleaning Procedure should I use ?

Light dirt If you just want to clean away light dirt, observe the following procedure for all devices:

- Use compressed air to blow away large particles.
- Clean the device with a dry cotton swab.
- Use compressed air to blow away any remaining filament left by the swab.

Heavy dirt If the above procedure is not enough to clean your instrument, follow one of the procedures below. Please consult *"Cleaning Instructions for this Device" on page 65* for the procedure relevant for this instrument.

If you are unsure of how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor

How to clean connectors

Cleaning connectors is difficult as the core diameter of a single-mode fiber is only about 9 µm. 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 a skilled person, 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 projected onto the card and becomes visible as a small circular spot.

Preferred Procedure

Use the following procedure on most occasions.

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 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

A 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.

How to clean 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

Use the following procedure on most occasions.

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 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.

How to clean 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

Use the following procedure on most occasions.

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 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.

How to clean 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.
- Deposit dissolved dirt in the groove, which can then dirty the surface of an inserted fiber.

Preferred Procedure

Use the following procedure on most occasions.

1 Blow away any dust or dirt with compressed air.

Procedure for Stubborn Dirt

Use this procedure when there is greasy dirt on 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.

CAUTION

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

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.

How to clean 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

Use the following procedure on most occasions.

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 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.

How to clean instruments with a fixed connector interface

You should only clean instruments with a fixed connector interface when it is absolutely necessary. This is because it is difficult to remove any used alcohol or filaments from the input of the optical block.

It is important, therefore, to keep dust caps on the equipment at all times, except when your optical device is in use.

If you do discover filaments or particles, the only way to clean a fixed connector interface and the input of the optical block is to use compressed air.

If there are fluids or fat in the connector, please refer the instrument to the skilled personnel of Agilent's service team.

CAUTION

Only use clean, dry compressed air. Make sure that the air is free of dust, water, and oil. If the air that you use is not clean and dry, this can lead to filmy deposits or scratches on the surface of your connector interface. This will degrade the performance of your transmission system.

Never try to open the instrument and clean the optical block by yourself, because it is easy to scratch optical components, and cause them to become misaligned.

How to clean instruments with an optical glass plate

Some instruments, for example, the optical heads from Agilent Technologies have an optical glass plate to protect the sensor. Clean this glass plate in the same way as optical lenses (see *"How to clean lenses" on page 77*).

How to clean instruments with a physical contact interface

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

Cleaning interfaces is difficult as the core diameter of a single-mode fiber is only about 9 µm. 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 eyesight.

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 projected onto the card and becomes visible as a small circular spot.

Preferred Procedure Use the following procedure on most occasions.

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 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.

How to clean instruments with a recessed lens interface

WARNING For instruments with a deeply recessed lens interface (for example the Agilent 81633A and 81634A Power Sensors) do NOT follow this procedure. Alcohol and compressed air could damage your lens even further.

Keep your dust and shutter caps on when your instrument is not in use. This should prevent it from getting too dirty. If you must clean such instruments, please refer the instrument to the skilled personnel of Agilent's service team.

Preferred Procedure

Use the following procedure on most occasions.

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 when there is greasy dirt on the interface, and using the preferred procedure 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.

How to clean optical devices which are sensitive to mechanical stress and pressure

Some optical devices, such as the Agilent 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

Use the following procedure on most occasions.

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 any part of 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.

How to clean 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

Use the following procedure on most occasions.

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 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.

Additional Cleaning Information

The following cleaning procedures may be used with other optical equipment:

- How to clean bare fiber ends
- How to clean large area lenses and mirrors

How to clean 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.

How to clean large area lenses and mirrors

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

Use the following procedure on most occasions.

1 Blow away any dust or dirt with compressed air.

Procedure for Stubborn Dirt

Use this procedure when there is greasy dirt on the lens:

CAUTION

Only use water if you are sure that there is no other way of cleaning your optical device without causing corrosion or damage.

Only use water if you are sure that there is no other way of cleaning your optical device without causing corrosion or damage. Do not use hot water, as this may cause mechanical stress, which can damage your optical device.

Ensure that your liquid soap has no abrasive properties or perfume in it. You should also avoid normal washing up liquid, as it can cover your device in an iridescent film after it has been air dried.

Some lenses and mirrors also have a special coating, which may be sensitive to mechanical stress, or to fat and liquids. For this reason we recommend you do not touch them.

If you are not sure how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor.

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.

Other Cleaning Hints

Selecting the correct cleaning method is an important element in maintaining your equipment and saving you time and money. This Appendix highlights the main cleaning methods, but cannot address every individual circumstance.

This section contain some additional hints which we hope will help you further. For further information, please contact your local Agilent Technologies representative.

Making the connection

Before you make any connection you must ensure that all lightwave cables and connectors are clean. If not, then use the appropriate cleaning methods.

When you insert the ferrule of a patchcord into a connector or an adapter, ensure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise, the fiber end will rub up against something which could scratch it and leave deposits.

Lens cleaning papers

Some special lens cleaning papers are not suitable for cleaning optical devices like connectors, interfaces, lenses, mirrors and so on. To be absolutely certain that a cleaning paper is applicable, please ask the salesperson or the manufacturer.

Immersion oil and other index matching compounds

Do not use immersion oil or other index matching compounds with optical sensors equipped with recessed lenses. They are liable to dirty the detector and impair its performance. They may also alter the property of depiction of your optical device, thus rendering your measurements inaccurate.

Cleaning the housing and the mainframe

When cleaning either the mainframe or the housing of your instrument, only use a dry and very soft cotton tissue on the surfaces and the numeric pad.

Never open the instruments as they can be damaged. Opening the instruments puts you in danger of receiving an electrical shock from your device, and renders your warranty void.

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