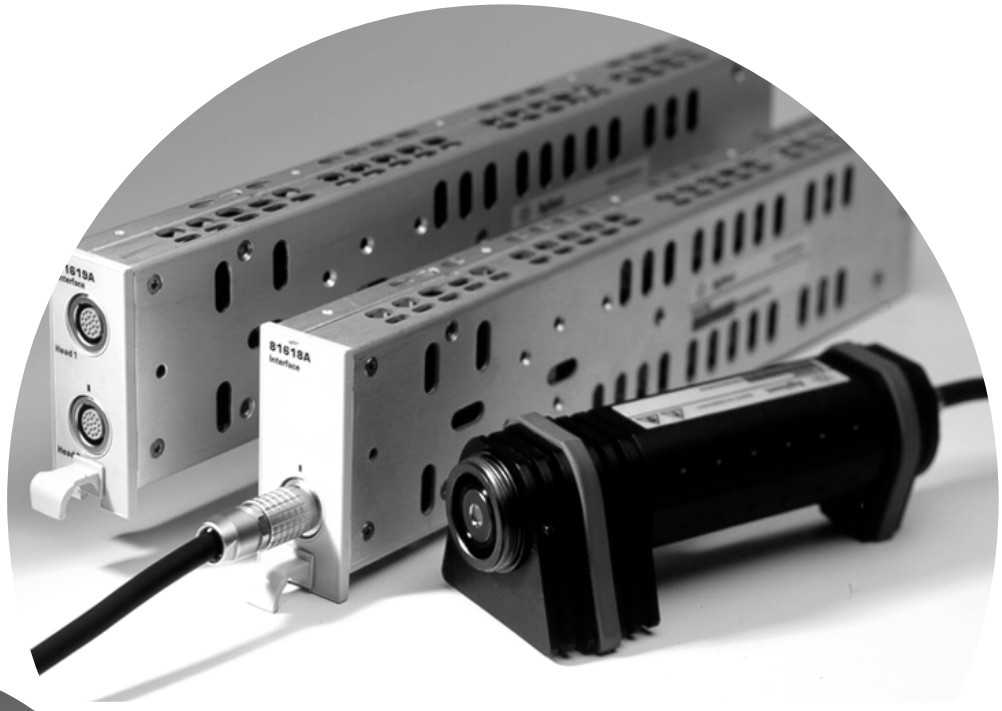
Agilent Power Sensor Modules
Agilent Optical Heads
Agilent Return Loss Modules

Data Sheet



Agilent Technologies

Optical power measurement modules

The Agilent optical power measurement modules provide high performance functionality to the Agilent Lightwave Measurement platform. These modules can be used with the mainframes 8163B, 8164B or 8166B as well as the earlier 816xA models.

Power sensor modules

Provide a front panel optical input that accepts various 81000xI connector interfaces for popular fiber connector types or bare fibers. Besides giving optical power in units of W or dBm or dB referred to a reference, calibrated for any wavelength in the available range, these advanced instruments provide high speed data logging of up to 20 k (100 k for the 81636B) values, triggered internally or externally. The min-max function keeps the maximum and minimum values continuously or over a chosen number of samples for simple determination of power variations. Averaging times can be set from 10 s down to 100 µs (25 µs for the 81636B).

Optical heads

Provide a 5 mm diameter detector area and allow flexible placement of the power meter which is then connected to the 81618A or 81619A interface module in the mainframe. The functionality is the same as for the sensor modules and a choice of adapters allows input from popular connector types, bare fibers or open beams. The simple geometry and high quality detectors allows the heads to offer the highest accuracy measurements. Special calibrations, especially to the 81624B provide metrology lab reference quality. The magnetic D-shaped adapters allow rapid removal and replacement on the head without twisting attached fibers.

Return loss modules

Use two power sensors and fiber couplers to provide a direct measurement of the optical return loss. One sensor measures the optical power reflected back to the instrument while the other monitors the optical power output from the instrument. The ratio provides the return loss. These modules can use an external light source and can also be provided with internal Fabry-Perot lasers for very stable measurements. Full calibration functions are available and especially supported by a built-in application of the 8163B. Using remote programming, these can also be configured to log up to 20 k values from each sensor, synchronized with a tunable laser attached to the external input for making wavelength dependent measurements.

As with the complete Lightwave Measurement platform, remote programming is available with SCPI commands and especially convenient using the 816x VXI*Plug&Play* driver. This driver especially simplifies power logging and coordinated measurements with tunable lasers, especially with multiple power meters.

Selection guidance

- 81635A: dual-channel sensor, lowest price
- 81634B: most accurate sensor, high sensitivity
- 81636B: fast power sensor, 100 k points, 25 µs, high dynamic range
- 81630B: high power sensor
- 81623B: Ge head, general purpose, also 850 nm specifications
- 81624B: InGaAs head, highest accuracy
- 81626B: InGaAs head, high power
- 81628B: InGaAs head with integrating sphere, highest power and accuracy at high power

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Specifications

Specification

Describes a guaranteed product performance that is valid under the specified conditions. Specifications are based on a coverage factor of 2 (unless otherwise stated), corresponding to a level of confidence of > 95%.

Typical value

A characteristic, describes the product performance that is usually met but not guaranteed.

Generally, specifications are valid after warm-up, after zeroing, in auto-range mode (if not differently stated) and at the stated operating conditions and measurement settings.

Technical Specifications

Power sensor module specifications

	Agilent 81635A	Agilent 81634B
Sensor element	InGaAs (dual)	InGaAs
Wavelength range	800 nm to 1650 nm	800 nm to 1700 nm
Power range	–80 dBm to +10 dBm	–110 dBm to +10 dBm
Applicable fiber type	Standard SM and MM up to 62.5 µm core size, NA ≤ 0.24	Standard SM and MM up to 100 µm core size, NA ≤ 0.3
Uncertainty (accuracy) at reference conditions[1]	Typ. < ±3.5%[10] (800 nm to 1200 nm) ±3% (1200 nm to 1630 nm)	±2.5% (1000 nm to 1630 nm)
Total uncertainty[2]	Typ. ±5.5% ±200 pW[9, 11] (800 nm to 1200 nm) ±5% ±20 pW[8, 9] (1200 nm to 1630 nm)	±4.5% ±0.5 pW (1000 nm to 1630 nm)
Relative uncertainty: - due to polarization[3] - spectral ripple (due to interference)[4]	 Typ. < ±0.015 dB Typ. < ±0.015 dB	 < ±0.005 dB < ±0.005 dB
Linearity (power):[5] - at 23 °C ±5 °C - at operating temp. range	CW –60 dBm to +10 dBm Typ. < ±0.02 dB[9] (800 nm to 1200 nm) < ±0.02 dB[9] (1200 nm to 1630 nm) Typ. < ±0.06 dB[9] (800 nm to 1200 nm) < ±0.06 dB[9] (1200 nm to 1630 nm)	CW –90 dBm to +10 dBm < ±0.015 dB (1000 nm to 1630 nm) < ±0.05 dB (1000 nm to 1630 nm)
Return loss[7]	> 40 dB	> 55 dB
Noise (peak to peak)[6]	Typ. < 200 pW (800 nm to 1200 nm) < 20 pW (1200 nm to 1630 nm)	< 0.2 pW (1200 nm to 1630 nm)
Averaging time (minimal)	100 µs	100 µs
Analog output	None	Included
Maximum safe input power	+16 dBm	+16 dBm
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")	75 mm x 32 mm x 335 mm (2.8"x 1.3"x 13.2")
Weight	0.5 kg	0.5 kg
Recommended recalibration period	2 years	2 years
Operating temperature	+10 °C to +40 °C	0 °C to +45 °C
Humidity	Non-condensing	Non-condensing
Warm-up time	20 min	20 min

1. *Reference Conditions:*
   - *Power level 10 µW (-20 dBm), continuous wave (CW)*
   - *Fiber 50 µm graded-index, NA = 0.2*
   - *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 sensor must correspond to source wavelength ±0.4 nm*
2. *Operating Conditions:*
   - *Fiber ≤ 50 µm, NA ≤ 0.2*
   - *81634B only: connectors with 2.5 mm ferrule with flat face (fiber tip offset not more than 0.3 mm from 2.5 mm cross-section) with straight or angled polish*
   - *81635A only: for LC connector use 81000LI adapter, not 81002LI; for MU connector use 81000MI, not 81002MI*
   - *Averaging time 1 s*
   - *Only Agilent 81635A: For fiber 62.5 µm graded-index (NA = 0.24): add ±2%*
   - *Within one year after calibration, add 0.3% for second year*
   - *Operating temperature range as specified humidity: none condensing*
3. *All states of polarization at constant wavelength (1550 nm ±30 nm) and constant power, straight connector, T = 23 °C ±5 °C. 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. *Does not include noise*
6. *Averaging time 1 s, T = 23 °C ±5 °C, ΔT ±1 °C, observation time 300 s*
7. *Conditions:*
   - *Wavelengths 1310 nm ±30 nm and 1550 nm ±30 nm*
   - *Standard single mode fiber, angled connector min 8°*
   - *T = 23 °C ±5 °C*
8. *For wavelengths > 1600 nm add ±0.06%/nm*
9. *For input power > 2 mW add ±0.02 dB*
10. *Add ±1% for wavelength 900 nm to 950 nm*
11. *Add ±3.5% for wavelength 900 nm to 950 nm*

High power sensor module specifications

	Agilent 81630B
Sensor element	InGaAs
Wavelength range	970 nm to 1650 nm
Power range	–70 dBm to +28 dBm
Applicable fiber type	Standard SM and MM up to 100 µm core size, NA ≤ 0.3
Uncertainty (accuracy) at reference conditions[1]	±3.0% for 1255 nm to 1630 nm at 980 nm ±3.5% (add ±0.5% per nm if 980 nm is not the center wavelength) at 1060 nm ±4.0% (add ±0.6% per nm if 1060 nm is not the center wavelength)
Total uncertainty[2,8]	±5% ±1.2 nW (1255 nm to 1630 nm) at 980 nm ±5.5% ±1.2 nW (add ±0.5% per nm if 980 nm is not the center wavelength) at 1060 nm ±6.0% ±1.2 nW (add ±0.6% per nm if 1060 nm is not the center wavelength)
Relative uncertainty: - due to polarization[3] - spectral ripple (due to interference)[4]	 < ±0.01 dB < ±0.005 dB
Linearity (power):[5] - at 23 °C ±5 °C - at operating temp. range	CW –50 dBm to +28 dBm (970 nm - 1630 nm) ≤ ±0.05 dB[8] ≤ ±0.15 dB[8]
Return loss[7]	> 55 dB
Noise (peak to peak)[6]	< 1.2 nW (1255 nm - 1630 nm)
Averaging time (minimal)	100 µs
Analog output	Included
Maximum safe input power	+28.5 dBm
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")
Weight	0.6 kg
Recommended recalibration period	2 years
Operating temperature	0 °C to +35 °C
Humidity	Non-condensing
Warm-up time	20 min

1. *Reference Conditions:*
   - *Power level 80 µW, continuous wave (CW)*
   - *SM Fiber; 9 µm; NA = 0.1*
   - *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 sensor must correspond to source wavelength ±0.4 nm*
2. *Operating Conditions:*
   - *Fiber ≤ 50 µm, NA ≤ 0.2*
   - *Connectors with 2.5 mm ferrule with flat face (fiber tip offset not more than 0.3 mm from 2.5 mm cross-section) with straight or angled polish*
   - *Averaging time 1 s*
   - *Within one year after calibration, add 0.3% for second year*
   - *Operating temperature range as specified, humidity: none condensing*
3. *All states of polarization at constant wavelength (1550 nm ±30 nm) and constant power, straight connector, T = 23 °C ±5 °C. 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. *Does not include noise*
6. *Averaging time 1 s, T = 23 °C ±5 °C, ΔT ±1 °C, observation time 300 s*
7. *Conditions:*
   - *Wavelengths 1310 nm ±30 nm and 1550 nm ±30 nm*
   - *Standard single mode fiber*
   - *Angled connector min 8°*
   - *T = 23 °C ±5 °C*
8. *For input power > +10 mW add: typ. ±0.0012 dB/mW In case of negative power change > 50 dB allow additional recovery time of 3 min*
9. *30 °C for > +20 dBm input power*

Fast power sensor module specifications

	Agilent 81636B
Sensor element	InGaAs
Wavelength range	1250 nm to 1640 nm
Power range	–80 dBm to +10 dBm
Applicable fiber type	Standard SM and MM up to 62.5 µm core size, NA ≤ 0.24
Uncertainty (accuracy) at reference conditions[1]	±3% (1260 nm to 1630 nm)
Total uncertainty[2, 9]	±5% ±20 pW[8] (1260 nm to 1630 nm)
Relative uncertainty: - due to polarization[3] - spectral ripple (due to interference)[4]	 Typ. ±0.015 dB Typ. ±0.015 dB
Linearity (power)[5, 9] - at 23 °C ±5 °C - at operating temperature range	CW –60 to +10 dBm, (1260 nm to 1630 nm) < ±0.02 dB < ±0.06 dB
Return loss[7]	> 40 dB
Noise (peak to peak)[6]	< 20 pW (1260 nm - 1630 nm)
Averaging time (minimal)	25 µs
Dynamic Range at manual range mode[5, 10] - at +10 dBm-range - at ±0 dBm-range - at –10 dBm-range - at –20 dBm-range	 Typ. > 55 dB Typ. > 55 dB Typ. > 52 dB Typ. > 45 dB
Noise at manual range mode (peak to peak):[10] - at +10 dBm-range - at ±0 dBm-range - at –10 dBm-range - at –20 dBm-range	CW –60 to +10 dBm, 1260 nm to 1630 nm < 50 nW < 5 nW < 1 nW < 500 pW
Analog output	Included
Maximum safe input power	+16 dBm
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")
Weight	0.5 kg
Recommended recalibration period	2 years
Operating temperature	+10 °C to +40 °C
Humidity	Non-condensing
Warm-up time	20 min

1. *Reference Conditions:*
   - *Power level 10 µW (-20 dBm), continuous wave (CW)*
   - *Fiber 50 µm graded-index, NA = 0.2*
   - *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 sensor must correspond to source wavelength ±0.4 nm*
2. *Operating Conditions:*
   - *Fiber ≤ 50 µm, NA ≤ 0.2*
   - *For LC connector use 81000LI adapter, not 81002LI; for MU connector use 81000MI, not 81002MI*
   - *Averaging time 1 s*
   - *Within one year after calibration, add 0.3% for second year*
   - *Operating temperature range as specified humidity: none condensing*
3. *All states of polarization at constant wavelength (1550 nm ±30 nm) and constant power, straight connector, T = 23 °C ±5 °C. 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. *Does not include noise*
6. *Averaging time 1 s, T = 23 °C ±5 °C, ΔT ±1 °C, observation time 300 s*
7. *Conditions:*
   - *Wavelengths 1310 nm ±30 nm and 1550 nm ±30 nm*
   - *Standard single mode fiber*
   - *Angled connector min 8°. T = 23 °C ±5 °C*
8. *For wavelengths > 1600 nm add ±0.06%/nm*
9. *For input power > 2 mW add ±0.02 dB*
10. *Conditions:*
    - *Averaging time 25 µs, T = 23 °C ±5 °C*
    - *Observation time 2.5 s*

Optical head specifications

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

	Agilent 81623B	Agilent 81623B Calibration option C85/C86	Agilent 81623B Calibration option C01/C02
Sensor element	Ge, Ø5 mm		
Wavelength range	750 nm to 1800 nm		
Power range	–80 dBm to +10 dBm		
Applicable fiber type Open beam	Standard SM and MM max 100 µm core size, NA ≤ 0.3 Parallel beam max Ø4 mm		
Uncertainty (accuracy) at reference conditions[1]	±2.2% (1000 nm to 1650 nm) ±3.0% typ. (800 nm to 1000 nm)	±2.2% (1000 nm to 1650 nm) ±2.5% (800 nm to 1000 nm)	±1.7% (1000 nm to 1650 nm) ±3.0% typ. (800 nm to 1000 nm)
Total uncertainty[2, 9]	±3.5% ±100 pW (1000 nm to 1650 nm) ±4.0% typ. ±250 pW (800 nm to 1000 nm)	±3.5% ±100 pW (1000 nm to 1650 nm) ±3.7% ±250 pW (800 nm to 1000 nm)	±3.0% ±100 pW (1000 nm to 1650 nm) ±4.0% typ. ±250 pW (800 nm to 1000 nm)
Relative uncertainty: - due to polarization[3] - spectral ripple (due to interference)[4]	< ±0.01 dB[10] (typ. < ±0.005 dB) < ±0.006 dB (typ. < ±0.003 dB)		
Linearity (power):[5] at 23 °C ±5 °C at operating temp. range	(CW –60 dBm to +10 dBm)[9] < ±0.025 dB < ±0.05 dB		
Return loss[7]	> 50 dB, typ. > 55 dB[8]		> 56 dB
Noise (peak to peak)[6]	< 100 pW (1200 nm to 1630 nm) < 400 pW (800 nm to 1200 nm)		
Averaging time (minimal)	100 µs		
Analog output	Included		
Maximum safe input power	+16 dBm		
Dimensions (H x W x D)	57 mm x 66 mm x 156 mm		
Weight	0.5 kg		
Recommended recalibration period	2 years		
Operating temperature	0 °C to 40 °C		
Humidity	Non-condensing		
Warm-up time	40 min		

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 sensor corresponding to source wavelength ±0.4 nm*
2. *Operating Conditions:*
   - *Parallel beam, 3 mm spot diameter on the center of the detector or connectorized fiber with NA ≤ 0.2 (straight connector, options C01/C02 also with angled connector ≤ 8°)*
   - *For NA > 0.2 add 1%*
   - *Averaging time 1 s*
   - *Within one year after calibration, add 0.3% for second year*
   - *Spectral width of source < 10 nm (FWHM)*
   - *Wavelength setting at power sensor corresponding to source wavelength ±0.4 nm*
3. *All states of polarization at constant wavelength (1550 nm ±30 nm) and constant power, straight connector, T = 23 °C ±5 °C. For angled connector (8°) add ±0.01 dB typ.*
4. *Conditions:*
   - *Wavelength 1550 nm ±30 nm, fixed state of polarization*
   - *Temperature 23 °C ±5 °C*
   - *Linewidth of source ≥ 100 MHz*
   - *Angled connector 8°*
5. *Does not include noise; for wavelength < 1000 nm applies for –50 dBm to +10 dBm*
6. *Averaging time 1 s, T = 23 °C ±5 °C, ΔT ±1 °C, observation time 300 s*
7. *Conditions:*
   Wavelengths 1550 nm ±30 nm
   Standard single mode fiber, angled connector min 8°
8. *With D-shape adapter 81001xx return loss > 60 dB typical*
9. *For input power > 2 mW add ±0.004 dB/mW (not for C01/C02); zeroing required*
10. *Specification valid for optical heads with S/N starting with "DE413..." (shipping began April 1, 2001)*

81624B high performance and 81626B high power optical head specifications

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

	Agilent 81624B	Agilent 81624B Calibration option C01/C02	Agilent 81626B	Agilent 81626B Calibration option C01/C02
Sensor element	InGaAs, Ø5 mm		InGaAs, Ø5 mm	
Wavelength range	800 nm to 1700 nm		850 nm to 1650 nm	
Power range	–90 dBm to +10 dBm		–70 to +27 dBm (1250 nm to 1650 nm) –70 to +23 dBm (850 nm to 1650 nm)	
Applicable fiber type Open beam	Standard SM and MM max 100 µm core size, NA ≤ 0.3 Parallel beam max Ø4 mm		Standard SM and MM max 100 µm core size, NA ≤ 0.3 Parallel beam max Ø4 mm	
Uncertainty (accuracy) at reference conditions[1]	±2.2% (1000 nm to 1630 nm)	±1.5% (970 nm to 1630 nm)	±3.0% (950 nm to 1630 nm)	±2.5% (950 nm to 1630 nm)
Total uncertainty[2]	±3.5% ±5 pW (1000 nm to 1630 nm)	±2.8% ±5 pW (970 nm to 1630 nm)	±5.0% ±500 pW[8] (950 nm to 1630 nm)	±4.5% ±500 pW[8] (950 to 1250 nm max 23 dBm) (1250 to 1630 nm max 27 dBm)
Relative uncertainty:[7] - due to polarization[3] - 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) ≤ ±0.005 dB (typ. < ±0.002 dB)	
Linearity (power):[5] - at 23 °C ±5 °C - at operating temp. range	CW –70 dBm to +10 dBm, 1000 nm to 1630 nm < ±0.02 dB < ±0.05 dB		CW –50 dBm to +27 dBm, 950 nm to 1630 nm < ±0.04 dB[8] < ±0.15 dB[8]	
Return loss	Typ. 60 dB[7]		> 45 dB	> 47 dB
Noise (peak to peak)[6]	< 5 pW		< 500 pW	
Averaging time (minimal)	100 µs		100 µs	
Analog output	Included		Included	
Maximum safe input power	+16 dBm		+23.5 dBm (850 nm to 1650 nm) +27.5 dBm (1250 nm to 1650 nm)	
Dimensions (H x W x D)	57 mm x 66 mm x 156 mm		57 mm x 66 mm x 156 mm	
Weight	0.5 kg		0.5 kg	
Recommended recalibration period	2 years		2 years	
Operating temperature	0 °C to 40 °C		0 °C to +35 °C[9]	
Humidity	Non-condensing		Non-condensing	
Warm-up time	40 min		40 min	

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 sensor corresponding to source wavelength ±0.4 nm*
2. *Operating Conditions:*
   - *Parallel beam, 3 mm spot diameter on the center of the detector or connectorized fiber with NA ≤ 0.2 (straight connector, options C01/C02 also with angled connector ≤ 8°)*
   - *For NA > 0.2 add 1%*
   - *Averaging time 1 s*
   - *Within one year after calibration, add 0.3% for second year*
   - *Zeroing required*
3. *All states of polarization at constant wavelength (1550 nm ±30 nm) and constant power, straight connector, T = 23 °C ±5 °C. For angled connector (8°) add ±0.01 dB typ.*
4. *Conditions:*
   - *Wavelength 1550 nm ±30 nm, fixed state of polarization*
   - *Temperature 23 °C ±5 °C*
   - *Linewidth of source ≥ 100 MHz*
   - *Angled connector 8°*
5. *Does not include noise; zeroing required*
6. *Averaging time 1 s, T = 23 °C ±5 °C, ΔT ±1 °C, observation time 300 s. Wavelength range 1200 nm to 1630 nm*
7. *Conditions:*
   - *Wavelengths 1550 nm ±30 nm*
   - *Standard single mode fiber, angled connector min 8°*
   - *With D-shape adapter 81001xx return loss > 60 dB typical*
8. *For input power > +10 mW:*
   - *Add typ. ±0.0016 dB/mW, or in case of options C01/C02 for wavelength ≤ 1550 nm add ±0.0006 dB/mW (guaranteed) using adaptor Agilent 81000AF*
   - *In case of decreasing power, allow time for stabilization of the reading (about 5 s per dB change)*
   - *In case of decreasing power by more than 50 dB, allow recovery time of 3 minutes.*
9. *Max 30 °C above +20 dBm input power*

High power optical head specifications

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

	Agilent 81628B with integrating sphere
Sensor element	InGaAs
Wavelength range	800 nm to 1700 nm
Power range	–60 dBm to +40 dBm (800 nm to 1700 nm) For operation higher than 34 dBm see safety note
Damage power	40.5 dBm
Applicable fiber type Open beam	Single mode NA ≤ 0.2, Multimode NA ≤ 0.4 Ø ≤ 3 mm center of sphere
Uncertainty (accuracy) at reference conditions[1, 8]	±3.0% (970 nm to 1630 nm)
Total uncertainty[2, 8] ≤ 10 dBm > 10 dBm to ≤ 20 dBm > 20 dBm to ≤ 38 dBm	(970 nm to 1630 nm) ±4.0% ±5 nW ±4.5% ±5%
Relative uncertainty: - due to polarization[3] - due to speckle noise at source linewidth:[4] 0.1 pm to 100 pm > 100 pm	 Typ. ≤ ±0.006 dB Typ. ≤ ±0.02 dB Typ. ≤ ±0.002 dB
Linearity (power):[5, 8] ≤ 10 dBm > 10 dBm to ≤ 20 dBm > 20 dBm to ≤ 37 dBm > 37 dBm to ≤ 38 dBm	(CW –40 dBm to +38 dBm), (970 nm to 1630 nm) ≤ ±0.03 dB ≤ ±0.06 dB ≤ ±0.09 dB ≤ ±0.10 dB at 23 °C ±5 °C, for operating temperature range add ±0.03 dB
Return loss	Typ. > 75 dB
Noise (peak to peak)[6]	< 5 nW
Averaging time (minimal)	100 µs
Analog output	Included
Dimensions (H x W x D)	55 mm x 80 mm x 250 mm
Weight	0.9 kg (without heat sink)
Recommended recalibration period	2 years
Operating temperature[7]	0 °C to +40 °C
Humidity	Non-condensing
Warm-up time	40 min

Safety Note:

For optical power higher than 34 dBm the attached heat sink MUST be used!

For continuous optical power or average optical power higher than 38 dBm the connector adapters will get warmer than permitted according to the safety standard IEC 61010-1.

The 81628B Optical Head can handle optical power up to 40 dBm, however, operation above 38 dBm is at the operators own risk.

Agilent Technologies Deutschland GmbH will not be liable for any damages caused by an operation above 38 dBm.

1. *Reference Conditions:*
   - *Power level 10 µW (-20 dBm), continuous wave (CW)*
   - *Averaging time 1 s*
   - *Parallel beam, 3 mm, center of sphere input*
   - *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 sensor must correspond to source wavelength ±0.4 nm*
   - *Humidity 50% ±10%*
2. *Operating Conditions:*
   - *Parallel beam, Ø3 mm, center of sphere input, or connectorized fiber with NA ≤ 0.2 (straight connector)*
   - *For NA > 0.2: add 1%*
   - *Within one year after calibration, add ±0.3% for second year*
   - *Operating temperature range as specified, humidity < 80% and non-condensing*
   - *Zeroing required*
3. *All states of polarization at constant wavelength (1550 nm ±30 nm) and constant power*
4. *Conditions:*
   - *Wavelength 1550 nm ±30 nm, fixed state of polarization, constant power*
   - *Temperature 23 °C ±5 °C*
   - *Measurement time ≤ 3 min*
5. *Does not include noise; zeroing required*
6. *Averaging time 1 s, T = 23 °C ±5 °C, ΔT ±1 °C, observation time 300 s, wavelength range 970 nm to 1630 nm, Thermal drift at 38 dBm, exposure time 30 min:*
   Recovery time 10 min: ≤ 30 nW
   30 min: ≤ 10 nW
7. *For optical power > 30 dBm the maximal operating temperature is limited to 35 °C*
8. *Wavelength must not be equal to any water absorption line*

Return loss module specifications

All modules require angled contact (8°) at input and output connectors

	Agilent 81610A	
Source	External input only[1]	
Sensor element	InGaAs	
Fiber type	Standard single-mode 9/125 µm	
External input	Max input power: 10 dBm Min input power: 0 dBm Damage input power: **16 dBm**	
Wavelength range for external input	1250 nm to 1640 nm	
Dynamic range	70 dB	
Relative uncertainty of[2] Return Loss (RL)	with broadband source	with Agilent FP sources
RL ≤ 55 dB RL ≤ 60 dB RL ≤ 65 dB RL ≤ 70 dB	< ±0.25 dB < ±0.3 dB < ±0.65 dB < ±1.7 dB	Typ. < ±0.5 dB Typ. < ±1.0 dB Typ. < ±2.0 dB
Total uncertainty	Add ±0.2 dB	Add typ. ±0.2 dB
Maximum safe input power	+16 dBm	
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8″ x 1.3″ x 13.2″)	
Weight	0.6 kg	
Recommended recalibration period	2 years	
Operating temperature	10 °C to 40 °C	
Humidity	Non-condensing	
Warm-up time[3]	20 minutes	

1. *Insertion Loss is in the range of 7 dB*
2. *Averaging time 1 s*
   - *calibration prior to measurement*
   - *constant temperature*
   - *broadband source: Agilent 83438A*
   - *FP Sources: Agilent 81650A, 81651A, 81654A with active Coherence Control*
   - *Reference Cable 81610CC used for total uncertainty*
   - *Length of measurement patch cord ≤ 2 m, angled connector in optimal optical conditions*
3. *Warm-up time 60 min, if previously not stored at the same temperature*

Reference Cable Specification

To connect to Return Loss Modules the cable requires connector Interface 81000SI DIN47256/4108

	Agilent 81610CC Reference cable
Return loss	As printed on cable
Return loss uncertainty	±0.2 dB[1]
Wavelengths	1310 nm and 1550 nm ±15 nm

1. *Clean reference reflector in perfect optical condition (Do not use with contact-type connectors)*

Return loss module specifications with internal source

(When used with external sources the specifications of Agilent 81610A return loss module apply)
All modules require angled contact (8°) at input and output connectors

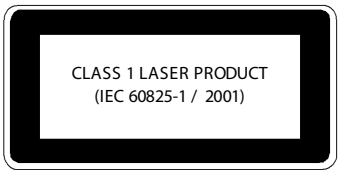
	Agilent 81613A	
Source	Fabry-Perot Laser (internal)	
Output power	Typ. –4 dBm ±1.0 dB typ.	
Center wavelength[1]	1310 nm/1550 nm ±20 nm typ.	
Sensor element	InGaAs	
Fiber type	Standard single-mode 9/125 µm	
Dynamic range	75 dB	
Relative uncertainty of return loss (RL)	User calibration[2]	Plug and play[3]
RL ≤ 55 dB	< ±0.5 dB (typ. < ±0.3 dB)	Typ. < ±0.6 dB
RL ≤ 60 dB	< ±0.6 dB (typ. < ±0.4 dB)	Typ. < ±1.5 dB
RL ≤ 65 dB	< ±0.8 dB (typ. < ±0.5 dB)	
RL ≤ 70 dB	< ±1.9 dB (typ. < ±0.8 dB)[4]	
RL ≤ 75 dB	Typ. < ±2.0 dB[4]	
Total uncertainty	Add ±0.2 dB	Add typ. ±0.2 dB
Maximum safe input power	+16 dBm	
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8″ x 1.3″ x 13.2″)	
Weight	0.6 kg	
Recommended recalibration period	2 years	
Operating temperature	10 °C to 40 °C	
Humidity	Non-condensing	
Warm-up time[5]	20 minutes	

1. *At 25 °C constant temperature, coherence control on, warm-up time after laser turn on > 5 min*
2. *Averaging time 1 s*
   - *calibration prior to measurement*
   - *constant temperature*
   - *coherence control on*
   - *warm-up time after laser turn on > 5 min*
   - *length of measurement patch cord ≤ 2 m*
   - *angled connector in optimal optical condition*
   - *Reference cable 81610CC used for total uncertainty*
3. *Use defaults settings (no user calibration necessary):*
   - *length of measurement patch cord ≤ 2 m*
   - *return loss of connectors ≥ 70 dB*
4. *For measurements performed immediately after calibration*
5. *Warm-up time 60 min, if previously not stored at the same temperature*

Laser Safety Information

The above products are classified as Class 1 according to IEC 60825 1 (2001).

All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2001-July-26.



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Revised: October 1, 2009

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, April 9, 2010
5988-1569EN

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