Optical Power Meter
Model 4100

Fast, Accurate Optical Power Measurement

The 4100 Optical Power Meter offers an unparalleled combination of speed, accuracy, repeatability, ease of use, and low cost.

High Speed

The 4100 combines 100,000 rps optical power meter modules with a powerful processor that can handle the measurement speed. With two channels, each channel still measures at 100,000 rps.

Wide Dynamic Range

The Model 4100 equipped with our precision power meter modules (Option 202) measures from +10 dB to -95 dB, for a full dynamic range of 105 dB.

Wide Dynamic Range at Full Speed

Even more important than full dynamic range is the achievable range while making a measurement without stopping to change range. Most meters take ~20 ms to change range. The 4100 power meters have a large dynamic range of > 65 dB at full speed—in most cases eliminating the need to change range.

Low Polarization Dependency

The Model 4100 with precision power meter modules utilizes a unique patented technology to achieve < 0.0015 dB polarization dependency of measurement. This allows for error-free measurement, even with highly polarized light.

Low Connection Variation

Repeatability is a major obstacle in obtaining consistent results in the lab and in eliminating discrepant materials in production. The 4100 provides repeatability of ±0.005 dB even with widely varying launch conditions.

Clear, Bright Display

The 4" x 6" VGA color display affords excellent ability to understand and analyze measurements directly on the power meter without the need to export to a PC. Trends, drifts, noise, and perturbations are all clearly indicated on the graphical display. The wide viewing angle makes results visible from anywhere in the lab.

Summary

- High speed measurement: 0-100,000 rps
- > 100 dB total dynamic range, > 65 dB dynamic range at full speed
- < 0.0015 dB polarization dependency
- < 0.0050 dB total connection variation
- Large color display makes data visualization and analysis simple
- Communicate over GPIB or Ethernet
- Exchange data using a USB flash drive
- 1 or 2 channels
- System can be upgraded with additional capabilities (such as polarization control, attenuation, shutter)
- 4-year warranty

Fast, Accurate, Affordable

Fast Data Transfer to Excel

The removable USB flash makes transferring data to Excel or other analysis software very simple. Built-in Ethernet and GPIB communications make getting data remotely very simple: Connect to your company's network and retrieve your data from your desktop or from a remote location over your VPN.

Convert to Optical Workbench

The 4100 can be converted into a Model 4500 Optical Workbench—complete with polarization controller options, attenuators, switches and sources. For more information, see the Model 4500 Optical Workbench section of this brochure.

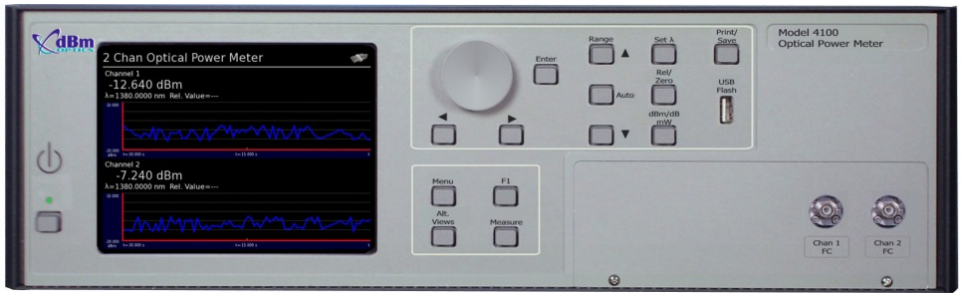
Overview
Optical Power Meter (Model 4100)

Alternative displays make data analysis simple:
• Large single-channel with trend chart
• 2-channel with trend chart
• Tabular data
• Very large single- or two-channel numeric display

Data entry and instrument setup are easy with the built-in knob or touch-screen display

High resolution 4” x 6” display brings data to life

USB flash drive allows simple data transfer



Built-in Ethernet means accessibility over a network, from a desktop, from home or other remote location via VPN

1 or 2 channels available

Measurements at any rate from 0.01 to 100,000 rps

Proprietary measurement technology yields 0.005 dB repeatability

High-speed GPIB makes the 4100 simple to integrate into any automated test rack

Optical Measurement from +10 dBm to -95 dBm
(Contact dBm directly if higher power is required—up to +23 dBm is available)

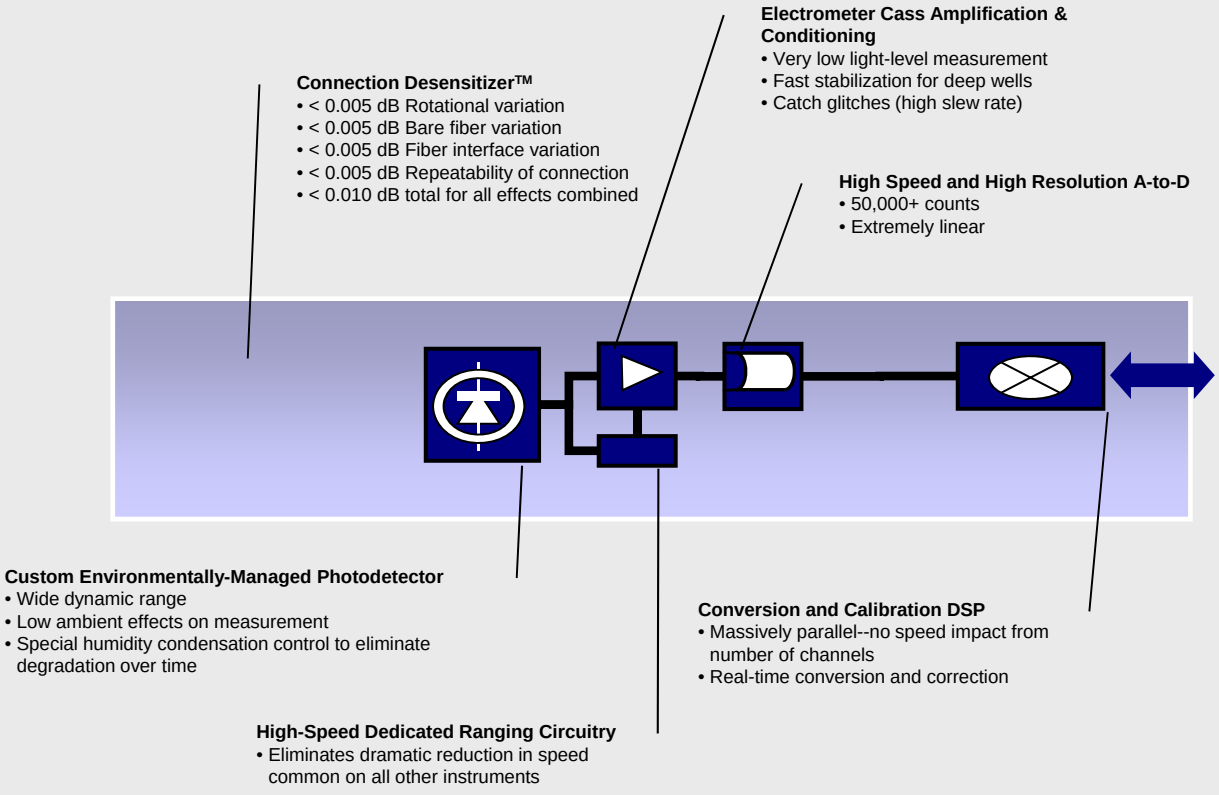
The Technology Behind the Performance
Optical Power Meter (Model 4100)

Polarization Dependency

The same breakthrough integrating sphere technology that provides high repeatability also serves to drastically reduce the polarization dependency of our Model 4100 Optical Power Meter. On average, each photon bounces 220 times inside our patented miniature integrating "sphere." This ensures that the polarization of the light reaching the detector is very well randomized, enabling a clean, consistent measurement. This yields a polarization dependency of measurement of < 0.0015 dB (1.5 mdB) typical and < 0.0035 dB (3.5 mdB) guaranteed.

Low-Level Detection

One of the core limits to making low level measurements is the dark current of the internal photodetector. Our precision power meter modules (Option 202) use a special reduced dark current detector. Because dark current is sensitive to temperature, we hired the world's authority on temperature control to design our temperature control circuitry. The photodiode is run at -20 ºC which substantially lowers dark current. We achieved stability of approximately
±0.002 ºC, making the dark current stable over time. The cooling is driven with high currents, allowing the device to stabilize quickly and to adapt to environmental changes without transient errors. To further enhance stability, our precision power meter module has a dual-stage controller.



The Technology Behind the Performance
Optical Power Meter (Model 4100)

Low-Level Amplification Without Compromising Speed

Most optical power meters use traditional current measurement techniques which involve putting an equivalent resistance across the diode and measuring the voltage drop. This technique is great for many current measurement applications, but breaks down at extremely low currents, which makes this technique very slow and susceptible to drift in photodiode current measurements. The high resistance needed for low currents, when combined with the photodiode capacitance, creates slow measurement response. Our measurement technology uses an electrometer approach. This allows us to measure much lower power (~200 fA or -95 dBm), at higher speed with less drift. The electrometer technique compensates for some of the capacitance of the photodiode, and provides for lower equivalent input resistance yielding lower noise and faster response.

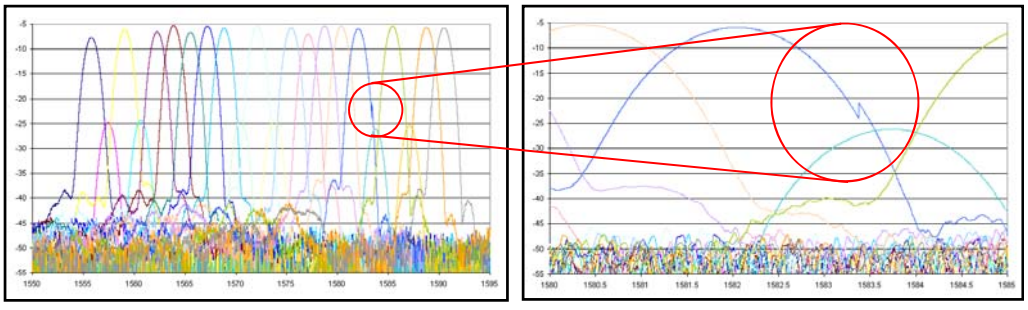
High Dynamic Range at Speed

Our Model 4100 optical power meter is the only power meter available that can measure at 100,000 readings per second. Most power meters drop to 50 readings per second to change ranges. The Model 4100 can auto-range across three full ranges, spanning over 67 dB, at full speed. The alternative—using a logarithmic amplifier—substantially compromises low-level measurement accuracy and linearity. (Note: For applications requiring over 65 dB of dynamic range, ask our Applications Team about built-in stitched measurements which expand the dynamic range at speeds to > 85 dB.)

Application

Deep-well devices are especially challenging to test. The desire is to test at narrowly spaced wavelengths using a continuously sweeping tunable laser. Measurements include the detailed nature of the passband and the structure of the stop band (which is important for crosstalk specifications and for development understanding of the device characteristics).

There were three alternatives in legacy systems: 1) Use a logarithmic amplifier, which compresses wide ranging signals into a small dynamic range, but the non-linearity (which varies with time and temperature) and the low-end noise have motivated most suppliers to avoid this approach. 2) Use slow sweeping and slow measurement with linear ranges; auto ranging the measurement for each point. This is impractical for a continuously sweeping laser but can be used with slower stepping systems. 3) Run multiple sweeps, one on each of two or three different ranges, then "stitch" them together after the fact. This requires the time to run the additional sweeps (and for the laser to return to home wavelength), and it also is susceptible to non-linearity between ranges, a specification that is typically not available. The graph below illustrates a typical problem in a legacy system.



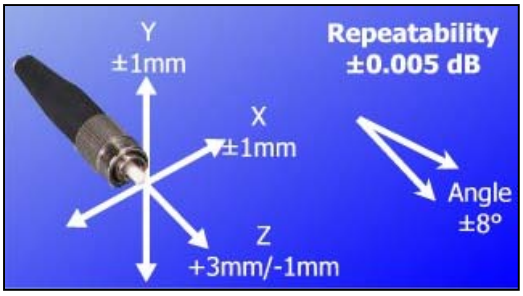
dBm Optics uses a patented technique to rapidly determine the correct measurement range, change to that gain, forcibly inject or deplete charge from the amplifiers (to force rapid settling), then make the measurement. All this (including the measurement) takes less than 10 µs. Our intra-range linearity is assured using a special calibration technique that occurs in the background.

The Technology Behind the Performance
Optical Power Meter (Model 4100)

Repeatably Capturing the Light

Unless all of the light from a source can consistently be captured, a repeatable measurement will not be made. The action of simply connecting and disconnecting fiber connections to a typical power meter can create large power deltas. The proprietary Connection Desensitizer™ reduces this variation by a factor of 2 to 20 (with reductions of 4 to 8 typical). This technology is based on a patented miniature integrating sphere technology.

The low connection sensitivity results in excellent performance with a bare fiber adapter (BFA). Many production teams perform temporary connectorization in production to accommodate in-process measurements. Our optical power meters give users the option of using a BFA instead of taking the extra time to connectorize.



Integrating sphere-like input eliminates most input variation

Model OMM-502

Model OMM-501

Measurement repeatability with bare fiber adapters is < 0.01 dB

Technical Note

With any of the following changes, a less than ±0.005 dB variation in the measurement can be expected. This compares with typical values for other meters of ±0.05 to ±0.2 dB:

±1 mm X variation;
±1 mm Y variation;
+3 mm/-1 mm Z variation (typical with a bare fiber adapter);
±8° angular variation

When using a bare fiber adapter to eliminate the need to connectorize in production, there is often a large variation when the bare fiber adapter is rotated in the chuck. The Connection Desensitizer™, combined with the low-stress, non-contact proprietary bare fiber adapter, reduces the rotational variation substantially.

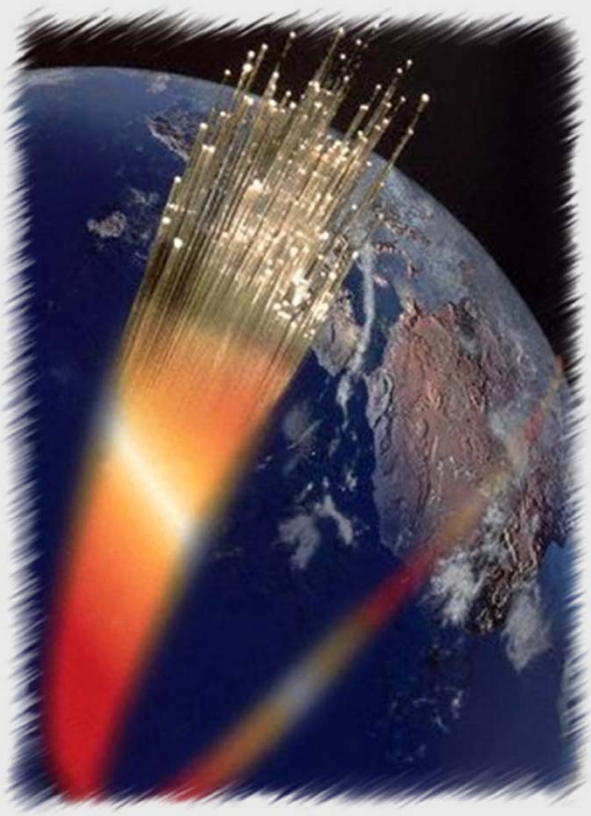
The Technology Behind the Performance Optical Power Meter (Model 4100)

Long-Term Stability

Any optical power meter that can measure low power levels is likely using some form of a cooled detector. One problem with cooled detectors is that the window of a cooled detector is a miniature condensing surface. Atmospheric moisture condensates on the window. Although typical telecom bands are not affected much by the absorption lines of H_2O, the contamination that comes with it is spectral in telecom bands. This contamination is one of the reasons optical power meters need to be recalibrated regularly. Our precision power meter modules virtually eliminate this problem by actively heating the photodiode enclosure, including the window. By holding the window 5 ^{o}C above ambient, any condensate, and the contamination that comes along with it, is discouraged. The result is a stable measurement over time. Many of our customers use two-year calibration cycles (rather than one-year calibration cycles) resulting in decreased downtime and increased dollar cost savings.

High-Speed Processing

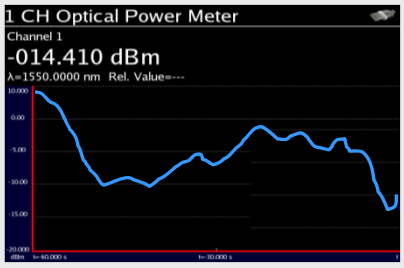
Measurement speed without the speed to retrieve the data is limiting. Our precision power meter modules have 40 Mflop DSP. This allows the channel card to process in real time—including calibration, corrections, linearizations, referencing, and real-time user-defined math. By the time the measurement is complete, most of the processing is also complete. The high-speed main processor then formats the data for the display, for external communication over Ethernet, GPIB, or onto a USB flash.

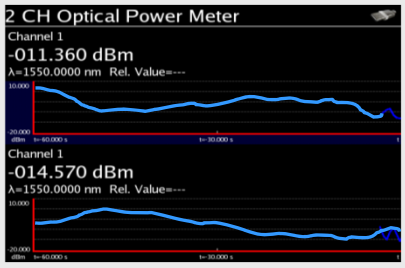


A Front Panel that Makes Your Work Easier
Optical Power Meter (Model 4100)

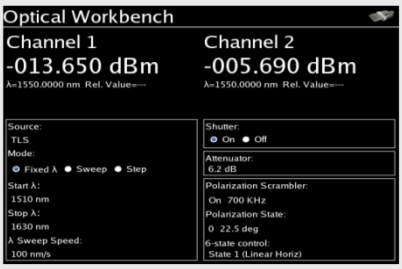
Multiple Alternate Displays

View the data as a typical power meter numeric display, a graphical display, multi-channel graphical display, or a tabular display. The 4100 Optical Power Meter offers a number of unique capabilities that will make a difference in the lab or on the production floor—at an affordable cost.





Single- and Dual-Channel Displays Make Data Visualization Simple



Comprehensive Control from a Single Display

Save Trace

Save the results of a measurement or set of measurements across wavelength and display or use that data automatically in subsequent measurements by using the Save Trace capability.

Max Hold and Min-Hold Traces

Turn these traces on and get a real-time graphic update of the envelope of your measurement at each wavelength. The maximum and minimum excursions of your measurement are displayed.

Capture Max and Min Excursions

Passband Analysis Trace

Average the data in the passband of a wavelength-dependent device and plot that single value along with values in other passbands for an easy visual indication of a device's performance.

Digital Filtering

Multiple digital filter types (including Hamming, Hanning, rectangle) can be used on each channel independently or together.

Model 4100: Optical Power Meter
Options and Ordering Information

Option	Description
4100	1-2 channel optical power meter mainframe
201	Power meter module, 800-1700 nm
202	Precision power meter module, 800-1700 nm
210	Remote power meter module, 800-1700 nm
222	Precision power meter module, 800-1700 nm, analog output
280	Photodiode measurement module
288	Photodiode measurement module, 8 channels
501	Bare fiber adapter, low stress, easy alignment
502	Bare fiber to FC adapter
705	Rack ears
Upgrade to Model 4500 Optical Workbench	• Polarization 4- and 6-state controller • 0-20 dB attenuator • Optical shutter • Internal TLS or fixed wavelength sources • Wavelength reference • Real-time power referencing

Model 4100: Optical Power Meter
Mainframe Specifications

Channels per mainframe	1 or 2 channels	
Input connections	Select from among the following at time of ordering:	
	1.5 UNIV	Universal 1.5 mm ferrule interface
	2.5 UNIV	Universal 2.5 mm ferrule interface
	BF	Bare fiber interface
	FC	FC connector interface
	LC	LC connector interface
	MU	MU connector interface
	SC	SC connector interface
	ST	ST connector interface
	SMA	SMA connector interface
Speed per channel	Variable measurement speed from 100K rps to 0.1 rps	
System transmit speed	Transmitting to host with Ethernet is 3 Mbytes/second (dedicated link) Transmitting to host with GPIB is 1.7 Mbytes/second into a PC	
Multiple channel speed	100K rps per channel regardless of number of channels	
Trigger latency[1]	< 40 ns latency; < 40 ns jitter	
Display	4" x 6" graphical display; VGA (800 x 600); TFT LCD color	
Data storage	Memory for > 100K readings per channel on all channels real-time storage	
Triggering	Software synchronous trigger or two selectable external trigger inputs	
Interfaces	IEEE-488, 100-BaseT Ethernet standard	
Command set	IEEE-488.2 compliant (SCPI-like)	
Power	90-265 VAC; 175 VA max; 47-63 Hz. No switch or fuse change required.	
Ambient temperature	10 ºC to 35 ºC (50 ºF to 95 ºF). Contact factory for 0 ºC to 40 ºC (32 ºF to 104 ºF)	
Storage temperature	-40 ºC to +70 ºC (-40 ºF to 158 ºF).	
Humidity	< 95% non-condensing 0 ºC to 35 ºC	
Warm-up time	60 minutes to full specifications; useable immediately after turn on	
Recalibration period	1 year; certificate of calibration included	
Warranty period	Standard warranty is 4 years (Options 402, 410, 953I, and all switch modules carry a one-year warranty)	
Size	16.8" w x 16.4" d x 5.25" h (42.6 cm x 41 cm x 10.5 cm)	
Weight	15 lbs (6.8 kg)	
Mounting	Benchtop or rack mount	

[1] Trigger latency defined as total time from trigger edge to initiation of measurement

Power Meter Modules
Option 201, Option 202, Option 221, Option 222, Option 210, Option 301
Specifications *(Page 1 of 2)*

Sensitivity and Noise

Range	Fixed Range	Measurement		Measurement Resolution [1]		Precision Power Meter Module (Option 202, Option 222 [11]) Noise RMS [2]						Power Meter Module (Option 201, Option 221 [11]) Noise RMS [2]					
						5 secs [7]		100 ms [8]		10 µs (full speed) [9]		5 secs [7]		100 ms [8]		10 µs (full speed) [9]	
		W	dBm	W	dBm	±W	±dBm	±W	±dBm	±W	±dBm	±W	±dBm	±W	dBm	±W	±dBm
Fast 10 mW	10 mW	10 mW	10	200 nW	-37	50 nW	-43	100 nW	-41	400 nW	-34	100 nW	-41	200 nW	-37	800 nW	-31
	1 mW	1 mW	0	20 nW	-47	8 nW	-51	20 nW	-50	40 nW	-44	20 nW	-47	40 nW	-44	80 nW	-41
	100 µW	100 µW	-10	2 nW	-57	2 nW	-57	2 nW	-57	8 nW	-51	4 nW	-54	4 nW	-54	16 nW	-48
Fast 100 µW	100 µW	100 µW	-10	2 nW	-57	1 nW	-60	1 nW	-60	4 nW	-54	4 nW	-54	4 nW	-54	16 nW	-48
	10 µW	10 µW	-20	200 pW	-67	30 pW	-75	40 pW	-74	800 pW	-61	400 pW	-64	400 pW	-64	4 nW	-54
	1 µW	1 µW	-30	20 pW	-77	20 pW	-77	20 pW	-77	300 pW	-65	200 pW	-67	200 pW	-67	2 nW	-57
Fast 1 µW	1 µW	1 µW	-30	20 pW	-77	10 pW	-80	6 pW	-82	100 pW	-70	50 pW	-73	50 pW	-73	500 pW	-63
	100 nW	100 nW	-40	2 pW	-87	2 pW	-87	3 pW	-85	40 pW	-74	20 pW	-77	50 pW	-73	500 pW	-63
	10 nW	10 nW	-50	0.2 pW	-97	1 pW	-90	2 pW	-87	40 pW	-74	20 pW	-77	50 pW	-73	500 pW	-63
Fast 10 nW	10 nW	10 nW	-50	0.2 pW	-97	1 pW	-90	2 pW	-87	4 pW	-84	20 pW	-77	50 pW	-73	500 pW	-63
	1 nW	1 nW	-60	0.02 pW	-107	1 pW	-90	2 pW	-87	3 pW	-85	20 pW	-77	50 pW	-73	500 pW	-63
	100 pW	100 pW	-70	2 fW	-117	1 pW	-90	2 pW	-87	2 pW	-87	20 pW	-77	50 pW	-73	500 pW	-63
Fast 100 pW	100 pW	100 pW	-70	2 fW	-117	300 fW	-95	300 fW	-95	300 fW	-95	20 pW	-77	50 pW	- 73	500 pW	-63

Accuracy [1, 6]

Absolute uncertainty at reference conditions [4]:	2.5%
Absolute operational uncertainty [5]:	5%
Relative uncertainty:	<1% + noise (per table above)

Measurement Speed

Auto-Range Mode	Full Measurement Range	Reading Time with Averaging of:		
		1 Reading	2,000 Readings	500,000 Readings
Fast 10 mW - 2 nW	10 dBm to -57 dBm	10 µs	20 ms	5.00 s
Fast 100 µW - 20 pW	-10 dBm to -77 dBm	10 µs	20 ms	5.00 s
Fast 1 µW - 200 fW	-30 dBm to -97 dBm	10 µs	20 ms	5.00 s
Fast 10 nW - 2 fW	-50 dBm to -107 dBm	10 µs	20 ms	5.00 s
Fast 1 nW - 0.5 fW	-60 dBm to -117 dBm	10 µs	20 ms	5.00 s
Med 10 mW - 20 pW	10 dBm to -77 dBm	1 ms	21 ms	5.00 s
Med 10 mW - 200 fW	10 dBm to -97 dBm	10 ms	30 ms	5.01 s
Slow 10 mW - 2 fW	10 dBm to -107 dBm	1.5 s	1.52 s	6.52 s
Slow 10 mW - 0.5 fW	10 dBm to -117 dBm	5 s	5.02 s	10.02 s

Connections*

Model	Description
1.5 UNIV	Universal 1.5 mm ferrule interface
2.5 UNIV	Universal 2.5 mm ferrule interface
BF	Bare fiber interface
FC	FC connector interface
LC	LC connector interface
MU	MU connector interface
SC	SC connector interface
ST	ST connector interface
SMA	SMA connector interface

* Select when ordering. Additional connectors may be available. Input connection can be changed in the field.

(Continued)

Power Meter Modules
Option 201, Option 202, Option 221, Option 222, Option 210, Option 301
Specifications *(Page 2 of 2)*

Polarization Uncertainty of Measurement

< ±0.0015 dB typical; 0.0035 dB guaranteed for precision power meter module (Option 202, Option 301)
< ±0.0050 dB for power meter module (Option 201, Option 210, Option 221, Option 222)

Return Loss

> 55 dB

Remote Power Meter Module, 800-1700 nm (Option 210)

Input configurations: 3 mm free space; 1 mm free space; FC, SC, ST, UC Universal connector or BF (bare fiber)
Input orientation: End (axial) entry or side entry
Cable length: 1 meter standard; call factory for additional lengths

Precision Power Meter Module, 800-1700 nm (Option 221)

Analog output: 0-2V (4V max)
Output impedience: 600 ohms typical
Maximum input voltage: ±10V
Bandwidth: DC up to 7.5 kHz depending on range

Precision Power Meter Module, Analog Output*, 800-1700 nm (Option 222)

Analog output: 0-2V (4V max)
Output impedience: 600 ohms typical
Maximum input voltage: ±10V
Bandwidth: DC up to 7.5 kHz depending on range

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[1] From 1500 to 1620 nm. For 1400-1635, add 3 dBm; for 800 nm-1650 nm, add 10 dB noise and resolution specs (or multiply to W by 10). Assume automatic or manual dark calibration performed.

[2] Peak noise is typically 3 to 3.5 times the RMS figure. Noise figures are typical performance.

[3] Per "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results;" NIST Technical Note #1297

[4] Wavelength = 1310, 1520-1625 nm, $T_{(ambient)}$ = 23C ± 2C, 1.1 mm diameter beam, 30 µW

[5] Wavelength = 800-1650 nm, $T_{(ambient)}$ = 10 to 35C, Fiber with N.A. <0.3, -70 dBm to +3 dBm (total wavelength range 800 nm-1700 nm)

[6] Above 5 dBm, accuracy is typical

[7] Maximum variation ± for 4 measurements, filter on

[8] Maximum variation ± for 50 measurements, filter on

[9] Maximum variation ± for 10,000 measurements, filter on

[10] Includes the time to change range and take readings. All readings equally spaced.

[11] Measurement noise may be higher with analog output due to conducted noise from devices and cables connected to the analog output connection.

Photodiode Measurement Modules (Internal)
Option 280, Option 288
Specifications

(For use in measuring responsivity or current from external photodiode)

General Specifications

Measurement rate	100,000 readings per second (10 μs measurement time)
Measurement modes	Current measurement; voltage measurement
Photodiode bias supply voltage range	0 to 10V
Photodiode bias supply voltage resolution	5 mW resolution
Photodiode bias supply voltage noise	< 50 μV DC to 20 KHz
Display, absolute measurement	Displays 1 mV per mA measured from photodiode with no user calibration applied. Display in linear (mW) or log (dBm).
Display, relative measurement (Pref ON)	Displays the cal factor of mA per mW applied. Display in log (dB).
Math	Both dB and linear offset functions available standard
PD calibration factors	Selectable from front panel; GPIB, Ethernet, or RS-232
Triggering	Selectable through CSA mainframe. < 40 ns maximum trigger misalignment.
Maximum input	±40 V peak (no damage)
Channels	1 channel for Option 280; 8 channels for Option 288
Input connection	12-pin circular connector

Voltage Mode Specifications

Range	Resolution	Noise @ 10 μs[1]
10 V	200 μV	< 1 mV
1 V	200 μV	< 200 μV

[1] Peak-to-peak noise

PD Current Mode Specifications

Range	Resolution	Noise @ 100 ms [1]	Noise @ 10 μs[1]	Equiv Optical Power (direct)		Equiv Optical Power (10% tap)	
1A	20 μA	< 20 μA	< 80 μA	30 dBm	1W	40 dBm	10 W
100 mA	2 μA	< 2 μA	< 8 μA	20 dBm	100 mW	30 dBm	1 W
10 mA	200 nA	< 200 nA	< 800 nA	10 dBm	10 mW	20 dBm	100 mW
1 mA	20 nA	< 20 nA	< 80 nA	0 dBm	1 mW	10 dBm	10 mW
100 μA	2 nA	< 2 nA	< 8 nA	-10 dBm	100 μW	0 dBm	1 mW
10 μA	200 pA	<200 pA	< 800 pA	-20 dBm	10 μW	-10 dBm	100 μW
1 μA	20 pA	< 20 pA	< 80 pA	-30 dBm	1 μW	-20 dBm	10 μW
100 nA	2 pA	< 2 pA	< 40 pA	-40 dBm	100 nW	-30 dBm	1 μW
10 nA	200 fA	< 200 fA	< 4 pA	-50 dBm	10 nW	-40 dBm	100 nW

[1] Peak-to-peak noise

Response Time Specifications

Range	Response with 1 pF PD Capacitance
1A	~ 20 KHz
100 mA	~ 20 KHz
10 mA	~ 20 KHz
1 mA	~ 20 KHz
100 μA	~ 7.5 KHz
10 μA	~ 7.5 KHz
1 μA	~ 0.1 KHz
100 nA	~ 0.1 KHz
10 nA	~ 0.01 KHz

Miscellaneous Option Specifications and Descriptions

Note: Each model/unit has an Options and Ordering Information sheet. Refer to this sheet to determine option availability.

Option	Description	Specifications
310	Optical shutter/automatic dark calibration	"Off" blocking: > 100 dB Wavelength range: 700-1700 nm
501	Bare fiber adapter, low stress, easy alignment	N/A
502	Bare fiber to FC adapter	N/A
692	Laser diode source module. Select one laser diode. (Up to 5 total laser diode sources; order additional sources using 692X-wwww.)	N/A
692X	Additional laser diodes for 692-wwww. Includes switch. Select up to 4.	N/A
705	Rack ears (4000 Series)	N/A
740	Internal GPIB controller (required to automatically control external TLS or external polarization controller)	Allows control of external TLS or external polarization controller
940	Internal optical return loss (ORL) module	ORL measurement range dependent on test system configuration: > 55 dB under most conditions; > 70 dB with optimal configurations. (See Application Note 2004-014A.)
956	Automated matrix method PDL/IL measurement	Works in conjunction with customer's Agilent/HP 8169A polarization controller. Requires Option 740.
972	Built-in source split with switches for 2 DUTs	Additional PDL: +0.015 PDL
973	Built-in source split with switches for 3 DUTs	Additional PDL: +0.040 PDL
974	Built-in source switch for 2 external lasers	N/A
974-PM	Built-in PM source switch for 2 external lasers	N/A
975	Built-in source switch for 3 external lasers	N/A
976	Built-in source switch for 4 external lasers	N/A
982	Built-in source split for 2 DUTs	Additional PDL: +0.015 PDL
983	Built-in source split for 3 DUTs	Additional PDL: +0.040 PDL

* Contact the factory for extended specification, custom-designed, and OEM products or specials.
* Technical data subject to change.