

Model 4500

Power Meter Optical Workbench



Optical Power Meters

Tunable Laser Sources

Polarization Control

Optical Switches

Optical Workbench

O-to-E and E-to-O Converters

General Purpose Optical Instruments

Flexible, Affordable Lab Tool

The 4500 Power Meter Optical Workbench offers a combination of measurement speed, accuracy and repeatability combined with a wide range of optical control options—all in one easy-to-use affordable package. Running optical experiments has never been simpler. All capabilities can be run from a single screen.

Wide Range of Optical Capabilities

Options, outlined in this data sheet, include polarization control, switching, attenuation, extinction ratio enhancement, photodiode measurement, and DC Voltage measurement.

High Speed

The 4500 combines 100,000 rps optical power meters 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 4500 with the 202 Optical Power Meters measures from +10 dBm to -95 dBm, for a full dynamic range of 105 dB.

Wide Dynamic Range at Full Speed

Even more important than full dynamic range is the range you can achieve while making a measurement without stopping to change range. Most meters take ~20 ms to change range. The 4500 Power Meter has a large dynamic range of >65 dB at full speed, eliminating the need to change range.

*Flexible, Affordable
Lab & Education Instrument*



Summary

- Full-function, high performance optical measurement laboratory in a box
- Combine tunable laser sources, fixed DFB/FP sources, shutters, attenuators, polarization control and optical, photodiode and voltage measurement
- High-speed measurement: 0-100,000 rps
- >100 dB total dynamic range; >65 dB dynamic range at full speed
- Large color display makes data visualization and analysis simple
- Communicate over GPIB or Ethernet
- Exchange data using a USB flash drive
- Full 4-year warranty

Low Polarization Dependency

The 202 Optical Power Meters inside the 4500 have lower than 0.0015 dB polarization dependency of measurement.

Clear, Bright Display

The 4" x 6" VGA color display affords excellent ability to understand and analyze measurements on the power meter without the need to export to a PC. Trends, drifts, noise, perturbations are all clearly indicated on the graphic display.

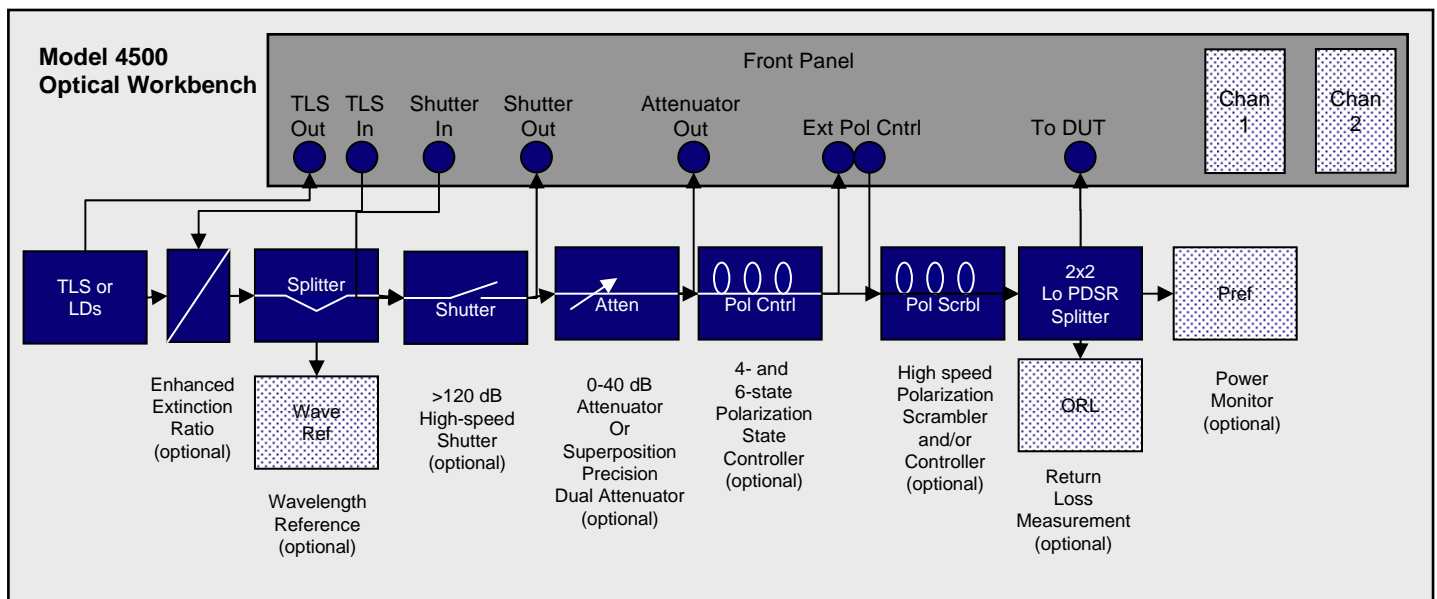
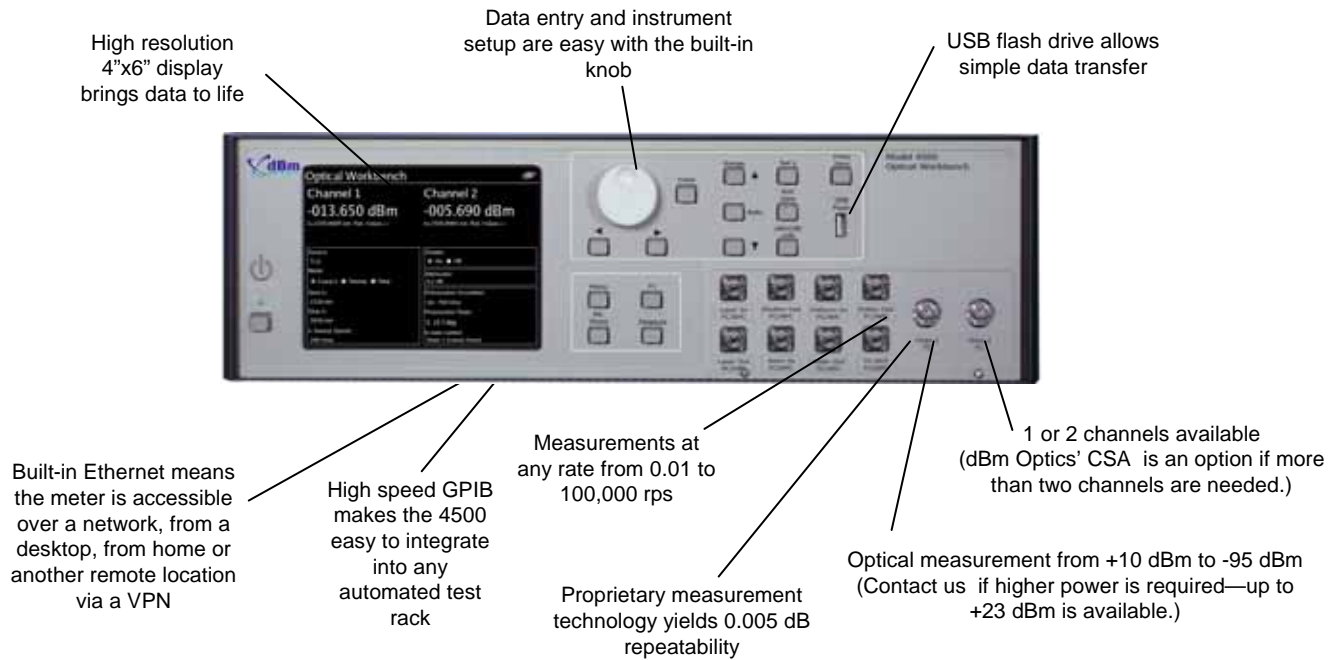
Fast Data Transfer to Excel

The removable USB flash memory drive makes getting data to Excel very simple. Built-in Ethernet and GPIB communications makes remote retrieval of data easy to do ... connect to your company's network and get data to your desktop, home or other location over a VPN.

Low Connection Variation

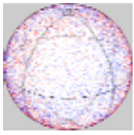
Repeatability is a major obstacle to consistent results in the lab and to eliminating discrepant materials in production. The 4500 provides repeatability of ± 0.005 dB for typical changes in the input configuration, including 1 mm changes in the x and y dimensions, and -1 mm + 3 mm in the z dimension.

Model 4500 Power Meter Optical Workbench Overview



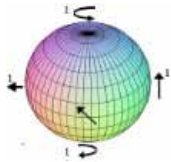
Model 4500 Power Meter Optical Workbench

Building a Customized Optical Workbench



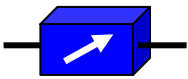
Polarization Scrambling

Add the 957I Polarization Scrambler Option to the 4500 and turn on and off high-speed polarization scrambling—turning your TLS output into a randomized polarization signal. This eliminates the effects of birefringence in your optical path.



Polarization State Control

The 956I 4- or 6-state polarization controller (or the upcoming 958 arbitrary polarization state controller) enables full control over the output state of the signal. The 956I provides 4 or 6 orthogonal states for use in polarization analysis—all in a low cost, fully integrated package. With the 953 Option, an external 8169 polarization controller can be used under direct control of the TLS.



Attenuation

With either the 921 or the 922 attenuator, 0 to 20 dB or 0 to 40 dB of attenuation can be added (respectively) and controlled from either the front panel or remotely. Alternatively, add the upcoming 923 Precision Superposition Dual Attenuator and achieve attenuation linearity in excess of 0.05%. By implementing dual path attenuators with shutters, exact divide-by-two output powers can be obtained.



Wavelength Referencing

Add the 401 or 410 Option to the 4500 and get real-time calibration of wavelength accuracy. By connecting through GPIB or Ethernet (or using the USB flash memory card) it is possible to obtain an accurate indication of the wavelength of the laser to $<1\text{pm}$ (–410) or $<1.8\text{ pm}$ (–401 with gas cell) or $<5\text{ pm}$ (–401).



Output Shutter

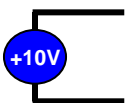
Add a model 310 shutter for fast stabilization power control of any tunable laser. The base laser can be turned on and off, but all TLS take some time to stabilize after current is applied to the laser. Using the shutter eliminates the stabilization time after turn-on.

Optical Measurement

All of the optical measurement cards are compatible with the 4500, including the 202 (800-1700 nm card); the 201 (800-1700 nm card); the 210 remote measurement module; and the upcoming 204 (400-1000 nm card). See the 4100 specifications sheet for more information.

Photodiode Measurement

The dBm Optics Photodiode Measurement options are all compatible with the 4500. These include the 280 single channel module, the 288 eight-channel module, the 290 APD module, and the upcoming 260 SMU module. For detailed specifications, see the data sheet for the 4600 Photodiode Test System.



Voltage Measurement

If you need to quantify a DC voltage along with your optical or photodiode measurements, the model 270 DC Voltage Module will provide this measurement.

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Specifications

Note: For Optical Measurement Modules data, see the 4100 Optical Power Meter specifications sheet.

For Photodiode Measurement Modules data, see the 4500 Photodiode Characterizer specifications sheet.

For Polarization Controller Modules data, see the 4300 Polarization Controller specifications sheet.

For Tunable Laser Module data, see the 4200 Tunable Laser Source specifications sheet.

Model	Description	Specifications	
270	DCV Measurement Module, 0-10 V	Input range: Max input: Resolution: Accuracy: Bandwidth: Sample rate: Input impedance:	±10 V true differential ±42 V (no damage) 500 µV 0.025% ±1 mV >15 KHz (3dB) 10 µs <50 pF, > 10 MΩ (typ 1 GΩ)
222-cc	Precision Optical Measurement Module with Analog Output	Analog output: Output impedance: Maximum input voltage: Bandwidth:	0-2 V (4 V max) 600 ohms typ +/-10 V DC up to 7.5 kHz depending on range
301	Power Reference Module (includes 931)	Accuracy:	Reference accuracy identical to -202 specifications
310	Automatic Dark Calibration Module	"Off" blocking: Wavelength range:	>100 dB 700-1700
401	Wavelength Reference Module	Accuracy: Repeatability: Optical Tap (930): Optical input power: Wavelength range: Maximum step size: Sweep rates supported:	<5 pm; <1.8 pm with "learn" <2 pm Included 10 dBm to -10 dBm 1525-1630 40 pm 0.01 nm/sec to 100 nm/sec
410	Precision Wavelength Reference Meter	Accuracy:	<1 pm (call factory)
740	System Communications Controller (GPIB Controller)	Allows control of external TLS or external polarization controller via second GPIB controller port on rear of instrument	
921	Built-in Variable Attenuator, >20 dB	Attenuation range: Wavelength range: Accuracy: Excess loss:	>20 dB 1260-1360 and 1510-1630 nm Call factory <0.5 dB typical, <0.7 dB max
922	Built-in Variable Attenuator, >40 dB	Attenuation range: Wavelength range: Accuracy: Excess loss:	>40 dB 1260-1360 and 1510-1630 nm Call factory <1 dB typical, <1.4 dB max
923	Precision Superposition Dual Attenuator	Attenuation range: Wavelength range: Linearity: Accuracy: Excess loss:	>60 dB 1260-1360 and 1510-1630 nm <0.05 dB Call factory <2 dB typical, <2.4 dB max
940	Optical Return Loss Module (ORL) with -202 Module	ORL Measurement range	Dependent on test system configuration. >55 dB under most conditions >70 dB with properly configured system (See Application Note 2004-014A)

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Specifications *(continued)*

Model	Description	Specifications	
952E	All States PDL Measurement including external controller	Measurement time: Accuracy:	1 second. Additional accuracy achieved with measurement times from 1-10 seconds. Depending on measurement time, typical accuracy from ± 0.015 dB PDL to ± 0.004 dB PDL. (See Application Note 2004-001 for more detail.)
952I	All States PDL Measurement including internal controller	PDL Measurement time: Accuracy: Insertion Loss: Center Wavelength: Wavelength Range: Output degree of polarization: Insertion loss variation:	1 second. Additional accuracy achieved with measurement times from 1-10 seconds. Depending on measurement time, typical accuracy from ± 0.015 dB PDL to ± 0.004 dB PDL. (See Application Note 2004-001 for more detail.) <0.05 dB 1550 nm standard. 980 nm, 1310 nm available >100 nm <5% <0.01 dB
953E	Fully Automatic Matrix Method PDL/IL Measurement with external controller	Measurement time: Accuracy:	10 μ seconds to 1 second. Depending on measurement time, typical accuracy from ± 0.015 dB PDL to ± 0.004 dB PDL. (See application note for more detail).
953I	Fully Automatic Matrix Method PDL/IL Measurement with Internal Controller	Measurement time: Accuracy: States generated: Insertion loss: Insertion loss variation: Wavelength Dependent Loss: SOP repeatability: SOP switching speed: Wavelength range:	10 μ seconds to 1 second. Depending on measurement time, typical accuracy from ± 0.015 dB PDL to ± 0.004 dB PDL. (See application note for more detail). -45, 0, 45, 90, RHC, LHC 1 dB typical <0.1 dB; <0.015 dB with real time referencing; <0.004 dB with RT reference and Polarization Reference <0.2 dB; <0.015 dB with real time referencing; <0.004 dB with RT reference and Polarization Reference 0.1 degrees on Poincaré sphere <250 μ sec 1480-1630 250 μ s 1480-1620 minimum
957E	High-Speed External Polarization Scrambler	Speed:	Fully scrambled in 10 μ s
957I	High-Speed Internal Polarization Scrambler	Insertion Loss: Center Wavelength: Wavelength Range: Output degree of polarization: Insertion loss variation: Scrambling base freq:	<0.05 dB 1550 nm standard. 980 nm, 1310 nm available >100 nm <5% <0.01 dB 700KHz
959	Extinction ratio enhancement (extended PER)		
962-cc/cc	Built-in source split with shutters for 2 DUTs		N/A
972-cc/cc	Built-in source split with switches for 2 DUTs		N/A
982-cc/cc	Built-in source split for 2 DUTs		N/A
992-cc/cc	Built-in 1x2 switch for 2 DUTs		N/A

Model 4500 Power Meter Optical Workbench

Ordering Information

Model	Description
4500	1-2 Channel Optical Power Meter Workbench (Included accessories: USB flash memory card; power cord; operating manual)
202	Precision Power Meter Module, 800nm-1700nm
201	Power Meter Module, 800nm-1700nm
201V (upcoming)	Power Meter Module, 190nm-1100nm
210	Remote Power Meter Module, 800nm-1700nm
210V (upcoming)	Remote Power Meter Module, 190nm-1100nm
222	Precision Power Meter Module, 800nm-1700nm, with Analog Output
270	DC Voltage Measurement Module
280	Photodiode measurement module
288	8-channel photodiode measurement module
290	APD measurement module
301	Real-time Power Reference Module
310	Optical Shutter/Automatic Dark Calibration
401	Wavelength Reference Module
410	Precision Wavelength Reference Module
501	Bare Fiber Adapter, low stress, easy alignment
502	Bare Fiber-to-FC Adapter
680LN	Tunable Laser Source, low noise; 1475-1625 nm; internal
680HP	Tunable Laser Source, high power; 1475-1625 nm; internal
692	Laser Diode Sources, 1-5 sources. Specify 1-5 of the most common sources: 1490 DFB, 1310 FP, 1550 DFB, or any of 1480 DFB, 980 SM, 980 MM Flexcore 5/125, 1490 FP, 1310 DFB, 1550 FP, or any wavelength from 1519 to 1630 nm DFB.
705	Rack ears and slides
706	Swivel handle
732	Add large data memory, +500MB
740	Internal GPIB controller
921	Built-in variable attenuator; 0-20 dB
750	Add printer port, external keyboard & mouse ports
922	Built-in variable attenuator; 0-40 dB
923	Precision superposition dual attenuator
940	Optical Return Loss (ORL) module
952I	Automated PDL all-states method and slow speed polarization independent insertion loss measurement
953E	Matrix Method PDL; external controller
953I	Polarization 4- and 6-state control; internal controller
957I	Polarization scrambler; internal
958	Precision arbitrary polarization controller
959	Extinction ratio enhancement (extended PER)