

# Model 4700 Photodiode Characterizer

## Complete PD Measurement system

The 4700 Photodiode Characterizer is a complete photodiode test system. It will characterize PDs or APDs (upcoming) without the need for additional power supplies. It is this simple: Connect your device and press "start."

## Sensitive Current Measurement

Like our optical power meters, the dBm Optics photodiode meters employ an electrometer-based design. This approach allows much lower currents to be measured (below 200 fA) at much higher speeds. Normal current meter approaches cannot operate this fast because the impedance and input capacitance combines with that of the photodiode to yield slow response time. This is not the case with the dBm Optics 4700.

## High Speed

In addition to the speed advantages of the electrometer-based measurement approach, the 4700 has a high-speed parallel architecture that allows higher speed measurements. The 4700 will characterize a photodiode over a 100 nm span in less than 1 second.

## Full Electrical Measurement

The photodiode measurement cards for the 4700 have built-in voltage bias, thus eliminating the need for separate supplies.

## Integrated Polarization Dependency Characterization

The 4700 will simultaneously measure responsivity and polarization dependent responsivity (PDR) by using traditional all-states, swept all-states, or 4- or 6-state matrix methods. Full PDR over wavelength takes <8 seconds.

## Integrated Return Loss

For fiber coupled devices, return loss is often an important specification. The ORL option for the 4700 provides return loss simultaneous with the responsivity measurement.

## Fiber Coupled or Free Space

The 4700 will perform fiber-coupled characterization three different ways: using a tunable laser; free space using a TLS and collimator; or using a monochromator.

## Summary

- Simultaneous responsivity, PDR, and return loss measurement across wavelength
- Measure linearity to < 0.05 dB
- Cover telecom photodiode wavelengths
- Measure directly from the photodiode, or 0-10 V from a trans-impedance amplifier
- Test embedded PD in amplifiers simultaneous with optical parametric tests
- Great absolute accuracy, measurements down to < 200 fA
- > 100 dB total dynamic range
- Confirm Polarization Dependent Responsivity to < 0.005 dB
- Linearity measurement to  $\pm 0.05$  dB
- High speed measurement: 0-100,000 rps
- Large color display makes data visualization and analysis simple
- Communicate over GPIB or Ethernet
- Exchange data using a USB flash drive
- 1-16 channels
- System can be upgraded with additional capabilities such as polarization control, attenuation, shutter
- 4-year warranty

## Complete Photodiode Measurement System

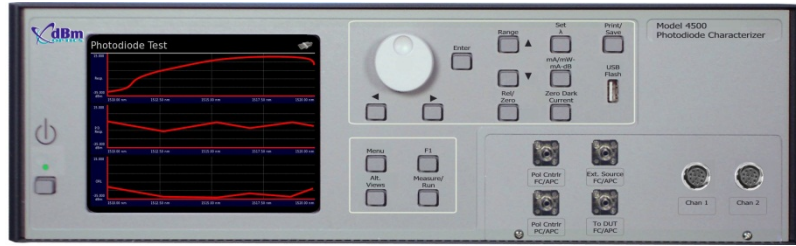


# Model 4700: Photodiode Characterizer Overview

High resolution  
4"x6" display

Data entry and instrument  
setup are easy with the  
built-in knob

USB flash drive allows  
simple data transfer



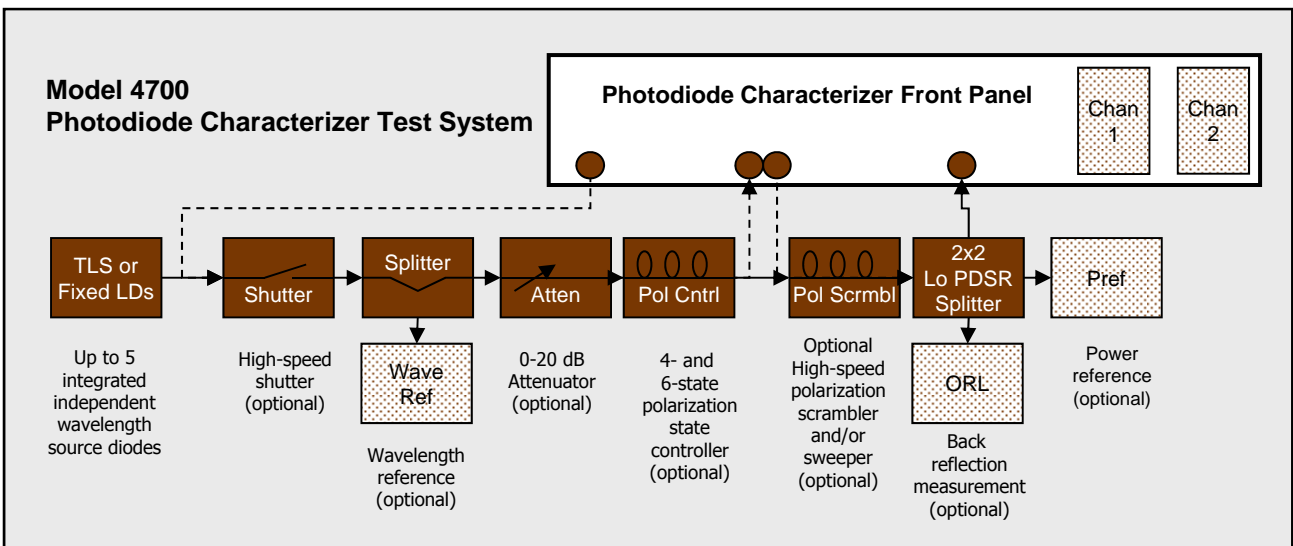
Built-in Ethernet means  
accessibility over a network, from  
a desktop, from home or another  
remote location via a VPN

Measurements at any rate from  
0.01 to 100,000 rps

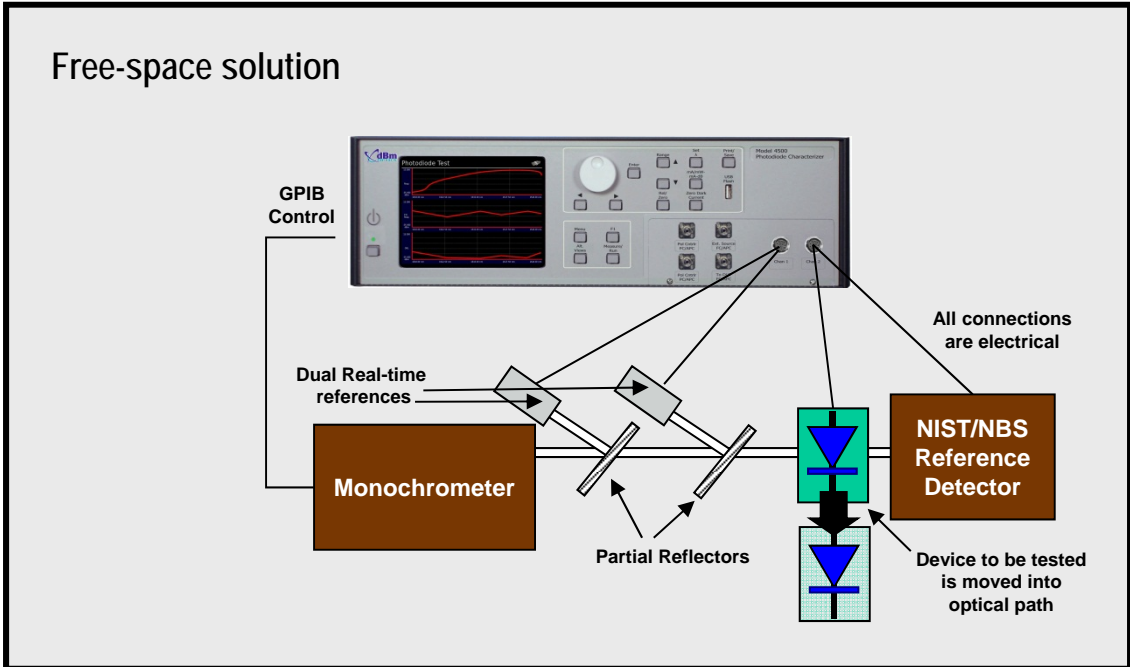
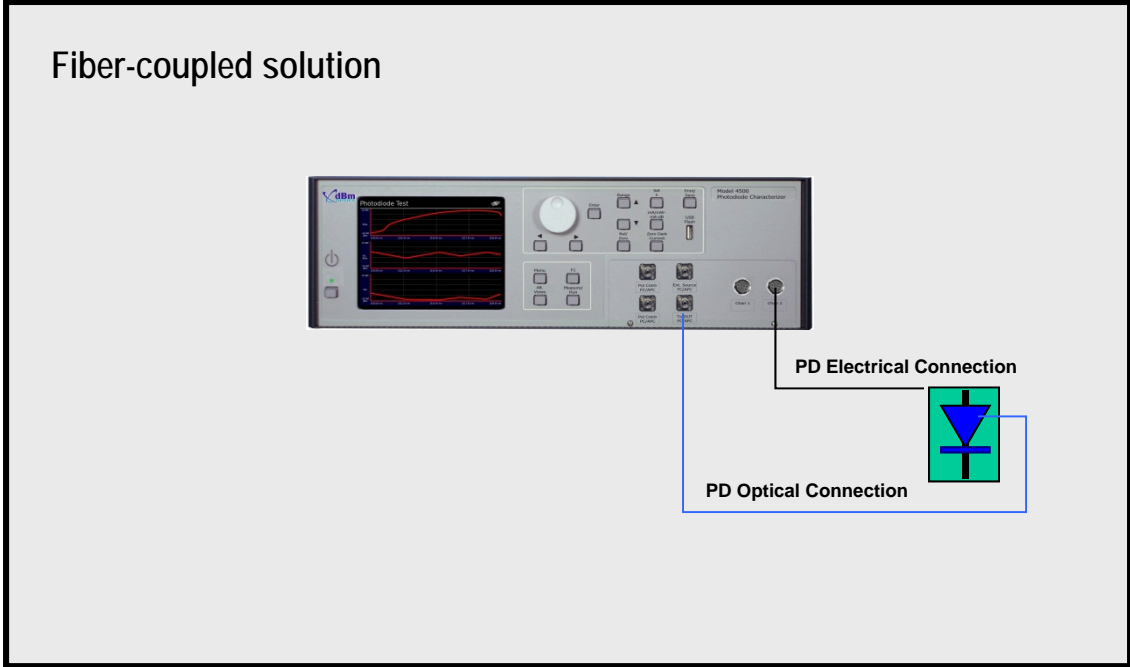
1 or 2 channels available  
(Contact dBm Optics  
if more than two channels  
are needed.)

High-speed GPIB makes the  
Model 4700 easy to integrate into  
an automated test rack

Real-time power reference,  
wavelength reference and ORL



# Model 4700: Photodiode Characterizer System Configuration



## Model 4700: Photodiode Characterizer Options and Ordering Information

4700	1-2 channel photodiode characterizer 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
301	Real-time power reference measurement module
310	Optical shutter/automatic dark calibration
402Q	Precision wavelength reference module (extended range); 5 pm accuracy; 5 pm repeatability
402T	Precision wavelength reference module; 5 pm accuracy; 5 pm repeatability
410Q	Precision wavelength reference module (extended range); 1 pm accuracy; 1 pm repeatability
410T	Precision wavelength reference module; 1 pm accuracy; 1 pm repeatability
501	Bare fiber adapter, low stress, easy alignment
502	Bare fiber to FC adapter
681HP	Internal tunable laser source, high power, 820-860 nm
684LN	Internal tunable laser source, low noise, 1260-1340 nm
684HP	Internal tunable laser source, high power, 1260-1340 nm
688LN	Internal tunable laser source, low noise, 1510-1620 nm
688HP	Internal tunable laser source, high power, 1520-1630 nm
692	Laser diode sources (1-5 sources). Specify 1-5 of the most common sources: 980 FBG; 1310 DFB; 1480 DFB; 1490 DFB; 1550 DFB; any wavelength from 1519-1630 nm DFB 980 FP; 1310 FP; 1490 FP; 1550 FP
705	Rack ears
740	Internal GPIB controller (required to automatically control external TLS or external polarization controller)
921	Internal variable attenuator, 0-20 dB, SM output
940	Internal optical return loss (ORL) module
953I-13	Internal automatic matrix method PDL/IL measurement (4- and 6-state polarization controller), 1310 nm version
953I-15	Internal automatic matrix method PDL/IL measurement (4- and 6-state polarization controller), 1550 nm version
962	Built-in source split with shutters for 2 DUTs
963	Built-in source split with shutters for 3 DUTs
972	Built-in source split with switches for 2 DUTs
973	Built-in source split with switches for 3 DUTs
982	Built-in source split for 2 DUTs
983	Built-in source split for 3 DUTs

## Model 4700: Photodiode Characterizer 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 <sup>1</sup>	< 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 °C to 35 °C (50 °F to 95 °F). Contact factory for 0 °C to 40 °C (32 °F to 104 °F).	
Storage temperature	-40 °C to +70 °C (-40 °F to 158 °F).	
Humidity	< 95% non-condensing 0 °C to 35 °C	
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	

<sup>1</sup> 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**

**Sensitivity and Noise**

Range	Fixed Range	Precision Power Meter Module (Option 202, Option 222 <sup>11</sup> ) Noise RMS <sup>2</sup>									Power Meter Module (Option 201, Option 221 <sup>11</sup> ) Noise RMS <sup>2</sup>						
		Measurement		Measurement Resolution <sup>1</sup>		5 secs <sup>7</sup>		100 ms <sup>8</sup>		10 $\mu$ s (full speed) <sup>9</sup>		5 secs <sup>7</sup>		100 ms <sup>8</sup>		10 $\mu$ s (full speed) <sup>9</sup>	
		W	dBm	W	dBm	$\pm$ W	$\pm$ dBm	$\pm$ W	$\pm$ dBm	$\pm$ W	$\pm$ dBm	$\pm$ W	$\pm$ dBm	$\pm$ W	dBm	$\pm$ W	$\pm$ 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 $\mu$ W	100 $\mu$ W	-10	2 nW	-57	2 nW	-57	2 nW	-57	8 nW	-51	4 nW	-54	4 nW	-54	16 nW	-48
Fast 100 $\mu$ W	100 $\mu$ W	100 $\mu$ W	-10	2 nW	-57	1 nW	-60	1 nW	-60	4 nW	-54	4 nW	-54	4 nW	-54	16 nW	-48
	10 $\mu$ W	10 $\mu$ W	-20	200 pW	-67	30 pW	-75	40 pW	-74	800 pW	-61	400 pW	-64	400 pW	-64	4 nW	-54
	1 $\mu$ W	1 $\mu$ W	-30	20 pW	-77	20 pW	-77	20 pW	-77	300 pW	-65	200 pW	-67	200 pW	-67	2 nW	-57
Fast 1 $\mu$ W	1 $\mu$ W	1 $\mu$ W	-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 <sup>1,6</sup>**

Absolute uncertainty at reference conditions <sup>4</sup> : 2.5%
Absolute operational uncertainty <sup>5</sup> : 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 $\mu$ s	20 ms	5.00 s
Fast 100 $\mu$ W - 20 pW	-10 dBm to -77 dBm	10 $\mu$ s	20 ms	5.00 s
Fast 1 $\mu$ W - 200 fW	-30 dBm to -97 dBm	10 $\mu$ s	20 ms	5.00 s
Fast 10 nW - 2 fW	-50 dBm to -107 dBm	10 $\mu$ s	20 ms	5.00 s
Fast 1 nW - 0.5 fW	-60 dBm to -117 dBm	10 $\mu$ s	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** *(Continued)*

**Polarization Uncertainty of Measurement**

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

**Return Loss**

> 55 dB
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**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 impedance: 600 ohms typical
Maximum input voltage: $\pm 10$ V
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 impedance: 600 ohms typical
Maximum input voltage: $\pm 10$ V
Bandwidth: DC up to 7.5 kHz depending on range

<sup>1</sup> 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.  
<sup>2</sup> Peak noise is typically 3 to 3.5 times the RMS figure. Noise figures are typical performance.  
<sup>3</sup> Per "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results;" NIST Technical Note #1297  
<sup>4</sup> Wavelength = 1310, 1520-1625 nm, T<sub>(ambient)</sub> = 23C  $\pm$  2C, 1.1 mm diameter beam, 30  $\mu$ W  
<sup>5</sup> Wavelength = 800-1650 nm, T<sub>(ambient)</sub> = 10 to 35C, Fiber with N.A. <0.3, -70 dBm to +3 dBm (total wavelength range 800 nm-1700 nm)  
<sup>6</sup> Above 5 dBm, accuracy is typical  
<sup>7</sup> Maximum variation  $\pm$  for 4 measurements, filter on  
<sup>8</sup> Maximum variation  $\pm$  for 50 measurements, filter on  
<sup>9</sup> Maximum variation  $\pm$  for 10,000 measurements, filter on  
<sup>10</sup> Includes the time to change range and take readings. All readings equally spaced.  
<sup>11</sup> 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 $\mu$ s 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 $\mu$ V 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	$\pm$ 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 $\mu$ s <sup>1</sup>
10 V	200 $\mu$ V	< 1 mV
1 V	200 $\mu$ V	< 200 $\mu$ V

<sup>1</sup> Peak-to-peak noise

## PD Current Mode Specifications

Range	Resolution	Noise @ 100 ms <sup>1</sup>	Noise @ 10 $\mu$ s <sup>1</sup>	Equiv Optical Power (direct)		Equiv Optical Power (10% tap)	
1A	20 $\mu$ A	< 20 $\mu$ A	< 80 $\mu$ A	30 dBm	1W	40 dBm	10 W
100 mA	2 $\mu$ A	< 2 $\mu$ A	< 8 $\mu$ A	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 $\mu$ A	2 nA	< 2 nA	< 8 nA	-10 dBm	100 $\mu$ W	0 dBm	1 mW
10 $\mu$ A	200 pA	<200 pA	< 800 pA	-20 dBm	10 $\mu$ W	-10 dBm	100 $\mu$ W
1 $\mu$ A	20 pA	< 20 pA	< 80 pA	-30 dBm	1 $\mu$ W	-20 dBm	10 $\mu$ W
100 nA	2 pA	< 2 pA	< 40 pA	-40 dBm	100 nW	-30 dBm	1 $\mu$ W
10 nA	200 fA	< 200 fA	< 4 pA	-50 dBm	10 nW	-40 dBm	100 nW

<sup>1</sup> 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 $\mu$ A	~ 7.5 KHz
10 $\mu$ A	~ 7.5 KHz
1 $\mu$ A	~ 0.1 KHz
100 nA	~ 0.1 KHz
10 nA	~ 0.01 KHz



**Wavelength Reference Module Options (Internal)**  
**Options 410Q, 410T, 410THR, 402Q, 402T**  
**Specifications**

	<b>410THR*</b>	<b>410Q</b>	<b>410T</b>	<b>402Q</b>	<b>402T</b>
Description	Precision wavelength reference module (high resolution)	Precision wavelength reference module (extended range)	Precision wavelength reference module	Wavelength reference module (extended range)	Wavelength reference module
Absolute wavelength accuracy	< 0.6 pm typical; < 1 pm guaranteed under enhanced accuracy conditions*	< ±1 pm +1 pm per mode hop	< ±1 pm +1 pm per mode hop	< ±5 pm +1 pm per mode hop	< ±5 pm +1 pm per mode hop
Repeatability	< 0.08 pm at one standard deviation typical under enhanced accuracy conditions*	< ±1 pm	< ±1 pm	< ±5 pm	< ±5 pm
Wavelength range	1510-1648 nm full accuracy; wider wavelength range at reduced accuracy	1260-1640 nm	1510-1648 nm full accuracy; wider wavelength range at reduced accuracy	1260-1640 nm	1510-1648 nm full accuracy; wider wavelength range at reduced accuracy
Minimum sweep range	1 nm from: 1520-1532; 1536-1550; 1561-1573; 1575-1594; 1595-1608; 1610-1638;  5 nm for other wavelengths	1 nm from: 1520-1532; 1536-1550; 1561-1573; 1575-1594; 1595-1608; 1610-1638;  10 nm for other wavelengths	1 nm from: 1520-1532; 1536-1550; 1561-1573; 1575-1594; 1595-1608; 1610-1638;  5 nm for other wavelengths	1 nm from: 1520-1532; 1536-1550; 1561-1573; 1575-1594; 1595-1608; 1610-1638;  10 nm for other wavelengths	1 nm from: 1520-1532; 1536-1550; 1561-1573; 1575-1594; 1595-1608; 1610-1638;  5 nm for other wavelengths
Maximum wavelength error that can be corrected	The "Wavelength Offset Wizard" corrects beginning-of-sweep wavelength errors up to 5 nm. The error in any 5 nm span of the sweep may not exceed 200 pm.	The "Wavelength Offset Wizard" corrects beginning-of-sweep wavelength errors up to 5 nm. The error in any 10 nm span of the sweep may not exceed 200 pm.	The "Wavelength Offset Wizard" corrects beginning-of-sweep wavelength errors up to 5 nm. The error in any 5 nm span of the sweep may not exceed 200 pm.	The "Wavelength Offset Wizard" corrects beginning-of-sweep wavelength errors up to 5 nm. The error in any 10 nm span of the sweep may not exceed 200 pm.	The "Wavelength Offset Wizard" corrects beginning-of-sweep wavelength errors up to 5 nm. The error in any 5 nm span of the sweep may not exceed 200 pm.
Optical input power	+3 dB to -3 dB	> -15 dBm into "TLS IN" PORT typical			
Minimum sweep rate	20 nm/second for full specifications.				
Maximum sweep rate	100 nm/second guaranteed; 120 nm/second typical.				
Mode hop correction	Automatic: Finds, characterizes and corrects for single or up to 15 mode hops encountered during the sweep. Mode hops must be at least 1 nm apart and not be at the beginning 1nm of the sweep.				
Wavelength resolution	0.01 pm				
Wavelength correction	Each power/IL/ORL/PDL measurement point wavelength is automatically connected to the actual wavelength				
Wavelength sweep rate	Full specifications generally apply to TLS at its maximum sweep rate. At slower rates, some TLS become unstable and can even sweep backwards for short periods of time. TLS must sweep forward monotonically.				
Data available	Wavelength axis automatically corrected when wavelength correction is enabled. Data trace showing wavelength correction applied (TLS wavelength error) may be displayed.				

\* The 410THR operates like the 410T in all respects except that accuracy and repeatability are enhanced with the 410THR. To obtain these enhanced results, the sweep should be configured as follows: 1) sweep rate 40 nm/second; 2) sweep start and sweep end in one of the following wavelength ranges: 1523 nm to 1530 nm, 1538 nm to 1550 nm, 1563 nm to 1571 nm, 1578 nm to 1588 nm, 1599 nm to 1605 nm, 1615 nm to 1623 nm; 3) analog filtering off 4) TLS models: Agilent model 81600B, New Focus model 6500, dBm Optics model 4200. Note: Accuracy is improved over the 410 outside these conditions, but performance may vary.

## Tunable Laser Sources (Internal) 680 Series\* Specifications

	681	684		688	
	HP	LN	HP	LN	HP
Tuning range	835-850 nm	1265-1345 nm		1520-1630 nm	
Tuning range, mode-hop free	835-850 nm	1265-1345 nm		1510-1620 nm	1520-1630 nm
Output power	+6 dBm	0 dBm	+6 dBm	0 dBm	+8 dBm
Signal to source spontaneous emission ratio (SSE) <sup>5,7</sup>	> 40 dB	> 70 dB	> 40 dB	70 dB	>45 dB (1540-1630) > 40 dB
Signal to total source spontaneous emission ratio (STSE) <sup>6,7</sup>	> 15 dB	> 55 dB	> 15 dB	> 60 dB (1540-1625) > 55 dB	15 dB
Tuning speed	2 to 1000 nm/s ( $\pm 1\%$ )				
Wavelength resolution <sup>2</sup>	0.08 pm (10 MHz)				
Absolute wavelength accuracy <sup>1</sup>	< $\pm 1$ pm with precision wavelength reference (Option 410) < $\pm 5$ pm with wavelength reference (Option 402) < $\pm 30$ pm in fixed wavelength mode < $\pm 1$ nm in swept mode without wavelength reference				
Wavelength repeatability <sup>2</sup>	< $\pm 1$ pm with precision wavelength reference (Option 410) < $\pm 5$ pm with wavelength reference (Option 402) < $\pm 30$ pm in fixed wavelength mode < $\pm 100$ pm in swept mode without wavelength reference				
Wavelength resolution	0.1 pm				
Wavelength stability <sup>3</sup>	< $\pm 2.5$ pm				
Tuning linearity <sup>1</sup>	< $\pm 1$ pm in swept mode with precision wavelength reference (Option 410) < $\pm 5$ pm in swept mode with wavelength reference (Option 402) < $\pm 80$ nm in swept mode without wavelength reference				
Linewidth	< 50 MHz				
Side mode suppression (SMSR)	> 50 dBc typical				
Optical shutter	> 80 dB extinction available with integrated optical shutter/automatic dark calibration (Option 310)				
RIN	-140 dBc (0.1 GHz to 1.0 GHz); -150 dBc/Hz (1 GHz to 2.5 GHz) typical				
Connector	FC/APC standard; FC/APC-PM available				
Trigger output	+5 volt trigger at beginning of continuous sweep				
Remote interfaces	GPIB (IEEE 488); Ethernet; USB Flash Drive				
Power	90-240 VAC				
Environmental: Operating	+10 °C to +32 °C (+55 °F to +90 °F); < 80% RH non-condensing				
Environmental: Storage	-20 °C to +70 °C (-4 °F to +158 °F); < 80% RH non-condensing				
Size	16.8" width x 16.4" depth x 5.25" height (42.6 cm x 41 cm x 10.5 cm)				
Weight	6 lbs (2.7 kg)				
Shock/vibration	ISTB Procedure 2B; 100G non-operating				
Laser safety	Class 3B (FDA 21 CFR 1040.10); Class 3A (IEC 825-1; 1993)				

\* Most common for optical component test applications.

**NOTE:** All specifications measured with one-hour warm up and constant temperature 23 °C ( $\pm 2$  °C).

**CAUTION:** Viewing the laser output with certain optical instruments (e.g., eye loupes, magnifiers, microscopes) within a distance of 100 mm may pose an eye hazard.

<sup>1</sup> Using installed wavelength correction option if noted, see Option 402 for specifications or Option 410 for operating parameters

<sup>2</sup> 1 pm in step mode

<sup>3</sup> In fixed wavelength mode

<sup>4</sup> 0.1 nm bandwidth; signal to max ASE; 1-3 nm from carrier

<sup>5</sup> 0.2 nm bandwidth; signal to max ASE; > 5 nm from carrier

<sup>6</sup> Signal to total ASE > 0.5 nm from carrier

<sup>7</sup> Measurement taken at maximum rated power

**Variable Attenuator (Internal)  
Option 921  
Specifications**

Parameter	Specification
Attenuation range	> 20 dB
Wavelength range	1525-1610 nm
Accuracy	0.3 dB
Excess loss	1.5 dB typical; 1.8 dB max

**Polarization Controller (Internal)  
Options 953I-13, 953I-15  
Specifications**

	953I-13	953I-15
Parameter	Internal 4- and 6-state polarization controller; 1310 nm version	Internal 4- and 6-state polarization controller; 1550 nm version
Insertion loss	1.0 dB typical	1.0 dB typical
Insertion loss variation	0.1 dB max for all SOP states	0.1 dB max for all SOP states
Wavelength dependent loss	< 0.6 dB 1260-1360 nm	< 0.6 dB 1530-1565 nm
Return loss	55 dB min	55 dB min
SOP repeatability	±0.1 degrees on Poincaré sphere	±0.1 degrees on Poincaré sphere
Rotation angle wavelength dependence	-0.068 degrees/nm	-0.068 degrees/nm
SOP switching speed	250 µs max	250 µs max
States generated	-45, 0, 45, 90, RHC, LHC	-45, 0, 45, 90, RHC, LHC
Maximum optical power	300 mW min	300 mW min
Wavelength	1260-1360 nm	1480-1620 nm

**Polarization Scrambler (Internal)  
Option 957-I  
Specifications**

Parameter	Specifications
Insertion loss	0.05 dB
Output degree of polarization	< 5%
Insertion loss variation	< 0.01 dB
Center wavelength	980, 1060, 1310, 1480, 1550, 1600
Wavelength range	100 nm centered on wavelength above
DOP	5%
ORL	65 dB
Scrambling bandwidth	DC to 700 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- <a href="#">www</a> .)	N/A
692X	Additional laser diodes for 692- <a href="#">www</a> . 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.



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