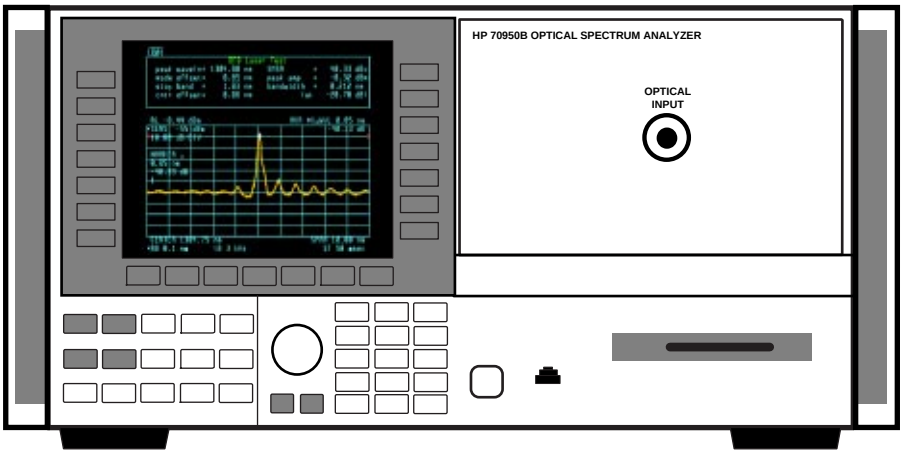
HP 71450B, 71451B, and 71452B Optical Spectrum Analyzers

Technical Specifications

Spectral Measurements from 600 to 1700 nm



The HP 71450B, 71451B, and 71452B are diffraction-grating-based optical spectrum analyzers that provide spectral measurements of optical power versus wavelength and advanced functions for measuring and characterizing optical components, amplifiers, LEDs, DFB lasers, and Fabry-Perot lasers.

This technical specifications sheet describes the measurement accuracy and operating conditions of the HP family of optical spectrum analyzer systems. The HP 71450B includes an HP 70950B module, the HP 71451B includes an HP 70951B module and the HP 71452B includes an HP 70952B module.

The **specifications** apply to all functions autocoupled over the temperature range 0 to 55° C and relative humidity <95% (unless otherwise noted). All specifications apply after the instrument's temperature has been stabilized after 1 hour continuous operation and the auto-align routine has been run. Unless otherwise noted, specifications apply without USER CAL.

Characteristics and Specifications

The distinction between specifications, *characteristics (shown in italicized text)*, typical performance, and nominal values is described as follows:

- **Specifications** describe warranted performance.
- **Characteristics** provide useful, but nonwarranted information about the functions and performance of the instrument.
- **Typical Performance**, where listed, is not warranted, but indicates performance which most units will exhibit.
- **Nominal Value** is an expected, but not warranted, value of the parameter.

Specifications for the HP Family of Optical Spectrum Analyzers

		HP 71450B	HP 71451B	HP 71452B
Wavelength				
Range			600 to 1700 nm	
Span range (continuously variable)			0.2 nm-full range and zero span	
Absolute accuracy[1]			±1 nm	
Absolute accuracy[1] (after user cal)		±0.3 nm	±0.3 nm	±0.2 nm
Multimode fiber (62.5 µm) coupling uncertainty[2]			*≤0.3 nm*	not applicable
Differential accuracy[1, 2]			*±0.1 nm, for separations ≤20 nm*	
Reproducibility ≤1 minute			±0.005 nm	
Tuning repeatability			±0.005 nm	
Settability			±0.005 nm	
Readout resolution[2]			*span/trace length*	
Resolution Bandwidth[1]				
FWHM			0.08 and 0.1 to 10 nm in a 1,2,5 sequence	
Resolution accuracy	≥0.5 , 1250 to 1600 nm		±20%	
	0.1 to 10 nm, 600 to 1700 nm[2]		*±30%*	
Corrected bandwidth accuracy for noise markers:				
	≥0.5 nm, 1250 to 1600 nm		±3%	
Amplitude				
Calibration accuracy[1, 6]	at –30 dBm, 1300 nm		±0.5 dB	
Scale fidelity[5]	autorange off (sample detector)		±0.1 dB	±0.05 dB
	autorange on (sample detector)		±0.2 dB	±0.07 dB
Display resolution	log		0.01 dB	
	linear		0.23% of measurement +0.01% of reference level	
Display scale			0.01 to 20 dB/div log in 0.01 dB steps, and linear	
Flatness				
	1290 to 1330 nm[1]	±0.25 dB	±0.25 dB	±0.25 dB
	1530 to 1570 nm[1]	±0.25 dB	±0.25 dB	±0.2 dB
	1250 to 1600 nm[1]	±1 db	±1 dB	±1 dB
	750 to 1600 nm[8]	*±1.5 dB*	*±1.5 dB*	*±1.5 dB*
	600 to 1700 nm[8]	*±2 dB*	*±2 dB*	*±2 dB*
Polarization dependence[1, 6]				
	1250 to 1600 nm[1]		±0.5 dB	
	1300 to 1320 nm		±0.5 dB	±0.125 dB
	1542 to 1562 nm		±0.5 dB	±0.05 dB
	750 to 1600 nm[2]		*±.1.5 dB*	
	600 to 1700 nm[2]		*±2.5 dB*	
Sensitivity[4]				
600 to 750 nm (second order only)			–60 dBm	
750 to 900 nm (second order)			–75 dBm	
750 to 900 nm (first order)			–70 dBm	
900 to 1100 nm			–75 dBm	
1100 to 1600 nm			–90 dBm	
1600 to 1700 nm[3]			–80 dBm	

Specifications for the HP Family of Optical Spectrum Analyzers (continued)

	HP 71450B	HP 71451B	HP 71452B
Dynamic Range[1] (in 0.1 nm resolution)			
Excluding multiple order grating responses			
600 to 1700 nm		–50 dB ≥±1 nm	
		–55 dB ≥±0.5 nm	
1250 to 1600 nm		–60 dB ≥ ±1 nm	
Chop mode on[2]		*–70 dB at ± 0.5 nm, ±1 nm, ±5 nm*	
Input Power			
1 dB compression level, within selected resolution		≥10 dBm	
Maximum displayed level[2]		*≥15 dBm*	
Maximum safe input level		+20 dBm per 5 nm, +30 dBm total	
Input Return Loss			
With PC or HMS-10/HP connector 9 μm		*>35 dB*	
Maximum limited by input fiber size		*>50 dB (internal reflections)*	
50 μm		*>28 dB*	not applicable
62.5 μm		*>26 dB*	not applicable
Sweep Time[2]			
Maximum sweep rate		*40 nm/50 ms*	
Maximum sweep rate in zero span		*50 μs/trace point*	
Sweep cycle time *50 nm span, auto zero off*		*<180 ms*	
50 nm span		*<340 ms*	
100 nm span		*<400 ms*	
full span		*<1 s*	
Pulse Mode			
Turn On >2 μs pulse width		*±0.2 dB*[2]	
Turn Off >10 μs pulse width and 27 dB extinction		*±0.2 dB*[2]	±0.2 dB
Signal-to-Noise[7] CW		±0.63	±0.18
Pulse Mode		±0.68	±0.29

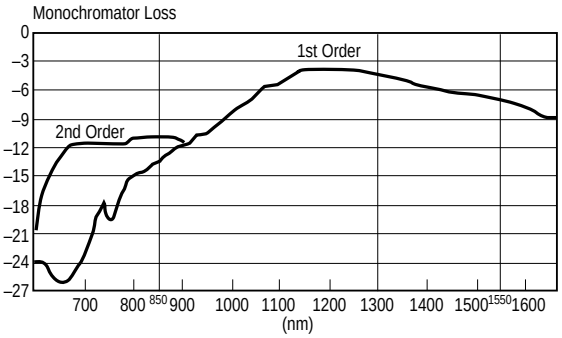
Additional Specifications for the HP 71451B (HP 70951B)

Monochromator Insertion Loss: (into 62.5 µm fiber)

(See characteristic plot)*

850 nm	<18 dB
1300 nm	< 7 dB
1550 nm	<10 dB

Characteristic Monochromator Loss



*Second order is selected when the stop wavelength is at or below 900 nm and resolution is <10 nm.

Monochromator Output (into 62.5 µm fiber)

Polarization dependence, for resolutions ≥ 0.2 nm	
1250 to 1600 nm	±0.5 dB[3]
700 to 1600 nm[2]	*±1.5 dB*
600 to 1700 nm[2]	*±2.5 dB*
Resolution selections (FWHM)	0.08 nm and 0.1 to 10 nm in a 1,2,5 sequence
Resolution accuracy for ≥0.5 nm, 1250 to 1600 nm	±20 %

Photodetector Input (in power meter mode)

Accuracy at –30 dBm[1] (ref to 1300 nm)	
20°C to 30°C	±0.35 dB
0°C to 55°C	±0.5 dB
Maximum safe power level	+20 dBm
1 dB compression level	≥+7 dBm
Scale fidelity for ≤2 dBm inputs[5]	
for any measurement with fixed reference level	±0.1 dB
for multiple measurements with different reference levels	±0.2 dB
Display resolution	
log	0.01 dB
linear	0.23% of measurement +0.01% of reference level

Power range (up to 50 dB in any reference level setting)	**1250 to 1600 nm**	**600 to 1700 nm**
Maximum displayed level[2]	*10 dBm*	*10 dBm*
Sensitivity	*–95 dBm*	*–85 dBm*
Flatness (for ≥2 dBm input)[1]	±0.4 dB	±2 dB

Transimpedance Input

Current range	0 to –10 mA
Maximum current	±10 mA
Maximum voltage	±10 V

Optional Current Source (Option 001)

Current Output

Range	0 to ±200 mA (source or sink)
Resolution	*50 μA steps*
Accuracy	±2% ±50 μA
Clamp voltage (nominal)	±2.7 V
Noise density at 1 kHz[2]	*<4nA/$\sqrt{Hz}$*
Stability within 30 minutes[2]	*<100 ppm ±500 nA*
Temperature drift[2]	*<(100 ppm ±500 nA)/ °C*

Pulse Mode

Pulse range	10 μs to 6.5 ms
Pulse resolution	100 ns
Duty cycle range	pulse width/1 s to 100%

Optional Built-In White Light Source (Option 002)

Light Source Output

Wavelength	900 to 1700 nm	
Minimum output power spectral density (9/125 μm fiber)		
	900 to 1600 nm	–67 dBm/nm (0.2 nW/nm)
	900 to 1600 nm (typical)	–64 dBm/nm (0.4 nW/nm)
	1600 to 1700 nm	–70 dBm/nm (0.1 nW/nm)
Minimum output power spectral density[2]		
	50/125 μm fiber	*–50 dBm/nm (10 nW/nm)*
	62.5/125 μm fiber	*–46 dBm/nm (25 nW/nm)*
Output stability[2]	*±0.02 dB over 10 minutes*	
Lamp lifetime[2]	*Mean time between failures (MTBF) >5000 hours*	

Stimulus Response System Specifications

Passive Optical-To-Optical Devices		**1250 to 1600 nm 9/125 μm fiber**	**900 to 1700 nm 62.5/125 or 50/125 μm fiber**
Measurement range	10 nm RBW	0 to 33 dB (36 dB typical)	0 to 30 dB 0 to 40 dB (1000 to 1600 nm)
Dynamic range[2]	*10 nm RBW* *10 nm RBW* *0.5 to 10 nm RBW*	*36 dB*	*24 dB (900 to 1000 nm)* *36 dB (1000 to 1600 nm)* *9 dB (1600 to 1700 nm)*
Measurement accuracy		±0.1 dB	±0.2 dB

Optical-To-Electrical Devices

(With HP 71451B or HP 70951B OSA)		
Minimum resposivity[2], Rshunt >1MΩ 0.01 A/W	*0.01 A/W*	
Accuracy[2]	*±0.9 dB*	*±0.9 dB*

Optional Swept Polarization Dependent Loss Kit (Option 003)

Swept PDL System Specifications	1250 to 1600 nm
(with HP 71451B or HP 70951B OSA containing Option 002 built-in white light source)	
Accuracy	
0/0 devices (external photodetector)	+0.1/–0.05 dB
0/0 devices (internal photodetector)[2]	*+0.2/–0.1 dB*
O/E devices[2]	*+0.075/–0.025 dB*
Polarizer extinction ratio	
Measurement range[2]	*0 to 30 dB*

General Specifications

Inputs/Outputs

Optical input (HP 70950B or HP 70951B)	Multimode fiber, standard
Optical input (HP 70952B)	9 μm fiber
Optical output (HP 70951B)	62.5 μm fiber
Optical connectors	FC/PC standard; other interface adapters available
Rear panel connectors	SMB (electrical)

Dimensions

HP 71450B, 71451B or 71452B	222 mm high x 425.4 mm wide x 526 mm long (8.75 in x 16.75 in x 20.7 in)
HP 70950B, 70951A or 70952B	Standard 4/8-width module

Weight

HP 71450B, 71451B or 71452B	28 kg (61.6 lb)
HP 70950B, 70951A or 70952B	8 kg (17.6 lb)

Environmental	Operational	Storage
Temperature	0°C to +55°C	–40°C to +71°C
Humidity	<95% R.H.	Noncondensing
Shock and vibration	Tested to MIL-T-28800D class 5 par. 3.7.4, 3.7.5.2 and 3	
EMI	Conducted and radiated interference is in compliance with CISPR Pub 11, FTZ526/527/79, and MIL-STD 461B part 7 CE03(AF) and RE02	

Power Requirements

HP 71450B, 71451B or 71452B	
Voltage and frequency	87 to 132 VAC, 47 Hz to 66 Hz and 356 Hz to 444 Hz 174 to 264 VAC, 47 Hz to 66 Hz
Maximum power	260 watts max (350 VA max)

Definition of Terms

Wavelength

- *Absolute Accuracy (after user cal)* refers to the wavelength accuracy after the user has performed the internal wavelength calibration using a source of known wavelength.
- *Multimode Fiber Coupling Uncertainty* refers to additional wavelength error which can occur from the loss of control of the image size and angle that the light is launched into the OSA. Multiple angles are a result of the multimoding in the larger fiber.
- *Differential Accuracy* indicates the maximum error in measuring the wavelength difference between two signals that are within the specified separation.
- *Reproducibility* refers to the amount of wavelength drift which can occur over the specified time while the OSA is tuned to a specific wavelength.
- *Tuning Repeatability* refers to the wavelength accuracy of returning to a wavelength after having tuned to a different wavelength.

Resolution

- *FWHM* refers to the Full-Width-Half-Maximum resolutions that are available. This indicates the width at half power level of the signal after passing through the resolution slits.

Amplitude

- *Scale Fidelity* refers to the potential errors in amplitude readout at amplitudes other than at the calibration point. This specification is sometimes called linearity.
- *Flatness* defines a floating band which describes the error in signal amplitude over the indicated wavelength range. (This error may be removed at a given wavelength by performing the user amplitude calibration.)
- *Polarization Dependence* refers to the amplitude change that can be seen by varying the polarization of the light entering the OSA. This is not to be confused with amplitude variations caused by the varying distribution of energy between the different modes in fiber that are multimode at the wavelength of interest.

Sensitivity

- *Sensitivity* is defined as the signal level that is equal to six times the RMS value of the noise. Displayed sensitivity values are nominal. Slightly lower values may have to be entered to achieve specified sensitivity.

Dynamic Range

- *Dynamic Range* is a measure of the ability to see low-level signals that are located very close (in wavelength) to a stronger signal. In electrical spectrum analyzers, this characteristic is generally called shape factor.

Sweep Time

- *Maximum Sweep Rate* refers to the maximum rate that the instrument is able to acquire data and display it. This rate may be limited by multiple internal processes.
- *Sweep Cycle Time* refers to the time required to make a complete sweep and prepare for the next sweep. It can be measured as the time from the start of one sweep to the start of the next sweep.

Photodetector Input

- *Scale Fidelity: For any measurement with fixed Reference Level* refers to the maximum error in a single power measurement. It also refers to the maximum error in the difference between two power measurements where the reference level was not changed between the measurements.
- *Scale Fidelity: For Multiple Measurements with Different Reference Levels* refers to the maximum error between two measurements when the reference level must be changed between the measurements.

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[1] With applied input fiber 9/125 µm
[2] Characteristic
[3] Temperature range 20°C to 30°C
[4] Signal value >6 times the RMS noise value
[5] To within 20 dB of the sensitivity noise limit
[6] For resolutions ≥0.2 nm
[7] Calculated from specified values; 1.15 x RSS of polarization sensitivity, scale fidelity, RBW accuracy, (and step response accuracy in pulse mode).
[8] With applied input fiber that is standard single mode at wavelength of interest

Ordering Information

Available Options	HP 71450B HP 70950B	HP 71451B HP 70951B	HP 71452B HP 70952B
Option 001 Built-in programmable current source	yes	yes	yes
Option 002 Built-in white light source	yes	yes	yes
Option 003 Swept PDL kit	not available	yes	not available
Option 010 Delete FC/PC interface	yes	yes	yes
Option 051 EDFA interpolation test personality	yes	yes	included
Option 052 EDFA time domain test personality	yes	yes	included
Option 053 EDFA noise gain profile measurement personality	yes	yes	included

Additional Interface Connectors:

HP 81000AI Diamond HMS-10
HP 81000GI D4
HP 81000KI SC
HP 81000SI DIN 47256
HP 81000VI ST
HP 81000WI Biconic
HP 81000FB FC/PC Bare fiber adapter

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