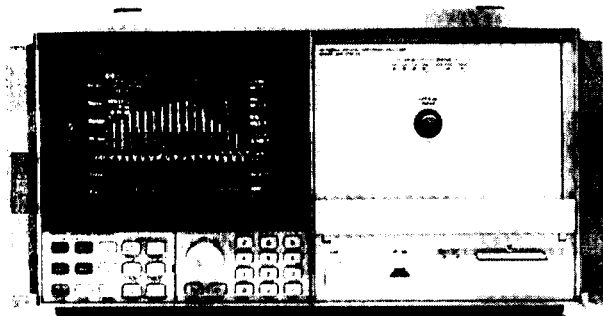


Optical Spectrum Analyzers

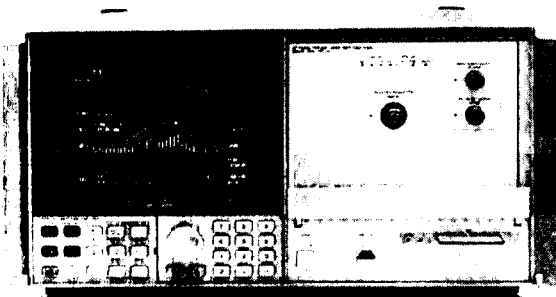
HP 71450B, 71451B, and 71452B Optical Spectrum Analyzer

- Excellent sensitivity, dynamic range, and wavelength accuracy
- LED, Fabry-Perot, or DFB laser characterization
- Stimulus response system for optical components
- Polarization dependent loss versus wavelength
- EDFA characterization with all common optical test methods



HP 71450B, 71452B

The HP 71450B, 71451B, and 71452B are diffraction-grating based optical spectrum analyzers (OSAs) using a unique double-pass monochromator design which offers the dynamic range of a double monochromator and the sensitivity of a single monochromator. All OSAs perform quick, precise spectral measurements from 600 to 1700 nm. They offer critical measurement capabilities needed in the laboratory and on the production floor.



HP 71451B

The HP 71450B, 71451B, and 71452B provide unprecedented performance with their outstanding dynamic range, sensitivity, high amplitude and wavelength accuracy, and polarization insensitivity. These instruments perform measurements quickly, especially when high sensitivity is required. Capable of sweeping 40 nm in 50 ms with reduced dead time, the analyzers can save hours of measurement time. In addition, the HP 71450B, 71451B, and 71452B can be left continually sweeping; you no longer need to stop the sweep to save wear and avoid costly repairs.

Each analyzer consists of a mainframe, color display, optical spectrum analyzer module, and a special keypad for ease of use. As part of the HP 70000 modular measurement system, the HP 70950B, 70951B, and 70952B optical spectrum analyzer modules can be added to an existing MMS system.

Small and Rugged

Both analyzers are contained in a single 9-inch high package. They operate over the full 0 °C to 55 °C temperature range and are tested to rigorous Class B2 environmental specifications, including those for vibration and shock. Now you can safely transport the instrument into the next room or across the country with confidence.

Ease of Use

All features of an electrical spectrum analyzer are available in these optical analyzers. Electronic modification of screen data allows immediate wavelength position or span adjustment. Fully-variable spans, with full control over sweep speed, sensitivity, and resolution, as well as choice of manual or automatic settings, make measurements easy.

The HP optical spectrum analyzers include automatic features. An auto-measure function quickly locates the signal, zooms in, and centers the display. An auto-align feature automatically centers the light on the photodiode for optimum amplitude accuracy and removes the need for fiber alignment on the monochromator output.

The HP 71451B extends the capabilities of the HP 71450B by adding an optical transfer switch. This switch provides access to key points in the spectrum analyzer block diagram. The monochromator output allows the input optical signal to be filtered by the monochromator with all resolution bandwidths available. The output is for use with other equipment in the analysis of WDM systems, mode partition noise analysis, and time resolved chirp. The photodetector input allows a signal to bypass the monochromator and be input directly into the photodetector. With the display in zero span and a slow sweep time, you can dynamically adjust a laser for maximum power output as shown in Figure 1 and Figure 2.

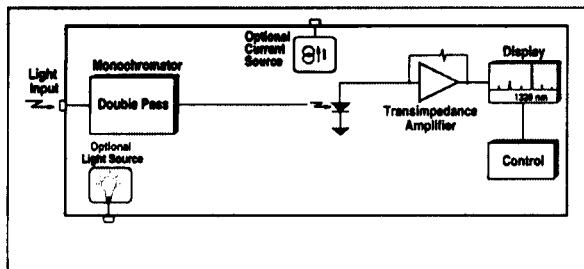


Figure 1. Standard operating mode of the HP 71450B or 71452B

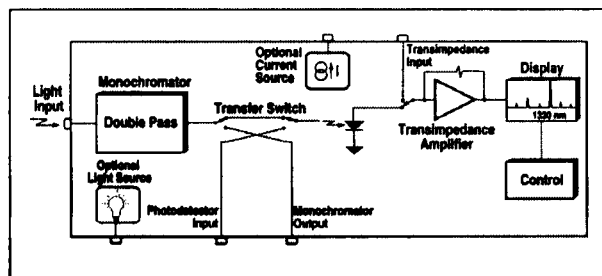


Figure 2. HP 71451B in OSA mode

The HP 71452B is the result of the optical amplifier research, development, and manufacturing industries' need for innovative measurement techniques and stringent performance specifications. Its block diagram is identical to the HP 71450B. However, the HP 71452B contains enhanced optical components for excellent accuracy in characterizing optical amplifiers.

Source Measurements

The OSAs include built-in programs for advanced measurement on DFB and Fabry-Perot lasers and LEDs. The LED measurement identifies and measures the spectral full-width half-maximum value, mean-wavelength position, and peak-power density of the LED as shown in Figure 3.

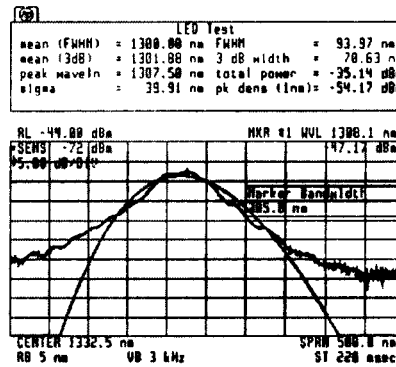


Figure 3. LED measurement

The Fabry-Perot (FP) laser measurement function measures the spectral full-width half-maximum or envelope bandwidth, center wavelength, mode spacing, and total power of the laser. The Gaussian or Lorentzian curve fit to your laser may also be displayed as shown in Figure 4.

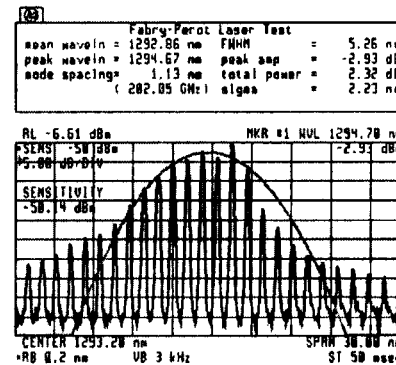


Figure 4. FP measurement

The DFB laser measurement function provides center wavelength, automatic side-mode suppression ratios, peak power, and stop-band characterization as shown in Figure 5.

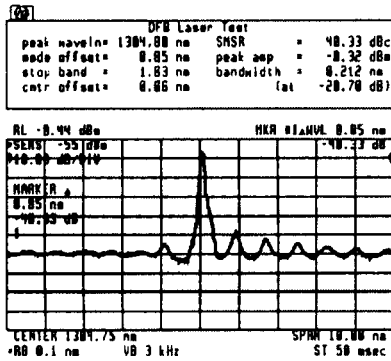


Figure 5. DFB measurement

All analyzers also offer an optional current source to bias your light source. A sink or source current up to 200 mA allows continuous or variable duty-ratio current pulses. The source can be set from the front panel or over the HP-IB. You can also set the maximum current limit to avoid accidentally overdriving the laser. The current source provides a transient suppression and voltage clamping to protect your diode under test.

Stimulus Response Testing

The HP 71450B and 71451B option 002 white light source adds swept-wavelength stimulus-response test capability to your optical spectrum analyzer, without increasing rack or bench space. The white light source has a wavelength range of 900 to 1600 nm. The output spectrum is filtered below 900 nm to prevent the detection of light at half the wavelength of interest. In addition, the need to frequently change the high-intensity halogen lamp of your white light source has been eliminated.

The long lifetime design provides a mean time between failures (MTBF) of greater than 5000 hours. Devices such as couplers, fibers, filters, and isolators can be characterized as a function of wavelength with the HP 71450B, 71451B, or 71452B. Responsivity as a function of wavelength on photodetectors and receivers can be quickly measured with the HP 71451B. Figure 6 shows the stimulus response measurement setup.

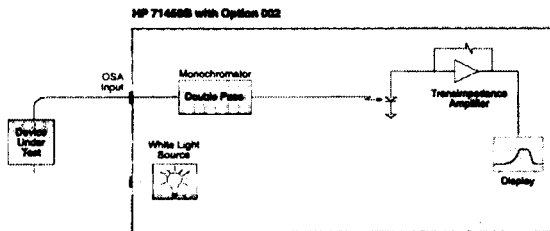


Figure 6. Stimulus response measurement setup

Swept Polarization Dependent Loss Testing

The option 003 polarization dependent loss kit provides the capability to make swept-polarization dependent loss measurements on optical-to-optical and optical-to-electrical components and devices. Combining the HP 71451B OSA, white light source, and swept PDL kit, provides a system that can accurately measure PDL from 1250 to 1600 nm.

The swept PDL kit contains a semi-rigid multimode fiber, semi-rigid multimode adapter, polarizer, 2-meter single-mode fiber with FC/PC connectors, and the HP 11896A polarization state controller. Figure 7 shows the swept PDL measurement setup.

The polarization dependent loss is measured by viewing the output spectrum of the device under test. As the polarization state controller is varied, the maximum and minimum outputs are measured and displayed. The difference of the maximum and minimum traces is the peak-to-peak PDL of the device.

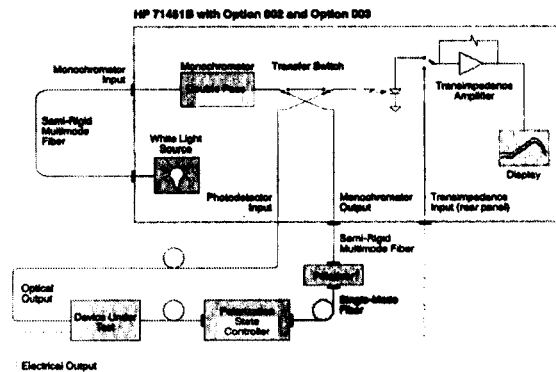


Figure 7. Swept PDL measurement setup

DWDM Component Testing

The DWDM component test kit (Option 031) augments the HP 71452B optical spectrum analyzer by adding an HP 11896A polarization controller and an HP 83438A Erbium ASE source with polarized light (Option 009). Furthermore, it removes all three EDFA test personalities from the OSA. Together, these three instruments are the core setup for testing passive components versus wavelength and polarization in the 1550 nm optical window.

Specifications for the HP 71450B, 71451B, and 71452B

Specifications describe the instrument's warranted performance. *Supplementary performance characteristics provide information about non-warranted instrument performance in the form of nominal values, and are printed in italic typeface.*

Specification Summary	HP 71450B	HP 71451B	HP 71452B
Absolute Accuracy^a (within 40 nm of cal signal)	±1 nm (±0.3 nm)	±1 nm (±0.3 nm)	±1 nm (±0.2 nm; ±0.05 nm)
Absolute Accuracy at -30 dBm, 1300 nm	±0.5 dB	±0.5 dB	±0.5 dB
Scale fidelity: autorange off	±0.1 dB	±0.1 dB	±0.05 dB
autorange on	±0.2 dB	±0.2 dB	±0.07 dB
Flatness: ^a 1290 nm–1330 nm	±0.25 dB	±0.25 dB	±0.25 dB
1530 nm–1570 nm	±0.25 dB	±0.25 dB	±0.2 dB
1250 nm–1600 nm	±1 dB	±1 dB	±1 dB
Polarization Dependence^b			
1300–1320 nm ^a	±0.5 dB	±0.5 dB	±0.125 dB
1542–1562 nm ^a	±0.5 dB	±0.5 dB	±0.05 dB
Pulse Response			
≥ 2 μs after rising edge	±0.2 dB	±0.2 dB	
≥ 10 μs after falling edge, extinction > 27 dB	±0.2 dB	±0.2 dB	±0.2 dB
Signal-to-Noise Measurement^c			
CW	±0.63 dB	±0.63 dB	±0.18 dB
Pulse mode	±0.68 dB	±0.68 dB	±0.29 dB
Input Return Loss^d			
With 9/125 μm fiber	> 35 dB	> 35 dB	> 35 dB
With 50/125 μm fiber	28 dB	28 dB	N/A
With 62.5/125 μm fiber	26 dB	26 dB	N/A
Wavelength Range	600–1700 nm		
Span Range (cont. variable)	0.2 nm, full range and zero span		
Differential Accuracy for separations ≤ 20 nm	±0.1 nm		
Tuning Repeatability	±0.005 nm		
Stability	0.005 nm		
Resolution Bandwidth FWHM (selectable) ^e	0.08, 0.1, 0.2, 0.5, 1, 2, 5, 10		0.065 ±15%; 0.1, 0.2, 0.5, 1, 2, 5, 10 Option 122 ±5% for 0.2 nm resolution
Resolution Accuracy (bandwidth ≥0.5 nm, 1250–1600 nm)			
Default accuracy	±20%		
Using noise marker (factory calibrated)	±3%		
Amplitude, Display Scale	0.01–20 dB log, and linear		
Sensitivity			
600–750 nm (second order only)	-60 dBm		
750–900 nm (second order)	-75 dBm		
750–900 nm (first order)	-70 dBm		
900–1100 nm	-75 dBm		
1100–1600 nm	-90 dBm		
1600–1700 nm	-80 dBm		
Dynamic Range in 0.1 nm resolution ^{a,f}			
600–1700 nm	-50 dB at ≥ ±1 nm		Option 122, 0.2 nm resolution
1250–1600 nm	-55 dB at ≥ ±0.5 nm		-58 dB at ≥ ±0.5 nm
1250–1600 nm, chop mode on	-70 dB at ±0.5 nm, ±1 nm, ±5 nm		-65 dB at ≥ ±1.0 nm
Input Power			
<0.05 dB Compression Level (within selected resolution)	> +10 dBm		
Maximum Safe Input Level	+20 dBm per 5 nm, +30 dBm total		
Sweep Time, Maximum Sweep Rate	40 nm/50 ms		
Sweep Cycle Time			
50 nm span (auto zero off)	< 180 ms		
Full span	< 1 s		

a. After user calibration, with applied input fiber 9/125 μm.

b. For resolutions ≥0.2 nm.

c. Calculated (1.15 × RSS) from polarization sensitivity, scale fidelity, resolution bandwidth, accuracy, and pulse response (in pulse mode).

d. Depends on the quality of the attached connector.

e. Resolution of 10 nm is available in first order only.

f. Excluding multiple order grating response.

Additional Specifications for the HP 71451B

Monochromator Output (into 62.5 μm fiber) Insertion loss, 850/1300/1550 nm, 1st order Polarization dependence in the range 1250–1600 nm ^a Resolution accuracy in the range 1250–1600 nm ^b	$< 18 \text{ dB}/< 7 \text{ dB}/< 10 \text{ dB}$ $\pm 0.5 \text{ dB}$ $\pm 20\%$
Photodetector Input (power meter mode) Absolute Accuracy at -30 dBm , 1300 nm ^c Sensitivity 1 dB compression level Maximum safe input power Flatness for $\leq 2 \text{ dBm}$ input	$\pm 0.35 \text{ dB}$ -95 dBm (1250–1600 nm), -85 dBm (600–1700 nm) $> +7 \text{ dBm}$ $+20 \text{ dBm}$ $\pm 0.4 \text{ dB}$ (1250–1600 nm)
HP 71451B Option 002 Built-in White Light Source Output	
Wavelength	900–1700 nm (filtered below 850 nm)
Spectral Power Density Into 9/125 μm fiber Into 50/125 μm fiber Into 62.5/125 μm fiber	0.2 nW/nm (900–1600 nm), 0.1 nW/nm (1600–1700 nm) 10 nW/nm 25 nW/nm
Stability over 10 minutes	$\pm 0.02 \text{ dB}$
Lamp Lifetime	Mean time between failure > 5000 hours
HP 71451B Option 003 Swept PDL Kit (with HP 71451B only)	
Accuracy (1250–1600 nm) ^d Optical-to-Optical Devices (external photodetector) Optical-to-Electrical Devices Polarization Extinction Measurement Range	$+0.1/-0.05 \text{ dB}$ $+0.075/-0.025 \text{ dB}$ $0 \text{ to } 30 \text{ dB}$
Stimulus Response System Specifications— Passive Optical-to-Optical Devices (with HP 71450B, 71451B)	
Measurement Range 1250–1600 nm and 9/125 μm fiber 1000–1600 nm and 50/125 or 62.5/125 μm fiber	$0 \text{ to } 33 \text{ dB}$ in 10 nm RBW (36 dB typical) $0 \text{ to } 40 \text{ dB}$ (10 nm RBW)
Dynamic Range 1250–1600 nm and 9/125 μm fiber 1000–1600 nm and 50/125 or 62.5/125 μm fiber	36 dB (with 10 nm RBW) 36 dB (10 nm RBW)
Measurement Accuracy 1250–1600 nm and 9/125 μm fiber 1000–1600 nm and 50/125 or 62.5/125 μm fiber	$\pm 0.1 \text{ dB}$ (excluding connector repeatability) $\pm 0.2 \text{ dB}$ (excluding connector repeatability)
Optical-to-Electrical Devices (with HP 71451B only) Minimum Responsivity Accuracy	0.01 A/W $\pm 0.9 \text{ dB}$ (excluding connector repeatability)

- a. For resolutions $\geq 0.2 \text{ nm}$.
- b. For resolutions $\geq 0.5 \text{ nm}$.
- c. 20–30°C.
- d. Assumes polarization controller achieves all desired states of polarization. Specification applies for devices with less than 5 dB loss.

Measurement Summary for the HP 71450B, 71451B, and 71452B

MEASUREMENT	HP 71450B	HP 71451B	HP 71452B
O/E and E/O Devices			
<input type="checkbox"/> Power spectrum, total power	good	good	good
<input type="checkbox"/> Noise density (W/nm)	good	good	good
<input type="checkbox"/> LED, FP, DFB characterization	good	good	good
<input type="checkbox"/> Detector responsivity	N/A	recommended	N/A
DWDM Passive Components			
<input type="checkbox"/> Insertion loss	good	good	good
<input type="checkbox"/> Polarization dependent loss	N/A	recommended (Option 003)	good
<input type="checkbox"/> Polarization mode dispersion	good	good	good
Optical Amplifiers			
<input type="checkbox"/> Output spectrum	good	good	recommended
<input type="checkbox"/> Gain and noise figure	*	*	recommended
<input type="checkbox"/> Noise gain profile	*	*	recommended
<input type="checkbox"/> Noise gain peak	*	*	recommended
Wavelength Division Multiplexing Systems			
<input type="checkbox"/> Output spectrum	good	good	recommended
<input type="checkbox"/> Non-linear effects	good	good	recommended
Supported Fiber Type	up to 62.5/125 μm	up to 62.5/125 μm	9/125 μm

*with reduced accuracy only

Ordering Information

HP 71450B	Optical Spectrum Analyzer*
Option 001	Programmable Current Source
Option 002	Built-in White Light Source
Option 051	EDFA Test Personality
Option 052	EDFA Time-Domain Test Personality
Option 053	EDFA Noise-Gain Profile Measurement Personality
Option 1CM	Rack Mount Kit
HP 71451B	Optical Spectrum Analyzer*
Option 001	Programmable Current Source
Option 002	Built-in White Light Source
Option 003	Swept PDL Kit
Option 051	EDFA Test Personality
Option 052	EDFA Time-Domain Test Personality
Option 053	EDFA Noise-Gain Profile Measurement Personality
Option 1CM	Rack Mount Kit
HP 71452B	Optical Spectrum Analyzer* (includes Option 051 EDFA interpolation test personality, Option 052 EDFA time-domain test personality, and Option 053 EDFA noise-gain profile measurement personality)
Option 001	Programmable Current Source
Option 002	Built-in White Light Source
Option 031	DWDM Component Test Kit
Option 122	Enhanced Dynamic Range Performance
Option 1CM	Rack Mount Kit
HP 70950B	Optical Spectrum Analyzer Module*
Option 001	Programmable Current Source
Option 002	Built-in White Light Source
Option 051	EDFA Test Personality
Option 052	EDFA Time-Domain Test Personality
Option 053	EDFA Noise-Gain Profile Measurement Personality
HP 70951B	Optical Spectrum Analyzer Module*
Option 001	Programmable Current Source
Option 002	Built-in White Light Source
Option 003	Swept PDL Kit
Option 051	EDFA Test Personality
Option 052	EDFA Time-Domain Test Personality
Option 053	EDFA Noise-Gain Profile Measurement Personality
HP 70952B	Optical Spectrum Analyzer* (includes Option 051 EDFA interpolation test personality, Option 052 EDFA time-domain test personality, and Option 053 EDFA noise-gain profile measurement personality)
Option 001	Programmable Current Source
Option 002	Built-in White Light Source
HP 70953A	Time-Domain Extinction Upgrade (For the HP 71450A, 71451A (HP 70950A, 70951A) only. After ordering the HP 70953A, the customer will receive packing material and instructions on how to return the HP 70950A, 70951A module to the factory where the upgrade will be done.)

Accessories

Interface Connectors

HP 81000AI	Diamond HMS-10
HP 81000FI	FC/PC
HP 81000GI	D4
HP 81000KI	SC
HP 81000SI	DIN 47256
HP 81000VI	ST
HP 81000WI	Biconic
HP 81000FB	FC/PC Bare Fiber Adapter
HP 85680-60093	BNC-to-SMB Cable The time-domain test personality requires one trigger cable. The noise-gain profile measurement personality requires two trigger cables.

* FC/PC connector interface (HP 81000FI) standard on each model.