

# Agilent 86140A Optical Spectrum Analyzer Family Technical Specifications



- **Excellent “Close-In” Dynamic Range**  
Accurately characterize 50 GHz WDM system performance
- **High Throughput**  
Fast sweep speeds at high sensitivity to maximize measurement throughput
- **Built-In Applications**  
Agilent’s new application concept makes complex and repetitive measurements simple
- **Benchtop and Portable Platforms**  
Choose between a large screen or small footprint package

	<b>Benchtop</b>	<b>Portable</b>
<b>High Accuracy:</b> Ideal for critical WDM system and component characterization	<b>Agilent 86142A</b>	<b>Agilent 86145A</b>
<b>Standard:</b> Ideal for a wide range of applications at value prices	<b>Agilent 86140A</b>	<b>Agilent 86143A</b>

The Agilent 86140A and 86142A optical spectrum analyzers are high performance benchtop instruments that offer a combination of flexibility, high accuracy and throughput for both R&D and manufacturing environments. These are complimented by the portable Agilent 86143A and 86145A, providing performance in a compact 14.5 kg package for environments where small size and weight are important.

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 and characteristics is described as follows:

- Specifications describe warranted performance.
- Characteristics provide useful, but nonwarranted information about the functions and performance of the instrument.



# Specifications

Agilent 86140A	Agilent 86143A	Agilent 86142A	Agilent 86145A
Standard		High Accuracy	
Benchtop	Portable	Benchtop	Portable

## Wavelength

<b>Range</b>	600 nm to 1700 nm
<b>Span range</b> (continuously variable)	0.2 nm to full range and zero span
<b>Accuracy</b> After calibration with internal wavelength reference signal <sup>1,2</sup> After user calibration within $\pm 40$ nm of calibration signal <sup>1,2</sup> After user calibration over full wavelength range <sup>1</sup> Absolute accuracy (Factory Calibration Cycle 2 yrs) <sup>1</sup>	$\pm 0.025$ nm (1510–1570), $\pm 0.035$ nm (1570–1640) $\pm 0.05$ nm $\pm 0.2$ nm $\pm 0.5$ nm
<b>Reproducibility</b> ( $\leq 1$ min) <sup>1</sup>	$\pm 0.003$ nm
<b>Span linearity</b> <sup>1,3</sup>	$\pm 0.05$ nm, for spans $< 40$ nm
<b>Span linearity</b> (1525 nm to 1570 nm) <sup>1,2,3</sup>	$\pm 0.02$ nm
<b>Tuning repeatability</b> <sup>1</sup>	$\pm 0.003$ nm

## Resolution Bandwidth (RBW)

<b>FWHM</b> (selectable) <sup>1,4</sup>	0.07, 0.1, 0.2, 0.5, 1, 2, 5, 10 nm	0.06, 0.1, 0.2, 0.5, 1, 2, 5, 10 nm
<b>Corrected Res. bandwidth accuracy</b> (using noise markers) <sup>1,3</sup>		
$\geq 0.5$ nm, 1525–1610 nm	$\pm 4\%$	$\pm 3\%$
0.2 nm, 1525–1610 nm	$\pm 6\%$	$\pm 5\%$
0.1 nm, 1525–1610 nm	$\pm 12\%$	$\pm 10\%$

## Amplitude

<b>Sensitivity</b> <sup>5</sup> 600–750 nm (No averaging required) <sup>6,7</sup> 750–900 nm (No averaging required) <sup>6,7</sup> 900–1250 nm (No averaging required) <sup>6</sup> 1250–1610 nm (No averaging required) <sup>6</sup> 1610–1700 nm (No averaging required) <sup>3</sup>		–60 dBm –75 dBm –75 dBm –90 dBm –80 dBm
<b>Maximum measurement power</b> <sup>2,8</sup> 1525–1700 nm 600–1000 nm 1000–1525 nm		+15 dBm per channel, +30 dBm total +15 dBm per channel, +30 dBm total +12 dBm per channel, +30 dBm total
<b>Maximum safe power</b> Total safe power Total power within any 10 nm portion of the spectrum		+30 dBm +23 dBm
<b>Calibration accuracy at –20 dBm, 1310 nm/1550 nm</b> <sup>9</sup>		$\pm 0.5$ dB
<b>Scale fidelity</b> (autorange off) <sup>3,10</sup> (autorange on) <sup>3,10</sup>	$\pm 0.07$ dB $\pm 0.1$ dB	$\pm 0.05$ dB $\pm 0.07$ dB
<b>Display scale</b> (log scale)	0.01–20 dB/DIV, –120 to +90 dBm	
<b>Amplitude stability</b> (1310 nm, 1550 nm) 1 minute 15 minutes <sup>2</sup>		$\pm 0.01$ dB $\pm 0.02$ dB
<b>Flatness</b> 1290–1330 nm <sup>1</sup> 1525–1570 nm <sup>1</sup> 1525–1610 nm <sup>1</sup> 1250–1610 nm <sup>1,11</sup>		$\pm 0.2$ dB $\pm 0.2$ dB $\pm 0.2$ dB $\pm 0.7$ dB
<b>Polarization dependence</b> <sup>1,12,13</sup> 1310 nm 1530 nm, 1565 nm 1600 nm 1250–1650 nm 1250–1650 nm (Multimode Fiber Opt. 025)	$\pm 0.25$ dB $\pm 0.2$ dB $\pm 0.25$ dB $\pm 0.3$ dB $\pm 0.4$ dB	$\pm 0.12$ dB $\pm 0.05$ dB $\pm 0.08$ dB $\pm 0.25$ dB —

Agilent HP 86140A	Agilent HP 86143A	Agilent HP 86142A	Agilent HP 86145A
Standard		High Accuracy	
Benchtop	Portable	Benchtop	Portable

## Dynamic Range

<b>In 0.1 nm resolution<sup>1,14</sup></b> 1250–1610 nm (chop mode on) <sup>2</sup> ±0.5 nm, ±1 nm, ±5 nm 1550 nm at ±0.8 nm (±100 GHz at 1550 nm) <sup>15</sup> 1550 nm at ±0.5 nm (±62.5 GHz at 1550 nm) 1550 nm at ±0.4 nm (±50 GHz at 1550 nm) 1550 nm at ±0.2 nm (±25 GHz at 1550 nm) <sup>2</sup>		-70 dB	
		-60 dB	
		-55 dB	-58 dB
		-52 dB	-55 dB
			-40 dB

## Monochromator Input

<b>Input return loss</b> Straight connector (9/125 μm) <sup>16</sup>	>35 dB
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## Sweep

<b>Max. sweep rate<sup>2</sup></b>	40 nm/50 ms
<b>Max. sampling rate in zero span<sup>2</sup></b>	50 μs/trace point
<b>Sweep cycle time<sup>2</sup></b>	
50 nm span auto zero off	<180 ms
50 nm span	<340 ms
100 nm span	<400 ms
500 nm span	<650 ms
<b>ADC trigger accuracy<sup>2</sup></b>	
Jitter (distributed uniformly)	<±0.5 μs
Trigger delay range	2 μs–6.5 ms

## Pulse Mode Accuracy

<b>Turn on</b> (≥2 μs after rising edge) <sup>2</sup>	<± 0.2 dB (starting from dark)	
<b>Turn off</b> (≥10 μs after falling edge)	<±0.2 dB <sup>2</sup>	<±0.2 dB (30 dB extinction)

## Computer Interfacing

<b>Remote control</b>	
Compatibility	IEEE-488-1, IEEE-488.2 (100%)
Interfaces	GPIB, Parallel Printer Port, External VGA Monitor, Keyboard (PS/2) and Mouse
<b>Floppy Disk</b>	3.5" 1.44MB, MS-DOS <sup>®</sup>
Data export	Spreadsheet and Word Processor Compatible (CSV ASCII)
Graphics export	CGM
<b>Instrument drivers</b>	Universal Instrument Drivers (PNP), Compatible with VEE, Labview <sup>®</sup> , Visual Basic and C++

MS-DOS is a U.S. registered trademark of Microsoft Corporation.

Labview is a U.S. registered trademark of National Instruments.

<b>Benchtop OSA</b> <b>Agilent 86140A/86142</b>	<b>Portable OSA</b> <b>Agilent 86143A/86145A</b>
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## General Specifications

<b>Dimensions</b>	222 high x 425 wide x 427 mm long	163 high x 325 wide x 427 mm long
<b>Weight</b>	16.5 Kg	14.5 Kg
<b>Environmental</b> Temperature <sup>17</sup> Humidity EMI	Operating 0°C to 55°C, Storage -40°C to 70°C Operating <95% RH, Storage Noncondensing Conducted and radiated interference is in compliance with CISPR pub11, IEC 801-3, IEC 801-4 and IEC555-2	
<b>Power Requirements</b> Voltage and frequency Maximum power consumption	90 Vac to 260 Vac, 44 to 444 Hz 230 W	

## Option 004/005 EELED Sources

<b>Minimum spectral power density</b> <sup>18</sup> 1540 to 1560 nm (Option 005) 1470 to 1620 nm (Option 005) <sup>2</sup> 1300 to 1320 nm, 1540 to 1560 nm (Option 004) 1250 to 1620 nm (Option 004) <sup>2</sup>	>-40 dBm/nm 100 nW/nm >-60 dBm/nm 1 nW/nm >-40 dBm/nm 100 nW/nm >-60 dBm/nm 1 nW/nm	
<b>Return loss</b> <sup>2</sup> With straight connector	>25 dB	
<b>Stability</b> (ambient temp. <±1°C) <sup>2</sup> Over 15 minutes Over 6 hours	<±0.02 dB <±0.05 dB	

<sup>1</sup> With applied input fiber 9/125 μm

<sup>2</sup> Characteristic

<sup>3</sup> Temperature range 20 to 30°C

<sup>4</sup> Resolution of 10 nm is available in first order only

<sup>5</sup> Sensitivity is defined as signal value >6 x RMS noise value.

<sup>6</sup> Temperature range 0 to 30°C.

<sup>7</sup> Second order

<sup>8</sup> Resolution bandwidth setting <channel spacing.

<sup>9</sup> For resolution ≥0.1 nm

<sup>10</sup> Excluding amplitude errors at low power levels due to noise

<sup>11</sup> Between 1350 nm and 1420 nm absorption of light by atmospheric moisture affects flatness.

<sup>12</sup> For resolution ≥0.2 nm

<sup>13</sup> At room temperature

<sup>14</sup> Excluding multiple order grating response

<sup>15</sup> Average of all states of polarization.

<sup>16</sup> Depends on the quality of the attached connector

<sup>17</sup> Floppy disk and printer operating temperature range 0 to 45°C.

<sup>18</sup> Temperature range 0 to 45°C

## Options and Accessories



Benchtop OSA Agilent 86140A/86142A	Portable OSA Agilent 86143A/86145A
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### Options (available on new instruments only)

<b>Built-in 1310 &amp; 1550 nm EELED Source</b>	Opt. 004	—
<b>Built-in 1550 nm EELED Source</b> Opt. 005	—	
<b>Wavelength Calibrator</b>	Opt. 006	Opt. 006
<b>Passive Component Test Application</b>	Included	Included
<b>Alternative Connector Interface</b> FC/PC	Standard	Standard
HMS-10	Opt. 011	Opt. 011
DIN	Opt. 013	Opt. 013
ST	Opt. 014	Opt. 014
SC	Opt. 017	Opt. 017
<b>Multimode Fiber Input</b> <sup>19</sup>	Opt. 025 (Agilent 86140A)	Opt. 025 (Agilent 86143A)
<b>Certificate of Calibration</b>	Included	Included

<sup>19</sup> 50 µm multimode input available on Agilent 86140A and 86143A OSAs only.

## Wavelength Calibrator Option 006

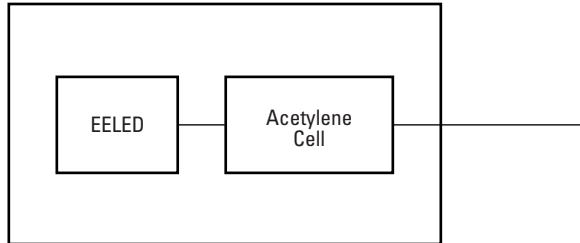


Figure 1. Wavelength calibrator block diagram

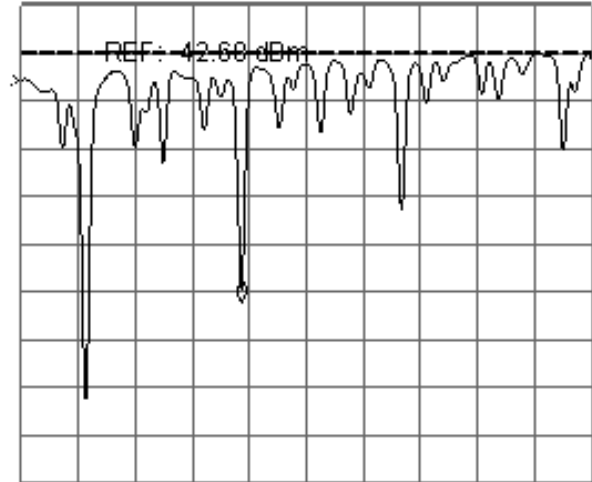


Figure 2. Wavelength calibrator absorption spectrum

The wavelength calibrator option provides an onboard wavelength reference that can be used to automatically calibrate the optical spectrum analyzer. The calibrator is based on an EELED and an Acetylene gas absorption cell, Figure 1. The Acetylene absorbs light at very specific wavelengths based on the molecular properties of gas. The cell is illuminated by an EELED and the OSA uses the absorption pits to perform a wavelength calibration, Figure 2. Since the absorption of the Acetylene gas is a physical constant it never needs calibrating.

The wavelength calibrator enhances the OSA to achieve better than  $\pm 50$  pm wavelength accuracy and removes the need to use a tunable laser source and multi-wavelength meter as an external reference.

<b>Benchtop OSA</b> Agilent 86140A/86142A	<b>Portable OSA</b> Agilent 86143A/86145A
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### Additional Parts and Accessories

<b>Printer Paper</b> (5 rolls / box)	9270-1370	9270-1370
<b>Additional Connector Interfaces</b>	See Agilent 81000 series	See Agilent 81000 series
<b>101/102 Keyboard</b> (OSA requires US layout)	C4735A	C4735A
<b>PS/2 Style Mouse</b>	C3751B	C3751B
<b>External 10 dB Attenuator</b> (FC/PC)	Opt. 030	Opt. 030
<b>Rack-mount Flange Kit</b>	Opt. AX4	N/A
<b>Transit Case</b>	9211-2657	9211-5604
<b>Soft Carrying Case</b>	N/A	Opt. 042
<b>BenchLink Lightwave Software</b> <sup>20</sup>	Standard	Standard

<sup>20</sup> Agilent N1031A BenchLink Lightwave allows transfer of measurement results over an GPIB Interface to a PC for the purposes of archiving, printing and further analysis.

### Literature Reference

**Brochure** (Agilent literature # 5968-1123E)

**Agilent 86140 Series Optical Spectrum Analysis Remote Programming.** Agilent product note (Agilent literature # 5968-1548E)

**Agilent Lightwave Catalog**

# 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.
- Reproducibility refers to the amount of wavelength drift which can occur over the specified time while the OSA is swept across a source of known 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.

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**<http://www.agilent.com/comms/lightwave>**

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Printed in U.S.A. 12/99  
5968-1124E



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