Agilent 8157xA Optical Attenuators

Technical Specifications
March 2006



Agilent's 8157xA Variable Optical Attenuators are instruments that attenuate and control the optical power level of light in optical fibers.
As plug-in modules for Agilent's Lightwave Solution platform (8163A/B, 8164A/B, 8166A/B) they allow you to set the attenuation factor and/or power level manually, or remotely via a common computer interface.
Their high accuracy combined with their flexibility makes them ideal as test and measurement equipment for the modern telecommunication industry.

Agilent Technologies

Modular Design for Lightwave Solution Platform

Agilent's 8157xA variable optical attenuators are a family of plug-in modules for Agilent's Lightwave Solution Platform 8163A/B, 8164A/B and 8166A/B. The attenuator modules 81570A, 81571A and 81578A occupy one slot, while modules 81576A and 81577A occupy two slots. With 17 slots, the Agilent 8166A/B Lightwave Multichannel System can host up to 17 single slot modules or up to 8 dual slot modules.

Variable Optical Attenuators



The Agilent 81570A, 81571A and 81578A are small, cost-effective attenuator modules with high resolution. They feature excellent wavelength flatness and can handle high input power levels. Combined with their low insertion loss, they are ideal for optical amplifier test, such as characterization of EDFAs and of Raman amplifiers, as well as for other multi-wavelength applications, such as DWDM transmission system test. Various calibration features allow the user to set a reference power. Both the attenuation and the power level, relative to the reference power, can then be set and displayed in the user interface. An integrated shutter, which can be used for protection purposes, or to simulate channel drops, is included.

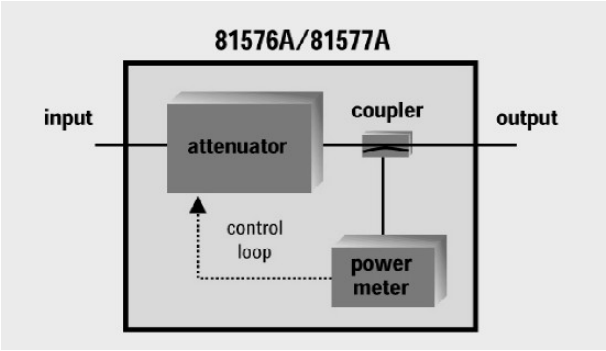
The multimode 81578A brings this performance to multimode test and can be ordered for 50 µm or 62.5 µm fiber.

Attenuators with Power Control

Agilent's 81576A and 81577A attenuators feature power control functionality that allows you to set the output power level of the attenuator. The attenuator module uses the feedback signal from a photodiode after a monitor tap, both integrated in the module, to set the desired power level at the output of the module. When the power control mode is enabled, the module automatically corrects power changes at the input to maintain the output level set by the user. After an initial calibration for the uncertainties at connector interfaces, absolute power levels can be set with high accuracy. The absolute accuracy of these power levels depends on the accuracy of the reference power meter used for calibration.



These modules also feature high power handling capability and excellent wavelength flatness for DWDM applications. To set a total power level of a multi-wavelength signal, it is necessary to determine the convolution of the signal's spectrum with the sensitivity of the photodiode over wavelength. An enhanced calibration feature supports this process and enables setting the integral power of a DWDM signal with a known spectrum.



Calibration Processes

Comprehensive offset functionality in the firmware enhances the calibration of the optical path in various test set-ups. There is an offset for the attenuation factor, and an independent offset for the output power level, to calibrate for losses due to the patch cords and connectors. Additionally, wavelength and offset value pairs can be stored in a table to compensate for wavelength dependent effects in the optical path of the set-up. This allows you to set the optical power level at your Device Under Test.

Calibration is even easier and more convenient if the reference power meter and the attenuator are hosted by the same mainframe: All power related offsets can be determined by a firmware function that reads a value from the reference power meter. The difference between the power value read by the reference power meter and the actual value of the attenuator is automatically stored as the offset.

Key Features

- High input powers up to 2 Watt
- Excellent wavelength flatness: typical ± 0.05 dB
- Low insertion loss: typical 0.7 dB
- Wide wavelength range: 1200 nm – 1700 nm (SM), 700 nm – 1400 nm (MM)
- High resolution: 0.001 dB
- Modular design allows up to 17 attenuators in one mainframe
- Active power control options to set power levels directly
- Comprehensive offsets allow easy calibration of the set-up
- Integrated shutter
- Agilent's versatile optical connector interfaces for all common types of connectors

Applications

- Bit error ratio test
- Characterization of transceivers, receivers, transmitters and line cards
- Test of single channel transmission systems
- DWDM channel equalization
- Loss simulation in fiber optic links
- Testing and calibrating the linearity of power meters
- Optical Amplifier Test
  - Characterization of EDFAs
  - Test of Raman amplifiers and SOAs
- Multi channel transmission system test
- Loss simulation of DWDM signals in fiber optic links



The Agilent 8157xA modules are produced to the ISO 9001 international quality system standard as part of Agilent's commitment to continually increasing customer satisfaction through improved quality control.

Variable Optical Attenuator Modules (Single Mode Fibers)

	81570A	81571A
Connectivity	straight connector versatile interface	angled connector versatile interface
Fiber type	9/125 μm SMF28	
Wavelength range	1200 nm – 1700 nm	
Attenuation range	0 – 60 dB	
Resolution	0.001 dB	
Repeatability [1]	± 0.01 dB	
Accuracy (uncertainty) [1], [2], [3], [4]	± 0.1 dB (at 1550 nm) typ. ± 0.1 dB (1250 nm – 1650nm)	
Settling time [5]	typ. 100 ms	
Transition speed	typ. 0.1 – 12 dB/s	
Attenuation flatness [1], [4], [6], [8]	± 0.07 dB; typ. ± 0.05 dB (1520 nm < λ < 1620 nm) typ. ± 0.10 dB (1450 nm < λ < 1640 nm)	
Spectral ripple [7]	typ. ± 0.003 dB	
Insertion loss [2], [4], [9], [10]	typ. 0.7 dB (excluding connectors) 1.6 dB; typ. 1.0 dB (including connectors) [11]	
Insertion loss flatness [1], [11]	typ. ± 0.1 dB (1420 nm < λ <1615 nm) [4]	
Polarization dependent loss [2], [11]	0.08 dBpp; typ. 0.03 dBpp (at 1550nm ± 15nm)	
Return loss [11]	typ. 45 dB (at 1550nm ± 15nm)	typ. 57 dB (at 1550nm ± 15nm)
Maximum input power [12]	+33 dBm	
Shutter isolation	typ. 100 dB	
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8″ x 1.3″ x 13.2″)	
Weight	0.9 kg	
Recommended recalibration period	2 years	
Operating temperature	10°C – 45°C	
Humidity	Non-condensing	
Warm-up time	30 minutes	

[1] At constant operating conditions
[2] Temperature within 23°C ± 5°C
[3] Input Power < +30 dBm
[4] For unpolarized light
[5] Step size < 1 dB, for full range: typ. 6 seconds
[6] Relative to reference at 0 dB attenuation
[7] Linewidth of source ≥ 100 MHz
[8] λ_{disp} set to 1550 nm; attenuation ≤ 20 dB;
for attenuation > 20 dB:
add typ. 0.01 dB (α [dB] – 20) for 1520 nm < λ < 1620 nm
add typ. 0.02 dB (α [dB] – 20) for 1450 nm < λ < 1640 nm
[9] For λ = 1550 nm ± 15 nm
[10] Add typ. 0.1 dB for λ = 1310 nm ± 15 nm
[11] Measured with Agilent reference connectors
[12] Agilent Technologies Deutschland GmbH assumes no responsibility for damages caused by scratched or poorly cleaned connectors.

Variable Optical Attenuator Modules with Power Control (Single Mode Fibers)

	81576A		81577A	
Connectivity	straight connector, versatile interface		angled connector, versatile interface	
Fiber type	9/125 μm SMF			
Wavelength range	1250 nm – 1650 nm			
Attenuation range	0 – 60 dB			
Resolution	0.001 dB			
	Attenuation Setting	Power Setting	Attenuation Setting	Power Setting
Repeatability	± 0.010 dB	± 0.015 dB [2]	± 0.010 dB	± 0.015 dB [2]
Accuracy (uncertainty) [1], [3], [4], [5]	± 0.1 dB		± 0.1 dB	
Settling time [6]	typ. 100 ms	typ. 300 ms	typ. 100 ms	typ. 300 ms
Transition speed	typ. 0.1 – 12 dB/s			
Relative power meter uncertainty [7], [8]	± 0.03 dB ± 200 pW			
Attenuation flatness [1], [5], [9], [10]	± 0.07 dB; typ. ± 0.05 dB (1520 nm < λ < 1620 nm) typ. ± 0.10 dB (1450 nm < λ < 1640 nm)			
Spectral ripple [11]	typ. ± 0.003 dB			
Insertion loss [3], [5], [12], [13]	typ. 0.9 dB (excluding connectors) 1.8 dB; typ. 1.2 dB (including connectors) [14]			
Insertion loss flatness [1], [14]	typ. ± 0.1 dB (1420 nm < λ < 1615 nm) [5]			
Polarization dependent loss [3], [12], [14]	0.10 dBpp; typ. 0.05 dBpp			
Return loss [12], [14]	typ. 45 dB		typ. 57 dB	
Maximum input power [15]	+ 33 dBm			
Shutter isolation	typ. 100 dB			
Dimensions (H x W x D)	75 mm x 64 mm x 335 mm (2.8″ x 2.6″ x 13.2″)			
Weight	1.3 kg			
Recommended recalibration period	2 years			
Operating temperature	10°C – 45°C			
Humidity	Non-condensing			
Warm-up time	30 minutes			

[1] At constant operating temperature
[2] Output power > -40 dBm, input power < +27 dBm. For input power > +27 dBm add typ. ± 0.01 dB
[3] Temperature within 23°C ± 5°C
[4] Input Power < +30 dBm; λ = 1550 nm ± 15 nm; typ. for 1250 nm < λ < 1650 nm
[5] For unpolarized light
[6] Step size < 1 dB; for full range: typ. 6 seconds
[7] Wavelength and SOP constant; temperature constant and between 23°C ± 5°C; λ < 1630 nm; 1s averaging time
[8] Output power >-45dBm,
input power ≤ 27dBm, for input power > + 27dBm add typ. ± 0.02dB
[9] Relative to reference at 0 dB attenuation
[10] λ_{disp} set to 1550 nm; attenuation ≤ 20 dB;
for attenuation > 20 dB:
add typ. 0.01 dB (α [dB] – 20) for 1520 nm < λ < 1620 nm
add typ. 0.02 dB (α [dB] – 20) for 1450 nm < λ < 1640 nm
[11] Linewidth of source ≥ 100 MHz
[12] For λ = 1550 nm ± 15 nm
[13] Add typ. 0.1 dB for λ = 1310 nm ± 15 nm
[14] Measured with Agilent reference connectors
[15] Agilent Technologies Deutschland GmbH assumes no responsibility for damages caused by scratched or poorly cleaned connectors.

Variable Optical Attenuator Modules (Multimode Fibers)

The specifications below are valid for constant operating and signal launch conditions.

	81578A #050	**81578A #062**
Connectivity	straight connector versatile interface	straight connector versatile interface
Fiber type	50/125 μm MMF	62.5/125 μm MMF
Wavelength range	700 nm – 1400 nm	
Attenuation range	0 – 60 dB	
Resolution	0.001 dB	
Repeatability [1] [2] [5]	± 0.015 dB	
Accuracy (uncertainty) [1] [2] [3] [4] [5]	typ. ± 0.15 dB (800 nm – 1350 nm) ± 0.2 dB (at 850 nm ± 15 nm, 1310nm ± 15 nm)	
Settling time [6]	typ. 100 ms	
Transition speed	typ. 0.1 – 12 dB/s	
Insertion loss [1] [2] [4] [5]	typ. 1.0 dB (NA = 0.1) typ. 1.3 dB (NA = 0.2) 2.0 dB (NA = 0.2)	typ. 1.0 dB (NA = 0.1) typ. 1.3 dB (NA = 0.2) 2.0 dB (NA = 0.2) typ. 3.0 dB (NA = 0.27)
Return loss [2] [5] [7]	typ. 27 dB	
Maximum input power [8]	+27 dBm	
Shutter isolation	typ. 100 dB	
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")	
Weight	0.9 kg	
Recommended recalibration period	2 years	
Operating temperature	10°C – 45°C	
Humidity	Non-condensing	
Warm-up time	30 minutes	

[1] At constant operating conditions
[2] Effective spectral bandwidth of source > 5 nm
[3] For mode launch conditions with NA = 0.2; for every ΔNA = 0.01 add typ. ± 0.01 dB
[4] Temperature within 23°C ± 5°C and unpolarized light
[5] At 850nm ± 15nm, 1310nm ± 15nm
[6] Step size < 1 dB, for full range: typ. 6 seconds
[7] The return loss is mainly limited by the return loss of the front panel connectors
[8] Agilent Technologies Deutschland GmbH assumes no responsibility for damages caused by scratched or poorly cleaned connectors.

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