Anritsu

MS9780A

Optical Spectrum Analyzer

0.6 to 1.75 μm

Supports fibers with core diameters of 50/62.5 μm

Compact High Performance

- 70 dB dynamic range
- –90 dBm guaranteed optical reception sensitivity
- Internal 3.5” FDD (Windows®)
- Optical pulse measurement
- Full range of WDM application functions
- Tracking with tunable laser source
- Supports fibers with core diameters of 50/62.5 μm

The MS9780A is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 0.6 to 1.75 μm wavelength band. The Anritsu MS9710B input section is redesigned to support fibers with core diameters of 50/62.5 μm, the input section of the Anritsu MS9710B can be used to measure the spectra of LDs and LEDs, etc. In addition to uses such as measurement of LD and LED spectra, it has functions for measuring the transmission characteristics of passive elements such as optical isolators, as well as the NF/Gain of optical fiber amplifier systems.
In addition to its basic features, the superior stability and reliability of the diffraction grating (patent pending) easily pass the severe specifications required for precise measurement of WDM communications methods, particularly in the 1.55 μm band. This analyzer has the dynamic range, reception sensitivity and sweep speed requested by users, backed by Anritsu’s high-level technology. The high sensitivity meets the exacting demands placed on today’s measuring instruments. In particular, the excellent wavelength and level specifications fully meet the dense WDM requirements in the 1.55 μm band. In addition to the high reliability and excellent basic performance, this analyzer has a full range of application functions to support accurate measurement in the fastest possible time.

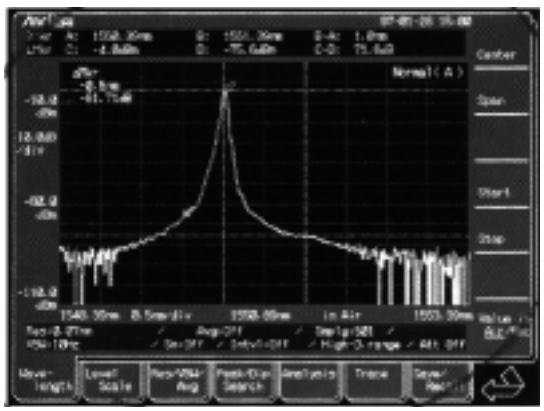
●70 dB dynamic range

The measurement dynamic range of the MS9780A in the normal measurement mode at a wavelength 1 nm from the peak wavelength is 62 dB. In the high-dynamic range measurement mode, better than 70 dB can be achieved. The analyzer demonstrates its excellence in SMSR measurement of DFB-LDs, as well as in evaluation of narrow-band optical band pass filters.

Measurement mode	Dynamic range (at SM fiber)	
	1 nm from peak	0.5 nm from peak
High dynamic range	70 dB	60 dB
Normal	62 dB	58 dB

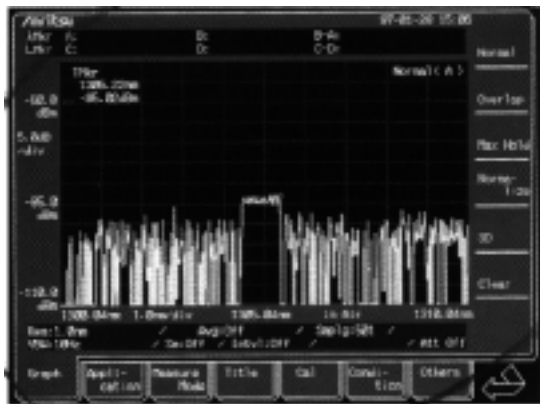
Wide-dynamic range measurement example with DFB-LD spectrum passed via narrow-band BPF.

DFB-LD — Narrow-band BPF — MS9780A

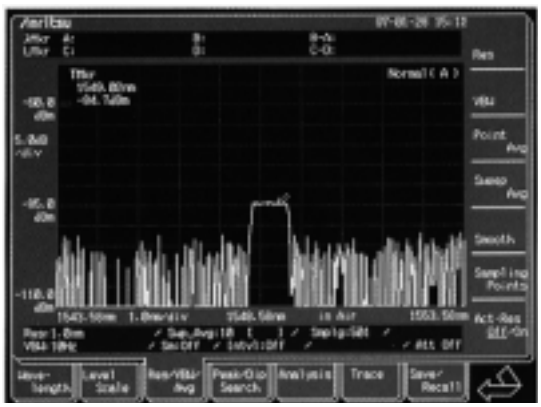


●–90 dBm guaranteed optical reception sensitivity

The MS9780A has achieved an improved S/N over a wide range by taking thorough countermeasures to noise and stray light. The RMS noise level at wavelengths from 1.25 to 1.6 μm is –90 dBm max. The screen display below is the waveform obtained when measuring a 1.55 μm DFB-LD optical source of –85 dBm; only 25 seconds are required for the measurement.



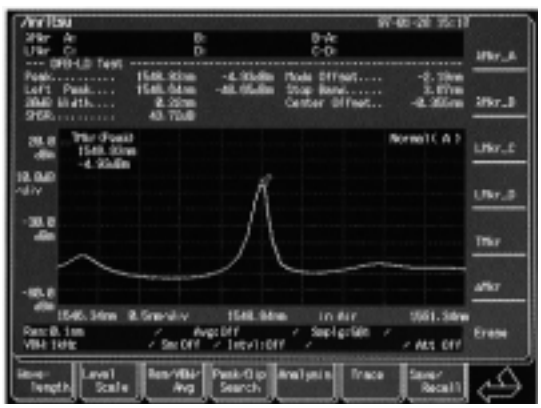
In addition, the S/N can be improved using sweep averaging. The screen display below shows the waveform after 10 averagings; the S/N is improved by more than 5 dB.



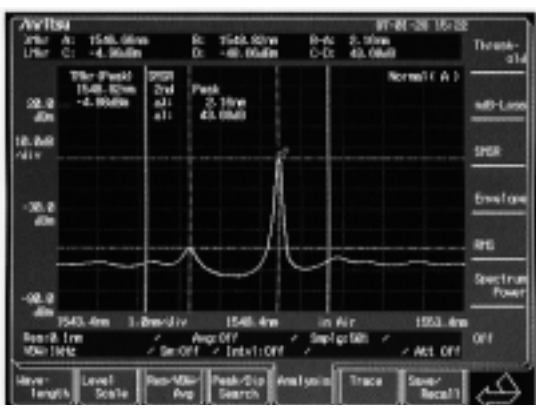
●Full function lineup

In addition to its excellent basic functions, the MS9780A comes with a full lineup of other useful functions summarized in the following table.

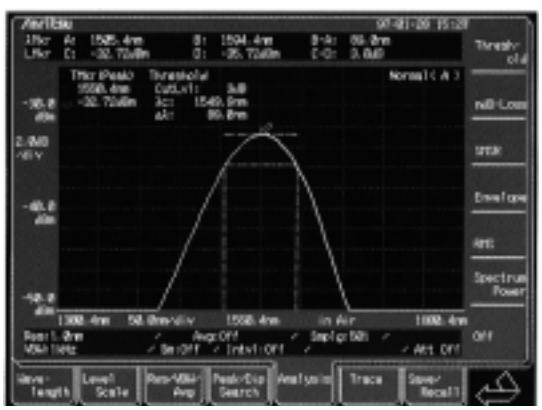
Device analysis	For analyzing and evaluating waveforms of optical elements (DFB-LDs, FP-LDs, LEDs)
Waveform analysis	For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis
Application measurement	EDFA NF and gain measurement, PMD measurement (See applications.)
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz (See applications.)
Markers	Multimarkers: Marker function for max. 50 points (See applications.) Zone markers: For waveform analysis in zone specified zone Peak/dip search: Searchs for a peak or dip
Power monitor	Also functions as optical power meter
Vacuum wavelength	Converts displayed wavelength to value in display vacuum
External interfaces	GPIB, RS-232C



DFB-LD waveform analysis



Waveform analysis in zone marker



Half-width measurement by threshold method

●Relying on 1.55 μm transmission band

As a result of the need for increased transmission capacity, R&D into large-capacity transmission techniques is becoming more active and Wavelength Multiplexing (WDM) is nearly at the stage of actual usage. This WDM transmission technology requires quantitative measurement of the wavelength transmission characteristics between each channel. Measuring instruments for this purpose require much more accurate wavelength and level measurement. Furthermore, accurate measurement of fiber-amplifier NF requires extremely good polarized light dependency and level linearity specifications.

The MS9780A design has achieved excellent wavelength and level specifications for this purpose in the 1.53 to 1.57 μm wavelength band. In particular, the wavelength accuracy can be calibrated automatically using an optional internal reference wavelength light source; the post-calibration accuracy is better than ±0.05 nm. Evaluation of WDM systems requires measurement without repeated calibration at each measurement and the MS9780A achieves high-accuracy measurement with high repeatability.

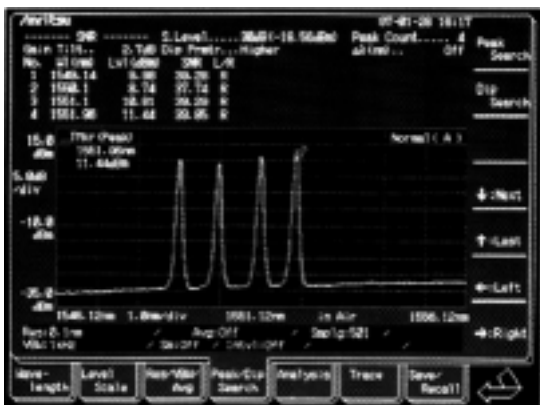
1.53 to 1.57 µm specifications

Wavelength accuracy	±0.05 nm (after calibration with optional wavelength reference light source)
Wavelength linearity	±0.02 nm
Wavelength resolution	0.07 nm (only SM fiber) 0.1 nm (GI fiber)
Polarized light dependency	±0.15 dB
Level linearity	±0.1 dB (0 to –50 dBm)

Applications for Every Need

●Spectrum analysis for WDM communication systems

Difficult problems in WDM transmission technology are the wavelength characteristics for the gain, and signal to noise ratio (SNR) between each channel. In evaluation, it is very important to measure this quantitatively. The MS9780A permits extremely quick and simple waveform analysis of up to 50 spectra. The waveform and level (SNR) of each peak exceeding the set threshold is displayed. The screen display below shows an example of the tilt gain.

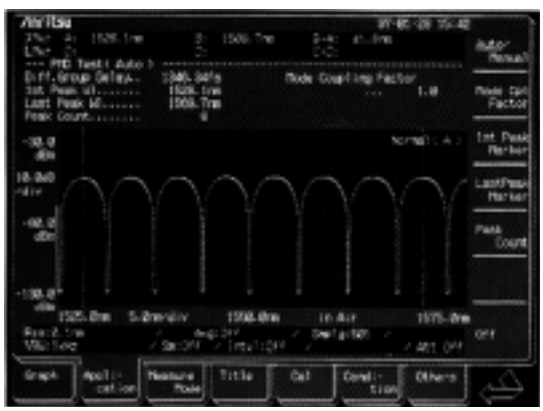


●Polarization mode dispersion

An important factor determining the upper limit of the transmission bit rate is the polarization mode dispersion (PMD). PMD is measured in the time and wavelength domains. The MS9780A can be used as a fixed analyzer to perform simple and automated measurement in the wavelength domain and immediately computes the PMD by data processing from the measured waveform. The wavelength difference ($\lambda_2 - \lambda_1$) between the peak wavelength (λ_1) and the wavelength at the Nth peak (λ_2) are read directly and the PMD is calculated from the following equation.

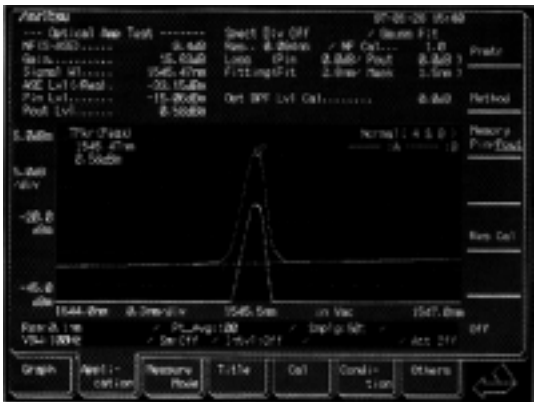
$$PMD = K \frac{N-1}{C} \times \frac{\lambda_1 - \lambda_2}{\Delta\lambda}$$

where: K is the mode coupling factor and C is the speed of light (m/s).



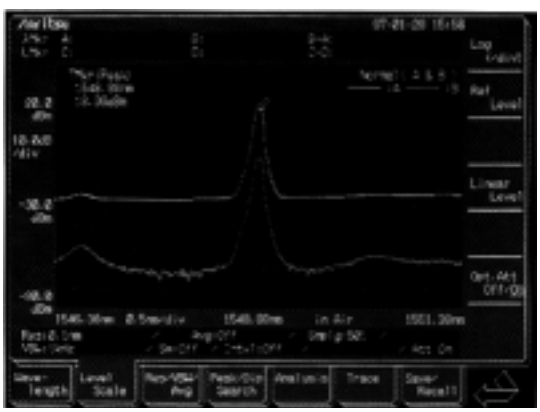
●NF measurement of fiber amplifier (EDFA)

NF measurement by the optical method using an optical spectrum analyzer measures the light input and output to and from the EDFA. NF is determined by the beat noise between the optical signal and the Amplified Spontaneous Emission (ASE) as well as by the beat noise between the ASE. Since the MS9780A measures the ASE level with very high accuracy, three methods can be used to measure NF: 1. Pulse measurement (JIS Method: under discussing), 2. Level calibration using fitting, and 3. Polarized light nulling. Moreover, measurement can be performed with the required dynamic range, level linearity and polarization dependency.



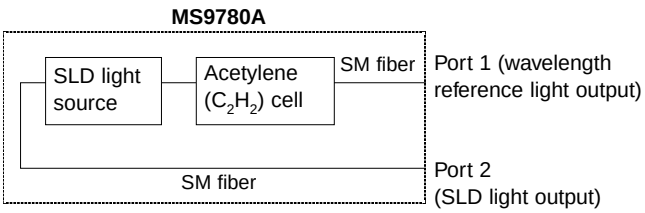
●Built-in attenuator for high-power optical sources

When the built-in attenuator is added, optical inputs of up to +20 dB can be measured. And since the attenuation is automatically corrected internally, there is no need for the user to calibrate the measurement. The screen display below shows the measurement of a +20 dB optical spectrum amplified by an EDFA.



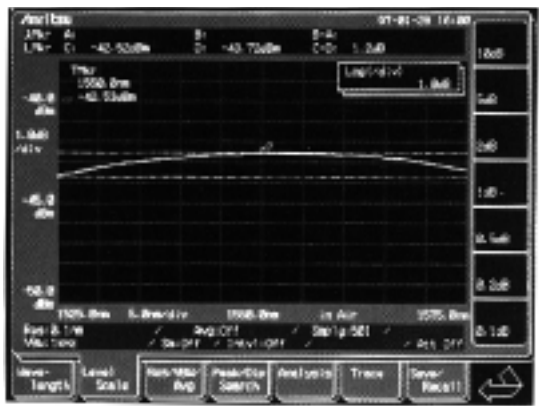
●Convenient light source option (refer wavelength light) for better accuracy

Any one of the wavelength reference & SLD light source (Option 03), SLD light source (Option 04), reference wavelength light source (Option 05), and white light source (Option 02) can be installed in the MS9780A.
The block diagram of the wavelength reference & SLD light source option is shown below. This option has two separate output ports: the Port 1 for wavelength calibration, and the Port 2 for measuring transmission characteristics. When the MS9780A is calibrated automatically by inputting the reference light for the wavelength, post-calibration wavelength accuracy in the 1.52 to 1.57 μm range is better than ±0.05 nm. This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.

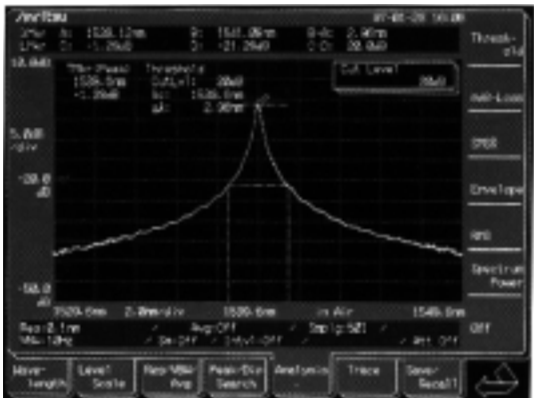


Block diagram of wavelength reference & SLD light

The following diagram shows the spectrum of the SLD light output from Port 2. When this light source is used instead of the earlier white light source for measurement of the wavelength transmission characteristics of optical receiver elements, it is possible to achieve a 20 dB wider dynamic range.

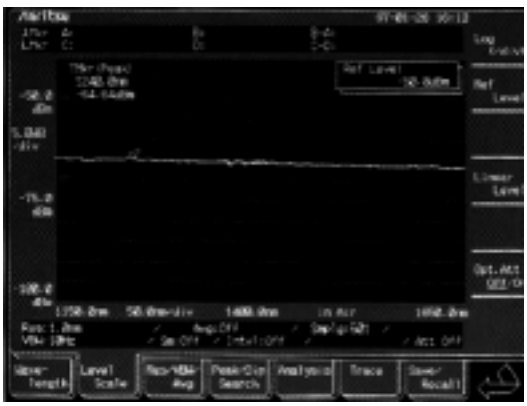


The following figure shows an example of measuring the transmission characteristics of optical band pass filter using the SLD light.



Measurement of optical band pass filter

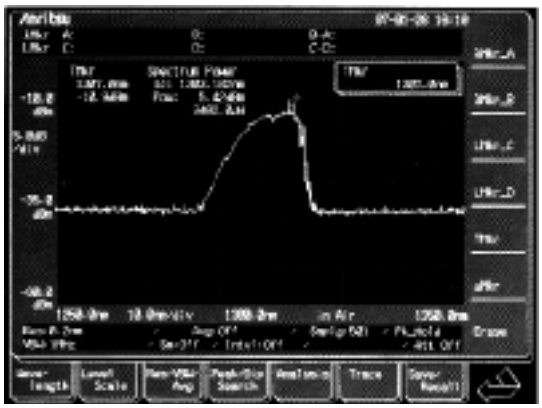
If this dynamic range is not required, a lower-cost white light source can be installed instead. The following figure shows the spectrum of the white light source. When this light is used, transmission characteristics can be measured in wide range of 900 to 1750 nm.



Spectrum of white light source

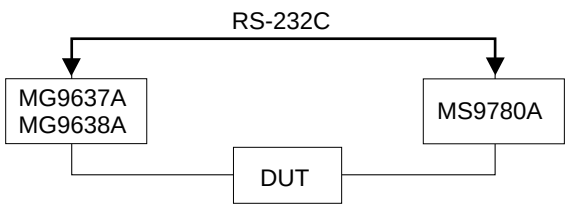
●Measurement of modulated and pulsed light

The synchronization signal for the measured modulated/ pulsed light is input to the external input trigger on the rear panel. With this analyzer, the data can be held by this sync signal. As a result, the spectrum of the modulated or pulsed light can be measured accurately without data loss.
In addition, an optical source that does not have a sync signal can be measured in the same manner by setting an appropriate gate time. The waveform in the diagram on the below shows measurement of an optical pulse (OTDR's light source) with a pulse width of 1 µs and a duty of 1%. However, for accurate spectrum measurement, the VBW must be set to a wider bandwidth than the modulation frequency of the measured light. The maximum settable VBW in the MS9780A is 1 MHz. (Refer to the specifications for the relationship between VBW, received light sensitivity and sweep time.)



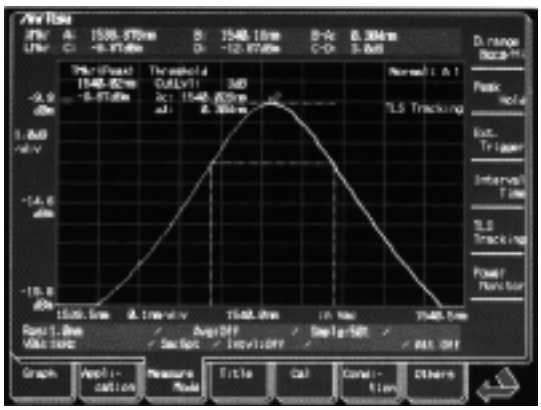
●Tracking with tunable laser source

This function eliminates the need for an external controller. As shown below, tracking operation is achieved by connecting the MG9637A/9638A and MS9780A with an RS-232C cable. This setup is very convenient for measuring the wavelength transmission characteristics of wide dynamic range optical elements.

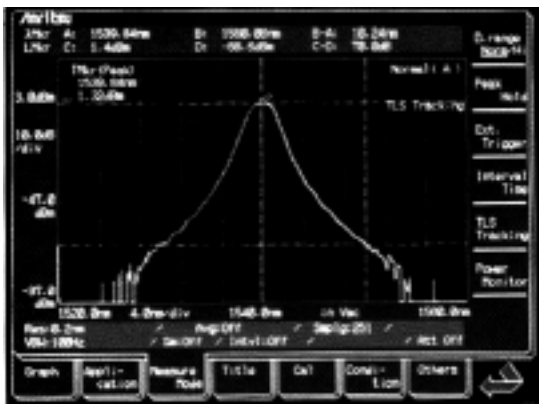


Tracking MG9637A/9638A and MS9780A

Measurement is performed using the MS9780A soft keys; the analyzer's marker, trace and smoothing functions permit easy analysis of measurement results, including transmission loss, full width half maximum (FWHM) stop-band loss characteristics.
Screens A and B below show measurement examples for a dielectric filter with a center wavelength of 1540 nm. Screen A shows the FWHM measurement; since the wavelength repeatability is better than ±7 pm, the FWHM can be measured with very high accuracy. Screen B shows a pass band and stop band loss characteristics. Measurement is possible at a wide dynamic range of better than 70 dB when the MS9780A resolution bandwidth is set 0.2 nm.



Screen A: FWHM measurement example



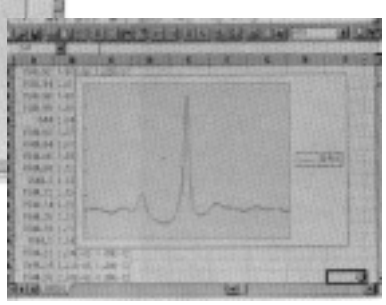
Screen B: Wide dynamic range measurement example

● **Easy-to-read color TFT-LCD**

● **Thermal printer built-in**
The MS9780A screen display can be hard-copied at high speed the internal printer, as well as output to an external printer via the GPIB.

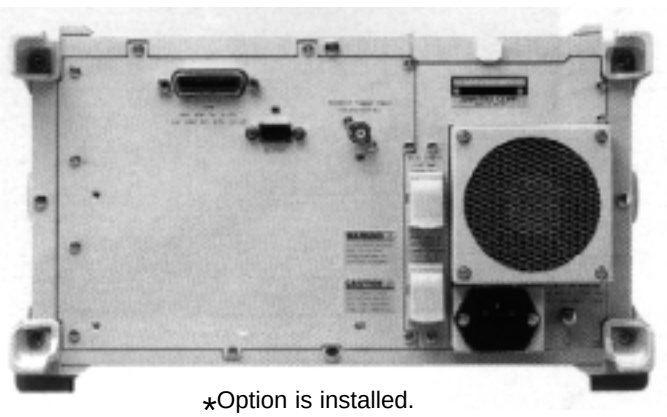
⁎**Pictures actual size**

● **3.5” internal FDD**
In addition to saving and recalling measurement data, etc., waveforms saved to floppy disk can be easily and directly read by a personal computer. The PC screen shown on the right is displaying an image of the MS9780A screen saved to floppy disk. Screen images can be saved to FD media and output as Windows® bitmap-format files. In addition, since the data can be output in text-file format, it can be manipulated easily using spreadsheet software.



● **Basic measurement direct keys**
Frequently-used high function keys can be set directly at these hard keys. Even a novice can perform basic measurements easily using these keys.

● **Cleanable optical input connector**
Six connector types can be used: FC/PC, DIN, ST, SC, HMS-10/A, E2000. (optical return loss of 32 dB min.) The input connector can be removed and refitted easily for fast cleaning.



*Option is installed.

Specifications

●MS9780A

Fiber	SM (9.5/125 μm), GI (50/125 μm)*1, GI (62.5/125 μm)*1
Wavelength	Range : 600 to 1750 nm Sweep width: 0, 0.2 to 1200 nm Accuracy: ±0.3 nm (600 to 1750 nm, after wavelength calibration with external light source) ±0.05 nm (1550 ±20 nm, resolution: 0.07 to 0.2 nm, after calibration with wavelength reference light source option)*2 ±0.1 nm (1550 ±20 nm, resolution: 0.5/1.0 nm, after calibration with wavelength reference light source option)*2 Stability: ±5 pm (1 minute)
Resolution	Setting: 0.07*2, 0.1, 0.2, 0.5, 1.0 nm Accuracy*2,*3: ±30% (1300/1550 nm, resolution: 0.1 nm), ±15% (1300/1550 nm, resolution: 0.2 nm), ±7% (1300/1550 nm, resolution: 0.5 nm)
Level	Measurement range (attenuator: off, 0° to +30°C): –65 to +10 dBm (600 to 1000 nm), –85 to +10 dBm (1000 to 1250 nm), –90 to +10 dBm (1250 to 1600 nm), –75 to +10 dBm (1600 to 1700 nm), –55 to +10 dBm (1700 to 1750 nm, +10° to +30°C) Measurement range (attenuator: on, 0° to +30°C): –65 to +20 dBm (1100 to 1650 nm) Accuracy*2: ±0.6 dB (1300/1500 nm, –23 dBm, resolution: ≥0.2 nm) Stability*2: ±0.1 dB (1550 nm, –23 dBm, resolution: ≥0.2 nm, 1 minute) Linearity*2: ±0.1 dB (1550 nm, –50 to 0 dBm) Polarization dependency*2: ±0.15 dB (1300/1500 nm, resolution: ≥0.5 nm) Dynamic range*2 Normal mode: 62 dB (±1 nm), 58 dB (±0.5 nm) ⁎1550 nm, resolution: 0.07 nm Wide dynamic range mode: 70 dB (±1 nm), 60 dB (±0.5 nm) ⁎1550 nm, resolution: 0.07 nm, 25° ±5°C Return loss*2: 32 dB (1300/1550 nm)
Sweep	Sweep width: 0, 0.2 to 1200 nm Sweep speed (typical*4): 0.5 s (sweep width: 500 nm, normal mode measurement, VBW: 10 kHz)
Display	6.4” color TFT-LCD
Memory	A, B (2 trace), 3.5” FDD (for Windows®)
Printer	Internal (thermal type)
Interface	GPIB, RS-232C
Main functions	Optical pulse measurement, power monitor, wavelength auto-calibration
Operating conditions	Operating temperature: 0° to +50°C (FDD: 5° to 50°C), Storage temperature: –20° to +60°C, Relative humidity: ≤90% (no condensation)
Power	85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)
Dimensions and mass	320(W) × 177(H) × 350(D) mm, ≤16.5 kg
EMC*5	EN55011: 1991, Group 1, Class A EN50082: 1992

*1: The NA of GI fiber is 0.2 for a core diameter of 50/125 μm and 0.275 for 62.5/125 μm. However, the permissible NA is 0.1 due to the spectroscope limitations.
*2: Connects to SM fiber (10/125 μm)
*3: Effective resolution valure
*4: Typical value for reference; not guaranteed specification
*5: Electromagnetic Compatibility

●White light source (Option 02)

Optical output	≥–59 dBm/1 nm (typical value: –55 dBm/1 nm)
Wavelength range	900 to 1600 nm
Operating temperature	18° to 28°C

●Wavelength reference & SLD light source (Option 03)

Optical output	≥–40 dBm/1 nm (single mode/fiber input)
Wavelength range	1540 to 1560 nm
Operating temperature	15° to 30°C
Wavelength reference	1.53 μm band Acetylene

●SLD light source (Option 04)

Optical output	≥–40 dBm/nm (single mode/fiber input)
Wavelength range	1540 to 1560 nm
Operating temperature	15° to 30°C

●Reference wavelength light source (Option 05)

Wavelength reference	1.53 μm band Acetylene

●VBW, sweep speed, minimum light reception sensitivity*6

VBW	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Sweep speed (typ.)	30 s	5 s	0.5 s	0.5 s	0.5 s	0.5 s
Minimum light reception sensitivity*7	–90 dBm	–80 dBm	–70 dBm	–60 dBm	–50 dBm	–40 dBm

*6: Data for reference; not guaranteed specifications (except tracking with MG9637A/9638A)
*7: RMS noise level (1.25 to 1.6 μm)

Note: Warm-up to the MS9780A for about 5 minutes to ensure stable operation. The above specifications were obtained 2 hours after power-on.

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS9780A	Optical Spectrum Analyzer	
	Standard accessories	
	Optical connector adapter *1:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (for 100 Vac system):	2 pcs
F0010	Fuse, 1.6 A (for 200 Vac system):	2 pcs
Z0312	Printer paper:	2 rolls
W1477AE	MS9780A operation manual:	1 copy
W1478AE	Remote control operation manual:	1 copy
MX978001S	LabVIEW® driver (RS-232C):	1
MX978001G	LabVIEW® driver (GPIB):	1
B0239G	Front cover:	1 pc
	Options	
MS9780A-02	White light source*2	
MS9780A-03	Wavelength reference & SLD light source*2	
MS9780A-04	SLD light source*2	
MS9780A-05	Reference wavelength light source*2	
MS9780A-06	Monitor output (VGA output)*3	
MS9780A-27	E2000 (Diamond) connector*3	
MS9780A-37	FC connector*4	
MS9780A-38	ST connector*4	
MS9780A-39	DIN connector*4	
MS9780A-40	SC connector*4	
MS9780A-43	HMS-10/A (Diamond) connector*4	

Model/Order No.	Name
	Application parts
J0654A	RS-232C cable 9P-9P
J0655A	RS-232C cable 9P-25P
J0007	GPIB cable, 1m
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A)
J0619B	Replaceable optical connector (SC)
J0635B	Optical fiber cord, 2 m
J0893B	FC·PC-FC·PC-2M-GI (50/125 µm)
J0894B	FC·PC-FC·PC-2M-GI (62.5/125 µm)
J0203	Optical fiber cord with lens attached to end (50 µm core diameter), 2 m
J0204	Optical fiber cord with lens attached to end (200 µm core diameter), 2 m
Z0282	Ferrule cleaner (Cletop A type, 1 pc)
Z0283	Tape for ferrule cleaner (6 pcs/set)
Z0284	Cleaner for optical adapter (stick-type, 200 pcs/set)
B0336C	Hard carrying case
B0330C	Tilt stand

*1: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified, the FC connector (MS9780A-37) is supplied as standard.
*2: Factory options; Two units cannot be installed simultaneously. Exchageable-type optical connectors (FC, ST, DIN, HMS-10/A) are supplied when specified at ordering. One conversion cord is supplied for connecting other optical connectors to the FC connector.
*3: Factory option
*4: User replaceable

Note:
Windows® is a registered trademark of Microsoft Corporation.
LabVIEW® is a registered trademark of National Instruments.

Anritsu

Specifications are subject to change without notice.

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