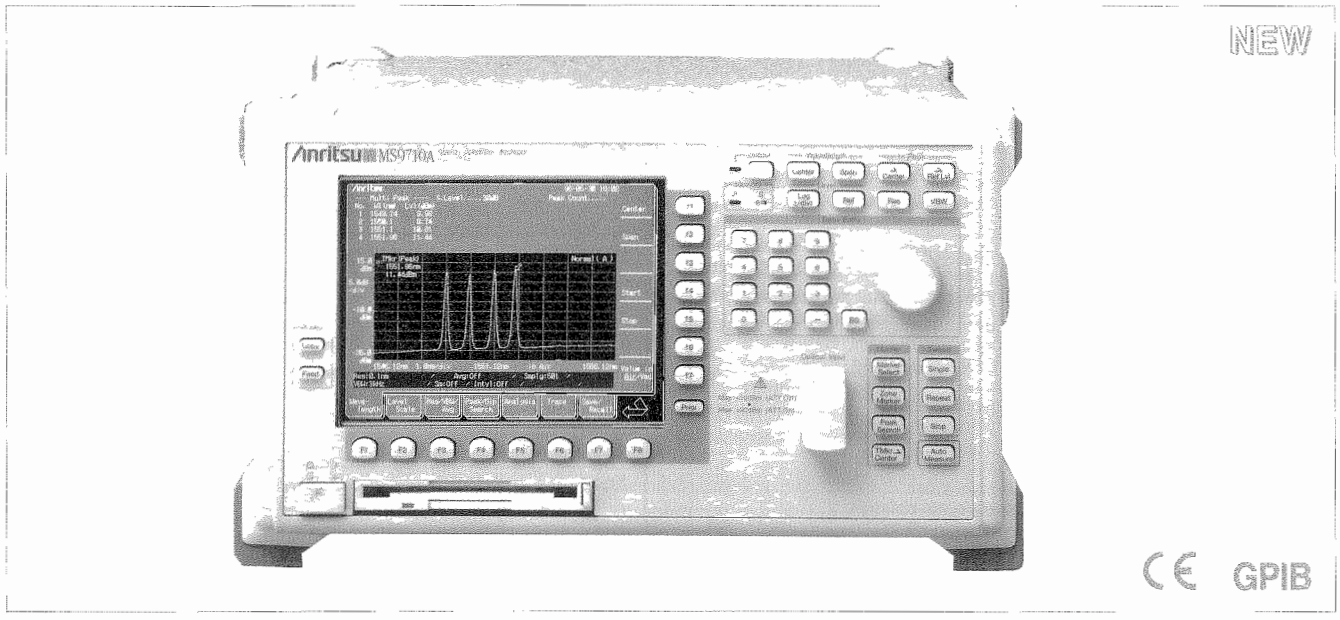
OPTICAL SPECTRUM ANALYZER
MS9710A
0.6 to 1.75 µm



The MS9710A is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 0.6 to 1.75 µm wavelength band. 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 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 having a much wider dynamic range, its compact portability (approx. 50% lighter) eliminates the large cumbersome image of earlier analyzers by perfectly combining portability with high performance. 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.

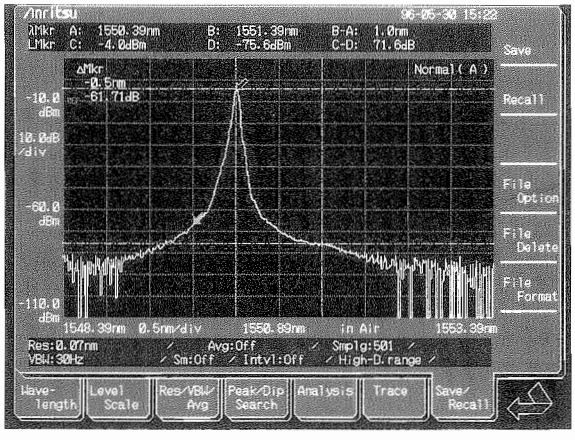
Features

- 70 dB dynamic range
- −90 dBm guaranteed optical reception sensitivity
- Internal 3.5" FDD (Windows®)
- Optical pulse measurement
- Full range of WDM application functions

Performance and functions

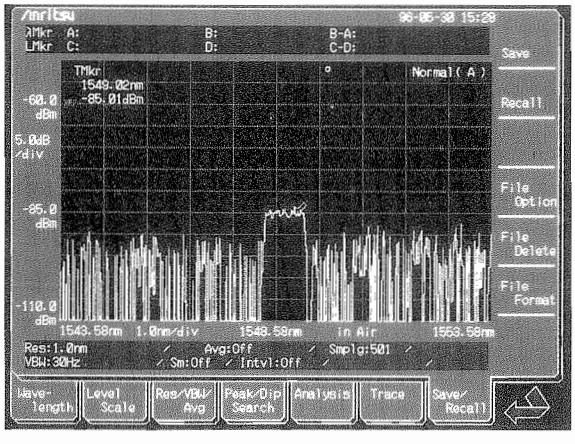
● 70 dB dynamic range

The measurement dynamic range of the MS9710A 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.



● −90 dBm guaranteed optical reception sensitivity

The MS9710A 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.



● Full function lineup

In addition to its excellent basic functions, the MS9710A 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
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 Peak/dip search: Searches for a peak or dip
Power monitor	Also functions as optical power meter
Vacuum wavelength display	Converts displayed wavelength to value in vacuum
External interfaces	GPIB, RS-232C

● 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 Division 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.

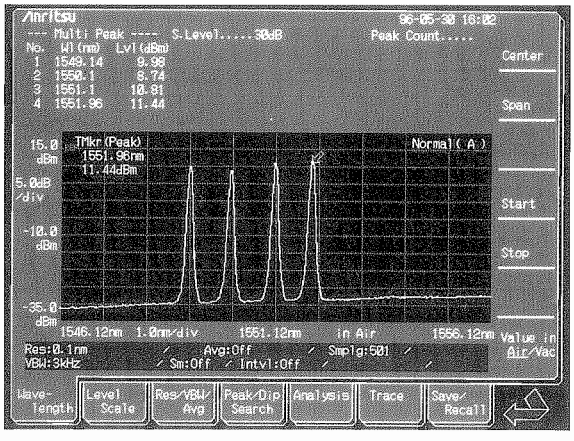
Measuring instruments for this purpose require much more accurate wavelength and level measurement. Furthermore, accurate measurement of fiber-amplifier NF requires extremely good polarized light dependency and level linearity specifications.

The MS9710A 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 MS9710A achieves high-accuracy measurement with high repeatability.

Applications

● Four wave mixing for WDM

One of the most difficult problems in WDM transmission technology is the wavelength characteristics for the gain and transmission between each channel. In evaluation, it is very important to measure this quantitatively. The MS9710A permits extremely quick and simple waveform analysis of up to 50 spectra using multimarkers. The waveform and level of each peak exceeding the set threshold is displayed. The screen display below shows an example of the tilt gain occurring due to the effect of four wave mixing.



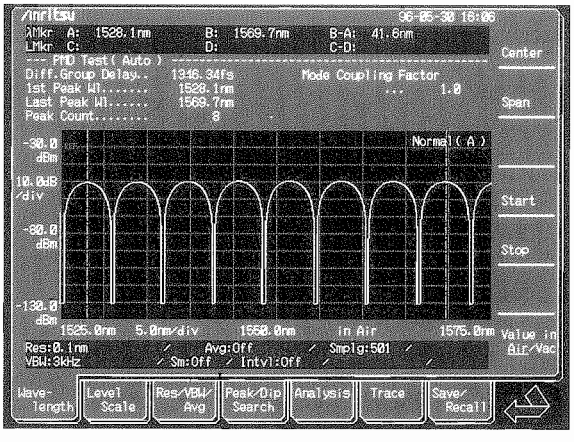
● Polarization mode dispersion

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 MS9710A 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 ($\lambda 1$) and the wavelength at the Nth peak ($\lambda 2$) are read directly and the PMD is calculated from the following equation.

$$PMD = K \frac{N-1}{C} \times \frac{\lambda 1 \cdot \lambda 2}{\Delta \lambda}$$

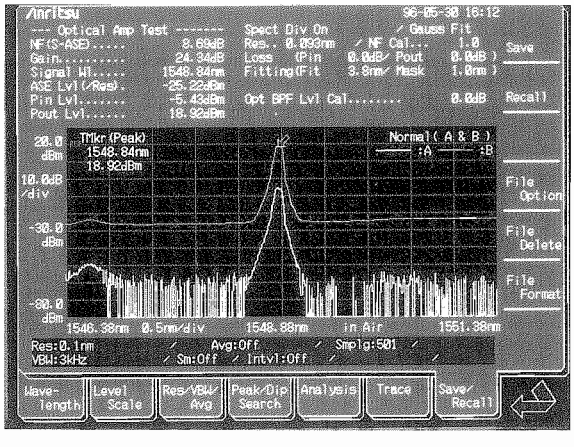
where: K is the mode coupling factor and C is the speed of light (m/s).



● NF measurement of fiber amplifier (EDFA)

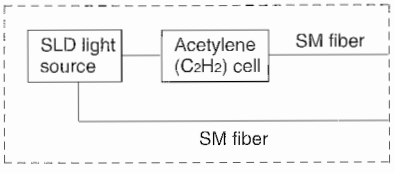
NF measurement by the optical method using an optical spectrum analyzer measures the light input and output to and from the EDFA. NF is determined by the beat noise between the optical signal and the Amplified Spontaneous Emission (ASE) as well as by the beat noise between the ASE.

Since the MS9710A 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.



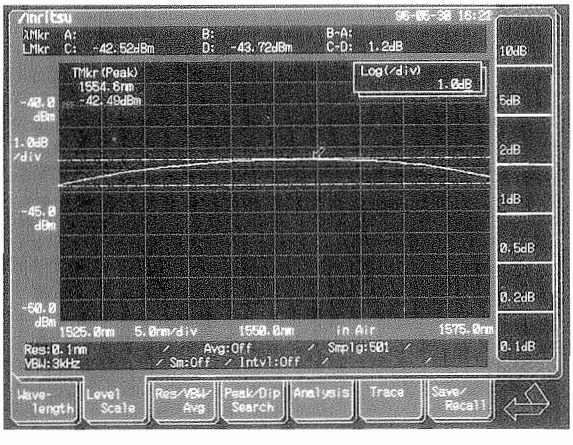
● Convenient light source option (reference wavelength or white light) for better accuracy

An optional reference wavelength light source or a white light source can be installed in the MS9710A. The following figure shows the block diagram for the reference wavelength light source. There are two reference optical output ports. Port 1 outputs the reference light for wavelength calibration. Port 2 outputs the level reference light (SLD light source) for measuring the transmission characteristics. When the MS9710A is calibrated automatically by inputting the reference light for the wavelength, post-calibration wavelength accuracy in the 1.53 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 reference wavelength light source

The following diagram shows the spectrum of the SLD light source 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.



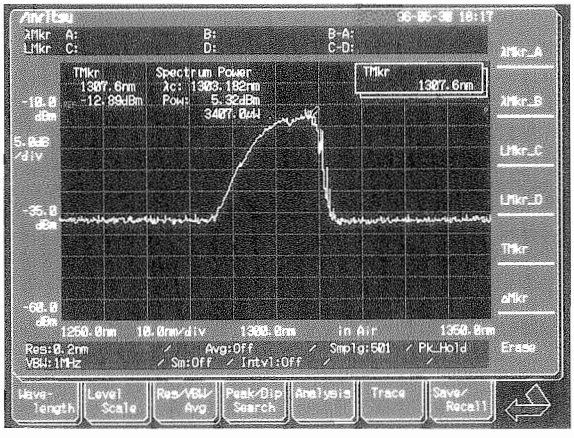
Spectrum of SLD light source

● 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 right 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 MS9710A is 1 MHz. (Refer to the specifications for the relationship between VBW, received light sensitivity and sweep time.)



Specifications

● MS9710A

Fiber	10/125 μm SM fiber (ITU-T G.652)
Optical connector*1	User replaceable: FC, SC, ST, DIN, HMS-10/A Factory option (not user replaceable): E2000 (Diamond), EC (Radial), FC-APC, SC-APC, HRL-10
Wavelength	Range: 600 to 1750 nm Accuracy: ±0.2 nm (1530 to 1570 nm, after wavelength calibration) ±0.3 nm (600 to 1750 nm, after wavelength calibration) ±0.05 nm (1530 to 1570 nm, resolution: 0.07 to 0.2 nm, after calibration with wavelength reference light source option) ±0.1 nm (1530 to 1570 nm, resolution: 0.5 to 1 nm, after calibration with wavelength reference light source option) Stability: ±5 pm (smoothing: 11 points, 1 minute, at half-width center wavelength) Linearity: ±20 pm (1530 to 1570 nm) Resolution: 0.07, 0.1, 0.2, 0.5, 1 nm Resolution accuracy*2: ±10% (1530 to 1570 nm, resolution: 0.1 nm), ±5% (1530 to 1570 nm, resolution: 0.2 nm), ±3% (1530 to 1570 nm, resolution: 0.5 nm), ±30% (at other conditions)
Level	Measurement range: −65 to +10 dBm (600 to 1000 nm, +10° to +30°C, VBW: 10 Hz, sweep averaging: 10 times) −85 to +10 dBm (1000 to 1250 nm, +10° to +30°C, VBW: 10 Hz, sweep averaging: 10 times) −90 to +10 dBm (1250 to 1600 nm, +10° to +30°C, VBW: 10 Hz, sweep averaging: 10 times) −75 to +10 dBm (1600 to 1700 nm, +10° to +30°C, VBW: 10 Hz, sweep averaging: 10 times) −55 to +10 dBm (1700 to 1750 nm, +10° to +30°C, VBW: 10 Hz, sweep averaging: 10 times) −65 to +20 dBm (1100 to 1600 nm, attenuator: on) Accuracy: ±0.4 dB (1550 nm, −23 dBm, resolution: ≧0.1 nm, constant temperature, no polarization shift) Stability: ±0.02 dB (1550 nm, −23 dBm, resolution: ≧0.1 nm, 1 minute, constant temperature, polarization must be unchanged) Linearity: ±0.05 dB (1550 nm, 0 to −50 dBm) Flatness: ±0.1 dB (1530 to 1570 nm)

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Polarization dependency	±0.05 dB (1.55 μm band, resolution: ≧0.5 nm), ±0.1 dB (1.3 μm band, resolution: ≧0.5 nm)
Dynamic range	70 dB (±1 nm, resolution: 0.07 nm, 1.55 μm band, high-dynamic range mode measurement, 20° to 30°C) 60 dB (±0.5 nm, resolution: 0.07 nm, 1.55 μm band, high-dynamic range mode measurement, 20° to 30°C) 62 dB (±1 nm, resolution: 0.07 nm, 1.55 μm band, normal mode measurement) 58 dB (±0.5 nm, resolution: 0.07 nm, 1.55 μm band, normal mode measurement)
Optical return loss	≧35 dB (1.3/1.55 μm band)
Sweep	Sweep width: 0, 0.2 to 1200 nm Sweep speed*3 (typical): 0.5 s (sweep width: 500 nm, normal mode measurement, VBW: 10 kHz)
Display	6.4" color TFT-LCD
Memory	A, B (2 traces), 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	177H × 320W × 350D mm, ≦16.5 kg
EMC*4	EN55011: 1991, Group 1, Class A EN50082-1: 1992

*1: One of these connector is attached. Please specify when ordering.
*2: Actual screen resolution, 0° to 30°C
*3: Typical value for reference; not guaranteed specification
*4: Electromagnetic compatibility

● White light source (Option 02)

Optical output	≧−59 dBm/1 nm (multimode/fiber input)
Wavelength range	900 to 1600 nm
Operating temperature	18° to 28°C

Warm-up to the MS9710A for about 5 minutes to ensure stable operation.
The above specifications were obtained 2 hours after power-on.

● 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

● VBW, sweep speed, minimum light reception sensitivity*1

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*2	−90 dBm	−80 dBm	−70 dBm	−60 dBm	−50 dBm	−40 dBm

*1: Data for reference; not guaranteed specifications
*2: RMS noise level (1.25 to 1.6 μm)

Ordering information

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

Model/Order No.	Name	
	Main frame	
MS9710A	Optical Spectrum Analyzer	
	Standard accessories	
	Optical connector adaptor*1:	1 pc
J0017	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
W1145AE	MS9710A operation manual:	1 copy
W1146AE	Remote control operation manual:	1 copy
MX971001S	LabVIEW® driver (RS-232C):	1
MX971001G	LabVIEW® driver (GPIB):	1
B0329G	Front cover:	1 pc
	Options	
MS9710A-02	White light source*2	
MS9710A-03	Wavelength reference & SLD light source*2	
MS9710A-25	FC-APC connector*3	
MS9710A-26	SC-APC connector*3	
MS9710A-27	E2000 (Diamond) connector*3	
MS9710A-31	EC (Radial) connector*3	
MS9710A-37	FC connector*4	
MS9710A-38	ST connector*4	
MS9710A-39	DIN connector*4	
MS9710A-40	SC connector*4	
MS9710A-43	HMS-10/A (Diamond) connector*4	
MS9710A-47	HRL-10 connector*3	

Model/Order No.	Name
	Application parts
J0654A	RS-232C cable 9P-9P
J0655A	RS-232C cable 9P-25P
J0007	GPIB cable, 1 m
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)
J0575	Optical fiber cord, 2 m
Z0282	Ferrule cleaner
Z0283	Tape for ferrule cleaner
Z0284	Cleaner for optical adapter
W1147BE	MS9710A service manual I
W1148BE	MS9710A service manual II
B0336C	Hard carrying case

*1: Specify one of FC, SC, ST, DIN, HMS-10/A (Diamond), E2000 (Diamond), EC (Radial), FC-APC, SC-APC, HRL-10.
*2: Factory options. Cannot be installed simultaneously.
Supplied with same optical connector (1 pc) as main frame, when the connector type is not specified.
*3: Factory option
*4: User replaceable

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