

## OPTICAL SPECTRUM ANALYZER MS9710C 600 to 1750 nm



### High Performance for DWDM Optical Communications



The MS9710C is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 600 to 1750 nm 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 NF/Gain of optical fiber amplifier systems.

In addition to its basic features, the superior stability and reliability of the diffraction grating (patent pending) offer the severe level and wavelength specifications particularly in the WDM 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 (1520 to 1620 nm).

The MS9710C Optical Spectrum Analyzer is the successor to the popular MS9710B but with improved functions and higher performance. The specifications have been upgraded for the important 1.55  $\mu\text{m}$  band for WDM communications and have also been optimized to include the new requirements for L-band (1570 to 1620 nm) use. 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

- Wavelength accuracy of  $\pm 20$  pm (C-band) and  $\pm 50$  pm (L-band)
- Dynamic range of 42 dB (0.2 nm from peak wavelength), 70 dB (1 nm from peak wavelength)
- WDM measurement of wavelength, level, and SNR for up to 128 channels

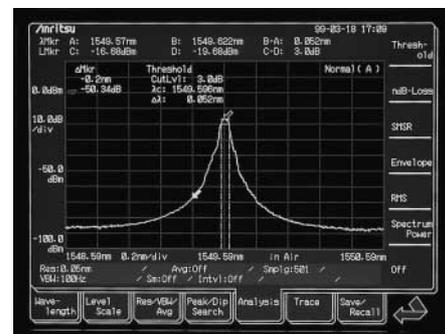
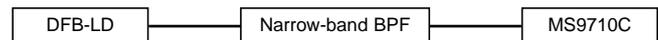
### Performance and applications

#### • 70 dB dynamic range

The dynamic range at 0.2 nm from the peak wavelength is better than 42 dB and is a high 58 dB min. at 0.4 nm from the peak, permitting high-accuracy measurement of DWDM systems with a 50 GHz (0.4 nm) channel spacing. The analyzer demonstrates its excellence in SNR measurement of WDM light sources, as well as in evaluation of narrow-band optical band pass filters.

Distance from peak wavelength	0.2 nm	0.4 nm	1 nm
Normal dynamic range mode	42 dB (45 dB typical)	58 dB	62 dB
High dynamic range mode	42 dB (45 dB typical)	60 dB	70 dB

High-dynamic range measurement example with DFB-LD spectrum passed via narrow-band Band-Pass Filter (BPF).



#### • Relying on WDM transmission

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 now in use. This WDM transmission technology requires quantitative measurement of the signal quality and wavelength transmission characteristics of each channel.

Measuring instruments for this purpose require highly-accurate wavelength and level measurements. Furthermore, accurate measurement of fiber-amplifier NF requires extremely good polarization dependant loss characteristics and level linearity specifications.

The MS9710C design achieves excellent wavelength and level specifications for this purpose in the 1520 to 1620 nm wavelength band and also in the extended band (L-band) to 1620 nm. In particular, the wavelength accuracy can be calibrated automatically using an optional internal reference wavelength light source; the post-calibration accuracy is better than  $\pm 20$  pm.

## Specifications for WDM application

Mainframe, option	MS9710C	With Option 15*2
Wavelength accuracy*1	±20 pm (1530 to 1570 nm) ±50 pm (1520 to 1600 nm)	±20 pm (1520 to 1620 nm)
Wavelength resolution	50 pm (FWHM of internal optical BPF)	
Resolution accuracy	≤±3% (1530 to 1570 nm, resolution: 0.2 nm)	≤±3% (1520 to 1620 nm, resolution: 0.2 nm)
Level flatness to wavelength	±0.1 dB (1530 to 1570 nm) ±0.3 dB (1520 to 1620 nm)	±0.1 dB (1520 to 1620 nm)
Polarization dependency	±0.05 dB (1550/1600 nm)	
Level linearity	±0.05 dB (1550 nm)	±0.05 dB (1550/1600 nm)
	-50 to 0 dBm (ATT: off), -30 to +20 dBm (ATT: on)	

\*1: After calibration with optical reference wavelength light source

\*2: L-band enhancement

## Full function lineup

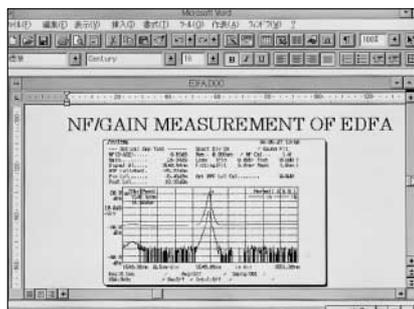
In addition to its excellent basic functions, the MS9710C comes with a full lineup of other useful functions summarized in the following table.

Device analysis	For analyzing and evaluating waveforms of optical devices (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, polarization mode dispersion measurement
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz
Markers	Multimarkers: Marker function for max. 300 points Zone markers: For waveform analysis within zone Peak/dip search: Searches for a peak or dip
Power monitor	Also functions an optical power meter
Vacuum wavelength display	Converts displayed wavelength to value in vacuum
External interfaces	GPIB, RS-232C, VGA monitor output

## • 3.5 inch 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.

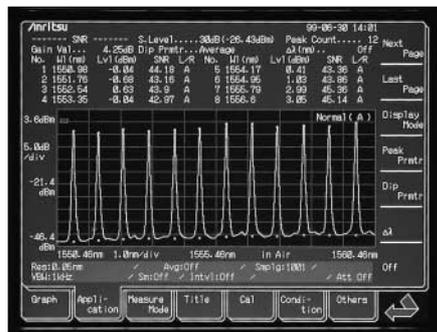
The PC screen shown on the right is displaying an image of the MS9710C screen saved to floppy disk. Screen images can be saved to FD media and output as Windows® bitmap-format files. In addition, since the data can be output in text-file format, it can be manipulated easily using spreadsheet software.



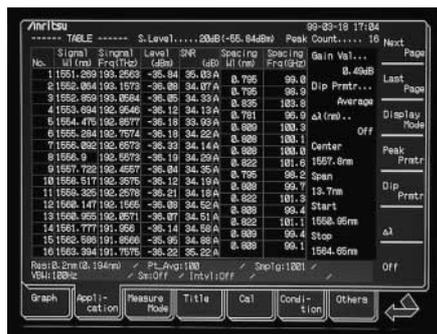
## • Spectrum analysis for WDM communication systems

The wavelength, level, and SNR of up to 300 WDM channels can be analyzed.

A new noise level left/right average function (shown below) has been added to a SNR measurement. In addition, the noise level is normalized to a per nm figure. Accurate SNR measurement can be achieved due to the high-resolution accuracy of the MS9710C.



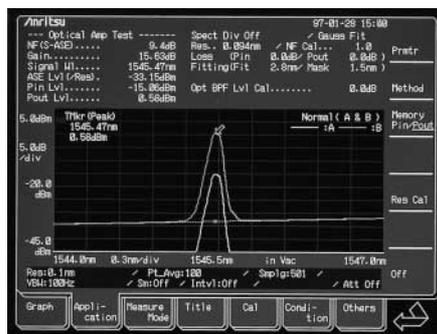
The measurement results described above can be switched to a table display that can be saved and recalled in text format. Both the wavelength and frequency are shown in the table.



## • NF measurement of fiber amplifier (EDFA)

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

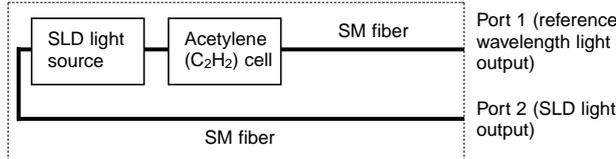
Since the MS9710C measures the ASE level with very high accuracy, three methods can be used to measure NF: 1. Pulse measurement (JIS: under discussion), 2. Level calibration using fitting, and 3. Polarization nulling. Moreover, measurement can be performed with the required dynamic range, level linearity, and polarization dependency.



• **Convenient light source option, including reference wavelength light source for better accuracy**

Any one of the Wavelength reference & SLD light source (Option 13), SLD light source (Option 14), Wavelength reference light source (Option 05), and White light source (Option 02) can be installed in the MS9710C.

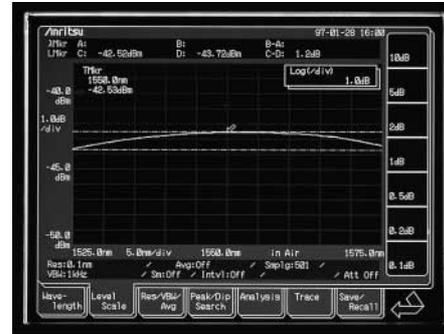
The block diagram of the SLD light source & Reference wavelength light source option is shown below. This option has two separate output ports: Port 1 for wavelength calibration, and the Port 2 for measuring transmission characteristics. When the MS9710C is calibrated automatically by inputting the reference wavelength light source, post-calibration wavelength accuracy in the 1520 to 1620 nm range is better than  $\pm 20$  pm (Option 15). This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.



Block diagram of SLD light source & Reference wavelength light

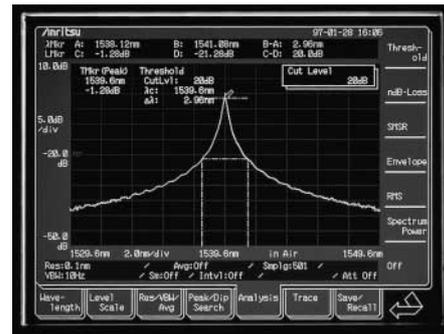
The following diagram shows the spectrum of the SLD light source output from Port 2.

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

The following figure is a measurement example of the transmission characteristics of an optical band pass filter using the SLD light source.



Measurement of optical bandpass filter

If this dynamic range is not required, a lower-cost white light source can be installed instead.

## Specifications

Main frame, option	MS9710C	With Option 15 (L-band enhancement)	
Applicable optical fiber	10/125 $\mu$ m SM fiber (ITU-T G.652)		
Optical connector*1	User replaceable (FC, SC, ST, DIN, HMS-10/A), factory option (E2000, FC-APC, SC-APC, HRL-10)		
Wavelength	Measurement range	600 to 1750 nm	
	Accuracy	$\pm 20$ pm (1530 to 1570 nm)*2, $\pm 50$ pm (1520 to 1600 nm)*2	
		$\pm 200$ pm (1530 to 1570 nm)*3, $\pm 300$ pm (600 to 1750 nm)*3	
	Stability	$\pm 5$ pm	
	Linearity	$\pm 20$ pm (1530 to 1570 nm)	
	Resolution	0.05, 0.07, 0.1, 0.2, 0.5, 1.0 nm (RBW: 3 dB optical filter; transmission bandwidth)	
	Read resolution	5 pm	
Resolution*4	$\leq \pm 2.2\%$ (1530 to 1570 nm, resolution: 0.5 nm) $\leq \pm 3\%$ (1530 to 1570 nm, resolution: 0.2 nm) $\leq \pm 7\%$ (1530 to 1570 nm, resolution: 0.1 nm) $\leq \pm 4\%$ (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.5 nm) $\leq \pm 5\%$ (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.2 nm) $\leq \pm 10\%$ (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.1 nm)	$\leq \pm 2.2\%$ (1520 to 1620 nm, resolution: 0.5 nm) $\leq \pm 3\%$ (1520 to 1620 nm, resolution: 0.2 nm) $\leq \pm 7\%$ (1520 to 1620 nm, resolution: 0.1 nm)	
	$\leq \pm 7\%$ (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.5 nm) $\leq \pm 15\%$ (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.2 nm) $\leq \pm 30\%$ (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.1 nm)		

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Main frame, option	MS9710C	With Option 15 (L-band enhancement)	
Level	Measurement range	-65 to +10 dBm (600 to 1000 nm, 0 to +30°C, optical ATT: off) -85 to +10 dBm (1000 to 1250 nm, 0 to +30°C, optical ATT: off) -90 to +10 dBm (1250 to 1600 nm, 0 to +30°C, optical ATT: off) -75 to +10 dBm (1600 to 1700 nm, 0 to +30°C, optical ATT: off) -55 to +10 dBm (1700 to 1750 nm, 0 to +30°C, optical ATT: off) -60 to +10 dBm (600 to 1000 nm, +30 to +50°C, optical ATT: off) -80 to +10 dBm (1000 to 1250 nm, +30 to +50°C, optical ATT: off) -85 to +10 dBm (1250 to 1600 nm, +30 to +50°C, optical ATT: off) -70 to +10 dBm (1600 to 1700 nm, +30 to +50°C, optical ATT: off) -50 to +10 dBm (1700 to 1750 nm, +30 to +50°C, optical ATT: off) -70 to +23 dBm (1100 to 1600 nm, 0 to +30°C, optical ATT: on) -65 to +23 dBm (1100 to 1600 nm, +30 to +50°C, optical ATT: on) [Resolution: $\geq 0.07$ nm, VBW: 10 Hz, sweep average: 10 times]	
	Accuracy	$\pm 0.4$ dB (1300/1550 nm, input: -23 dBm, resolution: $\geq 0.1$ nm)	
	Stability	$\pm 0.02$ dB (1 min, resolution: $\geq 0.1$ nm, input: -23 dBm, no polarization fluctuation)	
	Flatness	$\pm 0.1$ dB (1530 to 1570 nm, resolution: 0.5 nm, optical ATT: off) $\pm 0.3$ dB (1520 to 1620 nm, resolution: 0.5 nm, optical ATT: off)	$\pm 0.1$ dB (1520 to 1620 nm, resolution: 0.5 nm, optical ATT: off)
	Linearity	$\pm 0.05$ dB (1550 nm, -50 to 0 dBm, optical ATT: off) $\pm 0.05$ dB (1550 nm, -30 to +20 dBm, optical ATT: on)	$\pm 0.05$ dB (1550/1600 nm, -50 to 0 dBm, optical ATT: off) $\pm 0.05$ dB (1550/1600 nm, -30 to +20 dBm, optical ATT: on)
Polarization dependency	$\pm 0.05$ dB (1550/1600 nm), $\pm 0.1$ dB (1300 nm) *Setting resolution: $\geq 0.5$ nm		
Dynamic range*5	High-dynamic range mode (20° to 30°C): 70 dB (1 nm from peak wavelength), 60 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength) Normal mode (20° to 30°C): 62 dB (1 nm from peak wavelength), 58 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength)		
Optical return loss	$\geq 35$ dB (1300/1550 nm)		
Sweep	Sweep width: 0, 0.2 to 1200 nm Sweep speed (typical)*6 : 0.5 s (normal dynamic mode, sweep width: 500 nm, VBW: 10 kHz, center wavelength: 1200 nm, sweep start to stop, no optical input, sampling point: 501)		
Display	6.4 inch, color TFT-LCD		
Memory	A/B (2 trace), 3.5 inch FDD (for MS-DOS® format)		
Printer	Internal (thermal type)		
Interface	GPIB, RS-232C, VGA output		
Operating conditions	Operating temperature: 0° to +50°C (FDD: +5° to +50°C), storage temperature: -20° to +60°C, Relative humidity: $\leq 90\%$ (no condensation, FDD: 20 to 80%) Shock: 30 G, 11 ms pulse, half sine		
Power	85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)		
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, $\leq 16.5$ kg		
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)		
LVD	EN61010-1: 2001 (Pollution Degree 2)		

\*1: One of these connector is attached. Please specify when ordering.

\*2: After WI cal (ref) at wavelength reference optical light source (Option 05/13), resolution: 0.05 to 0.2 nm

\*3: After WI cal (Ext) at DFB-LD and soon external optical light source

\*4: Actual screen resolution, 0° to +30°C

\*5: Setting resolution: 0.05 nm, wavelength: 1550 nm, optical attenuator: off

\*6: Typical value for reference; not guaranteed specification

### 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 (501 points no averaging; not guaranteed specifications)

\*2: RMS noise level (1250 to 1600 nm)

Note: Warm-up the MS9710C for about 5 min. to ensure stable operation. The above specifications were obtained 2 hours after power-on.

### White light source (Option 02)

Optical output	$\geq -59$ dBm/nm (multimode fiber input)*1
Wavelength range	900 to 1600 nm
Operating temperature	+18° to +28°C

\*1: -65 dBm (typ) measured with MS9710C (at 1 nm wavelength resolution) which has single-mode fiber at the input.

### Wavelength reference light source (Option 05)

Wavelength reference	1530 nm band Acetylene
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### Wavelength reference & SLD light source (Option 13)

Wavelength range	1450 to 1650 nm
Output level	>−40 dBm/nm (1550 nm ±10 nm) >−60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710C setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0° to 40°C
Wavelength reference	1530 nm band Acetylene

\*1: Measured after one hour warm-up

### SLD light source (Option 14)

Wavelength range	1450 to 1650 nm
Output level	>−40 dBm/nm (1550 nm ±10 nm) >−60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710C setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0° to 40°C

\*1: Measured after one hour warm-up

### Ordering information

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

Model/Order No.	Name
MS9710C	<b>Main frame</b> Optical Spectrum Analyzer
	<b>Standard accessories</b>
	Optical connector adapter*1: 1 pc
	Power cord, 2.5 m: 1 pc
	Printer paper: 2 rolls
Z0312	MS9710C operation manual: 1 copy
W1579AE	Remote control operation manual: 1 copy
W1580AE	LabVIEW® driver (RS-232C): 1 pc
MX971003S	LabVIEW® driver (GPIB): 1 pc
MX971003G	Front cover: 1 pc
B0329G	
	<b>Options</b>
MS9710C-02	White light source*2
MS9710C-05	Wavelength reference light source*2
MS9710C-13	Wavelength reference & SLD light source*2
MS9710C-14	SLD light source*2
MS9710C-15	L-band enhancement
MS9710C-25	FC-APC connector*3
MS9710C-26	SC-APC connector*3
MS9710C-27	E2000 connector*3
MS9710C-31	EC (Radial) connector*3
MS9710C-37	FC connector*4
MS9710C-38	ST connector*4
MS9710C-39	DIN connector*4
MS9710C-40	SC connector*4
MS9710C-43	HMS-10/A connector*4
MS9710C-47	HRL-10 connector*3
	<b>Application parts</b>
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)
J0635B	FC-PC · FC-PC 2M-SM (FC-PC optical fiber cord, 2 m, SM)
Z0282	Ferrule cleaner
Z0283	Replacement reel for ferrule cleaner (for Z0282)
Z0284	Cleaner for optical adapter (stick type)
G0084A	Polarization rotation module (for PMD measurement)
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 (MS9710C-37) is supplied as standard.

\*2: Factory options; Two units cannot be installed simultaneously. Exchangeable-type optical connectors (FC, SC, 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

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