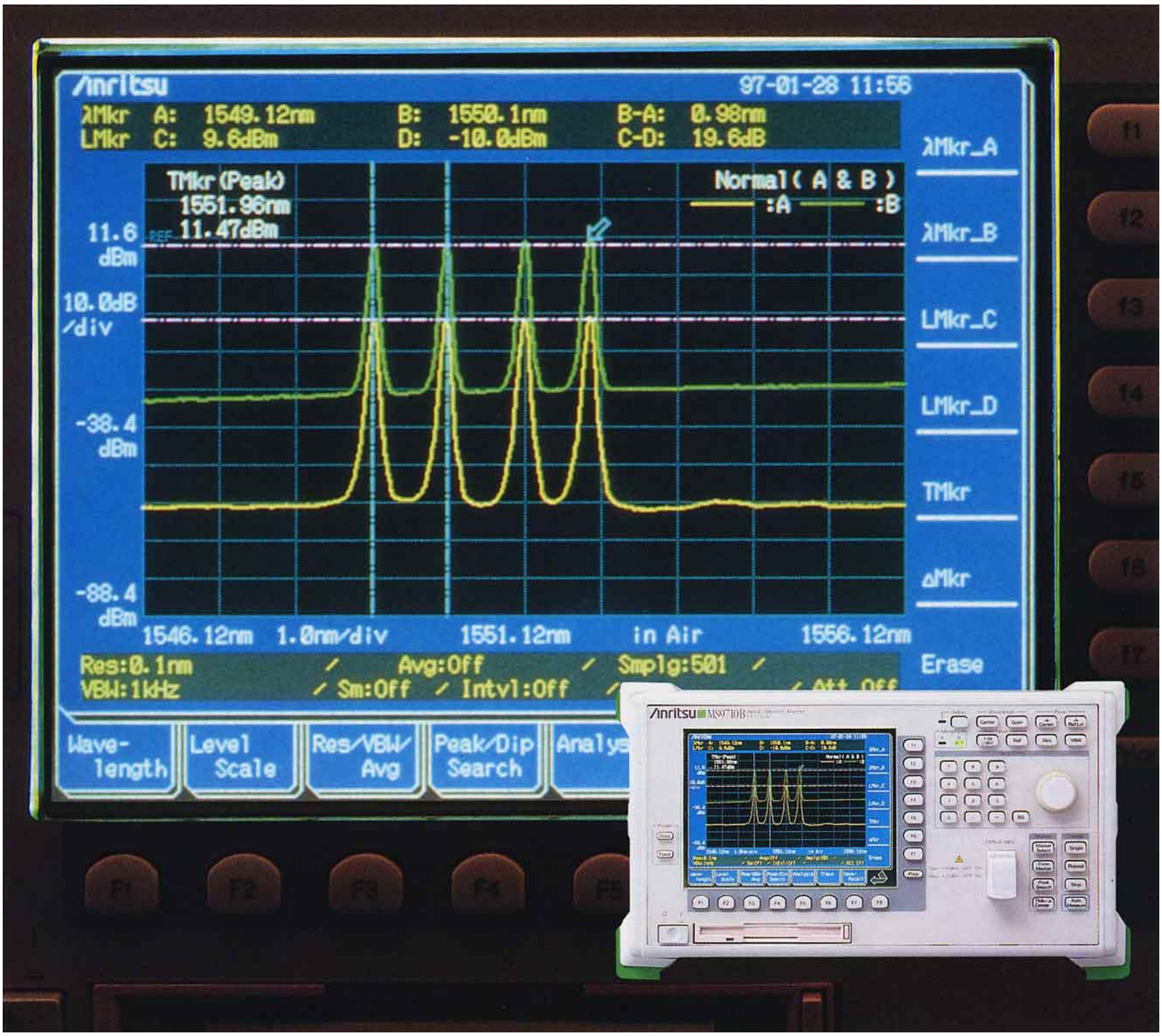
Anritsu

# MS9710B

## Optical Spectrum Analyzer

0.6 to 1.75 μm




*High-Performance, Portable Optical Spectrum Analyzer*

# Compact High Performance

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

The MS9710B 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.

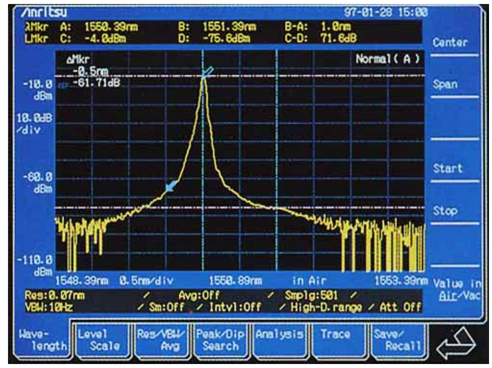
## 70 dB dynamic range

The measurement dynamic range of the MS9710B 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 | |
|---|---|---|
| | 1 nm from peak | 0.5 nm from peak |
| High dynamic range | 70 dB | 60 dB |
| Normal | 62 dB | 58 dB |

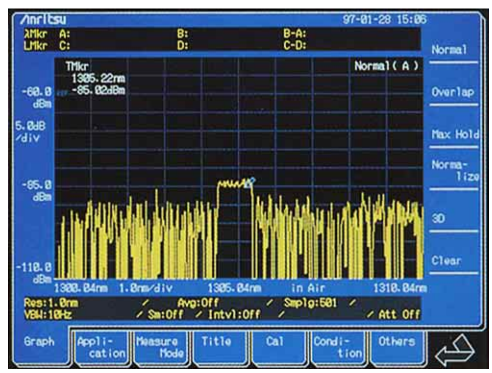
High-dynamic-range measurement example with DFB-LD spectrum passed via narrow-band BPF.

DFB-LD — Narrow-band BPF — MS9710B

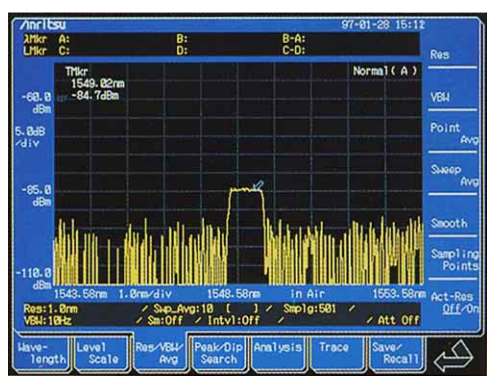



## –90 dBm guaranteed optical reception sensitivity

The MS9710B 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.



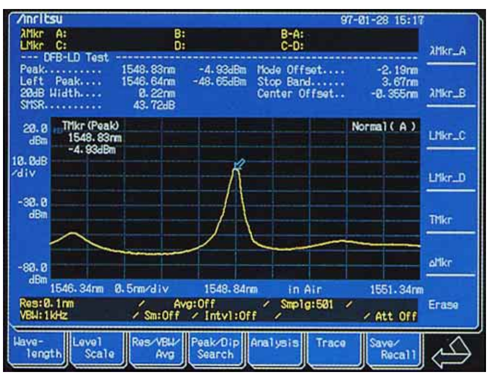

In addition, the S/N can be improved using sweep averaging. The screen display below shows the waveform after 10 averagings; the S/N is improved by more than 5 dB.



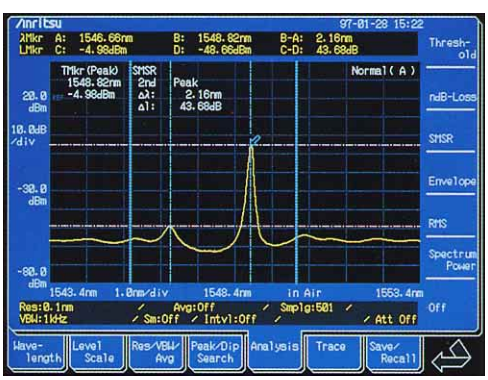
## Full function lineup

In addition to its excellent basic functions, the MS9710B comes with a full lineup of other useful functions summarized in the following table.

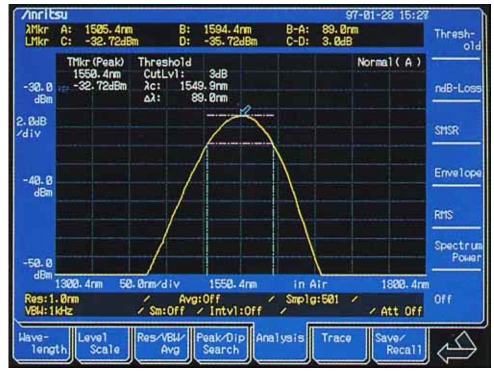
| | |
|---|---|
| Device analysis | For analyzing and evaluating waveforms of optical elements (DFB-LDs, FP-LDs, LEDs) |
| Waveform analysis | For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis |
| Application measurement | EDFA NF and gain measurement, PMD measurement (See applications.) |
| Modulation, pulsed light measurement | Max. frequency range (VBW) = 1 MHz (See applications.) |
| Markers | Multimarkers: Marker function for max. 128 points (See applications.)<br>Zone markers: For waveform analysis in zone<br>Peak/dip search: Search 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 |



DFB-LD waveform analysis



Waveform analysis in zone marker



Half-width measurement by threshold method

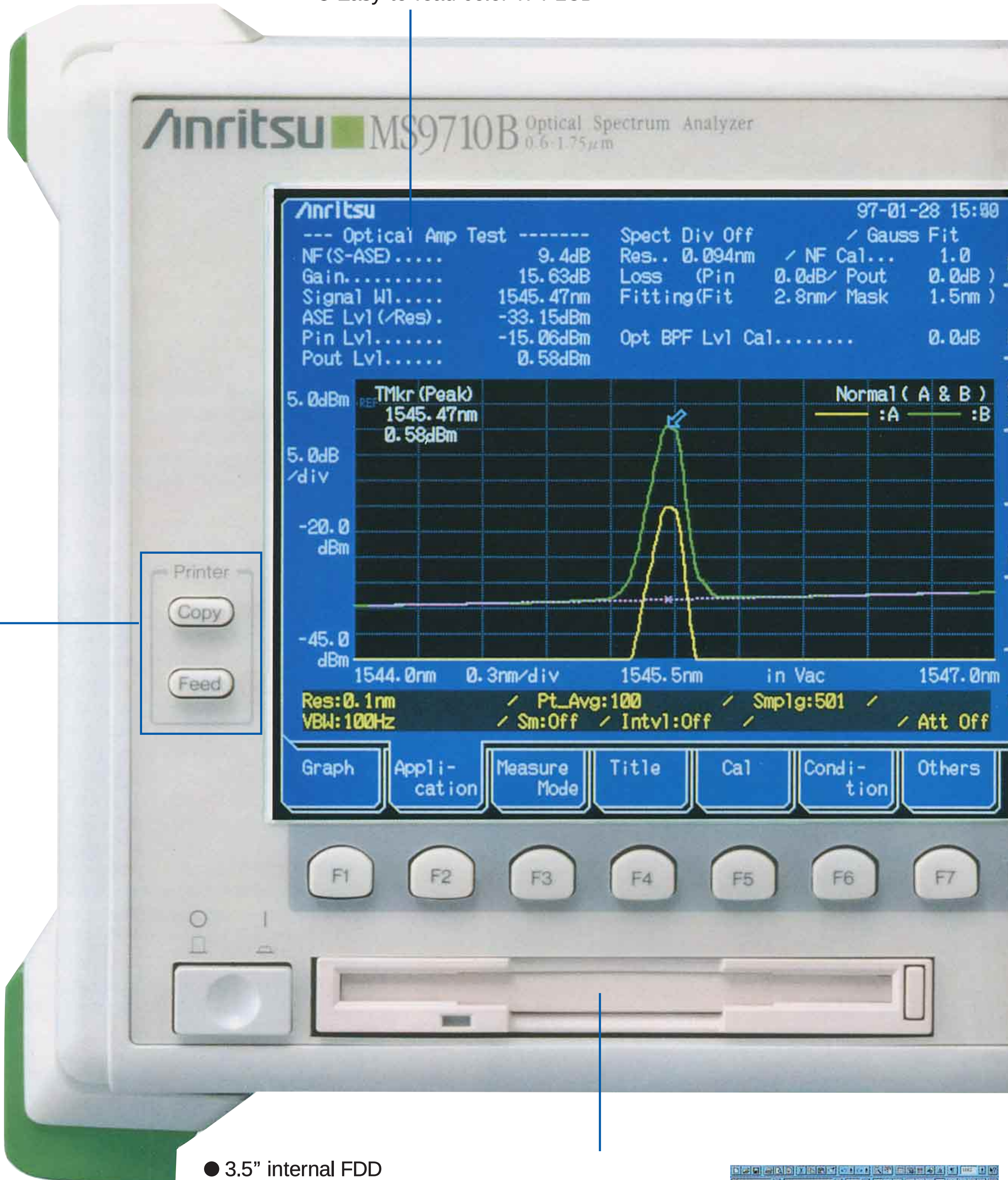
## Relying on 1.55 µm transmission band

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 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 MS9710B 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 MS9710B achieves high-accuracy measurement with high repeatability.

### 1.53 to 1.57 µm specifications

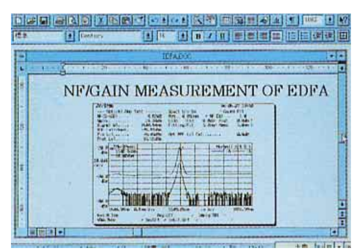
| | |
|---|---|
| Wavelength accuracy | ±0.05 nm (after calibration with optional light source) |
| Wavelength linearity | ±0.02 nm |
| Wavelength resolution | <0.07 nm +10% |
| Wavelength flatness | ±0.1 dB |
| Polarized light dependency | ±0.05 dB |
| Level linearity | ±0.05 dB (0 to –50 dBm) |

● Easy-to-read color TFT-LCD



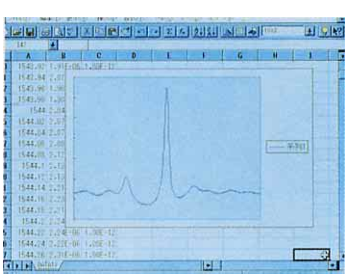

● Thermal printer built in
The MS9710B screen display can be hard-copied at high speed with the internal printer, as well as output to an external printer via the GPIB.

● 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 MS9710B 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.




*Pictures actual size


● 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.



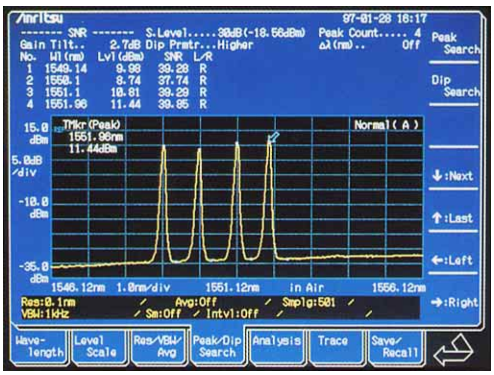
● Cleanable optical input connector
Seven connector types can be used: FC/PC, DIN, ST, SC, HMS-10/A, E2000, EC Radial (optical return loss of 35 dB min.). The input connector can be removed and refitted easily for fast cleaning.

Option is installed.

# Applications for Every Need

## Spectrum analysis for WDM communication system

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 MS9710B permits extremely quick and simple waveform analysis of up to 300 spectra. The waveform and level (SNR) of each peak exceeding the set threshold is displayed. The screen display below shows an example of the gain tilt.

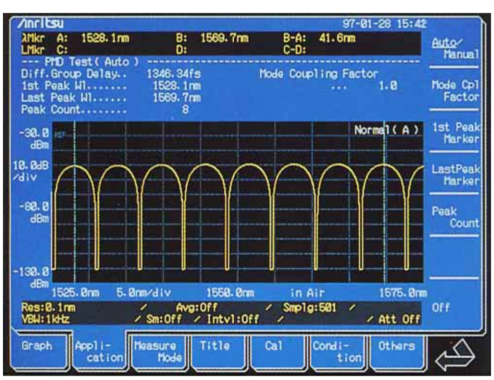



## Polarization mode dispersion

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 MS9710B 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).

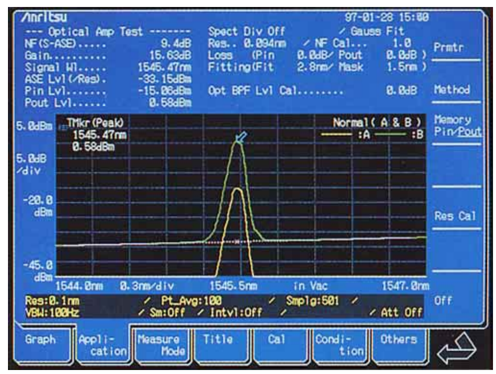



## NF measurement of fiber amplifier (EDFA)

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.

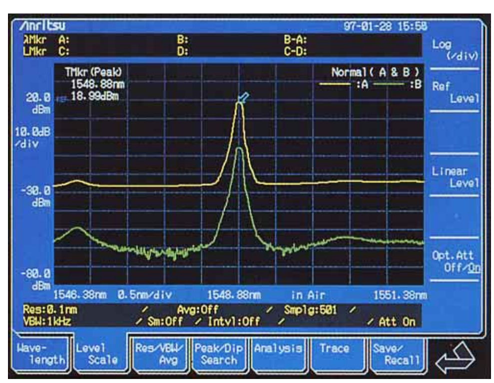
Since the MS9710B measures the ASE level with very high accuracy, three methods can be used to measure NF: 1. Pulse measurement (JIS Method: Under discussing), 2. Level calibration using fitting, and 3. Polarized light nulling*. Moreover, measurement can be performed with the required dynamic range, level linearity and polarization dependency.

* This analyzer is available as the ME7890A Optical Amplifier Test System (uses a pulse method) in combination with the MF9619B Optical Modulator and a personal computer, as the best system for measuring WDM signals with the smallest possible error.



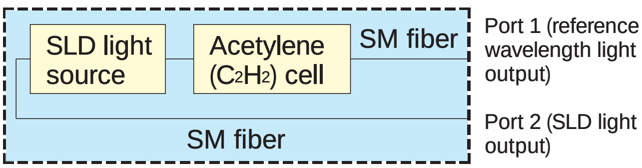

## Built-in attenuator for high-power optical sources

When the built-in attenuator is added, optical inputs of up to +20 dBm 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 dBm optical spectrum amplified by an EDFA.



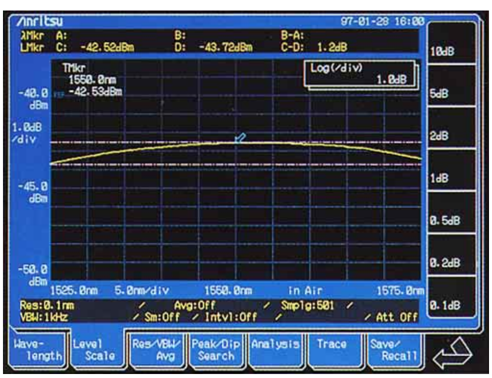
## Convenient light source option (refer wavelength light for better accuracy)

Any one of the SLD light source & reference wavelength light source (Option 13), SLD light source (Option 14), reference wavelength light source (Option 05), and white light source (Option 02) can be installed in the MS9710B.
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 Port 2 for measuring transmission characteristics. When the MS9710B 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.



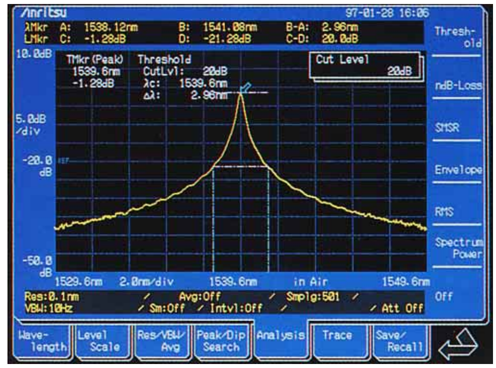

**Block diagram of SLD light source & reference wavelength light**

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.



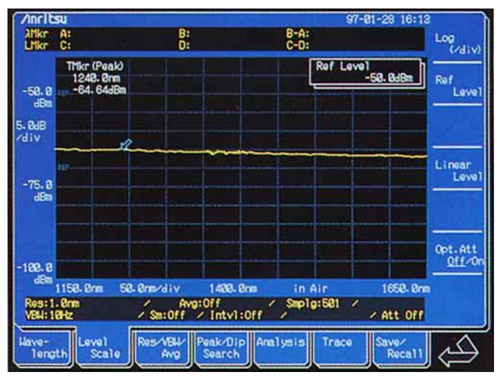

Spectrum of SLD light source

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 using SM fiber (for GI fiber, refer to the specifications of Option 02).

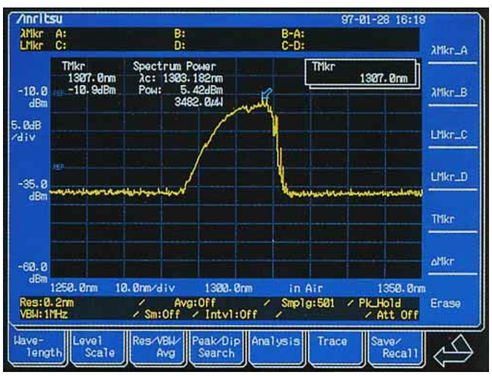



Spectrum of white light source

Note: The optical input section of the MS9710B is designed for connecting single-mode fibers. There is the MS9780A Optical Spectrum Analyzer which have the optical input section designed for connecting multi-mode fibers (50/62.5 µm).

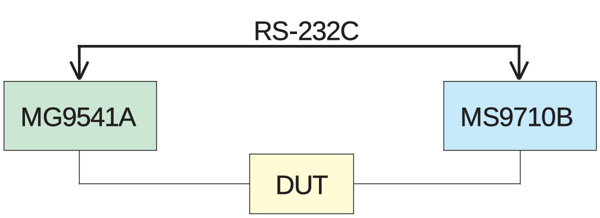
## Measurement of modulated and pulsed light

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 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 MS9710B is 1 MHz. (Refer to the specifications page for the relationship between VBW, received light sensitivity and sweep time.)



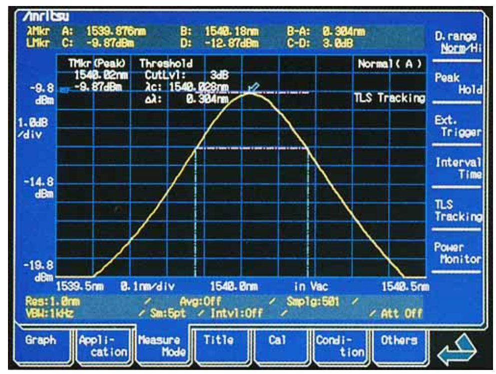

## Tracking with tunable laser source

This function eliminates the need for an external controller. As shown below, by connecting the TLS of MG9541A and the MS9710B with an RS-232C cable, tracking operation is achieved. This setup is very convenient for measuring the wavelength transmission characteristics of wide dynamic range optical elements.

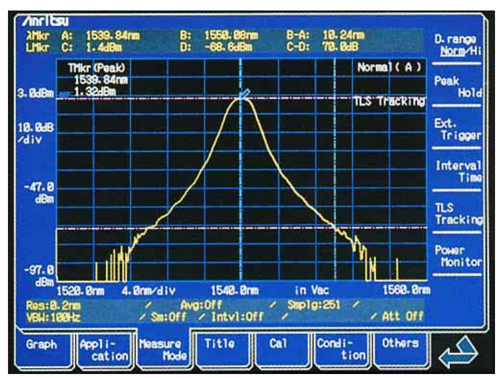



Tracking MG9541A and MS9710B

Measurement is performed using the MS9710B 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 MS9710B resolution bandwidth is set 0.2 nm.




Screen A: FWHM measurement example




Screen B: Wide dynamic range measurement example

# Specifications

### ◆ MS9710B

| | |
|---|---|
| Fiber | 10/125 µm SM fiber (ITU-T G. 652) |
| Optical connector*1 | User replaceable: FC, SC, ST, DIN, HMS-10A<br>Factory option (not user replaceable): E2000 (Diamond), EC (Radial), FC-APC, SC-APC, HRL-10 |
| Wavelength | Range: 600 to 1750 nm<br>Accuracy: ±0.2 nm (1530 to 1570 nm, after wavelength calibration)<br>±0.3 nm (600 to 1750 nm, after wavelength calibration)<br>±0.05 nm (1530 to 1570 nm, resolution: 0.07 to 0.2 nm, after calibration with wavelength reference light source option)<br>±0.1 nm (1530 to 1570 nm, resolution: 0.5 to 1 nm, after calibration with wavelength reference light source option)<br>Stability: ±5 pm (smoothing: 11 points, 1 minute, at half-width center wavelength)<br>Linearity: ±20 pm (1530 to 1570 nm)<br>Read resolution: 5 pm (display resolution: 1 pm)<br>Setting resolution: 0.07, 0.1, 0.2, 0.5, 1 nm (filter: 3 dB bandwidth)<br>Resolution accuracy*2: ±≤2.2% (resolution: 0.5 nm, 1550 ±20 nm), ±≤7% (resolution: 0.5 nm, at other wavelength)<br>±≤3% (resolution: 0.2 nm, 1550 ±20 nm), ±≤15% (resolution: 0.2 nm, at other wavelength)<br>±≤7% (resolution: 0.1 nm, 1550 ±20 nm), ±≤30% (resolution: 0.1 nm, at other wavelength) |
| Level | Measurement range:<br>–65 to +10 dBm ( 600 to 1000 nm, 0˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times)<br>–85 to +10 dBm (1000 to 1250 nm, 0˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times)<br>–90 to +10 dBm (1250 to 1600 nm, 0˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times)<br>–75 to +10 dBm (1600 to 1700 nm, 0˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times)<br>–55 to +10 dBm (1700 to 1750 nm, 0˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times)<br>–65 to +20 dBm (1100 to 1600 nm, attenuator: on)<br>Accuracy: ±0.4 dB (1550 nm, –23 dBm, resolution: ≥0.1 nm)<br>Stability: ±0.02 dB (1300/1550 nm, –23 dBm, resolution: ≥0.1 nm, 1 minute, constant temperature, no polarization shift)<br>Linearity: ±0.05 dB (1550 nm, 0 to –50 dBm)<br>Flatness: ±0.1 dB (1530 to 1570 nm) |
| 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)<br>60 dB (±0.5 nm, resolution: 0.07 nm, 1.55 µm band, high-dynamic range mode measurement, 20˚ to 30˚C)<br>62 dB (±1 nm, resolution: 0.07 nm, 1.55 µm band, normal mode measurement)<br>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 1,200 nm<br>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 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,<br>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 | 177 (H) x 320 (W) x 350 (D) mm, ≤16.5 kg |
| EMC | EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A) |
| LVD | EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2) |

*1: One of these connectors is attached. Please specify when ordering.
*2: Actual screen resolution
*3: Typical value for reference; not guaranteed specification

### ◆ White light source (Option 02)

| | |
|---|---|
| Optical output | ≥–59 dBm/1 nm (multimode/fiber input)*1 |
| Wavelength range | 900 to 1600 nm |
| Operating temperature | 18˚ to 28˚C |

### ◆ Wavelength reference & SLD light source (Option 13)

| | |
|---|---|
| Wavelength range | 1450 to 1650 nm |
| Output level | >–40 dBm/nm (1550 nm ±10 nm)<br>>–60 dBm/nm (1450 to 1650 nm) |
| Output level stability*2 | ±0.04 dB (MS9710B 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 |

### ◆ SLD light source (Option 14)

| | |
|---|---|
| Wavelength range | 1450 to 1650 nm |
| Output level | >–40 dBm/nm (1550 nm ±10 nm)<br>>–60 dBm/nm (1450 to 1650 nm) |
| Output level stability*2 | ±0.04 dB (MS9710B 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 |

### ◆ Reference wavelength light source (Option 05)

| | |
|---|---|
| Wavelength reference | 1530 nm band Acetylene |

### VBW, sweep speed, minimum light reception sensitivity*3

| 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*4 | –90 dBm | –80 dBm | –70 dBm | –60 dBm | –50 dBm | –40 dBm |

*1: –65 dBm (typ.) measured with MS9710B (at 1 nm wavelength resolution) which has single-mode fiber at the input
*2: Measured after one hour warm-up
*3: Data for reference; not guaranteed specifications (except tracking with MG9541A)
*4: RMS noise level (1.25 to 1.6 µm)

Note: Warm-up to the MS9710B 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** | |
| MS9710B | Optical Spectrum Analyzer | |
| | **Standard accessories** | |
| | Optical connector adapter*1: | 1 pc |
| | Power cord, 2.5 m: | 1 pc |
| F0012 | Fuse, 3.15 A (for 100/200 Vac system): | 2 pcs |
| Z0312 | Printer paper: | 2 rolls |
| W1283AE | MS9710B operation manual: | 1 copy |
| W1284AE | Remote control operation manual: | 1 copy |
| MX971002S | LabVIEW® driver (RS-232C): | 1 |
| MX971002G | LabVIEW® driver (GPIB): | 1 |
| B0329G | Front cover: | 1 pc |
| | **Options** | |
| MS9710B-02 | White light source*2 | |
| MS9710B-05 | Reference wavelength light source*2 | |
| MS9710B-06 | Monitor output (VGA output) | |
| MS9710B-13 | Wavelength reference & SLD light source*2 | |
| MS9710B-14 | SLD light source*2 | |
| MS9710B-25 | FC-APC connector*3 | |
| MS9710B-26 | SC-APC connector*3 | |
| MS9710B-27 | E2000 (Diamond) connector*3 | |
| MS9710B-31 | EC (Radial) connector*3 | |
| MS9710B-37 | FC connector*4 | |
| MS9710B-38 | ST connector*4 | |
| MS9710B-39 | DIN connector*4 | |
| MS9710B-40 | SC connector*4 | |
| MS9710B-43 | HMS-10/A (Diamond) connector*4 | |
| MS9710B-47 | HRL-10 connector*3 | |
| | **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) | |
| J0635B | Optical fiber cord, 2 m | |
| Z0282 | Ferrule cleaner | |
| Z0283 | Tape for ferrule cleaner | |
| Z0284 | Cleaner for optical adapter | |
| B0336C | Hard carrying case | |
| 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 (MS9710B-37) is supplied as standard.

*2: Factory option; 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

Specifications are subject to change without notice.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