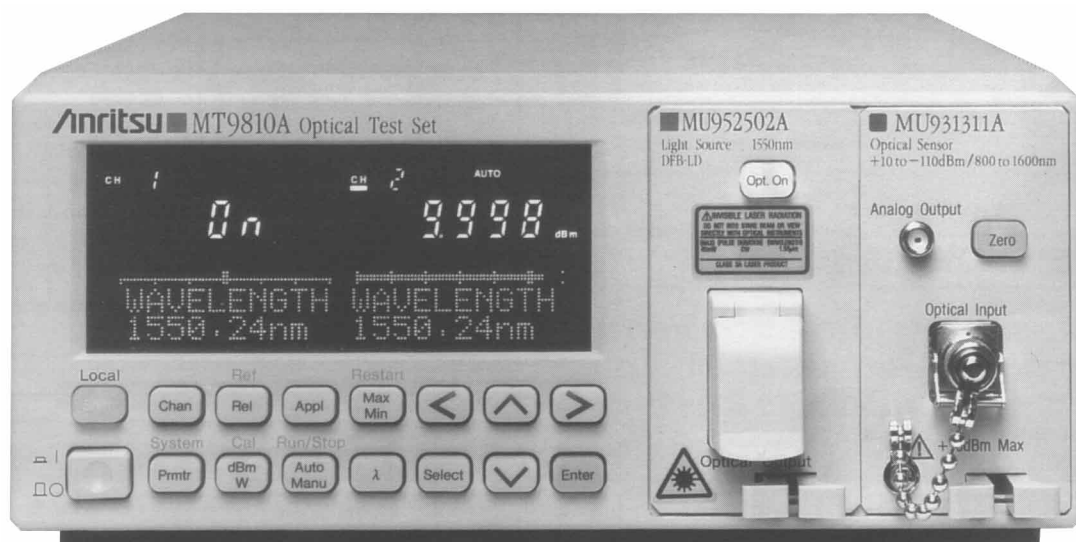




MT9810A

Optical Test Set



High Stability, High Reliability, Flexibility

Flexibility for Every Application

The MT9810A offers superior accuracy and reliability for evaluating a wide range of optical devices and systems. It has a full range of plug-in type high-output DFB-LDs complying with the ITU-T recommended wavelength grid, as well as high-accuracy optical sensors. It ensure effective support for future needs as a basic measuring instrument.

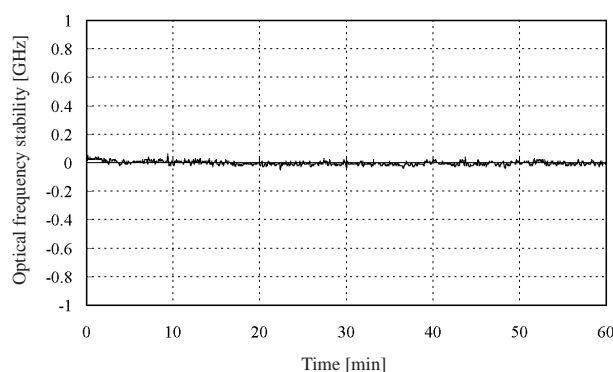
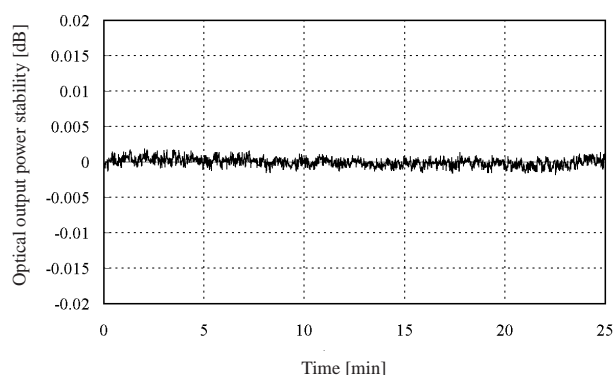
Superior operability is achieved through use of an easy-to-read 7 mm high, seven-segment and full dot matrix display. And a complete range of replaceable optical connectors eliminate all connection problems while making cleaning easy too. GPIB and RS-232C interfaces are standard and configuration of a remote control system is simplified using the bundled LabVIEW® software drivers.

Wide Dynamic Range

Optical loss of up to 120 dB can be measured using the high-output (+10 dBm) light sources and the high-sensitivity (−110 dBm min.) sensors.

High-Output, High-Stability DFB-LD Light Sources

The DFB-LD light sources have a high output of +10 dBm while achieving a stability of better than $\leq \pm 0.005$ dB and a center optical frequency stability of better than $\leq \pm 2$ GHz, facilitating high-stability and high reliability measurement.



Conforms to ITU-T Wavelength Grid

A complete line up of DFB-LD light sources for optical frequencies meeting the ITU-T recommendations for Dense-WDM (DWDM) networks (191.7 to 195.9 THz at 100 GHz interval) is available.

| Frequency | Display wavelength | Frequency | Display wavelength |
|-----------|--------------------|-----------|--------------------|
| 191.7 THz | 1563.86 nm | 193.9 THz | 1546.12 nm |
| 191.8 | 1563.05 | 194.0 | 1545.32 |
| 191.9 | 1562.23 | 194.1 | 1544.53 |
| 192.0 | 1561.42 | 194.2 | 1543.73 |
| 192.1 | 1560.61 | 194.3 | 1542.94 |
| 192.2 | 1559.79 | 194.4 | 1542.14 |
| 192.3 | 1558.98 | 194.5 | 1541.35 |
| 192.4 | 1558.17 | 194.6 | 1540.56 |
| 192.5 | 1557.36 | 194.7 | 1539.77 |
| 192.6 | 1556.55 | 194.8 | 1538.98 |
| 192.7 | 1555.75 | 194.9 | 1538.19 |
| 192.8 | 1554.94 | 195.0 | 1537.40 |
| 192.9 | 1554.13 | 195.1 | 1536.61 |
| 193.0 | 1553.33 | 195.2 | 1535.82 |
| 193.1 | 1552.52 | 195.3 | 1535.04 |
| 193.2 | 1551.72 | 195.4 | 1534.25 |
| 193.3 | 1550.92 | 195.5 | 1533.47 |
| 193.4 | 1550.12 | 195.6 | 1532.68 |
| 193.5 | 1549.32 | 195.7 | 1531.90 |
| 193.6 | 1548.51 | 195.8 | 1531.12 |
| 193.7 | 1547.72 | 195.9 | 1530.33 |
| 193.8 | 1546.92 | | |

High-Accuracy Optical Power Measurement

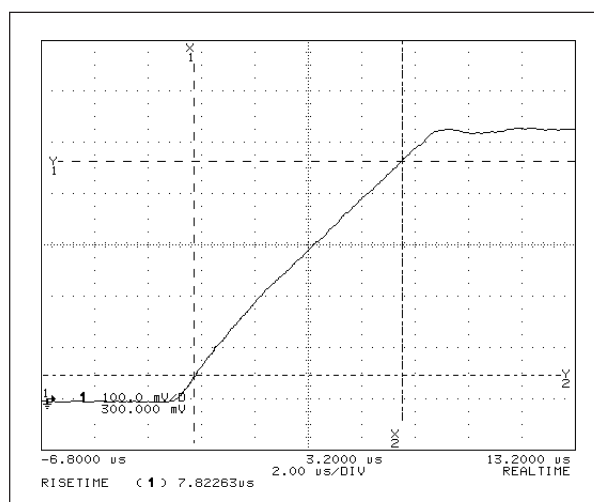
Under reference conditions, the optical power measurement uncertainty is $\leq \pm 2\%$, and under actual operating conditions, it is $\leq \pm 3.5\%$ with a linearity of better than $\leq \pm 0.01$ dB. These excellent specifications permit measurement of optical power with high accuracy and repeatability.

Sensors with High Return Loss and Low Polarization Dependency

Even without a reflection-suppression adapter, the sensor return loss and polarization dependency are 40 dB min., and 0.02 dB max. respectively, making them ideal for evaluating devices and systems that use optical amplifier.

High-Speed Analog Output

The optical sensors have a maximum bandwidth of 100 kHz (approx. 3 dB), permitting measurement of optical power variations with a response speed of approx. 10 μ s.



High-Resolution Optical Power Measurement

The MT9810A has a display resolution of 0.001 dB and optical power can be measured at a high resolution of 0.0001 dB via the GPIB and RS-232C interfaces.

GPIB and RS-232C I/F

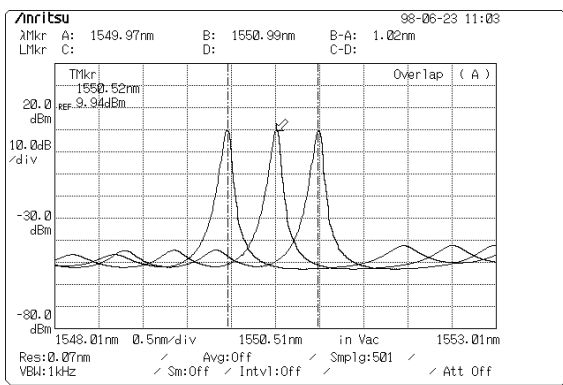
Since GPIB and RS-232C interfaces are standard, measurement can be controlled from a remote PC. In addition, the LabVIEW®* software driver bundle makes it easy to configure a remote measurement system.

* LabVIEW® is a registered trademark of National Instruments Corp.

Main Functions and Applications

Variable Optical Frequency

The center optical frequency of the DFB-LDs can be varied in a range of ≤ 60 GHz (approx. ≤ 0.5 nm). Moreover, it can be displayed in frequency and wavelength units [λ (nm) = c (m/s)/ f (Hz)], where c is the velocity of light in a vacuum (2.99792×10^8 m/s)].



Variable Optical Power Measurement Interval and Bandwidth

The best optical power measurement interval can be set according to the application; for example, a long interval for long-term measurement, and a short interval for high-speed measurement.

Additionally, the average power of a pulsed optical signal can be measured by narrowing the band, and the variations in optical power at optical switching can be measured by widening the band.

Measurement of Max. and Min. Optical Power and Variation

There is no need to save the measured optical power in memory because the maximum and minimum optical powers and variation are always displayed, permitting real-time evaluation of optical stability and polarization dependent loss (PDL).

Measurement Conditions Saved and Copied

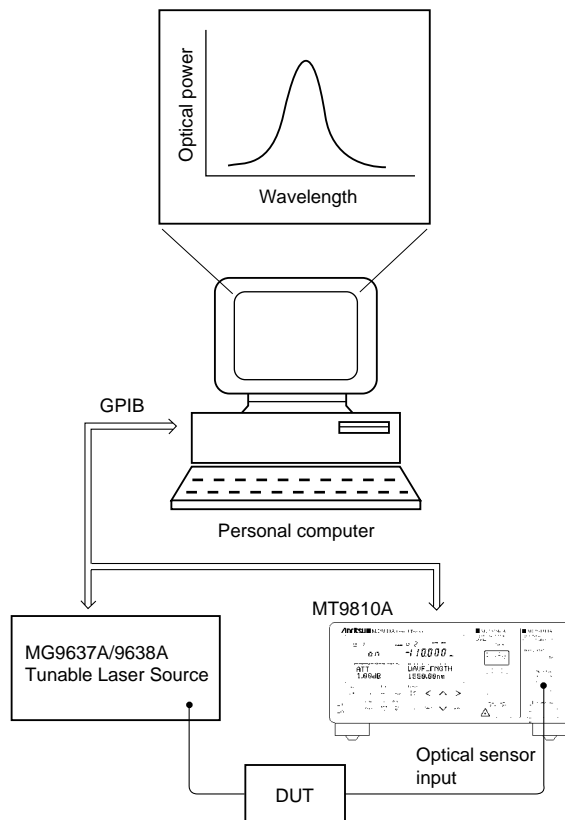
Up to 10 sets of measurement conditions can be saved for each channel (one of the 10 sets can be set as the default). Moreover, when channel 1 and channel 2 use the same type of unit, the measurement conditions for one side can be copied to the other side.

Saved Measured Optical Power

A maximum of 1000 power measurements per channel can be saved, and the saved measurements can be read by remote control, permitting various analyzes and processing.

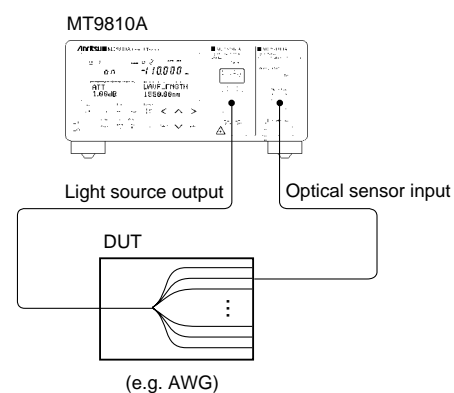
Evaluation of WDM Device Wavelength Characteristics

By combining the MG9637A/9638A Tunable Laser Source with the MT9810A, wavelength-loss characteristic measurements of WDM device (filter etc.) are possible.

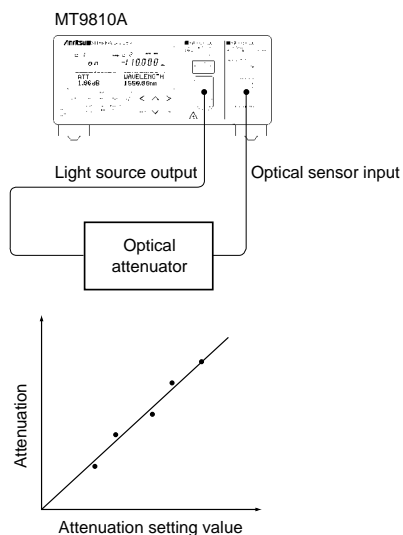


Insertion Loss and Optical Attenuation Measurement of Optical Couplers/Splitters

Combining a light source and optical sensor permits measurement of the insertion loss and isolation of optical couplers and Arrayed Waveguide Grating (AWG), etc. with a wide dynamic range of 120 dB max. Moreover, the high linearity of ± 0.01 dB facilitates attenuation evaluation of optical attenuators.

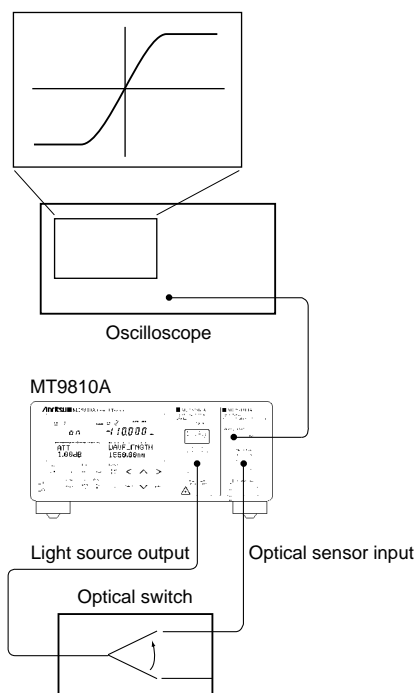


Optical Insertion Loss Measurement using Relative Value (MT9810A display)



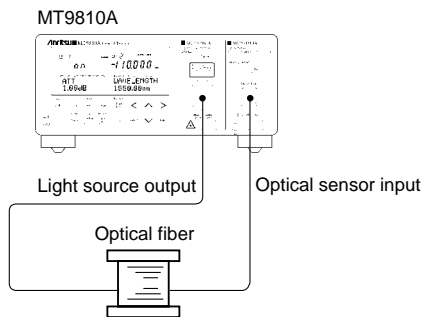
Optical Switching Characteristics

Optical switching times up to about 10 μ s can be evaluated by inputting the analog output to an oscilloscope, etc.



Optical Fiber Loss

When an optical sensor and light source are combined, optical fiber loss can be measured. Near-end and far-end measurements are possible using various reference values.



Parameter (PRMTR) Setting



Reference Data Input (MT9810A display)



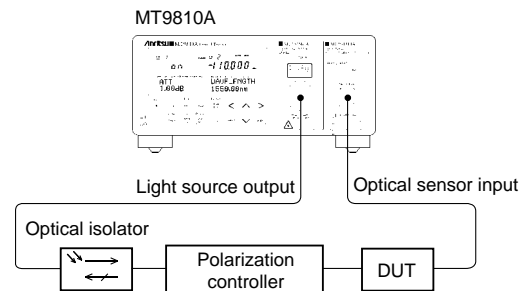
Ref Function



Measurement Relative to Reference Data
(MT9810A display)

Polarization Dependent Loss (PDL) of Optical Devices

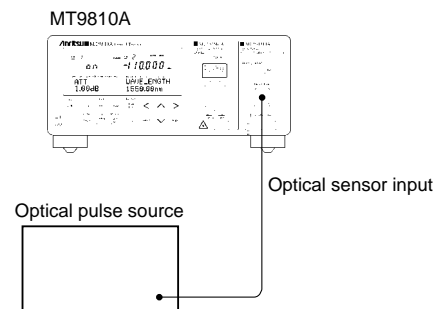
The PDL of the device under test can be read directly from the variation width using the Max. and Min. functions by inputting an optical signal scrambled by a polarization controller to the DUT and measuring the output with an optical sensor.



Optical Pulse Average Power Measurement

Average power is used to evaluate the power of an optical pulse with a long repetition cycle. At this time, the optical sensor bandwidth is switched to narrow band to measure the optical pulse average power. If the pulse duty is known, the peak power can be back-calculated. (However, there is some error due to the extinction ratio of the intensity modulation and the waveform distortion.)

$$P_{\text{peak}} (W) = \frac{P_{\text{average}} (W)}{\text{Duty} (\%)/100}$$



$$P_{\text{peak}} = P_{\text{average}} (\text{dBm}) + 20 \text{ dB (at 1\% duty)}$$

Specifications

● MT9810A Optical Test Set (main frame)

| | |
|----------------------------|---|
| Display resolution | dBm: 0.001, 0.01, 0.1 dB: 0.001, 0.01, 0.1 W: 5 digits |
| Display range | −199.999 to +199.999 dBm, ±0.0001 pW to ±10000 W |
| Display | Fluorescent character display tube, 7 segments (5-1/2 digits), 2 screens, dot matrix (138 × 20 dots), dedicated segments (AUTO, AVG, MOD, CAL, SYS, PRMTR, APPL, REMOTE) |
| System settings | Remote (GPIO, RS-232C) GPIO: Address RS-232C Data length: 7/8 bits, Stop bit: 1/2 bits Parity bit: None, odd, even Speed: 1200, 2400, 4800, 9600, 14400, 19200 bps Buzzer volume: 4 levels, Contrast: 9 levels Time setting: Year, month, day, hour, minute, second (24-hour display) |
| Functions | General Settings save: 10 max. (each channel) Settings copy: Between channels (only for same type of unit) Selectable controlled channel Using optical sensor Bar graph display: 60 dots Record measurement: 1000 max. data (each channel) Calculations: Channel subtraction, max./min./(max. – min.) displays, relative value display (measured value reference, numeric value input), calibration value correction |
| Remote control | GPIO, RS-232C |
| Remote interlock connector | Provided |
| Environmental conditions | Operating temperature: 0° to 50°C; storage: −25° to 71°C, Humidity: ≤90% (no condensation) |
| Plug-in units | 2 max. |
| LabVIEW® driver | Bundled as standard |
| Dimensions and mass | 213 (W) × 88 (H) × 351 (D) mm, ≤3.5 kg |
| Power supply | 100 to 120/200 to 240 Vac (+10%/−15%), ≤70 VA, 47.5 to 63 Hz |

● MU952501A/952502A/952503A/952504A/952505A Light Sources*1

| | |
|---------------------------------|--|
| Optical element | DFB-LD |
| Specified wavelength range (fp) | 191.7 to 195.9 THz (1563.86 to 1530.33 nm)*1 |
| Center optical frequency*2 | fp ±0.01 THz (approx. ±0.08 nm) |
| Spectrum half width*2 | ≤30 MHz |
| Fiber | SM fiber (ITU-T G.652) |
| Optical connector | FC-PC, ST, DIN, HMS-10/A, SC*7 |
| Optical output power*2 | +10 ±1 dBm |
| Laser safety | IEC825: Class 3A, FDA21CFR: Class III b |
| Optical output attenuation | 0.00 to 6.00 dB (0.01 dB steps), accuracy: ≤±0.5 dB (at 25°C when set to 6.00 dB) |
| Internal modulation | Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB |
| Optical output power stability | Time stability (short term)*2,*3,*4: ≤±0.005 dB Time stability (long term)*2,*3,*5: ≤±0.02 dB Temperature stability*2,*3,*6: ≤±0.25 dB |
| Center frequency stability | Time stability (short term)*2,*4: ≤±2 GHz (approx. ±0.02 nm) Time stability (long term)*2,*5: ≤±4 GHz (approx. ±0.04 nm) |
| Optical frequency tuning | Tuning range: fp ±60 GHz (approx. ±0.48 nm), Step: 1 GHz (approx. 0.01 nm), Accuracy*2: fp + 60 GHz, fp −60 GHz (setting: ≤±10 GHz, 25°C) |
| Warm-up time | 1-hour (after optical output on) |
| Environmental conditions | Operating temperature: +15° to +35°C; storage: −25° to +71°C, Humidity: ≤90% (no condensation) |
| Dimensions and mass | 41 (W) × 78 (H) × 335 (D) mm, ≤700 g |

Note: Wavelengths in vacuum

*1 Specify an optical frequency (wavelength) and model name from the ordering information.

*2 At CW, optical attenuation setting (0.00 dB), center optical frequency (fp) using SM fiber (ITU-T G.652) and FC-PC connector

*3 When return loss seen from light source side is 40 dB min.

*4 5-minutes at constant temperature

*5 1-hour at constant temperature

*6 8-hours at 15° to 35°C

*7 Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

● MU931311A/931421A Optical Sensors

| Model | MU931311A | MU931421A |
|---|--|---|
| Element | InGaAs-PD | |
| Input type | Fiber | |
| Optical connector | FC-PC, ST, DIN, HMS-10/A, SC*9 | |
| Wavelength range | 800 to 1600 nm | 750 to 1700 nm |
| Optical power measurement range*1 | CW: +10 to -110 dBm MOD: +7 to -90 dBm | CW: +10 to -80 dBm MOD: +7 to -90 dBm |
| Noise level*2 | ≤-93 dBm | ≤-73 dBm |
| Polarization dependency*3 | ≤0.02 dB | |
| Return loss*3 | ≥40 dB | |
| Optical power measurement uncertainty*4 | Reference conditions: ±2%, Operating conditions: ±3.5% | |
| Linearity*5 | ±0.05 dB (+10 to 0 dBm) ±0.01 dB ±0.3 pW (-90 to 0 dBm) | ±0.05 dB (+10 to 0 dBm) ±0.01 dB ±30 pW (-70 to 0 dBm) |
| Calibration factor input | -99.999 to +99.999 dB | |
| Wavelength sensitivity correction | Measurement wavelength input in 0.01 nm units | |
| Zero set operation | Automatic zero calibration | |
| Range select | Auto, manual | |
| Modulated light reception | CW/MOD selectable, MOD: 270 Hz, 1 kHz, 2 kHz | |
| Measurement interval*6 | 10, 20, 50, 100, 200, 500 ms, 1 s to 99 h 59 min 59 s | |
| Average setting | Off, 2, 5, 10, 20, 50, 100, 200, 500, 1000 times | |
| Analog output*7 | Approx. +2 V | |
| Bandwidth select*8 | Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10, 100 kHz (CW mode only) | Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10 kHz (CW mode only) |
| Environmental conditions | Operating temperature: 0° to +50°C; storage: -40° to +71°C, Humidity: ≤90% (no condensation) | |
| Dimensions and mass | 41 (W) × 78 (H) × 335 (D) mm, ≤700 g | 41 (W) × 78 (H) × 335 (D) mm, ≤550 g |

*1 Wavelength: 1300 nm

*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1300 nm

*3 SM Fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm

*4 Reference conditions

SM fiber (ITU-T G.652), master FC connector

Power level: 100 μW (-10 dBm), CW light, wavelength: 1300 nm, ambient temperature: 23° ±2°C

At day of calibration, warm-up: 1-hour for MU931311A and 30-minutes for MU931421A

Operating conditions

SM Fiber (ITU-T G.652), master FC connector, CW light, wavelength: 1000 to 1600 nm, ambient temperature: 23° ±5°C, within 1-year after calibration, warm-up: 1-hour for MU931311A and 30-minutes for MU931421A

*5 Measurement conditions: Constant temperature in 23° ±5°C, any wavelength in 1000 to 1600 nm, CW light, power level: 100 μW (-10 dBm) reference, warm-up: 1-hour for MU931311A and 30-minutes for MU931421A

*6 Only record measurements for measurement interval of ≤100 ms

*7 Full-scale value for each measurement range

*8 Approx. 3 dB bandwidth. Response time at bandwidth setting of 100 kHz varies according to analog output amplitude

*9 Specify connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

Ordering Information

Specify the model number/code, name and quantity when ordering.

| Model/Code No. | Name |
|----------------|--|
| MT9810A | Main frame Optical Test Set |
| | Standard accessories |
| W1428AE | MT9810A operation manual: 1 copy |
| W1483AE | MT9810A remote control operation manual: 1 copy |
| J0895 | RCA short pin: 1 pc |
| J0896 | RCA plug: 1 pc |
| Z0391 | Key (for laser output safety): 2 pcs |
| F0011 | Fuse, 2 A (for 100 Vac): 2 pcs |
| F0008 | Fuse, 1 A (for 200 Vac): 2 pcs |
| J0017F | Power cord, 2.5 m: 1 pc |
| MX981001A | LabVIEW® driver: 1 copy |
| | Application parts |
| J0006 | GPIO cable, 0.5 m |
| J0007 | GPIO cable, 1 m |
| J0008 | GPIO cable, 2 m |
| J0009 | GPIO cable, 4 m |
| J0655A | RS-232C cable (9P-25P, cross) |
| J0654A | RS-232C cable (9P-9P, cross) |
| J0897B | 8P modular cable, 1 m |
| J0897C | 8P modular cable, 2 m |
| J0897D | 8P modular cable, 5 m |
| J0897E | 8P modular cable, 10 m |
| B0427 | Blank panel |
| | Main frame |
| MU952501A | Light Source |
| MU952502A | Light Source |
| MU952503A | Light Source |
| MU952504A | Light Source |
| MU952505A | Light Source |
| | Standard accessory Optical connector adapter*1 |
| | Options |
| MU952501A-01 | Light source (fp: 193.10 THz, 1552.52 nm, standard) |
| MU952501A-02 | Light source (fp: 193.20 THz, 1551.72 nm) |
| MU952501A-03 | Light source (fp: 193.30 THz, 1550.92 nm) |
| MU952501A-04 | Light source (fp: 193.40 THz, 1550.12 nm) |
| MU952501A-05 | Light source (fp: 193.50 THz, 1549.32 nm) |
| MU952501A-06 | Light source (fp: 193.60 THz, 1548.51 nm) |
| MU952501A-07 | Light source (fp: 193.70 THz, 1547.72 nm) |
| MU952501A-08 | Light source (fp: 193.80 THz, 1546.92 nm) |
| MU952501A-09 | Light source (fp: 193.90 THz, 1546.12 nm) |
| MU952501A-10 | Light source (fp: 194.00 THz, 1545.32 nm) |
| MU952502A-01 | Light source (fp: 192.10 THz, 1560.61 nm) |
| MU952502A-02 | Light source (fp: 192.20 THz, 1559.79 nm) |
| MU952502A-03 | Light source (fp: 192.30 THz, 1558.98 nm) |
| MU952502A-04 | Light source (fp: 192.40 THz, 1558.17 nm) |
| MU952502A-05 | Light source (fp: 192.50 THz, 1557.36 nm) |
| MU952502A-06 | Light source (fp: 192.60 THz, 1556.55 nm) |
| MU952502A-07 | Light source (fp: 192.70 THz, 1555.75 nm) |
| MU952502A-08 | Light source (fp: 192.80 THz, 1554.94 nm) |
| MU952502A-09 | Light source (fp: 192.90 THz, 1554.13 nm) |
| MU952502A-10 | Light source (fp: 193.00 THz, 1553.33 nm) |
| MU952503A-07 | Light source (fp: 191.70 THz, 1563.86 nm) |
| MU952503A-08 | Light source (fp: 191.80 THz, 1563.05 nm) |
| MU952503A-09 | Light source (fp: 191.90 THz, 1562.23 nm) |
| MU952503A-10 | Light source (fp: 192.00 THz, 1561.42 nm) |

| Model/Code No. | Name |
|----------------|---|
| MU952504A-01 | Light source (fp: 194.10 THz, 1544.53 nm) |
| MU952504A-02 | Light source (fp: 194.20 THz, 1543.73 nm) |
| MU952504A-03 | Light source (fp: 194.30 THz, 1542.94 nm) |
| MU952504A-04 | Light source (fp: 194.40 THz, 1542.14 nm) |
| MU952504A-05 | Light source (fp: 194.50 THz, 1541.35 nm) |
| MU952504A-06 | Light source (fp: 194.60 THz, 1540.56 nm) |
| MU952504A-07 | Light source (fp: 194.70 THz, 1539.77 nm) |
| MU952504A-08 | Light source (fp: 194.80 THz, 1538.98 nm) |
| MU952504A-09 | Light source (fp: 194.90 THz, 1538.19 nm) |
| MU952504A-10 | Light source (fp: 195.00 THz, 1537.40 nm) |
| MU952505A-01 | Light source (fp: 195.10 THz, 1536.61 nm) |
| MU952505A-02 | Light source (fp: 195.20 THz, 1535.82 nm) |
| MU952505A-03 | Light source (fp: 195.30 THz, 1535.04 nm) |
| MU952505A-04 | Light source (fp: 195.40 THz, 1534.25 nm) |
| MU952505A-05 | Light source (fp: 195.50 THz, 1533.47 nm) |
| MU952505A-06 | Light source (fp: 195.60 THz, 1532.68 nm) |
| MU952505A-07 | Light source (fp: 195.70 THz, 1531.90 nm) |
| MU952505A-08 | Light source (fp: 195.80 THz, 1531.12 nm) |
| MU952505A-09 | Light source (fp: 195.90 THz, 1530.33 nm) |
| | Applications parts |
| J0617B | Replaceable optical connector (FC, user replaceable) |
| J0618D | Replaceable optical connector (ST, user replaceable) |
| J0618E | Replaceable optical connector (DIN, user replaceable) |
| J0618F | Replaceable optical connector (HMS-10/A, user replaceable) |
| J0619B | Replaceable optical connector (SC, user replaceable) |
| Z0282 | Ferrule cleaner |
| Z0283 | Ferrule cleaning tape (6 pcs/set) |
| Z0284 | Adapter cleaner (stick type, 200 pcs/set) |
| | Main frame |
| MU931311A | Optical Sensor |
| MU931421A | Optical Sensor |
| | Standard accessory Optical connector adapter*1 |
| | Applications parts |
| J0617B | Replaceable optical connector (FC, user replaceable) |
| J0618D | Replaceable optical connector (ST, user replaceable) |
| J0618E | Replaceable optical connector (DIN, user replaceable) |
| J0618F | Replaceable optical connector (HMS-10/A, user replaceable) |
| J0619B | Replaceable optical connector (SC, user replaceable) |
| Z0282 | Ferrule cleaner |
| Z0283 | Ferrule cleaning tape (6 pcs/set) |
| Z0284 | Adapter cleaner (stick type, 200 pcs/set) |
| J0575 | Optical fiber cord, 2 m (FC-PC connectors at both ends, RL: >50 dB, SM) |
| MZ8012A | Connector cleaning set |
| J0127A | Coax cord (BNC-P•RG-58A/U•BNC-P), 1 m |
| J0003A | Coax cord (SMA-P•3D-2W•SMA-P), 1 m |
| J0901 | Conversion connector (SMA-P•BNC-J) |
| J0902 | Conversion connector (SMA-J•BNC-P) |
| | Optical connector options (for Light Sources, Optical Sensors)*1 |
| [Model]-37 | FC-PC connector (user replaceable) |
| [Model]-38 | ST connector (user replaceable) |
| [Model]-39 | DIN connector (user replaceable) |
| [Model]-40 | SC connector (user replaceable) |
| [Model]-43 | HMS-10/A connector (user replaceable) |

*1 When ordering, the option specified connector is supplied as standard.

Specify the option number after the light source or optical sensor model number.

If a connector is not specified, a FC-PC (Option 37) connector is supplied as standard.



Specifications are subject to change without notice.

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