MT1000A OTDR Module

Network Master Pro
MT1000A

OTDR Module
MU100020A 1310/1550 nm SMF
MU100021A 1310/1550/850/1300 nm SMF/MMF
MU100022A 1310/1550/1625 nm SMF
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Specifications
1. Market trends

Mobile Network I&M Solutions

MT1000A platform for more efficient and higher reliability antenna, base station, and backhaul I&M
2. Fiber Connectors (1/3)

What is fiber?
There are two types of fiber: Single Mode (SM) and Multimode (MM).

- **SM fiber** has a core diameter of just 8 to 9 μm, and the cladding is 125 μm.
- **MM fiber** has a core diameter of either 50 or 62.5 μm. The cladding is 125 μm.
2. Fiber Connectors (2/3)

What is a connector?

**Causes  Loss and reflectance**

- Poor mating at fiber end faces (physical connectors)
- Reflections due to different refractive indexes (called Fresnel Reflection)
- Connection with degraded transmissions due to light returning to source and multiple reflections

(FC) Flat Polished (Flat Connectors)

(PC) Spherical Polished (Physical Contact)

(SPC) Super Polish PC

(UPC) Ultra Polish PC

(APC) Angular Polished
2. Fiber Connectors (3/3)

Connector Types

- Mechanical Connection
- Connect/Disconnect
- Connection Loss: 0.1 to 0.5 dB *¹
- Reflection Attenuation (-40 to -60 dB) *¹
- “Blue” usually indicated UPC (ultra/flat)
- “Green” usually indicated APC (angled polished connector)

*¹: Typical value
What is OTDR and what does it do?

Distance/Length

Loss/Attenuation

Reflectance/ORL

OTDR can measure from one end!
3. OTDR Fundamentals (2/5)

OTDR Basic Principles

An optical pulse is launched into the optical fiber and Rayleigh backscattered light and Fresnel reflections occurring in the optical fiber are received to measure the fiber length, loss, and return loss from the received light waveform.
3. OTDR Fundamentals (3/5)

Rayleigh Backscatter
This scattered light is generated by small random density differences in the optical fiber. It causes transmission path loss.

<table>
<thead>
<tr>
<th>Fiber Scattering Types</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rayleigh</td>
<td>Scattered light has same frequency as injected light; caused by small random differences in fiber internal density. Can be used for measuring loss distribution → OTDR measurement</td>
</tr>
<tr>
<td>Raman</td>
<td>Scattered light has different frequency to injected light; caused by interactions in fiber such as molecular vibration. Can be used to measure temperature distribution because has clear temperature dependency related to anti-Stokes light.</td>
</tr>
<tr>
<td>Brillouin</td>
<td>Scattered light has slightly different frequency to injected light; caused by interactions with sound waves in fiber. Can used for distortion distribution measurements because Quarts-fiber Brillouin frequency shift related to strain distortion.</td>
</tr>
</tbody>
</table>
3. OTDR Fundamentals (4/5)

Fresnel Backscatter
This scattering is caused by differences in the refractive index at boundary planes. It is one cause of loss. It can also causes degraded transmission waveforms due to light and reflections returning to the optical source.

\[ R = \left| \frac{n_1 - n_2}{n_1 + n_2} \right|^2 \]
\[ = \left( \frac{0.5}{2.5} \right)^2 \]
\[ = \frac{1}{25} \approx 4\% \quad (-14 \text{ dB}) \]

### Air
\[
\begin{align*}
n_1 & \approx 1 \\
100\% & \\
R & : 4\% \\
R & = 96\% \times 4\%
\end{align*}
\]

### Glass
\[
\begin{align*}
n_2 & \approx 1.5 \\
96\% & \\
92\% &
\end{align*}
\]

### Return Loss (Typical)

<table>
<thead>
<tr>
<th>Polish type</th>
<th>RL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Polished (FC)</td>
<td>25 dB</td>
</tr>
<tr>
<td>Spherical Polished (PC)</td>
<td>40 dB</td>
</tr>
<tr>
<td>Super Polish PC (SPC)</td>
<td>50 dB</td>
</tr>
<tr>
<td>Ultra Polish PC (UPC)</td>
<td>55 dB</td>
</tr>
<tr>
<td>Angled Polish (APC)</td>
<td>65 dB</td>
</tr>
</tbody>
</table>
OTDR trace
Since distance is displayed on the horizontal time axis, the transmission path loss can be found from the Rayleigh backscatter slope, the connection loss can be found from the level difference in the Rayleigh backscatter, and the return loss can be found from the height of the Fresnel reflection level.
4. MT1000A Features

- All-in-one
- Easy-to-use GUI
- Easy-to-see and easy-to-use 9” high-resolution touch panel
- Portable size
- Long-life battery
- All functions for I&M PHY layer tests
5. External Appearance (1/3)

9" high-resolution touch panel

MU100020A 1310/1550 nm
SMF OTDR module

MU100021A 1310/1550/850/1300 nm
SMF/MMF OTDR module

MU100022A 1310/1550/1625 nm
SMF OTDR module

Power switch
Speaker (not used)

Back Panel
Replaceable Battery
Carrying Strap and Handle
5. External Appearance (2/3)

- **MT1000A + MU100020A/21A/22A**
  - Main Frame + OTDR Module

- Visible Light Source Option
- Optical Power Meter
- OTDR Multimode Port 850/1300 nm (MU100021A)
- OTDR Single-Mode Port 1310/1550 nm (MU100020A/21A) 1310/1550/1625 nm (MU100022A)
- Back panel Cover
- OTDR Module MU100020A/21A/22A
- Main Frame MT1000A
- Audio
- AUX (Interface for GPS)
- Clock Input
- USB Mini-B
- USB A
- USB A
- Ethernet Interface (for Remote Control)
- DC Input (18 Vdc)
5. External Appearance (3/3)

- MT1000A + MU100020A/21A/22A + MU100010A
  Main Frame + OTDR Module + 10G Multi-rate Module
6. OTDR Applications

1) Easy-to-understand Pass/Fail evaluation using Fiber Visualizer function
2) High-accuracy event detection using multi-pulse measurement
3) Intuitive manual waveform analysis using touch panel
4) Supports long-distance optical fibers & 1 x 128 splitter PON measurement
5) Various high-accuracy OTDR measurement functions
6. OTDR Applications (1/5)

1: Easy-to-understand Pass/Fail evaluation using Fiber Visualizer function

- Fiber Visualizer displays optical fiber events using icons for simple display of analysis results
- Instant Pass/Fail output and evaluation based on preset thresholds
- Summarized analysis results displayed on Fiber Visualizer screen and measurement results on OTDR trace screen

Fiber Visualizer Screen
2: High-accuracy event detection using multi-pulse measurement

- Function using one measurement with multiple pulse widths
- High-accuracy measurement using multi-pulse measurement of even previously-difficult-to-measure short fibers
- Ideal for evaluation of complex optical lines, such as mobile fronthaul
6. OTDR Applications (3/5)

3: Intuitive manual waveform analysis using touch panel

- Simple manual analyses such as fiber distance, losses and return loss using intuitive operation
- 9 inch full-color, high-resolution touch panel
- Easy-to-use with same GUI as Network Master series
6. OTDR Applications (4/5)

4: Supports long-distance optical fibers & 1 x 128 splitter PON measurement

- MU100020A has dynamic range of 46 dB (typical)
- Supports long-distance fiber evaluation up to 100 km, such as Core and Metro networks
- Supports evaluation of PON systems, such as FTTH including splitter (up to 128 branches)

PON Measurement Screen
6. OTDR Applications (5/5)

5: Various high-accuracy OTDR measurement functions

• 0.8-m Event Dead Zone
• Up to 250,001 Sampling Points
• Optical Communications Signal/Connection Check Function
• Supports Shared OTDR Data Format
• Macro-bend Detection/Analysis
• Bi-Directional Measurement
• Multi-waveform Measurement/Display Functions
Construction Mode

The Construction mode simplifies installation work and is especially useful when pulling multi-core fiber cables. Work mistakes are eliminated by automated operation using pre-settings, such as project data (number of fibers, file names, etc.) and measurement conditions, to facilitate efficient measurement of multi-core fiber cables.

**Project Information**

- Project Name
- Number of Fibers
- Direction
- Locations
- ...etc
8. FTTA Measurements

FTTA (Fiber To The Antenna) Measurements

- Optimized for measurement parameters such as distance range used for short optical fibers used in RRH base stations
- Measurement results displayed as Fiber Visualizer and waveform eliminating analysis parameter settings
9. OLTS Measurements

OLTS Measurement (Optical Loss Test Set)

- Measures optical fiber loss using Light source and Optical power meter
- Measurement results managed with Loss Table
- Pass/Fail evaluation using preset threshold values
10. Others Applications VIP

Optical Connector End Face Analysis (VIP: Video Inspection Probe)

- Function for detecting presence of scratches and dirt on optical connector end face
- Displays results as Pass/Fail evaluation based on IEC61300-3-35 standard
- Supports various connector types

Anritsu supports VIP Series G0382A (USB Autofocus Type) and G0306B (USB Standard Type).
10. Others Applications  PDF Report Output

**PDF Report Output**

- Outputs results of OTDR/FTTA measurement as PDF report
- Outputs Fiber Visualizer, Event Table, waveforms, and VIP result displays
- Creates complete report of all results for easy Pass/Fail verification

*Example of PDF Report*
10. Others Applications OPM/VFL

Simultaneous measurements using Optical Power Meter (OPM) and Visible Fault Locator (VFL) source option functions

- Supports simultaneous use of OPM/VFL at OTDR and FTTA application
- Supports simultaneous use of visible light source (Opt-002) at each of OTDR, FTTA, and OLTS applications
- Increases work efficiency for multi-core fiber measurements, etc.
10. Others Applications  Remote Operation

Remote Operation Functions

Remote operation of MU100020A/21A/22A OTDR Module using VNC connection from PC over Ethernet

- Remote access
- Remote troubleshooting
- Long-term multi-site monitoring from central office
- Multi-user access to one MT1000A set
- Screen projection via PC
- Transfer of test settings files
- Transfer of results to other PCs
10. Others Applications 10G Module

Simultaneous built-in OTDR and Transport functions (10G OTN)
MT1000A + MU100010A + MT10002xA

- Functions for I&M of Remote Radio Head (RRH) base stations and reduction of operating costs
- Supports cable and transport quality evaluations using actual data at base station installation
- Easy-to-use with same GUI as Network Master series

Line Error Rate Measurement

Line Delay Measurement
10. Others Applications One-button

Value of Offering Automatic Measurement Solutions

- Simplifies multiple testing work, shortens on-site test time, eliminates human operation errors.
- Supports simultaneous multiple tests.
- Download free editing software (MX100003A) to create scenarios without need for programming skills.

Icon for loaded measurement scenario

Automation Test select

SEEK (Scenario Edit Environment Kit) MX100003A
APPENDIX
### Specifications (MT1000A Mainframe 1/2)

<table>
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<th>MT1000A Mainframe Common Specifications</th>
</tr>
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<tr>
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</tr>
<tr>
<td><strong>Supported Languages</strong></td>
</tr>
<tr>
<td><strong>USB Data Interface</strong></td>
</tr>
<tr>
<td><strong>Ethernet Interface</strong></td>
</tr>
<tr>
<td><strong>Audio Interface</strong></td>
</tr>
<tr>
<td><strong>AUX Connector</strong></td>
</tr>
<tr>
<td><strong>Built-in Loudspeaker</strong></td>
</tr>
<tr>
<td><strong>Ext. Clock Input</strong></td>
</tr>
</tbody>
</table>

*: Available for certified countries and regions including USA, Canada, Japan and all EU countries. Please contact Anritsu for updated information.
## Specifications (MT1000A Mainframe 2/2)

<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions and Mass</strong></td>
<td></td>
</tr>
<tr>
<td>MT1000A+ MU100020A/21A/22A</td>
<td>Dimensions: 257.6 (W) × 163 (H) × 84.3 (D) mm</td>
</tr>
<tr>
<td></td>
<td>Mass: 2.7 kg including battery (G0310A)</td>
</tr>
<tr>
<td>MT1000A+ MU100020A/21A/22A +MU100010A</td>
<td>Dimensions: 257.6 (W) × 163 (H) × 102.2 (D) mm</td>
</tr>
<tr>
<td></td>
<td>Mass: 3.5 kg including battery (G0310A)</td>
</tr>
<tr>
<td>MU100020A/21A/22A</td>
<td>Dimensions: 257.6 (W) × 163 (H) × 25 (D) mm (without rear panel)</td>
</tr>
<tr>
<td></td>
<td>Mass: &lt;=0.8 kg</td>
</tr>
<tr>
<td><strong>Mains Adapter</strong></td>
<td>Input: 100V (ac) to 240 V (ac), 50 Hz/60 Hz</td>
</tr>
<tr>
<td></td>
<td>Output: 18V(dc)</td>
</tr>
<tr>
<td><strong>Battery</strong></td>
<td>10.8V rechargeable and replaceable intelligent Li-ion battery</td>
</tr>
<tr>
<td></td>
<td>Operating time: 6.0 h (with MU100020A/21A), Telcordia GR-196-CORE Issue2, September 2010, 25°C</td>
</tr>
<tr>
<td><strong>Environmental Conditions</strong></td>
<td>Operating Temperature : 0 to +50°C, ≤85%RH (non-condensing) with MU100020A/21A/22A</td>
</tr>
<tr>
<td></td>
<td>Storage Temperature: -30 to +60°C, ≤90%RH (non-condensing, without battery or AC adapter) with MU100020A/21A/22A</td>
</tr>
<tr>
<td></td>
<td>-20 to +50°C, ≤90%RH (non-condensing, with battery and AC adapter) with MU100020A/21A/22A</td>
</tr>
<tr>
<td><strong>EMC</strong></td>
<td>EN61326-1, EN61000-3-2</td>
</tr>
<tr>
<td><strong>LVD</strong></td>
<td>EN61010-1</td>
</tr>
</tbody>
</table>
## Specifications (OTDR Module 1/5)

<table>
<thead>
<tr>
<th>MU100020A/MU100021A/MU100022A OTDR Module Common Specifications(1/2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IOR Setting</strong></td>
</tr>
<tr>
<td><strong>Units</strong></td>
</tr>
<tr>
<td><strong>Sampling Points</strong></td>
</tr>
<tr>
<td><strong>Sampling Resolution</strong></td>
</tr>
<tr>
<td><strong>Loss measurement accuracy (linearity)</strong></td>
</tr>
<tr>
<td><strong>Reflectance Accuracy</strong></td>
</tr>
<tr>
<td><strong>Distance Accuracy</strong></td>
</tr>
<tr>
<td><strong>Distance Range (IOR=1.50000)</strong></td>
</tr>
<tr>
<td><strong>Fiber Type</strong></td>
</tr>
<tr>
<td><strong>Pulse width</strong></td>
</tr>
<tr>
<td><strong>Realtime Sweep Time</strong></td>
</tr>
</tbody>
</table>
## Specifications (OTDR Module 2/5)

<table>
<thead>
<tr>
<th>MU100020A/MU100021A/MU100022A OTDR Module Common Specifications (2/2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Testing Modes</strong></td>
</tr>
<tr>
<td>OTDR application: Selectable automatic or manual set-up, Fiber Visualizer, Trace analysis, Light source, Power meter, Visual fault locator (Optional)</td>
</tr>
<tr>
<td>FTTA application: Automatic set-up, Fiber Visualizer, Trace analysis, Light source, Power meter, Visual fault locator (Optional)</td>
</tr>
<tr>
<td>Construction application: OTDR Measurement, Auto Save, Multi-core fiber measurements, Power meter</td>
</tr>
<tr>
<td>OLTS application: Power meter and Light source, Loss Table</td>
</tr>
<tr>
<td><strong>Fiber Event Analysis</strong></td>
</tr>
<tr>
<td>Fiber condition setup: Patch-cord setup (Launch/Receive), Splitter Setup (Up to 128 branch)</td>
</tr>
<tr>
<td>User defined Auto detect threshold: Event loss (Reflective and non-reflective), Reflectance, Fiber end, Macro bend detect On/OFF, Splitter detect: Up to 128 branch</td>
</tr>
<tr>
<td>User defined PASS/FAIL thresholds: Non-reflective event loss (fusion), Reflective event loss (connector, mechanical), Reflectance, Fiber loss (dB/km), Total loss, ORL, Splitter loss (Up to 128 branch)</td>
</tr>
<tr>
<td><strong>OTDR Trace Format</strong></td>
</tr>
<tr>
<td>Telcordia universal. SOR, issue 2 (SR-4731)</td>
</tr>
<tr>
<td><strong>Other Functions</strong></td>
</tr>
<tr>
<td>Loss modes: Splice loss, 2-pt loss, 2-pt LSA, dB/km loss, dB/km LSA, ORL</td>
</tr>
<tr>
<td>Averaging modes: Timed (5, 10, 15, 30sec, 1, 2, 3, 5, 10 min.)</td>
</tr>
<tr>
<td>Live Fiber detect: Verifies presence of communication light in optical fiber</td>
</tr>
<tr>
<td>Connection check: Automatic check of OTDR to FUT connection quality</td>
</tr>
</tbody>
</table>
## Specifications (OTDR Module 3/5)

**MU100020A OTDR Module Common Specifications**

<table>
<thead>
<tr>
<th>Options</th>
<th>Wavelength*¹</th>
<th>Dynamic Range*², *³</th>
<th>Deadzone (Fresnel)*⁴ (IOR=1.500000)</th>
<th>Deadzone (Backscatter)*⁵ (IOR=1.500000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MU100020A-020</td>
<td>1310/1550 nm ±25 nm</td>
<td>39/37.5 dB *⁶</td>
<td>≤80 cm (typ.)</td>
<td>≤3.8/4.3 m</td>
</tr>
<tr>
<td>MU100020A-021</td>
<td>1310/1550 nm ±25 nm</td>
<td>42/41 dB *⁶</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MU100020A-022</td>
<td>1310/1550 nm ±25 nm</td>
<td>46/46 dB *⁶</td>
<td>25/25 dB*⁶ (PW:100 ns)</td>
<td></td>
</tr>
</tbody>
</table>

*1: 25°C, Pulse width: 1 μs (1310/1550 nm), Except for when charging the battery.
*2: Pulse widths: 20 μs (1310/1550 nm)
  Distance range: 100 km (1310/1550 nm)
  Averaging: 180 sec., SNR = 1, 25°C
  Except for when charging the battery.
*3: Dynamic range (one-way back-scattered light), SNR = 1; The level difference between the RMS noise level and the level where near end back-scattering occurs.
*4: Pulse width: 3 ns,
  Return loss: 40 dB, 25°C (Refer to the figure below)
  Except for when charging the battery.
*5: Pulse width 10 ns, return loss 55 dB,
  Deviation ±0.5 dB, 25°C ±5°C

![Diagram of OTDR Module SNR and Distance](image)

*6: Typical. Subtract 1 dB for guarantee.
Specifications (OTDR Module 4/5)

### MU100021A OTDR Module Common Specifications

<table>
<thead>
<tr>
<th>Options</th>
<th>Wavelength*1</th>
<th>Dynamic Range*2, *3</th>
<th>Deadzone (Fresnel)*4 (IOR=1.500000)</th>
<th>Deadzone (Backscatter)*5 (IOR=1.500000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MU100021A-021</td>
<td>1310/1550 nm ±25 nm, 850/1300 nm ±30 nm</td>
<td>42/41 dB *6 29/28 dB *6,7</td>
<td>≤80 cm (typ.)</td>
<td>≤3.8/4.3 m ≤4/5 m</td>
</tr>
</tbody>
</table>

*1: 25°C, Pulse width: 1 μs (1310/1550 nm), 100 ns (850 nm/1300 nm)  
  Except for when charging the battery.

*2: Pulse widths: 20 μs (1310/1550 nm)  
  500 ns/4 μs (850/1300 nm)  
  Distance range: 100 km (1310/1550 nm)  
  25 km (850/1300 nm)  
  Averaging: 180 sec., SNR = 1, 25°C  
  Except for when charging the battery.

*3: Dynamic range (one-way back-scattered light), SNR = 1:  
  The level difference between the RMS noise level and the level where near end back-scattering occurs.

*4: Pulse width: 3 ns,  
  Return loss: 40 dB, 25°C (Refer to the figure below)  
  Except for when charging the battery.

*5: Pulse width 10 ns, return loss 55 dB,  
  Deviation ±0.5 dB, 25°C ±5°C

*6: Typical. Subtract 1 dB for guarantee

*7: At measurement of 50 μm/125 μm MM Fiber, the dynamic range drops by about 3.0 dB

---

Anritsu envisions: ensure
## Specifications (OTDR Module 5/5)

|------------------|------------------------|-----------------------|--------------------------------------|------------------------------------------|

[^1]: 25°C, Pulse width: 1 μs (1310/1550/1625 nm), Except for when charging the battery.

[^2]: Pulse widths: 20 μs (1310/1550 nm)
- Distance range: 100 km (1310/1550/1625 nm)
- Averaging: 180 sec., SNR = 1, 25°C
  Except for when charging the battery.

[^3]: Dynamic range (one-way back-scattered light), SNR = 1: The level difference between the RMS noise level and the level where near end back-scattering occurs.

[^4]: Pulse width: 3 ns,
  Return loss: 40 dB, 25°C (Refer to the figure below)
  Except for when charging the battery.

[^5]: Pulse width 10 ns, return loss 55 dB,
  Deviation ±0.5 dB, 25°C ±5°C

[^6]: Typical. Subtract 1 dB for guarantee

---

*Diagram showing Fresnel reflection and back-scattered light.*
# Specifications (Light Source)

- **Light Source Specifications – Standard on all models**

<table>
<thead>
<tr>
<th>Items</th>
<th>MU100020A</th>
<th>MU100021A</th>
<th>MU100022A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength*¹</td>
<td>1310/1550 nm ±30 nm</td>
<td>1310/1550 nm ±30 nm, 850/1300 nm ±30 nm</td>
<td>1310/1550/1625 nm ±30 nm</td>
</tr>
<tr>
<td>Spectral Width*¹</td>
<td>≤5 nm (1310 nm), ≤10 nm (1550 nm)</td>
<td>≤5 nm (1310 nm), ≤10 nm (1550/850/1300 nm)</td>
<td>≤5 nm (1310 nm), ≤10 nm (1550/1625 nm)</td>
</tr>
<tr>
<td>Optical Connector</td>
<td>Same as OTDR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Power*¹</td>
<td>-5 ±1.5 dBm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Stability*²</td>
<td>≤0.1 dB (1310/1550/1625 nm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modes of Operation</td>
<td>CW, 270 Hz, 1 kHz, 2 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warm up time</td>
<td>10 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laser Safety</td>
<td>Same as OTDR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1: CW, 25°C  
*2: CW, -10°C to 50°C (±1 °C) difference between max/min. values over 1 minute, SM fiber 2 m, when an optical power meter with 40 dB or greater return loss is used (SM), after warming up.
# Specifications (Power Meter)

### Standard Power Meter (Dedicated port)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Power Meter (Dedicated port)</td>
<td>Single Mode (SMF) 10/125 μm ITU-T G.652, GI Fiber 62.5/125 μm</td>
</tr>
<tr>
<td>Wavelength Range</td>
<td>800 to 1700 nm</td>
</tr>
<tr>
<td>Setting Wavelengths</td>
<td>1310, 1490, 1550, 1625, 1650, 850, 1300 nm</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>-67 to +6 dBm (CW, 1550 nm, -60 to +3 dBm@850 nm)</td>
</tr>
<tr>
<td></td>
<td>-70 to +3 dBm (Modulation, 1550 nm, -63 to 0 dBm@850 nm)</td>
</tr>
<tr>
<td>Optical Connector</td>
<td>2.5 mm/1.25 mm Universal</td>
</tr>
<tr>
<td>Accuracy*3</td>
<td>±5% (-10 dBm, 1310/1550 nm, CW, 25°C, Using Master FC fiber and 2.5 mm universal connector)</td>
</tr>
<tr>
<td></td>
<td>±10% (-10 dBm, 850 nm, CW, 25°C, Using Master FC fiber and 2.5 mm universal connector)</td>
</tr>
<tr>
<td>Modes of Operation</td>
<td>CW, 270 Hz, 1 kHz, 2 kHz</td>
</tr>
</tbody>
</table>

*3: After zero offset
## Specifications (Visible Light Source)

- **Visible Light Source (Option 002)**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central Wavelength</strong></td>
<td>650 nm±15 nm (at 25°C)</td>
</tr>
<tr>
<td><strong>Optical Output</strong></td>
<td>0 ±3 dBm (CW, 25°C)</td>
</tr>
<tr>
<td><strong>Output Optical Fiber</strong></td>
<td>10 μm/125 μm, SMF (ITU-T G.652)</td>
</tr>
<tr>
<td><strong>Optical Connector</strong></td>
<td>2.5 mm universal</td>
</tr>
<tr>
<td><strong>Output Function</strong></td>
<td>OFF, CW, Blink</td>
</tr>
<tr>
<td>*<em>Laser Safety <em>4</em></em></td>
<td>IEC 60825-1: 2007 CLASS 3R</td>
</tr>
<tr>
<td></td>
<td>21CFR1040.10 and 1040.11 Excludes deviations caused by conformance to Laser Notice No.50 dated June 24, 2007</td>
</tr>
</tbody>
</table>

*4: Safety measures for laser products

This option complies with optical safety standards in IEC 60825-1, 21CFR1040.10 and 1040.11; the following descriptive labels are affixed to the product