

Discover What's Possible™

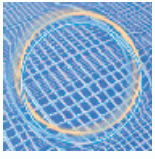
Anritsu

MP1590A

Network Performance Tester



PDH/DSn/SDH/SONET/OTN/Jitter Measurement with One Unit



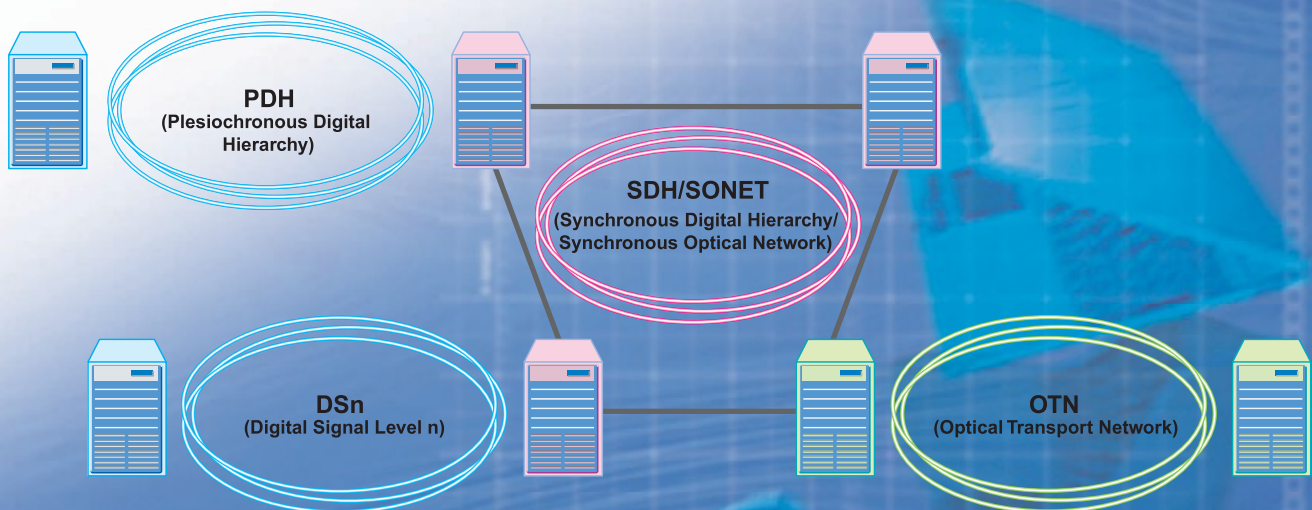
Supports ITU-T G.709 OTN Measurement

The MP1590A Network Performance Tester is a measuring instrument capable of testing PDH, DS_n, SDH/SONET and OTN equipment as well as making jitter measurements with only one unit.

It also can perform OTN, SDH/SONET testing using the input wavelength from an external Tunable Laser Source. Jitter measurement and external optical input functions are provided by plug-in units that can be used in various combinations as needed.

The MP1590A is equipped with Random error insertion and variable optical output power functions. So it can efficiently evaluate Forward Error Correction (FEC) used with OTN equipment.

For SDH/SONET equipment, the MP1590A can perform Tandem Connection and Automatic Protection Switch (APS) tests. For PDH or DS_n equipment, it can perform function tests using multiplexer/demultiplexer (MUX/DEMUX) measurement, error insertion or alarm addition.



■ Supports 1.5 Mbit/s to 10.7 Gbit/s interfaces with only one unit

The MP1590A supports the following electrical and optical interfaces.

Electrical interfaces: PDH (2.048, 8.448, 34.368, 139.264 Mbit/s), DS_n (1.544, 44.736 Mbit/s), STM-0/1/64, STS1/3/192 (51.84, 155.52, 9953.28 Mbit/s), OTU-2 (10.71 Gbit/s)

Optical interfaces: STM-0/1/4/16/64, OC-1/3/12/48/192 (51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s), OTU-1 (2.66 Gbit/s), OTU-2 (10.71 Gbit/s)

Because a plug-in system is employed, units can be used in various combinations as needed.

■ ITU-T G.709 OTN measurement

Supports setting/monitoring of all overhead for OTU-1 (2.66 Gbit/s) and OTU-2 (10.71 Gbit/s) conforming to ITU-T G.709. OTN equipment can be tested by error/alarm generation/detection functions. In particular, the Random error insertion function on the MP1590A enables FEC function evaluation. The built-in optical output power adjustable function allows one MP1590A to test the error correction ratio of OTN equipment based on its input power specification.

■ Concatenation mapping

In addition to traditional concatenation mapping, the MP1590A supports arbitrary concatenation.

Arbitrary concatenation

SONET	STS3-nc (n = 2 to 16)
SDH	VC-4-nc (n = 2 to 16)

■ SDH/SONET functions

The MP1590A is applicable for both SDH and SONET frames. It is easy to switch between SDH and SONET.

Transmission/reception with Tandem Connection pattern and "No frame" pattern are possible. Also, APS switching time testing is supported. Moreover, various error/alarm generation functions enable stress testing of SDH/SONET equipment.

■ SDH/SONET overhead setting and monitoring

SOH/TOH and POH within an SDH/SONET frame can be set and transmitted. Real-time monitoring is supported for K1/K2 bytes within SOH/TOH, K3/K4 bytes within POH, AU/STS pointer, TU/VT pointer, path trace and N1/Z5, N2 of the received signal.

■ Error analysis (error performance)

Measurements conforming to ITU-T Rec. G.821/G.826/G.828/G.829, M.2100/M.2101/M.2110/M.2120 and Telcordia GR-820 can be performed.

■ Jitter generation/measurement

Installing a 10/10.7G jitter unit enables SDH/SONET (52 to 9953 MHz), OTU-1 (2.66 GHz), OTU-2 (10.71 GHz) and 10.3 GHz jitter generation/measurement. Jitter tolerance and jitter transfer characteristic measurements conforming to ITU-T Rec. G.783, G.825, G.8251 and Telcordia GR-253 can be performed. The measured results are displayed in numeric values and graphs, allowing user evaluation and simplifying pass/fail judgment.

■ Through mode

Through mode operation can be used for all bit rates of PDH/DS_n, SDH/SONET and OTU-1/OTU-2.

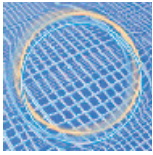
For SDH/SONET and OTU-1/OTU-2, either transparent through or overhead overwrite modes can be selected.

■ Clock/frame synchronization signal output

Divided-by-16 clock or frame synchronization signals can be output. Connecting this signal output to an external sampling oscilloscope allows the MP1590A to evaluate errors/alarms and the oscilloscope to evaluate the input waveform simultaneously. The MP1590A can provide both a transmission signal and the synchronized recovered clock from its received signal, making waveform analysis possible for devices that do not have their own synchronized signal output.

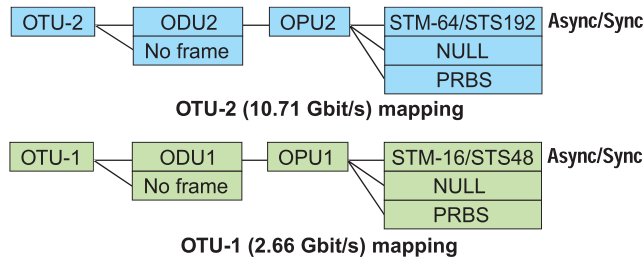
■ External optical input function

By using the MU150134A 10/10.7G Optical Unit (Transmission External Modulation), OTN and SDH/SONET tests based on a user-provided input wavelength can be performed. This is best suited to provide the reference optical source for jitter measurement because of its very fine waveform quality and low jitter characteristics.



OTN Test Solution

Transmission/reception with OTU-1 (2.66 Gbit/s) and OTU-2 (10.71 Gbit/s) frames conforming to ITU-T G.709 or with "No frame" can be performed. When mapping client is set to STM-64/STS192 or STM-16/STS48, various mappings used for SDH/SONET can be selected.

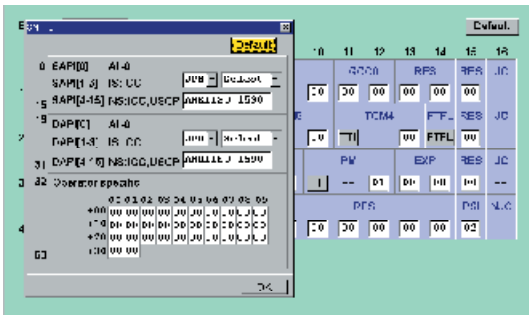


Overhead setting

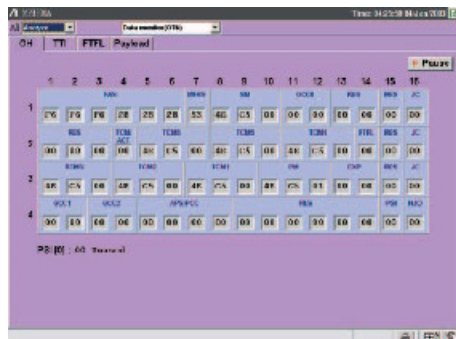
All overhead (except for parity, MFAS, and JC) can be set arbitrarily. Moreover, multi-frame overhead such as TTI can also be set up easily.

Error/alarm test

A stress test on OTN equipment can be performed by arbitrarily generating FAS, BIP-8 or BEI errors as well as LOF, LOM and AIS alarms and monitoring them with the MP1590A.



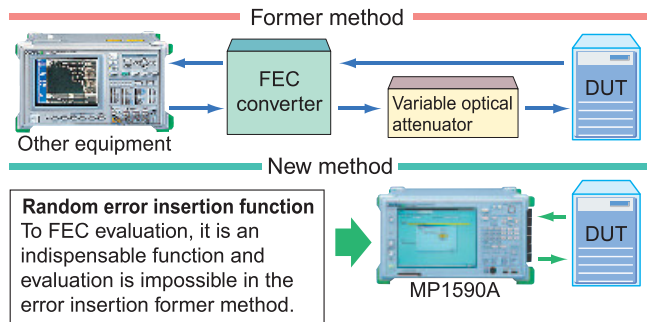
Overhead setting



Overhead monitor

FEC decode test

The MP1590A random error insertion function can evaluate whether the FEC function of the DUT meets the requirements of ITU-T G.709. By using the optional optical output power adjustable function, the error correction ratio vs optical input power to DUT can be tested by a single MP1590A unit.



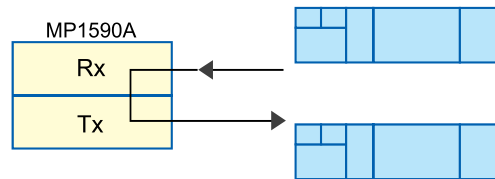
External equipment is not needed to vary the optical output power, and performance testing of the DUT FEC decoder is possible using only MP1590A.

Through mode

Two types of through mode testing are provided for OTN mapping: transparent through mode and overhead overwrite mode. Various errors can be inserted and alarms can be added to through signals.

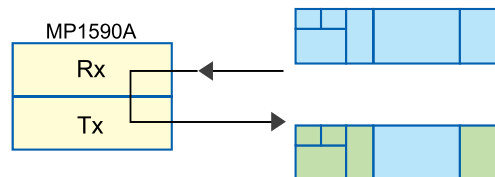
Transparent

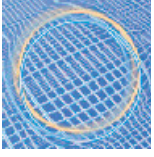
Loops the received signal back and outputs it as is. Random error insertion is possible.



Overhead overwrite

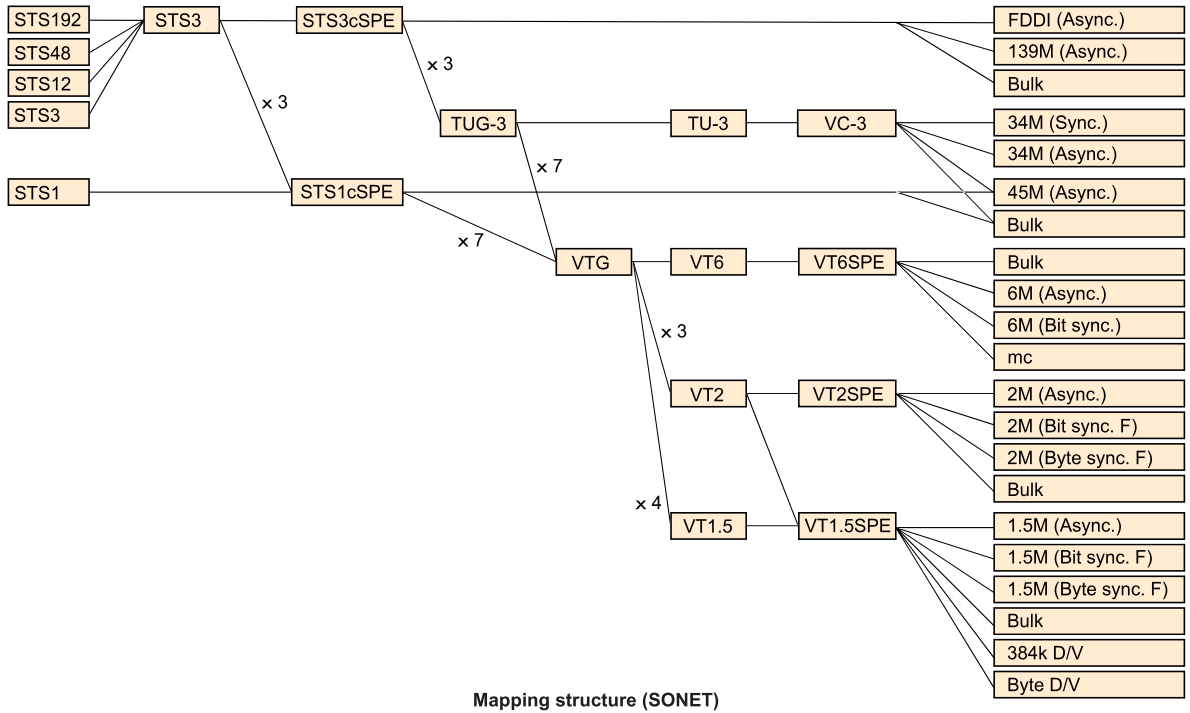
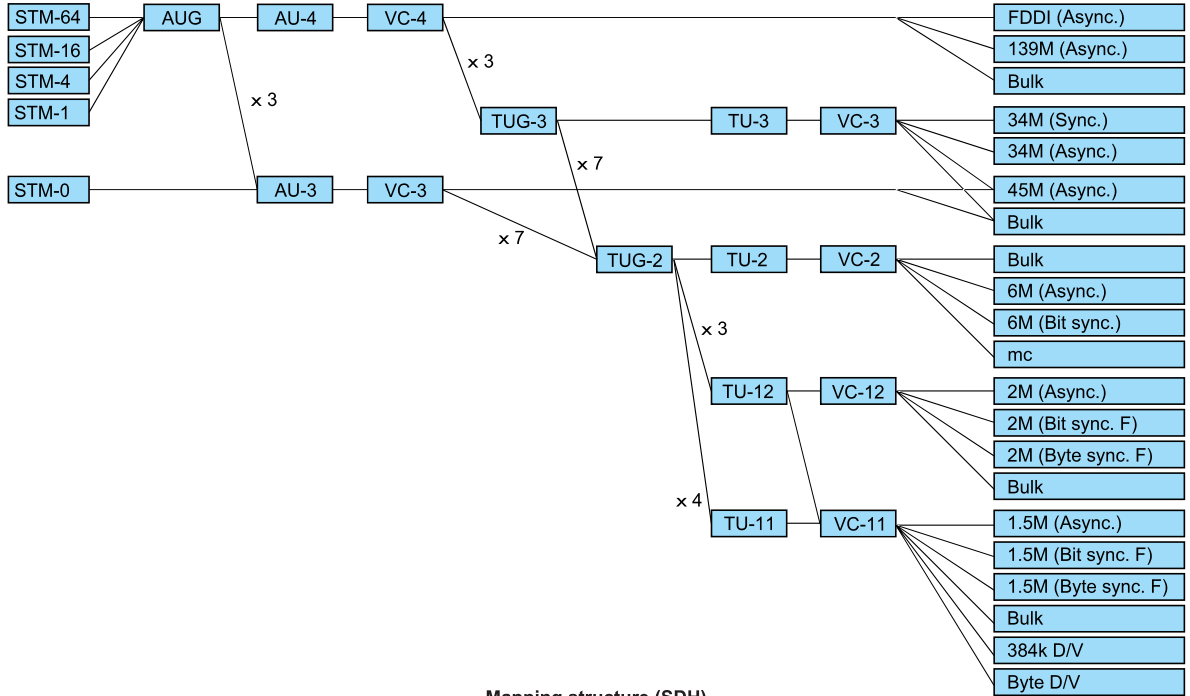
Replaces the overhead part of the received signal with the overhead set on the MP1590A, or with programmed data.





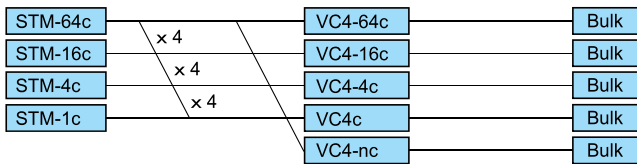
SDH/SONET, PDH, DS_n Test Solution

Mapping structures from 1.5 Mbit/s to 10 Gbit/s can be selected.
 Mappings for SDH, SONET, Japan, PDH (Europe) and DS_n (North America) are supported.

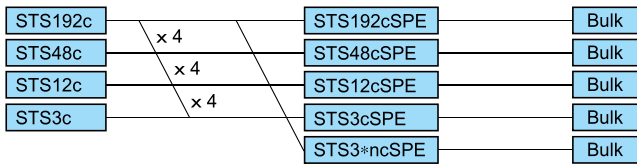


● **Concatenation mapping**

In concatenation mapping, STM-1c to STM-64c/STS3c to STS192c can be selected. In addition to traditional concatenation mappings such as VC4-64c/STS192cSPE and VC4-16c/STS48cSPE, the MP1590A supports VC4-nc/STS3ncSPE arbitrary concatenation.



Concatenation mapping (SDH)



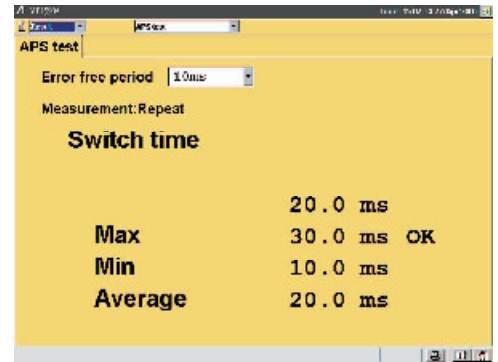
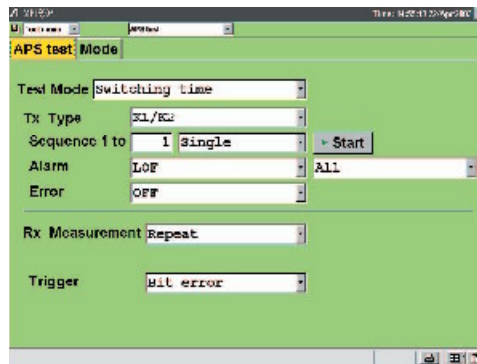
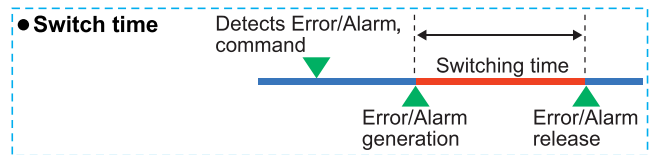
Concatenation mapping (SONET)

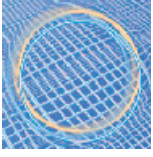
● **Add/Drop function**

When PDH/DSn asynchronous mapping is selected for a SDH/SONET bit rate, the PDH/DSn signal can be added to or dropped from the SDH/SONET signal.

● **APS Function**

Automatic Protection Switch (APS) testing can be performed. The switching time test measures the time from error/alarm occurrence to release. Switching time is measured with 0.1 msec resolution.





Jitter, Wander Test Solution

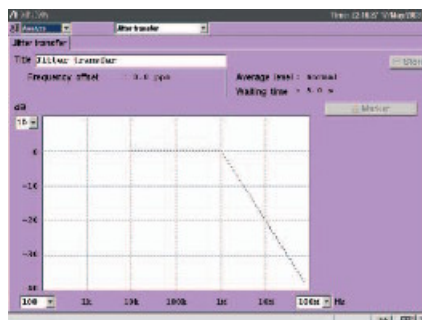
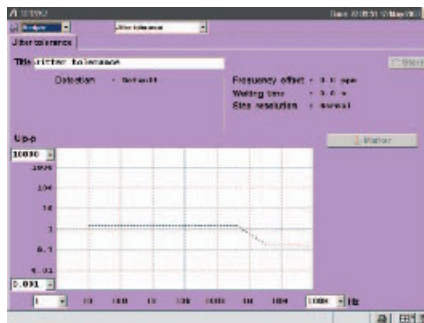
The 10/10.7G Jitter Unit can generate and measure jitter for SDH/SONET rates from 52 Mbit/s to 10 Gbit/s. Options enable jitter measurement at the 2.66 Gbit/s and 10.71 Gbit/s OTU-1 and OTU-2 rates as well as 10.3 GHz (clock) jitter measurement.

MU150125A 10/10.7G Jitter Unit

Bit rate	Tx range	Modulation frequency
9953M/10.7G/ 10.3G	4000 UI	0.1 to 600 Hz
	80 UI	0.1 to 1 MHz
	8 UI	0.1 to 4 MHz
2488M/2666M	0.5 UI	500 kHz to 80 MHz
	1000 UI	0.1 to 600 Hz
	20 UI	0.1 to 1 MHz
	2 UI	0.1 to 4 MHz
622M	0.5 UI	500 kHz to 20 MHz
	250 UI	0.1 to 15 kHz
	80 UI	0.1 to 60 kHz
	20 UI	0.1 to 600 kHz
156M	2 UI	0.1 to 5 MHz
	80 UI	0.1 to 150 kHz
	20 UI	0.1 to 1.5 MHz
52M	2 UI	0.1 to 3.8 MHz
	20 UI	0.1 to 500 kHz
	2 UI	0.1 to 1.3 MHz

Jitter tolerance and Jitter transfer tests can be performed automatically. Masks conforming to ITU-T Rec. G.783/G.825/G.8251, and Telcordia GR-253* are provided. This means that standard measurements can be performed by just pressing the Start key. In addition, users can freely set customized makes via on-screen editing.

*: Maximum value of jitter transfer tests mask is 100 times as much modulation frequency as a break point (fc).

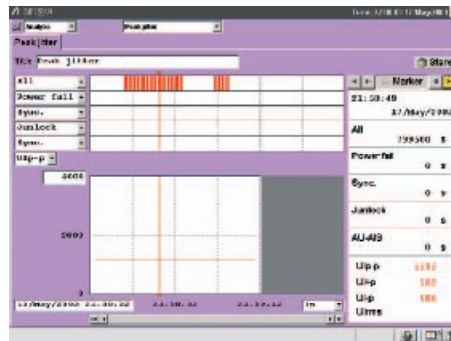


• Re-evaluation setting function

When re-evaluating measurements after having performed jitter tolerance or jitter transfer tests, users can change the mask while viewing the measured results.

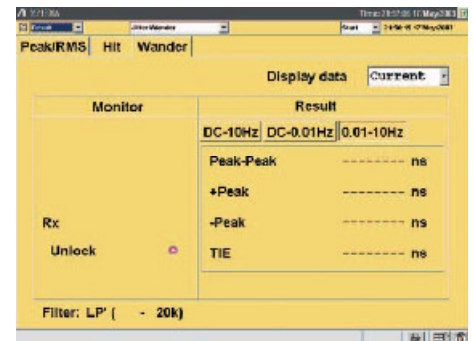
• Peak jitter

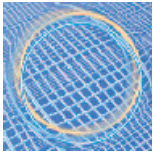
Long term jitter evaluation tests can be performed simultaneously with error/alarm measurements. This enables analyzing the relationship between error/alarm occurrence and jitter.



• Wander

Wander up to 400,000 Uip-p can be generated. Measured results in three bands can be displayed: DC to 10 Hz, DC to 0.01 Hz and 0.01 to 10 Hz (Wander measurement is an Option).



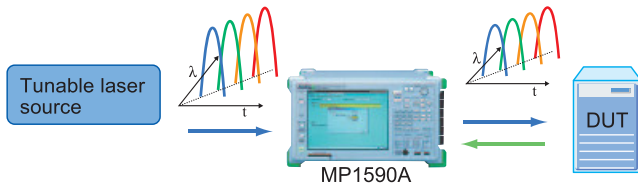


Additional Functions

External optical input function

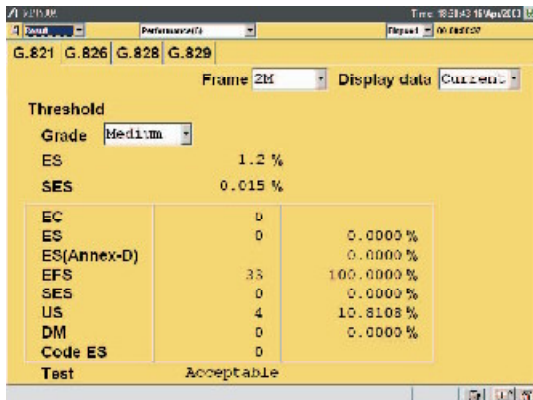
By using the MU150134A 10/10.7G Optical Unit (Tx External Modulation), OTN and SDH/SONET tests can be performed based on externally generated wavelengths.

This is best suited to provide the reference optical source for jitter measurement because of its very fine waveform quality and low jitter characteristics.



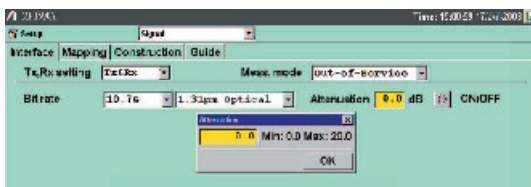
Error performance

Measurements conforming to ITU-T Rec. G.821/G.826/G.828/G.829, M.2100/M.2101/M.2110/M.2120 and Telcordia GR-820 can be performed. Error performance measurement parameters can be generated automatically.



Optical power measurement and optical attenuation functions

When using an optical interface, the average power of the input optical signal can be measured. With the optical output power adjustment option it is possible to attenuate the optical output level up to 30 dB (for 2.6 Gbit/s or lower) or 20 dB (for 10 Gbit/s and higher).

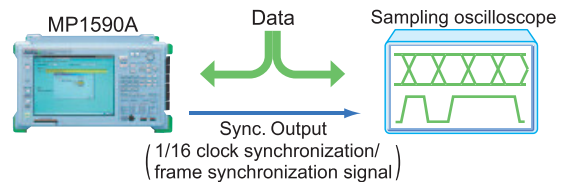


Order wire

The MP1590A is equipped with a CODEC, so communication over a selected channel is possible. A microphone and speaker with 8-level volume control are built into the MP1590A.

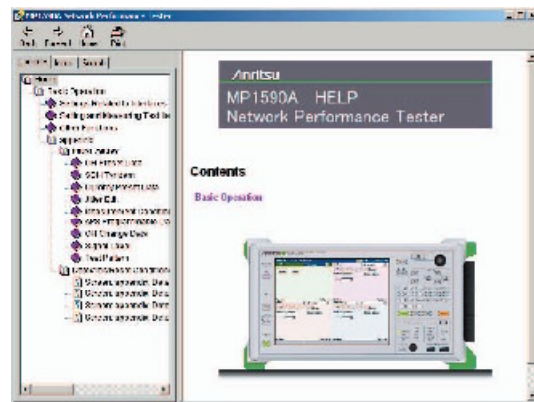
Trigger output

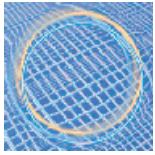
The MP1590A can output a trigger derived from the received signal to external units. The trigger output can be clock output, clock-divided output or frame-synchronized output. For example, connecting the trigger output to an external oscilloscope allows the MP1590A to evaluate errors/alarms and the oscilloscope to evaluate the input waveform at the same time.



Help function

By simply pushing the HELP key, help screen is displayed in a dedicated screen with cursor-selectable topics.





External Interface

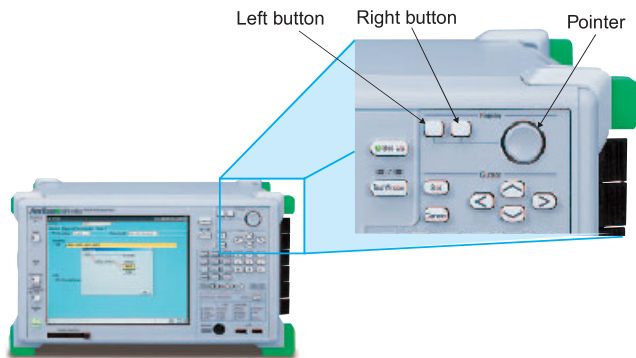
Portable unit with Microsoft® Windows® XP operating system and built-in screen

The MP1590A is equipped with Windows XP. A pointing device, USB port and compact flash interface slot are built in. This gives it high expandability with printers or external storage units and excellent data retention. The MP1590A is compact and portable with a built-in screen, so it is applicable to a variety of purposes including R&D, manufacturing, and maintenance.

Note: Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

Pointing device

The screen employs a graphical user interface. This means you can use a mouse to select items and change settings easily. In field tests, the MP1590A can be operated solely by its built-in pointing device and input keys.



Automatic test by remote commands

On the manufacturing line, it is often necessary to execute pre-set tests automatically and record the measured results. The MP1590A supports SCPI commands to enable control from an external controller (PC). It supports RS-232C, GPIB and Ethernet as remote control interfaces.

External clock input

The MP1590A can synchronize its internal clock to an input signal from an external device.

Synchronization can be performed on a 1/1 clock of 1.5 Mbit/s to 10.7 Gbit/s as well as 2 MHz, 1.5 MHz and 64k + 8k clocks etc.

Typical unit configurations

The MP1590A tester is used in the configurations shown below. Either MU150121A or MU150134A can be inserted in slot 3. Either MU150122A or MU150123A can be inserted in slot 4.

All 6 interface slots fully populated

1	MU150100A
2	
3	MU150121A or MU150134A
4	MU150122A or MU150123A
5	MU150125A
6	

Jitter testing up to 10.7G

1	MU150100A
2	
3	MU150121A or MU150134A
4	MU150123A
5	MU150125A
6	

With OTN option

Testing up to 10G without jitter

1	MU150100A
2	
3	MU150121A or MU150134A
4	MU150122A
5	Blank
6	

Jitter testing up to 2.7G

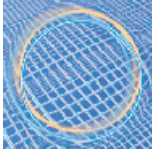
1	MU150100A
2	
3	Blank
4	Blank
5	MU150125A
6	

With OTN option

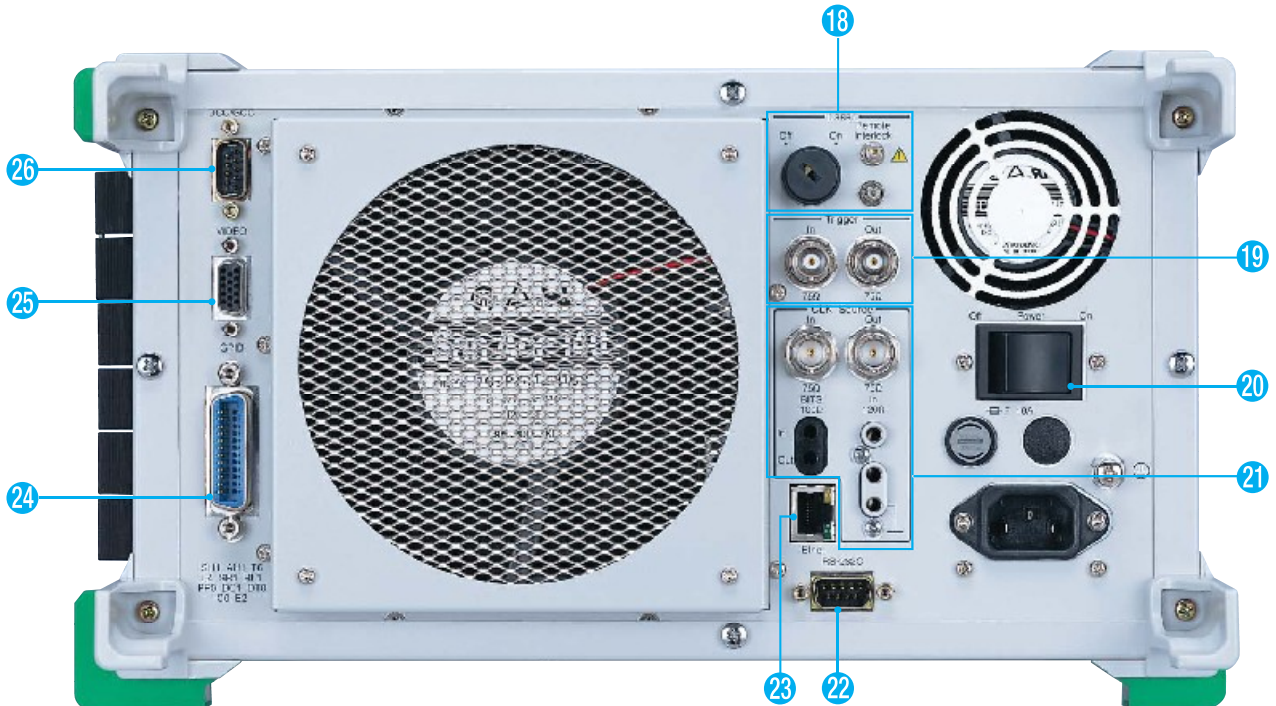
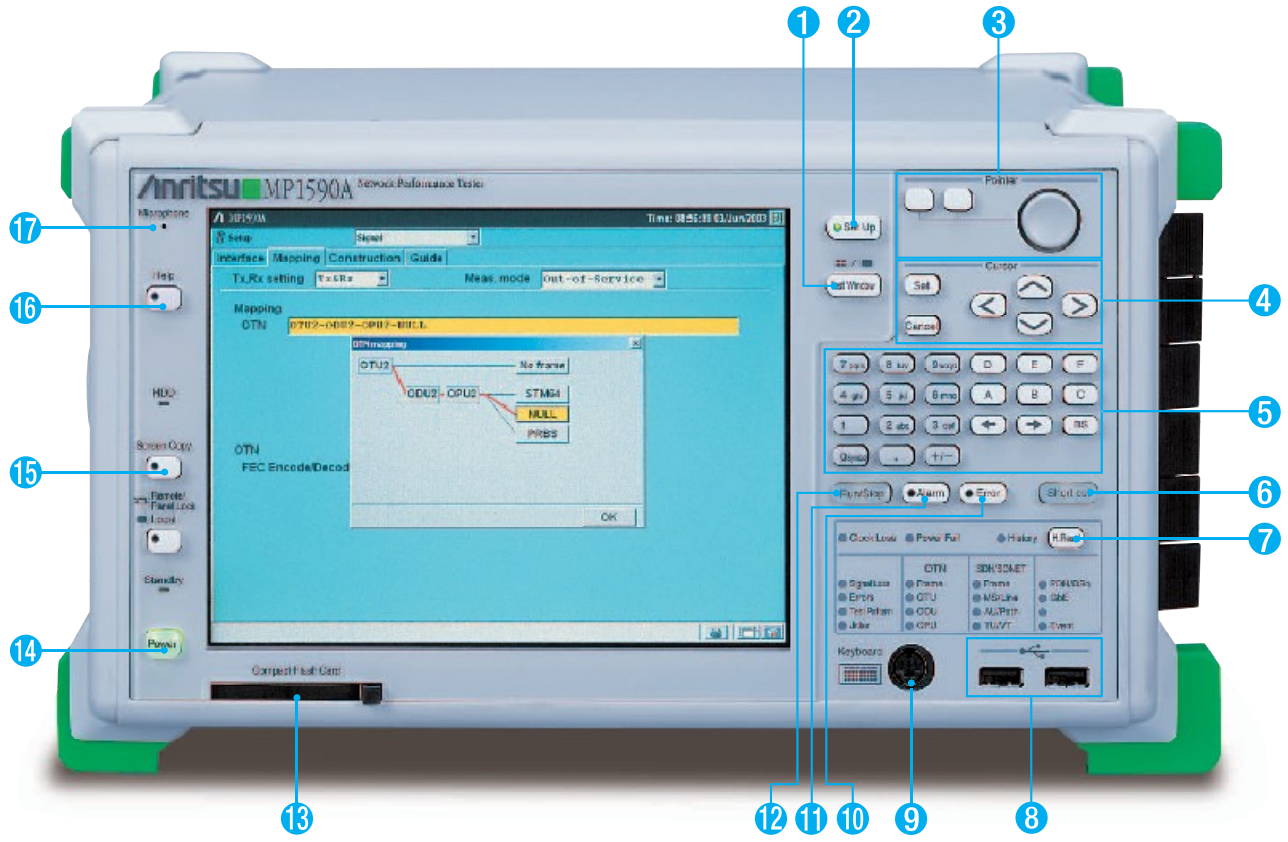
Testing up to 2.5G without jitter

1	MU150100A
2	
3	Blank
4	Blank
5	Blank
6	

With 10/10.7G Minus Option

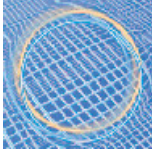


MP1590A Key Layout



- 1 **Test Window:** Switches Test window screen between full and 1/4 split screens.
- 2 **Setup:** Switches between Setup and Test window screens.
- 3 **Pointer:** Same function as mouse.
- 4 **Cursor**
 - Set: Sets data.
 - Cancel: Cancel data setting.
 - ^ v < >: Scrolls screen cursor.
- 5 **Input keys:** Inputs numeric data.
- 6 **Short cut:** (future capability)
- 7 **H.Reset:** Resets history data.
- 8 **USB Connector:** Connector for USB devices.
- 9 **Keyboard:** Connector for external keyboard.
- 10 **Error:** Starts/stops Error insertion.
- 11 **Alarm:** Starts/stops Alarm insertion.
- 12 **Run/Stop:** Starts/stops measurements and tests.
- 13 **Compact Flash Card:** Compact Flash memory interface.
- 14 **Power:** In operating condition (the power indicator is on), when power button is pushed, the MP1590A application ends, it automatically changes to Standby condition. In Standby condition (the Standby indicator is on), when power button is pushed, the MP1590A application software can be started and operated.
- 15 **Screen Copy:** Copies the displayed screen.
- 16 **Help:** Displays the Help screen.
- 17 **Microphone:** Microphone for order wire communication.
- 18 **Laser**
 - Key Switch: Switches optical signals "On" and "Off".
 - Remote interlock: Connector for laser remote interlock.
- 19 **Trigger**
 - In: Input connector for external trigger to control APS test and capture.
 - Out: Output connector for error/alarm and capture trigger.
- 20 **Power (Main power):** Switches MP1590A power on and off.
- 21 **CLK Source**
 - In: Reference signal input connector for synchronizing the transmission signal with an external reference signal.
 - Out: Reference signal output connector for synchronized signal with an transmission signal.
- 22 **RS-232C:** RS-232C remote control interface.
- 23 **Ether:** 10BASE-T/100BASE-TX Ethernet remote control interface.
- 24 **GPIB:** GPIB remote control interface.
- 25 **VIDEO:** Connector for external VGA display.
- 26 **DCC/GCC:** Input/output connector for add/drop of DCC (SDH/SONET), GCC (OTN) byte.





Specifications

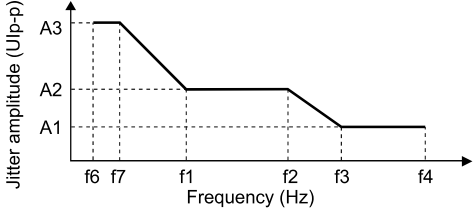
• MP1590A (main frame)

Reference Clock input	<p>Frequency Clock: 1.544 MHz, 2.048 MHz, 64 kHz + 8 kHz, 5 MHz, 10 MHz Data: 1.544 Mbit/s (BITS), 2.048 Mbit/s Input range: ± 50 ppm Level/Code 1.544 Mbit/s: ANSI T1.403 (B8ZS) 2.048 Mbit/s: ITU-T G.703 Table10 (HDB3) 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz: TTL (Rectangle, Sine Wave) 64 kHz + 8 kHz: 0.63 to 1.1 Vo-p (AMI, 8 kHz violation) Connector 1.544 MHz, 2.048 MHz, 2.048 Mbit/s, 5 MHz, 10 MHz: BNC 75 Ω 2.048 MHz, 2.048 Mbit/s, 64 kHz + 8 kHz: SIEMENS 120 Ω 1.544 Mbit/s: BANTAM 100 Ω Effective SDH/SONET/OTN bit rate.</p>
Reference Clock output	<p>Frequency Clock: 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz Data: 1.544 Mbit/s (BITS), 2.048 Mbit/s Level/Code 1.544 Mbit/s: ANSI T1.403 (B8ZS) 2.048 Mbit/s: ITU-T G.703 Table10 (HDB3) 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz: TTL (Rectangle) Connector 1.544 MHz, 2.048 MHz, 2.048 Mbit/s, 5 MHz, 10 MHz: BNC 75 Ω 1.544 Mbit/s: BANTAM 100 Ω *5 MHz is possible to use when the MU150125A is installed. Effective SDH/SONET/OTN bit rate.</p>
Trigger	<p>Trigger input: For capture/APS measurement Trigger output: Transmit Error/Alarm, Receive Error/Alarm, Capture trigger Level: TTL (active High) Connector: BNC 75 Ω</p>
DCC/GCC	<p>Data input/output: D1-D3 (192 kbit/s), D4-D12 (576 kbit/s), GCC0-2 (13124 kbit/s, 326.7 kbit/s) Clock output: 192 kHz, 576 kHz, 13124 kHz, 326.7 kHz Level: V.11 Connector: D-sub 9 pin</p>
Remote interface	RS-232C (installed Option 01), GPIB (installed Option 02), Ethernet (10BASE-T/100BASE-TX, installed Option 03)
Peripheral connection	VGA output (SVGA), USB (2 port, Rev. 1.1), keyboard (PS/2)
External memory	Compact flash (2 to 512 MB, recommended by CFA)
Pointing device	By standard pointing device for a main frame, cursor movement in a screen is possible.
Display size	8.4 inch, color TFT (800 x 600)
LED	<p>OTN: Frame, OTU, ODU, OPU SDH/SONET: Frame, MS/Line, AU/Path, TU/VT Standby, HDD, Clock Loss, Power Fail, History, Signal Loss, Errors, Test Pattern, Jitter, PDH/DSn, Event</p>
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)
Power	85 to 132/170 to 250 Vac (100/200 V system automatic change), 47.5 to 63 Hz
Power consumption	≤ 500 VA
Operational temperature	0° to +40 °C
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤ 13 kg (excluding plug-in units)

● MU150100A 10G/10.7G Unit

Electrical interface (1.544 to 155.52 Mbit/s)	<p>Bit rate PDH/DSn: 1.544 Mbit/s, 2.048 Mbit/s, 8.448 Mbit/s, 34.368 Mbit/s, 44.736 Mbit/s, 139.264 Mbit/s SDH/SONET: 51.84 Mbit/s, 155.52 Mbit/s</p> <p>Code 1.544 Mbit/s: AMI/B8ZS 2.048 Mbit/s, 8.448 Mbit/s, 34.368 Mbit/s: HDB3 44.736 Mbit/s, 51.84 Mbit/s: B3ZS 139.264 Mbit/s, 155.52 Mbit/s: CMI</p> <p>Connector 1.5M: BANTAM 100 Ω Balanced 2M: 3 pin Siemens 120 Ω Balanced 2/8/34/139/45/52/156M: BNC 75 Ω</p> <p>Level ANSI T1.102 (1.5/45M) ITU-T G.703 (2/8/34/139/156M) DSX output (1.5M): 0/655 feet DSX output (45M, 52M): 0/450/900 feet</p> <p>Monitor gain 20 dB, 26 dB: 1.5M/2M/8M/34M/45M/52M 20 dB: 139M/156M</p>
Electrical interface (9953.28 M, 10709.225 Mbit/s)	<p>Bit rate SDH/SONET: 9953.28 Mbit/s OTN: 10709.225 Mbit/s (Installed Option 05)</p> <p>Code: NRZ</p> <p>Connector: SMA 50 Ω</p> <p>Level Clock Output: 1.3 to 0.6 Vp-p Data Output: 0 to -0.2 V (High), -0.85 to -1.5 V (Low) Data Input: 1.5 to 0.3 Vp-p</p>
Optical interface	<p>Bit rate SDH/SONET: 51.84 Mbit/s, 155.52 Mbit/s, 622.08 Mbit/s, 2488.32 Mbit/s OTN: 2666.057 Mbit/s (Installed Option 05)</p> <p>Code: NRZ</p> <p>Connector: FC-PC (SMF), replaceable</p>
Optical output	<p>Level: -1 to +3 dBm (ATT = 0 dB, Option 04)</p> <p>Extinction ratio: ≥10 dB</p> <p>SMSR: ≥30 dB</p> <p>Peak wavelength: 1550 nm ±20 nm (Option 02,03), 1310 nm ±20 nm (Option 01,03)</p> <p>-20 dB width: ≤1 nm</p> <p>Safety classification: IEC 60825-1: CLASS 1M, 21CFR 1040.10: CLASS III b</p>
Optical input	<p>Optical input level: -8 to -33 dBm (52/156M), -8 to -29 dBm (622M/2.5G/2.6G)</p> <p>Wavelength: 1260 to 1610 nm</p> <p>Overload: +3 dBm (Average)</p>
Clock	<p>Internal, External (Reference input, 1/1 input), Receive</p> <p>Internal Accuracy: ±0.1 ppm Offset range: ±100 ppm/0.1 ppm step</p>
Frame	<p>1.544 Mbit/s: D4/ESF/Japan ESF 2.048 Mbit/s: 30, 31ch with or without CRC4 8.448 Mbit/s: G.742 34.368 Mbit/s: G.751 44.736 Mbit/s: M13/C-bit 139.264 Mbit/s: G.751 51.84 Mbit/s: SDH/SONET 155.52 Mbit/s: SDH/SONET 622.08 Mbit/s: SDH/SONET 2488.32 Mbit/s: SDH/SONET 9953.28 Mbit/s: SDH/SONET</p>
No frame	<p>1.544, 2.048, 8.448, 34.368, 44.736, 139.264 Mbit/s 51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s</p>

Test pattern	<p>PRBS, Word, all0, all1, 3 in 24 (only 1.5M) PRBS (SDH/SONET) No Frame: $2^{15} - 1$ (only 52/156M), $2^{23} - 1$, $2^{31} - 1$ Concatenation mapping: $2^{15} - 1$ (1c/4c), $2^{23} - 1$, $2^{31} - 1$ Another mapping: $2^{11} - 1$, $2^{15} - 1$, $2^{20} - 1$, $2^{20} - 1z$ (only 1.5M/45M), $2^{23} - 1$ Invert ON/OFF PRBS (PDH/DSn) $2^{11} - 1$, $2^{15} - 1$, $2^{20} - 1$, $2^{20} - 1z$ (only 1.5M/45M), $2^{23} - 1$ Invert ON/OFF Word: 16-bit programmable Transmit/Receive: An independent setup is possible</p>
OH preset	<p>SOH/TOH/POH: All bytes (except parity byte, K1/K2 byte, H1, H2 and H3) Dummy channel POH: All bytes (except parity byte)</p>
Error addition/ measurement	<p>PDH/DSn: Bit all (only addition), Code, Bit info, Bit 1.5M, Bit 2M, Bit 8M, Bit 34M, Bit 45M, Bit 139M, FAS 1.5M, FAS 2M, FAS 8M, FAS 34M, FAS 45M, FAS 139M, EXZ, CRC6, Ebit, Parity, Cbit, REI SDH: FAS, Frame (only measurement), B1, B2, HP-B3, LP-B3, BIP-2, MS-REI (M0/M1), HP-REI, LP-REI, Bit all (only addition), Bit info, OH bit, HP-IEC, LP-IEC, N2 BIP-2, HP-TC-REI, LP-TC-REI, HP-OEI, LP-OEI SONET: FAS, Frame (only measurement), B1, B2, HP-B3, LP-B3, BIP-2, REI-L (M0/M1), REI-P, REI-V, Bit all (only addition), Bit info, OH bit, HP-IEC, LP-IEC, N2 BIP-2, HP-TC-REI, LP-TC-REI, HP-OEI, LP-OEI</p>
Error addition timing	<p>Rate, Alternative, Single, Burst, All, Frame Rate Fix rate: $1 * 10^{-n}$ (n: 3 to 9), User program: $A * 10^{-B}$ (A: 1.0 to 9.9 step 0.1, B: 2 to 10) Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000 Frame (only PDH/DSn) : n in 16 frame (n: 1 to 4) B1, B2, B3, BIP-2 can be set Error bit.</p>
Alarm addition/ measurement	<p>PDH/DSn: LOS, LOF, AIS, RDI, RDI (MF) SDH: LOS, LOF, OOF (only measurement), RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-ERDIP, HP-ERDIS, HP-ERDIC, HP-TIM, HP-UNEQ, HP-SLM, TU-AIS, TU-LOP, TU-LOM, LP-RDI, LP-ERDIP, LP-ERDIS, LP-ERDIC, ISF, LP-RFI, LP-TIM, LP-UNEQ, LP-SLM, Sync. loss, OH Sync., HP-VC-AIS, LP-VC-AIS, HP-FAS, LP-FAS, HP-Incoming AIS, LP-Incoming AIS, HP-TC-RDI, LP-TC-RDI, HP-ODI, LP-ODI, HP-TC-TIM, LP-TC-TIM, HP-LTC, LP-LTC SONET: LOS, LOF, OOF (only measurement), RS-TIM, AIS-L, RDI-L, AIS-P, LOP-P, RDI-P, ERDIP-P, ERDIS-P, ERDIC-P, TIM-P, UNEQ-P, PLM-P, AIS-V, LOP-V, LOM-V, RDI-V, ERDIP-V, ERDIS-V, ERDIC-V, ISF, RFI-V, TIM-V, UNEQ-V, PLM-V, Sync. loss, OH Sync., HP-VC-AIS, LP-VC-AIS, HP-FAS, LP-FAS, HP-Incoming AIS, LP-Incoming AIS, HP-TC-RDI, LP-TC-RDI, HP-ODI, LP-ODI, HP-TC-TIM, LP-TC-TIM, HP-LTC, LP-LTC</p>
Alarm addition timing	<p>Single, Burst, Alternative, All Alternative Error frame = 0 to 64000, Normal frame = 1 to 64000</p>
Monitor	<p>PDH/DSn: FAS 1.5M, FW 2M, NFW 2M, MFW 2M, FAS 8M, FAS 34M, FAS 45M, FAS 139M, Info byte (only 2M) SDH/SONET: SOH/TOH/POH, Path Trace, Tandem byte, K1/K2 byte, AU/STS, TU/VT pointer</p>
Through	Transparent, Overhead overwrite (only SDH/SONET/OTN)
MUX/DEMUX	MUX/DEMUX is possible to 64 k units in PDH and DSn
Add/Drop	<p>PDH/DSn signal can be added to or dropped from the SDH/SONET mapping. Bit rate: 1.5 Mbit/s, 2 Mbit/s, 34 Mbit/s, 45 Mbit/s, 139 Mbit/s</p>
Delay measurement	<p>Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0.1 to 999 μs, 1.0 to 999.9 ms, 1.0 to 10.0 s, >Time out</p>
Dummy channel	<p>Mode: Copy/Dummy Dummy pattern: all 0, all 1, $2^{11} - 1$, $2^{15} - 1$ (Invert)</p>
Path Trace	<p>J0, J1, J2 byte can be set arbitrarily. 16 byte (CRC On), 32 byte (CRC Off)</p>
Tandem connection	<p>N1/Z5, N2 byte can be set arbitrarily. It can set ON/OFF</p>
Pointer generation	<p>AU/STS, TU/VT pointer Action: NDF, \pmJustification Timing: Manual, Burst (2 to 64), NDF</p>
Pointer measurement	<p>AU/STS, TU/VT pointer, C bit Measurement item: NDF, + PJC, -PJC, Cons, C, C1/C2</p>

Payload offset	Offset range: ± 100 ppm/0.1 ppm step can set at the Async. mapping.																																																												
APS test	Switching time measurement Measurement time: 0.1 to 2000.0 ms, Timeout APS Sequence Generator Generator timing: 2 to 64 word, Max. 8000 frame/word It can be set for each K1/K2, K3, K4.																																																												
Overhead sequence capture	Capture byte: K1/K2, K3, K4, AU/STS-Pointer, TU/VT-Pointer Size: 64 sequence Repeat: Max. 8000 frame/sequence																																																												
Overhead test	SOH/TOH/POH 1byte, A1/A2, K1/K2, RSOH, MSOH, SOH, POH (except parity byte) Timing: Alternative (A: 1 to 8000 times, B: 1 to 8000 times), A and B can be set up to 256 frames.																																																												
OH BERT test	Test byte: SOH/TOH/POH 1 byte, D1-D3, D4-D12 (except parity byte) Pattern: $2^{11} - 1$, $2^{15} - 1$ (Invert) Error addition: Bit (only Single) Measurement: Bit error, Sync loss																																																												
OH Add/Drop	Test byte: D1-D3, D4-D12																																																												
Performance	G.821, G.826, G.828, G.829, M.2100, M.2101, M.2110, M.2120, GR.820																																																												
Optical power meter	Wavelength: 1310 nm/1550 nm Measurement range: -7 to -40 dBm Measurement accuracy: ± 1 dB (-10 to -30 dBm), ± 2 dB (-7 to -9.9 dBm, -30.1 to -40 dBm)																																																												
Frequency counter	Measurement frequency (f0): 1.544, 2.048, 8.448, 34.368, 44.736, 139.264 MHz 51.84, 155.52, 622.08, 2488.320, 2666.057 MHz 9953.28, 10709.225 MHz Measurement range: $f_0 \pm 100$ ppm Accuracy: ± 0.1 ppm																																																												
Jitter tolerance	 <table border="1" data-bbox="414 1312 1242 1533"> <thead> <tr> <th>Bit rate (Mbit/s)</th> <th>A1 (UIp-p)</th> <th>A2 (UIp-p)</th> <th>A3 (UIp-p)</th> <th>f6 (Hz)</th> <th>f7 (Hz)</th> <th>f1 (Hz)</th> <th>f2 (Hz)</th> <th>f3 (Hz)</th> <th>f4 (Hz)</th> </tr> </thead> <tbody> <tr> <td>51.84</td> <td>20</td> <td>2</td> <td>0.2</td> <td>10</td> <td>30</td> <td>300</td> <td>2k</td> <td>20k</td> <td>400k</td> </tr> <tr> <td>155.52</td> <td>50</td> <td>2</td> <td>0.2</td> <td>10</td> <td>19.3</td> <td>500</td> <td>6.5k</td> <td>65k</td> <td>1.3M</td> </tr> <tr> <td>622.08</td> <td>200</td> <td>2</td> <td>0.2</td> <td>10</td> <td>10</td> <td>1k</td> <td>25k</td> <td>250k</td> <td>5M</td> </tr> <tr> <td>2488.32</td> <td>800</td> <td>2</td> <td>0.2</td> <td>10</td> <td>12.1</td> <td>20k</td> <td>400k</td> <td>4M</td> <td>20M</td> </tr> <tr> <td>2666.05*</td> <td>800</td> <td>2</td> <td>0.2</td> <td>10</td> <td>12.1</td> <td>20k</td> <td>400k</td> <td>4M</td> <td>20M</td> </tr> </tbody> </table> <p>Measurement condition: MU150100A loop-back measurement (*Built-in MU150125A-05) Temperature condition: $+10^{\circ}$ to $+40^{\circ}$ C Optical input level: -10 to -12 dBm (2488M, 2666M), -10 to -20 dBm (52M, 156M, 622M) Error threshold: 10^{-8} (52M), 10^{-9} (156M, 622M), 10^{-10} (2488M, 2666M) Optical input wavelength: 1310 nm/1550 nm Mapping SDH: VC3-Bulk (52M), VC4-nc (n = 1, 4, 16) (156M/622M/2488M) SONET: STSnc (n = 1, 3, 12, 48) OTU-1: ODU1-OPU1-PRBS Test pattern: PRBS23 (SDH/SONET), PRBS31 (OTU-1), Mark ratio 1/2, Scramble "On" Clock: internal</p>	Bit rate (Mbit/s)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	f6 (Hz)	f7 (Hz)	f1 (Hz)	f2 (Hz)	f3 (Hz)	f4 (Hz)	51.84	20	2	0.2	10	30	300	2k	20k	400k	155.52	50	2	0.2	10	19.3	500	6.5k	65k	1.3M	622.08	200	2	0.2	10	10	1k	25k	250k	5M	2488.32	800	2	0.2	10	12.1	20k	400k	4M	20M	2666.05*	800	2	0.2	10	12.1	20k	400k	4M	20M
Bit rate (Mbit/s)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	f6 (Hz)	f7 (Hz)	f1 (Hz)	f2 (Hz)	f3 (Hz)	f4 (Hz)																																																				
51.84	20	2	0.2	10	30	300	2k	20k	400k																																																				
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622.08	200	2	0.2	10	10	1k	25k	250k	5M																																																				
2488.32	800	2	0.2	10	12.1	20k	400k	4M	20M																																																				
2666.05*	800	2	0.2	10	12.1	20k	400k	4M	20M																																																				
Auxiliary interface	External clock input, Receive clock output, Cock/Frame sync. output																																																												
Optical output power adjustable (Option 04)	Variable range: 0 to 30 dB, Accuracy: $\leq \pm 0.5$ dB (0 to 10 dB), $\leq \pm 1.0$ dB (10.1 to 30 dB), Setting resolution: 0.1 dB																																																												

● MU150100A Option 05 (OTU-1/OTU-2)

Bite rate	10709.225 Mbit/s, 2666.057 Mbit/s
Frame	10709.225 Mbit/s: OTU-2, 2666.057 Mbit/s: OTU-1
No frame	10709.225 Mbit/s, 2666.057 Mbit/s
Test pattern	PRBS, Word, all 0, all 1 PRBS No frame: $2^{15} - 1$, $2^{23} - 1$, $2^{31} - 1$ PRBS mapping: $2^{15} - 1$, $2^{23} - 1$, $2^{31} - 1$ SDH/SONET mapping: According to SDH/SONET mapping Invert ON/OFF Word: 16-bit programmable Transmit/Receive: An independent setup is possible
OH preset	OTU, ODU, OPU, FAS (except parity byte, MFAS and JC byte) TTI (SPAI [1] - [15], DAPI [1] - [15]) can be set character. PT is set automatically according to mapping (can be edit).
FEC	G.709, RS (255, 239) It can set ON/OFF.
Justification	Generation Action: \pm Justification Timing: Single, Burst (2 to 64) Measurement item: + JC, -JC
Payload offset	Offset range: ± 65.9 ppm/0.1 ppm step can set at the Async. mapping.
Error addition/ measurement	FAS, BIP-8 (SM, PM, TCM1-6), BEI (SM, PM, TCM1-6), Bit all (only addition for OTN frame), Bit, Corrected error bit (only measurement), Uncorrectable FEC block (only measurement)
Error addition timing	Single, Rate, All, Alternate, Random (only Bit all) Rate Fix rate: 1×10^{-n} (n: 3 to 9), User program: $A \times 10^{-B}$ (A: 1.0 to 9.9, B: 2 to 10) Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000 Random: Only Bit all When the Parity error is set, it can be select Error position
Alarm addition/ measurement	LOF, OOF (only measurement), LOM, OOM (only measurement), BDI (SM, PM, TCM1-6), AIS (OTU, ODU), ODU-OCI, ODU-LCK, ODU-PLM (only measurement), IAE (SM, TCM1-6), TIM (SM, PM, TCM1-6), LTC (TCM1-6), BIAE (SM, TCM1-6)
Alarm addition timing	Alternative, All, Burst, Single Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000
Monitor	All OH (OTU, ODU, OPU), TTI, FTFL, Payload Multi-frame indicate is possible at the TTI and FTFL.
Overhead sequence capture	Capture byte: FAS, APS/PCC, EXP, FTFL, GCC0-2, PM, PSI, SM, TCMACT, TCM1-6, OPU Size: 64 sequence Repeat: Max. 8000 frame/sequence
Overhead test	OTU/ODU/OPU 1byte, FAS, APS/PCC, TCM1-6, SM, PM, GCC0-2, EXP (except parity byte, MFAS and JC byte) Timing: Alternative (A: 1 to 8000 times, B: 1 to 8000 times), A and B can be set up to 256 frames.
OH BERT test	GCC0-2, OH 1byte (except Parity byte) Pattern: $2^{11} - 1$, $2^{15} - 1$ (Invert) Error addition: Bit (only Single) Measurement: Bit error, Sync.loss
OH Add/Drop	Test byte: GCC0-2

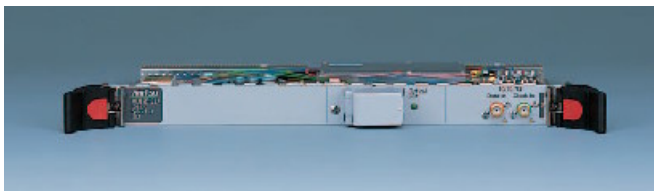
● **MU150100A Option 07 (10/10.7G Minus option)**

Function	This Option removes the 10/10.7G electrical capability from the MU150100A. This Option must be installed in the factory.
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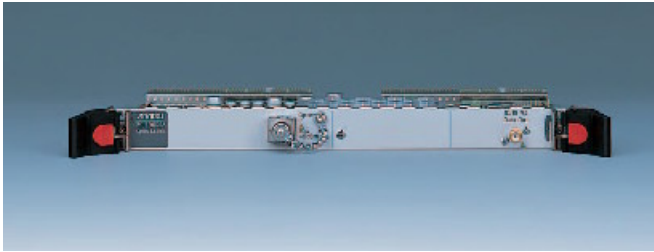
● **MU150121A 10/10.7G Optical Unit (Tx)**

Bit rate	9953.28 Mbit/s, 10709.225 Mbit/s Depends on frequency accuracy and external input frequency of the MU150100A.
Peak wavelength	1310 ±20 nm (Option 01, 03), 1550 ±20 nm (Option 02, 03)
-20 dB width	≤0.5 nm (@-20 dB)
SMSR	≥30 dB
Extinction ratio	≥10 dB
Optical output power	0 to +3 dBm
Signal code	NRZ
Connector	FC-PC (SMF), replaceable
Electrical input	9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm Input level H: 0 to -0.2 V, L: -0.85 to -1.5 V Impedance: 50 Ω Connector: SMA
Safety classification	IEC 60825-1: CLASS 1M, 21CFR 1040.10: CLASS III b
Optical output power adjustable (Option 04)	Variable range: 0 to 20 dB, Accuracy: ≤±0.5 dB (0 to 10 dB), ≤±1.0 dB (10.1 to 20 dB), Setting resolution: 0.1 dB



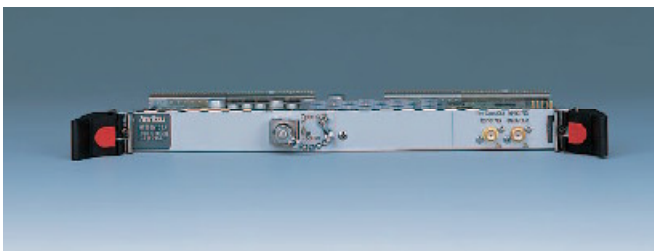
● **MU150122A 10/10.7G Optical Unit (Rx narrow)**

Bit rate	9953.28 Mbit/s \pm 100 ppm, 10709.225 Mbit/s \pm 100 ppm
Optical input wavelength	1260 to 1610 nm
Optical input sensitivity	-14 to 0 dBm
Absolute maximum optical input	+3 dBm (average)
Optical input signal code	NRZ
Optical input return loss	\geq 27 dB
Optical connector	FC-PC (SMF), replaceable
Electrical output signal	9953.28 Mbit/s, 10709.225 Mbit/s Output level: 0.2 to 1.0 Vp-p Signal code: NRZ Impedance: 50 Ω Connector: SMA
Optical input power measurement	Measurement range: -20 to +2 dBm Measurement accuracy: \leq \pm 0.5 dB (+2 to -10 dBm), \leq \pm 1.0 dB (-10.1 to -20 dBm)

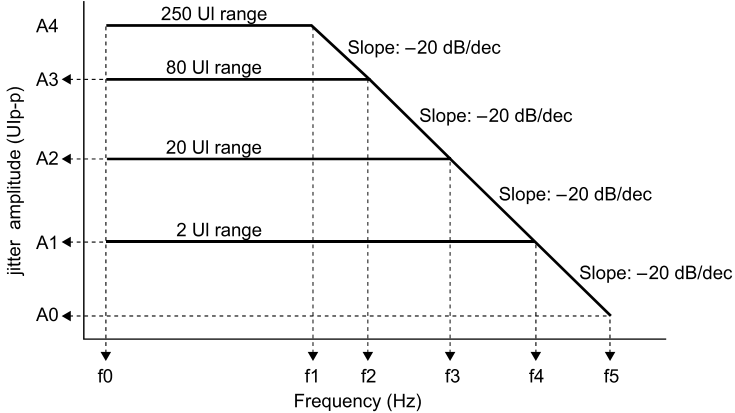
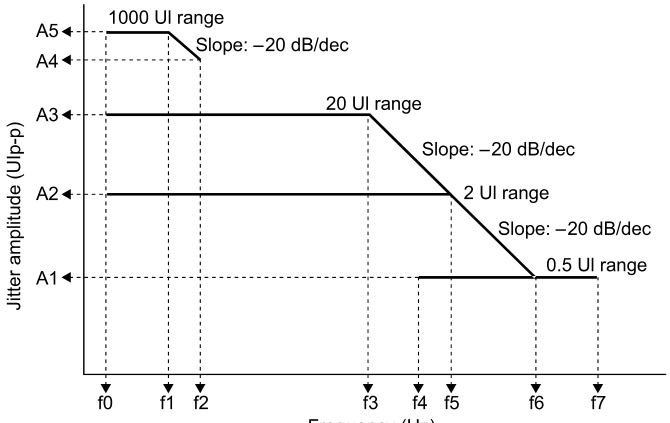


● **MU150123A 10/10.7G Optical Unit (Rx wide)**

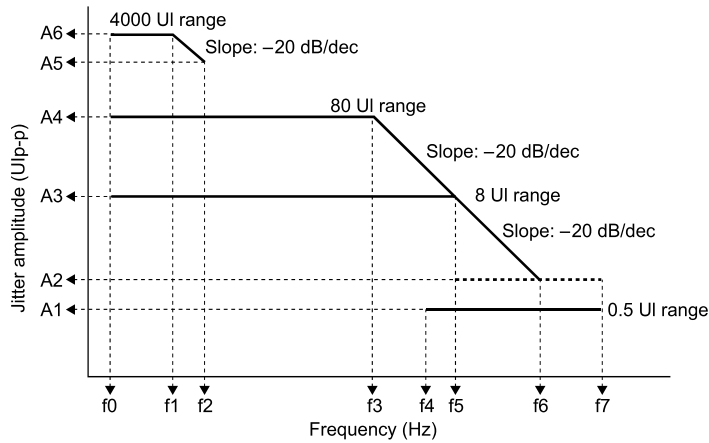
Bit rate	9953.28 Mbit/s \pm 100 ppm, 10709.225 Mbit/s \pm 100 ppm (Option 05)
Optical input wavelength	1260 to 1610 nm
Optical input sensitivity	-14 to 0 dBm
Absolute maximum optical input	+3 dBm (average)
Optical input signal code	NRZ
Optical input return loss	\geq 27 dB
Optical connector	FC-PC (SMF), replaceable
Electrical output signal	Data output: 9953.28 Mbit/s, 10709.225 Mbit/s (Option 05) Output level: 1.0 \pm 0.25 Vp-p Signal code:NRZ Clock output 9953.28 MHz, 10709.225 MHz (Option 05) Output level: 0.8 \pm 0.25 Vp-p Impedance: 50 Ω Connector: SMA
Optical input power measurement	Measurement range: -20 to +2 dBm Measurement accuracy: \leq \pm 0.5 dB (+2 to -10 dBm), \leq \pm 1.0 dB (-10.1 to -20 dBm)



● MU150125A 10/10.7G jitter Unit

Frequency	51.84 MHz, 155.52 MHz, 622.08 MHz, 2488.32 MHz, 9953.28 MHz 2666.06 MHz (Option 05), 10709.225 MHz (Option 05) 10312.5 MHz (Option 06)																																															
Jitter generation	<p>Frequency: 51.84 MHz ±100 ppm, 155.52 MHz ±100 ppm, 622.08 MHz ±100 ppm, 2488.32 MHz ±100 ppm, 2666.057 MHz ±100 ppm, 9953.28 MHz ±100 ppm, 10312.5 MHz ±100 ppm, 10709.225 MHz ±100 ppm</p> <p>Level: 0.8 Vp-p ±0.25 V Connector: SMA, 50 Ω Modulation frequency: 0.1 to 80 MHz Amplitude: 0 to 4040 Ulp-p</p> <p>Modulation value: 52M, 156M, 622M</p>																																															
																																																
	<table border="1"> <thead> <tr> <th>Bit rate (bit/s)</th> <th>f0 (Hz)</th> <th>f1 (kHz)</th> <th>f2 (kHz)</th> <th>f3 (kHz)</th> <th>f4 (kHz)</th> <th>f5 (MHz)</th> <th>A0 (Ulp-p)</th> <th>A1 (Ulp-p)</th> <th>A2 (Ulp-p)</th> <th>A3 (Ulp-p)</th> <th>A4 (Ulp-p)</th> </tr> </thead> <tbody> <tr> <td>52M</td> <td>0.1</td> <td>—</td> <td>—</td> <td>50</td> <td>500</td> <td>1.3</td> <td>0.776</td> <td>2.02</td> <td>20.20</td> <td>—</td> <td>—</td> </tr> <tr> <td>156M</td> <td>0.1</td> <td>—</td> <td>38</td> <td>150</td> <td>1500</td> <td>3.8</td> <td>0.797</td> <td>2.02</td> <td>20.20</td> <td>80.8</td> <td>—</td> </tr> <tr> <td>622M</td> <td>0.1</td> <td>4.8</td> <td>15</td> <td>60</td> <td>600</td> <td>5</td> <td>0.242</td> <td>2.02</td> <td>20.20</td> <td>80.8</td> <td>253.0</td> </tr> </tbody> </table>	Bit rate (bit/s)	f0 (Hz)	f1 (kHz)	f2 (kHz)	f3 (kHz)	f4 (kHz)	f5 (MHz)	A0 (Ulp-p)	A1 (Ulp-p)	A2 (Ulp-p)	A3 (Ulp-p)	A4 (Ulp-p)	52M	0.1	—	—	50	500	1.3	0.776	2.02	20.20	—	—	156M	0.1	—	38	150	1500	3.8	0.797	2.02	20.20	80.8	—	622M	0.1	4.8	15	60	600	5	0.242	2.02	20.20	80.8
Bit rate (bit/s)	f0 (Hz)	f1 (kHz)	f2 (kHz)	f3 (kHz)	f4 (kHz)	f5 (MHz)	A0 (Ulp-p)	A1 (Ulp-p)	A2 (Ulp-p)	A3 (Ulp-p)	A4 (Ulp-p)																																					
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Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (MHz)	f6 (MHz)	f7 (MHz)	A1 (Ulp-p)	A2 (Ulp-p)	A3 (Ulp-p)	A4 (Ulp-p)	A5 (Ulp-p)																																			
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9953M, 10.3G, 10.7G



Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (kHz)	f6 (MHz)	f7 (MHz)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	A4 (UIp-p)	A5 (UIp-p)	A6 (UIp-p)
9953M 10.3G 10.7G	0.1	15	600	100	500	1	4	80	0.505	2.02	8.08	80.8	110	4040

Accuracy:

- 0.5 UI range: $\pm Q$ % of setting ± 0.02 UIp-p
- 2 UI range: $\pm Q$ % of setting ± 0.02 UIp-p
- 8 UI range: $\pm Q$ % of setting ± 0.8 UIp-p
- 20 UI range: $\pm Q$ % of setting ± 0.2 UIp-p
- 20 UI range: $\pm Q$ % of setting ± 1.2 UIp-p (2488M, 2666M)
- 80 UI range: $\pm Q$ % of setting ± 1.2 UIp-p
- 80 UI range: $\pm Q$ % of setting ± 4.8 UIp-p (9953M, 10.3G, 10.7G)
- 250 UI range: $\pm Q$ % of setting ± 6 UIp-p
- 1000 UI range: $\pm Q$ % of setting ± 6 UIp-p
- 4000 UI range: $\pm Q$ % of setting ± 24 UIp-p

Frequency	Variable error Q	Frequency range
52 MHz	± 8 %	0.1 to 500 kHz
	± 12 %	500 kHz to 1.3 MHz
156 MHz	± 8 %	0.1 to 500 kHz
	± 12 %	500 kHz to 1.5 MHz
	± 15 %	1.5 MHz to 3.8 MHz
622 MHz	± 8 %	0.1 to 500 kHz
	± 12 %	500 kHz to 2 MHz
	± 15 %	2M to 5 MHz
2488 MHz 2666 MHz	± 8 %	0.1 to 500 kHz
	± 12 %	500 kHz to 2 MHz
	± 15 %	2M to 20 MHz
9953MHz 10.3 GHz 10.7 GHz	± 8 %	0.1 to 500 kHz
	± 12 %	500 kHz to 2 MHz
	± 15 %	2M to 80 MHz

Jitter generation

Jitter measurement	<p>Frequency: 51.84 MHz ±100 ppm, 155.52 MHz ±100 ppm, 622.08 MHz ±100 ppm, 2488.32 MHz ±100 ppm, 2666.057 MHz ±100 ppm, 9953.28 MHz ±100 ppm, 10312.5 MHz ±100 ppm, 10709.225 MHz ±100 ppm Level: 0.8 Vp-p ±0.3 V (52 MHz to 2.6 GHz), 0.8 Vp-p ±0.25 V (10/10.3/10.7 GHz) Connector: SMA, 50 Ω Manual jitter measurement: UIp-p, UI+p, UI-p/UIrms UIp-p measurement: 2 UI range (-1.010 to 1.010 UIp-p/Step 0.001 UIp-p) 20 UI range (-10.10 to 10.10 UIp-p/Step 0.01 UIp-p) 80 UI range (-40.4 to 40.4 UIp-p/Step 0.25 UIp-p) 250 UI range (-123.0 to 123.0 UIp-p/Step 0.5 UIp-p) 1000 UI range (-510.0 to 510.0 UIp-p/Step 1 UIp-p) 4000 UI range (-2020 to 2020 UIp-p/Step 2 UIp-p) UIrms measurement: 2 UI range (0.000 to 0.714 UIrms/Step 0.001 UIrms) 20 UI range (0.00 to 7.14 UIrms/Step 0.01 UIrms) Filter</p>																																																													
	<table border="1"> <thead> <tr> <th>Frequency (Hz)</th> <th>HP0 (Hz)</th> <th>HP1 (Hz)</th> <th>HP1' (Hz)</th> <th>HP2 (Hz)</th> <th>HP' (Hz)</th> <th>HP (Hz)</th> <th>LP (Hz)</th> <th>LP' (Hz)</th> </tr> </thead> <tbody> <tr> <td>52M</td> <td>10</td> <td>100</td> <td>—</td> <td>20k</td> <td>—</td> <td>12k</td> <td>400k</td> <td>—</td> </tr> <tr> <td>156M</td> <td>10</td> <td>500</td> <td>—</td> <td>65k</td> <td>—</td> <td>12k</td> <td>1.3M</td> <td>500</td> </tr> <tr> <td>622M</td> <td>10</td> <td>1k</td> <td>—</td> <td>250k</td> <td>—</td> <td>12k</td> <td>5M</td> <td>1k</td> </tr> <tr> <td>2488M 2666M</td> <td>10</td> <td>5k</td> <td>—</td> <td>1M</td> <td>—</td> <td>12k</td> <td>20M</td> <td>5k</td> </tr> <tr> <td>9953M 10.3G 10.7G</td> <td>10</td> <td>20k</td> <td>10k</td> <td>4M</td> <td>50k</td> <td>12k</td> <td>80M</td> <td>20k</td> </tr> </tbody> </table>	Frequency (Hz)	HP0 (Hz)	HP1 (Hz)	HP1' (Hz)	HP2 (Hz)	HP' (Hz)	HP (Hz)	LP (Hz)	LP' (Hz)	52M	10	100	—	20k	—	12k	400k	—	156M	10	500	—	65k	—	12k	1.3M	500	622M	10	1k	—	250k	—	12k	5M	1k	2488M 2666M	10	5k	—	1M	—	12k	20M	5k	9953M 10.3G 10.7G	10	20k	10k	4M	50k	12k	80M	20k							
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	9953M 10.3G 10.7G	10	20k	10k	4M	50k	12k	80M	20k																																																					
	<p>Accuracy (UIp-p, UI+p, UI-p): 2 UI range: ±R% ±W UIp-p 20 UI range: ±R% ±W UIp-p 80 UI range: ±R% ±W UIp-p 250 UI range: ±R% ±W UIp-p 1000 UI range: ±R% ±W UIp-p 4000 UI range: ±R% ±W UIp-p</p>																																																													
	<table border="1"> <thead> <tr> <th rowspan="3">Frequency (Hz)</th> <th colspan="7">W Clock signal</th> </tr> <tr> <th colspan="2">HP1+LP</th> <th colspan="2">HP2+LP</th> <th colspan="2">HP+LP*</th> <th>HP0+LP'</th> </tr> <tr> <th>2 UI</th> <th>20 UI</th> <th>2 UI</th> <th>20 UI</th> <th>2 UI</th> <th>20 UI</th> <th>80/250/1000/4000 UI</th> </tr> </thead> <tbody> <tr> <td>52M</td> <td>0.035</td> <td>0.5</td> <td>0.03</td> <td>0.3</td> <td>0.03</td> <td>0.3</td> <td>—</td> </tr> <tr> <td>156M</td> <td>0.035</td> <td>0.5</td> <td>0.02</td> <td>0.2</td> <td>0.03</td> <td>0.3</td> <td>2</td> </tr> <tr> <td>622M</td> <td>0.035</td> <td>0.5</td> <td>0.03</td> <td>0.3</td> <td>0.03</td> <td>0.3</td> <td>8</td> </tr> <tr> <td>2488M 2.6G</td> <td>0.035</td> <td>0.5</td> <td>0.03</td> <td>0.3</td> <td>0.03</td> <td>0.3</td> <td>20</td> </tr> <tr> <td>9953M 10.3G 10.7G</td> <td>0.05</td> <td>0.5</td> <td>0.03</td> <td>0.3</td> <td>0.03</td> <td>0.3</td> <td>80</td> </tr> </tbody> </table>	Frequency (Hz)	W Clock signal							HP1+LP		HP2+LP		HP+LP*		HP0+LP'	2 UI	20 UI	2 UI	20 UI	2 UI	20 UI	80/250/1000/4000 UI	52M	0.035	0.5	0.03	0.3	0.03	0.3	—	156M	0.035	0.5	0.02	0.2	0.03	0.3	2	622M	0.035	0.5	0.03	0.3	0.03	0.3	8	2488M 2.6G	0.035	0.5	0.03	0.3	0.03	0.3	20	9953M 10.3G 10.7G	0.05	0.5	0.03	0.3	0.03	0.3
Frequency (Hz)	W Clock signal																																																													
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9953M 10.3G 10.7G	0.05	0.5	0.03	0.3	0.03	0.3	80																																																							
<p>*: Apply HP+LP' at 9953M, 10.3G, 10.7G</p>																																																														

Jitter measurement

Accuracy (UIrms)

2 UI range: $\pm R\% \pm Y$ UIp-p

20 UI range: $\pm R\% \pm Y$ UIp-p

Bit rate (bit/s)/ frequency (Hz)	Y Clock signal	
	HP+LP*	
	2 UI	20 UI
52M	0.008	0.04
156M	0.008	0.04
622M	0.008	0.04
2488M 2666M	0.008	0.04
9953M 10.3G 10.7G	0.008	0.05

*: Apply HP+LP at 9953M, 10.3G, 10.7G

MU150100A loop back measurement

Bit rate (Mbit/s)	W data signal			
	UIp-p			UIrms
	HP1+LP	HP+LP	HP2+LP	HP+LP
	2 UI	2 UI	2 UI	2 UI
51.84 (Optical)	0.070	0.070	0.035	0.010
51.84 (Electrical)	0.070	0.070	0.035	0.010
155.52 (Optical)	0.070	0.070	0.035	0.010
155.52 (Electrical)	0.070	0.070	0.035	0.010
622.08 (Optical)	0.070	0.070	0.035	0.010
2488.32 (Optical)	0.080	0.080	0.060	0.010
2666.05* (Optical)	0.080	0.080	0.060	0.010

*: Built-in MU150125A-05

MU150100A with MU150125A Receiver only

Bit rate (Mbit/s)	W data signal (Typical)			
	UIp-p			UIrms
	HP1+LP	HP+LP	HP2+LP	HP+LP
	2 UI	2 UI	2 UI	2 UI
51.84 (Optical)	0.035	0.035	0.035	0.009
51.84 (Electrical)	0.035	0.035	0.035	0.009
155.52 (Optical)	0.035	0.035	0.035	0.009
155.52 (Electrical)	0.035	0.035	0.025	0.009
622.08	0.035	0.035	0.035	0.009
2488.32	0.035	0.035	0.035	0.009
2666.05*	0.035	0.035	0.035	0.009

*: Built-in MU150125A-05

Measurement condition

Temperature condition: +10° to +40°C

Optical input level: -10 to -12 dBm

Measurement time: 1 min

Optical input wavelength: 1310 nm/1550 nm

Mapping

SDH: VC3-Bulk (52M), VC4-nc (n = 1, 4, 16) (156M/622M/2488M)

SONET: STSnc (n = 1, 3, 12, 48)

OTU-1: ODU1-OPU1-PRBS

Test pattern: PRBS23 (SDH/SONET), PRBS31 (OTU-1), Mark ratio 1/2, Scramble "On"

Clock: internal

Jitter measurement

MU150100A, MU150121A, MU150123A loop back measurement

Bit rate (Mbit/s)	W data signal			
	Ulp-p			Ulrms
	HP1+LP	HP'+LP	HP2+LP	HP'+LP
	2 UI	2 UI	2 UI	2 UI
9953.280	0.080	0.080	0.060	0.010
10709.225*	0.080	0.080	0.060	0.010

*: Built-in MU150125A-05

Measurement condition

Temperature condition: +10° to +40°C
 Optical input level: -10 to -12 dBm
 Measurement time: 1 min
 Optical input wavelength: 1310 nm/1550 nm

Mapping

SDH: VC4-64c (9953M)
 SONET: STS192c (9953M)
 OTU-2: ODU2-OPU2-PRBS

Test pattern: PRBS23 (SDH/SONET), PRBS31 (OTU-2), Mark ratio 1/2, Scramble "On"

Clock: internal

MU150100A, MU150134A, MU150123A loop back measurement

Bit rate (Mbit/s)	W data signal			
	Ulp-p			Ulrms
	HP1+LP	HP'+LP	HP2+LP	HP'+LP
	2 UI	2 UI	2 UI	2 UI
9953.280	0.065	0.065	0.060	0.010
10709.225*	0.065	0.065	0.060	0.010

*: Built-in MU150125A-05

Measurement condition

Temperature condition: +10° to +40°C
 Optical input level: -10 to -12 dBm
 Measurement time: 1 min
 Optical input wavelength: 1550 nm

Mapping

SDH: VC4-64c (9953M)
 SONET: STS192c (9953M)
 OTU-2: ODU2-OPU2-PRBS

Test pattern: PRBS23 (SDH/SONET), PRBS31 (OTU-2), Mark ratio 1/2, Scramble "On"

Clock: internal

MU150123A with MU150125A Receiver only

Bit rate (Mbit/s)	W data signal (Typical)			
	Ulp-p			Ulrms
	HP1+LP	HP'+LP	HP2+LP	HP'+LP
	2 UI	2 UI	2 UI	2 UI
9953.280	0.050	0.035	0.035	0.009
10709.225*	0.050	0.035	0.035	0.009

*: Built-in MU150125A-05

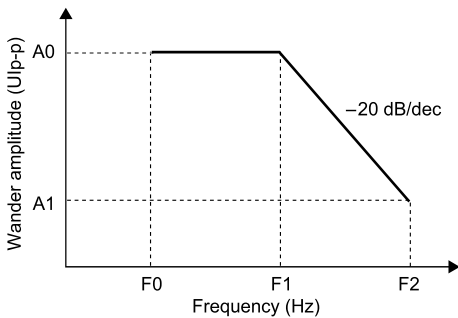
Measurement condition

Temperature condition: +10° to +40°C
 Optical input level: -10 to -12 dBm
 Measurement time: 1 min
 Optical input wavelength: 1310 nm/1550 nm

Mapping

SDH: VC4-64c (9953M)
 SONET: STS192c (9953M)
 OTU-2: ODU2-OPU2-PRBS

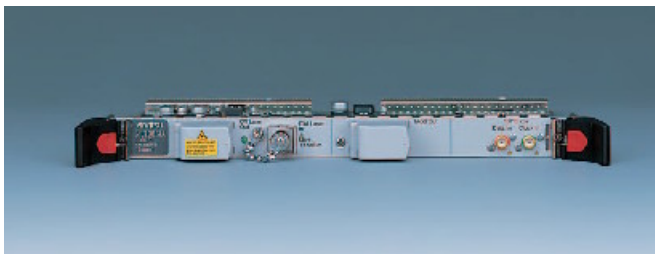
Jitter measurement	<p>Test pattern: PRBS23 (SDH/SONET), PRBS31 (OTU-2), Mark ratio 1/2, Scramble "On" Clock: internal</p> <p>Additional error [R]</p> <table border="1" data-bbox="397 430 1144 976"> <thead> <tr> <th data-bbox="397 430 544 462">Additional error</th> <th data-bbox="544 430 1144 462">Frequency range</th> </tr> </thead> <tbody> <tr> <td data-bbox="397 462 544 598">±15 %</td> <td data-bbox="544 462 1144 598"> <100 Hz (52M) <500 Hz (156M) <1 kHz (622M) <5 kHz (2488M, 2666M) <20 kHz (9953M/10.3G/10.7G) </td> </tr> <tr> <td data-bbox="397 598 544 735">±7 %</td> <td data-bbox="544 598 1144 735"> 100 Hz to 300 kHz (52M) 500 Hz to 300 kHz (156M) 1 kHz to 300 kHz (622M) 5 kHz to 300 kHz (2488M, 2666M) 20 kHz to 300 kHz (9953M/10.3G/10.7G) </td> </tr> <tr> <td data-bbox="397 735 544 787">±8 %</td> <td data-bbox="544 735 1144 787"> 300 kHz to 400 kHz (52M) 300 kHz to 1 MHz (≥156M) </td> </tr> <tr> <td data-bbox="397 787 544 850">±10 %</td> <td data-bbox="544 787 1144 850"> 1 MHz to 1.3 MHz (156M) 1 MHz to 3 MHz (≥622M) </td> </tr> <tr> <td data-bbox="397 850 544 913">±15 %</td> <td data-bbox="544 850 1144 913"> 3 MHz to 5 MHz (622M) 3 MHz to 10 MHz (≥2448M) </td> </tr> <tr> <td data-bbox="397 913 544 976">±20 %</td> <td data-bbox="544 913 1144 976"> 10 MHz to 20 MHz (2488M, 2666M) 10 MHz to 80 MHz (9953M/10.3G/10.7G) </td> </tr> </tbody> </table>	Additional error	Frequency range	±15 %	<100 Hz (52M) <500 Hz (156M) <1 kHz (622M) <5 kHz (2488M, 2666M) <20 kHz (9953M/10.3G/10.7G)	±7 %	100 Hz to 300 kHz (52M) 500 Hz to 300 kHz (156M) 1 kHz to 300 kHz (622M) 5 kHz to 300 kHz (2488M, 2666M) 20 kHz to 300 kHz (9953M/10.3G/10.7G)	±8 %	300 kHz to 400 kHz (52M) 300 kHz to 1 MHz (≥156M)	±10 %	1 MHz to 1.3 MHz (156M) 1 MHz to 3 MHz (≥622M)	±15 %	3 MHz to 5 MHz (622M) 3 MHz to 10 MHz (≥2448M)	±20 %	10 MHz to 20 MHz (2488M, 2666M) 10 MHz to 80 MHz (9953M/10.3G/10.7G)
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Hit measurement	Count, Hit seconds, % free seconds														
Jitter tolerance	<p>Evaluate jitter tolerance by selected Mask</p> <p>Mask selection:</p> <ul style="list-style-type: none"> Telcordia GR-253, ANSI T1.105.03 ITU-T G.783, G.825, G.813, G.8251 ETSI EN 302 084 User 														
Jitter transfer	<p>Evaluate jitter transfer by selected Mask</p> <p>Accuracy: ±0.05 dB ±0.12*<i>g</i></p> <p>Applicable frequency range</p> <p>0.01*<i>fc</i> to 100*<i>fc</i>, or maximum frequency setting value</p> <p>The maximum frequency setting value is applied in the case of 100*<i>fc</i></p> <p><i>g</i>: Transfer gain (dB) for every frequency point</p> <p><i>fc</i>: Cut-off frequency of transfer mask</p> <p>Measurement condition</p> <ul style="list-style-type: none"> Average level: Fine Waiting time: 20 s Input jitter value: ≥0.15 Ulp-p Jitter modulation frequency: ≥300 Hz Dynamic range: ≤-40 dB (at the above measurement condition) <p>Mask selection [Maximum value of a mask is 100 times as much modulation frequency as a break point (<i>fc</i>)]:</p> <ul style="list-style-type: none"> Telcordia GR-253 ANSI T1.105.03 ITU-T G.783, G.8251 ETSI 300 417-1-1 User 														

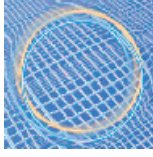
<p>Wander generation</p>	<p>Modulation frequency: 10 μHz to 10 Hz Amplitude: 0 to 400,000 UI/Step 1 Ulp-p</p>  <table border="1" data-bbox="389 703 1015 892"> <thead> <tr> <th>Bit rate (bit/s)</th> <th>F0 (Hz)</th> <th>F1 (Hz)</th> <th>F2 (Hz)</th> <th>A0 (Ulp-p)</th> <th>A1 (Ulp-p)</th> <th>Step (Ulp-p)</th> </tr> </thead> <tbody> <tr> <td>52M</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>156M</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>622M</td> <td>10 μ</td> <td>400m</td> <td>10</td> <td>400,000</td> <td>16,000</td> <td>1</td> </tr> <tr> <td>2488M</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>9953M</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Accuracy $\pm Q\%$ of setting ± 100 Ulp-p</p> <table border="1" data-bbox="389 976 803 1102"> <thead> <tr> <th>Error Q</th> <th>Frequency range</th> </tr> </thead> <tbody> <tr> <td>$\pm 8\%$</td> <td>10 μHz to 0.125 Hz</td> </tr> <tr> <td>$\pm 12\%$</td> <td>0.125 to 1 Hz</td> </tr> <tr> <td>$\pm 15\%$</td> <td>1 to 10 Hz</td> </tr> </tbody> </table>	Bit rate (bit/s)	F0 (Hz)	F1 (Hz)	F2 (Hz)	A0 (Ulp-p)	A1 (Ulp-p)	Step (Ulp-p)	52M							156M							622M	10 μ	400m	10	400,000	16,000	1	2488M							9953M							Error Q	Frequency range	$\pm 8\%$	10 μ Hz to 0.125 Hz	$\pm 12\%$	0.125 to 1 Hz	$\pm 15\%$	1 to 10 Hz
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<p>Wander measurement (Option 01)</p>	<p>Bit rate (bit/s): 52M, 156M, 622M, 2488M, 9953M Evaluation mode: TIE (P-P, +P, -P) MTIE, TDEV measurement is a future function Range p-p: 0.0 to 2E10 ns +p, -p: 0.0 to 1E10 ns Resolution: 0.1 ns Accuracy: TIE $\pm 0.5\% \pm Z0 (\tau)$</p> <table border="1" data-bbox="389 1344 803 1438"> <thead> <tr> <th>Z0 (τ)(ns)</th> <th>Observation time τ (s)</th> </tr> </thead> <tbody> <tr> <td>$2.5 + 0.0275 \tau$</td> <td>$0.05 \leq \tau \leq 1000$</td> </tr> <tr> <td>$29 + 0.001 \tau$</td> <td>$\tau > 1000$</td> </tr> </tbody> </table> <p>Filter selection: DC to 10 Hz, DC to 0.01 Hz, 0.01 to 10 Hz</p>	Z0 (τ)(ns)	Observation time τ (s)	$2.5 + 0.0275 \tau$	$0.05 \leq \tau \leq 1000$	$29 + 0.001 \tau$	$\tau > 1000$																																												
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● **MU150134A 10/10.7G Optical Unit (Tx external modulation)**

Bit rate	9953.28 Mbit/s 10709.225 Mbit/s Depends on frequency accuracy of the MU150100A and external input frequency.
Optical output modulation	Output power: +3 dBm (C band) However, typical value when using built-in CW light source, and modulating by data signal of mark ratio 1/2. Extinction ratio: ≥ 10 dB Signal code: NRZ Connector: FC-PC (SMF) replaceable
External optical input	Light source: CW light source, polarization preservation fiber is used Peak wavelength: C band, L band Maximum input power: +15 dBm Minimum input power: +6 dBm Insertion loss: ≤ 7 dB (C band), ≤ 8 dB (L band) Connector: FC-PC (PMF), replaceable
Clock input	Frequency: 9953.28 MHz ± 100 ppm, 10709.225 MHz ± 100 ppm Input voltage: 1.3 to 0.6 Vp-p Connector: SMA (50 Ω GND)
Data input	Bit rate: 9953.28 Mbit/s ± 100 ppm, 10709.225 Mbit/s ± 100 ppm Input voltage Hi: 0.0074 to -0.2074 V, Lo: -0.8426 to -1.3074 V Connector: SMA (50 Ω GND)
Optical reference output	Optical source: CW light source Peak wavelength: 1550 ± 20 nm (C band) -20 dB width: ≤ 1 nm Side mode suppression ratio: ≥ 30 dB Output power: +10 to +13 dBm Polarization Extinction ratio: ≥ 20 dB Connector: FC-PC (PMF), replaceable
Safety classification	IEC 60825-1: CLASS 1M, 21CFR 1040.10: CLASS III b
Optical output power adjustable (Option 04)	Variable range: 0 to 20 dB, Accuracy: $\leq \pm 0.5$ dB (0 to 10 dB), $\leq \pm 1.0$ dB (10.1 to 20 dB), Setting resolution: 0.1 dB





Ordering Information

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

Model/Order No.	Name
Main frame	
MP1590A	Network Performance Tester
Standard accessories	
J0491A*1	Shield power cord, 2.6 m: 1 pc
J0670A*1	Power cord L type (C7), 2.5 m: 1 pc
F0105	Fuse, 10 A: 2 pcs
E0008A	Optical output control key: 1 pc
E0010	Side cover: 1 pc
J0907Q	Remote inter lock cord: 1 pc
J0908	Remote inter lock terminator: 1 pc
B0329G	Front cover (3/4MW4U): 1 pc
W2234AE*2	MP1590A operation manual CD-ROM: 1 copy
J0617B*3, *4	Replaceable optical connector (FC-PC): 1 pc/2 pcs
J0739G*5	Optical adapter FC PANDA: 2 pcs
J0635A*6	Optical fiber cable (FC · PC-FC · PC-1M-SM), 1 m: 1 pc
J1200*7	Pmoptical fiber cord, 0.5 m: 1 pc
J0747B*8	Fixed optical attenuator (10 dB): 1 pc
J0747C*9	Fixed optical attenuator (15 dB): 1 pc
J1003N*10	Semi-rigid cable (136.6 mm): 2 pcs
J1003P*10	Semi-rigid cable (96 mm): 1 pc
J1003Q*11, *12	Semi-rigid cable (75.6 mm): 1 pc/2 pcs
J1003R*10	Semi-rigid cable (55.3 mm): 1 pc
J1003S*9	Semi-rigid cable (56.5 mm): 1 pc
Units	
MU150100A*13	10/10.7G Unit
MU150121A*13	10/10.7G Optical Unit (Tx)
MU150122A	10/10.7G Optical Unit (Rx Narrow)
MU150123A	10/10.7G Optical Unit (Rx Wide)
MU150125A	10/10.7G Jitter Unit
MU150134A	10/10.7G Optical Unit (Tx. Ex. mod)
Options	
MP1590A-01	RS-232C
MP1590A-02	GPIO
MP1590A-03	LAN
MU150100A-01	Wavelength 1.31 μm
MU150100A-02	Wavelength 1.55 μm
MU150100A-03	Wavelength 1.31/1.55 μm
MU150100A-04	Optical output power adjustable
MU150100A-05	OTU1/OTU2
MU150100A-07*14	10/10.7G Minus Option
MU150100A-37*15	FC connector
MU150100A-38*15	ST connector
MU150100A-39*15	DIN connector
MU150100A-40*15	SC connector
MU150100A-43*15	HMS-10/A connector
MU150121A-01	Wavelength 1.31 μm
MU150121A-02	Wavelength 1.55 μm
MU150121A-03	Wavelength 1.31/1.55 μm
MU150121A-04	Optical output power adjustable
MU150121A-37*15	FC connector
MU150121A-38*15	ST connector
MU150121A-39*15	DIN connector
MU150121A-40*15	SC connector
MU150121A-43*15	HMS-10/A connector
MU150122A-37*15	FC connector
MU150122A-38*15	ST connector
MU150122A-39*15	DIN connector
MU150122A-40*15	SC connector

Model/Order No.	Name
MU150122A-43*15	HMS-10/A connector
MU150123A-05	OTU2
MU150123A-37*15	FC connector
MU150123A-38*15	ST connector
MU150123A-39*15	DIN connector
MU150123A-40*15	SC connector
MU150123A-43*15	HMS-10/A connector
MU150125A-01	Wander measurement
MU150125A-05	OTU1/OTU2
MU150125A-06	10.3G
MU150134A-04	Optical output power adjustable
MU150134A-37*15	FC connector
MU150134A-38*15	ST connector
MU150134A-39*15	DIN connector
MU150134A-40*15	SC connector
MU150134A-43*15	HMS-10/A connector
Maintenance service	
MP1590A-90	Extended three year warranty service
MU150100A-90	Extended three year warranty service
MU150121A-90	Extended three year warranty service
MU150122A-90	Extended three year warranty service
MU150123A-90	Extended three year warranty service
MU150125A-90	Extended three year warranty service
MU150134A-90	Extended three year warranty service
Optional accessories	
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0617B	Replaceable optical connector (FC-PC)
J1003N	Semi-rigid cable (136.6 mm)
J1003P	Semi-rigid cable (96 mm)
J1003Q	Semi-rigid cable (75.6 mm)
J1003R	Semi-rigid cable (55.3 mm)
J1003S	Semi-rigid cable (56.5 mm)
J1200	Pmoptical fiber cord (both-end SFC-SP connector), 0.5 m
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0162A	Balanced cable (Siemens 3P- Siemens 3P), 1 m
J0162B	Balanced cable (Siemens 3P- Siemens 3P), 2 m
J0845A	Balanced cable (BANTAM 3P/BANTAM 3P), 6 ft
J0635A	Optical fiber cable (SM, FC-SPC connector both ends), 1 m
J0635B	Optical fiber cable (SM, FC-SPC connector both ends), 2 m
J0635C	Optical fiber cable (SM, FC-SPC connector both ends), 3 m
J0008	GPIO cable, 2 m
MZ8012A	Connector Cleaning Set
Z0478	Polarization rotating module (for MU150134A)
B0336C	Carrying case
B0448	Soft case
W2188AE	MP1590A SDH operation manual
W2189AE	MP1590A remote control manual
W2216AE	MP1590A SONET operation manual
W2217AE	MP1590A specification

*1: J0491 or J0670A is attached.

*2: Supplied with main frame only, include W2188AE, W2189AE, W2216AE, W2217AE.

*3: Supplied with MU150100A, MU150121A, MU150122A, MU150123A, MU150134A.

- *4: In MU150100A, 2 pcs are supplied.
- *5: Supplied with MU150134A.
- *6: Supplied with MU150100A, MU150122A, MU150123A. SM, FC-SPC connector both ends.
- *7: Supplied with MU150134A, FC · PANDA cord.
- *8: Supplied with MU150122A, MU150123A.
- *9: Supplied with MU150100A.
- *10: Supplied with MU150125A.
- *11: Supplied with MU150121A, MU150122A, MU150123A, MU150134A.
- *12: MU150122A/MU150123A: 1 pc, MU150121A/MU150134A: 2 pcs are supplied.
- *13: Requires Option 01, 02 or 03.
- *14: This Option must be installed in the factory.
- *15: Replaceable



Specifications are subject to change without notice.

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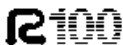
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