Anritsu envision:ensure

Network Master™ Series

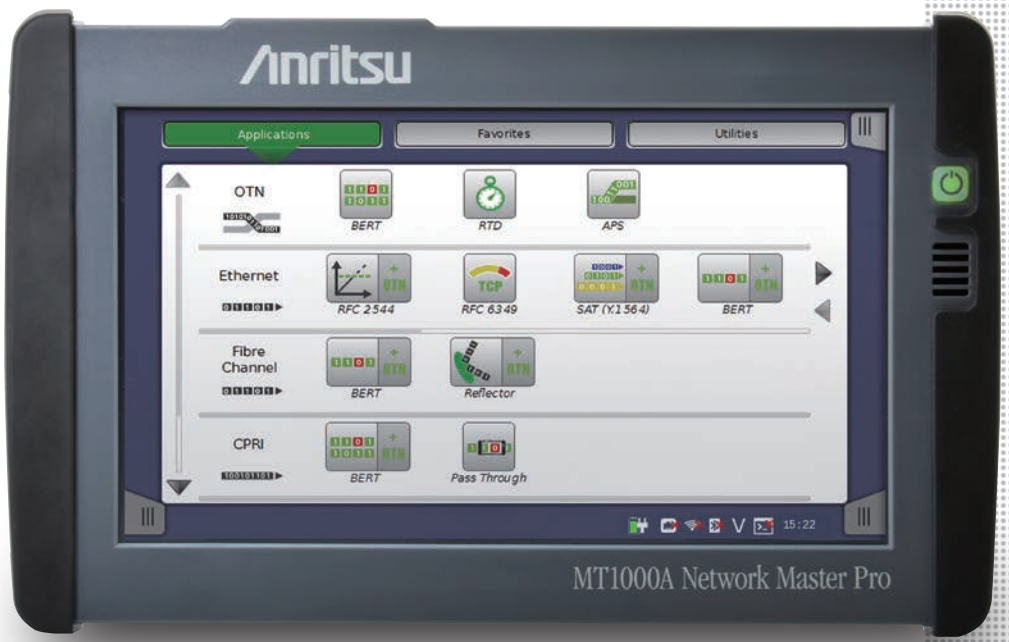
Network Master Pro

MT1000A

10G Multirate Module

MU100010A

Network Master Pro



Excellent Eco Product

Network Master Pro MT1000A Overview

Redefining Transport Testing

Today's communication networks are becoming more and more sophisticated as leading network operators install new technologies like OTN, MPLS-TP and Ethernet in their metro and backhaul networks and CPRI/OBSAI in Mobile Fronthaul networks. In some cases, operators must also support Fibre Channel links, while still keeping legacy technologies like SDH/SONET and PDH/DSn operational. The Network Master Pro MT1000A redefines the direction of future test platforms by bringing these network test requirements to a portable device, making it the ideal tool for field testing.

The compact, battery-powered and easy-to-use Anritsu MT1000A with 10G Multirate Module MU100010A has everything in a single, handy tester needed to install and maintain communication networks from 1.5 Mbps to 10 Gbps. This portable, compact, lightweight instrument makes network field testing easy. Service engineers can read and interpret data from the tested network directly on the 9-inch color display with easy-to-understand indications and graphical symbols. And the GUI makes it simple to configure and operate the instrument at its full potential.

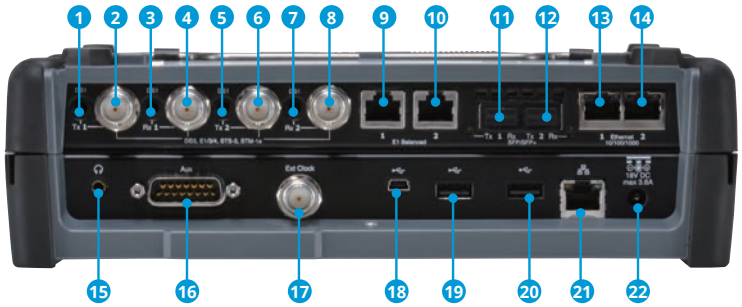
The MT1000A has been designed for easy expandability, reducing initial costs, and facilitating step-by-step customized investment.

Key Benefits and Features:	**Key Applications:**
• All-in-one transport tester supports testing from 1.5 Mbps to 10 Gbps • Easy and intuitive GUI • Dual port at all rates • WLAN*/*Bluetooth**/LAN connectivity • PDF, CSV and XML report generation for documenting test results • Remote operation (VNC, dedicated remote GUI operation software) • Remote control (scripting) • Compact, lightweight design for maximum field portability • Modular platform ensuring maximum return on investment	• Metro and core network installation and maintenance • OTN up to OTU2 including mapping of Ethernet, CPRI, Fibre Channel, SDH/SONET client signals, multistage mapping and FEC (Forward Error Correction) • Testing and verification of new OTN functions: ODU0 and ODUflex • Carrier Class Ethernet installation and troubleshooting • Ethernet testing up to 10 Gbps including RFC 2544, RFC 6349 and Y.1564 • Ethernet OAM up to 10 Gbps • MPLS-TP and PBB up to 10 Gbps • IP Channel Statistics up to 10 Gbps • Frame capture for advanced troubleshooting • Mobile backhaul installation and verification • Synchronous Ethernet Testing up to 10 Gbps (ITU-T G.826x) • IEEE 1588 v2 Time Synchronization Test (ITU-T G.827x) • Mobile Fronthaul Installation and Verification • CPRI testing up to 10 Gbps • OBSAI testing up to 6 Gbps • Powerful Storage Area Networking (SAN) testing • Fibre Channel up to 10 Gbps • Quick and easy testing of SDH/SONET and PDH/DSn networks • SDH/SONET (STM-1 to 64/OC-3 to 192) • PDH/DSn (E1, E3, E4, DS1, DS3)

*: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.

Connector Panel Overview

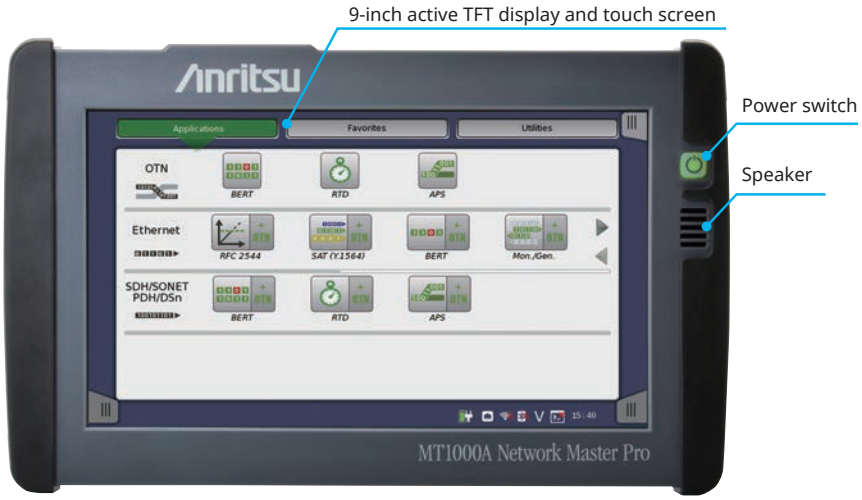
Standard Configuration



Module	10G Multirate Module	MU100010A
Mainframe	Network Master Pro	MT1000A

High Performance GPS Disciplined Oscillator Configuration

Module	10G Multirate Module	MU100010A
Module	High Performance GPS Disciplined Oscillator	MU100090A
Mainframe	Network Master Pro	MT1000A



Just a fraction larger than 9-inch screen

1. Port 1, Tx Bantam (DS1)
2. Port 1, Tx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
3. Port 1, Rx Bantam (DS1)
4. Port 1, Rx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
5. Port 2, Tx Bantam (DS1)
6. Port 2, Tx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
7. Port 2, Rx Bantam (DS1)
8. Port 2, Rx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
9. Port 1, Tx/Rx RJ48 (E1 balanced)
10. Port 2, Tx/Rx RJ48 (E1 balanced)
11. Port 1, Tx/Rx SFP+ (OTN, Ethernet, CPRI/OBSAI, Fibre Channel, SDH/SONET optical)
12. Port 2, Tx/Rx SFP+ (OTN, Ethernet, CPRI/OBSAI, Fibre Channel, SDH/SONET optical)
13. Port 1, Tx/Rx RJ45 (Ethernet electrical)
14. Port 2, Tx/Rx RJ45 (Ethernet electrical)
15. Audio (3.5ø: CTIA Standard)
16. AUX (G0325A/with MT1000A-005, MU100090A)
17. Clock Input
18. USB Mini-B
19. USB A
20. USB A
21. Ethernet Service Interface
22. DC Input (18 Vdc)
23. AUX D-SUB 9 pin
24. 1 pps Output
25. 10 MHz Output
26. GPS received LED
27. OCS LED
28. 1 pps Sync In
29. Antenna Input

Network Master Pro MT1000A Mainframe Specifications

User Interfaces	
Display	9-inch active TFT display (800 × 480 pixels) and touch screen
Supported Languages	English, Chinese, Japanese, French, Russian, Spanish

Service Interfaces	
USB Data Interface	MT1000A operates as host: USB 2.0 type A (2 ports) MT1000A operates as device: USB 2.0 type Mini-B (1 port)
Ethernet Interface	Ethernet 10M/100M/1000M, Connector: RJ45
WLAN Interface*	IEEE 802.11 b/g/n
Bluetooth Interface*	*Bluetooth* 2.1 +EDR

*: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.

Other Interfaces	
Audio Interface	For connection of CTIA Standard head set Connector: 3.5-mm diameter jack
AUX Connector	For connection of optional G0325A GPS receiver With MT1000A-005: For connection of Optional MU100090A
Built-in Loudspeaker	Monitors speech of voice channel Output level: user-controlled from user Interface
Ext. Clock Input	For connection of external clock signals: SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps) or 2.048 MHz TTL signal in accordance with ITU-T G.703, 10 MHz Connector: BNC (50Ω)

Miscellaneous	
Battery	10.8 V rechargeable and replaceable intelligent Li-ion battery Operating time: 4 hours (typ.) Charging time: 3 to 6 hours (typ.) Remaining capacity indication: %
Mains Adapter	Input: 100 V(ac) to 240 V(ac), 50 Hz/60 Hz Output: 18 V(dc), 3.62 A (max.) Power Consumption: ≤65 W
Dimensions and Mass	257 (W) × 164 (H) × 77 (D) mm ≤2.7 kg (including MT1000A, MU100010A and battery)
Environmental	Temperature Operating : 0° to +50°C (non-condensing) Charging: 0° to +40°C (non-condensing) Storage: –30° to +60°C (non-condensing, without battery or AC adapter) –20° to +50°C (non-condensing, with battery and AC adapter) Humidity Operating: ≤85% RH (non-condensing) Storage and Transportation: ≤90% RH (non-condensing)
EMC	EN61326-1, EN61000-3-2
LVD	EN61010-1
Laser Safety*2	IEC 60825-1: 2007 CLASS 1, 21CFR1040.10 and 1040.11*1: MU100010A with optical modules

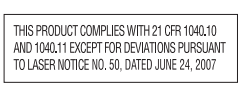
*1: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007
*2: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10, 1040.11 and IEC 60825-1; the following descriptive labels are affixed to the product.

Network Master Pro MT1000A

10G Multirate Module MU100010A Specifications

<table>
<tr><td>Test Port</td><td>SFP/SFP+: 2 slots
SFF-8431, SFF-8472 compliant, IEEE 802.3ae-2002, IEEE 802.3-2008 compliant
RJ45: 2 sockets
IEEE 802.3-2008 10BASE-T, 100BASE-TX, 1000BASE-T compliant
Auto MDI-X
10 Mbps/100 Mbps full/half duplex, 1000 Mbps full duplex
BNC: 2 ports (75Ω)
ITU-T G.703 compliant
RJ48: 2 sockets
ITU-T G.703 compliant
RTT Bantam: 2 ports
ANSI DS1.102 compliant</td></tr>
<tr><td>Bit Rate*1</td><td>
<table>
<tr><th>Standard</th><th>Bit Rate</th><th>Interfaces</th></tr>
<tr><td>10BASE-T</td><td>12.5 Mbps</td><td>RJ45</td></tr>
<tr><td>100BASE-TX</td><td>125 Mbps</td><td>RJ45</td></tr>
<tr><td>1000BASE-T</td><td>1.25 Gbps</td><td>RJ45</td></tr>
<tr><td>100BASE-XX</td><td>125 Mbps</td><td>SFP</td></tr>
<tr><td>1000BASE-XX</td><td>1.25 Gbps</td><td>SFP</td></tr>
<tr><td>10GBASE-XX</td><td>10.3125 Gbps</td><td>SFP+</td></tr>
<tr><td>STM-1/OC-3</td><td>155.52 Mbps</td><td>SFP</td></tr>
<tr><td>STM-4/OC-12</td><td>622.08 Mbps</td><td>SFP</td></tr>
<tr><td>STM-16/OC-48</td><td>2.48832 Mbps</td><td>SFP</td></tr>
<tr><td>STM-64/OC-192</td><td>9.95328 Mbps</td><td>SFP+</td></tr>
<tr><td>OTU1</td><td>2.666057143 Gbps</td><td>SFP</td></tr>
<tr><td>OTU2</td><td>10.70922532 Gbps</td><td>SFP+</td></tr>
<tr><td>OTU1e</td><td>11.04910714 Gbps</td><td>SFP+</td></tr>
<tr><td>OTU2e</td><td>11.09572785 Gbps</td><td>SFP+</td></tr>
<tr><td>OTU1f</td><td>11.27008929 Gbps</td><td>SFP+</td></tr>
<tr><td>OTU2f</td><td>11.31764241 Gbps</td><td>SFP+</td></tr>
<tr><td>1GFC</td><td>1.0625 Gbps</td><td>SFP</td></tr>
<tr><td>2GFC</td><td>2.125 Gbps</td><td>SFP</td></tr>
<tr><td>4GFC</td><td>4.25 Gbps</td><td>SFP</td></tr>
<tr><td>8GFC</td><td>8.5 Gbps</td><td>SFP+</td></tr>
<tr><td>10GFC</td><td>10.51875 Gbps</td><td>SFP+</td></tr>
</table>
<table>
<tr><th>Standard</th><th>Bit Rate</th><th>Interfaces</th></tr>
<tr><td>E1</td><td>2.048 Mbps</td><td>RJ48, BNC</td></tr>
<tr><td>E3</td><td>34.368 Mbps</td><td>BNC</td></tr>
<tr><td>E4</td><td>139.264 Mbps</td><td>BNC</td></tr>
<tr><td>DS1</td><td>1.544 Mbps</td><td>RTT Bantam</td></tr>
<tr><td>DS3</td><td>44.736 Mbps</td><td>BNC</td></tr>
<tr><td>STM-1e/STS-3</td><td>155.52 Mbps</td><td>BNC</td></tr>
<tr><td>CPRI1</td><td>614.4 Mbit/s</td><td>SFP</td></tr>
<tr><td>CPRI2</td><td>1228.8 Mbit/s</td><td>SFP</td></tr>
<tr><td>CPRI3</td><td>2457.6 Mbit/s</td><td>SFP, SFP+</td></tr>
<tr><td>CPRI4</td><td>3072.0 Mbit/s</td><td>SFP, SFP+</td></tr>
<tr><td>CPRI5</td><td>4915.2 Mbit/s</td><td>SFP+</td></tr>
<tr><td>CPRI6</td><td>6144.0 Mbit/s</td><td>SFP+</td></tr>
<tr><td>CPRI7</td><td>9830.4 Mbit/s</td><td>SFP+</td></tr>
<tr><td>CPRI8</td><td>10137.6 Mbit/s</td><td>SFP+</td></tr>
<tr><td>OBSAI 1x</td><td>768 Mbit/s</td><td>SFP</td></tr>
<tr><td>OBSAI 2x</td><td>1536 Mbit/s</td><td>SFP, SFP+</td></tr>
<tr><td>OBSAI 4x</td><td>3072 Mbit/s</td><td>SFP, SFP+</td></tr>
<tr><td>OBSAI 8x</td><td>6144 Mbit/s</td><td>SFP+</td></tr>
</table>
</td></tr>
<tr><td>Dimensions and Mass</td><td>257 (W) × 163 (H) × 38.5 (D) mm, ≤1.1 kg</td></tr>
<tr><td>Environmental</td><td>Temperature and Humidity
Operating: 0° to +50°C, ≤80% RH (non-condensing)
Storage: –30° to +60°C, ≤80% RH (non-condensing)</td></tr>
<tr><td>EMC</td><td>EN61326-1, EN61000-3-2</td></tr>
<tr><td>LVD</td><td>EN61010-1</td></tr>
<tr><td>Laser Safety*3</td><td>IEC 60825-1: 2007 CLASS 1
21CFR1040.10 and 1040.11*2</td></tr>
</table>

*1: The frequency accuracy depends on the accuracy of the MT1000A internal clock or the external clock of MT1000A.
Refer to the external interfaces in MT1000A specifications.
*2: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007
*3: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10, 1040.11 and IEC 60825-1; the following descriptive labels are affixed to the product.



10G Multirate Module MU100010A

High Performance GPS Disciplined Oscillator MU100090A Specifications

Internal Oscillator	Rubidium atomic clock Aging • 2.5×10^{-11}/Day • 1×10^{-10}/Month • 1×10^{-9}/Year
Input/Output Interface	10 MHz External Clock Output • Connector: BNC Jack • Level: TTL 50Ω 1 PPS Reference Output • Connector: BNC Jack • Level: TTL 50Ω • Holdover: 300 ns/10,000 seconds* 1 PPS Sync Input • Connector: BNC Jack • Level: TTL 50Ω • Input Frequency Range: ±10 ppb GPS Antenna Input • Connector: SMA Jack • Feeding Antenna: +3.3 V, +5 V (Selectable, 50 mA max.) AUX • Connector: D-SUB 9 pin • Usage: TOD (Time of Day) output (NMEA0184), Connection to MT1000A with J1705A
GPS Signal Receive Specification	Supported Signal • GPS L1 C/A code Number of Receivable Channels • 50 Time Accuracy to UTC • ±45 ns rms*
LED	GPS • GPS signal received (On: Tracking over four satellites) OCS • Oscillator lock (On: Locking)
Dimensions and Mass	257 (W) × 163 (H) × 25 (D) mm ≤0.8 kg
Environmental	Temperature and Humidity Operating: 0° to +50°C, ≤85% RH (non-condensing) Storage: –30° to +60°C, ≤90% RH (non-condensing)
EMC	EN61326-1, EN61000-3-2
LVD	EN61010-1

∗: When switching to holdover with rubidium oscillator synchronized for at least 30 minutes to GPS or external 1PPS.
At this time, the rubidium oscillator must be powered-on, and warmed-up for least 3 hours at a constant ambient temperature.

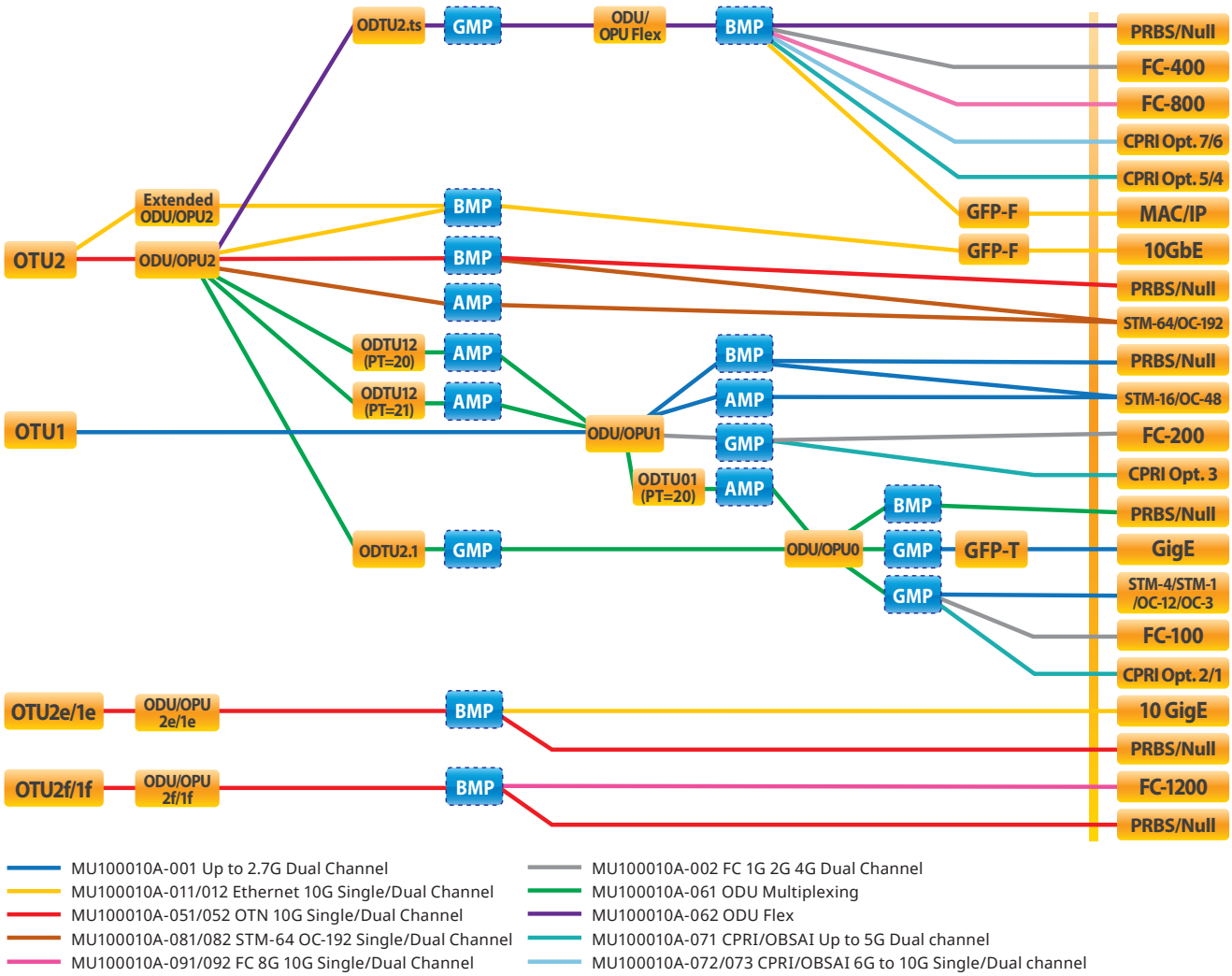
⚠ CAUTION

Do not subject the equipment mechanical vibration or shock. The accuracy will be degraded if the internal rubidium oscillator is damaged.

High Performance GPS Disciplined Oscillator MU100090A

OTN Testing Specifications

OTN Testing (Options MU100010A-001, MU100010A-051, MU100010A-052, MU100010A-061, MU100010A-062)

OTN Test	
Test Port	• OTU2, OTU1e, OTU2e, OTU1f, OTU2f optical line interfaces: 1 port (MU100010A-051), 2 ports (MU100010A-052) User-selectable optical modules: 1310 nm, 1550 nm • OTU1 optical line interfaces: 2 ports (MU100010A-001) User-selectable optical modules: 1310 nm, 1550 nm
Framing	OTU2, OTU1e, OTU2e, OTU1f, OTU2f, OTU1
Transmitter Clock	• Internal clock accuracy: 4.6 ppm, Clock offset: ±50 ppm (1-ppm steps) • Received clock • TTL level external 2 MHz clock • SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps) • Signal from optional GPS receiver
Receive Signal Rate	±50 ppm Frequency deviation indication resolution: ±1 ppm
Scrambling	Complies with ITU-T G.709
OTN Mappings	
OTN Alarms	Detected alarms • OTU layer: OTU-AIS, LOF, OOF, LOM, OOM, SM-TIM, SM-BIAE, SM-BDI, SM-IAE • ODU layer: LOS, ODU-AIS, ODU-OCI, ODU-LCK, PM-TIM, PM-BDI, FSF, FSD, BSF, BSD • ODU multiplexing: ODU-LOFLOM, ODU-OOF, OOM, ODU-AIS, ODU-OCI, ODU-LCK, PM-TIM, PM-BDI, MSIM • OPU layer: PLM, OPU-MSIM, Client-AIS, CSF, LSS • TCM: TCMi-TIM, TCMi-BIAE, TCMi-BDI, TCMi-IAE, TCMi-LTC (i = 1 to 6) Generated alarms • OTU layer: OTU-AIS, OTU-OOF/LOF, OOM/LOM, SM-TIM, SM-BIAE, SM-BDI, SM-IAE • ODU layer: ODU-AIS, ODU-OCI, ODU-LCK, PM-TIM, PM-BDI, FSF, FSD, BSF, BSD • ODU multiplexing: OOF/LOF, OOM/LOM, ODU-AIS, ODU-LCK, PM-TIM, PM-BDI, FSF, FSD, BSF, BSD • OPU layer: Client-AIS, CSF • TCM: TCMi-TIM, TCMi-BIAE, TCMi-IAE, TCMi-BDI, TCMi-LTC (i = 1 to 6)

OTN Testing Specifications

OTN Errors	Detected errors • OTU layer: FAS, MFAS, SM-BEI, SM-BIP8, FEC-Correctable, FEC-Uncorrectable • ODU layer: PM-BIP8, PM-BEI • OPU layer: Pattern error • GMP error: CRC8 error, CRC5 error • GFP errors: cHEC corrected, cHEC uncorrectable, tHEC corrected, tHEC uncorrectable, CSF Signal, SCF Sync, Invalid GFP Frame, Superblock CRC, eHEC corrected, eHEC uncorrectable, FCS, CMF Sync, CMF Signal, SSF, PTI Mismatch, UPI Mismatch • TCM: TCMi-BEI, TCMi-BIP-8 (i = 1 to 6) Generated errors • OTU layer: Bit all, FAS, OTU-FAS, MFAS, SM-BIP8, SM-BEI • ODU layer: PM-BIP8, PM-BEI, ODU-FAS • TCMi-BIP8, TCMi-BEI (i = 1 to 6) • Pattern error • GMP: CRC8, CRC5, Invalid JC1, Invalid JC2, Invalid JC1&JC2 • GFP: cHEC, tHEC, Superblock CRC, eHEC, FCS, CMF Inserted Error bits are editable.
Error Performance	• G.8201/M.2401 analysis of received signal based on detected errors and alarms: BBE, BBER, SES, SESR, UNAV
Justification Analysis	Count • AMP: Positive (+1), Positive (+2), Negative (–1), Offset (ppm) • GMP: CRC8 Error, CRC5 Error, Inc, Inc > 1, Inc > 2, Inc Over, Dec, Dec > 1, Dec > 2, Dec Over, Offset (ppm), Cm (t) Max., Cm (t) Min.
BER Test Pattern	Pattern generation and detection for bulk test patterns: • Test patterns: PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, Null PRBS patterns can be inverted. • User-defined patterns (Pattern length: 2048 bits, 32 bits)
FEC Test	ITU-T O.182 Random error insertion
Overhead	User-editable header bytes • OTU layer: FAS, SM, GCC0, RES • ODU layer: PM, FTFL, APS/PCC, GCC1, GCC2, RES, EXP, TCMi (i = 1 to 6) • OPU layer(s): PSI Capture and display current overhead bytes • The following signals are decoded: TTI (SM, PM, TCMi (i = 1 to 6) of high-order, FTFL, PT)
Tributary Signal	Ethernet functionality is supported for Ethernet signals embedded in selected ODU-n (Requires MU100010A-061, MU100010A-062 and MU100010A-001/011/012) SDH/SONET functionality is supported for SDH/SONET signals embedded in selected ODU-n (Requires MU100010A-061 and MU100010A-001/081/082) Fibre Channel functionality is supported for Fibre Channel signals embedded in selected ODU-n (Requires MU100010A-061 and MU100010A-002/091/092)
Through Mode	• Transparent mode • OH overwrite mode The OTU, ODU and OPU overhead can be changed. The FEC encoder and decoder can be set On/Off in any mode

OTN Results	
Status	Current information on: • Alarms and errors on monitored line • Input level indication for optical signals • Frequency • Frequency deviation
Statistics	User-defined measurement resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Logged information: Alarms (s), Errors (count or count and ratio), Client Frequency, Deviation Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
APS	APS (Automatic Protection Switching) test and analysis • APS switching time is measured. A switching time exceeding the user-defined threshold is highlighted. • Start and stop triggers can be selected independently. • Trigger events can be selected from the high-order OTU and ODU, Pattern bit error, LOS (Loss of Signal). • Switching time, Switching count, Pass/Fail, Minimum, Maximum and Average can be displayed. • APS switching time measurement resolution: 0.1 ms
Round Trip Delay (Propagation Time) Measurement	Resolution: 0.1 µs Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

Ethernet Testing (Options MU100010A-001, MU100010A-011, MU100010A-012)

Ethernet Test	
Test Port	• Optical line interfaces 10 Gbps (10G LAN-PHY and 10G WAN-PHY): 1 port (MU100010A-011) or 2 ports (MU100010A-012) User-selectable optical modules: 850 nm (SR), 1310 nm (LR), 1550 nm (ER) *NB: Correct functioning can be guaranteed only with optical modules purchased from Anritsu for the MU100010A.* • Optical line interfaces: 2 ports (MU100010A-001) 1000 Mbps User-selectable optical modules: 850 nm (SX), 1310 nm (LX) and 1550 nm (ZX) or 100 Mbps 1310 nm (FX) *NB: Correct functioning can be guaranteed only with optical modules purchased from Anritsu for the MU100010A.* • Electrical line interfaces: 2 ports (MU100010A-001) (in addition to optical ports) RJ45: 10 Mbps, 100 Mbps, 1000 Mbps (unshielded and shielded twisted pair cables, category 5, 5E, 6)
Test Configuration	• Monitor/Generate, Pass-through, Reflector
Encapsulation	• EtherType II (DIX v.2), IEEE 802.3 with 802.2 (LLC1), IEEE 802.3 with SNAP

Configuration, Monitor/Generate	
Traffic Generation	• Variable line rate traffic generation, up to full line rate • Line load profile: Constant, Ramp • Traffic duration: Continuous, Programmable number of seconds or frames • Adjustable frame size: 44 bytes to 16000 bytes • Frame sizes: Constant, Stepped, Random • Payload profiles: Data, Video, Voice • User-defined traffic mix of unicast and broadcast frames • Fixed or incremented IP identifier • User programmable DSCP/TOS byte • Configurable IP and Ethernet source and destination addresses (supports IPv4 and IPv6 addressing) IPv4: Fixed, DHCP, DNS IPv6: Fixed • Address increment, Decrement and Random generation supported • User programmable UDP/TCP address • Automatic TCP connect (user selectable) • UDP check sum: Automatic, Fixed (null); TCP check sum: Automatic • Generate pause frames, Respond to pause frames • Answer incoming ARP, Ping requests (On/Off)
Stacked VLAN	Up to 8 user-settable VLAN tags Parameters per VLAN tag: • Ether-type 0x8100 (802.1Q), 0x88a8 (802.1ad), 0x9100 or 0x9200 • User-defined VLAN ID, CFI, VLAN priority • Address increment, Decrement and Random generation supported Only one VLAN level supported at ping, traceroute and RFC 2544 router latency tests
Multistream	Number of streams: Up to 16 streams per port can be activated
Timing Functionality	Timing sources (selectable): Internal, Received clock, 2-MHz signal, SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps), PTP (IEEE 1588 v2) recovered clock or signal from optional GPS receiver Frequency deviation: ±100 ppm (1-ppm steps) The frequency deviation of received Ethernet signals can be measured against the internal clock.
Receiver Setting	• User-defined expected preamble length: 3 bytes to 15 bytes • User-defined IFG lower threshold: 8 bytes to 15 bytes (Ethernet 10 Mbps, 100 Mbps, 1000 Mbps) • User-defined Jumbo frame size upper limit: 1519 bytes to 16000 bytes
Error Generation	FCS, Preamble, Error symbol, IFG for ethernet 10 Mbps, 100 Mbps, 1000 Mbps, Wrong IP check sum, Fragmented IP, Wrong layer 4 check sum, PRBS bit error, BER test sequence error
Alarm Generation	No link, Remote fault, Local fault (Ethernet 10 Gbps), PCS 10 Gbps: High BER

Result, Monitor/Generate	
Status	• Link status, Interface type, Jabber detected, Frames present, MPLS/EoMPLS/VLAN, Speed, Full or half duplex, Local clock (Ethernet 1000 Mbps), LFS LF/RF (Ethernet 10 Gbps), Signal present, Bit rate of incoming Ethernet signal, Auto negotiation complete • Link partner abilities: Pause capable and Asymmetric pause request (not Ethernet 10 Gbps), Remote fault, Speed/Duplex • Indicators for Utilization, Throughput and Errored frames • Signal level indication for optical Ethernet interfaces
Resolution	User-defined resolution for statistical measurements: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
Performance Statistics	• Utilization (Max./Min./Avg.), Throughput (Max./Min./Avg.), Frame rate (Max./Min./Avg.)
Frame Statistics	• Total frames, Total valid frames, Unicast/Multicast/Broadcast frames, Number of pause frames • Number of VLAN tagged frames, Max. number of VLAN layers detected, Last received VLAN ID, Last received VLAN priority • Number of MPLS frames and MPLS-TP frames. Max. number of MPLS layers detected. Last received MPLS Label, MPLS Priority and MPLS TTL. • Number of PBB frames. Last received B/I-tag ID and B/I-tag priority. • Total errored frames, Fragmented frames, Number of oversized and undersized (runts) frames, Number of FCS errored frames, Error symbol frames (not Ethernet 10 Gbps)/Code violation frames (Ethernet 10 Gbps), Number of collisions (10 Mbps, 100 Mbps half duplex), Preamble violations, IFG violations (Ethernet 10 Mbps, 100 Mbps, 1000 Mbps), False carrier, 10G LFS LF (local fault), 10G LFS RF (remote fault)
Burst Statistics	Total frames, Total valid frames, Number of burst, Total frames in bursts, Burst size (Max./Min./Avg.)
Frame Distribution Statistics	• Total valid/ frames, 64 to 127, 128 to 255, 256 to 511, 512 to 1023, 1024 to 1518 byte frames, Total number of jumbo frames • Frame size (Max./Min./Avg.)
Multistream Statistics	Available information per stream: • Frame loss count/rate, Throughput, Latency, Packet jitter, Frames and bytes received and transmitted
Transmit Statistics	Total frames, Total valid frames, Unicast/Multicast/Broadcast frames, FCS errors, Total errors 64 to 127, 128 to 255, 256 to 511, 512 to 1023, 1024 to 1518 byte frames, Total number of jumbo frames Total number of frames (Tx (own port) – Rx (selectable port))

Ethernet Testing Specifications

Filter	Up to 8 filter conditions can be defined. Each condition can filter using: IP or MAC source address, IP or MAC destination address, Broadcast address, IEEE OUI value, Encapsulation type, VLAN ID and VLAN tag priority, MPLS, PBB source and destination MAC address, PBB B/I-tag, MPLS-TP source and destination MAC address, TPC/UDP source and destination port, User-defined pattern at defined offset
Adjustable Threshold	Utilization, Throughput, Errored frames, Collision rate, Unicast frames, Multicast frames, Broadcast frames, Pause frames, Fragmented frames, Undersized frames (runts), Oversized frames, FCS errored frames, IFG violations (Ethernet 10 Mbps, 100 Mbps, 1000 Mbps), Preamble violations, BER test pattern errors, Sequence errors, Diff.Tx-Rx
DHCP	• Display source IP address assigned by DHCP • Display current lease expire time • Display IP addresses of primary and secondary DNS server when obtained by DHCP • Gateway setup using DHCP

BER Test and Service Disruption Measurement	
BER Test	Generation and detection of test patterns, Count of errors in received test pattern, Pattern generation: Unframed (Layer 1), Framed Ethernet (MAC) header (Layer 2), Framed Ethernet (MAC) header with IP header (Layer 3) or Framed Ethernet (MAC) header, Framed with IP header and TCP/UDP header (Layer 4), User-defined header pattern (14 byte to 256 byte) Detection of sequence errors and loss of sequence synchronization Frame loss count and frame loss seconds Throughput measurement results are calculated for: • Utilization layer, Physical layer, Physical layer excluding preamble, Link layer, Network layer and Data layer • Min./Max./Avg. values Performance (M.2100 type) parameters: ES, SES, ALS, UAT, AVT, EFS Test patterns: PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, HF test pattern, CRPAT, JTPAT, SPAT, 55 Hex, Fox, 32-bit user programmable User-defined resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
Error Generation	FCS, Preamble, Error symbol, IFG for Ethernet (10 Mbps, 100 Mbps, 1000 Mbps), Wrong IP check sum, Fragmented IP, Wrong layer 4 check sum, PRBS bit error, BER test sequence error
Alarm Generation	No link, Remote fault
Service Disruption Measurement	Service disruption measurement activated as part of BER test • Max./Avg. service disruption time, Resolution: 0.1 µs • Number of service disruptions • Disruption Type: Packet, LOS

RFC 2544 Test	
RFC 2544 Test	Switch/Router test and Single ended network test modes: • Throughput, Frame loss, Latency or Packet jitter, Back-to-back frames (burstability) End-to-end network test mode (two MU100010A units in Local-remote setup) • Throughput, Frame loss, Back-to-back frames (burstability) Router latency test mode: IP ping based latency test or packet jitter

Service Activation Test (Y.1564)	
Service Activation Test	ITU-T Y.1564 Service Activation Test • Up to 8 services per port • Color-aware and non-color-aware in combinations (IP DSCP or VLAN PCP) • Test modes: One-way (uni- or bi-directional, symmetrical or asymmetrical), Round-trip • Verification against service acceptance criteria: Information rate, Frame transfer delay, Frame delay variation, Frame loss rate, Availability Optional GPS timing synchronization
Service Configuration Test	• Subtests for: Committed information rate, Excess information rate, Traffic policing, Committed burst size, Excess burst size • Step duration: 1 s to 60 s (user programmable) • Number of steps: 1 to 10 (user programmable) • Slope: Rising/Falling • Results: Pass/Fail indication, IR (Min./Avg./Max.), FL (Count/FLR), FTD, FDV (Min./Avg./Max./Current (during measurement))
Service Performance Test	• All services tested simultaneously at CIR • Duration 15 min, 2 h, 24 h, user programmable • Results: Pass/Fail indication, IR (Min./Avg./Max.), FL (Count/FLR), FTD, FDV (Min./Avg./Max./Current (during measurement)), AVAIL (%), Unavail (s)

RFC 6349 TCP Throughput Test (MU100010A-020 TCP Throughput)	
TCP Throughput Test	TCP Throughput Test According to RFC 6349 Supports connecting to iPerf server Test Direction Setup • Local → Remote • Remote → Local • Simultaneous in both directions For RFC 6349 test sequence, user can choose to measure for: • Path MTU • Baseline RTT • Window Scan and Throughput • Multi-Service Multi-Service: DSCP or TOS can be set to each TCP connections Measurement results include: • Auto-calculation of Bandwidth Delay Product (BDP) • Transmitted and Retransmitted Bytes • TCP Transfer Time Ratio • TCP Efficiency • Retransmitted Percentage • Buffer Delay Percentage

Ethernet Testing Specifications

Cable Test	
Cable Test	Identifies cable faults like short circuits, or breaks in wire pair, and displays distance from instrument to fault

Ping Test and Traceroute	
Ping Test	For Connectivity and Configuration check • Round Trip Time (RTT) • Supports IPv4 and IPv6 addressing • Answer incoming ping requests (On/Off)
Traceroute	Trace IP route over IP network • User-defined Max. number of hops (1 to 255) Information per hop: Ping time (Min./Max./Avg.), Number of ping timeouts

IP Channel Statistics	
Statistics	Statistics for up to 230 channels, identified by user-defined combinations of: • IPv4, IPv6 or MAC address • VLAN ID or MPLS label • Protocol information • IP next header (protocol) • TCP/UDP ports Traffic capacity: • 10 Mbps, 100 Mbps, 1 Gbps, 10 Gbps, line speeds: 100% line load Available Information per channel: • Frame count/rate, Throughput, Byte count, MPLS frames, IP frame/packet size distribution, IP header bytes, IP fragments, TTL threshold violations, IP packet count/rate, IP bytes, IP throughput, IP header errors, TCP/UDP bytes, TCP/UDP packet count/rate, Throughput, TCP/UDP errored packets, Undersize frames, Oversize frames

MPLS/MPLS –TP	
Number of MPLS Header	Up to 8 MPLS headers set by user
Parameters per MPLS Header	User-defined label, Exp and TTL fields in each MPLS header • Address increment, Decrement and Random generation An EoMPLS (Ethernet over MPLS) or PWE3 (Pseudo-wire emulation edge-to-edge) label (RFC 4448 control word) can be added. MPLS can only transport VLAN if EoMPLS activated.
Statistics	• Number of labels (Max./Min.) • Number of MPLS-TP frames • Last received MPLS-TP label/priority/TTL
OAM (MPLS-TP)	ITU-T G.8113.1 comply Supported OAM messages • ITU-T Y.1731: CCM, LBM, LBR, LTM, LTR, AIS, LCK, TST, MCC, LMM, LMR, 1DM, DMM, DMR, EXM, EXR, VSM, VSR, SLM, SLR • IEEE 802.1ag: CCM, LBM, LBR, LTM, LTR

PBB (Mac-in-Mac MiM)	
Programmable Field	B-tag, I-tag, MAC destination and source addresses
Result	Number of PBB frames, Last received B-tag VLAN ID, Last received B-tag priority, Last received I-tag priority, Last received I-tag service ID
OAM	Supported OAM messages • ITU-T Y.1731: CCM, LBM, LBR, LTM, LTR, AIS, LCK, TST, MCC, LMM, LMR, 1DM, DMM, DMR, EXM, EXR, VSM, VSR, SLM, SLR • IEEE 802.1ag: CCM, LBM, LBR, LTM, LTR

Ethernet OAM	
OAM Standards Supported	• ITU-T Y.1731 (Service layer OAM) • IEEE 802.1ag (Connectivity layer OAM) • IEEE 802.3 (formerly IEEE 802.3ah) (Access link OAM)
Messages Supported	Generates and receives following OAM messages. Supported OAM messages • ITU-T Y.1731: CCM, LBM, LBR, LTM, LTR, AIS, LCK, TST, MCC, LMM, LMR, 1DM, DMM, DMR, EXM, EXR, VSM, VSR, SLM, SLR • IEEE 802.1ag: CCM, LBM, LBR, LTM, LTR • IEEE 802.3ah: Information, Variable request, Variable response, Loopback control
IEEE 802.3ah Function	• Discovery • Loopback activate
Statistics	• Number of each message generated/received

Synchronous Ethernet Test	
SyncE (ITU-T G.826x) Functionality	Specify Quality Level (QL) of transmitted Ethernet signal. Analysis of QL indicated in received Ethernet signal with alarm at missing QL indications. SyncE results: SSM Rx count and rate, SSM Tx count, Indicated QL statistics, SSF seconds ESMC messages captured and exported in Wireshark format.

Ethernet Testing Specifications

IEEE 1588 v2 Functionality	• Each port of the Ethernet interface can act as a timing master or a timing slave independently. • Supported profiles: G.8265.1, G.8275.1, User Defined • When acting as master in Unicast (G.8265.1) mode, one slave is accepted at a time. • If the slave requires 32, 64, or 128 Sync messages per second, IEEE 1588-2008 paragraph 7.7.2.1 specifying 90% confidence interval is not followed. Configurable parameters Domain: 0 to 255 Step Mode: One-step, Two-step Delay Mechanism: Delay request/response, Peer delay Negotiation: On/Off (Unicast only) Clock Source: Internal or UTC locked with GPS Clock Identify Priority#1, #2, Class, Time Source, Accuracy Index: 0 to 255 Announce Interval: 1/8 to 32 s Announce Timeout: 2 to 255 s Sync Interval: 1/128 to 32 s Minimum Delay Request Interval: 1/128 to 32 s Unicast Duration: 60 s to 1,000 s Protocol Stack Layer2: Ethernet, Ethernet/VLAN, Ethernet/MPLS Layer3: None, IPv4, IPv6 PTP Protocol Analysis • Statistics of IEEE 1588 messages and message rate. • Logged IEEE 1588 events: Clock state transitions, State transition events, Faults and Changes in grand-master clock • IEEE 1588 messages captured and exported in Wireshark format
Sync Test Application (MT1000A-005 and MU100090A are required)	Time/Phase Synchronization Test Supported Interface: GigE, 10 GigE (only optical interface) • Two methods of TE (Time Error) testing, which are able to run simultaneously • 1 PPS TE Method: Comparing 1 PPS signal from the network with reference 1 PPS. (Accuracy is 5 ns) Test Items: max|TE|, cTE, dTE • Packet TE Method: Comparing time stamps inside PTP message with GPS locked UTC. Test Items: max|TE1|, max|TE4|, cTE1, cTE4

Ethernet Frame Capture	
Capture Buffer Size	1 Mbytes to 128 Mbytes, When capture buffer full: Stop or Wrap
Capture Frame Slicing	If activated capture frame is first 64 bytes or 128 bytes of each frame (ignores rest of frame)
Timestamp Resolution	100 ns
Include Tx Frame	On/Off
Capture Trigger	Manual, On error, Field match Trigger position: Top, Middle
Trigger Error	Fragmented frames, Oversize frames, Undersized frames, Undersized and oversized frames, FCS errored frames, Any type
Trigger Condition Field	Enabled when capture trigger setting is field match • Offset: 0 to 15999 bytes • Length: 1 bytes to 16 bytes • Value: 16-byte data Max.
Capture Data	Pcap format for display in Wireshark

10G WAN-PHY	
WAN Mode	10 Gbps Ethernet (normal)
Terminology	SDH or SONET
Error Generation	SDH: A1A2, B1, B2, MS-REI, B3, HP-REI SONET: A1A2, B1, B2, REI-L, B3, REI-P
Alarm Generation	SDH: LOF, OOF, MS-AIS, MS-RDI, MS-TIM, AU-AIS, AU-LOP, HP-PLM, HP-UNEQ, HP-TIM, HP-RDI, LCD SONET: LOF, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, TIM-P, PLM-P, UNEQ-P, RDI-P
Error Measurement	SDH: A1A2, B1, B2, MS-REI, B3, HP-REI SONET: A1A2, B1, B2, REI-L, B3, REI-P G.826, G.828+G.829 or M.2101.1 (M.2100) error performance parameters are calculated
Alarm Detection	SDH: LOS, LOF, OOF, MS-AIS, MS-RDI, MS-TIM, AU-AIS, AU-LOP, HP-PLM, HP-UNEQ, HP-TIM, HP-RDI, LCD, LSS SONET: LOS, LOF, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, TIM-P, PLM-P, UNEQ-P, RDI-P, LCD-P, LSS
Overhead Byte Functionality	Generation of user-defined overhead bytes Capture and display of current overhead bytes

Reflector		
Reflector Mode	The following parameters are user selectable:	
	• Reflector MAC/IP address	• Swap all MAC addresses or one specific MAC address
	• Swap IP addresses	• Swap port numbers on UDP/TCP frames
	• Force ACK on TCP frames	• Answer incoming ARP, Ping requests

CPRI/OBSAI, Fibre Channel Testing Specifications

CPRI/OBSAI Testing (Options MU100010A-071, MU100010A-072, MU100010A-073)

CPRI/OBSAI Testing	
Port Mode	Off, Normal, Through
Line Rate	CPRI: 614.4, 1228.8, 2457.6, 3072.0, 4915.2, 6144.0, 9830.4, 10137.6 Mbps OBSAI: 768, 1536, 3072.0, 6144.0 Mbps

Transmitter Clock	Reference Clock
	• Internal clock
	• External clock
	  • BITS
	  • SETS
	  • 2 MHz
	  • 10 MHz
	• GPS
	• Received clock

Content	Unframed, CPRI Link
Pattern	PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, User 32 bits, Off
CPRI Link	Start up: Enabled, Disabled Role: Master, Slave Protocol version: 1, 2 HDLC rate: no HDLC, 240, 480, 960, 1920, 2400 kbit/s, Highest possible Ethernet: On, Off; Pointer: 20 to 63
Alarm Insertion	Signal Loss, LOS, LOF, PSL, Remote-LOS, Remote-LOF, RAI, SDI, Reset
Error Insertion	Item: LCV, SHV, K30.7, Pattern error Insertion timing: Manual, Rate
Frequency Offset	±100 ppm, 1-ppm steps
Alarm Detection	Signal loss, LOS, LOF, PSL
Error Detection	LCV, SHV, K30.7, Pattern error
Remote Status	Remote LOS, Remote LOF, RAI, SDI, Reset
Link	Rx: Protocol version, HDLC rate, Pointer P Tx: Protocol version, HDLC rate, Pointer P
BER Test	Alarms: Signal loss, LOS, LOF, PSL, Remote LOS, Remote LOF, RAI, SDI, Reset Errors: LCV, SHV, K30.7, Pattern error Frames count: Rx hyper frame, Rx code words, Tx hyper frame, Tx code words Delay: Delay, Average Delay, Min. Delay, Max. Delay Measurement count

APS	APS (Automatic Protection Switching) test and analysis
	• APS switching time is measured. A switching time exceeding the user-defined threshold is highlighted.
	• Trigger events (user selectable)
	  • Alarm: Signal Loss, LOS, LOF
	  • Error: LCV, SHV, Pattern error
	  • Remote Alarm: Remote LOS, Remote LOF, RAI, SDI, Reset
	• Switching time, Switching count, Pass/Fail, Minimum, Maximum and Average can be displayed.
	• APS switching time measurement resolution: 1 µs

Pass Through	Alarms: Signal loss, LOS, LOF, PSL, Remote LOS, Remote LOF, RAI, SDI, Reset Errors: LCV, SHV, K30.7, Pattern error

Fibre Channel Testing (Options MU100010A-002, MU100010A-091, MU100010A-092)

Fibre Channel Test	

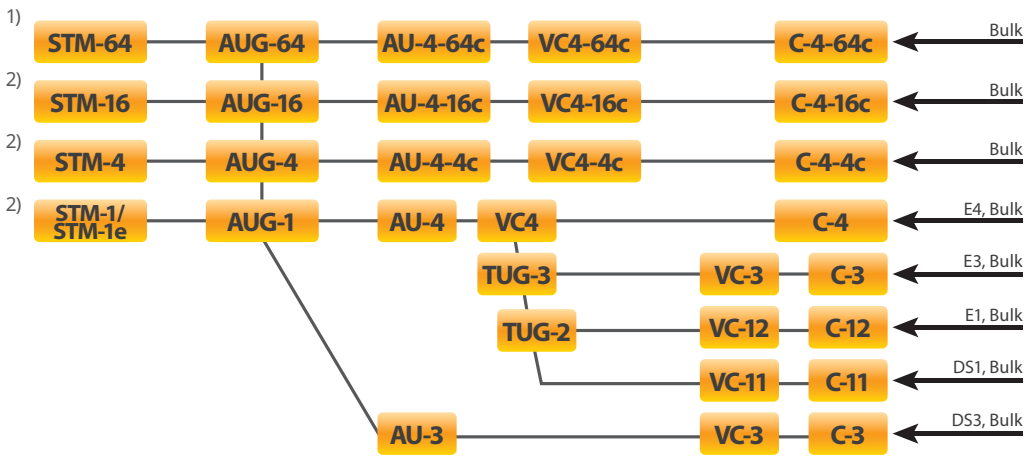
Test Port	• FC-800 (8GFC), FC-1200 (10GFC) optical line interfaces: 1 port (MU100010A-091), 2 ports (MU100010A-092)
	  User-selectable optical modules: 1310 nm, 1550 nm
	• FC-100 (1GFC), FC-200 (2GFC), FC-400 (4GFC) optical line interfaces: 2 ports (MU100010A-002)
	  User-selectable optical modules: 1310 nm, 1550 nm

Supported FC Bit Rate	1.0625 Gbps (FC-100/1GFC), 2.125 Gbps (FC-200/2GFC), 4.25 Gbps (FC-400/4GFC), 8.5 Gbps (FC-800/8GFC), 10.52 Gbps (FC-1200/10GFC)
Mode	Terminate, Monitor, Reflector
Topology	Point-to-point, Fabric
Primitive Sequence Protocol	Count and transmit primitive sequence: LR, LRR, NOS, OLS
Flow Control	Credit based transmitter: On/Off Buffer-to-buffer credit configuration: 1 to 65535, Buffer-to-buffer credit and R_RDY counters, R_RDY injection
Traffic Generation	• 1GFC (with SOF and EOF frame delimiters and 2GFC frames), Class-3 service frames • Traffic shaping: Constant, Ramp, Burst, 2GFC frame header configuration • Frame length configuration: 3240 bytes (Max.)
BER Test	• Test modes: Unframed BER test, Layer 1 BER test, Layer 2 BER test • Test patterns: PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, HF test pattern, CSPAT, CJPAT, CRPAT, JTPAT, SPAT, 55 Hex, Fox, 32-bit user programmable • Error injection: Bit, CRC, Symbol • Results: Pattern loss seconds, Traffic loss seconds, Bit error count, BER
Measurement	• Alarm detection: LOS, Link down, Pattern loss • Service disruption measurement: Average/Max service disruption, Number of service disruptions • Traffic statistics: Bandwidth utilization, Data rate, Frame count, Byte count, Frame size distribution, Buffer-to-buffer credit count, R_RDY count, Frame loss count, Round trip delay, Packet jitter, Bit errors, CRC errors, Symbol errors, LR, LRR, NOS, OLS

SDH/SONET and PDH/DSn Testing (Options MU100010A-001, MU100010A-081, MU100010A-082)

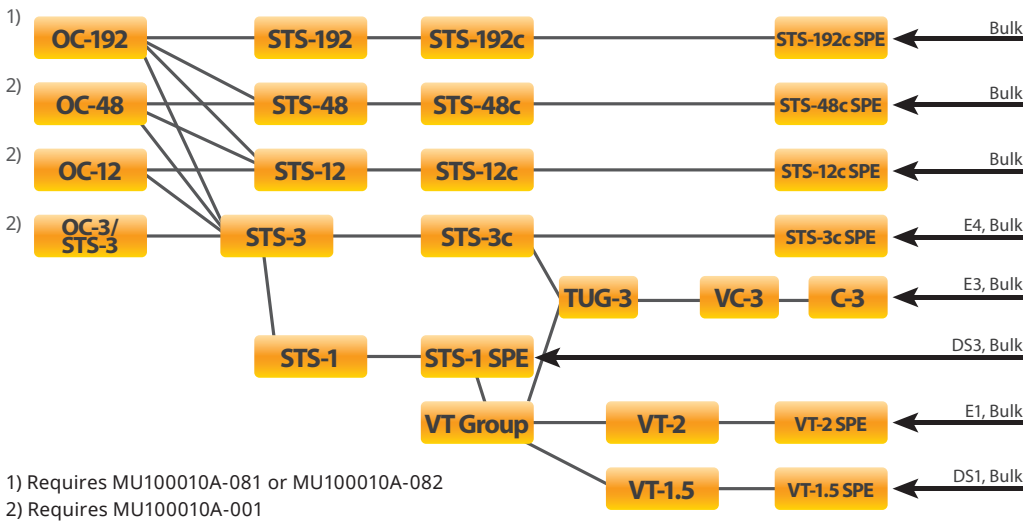
SDH and SONET Test	
Test Port	• STM-64, OC-192 optical interfaces: 1 port (MU100010A-081), 2 ports (MU100010A-082) User-selectable optical modules: 1310 nm, 1550 nm • STM-16/STM-4/STM-1, OC-48/OC-12/OC-3 optical interfaces: 2 ports (MU100010A-001) User-selectable optical modules: 1310 nm, 1550 nm • STM-1e, STS-3 electrical interfaces: 2 ports (MU100010A-001) Connector: BNC
Framing	SDH: Complies with ITU-T G.707, SONET: Complies with Telcordia GR-253
Transmitter Clock	• Internal clock accuracy: 4.6 ppm, Clock offset: ±50 ppm (1-ppm steps) • Recovered clock • TTL level external 2 MHz clock • SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps)
Receive Signal Rate	±50 ppm Frequency deviation indication resolution: ±1 ppm
STM-1e Electrical Attenuation and Impedance Mode	TERMINATE: Up to 12 dB cable attenuation, Nominal impedance MONITOR: 20 dB linear attenuation and up to 12 dB cable attenuation, Nominal impedance
TCM Frame Format	ITU-T G.783, G.707 Annex D (TCM option 2) and Annex E, POH bytes: N1 (VC-4, VC-3), Z5 (STS-3c, STS-1), N2 (VC-12, VC-11), Z6 (VT-2, VT-1.5) TCM Access Point Identifier (Apid): 15 bytes ASCII sequence, CRC-7
Scrambling	SDH: Complies with ITU-T G.707, SONET: Complies with Telcordia GR-253

SDH Mappings



1) Requires MU100010A-081 or MU100010A-082
2) Requires MU100010A-001

SONET Mappings



1) Requires MU100010A-081 or MU100010A-082
2) Requires MU100010A-001

SDH/SONET Testing Specifications

Alarms	Detected and generated alarms • SDH: LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-PLM, HP-UNEQ, HP-TIM, HP-RDI, TU-LOM, TU-AIS, TU-LOP, LP-PLM, LP-UNEQ, LP-TIM, LP-RDI, LSS • SONET: LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, LOP-P, TIM-P, PLM-P, UNEQ-P, RDI-P, LOM-V, AIS-V, LOP-V, PLM-V, UNEQ-V, RDI-V, TIM-V, LSS • TCM: TC-LTC, TC-TIM, TC-UNEQ, TC-AIS, TC-RDI, TC-ODI Inserted alarms • Permanent • Alternate: 1 to 8000 consecutive alarm frames, 1 to 8000 consecutive normal frames
Errors	Detected and generated errors • SDH: A1/A2, B1, B2, MS-REI, B3, HP-REI, V5/B3, LP-REI, Pattern error, ERR trans • SONET: A1/A2, B1, B2, REI-L, B3, REI-P, V5/B3, REI-V, Pattern error, ERR trans • TCM: TC-IEC, TC-BIP2, TC-REI, TC-OEI Error insertion • Manual: 1 to 8000 consecutive errors (excluding Pattern error) 1 to 4000 consecutive errors (for Pattern error) • Continuous: 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8}, 10^{-9}, 10^{-10} (The available highest rate varies depending on the error item.) • Alternate: 1 to 8000 consecutive error frames, 1 to 8000 consecutive normal frames (excluding Pattern error and ERR trans) 1 to 4000 consecutive error bits, 100 to 4000 consecutive normal bits (for Pattern error)
BER Test Pattern	Pattern generation and detection for O.181 bulk test pattern • Test patterns supported: PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31 PRBS patterns can be inverted. All 0 s, All 1 s, Alternating 1:1, Alternating 1:3, Alternating 1:7, 2 in 8 User-defined patterns (Pattern length: up to 2048, Length step: 8-bit)
Pointer	• Support pointer events monitoring and generation • Pointer test sequences: None, Single alternating, Regular + Double, Regular + Missing, Double alternating • Display pointer value of receiver side • Graphical display of pointer movements
Overhead	• Generation of section/transport and path overhead bytes • Display of current section/transport and path overhead bytes All overhead can be decoded, including decoded J0, J1, J2 byte.
SDH Tributary Signal	DS1 signals embedded in selected VC-11 (Requires MU100010A-001) E1 signals embedded in selected VC-12 (Requires MU100010A-001) E3/DS3 signals embedded in selected VC-3 (Requires MU100010A-001) E4 signals embedded in selected VC-4 (Requires MU100010A-001) The offset of tributary signals (DS1, E1, E3, DS3, E4) can be set at asynchronous mapping.
SONET Tributary Signal	DS1 signals embedded in selected VT-1.5 (Requires MU100010A-001) E1 signals embedded in selected VT-2 (Requires MU100010A-001) E3/DS3 signals embedded in selected STS-1 (Requires MU100010A-001) E4 signals embedded in selected STS-3c (Requires MU100010A-001) The offset of tributary signals (DS1, E1, E3, DS3, E4) can be set at asynchronous mapping.
Through Mode	• Transparent mode • OH overwrite mode: Can be changed SOH (SDH), TOH (SONET)

SDH and SONET Results	
Status	Current information on • Alarms and errors on monitored line • Input level indication for optical signals • Input level indication for electrical signals • Actual bit rate • Frequency deviation
Statistics	User-defined measurement resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Logged information: Alarms (seconds and ratio), Errors (count or count and ratio), Pointer operations Event log: Major measurement events incl. errors, alarms and pointer operations are logged with 1-second resolution.
Error Performance	G.826/G.828/G.829/M.2100 analysis of received signal based on detected errors and alarms: ES, SES, BBE (not M.2100), UNAV
APS	APS (Automatic Protection Switching) test and analysis • APS switching time is measured. A switching time exceeding the user-defined threshold is highlighted. • Trigger events (user selectable): • SDH: SDH alarms and errors, pattern bit error, APS switchover • SONET: SONET alarms and errors, pattern bit error, APS switchover • Number of switchovers indicated by APS protocol • K1/K2 bytes set and displayed Resolution of APS switching time measurement, SDH • SDH events excluding VC-12 and VC-11 events, LOS (Loss of Signal): 1 µs • VC-12 and VC-11 events: 0.5 ms Resolution of APS switching time measurement, SONET • SONET events excluding VT-1.5 and VT-2 events, LOS (Loss of Signal): 1 µs • VT-1.5 and VT-2 events: 0.5 ms
Round Trip Delay (Propagation Time) Measurement	Resolution: 0.1 µs Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

PDH/DSn Testing Specifications

E1 Test	
Test Port	Electrical line interfaces: 2 ports (MU100010A-001) Connector: BNC or RJ48 (selectable)
General	Complies with ITU-T G.703 for 2048 kbps
Impedance	Supported input impedances • 75Ω (unbalanced), 120Ω (balanced), High (>10 × nominal)
Line Code	HDB3 or AMI
Framing	Unframed or Framed: FAS/nFAS, Transmitter: Sa-bits (non-FAS), user-programmable
Transmitter Clock	• Internal 2.048 Mbps clock accuracy: 4.6 ppm, Clock offset: ±125 ppm (1-ppm steps) • Recovered from receiver • TTL level external 2.048 MHz clock • SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps)
Receive Signal Rate	• 2048 kbps ±150 ppm • Frequency deviation indication accuracy: ±1 ppm
Receiver Attenuation and Impedance Mode	TERMINATE • Up to 40 dB cable attenuation, Nominal impedance MONITOR • 20 to 26 dB linear attenuation and up to 6 dB cable attenuation, Nominal impedance • 20 to 30 dB linear attenuation, 0 dB cable attenuation, Nominal impedance BRIDGED • Up to 40 dB cable attenuation, High impedance
Drop and Insert	Supports drop & insert of one or multiple 64 kbps timeslots (TS) within E1
Alarms	Detected and generated alarms: No signal, AIS, No frame, Distant (RDI) alarm, Pattern sync. loss, No CAS, MFAS, Distant (RDI) MF alarms
Errors	Detected: FAS/nFAS, CRC4, E-bit, Code, Pattern, Pattern slips, Frame slips Generated: FAS bit, FAS word, CRC-4, E-bit, Code, Pattern, Transparent Error insertion • Manual: 1 to 255 consecutive errors (1 to 16 consecutive FAS word errors) • Continuous: 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} • Provoking of G.821, G.826 or M.2100 events (ES, SES etc.) (FAS, Pattern, CRC-4, E-bit) Manual slip insertion: Frame slips, Pattern slips
BER Test Pattern	Pattern generation • Unframed of Framed: n × 64 kbps in contiguous or non-contiguous channel access Supported test patterns • PRBS 6, PRBS 7, PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, QRSS 11, QRSS 20 • Fox pattern, Fox (CMA 3000), All 0, All 1, Alternating (1:1), (1:3), (1:7), (3:24) • User-defined up to 32 bits (Length: 1-bit steps) • User-defined up to 2048 bits (Length: 8-bit steps) All patterns can be inverted, except user-defined
CAS	CAS signaling bits can be set.
Tone and Speech Signal Insertion	Tone in one speech channel on one transmitter • Frequency: 1 Hz to 4 kHz (1-Hz steps) • Level: –70 to +3 dBm (1-dBm steps) • Artificial speech signal
Speech Decode	64 kbps (ITU-T G.703): A-law according to ITU-T G.711

E1 Results	
Status	Current Information on • Alarms and errors on monitored line • Input level indication • Actual bit rate • Frequency deviation • FAS/non-FAS and CAS bits • Traffic overview: Busy/Idle indication from all 31 channels
Time Slot Monitoring	Contents of single time slot including positive/negative peak values. • Frequency for encoded tone: 1 Hz to 4 kHz (1-Hz steps) • Level for encoded tone: –66 to +3 dBm (1-dBm steps)
Statistics	User-defined measurement resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Logged information: Alarms (seconds and ratio), Errors (count or count and ratio), Frequency deviation information Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
Error Performance	G.821, G.826 or M.2100 analysis of PRBS in received signal, or based on CRC-4, E-bit or FAS: ES, SES, BBE (G.826), UAT, EFS, AT % or count. Error performance evaluation for total measurement: • HR% for user-defined error performance parameter or programmable OK and not-OK limits for FAS, Pattern, CRC-4 or E-bit count or ratio
APS	APS switching time is measured. A switching time exceeding the user-defined threshold is highlighted. Number of switchovers. Trigger events (User selectable): 2 Mbps alarms (LOF or AIS; pattern bit error) Resolution of APS switching time measurement: LOF and AIS: 0.25 ms
Round Trip Delay (Propagation Time) Measurement	Resolution: 1 µs Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

PDH/DSn Testing Specifications

DS1 Test	
Test Port	Electrical line interfaces: 2 ports (MU100010A-001) Connector: Bantam
General	Complies with ANSI T1.102 for 1544 kbps.
Impedance	100Ω or High (10 × nominal; Receiver only) and DSX MON 100Ω ±1%
Line Code	B8ZS, AMI
Framing	Unframed or Framed, Framed: SF, ESF, J-ESF (J1)
Transmitter Clock	• Internal 1.544 Mbps clock accuracy: 4.6 ppm, Clock offset: ±125 ppm (1-ppm steps) • Recovered from receiver • TTL level external 2.048 MHz clock • SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps)
Line Build Out	0, –7.5, –15, –22.5 dB 0 to 133 ft, 133 to 266 ft, 266 to 399 ft, 399 to 533 ft, 533 to 655 ft
Receive Signal Rate	1544 kbps ±150 ppm Frequency deviation indication resolution: ±1 ppm
Receiver Sensitivity	DS1 Short Haul • 15 dB linear attenuation, 0 dB cable attenuation, Nominal impedance TERMINATE • Up to 36 dB cable attenuation, Nominal impedance DSX MONITOR • 15 to 25 dB linear attenuation, Nominal impedance BRIDGE • Up to 36 dB cable attenuation, High impedance
Drop and Insert	Drop & Insert of one or multiple 56 kbps or 64 kbps timeslots (TS) within DS1
Alarms	Generated and detected: LOS, OOF, AIS (Blue), RAI (Yellow), LSS
Errors	Generated or detected: Pattern, F-bit, S-bit, Pattern slips, BPV (Code), CRC-6, EXZ Error insertion • Manual: 1 to 255 consecutive errors • Continuous: 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} • For performance: ES, SES
BER Test Pattern	Supported test patterns • PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, QRSS 20 • All 0, All 1, Alternating (1:1), (1:3), (1:7), (3:24), Fox pattern, Fox (CMA 3000) • User-defined up to 32 bits (Length: 1-bit steps) • User-defined up to 2048 bits (Length: 8-bit steps) All patterns can be inverted, except User-defind
Loopback Code	Supported loopback codes: LLA, LLD, PLA, PLD, ULB, NLA, USR, ACS, DCS, AN1, DN1, AN2, DN2, 100K, USER_INBAND (User-defined FDL/in-band code) Insertion: On/Off
CAS	CAS signaling bits can be set.
Tone and Speech Signal Insertion	Tone in one speech channel on one transmitter • Frequency: 1 Hz to 4 kHz (1-Hz steps) • Level: –70 to +3 dBm (1-dBm steps) • Artificial speech signal
Speech Decode	64 kbps or 56 kbps: µ-law

DS1 Results	
Status	Current Information on • Alarms and errors on monitored line • Input level indication • Actual bit rate • Frequency deviation • Contents of one time slot • Framing and CAS bits • Traffic overview: Busy/Idle indication from all 24 channels
Time Slot Monitoring	Contents of single time slot including positive/negative peak values. • Frequency for encoded tone: 1 Hz to 4 kHz (1-Hz steps) • Level for encoded tone: –66 to +3 dBm (1-dBm steps)
Statistics	User-defined measurement resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Logged information: Alarms (seconds and ratio), Errors (count or count and ratio), Frequency deviation information Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
Error Performance	G.821, G826, or M.2100 analysis of PRBS in received signal, or based on detected errors: ES, SES, ALS, UAT, AVT, EFS, BBE (G.826)
APS	APS switching time is measured. A switching time exceeding the user-defined threshold is highlighted. Number of switchovers. Trigger events (User selectable): 1.5 Mbps alarms (OOF, AIS; pattern bit error) APS switching time measurement resolution: No frame, AIS: 0.25 ms
Round Trip Delay (Propagation Time) Measurement	Resolution: 1 µs Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

PDH/DSn Testing Specifications

E3 Test	
Test Port	Electrical line interfaces: 2 ports (MU100010A-001) Connector: BNC
General	Complies with ITU-T G.703 for 34368 kbps
Impedance	75Ω
Line Code	HDB3
Framing	Unframed or Framed: Complies with ITU-T G.751 for E3 signals
Transmitter Clock	• Internal clock accuracy: 4.6 ppm, Clock offset: ±125 ppm (1-ppm steps) • Recovered from receiver • TTL level external 2.048 MHz clock • SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps)
Receive Signal Rate	34368 kbps ±150 ppm Frequency deviation indication resolution: ±1 ppm
Attenuation and Impedance Mode	TERMINATE • Up to 12 dB cable attenuation, Nominal impedance MONITOR • 20 dB linear attenuation and up to 12 dB cable attenuation, Nominal impedance • 20 to 30 dB linear attenuation, 0 dB cable attenuation, Nominal impedance
Alarms	Detected and generated alarms: No signal, AIS, No frame, RDI, Pattern sync. loss
Errors	Detected and generated errors: Frame, Code, Pattern, Pattern slip Error insertion • Manual: 1 to 255 consecutive errors • Continuous: 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} • For performance: ES, SES
BER Test Pattern	Pattern Generation and Detection, Supported test patterns • PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23 • Fox pattern, Fox (CMA 3000), All 0, All 1, Alternating 1:1, Alternating 1:3, Alternating 1:7, Alternating 3:24 • User-defined up to 32 bits (Length: 1-bit steps) • User-defined up to 2048 bits (Length: 8-bit steps) All patterns can be inverted, except user-defined

E3 Results	
Status	Current Information on • Alarms and errors on monitored line • Input level indication • Actual bit rate • Frequency deviation
Statistics	User-defined measurement resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Logged information: Alarms (seconds and ratio), Errors (count or count and ratio), Frequency deviation information Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
Error Performance	G.826/M.2100 analysis of received signal, or based on detected errors ES, SES, ALS, UAT, AVT, EFS, BBE (G.826)
Round Trip Delay (Propagation Time) Measurement	Resolution: 1 µs Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

DS3 Test	
Test Port	Electrical line interfaces: 2 ports (MU100010A-001) Connector: BNC
General	Complies with ANSI for 44736 kbps
Impedance	75Ω
Line Code	B3ZS
Framing	Unframed or Framed, Framed: C-bit parity, M13 in accordance with ANSI T1.107
Transmitter Clock	• Internal clock accuracy: 4.6 ppm, Clock offset: ±125 ppm (1-ppm steps) • Recovered from receiver • TTL level external 2.048 MHz clock • SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps)
Line Build Out	0 ft, 225 ft
Receive Signal Rate	44736 kbps ±150 ppm Frequency deviation indication resolution: ±1 ppm
Attenuation and Impedance Mode	TERMINATE • Up to 12 dB cable attenuation, Nominal impedance MONITOR • 20 dB linear attenuation and up to 12 dB cable attenuation, Nominal impedance • 20 to 30 dB linear attenuation, 0 dB cable attenuation, Nominal impedance
Alarms	Detected and generated alarms: LOS, LOF, AIS (Blue), RAI (Yellow), DS3 idle, LSS
Errors	Detected and generated errors: Pattern, C-bit, F-bit, P-bit, Code (BPV), FEBE (detect only), EXZ (detect only) Error insertion • Manual: 1 to 255 consecutive errors • Continuous: 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}

PDH/DSn Testing Specifications

BER Test Pattern	Pattern generation and detection, Supported test patterns • PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, QRSS 20 • Fox pattern, Fox (CMA 3000), All 0, All 1, Alternating 1:1, Alternating 1:3, Alternating 1:7, Alternating 3:24 • User-defined up to 32 bits (Length: 1-bit steps) • User-defined up to 2048 bits (Length: 8-bit steps) All patterns can be inverted, except user-defined
Loopback Code	Supports FEAC and C-bits loopback (ANSI T1.404 & T1.107a)

DS3 Results	
Status	Current information on • Alarms and errors on monitored line • Input level indication • Actual bit rate • Frequency deviation
Statistics	User-defined measurement resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Logged information: Alarms (seconds and ratio), Errors (count or count and ratio), Frequency deviation Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
Error Performance	G.826/M.2100 analysis of received signal, or based on detected errors ES, SES, ALS, UAT, AVT, EFS, BBE (G.826)
Round Trip Delay (Propagation Time) Measurement	Resolution: 1 µs Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

E4 Test	
Test Port	Electrical line interfaces: 2 ports (MU100010A-001) Connector: BNC
General	Complies with ITU-T G.703 for 139264 kbps interfaces
Impedance	75Ω
Line Code	CMI
Framing	Unframed or Framed: Complies with ITU-T G.751 for E4 signals
Transmitter Clock	• Internal clock accuracy: 4.6 ppm, Clock offset: ±125 ppm (1-ppm steps) • Recovered from receiver • TTL level external 2.048 MHz clock • SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps)
Receive Signal Rate	139264 kbps ±150 ppm Frequency deviation indication resolution: ±1 ppm
Attenuation and Impedance Mode	TERMINATE • Up to 12 dB cable attenuation, Nominal impedance MONITOR • 20 dB linear attenuation and up to 12 dB cable attenuation, Nominal impedance
Alarms	Detected and generated alarms: No signal, AIS, No frame, RDI, Pattern sync. loss
Errors	Detected and generated errors: Frame, Pattern error, Pattern slips Error insertion • Manual: 1 to 255 consecutive errors • Continuous: 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} • For performance: ES, SES
BER Test Pattern	Pattern generation and detection, Supported test patterns • PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, QRSS 20 • All 0, All 1, Alternating 1:1, Alternating 1:3, Alternating 1:7, Alternating 3:24 • User-defined up to 32 bits (Length: 1-bit steps) • User-defined up to 2048 bits (Length: 8-bit steps) All patterns can be inverted, except user-defined

E4 Results	
Status	Current information on • Alarms and errors on monitored line • Input level indication • Actual bit rate • Frequency deviation
Statistics	User-defined measurement resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h Logged information: Alarms (seconds and ratio), Errors (count or count and ratio), Frequency deviation Event log: Major measurement events incl. errors and alarms are logged with 1-second resolution.
Error Performance	G.826/M.2100 analysis of received signal, or based on detected errors ES, SES, ALS, UAT, AVT, EFS, BBE (G.826)
Round Trip Delay (Propagation Time) Measurement	Resolution: 1 µs Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

Optical Modules Selection Guide

Optical interface tests can be run using the MT1000A/MU100010A just by inserting an optical module supporting the relevant standard into the SFP/SFP+ slot.
The following table lists the lineup of SFP/SFP+ application parts, and the corresponding standards.

Model/Order No.	Description (Approx. Distance)	Max. Input Power	Input Sensitivity	Input Wavelength	Output Power	Output Wavelength	Loop Back
G0332A 100M FX 1310 nm MM SFP	100BASE - FX 1310 nm multi mode (2 km)	–14 dBm	–31 dBm	1270 nm to 1600 nm	–20 to –15 dBm	1280 nm to 1380 nm	OK
G0329A 10G LR 1310 nm SFP+	10GBASE - LR 1310 nm single mode (10 km)	+0.5 dBm	–14 dBm	1260 nm to 1355 nm	–8.2 to +0.5 dBm	1260 nm to 1355 nm	OK
G0315A 10G LR/LW 1310 nm SFP+	10GBASE - LR 1310 nm single mode (10 km)	+0.5 dBm	–14.4 dBm	1260 nm to 1565 nm	–6 to –1 dBm	1290 nm to 1330 nm	OK
G0316A 10G ER/EW 1550 nm 40 km SFP+	10GBASE - ER 1550 nm single mode (40 km)	–1 dBm	–15.8 dBm	1260 nm to 1565 nm	–3 to +3 dBm	1530 nm to 1560 nm	>4 dB ATT
G0318A 10G ZR/ZW 1550 nm 80 km SFP+	10GBASE - ER 1550 nm single mode (80 km)	–8 dBm	–22 dBm	1260 nm to 1565 nm	0 to +5 dBm	1525 nm to 1565 nm	>13 dB ATT
G0319A Up to 2.7G 1310 nm 15 km SFP	STM-1/4/16 short haul 1310 nm single mode (15 km)	0 dBm	–18 dBm	1270 nm to 1580 nm	–5 to 0 dBm	1260 nm to 1360 nm	OK
G0320A Up to 2.7G 1310 nm 40 km SFP	STM-1/4/16 long haul 1310 nm single mode (40 km)	–9 dBm	–27 dBm	1270 nm to 1580 nm	–2 to +3 dBm	1280 nm to 1335 nm	>12 dB ATT
G0321A Up to 2.7G 1550 nm 80 km SFP	STM-1/4/16 long haul 1550 nm single mode (80 km)	–9 dBm	–28 dBm	1270 nm to 1580 nm	–2 to +3 dBm	1500 nm to 1580 nm	>12 dB ATT
G0328A 1G/2G/4G FC 850 nm SFP	1GFC, 2GFC, 4GFC 850 nm multi mode (0.5 km)	–3 dBm	–15 dBm	830 nm to 860 nm	–9 to 0 dBm	830 nm to 860 nm	>3 dB ATT
G0322A 1G/2G/4G FC 1310 nm SFP	1GFC, 2GFC, 4GFC 1310 nm single mode (10 km)	–3 dBm	–18 dBm	1260 nm to 1360 nm	–8 to 0 dBm	1260 nm to 1360 nm	>3 dB ATT
G0323A 1G/2G/4G FC 1550 nm SFP	1GFC, 2GFC, 4GFC 1550 nm single mode (40 km)	–3 dBm	–18 dBm	1470 nm to 1600 nm	0 to +5 dBm	1510 nm to 1590 nm	>8 dB ATT
G0356A 8G FC/10G SR 850 nm SFP+	8GFC, 10GFC, 10GBASE - SR 850 nm multi mode (0.3 km)	–1 dBm	–11.1 dBm	840 nm to 860 nm	–7.3 to –1.0 dBm	840 nm to 860 nm	OK

Model/ Order No.	Name	Form Factor	100 Meg Ethernet	156 Meg STM-1	614 Meg CPRI	622 Meg STM-4	768 Meg OBSAI	1 Gig FC	1.23 Gig CPRI	1.25 Gig Ethernet	1.54 Gig OBSAI	2 Gig FC	2.46 Gig CPRI	2.488 Gig STM-16	2.67 Gig OTU1	3.07 Gig CPRI OBSAI	4 Gig FC	4.92 Gig CPRI	6.14 Gig CPRI OBSAI	8 Gig FC	9.83 Gig CPRI	9.95 Gig STM-64	10.1 Gig CPRI	10.3 Gig Ethernet	10.5 Gig FC	10.7 Gig OTU2	11.05 Gig OTU1e	11.09 Gig OTU2e	11.27 Gig OTU1f	11.3 Gig OTU2f
G0332A	100M FX 1310 nm MM SFP	SFP	1310 nm, MM, 2 km																											
G0329A	10G LR 1310 nm SFP+	SFP+																					1310 nm, SM, 10 km							
G0315A	10G LR/LW 1310 nm SFP+	SFP+																		1310 nm, SM, 10 km										
G0316A	10G ER/EW 1550 nm 40 km SFP+	SFP+																		1550 nm, SM, 40 km										
G0318A	10G ZR/ZW 1550 nm 80 km SFP+	SFP+																		1550 nm, SM, 80 km										
G0319A	Up to 2.7G 1310 nm 15 km SFP	SFP		1310 nm, SM, 15 km																										
G0320A	Up to 2.7G 1310 nm 40 km SFP	SFP		1310 nm, SM, 40 km																										
G0321A	Up to 2.7G 1550 nm 80 km SFP	SFP		1550 nm, SM, 80 km																										
G0328A	1G/2G/4G FC 850 nm SFP	SFP						850 nm, MM, 0.5 km																						
G0322A	1G/2G/4G FC 1310 nm SFP	SFP						1310 nm, SM, 10 km																						
G0323A	1G/2G/4G FC 1550 nm SFP	SFP						1550 nm, SM, 40 km																						
G0356A	8G FC/10G SR 850 nm SFP+	SFP+																		850 nm, MM, 0.3 km										

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Mainframe

Model/Order No.	Name	
MT1000A	Network Master Pro	
Standard Accessories		
	Line Code*1:	1 pc
B0690A	Softbag:	1 pc
B0728A*2	Rear Panel kit:	1 pc
G0309A	AC Adapter:	1 pc
G0310A	Li-ion Battery:	1 pc
Z1746A	Stylus:	1 pc
Z1747A*3	Carrying Strap:	1 pc
Z1748A*4	Handle:	1 pc
Z1817A*5	Utilities ROM:	1 pc
Options		
MT1000A-003*6	Connectivity for WLAN/*Bluetooth*	
MT1000A-005*7	AUX I/O	

∗1: One line cord is attached to the area to shipment.
∗2: Set of B0720A (Rear Panel) and B0732A (Screw Set).
∗3: Shoulder strap for MT1000A.
∗4: Hand strap for MT1000A.
∗5: DVD ROM containing operation manual, remote script instruction manual, etc.
∗6: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.
∗7: Required to carry MU100090A. MT1000A-205 is a retrofit option.

Measuement Module

Model/Order No.	Name
MU100010A	10G Multirate Module
Standard accessories	
W3681AE	MT1000A/MU100010A Quick Reference Guide
B0692A*8	ESD Box (for optical modules)

∗8: Up to four SFP+/SFPs can be stored.

Options*9

Model/Order No.	Name
Low Rate	
MU100010A-001*10	Up to 2.7G Dual Channel
Ethernet	
MU100010A-011*11	Ethernet 10G Single Channel
MU100010A-012*11	Ethernet 10G Dual Channel
MU100010A-020*12	TCP Throughput
OTN	
MU100010A-051*13	OTN 10G Single Channel
MU100010A-052*13	OTN 10G Dual Channel
MU100010A-061*14	ODU Multiplexing
MU100010A-062*15	ODU Flex
CPRI/OBSAI	
MU100010A-071	CPRI/OBSAI Up to 5G Dual Channel
MU100010A-072*16	CPRI/OBSAI 6G to 10G Single Channel
MU100010A-073*16	CPRI/OBSAI 6G to 10G Dual Channel
SDH/SONET	
MU100010A-081*17	STM-64 OC-192 Single Channel
MU100010A-082*17	STM-64 OC-192 Dual Channel
Fibre Channel	
MU100010A-002	FC 1G 2G 4G Dual Channel
MU100010A-091*18	FC 8G 10G Single Channel
MU100010A-092*18	FC 8G 10G Dual Channel

∗9: These options can be retrofitted.
The Model/Order No. of retrofit options is "-3**".
Example
MU100010A-001 Up to 2.7G Dual Channel becomes MU100010A-301 Up to 2.7G Dual Channel Retrofit.
In addition, specify one of the following media along with the required option.
Z1849A: DVD-ROM for Retrofit Options
Z1850A: USB Stick for Retrofit Options
∗10: Includes OTN (OTU1), Ethernet (10 Mbps, 100 Mbps, 1 Gbps), SDH up to STM-16, SONET up to OC-48, PDH (E1, E3, E4), and DSn (DS1, DS3)
∗11: MU100010A-011, MU100010A-012: Only one of these options can be installed.
∗12: MU100010A-020: Requires that at least one of the following options is installed: MU100010A-001, MU100010A-011, MU100010A-012
∗13: MU100010A-051, MU100010A-052: Only one of these options can be installed.
∗14: MU100010A-061: Requires that at least one of the following options is installed: MU100010A-001, MU100010A-051, MU100010A-052
∗15: MU100010A-062: Requires that at least one of the following options is installed: MU100010A-001, MU100010A-051, MU100010A-052
∗16: MU100010A-072, MU100010A-073: Only one of these options can be installed.
∗17: MU100010A-081, MU100010A-082: Only one of these options can be installed.
∗18: MU100010A-091, MU100010A-092: Only one of these options can be installed.

GPS Disciplined Oscillator

Model/Order No.	Name
MU100090A*19	High Performance GPS Disciplined Oscillator
Standard accessories	
J1705A	AUX Conversion Adaptor
J1706A	GPS Antenna
J1710A	BNC Cable (20 cm) × 2

∗19: Excellent Eco Product non-compliant.
The MT1000A-005 option is required to install the MU100090A in the MT1000A.

Ordering Information

Optional Accessories

Model/Order No.	Name
Main Unit Accessories	
B0691B*20	Hard Case
B0733A*21	Hard Case
G0306A	Video Inspection Probe
G0324A	Battery Charger
G0325A	GPS Receiver
J1569A	Car 12 Vdc Adapter
J1570A	Head Set
J1667A*22	GPIB–USB Converter
Operation Manuals	
W3682AE	MT1000A/MU100010A Operation Manual
Z1821A*23	Utilities in USB Stick
Optical Module	
G0332A	100M FX 1310 nm MM SFP
G0356A	8G FC/10G SR 850 nm SFP+
G0329A	10G LR 1310 nm SFP+
G0315A	10G LR/LW 1310 nm SFP+
G0316A	10G ER/EW 1550 nm 40 km SFP+
G0318A	10G ZR/ZW 1550 nm 80 km SFP+
G0319A	Up to 2.7G 1310 nm 15 km SFP
G0320A	Up to 2.7G 1310 nm 40 km SFP
G0321A	Up to 2.7G 1550 nm 80 km SFP
G0328A	1G/2G/4G FC 850 nm SFP
G0322A	1G/2G/4G FC 1310 nm SFP
G0323A	1G/2G/4G FC 1550 nm SFP
Cables	
J1571A	Optical Cable SM LC/PC to SC/PC 3 m
J1575A	Optical Cable SM LC/PC to FC/PC 3 m
J1579A	Optical Cable SM LC/PC to LC/PC 3 m
J1581A	Optical Cable MM LC/PC to LC/PC 3 m
J1583A	Optical Attenuator 10 dB LC/PC to LC/PC
J1584A	RJ45 Cable 3 m
J1585A*24	RJ48 to Crocodile Clips Cable 3 m
J1586A*24	RJ48 to Crocodile Clips Cable 20 dB ATT 3 m
J1588A*25	BNC Cable 2.5 m
J1589A*25	BNC to 1.6/5.6 Cable 2.5 m
J1591A*24	RJ48 to Two 3-pin Banana Plug Cable 2.5 m
J1597A*24	RJ48 Balanced PDH Cable Crossed 3 m
J1598A*26	Bantam Cable 3 m
J1710A*27	BNC Cable 0.2 m
J0127B*27	COAXIAL CORD, 2.0 M
Module Connection Parts	
B0720A	Rear Panel
B0728A*28	Rear Panel Kit
B0729A*29	Screw 1U
B0730A*29	Screw 2U
B0731A*29	Screw 3U
B0732A*30	Screw Kit

⁎20: Can use module 1 to 2 in combination
⁎21: Can use module 1 to 3 in combination
⁎22: J1667A is required for SCPI remote control via GPIB
⁎23: Include MT1000A Operation Manual and the Remote Script Manual.
⁎24: E1 interface cable.
⁎25: E1, E3, E4, DS3, STM-1e, STS-3 interface cable. Impedance: 75Ω
⁎26: DS1 interface cable.
⁎27: 50Ω impedance cable for MU100090A and main-frame external clock input connector
⁎28: Includes B0720B and B0732A
⁎29: Includes 4 bolts of same length
⁎30: Four bolts of each length for 12 bolts total

Maintenance Service

Model/Order No.	Name
MT1000A-ES210	2 Years Extended Warranty Service
MT1000A-ES310	3 Years Extended Warranty Service
MT1000A-ES510	5 Years Extended Warranty Service
MU100010A-ES210	2 Years Extended Warranty Service
MU100010A-ES310	3 Years Extended Warranty Service
MU100010A-ES510	5 Years Extended Warranty Service
MU100090A-ES210	2 Years Extended Warranty Service
MU100090A-ES310	3 Years Extended Warranty Service
MU100090A-ES510	5 Years Extended Warranty Service

Note:

Anritsu envision : ensure

Specifications are subject to change without notice.

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