

Network Master™ Series

MT1100A
Network Master Flex

MU110010A 10G Multirate Module

MU110011A 100G Multirate Module

MU110012A 40/100G Module CFP2



Redefining Transport Testing

All-in-one Support for R&D, Manufacturing and I&M of 100 Gbps Core and Metro Networks

Today's core and metro communications networks are implementing 100 GigE and OTN technologies rapidly to provide sufficient bandwidth supporting the explosive increase in mobile communications data. These high-bit-rate networks demand very high reliability due to the large data volumes and variety of client signals in use. Consequently, every stage from R&D through to manufacturing, installation, and maintenance, requires precision testing and verification of network equipment and transport devices.

The all-in-one Network Master Flex MT1100A supports all the latest communications network technologies. Selecting and installing up to two modules from a range of three module options supports all-in-one R&D, manufacturing, installation and maintenance tests of network and transport equipment operating at bit rates from 1.5 Mbps to 100 Gbps. The large, 12.1-inch color LCD touch panel with easy-to-use GUI plus remote operation of a full range of test functions over an Internet connection greatly improves test efficiency and helps cut costs.

Key Benefits and Features:

- All-in-one transport tester
 - supports testing from 1.5 Mbps to 100 Gbps
- Up to 4 ports at all rates
- Easy and intuitive GUI
- WLAN*/Bluetooth*/LAN connectivity
- PDF and XML report generation for documenting test results
- Remote operation
- Remote control (scripting)
- Compact, lightweight design for maximum field portability
- High performance in small form factor
- Modular platform ensuring maximum return on investment

Key Applications:

- Core and metro networks installation and maintenance
- OTN up to OTU4 including mapping of Ethernet, Fibre Channel and SDH/SONET client signals, multistage mapping and FEC (Forward Error Correction) also supporting O.182 Poisson error addition
- Testing and verification of new OTN functions
 - ODU0, ODU2e, ODU3e1, ODU3e2, ODU4, ODUflex
- Carrier Class Ethernet installation and troubleshooting
- Ethernet testing up to 100 Gbps including RFC 2544 and Y.1564
- Ethernet OAM
- MPLS-TP and PBB/PBB-TE
- 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)
- 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 up to STM-64/OC-192
- PDH/DSn (E1, E3, E4, DS1, DS3)

*: Available for certified countries and regions including USA, Canada, Japan and all EU countries. Please contact Anritsu for updated information.

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Connector Panel Overview



Power Supply Module

- Battery and AC Power Supply Module MU110001A
- AC only High Power Supply Module MU110002A

Test Module (Select one or two modules)

- 10G Multirate Module MU110010A
- 100G Multirate Module MU110011A
- 40/100G Module CFP2 MU110012A

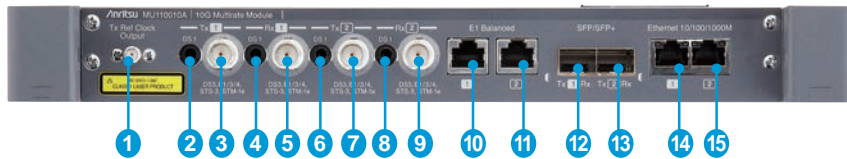
Mainframe

- Network Master Flex MT1100A



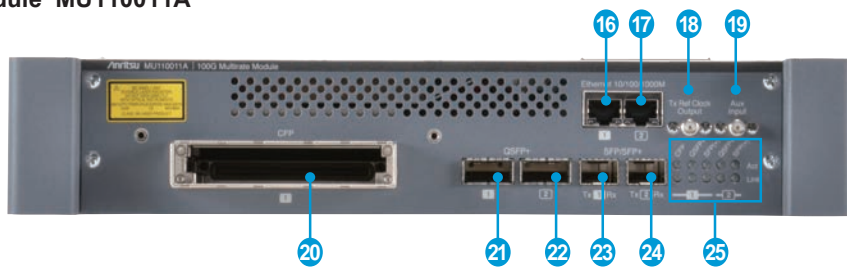
- 1 Unit Sync. Input (for future use)
- 2 Unit Sync. Output (for future use)
- 3 Audio
- 4 AUX (for G0325A, GPS receiver)
- 5 External Clock Input
- 6 USB Mini-B
- 7 USB A
- 8 USB A
- 9 Ethernet Service Interface

10G Multirate Module MU110010A



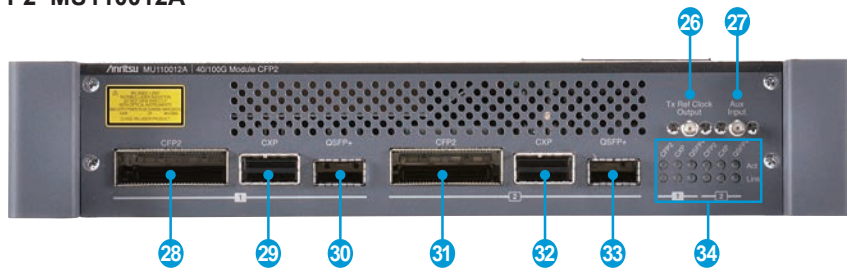
- 1 Tx Reference Clock Output
- 2 Port1, Tx Mini-bantam (DS1)
- 3 Port1, Tx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
- 4 Port1, Rx Mini-bantam (DS1)
- 5 Port1, Rx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
- 6 Port2, Tx Mini-bantam (DS1)
- 7 Port2, Tx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
- 8 Port2, Rx Mini-bantam (DS1)
- 9 Port2, Rx BNC (E1, E3, E4, DS3, STM-1e, STS-3)
- 10 Port1, Tx/Rx RJ48 (E1 balanced)
- 11 Port2, Tx/Rx RJ48 (E1 balanced)
- 12 Port1, Tx/Rx SFP/SFP+ (OTN, Ethernet, Fibre Channel, SDH/SONET optical)
- 13 Port2, Tx/Rx SFP/SFP+ (OTN, Ethernet, Fibre Channel, SDH/SONET optical)
- 14 Port1, Tx/Rx RJ45 (Ethernet electrical)
- 15 Port2, Tx/Rx RJ45 (Ethernet electrical)

100G Multirate Module MU110011A

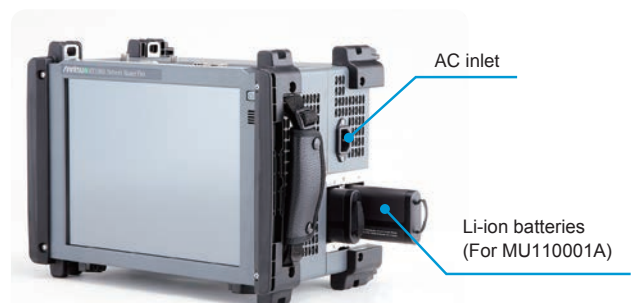


- 16 Port1, Tx/Rx RJ45 (Ethernet electrical)
- 17 Port2, Tx/Rx RJ45 (Ethernet electrical)
- 18 Tx Reference Clock Output
- 19 AUX Input (for future use)
- 20 Tx/Rx CFP (OTN, Ethernet, SDH/SONET optical)
- 21 Port1, Tx/Rx QSFP+ (OTN, Ethernet optical)
- 22 Port2, Tx/Rx QSFP+ (OTN, Ethernet optical)
- 23 Port1, Tx/Rx SFP/SFP+ (OTN, Ethernet, Fibre Channel, SDH/SONET optical)
- 24 Port2, Tx/Rx SFP/SFP+ (OTN, Ethernet, Fibre Channel, SDH/SONET optical)
- 25 Act, Link Indicators

40/100G Module CFP2 MU110012A



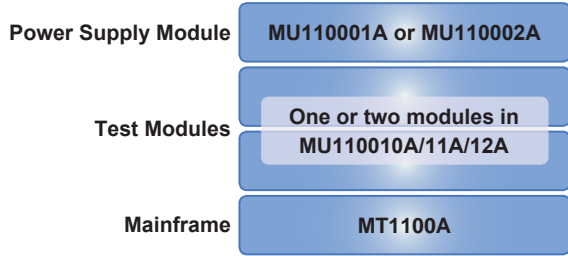
- 26 Tx Reference Clock Output
- 27 AUX Input (for future use)
- 28 Port1, Tx/Rx CFP2 (OTN, Ethernet optical)
- 29 Port1, Tx/Rx CXP (Ethernet optical)
- 30 Port1, Tx/Rx QSFP+ (OTN Ethernet optical)
- 31 Port2, Tx/Rx CFP2 (OTN, Ethernet optical)
- 32 Port2, Tx/Rx CXP (Ethernet optical)
- 33 Port2, Tx/Rx QSFP+ (OTN Ethernet optical)
- 34 Act, Link Indicators



Configuration Guide

Mainframe and Modules

Product Number	Product Name	Description
MT1100A	Network Master Flex	Network Master Flex Mainframe
MU110001A	Battery and AC Power Supply Module	Power supply module for MT1100A Includes G0237A × 2 (Battery), Z1862A (Hexagon wrench)
MU110002A	AC only High Power Supply Module	High power supply module for MT1100A Includes Z1862A (Hexagon wrench)
MU110010A	10G Multirate Module	SFP/SFP+: 2, RJ45: 2, BNC (Tx/Rx): 2, RJ48: 2, Mini-bantam (Tx/Rx): 2
MU110011A	100G Multirate Module	CFP: 1, QSFP+: 2, SFP/SFP+: 2, RJ45: 2
MU110012A	40/100G Module CFP2	CFP2: 2, CXP: 2, QSFP+: 2



One mainframe, one or two test modules and one power supply module can be combined flexibly for various applications.

Power Supply Modules and Test Modules Combination

MU110001A Battery and AC Supported Configuration	MU110010A 10G Multirate Module	MU110011A 100G Multirate Module	MU110012A 40/100G Module CFP2
One Module	✓		
		✓	
Two Modules			✓
	✓ ✓		
	✓	✓	
	✓		✓

MU110002A AC only Supported Configuration	MU110010A 10G Multirate Module	MU110011A 100G Multirate Module	MU110012A 40/100G Module CFP2
One Module	✓		
		✓	
Two Modules (Any two kinds of modules can be combined)			✓
	✓ ✓		
		✓ ✓	
	✓	✓	✓ ✓
	✓		✓
	✓		✓

Test Modules and Maximum Operating Ports

Protocol	PDH/DSn	OTU1	100 Mbps to 1 Gbps Ethernet	STM-16/OC-48	1GFC to 4GFC	OTU2/1e/2e/1f/2f	10 Gbps Ethernet	STM-64/OC-192	8GFC to 10GFC	OTU3/3e1/3e2	40 Gbps Ethernet	STM-256/OC-768	OTU4	100 Gbps Ethernet
MU110010A	2 ports	2 ports			2 ports									
MU110011A		2 ports			2 ports			2 ports*1		1 port				
MU110012A								2 ports		*2		2 ports		

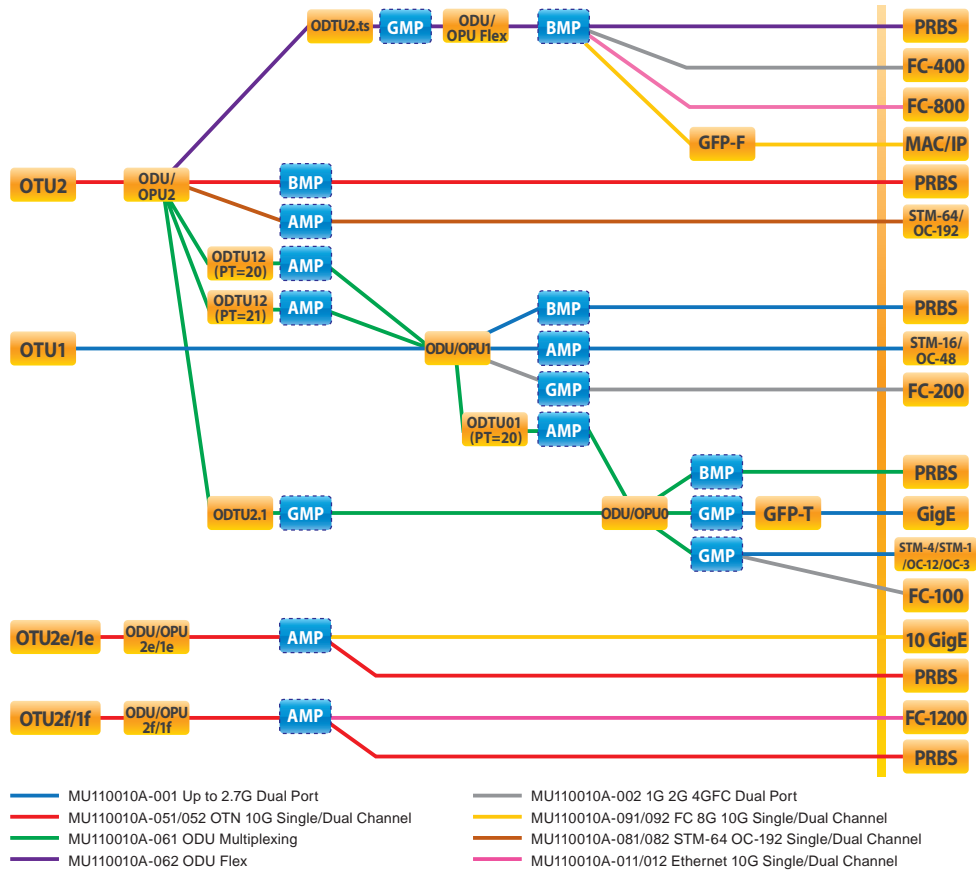
*1: Up to two ports in two QSFP+ and one CFP can be operated simultaneously.

*2: MU110012A does not have a STM-256/OC-768 physical interface.

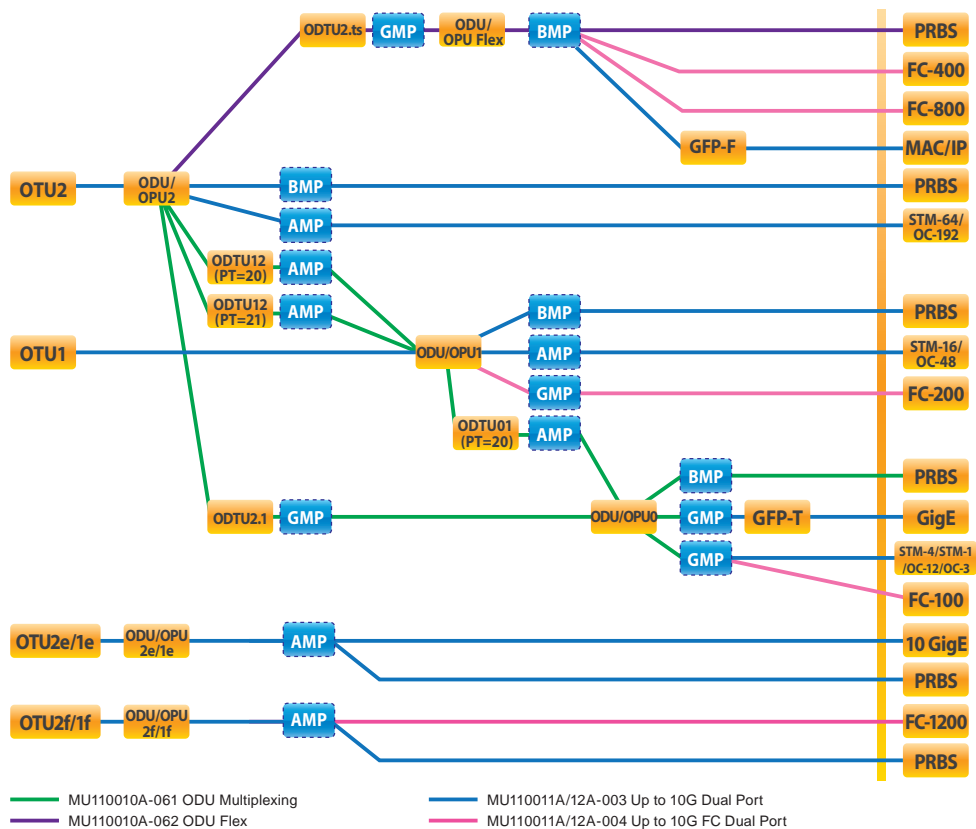
MU110012A-083/084 are the options for STM-256/OC-768 client signals mapped in the OTN. Please refer to page 6.

OTN Mappings

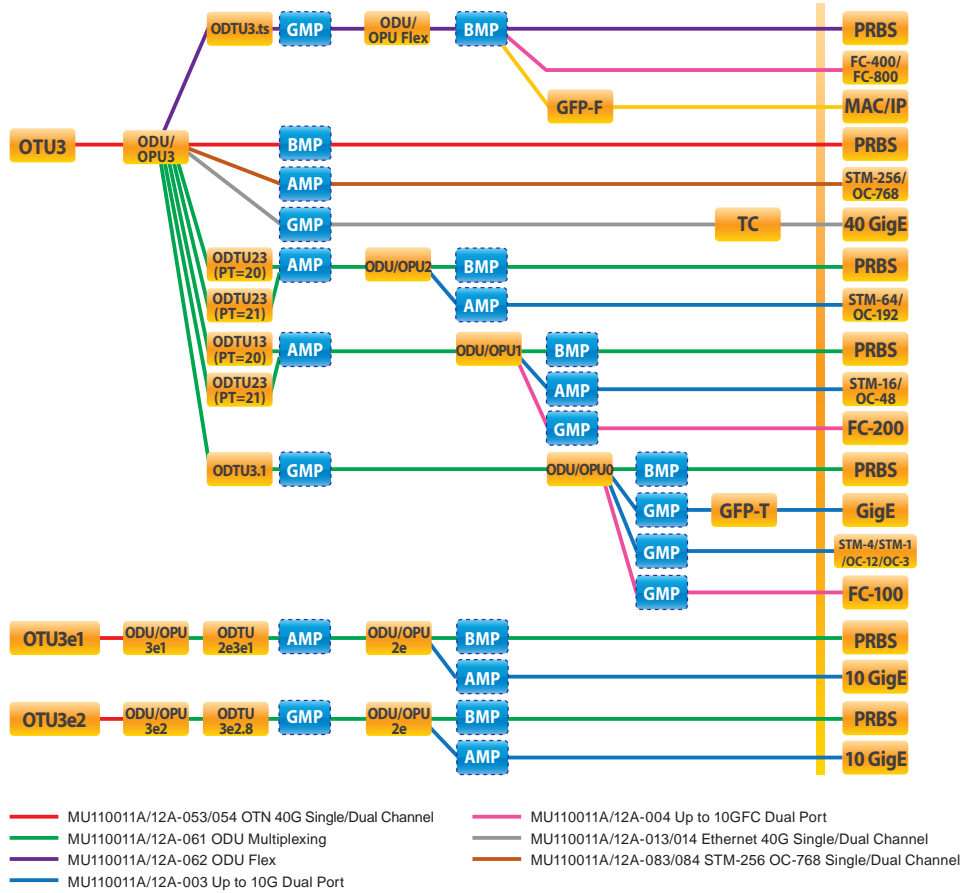
Support the mappings of OTU1 and OTU2x in MU110010A



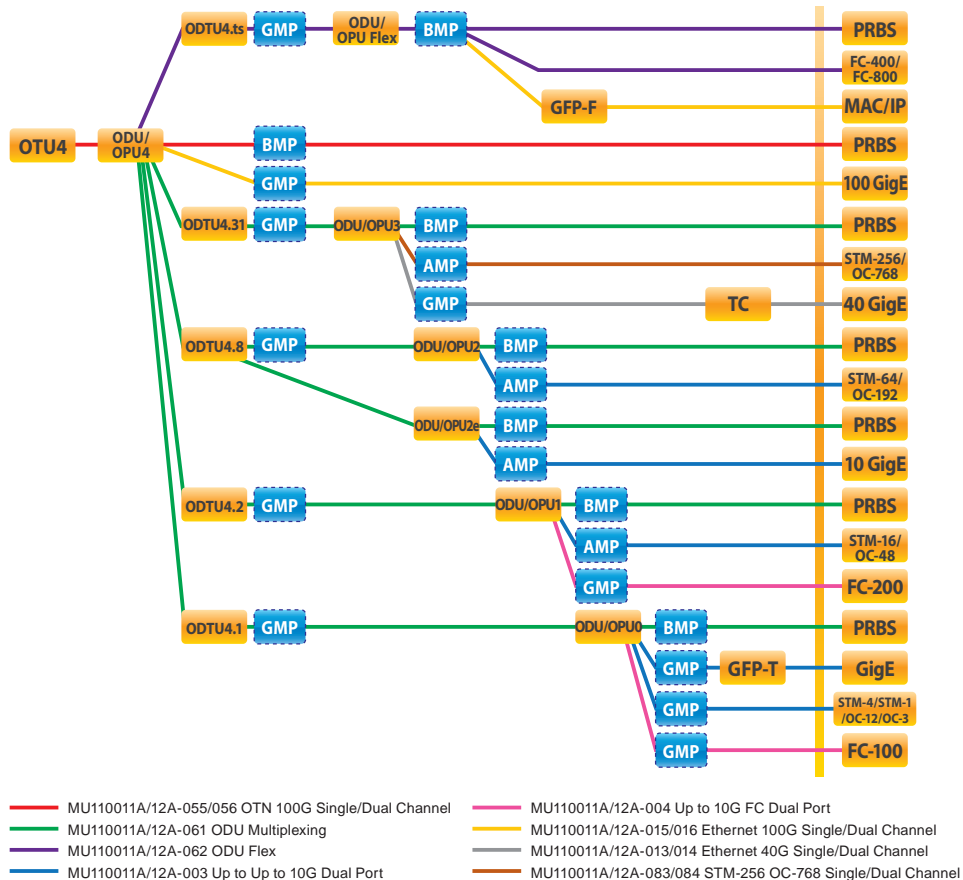
Support the mappings of OTU1 and OTU2x in MU110011A



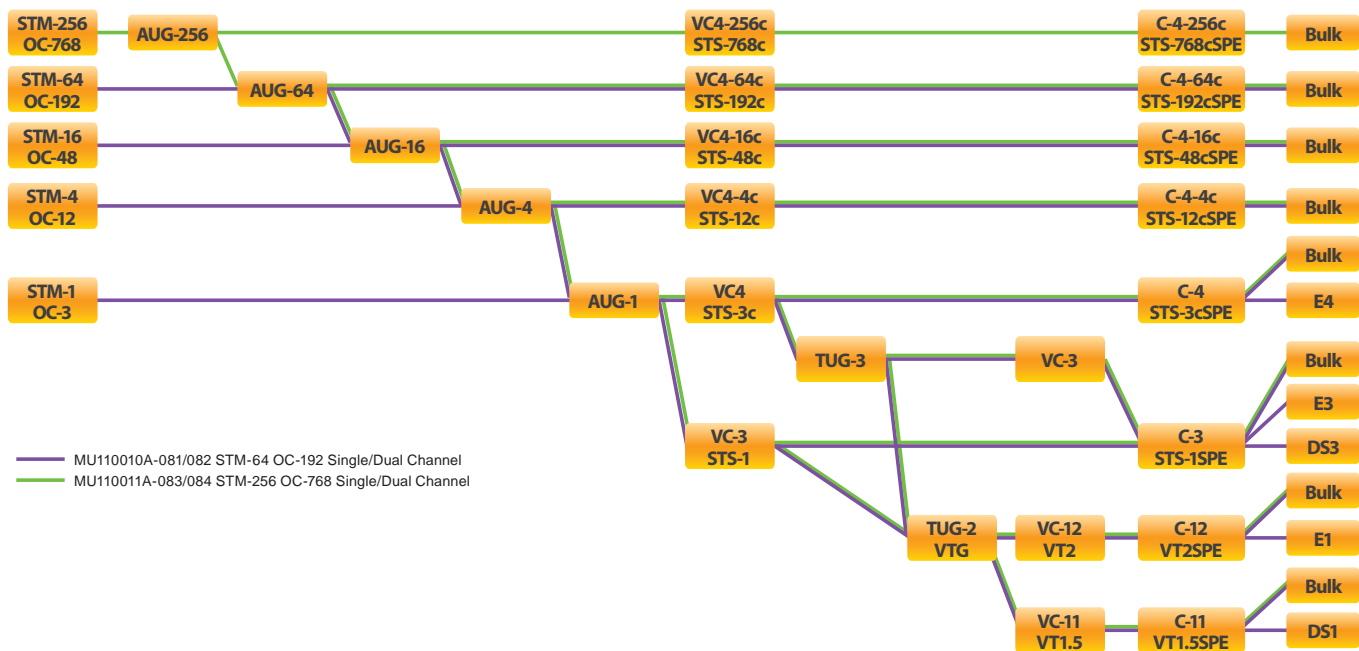
Support the mappings of OTU3 in MU110011A/12A



Support the mappings of OTU4 in MU110011A/12A



SDH/SONET Mappings



Optical Transceivers

Model/Order No.	Description (Approx. Distance)	Max. Input Power	Input Sensitivity	Input Wavelength	Output Power	Output Wavelength	Loop Back
G0311A 1G 850 nm SX SFP	1000BASE - SX 850 nm multi mode (0.5 km)	-3 dBm	-17 dBm	770 nm to 860 nm	-9.5 to -3 dBm	830 nm to 860 nm	OK
G0312A 1G 1310 nm LX SFP	1000BASE - LX 1310 nm single mode (10 km)	-3 dBm	-18 dBm	1260 nm to 1580 nm	-10 to -3 dBm	1260 nm to 1360 nm	OK
G0313A 1G 1550 nm ZX SFP	1000BASE - ZX 1550 nm single mode (80 km)	-3 dBm	-23 dBm	1260 nm to 1580 nm	-2 to +5 dBm	1480 nm to 1580 nm	>8 dB ATT
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
G0333A 10G SR/SW 850 nm SFP+	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
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
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
G0334A 40G LR4 1310 nm QSFP+	40G Ethernet/OTN 1310 nm single mode (10 km)	+2.3 dBm (per Lane)	-11.5 dBm (per Lane)	1264.5 nm to 1277.5 nm 1284.5 nm to 1297.5 nm 1304.5 nm to 1317.5 nm 1324.5 nm to 1337.5 nm	+8.3 dBm max. (Total) -2 to +2.3 dBm (per Lane)	1264.5 nm to 1277.5 nm 1284.5 nm to 1297.5 nm 1304.5 nm to 1317.5 nm 1324.5 nm to 1337.5 nm	OK
G0335A 40G LR4 1310 nm CFP	40G Ethernet/OTN 1310 nm single mode (10 km)	+2.3 dBm (per Lane)	-11.1 dBm (per Lane)	1264.5 nm to 1277.5 nm 1284.5 nm to 1297.5 nm 1304.5 nm to 1317.5 nm 1324.5 nm to 1337.5 nm	+8.3 dBm max. (Total) -2 to +2.3 dBm (per Lane)	1264.5 nm to 1277.5 nm 1284.5 nm to 1297.5 nm 1304.5 nm to 1317.5 nm 1324.5 nm to 1337.5 nm	OK
G0336A 40G FR 1550 nm CFP	40G SDH/OTN 1550 nm single mode (2 km)	+3 dBm (per Lane)	-6 dBm	1530 nm to 1565 nm	0 to +3 dBm	1530 nm to 1565 nm	OK
G0337A 100G LR4 1310 nm CFP	100G Ethernet/OTN 1310 nm single mode (10 km)	+4.5 dBm (per Lane)	-10.3 dBm (per Lane)	1294.53 nm to 1296.59 nm 1299.02 nm to 1301.09 nm 1303.54 nm to 1305.63 nm 1308.09 nm to 1310.19 nm	+8.9 dBm max. (Total) -2.9 to +2.9 dBm (per Lane)	1294.53 nm to 1296.59 nm 1299.02 nm to 1301.09 nm 1303.54 nm to 1305.63 nm 1308.09 nm to 1310.19 nm	OK
G0338A 100G LR4 1310 nm CFP2	100G Ethernet/OTN 1310 nm single mode (10 km)	+4.5 dBm (per Lane)	-10.3 dBm (per Lane)	1294.53 nm to 1296.59 nm 1299.02 nm to 1301.09 nm 1303.54 nm to 1305.63 nm 1308.09 nm to 1310.19 nm	+8.9 dBm max. (Total) -2.9 to +2.9 dBm (per Lane)	1294.53 nm to 1296.59 nm 1299.02 nm to 1301.09 nm 1303.54 nm to 1305.63 nm 1308.09 nm to 1310.19 nm	OK
G0339A 100G 850 nm CXP	100G Ethernet 850 nm multi mode (0.1 km)	+2.4 dBm (per Lane)	-9.5 dBm (per Lane)	840 nm to 860 nm	+8.9 dBm max. (Total) -7.6 to +2.4 dBm (per Lane)	840 nm to 860 nm	OK

MU110010A	MU110011A	MU110012A	Model/Order No.	Name	Form Factor	100M Ethernet	156M SDH/SONET	622M SDH/SONET	1GFC	1G Ethernet	2GFC	2.5G SDH/SONET	2.7G OTN	4GFC	8GFC	10G SDH/SONET, 10G	WAN-PHY	10G LAN-PHY Ethernet	10GFC	10G OTN	40G SDH/SONET	40G Ethernet	40G OTN	100G Ethernet	100G OTN		
✓	✓		G0311A	1G 850 nm SX SFP	SFP				850 nm, MM, 0.5 km																		
✓	✓		G0312A	1G 1310 nm LX SFP	SFP				1310 nm, SM, 10 km																		
✓	✓		G0313A	1G 1550 nm ZX SFP	SFP				1550 nm, SM, 80 km																		
✓	✓		G0332A	100M FX 1310 nm MM SFP	SFP	1310 nm, MM, 2 km																					
✓	✓		G0333A	10G SR/SW 850 nm SFP+	SFP+											850 nm, MM, 0.3 km											
✓	✓		G0356A	8G FC/10G SR 850 nm SFP+	SFP+											850 nm, MM, 0.3 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																		
		✓	G0334A	40G LR4 1310 nm QSFP+	QSFP+																	1310 nm, SM, 10 km					
		✓	G0335A	40G LR4 1310 nm CFP	CFP																	1310 nm, SM, 10 km					
		✓	G0336A	40G FR 1550 nm CFP	CFP																	1550 nm, SM, 2 km					
		✓	G0337A	100G LR4 1310 nm CFP	CFP																				1310 nm, SM, 10 km		
		✓	G0338A	100G LR4 1310 nm CFP2	CFP2																				1310 nm, SM, 10 km		
		✓	G0339A	100G 850 nm CXP	CXP																				850 nm, MM, 0.1 km		

Specifications

Network Master Flex MT1100A Mainframe

User Interface	
Display	12.1-inch active matrix TFT display (800 × 600 pixels) and touch screen
Service Interface	
USB Interface	MT1100A operates as host: USB 2.0 type A (2 ports) MT1100A 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/h
Bluetooth Interface*	Bluetooth 2.1 + EDR

*: Available for certified countries and regions including USA, Canada, Japan and all EU countries. Please contact Anritsu for updated information.

Other Interfaces	
Unit synchronization Input	(Not used)
Unit Synchronization Output	(Not used)
Audio Interface	For connection of optional head set Connector: 3.5-mm diameter jack
AUX Connector	For connection of G0325A GPS receiver
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 Connector: BNC

Miscellaneous	
Dimensions and Mass	320 (W) × 225 (H) × 46 (D) mm (without protector), ≤2.5 kg
Environmental	Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: -20° to +60°C, ≤80% RH (non-condensing)
EMC	EN61326-1, EN61000-3-2
LVD	EN61010-1

Battery and AC Power Supply Module MU110001A

Battery	14.4 V rechargeable and replaceable intelligent Li-ion battery Operation time: 1 hour (typ.) (with MU110011A, 100 Gbps Ethernet operation) Charging time: 6 hours (typ.) (25°C) Remaining capacity indication:%
Power Supply	100 V(ac) to 240 V(ac), 50 Hz/60 Hz 380 VA (Max.)
Dimensions and Mass	320 (W) × 225 (H) × 82 (D) mm (without protector), ≤3.0 kg (without battery)
Environmental	Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: -20° to +60°C, ≤80% RH (non-condensing, without battery) -20° to +50°C, ≤80% RH (non-condensing, with battery)
EMC	EN61326-1, EN61000-3-2
LVD	EN61010-1

AC only High Power Supply Module MU110002A

Power Supply	100 V(ac) to 240 V(ac), 50 Hz/60 Hz 700 VA (Max.)
Dimensions and Mass	320 (W) × 225 (H) × 72 (D) mm (without protector), ≤3.0 kg
Environmental	Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: -20° to +60°C, ≤80% RH (non-condensing)
EMC	EN61326-1, EN61000-3-2
LVD	EN61010-1

10G Multirate Module MU110010A

Test Port	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: 4 ports ITU-T G.703 compliant RJ48: 2 sockets ITU-T G.703 compliant RTT Bantam: 4 ports ANSI DS1.102 compliant																																																																																										
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Dimensions and Mass	320 (W) × 225 (H) × 37 (D) mm, ≤1.4 kg																																																																																										
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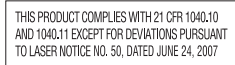
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Refer to the external interfaces in MT1100A specifications.

*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.



100G Multirate Module MU110011A

Test Port	CFP: 1 slot CFP MSA Hardware Specification, Rev. 1.4 compliant CFP MSA Management Interface Specification V2.2 R06a compliant (Not supported to MSA 100GLH) IEEE 802.3ba-2010 compliant QSFP+: 2 slots SFF-8436, SFF-8472 compliant IEEE 802.3ba-2010 compliant 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																																																																																													
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Tx Ref. Clock Output	Frequency Selectable from 1/16, or 1/64 against the bit rate of the lane. (RJ45 port cannot be selected) Level: 250 mVp-p (Min.), 550 mVp-p (Max.) Termination: 50Ω/AC (Single ended) Connector: SMA																																																																																													
AUX Connector	Termination: 50Ω/AC (Single ended) Connector: SMA																																																																																													
Dimensions and Mass	320 (W) × 225 (H) × 60 (D) mm, ≤3.0 kg																																																																																													
Environmental	Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: -20° to +60°C, ≤80% RH (non-condensing)																																																																																													
EMC	EN61326-1, EN61000-3-2																																																																																													
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Laser Safety*3	CFP: 100GBASE-LR4, 40GBASE-LR4, 40GBASE-FR QSFP+: 40GBASE-LR4 SFP: 4GFC(SX), 4GFC(LX), 4GFC(EX), OC-48 LR-1/STM L-16.1, OC-48 LR-2/STM L-16.2, 100BASE-FX, 100BASE-LX SFP+: 1000BASE-SX/LX/ZX, 10GBASE-LR, 10GBASE-ER, 10GBASE-ZR IEC 60825-1: 2007 CLASS 1 21CFR1040.10 and 1040.11*1 CFP: 100G BASE-SR10 QSFP+: 40GBASE-SR4 IEC 60825-1: 2007 CLASS 1M 21CFR1040.10 and 1040.11*1																																																																																													

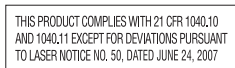
*1: The frequency accuracy depends on the accuracy of the MT1100A internal clock or the external clock of MT1100A.

Refer to the external interfaces in MT1100A 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.



40/100G Module CFP2 MU110012A

Test Port	CFP2: 2 slots CFP MSA CFP2 Hardware Specification, Rev. 1.0 compliant CFP MSA Management Interface Specification V2.2 R06a compliant (Not supported to MSA 100GLH) IEEE 802.3ba-2010 compliant CXP: 2 slots InfiniBand Architecture 1.2.1 Annex A6: CXP compliant SFF-8642, IEEE 802.3ba-2010 compliant QSFP+: 2 slots SFF-8436, SFF-8472 compliant IEEE 802.3ba-2010 compliant		
Bit Rate**	Standard	Bit Rate	Interfaces
	40 GigE	10.31250000 Gbps × 4 Lane	QSFP+
	100 GigE	10.31250000 Gbps × 10 Lane	CXP
	100 GigE	25.781250000 Gbps × 4 Lane	CFP2
	OTU3	10.75460339 Gbps × 4 Lane	QSFP+
	OTU3e1	11.14274364 Gbps × 4 Lane	QSFP+
	OTU3e2	11.14583889 Gbps × 4 Lane	QSFP+
	OTU4	27.952493392 Gbps × 4 Lane	CFP2
Tx Ref. Clock Output	Frequency Selectable from 1/16, or 1/64 against the bit rate of the lane. 40 GigE: QSFP+ 100 GigE: CXP OTU3: QSFP+ OTU3e1: QSFP+ OTU3e2: QSFP+ Selectable from 1/40, or 1/160 against the bit rate of the lane. 100 GigE: CFP2 OTU4: CFP2 Level: 250 mVp-p (Min.), 550 mVp-p (Max.) Termination: 50Ω/AC (Single ended) Connector: SMA		
AUX Connector	Termination: 50Ω/AC (Single ended) Connector: SMA		
Dimensions and Mass	320 (W) × 225 (H) × 69 (D) mm, ≤3.0 kg		
Environmental	Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: -20° to +60°C, ≤80% RH (non-condensing)		
EMC	EN61326-1, EN61000-3-2		
LVD	EN61010-1		
Laser Safety**3	CFP2: 100GBASE-LR4 QSFP+: 40GBASE-LR4 IEC 60825-1: 2007 CLASS 1 21CFR1040.10 and 1040.11*2 CXP: 100G BASE-SR10 QSFP+: 40GBASE-SR4 IEC 60825-1: 2007 CLASS 1M 21CFR1040.10 and 1040.11*2		

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Refer to the external interfaces in MT1100A specifications.

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*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.



THIS PRODUCT COMPLIES WITH 21 CFR 1040.10 AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Specifications for MU110010A, MU110011A, MU110012A

OTN Testing

OTN Test	
Framing	Complies with ITU-T G.709 [at each OTU rate] FEC: Complies with G.709, RS (255, 239), On/Off
Transmitter Clock	<ul style="list-style-type: none"> Internal clock accuracy: 4.6 ppm, Clock offset: ± 200 ppm (0.1-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	± 200 ppm Frequency deviation indication resolution: ± 0.1 ppm
Scrambling	Complies with ITU-T G.709
OTN Mapping	See page 5, 6
OTN Alarm	<p>Detected alarms</p> <ul style="list-style-type: none"> OTU layer: OTU-AIS, LOF, OOF, LOM, OOM, SM-TIM, SM-BIAE, SM-BDI, SM-IAE ODU layer: ODU-AIS, ODU-OCI, ODU-LCK, PM-TIM, PM-BDI ODU multiplexing: ODU-LOFLOM, ODU-OOF OPU layer: PLM, OPU-MSIM, Client-AIS, CSF, LSS TCM: TCMi-TIM, TCMi-BIAE, TCMi-BDI, TCMi-IAE, TCMi-LTC (i = 1 to 6) OTL: LOF, OOF, OOR, LOR, OOM, LOM, ILA/OLA (OTU3, 3e1, 3e2, 4) <p>Generated alarms</p> <ul style="list-style-type: none"> 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 ODU multiplexing: ODU-OOF/LOF, ODU-OOM/LOM OPU layer: Client-AIS, CSF TCM: TCMi-TIM, TCMi-BIAE, TCMi-IAE, TCMi-BDI, TCMi-LTC (i = 1 to 6) OTL: LOF, OOF, OOR, LOR (OTU3, 3e1, 3e2, 4)
OTN Error	<p>Detected errors</p> <ul style="list-style-type: none"> 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-T errors: Core HEC-Correctable errors, Core HEC-Uncorrectable errors, Type HEC-Correctable errors, Type HEC-Uncorrectable errors, CSF signal, CSF sync., Invalid GFP frame, Superblock CRC error TCM: TCMi-BEI, TCMi-BIP-8 (i = 1 to 6) OTL: FAS, MFAS, LLM (OTU3, 3e1, 3e2, 4) <p>Generated errors</p> <ul style="list-style-type: none"> OTU layer: Bit all, OTU-FAS, MFAS, SM-BIP8, SM-BEI ODU layer: PM-BIP8, PM-BEI, ODU-FAS TCM: TCMi-BIP8, TCMi-BEI (i = 1 to 6) Pattern error OTL: FAS, MFAS, LLM (OTU3, 3e1, 3e2, 4)
Error Performance	• G.8201/M.2401 analysis of received signal based on detected errors and alarms: BBE, BBER, SES, SESR, UNAV
Justification	<p>Justification (per AMP)</p> <ul style="list-style-type: none"> Negative (-1) Positive (+1) Positive (+2) Offset (ppm) <p>Cm(t) (per GMP)</p> <ul style="list-style-type: none"> Can be set Offset (ppm)
BER Test Pattern	<p>Pattern generation and detection for bulk test patterns:</p> <ul style="list-style-type: none"> Test patterns: PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31 PRBS patterns can be inverted. User-defined patterns (Pattern length: up to 2048 bits, Length step: 8 bits)
FEC Test	ITU-T O.182 Random error insertion
Overhead	<p>User-editable header bytes</p> <ul style="list-style-type: none"> 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 <p>Capture and display current overhead bytes</p> <p>The following signals are decoded: TTI (SM, PM, TCMi (i = 1 to 6) of high-order, FTFL, PT)</p>
OTL Skew	<p>OTU3, 3e1, 3e2, 4</p> <p>Insertion</p> <p>Bits: 0 to 32000 (Tx lane)</p> <p>Detection</p> <p>Relative skew, Marker map</p>
Through Mode	<ul style="list-style-type: none"> Transparent mode OH overwrite mode <p>The OTU, ODU and OPU overhead can be changed.</p> <p>The FEC encoder and decoder can be set On/Off in any mode</p>

OTN Result	
Status	Current information on: <ul style="list-style-type: none"> • 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)
APS	APS (Automatic Protection Switching) test and analysis <ul style="list-style-type: none"> • APS switching time is measured. A switching time exceeding the user-defined threshold is highlighted. • Start and stop triggers can be selected independently. <ul style="list-style-type: none"> • Trigger events can be selected from the high-order OTU and ODU. • 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 μ s Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s
Tributary Scan	Supports up to 10 Gbps Detected alarms: OTU-AIS, LOF, OOF, LOM, OOM, SM-BIAE, SM-BDI, SM-IAE, ODU-AIS, ODU-OCI, ODU-LCK, PM-BDI, LOFLOW

Ethernet Testing

Ethernet Test	
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	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Ether-type 0x8100 (802.1Q), 0x88a8 (802.1ad), 0x9100 or 0x9200 • User-defined VLAN ID, CFI, VLAN priority <ul style="list-style-type: none"> • 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: ± 200 ppm (0.1-ppm steps) The frequency deviation of received Ethernet signals can be measured against the internal clock.
Receiver Setting	<ul style="list-style-type: none"> • 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 40 Gbps/100 Gbps: Invalid block type (0x00, 0x2d, 0x33, 0x66), Invalid sync. header (00, 11), Invalid alignment marker, BIP error
Alarm Generation	No link, Remote fault, Local fault (10 Gbps) PCS 40 Gbps/100 Gbps: High BER
PCS Skew	40 Gbps, 100 Gbps Insertion 100 Gbps Tx lane: 0 to 4224 bits 40 Gbps, 100 Gbps physical lane: 0 to 8448 Detection Relative skew, Marker map

Result, Monitor/Generate	
Status	<ul style="list-style-type: none"> • 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 s, 2 s, 5 s, 10 s, 15 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h, 4 h, 6 h, 12 h
Performance Statistics	• Utilization (Max./Min./Avg.), Throughput (Max./Min./Avg.), Frame rate (Max./Min./Avg.)
Frame Statistics	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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))
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 Thresholds	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	<ul style="list-style-type: none"> • 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	<p>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)</p> <p>Detection of sequence errors and loss of sequence synchronization</p> <p>Frame loss count and frame loss seconds</p> <p>Throughput measurement results are calculated for:</p> <ul style="list-style-type: none"> • Utilization layer, Physical layer, Physical layer excluding preamble, Link layer, Network layer and Data layer • Min./Max./Avg. values <p>Performance (M.2100 type) parameters: ES, SES, ALS, UAT, AVT, EFS</p> <p>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</p> <p>User-defined resolution: 1, 2, 5, 10, 15, 30 s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 h</p>
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	<p>Service disruption measurement activated as part of BER test</p> <ul style="list-style-type: none"> • Max./Avg. service disruption time, Resolution: 0.1 μs • Number of service disruptions

RFC 2544 Test	
RFC 2544 Test	<p>Switch/Router test and Single ended network test modes:</p> <ul style="list-style-type: none"> • Throughput, Frame loss, Latency or Packet jitter, Back-to-back frames (burstability) <p>End-to-end network test mode (two MU110010A units in Local-remote setup)</p> <ul style="list-style-type: none"> • Throughput, Frame loss, Back-to-back frames (burstability) <p>Router latency test mode: IP ping based latency test or packet jitter</p>

Service Activation Test (Y.1564)	
Service Activation Test	<p>ITU-T Y.1564 Service Activation Test</p> <ul style="list-style-type: none"> • 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 <p>Optional GPS timing synchronization</p>
Service Configuration Test	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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)

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	<p>For Connectivity and Configuration check</p> <ul style="list-style-type: none"> • Round Trip Time (RTT) • Supports IPv4 and IPv6 addressing • Answer incoming ping requests (On/Off)
Traceroute	<p>Trace IP route over IP network</p> <ul style="list-style-type: none"> • User-defined Max. number of hops (1 to 255) <p>Information per hop: Ping time (Min./Max./Avg.), Number of ping timeouts</p>

IP Channel Statistics	
Supported Bit Rate	10 Mbps, 100 Mbps, 1 Gbps, 10 Gbps
Statistics	<p>Statistics for up to 230 channels, identified by user-defined combinations of:</p> <ul style="list-style-type: none"> • IPv4, IPv6 or MAC address • VLAN ID or MPLS label • Protocol information • IP next header (protocol) • TCP/UDP ports <p>Traffic capacity:</p> <ul style="list-style-type: none"> • 10 Mbps, 100 Mbps, 1 Gbps, 10 Gbps, line speeds: 100% line load <p>Available Information per channel:</p> <ul style="list-style-type: none"> • 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	<p>User-defined label, Exp and TTL fields in each MPLS header</p> <ul style="list-style-type: none"> • Address increment, Decrement and Random generation <p>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.</p>
Statistics	<ul style="list-style-type: none"> • Number of labels (Max./Min.) • Number of MPLS-TP frames • Last received MPLS-TP label/priority/TTL
OAM (MPLS-TP)	<p>ITU-T G.8113.1 comply</p> <p>Supported OAM messages</p> <ul style="list-style-type: none"> • 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/PBB-TE (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	<p>Supported OAM messages</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> 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	<p>Generates and receives following OAM messages.</p> <p>Supported OAM messages</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Discovery Loopback activate
Statistics	<ul style="list-style-type: none"> Number of each message generated/received

Synchronous Ethernet Test	
Supported Bit Rate	10 Mbps, 100 Mbps, 1 Gbps, 10 Gbps
SyncE (ITU-T G.826x) Functionality	<p>Specify Quality Level (QL) of transmitted Ethernet signal.</p> <p>Analysis of QL indicated in received Ethernet signal with alarm at missing QL indications.</p> <p>SyncE results: SSM Rx count and rate, SSM Tx count, Indicated QL statistics, SSF seconds</p> <p>ESMC messages captured and exported in Wireshark format.</p>
IEEE 1588 v2 Functionality	<p>Each port of the Ethernet interface can act as a timing master or a timing slave independently.</p> <p>Supported modes: Multicast (native PTP), Unicast (G.8265.1).</p> <p>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.</p> <p>Configurable parameters (per port):</p> <ul style="list-style-type: none"> Clock identity, Port number, Priority 1, Priority 2, Domain number, Clock class, Slave only mode, Time source, Encapsulation, Announce receipt timeout, Clock accuracy, Clock step mode, Announce interval, Sync interval, Minimum delay request interval and Unicast duration. The UTC offset used when acting as clock master can be specified. <p>IEEE 1588 clock results: Clock state, Announce count, Sync count, Follow-up count, Delay request/response/ follow-up counters, Peer delay request/response/response-follow-up counters</p> <p>Min./Max./Avg. for: Offset, Offset deviation, Offset variance, Mean path delay, Peer mean path delay, Path delay variance, Path delay variation</p> <p>With a GPS signal, the offset from UTC time is calculated. The offset time between the two clocks is always shown.</p> <p>Parent clock results: Identity, Port number</p> <p>Grand-master clock results: Identity, Class, Accuracy, Priority 1, Priority 2, Announced- and Observed offset variance</p> <p>Foreign master clock result (up to 5 clocks per port): Identity, Port number, Announce count</p> <p>Logged IEEE 1588 events: Clock state transitions, State transition events, Faults and Changes in grand-master clock</p> <p>IEEE 1588 messages captured and exported in Wireshark format</p>

Ethernet Frame Capture	
Capture Buffer Size	1 Mbytes to 128 Mbytes (10 Mbps, 100 Mbps, 1 Gbps, 10 Gbps) 512 kbytes (40 Gbps, 100 Gbps) 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)
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 <ul style="list-style-type: none"> 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	<p>The following parameters are user selectable:</p> <ul style="list-style-type: none"> • Swap all MAC addresses or one specific MAC address • Swap IP addresses • Swap port numbers on UDP/TCP frames • Force ACK on TCP frames

Fibre Channel Testing

Fibre Channel Test	
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
Topology	Point-to-point
Primitive Sequence Protocol	Count and transmit primitive sequence: LR, LRR, NOS, OLS
Flow Control	<p>Credit based transmitter: On/Off</p> <p>Buffer-to-buffer credit configuration: 1 to 65535, Buffer-to-buffer credit and R_RDY counters, R_RDY injection</p>
Traffic Generation	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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

Device Test	
Interface Type	Off, CFP, CFP2, CXP, QSFP+
Supported Bit Rate	Off, 40 Gbps Ethernet, 100 Gbps Ethernet, STM-256/OC-78, OTU3, OTU3e1, OTU3e2, OTU4
Timing Source	Internal clock External clock
Test Pattern	PRBS 7, PRBS 9, PRBS 15, PRBS 23, PRBS 31, Square wave
Frequency Offset	±200 ppm (0.1-ppm step)
Error Insertion	<p>Item</p> <ul style="list-style-type: none"> • Bit error • Insertion timing • Single
Monitor	<p>Signal level: dBm</p> <p>Frequency: Hz, ppm</p> <p>LOS, LSS, CDR lock, Bit error</p>
No Frame Measurement	Bit error, Frequency

SDH/SONET and PDH/DSn Testing

SDH and SONET Test	
Framing	SDH: Complies with ITU-T G.707, SONET: Complies with Telcordia GR-253
Transmitter Clock	<ul style="list-style-type: none"> Internal clock accuracy: 4.6 ppm, Clock offset: ±200 ppm (0.1-ppm steps) Recovered clock TTL level external 2 MHz clock SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps)
Receive Signal Rate	±200 ppm Frequency deviation indication resolution: ±0.1 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 Mapping	See page 7
Alarm	Detected and generated alarms <ul style="list-style-type: none"> 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 STM-256: LOF-STL, OOF-STL, LOR-STL, OOR-STL 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 OC-768: LOF-STL, OOF-STL, LOR-STL, OOR-STL TCM: TC-LTC, TC-TIM, TC-UNEQ, TC-AIS, TC-RDI, TC-ODI, STL (STM-256) Inserted alarms <ul style="list-style-type: none"> Permanent Alternate: 1 to 8000 consecutive alarm frames, 1 to 8000 consecutive normal frames
Error	Detected and generated errors <ul style="list-style-type: none"> SDH: A1/A2, B1, B2, MS-REI, B3, HP-REI, V5/B3, LP-REI, Pattern error, ERR trans STM-256: A1A2-STL SONET: A1/A2, B1, B2, REI-L, B3, REI-P, V5/B3, REI-V, Pattern error, ERR trans OC-768: A1A2-STL TCM: TC-IEC, TC-BIP2, TC-REI, TC-OEI Error insertion <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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.
STL Skew	STM-256, OC-768 Insertion Bits: 0 to 138240 Detection Relative skew, Marker map
Through Mode	<ul style="list-style-type: none"> Transparent mode OH overwrite mode Can be changed SOH (SDH), TOH (SONET)

SDH and SONET Result	
Status	Current information on <ul style="list-style-type: none"> 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
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 <ul style="list-style-type: none"> APS switching time is measured. A switching time exceeding the user-defined threshold is highlighted. <ul style="list-style-type: none"> Trigger events (user selectable): <ul style="list-style-type: none"> SDH: SDH alarms and errors; APS switchover SONET: SONET alarms and errors; APS switchover Number of switchovers indicated by APS protocol K1/K2 bytes set and displayed Resolution of APS switching time measurement, SDH <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 μ s Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s
Tributary Scan	Displays the alarm status of all channels in a specified layer except STM-256/OC-768 Green: No alarm Red: Alarm occurring Gray: Not applied

E1 Test	
Test Port	Electrical line interfaces: 2 ports (MU110010A-001) Connector: BNC or RJ48 (selectable)
General	Complies with ITU-T G.703 for 2048 kbps
Impedance	Supported input impedances <ul style="list-style-type: none"> 75Ω (unbalanced), 120Ω (balanced), High (>10 \times nominal)
Line Code	HDB3 or AMI
Framing	Unframed or Framed: FAS/nFAS, Transmitter: Sa-bits (non-FAS), User-programmable
Transmitter Clock	<ul style="list-style-type: none"> Internal 2.048 Mbps clock accuracy: 4.6 ppm, Clock offset: \pm125 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	<ul style="list-style-type: none"> 2048 kbps \pm150 ppm Frequency deviation indication accuracy: \pm1 ppm
Receiver Attenuation and Impedance Mode	<u>TERMINATE</u> <ul style="list-style-type: none"> Up to 40 dB cable attenuation, Nominal impedance <u>MONITOR</u> <ul style="list-style-type: none"> 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 <u>BRIDGED</u> <ul style="list-style-type: none"> Up to 40 dB cable attenuation, High impedance
Drop and Insert	Supports drop & insert of one or multiple 64 kbps timeslots (TS) within E1
Alarm	Detected and generated alarms: No signal, AIS, No frame, Distant (RDI) alarm, Pattern sync. loss, No CAS, MFAS, Distant (RDI) MF alarms
Error	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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Unframed or Framed: n \times 64 kbps in contiguous or non-contiguous channel access Supported test patterns <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 Result	
Status	Current Information on <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> 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
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: <ul style="list-style-type: none"> 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) Resolution of APS switching time measurement: LOF and AIS: 0.25 ms
Round Trip Delay (Propagation Time) Measurement	Resolution: 1 μ s Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

DS1 Test	
Test Port	Electrical line interfaces: 2 ports (MU110010A-001) Connector: Bantam
General	Complies with ANSI T1.102 for 1544 kbps.
Impedance	100 Ω or High (10 \times nominal; Receiver only) and DSX MON 100 Ω \pm 1%
Line Code	B8ZS, AMI
Framing	Unframed or Framed, Framed: SF, ESF, J-ESF (J1)
Transmitter Clock	<ul style="list-style-type: none"> Internal 1.544 Mbps clock accuracy: 4.6 ppm, Clock offset: \pm125 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 \pm 150 ppm Frequency deviation indication resolution: \pm 1 ppm
Receiver Sensitivity	<u>DS1 Short Haul</u> <ul style="list-style-type: none"> 15 dB linear attenuation, 0 dB cable attenuation, Nominal impedance <u>TERMINATE</u> <ul style="list-style-type: none"> Up to 36 dB cable attenuation, Nominal impedance <u>DSX MONITOR</u> <ul style="list-style-type: none"> 15 to 25 dB linear attenuation, Nominal impedance <u>BRIDGE</u> <ul style="list-style-type: none"> 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
Alarm	Generated and detected: LOS, OOF, AIS (Blue), RAI (Yellow), LSS
Error	Generated or detected: Pattern, F-bit, S-bit, Pattern slips, BPV (Code), CRC-6, EXZ Error insertion <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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-define
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 <ul style="list-style-type: none"> 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 Result	
Status	Current Information on <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> 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
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) APS switching time measurement resolution: No frame, AIS: 0.25 ms
Round Trip Delay (Propagation Time) Measurement	Resolution: 1 μ s Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

E3 Test	
Test Port	Electrical line interfaces: 2 ports (MU110010A-001) Connector: BNC
General	Complies with ITU-T G.703 for 34368 kbps
Impedance	75 Ω
Line Code	HDB3
Framing	Unframed or Framed: Complies with ITU-T G.751 for E3 signals
Transmitter Clock	<ul style="list-style-type: none"> Internal clock accuracy: 4.6 ppm, Clock offset: \pm125 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 \pm 150 ppm Frequency deviation indication resolution: \pm 1 ppm
Attenuation and Impedance Mode	TERMINATE <ul style="list-style-type: none"> Up to 12 dB cable attenuation, Nominal impedance MONITOR <ul style="list-style-type: none"> 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
Alarm	Detected and generated alarms: No signal, AIS, No frame, RDI, Pattern sync. loss
Error	Detected and generated errors: Frame, Code, Pattern, Pattern slip Error insertion <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 Result	
Status	Current Information on <ul style="list-style-type: none"> 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
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 μ s Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

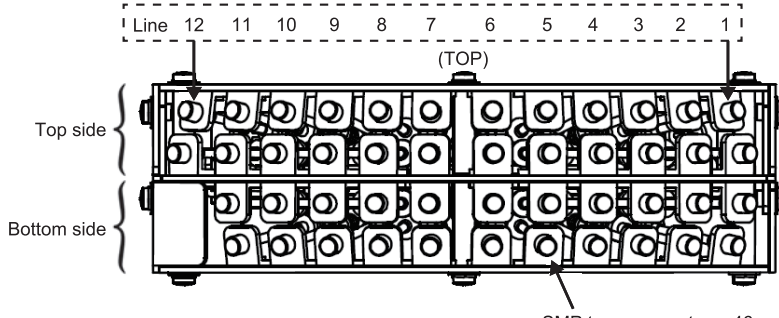
DS3 Test	
Test Port	Electrical line interfaces: 2 ports (MU110010A-001) Connector: BNC
General	Complies with ANSI for 44736 kbps
Impedance	75Ω
Line Code	B3ZS
Framing	Unframed or Framed, Framed: C-bit parity, M13 in accordance with ANSI T1.107
Transmitter Clock	<ul style="list-style-type: none"> Internal 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	<u>TERMINATE</u> <ul style="list-style-type: none"> Up to 12 dB cable attenuation, Nominal impedance <u>MONITOR</u> <ul style="list-style-type: none"> 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
Alarm	Detected and generated alarms: LOS, LOF, AIS (Blue), RAI (Yellow), DS3 idle, LSS
Error	Detected and generated errors: Pattern, C-bit, F-bit, P-bit, Code (BPV), FEBE (detect only), EXZ (detect only) Error insertion <ul style="list-style-type: none"> Manual: 1 to 255 consecutive errors Continuous: 10⁻², 10⁻³, 10⁻⁴, 10⁻⁵, 10⁻⁶, 10⁻⁷
BER Test Pattern	Pattern generation and detection, Supported test patterns <ul style="list-style-type: none"> 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 Result	
Status	Current information on <ul style="list-style-type: none"> 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
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 (MU110010A-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	<ul style="list-style-type: none"> 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	<u>TERMINATE</u> <ul style="list-style-type: none"> Up to 12 dB cable attenuation, Nominal impedance <u>MONITOR</u> <ul style="list-style-type: none"> 20 dB linear attenuation and up to 12 dB cable attenuation, Nominal impedance
Alarm	Detected and generated alarms: No signal, AIS, No frame, RDI, Pattern sync. loss
Error	Detected and generated errors: Frame, Pattern error, Pattern slips Error insertion <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 Result	
Status	Current information on <ul style="list-style-type: none"> 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
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 μ s Measured Max. time: 10.0 s Interval: 0.5, 1, 2, 5, 10 s

10 Lane Extender MZ1223C

Interface/Connector	Host side: CFP MSA Draft 1.4 Compatible Interface Network side: SMP (plug) \times 46																																																															
Insertion/Removal Cycles (Max.)	Host side: 180 (CFP connector) Network side: 480 (SMP connector)																																																															
Insertion Loss	\leq 3.5 dB @ 5.59050 GHz (1/2 \times 11.1809793568 Gbps) Including connector																																																															
Telecommunications Quality	Bit Error Rate: 1.0E-13 or less (Condition) for Evaluation: Installed in MT1100A, Loopback via 30 cm Semi-rigid cable Bit rate: 11.1809793568 Gbps \times 10 lanes Pattern: PRBS31																																																															
Connector Assignment	 <p style="text-align: center;">SMP type connector \times 46</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Line</th> <th>12</th> <th>11</th> <th>10</th> <th>9</th> <th>8</th> <th>7</th> <th>6</th> <th>5</th> <th>4</th> <th>3</th> <th>2</th> <th>1</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Top side</td> <td>RefCLK p</td> <td>Tx 9p</td> <td>Tx 7p</td> <td>Tx 5p</td> <td>Tx 3p</td> <td>Tx 1p</td> <td>Rx 10p</td> <td>Rx 8p</td> <td>Rx 6p</td> <td>Rx 4p</td> <td>Rx 2p</td> <td>Rx 0p</td> </tr> <tr> <td>RefCLK n</td> <td>Tx 9n</td> <td>Tx 7n</td> <td>Tx 5n</td> <td>Tx 3n</td> <td>Tx 1n</td> <td>Rx 10n</td> <td>Rx 8n</td> <td>Rx 6n</td> <td>Rx 4n</td> <td>Rx 2n</td> <td>Rx 0n</td> </tr> <tr> <td rowspan="2">Bottom side</td> <td></td> <td>Tx 10p</td> <td>Tx 8p</td> <td>Tx 6p</td> <td>Tx 4p</td> <td>Tx 2p</td> <td>Tx 0p</td> <td>Rx 9p</td> <td>Rx 7p</td> <td>Rx 5p</td> <td>Rx 3p</td> <td>Rx 1p</td> </tr> <tr> <td></td> <td>Tx 10n</td> <td>Tx 8n</td> <td>Tx 6n</td> <td>Tx 4n</td> <td>Tx 2n</td> <td>Tx 0n</td> <td>Rx 9n</td> <td>Rx 7n</td> <td>Rx 5n</td> <td>Rx 3n</td> <td>Rx 1n</td> </tr> </tbody> </table> <p>*: Each I/O of Tx10p, Tx10n, Rx10p, and Rx10n is not connected with MT1100A when MZ1223C is installed in MT1100A. *: Tx/Rx indicates transmission signal/reception signal. p/n indicates Positive/Negative sides for a differential interface. The logic level of the sending and receiving signal is 1.4VPMCL (Differential). *: MZ1223C and MT1100A are DC Coupled, and the capacitor for the AC coupling is not arranged in MZ1223C and MT1100A.</p>	Line	12	11	10	9	8	7	6	5	4	3	2	1	Top side	RefCLK p	Tx 9p	Tx 7p	Tx 5p	Tx 3p	Tx 1p	Rx 10p	Rx 8p	Rx 6p	Rx 4p	Rx 2p	Rx 0p	RefCLK n	Tx 9n	Tx 7n	Tx 5n	Tx 3n	Tx 1n	Rx 10n	Rx 8n	Rx 6n	Rx 4n	Rx 2n	Rx 0n	Bottom side		Tx 10p	Tx 8p	Tx 6p	Tx 4p	Tx 2p	Tx 0p	Rx 9p	Rx 7p	Rx 5p	Rx 3p	Rx 1p		Tx 10n	Tx 8n	Tx 6n	Tx 4n	Tx 2n	Tx 0n	Rx 9n	Rx 7n	Rx 5n	Rx 3n	Rx 1n
Line	12	11	10	9	8	7	6	5	4	3	2	1																																																				
Top side	RefCLK p	Tx 9p	Tx 7p	Tx 5p	Tx 3p	Tx 1p	Rx 10p	Rx 8p	Rx 6p	Rx 4p	Rx 2p	Rx 0p																																																				
	RefCLK n	Tx 9n	Tx 7n	Tx 5n	Tx 3n	Tx 1n	Rx 10n	Rx 8n	Rx 6n	Rx 4n	Rx 2n	Rx 0n																																																				
Bottom side		Tx 10p	Tx 8p	Tx 6p	Tx 4p	Tx 2p	Tx 0p	Rx 9p	Rx 7p	Rx 5p	Rx 3p	Rx 1p																																																				
		Tx 10n	Tx 8n	Tx 6n	Tx 4n	Tx 2n	Tx 0n	Rx 9n	Rx 7n	Rx 5n	Rx 3n	Rx 1n																																																				
Dimensions and Mass	160 (W) \times 59.7 (H) \times 218.4 (D) mm (excluding projections), \leq 2 kg																																																															
Environmental	Temperature range Operating: +10° to +30°C, Storage: -20° to +60°C																																																															

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.

1. Mainframe

Model/Order No.	Name
Mainframe	
MT1100A	Network Master Flex
Standard accessories for MT1100A	
Z1746A	Stylus
Z1870A	Utilities ROM
W3734AE	MT1100A Quick Reference Guide (English)
W3734AW	MT1100A Quick Reference Guide (Japanese)
Z1861A	Carrying Strap
Z1862A	Module Combination Kit
B0699A	Soft Case

2. Power Supply Module

Model/Order No.	Name
MU110001A*1	Battery and AC Power Supply Module
MU110002A*1	AC only High Power Supply Module
Standard accessories for MU110001A	
G0327A*2	Li-ion Battery

*1: Select MU110001A or MU110002A.
When installing two test modules in an MT1100A mainframe, one module must be an MU110010A to select MU110001A, battery powered power module.

*2: MU110001A requires two G0327A.

3. Test Module*3

Model/Order No.	Name
MU110010A	10G Multirate Module
MU110011A	100G Multirate Module
MU110012A	40/100G Module CFP2

*3: One or two modules of MU110010A/11A/12A can be installed in one mainframe.

4. Basic Options

Model/Order No.	Name
MU110010A-001	Up to 2.7G Dual Channel
MU110010A-002	FC 1G 2G 4G Dual Channel
MU110011/12A-003*4	Up to 10G Dual Channel
MU110011/12A-004*4	Up to 10G FC Dual Channel

5. Protocol Options*5

Model/Order No.	Name
Ethernet	
MU110010A-011	Ethernet 10G Single Channel
MU110010A-012	Ethernet 10G Dual Channel
MU110011A/12A-013	Ethernet 40G Single Channel
MU110011A/12A-014	Ethernet 40G Dual Channel
MU110011A/12A-015	Ethernet 100G Single Channel
MU110012A-016	Ethernet 100G Dual Channel
OTN	
MU110010A-051	OTN 10G Single Channel
MU110010A-052	OTN 10G Dual Channel
MU110011A/12A-053	OTN 40G Single Channel
MU110011A/12A-054	OTN 40G Dual Channel
MU110011A/12A-055	OTN 100G Single Channel
MU110012A-056	OTN 100G Dual Channel
MU110010A/11A/12A-061	ODU Multiplexing
MU110010A/11A/12A-062	ODU Flex
SDH/SONET	
MU110010A-081	STM-64 OC-192 Single Channel
MU110010A-082	STM-64 OC-192 Dual Channel
MU110011A/12A-083*4	STM-256 OC-768 Single Channel
MU110011A/12A-084*4	STM-256 OC-768 Dual Channel
Fibre Channel	
MU110010A-091	FC 8G 10G Single Channel
MU110010A-092	FC 8G 10G Dual Channel
Other options	
MT1100A-003	Connectivity for WLAN/Bluetooth

*4: MU110012A does not have a physical interface of this option.
This option is required for the client signal mapped in the OTN.
Please refer to the OTN mapping pages on the datasheet.

*5: "channel" means physical port or client signal test mapped in OTN.
Refer to page 5, 6 for OTN and client signals.

6. Optional Accessories

Model/Order No.	Name
G0311A	1G 850 nm SX SFP
G0312A	1G 1310 nm LX SFP
G0313A	1G 1550 nm ZX SFP
G0332A	100M FX 1310 nm MM SFP
G0333A	10G SR/SW 850 nm 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
G0334A	40G LR4 1310 nm QSFP+
G0335A	40G LR4 1310 nm CFP
G0336A	40G FR 1550 nm CFP
G0337A	100G LR4 1310 nm CFP
G0338A	100G LR4 1310 nm CFP2
G0339A	100G 850 nm CXP
B0697A	Hard Case
Z1860A	Battery Charger
J1570A	Head Set
G0325A	GPS Receiver
Z1871A	Utilities in USB Stick
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	RJ48 to Crocodile Clips Cable 3 m
J1586A	RJ48 to Crocodile Clips Cable 20 dB ATT 3 m
J1588A	BNC Cable 2.5 m
J1589A	BNC to 1.6/5.6 Cable 2.5 m
J1591A	RJ48 to Two 3-pin Banana Plug Cable 2.5 m
J1597A	RJ48 Balanced PDH Cable Crossed 3 m
J1598A	Bantam Cable 3 m
J0775D	Coaxial Cord, 2.0 m (75Ω)
B0692A	ESD Box*6
MZ1223C	10 Lane Extender*7, *8
J1502A	SMP-SMA Cable, 40 cm*9
J1503A	SMP-SMP Cable, 40 cm*9
J1540A	SMP-GPPO Cable, 40 cm*9
W3735AE	MT1100A Operation Manual (English)
W3735AW	MT1100A Operation Manual (Japanese)
W3736AE	MT1000A/MT1100A Remote Scripting Operation Manual (English)
W3736AW	MT1000A/MT1100A Remote Scripting Operation Manual (Japanese)
Z1578A	MZ1223C Operation Manual (CD-ROM)

*6: Up to four SFP+/SFPs can be stored.

*7: Supplied with Z1578A

*8: Use J1502A, J1503A or J1540A when connecting to the DUT. If the cables other than J1502A, J1503A or J1540A are used, the required performance may not be obtained.

*9: Application parts for MZ1223C. Cables sold as single units.

J1502A: SMP (Jack) - SMA (Plug)

J1503A: SMP (Jack) - SMP (Jack)

J1540A: SMP (Jack) - GPPO (Jack)

7. Extended Warranties

Model/Order No.	Name
MT1100A-ES210	2 Years Extended Warranty Service
MT1100A-ES310	3 Years Extended Warranty Service
MT1100A-ES510	5 Years Extended Warranty Service
MU110001A-ES210	2 Years Extended Warranty Service
MU110001A-ES310	3 Years Extended Warranty Service
MU110001A-ES510	5 Years Extended Warranty Service
MU110002A-ES210	2 Years Extended Warranty Service
MU110002A-ES310	3 Years Extended Warranty Service
MU110002A-ES510	5 Years Extended Warranty Service
MU110010A-ES210	2 Years Extended Warranty Service
MU110010A-ES310	3 Years Extended Warranty Service
MU110010A-ES510	5 Years Extended Warranty Service
MU110011A-ES210	2 Years Extended Warranty Service
MU110011A-ES310	3 Years Extended Warranty Service
MU110011A-ES510	5 Years Extended Warranty Service
MU110012A-ES210	2 Years Extended Warranty Service
MU110012A-ES310	3 Years Extended Warranty Service
MU110012A-ES510	5 Years Extended Warranty Service

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