

Ethernet Module Operation Manual

26th Edition

- This is an operation manual of MU120101A/02A/11A/12A/18A/18B/18C/21A/22A/31A/32A/38A.
- For safety and warning information, please read this manual before attempting to use the equipment.
- Additional safety and warning information is provided in the MD1230A Data Quality Analyzer Operation Manual, MD1230B Data Quality Analyzer Operation Manual, MD1231A/A1 IP Network Analyzer Operation Manual, MP1590B Network Performance Tester Operation Manual, MP1591A Network Performance Tester Operation Manual, and the MT7407A Multislot chassis Operation Manual. Please also refer to one of these documents before using the equipment.
- Keep this manual with the equipment.

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Symbols used in manual



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This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.



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This indicates a hazardous procedure that could result in serious injury or death if not performed properly.



CAUTION

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This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.



This indicates a note. The contents are described in the box.



These indicate that the marked part should be recycled.

Ethernet Module
Operation Manual

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- In places where abnormal power voltages (high or low) or instantaneous power failures occur
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RCM marking



1. Product Model

Plug-in Modules: MU120101A/11A 10M/100M Ethernet Module,
MU120121A/31A 10/100/1000M Ethernet Module,
MU120102A/12A/22A/32A
Giga-bit Ethernet Module,
MU120118A/18B/18C 10 Giga-bit Ethernet Module

2. Applied Directive and Standards

When the above modules and accessories are installed in the main frames shown below, the applied directive and standards of these modules and accessories conform to those of the main frame.

Main frame: MD1230A/B Data Quality Analyzer,
MD1231A/A1 IP Network Analyzer,
MT7407A Multislot Chassis,
MP1590B Network Performance Tester
MP1591A Network Performance Tester

PS: About main frame

Please contact Anritsu for the latest information on the main frame types that the above modules and accessories can be used with.

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About This Manual

This operation manual is for MD1230 and MP1590 families.

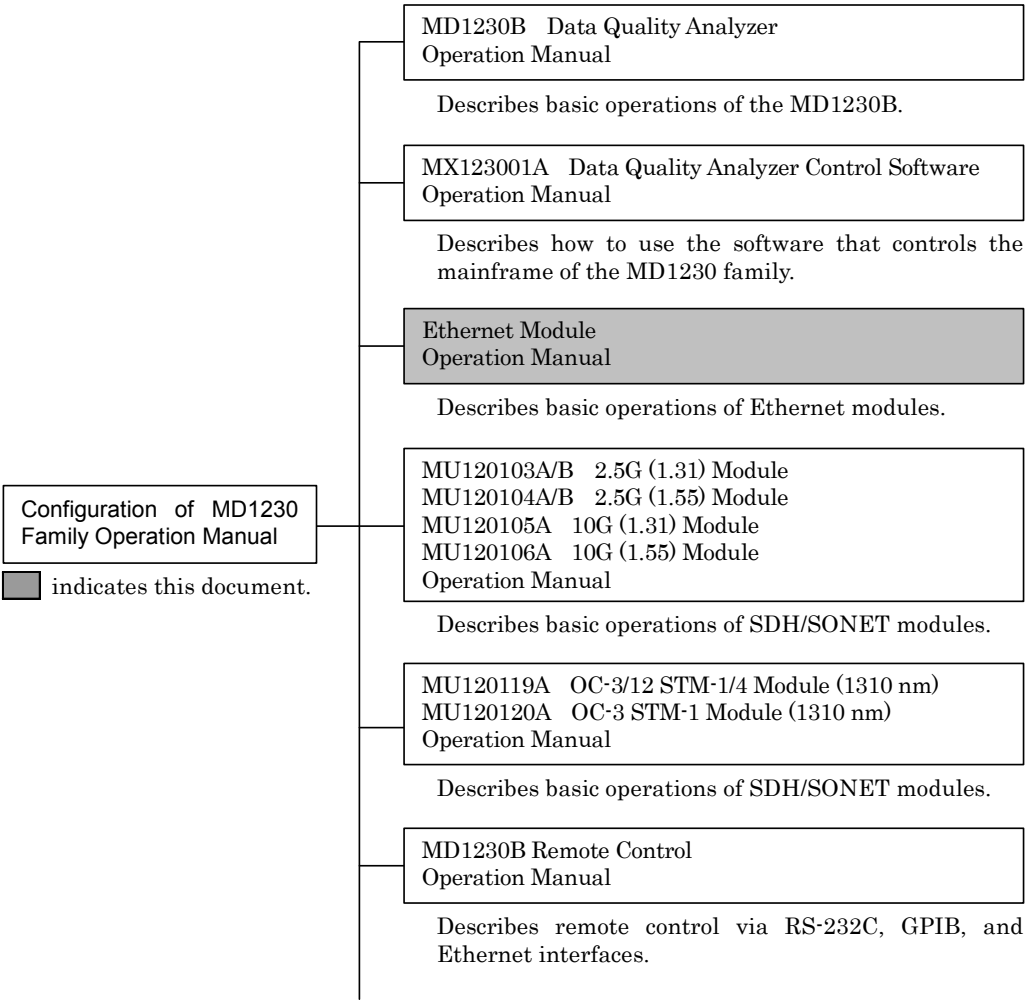
Note:

MD1230 family is a general name for the MD1230A/B Data Quality Analyzer, the MD1231A/A1 IP Network Analyzer, and the MT7407A Multislot Chassis.

The MP1590 family is a general name for the MP1590B Network Performance Tester and the MP1591A Network Performance Tester.

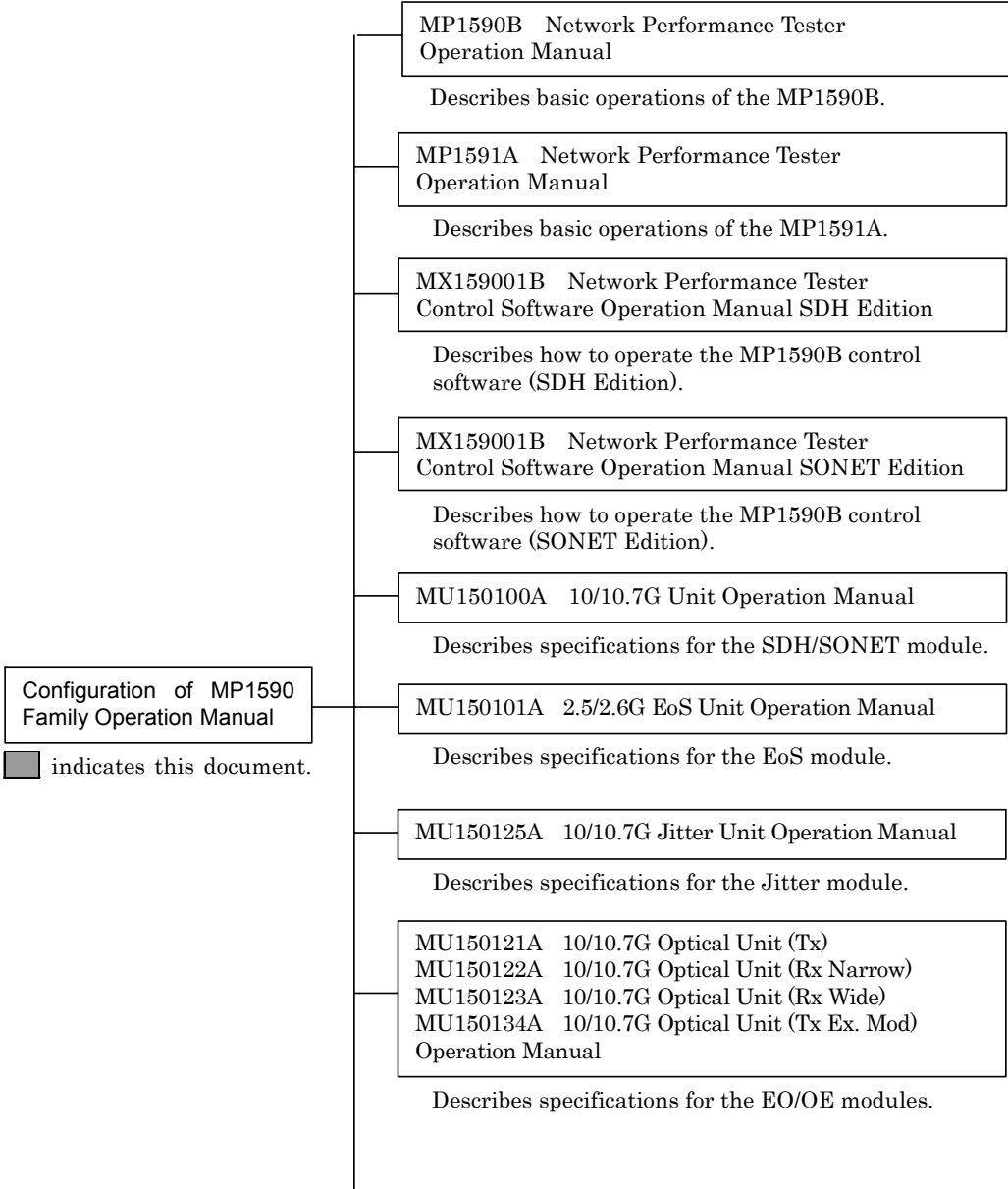
Note that the MD1230A, MD1231A/A1, and MT7407A are not supported in Ver. 7.0 and above.

The MD1230 family operation manuals consist of separate documents for the main unit, control software, module(s), remote control operation, and options, as shown below.



	<div>Decode Module Operation Manual</div> <div>Describes basic operations of Decode modules.</div>
	<div>Tcl Interface Operation Manual</div> <div>Describes basic operations of Tcl Interface.</div>
	<div>Expert Analysis Module Operation Manual</div> <div>Describes basic operations of Expert Analysis modules.</div>
	<div>Application Traffic Monitor Operation Manual</div> <div>Describes how to operate the software for monitoring Ethernet traffic.</div>
	<div>MD1230B-26 PPPoE Operation Manual</div> <div>Describes how to operate the software for measuring traffic on PPPoE.</div>

The MP1590 family operation manuals consist of separate documents for the mainframe, module(s), control software, remote control operation, and options, as shown below.



	<p>MU150121B 10/10.7G Optical/Electrical Unit (Tx)</p> <p>MU150123B 10/10.7G Optical/Electrical Unit (Rx Wide)</p> <p>Operation Manual</p>
	<p>Describes specifications for the MU150121B/23B.</p>
	<p>MU150124B 10.3G Optical/Electrical Unit (Rx Wide)</p> <p>Operation Manual</p>
	<p>Describes specifications for the MU150124B.</p>
	<p>Ethernet Module</p> <p>Operation Manual</p>
	<p>Describes basic operations of Ethernet modules.</p>
	<p>MU120103A/B 2.5G (1.31) Module</p> <p>MU120104A/B 2.5G (1.55) Module</p> <p>MU120105A 10G (1.31) Module</p> <p>MU120106A 10G (1.55) Module</p> <p>Operation Manual</p>
	<p>Describes basic operations of SDH/SONET modules.</p>
	<p>MU120119A OC-3/12 STM-1/4 Module (1310 nm)</p> <p>MU120120A OC-3 STM-1 Module (1310 nm)</p> <p>Operation Manual</p>
	<p>Describes basic operations of SDH/SONET modules.</p>
	<p>MP1590B/MP1591A Network Performance Tester</p> <p>Remote Control Operation Manual</p>
	<p>Describes remote control via RS-232C, GPIB, and Ethernet Interfaces.</p>
	<p>MP1590A/B-30 High Precision Jitter Analysis</p> <p>Operation Manual</p>
	<p>Describes specifications for the MP1590A/B-30.</p>
	<p>Application Traffic Monitor</p> <p>Operation Manual</p>
	<p>Describes how to operate the software for monitoring Ethernet traffic.</p>

This manual uses the following notations.

(1) Notation on equipment name

This manual uses the following abbreviations on equipment name.

Full Name	Abbreviated Name
MD1230B Data Quality Analyzer	MD1230B
MU120101A/11A 10M/100M Ethernet Module MU120121A 10/100/1000M Ethernet Module MU120102A/12A/22A Giga-bit Ethernet Module MU120118A/18B/18C 10 Giga-bit Ethernet Module	Ethernet Module
MU120101A/11A 10M/100M Ethernet Module	10M/100M Ethernet Module
MU120121A/31A 10/100/1000M Ethernet Module	10/100/1000M Ethernet Module
MU120102A/12A/22A/32A Giga-bit Ethernet Module	Giga-bit Ethernet Module
MU120118A/18B/18C/38A 10 Giga-bit Ethernet Module	10 Giga-bit Ethernet Module

Note:

This manual gives an explanation using an example of the MD1230B.

Note that the MD1230A, MD1231A/A1, and MT7407A are not supported in Ver. 7.0 and above.

MU120102A/12A/22A/32A Giga-Bit Ethernet Module is also referred to as “GbE module” in the control software operation manual.

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Section 1 Overview

This section offers an overview of functions for the Ethernet Modules.

-  For specifications and performance, refer to Appendix A “Specifications.”
-  For options and related products, refer to Appendix B “Application Parts.”

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1.1 Product Overview

When using the MD1230B with Ethernet module installed, Ethernet switches and routers can be tested and traffic flows between switches can be captured and monitored.

1.1.1 MU120101A 10M/100M Ethernet Module

The MU120101A 10M/100M Ethernet Module conforms to Ethernet standards. This module is capable of conducting performance tests on 10 Mbit/s Ethernet or 100 Mbit/s Ethernet switches or routers and capturing or monitoring data flowing between switches based on the full-wire rate stream transmission function in order to analyze network faults.

- (1) Applicable interface
Applicable are 10BASE-T and 100BASE-TX interfaces.
- (2) Number of ports
The 10M/100M Ethernet Module is equipped with an 8-port interface per module. Test items can be independently set to each port.
- (3) Stream generation function and data analysis function
 - (a) Up to 256 types of streams can be generated via full-wire rate so that increment or random can be selected for the frame length of each stream.
 - (b) An arbitrary inter-frame gap can be selected between streams. Also, inter-frame gap can be generated at random.
 - (c) Streams can be generated to conduct tests such as throughput, latency, frame loss rate, back-to-back, system recovery and reset tests, necessary for performance evaluation of network devices stipulated in RFC1242 and RFC2544. Such tests are carried out automatically.
 - (d) Counting of frames is possible, including: number of transmitted or received frames, number of transmitted or received bytes, line errors, FCS errors, under size, over size, Alignment errors, Dribble bit errors, IP checksum errors, TCP/UDP checksum errors, number of QoS packets per each of eight levels of priority.
 - (e) Various filter/trigger conditions (such as MAC address and 32-bit user-defined patterns as well as error occurrence) can be used to capture data flowing between devices in order to analyze the transferred protocols.

- (f) Frame arrival interval can be monitored to check fluctuation of a network (Frame Arrival Time measurement).
 - (g) Traffic flows between devices can be monitored. Using this function supports counting and monitoring of Ethernet traffic by MAC address pair, IP data by IP address pair, and traffic by protocol type.
- (4) Protocol support function
Protocol emulation of ARP, ICMP, IGMP and BGP-4 is possible.

1.1.2 MU120102A Gigabit Ethernet Module

The MU120102A Giga-bit Ethernet Module conforms to Giga-bit Ethernet standards. This module is capable of conducting performance tests on the Giga-bit Ethernet switch or router and capturing or monitoring data flowing between switches based on the full-wire rate stream transmission function in order to analyze network faults.

- (1) Applicable interfaces
Applicable interfaces are those conforming to 1000BASE-SX or 1000BASE-LX standards. In order to extend transmission distance, interfaces conforming to 1000BASE-LH or 1000BASE-ZX standards using long wavelengths are also applicable. These optical interfaces use the GBIC (Sold separately) that allows the user to readily replace optical interfaces (GBIC is an application part).
- (2) Number of ports
The Gigabit Ethernet Module is equipped with a 2-port interface per module. Test items can be independently set to each port.
- (3) Stream generation function and data analysis function
- (a) Up to 256 types of streams can be generated via full-wire rate so that increment or random can be selected for frame length per stream.
 - (b) An arbitrary inter-frame gap can be selected between streams. In addition, a random inter-frame gap can be generated.
 - (c) Streams can be generated to conduct tests such as throughput, latency, frame loss rate, back-to-back, system recovery and reset tests necessary for performance evaluation of network devices stipulated in RFC1242 and RFC2544. Such tests are carried out automatically.
 - (d) Counting of frames is possible, including: number of transmitted or received frames, number of transmitted or received bytes, line errors, FCS errors, under size, over size, IP checksum errors, TCP/UDP checksum errors, and number of QoS packets per each of eight levels of priority.

- (e) Various filter/trigger conditions such as MAC address and 32-bit user-defined patterns as well as error occurrence can be used to capture data flowing between devices in order to analyze transferred protocols.
 - (f) Frame arrival interval can be monitored to check fluctuation of a network (Frame Arrival Time measurement).
 - (g) Traffic flowing between devices can be monitored. Using this function supports counting and monitoring of Ethernet traffic by MAC address pair, IP data by IP address pair, and traffic by protocol type.
 - (h) The unframed BER can be measured with the PRBS23, PRBS31, CRPAT, CJPAT, etc. The packet BER can be measured with MD1230B-11.
- (4) Protocol support function
- Protocol emulation of ARP, ICMP, IGMP and BGP-4 are possible.

1.1.3 MU120111A 10/100M Ethernet Module

The MU120111A 10/100M Ethernet Module conforms to Ethernet standards. This module is capable of conducting performance tests on 10 Mbit/s Ethernet or 100 Mbit/s Ethernet switches or routers and capturing or monitoring data flowing between switches based on the full-wire rate stream transmission function in order to analyze network faults.

- (1) Applicable interface
- Applicable 10BASE-T and 100BASE-TX interfaces.
- (2) Number of ports
- The MU120111A 10/100M Ethernet Module is equipped with an 8-port interface per module. Test items can be independently set to each port.
- (3) Stream generation function and data analysis function
 - (a) Up to 256 types of streams can be generated via full-wire rate so that increment or random can be selected for the frame length of each stream.
 - (b) An arbitrary inter-frame gap can be selected between streams. In addition, a random inter-frame gap can be generated.
 - (c) Streams can be generated to conduct tests such as throughput, latency, frame loss rate, back-to-back, system recovery and reset tests, necessary for performance evaluation of network devices stipulated in RFC1242 and RFC2544. Such tests are carried out automatically.

- (d) Counting of frames is possible, including: number of transmitted or received frames, number of transmitted or received bytes, line errors, FCS errors, under size, over size, Alignment errors, Dribble bit errors, IP checksum errors, TCP/UDP checksum errors, number of QoS packets per each of eight levels of priority.
- (e) Various filter/trigger conditions (such as MAC address and 128-bit user-defined patterns as well as error occurrence) can be used to capture data flowing between devices in order to analyze the transferred protocols.
- (f) Frame arrival interval can be monitored to check fluctuation of a network (Frame Arrival Time measurement).
- (g) Traffic flowing between devices can be monitored.

Using this function supports counting and monitoring of Ethernet traffic by MAC address pair, IP data by IP address pair, and traffic by protocol type.

- (h) The unframed BER can be measured with the PRBS23, PRBS31, USER16, etc. The packet BER can be measured with MD1230B-11.

(4) Protocol support function

Protocol emulation of ARP, ICMP, IGMP, BGP-4, OSPF*¹, MPLS (LDP/CR-LDP)*², MPLS (RSVP)*³, OSPFv3*⁴, BGP4+*⁵, PIM-SMv2*⁶ and MLDA*⁷ are possible.

*1: Available only when the MD1230B-07 OSPF Protocol is installed.

*2: Available only when the MD1230B-08 MPLS (LDP/CR-LDP) Protocol is installed.

*3: Available only when the MD1230B-09 MPLS (RSVP) Protocol is installed.

*4: Available only when MD1230B-18 OSPFv3 Protocol is installed.

*5: Available only when MD1230B-19 BGP4+ Protocol is installed.

*6: Available only when MD1230B-21 PIM-SMv2 Protocol is installed.

*7: Available only when MD1230B-22 MLDA Protocol is installed.

1.1.4 MU120112A Gigabit Ethernet Module

The MU120112A Giga-bit Ethernet Module conforms to Giga-bit Ethernet standards. This module is capable of conducting performance tests on the Giga-bit Ethernet switch or router and capturing or monitoring data flowing between switches based on the full-wire rate stream transmission function in order to analyze network faults.

(1) Applicable interfaces

Applicable are those conforming to 1000BASE-SX, 1000BASE-LX, 1000BASE-LH or 1000BASE-ZX standard using optical fiber, as well as 1000BASE-T standard using category 5e cable. These optical interfaces use the GBIC that allows the user to readily replace optical interfaces (GBIC is an application part.).

(2) Number of ports

The MU120112A Gigabit Ethernet Module is equipped with a 2-port interface per module. Test items can be independently set to each port.

(3) Stream generation function and data analysis function

(a) Up to 256 types of streams can be generated via full-wire rate so that increment or random can be selected for frame length per stream

(b) An arbitrary inter-frame gap can be selected between streams. In addition, a random inter-frame gap can be generated.

(c) Streams can be generated to conduct tests such as throughput, latency, frame loss rate, back-to-back, system recovery and reset tests necessary for performance evaluation of network devices stipulated in RFC1242 and RFC2544. Such tests are carried out automatically.

(d) Counting of frames is possible, including: number of transmitted or received frames, number of transmitted or received bytes, line errors, FCS errors, under size, over size, IP checksum errors, TCP/UDP checksum errors, and number of QoS packets per each of eight levels of priority.

(e) Various filter/trigger conditions such as MAC address and 128-bit user-defined patterns as well as error occurrence can be used to capture data flowing between devices in order to analyze transferred protocols.

(f) Frame arrival interval can be monitored to check fluctuation of a network (Frame Arrival Time measurement).

(g) Traffic flowing between devices can be monitored.

Using this function supports counting and monitoring of Ethernet traffic by MAC address pair, IP data by IP address pair, and traffic by protocol type.

(h) The unframed BER can be measured with the PRBS23, PRBS31, CRPAT, CJPAT, etc. The packet BER can be measured with MD1230B-11.

(4) Protocol support function

Protocol emulation of ARP, ICMP, IGMP, BGP-4, OSPF^{*1}, MPLS (LDP/CR-LDP)^{*2}, MPLS (RSVP)^{*3}, OSPFv3^{*4}, BGP4+^{*5}, PIM-SMv2^{*6} and MLDA^{*7} are possible.

*1: Available only when the MD1230B-07 OSPF Protocol is installed.

*2: Available only when the MD1230B-08 MPLS (LDP/CR-LDP) Protocol is installed.

*3: Available only when the MD1230B-09 MPLS (RSVP) Protocol is installed.

*4: Available only when MD1230B-18 OSPFv3 Protocol is installed.

*5: Available only when MD1230B-19 BGP4+ Protocol is installed.

*6: Available only when MD1230B-21 PIM-SMv2 Protocol is installed.

*7: Available only when MD1230B-22 MLDA Protocol is installed.

1.1.5 MU120118A/18B/18C 10 Gigabit Ethernet Module

The MU120118A/18B/18C 10 Giga-bit Ethernet Module supports 10 Giga-bit Ethernet specifications. It can perform network failure analysis by capturing and monitoring 10 Giga-bit Ethernet switches where wireless streaming transmission functions are used, router performance tests as well as data running between switches.

(1) Corresponding interface

This module employs the XENPAK interface, enabling simple interface replacement (XENPAK is the applied product).

(2) Number of Ports

The MU120118A/B module is equipped with 2 interface ports per module. The MU120118C module is equipped with 1 interface ports per module. Each port is stand-alone enabling test item to be set.

(3) Stream generation and data analysis functions

(a) Up to 256 types of streams can be generated at full wire rate, with frame lengths increment/ random selection available for each stream.

(b) Any inter-frame gaps can be selected for stream intervals.

In addition, a random inter-frame gap can be generated.

(c) Streams for throughput, latency, frame loss rate, back-to-back, system recovery and reset tests, critical for performance tests on network devices specified in RFC1242 and RFC2544 can be generated (automatic test)

(d) Frame counts are available for transmitted or received frames, transmitted or received bytes, FCS errors, undersize, oversize, IP checksum errors, TCP/UDP checksum errors, QoS packets at each of 8 priority levels.

(e) Data running between equipment can be captured and running protocol can be analyzed by using rich filters such as MAC address, 128-bit user-defined patterns or errors, and trigger conditions.

(f) Frame arrival intervals are monitored, enabling network fluctuations to be checked (Frame Arrival Time measurement).

(g) Traffic running between equipment can be monitored.

Using this function supports counting and monitoring of Ethernet traffic by MAC address pair, IP data by IP address pair, and traffic by protocol type.

(h) Unframe BER can be measured with PRBS23, PRBS31, CRPAT, CJPAT, etc. (by using the MD1230B-13 XENPAK Test) while the packet BER can be measured with MD1230B-11.

(4) Protocol support function

The ARP, ICMP, IGMP, BGP-4, OSPF^{*1}, MPLS (LDP/CR-LDP)^{*2} and MPLS (RSVP)^{*3}, OSPFv3^{*4}, BGP4+^{*5}, PIM-SMv2^{*6} and MLDA^{*7} protocols can be emulated.

*1: Available only when the MD1230B-07 OSPF Protocol is installed.

*2: Available only when the MD1230B-08 MPLS (LDP/CR-LDP) Protocol is installed.

*3: Available only when the MD1230B-09 MPLS (RSVP) Protocol is installed.

*4: Available only when MD1230B-18 OSPFv3 Protocol is installed.

*5: Available only when MD1230B-19 BGP4+ Protocol is installed.

*6: Available only when MD1230B-21 PIM-SMv2 Protocol is installed.

*7: Available only when MD1230B-22 MLDA Protocol is installed.

1.1.6 MU120121A 10/100/1000M Ethernet Module

The MU120121A 10/100/1000M Ethernet Module conforms to the 10M/100M/1000M Ethernet standards. This module is capable of conducting performance tests on 10/100/1000 Mbits/s Ethernet switches or routers and capturing or monitoring data flowing between switches based on the full-wire rate stream transmission function in order to analyze network faults.

(1) Applicable interface

Applicable interfaces are the RJ-45 interfaces supporting the 10BASE-T, 100BASE-TX, and 1000BASE-T standards.

(2) Number of ports

The MU120121A 10/100/1000M Ethernet Module is equipped with four RJ-45 interface ports supporting 10BASE-T/100BASE-TX/1000BASE-T per module. Test items can be independently set to each port.

- (3) Stream generation function and data analysis function
 - (a) To maintain backwards compatibility with the MU120111A, the MU120121A has the stream generation and data analysis functions of the MU120111A or better.
 - (b) Receive frames can be counted for each value of fields specified by the user (multiflow counter). As an example, this function enables counting of UDP packets received by this module for each destination UDP port number.
 - (c) The MU120121A module supports multiple VLAN tags up to 10 levels. This function enables full-wire rate transmission and counting of frames with multiple VLAN tags, and analysis and display of captured packets. Since the multi-flow counter function described in (b) above supports multiple VLAN tags, received frames can be counted according to the VLAN ID of the VLAN tag at the specified level.
 - (d) Transmission clocks can be adjusted within a range of ± 100 ppm, enabling evaluation of the margin for the transmission clock of DUT.
- (4) Protocol support function

Protocol emulation of ARP, ICMP, IGMP, IGAP, BGP-4, MLD, OSPFv2^{*1}, MPLS (LDP/CR-LDP)^{*2}, MPLS (RSVP)^{*3}, OSPFv3^{*4}, BGP4+^{*5}, PIM-SMv2^{*6}, and MLDA^{*7} are possible.

 - *1: Available only when the MD1230B-07 OSPF Protocol is installed.
 - *2: Available only when the MD1230B-08 MPLS (LDP/CR-LDP) Protocol is installed.
 - *3: Available only when the MD1230B-09 MPLS (RSVP) Protocol is installed.
 - *4: Available only when the MD1230B-18 OSPFv3 Protocol is installed.
 - *5: Available only when the MD1230B-19 BGP4+ Protocol is installed.
 - *6: Available only when the MD1230B-21 PIM-SMv2 Protocol is installed.
 - *7: Available only when the MD1230B-22 MLDA Protocol is installed.

1.1.7 MU120122A Gigabit Ethernet Module

The MU120122A Gigabit Ethernet Module conforms to the 10/100/1000M Ethernet standards. This module is capable of conducting performance tests on 10/100/1000 Mbps/s Ethernet switches or routers and capturing or monitoring data flowing between switches based on the full-wire rate stream transmission function in order to analyze network faults.

(1) Applicable interfaces

Applicable interfaces are those conforming to the 1000BASE-SX/LX/LE/LR standards using a fiber-optic cable, as well as the RJ-45 interfaces supporting the 10BASE-T, 100BASE-TX, and 1000BASE-T standards. These optical interfaces use SFP, which allows the user to readily replace optical interfaces (SFP is an application part).

(2) Number of ports

The MU120122A Gigabit Ethernet Module is equipped with four interface ports per module: two RJ-45 interface ports of 10BASE-T/100BASE-TX/1000BASE-T and two SFP interface ports supporting 1000BASE-SX/LX/LE/LR. Test items can be independently set to each port.

(3) Stream generation function and data analysis function

- (a) To maintain backwards compatibility with the MU120111A/12A, the MU120122A has the stream generation and data analysis functions of the MU120111/12A or better.
- (b) Receive frames can be counted for each value of fields specified by the user (multiflow counter). Receive frames can be counted for each value of fields specified by the user (multiflow counter). As an example, this function enables counting of UDP packets received by this module for each destination UDP port number.
- (c) The MU120122A module supports multiple VLAN tags up to 10 levels. This function enables full-wire rate transmission and counting of frames with multiple VLAN tags, and analysis and display of captured packets. Since the multi-flow counter function described in (b) above supports multiple VLAN tags, received frames can be counted according to the VLAN ID of the VLAN tag at the specified level.
- (d) Transmission clocks can be adjusted within a range of ± 100 ppm, enabling evaluation of the margin for the transmission clock of DUT.

(4) Protocol support function

Protocol emulation of ARP, ICMP, IGMP, IGAP, BGP-4, MLD, OSPFv2^{*1}, MPLS (LDP/CR-LDP)^{*2}, MPLS (RSVP)^{*3}, OSPFv3^{*4}, BGP4+^{*5}, PIM-SMv2^{*6}, and MLDA^{*7} are possible.

*1: Available only when the MD1230B-07 OSPF Protocol is installed.

*2: Available only when the MD1230B-08 MPLS (LDP/CR-LDP) Protocol is installed.

*3: Available only when the MD1230B-09 MPLS (RSVP) Protocol is installed.

*4: Available only when the MD1230B-18 OSPFv3 Protocol is installed.

*5: Available only when the MD1230B-19 BGP4+ Protocol is installed.

*6: Available only when the MD1230B-21 PIM-SMv2 Protocol is installed.

*7: Available only when the MD1230B-22 MLDA Protocol is installed.

1.1.8 MU120131A 10/100/1000M Ethernet Module

The MU120131A 10/100/1000M Ethernet Module, which conforms to 10M/100M/1000M Ethernet standards, supports analysis of network failures via capturing and monitoring of data transferred between the switches, and can test performances of 10M/100M/1000 Mbit/s Ethernet switches and routers by using the full-wire rate stream transmission function.

(1) Applicable interfaces

RJ-45 interfaces supporting the 10BASE-T, 100BASE-TX, and 1000BASE-T standards can be used.

(2) Number of ports

The MU120131A 10/100/1000M Ethernet Module is equipped with twelve RJ-45 interface ports per module supporting 10BASE-T/100BASE-TX/1000BASE-T. Test items can be independently set to each port.

(3) Stream generation function and data analysis function

(a) To maintain backwards compatibility with the MU120111A, the MU120131A has the stream generation and data analysis functions of the MU120111A or better.

(b) Receive frames can be counted for each value of fields specified by the user (multiflow counter). Receive frames can be counted for each value of fields specified by the user (multiflow counter). As an example, this function enables counting of UDP packets received by this module for each destination UDP port number.

(c) The MU120131A module supports up to 10 levels of multiple VLAN tags. This function enables full-wire rate transmission and counting of frames with multiple VLAN tags, and analysis and display of captured packets. Since the multi-flow counter function described in (b) above supports multiple VLAN tags, received frames can be counted according to the VLAN ID of the VLAN tag at the specified level.

(d) Transmission clocks can be adjusted within a range of ± 100 ppm, enabling evaluation of the margins for the DUT transmission clock.*1

*1: Available only when MU120131A-01 Clock Measurement is installed.

(4) Protocol support function

Protocol emulation of ARP, ICMP, IGMPv2, and IGMPv3 are possible.

(5) PoE function*²

The MU120131A module can serve as a PoE receiver, and can be specified from class 0 to 4, and is capable of evaluating supplied voltages at 3 levels: Off/Under/Normal.

*²: Available only when MU120131A-02 PoE installed.

1.1.9 MU120132A Gigabit Ethernet Module

The MU120132A Gigabit Ethernet Module, which conforms to 1000M Ethernet standards, supports analysis of network failures via capturing and monitoring of data transferred between the switches, and can test performances of 1000 Mbit/s Ethernet switches and routers by using the full-wire rate stream transmission function.

(1) Applicable interfaces

Supports 1000BASE-SX/LX/LE/LR interfaces using fiber-optic cables. These interfaces use SFP, which allows the user to easily exchange interfaces (SFP is an application part).

(2) Number of ports

The MU120132A Gigabit Ethernet Module is equipped with eight SFP interface ports supporting 1000BASE-SX/LX/LE/LR. Test items can be independently set to each port.

(3) Stream generation function and data analysis function

(a) To maintain backwards compatibility with the MU120112A, the MU120132A has the stream generation and data analysis functions of the MU120112A or better.

(b) Receive frames can be counted for each value of fields specified by the user (multiflow counter). As an example, this function enables counting of UDP packets received by this module for each destination UDP port number.

(c) The MU120132A module supports up to 10 levels of multiple VLAN tags. This function enables full-wire rate transmission and counting of frames with multiple VLAN tags, and analysis and display of captured packets. Since the multi-flow counter function described in (b) above supports multiple VLAN tags, received frames can be counted according to the VLAN ID of the VLAN tag at the specified level.

(d) Transmission clocks can be adjusted within a range of ± 100 ppm, enabling evaluation of the margin for the DUT transmission clock.*1

*1: Available only when MU120132A-01 Clock Measurement is installed.

(e) The MU120132A module supports E-PON, and thus can decode the Preamble section. Recalculates CRC within the Preamble, and can display error existence/absence.

(4) Protocol support function

Protocol emulation of ARP, ICMP, IGMPv2, and IGMPv3 are possible.

1.1.10 MU120138A 10 Gigabit Ethernet Module

The MU120138A 10 Gigabit Ethernet Module, which conforms to 10G Ethernet standards, supports analysis of network failures via capturing and monitoring of data transferred between the switches, and can test performances of 10Gbit/s Ethernet switches and routers by using the full-wire rate stream transmission function.

(1) Applicable interfaces

Supports 10GBASE-SR/LR/ER interfaces using fiber-optic cables. These interfaces use SFP+, which allows the user to easily exchange interfaces (SFP+ is an application part).

(2) Number of ports

The MU120138A 10 Gigabit Ethernet Module is equipped with four SFP+ interface ports supporting 10GBASE-SR/LR/ER. Test items can be independently set to each port.

(3) Stream generation function and data analysis function

(a) To maintain backwards compatibility with the

MU120118A/18B/18C, the MU120138A has the stream generation and data analysis functions of the MU120118A/18B/18C or better.

(b) Receive frames can be counted for each value of fields specified by the user (multiflow counter). As an example, this function enables counting of UDP packets received by this module for each destination UDP port number.

(c) The MU120138A module supports up to 10 levels of multiple VLAN tags. This function enables full-wire rate transmission and counting of frames with multiple VLAN tags, and analysis and display of captured packets. Since the multi-flow counter function described in (b) above supports multiple VLAN tags, received frames can be counted according to the VLAN ID of the VLAN tag at the specified level.

(d) Transmission clocks can be adjusted within a range of ± 100 ppm, enabling evaluation of the margin for the DUT transmission clock.*1

*1: Available only when MU120132A-01 Clock Measurement is installed.

(e) The MU120138A module captures the Preamble section.

(4) Protocol support function

Protocol emulation of ARP, ICMP, IGMPv2, and IGMPv3 are possible.

Section 2 Before Use

This section provides information that the user should understand before using the Ethernet modules. It also covers precautions for securing safety and avoiding malfunctioning of the device in use. Read through this section before using the Ethernet modules.

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2.1 Environmental Conditions at Installation Site

The Ethernet modules operate normally within a temperature range of 0°C to 40°C. Avoid using them under the following conditions to prevent malfunctioning:

- In places of direct sunlight
- In dusty places
- Outdoors
- In liquids, such as water, oil, or organic solvents, and medical fluids, or places where these liquids may adhere
- In salty air or in place chemically active gases (sulfur dioxide, hydrogen sulfide, chlorine, ammonia, nitrogen dioxide, or hydrogen chloride etc.) are present
- In places where high-intensity static electric charges or electromagnetic fields are present
- In places where abnormal power voltages (high or low) or instantaneous power failures occur
- In places where condensation occurs
- In the presence of lubricating oil mists
- In places at an altitude of more than 2,000 m
- In the presence of frequent vibration or mechanical shock, such as in cars, ships, or airplanes

CAUTION

Condensation may result inside the Ethernet modules when moved to a location with a high temperature after being used for a substantial period in a location at a low temperature. In such a case, dry them before turning their power On, otherwise the internal device may short-circuit causing a malfunction.

2.2 Installing the GBIC

GBIC Installation

This section explains attachment of the GBIC used for the MU120102A/12A Giga-bit Ethernet Module. A device under test cannot be connected to the MU120102A/12A Giga-bit Ethernet Module unless the GBIC is attached.

(1) What is the GBIC?

The Gigabit Interface Converter (GBIC) is a small input/output device based on a common standard that can be installed in and removed from an active circuit while the power is on. The MU120102A/12A Giga-bit Ethernet module provides GBICs conforming to 1000BASE-SX, -LX, -LH, -ZX and T. The can select a desired interface by merely replacing a GBIC. (1000BASE-T is available only for the MU120112A.)

Installing the GBIC (*Note 1*)

1. Check whether the GBIC is compatible with the target network type.
 For types of GBICs, refer to Appendix B “Application Parts.”
2. Pinch both side tabs of the GBIC and insert it into the slot in the Giga-bit Ethernet Module front panel. The GBIC for 1000BASE-T is not equipped with side tabs. Just insert it into the slot.
3. Lift up the slot cover and slide the GBIC inside the slot until it clicks (*Note 2*).
4. Use a fiber-optic cable to connect the GbE Module to a device under test.

Note 1:

GBIC is hot-swapping-capable.

Note 2:

GBIC is equipped with a key that prevents improper insertion.

Removing the GBIC

1. Remove the fiber-optic cable from GBIC SC connector.
2. Block the light signal input/output hole with a plug.
3. Pinch both side tabs of the GBIC and pull the GBIC out of the slot. The GBIC for 1000BASE-T is not equipped with side tabs. Just pull it out of the slot.
4. The protective cover in the MU120102A/12A Giga-bit Ethernet Module closes when the GBIC is pulled out of the slot.

CAUTION

- The GBIC is susceptible to electro-static discharge (ESD). To prevent ESD, touch a grounded metal to discharge electricity from your body.
 - The GBIC is susceptible to dust. Block the light input/output hole with a cap etc. when the GBIC is stored or when a fiber-optic cable is not inserted.
 - The light input/output hole is most likely contaminated by fragments attached to the ferrule on the optical connector. Wipe any dirt off of this ferrule with alcohol.
 - When a fiber-optic cable is not connected, laser rays may be emitted from the light input/output hole of the GBIC. Never look into this hole and avoid exposure to radiation.
 - Do not attach or remove the GBIC with the fiber-optic cable connected. Otherwise, the GBIC light input/output hole and the fiber-optic cable connector may be damaged.
 - Do not touch the connector on the back of the GBIC. Otherwise, the GBIC may fail.
 - Operation is assured only with the MU120102A and MU120112A application parts; operation with other application parts is not assured.
-

2.3 Installing the SFP

How to attach SFP

This section explains attachment of SFP used for the MU120122A/32A Giga-Bit Ethernet Module. A device under test cannot be connected to the MU120122A/32A Giga-Bit Ethernet Module via 1000BASE-SX/LX/LE/LR unless an SFP is attached to the MU120122A module.

2

Before Use

(1) What is the SFP?

The Small Form Factor Pluggable (SFP) is a small input/output device based on a common standard that can be installed in and removed from an active circuit while the power is on. The MU120122A/32A Giga-Bit Ethernet Module provides SFPs conforming to 1000BASE-SX, LX, LE, and LR. The can select a desired interface by merely replacing the SFP. The figure below shows the exterior appearance of SFP.

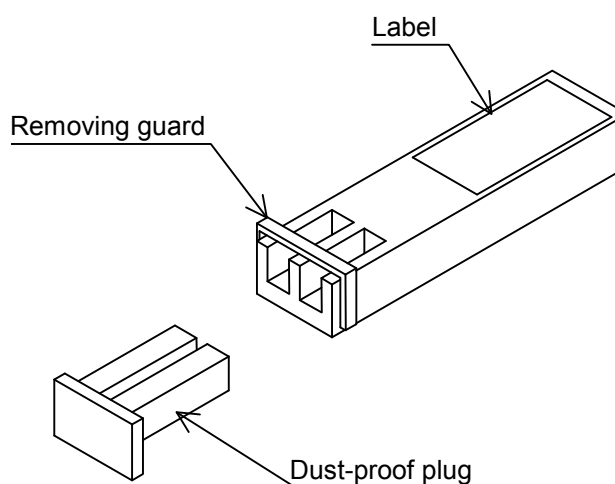


Fig.2.3-1 SFP appearance

Installing the SFP

1. Check whether the SFP is compatible with the target network type.
 [Hand icon] For types of SFPs, refer to Appendix B "Application Parts."
2. Insert the SFP module securely into the SFP port with the label upmost and the Removing Guard fitted to the SFP. Check that it is plugged all the way in.
3. Connect the module with the SFP installed to the device under test using a fiber-optic cable.

Removing the SFP

1. Remove the fiber-optic cable from the SFP.
2. Pull the removing guard down and hold it to pull out the SFP of the SFP port. The dust-proof plug should not be attached while removing the SFP.

CAUTION

- Be sure to insert the SFP with the removing guard up. The SFP may not be attached securely if it is inserted with the removing guard down.
 - Be sure to attach the dust-proof plug to the removed SFP. Otherwise, dust may accumulate on the light input/output hole of the SFP, resulting in a failure.
 - The SFP is susceptible to electro-static discharge (ESD). To prevent ESD, touch a grounded metal to discharge electricity from your body.
 - The SFP is susceptible to dust. Block the light input/output hole with a cap etc. when the SFP is stored or when a fiber-optic cable is not inserted.
 - The light input/output hole is most likely contaminated by fragments attached to the ferrule on the optical connector. Wipe any dirt off of this ferrule with alcohol.
 - When a fiber-optic cable is not connected, laser rays may be emitted from the light input/output hole of the SFP. Never look into this hole and avoid exposure to radiation.
 - Do not attach or remove the SFP with the fiber-optic cable connected. Otherwise, the SFP light input/output hole and the fiber-optic cable connector may be damaged.
 - Do not touch the connector on the back of the SFP. Otherwise, the SFP may fail.
 - Operation is assured only with the MU120122A and MU120132A application parts; operation with other application parts is not assured.
-

2.4 Installing the XENPAK

XENPAK Installation

The following will describe the installation of XENPAK, used with MU120118A/18B/18C 10 Giga-bit Ethernet Modules. The 10 Giga-bit Ethernet Module cannot be connected to the device under test unless the XENPAK is installed.

(1) What is the XENPAK?

XENPAK is a small input/output device based on a common standard that can be installed in and removed from an active circuit while the power is on. Interfaces can be changed as requested by simply by exchanging the XENPAK.

Installing XENPAK (*Note 1*)

1. Check whether the XENPAK matches the network type to be connected.



For XENPAK types, refer to Appendix B “Application Parts.”

2. Grab the XENPAK side and insert into the front panel slot of the 10 Giga-bit Ethernet Module.
3. The XENPAK will slide in the slot. Insert all the way to the back of the slot.
4. Tighten the screws on the XENPAK front side to anchor the XENPAK to the module.
5. Connect to the device under test with the fiber cable.

Note 1:

XENPAK supports hotswap.

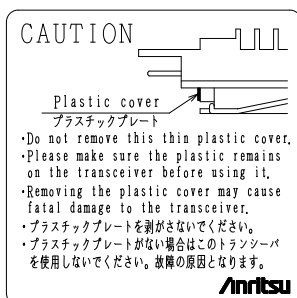
Removing XENPAK

1. Remove the fiber cable from the SC connector of XENPAK.
2. Close the signal I/O opening with the plug.
3. Loosen the screws on the XENPAK front side.
4. Grab the XENPAK screws to pull out the XENPAK from the slot.

CAUTION

- The XENPAK is susceptible to electro-static discharge (ESD). To prevent ESD, touch a grounded metal to discharge electricity from your body.
 - The XENPAK is susceptible to dust. Block the light input/output hole with a cap etc. when the XENPAK is stored or when a fiber-optic cable is not inserted.
 - The light input/output hole is most likely contaminated by fragments attached to the ferrule on the optical connector. Wipe any dirt off of this ferrule with alcohol.
 - When a fiber-optic cable is not connected, laser rays may be emitted from the light input/output hole of the XENPAK. Never look into this hole and avoid exposure to radiation.
 - Do not attach or remove the XENPAK with the fiber-optic cable connected. Otherwise, the XENPAK light input/output hole and the fiber-optic cable connector may be damaged.
 - Do not touch the connector on the back of the XENPAK. Otherwise, the XENPAK may fail.
 - Insertion/removal life of the XENPAK connector is 50 times.
 - The MU120118A/18B/18C modules must have the Adaptable Power Supply (APS) function for installing G0192A XENPAK (10GBASE-LR), or G0193A XENPAK (10GBASE-ER). The MU120118A/18B/18C modules with the APS function are identified by a “with APC” label, affixed on the top of the XENPAK slot.
 - When installing the XENPAK (10GBASE-LW), the Anritsu Corporation XENPAK (10GBASE-LW) optional accessory must be used and this module must have WAN-PHY option.
-

⚠ CAUTION



- Do not install a XENPAK (10GBASE-LW) in this module without the WAN-PHY option, otherwise the XENPAK fail.
- Do not install a third-party XENPAK (10GBASE-LW) in this module, otherwise the XENPAK or module will fail.
- Check that the plastic cover is on the XENPAK (10GBASE-LW) before installing it. Removing the plastic cover may cause fatal damage to the XENPAK. Leave the seal attached to the left of the XENPAK (10GBASE-LW).
- Operation is assured only with the MU120118A, MU120118B and MU120118C application parts; operation with other application parts is not assured.

2.5 Installing the SFP+

How to attach SFP+

This section explains attachment of SFP+ used for the MU120138A 10 Giga-Bit Ethernet Module. A device under test cannot be connected to the MU120138A 10 Giga-Bit Ethernet Module via 10GBASE-SR/LR/ER unless an SFP+ is attached to the MU120138A module.

(1) What is the SFP+?

The Small Form Factor Pluggable Plus (SFP+) is a small input/output device based on a common standard that can be installed in and removed from an active circuit while the power is on. The MU120138A 10 Giga-Bit Ethernet Module provides SFP+ conforming to 10GBASE-SR, LR, and ER. The can select a desired interface by merely replacing the SFP+. The figure below shows the exterior appearance of SFP+.

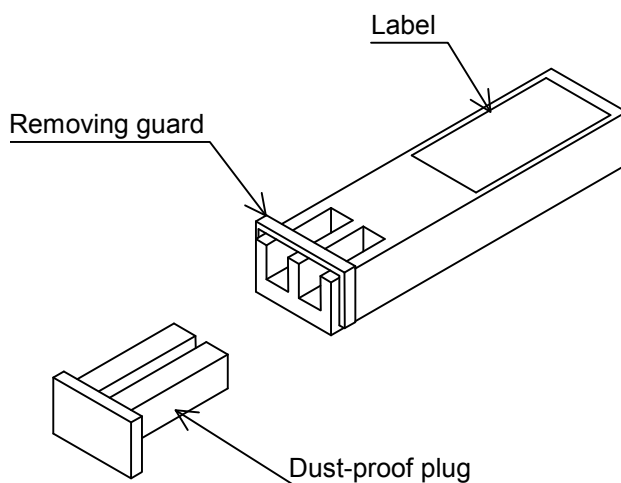


Fig.2.5-1 SFP+ appearance

Installing the SFP+

1. Check whether the SFP+ is compatible with the target network type.
 For types of SFP+s, refer to Appendix B “Application Parts.”
2. Insert the SFP+ into the SFP+ port securely with the label upside and the removing guard up.
3. Connect the module with the SFP+ installed to the device under test using a fiber-optic cable.

Removing the SFP+

1. Remove the fiber-optic cable from the SFP+.
2. Pull the Removing Guard down and hold it to pull out the SFP+ of the SFP+ port. The dust-proof plug should not be attached while removing the SFP+.

**CAUTION**

- Be sure to insert the SFP+ with the removing guard up. The SFP+ may not be attached securely if it is inserted with the removing guard down.
- Be sure to attach the dust-proof plug to the removed SFP+. Otherwise, dust may accumulate on the light input/output hole of the SFP+, resulting in a failure.
- The SFP+ is susceptible to electro-static discharge (ESD). To prevent ESD, touch a grounded metal to discharge electricity from your body.
- The SFP+ is susceptible to dust. Block the light input/output hole with a cap etc. when the SFP+ is stored or when a fiber-optic cable is not inserted.
- The light input/output hole is most likely contaminated by fragments attached to the ferrule on the optical connector. Wipe any dirt off of this ferrule with alcohol.
- When a fiber-optic cable is not connected, laser rays may be emitted from the light input/output hole of the SFP+. Never look into this hole and avoid exposure to radiation.
- Do not attach or remove the SFP+ with the fiber-optic cable connected. Otherwise, the SFP light input/output hole and the fiber-optic cable connector may be damaged.
- Do not touch the connector on the back of the SFP+. Otherwise, the SFP+ may fail.
- Operation is assured only with the MU120138A application part; operation with other application parts is not assured.

2.6 Connecting the GBIC and Device Under Test

The Giga-bit Ethernet Module uses different cables depending on the MU120102A/12A GBIC inserted in the slot. The following table shows specifications of compatible cables. Use a cable conforming to the GBIC in use. All GBICs use SC-type connectors.

Optical GBIC type	Wave length band (μm)	Fiber type	Core/Clad size (μm)	Maximum cable length (m)
1000BASE-SX	0.85	MMF	62.5/125 50/125	220 500
1000BASE-LX	1.31	MMF	62.5/125 50/125	550 550
		SMF	9/125	10 k
1000BASE-LH	1.31	SMF	9/125	30 k
1000BASE-ZX	1.55	SMF	9/125	80 k (Note 1)

Note 1:

Fiber loss plus losses in the other system must not exceed 21.5 dB.

Electric GBIC type	Cable	Maximum cable length (m)
1000 Base-T	Category 5e	80



CAUTION

- Check the input/output signal power level before connecting with a device under test. Input of a signal exceeding the rated level could destroy the internal devices thus causing malfunctioning. Avoid connecting two output connectors together in order to prevent possible malfunctions.
- All Optical GBICs are Class 1 laser products.

2.7 Connecting the SFP and Device Under Test

The MU120122A Giga-Bit Ethernet Module uses different cables depending on the SFP inserted in the slot. The following table shows specifications of compatible cables. Use a cable conforming to the SFP in use. All SFPs use LC-type connectors.

Optical SFP type	Wave length band (μm)	Fiber type	Core/Clad size (μm)	Maximum cable length (m)
1000BASE-SX	0.85	MMF	62.5/125 50/125	220 500
1000BASE-LX	1.31	MMF	62.5/125 50/125	550 550
		SMF	9/125	10 k
1000BASE-LE	1.31	SMF	9/125	30 k
1000BASE-LR	1.55	SMF	9/125	80 k (Note 1)

Note 1:

The total of the fiber loss and loss in the other systems must not exceed 21.5 dB.



CAUTION

- Check the input/output signal power level before connecting with a device under test. Input of a signal exceeding the rated level could destroy the internal devices thus causing malfunctioning. Avoid connecting two output connectors together in order to prevent possible malfunctions.
- All optical SFPs are Class 1 laser products.

2.8 Connecting the XENPAK and Device Under Test

The interface for the 10 Giga-bit Ethernet Module can be changed to suit the particular XENPAK attached to the slot. The table shown below lists the interfaces. Use a fiber matching the XENPAK to be used. The XENPAK uses a SC-type connector

XENPAK type	Wave length band (μm)	Fiber type	Core/Clad size (μm)	Maximum cable length (m)
10GBASE-SR	0.85	MMF	62.5/125 50/125	33 300
10GBASE-LR	1.31	SMF	9/125	10 k
10GBASE-ER	1.55	SMF	9/125	40 k
10GBASE-LW	1.35	SMF	9/125	10 k



CAUTION

- Check the input/output signal power level before connecting with a device under test. Input of a signal exceeding the rated level could destroy the internal devices thus causing malfunctioning. Avoid connecting two output connectors together in order to prevent possible malfunctions.
- The XENPAKs are Class 1 laser products.
- The voltage of the APS power supply to the XENPAK from this module is fixed to +1.8 V. Do not use a XENPAK with another voltage. When the WAN-PHY option is installed in this module, the APS power supply voltage can be adjusted.

2.9 Connecting the SFP+ and Device Under Test

The MU120138A 10 Giga-Bit Ethernet Module uses different cables depending on the SFP+ inserted in the slot. The following table shows specifications of compatible cables. Use a cable conforming to the SFP+ in use. All SFP+ use LC-type connectors.

Optical SFP+ type	Wave length band (μm)	Fiber type	Core/Clad size (μm)	Maximum cable length (m)
10GBASE-SR	0.85	MMF	62.5/125 50/125	33 300
10GBASE-LR	1.31	SMF	9/125	10 k
10GBASE-ER	1.55	SMF	9/125	40 k



CAUTION

- Check the input/output signal power level before connecting with a device under test. Input of a signal exceeding the rated level could destroy the internal devices thus causing malfunctioning. Avoid connecting two output connectors together in order to prevent possible malfunctions.
- Optical SFP+ are Class 1 or Class 1M laser products.

2.10 Connecting the 10 Giga-bit Ethernet Module, XAUI Extender, and XENPAK Interface

Before connection

Optional accessories are shown below. All of the options are sold separately.

- XAUI extender
- XENPAK interface
- XAUI cable
- MDIO cable

In addition, a +5 V constant voltage regulator, which has an output facility of 4 A or more, is required to measure.

How to connect devices

1. Insert the XAUI extender to the slot on the front panel of 10 Giga-bit Ethernet Module.
2. Connect the XAUI extender to the XENPAK interface with the XAUI and MDIO cables.
3. Connect the XENPAK interface to the +5 V constant voltage regulator.

Note :

After connecting the XENPAK interface to the +5 V constant voltage regulator, power the +5 V constant voltage regulator.

4. Insert the XENPAK to the XENPAK interface.

Note :

Radiate heat appropriately for the XENPAK by means such as exposure to wind.



CAUTION

When the WAN-PHY option is installed, the XAUI extender and XENPAK interface cannot be used with 10 Giga-bit Ethernet Module.

2.10 Connecting the 10 Giga-bit Ethernet Module, XAUI Extender, and XENPAK Interface

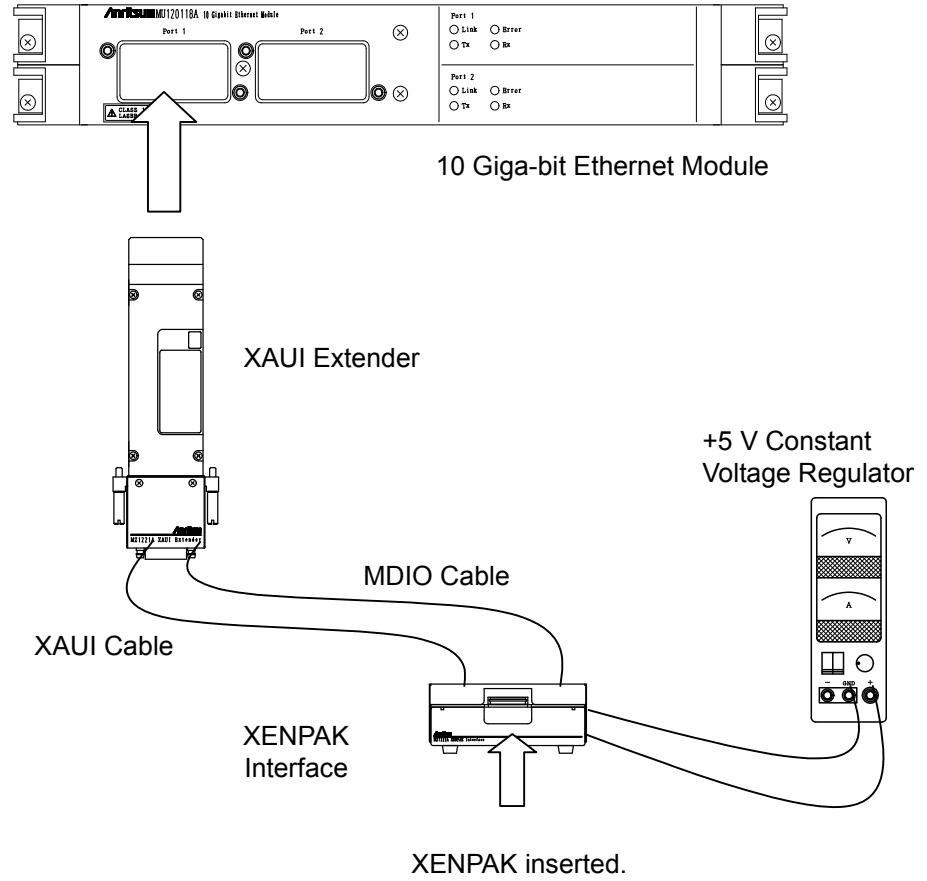


Fig. 2.10-1 Connection Diagram of 10 Giga-bit Ethernet Module, XAUI Extender, and XENPAK Interface

Section 3 Control Names and Functions

This section explains the names and functions of individual controls on the Ethernet module panel.

3.1	Panel Layout and Explanation	3-2
3.1.1	MU120101A 10M/100M Ethernet Module	3-2
3.1.2	MU120102A Giga-Bit Ethernet Module	3-3
3.1.3	MU120111A 10/100M Ethernet Module	3-4
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3.1.5	MU120118A/18B/18C 10 Giga-bit Ethernet Module	3-6
3.1.6	MU120121A 10/100/1000M Ethernet Module	3-8
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3.1 Panel Layout and Explanation

3.1.1 MU120101A 10M/100M Ethernet Module

The figure below shows the front panel of the 10M/100M Ethernet Module.

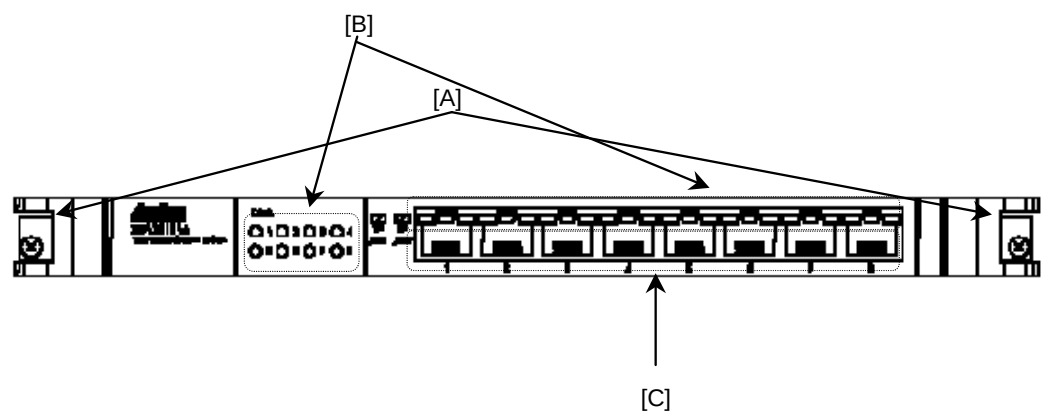


Fig. 3.1.1-1 10M/100M Ethernet Module

[A]	Ejector			Used to insert/remove a module.
[B]	LED	Link	Green	Comes on when synchronization with Auto Negotiation Pulse, Link Pulse or Idle Pulse is successfully established.
			Orange	Comes on when a collision is detected.
		Tx/Col	Green	Comes on when Ethernet frames are transmitted.
			Orange	Comes on when Ethernet frames are received.
[C]	RJ-45 slot	Rx/Err	Green	Comes on when an error is detected for all errors countable with a counter.
			Orange	Comes on when an error is detected for all errors countable with a counter.

3.1.2 MU120102A Giga-Bit Ethernet Module

The figure below shows the front panel of the Giga-bit Ethernet Module.

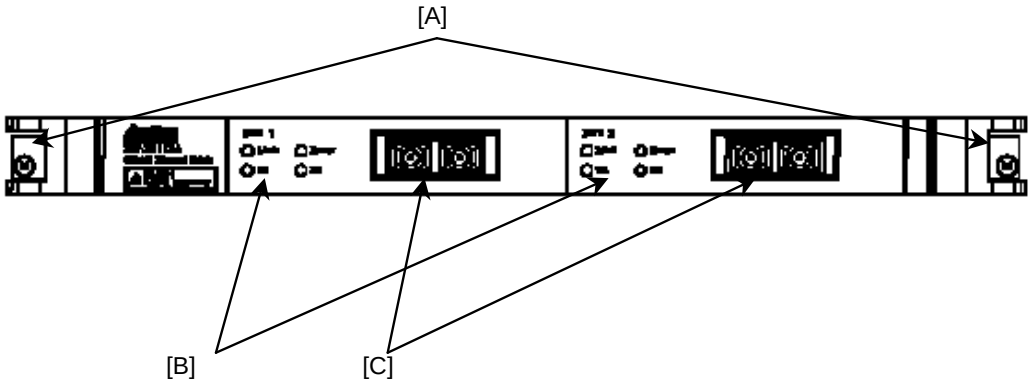


Fig. 3.1.2-1 Giga-bit Ethernet Module

[A]	Ejector			Used to insert/remove a module.	
[B]	LED	Link	Green	Auto Negotiation Off	Comes on when syn- chronization is estab- lished.
				Auto Negotiation On	Comes on when syn- chronization is estab- lished and Auto-Negotiation is normally terminated.
		Tx	Green	Comes on when Ethernet frames are trans- mitted.	
		Rx	Green	Comes on when Ethernet frames are re- ceived.	
		Error	Orange	Comes on when an error is detected for all errors countable with a counter.	
[C]	GBIC slot			Connects with DUT. GBIC is inserted.	

3.1.3 MU120111A 10/100M Ethernet Module

The front panel of the 10/100M Ethernet Module is shown.

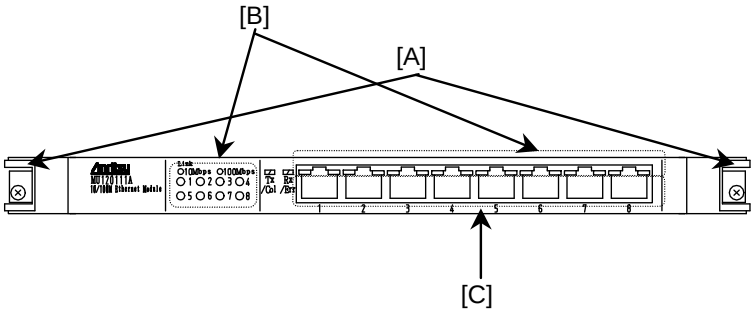


Fig. 3.1.3-1 10/100M Ethernet Module

[A]	Ejector				Used to insert/remove a module.
[B]	LED	Link	10 Mbit/s	Orange	Comes on when synchronization with Auto Negotiation Pulse, Link Pulse or Idle Pulse is successfully established.
			100 Mbit/s	Green	
		Tx/Col	Green	Comes on when Ethernet frames are transmitted.	
			Orange	Comes on when a collision is detected.	
		Rx/Err	Green	Comes on when Ethernet frames are received.	
			Orange	Comes on when an error is detected for all errors countable with a counter.	
[C]	RJ-45 slot				Connects with DUT. Use to insert a 10BASE-T or 100BASE-TX cable.

3.1.4 MU120112A Giga-Bit Ethernet Module

The figure below shows the front panel of the Giga-bit Ethernet Module.

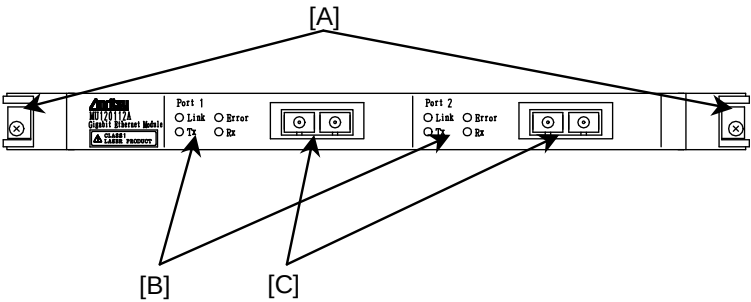


Fig. 3.1.4-1 Giga-bit Ethernet Module

[A]	Ejector			Used to insert/remove a module.	
[B]	LED	Link	Green	Auto Negotiation Off	Comes on when synchronization is established.
				Auto Negotiation On	Comes on when synchronization is established and Auto-Negotiation is normally terminated.
		Tx	Green	Comes on when Ethernet frames are transmitted.	
		Rx	Green	Comes on when Ethernet frames are received.	
		Error	Orange	Comes on when an error is detected for all errors countable with a counter.	
[C]	GBIC slot			Connects with DUT. GBIC is inserted.	

3.1.5 MU120118A/18B/18C 10 Giga-bit Ethernet Module

The figure below shows the front panel of the 10 Giga-bit Ethernet Module.

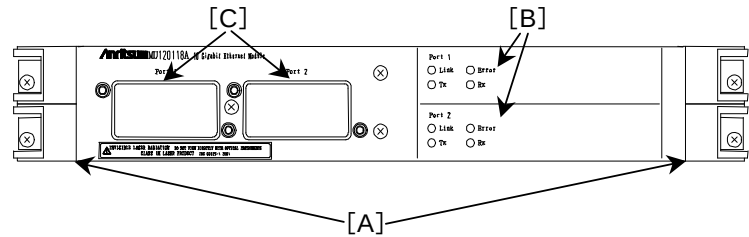


Fig. 3.1.5-1 MU120118A/B Module

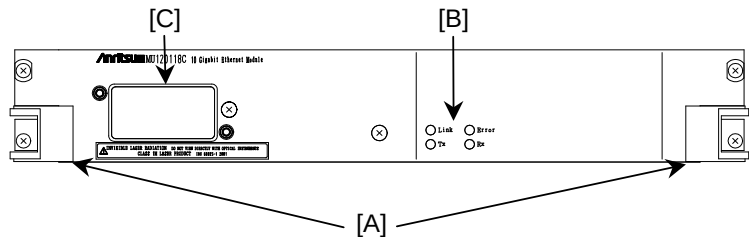


Fig. 3.1.5-2 MU120118C Module

[A]	Ejector			Used to insert/remove a module.
[B]	LED	Link	Green	Comes on when synchronization is established.
		Tx	Green	Comes on when Ethernet frames are transmitted.
		Rx	Green	Comes on when Ethernet frames are received.
		Error	Orange	Comes on when an error is detected for all errors countable with a counter.
[C]	XENPAK Slot			Connects with DUT. Inserts XENPAK.



CAUTION

1. When installing XENPAK in the MU120118A/18B/18C, always use the Anritsu-supplied accessory XENPAK. If another company's XENPAK is installed there is a risk of damage to the installed XENPAK or module.
2. If the G0192A XENPAK (10GBASE-LR) or G0193A XENPAK(10GBASE-ER) is installed in the MU120118A/18B/18C without the APS function, there is a risk of damage to the installed XENPAK.
3. When installing the XENPAK (10GBASE-LR) in the MU120118A/18B/18C module in which the WAN-PHY option is not installed, [option required] is displayed in red characters and there is a risk of damage to the installed XENPAK.

3.1.6 MU120121A 10/100/1000M Ethernet Module

The front panel of the 10/100/1000M Ethernet Module is shown below.

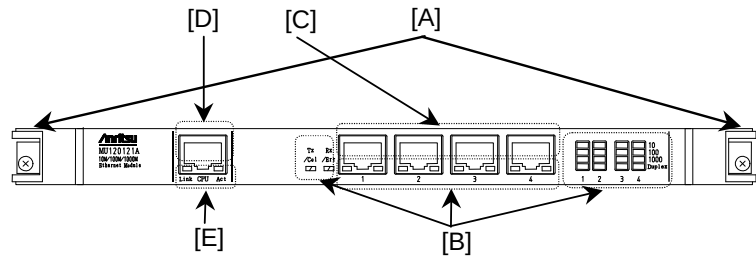


Fig. 3.1.6-1 10/100/1000 M Ethernet Module

[A]	Ejector			Used to insert/remove a module.	
[B]	RJ-45 Port LED	Link	10 Mbit/s	Green	When synchronization with Auto Negotiation Pulse, Link Pulse or Idle Pulse is successfully established, LED corresponding to established link-speed comes on.
			100 Mbit/s	Green	
			1000 Mbit/s	Green	
			Duplex	Green	
		Tx/Col	Green	Comes on when Ethernet frames are transmitted.	
			Orange	Comes on when a collision is detected.	
		Rx/Err	Green	Comes on when Ethernet frames are received.	
			Orange	Comes on when an error is detected for all errors countable with a counter.	
[C]	RJ-45 slot			Connects with DUT. Inserts cables of 10BASE-T, 100BASE-TX, 1000BASE-T.	
[D]	CPU Port LED	Link	Green	Comes on when synchronization with Auto Negotiation Pulse, Link Pulse or Idle Pulse is successfully established.	
		Active	Green	Comes on when Ethernet frames are transmitted.	
[E]	CPU Port RJ-45 slot			Performs external control of this module by connecting an external PC, etc. (At the present, the external control due to the CPU port is not available because software does not correspond.) Inserts a 10BASE-T or 100BASE-TX cable.	

3.1.7 MU120122A Giga-bit Ethernet Module

The front panel of Giga-bit Ethernet Module is shown.

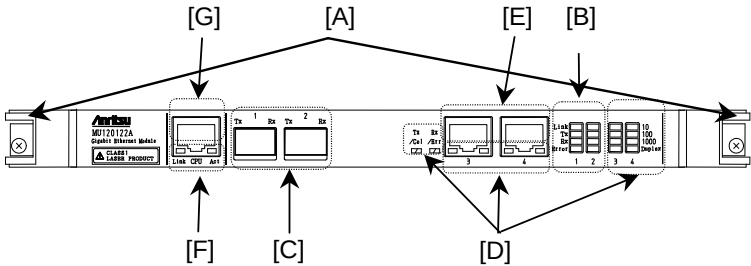


Fig. 3.1.7-1 Giga-bit Ethernet Module

[A]	Ejector			Used to insert/remove a module.	
[B]	SFP Port LEDs	Link	Green	Auto Negotia-tion Off	Comes on when synchro-nization is established.
				Auto Negotia-tion On	Comes on when synchro-nization is established and Auto-Negotiation is nor-mally terminated.
				Auto Negotia-tion On	Comes on when synchro-nization is established and Auto-Negotiation is ter-minated normally.
		Tx	Green	Comes on when Ethernet frames are transmitted.	
		Rx	Green	Comes on when Ethernet frames are received.	
		Error	Red	Comes on when an error is detected for all errors countable with a counter.	
[C]	SFP slot			Connects with DUT. Inserts SFP.	

[D]	RJ-45 Port LED	Link	10 Mbit/s	Green	When synchronization with Auto Negotiation Pulse, Link Pulse or Idle Pulse is successfully established, LED corresponding to established link-speed comes on.
			100 Mbit/s	Green	
			1000 Mbit/s	Green	
			Duplex	Green	
		Tx/Col	Green	Comes on when Ethernet frames are transmitted.	
			Orange	Comes on when a collision is detected.	
		Rx/Err	Green	Comes on when Ethernet frames are transmitted.	
			Orange	Comes on when an error is detected for all errors countable with a counter.	
[E]	RJ-45 slot				Connected with the DUT. Inserts cables of 10BASE-T, 100BASE-TX, 1000BASE-T.
[F]	CPU Port LED	Link	Green	Comes on when synchronization with Auto Negotiation Pulse, Link Pulse or Idle Pulse is successfully established.	
		Active	Green	Comes on when Ethernet frames are transmitted.	
[G]	CPU Port RJ-45 slot				Performs external control of this module by connecting an external PC, etc. (At the present, the external control due to the CPU port is not available because software does not correspond.) Inserts cables of 10BASE-T, 100BASE-TX.

3.1.8 MU120131A 10/100/1000M Ethernet Module

The front panel of the 10/100/1000M Ethernet Module is shown below.

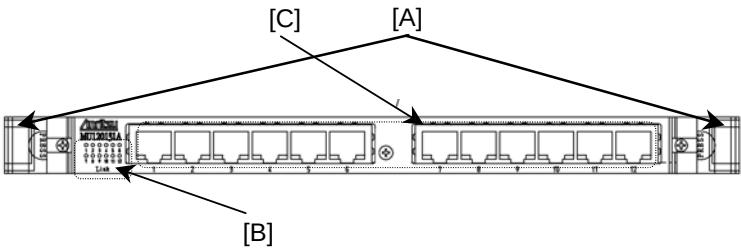


Fig. 3.1.8-1 10/100/1000 M Ethernet Module

[A]	Ejectors	Used to insert/remove a module.
[B]	Link	Comes on when Link is established.
[C]	RJ-45 slots	Connect with DUT. Insert 10BASE-T, 100BASE-TX, or 1000BASE-T cables.

3.1.9 MU120132A Giga-bit Ethernet Module

The front panel of Giga-bit Ethernet Module is shown below.

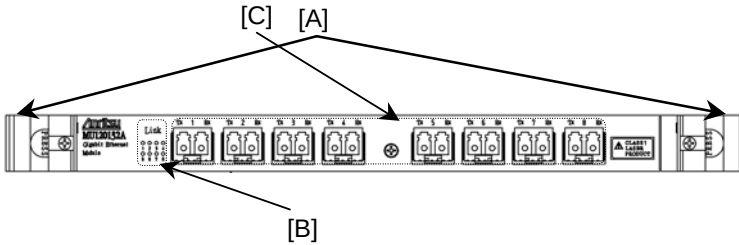


Fig. 3.1.9-1 Giga-bit Ethernet Module

[A]	Ejectors	Used to insert/remove a module.
[B]	Link	Comes on when Link is established.
[C]	SFP slots	Connect with DUT. Insert SFP.

3.1.10 MU120138A 10 Giga-bit Ethernet Module

The front panel of 10 Giga-bit Ethernet Module is shown below.

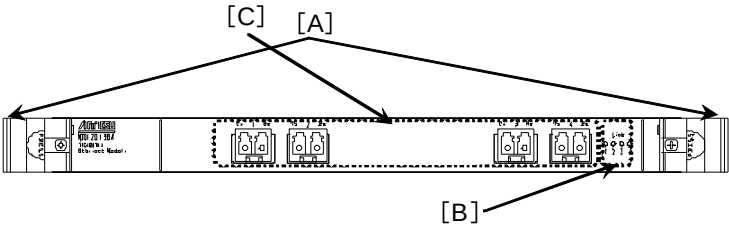


Fig. 3.1.10-1 10 Giga-bit Ethernet Module

[A]	Ejectors	Used to insert/remove a module.
[B]	Link	Comes on when Link is established.
[C]	SFP+ slots	Connect with DUT. Insert SFP+.

Appendix

Appendix A	Specifications.....	A-1
Appendix B	Application Parts.....	B-1

Appendix A Specifications

A.1 MU120101A

Module (MU120101A)

Item	Specifications
Model name	MU120101A
Apparatus name	10M/100M Ethernet Module
Composition	Module × 1
Interface	
Corresponding Specification	10BASE-T, 100BASE-TX
Connector	RJ-45
Number of Ports	8
Bit Rate	10 M, 100 Mbit/s
Auto Negotiation	On/Off
Flow Control	On/Off
LED	Link, Tx/Collision, Rx/Error
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	IPv4 Address, Netmask, Gateway
ARP Reply	Not send, Reply to this port ARP request, Reply to all ARP request
ICMP Echo(PING)Reply	Not send, Reply to this port ping request
Duplex Mode	Full/Half
MII/MDIO properties	Auto negotiation On/Off, Restart, Loop back On/Off, MII registers (Allows the current MII register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode	Normal, Monitor, Through ^{*1}
Stream	
Number of Streams	256 Streams/Port
Stream Setting	
Distribution	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)
Frame per Burst	1 to 16,777,215
Burst per Stream	1 to 16,777,215
Frame View	Raw Frame, Decoded

*1: On MU120101A, the through mode can be used with port 1 and port 2, and with port 5 and port 6.

Module (MU120101A) (Cont'd)

Item	Specifications
Gap Setting	
Inter Frame Gap	10BASE-T: Resolution of 800 ns, 8 us to 1700 s Settable as Fixed or Random. 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed or Random.
Inter Burst Gap	10BASE-T: Resolution of 800 ns, 8 us to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed
Inter Stream Gap	10BASE-T: Resolution of 800 ns, 8 us to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed
Frame Setting	Preamble Size: 4 to 255 bytes MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA) VLAN tag*2: 1layer VLAN tag can be appended. VLAN ID can be set Static, Increment, Decrement, Random. MPLS label*2: Up to 10 MPLS labels can be appended. Fixed setting. Protocol Editing:None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame) IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment*3, Decrement*3, Random*3 independently.*3 TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random. Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9. Only Data Field 1 can set Programmable, Time Stamp*4, Sequence Number*4, Test Frame*5. Programmable Header Pattern: 1 user defined pattern can be set.

*2: VLAN tag and MPLS labels cannot both be used simultaneously.

*3: For IPv6, any Increment, Decrement, or Random setting can be specified for bit widths 1 to 32.

*4: When a sequence number or time stamp is used, the checksum field of the TCP/UDP packet contains an error code.

- *5: When a test frame is sent From the MU120101A to another module, Packet BER Test is disabled.

Module (MU120101A) (Cont'd)

Item	Specifications
Frame Size	18 to 10,000 bytes (Settable as Auto, Fixed, Increment* ⁶ , or Random* ⁶)
Protocol Setting Ethernet IPv4 (RFC791)	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p> <p>Version (4 bit): 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0) Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

*6: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

Module (MU120101A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 (DEC) Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120101A) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120101A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120101A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8 bit): User defined 6 = for MAC address Hops (8 bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined
MPLS (RFC3031, 3032)	Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.
VLAN (IEEE802.1Q-1998)	TPID: 0x8100, User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet IP TCP/UDP	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error, Dribble Bit Error, Alignment Error, Collision IPv4 Header Checksum Error TCP/UDP Checksum Error
Measurement Function Counter Mode	Accumulated, 1 s current

Module (MU120101A) (Cont'd)

Item	Specifications
Ethernet	Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Dribble Bit, Alignment Error, Collision Line Error
IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error
TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packer Rate, TCP Checksum Error ^{*7} , UDP Checksum Error ^{*7}
Data	Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority). User Defined counter conditions; Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Graph	8 kinds of graph are displayed simultaneously. 1 s, 1 min, 15 min, 60 min resolution

^{*7}: On MU120101A, the packets fragmented in the IP layer are counted as error packets.

Module (MU120101A) (Cont'd)

Item	Specifications
Capture	8 Mbytes/Port
Capture Buffer	Filter condition settings:
Capture Filter/Trigger	Destination MAC Address: don't care, Match, Not match
	Source MAC Address: don't care, Match, Not match
	Pattern1: don't care, Match, Not match
	Pattern2: don't care, Match, Not match
	Error: don't care, Match, Not match
	Trigger condition settings:
	Destination MAC Address: don't care, Match, Not match
	Source MAC Address: don't care, Match, Not match
	Pattern1: don't care, Match, Not match
	Pattern2: don't care, Match, Not match
	Error: don't care, Match, Not match
	External Trigger:
	Traffic is out of range:0to100%
	Latency is out of range:1 nsto59 s
	Manual Trigger:
	Trigger Position Settings: Top, Middle, Bottom
Pattern and Error Conditions	Destination MAC Address:48 bit Mask:bit mask
	Source MAC Address:48 bit Mask:bit mask
	Pattern1,2;
	Pattern:32 bit Mask:byte mask
	Base position:Top of Frame, Top of IPv4 Header, Top of IPv6 Header*8,IPv6 Extension Headers(Hop by Hop,Destination, Routing,Fragment,Authentication, ESP)*8,Top of IP Payload
	Offset:0 to 65535
	Error;
	Error type: Good Frame,FCS Error,Undersize, Fragments,Oversize,Oversize&FCS Error, Dribble Bit Error, Alignment Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*9, PRBS Frame Error*9
	Combination: And,Or

*8: Option 12 IPv6 Expansion is required.

*9: Option 11 Packet BER Test is required.

Module (MU120101A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400. MD1230 Family includes Ethereal/Wireshark Convert Function.
Replay	Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP, ICMP, IGMP, BGP-4
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s. Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)

Module (MU120101A) (Cont'd)

Item	Specifications
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095
Test Setting	Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999

Module (MU120101A) (Cont'd)

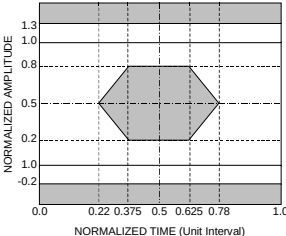
Item	Specifications
Throughput	Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), or Frame/s or Bit/s or byte/s vs. Frame Size, Theoretical value
Latency	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size
Frame Loss Rate	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop

Module (MU120101A) (Cont'd)

Item	Specifications
Tools Fragment	Fragments already registered Stream data Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.
Environmental Performance Temperature range Power Consumption Size Weight	Operation: 0 to +40°C Storage: -20 to +60°C Less than 20 W Based on PICMG2.0 R2.1 262.0 (W) × 20.0 (H) × 174.5 (D) mm It doesn't contain protuberance. Less than 1.0 kg

A.2 MU120102A

Module (MU120102A)

Item	Specifications
Model name Apparatus name Composition	MU120102A Gigabit Ethernet Module Module × 1
Interface Corresponding Specification Connector Number of Ports Bit Rate Pulse Mask	1000BASE-SX/LX/LH/ZX (depend on GBIC Module) GBIC (SC) 2 1000 Mbit/s 
Laser Safety Auto Negotiation Flow Control LED	21 CFR 1040.10:1995 CLASS I, IEC60825-1:2001 CLASS 1 On/Off On/Off Link, Tx, Rx, Error
Port setting MAC Address IPv4 This port ARP Reply ICMP Echo(PING) Reply Duplex Mode MII/MDIO properties Mode Optical Send	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF IPv4 Address, Netmask, Gateway Not send,Reply to this port ARP request,Reply to all ARP request Not send,Reply to this port ping request Full Auto negotiation On/Off, Restart, Loop back On/Off, MII registers (Allows the current MII register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined) Normal, Monitor, Through On/Off
Stream Number of Streams	256 Streams/Port
Stream Setting Distribution Frame per Burst Burst per Stream Frame View	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000) 1 to 16,777,215 1 to 16,777,215 Raw Frame, Decoded

Module (MU120102A) (Cont'd)

Item	Specifications
Gap Setting	At least 72 ns (9 bytes) when the frame length is an odd number and Random or Inc is set.
Inter Frame Gap	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed or Random.
Inter Burst Gap	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed
Inter Stream Gap	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed
Frame Setting	<p>Preamble Size: 2 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag*1: 1layer VLAN tag can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label*1: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame)</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment*2, Decrement*2, Random*2 independently.*2</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Only Data Field 1 can set Programmable, Time Stamp*3, Sequence Number*3, Test Frame*4.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p>
Frame Size	48 to 65,280 bytes (Settable as Auto, Fixed, Increment*5, or Random*5)

*1: VLAN tag and MPLS labels cannot both be used simultaneously.

*2: For IPv6, any Increment, Decrement, or Random setting can be specified for bit widths 1 to 32.

*3: When a sequence number or time stamp is used, the checksum field of the TCP/UDP packet contains an error code.

*4: When a Test Frame is sent from the MU120101A to another module, Packet BER Test is disabled.

*5: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

Module (MU120102A) (Cont'd)

Item	Specifications
Protocol Setting	
Ethernet	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p>
IPv4 (RFC791)	<p>Version (4 bit): 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

Module (MU120102A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 (DEC) Traffic Class (8 bit): 0- User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120102A) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120102A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120102A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8 bit): User defined 6 = for MAC address Hops (8bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined
MPLS (RFC3031, 3032)	Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.
VLAN (IEEE802.IQ-1998)	TPID: 0x8100, User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, L CK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option 11 Packet BER Test: PRBS Error

Module (MU120102A) (Cont'd)

Item	Specifications
Unframed BER Setting	Test Pattern: All 0, All 1, User 16, PRBS23, PRBS31, CJPAT, CRPAT Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)
Measurement Function Counter Mode Ethernet	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Byte Alignment Error Line Error
IPv4 TCP/UDP Data Packet BER Test (Opt11)	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packer Rate, TCP Checksum Error*6, UDP Checksum Error*6 Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority). User Defined counter conditions: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture. Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate

*6: On MU120102A, the packets fragmented in the IP layer are not counted as error packets.

Item	Specifications
Unframed BER Test Graph	Bit Error Count/Rate, Pattern Sync. Loss Count/Second 8 kinds of graph are displayed simultaneously. 1 s, 1 min, 15 min, 60 min resolution
Capture Capture Buffer Capture Filter/Trigger	32 Mbytes/Port Filter condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s Manual Trigger: Trigger Position Settings: Top, Middle, Bottom
Pattern and Error Conditions	Destination MAC Address:48 bit Mask:bit mask Source MAC Address:48 bit Mask:bit mask Pattern1,2; Pattern:32 bit Mask:byte mask Base position: Top of Frame, Top of IPv4 Header, Top of IPv6 Header*7,IPv6 Extension Headers(Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*7, Top of IP Payload Offset:0to65535 Error: Error type: Good Frame, FCS Error, Undersize, Fragments, Oversize, Oversize&FCS Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*8, PRBS Frame Error*8 Combination: And, Or

*8: Option 11 Packet BER Test is required.

Module (MU120102A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400.
Replay	MD1230 Family includes Ethereal/Wireshark Convert Function. Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP, ICMP, IGMP, BGP-4
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter)	
Resolution	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s.
Offset	Depend on resolution, Max. 3 min.
Graph	Frame Count vs. Time Interval Auto scale: On/Off

Module (MU120102A) (Cont'd)

Item	Specifications
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095
Test Setting	Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999
Throughput	Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), or Frame/s or Bit/s or byte/s vs. Frame Size, Theoretical value
Latency	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size

Module (MU120102A) (Cont'd)

Item	Specifications
Frame Loss Rate	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop
RFC2889 Automatic Test (Opt10)	Following 10 types of tests can be supported. [1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate [2] Partially Meshed One-to-Many/Many-to-One [3] Partially Meshed Multiple Devices [4] Partially Meshed Unidirectional Traffic [5] Congestion Control [6] Forward Pressure and Maximum Forwarding Rate [7] Address Caching Capacity [8] Address Learning Rate [9] Error-Frame Filtering [10] Broadcast Frame Forwarding and Latency
Fully Meshed Throughput, Frame Loss and Forwarding Rates	Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N = 0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120102A) (Cont'd)

Item	Specifications
Partially Meshed One to Many/Many to One	Inter Frame Gap: (Refer to Inter Frame Gap) Burst size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N = 0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed Multiple Devices	Traffic: Tx/Rx Ports $\leftrightarrow$ Tx/Rx Ports Local Traffic Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N = 0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed Unidirectional Traffic	Traffic: Tx/Rx Ports $\rightarrow$ Tx/Rx Ports Local Traffic Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N = 0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120102A) (Cont'd)

Item	Specifications
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: Step Size: 1 to 4294967295 frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Caching Capacity	<p>Traffic : Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535 s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 byte</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Learning Rate	<p>Traffic: Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535 s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 byte</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Error Frame Filtering	<p>Traffic: Tx Port, Rx port</p> <p>Duration: 2 to 300 s</p> <p>ILoad: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: 64 byte</p> <p>Result: Frame count, pass/fail</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120102A) (Cont'd)

Item	Specifications
Broadcast Frame Forwarding and Latency	<p>Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) , Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Tools Fragment	<p>Fragments already registered Stream data Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>
Environmental Performance Temperature range Power Consumption Size Weight	<p>Operation: 0 to +40°C Storage: -20 to +60°C Less than 25 W Based on PICMG2.0 R2.1 262.0 (W) × 20.0 (H) × 174.5 (D) mm It doesn't contain protuberance. Less than 1.0 kg</p>

A.3 MU120111A

Module (MU120111A)

Item	Specifications
Model name	MU120111A
Apparatus name	10/100M Ethernet Module
Composition	Module × 1
Interface	
Corresponding Specification	10BASE-T, 100BASE-TX
Connector	RJ-45
Number of Ports	8
Bit Rate	10 M, 100 Mbit/s
Auto Negotiation	On/Off
Flow Control	On/Off
LED	Link, Tx/Collision, Rx/Error
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	IPv4 Address, Netmask, Gateway
ARP Reply	Not send, Reply to this port ARP request, Reply to all ARP request
ICMP Echo (PING) Reply	Not send, Reply to this port ping request
IPv6(Opt12)	
This port	IPv6 Address, Default Router, Link-Local Address
Neighbor Solicitation Reply	Not send, Reply to this port IPv6 Address, Reply to all IPv6 Addresses
Echo Reply	Not send, Reply to This port Echo Request
Duplex Mode	Full/Half
MII/MDIO properties	Auto negotiation On/Off, Restart, Loop back On/Off, MII registers (Allows the current MII register values to be read and written), Flow Control Receive (Full Duplex Only), Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode	Normal, Monitor, Through*1, Address Swap*2
Stream	
Number of Streams	256 Streams/Port
Stream Setting	
Distribution	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)
Frame per Burst	1 to 16,777,215
Burst per Stream	1 to 16,777,215
Frame View	Raw Frame, Decoded

*1: On MU120111A, the Through mode can be used with port 1 and port 2, and with port 5 and port 6.

*2: On MU120111A, the Address Swap mode can be used with port 1 and port 5.

Appendix A Specifications

Module (MU120111A) (Cont'd)

Item	Specifications
Gap Setting	
Inter Frame Gap	10BASE-T: Resolution of 800 ns, 8 us to 1700s Settable as Fixed or Random. 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed or Random.
Inter Burst Gap	10BASE-T: Resolution of 800 ns, 8 us to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed
Inter Stream Gap	10BASE-T: Resolution of 800 ns, 8 us to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed

Module (MU120111A) (Cont'd)

Item	Specifications
Frame Setting	<p>Preamble Size: 4 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*3}: 1 layer VLAN tag can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label^{*3}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by PIM-SMv2 Protocol (Opt21): PIM Register Message</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*4}, Sequence Number^{*4}, Test Frame.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p>
Frame Size	<p>18 to 10,000 bytes (Settable as Auto, Fixed, Increment^{*5}, or Random^{*5})</p>

^{*3}: VLAN tag and MPLS labels cannot both be used simultaneously.

^{*4}: When a sequence number or time stamp is used, the checksum field of the TCP/UDP packet contains an error code.

^{*5}: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

Module (MU120111A) (Cont'd)

Item	Specifications
Protocol Setting	
Ethernet	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p>
IPv4 (RFC791)	<p>Version (4 bit): 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

Module (MU120111A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 (DEC) Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number (32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120111A) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120111A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120111A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	<p>Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply</p> <p>Hardware Type (8 bit): User defined 1 = 10MB Ethernet</p> <p>Hardware Address Length (8 bit): User defined 6 = for MAC address</p> <p>Hops (8 bit): User defined (0 to 255)</p> <p>Transaction ID (32 bit): User defined (0 to 4294967295(DEC))</p> <p>Seconds (16 bit): User defined (0 to 65535(DEC))</p> <p>Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast</p> <p>Client IP Address (32 bit): User defined</p> <p>Your IP Address (32 bit): User defined</p> <p>Server IP Address (32 bit): User defined</p> <p>Relay Agent IP Address (32 bit): User defined</p> <p>Client Hardware Address (16 byte): User defined</p> <p>Server Host Name (64 byte): User defined</p> <p>Boot File Name (128 byte): User defined</p> <p>Option (0 to 64 byte): User defined</p>
MPLS (RFC3031, 3032)	<p>Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved</p> <p>EXP (3 bit): User defined</p> <p>S (1 bit): Bottom of stack</p> <p>TTL (8 bit): User defined</p> <p>10 kinds of MPLS can set.</p>
VLAN (IEEE802.IQ-1998)	<p>TPID: 0x8100, User defined</p> <p>User priority (3 bit): 0 to 7 User defined</p> <p>CFI (1 bit): 1 = set 0 = reset</p> <p>VID (12 bit): Static, Increment, Decrement, Random Display at decimal</p>

Module (MU120111A) (Cont'd)

Item	Specifications
PIM (RFC2117)	<p>PIM Ver (4 bit): PIM Version number is 2.</p> <p>Type (4 bit): Types for specific PIM messages.</p> <ul style="list-style-type: none"> 0 = Hello 1 = Register 2 = Register-Stop 3 = Join/Prune 4 = Bootstrap 5 = Assert 6 = Graft (used in PIM-DM only) 7 = Graft-Ack (used in PIM-DM only) 8 = Candidate-RP-Advertisement <p>Adder length (8 bit): Auto</p> <p>Checksum (16 bit): Auto</p> <p>(The checksum is the 16-bit one's complement of the one's complement sum of the entire PIM message, (excluding the data portion in the Register message). For computing the checksum, the checksum field is zeroed.)</p>
MLDA (IETF Draft)	<p>MLDA Listener Query,</p> <p>MLDA Listener Acknowledgement,</p> <p>MLDA Listener Report</p>
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM

Appendix A Specifications

Module (MU120111A) (Cont'd)

Item	Specifications
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error Dribble Bit Error, Alignment Error, Collision IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option11 Packet BER Test: PRBS Error
Unframed BER Setting	Test Pattern*6: All 0, All 1, User 16, PRBS 23, PRBS 31 Error Insertion: Bit All Insertion Timing: Single, Rate(1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)
Measurement Function Counter Mode Ethernet IPv4 IPv6 (Opt12) TCP/UDP	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Dribble Bit, Alignment Error, Collision Line Error Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*7, UDP Checksum Error*7

*6: Only port 1 or 5 can be used for the unframed BER test on the MU120111A.

*7: On MU120111A, the packets fragmented in the IP layer are counted as error packets.

Appendix

Module (MU120111A) (Cont'd)

Item	Specifications
Data	<p>Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).</p> <p>User Defined counter conditions: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Packet BER Test (Opt11)	<p>Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate</p>

Module (MU120111A) (Cont'd)

Item	Specifications
Unframed BER Test Graph	Bit Error Count/Rate, *6 Pattern Sync. Loss Count/Second*6 8 kinds of graph are displayed simultaneously. 1 s, 1 min, 15 min, 60 min resolution
Capture Capture Buffer Capture Filter/Trigger Pattern and Error Conditions	8 Mbytes/Port Filter condition settings; Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings: Destination MAC Address: don't care, Match,Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s Manual Trigger: Trigger Position Settings; Top, Middle, Bottom Destination MAC Address:48 bit Mask:bit mask Source MAC Address:48 bit Mask:bit mask Pattern1,2; Pattern:128 bit Mask:byte mask Base position: Top of Frame, Top of IPv4 Header, Top of IPv6 Header*8,IPv6 Extension Headers(Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*8, Top of IP Payload Offset:0to65535 Error; Error type: Good Frame,FCS Error,Unclassified, Undersize, Fragments, Oversize,Oversize&FCS Error, Dribble Bit Error, Alignment Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*9, PRBS Frame Error*9 Combination; And,Or

*6: Only port 1 or 5 can be used for the unframed BER test on the MU120111A.

*8: Option 12 IPv6 Expansion is required.

*9: Option 11 Packet BER Test is required.

Module (MU120111A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400.
Replay	MD1230 Family includes Ethereal/Wireshark Convert Function. Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)*8, BGP4+ (Opt19) *8, IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2 (Opt12), MLDA (Opt22) *8, PIM-SMv2 (Opt21) *10, MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL

*8: Option 12 IPv6 Expansion is required.

*10: Option 12 IPv6 Expansion is required when IPv6 Addresses are used.
Option 21 supports only IPv4 Addresses.

Appendix A Specifications

Module (MU120111A) (Cont'd)

Item	Specifications
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s. Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
Automatic Test RFC2544 Automatic Test Port Pairs Test Setting Throughput	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095 Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999 Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%):Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), Frame/s, Bit/s, byte/s vs. Frame Size, Theoretical value

Module (MU120111A) (Cont'd)

Item	Specifications
Latency	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size
Frame Loss Rate	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop

Module (MU120111A) (Cont'd)

Item	Specifications
RFC2889 Automatic Test (Opt10)	<p>Following 10 types of tests can be supported.</p> <p>[1] Fully Meshed Throughput, Frame Loss, and Forwarding rate</p> <p>[2] Partially Meshed One-to-Many/Many-to-One</p> <p>[3] Partially Meshed Multiple Devices</p> <p>[4] Partially Meshed Unidirectional Traffic</p> <p>[5] Congestion Control</p> <p>[6] Forward Pressure and Maximum Forwarding Rate</p> <p>[7] Address Caching Capacity</p> <p>[8] Address Learning Rate</p> <p>[9] Error-Frame Filtering</p> <p>[10] Broadcast Frame Forwarding and Latency</p>
Fully Meshed Throughput, Frame Loss and Forwarding Rates	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed One to Many/Many to One	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports $\leftrightarrow$ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120111A) (Cont'd)

Item	Specifications
Partially Meshed Unidirectional Traffic	<p>Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: Step Size: 1 to 4294967295 frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Caching Capacity	<p>Traffic : Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535 s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 byte</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Appendix A Specifications

Module (MU120111A) (Cont'd)

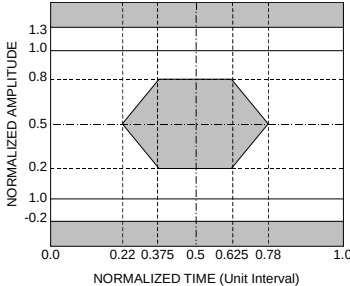
Item	Specifications
Address Learning Rate	Traffic: Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120111A) (Cont'd)

Item	Specifications
Error Frame Filtering	Traffic: Tx Port, Rx port Duration: 2 to 300 s ILoad: 0.01 to 100 %, 0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095
Broadcast Frame Forwarding and Latency	Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) , Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095
Tools Fragment	Fragments already registered Stream data Support Protocol: IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern: All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification: 0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.
Environmental Performance	
Temperature range	Operation: 0 to +40°C Storage: -20 to +60°C
Power Consumption	Less than 25 W
Size	Based on PICMG2.0 R2.1 262.0 (W) × 20.0 (H) × 174.5 (D) mm It doesn't contain protuberance.
Weight	Less than 1.0 kg

A.4 MU120112A

Module (MU120112A)

Item	Specifications
Model name Apparatus name Composition	MU120112A Gigabit Ethernet Module Module × 1
Interface Corresponding Specification Connector Number of Ports Bit Rate Pulse Mask	1000BASE-SX/LX/LH/ZX/T (depend on GBIC Module) GBIC (SC, RJ-45) 2 1000 Mbit/s 
Laser Safety Auto Negotiation Flow Control LED	IEC60825-1:2007 CLASS 1 On/Off On/Off Link, Tx, Rx, Error
Port setting MAC Address IPv4 This port ARP Reply ICMP Echo(PING) Reply IPv6(Opt12) This port Neighbor Solicitation Reply Echo Reply	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF MAC Address IPv4 Address, Netmask, Gateway Not send,Reply to this port ARP request,Reply to all ARP request Not send,Reply to this port ping request MAC Address IPv6 Address,Default Router,Link-Local Address Not send,Reply to this port IPv6 Address,Reply to all IPv6 Addresses Not send,Reply to This port Echo Request

Module (MU120112A) (Cont'd)

Item	Specifications
Protocols	IGMP:On/Off IGAP:On/Off MLD:On/Off MLDA:On/Off PIM:On/Off OSPF:On/Off OSPFv3:On/Off BGP4:On/Off BGP4+:On/Off MPLS(LDP/CR-LDP):On/Off MPLS(RSVP):On/Off
Duplex Mode	Full
MII/MDIO properties	Auto negotiation On/Off, Restart, Loop back On/Off, MII registers (Allows the current MII register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode	Normal, Monitor, Through, Address Swap
Optical Send	On/Off

Module (MU120112A) (Cont'd)

Item	Specifications
Stream Number of Streams	256 Streams/Port
Stream Setting Distribution Frame per Burst Burst per Stream Frame View	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000) 1 to 16,777,215 1 to 16,777,215 Raw Frame, Decoded
Gap Setting Inter Frame Gap Inter Burst Gap Inter Stream Gap	Minimum GAP when the length of the frame is a case of the odd number and Random/Inc is from 72 ns(9 bytes). Resolution of 8 ns, 64 ns to 120 s Settable as Fixed or Ran- dom. Resolution of 8 ns, 64 ns to 120 s Settable as Fixed Resolution of 8 ns, 64 ns to 120 s Settable as Fixed

Module (MU120112A) (Cont'd)

Item	Specifications
Frame Setting	<p>Preamble Size: 2 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*1}: 1 layer VLAN tag can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label^{*1}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by PIM-SMv2 Protocol (Opt21): PIM Register Message</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*2}, Sequence Number^{*2}, Test Frame.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p>
Frame Size	<p>48 to 65,280 bytes</p> <p>(Settable as Auto, Fixed, Increment^{*3}, or Random^{*3})</p>

*1: VLAN tag and MPLS labels cannot both be used simultaneously.

*2: When a sequence number or time stamp is used, the checksum field of the TCP/UDP packet contains an error code.

*3: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

Module (MU120112A) (Cont'd)

Item	Specifications
Protocol Setting	
Ethernet	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p>
IPv4 (RFC791)	<p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

Module (MU120112A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit) : User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120112A) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120112A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120112A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	<p>Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply</p> <p>Hardware Type (8bit): User defined 1 = 10MB Ethernet</p> <p>Hardware Address Length (8bit): User defined 6 = for MAC address</p> <p>Hops (8bit): User defined (0 to 255)</p> <p>Transaction ID (32bit): User defined (0 to 4294967295(DEC))</p> <p>Seconds (16 bit): User defined (0 to 65535(DEC))</p> <p>Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast</p> <p>Client IP Address (32 bit): User defined</p> <p>Your IP Address (32 bit): User defined</p> <p>Server IP Address (32 bit): User defined</p> <p>Relay Agent IP Address (32 bit): User defined</p> <p>Client Hardware Address (16 byte): User defined</p> <p>Server Host Name (64 byte): User defined</p> <p>Boot File Name (128 byte): User defined</p> <p>Option (0 to 64 byte): User defined</p>
MPLS (RFC3031, 3032)	<p>Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved</p> <p>EXP (3 bit): User defined</p> <p>S (1 bit): Bottom of stack</p> <p>TTL (8 bit): User defined</p> <p>10 kinds of MPLS can set.</p>
VLAN (IEEE802.IQ-1998)	<p>TPID: 0x8100, User defined</p> <p>User priority (3 bit): 0 to 7 User defined</p> <p>CFI (1 bit): 1 = set 0 = reset</p> <p>VID (12 bit): Static, Increment, Decrement, Random Display at decimal</p>

Module (MU120112A) (Cont'd)

Item	Specifications
PIM (RFC2117)	<p>PIM Ver (4 bit): PIM Version number is 2.</p> <p>Type (4 bit): Types for specific PIM messages.</p> <ul style="list-style-type: none"> 0 = Hello 1 = Register 2 = Register-Stop 3 = Join/Prune 4 = Bootstrap 5 = Assert 6 = Graft (used in PIM-DM only) 7 = Graft-Ack (used in PIM-DM only) 8 = Candidate-RP-Advertisement <p>Adder length (8 bit): Auto</p> <p>Checksum (16 bit): Auto</p> <p>(The checksum is the 16 bit one's complement of the one's complement sum of the entire PIM message, (excluding the data portion in the Register message). For computing the checksum, the checksum field is zeroed.)</p>
MLDA (IETF Draft)	<p>MLDA Listener Query,</p> <p>MLDA Listener Acknowledgement,</p> <p>MLDA Listener Report</p>
Template Ethernet OAM(Opt28)	<p>CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM</p>

Module (MU120112A) (Cont'd)

Item	Specifications
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option11 Packet BER Test: PRBS Error
Unframed BER Setting	Test Pattern: All 0, All 1, User 16, PRBS 23, PRBS 31, CJPAT, CRPAT Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)
Measurement Function Counter Mode Ethernet IPv4 IPv6 (Opt12) TCP/UDP	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Byte Alignment Error Line Error Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*4, UDP Checksum Error*4

*4: On MU120112A, the packets fragmented in the IP layer are not counted as error packets.

Module (MU120112A) (Cont'd)

Item	Specifications
Data	<p>Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).</p> <p>User Defined counter conditions; Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate

Module (MU120112A) (Cont'd)

Item	Specifications
Unframed BER Test Graph	Bit Error Count/Rate, Pattern Sync. Loss Count/Second 8 kinds of graph are displayed simultaneously. 1 s, 1 min, 15 min, 60 min resolution
Capture Capture Buffer Capture Filter/Trigger	32 Mbytes/Port Filter condition settings; Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s
Pattern and Error Conditions	Manual Trigger: Trigger Position Settings; Top, Middle, Bottom Destination MAC Address:48 bit Mask:bit mask Source MAC Address:48 bit Mask:bit mask Pattern1,2; Pattern:128 bit Mask:byte mask Base position:Top of Frame, Top of IPv4 Header, Top of IPv6 Header*5,IPv6 Extension Headers(Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*5, Top of IP Payload Offset:0 to 65535 Error; Error type: Good Frame,FCS Error,Undersize, Fragments, Oversize,Oversize&FCS Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*6, PRBS Frame Error*6 Combination; And,Or

*5: Option 12 IPv6 Expansion is required.

*6: Option 11 Packet BER Test is required.

Module (MU120112A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400.
Replay	MD1230 Family includes Ethereal/Wireshark Convert Function.
Latency	Capture frames are converted to Tx streams.
Protocol Emulation	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Ping	ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18) ^{*5} , BGP4+ (Opt19) ^{*5} , IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2 (Opt12), MLDA (Opt22) ^{*5} , PIM-SMv2 (Opt21) ^{*7} , MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)
	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL

^{*5}: Option 12 IPv6 Expansion is required.

^{*7}: Option 12 IPv6 Expansion is required when IPv6 Addresses are used.
Option 21 supports only IPv4 Addresses.

Appendix A Specifications

Module (MU120112A) (Cont'd)

Item	Specifications
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s. Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
Auto Negotiation Analysis (Opt15)	10B Code data transmitted function, Auto negotiation sequence capture function, Link timer value variable function

Module (MU120112A) (Cont'd)

Item	Specifications
Application Traffic Monitor (Opt20) Application Traffic Monitor	<p>Monitor Resolution: 1 ms</p> <p>Display Resolution: 1 ms, 10 ms, 100 ms, 500 ms, 1 s</p> <p>Counter Filter</p> <p>Counter: Counter 1, Counter 2</p> <p>Type: Pattern 1, Pattern 2, Source MAC, Destination MAC, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Filter:</p> <p>Type: Pattern 1, Pattern 2, Source MAC, Destination MAC, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Trigger:</p> <p>Type: Pattern 1, Pattern 2, Source MAC, Destination MAC, Error, Counter 1 Over, Counter 2 Over</p> <p>Condition: don't care, Match, Not match</p> <p>Flow:</p> <p>Display: On/Off, Up to 4 flows</p> <p>Flow/port: 2</p> <p>Marker: Marker 1, Marker 2, On/Off</p> <p>Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s</p> <p>Peak Hold Time: On/Off, 1s, 10s, 1min, 15min, Untimed</p> <p>Time Width: 100 to 2,000ms, Step 1ms (Display Resolution 1ms)</p> <p>1,000 to 20,000 ms, Step 10 ms (Display Resolution 10 ms)</p> <p>10,000 to 100,000 ms, Step 100 ms (Display Resolution 100 ms)</p> <p>50,000 to 500,000 ms, Step 500 ms (Display Resolution 500 ms)</p> <p>100,000 to 1,000,000 ms, Step 1,000 ms (Display Resolution 1 s)</p> <p>Range of Monitor Display:</p> <p>Minimum Value: 0 to 999,999,999 bit/s</p> <p>Maximum Value: (Minimum Value + 1) to 1,000,000,000 bit/s</p> <p>Result of Monitor: Graph display, MAX/MIN/AVE</p> <p>Logarithm: On/Off</p> <p>Auto scale: On/Off</p> <p>Full Screen: On/Off</p> <p>Log: On/Off, Log stop On/Off</p>

Appendix A Specifications

Module (MU120112A) (Cont'd)

Item	Specifications
Application Traffic Monitor Player	<p>Display Resolution: 1 ms, 10 ms, 100 ms, 500 ms, 1 s</p> <p>Flow:</p> <p>Display: On/Off, Up to 4 flows</p> <p>Marker: Marker 1, Marker 2, On/Off</p> <p>Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s</p> <p>Peak Hold Time: On/Off, 1 s, 10 s, 1 min, 15 min, Untimed</p> <p>Time Width: 100 to 2,000 ms, Step 1 ms (Display Resolution 1 ms)</p> <p>1,000 to 20,000 ms, Step 10 ms (Display Resolution 10 ms)</p> <p>10,000 to 100,000 ms, Step 100 ms (Display Resolution 100 ms)</p> <p>50,000 to 500,000 ms, Step 500 ms (Display Resolution 500 ms)</p> <p>100,000 to 1,000,000 ms, Step 1,000 ms (Display Resolution 1 s)</p> <p>Range of Monitor Display:</p> <p>Minimum Value: 0 to 999,999,999 bit/s</p> <p>Maximum Value: (Minimum Value + 1) to 1,000,000,000 bit/s</p> <p>Result of Monitor: Graph display, MAX/MIN/AVE</p> <p>Logarithm: On/Off</p> <p>Auto scale: On/Off</p> <p>Player: Playback, Temporally stop, Stop</p> <p>Display Movement: Top/end button, Slider bar</p> <p>Peak Search/Traffic Calculation</p> <p>Specify Range</p> <p>Mode: All, User defined</p> <p>Start: ms, s, min, hour</p> <p>Range: ms, s, min, hour</p> <p>Peak Search: Time, Traffic</p> <p>Traffic Calculation: Amount of Traffic</p>

Module (MU120112A) (Cont'd)

Item	Specifications
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095
Test Setting	Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999
Throughput	Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), Frame/s, Bit/s, byte/s vs. Frame Size, Theoretical value
Latency	Duration: 2 to 999 s Number of trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size
Frame Loss Rate	Duration: 2 to 999 s Number of trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate

Module (MU120112A) (Cont'd)

Item	Specifications
Back-to-Back Frames	Duration: 2 to 999 s Number of trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop
RFC2889 Automatic Test (Opt10)	Following 10 types of tests can be supported. [1] Fully Meshed Throughput, Frame Loss, and Forwarding rate [2] Partially Meshed One-to-Many/Many-to-One [3] Partially Meshed Multiple Devices [4] Partially Meshed Unidirectional Traffic [5] Congestion Control [6] Forward Pressure and Maximum Forwarding Rate [7] Address Caching Capacity [8] Address Learning Rate [9] Error-Frame Filtering [10] Broadcast Frame Forwarding and Latency
Fully Meshed Throughput, Frame Loss and Forwarding Rates	Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120112A) (Cont'd)

Item	Specifications
Partially Meshed One to Many/Many to One	Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed Multiple Devices	Traffic: Tx/Rx Ports $\leftrightarrow$ Tx/Rx Ports Local Traffic Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed Unidirectional Traffic	Traffic: Tx/Rx Ports $\rightarrow$ Tx/Rx Ports Local Traffic Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Congestion Control	Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Appendix A Specifications

Module (MU120112A) (Cont'd)

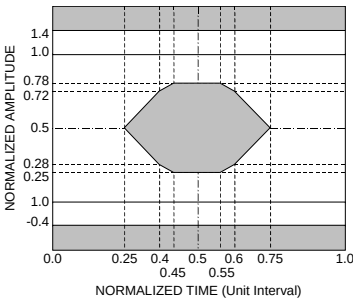
Item	Specifications
Forward Pressure and Maximum Forwarding Rate	Traffic: Tx Ports, Rx Port Duration: 2 to 300 s Frame Rate: Step Size: 1 to 4294967295 frame/s Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Maximum Forwarding Rate (fps), Result of forward pressure test VLAN Tag: On/Off VLAN ID: 0 to 4095
Address Caching Capacity	Traffic : Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Address Learning Rate	Traffic: Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Error Frame Filtering	Traffic: Tx Port, Rx port Duration: 2 to 300 s ILoad: 0.01 to 100 %, 0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095
Broadcast Frame Forwarding and Latency	Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) , Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120112A) (Cont'd)

Item	Specifications
Tools Fragment	<p>Fragments already registered Stream data</p> <p>Support Protocol: IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6</p> <p>Support Data Field: Data Field1</p> <p>Support Data Pattern: All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9</p> <p>Stream ID: 1 to 255, All</p> <p>MTU: 1 to 9936 byte</p> <p>Number of Datagrams: 1 to 127</p> <p>Initial Identification: 0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6)</p> <p>Increment Identification: On/Off</p> <p>To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>
Environmental Performance Temperature range	Operation: 0 to +40°C Storage: -20 to +60°C
Power Consumption	Less than 30 W
Size	Based on PICMG2.0 R2.1 262.0 (W) × 20.0 (H) × 174.5 (D) mm It doesn't contain protuberance.
Weight	Less than 1.0 kg

A.5 MU120118A

Module (MU120118A)

Item	Specifications
Model name	MU120118A
Apparatus name	10 Gigabit Ethernet Module
Composition	Module × 1
Option	MU120118A-01 WAN-PHY
Interface	
Corresponding Specification	10GBASE-SR/LR/ER/LW*1*2 (depend on XENPAK Module) 10GBASE-SR: IEEE 802.3ae-2002 Table52-7, 52-9 10GBASE-LR/LW: IEEE 802.3ae-2002 Table52-12, 52-13 10GBASE-ER: IEEE 802.3ae-2002 Table52-16, 52-17
Connector	XENPAK (SC)
Number of Ports	2
Bit Rate	10 Gbit/s
Clock Variation	Variable (XAUI Clock) Variable range: ±100 ppm
Pulse Mask	
Laser Safety	21 CFR 1040.10:1995 CLASS I, IEC60825-1:2001 CLASS 1
Flow Control	On/Off
LED	Link, Tx, Rx, Error

*1: Optical transmission/reception specifications conform to IEEE 802.3ae-2002.

*2: 10GBASE-LW needs MU120118A-01

Module (MU120118A) (Cont'd)

Item	Specifications
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	MAC Address IPv4 Address, Netmask, Gateway
ARP Reply	Not send, Reply to this port ARP request, Reply to all ARP request
ICMP Echo(PING) Reply	Not send, Reply to this port ping request
IPv6(Opt12)	
This port	MAC Address IPv6 Address, Default Router, Link-Local Address
Neighbor Solicitation Reply	Not send, Reply to this port IPv6 Address, Reply to all IPv6 Addresses
Echo Reply	Not send, Reply to this port Echo Request
Protocols	IGMP:On/Off IGAP:On/Off MLD:On/Off MLDA:On/Off PIM:On/Off OSPF:On/Off OSPFv3:On/Off BGP4:On/Off BGP4+:On/Off MPLS(LDP/CR-LDP):On/Off MPLS(RSVP):On/Off
Duplex Mode	Full
MII/MDIO properties	Loop back On/Off, MDIO registers (Allows the current MDIO register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode	Normal, Monitor, Through
Optical Send	On/Off

Appendix A Specifications

Module (MU120118A) (Cont'd)

Item	Specifications
Stream Number of Streams	256 Streams/Port
Stream Setting Distribution Frame per Burst Burst per Stream Frame View	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000) 1 to 1,099,511,627,775 1 to 1,099,511,627,775 Raw Frame, Decoded
Gap Setting Inter Frame Gap Inter Burst Gap Inter Stream Gap	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed or Random. Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed Resolution of 0.8 ns, 9.6 ns to 120 s Settable as Fixed

Module (MU120118A) (Cont'd)

Item	Specifications
Frame Setting	<p>Preamble Size: 2 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*3}: 1 layer VLAN tag can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label^{*3}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by PIM-SMv2 Protocol (Opt21): PIM Register Message</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*4}, Sequence Number^{*4}, Hardware Random Pattern^{*4}, Test Frame.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p>

^{*3}: VLAN tag and MPLS labels cannot both be used simultaneously.

^{*4}: When a sequence number or time stamp is used, the checksum field of the TCP/UDP packet contains an error code.

Module (MU120118A) (Cont'd)

Item	Specifications
Frame Size	48 to 65,280 bytes *5 (Settable as Auto, Fixed, Increment*6, or Random*6) *7
Protocol Setting Ethernet IPv4 (RFC791)	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p> <p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0) Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

*5: Frame Size is 48 to 9,600 bytes in WAN mode of 10GBASE-LW

*6: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

*7: Settable as only Auto, Fixed in WAN mode of 10GBASE-LW.

Module (MU120118A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial All 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max response time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120118A) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120118A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120118A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	<p>Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply</p> <p>Hardware type (8 bit): User defined 1 = 10MB Ethernet</p> <p>Hardware Address length (8 bit): User defined 6 = for MAC address</p> <p>Hops (8 bit): User defined (0 to 255)</p> <p>Transaction ID (32 bit): User defined (0 to 4294967295(DEC))</p> <p>Seconds (16 bit): User defined (0 to 65535(DEC))</p> <p>Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast</p> <p>Client IP Address (32 bit): User defined</p> <p>Your IP Address (32 bit): User defined</p> <p>Server IP Address (32 bit): User defined</p> <p>Relay Agent IP Address (32 bit): User defined</p> <p>Client Hardware Address (16 byte): User defined</p> <p>Server Host Name (64 byte): User defined</p> <p>Boot File Name (128 byte): User defined</p> <p>Option (0 to 64 byte): User defined</p>
MPLS (RFC3031, 3032)	<p>Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved</p> <p>EXP (3 bit): User defined</p> <p>S (1 bit): Bottom of stack</p> <p>TTL (8 bit): User defined</p> <p>10 kinds of MPLS can set.</p>
VLAN (IEEE802.IQ-1998)	<p>TPID: 0x8100, User defined</p> <p>User priority (3 bit): 0 to 7 User defined</p> <p>CFI (1 bit): 1 = set 0 = reset</p> <p>VID (12 bit): Static, Increment, Decrement, Random Display at decimal</p>

Module (MU120118A) (Cont'd)

Item	Specifications
PIM (RFC2117)	PIM Ver (4 bit): PIM Version number is 2. Type (4 bit): Types for specific PIM messages. 0 = Hello 1 = Register 2 = Register-Stop 3 = Join/Prune 4 = Bootstrap 5 = Assert 6 = Graft (used in PIM-DM only) 7 = Graft-Ack (used in PIM-DM only) 8 = Candidate-RP-Advertisement Adder length (8 bit): Auto Checksum (16 bit): Auto (The checksum is the 16 bit one's complement of the one's complement sum of the entire PIM message, (excluding the data portion in the Register message). For computing the checksum, the checksum field is zeroed.)
MLDA (IETF Draft)	MLDA Listener Query, MLDA Listener Acknowledgement, MLDA Listener Report
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error

Module (MU120118A) (Cont'd)

Item	Specifications
IP TCP/UDP Data	IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option11 Packet BER Test: PRBS Error
Unframed BER Setting	Test Pattern: All 0, All 1, User 16, PRBS 23, PRBS 31, CJPAT, CRPAT* ⁸ Error Insertion: Bit All, Bit All(Lane 0 to 3) Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 2.0E-3)
Measurement Function Counter Mode Ethernet IPv4 IPv6 (Opt12) TCP/UDP	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error* ⁹ , UDP Checksum Error* ⁹

*8: Cannot use Unframed in WAN mode of 10GBASE-LW

*9: On MU120118A, the packets fragmented in the IP layer are not counted as error packets.

Appendix A

Appendix

Module (MU120118A) (Cont'd)

Item	Specifications
Unframed BER Test	When XENPAK Test (Opt13) is installed: Bit Error Count/Rate, Pattern Sync. Loss Count/Second, Lane 0 to 3 Bit Error Count/Rate, Lane 0 to 3 Pattern Sync. Loss Count/Second
LFS (Opt16)	Transmitted/Received RF Signal, Transmitted/Received LF Signal
Graph	8 kinds of graph are displayed simultaneously. 1 s, 1 min, 15 min, 60 min resolution
Capture Capture Buffer Capture Filter/Trigger	256 Mbyte/Port Filter condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s Manual Trigger: Trigger Position Settings: Top, Middle, Bottom

Module (MU120118A) (Cont'd)

Item	Specifications
Pattern and Error Conditions	Destination MAC Address:48 bit Mask:bit mask Source MAC Address:48 bit Mask:bit mask Pattern1,2; Pattern:128 bit Mask:byte mask Base position:Top of Frame, Top of IPv4 Header, Top of IPv6 Header* ¹⁰ ,IPv6 Extension Headers(Hop by Hop,Destination, Routing,Fragment,Authentication, ESP)* ¹⁰ ,Top of IP Payload Offset:0 to 65535 Error; Error type: Good Frame,FCS Error,Undersize, Fragments, Oversize,Oversize&FCS Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error* ¹¹ , PRBS Frame Error* ¹¹ Combination: And,Or

*10: Option 12 IPv6 Expansion is required.

*11: Option 11 Packet BER Test is required.

Module (MU120118A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400. MD1230 Family includes Ethereal/Wireshark Convert Function.
Replay	Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1 s sampling value, max, min, avg. and number of samples. Note: Because the WAN-PHY XENPAK module has a buffer, the Latency dispersion is large compared to the LAN-PHY XENPAK module.
Protocol Emulation	ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)* ¹⁰ , BGP4+ (Opt19) * ¹⁰ , IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2(Opt12), MLDA (Opt22) * ¹⁰ , PIM-SMv2 (Opt21)* ¹² , MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)

*10: Option 12 IPv6 Expansion is required.

*12: Option 12 IPv6 Expansion is required when IPv6 Addresses are used.
Option 21 supports only IPv4 Addresses.

Module (MU120118A) (Cont'd)

Item	Specifications
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s. Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
LFS (Opt16)	Send Data function Signal Pattern: Remote Fault Signal, Local Fault Signal, Edit Signal. Edit Signal Pattern: TXC 1000 to 1111(bin), TXD 9C000000 to 9CFFFFFF(hex) Physical Layer Capture function Port: Port1, Port2, Port1&Port2 capture size: 512Line (1Line Lane1 to Lane4 (RXC 4bit, RXD 4byte)) Trigger setting: On/Off Trigger Pattern: Data RXC 4bit, RXD 4byte
WAN-PHY (Opt01)	PCS Type: WAN, LANLOP-P Detection: On/Off Counter Error: Far End Path Block Error, Path Block Error, Far End Line BIP Error, Line BIP Error, Section BIP Error Alarm: Far End AIS-P/LOP-P, Far End PLM-P/LCD-P, PLM-P, LOP-P, AIS-P, RDI-L, AIS-L, SEF/LOF, LOS Monitor STS Pointer(H1, H2): NDF, SS, Pointer STS Pointer(CI): NDF, SS, Pointer

Module (MU120118A) (Cont'd)

Item	Specifications
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120118A) (Cont'd)

Item	Specifications
Test Setting	Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999
Throughput	Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), Frame/s, Bit/s, byte/s vs. Frame Size, Theoretical value
Latency	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size
Frame Loss Rate	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop

Module (MU120118A) (Cont'd)

Item	Specifications
RFC2889 Automatic Test (Opt10)	<p>Following 10 types of tests can be supported.</p> <p>[1] Fully Meshed Throughput, Frame Loss, and Forwarding rate</p> <p>[2] Partially Meshed One-to-Many/Many-to-One</p> <p>[3] Partially Meshed Multiple Devices</p> <p>[4] Partially Meshed Unidirectional Traffic</p> <p>[5] Congestion Control</p> <p>[6] Forward Pressure and Maximum Forwarding Rate</p> <p>[7] Address Caching Capacity</p> <p>[8] Address Learning Rate</p> <p>[9] Error-Frame Filtering</p> <p>[10] Broadcast Frame Forwarding and Latency</p>
Fully Meshed Throughput, Frame Loss and Forwarding Rates	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed One to Many/Many to One	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports ↔ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 10to 4095</p>

Module (MU120118A) (Cont'd)

Item	Specifications
Partially Meshed Unidirectional Traffic	<p>Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: Step Size: 1 to 4294967295 frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Caching Capacity	<p>Traffic : Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535 s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 byte</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Appendix A Specifications

Module (MU120118A) (Cont'd)

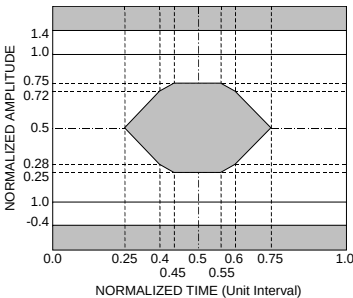
Item	Specifications
Address Learning Rate	<p>Traffic: Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Error Frame Filtering	<p>Traffic: Tx Port, Rx port Duration: 2 to 300 s ILoad: 0.01 to 100 %, 0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Broadcast Frame Forwarding and Latency	<p>Traffic: Tx Port, Rx port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Tools Fragment	<p>Fragments already registered Stream data Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>

Module (MU120118A) (Cont'd)

Item	Specifications
Environmental Performance	
Temperature range	Operation: 0 to +40°C Storage: -20 to +60°C
Power Consumption	Less than 70 W
Size	Based on PICMG2.0 R2.1 262.0 (W) × 40.0 (H) × 174.5 (D) mm It doesn't contain protuberance.
Weight	Less than 2.0 kg

A.6 MU120118B

Module (MU120118B)

Item	Specifications
Model name	MU120118B
Apparatus name	10 Gigabit Ethernet Module
Composition	Module × 1
Option	MU120118B-01 WAN-PHY
Interface	
Corresponding Specification	10GBASE-SR/LR/ER/LW*1*2 (depend on XENPAK Module) 10GBASE-SR: IEEE 802.3ae-2002 Table52-7, 52-9 10GBASE-LR/LW: IEEE 802.3ae-2002 Table52-12, 52-13 10GBASE-ER: IEEE 802.3ae-2002 Table52-16, 52-17
Connector	XENPAK (SC)
Number of Ports	2
Bit Rate	10 Gbit/s
Clock Variation	Variable (XAUI Clock) Variable range: ±100 ppm
Pulse Mask	
Laser Safety	IEC60825-1:2007 CLASS 1
Flow Control	On/Off
LED	Link, Tx, Rx, Error

*1: Optical transmission/reception specifications conform to IEEE 802.3ae-2002.

*2: 10GBASE-LW needs MU120118B-01

Module (MU120118B) (Cont'd)

Item	Specifications
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	MAC Address IPv4 Address, Netmask, Gateway
ARP Reply	Not send, Reply to this port ARP request, Reply to all ARP request
ICMP Echo(PING) Reply	Not send, Reply to this port ping request
IPv6(Opt12)	
This port	MAC Address IPv6 Address, Default Router, Link-Local Address
Neighbor Solicitation Reply	Not send, Reply to this port IPv6 Address, Reply to all IPv6 Addresses
Echo Reply	Not send, Reply to This port Echo Request
Protocols	IGMP:On/Off IGAP:On/Off MLD:On/Off MLDA:On/Off PIM:On/Off OSPF:On/Off OSPFv3:On/Off BGP4:On/Off BGP4+:On/Off MPLS(LDP/CR-LDP):On/Off MPLS(RSVP):On/Off
Duplex Mode	Full
MII/MDIO properties	Loop back On/Off, MDIO registers (Allows the current MDIO register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode	Normal, Monitor, Through
Optical Send	On/Off
Stream	
Number of Streams	256 Streams/Port
Stream Setting	
Distribution	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000),
Frame per Burst	1 to 1,099,511,627,775
Burst per Stream	1 to 1,099,511,627,775
Frame View	Raw Frame, Decoded
Gap Setting	
Inter Frame Gap	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed or Random.
Inter Burst Gap	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed
Inter Stream Gap	Resolution of 0.8 ns, 9.6 ns to 120 s Settable as Fixed

Module (MU120118B) (Cont'd)

Item	Specifications
Frame Setting	<p>Preamble Size: 2 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*3}: 1 layer VLAN tag can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label^{*3}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by PIM-SMv2 Protocol (Opt21): PIM Register Message</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*4}, Sequence Number^{*4}, Hardware Random Pattern^{*4}, Test Frame.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p>

*3: VLAN tag and MPLS labels cannot both be used simultaneously.

*4: When a sequence number or time stamp is used, the checksum field of the TCP/UDP packet contains an error code.

Module (MU120118B) (Cont'd)

Item	Specifications
Frame Size	48 to 65,280 bytes * ⁵ (Settable as Auto, Fixed, Increment* ⁶ , or Random* ⁶) * ⁷
Protocol Setting Ethernet IPv4 (RFC791)	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p> <p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0) Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

*⁵: Frame Size is 48 to 9,600 bytes in WAN mode of 10GBASE-LW

*⁶: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

*⁷: Settable as only Auto, Fixed in WAN mode of 10GBASE-LW.

Module (MU120118B) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120118B) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120118B) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120118B) (Cont'd)

Item	Specifications
DHCP (RFC2131)	Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8 bit): User defined 6 = for MAC address Hops (8 bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined
MPLS (RFC3031, 3032)	Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.
VLAN (IEEE802.IQ-1998)	TPID: 0x8100, User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal

Module (MU120118B) (Cont'd)

Item	Specifications
PIM (RFC2117)	<p>PIM Ver (4 bit): PIM Version number is 2.</p> <p>Type (4 bit): Types for specific PIM messages.</p> <ul style="list-style-type: none"> 0 = Hello 1 = Register 2 = Register-Stop 3 = Join/Prune 4 = Bootstrap 5 = Assert 6 = Graft (used in PIM-DM only) 7 = Graft-Ack (used in PIM-DM only) 8 = Candidate-RP-Advertisement <p>Adder length (8 bit): Auto</p> <p>Checksum (16 bit): Auto (The checksum is the 16 bit one's complement of the one's complement sum of the entire PIM message, (excluding the data portion in the Register message). For computing the checksum, the checksum field is zeroed.)</p>
MLDA (IETF Draft)	<p>MLDA Listener Query,</p> <p>MLDA Listener Acknowledgement,MLDA Listener Report</p>
Template Ethernet OAM(Opt28)	<p>CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM</p>
Error Insertion Ethernet	<p>FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error</p>

Module (MU120118B) (Cont'd)

Item	Specifications
IP TCP/UDP Data	IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option11 Packet BER Test: PRBS Error
Unframed BER Setting	Test Pattern: All 0, All 1, User 16, PRBS 23, PRBS 31, CJPAT, CRPAT* ⁸ Error Insertion: Bit All, Bit All(Lane 0 to 3) Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 2.0E-3)
Measurement Function Counter Mode Ethernet IPv4 IPv6 (Opt12) TCP/UDP Data Packet BER Test (Opt11)	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error* ⁹ , UDP Checksum Error* ⁹ Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority). User Defined counter conditions; Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture. Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate

- *8: Cannot use Unframed in WAN mode of 10GBASE-LW
- *9: On MU120118B, the packets fragmented in the IP layer are not counted as error packets.

Module (MU120118B) (Cont'd)

Item	Specifications
Unframed BER Test	When XENPAK Test (Opt13) is installed: Bit Error Count/Rate, Pattern Sync. Loss Count/Second, Lane 0 to 3 Bit Error Count/Rate, Lane 0 to 3 Pattern Sync. Loss Count/Second
LFS (Opt16)	Transmitted/Received RF Signal, Transmitted/Received LF Signal
Graph	8 kinds of graph are displayed simultaneously. 1 s, 1 min, 15 min, 60 min resolution
Capture Capture Buffer Capture Filter/Trigger	256 Mbyte/Port Filter condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range: 0 to 100% Latency is out of range: 1 ns to 59 s Manual Trigger: Trigger Position Settings: Top, Middle, Bottom

Module (MU120118B) (Cont'd)

Item	Specifications
Pattern and Error Conditions	<p>Destination MAC Address:48 bit Mask:bit mask Source MAC Address:48 bit Mask:bit mask Pattern1,2; Pattern:128 bit Mask:byte mask Base position:Top of Frame, Top of IPv4 Header, Top of IPv6 Header*¹⁰,IPv6 Extension Headers(Hop by Hop,Destination, Routing,Fragment,Authentication, ESP)*¹⁰, Top of IP Payload Offset:0 to 65535 Error; Error type: Good Frame,FCS Error,Undersize, Fragments, Oversize,Oversize&FCS Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*¹¹, PRBS Frame Error*¹¹ Combination; And,Or</p>
Decode Protocol	<p>Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be in- creased up to 400. MD1230 Family includes Ethereal/Wireshark Convert Function.</p>
Extended Decode Protocol	
Replay	Capture frames are converted to Tx streams.
Latency	<p>When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples. Note: Because the WAN-PHY XENPAK module has a buffer, the Latency dispersion is large compared to the LAN-PHY XENPAK module.</p>
Protocol Emulation	<p>ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)*¹⁰, BGP4+ (Opt19) *¹⁰, IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2 (Opt12), MLDA (Opt22) *¹⁰, PIM-SMv2 (Opt21)*¹², MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)</p>
Ping	<p>Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL</p>

*10: Option 12 IPv6 Expansion is required.

*11: Option 11 Packet BER Test is required.

*12: Option 12 IPv6 Expansion is required when IPv6 Addresses are used.
Option 21 supports only IPv4 Addresses.

Module (MU120118B) (Cont'd)

Item	Specifications
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s. Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
LFS (Opt16)	Send Data function Signal Pattern: Remote Fault Signal, Local Fault Signal, Edit Signal. Edit Signal Pattern: TXC 1000 to 1111(bin), TXD 9C000000 to 9CFFFFFF(hex) Physical Layer Capture function Port: Port1, Port2, Port1&Port2 capture size: 512Line (1Line Lane1 to Lane4 (RXC 4bit, RXD 4byte)) Trigger setting: On/Off Trigger Pattern: Data RXC 4bit, RXD 4byte
WAN-PHY (Opt01)	PCS Type: WAN, LAN LOP-P Detection: On/Off Counter Error: Far End Path Block Error, Path Block Error, Far End Line BIP Error, Line BIP Error, Section BIP Error Alarm: Far End AIS-P/LOP-P, Far End PLM-P/LCD-P, PLM-P, LOP-P, AIS-P, RDI-L, AIS-L, SEF/LOF, LOS Monitor STS Pointer(H1, H2): NDF, SS, Pointer STS Pointer(CI): NDF, SS, Pointer

Module (MU120118B) (Cont'd)

Item	Specifications
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095
Test Setting	Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999

Module (MU120118B) (Cont'd)

Item	Specifications
Throughput	Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), Frame/s, Bit/s, byte/s vs. Frame Size, Theoretical value
Latency	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size
Frame Loss Rate	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop

Module (MU120118B) (Cont'd)

Item	Specifications
RFC2889 Automatic Test (Opt10)	<p>Following 10 types of tests can be supported.</p> <p>[1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate</p> <p>[2] Partially Meshed One-to-Many/Many-to-One</p> <p>[3] Partially Meshed Multiple Devices</p> <p>[4] Partially Meshed Unidirectional Traffic</p> <p>[5] Congestion Control</p> <p>[6] Forward Pressure and Maximum Forwarding Rate</p> <p>[7] Address Caching Capacity</p> <p>[8] Address Learning Rate</p> <p>[9] Error-Frame Filtering</p> <p>[10] Broadcast Frame Forwarding and Latency</p>
Fully Meshed Throughput, Frame Loss and Forwarding Rates	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed One to Many/Many to One	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports $\leftrightarrow$ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120118B) (Cont'd)

Item	Specifications
Partially Meshed Unidirectional Traffic	Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Congestion Control	Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Forward Pressure and Maximum Forwarding Rate	Traffic: Tx Ports, Rx Port Duration: 2 to 300 s Frame Rate: Step Size: 1 to 4294967295 frame/s Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Maximum Forwarding Rate (fps), Result of forward pressure test VLAN Tag: On/Off VLAN ID: 0 to 4095
Address Caching Capacity	Traffic : Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120118B) (Cont'd)

Item	Specifications
Address Learning Rate	Traffic: Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Error Frame Filtering	Traffic: Tx Port, Rx port Duration: 2 to 300 s ILoad: 0.01 to 100 %, 0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095
Broadcast Frame Forwarding and Latency	Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095
Tools Fragment	Fragments already registered Stream data Support Protocol: IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern: All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification: 0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.

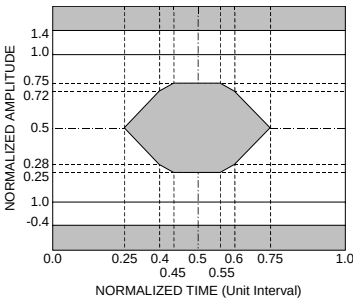
Appendix A Specifications

Module (MU120118B) (Cont'd)

Item	Specifications
Environmental Performance	
Temperature range	Operation: 0 to +40°C Storage: -20 to +60°C
Power Consumption	Less than 70 W
Size	Based on PICMG2.0 R2.1 262.0 (W) × 40.0 (H) × 174.5 (D) mm It doesn't contain protuberance.
Weight	Less than 2.0 kg

A.7 MU120118C

Module (MU120118C)

Item	Specifications
Model name	MU120118C
Apparatus name	10 Gigabit Ethernet Module
Composition	Module × 1
Option	MU120118C-01 WAN-PHY
Interface	
Corresponding Specification	10GBASE-SR/LR/ER/LW*1*2 (depend on XENPAK Module 10GBASE-SR: IEEE 802.3ae-2002 Table52-7, 52-9 10GBASE-LR/LW: IEEE 802.3ae-2002 Table52-12, 52-13 10GBASE-ER: IEEE 802.3ae-2002 Table52-16, 52-17
Connector	XENPAK (SC)
Number of Ports	1
Bit Rate	10 Gbit/s
Clock Variation	Variable (XAUI Clock) Variable range: ±100 ppm
Pulse Mask	
Laser Safety	IEC60825-1:2007 CLASS 1
Flow Control	On/Off
LED	Link, Tx, Rx, Error

*1: Optical transmission/reception specifications conform to IEEE 802.3ae-2002.

*2: 10GBASE-LW needs MU120118C-01.

Module (MU120118C) (Cont'd)

Item	Specifications
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	MAC Address IPv4 Address, Netmask, Gateway
ARP Reply	Not send, Reply to this port ARP request, Reply to all ARP request
ICMP Echo(PING) Reply	Not send, Reply to this port ping request
IPv6(Opt12)	
This port	MAC Address IPv6 Address, Default Router, Link-Local Address
Neighbor Solicitation Reply	Not send, Reply to this port IPv6 Address, Reply to all IPv6 Addresses
Echo Reply	Not send, Reply to This port Echo Request
Protocols	IGMP:On/Off IGAP:On/Off MLD:On/Off MLDA:On/Off PIM:On/Off OSPF:On/Off OSPFv3:On/Off BGP4:On/Off BGP4+:On/Off MPLS(LDP/CR-LDP):On/Off MPLS(RSVP):On/Off
Duplex Mode	Full
MII/MDIO properties	Loop back On/Off, MDIO registers (Allows the current MDIO register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode	Normal, Monitor, Through
Optical Send	On/Off
Stream	
Number of Streams	256 Streams/Port
Stream Setting	
Distribution	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)
Frame per Burst	1 to 1,099,511,627,775
Burst per Stream	1 to 1,099,511,627,775
Frame View	Raw Frame, Decoded

Module (MU120118C) (Cont'd)

Item	Specifications
Gap Setting	
Inter Frame Gap	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed or Random.
Inter Burst Gap	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed
Inter Stream Gap	Resolution of 0.8 ns, 9.6 ns to 120 s Settable as Fixed
Frame Setting	<p>Preamble Size: 2 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*3}: 1 layer VLAN tag can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label^{*3}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by PIM-SMv2 Protocol (Opt21): PIM Register Message</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*4}, Sequence Number^{*4}, Hardware Random Pattern^{*4}, Test Frame.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p>

- *3: VLAN tag and MPLS labels cannot both be used simultaneously.
- *4: When a sequence number or time stamp is used, the checksum field of the TCP/UDP packet contains an error code.

Module (MU120118C) (Cont'd)

Item	Specifications
Frame Size	48 to 65,280 bytes * ⁵ (Settable as Auto, Fixed, Increment* ⁶ , or Random* ⁶) * ⁷
Protocol Setting Ethernet IPv4 (RFC791)	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p> <p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0) Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

*⁵: Frame Size is 48 to 9,600 bytes in WAN mode of 10GBASE-LW

*⁶: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

*⁷: Settable as only Auto, Fixed in WAN mode of 10GBASE-LW.

Module (MU120118C) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120118C) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120118C) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120118C) (Cont'd)

Item	Specifications
DHCP (RFC2131)	Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8 bit): User defined 6 = for MAC address Hops (8 bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined
MPLS (RFC3031, 3032)	Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.
VLAN (IEEE802.IQ-1998)	TPID: 0x8100, User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal

Appendix A Specifications

Module (MU120118C) (Cont'd)

Item	Specifications
PIM (RFC2117)	PIM Ver (4 bit): PIM Version number is 2. Type (4 bit): Types for specific PIM messages. 0 = Hello 1 = Register 2 = Register-Stop 3 = Join/Prune 4 = Bootstrap 5 = Assert 6 = Graft (used in PIM-DM only) 7 = Graft-Ack (used in PIM-DM only) 8 = Candidate-RP-Advertisement Adder length (8 bit): Auto Checksum (16 bit): Auto (The checksum is the 16 bit one's complement of the one's complement sum of the entire PIM message, (excluding the data portion in the Register message). For computing the checksum, the checksum field is zeroed.)
MLDA (IETF Draft)	MLDA Listener Query, MLDA Listener Acknowledgement, MLDA Listener Report
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error

Module (MU120118C) (Cont'd)

Item	Specifications
IP TCP/UDP Data	IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option11 Packet BER Test: PRBS Error
Unframed BER Setting	Test Pattern: All 0, All 1, User 16, PRBS 23, PRBS 31, CJPAT, CRPAT* ⁸ Error Insertion: Bit All, Bit All(Lane 0 to 3) Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 2.0E-3)
Measurement Function Counter Mode Ethernet	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply
IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error
IPv6 (Opt12)	Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count
TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error* ⁹ , UDP Checksum Error* ⁹
Data	Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority). User Defined counter conditions; Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate

- *8: Cannot use Unframed in WAN mode of 10GBASE-LW
- *9: On MU120118C, the packets fragmented in the IP layer are not counted as error packets.

Module (MU120118C) (Cont'd)

Item	Specifications
Unframed BER Test	When XENPAK Test (Opt13) is installed: Bit Error Count/Rate, Pattern Sync. Loss Count/Second, Lane 0 to 3 Bit Error Count/Rate, Lane 0 to 3 Pattern Sync. Loss Count/Second
LFS (Opt16)	Transmitted/Received RF Signal, Transmitted/Received LF Signal
Graph	8 kinds of graph are displayed simultaneously. 1 s, 1 min, 15 min, 60 min resolution
Capture Capture Buffer Capture Filter/Trigger	256 Mbyte/Port Filter condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings: Destination MAC Address: don't care, Match, Not match Source MAC Address: don't care, Match, Not match Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s Manual Trigger: Trigger Position Settings: Top, Middle, Bottom

Module (MU120118C) (Cont'd)

Item	Specifications
Pattern and Error Conditions	<p>Destination MAC Address:48 bit Mask:bit mask Source MAC Address:48 bit Mask:bit mask Pattern1,2; Pattern:128 bit Mask:byte mask Base position:Top of Frame, Top of IPv4 Header, Top of IPv6 Header*¹⁰,IPv6 Extension Headers(Hop by Hop,Destination, Routing,Fragment,Authentication, ESP)*¹⁰, Top of IP Payload Offset:0 to 65535 Error; Error type: Good Frame,FCS Error,Undersize, Fragments, Oversize,Oversize&FCS Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*¹¹, PRBS Frame Error*¹¹ Combination; And,Or</p>
Decode Protocol	<p>Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be in- creased up to 400. MD1230 Family includes Ethereal/Wireshark Convert Function.</p>
Extended Decode Protocol	
Replay	<p>Capture frames are converted to Tx streams.</p>
Latency	<p>When Test Frames are received, the latency is indicated. The result includes 1 s sampling value, max, min, avg. and number of samples. Note: Because the WAN-PHY XENPAK module has a buffer, the Latency dispersion is large compared to the LAN-PHY XENPAK module.</p>
Protocol Emulation	<p>ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)*¹⁰, BGP4+ (Opt19) *¹⁰, IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2 (Opt12), MLDA (Opt22) *¹⁰, PIM-SMv2 (Opt21)*¹², MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)</p>

*10: Option 12 IPv6 Expansion is required.

*11: Option 11 Packet BER Test is required.

*12: Option 12 IPv6 Expansion is required when IPv6 Addresses are used.
Option 21 supports only IPv4 Addresses.

Module (MU120118C) (Cont'd)

Item	Specifications
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s. Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
LFS (Opt16)	Send Data function Signal Pattern: Remote Fault Signal, Local Fault Signal, Edit Signal. Edit Signal Pattern: TXC 1000 to 1111(bin), TXD 9C000000 to 9CFFFFFF(hex) Physical Layer Capture function Port: Port1 capture size: 512Line (1Line Lane1 to Lane4 (RXC 4bit, RXD 4byte)) Trigger setting: On/Off Trigger Pattern: Data RXC 4bit, RXD 4byte
WAN-PHY (Opt01)	PCS Type: WAN, LAN LOP-P Detection: On/Off Counter Error: Far End Path Block Error, Path Block Error, Far End Line BIP Error, Line BIP Error, Section BIP Error Alarm: Far End AIS-P/LOP-P, Far End PLM-P/LCD-P, PLM-P, LOP-P, AIS-P, RDI-L, AIS-L, SEF/LOF, LOS Monitor STS Pointer(H1, H2): NDF, SS, Pointer STS Pointer(CD): NDF, SS, Pointer

Module (MU120118C) (Cont'd)

Item	Specifications
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120118C) (Cont'd)

Item	Specifications
Test Setting	Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999
Throughput	Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), or Frame/s or Bit/s or byte/s vs. Frame Size, Theoretical value
Latency	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size
Frame Loss Rate	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop

Module (MU120118C) (Cont'd)

Item	Specifications
RFC2889 Automatic Test (Opt10)	<p>Following 10 types of tests can be supported.</p> <p>[1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate</p> <p>[2] Partially Meshed One-to-Many/Many-to-One</p> <p>[3] Partially Meshed Multiple Devices</p> <p>[4] Partially Meshed Unidirectional Traffic</p> <p>[5] Congestion Control</p> <p>[6] Forward Pressure and Maximum Forwarding Rate</p> <p>[7] Address Caching Capacity</p> <p>[8] Address Learning Rate</p> <p>[9] Error-Frame Filtering</p> <p>[10] Broadcast Frame Forwarding and Latency</p>
Fully Meshed Throughput, Frame Loss and Forwarding Rates	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed One to Many/Many to One	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports ↔ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120118C) (Cont'd)

Item	Specifications
Partially Meshed Unidirectional Traffic	<p>Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: Step Size: 1 to 4294967295 frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Caching Capacity	<p>Traffic : Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535 s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 byte</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Appendix A Specifications

Module (MU120118C) (Cont'd)

Item	Specifications
Address Learning Rate	<p>Traffic: Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Error Frame Filtering	<p>Traffic: Tx Port, Rx Port Duration: 2 to 300 s ILoad: 0.01 to 100 %, 0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Broadcast Frame Forwarding and Latency	<p>Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Tools Fragment	<p>Fragments already registered Stream data Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>

Module (MU120118C) (Cont'd)

Item	Specifications
Environmental Performance	
Temperature range	Operation: 0 to +40°C Storage: -20 to +60°C
Power Consumption	Less than 35 W
Size	Based on PICMG2.0 R2.1 262.0 (W) × 40.0 (H) × 174.5 (D) mm It doesn't contain protuberance.
Weight	Less than 1.5 kg

A.8 MU120121A

Module (MU120121A)

Item	Specifications
Model name	MU120121A
Apparatus name	10/100/1000M Ethernet Module
Composition	Module × 1
Interface	
Corresponding Specification	Electrical: 10BASE-T, 100BASE-TX, 1000BASE-T
Connector	RJ-45 (Auto MDI-X)
Number of Ports	4
Bit Rate	10, 100, 1000 Mbit/s
Auto Negotiation	On/Off
Flow Control	On/Off
LED	Tx/Collision, Rx/Error, 10 M, 100 M, 1000M, Duplex
CPU Port	Inter face: 10BASE-T, 100BASE-TX Connector: RJ-45 (Auto MDI-X) LED: Link, ACT
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	MAC Address IPv4 Address, Netmask, Gateway
ARP Reply	Not send,Reply to this port ARP request,Reply to all ARP request
ICMP Echo(PING) Reply	Not send,Reply to this port ping request
IPv6(Opt12)	
This port	MAC Address IPv6 Address,Default Router,Link-Local Address
Neighbor Solicitation Reply	Not send,Reply to this port IPv6 Address,Reply to all IPv6 Addresses
Echo Reply	Not send,Reply to This port Echo Request
VLAN (IEEE802.IQ-1998)	Enabled:On/Off Only VLAN-Tagged Frames:On/Off TPID,Priority,VID Acceptable VID:This Port VID,All VID
Ethernet OAM(Opt28)	Enabled:On/Off Standard:ITU-T/IEEE DUT MEP ID:0to8191
This port	Reply to This Port LBM:On/Off Reply to This Port LTM:On/Off LTR TLVs:0to120 byte Send CCM:On/Off Insert RDI:On/Off MEG Level:0 to 7 MEP ID:0 to 8191 MEG ID:48 byte CCM Period:1 s, 10 s, 1 min, 10 min. CCM TLVs:0 to 80 byte

Module (MU120121A) (Cont'd)

Item	Specifications
Protocols	IGMP:On/Off IGAP:On/Off MLD:On/Off MLDA:On/Off PIM:On/Off OSPF:On/Off OSPFv3:On/Off BGP4:On/Off BGP4+:On/Off MPLS(LDP/CR-LDP):On/Off MPLS(RSVP):On/Off
Duplex Mode	Full/Half
MII/MDIO properties	1000Mbps Half Duplex is used only for the link test.
	Auto negotiation On/Off, Restart, Loop back On/Off, Auto MDI/MDI-X On/Off, MII registers (Allows the current MII register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode	Normal, Monitor, Through* ¹ , Address Swap, Impairment(opt17)* ²
Preamble	On/Off
	Note: To capture the preamble data of frames, set "Preamble" to On.

*1: On MU120121A, the Through mode can be used with port 1 and port 2, and with port 3 and port 4.

*2: Only Impairment can be selected when Impairment is selected by Setup Utility.

Module (MU120121A) (Cont'd)

Item	Specifications
Link Mode	On/Off
Frequency Monitor Accuracy	Frequency(Hz), Difference(Hz), Difference(ppm) Difference display range: –1000 to +1000 ppm Enabled for 100BASE-TX and 1000BASE-T. Based on 125 MHz in the case of 100BASE-TX. Based on 1250 MHz in the case of 1000BASE-T. ±4.0 ppm
Clock Offset Accuracy	–100 to +100 ppm ±4.0 ppm
Stream Number of Streams	256 Streams/Port
Stream Setting Distribution Frame per Burst Burst per Stream Frame View	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000), Jump to Stream for Count and Stop (Loop Count: 1 to 16,000,000) 1 to 16,777,215 1 to 1,099,511,627,775 Raw Frame, Decoded
Gap Setting Inter Frame Gap Inter Burst Gap Inter Stream Gap	10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as Fixed or Random. 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed or Random, 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed or Random. 10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed 10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed

Module (MU120121A) (Cont'd)

Item	Specifications
Frame Setting	<p>Preamble Size: 4 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*3}: Up to 10 layer VLAN tags can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label^{*3}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Programmable Data Link Layer^{*3}: Up to 32 bytes field can be set.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC, Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMP/IPv6 over IPv4, TCP/IPv6, over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by PIM-SMv2 Protocol (Opt 21): PIM Register Message</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Test Frame. Settable Flow ID number when Test Frame is used.</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*4}, Sequence Number^{*4}, Hardware Random Pattern^{*4}, Programmable Header Pattern: 1 user defined pattern can be set.</p>
Frame Size	<p>48 to 10,000 bytes (Settable as Auto, Fixed, Increment^{*5}, or Random^{*5})</p>

^{*3}: VLAN tag and MPLS labels cannot both be used simultaneously.

^{*4}: When a sequence number or time stamp or hardware random pattern is used, the checksum field of the TCP/UDP packet contains an error code.

- *5: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

Module (MU120121A) (Cont'd)

Item	Specifications
Protocol Setting	
Ethernet	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→Refer to Frame setting/MAC Address)</p> <p>SA: (→Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p>
IPv4 (RFC791)	<p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1 = High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1 = Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1 = More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

Module (MU120121A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120121A) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120121A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120121A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8bit): User defined 6 = for MAC address Hops (8bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined
MPLS (RFC3031, 3032)	Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.
VLAN (IEEE802.IQ-1998)	TPID: 0x8100, User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal

Module (MU120121A) (Cont'd)

Item	Specifications
PIM (RFC2117)	<p>PIM Ver (4 bit): PIM Version number is 2.</p> <p>Type (4 bit): Types for specific PIM messages.</p> <ul style="list-style-type: none">0 = Hello1 = Register2 = Register-Stop3 = Join/Prune4 = Bootstrap5 = Assert6 = Graft (used in PIM-DM only)7 = Graft-Ack (used in PIM-DM only)8 = Candidate-RP-Advertisement <p>Adder length (8 bit): Auto</p> <p>Checksum (16 bit): Auto (The checksum is the 16-bit one's complement of the one's complement sum of the entire PIM message(excluding the data portion in the Register message).</p> <p>For computing the checksum, the checksum field is zeroed.)</p>

Module (MU120121A) (Cont'd)

Item	Specifications
MLDA (IETF Draft) Test Frame	MLDA Listener Query, MLDA Listener Acknowledgement,MLDA Listener Report Type: PRBS9 (Single), Flow ID

Module (MU120121A) (Cont'd)

Item	Specifications
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error Dribble Bit Error, Alignment Error, Collision IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option 11 Packet BER Test: PRBS Error
Unframed BER Setting	Test Pattern (Electrical): All 0, All 1, User 16, PRBS23, PRBS31 Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)
Measurement Function Counter Mode Ethernet Ethernet OAM Alarm (Opt28) IPv4 IPv6 (Opt12) TCP/UDP	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply, Transmitted/Received Protocol Frame Dribble Bit, Alignment Error, Collision Line Error LOC (0.1 ms Resolution) AIS (0.1 ms Resolution) RDI (0.1 ms Resolution) Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*6, UDP Checksum Error*6

*6: The packets fragmented in the IP layer are not counted as error packets.

Module (MU120121A) (Cont'd)

Item	Specifications
Data	<p>Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).</p> <p>User Defined counter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Packet BER Test (Opt11)	<p>Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate</p>
Unframed BER Test	<p>Bit Error Count/Rate, Pattern Sync. Loss Count/Second (Port 1,2 Only)</p>
Traffic Impairment Counter(Opt17)	<p>Transmitted Frame: Count of Through Frames at Traffic Impairment Emulator</p> <p>Transmitted Byte: Count of Through bytes at Traffic Impairment Emulator</p> <p>Impairment Filter Frame: Count of Frames matching Traffic Impairment Emulator filter</p> <p>Impairment Filter Byte: Count of bytes matching Traffic Impairment Emulator filter</p> <p>Unavoidably Dropped Frame: Count of Frames discarded by Traffic Impairment Emulator mixer</p> <p>Discarded Frame: Count of Frames lost (intentionally) by Traffic Impairment Emulator Filter/Loss</p> <p>Passage Delay: Delay Monitor value 0.001-ms units</p>

Module (MU120121A) (Cont'd)

Item	Specifications
Multi Flow Counter	<p>(Port 1, 2 only)</p> <p>Settable as up to 16 bits filter to count each value at a special bit in frames. (Max 65,536 values)</p> <p>32 of 65,536 counters are supported for real time count.</p> <p>Mode: Tx, Rx</p> <p>Flow Count Field:</p> <p>Type: User Defined, Test Frame Flow ID</p> <p>Base Position: Top of Frame, Top of IPv4 Header, Top of IPv6 Header^{*7}, IPv6 Hop-by-hop Option Header, IPv6 Destination Option Header, IPv6 Routing Header, IPv6 Fragment Header, VLAN Tag 1 to 10, Top of TCP Header, Top of UDP Header, Top of Ethernet OAM PDU^{*8}</p> <p>Offset: 0 to 65,535byte, 0 to 7 bit</p> <p>Length: 1 to 16 bit</p> <p>Filter(Rx):</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>Combination: AND, OR</p> <p>Refer to Pattern and Error conditions of Capture.</p> <p>Flow Count Item:</p> <p>Transmitted Frame</p> <p>Received Frame</p>
Graph	<p>8 kinds of graph are displayed simultaneously.</p> <p>1 s, 1 min, 15 min, 60 min resolution</p>

*7: Option 12 IPv6 Expansion is required.

*8: Option 28 Ethernet OAM is required.

Module (MU120121A) (Cont'd)

Item	Specifications
Capture	
Capture Buffer	64 Mbyte/Port
Capture Filter/Trigger	Filter condition settings; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s
Pattern and Error Conditions	Manual Trigger: Trigger Position Settings; Top, Middle, Bottom Pattern1,2,3,4; Pattern:128 bit Mask:byte or Pattern:16 bit Mask:bit Base position:Top of Preamble, Top of Frame, Top of VLAN tag1 to 10, Top of Ethernet OAM PDU*7, Top of IPv4 Header, Top of IPv6 Header*8,IPv6 Extension Headers(Hop by Hop,Destination, Routing,Fragment,Authentication, ESP)*8, Top of IP Payload,Top of TCP Header, Top of UDP Header Offset:0 to 65535 Error; Error type: Good Frame,FCS Error,Undersize, Fragments, Oversize, Oversize&FCS Error, Dribble Bit Error, Alignment Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*9, PRBS Frame Error*9 Combination; And,Or

*7: Option 12 IPv6 Expansion is required.

*8: Option 28 Ethernet OAM is required.

*9: Option 11 Packet BER Test is required.

Module (MU120121A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A MD1230A Expert Analysis Module, the number of decode protocols can be increased up to 400. MD1230 Family includes Ethereal/Wireshark Convert Function.
Replay	Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1 s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)*7, BGP+4 (Opt19) *7, IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2 (Opt12), MLDA (Opt22) *7, PIM-SMv2 (Opt21) *10, MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL

*7: Option 12 IPv6 Expansion is required.

*10: Option 12 Ipv6 Expansion is required when IPv6 Addresses are used.
Option 21 supports only IPv4 Addresses.

Module (MU120121A) (Cont'd)

Item	Specifications
<p>Frame Arrival Time Variation (Packet Jitter)</p> <p>Resolution</p> <p>Offset</p> <p>Graph</p> <p>Filter</p>	<p>32 counters indicate the results.</p> <p>Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s.</p> <p>Depend on resolution, Max. 3 min.</p> <p>Frame Count vs. Time Interval</p> <p>Auto scale: On/Off</p> <p>Frame Arrival Time Variation filter conditions;</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
<p>Latency Variation</p> <p>Resolution</p> <p>Offset</p> <p>Graph</p> <p>Filter</p>	<p>32 counters indicate the results.</p> <p>Resolution: 50 ns, 100 ns, 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms.</p> <p>Depend on resolution, Max. 3 s.</p> <p>Frame Count vs. Latency</p> <p>Auto scale: On/Off</p> <p>Latency Variation filter conditions;</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Custom Counter	<p>Frame Loss</p> <p>Frame Loss Rate (%)</p> <p>Received Bit Rate (Mbps)</p> <p>Received Average Frame Size (byte)</p> <p>Service Disruption Time (s)</p>

Module (MU120121A) (Cont'd)

Item	Specifications
Application Traffic Monitor (Opt20) Application Traffic Monitor	Monitor Resolution: 1 ms Display Resolution: 1 ms, 10 ms, 100 ms, 500 ms, 1 s Counter Filter Counter: Counter 1, Counter 2, Counter 3, Counter 4 Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error Condition: don't care, Match, Not match Capture Filter: Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error Condition: don't care, Match, Not match Capture Trigger: Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error, Counter 1 Over, Counter 2 Over, Counter 3 Over, Counter 4 Over Condition: don't care, Match, Not match Flow: Display: On/Off, Up to 4 flows Flow/port: 4 Marker: Marker 1, Marker 2, On/Off Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s Peak Hold Time: On/Off, 1 s, 10 s, 1 min, 15 min, Untimed Time Width: 100 to 2,000 ms, Step 1 ms (Display Resolution 1 ms) 1,000 to 20,000 ms, Step 10 ms (Display Resolution 10 ms) 10,000 to 100,000 ms, Step 100 ms (Display Resolution 100 ms) 50,000 to 500,000 ms, Step 500 ms (Display Resolution 500 ms) 100,000 to 1,000,000 ms, Step 1,000 ms (Display Resolution 1 s) Range of Monitor Display: Minimum Value: 0 to 999,999,999 bit/s Maximum Value: (Minimum Value + 1) to 1,000,000,000 bit/s Result of Monitor: Graph display, MAX/MIN/AVE Logarithm: On/Off Auto scale: On/Off Full Screen: On/Off Log: On/Off, Log stop On/Off

Module (MU120121A) (Cont'd)

Item	Specifications
Application Traffic Monitor Player	<p>Display Resolution: 1 ms, 10 ms, 100 ms, 500 ms, 1 s</p> <p>Flow:</p> <p>Display: On/Off, Up to 4 flows</p> <p>Marker: Marker 1, Marker 2, On/Off</p> <p>Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s</p> <p>Peak Hold Time: On/Off, 1 s, 10 s, 1 min, 15 min, Untimed</p> <p>Time Width: 100 to 2,000 ms, Step 1 ms (Display Resolution 1 ms) 1,000 to 20,000 ms, Step 10 ms (Display Resolution 10 ms) 10,000 to 100,000 ms, Step 100 ms (Display Resolution 100 ms) 50,000 to 500,000 ms, Step 500 ms (Display Resolution 500 ms) 100,000 to 1,000,000 ms, Step 1,000 ms (Display Resolution 1 s)</p> <p>Range of Monitor Display:</p> <p>Minimum Value: 0 to 999,999,999 bit/s</p> <p>Maximum Value: (Minimum Value + 1) to 1,000,000,000 bit/s</p> <p>Result of Monitor: Graph display, MAX/MIN/AVE</p> <p>Logarithm: On/Off</p> <p>Auto scale: On/Off</p> <p>Player: Playback, Temporally stop, Stop</p> <p>Display Movement: Top/end button, Slider bar</p> <p>Peak Search/Traffic Calculation</p> <p>Specify Range</p> <p>Mode: All, User defined</p> <p>Start: ms, s, min, hour</p> <p>Range: ms, s, min, hour</p> <p>Peak Search: Time, Traffic</p> <p>Traffic Calculation: Amount of Traffic</p>

Module (MU120121A) (Cont'd)

Item	Specifications
Traffic Impairment Emulator(Opt17)	Various effects on Through data
Filter	<p>Traffic Impairment Emulator filter conditions:</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Loss	<p>Unmatched Frames:</p> <p>Discard</p> <p>Mix</p> <p>Effect: On/Off</p> <p>Timing:</p> <p>All</p> <p>Single Burst: Burst 1 to 1,000,000</p> <p>Periodic Burst: Burst 1 to 1,000,000 Period 1 to 1,000,000</p> <p>Rate: Rate 0.0000 to 100.0000 %, step 0.0001 %</p> <p>Policing</p> <p>Policing Rate: 0 to 1,000,000 kbps step 1 kbps</p> <p>Policing Preset 64k, 384k, 1.5M(T1), 2M(E1), 10M(10BASE-T), 34M(E3), 45M(T3), 52M(OC-1/STM-0), 100M(100BASE-T-X), 139M(E4), 155M(OC-3/STM-1), 622M(OC-12/STM-4)</p>

Module (MU120121A) (Cont'd)

Item	Specifications
Overwirte/Error	<p>Effect: On/Off</p> <p>Timing:</p> <p> All</p> <p> Single Burst: Burst 1 to 1,000,000</p> <p> Periodic Burst: Period 1 to 1,000,000 Burst 1 to 1,000,000</p> <p> Rate: Rate 0.0000 to 100.0000 %, step 0.0001 %</p> <p>Error Insertion</p> <p>Error Type:</p> <p> FCS Error, IP Header Checksum Error, TCP Checksum Error,UDP Checksum Error,</p> <p>Overwrite:</p> <p> Pattern1,2,3,4</p> <p> Pattern: 16 bit Mask:bit</p> <p> Base position: Top of Frame, Top of VLAN tag1 to 10, Top of Ethernet OAM PDU*⁸, Top of IPv4 Header,Top of IPv6 Header*⁷, IPv6 Extension Headers(Hop by Hop, Destination,Routing,Fragment, Authentication,ESP)*⁷,Top of IP Payload,Top of TCP Header, Top of UDP Header</p> <p> Offset:0 to 65535</p> <p>(Error Type and Overwrite cannot be used simultaneously.)</p>

*7: Option 12 IPv6 Expansion is required.

*8: Option 28 Ethernet OAM is required.

Module (MU120121A) (Cont'd)

Item	Specifications
Delay	<p>Effect: On/Off</p> <p>Fixed Delay</p> <p>Range: 500 ms, 5 s, 50 s</p> <p>Delay: 0.01 to 512 ms step 0.01 ms (Range 500 ms)</p> <p>0.1 to 5.12 s step 0.1 ms (Range 5 s)</p> <p>1 ms to 51.2 s step 1 ms (50 s)</p> <p>Delay Variation</p> <p>Distribution: Uniform, Normal, Exponential, User Defined</p> <p>Uniform</p> <p>Minimum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Maximum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Normal</p> <p>Minimum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Maximum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Average: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Standard Deviation: 1 to 100 step 0.01</p> <p>Exponential</p> <p>Minimum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Maximum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Lambda: 0.01 to 2.00 step 0.01</p> <p>User Defined</p> <p>Minimum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p> <p>Maximum Delay: 1 ms (10M), 0.1 ms (100M), 0.01 ms (1000M)</p>
Line Error	<p>Timing;</p> <p>Single</p> <p>100BASE-TX/1000BASE-T: Code (can only be inserted into frame)</p> <p>10BASE-T: Not Support</p>
Limitation	Half Duplex not supported
Automatic Test	
RFC2544 Automatic Test	<p>Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]).</p> <p>[1] Throughput</p> <p>[2] Latency</p> <p>[3] Frame Loss Rate</p> <p>[4] Back-to-back Frames</p> <p>[5] System Recovery</p> <p>[6] Reset</p>

Appendix A Specifications

Module (MU120121A) (Cont'd)

Item	Specifications
Port Pairs	<p>Traffic Distribution: One to one, Partially meshed, Fully meshed</p> <p>Traffic Orientation: Unidirectional, Bidirectional</p> <p>Mesh Type: Round Robin, Peak Loading</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Test Setting	<p>Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte</p> <p>Custom: 1 to 25 point</p> <p>Step: Start form 64 to 65535</p> <p>Step Size 1 to 65471</p> <p>Count 1 to 25</p> <p>Test Frame Protocol: MAC, IP</p> <p>Device Type: Store and Forward, Bit Forward</p> <p>Leaning Frame:</p> <p>Leaning Mode: Never, Once, Every Trial</p> <p>Retries: 1 to 999</p>
Throughput	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Burst Size: 1 to 1000</p> <p>Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step</p> <p>Loss Tolerance: 0 to 100%, 0.0001% step</p> <p>Result: Frame Rate (%), Frame/s, Bit/s, byte/s</p> <p>Graph: Frame Rate (%), or Frame/s or Bit/s or byte/s vs. Frame Size, Theoretical value</p>
Latency	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate</p> <p>Burst Size: 1 to 1000</p> <p>Result: Latency (0.01 us resolution)</p> <p>Graph: Latency vs. Frame Size</p>
Frame Loss Rate	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Frame Rate (%): Initial Rate, Step Rate, 0.01% step</p> <p>Burst Size: 1 to 1000</p> <p>Result: Frame Loss Rate (%)</p> <p>Graph: Frame Rate vs. Frame Loss Rate</p>
Back-to-Back Frames	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step</p> <p>Burst Size: 1 to 1000</p> <p>Loss Tolerance: 0 to 100%, 0.0001% step</p> <p>Result: Number of frames</p> <p>Graph: Number of frames vs. Frame Size</p>

Module (MU120121A) (Cont'd)

Item	Specifications
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop
RFC2889 Automatic Test (Opt10)	Following 10 types of tests can be supported. [1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate [2] Partially Meshed One-to-Many/Many-to-One [3] Partially Meshed Multiple Devices [4] Partially Meshed Unidirectional Traffic [5] Congestion Control [6] Forward Pressure and Maximum Forwarding Rate [7] Address Caching Capacity [8] Address Learning Rate [9] Error-Frame Filtering [10] Broadcast Frame Forwarding and Latency
Fully Meshed Throughput, Frame Loss and Forwarding Rates	Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed One to Many/Many to One	Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$) Duration: 2 to 300 s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120121A) (Cont'd)

Item	Specifications
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports ↔ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed Unidirectional Traffic	<p>Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: Step Size: 1 to 4294967295 frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120121A) (Cont'd)

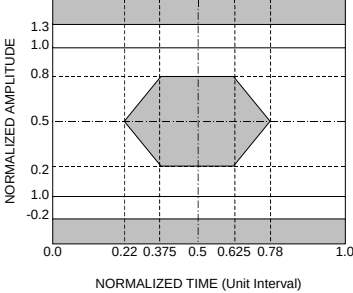
Item	Specifications
Address Caching Capacity	Traffic : Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Address Learning Rate	Traffic: Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Error Frame Filtering	Traffic: Tx Port, Rx Port Duration: 2 to 300 s ILoad: 0.01 to 100 %, 0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095
Broadcast Frame Forwarding and Latency	Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address Per port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120121A) (Cont'd)

Item	Specifications
Tools Fragment	<p>Fragments already registered Stream data</p> <p>Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6</p> <p>Support Data Field: Data Field1</p> <p>Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9</p> <p>Stream ID: 1 to 255, All</p> <p>MTU: 1 to 9936 byte</p> <p>Number of Datagrams: 1 to 127</p> <p>Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6)</p> <p>Increment Identification: On/Off</p> <p>To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>
Environmental Performance Temperature range	<p>Operation: 0 to +40°C</p> <p>Storage: -20 to +60°C</p>
Power Consumption	<p>Less than 90 W</p>
Size	<p>Based on PICMG2.0 R2.1</p> <p>262.0 (W) × 20.0 (H) × 174.5 (D) mm</p> <p>It doesn't contain protuberance.</p>
Weight	<p>Less than 1.5 kg</p>

A.9 MU120122A

Module (MU120122A)

Item	Specifications
Model name	MU120122A
Apparatus name	Gigabit Ethernet Module
Composition	Module × 1
Interface	<p>Electrical: 10BASE-T, 100BASE-TX, 1000BASE-T Optical: 1000BASE-SX/LX/LE/LR (depend on SFP Module) SFP (LC), RJ-45 (Auto MDI-X) SFP: 2, RJ-45: 2 10, 100, 1000 Mbit/s</p>  <p>IEC60825-1:2007 CLASS 1</p> <p>On/Off</p> <p>On/Off</p> <p>Electrical: Tx/Collision, Rx/Error, 10 M, 100 M, 1000 M, Duplex Optical: Link, Tx, Rx, Error Inter face: 10BASE-T, 100BASE-TX Connector: RJ-45 (Auto MDI-X)</p>
Corresponding Specification	
Connector	
Number of Ports	
Bit Rate	
Pulse Mask	
Laser Safety	
Auto Negotiation	
Flow Control	
LED	
CPU Port	Link, ACT
LED	

Module (MU120122A) (Cont'd)

Item	Specifications
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	MAC Address IPv4 Address, Netmask, Gateway
ARP Reply	Not send,Reply to this port ARP request,Reply to all ARP request
ICMP Echo(PING) Reply	Not send,Reply to this port ping request
IPv6(Opt12)	
This port	MAC Address IPv6 Address,Default Router,Link-Local Address
Neighbor Solicitation Reply	Not send,Reply to this port IPv6 Address,Reply to all IPv6 Addresses
Echo Reply	Not send,Reply to This port Echo Request
VLAN (IEEE802.IQ-1998)	Enabled:On/Off Only VLAN-Tagged Frames:On/Off TPID,Priority,VID Acceptable VID:This Port VID,All VID
Ethernet OAM(Opt28)	Enabled:On/Off Standard:ITU-T/IEEE DUT MEP ID:0 to 8191
This port	Reply to This Port LBM:On/Off Reply to This Port LTM:On/Off LTR TLVs:0to120 byte Send CCM:On/Off Insert RDI:On/Off MEG Level:0 to 7 MEP ID:0 to 8191 MEG ID:48 byte CCM Period:1 s, 10 s, 1 min, 10 min. CCM TLVs:0to80 byte
Protocols	IGMP:On/Off IGAP:On/Off MLD:On/Off MLDA:On/Off PIM:On/Off OSPF:On/Off OSPFv3:On/Off BGP4:On/Off BGP4+:On/Off MPLS(LDP/CR-LDP):On/Off MPLS(RSVP):On/Off
Duplex Mode	Electrical: Full/Half, Optical: Full 1000Mbps Half Duplex is used only for the link test.

Module (MU120122A) (Cont'd)

Item	Specifications
MII/MDIO properties	Auto negotiation On/Off, Restart, Loop back On/Off, Auto MDI/MDI-X On/Off(Except 1000BASE-X), Timeout enable On/Off(Only 1000BASE-X), Link Timer Fixed, Variable(1 to 100 ms, 1 ms step)(Only 1000BASE-X), MII registers (Allows the current MII register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)
Mode Preamble	Normal, Monitor, Through ^{*1} , Address Swap, Impairment(opt17) ^{*2} On/Off Note: To capture the preamble data of frames, set "Preamble" to On.
Link Mode	On/Off
Frequency monitor Accuracy	(Frequency (Hz), Difference (Hz), Difference (ppm)) Difference display range: -1000 to +1000 ppm Enabled for 100BASE-TX and 1000BASE-T. Based on 125 MHz in the case of 100BASE-TX. Based on 1250 MHz in the case of 1000BASE-T. ±4.0 ppm
Clock Offset Accuracy	-100 to +100 ppm ±4.0 ppm
Stream Number of Streams	256 Streams/Port

*1: On MU120122A, the Through mode can be used with port 1 and port 2, and with port 3 and port 4.

*2: Only Impairment can be selected when Impairment is selected by Setup Utility.

Module (MU120122A) (Cont'd)

Item	Specifications
Stream Setting Distribution	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000), Jump to Stream for Count and Stop (Loop Count: 1 to 16,000,000)
Frame per Burst	1 to 16,777,215
Burst per Stream	1 to 1,099,511,627,775
Frame View	Raw Frame, Decoded
Gap Setting Inter Frame Gap	10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as Fixed or Random. 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed or Random, 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed or Random. Optical: Resolution of 8 ns, 64 ns to 120 s Settable as Fixed or Random. Minimum GAP when the length of the frame is a case of the odd number and Random/Inc is from 72 ns(9 bytes).
Inter Burst Gap	10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed Optical: Resolution of 8 ns, 64 ns to 120 s Settable as Fixed Minimum GAP when the length of the frame is a case of the odd number and Random/Inc is from 72 ns(9 bytes).
Inter Stream Gap	10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed Optical: Resolution of 8 ns, 64 ns to 120 s Settable as Fixed Minimum GAP when the length of the frame is a case of the odd number and Random/Inc is from 72 ns(9 bytes).

Module (MU120122A) (Cont'd)

Item	Specifications
Frame Setting	<p>Electrical: Preamble Size: 4 to 255 bytes, Optical: Preamble Size: 2 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units) , Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*3}: Up to 10 layer VLAN tags can be appended. VLAN ID can be set Increment, Decrement, Random.</p> <p>MPLS label^{*3}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Programmable Data Link Layer^{*3}: Up to 32 byte field is fully programmable.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC, Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMP/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by PIM-SMv2 Protocol (Opt 21): PIM Register Message</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9.</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*4}, Sequence Number^{*4}, Hardware Random Pattern^{*4}, Test Frame. Settable Flow ID number when Test Frame is used.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p>

^{*3}: VLAN tag and MPLS labels cannot both be used simultaneously.

^{*4}: When a sequence number or time stamp or hardware random pattern is used, the checksum field of the TCP/UDP packet contains an error code.

Module (MU120122A) (Cont'd)

Item	Specifications
Frame Size	48 to 10,000 bytes (Settable as Auto, Fixed, Increment*5, or Random*5)
Protocol Setting Ethernet IPv4 (RFC791)	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer to Frame setting/MAC Address)</p> <p>SA: (→ Refer to Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p> <p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1= High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1= Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1= More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

*5: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120122A) (Cont'd)

Item	Specifications
ICMP (RFC792, 950, 1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 bytes entry

Module (MU120122A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120122A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	<p>Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8 bit): User defined 6 = for MAC address Hops (8 bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined</p>
MPLS (RFC3031, 3032)	<p>Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.</p>
VLAN (IEEE802.IQ-1998)	<p>TPID: 0x8100, User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal</p>

Module (MU120122A) (Cont'd)

Item	Specifications
PIM (RFC2117)	<p>PIM Ver (4 bit): PIM Version number is 2.</p> <p>Type (4 bit): Types for specific PIM messages.</p> <ul style="list-style-type: none"> 0 = Hello 1 = Register 2 = Register-Stop 3 = Join/Prune 4 = Bootstrap 5 = Assert 6 = Graft (used in PIM-DM only) 7 = Graft-Ack (used in PIM-DM only) 8 = Candidate-RP-Advertisement <p>Adder length (8 bit): Auto</p> <p>Checksum (16 bit): Auto (The checksum is the 16-bit one's complement of the one's complement sum of the entire PIM message(excluding the data portion in the Register message). For computing the checksum, the checksum field is zeroed.)</p>

Module (MU120122A) (Cont'd)

Item	Specifications
MLDA (IETF Draft) Test Frame	MLDA Listener Query,MLDA Listener Acknowledgement, MLDA Listener Report Type: PRBS9(Single), Flow ID

Module (MU120122A) (Cont'd)

Item	Specifications
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error Dribble Bit Error, Alignment Error, Collision IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option 11 Packet BER Test: PRBS Error
Unframed BER Setting	Test Pattern (Electrical): All 0, All 1, User 16, PRBS23, PRBS31 Test Pattern (Optical): All 0, All 1, User 16, PRBS23, PRBS31, CJPAT, CRPAT Error Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)
Measurement Function Counter Mode Ethernet	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply, Transmitted/Received Protocol Frame Dribble Bit, Alignment Error, Collision, Byte Alignment Error Line Error Counter Setting (Port1,2 only); The count object can be chosen according to three kinds. 8B/10B code Error RD (Running Disparity Error) Code Error or RD Error
Ethernet OAM Alarm (Opt28)	LOC (0.1 ms Resolution) AIS (0.1 ms Resolution) RDI (0.1 ms Resolution)

Module (MU120122A) (Cont'd)

Item	Specifications
IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error
IPv6 (Opt12)	Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count
TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*6, UDP Checksum Error*6
Data	Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority). User Defined counter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate
Unframed BER Test	Bit Error Count/Rate, Pattern Sync. Loss Count/Second
Traffic Impairment Counter(Opt17)	(Port 1,2 Only) Transmitted Frame: Count of Through Frames at Traffic Impairment Emulator Transmitted Byte: Count of Through bytes at Traffic Impairment Emulator Impairment Filter Frame: Count of Frames matching Traffic Impairment Emulator filter Impairment Filter Byte: Count of bytes matching Traffic Impairment Emulator filter Unavoidably Dropped Frame: Count of Frames discarded by Traffic Impairment Emulator mixer Discarded Frame: Count of Frames lost (intentionally) by Traffic Impairment Emulator Filter/Loss Passage Delay: Delay Monitor value 0.001-ms units

*6: The packets fragmented in the IP layer are not counted as error packets.

Module (MU120122A) (Cont'd)

Item	Specifications
Multi Flow Counter	<p>(Port 1, 2 only)</p> <p>Settable as up to 16 bits filter to count each value at a special bit in frames. (Max 65,536 values)</p> <p>32 of 65,536 counters are supported for real time count.</p> <p>Mode: Tx, Rx</p> <p>Flow Count Field:</p> <p>Type: User Defined, Test Frame Flow ID</p> <p>Base Position: Top of Frame, Top of IPv4 Header, Top of IPv6 Header^{*7}, IPv6 Hop-by-hop Option Header, IPv6 Destination Option Header, IPv6 Routing Header, IPv6 Fragment Header, VLAN Tag 1 to 10, Top of TCP Header, Top of UDP Header, Top of Ethernet OAM PDU^{*8}</p> <p>Offset: 0 to 65,535 byte, 0 to 7 bit</p> <p>Length: 1 to 16 bit</p> <p>Filter(Rx):</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>Combination: AND, OR</p> <p>Refer to Pattern and Error conditions of Capture.</p> <p>Flow Count Item:</p> <p>Transmitted Frame</p> <p>Received Frame</p>
Graph	<p>8 kinds of graph are displayed simultaneously.</p> <p>1 s, 1 min, 15 min, 60 min resolution</p>
Capture Capture Buffer	64 Mbyte/Port

*7: Option 12 IPv6 Expansion is required.

*8: Option 28 Ethernet OAM is required.

Module (MU120122A) (Cont'd)

Item	Specifications
Capture Filter/Trigger	<p>Filter condition settings;</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>Trigger condition settings;</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>External Trigger:</p> <p>Traffic is out of range:0 to 100%</p> <p>Latency is out of range:1 ns to 59 s</p> <p>Manual Trigger:</p> <p>Trigger Position Settings; Top, Middle, Bottom</p>
Pattern and Error Conditions	<p>Pattern1,2,3,4;</p> <p>Pattern:128 bit Mask:byte or Pattern:16 bit Mask:bit</p> <p>Base position:Top of Preamble, Top of Frame,</p> <p>Top of VLAN tag1 to 10, Top of Ethernet OAM PDU*8, Top of IPv4 Header, Top of IPv6 Header*7,IPv6 Extension Headers (Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*7, Top of IP Payload, Top of TCP Header, Top of UDP Header</p> <p>Offset:0 to 65535</p> <p>Error;</p> <p>Error type: Good Frame, FCS Error, Undersize, Fragments, Oversize, Oversize&FCS Error, Dribble Bit Error*10, Alignment Error*10, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*9, PRBS Frame Error*9</p> <p>Combination; And, Or</p>

*7: Option 12 IPv6 Expansion is required.

*8: Option 28 Ethernet OAM is required.

*9: Option 11 Packet BER Test is required.

*10: Port3 and Port4 only.

Module (MU120122A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400.
Replay	MD1230 Family includes Ethereal/Wireshark Convert Function. Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)*7, BGP4+ (Opt19)*7, IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2 (Opt12), MLDA (Opt22)*7, PIM-SMv2 (Opt21)*11, MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter)	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s. Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off Frame Arrival Time Variation filter conditions: Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Resolution	
Offset	
Graph	
Filter	

*7: Option 12 IPv6 Expansion is required.

*11: Option 12 Ipv6 Expansion is required when IPv6 Addresses are used.
Option 21 supports only IPv4 Addresses.

Module (MU120122A) (Cont'd)

Item	Specifications
Latency Variation Resolution Offset Graph Filter	32 counters indicate the results. Resolution: 50 ns, 100 ns, 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms. Depend on resolution, Max. 3 s. Frame Count vs. Latency Auto scale: On/Off Latency Variation filter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
Auto Negotiation Analysis (Opt15)	10B Code data transmitted function, Auto negotiation sequence capture function, Link timer value variable function

Module (MU120122A) (Cont'd)

Item	Specifications
Application Traffic Monitor (Opt20) Application Traffic Monitor	<p>-</p> <p>Monitor Resolution: 1 ms</p> <p>Display Resolution: 1 ms, 10 ms, 100 ms, 500 ms, 1 s</p> <p>Counter Filter</p> <p>Counter: Counter 1, Counter 2, Counter 3, Counter 4</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Filter:</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Trigger:</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error, Counter 1 Over, Counter 2 Over, Counter 3 Over, Counter 4 Over</p> <p>Condition: don't care, Match, Not match</p> <p>Flow:</p> <p>Display: On/Off, Up to 4 flows</p> <p>Flow/port: 4</p> <p>Marker: Marker 1, Marker 2, On/Off</p> <p>Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s</p> <p>Peak Hold Time: On/Off, 1 s, 10 s, 1 min, 15 min, Untimed</p> <p>Time Width: 100 to 2,000 ms, Step 1 ms</p> <p>(Display Resolution 1 ms)</p> <p>1,000 to 20,000 ms, Step 10 ms</p> <p>(Display Resolution 10 ms)</p> <p>10,000 to 100,000 ms, Step 100 ms</p> <p>(Display Resolution 100 ms)</p> <p>50,000 to 500,000 ms, Step 500 ms</p> <p>(Display Resolution 500 ms)</p> <p>100,000 to 1,000,000 ms, Step 1,000 ms</p> <p>(Display Resolution 1 s)</p> <p>Range of Monitor Display:</p> <p>Minimum Value: 0 to 999,999,999 bit/s</p> <p>Maximum Value: (Minimum Value + 1) to 1,000,000,000 bit/s</p> <p>Result of Monitor: Graph display, MAX/MIN/AVE</p> <p>Logarithm: On/Off</p> <p>Auto scale: On/Off</p> <p>Full Screen: On/Off</p> <p>Log: On/Off, Log stop On/Off</p>

Module (MU120122A) (Cont'd)

Item	Specifications
Application Traffic Monitor Player	<p>Display Resolution: 1 ms, 10 ms, 100 ms, 500 ms, 1 s</p> <p>Flow:</p> <p>Display: On/Off, Up to 4 flows</p> <p>Marker: Marker 1, Marker 2, On/Off</p> <p>Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s</p> <p>Peak Hold Time: On/Off, 1s, 10s, 1min, 15min, Untimed</p> <p>Time Width: 100 to 2,000 ms, Step 1 ms (Display Resolution 1 ms) 1,000 to 20,000 ms, Step 10 ms (Display Resolution 10 ms) 10,000 to 100,000 ms, Step 100 ms (Display Resolution 100 ms) 50,000 to 500,000 ms, Step 500 ms (Display Resolution 500 ms) 100,000 to 1,000,000 ms, Step 1,000 ms (Display Resolution 1 s)</p> <p>Range of Monitor Display:</p> <p>Minimum Value: 0 to 999,999,999 bit/s</p> <p>Maximum Value: (Minimum Value + 1) to 1,000,000,000 bit/s</p> <p>Result of Monitor: Graph display, MAX/MIN/AVE</p> <p>Logarithm: On/Off</p> <p>Auto scale: On/Off</p> <p>Player: Playback, Temporally stop, Stop</p> <p>Display Movement: Top/end button, Slider bar</p> <p>Peak Search/Traffic Calculation</p> <p>Specify Range</p> <p>Mode: All, User defined</p> <p>Start: ms, s, min, hour</p> <p>Range: ms, s, min, hour</p> <p>Peak Search: Time, Traffic</p> <p>Traffic Calculation: Amount of Traffic</p>

Module (MU120122A) (Cont'd)

Item	Specifications
Traffic Impairment Emulator(Opt17)	Various effects on Through data
Filter	<p>Traffic Imparment Emulator filter conditions;</p> <p>Pattern1: don't care, Match, Not match</p> <p>Pattern2: don't care, Match, Not match</p> <p>Pattern3: don't care, Match, Not match</p> <p>Pattern4: don't care, Match, Not match</p> <p>Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Loss	<p>Unmatched Frames:</p> <p>Discard</p> <p>Mix</p> <p>Effect: On/Off</p> <p>Timing;</p> <p>All</p> <p>Single Burst: Burst 1 to 1,000,000</p> <p>Periodic Burst: Burst 1 to 1,000,000</p> <p>Period 1 to 1,000,000</p> <p>Rate: Rate 0.0000 to 100.0000 %, step 0.0001 %</p> <p>Policing</p> <p>Policing Rate: 0 to 1,000,000 kbps step 1 kbps</p> <p>Policing Preset 64k, 384k, 1.5M(T1), 2M(E1), 10M(10BASE-T), 34M(E3), 45M(T3), 52M(OC-1/STM-0), 100M(100BASE-TX), 139M(E4), 155M(OC-3/STM-1), 622M(OC-12/STM-4)</p>

Module (MU120122A) (Cont'd)

Item	Specifications
Overwirte/Error	<p>Effect; On/Off</p> <p>Timing;</p> <p> All</p> <p> Single Burst: Burst 1 to 1,000,000</p> <p> Periodic Burst:</p> <p> Period 1 to 1,000,000</p> <p> Burst 1 to 1,000,000</p> <p> Rate: Rate 0.0000 to 100.0000 %, step 0.0001 %</p> <p>Error Insertion</p> <p>Error Type;</p> <p> FCS Error, IP Header Checksum Error, TCP Checksum Error, UDP Checksum Error</p> <p>Overwrite;</p> <p> Pattern1,2,3,4</p> <p> Pattern: 16 bit Mask:bit</p> <p> Base position:Top of Frame,</p> <p> Top of VLAN tag1 to 10,</p> <p> Top of Ethernet OAM PDU*8,</p> <p> Top of IPv4 Header,</p> <p> Top of IPv6 Header*7,</p> <p> IPv6 Extension Headers(Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*7,</p> <p> Top of IP Payload, Top of TCP Header,</p> <p> Top of UDP Header</p> <p> Offset:0 to 65535</p> <p>(Error Type and Overwrite cannot be used simultaneously.)</p>

*7: Option 12 IPv6 Expansion is required.

*8: Option 28 Ethernet OAM is required.

Module (MU120122A) (Cont'd)

Item	Specifications
Delay	Effect: On/Off Fixed Delay Range: 500 ms, 5 s, 50 s Delay: 0.01 to 512 ms step 0.01 ms (Range 500 ms) 0.1 to 5.12 s step 0.1 ms (Range 5 s) 1 to 51.2 s step 1 ms (50 s) Delay Variation Distribution: Uniform, Normal, Exponential, User Defined Uniform Minimum Delay: 0.01 ms (1000M) Maximum Delay: 0.01 ms (1000M) Normal Minimum Delay: 0.01 ms (1000M) Maximum Delay: 0.01 ms (1000M) Average: 0.01 ms (1000M) Standard Deviation: 1 to 100 step 0.01 Exponential Minimum Delay: 0.01 ms (1000M) Maximum Delay: 0.01 ms (1000M) Lambda: 0.01 to 2.00 step 0.01 User Defined Minimum Delay: 0.01 ms (1000M) Maximum Delay: 0.01 ms (1000M) (Fixed Delay and Delay Variation cannot be used simultaneously.)
Line Error	Timing; Single Optical port; Line Error (8B/10B Code), Line Error (RD), Line Error (8B/10B Code & RD)
Limitation	Half Duplex not supported
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120122A) (Cont'd)

Item	Specifications
Test Setting	<p>Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 byte Custom: 1 to 25 point Step: Start form 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC, IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999</p>
Throughput	<p>Duration: 2 to 999 s Number of trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%):Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%, 0.0001% step Result: Frame rate (%), Frame/s, Bit/s, byte/s Graph: Frame rate (%), or Frame/s or Bit/s or byte/s vs. Frame Size, Theoretical value</p>
Latency	<p>Duration: 2 to 999 s Number of trials: 1 to 50 Frame Rate (%):Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (0.01 us resolution) Graph: Latency vs. Frame Size</p>
Frame Loss Rate	<p>Duration: 2 to 999 s Number of trials: 1 to 50 Frame Rate (%):Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame loss rate (%) Graph: Frame Rate vs. Frame Loss Rate</p>
Back-to-Back Frames	<p>Duration: 2 to 999 s Number of trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of Frames Graph: Number of Frames vs. Frame Size</p>
System Recovery	<p>Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload rate (110% of the throughput rate), Moderate rate Burst Size: 1 to 1000 Result: Recovery time (1 us resolution, Accuracy 1 us) Graph: Recovery time vs. Frame size</p>
Reset	<p>Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop</p>

Module (MU120122A) (Cont'd)

Item	Specifications
RFC2889 Automatic Test (Opt10)	<p>Following 10 types of tests can be supported.</p> <p>[1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate</p> <p>[2] Partially Meshed One-to-Many/Many-to-One</p> <p>[3] Partially Meshed Multiple Devices</p> <p>[4] Partially Meshed Unidirectional Traffic</p> <p>[5] Congestion Control</p> <p>[6] Forward Pressure and Maximum Forwarding Rate</p> <p>[7] Address Caching Capacity</p> <p>[8] Address Learning Rate</p> <p>[9] Error-Frame Filtering</p> <p>[10] Broadcast Frame Forwarding and Latency</p>
Fully Meshed Throughput, Frame Loss and Forwarding Rates	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed One to Many/Many to One	<p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports ↔ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120122A) (Cont'd)

Item	Specifications
Partially Meshed Unidirectional Traffic	<p>Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: Step size: 1 to 4294967295frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding rate (fps), Result of forward pressure test</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Caching Capacity	<p>Traffic : Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535 s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 byte</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120122A) (Cont'd)

Item	Specifications
Address Learning Rate	Traffic: Test Port, Learning Port, Monitoring Port Age time: 1 to 65535 s Address Learning rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Error Frame Filtering	Traffic: Tx Port, Rx Port Duration: 2 to 300 s ILoad: 0.01 to 100 %, 0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095
Broadcast Frame Forwarding and Latency	Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095
Tools Fragment	Fragments already registered Stream data Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.

Appendix A Specifications

Module (MU120122A) (Cont'd)

Item	Specifications
Environmental Performance	
Temperature range	Operation: 0 to +40°C Storage: -20 to +60°C
Power Consumption	Less than 90 W
Size	Based on PICMG2.0 R2.1 262.0 (W) × 20.0 (H) × 174.5 (D) mm It doesn't contain protuberance.
Weight	Less than 1.5 kg

A.10 MU120131A

Module (MU120131A)

Item	Specifications
Model name	MU120131A
Apparatus name	10/100/1000M Ethernet Module
Composition	Module × 1
Module Options	MU120131A-01: Clock Measurement MU120131A-02: PoE
Interface	
Corresponding Specification	Electrical: 10BASE-T, 100BASE-TX, 1000BASE-T
Connector	RJ-45 (Auto MDI-X)
Number of Ports	12
Bit Rate	10, 100, 1000 Mbit/s
Pulse Mask	1000BASE-T: IEEE802.3-2002 Template 100BASE-TX: ANSIx3.263 Template
Auto Negotiation	On/Off
Flow Control	On/Off
LED	Link

Module (MU120131A) (Cont'd)

Item	Specifications
Port setting	
MAC Address	00-00-00-00-00-00toFF-FF-FF-FF-FF-FF
IPv4	
This port	IPv4 Address, Netmask, Gateway
ARP Reply	Not send,Reply to this port ARP request,Reply to all ARP request
ICMP Echo(PING) Reply	Not send,Reply to this port ping request
IPv6(Opt12)	
This port	IPv6 Address, Default Router, Link-Local Address
Neighbor Solicitation Reply	Not send, Reply to this port IPv6 Address, Reply to all IPv6 Addresses
Echo Reply	Not send, Reply to This port Echo Request
VLAN (IEEE802.IQ-1998)	Enabled(Ethernet OAM Only):On/Off(Opt28)
Ethernet OAM(Opt28)	TPID,Priority,VID
	Enabled:On/Off
	Standard:ITU-T/IEEE
	DUT MEP ID:0to8191
This port	Reply to This Port LBM:On/Off
	Reply to This Port LTM:On/Off
	LTR TLVs:0 to 120 byte
	Send CCM:On/Off
	Insert RDI:On/Off
	MEG Level:0 to 7
	MEP ID:0 to 8191
	MEG ID:48 byte
	CCM Period:1 s, 10 s, 1 min, 10 min.
	CCM TLVs:0 to 80 byte
Protocols	IGMP:On/Off
	IGAP:On/Off
	MLD:On/Off
	MLDA:On/Off
Duplex Mode	Full/Half
	1000Mbps Half Duplex is used only for the link test.
MII/MDIO properties	Auto negotiation On/Off, Restart, Loop back On/Off, Auto MDI/MDI-X On/Off, MII registers (Allows the current MII register values to be read and written, Default), Flow control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined), Timing Auto/Master/Slave
Mode	Normal, Monitor, Through*1, Address Swap
Preamble	On/Off
	Note: To capture the preamble data of frames, set the "Preamble" on.

*1: On MU120131A, the Through mode can be used with port 1 and port 2, with port 3 and port 4, with port 5 and port 6, with port 7 and port 8, with port 9 and port 10, with port 11 and port 12.

Module (MU120131A) (Cont'd)

Item	Specifications
Test Pattern	Single PRBS9/Cross PRBS23/Cross PRBS31 Cross PRBS23 and Cross PRBS31 means PRBS bit stream of each frame is not reset and PRBS bit stream of each frame is not continuous.
Link	
Mode	On, Off, Flap
Flap Setting	Count: 0 to 65535, Infinit Interval On: 10 to 3600 Interval Off: 1 to 3600 No/Go Check: On/Off
Frequency Monitor	MU120131A-01 Frequency (Hz), Difference (Hz), Difference (ppm) The Difference value is shown from -1000 to +1000 ppm. Enabled for 100BASE-TX and 1000BASE-T. When 100BASE-TX, 125 MHz is the reference. When 1000BASE-T, 1250 MHz is the reference.
Accuracy	Depend on the unit. MD1230 family: +/- 4.0 ppm MP1590B: +/- 0.1 ppm MP1591A: +/- 0.1 ppm

Module (MU120131A) (Cont'd)

Item	Specifications
Clock Select	MU120131A-01 Clock1,Clock2 This setting is common in Port 1 to 4, Port 5 to 8 and Port 9 to 12.
Offset	-100 to +100 ppm This setting is common in Port 1 to 12
Accuracy	Depend on the unit. MD1230 family: +/- 4.0 ppm MP1590B: +/- 0.1 ppm MP1591A: +/- 0.1 ppm
PoE	MU120131A-02 On, Off
Class	Class 0 to 4, Off
Level	Off: 0 to 31.7 V Under: 31.7 to 43.3 V Normal: 43.3 V and over Note: Hysteresis voltage is 0.05 x Vdetect. Accuracy: ±0.7 V The level is detected after PoE detection.

Module (MU120131A) (Cont'd)

Item	Specifications
Stream	
Number of Streams	256 Streams/Port
Stream Setting	
Distribution	Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000), Jump to Stream for Count and Stop (Loop Count: 1 to 16,000,000)
Frame per Burst	1 to 16,777,215
Burst per Stream	1 to 1,099,511,627,775
Frame View	Raw Frame, Decoded
Gap Setting	
Inter Frame Gap	10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as Fixed or Random. 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed or Random, 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed or Random.
Inter Burst Gap	10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed
Inter Stream Gap	10BASE-T: Resolution of 800 ns, 8 us to 12000 s Settable as fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed

Module (MU120131A) (Cont'd)

Item	Specifications
Frame Setting	<p>Electrical: Preamble Size: 4 to 255 bytes</p> <p>MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA)</p> <p>VLAN tag^{*2}: Up to 10 layer VLAN tags can be appended. VLAN ID can be set Static, Increment, Decrement, Random.</p> <p>MPLS label^{*2}: Up to 10 MPLS labels can be appended. Fixed setting.</p> <p>Programmable Data Link Layer^{*2}: Up to 32 byte field is fully programmable.</p> <p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC, Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMP/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 byte, 2 bytes), Increment, Decrement, Random, Single PRBS9</p>

^{*2}: VLAN, MPLS and Programmable Data Link Layer cannot both be used simultaneously.

Module (MU120131A) (Cont'd)

Item	Specifications
Frame Size	<p>Only Data Field 1 can set Programmable, Time Stamp^{*3}, Sequence Number^{*3*6}, Hardware Random Pattern^{*3}, Test Frame^{*4}</p> <p>Settable Flow ID number when Test Frame is used.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p> <p>48 to 10,000 byte</p> <p>Settable as Auto, Fixed, Increment^{*5}, or Random^{*5}</p>

*3: When a sequence number or time stamp or hardware random pattern is used, the checksum field of the TCP/UDP packet contains an error code.

*4: Test Frame is set when Increment is set for the TCP/UDP port number.

*5: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

*6: Continuous sequence numbers are assigned for each flow ID.

Module (MU120131A) (Cont'd)

Item	Specifications
Protocol Setting	
Ethernet	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer Frame setting/MAC Address)</p> <p>SA: (→ Refer Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p>
IPv4 (RFC791)	<p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1 = High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1 = Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1 = More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

Module (MU120131A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number (32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120131A) (Cont'd)

Item	Specifications
ICMP (RFC792,950,1256)	<p>Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply</p> <p>Code (8 bit): User defined 0 to 255</p> <p>Checksum (16 bit): Automatically calculated (Soft)</p> <p>Data: For Echo Request/Response</p> <p>Identifier (16 bit): User defined</p> <p>Sequence Number (16 bit): User defined</p>
RIP (RFC2453)	<p>Command (8 bit): 1: Request 2: Response</p> <p>Version (8 bit): 1 = RIP version1 2 = RIP version2</p> <p>Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next</p> <p>Route tag: User defined</p> <p>IP Address: User defined</p> <p>Subnet Mask: User defined for Version2</p> <p>Next hop: User defined for Version2</p> <p>Metric: 0 to 4294967295 (DEC)</p> <p>Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest</p> <p>Algorithm</p> <p>Authentication Data: ASCII 16 byte entry</p>

Module (MU120131A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit) : User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120131A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address length (8bit): User defined 6 = for MAC address Hops (8 bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit): User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined

Module (MU120131A) (Cont'd)

Item	Specifications
MPLS (RFC3031,3032)	Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.
VLAN(IEEE802.IQ-1998)	TPID: 0x8100,User defined User priority (3bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal

Appendix A Specifications

Module (MU120131A) (Cont'd)

Item	Specifications
MLDA (IETF Draft)	MLDA Listener Query, MLDA Listener Acknowledgement, MLDA Listener Report

Module (MU120131A) (Cont'd)

Item	Specifications
Test Frame	Type: PRBS9(Single),PRBS23(Cross), PRBS31(Cross),Flow ID
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error Dribble Bit Error, Alignment Error, Collision IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option 11 Packet BER Test: PRBS Error Insertion Timing is available, only when Test Frame Type is PRBS23 (Cross) or PRBS31 (Cross) (Refer to Cross PRBS Error Setting).
Unframed BER Setting	Test Pattern (Electrical): All 0, All 1, User 16, PRBS23, PRBS31 Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Pro- grammable Rate (1.0E-10 to 9.9E-3)
Cross PRBS Error Setting	Test Pattern (Optical):Single, PRBS23, PRBS31 Error Insertion: Cross PRBS Error Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)

Module (MU120131A) (Cont'd)

Item	Specifications
Measurement Function	
Counter	
Mode	Accumulated, 1 s current
Ethernet	Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply, Dribble Bit, Alignment Error, Collision, Line Error, Frequency, Frequency Difference (Hz), Frequency Difference (ppm), Link Failed
Ethernet OAM Alarm (Opt28)	LOC (0.1 ms Resolution) AIS (0.1 ms Resolution) RDI (0.1 ms Resolution)
IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error
IPv6 (Opt12)	Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count
TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate TCP Checksum Error ^{*7} , UDP Checksum Error ^{*7}

^{*7}: The packets fragmented in the IP layer are not counted as error packets.

Module (MU120131A) (Cont'd)

Item	Specifications
Data	<p>Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).</p> <p>User Defined counter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate
Unframed BER Test	Bit Error Count/Rate, Pattern Sync. Loss Count/Second

Module (MU120131A) (Cont'd)

Item	Specifications
Multi Flow Counter	<p>Settable as up to 16 bits 4 filters to count each value at a special bit in frames. (Max 255 values)</p> <p>Mode: Tx, Rx</p> <p>Flow Count Field:</p> <p>Type: User Defined, Test Frame Flow ID</p> <p>Base Position: Top of Preamble , Top of Frame, Top of IPv4 Header, Top of IPv6 Header*⁸, IPv6 Hop-by-hop Option Header, IPv6 Destination Option Header, IPv6 Routing Header, IPv6 Fragment Header, VLAN Tag 1 to 10, Top of TCP Header, Top of UDP Header, Flow ID*⁹ Top of Ethernet OAM PDU*¹⁰</p> <p>Offset: 0 to 65,535byte, 0 to 7 bit</p> <p>Length: 1 to 16 bit</p> <p>Filter(Rx): On/Off</p> <p>Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p> <p>Flow Count Item:</p> <p>Transmitted Bit Rate (Mbit/s)</p> <p>Transmitted Rate (%)</p> <p>Transmitted Byte</p> <p>Transmitted Frame</p> <p>Transmitted Frame (fps)</p> <p>Received Bit Rate (Mbit/s)</p> <p>Received Rate (%)</p> <p>Received Byte</p> <p>Received Frame</p> <p>Received Frame (fps)</p> <p>Sequence Error</p> <p>Max Latency (us)</p> <p>Min Latency (us)</p> <p>Current Latency (us)</p> <p>Avg Latency (us)</p>

*8: Option 12 IPv6 Expansion is required.

*9: Option 11 Packet BER Test is required.

*10: Option 28 Ethernet OAM is required.

Module (MU120131A) (Cont'd)

Item	Specifications
Graph	1s, 1min, 15min, 60min resolution, 8 kinds of graph are displayed simultaneously.
Capture Capture Buffer Capture Filter/Trigger	16 Mbyte/Port Filter condition settings; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s Manual Trigger: Trigger Position Settings; Top, Middle, Bottom
Pattern and Error Conditions	Pattern1,2,3,4; Pattern:128 bit Mask:byte or Pattern:16 bit Mask:bit Base position:Top of Preamble, Top of Frame, Top of VLAN tag1 to 10, Top of Ethernet OAM PDU*10, Top of IPv4 Header, Top of IPv6 Header*8,IPv6 Extension Headers (Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*8, Top of IP Payload, Top of TCP Header, Top of UDP Header, Flow ID*9 Offset:0 to 65535 Error; Error type: Good Frame, FCS Error, Undersize, Fragments, Oversize, Oversize & FCS Error, Dribble Bit Error, Alignment Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*9, PRBS Frame Error*9 Combination; And, Or

*8: Option 12 IPv6 Expansion is required.

*9: Option 11 Packet BER Test is required.

*10: Option 28 Ethernet OAM is required.

Module (MU120131A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame Preamble, OAM (IEEE802.3), MPCP, EoPMLS
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400.
Replay	MD1230 Family includes Ethereal/Wireshark Convert Function. Capture frames are converted to Tx streams.

Module (MU120131A) (Cont'd)

Item	Specifications
Latency	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP, ICMP, IGMPv2, IGMPv3,
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph Filter	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off Frame Arrival Time Variation filter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Latency Variation Resolution Offset Graph Filter	32 counters indicate the results. Resolution: 50 ns, 100 ns, 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms. Depend on resolution, Max. 3 s. Frame Count vs. Latency Auto scale: On/Off Latency Variation filter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)

Module (MU120131A) (Cont'd)

Item	Specifications
<p>Application Traffic Monitor (Opt20)</p> <p>Application Traffic Monitor</p>	<p>Monitor Resolution: 1ms</p> <p>Display Resolution: 1ms/10ms/100ms/500ms/1s</p> <p>Counter Filter</p> <p>Counter: Counter 1, Counter 2, Counter 3, Counter 4</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Filter:</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Trigger:</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error, Counter 1 Over, Counter 2 Over, Counter 3 Over, Counter 4 Over</p> <p>Condition: don't care, Match, Not match</p> <p>Flow:</p> <p>Display: On/Off, Up to 4 flows</p> <p>Flow/port: 4</p> <p>Marker: Marker 1, Marker 2, On/Off</p> <p>Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s</p> <p>Peak Hold Time: On/Off, 1s, 10s, 1min, 15min, Untimed</p> <p>Time Width: 100 to 2,000ms, Step 1ms</p> <p>(Display Resolution 1ms)</p> <p>1,000 to 20,000ms, Step 10ms</p> <p>(Display Resolution 10ms)</p> <p>10,000 to 100,000ms, Step 100ms</p> <p>(Display Resolution 100ms)</p> <p>50,000 to 500,000ms, Step 500ms</p> <p>(Display Resolution 500ms)</p> <p>100,000 to 1,000,000ms, Step 1,000ms</p> <p>(Display Resolution 1s)</p> <p>Range of Monitor Display:</p> <p>Minimum Value: 0 to 999,999,999bit/s</p> <p>Maximum Value:</p> <p>(Minimum Value + 1) to 1,000,000,000bit/s</p> <p>Logarithm: On/Off</p> <p>Auto scale: On/Off</p> <p>Full Screen: On/Off</p> <p>Log: On/Off, Log stop On/Off</p>

Module (MU120131A) (Cont'd)

Item	Specifications
Application Traffic Monitor Player	Display Resolution: 1ms/10ms/100ms/500ms/1s Flow: Display: On/Off, Up to 4 flows Marker: Marker 1, Marker 2, On/Off Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s Peak Hold Time: On/Off, 1s, 10s, 1min, 15min, Untimed Time Width: 100 to 2,000ms, Step 1ms (Display Resolution 1ms) 1,000 to 20,000ms, Step 10ms (Display Resolution 10ms) 10,000 to 100,000ms, Step 100ms (Display Resolution 100ms) 50,000 to 500,000ms, Step 500ms (Display Resolution 500ms) 100,000 to 1,000,000ms, Step 1,000ms (Display Resolution 1s) Range of Monitor Display: Minimum Value: 0 to 999,999,999bit/s Maximum Value: (Minimum Value + 1) to 1,000,000,000bit/s Result of Monitor: Graph display, MAX/MIN/AVE Logarithm: On/Off Auto scale: On/Off Player: Playback, Temporally stop, Stop Display Movement: Top/end button, Slider bar Peak Search/Traffic Calculation Specify Range Mode: All, User defined Start: ms, s, min, hour Range: ms, s, min, hour Peak Search: Time, Traffic Traffic Calculation: Amount of Traffic
Automatic Test RFC2544 Automatic Test	Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]). [1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset

Module (MU120131A) (Cont'd)

Item	Specifications
Port Pairs	Traffic Distribution: One to one, Partially meshed, Fully meshed
Test Setting	Traffic Orientation: Unidirectional, Bidirectional Mesh Type: Round Robin, Peak Loading VLAN Tag: On/Off VLAN ID: 0 to 4095 Frame Size: 64,128,256,512,1024,1280,1518 byte Custom: 1 to 25 point Step: 64 to 65535 Step Size 1 to 65471 Count 1 to 25 Test Frame Protocol: MAC,IP Device Type: Store and Forward, Bit Forward Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999
Throughput	Duration: 2 to 999 s Number of Trials: 1 to 50 Burst Size: 1 to 1000 Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step Loss Tolerance: 0 to 100%,0.0001% step Result: Frame Rate (%), Frame/s, Bit/s, byte/s Graph: Frame Rate (%), Frame/s, Bit/s, byte/s vs. Frame Size, Theoretical value
Latency	Duration: 2 to 999 s Number of trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate Burst Size: 1 to 1000 Result: Latency (Resolution 0.01 us) Graph: Latency vs. Frame size
Frame Loss Rate	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, 0.01% step Burst Size: 1 to 1000 Result: Frame Loss Rate (%) Graph: Frame Rate vs. Frame Loss Rate
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size

Module (MU120131A) (Cont'd)

Item	Specifications
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time 1us resolution, Accuracy: 1us Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop
RFC2889 Automatic Test (Opt10)	Following 10 types of tests can be supported. [1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate [2] Partially Meshed One-to-Many/Many-to-One [3] Partially Meshed Multiple Devices [4] Partially Meshed Unidirectional Traffic [5] Congestion Control [6] Forward Pressure and Maximum Forwarding Rate [7] Address Caching Capacity [8] Address Learning Rate [9] Error-Frame Filtering [10] Broadcast Frame Forwarding and Latency
Fully Meshed Throughput, Frame Loss and Forwarding Rates	Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$) Duration: 2 to 300s Frame Rate: 0.01to 100 %,0.01% step Frame Size: Default(64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%),Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed One to Many/Many to One	Inter Frame Gap: (Refer to Inter Frame Gap) Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,...24$) Duration: 2 to 300s Frame Rate: 0.01to 100 %,0.01% step Frame Size: Default(64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%),Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120131A) (Cont'd)

Item	Specifications
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports $\Leftrightarrow$ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2N (N=0,1,2,3,...24)</p> <p>Duration: 2 to 300s</p> <p>Frame Rate: 0.01to 100 %,0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%),Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Partially Meshed Unidirectional Traffic	<p>Traffic: Tx/Rx Ports $\Leftrightarrow$ Tx/Rx Ports Local Traffic</p> <p>Inter Frame Gap: (Refer to Inter Frame Gap)</p> <p>Burst size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2N (N=0,1,2,3,...24)</p> <p>Duration: 2 to 300s</p> <p>Frame Rate: 0.01to 100 %,0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%),Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap:(Refer to Inter Frame Gap)</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2N(N=0,1,2,3,...24)</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: 0.01 to 100 %,0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%),Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300 s</p> <p>Frame Rate: Step Size: 1 to 4294967295 frame/s</p> <p>Frame Size: Default (64, 128, 256, 512, 1024, 1280, 1518 byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120131A) (Cont'd)

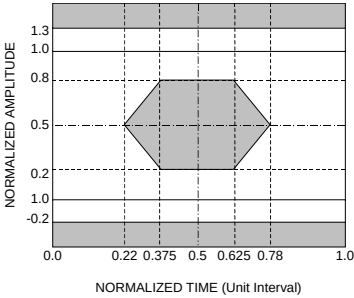
Item	Specifications
Address Caching Capacity	Traffic : Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Address Learning Rate	Traffic: Test Port, Learning Port, Monitoring Port Age Time: 1 to 65535 s Address Learning Rate: 1 to 4294967295 frame/s Initial Address: 1 to 16777216 Frame Size: 64 byte Result: # of Address VLAN Tag: On/Off VLAN ID: 0 to 4095
Error Frame Filtering	Traffic: Tx Port, Rx port Duration: 2 to 300 s ILoad: 0.01 to 100 %,0.01% step Frame Size: 64 byte Result: Frame count, pass/fail VLAN Tag: On/Off VLAN ID: 0 to 4095
Broadcast Frame Forwarding and Latency	Traffic: Tx Port, Rx Port Duration: 2 to 300 s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %,0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 byte) Custom: 1 to 25 point Result: Frame Loss Rate(%),Throughput (%),Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%), Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120131A) (Cont'd)

Item	Specifications
Tools Fragment	<p>Fragments already registered Stream data</p> <p>Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6</p> <p>Support Data Field: Data Field1</p> <p>Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9</p> <p>Stream ID: 1 to 255, All</p> <p>MTU: 1 to 9936 byte</p> <p>Number of Datagrams: 1 to 127</p> <p>Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6)</p> <p>Increment Identification: On/Off</p> <p>To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>
Environmental Performance Temperature range	Operation: +5 to +40 °C Storage: -20 to +60 °C
Humidity range	Operation: 20 to 80 %RH Storage: 20 to 80 %RH
Power Consumption	Less than 50 W
Size	<p>BASED ON PICMG2.0 R2.1</p> <p>262.0 (W) × 20.0 (H) × 174.5 (D) mm</p> <p>It doesn't contain protuberance.</p>
Weight	Less than 1.5 kg

A.11 MU120132A

Module (MU120132A)

Item	Specifications
Apparatus name	Gigabit Ethernet Module
Composition	Module × 1
Module Options	MU120132A-01: Clock Measurement
Interface	
Corresponding Specification	1000BASE-SX/LX/LE/LR (depend on SFP Module)
Connector	SFP (LC)
Number of Ports	SFP: 8
Bit Rate	1000 Mbit/s
Pulse Mask	
Laser Safety	IEC60825-1:2007 CLASS 1
Auto Negotiation	On/Off
Flow Control	On/Off
LED	Link

Module (MU120132A) (Cont'd)

Item	Specifications
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	MAC Address IPv4 Address, Netmask, Gateway
ARP Reply	Not send, Reply to this port ARP request, Reply to all ARP request
ICMP Echo(PING) Reply	Not send, Reply to this port ping request
IPv6(Opt12)	
This port	MAC Address IPv6 Address, Default Router, Link-Local Address
Neighbor Solicitation Reply	Not send, Reply to this port IPv6 Address, Reply to all IPv6 Addresses
Echo Reply	Not send, Reply to This port Echo Request
VLAN (IEEE802.IQ-1998)	Enabled(Ethernet OAM Only):On/Off(Opt28) TPID,Priority,VID
Ethernet OAM(Opt28)	Enabled:On/Off Standard:ITU-T/IEEE DUT MEP ID:0 to 8191
This port	Reply to This Port LBM:On/Off Reply to This Port LTM:On/Off LTR TLVs:0 to 120 byte Send CCM:On/Off Insert RDI:On/Off MEG Level:0 to 7 MEP ID:0 to 8191 MEG ID:48 byte CCM Period:1 s, 10 s, 1 min, 10 min. CCM TLVs:0 to 80 byte
Protocols	IGMP:On/Off IGAP:On/Off MLD:On/Off MLDA:On/Off
Duplex Mode	Full
MII/MDIO properties	Auto negotiation On/Off, Restart, Loop back On/Off, Time-out enable On/Off, Link Timer Fixed, Variable(1ms to 100ms 1ms step), MII registers (Allows the current MII register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)

Module (MU120132A) (Cont'd)

Item	Specifications
Mode	Normal, Monitor, Through*1, Address Swap
Preamble	On/Off Note: To capture the preamble data of frames, set the "Preamble" on.
E-PON	On/Off Note: To decode and calculate CRC the preamble data of E-PON frames, set the "E-PON" on.
Test Pattern	Single PRBS9/Cross PRBS23/Cross PRBS31 Cross PRBS23 and Cross PRBS31 means PRBS bit stream of each frame is not reset and PRBS bit stream of each frame is not continuous.
Link	
Mode	On, Off, Flap
Flap Setting	Count: 0 to 65535, Infinit Interval On: 10 to 3600 Interval Off: 1 to 3600 No/Go Check: On/Off
Frequency Monitor	MU120132A-01 Frequency(Hz),Difference(Hz),Difference(ppm) The Difference value is shown from -1000 to +1000 ppm. 1250 MHz is the reference.
Accuracy	Depend on the unit. MD1230 family: +/- 4.0 ppm MP1590B: +/- 0.1 ppm MP1591A: +/- 0.1 ppm

*1: On MU120132A, the Through mode can be used with port 1 and port 2, port 3 and port 4, port 5 and port 6, and port 7 and port 8.

Module (MU120132A) (Cont'd)

Item	Specifications
Clock Select Offset Accuracy	MU120132A-01 Clock1, Clock2 -100 to +100 ppm This setting is common in Port 1 to 8. Depend on the unit. MD1230 family: +/- 4.0 ppm MP1590B: +/- 0.1 ppm MP1591A: +/- 0.1 ppm
Stream Number of Streams Stream Setting Distribution Frame per Burst Burst per Stream Frame View	256 Streams/Port Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000), Jump to Stream for Count and Stop (Loop Count: 1 to 16,000,000) 1 to 16,777,215 1 to 1,099,511,627,775 Raw Frame, Decoded
Gap Setting Inter Frame Gap Inter Burst Gap Inter Stream Gap	At least 72 ns (9 bytes) when the frame length is an odd number and Random or Inc is set. Resolution of 8 ns, 64 ns to 120 s Settable as Fixed or Random Resolution of 8 ns, 64 ns to 120 s Settable as Fixed Resolution of 8 ns, 64 ns to 120 s Settable as Fixed
Frame Setting	Preamble Size: 2 to 255 bytes MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA) VLAN tag*2: Up to 10 layer VLAN tags can be appended. VLAN ID can be set Increment, Decrement, Random. MPLS label*2: Up to 10 MPLS labels can be appended. Fixed setting. Programmable Data Link Layer*2: Up to 32 byte field is fully programmable.

*2: VLAN, MPLS and Programmable Data Link Layer cannot both be used simultaneously.

Module (MU120132A) (Cont'd)

Item	Specifications
Frame Size	<p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC, Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMP/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate 1/0 (Each bit, Each 2bits, Each 4bits, Each 1 byte, 2 bytes), Increment, Decrement, Random, Single PRBS9</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*3}, Sequence Number^{*3*6}, Hardware Random Pattern^{*3}, Test Frame^{*4}</p> <p>Settable Flow ID number when Test Frame is used.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p> <p>48 to 10,000 byte</p> <p>Settable as Auto, Fixed, Increment^{*5}, or Random^{*5}</p>

^{*3}: When a sequence number or time stamp or hardware random pattern is used, the checksum field of the TCP/UDP packet contains an error code.

^{*4}: Test Frame is set when Increment is set for the TCP/UDP port number.

^{*5}: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

^{*6}: Continuous sequence numbers are assigned for each flow ID.

Module (MU120132A) (Cont'd)

Item	Specifications
Protocol Setting Ethernet	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer Frame setting/MAC Address)</p> <p>SA: (→ Refer Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p>
IPv4 (RFC791)	<p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1 = High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1 = Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1 = More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

Module (MU120132A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Sequence number (32 bit): User defined Acknowledgement number (32 bit): User defined, 0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined, 0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined, 0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined, 0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined, 0 to 65535 Destination Port (16 bit): User defined, 0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined, 0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120132A) (Cont'd)

Item	Specifications
ICMP (RFC792,950,1256)	<p>Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply</p> <p>Code (8 bit): User defined 0 to 255</p> <p>Checksum (16 bit): Automatically calculated (Soft)</p> <p>Data: For Echo Request/Response</p> <p>Identifier (16 bit): User defined</p> <p>Sequence Number (16 bit): User defined</p>
RIP (RFC2453)	<p>Command (8 bit): 1 = Request 2 = Response</p> <p>Version (8 bit): 1 = RIP version1 2 = RIP version2</p> <p>Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next</p> <p>Route tag: User defined</p> <p>IP Address: User defined</p> <p>Subnet Mask: User defined for Version2</p> <p>Next hop: User defined for Version2</p> <p>Metric: 0 to 4294967295 (DEC)</p> <p>Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm</p> <p>Authentication Data: ASCII 16 byte entry</p>

Module (MU120132A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit): User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120132A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	<p>Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8bit): User defined 6 = for MAC address Hops (8 bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined</p>
MPLS (RFC3031,3032)	<p>Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.</p>
VLAN(IEEE802.IQ-1998)	<p>TPID: 0x8100,User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal</p>
MLDA (IETF Draft)	<p>MLDA Listener Query, MLDA Listener Acknowledgement,MLDA Listener Report</p>

Module (MU120132A) (Cont'd)

Item	Specifications
Test Frame	Type: PRBS9(Single),PRBS23(Cross), PRBS31(Cross),Flow ID
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option 11 Packet BER Test: PRBS Error Insertion Timing is available, only when Test Frame Type is PRBS23 (Cross) or PRBS31 (Cross) (Refer to Cross PRBS Error Setting).
Unframed BER Setting	Test Pattern:All 0, All 1, User 16, PRBS23, PRBS31, CJPAT, CRPAT Error Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8 ,1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Pro- grammable Rate (1.0E-10 to 9.9E-3)

Module (MU120132A) (Cont'd)

Item	Specifications
Cross PRBS Error Setting	Test Pattern (Optical): Single, PRBS23, PRBS31 Error Insertion: Cross PRBS Error Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 2.0E-3)
Measurement Function Counter Mode Ethernet	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Byte Alignment Error Line Error Frequency, Frequency Difference (Hz), Frequency Difference (ppm), Link Failed
IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error
Ethernet OAM Alarm (Opt28)	LOC (0.1 ms Resolution) AIS (0.1 ms Resolution) RDI (0.1 ms Resolution)
IPv6 (Opt12)	Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count
TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*7, UDP Checksum Error*7

*7: The packets fragmented in the IP layer are not counted as error packets.

Module (MU120132A) (Cont'd)

Item	Specifications
Data	<p>Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).</p> <p>User Defined counter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p>
Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate
Unframed BER Test	Bit Error Count/Rate, Pattern Sync. Loss Count/Second

Module (MU120132A) (Cont'd)

Item	Specifications
Multi Flow Counter	<p>Settable as up to 16 bits 4 filters to count each value at a special bit in frames. (Max 255 values)</p> <p>Mode: Tx, Rx</p> <p>Flow Count Field:</p> <p>Type: User Defined, Test Frame Flow ID</p> <p>Base Position: Top of Preamble , Top of Frame, Top of IPv4 Header, Top of IPv6 Header*⁸, IPv6 Hop-by-hop Option Header, IPv6 Destination Option Header, IPv6 Routing Header, IPv6 Fragment Header, VLAN Tag 1 to 10, Top of TCP Header, Top of UDP Header, Flow ID*⁹, Top of Ethernet OAM PDU*¹⁰</p> <p>Offset: 0 to 65,535 byte, 0 to 7 bit</p> <p>Length: 1 to 16 bit</p> <p>Filter(Rx): On/Off</p> <p>Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p> <p>Flow Count Item:</p> <p>Transmitted Bit Rate (Mbit/s)</p> <p>Transmitted Rate (%)</p> <p>Transmitted Byte</p> <p>Transmitted Frame</p> <p>Transmitted Frame (fps)</p> <p>Received Bit Rate (Mbit/s)</p> <p>Received Rate (%)</p> <p>Received Byte</p> <p>Received Frame</p> <p>Received Frame (fps)</p> <p>Sequence Error</p> <p>Max Latency (us)</p> <p>Min Latency (us)</p> <p>Current Latency (us)</p> <p>Avg Latency (us)</p> <p>E-PON</p> <p>Preamble CRC Error</p> <p>Graph</p> <p>1s, 1min, 15min, 60min resolution, 8 kinds of graph are displayed simultaneously.</p>

*8: Option 12 IPv6 Expansion is required.

*9: Option 11 Packet BER Test is required.

*10: Option 28 Ethernet OAM is required.

Item	Specifications
Capture	16 Mbyte/Port
Capture Buffer	Filter condition settings: Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match
Capture Filter/Trigger	Trigger condition settings: Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s
	Manual Trigger: Trigger Position Settings: Top, Middle, Bottom
Pattern and Error Conditions	Pattern1,2,3,4; Pattern:128 bit Mask:byte or Pattern:16 bit Mask:bit Base position:Top of Preamble, Top of Frame, Top of VLAN tag1 to 10, Top of Ethernet OAM PDU*10, Top of IPv4 Header, Top of IPv6 Header*8,IPv6 Extension Headers (Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*8, Top of IP Payload, Top of TCP Header, Top of UDP Header, Flow ID*9 Offset:0 to 65535 Error; Error type: Good Frame, FCS Error, Undersize, Fragments, Oversize, Oversize&FCS Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*9, PRBS Frame Error*9 Combination: And, Or

*9: Option 11 Packet BER Test is required.

*10: Option 28 Ethernet OAM is required.

Module (MU120132A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame Preamble, OAM (IEEE802.3), MPCP, EoPMLS
Extended Decode Protocol	By Sniffer Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400.
Replay	MD1230 Family includes Ethereal/Wireshark Convert Function. Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP,ICMP,IGMPv2,IGMPv3
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter) Resolution Offset Graph Filter	32 counters indicate the results. Resolution: 1 us,10 us,100 us,1 ms,10 ms,100 ms,1 s Depend on resolution, Max. 3 min. Frame Count vs. Time Interval Auto scale: On/Off Frame Arrival Time Variation filter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.

Module (MU120132A) (Cont'd)

Item	Specifications
Latency Variation Resolution Offset Graph Filter	32 counters indicate the results. Resolution: 50 ns, 100 ns, 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms. Depend on resolution, Max. 3 s. Frame Count vs. Latency Auto scale: On/Off Latency Variation filter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s)
Auto Negotiation Analysis (Opt15)	10B Code data transmitted function, Auto negotiation sequence capture function, Link timer value variable function

Module (MU120132A) (Cont'd)

Item	Specifications
Application Traffic Monitor (Opt20) Application Traffic Monitor	<p>Monitor Resolution: 1ms</p> <p>Display Resolution: 1ms/10ms/100ms/500ms/1s</p> <p>Counter Filter</p> <p>Counter: Counter 1, Counter 2, Counter 3, Counter 4</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Filter:</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error</p> <p>Condition: don't care, Match, Not match</p> <p>Capture Trigger:</p> <p>Type: Pattern 1, Pattern 2, Pattern 3, Pattern 4, Error, Counter 1 Over, Counter 2 Over, Counter 3 Over, Counter 4 Over</p> <p>Condition: don't care, Match, Not match</p> <p>Flow:</p> <p>Display: On/Off, Up to 4 flows</p> <p>Flow/port: 4</p> <p>Marker: Marker 1, Marker 2, On/Off</p> <p>Unit: bit/s, Kbit/s, Mbit/s, byte/s, Kbyte/s, Mbyte/s</p> <p>Peak Hold Time: On/Off, 1s, 10s, 1min, 15min, Untimed</p> <p>Time Width: 100 to 2,000ms, Step 1ms (Display Resolution 1ms)</p> <p>1,000 to 20,000ms, Step 10ms (Display Resolution 10ms)</p> <p>10,000 to 100,000ms, Step 100ms (Display Resolution 100ms)</p> <p>50,000 to 500,000ms, Step 500ms (Display Resolution 500ms)</p> <p>100,000 to 1,000,000ms, Step 1,000ms (Display Resolution 1s)</p> <p>Range of Monitor Display: Minimum Value: 0 to 999,999,999bit/s</p> <p>Maximum Value: (Minimum Value + 1) to 1,000,000,000bit/s</p> <p>Result of Monitor: Graph display, MAX/MIN/AVE</p> <p>Logarithm: On/Off</p> <p>Auto scale: On/Off</p> <p>Full Screen: On/Off</p> <p>Log: On/Off, Log stop On/Off</p>

Module (MU120132A) (Cont'd)

Item	Specifications
Automatic Test	
RFC2544 Automatic Test	<p>Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]).</p> <p>[1] Throughput [2] Latency [3] Frame Loss Rate [4] Back-to-back Frames [5] System Recovery [6] Reset</p>
Port Pairs	<p>Traffic Distribution: One to one, Partially meshed, Fully meshed</p> <p>Traffic Orientation: Unidirectional, Bidirectional</p> <p>Mesh Type: Round Robin, Peak Loading</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Test Setting	<p>Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 bytes</p> <p>Custom: 1 to 25 point</p> <p>Step: Start 64 to 65535 Step Size 1 to 65471 Count 1 to 25</p> <p>Test Frame Protocol: MAC,IP</p> <p>Device Type: Store and Forward, Bit Forward</p> <p>Leaning Frame: Leaning Mode: Never, Once, Every Trial Retries: 1 to 999</p>
Throughput	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Burst Size: 1 to 1000</p> <p>Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, resolution, 0.01% step</p> <p>Loss Tolerance: 0 to 100%,0.0001% step</p> <p>Result: Frame Rate (%),Frame/s, Bit/s, byte/s</p> <p>Graph: Frame Rate (%), Frame/s, Bit/s, byte/s vs. Frame Size, Theoretical value</p>
Latency	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate</p> <p>Burst Size: 1 to 1000</p> <p>Result: Latency (Resolution0.01 us)</p> <p>Graph: Latency vs. Frame Size</p>
Frame Loss Rate	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Frame Rate (%): Initial Rate, Step Rate, 0.01% step</p> <p>Burst Size: 1 to 1000</p> <p>Result: Frame Loss Rate (%)</p> <p>Graph: Frame Rate vs. Frame Loss Rate</p>

Module (MU120132A) (Cont'd)

Item	Specifications
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time 1us resolution, Accuracy: 1us Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop
RFC2889 Automatic Test (Opt10)	Following 10 types of tests can be supported. [1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate [2] Partially Meshed One-to-Many/Many-to-One [3] Partially Meshed Multiple Devices [4] Partially Meshed Unidirectional Traffic [5] Congestion Control [6] Forward Pressure and Maximum Forwarding Rate [7] Address Caching Capacity [8] Address Learning Rate [9] Error-Frame Filtering [10] Broadcast Frame Forwarding and Latency
Fully Meshed Throughput, Frame Loss and Forwarding Rates	Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N (N=0,1,2,3,...24) Duration: 2 to 300s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120132A) (Cont'd)

Item	Specifications
Partially Meshed One to Many/Many to One	Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300s Frame Rate: 0.01to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed Multiple Devices	Traffic: Tx/Rx Ports ↔ Tx/Rx Ports Local Traffic Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300s Frame Rate: 0.01to 100%, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095
Partially Meshed Unidirectional Traffic	Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300s Frame Rate: 0.01to 100%, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120132A) (Cont'd)

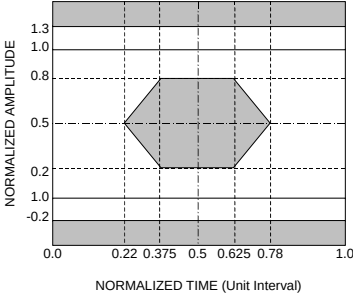
Item	Specifications
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: → 6.3.1 Reference</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300s</p> <p>Frame Rate: 0.01 to 100%, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 bytes)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%)</p> <p>Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300s</p> <p>Frame Rate: Step Size: 1 to 4294967295frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test,</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Caching Capacity	<p>Traffic : Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 bytes</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Learning Rate	<p>Traffic: Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 bytes</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Error Frame Filtering	<p>Traffic: Tx Port, Rx port</p> <p>Duration: 2 to 300s</p> <p>ILoad: 0.01 to 100 %, 0.01% step</p> <p>Frame Size: 64 bytes</p> <p>Result: Frame count, pass/fail</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120132A) (Cont'd)

Item	Specifications
Broadcast Frame Forwarding and Latency	<p>Traffic: Tx Port, Rx Port Duration: 2 to 300s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s), VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Tools Fragment	<p>Fragments already registered Stream data Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>
Environmental Performance Temperature range Humidity range Power Consumption Size Weight	<p>Operation: +5 to +40 °C Storage: -20 to +60 °C Operation: 20 to 80 %RH Storage: 20 to 80 %RH Less than 45 W BASED ON PICMG2.0 R2.1 262.0 (W) × 20.0 (H) × 174.5 (D) mm It doesn't contain protuberance. Less than 1.5 kg</p>

A.12 MU120138A

Module (MU120138A)

Item	Specifications
Apparatus name Composition Module Options	10 Gigabit Ethernet Module Module × 1 MU120138A-01: Clock Measurement MU120138A-03: Link Fault Signaling
Interface Corresponding Specification Connector Number of Ports Bit Rate Pulse Mask	10GBASE-SR/LR/ER (depend on SFP+ Module) 10GBASE-SR: IEEE 802.3ae-2002 Table52-7, 52-9 10GBASE-LR: IEEE 802.3ae-2002 Table52-12, 52-13 10GBASE-ER: IEEE 802.3ae-2002 Table52-16, 52-17 SFP+ (LC) 4 10 Gbit/s (10.3125Gbit/s NRZ) 
Laser Safety Flow Control LED	IEC60825-1:2007 CLASS 1M On/Off Link

Module (MU120138A) (Cont'd)

Item	Specifications
Port setting	
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
IPv4	
This port	IPv4 Address, Netmask, Gateway
ARP Reply	Not send, Reply to this port ARP request, Reply to all ARP request
ICMP Echo(PING) Reply	Not send, Reply to this port ping request
IPv6(Opt12)	
This port	IPv6 Address, Default Router, Link-Local Address
Neighbor Solicitation Reply	Not send, Reply to this port IPv6 Address, Reply to all IPv6 Addresses
Echo Reply	Not send, Reply to This port Echo Request
VLAN (IEEE802.IQ-1998)	Enabled(Ethernet OAM Only):On/Off(Opt28)
Ethernet OAM(Opt28)	TPID, Priority, VID
	Enabled:On/Off
	Standard:ITU-T/IEEE
	DUT MEP ID:0 to 8191
This port	Reply to This Port LBM:On/Off
	Reply to This Port LTM:On/Off
	LTR TLVs:0 to 120 byte
	Send CCM:On/Off
	Insert RDI:On/Off
	MEG Level:0 to 7
	MEP ID:0 to 8191
	MEG ID:48 byte
	CCM Period:1 s, 10 s, 1 min, 10 min.
	CCM TLVs:0 to 80 byte
Protocols	IGMP:On/Off
	IGAP:On/Off
	MLD:On/Off
	MLDA:On/Off
Duplex Mode	Full
MII/MDIO properties	Loop back On/Off, MDIO registers (Allows the current MDIO register values to be read and written, Default), Flow Control Receive, Multicast Pause Address (01-80-C2-00-00-01), Directed Address (This Port, User Defined)

Module (MU120138A) (Cont'd)

Item	Specifications
Mode	Normal, Monitor, Through*1, Address Swap
Preamble	On/Off Note: To capture the preamble data of frames, set the "Preamble" on.
Test Pattern	Single PRBS9/Cross PRBS23/Cross PRBS31 Cross PRBS23 and Cross PRBS31 means PRBS bit stream of each frame is not reset and PRBS bit stream of each frame is not continuous.
Link	
Mode	On, Off, Flap
Flap Setting	Count: 0 to 65535, Infinit Interval On: 10 to 3600 Interval Off: 1 to 3600
Frequency Monitor	MU120138A-01 Frequency(Hz),Difference(Hz),Difference(ppm) The Difference value is shown from -1000 to +1000 ppm. 10.3125 GHz is the reference.
Accuracy	Depend on the unit. MD1230 family: +/- 4.0 ppm MP1590B: +/- 0.1 ppm MP1591A: +/- 0.1 ppm

*1: On MU120138A, the Through mode can be used with port 1 and port 2, port 3 and port 4.

Module (MU120138A) (Cont'd)

Item	Specifications
Clock Select Offset Accuracy	MU120138A-01 Clock1, Clock2 -100 to +100 ppm This setting is common in Port 1 to 4. Depend on the unit. MD1230 family: +/- 4.0 ppm MP1590B: +/- 0.1 ppm MP1591A: +/- 0.1 ppm
Stream Number of Streams Stream Setting Distribution Frame per Burst Burst per Stream Frame View	256 Streams/Port Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000), Jump to Stream for Count and Stop (Loop Count: 1 to 16,000,000) 1 to 1,099,511,627,775 1 to 1,099,511,627,775 Raw Frame, Decoded
Gap Setting Inter Frame Gap Inter Burst Gap Inter Stream Gap	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed or Random Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed Resolution of 0.8 ns, 9.6 ns to 120 s Settable as Fixed
Frame Setting	Preamble Size: 2 to 255 bytes MAC Address: Static, Increment, Decrement, Random (Changeable portion specified in 4 bits units), Gateway (Only for DA), This port (Only for SA) VLAN tag*2: Up to 10 layer VLAN tags can be appended. VLAN ID can be set Increment, Decrement, Random. MPLS label*2: Up to 10 MPLS labels can be appended. Fixed setting. Programmable Data Link Layer*2: Up to 32 byte field is fully programmable.

*2: VLAN, MPLS and Programmable Data Link Layer cannot both be used simultaneously.

Module (MU120138A) (Cont'd)

Item	Specifications
	<p>Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC, Control Frame (Pause Frame)</p> <p>Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMP/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4</p> <p>IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.</p> <p>TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.</p> <p>Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message</p> <p>Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU</p> <p>Data Field: Can set any portions of data field as All 0, All 1, Alternate 1/0 (Each bit, Each 2bits, Each 4bits, Each 1 byte, 2 bytes), Increment, Decrement, Random, Single PRBS9</p> <p>Only Data Field 1 can set Programmable, Time Stamp^{*3}, Sequence Number^{*3*6}, Hardware Random Pattern^{*3}, Test Frame^{*4}</p> <p>Settable Flow ID number when Test Frame is used.</p> <p>Programmable Header Pattern: 1 user defined pattern can be set.</p> <p>Frame Size</p> <p>48 to 10,000 byte</p> <p>Settable as Auto, Fixed, Increment^{*5}, or Random^{*5}</p>

*3: When a sequence number or time stamp or hardware random pattern is used, the checksum field of the TCP/UDP packet contains an error code.

*4: Test Frame is set when Increment is set for the TCP/UDP port number.

*5: Increment and Random settings can be specified for the Frame Size only when None is selected for the protocol.

*6: Continuous sequence numbers are assigned for each flow ID.

Module (MU120138A) (Cont'd)

Item	Specifications
Protocol Setting	
Ethernet	<p>Preamble: 55(hex) (User can be changed, only first byte fixed 01010101)</p> <p>SFD: D5(hex) (User can be changed)</p> <p>DA: (→ Refer Frame setting/MAC Address)</p> <p>SA: (→ Refer Frame setting/MAC Address)</p> <p>Type: Automatically assigned, User defined</p> <p>FCS: Automatically calculated</p>
IPv4 (RFC791)	<p>Version: 4 (DEC)</p> <p>IHL: Auto</p> <p>Type of service: User defined (initial 00(hex))</p> <p>Bit0 to 2 (Precedence): 111-Network control 110-Internetwork control 101-CRITIC/ECP 100-Flash override 011-Flash 010-Immediate 001-Priority 000-Routine</p> <p>Bit3: 0 = Normal delay, 1 = Low delay</p> <p>Bit4: 0 = Normal throughput, 1 = High throughput</p> <p>Bit5: 0 = Normal Reliability, 1 = High Reliability</p> <p>Bit6 to 7: 2 bit user defined</p> <p>Total Length: Auto</p> <p>Identification: User defined (4 byte)</p> <p>Flag: User defined (initial 010(b))</p> <p>Bit0: User defined</p> <p>Bit1: (DF) 0 = May Fragment, 1 = Don't Fragment</p> <p>Bit2: (MF) 0 = Last Fragment, 1 = More Fragment</p> <p>Fragment Offset: 0 to 8191(DEC) user defined (initial 0)</p> <p>Time to Live: from 0 to 255 (DEC) user defined (initial 64)</p> <p>Protocol: 0 to 255 (DEC) user defined (initial 0)</p> <p>Automatically set if TCP or UDP is selected.</p> <p>Header Checksum: Auto</p> <p>Source Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Destination Address: Static, Increment, Decrement, Random with class and mask setting</p> <p>Option: 0 to 40 bytes</p>

Module (MU120138A) (Cont'd)

Item	Specifications
IPv6 (RFC2460)	Version (4 bit): 6 Traffic Class (8 bit): User defined Flow Label (20 bit): 20 bit user defined (initial all 0) Payload Length (16 bit): Auto Next Header (8 bit): 0 to 255 (DEC) user defined (initial 59) Hop Limit (8 bit): 0 to 255 user defined (initial 0) Source Address (128 bit): Static, Increment, Decrement, Random with mask setting Destination Address (128 bit): Static, Increment, Decrement, Random with mask setting
TCP (RFC793)	Source Port (16 bit): User defined,0 to 65535 Destination Port (16 bit): User defined,0 to 65535 Sequence number (32 bit): User defined Acknowledgement number(32 bit): User defined,0000 to FFFF Data offset (4 bit): Auto Reserved (6 bit): User defined,0 to 63 Control bit (6 bit): User Defined, Setting by bit Window (16 bit): User defined,0 to 65535 Checksum (16 bit): Auto Urgent pointer (16 bit): User defined,0 to 65535 Option: 0 to 40 bytes Padding: All 0
UDP (RFC768)	Source Port (16 bit): User defined,0 to 65535 Destination Port (16 bit): User defined,0 to 65535 Length (16 bit): Auto Checksum (16 bit): Auto
IGMP (RFC2236)	Type (4 bit): 11- Membership Query 12- Version1 Membership Report 16- Version2 Membership Report 17- Leave Group Max Response Time (8 bit): User defined,0 to 255 Checksum (16 bit): Automatically calculated Group Address (32 bit): User defined Version: set to 2

Module (MU120138A) (Cont'd)

Item	Specifications
ICMP (RFC792,950,1256)	Type (8 bit): 0 = Reply 3 = Destination Unreachable 4 = Source Quench 5 = Redirect 8 = Echo 9 = Router Advertisement 10 = Router Solicitation 11 = Time Exceeded 12 = Parameter Problem 13 = Time Stamp 14 = Time Stamp Reply 15 = Information Request 16 = Information Reply 17 = Address Mask Request 18 = Address Mask Reply Code (8 bit): User defined 0 to 255 Checksum (16 bit): Automatically calculated (Soft) Data: For Echo Request/Response Identifier (16 bit): User defined Sequence Number (16 bit): User defined
RIP (RFC2453)	Command (8 bit): 1 = Request 2 = Response Version (8 bit): 1 = RIP version1 2 = RIP version2 Address Family Identifier (16 bit): 0000 0002 = IP protocol FFFF = Authentication entry see next Route tag: User defined IP Address: User defined Subnet Mask: User defined for Version2 Next hop: User defined for Version2 Metric: 0 to 4294967295 (DEC) Authentication type (16 bit): 1-IP Route 2-Password 3-Keyed Message Digest Algorithm Authentication Data: ASCII 16 byte entry

Module (MU120138A) (Cont'd)

Item	Specifications
IPX	Checksum (16 bit): Auto Packet Length (16 bit): Auto Transport Control (8 bit): User defined 0 to 255 Packet Type (8 bit): 0 = Unknown 1 = RIP 2 = Echo 3 = Error 4 = IPX 5 = SPX 17 = NCP Destination Network (4 byte): User defined Destination Node (6 byte): User defined Destination Socket (2 byte): User defined Source Network (4 byte): User defined Source Node (6 byte): User defined Source Socket (2 byte): User defined
ARP (RFC826)	HW Type (16 bit): 1 Protocol Type (16 bit): 0800 (h) HA Length (8 bit): 6 PA Length (8 bit): 4 Operation (16 bit): User defined 1 = ARP Request 2 = ARP Reply 3 = RARP Request 4 = RARP Reply Sender MAC Address (48 bit): User defined Sender IP Address (32 bit): User defined Target MAC Address (48 bit): User defined Target IP Address (32 bit): User defined Padding: Not support

Module (MU120138A) (Cont'd)

Item	Specifications
DHCP (RFC2131)	Op Code (8 bit): User defined 1 = Boot request 2 = Boot reply Hardware Type (8 bit): User defined 1 = 10MB Ethernet Hardware Address Length (8bit): User defined 6 = for MAC address Hops (8 bit): User defined (0 to 255) Transaction ID (32 bit): User defined (0 to 4294967295(DEC)) Seconds (16 bit): User defined (0 to 65535(DEC)) Flag (16 bit) : User defined 0000 = Nobroadcast 8000 = Broadcast Client IP Address (32 bit): User defined Your IP Address (32 bit): User defined Server IP Address (32 bit): User defined Relay Agent IP Address (32 bit): User defined Client Hardware Address (16 byte): User defined Server Host Name (64 byte): User defined Boot File Name (128 byte): User defined Option (0 to 64 byte): User defined
MPLS (RFC3031,3032)	Label (20 bit): User defined 0 = IPv4 explicit null label 1 = Router alert label 2 = IPv6 explicit null label 3 = Implicit null label 4 to 15 = Reserved EXP (3 bit): User defined S (1 bit): Bottom of stack TTL (8 bit): User defined 10 kinds of MPLS can set.
VLAN(IEEE802.IQ-1998)	TPID: 0x8100,User defined User priority (3 bit): 0 to 7 User defined CFI (1 bit): 1 = set 0 = reset VID (12 bit): Static, Increment, Decrement, Random Display at decimal

Module (MU120138A) (Cont'd)

Item	Specifications
MLDA (IETF Draft) Test Frame	MLDA Listener Query, MLDA Listener Acknowledgement, MLDA Listener Report Type: PRBS9(Single),PRBS23(Cross), PRBS31(Cross),Flow ID
Template Ethernet OAM(Opt28)	CCM, LBR, LBM, LTR, LTM, AIS, LCK, TST, APS, MCC, LMR, LMM, 1DM, DMR, DMM, EXR, EXM, VSR, VSM
Error Insertion Ethernet IP TCP/UDP Data	FCS Error, Undersize, Oversize, Fragments, Oversize & FCS Error IPv4 Header Checksum Error TCP/UDP Checksum Error Supported by Option 11 Packet BER Test: PRBS Error Insertion Timing is available, only when Test Frame Type is PRBS23 (Cross) or PRBS31 (Cross) (Refer to Cross PRBS Error Setting).
Unframed BER Setting	Test Pattern:All 0, All 1, User 16, PRBS23, PRBS31, CJPAT, CRPAT Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8 ,1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Pro- grammable Rate (1.0E-10 to 2.0E-3)

Module (MU120138A) (Cont'd)

Item	Specifications
Cross PRBS Error Setting	Test Pattern (Optical): Single, PRBS23, PRBS31 Error Insertion: Cross PRBS Error Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 2.0E-3)
Measurement Function Counter Mode Ethernet	Accumulated, 1 s current Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Rate, Transmitted/Received byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error, MAC Control Frame, Transmitted/Received ARP Request, Transmitted/Received ARP Reply Line Error (XGMII) Frequency, Frequency Difference (Hz), Frequency Difference (ppm), Link Failed
IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error
Ethernet OAM Alarm (Opt28)	LOC (0.1 ms Resolution) AIS (0.1 ms Resolution) RDI (0.1 ms Resolution)
IPv6 (Opt12)	Transmitted/Received IPv6 Packet Count, Transmitted/Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count
TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error ^{*7} , UDP Checksum Error ^{*7}

^{*7}: The packets fragmented in the IP layer are not counted as error packets.

Module (MU120138A) (Cont'd)

Item	Specifications
Data	Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate, QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority). User Defined counter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Frame Error Count/Rate, Received PRBS Bit Error Count/Rate
Unframed BER Test LFS	Bit Error Count/Rate, Pattern Sync. Loss Count/Second MU120138A-03 Transmitted/Received RF Signal, Transmitted/Received LF Signal

Module (MU120138A) (Cont'd)

Item	Specifications
Graph	<p>Settable as up to 16 bits 4 filters to count each value at a special bit in frames. (Max 255 values)</p> <p>Mode: Tx, Rx</p> <p>Flow Count Field:</p> <p>Type: User Defined, Test Frame Flow ID</p> <p>Base Position: Top of Preamble , Top of Frame, Top of IPv4 Header, Top of IPv6 Header*⁸, IPv6 Hop-by-hop Option Header, IPv6 Destination Option Header, IPv6 Routing Header, IPv6 Fragment Header, VLAN Tag 1 to 10, Top of TCP Header, Top of UDP Header, Flow ID*⁹, Top of Ethernet OAM PDU*¹⁰</p> <p>Offset: 0 to 65,535 byte, 0 to 7 bit</p> <p>Length: 1 to 16 bit</p> <p>Filter(Rx): On/Off</p> <p>Error: don't care, Match, Not match</p> <p>Refer to Pattern and Error conditions of Capture.</p> <p>Flow Count Item:</p> <p>Transmitted Bit Rate (Mbit/s)</p> <p>Transmitted Rate (%)</p> <p>Transmitted Byte</p> <p>Transmitted Frame</p> <p>Transmitted Frame (fps)</p> <p>Received Bit Rate (Mbit/s)</p> <p>Received Rate (%)</p> <p>Received Byte</p> <p>Received Frame</p> <p>Received Frame (fps)</p> <p>Sequence Error</p> <p>Max Latency (us)</p> <p>Min Latency (us)</p> <p>Current Latency (us)</p> <p>Avg Latency (us)</p> <p>1s, 1min, 15min, 60min resolution, 8 kinds of graph are displayed simultaneously.</p>

*8: Option 12 IPv6 Expansion is required.

*9: Option 11 Packet BER Test is required.

*10: Option 28 Ethernet OAM is required.

Module (MU120138A) (Cont'd)

Item	Specifications
Capture	
Capture Buffer	256 Mbyte/Port
Capture Filter/Trigger	Filter condition settings; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Trigger condition settings; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match External Trigger: Traffic is out of range:0 to 100% Latency is out of range:1 ns to 59 s
Pattern and Error Conditions	Manual Trigger: Trigger Position Settings: Top, Middle, Bottom Pattern1,2,3,4; Pattern:128 bit Mask:byte or Pattern:16 bit Mask:bit Base position:Top of Preamble, Top of Frame, Top of VLAN tag1 to 10, Top of Ethernet OAM PDU*10, Top of IPv4 Header, Top of IPv6 Header*8,IPv6 Extension Headers (Hop by Hop, Destination, Routing, Fragment, Authentication, ESP)*8, Top of IP Payload, Top of TCP Header, Top of UDP Header, Flow ID*9 Offset:0 to 65535 Error; Error type: Good Frame, FCS Error, Undersize, Fragments, Oversize, Oversize&FCS Error, IP Header checksum Error, TCP checksum Error, UDP checksum Error, Sequence Error*9, PRBS Frame Error*9 Combination: And, Or

*8: Option 12 IPv6 Expansion is required.

*9: Option 11 Packet BER Test is required.

*10: Option 28 Ethernet OAM is required.

Module (MU120138A) (Cont'd)

Item	Specifications
Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, Ethernet OAM, IP, IPv6 (include Extended, Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA), TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPv6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame Preamble, OAM (IEEE802.3), MPCP, EoPMLS
Extended Decode Protocol	By Sniffer® Technologies (Opt04) or MX123002A Expert Analysis Module, the number of decode protocols can be increased up to 400. MD1230 Family includes Ethereal®/Wireshark® Convert Function.
Replay	Capture frames are converted to Tx streams.
Latency	When Test Frames are received, the latency is indicated. The result includes 1s sampling value, max, min, avg. and number of samples.
Protocol Emulation	ARP, ICMP, ICMPv6 (Opt12), IGMPv2, IGMPv3, IGAP (Opt14), MLDv1 (Opt12), MLDv2 (Opt12), MLDA (Opt22)*11
Ping	Destination: User defined Send: 4 times Result: Reply, bytes, time, TTL
Frame Arrival Time Variation (Packet Jitter) Resolution	32 counters indicate the results. Resolution: 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms, 1 s
Offset	Depend on resolution, Max. 3 min.
Graph	Frame Count vs. Time Interval Auto scale: On/Off
Filter	Frame Arrival Time Variation filter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.

*11: Option 12 IPv6 Expansion is required.

Module (MU120138A) (Cont'd)

Item	Specifications
Latency Variation Resolution Offset Graph Filter	32 counters indicate the results. Resolution: 50 ns, 100 ns, 1 us, 10 us, 100 us, 1 ms, 10 ms, 100 ms. Depend on resolution, Max. 3 s. Frame Count vs. Latency Auto scale: On/Off Latency Variation filter conditions; Pattern1: don't care, Match, Not match Pattern2: don't care, Match, Not match Pattern3: don't care, Match, Not match Pattern4: don't care, Match, Not match Error: don't care, Match, Not match Refer to Pattern and Error conditions of Capture.
Custom Counter	Frame Loss Frame Loss Rate (%) Received Bit Rate (Mbps) Received Average Frame Size (byte) Service Disruption Time (s).
LFS	MU120138A-03 Send Data function Signal Pattern: Remote Fault Signal, Local Fault Signal, Edit Signal. Edit Signal Pattern: TXC 1000 to 1111(bin), TXD 9C000000 to 9CFFFFFF(hex) Physical Layer Capture function Port: Port1, Port2, Port3, Port4, select 2Port capture size: 4096Line (1Line Lane1 to Lane4 (RXC 4bit, RXD 4byte)) Trigger setting: On/Off Trigger Pattern: Data RXC 4bit, RXD 4byte

Module (MU120138A) (Cont'd)

Item	Specifications
Automatic Test	
RFC2544 Automatic Test	<p>Following 6 types of tests can be supported. (MD1230 Family supports continuous test [1] to [5]).</p> <p>[1] Throughput</p> <p>[2] Latency</p> <p>[3] Frame Loss Rate</p> <p>[4] Back-to-back Frames</p> <p>[5] System Recovery</p> <p>[6] Reset</p>
Port Pairs	<p>Traffic Distribution: One to one, Partially meshed, Fully meshed</p> <p>Traffic Orientation: Unidirectional, Bidirectional</p> <p>Mesh Type: Round Robin, Peak Loading</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Test Setting	<p>Frame Size: 64, 128, 256, 512, 1024, 1280, 1518 bytes</p> <p>Custom: 1 to 25 point</p> <p>Step: Start 64 to 65535</p> <p>Step Size 1 to 65471</p> <p>Count 1 to 25</p> <p>Test Frame Protocol: MAC,IP</p> <p>Device Type: Store and Forward, Bit Forward</p> <p>Leaning Frame:</p> <p>Leaning Mode: Never, Once, Every Trial</p> <p>Retries: 1 to 999</p>
Throughput	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Burst Size: 1 to 1000</p> <p>Frame Rate (%): Initial Rate, Minimum Rate, Maximum Rate, Resolution, 0.01% step</p> <p>Loss Tolerance: 0 to 100%,0.0001% step</p> <p>Result: Frame Rate (%),Frame/s, Bit/s, byte/s</p> <p>Graph: Frame Rate (%), Frame/s, Bit/s, byte/s vs. Frame Size, Theoretical value</p>
Latency	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step, Result of Throughput Rate</p> <p>Burst Size: 1 to 1000</p> <p>Result: Latency (Resolution0.01 us)</p> <p>Graph: Latency vs. Frame Size</p>
Frame Loss Rate	<p>Duration: 2 to 999 s</p> <p>Number of Trials: 1 to 50</p> <p>Frame Rate (%): Initial Rate, Step Rate, 0.01% step</p> <p>Burst Size: 1 to 1000</p> <p>Result: Frame Loss Rate (%)</p> <p>Graph: Frame Rate vs. Frame Loss Rate</p>

Module (MU120138A) (Cont'd)

Item	Specifications
Back-to-Back Frames	Duration: 2 to 999 s Number of Trials: 1 to 50 Frame Rate (%): Initial Rate, Step Rate, Step Count, 0.01% step Burst Size: 1 to 1000 Loss Tolerance: 0 to 100%, 0.0001% step Result: Number of frames Graph: Number of frames vs. Frame Size
System Recovery	Duration: 2 to 999 s Number of Trials: 1 to 50 Threshold Time: 0 to 999 s Rate (%): Overload Rate (110% of the throughput rate user defined), Moderate Rate Burst Size: 1 to 1000 Result: Recovery time 1us resolution, Accuracy: 1us Graph: Recovery time vs. Frame Size
Reset	Frame Rate (%): User defined Burst Size: 1 to 1000 Sequence: Start → Waiting trigger → Triggered → Stop
RFC2889 Automatic Test (Opt10)	Following 10 types of tests can be supported. [1] Fully Meshed Throughput, Frame Loss, and Forwarding Rate [2] Partially Meshed One-to-Many/Many-to-One [3] Partially Meshed Multiple Devices [4] Partially Meshed Unidirectional Traffic [5] Congestion Control [6] Forward Pressure and Maximum Forwarding Rate [7] Address Caching Capacity [8] Address Learning Rate [9] Error-Frame Filtering [10] Broadcast Frame Forwarding and Latency
Fully Meshed Throughput, Frame Loss and Forwarding Rates	Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N (N=0,1,2,3,...24) Duration: 2 to 300s Frame Rate: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095

Module (MU120138A) (Cont'd)

Item	Specifications
Partially Meshed One to Many/Many to One	<p>Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300s Frame Rate: 0.01to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Partially Meshed Multiple Devices	<p>Traffic: Tx/Rx Ports ↔ Tx/Rx Ports Local Traffic Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300s Frame Rate: 0.01to 100%, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Partially Meshed Unidirectional Traffic	<p>Traffic: Tx/Rx Ports → Tx/Rx Ports Local Traffic Inter Frame Gap: → 6.3.1 Reference Burst Size: 1 to 930 Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$) Duration: 2 to 300s Frame Rate: 0.01to 100%, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518 bytes) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput(%) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%) VLAN Tag: On/Off VLAN ID: 0 to 4095</p>

Module (MU120138A) (Cont'd)

Item	Specifications
Congestion Control	<p>Traffic: Tx Ports, Rx Port, Uncongested Rx Port, Congested Port</p> <p>Inter Frame Gap: → 6.3.1 Reference</p> <p>Burst Size: 1 to 930</p> <p>Address per Port: 1 to 16777216 Step 2^N ($N=0,1,2,3,\dots,24$)</p> <p>Duration: 2 to 300s</p> <p>Frame Rate: 0.01 to 100%, 0.01% step</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518 bytes)</p> <p>Custom: 1 to 25 point</p> <p>Result: Frame Loss Rate(%), Throughput(%)</p> <p>Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%)</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Forward Pressure and Maximum Forwarding Rate	<p>Traffic: Tx Ports, Rx Port</p> <p>Duration: 2 to 300s</p> <p>Frame Rate: Step Size: 1 to 4294967295frame/s</p> <p>Frame Size: Default (64,128,256,512,1024,1280,1518byte)</p> <p>Custom: 1 to 25 point</p> <p>Result: Maximum Forwarding Rate (fps), Result of forward pressure test,</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Caching Capacity	<p>Traffic : Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 bytes</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Address Learning Rate	<p>Traffic: Test Port, Learning Port, Monitoring Port</p> <p>Age Time: 1 to 65535 s</p> <p>Address Learning Rate: 1 to 4294967295 frame/s</p> <p>Initial Address: 1 to 16777216</p> <p>Frame Size: 64 byte</p> <p>Result: # of Address</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>
Error Frame Filtering	<p>Traffic: Tx Port, Rx port</p> <p>Duration: 2 to 300s</p> <p>ILoad: 0.01 to 100 %, 0.01% step</p> <p>Frame size: 64byte</p> <p>Result: Frame count, pass/fail</p> <p>VLAN Tag: On/Off</p> <p>VLAN ID: 0 to 4095</p>

Module (MU120138A) (Cont'd)

Item	Specifications
Broadcast Frame Forwarding and Latency	<p>Traffic: Tx Port, Rx Port Duration: 2 to 300s Address per Port: 1 to 16777216 ILoad: 0.01 to 100 %, 0.01% step Frame Size: Default (64,128,256,512,1024,1280,1518byte) Custom: 1 to 25 point Result: Frame Loss Rate(%), Throughput (%), Latency(s) Graph: Input Frame Rate(%) vs. Frame Loss Rate(%) Frame Size vs. Frame Rate(%), Frame Size vs. Latency(s), VLAN Tag: On/Off VLAN ID: 0 to 4095</p>
Tools Fragment	<p>Fragments already registered Stream data Support Protocol:IPv4, IPv6, UDP/IPv4, TCP/IPv4, UDP/IPv6, TCP/IPv6 Support Data Field: Data Field1 Support Data Pattern:All0, All1, Alternate 1/0, Increment by byte, Decrement by byte, Programmable, PRBS9 Stream ID: 1 to 255, All MTU: 1 to 9936 byte Number of Datagrams: 1 to 127 Initial Identification:0x0000 to 0xffff (IPv4), 0x00000000 to 0xffffffff (IPv6) Increment Identification: On/Off To use the Fragment tool, set Active Interface of Remote Control at the Setup Utility to None or Ethernet.</p>
Environmental Performance Temperature range Humidity range Power Consumption Size Weight	<p>Operation: +5 to +40 °C Storage: -20 to +60 °C Operation: 20 to 80 %RH Storage: 20 to 80 %RH Less than 50 W BASED ON PICMG2.0 R2.1 262.0 (W) × 20.0 (H) × 174.5 (D) mm It doesn't contain protuberance. Less than 1.5 kg</p>

Appendix B Application Parts

B. Application Parts

Application parts available to the MU120102A/12A are listed in the following table:

Model name or No.	Product name	Remarks
G0105A	SX GBIC 850 nm	850 nm band, using MM fiber
G0106A	LX GBIC 1310 nm	1310 nm band, using SM/MM fiber
G0107A	LH GBIC 1310 nm	1310 nm band, using SM fiber
G0108A	ZX GBIC 1550 nm	1550 nm band, using SM fiber
G0124A	T GBIC	Uses Category 5e cable. For the MU120112A only.

Note:

Operation is assured only with the MU120102A and MU120112A application parts; operation with other parts is not assured.

Application parts available to the MU120118A/18B/18C are listed in the following table.

Model name or No.	Product name	Remarks
G0126A	XENPAK (10GBASE-LR)	1310 nm band, using SM fiber
G0131	XENPAK (10GBASE-ER)	1550 nm band, using SM fiber
G0132	XENPAK (10GBASE-SR)	850 nm band, using MM fiber
G0150A	XENPAK (10GBASE-LW) See Note 1	1310 nm band, using SM fiber
G0192A	XENPAK (10GBASE-LR) See Note 3	1310 nm band, using SM fiber
G0193A	XENPAK (10GBASE-ER) See Note 3	1550 nm band, using SM fiber
G0277A	XENPAK (10GBASE-SR)	850 nm band, using MM fiber
MZ1222A	XENPAK interface See Note 2	Interface for MDIO, XAUI, and XENPAK
MZ1221A	XAUI extender See Note 2	Extender for MDIO, XAUI
J1163A	XAUI cable See Note 2	Extension cable for XAUI, 0.5 m
J1164A	MDIO cable See Note 2	Extension cable for MDIO, 0.5 m

Notes:

1. The WAN-PHY option is required.
2. When the WAN-PHY option is installed, the XAUI Extender and XENPAK Interface cannot be used.
3. APS function is required.



For APS function, refer to “2.4 Installing the XENPAK.”

4. Operation is assured only with the MU120118A, MU120118B and MU120118C application parts; operation with other parts is not assured.

B. Application Parts

Application parts available to the MU120122A/32A are listed in the following table.

Model name or No.	Product name	Remarks
G0136	SFP SX 850 nm	850 nm band, using MM fiber
G0137	SFP LX 1310 nm	1310 nm band, SM, using MM fiber
G0138	SFP LE 1310 nm	1310 nm band, using SM fiber
G0139	SFP LR 1550 nm	1550 nm band, using SM fiber
G0181A	SFP SX 850 nm	850 nm band, using MM fiber
G0182A	SFP LX 1310 nm	1310 nm band, SM, using MM fiber
G0183A	SFP LE 1310 nm	1310 nm band, using SM fiber
G0184A	SFP LR 1550 nm	1550 nm band, using SM fiber

Note:

Operation is assured only with the MU120122A and MU120132A application parts; operation with other parts is not assured.

Appendix B Application Parts

Application parts available to the MU120138A are listed in the following table.

Model name or No.	Product name	Remarks
G0238A	SFP+ SR 850 nm	850 nm band, using MM fiber
G0239A	SFP+ LR 1310 nm	1310 nm band, using SM fiber
G0271A	SFP+ ER 1550nm	1550 nm band, using SM fiber

Note:

Operation is assured only with the MU120138A application part;
operation with other parts is not assured.

Application parts for connecting the DUT are listed in the following table.

Model name or No.	Product name
J1271	Optical fiber cord (Duplex, SM, LC-LC connector), 2 m
J1272	Optical fiber cord (Duplex, SM, LC-SC connector), 2 m
J1273	Optical fiber cord (Duplex, GI, LC-LC connector), 2 m
J1274	Optical fiber cord (Duplex, GI, LC-SC connector), 2 m
J0660B	Optical fiber cord (SM, SC-SC connector), 2 m
J0773B	Optical fiber cord (GI, SC-SC connector), 2 m
J1119B	Optical fiber cord (Duplex, MM, SC-SC connector), 2 m
J1049A	Fixed Optical ATT:SC (5 dB)
J1049B	Fixed Optical ATT:SC (10 dB)
J1049C	Fixed Optical ATT:SC (15 dB)
J1275	LAN cable (CAT5E, straight), 1 m
J1275B	LAN cable (CAT5E, straight), 5 m
J1275C	LAN cable (CAT5E, cross), 1 m
J1275D	LAN cable (CAT5E, cross), 5 m
J1110B	LAN cable (CAT5, straight), 5 m
J1109B	LAN cable (CAT5, cross), 5 m

Table B-1 GBIC to Host Connector assignment

Pin No.	Name	I/O	Function	Sequence
1	RX_LOS	O	Received Loss of signal H: Loss of Signal L: Signal detect	2
2	RGND		Receiver Ground	2
3	RGND		Receiver Ground	2
4	MOD_DEF (0)	O	Low	2
5	MOD_DEF (1)	I	SCL Serial Clock Signal	2
6	MOD_DEF (2)	I/O	SDA Serial Data Signal	2
7	TX_DISABLE	I	Transmit Disable H: Disable L: Enable	2
8	TGND		Transmitter Ground	2
9	TGND		Transmitter Ground	2
10	TX_FAULT	O	Transmit Fault	2
11	RGND		Receiver Ground	1
12	-RX_DAT	O	Received Data, Differential PECL	1
13	+RX_DAT	O	Received Data, Differential PECL	1
14	RGND		Receiver Ground	1
15	VDDR	I	Receiver +5 V supply	2
16	VDDT	I	Transmitter +5 V supply	2
17	TGND		Transmitter Ground	1
18	+TX_DAT	I	Transmit Data, Differential PECL	1
19	-TX_DAT	I	Transmit Data, Differential PECL	1
20	TGND		Transmitter Ground	1

Note:

“Sequence” indicates the order of contact for Insertion of connector.
Contact is established with Sequence 1 pin at first.

Table B-2 SFP to Host Connector assignment

Pin No.	Name	I/O	Function	Sequence
1	V _{EE} T	–	Transmitter Ground	1
2	TX_FAULT	O	Transmit Fault Indication H: Fault Condition L: Normal Condition	3
3	TX_DISABLE	I	Optical Output control H: Disable L: Enable	3
4	MOD_DEF (2)	I/O	SDA Serial Data Signal	3
5	MOD_DEF (1)	I	SCL Serial Clock Signal	3
6	MOD_DEF (0)	O	Module present indicator	3
7	RATE SELECT	I	Receive bandwidth select H: Full bandwidth L: Reduce bandwidth	3
8	RX_LOS	O	Loss of signal H: Loss of received optical signal L: Received optical signal	3
9	V _{EE} R	–	Receiver Ground	1
10	V _{EE} R	–	Receiver Ground	1
11	V _{EE} R	–	Receiver Ground	1
12	RD–	O	Received Data, Inv.	3
13	RD+	O	Received Data,	3
14	V _{EE} R		Receiver Ground	1
15	V _{CC} R	I	Receiver +3.3 V supply ±5%	2
16	V _{CC} T	I	Transmitter +3.3 V supply ±5%	2
17	V _{EE} T	–	Transmitter Ground	1
18	TD+	I	Transmit Data	3
19	TD–	I	Transmit Data, Inv.	3
20	V _{EE} T		Transmitter Ground	1

Note:

“Sequence” indicates the order of contact for Insertion of connector.
Contact is established with Sequence 1 pin at first.

Table B-3 XENPAK to Host Connector assignment

Pin No.	Name	I/O	Function
1	GND		Electrical Ground
2	GND		Electrical Ground
3	GND		Electrical Ground
4	5.0V		Power
5	3.3V		Power
6	3.3V		Power
7	APS		Adaptable Power Supply
8	APS		Adaptable Power Supply
9	LASI		Open Drain Compatible 10K-22K pull up on host Logic High: Normal Operation Logic Low: LASI Asserted
10	RESET	I	Logic High: Normal Operation, Low: Reset
11	VEND SPWCIFIC		Vendor Specific Pin Leave unconnected when not in use.
12	TX ON/OFF	I	Open Drain Compatible. 10-22K pull-up on transceiver Logic high = Transmitter On Logic low = Transmitter Off
13	Reserved	O	Reserved
14	MOD DE- TECT	O	Pulled low inside module through 1k
15	VEND SPWCIFIC		Vendor Specific Pin Leave unconnected when not in use.
16	VEND SPWCIFIC		Vendor Specific Pin Leave unconnected when not in use.
17	MDIO	I/O	Management Data I/O
18	MDC	I	Management Data Clock
19	PRTAD4	I	Port Address Bit 4
20	PRTAD3	I	Port Address Bit 3
21	PRTAD2	I	Port Address Bit 2
22	PRTAD1	I	Port Address Bit 1
23	PRTAD0	I	Port Address Bit 0
24	VEND SPWCIFIC		Vendor Specific Pin Leave unconnected when not in use.
25	APS SET		Feedback input for APS
26	Reserved		Reserved for Avalanche Photodiode use.
27	APS SENSE		APS Sense Connection
28	APS		Adaptable Power Supply
29	APS		Adaptable Power Supply
30	3.3V		Power

Pin No.	Name	I/O	Function
31	3.3V		Power
32	5.0V		Power
33	GND		Electrical Ground
34	GND		Electrical Ground
35	GND		Electrical Ground
36	GND		Electrical Ground
37	GND		Electrical Ground
38	Reserved	O	Reserved
39	Reserved	O	Reserved
40	GND		Electrical Ground
41	RX LANE 0+	O	Module XAUI Output Lane 0+
42	RX LANE 0–	O	Module XAUI Output Lane 0–
43	GND		Electrical Ground
44	RX LANE 1+	O	Module XAUI Output Lane 1+
45	RX LANE 1–	O	Module XAUI Output Lane 1–
46	GND		Electrical Ground
47	RX LANE 2+	O	Module XAUI Output Lane 2+
48	RX LANE 2–	O	Module XAUI Output Lane 2–
49	GND		Electrical Ground
50	RX LANE 3+	O	Module XAUI Output Lane 3+
51	RX LANE 3–	O	Module XAUI Output Lane 3–
52	GND		Electrical Ground
53	GND		Electrical Ground
54	GND		Electrical Ground
55	TX LANE 0+	I	Module XAUI Input Lane 0+
56	TX LANE 0–	I	Module XAUI Input Lane 0–
57	GND		Electrical Ground
58	TX LANE 1+	I	Module XAUI Input Lane 1+
59	TX LANE 1–	I	Module XAUI Input Lane 1–
60	GND		Electrical Ground
61	TX LANE 2+	I	Module XAUI Input Lane 2+
62	TX LANE 2–	I	Module XAUI Input Lane 2–
63	GND		Electrical Ground
64	TX LANE 3+	I	Module XAUI Input Lane 3+
65	TX LANE 3–	I	Module XAUI Input Lane 3–
66	GND		Electrical Ground
67	Reserved	I	Reserved
68	Reserved	I	Reserved
69	GND		Electrical Ground
70	GND		Electrical Ground

Table B-4 SFP+ to Host Connector assignment

Pin No.	Name	I/O	Function	Sequence
1	V _{EE} T	–	Transmitter Ground	1
2	TX_FAULT	O	Transmit Fault Indication H:Fault Condition L:Normal Condition	3
3	TX_DISABLE	I	Optical Output control H:Disable L:Enable	3
4	SDA	I/O	2-Wire Serial Interface Data Line (Same as MOD DEF2)	3
5	SCL	I/O	2-Wire Serial Interface Clock Line (Same as MOD DEF1)	3
6	MOD_ABS	–	Module Absent, connected to V _{EE} T or V _{EE} R in the module	3
7	RSO	I	NA	3
8	RX_LOS	O	Loss of signal H:Loss of received optical signal L:Received optical signal	3
9	RS1	I	NA	3
10	V _{EE} R	–	Receiver Ground	1
11	V _{EE} R	–	Receiver Ground	1
12	RD–	O	Received Data, Inv.	3
13	RD+	O	Received Data,	3
14	V _{EE} R	–	Receiver Ground	1
15	V _{CC} R	–	Receiver +3.3 V supply ±5%	2
16	V _{CC} T	–	Transmitter +3.3 V supply ±5%	2
17	V _{EE} T	–	Transmitter Ground	1
18	TD+	I	Transmit Data,	3
19	TD–	I	Transmit Data, Inv.	3
20	V _{EE} T	–	Transmitter Ground	1

Note:

“Sequence” indicates the order of contact for Insertion of connector. Contact is established with Sequence 1 pin at first.

G

GBIC 1.1.2, 1.1.4, 2.2, 2.6,
3.1.2, 3.1.4, A, B

M

MU120101A 1.1.1, 3.1.1, A
MU120102A 1.1.2, 3.1.2, A
MU120111A 1.1.3, 3.1.3, A
MU120112A 1.1.4, 3.1.4, A
MU120118A/18B/18C 1.1.5, 3.1.5, A
MU120121A 1.1.6, 3.1.6, A
MU120122A 1.1.7, 3.1.7, A
MU120131A 1.1.8, 3.1.8, A
MU120132A 1.1.9, 3.1.9, A
MU120138A 1.1.10, 3.1.10, A

R

RJ-45 1.1.6, 1.1.7, 1.1.8,
3.1.1, 3.1.3, 3.1.6,
3.1.7, 3.1.8, A

S

SFP 1.1.7, 1.1.9, 2.3, 2.7,
3.1.7, 3.1.9, A, B
SFP+ 1.1.10, 2.5, 2.9,
3.1.10, A, B

X

XAUI Extender 2.10, B
XENPAK 1.1.5, 2.4, 2.8, 2.10,
3.1.5, A, B

