MU181620A
Stressed Eye Transmitter
Operation Manual

Fourth Edition

- **For safety and warning information, please read this manual before attempting to use the equipment.**
- **Additional safety and warning information is provided in the MP1800A Signal Quality Analyzer Installation Guide and the MT1810A 4 Slot Chassis Installation Guide. Please also refer to one of these documents before using the equipment.**
- **Keep this manual with the equipment.**

ANRITSU CORPORATION

Document No.: M-W2998AE-4.0

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

Symbols used in manual

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

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

⚠ CAUTION This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.

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.

MU181620A
Stressed Eye Transmitter
Operation Manual

5 November 2007 (First Edition)
30 November 2012 (Fourth Edition)

For Safety

⚠ WARNING

1. Laser radiation warning
   - NEVER look directly into the cable connector on the equipment nor into the end of a cable connected to the equipment. There is a risk of injury if laser radiation enters the eye.
   - The Laser Safety label is attached to the equipment for safety use as indicated in "Laser Safety" later in this section.

Class 1 indicates the danger degree of the laser radiation specified below according to IEC 60825-1:2007.

Class 1: Lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

⚠ CAUTION

Caution-Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

For Safety

Laser Safety

The laser in this equipment is classified as Class 1 according to the IEC 60825-1:2007 standard.

Table 1 Laser Safety Classifications Based on IEC 60825-1:2007

Model Name	Recommended Module Model Name or Option Model Name/Part Name	Class	Max. Optical Output Power (mW) *1	Pulse Width (s)/Re-petition Rate	Emitted Wave-length (nm)	Beam Divergence (deg)	Laser Aperture
MU181620A	Option-x01 1310 nm Reference	1	5.0	CW	1290-1330	11.5	Fig. 1, [1]
	Option-x02 1550 nm Reference	1	5.0	CW	1530-1565	11.5	Fig. 1, [1]
	Option-x03 1310/1550 nm Reference	1	5.0	CW	1290-1330 or 1530-1565 *2	11.5	Fig. 1, [1]
	Option-x11 1310 nm Stressed Eye	1	5.0	CW	1290-1330	11.5	Fig. 1, [1]
	Option-x12 1550 nm Stressed Eye	1	5.0	CW	1530-1565	11.5	Fig. 1, [1]
	Option-x13 1310/1550 nm Stressed Eye	1	5.0	CW	1290-1330 or 1530-1565 *2	11.5	Fig. 1, [1]

*1: Indicates the possible optical output power when each and every reasonably foreseeable single-fault condition is included.

*2: A light of either wavelength will be emitted.

Table 2 Incorporated Laser Specification

Model Name	Recommended Module Model Name or Option Model Name/Part Name	Max. Optical Output Power (mW)*1	Pulse Width (s)/Rep-etition Rate	Emitted Wave-length (nm)	Beam Divergence (deg)
MU181620A	Optionx01 1310nm Reference	5.0	CW	1290-1330	11.5
	Optionx02 1550nm Reference	5.0	CW	1530-1565	11.5
	Optionx03 1310nm/1550nm Reference	5.0	CW	1290-1330 or 1530-1565*2	11.5
	Optionx11 1310nm Stressed Eye	5.0	CW	1290-1330	11.5
	Optionx12 1550nm Stressed Eye	5.0	CW	1530-1565	11.5
	Optionx13 1310nm/1550nm Stressed Eye	5.0	CW	1290-1330 or 1530-1565*2	11.5

*1: Indicates the possible optical output power when each and every reasonably foreseeable single-fault condition is included.

*2: A light of either wavelength will be emitted.

Table 3 Indication Labels on Product

	Type	Sample	Affixed to:	Model Name
1	Explanation	⚠ CLASS 1 LASER PRODUCT IEC 60825-1:2007	Fig. 1, A	MU181620A
2	Explanation	⚠ IEC 60825-1:2007 CLASS 1 LASER PRODUCT	Fig. 2, A Fig. 3, A	MP1800A MT1810A
3	Certification	CERTIFICATION LABEL THIS PRODUCT COMPLIES WITH 21 CFR 1040.10 AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50, DATED JUNE 24, 2007	Fig. 2, B Fig. 3, B	MP1800A MT1810A
4	Identification	IDENTIFICATION LABEL ANRITSU CORP. 5-1-1,ONNA,ATSUGI-SHI KANAGAWA 243-8555,JAPAN MANUFACTURED AT:TOHOKU ANRITSU CO., LTD KORIYAMA PLANT, .20	Fig. 2, C Fig. 3, C	MP1800A MT1810A

For Safety

Laser Radiation Markings

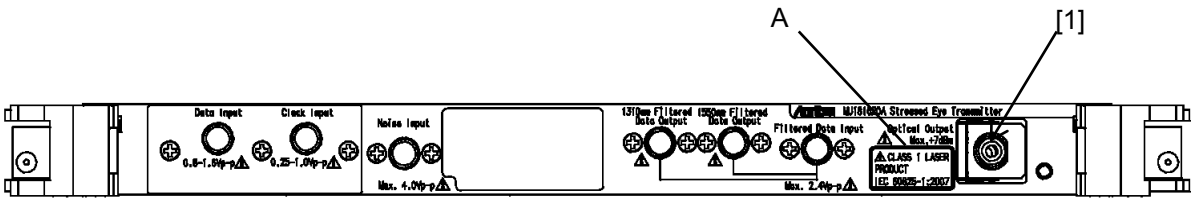


Fig. 1 Front Panel of MU181620A Module

Laser Radiation Markings

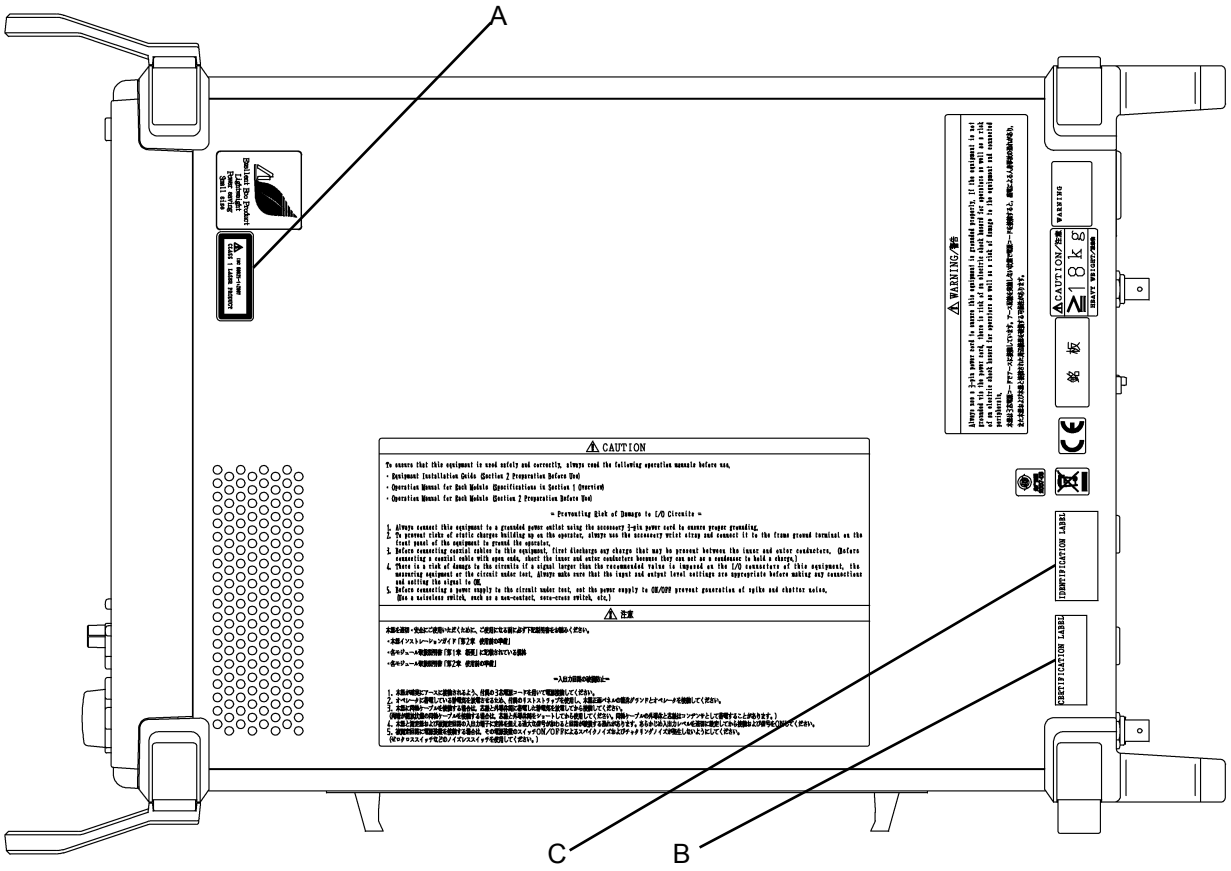


Fig. 2 MP1800A Exterior

Laser Radiation Markings

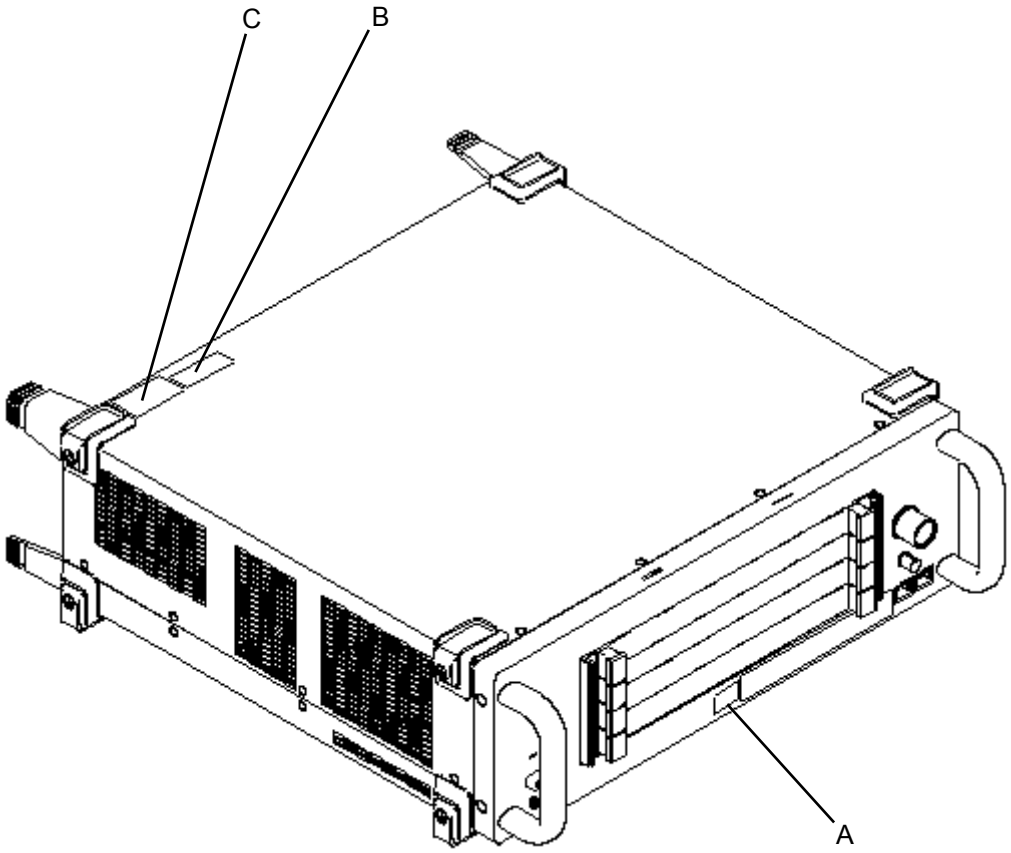


Fig. 3 MT1810A Exterior

For Safety

⚠ CAUTION

Lifetime of Parts

The life span of certain parts used in this instrument is determined by the operating time or the power-on time. Due consideration should be given to the life spans of these parts when performing continuous operation over an extended period. These parts must be replaced at the customer's expense even if within the guaranteed period described in Warranty at the beginning of this manual.
For details on life-span, refer to the corresponding section in this manual.
For coaxial switch: See Section 1.3 “Specifications”.

Equipment Certificate

Anritsu Corporation certifies that this equipment was tested before shipment using calibrated measuring instruments with direct traceability to public testing organizations recognized by national research laboratories, including the National Institute of Advanced Industrial Science and Technology, and the National Institute of Information and Communications Technology, and was found to meet the published specifications.

Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within one year after shipment due to a manufacturing fault. However, software fixes will be made in accordance with the separate Software End-User License Agreement. Moreover, Anritsu Corporation will deem this warranty void when:

- The fault is outside the scope of the warranty conditions separately described in the operation manual.
- The fault is due to mishandling, misuse, or unauthorized modification or repair of the equipment by the customer.
- The fault is due to severe usage clearly exceeding normal usage.
- The fault is due to improper or insufficient maintenance by the customer.
- The fault is due to natural disaster, including fire, wind, flooding, earthquake, lightning strike, or volcanic ash, etc.
- The fault is due to damage caused by acts of destruction, including civil disturbance, riot, or war, etc.
- The fault is due to explosion, accident, or breakdown of any other machinery, facility, or plant, etc.
- The fault is due to use of non-specified peripheral or applied equipment or parts, or consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.
- The fault is due to use in unusual environments(Note).
- The fault is due to activities or ingress of living organisms, such as insects, spiders, fungus, pollen, or seeds.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation shall assume no liability for injury or financial loss of the customer due to the use of or a failure to be able to use this equipment.

Note:
For the purpose of this Warranty, "unusual environments" means use:

- 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 places where chemically active gases (SO_2, H_2S, Cl_2, NH_3, NO_2, or HCl, 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
- At low atmospheric pressure
- In the presence of frequent vibration or mechanical shock, such as in cars, ships, or airplanes

Anritsu Corporation Contact

In the event of this equipment malfunctions, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

Notes On Export Management

This product and its manuals may require an Export License/Approval by the Government of the product's country of origin for re-export from your country.

Before re-exporting the product or manuals, please contact us to confirm whether they are export-controlled items or not.

When you dispose of export-controlled items, the products/manuals need to be broken/shredded so as not to be unlawfully used for military purpose.

About This Manual

A testing system combining an MP1800A Signal Quality Analyzer or MT1810A 4-Slot Chassis mainframe, module(s), and control software is called a Signal Quality Analyzer Series. The operation manuals of the Signal Quality Analyzer Series consist of separate documents for the installation guide, the mainframe, remote control operation, module(s), and control software, as shown below.

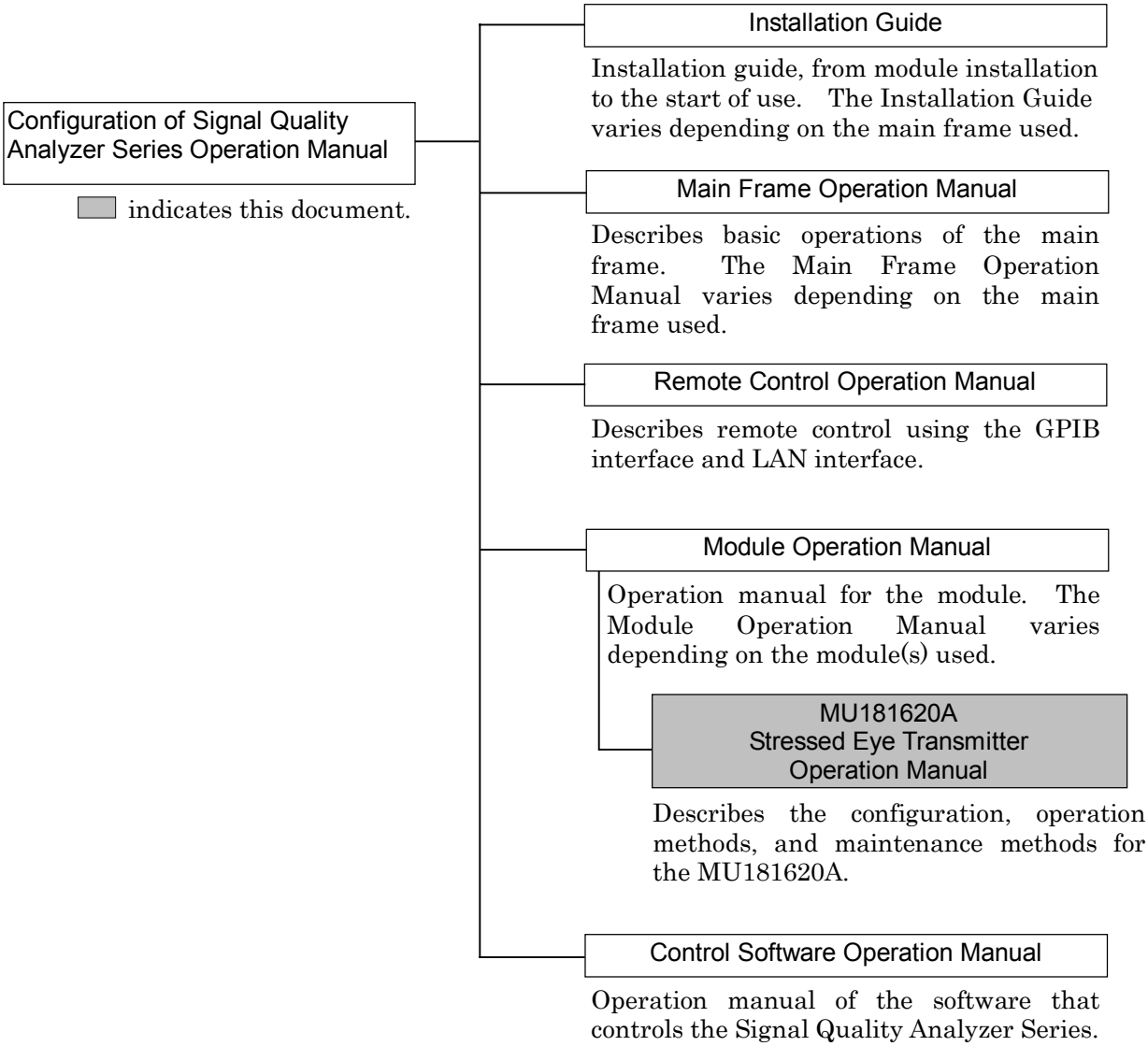


Table of Contents

IV.

Section 1 Overview

This section provides an overview of the MU181620A Stressed Eye Transmitter (hereinafter referred to as “MU181620A”).

1.1 Product Overview

The MU181620A is a plug-in module that can be built into a Signal Quality Analyzer Series main unit. It converts electrical digital signals input from an external device into optical signals and outputs them. The MU181620A is therefore useful for research, development, and production of various types of digital communication equipment as well as digital communication modules and devices.

The main features of the MU181620A are as follows:

- Two wavelengths can be installed: 1310 and 1550 nm
- Capable of generating reference waveforms as reference light sources (supported by MU181620A-x01, -x02, -x03) and stressed waveforms (supported by MU181620A-x11, -x12, -x13)
- Stress test conforming to the IEEE802.3-2005 standard can be conducted by using in combinations with external devices and the MX180002A Stressed Eye Measurement Control Software.

1.2 Product Composition

1.2.1 Standard composition

Table 1.2.1-1 shows the items standardly included with the MU181620A.

Table 1.2.1-1 Standard composition

Item	Model name/symbol	Product name	Q'ty	Remarks
Main unit	MU181620A	Stressed Eye Transmitter	1	One of MU181620A-x01, -x02, -x03, -x11, -x12, and -x13 must be installed.
Accessories	Z0897A	MP1800A Manual CD	1	CD-ROM
	J1404A	Semirigid cable	1	When MU181620A-x11 or x13 is installed For connection between Filtered Output and Filtered Data Input, 1310 nm wavelength
	J1405A	Semirigid cable	1	When MU181620A-x12 or x13 is installed For connection between Filtered Output and Filtered Data Input, 1550 nm wavelength
	J1137	Coaxial terminator	1	50 Ω SMA For Noise Input connection
	–	Replaceable optical connector	1	Select according to optical connector option.
	Z0918A	MX180000A Software CD	1	CD-ROM

1.2.2 Options

Table 1.2.2-1 shows the options for the MU181620A. All options are sold separately.

Table 1.2.2-1 Options

Item	Model name/symbol	Product name	Q'ty	Remarks
Options	MU181620A-x01	1310 nm Reference	1	Generates only reference waveforms of 1310 nm
	MU181620A-x02	1550 nm Reference	1	Generates only reference waveforms of 1550 nm
	MU181620A-x03	1310 nm/1550 nm Reference	1	Generates only reference waveforms of 1310 nm and 1550 nm
	MU181620A-x11	1310 nm Stressed Eye	1	Generates both reference and stressed waveforms of 1310 nm
	MU181620A-x12	1550 nm Stressed Eye	1	Generates both reference and stressed waveforms of 1550 nm
	MU181620A-x13	1310 nm/1550 nm Stressed Eye	1	Generates both reference and stressed waveforms of 1310 nm and 1550 nm
	MU181620A-037	FC Connector	1	Optical connector option
	MU181620A-040	SC Connector	1	

1.2.3 Application parts

Table 1.2.3-1 shows the application parts for the MU181620A. All application parts are sold separately.

Table 1.2.3-1 Application parts for MU181620A

Model name/symbol	Product name	Q'ty	Remarks
J0617B	Replaceable optical connector (FC-PC)	1	
J0619B	Replaceable optical connector (SC)	1	
J0635A	FC•PC-FC•PC-1M-SM	1	Single mode fiber FC-PC at both ends, 1 m
J0660A	SC•PC-SC•PC-1M-SM	1	Single mode fiber SC-PC at both ends, 1 m
J1342A	Coaxial cable 0.8 m	1	APC3.5 connector
W2998AE	MU181620A operation manual	1	Printed version (English)
Z0284	Adapter cleaner	1	Stick type (200 pcs/set)
Z0914A	Ferrule cleaner	1	CLETOP type
Z0915A	Replacement cartridge	1	6 pcs/set
Z0916A	Ferrule side cleaner	1	Stick type (200 pcs/set)

1.3 Specifications

Table 1.3-1 Specifications

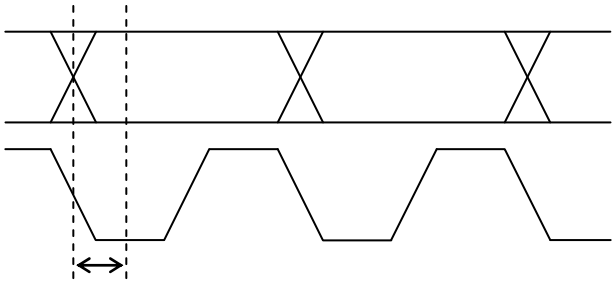
Item		Specifications
I/O interface		These specifications are defined on the condition that the Data Input signal is PRBS2^{31} – 1 and mark ratio is 1/2.
Operating bit rate		0.1 to 12.5 Gbit/s
Data input	Bit rate	0.1 to 12.5 Gbit/s
	Amplitude	0.8 to 1.6 Vp-p
	Vih level	0.0 V typ.
	Waveform	NRZ (Cross point 50 ± 5%)
	Terminator	50 Ω/GND
	Connector	SMA
Clock input	Frequency	1.0 to 12.5 GHz
	Amplitude	0.25 to 1.0 Vp-p
	Terminator	50 Ω/GND
	Duty	50±15%
	Connector	SMA
	Data/clock input phase margin	±100 mUI When data/clock output of the MU181020A-x030 is connected to data/clock input of the MU181620A:  Data/Clock Input
Noise input		When MU181620A-x11, x12, or x13 is installed
	Frequency	Max. 3.2 GHz
	Amplitude	Max. 4.0 Vp-p
	Offset	AC or Vth 0 V
	Terminator	50 Ω/GND
	Connector	SMA
1310 nm Filtered Data Output		When MU181620A-x11 or x13 is installed Connected to Filtered Data Input, via a semirigid cable (J1404A).
	Amplitude	Max. 2.4 Vp-p
	Terminator	50 Ω/GND
	Connector	SMA

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
1550 nm Filtered Data Output		When MU181620A-x12 or x13 is installed Connected to Filtered Data Input via a semirigid cable (J1405A).
	Amplitude	Max. 2.4 Vp-p
	Terminator	50 Ω/GND
	Connector	SMA
Filtered Data Input		When MU181620A-x11, x12, or x13 is installed
	Amplitude	Max. 2.4 Vp-p
	Vih level	–0.6 to 0.0 V
	Terminator	50 Ω/GND
	Connector	SMA
Optical output*1, 2		These specifications are defined with Power Control being Off (maximum output). They are also defined with the waveform retiming function being On when the bit rate is 1.0 Gbit/s or higher.

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
1310 nm reference		When MU181620A-x01, -x03, -x11, or -x13 is installed
	Output power (average)	Min. –4.0 dBm, Max. +4.0 dBm When no modulation or input is OPEN: Max. +7 dBm
	Output power stability*5	±0.02 dB (for 1 hour at constant temperature)
	Optical safety standard	Class 1 (IEC60825-1 2007, 21CFR 1040.10 Laser Safety Notice 50)
	Center wavelength	Min. 1290 nm, Max. 1330 nm
	Side-mode suppression ratio	≥30 dB
	Extinction ratio setting range	5.0 to 10.0 dB, in 0.1-dB steps
	Cross point*1, 2	50% typ.
	Vertical Eye Closure Penalty (VECP)*1	≤0.5 dB, in the center 20% region of the eye (Defined with an extinction ratio of 9.0 dB, an Anritsu-specified reference O/E signal used, at 20 to 30°C)
	Rise/fall time*1	≤30 ps (20 to 80%, Extinction ratio setting value: 10 dB)
	Jitter (10,000 hits)*1	Compliant with IEEE802.3-2005 ≤0.2 UIp-p (0.1 UIp-p typ.) (Extinction ratio: 10 dB, Use an oscilloscope with a residual jitter of 200 fs (RMS) or less)
	Eye mask	Compliant with STM64/OC192 (9.95328 Gbit/s), IEEE802.3-2005 (10.3125 Gbit/s, mask margin ≥30%) and STM64/OC192 with FEC (10.709 Gbit/s) (Extinction ratio: 10 dB)
	Applicable fiber	SM fiber (ITU-T G.652)
	Connector	MU181620A-037 FC Connector (PC type), MU181620A-040 SC Connector (PC type) Replaceable by users

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
1310 nm stressed eye		When MU181620A-x11 or -x13 is installed For MU181620A-x13, when a 1310 nm wavelength is selected
	Output power (average)	Min. –4.0 dBm, Max. +4.0 dBm When no modulation or input is OPEN: Max. +7 dBm
	Output power stability*5	±0.02 dB (for 1 hour at constant temperature)
	Optical safety standard	Class 1 (IEC60825–1 2007, 21 CFR 1040.10 Laser Safety Notice 50)
	Optical modulation amplitude (OMA)*3	≥–5.2 dBm
	Center wavelength	Min. 1290 nm, Max. 1330 nm
	Side-mode suppression ratio	≥30 dB
	Extinction ratio setting range	2.0 to 6.0 dB, in 0.1-dB steps
	Cross point*1, 2	50% typ.
	Vertical Eye Closure Penalty (VECP)*1, 2, 3	Min. 1.47 dB, Max. 2.2 dB, in the center 1% region of the Eye, without Noise Input Min. 2.2 dB, Max. 4.5 dB, in the center 1% region of the Eye, Noise Input 2.0 Vp-p Defined at 20 to 30°C
	Jitter (10,000 hits) *1, 2, 3	Compliant with IEEE802.3-2005 ≤0.25 UIp-p Use an oscilloscope with a residual jitter of 200 fs (RMS) or less.
	Eye mask*3	Compliant with IEEE802.3-2005 (10.3125 Gbit/s)
	Applicable fiber	SM fiber (ITU-T G.652)
	Connector	MU181620A-037 FC Connector (PC type), MU181620A-040 SC Connector (PC type) Replaceable by users

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
1550 nm reference		When MU181620A-x02, -x03, -x12, or -x13 is installed
	Output power (average)	Min. –2.0 dBm, Max. +4.0 dBm When no modulation or input is OPEN: Max. +7 dBm
	Output power stability*5	±0.02 dB (for 1 hour at constant temperature)
	Optical safety standard	Class 1 (IEC60825–1 2007, 21 CFR 1040.10 Laser Safety Notice 50)
	Center wavelength	Min. 1530 nm, Max. 1565 nm
	Side-mode suppression ratio	≥30 dB
	Extinction ratio setting range	6.0 to 10.0 dB, in 0.1-dB steps
	Cross point*1, 2	50% typ.
	Vertical Eye Closure Penalty (VECP)*1	≤0.5 dB, in the center 20% region of the Eye (Defined with an extinction ratio of 9.0 dB, an Anritsu-specified reference O/E signal used, at 20 to 30°C)
	Rise/fall time*1	≤30 ps (20 to 80%, Extinction ratio setting value: 10 dB)
	Jitter (10,000 hits)*1	Compliant with IEEE802.3-2005 ≤0.2 UIp-p (0.1 UIp-p typ.) (Extinction ratio: 10 dB, Use an oscilloscope with a residual jitter of 200 fs (RMS) or less)
	Eye mask	Compliant with STM64/OC192 (9.95328 Gbit/s), IEEE802.3-2005(10.3125 Gbit/s, mask margin ≥ 30%) and STM64/OC192 with FEC (10.709 Gbit/s) (Extinction ratio: 10 dB)
	Applicable fiber	SM fiber (ITU-T G.652)
	Connector	MU181620A-037 FC Connector (PC type), MU181620A-040 SC Connector (PC type) Replaceable by users

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
1550 nm stressed eye		When MU181620A-x12 or -x13 is installed For MU181620A-x13, when wavelength of 1550 nm is selected.
	Output power (average)	Min. –2.0 dBm, Max. +4.0 dBm When no modulation or input is OPEN: Max. +7 dBm
	Output power stability*5	±0.02 dB (for 1 hour at constant temperature)
	Optical safety standard	Class 1 (IEC60825-1 2007, 21 CFR 1040.10 Laser Safety Notice 50)
	Optical modulation amplitude (OMA)*4	≥–1.7 dBm
	Center wavelength	Min. 1530 nm, Max. 1565 nm
	Side-mode suppression ratio	≥30 dB
	Extinction ratio setting range	2.0 to 5.0 dB, in 0.1-dB steps
	Cross point*1, 2	50% typ.
	Vertical Eye Closure Penalty (VECP)*1, 2, 4	Min. 1.8 dB, Max. 2.7 dB, in the center 1% region of the Eye, without Noise Input Min. 2.7 dB, Max. 5.0 dB, in the center 1% region of the Eye, Noise Input 2.0 Vp-p Defined at 20 to 30°C
	Jitter (10,000 hits)*1, 2, 4	Compliant with IEEE802.3-2005 ≤0.25 UIp-p (Use an oscilloscope with a residual jitter of 200 fs (RMS) or less)
	Eye mask*4	Compliant with IEEE802.3-2005(10.3125 Gbit/s)
	Applicable fiber	SM fiber (ITU-T G.652)
	Connector	MU181620A-037 FC Connector (PC type), MU181620A-040 SC Connector (PC type) Replaceable by users
Optical attenuator		When MU181620A-x01, -x02, -x03, -x11, -x12, or -x13 is installed
Output power variable	Setting range	1310 nm: –20.00 to –4.00 dBm, in 0.01-dB steps (MU181620A-x01, -x03, -x11, -x13) 1550 nm: –20.00 to –2.00 dBm, in 0.01-dB steps (MU181620A-x02, -x03, -x12, -x13)
	Accuracy*6	±0.50 dB typ. (defined at 20 to 30°C)

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
Attenuation variable	Setting range	1310 nm: 0.00 to 16.00 dB, in 0.01 dB-steps (MU181620A-x01, -x03, -x11, -x13) 1550 nm: 0.00 to 18.00 dB, in 0.01-dB steps (MU181620A-x02, -x03, -x12, -x13)
	Accuracy*6	±0.50 dB typ. (defined at 20 to 30°C)
Operation warm-up time		0.5 h (for optical output power stability, 1 hour after turning on optical output)
Mechanical performance	Dimensions	234 mm (W) × 21 mm (H) × 175 mm (D) (Compact-PCI 1 slot) (Protrusions excluded)
	Mass	1.5 kg or less (Options included)
Environmental performance	Operating temperature	+5 to +40°C (temperature around equipment when installed in the mainframe)
	Storage temperature	–20 to +60°C (recommended range: +5 to +30°C)

*1: Defined with bit rate 10.3125 Gbit/s

*2: Perform measurement with a filter of 75% of bit rate

*3: Defined at extinction ratio = 3.5 dB

*4: Defined at extinction ratio = 3.0 dB

*5: Stability during one hour when one hour has elapsed after the optical output is set to On.

*6: Defined with a bit rate of at least 1 Gbit/s and waveform retiming function on.

CAUTION ⚠

The MU181620A uses a coaxial switch for switching of the wavelength between 1310 and 1550 nm, and for switching of the test type between Reference and Stressed Eye.
The guaranteed operating time of the coaxial switch is one million times. Take the operating lifetime into consideration when performing long-time continuous operation.

Section 2 Preparation before Use

This section describes preparations required before using the MU181620A.

2.1 Installation to Signal Quality Analyzer

For information on how to install the MU181620A to the Signal Quality Analyzer and how to turn on the power, refer to Section 2 “Preparation before Use” in the Signal Quality Analyzer Series Installation Guide.

2.2 How to Operate Application

The modules connected to the Signal Quality Analyzer are controlled by operating the MX180000A Signal Quality Analyzer Control Software (hereinafter, referred to as “MX180000A”).

For information on how to start up, shut down, and operate the MX180000A, refer to the MX180000A Signal Quality Analyzer Control Software Operation Manual.

2.3 Preventing Damage

Be sure to observe the rating voltage ranges when connecting input and output of the MU181620A. Otherwise, the MU181620A may become damaged.

CAUTION ⚠

1. **When signals are input to the MU181620A, avoid excessive voltage beyond the rating. Otherwise, the circuit may be damaged.**

2. **Use a 50 Ω/GND terminator at the output. Never feed any current to the output.**

3. **As a countermeasure against static electricity, ground other devices to be connected (including experimental circuits) with ground wires before connecting the I/O connector.**

4. **The outer conductor and core of the coaxial cable may become charged as a capacitor. Use metal like a copper wire to discharge electricity between the outer conductor and core before use.**

5. **Never open the MU181620A. If you open it and sufficient performance cannot be obtained, we may decline to repair the MU181620A.**

6. **To protect the MU181620A from electrostatic discharge failure, a conductive sheet should be placed onto the workbench, and the operator should wear an electrostatic discharge wrist strap. Connect the ground connection end of the wrist strap to the conductive sheet or to the ground terminal of the mainframe.**

Section 3 Panel Layout and Connectors

This section describes the panels and connectors of the MU181620A.

3.1 Panel Layout

3.1.1 Panel layout of MU181620A

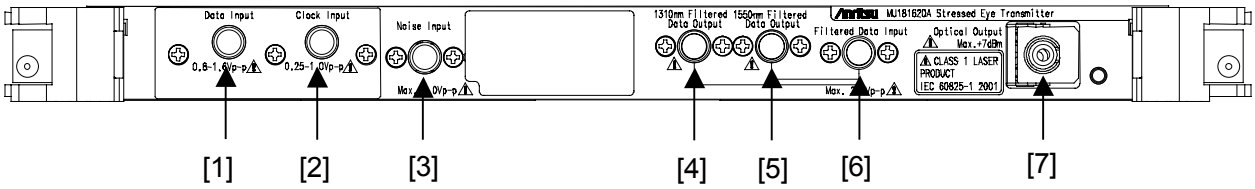


Fig. 3.1.1-1 Panel of MU181620A

Table 3.1.1-1 Name and Function of Each Part on MU181620A panel

No.	Name	Description
[1]	Data Input	Electric signal input connector for Data signal input. Input signal is DC input. When connecting to the Data Output connector of the MU181020A, use a cable with the same length as the coaxial cable that connects the Clock Output connector of the MU181020A and the Clock Input connector of the MU181620A.
[2]	Clock Input	Electric signal input connector for Clock signal input. Input signal is AC input.
[3]	Noise Input	Noise signal input connector for superimposing vertical noises (When MU181620A-x11, -x12, or -x13 is installed). Connect the supplied coaxial terminator when no signal is input to this connector.
[4]	1310 nm Filtered Data Output	When generating 1310 nm stressed signals, connect the signal output from this connector to the Filtered Data Input connector. Electric signal passed through the internal Bessel filter is output (When MU181620A-x11 or -x13 is installed).
[5]	1550 nm Filtered Data Output	When generating 1550 nm stressed signals, connect the signal output from this connector to the Filtered Data Input connector. Electric signal passed through the internal Bessel filter is output (When MU181620A-x12 or -x13 is installed).
[6]	Filtered Data Input	Data input connector to generate 1310/1550 nm stressed signals. Input signal is DC input (When MU181620A-x11, -x12, or -x13 is installed).
[7]	Optical Output	Output connector for 1310/1550 nm reference or stressed optical waveforms.

3.2 Inter-Module Connection

A connection example between the MU181620A, MU181000A 12.5 GHz Synthesizer (hereinafter referred to as "MU181000A"), MU181020A 12.5 Gbit/s PPG (hereinafter referred to as "MU181020A"), and MU181640A Optical Receiver (hereinafter referred to as "MU181640A"), and MU181040A 12.5 Gbit/s ED (hereinafter referred to as "MU181040A") that are installed into a mainframe is shown below.

1. Connect the 3-pin power cord of the mainframe to the outlet. Be sure to use the 3-pin power cord supplied with the mainframe and a 3-pin outlet.
2. Connect the Clock Output connector of the MU181000A-001 and the Ext Clock Input connector of the MU181020A, using a coaxial cable.
3. Connect the Data Output connector of the MU181020A and the Data Input connector of the MU181620A, using a coaxial cable.
4. Connect the Clock Output connector of the MU181020A and the Clock Input connector of the MU181620A, using a coaxial cable.
5. Connect the 1310 nm Filtered Data Output (or 1550 nm Filtered Data Output) connector and the Filtered Data Input connector of the MU181620A, using the supplied semirigid cable. Calibration results may be incorrect if a cable other than the supplied semirigid cable is used.

Note:

Be sure to perform this connection, since the maximum power (+7 dBm) will be output if this connection is not implemented.

6. Connect the Noise Input connector of the MU181620A and the Output connector of the external noise generator, using a coaxial cable.
7. Connect the Optical Output connector of the MU181620A and the input connector of the DUT, using optical fiber cables.
8. Connect the output connector of the DUT and the Optical Input connector of the MU181640A, using optical fiber cables.
9. Connect the Data Output connector of the MU181640A and the Data Input connector of the MU181040A, using a coaxial cable.

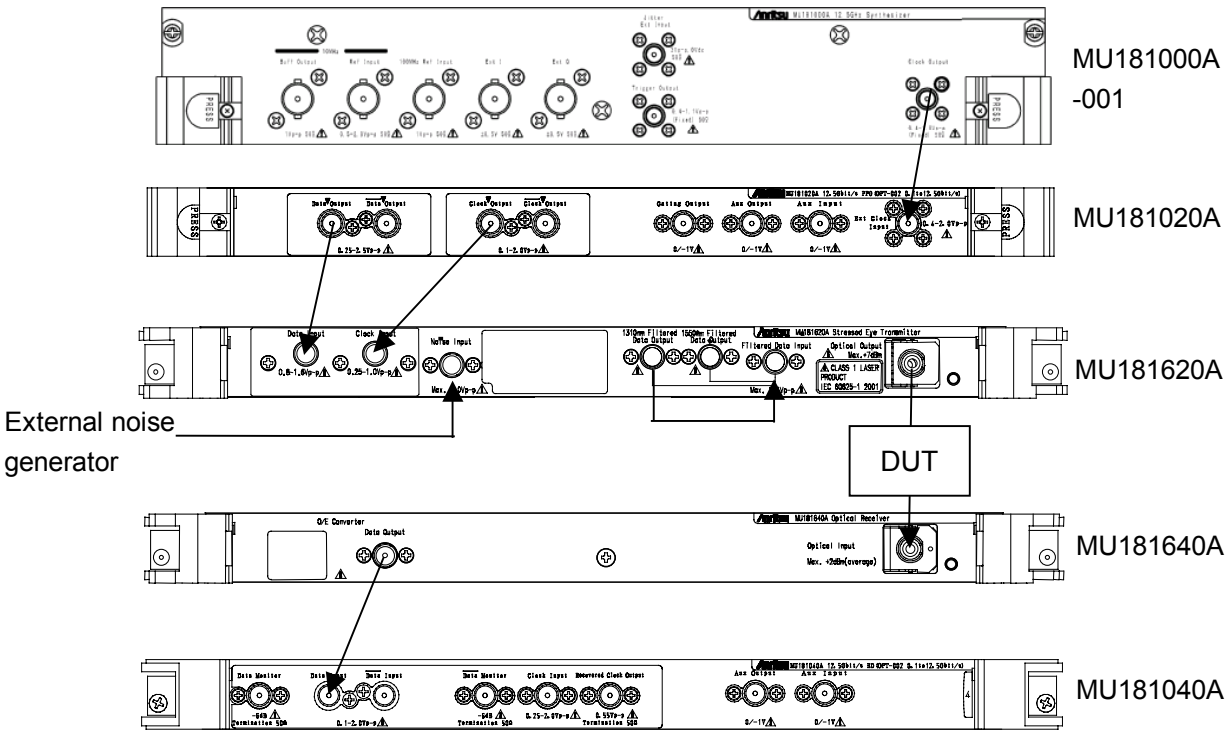


Fig. 3.2-1 Example of inter-module connection

WARNING ⚠

1. When signals are input to the MU181620A, avoid excessive voltage or optical power beyond the rating. Otherwise, the circuit may be damaged.

2. As a countermeasure against static electricity, ground other devices to be connected (including experimental circuits) with earth wires before connecting the I/O connector.

3. The outer conductor and core of the coaxial cable may become charged as a capacitor. Use any metal object to discharge the outer conductor and core before use.

4. The power supply voltage rating for the mainframe is shown on the rear panel. Be sure to operate the mainframe within the rated voltage range. The mainframe may be damaged if a voltage beyond the rated range is applied.

5. To protect the MU181620A from electrostatic discharge failure, a conductive sheet should be placed onto the workbench, and the operator should wear an electrostatic discharge wrist strap. Connect the earth connection end of the wrist strap to the conductive sheet or to the earth jack of the mainframe.

6. When removing a cable from a connector on the front panel of the MU181620A, be careful not to add excessive stress to the connector. Addition of excessive stress to a connector may result in characteristic degradation or a failure. Use a torque wrench (recommended torque: 0.9 N-M) when attaching or removing a cable.

Section 4 Screen Configuration

This section describes the main screen configuration.

4.1 Configuration of Main Screen

The configuration of the main screen when the MU181620A is installed into a mainframe is shown below.

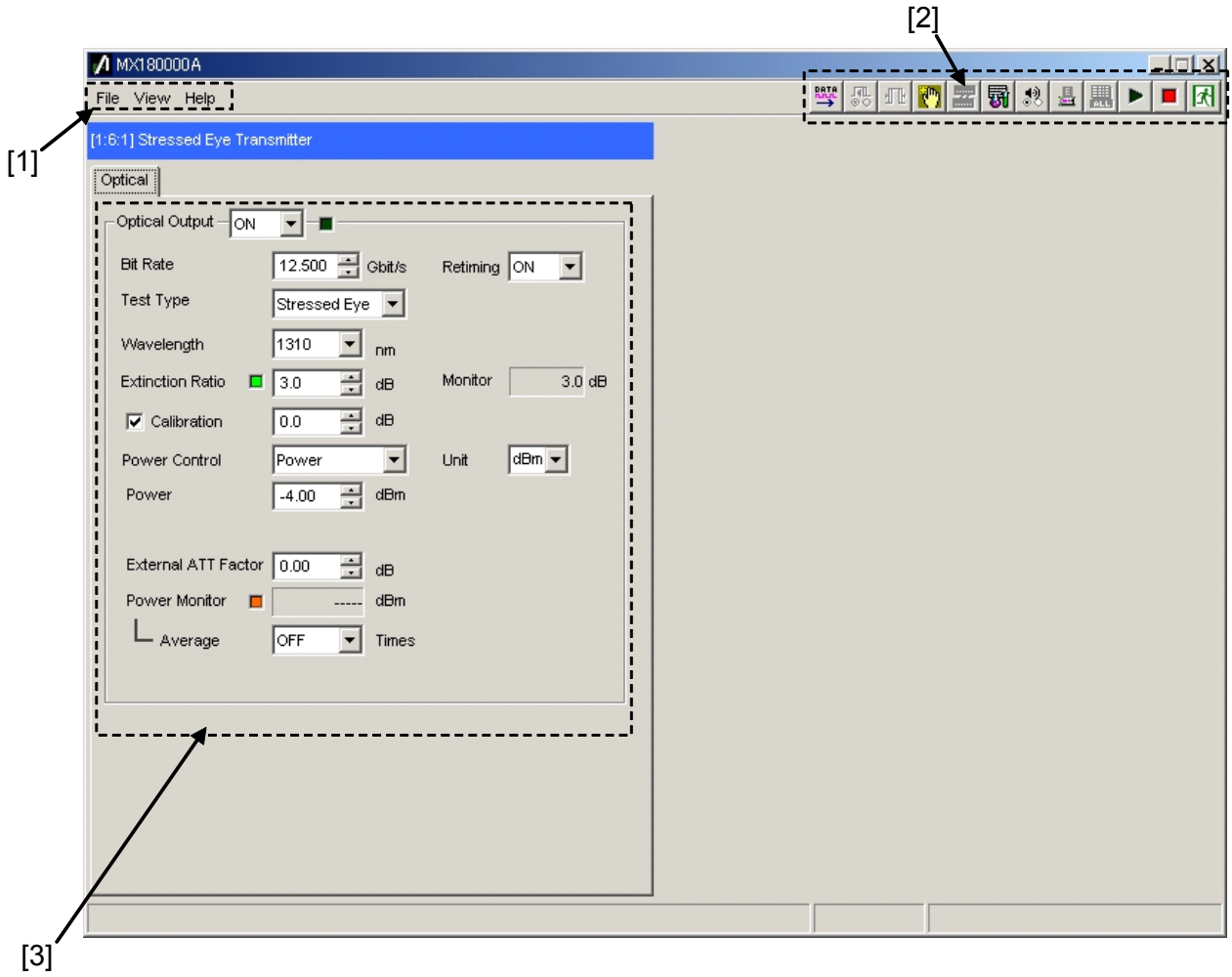


Fig. 4.1-1 Configuration of main screen

The main screen consists of three basic blocks as shown in Fig. 4.1-1. Table 4.1-1 describes each of the blocks.

Table 4.1-1 Functions of blocks

No.	Block name	Function
[1]	Menu bar	Selects the settings related to the entire device. Refer to the MX180000A Signal Quality Analyzer Control Software Operation Manual for details.
[2]	Module function buttons	Shortcut buttons for the function items specific to the displayed module. Users can customize the pre-defined function buttons according to their own applications. Refer to the MX180000A Signal Quality Analyzer Control Software Operation Manual for details.
[3]	Operation window	Configures settings specific to the module.

4.2 Operation Window

The operation window for the MU181620A is shown below.

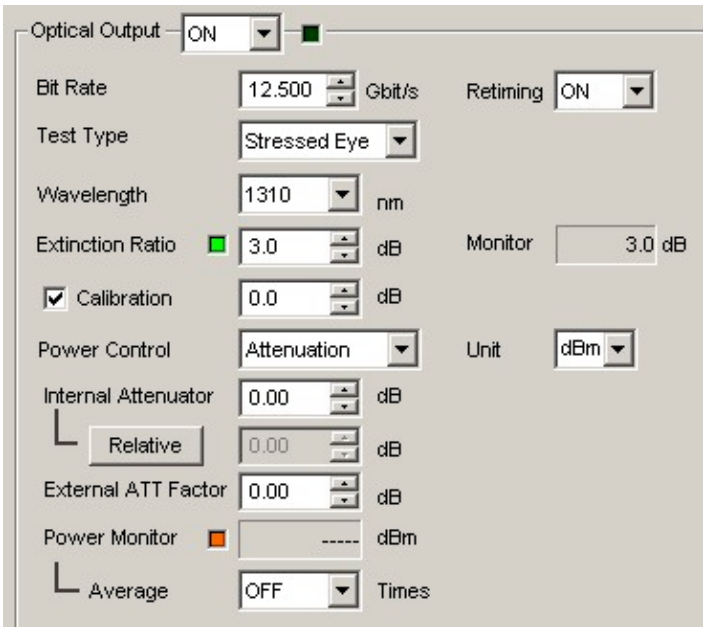


Fig. 4.2-1 Operation window

Table 4.2-1 Items in operation window for MU181620A

Item	Description
Optical Output	Sets the optical output ON/OFF. ON: Optical signals are output from the MU181620A. OFF: Optical signal output is stopped. The optical output is also controlled by the optical output ON/OFF button . Optical signals are output when this item is set to ON and the module function button is selected (recessed). When optical signals are being output, the LED display on the right of this item illuminates green. Changing wavelength sets optical output to OFF.
Bit Rate	Sets the data rate for the output waveform of the MI181620A. Correctly set this item to output waveforms conforming to the specifications. 0.100 to 12.500 Gbit/s/Step 0.001 Gbit/s
Retiming	Setting this item to ON enables the internal retiming circuit and output waveform jitter is thus reduced. When setting this item to ON, be sure to input signals to the Data Input and Clock Input connectors at the timing shown in Section 1.3 “Specifications.” 1≤Bit Rate≤12.5 Gbit/s: Set this item to ON. 0.1≤Bit Rate<1 Gbit/s: Set this item to OFF.

Table 4.2-1 Items in operation window for MU181620A (Cont'd)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Test Type</td><td>Select reference or stressed output.
MU181620A-x01, -x02, -x03: Only Reference can be selected.
MU181620A-x11, -x12, -x13: Select Reference or Stressed Eye.
After this, the status in which Reference is set for Test Type is referred to as the reference mode, and the status in which Stressed Eye is set is referred to as the stressed eye mode.</td></tr>
<tr><td>Wavelength</td><td>Displays the wavelength of the optical signal output from the Optical Output connector.
MU181620A-x01, -x11: Only 1310 nm can be selected.
MU181620A-x02, -x12: Only 1550 nm can be selected.
MU181620A-x03, -x13: Select 1310 or 1550 nm.</td></tr>
<tr><td>Extinction Ratio</td><td>Sets the extinction ratio.
The setting range varies depending on the Wavelength and Test Type settings, as shown below:
<table>
<tr><th>Wavelength setting</th><th>Test Type</th><th>Extinction Ratio</th><th>Step</th></tr>
<tr><td rowspan="2">When 1310 nm wavelength selected</td><td>Reference</td><td>4.0 to 10.0 dB [Specification value]
2.0 to 11.0 dB</td><td>0.1 dB</td></tr>
<tr><td>Stressed Eye</td><td>2.0 to 6.0 dB [Specification value]
1.0 to 7.0 dB</td><td>0.1 dB</td></tr>
<tr><td rowspan="2">When 1550 nm wavelength selected</td><td>Reference</td><td>6.0 to 10.0 dB [Specification value]
2.0 to 11.0 dB</td><td>0.1 dB</td></tr>
<tr><td>Stressed Eye</td><td>2.0 to 5.0 dB [Specification value]
1.0 to 7.0 dB</td><td>0.1 dB</td></tr>
</table>
Operation is guaranteed if the extinction ratio is set to a value within the specification value range in this table. If the extinction ratio is set to a value out of the specification value range, the LED display on the left of this item illuminates red to indicate that the set value is out of the specification.</td></tr>
<tr><td>Calibration</td><td>Select this check box to perform calibration of the extinction ratio.
Selecting this checkbox enables the text box on the right for correction value input. The error factor of the extinction ratio on the device (component) connected to the Optical Output connector of the MU181620A can then be corrected. Note that the extinction ratio does not change even if the correction value is set here.
The extinction ratio value after correction is displayed in the Monitor text box.
–3.0 to +3.0 dB/Step 0.1 dB</td></tr>
</table>

Table 4.2-1 Items in operation window for MU181620A (Cont'd)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Monitor</td><td>Enabled when the Calibration check box is selected.
The monitor value after correction obtained from the following expression is displayed:
Monitor Output = Extinction Ratio + Calibration (correction value)
When the Calibration checkbox is not selected, "-----" is displayed.</td></tr>
<tr><td>Power Control</td><td>Sets the optical output control method.
OFF: Optical output power becomes maximum though the optical output power can not be changed.
Power: Optical output power can be changed in 0.01 dBm units.
Attenuation: Optical output attenuation can be changed in 0.01 dB units.
The following table shows the values to be set according to the Power Control setting (Power or Attenuation).
<table>
<tr><th colspan="2">Power Control setting</th><th>Corresponding value</th></tr>
<tr><td rowspan="2">Power</td><td>1310 nm</td><td>–4.00 dBm</td></tr>
<tr><td>1550 nm</td><td>–2.00 dBm</td></tr>
<tr><td colspan="2">Attenuation</td><td>0.00 dB</td></tr>
</table>
</td></tr>
<tr><td>Unit</td><td>Selects dBm or μW as the unit for the Power value, which can be set when the monitor display unit of Power Monitor or Power Control is set to Power.
[dBm]: Selects dBm as the unit for the Power value.
[μW] : Selects μW as the unit for the Power value.</td></tr>
<tr><td>Power</td><td>Sets the optical output power when Power Control is set to Power.
The Power value setting unit is selected from dBm or μW in the Unit drop-down list.
<table>
<tr><th>Wavelength, Unit setting</th><th>Setting range</th><th>Step</th></tr>
<tr><td>1310 nm, dBm</td><td>–20.00 to –4.00 dBm</td><td>0.01</td></tr>
<tr><td>1310 nm, μW</td><td>10 to 398 μW</td><td>1</td></tr>
<tr><td>1550 nm, dBm</td><td>–20.00 to –2.00 dBm</td><td>0.01</td></tr>
<tr><td>1550 nm, μW</td><td>10 to 630 μW</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>Internal Attenuation</td><td>Settable when Power Control is set to Attenuation. Sets the internal attenuation to change the optical output power.
<table>
<tr><th>Wavelength setting</th><th>Setting range</th><th>Step</th></tr>
<tr><td>When 1310 nm wavelength selected</td><td>0.00 to 16.00 dB</td><td>0.01</td></tr>
<tr><td>When 1550 nm wavelength selected</td><td>0.00 to 18.00 dB</td><td>0.01</td></tr>
</table>
</td></tr>
</table>

Table 4.2-1 Items in operation window for MU181620A (Cont'd)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Relative</td><td>Settable when Power Control is set to Attenuation.
Clicking the [Relative] button enables the text box on the right for relative attenuation input. At this time, the attenuation is set using the value in this text box, based on the value set in the Internal Attenuator text box as "0."
This item becomes disabled when the Wavelength setting is changed or the Power Control is changed to Power.
<table>
<tr><th>Wavelength setting</th><th>Setting, range</th><th>Step</th></tr>
<tr><td>When 1310 nm wavelength selected</td><td>Internal Attenuation value
(16.00-Internal Attenuation value)
0.00 to 16.00 dB</td><td>0.01</td></tr>
<tr><td>When 1550 nm wavelength selected</td><td>Internal Attenuation value
(18.00-Internal Attenuation value)
0.00 to 18.00 dB</td><td>0.01</td></tr>
</table>
</td></tr>
<tr><td>External ATT Factor</td><td>When an external attenuator is connected, set the attenuation of that attenuator in this box. When this parameter is set, the optical output power of a signal after passing through the external attenuator is displayed in the Power Monitor box.
Note that this setting does not change the output power of the MU181620A.
0.00 to 40.00 dB/Step 0.01 dB</td></tr>
<tr><td>Power Monitor</td><td>Displays the monitored power of the optical signal output from the Optical Output connector. The monitor value averaged according to the Average setting is displayed. During averaging calculation processing, the LED display on the left of this box illuminates orange.
When no optical signal is output or during averaging calculation, "-----" is displayed.</td></tr>
<tr><td>Average</td><td>Sets the number of averaging for the Power Monitor value.
OFF: Displays the instantaneous output power value every 500 ms in the Power Monitor box.
2, 5, 10, 20, 50, 100: Displays the output power value averaged by the specified number every 500 ms in the Power Monitor box.</td></tr>
</table>

Section 5 Use Example

This section provides measurement examples using the MU181620A.

5.1 IEEE802.3-2005 Test Example Using MU181620A

The following shows an example of how to execute a stress test of the IEEE802.3-2005-compliant XFP optical transceiver module, using the MU181620A.

5.1.1 Connection

The following shows a test example where the MU181000A, MU181020A, MU181040A 12.5 Gbit/s Error Detector (hereinafter referred to as "MU181040A"), and MU181620A are mounted onto the MP1800A Signal Quality Analyzer (hereinafter referred to as "MP1800A").
The options configuring the test system are as follows:

MP1800A-014
MU181000A-001
MU181020A-002 + x10 + x30
MU181040A-002 + x20 + x30
MU181620A-x11 or -x13

The connection example is as follows.

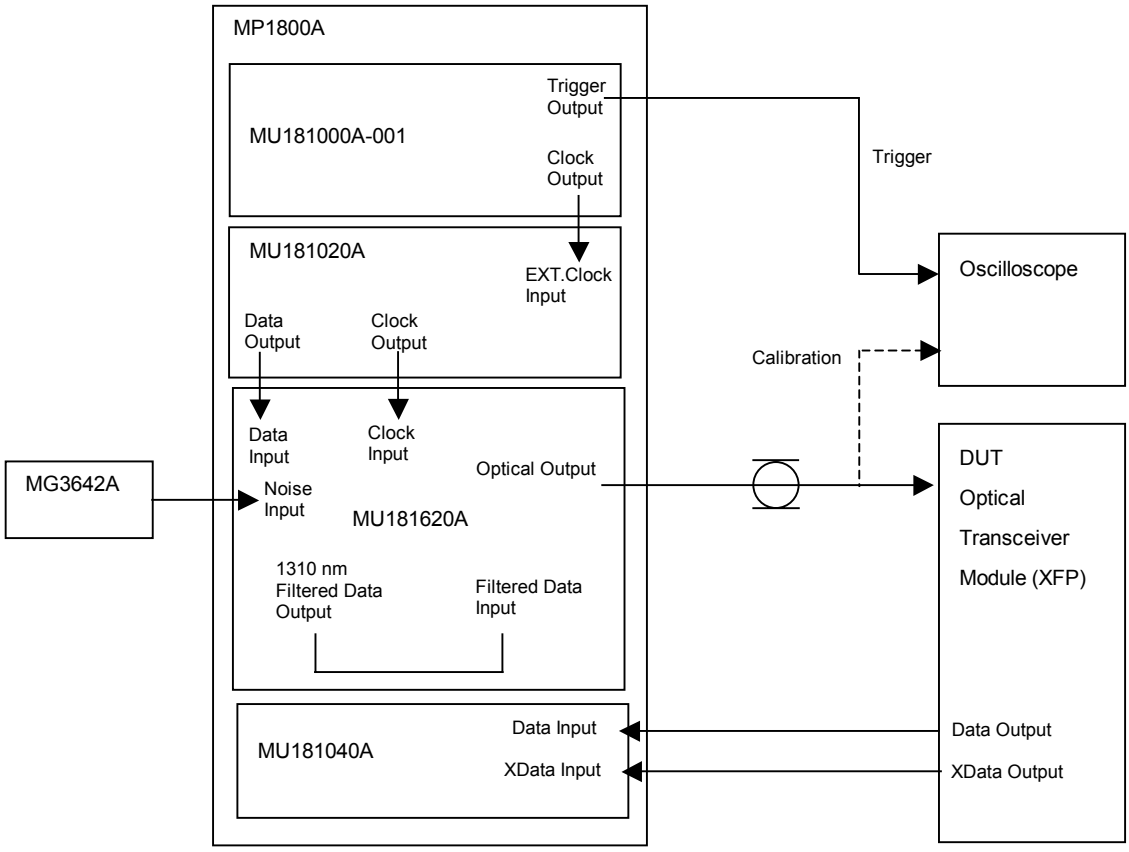


Fig. 5.1.1-1 Connection diagram

CAUTION ⚠

If an excessive voltage is applied to the input connector, the protective circuit may be damaged. Avoid any input beyond the rated voltage. See Section 3.2 "Inter-Module Connection" for details.

5.1.2 Measurement procedure

1. Connect the GND of the MP1800A and that of the DUT (device under test), and earth them.
2. Connect the power cables.
3. Turn on the MP1800A, and then connect the instruments, referring to Fig. 5.1.1-1.

   Be sure to set Optical Output to Off to disable the optical output before connecting the DUT.
4. Set the bit rate for measurement to the MU181000A.
5. Set the test pattern (PRBS 2^{31} – 1) to the MU181020A and MU181040A.
6. Connect the Optical Input connector of the DUT and the Optical Output connector of the MU181640A, and then connect the O/E output connectors (Data Output and XData Output) of the DUT and the Data Input and XData Input connectors of the MU181040A, respectively (see Fig. 5.1.1-1).
7. Enable the optical signal output of the MU181620A.
8. Execute Auto Search and check that no errors are detected in the MU181040A.
9. Enable the jitter of the MU181000A, and then set the modulation frequency and modulation amount to apply the jitter modulation.
10. Set the frequency and output level of the MG3642A Synthesized Signal Generator, and then add Noise in vertical direction so that the desired VECP can be obtained. Refer to Section 5.1.4 “How to calcuate VECP” for the VECP setting method.
11. Gradually increase the optical power level of the MU181620A to find a point where an error is detected.
12. Decrease the optical power level to find a point where the measurement result at the MU181040A equals the specified error rate. The optical input average power to the DUT at that point is determined to be the light receiving sensitivity.
13. Waveform calibration and light receiving sensitivity tests at the specified modulation frequency can be performed automatically for the DUT by using the MX180002A Stressed Eye Measurement Control Software.

5.1.3 How to calculate OMA

Optical Modulation Amplitude (OMA) can be calculated by using a sampling oscilloscope. OMA is required for calculating VECP during a test.

1. Set the test pattern of the MU181020A to 11110000.
2. Use the sampling oscilloscope to measure the high-level power in the central 20% window of the histogram graph, and define the result as P1.
3. In a similar manner, measure the low-level power in the central 20% window of the histogram graph, and define the result as P0.
4. Obtain the OMA value by calculating the following expression.

   OMA = P1 – P0 (W)

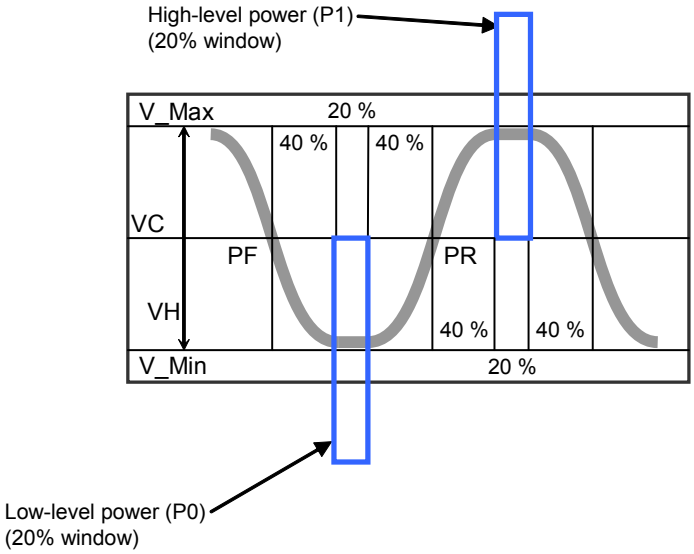


Fig. 5.1.3-1 Diagram of OMA measurement

5.1.4 How to calcuate VECP

Vertical eye closure penalty (VECP) can be calculated by using a sampling oscilloscope.

1. Set the test pattern of the MU181020A to PRBS $2^{31} - 1$.
2. Change the level of the signal input to the Noise Input connector so that the desired Eye aperture is obtained.
3. Measure the histogram distribution at the center between the crosspoints based on the time (see Fig. 5.1.4-1), and then obtain a range that includes 99.9% of this distribution for both Voh and Vol. The Eye aperture at this time is defined as A_0 .
4. Obtain the VECP value by calculating the following expression.

$$\text{VECP [dB, optical]} = 10 \times \log\frac{\text{OMA}}{A_0}$$

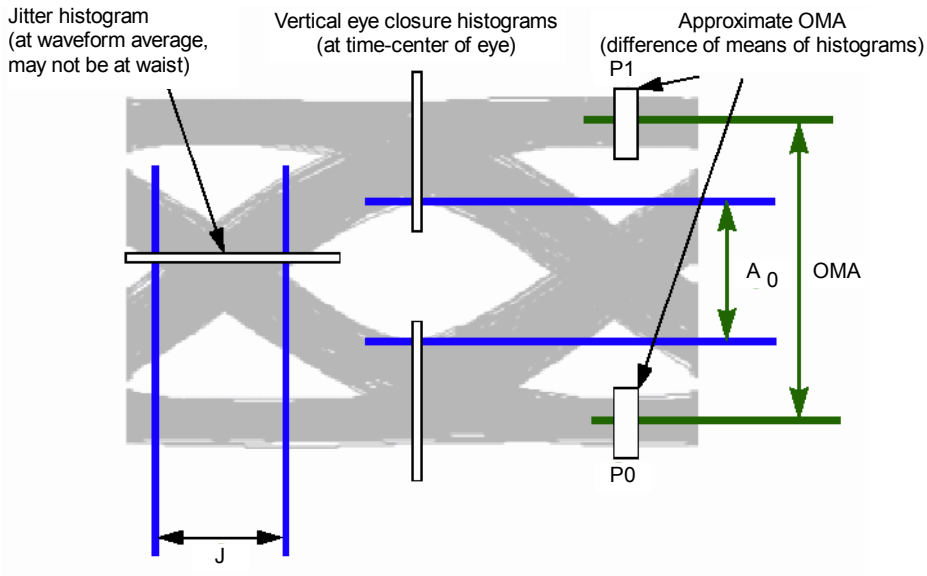


Fig. 5.1.4-1 Diagram of VECP measurement

Section 6 Performance Tests

This section describes the performance testing of the MU181620A.

6.1 Overview

Performance tests are executed to check that the major functions of the MU181620A meet the required specifications. Execute performance tests at acceptance inspection, operation check after repair, and periodic (once every six months) testing.

6.2 Devices Required for Performance Tests

Before starting performance tests, warm up the MU181620A and the measuring instruments for at least 30 minutes. Table 6.2-1 shows the devices required for performance tests.

Table 6.2-1 Devices required for performance tests

Device	Required Performance
Synthesizer (MP1800A + MU181000A)	Operating frequency: 9.5 to 12.5 GHz Clock output amplitude: 0.4 to 2.0 Vp-p
Pulse pattern generator (MP1800A + MU181020A-002)	Operating frequency: 0.1 to 12.5 Gbit/s NRZ data output amplitude: Connect to the MU181620A 1/1 clock output amplitude: 0.25 Vp-p or more, for MU181620A clock input
Error detector (MP1800A + MU181040A)	Operating frequency: 9.5 to 12.5 Gbit/s Data input sensitivity: 0.1 Vp-p or more
Sampling oscilloscope	Optical interface: 28 GHz or more band Electrical interface: 40 GHz or more band
Optical power meter (MT9810B + MU931422A)	Wavelength range: 750 to 1700 nm Linearity: ±0.05 dB
Optical spectrum analyzer (MS9780A)	Wavelength range: 750 to 1700 nm

Note:

Before starting the performance tests, warm up the device under test and the measuring instruments for at least 30 minutes and wait until they become sufficiently stabilized, unless otherwise specified. Additional conditions are required for maximum measurement accuracy: measurements must be performed at room temperature, fluctuations of AC power supply voltage must be small, and noise, vibration, dust, and humidity must be insignificant.

6.3 Performance Test Items

This section describes the following test items.

(1) Optical output rise/fall time and jitter
(2) Optical output Eye mask
(3) Optical output power
(4) Optical output center wavelength and side-mode suppression ratio
(5) Optical modulation amplitude (OMA)

6.3.1 Optical output rise/fall time and jitter

(1) Specifications

Table 6.3.1-1 Optical output rise/fall time and jitter

Item	Specifications
Rise/fall time Bit rate: 10.3125 Gbit/s PRBS $2^{31} - 1$	When Reference mode is selected (with MU181620A-x01, -x02, -x03, -x11, -x12 or -x13 installed) ≤30 ps (20 to 80%)
Jitter Bit rate: 10.3125 Gbit/s PRBS $2^{31} - 1$ Using oscilloscope with a residual jitter of 200 fs (RMS) or less.	When Reference mode is selected (with MU181620A-x01, -x02, -x03, -x11, -x12 or -x13 installed) ≤0.2 UIp-p
	When Stressed Eye mode is selected (with MU181620A-x11, -x12 or -x13 installed) ≤0.25 UIp-p

(2) Connection

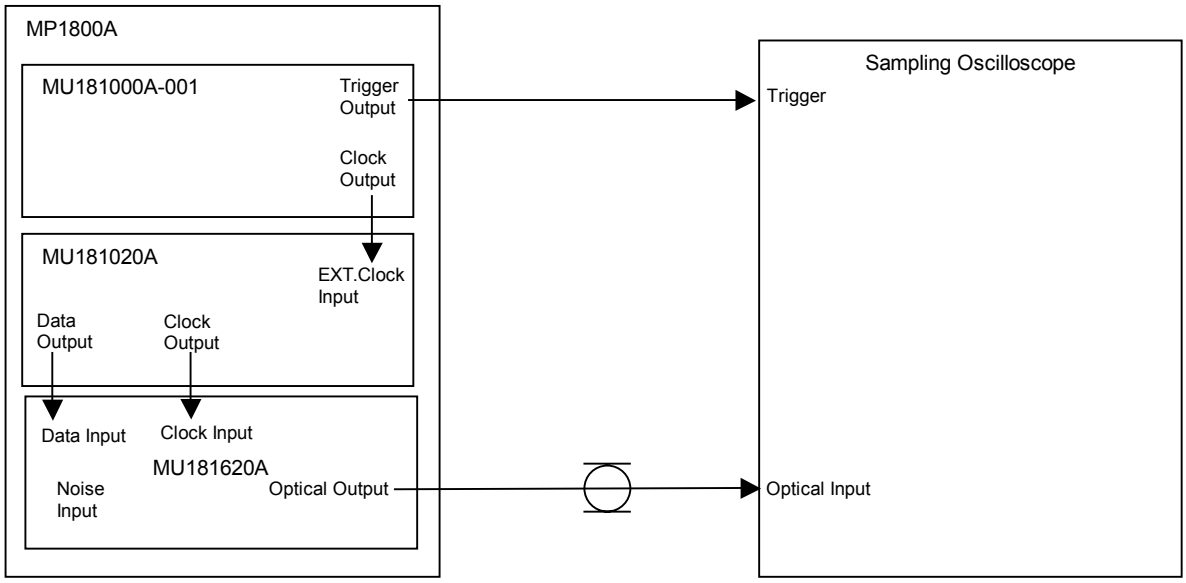


Fig. 6.3.1-1 Connection diagram for optical output rise/fall time and jitter measurement

(3) Procedure

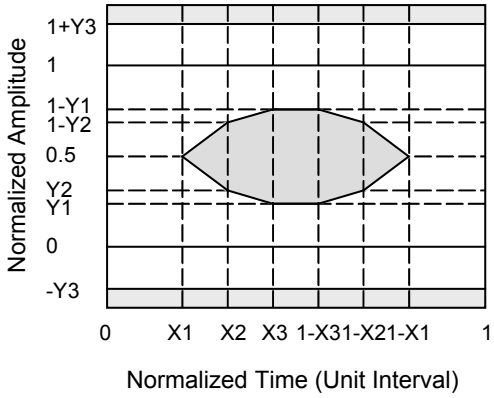
1. Install the modules into the MP1800A, connect the cables except for the optical fiber cable, and then turn on the power.
2. Turn on the sampling oscilloscope, and warm up the measuring instruments.
3. Set the Clock Output frequency of the MU181000A to 10.3125 GHz.
4. Set f/64 for the MU181000A-001 Trigger and connect it to the Trigger of the sampling oscilloscope.
5. Set the bit rate to 10.3125 Gbit/s, amplitude to 0.8 Vp-p, test pattern to PRBS 2^{31} – 1, and mark ratio to 1/2 for the Data Output signal of the MU181020A.
6. Set the MU181620A signal output to ON to output signals.
7. After checking that the optical output power of the MU181620A does not exceed the optical input rating of the connected device, connect the Optical Output connector of the MU181620A and the Optical Input connector of the sampling oscilloscope.
8. Check that the measured results of the optical output rise/fall time and jitter meet the specification requirements.

6.3.2 Optical output Eye mask

(1) Specifications

Table 6.3.2-1 Specifications for Eye mask

Item	Specifications
Eye Mask	{X1, X2, X3, Y1, Y2, Y3} {0.25, 0.40, 0.45, 0.25, 0.28, 0.40}



Test Conditions
Bit rate: 10.3125 Gbit/s
Test pattern: PRBS $2^{31}-1$
Mark ratio: 1/2
Bessel filter: 75 % of bit rate

Fig. 6.3.2-1 Transmitter optical output Eye mask

(2) Connection

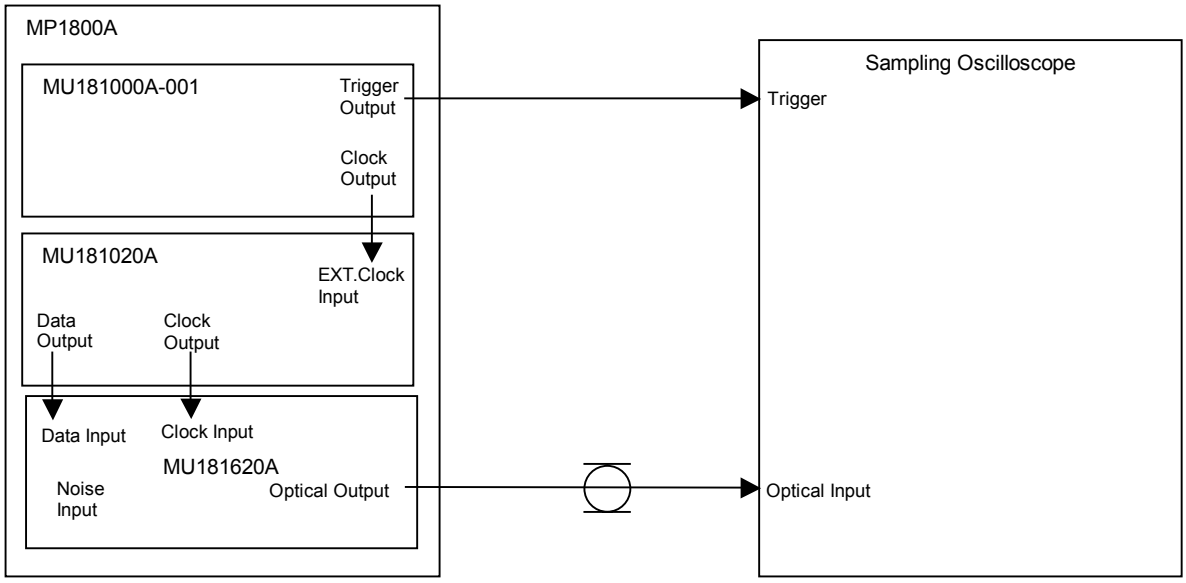


Fig. 6.3.2-2 Connection diagram for transmitter optical output Eye mask

(3) Procedure

1. Install the modules into the MP1800A, connect the cables except for the optical fiber cable, and then turn on the power.
2. Turn on the sampling oscilloscope, and warm up the measuring instruments.
3. Set the Clock Output frequency of the MU181000A to 10.3125 GHz.
4. Set f/64 for the MU181000A-001 Trigger and connect it to the Trigger of the sampling oscilloscope.
5. Set the bit rate to 10.3125 Gbit/s, amplitude to 0.8 Vp-p, test pattern to PRBS $2^{31} - 1$, and mark ratio to 1/2 for the Data Output signal of the MU181020A.
6. Set the MU181620A signal output to ON to output signals.
7. After checking that the optical output power of the MU181620A does not exceed the optical input rating of the connected device, connect the Optical Output connector of the MU181620A and the Optical Input connector of the sampling oscilloscope.
8. Insert the Bessel LPF with a bandwidth of 75 % of the specified bit rate, and check that the observed waveform meets the specification (Eye mask).

6.3.3 Optical output power

(1) Specifications

Table 6.3.3-1 Specifications for transmitter optical output power

Item	Specifications
Optical Output Power PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: OFF	Min. –4.0 dBm, Max. +3.0 dBm (with MU181620A-x01, -x03, -x11, or -x13 installed, 1310 nm) Min. –2.0 dBm, Max. +3.0 dBm (with MU181620A-x02, -x03, -x12, or -x13 installed, 1550 nm)
Optical Output Power Accuracy PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: Power	±0.5 dB (Typ. 25 ± 5°C)
Optical Output Power Stability PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: OFF	±0.02 dB (1 hour at 25 ± 5°C) Stability during one hour when one hour has elapsed after optical output is set to On.

(2) Connection

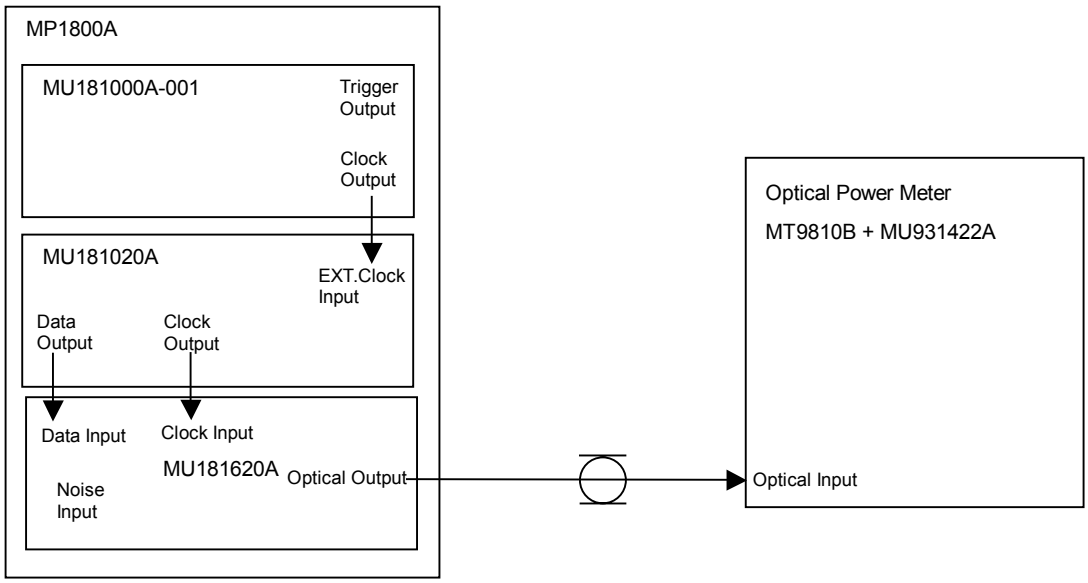


Fig. 6.3.3-1 Connection diagram for transmitter optical output power measurement

(3) Procedure

1. Install the modules into the MP1800A, connect the cables, and then turn on the power.
2. Turn on the optical power meter and warm up the measuring instruments.
3. Set the target wavelength for measurement using the optical power meter.
4. Set the Clock Output frequency of the MU181000A to 10.3125 GHz.
5. Set the bit rate to 10.3125 Gbit/s, amplitude to 0.8 Vp-p, test pattern to PRBS $2^{31} - 1$, and mark ratio to 1/2 for the Data Output signal of the MU181020A.
6. Set the MU181620A signal output to ON to output signals.
7. Check that the optical power measured on the optical power meter meets the specification requirements.

6.3.4 Optical output center wavelength and side-mode suppression ratio

(1) Specifications

Table 6.3.4-1 Specifications for transmitter optical output center wavelength and side-mode suppression ratio

Item	Specifications
Center wavelength PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: OFF	Min. 1290 nm, Max. 1330 nm (with MU181620A-x01 or -x03 installed, 1310 nm) Min. 1530 nm, Max. 1565 nm (with MU181620A-x02 or -x03 installed, 1550 nm)
Side-mode suppression ratio test PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: OFF	≥30.0 dB

(2) Connection

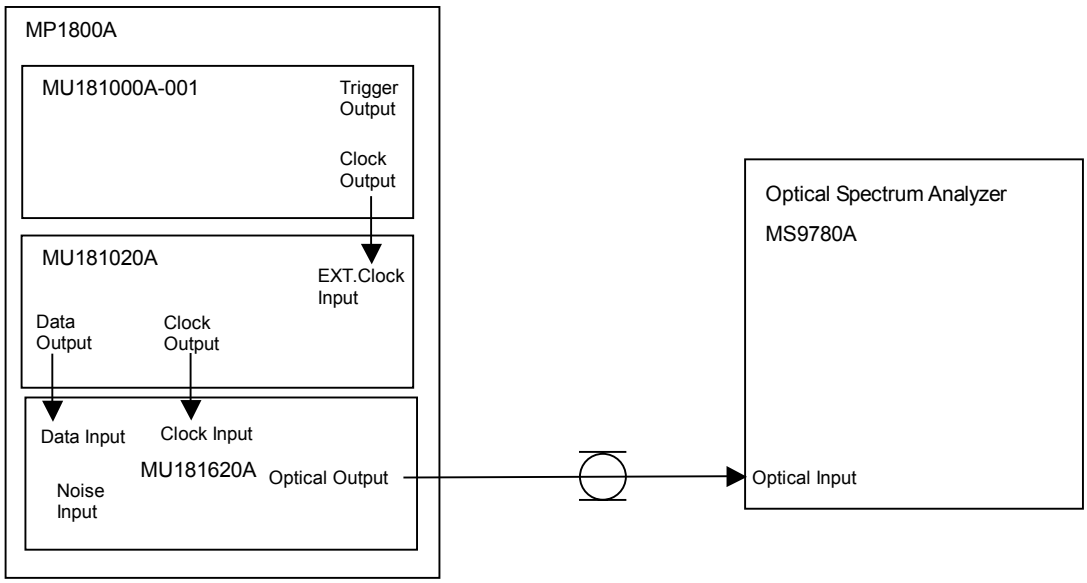


Fig. 6.3.4-1 Connection diagram for transmitter optical output center wavelength and side-mode suppression ratio measurement

(3) Procedure

1. Install the modules into the MP1800A, connect the cables, and then turn on the power.
2. Turn on the optical spectrum analyzer and warm up the measuring instruments.
3. Set the target wavelength for measurement using the optical spectrum analyzer.
4. Set the Clock Output frequency of the MU1810000A to 10.3125 GHz.
5. Set the bit rate to 10.3125 Gbit/s, amplitude to 0.8 Vp-p, test pattern to PRBS $2^{31} - 1$, and mark ratio to 1/2 for the Data Output signal of the MU181020A.
6. Set the MU181620A signal output to ON to output signals.
7. After checking that the optical output power of the MU181620A does not exceed the optical input rating of the connected device, connect the Optical Output connector of the MU181620A and the Optical Input connector of the optical spectrum analyzer.
8. Check that the measured results of the center wavelength and side-mode suppression ratio (1310 nm, 1550 nm) meet the specification requirements.

6.3.5 Optical Modulation Amplitude (OMA)

(1) Specifications

Table 6.3.5-1 OMA

Item	Specifications
OMA Bit rate: 10.3125 Gbit/s	≥ –5.2 dBm When Stressed Eye mode is selected (with MU181620A-x11 or -x13 installed, 1310 nm) ≥ –1.7 dBm When Stressed Eye mode is selected (with MU181620A-x12 or -x13 installed, 1550 nm)

(2) Connection

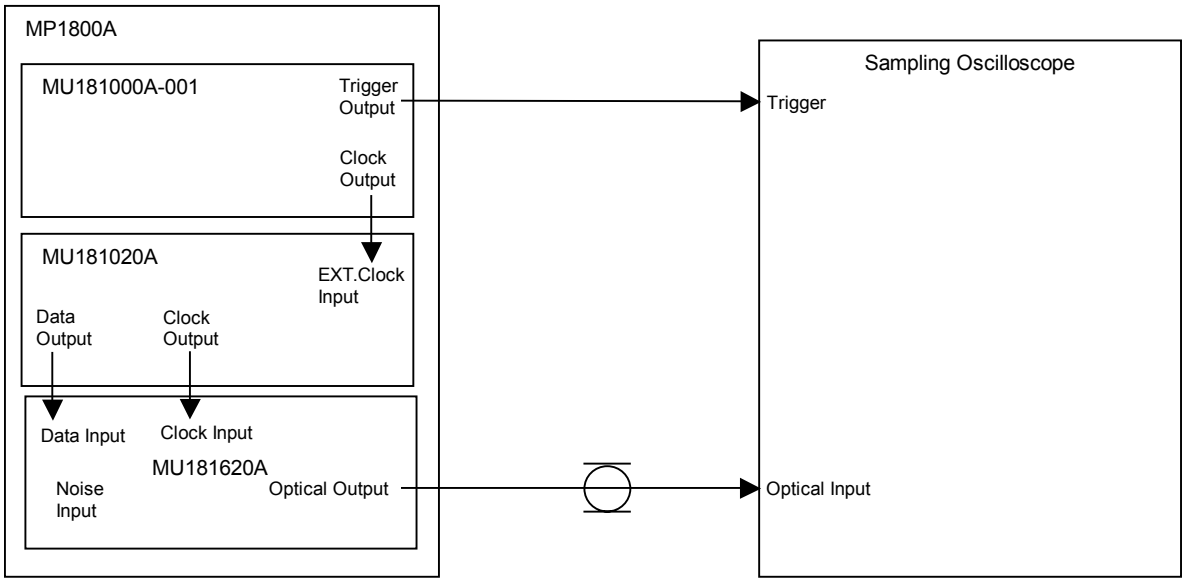


Fig. 6.3.5-1 Connection diagram for OMA measurement

(3) Procedure

1. Install the modules into the MP1800A, connect the cables except for the optical fiber cable, and then turn on the power.
2. Turn on the sampling oscilloscope, and warm up the measuring instruments.
3. Set the Clock Output frequency of the MU181000A to 10.3125 GHz.
4. Select f/64 for the MU181000A-001 Trigger and connect it to the Trigger of the sampling oscilloscope.
5. Set the MU181620A signal output to ON to output signals.
6. After checking that the optical output power of the MU181620A does not exceed the optical input rating of the connected device, connect the Optical Output connector of the MU181620A and the Optical Input connector of the sampling oscilloscope.
7. Set the test pattern of the MU181020A to 11110000.
8. Use the sampling oscilloscope to calculate the OMA for both the high-level and low-level powers through histogram analysis (see (4) below), and check that the measured results meet the specification requirements.

(4) Calculation of OMA

OMA = P1 − P0 (W)

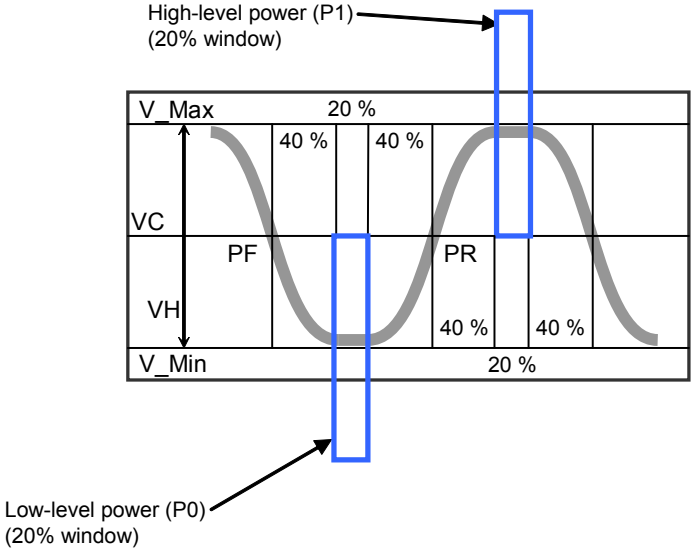


Fig. 6.3.5-2 Diagram of OMA measurement

Section 7 Maintenance

This section describes the maintenance of the MU181620A.

7.1 Daily Maintenance

- Wipe off any external stains with a cloth damped with diluted mild detergent.
- Vacuum away any accumulated dust or dirt with a vacuum cleaner.
- Tighten any loose parts fixed with screws, using the specified tools.

7.2 Cleaning Optical Connector and Optical Adapter

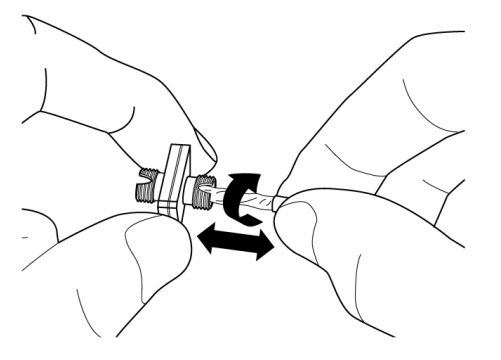
Cleaning optical adapter

When cleaning an optical adapter used for optical fiber cable connection, be sure to use an adapter cleaner that is specified as the application parts for the MU181620A(see Table 1.2.3-1 in Section 1).

The following shows how to clean an optical adapter, taking an FC adapter as an example. Clean other types of optical adapters in the same manner. The following method should also be used for cleaning the adapter, which is removed before cleaning the end surface of the MU181620A optical cable ferrule.

(1) Insert an adapter cleaner inside the split sleeve of the optical adapter.

(2) Rotate the adapter cleaner in one direction, while moving the optical adapter back and forth.

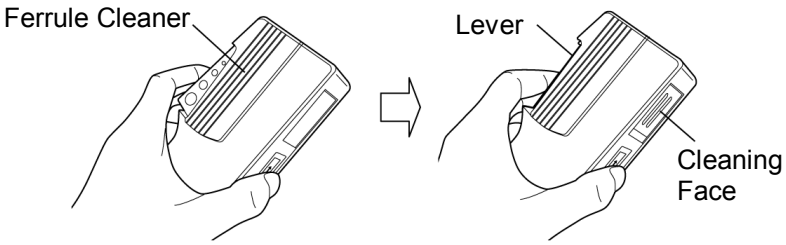


Cleaning ferrule end surface of optical fiber cable

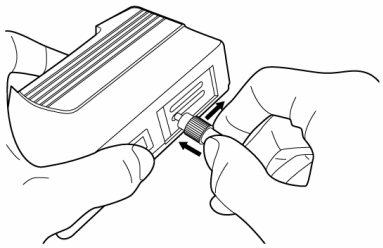
When cleaning the ferrule end surface of an optical fiber cable, be sure to use a ferrule cleaner that is specified as the application parts for the MU181620A(see Table 1.2.3-1 in Section 1).

The following shows how to clean the ferrule end surface, taking an FC connector as an example. Clean other types of optical connectors in the same manner.

(1) Push the lever of the ferrule cleaner to show the cleaning face.



(2) While holding the lever in a depressed position, press the ferrule end surface of the optical connector against the cleaning face, and slide it in one direction.



Cautions on cleaning

(1) Do not use used ferrule cleaners for cleaning.

(2) Do not use a cotton swab for final cleaning because cotton fiber may adhere to the ferrule.

(3) Place a cap onto the connector not in use.

WARNING

When cleaning and checking the ferrule end surface, check that there is no light being emitted.

CAUTION ⚠

Performance will be unsatisfactory if the MU181620A is used with dust or dirt accumulated on the ferrule end surfaces. The ferrule end surfaces of the connected may burn if high-output lights are used with dust or dirt accumulated. Thoroughly clean the ferrule end surfaces of the connected fibers and the MU181620A before measurement.

7.3 Cautions on Storage

Wipe off any dust, soil, or stain on the MU181620A prior to storage. Avoid storing the MU181620Ain any of the following locations:

- Where there is direct sunlight
- Where there is dust
- Where humidity is high and dew may accumulate
- Where chemically active gases are present
- Where the MU181620A may become oxidized
- Where strong vibrations are present
- Under the following temperature and humidity conditions:
  Temperature range of ≤–20°C or ≥ 60°C
  Humidity range of ≥85%

Recommended storage conditions

In addition to the abovementioned storage cautions, the following environment conditions are recommended for long-term storage.

- Temperature range of 5 to 30°C
- Humidity range of 40 to 75%
- Slight daily fluctuation in temperature and humidity

7.4 Transportation

Use the original packing materials, if possible, when packing the MU181620A for transport. If you do not have the original packing materials, pack the MU181620A according to the following procedure. When handling the MU181620A, always wear clean gloves, and handle it gently so as not to damage it.

<Procedure>

1. Use a dry cloth to wipe off any stain or dust on the exterior of the MU181620A.
2. Check for loose or missing screws.
3. Provide protection for structural protrusions and parts that can easily be deformed, and wrap the MU181620A with a sheet of polyethylene. Finally, cover with moisture-proof paper.
4. Place the wrapped MU181620A into a cardboard box, and tape the flaps with adhesive tape. Furthermore, store it in a wooden box as required by the transportation distance or method.
5. During transportation, place it under an environment that meets the conditions described in Section 7.3 “Cautions on Storage”.

7.5 Calibration

Regular maintenance such as periodic inspections and calibration is essential for the Signal Quality Analyzer Series for long-term stable performance. Regular inspection and calibration are recommended for using the Signal Quality Analyzer Series in its prime condition at all times. The recommended calibration cycle after delivery of the Signal Quality Analyzer Series is twelve months.

If you require support after delivery, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

We may not provide calibration or repair if any of the following cases apply.

- Seven or more years have elapsed after production and parts for the instrument are difficult to obtain, or it is determined that reliability cannot be maintained after calibration/repair due to significant wear.
- Circuit changes, repair, or modifications are done without our approval.
- It is determined that the repair cost would be higher than the price of a new item.

7.6 Disposal

Confirm the notes described in the Signal Quality Analyzer Series Installation Guide and observe national and local regulations when disposing of the MU181620A.

Section 8 Troubleshooting

This section describes how to check whether a failure has arisen when an error occurs during the operation of the MU181620A.

8.1 Problems Discovered during Module Replacement

Table 8.1-1 Remedies for problems discovered during replacement of MU181620A

Symptom	Location to Check	Remedy
Module is not recognized.	Is the module installed properly?	Install the module again by referring to Section 2.3 "Installing and Removing Modules" in the installation guide.
	Is the module supported by the mainframe?	Check our Web site (http://www.anritsu.co.jp/E/MP1800) for the supported modules and the software version of the MU181620A. If the module is supported, it may have failed. Contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

8.2 Problems Discovered during use of MU181620A

Table 8.2-1 Remedies for problems discovered during use of MU181620A

Symptom	Location to Check	Remedy
No light is emitted, or the optical output level is too low.	Are the optical connector end faces clean?	Use a ferrule cleaner to clean the connector end faces.
	Is the used fiber appropriate for the MU181620A?	Replace the fiber with an applicable fiber for the MU181620A.
	Is Optical Output ON?	Click the Optical Output button to set it to ON.
	Is the Output Control switch ON?	Click the Optical control switch button to set it to ON.
	Are the Data and Clock signals being output from the MU181020A? Is the output pattern correct?	Click the Output button of the MU181020A to set it to ON. Confirm the output of the MU181020A by setting the pattern type to PRBS or Data. If the problem continues, the MU181620A may have failed. Contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

Table 8.2-1 Remedies for problems discovered during use of MU181620A (Cont'd)

Symptom	Location to Check	Remedy
Optical output waveforms cannot be observed correctly.	Is the data rate set properly?	Set the Data Rate setting to the bit rate actually used.
	Is the retiming set to ON?	The jitter of the output waveform may be too large when the Retiming setting is set to OFF. When the bit rate of 1 Gbit/s or more is used, set the Retiming setting to ON.
	If Stressed Eye mode is selected, are the Filtered Data Out and Filtered Data Input connectors for the set frequency connected via a proper cable?	Use the supplied semirigid cable to connect them.
	Are the signals input to the Data Input and Clock Input connectors at the correct timing?	Input the signals at the timing described in Section 1.3 "Specifications." If they are input correctly, the MU181620A may have failed. Contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.
An error occurs.	Are the signals input to the Data Input and Clock Input connectors at the correct timing?	Input the signals at the timing described in Section 1.3 "Specifications."
	Is the electric interface cable loose?	Tighten the connector.
	Are the unused output connectors terminated?	Terminate them properly. When noise is not input to the noise input connector, use the supplied coaxial terminator to terminate the connector.
	Do the cables and connectors used have good high-frequency characteristics?	Use cables and connectors with good high-frequency characteristics. If the high-frequency characteristics are good, the mainframe, MU181620A, or other modules may have failed. Contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.
	Does any error occur in the mainframe or other modules?	The mainframe, other modules, or the MU181620A may have failed. Contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

If a problem cannot be solved by using any of the items listed above, perform initialization and check the items again. If the problem still occurs, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

Appendix

A.1 Performance Test Result Sheet

Device name: MU181620A Stressed Eye Transmitter

Serial No.: _____

Ambient temperature: _____ °C

Relative humidity: _____ %

Table A.1-1 Optical output rise/fall time and jitter

Item	Specifications	Measured Result
Rise/fall time	≤30 ps (20 to 80%)	
Jitter Bit rate: 10.3125 Gbit/s PRBS $2^{31} - 1$ Extinction ratio: 10 dB Using oscilloscope with a residual jitter of 200 fs (RMS) or less.	When Reference mode is selected (with MU181620A-x01, -x02, -x03, -x11, -x12 or -x13 installed) ≤0.2 UIp-p	
	When Stressed Eye mode is selected (with MU181620A-x11, -x12 or -x13 installed) ≤0.25 UIp-p	

Table A.1-2 Optical output Eye mask

Item	Specifications	Measured Result
Eye Mask	{X1, X2, X3, Y1, Y2, Y3} {0.25, 0.40, 0.45, 0.25, 0.28, 0.40}	

Table A.1-3 Optical output power

Item	Specifications	Measured Result
Optical Output Power PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Waveform Retiming Function: On Power Control: OFF	Min. –4.0 dBm, Max. +3.0 dBm (with MU181620A-x01, -x03, -x11, or -x13 installed, 1310 nm) Min. –2.0 dBm, Max. +3.0 dBm (with MU181620A-x02, -x03, -x12, or -x13 installed, 1550 nm)	
Optical Output Power Accuracy PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: Power Waveform Retiming Function: On	±0.5 dB (Typ. 25 ± 5°C)	
Optical Output Power Stability PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: OFF	±0.02 dB (1 hour at 25 ± 5°C) Stability during one hour when one hour has elapsed after the optical output is set to On	

Table A.1-4 Center wavelength

Item	Specifications	Measured Result
Center wavelength PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: OFF	Min. 1290 nm, Max. 1330 nm (with MU181620A-x01 or -x03 installed, 1310 nm) Min. 1530 nm, Max. 1565 nm (with MU181620A-x02 or -x03 installed, 1550 nm)	

Table A.1-5 Side-mode suppression ratio

Item	Specifications	Measured Result
Side-mode suppression ratio test PRBS $2^{31} - 1$ Bit rate: 10.3125 Gbit/s Power Control: Power	≥30.0 dB	

Table A.1-6 OMA

Item	Specifications	Measured Result
OMA Bit rate: 10.3125 Gbit/s	≥–5.2 dBm When Stressed Eye mode is selected (with MU181620A-x11 or -x13 installed, 1310 nm) ≥–1.7 dBm When Stressed Eye mode is selected (with MU181620A-x12 or -x13 installed, 1550 nm)	

B.1 List of Initial Settings

All settings can be initialized by selecting “Initialize” from the File menu.

Table B.1-1 List of Initial Settings

<table>
<tr><th>Item</th><th>Setting</th></tr>
<tr><td>Optical Output</td><td>ON</td></tr>
<tr><td>Bit Rate</td><td>12.500 Gbit/s</td></tr>
<tr><td>Retiming</td><td>ON</td></tr>
<tr><td>Test Type</td><td>Reference</td></tr>
<tr><td>Wavelength</td><td>1310 nm (when MU181620A-x01, -x03, -x11, or -x13 is installed)
1550 nm (when MU181620A-x02 or -x12 is installed)</td></tr>
<tr><td>Extinction Ratio</td><td>The initial value varies depending on the Wavelength and Test Type settings, as shown below.
<table>
<tr><th>Wavelength</th><th>Test Type</th><th>Extinction Ratio
Initial Setting Value</th></tr>
<tr><td rowspan="2">1310 nm</td><td>Reference</td><td>10.0 dB</td></tr>
<tr><td>Stressed Eye</td><td>3.0 dB</td></tr>
<tr><td rowspan="2">1550 nm</td><td>Reference</td><td>10.0 dB</td></tr>
<tr><td>Stressed Eye</td><td>3.5 dB</td></tr>
</table></td></tr>
<tr><td>Calibration Checkbox</td><td>Cleared</td></tr>
<tr><td>Calibration</td><td>0.0 dB</td></tr>
<tr><td>Power Control</td><td>OFF</td></tr>
<tr><td>Unit</td><td>dBm</td></tr>
<tr><td>Power
(When Power Control is set to Power)</td><td>The initial value varies depending on the Wavelength and Unit settings, as shown below.
<table>
<tr><th>Wavelength</th><th>Unit</th><th>Power
Initial Setting Value</th></tr>
<tr><td rowspan="2">1310 nm</td><td>dBm</td><td>–4.00 dBm</td></tr>
<tr><td>μW</td><td>398 μW</td></tr>
<tr><td rowspan="2">1550 nm</td><td>dBm</td><td>–2.00 dBm</td></tr>
<tr><td>μW</td><td>630 μW</td></tr>
</table></td></tr>
</table>

Table B.1-1 List of Initial Settings (Cont'd)

Item	Setting
Internal Attenuator (When Power Control is set to Attenuation)	0.00 dB
Relative button (When Power Control is set to Attenuation)	OFF
Relative (When Power Control is set to Attenuation)	0.00 dB
External ATT Factor	0.00 dB
Average	OFF