MT9812B
Multi Channel Box
Operation Manual

Ninth Edition

For safety and warning information, please read this manual before attempting to use the equipment.
Keep this manual with the equipment.

ANRITSU CORPORATION

Document No.: M-W1555AE-9.0

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.

MT9812B
Multi Channel Box
Operation Manual

1 February 1999 (First Edition)
9 May 2008 (Ninth Edition)

For Safety

WARNING ⚠

1. ALWAYS refer to the operation manual when working near locations at which the alert mark shown on the left is attached. If the advice in the operation manual is not followed there is a risk of personal injury or reduced equipment performance. The alert mark shown on the left may also be used with other marks and descriptions to indicate other dangers.

2. IEC 61010 Standard
   The IEC 61010 standard specifies four categories to ensure that an instrument is used only at locations where it is safe to make measurements. This instrument is designed for measurement category I (CAT I). DO NOT use this instrument at locations specified as category II, III, or IV as defined below.
   Measurement category I (CAT I):
   Secondary circuits of a device that is not directly connected to a power outlet.
   Measurement category II (CAT II):
   Primary circuits of a device that is directly connected to a power outlet, e.g., portable tools or home appliance.
   Measurement category III (CAT III):
   Primary circuits of a device (fixed equipment) to which power is supplied directly from the distribution panel, and circuits running from the distribution panel to power outlet.
   Measurement category IV (CAT IV):
   Building service-line entrance circuits, and circuits running from the service-line entrance to the meter or primary circuit breaker (distribution panel).

For Safety

WARNING ⚠

3. 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.

Electric Shock

4. To ensure that the instrument is earthed, always use the supplied 3-pin power cord, and insert the plug into an outlet with an earth terminal. If power is supplied without earthing the equipment, there is a risk of receiving a severe or fatal electric shock or causing damage to the internal components.

Repair

WARNING ⚠

5. This equipment cannot be repaired by the operator. DO NOT attempt to remove the equipment covers or unit covers or to disassemble internal components. Only qualified service personnel with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Calibration

6. The performance-guarantee seal verifies the integrity of the equipment. To ensure the continued integrity of the equipment, only Anritsu service personnel, or service personnel of an Anritsu sales representative, should break this seal to repair or calibrate the equipment. If the performance-guarantee seal is broken by you or a third party, the performance of the equipment cannot be guaranteed. Be careful not to break the seal by opening the equipment or unit covers.

Falling Over

7. This equipment should always be positioned in the correct manner. If the cabinet is turned on its side, etc., it will be unstable and may be damaged if it falls over as a result of receiving a slight mechanical shock.
   Always set up the equipment in a position where the power switch can be reached without difficulty.

For Safety

CAUTION ⚠

Fuse Replacement

CAUTION ⚠

1. Always remove the mains power cable from the power outlet before replacing blown fuses. There is a risk of electric shock if fuses are replaced with the power cable connected. Always use new fuses of the type and rating specified on the rear panel of the instrument. There is a risk of fire if a fuse of a different rating is used.

   T5A indicates a time-lag fuse.

Cleaning

2. Keep the power supply and cooling fan free of dust.
   - Clean the power inlet regularly. If dust accumulates around the power pins, there is a risk of fire.
   - Keep the cooling fan clean so that the ventilation holes are not obstructed. If the ventilation is obstructed, the cabinet may overheat and catch fire.

For Safety

Class 1, 1M indicate the danger degree of the laser radiation specified below according to IEC 60825-1:2001.

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

Class 1M: Lasers emitting in the wavelength range from 302.5 to 4000 nm that are safe under reasonably foreseeable conditions of operation, but may be hazardous if the user employs optics within the beam. Two conditions apply:

a) for diverging beams, if the user views the laser output with certain optical instruments (for example, eye loupes, magnifiers and microscopes) within a distance of 100 mm; or

b) for collimated beams, if the user views the laser output with certain optical instruments (for example, telescopes and binoculars).

Class I, IIa, II, IIIa, IIIb indicate the degree of danger of the laser radiation outlined below as defined by 21 CFR 1040.10:1995.

Class I: Class I levels of laser radiation are not considered to be hazardous.

Class IIa: Class IIa levels of laser radiation are not considered to be hazardous if viewed for any period of time less than or equal to 1×10^3 seconds but are considered to be a chronic viewing hazard for any period of time greater than 1×10^3 seconds. The wavelength range of laser radiating is in 400 to 710 nm.

Class II: Class II levels of laser radiation are considered to be a chronic viewing hazard. The wavelength range of laser radiating is in 400 to 710 nm.

Class IIIa: Class IIIa levels of laser radiation are considered to be, depending upon the irradiance, either an acute intrabeam viewing hazard or chronic viewing hazard, and an acute viewing hazard if viewed directly with optical instruments. The wavelength range of laser radiating is in 400 to 710 nm.

Class IIIb: Class IIIb levels of laser radiation are considered to be an acute hazard to skin and eyes from direct radiation.

For Safety

CAUTION ⚠

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

The use of optical instruments with this product will increase eye hazard.

For Safety

WARNING ⚠

Laser Safety

Before using this instrument, always ensure that the warning light is lit when the optical output switch is turned on.

If this warning light does not turn on, the equipment may be faulty and for safety reasons should be returned to an Anritsu service center or representative for repair.

The laser in the plug-in unit provided for this equipment is classified as Class 1, 1M according to the IEC 60825-1:2001 standard, or as Class I, IIIb according to the 21 CFR 1040.10:1995 standard.

Never use optical instruments to directly view Class 1M laser products. Doing so may result in serious damage to the eyes.

Table 1 Laser Safety Classifications Based on IEC 60825-1:2001

Model Name	Class	Max. Optical Output Power (mW)*	Pulse Width (s)/ Repetition Rate	Emitted Wavelength (nm)	Laser Aperture
MU954501A	Class 1	10	CW	1550	Fig. 1, [1]
MU952501A	Class 1M	40	CW	1545-1553	Fig. 1, [1]
MU952502A	Class 1M	40	CW	1553-1561	Fig. 1, [1]
MU952503A	Class 1M	40	CW	1561-1564	Fig. 1, [1]
MU952504A	Class 1M	40	CW	1537-1545	Fig. 1, [1]
MU952505A	Class 1M	40	CW	1530-1537	Fig. 1, [1]
MU952601A	Class 1M	40	CW	1564-1569	Fig. 1, [1]
MU952602A	Class 1M	40	CW	1569-1578	Fig. 1, [1]
MU952603A	Class 1M	40	CW	1577-1586	Fig. 1, [1]
MU952604A	Class 1M	40	CW	1586-1594	Fig. 1, [1]
MU952605A	Class 1M	40	CW	1594-1603	Fig. 1, [1]
MU952606A	Class 1M	40	CW	1603-1610	Fig. 1, [1]
MU951301A	Class 1M	40	CW	1310	Fig. 1, [1]
MU951501A	Class 1M	40	CW	1550	Fig. 1, [1]
MU951001A	Class 1M	40	CW	1310/1550	Fig. 1, [1]

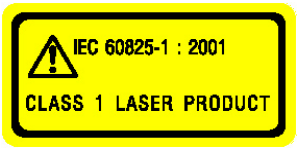
*: Indicates the possible optical output power when each and every reasonably foreseeable single-fault condition is included.

Table 2 Laser Safety Classifications Based on FDA21 CFR 1040.10:1995

Model Name	Class	Max. Optical Output Power (mW)	Pulse Width (s)/ Repetition Rate	Emitted Wavelength (nm)	Laser Aperture
MU954501A	Class I	10	CW	1550	Fig. 1, [1]
MU952501A	Class IIIb	40	CW	1545-1553	Fig. 1, [1]
MU952502A	Class IIIb	40	CW	1553-1561	Fig. 1, [1]
MU952503A	Class IIIb	40	CW	1561-1564	Fig. 1, [1]
MU952504A	Class IIIb	40	CW	1537-1545	Fig. 1, [1]
MU952505A	Class IIIb	40	CW	1530-1537	Fig. 1, [1]
MU952601A	Class IIIb	40	CW	1564-1569	Fig. 1, [1]
MU952602A	Class IIIb	40	CW	1569-1578	Fig. 1, [1]
MU952603A	Class IIIb	40	CW	1577-1586	Fig. 1, [1]
MU952604A	Class IIIb	40	CW	1586-1594	Fig. 1, [1]
MU952605A	Class IIIb	40	CW	1594-1603	Fig. 1, [1]
MU952606A	Class IIIb	40	CW	1603-1610	Fig. 1, [1]
MU951301A	Class IIIb	40	CW	1310	Fig. 1, [1]
MU951501A	Class IIIb	40	CW	1550	Fig. 1, [1]
MU951001A	Class IIIb	40	CW	1310/1550	Fig. 1, [1]

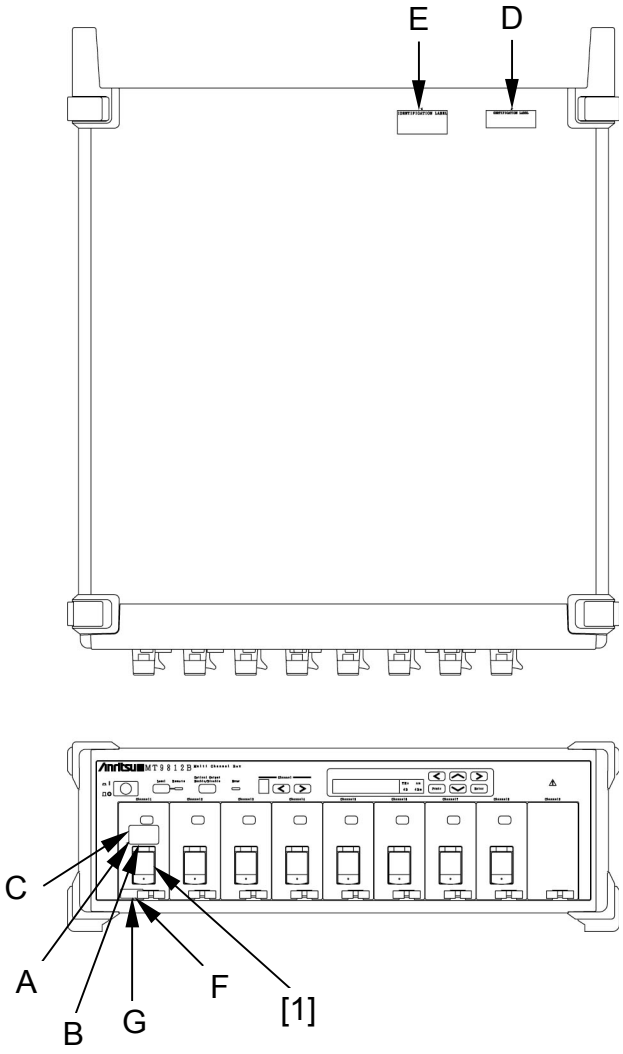
For Safety

Table 3 Indication Labels on Product

	Type	Sample	Affixed to:	Model Name
1	Explanation		Fig. 1, A	MU954501A
2	Explanation		Fig. 1, B	MU952501A/02A/03A/04A/05A MU952601A/02A/03A/04A/05A/06A MU951301A MU951501A MU951001A
3	Explanation		Fig. 1, C	MU952501A/02A/03A/04A/05A MU952601A/02A/03A/04A/05A/06A MU951301A MU951501A MU951001A
4	Certification		Fig. 1, D	MT9810B MT9812B
5	Identification		Fig. 1, E	MT9810B MT9812B
6	Warning		Fig. 1, F	MU954501A MU952501A/02A/03A/04A/05A MU952601A/02A/03A/04A/05A/06A MU951301A MU951501A MU951001A
7	Aperture		Fig. 1, G	MU954501A MU952501A/02A/03A/04A/05A MU952601A/02A/03A/04A/05A/06A MU951301A MU951501A MU951001A

For Safety

Laser Radiation Markings



For Safety

CAUTION ⚠

Replacing Memory Back-up Battery

This equipment uses a Poly-carbomonofluoride lithium battery to backup the memory. This battery must be replaced by service personnel when it has reached the end of its useful life; contact the Anritsu sales section or your nearest representative.

Note: The battery used in this equipment has a maximum useful life of 7 years. It should be replaced before this period has elapsed.

Use in a residential environment

This instrument is designed for an industrial environment.
In a residential environment this instrument may cause radio interference in which case the user may be required to take adequate measures.

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, under the condition that this warranty is void when:

- The fault is outside the scope of the warranty conditions 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, flooding, earthquake, etc.
- The fault is due to use of non-specified peripheral equipment, peripheral parts, consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.

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.

Anritsu Corporation Contact

In the event that 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.

Crossed-out Wheeled Bin Symbol

Equipment marked with the Crossed-out Wheeled Bin Symbol complies with council directive 2002/96/EC (the "WEEE Directive") in European Union.

For Products placed on the EU market after August 13, 2005, please contact your local Anritsu representative at the end of the product's useful life to arrange disposal in accordance with your initial contract and the local law.

CE Conformity Marking

Anritsu affixes the CE conformity marking on the following product(s) in accordance with the Council Directive 93/68/EEC to indicate that they conform to the EMC and LVD directive of the European Union (EU).

CE marking

CE

1. Product Model

Model: MT9812B Multi Channel Box

2. Applied Directive

EMC: Directive 2004/108/EC
LVD: Directive 2006/95/EC

3. Applied Standards

- EMC: Emission: EN 61326: 1997 + A1: 1998 + A2: 2001 + A3: 2003 (Class A)
  Immunity: EN 61326: 1997 + A1: 1998 + A2: 2001 + A3: 2003 (Annex A)

	Performance Criteria*
IEC 61000-4-2 (ESD)	B
IEC 61000-4-3 (EMF)	A
IEC 61000-4-4 (Burst)	B
IEC 61000-4-5 (Surge)	B
IEC 61000-4-6 (CRF)	A
IEC 61000-4-11 (V dip/short)	B

*: Performance Criteria
A: During testing, normal performance within the specification limits.
B: During testing, temporary degradation, or loss of function or performance which is self-recovering.

Harmonic current emissions:
EN 61000-3-2: 2000 + A2: 2005 (Class A equipment)

- LVD: EN 61010-1: 2001 (Pollution Degree 2)

4. Authorized representative

Name:	Loic Metais European Quality Manager ANRITSU S.A. France
Address, city:	16/18 Avenue du Québec SILIC 720 Zone de Courtaboeuf 91951 Les Ulis Cedex
Country:	France

C-tick Conformity Marking

Anritsu affixes the C-tick mark on the following product(s) in accordance with the regulation to indicate that they conform to the EMC framework of Australia/New Zealand.

C-tick marking

1. Product Model

Model: MT9812B Multi Channel Box

2. Applied Standards

EMC:Emission: EN 61326: 1997 + A1: 1998 + A2: 2001 + A3: 2003
(Class A equipment)

Power Line Fuse Protection

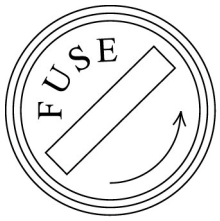
For safety, Anritsu products have either one or two fuses in the AC power lines as requested by the customer when ordering.

Single fuse: A fuse is inserted in one of the AC power lines.

Double fuse: A fuse is inserted in each of the AC power lines.

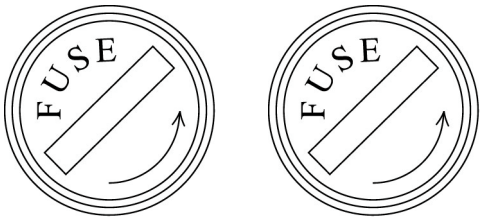
Example 1: An example of the single fuse is shown below:

Fuse Holder



Example 2: An example of the double fuse is shown below:

Fuse Holders



About This Manual

This manual provides descriptions of the operation, calibration and maintenance methods of the MT9812B Multi Channel Box. Section 4 outlines the basic functions and operations of MT9812B.
By connecting to an external computer, this device can be remote-controlled. Section 5 describes the setting method and device messages of this device.

Indicator  indicates item numbers for which more detailed explanations and relevant descriptions are available.
Moreover, matters that require attention in terms of operations and useful information are given as "**POINT**"; use these as reference.

Table of Contents

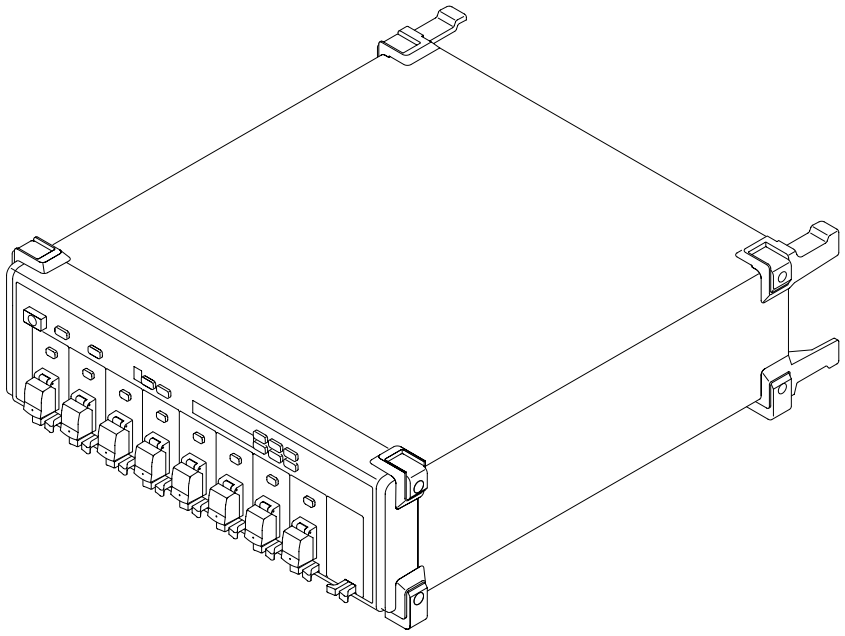
Section 1 General

This section provides an outline of functions of the MT9812B Multi Channel Box and the plug-in unit, and explanations of the product features.

1.1 MT9812B Multi Channel Box

The MT9812B Multi Channel box, that is one of the optical test set series, has slots in which up to nine plug-in units can be mounted. The MT9812B operates the unit mounted in each slot and displays the state of each unit and the measurement results.

Using the GPIB and RS-232C, the MT9812B can be remote-controlled.



1.2 Plug-in Unit

The MT9812B enables mounting of the units shown below.

MU952501A - MU952505A Light Source
DFB-LD light source
MU952601A - MU952606A Light Source
DFB-LD light source
MU951301A Light Source
FP-LD light source
MU951501A Light Source
FP-LD light source
MU951001A Light Source
Switchable FP-LD light source
MU931311A Light Sensor
High-sensitivity type
MU931421A Light Sensor
General-purpose type

2.2 Specifications

See the ordering information to select the model name and option number when specifying the optical frequency (wavelength) of the light source.

2.3 Application Parts and Options

Incidentally, to specify an optical connector, add the double figure shown below together with a hyphen at the end of each unit model name. The absence of the double figure means to specify a unit with an FC connector.

Unit with a FC-PC connector	<Model name>-37
Unit with an ST connector	<Model name>-38
Unit with a DIN connector	<Model name>-39
Unit with an SC connector	<Model name>-40
Unit with a HMS-10/A connector	<Model name>-43

2.3 Application Parts and Options

1.3 Features

(1) Mounting up to nine units

The MT9812B enables to mount up to nine units for the MT9810A Optical Test Set. It is an appropriate light source to evaluate a multiplexed-wavelength optical communication system.

(2) Compatible with wavelength conforming to ITU-T

Provides a lineup of DFB-LD light sources of optical frequencies conforming to ITU-T compatible with Dense-WDM. Available at intervals ranging from 186.3 and 195.9 THz/100 GHz.

(3) High-precision optical power measurement

The measurement error is within ±2 % in the reference condition, ±3.5 % in the operating condition and the linearity is less than or equal to ±0.01 dB, enabling high-precision optical power measurement.

(4) High return loss and low polarization dependency

Even if in the absence of a reflection suppressing adapter, the return loss is 40 dB or more and then the return light is very low. In addition, the polarization dependency is 0.02 dB or less. It is therefore optimal for the evaluation of a device or a system using an optical amplifier.

(5) Standard mounting of GPIB and RS-232C

As RS-232C in addition to GPIB is mounted as the standard remote interface, remote control can be enabled by using the personal computer.

POINT

Although RS-232C is named EIA-232-E in accordance with the formal standards of ANSI/EIA, this document and descriptions relating to the MT9812B use the general name of RS-232C for explanations.

Section 2 Specifications

2.1 Component

Take the MT9812B Multi Channel Box out from the packing carton and check the articles provided with the component list. If any article is found missing or broken, quickly contact ANRITSU or an ANRITSU dealer.

Item Name		Quantity	Model Name/Ordering No.
Main unit	Multi Channel Box	1	MT9812B
Standard accessories	AC power source code	1	
	Tripolar to bipolar conversion adapter	1	J0266
	5.0 A fuse	2	T5.0A250V
	Remote interlock connection plug	1	J0896
	Remote interlock short plug	1	J0895
	Optical output modifier key	2	Z391
	Blank panel	8	B425
	Operation manual (this document)	1	W1555AE

2.2 Specifications

Specifications of MT9812B Multi Channel Box

Item		Specification
Number of units to be accommodated		Nine (Max.)
Indicator	Channel number	7-segment LED
	Set value display	7-segment LED, 7 digits (sign: one digit, number: six digits)
Panel manual control		Channel change, display item selection, parameter setting
External control		GPIB, RS-232C
Laser safety mechanism		Remote inter-lock, optical output control (key control)
Operating temperature/humidity		0 to 40 ºC (depends on the installed unit specification)
Storage temperature/humidity		–30 to +71 ºC, ≤95 % RH (must be condensation free)
Dimensions		133(H) × 426(W) × 451(D) mm
Mass		≤9 kg (excluding unit and Blank panel)
Power source		85 to 132 (rated 100 to 120 V)/170 to 250 V (rated 200 to 240 V), 47.5 to 63 Hz, ≤250 VA

Specifications of Units (DFB-LD light sources)

Model name	MU952501A to MU952505A*1
Light emitting device	DFB-LD
Specified optical frequency (wavelength) range	191.7 to 195.9 THz (1563.86 to 1530.33 nm)*1
Center optical frequency*2	fp ±0.01 THz
Spectrum half-amplitude level*2	30 MHz (Max.)
Conforming fiber	SM fiber (ITU-T.G. 652)
Connector	Compatible with FC-PC, ST, DIN, HMS-10/A and SC*7
Output power*2	+10 ±1 dBm
Laser product safety standards	IEC60825-1: Class 1M, 21CFR1040; Class IIIb
Magnitude of attenuation of optical output	0.00 to 6.00 dB, 0.01 dB step
Inter-modulation function	270/1 k/2 kHz, extinction ratio 13 dB (Min.)
Time stability (short time)*2, *3, *4	±0.005 dB
Time stability (long time)*2, *3, *5	±0.02 dB
Temperature stability*2, *3, *6	±0.25 dB
Center optical frequency time stability (short time)*2,*4	±2 GHz (Max.)
Center optical frequency time stability (long time)*2,*5	±4 GHz (Max.)
Variable range of optical frequency	fp –60 GHz
Optical frequency setting resolution	1 GHz
Warming up time	One hour after the optical output is turned ON
Environmental conditions	Operating temperature: 15 to 35 °C, humidity of not greater than 90 % (must be condensation free) Storage temperature: –25 to 71 °C, humidity of not greater than 95 % (must be condensation free)
Dimensions and mass	78(H) × 41(W) × 335(D) mm, 700 g (Max.)

NOTE: All the values for the optical frequency (wavelength) are values registered in a vacuum state.

∗1: The wavelength is specified by the model name and option No. See the ordering information.

∗2: At the time of CW light, magnitude of optical attenuation set at 0.00 dB and the center frequency of fp. At the time of using the SM fiber (ITU-T.G.652) and FC-PC connector.

∗3: When the return loss viewed from the light source is 40 dB or greater.

∗4: Temperature kept constant for five minutes

∗5: Temperature kept constant for one hour

∗6: Temperature kept between 15 and 35 °C for eight hours

∗7: A connector specified from among optical connector options is attached as a standard feature. When no specifications are given, the FC-PC connector (option 37) will be supplied as a standard feature.

Specifications of Units (DFB-LD light sources)

Model name	MU952601A to MU952606A*1
Light emitting device	DFB-LD
Specified optical frequency (wavelength) range fp	186.3 to 191.6 THz (1609.19 to 1564.68 nm)*1
Center optical frequency*2	fp ±0.01 THz
Spectrum half-amplitude level*2	30 MHz (Max.)
Conforming fiber	SM fiber (ITU-T.G. 652)
Connector	Compatible with FC-PC, ST, DIN, HMS-10/A and SC*7
Output power*2	+7 ±1 dBm
Laser product safety standards	IEC60825-1: Class 1M, 21CFR1040: Class IIIb
Magnitude of attenuation of optical output	0.00 to 6.00 dB, 0.01 dB step
Inter-modulation function	270/1 k/2 kHz, extinction ratio 13 dB (Min.)
Time stability (short time)*2, *3, *4	±0.01 dB
Time stability (long time)*2, *3, *5	±0.02 dB
Temperature stability*2, *3, *6	±0.25 dB
Center optical frequency time stability (short time)*2,*4	±2 GHz (Max.) (Approximately ±0.02 nm)
Center optical frequency time stability (long time)*2,*5	±4 GHz (Max.) (Approximately ±0.04 nm)
Variable range of optical frequency	fp –60 GHz (Approximately ±0.48 nm)
Optical frequency setting resolution	1 GHz (Approximately 0.01 nm)
Optical frequency accuracy*2	≤ ±10 GHz (at fp +60 GHz or fp –60 GHz setting, 25 °C)
Warming up time	One hour after the optical output is turned ON
Environmental conditions	Operating temperature: 15 to 35 °C, humidity of not greater than 90 % (must be condensation free) Storage temperature: –25 to 71 °C, humidity of not greater than 90 % (must be condensation free)

NOTE: All the values for the optical frequency (wavelength) are values registered in a vacuum state.

∗1: The wavelength is specified by the model name and option No. See the ordering information.

∗2: At the time of CW light, magnitude of optical attenuation set at 0.00 dB and the center frequency of fp. At the time of using the SM fiber (ITU-T.G.652) and FC-PC connector.

∗3: When the return loss viewed from the light source is 40 dB or greater.

∗4: Temperature kept constant for five minutes

∗5: Temperature kept constant for one hour

∗6: Temperature kept between 15 and 35 °C for eight hours

∗7: A connector specified from among optical connector options is attached as a standard feature. When no specifications are given, the FC-PC connector (option 37) will be supplied as a standard feature.

Specifications of Units (FP-LD light sources)

Model name	MU951301A	MU951501A	MU951001A
Light emitting device	FP-LD		
Center frequency*1	1310 ±20 nm	1550 ±20 nm	1310 ±20 nm/1550 ±20 nm
Spectrum half-amplitude level*1	≤5 nm or less	≤10 nm or less	≤5 nm or less/≤10 nm or less
Conforming fiber	SM fiber (ITU-T.G. 652)		
Connector	Compatible with FC-PC, ST, DIN, HMS-10/A and SC*6		
Output power*1	+7 ±1 dBm		
Laser product safety standards	IEC60825-1: Class 1M, 21CFR1040: Class IIIb		
Magnitude of attenuation of optical output	0.00 to 6.00 dB, 0.01 dB step		
Inter-modulation function	270/1 k/2 kHz, extinction ratio 13 dB (Min.)		
Time stability (short time)*1, *2, *3	±0.002 dB		±0.005 dB
Time stability (long time)*1, *2, *4	±0.02 dB		±0.05 dB
Temperature stability*1, *2, *5	±0.1 dB		±0.15 dB
Warming up time	One hour after the optical output is turned ON		
Environmental conditions	Operating temperature: 0 to 50 °C, humidity of not greater than 90 % (must be condensation free) Storage temperature: –40 to 71 °C, humidity of not greater than 95 % (must be condensation free)		
Dimensions and weight	78(H) × 41(W) × 335(D) mm, 700 g (Max.)		

NOTE: All the values for the wavelength are values registered in a vacuum state.

Only one MU951001A can be installed.

*1: At the time of CW light, magnitude of optical attenuation set at 0.00 dB and the center frequency of fp. At the time of using the SM fiber (ITU-T.G. 652) and FC-PC connector.

*2: When the reflection loss viewed from the light source is 40 dB or greater.

*3: Temperature kept constant for 15 minutes between 20 and 30 °C.

*4: Temperature kept constant for six hours.

*5: Temperature kept constant for eight hours between 0 and 50 °C.

*6: A connector specified from among optical connector options is attached as a standard feature. When no specifications are given, the FC-PC connector

(option 37) will be supplied as a standard feature.

Specifications of Optical Sensors

Model name	MU931311A	MU931421A
Light receiving element	InGaAs-PD	
Input system	Fiber input	
Connector	Compatible with FC-PC, ST, DIN, HMS-10/A and SC*8	
Wavelength range	800 to 1600 nm	750 to 1700 nm
Optical power measurement range continuous light	+10 to –110 dBm	+10 to –80 dBm
Optical power measurement range modulated light	+7 to –90 dBm	
Noise level*1	–93 dBm	–73 dBm
Polarization dependability*2	0.02 dB (Max.)	
Reflection loss*2	40 dB (Min.)	
Optical power Reference measurement conditions accuracy	±2 %	
Optical power Reference measurement conditions operating*3	±3.5 %	
Linearity*4	±0.05 dB (+10 to 0 dBm) ±0.01 dB ±0.3 pW (≤0 dBm)	±0.05 dB (+10 to 0 dBm) ±0.01 dB ±30 nW (≤0 dBm)
Wavelength sensitivity characteristic correction function	Measuring wavelength enabled to be input by the unit of 0.01 nm	
Measurement interval setting*5	1 ms to 99 hours 59 minutes 59 seconds	
Average setting	2 to 1,000 times	
Analog output*6	Approximately +2 V	
Bandwidth select*7	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10, 100 kHz (CW mode only)	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10 kHz (CW mode only)
Environmental conditions	Operating temperature: 0 to 50 ˚C, humidity of not greater than 90 % (must be condensation free) Storage temperature: –40 to 71 ˚C, humidity of not greater than 95 % (must be condensation free)	
Dimensions and mass	78(H) × 41(W) × 335(D) mm, 700 g (Max.)	78(H) × 41(W) × 335(D) mm, 550 g (Max.)

NOTE:

*1: Measurement interval 1s, peak to peak

*2: SM fiber (ITU-T.G.652) used. Reflection loss 45 dB (Min.)
Wavelength 1550 nm

*3: Reference conditions: SM fiber (ITU-T.G.652), master FC connector used
Power level 100 μW (–10 dBm), CW light, wavelength 1300 nm
Ambient temperature: 23 ±2 °C
On the day of calibration
Warming up time: After one hour for MU931311A and after 30 minutes for MU931421A

Operating conditions: SM fiber (ITU-T.G.652), master FC connector used
CW light, one wavelength in the range between 1000 to 1600 nm (MU931311A)/1000 to 1650 nm (MU931421A)
Ambient temperature: 23 ±5 °C
Within a year from calibration
Warming up time: After one hour for MU931311A and after 30 minutes for MU931421A

*4: Measurement conditions: Constant temperature at 23 ± 5 °C, one wavelength in the range between 1000 to 1600 nm
CW light, power level 100 μW (–10 dBm) set as reference
Warming up time: After one hour for MU931311A and after 30 minutes for MU931421A

*5: However, the measurement intervals not greater than 100 ms are effective only at the time of recording and measurement.

*6: Based on the full-scale values of each measurement range

*7: Bandwidth of approximately 3 dB

*8: A connector specified from among optical connector options is attached as a standard feature. When no specifications are given, the FC-PC connector (option 37) will be supplied as a standard feature.

2.3 Application Parts and Options

Model name and code	Item name	Remarks
	–Application parts–	
J0006	GPIB cable 0.5 m	
J0007	GPIB cable 1 m	
J0008	GPIB cable 2 m	
J0009	GPIB cable 4 m	
J0655A	RS-232C cable 9P-25P cross	
J0654A	RS-232C cable 9P-9P cross	
	–Main unit–	
MU952501A	Light source (DFB-LD)	
MU952502A	Light source (DFB-LD)	
MU952503A	Light source (DFB-LD)	
MU952504A	Light source (DFB-LD)	
MU952505A	Light source (DFB-LD)	
MU952601A	Light source (DFB-LD)	
MU952602A	Light source (DFB-LD)	
MU952603A	Light source (DFB-LD)	
MU952604A	Light source (DFB-LD)	
MU952605A	Light source (DFB-LD)	
MU952606A	Light source (DFB-LD)	
MU951001A	Light source (FP-LD)	λ=1.31 μm and 1.55 μm
MU951002A	Light source (FP-LD)	λ=1.31 μm and 1.55 μm
MU951301A	Light source (FP-LD)	λ=1.31 μm
MU951302A	Light source (FP-LD)	λ=1.31 μm
MU951501A	Light source (FP-LD)	λ=1.55 μm
MU951502A	Light source (FP-LD)	λ=1.55 μm
	–Standard accessories–	
	Optical connection adapter *1	
	–Option–	
MU952501A -01	Light source	fp =193.10 THz
MU952501A -02	Light source	fp =193.20 THz
MU952501A -03	Light source	fp =193.30 THz
MU952501A -04	Light source	fp =193.40 THz
MU952501A -05	Light source	fp =193.50 THz
MU952501A -06	Light source	fp =193.60 THz
MU952501A -07	Light source	fp =193.70 THz
MU952501A -08	Light source	fp =193.80 THz
MU952501A -09	Light source	fp =193.90 THz
MU952501A -10	Light source	fp =194.00 THz
MU952502A -01	Light source	fp =192.10 THz
MU952502A -02	Light source	fp =192.20 THz
MU952502A -03	Light source	fp =192.30 THz
MU952502A -04	Light source	fp =192.40 THz
MU952502A -05	Light source	fp =192.50 THz
MU952502A -06	Light source	fp =192.60 THz
MU952502A -07	Light source	fp =192.70 THz
MU952502A -08	Light source	fp =192.80 THz
MU952502A -09	Light source	fp =192.90 THz
MU952502A -10	Light source	fp =193.00 THz
MU952503A -07	Light source	fp =191.70 THz

Model name and code	Item name	Remarks
	–Option– (continued)	
MU952503A -08	Light source	fp =191.80 THz
MU952503A -09	Light source	fp =191.90 THz
MU952503A -10	Light source	fp =192.00 THz
MU952504A -01	Light source	fp =194.10 THz
MU952504A -02	Light source	fp =194.20 THz
MU952504A -03	Light source	fp =194.30 THz
MU952504A -04	Light source	fp =194.40 THz
MU952504A -05	Light source	fp =194.50 THz
MU952504A -06	Light source	fp =194.60 THz
MU952504A -07	Light source	fp =194.70 THz
MU952504A -08	Light source	fp =194.80 THz
MU952504A -09	Light source	fp =194.90 THz
MU952504A -10	Light source	fp =195.00 THz
MU952505A -01	Light source	fp =195.10 THz
MU952505A -02	Light source	fp =195.20 THz
MU952505A -03	Light source	fp =195.30 THz
MU952505A -04	Light source	fp =195.40 THz
MU952505A -05	Light source	fp =195.50 THz
MU952505A -06	Light source	fp =195.60 THz
MU952505A -07	Light source	fp =195.70 THz
MU952505A -08	Light source	fp =195.80 THz
MU952505A -09	Light source	fp =195.90 THz
MU952601A -01	Light source	fp =191.10THz
MU952601A -02	Light source	fp =191.20THz
MU952601A -03	Light source	fp =191.30THz
MU952601A -04	Light source	fp =191.40THz
MU952601A -05	Light source	fp =191.50THz
MU952601A -06	Light source	fp =191.60THz
MU952602A -01	Light source	fp =190.10THz
MU952602A -02	Light source	fp =190.20THz
MU952602A -03	Light source	fp =190.30THz
MU952602A -04	Light source	fp =190.40THz
MU952602A -05	Light source	fp =190.50THz
MU952602A -06	Light source	fp =190.60THz
MU952602A -07	Light source	fp =190.70THz
MU952602A -08	Light source	fp =190.80THz
MU952602A -09	Light source	fp =190.90THz
MU952602A -10	Light source	fp =191.00THz
MU952603A -01	Light source	fp =189.10THz
MU952603A -02	Light source	fp =189.20THz
MU952603A -03	Light source	fp =189.30THz
MU952603A -04	Light source	fp =189.40THz
MU952603A -05	Light source	fp =189.50THz
MU952603A -06	Light source	fp =189.60THz
MU952603A -07	Light source	fp =189.70THz
MU952603A -08	Light source	fp =189.80THz
MU952603A -09	Light source	fp =189.90THz
MU952603A -10	Light source	fp =190.00THz
MU952604A -01	Light source	fp =188.10THz
MU952604A -02	Light source	fp =188.20THz
MU952604A -03	Light source	fp =188.30THz
MU952604A -04	Light source	fp =188.40THz
MU952604A -05	Light source	fp =188.50THz

Model name and code	Item name	Remarks
	–Option– (continued)	
MU952604A -06	Light source	fp =188.60THz
MU952604A -07	Light source	fp =188.70THz
MU952604A -08	Light source	fp =188.80THz
MU952604A -09	Light source	fp =188.90THz
MU952604A -10	Light source	fp =189.00THz
MU952605A -01	Light source	fp =187.10THz
MU952605A -02	Light source	fp =187.20THz
MU952605A -03	Light source	fp =187.30THz
MU952605A -04	Light source	fp =187.40THz
MU952605A -05	Light source	fp =187.50THz
MU952605A -06	Light source	fp =187.60THz
MU952605A -07	Light source	fp =187.70THz
MU952605A -08	Light source	fp =187.80THz
MU952605A -09	Light source	fp =187.90THz
MU952605A -10	Light source	fp =188.00THz
MU952606A -03	Light source	fp =186.30THz
MU952606A -04	Light source	fp =186.40THz
MU952606A -05	Light source	fp =186.50THz
MU952606A -06	Light source	fp =186.60THz
MU952606A -07	Light source	fp =186.70THz
MU952606A -08	Light source	fp =186.80THz
MU952606A -09	Light source	fp =186.90THz
MU952606A -10	Light source	fp =187.00THz
MT9812B-01	Option for High Power Sensor	
	<Optical sensor>	
	–Main unit–	
MU931311A	Optical sensor	
MU931421A	Optical sensor	
MU931422A	Optical sensor	
MU931431A	Optical sensor	
	–Standard accessories–	
	Optical connection adapter *1	
	–Application parts–	
J0617B	Replaceable optical connector (FC)	Replacement by user enabled
J0618D	Replaceable optical connector (ST)	Replacement by user enabled
J0618E	Replaceable optical connector (DIN)	Replacement by user enabled
J0618F	Replaceable optical connector (HMS-10/A)	Replacement by user enabled
J0619B	Replaceable op tical connector (SC)	Replacement by user enabled
Z0282	Ferrule cleaner	
Z0283	Ferrule cleaner replacement tape	Six/set
Z0284	Adapter cleaner	Stick type, 200/set
	Optical connector option>*1	
<Model name>-37	FC-PC connector	Replacement by user enabled
<Model name>-38	ST connector	Replacement by user enabled
<Model name>-39	DIN connector	Replacement by user enabled
<Model name>-40	SC connector	Replacement by user enabled
<Model name>-43	HMS-10/A connector	Replacement by user enabled

1:

A connector specified from among the optical connector options listed above will be supplied when an order is placed. When no specifications are given, the FC-PC connector (option 37) will be supplied as a standard feature.

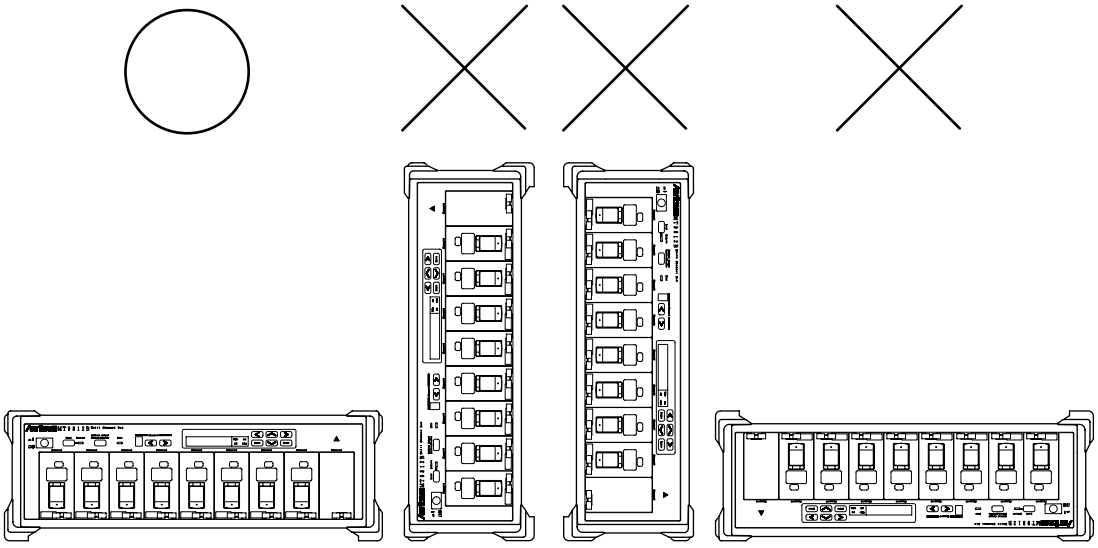
Section 3 Before Use

This section summarizes matters you are advised to learn before you start using the MT9812B. It is recommended that you read through this section at least once since this section provides descriptions of matters that require attention in order to ensure safety during the MT9812B use and avoid failures.

3.1 Installation

3.1.1 Installation Conditions

Install the MT9812B on a level surface.



3.1.2 Installation Environment

The installation environment condition of the MT9812B depends on the unit to be used.

2.2 Specifications

It is advised not to use the MT9812B under environments such as the ones listed below as this may result in failure.

- Places subject to vibrations
- Humid and dusty places
- Places with gradient
- Places exposed to direct sunlight
- Places that may be exposed to active gases
- Places to experience drastic temperature fluctuations

Moreover, moving the MT9812B to a place of high temperature after using it for many hours in a place of low temperature may cause condensation in the MT9812B interior. Turning the power source ON in this status may cause a failure such as short circuit. In a case like this, turn the power source ON after thoroughly drying the MT9812B.

The MT9812B incorporates a cooling fan inside. Accordingly, place the MT9812B at least 10 cm away from an obstacle such as the wall and peripheral equipment to ensure excellent ventilation of air.

3.1.3 Power Source Voltage and Frequency

Supply the MT9812B with power in the range between 85 and 132 Vac or between 170 and 250 Vac of voltage, and between 47.5 and 63 Hz of frequency.
Although switching the setting between 100 and 200 V systems is not required.

WARNING ⚠

To replace the fuse, first turn the power source OFF and pull the power source cord out from the power receptacle, and then, replace the fuse. Attempting to replace the fuse without pulling the power source cord out from the power receptacle may cause electric shock.
Moreover, check whether the fuse to replace is the same as that prescribed in the manual, or use a fuse of the same rating or the same properties of the fuse indicated on the back of the MT9812B frame. Using a wrong fuse may cause frequent fusing, burnout or fires.

3.2 Connecting the Power Cord

Check that the power switch on the front panel is turned off.
Insert the power plug into an outlet, and connect the other end to the power inlet on the rear panel. To ensure that the instrument is earthed, always use the supplied 3-pin power cord, and insert the plug into an outlet with a earth terminal.

WARNING ⚠

If the power cord is connected without the instrument earthed, there is a risk of receiving a fatal electric shock. In addition, the peripheral devices connected to the instrument may be damaged.
When connecting to the power supply, DO NOT connect to an outlet without a earth terminal. Also, avoid using electrical equipment such as an extension cord or a transformer.

CAUTION ⚠

If an emergency arises causing the instrument to fail or malfunction, disconnect the instrument from the power supply by either turning off the power switch on the front panel (switch to the (O) side), or by pulling out the power cord or the power inlet.
When installing the instrument, place the instrument so that an operator may easily operate the power switch.
If the instrument is mounted in a rack, a power switch for the rack or a circuit breaker may be used for power disconnection.

3.3 Mounting and Removal of Plug-in Unit

Mounting

(1) Check that the power source of the MT9812B is OFF.
(2) Check the top and bottom of the unit and gently insert the unit along the guide rail of the plug-in slot.
(3) Push in the drawing lever until it clicks to slightly widen to become locked.

Removal

(1) Check that the power source of the MT9812B is OFF.
(2) Pinch the drawing lever of the unit from the left and right, and gently pull it out straightly toward you.

CAUTION ⚠

Make sure to first turn the power source of the MT9812B OFF before mounting or removing the plug-in unit to or from the MT9812B. Mounting or removing the unit while the power source remains ON may cause damage to the MT9812B and the plug-in unit.

3.4 Laser Safety

The light source used by the MT9812B includes an element to radiate the laser light that corresponds to Class 1M in accordance with the IEC 60825-1 stipulations and Class III B in accordance with the FDA and 21 CFR stipulations.

"For Safety" at the beginning of this manual

The MT9812B incorporates the following two safety devices to prevent the light from being radiated suddenly.

(1) Remote interlock connector

Light will not be output unless the remote interlock connector is in the state of short circuit.

3.5 Connection of Remote Interlock Connector

(2) Optical output modifier key switch

Light will not be output unless the switch is turned ON by the removable key.

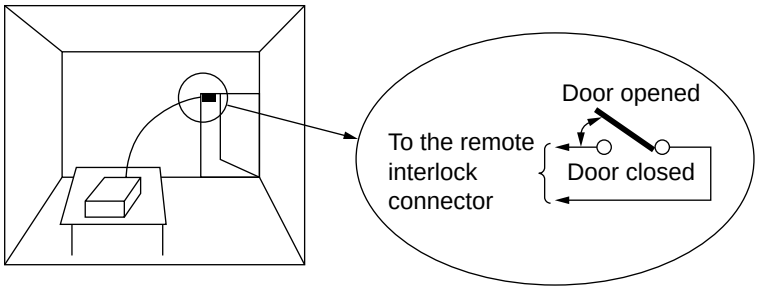
3.6 Optical Output Modifier Key Switch

CAUTION ⚠

Do not look into the connection surface of the optical fiber cord of the light source optical connector or the end face of the optical fiber cord connected to the light source as invisible laser light output may cause visual deficit and other problems.
Moreover, procedures and operations other than those prescribed in this manual may cause exposure to the invisible laser light.

3.5 Connection of Remote Interlock Connector

The MT9812B incorporates the remote interlock connector as one of the laser equipment safety devices to be used when the light source is used. Unless the terminal located in the back is in the state of short circuit, no light will be output even if the optical output key on the front panel of the unit is switched ON.
It is advised to normally use the connector together with the short plug that comes with the MT9812B.
To output the radiation from the light source into the experiment chamber as the space light, use the connector by connecting it as shown below so that the light will not escape when the chamber door (or window) is suddenly opened.



(1) Install a switch that is linked to the movements of the chamber door (or window) so that when the door opens, the switch opens and when the door is closed, the switch is short-circuited.

(2) Remove the short plug affixed to the remote interlock connector. (Make sure not to lose the removed short plug.)

(3) Connect the remote interlock connection plug that comes with the MT9812B and the switch as shown in the figure above, and affix the plug to the remote interlock connector.

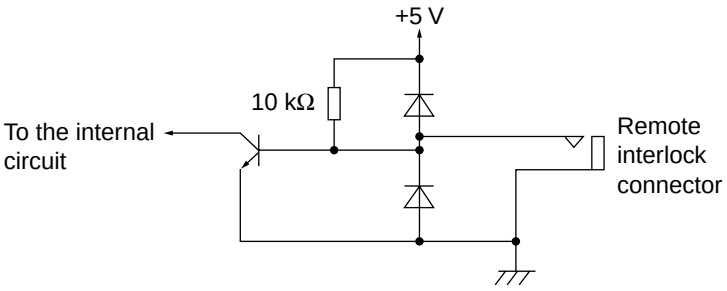
CAUTION ⚠

To connect the plug and switch to the remote interlock connector, first turn the power source of the Device OFF and pull out the power source cord from the power receptacle. Connecting them while the MT9812B remains ON may cause electric shock.
Moreover, do not connect items other than the short plug or the remote interlock connection plug, and short-circuit switch to the remote interlock connector by all means. Failing to do so may cause a circuit failure or burnout.

When the remote interlock connector is in the state of open, and if the optical output of the light source is turned on; the Opt. On key blinks to indicate that a device of the safety measure is active.

POINT

Polarity is not particularly specified in regard to connection to the remote interlock connector. The figure below shows the interior equivalent circuit.



Unless the following three conditions are met, no optical output will be made from the light source.

(1) The optical output ON/OFF key on the front panel of the light source is ON.

(2) The remote interlock connector is in the state of short circuit.

(3) Optical output modifier key switch is ON.

3.6 Optical Output Modifier Key Switch

The MT9812B incorporates the optical output modifier key switch as one of the laser equipment safety devices to be used when the light source is used. Unless the switch with a removable key located at the back is ON, no light will be output even if the optical output key on the front panel of the unit is switched ON.
It is advised to normally keep inserted the key which comes with the Device to set the switch ON.
The key can be taken out at the OFF position.

When the optical output modifier key switch is OFF, and if the optical output of the light source is turned on; the Opt. On key blinks to indicate that a device of the safety measure is active.

POINT

Unless the following three conditions are met, no optical output will be made from the light source.

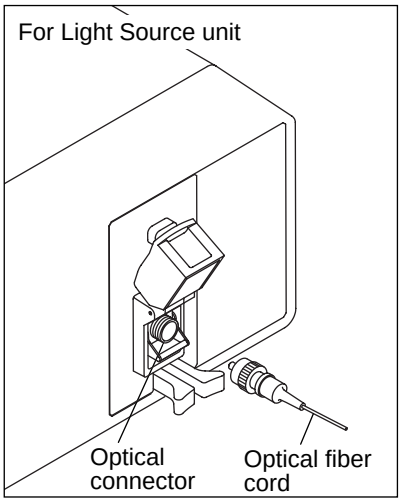
(1) The optical output ON/OFF key on the front panel of the light source is ON.

(2) The remote interlock connector is in the state of short circuit.

(3) Optical output modifier key switch is ON.

3.7 Connection of Optical Fiber Cord

Remove the cap (or open the cover) which is affixed to the optical connector on the front panel of the plug-in unit and connect the optical fiber cord.

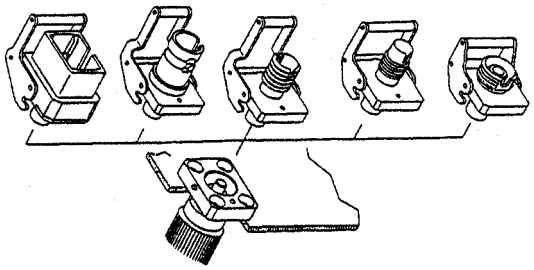


CAUTION ⚠

Make sure to clean the end face of the optical fiber cord to be used before the cord is connected. Moreover, check that the receptacle of the plug-in unit is regularly cleaned. Inputting or outputting intense light while they are stained may cause burnout of components. See 7.1 for the cleaning method.

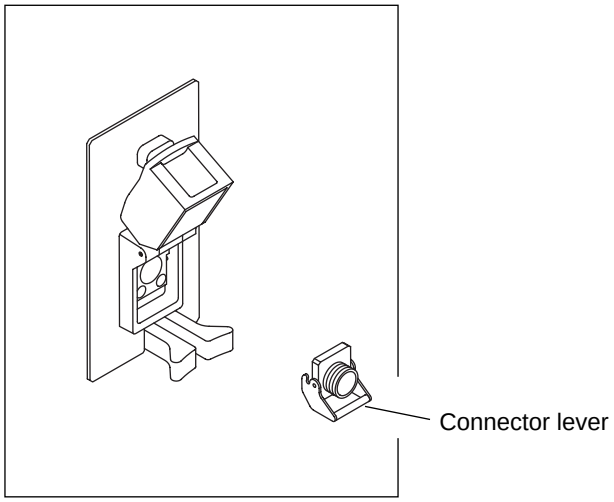
3.8 Replacement of Optical Connector

The optical connector of the plug-in unit can be removed and replaced with a connector of another shape (optionally available), or its interior can be cleaned.



Follow the procedures set out below to replace the optical connector. See 7.1 for the cleaning method.

(1) Remove the cap (or open the cover) affixed to the connector.
(2) Pull up the connector lever toward you, check that the latch has been released, and then, gently pull the connector out straight toward you.



(3) Follow the procedures on the other way around to affix the connector. In this case, pay due attention so that the connector or other items will not scratch the end face of the ferrule.

When no particular specification is given, the FC-PC connector (<Model name>-37) is affixed to each unit. This connector can be replaced with any one of connectors listed below by the customer.

FC-PC connector	<Model name>-37
ST connector	<Model name>-38
DIN connector	<Model name>-39
SC connector	<Model name>-40
HMS-10/A connector	<Model name>-43

2.3 Application Parts and Options

3.9 Replacement of Fuse

When the fuse has blown, eliminate the cause and replace the fuse by following the procedure set out below.

WARNING ⚠

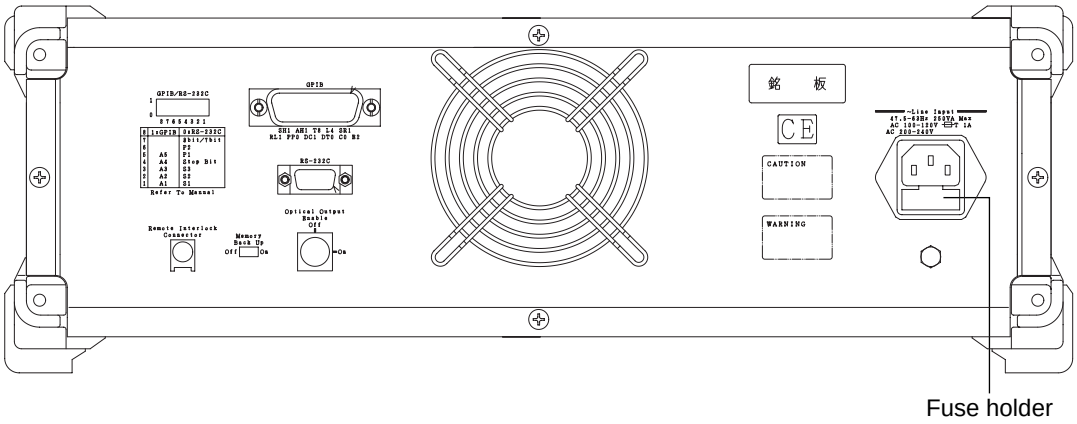
To replace the fuse, first turn the power source OFF and pull the power source cord out from the power receptacle, and then, replace the fuse. Attempting to replace the fuse without pulling the power source cord out from the power receptacle may cause electric shock.
Moreover, check whether the fuse to replace is the same as that prescribed in the manual, or use a fuse of the same rating or the same properties of the fuse indicated on the back of the MT9812B frame. Using a wrong fuse may cause frequent fusing, burnout or fires.
A fuse indication of TxxxA signifies fuses of time lag type. The MT9812B uses time lag type fuses of 5.0 A.

Procedure for fuse replacement

(1) The lower part of the AC inlet in the back of the MT9812B incorporates a fuse holder. Apply the tip of a minus driver or similar objects to the upper edge of the fuse holder.

(2) The fuse holder has two fuses mounted. Remove the fuses from the fuse holder and mount new fuses. In this case, replacing the blown fuse only normally presents no problems. However, the other fuse may retain certain stress and therefore is more likely to blow. Therefore, replacing two fuses at the same time is recommended.

(3) Mount the fuse holder on the lower part of the AC inlet like it was before.



3.10 Others

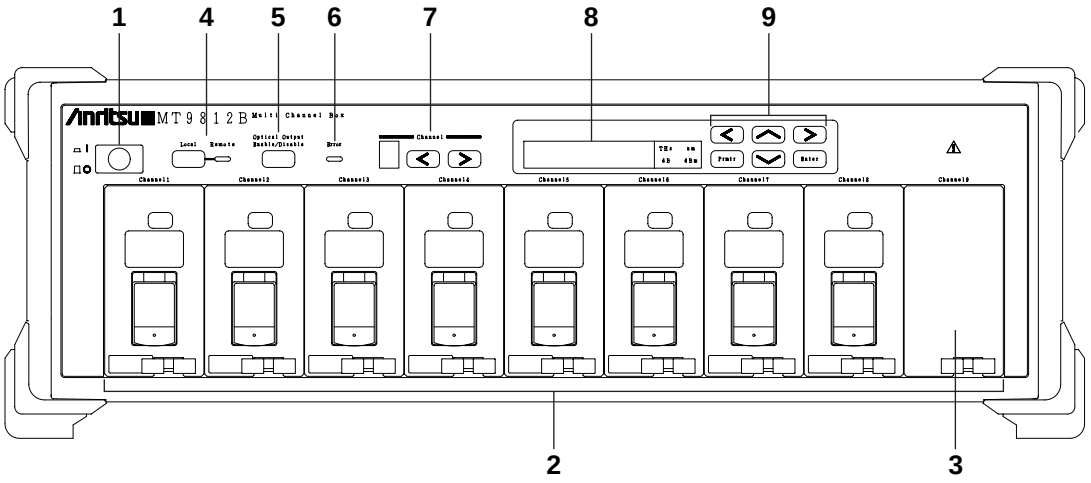
The electronic circuits and optical modules of the MT9812B and each plug-in unit are assembled and adjusted with precision. Disassembly or component replacement to be conducted by the customer without due precaution may cause not only problems in maintaining the function but also operation failures.

If you come across problems, you are advised to first refer to “7.4 Troubleshooting.” Then, contact ANRITSU branch, local office or operation office that is located closest to you listed in this manual.

Section 4 Operation

4.1 Panel Description

4.1.1 Front Panel



1 Power switch — A switch to turn ON/OFF the power source.
Pressing the switch (I) turns the power source ON. Pressing it again to switch it into the projected state (O) turns the power source OFF.

2 Plug-in slot — Places to mount units. When no units are mounted, blank panels can be mounted.

3 Blank panel — A cover to be used when no units are mounted.
(It is not possible to concurrently mount the blank panel and the unit.)

4 Control key — When the MT9812B is in remote mode, the lamp on the right lights on. If this key is pressed in the remote mode, the mode returns to the local mode. In the local mode, the lamp goes off and the manual panel operation become enabled.

5 Optical Output Enable/Disable
Turns on and off the outputs of all light sources inserted in the MT9812B at one time.

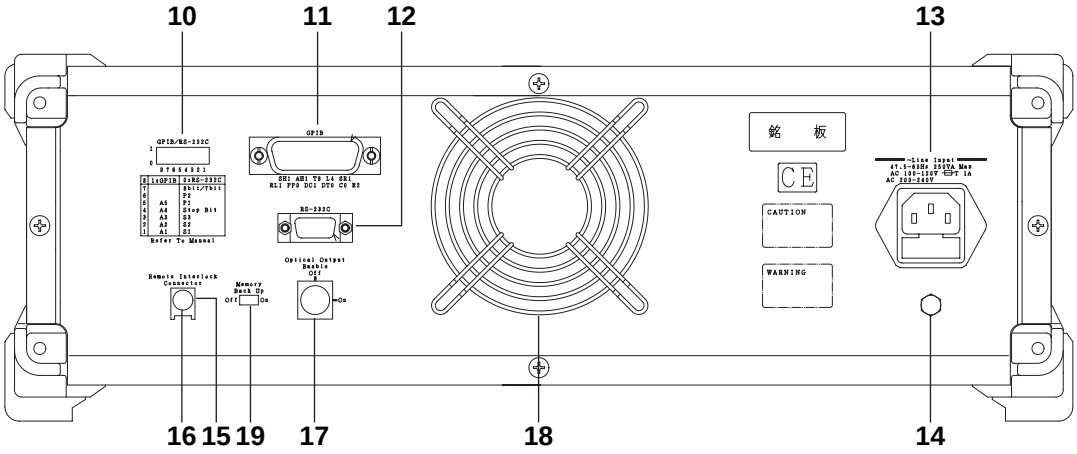
6 Error display — When an error occurs in the MT9812B or an inserted unit, an error code is displayed in the parameter display field and this lamp lights on.

7 Channel selection — Selects the unit to be operated on the panel, manually.

8 Parameter display — Displays the setting conditions of the unit whose channel is selected.

9 Operation keys — Selects the parameter item to be set or displayed, and inputs numeric values.

4.1.2 Rear Panel



10 GPIB/RS-232C setting switches

Specifies the GPIB address or RS-232C communication conditions, and switches the interface (GPIB or RS-232C) to be used.

11 GPIB interface connector — GPIB interface to connect an external computer and execute remote control of the MT9812B.

12 RS-232C interface connector — RS-232C interface to connect an external computer and execute remote control of the MT9812B.

13 AC power source inlet — A connector for the AC power source input, with a built-in fuse.

3.9 Replacement of Fuse

14 Protective earth terminal — A terminal to connect the ground line to ground the MT9812B to ensure safety.

15 Remote interlock connector — A connector for laser safety. In the open status, no light will be output even when the light output switch on the front panel of the light source is turned ON.

3.5 Connection of Remote Interlock Connector

16 Short plug — A plug to switch the remote interlock connector into the short-circuited status and enable optical output.

3.5 Connection of Remote Interlock Connector

17 Optical output modifier key switch

A switch with a key for the purpose of laser safety. When the switch is set OFF, no light will be output even when the light output switch on the front panel of the light source is turned ON.

18 Fan — A cooling fan

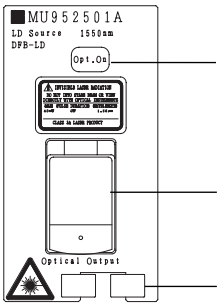
19 Memory Back Up — A switch to select the previous parameters or the unit initial values at power on.

POINT

Although RS-232C is named EIA-232-E in accordance with the formal standards of ANSI/EIA, this document and descriptions relating to the MT9812B use the general name of RS-232C for explanations.

4.1.3 Light Source Front Panel

MU952501A



1 Optical output ON/OFF key

2 Optical connector
(located in the connector cap)

3 Drawing lever

1 Optical output ON/OFF key Used to switch the optical output ON and OFF.

4.2.2 Optical Output ON/OFF

2 Optical connector Connects optical fiber cord in order to take out the light.

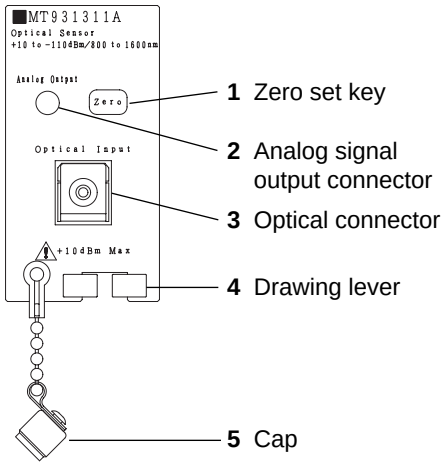
3.7 Connection of Optical Fiber Cord

3 Drawing lever Incorporates a locking mechanism to be used when unit is mounted on the main unit. Pinch the lever and draw it out to remove the unit.

3.3 Mounting and Removal of Plug-in Unit

4.1.4 Optical Sensor Front Panel

MU931311A



1 Zero set key

Used to remove the electrical offset of the light intercepting circuit.

4.3.2 Zero Set

2 Optical connector

Connects the optical fiber cable to input measuring beam.

3.7 Connection of Optical Fiber Cord

CAUTION ⚠

Do not input light of intensity exceeding +11 dBm by all means. This may cause permanent damage to the equipment such as burnout of the optical receiver and ferrule end face.

3 Analog signal output connector

An SMA connector for analog output with an output range between 0 and 2 V and output impedance of approximately 1 kΩ. This connector outputs a voltage proportionate to the optical input. The connector outputs a voltage of approximately 2 V when light at the full scale level of each measurement range is intercepted.*

* For example, this means optical input of –10 dBm when the range is set at –10 dBm.

CAUTION ⚠

The analog signal output connector is exclusively for output. When signals are input by mistake, this may cause damage to the Device or the signal source connected.
Do not pull the cord while the cord remains inserted to the analog signal output connector. This may cause damage to the connector or the internal circuit.

POINT

Analog signals are directly output without correction of the wavelength sensitivity of the signals from the light intercepting circuit of the optical sensor. For this reason, the relationship between the level indication and the voltage output merely serves as a guideline and they do not necessary match each other. However, this function will prove useful to observe changes that take place more quickly than the display of numerical values on the main unit is able to indicate.

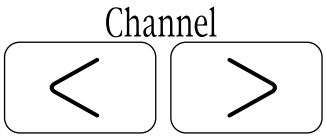
4 Drawing lever — Incorporates a locking mechanism to be used when units are mounted on the main unit. Pinch the lever and draw it out to remove the lever.

3.3 Mounting and Removal of Plug-in Unit

5 Cap — A cap for optical connector protection and shading from light.

4.2 Light Source Operation

4.2.1 Switching Control Channels



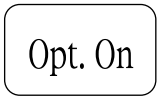
Before setting the parameters on the MT9812B, selection of the unit to be set is performed, as described below.

Operation	Remarks
Press the < or > key.	The selected channel is displayed on the number indicator on the left. Press these keys until a desired channel number appears.

POINT

"Setting parameter" means the setting each item after pressing the "Prmtr key". Therefore, the optical output ON/OFF and settings on the rear panel can be performed, regardless of the channel selection.

4.2.2 Optical Output ON/OFF (each unit)



(* Front of the unit)

The optical output is set ON or OFF. The illuminated key is located on the front panel of the unit.

Operation	Remarks
Press the Opt. On key.	

Every time the Opt. On key is pressed, the mode switches ON and OFF alternately. When the light is output, the Opt. On key remains lit. Even when the mode is set ON, if a safety device such as remote interlock is working to shade light, the key flickers.

When the mode is set OFF, the key is unlit.

POINT

The MT9812B incorporates the remote interlock connector and optical output modifier key as light safety devices to be used when the light source is used. Unless the remote interlock connector is in the state of short circuit or the optical output modifier switch is ON, no light will be output even if the optical output key is switched ON.

See "3.5 Connection of Remote Interlock Connector" for more information on how to use the remote interlock connector.

4.2.3 Optical Output Enable/Disable (all light sources)

Optical Output Enable/Disable

The optical outputs of all light sources inserted in the MT9812B can be turned on and off at the same time, as described below.

Operation	Remarks
Press the Optical Output Enable/Disable key.	

Each time the Enable/Disable key is pressed, Enable (optical output on) and Disable (optical output off) are set, alternately. While light is outputted, this key lights on, continuously.
When the optical output is set to ON using the optical output ON/OFF function (described in para. 4.2.2), and if the light is cut off by the optical output Disable function or the safety-measure device of remote interlock; the Opt. On key blinks.

4.2.4 Setting Output Optical Frequency (or Wavelength)

Prmtr

If a light source is provided with a tunable optical frequency (or wavelength) function, its frequency can be set at a value either greater or less than the reference frequency (or wavelength) within the range defined by the specification. The optical frequency or wavelength displayed after such a change is only an approximate value. The exact value should be determined using an optical wavelength meter or an optical spectrum analyzer.

[When tunable optical frequency (or wavelength) function is provided.]

(1) Setting of the output optical frequency

Operations	Remarks
Press the Prmtr key.	Continue pressing the key until the unit display turns to “THz”.
Press the < or > key.	Select the input digit.
Press the ∧ or ∨ key.	Set the value.
Press the Enter key.	The pressing this key establishes the setting.

(2) Setting of the output optical wavelength

Operations	Remarks
Press the Prmtr key.	Continue pressing the key until the unit display turns to “nm”.
Press the < or > key.	Select the input digit.
Press the ∧ or ∨ key.	Set the value.
Press the Enter key.	The pressing this key establishes the setting.

One of the digits of the displayed output optical frequency (or wavelength) flickers. This implies that the MT9812B is now in the setting mode. The value of the flickering digit can be changed by pressing either the ∧ or ∨ key, and the flickering digit (which can be inputted) can be changed by pressing either the < or > key.

[When switchable light source is used.]

(1) Switching of the output optical frequency

Operations	Remarks
Press the Prmtr key.	Continue pressing the key until the unit display turns to “THz” or “nm”.
Press the [∧] or [∨] key.	The output optical frequency (or wavelength) is switched by each pressing the key.
Press the Enter key.	The pressing this key establishes the setting.

POINT

You can change the setting of the optical frequency (or wavelength) without pressing the Enter key, but the display continues to flicker. It is therefore recommended that the setting be confirmed by pressing the Enter key and the setting status be completed.

The conversion between the optical frequency and wavelength is executed using the following formula.

$\lambda = c/f$, C = 2.99792458 $\times$ 10^8 m/s (Light velocity in vacuum)

The execution result is displayed after rounding the value at less than the displayed least digit. As a result, the value obtained after the conversion process from optical frequency to wavelength and the one from wavelength to optical frequency may differ.

Example:
192.859 THz $\rightarrow$ 1554.46 nm
1554.46 nm $\rightarrow$ 192.860 THz

4.2.5 Setting ATT

Prmtr

The light source incorporates an attenuator function, which can be set in the range between 0.00 dB and 6.00 dB. The resolution is set at 0.01 dB.

Operations	Remarks
Press the Prmtr key.	Continue pressing the key until the unit display turns to “dB” .
Press the < or > key.	Select the input digit.
Press the ∧ or ∨ key.	Set the value.
Press the Enter key.	The pressing this key establishes the setting.

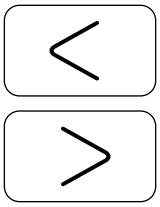
A numerical character constituting one of the digits of the attenuator value shown on the message display flickers to signify that it is currently being set. The numerical character constituting the flickering digit can be changed by pressing the or key. Moreover, the flickering digit (the digit allowed to be input) can be changed by pressing the or key.

POINT

The magnitude of attenuation set by the ATT setting function is merely a guideline and therefore does not guarantee absolute accuracy. Moreover, as this function adjusts the magnitude of attenuation by varying the electric current that drives the LD element, this may cause deviation in the output optical frequency (wavelength). If an absolute magnitude of attenuation is required, use the optical attenuator separately.

The ATT setting has already been modified without pressing the Enter key. However, as the message display remains flickering, it is recommended to press the Enter key to establish the setting and terminate the setting mode.

4.2.6 Viewing Parameter



The details of the parameters set can be viewed (confirmed) without switching the mode to parameter setting.

Operation	Remarks
Press the < or > key.	Pressing the key enables selection of the item to be viewed.

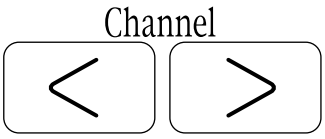
Pressing the > key causes the display to switch as follows.

Output optical frequency (Displayed unit: “THz”) → Output wavelength (Displayed unit: “nm”) → Attenuator set value (Displayed unit: “dB”) → Output optical frequency (Displayed unit: “THz”)

Pressing the < key causes the display to switch in the order reverse to above.

4.3 Optical Sensor Operation

4.3.1 Switching Control Channels



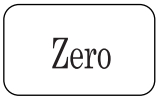
Before setting the parameters on the MT9812B, select the unit to be controlled as described below.

Operation	Remarks
Press the < or > key.	The selected channel is displayed on the number indicator on the left. Press these keys until a desired channel appears.

POINT

"Parameter setting" means the setting each item after pressing the "Prmtr key". Therefore, the optical output ON/OFF and settings on the rear panel can be performed, regardless of the channel selection.

4.3.2 Setting Zero Power Point (for Each Unit)



(* Front of the unit)

This function is used to remove the electrical offset of the light-receive circuit within an optical sensor.
The key, which is illuminated, is located on the front panel of each unit.

(1) Executing of the zero point setting

Operations	Remarks
Attach the light insulation cap to the optical connector.	Use the metal cap attached to this unit for complete light insulation.
Press the Zero key.	During the execution, the parameter display field indicates the "moving 0 (zero) to left and right" to show that the zero setting is being carried out.

Execution of the zero point setting usually takes about 30 seconds.
After the processing is completed normally, the parameter display field returns to the values displayed before the execution of the zero setting.

2) Interrupting of the zero point setting

Operation	Remarks
Press the Zero key.	

POINT

"E-007" is displayed when the zero setting is executed with insufficient light insulation.
After displaying the value, the MT9812B returns to the measurement status. In this case, however, the measurement value (absolute value) may not be correct. Ensure that the metal light insulation cap located on the unit front panel is attached to the optical connector and re-execute the zero setting.

The electrical offset of the light-receive circuit within the optical sensor depends on the ambient temperature and time elapse.
When the light levels less than –40 dBm are to be measured or when a high-precision measurement is to be performed, it is necessary to execute the zero setting just prior to the start of the measurement.

The execution time mentioned above (30 s) is the typical value at room temperature (25 °C). Execution may occasionally take 2 minutes, especially for a high ambient temperature.
When the "0 (zero)" of the seven-segment number moves to the right and left, the execution of zero setting is in progress. Then, you must wait for a while.
If the "0" display does not move, refer to paragraph "7.4 Troubleshooting."

4.3.3 Setting Calibration Wavelength (Optical Frequency)

As the photodetector of the optical sensor of the MT9812B has the wavelength sensitivity characteristics, the sensitivity compensation is required therefore to acquire the correct absolute measured value.
Automatic compensation is carried out in the MT9812B when setting the wavelength (optical frequency) of the light to be measured.

(1) Setting of the optical wavelength to be calibrated

Operations	Remarks
Press the Prmtr key.	Continue pressing the key until the unit display turns to "nm".
Press the [<] or [>] key.	Select the input digit.
Press the [∧] or [∨] key.	Set the value.
Press the Enter key.	The pressing this key establishes the setting.

One of the digits of the displayed calibration wavelength flickers. This implies that the MT9812B is now in the setting mode. The value of the flickering digit can be changed by pressing either the ↑ or ↓ key, and the flickering digit (which can be inputted) can be changed by pressing either the ← or → key.

(2) Setting of the optical frequency to be calibrated

Operations	Remarks
Press the Prmtr key.	Continue pressing the key until the unit display turns to "THz".
Press the [<] or [>] key.	Select the input digit.
Press the [∧] or [∨] key.	Set the value.
Press the Enter key.	The pressing this key establishes the setting.

One of the digits of the displayed calibration optical frequency flickers.
This implies that the system is now in the setting mode.
The value of the flickering digit can be changed by pressing either the [∧] or [∨] key, and the flickering digit (which can be inputted) can be changed by pressing either the [<] or [>] key.

POINT

You can change the setting of the calibration wavelength (optical frequency) without pressing the Enter key, but the display continues to flicker. It is therefore recommended that the setting be confirmed by pressing the Enter key and the setting status be completed.

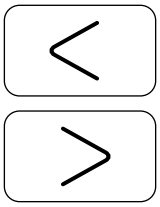
The conversion between the optical frequency and wavelength is executed using the following formula.

$\lambda = c/f$, C = 2.99792458 $\times$ 10^8 m/s (Light velocity in vacuum)

The execution result is displayed after rounding the value at less than the displayed least digit. As a result, the value obtained after the conversion process from optical frequency to wavelength and the value from wavelength to optical frequency may differ.

Example:
192.859 THz → 1554.46 nm
1554.46 nm → 192.860 THz

4.3.4 Reading Parameters



The parameter values can be confirmed without entering the parameter setting status.

Operation	Remarks
Press either the < or > key. Select the parameter item to be read.	

When pressing the > key, the following parameters are sequentially displayed.

Measurement value display (unit: dBm) → Calibration optical frequency (unit: THz) → Calibration wavelength (unit: nm) → Measurement value display (unit: dBm)

When pressing the < key, the parameters are displayed in the reverse order.

Section 5 Remote Control

5.1 Settings

5.1.1 Setting GPIB and RS-232C

Set the 8-pin DIP switches (Fig. 5-1) on the rear panel to use the GPIB or RS-232C.

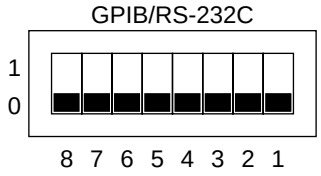


Fig. 5-1

(1) Using GPIB

Pin 8: Set to 1.

Pin 7: Not used. (Even if this pin is set to either 0 or 1, communication is not affected.)

Pin 6: Not used. (Even if this pin is set to either 0 or 1, communication is not affected.)

Pin 5: Specifies the address for 2^4.

Pin 4: Specifies the address for 2^3.

Pin 3: Specifies the address for 2^2.

Pin 2: Specifies the address for 2^1.

Pin 1: Specifies the address for 2^0.

Specify the GPIB address with a binary number in the range of 0 to 30 (decimal number), using the pins 1 to 5.

Fig. 5-2 shows a GPIB address setting example.

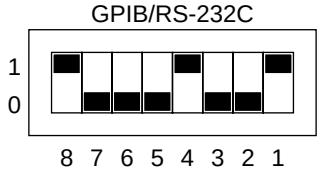


Fig. 5-2 GPIB Address 01001 Setting Example

Address 9 (= $0 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0$)

(2) Using RS-232C

Pin 8: Sets to 0 for RS-232C.

Pin 7: Specifies the bit length. 0: 8 bits, 1: 7 bits

Pin 6: Specifies whether parity is valid or not. 0: Invalid, 1: Valid
When 1 (Valid) is specified, the pin-5 setting becomes valid.

Pin 5: Specifies the parity. 0: Odd, 1: Even

Pin 4: Sets the stop bit. 0: 1 bit, 1: 2 bits

Pin 3: Specifies the speed for S3.

Pin 2: Specifies the speed for S2.

Pin 1: Specifies the speed for S1.

Next table shows the speed setting

Speed (bps)	S3	S2	S1
1200	0	0	0
2400	0	0	1
4800	0	1	0
9600	0	1	1
14400	1	0	0
19200	1	0	1
19200	1	1	0
19200	1	1	1

Fig. 5-3 shows a RS-232C setting example.

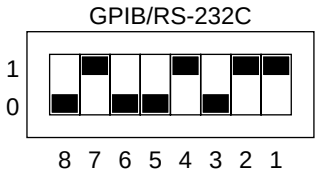


Fig. 5-3 RS-232C Setting Example

RS-232C, 8 bits, no parity, stop bit: 2 bits, 9600 bps

POINT

The changed DIP switch setting becomes valid after the next power on. So, for using the MT9812B with the changed switch setting, turn the power on again.

5.2 Specifications

5.2.1 GPIB Specifications

The GPIB specifications of the MT9812B is compatible with the IEEE488.2. The MT9812B can be controlled as an device from an external controller.
Table 5-1 lists the GPIB interface functions of the MT9812B.

Table 5-1 GPIB interface functions of MT9812B

Specification	Description
SH1	All of source handshake functions are supported.
AH1	All of acceptor handshake functions are supported.
T6	Basic talker functions are supported. A serial port function is supported. A talk-only function is not supported. The function of releasing the talker with MLA is supported.
L4	Basic listener functions are supported. A listen-only function is not supported. The function of releasing the listener by MTA is supported.
SR1	Service request function is supported.
RL1	Remote/local operation selection function is supported.
PP0	A parallel poll function is not supported.
DC1	All of device clear functions are supported.
DT0	A device trigger function is not supported.
C0	A controller function is not supported.

5.2.2 RS-232C Specifications

Table 5-2 shows the RS-232C specifications of the MT9812B.

Table 5-2 RS-232C Specifications of MT9812B

Item	Specifications
Function	Control from external controller
Communication method	Asynchronous (start-stop), half-duplex
Communication control method	No flow control
Baud rate	1200, 2400, 4800, 9600, 14400, 19200 bit/s
Data bits	7 bits, 8 bits
Parity	Odd parity (ODD), even parity (EVEN), non-parity (NON)
Start bits	1 bit
Stop bits	1 bit, 2 bits
Connector	D-sub 9-pin connector, female

When the MT9812B is used with RS-232C, send the carriage return (CR) and the line feed (LF) after command.

5.3 Device Message

The following device messages are commands used commonly for both the GPIB and the RS-232C.
The lowercase letters in the program messages can be omitted.

5.3.1 Commands for Setting Multiple Units

The multiple-unit setting commands can specify the same set value for the multiple units specified in <ch - list>.

MFRame:CATalog

Function

Inquires the inserted unit.

Program message

`MFRame:CATalog?`

Response message

`< uid >< ch - list > {, < uid >< ch - list >}*`

Parameter

`< uid >` := {OPM, OLS}
`< ch - list >` := (@< channel >{,< channel >}*)
`< channel >` := {n|1 ≤ n ≤ 9}

Explanation

This command returns a list of inserted units.
This command is valid for all the channels, and does not return a channel list.
The notification <uid> identifies the following unit.

< uid >	Unit
OPM	Optical sensor unit
OLS	Light source unit

MFRame:POWer:STATe

Function
Sets optical output state.

Program message
```
MFRame:POWer:STATe < sw >, < ch - list >
MFRame:POWer:STATe? < ch - list >
```

Response message
```
< sw > {, < sw >}*
```

Parameter
< sw > := {ON, OFF, 1, 0}
< ch - list > := (@< channel >{,< channel >}*)
< channel > := {n|1 ≤ n ≤ 9}

Explanation
This command turns the optical output on and off.
The response messages are outputted in the order of the channel list.
Example
MFR:POW:STAT 1, (@2, 5, 8)
Turns on the light sources of 2, 5 and 8 channels.

MFRame:POWer:FREQuency

Function
Sets modulation frequency.

Program message
```
MFRame:POWer:FREQuency  CW | < freq > [< unit >], < ch - list >
MFRame:POWer:FREQuency? < ch - list >
```

Response message
```
< freq > {, < freq >}*
```

Parameter
< freq > := {0, 270, 1000, 2000} (Unit: Hz)
< unit > := {HZ, KHZ}
< ch - list > := (@< channel >{,< channel >}*)
< channel > := {n|1 ≤ n ≤ 9}

Explanation
Set the modulation light frequency to either CW or the modulation frequency specified in <freq>. If the units in <freq> are omitted, Hz is used as the unit; or if the unit is defined in <unit>, the defined unit is used. The CW is used when 0 Hz is defined.
The response messages are outputted in Hz unit in the order of the channel list.

MFRame:POWer:WAVelength

Function

Sets optical frequency (wavelength).

Program message

```
MFRame:POWer:WAVelength  < wavelength > [< unit >], < ch - list >
MFRame:POWer:WAVelength? < ch - list >
```

Response message

```
< wavelength > {, < wavelength >}*
```

Parameter

< wavelength > := {f(m)|$380 \times 10^{-9} \leq f \leq 1800 \times 10^{-9}$}
< wavelength > := {f(Hz)|$166.551 \times 10^{12} \leq f \leq 788.927 \times 10^{12}$}
< unit > := {NM, UM, M, HZ}
< ch - list > := (@< channel >{,< channel >}*)
< channel > := {n|$1 \leq n \leq 9$}

Explanation

This command sets the optical frequency (wavelength) to the value specified in <wavelength>. The actual optical frequency (wavelength) setting range and resolution depend on the unit specification. The response messages are outputted in frequency unit at the order of the channel list.

MFRame:FETCh:POWer

Function

Inquiries the measured data.

Program message

```
MFRame:FETCh:POWer? < ch - list >
```

Response message

```
< level > {, < level >}*
```

Parameter

< level > :=< NR3 >
< ch - list > := (@< channel >{,< channel >}*)
< channel > := {n|$1 \leq n \leq 9$}

Explanation

This command returns the currently measured data. It is valid only for the optical sensor unit. The measured data are output in dBm depending on the order of the channel list. (Cannot read the data in W.)
Each optical sensor unit does not measure the data synchronizing with other units. The data of each unit is the latest one at the time of inquiry, that is, they are not the data acquired at the same time.

5.3.2 Commands for Setting Light Source Unit

The light source unit setting commands specify various conditions for one light source unit specified in <n>.

SOURce<n>:AM[:INTerval]:FREQuency

Function

Sets the modulation frequency.

Program message

```
SOURce<n>:AM[:INTerval]:FREQuency  CW | < freq > [< unit >]
SOURce<n>:AM[:INTerval]:FREQuency?
```

Response message

```
< freq >
```

Parameter

`< freq >` := {0, 270, 1000, 2000} (Unit: Hz)
`< unit >` := {HZ, KHZ}

Explanation

This command sets the optical output to CW or the modulation frequency specified in <freq>.
If the unit of <freq> is omitted, Hz is assumed. If the unit is specified in <unit>, it is set in the specified unit. For 0 Hz, CW is set.
The response message is always output in Hz.

SOURce<n>:POWer:ATTenuation

Function

Sets the attenuation.

Program message

```
SOURce<n>:POWer:ATTenuation  < level > [DB]
SOURce<n>:POWer:ATTenuation?
```

Response message

```
< level >
```

Parameter

`< level >` := {f(dB)|0.00 ≤ f ≤ 6.00}

Explanation

This command reduces the optical output from the maximum output level by the value specified in <level>. The setting range and the setting resolution of <level> are dependent on the light source unit. <level> is rounded off to the setting resolution. The attenuation is always output in dB. The unit may be omitted.

SOURce<n>:POWer:STATe

Function
Sets the optical power ON/OFF.

Program message
```
SOURce<n>:POWer:STATe  < sw >
SOURce<n>:POWer:STATe?
```

Response message
```
<status>
```

Parameter
< sw > := {ON, OFF, 1, 0}
< status > := {1, 0}
1 ..... ON
0 ..... OFF

Explanation
This command turns optical power ON/OFF.

SOURce<n>:POWer:WAVelength

Function
Sets the wavelength.

Program message
```
SOURce<n>:POWer:WAVelength
UPPer | LOWer | CENTer | < wavelength > [<unit>]
SOURce<n>:POWer:WAVelength?
```

Response message
```
< wavelength >
```

Parameter
< wavelength > : = {f(m)|$380 \times 10^{-9} \leq f \leq 1800 \times 10^{-9}$}
< wavelength > : = {f(Hz)|$166.551 \times 10^{12} \leq f \leq 788.927 \times 10^{12}$}
< unit > : = {NM, UM, M, Hz}

Explanation
This command sets the wavelength at <wavelength>.
The range and resolution of the wavelength depends on its light source unit. The actual set values are rounded by the resolution.
Whenever the unit is omitted on the program message, the unit is assumed as m. When an unit is added, it is set with the unit.
Response message is output by the unit system (m or Hz) currently set.
Only when the light source with two wavelengths is used, “UPPer” and “LOWer” can be specified on the parameters; which are the wavelengthes of the longer and the shorter sides, respectively.
Even if the wavelength is set either with “UPPer” or “LOWer” wavelength, the response message returns the value for the longer wavelength or the shorter wavelength.
Only when a DFB-LD light source is used, “CENTer” wavelength can be specified on the parameter. In this case, set the wavelength at the center of the wavelength.

SOURce<n>:POWer:WAVelength:UNIT

Function

Sets the display unit of wavelength.

Program message

```
SOURce<n>:POWer:WAVelength:UNIT  < unit >
SOURce<n>:POWer:WAVelength:UNIT?
```

Response message

```
< unit >
```

Parameter

`< unit >` := {M, HZ}

Explanation

This command switches the display unit of wavelength.

SOURce<n>:MEMory:COPY[:NAME]

Function

Initializes the measuring condition of light source unit.

Program message

```
SOURce<n>:MEMory:COPY[:NAME]  0, MC
```

Explanation

This command returns the measuring condition of the light source unit to the status at the shipment.

POINT

The MT9812B is not provided with the measuring-condition saving function, but units are initialized by the same message (reading out the contents in memory "0") as that used in the Optical Test Set MT9810A.

5.3.3 Commands for Setting Optical Sensor Unit

Using the optical sensor unit setting commands, the setting is made for the optical sensor unit specified by <n>.

SENSe<n>:CORRection:COLLect:ZERO

Function

Executes offset.

Program message

```
SENSe<n>:CORRection:COLLect:ZERO
SENSe<n>:CORRection:COLLect:ZERO?
```

Response message

```
< result >
```

Parameter

`< result >` :=< NR1 >

Explanation

This command executes offset processing. The response message has one of the following values. See “SYSTem:ERRor” for information on error codes.

< result >	Status
0	Normal termination
1	Offset processing not executed by remote control.
2	Offset processing in progress
Negative number	Error

SENSe<n>:POWer:RANGe:AUTO

Function

Sets autorange.

Program message

```
SENSe<n>:POWer:RANGe:AUTO  < sw >
SENSe<n>:POWer:RANGe:AUTO?
```

Response message

```
< status >
```

Parameter

`< sw >` := {ON, OFF, 1, 0}

`< status >` := {1, 0}

Explanation

Switches the measuring range between “AUTO range” and “MANUAL range.” Two modes are provided for the measuring range of the optical sensor; one is “AUTO range” which automatically changes the measuring range depending on the input optical level, and the other is “MANUAL range” which measures in an arbitrary specified fixed range.

“AUTO range” is set when the parameter is “ON” or “1”, and “MANUAL range” is set when it is “OFF” or “0.”

When the “MANUAL range” mode is used, specify the range using “SENSe<n>: POWer:RANGe[:UPPer].”

POINT

It is recommended that measurements be carried out in the “AUTO range” mode, when the optical level to be measured is unknown or varies significantly (by 10 dB or higher). On the other hand, when the optical level to be measured is known and I-L measurements are to be performed, it is recommended that measurements be made in the “MANUAL range” mode by fixing the measuring range.

SENSe<n>:POWer:RANGe[:UPPer]

Function

Sets manual range.

Program message

```
SENSe<n>:POWer:RANGe[:UPPer]  < level > [DBM]
SENSe<n>:POWer:RANGe[:UPPer]?
```

Response message

```
< level >
```

Parameter

`< level >` := {30, 20, 10, 0, –10, –20, –30, –40, –50, –60, –70, –80, –90, –100, –110}

Explanation

This command executes measurements in the fixed <level> measuring range when the "MANUAL range" mode is set in the "SENSe<n>:POWer:RANGe :AUTO" setting. The units are "DBM" only or the units can be omitted.

POINT

- **In the case of "AUTO range" mode, a certain time lag is unavoidable for switching the range. It is therefore recommended that the measurements be made in the "MANUAL range" mode when the optical level to be measured is roughly known or the variation of its level is not significant (2 to 3 dB).**
- **When you switch from "AUTO range" mode to "MANUAL range" mode, the measuring range becomes the last range of the "AUTO range", and not that of "MANUAL range" which was set previously.**
- **The <level> depends on the "optical power measuring range" of the unit currently in use and the bandwidth that is set in "SENSe<n>:BANDwidth." It may not be possible to set some <level> values in a unit. Refer to paragraph "2.2 Specifications" and descriptions of bandwidth setting for the range of each unit currently in use.**

SENSe<n>:POWer:WAVelength

Function
Sets wavelength.

Program message
```
SENSe<n>:POWer:WAVelength  < wavelength > [< unit >]
SENSe<n>:POWer:WAVelength?
```

Response message
```
< wavelength >
```

Parameter
< wavelength > := {f(m)|$380 \times 10^{-9} \leq f \leq 1800 \times 10^{-9}$}
< wavelength > := {f(Hz)|$166.551 \times 10^{12} \leq f \leq 788.927 \times 10^{12}$}
< unit > := {NM, UM, M, HZ}

Explanation
This command sets wavelength (or light frequency) correction at the <wavelength> value. When the units are omitted in the Program message, they are considered as an m value. The response message is output in the unit value that is set at "SENSe<n>:POWer:WAVelength:UNIT."
When the unit is m, all the data are output with M.

POINT

The <wavelength> value depends on the "range of wavelength" of the unit currently in use. It may not be possible to set a value to <wavelength > in some units. Refer to paragraph "2.2 Specifications" for the wavelength range of the unit currently in use.

SENSe<n>:POWer:WAVelength:UNIT

Function
Sets the wavelength display unit.

Program message
```
SENSe<n>:POWer:WAVelength:UNIT  < unit >
SENSe<n>:POWer:WAVelength:UNIT?
```

Response message
```
< unit >
```

Parameter
< unit > := {M, HZ}

Explanation
Switches the display unit of the calibration wavelength (or light frequency) to the wavelength or the light frequency.

FETCh<n>[:SCALar]:POWer[:DC]

Function

Inquiries the measured data.

Program message

```
FETCh<n>[:SCALar]:POWer[:DC]?
```

Response message

```
< level >
```

Parameter

`< level >` :=< NR3 >

Explanation

This command returns the latest data measured at the time of issuing the message. The response message is output in the unit value that is set in "SENSe<n>: POWer:UNIT"

SENSe<n>:POWer:UNIT

Function

Switches the readout-data unit system.

Program message

```
SENSe<n>:POWer:UNIT  < unit >
SENSe<n>:POWer:UNIT?
```

Response message

```
< unit >
```

Parameter

`< unit >` := {DBM, W}

Explanation

Switches the unit of the response to "FETCH<n>[:SCALar]:POWer[:DC]?."

POINT

This command switches only the units of the response message. The unit display on the front panel of the MT9812B remains "dBm." In addition, the unit of the response message to "MFRame:FETCh:POWer? <ch-list>" also remains "dBm."

SENSe<n>:AVERage:COUNt

Function
Sets the number of averagings.

Program message
```
SENSe<n>:AVERage:COUNt  < count >
SENSe<n>:AVERage:COUNt?
```

Response message
```
< count >
```

Parameter
< count > := {1, 2, 5, 10, 20, 50, 100, 200, 500, 1000}

Explanation
This command sets the number of averagings for a averaging processing. When the measured light contains noise components, the S/N ratio can be improved by the averaging processing.
When “1” is set in the <count>, the averaging processing is stopped.

SENSe<n>:BANDwidth:AUTO

Function
Sets the light-receive bandwidth.

Program message
```
SENSe<n>:BANDwidth:AUTO  < sw >
SENSe<n>:BANDwidth:AUTO?
```

Response message
```
< status >
```

Parameter
< sw > := {ON, OFF, 1, 0}
< status > := {1, 0}

Explanation
This command switches whether or not the automatic setting of light-receive-circuit bandwidth is enabled.

The MT9812B switches the measuring level range between “AUTO range” and “MANUAL range.”
The measuring range of the optical sensor unit is provided with two modes; one is “AUTO range” which automatically changes the measuring range in accordance with the input optical level, and the other is “MANUAL range” which measures in an arbitrary specified fixed range.
“AUTO range” is set when the parameter is “ON” or “1”, and “MANUAL range” is set when it is “OFF” or “0.”
When using in “MANUAL range” mode, specify the bandwidth using “SENSe <n>:BANDwidth.”

SENSe<n>:BANDwidth

Function
Sets the bandwidth.

Program message
```
SENSe<n>:BANDwidth  < bw > [< unit >]
SENSe<n>:BANDwidth?
```

Response message
```
< bw >
```

Parameter
< bw > := {0.1, 1, 10, 100, 1000, 10000, 100000} (Unit: Hz)
< unit > := {HZ, KHZ}

Explanation
This command sets the bandwidth to the value specified by <bw>.
In the Program message, the value in Hz or in kHz can be set. However, the response message value is only in Hz unit.

The bandwidth which can be set is different depending on the optical sensor in use. The bandwidth is also restricted in "MANUAL RANGE" Mode.
In the following table, the combinations of the measuring range and bandwidth which are marked with an × cannot be set. Set only the combinations which are marked with a ○.
When the bandwidth is increased while keeping the level range fixed (moving to the right in the table below), and the combination becomes ×; then the level range is changed automatically to a level range which is marked with ○.

Example: In the case of MU931421A, set the range to –70 dBm. However, when the bandwidth is changed from 100 Hz to 1 kHz, the range is automatically changed to –50 dBm.

Table 5-3 Combinations of Measuring Range and Bandwidth for MU931421A

Range	0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz
+10 to 0 dBm	○	○	○	○	○	○
0 to –10 dBm	○	○	○	○	○	○
–10 to –20 dBm	○	○	○	○	○	○
–20 to –30 dBm	○	○	○	○	○	○
–30 to –40 dBm	○	○	○	○	○	○
–40 to –50 dBm	○	○	○	○	○	○
–50 to –60 dBm	○	○	○	○	○	×
–60 to –70 dBm	○	○	○	○	×	×
–70 to –80 dBm	○	○	○	○	×	×

Table 5-4 Combinations of Measuring Range and Bandwidth for MU931311A

Range	0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz
+10 to 0 dBm	○	○	○	○	○	○	○
0 to –10 dBm	○	○	○	○	○	○	○
–10 to –20 dBm	○	○	○	○	○	○	○
–20 to –30 dBm	○	○	○	○	○	○	○
–30 to –40 dBm	○	○	○	○	○	○	○
–40 to –50 dBm	○	○	○	○	○	○	○
–50 to –60 dBm	○	○	○	○	○	○	×
–60 to –70 dBm	○	○	○	○	○	×	×
–70 to –80 dBm	○	○	○	○	×	×	×
–80 to –90 dBm	○	○	×	×	×	×	×
–90 to –110 dBm	○	○	×	×	×	×	×

HINT

It is recommended that ordinarily the bandwidth setting be selected as "AUTO." When using the MT9812B with an arbitrary specified fixed bandwidth, the measurement value can contain some error.

SENSe<n>:FILTer:BPASs:FREQuency

Function

Sets the modulation frequency.

Program message

```
SENSe<n>:FILTer:BPASs:FREQuency  CW | < freq > [< unit >]
SENSe<n>:FILTer:BPASs:FREQuency?
```

Response message

```
< freq >
```

Parameter

`< freq >` := {0, 270, 1000, 2000} (Unit: Hz)

`< unit >` := {HZ, KHZ}

Explanation

This command sets the modulation frequency of the incident light to be measured. When the units of the <freq> are omitted, they are set in Hz unit. When the units are specified with the value of the <unit>, it is set in the specified one.

For 0 Hz, it is set as CW.

In the Program message, the value in either Hz or kHz can be set. But the response message value is output only in Hz unit.

SENSe<n>:POWer:INTerval

Function
Sets the measuring interval.

Program message
```
SENSe<n>:POWer:INTerval  < time >
SENSe<n>:POWer:INTerval?
```

Response message
```
SENSE<n>:POWER:INTERVAL  < time >
```

Parameter
`< time >` := {f|0:001 ≤ f ≤ 359999}

Explanation
This command sets the measuring interval.
The interval can be set as 0.001 s (1 ms), 0.01 s (10 ms), 0.02 s (20 ms), 0.05 s (50 ms), 0.1 s (100 ms), 0.2 s (200 ms), 0.5 s (500 ms), or a value between 1 s and 359,999 s with 1 s resolution.
The <time> is set in units of seconds and rounded off by the resolution.

POINT

The MT9812B does not support the data read-out function for a measuring interval of 100 ms or shorter. So, the measuring interval between 1 ms and 50 ms for the optical sensor unit can be set, but the measured value may not be read-out, correctly. When using the optical sensor unit in the MT9812B, set the measuring interval to 100 ms or longer.

SENSe<n>:MEMory:COPY[:NAME]

Function
Initializes the measuring condition of optical sensor unit.

Program message
```
SENSe<n>:MEMory:COPY[:NAME]  0, MC
```

Explanation
This command returns the measuring condition of the optical sensor unit to the status at the shipment.

POINT

The MT9812B is not provided with the measuring-condition saving function, but units are initialized by the same message (reading out the contents in memory "0") as that used in the Optical Test Set MT9810A.

5.3.4 Commands for Setting MT9812B

The setting MT9812B commands sets the necessary conditions of the MT9812B, separately from the unit settings, when using the remote control.

SYSTem:ERRor

Function

Inquires the error value.

Program message

`SYSTem:ERRor?`

Response message

`< code >`

Explanation

The MT9812B supports the following messages.

1. Command errors [-100 to -199]
   The error codes [-100 to -199] indicate the occurrence of syntax errors in IEEE 488.2. At this time, bit 5 in the event status register is set.
   These errors are issued if any of the following events occur.
   - The device received a message against the IEEE 488.2 standard.
   - The device received a header that does not conform to the regulation of the device specific commands or the common commands.
   - GET (Group Execute Trigger) was sent to a program message.

Code	Message	Error detecting condition
-101	Invalid character	Invalid characters are included in the header or parameter.
-104	Data type error	The parameter type is different from that of the specified type.
-105	GET not allowed	GET (Group Execute Trigger) was sent to a program message.
-108	Parameter not allowed	The number of parameters is larger than the specified number.
-112	Program mnemonic too long	The program mnemonic consists of more than 12 characters.
-113	Undefined header	Though the syntax of the header is correct, it is not defined in the device.
-120	Numeric data error	There is an error in the numeric data.
-121	Invalid character in number	An invalid character is included in the numeric data.
-130	Suffix error	There is an error in the suffix.
-144	Character data too long	The character data consists of more than 12 characters.

2. Execution time error [-200 to -299]

The error codes [-200 to -299] indicate the occurrence of errors in the execution control unit of the device. If an error of this type occurs, bit 4 in the event status register is set.

These errors are issued if any of the following events occur.

- <PROGRAM DATA> following the header is out of the regulation of the device.
- The program message cannot be executed due to the state of the device.

Code	Message	Error detecting condition
-220	Parameter error	There is an error in the parameter.
-221	Setting conflict	Though the parameter is correct, it cannot be executed due to the state of the device.
-222	Data out of range	The numeric data is out of the regulation of the device.
-224	Illegal parameter value	The received parameters is illegal.
-240	Hardware error	The command cannot be executed due to the hardware failure.

3. Device specific error [-300 to -399]

The error codes [-300 to -399] indicate the occurrence of errors other than command, query, and execution errors. These errors include the failure of hardware/firmware and self-diagnosis errors.

If an error of this type occurs, bit 3 in the event status register is set.

Code	Message	Error detecting condition
-310	System error	An error occurred in the system.
-315	Configuration memory error	Resume memory is lost.
-350	Queue overflow	There was an abnormality in self-diagnosis.

4. Query error [-400 to -499]

The error codes [-400 to -499] indicate the occurrence of errors concerning the message exchange control protocol in the output queue control. If an error of this type occurs, bit 2 in the event status register is set.

These errors are issued if any of the following events occur.

- Reading is executed from the output queue when there is no output.
- The data in the output queue is lost.

Code	Message	Error detecting condition
-410	Query interrupted	Before the device completes the transmission of the response message, an interrupt by a new command occurred.
-420	Query unterminated	No query corresponding to the response message to be read is sent.
-430	Query deadlocked	An attempt is made to buffer the data exceeding the free area in the storage.

SYStem:COMMunicate:GPIB:HEAD

Function
Sets the addition of header.

Program message
```
SYSTem:COMMunicate:GPIB:HEAD  < flag >
SYSTem:COMMunicate:GPIB:HEAD?
```

Response message
```
SYSTEM:COMMUNICATE:GPIB:HEAD  < status >
```

Parameter
< flag > := {ON, OFF, 1, 0}
< status > := {1, 0}
1 ..... ON
0 ..... OFF

Explanation
Sets whether the header is appended at the response message, or not.
For the default value, the header is not appended.
There are the same setting items at GPIB and Serial (namely, System: COMMunicate:GPIB:HEAD and System:COMMunicate:SERial:HEAD), and these are dependent on each another. When the one is set, the another is set to the same.

SYStem:COMMunicate:SERial:HEAD

Function
Sets the addition of header.

Program message
```
SYSTem:COMMunicate:SERial:HEAD  < flag >
SYSTem:COMMunicate:SERial:HEAD?
```

Response message
```
SYSTEM:COMMUNICATE:SERIAL:HEAD  < status >
```

Parameter
< flag > := {ON, OFF, 1, 0}
< status > := {1, 0}
1 ..... ON
0 ..... OFF

Explanation
Sets whether the header is appended at the response message, or not.
For the default value, the header is not appended.
There are the same setting items at GPIB and Serial (namely, System: COMMunicate:GPIB:HEAD and System:COMMunicate:SERial:HEAD), and these are dependent on each another. When the one is set, the another is set to the same.

5.4 IEEE 488.2 Standard Status Model

The diagram shown below is the standard model of the status data structure specified by IEEE 488.2.

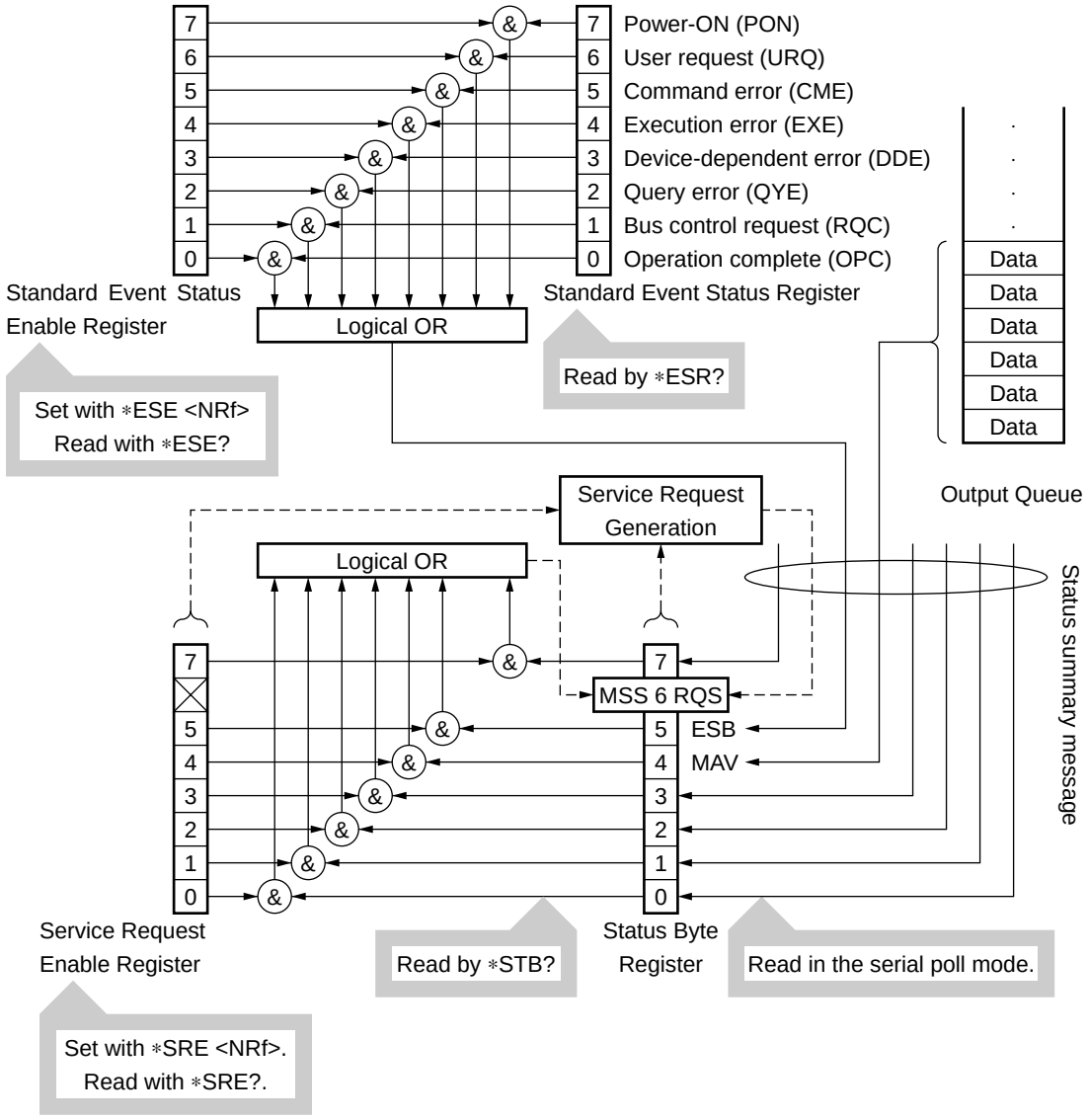


Fig. 5-4 Standard status model

The status model uses an IEEE 488.1 status byte. This status byte consists of seven summary message bits provided by the status data structure. To generate these summary message bits, the status data structure is comprised of two models: a register model and a queue model.

Register model

A pair of registers used to record an event that a device has encountered and a condition. It consists of an event status register and an event status enable register. When the results of ANDing the values of bits of these registers is not 0, the corresponding status register bits are set to 1s. In other cases, the corresponding status register bits are set to 0s. If the result of ORing the values of status register bits is 1, the summary message bit is set to 1. If the result of ORing these bits is 0, the summary message bit is set to 0.

Queue model

A data structure in which status values or information are removed in the same order of which those were entered. Only when the queue structure contains data, the corresponding bit is set to 1. If it is empty, the corresponding bit is set to 0.
Based on the concept of the above register model and queue model, the IEEE 488.2 standard status model is constructed from two types of register models and a queue model.

(1) Standard event status register and standard event status enable register

This register has the register model structure mentioned above. It has eight bits corresponding to eight standard events listed below encountered by the device.

(a) power on
(b) user request
(c) command error
(d) execution error
(e) device dependent error
(f) query error
(g) bus control request
(h) operation complete.

The result of logical OR is output to the status byte register bit 5 (DIO 4) as an event status bit (ESB) summary message.

(2) Status byte (STB) register and service request enable (SRE) register

The status byte register consists of an RQS bit and seven summary message bits for setting status summary messages from the status data structure. It is used in combination with a service request enable register. When the result of ORing the values of these two registers is 0, the SRQ is set ON. In this case, the status byte register bit "DIO 7" is reserved by the system as an RSQ bit, so this bit indicates to an external controller that a service request exists. The function of the SRQ conforms to IEEE 488.1.

(3) Output queue

This queue has the queue model structure mentioned above. Its contents are summarized and transferred to the status byte register bit 4 (DIO 5) as a MAV (message available) summary message.

5.5 Status Byte Register

The status byte register consists of device STB and RQS (or MSS) messages. IEEE 488.1 defines the method of reporting STB and RQS messages, but it does not define the setting and clearing protocols and STB meaning. IEEE 488.2 defines device status summary messages and MSS transferred to bit 6 along with an STB in response to the ∗STB? common query.

5.5.1 ESB and MAV Summary Message

The followings are the explanations of an ESB summary message and an MAV summary message.

(1) ESB summary message

The ESB (event summary bit) summary message is defined by IEEE 488.2. It appears in status byte register bit 5. This bit indicates whether one or more IEEE 488.2 defined events have occurred, with the service request enable register set to allow events to occur, after the standard event status register was read or cleared last. The ESB summary message bit becomes True when at least one event registered in the standard event status register becomes True with event occurrence enabled. Conversely, the ESB summary bit becomes False when none of the registered events has occurred even if event occurrence is enabled.

(2) MAV summary message

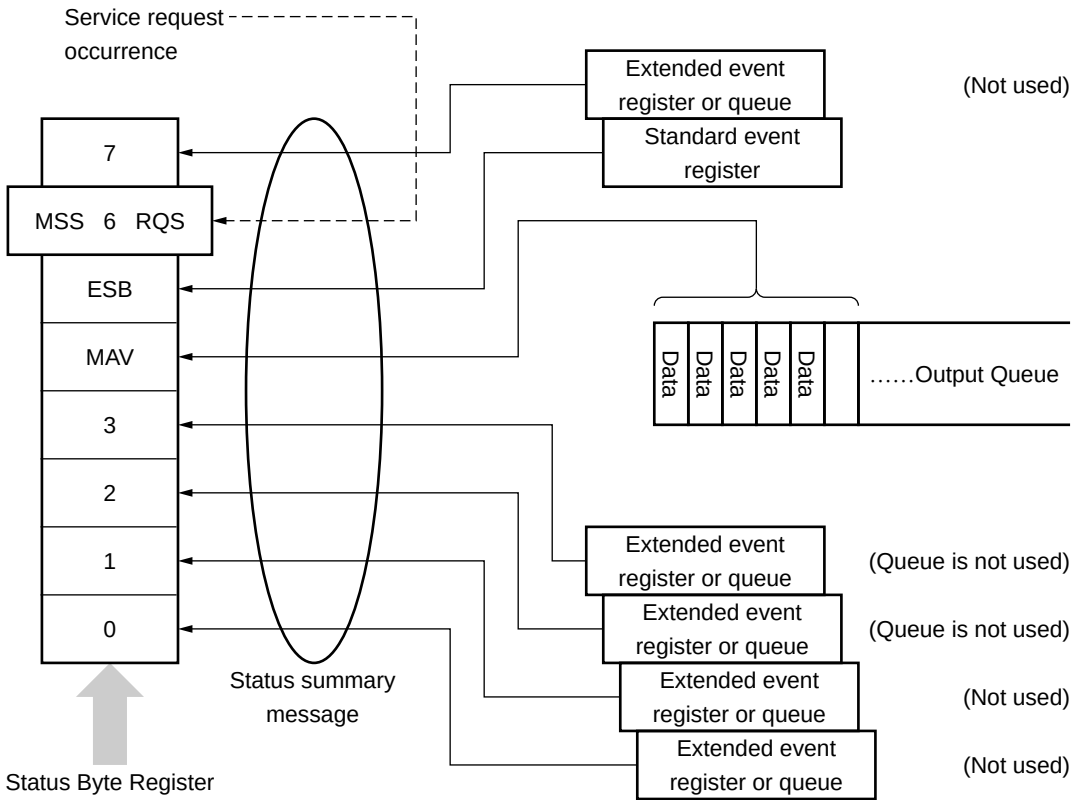
The MAV (message available) summary message is defined by IEEE 488.2. It appears in status byte register bit 4. This bit indicates whether the output queue is empty. When a device is ready for accepting response messages from the controller, the MAV summary message bit becomes 1 (True). When the output queue is empty, this bit becomes 0 (False). This message is used to synchronize information exchange with the controller. For example, the controller can send a query message to the device and wait for the MAV to become True. The controller can perform another processing while waiting for a response from the device. If the controller has started reading the output queue without checking the MAV, all system bus operations are suspended until a response is received from the device.

5.5.2 Device Dependent Summary Message

IEEE 488.2 does not define whether status register bit 7 (DIO 8) and bit 3 (DIO 4) to bit 0 (DIO 1) are used as status register summary bits or the bits indicating existence of data in the queue. Accordingly, these bits can be used as device dependent summary message bits.

Device dependent summary messages have a register model or queue model status data structure. This status register is a pair of registers used to report events and states in parallel or a queue used to report states and information sequentially. The summary bit provides a summary of the current status of the corresponding status data structure. For the register model, the summary message bit becomes True when one or more events have become True with occurrence of events enabled. For the queue model, the summary message bit becomes True when the queue is not empty.

In the MT9810A, bit 1 and bit 0 are unused, and bits 3 and 7 are used as summary bits of the status register; bit 2 is allocated to the queue as shown in the following diagram. Therefore, there are four types (two types for extension) of register models and there are two types (one type for extension) of queue models.



5.5.3 Reading and Clearing the Status Byte Register

Status byte register contents can be read using serial polling or an ∗STB? common inquiry. IEEE 488.1 defined STB messages can be read by either method, but the value transferred to bit 6 (position) varies depending on the method.
status byte register contents can be cleared using a ∗CLS command.

(1) Reading the status byte register using serial polling (only when a GPIB interface bus is used)

When IEEE 488.1 defined serial polling is carried out, the device must return a 7 bit status byte and IEEE 488.1 defined RQS message bit. According to IEEE 488.1, the RQS message indicates whether the device has issued SRQs in the True state. The status byte value is not affected by serial polling. Immediately after being polled, the device must set the rsv message in the False state. If the device is polled again before a cause of issuing a new service request occurs, the RQS message has already been set in the False state.

(2) Reading the status byte register using an ∗STB? common query

The ∗STB? common query causes the device to output status byte register contents and one <NR1 NUMERIC RESPONSE DATA> from the MSS summary message. The response is the total of the status register value assigned binary weights and MSS summary message value. Status byte register bits 0 to 5 and 7 are assigned weighs 1, 2, 4, 8, 16, 32, and 128 respectively, and the MSS is assigned weights 64. The response to the ∗STB? is the same as that to serial polling with the exception that an MSS summary message appears in bit 6 instead of an RQS message.

(3) Definition of MSS (Master Summary Status)

The MSS indicates that the device has at least one cause of issuing a service request. In the device's response to the ∗STB? query, the MSS message appears in bit 6. However, it does not appear in the response to serial polling. It must not be regarded as part of the IEEE 488.1 defined status byte. The MSS is the result of ORing the values of status byte register and SRQ enable (SRE) register bits totally. Specifically, the MSS is defined as follows:

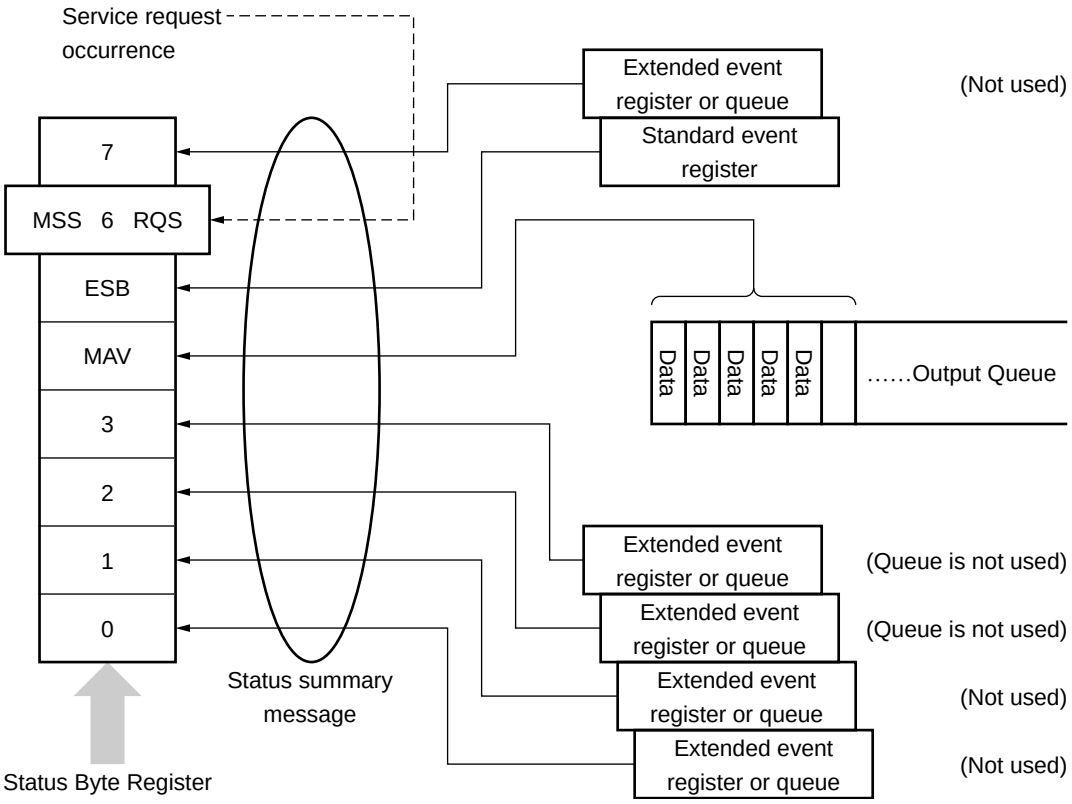
(STB Register bit 0 AND SRE Register bit 0)
OR
(STB Register bit 1 AND SRE Register bit 1)
OR
:
:
(STB Register bit 5 AND SRE Register bit 5)
OR
(STB Register bit 7 AND SRE Register bit 7)

In the definition of the MSS, the values of bits 6 of the status byte register and SRQ enable register are ignored. Accordingly, when calculating the MSS value, the status byte may be handled assuming that it is represented by 8 bits and bit 6 is always 0.

(4) Clearing the status byte register using a ∗CLS common command

The ∗CLS common command clears all status structures, except the output queue and MAV summary message (i.e., event registers and queues), and the corresponding summary messages.

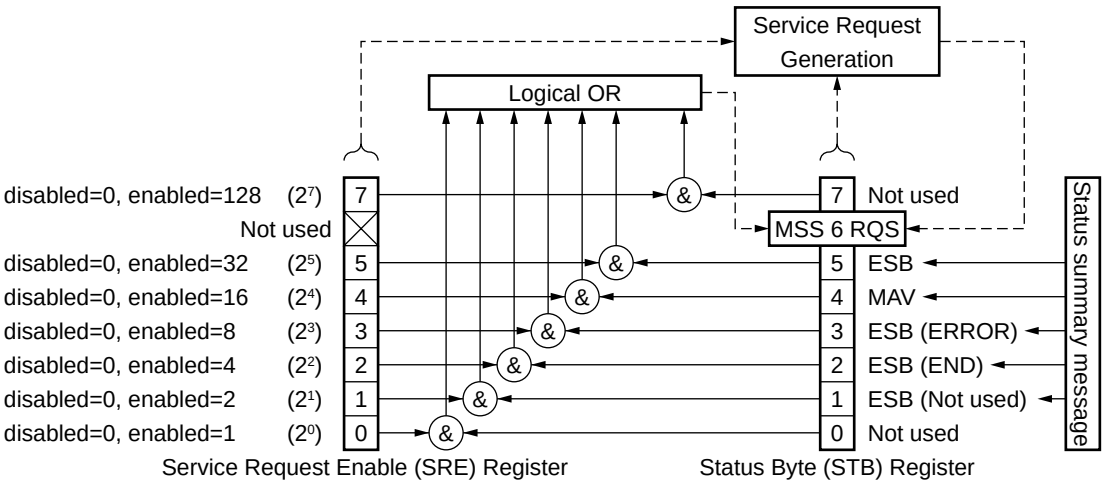
Issuing a ∗CLS command after the <PROGRAM MESSAGE TERMINATOR> element or before the <Query MESSAGE UNIT> element clears all status bytes. With this method, all unread messages in the output queue are cleared and the MAV message becomes False. When replying to the ∗STB?, the MSS message becomes False, too. Values of enable registers are not affected by ∗CLS.



5.6 Enabling the SRQ

Enabling the SRQ allows a summary message in the status byte register to be selected in response to a service request. The service request enable (SRE) register shown below can be used to select a summary message.

Bits of the service request enable register correspond to the bits of the status byte (STB) register. When 1 is set in a status byte bit corresponding to a significant bit of the service request enable register, the devices sets the RQS bit to 1 and issues a service request to the controller. For example, when bit 4 of the service request enable register is set (enabled) in advance, a service request can be issued to the controller each time the MAV bit is set to 1 (if the output queue has data).



(1) Reading the service request enable register

service request enable register contents can be read using an ∗SRE? common inquiry. The response message to this query is <NR1 NUMERIC RESPONSE DATA>, an integer ranging from 0 to 255. It is a total of values of the service request enable register. Service request enable register bits 0 to 5 and 7 are assigned weights 1, 2, 4, 8, 16, 32, and 128, respectively. Unused bit 6 must always be 0.

(2) Updating the service request enable register

The service request enable register is written using an ∗SRE common command. The ∗SRE common instruction is followed by a <DECIMAL NUMERIC PROGRAM DATA> element. <DECIMAL NUMERIC PROGRAM DATA> is rounded to an integer. It is represented in binary notation using a base 2, indicating the total of values of service request enable register bits (weight value). When the value of this bit is 1, it indicates the enabled state. When the value of this bit is 0, it indicates the disabled state. The value of bit 6 must always be ignored.

(3) Clearing the service request enable register

The service request enable register can be cleared by executing an ∗SRE common command or turning on the power.

When an ∗SRE common command is used, the service request enable register can be cleared by bringing the <DECIMAL NUMERIC PROGRAM DATA> element value to 0. Clearing the service request enable register disables the status information to generate an rsv local message, suppressing issue of a service request.

When the power is turned on, the service request enable register is cleared if the Power-ON status clear flag is True and the ∗PSC command for disabling clearing of this register is not supported.

5.7 Standard Event Status Register

5.7.1 Definition of Standard Event Status Register Bits

Any device conforming to IEEE 488.2 must have the standard event status register. Operation of the standard event register model is shown below, and the meaning of standard event status register bits given in IEEE 488.2 is explained in the Table 5-5.

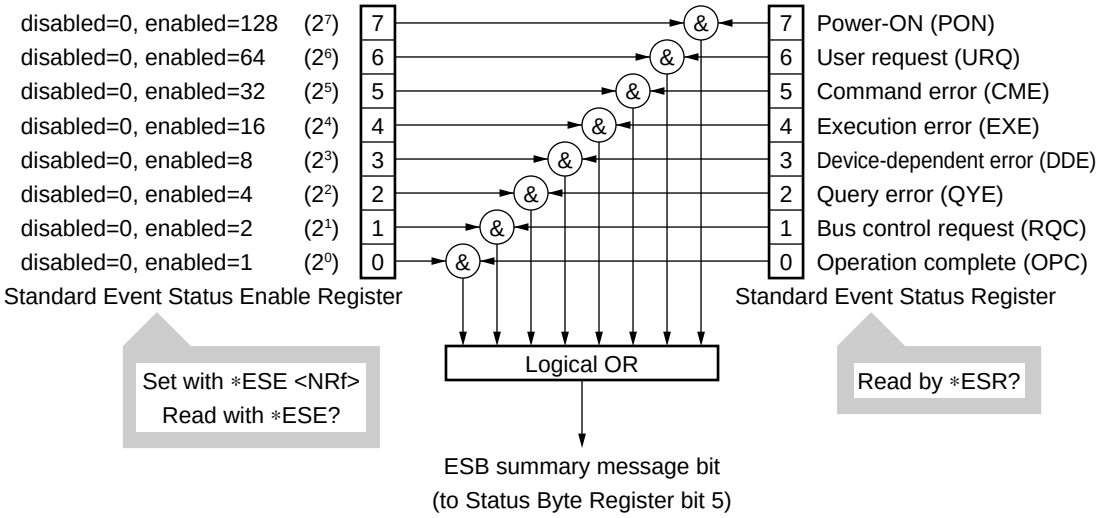


Table 5-5

Bit	Event name	Description
7	Power-ON (PON)	The power has been turned ON.
6	User request (URQ)	Local control is requested. This bit is set irrespective of the remote/local state of the device. Since this bit is not supported by MT9810A, it is always 0.
5	Command error (CME)	A program message including a syntax error or a misspelled command has been received or a GET command has been received in a program message.
4	Execution error (EXE)	A program message which is syntactically correct but cannot be executed has been received.
3	Device-dependent error (DDE)	An error other than CME, EXE, and QYE has occurred.
2	Query error (QYE)	An attempt was made to read data from the output queue while it has no data, or the data in the output queue has been lost due to overflow, etc.
1	Request control (RQC)	The device is required to be an active controller. Since this bit is not used by MT9810A, it is always 0.
0	Operation complete (OPC)	The device has completed the specified pending operation and ready for receiving a new instruction. This bit responds only to the ∗OPC command and sets the operation complete bit.

5.7.2 Details on Query Errors

Table 5-6

No.	Item	Description
1	Incomplete program message	When a device receives an MTA from the controller before receiving a program message terminator, it discards the incomplete message which has been received so far and waits for the next program message. To discard the incomplete program message, the device clears the input/output buffer, reports a query error to the status report part, and sets the standard status register bit 2 (query error bit).
2	Interruption of response message output	When a device receives an MLA from the controller before completing output of a response message terminator, it automatically interrupts output of the response message and waits for a next program message. To interrupt output of the response message, the device clears the input/output buffer, reports a query error to the status report part, and sets the standard status register bit 2 (query error bit).
3	When the next program message is sent without reading a response message	When the device cannot output a response message because the controller has output a program message (including a query message) and the next program message in succession, the device discards the response message and waits for the next program message. A query error is reported to the status report part like item No. 2.
4	Output queue overflow	When a program message containing many query messages is executed one after another, too many response messages to be stored in the output queue (256 bytes) may be generated. If more query messages are input and the response messages to queries must be output, the output queue overflows. When this happens, the device clears the output queue and resets the response message generation part. The device also sets the standard event status register bit 2 (query error bit) in the status report part.

5.7.3 Reading, Writing, and Clearing the Standard Event Status Register

Table 5-7

Read	This register is read destructively in response to the ∗ESR? common command. In other words, this register is cleared after being read. The event bit assigned binary weights and converted to a decimal value <NR1> is the response message.
Write	This register cannot be written externally; however, it can be cleared.
Clearing	This register is cleared in the following cases: (1) A ∗CLS command is received. (2) The power is turned on if the Power-ON status clear flag is True. The device executing a Power-ON sequence first clears the standard event status register, then records the events that have occurred in this sequence (e.g., PON event bit setting). (3) An event is read in response to an ∗ESR? query command.

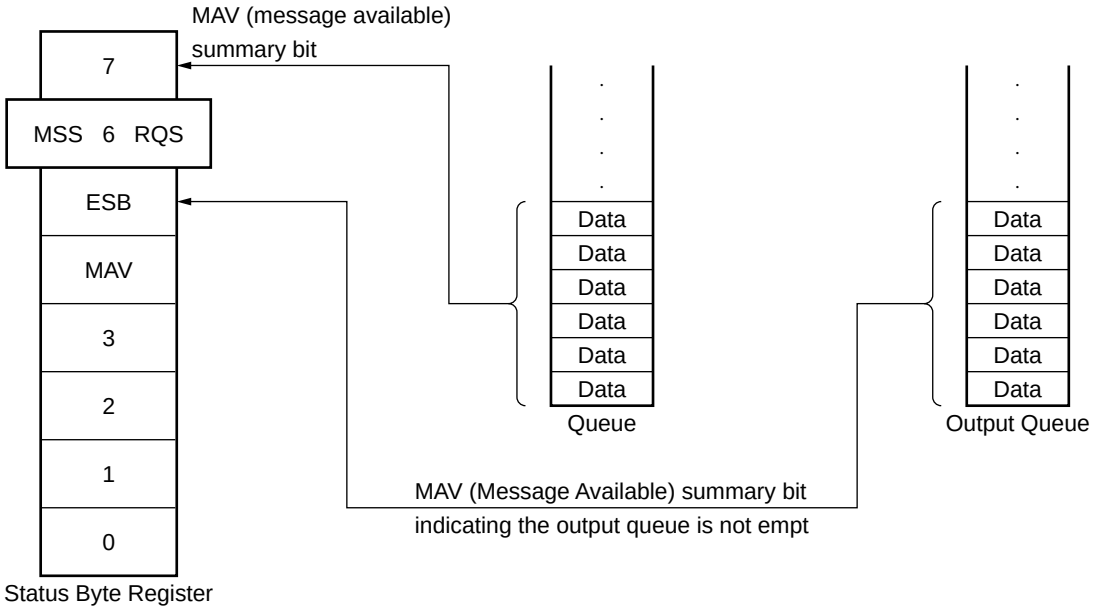
5.7.4 Reading, Writing, and Clearing the Standard Event Status Enable Register

Table 5-8

Read	This register is read non-destructively in response to the ∗ESR? common command. In other words, this register is not cleared after being read. The response message is assigned binary weights, converted from a binary value to a decimal value <NR1>, and returned.
Write	This register is written using an ∗ESS common command. Register bits 0 to 8 are assigned weights 1, 2, 4, 8, 16, 32, 64, and 128 respectively, so a total of values of the desired write data bits is sent as <DECIMAL NUMERIC PROGRAM DATA>.
Clearing	This register is cleared in the following cases: (1) An ∗ESE command with its data value being 0 is received. (2) The power is turned on with the Power-ON status clear flag in the True state or the power is turned on when a ∗PSC command is not supported. The standard event status register is not affected by the following: (1) Change in the state of the IEEE 488.1-defined device clear function (2) Reception of an ∗RST common command (3) Reception of a ∗CLS common command

5.8 Queue Model

The right-hand side of the figure below shows a queue model having a status data structure. A queue is a data structure in which data is arranged sequentially, providing information such as sequential status. A summary message indicates that such information exists in the queue. Queue contents are read by an handshake when the device is in TACS (talker active state).



The queue that outputs an MAV summary bit to status byte register bit 4 is called an "output queue." This queue is mandatory. The queue that can output an MAV summary message to one of status byte register bits 0 to 3 and 7 is simply called a "queue." It is optional. A summary message from the register model can also be output to status byte register bits 0 to 3 and 7, so the summary message type depends on the device type.

Refer to the Table 8-5 for a comparison of the output queue to general queues.

Table 5-9 Comparison of Output Queue to General Queues

Item	Output queue	Queue
Data input/output type	FIFO type	Not necessary to be FIFO type
Read	Response message units are read using only an IEEE 488.2 message exchange protocol. The type of these response message units depends on the query type.	Response message units are read with device-dependent query commands. These response message units must be of the same type.
Write	Program message elements are not written directly. This queue communicates with the system interface using only an IEEE 488.2 message exchange protocol.	Program message elements are not written directly. Coded device information is indicated.
Summary message	When the output queue is not empty, the summary message bit becomes True (1). When it is empty, the summary message bit becomes False (0). The MAV summary message is used to synchronize information exchange between a device and the controller.	When the queue is not empty, the summary message bit becomes True (1). When it is empty, the summary message bit becomes False (0).
Clearing	This queue is cleared in the following cases: (a) All items in the queue are read. (b) A DCL bus command is received for message exchange. (c) The PON bit becomes True at Power-ON. (d) Operation is unterminated or interrupted.	This queue is cleared in the following cases: (a) All items in the queue are read. (b) A ∗CLS command is received. (c) Other device-dependent means

5.9 IEEE488.2 Common Commands

The following commands are used only for GPIB control.

∗CLS

Function

Clears the status.

Program message

∗CLS

Explanation

The ∗CLS common command clears all event registers and queues except an output queue and its MAV summary messages, thus clearing the corresponding summary messages.
Values set in enable registers are not changed by the ∗CLS command.

∗ESE

Function

Enables the standard event status.

Program message

∗ESE < mask >
∗ESE?

Response message

< mask >

Parameter

< mask > := {Logical sum of $2^n | 0 \leq n \leq 7$}

Explanation

The sum total of values ($2^0 = 1$, $2^1 = 2$, $2^2 = 4$, $2^3 = 8$, $2^4 = 16$, $2^5 = 32$, $2^6 = 64$, and/or $2^7 = 128$) corresponding to the standard event status enable register bits 1, 2, 3, 4, 5, 6, and/or 7 that are to be enabled becomes the parameter. The value of the bit to be disabled is 0.

	Register contents	Set value
Bit 7	Power On	128
Bit 6	Not used	64
Bit 5	Command Error	32
Bit 4	Execution Error	16
Bit 3	Device Dependent Error	8
Bit 2	Query Error	4
Bit 1	Not used	2
Bit 0	Operation Complete	1

∗ESR

Function
Confirms the standard event status register.

Program message
∗ESR?

Response message
< code >

Parameter
< code > := {Logical sum of 2^n |0 ≤ n ≤ 7}

Explanation
The current value of the standard event status register is returned. The sum total of values (2^0 = 1, 2^1 = 2, 2^2 = 4, 2^3 = 8, 2^4 = 16, 2^5 = 32, 2^6 = 64, and/or 2^7 = 128) corresponding to the standard event status enable register bits 1, 2, 3, 4, 5, 6, and/or 7 that are enable. When the response is read, this register is cleared.

	Register contents	Set value
Bit 7	Power On	128
Bit 6	Not used	64
Bit 5	Command Error	32
Bit 4	Execution Error	16
Bit 3	Device Dependent Error	8
Bit 2	Query Error	4
Bit 1	Not used	2
Bit 0	Operation Complete	1

∗IDN

Function
Confirms the product information.

Program message
∗IDN?

Response message
< manufacture >, < type >, < serial >, < farmware >

Explanation
This command displays the manufacturer name, model number, manufacture serial number, and firmware version, as follows.

Manufacture name: ANRITSU
Model no.: MT9812B
Manufacture serial number: 0
Firmware version: 0

∗OPC

Function
Indicates the completion of the device operation.

Program message
∗OPC
∗OPC?

Explanation
When the device operation is completed, the bit 0 of the standard event status register is set. Then, "1" is set in the output queue, and an MAV summary message is generated. However, the MT9812B does not have any overlap command, therefore, this command has no meaning.

∗RST

Function
Clears the measurement conditions and the device.

Program message
∗RST

Explanation
This command resets a device at level 3, and does not affect the following items.
- State of IEEE488.1 interface.
- Device address
- Output queue
- Service request enable register
- Standard event status enable register
- Power-on-status-clear flag setting
- Composition data that affects the device specification.
- RS-232C interface condition

∗SRE

Function
Enables the service request.

Program message
∗SRE < mask >
∗SRE?

Response message
< mask >

Parameter
< mask > := {Logical sum of 2^n |$0 \leq n \leq 7$}

Explanation

The total of values ($2^0 = 1$, $2^1 = 2$, $2^2 = 4$, $2^3 = 8$, $2^4 = 16$, $2^5 = 32$, and/or $2^7 = 128$) corresponding to the service request enable register bits 1, 2, 3, 4, 5, 6, and/or 7 that are enabled becomes parameter. The value of the bit to be disabled is 0.

	Register contents	Set value
Bit 7	Operation Status	128
Bit 6	RQS/MSS	64
Bit 5	ESB	32
Bit 4	MAV	16
Bit 3	Questionable Status	8
Bit 2	QUE	4
Bit 1	Not used	2
Bit 0	Source Status	1

*STB

Function

Reads the status byte.

Program message

*STB?

Response message

< code >

Parameter

< code > := {Logacal sum of 2^n |$0 \leq n \leq 7$}

Explanation

This command returns the sum total of the status register value assigned binary weights and MSS (Master Summary Status) summary message value.

	Register contents	Set value
Bit 7	Operation Status	128
Bit 6	RQS/MSS	64
Bit 5	ESB	32
Bit 4	MAV	16
Bit 3	Questionable Status	8
Bit 2	QUE	4
Bit 1	Not used	2
Bit 0	Source Status	1

∗TST

Function
Selftest results

Program message
∗TST?

Response message
< code >

Parameter
< code > := {0, 1}

Explanation
This command conducts a self-test inside the device. The test result is set in the output queue. The data in the output queue indicates that the test has been completed without causing any error.

< code >	Contents
0	Test completed without error.
1	Test not executed, or executed with error occurred.

∗WAI

Function
Waits the next command.

Program message
∗WAI

Explanation
This command executes overlap commands as sequential commands.
If this command is executed after an overlap command, the next command must wait for the current command to end.
However, since the MT9812B does not have overlap commands, this command counts for nothing.

5.10 Status Commands

This paragraph explains the device status report and the data structure defined by the IEEE488.2 standards.

Each status register has the following configuration.

(1) CONDITION REGISTER

The condition register remains unchanged even after reading from the external device (controller). It cannot be set by any of the commands from the external device (controller) and can be set only by the state change in the measuring instrument.

(2) TRANSITION FILTER

The transition filter is used to determine whether to report the state change reported to the condition register to the event status register.
The filter for change from 0 to 1 is called the P-transition filter, while the filter for change from 1 to 0 is called the N-transition filter. These filters are rewritten as a mask pattern in accordance with the request from the external device (controller) (set/clear for each bit). These mask patterns remain unchanged even after the reading from the controller.

(3) EVENT REGISTER

The event register can be set indirectly through the condition register or the P/N-transition filter from the inside of the measuring instrument. The event resister cannot be directly accessed from an application program.

(4) EVENT ENABLE REGISTER

An event enable register for the event register.

(5) ERROR/EVENT QUEUE

While a message is stored in this queue, the corresponding bit in the status byte register is set. If a message goes out of the message queue, the corresponding bit in the status byte register is cleared.

5.10.1 Status Register

STATus:PRESet

Function

Initializes the enable register and transition filters.

Program message

`STATus:PRESet`

Explanation

This command initializes the enable register and transition filters.
Each register is set as shown in the table below.

Register	Filter/Enable	Preset Value
Operation	Enable	all 0
	PTR	all 1
	NTR	all 0
Questionable	Enable	all 0
	PTR	all 1
	NTR	all 0
SUMmary	Enable	all 0
	PTR	all 1
	NTR	all 0
INSTrument	Enable	all 1
	PTR	all 1
	NTR	all 0
Others	Enable	all 1
	PTR	all 1
	NTR	all 0

< node >:CONDition

Function

Checks the condition register.

Program message

`< node >:CONDition?`

Response message

`< code >`

Parameter

`< code >` := {n|0 ≤ n ≤ 32767}

Explanation

This command returns the sum total of the values of the condition register. The item of the condition register to be specified is determined with <node>.

< node >:ENABle

Function
Sets the event enable register.

Program message
```
< node >:ENABle  < mask >
< node >:ENABle?
```

Parameter
< code > := {Logical sum of 2^n |$0 \leq n \leq 15$}

Explanation
This command finds the sum total of the bit digit values when the bit to be enabled in the event enable register becomes the parameter. The bit digit value to be disabled is zero. The item of the event enable register to be specified is determined with <node>.

< node >[:EVENt]

Function
Checks the event register.

Program message
```
< node >[:EVENt]?
```

Response message
```
< code >
```

Parameter
< code > := {Logical sum of 2^n |$0 \leq n \leq 15$}

Explanation
This command returns the sum total of the values of the event register. The item of the event register to be specified is determined with <node>.

< node >:NTRansition

Function

Sets the N-transition register.

Program message

```
< node >:NTRansition  < mask >
< node >:NTRansition?
```

Response message

```
< mask >
```

Parameter

< mask > := {Logical sum of 2^n |0 ≤ n ≤ 15}

Explanation

This command finds the sum total of the bit digit values when the bit to be enabled in the N-transition register becomes the parameter. The bit digit value to be disabled is zero. The item of the N-transition register to be specified is determined with <node>.

< node >:PTRansition

Function

Sets the P-transition register.

Program message

```
< node >:PTRansition  < mask >
< node >:PTRansition?
```

Response message

```
< mask >
```

Parameter

< mask > := {Logical sum of 2^n |0 ≤ n ≤ 15}

Explanation

This command finds the sum total of the bit digit values when the bit to be enabled in the P-transition register becomes the parameter. The bit digit value to be disabled is zero. The item of the P-transition register to be specified is determined with <node>.

5.10.2 Operation Status Register

The operation status register indicates the state of the equipment.
The commands are shown below. Insert these commands into the <node> portion in the status register.

Command	Description
STATus:OPERATION	Operation status register
STATus:OPERATION:SETTLING	State of temperature of light source unit

STATus:OPERation

Function

Indicates the operation status register.

Explanation

Specifies the operation status register to be referenced.
The state of the equipment is indicated by allocating to bits. Each bit indicates the following.

Bit	Description
1	State of temperature of light source unit

STATus:OPERation:SETTling

Function

Indicates the state of temperature of light source unit.

Explanation

This command indicates the state of the temperature of the light source unit and indicates whether it can be used.
The bits correspond one for one with the channels in order with bit 0 as Channel 1.
Depending on the state, whether the light source unit can be used is indicated.

Bit	Corresponding channel
0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4
4	Channel 5
5	Channel 6
6	Channel 7
7	Channel 8
8	Channel 9

State	Description
0	Cannot be used
1	Can be used.

5.10.3 QUESTIONABLE Status Register

QUESTIONABLE status register has the following information.

- Output power of light source
- Abnormalities of current/temperature/power-supply

The QUESTIONABLE status register has the following commands, which are inserted into the <node> field of the status register for use.

Command	Description
STATus:QUESTIONABLE:POWER	QUESTIONABLE status register
STATus:QUESTIONABLE:POWER:SOURCE	Output power of light source
STATus:QUESTIONABLE:CURRENT	Current abnormality
STATus:QUESTIONABLE:ENVTEMP	Temperature abnormality
STATus:QUESTIONABLE:POWER	Power supply abnormality

STATus:QUEStionable:POWer

Function

QUSTIONABLE status register

Explanation

Specifies the status register to be referenced.
Each device state is indicated at a bit allocated to it.
Each bit content is as follows.

Bit	Contents
2	Remote interlock
3	Output power of light source
6	Current abnormality
7	Temperature abnormality
8	Power supply abnormality

These bits have the low-order structure, excluding the remote interlock. When the remote interlock is set to 1, the system is in the remote-interlock on state. When it is set to 0, the system is in the remote-interlock off state.

STATus:QUEStionable:POWer:SOURce

Function

Indicates output ON/OFF state of light source.

Explanation

This command indicates the output ON/OFF state of light source.
Each bit corresponds to a channel in sequence, assuming the bit 0 to be the channel 1. This state indicates whether the optical output of the light source unit is on or off.

Bit	Corresponding channel
0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4
4	Channel 5
5	Channel 6
6	Channel 7
7	Channel 8
8	Channel 9

State	Contents
0	Output Off
1	Output On

STATus:QUEStionable:POWer:CURRent

Function

Indicates the current abnormality.

Explanation

This command indicates the occurrence of current abnormality.
The bits correspond one for one with the channels in order with bit 0 as Channel 1.
Depending on the state, whether current abnormality is occurring is indicated.

Bit	Corresponding channel
0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4
4	Channel 5
5	Channel 6
6	Channel 7
7	Channel 8
8	Channel 9

State	Contents
0	Current abnormality not occurred.
1	Current abnormality occurred.

STATus:QUEStionable:POWer:ENVTemp

Function

Indicates the temperature abnormality.

Explanation

This command indicates the occurrence of temperature abnormality.
The bits correspond one for one with the channels in order with bit 0 as Channel 1.
Depending on the state, whether temperature abnormality is occurring is indicated.

Bit	Corresponding channel
0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4
4	Channel 5
5	Channel 6
6	Channel 7
7	Channel 8
8	Channel 9

State	Contents
0	Temperature abnormality not occurred.
1	Temperature abnormality occurred.

STATus:QUEStionable:POWer:POWer

Function

Indicates the power supply abnormality.

Explanation

This command indicates the occurrence of power supply abnormality.
The bits correspond one for one with the channels in order with bit 0 as Channel 1.
Depending on the state, whether power supply abnormality is occurring is indicated.

Bit	Corresponding channel
0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4
4	Channel 5
5	Channel 6
6	Channel 7
7	Channel 8
8	Channel 9

State	Contents
0	Power supply abnormality not occurred.
1	Power supply abnormality occurred.

Section 6 Performance Test

This section provides explanations of the method to check the performance of the light source inserted to the MT9812B as well as the method to calibrate the measured values.

When the light source tested here is found to fail to meet specifications given here through the performance test explained in this section, please contact one of the ANRITSU branches, local offices, operation offices or dealers listed in this manual which is located closest to you.

In case you ask for repair, first check the following points:

(1) Equipment name and serial number indicated on the back panel or the chassis
(2) State of the failure
(3) Name and contact number of the person in charge who will act as a liaison when we check with the state of the failure and when the repair is completed.

6.1 Light Source Performance Test

Perform tests on two items shown below to check the performance of the light source.

- Optical output level
- Center optical frequency

Clean the optical connector before starting the test.

7.1 Daily Care and Cleaning

Perform the performance test after a sufficient time for warming up following power on.

2.2 Specifications

POINT

To record results of the performance test, it is advised to copy the list of performance test result record of Appendix A at the end of this document or prepare a similar list to ensure convenience of recording.

Measuring instruments necessary for the test

- Optical output level — Optical Power Meter
  MT9810A + MU931421A
  Wavelength: 0.75 to 1.7 μm
  Level: +10 dBm
- Center optical frequency — Optical Frequency Counter
  MF9630A
  Wavelength: 0.6 to 1.6 μm
  Measurement accuracy: ±0.5 ppm
  Resolution: 0.1 ppm (Max.)

6.1.1 Optical Output Level

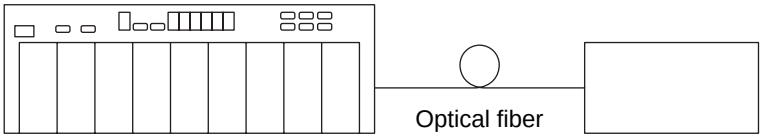


Fig. 6-1

Step	Operation
1	Set up a measurement system like that shown in the figure, above.
2	Set the optical output mode of the measuring instrument to be tested to the CW mode, and set ATT at 0 dB.
3	Set the measuring instrument to be tested to the center frequency.
4	Measure the optical output level by the optical power meter.
5	Check that the value measured comes within the specified level.

6.1.2 Center Optical Frequency

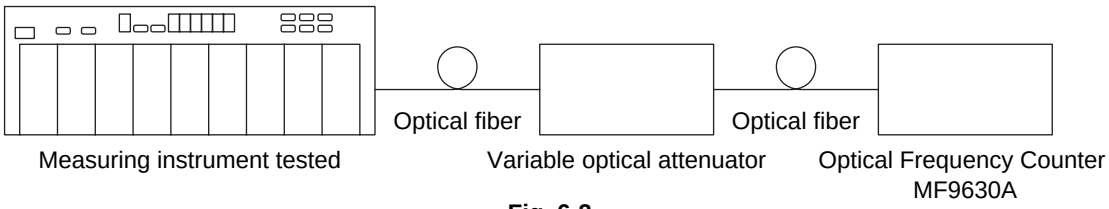


Fig. 6-2

Step	Operation
1	Set up a measurement system like that shown in the figure, above.
2	Set the optical output mode of the measuring instrument to be tested to the CW mode, and set ATT at 0 dB.
3	Set the measuring instrument to be tested to the center frequency.
4	Adjust the optical output to or below the maximum input level of the optical frequency counter using the optical attenuator.
5	Measure the optical frequency by the optical frequency counter.
6	Check that the value measured comes within the specified value.

6.2 Optical Sensor Performance Test

Perform tests on two items shown below to check the performance of the light sensor.

- Linearity Between Ranges
- Polarization Dependency
- Return Loss
- Noise Level

Clean the optical connector before starting the test.

7.1 Daily Care and Cleaning

Perform the performance test after a sufficient time for warming up following power on.

2.2 Specifications

POINT

To record results of the performance test, it is advised to copy the list of performance test result record of Appendix A at the end of this document or prepare a similar list to ensure convenience of recording.

Measuring instruments necessary for the test

- Optical attenuator
  - Wavelength: 1.1 to 1.65 μm
  - Max. attenuation: 60 dB or more
  - Max. light input level: +23 dBm or more
- Light source
  - Optical output: +10 ±1 dBm
  - Stability: 0.005 dB or less

6.2.1 Linearity Between Ranges

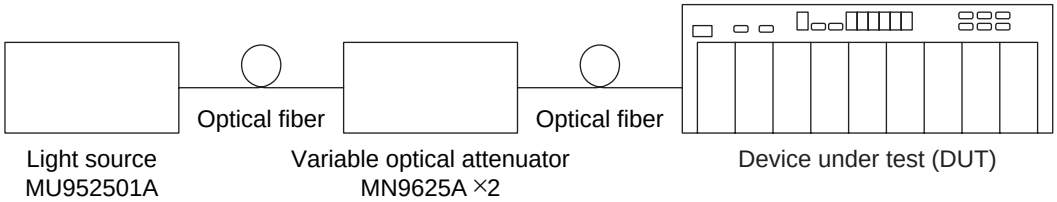


Fig. 6-3

Step	Operation
1	Set up a measurement system like that shown in figure, above.
2	Insulate the DUT from the light for performing the zero-level calibration.
3	Set the range of the DUT to +10 dBm.
4	Adjust the optical attenuator so that the display of the DUT shows 0 dBm in the specified range.
5	Record the measured value (Measured value 1).
6	Lower the range of the DUT by 1 stage, and record the measured value (Measured value 2).
7	The difference between measured values 1 and 2 indicates the error between the ranges.
8	Increase the attenuation value of the optical attenuator by 10 dB, and repeat the operation from step 5 through 7 up to the minimum range of the DUT.

6.2.2 Polarization Dependency

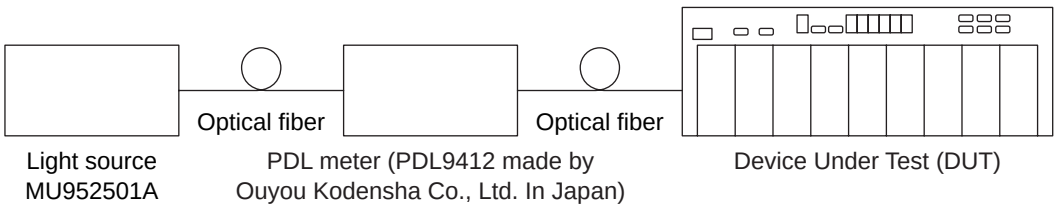


Fig. 6-4

Step	Operation
1	Set up a measurement system like that shown in figure, above.
2	Insulate the DUT from the light for performing the zero-level calibration.
3	Set the DUT for P-P measurement.
4	Using the PDL meter, rotate the plane of polarization by 360 degrees or more (it takes 30 seconds or longer) and perform measurement.
5	The P-P value after the measurement becomes the measured value of polarization dependency.

6.2.3 Return Loss

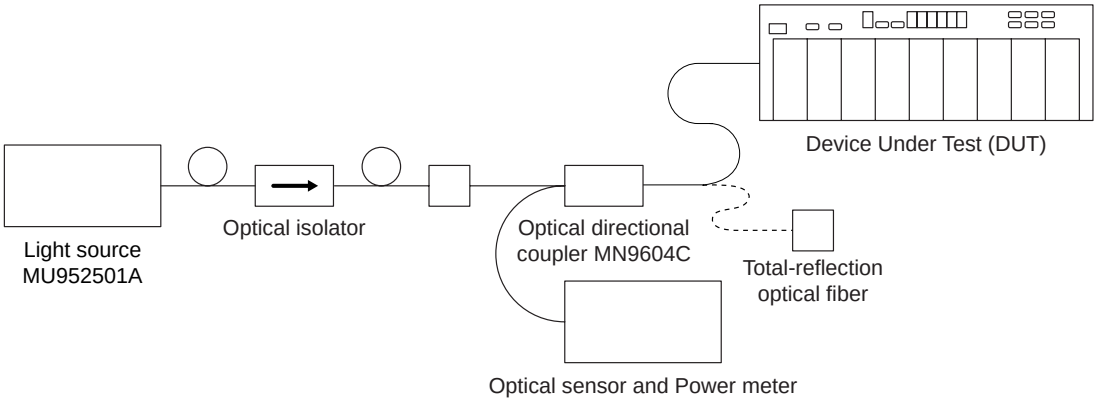


Fig. 6-5

Step	Operation
1	Set up a measurement system like that shown in figure, above.
2	Input the light of about –20 dBm with the total-reflection optical fiber attached to the measuring system.
3	Set the power meter to Relative measurement.
4	Connect the optical directional coupler to the DUT, detaching the total-reflection optical fiber, and perform measurement using the power meter.
5	The absolute value of the power meter display becomes the return loss.

6.2.4 Noise Level

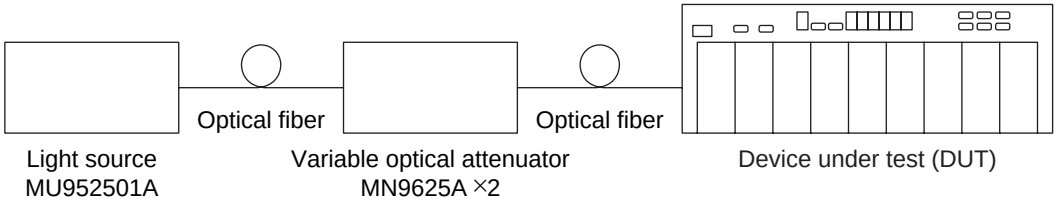


Fig. 6-6

Step	Operation
1	Set up a measurement system like that shown in figure, above.
2	Set the bandwidth and number of averagings of the DUT to 1 Hz and 10, respectively.
3	Insulate the DUT from the light for performing the zero-level calibration.
4	Adjust the optical attenuator so that the indicator of the DUT shows –80 dBm.
5	Set the DUT for P-P measurement (% display), and perform the measurement for about 30 minutes.
6	Noise level can be calculated using the P-P value after the completion of the measurement, using the following formula; Formula: Noise level (dBm) $= -80+\log_{10}([100 - \text{Measured value}]/100)$

Section 7 Maintenance and Re-transportation

This section provides descriptions of matters that require attention in regard to daily care and cleaning and re-transportation and actions to be taken in the event of abnormalities.

7.1 Daily Care and Cleaning

7.1.1 External Stains

When external stains have grown conspicuous, when the MT9812B was used in dusty location or before the MT9812B is put to storage for a long time; lightly wipe the MT9812B to remove stains with a cloth soaked with soapy water. Using thinner or benzene may cause damage to the coating.

CAUTION ⚠

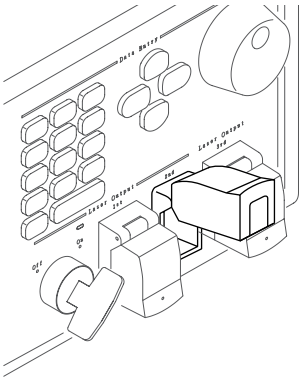
To wipe off stain with a cloth soaked with soapy water, first turn the power source of the MT9812B OFF and pull out the power source cord from the power receptacle. Trying to perform operations without pulling the power source cord off from the power receptacle may cause electric shock.

7.1.2 Optical connector & optical adapter cleaning

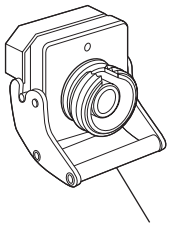
Cleaning built-in ferrule end-face

Use adapter cleaner supplies for this unit to clean the built-in optical I/O connector ferrule. Clean the ferrule periodically. An example of the FC adapter is described below. Follow similar methods and steps for cleaning other adapters.

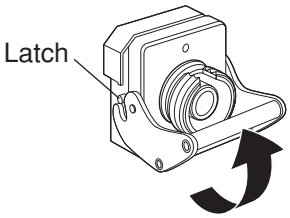
(1) Open the connector cover.

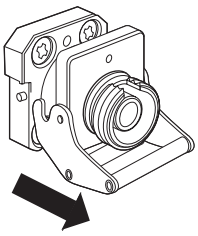


(2) Pull the adapter lever up then gently pull the adapter out straight towards you after checking that the latch is released.

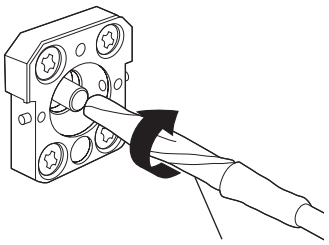


Adapter Lever



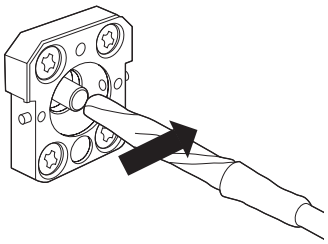


(3) Clean by pressing the adapter cleaner which is soaked in alcohol to the ferrule end-face and side face.



Adapter Cleaner

(4) Finish by pressing the tip of a new adapter cleaner without any alcohol on it to the ferrule end-face and wipe in one direction 2 or 3 times.



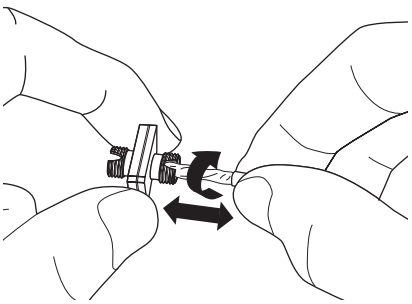
(5) Clean the adapter interior with adapter cleaner.
(Refer to “Cleaning optical adapter” below.)

(6) Attach the adapter using the steps in reverse order. Be careful not to scratch the ferrule end-face.

Cleaning optical adapter

Use adapter cleaner supplies for this unit to clean the optical adapter for connection to the fiber-optic cable. An example of the FC adapter is described below. Follow similar methods and steps for cleaning other adapters. In addition, clean the adapter which was removed to clean the built-in ferrule end-face using the following steps.

Insert the adapter cleaner to the split sleeve interior of the adapter then move it back and forth while rotating it in one direction.



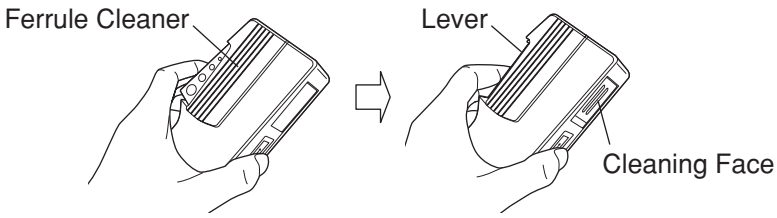
Note:

Check the ferrule radius. Use only a f1.25 mm or f2.5 mm dedicated adapter cleaner.

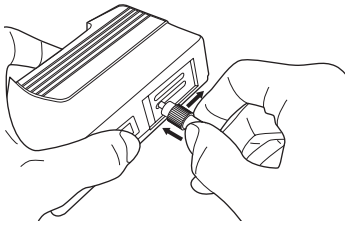
Cleaning the ferrule end-face of the fiber-optic cable

Use ferrule cleaner supplies for this device to clean the ferrule of the cable end. An example of the FC connector is described below. Follow similar methods and steps for cleaning other connectors.

(1) Lift the ferrule cleaner lever to access the cleaning face.



(2) Keep the lever in this position then press down the ferrule end-face of the optical connector on the cleaning face and rub in one direction.



Notes on cleaning

(1) Do not clean with used adapter cleaner.
(2) Do not finish clean with a cotton swab as cotton fibers may adhere to the surface.
(3) Make sure to cap adapters that are not in use.

WARNING ⚠

Ensure that no light is emitted when cleaning or checking the ferrule end-face.

CAUTION ⚠

Performance may be degraded if used when dust or dirt is adhering to the ferrule end-face. In addition, the connected fiber-optic cable & ferrule end-face of this unit may burn out if high-output light is used in this state. Clean the connected fiber-optic cable and ferrule end-face of this device before performing measurements.

7.2 Matters Requiring Attention for Storage

Avoid storing the MT9812B and the plug-in units in places such as those listed below.

- Places that experience temperatures of 70 ˚C or higher and of –20 ˚C or lower.
- Places exposed to direct sunlight
- Dusty places
- Places of high humidity that may cause condensation
- Places likely to be exposed to active gases

7.3 Re-transportation

Pay attention to the matters listed below to re-transport the MT9812B and plug-in units.

- Use the packing materials used at the time of product purchase.
- As the products are classified as the precision electronic equipment, instruct the carrier that “wetting” and “throwing away” of the products is strictly prohibited during transportation.

Take the following actions in case packing materials used at the time of purchase are lost.

(1) Make air cell mat (air cap sheet) or sheet with equivalent cushioning effects available.
(2) Wrap the entire MT9812B or plug-in unit with the sheet.
(3) Make available a solid packing carton such as cardboard, wooden and aluminum boxes with between 10 and 15 cm margins in all directions over the size of the product wrapped in sheet, and fill cushioning material between 10 and 15 cm thick at the bottom of the box.
(4) Put the MT9812B or the plug-in unit packed in sheet into the box and fill cushioning material around it.
(5) Pack the carton box fast with string, tape or belt.

7.4 Troubleshooting

7.4.1 Common Items

Phenomenon	Possible cause	Action
Power is not activated.	The power switch is not properly pressed.	Press the power switch properly.
	The AC power source inlet and power source cord are not properly connected, or the power source cord and power receptacle are not properly connected.	Connect the AC power source inlet, power source cord and power receptacle properly.
	The fuse has been blown.	Replace the fuse.  **3.9 Replacement of Fuse**
The self check does not end even when at least a minute has elapsed after the power source is turned ON.		First turn the power source OFF and turn it ON again. If the unit still switches in the same state, turn the power source OFF promptly and contact the service center.
Even when the power source is turned ON, no indication appears on the display or the display remains dark.	The display circuit is broken.	First turn the power source OFF and turn it ON again. If no indication appears during the self check, turn the power source OFF promptly and contact the service center.
The optical fiber cord cannot be connected.	The shapes of the optical fiber cord a connector of a correct shape.	Use a connector of a correct shape.  **3.8 Replacement of Optical Connector**
	The directions of insertion (such as the position of the pawl) of the optical fiber cord and connector are different.	Check the position and direction of the pawl.
GPIB and RS-232C do not work.	The GPIB and RS-232C cables are not properly connected.	Connect the GPIB and RS-232C cables properly.
	The RS-232C cable type is wrong.	Use the cross cable as the RS-232C cable.
	The GPIB and RS-232C interface setting (selection) is not correct.	Set the GPIB and RS-232C interfaces correctly.
	The GPIB address setting is wrong.	Set the correct GPIB address.
	The RS-232C setting conditions are wrong.	Set the correct RS-232C setting conditions.

7.4.2 Light Source

Phenomenon	Possible cause	Action
The output power is low.	The mode is set to ATT.	Set the ATT to 0.00 dB.
	The end face of the fiber cord or the connector is stained.	Clean the end face of the fiber cord or the connector.  **7.1 Daily Care and Cleaning**
The optical level does not stabilize.	The mode is set to MOD.	Set the mode to CW.
	The end face of the fiber cord or the connector is stained.	Clean the end face of the fiber cord or the connector.  **7.1 Daily Care and Cleaning**
The optical frequency stability is poor.	The mode is set to MOD.	Set the mode to CW.
	The end face of the fiber cord or the connector is stained.	Clean the end face of the fiber cord or the connector.  **7.1 Daily Care and Cleaning**
No light is output.	The remote interlock connector is open.	 **3.5 Connection of Remote Interlock Connector.**
	The optical output modifier key switch is off.	 **3.6 Optical Output Modifier Key Switch**

7.4.3 Optical Sensor

Phenomenon	Possible cause	Action
The measured value is low.	The settings of the measuring beam and calibrated wavelength are different.	Set the setting of the calibrated wave length to that of the wavelength of the measuring beam.
	As light of high power level was entered while the connector remains stained, the ferrule burned out.	Clean the end face of the fiber cord or the connector. **7.1 Daily Care and Cleaning** If the problem remains unsolved, repair will be necessary. In this case, contact the service center.
	The end face of the fiber cord or the connector is stained.	Clean the end face of the fiber cord and connector. **7.1 Daily Care and Cleaning**
The measured values do not stability.	The modulated light is measured in the CW setting.	Set the mode to the modulation mode to measure modulated light and also set the modulation frequency correctly.
The numerical values displayed are slow to change.	The time set for measurement interval is long.	Set a shorter time for measurement interval.
The indication does not change even if light is input.	The CW light is measured in the modulation mode setting.	Set the mode to the CW mode to measure CW light.
Zero setting will not end.	The ambient temperature is high.	When the ambient temperature is high, processing takes longer. Please wait until the processing ends.
	Shading of light is insufficient.	Affix the metallic light shading cap on the front panel properly and perform zero setting.
Zero setting results in error.	Shading of light is insufficient.	Affix the metallic light shading cap on the front panel properly and perform zero setting.

Appendix

Appendix A Performance Test Result Recording List

Light Source (DFB-LD) List of Performance Test Result Record

Model: MU95250 A-
Serial No.:

Date:
Temperature: °C
Humidity: %
Atmospheric pressure: hPa
Person in charge:

1. Center Frequency

Minimum*		Reading		Maximum*
THz	≤	[ ] THz	≤	THz

*Minimum,Maximum: Select the appropriate one from the table below and enter it.

Model Name	Minimum	fc	Maximum
MU952501A-01	193.09THz	193.10THz	193.11THz
MU952501A-02	193.19THz	193.20THz	193.21THz
MU952501A-03	193.29THz	193.30THz	193.31THz
MU952501A-04	193.39THz	193.40THz	193.41THz
MU952501A-05	193.49THz	193.50THz	193.51THz
MU952501A-06	193.59THz	193.60THz	193.61THz
MU952501A-07	193.69THz	193.70THz	193.71THz
MU952501A-08	193.79THz	193.80THz	193.81THz
MU952501A-09	193.89THz	193.90THz	193.91THz
MU952501A-10	193.99THz	194.00THz	194.01THz
MU952502A-01	192.09THz	192.10THz	192.11THz
MU952502A-02	192.19THz	192.20THz	192.21THz
MU952502A-03	192.29THz	192.30THz	192.31THz
MU952502A-04	192.39THz	192.40THz	192.41THz
MU952502A-05	192.49THz	192.50THz	192.51THz
MU952502A-06	192.59THz	192.60THz	192.61THz
MU952502A-07	192.69THz	192.70THz	192.71THz
MU952502A-08	192.79THz	192.80THz	192.81THz
MU952502A-09	192.89THz	192.90THz	192.91THz
MU952502A-10	192.99THz	193.00THz	193.01THz
MU952503A-07	191.69THz	191.70THz	191.71THz
MU952503A-08	191.79THz	191.80THz	191.81THz
MU952503A-09	191.89THz	191.90THz	191.91THz
MU952503A-10	191.99THz	192.00THz	192.01THz

Model Name	Minimum	fc	Maximum
MU952504A-01	194.09THz	194.10THz	194.11THz
MU952504A-02	194.19THz	194.20THz	194.21THz
MU952504A-03	194.29THz	194.30THz	194.31THz
MU952504A-04	194.39THz	194.40THz	194.41THz
MU952504A-05	194.49THz	194.50THz	194.51THz
MU952504A-06	194.59THz	194.60THz	194.61THz
MU952504A-07	194.69THz	194.70THz	194.71THz
MU952504A-08	194.79THz	194.80THz	194.81THz
MU952504A-09	194.89THz	194.90THz	194.91THz
MU952504A-10	194.99THz	195.00THz	195.01THz
MU952505A-01	195.09THz	195.10THz	195.11THz
MU952505A-02	195.19THz	195.20THz	195.21THz
MU952505A-03	195.29THz	195.30THz	195.31THz
MU952505A-04	195.39THz	195.40THz	195.41THz
MU952505A-05	195.49THz	195.50THz	195.51THz
MU952505A-06	195.59THz	195.60THz	195.61THz
MU952505A-07	195.69THz	195.70THz	195.71THz
MU952505A-08	195.79THz	195.80THz	195.81THz
MU952505A-09	195.89THz	195.90THz	195.91THz

2. Optical Output Level

Minimum		Reading		Maximum
9.0 dBm	≤	[ ] dBm	≤	11.0 dBm

Light Source (DFB-LD) List of Performance Test Result Record

Model: MU95260 A-
Serial No.:

Date:
Temperature: °C
Humidity: %
Atmospheric pressure: hPa
Person in charge:

1. Center Frequency

Minimum*	Reading	Maximum*
THz ≤	[ ] THz	≤ THz

*Minimum,Maximum: Select the appropriate one from the table below and enter it.

Model Name	Minimum	fc	Maximum
MU952601A-01	191.09THz	191.10THz	191.11THz
MU952601A-02	191.19THz	191.20THz	191.21THz
MU952601A-03	191.29THz	191.30THz	191.31THz
MU952601A-04	191.39THz	191.40THz	191.41THz
MU952601A-05	191.49THz	191.50THz	191.51THz
MU952601A-06	191.59THz	191.60THz	191.61THz
MU952602A-01	190.09THz	190.10THz	190.11THz
MU952602A-02	190.19THz	190.20THz	190.21THz
MU952602A-03	190.29THz	190.30THz	190.31THz
MU952602A-04	190.39THz	190.40THz	190.41THz
MU952602A-05	190.59THz	190.50THz	190.51THz
MU952602A-06	190.59THz	190.60THz	190.61THz
MU952602A-07	190.69THz	190.70THz	190.71THz
MU952602A-08	190.79THz	190.80THz	190.81THz
MU952602A-09	190.89THz	190.90THz	190.91THz
MU952602A-10	190.99THz	191.00THz	191.01THz
MU952603A-01	189.09THz	189.10THz	189.11THz
MU952603A-02	189.19THz	189.20THz	189.21THz
MU952603A-03	189.29THz	189.30THz	189.31THz
MU952603A-04	189.39THz	189.40THz	189.41THz
MU952603A-05	189.49THz	189.50THz	189.51THz
MU952603A-06	189.59THz	189.60THz	189.61THz
MU952603A-07	189.69THz	189.70THz	189.71THz
MU952603A-08	189.79THz	189.80THz	189.81THz
MU952603A-09	189.89THz	189.90THz	189.91THz
MU952603A-10	189.99THz	190.00THz	190.01THz
MU952604A-01	188.09THz	188.10THz	188.11THz
MU952604A-02	188.19THz	188.20THz	188.21THz
MU952604A-03	188.29THz	188.30THz	188.31THz
MU952604A-04	188.39THz	188.40THz	188.41THz

Model Name	Minimum	fc	Maximum
MU952604A-05	188.49THz	188.50THz	188.51THz
MU952604A-06	188.59THz	188.60THz	188.61THz
MU952604A-07	188.69THz	188.70THz	188.71THz
MU952604A-08	188.79THz	188.80THz	188.81THz
MU952604A-09	188.89THz	188.90THz	188.91THz
MU952604A-10	188.99THz	189.00THz	189.01THz
MU952605A-01	187.09THz	187.10THz	187.11THz
MU952605A-02	187.19THz	187.20THz	187.21THz
MU952605A-03	187.29THz	187.30THz	187.31THz
MU952604A-08	187.79THz	187.80THz	187.81THz
MU952604A-09	187.89THz	187.90THz	187.91THz
MU952604A-10	187.99THz	187.00THz	187.01THz
MU952605A-04	187.39THz	187.40THz	187.41THz
MU952605A-05	187.49THz	187.50THz	187.51THz
MU952605A-06	187.59THz	187.60THz	187.61THz
MU952605A-07	187.69THz	187.70THz	187.71THz
MU952605A-08	187.79THz	187.80THz	187.81THz
MU952605A-09	187.89THz	187.90THz	187.91THz
MU952605A-10	187.99THz	188.00THz	188.01THz
MU952606A-03	186.29THz	186.30THz	186.31THz
MU952606A-04	186.39THz	186.40THz	186.41THz
MU952606A-05	186.49THz	186.50THz	186.51THz
MU952606A-06	186.59THz	186.60THz	186.61THz
MU952606A-07	186.69THz	186.70THz	186.71THz
MU952606A-08	186.79THz	186.80THz	186.81THz
MU952606A-09	186.89THz	186.90THz	186.91THz
MU952606A-10	186.99THz	187.00THz	187.01THz

2. Optical Output Level

Minimum	Reading	Maximum
6.0 dBm ≤	[ ] dBm	≤ 8.0 dBm

Light Source (FP-LD) List of Performance Test Result Record

Model: MU95 A
Serial No.:

Date:
Temperature: °C
Humidity: %
Atmospheric pressure: hPa
Person in charge:

1. Center Wavelength

Minimum		Reading			Maximum
1290 mn	≤		nm	≤	1330 nm [1310 nm]
1530 mn	≤		nm	≤	1570 nm [1550 nm]

2. Optical Output Level

Minimum		Reading			Maximum
6.0 dBm	≤		dBm	≤	8.0 dBm [1310 nm]
6.0 dBm	≤		dBm	≤	8.0 dBm [1550 nm]

Optical Sensor List of Performance Test Result Record

Model: MU931311A
Serial No.:

Date:
Temperature: °C
Humidity: %
Atmospheric pressure: hPa
Person in charge:

1. Linearity Test

Range	Power1 (dBm)		Power2 (dBm)		Power1–Power2 (dB)	
+10 dBm → 0 dBm		–		=		= [1]
0 dBm → –10 dBm		–		=		= [2]
–10 dBm → –20 dBm		–		=		= [3]
–20 dBm → –30 dBm		–		=		= [4]
–30 dBm → –40 dBm		–		=		= [5]
–40 dBm → –50 dBm		–		=		= [6]
–50 dBm → –60 dBm		–		=		= [7]
–60 dBm → –70 dBm		–		=		= [8]
–70 dBm → –80 dBm		–		=		= [9]
–80 dBm → –90 dBm		–		=		= [10]

Range	Minimum		Calculation		Maximum
+10 dBm (–[1]–[2])	–0.050 dB	≤		≤	0.050 dB
0 dBm (–[2])	–0.010 dB	≤		≤	0.010 dB
–10 dBm			0.000 dB		
–20 dBm ([3])	–0.010 dB	≤		≤	0.010 dB
–30 dBm ([3]+[4])	–0.010 dB	≤		≤	0.010 dB
–40 dBm ([3]+[4]+[5])	–0.010 dB	≤		≤	0.010 dB
–50 dBm ([3]+[4]+···+[6])	–0.010 dB	≤		≤	0.010 dB
–60 dBm ([3]+[4]+···+[7])	–0.011 dB	≤		≤	0.011 dB
–70 dBm ([3]+[4]+···+[8])	–0.023 dB	≤		≤	0.023 dB
–80 dBm ([3]+[4]+···+[9])	–0.138 dB	≤		≤	0.138 dB
–90 dBm ([3]+[4]+···+[10])	–1.149 dB	≤		≤	1.149 dB

2. Polarization Dependence Test

Reading		Maximum
dB	≤	0.02 dB

3. Return Loss Test

Reading		Minimum
dB	≥	40 dB

4. Noise Dependence Test

Calculation		Maximum
dBm	≤	–93 dBm

Optical Sensor List of Performance Test Result Record

Model: MU931421A
Serial No.:

Date:
Temperature: °C
Humidity: %
Atmospheric pressure: hPa
Person in charge:

1. Linearity Test

Range	Power1 (dBm)		Power2 (dBm)		Power1–Power2 (dB)	
+10 dBm → 0 dBm		–		=		= [1]
0 dBm → –10 dBm		–		=		= [2]
–10 dBm → –20 dBm		–		=		= [3]
–20 dBm → –30 dBm		–		=		= [4]
–30 dBm → –40 dBm		–		=		= [5]
–40 dBm → –50 dBm		–		=		= [6]
–50 dBm → –60 dBm		–		=		= [7]
–60 dBm → –70 dBm		–		=		= [8]

Range	Minimum		Calculation		Maximum
+10 dBm (–[1]–[2])	–0.050 dB	≤		≤	0.050 dB
0 dBm (–[2])	–0.010 dB	≤		≤	0.010 dB
–10 dBm			0.000 dB		
–20 dBm ([3])	–0.010 dB	≤		≤	0.010 dB
–30 dBm ([3]+[4])	–0.010 dB	≤		≤	0.010 dB
–40 dBm ([3]+[4]+[5])	–0.011 dB	≤		≤	0.011 dB
–50 dBm ([3]+[4]+⋯+[6])	–0.023 dB	≤		≤	0.023 dB
–60 dBm ([3]+[4]+⋯+[7])	–0.138 dB	≤		≤	0.138 dB
–70 dBm ([3]+[4]+⋯+[8])	–1.149 dB	≤		≤	1.149 dB

2. Polarization Dependence Test

Reading		Maximum
dB	≤	0.02 dB

3. Return Loss Test

Reading		Minimum
dB	≥	40 dB

4. Noise Dependence Test

Calculation		Maximum
dBm	≤	–73 dBm

Appendix B Error Code

When an error occurs in the MT9812B or a inserted unit in the MT9812B, the code corresponding to the error is displayed in the parameter field.
The error codes and causes are described below.

E-001 An error occurred in mainframe memory.
E-002 A communication (remote interface of GPIB/RS-232C) error occurred.
E-003 An error occurred in unit memory.
E-005 The unit internal temperature out of the allowable range.
E-006 An error occurred in power measuring circuit.
E-007 Offset level abnormal
E-008 The PD-module temperature out of the allowable range.
E-009 The ATC circuit current exceeded the limit.
E-010 The optical output monitoring value exceeded the limit.
E-011 The LD driving current exceeded the limit.
E-012 The LD temperature exceeded the limit.
E-013 An APC control error
E-014 An ATC control error
E-199 Other error occurred.