ADVANTEST®

ADVANTEST CORPORATION

Q8221

Optical Multi-power Meter

Operation Manual

MANUAL NUMBER FOE-8324203J00

This product has been discontinued.
The Operation Manual is provided by ADC Corporation under the agreement with Advantest Corporation.

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Printed in Japan

Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that ADC Corporation (hereafter referred to as ADC) bears absolutely no responsibility for the result of operations caused due to incorrect or inappropriate use of this instrument.

If the equipment is used in a manner not specified by ADC, the protection provided by the equipment may be impaired.

- **Warning Labels**

  Warning labels are applied to ADC products in locations where specific dangers exist. Pay careful attention to these labels during handling. Do not remove or tear these labels. If you have any questions regarding warning labels, please ask your nearest ADC dealer. Our address and phone number are listed at the end of this manual.

  Symbols of those warning labels are shown below together with their meaning.

  DANGER: Indicates an imminently hazardous situation which will result in death or serious personal injury.

  WARNING: Indicates a potentially hazardous situation which will result in death or serious personal injury.

  CAUTION: Indicates a potentially hazardous situation which will result in personal injury or a damage to property including the product.

- **Basic Precautions**

  Please observe the following precautions to prevent fire, burn, electric shock, and personal injury.

  - Use a power cable rated for the voltage in question. Be sure however to use a power cable conforming to safety standards of your nation when using a product overseas.
  - When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.
  - When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
  - Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
  - Connect the power cable to a power outlet that is connected to a protected ground terminal. Grounding will be defeated if you use an extension cord which does not include a protective conductor terminal.
  - Be sure to use fuses rated for the voltage in question.
  - Do not use this instrument with the case open.
  - Do not place anything on the product and do not apply excessive pressure to the product. Also, do not place flower pots or other containers containing liquid such as chemicals near this

product.

- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

- **Caution Symbols Used Within this Manual**

Symbols indicating items requiring caution which are used in this manual are shown below together with their meaning.

DANGER: Indicates an item where there is a danger of serious personal injury (death or serious injury).

WARNING: Indicates an item relating to personal safety or health.

CAUTION: Indicates an item relating to possible damage to the product or instrument or relating to a restriction on operation.

- **Safety Marks on the Product**

The following safety marks can be found on ADC products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

The following parts used in the instrument are main parts with limited life.
Replace the parts listed below before their expected lifespan has expired to maintain the performance and function of the instrument.
Note that the estimated lifespan for the parts listed below may be shortened by factors such as the environment where the instrument is stored or used, and how often the instrument is used.
The parts inside are not user-replaceable. For a part replacement, please contact the ADC sales office for servicing.

Each product may use parts with limited life.
For more information, refer to the section in this document where the parts with limited life are described.

Main Parts with Limited Life

Part name	Life
Unit power supply	5 years
Fan motor	5 years
Electrolytic capacitor	5 years
LCD display	6 years
LCD backlight	2.5 years
Floppy disk drive	5 years
Memory backup battery	5 years

- **Hard Disk Mounted Products**

The operational warnings are listed below.

- Do not move, shock and vibrate the product while the power is turned on.
  Reading or writing data in the hard disk unit is performed with the memory disk turning at a high speed. It is a very delicate process.

- Store and operate the products under the following environmental conditions.
  An area with no sudden temperature changes.
  An area away from shock or vibrations.
  An area free from moisture, dirt, or dust.
  An area away from magnets or an instrument which generates a magnetic field.

- Make back-ups of important data.
  The data stored in the disk may become damaged if the product is mishandled. The hard disc has a limited life span which depends on the operational conditions. Note that there is no guarantee for any loss of data.

- **Precautions when Disposing of this Instrument**

When disposing of harmful substances, be sure dispose of them properly with abiding by the state-provided law.

Harmful substances: (1) PCB (polycarbon biphenyl)
(2) Mercury
(3) Ni-Cd (nickel cadmium)
(4) Other
Items possessing cyan, organic phosphorous and hexadic chromium and items which may leak cadmium or arsenic (excluding lead in solder).

Example: fluorescent tubes, batteries

Environmental Conditions

This instrument should be only be used in an area which satisfies the following conditions:

- An area free from corrosive gas
- An area away from direct sunlight
- A dust-free area
- An area free from vibrations
- Altitude of up to 2000 m

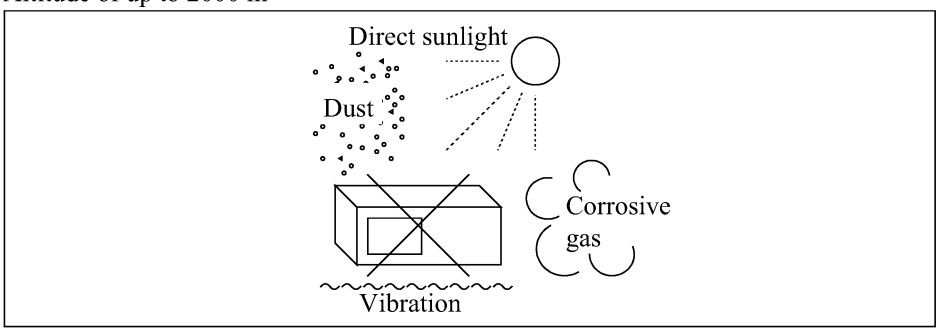


Figure-1 Environmental Conditions

- Operating position

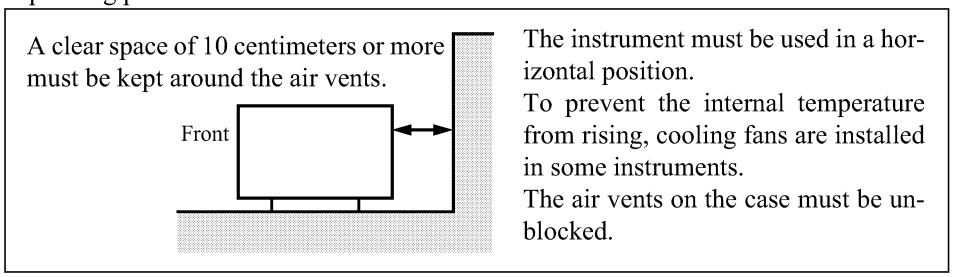


Figure-2 Operating Position

- Storage position

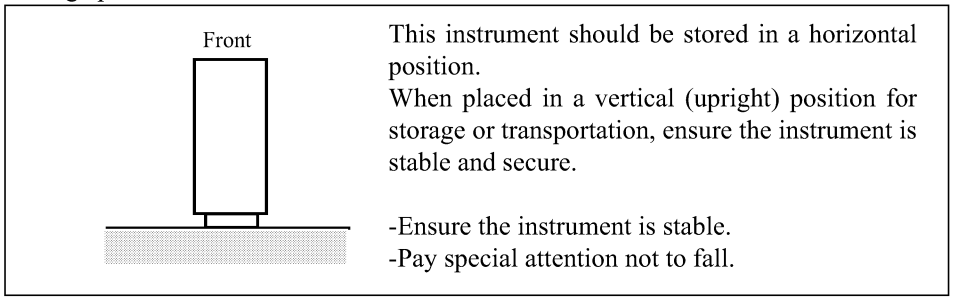


Figure-3 Storage Position

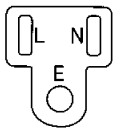
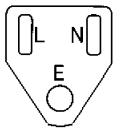
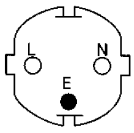
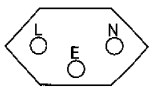
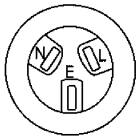
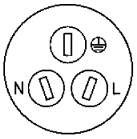
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  Impulse withstand voltage (over-voltage) category II defined by IEC60364-4-443

  Pollution Degree 2

Types of Power Cable

Replace any references to the power cable type, according to the following table, with the appropriate power cable type for your country.

Plug configuration	Standards	Rating, color and length	Model number (Option number)
	PSE: Japan Electrical Appliance and Material Safety Law	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
	UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
	CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
	SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
	SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
	BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417
	CCC:China	250 V at 10 A Black 2 m (6 ft)	Straight: A114009 (Option 94) Angled: A114109

Certificate of Conformity

CE

This is to certify, that

Optical Multi-Power Meter

Q8221,Q82202,Q82203,Q82208,Q82214,Q82215,Q82216,Q82227,Q81201
Q81202,Q81203,Q81204,Q81205,Q81206,Q81207,Q81212

instrument, type, designation

complies with the provisions of the EMC Directive 89/336/EEC in accordance with EN61326 and Low Voltage Directive 73/23/EEC in accordance with EN61010.

ADVANTEST Corp.

Tokyo, Japan

ROHDE&SCHWARZ

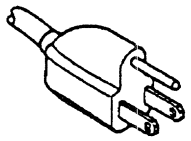
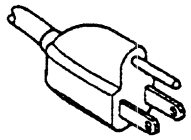
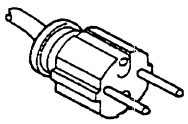
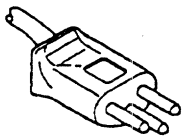
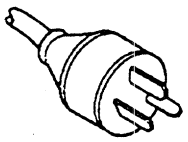
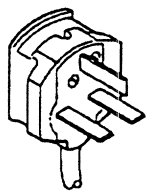
Engineering and Sales GmbH
Munich, Germany

8221.01

Table of Power Cable Options

There are six power cable options (refer to following table).

Order power cable options by Model number.

	Plug configuration	Standards	Rating, color and length	Model number (Option number)
1		JIS: Japan Law on Electrical Appliances	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
2		UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
3		CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
4		SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
5		SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
6		BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417

CLASS 1 LASER PRODUCT Labels

Q81211 and Q81212 are Class 1 Laser Products.
The following warning labels are packaged with accessories.

INTERNATIONAL LASER WARNING LABELS

JAPANESE	クラス1レーザ製品	クラス1レーザ製品	FOR: JAPAN
ENGLISH	CLASS 1 LASER PRODUCT	CLASS 1 LASER PRODUCT	FOR: UK NORWAY SWEDEN DENMARK BELGIUM NETHERLANDS
FRENCH	APPAREIL LASER DE LA CLASSE 1	APPAREIL LASER DE LA CLASSE 1	FOR: FRANCE BELGIUM SWITZERLAND
GERMAN	LASER KLASSE 1	LASER KLASSE 1	FOR: GERMANY BELGIUM SWITZERLAND AUSTRIA
SPANISH	PRODUCTO LASER CLASE 1	PRODUCTO LASER CLASE 1	FOR: SPAIN
ITALIAN	LASER CLASSE 1	LASER CLASSE 1	FOR: ITALY SWITZERLAND
FINNISH	LUOKAN 1 LASER	LUOKAN 1 LASER	FOR: FINLAND

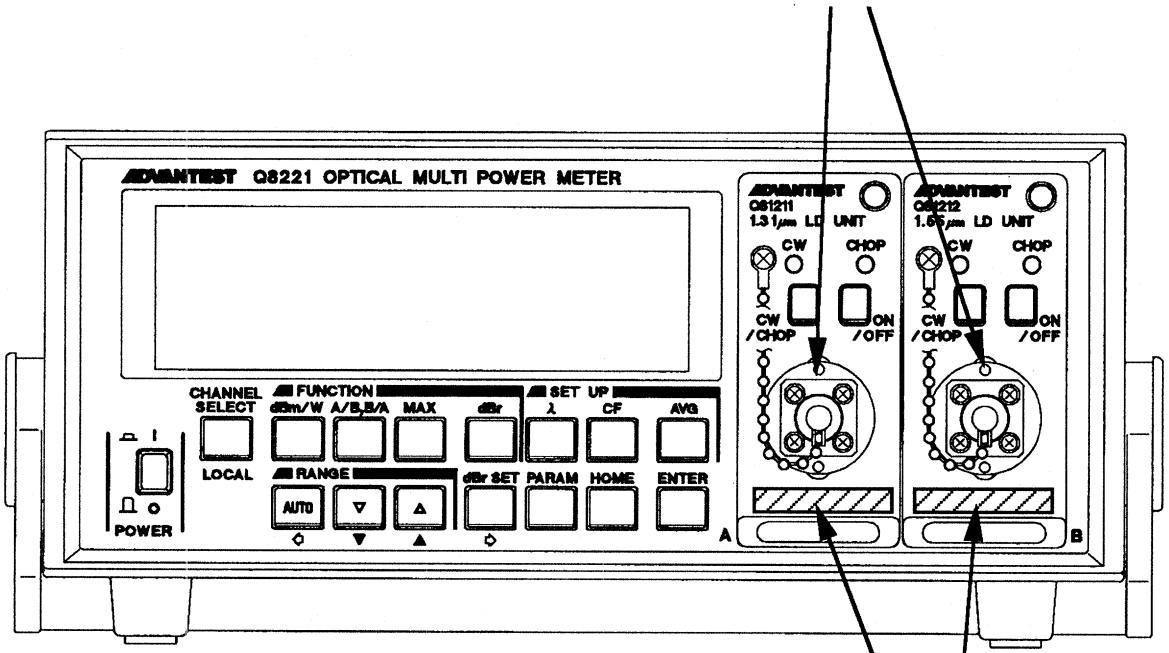
PLEASE NOTE

SWITZERLAND MAY REQUIRE FRENCH, GERMAN, OR ITALIAN LABELING.
BELGIUM MAY REQUIRE ENGLISH, FRENCH, OR GERMAN LABELING.

MNS-E0168A

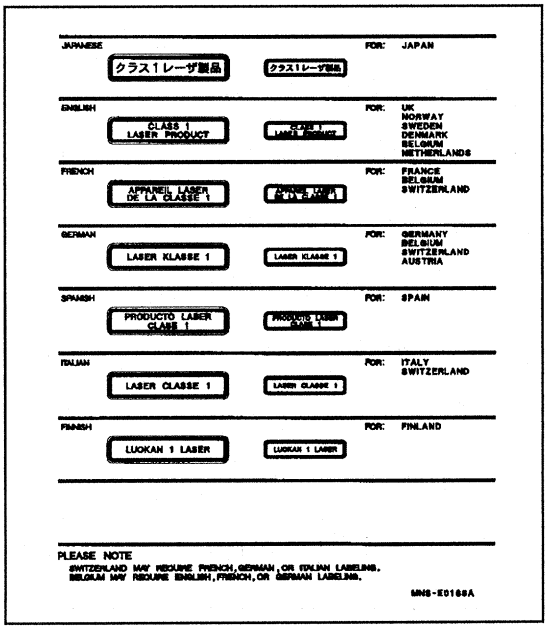
Q81211 and Q81212 are Class 1 Laser Products.
Put a label on the place shown in the following illustration according to the useful language in your country.

When the fiber is not inserted, cover the terminal with the cap to prevent the dust and the laser radiation from the inside of Q81211 and Q81212.



Q8221, Q81211, and Q81212 Front view

Put it on here.



Lithium Battery

(1) Q8221 backs up Memory by using the CPU board (BLK-019094).

In Q8221, the memory is backed up by a lithium battery (ER3 produced by Hitachi Maxwell).

ER3 produced by Hitachi Maxwell
ADVANTEST stock No.DBP-00148

(2) Dispose of the old lithium battery in accordance with the state-provided law.

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1. GENERAL

1.1 Product Outline

The Q8221 optical multi-power meter is equipped with 2 plug-in slots (A and B), and it can be used as an optical power meter with a maximum of 2 channels, or as a light source. The Q82202 plug-in unit connects short wave sensor Q82214 and long wave sensors Q82215, Q82216, and Q82226. The unit also measures space propagation light and fiber light by combining the functions of the various adapters.

The Q82203 plug-in unit connects long wavelength, high sensibility, high power sensor "Q82227" and high sensitivity, low polarization dependency sensor "Q82232", "Q82233" in addition to Q82214, Q82215, Q82216 and Q82226 and allows optical power measurement.

The Q82227 plug-in unit is capable of measuring the intensity of the high-power laser used in the optical fiber amplifier. When a tape fiber adapter is installed in the Q82216, it is also possible for the unit to measure multicore fiber loss.

The Q82208 plug-in unit of the long wave sensor is a high-precision, high-sensitivity piece of equipment used exclusively for fiber optics. This unit is capable of precisely measuring the loss of various optical parts by combining with the light source.

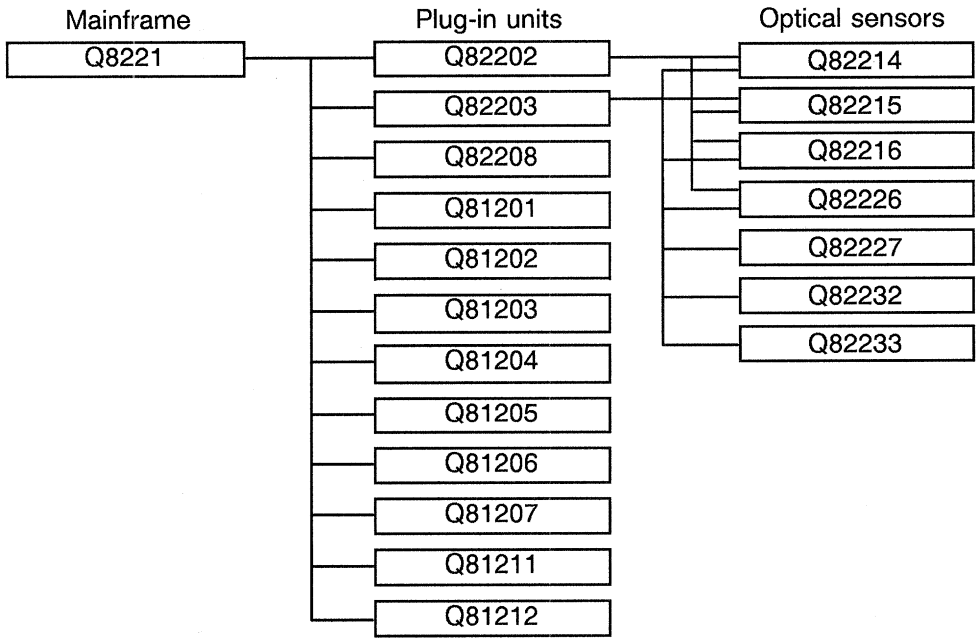
A total of 9 types of light source plug-in units are available, such as LED, LED with filter, Edge-Emitting LED (EELED), and LD. These units feature various operation functions such as a relative value operation between channels A and B, a dB reference operation, an averaging operation, and a MAX hold function.

In addition, the temporary data storage and data read functions are made possible by the 5 different memory settings and the recording functions of the 400 data channels. It is possible to output the stored data to the external plotter as a direct time series data graph by using the direct plotting function. The unit is equipped with a standard GPIB interface, the external controller can be operated by remote control, and the system start-up process is easy to perform.

Q8221 has independent two channels of analog output. It allows evaluating the long term stability of the optical device and the waveform response of the modulation light.

1.2 System Configuration

The plug-in units and optical sensors that are connectable to the Q8221 optical multi-power meter are as shown in the table below:



Use a sensor cable to connect Q82202 and Q82203 with light sensor of Q82214, Q82215, Q82216, Q82226 and Q82227.
(Sensor cable is accessory of Q82202 and Q82203.)

Model	Product name
Q82202	Interface plug-in unit (For connecting Q82214, Q82215, Q82216 and Q82226)
Q82203	Interface plug-in unit (For connecting Q82214, Q82215, Q82216, Q82226 Q82227, Q82232 and Q82233)
Q82208	High-sensitivity plug-in unit used exclusively for long-wave fibers
Q82214	Sensor used for measuring both shortwave space propagation light and fiber light *1
Q82215	Sensor used for measuring both long wave, space propagation light and fiber light *1
Q82216	Middle-sensitivity sensor used for measuring both long wave, space propagation light and fiber light *1
Q82226	High-power sensor used exclusively for long-wave fibers *1
Q82227	High-sensitivity and high-power sensor used exclusively for long-wave fibers *2
Q82232	High-sensitivity and low polarization dependency sensor for long wave fibers *2
Q82233	High-sensitivity and low polarization dependency sensor for long wave fibers *2
Q81201	850 nm LED light source plug-in unit
Q81202	1310 nm LED light source plug-in unit
Q81203	1550 nm LED light source plug-in unit
Q81204	1310 nm LED with filter light source plug-in unit
Q81205	1550 nm LED with filter light source plug-in unit
Q81206	1300 nm Edge-Emitting LED light source plug-in unit
Q81207	1550 nm Edge-Emitting LED light source plug-in unit
Q81211	1310 nm LD light source plug-in unit (Class 1 Laser Product)
Q81212	1550 nm LD light source plug-in unit (Class 1 Laser Product)

*1: It is necessary to use Q82202 or Q82203 with Q82214, Q82215, Q82216, and Q82226.

*2: When Q82227, Q82232 and Q82233 is used, it is necessary to use Q82203 together.

2. BEFORE GETTING STARTED

2.1 Checking Accessories

On receiving the Q8221, check if for any shipping damages. Next, check that the model name and the quantity of standard accessories are as shown in Table 2-1.
If any crack or damage is found or if any of the standard accessories is missing, contact the nearest ADVANTEST dealer.
A list of address and telephone number is given at the end of this manual.

Table 2-1 Standard Accessory List

Accessory	Specifications		Quantity	Remarks
	Model name	Stock No.		
Power cable	A01402	DCB-DD2428X01	1	
Power fuse	EAWK1.0A	DFT-AA1A	2	250V/1.0A (slow-blow fuse)
Instruction manual	——	EQ8221	1	English manual
Label for Class 1 Laser Product		MNS-E0168	1	Attached to Q81211/Q81212

Note: When ordering additional accessories, use the model name (or stock number).

2.2 Operating Environment

(1) AC power source

Be sure to use the supplied power cable (A01402) to operate the Q8221 by an AC power source. The AC power source can be used within the range of 100 V to 240 V without switching the input voltage. Also it must be used at a frequency range form 48 Hz to 66 Hz.

(2) Installation

The socket-outlet shall be installed near the equipment and shall be easily accessible.

(3) Ambient conditions for use

Keep an ambient temperature from 0°C to 40°C and an ambient humidity of 85% or less. Use the Q8221 in ventilated places not exposed to direct sunlight.

(4) Cleaning

To clean the Q8221, wipe with the cloth which is dry or soaked in the neutral detergent. And observe the following precaution.

CAUTION

To maintain or clean the Q8221, do not use any solvent which may degrade plastics (organic solvent such as benzene, toluene and acetone).

2.3 Fuse Check and Replacement

Procedure for checking or confirming a fuse is described below:

① Remove the power cable from the AC power connector.

② Pull out the fuse holder using a minus screwdriver. (See Figure 2-1.)

③ Replace the broken fuse with a new fuse if the fuse attached with the fuse holder is broken.

④ Insert the new fuse into the fuse holder then install the power cable to the AC power connector.

CAUTION

Be sure to replace with a fuse of the correct rating. If not, the Q8221 may be damaged.

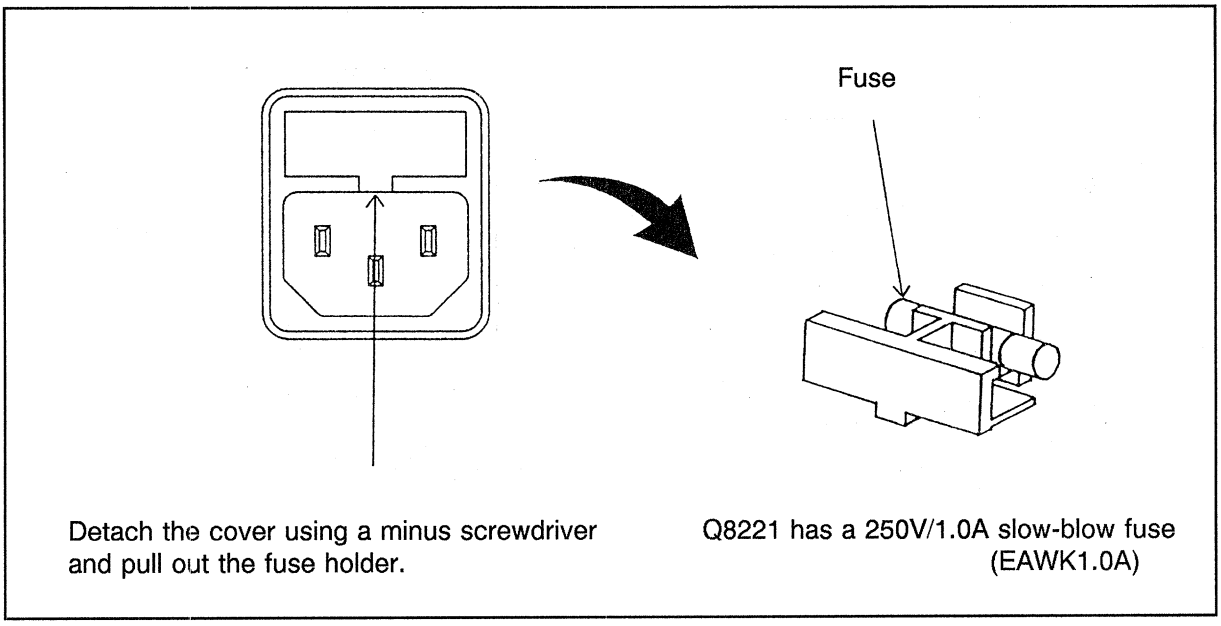


Figure 2-1 Checking Fuse

2.4 Storing and Transporting

(1) Storage

If the Q8221 is not used for a long time, avoid to store the Q8221 in the following places:

- Places exposed to direct sunlight
- Places subjected to corrosive gas generation
- Dusty places
- Much vibrating places
- High temperature and high humidity

The Q8221 is used in the following storage environment:

Temperature: −25°C to +70°C
Humidity: 90% or less

(2) Transporting

Use the original packing materials or its equivalents for transportation. Avoid the exclusive vibration and the machine damage.

Calibration

Calibration work should be performed at an ADVANTEST CORPORATION site.
When you want to calibrate the analyzer, please contact a sales representative.

Desirable Period	1 year

3. DESCRIPTION OF PANEL SURFACE

3.1 Description of Front Panel

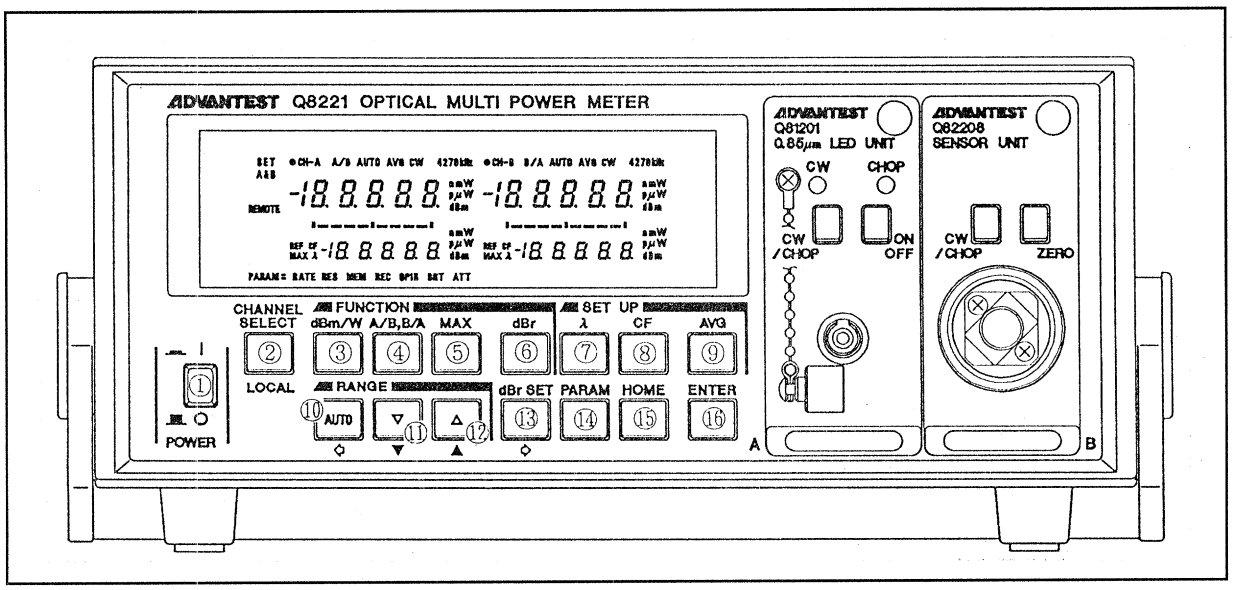


Figure 3-1 Q8221 Front Panel

① POWER Switch (Page 4-1)

This is the power switch. The Q8221 is operational only when the power switch is turned ON. The power supply is discontinued when the power switch is turned OFF.

② CHANNEL SELECT/LOCAL Key (Page 4-4)

This key functions as the CHANNEL SELECT key when the Q8221 is in the local mode, and it functions as the LOCAL key when the Q8221 is in the remote mode (REMOTE LAMP lights). On which channel each key is effective is determined by the setting of the CHANNEL SELECT key. The setting of the key will be displayed by the SET A&B lamp. The LOCAL key is used to change the setting from the remote state to the local state. The Q8221 is automatically in the local state when its power is turned ON.

③ dBm/W Key (Page 4-4)

This key sets the measuring value unit. The display unit changes from dBm to W each time this key is pressed. When this key is pressed in the relative value measurement mode (dBr mode), that mode is turned OFF.

④ A/B, B/A Key

This key performs operations between the measured values of the 2 channels (A & B). Each time this key is pressed, the operation mode changes from A/B to B/A or vice-versa, and to operation OFF.

⑤ MAX Key

This key holds the measured value at its maximum. When this key is pressed, the MAX lamp lights and the maximum value is displayed at the sub-measurement section. When the key is pressed again, the MAX hold function is turned OFF.

⑥ dBr Key

This key performs the relative value measurement function (dB Reference). When the key is pressed again, the relative value measurement function is turned OFF.

⑦ λ Key

This key functions to enter the mode that sets the measurement light wavelength.

⑧ CF Key

This key functions to enter the constant setting mode, which performs scaling and dB offset operations on the measurement values.

⑨ AVG Key

This key functions to enter the mode that sets the operation frequency during the conduction of moving average operations on the measurement values.

⑩ AUTO/ ⇦ Key

This key performs switching between the AUTO range and manual range settings (range hold) in the measurement mode. This key also changes the setting digit in the setting mode.

⑪ ▽/▼ Key

This key can be used to manually lower the measurement mode range. This key also reduces the set value in the setting mode.

⑫ △/▲ Key

This key can be used to manually raise the measurement mode range. This key also increases the set value in the setting mode.

⑬ dBr SET/ ⇨ Key

This key measures the reference value during relative value measurement (dB Reference). The measured value just before the key is pressed shall be the reference value of the relative value measurement.

⑭ PARAM Key

This key functions to enter the setting mode of sampling rate (Page 6-12), display digit (Page 6-14), memory function (Page 6-16), recording function (Page 6-18), direct plotting function (Page 6-18), GPIB function(Page 7-8), brightness variable function (Page 6-33) and output-power variable function of light source (Page 6-34).

⑮ HOME Key

This key cancels the set parameters and returns to the measurement mode and the parameters set before the setting mode was entered.

⑯ ENTER Key

This key stores the currently set parameters and returns the Q8221 to the measurement mode.

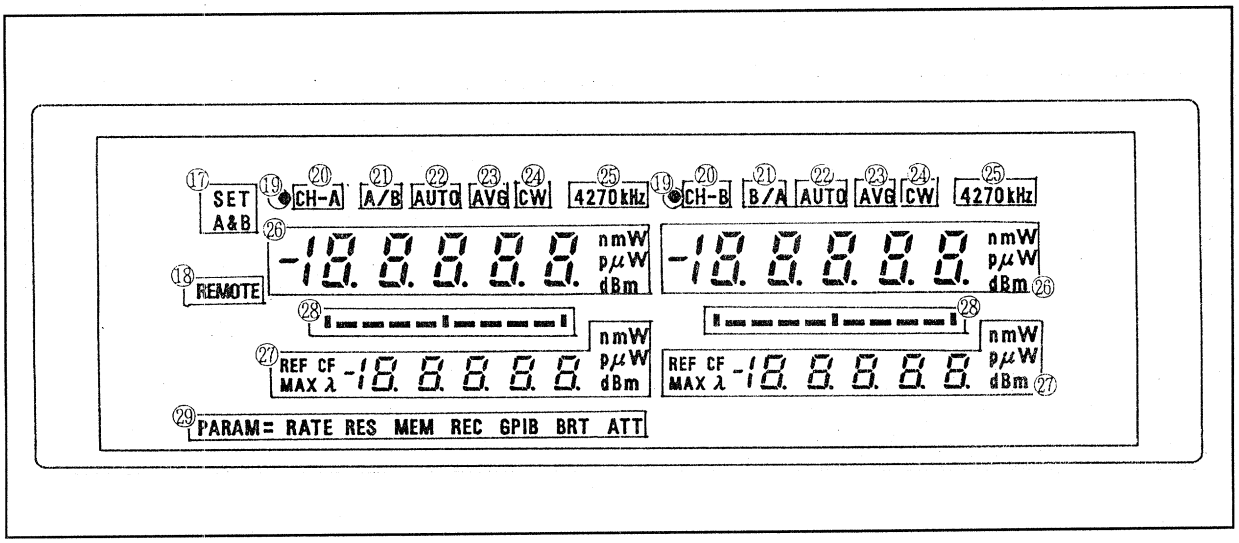


Figure 3-2 Q8221 Display

⑰ SET A&B Lamp (Page 4-4)

This lamp indicates which channel (A or B) is currently in use.

⑱ REMOTE Lamp

This lamp lights when the Q8221 is in remote control mode.

⑲ SAMPLING Lamp

This lamp lights during sampling timing.

⑳ CH-A / CH-B Lamp

This lamp lights when the plug-in unit is inserted and the Q8221 is in operation.

㉑ A/B / B/A Lamp

This lamp lights when channels A/B or B/A are in operation.

㉒ AUTO Lamp

This lamp lights during auto range.

㉓ AVG Lamp

This lamp lights when the moving average operation frequency is more than two (2). The lamp flashes when the averaging data frequency is less than the set frequency. The lamp then lights when the averaging data frequency reaches the set frequency.

㉔ CW Lamp

This lamp lights when the sensor plug-in unit is inserted and is in the CW-light measurement mode. The lamp lights when the light source plug-in unit is inserted and is in the CW light-output mode.

㉕ 4270 KHz Lamp

This lamp indicates "270Hz" when the sensor plug-in unit is inserted and is in the chopped-light measurement mode. The CHOP frequencies (270 Hz, 2 kHz, 4 kHz) are displayed when the light source plug-in unit is inserted and is in the chopped-light output mode.

㉖ Main measuring section and unit section

The measurement results are displayed when the Q8221 is in measurement mode. The currently set parameters are displayed when the Q8221 is in the setting mode.

㉗ Sub-measuring section and unit section

Normally, the currently set wavelength is displayed. In CF operation, the CF set value is displayed. The reference value is displayed during relative value measurement, and the MAX value is displayed during MAX hold measurement.

㉘ LEVEL Meter

This meter indicates the level of the A/D conversion result.

㉙ PARAMETER Display Lamp

This lamp displays the currently set parameters.

㉚ PLUG-IN Slot

This slot is for the insertion of the plug-in unit.

3.2 Description of Rear Panel

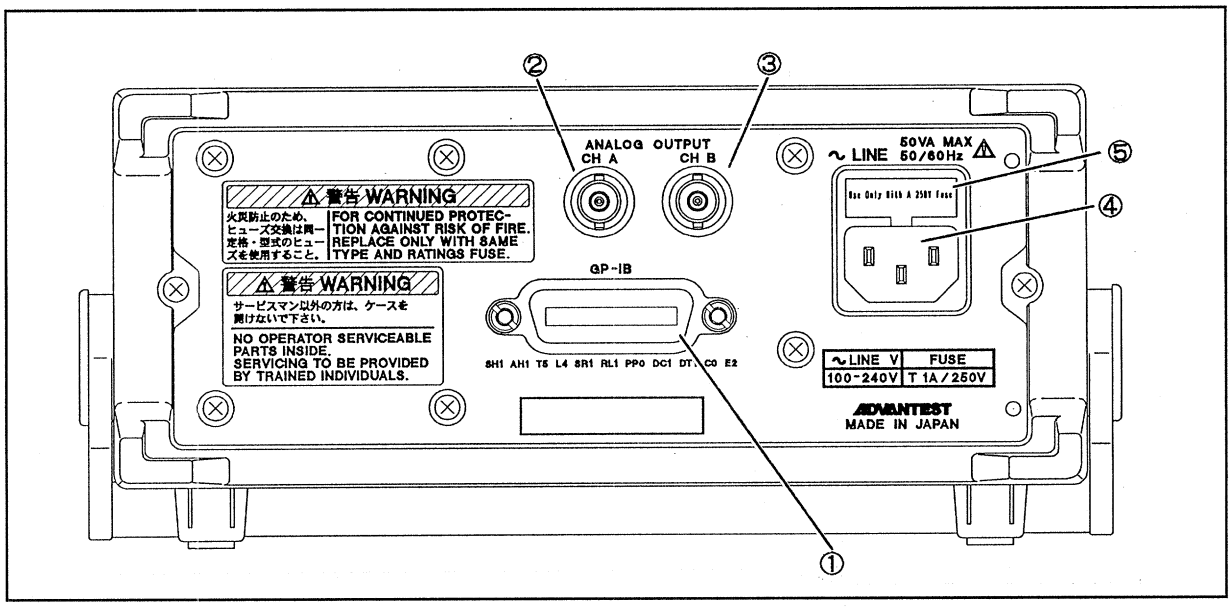


Figure 3-3 Q8221 Rear Panel

① GPIB Connector

24-pin connector for IEEE488 bus

② ANALOG Output terminal (CH-A)

Terminal for outputting an analog voltage of the measured value (CHANNEL A). The same voltage value of the voltage input into the A/D converter is output. The range of output voltage is 0 to 2 V. (Refer to "6.12 Analog-Output Function" for details.)

③ ANALOG Output terminal (CH-B)

Terminal for outputting an analog voltage of the measured value (CHANNEL B). The same voltage value of the voltage input into the A/D converter is output. The range of output voltage is 0 to 2 V. (Refer to "6.12 Analog-Output Function" for details.)

④ AC Power connector

Connector for AC Power supply.
Connect the power cable to this connector.

⑤ Power Supply fuse

Insert the slow-blow fuse of 1.0 A.

3.3 Panel Description of Plug-in Unit

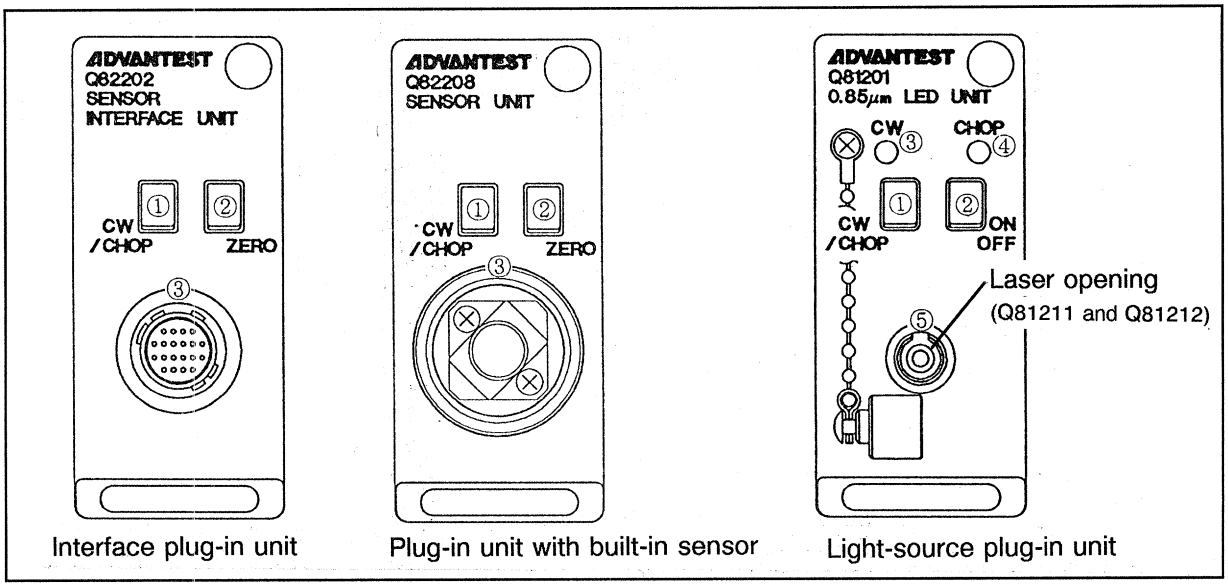


Figure 3-4 Plug-in Unit

3.3.1 Interface Plug-in Unit

① CW/CHOP Key

This key toggles the CW-light measurement mode and the chopped-light (270 Hz) measurement mode.

② ZERO Key

This key corrects the offset value when shielding the light.

③ Input connector

This connector is used to connect the sensors (Q82214, Q82215, Q82216, Q82226, Q82227 etc.) using the connector cables.

3.3.2 Plug-in Unit with Built-in Sensor

① CW/CHOP Key

This key toggles the CW-light measurement mode and the chopped-light (270 Hz) measurement mode.

② ZERO Key

This key corrects the offset value when shielding the light.

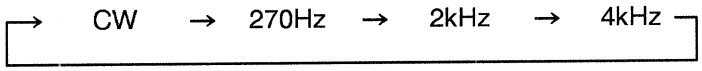
③ Optical input connector

This connector is used to connect the optical fiber and to perform the rays of light incident upon the Q8221.

3.3.3 Light Source Plug-in Unit

① CW/CHOP Key

By pressing this key each time, the output-light mode changes in the following order:



If the power level of the light source is set in the range of 0.1 dB to 6.0 dB by the output-power variable function, however, 2 kHz and 4 kHz can not be selected. (For the output-power variable function, refer to [6.11 Output-Power Variable Function of Light source].)

② ON/OFF Key

By pressing this key each time, ON/OFF is toggled.

③ CW LED

LED lights when the light source output is set to the CW mode and is emitting light.

④ CHOP LED

LED lights when the light source output is set to the CHOP mode and is emitting light.

⑤ Light-output connector

This connector is used to connect the optical fiber and to perform the rays of light incident upon the Q8221.

4. Q8221 Easy Operation

4.1 Setting Up

(1) Inserting the plug-in unit

Insert the plug-in unit into the CHANNEL A or B before turning on the power.

CAUTION

Be sure to insert the plug-in unit in the power OFF condition.
The Q8221 and the plug-in unit may be damaged if the plug-in unit is installed or removed in the power ON condition.

(2) Power ON

Turn on the POWER switch.

(3) Pre-heating time

All the function of the Q8221 is available by turning the power on, and the waiting time is required to keep the standard accuracy; at least 30 minutes for the optical sensor, at least 60 minutes for the light source.

4.2 Backup and Initializing the Setting Parameters

Various setup parameters are backup by the battery in the Q8221. The previous setup conditions are kept when the Q8221 is turned off and re-starts. Refer to Table 4-1 for initial condition.

Table 4-1 Setup Parameter Default Value

Parameter	Default value	Parameter	Default value
SET A&B	A	CF (dB)	0.00dB
Range	AUTO	CF (linear)	1.000
dBm/W	dBm	AVG	1
A/B, B/A	OFF (*)	RATE	100ms (SL)
MAX	OFF	RES	6 digits
dBr	OFF (*)	GPIB (address)	8
dBr Reference value	Clear	GPIB (header)	ON
CW/CHOP	CW	BRT	4
λ	780nm or 1300nm	ATT	0.0dB

Note: (*) is not backuped.

(Procedure for initializing the parameter)

The following procedure is required to initialize the all setup values.

① Turn off the POWER Switch.

② Turn on the POWER Switch by pressing the dBr key.

③ Hold down the dBr key after displaying the TEST.

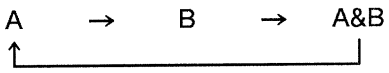
4.3 Measurement Procedure

The following shows the basic procedure for light-power measurement.
Chapter 5 describes the measurement methods for applications, and chapter 6 for the use of various functions. For advanced measurements, refer to each chapter.

(1) Setting the channel	When plug-in units are installed into both channels, select the channel A or B. The following operation is available for the already set channel. If any one of plug-in unit in channels is installed, the channel of the plug-in unit installed is selected.
(2) Setting the CW/CHOP (270 Hz)	Sets the type of the light to be measured. To measure the CW light, select the CW mode. In case of the 270 Hz modulation light, select the CHOP mode.
(3) Setting the dBm/W	Selects the unit of dBm or the unit of W to measure.
(4) Setting the Wavelength	Sets the wavelength of light to be measured in advance. The sensitivity of sensor is different in accordance with the wavelength of light.
(5) Zero offset	Shields the light receiving connector of the sensor. The value after pressing the ZERO key of the plug-in unit is assumed as an offset value. The measurement value is automatically canceled.
(6) Light incidence	Enters the light to be measured into sensors.
(7) Setting the range	When the auto range is set, the optimum range is selected in accordance with the power level of light to be measured. To monitor the analog output, recommend to select the manual range.
(8) Read out the display	Read out the displayed light-power to be measured.

(1) Setting the channel

When plug-in units are installed into both channels (A, B), set the channel using the CHANNEL SET UP key. By pressing the CHANNEL SET UP key each time, the SET A&B lamp lights as follows:



When the A or B lights, various control keys are available for the channel A or B. When the A&B lights, various control keys are effective for both channels. However, if the parameters for the channel B are outside of the specified range, only channel A is set (channel B is not set in this case). In addition, if the optical sensor and the light source are installed at the same time, the A/B is not set.

(2) Setting the CW/CHOP (270 Hz)

Sets the type of measurement light using the CW/CHOP key of the plug-in panel. By pressing the CW/CHOP key each time, the CW-light (continuous light) measurement mode and the CHOP-light (270 Hz modulation light) measurement mode is switched.
When the CW-light measurement mode is selected, the CW lamp lights. In case of CHOP-light measurement mode, the 270 Hz lamp lights.

CHOP light measurement mode that is the measurement mode only component of the modulation light by 270 Hz chopping.

(3) Setting the dBm/W

By pressing the dBm/W key, select the unit of dBm or the unit of W. The unit is switched by pressing the dBm/W key each time.

(4) Setting the wavelength

With the compensation function of wavelength sensibility, the sensibility difference depending on the wavelength of the optical sensor can be automatically compensated. It allows direct reading of the measurement value after the compensation. Be sure to set the wavelength of the input light to measure the absolute value of the optical power.
Enters the wavelength setup mode by pressing the λ key, set the wavelength of the light to be measured.

① Previous wavelength setup value is displayed.
② Blink the digit to change the setting value using ⇦ or ⇨ key.
③ Using the ▲ or ▼ key enables to increase or decrease the digit blinking.

④ When the desired value is set, press the ENTER key. The wavelength setup is completed and the Q8221 returns to the measurement mode.

The following shows the example for changing the setting value from 1300nm to 1550nm.

Operation	Display
λ	Main-display section: L 1 3 0 0 nm
⇦ ⇦	Main-display section: L 1 3 0 0 nm
▲ ▲	Main-display section: L 1 5 0 0 nm
⇨	Main-display section: L 1 5 0 0 nm
▲ ▲ ▲ ▲ ▲	Main-display section: L 1 5 5 0 nm
ENTER	Sub-display section: 1 5 5 0 nm

Note: Crosshatching displays the flashing digit.

(5) Zero correction

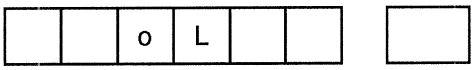
The offset is generated by the dark current of light element and the offset voltage of calculation amplifier in the CW-light measurement mode.
The measurement value after performing the zero correction is automatically canceled with offset.
When the ZERO key is pressed after shielding the sensor, the zero correction is performed. The message "0 ADJ" is displayed during operation. When the message disappears, the zero correction is completed and the offset is canceled.
To break the zero correction, push the CW/CHOP or zero key with "0 ADJ" displayed. After "Err. 32" is displayed, the zero correction is broken off.

CAUTION

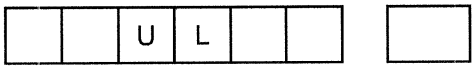
The offset may be generated in the measurement value due to the environment change such as temperature. Check that the offset is canceled by shielding the sensor. If not, perform the zero correction.

(6 to 8) Entering the light, setting the range, and read out the display

Enter the light to be measured into the sensor.
When the auto range is set by pressing the AUTO key (AUTO lamp lights), the optimum range is selected in accordance with the power level of the light to be measured and the light-power value is displayed.
When the AUTO key is re-pressed, the AUTO lamp disappears and the manual range (range hold) is set. In addition, pressing the △ or ▽ key enables to increase/decrease the range then the manual range is set.
If any input value exceeding the full scale of each range is applied, the screen is overflowed shown below. In this case, increase the range using the △ key.



In dB measurement, if any input value less than the full scale of 1/20000 is applied, the screen is minimum flowed shown below. In this case, decrease the range using the ▽ key.



4.4 Replacing and Cleaning the Optical-Connector Adapter of Q82208, Q82227, Q82232 and Q82233

(1) Replacing the optical-connector adapter

The FC-type connector adapter is equipped with standard for the Q82208, Q82227, Q82232 and Q82233. The optional optical-connector adapters such as SC-type or ST-type are provided as accessories. The method of replacing the optical-connector adapter is shown in Figure 4-1 and 4-2. Easy replacement can be conducted by removing the fixed cap for the adapter and pulling out the adapter.

(2) Cleaning the optical connector

Remove the adapter same as the procedure of adapter replacement and clean the tip of light-input section with alcohol. If Q82208 and Q82227 are used with the dirty light-input part, some error may occur in its measurement value.

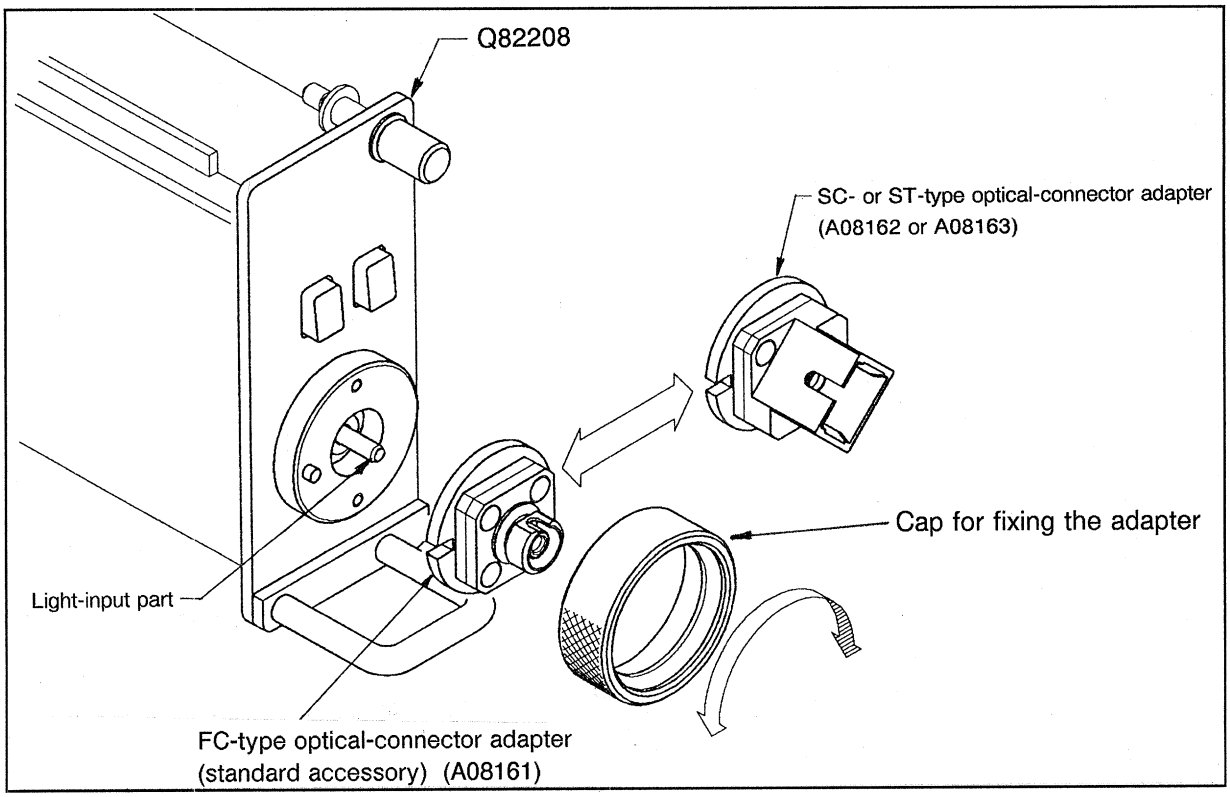


Figure 4-1 Replacing and Cleaning the Optical-Connector Adapter of Q82208

Note : Screw up surely after clearing of the optical connector and or exchanging of the optical connector adapter.

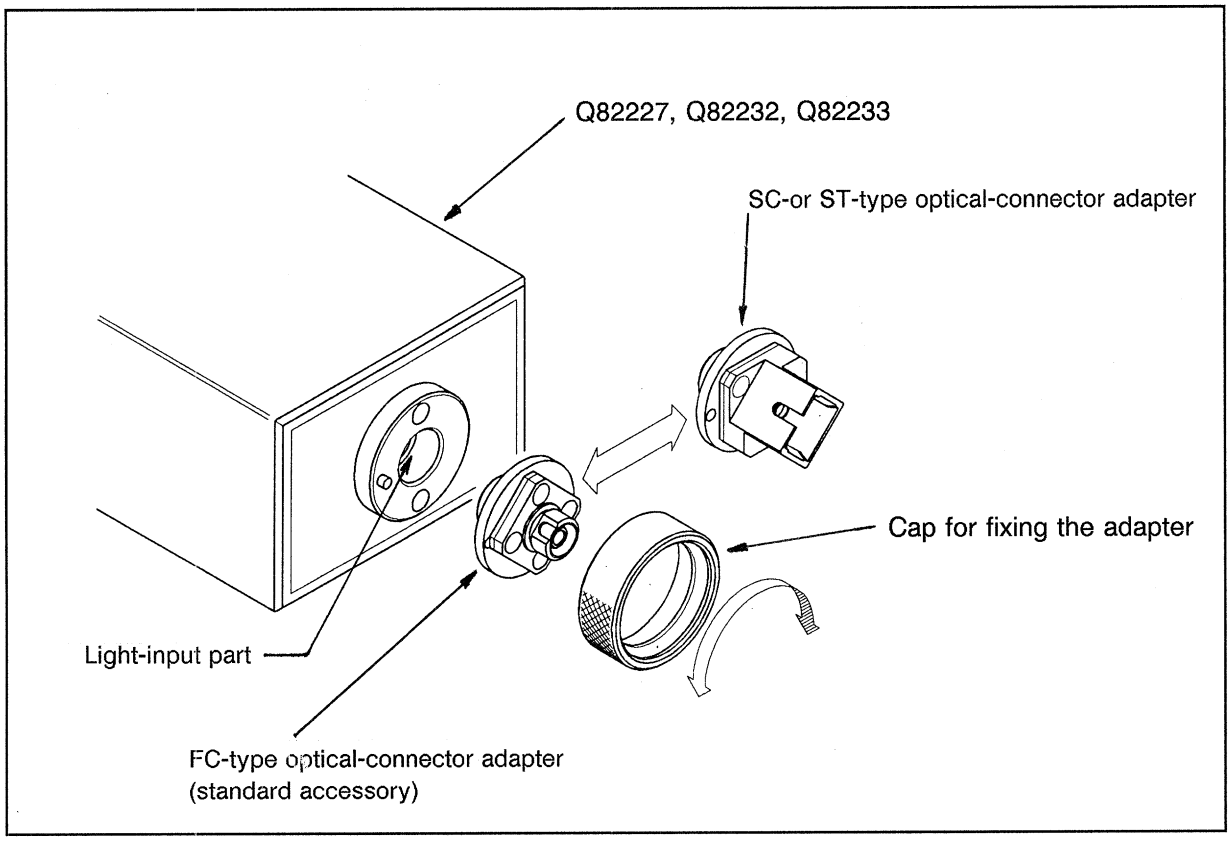


Figure 4-2 Replacing and Cleaning the Optical-Connector Adapter of Q82227, Q82232 and Q82233

Note : Screw up surely after clearing of the optical connector and or exchanging of the optical connector adapter.

4.5 Using High Return-loss Adapter

(1) Purpose of Using High Return-loss Adapter

High return-loss adapter can reduce the reflection return light from the input connection part of the optical sensor. Therefore, optical power can be measured with high stability of measurement system and light source. Since the optical fiber inside the high return-loss adapter has big core diameter, coupling loss (insertion loss) can be minimized by using the SM 10μmϕ optical connector. The coupling loss (insertion loss) is Typical 0.07dB.

(2) Using Procedure of High Return-loss Adapter

Connecting part (a) with the optical sensor is FC type connector/bevel ground as shown in Figure 4-3. Connect the part (a) with the optical sensor input part. Optical fiber input part (b) is ground in SPC (super PC). Connect the part (b) to the optical fiber connector to be measured.
FC, SC, ST and plug-in (for mounting DS) are provided as the connector type of optical fiber input part (b) as shown in Table 4-2. They can be ordered by its own accessory number.

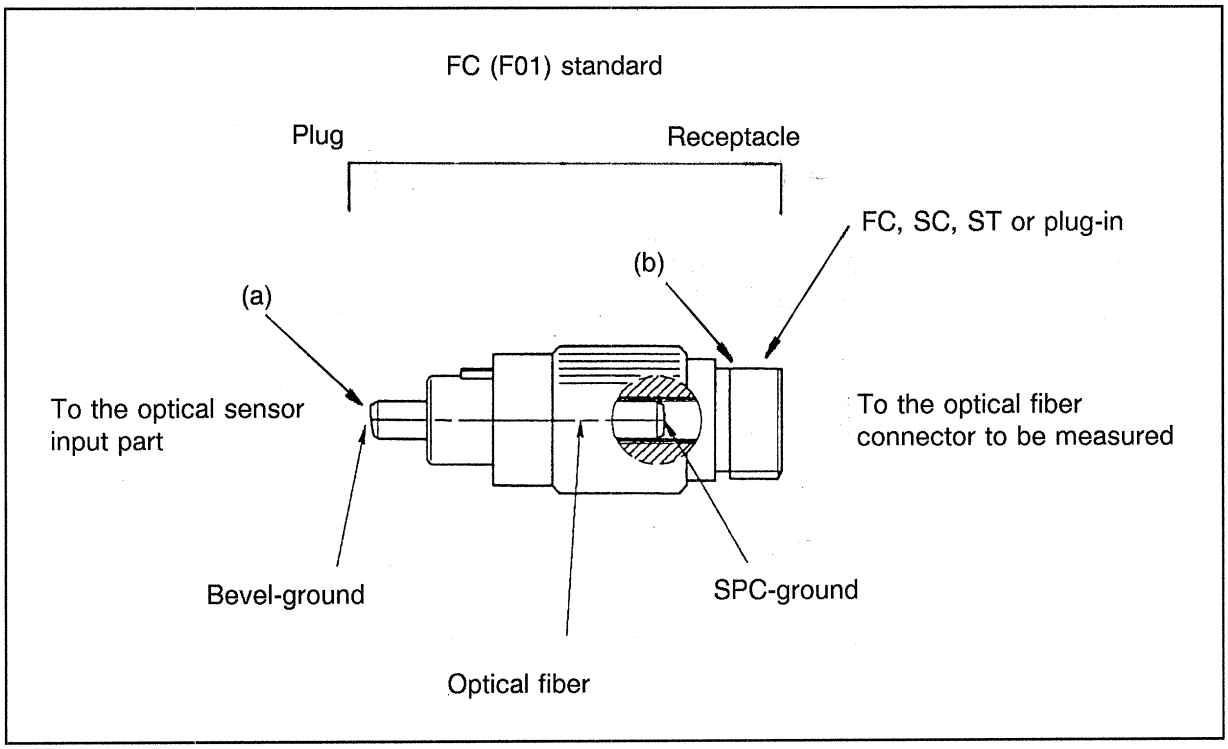


Figure 4-3 Using High Return-loss Adapter

Table 4-2 List of High Return-loss Adapters

Connector type of the optical fiber connector to be measured	Accessory number
FC	A08328
SC	A08329
ST	A08330
Plug-in (for mounting DS)	A08331

(3) Using Plug-in (for mounting DS) Type High Return-loss Adapter

The attachments of side (b) for plug and for jack are provided as shown in Figure 4-4. This adapter can correspond to both of plug and jack by selecting these attachments. These attachments are included in the plug-in (for mounting DS) type high return-loss adapter (A08331).

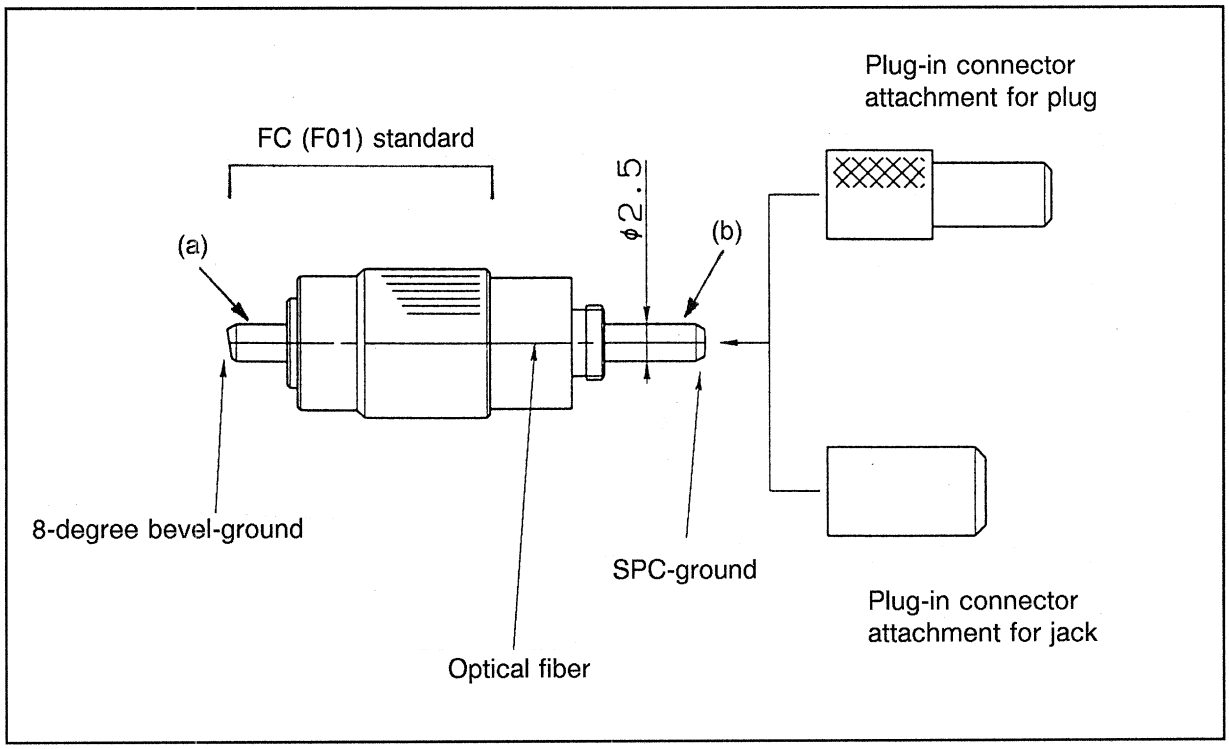


Figure 4-4 Using Plug-in (For Mounting DS) High Return-loss Adapter

(4) Notice on High Return-loss Adapter Usage

Return-loss at using the high return-loss adapter is specified in "9.2 Sensor Plug-in Unit Specifications". As the connecting times with the optical fiber connector to be measured increases, the specification value can not be satisfied by refuse or flaw attached to the contact surface. Clean the contact surface by using cotton swab etc. If the contact surface is scratched, purchase new one.

(5) Correction of High Return-loss Adapter Coupling Loss (Insertion loss)

Coupling loss (insertion loss) is Typical 0.07dB or so (When using SM 10μmϕ fiber.). Execute the following procedure to correct the coupling loss.

① Connect the optical fiber connector to be measured to the optical sensor directory and measure the optical power. (Measurement value (a))

② Measure the optical power by using the high return-loss adapter. (Measurement value (b))

③ Correct the coupling loss of (Measurement value (b)) - (Measurement value (a)) by using CF function of this instrument. The result after the correction can be read directory by this procedure.

CAUTION

When the coupling loss is measured by above procedure, the return light from the optical sensor is changed. Measure the coupling loss with optical isolator so that the optical power output light of the light source side is not changed by this return light.

4.6 Using Falling Prevention Cap (A08332)

Falling prevention cap (A08332) prevents that the FC type high return loss adapter (A08328) is disconnected accidentally.

The usage is shown in Figure 4-5.
Available optical sensors are Q82208 and Q82227.

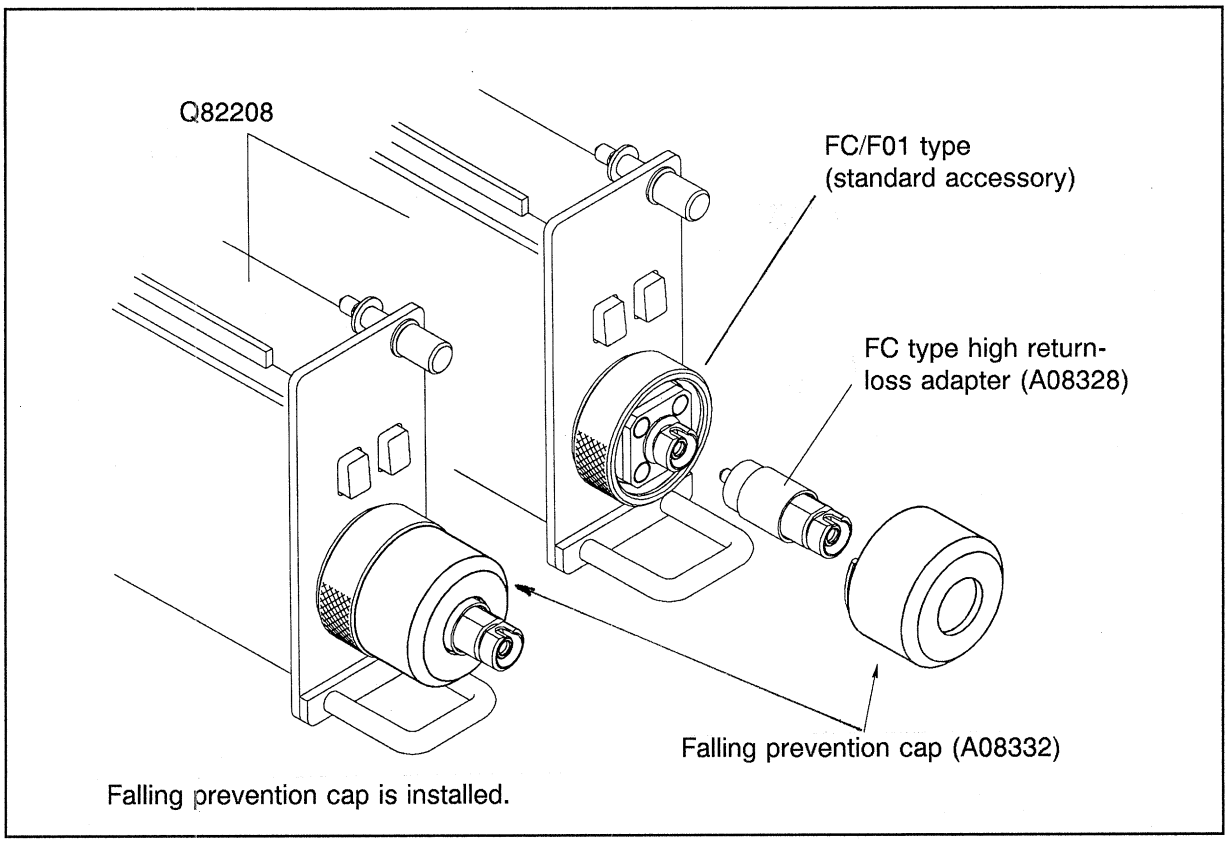


Figure 4-5 Using Falling Prevention Cap (A08332)

5. MEASUREMENT PRACTICAL EXAMPLE

5.1 General Light-Power Measurement

This chapter describes the procedure to measure the light source light-power in the configurations of the Q8221 + Q82202 + Q82215 and to display the dBm.

(1) Setup

Setup method is shown in Figure 5-1.

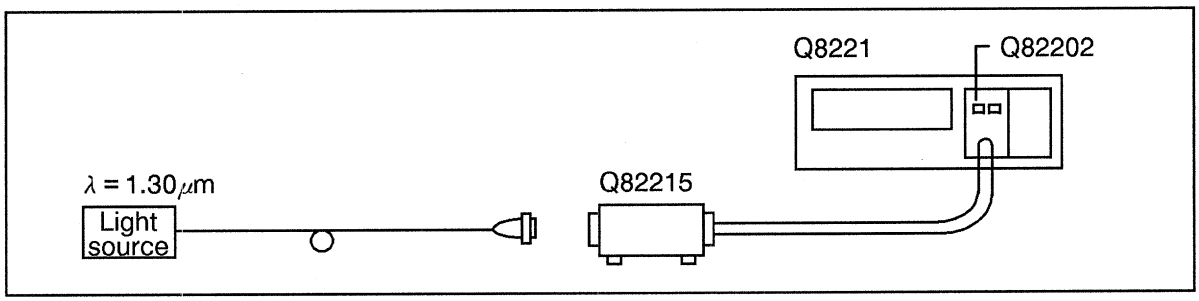


Figure 5-1 Output-Power Measurement of Light Source

(2) Selecting the CH A (channel A)

When the "SET A" is not lit up, check whether the "SET A" is lit up by pressing the CHANNEL SELECT / LOCAL key.
⟶ "SET A" lights.

(3) Selecting the unit of dBm

When the unit of W is displayed, press the dBm/W key to set the unit of dBm.
⟶ The unit of dBm is displayed.

(4) Selecting the auto range

When the AUTO indicator is not lit up, press the AUTO ← key to set the auto range.
⟶ AUTO indicator lights.

(5) Inputting the light

Connect the fiber with the sensor connector to input the light.
⟶ Measurement value is displayed.

5.2 Measurement of Optical Fiber Loss

This subsection describes the procedure to measure the optical fiber loss by the attachment/ detachment of the connector in the configurations of the Q8221 + Q82202 + Q82215.

(1) Setup

Setup method is shown in Table 5-2.

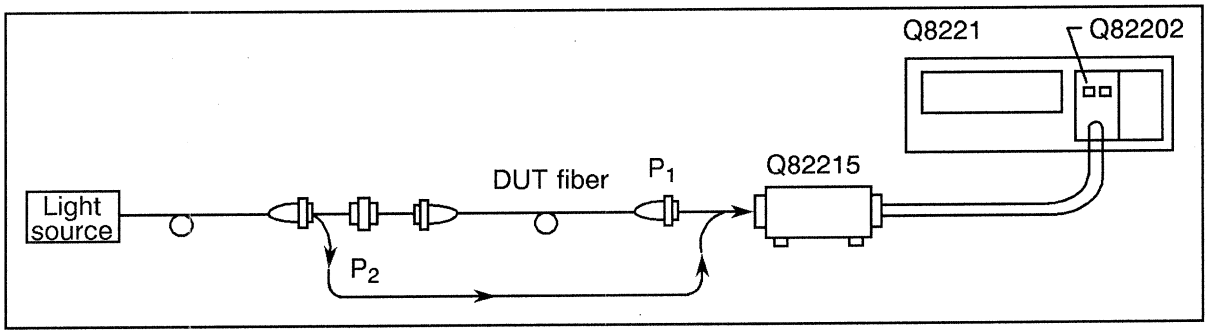


Figure 5-2 Measurement of Optical Fiber Loss by Connecting the Connector

(2) Connecting the dummy fiber

Connect the dummy fiber to the light source.

(3) Connecting the dummy fiber with DUT

Connect the DUT fiber to the dummy fiber edge using the connector.

(4) Measuring the P_1

Connect the DUT fiber edge to the connector of the Q82215. In this case, the power to be measured is assumed as P_1 (dBm).

(5) Measuring the P_2

Remove the dummy fiber from the connector and connect it to the connector of the Q82215. In this case, the power to be measured is assumed as P_2 (dBm).

(6) Calculating the loss P

Loss P (dB) of the DUT fiber is calculated as follows:

$$P = P_2 - P_1 \text{ (dB)}$$

5.3 Measurement of Tape Fiber Loss

The Q8221 enables to connect the sensor Q82216 which is available to measure the optical power of the tape fiber. The following shows how to measure the tape fiber loss by the cut-back method.

(1) Setup

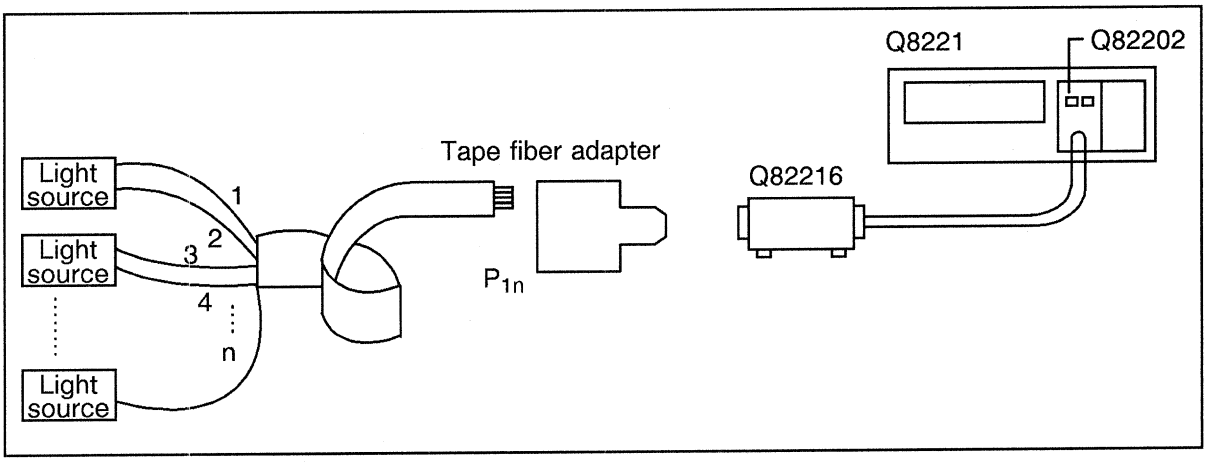


Figure 5-3 Measurement of Tape Fiber Loss

(2) Setting the CHOP-light measurement mode

① When the "SET A" is not lit up, check whether the "SET A" is lit up by pressing the CHANNEL SELECT / LOCAL key.

② Press the CW/CHOP key to light up the indicator of 270 Hz. The CHOP-light measurement mode is set.

(3) Measuring the P_{1n}

The Q8221 enables to measure the CHOP light (270 Hz modulation light) of −43 dBm or less without no affection of CW light if the CW light of −22 dBm or less is superimposed. (P_{11}) By using this function, the waiting time for the power stability can be shorten since the measurement is performed without turning off the power. Therefore, the CHOP light (270 Hz modulation light) power of each fiber can be measure. (P_{12}, P_{13}, ...)

(4) Measuring the P_{2n}

Cut the tape fiber and re-connect it with the tape fiber adapter (see Figure 5-4). Next likely the P_{1n}, input the CHOP light (270 Hz modulation light) into each fiber step by step. In this case, the power is assumed as P_{2n}.

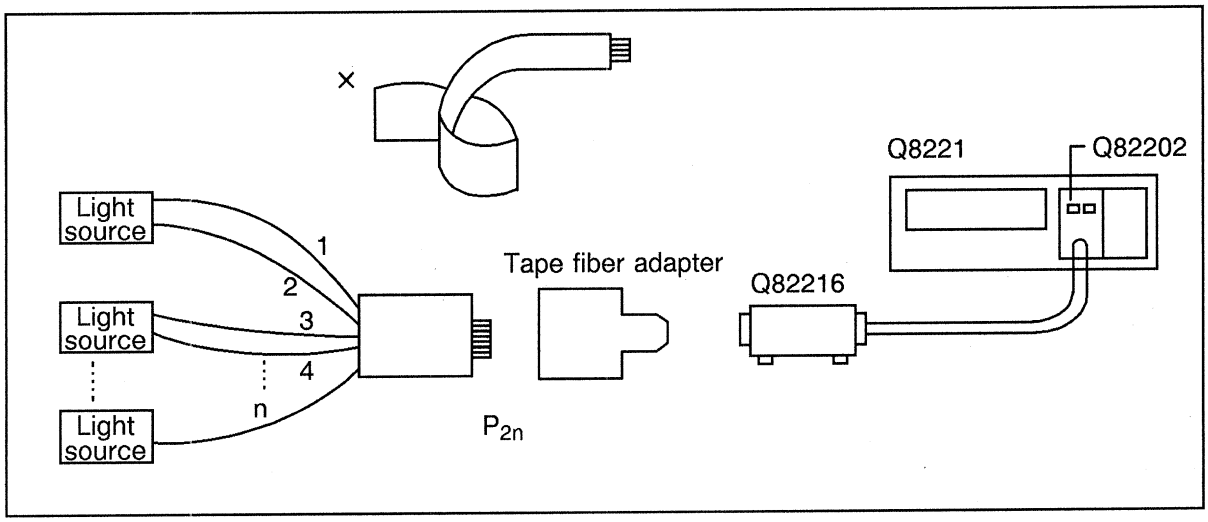


Figure 5-4 Connecting the Fiber Adapter (Tape Fiber)

(5) Measuring the loss P_n

Loss P_n (dB) of each DUT fiber is calculated as follows:

$$P_n = P_{2n} - P_{1n} \text{ (dB)}$$

5.4 High-Resolution Stability Measurement Using dBr Function

The Q8221 enables to perform the high-resolution measurement by 1/1000 dB resolution.
The following shows the example for performing the stability measurement of the connector adapter.

(1) Setup

Setup procedure is shown in Figure 5-5.

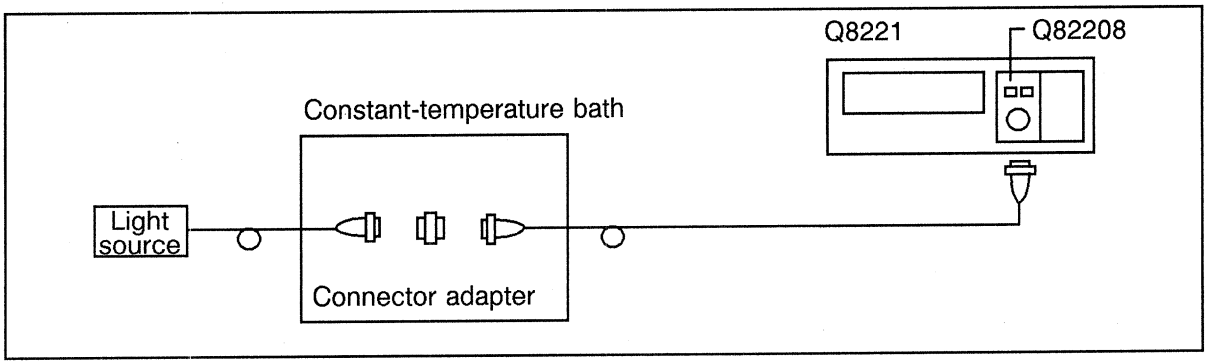


Figure 5-5 Setup for High-Resolution Stability Measurement of Connector Adapter

(2) Setting the dBr

① When the "SET A" is not lit up, check whether "SET A" is lit up by pressing the CHANNEL SELECT / LOCAL key.

② Press the dBr SET key. The previous measurement value just before pressing the dBr SET key is assumed as a reference value.

③ Press the dBr key. The dBr mode is set and then the unit of dB is displayed with the value changed against the reference value.

④ By changing the temperature setting value of constant-temperature bath, the temperature stability characteristic of the connector adapter can be measured.

5.5 Measuring the Branch Ratio of Optical Branch-Unit

To measure the branch ration of optical branch-unit, the calculation function between 2 channels of the Q8221 is available.

(1) Setup

Connect the light source and the Q8221, the optical branch-unit, and the sensors as shown in Figure 5-6. Connect the light source with the input terminal of the optical branch-unit, each output terminal of the optical branch-unit with each input terminal of the Q82208 by using fibers.

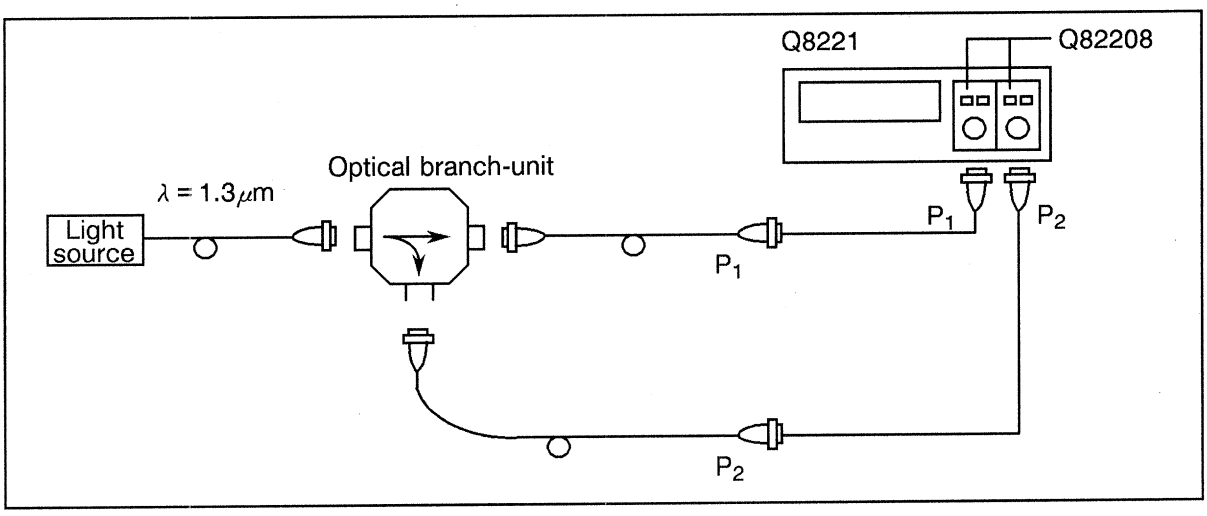


Figure 5-6 Measuring the Branch Ratio

(2) Setting the A/B (or B/A)

When the "CH B" is referenced, press the A/B, B/A ☐ key to display the A/B.

When the "CH A" is referenced, press the A/B, B/A ☐ key to display the B/A.
In case of A/B, the branch ratio is displayed in the CH A display area and the P_2 in the CH B area. In addition, the P_1 and the P_2 indicate the measured light-power of each sensor.

(3) Canceling the calculation between 2 channels

To measure the P_1 and P_2 with canceling the calculation between 2 channels, press the A/B, B/A ☐ key.

6. FUNCTIONS

6.1 A/B, B/A Calculation

(1) Outline

When the sensor plug-in unit is inserted into both the channels, the relative value between them will appear. The display indicates division results of both measured values for W measurement and subtraction results of them for dBm measurement.
If either of A or B channel is used for dBr calculation, A/B or B/A calculation cannot be set to ON.
Also, MAX HOLD function is not available during A/B and B/A calculation.
Since A/B or B/A calculation performs the simultaneous sampling, two phenomena can be compared simultaneously.
For A/B calculation, A/B lamp lights, and the A/B calculation result appears on the A channel side and the measured value of B channel appears as a reference on the B channel side.
For B/A calculation, B/A lamp lights, and the B/A calculation result appears on the B channel side and the measured value of A channel appears as a reference on the A channel side.
Note that the A/B or B/A calculation is cleared by powering OFF.

(2) Executing the A/B or B/A calculation

When powering ON, A/B or B/A calculation function is set to OFF. Pressing the A/B or B/A key once will cause the A/B calculation mode to be entered, another pressing will cause the B/A calculation mode to be entered, and pressing once more results in returning the calculation mode OFF.
Note that if the sensor unit connects to only either channel, the A/B or B/A calculation is invalid and therefore pressing the A/B or B/A key will cause nothing.

(3) Sampling rates when calculating A/B or B/A

When calculating a ratio of A/B or B/A, the sampling rate of the channel used for the denominator (for example, when calculating A/B, the channel used for the denominator is channel B) is automatically set for both channels.
In addition, when the denominator of a sampling rate is FS-3, the resultant sampling rate is either of the two as shown below, depending on the numerator:
(When the channel for the numerator can use FS-3, FS-3 is set for both channels.
(When the channel for the numerator cannot use FS-3, FS2 is set for both channels.
After terminating an A/B or B/A calculation, the sampling rate for each channel is reset to the conditions before the calculation.

Operation	Display	Description
Power ON	CH-A Measured value | CH-B Measured value	When power is turned on, calculation is set to OFF.
Press A/B or B/A key.	A/B A/B Calculated value | CH-B Measured value	A/B calculation is performed, the A/B calculation value is displayed on the side A and the CH-B measurement value on the side B.
Press A/B or B/A key.	B/A CH-A Measured value | B/A Calculated value	B/A calculation is performed, the CH-A measurement value is displayed on the side A and the B/A calculation value on the side B.
Press A/B or B/A key.	CH-A Measured value | CH-B Measured value	The calculation is set to OFF.
Press A/B or B/A key.	A/B A/B Calculated value | CH-B Measured value	A/B calculation is performed, the A/B calculation value is displayed on the side A and the CH-B measurement value on the side B.

6.2 MAX HOLD Function

(1) Outline

MAX HOLD function displays the maximum value after operation. The maximum value is displayed on the sub-measurement section and the current measured value is displayed on main-measurement section.
It is suitable for applications for adjusting the position of the maximum value. Note that the MAX value held once is cleared according to the following conditions:

- When MAX HOLD function is canceled.
- When dBr calculation (ON/OFF) is toggled.
- When the range is changed using the UP/DOWN key.
- When the CF calculation (ON/OFF) is toggled.
- When the unit of measurement is changed.
- When the averaging count is changed.

The MAX HOLD function is cleared by powering OFF. However, the MAX value is not updated during the AVG lamp lights.

(2) Executing the MAX HOLD function

The MAX HOLD function is set to OFF when the power is turned on. When the MAX key is pressed once, the MAX mode is set to ON. The key is pressed again, the MAX mode is set to OFF. The MAX lamp is lit up when the MAX mode is set to ON.

Operation	Display		Description
Power ON	Main display	Measured value	When power is turned on, MAX is set to OFF.
	Sub display	λ setting value, etc.	
Press MAX key.	Main display	Measured value	MAX is set to ON, the main display shows the currently measured result and the sub display shows the MAX value.
	Sub display	MAX MAX value	
Press MAX key.	Main display	Measured value	MAX is set to OFF.
	Sub display	λ setting value, etc.	

6.3 Relative Value Measurement Function

(1) Outline

The function uses the measurement result, for a reference, at the time point when dBr SET key is pressed and displays the variation from the latest measurement result (in dB unit) on the main measurement part. In addition, the sub-measurement part displays the measurement value used for the reference.
It is suitable for applications such as measuring stability of light sources or optical parts and measuring losses of optical parts. Note that the relative value measurement function is cleared by powering OFF.

(2) Setting and updating the reference value

When the dBr SET key is pressed, the measured value at that time is the reference value and each pressing of the key will update the reference value.
Also, if the dBr key is pressed when the reference value is cleared, the measured value at that time is the reference value and causes the relative value measurement to be entered.

(3) Executing the relative value measurement

Pressing the dBr key turns ON the dBr measurement (relative value measurement) and another pressing turns OFF it. In the dBr measurement unit, REF lamp is lit up.
When the relative value measurement function is turned ON, the measurement unit is changed to dB.

Operation	Display		Description
	Main display	Measured value	When power is turned on, dBr is set to OFF.
	Sub display	λ setting value, etc.	
Press dBr key.	Main display	Relative value	dBr is set to ON, the main display shows relative value and the sub display shows reference value.
	Sub display	REF Reference value	
Press dBr key.	Main display	Measured value	dBr is set to OFF.
	Sub display	λ setting value, etc.	

(4) Clearing the reference value

The reference value for relative measurement can be cleared by powering OFF while pressing the dBr key.

6.4 CF (Compensation Factor) Calculation Function

(1) Outline

For W measurement, the main measurement part displays the value obtained by multiplying the measured value by the CF setting value. For dBm measurement, the main measurement part displays the value obtained by adding the CF setting value to the measured value. When the CF setting value is other than 1 and 0 dB, the CF calculation is performed, the CF lamp is lit up, and the CF setting value appears on the sub measurement parts.

Even if the attenuator is fixed on the sensor, the use of the CF calculation allows optical power to be directly read out by setting the attenuation value.
The CF value can be set in either of WATT or dB. If the value is set in WATT, the value in dB will be also changed.

(2) Setting the CF value (for W measurement)

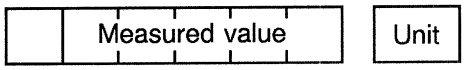
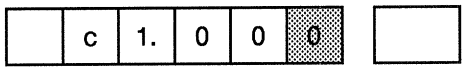
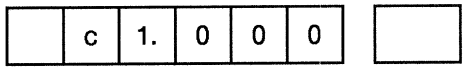
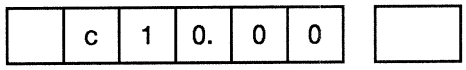
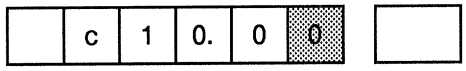
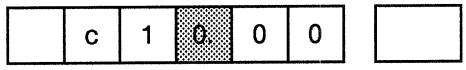
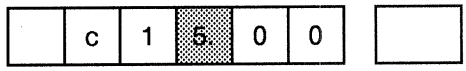
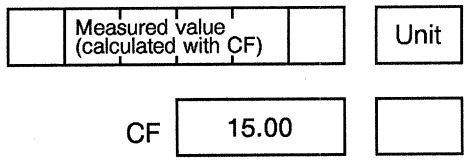
Pressing the CF key causes the CF setting mode to be entered.
Using ⇦ or ⇨ key, flash the column to be changed.
Pressing △ increases the value of the flashed column and pressing ▽ decreases the value.

Pressing "ENTER" key determines the displayed setting and causes the current mode to return to the measurement mode. In addition, if ⇦ is pressed when the column at the left end is flashing or ⇨ is pressed when the column at the right end is flashing, the decimal point will move toward left or right.

Pressing the CF key during the change of setting value allows the value to be changed the previous setting. Also, pressing the CF key in that condition (in previous setting) allows the CF value to be changed to the value at OFF condition (i.e., 1.00 for W measurement or 0.00 for dB measurement).

The range of setting value is 0.100 to 1000. If any value out of range is entered, buzzer alarms. Then, pressing "ENTER" key allows the display to return to the previous condition.
In order to return to the setting before entering the setting mode, press "HOME" key and the display will return to the measurement mode with the previous setting.

The following shows the example for setting the value of 15.00.

Operation	Display	Description
		A normal measurement is made.
Press CF key.		The Q8221 enters the CF setting mode and displays the previous set value.
Press ⇨ key once.		The decimal point flashes.
Press ▽ key once.		The decimal point moves.
Press ⇦ key once.		The value of the lowest digit flashes.
Press ⇦ key twice.		The flashing digit moves 2 places to the left.
Press △ key 5 times.		The value of the flashing digit increases.
Press ENTER key.		The CF value is set and the Q8221 returns to the measurement mode. The calculated value after the CF calculation is displayed at the main-display section and the set value is displayed at the sub-display section.

Note: Crosshatching displays the flashing digit.

(3) Setting the CF value (for dBm measurement)

Pressing the CF key causes the CF setting mode to be entered.
Using ⇦ or ⇨ key, flash the column to be changed.
Pressing △ increases the value of the flashed column and pressing ▽ decreases the value.
Pressing ENTER key determines the displayed setting and causes the current mode to return to the measurement mode.

When the △ key is pressed for the uppermost digit, the setting changes as follows: – 1→ 0 → 1 → 2 → 3→ – 1... (The setting changes in the reverse order when the ▽ key is pressed.)
The range of setting value is – 19.99 dB to 30.00 dB.
In order to return to the setting before entering the setting mode, press the HOME key and the display will return to the measurement mode with the previous setting.

The following shows the example for setting the value of – 0.30 dB.

Operation	Display	Description
	Measured value dBm	A normal measurement is made.
Press CF key.	c 0 0. 0 0 dB	The Q8221 enters the CF setting mode and displays the previous set value.
Press ⇦ key.	c 0 0. 0 0 dB	The flashing digit moves 1 places to the left.
Press ▽ key 3 times.	c - 0. 3 0 dB	The uppermost digit is set to - (minus) by pressing the ▽ key.
Press ENTER key.	Measured value (calculated with CF) dB CF – 0.30 dB	The CF value is set and the Q8221 returns to the measurement mode. The calculated value after the CF calculation is displayed at the main-display section and the set value is displayed at the sub-display section.

Note: Crosshatching displays the flashing digit.

6.5 Averaging Calculation Function

(1) Outline

The averaging function serves as a digital filter when a noise exceeds the measured value. S/N will improve in proportion to the square root of the averaging count. The averaging function of this unit is the moving average of a maximum of 256 counts.
Pressing the AVE key during the set value change returns the unit to the previously set value. In addition, the averaging can be changed to value (1) of the averaging calculation function OFF by pressing the AVG key when the set value is the same as the previously set value. An example of the procedure when the averaging is 3 times is shown below (the average of the current measured value and the 2 previously measured values will be displayed):

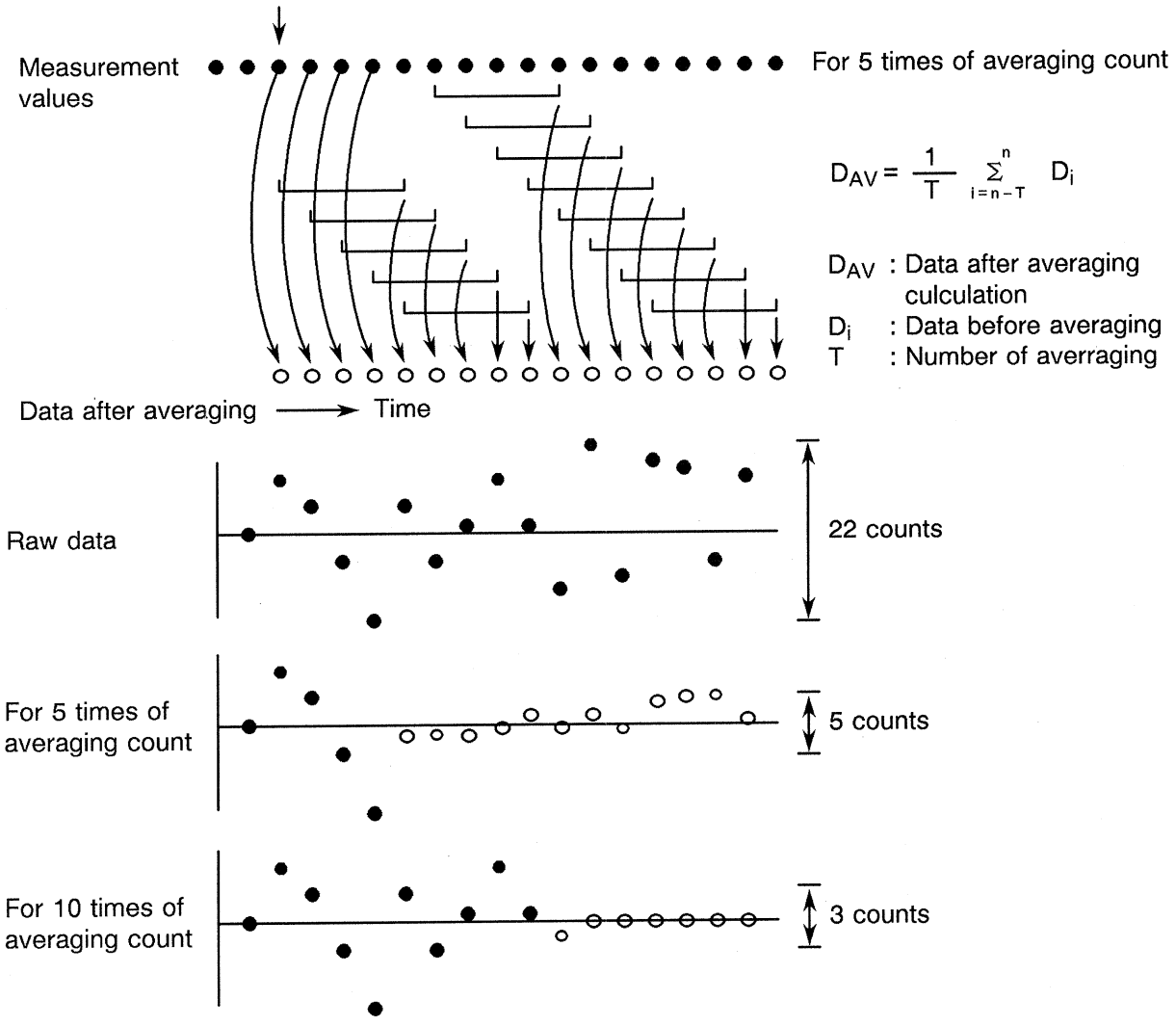


Figure 6-1 Operation of Averaging Function

(2) Setting the number of averaging

The Q8221 enters the averaging time setting mode when the AVG key is pressed. Specify the digit to change by pressing the ⇦ key or ⇨ key (the specified digit will flash). The value of the flashing digit is increased when the △ key is pressed, and decreased when the ▽ key is pressed.
The display content is set and the Q8221 returns to the measurement mode when the ENTER key is pressed. The AVG lamp lights when the averaging is more than 2.
The setting range of the averaging count is between 1 and 256.
In addition, when you wish to return to the previous setting before entering the setting mode, press the HOME key and the Q8221 will return to the measurement mode and the previous setting.

The following is the procedure for setting the averaging count to 10 times:

Operation	Display	Description
	Measured value | Unit	A normal measurement is made.
Press AVG key.	A _ _ 1	The unit enters the AVG set mode and displays the previous set value.
Press ⇦ key once.	A _ _ 1	The flashing digit moves 1 place to the right.
Press △ key once.	A _ 1 1	The value of the flashing digit increases.
Press ⇨ key once.	A _ 1 1	The flashing digit moves 1 place to the right.
Press ▽ key once.	A _ 1 0	The value of the flashing digit decreases.
Press ENTER key.	AVG Measured value (calculated with AVG) | Unit	The AVG count is set and the Q8221 returns to the measurement mode. The AVG lamp lights and the value after the AVG calculation is performed is displayed in the main display section.

Note: Crosshatching displays the flashing digit.

(3) Note

The AVG lamp flashes when the measured value is less than the AVG count. If "U.L" and "O.L" are displayed, however, since the measurement value is not counted, the AVG lamp keeps lighting. The displayed value during this period may incorrect.

(4) Canceling the averaging calculation

Set the averaging time to 1 when canceling the averaging calculation.

6.6 Sampling Variable Function

(1) Outline

This optical multi-power meter uses an integral A/D converter, sampling can be changed from high-speed measurement to slow-speed measurement by changing the reset times to 100 ms, 20 ms and 7 ms.
Select 100 ms integrating time for stability measurement. Select 7 ms or 2 ms integrating time for fast sampling measurement.

Table 6-1 Integral Time

Integrating time	Display	Sampling number of times per sec
100ms	SL (Omission of SLOW)	About 9 times per sec
20ms	FS-1 (Omission of FAST-1)	About 30 times per sec
7ms	FS-2 (Omission of FAST-2)	About 50 times per sec
2ms	FS-3 (Omission of FAST-3)	About 100 times per sec

(2) Setting method

The Q8221 enters into the parameter setting mode by pressing the PARAM key. The most recent time setting parameters will be displayed. Since the setting changes when the PARAM key is pressed again, it is set according to the sampling rate setting mode (RATE lights). When the △ key is pressed, the setting changes as follows: SL → FS-1 → FS-2 → FS-3 → SL →... (The setting changes in the reverse order when the ▽ key is pressed.) When the ENTER key is pressed, the displayed content is set and the Q8221 returns to the measurement mode.

The following table shows the procedure for setting the sampling rate to FS-1 (20 ms):

Operation	Display	Description
	Measured value Unit	A normal measurement is made.
Press PARAM key.	S L PARAM = RATE	The Q8221 enters into the parameter setting mode. The RATE lamp lights when the previous setting is the same as the sampling rate setting.
Press △ key once.	F S - 1 PARAM = RATE	The display content changes.
Press ENTER key.	Measured value Unit	The sampling rate is set and the Q8221 returns to measurement mode.

Note: Crosshatching displays the flashing digit.

6.7 Display Resolution Variable Function

(1) Outline

The display value is sometimes read out difficulty if the measured result is long digit on the display area or the lower digits is vary widely. In that case, it is possible to reduce/increase the display digit area between 4 digits and 6 digits.
The display resolution is changed according to Table 6-2. Increase the display digit to perform the high-resolution measurement.

Table 6-2 Display Resolution

Display digit	Display at setting	at W measurement	at dB measurement
4 digits	– 1888	0.5% max.	0.1dB
5 digits	– 18888	0.05% max.	0.01dB
6 digits	– 188888	0.005% max.	0.001dB

(2) Setting method

The Q8221 enters into the parameter setting mode by pressing the PARAM key. The most recent time setting parameters will be displayed. Since the setting changes when the PARAM key is pressed again, it is set according to the display resolution setting mode (RES lights).

When the △ key is pressed, the setting changes as follows: – 1888 → – 18888 → – 188888 → – 1888 → ... (The setting changes in the reverse order when the ▽ key is pressed.) When the ENTER key is pressed, the displayed content is set and the Q8221 returns to the measurement mode.

The following shows the example for setting the value of -18888 (5 digits).

Operation	Display	Description
	Measured value Unit	A normal measurement is made.
Press PARAM key.	S L PARAM = RATE	The Q8221 enters into the parameter setting mode. RES lights if the previous setting is set to the sampling rate.
Press PARAM key once.	-1 8 8 8 8 8 PARAM = RES	The Q8221 enters into the resolution setting mode and RES lights.
Press ▽ key once.	-1 8 8 8 8 RES	The display contents changes.
Press ENTER key.	Measured value _ Unit	The display resolution is set and the Q8221 returns to the measurement mode. ("_" is displayed for the figure that is masked the display.)

Note: Crosshatching displays the flashing digit.

6.8 Memory Function

(1) Outline

This function enables to store the setup condition with a maximum of 5 data for each A/B channel. Since the stored setting conditions are backed up by the battery, it is convenient to set the previous setting condition again. (The memory function does not enable to store the measured value.) When plug-in units are changed, this setup condition is cleared.
Furthermore, this setup condition is also cleared in initializing. For initializing, refer to [4.2 Backup and Initializing the Setting Parameters].

This memory function can be used only when the channel setting is set to A or B. That is to say, the store, deletion and read out of A channel setting can be done in case of A is set to channel setting. The store, deletion and read out of B channel setting can be done in case of B is set to channel setting.
The memory function cannot be selected when both A and B is set therefore, in this status, use memory function of A channel and B channel separately. (Refer to [4.3 Measurement Procedure] (1) Channel setting for the method of the channel setting.)

The memory function has following three modes.

- St (Store) : Store
- CL (Clear) : Deletion
- rC (Recall) : Read out

(2) Storing (store) the data

The number of memory that has already been stored a setting condition on the sub-screen is displayed by pressing the PARAM key and selecting the memory setup mode (MEN lights.). ("_" is displayed at the number of memory not-storing the setting condition.)

After pressing the ⇦ or ⇨ key and flashing the uppermost digit, and pressing the △ key, the setting changes as follows: St (store) → CL (clear) → rC (recall) → St (store) → ... (The setting changes in the reverse order when the ▽ key is pressed.) Select the St (store).

Pressing the ⇨ key enables to specify the memory number.
The setting condition at the time when ENTER key is pressed is stored into memory corresponding to the specified memory number according to the above-stated operation.

The following shows the example for storing the setting condition in the channel A into the No.3.

Operation	Display	Description
	Measured value / Unit	A normal measurement is made.
Press PARAM key.	S L / PARAM = RATE	The Q8221 enters into the parameter setting mode. RATE lights if the previous setting is set to the sampling rate.
Press PARAM key twice.	S t A 1 / 1 _ _ 4 _ / PARAM = MEM	The Q8221 enters into the Memory setup mode and MEM lights. The already stored memory number is displayed on the sub-display.
Press △ key twice.	S t A 3 / PARAM = MEM	The memory number changes to 3.
Press ENTER key.	Measured value / Unit	The setting condition of CH-A is stored into No.3 and the measurement is continued.

Note: Crosshatching displays the flashing digit.

(3) Clearing (clear) the data

Adjust to CL (clear) using the PARAM key and the △ key.
Set the memory number using the ⇨ key and the △key.
When ENTER key is pressed, contents stored into the specified memory is deleted. If the number of memory not-storing anything is specified, the operation is not performed.

(4) Recalling (recall) the data

Adjust to rC (recall) using the PARAM key and the △ key.
Set the memory number using the ⇨ key and the △key.
When ENTER key is pressed, contents stored into the specified memory is recalled. If the number of memory not-storing anything is specified, the operation is not performed.

6.9 Recording Function and Direct Plotting Function

(1) Outline

It is possible to store the continuous measured value of the maximum 400 data to A channel and B channel of the set time interval (0.00 to 250 seconds) separately. Batch read-out can be performed by the GPIB. Therefore, it is possible to later conduct graphing and data processing of the measured data under a free format, even when there is no controller, such as a personal computer, at measurement. Moreover, Maximum value, minimum value and Difference value (Maximum value - minimum value) of the stored data can be displayed. This is convenience for the measurement of the loss fluctuations.

Record function has following eight modes.

- It (Interval Time): Setting of the measurement interval.
- dP (Data Point): Setting of the point number of stored data.
- StArt (Start): Execution of record function. (Start of the data store)
- SH (Show): Display of maximum value, minimum value and difference value. (Maximum value - minimum value)
- Sd (Show Data): Display of record data. (The measurement value of each point is displayed)
- PLot (Plot): Execution of plotter output
- PdL (PDL): Execution of PDL function
- Pdr (PDR): Execution of PDR function

Operating procedure 1. To operate the recording function only once

① The measurement interval and the stored data point number are set by IT (Interval time) and dP (Data pointer).
Example: In case of It = 3.1 seconds and dP = 400, 400 data are stored sequentially in each 3.1 seconds interval. That is to say, the total measurement time is as follows.
3.1 seconds/ point × 400 points = 1240 seconds (Total measurement time)

② Execute StArt (Start). The measurement is ended after 1240 seconds.

③ The measurement values are analyzed using by SH, Sd and Plot.
Moreover, all of the data and the setting conditions can be read out to the personal computer using by GPIB.

Note: • "It" and "dP" can be specified in both A and B channel. Hence, if "It" and "dP" is specified with the channel set to either A or B, the same data specified at "It" and "dP" is input in another channel.

- If the record function is performed with the channel set to either A or B and if the recoreded data exist in another channel, the recorded data is automatically cleared.

Operating procedure 2. To operate the recording function anytime (PDL, PDR modes)

- PDL mode

  PDL (Polarization Dependent Loss): This mode is used when a measurement such as polarization dependent loss is executed at anytime.

  Measurement is executed by the measurement interval set by "It" and the number of data point set by "dP", the following calculation is executed during series of data inside the optical power meter and the value of PDL is displayed. When a series of measurement ends, next measurement is executed automatically and the PDL value is measured normally.

$$\text{PDL(dB)} = 10\log\left(\frac{\text{Maximum value of optical power (W)}}{1\text{mW}}\right) - 10\log\left(\frac{\text{Minimum value of optical power (W)}}{1\text{mW}}\right)$$

- PDR mode

  PDR (Polarization Dependent Ratio): This mode is used when the polarization dependent ratio is measured at anytime.

  Measurements of channels A and B are executed simultaneously by the measurement interval set by "It" and the number of data point set by "dP", the following calculation is executed during series of data inside the optical power-meter and the PDR value is displayed. When a series of measurement ends, next measurements executed automatically and the PDR value is measured anytime. PDR value is displayed in the main display part of the channel A. In the main display part of the channel B, the measurement value of the channel B is displayed.

$$\text{PDR(dB)} = \left(\text{Maximum value of } 10\log\left(\frac{\text{N-th data of channel A (W)}}{\text{N-th data of channel B (W)}}\right)\right) - \left(\text{Minimum value of } 10\log\left(\frac{\text{N-th data of channel A (W)}}{\text{N-th data of channel B (W)}}\right)\right)$$

① Set the measurement interval by the It (Interval Time) and the number of measurement data by the dP (Data Point). (Same as the operating procedure 1.)

If you want to measure in the maximum speed, set the sampling rate to FS-2 and the It to 0.00 second in advance.

② Execute PDL and PDR. This procedure exits from the PARAM mode automatically and measures PDL value and PDR value anytime.

(2) Setting method of measurement interval (Interval time)

The Q8221 enters into the parameter setting mode and displays the previously set parameters when the PARAM key is pressed.

In addition, since the setting changes when the PARAM key is pressed, the Q8221 is set to the recording setting mode (REC lights). When the △ key is pressed, the Q8221 changes as follows: It (Measuring interval) → dP (No. of data) → StArt (Execution) → SH (Display of maximum value, minimum value and difference value) → Sd (Display of record data) → Plot (Plotter output) → PdL (Execution of PDL function) → Pdr (Execution of PDR function) → It (Measuring interval) → ···.

Changes occur in the reverse order when the ▽ key is pressed. Set the desired parameters. When the measurement interval is set to 0, the data acquisition interval is dependent on the sampling rate.

The following shows the example for setting the measurement interval to 0.8 seconds.

(1 of 2)

Operation	Display	Description
	Measured value Unit	A normal measurement is made.
Press PARAM key.	S L PARAM = RATE	It goes to the parameter setting mode. If the last setting is sampling rate then RATE turns on a light.
Press PARAM key 3 times.	S H H I Maximum value PARAM = REC	It goes to record setting mode and REC turns on a light.
Press ⇧ key 5 times.	I T 0. 0 0 Maximum value PARAM = REC	It goes to interval setting screen.

Note: Crosshatching displays the flashing digit.

(2 of 2)

Operation	Display	Description
Press ⇨ key 3 times.	I T 0. 0 0 Unit Maximum value PARAM = REC	Move the flashing light position to the digit to be changed.
Press ⇧ key 8 times.	I T 0. 0 8 Maximum value PARAM = REC	A numerical value is increased.
Press ⇨ key once.	I T 0. 0 8 Maximum value PARAM = REC	Decimal point is flickered.
Press ⇩ key once.	I T 0 0. 8 Maximum value PARAM = REC	Decimal point is moved.
Press ENTER key.	Measured value Unit	It returns back to the normal measurement.

Note: Crosshatching displays the flashing digit.

(3) Setting the number of data (Data point)

The following shows the example for setting the number of data to 200.

Operation	Display	Description
	Measured value | Unit	A normal measurement is made.
Press PARAM key.	S H H I | PARAM = REC	The Q8221 enters into the parameter setting mode. The REC lamp lights when the previous setting is the same as the record setting.
Press ▽ key 2 times.	d P 1 0 0 | PARAM = REC	The Q8221 enters into the number of data setting mode.
Press ⇨ key once.	d P 1 0 0 | PARAM = REC	The digit to be changed flashes.
Press △ key once.	d P 2 0 0 | PARAM = REC	The value of the flashing digit increases.
Press ENTER key.	Measured value | Unit	The Q8221 returns to the normal measurement.

Note: Crosshatching displays the flashing digit.

(4) Execution (Start)

The following shows the example for executing the set measurement interval and the number of data record function.

When aborting the operation, press the PARAM key to change to the RECODE mode and "STOP" is displayed on the main-display then press the ENTER key. The screen returns to the measurement value display.

Operation	Display	Description
	Measured value / Unit	A normal measurement is made.
Press PARAM key.	S H H I / PARAM = REC	The Q8221 enters into the parameter setting mode. The REC lamp lights when the previous setting is the same as the record setting.
Press ▽ key once.	S t A r t / PARAM = REC	The "StArt" flashes.
Press ENTER key.	Measured value / Unit d P Number of data	The data recording function is executed. The number of data obtained is displayed on the sub display. (This is incremented automatically for each measurement.)

Note: Crosshatching displays the flashing digit.

(5) Display of maximum value, minimum value and Difference value (Show)

Maximum value, minimum value, and Difference value of record data can be referred from the panel.

The display of the indicator is as follows.

- HI : Maximum value.
- LO : Minimum value.
- dI : Difference value (Maximum value - Minimum value).

Note : In case of the channel setting is "A&B", the maximum value, minimum value, and Difference value of A channel is displayed but B channel is not displayed.
Reset "B" channel for the display of the maximum value, minimum value, and difference value of B channel.

The following shows the example for display of the maximum value, minimum value, and difference value.

(1 of 2)

Operation	Display	Description
	Measured value | Unit	A normal measurement is made.
Press PARAM key.	S L PARAM = RATE	It goes to the parameter setting mode. If the last setting is sampling rate then RATE turns on a light.
Press PARAM key 3 times.	S H H I Maximum value PARAM = REC	It goes to record setting mode and REC turns on a light. When if record data exists then the maximum value is displayed.
Press ⇨ key once.	S H H I Maximum value PARAM = REC	The flashing light position is transferred to the content of the display.

Note: Crosshatching displays the flashing digit.

(2 of 2)

Operation	Display	Description
Press ⇩key once.	S H L o Minimum value PARAM = REC	The display content is changed to minimum value.
Press ⇩key once.	S H d i Difference value PARAM = REC	The display content is changed to difference value.
Press ENTER key.	Measured value Unit	The Q8221 returns to the normal measurement.

Note: Crosshatching displays the flashing digit.

(6) The display of the record data (Show data)

The recording data is displayed on the panel. The data point is input then the measurement value of the each point is displayed.

Note: In case of the channel setting is "A&B", only record data of A channel is displayed but B channel is not displayed.
Reset "B" channel for the display of the record data of the measurement value of B channel.
(Refer to [4.3 Measurement Procedure] (1) Channel setting for the method of the channel setting.)

The following shows the example for display of the data at the 200 point.

(1 of 2)

Operation	Display	Description
	Measured value | Unit	A normal measurement is made.
Press PARAM key.	S H d l PARAM = RATE	It goes to the parameter setting mode. If the last setting is sampling rate then REC turns on a light.
Press △ key once.	S d 0 0 1 Measured value of data point 1 PARAM = REC	It goes to record data display mode (Sd). When if record data exists then the measurement value of the data point 1 is displayed.
Press ⇨ key once.	S d 0 0 1 Measured value of data point 1 PARAM = REC	Move the flashing light position to the digit to be changed.
Press △ key twice.	S d 2 0 1 Measured value of data point 201 PARAM = REC	A numerical value is increased.
Press ⇨ key twice.	S d 2 0 1 Measured value of data point 201 PARAM = REC	Move the flashing light position to the digit to be changed.

Note: Crosshatching displays the flashing digit.

(2 of 2)

Operation	Display	Description
Press ▽ key once.	S d 2 0 0 Measured value of data point 200 PARAM = REC	A numerical value is decreased. Measurement value of data point 200 is displayed.
Press ENTER key.	Measured value	The Q8221 returns to the normal measurement.

Note: Crosshatching displays the flashing digit.

(7) Read out the record data by GPIB

To read out the record data, batch read-out can be performed using the GPIB command. For details, refer to "7.4 Talker Format".

(8) Direct plotting function for record data (Plot)

This function enables to output the record data obtained directly to the external plotter as a direct time series data graph by using the direct plotting function.
By using the record function and direct plotting function, the Q8221 enables to measure/output the data without the external controller (personal computer) as a data graph.

It is suitable for applications such as measuring stability of temperature and measuring change of long time.

The following shows the procedure for outputting the data to the plotter.

Operation	Display	Description
	Measured value Unit	A normal measurement is made.
Press PARAM key.	d P 2 0 0 PARAM = REC	The Q8221 enters into the parameter setting mode. The REC lamp lights when the previous setting is the same as the record setting.
Press ▽ key 4 times.	P L o t PARAM = REC	The "PLot" flashes.
Press ENTER key	P L o t PARAM = REC	The data plotting function is executed.

Note: Crosshatching displays the flashing digit.

In case of the record data exist in both A and B channel when the photo sensors are used by 2 channels that are connected, the following formats are plotted, and are output.

- In case of the channel setting is "A": The recorded data of A channel is made graph, and is plotted, and is output.
- In case of the channel setting is "B": The recorded data of B channel is made graph, and is plotted, and is output.
- In case of the channel setting is "A&B": The each recorded data of A and B channel is made graph, and is plotted, and is output. (The graph of 2 channels is separately plotted on 1 plotting paper.)

[Before outputting to the plotter]

① Check that the plotter mode is set to LISTEN ONLY mode.

② Checking the plotter types

Plotter type which is available to output

- 682-XA (ADVANTEST, HPGL type)
- HP7550A (HPGL type)

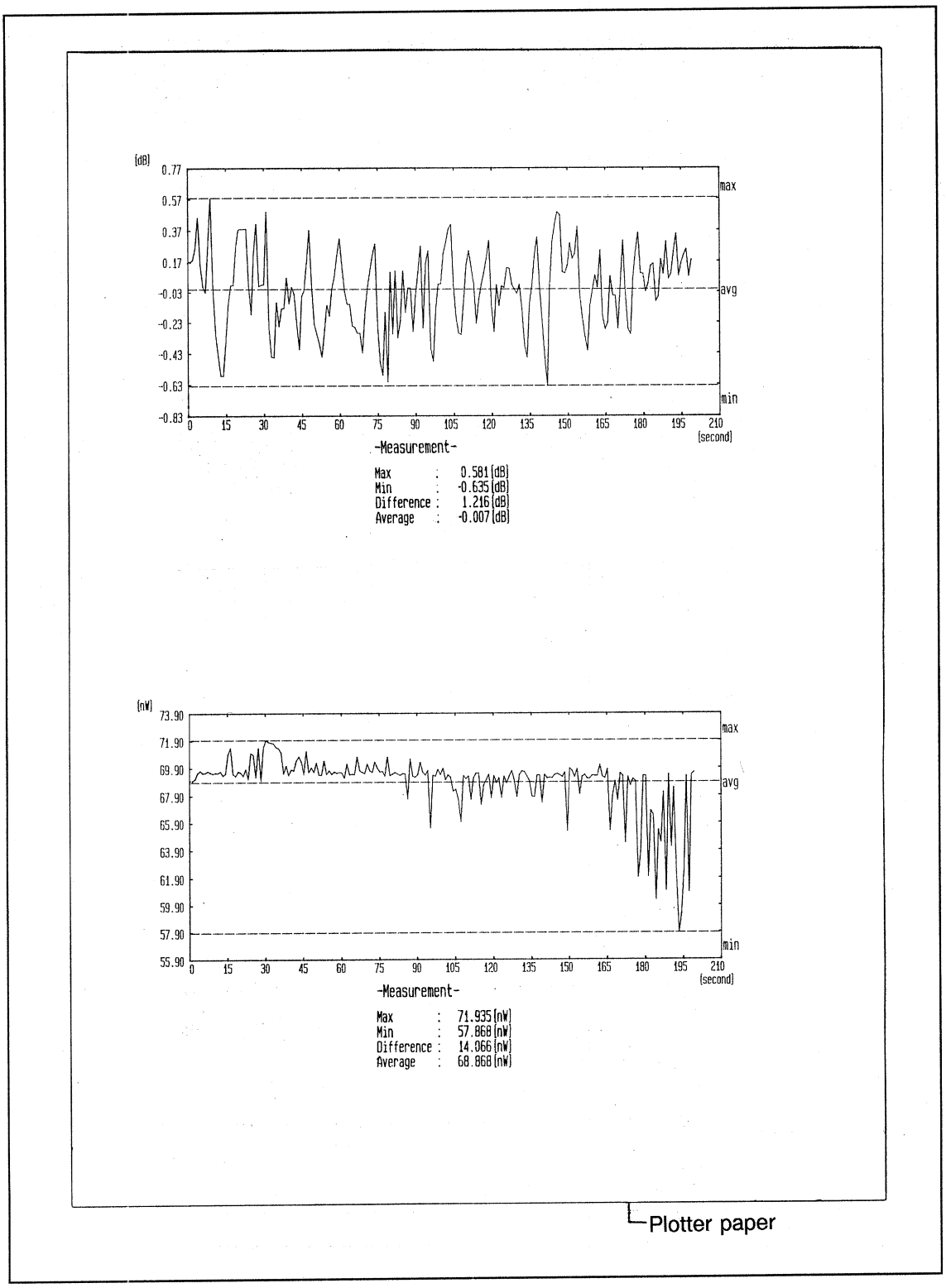
③ Selecting the pens

The following shows the pen numbers and the corresponding output contents when outputting to the plotter.

Pen No.	Description
1	Waveform (record data)
2	Graph vertical-axis, horizontal-axis value
3	Graph frame
4	Setup parameter for recording, MAX value, MIN value, DIFF value, AVE value
5	Title, etc.

Note: If the data obtained by PDL and PDR modes are plotted directory, the plot of the data at the STOP is output.

[Example of plotter output] In case of the plot by the channel setting is "A&B"



(9) Operating Procedure of PDL Mode

Executing procedure of the PDL function by setting measurement interval and the number of data is shown below.
If you want to abort the execution, press the ENTER key when STOP is displayed in the main screen of the RECORD mode by pressing the PARAM key. The PDL mode is aborted and the display returns to the normal measurement value display.

Operation	Display	Description
	Measured value / Unit	A normal measurement is made.
Press PARAM key.	S H H I / PARAM = REC	The Q8221 enters into the parameter setting mode. The REC lamp lights when the previous setting is the same as the record setting.
Press ▽ key 5 times.	P d L	The "PdL" flashes.
Press ENTER key.	PDL value / Unit d P Number of data	Execute PdL function. The number of data obtained is displayed on the sub display and PdL value is displayed by each series of data.

Note: ●Crosshatching displays the flashing digit.

●If the PDL function is executed, its unit system is changed to dB forcefully.

(10) Operating Procedure of PDR Mode

Executing procedure of the PDR function by setting measurement interval and the number of data is shown below.
If you want to abort the execution, press the ENTER key when STOP is displayed in the main screen of the RECORD mode by pressing the PARAM key. The PDR mode is aborted and the display returns to the normal measurement value display.

Operation	Display	Description
	Measured value Unit	A normal measurement is made.
Press PARAM key.	S H H I PARAM = REC	The Q8221 enters into the parameter setting mode. The REC lamp lights when the previous setting is the same as the record setting.
Press ▽ key 4 times.	P d R	The "PdR" flashes.
Press ENTER key.	PDR value Unit d P Number of data	Execute PdR function. The number of data obtained is displayed on the sub display and PdR value is displayed by each series of data.

Note: ●Crosshatching displays the flashing digit.

●If the PDR function is executed, its unit system is changed to dB forcefully.

●When the PDR function is operated, set the channel selection to A or A&B. PDR function is not operated when the channel selection is B.

6.10 Brightness Variable Function

(1) Outline

Since the brightness of the display can be changed by stages, the unit can be used so that it can match the room brightness. The display is changeable in four stages with key operation and can be completely turned off through the GPIB (i.e., in five stages).
For use in a dark room, no affect will made on the measured object.

(2) Setting the brightness

Pressing PARAM key causes the parameter setting mode to be entered and displays the parameters previously set. By pressing the key furthermore, call the brightness setting mode and BRT will turn on. Note that this setting is available for the bottom line and ⇦ and ⇨ keys are invalid.
Press △(up) or ▽(down) key and increase or decrease the value to the desired setting. The higher the number, the brighter the display.
The example below shows the case where the display is darkest (brt-1).

Operation	Display	Description
	Measured value | Unit	A normal measurement is made.
Press PARAM key.	S L PARAM = RATE	The Q8221 enters into the parameter setting mode. The RATE lamp lights when the previous setting is the same as the sampling rate setting.
Press PARAM key 5 times.	b r t - 4 PARAM = BRT	The Q8221 enters into the brightness setting mode.
Press ▽ key 3 times.	b r t - 1 PARAM = BRT	The value of the flashing digit decreases.
Press ENTER key.	Measured value | Unit	The Q8221 returns to the normal measurement.

Note: Crosshatching displays the flashing digit.

6.11 Output-Power Variable Function of Light Source

(1) Outline

When the light source plug-in unit is inserted into the Q8221, the power level of the light source can be changed in the range from a maximum value (0 dB) to 6 dB. (output-power variable function is in Q81211 and Q81212). If as high resolution as possible is required for the loss measurement and others, it is convenient to use the Q8221 near the full scale by adjusting the power level of the light source.

(2) Changing the output power of light source

Pressing PARAM key causes the parameter setting mode to be entered and displays the parameters previously set. By pressing the key furthermore, call the output power setting mode of the light source and ATT will turn on.
By pressing ⇦ or ⇨ key, flash up the desired column.
With △(up) or ▽(down) key, adjust the setting to the desired value. Since the power output changes together with the setting value at that time, the power output can be set while confirming to output level.

The following shows the example for setting the value of 0.5 dB.

Operation	Display	Description
	Measured value Unit	A normal measurement is made.
Press PARAM key.	S t b 1 PARAM = MEM	The Q8221 enters into the parameter setting mode. The MEM lamp lights when the previous setting is the same as the memory setup mode.
Press PARAM key 3 times.	A t 0. 0 PARAM = ATT	The Q8221 enters into the optical power level setting mode.
Press △ key 5 times.	A t 0. 5 PARAM = ATT	The value of the flashing digit increases.
Press ENTER key.	Measured value Unit	The Q8221 returns to the normal measurement.

Note: Crosshatching displays the flashing digit.

6.12 Analog-Output Function

The voltage just before the input to the A/D converter is output to the BNC connector in the rear panel. The analog output is individually output to each channel A and channel B. Output voltage value matches displayed value at W measurement. (2V at the display of 200000 counts) Voltage after correction of wavelength sensibility of the sensor is output continuously for this analog output voltage. Long term stability measurement can be done by using this analog output inputting to the pen recorder etc. Also, waveform response analysis of modulating light can be executed by using this analog output inputting to the oscilloscope.

Each measurement range has a typical pulse response time specific to the model as shown below:

Measurement Range	Q82202/03	Q82208
20 mW (2000 mW)	800 μs	5 μs
2000 μW (200 mW)	800 μs	30 μs
200 μW (20 mW)	800 μs	15 μs
20 μW (2000 μW)	800 μs	30 μs
2000 nW (200 μW)	800 μs	300 μs
200 nW (20 μW)	800 μs	300 μs
20 nW (2000 nW)	100 ms	50 ms
2000 pW (200 nW)	100 ms	50 ms
200 pW (20 nW)	100 ms	50 ms

* The values in parentheses ( ) are for the Q82226/Q82227.
* The response time is 10-to-90% response (of pulse peak).
* The values are typical response times.

7. GPIB

The Q8221 is equipped with the GPIB. By using the GPIB, enables to perform each setup for reading the measurement data, the measurement mode, the measurement range, etc.

7.1 Outline of GPIB

The GPIB is the interface system which connects the tester to the controller and the peripheral devices using a simple cable (bus line).
The GPIB is an easy-to-use interface system with higher expandability compared to other systems. In addition, it provides electrical, mechanical and functional compatibility with other manufacturers' products. Therefore, the GPIB can make up not only a simple system but an automatic instrumentation system using the single bus cabal.
In the GPIB system, it is necessary to set the address of each component connected to the bus line. Each component may play one or more roles of the controller, talker and listener.
During operation of the system, only one talker can transmit data on the bus line while the listeners receive the data.
The controller specifies the addresses of the talker and the listeners. It transfers data from the talker to the listeners and sets the measuring conditions from itself (or the talker) to the listeners.
For data transfer among components of the system, eight data lines of the bit parallel and byte serial are used for asynchronous two-way transmission. The asynchronous system allows high-speed and low-speed compound devices to be connected arbitrarily.
A collection of data (messages) sent and received among devices includes measurement data, measuring conditions (programs) and commands. The ASCII code is mainly used.
Beside the above mentioned eight data lines, the system includes three handshaking lines to control asynchronous data transfer among devices and five control lines to control the information flow on the bus.

- The following signals are used for the handshaking lines.

DAV (Data Valid)	:	Signal to indicate the data valid state
NRFD (Not Ready For Data)	:	Signal to indicate the data reception enabled state
NDAC (Not Data Accepted)	:	Signal to indicate the reception completion state

- The following signals are used for the control lines.

ANT (Attention)	:	This signal identifies whether the signal on the data line is an address, command or other information.
IFC (Interface Clear)	:	Signal to clear the interface
EOI (End or Identify)	:	Signal to be used on the termination of information transfer

SRQ (Service Request) : Signal to cause an arbitrary device to present a request for services from the controller

REN (Remote Enable) : Signal to be used for remote control of a remote-programmable device

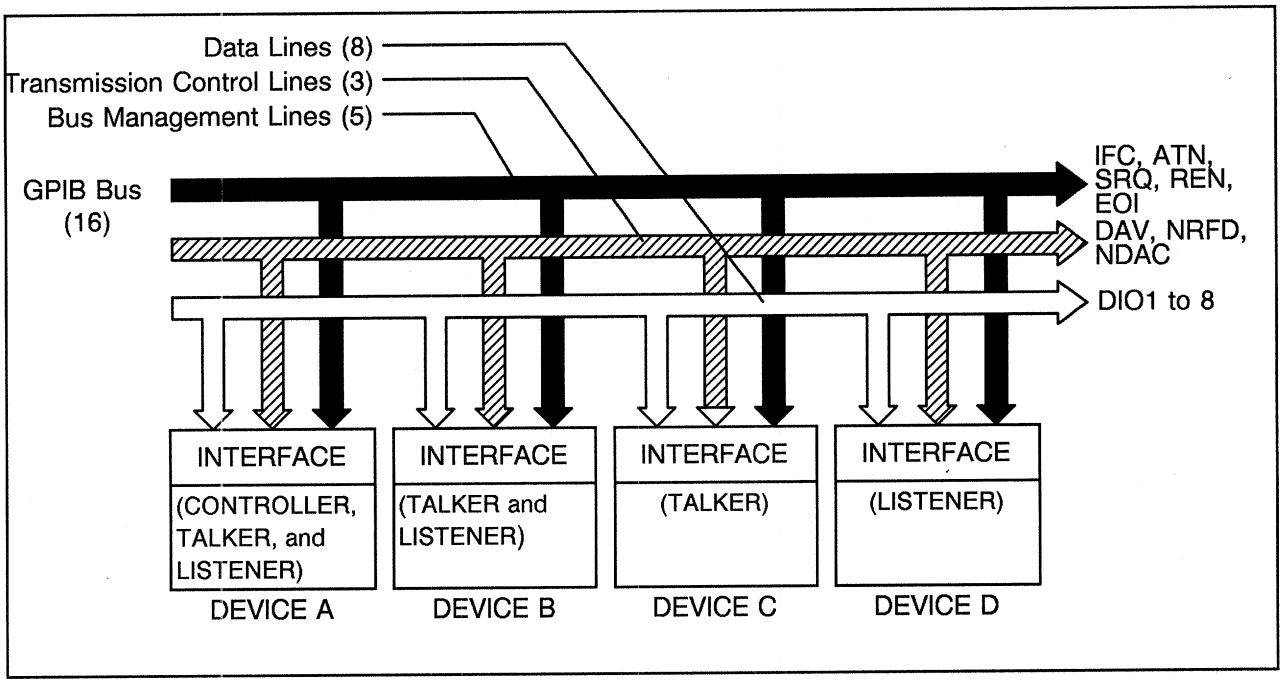


Figure 7-1 Outline of GPIB

7.2 GPIB Specification

Governing specification	:	IEEE standard 488-1978
Available code	:	ASCII code and binary code
Logic level	:	Logic 0 "High" state +2.4 VDC or more Logic 1 "Low" state +0.4 VDC or less
Termination of signal line	:	16 bus lines are terminated as follows:

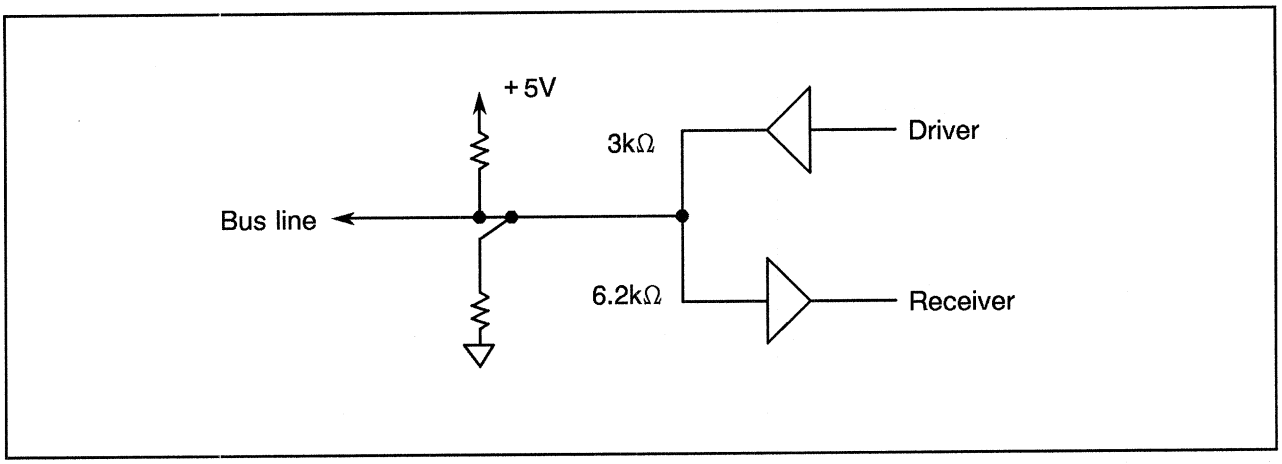


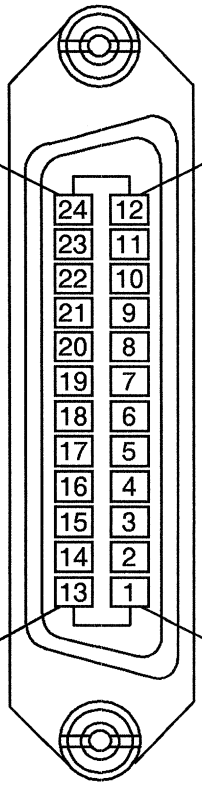
Figure 7-2 Termination of Signal Conductors

Driver specification	:	Try-state method "Low" state output voltage : +0.4 VDC or less, 4.8 mA "High" state output voltage : +2.4 VDC or more, −5.2 mA
Receiver specification	:	"Low" state at +0.6 VDC or less "High" state at +2.0 VDC or more
Bus cable length	:	The length of each bus cable must not exceed : (the number of devices connected to the bus) × 2 m or 20 m in total.
Addressing	:	The address selection switch on the front panel allows 31 types of talk/listen address to be selected.

Connector : 24-pin GPIB connector, 57FE-20240-20SD35
(Equivalent to the product manufactured by Daiich Denshi Kogyo)

24-pin GPIB connector

Signal name	Pin No.
GND LOGIC	24
GND (ATN)	23
GND (SRQ)	22
GND (IFC)	21
GND (NDAC)	20
GND (NRFD)	19
GND (DAV)	18
REN	17
DIO 8	16
DIO 7	15
DIO 6	14
DIO 5	13



Pin No.	Signal name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO 4
3	DIO 3
2	DIO 2
1	DIO 1

Figure 7-3 Pin Assignment of GPIB Connector

Interface functions : Refer to Table 7-1.

Table 7-1 Interface Functions

Code	Interface Functions
SH1	Source handshake function
AH1	Acceptor handshake function
T5	Basic talker function, Serial polling function, Talk only mode function, Listener-specified talker cancel function
L4	Basic listener function, Talker-specified listener cancel function
SR1	Service request function
RL1	Remote/Local switching function
PP0	No parallel function
DC1	Device clear function (SDC and DCL commands are available.)
DT1	No device trigger function
C0	No controller function
E2	Use of three-state bus driver

7.3 Notes on Using GPIB

7.3.1 Connection to Peripheral Units

Because a GPIB system is built of multiple components, take notice of the following instructuins in building one:

(1) Prior to cabling, verify the correct status and operation of the Q8221, controller, peripheral equipment and so on as directed in their instruction manuals.

(2) Do not extend the interconnecting cable and bus cable extensions longer than necessary. Make sure that they do not exceed standard length.
Total length of whole bus cables is less than 2m (number of peripheral unit to be connected with bus)
Table 6-2 lists the standard bus cables available from ADVANTEST.

Table 7-2 Standard Bus Cables (optional)

Length	Name
0.5m	408JE-1P5
1m	408JE-101
2m	408JE-102
4m	408JE-104

(3) Bus cables have a piggyback connector; that is, a single connector assembly has both a male and a female connector, which can be used piled up.
In connecting bus cables, do not pile up three or more connectors together. Be sure to clamp them firmly with connector mounting screws.

(4) Turn on the power to the components, but not before checking their input power requirements, grounding status and, when appropriate, their setup conditions. Be sure that you switch on all the components on the GPIB bus. Satisfactory system performance would be unpredictable if any component is left switched off.

(5) In connecting/removing bus cables, make sure to remove the power cable from the outlet.

7.3.2 Precaution for GPIB

The following is required before starting the measurement from GPIB.

(1) Connect the DUT with the Q8221.

(2) Check the following three items by pressing the PARAM key using the GPIB parameters.

(a) Device address (0 to 30)

(b) Address mode (Addressable/Talker only)

(c) Format mode when outputting the measured data. (Header ON/OFF)

(3) If any setting item is required on the panel surface, perform it.

*1: Refer to "4.3 Measurement Procedure" for the setting method.

*2: For device address
Note that some controllers are required for their exclusive-use ASCII codes instead of numeric value from 0 to 30 to write into the address. In this case, refer to Table 7-3.

Table 7-3 ASCII Corresponding Address Codes

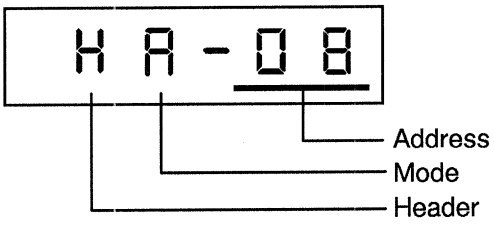
ASCII code character		Decimal code	ASCII code character		Decimal code
LISTEN	TALK		LISTEN	TALK	
SP	@	00	0	P	16
!	A	01	1	Q	17
"	B	02	2	R	18
#	C	03	3	S	19
$	D	04	4	T	20
%	E	05	5	U	21
&	F	06	6	V	22
'	G	07	7	W	23
(	H	08	8	X	24
)	I	09	9	Y	25
*	J	10	:	Z	26
+	K	11	;	[	27
,	L	12	<		28
-	M	13	=	]	29
.	N	14	>	-	30
/	O	15			

7.3.3 Setting GPIB Parameter

The following describes the methods of setting the Q8221 and of changing the header.

① Press the PARAM key to display the GPIB codes on the parameter display area.

② The following screen is displayed, then select the parameter for setup using ← and dBr SET → keys.



Header : H (ON), _(OFF)
Mode : A (Addressable), 0 (Talk only)
Address : 0 to 30

③ Change the setting value using the ▽ and △ keys, and update it using the ENTER key.

When the header is set to ON, the alphanumeric codes corresponded with the measurement data are output as a header.

When the mode is set to "addressable", the address specification from the controller is available. In case of the talk only mode, the data is sent with no correspondence with the address specification form the external device. The address can be selected from 31 types of 0 to 30.

7.3.4 Notes on Operating

(1) Notes on Only Mode

When the Q8221 is used in the only mode, set the mode to the talk only at the address setting. Also, set the address of listener unit connected with the bus cable.
However, do not use (operate) the controller at the same time when the Q8221 is used in the only mode. The Q8221 cannot operate correctly when the controller is used in the only mode.

(2) Changing the address setting during operation

When changing the address of the Q8221 during operation, the Q8221 continues the operations. If the previous set address is specified from the controller, the specification is ignored. Therefore, it is necessary to set the program to the new address.

(3) ATN interruption during message transfer

If an ATN request is issued while transferring a message of device side, the ATN signal is given priority and the preceding state is canceled.

7.4 Talker Format

7.4.1 Outputting the Measured Data

The following shows the measured data output format:

Example

×××	±ddddddd	E±dd	CRLF
(1)	(2)	(3)	(4)

(1) Header: Three-letter alphanumeric string and Space

Header indicates the type of output data. The header is consist of two-character main header and one-character sub header.
When the header switch is set to OFF, the code can be omitted.

	Header code	Type of send data	Priority
Main header	DR	Measurement power relative value	High
	W	Measurement Power (WATT)	↕
	DB	Measurement Power (dB)	Low
Sub header	O	Scale overflow data	High
	U	Scale under data	↕
	E	Calculation error	
	/	A/B, B/A calculation data	
	X	MAX calculation data	
	A	CH-A measurement data	
	B	CH-B measurement data	Low

Scale overflow data is output in the following format:

DB0 +999.9999 +E09

+E09 → 10^9

+999.9999 → 7-digit fixed, always 9

(2) Mantissa part: Sign bit + Decimal + Numeric of 6- to 9-digit

The mantissa part on the measurement value is changed to 6- to 9-digit in accordance to the display mask digit. Decimal point is output in association with the display on the Q8221.

(3) Exponent part: E + Sign bit + Numeric of 2-digit

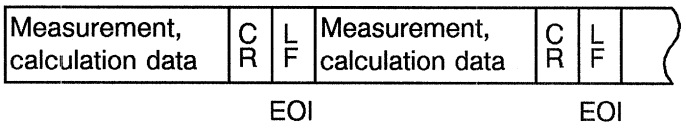
The following shows the mantissa part corresponding to each range and the format of exponent part.

Measurement mode	Range	Mantissa data	
Optical power measurement (WATT)	200 pW	± ddd.ddd	E-12
	2000 pW	± dddd.dd	E-12
	20nW	± dd.dddd	E-09
	200 nW	± ddd.ddd	E-09
	2000 nW	± dddd.dd	E-09
	20 μW	± dd.dddd	E-06
	200 μW	± ddd.ddd	E-06
	2000 μW	± dddd.dd	E-06
	20 mW	± dd.dddd	E-03
	200 mW	± ddd.ddd	E-03
	2000 mW	± dddd.dd	E-03
	20 W	± dd.dddd	E-00
Optical power measurement (dBm)	All ranges	± ddd.dddd	E-00
		± ddd.ddd	E-00
		± ddd.dd	E-00
		± ddd.d	E-00
Optical power measurement (dB)	All ranges	± ddd.dddd	E-00
		± ddd.ddd	E-00
		± ddd.dd	E-00
		± ddd.d	E-00

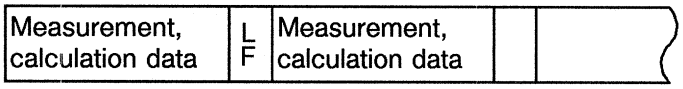
(4) Delimiter: Avairable to change by program code

Delimiter is transmitted as the end of one data.
The delimiter can be selected, using program codes, from among the three choices given in Table 6-5.

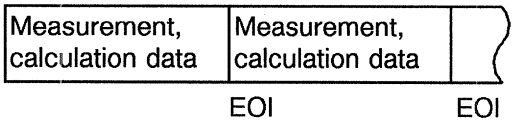
① A 2-byte code of CR (15_8) and LF (12_8) is transmitted, together with a single-line signal EOI synchronized with the LF byte.



② A 1-byte code of LF (12_8) is transmitted.



③ A single-line signal EOI is transmitted concurrently with last byte of data.



The initial state is "① CR, LF(EOI)" above.

7.4.2 Outputting the Record Data

(1) Read out each parameter when obtaining the record data

[Command] RECC?

This command is used to read out the parameter in the order below by delimiting the character using the string delimiter in the following format:
After the command is transmitted, the readout time is somewhat needed. Do read out after somewhat waiting time is passed.

Contents	Format
Number of record data point	"DATA POINT : *** "
Record interval time	"INTERVAL TIME : ***[SEC] "
Correction wavelength value	"WAVELENGTH : ****[NM] "
CF value (WATT) (dB) *	"CF : ***.*** " "CF : **.***[DB] "
Averaging time	"AVERAGE TIME : *** "
Sampling time *	"SAMPLING : SLOW " "SAMPLING : FAST-1 " "SAMPLING : FAST-2 "
A/B, B/A calculation on/off information *	"CALCULATION : A/B " "CALCULATION : B/A " "CALCULATION : -----
dB calculation reference value *	"DB REFERENCE : **.****[DB] " "DB REFERENCE : ------- "

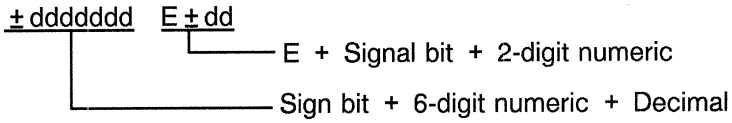
* : Any one of formats is used to read out the parameter.

(2) Record data measurement value

[Command] RECD?

Header cannot be transmitted for reading out the record data, unless otherwise the header output on/off. After the command is transmitted, the readout time is somewhat needed. Do read out after somewhat waiting time is passed.

This command is used to read out each data by delimiting the character using the string delimiter in the following format:



(3) Read out of maximum value, minimum value and Difference value

[Command] RECR?

The output in the order of the maximum value, minimum value and difference value that are punctuated by the string delimits.
After the command is transmitted, the readout time is somewhat needed. Do read out after somewhat waiting time is passed.

7.4.3 Query Output Data Format

Using the query command (**?) enables to read out each setting value from the GPIB.
After sending the query command, a few time is required to read out the value. Therefore, read out operation is executed after a few time.
Each setting value format that is read out is shown below. In the output data, the header can be omitted by setting the header off.

[Sensor unit]

Contents	Header	Data	Query command
Correction wavelength	WL	dddd	WL?
dB reference value (when A/B, B/A calculation on) (when A/B, B/A calculation off)	DF/DF	±ddd.dddd E+00 ±ddd.dddd E+00	REFST?
CF value (WATT) (WATT) (dB) (dB)	CFA CFB DBA DBB	±ddddd ±ddddd ±dd. dd ±dd. dd	CF? (CH-A) CF? (CH-B) DB? (CH-A) DB? (CH-B)

[Light-power unit]

Contents	Header	Data	Query command
Power output (ON) (OFF)	OP	0 1	OP?
Output-power attenuation value	AT	d.d	AT?

7.5 Remote Programming

7.5.1 Notes on Programming Commands

When using the remote programming, keep the following in mind:

- The command array that can be set in one line is up to 40 characters
- If the command is written continuously, the Q8221 may not operate correctly. To prevent malfunction, it is recommended to place (write) the delimiting characters (space or comma) among each command.

  Example: When "Z" and "R*" is used (written)
  PRINT @8;"ZR4"

  In this case, the command is determined as "ZR", the Q8221 cannot operate normally with malfunction.

- The commands "C" and "Z" are used to initialize the currently set condition, so the Q8221 is required to re-set up the condition from the beginning. Therefore, the following commands may not be used, be sure to send these commands with a single-line signal.

7.5.2 Common Commands of Each Plug-in Unit

Function	Command	Parameter	Contents	Default value
Channel setting	CH	0 1 2	Selects CHA. Selects CHB. Selects CHA&B.	CH0
Memory function	SA	0 to 5	Saves the currently set condition to the number specified by the parameter.	
	CL	0 to 5	Clears the set information of the number specified by the parameter.	
	RC	0 to 5	Reads out the set information of the number specified by the parameter, and changes the set condition.	
Brightness adjustment function	BR	0 1 2 3 4	Sets the panel display to OFF. Sets the panel display to ON. Brightness Dark Sets the panel display to ON. ↕ Sets the panel display to ON. Sets the panel display to ON. Bright	BR4
GPIB	S	0 1	Sends the SRQ signal. Does not send the SRQ signal.	S1
	H	0 1	Does not output the header. Outputs the header.	H1
	DL	0 1 2	Sets the block delimiter. CR + LF + <EIO> Sets the block delimiter. LF Sets the block delimiter. <EOI>	DL0
	SL	0 1 2	Sets the string delimiter. ',' (comma) Sets the string delimiter. ' ' (space) Sets the string delimiter. CR + LF	SL0
Initialization	C		Executes the power-on equivalent routine. Initializes each parameter.	
	Z		Executes the equivalent processing when the power is turned on. Initializes each parameter and the backup parameter.	
GPIB	CS		Clears the status byte.	
	MS	0 to 255	Masks the status byte.	MS0

7.5.3 GPIB Commands for Sensor Plug-in Unit

Function	Command	Parameter	Contents	Default value
Measurement mode setting	CW	0 1	CW measurement CHOP measurement (270 Hz)	CW0
Unit setting	DW	0 1	dBm mode WATT mode	DW0
Sampling mode setting	M	0 1	FREE RUN measurement mode HOLD measurement mode	M0
Sampling rate adjustment function	PR	0 1 2 3	Sampling rate FAST-3 (2ms) Sampling rate FAST-2 (7ms) Sampling rate FAST-1 (20ms) Sampling rate SLOW- (100ms)	PR3
Measurement range	R	0 2 3 4 5 6 7 8 9 10 11 12 13	AUTO range dBm: -70 dBm WATT: 200 pW -60 dBm 2000 pW -50 dBm 20 nW -40 dBm 200 nW -30 dBm 2000 nW -20 dBm 20 μW -10 dBm 200 μW 0 dBm 2000 μW 10 dBm 20 mW 20 dBm 200 mW 30 dBm 2000 mW 40 dBm 20 W	R0
	RX		Switching the AUTO range to the manual range.	
Relative value measurement function	DR	0 1	dBr calculation OFF dBr calculation ON (Setting of dBr calculation reference *1)	DR0
	REFST		Updates the dBr calculation reference value.	
	REFST?		Reads out the calculation reference value.	
Zero compensation	ZR		Executes the ZERO ADJUST.	
A/B and B/A calculation function	CA	0 1 2	A/B, B/A calculation OFF A/B calculation ON (B/A calculation OFF) B/A calculation ON (A/B calculation OFF)	CA0

*1: When dBr calculation reference value is not set.

Function	Command	Parameter	Contents	Default value
MAX hold function	MAX	0 1	MAX calculation OFF MAX calculation ON	MAX0
CF operation function	CF	0.100 to 1000	Sets the CF factor value (WATT). Parameter can be set up to 5 digits including the decimal point. Up to 3 digits numeric value of decimal point can be recognized.	CF1.000
	CF?		Reads out the CF factor value (WATT).	
	DB	−19.99 to +30.00	Parameter can be set up to 6 digits including the decimal point and the sign bit. (Cannot be recognized when "20.002" is set.)	DB+00.00
	DB?		Reads out the CF factor value (dB).	
Wavelength setting	WL	Sensor wavelength See range.	Sets the correction wavelength. Parameter can be set up to 4 digits.	Calibration wavelength of each sensor (Refer to [9.2 Sensor Plug-in Unit Specification].)
	WL?		Reads out the correction wavelength.	
Average calculation function	ST	1 to 256	Sets the averaging time. Parameter can be set up to 3 digits.	ST1
Display resolution adjustment function	RES	3 4 5	Sets the measurement display digit. Sets it in 3 1/2 digit. Sets it in 4 1/2 digit. Sets it in 5 1/2 digit.	RES5

Function	Command	Parameter	Contents	Default value
Record function	IT	0.00 to 250	Sets the interval time for obtaining the record data. Unit of "second" must be used. However, in case of 0, the unit is depend on the sampling rate. Parameter is maximum 4 digits that is included with decimal point. The maximum 2 digits of the number of decimal places is recognized.	IT0
	DP	1 to 400	Sets the number of data for obtaining the record data.	DP100
	REC	0 1 2 3	Stops the record. Starts the record. (At one-time measurement) Starts the PDL function. Starts the PDR function.	
	RECC?		Reads out the set information of record data.	
	RECD?		Reads out the measured value of record data.	
	RECR?		Reads out the maximum value, minimum value and Difference value of the record data.	
Sampling trigger	E		External start trigger	

7.5.4 GPIB Commands for Light Source Plug-in Unit

Function	Command	Parameter	Contents	Default value
Output modulation mode setting	CW	0 1 2 3	CW light-producing CHOP light-producing (270 Hz) CHOP light-producing (2 kHz) CHOP light-producing (4 kHz)	CW0
Output ON/OFF	OP	0 1	Power output OFF Power output ON	OP0
	OP?		Reads out the power-output ON/OFF setting condition.	
Output power adjustment function	AT	0.0 to 6.0	Sets the output-power attenuation. Parameter can be set up to 3 digits including the decimal point. Up to 1 digit numeric value of decimal point can be recognized. (The last value 5 cannot be recognized when ".15" is set.)	AT0.0
	AT?		Reads out the output-power attenuation.	

7.6 Service Request (SRQ)

The Q8221, when set in the SO mode, transmits a service request to the controller at the end of a measurement operation or on receiving an undefined code. It then proceeds to transmit a status byte in response to serial polling from the controller.
When set in the S1 mode, the Q8221 does not transmit service request, but it transmits a status byte.

(1) Service request at the end of measurement

The Q8221 transmits a service request when it is not designated as a talker at the end of a measurement operation. It responds to the controller's serial polling, however, its status byte is not cleared until it is designated as a talker to transmit measurement data.

MSB LSB

0	1	0	0	0	0	0	1

Decimal code: 65

(2) Service request on occurrence of SYNTAX error

When the Q8221 receives an undefined program code status byte during remote programming, it transmits a service request. The status byte is not cleared, because of its remote setting, until the Q8221 is designated as a listener.

MSB LSB

0	1	0	0	0	0	1	0

Decimal code: 66

(3) Service request caused by the averaging calculation

When the averaging calculation is set to ON and the measurement value reaches to the averaging set times, the Q8221 transmits a service request. The status byte is not cleared until the averaging calculation is set to OFF, or is cleared by changing the range, etc. The status byte is shown below:

[CH-A side]

MSB LSB

0	1	0	0	0	1	0	0

Decimal code: 68

[CH-B side]

MSB LSB

0	1	0	0	1	0	0	0

Decimal code: 72

(4) Service request caused by terminating the zero correction

When the zero correction executed by using the ZERO key or "ZR" command is completed, the Q8221 transmits a service request. The status byte is shown below. This status byte is cleared during serial polling.

[CH-A side]

MSB LSB

0	1	0	1	0	0	0	0

Decimal code: 80

[CH-B side]

MSB LSB

0	1	1	0	0	0	0	0

Decimal code: 96

(5) Service request caused by terminating the record

When the number of record data reaches to the number of record data point during obtaining the record data, the Q8221 transmits a service request.
The status byte is shown below. This status byte is cleared during serial polling.

MSB							LSB
1	1	0	0	0	0	0	0

Decimal code: 192

Note: If each service request occurs concurrently, all the corresponding bits of the status byte are set at the same time.

7.7 GPIB Interface Operation Flowchart

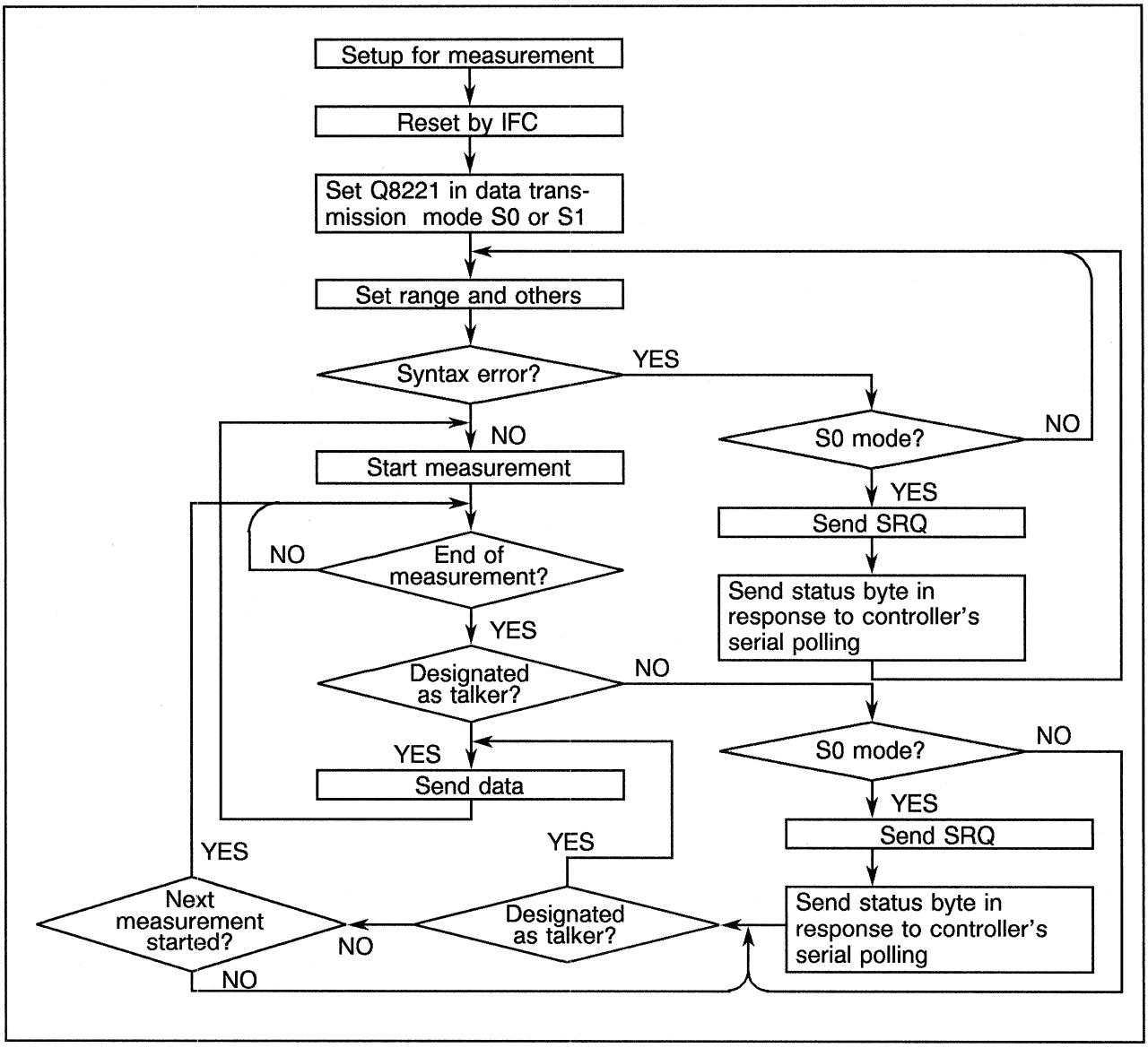


Figure 7-4 GPIB Interface Operation Flowchart

7.8 Notes on Operation

(1) Operation at the service request

Since the Q8221 operates as shown in Figure 7-5 when the measurement is ended or when the service request is transmitted by the SYTAX error (in S0 mode), care should be taken during programming.

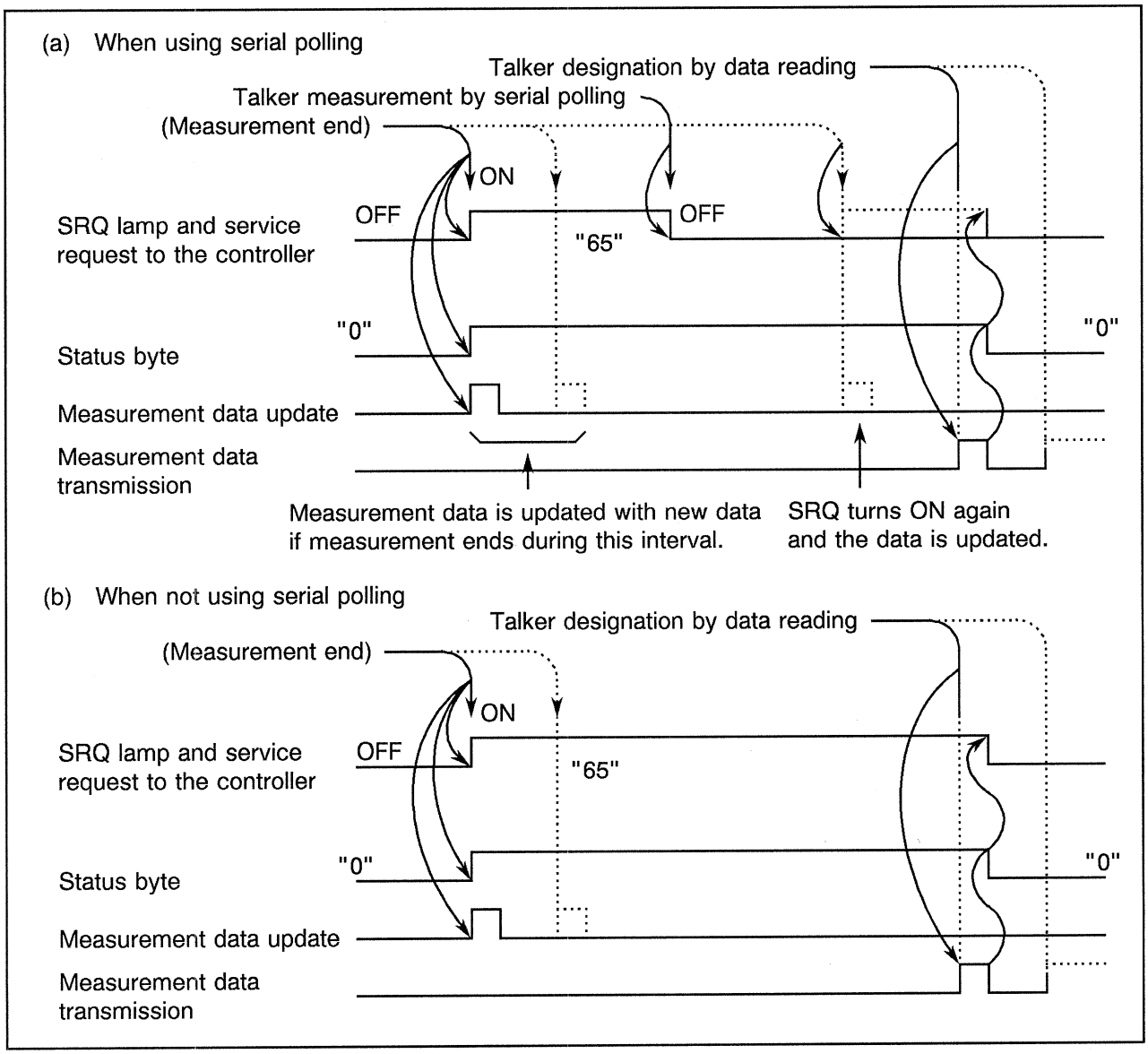


Figure 7-5 Service Request Operation Timing Chart (1 of 2)

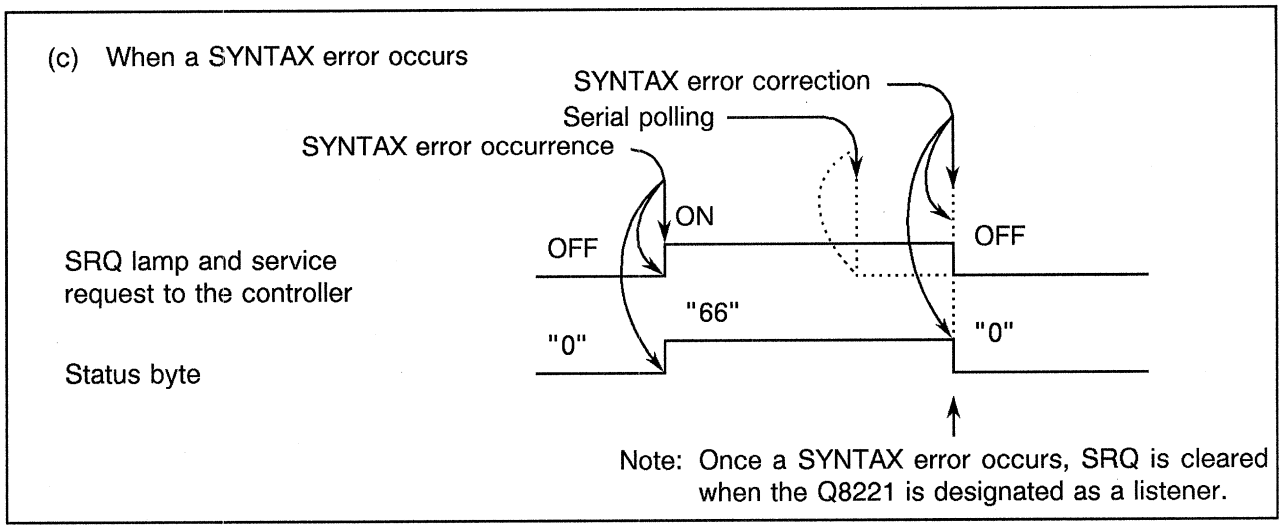


Figure 7-5 Service Request Operation Timing Chart (2 of 2)

(2) Differences in transmitted data dependent on the timing of talker designation

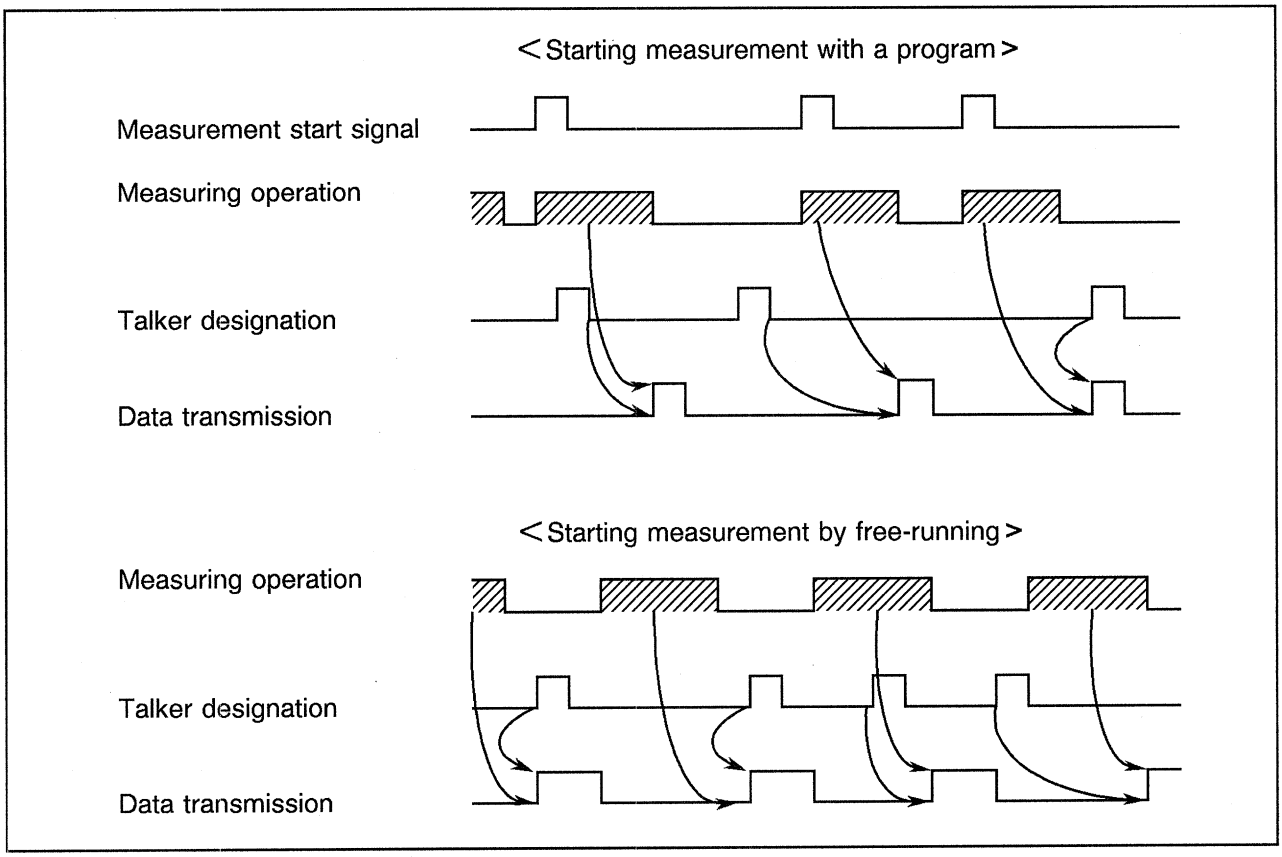
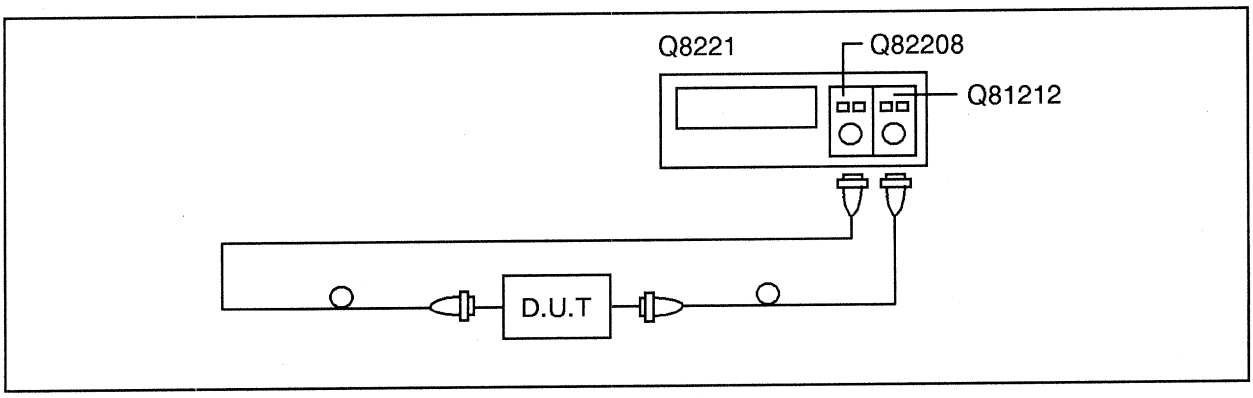


Figure 7-6 Differences in Transmitted Data Dependent on the Timing of Talker Designation

7.9 Sample Programs

Example 1: This section introduces the sample programs that is used to measure the stability of DUTs by connecting the Q82208 (long wavelength sensor) to CH-A, the Q81212 (1.55 μm LD light source) to CH-B.



Program (N88 BASIC of PC98 series is used)

```
100  OPM=8
110  '
120  ISET IFC
130  ISET REN
140  CMD DELIM=0
150  '
160  PRINT @OPM;"Z"
170  PRINT @OPM;"CH0,DW0,WL1550,R0,PR3"
180  PRINT @OPM;"CH1,AT3.0,CW0,OP1"
190  FOR I=1 TO 5000:NEXT 1
200  PRINT @OPM;"CH0,DR1,REFST"
210  INPUT @OPM;A$
220  PRINT A$
230  GOTO 210
240  '
250  END
```

Note: If a PC98 series personal computer is stopped during the program is running, the listener or talker condition is held. Therefore, there are occasions when the remote condition can not be released with the LOCAL key of Q8221.
In this case, execute "ISET IFC" in the personal computer.

Explanation

```
100 Assign the Q8221 address as 8 to the variable "OPM".
120 Send "interface clear".
130 Set the "remote enable" to "true".
140 Define the delimiter as "CR + LF".
160 Initialize all the Q8221 parameters.
170 Set the Q8221 parameters.
        CH0     :Specify the channel A.
        DW0     :dBm measurement mode
        WL1550  :Wavelength 1550nm
        R0      :Auto-range mode
        PR3     :Set the sampling rate to "SLOW".
180 Set the Q8221 parameters.
        CH1     :Specify the channel B.
        AT3.0   :Attenuate the light source output 3 dB lower.
        CW0     :CW light
        OP1     :Light source output ON
190 Wait until the light source output becomes stable.
200 Set the Q8221 parameters.
        CH0     :Specify the channel A.
        DR1     :dBr ON
        REFST   :Store the reference data.
210 Read the measurement data from the Q8221.
220 Display the measurement data on CRT.
230 Branch to line 210.
250 Program end
```

Example 2: Obtains the data using the record function and detects the end of the record by the SRQ interruption. Also, reads the measurement condition and the data obtained, then displays them on CRT.

Program (N88 BASIC of PC98 series is used)

```
100  OPTION BASE 1
110  OPM=8
120  DIM A$(8)
130  DIM DT(500)
140  '
150  ISET IFC
160  ISET REN
170  CMD DELIM=0
180  '
190  DEF SEG=SEGPTR(7)
200  A%=PEEK(&H9F3)
210  A%=A% AND &HBF
220  POKE &H9F3, A%
230  '
240  ON SRQ GOSUB 580
250  PRINT @OPM;"Z"
260  PRINT @OPM;"DW1,PR3,R0,S0"
270  WAITF=0
280  SRQ ON
290  PRINT @OPM;"IT5,DP10,REC1"
300  IF WAITF=0 THEN 300
310  '
320  PRINT @OPM;"SL2"
330  PRINT @OPM;"RECC?"
340  '
350  FOR I=1 TO 8
360   INPUT @OPM;A$(I)
370   PRINT A$(I)
380   NEXT I
390  '
400  '
410  D$=MID$(A$(1),22,3)
420  DCOUNT=VAL(D$)
430  PRINT @OPM;"RECD?"
440  '
450  FOR I=1 TO DCOUNT
460   INPUT @OPM;"A$
470   DT(I)=VAL(A$)
480   NEXT I
490  '
500  FOR I=1 TO DCOUNT
510   PRINT I,DT(I)
520   NEXT I
```

Program

```
530  '
540  STOP
550  '
560  '
570  '
580  POLL OPM,S
590  IF S < 128 THEN 610
600  WAITF=1
610  SRQ ON
620  RETURN
630  '
640  END
```

Explanation

```
100  Specify the minimum value of the subscript on the arrangement to 1.
110  Assign the Q8221 address as 8 to the variable "OPM".
120  Define the character type array variable "A$".
130  *3: Define the array variable "DT".
150  Send "interface clear".
160  Set "remote enable" to "true".
170  Set the delimiter as CR + LF.
190  ┌
200  │   *1: Clear the SRQ signal of PC9801 internal GPIB.
210  │
220  └
240  Specify the destination of subroutine by SRQ interruption.
250  Initialize all the Q8221 parameters.
260  Set the Q8221 parameters.
          DW1 : W measurement mode
          PR3 : Set the sampling rate to "SLOW".
          R0  : Auto-range mode
          S0  : SRQ on
270  Clear the interruption receive flag.
280  Set the SRQ interruption to "Enable".
290  Set the Q8221 parameters.
          IT5 : Interval time 5 s
          DP10: Number of record data 10 points
          REC1: Record start
300  Repeat until the interruption receiving flag is set.
320  Set the string delimiter as CF + LF.
330  Specify the read out of record data measurement.
350  Loop 8 times.
360  Read the measurement condition of one line from Q8221.
370  Display the measurement condition read on CRT.
```

```
410  With the read setting information, take out the number of data in the file into the
     character-type array variable "D$".
420  Convert the the number of data from the character-type array to the numeric type and
     assign it to the variable "DCOUNT".
430  Specify the record data read out to Q8221.
450  Repeat the number of data.
460  Read one data from the Q8221.
470  Convert the read data to the numeric type and assign it to the array variable "DT".
500  Repeat the data.
510  Display one data on CRT.
540  End
580  Execute the serial polling and store the Q8221 status in the variable "S".
590  Branch to line 610 if the status has not been recorded.
600  Set the interruption receiving flag.
610  Set the SRQ interruption to "Enable".
620  Subroutine end
640  Program end
```

*1: In some case the SRQ processing may not operate correctly if PC9801 does not clear the SRQ signal in the GPIB.
When the SRQ is used, be sure to program the line 190 to 220 in the same manner. If N88-BASIC is used on the MS-DOS, specify the segment base to "DEF SEG = SEGPTR(7)"; otherwise, specify to "DEF SEG = &H60".

8. DESCRIPTION OF OPERATION

8.1 Description of Q8221 Operation

The Q8221 mainframe controls plug-in units, displays measured values, and performs key detection. An optical sensor and an light source are connectable to the plug-in units. When an optical sensor has been connected, the A/D converted data is received as the serial data and displayed after wavelength sensitivity correction has been performed. In addition, when an light source has been connected, CHOP signals of 270 Hz, 2 kHz and 4 kHz are generated by the CHOP signal generator and sent to the plug-in units.

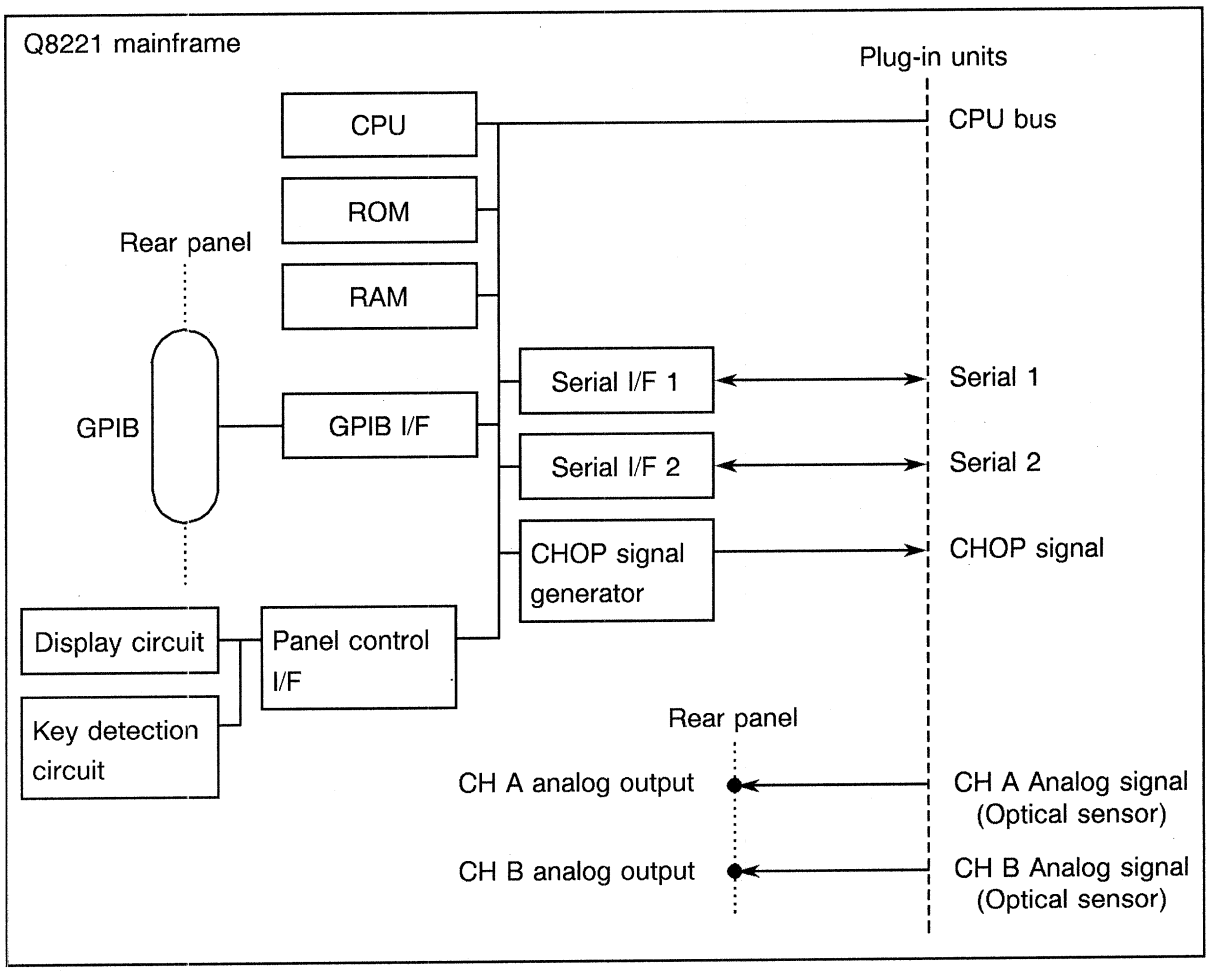


Figure 8-1 Q8221 Block Diagram

8.2 Operation Principle of Sensor Plug-in Unit

The sensor plug-in units are used for measuring the optical power of monochromatic lights such as the LED light and the laser beam. Various sensors complying with the wavelength band and power range are available.

The following is a schematic block diagram of high-sensitivity sensor plug-in unit Q82208 used exclusively for long wavelength fibers:

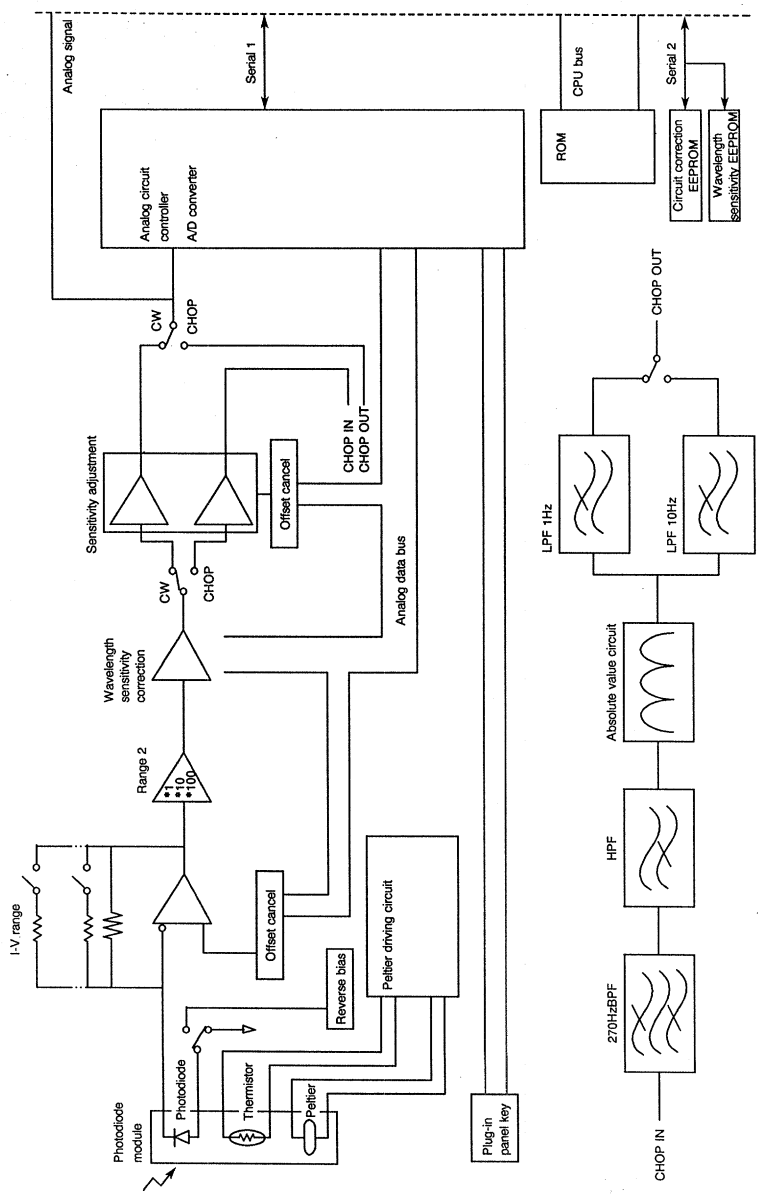


Figure 8-2 Block Diagram of Sensor Plug-in Unit (Q82208)

The Q2208 sensor plug-in unit uses an InGaAs photodiode as its light-intercepting element. The unit also contains a Peltier element and a thermistor with a module for temperature control, therefore enabling a stable measurement.

Conversion from light to current is performed by the photodiode, voltage conversion is performed by the I-V converter, and, after the necessary gain is applied, measurement is performed by the A/D converter. In this case, the following are the gain controls performed during this procedure: Range gain, which changes for each digit of input power; wavelength sensitivity correction, which corrects the sensitivity of the photodiode caused by the incident light wavelengths; and sensitivity adjustment, which corrects in efficiencies in the calibrated wavelengths of the diode.

There are 2 modes (CW and CHOP) of optical power measurement in the sensor plug-in units of the Q8221 series. The CW mode is used for measuring the absolute value of the optical power, and the CHOP mode is used for measuring the loss of fiber. In the CHOP mode, various gain adjustments are conducted, and after the current passes through a band-pass filter (BPF) of 270 Hz and absolute value detection is conducted, it passes through the A/D converter and is converted to direct current by the low-pass filter (LPF).

Since the optical sensors of the Q8221 series each contain wavelength sensitivity correction data, it is possible to measure wavelengths (other than calibrated wavelengths) with little error.

8.3 Operation Principle of Light Source Plug-in Units

Light source plug-in units output LED light or laser beams. The following is a schematic block diagram of the laser light source of Q81211:

The Q81211 unit uses an Fabry Perot interferometer type laser diode as its light-emitting element, and the module contains a monitor photodiode, a Peltier element, and a thermistor. The APC circuit in the diagram delivers a current to the laser diode. The output power is then monitored and controlled by the photodiode. In addition, the power can be varied by the offset variable.

In the ATC circuit shown in the diagram, the thermistor monitors the laser module temperature, and the Peltier element stabilizes the temperature at 25°C.

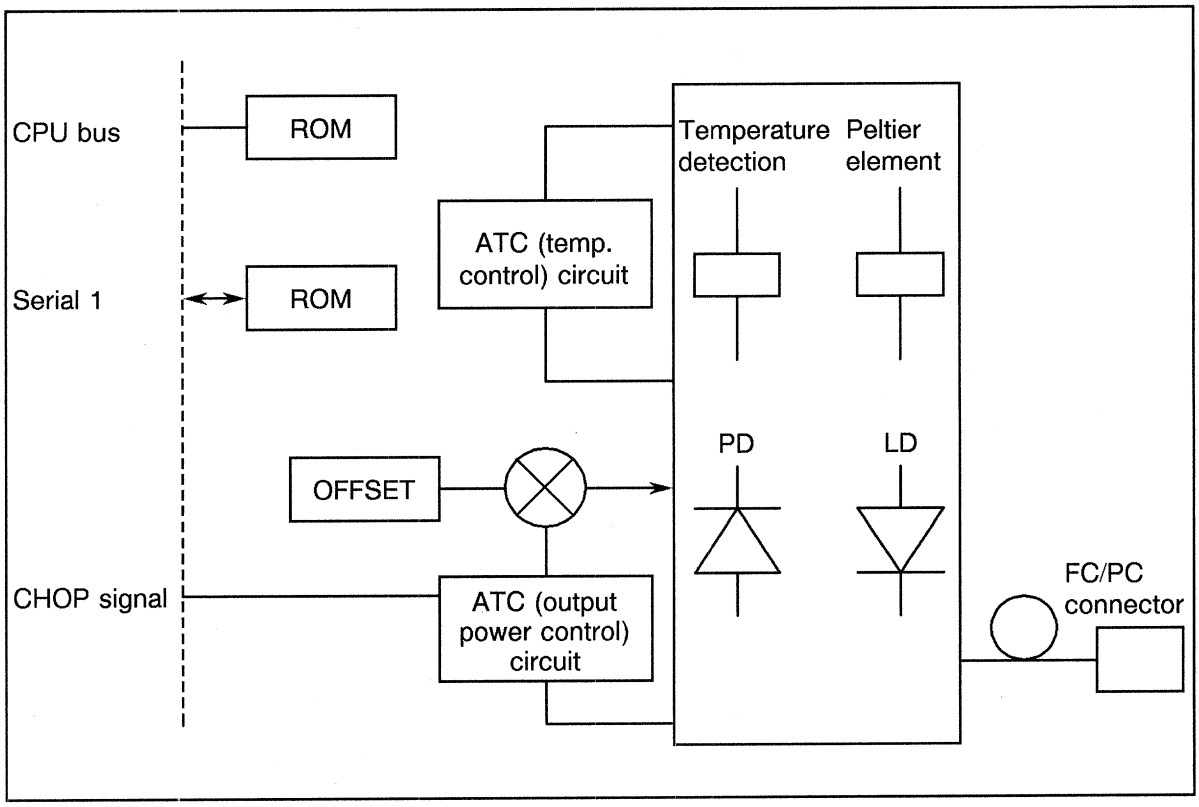


Figure 8-3 Block Diagram of Light Source Plug-in Units (Q81211, Q81212)

9. SPECIFICATIONS

9.1 Q8221 Specifications

(1) Optical power measuring specifications

Number of sensor connecting channels	2 channels of CH A and CH B
Resolution	dBm display: 0.001dB (0.0001dB at the data output by GPIB) W display: 199,999 counts max.
Measuring mode	Optical measuring modes of CW and CHOP (270Hz) are selectable.
Sensor wavelength sensitivity calibration	Entering the wavelength and wavelength sensitivity of the sensor is calibrated automatically by calibration value corresponding to the input wavelength
Relative value measuring (dBr)	Relative measuring in contrast with reference measurement value (dB) Maximum resolution: 0.001dB (0.0001dB at the data output by GPIB)
Display unit	W(mW, μW, nW, pW), dBm, dB
Display of measurement value	Decimal 5-1/2 digit mode, 7 segments of fluorescent display lamp
Switch of ranges	Automatic, manual and remote
Setting function of integral times	100 ms, 20 ms, 7 ms, 2 ms
Measuring rate	Approx. 100 sampling per sec (When integrating time is 2 ms and operating is in 1 channel). Approx. 50 sampling per sec (When integrating time is 7 ms and operating is in 1 channel). Approx. 30 sampling per sec (When integrating time is 20 ms and operating is in 1 channel). Approx. 9 sampling per sec (When integrating time is 100 ms and operating is in 1 channel).
Level meter	Display with 11 dots in order to the measurement value
Calculation function	A/B, B/A CF (W: add the constant to the measurement value, dBm: offset enable)
MAX hold function	Displays the maximum value of measurement
Averaging function	Enables to set up the averaging count within 2 to 256 counts by the movement averaging method

(2) Specification of light source plug-in unit

Number of light source connecting channels	2 channels of CH A and CH B
Output power activate function	Output power is selectable in the range of 0 to -6.0dB for the specified value. Setup resolution: 0.1dB
Switch of output waveform	Enable to select the CW light or CHOP light

(3) Other functions

Recording function	Enables to store 400 measured data into the backup memory, CH A and CH B independently, and reads out them to the personal computer using a GPIB. The maximum value, minimum value and difference value of the stored data can be displayed.
Memory function	Enables to read out the setup condition with a maximum of 5 methods to CH A and CH B independently, and reads out them.
Direct plot function	Enables to directly plot out the stored data to the external plotter as a direct time series data graph by using the recording function.
Brightness variable function	Enables to set the display brightness (5 steps).
Output function	GPIB Interface (complied with IEEE 488-1978) Analog output: Outputs the analog digital in accordance with the light input power. Continuous signal after wavelength sensibility correction is output. (It is not DA output.) Output voltage: 0 to +2V (F.S.) to each range Output impedance: 0.5Ω or less Output terminal: BNC connector

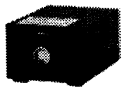
(4) General specifications

Ambient temperature	Environment temperature:0°C to +40°C Relative humidity: Up to 85%
Storage temperature	Environment temperature: – 25°C to +70°C
Power supply	Voltage : AC100V to 240V (90 to 250V (usable range) depending on specification) Frequency : 50Hz/60Hz
Power consumption	50VA or less (including plug-in unit and sensor)
External dimensions	Approx. 212(W) × 88(H) × 360(D) mm
Mass	3.9 kg or less (including plug-in unit)

(5) Accessories

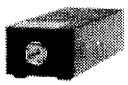
A02463	Rack mount set (EIA single)
A02464	Rack mount set (EIA twin)
A02263	Rack mount set (JIS single)
A02264	Rack mount set (JIS twin)
R16218	Carrying case
OCS-F2SFW-2	Optical fiber code (G150/125 μm, 2m)
OCS F2SPS-2	Optical fiber code (SM10/125 μm, 2m)

9.2 Sensor Plug-in Unit Specifications

								
Model		**Q82214**		**Q82215**		**Q82216**		
Product Type		Short Wavelength General-Purpose		Long Wavelength General-Purpose		Long Wavelength Large-Caliber Medium-Sensitivity		
Wavelength Range		400 to 1100 nm		800 to 1750 nm		800 to 1750 nm		
Power Range		-80 to +17 dBm*1		-60 to +10 dBm*1		-77 to +10 dBm*1		
	Range*2	CW	CHOP	CW	CHOP	CW	CHOP	
	Max.	200 mW	200 mW	20 mW	20 mW	20 mW	20 mW	
	Min.	20 nW	20 nW	2000 nW	2000 nW	20 nW	20 nW	
Sensor Element		Si 8mm ϕ		Ge 5mm ϕ		Ge 5mm ϕ Cooled		
Optical Input Form	Beam	Possible (Optical Input Diameter 8mm ϕ)		Possible (Optical Input Diameter 5mm ϕ)				
	Fiber	Core Diameter ≤100 µm, NA ≤0.3 PC,APC,and Slanted Rubbed Connectors (Use With Appropriate Connector Adaptor For Each)						
Measurement Accuracy*2*7		CW	CHOP	CW	CHOP	CW	CHOP	
At Calibration Wavelength		±3.0%	±4.0%	±3.0%	±4.0%	±2.5%	±3.5%	
		780 nm 1 mW 0 to 40℃		1300 nm 1 mW 0 to 40℃		1300 nm 1 mW 0 to 40℃		
At Wide Wavelength range		CW	CHOP	CW	CHOP	CW	CHOP	
		±5.0%	±6.0%	±5.0%	±6.0%	±4.5%	±5.5%	
		480 to 900 nm 1 mW 23±3℃		950 to 1600 nm 1 mW 23±3℃		950 to 1600 nm 1 mW 0 to 40℃		
Linearity (At Averange Time : 1 sec.)		±0.5%±10 pW -54 to + 17 dBm 23±3℃		±0.5% ±1 nW -37 to +10 dBm 23±3℃		±0.5%±20 pW -47 to +10 dBm 23±3℃		
		±1.0%±10 pW -57 to +17 dBm 23±3℃		±1.0%±1 nW -40 to +10 dBm 23±3℃		±1.0%±20 pW -50 to +10 dBm 23±3℃		
Noise Level*3	At Averaging Time : 1 sec.	-80 dBm		-60 dBm		-77 dBm		
	Without Averaging*4							
	SLOW (approx. 9/sec.)	-75 dBm		-55 dBm		-72 dBm		
	FS-1 (approx. 30/sec.)	-71 dBm		-51 dBm		-68 dBm		
	FS-2 (approx. 50/sec.)	-69 dBm		-48 dBm		-65 dBm		
	FS-3 (approx. 100/sec.)	-66 dBm		-45 dBm		-62 dBm		
Polarization Dependence (at wavelength 1550 nm)		—		0.03 dBp-p (Typical)*5		0.03 dBp-p (Typical)*5		
Return Loss	With APC,or slanted Rubbed Connector	60 dB or more						
	With high return loss adaptor*6	45 dB or more (Typical 47 dB)						
	With PC rubbed connector	approx. 14 dB						
Dimensions and Mass		Approx. 60(W) × 43(H)× 110(D) mm, 270 g or less						
Connectors to Adaptor Correspondence List	FC	A08012						
	SC	A08090						
	ST	A08096						
	MU	A08369						
	Plug-in	—						
	MT Adaptor (Mating to 12-pin SMF)	—		A08187 (Mating to 12-pin SMF)				
High Return Loss Adaptor Correspondence List *9	FC	A08328						
	SC	A08329						
	ST	A08330						
	Plug-in	A08331						
Connection to the Q8221 Main Unit		Q82202 or Q82203 Interface Plug-in Unit Required. Connection Cable Available as Accessory with Q82202, or Q82203						

*1 Level at Max. is when optical input was received with entire sensor area.
*2 CW : Continuous Optical Measurement Mode used.
CHOP : 270 Hz Chopped light Measurement Mode used.
*3 Noise Level with CW Mode and at calibration wavelength
(With CHOP Mode,noise level at FS-1 and FS-2 are approx. the same as at SLOW.)
*4 SLOW : Integration Time , 100 msec FS-1 : Integration Time, 20 msec FS-2 : Integration Time, 7 msec






Q82227		Q82232		Q82233		Q82208		Model
Long Wavelength High-Sensitivity High-Power		Long Wavelength High-Sensitivity Low Polarization				Long Wavelength High-Sensitivity		Product Type
900 to 1650 nm						800 to 1700 nm		Wavelength Range
-80 to +27 dBm		-94 to +10 dBm						Power Range
CW	CHOP	CW	CHOP	CW	CHOP	CW	CHOP	Range*2
2000 mW	2000 mW	20 mW	20 mW	20 mW	20 mW	20 mW	20 mW	Max.
20 nW	2000 nW	200 pW	200 nW	200 pW	200 nW	200 pW	200 nW	Min.
In GaAs Cooled								Sensor Element
Not Possible								Beam
Core Diameter ≤10 μm, NA ≤ 0.19 PC, APC, and Slanted Rubbed Connectors		Core Diameter ≤10 μm, NA ≤ 0.19 PC Rubbed Connector				Core Diameter ≤ 62.5mm, NA ≤ 0.21 PC, APC, and Slanted Rubbed Connectors		Optical Input Form / Fiber
CW	CHOP	CW	CHOP	CW *8	CHOP *8	CW	CHOP	Measurement Accuracy*2
±2.5%	±3.5%	±2.5%	±3.5%	±7.5%	±8.5%	±2.5%	±3.5%	
1550 nm 1 mW 0 to 40℃						1300 nm 1 mW 0 to 40℃		At Calibration Wavelength
CW	CHOP	CW	CHOP	CW *8	CHOP *8	CW	CHOP	At Wide Wavelength range
±4.5%	±5.5%	±4.5%	±5.5%	±14.5%	±15.5%	±4.5%	±5.5%	
950 to 1630 nm 1 mW 0 to 40℃		950 to 1600 nm 1 mW 0 to 40℃				1000 to 1650 nm 1 mW 0 to 40℃		
±0.5% ±10 pW -58 to +27 dBm 0 to 40℃		±0.5% ±0.4 pW -72 to +10 dBm 0 to 40℃						Linearity (At Average Time : 1 sec.)
±1.0% ±10 pW -61 to +27 dBm 0 to 40℃		±1.0% ±0.4 pW -75 to +10 dBm 0 to 40℃						
-80 dBm		-94 dBm						At Averaging Time : 1 sec. / Noise Level*3
-79 dBm		-93 dBm						Without Averaging*4 / SLOW (approx. 9/sec.)
-76 dBm		-90 dBm				-91 dBm		FS-1 (approx. 30/sec.)
-70 dBm		-88 dBm				-90 dBm		FS-2 (approx. 50/sec.)
-67 dBm		-85 dBm				-87 dBm		FS-3(approx. 100/sec.)
0.05 dBp-p or less		0.003 dBp-p or less		0.005 dBp-p or less		0.02 dBp-p or less (Typical 0.015 dBp-p)		Polarization Dependence (at wavelength 1550 nm)
60 dB or more		—				50 dB or more		With APC, or slanted Rubbed Connector / Return Loss
45 dB or more (Typical 47 dB)		—				43 dB or more (Typical 45 dB)		With high return loss adaptor*6
approx. 14 dB				45 dB or more *6		approx. 14 dB		With PC rubbed connector
Approx. 60 (W)×43 (H)×135 (D) mm 500 g or less		Approx. 60 (W)×43 (H)×135(D) mm 590 g or less		Approx. 60 (W)×43 (H)×166 (D) mm 660 g or less		Plugs into Q8221		Dimensions and Mass
A08340 (Standard Accessory)				A08161(Standard Accessory)				FC / Connectors to Adaptor Correspondence List
A08338				A08162				SC
A08339				A08163				ST
A08371				A08370				MU
—				Jack-type Possible				Plug-in
—								MT Adaptor (Mating to 12-pin SMF)
A08328		Usage of high return loss adaptors are not possible				A08328		FC / High return loss adaptor Correspondence List *9
A08329		Usage of high return loss adaptors are not possible				A08329		SC
A08330		Usage of high return loss adaptors are not possible				A08330		ST
A08331		Usage of high return loss adaptors are not possible				A08331		Plug-in
Q82203 Required Connection Cable Available as Accessory with Q82203						Q82202 or Q82203 Not Required		Connection to the Q8221 Main Unit

*5 Typical Figure (Not Specified)
*6 When using PC rubbed connector with return loss 45 dB or more.
*7 An optional calibration wavelength of 1550 nm is provided for Q82215/16/08. (OPT82215+25, OPT82216+25, and OPT82208+25) Then, the measurement accuracy for these models is shown in the table above at a calibration wavelength of 1550nm.
*8 When using dispersion shift fiber with master grade A.
*9 The connection loss with signal mode fiber is typically 0.07 dB.

9.3 Light Source Plug-in Unit Specification

Model	Q81201	Q81202	Q81203	Q81204
Light emitting device	LED	LED	LED	LED
Wavelength	850 ± 25nm	1310 ± 40nm	1550 ± 30nm	1310 ± 10nm
Full wave half medium of spectrum	55nm or less	160nm or less	210nm or less	20 ± 5nm
Output power	−15 ± 1dBm *1	−20 ± 1dBm *1	−43 ± 1dBm *2	−35 ± 1dBm *1
Output power adjustment	−	−	−	−
Stability				
23°C ± 1°C/1m	−	−	−	−
23°C ± 2°C/1h	± 0.02dB or less	± 0.02dB or less	± 0.04dB or less	± 0.02dB or less
Between 0 and 40°C ± 2°C/1h	−	−	−	−
0 to 40°C/8h	± 0.2dB or less	± 0.2dB or less	± 0.2dB or less	± 0.2dB or less
Output waveform	CW or chopping light by 270, 2k or 4kHz *3			
Output connector	FC type			
Warm up time	60 minutes after power on			

*1 : GI 50/125μm 2m fiber by injection molding tip
*2 : SM 10/125μm 2m fiber by injection molding tip
*3 : Frequency ± 0.1%, 270Hz: Duty 50 ± 5%
2k, 4kHz: Duty 50 ± 10%

Model	Q81205	Q81206	Q81207	Q81211	Q81212
Light emitting device	LED	Edge-emitting LED	Edge-emitting LED	FP-LD (Class 1 Laser Product)	FP-LD (Class 1 Laser Product)
Wavelength	1550 ± 10nm	1300 ± 30nm	1550 ± 30nm	1310 ± 10nm	1550 ± 20nm
Full wave half medium of spectrum	20 ± 5nm	100nm or less	140nm or less	5nm or less	10nm or less
Output power	−53 ± 1dBm *2	−14 ± 1dBm *2	−17 ± 1dBm *2	0 ± 1dBm *2	0 ± 1dBm *2
Output power adjustment	−	−	−	0 to −6dB 0.1dB step	0 to −6dB 0.1dB step
Stability					
23°C ± 1°C/1m	−	−	−	± 0.01dB or less	± 0.01dB or less
23°C ± 2°C/1h	± 0.04dB or less	−	−	−	−
Between 0 and 40°C ± 2°C/1h	−	± 0.02dB or less	± 0.04dB or less	± 0.05dB or less	± 0.05dB or less
0 to 40°C/8h	± 0.2dB or less	± 0.4dB or less	± 0.4dB or less	± 1dB or less	± 1dB or less
Output waveform	CW or chopping light by 270, 2k or 4kHz *3				
Output connector	FC type				
Warm up time	60 minutes after power on				

*2 : SM 10/125μm 2m fiber by injection molding tip

*3 : Frequency ± 0.1%, 270Hz: Duty 50 ± 5%
2k, 4kHz: Duty 50 ± 10%

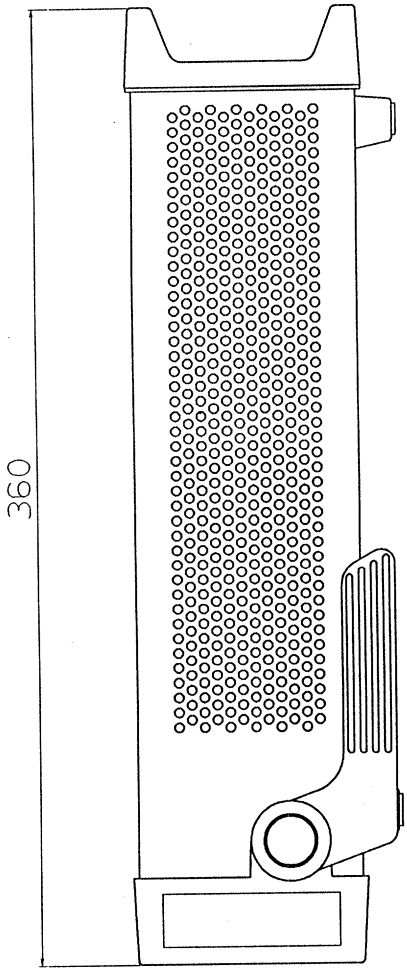
APPENDIX

A.1 Error Message List

Error message	Explanation	Measures
Err.20	An error is detected in the contents of parameter backed up.	Initialize the parameter backed up. See section 4.2.
Err.31	An error is detected when the measurement value during zero correction is out of range.	Execute zero correction after shielding the optical input connector.
Err.32	An error is detected when the CW/CHOP key or the ZERO key is pressed during zero correction.	Zero correction is forcibly aborted.
Err.70	An error is detected in the plotter.	Abort the plotter output operation.
Err.71	An error is detected in the plotter output data.	
Err.72	An error is detected due to output the data to the plotter with the recorded data value of 1 or less.	
Err.75	Execution Error of Data Record • Data could not be obtained at all. • When the record data is all "oL". • When the record data is all "UL".	Set an optimum range, then execute the Data Record function again.
Err.80	The power is turned on with keeping the Q82202 or Q82203 interface plug-in unit connected with no head.	Turn off the power and connect the sensor head with sensor unit, and restart the Q8221.
Err.81	An error is detected when Q82227 is connected to Q82202 (Interface plug-in Unit)	To use Q82227, always use Q82203 together. (Refer to "1.2 System Configuration".)
Err.90	Calculation error An error is detected in the calculated data during the A/B or B/A calculation. (division, etc: divided by 0 as denominator)	———

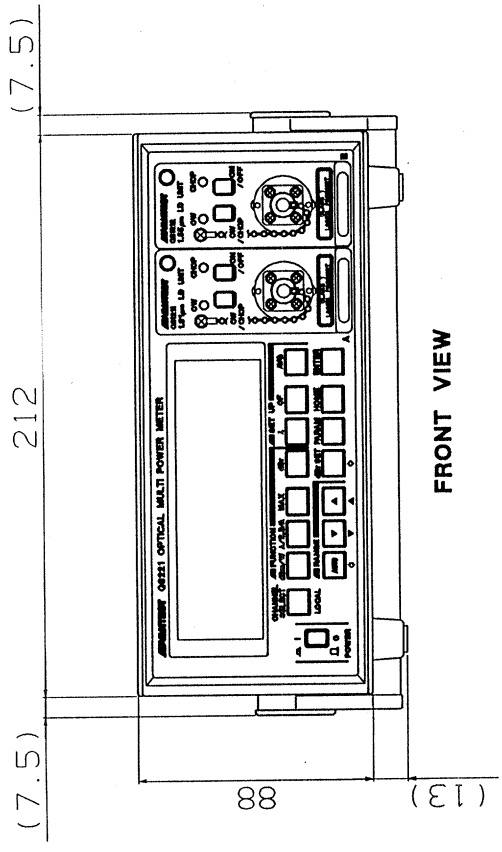
CAUTION

If the message "Err.00 to Err.19" is displayed, inspection or repairing is required. Please contact ATCE or the nearest sales offices.

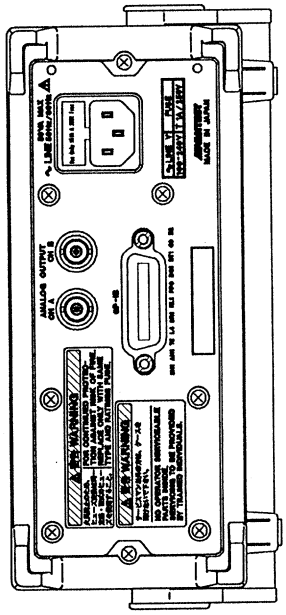


SIDE VIEW

Unit : mm

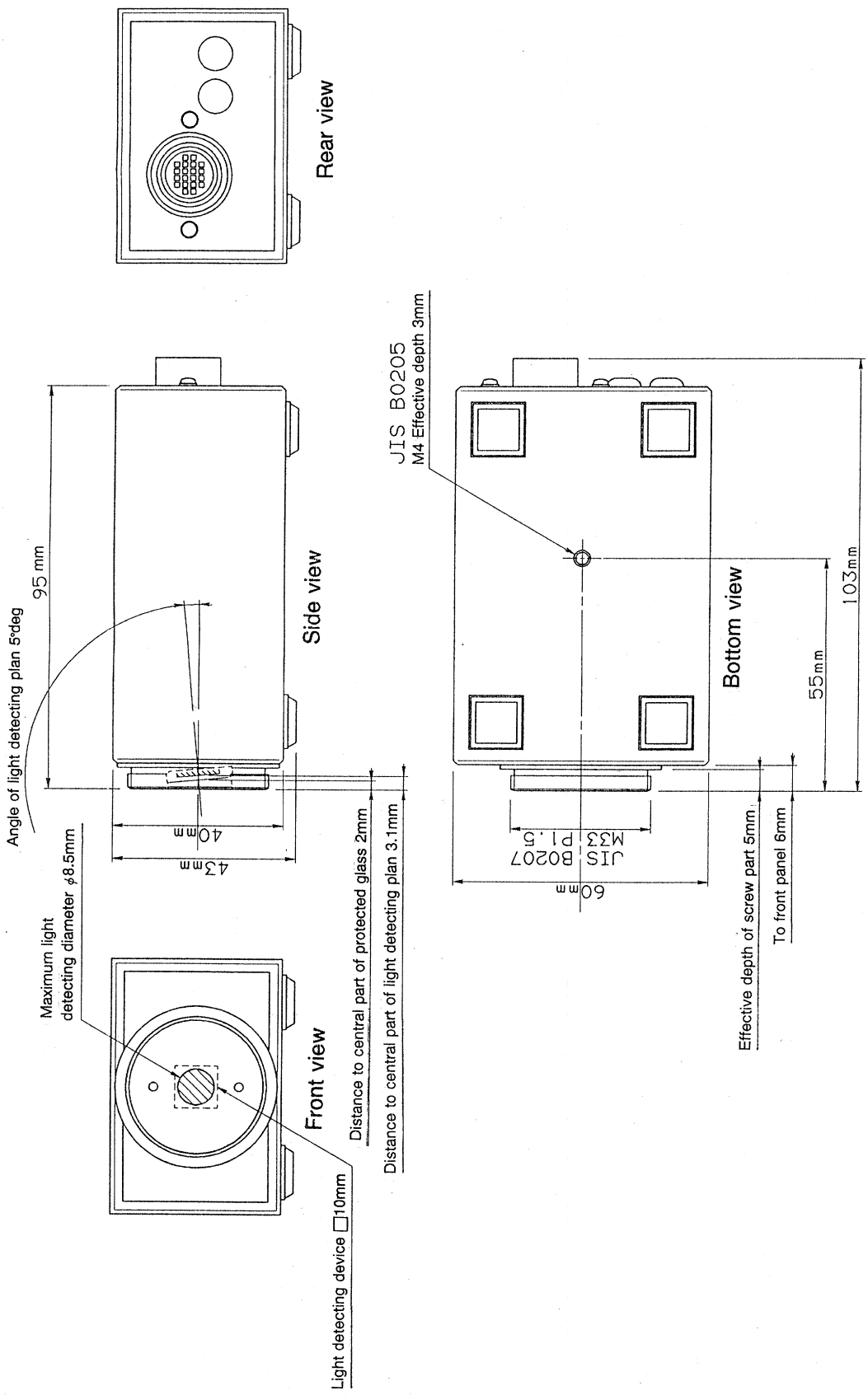


FRONT VIEW

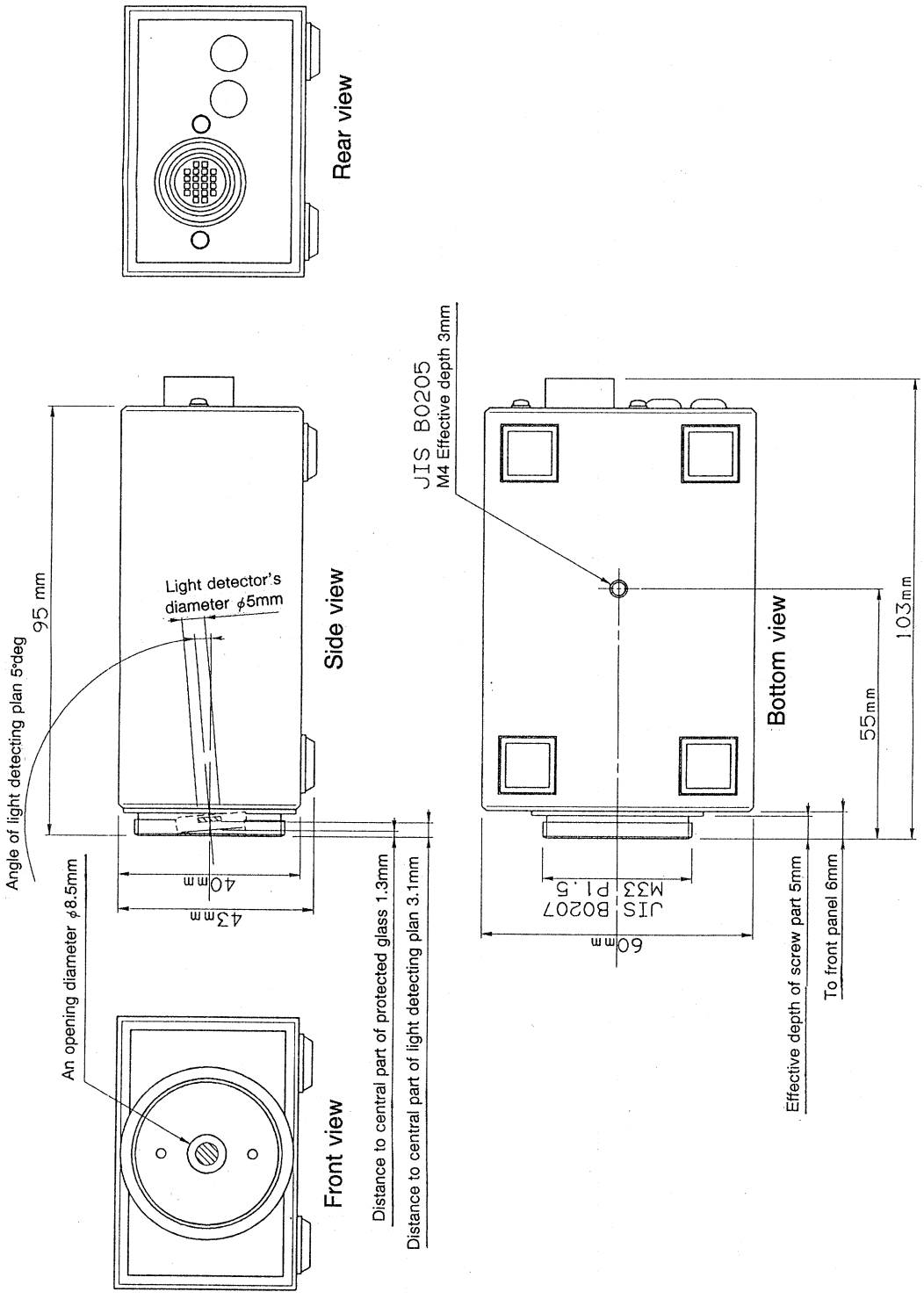


REAR VIEW

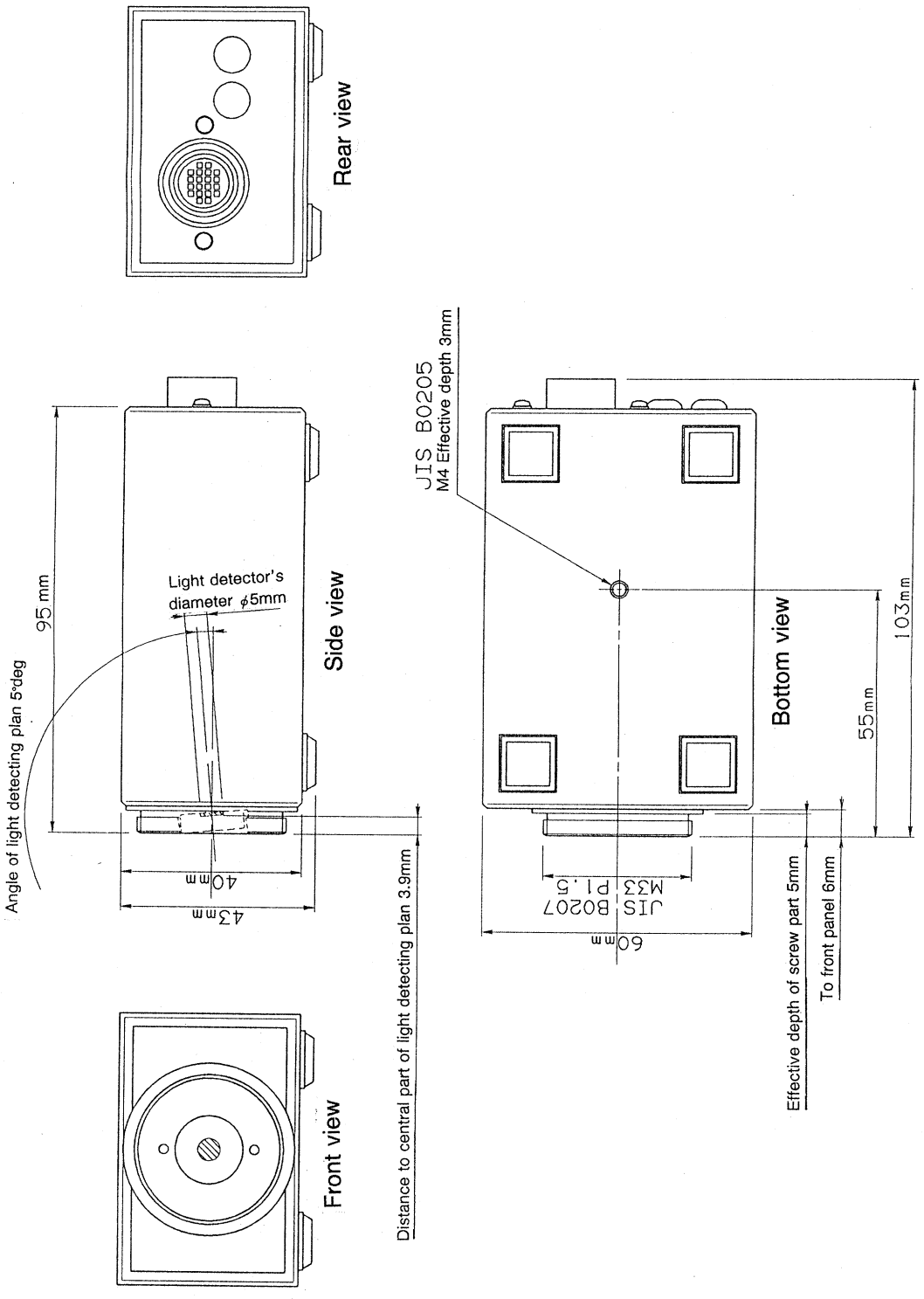
Q8221 EXTERNAL VIEW



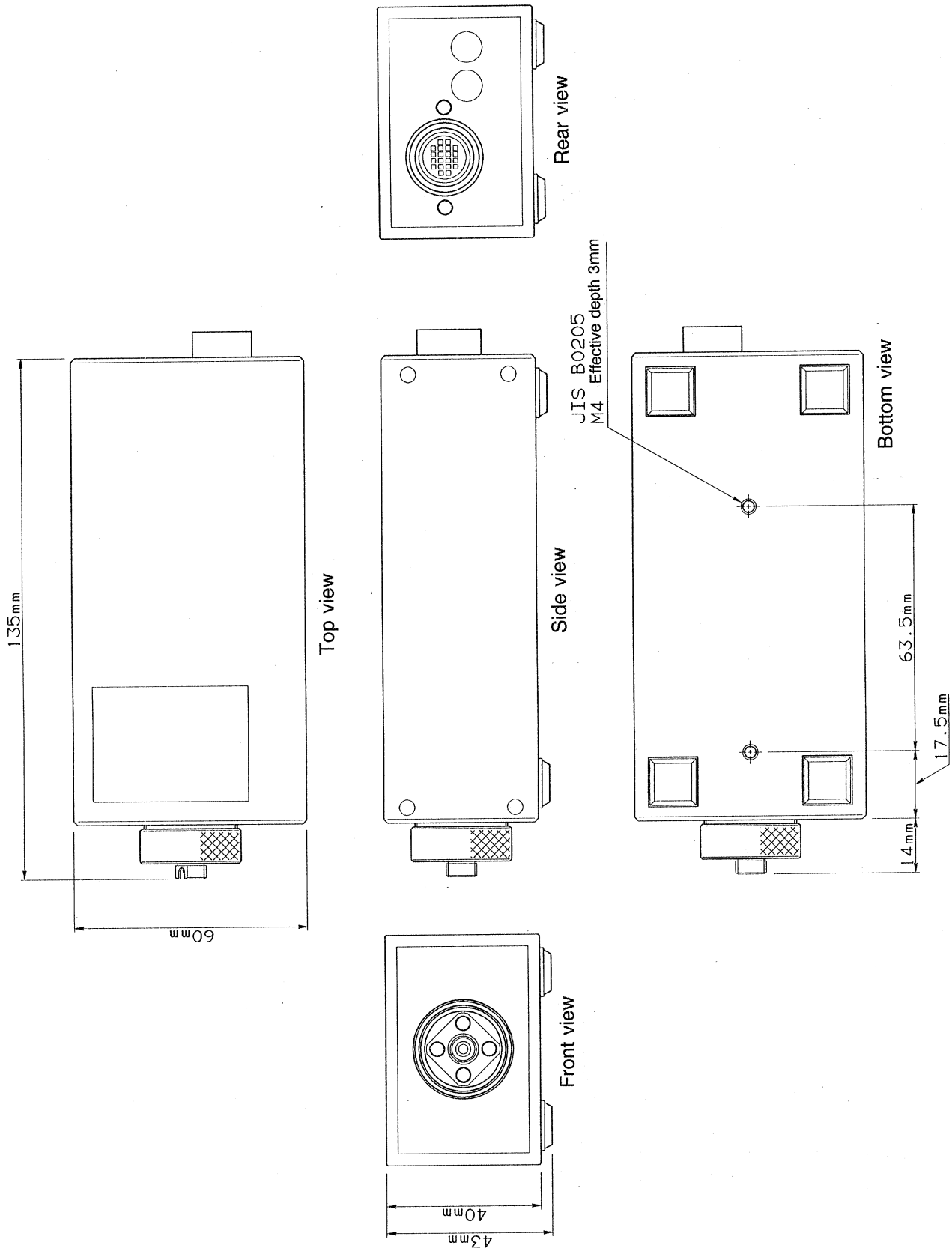
Mechanical dimension of Q82214



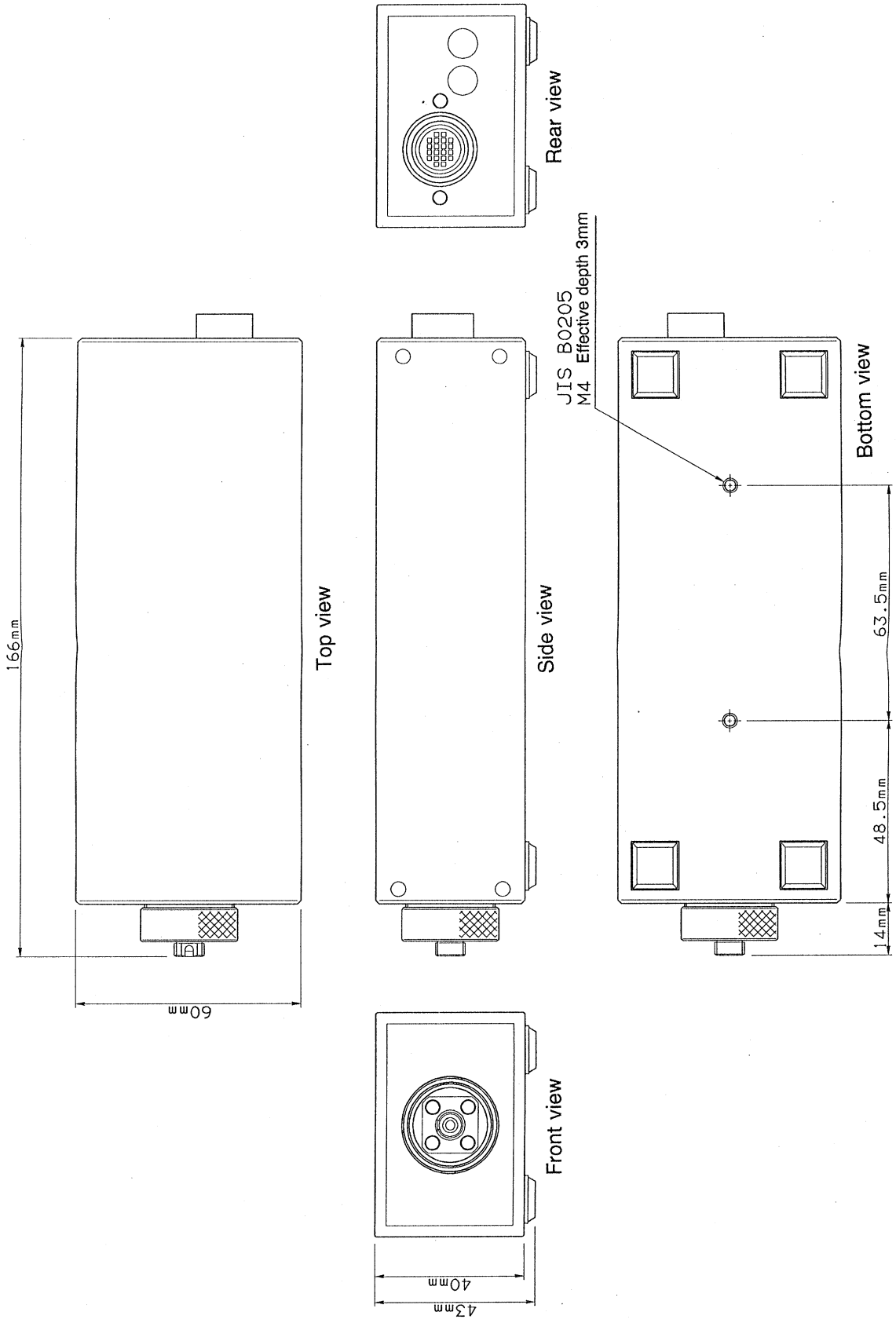
Mechanical dimension of Q82215



Mechanical dimension of Q82216



Mechanical dimension of Q82227, Q82232



Mechanical dimension of Q82233

ALPHABETICAL INDEX

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(2) The repair and calibration services may be declined if either of the following situations arise.

1) When required parts cannot be procured.

2) When the performance of the Product cannot be maintained after repair.

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