
ADVANTEST®
ADVANTEST CORPORATION

**INSTRUCTION
MANUAL**

Q84421L/M

**OPTICAL FIBER BAND
CHARACTERISTIC TEST SET**

MANUAL NUMBER OEA00 9012

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List of Related Manuals

LIST OF RELATED MANUALS

Manual No.	Manual Name
TR4135	RF Spectrum Analyzer
TR4153A/B	Tracking Generator
TR4154	Tracking Generator

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1.1 Preface

1. INTRODUCTION

1.1 Preface

This operation manual describes how to use the Q84421L/M Optical fiber band characteristic test set. For the use of other equipment, refer to the corresponding operation manual.

1.2 Outline

Q84421L is a $1.3\mu\text{m}$ multimode fiber band measuring instrument, and Q84421M is a $0.85\mu\text{m}$ multimode fiber band measuring instrument. The multimode fiber transmission band can be directly viewed through combined use of Q84421L/M, an RF spectrum analyzer, and a tracking generator. Only the fiber characteristic to be measured can be measured using a normalize function of our company's spectrum analyzer. The light-emitting element of Q84421L/M's E/O section employing a laser diode (LD) has a high output and wide band. It is also controlled in temperature and has an excellent wavelength stability. The optical emitting end connector uses a PC-type connector to suppress the disturbance of a frequency characteristic due to the reflected light (for FC-type and compatible internal ferrule connectors, the convex spherical surface is polished).

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1.3 Before Use

1.3 Before Use

1.3.1 Confirmation of Appearance and Accessories Supplied

Inspect the Q84421L/M's external appearance and check that there is no flaw or damage occurring during transport. Confirm the quantity and specification of the standard accessories supplied while referring to Table 1-1.

If you have any flaw, damage, or insufficient accessories, consult ATCE or your nearest service facility.

The reference for an inquiry is described at the end of this manual.

Table 1-1 Standard Accessories Supplied

Description	Type	Quantity
Power cable	MP-43A	1
3-2pin adaptor	KPR-18	1
Power fuse	T0.3A*	2
Coaxial cable	MI-09	2
N-BNC conversion adaptor	JUG-201A/U	2
Operation manual	EQ84421L/M	1

*:T0.15A for 220VAC/240VAC

1.3.2 Operating Environment

- (1) To operate Q84421L/M on an AC power, use a supplied power cable (MP-43A). The AC power uses $100\text{VAC} \pm 10\%$ (120VAC , $220\text{VAC} \pm 10\%$, and $240\text{VAC} \pm 10\%$ as specified) in 48 to 66Hz. Connect the power cable to Q84421L/M after the power switch is set to off.
- (2) The operating temperature is 0 to $+40^{\circ}\text{C}$, and the operating humidity is less than 85%. Do not leave the set in a place subject to direct sunlight and use it in a well-ventilated place.
- (3) Avoid subjecting the set to mechanical shock.
- (4) Cover it with vinyl and put it in a corrugated cardboard box if the set is not to be used for an extended period of time. Keep the set in a place not subject to excessive moisture and direct sunlight. The storage temperature is -25 to $+70^{\circ}\text{C}$.

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2.1 Precautions Before Use

2. HOW TO USE

2.1 Precautions Before Use

For the output operation using an AC power, connect the center pin of the Q84421L/M power connector to ground to prevent the AC power from electric shock. The plug of a supplied power cable has three pins. The round pin in the center is used for ground. Therefore, when the 3-pin plug is connected to a 3-pole wall outlet, the center pin is connected to ground.

If this plug is connected to the wall outlet using a 3-2 pin conversion adaptor (A09034), connect the ground wire (see Figure 2-1 (a)) projecting from the adaptor to ground.

As shown in Figure 2-1 (b), the two electrodes of the A09034 adaptor differ in width A and B. Confirm the direction of the plug and wall outlet when connecting the adaptor to the wall outlet.

Use optional adaptor KPR-13 when the A09034 adaptor cannot be connected to the wall outlet used.

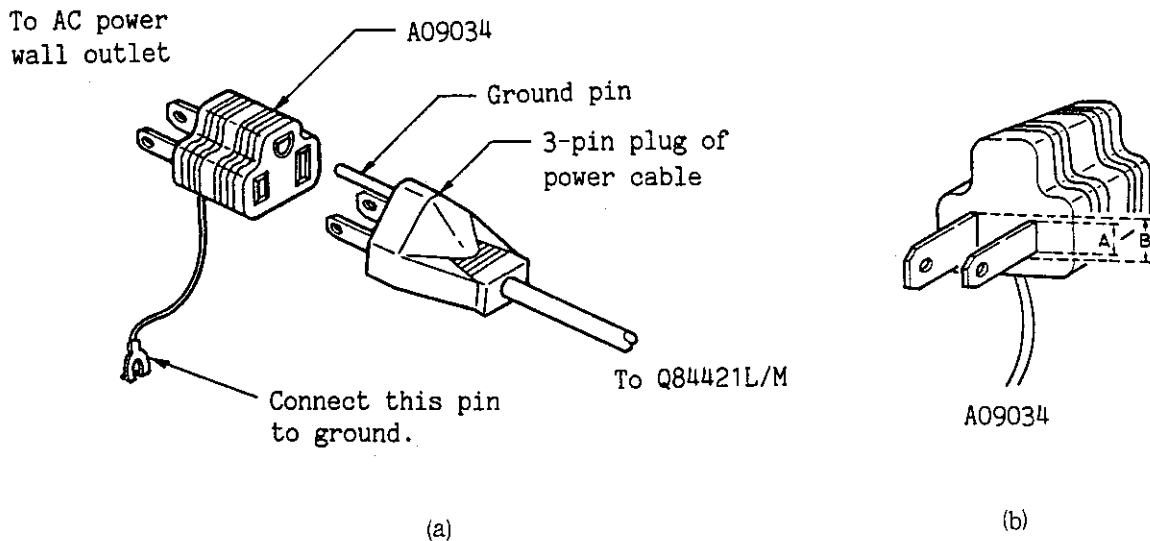


Figure 2-1 Power Cable

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2.2 Precautions During Use

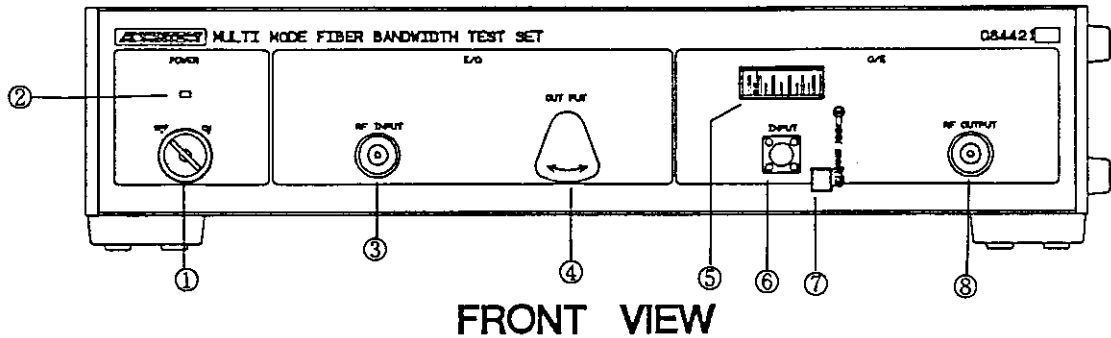
2.2 Precautions During Use

- (1) Do not view the optical output connector end or the emitting end of a connected optical fiber directly in the light emitting state. An invisible laser ray is emitted from the end. This may damage your eyes.
- (2) Clean the connector end surface of a connected optical fiber with alcohol (see 4.1, "Maintenance"). The stain or flaw on the end surface makes an accurate measurement impossible. This may also damage the internal connector end surface of Q84421L/M.
- (3) The allowable input level of an external modulation input is +3dBm (2mW, 50 Ω) (maximum).
An excessive input level may damage the laser diode (LD). If static electricity is discharged in the center electrode of an external modulation input connector, the laser diode may be damaged.

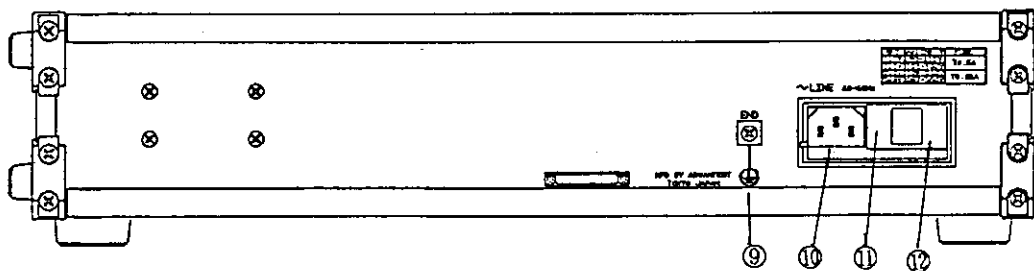
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2.3 Front and Rear Panels

2.3 Front and Rear Panels



FRONT VIEW



REAR VIEW

- ① Power switch

Key lock switch. The key can be locked or unlocked only when the power switch is off.

- ② Power indicator

The power indicator lights (red) when the power is turned on and goes off when it is turned off.

- ③ Modulation signal input terminal

N-type connector with an input impedance of 50Ω . The allowable input level is +3dBm.

- ④ Optical output connector (with shutter)

FC-type optical connector. This connector has an internal PC-type connector (with the convex spherical surface polished).

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2.3 Front and Rear Panels

⑤ Optical input level indicator

This indicator indicates the allowable input level in the full-scale range (-15dBm for Q84421L and -20dBm for Q84421M).

⑥ Optical input connector

O/E optical input connector (FC-type).

⑦ Protection cap

Put this protection cap in the connector when an optical input connector is not used.

⑧ Modulation output terminal

N-type connector with an output impedance of 50Ω .

⑨ Ground terminal

⑩ Power connector

Use a power cable used exclusively for the power connector.

⑪ Fuse

⑫ Supply voltage selection panel

Different AC voltages can be used by replacing the selection panel.

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2.4 Connection

2.4 Connection

- (1) Connect the power cable.
- (2) Connect Q84421L/M to a spectrum analyzer (SPA) and tracking generator (TG).
 - ① Connect the RF input terminal of the spectrum analyzer and the RF output (RF OUTPUT) terminal of Q84421L/M using a supplied coaxial cable.
 - ② Connect the output (TG OUT) terminal of the tracking generator and the RF input (RF INPUT) terminal of Q84421L/M using a supplied coaxial cable.

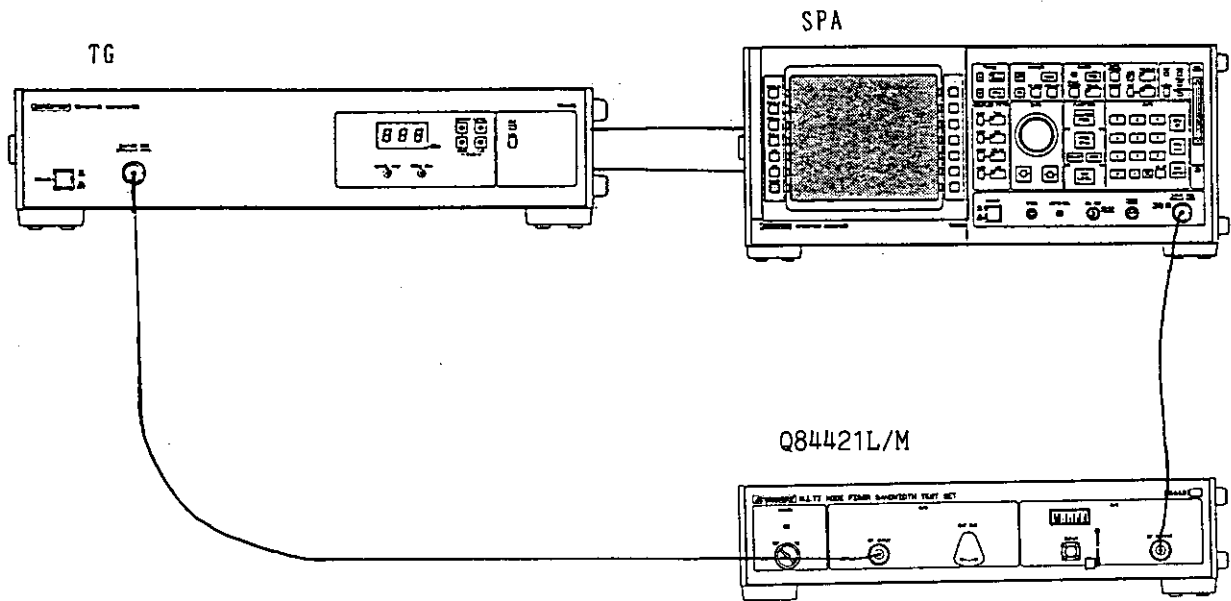


Figure 2-2 Connection of Q84421L/M to Spectrum Analyzer and Tracking Generator

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2.4 Connection

(3) Connect an optical fiber to Q84421L/M.

- ① Open the OPT OUTPUT shutter of Q84421L/M and connect the optical fiber exciter (see note 1) for a baseband characteristic.
- ② Connect the exciter and the fiber code with one-end connector via an optical connector.
- ③ Connect the pigtail end (to which no connector is attached) of the optical fiber code with one-end connector to the measured fiber using V-groove connector (A).
- ④ Connect the other end of the measured fiber to the pigtail end of the fiber code with one-end connector using V-groove connector (B).
- ⑤ Connect the connector of the fiber code with one-end connector to the optical ATT.
- ⑥ Connect the optical ATT and the OPT INPUT terminal of Q84421L/M using an optical fiber code with both-end connector.

※Note 1: Use an SGS exciter when the measured fiber is GI50.

It is recommended to use the SGS exciters below.

- | | |
|------------------------|----------|
| - Furukawa Denki Kogyo | OT-85639 |
| - Sumitomo Denki Kogyo | LB-1C |
| - Fujikura Densen | FBW-01 |

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2.4 Connection

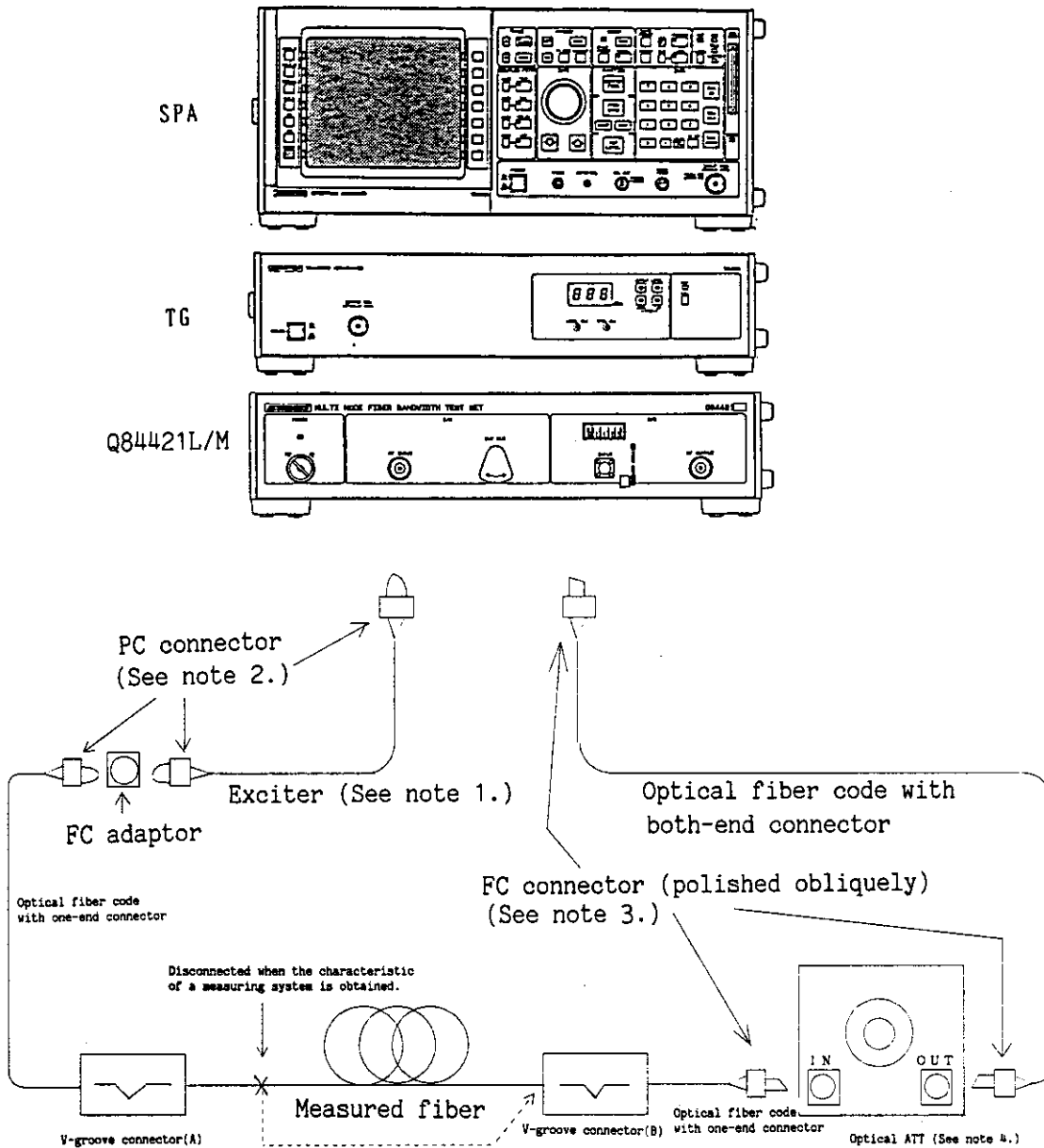


Figure 2-3 Measurement Setup (example)

- ※Note 2: Use a PC-type connector (with the convex spherical surface polished).
- ※Note 3: Use an FC-type connector with the surface polished obliquely.
- ※Note 4: Use an optical ATT that conforms to the wavelength used and is protected from the influence of reflected light.

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2.5 High-Precision Measurement

2.5 High-Precision Measurement

- (1) For an optical connector, use a PC-type connector or a connector with the surface polished obliquely to prevent the influence of reflection (see Figure 2-4).
If light reflection exists in the connector end, a resonator is constituted between the light-emitting end surface of a laser diode and the connector end or the connector ends. A periodic ripple then occurs in the frequency characteristic. The relationship between the resonator length (fiber length) and ripple period is given by the expression below.

$$\Delta f = c / 2nl$$

l fiber length
 n group refractive index of a fiber
 c light velocity (in vacuum) = 3×10^8 (m/sec)
 Δf ripple frequency interval

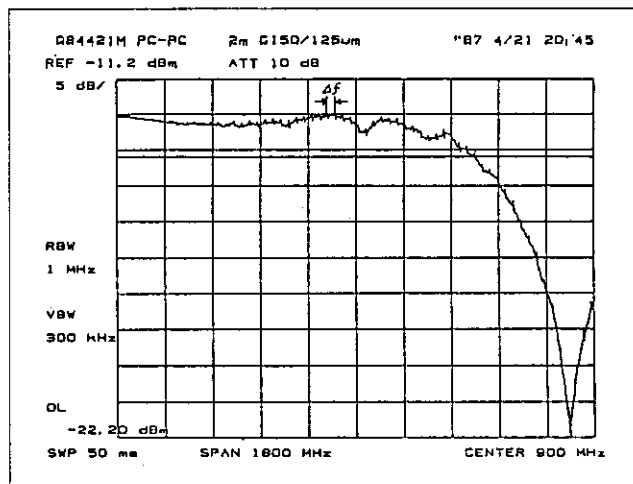


Figure 2-4 Ripple in Frequency Characteristic by Light Reflection

- (2) Set the resolution bandwidth (RBW) of a spectrum analyzer to more than 100kHz. In the measurement of a long fiber, a tracking generator and receive signal may not be tracked and a noise may be increased due to the propagation delay of the long fiber. For example, if a fiber of 5km is measured, the noise is increased when the resolution bandwidth is less than 30kHz.
- (3) Always keep the optical connector clean.
Q84421L/M uses a PC-type optical connector so that it is protected from the influence of reflected light. The stain on the end surface causes an increase in reflected light and connection loss. Do not apply matching oil to the connector block. This causes dust to attach to the connector block (see 4.1, "Maintenance").
- (4) Adjust the optical ATT so that the level indicator pointer does not deflect completely.
An excessive optical power activates a limiter to protect an APD circuit. No normal frequency characteristic can then be obtained.

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2.6 Operation Procedure

2.6 Operation Procedure

An operation procedure example when a TR4135 spectrum analyzer (SPA) and TR4154 tracking generator (TG) are used is described below.

- (1) Turn on the power to the Q84421L/M, spectrum analyzer, and tracking generator.
- (2) Initialization of tracking generator

Set the output level of the tracking generator to -10dBm.

- (3) Initialization of spectrum analyzer

Press each key of the spectrum analyzer sequentially as described below.

- ① Center frequency: 0.5GHz

Operation

CENTER
 FREQ GHz
 dB

- ② Frequency span: 1GHz

Operation

FREQ
 SPAN GHz
 dB

- ③ Reference level: -10dBm

Operation

REF
 LEVEL GHz
 dB

- ④ Sweep time: 1sec

Operation

TIME MHz
 SEC

- ⑤ Resolution bandwidth: 1MHz

Operation

RBW MHz
 SEC

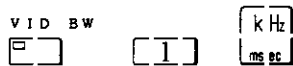
(An initial resolution bandwidth of 1MHz can be omitted.)

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2.6 Operation Procedure

- ⑥ Video bandwidth: 1kHz

Operation



- ⑦ Y axis: 5dB/division

Operation



- *1 : indicates the soft key that employs a CRT display.
- *2 : is displayed by pressing the key on the right of the fluorescent display screen.

- (4) Connection of measured fiber

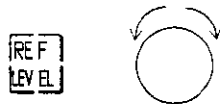
Connect a measured fiber to the V-groove connector (see Figure 2-4).

- (5) Measure the characteristic of a measured fiber.

- ① Level adjustment

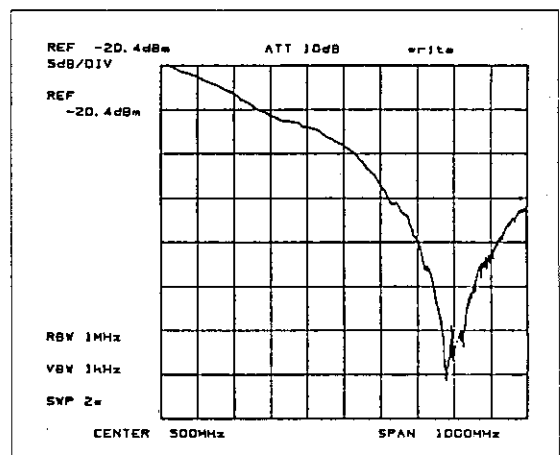
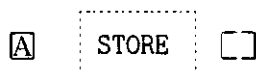
Adjust the reference level of an optical ATT and spectrum analyzer so that the measured data is put on the screen. The reference level can then be adjusted using a rotary knob.

Operation



- ② Store the data on screen A.

Operation



Long data (on screen A)

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2.6 Operation Procedure

(6) Obtain the characteristic of a measuring system by the cutback.

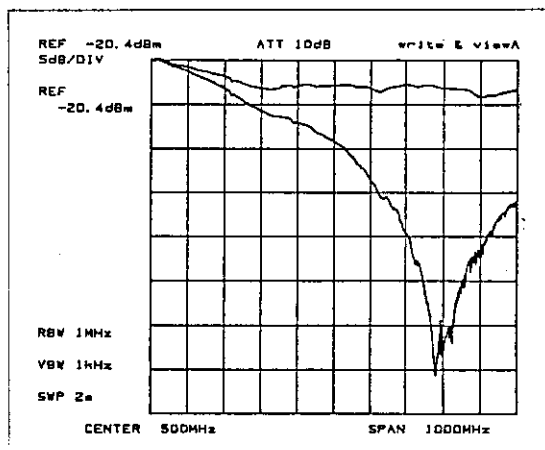
① Cutback

1. Cut a measured fiber at the point 1 to 3m away from V-groove connector (A).
2. Remove the measured fiber (long data) from V-groove connector (B).
3. Connect the remaining measured fiber (short data) to V-groove connector (B) (see Figure 2-4).

② Level adjustment

Set a trace to WRITE and adjust the reference level so that the trace overlaps in the low-frequency area (e.g., 10MHz).

Operation



Short data

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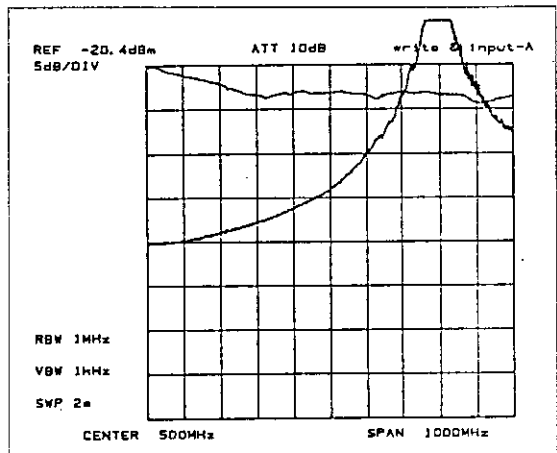
2.6 Operation Procedure

- (7) Normalize the characteristic of a measured fiber by the characteristic of a measuring system.

Operation

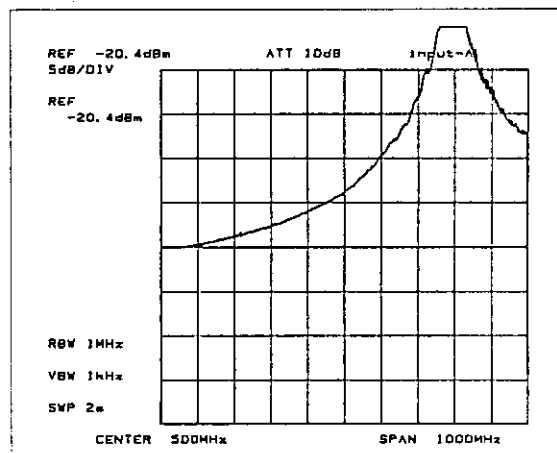
TRACE
 MENU DISP FNC INPUT-A RETURN

* The Y axis display a data loss.



- (8) Erase the input trace.

TRACE
 WRITE (The LED goes off.)



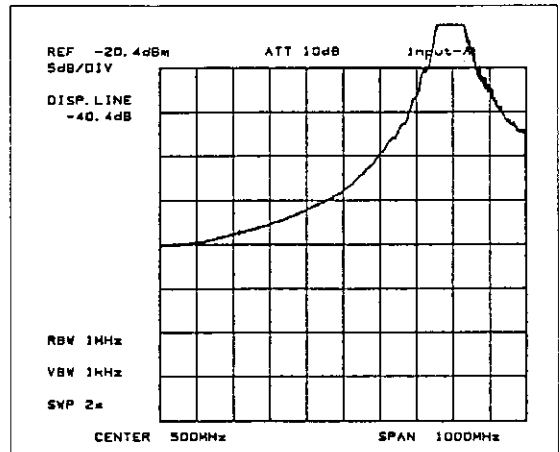
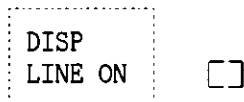
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2.6 Operation Procedure

(9) 6dB point detection

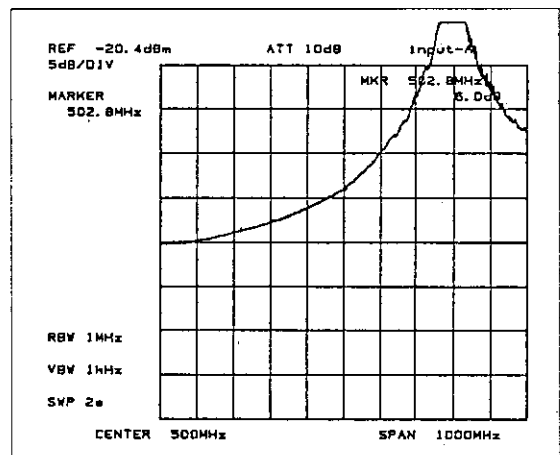
- ① Display the display line.

Operation



- ② Change the marker from the low- to high-frequency level using a data knob and adjust so that the marker data is 6dB.

Operation



- ③ A cutoff frequency is displayed in the marker data.

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2.7 Fuse Replacement

2.7 Fuse Replacement

If a power fuse is blown, Q84421L/M is not activated even if the power switch is turned on. Replace the fuse by a new one.

Replacement

Set the power switch to off and remove the power cable from the power connector before replacing a power fuse. Slide the plastic cover of the fuse box on the right of the power connector in the left direction. Pull out the lever described as "FUSE PULL" toward you. You can then remove the fuse (see figure 2-5).

100V/120V AC Time lag 0.3A
220V/240V AC Time lag 0.15A

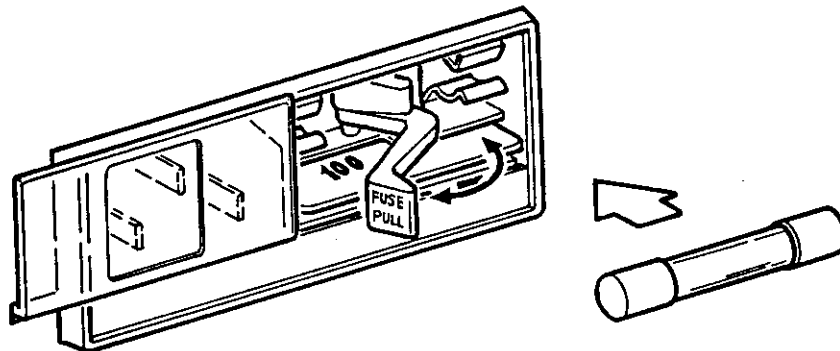


Figure 2-5 Power Fuse Replacement

Caution

Be sure to turn the power switch off and remove the power cable from the wall outlet before replacing a fuse.

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3. OPERATION DESCRIPTION

3.1 Outline

Q84421L/M primarily consists of E/O and O/E sections. The E/O section is constituted by a laser diode (LD), bias circuit, APC circuit, and ATC circuit. The O/E section is constituted by an APD circuit, RF amplifier, and APD bias circuit.

3.2 Location and Functions of Each Part

(1) E/O section

① Laser diode

Q84421L uses an indium gallium arsenide (GaAs) photodiode (PD)/laser diode (LD) of $1.30\mu\text{m}$, and Q84421M uses a gallium arsenide (GaAs) photodiode (PD)/laser diode (LD) of $0.85\mu\text{m}$. The emitting end of a fiber uses a PC-type connector (FC-type connector with the convex spherical surface polished) to suppress the influence (see 2.5, "High-Precision Measurement") of reflected light.

② Bias circuit

The bias circuit adds a signal from the RF INPUT terminal to a current from the APC circuit.

③ APC circuit

The APC circuit detects the output light in the rear stage of the laser diode using a photodiode to keep the average optical output level constant and controls it by the feedback.

④ ATC circuit

The ATC circuit detects the temperature using a thermistor to keep the temperature of a laser diode constant and drives the Peltier device.

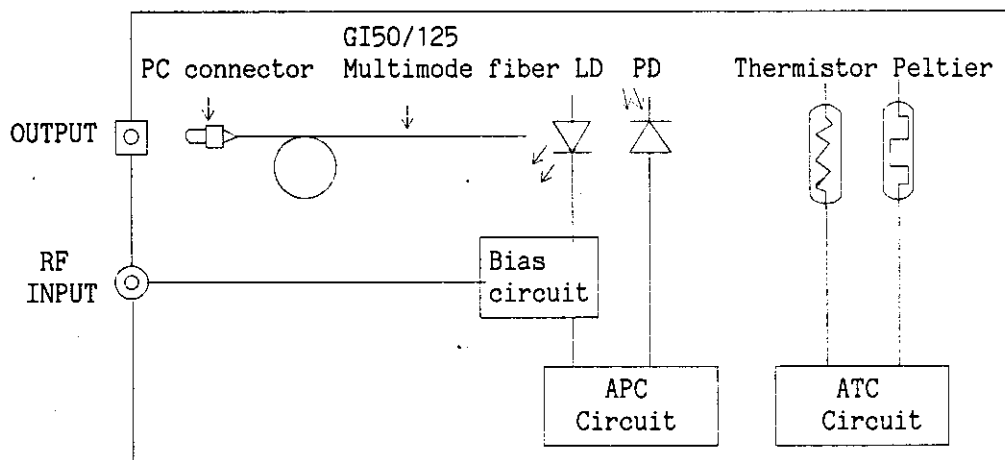


Figure 3-1 Block Diagram (of E/O section)

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3.2 Location and Functions of Each Part

(2) O/E section

① APD circuit

Q84421L uses a germanium APD circuit, and Q84421M uses a silicon APD circuit.

② RF amplifier

The RF amplifier amplifies the demodulation signal detected by the APD circuit using a wideband amplifier.

③ APD bias circuit

The APD bias circuit generates a bias voltage so that the APD circuit has an optimum amplification factor. When an incident power exceeds the maximum photosensing level, a limiter is activated to protect the APD circuit. No normal frequency characteristic can be obtained when the limiter is activated. Therefore, use an optical ATT together with the limiter to suppress the incident power.

④ Level indicator

The level indicator indicates the optical power that is photosensed using an APD circuit. It also displays the maximum photosensing level in the full-scale range (-15dBm for Q84421L, and -20dBm for Q84421M).

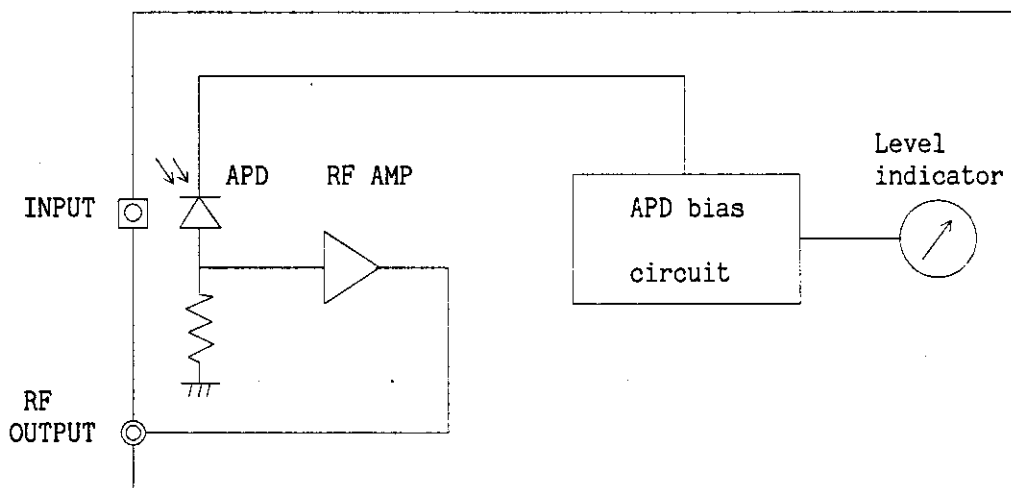


Figure 3-2 Block Diagram (of O/E section)

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4.1 Maintenance

4. MAINTENANCE AND INSPECTION

4.1 Maintenance

(1) Fiber connector cleaning

Clean the stains at the phenol tip and on the phenol side of a connector with lens cleaning paper or absorbent gauze moistened with alcohol.

(2) Cleaning in optical output connector

Blow off dust using an inert gas spray for lens cleaning.

Caution

To prevent troubles, clean the connector with the power switch set to off.

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4.2 Inspection and Repair

4.2 Inspection and Repair

If you have any troubles, consult ATCE or your nearest service facility after confirming the items below. The reference for an inquiry is described at the end of this manual.

You must pay a charge for repair even when the repair content is described in the check items below. Inspect troubles referring to the items shown in Table 4-1 Before Repair.

Table 4-1 Inspection and Check Items

Trouble	Cause	Remedy
The power indicator does not light.	A power fuse is blown. Do not check a fuse visually for inspection. Check that the digital voltmeter is less than 15Ω .	Replace the blown fuse by a supplied one referring to 2.7, "Fuse Replacement."
No optical output appears or the output level is low.	A fiber cable is disconnected.	Replace the optical fiber cable
	Stains on the end surface of fiber connector	Clean the connector referring to 4.1 (1), "Fiber Connector Cleaning."
The optical output level fluctuates excessively.	Stains on the end surface of fiber connector	Clean the connector referring to 4.1 (1), "Fiber Connector Cleaning."
	Used in a location with rapid change of an ambient temperature.	Use in a location where a change in ambient temperature is low.
The level meter pointer fully deflects, but no frequency characteristic is obtained.	A current limiter is activated to protect an APD circuit because of excessive input.	Insert an optical ATT and use in the level in which the level meter pointer does not deflect fully.

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5.1 Optical Outputs and Electrical Characteristics

5. SPECIFICATIONS

5.1 Optical Outputs and Electrical Characteristics

(1) Q84421L

Table 5-1 Optical Outputs and Electrical Characteristics

	Item	Specification	Remarks
E/O section	Light-emitting peak wavelength	1,300 ± 10nm	
	Spectrum half-value width	3nm	Non-modulation(typical)
	Wavelength stability	5nm or less	0 to +40°C
	Optical output level	-15dBm or more	0 to +40°C
	Optical output stability	1dB or less	0 to +40°C
	Optical connector	FC/PC	
	Applicable fiber	GI 50 or more	
	Allowable modulation input level	+3dBm	
	Input impedance	50Ω	
	Input connector	N type	
	Frequency band	0.1MHz to 1,000MHz 10MHz reference ± 6dB	Including O/E section
O/E section	Photosensor	Ge APD	
	Maximum photosensing level	-15dBm	
	Optical connector	FC	
	Applicable fiber	SI 80 or less	
	Demodulation output level	-25dBm or more	Optical input -20dBm Modulation factor 60%
	Residual noise	-130dBm/Hz or less	For no optical input
	Output impedance	50 Ω	
	Output connector	N type	

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5.1 Optical Outputs and Electrical Characteristics

(2) Q84421M

Table 5-2 Optical Outputs and Electrical Characteristics

	Item	Specification	Remarks
E/O section	Light-emitting peak wavelength	850±10nm	
	Spectrum half-value width	1nm or less	Non-modulation
	Wavelength stability	2nm or less	0 to +40°C
	Optical output level	-15dBm or more	0 to +40°C
	Optical output stability	1dB or less	0 to +40°C
	Optical connector	FC/PC	
	Applicable fiber	GI 50 or more	
	Allowable modulation input level	+3dBm	
	Input impedance	50Ω	
	Input connector	N type	
	Frequency band	0.1MHz to 1,000MHz 10MHz reference ±6dB	Including O/E section
O/E section	Photosensor	Si APD	
	Maximum photosensing level	-20dBm	
	Optical connector	FC	
	Applicable fiber	SI 80 or less	
	Demodulation output level	-30dBm or more	Optical input -30dBm Modulation factor 60%
	Residual noise	-130dBm/Hz or less	For no optical input
	Output impedance	50Ω	
	Output connector	N type	

Q84421L/M
OPTICAL FIBER BAND CHARACTERISTIC TEST SET
INSTRUCTION MANUAL

5.2 General Specifications

5.2 General Specifications

Operating environment: Ambient temperature 0°C to +40 °C
Relative humidity 85% or less

Storage temperature : Ambient temperature -25°C to +70°C

Power supply : 90 to 110V AC, 48 to 66Hz

Supply voltage range

Option No.	Reference	32	42	44
Supply voltage	90 to 110V	108 to 132V	198 to 242V	216 to 250V

Power consumption : 30VA or less

Dimensions : Approx. 424(W) × 88(H) × 500(D)mm

Weight : 7.5kg or less

IMPORTANT INFORMATION FOR ADVANTEST SOFTWARE

PLEASE READ CAREFULLY: This is an important notice for the software defined herein. Computer programs including any additions, modifications and updates thereof, operation manuals, and related materials provided by Advantest (hereafter referred to as "SOFTWARE"), included in or used with hardware produced by Advantest (hereafter referred to as "PRODUCTS").

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3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.
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 - (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;
 - (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;
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 - (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;
 - (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or
 - (h) any negligent act or omission of the Purchaser or any third party other than Advantest.
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CUSTOMER SERVICE DESCRIPTION

In order to maintain safe and trouble-free operation of the Product and to prevent the incurrence of unnecessary costs and expenses, Advantest recommends a regular preventive maintenance program under its maintenance agreement.

Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

SALES & SUPPORT OFFICES

Advantest Korea Co., Ltd.

22BF, Kyobo KangNam Tower,
1303-22, Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071
Fax: +82-2-532-7132

Advantest (Suzhou) Co., Ltd.

Shanghai Branch Office:
Bldg. 6D, NO.1188 Gumei Road, Shanghai, China 201102 P.R.C.
Phone: +86-21-6485-2725
Fax: +86-21-6485-2726

Shanghai Branch Office:
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing,
China 100083
Phone: +86-10-8235-3377
Fax: +86-10-8235-6717

Advantest (Singapore) Pte. Ltd.

438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

Advantest America, Inc.

3201 Scott Boulevard, Suite, Santa Clara, CA 95054, U.S.A
Phone: +1-408-988-7700
Fax: +1-408-987-0691

ROHDE & SCHWARZ Europe GmbH

Mühldorfstraße 15 D-81671 München, Germany
(P.O.B. 80 14 60 D-81614 München, Germany)
Phone: +49-89-4129-13711
Fax: +49-89-4129-13723

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<http://www.advantest.co.jp>