ADVANTEST®
ADVANTEST CORPORATION

COHERENT OTDR

OPERATION MANUAL

MANUAL NUMBER OEI01 9702

Before reselling to other corporations
or re-exporting to other countries, you
are required to obtain permission from
the Japanese Government under its
Export Control Act.

First printing July 8, 1994
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 Advantest 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 Advantest, the protection provided by the equipment may be impaired.

■Warning Labels

Warning labels are applied to Advantest 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 Advantest 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. Do not place anything heavy on top of the power cable.

●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.

●Be sure to plug the power cable into an electrical outlet which has a safety ground terminal. Grounding will be defeated if you use an extension cord which does not include a safety ground terminal.

●Be sure to use fuses rated for the voltage in question.

●Do not use this instrument with the case open.

●Do not place objects on top of this 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 Advantest products.

⚠ : ATTENTION - Refer to manual.

⏚ : Protective ground (earth) terminal.

⚡ : DANGER - High voltage.

⚠ : CAUTION - Risk of electric shock.

■Precautions when Disposing of this Instrument

When disposing of harmful substances and batteries, 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).

Safety Information for Laser Source

The specifications for the laser source are as follows.

	Q8490 OTDR Unit	Q8490 Laser Source

Laser Class
    According to IEC 825
    (Europe)
    According to 21 CFR 1040.10
    (Canada, USA)
	3A
	
	1
		3A
		
		1

CAUTION

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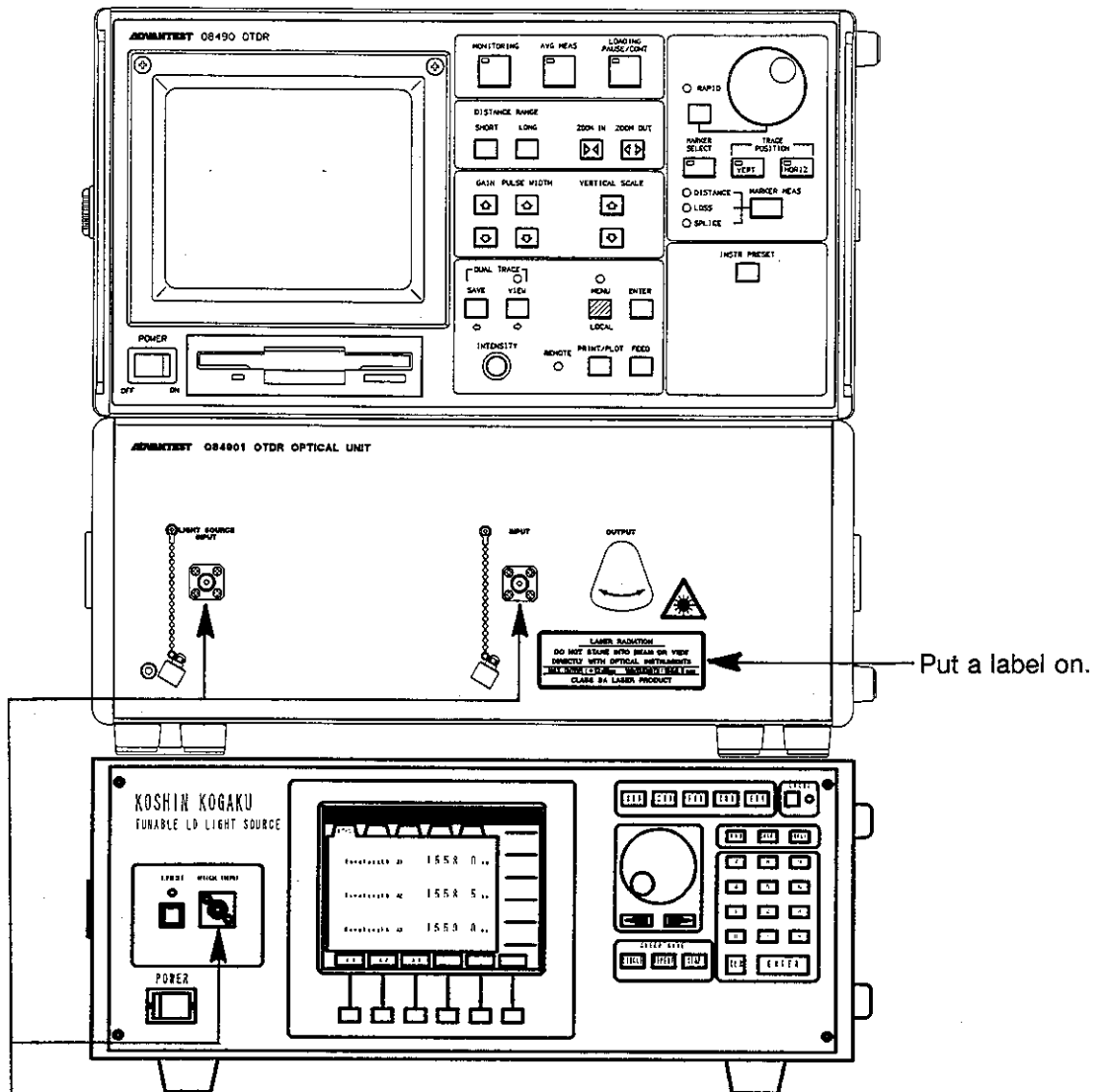

WARNING

1. An invisible laser is irradiated from the connectors. Never try to see the connector with your eyes.

2. When failures or abnormal conditions are encountered on this unit, please contact your nearest Advantest sales office or agency. The address and the phone number are listed at the end of this document.
    Advantest assumes no responsibility for trouble caused by disassembling without permission.

CLASS 3A Laser Product Labels

This product is the class 3A (According to IEC 825) laser product.
The following warning labels are packaged with accessories.

INTERNATIONAL LASER WARNING LABELS

JAPANESE

不可視レーザ放射
ビームをのぞき込まないこと
光学機器で直接ビームを見ないこと
最大出力：＋12dBm　波長：1558.5nm
クラス3Aレーザ製品

FOR: JAPAN

ENGLISH

LASER RADIATION
DO NOT STARE INTO BEAM OR VIEW
DIRECTLY WITH OPTICAL INSTRUMENTS
MAX. OUTPUT : +12dBm   WAVELENGTH : 1558.5nm
CLASS 3A LASER PRODUCT

FOR: UK
NORWAY
SWEDEN
DENMARK
BELGIUM
NETHERLANDS

FRENCH

RAYONNEMENT LASER
NE PAS REGARDER DANS LE FAISCEAU
NI À L' CEIL NU NI À L' AIDE D' UN INSTRUMENT
D' OPTIQUE
LA VALEUR MAX : +12dBm   LONGUER D' ONDE : 1558.5nm
APPAREIL À LASER DE CLASSE 3A

FOR: FRANCE
BELGIUM
SWITZERLAND

GERMAN

LASERSTRAHLUNG
NICHT IN DEN STRAHL BLICKEN
ODER DIREKT MIT OPTISCHEN
INSTRUMENTEN BETRACHTEN !
MAX. LEISTUNG : +12dBm   WELLENLÄNGE : 1558.5nm
LASERKLASSE 3A

FOR: GERMANY
BELGIUM
SWITZERLAND
AUSTRIA

SPANISH

RADIACION LASER
NO FIJAR LA MIRADA EN EL HAZ DE RAYOS
NI EXAMINARLO DIRECTAMENTE
CON APARATOS OPTICOS
MAX. SALIDA : +12dBm   LONGITUD DE ONDA : 1558.5nm
PRODUCTO LASER DE CLASE 3A

FOR: SPAIN

ITALIAN

RADIAZIONE LASER
NON GUARDARE DIRETTAMENTE NEL FASCIO
AD OCCHIO NUDO O CON STRUMENTI OTTICI
POTENZA MASSIMA : +12dBm
LUNGHEZZA D' ONDA : 1558.5nm
APPARECCHIO LASER DI CLASSE 3A

FOR: ITALY
SWITZERLAND

FINNISH

LASERSÄTEILYÄ
ÄLÄ TUIJOTA SÄTEESEEN ÄLÄKÄ KATSO
SITÄ OPTISEN LAITTEEN LÄPI
ULOSTULOTEHO MAKS. : +12dBm
AALLONPITUUS : 1558.5nm
LUOKAN 3A LASER

FOR: FINLAND

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

MNS-E0270A

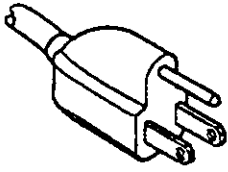Be sure to put a label written in your language on the place shown in the following illustration.

Put a label on.
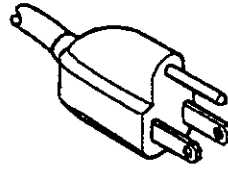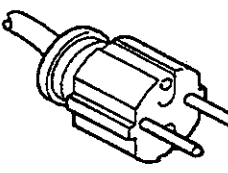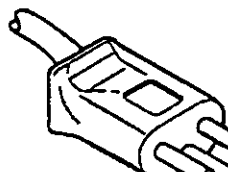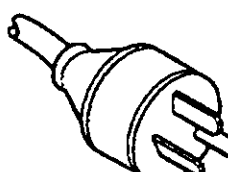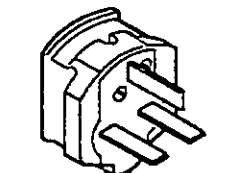
COHERENT OTDR Front view

When the fiber is not inserted, cover the terminal
with the cap to prevent the dust.

Table of Power Cable options

There are six power cable options (refer to following table).
Order power cable options by Accessory Codes.

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

PREFACE

1. Coherent OTDR consists of two units.

Q8490 OTDR UNIT
LS-201B-AT Light source Unit

— Coherent OTDR
Q84901 (OTDR OPTICAL UNIT) is a part of Q8490.
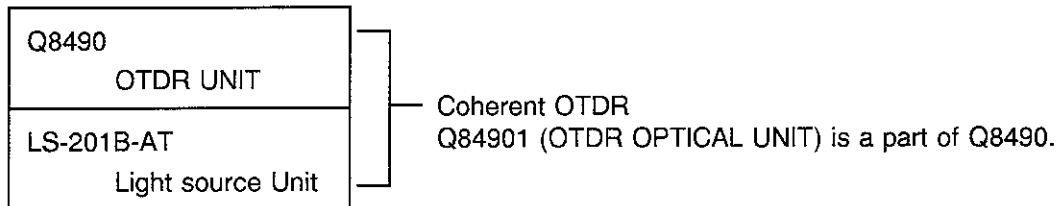
2. Instruction Manuals

The following three kinds of manuals are provided.

Type	Contents	Remarks
Coherent OTDR Instruction Manual (this manual)	Contains explanation for using this instrument. ● Outline of this instrument ● Explanation from installation to connection of this instrument ● Required information before measurement start	● These manuals Assume that the user has a certain degree of knowledge + exparience with light measuring apparatus. ● Read through these manuals, before you use dueinstrument for the first time.
Q8490 OTDR UNIT Instruction Manual	Explains how to use Q8490. ● Accessories list ● Initial setting and operating method ● GPIB	
LS-201B-AT Light Source Unit Instruction Manual	Explains how to use LS-201B-AT. ● Accessories list ● Operating method ● GPIB	

Oct 31/96

Attention to Use this Unit Safely

1. Eye protection from laser beam

    This unit irradiates an invisible laser beam from the OPTICAL OUTPUT connector. Never try to see the connector with your eyes.

2. Cautions for high voltage

    This unit has high voltage section for CRT. Do not open the case.

TABLE OF CONTENTS

1. GENERAL

1.1 Outline of Unit

This unit (coherent OTDR) is an instrument to search a fault point of the repeater and the cable in the optical-amplifier submarine cable system. This unit also measures optical transmission loss and connection loss with fine accuracy.

Optical modulating form	FSK sequential signal
Optical wave detecting form	self-heterodyne detection
Optical receiving form	balance-type single polarized wave receiving
Demodulating form	envelope detection

< Feature >

● Dynamic range
  ONE-WAY 7dB   Input accumulated noise level: -7 dBm/nm
         Optical noise band: 2 nm
         Backscattered light level: -65 dBm
         Number of averaging times: 2^{16} times
  ONE-WAY 17dB   Input accumulated noise level: -27 dBm/nm
         Optical noise band: 2 nm
         Backscattered light level: -65 dBm
         Number of averaging times: 2^{16} times

● Maximum measuring distance range
  10000 km

● Resolution for reading loss
  0.001 dB

● Built-in thermal printer
  Prints the on-screen data in 7 seconds.

● 3.5-inch floppy disk
  3.5-inch FDD can be used for writing/reading waveforms and measurementconditions.
  (Up to 190 waveforms)

● Internal waveform memory (backup memory)
  Waveforms and measurement conditions can be written or read. (32 waveforms)

1.2 Ambient Conditions and Notes

(1) Temperature and humidity
Use this unit in the ambient temperature of +5 °C to +40 °C and relative humidity of 85% or less to have the reliable system operation.

(2) Installation location
As this unit is a highly sensitive measuring instrument, keep it from excessive dust of vibration, direct sun, and corrosive gases. Place the system on a stable base so that it may be not in danger of being dropped.

(3) Eye protection from laser beam

```
┌─────────────────────── DANGER ──────────────────────────┐
│                                                          │
│  This unit uses the laser diode as the optical light source.  The beam is invisible and │
│  harmful to your eyes.  Never try to see the optical light source and its related connector │
│  sections with your eyes.                                │
│                                                          │
└──────────────────────────────────────────────────────────┘
```

(4) Cautions for high voltage
This unit uses high voltage power for the CRT.
Never disassemble this unit when the power is ON.

(5) Cooling and ventilation
The system uses a cooling fan to avoid internal temperature rise. As the fan is of discharging type, use it with cares concerning ambient ventilation.
Never place this unit upright or put other objects behind this unit that will block ventilation.

(6) Storage
The temperature range for storage of this unit is 0 °C to +45 °C. If the system is out of service for a long period, cover it with vinyl sheets and keep it from dew condensation with a carton box or others.
Place it on a dry position free from direct sun.

(7) Cautions for dew condensation
This unit uses lenses internally, as a result observes caution such that condensation due to sudden temperature change does not occur. If dew condensation is observed on the system, dry it completely before use.

(8)   Warming up

Allow for a 30-minute or more warm up period before use in order to obtain satisfactory measuring accuracy.

(9)   Prohibition of disassembling

```
┌──────────────────────── WARNING ────────────────────────┐
│                                                          │
│  When failures or abnormal conditions are encountered    │
│  on this unit, please contact your nearest Advantest      │
│  sales office or agency.  The address and the phone      │
│  number are listed at the end of this document.          │
│  Advantest assumes no responsibility for trouble caused   │
│  by disassembling without permission.                     │
└──────────────────────────────────────────────────────────┘
```

1.3   Connecting Main Unit with Light Source
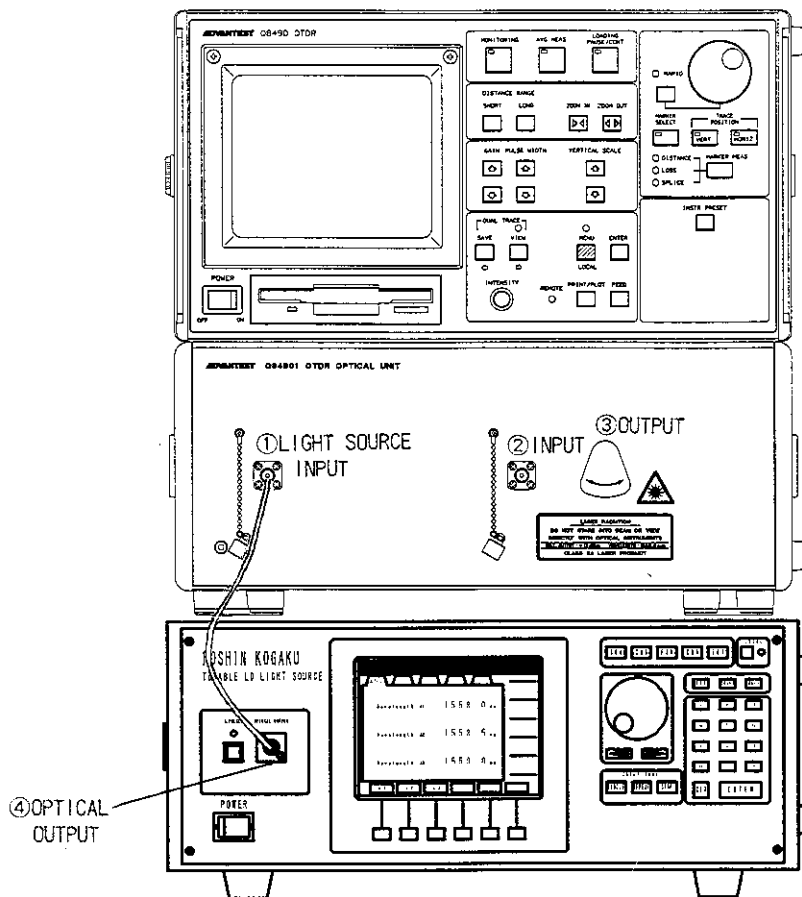
CAUTION

Always use FCD1 to connect ① and ④. If other fiber cable than FCD1 is used, the performance cannot be ensured.

Connect the output terminal (Up stream line) of the optical cable system with ②.
Connect the input terminal (Down stream line) of the optical cable system with ③.

WARNING

An invisible laser beam is irradiated from the connectors ③ and ④. Never try to see the connector with your eyes.

1.4 Notes on Setting of Light Source and Wavelength Stability

1.4.1 Setting Light Source (LS-201B-AT)

After power is turned on, confirm that the following screen is indicated. If not, set the λ preset mode switch to ON.
The initial setting of the wavelength is $\lambda2$:1558.5mm.
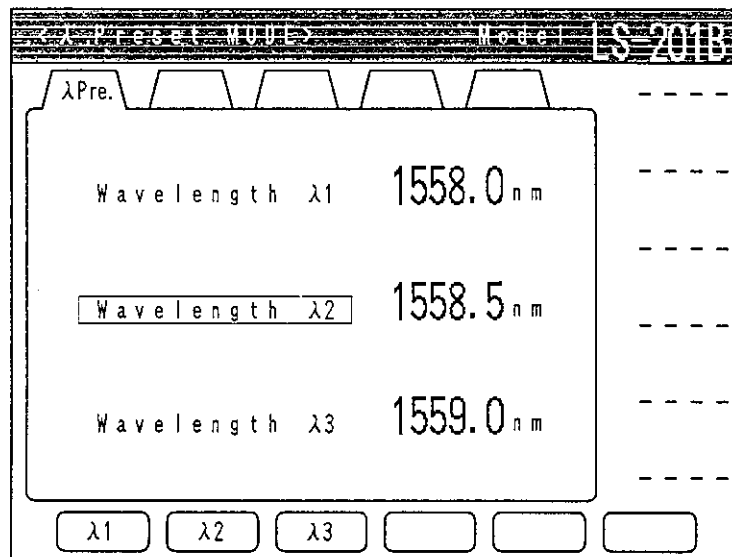
To set wavelength other than the initial set one, select $\lambda1$ or $\lambda3$ or reset wavelength according to the LS-201B-AT Light Source Instruction Manual of Section 2. Panel and Operation.

1.4.2 Notes on Wavelength Stability of Light Source (LS-201B-AT)

The light source has a highly sensitive mechanism. After powering on, warm up the light source for 30 minutes or more to stabilize the wavelength .
If you change the wavelength setting, start measurement after few minutes.
In case the light source gets a sudden temperature change or an external shock, also start measurement after few minutes.

Jun 10/96

1.5   Connecting Optical I/O of this Unit

1.5.1   Adjustment of Optical Output Level

The level of the optical signal that is output from the OUTPUT connector has been set to + 3 dBm at the shipment of this unit. When the output connector is connected with the input connector of the optical cable system, adjust the level by using the OUTPUT POWER ADJUST screw on the rear panel of this unit or adjust the level within the optical input level, standardized in the optical cable system, by using the optical attenuator.

1.5.2   Adjustment of Optical Input Level

Adjust the optical input level for the INPUT connector as follows:
>   Total optical power (measured by using optical power meter), such as ASE light of optical amplifier, should be + 4dBm or less.
>   Fresnel reflection optical power (measured by using optical spectrum analyzer) should be - 25dBm or less.

If the light having the level more than the above range is input, accurate measurement may not be done due to saturation of the internal circuit. In this case, use an optical attenuator.

```
───────────────────────── CAUTION ─────────────────────────

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

1.6   Measuring Method using 3 dB Coupler

Using 3dB coupler allows this unit to perform measurement as same as the standard OTDR does.
An example on the measurement is shown below.

Connect the light source input ① with the optical output ④ (shown in Section 1.3) by using the special optical fiber cable of FCD1.
Connect the 3dB coupler with ② and ③ as the following illustration.

③ OUTPUT

Fiber cable to be measured

② INPUT

ASLANT
CONTACT
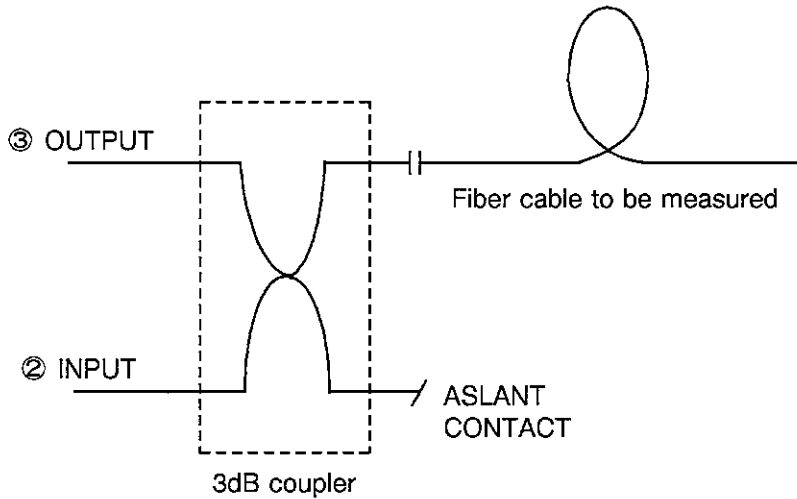
3dB coupler

This unit is designed to measure optical path that uses an optical amplifier in the loop-back form.
In the measuring method using 3dB coupler as above, the linearity may be worse because the level of the optical signal and the optical noise differ from the premise. ALC (Auto level control) operation may not be correct. In this case, select ALC off mode, and set gain to 3 in manual operation. (Refer to Q8490 OTDR UNIT Instruction Manual of Subsection 2.5.7 ALC and Gain Setting.)

1.7 Using Q8490 with Connecting External Polarization Scrambler (Q8163)

Connecting Q8163 (Polarization Scrambler) to the optical output of this unit, fluctuations of sensitivity can be suppressed and more stabilized measurement results can be obtained.

CAUTION

When using Q8490 with connecting Q8163, be sure to set the polarization scramble speed of Q8163 to LOW.
On the condition that Q8163 is connected to Q8490, adjust the optical output of Q8490 as monitoring the optical output power of Q8163.
(The insertion loss of Q8163 is 3 dB at the maximum.)

Q8163 can be controlled through Q8490.

< Procedure >

① Set Q8163 to be in the listen-only mode.

② Connect Q8163 and Q8490 with the GPIB cable.
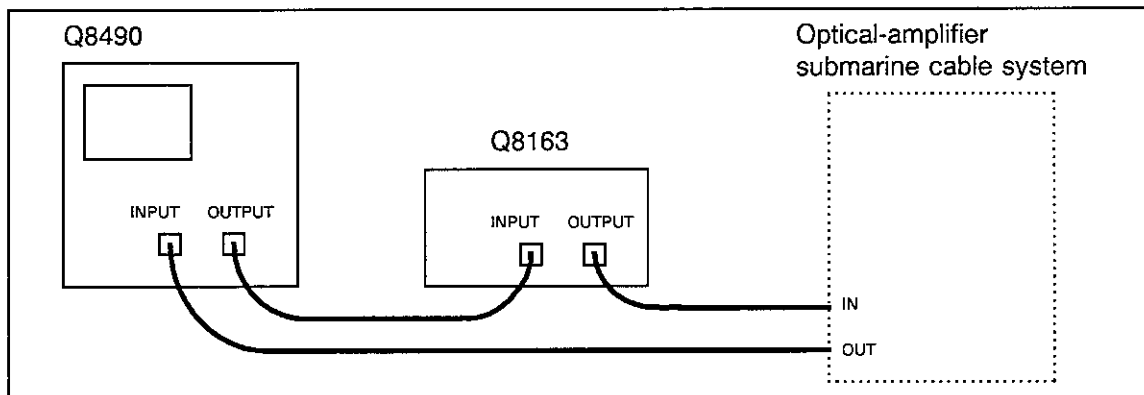
Connection

③ Press the menu key. Then, select SCRAMBL in the window and set it to "ON".

Accordingly, it is possible to prevent mistakes in the polarization scramble speed setting and to prevent executing measurement under the condition where the polarization scrambler is in scramble OFF.

CAUTION

To control Q8163 connected to Q8490 by the external controller (such as a personal computer) through GPIB, reset the listen-only mode of Q8163 and set the GPIB address. Then, control Q8490 and Q8163 individually.

---

2. SPECIFICATIONS

< Performance specifications >

Characteristic	Performance
Wavelength (signal light)	1558.5 nm, 1558.0 nm, 1559.0 nm
Optical output level	+ 3 dBm (variable between -3 dBm and + 5 dBm)
Pulse width/Resolution	3, 10, 30, 100 μs/300m, 1 km, 3km, 10 km
Dynamic range	7dB (Pulse width = 10 μs, ASE = -7 dBm/nm, BS level = -65 dBm, Averaging times = 2^{16}) 17dB (Pulse width = 10 μs, ASE = -27 dBm/nm, BS level = -65 dBm, Averaging times = 2^{16})

Maximum input level
    ASE total optical power
    Fresnel reflections optical power
	
	+ 4 dBm MAX
	-25 dBm MAX

Dead zone	1.5 km

Distance axis
    Distance range
    Span
    Reading resolution
    Accuracy
	
	10000 km MAX (1000 km step)
	5; 10; 20; 50; 100; 200; 500; 1000; 2000; 5000; 10000 km
	10m to 20 km
	± 50 m $\pm 5 \times 10^{-6} \times$ (measurement value) m
	Exclusive of any error in refractive index setting

Vertical axis
    Scale
    Reading resolution
	
	0.5 dB/div; 1 dB/div; 2 dB/div; 5 dB/div
	0.001 dB

Averaging times
    Monitoring
    Averaging
	
	2^8 times
	Max 2^{24} times

Allowable range of index	1.4000 to 1.6000 (0.0001 step)
GPIB	IEEE488-1978
Printer	Built-in thermal printer
Floppy disk	3.5-inch FDD

< General specifications >

Characteristic	Performance

Source voltage
        Main unit
        Light source
	90 VAC to 250 VAC
	90 VAC to 250 VAC (Manual switch)

Power frequency	48 Hz to 66 Hz

Power consumption
        Main unit
        Light source
	220 VA or less
	140 VA or less

Operating ambient range	5°C to 40°C, relative humidity of 85% or less
Storing temperature range	0°C to 45°C

External dimensions
        Main unit
        Light source
	Approx. 330 (width)×320 (height)×500 (depth) mm
	350 (width)×147 (height)×415 (depth) mm

Mass
        Main unit
        Light source
	22 kg or less
	18 kg or less

APPENDIX

Block Diagram

CPL:Coupler
AOM:Acoustic-optic modulator
PS:Polarization Scrambler
OBR:Optical Balanced Receiver
OFLTR:Optical filter
→ :Fiber

Unit; mm

Q8490
OTDR UNIT

SIDE VIEW

(34.5)

461.5±3

69

(10.5)

330±3

ADVANTEST Q8490 OTDR OPTICAL UNIT

FRONT VIEW

(5)

132   (0.5)   177

309.5±3

(13)

REAR VIEW

ADVANTEST CORPORATION

EXT1-9606-B

LS-201B-AT
TUNABLE LASER DIODE
LIGHT SOURCE

Unit; mm

SIDE VIEW

FRONT VIEW

KOSHIN KOGAKU
TUNABLE LD LIGHT SOURCE

REAR VIEW

EXT2-9603-B

ACCESSORIES

①

②

⑤

③

④

**Q8490
PACKING PROCEDURE**

Q8490
DOUBLE PACKING PROCEDURE

Upper Cover

Light Source

Air Bag
700×1100-1

Lower Cover

Inner Box
440×510×260

LS-201B-AT
INNER BOX PACKING PROCEDURE

Air Bag
590 × 630-3

Air Bag
440 × 510-4

Light Source
in Inner Box

Air Bag
330 × 590-5

Air Bag
330 × 590-6

Pattern
Corrugated
Cardboard

Accessory Box

Air Bag
330 × 590-3

Air Bag
330 × 590-5

Air Bag
590 × 630-3

Corrugated
Carton
600 × 650 × 390

LS-201B-AT
PACKING PROCEDURE

④

LS-201B-AT
DOUBLE PACKING PROCEDURE

ADVANTEST

ADVANTEST CORPORATION

Q8490

OTDR UNIT

OPERATION MANUAL

Safety Information for Laser Source

The specifications for the laser source are as follows.

	Q8490 OTDR Unit	Q8490 Laser Source
Laser Class According to IEC 825 (Europe)	3A	3A
According to 21 CFR 1040.10 (Canada, USA)	1	1

CAUTION

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

WARNING

1. An invisible laser is irradiated from the connectors. Never try to see the connector with your eyes.

2. When failures or abnormal conditions are encountered on this unit, please contact your nearest Advantest sales office or agency. The address and the phone number are listed at the end of this document.
   Advantest assumes no responsibility for trouble caused by disassembling without permission.

CLASS 3A Laser Product Labels

This product is the class 3A (According to IEC 825) laser product.
The following warning labels are packaged with accessories.

INTERNATIONAL LASER WARNING LABELS

JAPANESE   FOR: JAPAN

> 不可視レーザ放射
> ビームをのぞき込まないこと
> 光学機器で直接ビームを見ないこと
> 最大出力：＋12dBm　波長：1558.5nm
> クラス3Aレーザ製品

ENGLISH   FOR: UK
      NORWAY
      SWEDEN
      DENMARK
      BELGIUM
      NETHERLANDS

> LASER RADIATION
> DO NOT STARE INTO BEAM OR VIEW
> DIRECTLY WITH OPTICAL INSTRUMENTS
> MAX. OUTPUT : +12dBm   WAVELENGTH : 1558.5 nm
> CLASS 3A LASER PRODUCT

FRENCH   FOR: FRANCE
      BELGIUM
      SWITZERLAND

> RAYONNEMENT LASER
> NE PAS REGARDER DANS LE FAISCEAU
> NI À L' ŒIL NU NI À L' AIDE D' UN INSTRUMENT
> D' OPTIQUE
> LA VALEUR MAX : +12dBm   LONGUER D'ONDE : 1558.5 nm
> APPAREIL À LASER DE CLASSE 3A

GERMAN   FOR: GERMANY
      BELGIUM
      SWITZERLAND
      AUSTRIA

> LASERSTRAHLUNG
> NICHT IN DEN STRAHL BLICKEN
> ODER DIREKT MIT OPTISCHEN
> INSTRUMENTEN BETRACHTEN !
> MAX. LEISTUNG : +12dBm   WELLENLÄNGE : 1558.5nm
> LASERKLASSE 3A

SPANISH   FOR: SPAIN

> RADIACION LASER
> NO FIJAR LA MIRADA EN EL HAZ DE RAYOS
> NI EXAMINARLO DIRECTAMENTE
> CON APARATOS OPTICOS
> MAX. SALIDA : +12dBm   LONGITUD DE ONDA : 1558.5nm
> PRODUCTO LASER DE CLASE 3A

ITALIAN   FOR: ITALY
      SWITZERLAND

> RADIAZIONE LASER
> NON GUARDARE DIRETTAMENTE NEL FASCIO
> AD OCCHIO NUDO O CON STRUMENTI OTTICI
> POTENZA MASSIMA : +12dBm
> LUNGHEZZA D' ONDA : 1558.5 nm
> APPARECCHIO LASER DI CLASSE 3A

FINNISH   FOR: FINLAND

> LASERSÄTEILYÄ
> ÄLÄ TUIJOTA SÄTEESEEN ÄLÄKÄ KATSO
> SITÄ OPTISEN LAITTEEN LÄPI
> ULOSTULOTEHO MAKS. : +12dBm
> AALLONPITUUS : 1558.5 nm
> LUOKAN 3A LASER

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

MNS-E0270A

Be sure to put a label written in your language on the place shown in the following illustration.

Q8490 Front view

When the fiber is not inserted, cover the terminal
with the cap to prevent the dust.

Put a label on.

Table of Power Cable options

There are six power cable options (refer to following table).
Order power cable options by Accessory Codes.

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

PREFACE

This manual is intended to be used by the user who is familiar with the optical measuring instruments (or optical system).
If you use this unit for the first time, you should read this manual from its beginning.

Chapter 3 explains GPIB (General-Purpose Interface Bus). To understand this chapter, the basic programming knowledge is required for the user. Refer to the programming guide and controller instruction manual if necessary.

1. General	. . . . Accessories list General operation notes
2. Explanation for operation	. . . . Initial setting and operation method
3. GPIB	. . . . Remote control via GPIB
4. Specifications	. . . . Specifications Block diagram External view

Attention to Use this Unit Safely

1. Eye protection from laser beam

    This unit irradiates an invisible laser beam from the OPTICAL OUTPUT connector. Never try to see the connector with your eyes.

2. Cautions for high voltage

    This unit has high voltage section for CRT. Do not open the case.

Certificate of Conformity

C E
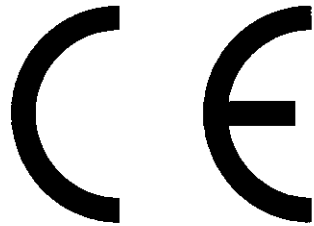
This is to certify, that

Coherent OTDR

Q8490

instrument, type, designation

complies with the provisions of the EMC Directive 89/336/EEC in accordance with
EN50081-1 and EN50082-1 and Low Voltage Directive 73/23/EEC in accordance with
EN61010.

ADVANTEST Corp.

Tokyo, Japan

ROHDE&SCHWARZ

Engineering and Sales GmbH

Munich, Germany

8490.00

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1. GENERAL

1.1 Appearance Check and Accessories Check

On receiving this unit, check it for defects due to transportation.

Then check the quantity and their IDs of standard accessories according to the following Table 1-1.

If any defect or shortage is found, contact your nearest dealer or support office.

The addresses and telephone numbers of our service representatives are listed at the end of this manual.

Table 1-1 Accessories

Accessory name	Model name	Stock No.	Quantity	Remarks
Power cable	———	DCB-DD3130×01-1	2	With 2-pin adapter
Power fuse	EAWK3.15A	DFT-AA3R15A	2	Used for the upper AC line connector
Recording paper	A09075	———	3	
Operation manual*	———	JQ8490	1	Japanese version
	———	EQ8490	1	English version
Floppy disk (2HD)	———	ESM-000364	1	
Power fuse	EAWK2.5A	DFT-AA2R5A	2	Used for the lower AC line connector
Signal cable	———	DCB-FF4894X04	1	Cable with BNC connector
Signal cable	———	DCB-FF3981X02	1	Cable with SMA connector
Signal cable	———	DCB-SS5425X02	1	Cable with RS232C type connector
Optical fiber code (FCD1)	———	DCB-HH6265X01	1	Polarized wave holding fiber

Accessories in the light source are listed in the instruction manual of LS-201B-AT Coherent OTDR (Light Source).

* : An English or a Japanese version instruction manual is attached to this unit.

1.2   Power Source

1.2.1   Power Source Condition

```
┌─────────────────────── CAUTION ───────────────────────┐
│                                                        │
│  Follow the standard power source condition to use this unit safely.  If not followed, this  │
│  unit might be destroyed.                              │
│                                                        │
└────────────────────────────────────────────────────────┘
```

The standard power source condition of this unit is as follows:

Power source condition	
Input voltage	90 v to 250 v
Frequency	48 Hz to 66 Hz
Fuse Upper unit Lower unit	3.15 A 2.5 A
Power consumption	220 VA or less

Use a suitable power source line for this condition.

1.2.2 Changing Power Fuse

CAUTION

1. Before replacing the power fuse, turn off the power switch and unplug the power cable.
2. Use a power fuse appropriate to the source voltage to protect the unit from a fire.

Check the power fuse which is mounted in the power source connector at the rear panel of Q8490.
Check or replace the power fuse as follows:

Remove the fuse from the power source connector on the rear panel.

Check or replace the fuse, and then mount the fuse as it is.

Standard of the fuse
  3.15 A for the upper unit
  2.5 A for the lower unit

Unscrew the power source connector with a minus screwdriver and pull out the power fuse.
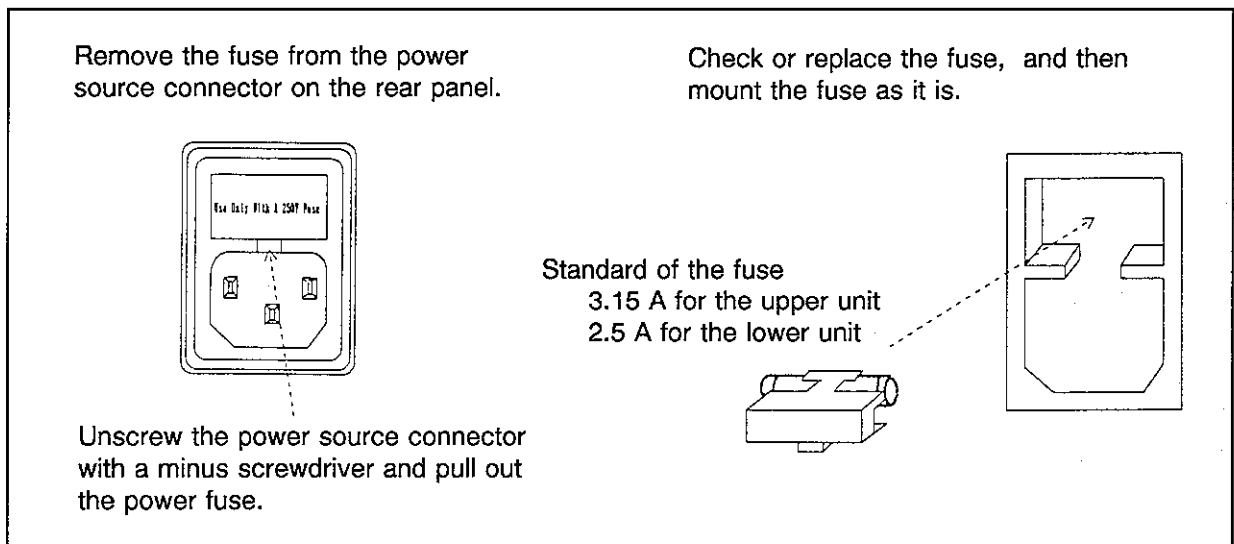
Figure 1-1 Changing/Replacing of Power Fuse

1.2.3 Connecting Power Cable

CAUTION

1. Power Cable
   - Use the attached cable to prevent fire and electrical shock.
     The attached cable conforms to electric articles management method.
   - Use power cable which applies to the safety standard of each country for the case in which this unit is used in the foreign country.
   - After turning the power switch to OFF, connect the power cable to the outlet.
   - Take the plug when you pull out the power cable from the outlet.

2. Protection ground
   - Connect the power plug cable with the power outlet by which the protective earth terminal prepares.
   - If the extension cord by which the protective ground terminal does not prepare is used, the protection ground will become invalid.
   - If you use the AC adapter to convert 3-pin plug to 2-pin plug, ground the ground pin that goes out from the AC adapter to the ground of the outlet or connect the ground terminal on the rear panel (if existing) with the external ground to ground it.

---

(1) In Japan, there are few electric power connectors with 3-pins. Therefore the AC adapter is attached.

The height of the electrode of the 2 lines is different. After confirming the direction of the plug and the outlet, connect the adapter with the outlet.
If the adapter cannot be connected with the user receptacle, use the optional adapter.
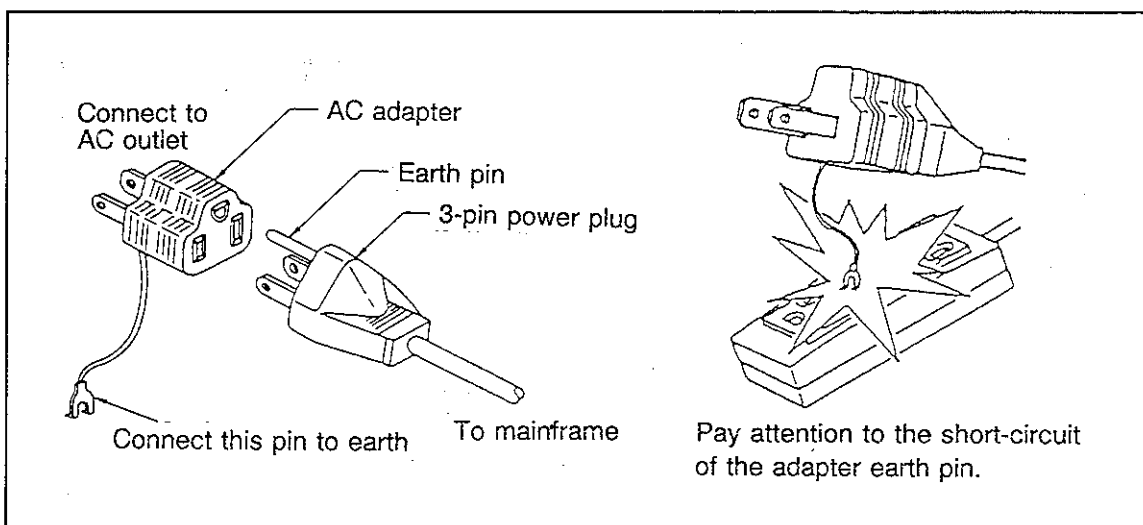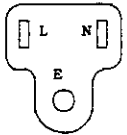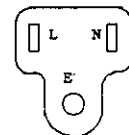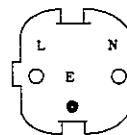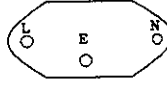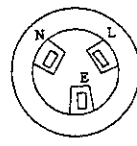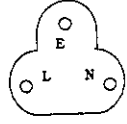
(2) ADVANTEST provides the following power plugs for each country.

If there is any inconvenience on your use, please contact our subsidiaries or ADVANTEST representatives.

Table 1-2   Power Plugs for each Country

Type name	Straight type	A01402 (Standard)	A01403 (Opt.95)	A01404 (Opt.96)
	Angle type	A01412	A01413	A01414
Applicable standard		JIS: Japan Law on Electrical Appliances	UL: USA CSA: Canada	*
Ratings and colors		125V/7A, Black, 2m	125V/7A, Black, 2m	250V/6A, Gray, 2m
Plug				
Type name	Straight type	A01405 (Opt.97)	A01406 (Opt.98)	A01407
	Angle type	A01415		A01417
Applicable standard		SEV: Switzerland	SAA: Australia New Zealand	BS: UK
Ratings and colors		250V/6A, Gray, 2m	250V/6A, Gray, 2m	250V/6A, Black, 2m
Plug				

* :   CEE: Europe   CEBEC: Belgium
        DEMKO: Denmark   OVE: Austria
        NEMKO: Norway   FIMKO: Finland
        VED: Old West Germany   SEMKO: Sweden
        KEMA: Netherlands

1.3 Ambient Conditions and Notes

```
──────────────────────── CAUTION ────────────────────────

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

(1) Temperature and humidity
Use this unit (The light source is contained) in the ambient temperature of + 5 °C to + 40 °C and
relative humidity of 85% or less to have the reliable system operation.

(2) Installation location
As this unit is a highly sensitive measuring instrument, keep it from excessive dust of vibration,
direct sun, and corrosive gases. Place the system on a stable base so that it may be not in
danger of being dropped.

(3) Eye protection from laser beam

```
──────────────────────── DANGER ────────────────────────

This unit uses the laser diode as the optical light source.  The beam is invisible and
harmful to your eyes.  Never try to see the optical light source and its related connector
sections with your eyes.
```

(4) Cautions for high voltage
This unit uses high voltage power for the CRT.
Never disassemble this unit when the power is ON.

(5) Cooling and ventilation
The system uses a cooling fan to avoid internal temperature rise. As the fan is of discharging
type, use it with cares concerning ambient ventilation.
Never place this unit upright or put other objects behind this unit that will block ventilation.

(6) Storage
The temperature range for storage of this unit (The light source is contained) is 0 °C to + 45 °C.
If the system is out of service for a long period, cover it with vinyl sheets and keep it from dew
condensation with a carton box or others.
Place it on a dry position free from direct sun.

(7) Cautions for dew condensation

This unit uses lenses internally, as a result observes caution such that condensation due to sudden temperature change does not occur. If dew condensation is observed on the system, dry it completely before use.

(8) Warming up

Allow for a 30-minute or more warm up period before use in order to obtain satisfactory measuring accuracy.

(9) Prohibition of Disassembling

WARNING

When failures or abnormal conditions are encountered on this unit, please contact your nearest Advantest sales office or agency. The address and the phone number are listed at the end of this document.

Advantest assumes no responsibility for trouble caused by disassembling without permission.

MEMO ✐

2. OPERATION

(Description for the light source, refer to "LS-201B-AT Light Source Unit Instruction Manual".)

```
─────────────────────────── CAUTION ───────────────────────────

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

2.1   Panel Description

2.1.1 Front Panel (The front view is shown in Page 2-4.)

① POWER switch: Turns on or off the Q8490 power source.

② INTENSITY volume: Adjusts intensity of the CRT screen.

```
──────────────────────────── WARNING ───────────────────────────

Follow the standard power source condition to use this unit safely.  If not followed, this
unit might be destroyed.
```

③ REMOTE LED: Lights when this unit operates in the remote control mode from a peripheral via GPIB.

④ PRINT/PLOT key: Prints the on-screen data to the built-in printer or the external plotter as it is. (Refer to Subsection 2.12.2.)

⑤ FEED key: Feeds the print forms approximately 6 cm.

⑥ MONITORING key: Repeats measurement and displays data by executing averaging 256 times. You can set the measurement conditions in this mode. (Refer to Subsection 2.4.3.)

⑦ AVG MEAS key: Executes averaging 256 times or more under the conditions that are set in the monitor mode. (Refer to Subsection 2.4.4.)

⑧ LOADING
PAUSE/CONT key: When this key is pressed in the monitor mode, the mode is temporary end and the loading mode starts. (Refer to Subsection 2.4.5.) When this key is pressed in the averaging measurement mode, the mode is temporary end. If this key is pressed again, the averaging measurement mode starts. (Refer to Subsection 2.4.5.)

⑨ SHORT key: Narrows the distance range by pressing this key. (Refer to Subsection 2.5.1.)

⑩ LONG key: Expands the distance range by pressing this key. (Refer to Subsection 2.5.1.)

⑪ ZOOM IN key: When ALC off, pressing this key decreases the distance span.
    |▷◁| (Refer to Subsection 2.5.4.)

⑫ ZOOM OUT key: Pressing this key increases the distance span.
    |◁▷| (Refer to Subsection 2.5.4.)

⑬ GAIN key: Selects the internal gain. (Refer to Subsection 2.5.7.)

                          |⇧| :   Selects the larger gain.

                          |⇩| :   Selects the smaller gain.

⑭ PULSE key: Selects the probe-light pulse width. (Refer to Subsection 2.5.2.)

                          |⇧| :   Pulse width can be selected in the ascending step value.

                          |⇩| :   Pulse width can be selected in the descending step value.

⑮ VERTICAL SCALE key: Selects the scale on the vertical axis. (Refer to Subsection 2.5.5.)

                          |⇧| :   Changes the vertical-axis scale in the ascending step value.

                          |⇩| :   Changes the vertical-axis scale in the descending step value.

⑯ SAVE key: Saves the measured waveform to the internal memory. (Refer to
    (⇦)   Section 2.9.)
                    (Move the cursor to the left when the ADVANCE FUNCTION menu is displayed. Move the cursor to the left when STEP of the automatic measurement mode is being displayed.)

⑰ VIEW key: Displays the waveform being measured and the previously saved
    (⇨)   waveform on the screen at a time. (Refer to Section "2.9 Dual Screen Indication".)

                    ☼ (LED goes on) : Shows DUAL TRACE is being executed.
                    ● (LED goes off) : Displays the waveform being measured.
                    (Move the cursor to the right when the ADVANCE FUNCTION menu is displayed. Move the cursor to the right when STEP of the automatic measurement mode is being displayed.)

⑱ MENU key (LOCAL): The menu indication is ON or OFF by pressing this key.

(Key input from the panel key is available when this unit is operating in the remote control mode from a peripheral via the GPIB.)

⑲ ENTER key: Used to select or execute a function in the window.

⑳ RAPID key: Switches the operation speed of the data knob (for the marker or the waveform movement).

When this key is pressed, its LED lights to indicate the RAPID mode.

㉑ Data knob: Changes data in various operation modes such as marker movement, label input and movement of waveform display position.

㉒ MARKER SELECT key: Selects a marker to be moved by using the data knob. (Refer to Section 2.8.)

㉓ VERT key: Moves the waveform display position in the vertical direction.

㉔ HORIZ key: Moves the waveform display position in the horizontal direction.

㉕ MARKER MEAS key: Selects a mode which is used to measure light by using a marker.

㉖ INSTR PRESET key: This unit is preset as the initial setting conditions. (Refer to Subsection 2.4.2.)

㉗ OUTPUT connector: A connector for connecting the optical fiber is located behind the protection cover. A probe light is irradiated from the connector. (Refer to Section 2.4.)

㉘ INPUT connector: An input connector for the light to be measured. (Refer to Section 2.4.)

㉙ LIGHT SOURCE INPUT connector:

An input connector for an external light source. (Refer to Section 2.4.)

Connects this unit with the external light source by using the provided optical fiber cord (FCD1).

Jun 10/96
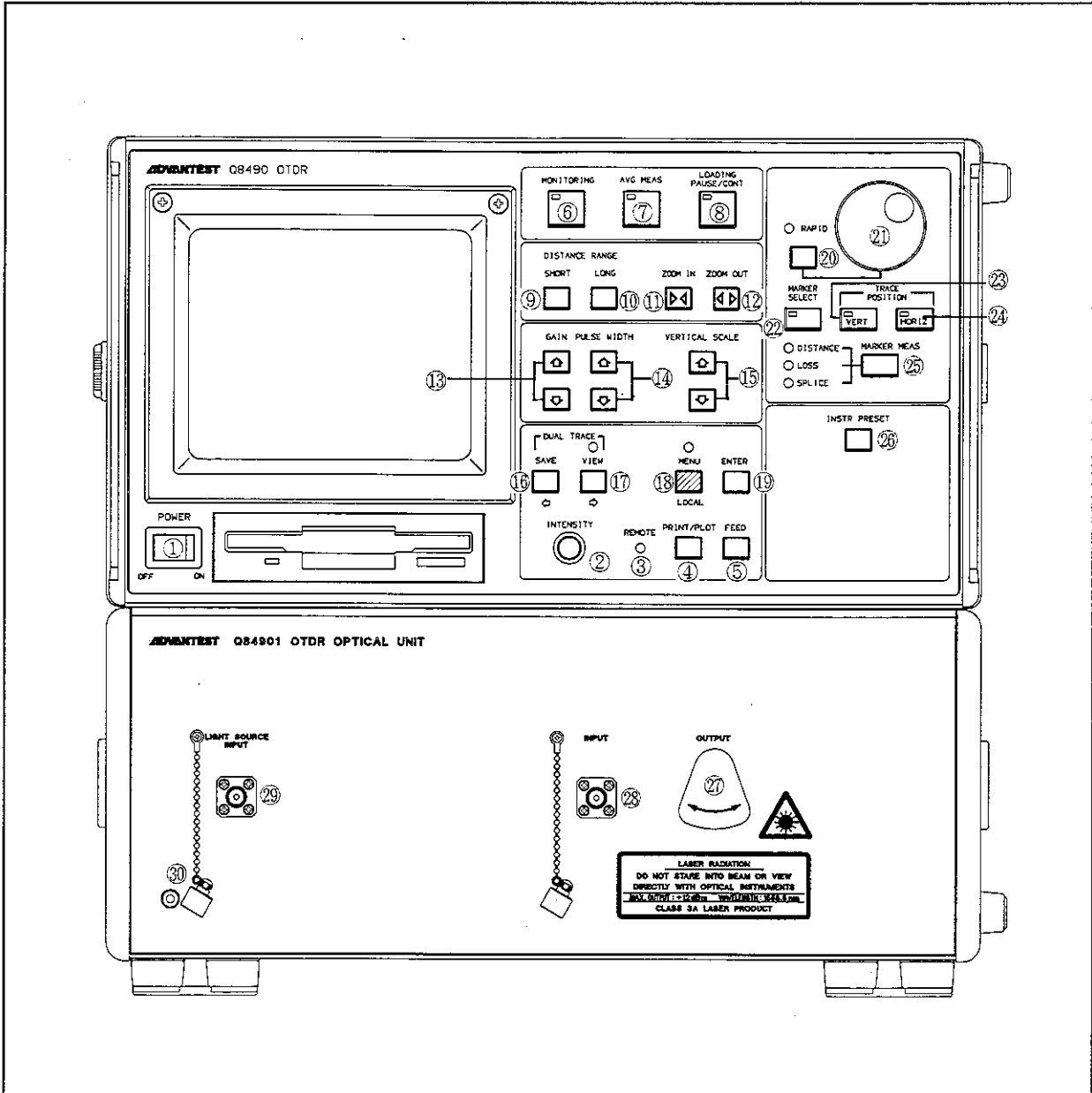
FRONT VIEW

2.1.2 Rear Panel (The rear view is shown in Page 2-6.)

① VIDEO OUT connector: Outputs composite video signal. Monitor TV or video printer can be connected by using the cable with BNC connector. When making a hard copy of the screen onto a video printer, keep the waveform stable by pressing PAUSE key.

② GND terminal

③ Power connector

④ Fuse holder: When the holder cover is opened, the fuse can be removed. Replace the fuse with an appropriate one (rating current of 3.15A).

⑤ Fan: A cooling fan is provided to prevent an overheat of internal circuits. This fan is a discharge type fan. Do not obstruct air flow of this fan.

⑥ GPIB connector

⑦ Lock for prevention of plug-in unit falling out

⑧ TRIGGER OUT: A connector for a trigger signal (Refer to Section 2.2.)
Connects with TRIGGER IN ⑫ by using a special cable.

⑨ SIGNAL IN: A connector for a measurement signal
Connects with SIGNAL OUT ⑪ by using a special cable. (Refer to Section 2.2.)

⑩ CONTROL: A connector for a control signal
Connects with CONTROL ⑬ by using a special cable. (Refer to Section 2.2.)

⑪ SIGNAL OUT: A connector for a measurement signal
Connects with SIGNAL IN ⑨ by using a special cable. (Refer to Section 2.2.)

⑫ TRIGGER IN: A connector for a trigger signal
Connects with SIGNAL IN ⑧ by using a special cable. (Refer to Section 2.2.)

⑬ CONTROL: A connector for a control signal
Connects with CONTROL ⑩ by using a special cable. (Refer to Section 2.2.)

⑭ WAVELENGTH ADJUST: Adjusts the wavelength of the internal light source.

⑮ OUTPUT POWER ADJUST: Adjusts the light output power.

⑯ GND terminal

⑰ Power connector

⑱ Fuse holder: This is the same as the above ④ (rating current of 2.5A).

⑲ LD POWER ADJUST: Adjusts output from the internal light source.

⑳, ㉒ Use the specified fuse to prevent a fire.

㉑, ㉓ Don't disassemble this except ADVANTEST engineers.
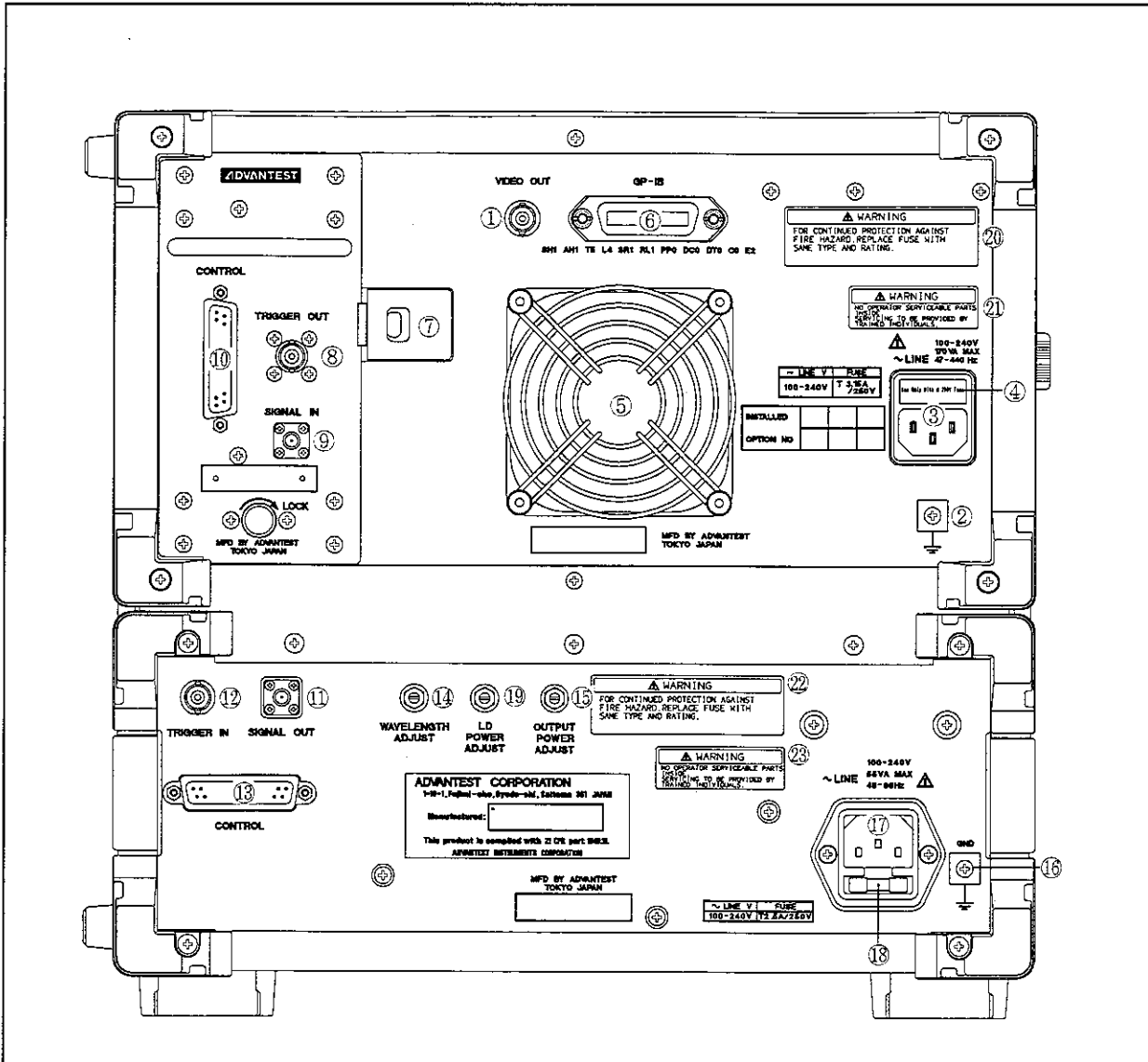
REAR VIEW

2.2 Cable Connection

Before powering on, connect connectors as follows with a cable on the rear panel.

	Connector name of Q8490 (upper unit)	Connector name of Q84901 (lower unit)	Cable
①	SIGNAL IN	SIGNAL OUT	Cable with SMA connector
②	TRIGGER OUT	TRIGGER IN	Cable with BNC connector
③	CONTROL	CONTROL	Cable with Dsub (25pin) type connector
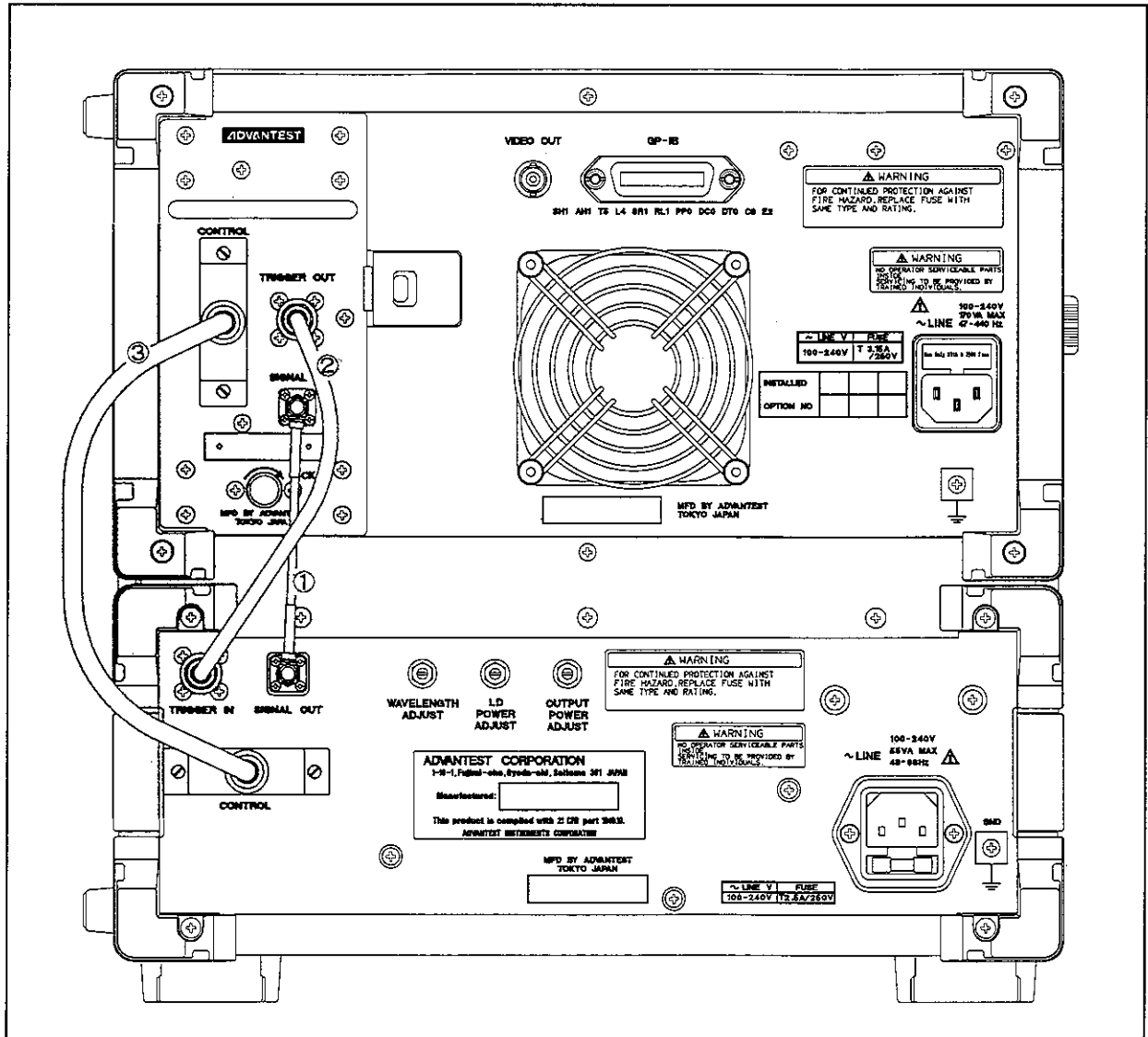
2.3 Powering on and Description of CRT Display

(1) Powering on

After connecting connectors according to Section 2.2, turn the POWER switch of this unit to ON. At this time, the measurement conditions is succeeded that just before the previous powering off. However, the following items comply the following table.

Item	Conditions
MONITORING/AVG MEAS	MONITORING
PAUSE/CONT LOADING	PAUSE ON LOADING mode
DUAL TRACE	OFF
MENU	OFF

Warm up this unit for 30 minutes or more.

(2) CRT display

The measured data and various setup conditions are displayed on the CRT display.
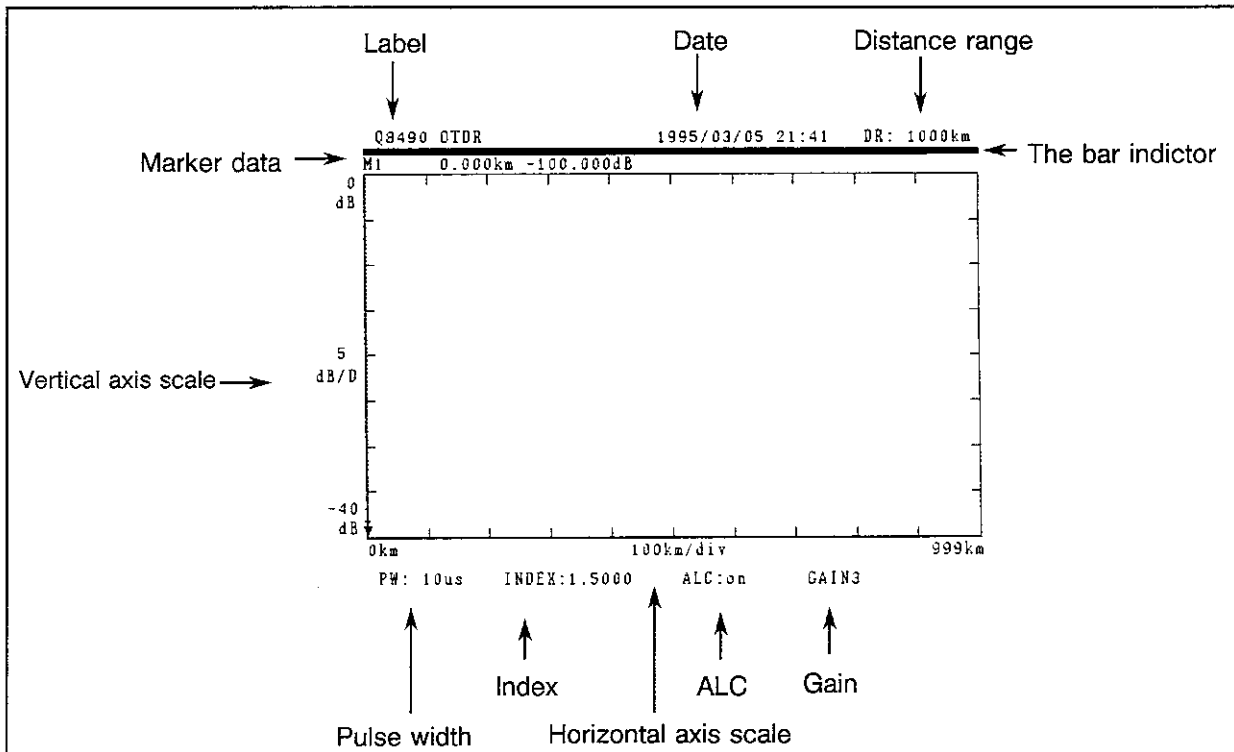
Figure 2-1   CRT Display

2.4 Operations

2.4.1 Operating Procedure

The following illustrates the standard system operating procedure.

Set up	┌ Connect cables │ Power on the unit │ Power on the external light source │ Check the input/output power │ Connect optical fiber of the light source │ Connect output optical fiber └ Connect optical fiber to be measured
Set the basic measuring conditions.	Set the basic measuring conditions in the monitoring mode.
INDEX setting	Set the refractive index of the optical fiber to be measured. (Refer to Subsection 2.5.3.)
DISTANCE RANGE setting	Set the measurement distance range. (Refer to Subsection 2.5.1.)
ZOOM IN/OUT selection	Set the range for distance display. (Refer to Subsection 2.5.4.)
PULSE WIDTH selection	Select applicable pulse width to the measurement distance range. (Refer to Subsection 2.5.2.)
Data indication	
VERTICAL SCALE selection	Select the scale on the vertical axis. (Refer to Subsection 2.5.5.)
AVG MEAS execution	Execute average measuring mode to improve S/N. (Refer to Subsection 2.4.4.)
ZOOM IN/OUT	Zoom in/out of waveform display. (Refer to Subsection 2.5.4.)
MARKER MEAS	Allows direct data read by the marker. (Refer to Section 2.8.)
SPLICE/LOSS mode selection	Select the point-to-point signal loss measuring mode or the line signal loss measuring mode. (Refer to Section 2.8.)

2.4.2 Initialization of Measuring Conditions

(1) When you press the INSTR PRESET key, the following message is displayed.
Press "INSTR PRESET key" once more.
If the INSTR PRESET key is pressed once more, the measuring conditions is initialized as follows. The internal memory data remain as they are.

Table 2-1 INSTR PRESET

Item	State
MEASURING MODE	MONITORING PAUSE
LABEL	NOT CHANGE
CLOCK	NOT CHANGE
DISTANCE RANGE	NOT CHANGE
SPAN	MAX SPAN
HORIZONTAL START DISTANCE	0km
VERTICAL SCALE	5dB/DIV
VERTICAL POSITION	0 to -40dB
PULSE WIDTH	NOT CHANGE
INDEX	NOT CHANGE
GAIN	ALC ON (GAIN3)
DISK FUNCTION FILE NAME	NOT CHANGE
DISK FUNCTION DATA TYPE	NOT CHANGE
DISK FUNCTION INFORMATION	NOT CHANGE
INTERNAL MEMORY DATA	NOT CLEAR
DUAL TRACE FUNCTION	OFF
DUAL TRACE WAVEFORM	CLEAR
AVERAGE TIMES	256
BUZZER	ON
GPIB ADDRESS	NOT CHANGE
HDCOPY	NOT CHANGE
FILTER	NORMAL
DATA KNOB RAPID	OFF
MARKER	DISTANCE
PRINTER	SHORT
AVG EXECUTION PROCESSING DISPLAY	TIME

(2) When you turn the POWER switch to ON, all green LEDs light instantaneously.

Pressing the MENU/LOCAL key sets the measuring conditions as the above table and clears all internal saved data (becomes the same conditions as shipment).

Table 2-2 POWER ON LOCAL

Item	State
MEASURING MODE	MONITORING PAUSE
LABEL	Q8490 OTDR
CLOCK	NOT CHANGE
DISTANCE RANGE	1000km
SPAN	1000km
HORIZONTAL START DISTANCE	0km
VERTICAL SCALE	5dB/DIV
VERTICAL POSITION	0 to -40dB
PULSE WIDTH	$10\mu s$
INDEX	1.5000
GAIN	ALC ON (GAIN3)
DISK FUNCTION FILE NAME	00000000.DSP
DISK FUNCTION DATA TYPE	DSP, BINARY
DISK FUNCTION INFORMATION	CLEAR
INTERNAL MEMORY DATA	CLEAR
DUAL TRACE FUNCTION	OFF
DUAL TRACE WAVEFORM	CLEAR
AVERAGE TIMES	256
BUZZER	ON
GPIB ADDRESS	11
HDCOPY	PRINTER
FILTER	NORMAL
DATA KNOB RAPID	OFF
MARKER	DISTANCE
PRINTER	SHORT
AVG EXECUTION PROCESSING DISPLAY	TIME

2.4.3 Monitor (MONITORING) Mode

Pressing the MONITORING key (see subsection 2.1.1, 6)) sets the monitor mode.

Executing monitoring displays waveform while executing averaging 256 times.

In this mode, setting can be made while monitoring various measuring conditions.

Distance range, pulse width, gain (ON/OFF of ALC) and zooming can be set only in the monitoring mode.

2.4.4 Average Measuring (AVG MEAS) Mode

Pressing AVG MEAS key (see Subsection 2.1.1, 7)) sets average measuring mode.

In the average measuring, data is averaged from 2^{12} to 2^{24} times and the measurement noise ratio is improved.

For the setting of averaging times, refer to Subsection 2.5.8.

The averaging rate is shown at the bar indicator.

Elapsed time, %, or cycles can be selected from the menu to see the execution progress.

2.4.5 Pause/Continue and Loading (LOADING, PAUSE/CONT) Mode

Pressing LOADING or PAUSE/CONT key (see Subsection 2.1.1, 8)) stops the monitor or average measurement temporarily. It can be restarted by pressing the key again.

While the monitor is stopped temporarily, the loading mode is set. In the loading mode, light output is as follows:

		MONITORING AVG MEAS	LOADING
Signal light (External light source)	Modulated	ON	OFF *
Loading light (Internal light source)	Modulated	ON	CW

* : Signal light cannot be output from the OUTPUT connector.

Only a dummy light can be output.

2.5 Measuring Conditions Setting (using panel keys)

2.5.1 Distance Range
(It can be set only if the Q8490 is in the monitor mode)

Select the distance range that is longer than the length of optical fiber cable being measured. The selected range is displayed as DR (Distance Range) at the right upper end on the screen.

1000 km ↔ 2000 km ↔ 3000 km ↔ 4000 km ↔ 5000 km ↔ 6000 km ↔ 7000 km ↔ 8000 km ↔ 9000 km ↔ 10000 km
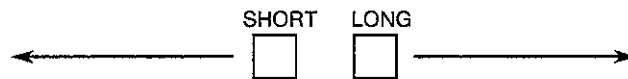
Select the distance range that is longer than the length of optical fiber cable being measured. The selected range is displayed as DR (Distance Range) at the right upper end on the screen.

2.5.2 Pulse Width
(It can be set only if the Q8490 is in the monitor mode)

Set the suitable pulse width of probe light for the measuring purpose. Pulse width is changed as follows by pressing the PULSE key (see Subsection 2.1.1, 14)). The selected pulse width is indicated at the bottom of the screen.

3 μs ↔ 10 μs ↔ 30 μs ↔ 100 μs

The longer the pulse width is, the broader the dynamic range becomes. While this unit can measure the long optical fiber, the spatial resolution drops. Conversely, shortening the pulse width provides higher spatial resolution while the dynamic range is narrowed.

2.5.3 INDEX (Refractive Index)

Q8490 measures the time (in seconds) of optical pulse transferred via the optical fiber cable and calculates the distance according to the refractive index of the cable core.
Set the refractive index of the optical fiber cable core as follows:

Press the [MENU] key to select the ADVANCE FUNCTION mode. Select INDEX by using

[SAVE ⇦] and [VIEW ⇨] keys. The refractive index will be displayed in the upper right window of the

screen. Enter the desired value by using the data knob and press the MENU key again to determine the refractive index.

2.5.4 Horizontal Span and Position

(1) Horizontal span changing (in the monitor mode)
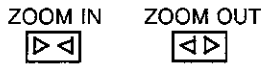
ZOOM IN   ZOOM OUT
▷◁   ◁▷   Scales up or scales down the horizontal span on the screen.
The span changes at each step when the ZOOM IN/ZOOM OUT
key is pressed in each range.

The allowable range is as follows.
The span is scaled up or scaled down with the cursor marker position as the center.

Range \ Span	5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	3000 km	4000 km	5000 km
1000 km	●	●	●	●	●	●	●	●				
2000 km	●	●	●	●	●	●	●	●	●			
3000 km	●	●	●	●	●	●	●	●	●	●		
4000 km	●	●	●	●	●	●	●	●	●		●	
5000 km	●	●	●	●	●	●	●	●	●			●
6000 km	●	●	●	●	●	●	●	●	●			●
7000 km	●	●	●	●	●	●	●	●	●			●
8000 km	●	●	●	●	●	●	●	●	●			●
9000 km	●	●	●	●	●	●	●	●	●			●
10000 km	●	●	●	●	●	●	●	●	●			●

Range \ Span	6000 km	7000 km	8000 km	9000 km	10000 km
1000 km					
2000 km					
3000 km					
4000 km					
5000 km					
6000 km	●				
7000 km		●			
8000 km			●		
9000 km				●	
10000 km					●

(2) Horizontal movement of displayed waveform
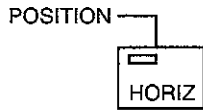
POSITION

Press the HORIZ key. The LED lights up. Now the user can move the waveform in the horizontal position.

When the data knob is rotated clockwise, the waveform is moved away from the output connector. When it is rotated counterclockwise, the waveform is moved toward the output connector.

(3) Horizontal span changing (in AVG MEAS mode)

When the average measuring mode is being operated or completed, the span can be scaled up or scaled down within the range of the internal data.

The allowable range of scaling up or scaling down is as follows:

< How to see the table >

Example : Pressing the AVG.MEAS key under the distance range of 1000 km and the span of 50 km allows span change from 10 to 200 km.

When the distance range is set to 1000 km.

SPAN							
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km
●	⇨	⇨	⇨	⇨	—	—	—
⇦	●	⇨	⇨	⇨	—	—	—
⇦	⇦	●	⇨	⇨	—	—	—
—	⇦	⇦	●	⇨	⇨	—	—
—	⇦	⇦	⇦	●	⇨	—	—
—	—	⇦	⇦	⇦	●	⇨	—
—	—	—	⇦	⇦	⇦	●	⇨
—	—	—	—	⇦	⇦	⇦	●

● : Shows the set span when the AVG MEAS key is pressed.

⇦ , ⇨ : Shows the span can be expanded or compressed.

When the distance range is set to 2000 km.

SPAN								
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km
●	⇒	⇒	⇒	⇒	—	—	—	—
⇐	●	⇒	⇒	⇒	—	—	—	—
⇐	⇐	●	⇒	⇒	—	—	—	—
—	⇐	⇐	●	⇒	⇒	—	—	—
—	⇐	⇐	⇐	●	⇒	—	—	—
—	—	⇐	⇐	⇐	●	⇒	—	—
—	—	—	⇐	⇐	⇐	●	⇒	—
—	—	—	—	⇐	⇐	⇐	●	⇒
—	—	—	—	⇐	⇐	⇐	⇐	●

When the distance range is set to 3000 km.

SPAN									
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	3000 km
●	⇒	⇒	⇒	⇒	—	—	—	—	—
⇐	●	⇒	⇒	⇒	—	—	—	—	—
⇐	⇐	●	⇒	⇒	—	—	—	—	—
—	⇐	⇐	●	⇒	⇒	—	—	—	—
—	⇐	⇐	⇐	●	⇒	—	—	—	—
—	—	⇐	⇐	⇐	●	⇒	—	—	—
—	—	—	⇐	⇐	⇐	●	⇒	—	—
—	—	—	—	⇐	⇐	⇐	●	⇒	⇒
—	—	—	—	⇐	⇐	⇐	⇐	●	⇒
—	—	—	—	⇐	⇐	⇐	⇐	⇐	●

● : Shows the set span when the AVG MEAS key is pressed.

⇐ , ⇒ : Shows the span can be expanded or compressed.

When the distance range is set to 4000 km.

SPAN									
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	4000 km
●	→	→	→	→	—	—	—	—	—
←	●	→	→	→	—	—	—	—	—
←	←	●	→	→	—	—	—	—	—
—	←	←	●	→	→	—	—	—	—
—	←	←	←	●	→	—	—	—	—
—	—	←	←	←	●	→	—	—	—
—	—	—	←	←	←	●	→	—	—
—	—	—	—	←	←	←	●	→	—
—	—	—	—	←	←	←	←	●	—
—	—	—	—	—	←	←	←	←	●

When the distance range is set to 5000 km.

SPAN									
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	3000 km
●	→	→	→	→	—	—	—	—	—
←	●	→	→	→	—	—	—	—	—
←	←	●	→	→	—	—	—	—	—
—	←	←	●	→	→	—	—	—	—
—	←	←	←	●	→	—	—	—	—
—	—	←	←	←	●	→	—	—	—
—	—	—	←	←	←	●	→	—	—
—	—	—	—	←	←	←	●	→	—
—	—	—	—	←	←	←	←	●	—
—	—	—	—	—	←	←	←	←	●

● :   Shows the set span when the AVG MEAS key is pressed.

← , → : Shows the span can be expanded or compressed.

When the distance range is set to 6000 km.

SPAN										
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	5000 km	6000 km
●	⇨	⇨	⇨	⇨	—	—	—	—	—	—
⇦	●	⇨	⇨	⇨	—	—	—	—	—	—
⇦	⇦	●	⇨	⇨	—	—	—	—	—	—
—	⇦	⇦	●	⇨	⇨	—	—	—	—	—
—	⇦	⇦	⇦	●	⇨	—	—	—	—	—
—	—	⇦	⇦	⇦	●	⇨	—	—	—	—
—	—	—	⇦	⇦	⇦	●	⇨	—	—	—
—	—	—	—	⇦	⇦	⇦	●	⇨	—	—
—	—	—	—	⇦	⇦	⇦	⇦	●	—	—
—	—	—	—	—	⇦	⇦	⇦	⇦	●	⇨
—	—	—	—	—	⇦	⇦	⇦	⇦	⇦	●

When the distance range is set to 7000 km.

SPAN										
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	5000 km	7000 km
●	⇨	⇨	⇨	⇨	—	—	—	—	—	—
⇦	●	⇨	⇨	⇨	—	—	—	—	—	—
⇦	⇦	●	⇨	⇨	—	—	—	—	—	—
—	⇦	⇦	●	⇨	⇨	—	—	—	—	—
—	⇦	⇦	⇦	●	⇨	—	—	—	—	—
—	—	⇦	⇦	⇦	●	⇨	—	—	—	—
—	—	—	⇦	⇦	⇦	●	⇨	—	—	—
—	—	—	—	⇦	⇦	⇦	●	⇨	—	—
—	—	—	—	⇦	⇦	⇦	⇦	●	—	—
—	—	—	—	—	⇦	⇦	⇦	⇦	●	—
—	—	—	—	—	—	⇦	⇦	⇦	⇦	●

● :   Shows the set span when the AVG MEAS key is pressed.

⇦ , ⇨ : Shows the span can be expanded or compressed.

When the distance range is set to 8000 km.

SPAN										
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	5000 km	8000 km
●	⇨	⇨	⇨	⇨	—	—	—	—	—	—
⇦	●	⇨	⇨	⇨	—	—	—	—	—	—
⇦	⇦	●	⇨	⇨	—	—	—	—	—	—
—	⇦	⇦	●	⇨	⇨	—	—	—	—	—
—	⇦	⇦	⇦	●	⇨	—	—	—	—	—
—	—	⇦	⇦	⇦	●	⇨	—	—	—	—
—	—	—	⇦	⇦	⇦	●	⇨	—	—	—
—	—	—	—	⇦	⇦	⇦	●	⇨	—	—
—	—	—	—	—	⇦	⇦	⇦	●	⇨	—
—	—	—	—	—	—	⇦	⇦	⇦	●	—
—	—	—	—	—	—	⇦	⇦	⇦	⇦	●

When the distance range is set to 9000 km.

SPAN										
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	5000 km	9000 km
●	⇨	⇨	⇨	⇨	—	—	—	—	—	—
⇦	●	⇨	⇨	⇨	—	—	—	—	—	—
⇦	⇦	●	⇨	⇨	—	—	—	—	—	—
—	⇦	⇦	●	⇨	⇨	—	—	—	—	—
—	⇦	⇦	⇦	●	⇨	—	—	—	—	—
—	—	⇦	⇦	⇦	●	⇨	—	—	—	—
—	—	—	⇦	⇦	⇦	●	⇨	—	—	—
—	—	—	—	⇦	⇦	⇦	●	⇨	—	—
—	—	—	—	—	⇦	⇦	⇦	●	⇨	—
—	—	—	—	—	—	⇦	⇦	⇦	●	—
—	—	—	—	—	—	⇦	⇦	⇦	⇦	●

● : Shows the set span when the AVG MEAS key is pressed.

⇦ , ⇨ : Shows the span can be expanded or compressed.

When the distance range is set to 10000 km.

SPAN										
5 km	10 km	20 km	50 km	100 km	200 km	500 km	1000 km	2000 km	5000 km	10000 km
●	⇨	⇨	⇨	⇨	—	—	—	—	—	—
⇦	●	⇨	⇨	⇨	—	—	—	—	—	—
⇦	⇦	●	⇨	⇨	—	—	—	—	—	—
—	⇦	⇦	●	⇨	⇨	—	—	—	—	—
—	⇦	⇦	⇦	●	⇨	—	—	—	—	—
—	—	⇦	⇦	⇦	●	⇨	—	—	—	—
—	—	—	⇦	⇦	⇦	●	⇨	—	—	—
—	—	—	—	⇦	⇦	⇦	●	⇨	—	—
—	—	—	—	—	⇦	⇦	⇦	●	—	—
—	—	—	—	—	—	⇦	⇦	⇦	●	—
—	—	—	—	—	—	⇦	⇦	⇦	⇦	●

● : Shows the set span when the AVG MEAS key is pressed.

⇦ , ⇨ : Shows the span can be expanded or compressed.

2.5.5 Vertical scale setting

(1) Vertical scale setting

When the VERTICAL SCALE key is pressed, the scale of the vertical axis changes as follows:

5 dB/div

2 dB/div

1 dB/div

0.5 dB/div
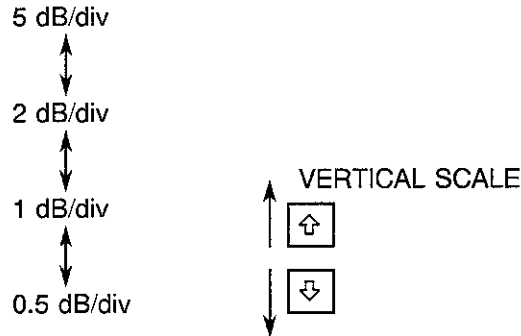
VERTICAL SCALE

Select an appropriate vertical scale according to the signal loss of optical fiber cable or connection loss.

(2) Vertical movement of displayed waveform

POSITION
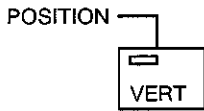
VERT

Press the VERT key. The LED lights up. Now the user can move the waveform in the vertical direction by using the data knob.

Rotate the data knob clockwise to move the waveform upward. Rotate the data knob counterclockwise to move the waveform downward.

2.5.6 Smoothing of Displayed Waveform

Function to smooth waveform by using moving average method.

Setting

① Press the MENU key and select FILTER.

② Select NORMAL or Wide D. Range by using the data knob.

NORMAL: Moving averaging is executed with a bandwidth of one-forth pulse width.

Wide D. Range: Moving averaging is executed with bandwidth of a half pulse width. The dead zone and the spatial resolution are worsened 1.5 times them.

2.5.7 ALC (Automatic Level Control) and Gain Setting

The setting can be changed only if Q8490 is in the monitoring mode.

Setting

① Press the [MENU] key and select ALC.

② Select ALC on or ALC off by using the data knob.

ALC on: Detects a maximum level at AVG MEAS setting and automatically sets the most applicable gain to avoid over scaling.

ALC off: Set the monitoring mode and set the gain larger in the manual operation for measuring a low level signal minutely by overscaling the high level signal such as Fresnel reflections. One of four kinds of gain, Gain 0 to Gain 3, can be selected.

Gain 0 has the smallest gain and Gain 3 has the largest gain. If overscaling occurs in Gain 0, the internal circuit may be saturated. In this case, add an optical attenuator to the optical signal output to decrease the level, then measure the signal.

2.5.8 Display Mode of Averaging Times and Processing time

Press the [MENU] key and select AVERAGE.

Press the [ENTER] key to select the setting item.

(1) No.: Select a value from among 16 to 65536 in the window by using the data knob. In this unit, the waveform which is averaged 2^8 times is assumed as a base one.

Therefore, the total number of averaging times is as follows:

In case the averaging times is selected as 16: $2^8 \times 16 = 2^{12}$

In case the averaging times is selected as 256: $2^8 \times 256 = 2^{16}$

In case the averaging times is selected as 65536: $2^8 \times 65536 = 2^{24}$

(2) MODE: If No. is selected, the number of averaging times is displayed.

If % is selected, a ratio between the executed number of averaging times and the specified number of averaging times.

If Time is selected, a time elapsed since the averaging starts is displayed.

2.5.9 Writing Label

Information can be labeled to the storage data by using up to 23 alphanumeric characters.
The label is indicated in the top line of the screen.

Press the [MENU] key to select ADVANCE FUNCTION and select LABEL. The following screen will appear.

Reversely highlight the character to be entered by using the data knob and press the [ENTER] key. The character will be entered.

DELETE	:	Deletes a character on the cursor position.
⇦	:	Moves the cursor to the left.
⇨	:	Moves the cursor to the right.
ALL DELETE	:	Deletes all characters of the label.

2.5.10 Clock Setting

You can set time (minute and hour), date, month and year.

Press the [MENU] key and select ADVANCE FUNCTION mode, then select CLOCK.

Press the [ENTER] key to select the setting item.

(1) Year: Check that the cursor is on YEAR.
             Set an appropriate number by turning the data knob.

(2) Month: Press the [ENTER] key and move the cursor to MONTH.
             Set an appropriate number by turning the data knob.

(3) Day: Press the [ENTER] key and move the cursor to DAY
             Set an appropriate number by turning the data knob.

(4) Hour: Press the [ENTER] key and move the cursor to HOUR.
             Set an appropriate number by turning the data knob.

(5) Minute: Press the [ENTER] key and move the cursor to MIN.
             Set an appropriate number by turning the data knob.

2.6   Saving/Recalling Measurement Conditions to/from Internal Memory

If a waveform is recalled from the internal memory, a measuring condition can be selected and set from among 32 conditions saved in the internal memory.

After recalling the waveform, press the MONITORING or the AVG MEAS key. A measurement starts in the same measuring condition as the recalled waveform. (In this case, the current time is indicated.)

For how to use internal memory, refer to Section 2.10.

2.7   Saving/Recalling Measuring Conditions to/from Floppy Disk

If a waveform is recalled from a floppy disk, the measuring condition saved in the floppy disk is set.

After recalling the waveform, press the MONITORING or the AVG MEAS key. A measurement starts in the same measuring condition as the recalled waveform. (In this case, the current time is indicated.)

For how to use floppy disk, refer to Section 2.11.

2.8   Readout by Marker

Three kinds of of readout function, DISTANCE, LOSS and SPLICE, can be preformed by using marker.

The function can be selected by pressing MARKER MEAS key (see Subsection 2.1.1, ㉕).

The function whose LED is lit can be monitored.

2.8.1   Distance Indication

DISTANCE (M1):The M1 marker is indicated on the screen. The distance (km) from the near end to M1 and the level (dB) can be measured.

2.8.2   Loss Indication

LOSS (M1, M2): LOSS (M1, M2): The M1 and M2 markers are indicated on the screen. The signal level difference (dB) between M1 and M2, the distance (km) between M1 and M2, and the signal loss per kilometer (dB/km, calculated in the least squares method) between M1 and M2 can be measured.

The marker which is moved by the data knob can be selected by the MARKER SELECT key.

2.8.3 Splice Loss Indication

SPLICE (M1, M2, M3): SPLICE (M1, M2, M3): The M1, M2 and M3 markers are indicated on the screen. The anastomosis or connection loss due to connector can be measured by using these 3 markers.

Measurement procedure

① As shown in the figure, set the M2 marker as a splice change point. Then set M1 and M3 markers on any two points of both fibers with the splice point asthe center.

② To execute calculation through the least squares method, set m1 on a distance of δ_1 and m2 on a distance of δ_2 from the center of M2.
The points of m1 and m2 are indicated as X on the screen.

③ From the distance data between M1 and m1 and between M3 and m2, the intersection point to the approximate value is set as P0 and P1. The level difference between P0 and P1 is set as the splice loss.

④ After M3 is set, pressing MARKER SELECT key indicates cursors for each marker of M1, M2 and M3. Markers can be moved with their interval fixed.

δ_2 = Distance corresponding to pulse width.

δ_1 = 300m (fixed)
δ_2 = 900m (PW= 3μS)
  =2200m (PW= 10μS)
  = 5km (PW= 30μS)
  = 15km (PW=100μS)
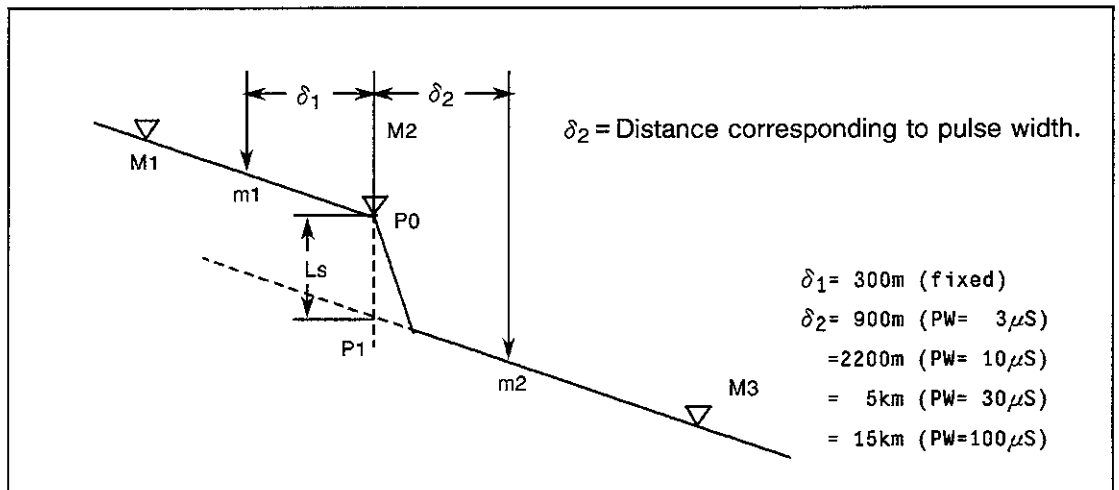
2.9 Dual Screen Indication

A function to display and compare two waveforms on a screen.

(1) Saving by the [SAVE] Key and Recalling by the [VIEW] key

Pressing the [SAVE] key saves the waveform data being displayed. Only one waveform can be saved. Its measurement conditions, etc. cannot be saved.

Pressing the [VIEW] key recalls the saved waveform onto the screen.

(DUAL TRACE function)

The saved waveform and the waveform currently being measured can be displayed on a screen at a time. This is effective to compare waveforms.

LED of the VIEW key shows the following conditions.

Pressing the [VIEW] key again allows the VIEW waveform to disappear from the screen.

Waves memorized by pressing the [SAVE] key is cleared upon power-down.

○
VIEW
[ ]

⚡ (LED goes on) :   DUAL TRACE is in progress.

● (LED goes off) :   Waveform currently being measured is displayed.

```
Q8490 OTDR              1995/03/06 16:21    DR: 1000km
M1      0.000km    -16.812dB              AAA00000.DSP
-11
dB




  5
dB/D




-51
dB
 0km                    10km/div                 102km
  PW: 10us      INDEX:1.4750      ALC:off      GAIN3
```
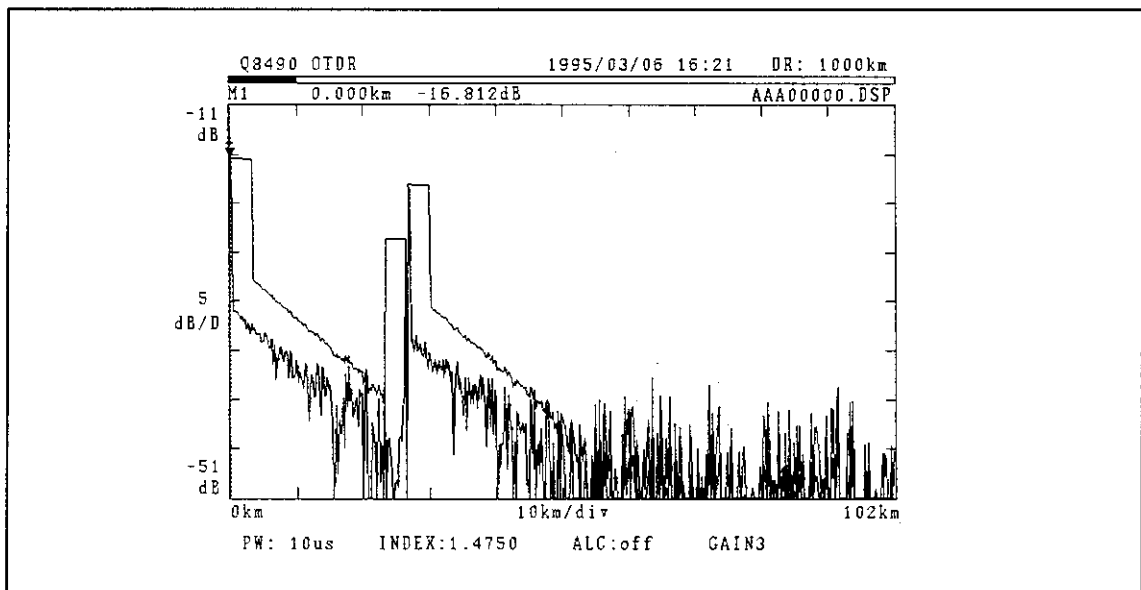
Figure 2-2 Comparison of Two Waveforms by Using SAVE/VIEW Function

2.10 Function of Internal Memory

Internal memory function can memorize 32 screens of waveform with its measurement conditions. The function has a back-up feature, so the memory is retained if the power is turned off.

For these features, not only saving of waveforms and its measurement conditions but also variation measurement for the fiber can be made at every time.

(Using memory function)

Press the [MENU] key and select MEMORY.

2.10.1 Writing

Procedure:

① Press the [MENU] key and select SAVE in the MEMORY window.

② Move the cursor on a waveform number of 1 to 32 to be saved. Press the [ENTER] key, then the waveform is saved into the memory.

Data are saved to each item (LABEL characters to TITLE, date to DATE and time to TIME).

If you select an data item and press the [ENTER] key, the following message appears.

  *** If you are going to rewrite,
    please push "ENTER" key. ***

When the [ENTER] key is pressed once more, the previously saved data is cleared and the current waveform is saved.

③ After the waveform is saved, the memory initial screen is indicated. The initial screen can also be indicated by selecting EXIT, then pressing the [ENTER] key.

2.10.2 Reading

Procedure:

① Press the [MENU] key and select RECALL in the MEMORY window.

② Move the cursor on a waveform number of 1 to 32 to be read. Press the [ENTER] key, then the waveform is recalled from the memory. Memory initial screen is indicated.

The initial screen can also be indicated by selecting EXIT, then pressing the [ENTER] key.

③ Press the [MENU] key to escape from the ADVANCE FUNCTION mode.

If the [MONITORING] key is pressed, measurement starts. In this case, the current date and time is indicated.

2.10.3 Deletion

Procedure:

① Press the [MENU] key and select DELETE from the MEMORY window.

② Move the cursor on a waveform number of 1 to 32 to be deleted. Press the [ENTER] key, then the following message is displayed.

*** If you are going to delete the file,
                please push "ENTER" key. ***

③ To delete the waveform, press the [ENTER] key.

Select EXIT and press the [ENTER] key, the memory initial screen is indicated.

All data in the memory can be deleted by selecting ALL DELETE and pressing the [ENTER] key.

2.11 Floppy Disk Function

The measured data and its setting conditions can be saved to/recalled from a floppy disk.
As its format conforms to MS-DOS, data can be handled by personal computers running on MS-DOS.

- Specifications of the floppy disk drive
  Disk drive type: 3.5-inch micro floppy disk drive
  Usable floppy disk: 2DD (Double-sided double-density)
                             2HD (Double-sided high-density)
  Capacity when formatted: 720K bytes (2DD)/1M bytes (2HD)
  Recording format: 720K bytes (2DD)/1M bytes (2HD)
  Recording format: 2DD IBM/NEC common format
                             2HD IBM format

Number of recording files:

Data type (waveform data point number)	Number of recording files		Internal data (ALL) (See Note 2.) (Max. 15344 points) (See Note 3.)
	Screen data (DSP) (See Note 1.) (501 points)		
Data format	Binary	ASCII	Binary
2DD (720K bytes)	112 files	101 files	5 files
2HD (1.44M bytes)	224 files	219 files	10 files

Note 1: Screen data means only the waveform data being displayed. Expanding of compressing of the waveform cannot be made.

Note 2: Internal data means the waveform data being displayed and its measurement conditions. Expanding and compressing the waveform can be made.

Note 3: The number of recording files differs depending on the number of the internal data points.
Internal data cannot be recorded in ASCII format.

2.11.1 Handling of Floppy Disk

(1) Write-protection
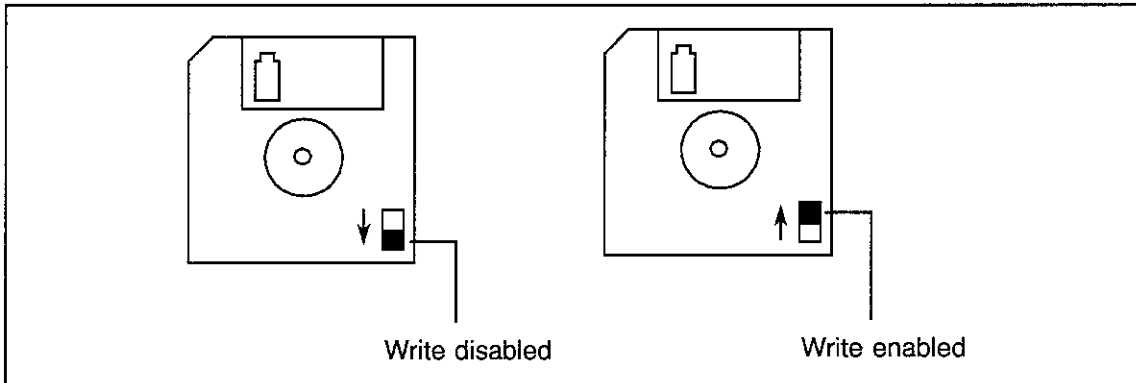
Figure 2-3   Write-protection of Floppy Disk

A 3.5-inch micro-floppy disk can be write-protected so as not to erroneously erase the valuable data. The disk is write-protected if the write-protection notch is slide downward as shown in Figure 3-2.

(2) Floppy disk drive handling notes

- Do not place the Q8490 upside down when the floppy disk drive is being used.
- Giving a strong impact on the floppy disk drive may damage the head of the drive or a floppy disk.
- Pulling out a floppy disk before it is completely ejected may cause the head to catch the disk shutter widow. The head may be damaged at this event.
- Inserting a floppy disk when not completely ejected may damage the head.

Insert a floppy disk with its labeled side up into the slot.
Press the disk forward with a finger until it reaches the end and is fixed on the drive.
To remove the disk, press the eject button. The disk will automatically come out.

```
──────────────────── WARNING ────────────────────

Do not press the eject button when the red lamp is lit on the drive unit.
```

2.11.2 Writing

Press the [MENU] key and select SAVE in the DISK window.   Write the waveform data and its setting conditions according to the following procedure.

① FILE NAME

Up to eight alphanumeric characters can be entered. Reverse the character what you want to enter with the data knob and press the [ENTER] key.

The | DELETE | , | ⇦ | , | ⇨ | , and | ALL DELETE | keys function as follows when followed by the [ENTER] key.

| DELETE | :   Deletes a character on the cursor position.

| ⇦ | :   Moves the cursor to the left.

| ⇨ | :   Moves the cursor to the right.

| ALL DELETE | :   Deletes all of the label name.

② NAMING MODE

Reverse the item what you want to enter with the data knob and press the [ENTER] key.
If you select AUTO ON, the seventh and eighth characters are updated automatically so that you need not enter an file name every time you save the file.
When you select AUTO ON, specify eight characters for a file name with numerics for the seventh and eighth characters.
Example:
FILE NAME: FIBER-00

③ DATA TYPE

Reverse the item what you want to enter with the data knob and press the [ENTER] key.
DATA TYPE specifies the type of data to be saved. An extension is automatically added to the file when saved.
Each data type represents the following.
DSP (DISPLAY):   LOG-converted waveform data on the screen.
ALL (ALL-LINEAR):   All internal waveform data (raw data) before LOG-conversion.
The loaded waveform can be expanded or compressed and shifted in the horizontal direction.

④ DATA FORMAT

ENTER

Reverse the item what you want to enter with the data knob and press the ☐ key.

DATA FORMAT specifies the format of data to be saved.

BINARY: Saves waveform data in binary format.

ASCII: Saves waveform data in ASCII format.

```
──────────────── CAUTION ────────────────

ALL and ASCII can not be used in combination.

```

⑤ Saving

ENTER

Select EXECUTE with the data knob and press the ☐ key to save data such as waveform data into the disk. After the data are saved, the FDD functions initial screen reappears. To return to the FDD functions initial screen with out saving data, select EXIT

ENTER

and press the ☐ key.

```
──────────────── CAUTION ────────────────

1. The data which is read from the internal memory cannot be saved into the floppy disk.

2. If DATA TYPE and DATA FORMAT differ between the conditions before loading and
   the current conditions, the data cannot be saved.

```

2.11.3 Reading

Press the ⬚ (MENU) key and select LOAD in the DISK window to read data such as waveform data and its measurement conditions.

① Operation procedure

Move the cursor on the desired file No. using the data knob and press the ⬚ (ENTER) k e y to read waveform data from the disk. After the data are read out, the FDD functions initial screen reappears. To return to the FDD functions initial screen without loading data, select EXIT and press the ⬚ (ENTER) key.

② Span change and horizontal position shift concerning the loaded waveform data
Operation of span change and horizontal position shift differ depending on the type ofthe loaded waveform data.

DSP(DISPLAY):   Inhibits span change and horizontal position shift.
ALL(ALL-LINEAR):   Permits span change and horizontal position shift.

After selecting, press the ⬚ (MENU) key to exit the ADVANCE FUNCTION mode.

Press the ⬚ (MONITORING) key to start measurement.
Note that the current data and time are set.

2.11.4 Other Functions of Floppy Disk

The functions, when the ⬚ (MENU) key is pressed and DISK is selected, are explained below.

(1) DIRECTORY mode
Lists the files saved in the disk.

① Meaning of items in the list
    No.:   File number
    FILE NAME: File name
    TYPE: Type of the save data
    SIZE: Size of the file in bytes
    DATE: Year, month, and date when the file is saved
    TIME: Time when the file is saved

② Operation
The list can be scrolled by using the data knob.

Select EXIT and press the ⬚ (ENTER) key to return to the FDD initial screen.

(2) DELETE mode
Deletes a file.

Operation procedure

① Move the cursor on the file number what you want to delete and press the ENTER key.
The following messages will appear for confirmation.
     DELETE: PUSH "ENTER KEY"
     ESCAPE: ROTATE "KNOB"

② To delete the file, press the [ENTER] key again.
Or to cancel the deletion, rotate the data knob.

To return to the FDD functions initial screen, select EXIT and press the [ENTER] key.

(3) FORMAT mode
This mode is used to format a disk.

Operation procedure

① Select EXECUTE with the data knob and press the ENTER key. The following messages
will appear for confirmation.
     FORMAT: PUSH "ENTER KEY"
     ESCAPE: ROTATE "KNOB"

② Press the [ENTER] key again to start formatting, or rotate the data knob to cancel for matting.

To return to the FDD functions initial screen, select EXIT and press the [ENTER] key.

(4) INFORMATION mode
When commands of the floppy disk drive functions are executed, messages including error
messages are indicated on the screen.
Messages and their meaning are given below.

(5) TYPE mode

Set the data type before the waveform data is saved in the disk.

① DATA TYPE

Reverse the item what you want to enter with the data knob and press the ENTER ☐ key.

DATA TYPE specifies the type of data to be saved. An extension is automatically added to the file when saved.

Each data type represents the following.

DSP (DISPLAY):   LOG-converted waveform data on the screen.

ALL (ALL-LINEAR):   All internal waveform data (raw data) before LOG-conversion.

The loaded waveform can be expanded or compressed and shifted in the horizontal direction.

② DATA FORMAT

Reverse the item what you want to enter with the data knob and press the ENTER ☐ key.

DATA FORMAT specifies the format of data to be saved.

BINARY: Saves waveform data in binary format.

ASCII: Saves waveform data in ASCII format.

```
――――――――――――――― CAUTION ―――――――――――――――

ALL and ASCII can not be used in combination.
```

2.11.5 Error Messages

When commands of the floppy disk drive functions are executed, messages including error messages are indicated on the screen.
Messages and their meaning are given below.

Error message	Meaning
ERROR:DRIVE NOT READY	No floppy disk is in the disk drive unit. The disk is not formatted or with an invalid format.
ERROR:WRITE PROTECTOR	The floppy disk is write-protected.
ERROR:FILE NOT FOUND	The specified disk is not in the disk.
ERROR:DISK FULL	The disk is full and has no space for a new file.
ERROR:FILE NAME ERROR	The file name is incorrect.
ERROR:DATA TYPE ERROR	LOG type data cannot be saved in the REFLECTION mode. Only the data having an applicable data format to this unit can be loaded.
ERROR:CAN NOT SAVE	Data recalled by the memory function cannot be saved. Data cannot be saved because DATA TYPE and DATA FORMAT are differ between the conditions after loaded by the FDD function and the current conditions.
OVERWRITE:PUSH "ENTER KEY" ESCAPE:ROTATE "KNOB"	The same file already exists. If the ⬚ ENTER key is pressed, the new file is overwritten to the existing one. If the data knob is rotated, the command is canceled.
DELETE:PUSH "ENTER KEY" ESCAPE:ROTATE "KNOB"	These messages are displayed for confirmation before the file deleting command is executed. Pressing the ⬚ ENTER key executes the command. Rotating the data knob cancels the command.
FORMAT:PUSH "ENTER KEY" ESCAPE:ROTATE "KNOB"	These messages are displayed for confirmation before the format command is executed. Pressing the ⬚ ENTER key executes the command. Rotating the data knob cancels the command.

2.11.6 FD Format

The format of data files saved by Q8490 is shown below. It is a MS-DOS format. When you analyze data with a personal computer, refer to the following.
The floppy disk area is divided into five blocks as follows:

Block name	Total number of bytes
Header	128
Measuring condition	239
Information data	256
Internal flag information	154
Waveform data	*

* : Means that the total number of bytes varies with data
types and the number of waveform points.

The following are details of each block.

(1) Header

Item	Number of bytes
Company name	16
Product name	16
Software version	16
Save waveform data type	16
Save waveform data format	16
Number of data (Display, Internal)	16
Average times	16
Spare	16

(2)   Measuring condition

Item	Number of bytes
Measuring mode	14
Label	24
Clock	17
Distance range	11
Span	11
Data start distance (Display, Internal)	26
Data end distance (Display, Internal)	24
Vertical scale	8
Display screen maximum level	12
Display screen minimum level	12
Index	13
Pulse width	9
ALC setting	8
Gain	7
Filter function	20
Average times	23

(3)   Information data (Number of byte = 256)

There is information data about the floppy function.

(4)   Internal flag information(Number of byte = 154)

This is data to be set inside OTDR and unnecessary for a personal computer processing.

(5) Waveform data

The combination of the save waveform data type and the save waveform data format produce three kinds of waveform data.

	Save waveform data type	Save waveform data format	Byte
①	DSP	ASC	Number of data (Header) × 8
②	DSP	LIN	Number of data (Header) × 4
③	ALL	LIN	Number of data (Header) × 4 × 2

How to convert data.

Case ①

> Data consists of eight bytes.
> Example :   -100.000

Case ②

> Data consists of four bytes.
> The following process is done on a byte-by-byte basis in a reading order, for example, in the order of D1-D2-D3-D4.

> $$D = D1 \times 2^{24} + D2 \times 2^{16} + D3 \times 2^{8} + D4$$

> In the case of $D < 2^{16}$
> $DATA = D/2^{16}$

> In the case of $D \geq 2^{16}$
> $DATA = (D - 2^{32})/2^{16}$

Case ③

Waveform data consists of two kinds of data, (Waveform A and Waveform B).
Its data is stored in the order of Waveform A-Waveform B.

Waveform A	Waveform B
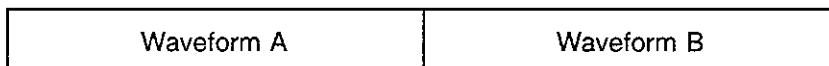
Each waveform data consists of four bytes.
The following process is done on a byte-by-byte basis in a reading order, for example, in the order of D1-D2-D3-D4.

$$D = D1 \times 2^{24} + D2 \times 2^{16} + D3 \times 2^8 + D4$$

After the above calculation, the data of Waveform A becomes
$D_{A1}, D_{A2}, D_{A3}, \ldots D_{AN}$.

After above calculation, the data of Waveform B becomes
$D_{B1}, D_{B2}, D_{B3}, \ldots D_{BN}$.

Then, the n-th data becomes
$$DATA_N = 5 \times Log(D_{AN}/2^{16}/AVG) + 5 \times Log(D_{BN}/2^{16}/AVG)$$
$$= 5 \times Log(D_{AN} \times D_{BN}/2^{16}/AVG).$$

Here, AVG is the number of times that the header is averaged.
In the case of AVG > 33023, AVG = AVG/2 is lead.

2.12 I/O

Press the ☐ MENU key. Select GPIB, HDCOPY, PRINTER, BUZZER or SCRAMBL by pressing the ☐ ENTER key.

2.12.1 GPIB Address

Specify the device address for remote control via GPIB. Address can be set from among 0 to 30. Use the data knob for address setting.

2.12.2 HDCOPY

Outputs a hard copy of the on-screen data of this unit.
Select one of the following two devices by using the data knob.
* PRINTER: Built-in thermal printer
* PLOTTER: External plotter

(1) Hard copy output via the internal printer

Check that the PRINTER has been selected by the ☐ MENU key.

Press the ☐ PRINT/PLOT key to output the data to the printer.

ressing the ☐ FEED key feeds the thermal paper.

Changing printing paper

① Turn up the head-up lever.

② Place a roll paper out side down into the holder.

③ Insert the roll paper from the upper part of printer mechanical section so that the paper will come out from the front side.

④ Turn down (hold) the head-up lever.

⑤ Perform feeding to check it whether paper is fed correctly.
Printing paper: A09075 (ordering article number)
                   5 rolls/carton (can be ordered by one carton)
                   Roll paper with revoluting thermal face: 30m long
                   Paper width: 114mm

Note: Do not use the paper other than the specification paper.

(2) Hard copy output via the external plotter

① Procedure
- Using I/O of the ADVANCE FUNCTION mode, make sure that PLOTTER is selected.
- Make sure that the plotter is set to the LISTEN ONLY mode.
- Plotter output starts by pressing the PRINT/PLOT ☐ key.

 CAUTION

Plotter producing hard copy outputs can't be controlled through GPIB.

---

② Applicable plotters
R9833 (ADVANTEST)
HP7470A (HP)
HP7475A (HP)

③ Selecting the tracing pen
The following table shows pen number and description of the plotter output.

Pen number	Usage
1	Character strings
2	Window display (including characters in the window)
3	Bar, signal frame and window frame
4	Waveforms
5	Dual waveforms
6	Marker
7	Cursor

2.12.3 Printer

The embedded thermal printer has the following two modes to set the print style of waveforms.

Short: This mode outputs waveform at the resolution set on the screen.

Long: This mode outputs waveforms at an internal data resolution.
A waveform output form would be up to 3 m in a certain setting.

2.12.4 Buzzer

Switches whether on or off the key input tone or input disable tone.
ON: Sounds the key input tone or input disable tone when a key is pressed.
OFF: Does not sound the tone.

2.12.5 SCRAMBL

Makes a setting so that Q8490 controls or does not control Q8163 (external polarization scrambler).
ON: Q8490 controls Q8163.
OFF: Q8490 does not control Q8163.

< Procedure >

① Set Q8163 to be in the listen-only mode.

② Connect Q8163 and Q8490 with the GPIB cable.

③ Press the menu key. Then, select SCRAMBL in the window and set it to "ON".

MEMO ✐

3. GPIB: REMOTE CONTROL

3.1 General

Q8490 can operate in the remote control mode via the standard IEEE-488-1979 measuring bus GPIB (General-Purpose Interface Bus).

3.1.1 Outline of GPIB

GPIB is an interface system that can configure an automatic measuring system by simply connecting the measuring instrument with controllers and peripheral devices using the bus cable. GPIB is an interface system that can configure an automatic measuring system by simply connecting the measuring instrument with controllers and peripheral devices using the bus cable. When compared with the conventional interfacing, GPIB provides the much higher flexibility in system expansion. Also it provides the electrical, mechanical, and functional compatibility with the products of different manufacturers. A full lineup from the very simple system to the system having the highest functions can be configured by using a single bus cable.

For the GPIB system, each device connected via the bus lines must be assigned a different address. Each device can have one or more of controller, talker and listener functions.

Only one talker can send data onto the bus lines, and multiple listeners can receive the data.

The controller addresses the talker and listeners so that the data can be transferred from the talker to the listeners. Also, the controller (talker) can set the measuring conditions for the listeners.

The bit parallel and byte serial eight data lines are provided for data transfer between system devices. Data is transferred asynchronously in both directions. Because the system is asynchronous, both the high-speed and low-speed devices can be mixed.

The data (messages) to be transferred between devices are the measuring data and measuring conditions (programs), and various commands. ASCII codes for data are used.

In addition to 8 data lines, 3 handshaking lines are provided to control asynchronous data transfer between devices. Also, 5 control lines are provided to control information flow between the handshaking lines and the buses.
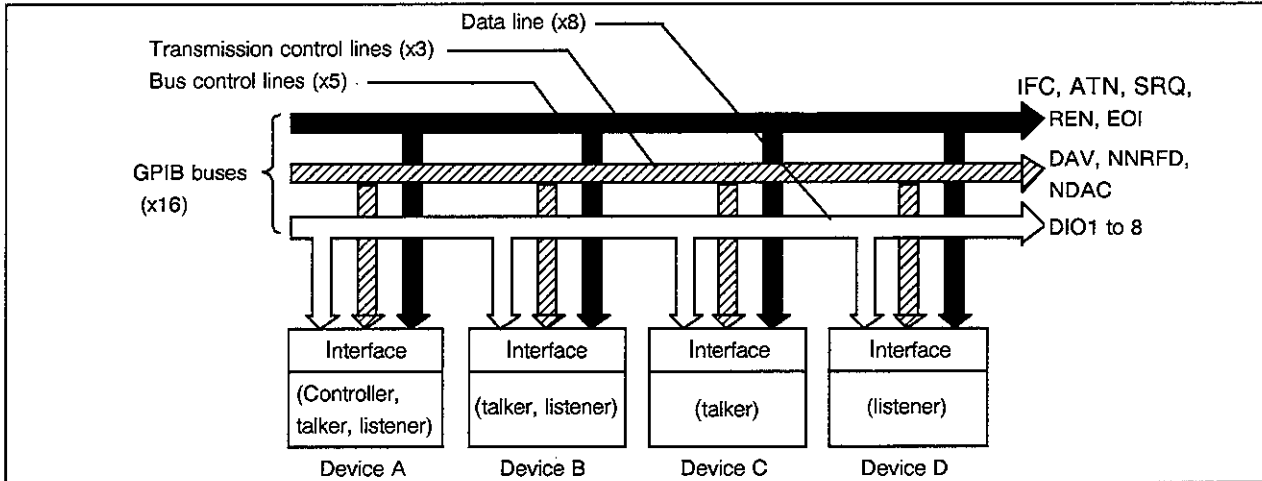
Figure 3-1   GPIB Bus Lines

● The following signals are transferred via the handshaking lines:

DAV (Data Valid): The signal indicating the data validity.
NRFD (Not Ready For Data): The signal indicating the data receive ready status.
NDAC (Not Data Accepted): The signal indicating the end of data receive status.

● The following signals are transferred via the control lines:

ATN (Attention): The signal used to indicate that the signals on the data line are address or command or any other information.
IFC (Interface Clear): The signal which clears interfacing.
EOI (End of Identify): The signal used to indicate the end of information transfer.
REN (Remote Enable): The signal for remote control of a device that can be programmed for remote control.

3.1.2 GPIB Standards and Specifications

Standard: IEEE488-1978
Codes used: ASCII codes, or binary codes if the packed format is used.
Logical level: Logical 0 (high) at +2.4VDC or more
Logical 1 (low) at +0.4VDC or less
Driver specifications: Open collector form (except EOI and DAV)
Logical low at +0.4VDC or less, 48mA
Logical high at +2.4VDC or more, -5.2mA
Receiver specifications: Logical low at +0.6VDC or less
Logical high at +2.0VDC or more
Addressing: Up to 31 kinds of talk or listen addresses can be set by using the ADDRESS switch.
Cable length: The total length of bus cables is limited as the following:
(Number of devices connected to the bus) x 2m and less than 20m

Connector: 24-pin GPIB connector 57-2024-D35A (Amphenol or equivalent)

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
DIO8	16
DIO7	15
DIO6	14
DIO5	13

Pin No.	Signal name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO4
3	DIO3
2	DIO2
1	DIO1
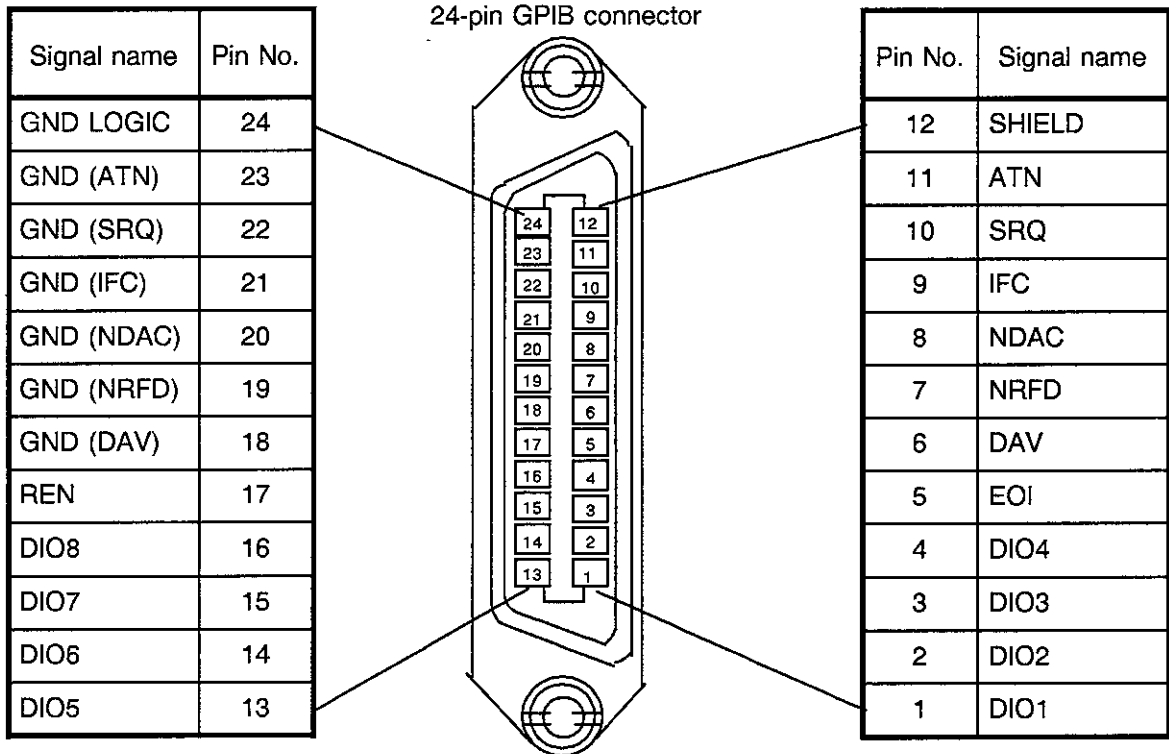
Figure 3-2 GPIB Connector

Inter face functions: See Table 3-1 below.

Table 3-1 Interface Functions

Code	Function and Explanation
SH1	Source handshaking function
AH1	Acceptor handshaking function
T5	Basic talker function, serial polling function, talker only function, and talker release function by specifying the listener
L4	Basic listener function, and listener release function by specifying the talker.
SR1	Service request function
RL1	Remote control function
PRO	Without parallel function
DCO	Device clear function
DTO	Without device trigger function
CO	Without controller function
E2	Tristate output

3.1.3 Connecting System Devices

As a GPIB system is configured by various devices, the following notes should be followed during preparation:

(1) Check the normal status (for preparation) and operation of the connected devices referring to the instruction manuals of the controller and peripheral devices.

(2) Avoid using excessive length of bus cables when connecting the measuring instrument and controller. The length of bus cable should not exceed the following limit:
(Number of devices connected to the bus) x 2m and less than 20m
The following standard bus cables are provided as optional.

Table 3-2 Standard Bus Cables (optional)

Length	Cable name	Parts No.
0.5 m	408JE-1P5	DCB-SS1076X01-1
1 m	408JE-101	DCB-SS1076X02-1
2 m	408JE-102	DCB-SS1076X03-1
4 m	408JE-104	DCB-SS1076X04-1

(3) The bus cable has piggy-back connectors. A single connector has male and female connectors and they can be used as a pair. However, do not use 3 or more connectors as a pair.
The connector must be secured by using the tightening screws.

(4) Check the power conditions, grounding and setup conditions of each device before turning its power supply on.
The power supply of all devices connected to the bus must be turned on. If not, the entire system operation is unreliable.

3.1.4 Sections Referring to GPIB on Operation Panel
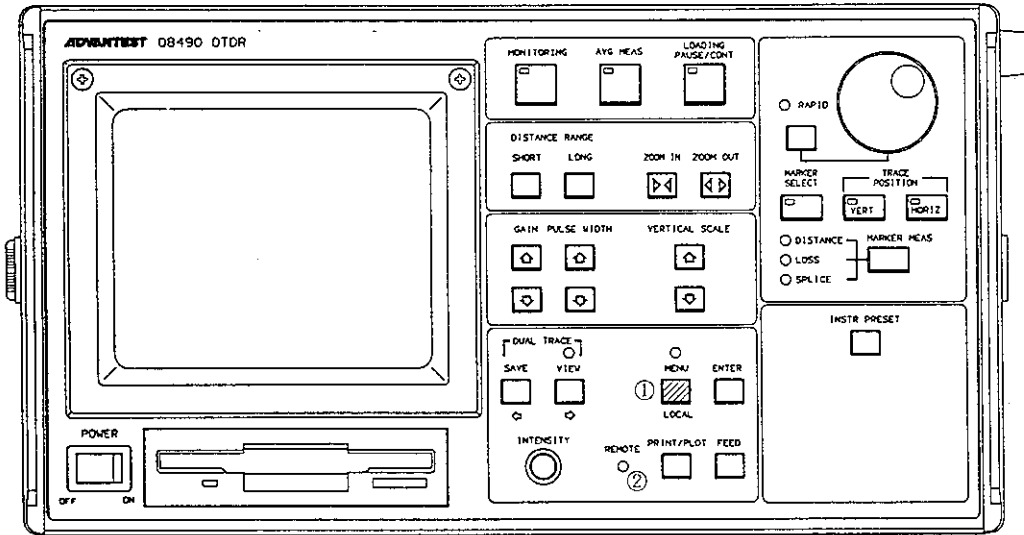
① MENU / LOCAL Key

Releases the remote control mode if Q8490 is in the remote control mode (the REMOTE LED is on). In the local mode, the key input on the front panel is made valid.

When the system power supply is turned on, the local mode is selected automatically.

② REMOTE LED

Kept on when Q8490 is controlled by an external controller in the remote control mode.

In the remote control mode, the key input on the front panel is made invalid.

③ GPIB address setting

The setting of the GPIB address can be changed by the ADVANCE FUNCTION mode.

Press the MENU key and select the ADVANCE FUNCTION mode, then select I/O.

Select the GPIB address by turning the data knob.

--- CAUTION ---

This unit will enter the TALK ONLY mode if you select I/O following setting of the ADVANCE FUNCTION mode using the MENU key and then select PLT (plotter output) from HDCOPY (hardcopy).

To operate this unit in the ADDRESSABLE mode, therefore, change PLT over to PRT (printer output).

3.2 Service Request

When the Q8490 system is set to the S0 mode and when each bit of the status byte is set to 1, Q8490 sends a service request to the controller.
The system sends the status byte after serial poling from the controller.

< Status byte >

8	7	6	5	4	3	2	1
0			0	0	0		

Logical 1 is set at the end of measurement.

Logical 1 is set if a syntax error occurs.

Logical 1 is set at the end of averaging.

Request Service (RQS)
1 is set if one or more of bits 1, 2 and 6 is set to logical 1.
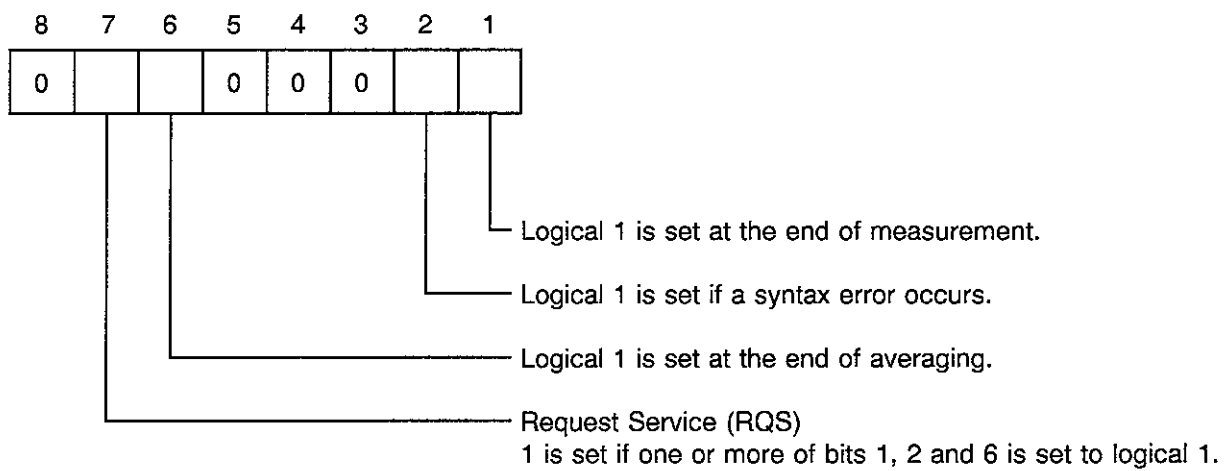
3.3 GPIB Talker Format

Issue the read command to output the GPIB talker format. The following two types of outputs are used according to the read command it has been issued.

① Binary output
Available commands:

    1 byte per data: RDTB, RMDB, RADB
    2 bytes per data: RDTW, RMDW, RADW
    4 bytes per data: RDTL, RMDL, RADL

Format:

Header	Data 1	Data 2		Data N	BD

Header: 6-byte ASCII data to be set by using the Hn command.
              It is output only when the header output is set to ON (see Paragraph 8) in Subsection 3.3.1).
Data: See the related read command.
BD: Block delimiter to be set by using the DLn command.

② ASCII output
If multiple data sets are used:

Header	Data 1	SD	Data 2	SD		SD	Data N	BD

If a single data set is used:

Header	Data 1	BD

Multiple data sets or a single data set can be used depending on the specified read command. See the related read command section.

Header: 6-byte ASCII data to be set by using the Hn command.
              It is output only when the header output is set to ON.
SD: String delimiter to be set by using the SLn command.
              (See Paragraph 7) in Subsection 3.3.1.)
BD: Block delimiter to be set by using the DLn command.
              (See Paragraph 6) in Subsection 3.3.1.)

3.3.1 GPIB Setting Commands

The following lists the GPIB setting commands and provides their detailed explanation.

Table 3-3 GPIB Setting Command List (1 of 2)

	Command	Function	Page
①	C	Clear	3-9
②	Z	Clears as initial setting	3-10
③	Sn	Issue or no issue of service request	3-11
④	SMKn	Mask setting of service request	3-11
⑤	CS	Clears the status byte	3-11
⑥	DLn	Selects the delimiter mode	3-12
⑦	SLn	Selects the string delimiter mode	3-13
⑧	Hn	Display or no display of header	3-13
⑨	MON	Selects the monitoring mode	3-14
⑩	AVG	Selects the averaging mode	3-14
⑪	PSE	Sets the pause state/loading mode	3-14
⑫	IDXn	Sets an index	3-14
⑬	DRn	Sets the distance range	3-14
⑭	GANn	Sets the gain	3-15
⑮	SSPn	Sets the horizontal span	3-15
⑯	SSTn	Sets the horizontal position	3-16
⑰	VSLn	Sets the vertical scale	3-16
⑱	VPSn	Sets the vertical position	3-16
⑲	PWn	Sets the pulse width	3-16
⑳	KNBn	Selects the rapid mode	3-17
㉑	TST	Saves the dual trace waveforms	3-17
㉒	TVWn	Display or no display of dual trace waveforms	3-17
㉓	LSSn	Selects a marker (STANDARD of ADVANCE FUNCTION)	3-17

(2 of 2)

	Command	Function	Page
㉔	MKAn MKBn MKCn	Sets a marker	3-18
㉕	MSTn	Saves the waveform memory	3-18
㉖	MRCn	Recalls the waveform memory	3-18
㉗	MDLn	Deletes the waveform memory	3-18
㉘	LBLn	Sets a label	3-19
㉙	PFD	Printer feeding	3-19
㉚	PRT	Print out	3-19
㉛	PRMn	Sets the printer mode	3-19
㉜	CLOCKn	Sets a clock	3-19
㉝	SAVGn	Sets the number of averaging times	3-19
㉞	AVMn	Sets the display mode of averaging	3-20
㉟	BZn	Turns the buzzer on or off	3-20
㊱	FLTn	Sets the filtering	3-20
㊲	LDMn	Sets the loading mode	3-20

① C

Function: Clears the system to the initial status that is the same as when its power supply is turned on.

Parameter: None

Explanation: The present setup state (such as pulse width and distance range) does not change. The system is set to the following status:

Item	Status
MONITOR/AVERAGE	MONITOR
PAUSE	ON
DUAL TRACE function	OFF
MENU	OFF

② Z

Function: Clears the system to its initial status.

Parameter: None

Explanation: The system is set to the following status:

GPIB "Z" Command

Item	State
MEASURING MODE	MONITORING PAUSE
LABEL	Q8490 OTDR
CLOCK	NOT CHANGE
DISTANCE RANGE	1000km
SPAN	1000km
HORIZONTAL START DISTANCE	0km
VERTICAL SCALE POSITION	5dB/DIV
VERTICAL POSITION	0 to -40dB
PULSE WIDTH	$10\mu s$
INDEX	1.5000
GAIN	ALC ON (GAIN3)
DISK FUNCTION FILE NAME	00000000.DSP
DISK FUNCTION DATA TYPE	DSP, BINARY
DISK FUNCTION INFORMATION	CLEAR
INTERNAL MEMORY DATA	CLEAR
DUAL TRACE FUNCTION	OFF
DUAL TRACE WAVEFORM	CLEAR
AVERAGE TIMES	256
BUZZER	ON
GPIB ADDRESS	NOT CHANGE
HDCOPY	PRINTER
FILTER	NORMAL
DATA KNOB RAPID	OFF
MARKER	DISTANCE
PRINTER	SHORT
AVG EXECUTION PROCESSING DISPLAY	TIME

③ Sn

Function: Issues a service request.
Parameter:

n = 0	Issues a service request.
n = 1	Does not issue a service request.

Explanation: The Sn command issues a service request if the S0 mode has been selected (as described in Section 3.2).
An initial value n is 1.

④ SMKn

Function: Masks the service request.
Parameter: n = 0 to 127
Explanation: This command masks the status byte. Once masked, a service request of the masked bit is ignored. Parameter "n" is a decimal value.

Example: If n is 3, status bytes 1 and 2 are masked.

8	7	6	5	4	3	2	1
0	0	0	0	0	0	1	1
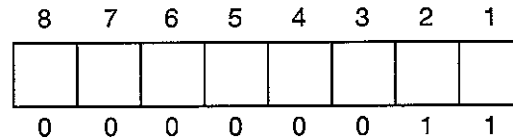
⑤ CS

Function: Clears the status byte.
Parameter: None
Explanation: This command clears a bit if its status has been set to 1.

Jul 15/95

⑥ DLn

Function: Selects the delimiter mode.

Parameter:

n = 0	CR/LF + EOI
n = 1	LF only
n = 2	EOI only

Explanation: This command indicates the end of data.

Header	Data	SD	Data	SD	Data	SD

Header	Data	BD

The specified block delimiter is added regardless of the number of data settings (single or multiple) or the output format (binary or ASCII).

DL0: CR/LF + EOI

DL1: LF only

DL2: EOI only

An initial value is DL0.

⑦ SLn

Function: Selects the string delimiter mode.
Parameter:

n = 0	" , "
n = 1	⊔ (space)
n = 2	CRLF

Explanation: An output request is issued by the read command. If its output format is ASCII and multiple data sets are used, the delimiters are added to the output data.

Header	Data	SD	Data	SD	Data	BD

A delimiter between data sets: A block delimiter is added as follows:
SL0: , (comma)   DL0: CR/LF + EOI
SL1: ⊔ (space)   DL1: LF only
SL2: CRLF   DL2: EOI only
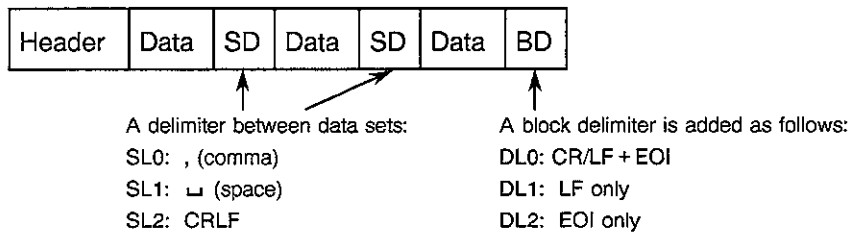
An initial value is SL0.

⑧ Hn

Function: Display or no display of header.
Parameter:

n = 0	OFF
n = 1	ON

Explanation: If an output request is issued by the read command and if the header display mode is selected (ON), this command adds a 6-byte ASCII data to the beginning of the output data as the header. The read command is added as it is.

Header	Data	··········	BD

6-byte ASCII data
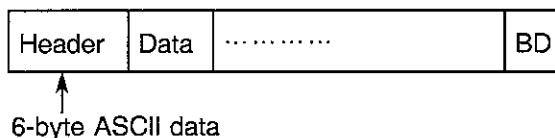
If the header display mode is off, nothing is added to data. It is added if the header display mode is on regardless of the ASCII or binary output format.
An initial value is H0.

⑨ MON

Function:	Selects the monitor mode.
Parameter:	None
Explanation:	Selects the monitor mode in the specified conditions. Some parameters can be changed only in the monitor mode.

⑩ AVG

Function:	Selects the averaging mode.
Parameter:	None
Explanation:	• Starts averaging in the setup conditions.
	• Averaging continues after pause by Average Pause.
	• If you increase the number of averaging times and issue this command at the end of previous averaging, additional averaging starts.

⑪ PSE

Function:	Selects the PAUSE mode.
Parameter:	None
Explanation:	This command pauses operation in the average mode or the monitor mode.

⑫ IDXn

Function:	Sets an index (refractive index) value.
Parameter:	$1.4000 \leq n \leq 1.6000$
Explanation:	This command sets the refractive index.

⑬ DRn

Function:	Selects the distance range.
Parameter:	

n = 1	1000 km	n = 6	6000 km
n = 2	2000 km	n = 7	7000 km
n = 3	3000 km	n = 8	8000 km
n = 4	4000 km	n = 9	9000 km
n = 5	5000 km	n = 10	10000 km

Explanation:	• Distance range can be set only in the monitor mode.
	• Selects a distance range longer than the optical fiber length. If not, a multipath reflection may occur and the measurement may fail.

⑭ GANn

Function: Selects the GAIN.
Parameter:

n = 0	GAIN 0
n = 1	GAIN 1
n = 2	GAIN 2
n = 3	GAIN 3
n = 99	ALC: ON

Explanation: GAIN can be selected only in the monitor mode.
              When n is 1, 2, or 3, ALC becomes OFF.

⑮ SSPn

Function: Changes the horizontal span.
Parameter:

Parameter (n)	0	1	2	3	4	5	6	7	8
Span (km)	5	10	20	50	100	200	500	1000	2000

Parameter (n)	9	10	11	12	13	14	15	16
Span (km)	3000	4000	5000	6000	7000	8000	9000	10000

Explanation: Scaling up or scaling down of the span depends on the display status and its
              distance range.

CAUTION
---

1. The span cannot be scaled up or scaled down for the waveforms recalled from memory.
2. The span is scaled up or scaled down with the marker position as the center.

⑯ SSTn

Function: Sets the horizontal position.

Parameter: n = 0 to 10000

Explanation: This command sets the start point on the distance axis (horizontal position) in kilometer.

The horizontal position may not be set by using the distance range, span, or index value.

Although a decimal value can be set, the expected result may not be obtained due to the limited resolution of internal data or an error of index.

⑰ VSLn

Function: Sets the vertical axis scale.

Parameter: < In case of the backscatter mode >

	Vertical Scale
n = 0	5 dB/DIV
n = 1	2
n = 2	1
n = 3	0.5

⑱ VPSn

Function: Sets the upper limit of the vertical position.

Parameter: n = -30 to 15

Explanation: ● This command sets the vertical axis position in units of dB.

⑲ PWn

Function: Sets the pulse width.

Parameter:

n = 0	n = 1	n = 2	n = 3
3 μs	10 μs	30 μs	100 μs

Explanation: Pulse width can be set only in the monitor mode.

⑳ KNBn

Function: Selects the RAPID mode of the data knob to ON or OFF.
Parameter:

n = 0	OFF
n = 1	ON

㉑ TST

Function: Saves the waveform data in the dual trace memory.
Parameter: None
Explanation: This command saves only the waveform data in the dual trace memory. If data already exists in this memory, it is overwritten by new waveform data. The previous data is erased. When the system power supply is turned off, all data is erased from memory.

㉒ TVWn

Function: Displays the dual trace or suppresses to display it.
Parameter:

n = 0	OFF
n = 1	ON

Explanation: This command specifies the display or no display of save data of the dual trace memory by using the TST command.

㉓ LSSn

Function: Sets the marker function.
Parameter:

n = 0	DISTANCE
n = 1	LOSS
n = 2	SPLICE

㉔ MKAn, MKBn, MKCn

    Function: MKA moves marker 1.

                       MKB moves marker 2.

                       MKC moves marker 3.

    Parameter: $n = 0$ to 500

    Explanation: Set 0 to the leftmost end of the screen and 500 to the rightmost end of that. The distance on the horizontal axis is not affected.

㉕ MSTn

    Function: Saves the waveform data and the setup conditions in the internal memory.

    Parameter: $n = 1$ to 32

    Explanation: This command saves both the waveform data and setup conditions in the internal memory. If data already exists in the selected file number, the existing data is overwritten with the new data.

                       For memory function details, see SAVE mode of Subsection 2.10.1.

㉖ MRCn

    Function: Recalls the waveforms and setup conditions from memory.

    Parameter: $n = 1$ to 32

    Explanation: For memory function details, see RECALL mode of Subsection 2.10.2.

㉗ MDLn

    Function: Deletes waveform data from memory.

    Parameter: $n = 1$ to 32

    Explanation: This command deletes data from the specified No. of the file. For memory function details, see DELETE mode of Subsection 2.10.3.

㉘ LBLn

    Function: Enters a label.

    Parameter:n = " # label # "

                 ↑   ↑

              Special characters

    Explanation: This command enters a character string enclosed by a pair of special characters. Up to 23 characters can be entered. The characters are entered as they are from the begging of the leftmost end position.

㉙ PFD

    Function: Feeds forms on the built-in printer.

    Parameter: None

    Explanation: This command feeds forms on the built-in printer.

㉚ PRT

    Function: Prints data on the built-in printer.

    Parameter: None

    Explanation: You must set the I/O as the printer. If the plotter output has been set, no GPIB control is supported.

㉛ PRMn

    Function: Sets the output mode of the built-in printer.

    Parameter:

n = 0	short
n = 1	long

㉜ CLOCKn

    Function: Sets the date and clock time.

    Parameter: Example: To set 20:45 on December 25, 1994, enter as follows:

                 n = 1994, 12, 25, 20, 45

㉝ SAVGn

    Function: Sets the number of averaging times.

    Parameter:

Parameter	0	1	2	3	4	5	6
Count	16	32	64	128	256	512	1024

Parameter	7	8	9	10	11	12
Count	2048	4096	8192	16384	32768	65536

㉞ AVMn

Function: Sets the display mode of averaging.

Parameter:

$n = 0$	time	elapsed time
$n = 1$	%	ratio of numbers
$n = 2$	No.	executed numbers

㉟ BZn

Function: Turns the buzzer on or off.

Parameter:

$n = 0$	OFF
$n = 1$	ON

Explanation: This command turns the buzzer sound mode on or off. The valid and invalid GPIB command input can be identified by the buzzer sound.

㊱ FLTn

Function: Executes filtering for the waveform which is sampled.

Parameter:

$n = 0$	Normal mode
$n = 1$	Wide dynamic range mode

Explanation: Filtering process differs depending on the pulse width and the span.

㊲ LDMn

Function: Sets the loading mode.

Parameter:

$n = 0$	Measuring mode
$n = 1$	Loading mode

Explanation: When the loading mode is set, operation is paused.

3.3.2 GPIB Read Commands

The following lists the GPIB read commands and provides their detailed explanation.

Table 3-4   GPIB Read Command List (1 of 2)

	Command	Function	Page
①	RDTB	Outputs the on-screen data (binary 1 byte per data).	3-22
②	RDTW	Outputs the on-screen data (binary 2 bytes per data).	3-23
③	RDTL	Outputs the on-screen data (binary 4 bytes per data).	3-23
④	RDTS	Outputs the on-screen data (ASCII 8 bytes per data).	3-23
⑤	RMDB	Outputs the dual trace memory data (binary 1 byte per data).	3-24
⑥	RMDW	Outputs the dual trace memory data (binary 2 bytes per data).	3-24
⑦	RMDL	Outputs the dual trace memory data (binary 4 bytes per data).	3-25
⑧	RMDS	Outputs the dual trace memory data (ASCII 8 bytes per data).	3-25
⑨	RADB	Outputs all internal data (binary 1 byte per data).	3-26
⑩	RADW	Outputs all internal data (binary 2 bytes per data).	3-26
⑪	RADL	Outputs all internal data (binary 4 bytes per data).	3-27
⑫	RADS	Outputs all internal data (ASCII 8 bytes per data).	3-27
⑬	RDTC	Reads the number of on-screen data.	3-28
⑭	RMDC	Reads the number of dual-trace memory data.	3-28
⑮	RADC	Reads the total number of internal data and the distance between start and end points.	3-28
⑯	RGAN	Reads the gain.	3-28
⑰	RVSL	Reads the vertical scale.	3-29
⑱	RVPS	Reads the vertical position.	3-29
⑲	RHPS	Reads the horizontal position.	3-29
⑳	RSP	Reads the horizontal span.	3-29
㉑	RDR	Reads the distance range.	3-30

(2 of 2)

	Command	Function	Page
㉒	RLSS	Reads the marker type.	3-30
㉓	RMKA	Reads data of Marker-1.	3-30
㉔	RMKB	Reads data of Marker-2.	3-30
㉕	RMKC	Reads data of Marker-3.	3-31
㉖	RRDO	Reads data from the window.	3-31
㉗	RPW	Reads the pulse width.	3-32
㉘	RLBL	Reads the label.	3-32
㉙	RIDX	Reads the index.	3-32
㉚	RCLOCK	Reads the date and time.	3-32
㉛	RSAVG	Reads the number of averaging times.	3-33
㉜	RALC	Reads the ALC mode.	3-33

① RDTB

Function: Reads the on-screen data.

Explanation: Binary format output (1byte per data)

Header	Data 1	Data 2	Data 3	··	Data n	BD

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.
Data: 1-byte (0 to 255) binary data.
           The bottom of the screen is 0, and the top of the screen is 255.
           The specified number of data sets is read by the RDTC
           command.
BD: Block delimiter that can be selected by using the DLn command.

② RDTW

Function: Reads the on-screen data.

Explanation: Binary format output (2 bytes per data)

Header	Data 1	Data 2	Data 3	··	Data n	BD

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.

Data: 2-byte binary data
           The high-order 1 byte represents the integer part of data, and
           the low-order 1 byte is the decimal part. The specified number
           of data sets is read by using the RDTC command.

BD: Block delimiter that can be selected by using the DLn command.

③ RDTL

Function: Reads the on-screen data.

Explanation: Binary format output (4 bytes per data)

Header	Data 1	Data 2	Data 3	··	Data n	BD

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.

Data: 4-byte binary data
           The high-order 2 bytes represent the integer part of data, and
           the low-order 2 bytes are the decimal part.
           The specified number of data sets is read by using the RDTC
           command.

BD: Block delimiter that can be selected by using the DLn command.

④ RDTS

Function: Reads the on-screen data.

Explanation: ASCII format output (8 bytes per data)

Header	Data 1	SD	Data 2	SD	Data 3	SD	···	Data n	BD

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.

Data: 8-byte ASCII data
           The number of data sets is read by using the RDTC command.

SD: String delimiter which can be selected by using the SLn
           command.

BD: Block delimiter that can be selected by using the DLn command.

⑤ RMDB

Function: Reads data from the dual trace memory.
Explanation: Binary format output (1 byte per data)

| Header | Data 1 | Data 2 | Data 3 | · · | Data n | BD |

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.
Data: 1-byte (0 to 255) binary data
           The bottom of the screen is 0, and the top of the screen is 255.
           The number of data sets can be read by using the RMDC
           command.
BD: Block delimiter that can be selected by using the DLn command.

⑥ RMDW

Function: Reads data from the dual trace memory.
Explanation: Binary format output (2 bytes per data)

| Header | Data 1 | Data 2 | Data 3 | · · | Data n | BD |

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.
Data: 2-byte binary data
           The high-order 1 byte represents the integer part of data, and
           the low-order 1 byte is the decimal part. The number of data
           sets is read by using the RMDC command.
BD: Block delimiter that can be selected by using the DLn command.

⑦ RMDL

Function: Reads data from the dual trace memory.
Explanation: Binary format output (4 bytes per data)

Header	Data 1	Data 2	Data 3	··	Data n	BD

Header: 6-byte ASCII data
          It is output only when the header display mode has been turned
          on by using the Hn command.
Data: 4-byte binary data
          The high-order 2 bytes represent the integer part of data, and
          the low-order 2 bytes are the decimal part. The number of data
          sets is read by using the RMDC command.
BD: Block delimiter that can be selected by using the DLn command.

⑧ RMDS

Function: Reads data from the dual trace memory.
Explanation: ASCII format output (8 bytes per data)

Header	Data 1	SD	Data 2	SD	Data 3	SD	···	Data n	BD

Header: 6-byte ASCII data
          It is output only when the header display mode has been turned
          on by using the Hn command.
Data: 8-byte ASCII data
          The number of data sets is read by using the RMDC command.
SD: String delimiter which can be selected by using the SLn
          command.
BD: Block delimiter that can be selected by using the DLn command.

⑨ RADB

Function: Reads all internal data.
Explanation: Binary format output (1 byte per data)

Header	Data 1	Data 2	Data 3	··	Data n	BD

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.
Data: 1-byte (0 to 255) binary data
           The bottom of the screen is 0, and the top of the screen is 255.
           The number of data sets can be read by using the RADC
           command.
BD: Block delimiter that can be selected by using the DLn command.

⑩ RADW

Function: Reads all internal data.
Explanation: Binary format output (2 bytes per data)

Header	Data 1	Data 2	Data 3	··	Data n	BD

Header: 6-byte ASCII data
           It is output only when the header display mode has been turned
           on by using the Hn command.
Data: 2-byte binary data
           The high-order 1 byte represents the integer part of data, and
           the low-order 1 byte is the decimal part.   The number of data
           sets can be read by using the RADC command.
BD: Block delimiter that can be selected by using the DLn command.

⑪ RADL

Function: Reads all internal data.

Explanation: Binary format output (4 bytes per data)

Header	Data 1	Data 2	Data 3	··	Data n	BD

Header: 6-byte ASCII data

The high-order 2 bytes represent the integer part of data, and the low-order 2 byte are the decimal part.   The number of data sets can be read by using the RADC command.

Data: 4-byte binary data

The high-order 2 bytes represent the integer part of data, and the low-order 2 byte are the decimal part.   The number of data sets can be read by using the RADC command.

BD: Block delimiter that can be selected by using the DLn command.

⑫ RADS

Function: Reads all internal data.

Explanation: ASCII format output (8 bytes per data)

Header	Data 1	SD	Data 2	SD	Data 3	SD	···	Data n	BD

Header: 6-byte ASCII data

It is output only when the header display mode has been turned on by using the Hn command.

Data: 8-byte ASCII data

The number of data sets can be read by using the RADC command.

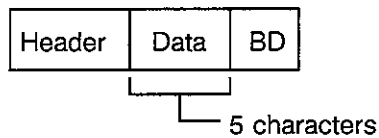SD: String delimiter which can be selected by using the SLn command.

BD: Block delimiter that can be selected by using the DLn command.

⑬ RDTC

Function: Reads the number of on-screen data sets.
Explanation: This command reads the number of on-screen data sets.
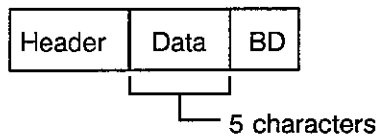   Talker format

Header	Data	BD

└─ 5 characters

⑭ RMDC

Function: Reads the number of data sets.
Explanation: This command reads the number of data sets from the dual trace memory.
              Talker format

Header	Data	BD

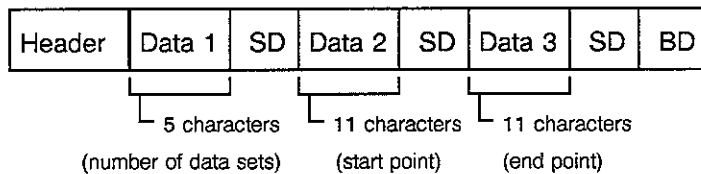└─ 5 characters

⑮ RADC

Function: Reads the number of data sets.
Explanation: This command reads the total number of internal data sets and the distance
              between start and end points of data in units of km.
              Command RADC
              Talker format

Header	Data 1	SD	Data 2	SD	Data 3	SD	BD

└─ 5 characters   └─ 11 characters └─ 11 characters
(number of data sets)   (start point)   (end point)

⑯ RGAN

Function: Reads the GAIN.
Explanation: This command reads the set GAIN.
              Talker format
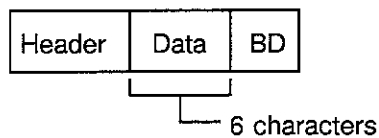
Header	Data	BD

└─ 6 characters

⑰ RVSL

Function: Reads the vertical position.

Explanation: This command reads the vertical axis position. The upper limit value is read.
Talker format

Header	Data	BD

└─────┘
└── 7 characters
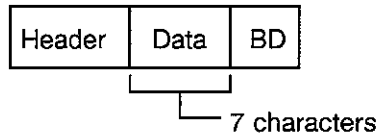
⑱ RVPS

Function: Reads the vertical position.
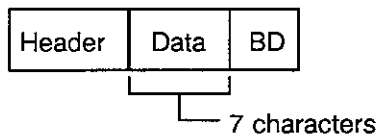
Explanation: This command reads the vertical axis position. The upper limit value is read.
Talker format

Header	Data	BD

└─────┘
└── 5 characters
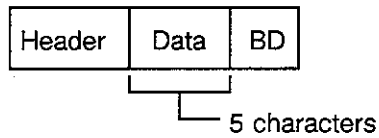
⑲ RHPS

Function: Reads the horizontal position.

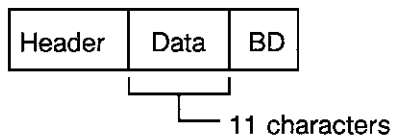Explanation: This command reads the specified distance position. The leftmost end value
on the screen is read.
Talker format

Header	Data	BD

└─────┘
└── 7 characters

⑳ RSP

Function: Reads the horizontal span.

Explanation: This command reads the specified horizontal span.
Talker format

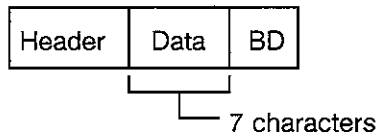| Header	Data	BD

└─────┘
└── 11 characters

㉑ RDR

    Function: Reads the distance range.

    Explanation: This command reads the distance range shown on the right upper end of the screen.
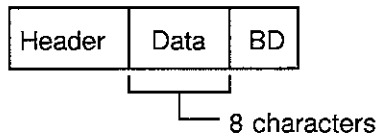
    Talker format

Header	Data	BD

                  7 characters

㉒ RLSS

    Function: Reads the marker type.

    Explanation: This command reads the specified marker function.

    Talker format

Header	Data	BD

                  8 characters

㉓ RMKA

    Function: Reads data of Marker-1.

    Explanation: This command reads data identified by the on- screen marker-1.

    Talker format

Header	Data 1	SD	Data 2	SD	Data 3	BD

        15 characters 13 characters 9 characters
          (M1)   (Distance)   (Loss)

㉔ RMKB

    Function: Reads data of Marker-2.

    Explanation: This command reads data identified by the on- screen marker-2.

    Talker format

Header	Data 1	SD	Data 2	SD	Data 3	BD

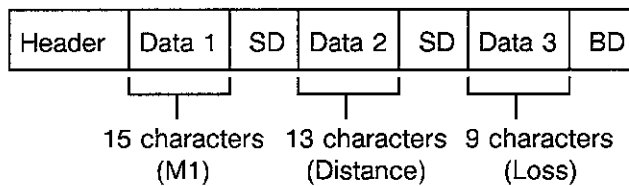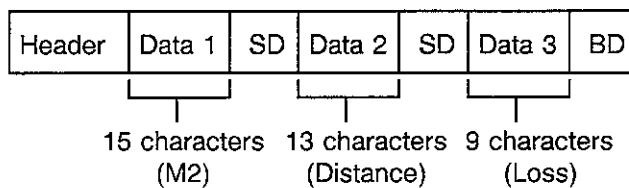   15 characters 13 characters 9 characters
          (M2)   (Distance)   (Loss)
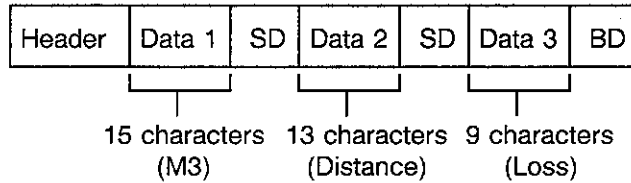
㉕ RMKC

Function: Reads data of Marker-3.

Explanation: This command reads data identified by the on- screen marker-3.

Talker format

Header	Data 1	SD	Data 2	SD	Data 3	BD

15 characters   13 characters   9 characters
(M3)   (Distance)   (Loss)

㉖ RRDO

Function: Reads data from the window.

Explanation: This command reads data identified by the on-screen marker.

Talker format

Header	Data 1	SD	Data 2	SD	·	SD	Data N	BD
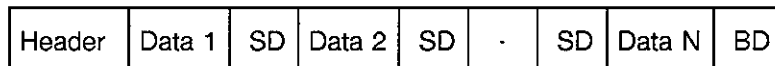
The following shows the number of characters of data 1 to data N.

STANDARD	Number of data	Number of characters	Contents
(DISTANCE)	1	15	Title
	2	13	Distance
	3	9	Loss
(LOSS)	1	15	Title
	2	13	Distance
	3	9	Loss
	4	14	Loss/Distance
(SPLICES)	1	15	Title
	2	9	Loss
	3	13	Distance

㉗ RPW

Function: Reads the specified pulse width.
Explanation: Talker format

Header	Data	BD

└─ 5 characters
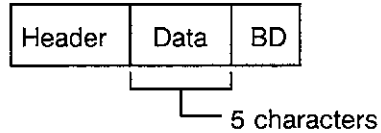
㉘ RLBL

Function: Reads the specified label.
Explanation: Talker format

Header	Data	BD

└─ 23 characters
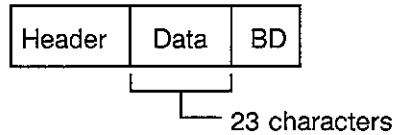
㉙ RIDX

Function: Reads the specified index.
Explanation: Talker format

Header	Data	BD

└─ 6 characters
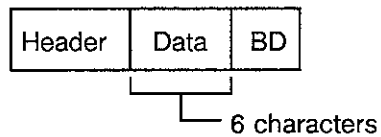
㉚ RCLOCK

Function: Reads the date and time.
Explanation: Talker format

Header	Data	BD

└─ 16 characters
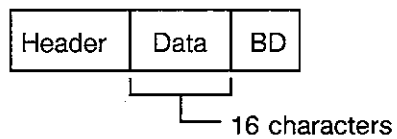
㉛ RSAVG
Function: Reads the specified number of averaging times.
Explanation: Talker format

Header	Data	BD

└─ 5 characters
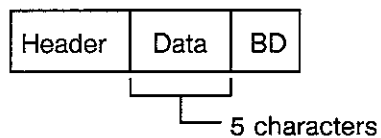
㉜ RALC
    Function: Reads the ALC mode.
    Explanation: Talker format

Header	Data	BD

└─── 7 characters
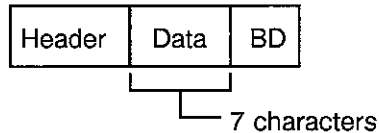
Data conversion equations

● In a two-bytes-per-one-data binary format output
   A byte in high order is output and then a byte in low order is output. A byte in high order represents the integer part of data, and a byte in low order represents the decimal part of data.

   < Conversion equation >

   Data = (a byte in high order) + (a byte in low order)/256 -256

● In a four-bytes-per-one-data binary format output
   Four bytes are output on a byte-by-byte basis from the highest order of them.
   Two bytes in high order represent the integer part of data, and two bytes in low order represent the decimal part of data. (A byte in the highest order, however, is not used substantially.)

   < Conversion equation >

   When A, B, C, and D are given in higher order, the equation is as follows:

   Data = B + C/256 + D/65536 - 256
   (A is not used.)

3.4 Programming Examples

The following gives programming examples when the PC9801 series controller is used.   (When N88BASIC is used.)

(1)   Program to set the measuring parameter.

```
1000 '
1010 ' EXAMPLE PROGRAM
1020 '
1030 '
1040  OTDR=11
1050 '
1060  ISET IFC
1070  ISET REN
1080 '
1090  PRINT @OTDR;"MON"
1100  PRINT @OTDR;"IDX1.4700"
1110  PRINT @OTDR;"DR2"
1120  PRINT @OTDR;"PW1"
1130 '
1140  END
```

Program description

No.	Explanation
:	
1040	Defines the unit address of 11.
:	
1060	Clears the interface.
1070	Enables remote control.
:	
1090	Sets the monitoring mode.
1100	Sets the index to 1.4700.
1110	Sets the distance range to 2000km.
1120	Sets the pulse width to $10\mu s$
:	

(2) Program to read the setting data.

```
1000 '          ·          ·
1010 ' EXAMPLE PROGRAM
1020 '
1030 '
1040 '
1050 '
1060  OTDR=11
1070 '
1080  ISET IFC
1090  ISET REN
1100 '
1110  PRINT @OTDR;"RPW"
1120  INPUT @OTDR;A$
1130 '
1140  PRINT @OTDR;"RLBL"
1150  INPUT @OTDR;B$
1160 '
1170  PRINT @OTDR;"RIDX"
1180  INPUT @OTDR;C$
1190 '
1200  PRINT A$,B$,C$
1210 '
1220  END
```

Program description

(1 of 2)

No.	Explanation
⋮	
1060	Defines the unit address of 11.
⋮	
1080	Clears the interface.
1090	Enables remote control.
⋮	
1110	Selects the pulse width read mode.
1120	Reads the pulse width in "A$".
⋮	

(2 of 2)

No.	Explanation
1140	Selects the label read mode.
1150	Reads the label in "B$".
⋮	
1170	Selects the index read mode.
1180	Reads the index in "C$".
⋮	
1200	Prints the pulse width, label, and index on the screen.

(3)   Reading the on-screen waveform in ASCII format.

```
1000 '
1010 ' EXAMPLE PROGRAM
1020 '
1030  DIM A$(501)
1040 '
1060  OTDR=11
1070 '
1080  ISET IFC
1090  ISET REN
1100 '
1110  NDATA=501
1120  CMD DELIM=0
1130  PRINT @OTDR;"DL0"
1140  PRINT @OTDR;"SL2"
1150  PRINT @OTDR;"RDTS"
1160 '
1170  FOR N=1 TO NDATA
1180    INPUT @OTDR;A$(N)
1190  NEXT N
1200 '
1210  FOR I=1 TO NDATA
1220    PRINT A$(I)
1230  NEXT I
1240 '
1250  END
```

Program description

No.	Explanation
⋮	
1030	Defines the buffer.
⋮	
1060	Defines the unit address of 11.
⋮	
1080	Clears the interface.
1090	Enables remote control.
⋮	
1110	Assigns the number of data sets to the variable.
1120	Sets the delimiter of the controller as CR + LF.
1130	Sets the block delimiter of the unit as CR + LF + EOI.
1140	Sets the string delimiter of the unit as CR + LF.
1150	Selects the waveform data read mode.
⋮	
1170	Specifies a loop for the number of data sets (501 levels).
1180	Reads 1 data.
1190	Loop
⋮	
1210	specifies a loop for the number of data sets (501 levels).
1220	Prints the data.
1230	Loop

(4) Reading the on-screen waveform data in 1 byte binary format.

(1 of 2)

```
1000 '
1010 ' EXAMPLE PROGRAM
1020 '
1030 '
1040   DIM A(501)
1050 '
1060   UNL=&H3F : UNT=&H5F : MTA=&H40 : MLA=&H20
1070   OTDR=11
1080   PC98=IEEE(1) AND &H1F
1090 '
1100   ISET IFC
1110   ISET REN
1120 '
1130   NDATA=501
1140   PRINT @OTDR;"DL2"
1150   PRINT @OTDR;"RDTB"
1160 '
1170   TALK=MTA+OTDR : LISTEN=MLA+PC98
```

```
1180  WBYTE UNL,TALK,LISTEN;
1190  '
1200  FOR N=1 TO NDATA
1210    RBYTE;RDT1
1220  '
1230    A(N)=RDT1
1240  NEXT N
1250  '
1260  FOR I=1 TO NDATA
1270    PRINT A(I)
1280  NEXT I
1290  '
1300  END
```

Program description

No.	Explanation
1040	Defines the buffer.
1060	Assigns the interface message code to the variable.
1070	Defines the unit address of 11.
1080	Reads the controller address and assigns it to the variable.
1100	Clears the interface.
1110	Enables remote control.
1130	Assigns the number of data sets to the variable.
1140	Sets the block delimiter as EOI only.
1150	Selects the waveform data read mode.
1170	Assigns the talker and listener addresses to the respective variables.
1180	Defines the unit as talker and the controller as listener.
1200	Specifies a loop for the number of data sets (501 levels).
1210	Reads 1 byte of data.
1230	Assigns the data to the buffer.
1240	Loop
1260	Specifies a loop for the number of the data sets (501 levels).
1270	Prints the data.
1280	Loop

(5) Reading the on-screen waveform data in 2 byte binary format.

```
1000 '
1010 ' EXAMPLE PROGRAM
1020 '
1030 '
1040  DIM A(501)
1050 '
1060  UNL=&H3F : UNT=&H5F : MTA=&H40 : MLA=&H20
1070  OTDR=11
1080  PC98=IEEE(1) AND &H1F
1090 '
1100  ISET IFC
1110  ISET REN
1120 '
1130  NDATA=501
1140  PRINT @OTDR;"DL2"
1150  PRINT @OTDR;"RDTW"
1160 '
1170  TALK=MTA+OTDR : LISTEN=MLA+PC98
1180  WBYTE UNL,TALK,LISTEN;
1190 '
1200  FOR N=1 TO NDATA
1210    RBYTE;RDT1
1220    RBYTE;RDT2
1230 '
1240    RDT=RDT1+(RDT2/256)-256
1250 '
1260    A(N)=RDT
1270  NEXT N
1280 '
1290  FOR I=1 TO NDATA
1300    PRINT A(I)
1310  NEXT I
1320 '
1330  END
```

Program description

No.	Explanation
:	
1040	Defines the buffer.
:	
1060	Assigns the interface message code to the variable.
:	
1070	Defines the unit address of 11.
1080	Reads the controller address and assigns it to the variable.
:	
1100	Clears the interface.
1110	Enables remote control.
:	
1130	Assigns the number of data sets to the variables.
1140	Sets the block delimiter as EOI only.
1150	Selects the waveform data read mode.
:	
1170	Assigns the talker and listener addresses to the respective variables.
1180	Defines the unit as talker and the controller as listener.
:	
1200	Specifies a loop for the number of data sets (501 levels).
1210	Reads 1 byte of data. (Integer part)
1220	Reads 1 byte of data. (Decimal part)
:	
1240	Converts the number of data to data.
:	
1260	Assigns the data to the buffer.
1270	Loop
:	
1290	Specifies a loop for the number of data sets (501 levels).
1300	Prints the data.
1310	Loop

(6) Reading the on-screen waveform data in 4 byte binary format.

```
1000 '          .        .
1010 ' EXAMPLE PROGRAM
1020 '
1030 '
1040  DIM A(501)
1050 '
1060  UNL=&H3F : UNT=&H5F : MTA=&H40 : MLA=&H20
1070  OTDR=11
1080  PC98=IEEE(1) AND &H1F
1090 '
1100  ISET IFC
1110  ISET REN
1120 '
1130  NDATA=501
1140  PRINT @OTDR;"DL2"
1150  PRINT @OTDR;"RDTL"
1160 '
1170  TALK=MTA+OTDR : LISTEN=MLA+PC98
1180  WBYTE UNL,TALK,LISTEN;
1190 '
1200  FOR N=1 TO NDATA
1210    RBYTE;RDT1
1220    RBYTE;RDT2
1230    RBYTE;RDT3
1240    RBYTE;RDT4
1250 '
1260    RDT=RDT2+(RDT3/256)+(RDT4/65536!)-256
1270 '
1280    A(N)=RDT
1290  NEXT N
1300 '
1310  FOR I=1 TO NDATA
1320    PRINT A(I)
1330  NEXT I
1340 '
1350  END
```

Program description

No.	Explanation
⋮	
1040	Define the buffer.
⋮	
1060	Assigns the interface message code to the variable.
⋮	
1070	Defines the unit address of 11.
1080	Reads the controller address and assigns it to the variable.
⋮	
1100	Clears the interface.
1110	Enables remote control.
⋮	
1130	Assigns the number of data sets to the variable.
1140	Sets the block delimiter for the EOI only.
1150	Selects the waveform data read mode.
⋮	
1170	Assigns the talker and listener addresses to the respective variables.
1180	Defines the unit as talker and the controller as listener.
⋮	
1200	Specifies a loop for the number of data sets (501 levels).
1210	Reads 1 byte of data. (The high order byte of integer part, Unused data.)
1220	Reads 1 byte of data. (The low order byte of integer part.)
1230	Reads 1 byte of data. (The high order byte of decimal part.)
1240	Reads 1 byte of data. (The low order byte of decimal part.)
⋮	
1260	Converts the number of data to data.
⋮	
1280	Assigns the data to the buffer.
1290	Loop
⋮	
1310	Specifies a loop for the number of data sets (501 levels).
1320	Prints the data.
1330	Loop

(7) Service request

```
1000 '
1010 ' EXAMPLE PROGRAM
1020 '
1030  OTDR=11
1040 '
1050  ISET IFC
1060  ISET REN
1070 '
1120 '
1130  ON SRQ GOSUB *SRQFUN
1140  SRQ ON
1150 '
1160  PRINT @OTDR;"CS"
1170  PRINT @OTDR;"S0"
1180  PRINT @OTDR;"SMK67"
1190  PRINT @OTDR;"AVG"
1200 '
1210 *LOOP1
1220   GOTO *LOOP1
1230 '
1240 *SRQFUN
1250   POLL OTDR, STS
1260   PRINT "AVERAGE COMPLETED"
1280   END
```

Program description

No.	Explanation
:	
1030	Define the buffer.
:	
1050	Clears the interface.
1060	Enables remote control.
:	
1130	Specifies the SRQ subroutine.
1140	Enables an SRQ reception.
:	
1160	Clears the status.
1170	Selects the service request send mode.
1180	Masks a cause except the end of averaging.
1190	Sets the function to the average level.
:	
1210	*LOOP
1220	Permanent loop
:	
1240	*SRQFUN
1250	Performs serial polling and assigns the status to the variable.
1260	Print characters.
1280	Stops the program.

4. SPECIFICATIONS
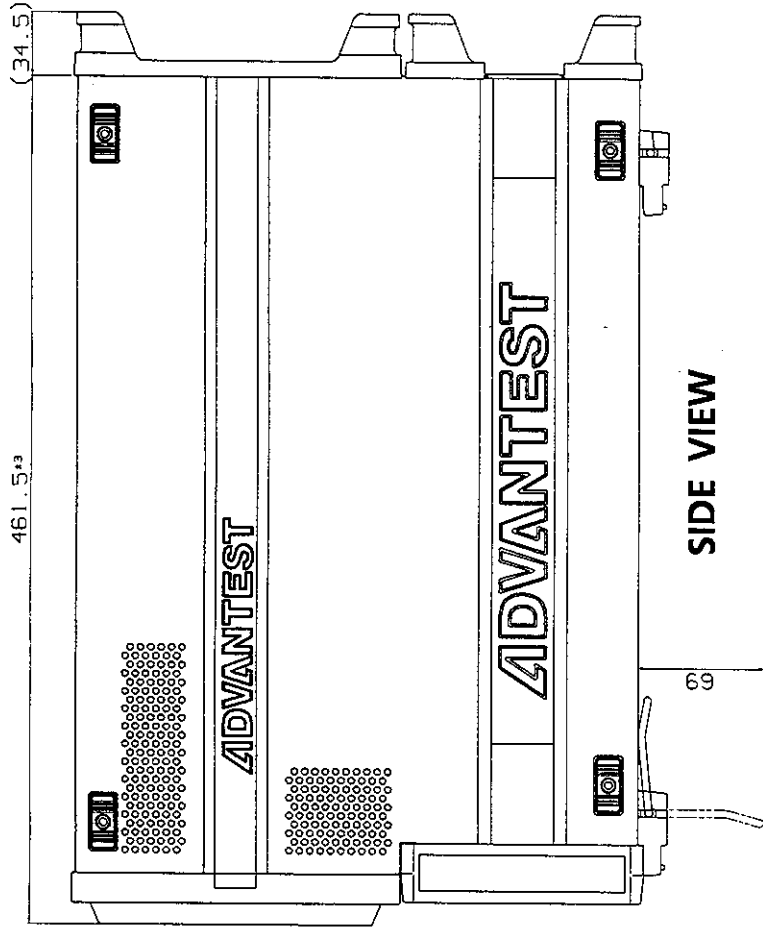
< Performance specifications >

Characteristic	Performance
Wavelength (signal light)	1558.5 nm, 1558.0 nm, 1559.0 nm
Optical output level	+ 3 dBm (variable between -3 dBm and + 5 dBm)
Pulse width/Resolution	3, 10, 30, 100 μs/300m, 1 km, 3km, 10 km
Dynamic range	7dB (Pulse width = 10 μs, ASE = -7 dBm/nm, BS level = -65 dBm, Averaging times = 2^{16}) 17dB (Pulse width = 10 μs, ASE = -27 dBm/nm, BS level = -65 dBm, Averaging times = 2^{16})

Maximum input level
     ASE total optical power
     Fresnel reflections optical power
	
	 + 4 dBm MAX
	 -25 dBm MAX

Dead zone	1.5 km

Distance axis
     Distance range
     Span
     Reading resolution
     Accuracy
	
	 10000 km MAX (1000 km step)
	 5; 10; 20; 50; 100; 200; 500; 1000; 2000; 5000; 10000 km
	 10m to 20 km
	 ± 50 m $\pm 5 \times 10^{-6} \times$ (measurement value) m
	 Exclusive of any error in refractive index setting

Vertical axis
     Scale
     Reading resolution
	
	 0.5 dB/div; 1 dB/div; 2 dB/div; 5 dB/div
	 0.001 dB

Averaging times
     Monitoring
     Averaging
	
	 2^8 times
	 Max 2^{24} times

Allowable range of index	1.4000 to 1.6000 (0.0001 step)
GPIB	IEEE488-1978
Printer	Built-in thermal printer
Floppy disk	3.5-inch FDD

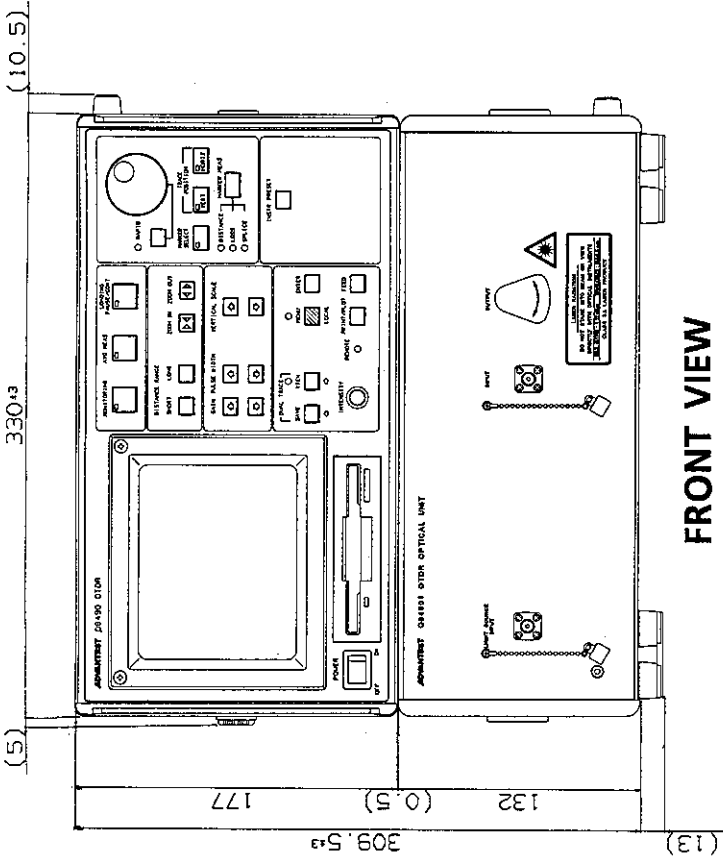< General specifications >

Characteristic	Performance
Source voltage 　　Main unit 　　Light source	90 VAC to 250 VAC 90 VAC or 250 VAC (Manual switch)
Power frequency	48 Hz to 66 Hz
Power consumption 　　Main unit 　　Light source	220 VA or less 140 VA or less
Operating ambient range	5°C to 40°C, relative humidity of 85% or less
Storing temperature range	0°C to 45°C
External dimensions 　　Main unit 　　Light source	Approx. 330 (width) × 320 (height) × 500 (depth) mm 350 (width) × 147 (height) × 415 (depth) mm
Mass 　　Main unit 　　Light source	22 kg or less 18 kg or less

(34.5)

461.5*3

SIDE VIEW

69

**Q8490 OTDR
EXTERNAL VIEW**

Unit: mm

(10.5)

330*3

(5)

FRONT VIEW

ADVANTEST Q8490 OTDR

ADVANTEST Q8490 OTDR OPTICAL UNIT

(13)   309.5*3

177   (0.5)   132

REAR VIEW

Q8490 EXT1-9606-B

ADVANTEST
ADVANTEST CORPORATION

LS-201B-AT

TUNABLE LASER DIODE LIGHT SOURCE

OPERATION MANUAL

Table of Power Cable options

There are six power cable options (refer to following table).
Order power cable options by Accessory Codes.

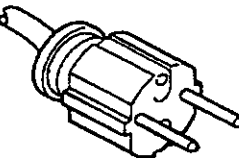|	Plug Configuration	Standards	Rationg, Color and Length	Accessory Codes (Option Number)
1		JIS: Japan Law on Electrical Appliances	125V at 7A Black 2m (6ft)	Straight: A01402 (Standard) Angled: A01412
2		UL: United States of America CSA: Canada	125V at 7A Black 2m (6ft)	Straight: A01403 (Option 95) Angled: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

PREFACE

Attention to Use this Unit Safely

1. Eye protection from laser beam

    This unit irradiates an invisible laser beam from the OPTICAL OUTPUT connector. Never try to see the connector with your eyes.

2. Cautions for high voltage

    This unit has high voltage section for CRT. Do not open the case.

CONTENTS

1. INTRODUCTION

1.1 SUMMARY

This equipment is external-cavity tunable semiconductor laser consist of a Fabry-Perot LD as gain media and a highly efficient interference band pass filter as a wavelength selector.

This equipment is characterized by the following features:

① High output power

② Wide tunable range

③ Sufficient suppression of spontaneous emission

④ Light and compact

⑤ Output power and wavelength stability

⑥ Low price

1.2 ACCESSORIES

Please checking quantity and norm about accessories according to table 1-1.

table 1-1. Standard accessories

items	quantity	note
power cable	1	
fuse, time lag type	2	T 1.25A, 250V
fuse, time lag type	2	T 0.63A, 250V
instruction manual	1	

1.3 POWER SUPPLY

(1) Connect the power cord after checking that the power voltage to use is correct.

$$
\begin{array}{llll}
\text{AC 100 V} & (\text{AC } 90 \sim 110 \text{ V,} & \text{fuse} & \text{T 1.25A }), \\
\text{AC 120 V} & (\text{AC 103} \sim 132 \text{ V,} & \text{fuse} & \text{T 1.25A }), \\
\text{AC 220 V} & (\text{AC 198} \sim 242 \text{ V,} & \text{fuse} & \text{T 0.63A }), \\
\text{AC 240 V} & (\text{AC 207} \sim 250 \text{ V,} & \text{fuse} & \text{T 0.63A })
\end{array}
$$

(2) If the power voltage to use is not correct, change it as follows:

1. Pull the plug of the power cord from the power outlet.

2. Remove the fuse holder in the rear panel using a standard screwdriver.

3. Check the fuse referring to LINE VOLTAGE RANGE on rear panel.

4. Set the label of your line voltage to the mark ' ▼ ' and plug the fuse holder back into place.

(3) In case the fuse has blown, find out the cause. If the fuse itself is the cause, replace it as follows:

1. Pull the plug of the power cord from the power outlet.

2. Remove the fuse holder in the rear panel using a standard screwdriver.

3. Take out the blown fuse.

4. Check a new fuse referring to LINE VOLTAGE RANGE on rear panel, and insert the fuse into the fuse holder.

5. Set the label of your line voltage to mark ' ▼ ' then plug the fuse holder containing the new fuse into the rear panel.

WARNING : The protective earth grounding on this equipment must be maintained to provide protection from electric shock.

1.4 ENVIRONMENT AND PRECAUTION FOR USE

(1) Do not use at following places:

1. Dusty place, sunny place or vibratory place.
2. The place that corrosive gas exists.

(2) This equipment has cooling fan in rear panel for adjust the inside temperature.

Give care to surrounding ventilation and these openings must not be blocked or covered.

(3) This equipment builds in a precision mechanism. So horizontal use only is available.

And do not put anything on this equipment.

(4) Operation temperature range is 10-35 ℃ . But recommending use at 15-30 ℃ because of specification temperature is 15-30 ℃ .

(5) Age the equipment for more than 30 minutes until the operation becomes stable.

And further in the cold region, press the power switch after checking this equipment is warmed at room temperature(10-30 ℃).

(6) In case of transport, use packing materials when this equipment is delivered.
If there is no packing materials, prepare the box that has about 10cm space against this equipment dimensions and pack with sufficient cushion.

(7) In case of carrying this equipment, hold both side handles.
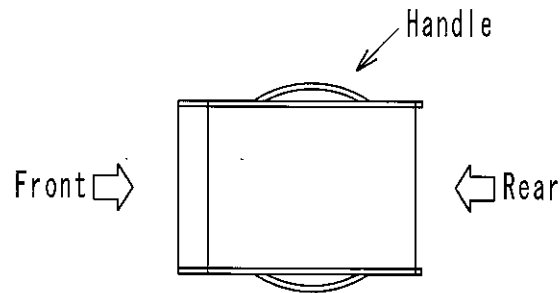
Caution : The center of gravity of this equipment is at the rear side.　take care in case of carying.

(8) If the optical connector is dirty, the optical loss will increase and the optical reflection will occur.

Connect the optical connector after cleaning.

And further clean the optical connector in this equipment in case the optical loss becomes large or the optical power stability becomes bad.

< CLEANING PROCEDURES >

① Loosen screw (1,2) and remove them.
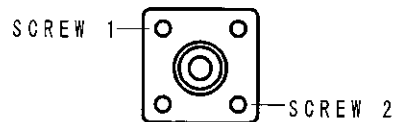
② Pulling out optical output parts about 5cm. Take notice of not be broken the inside optical fiber.
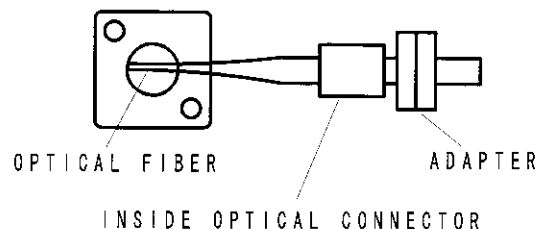
③ Removing an adapter and cleaning the inside optical connector.

④ Fix the optical connector to the adapter and put back slowly.

⑤ Tighten up screws (1,2) and fix them.

(9) This equipment belongs laser class 3A according to IEC 825+A1.

Because the optical beam is invisible, do not stare into beam or view directly with optical instruments.

1.5 SPECIFICATIONS

The following is specifications of this equipment.

table 1-2. Specifications

Wavelength range	40nm
Central wavelength	1550.0nm
Wavelength accuracy	< ± 0.5nm (< ± 0.2nm 1558.0, 1558.5, 1559.0nm)
Optical power	+1.5 ± 0.4dBm
Linewidth	100kHz
Optical power stability*	< ± 0.05dB (30min)
Frequency stability*	< ± 1GHz (30min) and 400kHz/0.1sec
Seek time	250ms/nm
APC	Possess
Optical power moniter	Possess
Interface	GP-IB
Power requirements	100/120/220/240Vac 140VA MAX
Operation temperature	10 ~ 35 ℃ (Accuracy guarantee 15 ~ 30 ℃)
Dimensions & mass	147H × 350W × 415D, 18kg

*Note: Constant environmental conditions

Specifications are subject to change without notice.

2. PANELS AND OPERATING PROCEDURES

2.1 FRONT PANEL EXPLANATION
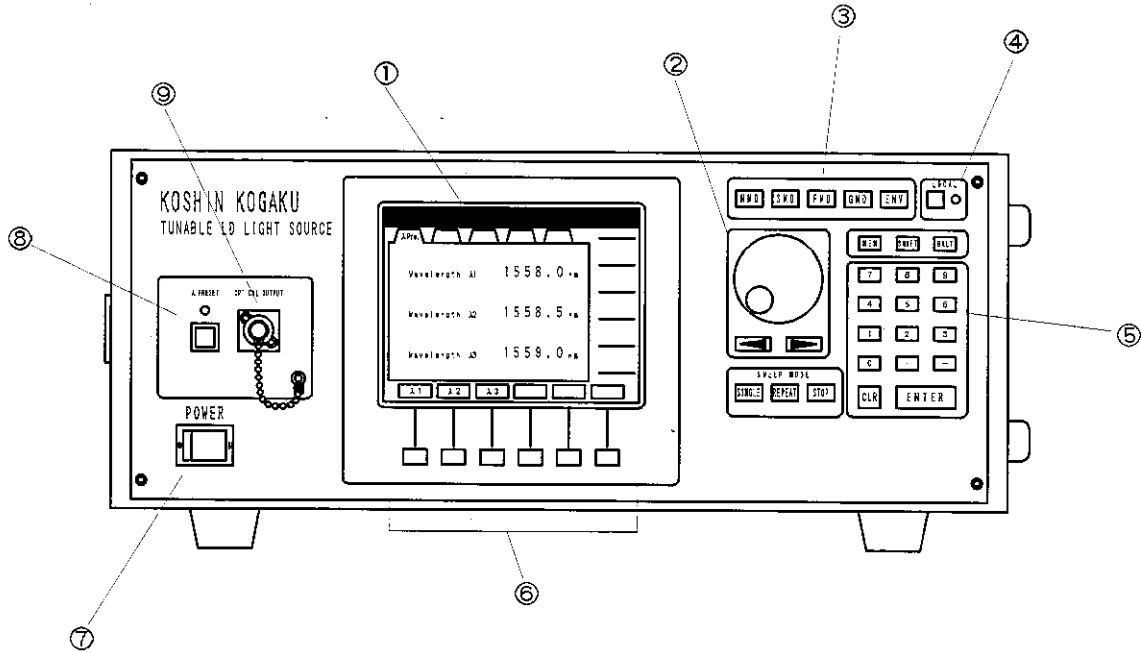
① LCD unit display

There are five modes function in LCD unit display.

(1) Normmal Mode

This is an ordinary mode. This mode is for the use of wavelength setting.
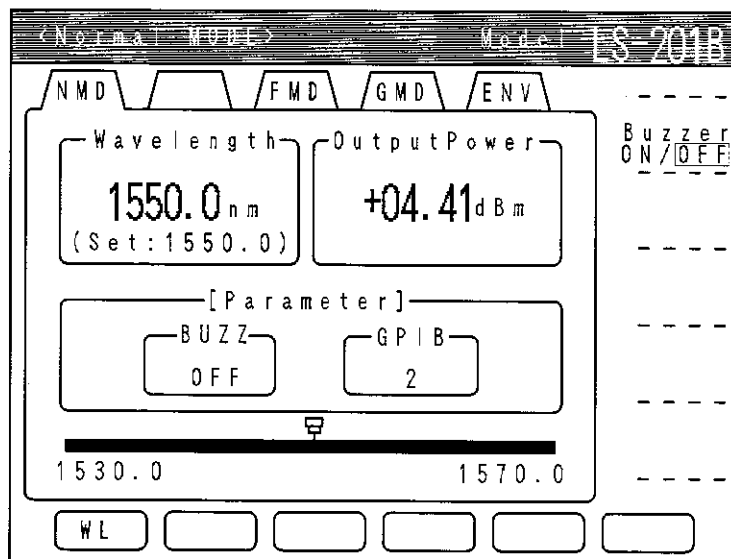
(2) λ Preset Mode

This mode is for the use of selecting the wavelength that was set in advance for one touch setting. This mode is set after power on sequence.

(default = 1558.5nm)
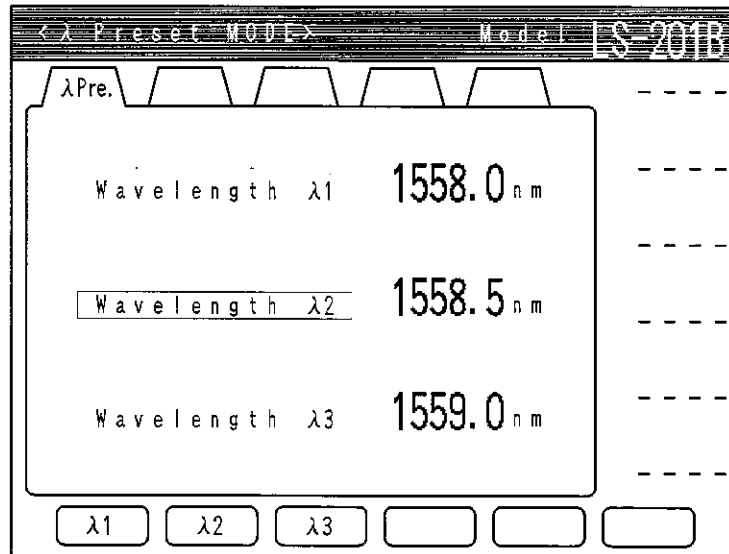
Note : In this mode, [λ Preset], [λ 1] ~ [λ 3] keys are available.
Other keys are unavailable.

(3) Free Set Mode

This mode is for the use of a manual setting (wavelength and optical power).
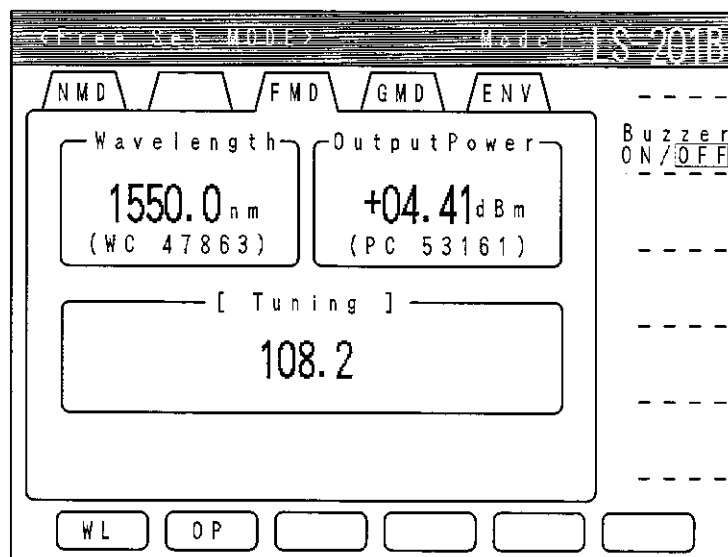
Notes : Using this mode, check the optical spectrum by an optical spectrum analyzer.

(4) GP-IB Address Mode

This mode is for the use of a GP-IB address setting

```
┌─────────────────────────────────────────────────┐
│ <GP-IB Address MODE>        Model  LS-201B        │
├─────────────────────────────────────────────────┤
│ /NMD\ /    \ /FMD\ /GMD\ /ENV\        ─ ─ ─ ─    │
│ ┌─────────────────────────────────┐              │
│ │   GP-IB  address    :    2      │   ─ ─ ─ ─   │
│ └─────────────────────────────────┘              │
│                                      ─ ─ ─ ─    │
│                                                  │
│                                      ─ ─ ─ ─    │
│                                                  │
│                                      ─ ─ ─ ─    │
│                                                  │
│                                      ─ ─ ─ ─    │
│ (GPIB) (    ) (    ) (    ) (    )   (    )      │
└─────────────────────────────────────────────────┘
```
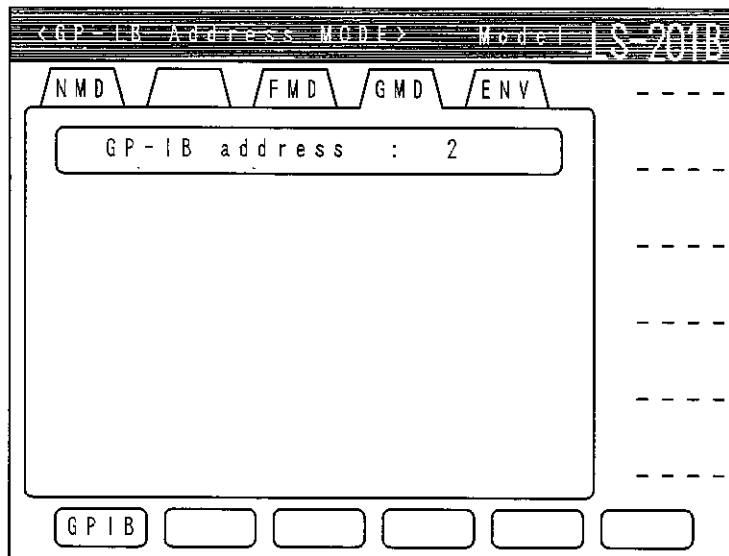
(5) Environment Mode

This mode is for the use of a environment setting. The setting is for [ON]/[OFF] of buzzer or unit of optical output.

```
┌─────────────────────────────────────────────────┐
│ <Environment MODE>          Model  LS-201B        │
├─────────────────────────────────────────────────┤
│ /NMD\ /    \ /FMD\ /GMD\ /ENV\        ─ ─ ─ ─    │
│ ┌─────────────────────────────────┐              │
│ │   Buzzer            : ON/OFF     │   ─ ─ ─ ─   │
│ └─────────────────────────────────┘              │
│ ┌─────────────────────────────────┐   ─ ─ ─ ─   │
│ │ OP DISP(LIN/LOG) : LIN/LOG       │              │
│ └─────────────────────────────────┘   ─ ─ ─ ─   │
│                                                  │
│                                      ─ ─ ─ ─    │
│                                                  │
│                                      ─ ─ ─ ─    │
│ (BUZZ) (LNLG) (    ) (    ) (    )   (    )      │
└─────────────────────────────────────────────────┘
```
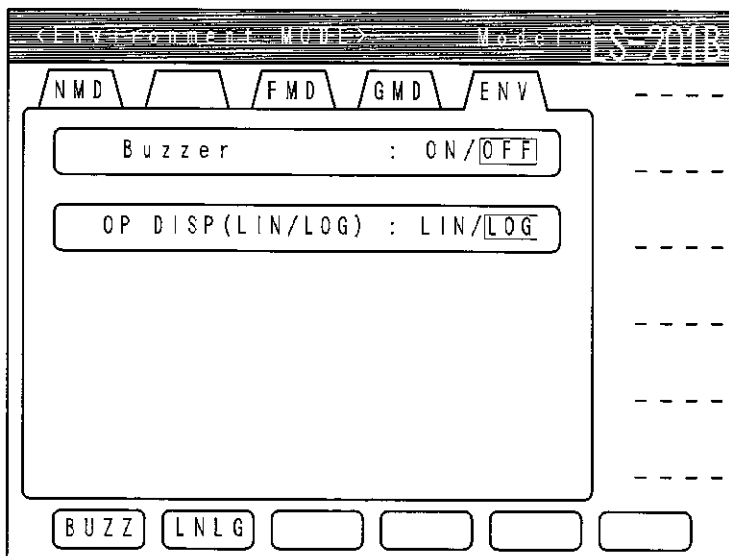
② Rotary knob (dial)

    The knob for adjusting wavelength or optical power continuously.

③ Mode function key

    Keys for selecting mode function.

④ Local switch & remote LED

    The switch for changing the remote state into the local state.

    The LED indicates that this equipment is on the remote state.

⑤ Ten key

    Keys for setting numerical data.

⑥ Soft function key

    Keys for various functions which is indicated on the LCD unit display..

⑦ Power switch

    The switch for power ON/OFF

⑧ λ preset switch & λ preset LED

    The switch for λ preset ON/OFF

⑨ Optical output (FC connecttor)

    An optical connector for optical output

WARNING : This equipment belongs laser class 3A according to IEC 825 + A1.

                Because the optical beam is invisible. Do not stare into beam or view

                directly with optical instruments.

2.2 REAR PANEL EXPLANATION
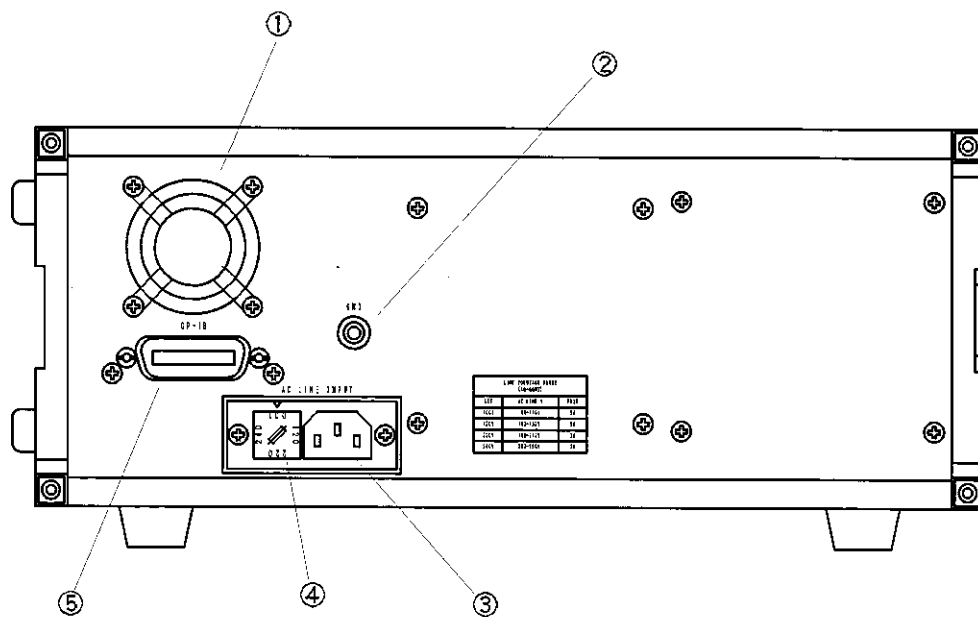
① Cooling fan

This equipment has one low noise fans.

② Gronud connecting terminal

A terminal for a ground wire.

③ AC line input

④ Fuse holder / Line voltage selector

To change the power voltage , unplug the power cord from the power socket.

Then switch to the required voltage. (See " 1.3 POWER SUPPLY" for details)

⑤ GP-IB connector

A connector for GP-IB interface cables.

2.3 PANEL OPERATING PROCEDURES

(1) Introduction to operation

"<< SELF TEST IN PROGRESS >>" is indicated on LCD unit display when the power switch is depressed. Then λ preset mode is set. This equipment has five mode functions.

① Normal Mode · · · · · · · · · · This is a basic mode.

② λ preset Mode · · · · · · · · This mode for the use of selecting the wavelength that was set in advance for one touch setting.

③ Free Set Mode · · · · · · · · · This mode for the use of tuning by manual setting.

④ GP-IB Address Mode · · · · · This mode for the use of setting GP-IB address.

⑤ Environment Mode · · · · · · This mode for the use of optical output power unit and [ON] / [OFF] buzzer setting.

(2) Explanation for each mode operations

① Normal Mode

1) Setting a wavelength

Firstly, press the [WL] key. Secondly, set a ten key or rotary knob or [◄] / [►] key. Thirdly, press the [ENT] key.

2) Wavelength variable range

1530.0 - 1570.0nm

3) Changing into another mode

change into λ preset Mode	: Press the ' λ Preset ' button
change into Free Set Mode	: Press the '[FMD]' key
change into GP-IB Address Mode	: Press the '[GMD]' key
change into Environment Mode	: Press the '[ENV]' key

② λ Preset Mode

1) Setting procedure

Select the '[λ 1]', '[λ 2]', '[λ 3]' key. Then the wavelength that was set in advance comes out.

[λ 1] = 1558.0nm

[λ 2] = 1558.5nm   (default)

[λ 3] = 1559.0nm

* When the wavelength is changed, it takes about one minute that the wavelength becomes stable.

2) Changing into another mode

Press the [λ Preset] button. Then the mode returns to the previous mode.

③ Free Set Mode

1) Setting procedure

In the first place, set the wavelength that you require by Normal Mode. Then press the ' [FMD] ' key.

2) Setting for optical output power

Firstly, press the ' [OP] ' key. Secondly, set a power by ten key or the rotary knob. Thirdly, press the ' [ENT] ' key.

3) Setting for wavelength

Firstly, press the ' [WL] ' key. Secondly, set a wavelength by ten key or the rotary knob.

Notes : Decreasing the optical output power about 1 dB, the optimum wavelength is moved to the short wavelength side about 0.1nm.

4) Changing into another mode

Change into Normal Mode	: Press the '[NMD]' key.
Change into λ Preset Mode	: Press the '[λ Preset]' button.
Change into GP-IB Mode	: Press the '[GMD]' key.
Change into Environment Mode	: Press the '[ENV]' key.

④ GP-IB Address Mode

   1) Setting for GP-IB Address

     Firstly, press the '[GP-IB]' key. Secondly, set a ten key or the rotary knob.

     Thirdly, decide the '[ENT]' key.

    Note : The address is memorized permanently.

   2) Changing into another mode

     Change into Normal Mode ·   : Press the '[NMD]' key.

     Change into λ Preset Mode   : Press the '[λ Preset]' button.

     Change into Free set Mode   : Press the '[FMD]' key.

     Change into Environment Mod   : Press the '[ENV]' key.

⑤ Environment Mode

   1) Setting for Buzzer

     Firstly, Press the '[BUZZ]' key. Secondly, choice the [ON] / [OFF] key.

     Thirdly, Press the '[ENT]' key.

   2) Setting for optical output indication

     Firstly, Press the '[LNLG]' key. Secondly, choice the [LIN] / [LOG] key.

     Thirdly, Press the '[ENT]' key.

    Note :   LIG : The optical output is indicated by [μ W] unit.

              LOG : The optical output is indicated by [dBm] unit.

   3) Changing into another mode

     Change into Normal Mode   : Press the '[NMD]' key.

     Change into λ Preset Mode   : Press the '[λ Preset]' button.

     Change into Free set Mode   : Press the '[FMD]' key.

     Change into GP-IB Mode   : Press the '[GMD]' key.

3. GP-IB CONTROL

3.1 INTRODUCTION TO GP-IB OPERATION

This GP-IB interface is able to control wavelength, 'SRQ' interruption and reading optical power.

3.2 HANDLING GP-IB CABLES

Be sure to disconnect the power cable from the socket before handling GP-IB cables.

3.3 SET GP-IB ADDRESS AND CONFIRMATION

Set a GP-IB address by GP-IB Address Mode. "02h" is set initially at factory side.

The address is memorized permanently.

3.4 GP-IB INTERFACE FUNCTIONS

The following is interface functions of this equipment.

table 3-1. interface functions

CODE	FUNCTION	
SH1,AH1	all hand-shake functions	O
T6	talker function	O
L4	listener function	O
SR1	service request function	O
RL1	remote local function	O
PP0	parallel poll function	×
DC1	device clear function	O
DT0	device trigger function	×
CO	controller function	×
E2	tri-state driver	—

Note: O · · · possible

× · · · impossible

3.5 DEVICE MESSAGE

The following is device messages and codes of this equipment.

table 3-2. device messages and codes

CONTROL ITEN	FUNCTION	CONTROL CODE
wavelength Set*	set a wavelength (nm)	WL Δ dddd.d
Service Request*	send the SRQ	SQ Δ 1
	not send the SRQ	SQ Δ 0
Actual wave Read*	read the wavelength (nm)	AW?
Optical power Read*	read the optical power (dBm)	PW?

Status Message

```
 7   6   5   4   3   2   1   0
┌───┬───┬───┬───┬───┬───┬───┬───┐
│ — │ × │ — │ — │ — │ — │ × │ × │
└───┴───┴───┴───┴───┴───┴───┴───┘
```

0: setting wavelength possible

1: setting wavelength impossible

This bit is set when grammer error or setting error is detected. And this bit is cleared at receiving next code.

0: sending SRQ

1: not sending SRQ

*Note: Use these device messages independently.

3.6 GP-IB OPERATING PROCEDURES

GP-IB control is abie to execute at only Normal Mode. So if the other mode is set,
you must change into Normal Mode.

Maximum seek takes about 10 seconds. If you would like to synchronize seek end,
use SRQ interruption or refer to bit 0 in status message.

Note: Sufficient delay is required between IFC (Inter Face Clear) and REN (Remote ENable).

4. THE OUTLINE THIS EQUIPMENT

4.1 The outline of this equipment

SIDE VIEW

FRONT VIEW

REAR VIEW

KOSHIN KOGAKU
TUNABLE LD LIGHT SOURCE
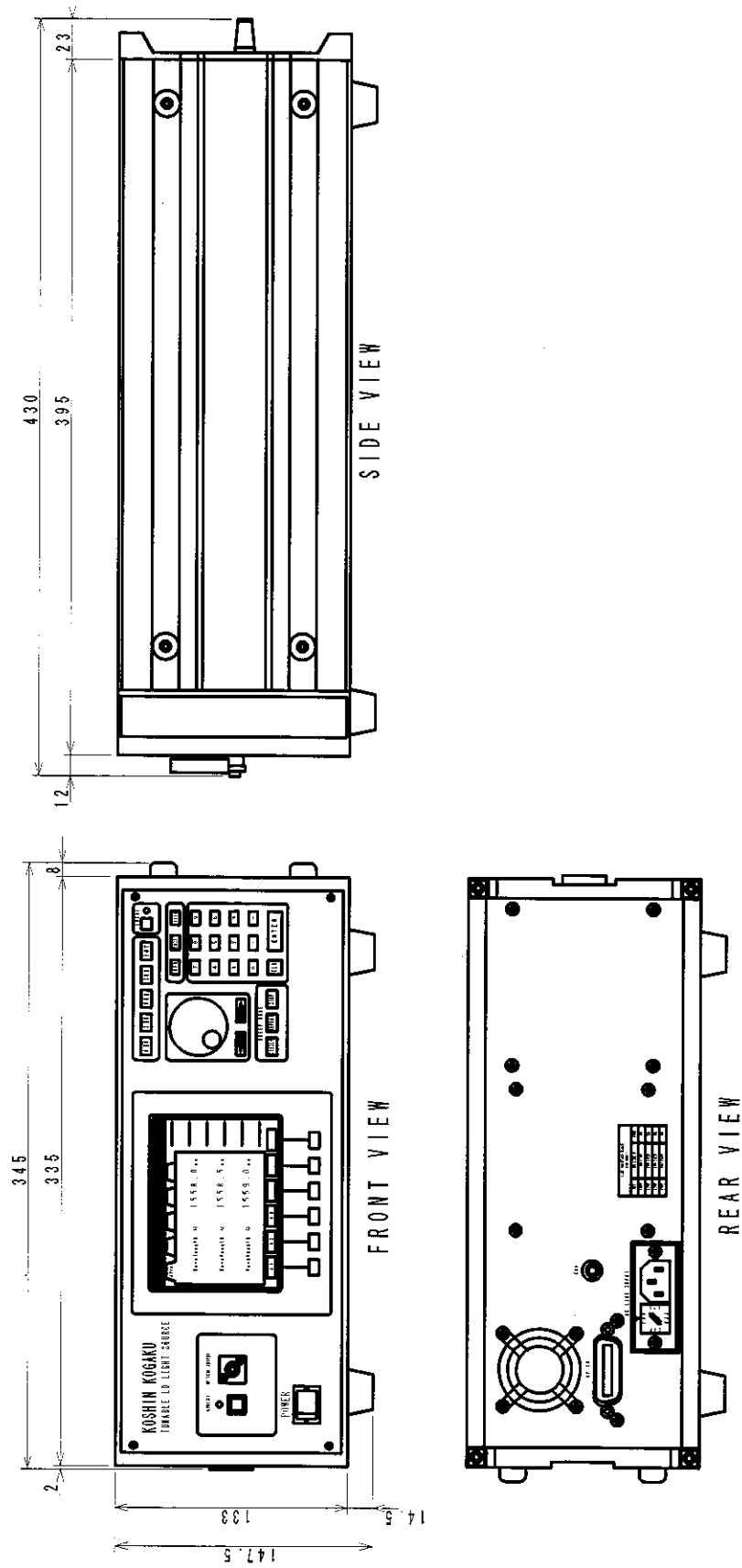
5. STORAGE / WARRANTY / MAINTENANCE

5.1 RECOMMENDABLE STORAGE CONDITIONS

temperture   : 0 — 45 ℃

relative humidity   : ≦ 85%

5.2 WARRANTY

This equipment is guaranteed to be free from defects in workmanship and materials
for a year and a half from date of shipment.

5.3 MAINTENANCE

reference to : KOSHIN KOGAKU Co. , LTD.

☐ Factry, Office

69 - 3 Bodai

Hadano - shi, Kanagawa   Phone 81 - 463 - 75 - 3331

259 - 13 Japan   Fax   81 - 463 - 75 - 3535

☐ R&D Center

667 - 2 Soya

Hadano - shi, Kanagawa   Phone 81 - 463 - 82 - 5360

257 Japan   Fax   81 - 463 - 82 - 0315

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   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

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   (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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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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