ADVANTEST

ADVANTEST CORPORATION

Q7760

Optical Network Analyzer

Operation Manual

MANUAL NUMBER FOE-8370633C00

First printing November 20, 2000
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.
  - When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.
  - When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
  - Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
  - Connect the power cable to a power outlet that is connected to a protected ground terminal. Grounding will be defeated if you use an extension cord which does not include a protected 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 anything on the product and do not apply excessive pressure to the product. Also, do not place flower pots or other containers containing liquid such as chemicals near this

product.

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

- **Caution Symbols Used Within this Manual**

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

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

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

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

- **Safety Marks on the Product**

The following safety marks can be found on Advantest products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

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

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

Main Parts with Limited Life

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

- **Hard Disk Mounted Products**

The operational warnings are listed below.

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

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

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

- **Precautions when Disposing of this Instrument**

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

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

Example: fluorescent tubes, batteries

Environmental Conditions

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

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

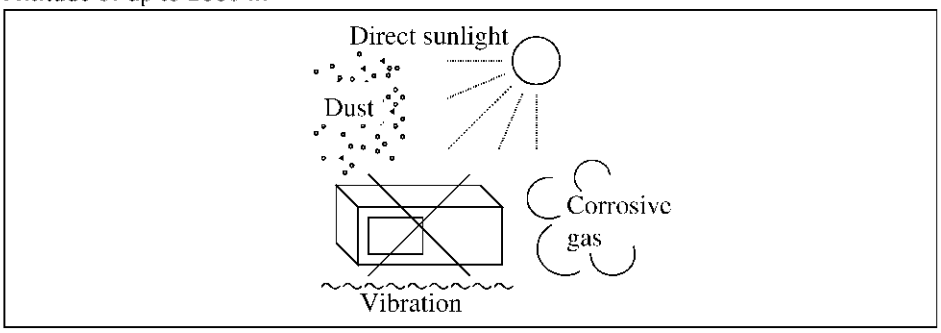


Figure-1 Environmental Conditions

- Operating position

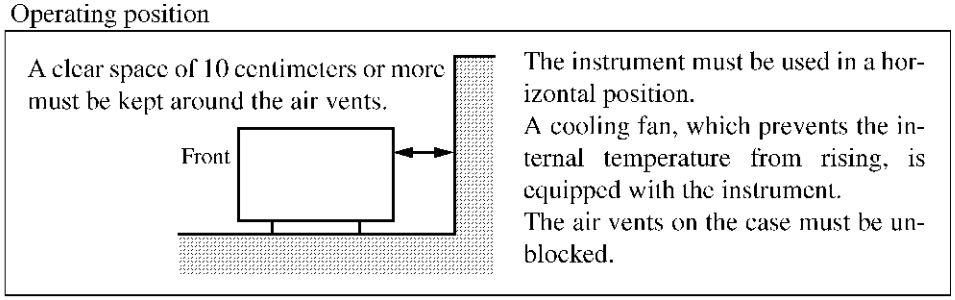


Figure-2 Operating Position

- Storage position

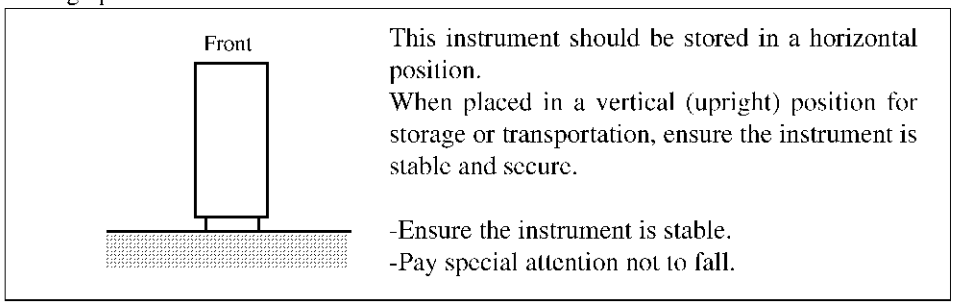


Figure-3 Storage Position

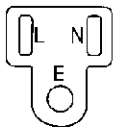
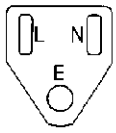
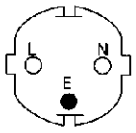
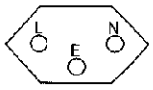
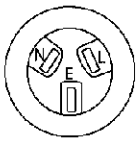
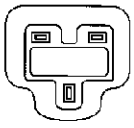
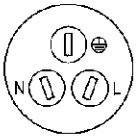
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

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

  Pollution Degree 2

Types of Power Cable

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

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

CAUTIONS

1. CLASS 1 LASER PRODUCT LABEL

The Q7760 is a class 1 laser product.
The warning labels shown in Figure-1 are included as accessories for this instrument.
Attach the correct warning labels for your country on the analyzer in the locations shown in Figure-2.

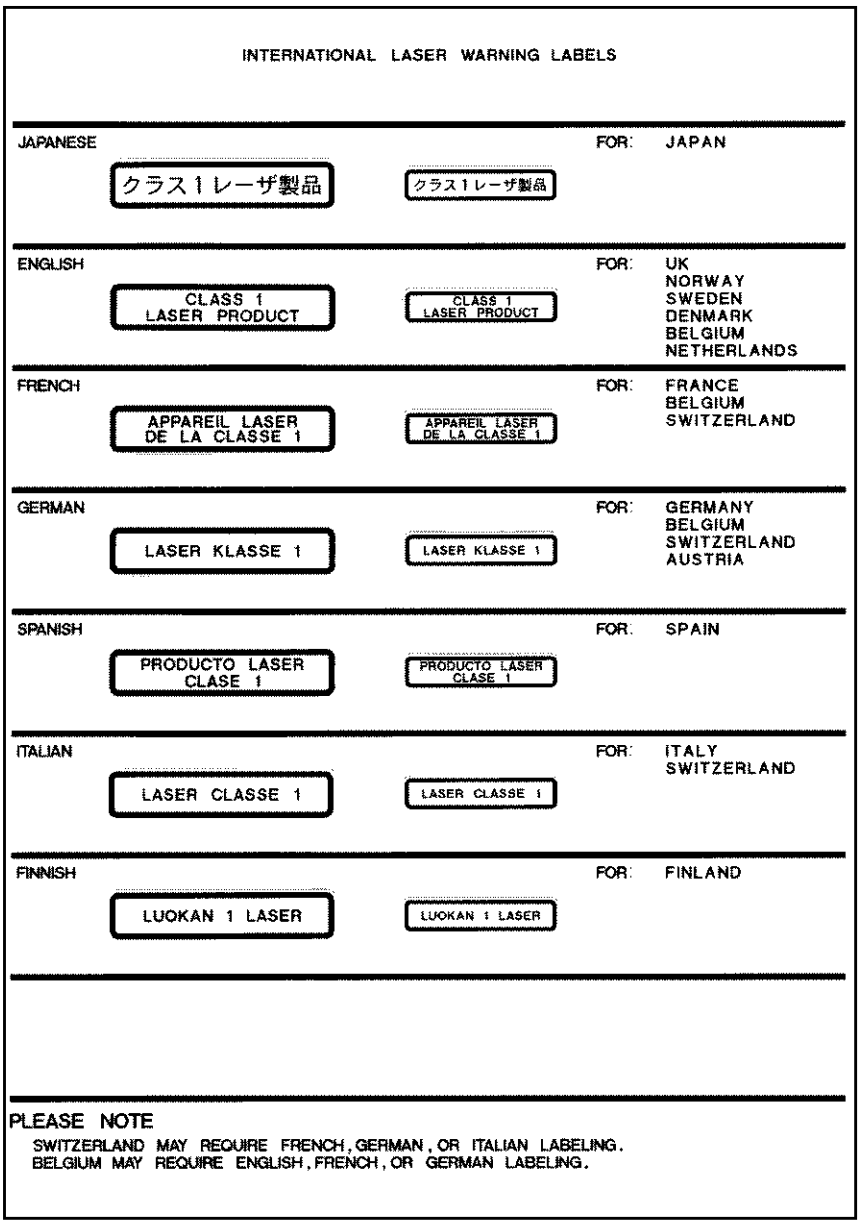
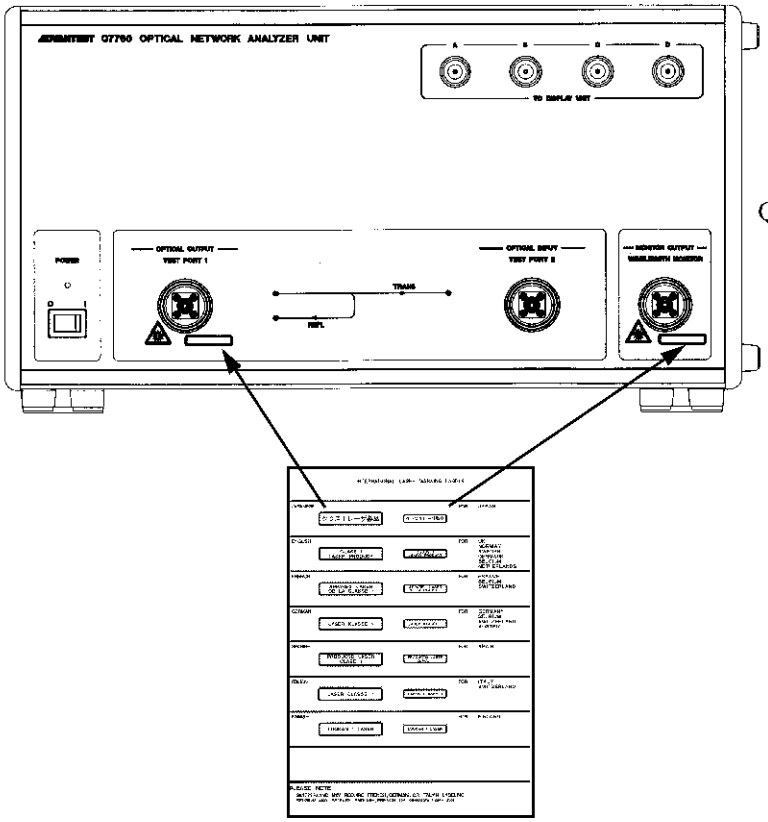


Figure-1 CLASS 1 LASER PRODUCT LABEL



Q7760 Front view

Figure-2 Warning Label Locations

2. LASER SPECIFICATIONS

Wavelength	1.55μm
Output Level	-5dBm

3. LASER SAFETY

(1) This instrument constantly generates a class 1 laser beam while the power is on. Never attempt to look into the optical output connector or the end of the optical fiber cord to observe the emitted light. Your eyesight may be seriously damaged by looking into this light.

(2) Never attempt to look into the optical output connector or the end of optical fiber cord to observe the emitted laser beam using an optical instrument. Your eyesight may be seriously damaged.

(3) Caution-use of controls or dajustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

(4) Do not attempt to open the unit. The unit should be serviced only by ADVANTEST representatives. ADVANTEST assumes no responsibility for any damage caused by unauthorized service.

Certificate of Conformity

CE

This is to certify, that

Optical Network Analyzer

Q7760

instrument, type, designation

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

ADVANTEST Corp.

Tokyo, Japan

ROHDE&SCHWARZ

Engineering and Sales GmbH
Munich, Germany

7760.01

PREFACE

This manual provides the information necessary to check functionality, operate and program the Q7760 Optical Network Analyzer Operation. Be sure to read this manual carefully in order to use the Optical Network Analyzer safely.

- Organization of this manual
  This manual consists of the following chapters:

1. Introduction	Includes the accessories along with information on the analyzers' operating environment, and information on how to perform a system checkout for users who operate the analyzer for the first time.
2. Operation	Describes the names and the functions of each part on the panels. Describes the basic operations of the optical network analyzer.
3. Measurement Examples	You can learn how to use this analyzer through the measurement examples.
4. Reference	Shows a list of operation keys, and describes the function of each key.
5. Remote Programming	Gives an outline of the GPIB interface, and how to connect and set them up. Also included are a list of commands necessary for programming.
6. Principle of measurement	Describes the principle of operation necessary for taking measurements more accurately.
7. Specifications	Shows the specifications of the Optical Network Analyzer.
APPENDIX 1. Troubleshooting	Refer to this section when you have any problems.
APPENDIX 2. Error Code List	If errors occur when the self-test is performed, the error codes are displayed on the screen. If an error occurs in the optical network analyzer, an error message is displayed. The error codes are explained in detail here.
APPENDIX 3. List of Simultaneous Executions and Settings for Each Function	The table shows which functions are executable for each measurement

- Key notations in this manual
  Typeface conventions used in this manual.

  Panel keys: In bold type — Example: **MAG**, **SYSTEM**
  Soft keys: In bold and italic type — Example: ***CENTER***, ***PRESET***

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

List of Illustrations

LIST OF TABLES

1 INTRODUCTION

Includes the accessories along with information on the analyzers' operating environment, and information on how to perform a system checkout for users who operate the analyzer for the first time.

1.1 Product Description

The Q7760 Optical Network Analyzer is an analyzer used to analyze the magnitude, group delay time, dispersion characteristics, dispersion slope characteristics and dispersion characteristics in the polarization mode (only transmitted light) of transmitted and reflected light from optical devices at high speed and with high resolution by adopting the phase shift method for chromatic dispersion measurement.

The features of the Q7760 are as follows.

(1) Measurable wavelength range: 1525 nm to 1635 nm

(2) Absolute wavelength accuracy: ±0.054 nm

(3) Modulation frequency range: 40 MHz to 3 GHz

(4) Measured items: Magnitude, group delay time, dispersion characteristics and dispersion slope characteristics of transmitted and reflected light.
Dispersion characteristics of transmitted light in the polarization mode

(5) Dynamic range: 40 dB (Typical)

(6) Save and load functions which you can use to store measurement conditions and data in TEXT format.

(7) A 3.5-inch floppy disk drive equipped as standard.

(8) Support for ESC/P, ESC/P R and PCL compatible printers.

(9) Remote control capabilities which allow you to setup an automatic measurement system. This remote control function complies with GPIB specifications.

1.2 Standard Accessories

The table below lists the standard accessories shipped with the analyzer. If any of the accessories are damaged or missing, contact the nearest ADVANTEST Field Office or representative. Additional accessories should be referred to by model name when ordered.

Table 1-1 Standard Accessories List

Name	Model name	Quantity	Remarks
Power cable	A01412	2	*1
N cable	DCB-FF0388X06	4	
I/O cable	DCB-RR9980X01	1	
GPIB cable	DCB-SS1076X01	1	
Class 1 laser Product label	MNS-E1068A	2	
Joint set	MAE-J7488A	1	
Fuse (Display unit)	DFT-AP6R3A	2	
Fuse (Optical network analyzer unit)	DFT-AA3R15A	2	
SMF optical fiber for Normalize	DCB-HHC224X04	1	
Ferrite core	DEE-003093	4	Used for EMC and EMS
Operation manual	EQ7760	1	

* 1: The cable supplied with the Optical Network Analyzer depends on what type (specified by model number above) was ordered when the Optical Network Analyzer was purchased (see Table 1-4).

1.3 Optional Accessories

The options and accessories used for the analyzer are shown below. Accessories should be referred to by model name when ordered.

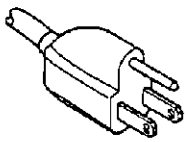
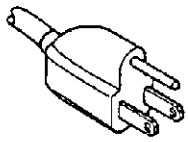
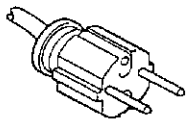
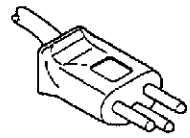
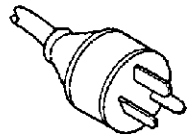
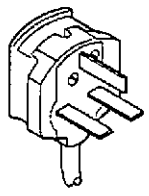
Table 1-2 Option

Name	Model Name	Remarks
Polarization mode dispersion measurement option	OPTQ7760+15	Installed at the factory before shipping.
	OPTQ7760+15A	Installed at the factory after the analyzer has been brought to the factory.

Table 1-3 Accessories

Name	Model Name	Remarks
FC connector and adapter	A08694	Optical connector and adapter
SC connector and adapter	A08695	Optical connector and adapter
ST connector and adapter	A08696	Optical connector and adapter

Table 1-4 Power Cable Options

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

1.4 Operating Environment

This section describes the environmental conditions and power requirements necessary to use the Optical Network Analyzer.

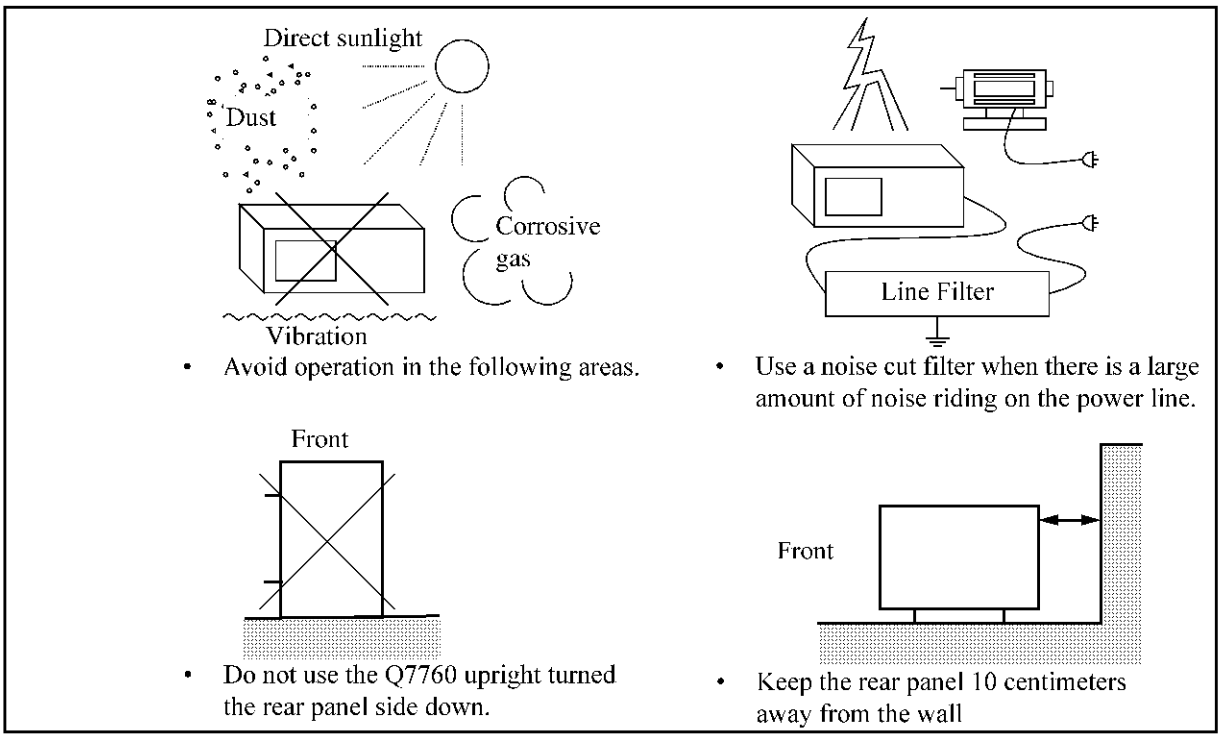
1.4.1 Environmental Conditions

The Q7760 should be only be used in an area which satisfies the following conditions:

- Ambient temperature: +15°C to +35°C (operating temperature)
- Relative humidity: 85% or less (without condensation)
- An area free from corrosive gas
- An area away from direct sunlight
- A dust-free area
- An area free from vibrations
- A low noise area
  Although the Q7760 has been designed to withstand a certain amount of noise riding on the AC power line, it should be used in an area of low noise. Use a noise cut filter when ambient noise is unavoidable.
- An area allowing unobstructed air flow

CAUTION: This analyzer should be used in a horizontal state.

An exhaust fan is installed on the rear panel. Additional vents are provided on both sides.



- Avoid operation in the following areas.
- Use a noise cut filter when there is a large amount of noise riding on the power line.
- Do not use the Q7760 upright turned the rear panel side down.
- Keep the rear panel 10 centimeters away from the wall

Figure 1-1 Operating Environment

The analyzer can be used safely under the following conditions:

- Altitude of up to 2000 m
- Installation Categories II
- Pollution Degree 2

1.4.2 Power Supply

The power supply specifications of the Optical Network Analyzer are listed in Table 1-5.

During operation, the power supply automatically switches between input voltage levels of 100VAC and 200VAC. Be sure, however, to use a power cable that matches the input voltage and meets the related standard (see Table 1-4).

CAUTION ***To prevent damage, operate the Optical Network Analyzer within the specified input voltage and frequency ranges.***

Table 1-5 Power Supply Specifications

		In operation under 100 VAC	In operation under 200 VAC
Display unit			
	Input voltage	90V to 132V	198V to 250V
	Frequency	50Hz/60Hz	
	Power consumption	300VA or less.	
Optical network analyzer unit			
	Input voltage	90V to 132V	198V to 250V
	Frequency	50Hz/60Hz	
	Power consumption	310VA or less.	

1.4.3 Power Fuse

CAUTION ***When a fuse blows, there may be some problem with the analyzer so contact a qualified ADVANTEST service representative before replacing the fuse.***

The power fuse is placed in the fuse holder which is mounted on the rear panel.
To check or replace the power fuse, use the following procedure:

1. Press the **POWER** switch to the OFF position.
2. Disconnect the power cable from the AC power supply.
3. Remove the fuse holder on the rear panel.
4. Check (and replace if necessary) the power fuse and put it back in the fuse holder.

Table 1-6 Fuse

Unit	Part code	Rated current
Display unit	DFT-AA6R3A	T6.3A
Optical network analyzer unit	DFT-AA3R15A	T3.15A

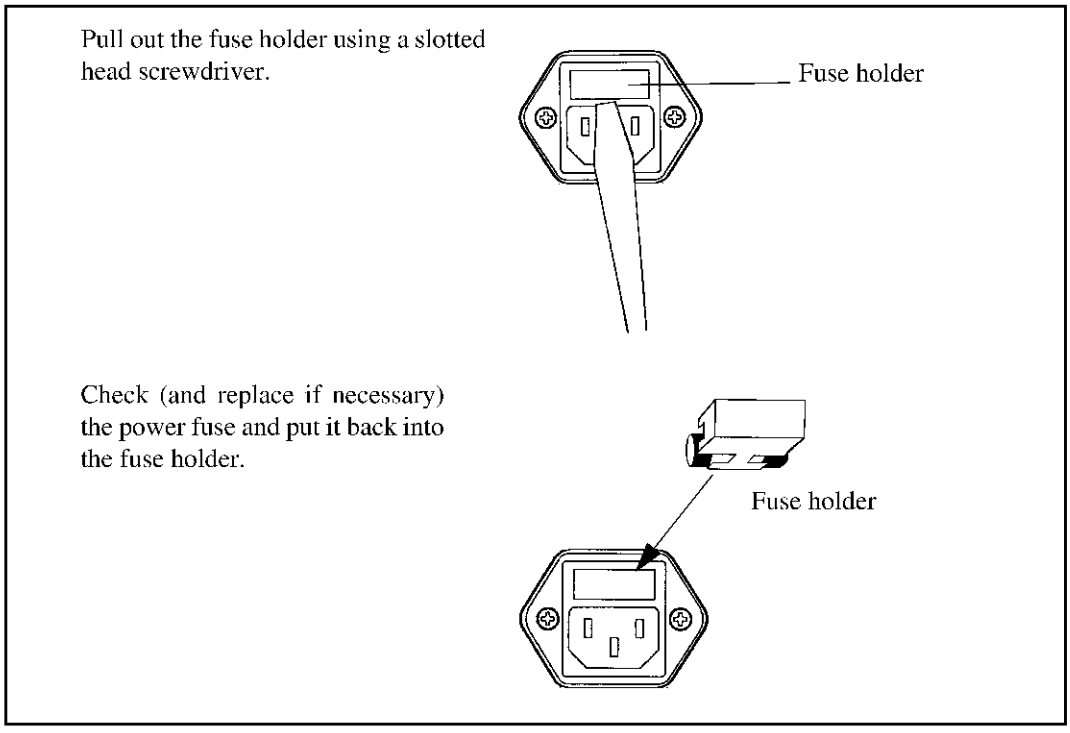


Figure 1-2 Replacing the Power Fuse

1.4.4 Power Cable

CAUTION:

1. ***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 (See Table 1-4).***
2. ***Be sure to plug the power cable into an electrical outlet which has a safety ground terminal. Grounding is defeated if you use an extension cord which dose not include a safety ground terminal.***
3. ***Turn the MAIN POWER switch (on the rear panel) and the POWER switch (on the front panel) off prior to connecting the power cable.***

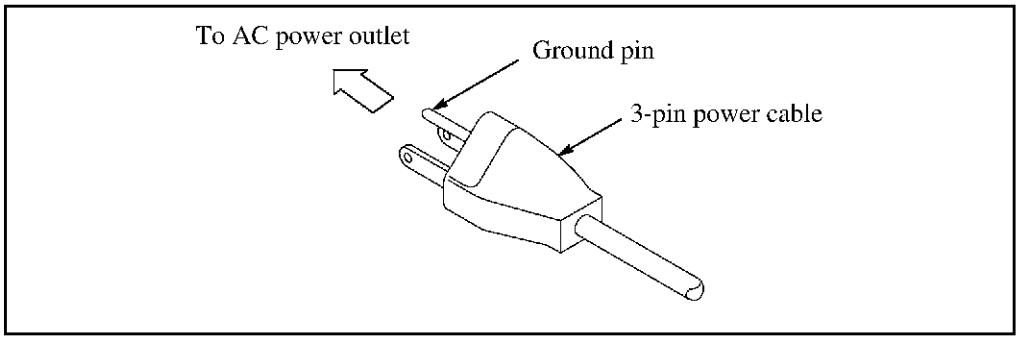


Figure 1-3 Power Cable

1.5 Precautions in Use

(1) Before starting measurement

When turning power on, do not connect the DUT.

(2) Opening the case

Only ADVANTEST authorized service personnel can open the case.
This analyzer contains high-temperature and high-voltage components.

(3) If an abnormality occurs

If the analyzer issues smoke, a bad odor, or an unusual sound, turn off the **POWER** switch. Pull out the power cable from the outlet and contact ADVANTEST.

(4) Electromagnetic interference

High-frequency noise is generated when using this analyzer.
Electromagnetic interference may adversely affect the television or the radio due to improper installation and use of this analyzer.
If turning off the power of this analyzer reduces electromagnetic inference, then this analyzer is its cause.
Prevent electromagnetic interference as follows:

- Change the direction of the television or radio antenna to stop the electromagnetic interference.
- Place this analyzer on the other side of the television or the radio.
- Place this analyzer away from the television or radio.
- Use a different outlet for the television or radio.

1.6 Setup

This section explains how to set up the Q7760.

This analyzer consists of an optical network analyzer unit and a display unit. It is recommended that you set up the analyzer system according to the following procedure.

CAUTION: ***The setup should be done on a horizontal work-bench without connection to an electrical power.***

---

1. First, stack the two units.
   Lay the display unit on top of the optical network analyzer unit.
   At this time, be sure to fit the foot projection at the front of the base of the display unit into the slot at the front of the top of the optical network analyzer unit.

CAUTION: ***Be careful not to connect any cables from the connectors on this unit to other units during the following setup procedure. Otherwise, the analyzer and/or other connected units may be damaged.***

---

2. The two units are connected.
   Connect the display unit to the optical network analyzer using the attached joint set.

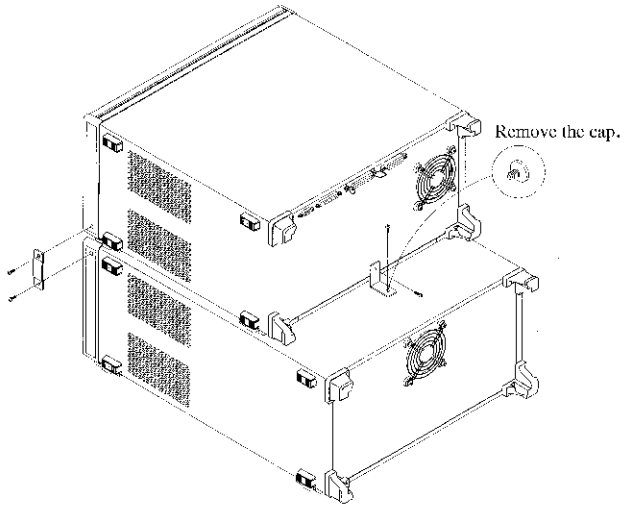


Figure 1-4 Connecting Units

CAUTION: ***When transporting this analyzer system, disconnect the units, then transport the display unit and the optical network analyzer unit separately.***

---

3. Connect signal ports.
   Connect the N cables from the **A, B, C** and **D** connectors (on the front panel) on the display unit signal port to the corresponding connectors (on the front panel) on the optical network analyzer.

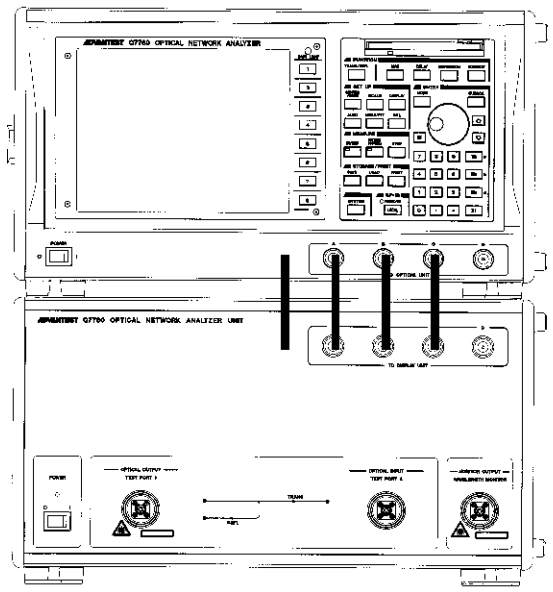


Figure 1-5 Front Panel Connections

4. Connect I/O connectors.
   Connect the I/O cable from the **A port** on the rear panel of one unit to the **A port** on the rear panel of another unit.

5. Connect B port connectors
   Connect the GPIB cable from the **B port** on the rear panel of one unit to the **B port** on the rear panel of another unit.

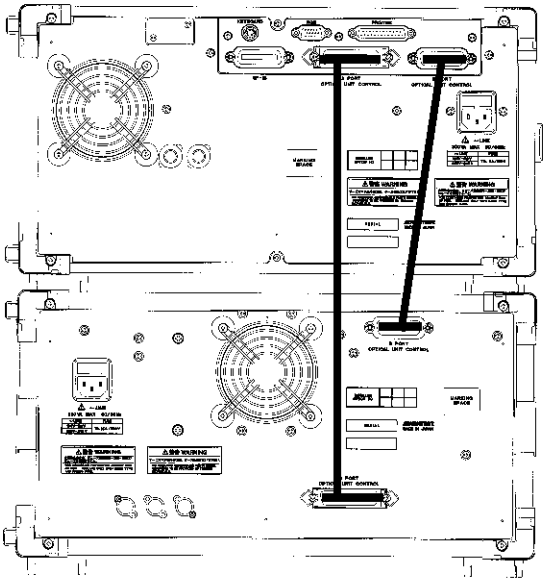
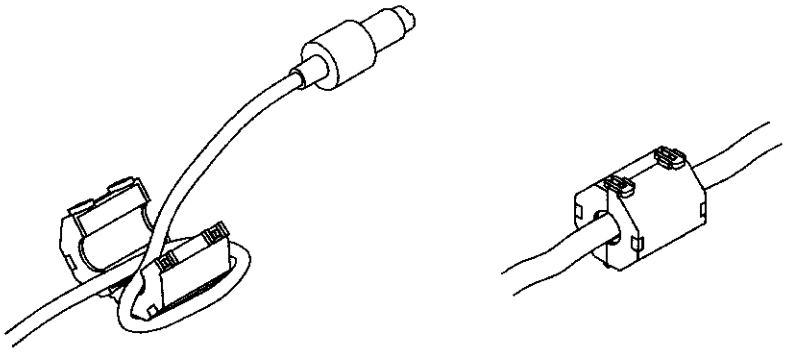


Figure 1-6 Rear Panel Connections

6. Connect power cords
   Connect the power cords to the **AC** connectors on the rear panels of the two units.

NOTE: ***Attach ferrite cores on the B PORT, GPIB, printer and keyboard cables at the end closest to the optical network analyzer as shown in Figure 1-7.***



For the keyboard cable

For the GPIB cable

Figure 1-7 How to Attach the Ferrite cores

1.7 System Checkout

This section describes the Self Test which must be performed when operating the Optical Network Analyzer for the first time. Follow the procedure below:

Setup

1. Referring to the 1.6 Setup, connect the display unit to the optical network analyzer unit.
2. Make sure that the **POWER** switch (on the front panel) on each unit is in the OFF position.
3. Connect the power cable on each unit to the outlet.

CAUTION: ***To prevent damage, operate the Optical Network Analyzer within specified input voltage and frequency ranges.***

System checkout

4. On the Optical Network Analyzer unit (which is underneath of the Display unit), press the **POWER** switch to the ON position.
5. On the Display unit (which is mounted on top of the Optical Network Analyzer unit), press the **POWER** switch to the ON position.
   The Optical Network Analyzer performs the Initial test for approximately three minutes, then displays the startup screen as shown in Figure 1-8.

NOTE: ***There is a possibility that the screen display is different from the one shown in Figure 1-8, depending on previously saved conditions.***

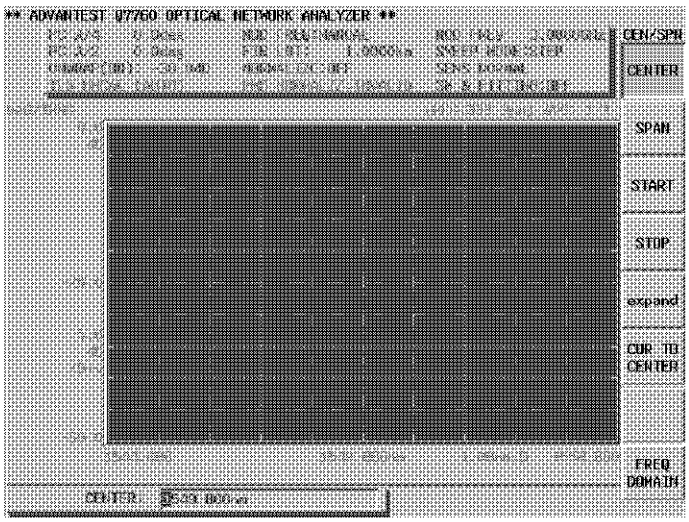


Figure 1-8 Startup Screen

1.8 Cleaning, Storing and Transporting the Q7760 Optical Network Analyzer

1.8.1 Replacing the Optical Connector-Adapter and Cleaning the Optical Connector

(1) Replacing the optical connector-adapter

The Q7760 provides a FC type connector-adapter as a standard accessory. In addition, SC type and ST type connector-adapters are also available as optional accessories. Replacement is easily accomplished by removing the screw and pulling the connector-adapter out as shown in Figure 1-9.

(2) Cleaning the optical connector

Remove the connector-adapter in the same manner used during replacement. Then, pull out the optical fiber and clean the tip with alcohol.

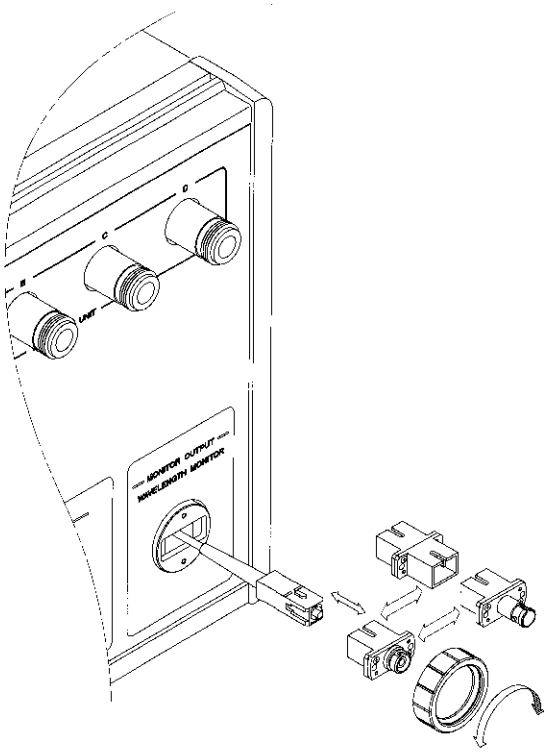


Figure 1-9 Replacing the Optical Connector-Adapter and Cleaning the Optical Connector

---

CAUTION:

1. ***Make sure to adequately tighten the screw on the optical connector-adapter after replacing it or after cleaning the optical connector.***
2. ***Do not pull the optical connector cable out of the instrument casing beyond the white label or red marking band on the cable.***

1.8.2 Cleaning

Remove dust from the outside of the Optical Network Analyzer by wiping or brushing the surface with a soft cloth or small brush. Use a brush to remove dust from around the panel keys. Hardened dirt can be removed by using a cloth which has been dampened in water containing a mild detergent.

CAUTION:

1. ***Do not allow water to get inside the Optical Network Analyzer.***
2. ***Do not use organic cleaning solvents, such as benzene, toluene, xylene, acetone or similar compounds, since these solvents may damage the plastic parts.***
3. ***Do not use abrasive cleaners.***

1.8.3 Storing

Store the Optical Network Analyzer in an area which has a temperature from -10°C to +45°C. If you plan to store the Optical Network Analyzer for a long period (more than 90 days), put the Optical Network Analyzer in a vapor-barrier bag with a drying agent and store the Optical Network Analyzer in a dust-free location out of direct sunlight.

1.8.4 Transporting

When you ship the Optical Network Analyzer, use the original container and packing material. If the original packaging is not available, pack the Optical Network Analyzer using the following guidelines:

- To allow for cushioning, use a corrugated cardboard container with inner dimensions that are at least 15 centimeters more than those of the Optical Network Analyzer.
- Surround the Optical Network Analyzer with plastic sheeting to protect the finish.
- Cushion the Optical Network Analyzer on all sides with packing material or plastic foam.
- Seal the container with shipping tape or a heavy-duty, industrial stapler.

If you are shipping the Optical Network Analyzer to a service center for service or repair, attach a tag to the Optical Network Analyzer that shows the following information:

- Owner and address
- Name of a contact person at your location
- Serial number of the Optical Network Analyzer (located on the rear panel)
- Description of the service requested

1.9 Warming up

After the analyzer is at room temperature, turn the power on and allow it to warm up for approximately 2 hours.

1.10 Ensured High Performance for Absolute Wavelength Accuracy

The Q7760 ensures high performance for the absolute wavelength accuracy under the following conditions:

- Allow the instrument to warm up for at least two hours after turning the power on.
- Calibrate the tunable light source after the appropriate warm-up time.
- Perform the calibration every 24 hours.
- If the room temperature rises or decreases over 5°C during the calibration, perform the calibration again.
- Always keep the instrument in a horizontal position during use.

For more information, refer to section 6.13, "Tunable Light Source Calibration."

1.11 Calibration

When instrument calibration is required, contact Advantest or an Advantest sales representative. The calibration work is performed at Advantest or an Advantest service representative.

Desirable Period	One year

1.12 Part life spans

The Q7760 uses the following parts which have a limited lifespan and are not listed in the Safety Summary. Replace those parts according to the table below:

Part name	Life
Soft key switch	Half million times operable
LCD back-light	Seven thousand hours operable

2 OPERATION

Describes the names and the functions of each part on the panels. You can learn the basic operation of the Optical Network Analyzer through the examples shown in this chapter.

2.1 Description of Panels

This section gives an explanation of the names of the parts and the functions of the front and rear panels and the display annotation.

2.1.1 Front Panel (Display Unit)

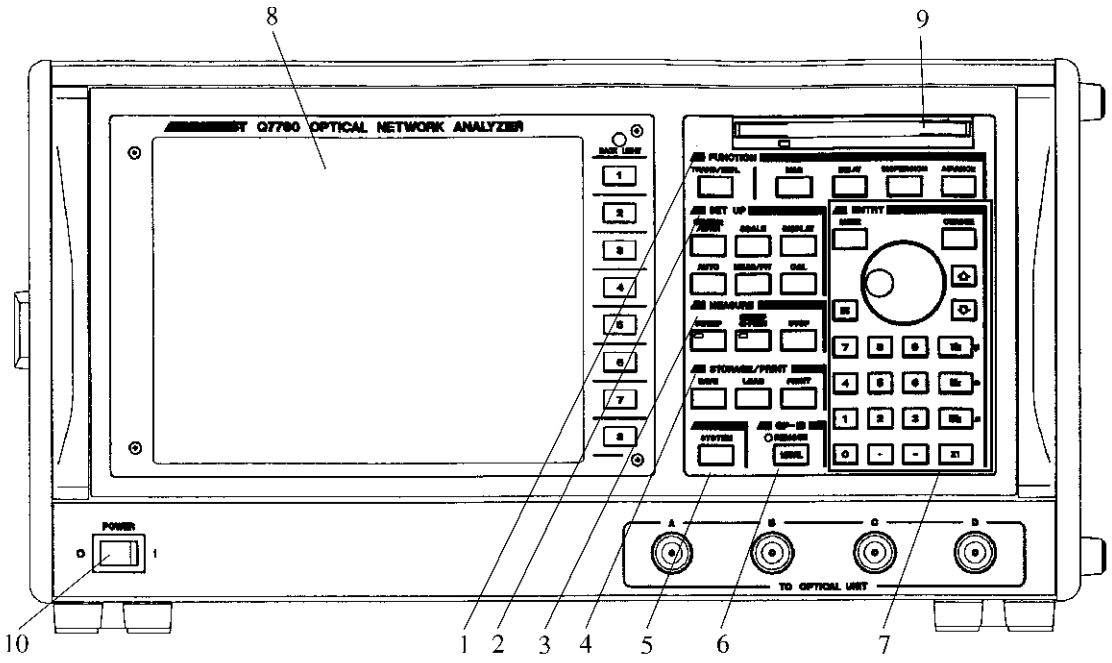


Figure 2-1 Description of the Front Panel

1. FUNCTION section
2. SET UP section
3. MEASURE section
4. STRAGE/PRINT section
5. SYSTEM section
6. GPIB section
7. ENTRY section
8. Display section
9. Floppy disk drive section
10. POWER switch section

2.1.1.1 Display section

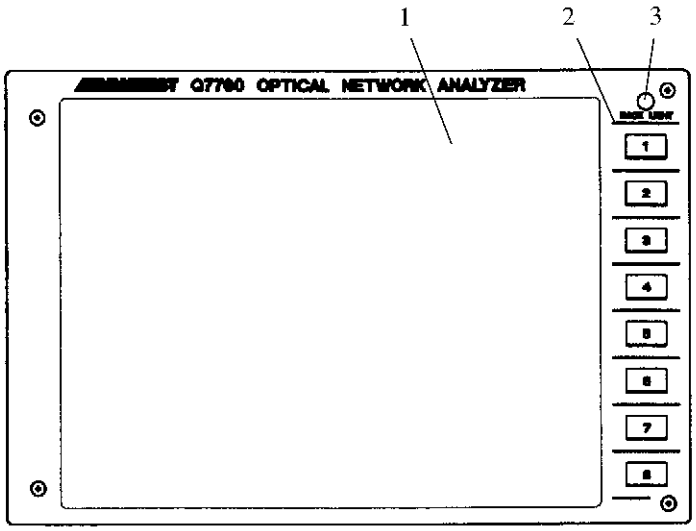


Figure 2-2 Description of the Display Section

1.	Liquid crystal display	Displays trace and measurement data.
2.	Soft keys	The eight soft keys correspond to the menu display on the left side. Pressing the soft keys enables you to select a soft menu.
3.	**BACK LIGHT** key	Turns the back light on or off.

2.1.1.2 FUNCTION section

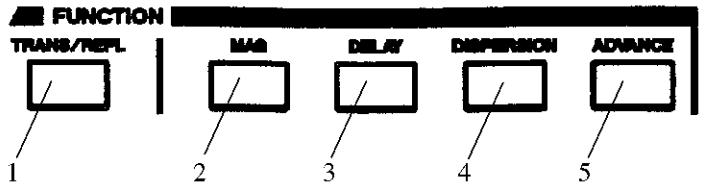


Figure 2-3 Description of FUNCTION Section

1. **TRANS/REFL** key — Selects transmission/reflection characteristics.
2. **MAG** key — Displays magnitude characteristics.
3. **DELAY** key — Displays group delay characteristics.
4. **DISPERSION** key — Displays chromatic dispersion characteristics.
5. **ADVANCE** key — Sets the fiber length and the polarization controller.

2.1.1.3 SET UP section

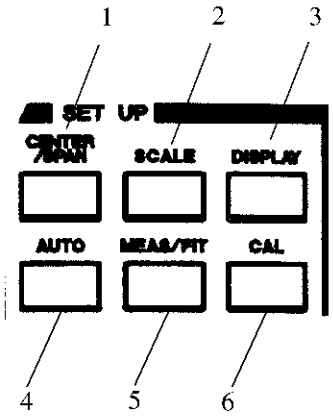


Figure 2-4 Description of SET UP Section

1. **CENTER/SPAN** key — Sets the range of sweeping.
2. **SCALE** key — Sets the vertical axis range.
3. **DISPLAY** key — Sets the display modes.
4. **AUTO** key — Sets the modulation frequnecy automatically.
5. **MEAS/FIT** key — Sets averaging and leveling.
6. **CAL** key — Performs calibration.

2.1.1.4 MEASURE section

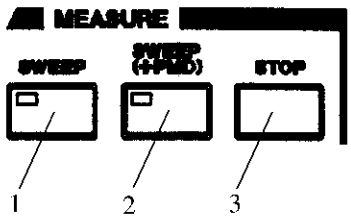


Figure 2-5 Description of MEASURE Section

1. **SWEEP** key — Measures in Sweep mode.
2. **SWEEP(+PMD)** key — Measures in SWEEP (TPMD).
3. **STOP** key — Stops the measurement.

2.1.1.5 STORAGE/DATA OUT section

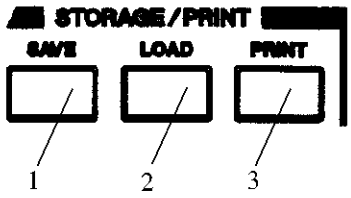


Figure 2-6 Description of STORAGE/DATA OUT Section

1. **SAVE** key — Saves measurement conditions and measurement data.
2. **LOAD** key — Recalls measurement conditions and measurement data.
3. **PRINT** key — Outputs displays.

2.1.1.6 SYSTEM section

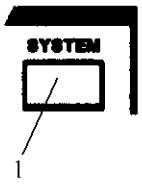


Figure 2-7 Description of SYSTEM Section

1. **SYSTEM** key — Sets the clock and the display colors.

2.1.1.7 GPIB section

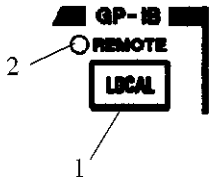


Figure 2-8 Description of GPIB Section

1. **LOCAL** key — Sets operating conditions of interfaces, etc.
2. **REMOTE** indicator — Goes ON in remote mode.

2.1.1.8 ENTRY section

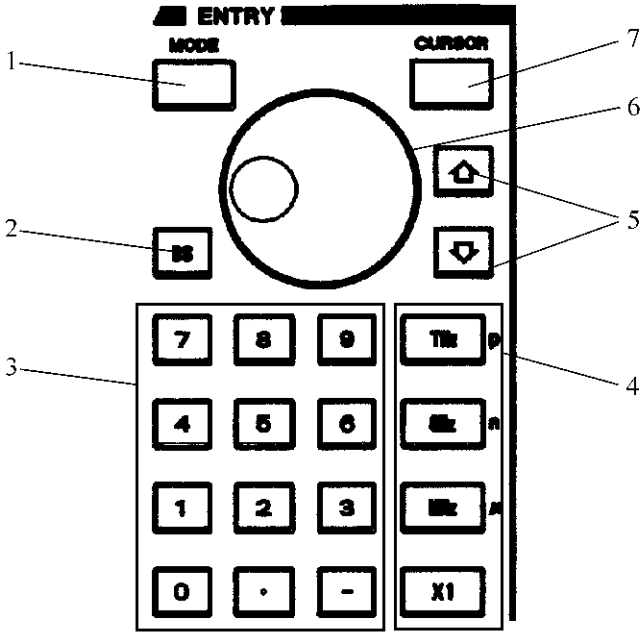


Figure 2-9 Description of ENTRY Section

1. **MODE** key — Selects cursor functions.
2. **BS** key — Revises ten key entries.
3. Numeric keys — Enters numbers.
   Numeric keys (**0** to **9**), decimal point key (**.**) and minus key (**-**) are provided.
4. Unit keys — Selects units and sets numbers.
   The **THz** key sets THz unit or pm unit.
   The **GHz** key sets GHz unit or nm unit.
   The **MHz** key sets MHz unit or μm unit.

		The **X1** key sets dB unit. In addition, defines the entered data.
5.	Step key	Enters steps of data.
6.	Data knob	Enters continuous data.
7.	**CURSOR** key	Displays the cursor.

2.1.1.9 Signal Port section

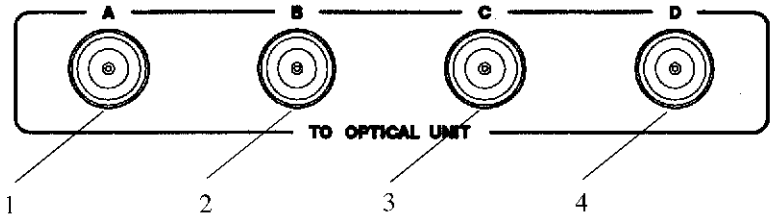


Figure 2-10 Description of Signal Port Section

1.	**A** connector	Connected to the optical analyzer unit.
2.	**B** connector	Connected to the optical analyzer unit.
3.	**C** connector	Connected to the optical analyzer unit.
4.	**D** connector	Connected to the optical analyzer unit.

2.1.1.10 Floppy Disk Drive section

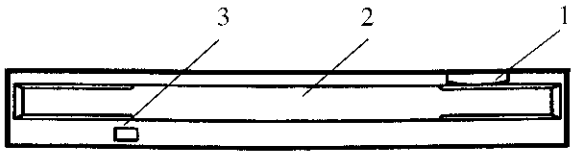


Figure 2-11 Description of Floppy Disk Drive Section

1.	Eject button	Ejects the inserted floppy disk.
2.	Slot for inserting Floppy Disk	Sets up the Floppy disk.
3.	Access indicator	Turns on when accessing the floppy disk.

2.1.1.11 POWER Switch section

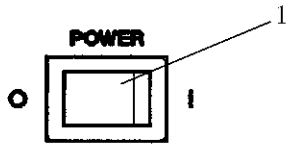


Figure 2-12 Description of POWER Switch Section

1. **POWER** switch Turns the power on or off.

2.1.2 Front Panel (Optical Network Analyzer Unit)

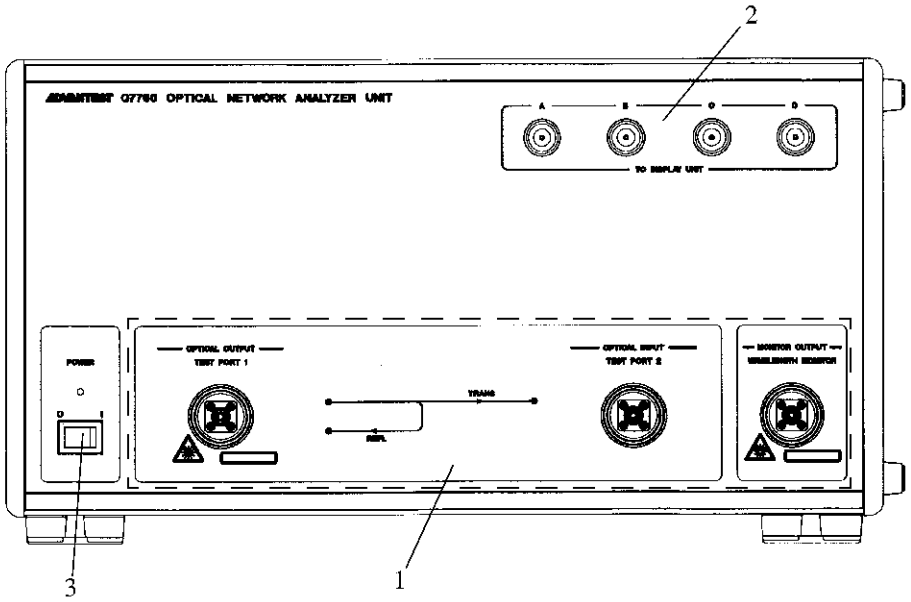


Figure 2-13 Description of the Front Panel

1. Test port section — Connected to the DUT.
2. Signal port section — Connected to the display unit.
3. POWER switch section — Turns the power on or off.

2.1.2.1 Test Port section

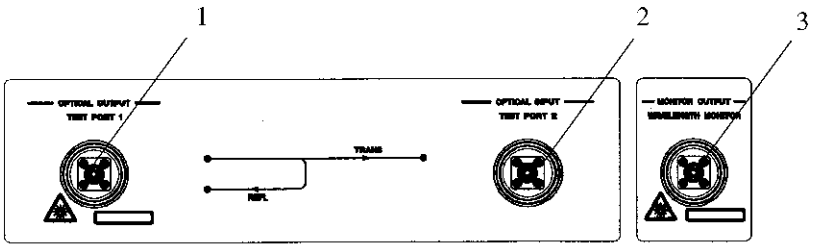


Figure 2-14 Description of Test Port Section

1. **TEST PORT 1** connector — Connected to the input connector of the DUT.
2. **TEST PORT 2** connector — Connected to the input connector of the DUT.
3. **WAVELENGTH MONITOR** connector — Outputs wavelength monitor signals.

CAUTION *A class 1 laser is emitted from the TEST PORT 1 and WAVELENGTH MONITOR connectors.*

2.1.2.2 Signal Port section

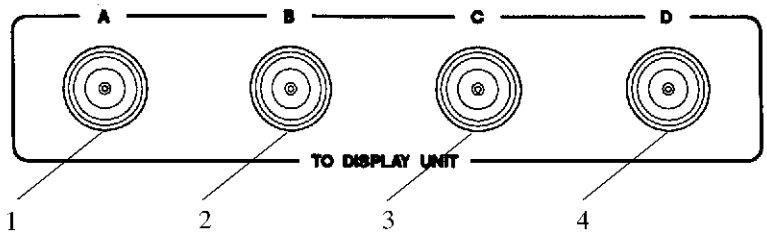


Figure 2-15 Description of Signal Port Section

1. **A** connector — Connected to the display unit.
2. **B** connector — Connected to the display unit.
3. **C** connector — Connected to the display unit.
4. **D** connector — Connected to the display unit.

2.1.2.3 POWER Switch section

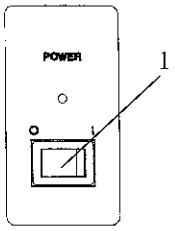


Figure 2-16 Description of POWER Switch Section

1. **POWER** switch — Turns the power on or off

2.1.3 Rear Panel (Display Unit)

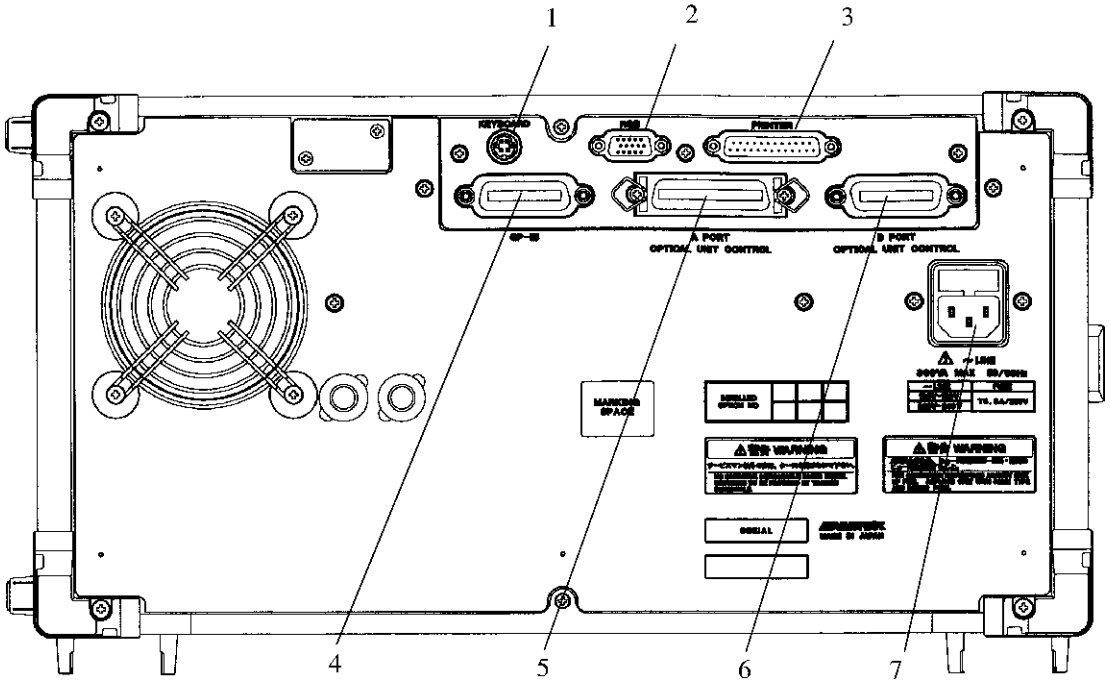


Figure 2-17 Description of Rear Panel (Display Unit) Section

1. **KEYBOARD** connector — Connects the external keyboard.

CAUTION: ***Attach a ferrite core for noise reduction on the cable when this type of connector is used.***

2. **RGB** connector
3. **PRINTER** connector — Connects the printer.
4. **GPIB** connector — Connects the external controller.

CAUTION: ***Attach a ferrite core for noise reduction on the cable when this type of connector is used.***

5. **A PORT** connector — Connected to the optical network analyzer unit.
6. **B PORT** connector — Connected to the optical network analyzer unit.
7. **AC** connector — Connects the power cable.

2.1.4 Rear Panel (Optical Network Analyzer Unit)

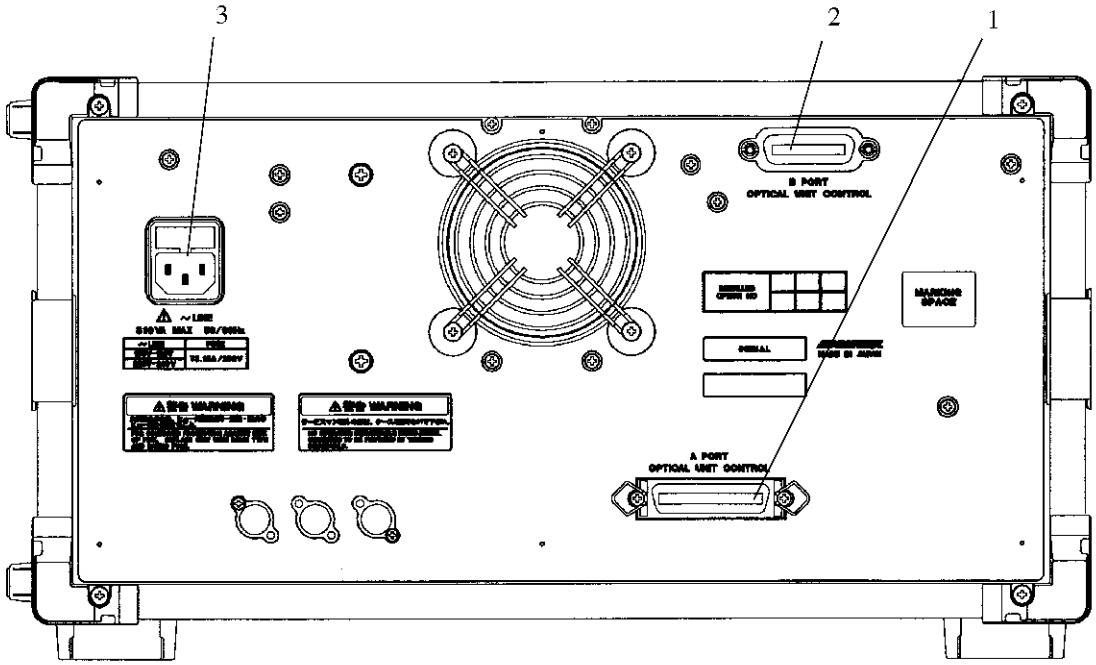


Figure 2-18 Description of Rear Panel (Optical Network Analyzer Unit) Section

1. **A PORT** connector — Connected to the display unit.
2. **B PORT** connector — Connected to the display unit.
3. **AC** connector — Connects the power cable.

2.1.5 Display Annotation

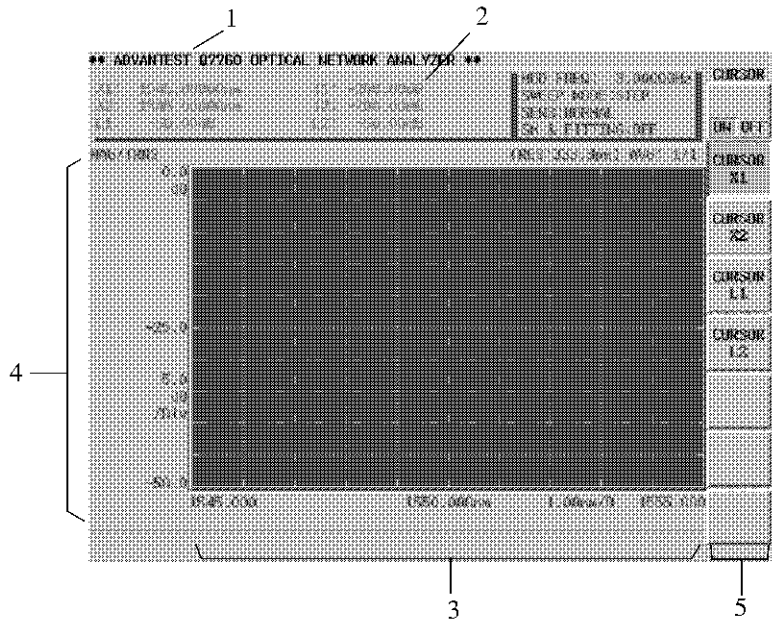


Figure 2-19 Display Annotation

1. Title area — Displays labels and calendars.
2. Cursor area — Displays cursor values.
3. X axis area — Displays set values for the X axis.
4. Y axis area — Displays set values for the Y axis.
5. Soft key area — Displays soft key menu.

2.1.6 Status Window

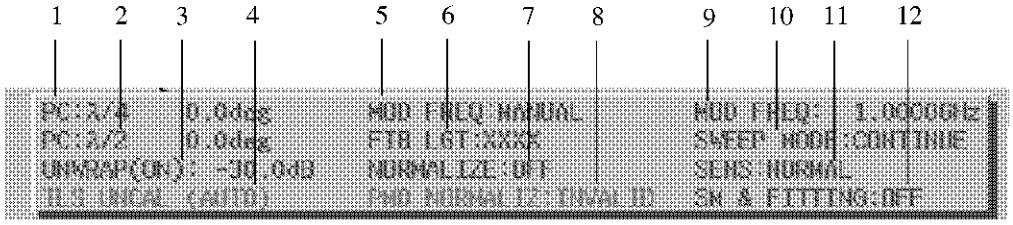


Figure 2-20 Status Window

1. PC : Polarization Controller, angle of λ/4 wave plate
2. PC : Polarization Controller, angle of λ/2 wave plate
3. UNWRAP(ON) : ON/OFF for phase unwrap, threshold when performing the phase unwrap
4. TLS UNCAL(AUTO) : Calibration information for tunable light source

   TLS CAL (white) :
   The wavelength accuracy of the light source is within the appropriate range.

   TLS UNCAL (pink) :
   The wavelength accuracy of the light source is not in the appropriate range.

   IN CALIBRATION (green):
   Light source calibration is being performed.
5. MOD FREQ : AUTO measurement mode

   MOD FREQ: AUTO:
   Modulated frequency AUTO: ON, PMD range AUTO: OFF

   MOD FREQ: MANUAL:
   Modulated frequency AUTO: OFF, PMD range AUTO: OFF

   MODFRQ: AUTO: PMD AUTO:
   Modulated frequency AUTO: ON, PMD range AUTO: ON

   MODFRQ: MAN: PMD AUTO:
   Modulated frequency AUTO: OFF, PMD range AUTO: ON
6. FIB LGT : Fiber length
   The screen displays "XXXX" when a measurement is not being conducted or nothing is being set.
7. NORMALIZE : Normalization information

   OFF (FIT): Normalization OFF, Normalization Fitting ON

   ON (FIT): Normalization ON, Normalization Fitting ON

OFF: Normalization OFF, Normalization Fitting OFF

ON: Normalization ON, Normalization Fitting OFF

8. PMD NORMALIZE : PMD Normalization information

INVALID (pink):
PMD normalization is ineffective.

VALID (white):
PMD normalization is effective.

9. MOD FREQ : Modulated frequency

10. SWEEP MODE : Sweep mode

CONTINUE :
CONT sweep (Wavelength correction function is set to OFF.)

CONT(λ): CONT sweep (Wavelength correction function is set to ON.)

STEP: STEP sweep (Wavelength correction function is set to OFF.)

STEP (λ): STEP sweep (Wavelength correction function is set to ON.)

STEP (λ/DIFF):
STEP sweep (Wavelength correction function is set to ON, Differential measurement is set to OFF.)

STEP (DIF):
STEP sweep (Wavelength correction function is set to OFF, Differential measurement is set to ON.)

11. SENS : Sensitivity

HIGH SENS: High sensitivity mode

MIDDLE SENS: Middle sensitivity mode

NORMAL SENS: Normal mode

HI SPEED: High-speed mode

12. SM & FITTING : Smoothing: ON/OFF, Smoothing width, Fitting: ON/OFF, Ripple extraction ON/OFF information

2.1.7 Report Display

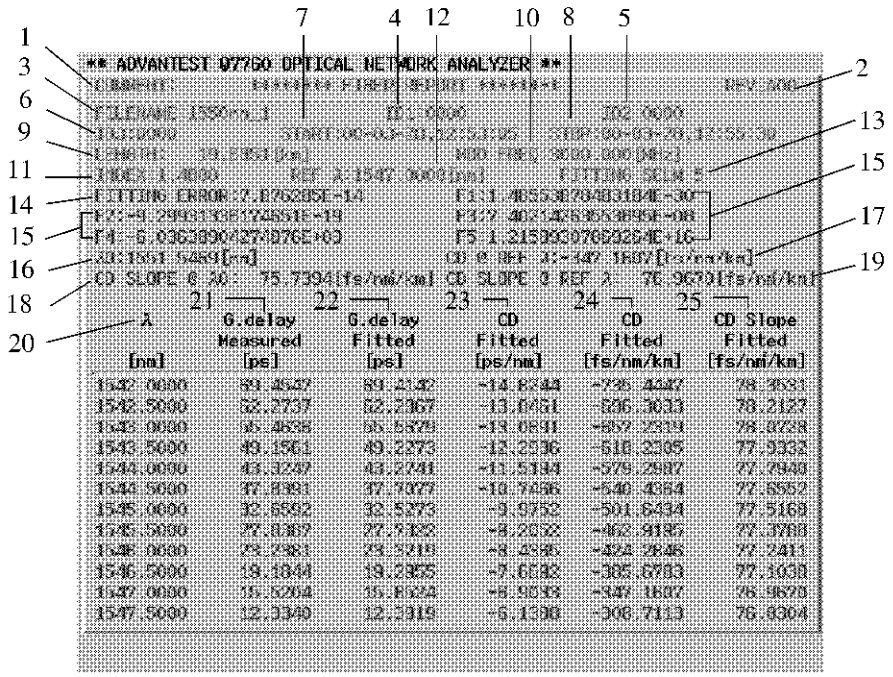


Figure 2-21 Report Display

Selecting ON from the Report menu displays the report as shown in Figure 2-21.

1. COMMENT
2. REV.: Software revision number
3. FILENAME
4. ID1: ID1
5. ID2: ID2
6. ID3: ID3
7. START: Measurement start time
8. STOP: Measurement stop time
9. LENGTH: Fiber length
10. MOD FREQ: Modulated frequency
11. INDEX: Refractive index of the fiber
12. REF λ: Reference value for λ
13. FITTING: Fitting type
14. FITTING ERROR: Statistical dispersion modified by the curve fitting
15. F1 to F5: Fitting coefficients
16. λ0: Zero-dispersion wavelength

17. CD @ REF λ: Chromatic dispersion per one kilometer at the reference value for λ
18. CD SLOPE @ λ0: Chromatic dispersion slop per one kilometerat λ0
19. CD SLOPE @ REF λ: Chromatic dispersion slope per one kilometer at the reference value for λ
20. λ: Wavelength
21. G.Delay measured: Group delay time measurements *
22. G.Delay Fitted: Group delay time measurements modified by the curve fitting *
23. CD Fitted: Chromatic dispersion measurements modified by the curve fitting
24. CD Fitted: Chromatic dispersion per one kilometer modified by the curve fitting
25. CD Slope Fitted: Chromatic dispersion slopes per one kilometer modified by the curve fitting

* The group delay time displayed in the report has an offset value which sets the group delay at 0 for a zero-dispersion wavelength.

2.2 Basic Operation

2.2.1 Menu Operation and Data Entry

This subsection explains how to operate panel keys and soft keys.

Menu selection

Pressing the panel key displays the soft menu on the display area of the screen (some keys such as **SWEEP**, however, may not be displayed.

For example, pressing **CENTER/SPAN** key displays the following soft menus.
When selecting a soft menu, press the soft key on the right.

CEN/SPN
CENTER
SPAN
START
STOP
zoom
CUR TO CENTER
FREQ DOMAIN

Figure 2-22 Soft Menu

Hierarchy of Soft Menu

Some soft menus include lower submenus.
The settings are switched every time you press the soft keys in some soft menus.
Figure 2-23 shows the hierarchy of a soft menu, as exemplified by the **ADVANCE** key.

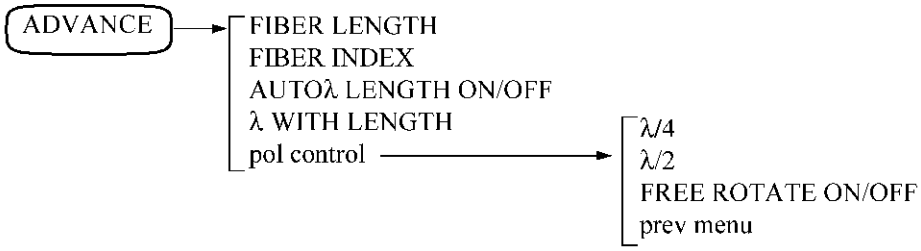


Figure 2-23 Hierarchy of Soft Menu

Submenu Display

With a menu with which a display is shown in small letters, pressing the soft key displays the next or the previous layer.

Switching Setting

In using soft menus (ON/OFF) that contain a function to switch settings, the settings can be switched every time you press the soft key.
The status currently selected is displayed in reverse video.

Entering Data

When a set value is displayed on the active area, it is possible to change the set value with the numeric keys, the step keys or the data knob.

Data Entry with numeric keys

Data is entered using the numeric keys, decimal point key, - (minus) and **BS** (back space) keys.
If a mistake is made in entering data, reenter the correct data by erasing the characters one by one with BS key.
Upon entering values and then pressing the unit, data entry is completed.

CAUTION: ***Prior to completing data entry, pressing another panel key will invalidate the entered data.***

Example 1: Set the center wavelength to 1550 nm with the numeric keys.
Press **CENTER/SPAN**, ***CENTER*** and **1, 5, 5, 0, GHz(n)**.
The center wavelength setting becomes active, and the entered data will then be displayed.
A center wavelength of 1550 nm is set.

Data Entry with step keys

The step keys are used to enter data with a predetermined step size. Pressing the "↑" key increases the data value; while pressing "↓" key decreases the value.

Data Entry with data knob

Using the data knob permits you to enter data continuously. This is conveniently used for fine adjustment of entered data.

Entering Data and Controlling Menus from the External Keyboard

The following actions can also be performed from the external keyboard attached to this instrument which are normally controlled from the panel keys.

- Selecting soft menus.
- Entering file names.
- Entering titles.
- Entering numeric data

Associated Keys

- Selecting soft menus
  Function keys F1 to F8 (on the external keyboard) correspond to soft keys 1 to 8, respectively.
- Entering file names or titles
  Use the cursor keys(↑ ↓ ← and →) to select characters. In addition, use sign and alphanumeric keys to enter data directly from the external keyboard.
- Entering numeric data
  Use the numeric and function keys F9 to F12 (see below for the units corresponding to these keys).

  F9 THz(p)
  F10 GHz(n)
  F11 MHz(μ)
  F12 X1

2.2.2 Measurement Using the SWEEP Key

There are two measurement keys; the **SWEEP** and the **SWEEP(+PMD)** keys. Each key is used to measure the transmission and reflection characteristics as described below:

The SWEEP key: Used to measure the transmission and reflection characteristics for magnitude, the group delay time, chromatic dispersion and chromatic dispersion slope.

The SWEEP(+PMD) key: Used to measure the transmission characteristics for magnitude, the group delay time, chromatic dispersion, chromatic dispersion slope and polarization mode dispersion.

	SWEEP		SWEEP(+PMD)	
	Transmission	Reflection	Transmission	Reflection
Magnitude characteristics	○	○	○	×
Group delay time characteristics	○	○	○	×
Chromatic dispersion	○	○	○	×
Chromatic dispersion slope	○	○	○	×
Polarization mode dispersion	×	×	○	×

Before measurements using the **SWEEP(+PMD)** key are performed, execute polairization controller calibration and PMD normalization (hereafter, referred to as POL CAL and PMD NORMALIZ, respectively). The measurement with the **SWEEP (+PMD)** key can be effective only within the wavelength range and with modulated frequency, both of which are used when POL, CAL, and PMD normalization are performed.

Whether or not POL CAL and PMD NOMALIZ have been completed is displayed in the PMD NORMALIZ field of the status screen.

When completed: PMD NORMALIZE:VALID (in white color)

When not completed: PMD NORMALIZE:INVALID (in pink color)

NOTE:

1. ***If you have changed the range of wavelength or modulation frequency, or if eight hours have passed since the first POL CAL and PMD NORMALIZ, execute POL CAL and PMD NOMALIZ again. Note that when only the modulated frequency is changed, only PMD normalization is performed. Calibration of the polarization controller is not required.***
2. ***The following mode and functions cannot be used for a measurement performed using the SWEEP(+PMD) key.***
   The average function
   The smoothing function
   The normalization function

2.2.3 Measurements and Cursor Operation

This subsection describes a simple measurement of fiber grating (with a center wavelength 1551.9 nm) and data reading with the cursor.

NOTE: ***In order to make accurate measurements, this analyzer should be used within the specified environmental temperature range. In addition, calibration should be done after warming up the analyzer for more than 2 hours, following turning on the power. A description of warm-up and calibration is omitted here because this description is of operations.***

Setup

1. Referring to the "1.6 Setup", connect the display unit to the optical network analyzer unit.

Turning the Power On

2. Check whether the **POWER** switch on each front panel is turned OFF.

CAUTION: ***To prevent damage, input voltage or frequency over the specified range should not be applied to this analyzer.***

---

3. Connect the power cables to the outlets.

4. Turn on the **POWER** switches (on the front panels).
The internal initialization and self test is performed.
Upon completing the self test, the initial screen is displayed. (It takes about one minute to display the screen.)

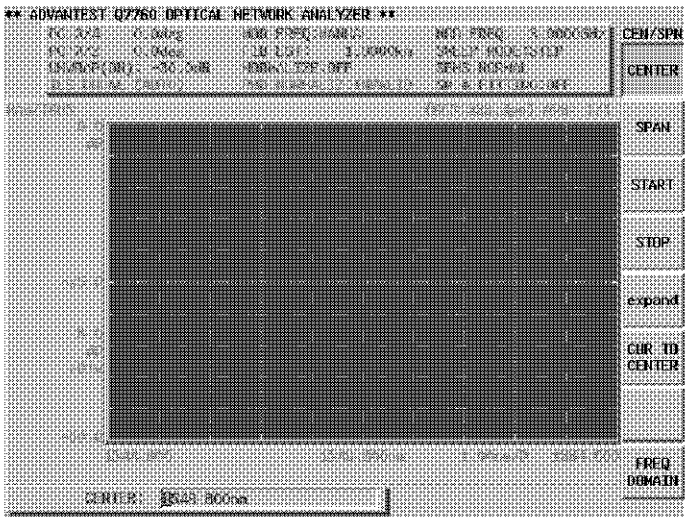


Figure 2-24 Initial Screen

NOTE: The display after tuning the power on will differ depending on the previous state of use.

Initializing Set State

Initialize the set state of this analyzer.

5. Press the **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

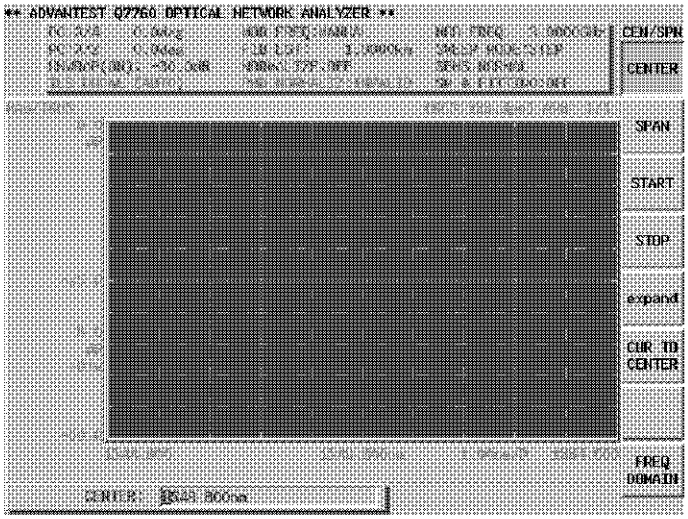


Figure 2-25 Initial Set Screen

Connecting DUT

6. Connect the optical fiber cable from **TEST PORT 1** on the front panel to the input connector of the DUT.

7. Connect another optical fiber cable from **TEST PORT 2** on the front panel to the output connector of the DUT.

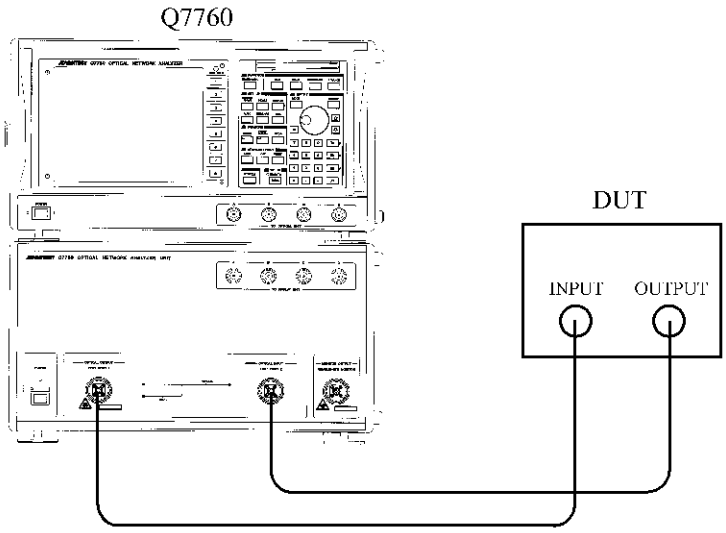


Figure 2-26 Connecting the DUT

Setting Measurement Conditions

Set the measurement conditions so that the input signal may be easily observed.

8. Press **TRANS/REFL**.
   The TRANS/REFL menu for setting the measurement mode is displayed

9. Press the ***REFL***.
   The measurement mode is set to the reflection mode.

10. Press the **MAG**, ***MAG***.
    The display mode is set to the magnitude characteristic mode.

11. Press **CENTER/SPAN**.
    The CEN/SPAN menu for setting the display range is displayed.

12. Press ***CENTER***, **1**, **5**, **5**, **1**, **.**, **9** and **GHz(n)**.
    The center wavelength is set to 1551.9 nm.

13. Press ***SPAN***, **1**, **.**, **2** and **GHz(n)**.
    The display width is set to 1.2 nm.

14. Press **MEAS/FIT**, ***sweep mode*** and ***CONT SWEEP***.
    The sweep mode is set to the continuous sweep mode.

15. Press **MEAS/FIT**, ***sweep mode***, ***cont reso***, ***DATA POINTS***, **6**, **0**, **1** and **X1**.
    The number of measurement points is set to 601.

16. Press the **SWEEP**.

The reflection magnitude characteristics of the DUT are displayed.

17. Press **SCALE** and ***AUTO***.

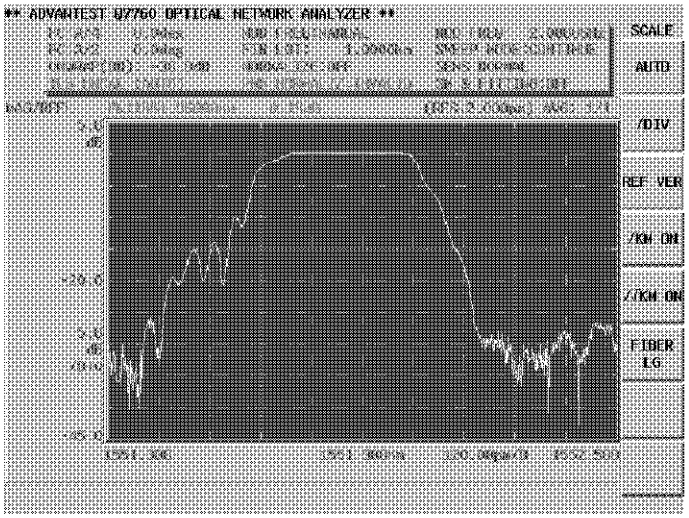


Figure 2-27 Reflection Magnitude Characteristics

Displaying Cursor

18. Press **CURSOR** and ***ON/OFF***(ON).
The X1 cursor is displayed. Also the wavelength and level of this position are displayed on the cursor area of the screen.

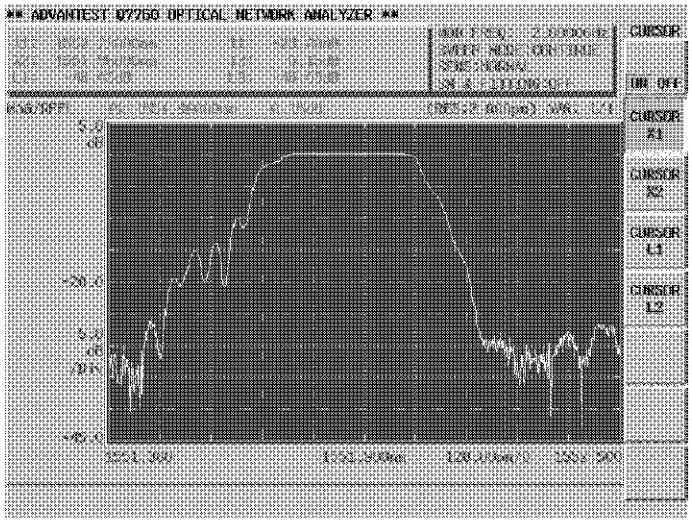


Figure 2-28 Displaying the Cursor

19. Move the cursor by turning the knob.
Turn the knob so that the X1 cursor will meet the flat part (pass band) of the trace. The wavelength at the position of the cursor and the loss at the point are displayed

on the cursor area.

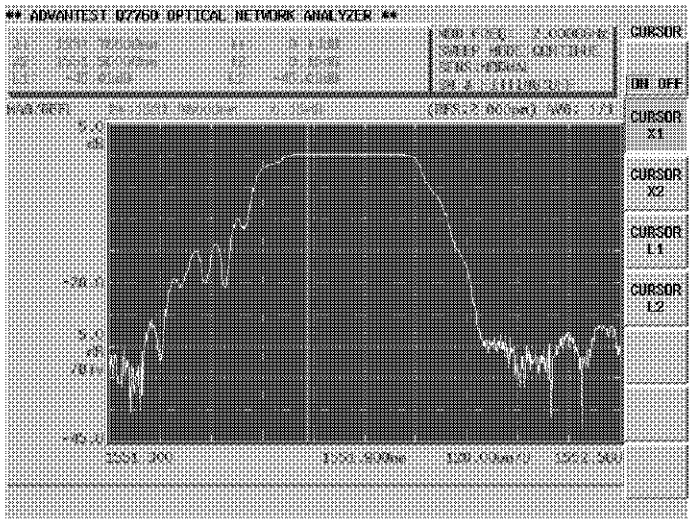


Figure 2-29 Reading with the Cursor

2.2.4 Measurement Using the SWEEP(+PMD) Key

This section describes an example for a PANDA fiber characteristic measurement using SWEEP(+PMD) together with the examples for a polarization controller calibration and a PMD Normalize operation.

Initializing the panel settings

1. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

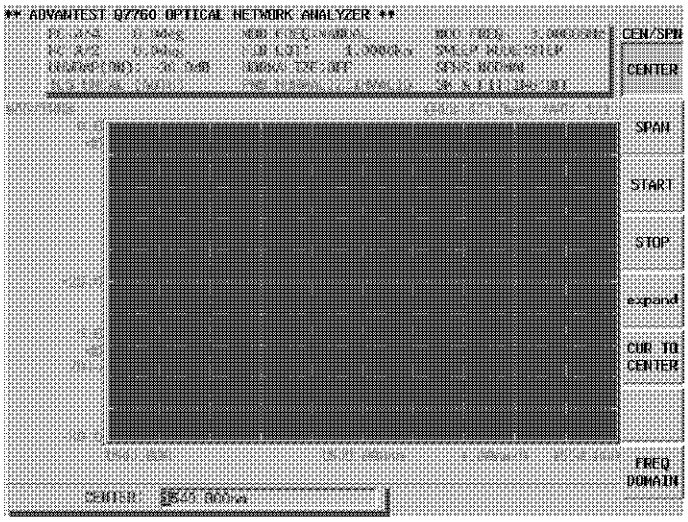


Figure 2-30 Initial Set Screen

POL CAL and PMD NORMALIZ

2. Connect the short-size single mode optical fiber cable from the **TEST PORT1** to the **TEST PORT2** on the front panel.

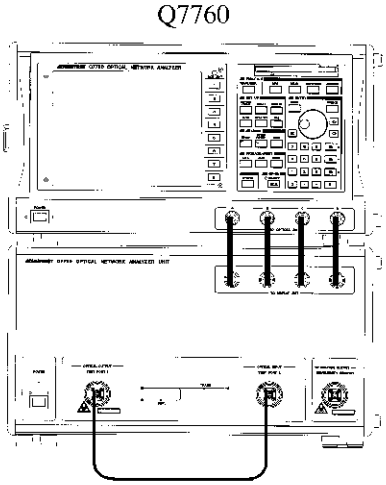


Figure 2-31 Short-size Single Mode Optical Fiber Cable Connection

3. Press **TRANS/REFL** and ***TRANS***.
   The measurement mode is set to the transmission characteristic mode.

4. Press **DISPERSION** and ***PMD***.
   The measurement mode is set to the transmission PMD characteristic mode.

5. Press **CENTER/SPAN**.
   The menu used to set the measurement range is displayed.

6. Press ***CENTER***, **1**, **5**, **5**, **4** and **GHz(n)**.
   The center wavelength is set to 1554 nm.

7. Press ***SPAN***, **2** and **GHz(n)**.
   The display width is set to 2 nm.

8. Press **MEAS/FIT**, ***sweep mode*** and ***CONT SWEEP***.
   The sweep mode is set to continuous sweep.

9. Press **MEAS/FIT**, ***sweep mode***, ***cont reso***, ***DATA POINTS***, **6**, **0**, **1** and **X1**.
   The number of measurement points is set to 601.

10. Press **MEAS/FIT**, ***MODE FREQ***, **1** and **GHz**.
    The modulation frequency is set to 1 GHz.

11. Press **MEAS/FIT**, ***sens*** and ***HIGH SENS***.
    The sensitivity mode is set to HIGH SENS.

12. Press **CAL** and ***POL CAL***.
    POL CAL is executed (for about one minute).

13. Press **CAL** and ***PMD NORMLIZ***.
    PMD NORMALIZ is executed using the set wavelength span (for about one and a half minutes).

    When PMD NORMLIZ has been completed, the PMD NORMLIZ display is changed from INVALID (in pink color) to VALID (in white color) in the status screen.

Measurement

14. Connect the optical fiber cable between the **TEST PORT1** connector on the front panel and the DUT input connector.

15. Connect the optical fiber cable between the **TEST PORT2** connector on the front panel and the DUT output connector.

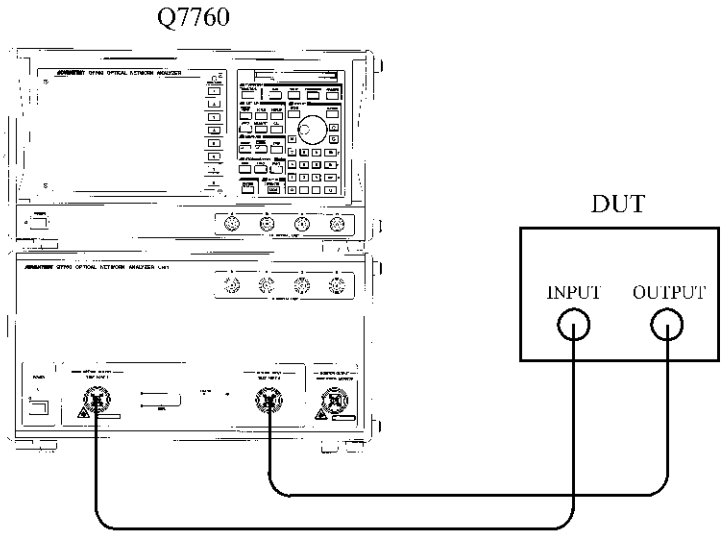


Figure 2-32 DUT Connection

16. Press **SWEEP(+PMD)**.
    Measurement is started.

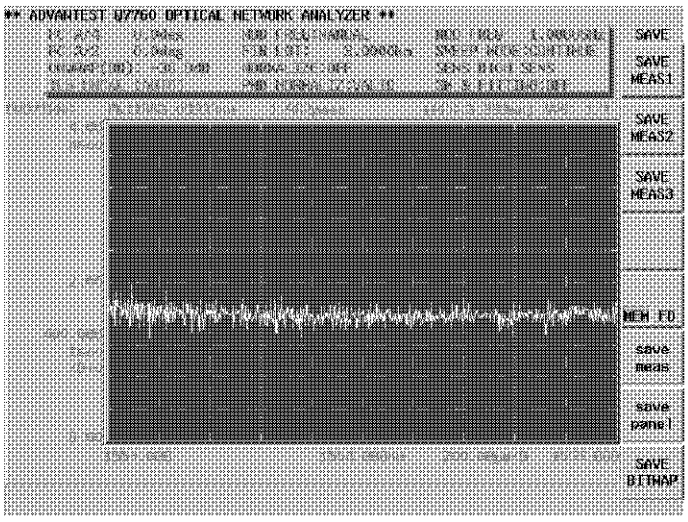


Figure 2-33 PMD Characteristics

2.2.5 Analysis with Dual Screen Display

The magnitude and group delay characteristics can be observed simultaneously by use of the dual screen mode.

Setup

1. Referring to the "1.6 Setup", connect the display unit to the optical network analyzer unit.

Turning the Power On

2. Turn the **POWER** switch on each front panel ON.
   The internal initialization and self test is performed.
   Upon completing the self test, the initial screen is displayed. (It takes about three minutes to display the screen.)

Initializing Set State

Initialize the set state of this analyzer.

3. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

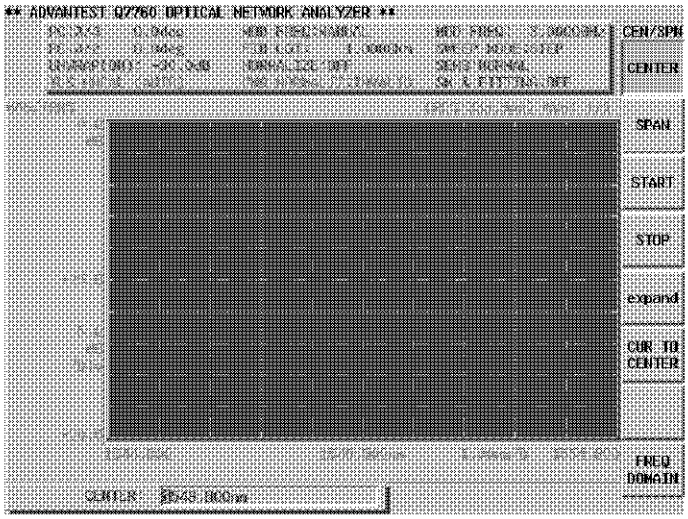


Figure 2-34 Initial Set Screen

Connecting DUT

4. Connect an optical fiber cable from **TEST PORT 1** on the front panel to the input connector of the DUT.

5. Connect another optical fiber cable from **TEST PORT 2** on the front panel to the output connector of the DUT.

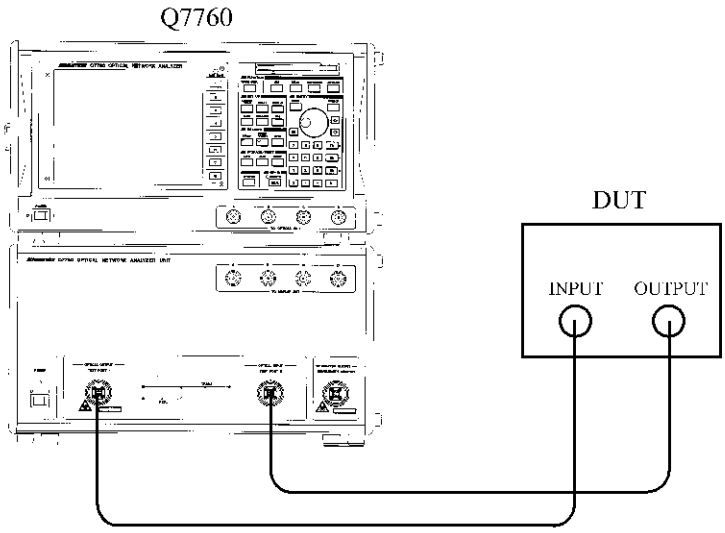


Figure 2-35 Connecting the DUT

Setting Measurement Conditions

Set the measurement conditions so that the input signal may be easily observed.

6. Press **TRANS/REFL**.
   The TRANS/REFL menu for setting the measurement mode is displayed.

7. Press ***REFL***.
   The measurement mode is set to the reflection mode.

8. Press **MAG** and ***MAG***.
   The displayed mode is set to the magnitude characteristic mode.

9. Press **CENTER/SPAN**.
   The CEN/SPAN menu for setting the display range is displayed.

10. Press ***CENTER***, **1**, **5**, **5**, **1**, **.**, **9** and **GHz(n)**.
    The center wavelength is set to 1551.9 nm.

11. Press ***SPAN***, **1**, **.**, **2** and **GHz(n)**.
    The display width is set to 1.2 nm.

12. Press **MEAS/FIT**, ***sweep mode*** and ***CONT SWEEP***.
    The sweep mode is set to the continuous sweep mode.

13. Press **MEAS/FIT**, ***sweep mode***, ***cont reso***, ***DATA POINTS***, **6**, **0**, **1** and **X1**.
    The number of measurement points is set to 601.

14. Press the **SWEEP**.
    The transmission magnitude characteristics of the DUT is displayed.

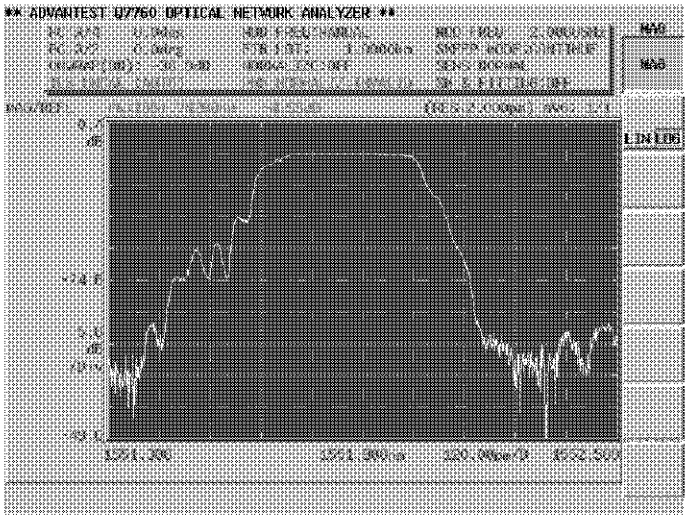


Figure 2-36 Single Screen Display

Dual Screen Display

Switch the screen display mode to the dual screen display mode.

15. Press **DISPLAY,** ***dual disp*** and ***DUAL DISP ON/OFF***(ON).
The display mode is switched to the dual screen display mode. The reflection magnitude characteristics are displayed on both screens.

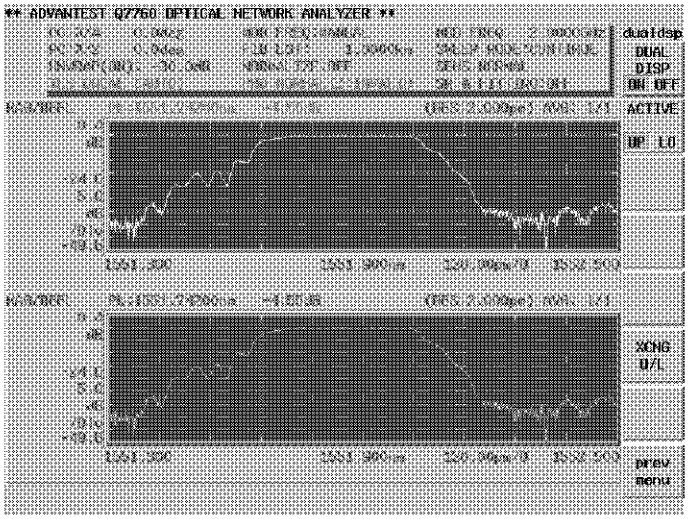


Figure 2-37 Dual Screen Display (1)

The magnitude and group delay characteristics are displayed.

16. Press **DELAY** and ***GROUP DELAY.***
The upper screen is changed to display of the group delay characteristics.
In dual screen display, the entry of measurement conditions is basically for the high priority screen.

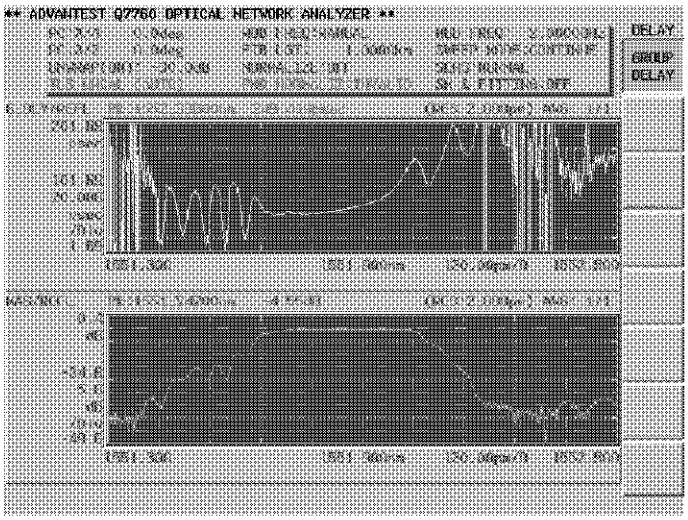


Figure 2-38 Dual Screen Display (2)

17. Press **DISPLAY,** ***dual disp*** and ***XCNG U/L.***
The upper screen is replaced with the lower screen. The magnitude characteristics are displayed on the upper screen while the group characteristics are displayed on the lower screen.

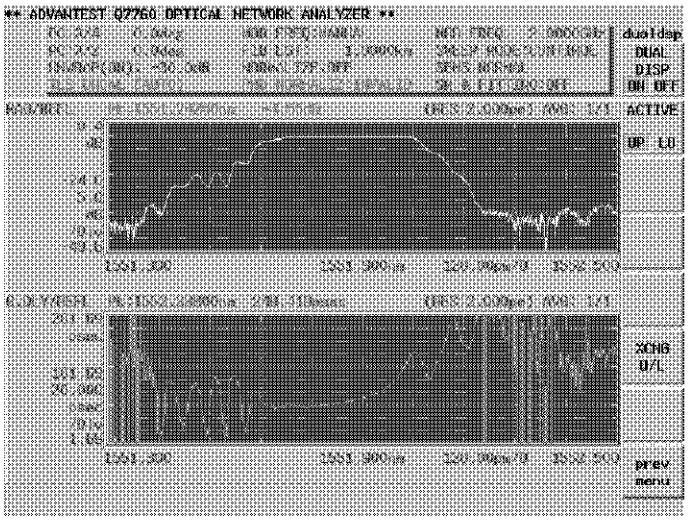


Figure 2-39 Replacing Screens

18. Press **DISPLAY** and ***BOTH MEAS ON/OFF***(ON).
The settings shown below are set from the low priority screens instead of the high priority screens (that can be set using ACTIVE UP or LO, or ACTIVE LF or RI). When **SWEEP** and **SWEEP (+PMD)**, which are located in the **MEASURE** section, are pressed data on both the high and low priority screens is updated.

Unified measurement conditions

CENTER/SPAN
Number of points (Resolution)
Modulation frequency
Measurement mode (Normal measurement and Differential measurement)
Sensitivity
Wavelength/frequency domain
Average setting
Setting conditions related to wavemeters and CAL

NOTE:

1. ***The measurement conditions on the low priority screens are automatically changed if the following measurement conditions are changed while BOTH MEAS ON/OFF is turned on and the display mode is set to Dual screen or Superimposing mode.***
CENTER/SPAN
Number of points (Resolution)
Modulation frequency
Measurement mode (Normal measurement and Differential measurement)
Sensitivity
Wavelength/Frequency domain
Average setting
Setting conditions related to wavemeters and CAL
2. ***Only data on high priority screens can be saved to memory or floppy disks.***

2.2.6 Partial Fitting Operation

This section describes how to fit measurements within the specified range using the partial fitting function.

Setup

1. Connect the optical network analyzer and display unit.

Turning the power on

2. Check that the **POWER** switch on each front panel is turned off.
3. Connect the **POWER** cables to the receptacles.
4. Turn on the **POWER** switch on each front panel.
   The initialization and self-test are performed individually. On completion of the self-test, the initial screen is displayed (it takes approximately one minute).

Initializing Settings

5. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

Connecting the DUT

6. Connect the optical fiber cable between the **TEST PORT1** on the front panel and the DUT input connector.
7. Connect the optical fiber cable between the **TEST PORT2** on the front panel and the DUT output connector.
8. Press **TRANS/REFL** and ***REFL***.
   The measurement mode is set to reflection t.
9. Press **DELAY** and ***GROUP DELAY***.
   The measurement mode is set to group delay time t.
10. Press ***CENTER/SPAN***.
    The CEN/SPAN menu that sets the measurement range is displayed.
11. Press ***CENTER***,**1**,**5**,**5**,**1**, ., **9** and **GHz(n)**.
    The center frequency is set to 1551.9 nm.
12. Press ***SPAN***,**1**, ., **2** and **GHz(n)**.
    The display span is set to 1.2 nm.
13. Press **MEAS/FIT**, ***sweep mode*** and ***CONT SWEEP***.
    The sweep mode is set to the continuous sweep mode.
14. Press **MEAS/FIT, sweep mode, cont reso, DATA POINTS, 6, 0, 1** and **X1**.
    The number of measurement points is set to 601.

15. Press **SWEEP**.
The measurement starts. The group delay characteristic of the DUT is displayed.

16. Press **SCALE** and ***AUTO***.
The vertical axis scale is optimized to display measurements on the entire screen.

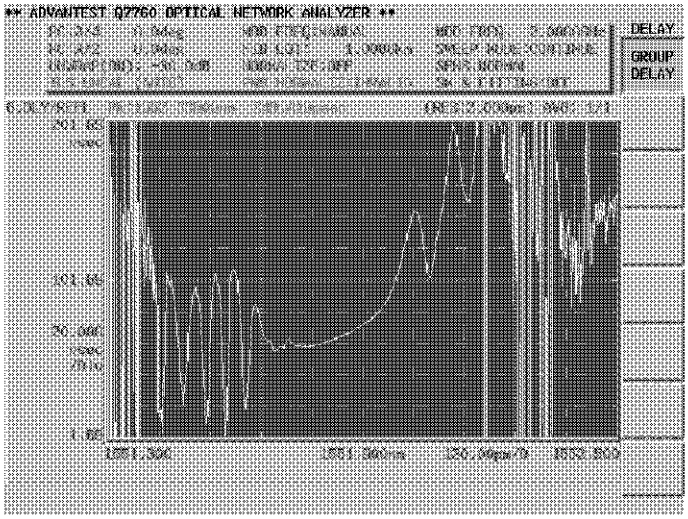


Figure 2-40 Partial Fitting 1

17. Press **CURSOR** and ***CURSOR X1***.
The X1 cursor is activated.

18. Turn the knob to set the X1 cursor to the left end of the fitting range.

19. Press **CURSOR** and ***CURSOR X2***.
The X2 cursor is activated.

20. Turn the knob to move the X2 cursor to the right end of the fitting range.
The partial fitting range is set between the cursors X1 and X2.

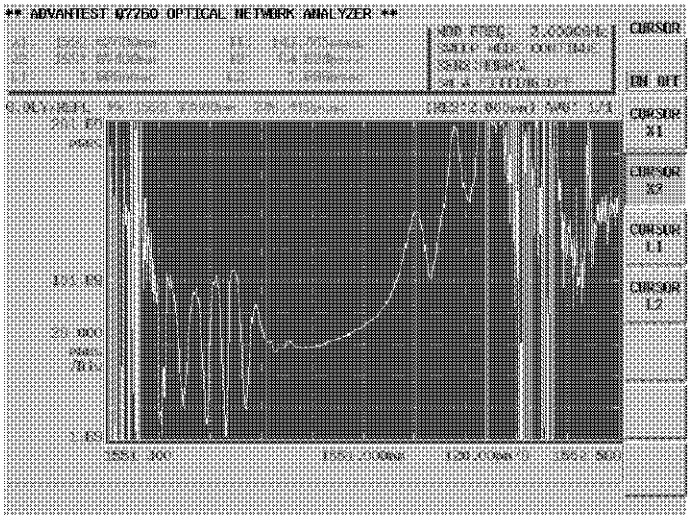


Figure 2-41 Partial Fitting 2

21. Press **MEAS/FIT**, ***fit*** and ***PARTIAL ON/OFF***(ON).
The partial fitting function is activated.

22. Press **MEAS/FIT**, ***fit, fit mode*** and ***QUAD FIT***.
A quadratic polynomial is selected for the curve fitting function.

23. Press **MEAS/FIT**, ***fit*** and ***FIT ON/OFF***(ON).
The fitting function is activated. Fitting is executed in the range between the cursors X1 and X2.

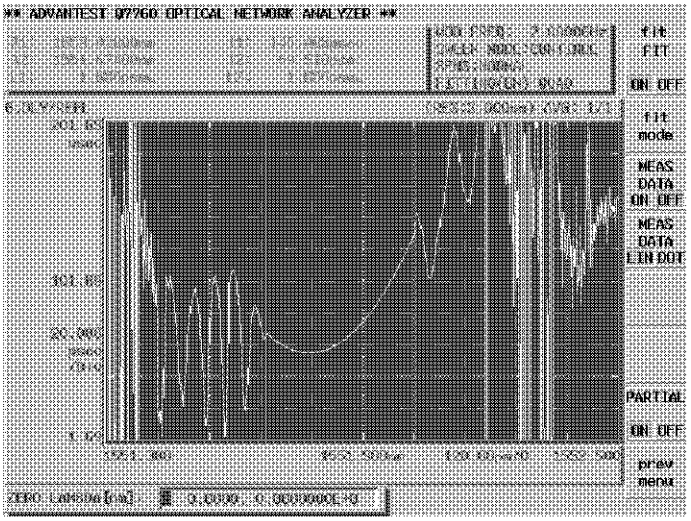


Figure 2-42 Partial Fitting 3

2.2.7 Limit Line Function (Using a User File)

This section explains how to make pass/fail judgments for measurements using a user file that was edited with a personal computer.

Setup

1. Connect the optical network analyzer and display unit.

Turning the power on

2. Check that each **POWER** switch on the front panel is turned off.
3. Connect the power cables to the receptacles.
4. Turn on the **POWER** switch on each front panel.
   Initialization and self-test are performed individually. On completion of the self-test, the initial screen is displayed (it takes approximately three minutes).

Initializing Settings

5. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

DUT Connection

6. Connect the optical fiber cable between the **TEST PORT1** on the front panel and the DUT input connector.
7. Connect the optical fiber cable between the **TEST PORT2** on the front panel and the DUT output connector.

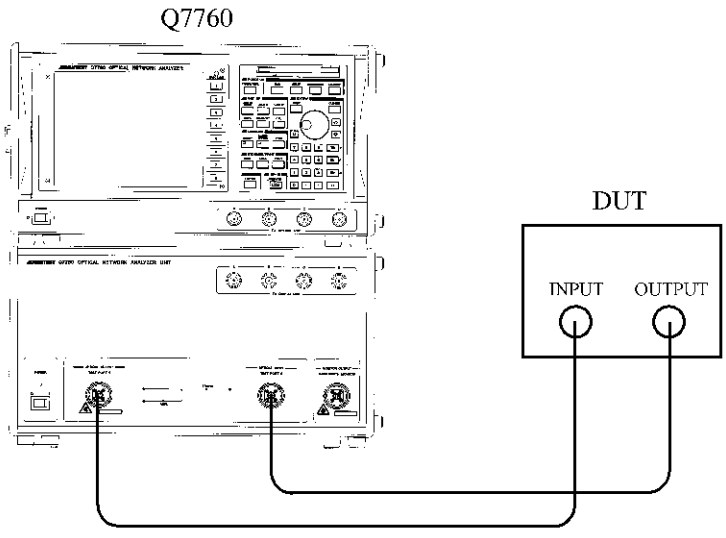


Figure 2-43 DUT Connection

Creating a limit line data file

8. Create a limit line data file using a personal computer and enter the limit line data. Then save the file to a floppy disk using the name listed in the table below.
For example, the limit line data is saved to the FD:\LmtLn\lmtln1.txt file as shown in Figure 2-44.
(For more information, refer to Section 6.12, "Creating Limit Line Data Files.")

Specified file name	Remarks
FD:\LmtLn\lmtln1.txt	Corresponds to ***PATTERN 1***
FD:\LmtLn\lmtln2.txt	Corresponds to ***PATTERN 2***
FD:\LmtLn\lmtln3.txt	Corresponds to ***PATTERN 3***
FD:\LmtLn\lmtln4.txt	Corresponds to ***PATTERN 4***
FD:\LmtLn\lmtln5.txt	Corresponds to ***PATTERN 5***

```
[Fundamental]
MeasMode=MAGLOG              ' MAG table
Domain=WAVE                  ' Waveform domain

[Reference]
DataModeX=REL                ' Sets the X-axis coordinate to the relative scale.
RefModeX=LEFT                ' Sets the left edge of the screen graph to a reference point.
RefUserX=                    ' No specification
OffsetX=0                    ' Sets the X offset to zero.
DataModeY=ABS                ' Sets the Y-axis coordinate to the absolute scale.
RefModeY=                    ' No specification
RefUserY=                    ' No specification
OffsetY=0                    ' Sets the Y offset to zero.

[TableUp]
PassRange=UNDER              ' The test result is pass if the measurement is below the line.
+0.0,  +5.0                  ' The X axis coordinate is relative to the START waveform
+1.0,  +5.0                  ' and is expressed with the nm unit.
+1.0, +10.0                  ' Power (dB) is used to express Y-axis amplitudes.
+3.0, +10.0                  ' The psec unit is used to express other than
+3.0, +30.0                  ' Y-axis amplitudes.
+5.0, +30.0
+5.0, +25.0
+8.0, +25.0
+8.0, +15.0
+10.0,+15.0

[TableLow]
PassRange=OVER               ' The test result is pass if the measurement is above the line.
+0.0,  -5.0
+1.0,  -5.0
+1.0, -10.0
+3.0, -10.0
+3.0, -30.0
+5.0, -30.0
+5.0, -25.0
+8.0, -25.0
+8.0, -15.0
+10.0,-15.0
```

Figure 2-44 Limit Line Data Example

Setting the limit line and measurement conditions

9. Press **DISPLAY** and ***limit line*** to display the limit menu.

10. Insert the floppy disk that includes the limit line data file to the floppy drive.

11. Select the pattern you want to use. (***PATTERN 1- 5***)
For the purpose of this example, select ***PATTERN 1***.

    Load the limit line pattern data file from the floppy disk to display the limit line on the screen. The limit line data file also causes the Q7760 to change the measurement mode and domain information as appropriate.

NOTE: ***If the appropriate file has not been saved in the floppy disk, or the floppy disk is not inserted into the floppy drive, attempting to load one of these files causes an error.***

---

12. Change the measurement conditions such as the START/STOP wavelength and REF level as necessary.

Measurement

13. Press **SWEEP** to start the measurement.

Pass/fail judgment

14. When the measurement has been completed, press ***PASS/FAIL*** to make a pass/fail judgment and display the result on the screen.

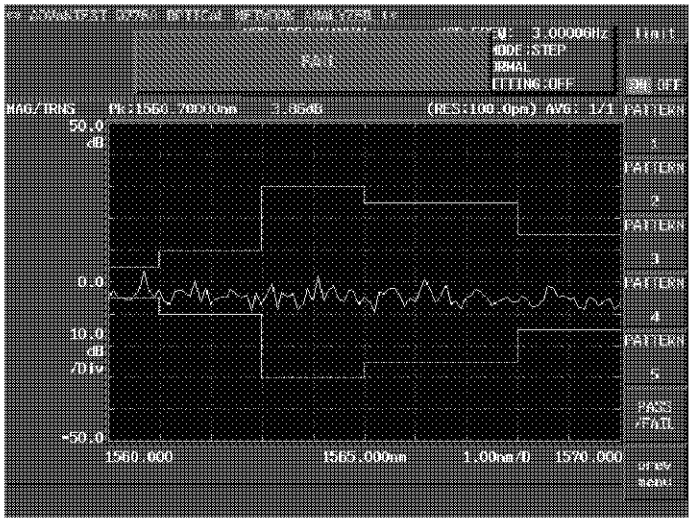


Figure 2-45 Pass/Fail Judgment Result

2.2.8 Normalization

Normalization is used to measure correct DUT characteristics by correcting measurement errors caused by elements such as optical fiber cables and connectors for connecting the DUT.

Acquiring the correction data for the normalizing function should be performed in the same mode and wavelength range as when actually measuring the DUT.

2.2.8.1 Normalization (Transmission Characteristics Mode)

DUT transmission characteristics are measured using a center wavelength of 1534.95 nm and a span of 1.6 nm with the normalization function enabled.

Setup

1. Referring to "1.6 Setup", connect the display unit to the optical network analyzer.

Turning Power On

2. Turn on the **POWER** switches on the front panels.
   Initialization and self-test are done.
   When the self-test is completed, the initial screen is displayed (it takes about three minutes).

Initializing Set State

Initialize the set state of this analyzer.

3. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

Acquiring Normalized Data

4. Connect the cable between **TEST PORT 1** and **TEST PORT 2** bypassing the DUT.

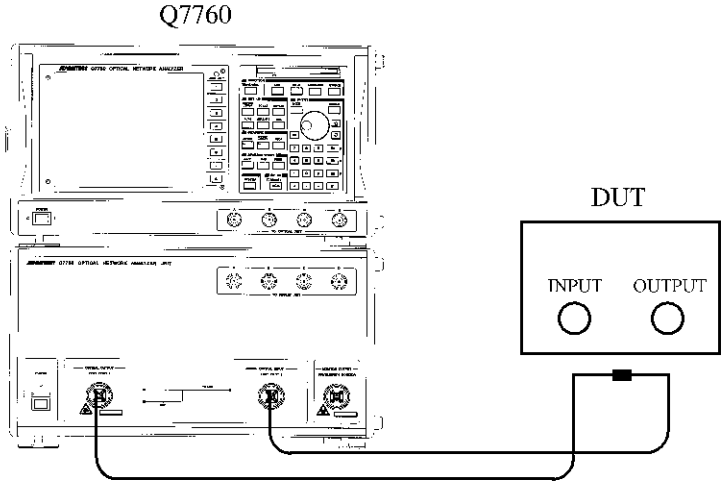


Figure 2-46 Connection with the DUT Bypassed

Measurement system characteristics are measured in the same mode and wavelength range as when actually measuring the DUT.

5. Press **TRANS/REFL** and ***TRANS***.
   The measurement mode is set to the transmission characteristic mode.

6. Press **MAG** and ***MAG***.
   The display mode is set to the magnitude characteristic mode.

7. Press **CENTER/SPAN**, ***CENTER***, **1, 5, 3, 4, ., 9, 5** and **GHz(n)**.
   The center wavelength is set to 1534.950 nm.

8. Press ***SPAN***, **1, ., 6** and **GHz(n)**.
   The display width is set to 1.6 nm.

9. Press **SWEEP**.
   Measurement system characteristics are displayed.

10. Press **CAL**, ***trans normliz*** and ***SV REF***.
    Measured measurement system characteristics are stored in reference memory.

11. Press ***NORMLIZ***.
    For subsequent measurement, normalization is effective.

Connecting the DUT

12. Connect the DUT to be measured to the analyzer.

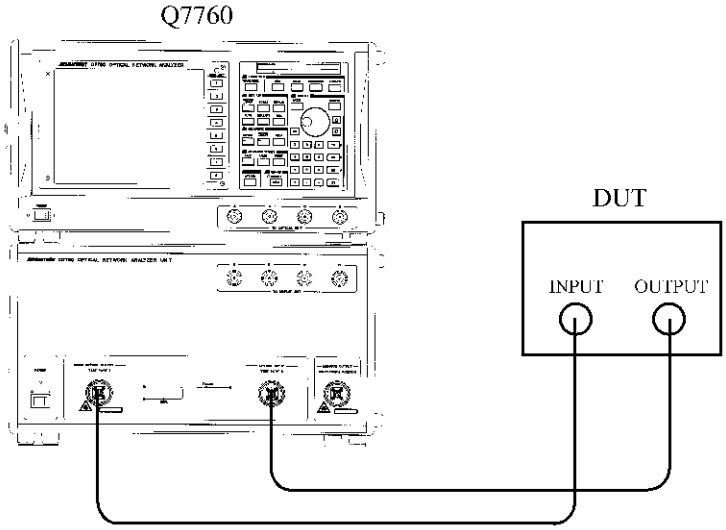


Figure 2-47 Connecting the DUT

Measuring the DUT

13. Press **SWEEP**.
Corrected DUT characteristics acquired by correcting errors in the measurement system are displayed.

2.2.8.2 Normalization (Reflection Characteristics Mode)

Normalization is available in the two states shown below with reference to the correction.

(1) Total reflection state (A total reflection fiber is connected to the tip of the fiber).

(2) Full Fresnel reflection (The tip of the fiber is opened).

DUT reflection characteristics are measured at a center wavelength of 1534.95 nm and a span of 1.6 nm with reference to the total reflection state using the normalization function.

Setup

1. Referring to "1.6 Setup", connect the display unit to the optical network analyzer.

Turning Power On

2. Turn on the **POWER** switches on the front panels.
Initialization and self-test are done.
When the self-test is completed, the initial screen is displayed (it takes about three minutes).

Initializing Set State

Initialize the set state of this analyzer.

3. Press **SYSTEM** and ***PRESET***.
Measurement conditions for this instrument are initialized.

Acquiring Normalized Data

4. Connect the full reflection fiber.

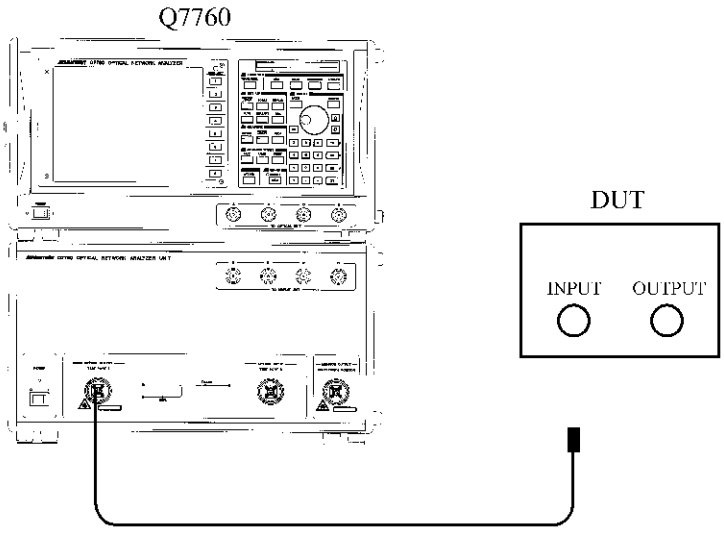


Figure 2-48 Connection with the DUT Bypassed

Measurement system characteristics are measured in the same mode and wavelength range as when actually measuring the DUT.

5. Press **TRANS/REFL** and ***REFL***.
   The measurement mode is set to the reflection characteristic mode.

6. Press **MAG** and ***MAG***.
   The display mode is set to the magnitude characteristic mode.

7. Press **CENTER/SPAN**, ***CENTER***, **1, 5, 3, 4, ., 9, 5** and **GHz(n)**.
   The center wavelength is set to 1534.950 nm.

8. Press ***SPAN***, **1, .,6** and **GHz(n)**.
   The display width is set to 1.6 nm.

9. Press **SWEEP**.
   Measurement system characteristics are displayed.

10. Press **CAL**, ***refl normliz*** and ***SV REF***.
    Measured measurement system characteristics are stored in reference memory.

11. Press ***NORMLIZ***.
    For subsequent measurement, normalization is effective.

Connecting the DUT

12. Connect the DUT to be measured to the analyzer.

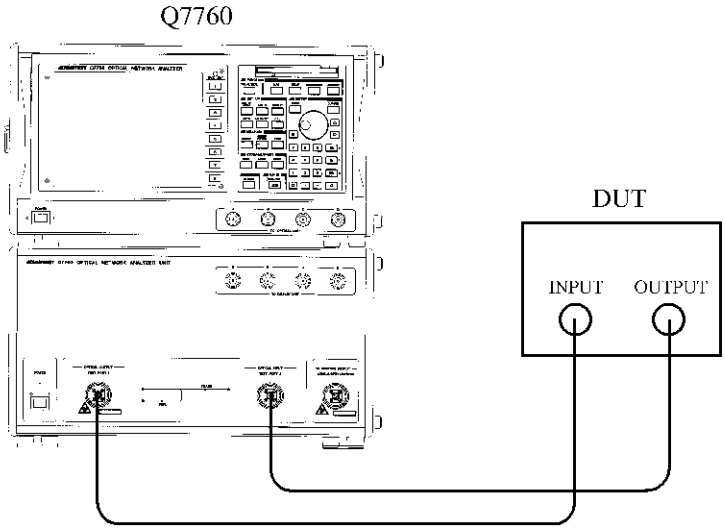


Figure 2-49 Connecting the DUT

Measuring the DUT

13. Press **SWEEP**.
    Corrected DUT characteristics acquired by correcting errors in the measurement system are displayed.

2.2.9 Correcting Wavelength

This analyzer can perform highly accurate wavelength measurements by correcting the wavelength errors with one of the following the wavelength meters: TQ8325 or Q8326 (Advantest), the 86120 B/C (Agilent Technologies), or WA-1650 (Burleigh Instrument, Inc).

This section describes the measurement for reflection characteristics of DUTs within a center wavelength of 1534.95 nm and a span of 1.6 nm using the wavelength correction function of the Q8326 optical wavelength meter.

Setup

1. Referring to "1.6 Setup", connect the display unit to the optical network analyzer.
2. Connect the **B PORT** of the display unit to the **GPIB** connector of the wavelength meter.
3. Connect the optical fiber cable from the **WAVELENGTH MONITOR** connector on the front panel of the optical network analyzer (used with Optscope) to the input connector on the wavemeter.

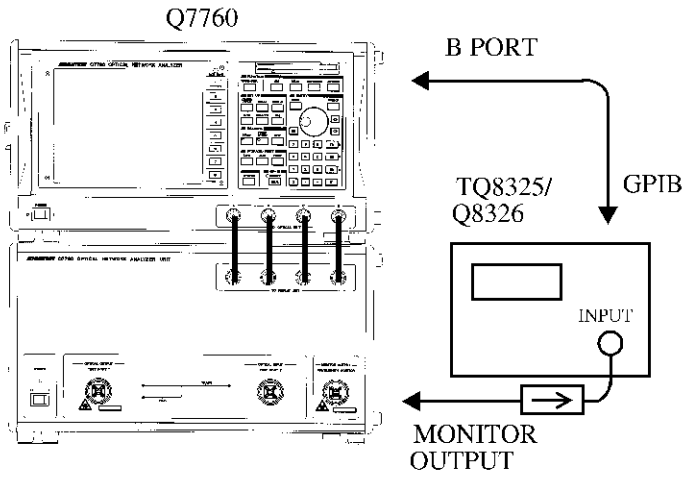


Figure 2-50 Connecting the Wavelength Meter

Turning the Power On

4. Turn on the **POWER** switch on the front panel.

Initializing Set State

5. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

Setting GPIB

6. Set the GPIB address of the wavelength meter to 8.

For address setting, refer to the wavelength meter operation manual.

CAUTION: ***When WA-1650 is used, the GPIB ON/OFF setting is required.***

Wavelength Compensation Function

Setting the wavelength compensation function

7. Press **CAL** and ***λ comp***.
   The wavelength compensation menu is displayed.

8. Press ***λ COMP ON/OFF***(ON).
   The wavelength compensation function is turned on.

9. Press ***Q8326***.
   The Q8326 is designed to correct wavelength.

Connecting the DUT

10. Connect the optical fiber cable from **TEST PORT 1** connector on the front panel to the input connector of the DUT.

11. Connect the optical fiber cable from **TEST PORT 2** connector on the front panel to the output connector of the DUT.

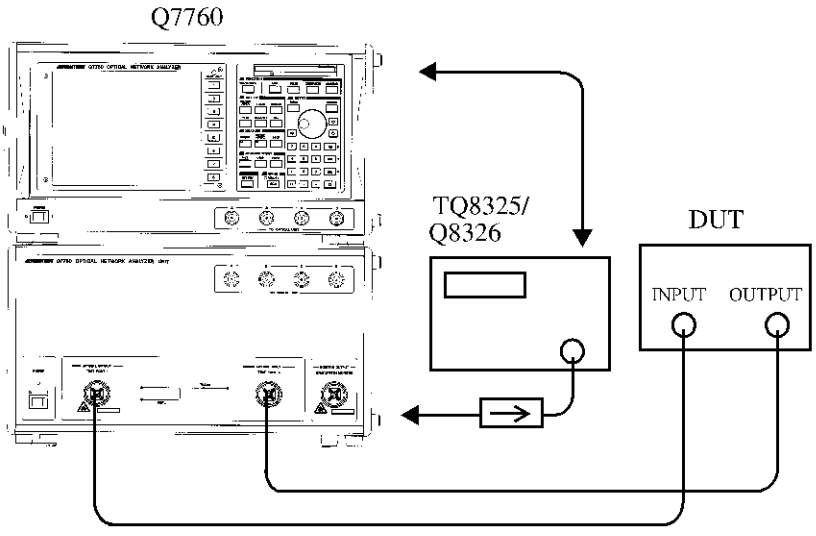


Figure 2-51 Connecting the DUT

Setting Measurement Conditions.

12. Press **TRANS/REFL** and ***REFL***.

13. Press **MAG** and ***MAG***.

14. Press **CENTER/SPAN**.

15. Press ***CENTER***, **1, 5, 3, 4, ., 9, 5** and **GHz(n)**.

16. Press ***SPAN***, **1, ., 6** and **GHz(n)**.

17. Press **MEAS/FIT**, ***sweep mode*** and ***CONT SWEEP***.
    The sweep mode is set to the continuous sweep mode.

18. Press **MEAS/FIT**, ***sweep mode, cont reso, DATA POINTS***, **6, 0, 1** and **X1**.
    The number of measurement points is set to 601.

19. Press **SWEEP**.
    The highly accurate horizontal axis with wavelength error correction and DUT reflection magnitude characteristics are displayed.

2.2.10 Ripple Extraction Function

This section describes how to use the Ripple Extraction function.

Setup

1. Referring to "1.6 Setup", connect the display unit to the optical network analyzer.

Turning the Power On

2. Make sure that the **POWER** switches on both front panels are turned off.
3. Connect the power cables to the outlet.
4. Turn on the **POWER** switch on the front panel.
   Initialization and self-test are performed first. When the self-test is complete, the initial screen appears. It takes approximately one minute for the analyzer to display the initial screen.

Initializing Set State

5. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

Connecting the DUT

6. Connect the optical fiber cable from **TEST PORT 1** connector on the front panel to the input connector of the DUT.
7. Connect the optical fiber cable from **TEST PORT 2** connector on the front panel to the output connector of the DUT.

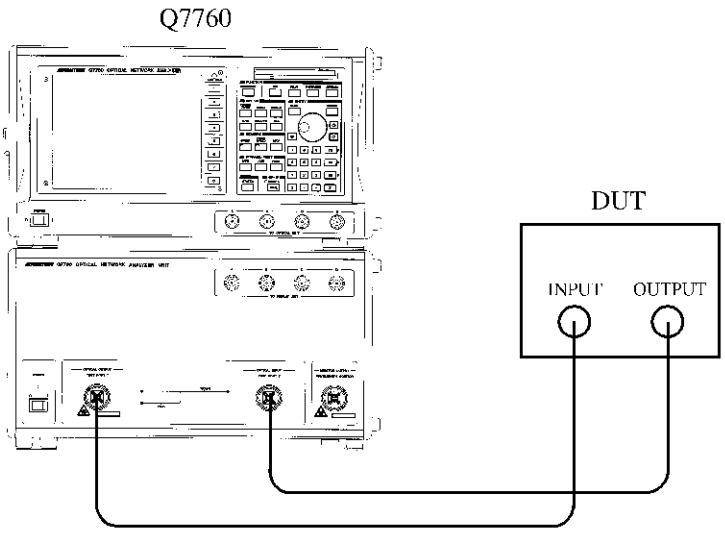


Figure 2-52 Connecting the DUT

Setting Measurement Conditions

8. Press **TRANS/REFL** and ***REFL***.
   The measurement mode becomes the reflection characteristic mode.

9. Press **DELAY** and ***GROUP DELAY***.
   The measurement mode becomes the reflection group delay time characteristics.

10. Press **CENTER/SPAN**.
    The CEN/SPN menu used for specifying a measurement range is displayed.

11. Press **CENTER**, **1**, **5**, **5**, **9**, **.**, **9**, **5** and **GHz(n)**.
    The center wavelength is set to 1559.95 nm.

12. Press **SPAN**, **1**, **.**, **5**, and **GHz(n)**.
    The display width is set to 1.5nm.

13. Press **MEAS/FIT**, ***sweep mode***, and ***CONT SWEEP***.
    The sweep mode is set to Continuous Sweep.

14. Press **MEAS/FIT**, ***MOD FREQ***, **5**, **0**, **0**, and **MHz**.
    The modulated frequency is set to 500 MHz.

Measurement

15. Press **SWEEP**.
    The measurement starts. Then, the group delay time characteristics of the DUT is displayed. It takes approximately 30 seconds to display the group delay time characteristics of the DUT.

16. Press **SCALE** and **AUTO**.
    The scale of the vertical axis is adjusted according to the measurement value.

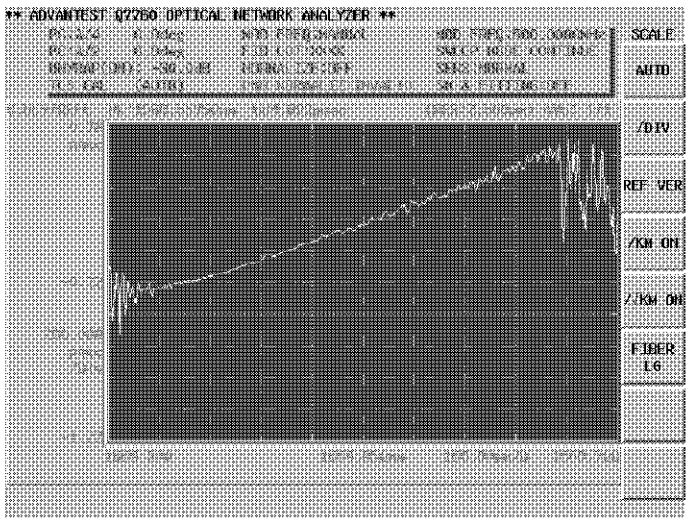


Figure 2-53 Reflection Group Delay Time Characteristics

Ripple Extraction Function

17. Press **CURSOR** and ***CURSOR X1***.
    The X1 cursor becomes active.

18. Turn the knob and put the X1 cursor on the left side of the analyzing range.

19. Press **CURSOR** and ***CURSOR X2***.
    The X2 cursor becomes active.

20. Turn the knob and put the X2 cursor on the right side of the analyzing range.
    The arithmetic range of the Ripple Extraction function is specified between the X1 and X2 cursors.

21. Press **MEAS/FIT**, ***ripple***, and ***LINEAR***.
    The arithmetic mode of the Ripple Extraction function is set to LINEAR.

22. Press **MEAS/FIT**, ***ripple***, and ***RIPPLE ON/OFF***(ON).
    The Ripple Extraction is executed in the range specified by the cursors.

23. Press **SCALE** and ***AUTO***.
    The scale of the vertical axis is adjusted based on the measurement value.

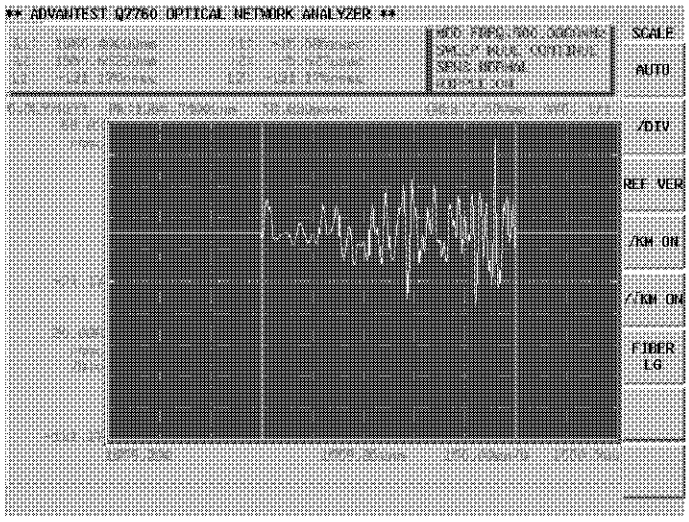


Figure 2-54 Ripple Waveform of Group Delay Time Characteristics

2.3 Enhanced Functions

2.3.1 Save/Load

This analyzer can save/load measurement conditions and measurement results to/from memory and floppy disks.

The following operational examples are explained here.

Saving measurement results using a simple operation
Loading measurement results using a simple operation
Saving measurement conditions
Loading measurement conditions
Saving the displayed results to a floppy disk
Saving measurement results to a floppy disk in binary format
Saving measurement result to a floppy disk in ASCII format
Saving displayed screen data

(1) Simple saving of measurement results

Saving measurement results

1. Press **SAVE**.
   The SAVE menu is displayed.

2. Press ***SAVE MEAS1***.
   The measurement results currently displayed on the screen are saved in the memory with the FILE_001.SPE file name. The measurement results are also saved with the FILE_002.SPE and FILE_003.SPE file names.

(2) Simple loading of measurement results

Recalling of measurement results

1. Press the **LOAD**.
   The LOAD menu is displayed.

2. Press ***LOAD MEAS1***.
   Measurement results that are saved with the FILE_001.SPE file name are downloaded on the screen. The measurement results that are saved with the FILE_002.SPE and FILE_003.SPE file names can also be downloaded on the screen.

(3) Saving measurement conditions to floppy disk

Setting the saving destination

1. Press **SAVE**.
   SAVE menu is displayed.

2. Press the ***MED/FD***(FD).
   The floppy disk is selected.

Selecting file

3. Press ***save panel.***
   The directory list of the floppy disk and the save panel menu are displayed.

4. Turn the knob to select the empty column.
   Select the empty row of the directory list in order to save the measurement conditions again.

File name entry

When saving, it is possible to fix a unique name as well as the file name to the file automatically (based on the current center wavelength and the serial number).
If a unique name is not needed, skip to the 8 step. In this case, enter "AMP_TEST" as the file name.

5. Press the ***name.***
   The name menu and the Character list are displayed.

6. Enter the character "A"
   Turn the knob to put the cursor on "A" in the character list, then press the **ENTER** key.
   The character "A" is entered into the input buffer.
   Enter "A," "M," "P," "_," "T," "E," "S" and "T" likewise.

7. Press any one of the keys **THz(p)**, **GHz(n)**, **MHz(μ)** and **X1**.
   "AMP_TEST" entered into the input buffer is displayed as a file name on the directory list.

Executing save

8. Press ***SAVE.***
   The currently set measurement conditions are saved to floppy disk.

9. Press ***EXIT.***
   The mode will return to the measurement state.

(4) Loading measurement conditions from floppy disk

Setting the load source

1. Press **LOAD.**
   The LOAD menu is displayed.

2. Press the ***MEM/FD*** (FD).
   The floppy disk is selected.

Selecting file

3. Press **LOAD** then ***load panel.***
   The directory list of the floppy disk and the load panel menu are displayed.

4. Turn the knob to select a file. Then press **LOAD**.
   The specified file is recalled and the analyzer system enters the measurement state.

(5) Saving the displayed results to a floppy disk

Selecting an output device

1. Press **SAVE**.
   The SAVE menu is displayed.

2. Press ***MEM/FD***(FD).
   The floppy disk drive is selected.

Selecting a file

3. Press ***save meas***.
   The list of floppy disk directories and the save meas menu are displayed.

Entering a file name

Any file name can be entered, although a default file name based on the current center frequency and serial number can be used. For more information, refer to paragraph "(3) Saving measurement conditions to floppy disk."

Selecting the displayed result

4. Press ***FD DATA DIS/MEA***(DIS).
   Selects the displayed results only.

Selecting a unit

5. Press ***UNIT NRM/DIS***(NRM).
   Selects normalized unit for the results.
   (Select ***UNIT NRM/DIS***(DIS) to save the displayed unit.)

Saving data

6. Press ***SAVE***.
   The currently displayed measurement results as well as the current measurement conditions are saved to a floppy disk in ASCII format.

7. Press ***EXIT***.
   The optical network analyzer enters the measurement mode.

(6) Saving measurement results to a floppy disk in binary format

1. Press **SAVE**.
   The SAVE menu is displayed.

2. Press ***MEM/FD***(FD).

The floppy disk drive is selected.

Selecting a file

3. Press ***save meas***.
   The list of floppy disk directories and the save meas menu are displayed.

Entering a file name

Any file name can be entered, although a default file name based on the current center frequency and serial number can be used. For more information, refer to paragraph "(3) Saving measurement conditions to floppy disk."

Selecting the measurement result

4. Press ***FD DATA DIS/MEA***(MEA).
   Selects the measurement results.

Selecting the binary format

5. Press ***MEAS FORMAT ASC/BIN***(BIN).
   Selects the binary format for the results.

Saving data

6. Press ***SAVE***.
   The currently displayed measurement results as well as the current measurement conditions are saved to a floppy disk in binary format.

7. Press ***EXIT***.
   The optical network analyzer enters the measurement mode.

(7) Saving measurement result to a floppy disk in ASCII format

1. Press **SAVE**.
   The SAVE menu is displayed.

2. Press ***MEM/FD***(FD).
   The floppy disk drive is selected.

Selecting a file

3. Press ***save meas***.
   The list of floppy disk directories and the save meas menu are displayed.

Entering a file name

Any file name can be entered, although a default file name based on the current center frequency and serial number can be used.. For more information, refer to paragraph "(3) Saving measurement conditions to floppy disk."

Selecting the measurement result

4. Press ***FD DATA DIS/MEA***(MEA).
   Selects the measurement results.

Selecting ASCII

5. Press ***MEAS FORMAT ASC/BIN***(ASC).
   Selects the ASCII format for the results.

Selecting a unit

6. Press ***UNIT NRM/DIS***(NRM).
   Selects normalized unit for results.
   (Select ***UNIT NRM/DIS***(DIS) to save the displayed unit.)

Saving data

7. Press ***SAVE***.
   The currently displayed measurement results (MAG, GROUP DELAY, CD, CD Slope and PMD) as well as the current measurement conditions are saved to a floppy disk in binary format.

8. Press ***EXIT***.
   The optical network analyzer enters the measurement mode.

(8) Saving displayed screen data to a floppy disk

Displayed screen data is saved to a floppy disk as a bitmap file (extension: rle).
These bitmap files can be opened on any personal computer which uses Windows 95, Windows 98 or the Macintosh OS.

Saving Displayed Screen Data

1. Press **SAVE** and ***SAVE BITMAP***.
   The currently displayed screen data is saved to a floppy disk as image data.

2.3.2 Initializing Media

This section explains how to initialize floppy disks.

A new floppy disk must be formatted before storing data on it.

3.5 inch 2DD 720KB, and 2HD 1.44MB floppy disks (conformed to the MS-DOS format) can be used for this analyzer.

Write protection of floppy disk

A floppy disk has a write protection function so that stored data will not be erased or overwritten by an operational error.
The write protection tab on the rear side of the floppy disk is used for write protection.

Setting write protection: Slide the write protection tab so that the hole is opened.

Releasing write protect: Slide the write protection tab so that the hole is closed.

Initializing the floppy disk

Confirming write protection

1. Check whether write protection on the floppy disk has been released.
2. Insert the floppy disk into the disk drive.

Initializing the floppy disk

CAUTION: ***Initializing the floppy disk will erase all data on the disk.***

---

3. Press **SYSTEM,** ***floppy*** and ***format.***
   The format menu initializing the floppy disk is displayed.
4. Press ***2HD (1.44M)*** and ***EXECUTE.***
   The floppy disk is initialized to MS-DOS 1.44MB format. The access indicator flashes during initialization (for about one minute).
5. Press ***prev menu.***

Volume name entry

When there is no need to manage floppy disks with a volume name attached, the following operation is unnecessary.

In this case, set the volume name to "DATA1."

6. Press ***volume.***
   The volume name and the Character list is displayed.

7. Enter the character "D"
   Turn the knob to put the cursor on "D" in the character list. Then press the **ENTER** key.
   The character "D" is entered into the input buffer.
   Enter "A," "T," "A" and "1."

8. Press any one of the keys **THz(p)**, **GHz(n)**, **MHz(μ)** and **X1**.
   The "DATA1" entered in the input buffer is read as a volume name into the floppy disk.

2.3.3 Setting Date/Time

This section explains how to set the date and the time.

For example, the clock is set to 13:45, March 16, 2001.

Setting date

1. Press **SYSTEM** and ***clock***.
   The clock menu is displayed.

2. Press ***YEAR***.
   Set "2001" with the data knob, ↑ or ↓ key.
   The year 2001 is set.

3. Press ***MONTH***.
   Set "2" with the data knob, ↑ or ↓ key.
   March is set.

4. Press ***DAY***.
   Set "16" with the data knob, ↑ or ↓ key.
   The ninth is set.

Setting time

5. Press ***HOUR***.
   Set "13" with the data knob, ↑ or ↓ key.
   13:00 is set.

6. Press ***MINUTE***.
   Set "45" with the data knob, ↑ or ↓ key.
   00:45 is set.

2.3.4 Screen Data Output

This section describes how to print out screen data.

This analyzer system can output screen data to the provided printer using a parallel interface (compliant with the Centronics). Even though a color printer is connected to the analyzer, the printer prints out in monochrome.

NOTE: ***The output resolution of this analyzer system is 180 dots/inch. Using a printer with a resolution other than integral multiples of 180 dots/inch may cause striped patterns to appear.***

Printers provided with ESC/P, ESC/P R, or HP PCL as the printer control code can be used with this analyzer (some printer operations may be restricted). Table 2-1 shows typical examples.

Table 2-1 Recommended Printers

Manufacturer	Model
EPSON	PM-760C (ESC/P R)
HEWLETT-PACKARD	DeskJet 694C, DeskJet 880L (PCL)
Canon	BJ M70 (ESC/P)

CAUTION ***Carefully check the recommended printers for their power supply specifications before using them in countries outside of Japan, since these specifications only comply with the Japanese standards.***

Connecting the printer

1. Connect the printer cable to the PRINTER connector on the rear panel.
   The printer cable specified by the printer manufacturer must conform to IBM-PC specifications.

   CAUTION: ***To prevent the units from being damaged, the printer cable should be connected after turning the power off.***

Setting the print mode

2. Press **PRINT** while displaying the screen to be printed.
   The PRINT menu used to copy measurement results is displayed.

3. Press ***ESC/P, ESC/P R or PCL.***
   ESC/P, ESC/P R or PCL then becomes valid.
   This analyzer system uses ESC/P (Epson Standard Code for Printers), ESC/PR (Epson Standard Code for Printer Raster mode), or HP PCL (Hewlett-Packard Printer Command Language) as the printer control code. Choose the printer control code that matches the printer to be used.

Print Operation

4. Press **EXE PRINT** while displaying the screen to be printed.
   The screen data is output to the printer. The time required for printing depends on the print mode and the printer used, etc.

3 MEASUREMENT EXAMPLES

You can learn how to use this analyzer through the following measurement examples.

3.1 Fiber Bragg Grating Filter Measurement

This analyzer can be used to measure the following reflection and transmission characteristics simultaneously: magnitudes (MAG), the group delay time (GROUP DELAY), chromatic dispersion (CD) and chromatic dispersion slope (CD SLOPE). In this example, how to use this analyzer to analyze the magnitude and group delay time in the reflection characteristic and the transmission characteristic of Fiber Bragg Grating Filter for the 50 GHz band width Add/Drop using the following functions is described.

- 2-screen display: Two graphs are displayed simultaneously.
- Cursor display: The measured value can be verified using the cursor.
- Bandwidth analysis: Analyzes the bandwidth.

Measurement conditions

Center wavelength: 1551.9 nm

Wavelength span: 1.2 nm

Sweep mode: Continuous sweep

Modulation frequency: 2 GHz

NOTE: ***Use this instrument within the specified temperature range in order to conduct the measurement correctly. After turning the power on, allow the instrument to warm up for at least two hours before starting calibration.***
This section focuses on the operation for the Fiber Bragg Grating Filter measurement, so the warm-up and calibration procedures are not described in this section.

Setup

1. Connect the appropriate cables between the optical network analyzer and the display units.

Turning Power On

2. Make sure that the **POWER** switch (on the front panel) is in the OFF position for each panel.

3. Plug the power cable into the outlet.

4. Turn on the **POWER** switch (on the front panel) of each unit.
Internal initialization and self-test are automatically performed. The initial screen is displayed when the self-test is complete (This process approximately one minute in total).

Initializing the Set Conditions

5. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

Connecting the DUT

6. Connect the optical fiber cable from **TEST PORT 1** on the front panel to the input connector of the DUT.

7. Connect another optical fiber cable from **TEST PORT 2** on the front panel to the output connector of the DUT.

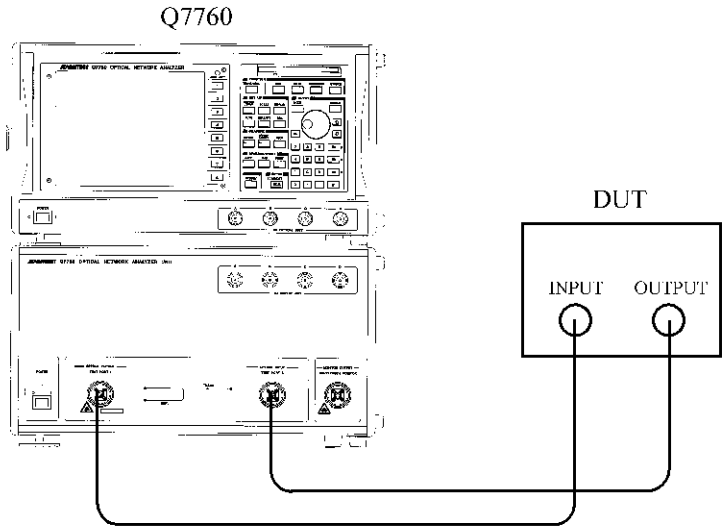


Figure 3-1 Connecting the DUT

Setting the Measurement Conditions

8. Press **TRANS/REFL** and ***TRANS***.
   The measurement mode is set to the transmission measurement mode.

9. Press **MAG** and ***MAG***.
   The measurement mode is set to the transmission magnitude.

10. Press **CENTER/SPAN**.
    The CEN/SPAN menu used to set measurable ranges is displayed.

11. Press ***CENTER***, **1**, **5**, **5**, **1**, **.**, **9** and **GHz(n)**.
    A center wavelength of 1551.9 nm is set.

12. Press ***SPAN***, **1**, **.**, **2** and **GHz(n)**.
    A display width of 1.2 nm is set.

13. Press **MEAS/FIT**, ***sweep mode*** and ***CONT SWEEP***.
The sweep mode is set to Continuous sweep mode.

14. Press **MEAS/FIT**, ***sweep mode***, ***cont reso***, ***DATA POINTS***, **6**, **0**, **1** and **X1**.
The number of measurement points is set to 601.

NOTE: ***There are two sweep modes: Continuous and Step sweep modes. Continuous sweep mode is suitable for measuring Fiber Bragg Grating filters and so on which require a narrow-band; and Step sweep mode is suitable for measuring long distance fibers which require a wide-band.***

---

15. Press **MEAS/FIT**, ***sens*** and ***NORMAL***.
The sensitivity is set to NORMAL.

NOTE: ***There are four settings: HIGH SENS, MIDDLE SENS, NORMAL SENS and HI SPEED.***
If HIGH SENS is used, better S/N ratio measurement results are obtained, although the sweep speed is slower. If III SPEED is used, S/N ratio measurement results are not as good, but the sweep speed is faster (refer to section 6.5, "Sensitivity"). Especially in the continuous sweep mode, the sweep speed difference is prominent according to the level of sensitivity.

---

16. Press **MEAS/FIT**, ***MOD FREQ***, **2** and **GHz**.
A modulation frequency of 2 GHz is set.

NOTE: ***The modulation frequency determines the resolution of the vertical axis and the effective range when measuring the group delay time, dispersion or dispersion slope (refer to section 6.4, "Modulation Frequency"). A high modulation frequency must be used to obtain a high group delay time resolution for optical devices which have a low dispersion.***

Measuring the DUT

17. Press **SWEEP**.
The measurement starts, and then DUT magnitude characteristic data is displayed (This process approximately 30 seconds to do this).

18. Press **SCALE** and ***AUTO***.
The scale of the vertical axis is optimized according to the measured value.

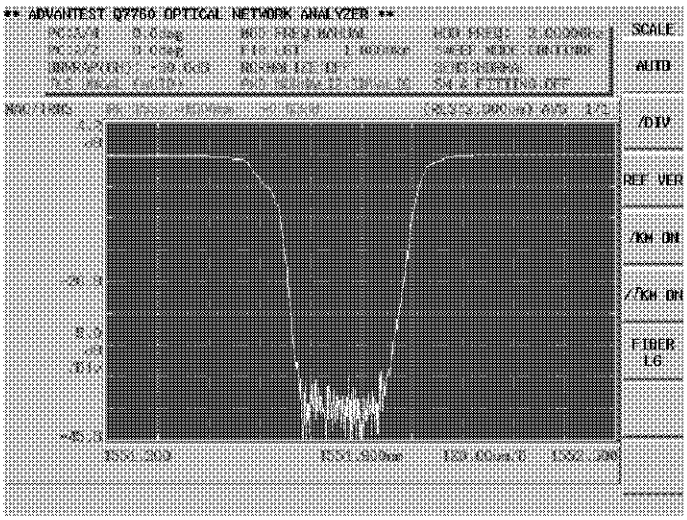


Figure 3-2 Transmission Magnitude Characteristics

19. Press **TRANS/REFL** and ***REFL***.
    The reflection magnitude characteristic data is displayed.

20. Press **SCALE** and ***AUTO***.
    The scale of the vertical axis is optimized according to the measured value.

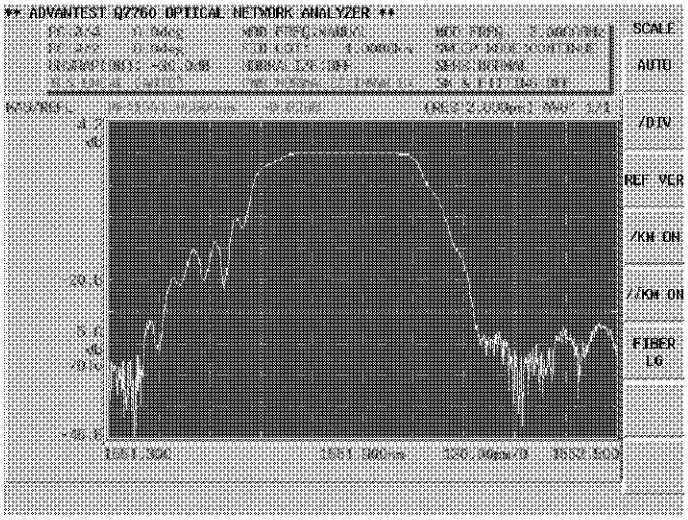


Figure 3-3 Reflection Magnitude Characteristics

21. Press **DELAY** and ***GROUP DELAY***.
    The reflection group delay time characteristic data is displayed.

22. Press **SCALE** and ***AUTO***.
    The scale of the vertical axis is optimized according to the measured value.

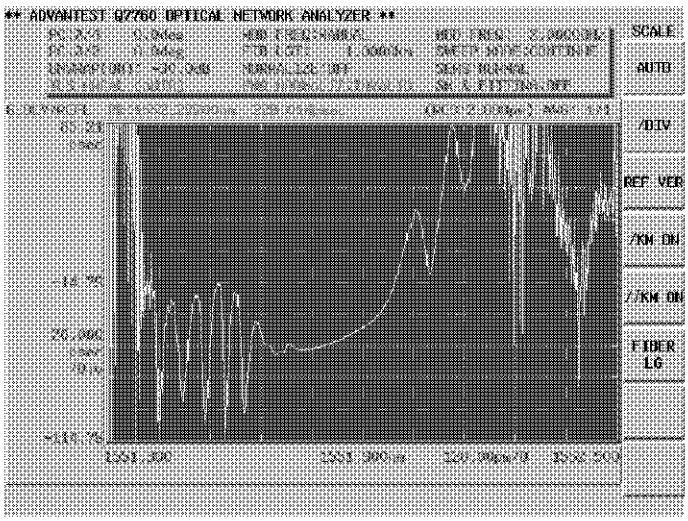


Figure 3-4 Reflection Group Delay Time Characteristics

Two-screen Display

23. Press **DISPLAY**, ***dual disp*** and ***DUAL DISP ON/OFF***(ON).
The screen display is in 2-screen display mode.

24. Press **MAG** and ***MAG***.
The reflection magnitude characteristic data is displayed in the upper part of the screen, and the group delay time characteristic data of reflection is displayed in the lower part of the screen.

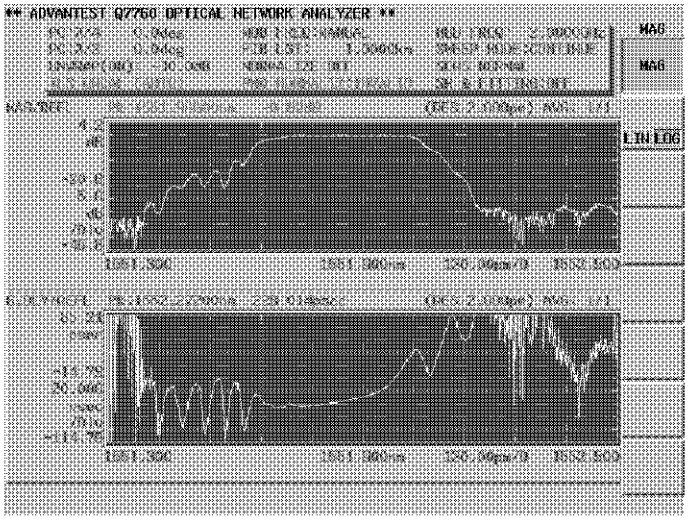


Figure 3-5 Two-Screen Display

25. Press **DISPLAY**, ***dual disp*** and ***DUAL DISP ON/OFF***(OFF).
The screen display is switched back to one-screen mode.

Using the Cursor

26. Press **CURSOR** and ***ON/OFF***(ON).
The X1 cursor is displayed. The wavelength and level of the current cursor position is displayed in cursor area.

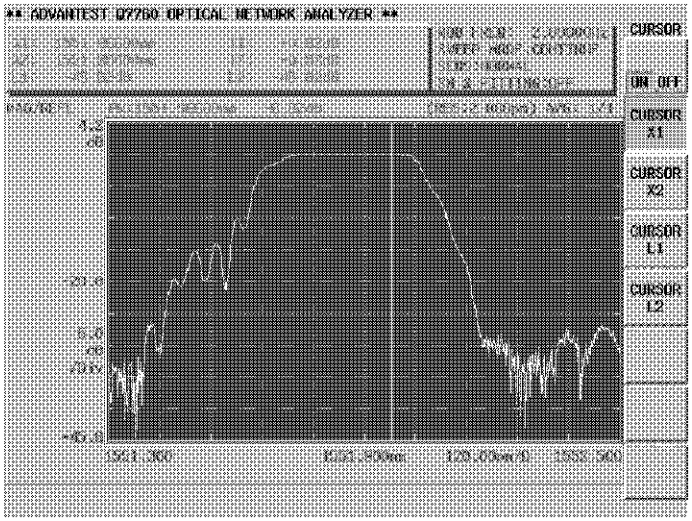


Figure 3-6 Cursor Display

27. Move the cursor using the data knob.
Turn the data knob until the X1 cursor is within the flat part (pass band). The wavelength and the transmission magnitude characteristic data of the current cursor position are displayed in the cursor area.

28. Press **CURSOR** and ***CURSOR X2***.
The X2 cursor is displayed. The wavelength and level of the current cursor position are displayed in the cursor area. Turning the data knob under these conditions moves the X2 cursor.

Measuring Bandwidth

Analyzes a bandwidth and its center wavelength.

29. Press **CURSOR** and ***CURSOR X1***.
The X1 cursor is activated.

30. Move the X1 cursor to the left end of the analysis range by turning the data knob.

31. Press **CURSOR** and ***CURSOR X2***.
The X2 cursor is activated.

32. Move the X2 cursor to the right end of the analysis range by turning the data knob.
    The span between the X1 and X2 cursors becomes the target band.

33. Press **MODE**, ***band width***, ***param***, ***XdB***, **3** and **X1**.
    The attenuation, which is used to calculate the bandwidth, is set to 3 dB.

34. Press ***prev menu***.

35. Press ***PK-XdB***.
    The two cursors are displayed at both ends of the 3-dB bandwidth, and this 3-dB bandwidth and the center wavelength are displayed in the cursor area.

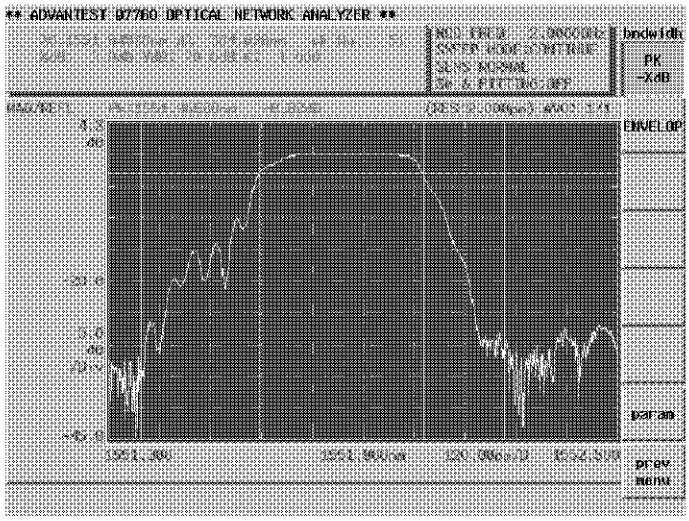


Figure 3-7 Bandwidth Analysis

3.2 Chromatic Dispersion Compensation Fiber Bragg Grating Measurements (PMD Measurement Option)

The analyzer is used to measure the following characteristics simultaneously: the magnitude (MAG), group delay time (GROUP DELAY), chromatic dispersion (CD) and chromatic dispersion slope (CD SLOPE), and the polarization mode dispersion (PMD) characteristics of the transmission characteristics.

---

*NOTE: **PMD is an optional function. PMD measurements can be made only if the PMD option is installed on the optical network analyzer.***

This example describes how to measure the magnitude, group delay time and polarization mode dispersion (hereinafter, referred to as PMD) characteristics of the Chromatic Dispersion Compensation Fiber Bragg Grating reflection characteristics using a circulator.

---

*NOTE: **Use this instrument within the specified temperature range in order to conduct the measurement correctly. After turning the power on, allow the instrument to warm up for at least two hours before starting calibration.***
This section focuses on the operation for the Fiber Bragg Grating Filter measurement, so the warm-up and calibration procedures are not described in this section.

---

*NOTE: **It is recommended that you use the Wavelength correction function in the optical wavemeter for more accurate PMD measurements (refer to section 2.2.9, "Correcting Wavelength").***

Setup

1. Connect the specified cables to the optical network analyzer and the display unit.

Turning the power on

2. Confirm that the **POWER** switch on each front panel is turned off.
3. Connect the power cable of each instrument to the outlet.
4. Turn on the **POWER** switch on each front panel.
   The internal initialization and self test are performed.
   Upon completing the self test, the initial screen is displayed. (It takes about three minutes to display the initial screen.)

Initializing the panel settings

5. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

Calibration

6. Connect the short-size single mode fiber to the TEST PORT 1 and TEST PORT

2 connectors that are located on the front panel.

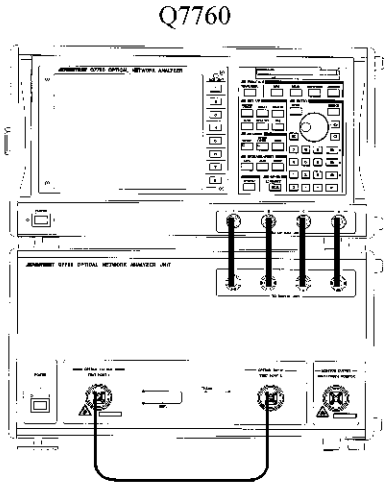


Figure 3-8 Connecting the Short-size Single Mode Optical Fiber Cable

7. Press **TRANS/REFL** and ***TRANS***.
   The measurement mode is set to the transmission mode.

8. Press **DISPERSION** and ***PMD***.
   The measurement mode is set to the transmission PMD characteristics.

9. Press **CENTER/SPAN**.
   The CEN/SPAN menu used to set the measurement range is displayed.

10. Press ***CENTER***, **1, 5, 3, 5** and **GHz(n)**.
    A center frequency of 1535 nm is set.

11. Press ***SPAN***, **1, ., 5** and **GHz(n)**.
    A display width of 1.5 mm is set.

12. Press **MEAS/FIT**, ***sweep mode*** and ***CONT SWEEP***.
    The sweep mode is set to the continuous sweep mode.

13. Press **MEAS/FIT**, ***MOD FREQ***, **5, 0, 0** and **MHz**.
    A modulation frequency of 500 MHz is set.

14. Press **MEAS/FIT**, ***sens*** and ***MIDDLE SENS***.
    The sensitivity is set to MIDDLE SENS.

15. Press **CAL** and ***POL CAL***.
    A calibration for the polarization controller is started (it takes approximately 1 minute to complete).

16. Press **CAL** and ***PMD NORMLIZ***.
    PMD Normalize for the specified wavelength span is started (this takes approx. 1 minute and 30 seconds).

NOTE: A calibration for the polarization controller and PMD Normalize must be carried out prior to making a PMD measurement. The result of a PMD Normalize measurement is valid only for the wavelength range and modulating frequency used.
The calibration for the polarization controller and PMD Normalize must be carried out again when the wavelength range and the modulating frequency have been changed, or eight hours have passed since the previous calibration was performed. However, a calibration for the polarization controller is not required if only the modulation frequency has been changed.

Measurement

17. Connect the fiber grating and the circulator as shown in Figure 3-9 to measure the reflection characteristics.

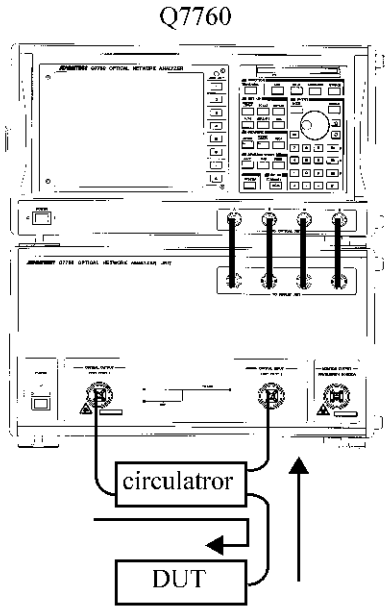


Figure 3-9 Connecting the DUT

18. Press **SWEEP(+PMD)**.
A PMD measurement is started (it takes approximately 1 minute and 30 seconds).

NOTE: There are two keys; the SWEEP and SWEEP (+PMD) key. The SWEEP key is used to measure the magnitude, group delay time, wavelength chromatic dispersion and wavelength chromatic dispersion slope of the reflection and transmission characteristics, but it is not used to measure the PMD.
The SWEEP (+PMD) key is used to measure the magnitude, group delay time, wavelength chromatic dispersion, wavelength chromatic dispersion slope and the PMD of the transmission characteristics, but it is not used to measure the reflection characteristics.

19. Press **SCALE** and ***AUTO***.
The vertical scale is optimized according to the measurement values.

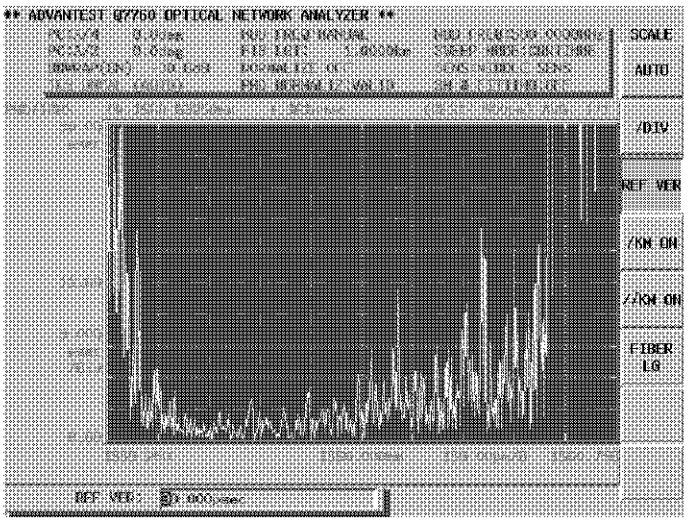


Figure 3-10 PMD Characteristics

20. Press **DISPLAY**, ***super impose*** and ***SUPER IMPOSE ON/OFF***(ON).
The screen display is switched to S.IMPOSE mode display.

21. Press **MAG** and ***MAG***.
The magnitude characteristic is displayed.

22. Press **SCALE** and ***AUTO***.
The vertical scale is optimized according to the measurement values.

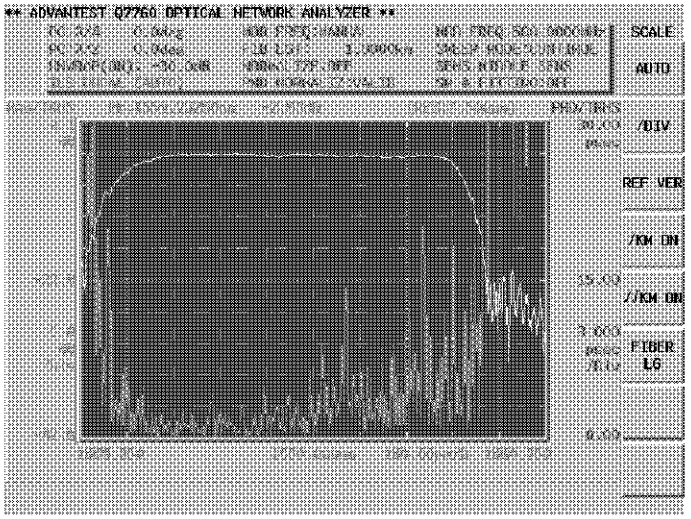


Figure 3-11 Magnitude and PMD Characteristics Superimposed Display

23. Press **DELAY** and ***GROUP DELAY***.
    The group delay time characteristic is displayed.

24. Press **SCALE** and ***AUTO***.
    The vertical scale is optimized according to the measurement values.

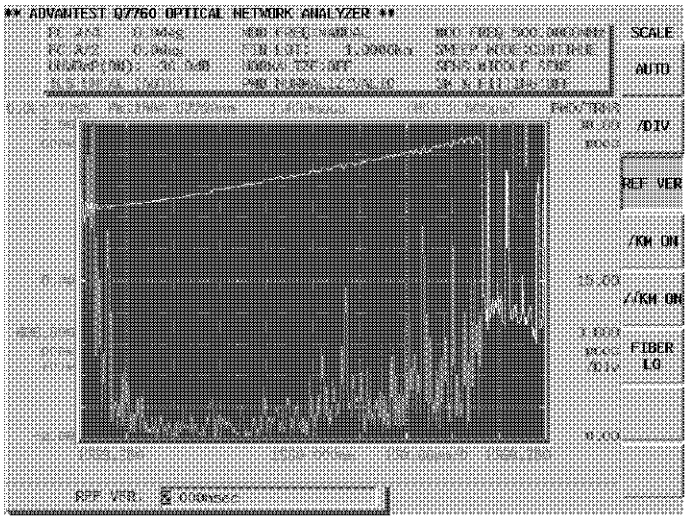


Figure 3-12 Magnitude, Group Delay Time and PMD Characteristics Superimposed Display

3.3 Example of Optical Fiber Characteristic Measurement

This Optical Network Analyzer can be used to measure the following reflection and transmission characteristics simultaneously: magnitudes (MAG), the group delay time (GROUP DELAY), chromatic dispersion (CD) and chromatic dispersion slope (CD SLOPE). This example shows how to measure the transmission group delay time, chromatic dispersion and chromatic dispersion slope of a dispersion shift fiber of approximately 20 km using the following functions.

- Differential measurement function: Removes the effects caused by the group delay drift of a DUT.
- Normalization function: Compensates for the characteristics of the fiber used to connect the DUT.
- Distance measurement: Measures the length of the DUT.
- Curve fitting function: Makes an approximation from the measurement data using a polynomial.
- Report display function: Displays a list of measurement conditions or measurement data.

Measurement conditions

Wavelength range: 1530 nm to 1590 nm

Sweep mode: Step sweep

Number of measurement points: 21 (Wavelength resolution: 3.0 nm)

Optical fiber refraction factor: 1.475

NOTE: ***Use this instrument within the specified temperature range in order to conduct the measurement correctly. After turning the power on, allow the instrument to warm up for at least two hours before starting calibration.***
This section focuses on the operation for the Fiber Bragg Grating Filter measurement, so the warm-up and calibration procedures are not described in this section.

Setup

1. Connect the necessary cables between the optical network analyzer and the display units.

Turning the Power On

2. Plug the power cable into the outlet.

3. Turn on the **POWER** switch (on the front panel) for each unit.
Internal initialization and self-test are automatically performed. The initial screen is displayed when the self-test is complete (This process approximately three minutes to complete).

Initializing the Set Conditions

4. Press **SYSTEM** and ***PRESET***.
Measurement conditions for this instrument are initialized.

Setting Measurement Conditions

The measurement conditions are set so that the characteristic data can easily be observed.

5. Press **TRANS/REF** and ***TRANS***.
   Measurement mode is set to the transmission characteristic mode.

6. Press **DELAY** and ***GROUP DELAY***.
   The group delay time of the transmission characteristics is selected as the measurement target.

7. Press **CENTER/SPAN**.
   The CEN/SPAN menu used to set the measurable range is displayed.

8. Press ***START***, **1**, **5**, **3**, **0** and **GHz(n)**.
   A start wavelength of 1530.0 nm is set.

9. Press ***STOP***, **1**, **5**, **9**, **0** and **GHz(n)**.
   A stop wavelength of 1590.0 nm is set.

10. Press **MEAS/FIT**, ***sweep mode*** and ***STEP SWEEP***.
    The sweep mode is set to Step Sweep mode.

11. Press **MEAS/FIT**, ***sweep mode***, ***meas mode*** and ***DIFF MEAS***.
    The differential measurement mode is turned on.

NOTE: ***If NORMAL MEAS is turned on, adjacent data points are measured sequentially. If DIFF MEAS is turned on, differential measurements are made to cancel the effects of group delay time drift to provide a stable measurement. The amount of time required to perform the sweep, however, is approximately two times that for NORMAL MEAS Mode (refer to Section 6.6, "Differential Measurement").***

---

12. Press **MEAS/FIT**, ***sweep mode***, ***step reso***, ***DATA POINTS***, **2**, **1** and **X1**.
    The number of measurement points is set to 21.

NOTE: ***There are two sweep modes: Continuous and Step sweep modes. Continuous sweep mode is suitable for measuring fiber grating which require a narrow-band, and Step sweep mode is suitable for measuring long distance fibers which require a wide-band. The number of measurement points for Continuous sweep mode can be any value between 101 and 12001, but the number of measurement points for Step sweep can only be a value between 11 and 1101.***
In addition, the wavelength resolution can be specified directly instead of using the number of points.

---

13. Press ***MEAS/FIT***, ***sens*** and ***HIGH SENS***.
The sensitivity is set to HIGH SENS.

NOTE: ***There are four classes of sensitivities: IIIGH SENS, MIDDLE SENS, NORMAL SENS and HI SPEED.***
If IIIGH SENS is used, better S/N ratio measurement results are obtained, although the sweep speed is slower. If HI SPEED is used, S/N ratio measurement results are not as good, but the sweep speed is faster (refer to Section 6.5, "Sensitivity"). Especially in the continuous sweep mode, the sweep speed difference is prominent according to the level of sensitivity.

---

14. Press **ADVANCE**, ***FIBER INDEX***, **1**, **.**, **4**, **7**, **5** and **X1**.
The refraction factor of the targeted optical fiber is set to 1.475.

Acquiring Normalized Data

NOTE: ***This function is used to cancel the effect caused by the dummy fiber. Use this function as needed.***

---

15. Bypass the DUT and connect the optical fiber used for the setup.

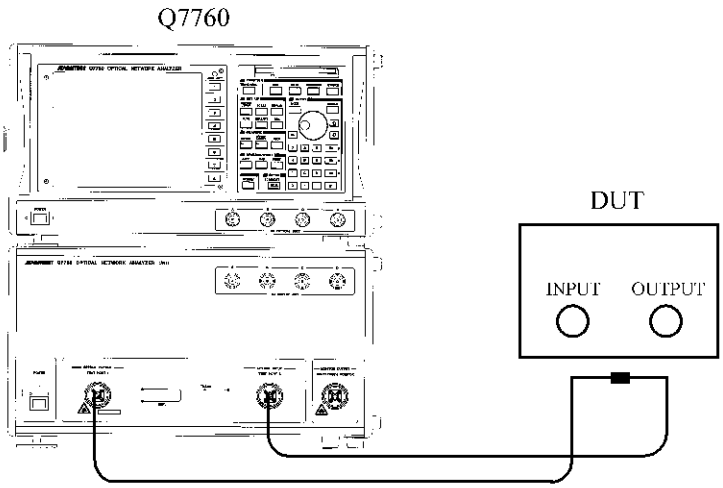


Figure 3-13 Connection Bypassed the DUT

16. Press **ADVANCE** and ***FIBER LENGTH***.
The length of the optical fiber used for the setup is measured. (It takes a few minutes to complete.)

17. Press **AUTO** and ***MOD FREQ***.
MOD FREQ AUTO is set to make measurements.

18. Press **SWEEP**.
The modulation frequency is automatically set, and the characteristics of the optical fiber (used for connections) are measured (this takes approx. 3 minutes).

NOTE: ***The modulation frequency determines the resolution of the vertical axis and the effective range when measuring the group delay time, dispersion or dispersion slope (refer to section 6.4, "Modulation Frequency"). The modulation frequency must be set to an optimum value to accurately measure an optical fiber using a long span because measured values vary greatly. MOD FREQ AUTO is used to do this by automatically adjusting the modulation frequency to an optimum value.***

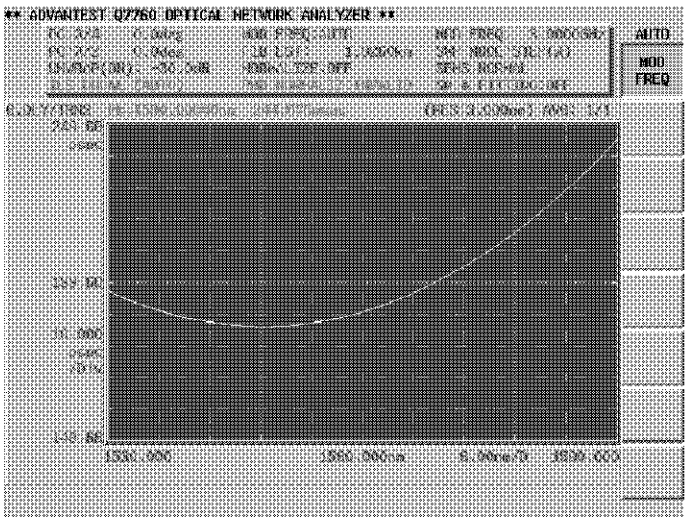


Figure 3-14 Characteristics Obtained By Bypassing the DUT

19. Press **CAL,** ***trans normliz*** and ***SV REF***.
The measured data of the optical fiber is saved as reference data. The measured data on the fiber length (obtained in Step 16) is also saved.

Measuring the DUT

20. Connect the DUT.

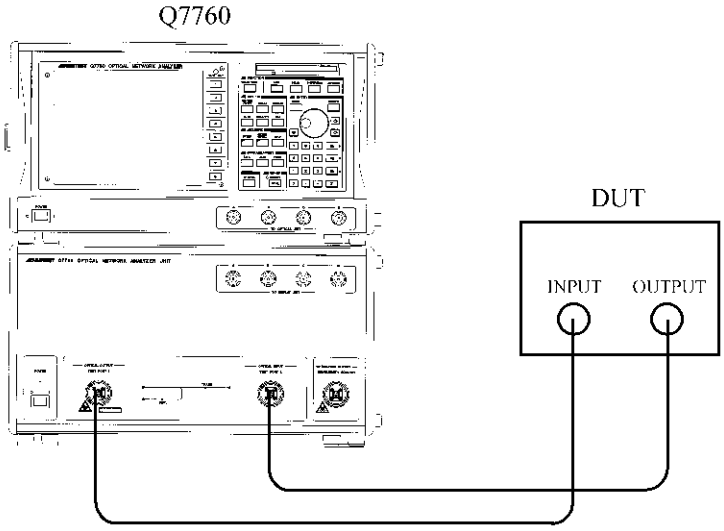


Figure 3-15 Connecting the DUT

21. Press **ADVANCE** and ***FIBER LENGTH***.
    The fiber length of the DUT is measured (This process a few minutes to do this). The result is displayed in the lower left-hand corner on the screen when the measurement finishes.

22. Press **SWEEP**.
    The modulation frequency is automatically set to measure the characteristics of the DUT (This process approximately three minutes to measurement).

23. Press **CAL,** ***trans normliz*** and ***NORMLIZ***.
    The normalization function is turned on. The DUT characteristic data (which has been compensated for the distance of the fiber (used for the setup) and has been saved in Step 19) is displayed.

24. Press **SCALE,** ***AUTO***.
    The scale of the vertical axis is optimized.

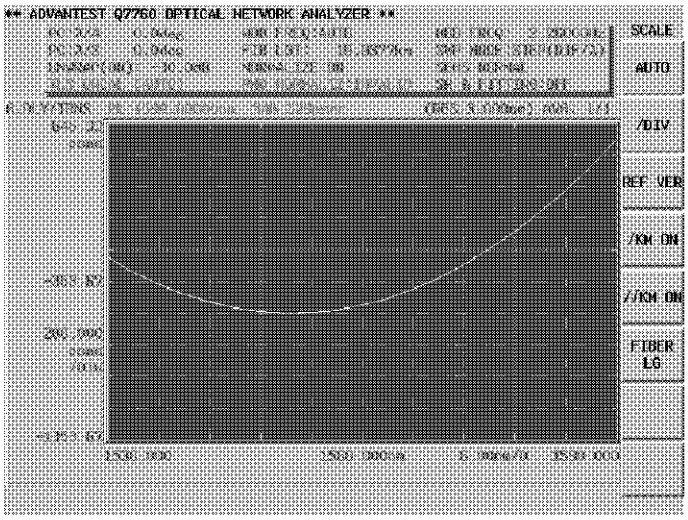


Figure 3-16 Group Delay Time Characteristics

Curve Fitting Function

The curve fitting function is used to analyze optical fiber measurement results.

25. Press **MEAS/FIT** and *fit*.
The menu used for fitting is displayed.

NOTE: ***There are four expressions used to perform curve fitting: the linear expression (LINEAR FIT), the quadratic polynomial (QUAD FIT), the Sellmeier's cubic polynomial (SELM 3 FIT) and the Sellmeier's quintic polynomial (SELM 5 FIT). (refer to section 6.9, "Curve Fitting Function and Statistical Variance")***

---

26. Press *fit mode* and *SELM5 FIT*.
The curve fitting function is set to the Sellmeier's quintic polynomial.

27. Press **MEAS/FIT**, *fit* and *FIT ON/OFF*(ON).
The curve fitting function is turned on and a graph using curve fitting is displayed. The zero-dispersion wavelength and the fitting error are displayed in the upper left corner together with the graph using curve fitting.

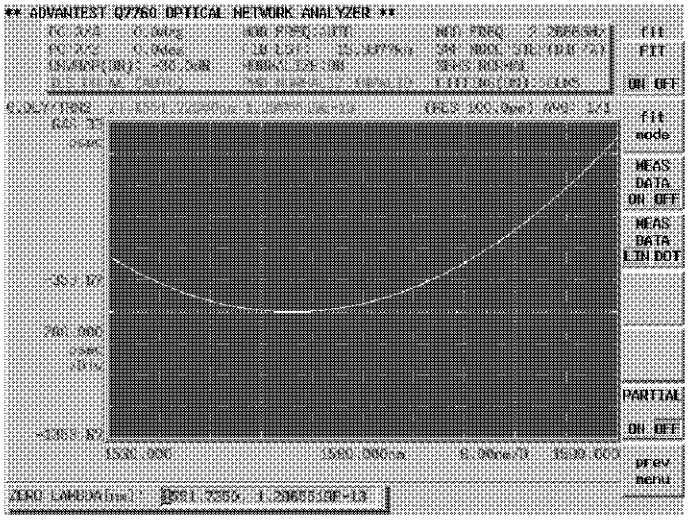


Figure 3-17 Group Delay Time Characteristics with Curve Fitting

28. Press **DISPERSION** and ***CD*** (or ***CD SLOPE***).
The chromatic dispersion characteristic data (chromatic dispersion slope characteristics) is displayed.

29. Press **SCALE** and ***AUTO***.
The scale of the vertical axis is optimized according to the measurement results.

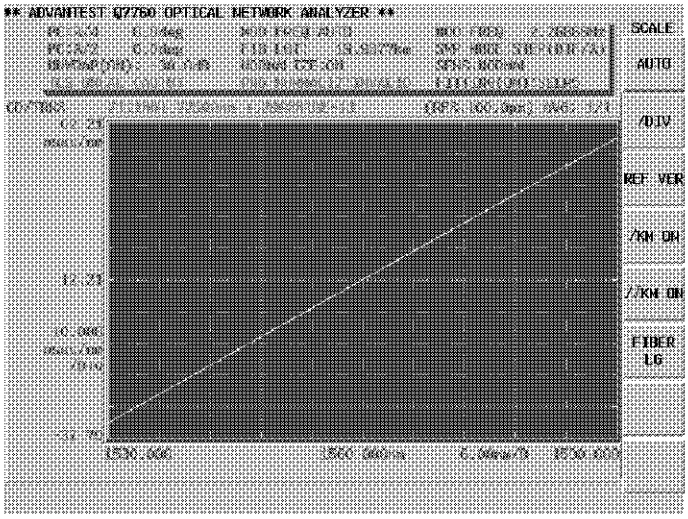


Figure 3-18 Chromatic Dispersion Characteristics with Curve Fitting

30. Press **SCALE** and ***/KM ON***.
The characteristic data per kilometer is displayed.

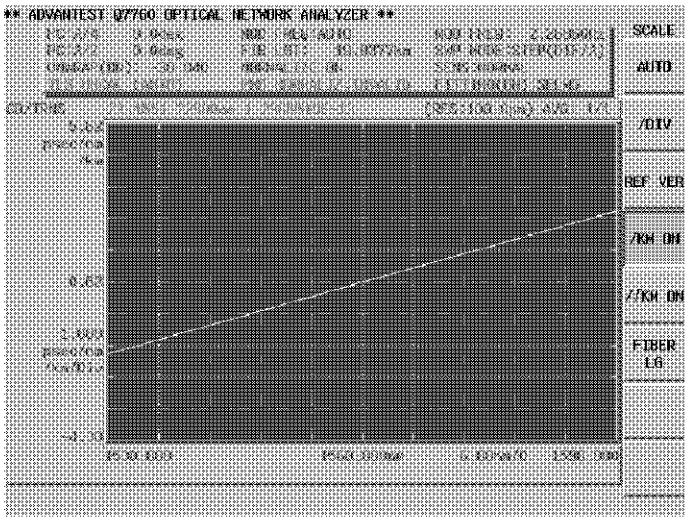


Figure 3-19 Chromatic Dispersion Characteristic Data per Kilometer

Report Display Function

31. Press **DISPLAY**, ***report*** and ***REPORT ON/OFF***(ON).
A list showing the measurement conditions and measured values is displayed.

NOTE: ***The following information is displayed, starting from the left side:***
- Wavelength (λ)
- Group delay time (G. delay Measured)
- Group delay time using curve fitting (G. delay With Fitted)
- Group delay dispersion using curve fitting (CD Fitted)
- Group delay dispersion slope using curve fitting (CD Slope Fitted)
- Group delay dispersion slope using curve fitting and displayed in kilome ters (CD Slope Fitted /km). (refer to section 2.1.7, "Report Display")
In addition, the group delay time on the report display is offset so that the group delay time at the zero chromatic dispersion can be zero.

---

32. Press **1**, **5**, **4**, **2** and **GHz(n)**.
A value of 1542 nm is set to the top of the list.
In addition, you can scroll through the list turning the knob.

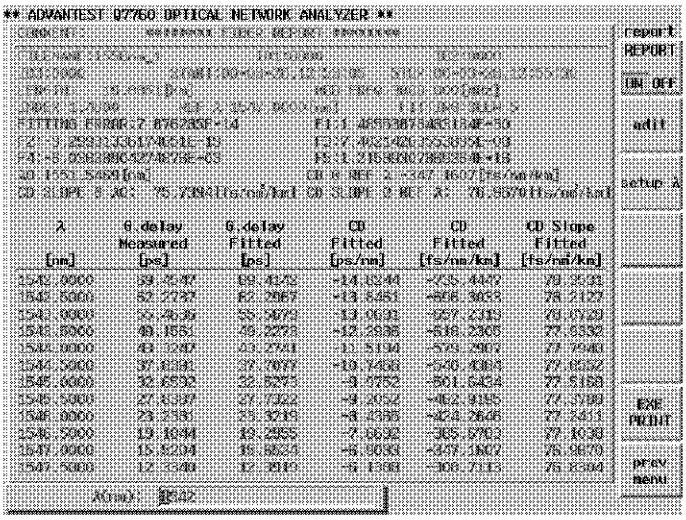


Figure 3-20 Displaying the Report

3.4 Example of Single Mode Fiber Measurement (PMD Measurement)

This analyzer measures the following characteristics simultaneously:

Magnitude of transmission (MAG)

Group delay time (DELAY)

Chromatic dispersion (CD)

Chromatic dispersion slope (CD SLOPE)

Polarization mode dispersion (PMD)

This section explains the operating procedures for performing the Group delay time (DELAY) and Polarization mode dispersion (PMD) measurements in the transmission characteristics of the single mode fiber under the conditions shown below:

Measurement conditions

Wavelength range: 1530 nm to 1570 nm

Sweep mode: Step sweep

Number of measurement points: 21 (Wavelength resolution: 2.0 nm)

SENS: HIGH SENS

NOTE

1. ***Use the instrument within the specified temperature range in order to conduct the measurement correctly. After turning the power on, allow the instrument to warm up for at least two hours before starting calibration. This section focuses on the operation for the above measurements, so the warm-up and calibration procedures are not described in this section.***
2. ***The PMD measurement is an optional function. The measurement can be conducted only when this option is installed.***

NOTE: ***It is recommended that you use the Wavelength correction function in the optical wavemeter for more accurate PMD measurements (refer to section 2.2.9, "Correcting Wavelength").***

Setup

1. Connect the necessary cables between the optical network analyzer and the display units.

Turning the Power On

2. Make sure that the **POWER** switches on both front panels are turned off.
3. Connect the power cables to the outlet.
4. Turn on the **POWER** switch on the front panel.
   Initialization and self-test are performed first. When the self-test is complete, the

initial screen appears. It takes approximately one minute for the analyzer to display the initial screen.

Initializing Set State

5. Press **SYSTEM** and ***PRESET***.
   Measurement conditions for this instrument are initialized.

Setting the modulated frequency

6. Connect the DUT to **TEST PORT 1** and **TEST PORT 2** on the front panel.

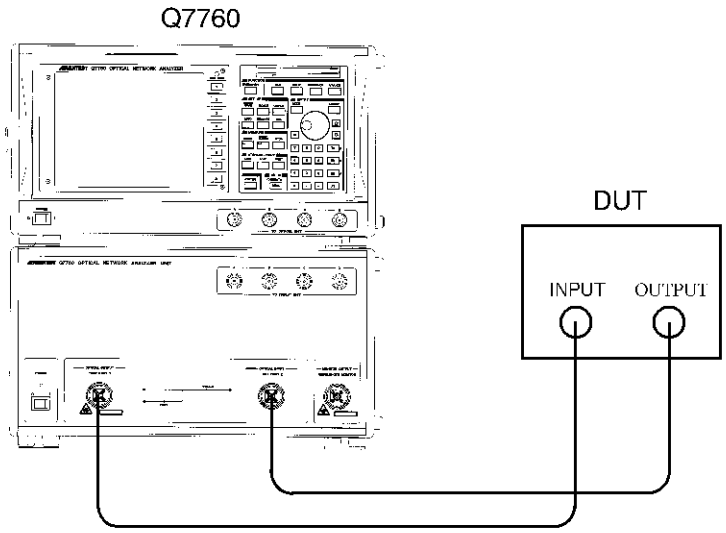


Figure 3-21 Connecting the DUT

7. Press **TRANS/REFL** and ***TRANS***.
   The measurement mode becomes the transmission characteristic mode.

8. Press **CENTER/SPAN**.
   The CEN/SPN menu used for specifying a measurement range is displayed.

9. Press ***CENTER***, **1**, **5**, **5**, **0** and **GHz(n)**.
   The center wavelength is set to 1550 nm.

10. Press **SPAN**, **4**, **0** and **GHz(n)**.
    The display width is set to 40 nm.

11. Press **MEAS/FIT**, ***sweep mode*** and ***STEP SWEEP***.
    The sweep mode is set to Step Sweep.

12. Press **MEAS/FIT**, ***sweep mode***, ***step reso***, ***DATA POINTS***, ***2***, ***1*** and **X1**.
    The number of the measurement point is set to 21.

13. Press **MEAS/FIT**, ***sens*** and ***HIGH SENS***.

The sensitivity is set to HIGH SENS.

14. Press **AUTO** and ***MOD FREQ***.
    The mode for MOD FREQ AUTO is set.

15. Press **SWEEP**.
    The modulated mode is automatically set and the optical fiber characteristics for connection are measured.

Calibration

16. Connect the short single mode fibers to **TEST PORT 1** and **TEST PORT 2** on the front panel.

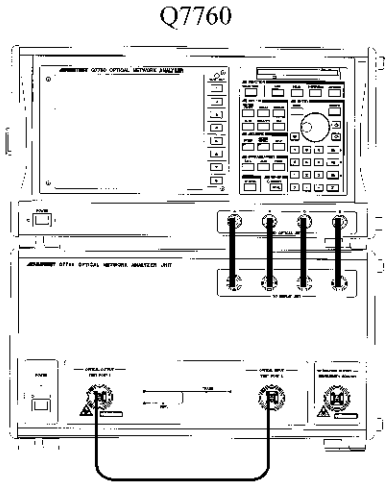


Figure 3-22 Connecting the Short-size Single Mode Optical Fiber Cable

17. Press **CAL** and ***POL CAL***.

18. Press **CAL** and ***PMD NORMLIZ***.
    PMD normalization with the specified wavelength span starts.

CAUTION: ***When measuring the PMD, perform a calibration of the polarization controller and PMD normalization first. Only the wavelength range and modulated frequency used when the PMD normalization was performed are effective.***
Perform a calibration of the polarization controller and PMD normalization again if the wavelength range or modulated frequency has changed, or eight hours have passed since the last calibration. Calibration of the polarization controller is not required when only the modulated frequency is changed.

Measurement

19. Connect the DUT to **TEST PORT 1** and **TEST PORT 2** on the front panel.

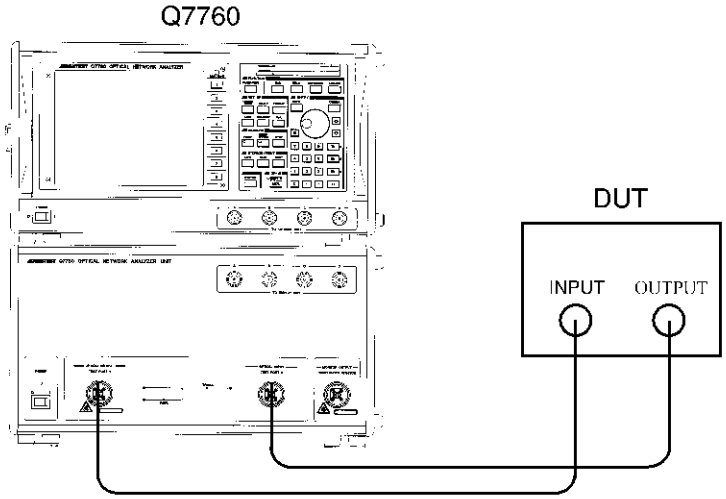


Figure 3-23 Connecting the DUT

20. Press **AUTO**, ***pmd range in step*** and ***AUTO ON/OFF***(ON).
The mode for pmd range AUTO is set.

CAUTION: ***When measuring PMD in the step sweep mode, measure it in the optimum mode that you can select from the three measurement ranges, 25ps, 10ps, and 1ps, that corresponds to the PMD value of DUT. Each value indicates the maximum value of PMD that can be measured***
When measuring PMD in the pmd range in the step-AUTO ON mode, pre-sweep is conducted and the appropriate measurement range mode is automatically set. In addition, ON/OFF for the differential measurement is also automatically set before the instrument performs the measurement (refer to section 2.2.2, "Measurement Using the SWEEP Key").

---

21. Press **SWEEP(+PMD)**.
The PMD measurement starts.

CAUTION: ***There are two sweep keys, the SWEEP key and the SWEEP(+PMD) key. The SWEEP key can be used for measurements of reflection, transmission magnitude, group delay time, wavelength dispersion, and wavelength dispersion slope. PMD can not be measured with the SWEEP key. The SWEEP(+PMD) key can be used for measurements of transmission magnitude, group delay time, wavelength dispersion, wavelength dispersion slope, and PMD. Reflection can not be measured with the SWEEP(+PMD) key.***

---

22. Press **SCALE**, **REF VER**, **1** and **THz(p)**.
The upper limit of the scale along the vertical axis is set to 1 psec.

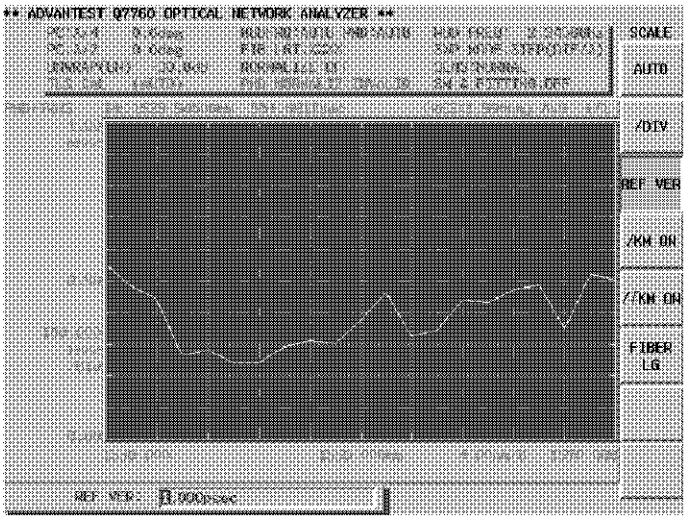


Figure 3-24 PMD Characteristics

23. Press **DISPLAY**, ***statistics analysis*** and ***PMD AVG***.
The averaging value, averaging square root, and standard deviation of the PMD measurement values are calculated and displayed.

CAUTION: ***The following parameters for the PMD measurement value can be calculated and displayed:***
- ***Maximum value***
- ***Minimum value***
- ***Number of measurement points***
- ***Average***
- ***Root-mean-square***
- ***Standard deviation***
- ***α parameter of Maxwell distribution function***
- ***Most probable value of Maxwell distribution function***

For more information, refer to Section 6.13,"Tunable Light Source Calibration."

---

24. Press **DELAY** and ***GROUP DELAY***.
The characteristics of group delay time are displayed.

25. Press **SCALE** and ***AUTO***.
The scale of the vertical axis is optimized based on the measurement value.

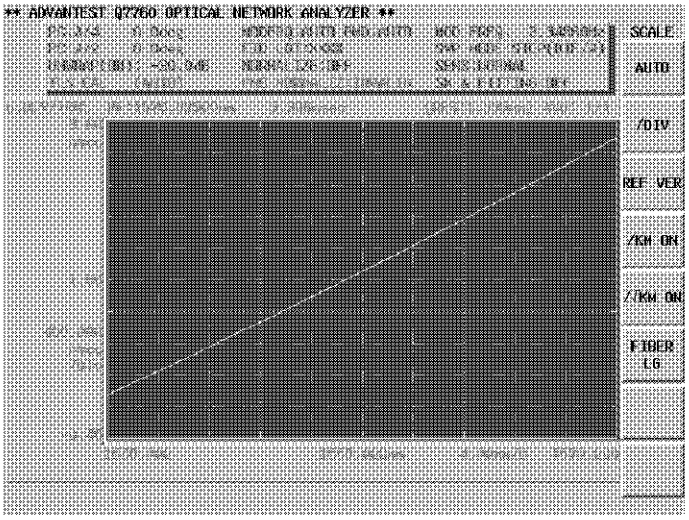


Figure 3-25 Group Delay Time Characteristics

4 REFERENCE

Shows a list of operation keys, and describes the function of each key.

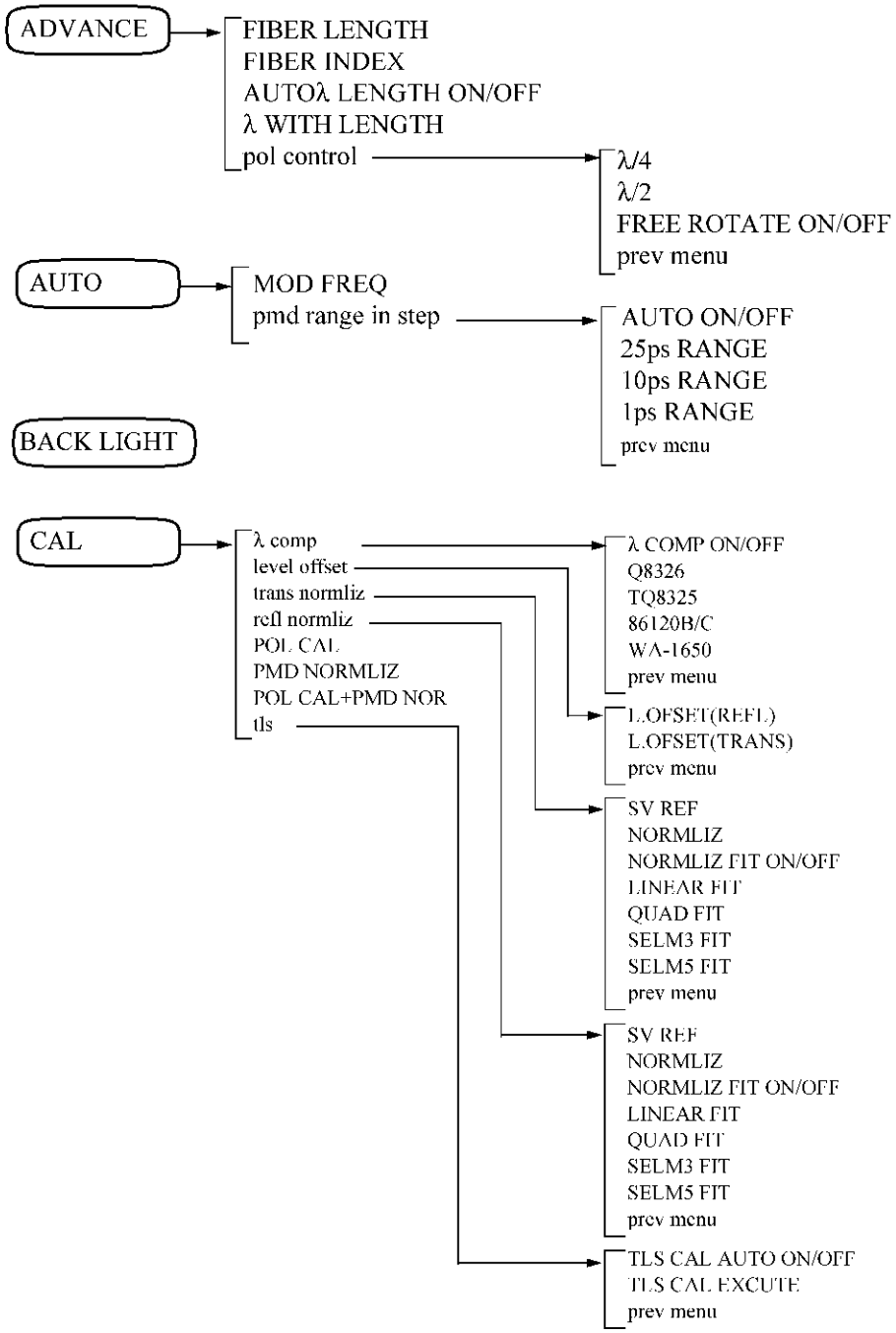
4.1 Menu Index

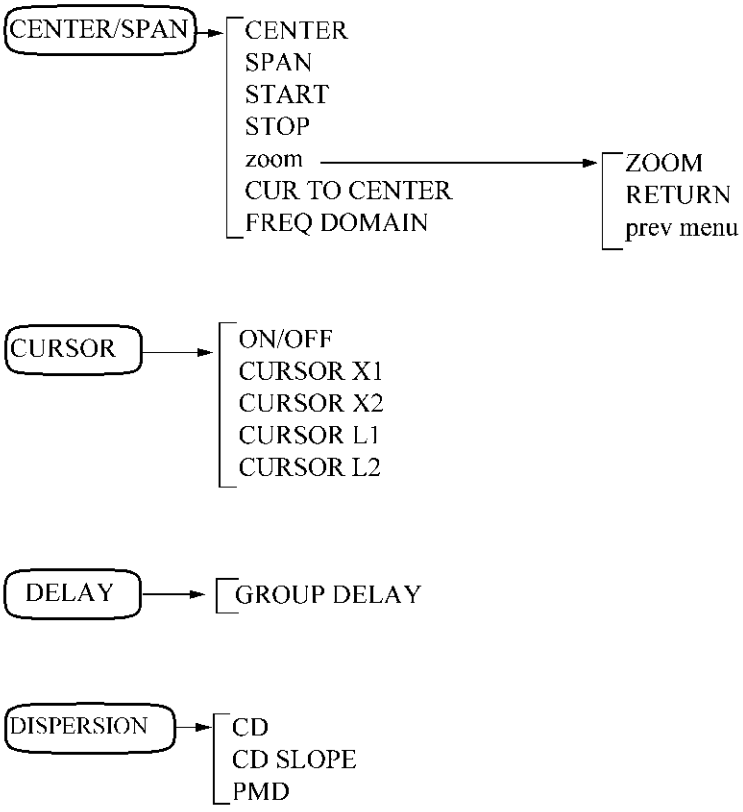
This menu index is used to easily find the keys described in Chapter 4.

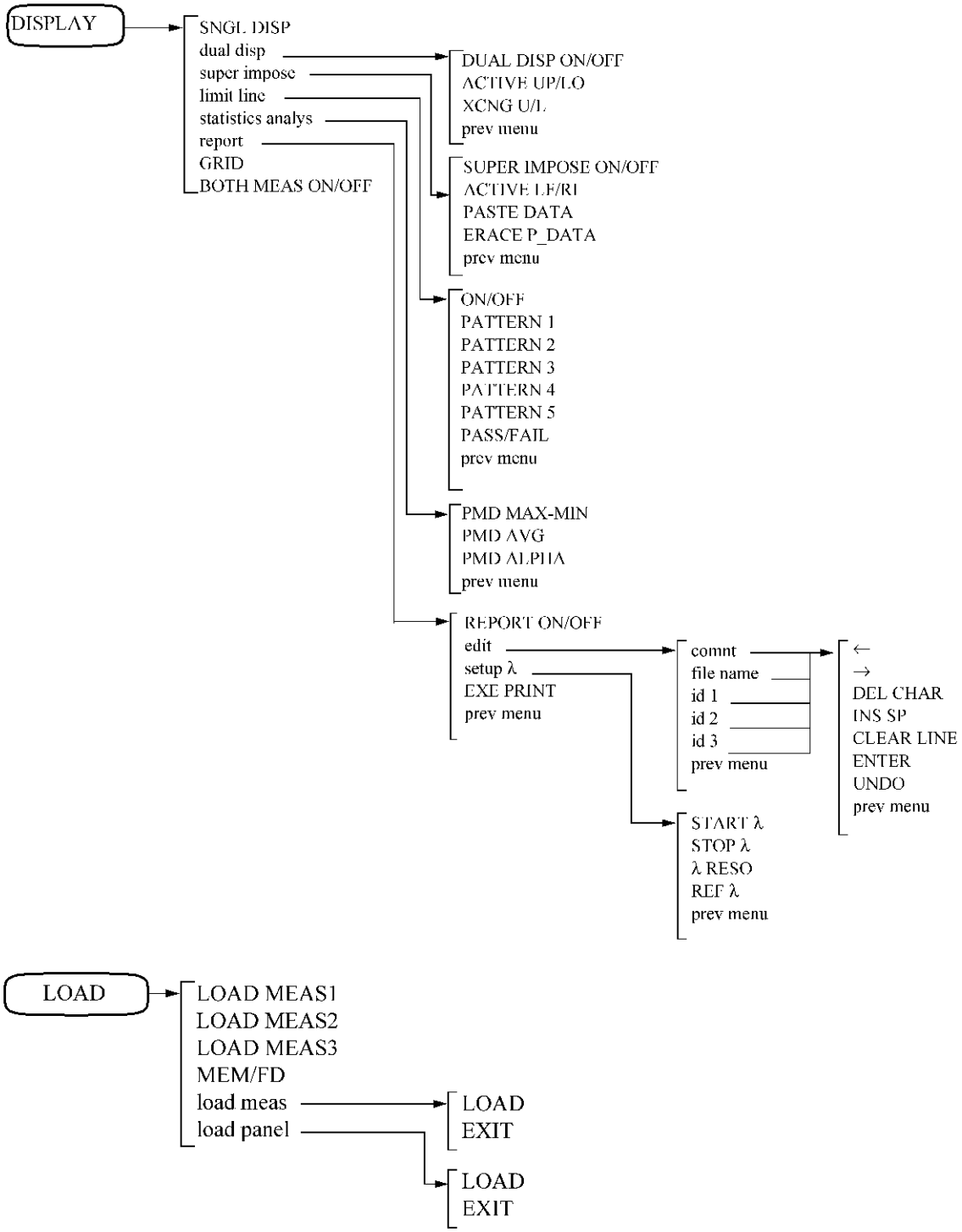
4.2 Menu Map

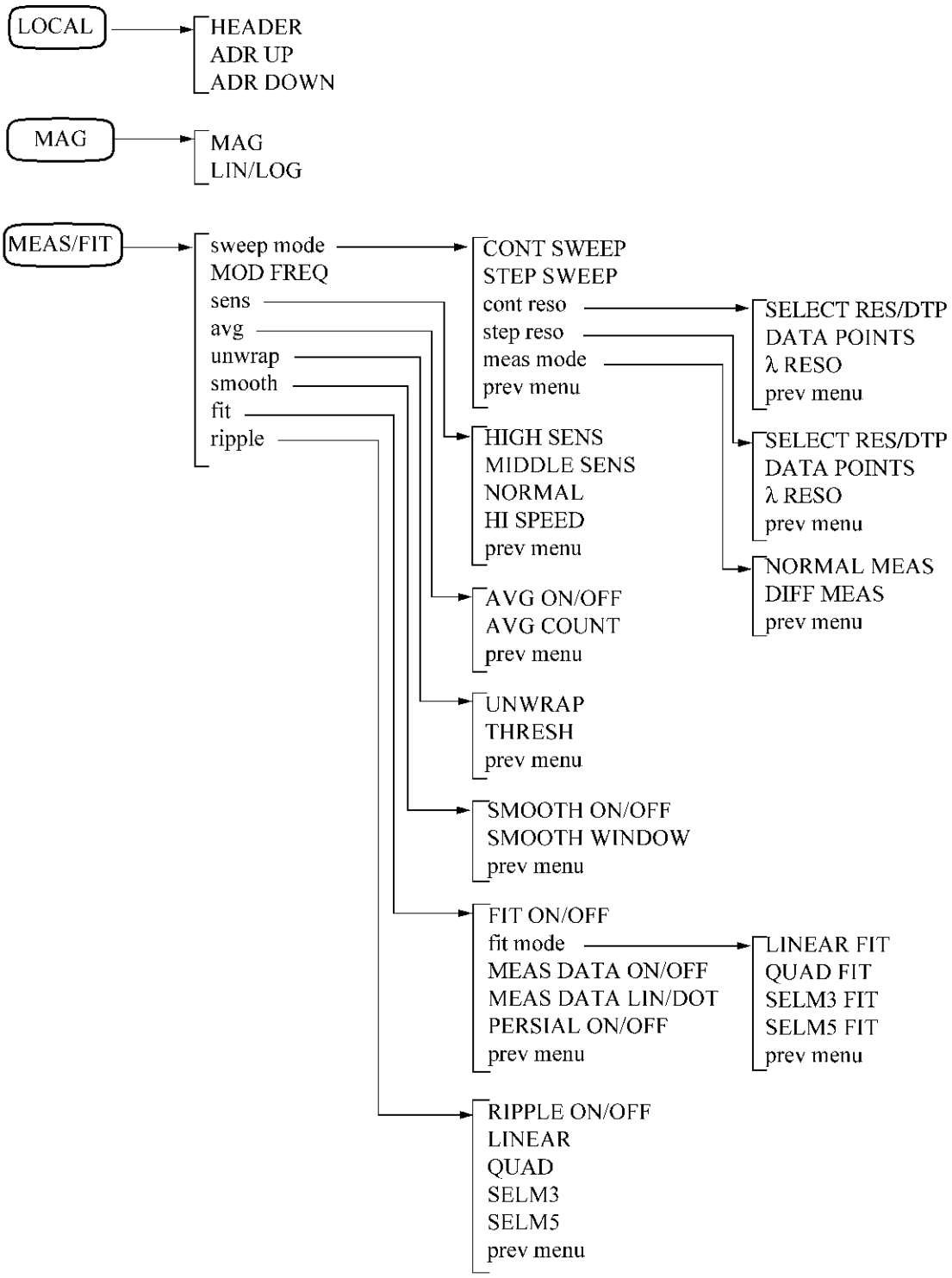
This section shows the hierarchical menu configuration on a panel key basis.

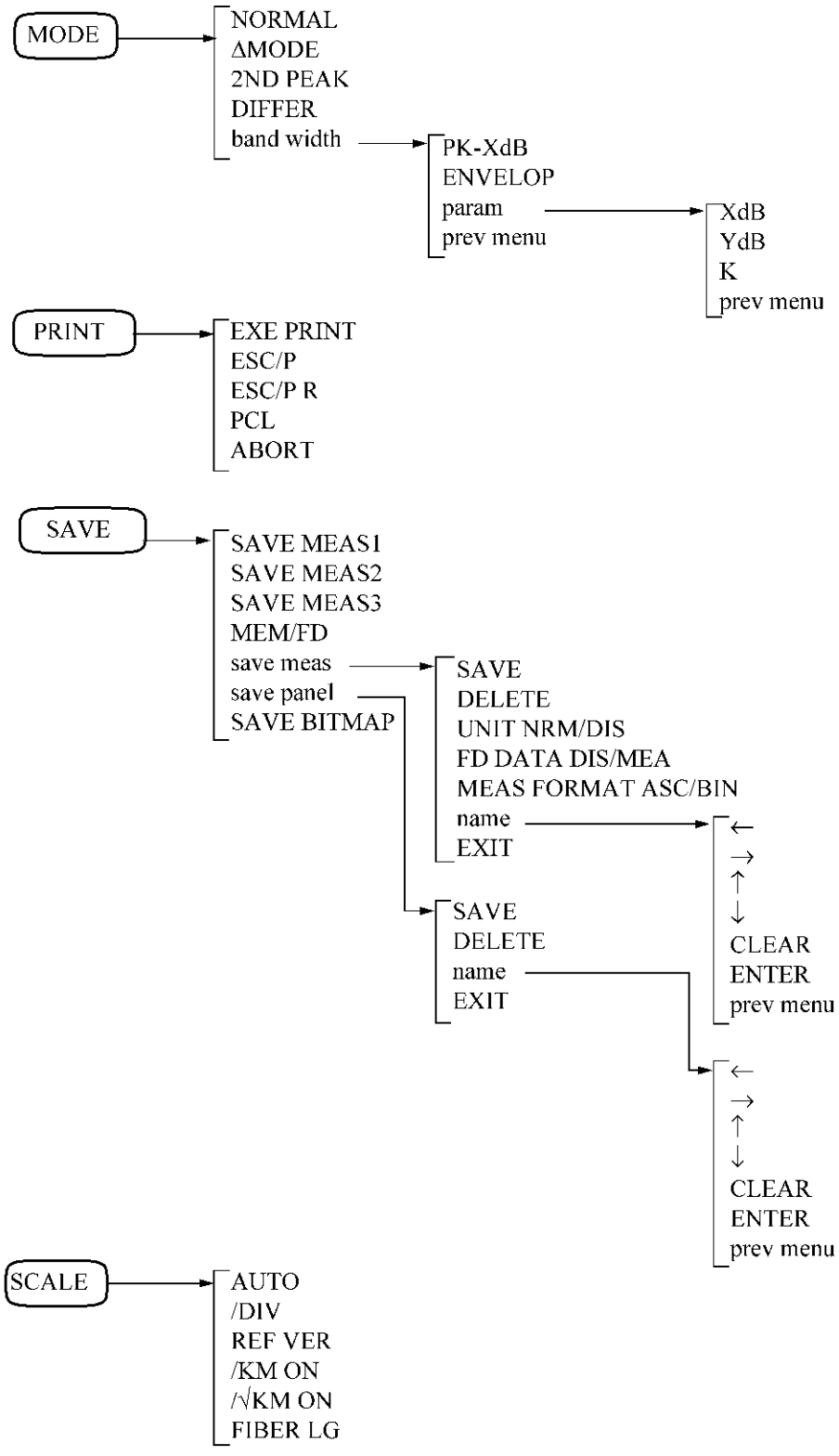
NOTE: ( ) ***is Panel key.***

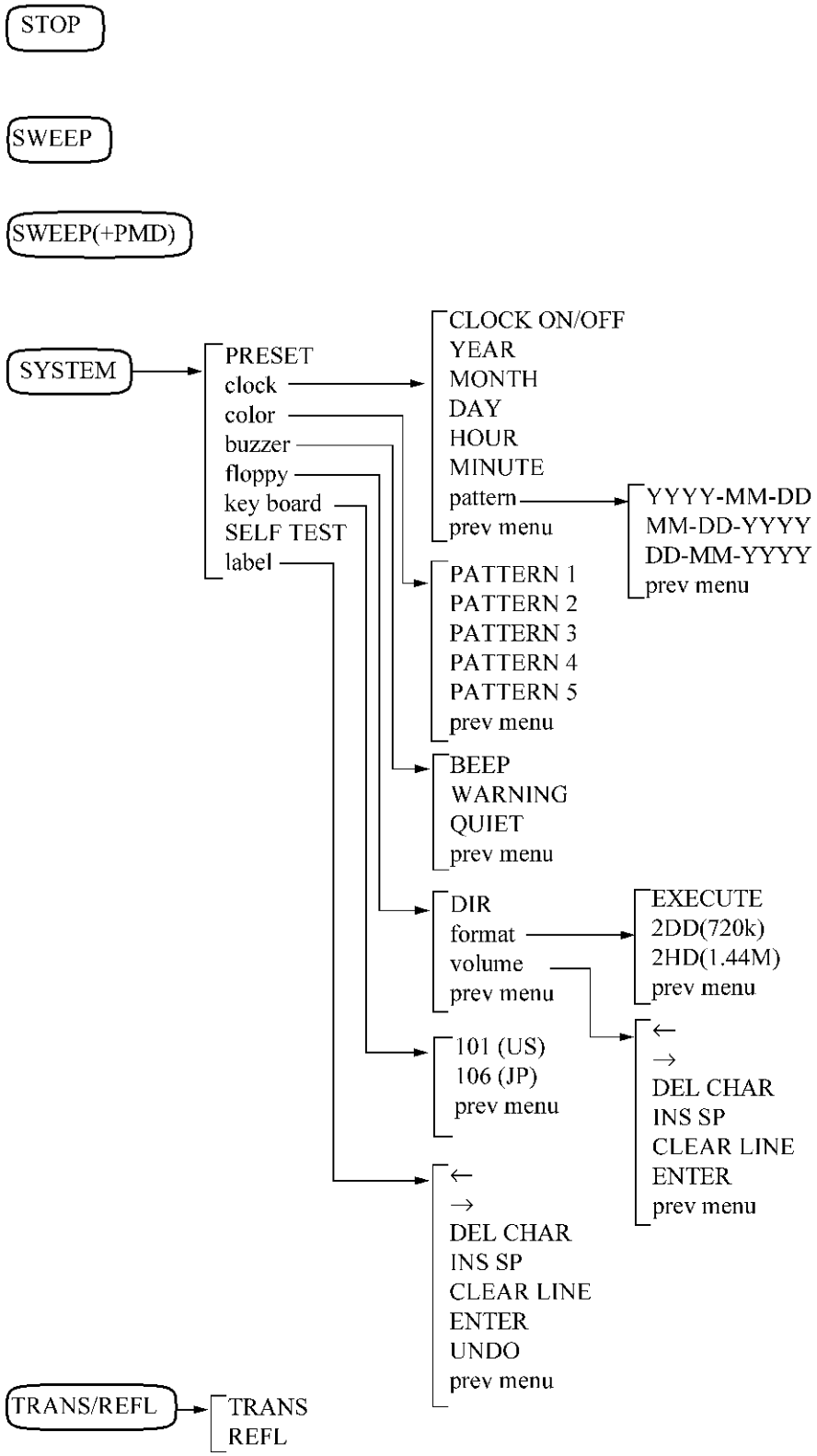



CENTER/SPAN
CENTER
SPAN
START
STOP
zoom
CUR TO CENTER
FREQ DOMAIN
ZOOM
RETURN
prev menu
CURSOR
ON/OFF
CURSOR X1
CURSOR X2
CURSOR L1
CURSOR L2
DELAY
GROUP DELAY
DISPERSION
CD
CD SLOPE
PMD


DISPLAY
SNGL DISP
dual disp
super impose
limit line
statistics analys
report
GRID
BOTH MEAS ON/OFF
DUAL DISP ON/OFF
ACTIVE UP/LO
XCNG U/L
prev menu
SUPER IMPOSE ON/OFF
ACTIVE LF/RI
PASTE DATA
ERACE P_DATA
prev menu
ON/OFF
PATTERN 1
PATTERN 2
PATTERN 3
PATTERN 4
PATTERN 5
PASS/FAIL
prev menu
PMD MAX-MIN
PMD AVG
PMD ALPHA
prev menu
REPORT ON/OFF
edit
setup λ
EXE PRINT
prev menu
comnt
file name
id 1
id 2
id 3
prev menu
←
→
DEL CHAR
INS SP
CLEAR LINE
ENTER
UNDO
prev menu
START λ
STOP λ
λ RESO
REF λ
prev menu
LOAD
LOAD MEAS1
LOAD MEAS2
LOAD MEAS3
MEM/FD
load meas
load panel
LOAD
EXIT
LOAD
EXIT


LOCAL
HEADER
ADR UP
ADR DOWN
MAG
MAG
LIN/LOG
MEAS/FIT
sweep mode
MOD FREQ
sens
avg
unwrap
smooth
fit
ripple
CONT SWEEP
STEP SWEEP
cont reso
step reso
meas mode
prev menu
SELECT RES/DTP
DATA POINTS
λ RESO
prev menu
HIGH SENS
MIDDLE SENS
NORMAL
HI SPEED
prev menu
SELECT RES/DTP
DATA POINTS
λ RESO
prev menu
NORMAL MEAS
DIFF MEAS
prev menu
AVG ON/OFF
AVG COUNT
prev menu
UNWRAP
THRESH
prev menu
SMOOTH ON/OFF
SMOOTH WINDOW
prev menu
FIT ON/OFF
fit mode
MEAS DATA ON/OFF
MEAS DATA LIN/DOT
PERSIAL ON/OFF
prev menu
LINEAR FIT
QUAD FIT
SELM3 FIT
SELM5 FIT
prev menu
RIPPLE ON/OFF
LINEAR
QUAD
SELM3
SELM5
prev menu


MODE
NORMAL
ΔMODE
2ND PEAK
DIFFER
band width
PK-XdB
ENVELOP
param
prev menu
XdB
YdB
K
prev menu
PRINT
EXE PRINT
ESC/P
ESC/P R
PCL
ABORT
SAVE
SAVE MEAS1
SAVE MEAS2
SAVE MEAS3
MEM/FD
save meas
save panel
SAVE BITMAP
SAVE
DELETE
UNIT NRM/DIS
FD DATA DIS/MEA
MEAS FORMAT ASC/BIN
name
EXIT
←
→
↑
↓
CLEAR
ENTER
prev menu
SAVE
DELETE
name
EXIT
←
→
↑
↓
CLEAR
ENTER
prev menu
SCALE
AUTO
/DIV
REF VER
/KM ON
/√KM ON
FIBER LG


STOP
SWEEP
SWEEP(+PMD)
SYSTEM
PRESET
clock
color
buzzer
floppy
key board
SELF TEST
label
CLOCK ON/OFF
YEAR
MONTH
DAY
HOUR
MINUTE
pattern
prev menu
YYYY-MM-DD
MM-DD-YYYY
DD-MM-YYYY
prev menu
PATTERN 1
PATTERN 2
PATTERN 3
PATTERN 4
PATTERN 5
prev menu
BEEP
WARNING
QUIET
prev menu
DIR
format
volume
prev menu
EXECUTE
2DD(720k)
2HD(1.44M)
prev menu
101 (US)
106 (JP)
prev menu
←
→
DEL CHAR
INS SP
CLEAR LINE
ENTER
prev menu
←
→
DEL CHAR
INS SP
CLEAR LINE
ENTER
UNDO
prev menu
TRANS/REFL
TRANS
REFL

4.3 Functional Description

ADVANCE — Displays the ADVANCE menu used to set the display modes.

FIBER LENGTH — Calculates and displays the fiber length after DUT's group delay time was measured based on the refraction factor set in the FIBER INDEX menu.

FIBER INDEX — Allows you to set DUT's refraction factor to calculate the fiber length.

AUTOλ LENGTH ON/OFF — Toggles AUTO λ LENGTH setting on or off.

ON: Sets the current center wavelength for distance measurements.

OFF: Sets the wavelength for distance measurements using λ WITH LENGTH menu.

λ WITH LENGTH — Enters a wavelength for distance measurements.

pol control — Displays the pol control menu.

λ/4 — Sets the angle for the λ/4 wavelength.

λ/2 — Sets the angle for the λ/2 wavelength.

FREE ROTATE ON/OFF
Toggles the FREE ROTATE function on or off.

prev menu — Displays the ADVANCE menu.

AUTO — Displays the AUTO menu.

MOD FREQ — When the SWEEP key is pressed, the modulation frequency is optimized for the present span, and the sweep mode is set.

pmd range in step — This command is used to display the pmd range in step menu.

AUTO ON/OFF — Sets the PMD range mode automatically when measuring with the SWEEP(+PMD) key in the step sweep mode, and can switch the sweep mode between ON and OFF. It can also automatically switch the differential measurement mode between ON and OFF.

25ps RANGE — Sets the mode that can measure PMD at a maximum of 25ps in the step sweep mode. When measuring with the SWEEP(+PMD) key in this condition, specify a wavelength resolution of over 100 pm.

CAUTION: When PMD Normalize is performed in 25ps RANGE,

SWEEP(+PMD) can be performed only in 25ps RANGE.

10ps RANGE Sets the mode that can measure PMD at a maximum of 10 ps in the step sweep mode. When measuring with the SWEEP(+PMD) key in this condition, specify a wavelength resolution of over 100 pm.

CAUTION: ***When PMD Normalize is performed in 10ps RANGE, SWEEP(+PMD) can be performed in 1ps RANGE or 10ps RANGE .***

1ps RANGE Sets the mode that can measure PMD at a maximum of 1 ps in the step sweep mode. When measuring with the SWEEP(+PMD) key in this condition, specify a wavelength resolution of over 1 nm.

CAUTION: ***When PMD Normalize is performed in 1ps RANGE, SWEEP(+PMD) can be performed in 1ps RANGE or 10ps RANGE.***

---

prev menu Displays the AUTO menu.

BACK LIGHT Turns the back light on or off.

CAL Displays the CAL menu.

λ *comp* Displays the λ comp menu.

λ *COMP ON/OFF* Toggles the wavelength compensation function on or off.

ON: Takes a measurement compensated for wavelength using the wavemeter (TQ8325/Q8326)

OFF: Does not compensate for the wavelength.

CAUTION: ***The Wavelength Correction function cannot be used with the Average function.***

Q8326 Selects the Q8326 (ADVANTEST-made) for the wavemeter model.

TQ8325 Selects the Q8325 (ADVANTEST-made) for the wavemeter model.

86120B/C Sets the wavemeter model to the 86120B/C (Agilent-made).

WA-1650 Sets the wavemeter model to the WA-1650 (Burleigh-made).

CAUTION: ***The operation of the wavelength meter specified below may be disabled if one of the following conditions is satisfied:***
A wavelength meter made by a manufacturer other than ADVANTEST is connected when the wavelength meter type is set to the Q8326 or TQ8325.
An ADVANTEST wavelength meter is connected when the wavelength meter type is set to the 86120B/C or WA-1650.
An inappropriate instrument other than those previously mentioned is connected. If this happens, use the following procedure.

1. ***Turn off the powers of the Q7760 and wavelength meter.***
2. ***Check that the Q7760 and the wavelength meter are properly connected.***
3. ***Turn on the powers of the Q7760 and wavelength meter.***
4. ***Set the wavelength meter model (Q8326, TQ8325, 86120B/C or WA-1650) correctly.***

---

prev menu Displays the CAL menu.

level offset Displays the offset menu.

L.OFSET(REFL) Calibrates the power level in the reflection characteristic mode. (-20dB to +20dB)

L.OFSET(TRANS) Calibrates the power level in the transmission characteristic mode. (-20 dB to +20 dB)

prev menu Displays the CAL menu.

trans normliz Displays the trans normalize menu.

SV REF Saves the current measurement value in the standard memory as correction data for transmission characteristics.

NORMLIZ Sets the mode that corrects the level of transmission characteristics based on data that is saved in the standard memory.

NORMLIZ FIT ON/OFF
Performs a curve fitting against normalized data of transmission characteristics.

LINEAR FIT Sets the approximation function in ***trans normliz***, ***NORMLIZ FIT*** to a linear expression.

QUAD FIT This setting is used to set the approximation function in ***trans normliz***, ***NORMLIZ FIT*** to a quadratic polynomial expression.

SELM3 FIT Sets the approximation function in ***trans normliz***, ***NORMLIZ FIT*** to Sellmeier's cubic polynomial expression.

SELM5 FIT Sets the approximation function in ***trans normliz***, ***NORMLIZ FIT*** to Sellmeier's cubic polynomial expression.

prev menu Displays the CAL menu.

refl normliz Displays the trans normalize menu.

SV REF Saves the current measurement value in the standard memory as correction data for reflection characteristics.

NORMLIZ Sets the mode that corrects the level of reflection characteristics based on data that is saved in the standard memory.

NORMLIZ FIT ON/OFF
Performs a curve fitting against normalized data of reflection characteristics.

LINEAR FIT Sets the approximation function in ***refl normliz***, ***NORMLIZ FIT*** to a linear expression.

QUAD FIT This setting is used to set the approximation function in ***refl normliz***, ***NORMLIZ FIT*** to a quadratic polynomial expression.

SELM3 FIT Sets the approximation function in ***refl normliz***, ***NORMLIZ FIT*** to Sellmeier's cubic polynomial expression.

SELM5 FIT Sets the approximation function in ***refl normliz***, ***NORMLIZ FIT*** to Sellmeier's cubic polynomial expression.

prev menu Displays the CAL menu.

POL CAL Performs a calibration for the polarization controller.

PMD NORMLIZ Acquires normalized data which can be used for a measurement performed by pressing the **SWEEP(+PMD)** key.

POL CAL+PMD NOR Executes POL CAL and then PMD NORMLIZ.

tls Displays the tls menu.

TLS CAL AUTO ON/OFF
Switches the light source CAL auto mode between ON and OFF according to the time elapsed.

TLS CAL EXCUTE
Executes light source CAL.

CAUTION: ***The performance of the absolute wavelength accuracy is ensured only when the light source CAL is performed correctly. For more information, refer to section 6.13, "Tunable Light Source Calibration."***

---

prev menu Displays the CAL menu.

CENTER/SPAN Displays the CEN/SPAN menu setting for the range of the display.

CENTER Sets the center of the display to active.

SPAN Sets the span of the display to active.

START Sets the start point of the display to active.

STOP Sets the stop point of the display to active.

zoom Displays the zoom menu.

ZOOM Displays the expanded view of the range indicated by the cursors.

RETURN Resets the expanded display to the original display.

prev menu Returns to the DISPLAY menu.

CUR TO CENTER When either the X1 or X2 cursor is displayed, the displayed cursor wavelength is set as the center wavelength. When both X1 and X2 cursors are displayed, the center wavelength is set in the center between the two cursors.

FREQ DOMAIN Selects the wavelength and frequency for the horizontal axis unit.

ON: sets the horizontal axis unit to frequency.

OFF: sets the horizontal axis unit to wavelength.

CURSOR — Displays the CURSOR menu.

ON/OFF — Selects the window and whether or not cursor information is displayed.

ON: Displays the cursor information.

OFF: Erases the four cursors and cursor information.

CURSOR X1 — Selects ON and OFF for the X CURSOR 1.

ON: displays the X CURSOR 1 and makes the setting active.

OFF: erases the X CURSOR 1.

CURSOR X2 — Selects ON and OFF for the X CURSOR 2.

ON: displays the X CURSOR 2 and makes the setting active.

OFF: erases the X CURSOR 2.

CURSOR L1 — Selects ON and OFF for the L CURSOR 1.

ON: displays the L CURSOR 1 and makes the setting active.

OFF: erases the L CURSOR 1.

CURSOR L2 — Selects ON and OFF for the L CURSOR 2.

ON: displays the L CURSOR 2 and makes the setting active.

OFF: erases the L CURSOR 2.

DELAY — The DELAY menu which sets the display mode is displayed.

GROUP DELAY — Sets the display mode to the group delay mode.

DISPERSION — The DISPERSION menu to set the display mode is displayed.

CD — Sets the display mode to the dispersion mode.

CD SLOPE — Sets the display mode to the dispersion slope mode.

PMD — Sets the display mode to the polarization dispersion mode.

DISPLAY — Displays the DISPLAY menu for setting the display mode.

SNGL DISP — Sets the display mode to the single screen figure mode.

dual disp — Displays the dual disp menu.

DUAL DISP ON/OFF

Selects ON and OFF for the dual screen display mode.

ON: sets the display mode to the dual screen mode.
OFF: sets the display mode to the single screen mode.

ACTIVE UP/LO Sets the upper or lower part of the screen to Active when Dual mode is turned on.

UP: Sets the upper part of the screen to Active.
LO: Sets the lower part of the screen to Active.

NOTE: ***Making a screen Active allows you to change settings, save or load data or make other changes. When a screen is not Active, no changes can be made.***

XCNG U/L Replaces the upper screen with the lower screen.
This operation is disabled when the average function is turned or any item of the measurement conditions (such as wavelength range) in one screen does not match the counterpart of another screen.

prev menu Displays the DISPLAY menu.

super impose Displays the super impose menu.

SUPER IMPOSE ON/OFF

Toggles Superimpose mode on or off.

ON: Superimpose mode is turned on.
OFF: Normal mode is turned off.

ACTIVE LF/RI Sets the left or right part of the screen to Active when Superimpose mode is turned on.

LF: Sets the left side of the screen to Active.
RI: Sets the right side of the screen to Active.

PASTE DATA Pastes the data from the Active part of the screen in the lower part on the screen if this key is pressed while Superimpose mode is turned on.

ERACE P_DATA Erases the pasted data if this key is pressed while Superimpose mode is turned on.

prev menu Displays the DISPLAY menu.

limit line Displays the limit menu.

ON/OFF Toggles the limit line display on or off. If the limit has not been loaded, the limit line cannot be displayed.

PATTERN 1 Loads the FD:\LmtLn\lmtln1.txt file from the floppy disk and display the limit line.

PATTERN 2 Loads the FD:\LmtLn\lmtln2.txt file from the floppy disk and display the limit line.

PATTERN 3 Loads the FD:\LmtLn\lmtln3.txt file from the floppy disk and display the limit line.

PATTERN 4 Loads the FD:\LmtLn\lmtln4.txt file from the floppy disk and display the limit line.

PATTERN 5 Loads the FD:\LmtLn\lmtln5.txt file from the floppy disk and display the limit line.

PASS/FAIL Checks the waveform and limit line. If the waveform is inside the specified area, PASS is displayed. Otherwise, FAIL is displayed.

prev menu Returns to the DISPLAY menu.

statistics analys Displays the statistics analysis menu.

PMD MAX-MIN Displays the maximum value and minimum value of PMD.

PMD AVG Average, Root-mean-square, and standard deviation of PMD

PMD ALPHA Displays α parameter, which is obtained when the Maxwell distribution function is applied to a PMD histogram (refer to section 6.14, "PMD Statistical Analysis Process").

prev menu Displays the DISPLAY menu.

report Displays the REPORT menu.

REPORT ON/OFF Toggles the report display on or off.

ON: Displays the report.
OFF: Displays the graph.

edit Displays the edit menu.

comnt Enters your comment in the report.

← Moves the input buffer cursor one character to the left.

→ Moves the input buffer cursor one character to the right.

DEL CHAR
Deletes the character at the current position of the input buffer cursor.

INS SP
Inserts a space at the current position of the input buffer cursor.

CLEAR LINE
Deletes all characters in the input buffer.

ENTER
Enters the characters selected by the CHARACTER menu in the input buffer.

UNDO
Cancels the edited series of characters and restores them to the original series of characters before editing.

prev menu
Displays the report menu.

file name
Enters the file name in the report.

← Moves the input buffer cursor one character to the left.

→ Moves the input buffer cursor one character to the right.

DEL CHAR
Deletes the character at the current position of the input buffer cursor.

INS SP
Inserts a space at the current position of the input buffer cursor.

CLEAR LINE
Deletes all characters in the input buffer.

ENTER
Enters the characters selected by the CHARACTER menu in the input buffer.

UNDO
Cancels the edited series of characters and restores them to the original series of characters before editing.

prev menu
Displays the report menu.

id 1 Enters the ID1 in the report.

← Moves the input buffer cursor one character to the left.

→ Moves the input buffer cursor one character to the right.

DEL CHAR
Deletes the character at the current position of the input buffer cursor.

INS SP
Inserts a space at the current position of the input buffer cursor.

CLEAR LINE
Deletes all characters in the input buffer.

ENTER
Enters the characters selected by the CHARACTER menu in the input buffer.

UNDO
Cancels the edited series of characters and restores them to the original series of characters before editing.

prev menu
Displays the report menu.

id 2 Enters the ID2 in the report.

← Moves the input buffer cursor one character to the left.

→ Moves the input buffer cursor one character to the right.

DEL CHAR
Deletes the character at the current position of the input buffer cursor.

INS SP
Inserts a space at the current position of the input buffer cursor.

CLEAR LINE
Deletes all characters in the input buffer.

ENTER
Enters the characters selected by the CHARACTER menu in the input buffer.

UNDO
Cancels the edited series of characters and restores them to the original series of characters before editing.

prev menu
Displays the report menu.

id 3 Enters the ID3 in the report.

← Moves the input buffer cursor one character to the left.

→ Moves the input buffer cursor one character to the right.

DEL CHAR
Deletes the character at the current position of the input buffer cursor.

INS SP
Inserts a space at the current position of the input buffer cursor.

CLEAR LINE
Deletes all characters in the input buffer.

ENTER
Enters the characters selected by the CHARACTER menu in the input buffer.

UNDO
Cancels the edited series of characters and restores them to the original series of characters before editing.

prev menu
Displays the report menu.

prev menu
Returns to the DISPLAY menu.

setup λ Displays the setup λ menu.

START λ
Enters the start wavelength displayed in the report.

STOP λ Enters the stop wavelength displayed in the report.

λ RESO Enters the wavelength resolution displayed in the report.

REF λ Enters the reference wavelength displayed in the report.

prev menu
Displays the report menu.

EXE PRINT Prints the measurement results in report form as described below.

First page:
In the upper half of the first page, the group delay time measurements and a graph modified using curve fitting is printed.
In the lower half of the first page, the chromatic dispersion measurements and a graph modified using curve fitting is printed.

Second page or later:
The current displayed screen, showing all measurements, is printed.

prev menu Returns to the DISPLAY menu.

GRID Selects ON and OFF for the grid display in the display area.

ON: displays the grid.
OFF: erases the grid.

BOTH MEAS ON/OFF Selects whether or not the data for both screens is updated during a measurement when Dual screen or Superimpose mode is turned on.

ON: Data is updated for both screens during a measurement.
OFF: Data for the Active screen is updated during a measurement.

NOTE: ***When this key is pressed, some of the settings on the inactive screen are also changed when they are changed on the Active screen. For more information on these linked settings, refer to section 2.2.5, "Analysis with Dual Screen Display."***

LOAD Displays the LOAD menu.

LOAD MEAS1 Reads out the measurement results from the FILE_001.SPE file.

LOAD MEAS2 Reads out the measurement results from the FILE_002.SPE file.

LOAD MEAS3 Reads out the measurement results from the FILE_003.SPE file.

MEM/FD Selects whether read data is stored in the backup memory or the floppy disk.

load meas Displays the ld meas and the directory list for reading out the measurement results.
At this time, selection of the object file can be made with the knob.

LOAD Reads out measurement results from memory or the file specified on a floppy disk.
All waveform data (MAG, Group Delay, CD, CD Slope, and PMD) can be downloaded from the memory. When reading it out from a floppy disk file, the waveform data which can be read out depends on the mode used to save the waveform data. If the DISP mode was used to save the waveform data, only waveform data that was being displayed when it was saved can be read out. If the MEA-BIN mode was used, all the waveform data (MAG, Group Delay, CD, CD Slope and PMD) can be read out.

	EXIT	Returns to the measurement state.
load panel		Displays the ld panel menu and the directory list for reading out measurement conditions. At this time, the selection of the object file can be made with the knob.
	LOAD	Reads out the measurement conditions from the memory or the file specified on a floppy disk.
	EXIT	Returns to the measurement state.
LOCAL		Displays the LOCAL menu for setting the GPIB. If this analyzer is in the lockout state at this time, the state is released.
	HEADER	Selects ON and OFF for the header. ON: attaches the header to the output data. OFF: does not attach the header to the output data.
	ADR UP	Increases the GPIB address. (0 to 30)
	ADR DOWN	Decreases the GPIB address. (0 to 30)
MAG		Displays the MAG menu for setting the display mode.
	MAG	Sets the magnitude characteristic mode.
	LIN/LOG	Selects the display method for the level. LIN: displays the level with linear power. LOG: displays the level with dB.
MEAS/FIT		Displays the MEAS/FIT menu.
sweep mode		Displays the sweep mode menu.
	CONT SWEEP	This is used to set the Sweep mode to the Continuous Sweep mode. It is also used to set the data point number specified in the cont reso-DATA POINTS menu or the data point number based on the Wavelength resolution specified in the λ RESO menu.
	STEP SWEEP	This is used to set the Sweep Mode to the Step Sweep mode. It is also used to set the data point number specified in the cont reso-DATA POINTS menu or the data point number based on the

Wavelength resolution specified in the λ RESO menu.

cont reso Displays the cont reso menu.

SELECT RES/DTP
Sets whether or not the fixed resolution is used, when the wavelength or frequency span has been changed.

RES: Sets the fixed resolution mode.
DTP: Sets the mode where the number of data points is fixed.

DATA POINTS
Sets the number of data point.

Setting range:
101 to 12001
However, the range is from 101 to 721 if the span is not 72 GHz or less.

λ RESO Sets the wavelength resolution.

Setting range:
0.15pm to 20pm
However, the range is from 1pm to 20pm if the span is 72 GHz or more.

prev menu
Displays the sweep mode menu.

step reso Displays the step reso menu

SELECT RES/DTP
Sets whether or not the fixed resolution is used, when the wavelength or frequency span has been changed.

RES: Sets the fixed resolution mode.
DTP: Sets the mode where the number of data points is fixed.

DATA POINTS
Sets the number of data point.

Setting range:
11 to 1101

λ RESO Sets the wavelength resolution.

Setting range:
0.01nm to 11nm

prev menu
Displays the sweep mode menu.

meas mode Displays the meas mode menu.

NORMAL MEAS
Turns the mode in which adjacent data points are sequentially measured on.

DIFF MEAS
Turns the mode in which differential measurements are made on.

prev menu
Displays the sweep mode menu.

prev menu Displays the MEAS/FIT menu.

MOD FREQ Sets the MOD FREQ value. (Units: Time or frequency)

sens Displays the sens menu.

HIGH SENS Sets high sensitivity mode.

MIDDLE SENS Sets middle sensitivity mode.

NORMAL Sets normal mode.

HI SPEED Sets high-speed mode.

prev menu Displays the MEAS/FIT menu.

avg Displays the avg menu.

AVG ON/OFF Toggles the averaging function on or off.

ON: Displays the averaged value of the measurement results for the counts set to the AVG COUNT.
OFF: Does not average the measurement results.

CAUTION: ***The Average function cannot be used with the Wavelength Correction function.***

AVG COUNT Allows you to set the counts used for averaging. (1 to 16)

prev menu Displays the MEAS/FIT menu.

unwrap Displays the unwrap menu.

UNWRAP Toggles the unwrapping function on or off.
This function is valid only when measuring the following characteristics.

- Group delay characteristics
- Dispersion characteristics
- Chromatic dispersion slope characteristics

- Polarization mode dispersion characteristics

ON: Performs the unwrapping function within the effective range set by the THRESHOLD menu.
OFF: Turns the unwrapping function off.

THRESH Allows you to set the effective range of the unwrapping function. The unwrapping function becomes valid (unit: dB) within the range where the magnitude characteristic is greater than the threshold set here.

prev menu Displays the MEAS/FIT menu.

smooth Displays the smooth menu.

SMOOTH ON/OFF
Toggles the smoothing function on or off.

ON: Displays the smoothed value of the measurement results in the section set in SMOOTH WINDOW.
OFF: Does not smooth the measurement results.

SMOOTH WINDOW
Allows you to set the width of the section to be smoothed.

prev menu Displays the MEAS/FIT menu.

fit Displays the fit menu.

FIT ON/OFF Toggles the fitting function on or off.

NOTE: The fitting function is disabled for the amplitude characteristics and polarization mode dispersion characteristics even if it is turned on.

---

fit mode Displays the fit mode menu.

LINEAR FIT
Sets the approximation function to the linear expression.

QUAD FIT
Sets the approximation function to the quadratic polynomial.

SELM3 FIT
Sets the approximation function to Sellmeier's cubic polynomial.

SELM5 FIT
Sets the approximation function to Sellmeier's quintic polynomial.

prev menu
Displays the fit menu.

MEAS DATA ON/OFF
Selects whether or not the raw measurement is displayed.

ON: Displays the raw data.
OFF: Does not display the raw data.

MEAS DATA LIN/DOT
Selects whether or not the raw measurement data is displayed using solid lines.

LIN: The raw data is displayed using solid lines.
DOT: The raw data is displayed using dashed lines.

PARTIAL ON/OFF
Specifies the range used for curve fitting.

ON: Curve fitting applies to the range between two X cursors. For other areas, linear interpolation is used.
OFF: Curve fitting applies to the entire range.

prev menu Displays the MEAS/FIT menu.

ripple isplays the ripple menu.

RIPPLE ON/OFF Toggles the ripple extraction function on or off.
When this function is turned on, ripple is extracted from the area enclosed by the X1 and X2 cursors, or is extracted from the entire area if no cursors are displayed.

LINEAR Sets the approximation function to the linear expression when the ripple characteristics are calculated.

QUAD Sets the approximation function to the quadratic polynomial when the ripple characteristics are calculated.

SELM3 Sets the approximation function to Selmeier's three-term polynomial when the ripple characteristics are calculated.

SELM5 Sets the approximation function to Selmeier's five-term polynomial when the ripple characteristics are calculated.

prev menu Displays the MEAS/FIT menu.

MODE Displays the MODE menu.

NORMAL Displays the wavelength (frequency) and the level at the cursor position.

ΔMODE Displays the wavelength (frequency) difference and the level difference between cursors.

2ND PEAK Displays the wavelength (frequency) difference and the level difference between the maximum peak and the second peak.

DIFFER Displays the vertical difference between the two values indicated by λ cursors on the superimposed screen.

diff1: Difference between the two values indicated by the λ1 cursor.
diff2: Difference between the two values indicated by the λ2 cursor.

band width Displays the band width menu for obtaining the band width.

PK-XdB Displays the full width half maximum calculated with the peak XdB method.

ENVELOP Displays the full width half maximum calculated by the Envelope method.

param Displays the parameter menu.

XdB Makes setting of the level difference calculated by peak XdB active.
Initial value: 3 dB Setting range: 0.1 dB to 59.9 dB

YdB Makes setting the peak threshold which is used for the envelope method active. (Otherwise, this is also used in need of the numbers of peaks.)
Initial value: 20 dB Set range: 0.1dB to 99.9 dB

K Makes setting of the correction coefficient of band width active.
Initial value: 1.0 setting range: 0.100 to 100.00

prev menu
Displays the band width menu.

prev menu Displays the MODE menu.

PRINT Displays the PRINT menu for copying measurement results.

EXE PRINT Outputs displayed data to the printer.

ESC/P Enables to use the printer to be used with ESC/P specifications.

ESC/P R Enables to use the printer to be used with ESC/P raster specifications.

PCL Enables to use the printer to be used with PCL specifications.

ABORT Outputting to a printer is canceled.

SAVE Displays the SAVE menu.

SAVE MEAS1 Pressing this key saves the measurement results (the waveform data in the current display) and measurement conditions in the memory with the FILE_001.SPE file name.

SAVE MEAS2 Pressing this key saves the measurement results (the waveform data in the current display) and measurement conditions in the memory with the FILE_002.SPE file name.

SAVE MEAS3 Pressing this key saves the measurement results (the waveform data in the current display) and measurement conditions in the memory with the FILE_003.SPE file name.

MEM/FD Selects whether to store data in the backup memory or the floppy disk.

save meas Displays the sv meas menu and the directory list for saving the measurement results.
At this time, selection of the object file can be made with the knob.

SAVE Saves the measurement result and measurement conditions to the specified file in the memory or floppy disk.
When ***MEM*** is selected for the ***MEM/FD*** setting, the MEA mode can only be used for save operation. If ***FD*** is selected, both DISP mode and the MEA mode can be used for save operations.

NOTE: When using a dual display screen or when there are multiple windows on the screen, the information in the currently active window is saved.

DELETE Deletes the specified file from memory or from a floppy disk.

UNIT NRM/DIS Sets the unit used for the ASCII data.

NRM: Saves the unit after it has been normalized to a basic unit (for example, m, sec, sec/m, etc).
DIS: Saves the unit currently displayed on the screen (for example, nm, psec and psec/nm).
Wavelength: nm
Frequency: THz
MAG: dB
GROUP DELAY:

	psec
CD:	psec/nm
CD Slope:	psec/nm^2
PMD:	psec

Example: When the data is 1550.5 nm
A numeric value of 1.5505E-6 is saved when NRM is set.
A numeric value of 1.5505E+3 is saved when DIS is set.

FD DATA DIS/MEA

Sets the data type which is saved.

DIS: Saves the measurement conditions and the waveform data currently displayed on the screen.

MEA: Saves the measurement conditions and data in all formats (MAG, GROUP DELAY, CD, CD Slope and PMD)

If the data was saved using DIS, only the waveform data that was displayed when the data was saved can be loaded.
If the data was saved using MEA, data in all formats (MAG, GROUP DELAY, CD, CD Slope and PMD) can be loaded. However, data cannot be loaded if it was saved using ***MEAS FORMAT ASC***.

MEAS FORMAT ASC/BIN

Sets the data type when saving data using ***FD DATA MEA***.

ASC: All measurement conditions and results in the measurement mode (the transmission characteristic mode or reflection characteristic mode) that are specified in the primary screen are saved as ASCII data.
The data is intended for use in spreadsheet applications, and cannot be loaded in the analyzer.

BIN: Saves all measurement conditions and measurement data in binary format, which can be loaded by the analyzer.

NOTE: ***The "primary screen" indicates either the dual-display screen selected in DISPLAY-dual disp-ACTIVE UP/LOW or the active screen selected in DISPLAY-super impose-ACTIVE LF/RI.***

---

name Makes file name entry active and displays the name menu and Character list.
At this time, the selection of characters can be performed by knob.

← Moves the cursor in the input buffer to the left by one character.

→ Moves the cursor in the input buffer to the right by one character.

↑ Moves the selection for the object file up by one.

↓ Moves the selection for the object file down by one.

CLEAR Clears the input buffer.

ENTER Enters the specified character in Character list into the input buffer.

prev menu
Displays the SAVE menu.

EXIT Returns to the measurement state.

save panel Displays the sv panl menu and the directory list for saving the measurement condition.
At this time, the selection of characters can be performed by knob.

SAVE Saves the measurement results in the specified file to memory or floppy disk.

DELETE Deletes the specified file of measurement results in memory or on the floppy disk.

name Makes file name entry active and displays the name menu and Character list.
At this time, the selection of characters can be performed by knob.

← Moves the cursor in the input buffer to the left by one character.

→ Moves the cursor in the input buffer to the right by one character.

↑ Moves the selection for the object file up by one.

↓ Moves the selection for the object file down by one.

CLEAR Clears the input buffer.

ENTER Enters the specified character in Character list into the input buffer.

prev menu
Displays the SAVE menu.

EXIT Returns to the measurement state.

SAVE BITMAP Saves the displayed screen to the floppy disk in bitmap format.

SCALE Displays the SCALE menu for setting the display conditions of

levels.

AUTO — Automatically sets the display level range according to the measurement results.

/DIV — Makes the level setting per 1DIV active and fixes the display level range.

REF VER — Makes setting active for the reference level.

/KM ON — Selects either ON or OFF for /km conversion.

ON: converts the measurement results to values /km, then displays the values.
OFF: does not perform /km conversion.

/√KM ON — Toggles the /√km conversion on or off.

ON: Displays the measurement result after it has been converted using /√km.
OFF: Does not convert the measurement result

FIBER LG — Makes the setting of sample lengths active.

STOP — Interrupts measurement, then stops. While the analyzer system is in idle, a new measurement is started when you press the **SWEEP(+PMD)** or the **SWEEP** key.

SWEEP — Measures the following characteristics once for each of the transmission and reflection characteristics and stops: the magnitude, group delay time, chromatic dispersion and chromatic dispersion slope.

SWEEP(+PMD) — Measures the following characteristics once for the transmission characteristics and stops: the magnitude, group delay time, chromatic dispersion, chromatic dispersion slope and polarization mode dispersion.

CAUTION: ***When the Average function is set to ON, the SWEEP (4PMD) cannot be performed.***

SYSTEM — Displays the SYSTEM menu.

PRESET Initializes the settings for this analyzer (refer to section 4.4, "Initialize").

clock Displays the clock menu.

CLOCK ON/OFF Selects either ON or OFF for the clock display.

ON: displays the date and time.
OFF: erases the date and time.

YEAR Makes setting of the year active.

MONTH Makes setting of the month active.

DAY Makes setting of the day active.

HOUR Makes setting of the hour active.

MINUTE Makes setting of the minute active.

pattern Displays the Pattern menu.

YYYY-MM-DD
Displays YYYY-MM-DD for the date display pattern.

MM-DD-YYYY
Displays MM-DD-YYYY for the date display pattern.

DD-MM-YYYY
Displays DD-MM-YYYY for the date display pattern.

prev menu
Displays the clock menu.

prev menu Displays the SYSTEM menu.

color Displays the color menu.

PATTERN 1 Sets the color of the display screen to pattern 1.

PATTERN 2 Sets the color of the display screen to pattern 2.

PATTERN 3 Sets the color of the display screen to pattern 3.

PATTERN 4 Sets the color of the display screen to pattern 4.

PATTERN 5 Sets the color of the display screen to pattern5.

prev menu Displays the SYSTEM menu.

buzzer Displays the BUZZER menu.

BEEP Selects either ON or OFF for operating sound.

ON: outputs operating sound.
OFF: does not output operating sound.

WARNING Selects either ON or OFF for warning sound.

ON: outputs warning sound.
OFF: does not output warning sound.

QUIET Selects the volume levels for the operating sound and warning sound.

ON: lowers the volume levels for the operating sound and warning sound.
OFF: sets the volume levels for the operating sound and warning sound to the normal level.

prev menu Displays the SYSTEM menu.

floppy Displays the floppy menu for saving measurement results.

DIR Displays the contents of the floppy disk.

format Displays the format menu for initializing the floppy disk.

EXECUTE
Executes initialization.

2DD(720k)
Sets the format to 2DD(720 k).

2HD(1.44M)
Sets the format to 2HD(1.44 M).

prev menu
Displays the floppy menu.

volume Makes input of volume active, then displays the volume menu.

← Moves the cursor in the input buffer to the left by one character.

→ Moves the cursor in the input buffer to the right by one character.

DEL CHAR
Deletes the character at the cursor position in the input buffer.

INS SP Inserts a space at the cursor position in the input buffer.

CLEAR LINE
Clears all characters in the input buffer.

ENTER Enters the character selected by the character menu into the input

buffer.

prev menu
Displays the floppy menu.

prev menu Displays the SYSTEM menu.

key board Displays the key board menu.

101 (US) Sets the 101 type key board.

106 (JP) Sets the 106 type key board.

prev menu Displays the SYSTEM menu.

SELF TEST Performs a self test.
When a self test is completed, the waveform display is cleared.

label The label input buffer is displayed.

← Moves the input buffer cursor one character to the left.

→ Moves the input buffer cursor one character to the right.

DEL CHAR Deletes the character at the current position of the input buffer cursor.

INS SP Inserts a space at the current position of the input buffer cursor.

CLEAR LINE Deletes all characters in the input buffer.

ENTER Enters the characters selected by the CHARACTER menu in the input buffer.

UNDO Cancels the edited series of characters and restores them to the original series of characters before editing.

prev menu Displays the SYSTEM menu.

TRANS/REFL Displays the TRANS/REFL menu for selecting measurement modes. This key has no effect during sweeping.

TRANS Sets the measurement mode to the transmission characteristics mode.

REFL Sets the measurement mode to the reflection characteristics mode.

4.4 Initialize

Item	Initial value
Trans/Refl	Trans
Dispersion/Mag/GROUP DELAY	Mag
Center wavelength	1550.000nm
Span	10.00nm
Wavelength/Frequency	Wavelength domain
/Div(Scale)	5.0dB/div
Ref Ver	0.0dB
MOD FREQ	1.0GHz
Average	off
Smoothing	off
Sensitivity	NORMAL
Normalize	off
/km display, /√km display	off
MEM/FD (Specifying places for storing)	MEN
Specifying colors	PATTERN 1
BEEP(BUZZER)	on
WARNING(BUZZER)	on
QUIET(BUZZER)	off
Label	**ADVANTEST Q7760 OPTICAL NETWORK ANALYZER**
CURSOR Mode	NORMAL
Band width Mode	PK-XdB

4.5 Floppy Disk

4.5.1 Media Specifications

Disk type: 3.5-inch micro floppy disk

Usable media: 2HD (double-sided high density)

Format capacity: 1.44 Mbytes (2HD)

Storage format: In conformance with MS-DOS.
2HD (1.44 Mbytes)

4.5.2 Data type Used with Floppy Disk

The format used to store measurement conditions and measurement data onto the floppy disk is shown below.

Table 4-1 Data Type

Data type	File extension
Measurement conditions	CON
Measurement data (in binary)	SPE
Measurement data (in ASCII)	TXT

Company name <CR/LF>
Product name <CR/LF>
Software version <CR/LF>
File extension <CR/LF>

[MAG X]\t[MAG Y] ... Data header
12001 ... Number of points
1.5500000E-0 \t 0.1230000E+00 ... MAG X-and Y-axis data
:
:
\t[GDLY Y] ... Data header
12001 ... Number of points
\t 3.4560000E-12 ... GROUP DELAY Y-axis data
:
:
:

From this point onwards, all data is in ASCII and in the same format as before. A return code (CR/LF) is added to the end of each line. In addition, the separator is represented by the TAB code (\t).

Figure 4-1 File Fomat with an Extension of TXT

NOTE:

1. ***The file format with an extension of SPE is not shown.***
2. ***Files with an extension of TXT can not be loaded into the optical network analyzer.***

<Measurement data (ASCII) file>

Table 4-2 Normal Measurement (Selecting ASC from ASC/BIN)

Item		Size (bytes)	Extension
(1)	File header		TXT
(2)	Waveform (MAG X, Y) (ASCII)	Variable length	
(3)	Waveform (GROUP DELAY Y) (ASCII)	Variable length	
(4)	Waveform (CD X, Y) (ASCII)	Variable length	
(5)	Waveform (CD Slope X, Y) (ASCII)	Variable length	
(6)	Measurement condition (ASCII)	Variable length	

NOTE: All data, except for some of the measurement conditions, is in ASCII code. Waveform data is basically in an X- and Y-format, although the X value of GROUP DELAY is omitted because it is the same as that of MAG.

Table 4-3 PMD Measurement (Selecting ASC from ASC/BIN)

Item		Size (bytes)	Extension
(1)	File header		TXT
(2)	Waveform (MAG X, Y) (ASCII)	Variable length	
(3)	Waveform (GROUP DELAY Y) (ASCII)	Variable length	
(4)	Waveform (CD X, Y) (ASCII)	Variable length	
(5)	Waveform (CD Slope X, Y) (ASCII)	Variable length	
(6)	Waveform (PMD Y) (ASCII)	Variable length	
(7)	Measurement condition (ASCII)	Variable length	

NOTE: All data, except for some of the measurement conditions, is in ASCII code. Waveform data is basically in an X- and Y-format, although the X value of GROUP DELAY is omitted because it is the same as that of MAG.

NOTE: ***Be aware that specifications such as the data block are subject to change without notice for reasons such as customer requests and quality control.***

4.5.3 Items in a Data File

(1) Header

Information such as company name, product model, software revision and file type is stored. For more information, see the chart below.

Table 4-4 File Header Contents

Contents	Number of bytes	Remarks
Company name	16	Space codes for the remainder
Product name	16	Space codes for the remainder
Software version	16	Space codes for the remainder
File type	16	Space codes for the remainder
Model ID	2	7760 (H) for the Q7760
Option ID	2	Option information, etc.
Title	28	Arbitrarily set title
New format ID	2	ID (0916H) to represent a new format
Reserved	14	
Is there measurement raw data? Yes/No	1	Yes, if it is 16 (H). Otherwise, no raw data exits.
Is there a measurement data unit? Yes/No	1	Display unit conversion, if it is 16 (H). Otherwise, the unit is converted into m, sec or Hz.
Reserved	1	
Is this a PMD measurement?	1	A PMD measurement, if it is 16 (H). Otherwise, it is a normal measurement.
What band is used?	1	Normal band if it is 11 (H). L band if it is 22 (H). Otherwise, functions as a normal band.
Domain?	1	Wavelength axis if it is 0. Frequency axis if it is 1.
LOG/LIN?	1	LOG scale if this is set to 0 LIN scale if this is set to 1 (for MAG display only).
Reserved	9	
Total	128	

(2) Data block header

Information such as the block ID, next block ID and data size is recorded. The contents are as follows.

Table 4-5 Data Block Header Contents

Contents	Number of bytes	Remarks
Model ID	2	7760 (H) for the Q7760
Option ID	2	Option information, etc.
Reserved	4	
Software version	8	
Block ID	2	
Next block ID	2	0 if this is used for the last block.
Reserved	6	
Data size	4	Denotes the actual data size in bytes
Sum value	2	The sum of data blocks (excluding the header). Judges whether or not the data has been corrupted from this value.
Total	32	

(3) Measurement condition (in binary)

Records the parameters which are used to reproduce the measurement conditions or measurement data using the analyzer. They are basically the same as those listed in paragraph (7). The data in this part consists of integer or floating point values (IEEE 64-bit floating point values), although those in paragraph (7) are characters in ASCII format.

(4) X-axis data (in binary)

Records the wavelength or frequency data (IEEE 64-bit floating point values) that corresponds to the number of measurement points of up to 12001 as binary data.
This data is used to reproduce the measurement results produced by the analyzer.

(5) Y-axis data (in binary)

Records the data for the Y-axis such as level data and normalization reference data (IEEE 64-bit floating point values) that corresponds to the number of measurement points of up to 12001 as binary data.
This data is used to reproduce the measurement results produced by the analyzer.

(6) Waveform data (in ASCII)

Records wavelength data and the level data related to the wavelength data. When ***DIS/MES***(DIS) is selected, up to 12001 points of the currently displayed data can be recorded. When ***DIS/MES***(MES) is selected, up to 12001 points of data can be recorded for each measurement mode.

Before wavelength and level data is recorded, the user can select whether or not the displayed units are recorded together with the data. When ***UNIT NRM/DIS***(NRM) is selected, the units are converted into m, sec, Hz, and so on. Note that level data can be recorded with [sec], [deg] or [none] regardless of the scale (LIN/LOG) used when the level was recorded. Use the following expression to convert a value into [dB].

Expression used to convert a value into [dB]: $P_{dB} = 10 \times \log_{10}(P)$
$(= 10 \times (\log_2 P / \log_2 10))$

When ***UNIT NRM/DIS***(DIS) is selected, data is recorded after it has been converted to the displayed unit (such as nm, psec or THz). The level data, however, is recorded with the same scale (LIN or LOG) as the one used when it was recorded. As a result, [dB] is used for the log scale.

The waveform data has the following format.

Table 4-6 Waveform Format Consisting of the X and Y Values

Data example (\t (Backslash-T)TAB)	Remarks
[MAG X]\t[MAG Y]<CR/LF>	Title
12001<CR/LF>	Number of data
+1.54500000E-06\t +19.0095E+00<CR/LF>	First X- or Y-data stream (use tab characters as separators)
+1.54533333E-06\t +9.13829E+00<CR/LF>	Second X- or Y-data stream
.....	
+1.55500000E-06\t +11.7033E+00<CR/LF>	12001st X- or Y-data stream

When either ***DIS/MES***(DIS) or ***DIS/MES***(MES) is selected and X- or Y- value is output as a result of measuring the MAG or CD, the data items shown in Table 4-6 are delimited with tab characters and recorded in order of: title, number of waveform data, X(n) level data, Y(n) level data and CR(0Dh)/LF(0Ah).

Table 4-7 Waveform Format Consisting of Y Values

Data example (\t (Backslash-T)TAB)	Remarks
\t[PMD Y]<CR/LF>	Title
12001<CR/LF>	Number of data
\t+19.0095E+00<CR/LF>	First X- or Y-data stream (use tab characters as separators)
\t+9.13829E+00<CR/LF>	Second X- or Y-data stream
.....	
\t+11.7033E+00<CR/LF>	12001st X- or Y-data stream

When X- values are omitted in the same way as an X value of the MAG, data items shown in Table 4-7 are delimited with tab characters and recorded in order of: title, number of waveform data, Y(n)

level data and CR(0Dh)/LF(0Ah).

(7) Measurement conditions (in ASCII)

Each parameter of a measurement condition is recorded as character strings in ASCII code. To reproduce data on a computer from a floppy disk, measurement data is read from this part. Each value consists of "Mantissa and Exponent" based on reference data [in m, Hz, dB or sec], and is recorded in the sequence shown below.
In addition, each parameter has a fixed size, and the unused part is filled with "0s" (NULL codes).

Table 4-8 Parameter Data Example

Parameter	Size	Data example
(1) Label	50	**ADVANTEST Q7760 OPTICAL NET-WORK ANALYZER**
(2) Number of measurement points	8	161
(3) Start wavelength [Frequency]	18	+1.54320000E-06
(4) Stop wavelength [Frequency]	18	+1.55200000E-06
(5) Center frequency	18	+1.54760000E-06
(6) Span	18	+8.80000000E-09
(7) Resolution	18	+55.0000000E-12
(8) REF LEVEL (upper)	18	+15.1005E+00
(9) REF LEVEL (lower)	18	-34.8995E+00
(10) Averaging Number	8	1/1
(11) Date	12	2000-11-05
(12) Time	12	13:16:25
(13) REFLECTION/TRANS	18	TRANS
(14) FORMAT	18	MAG(LOG)
(15) /KM ON/OFF	12	/KM:OFF
(16) FIBER LG	18	+1.00000E+00
(17) F-DOMAIN	18	F_DOMAIN:OFF
(18) MOD FREQ	18	+100.000E+06
(19) SENSITIVITY	18	NORMAL (100Hz)
(20) SMOOTHING ON/OFF	18	SMOOTHING:OFF
(21) SMOOTHING WINDOW	18	+0.00000000E+00
(22) FITTING ON/OFF, FITTING MODE	18	FITTING ON : (QUAD)
(23) Zero wavelength	30	ZEROLMD: +0.00000000E+00
(24) FITTING ERROR	32	FITTING ERROR: +0.00000000E+00
(25) Fitting coefficient F1	30	F1:1.00000000000000E+01
(26) Fitting coefficient F2	30	F2:1.00000000000000E+01
(27) Fitting coefficient F3	30	F3:1.00000000000000E+01
(28) Fitting coefficient F4	30	F4:1.00000000000000E+01
(29) Fitting coefficient F5	30	F5:1.00000000000000E+01
(30) RIPPLE ON/OFF	18	RIPPLE:OFF

Parameter	Size	Data example
(31) PMD statistical analysis result Upper label	30	--- STATISTICS ANALYSYS ---
(32) PMD MAX	30	MAX: +0.000000E+00
(33) PMD MIN	30	MIN: +0.000000E+00
(34) PMD average	30	Average: +0.000000E+00
(35) PMD Root-mean-square	30	RMS: +0.000000E+00
(36) PMD standard deviation	30	Std Deviation: +0.000000E+00
(37) PMD α parameter	30	Maxwell Alpha:+0.000000E+00
(38) PMD most probable value	30	M.P.Value: +0.000000E+00
(39) PMD statistical analysis result Lower label	30	----------
(40) NORMALIZE FITTING Upper label	30	--- NORMALIZE FITTING ---
(41) NORMALIZE FITTING FITTING ON/OFF, MODE	30	FITT:OFF(QUAD)
(42) NORMALIZE FITTING Fitting coefficient F1	30	F1:0.00000000000000E+00
(43) NORMALIZE FITTING Fitting coefficient F2	30	F2:0.00000000000000E+00
(44) NORMALIZE FITTING Fitting coefficient F3	30	F3:0.00000000000000E+00
(45) NORMALIZE FITTING Fitting coefficient F4	30	F4:0.00000000000000E+00
(46) NORMALIZE FITTING Fitting coefficient F5	30	F5:0.00000000000000E+00
(47) NORMALIZE FITTING Lower label	30	----------
(48) Reserved	3942	
Total	5120	

5 REMOTE PROGRAMMING

Gives an outline of the GPIB interface, and how to connect and set them up. Also included are a list of commands necessary for programming and using the program examples.

5.1 GPIB Command Index

This GPIB command index can be used as the index for Chapter 5.

5.2 Overview of GPIB

The GPIB is an interface connected to the measurement device, controller, and peripheral units, etc., through a simple cable (bus line).

The GPIB is more expandable than conventional interfaces, is easy to use, and has electrical, mechanical, and functional compatibility with other manufacturers' products, making it applicable to system configurations from simple systems to automatic design systems with high-level functions using one bus cable.

In the GPIB system, the address for each device connected to a bus line must be set in advance. Each instrument is assigned one or more roles from the following three roles: controller, talker (TALKER), or listener (LISTENER).

During system operation, only one "talker" can send data to the bus line, but plural "listeners" can receive it.

The controller specifies the addresses of "talker" and "listener" to transfer data from "talker" to "listener", and the controller sets setting conditions from "talker" to "listener".

Data is synchronously transferred synchronously bidirectionally between devices via eight data lines in the bit-parallel, byte-serial form. Because this is a synchronous system, using high-speed and low-speed devices together in the same system is possible.

Data (messages) transferred between devices include measurement data, measurement conditions (programs), and commands; they are in ASCII.

In addition to eight data lines, the GPIB has three handshake lines for controlling the synchronous data transmission between instruments, and five control lines for controlling the bus information flow.

5.3 Interface Functions

Table 5-1 shows analyzer interface functions.

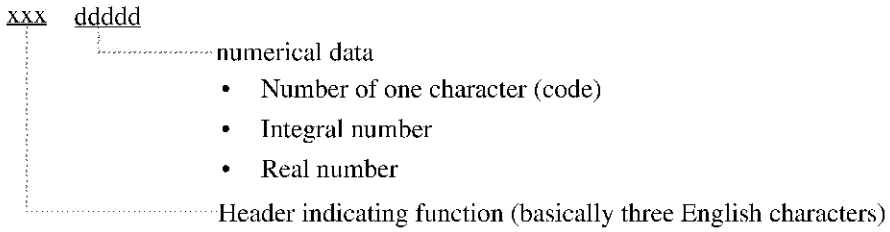
Table 5-1 Interface Functions

Code	Function
SH1	Source handshake
AH1	Acceptor handshake
T5	Basic talker Serial polling Talker reset based on listener specification
L4	Basic listener Listener reset based on talker specification
SR1	Service request
RL1	Remote
PP0	No parallel function
DC1	Device clear
DT1	Device trigger
C0	No controller function
E2	Three-state-bus-driver used

5.4 Program Code

This section explains the program code through which the outside controller sets analyzer conditions.

Each program code consists of three English characters which indicate the functions and numerical data for setting functions as follows:



The state of each condition is read in by adding "?" after the functional header.

NOTE

1. ***For the functional header and unit, either a capital letter or a lower-case letter is used for setting. Any space code (20H) is set in a program code.***
2. ***In this analyzer, the program code is processed in one row to the terminator. The maximum allowable characters set in one row are 255.***
   When describing a plurality of program codes in one row, set the program codes by punctuating with comma (,) or semicolon (;).

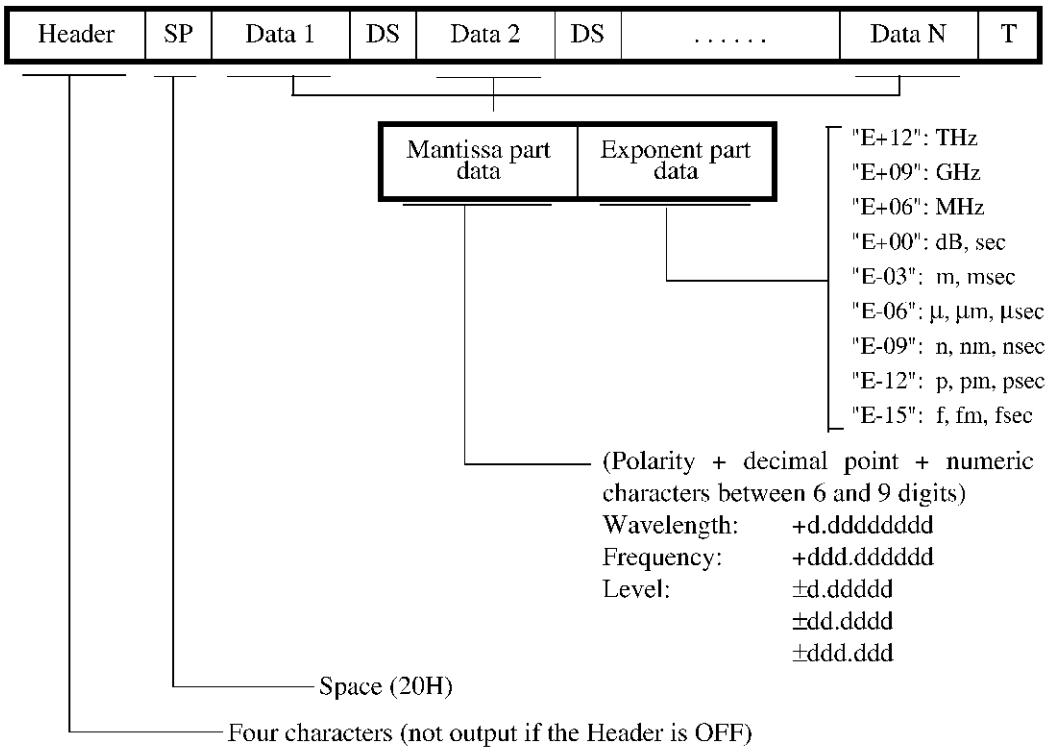
5.5 Talker Formats (Data Output Formats)

This section describes the talker formats used when this analyzer system transfers data to an external controller.

Data is classified roughly into six types of formats: waveform data, peak search data, cursor data, half-width data and condition data.

(1) Waveform data (program code "OSD0," "OSD1")

- ASCII format (format specification code "FMT0")

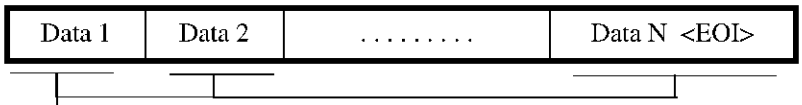


Header	Data type
LMUM	Wavelength [m]
FQTH	Frequency [Hz]
LVLG	Level in logarithmic scale [dB]
LVLI	Level in linear scale

DS: Data Separator (either ',' ';' CR or NL)
Can be specified by the program code "SDLn" ("DSn").

T: Terminator (either NL<EOI>, NL<EOI> or "CR,NL<EOI>")
Can be specified by the program code "DELn" ("DLn").

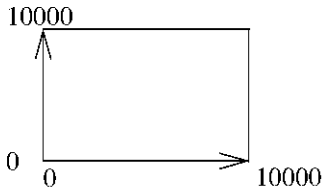
- BINARY format (format specification code ("FMT1", "FMT2", "FMT3"))



Is output in either of the following three formats according to the setting of the format specification code "FMTn."

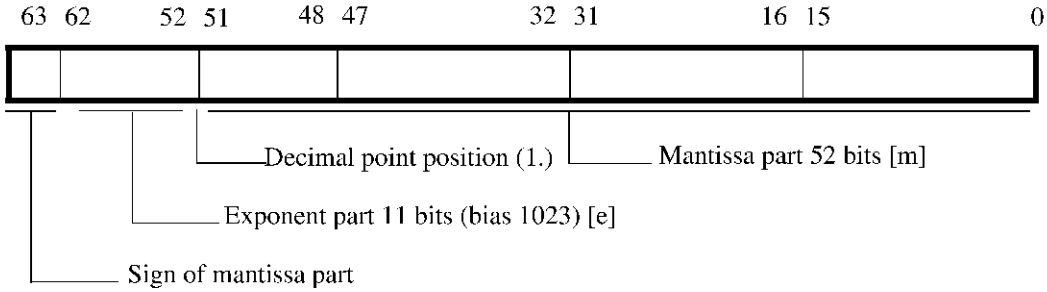
(a) "FMT1" ... 64 bits (integer type)

Is output within the range of 0 to 10000 on the X axis and within 0 to 10000 on the Y axis by setting all data on the screen as linear scale.



(b) "FMT2" ... 64 bits (floating point type)

Outputs data in the floating-point format (IEEE Std.754-1985 format) as shown below.

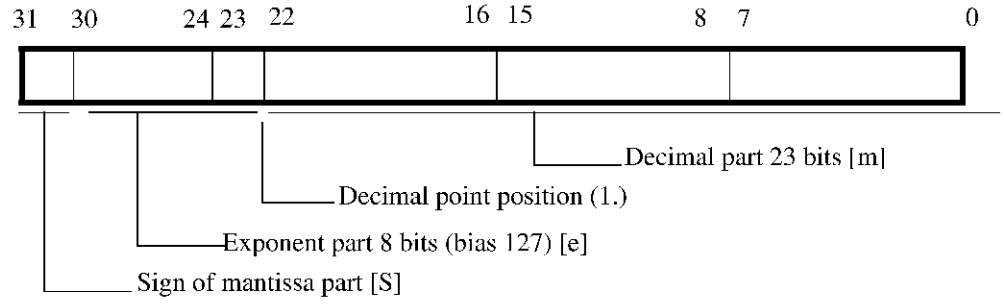


The formula is shown below.

$(-1)^S \times 1.m \times 2^{(e-1023)}$

(c) "FMT3" ... 32 bits (IEEE floating-point type)

Outputs data in the floating-point format (IEEE Std.754-1985 format) as shown below.

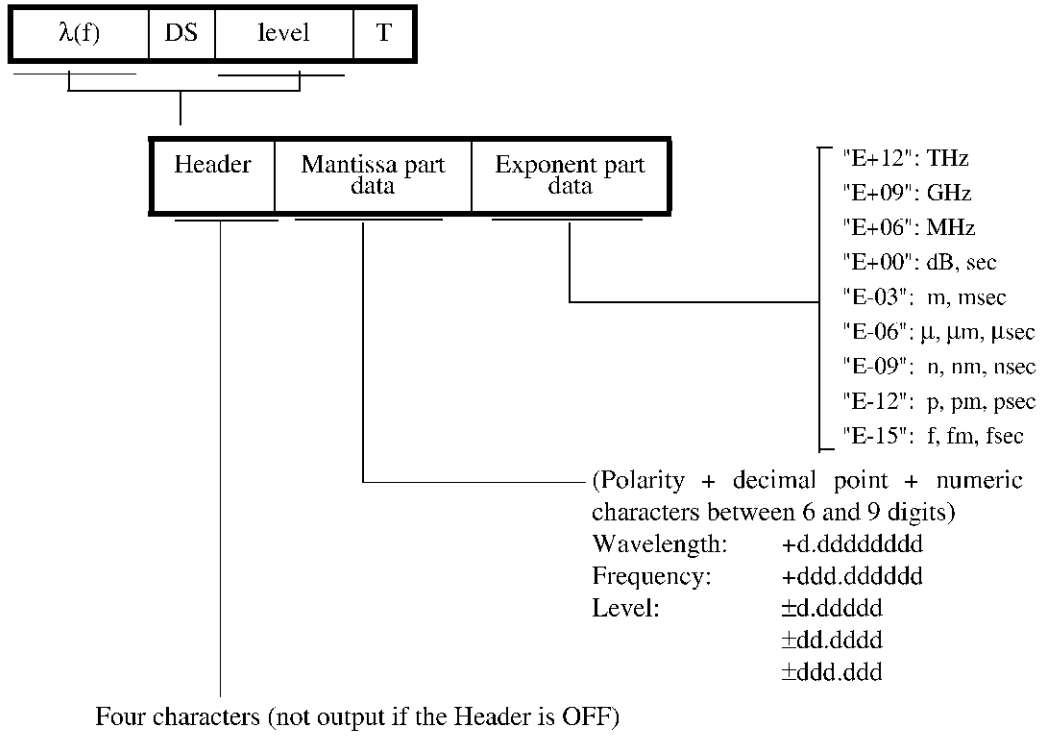


The formula is shown below.

$(-1)^S \times 1.m \times 2^{(e-127)}$

(2) Peak search data (program code "OPK")

- Spectrum mode

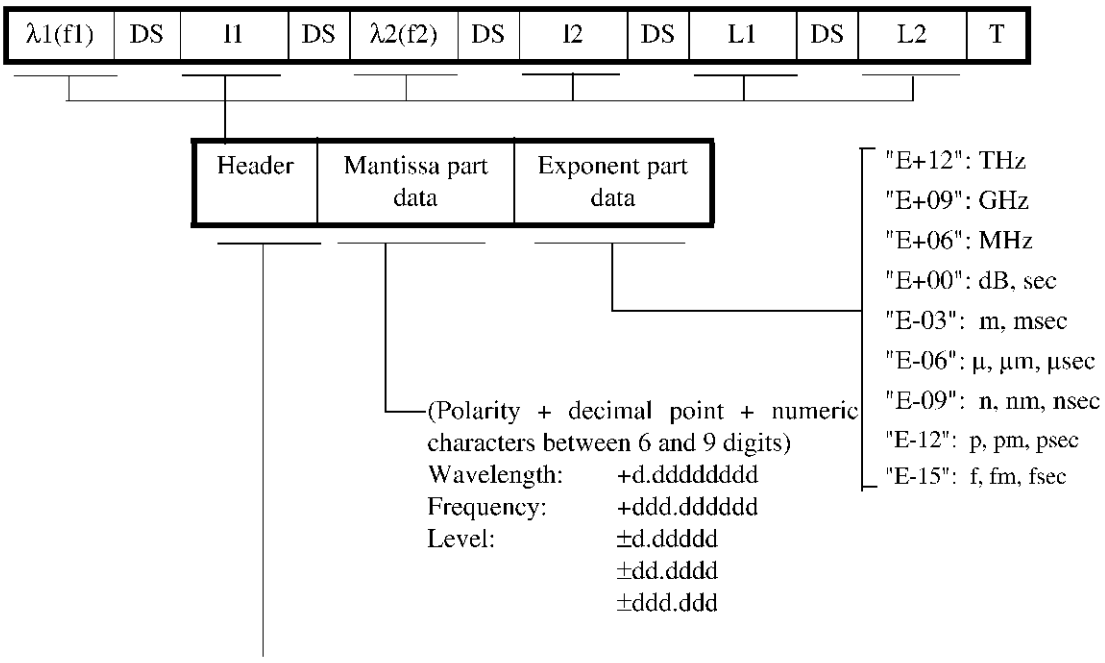


Header	Data type
LMPK	Peak wavelength (λ)
LVPK	Peak level (level)
FQPK	Peak Frequency (f)

(3) Cursor data (program code "OCD")

Is output in one of the following four types of formats according to the specification code "CUDn" in the cursor display mode.

- "CUD0" ... NORMAL



Header	Data type
LMXA	Wavelength of X1 cursor (λ1)
LVXA	Level of X1 cursor (I1)
LMXB	Wavelength of X2 cursor (λ2)
FQXA	Frequency of X1 cursor (f1)
FQXB	Frequency of X2 cursor (f2)
LVXB	Level of X2 cursor (I2)
LVYA	Level of Y1 cursor (L1)
LVYB	Level of Y2 cursor (L2)

DS: Data Separator (either "',' ';' CR" or NL)
Can be specified by the program code "SDLn" ("DSn").

T: Terminator (NL<EOI>, NL<EOI>or "CR,NL<EOI>")
Specification by the program code "DELn" ("DLn").

NOTE: ***The data becomes "0" if the corresponding cursor is OFF.***
The formats of the mantissa and exponent parts are common to all "CUDn."

- "CUD1" ... ΔMODE

λ1(f1)	DS	l1	DS	ΔΛ(Δf)	DS	Δl	DS	L1	DS	ΔL	T

Four characters (not output if the Header is OFF)

Header	Data type
LMXA	Wavelength of X1 cursor (λ1).
LVXA	Level of X1 cursor (l1).
LMDX	Wavelength difference between X1 cursor and X2 cursor (ΔΛ).
FQXA	Frequency of X1 cursor (f1).
FQDX	Frequency difference between X1 cursor and X2 cursor (Δf).
LVDX	Level difference between X1 cursor and X2 cursor (Δl).
LVYA	Level of Y1 cursor (L1).
LVDY	Level difference between Y1 cursor and Y2 cursor (ΔL).

- "CUD2" ... 2ND PEAK

λ1(f1)	DS	l1	DS	ΔΛ(Δf)	DS	Δl	T

Four characters (not output if the Header is OFF)

Header	Data type
LMPK	Peak wavelength (λ1)
LVPK	Peak level (l1)
LMDP	Wavelength difference between the maximum peak and the second peak (ΔΛ)
FQPK	Peak frequency (f1)
FQDP	Frequency difference between the maximum peak and the second peak (Δf)
LVDP	Level difference between the maximum peak and the second peak (Δl)

- "CUD4" ... DIFFER

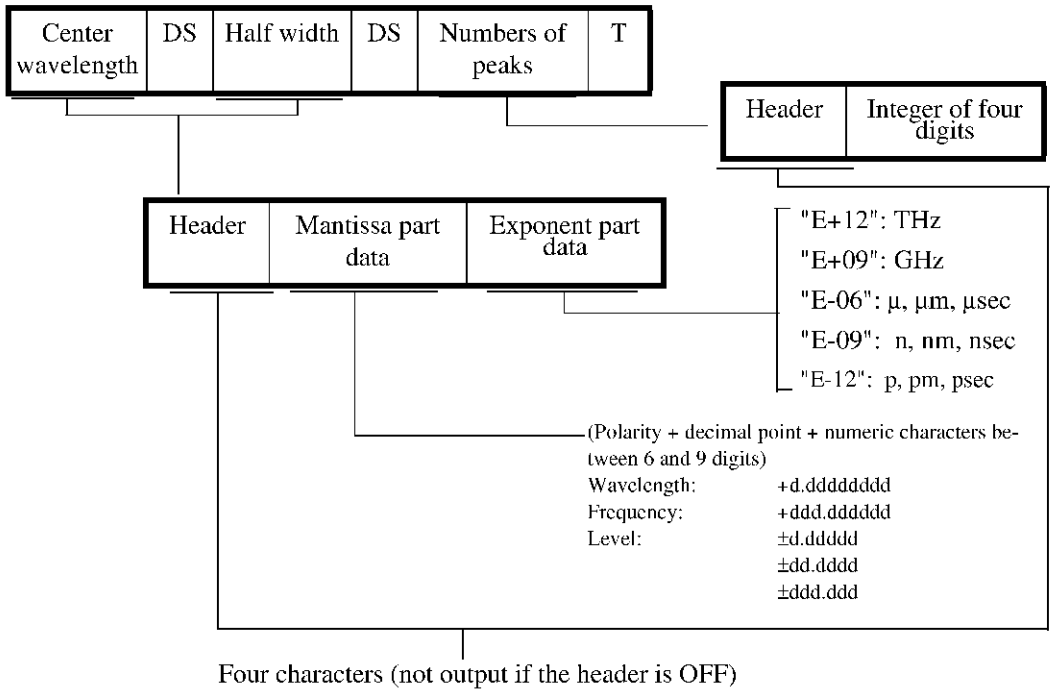
λ1(f1)	DS	di1	DS	λ2(f2)	DS	di2

Four characters (these characters are not output when the header is turned off).

Header	Data type
LMXA	Wavelength at the X1cursor (λ1)
LVDA	Difference value at the X1cursor (di1)
LMXB	Wavelength at the X2 cursor (λ2)
LVDB	Difference value at the X2 cursor (di2)
FQXA	Frequency at the X1cursor (f1)
FQXB	Frequency at the X2 cursor (f2)

(4) Half-width data (program code "OSW")

Half-width data is generated in the following format when the Peak XdB method or the Envelope method is used for the calculation.



Header	Data type
LMCN	Center wavelength
LMHW	Half width (wavelength domain)
FQCN	Center frequency
FQHW	Half width (frequency domain)
NOSP	Numbers of peaks

DS: Data Separator (',', ';', CR or NL)
Can be specified by the program code "SDLn" ("DSn").

T: Terminator (NL<EOI>, NL<EOI>, or "CR,NL<EOI>")
Can be specified by the program code "DELn" ("DLn").

(5) Inquiry about the analyzer ID

Outputs the following data by receiving the program code "*IDN?."

ADVANTEST , Q7760, 12345678, A01

- A01: Serial number (Manufacturing number)
- 12345678: Software revision (Processing system)

(6) Condition data

Header	Data	T

- Header: Same as the functional header to be set.
- Data:
  - Integer

    RTR, FOR, LIN, ALD, RDM, FDO, LEV, AUM, EXP, DUA, SIM, AUL, GRI, BOM, REP, EAV, AVG, SMO, SEN, NOR, NRT, PKM, UWR, EGD, DPS, DTM, DIF, CDP, FIT, FIM, MED, DOT, PFT, WCA, ACR, WMT, MEA, SMS, UNM, PRT, CKD, CPT, BUZ, WAR, QUI, *TST?, FON, CUD, SPW, WTY, CUR, XAC, XBC, YAC, YBC, DSP, HED, DEL, SDL, FMT, OVS, SRQ, S, MSK

  - Mantissa part data + exponent part data

    Exponent part data:
    "E+12": THz
    "E+09": GHz
    "E+06": MHz
    "E+00": dB, sec
    "E-03": m, msec
    "E-06": m, mm, msec
    "E-09": n, nm, nsec
    "E-12": p, pm, psec
    "E-15": f, fm, fsec

    Mantissa part data: (Polarity + decimal point + numeric characters between 6 and 9 digits)

Wavelength:	+d.ddddddddd
Frequency:	+ddd.dddddd
Level:	±d.ddddd
	±dd.dddd
	±ddd.ddd

    CEN, SPA, STA, STO, REF, MOF, SMW, LCA, LCT, STL, FIB, UWP, EDT, XAS, XBS, YAS, YBS, WPX, WPY, WPK

  - Others

    LAB 1 to 48 characters
    CLO YY-MM-DD,hh:mm:ss
    CUS RRR-GGG-BBB

5.6 Device Triggering Function

This analyzer system performs a SINGLE measurement operation similar to the case in which it receives the program codes "MEA1," "E" and "*TRG" through the address specification command 'GET' (Group Execute Trigger).

5.7 Device Clear Function

This analyzer system is set to the initial state when turning the power on, similar to the case in which it receives the program codes "C" and "*RST" through the address specification command 'SDC' (Selected Device Clear) and the universal command 'DCL' (Device CLear).

The initial state after turning the power on is shown in Table 5-2.

Table 5-2 Initial State After Turning the Power On

Item	Initial state
1. Measurement conditions (FUNCTION section)	Previous state
2. Data display	Normal display (Dual screen, superimposing and list display are all OFF).
3. Cursor display	All are OFF.
4. Half width calculation	OFF
5. GPIB-related	
Status byte	0 (Clear)
Masking status bytes	"MSK0" (No mask)
Transmission of SRQ signal	"SRQ0" (Mode in which the SQR signal is not sent)
Output format of waveform data	"FMT0" (ASCII)
Terminator	"DEL0" (DL0) ⇒(NL<EOI>)
Data separator	"SDL0" (DS0)⇒(,)

5.8 State Changes According to the Commands

This analyzer system is in the states listed in Table 5-3 after turning the power on and receiving the various commands.

Table 5-3 State Changes According to the Commands

Command code	Talker	Listener	Remote	SRQ	Status byte	Transferred data	Parameters and Operation State
POWER ON	Clear	Clear	Local	Clear	Clear	Clear	Partial initialization
IFC	Clear	Clear	-	-	-	-	-
DCL	-	-	-	Clear	Clear	Clear	Partial initialization
SDC	Clear	Set	-	Clear	Clear	Clear	Partial initialization
C, *RST	Clear	Set	Remote	Clear	Clear	Clear	Partial initialization
IPR	Clear	Set	Remote	Clear	Clear	Clear	Initialization
GET	Clear	Set	-	=	Clear b0, 2, 3 and 5	Clear	-
E, *TRG	Clear	Set	Remote	=	Clear b0, 2, 3 and 5	Clear	-
Specifying the talker for this analyzer system.	Clear	Clear	-	-	-	-	-
Command for turning the talker off.	Clear	-	-	-	-	-	-
Specifying the listener for this analyzer system.	Clear	Set	-	-	-	-	-
Command for turning the listener off.	-	Clear	-	-	-	-	-
Serial polling	Set	Clear	-	Clear	-	-	-

-: Indicates that the previous state does not change.

=: Indicates indefinite state

DCL: Device Clear

SDC: Selected Device Clear

GET: Group Execute Trigger

5.9 Status Byte

The functions of each bit in the status byte (used for this analyzer system) are shown below.

b7	b6	b5	b4	b3	b2	b1	b0

b0: measure end
Is set to 1 at the end of measurement.
Is set to 0 upon starting the next measurement.

b1: syntax error
Is set to 1 if there are any syntax errors in the received program codes, and when the command is received while performing light source CAL.
Is set to 0 upon receiving the next program codes.

b2: calculation end
Is set to 1 when a fitting calculation, half width calculation or fiber length measurement is completed.
Is set to 0 when a fitting calculation, half width calculation or fiber length measurement is started.

b3: copy end, floppy access end or memory access end
Is set to 1 at the end of printer output or access to the floppy disk memory (writing, reading or initialization).
Is set to 0 upon starting a measurement, receiving an "EPR" code to the floppy disk.

b4: Is set to 1 when the modulation frequency AUTO mode ends.
Is set to 0 when the modulation frequency AUTO mode is executed.
Is set to 1 when a calibration or the PMD normalization is being executed.
Is set to 0 when a calibration or the PMD normalization ends.

b5: average end
Is set to 1 if the measurements of specified counts are completed while averaging processing is ON.
Is set to 0 when measurement is started or averaging processing is OFF.

b6: RQS
Is the bit that indicates that it is issuing a service request and Set to 1 if any of bits b0 to b5 and b7 is 1.
Is set to 0 if all bits are 0.

b7: self-test error
Is set to 1 if any abnormality occurs while performing the self-test function.
Is set to 1 if an error occurs in the optical network analyzer unit.

5.10 Code Table

Table 5-4 FUNCTION

Item	Command		Query	Description
	Header	Parameter		
REF/TRANS				
REF/TRANS	RTR	0, 1	RTR?	0: Refrection 1: TRANS
FORMAT				
FORMAT	FOR	0, 2, 3, 4, 5	FOR?	0: Mag 2: GROUP DELAY 3: CD 4: CD SLOPE 5: PMD
LIN/LOG	LIN	0, 1	LIN?	0: OFF(LOG) 1: ON (LINEAR)
Fiber Index	IND	Numeric value	IND?	1.0 ~ 2.0
Execution of FIBER LENGTH	ELG	---	---	
FIBER LENGTH readout	---	---	OFL? (OFL)	
ADVANCE				
AUTO λ LENGTH	ALD	0, 1	ALD?	0: OFF, 1: ON
λ with LENGTH	LWD	Numeric value + unit	LWD?	UM: μm(Default), NM: nm
λ/4	QWP	Numeric value	QWP?	-360 to 360
λ/2	HWP	Numeric value	HWP?	-360 to 360
Free rotation	RDM	0, 1	RDM?	0:OFF, 1:ON

Table 5-5 SETUP

Item	Command		Query	Description
	Header	Parameter		
CENTER/SPAN				
CENTER	CEN	Numerical value+Unit	CEN?	UM: μm(Default) NM: nm THZ: THz GHZ: GHz Ex. CEN1.55UM Ex. CEN1530NM Ex. CEN1.54
SPAN	SPA	Numerical value+Unit	SPA?	UM: μm NM: nm(Default) NMD: nm/DIV THZ: THz GHZ: GHz THZD: THz/DIV GHZD: GHz/DIV Ex.SPA50NM
FREQ DOMAIN	FDO	0, 1	FDO?	0: Wave Length 1: Frequency
START	STA	Numerical value+Unit	STA?	UM: μm(Default) NM: nm THZ: THz GHZ: GHz Ex. STA1.55UM Ex. STA1530NM
STOP	STO	Numerical value+Unit	STO?	UM: μm(Default) NM: nm THZ: THz GHZ: GHz Ex. STO1.6UM Ex. STO1560NM

Item	Command		Query	Description
	Header	Parameter		
Magnified display execution	EEX	---	---	
Magnified display reset	REX	---	---	
Magnified-display state readout	---	---	OEX? (OEX)	0: OFF 1: ON
CURSOR TO CENTER	CUC	---	---	Sets the center wavelength according to the X1 and X2 cursor displays.
LEVEL SCALE				
AUTO	LAU	---	---	Auto Level
LEVEL SCALE	LEV	0 to 5	LEV?	0: 10dB/D 1: 5dB/D 2: 2dB/D 3: 1dB/D 4: 0.5dB/D 5: 0.2dB/D
REF VER	REF	Numerical value+Unit	REF?	DB: dB (LOG MAG) M: m(*1) U: μ(*1) N: n(*1) (*1 LIN MAG, GROUP DELAY, CD)
MODURATION FREQUENCY				
MODURATION FREQUENCY	MOF	Numerical value+Unit	MOF?	GHZ: GHz (Can be omitted)
AUTO MOD FREQ ON/OFF	AUM	0, 1	AUM?	0: OFF 1: ON
pmd range				
PMD STEP AUTO	PSA	0, 1	PSA?	0: OFF 1: ON
PMD STEP RANGE	PRS	0, 1, 2	PRS?	0: 25ps range 1: 10ps range 2: 1ps range

Item	Command		Query	Description
	Header	Parameter		
PMD STEP sweep resolution error	---	---	OPD? (OPD)	0: No error 1: Error When the PMD STEP RANGE is 25 ps or 10 ps, an error will occur if the wavelength resolution setting is below 100 pm. When the PMD STEP RANGE is 1 ps, an error will occur if the wavelength resolution setting is below 1000 pm.
DISPLAY				
DUAL	DUA	0, 1	DUA?	0: OFF 1: ON (dual screen display)
SUPER IMPOSE	SIM	0, 1	SIM?	0: OFF 1: ON (superimposing mode)
XCNG U/L	XUL	---	---	Exchange of upper and lower screens
ACTIVE UP/LW (ACTIVE LF/RI)	AUL	0, 1	AUL?	0: Sets the lower (right) screen to Active. 1: Sets the upper (left) screen to Active.
PASTE DATA	PAD	---	---	Pastes the data to the Active screen.
ERACE DATA	ERD	---	---	Erases the pasted data.
GRID	GRI	0, 1	GRI?	0: OFF 1: ON
BOTH MEAS ON/OFF	BOM	0, 1	GRI?	0: Turns the BOTH measurement mode off. 1: Turns the BOTH measurement mode on.

Item	Command		Query	Description
	Header	Parameter		
LIMIT LINE				
Limit Line ON/ OFF	LIM	0, 1	LIM?	0: OFF 1: ON
READ PATTERN FILE	LPT	1 to 5	---	1: PATTERN1 2: PATTERN2 3: PATTERN3 4: PATTERN4 5: PATTERN5
PASS/FAIL	---	---	OPF? (OPF)	0: FAIL 1: PASS
statistics analys				
Maximum PMD value	---	---	DMA? (DMA)	Maximum PMD value 0 is returned when PMD is not measured.
Minimum PMD value	---	---	DMI? (DMI)	Minimum PMD value 0 is returned when PMD is not measured.
PMD average	---	---	DAV? (DAV)	PMD average 0 is returned when PMD is not measured.
PMD Root-mean-square	---	---	DRM? (DRM)	PMD Root-mean-square 0 is returned when PMD is not measured.
PMD standard deviation	---	---	DSD? (DSD)	PMD standard deviation 0 is returned when PMD is not measured.
PMD a parameter	---	---	DAL? (DAL)	PMD α parameter 0 is returned when PMD is not measured.
PMD most probable value	---	---	DMP? (DMP)	PMD most probable value 0 is returned when PMD is not measured.

Item	Command		Query	Description
	Header	Parameter		
DISPLAY REPORT				
REPORT ON/OFF	REP	0, 1	REP?	0: OFF 1: ON
COMMENT	RCO	#Volume name#	RCO?	Sets the COMMENT statement. (Up to 47 characters are available.)
ID1	RCA	#Volume name#	RCA?	Sets the ID1 statement. (Up to 11 characters are available.)
ID2	RSM	#Volume name#	RSM?	Sets the ID2 statement. (Up to 11 characters are available.)
ID3	RFB	#Volume name#	RFB?	Sets the ID3 statement. (Up to 11 characters are available.)
FILENAME	RFI	#Volume name#	RFI?	Sets the FILENAME statement. (Up to 11 characters are available.)
EXECUTE REPORT PRINT	ERP	---	---	Prints the report.
START λ	RSL	Numeric value + Unit	RSL?	UM: µm (Default), NM: nm
STOP λ	RPL	Numeric value + Unit	RPL?	UM: µm (Default), NM: nm
λ RESOLUTION	RRS	Numeric value + Unit	RRS?	UM:µm (Default), NM: nm
REFERENCE λ	RRF	Numeric value + Unit	RRF?	UM: µm (Default), NM: nm
Fitting coefficient1(F1)	---	---	OFA? (OFA)	Fitting coefficient, F1 value 9.9999…E+99 when FITTING is turned off.
Fitting coefficient2(F2)	---	---	OFB? (OFB)	Fitting coefficient, F2 value 9.9999…E+99 when FITTING is turned off.
Fitting coefficient3(F3)	---	---	OFC? (OFC)	Fitting coefficient, F3 value 9.9999…E+99 when FITTING is turned off.

Item		Command		Query	Description
		Header	Parameter		
	Fitting coefficient4(F4)	---	---	OFD? (OFD)	Fitting coefficient, F4 value 9.9999…E+99 when FITTING is turned off.
	Fitting coefficient5(F5)	---	---	OFE? (OFE)	Fitting coefficient, F5 value 9.9999…E+99 when FITTING is turned off.
	CD @ REFERENCE λ	---	---	ORC? (ORC)	CD @ REFERENCE λ value
	CD SLOPE @ ZERO -DISPERSION λ	---	---	OZS? (OZS)	CD SLOPE @ ZERO-DISPERSION λ value
	CD SLOPE @ REFERENCE λ	---	---	ORS? (ORS)	CDSLOPE @ REFERENCE λ
MEAS/FIT					
	AVG ON/OFF	EAV	0, 1	EAV?	0: OFF 1: ON
	AVERAGE	AVG	1 to 16	AVG?	Integer value Ex. AVG 16
	SMOOTHING ON/OFF	SMO	0, 1	SMO?	0: OFF 1: ON
	SMOOTHING WINDOW	SMW	Numerical value+Unit	SMW?	UM: μm NM: nm (Default) THz: THZ GHz: GHZ
	Sweep Mode	DTM	0, 1	DTM?	0: CONTINUE 1: STEP
	Setting the fixed resolution mode when set to the Step sweep mode	SRP	0, 1	SRP?	0: Sets the fixed resolution mode 1: Sets the mode where the number of data points is fixed.

Item	Command		Query	Description
	Header	Parameter		
Data point when set to the Step sweep mode	DPS	11 to 1101	DPS?	
Setting wavelength resolution when set to the Step sweep mode	STL	Numerical value+Unit	STL?	NM: nm (Default) PM: pm (0.01nm ~ 11nm)
Using a fixed resolution, when set to the continuous mode	CRP	0, 1	CRP?	0: Sets the fixed resolution mode 1: Sets the mode where the number of data points is fixed.
Data point when set to the continuous mode	CDP	101 to 12001	CDP?	
Wavelength resolution when set to the continuous mode	CRS	Numerical value+Unit	CRS?	NM: nm (Default) PM: pm (0.15pm ~ 20pm)
MEAS MODE	DIF	0, 2	DIF?	0: NORMAL MEAS 2: DIFF MEAS
MEAS/FIT FIT				
Fitting ON/OFF	FIT	0, 1	FIT?	0: OFF 1: ON
Fitting Mode	FIM	0 to 3	FIM?	0: Liner Fit 1: Quad Fit 2: Selm3 Fit 3: Slem5 Fit
MEAS DATA ON/OFF	MED	0, 1	MED?	0: Displays FITTING data only. 1: Displays FITTING data and raw measurement data.
MEAS DATA LIN/DOT	DOT	0, 1	DOT?	0: Displays the raw measurement data using solid lines. 1: Displays the raw measurement data using dashed lines.
PARTIAL FIT ON/OFF	PFT	0, 1	PFT?	0: OFF 1: ON

Item	Command		Query	Description
	Header	Parameter		
Zero-dispersion warve-length readout	---	---	OZL? (OZL)	
FITTING ERROR	---	---	ODI? (ODI)	Fitting error
MEAS/FIT RIPPLE				
Ripple wave-form display ON/ OFF	RPP	0, 1	RPP?	0: OFF 1: ON
Fitting mode used while a rip-ple waveform is calculated.	RPM	0 to 3	RPM?	0: LINER 1: QUADRATIC 2: SELM 3 3: SELM 5
SENSITIVITY	SEN	0 to 3	SEN?	0: HIGH SENS 1: MIDDLE SENS 2: NOMAL 3: HI SPEED
CALIBRATION				
Wavelength CAL	WCA	0, 1	WCA?	0: OFF 1: ON
Selects the type of the wavemeter	WMT	0, 1, 2, 3	WMT?	0: Q8326 1: TQ8325 2: 86120B/C 3: WA-1650 (NOTE 1)
Level Offset (REFL)	LCA	Numerical value+Unit	LCA?	DB: dB (Can be omitted)
Level Offset (TRANS)	LCT	Numerical value+Unit	LCT?	

(NOTE 1)The operation of the wavelength meter specified below may be disabled if one of the following conditions is satisfied:
A wavelength meter made by a manufacturer other than ADVANTEST is connected when the wavelength meter type is set to the Q8326 or TQ8325.
An ADVANTEST wavelength meter is connected when the wavelength meter type is set to the 86120B/C or WA-1650.
An inappropriate instrument other than those previously mentioned is connected. If this happens, use the following procedure.
1. Turn off the powers of the Q7760 and wavelength meter.
2. Check that the Q7760 and the wavelength meter are properly connected.
3. Turn on the powers of the Q7760 and wavelength meter.
4. Set the wavelength meter model (***Q8326***, ***TQ8325***, ***86120B/C*** or ***WA-1650***) correctly.

Item	Command		Query	Description
	Header	Parameter		
CALIBRATION				
SAVE REF (REFL)	SAR	---	---	Save to Ref. memory (REFL)
SAVE REF (TRANS)	SRT	---	---	Save to Ref. memory (TRANS)
NORMALIZE (REF)	NOR	0, 1	NOR?	0: OFF
NORMALIZE (TRANS)	NRT	0, 1	NRT?	1: ON
TRANS NORMALIZE FIT	TNF	0, 1	TNF?	0: OFF 1: ON
TRANS NORMALIZE FIT MODE	TFM	0, 1, 2, 3	TFM?	0: Linear Fit 1: Quad Fit 2: Selm3 Fit 3: Selm5 Fit
REFL NORMALIZE FIT	ENF	0, 1	ENF?	0: OFF 1: ON
REFL NORMALIZE FIT MODE	EFM	0, 1, 2, 3	EFM?	0: Linear Fit 1: Quad Fit 2: Selm3 Fit 3: Selm5 Fit
Start wavelength of TRANS SV REF data	---	---	OTS? (OTS)	0.00000000E+00 is returned when CAL-trans normliz-SVREF is not executed.
Stop wavelength of TRANS SV REF data	---	---	OTP? (OTP)	0.00000000E+00 is returned when CAL-trans normliz-SVREF is not executed.
Start wavelength of REFL SV REF data	---	---	OES? (OES)	0.00000000E+00 is returned when CAL-refl normliz-SVREF is not executed.
Stop wavelength of REFL SV REF data	---	---	OEP? (OEP)	0.00000000E+00 is returned when CAL-refl normliz-SVREF is not executed.

Item	Command		Query	Description
	Header	Parameter		
TRANS NORMALIZE Coefficient F1	---	---	OTA? (OTA)	9.999...E+99 is returned when CAL-trans normliz-SVREF is not executed.
TRANS NORMALIZE Coefficient F2	---	---	OTB? (OTB)	9.999...E+99 is returned when CAL-trans normliz-SVREF is not executed.
TRANS NORMALIZE Coefficient F3	---	---	OTC? (OTC)	9.999...E+99 is returned when CAL-trans normliz-SVREF is not executed.
TRANS NORMALIZE Coefficient F4	---	---	OTD? (OTD)	9.999...E+99 is returned when CAL-trans normliz-SVREF is not executed.
TRANS NORMALIZE Coefficient F5	---	---	OTE? (OTE)	9.999...E+99 is returned when CAL-trans normliz-SVREF is not executed.
REFL NORMALIZE Coefficient F1	---	---	OEA? (OEA)	9.999...E+99 is returned when CAL-refl normliz-SVREF is not executed.
REFL NORMALIZE Coefficient F2	---	---	OEB? (OEB)	9.999...E+99 is returned when CAL-refl normliz-SVREF is not executed.
REFL NORMALIZE Coefficient F3	---	---	OEC? (OEC)	9.999...E+99 is returned when CAL-refl normliz-SVREF is not executed.
REFL NORMALIZE Coefficient F4	---	---	OED? (OED)	9.999...E+99 is returned when CAL-refl normliz-SVREF is not executed.
REFL NORMALIZE Coefficient F5	---	---	OEE? (OEE)	9.999...E+99 is returned when CAL-refl normliz-SVREF is not executed.
NORMALIZE Range error	---	---	OSE? (OSE)	Judges whether or not the specified wavelength is within the normalized range 0: within the range 1: Trans is out of the range 2: Refl is out of the range 3: Both Trans and Refl are out of the range Execute NORMALIZE before pressing the SWEEP key in order to make sure that the specified wavelength is within the normalized range.

Item		Command		Query	Description
		Header	Parameter		
	/KM Coefficient	PKM	0, 1	PKM?	0: OFF 1: ON
	/√km display	RKM	0, 1	RKM?	0: OFF 1: ON
	FIBER LENGTH	FIB	Numerical value	FIB?	Scaling value (0.0 ~ 99999.0)
	Phase Unwrap	UWR	0, 1	UWR?	0: OFF 1: ON
	Phase Unwrap threshold(dB)	UWP	Numerical value	UWP?	Range of setting: -100.0 to 20.0 Ex. UWP-10.0
	Calibration for the calibration controller	POL	---	---	
	PMD normalize	PDC	---	---	
	Calibration for the calibration controller and PMD normalize	PPN	---	---	
tls cal					
	Light source calibration execution	TLE	---	---	
	Mode setting for light source calibration	TLA	0, 1	TLA?	0: Auto mode 1: Manual mode

Table 5-6 MEASURE

Item	Command		Query	Description
	Header	Parameter		
MEASURE	MEA	0, 1, 3	MEA?	0: STOP 1: SINGLE SWEEP 3: PMD SWEEP

Table 5-7 STORAGE/DATA OUT

Item		Command		Query	Description
		Header	Parameter		
Save/Load					
	Floppy SAVE MEAS	SAV	# File name #	---	Ex. SAV#MAG1550#
	Floppy SAVE PANEL	SVP	# File name #	---	Ex. SVP#MAG1550#
	Floppy LOAD MEAS	RCL	# File name #	---	Ex. RCL#MAG1550#
	Floppy LOAD PANEL	RCP	# File name #	---	Ex. RCP#MAG1550#
	Floppy DELETE MEAS	DFD	# File name #	---	Ex. DFD#MAG1550#.SPE
	Floppy DELETE PANEL	DFP	# File name #	---	Ex. DFP#MAG1550#.SPE
	Memory SAVE MEAS	SVM	# File name #	---	Ex. SVM#MAG1550#
	Memory SAVE PANEL	SPM	# File name #	---	Ex. SPM#MAG1550#
	Memory LOAD MEAS	LDM	# File name #	---	Ex. LDM#MAG1550#
	Memory LOAD PANEL	LPM	# File name #	---	Ex. LPM#MAG1550#
	Memory DELETE MEAS	DMD	# File name #	---	Ex. DMD#MAG1550#.SPE
	Memory DELETE PANEL	DPC	# File name #	---	Ex. DPC#MAG1550#.SPE
	DISP/MEAS	SMS	0, 1	SMS?	0: DISP, 1: MEAS
	BITMAP SAVE	BIT	---	---	Save the bitmap image.
	UNIT NORMALIZE	UNM	0, 1	UNM?	0: DIS, 1: NRM
	MEAS FORMAT	ASC	0, 1	ASC?	0: BIN, 1: ASCII
PRINT					
	PRINT	EPR	---	---	Output to Ext. printer
	PRINTER TYPE	PRT	0 to 2	PRT?	0: ESC/P 1: ESC/P R 2: PCL

Table 5-8 SYSTEM

Item	Command		Query	Description
	Header	Parameter		
SYSTEM				
PRESET	IPR	---	---	Sets the measurement conditions etc. to the pre-determined initial state.
CLOCK				
CLOCK ON/OFF	CKD	0, 1	CKD?	0: CLOCK display OFF 1: CLOCK display ON
CLOCK	CLO ##	Refer to the following	CLO ##?	Setting the date and the hour.
		CLO # YY-MM-DD,hh,mm:ss # YY: year (00 to 99) MM: month (01 to 12) DD: date (00 to 31) hh: hour (00 to 23) mm: minute (00 to 59) ss: second (00 to 59) YY=80 to 90: 1980 to 1999 YY=00 to 79: 2000 to 2079		
COLOR				
COLOR PATTERN	CPT	0 to 4	CPT?	Setting color patterns 0: Color pattern 1 1: Color pattern 2 2: Color pattern 3 3: Color pattern 4 4: Color pattern 5
BUZZER				
BUZZER(BEEP)	BUZ	0, 1	BUZ?	0: OFF 1: ON
WARNING	WAR	0, 1	WAR?	0: OFF 1: ON
QUIET BEEP	QUI	0, 1	QUI?	0: NORMAL 1: QUIET

Item	Command		Query	Description
	Header	Parameter		
SELF TEST				
SELF TEST	---	---	*TST?	Execution of self-diagnostic feature and output request for results 0000: Normal 030X: Backup-RAM error 30XX: Error in the measurement system
FLOPPY				
FROPPY ON/OFF	FON	0, 1	FON?	0: FROPPY-OFF (MEMORY) 1: FROPPY-ON
FORMATTING	FFO	1, 2	---	Executes initialization of the floppy disk. 1: 2DD(720k) 2: 2HD(1.44M)
VOLOME LABEL	FVO	#volume name#	FVO?	Sets the volume name for the floppy disk (up to eleven characters) Ex. FVO#LD-1530# Ex. FVO#BEUE-LED#

Table 5-9 MODE

Item		Command		Query	Description
		Header	Parameter		
LABEL		LAB	#LABEL#	LAB?	Set the label LAB#----------# (up to 48 characters)
MODE					
	NOMAL ΔMODE 2ND PEAK DIFFER	CUD	0 to 2, 4	CUD?	0: NORMAL 1: ΔMODE 2: 2ND PEAK 4: DIFFER
	band width	SPW	0, 1	SPW?	0: OFF 1: ON
	band width mode	WTY	0, 1	WTY?	0: PK - XdB 1: ENVELOPE
	XdB parameter	WPX	Numerical value	WPX?	Range of setting: 0.1 to 59.9 Ex. WPX3.0,WPX12.0
	YdB parameter	WPY	Numerical value	WPY?	Range of setting: 0.1 to 99.9 Ex. WPY20,WPY35.0
	K parameter	WPK	Numerical value	WPK?	Range of setting: 0.1 to 100.0

Table 5-10 CURSOR

Item	Command		Query	Description
	Header	Parameter		
CURSOR				
ON/OFF	CUR	0, 1	CUR?	0: CURSOR OFF 1: CURSOR ON
CURSOR-X1 ON/OFF	XAC	0, 1	XAC?	0: X1 OFF 1: X1 ON
SET CURSOR-X1	XAS	Numerical value+Unit	XAS?	UM: μm (Default) NM: nm THZ: THz GHZ: GHz Ex. XAS0.78UM
CURSOR-X2 ON/OFF	XBC	0, 1	XBC?	0: X2 OFF 1: X2 ON
SET CURSOR-X2	XBS	Numerical value+Unit	XBS?	UM: μm (Default) NM: nm THZ: THz GHZ: GHz Ex. XBS 630.5NM
CURSOR-L1 ON/OFF	YAC	0, 1	YAC?	0: Y1 OFF 1: Y1 ON
SET CURSOR-L1	YAS	Numerical value+Unit	YAS?	DB: dB (Can be omitted) M: m U: μ N: n (NOTE 2)
CURSOR-L2 ON/OFF	YBC	0, 1	YBC?	0: L2 OFF 1: L2 ON
SET CURSOR-L2	YBS	Numerical value+Unit	YBS?	DB: dB (Can be omitted) M: m U: μ N: n (NOTE 2)

(NOTE 2)
When the unit is not specified, the displayed unit is used.

Table 5-11 GPIB

Item	Command		Query	Description
	Header	Parameter		
Output request for peak search data	---	---	OPK? (OPK)	
Output request for cursor data	---	---	OCD? (OCD)	Output data differ depending on the cursor display mode.
Output request for waveform data	OSD	0, 1	---	0: output of Y axis data 1: output of X axis data
Output request for numbers of waveform data	---	---	ODN? (ODN)	Output of number of data items existing on screen specified by OVSn.
Query for the half-width operation results	---	---	OSW? (OSW)	
Output control of header data	HED (HD)	0, 1	HED?	0: HEADER OFF 1: HEADER ON
Specification of terminator	DEL (DL)	0 to 3	DEL?	0: NL<EOI> 1: NL 2:<EOI> 3: CR NL<EOI>
Specification of data separator (ASCII waveform data)	SDL (DS)	0 to 2	SDL?	0: ,(comma) 1: SP (space) 2: CR NL
Specification of data output format (valid for waveform data)	FMT	0 to 3	FMT?	0: ASCII 1: BINARY(16bit) 2: BINART(64bit float) 3: BINART(32bit float)
Specification of data output screen	OVS	0, 1	OVS?	0: upper (upper screen) 1: lower (lower screen) (Valid in dual screen display mode)

Item	Command		Query	Description
	Header	Parameter		
Control of SRQ signal	SRQ	0, 1	SRQ?	0: mode sending no SRQ 1: mode sending SRQ
	S	0, 1	S?	0: mode sending SRQ 1: mode sending no SRQ
Masking status byte	MSK	0 to 255 (Masking is impossible in case of bit 6)	MSK?	Sets "1" to the bit to be masked in the status byte (initial value: 0). Ex. masks b1 and b2 : MSK6
Clearing status byte	CSB	---	---	
SWEEP measurement	E (*TRG)	---	---	Execution of SWEEP measurement operation.
Setting to the initial state	C (*RST)	---	---	Sets this analyzer to the initial state when the power was turned on.
Output request for the unit ID	---	---	*IDN?	Output request for manufacturer name, product name, serial number and software revision.

5.11 Example Programs

This section describes remote control examples used with GPIB port.

5.11.1 Sample Programs for Setting or Measurement Conditions

CAUTION ***Visual Basic 6.0 (referred to as VB henceforth) is used in the sample programs shown here. Also, National Instruments-made GPIB board (referred to as NI-made for brevity henceforth) is used for the GPIB control board; NI-made driver is used for the control driver.***

- Program examples using VB

  Example VB-1: The following program shows how to specify a center wavelength and a span wavelength after the instrument is preset:

```
Dim Q7760 As Integer
Dim address As Integer
Dim boardID As Integer
Dim Dev As Integer

address = 8

boardID = 0                                                    '
Dev%=ildev(boardID,address,0,T100s,1,BIN+XEOS+LF)              '
Q7760 = Dev%

Call ibclr(Q7760)                          'Clears the device.

Call ibwrt(Q7760, "CEN1550NM")             'Specifies a center wavelength of 1550 nm
Call ibwrt(Q7760, "SPA2NM")                'Specifies a span wavelength of 2 nm

ilonl Q7760, 0                             '
```

Example VB-2 After specifying the center wavelength and span wavelength, the program starts measurements and the cursor is displayed. (SRQ is not used.)

```
Dim Q7760 As Integer
Dim address As Integer
Dim boardID As Integer
Dim Dev As Integer
Dim res As Integer

address = 8

boardID = 0                                                    '
Dev%=ildev(boardID,address,0,T100s,1,BIN+XEOS+LF)              '
Q7760 = Dev%

Call ibclr(Q7760)                          'Clears the device

Call ibwrt(Q7760, "IPR")                   'PRESET
Call ibwrt(Q7760, "DTM0")                  'Sets the sweep mode to CONTINUE
Call ibwrt(Q7760, "CEN1550NM")             'Specifies a center wavelength of 1550 nm
Call ibwrt(Q7760, "SPA2NM")                'Specifies a span wavelength of 2 nm
Call ibwrt(Q7760, "CDP601")                'Sets the number of data points to 601
Call ibwrt(Q7760, "RTR1")                  'Sets to TRANS
Call ibwrt(Q7760, "FOR3")                  'Displays CD
Call ibwrt(Q7760, "MOF1GHZ")               'Specifies a modulated frequency of 1 GHz
Call ibwrt(Q7760, "SEN2")                  'Sets SENSITIVITY to NORMAL
Call ibwrt(Q7760, "MSK254")                'Sets measure-end (b0) of the status byte to valid
Call ibwrt(Q7760, "CSB")                   'Clears the status byte
Call ibwrt(Q7760, "SRQ0")                  'Does not use the SRQ signal
Call ibwrt(Q7760, "MEA1")                  'Starts the 1st cycle of measurements

Do
 DoEvents                                  'Checks other events that are being held in the loop
 Call ibrsp(Q7760, res)                    'Reads out the status byte

Loop Until res = 1                         'Exits the loop if the measurement-end bit is high

Call ibwrt(Q7760, "LAU")                   'Sets the level scale automatically
Call ibwrt(Q7760, "XAC1")                  'Displays cursor (X1)
Call ibwrt(Q7760, "XAS1550NM")             'Specifies cursor (X1) of 1550 nm

ilonl Q7760, 0
```

6 SUPPLEMENTARY INFORMATION

Describes the principle of operation necessary for taking measurements more accurately.

6.1 Measurement Principle

This section describes the measurement principle of the Q7760.

Figure 6-1 shows a block diagram of the Q7760.
The CW light emitted from the tunable light source is projected into the light intensity modulator, where it is intensity-modulated by the phase reference signal. The intensity-modulated light is passed through the optical coupler and applied to the DUT (device under test) through the test port 1.

The light signal that passes through the DUT enters test port 2 and is converted to an electrical signal by the O/E converter to measure its intensity. Then the phase difference between the light signal and the phase reference signal is measured by the phase comparator for the transmitted light.

This determines the magnitude and phase characteristics of the transmission characteristics of the DUT.

The delay time is obtained from the phase difference ϕtrans, using the following formula.

$$\tau_{trans} = \frac{\phi trans}{2\pi\, fm}$$

The characteristics against wavelengths are calculated by taking measurements and making calculations while sweeping the tunable light source along its wavelengths

The chromatic dispersion Dtrans can be calculated by differentiating the values of group delay times with respect to the wavelengths.

$$D_{trans} = \frac{\partial\, \tau_{trans}}{\partial\, \lambda opt}$$

Furthermore, the reflection characteristics of the DUT can be obtained through the same process after the light reflected from the DUT is returned to test port, branched by the optical coupler and converted to an electrical signal by the O/E converter.

This method is generally referred to as the phase shift method.

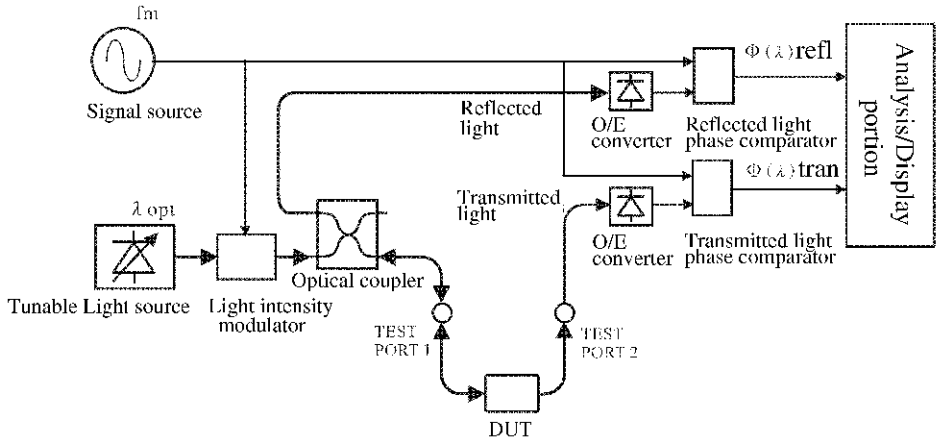


Figure 6-1 Q7760 Block Diagram

6.2 PMD Measurement Principles

The polarization mode dispersion (PMD) of the analyzer is measured using the polarization phase shift method shown below.

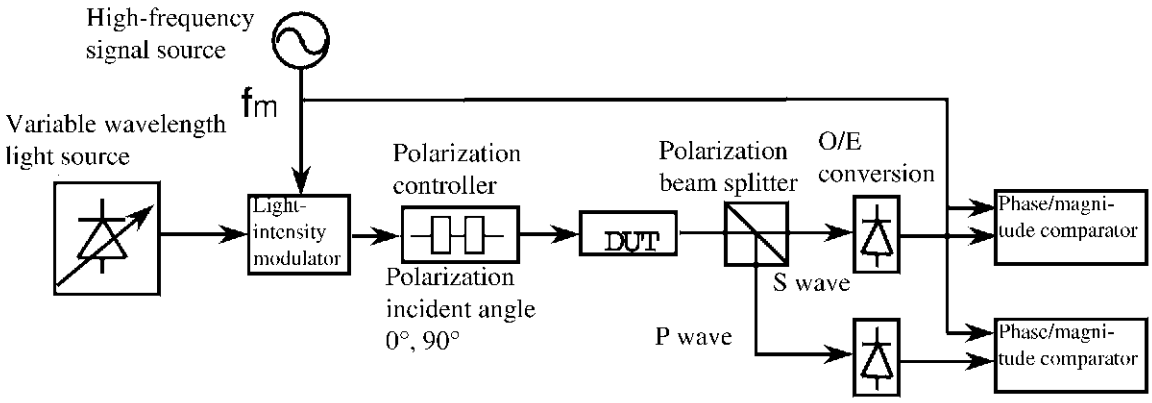


Figure 6-2 Measurement Principles of the Polarization Phase Shift Method

The 0° and 90° of linearly polarized light are incident to a DUT using the polarization controller, and the magnitude and phase for each polarization state (of the P and S waves) are measured as a function of wavelength (optical angular frequency). The PMD can be calculated by measuring the optical angular frequency changes in the polarization outgoing angle from the DUT, and the phase shift between the two polarization states.

6.3 Calculating the CD, CD Slope and Wavelength Axis

The CD is calculated as a change of rate of the group delay with respect to the wavelength. Based on this definition, the wavelength of CD is the center between two wavelengths whose values are derived from the targeted the Group delays (see Figure 6-3). The group delay, CD and CD slope each can be expressed using unique wavelengths and unique data points.

λ cd_i (the i-th wavelength of the CD) and dgd_i (the calculated CD value at this wavelength) are calculated from the following expression. Where λ gd_i and dgd_i are the i-th wavelength and the measurement value at the ith wavelength within the group delay, respectively:

dcd_i = (dgd_i+1 - dgd_i)/(λ gd_i+1 - λ gd_i) λ cd_i= (λ gd_i+1 - λ gd_i)/2

λ cd_i (the ith wavelength of the CD slope) and dcds_i (the measured value of the CD at this wavelength) are calculated from the following expression in the same manner.

dcd_i = (dcd_i+1 - dcd_i)/(λ cd_i+1 - λ cd_i)λ cds_i= (λ gds_i+1 - λ gds_i)/2

The group delay, CD and CD slope can be expressed using the same wavelength axis, because differential coefficients can be analytically calculated along the entire wavelength while the curve fitting function is being used (refer to section 6.9, "Curve Fitting Function and Statistical Variance").

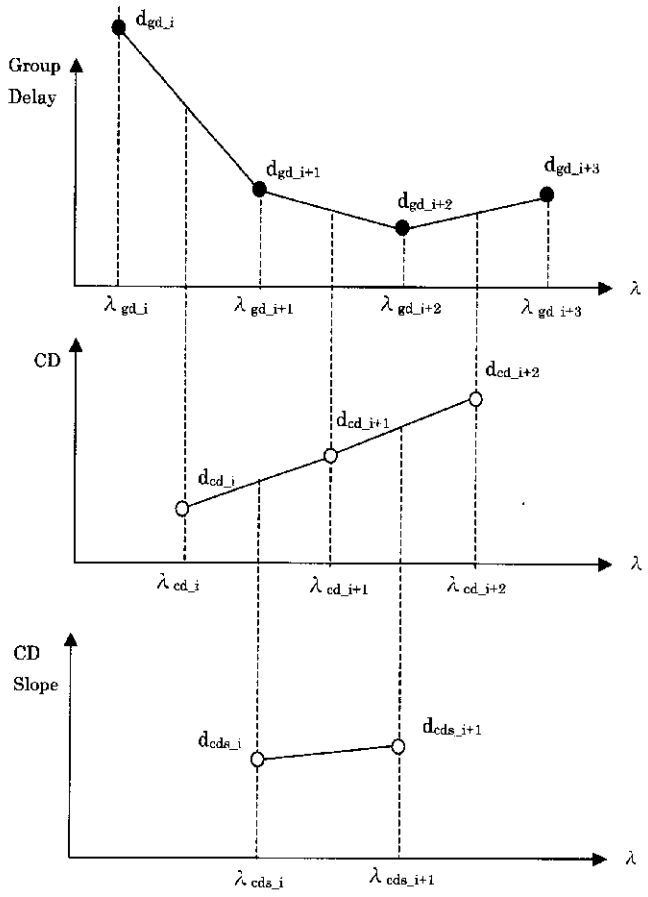


Figure 6-3 Difference between the Group Delay and the CD Wavelength Axis

6.4 Modulation Frequency

The modulation frequency refers to the frequency of the modulation signal used for the light intensity modulator. In the phase shift method, the higher the modulation frequency is, the more accurately the phase difference between the reference phase signal and modulation frequency can be measured, which heightens the resolution of delay time.

The measurement range equals the modulation signal period, therefore, if the modulation frequency becomes higher, the effective range is narrower.

The effective range of group delay time, ΔT, is expressed using the modulation frequency of fmod as follows:

$\Delta T = 1/fmod$

For example, when the modulation frequency is 1 GHz, the effective range of group delay time is 1 nsec.

When the modulation frequency is determined, the influence on the sideband by the modulation must be considered. If the modulation frequency is set to fmod, the sideband is generated on both sides of intensity-modulated light carriers away from the fmod distance. This means the spectrums expand from the measured light and the practical Wavelength resolution is restricted from the sideband. The practical wavelength resolution $\Delta\lambda$ is described in the following formula using the modulation frequency fmod:

$$\Delta\lambda = 2 \cdot \frac{\lambda^2 \cdot fmod}{C}$$

In the above formula, λ expresses the wavelength, c expresses the light speed.
For example, when the wavelength is 1550 nm and the modulation frequency is 1 GHz then $\Delta\lambda$ is 0.016 nm.

6.5 Sensitivity

Four levels of sensitivity can be set.

1. HIGH SENS : High sensitivity
2. MIDDLE SENSE : Middle sensitivity
3. NORMAL SENS : Normal sensitivity
4. HI SPEED : High-speed sensitivity

The measurement sensitivities are graded in order of 1, 2, 3 and 4 (with the highest as one). The higher measurement sensitivity allows the S/N ratios of the magnitude and group delay time characteristic to be improved. On the other hand, the lower the measurement sensitivity, the less the S/N ratios and measurement time.

The S/N ratio is improved depending on the sensitivity.

HIGH SENS: 2.4 dB as compared with MIDDLE SENS

MIDDLE SENS: 2.6 dB as compared with NORMAL SENS

NORMAL SENS: 2.4 dB as compared with HI SPEED.

6.6 Differential Measurement

Errors due to group delay time drift (caused by fiber length changes resulting from temperature changes) may occur when group delay time and chromatic dispersion characteristics are measured.

Figure 6-4 shows that group delay times are sequentially measured in the order of λ1, λ2 and so on when the group delay time drift tends to decrease. The characteristic curve indicated by the black dots shows that the measured group delay times are not affected by the group delay time drift. If the group delay time decreases along the time axis as shown in Figure 6-5, the characteristic curve indicated by the white dots, which contains group delay time errors, is shown Figure 6-4. As a result, there is a possibility that large errors in the zero chromatic dispersion wavelength, chromatic dispersion and the chromatic dispersion slope may occur.

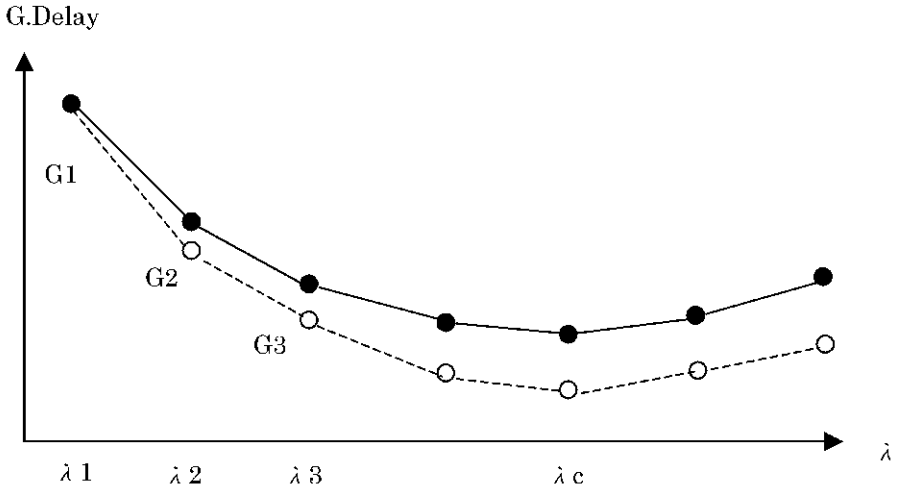


Figure 6-4 Difference between Group Delay Time Characteristics due to Group Delay Time Drift

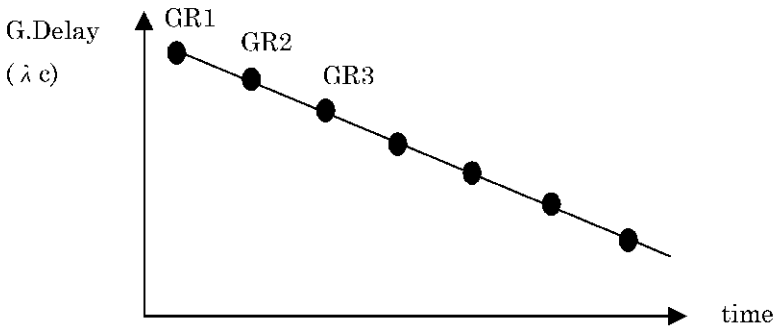


Figure 6-5 Group Delay Time Drift at the Reference Wavelength (λc)

A differential measurement is made in the following manner: the reference wavelength (λc) is set to examine the group delay time drift, and then the difference between the group delay time at a measurement point and the group delay time at the reference wavelength is calculated for each measurement point to make a measurement accurately by canceling the error due to group delay time drift (see Figure 6-6). This method, however, needs a sweep time twice that for the normal method.

Calculate the group delay time of the nth point in the differential measurement (Dn) using the following expression. Where Gn is the nth point group delay time, GRn is the group delay time at the reference wavelength used when Gn is measured.

Dn = Gn - GRn (n: 0, 1, 2 ...)

The reference wavelength is set to the center wavelength of the set span, and measured by performing sweeps in the order of λ1, λc, λ2 and λc.

NOTE: ***The differential measurement mode is not available to calculate measurement data for the magnitude characteristic .***

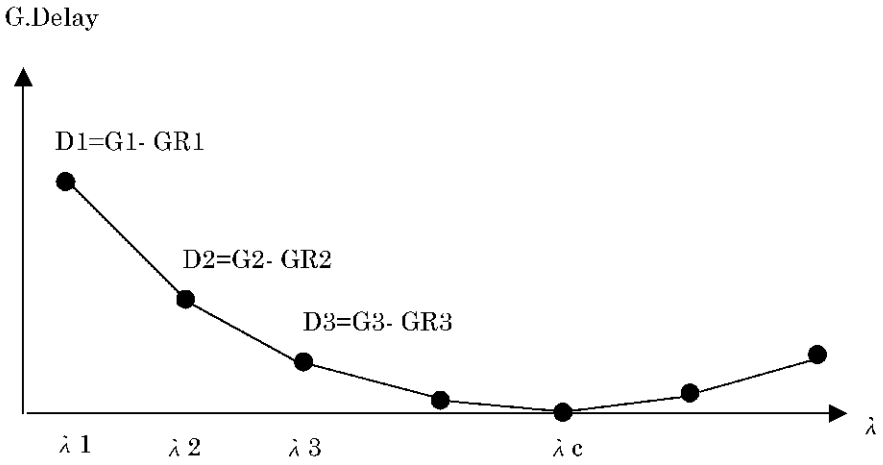


Figure 6-6 Result Obtained in Differential Measurement Mode

6.7 Unwrap Function

When the measured value is between -180° and 180°, the phase shift method is executed to rotate the phase as shown in Figure 6-7. As a result, the phase characteristic is dramatically changed.

When the difference between the measured and displayed values is 180° or greater, the unwrap function senses that the phase rotation has occurred, and unwraps the displayed value as shown in Figure 6-7 .

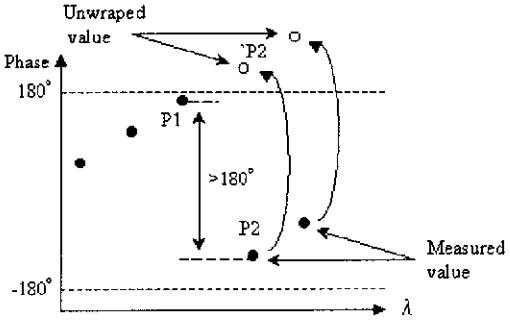


Figure 6-7 Unwrap Function

Specific conditions and expressions for unwrapping are as follows:

When (P1 - P2) is greater than 180°, P2' = P2 + 360°

When (P1 - P2) is less than -180°, P2' = P2 - 360°

Where, P1 is the previous measured value, P2 is the measured value before unwrapping, and P2' is the measured value after unwrapping.

When the DUT magnitude level is low, noises from group delay time affect phase measurements. As a result, the phase measurements are unwrapped incorrectly.

Therefore, a threshold level which is specified by selecting THRESH from the menu can be used as the minimum magnitude level to be unwrapped. The minimum magnitude level (or lower) is not unwrapped. (See Figure 6-8.)

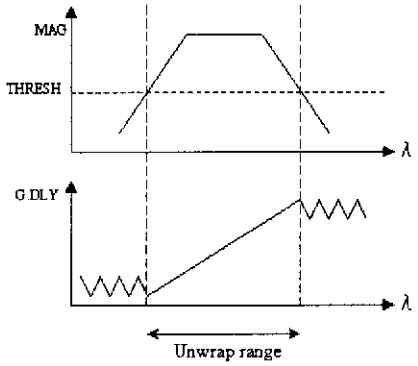


Figure 6-8 Setting Threshold for Unwrapping

6.8 Smoothing Calculation

Use the following expressions to smooth data.

$$d'_i = \frac{1}{W}\sum_{k=0}^{n-1} a_k d_{k+i-(n-1)/2} \qquad (1)$$

$d_0, d_1 \ldots d_{N-1}$: Measured data

$d'_0, d'_1 \ldots d'_{N-1}$: Smoothed data

$a_0, a_1 \ldots a_{N-1}$: Weighting factor for smoothed data

$$a_i = 3m(m+1) - 1 - 5i^2 \quad (n = 2m+1) \qquad (2)$$

$$W = \frac{(4m^2-1)(2m+3)}{3} \qquad (3)$$

N: Number of measurement points ($3 \le N \le 31$)

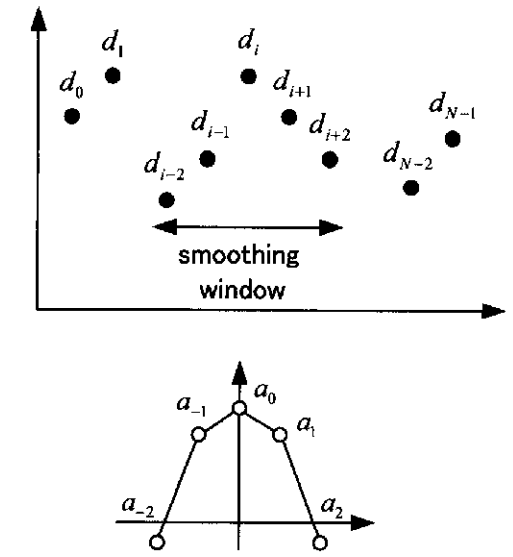
n: Number of points for smoothing

The number of points "n" can be obtained using the following expression.

n = (Smoothing zone width/Wavelength span) × N (4)

For the smoothing zone width "n" in the above expression, the value of modulation frequency x 4, or the value of the range containing all the measurement points (N) can be set to the maximum.

Smoothing calculations can be performed for a waveform which has been measured using the **SWEEP** key only. If the waveform is measured using the **SWEEP(+PMD)** key, smoothing calculations cannot be performed for that waveform.



$$d_i' = \frac{a_{-2}d_{i-2} + a_{-1}d_{i-1} + a_0 d_i + a_1 d_{i+1} + a_2 d_{i+2}}{W}$$

Figure 6-9 Smoothing Calculation (n=5)

6.9 Curve Fitting Function and Statistical Variance

Curve fitting function

Linear expression (LINER):	$F_1\lambda+F_2$
Quadratic polynomial (QUAD):	$F_1\lambda^2+F_2\lambda+F_3$
Three-term Sellmeier's polynomial (SELM3):	$F_1/\lambda^2+F_2+F_3\lambda^2$
Five-term Sellmeier's polynomial (SELM5):	$F_1/\lambda^4+F_2/\lambda^2+F_3+F_4\lambda^2+F_5\lambda^4$

F_1 through F_5 represent fitting coefficients displayed on the report screen.

When the curve fitting is executed, the group delay time characteristics is approximated by the above expressions.

The dispersion characteristics can be obtained by differentiating the group delay time characteristics obtained by the curve fitting once with respect to λ. The dispersion slope characteristics can also be obtained by differentiating the group delay twice.

The statistical variance is shown by the following expression:

$$\text{Statistical variance} = \sqrt{\frac{1}{N}\sum_{i=0}^{N-1}(d_i - d'_i)^2}$$

$d_0, d_1, .., d_{N-1}$: Measured values

$d'_0, d'_1, .., d'_{N-1}$: Curve fitting values

N : Number of measurements

6.10 Bandwidth Calculation Method

The Q7760 Pk-XdB function allows an easy calculation of transmission bandwidth.

Processing procedure

(1) The maximum peak of the trace is obtained.

(2) Intersections a and b on the XdB attenuation level curve from the maximum peak value of the trace are defined.

(3) The bandwidth and center wavelength are obtained from each wavelength at intersections a and b using the following formula.

$\lambda o = (\lambda a+\lambda b)/2$

$\Delta\lambda = \lambda b-\lambda a$

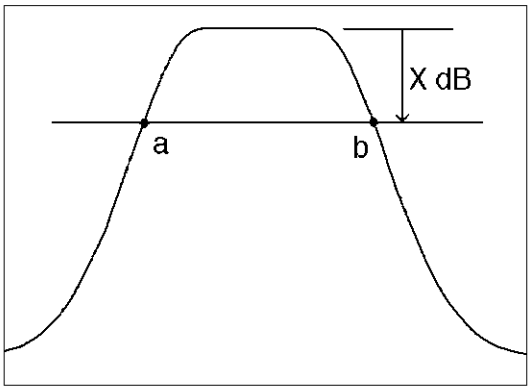


Figure 6-10 Bandwidth Calculation Method

6.11 Polarization Control Function

This function uses a built-in polarization controller consisting of a 1/4λ plate and a 1/2λ plate. The polarization state of the outgoing light can be controlled by adjusting the plates individually. In addition, this section can also generate a pseudo random polarization, which can be obtained by mutually adjusting the 1/4λ plate and the 1/2λ plate, as well as a normal polarization control function.

6.12 Creating Limit Line Data Files

The Q7760 can make pass/fail judgments on measurements using the limit line function.

(1) Creating the data file

Use a personal computer and text editor such as Note to create data files and save the files using the names as listed below.

Specified file name:
FD:\LmtLn\lmtln1.txt
FD:\LmtLn\lmtln2.txt
FD:\LmtLn\lmtln3.txt
FD:\LmtLn\lmtln4.txt
FD:\LmtLn\lmtln5.txt

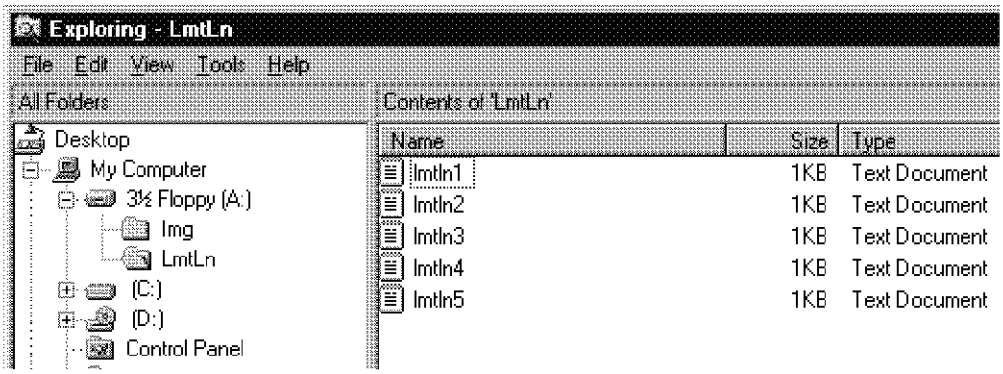


Figure 6-11 Data File in the LmtLn Folder

Each file corresponds to the menu items ***PATTERN 1*** through ***PATTERN 5*** as shown below.

FD:\LmtLn\lmtln1.txt corresponds to ***PATTERN1***.
FD:\LmtLn\lmtln2.txt corresponds to ***PATTERN2***.
FD:\LmtLn\lmtln3.txt corresponds to ***PATTERN3***.
FD:\LmtLn\lmtln4.txt corresponds to ***PATTERN4***.
FD:\LmtLn\lmtln5.txt corresponds to ***PATTERN5***.

Figure 6-12 shows a sample of limit line data. When the data is loaded to the Q7760, the limit lines shown in Figure 6-13 are displayed.

```
[Fundamental]
MeasMode=MAGLOG              ' MAG table
Domain=WAVE                  ' Waveform domain

[Reference]
DataModeX=REL                ' Sets the X-axis coordinate to the relative scale.
RefModeX=LEFT                ' Sets the left edge of the screen graph to a reference point.
RefUserX=                    ' No specification
OffsetX=0                    ' Sets the X offset to zero.
DataModeY=ABS                ' Sets the Y-axis coordinate to the absolute scale.
RefModeY=                    ' No specification
RefUserY=                    ' No specification
OffsetY=0                    ' Sets the Y offset to zero.

[TableUp]
PassRange=UNDER              ' The test result is pass if the measurement is below the line.
+0.0,  +5.0                  ' The X axis coordinate is relative to the START waveform
+1.0,  +5.0                  ' and is expressed with the nm unit.
+1.0, +10.0                  ' Power (dB) is used to express Y-axis amplitudes.
+3.0, +10.0                  ' The psec unit is used to express other than
+3.0, +30.0                  ' Y-axis amplitudes.
+5.0, +30.0
+5.0, +25.0
+8.0, +25.0
+8.0, +15.0
+10.0,+15.0

[TableLow]
PassRange=OVER               ' The test result is pass if the measurement is above the line.
+0.0,  -5.0
+1.0,  -5.0
+1.0, -10.0
+3.0, -10.0
+3.0, -30.0
+5.0, -30.0
+5.0, -25.0
+8.0, -25.0
+8.0, -15.0
+10.0,-15.0
```

Figure 6-12 Limit Line Data File Example

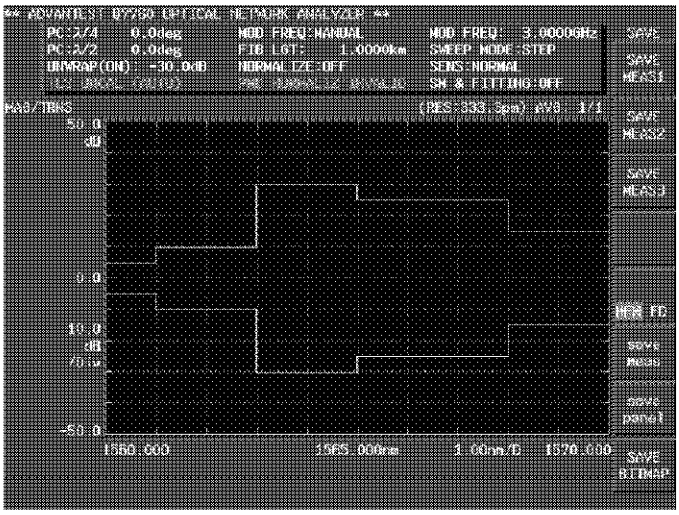


Figure 6-13 Limit Line Examples

(2) Limit line settings

Limit lines are defined using specified keywords and values as shown below.

```
[Group name]
Keyword = One or two values delimited by a comma.
```

(a) Group name

There are four groups Fundamental, Reference, TableUp and TableLow. Each group title is parenthesized by brackets [] and follows a keyword, equal (=) and value(s) written line by line.

Various keywords and values are provided for each group.

To define a limit line, X and Y values have to be specified being delimited by a comma.

NOTE: The group name setting cannot be omitted.

(b) MeasMode: Belongs to the Fundamental group.

```
MeasMode=MAGLOG     ' Specifies magnitude measurements and displays the measured
                      magnitudes in the logarithmic scale. (default)
         MAGLIN     ' Specifies magnitude measurements and displays the measured
                      magnitude in the linear scale.
         GDELAY     ' Specifies group delay measurements.
         CD         ' Specifies chromatic dispersion measurements.
         CDS        ' Specifies chromatic dispersion slope measurements.
         PMD        ' Specifies polarization mode dispersion measurements.
```

The measurement mode is specified.

NOTE: Loading the MeasMode setting to the Q7760 automatically changes the current limit line setting.

(c) Domain: Belongs to the Fundamental group.

```
Domain=FREQ     ' Specifies a frequency domain. (default)
       WAVE     ' Specifies a waveform domain.
```

The domain is specified.

NOTE: Loading the Domain setting to the Q7760 automatically changes the current limit line setting.

(d) DataModeX: Belongs to the Reference group.

```
DataModeX=ABS     ' Sets the X-axis coordinate to the relative scale. (default)
          REF     ' Sets the X-axis coordinate to the absolute scale.
```

This keyword is used to select relative or absolute scale for the X-axis coordinate. When absolute scale is selected, the actual measurements are used. However, when relative scale is selected, the measurements are converted to values which are relative to the reference point.

NOTE: When REL is selected for the above setting, REL has to be specified for both RefModeX and RefUserX.

(e) RefModeX: Belongs to the Reference group.

RefModeX=LEFT ' Sets an X coordinate reference point at the left edge of the screen graph when relative scale is selected. (default)

CENTER ' Sets an X coordinate reference point at the center of the screen graph when relative scale is selected.

USER ' Sets an X coordinate reference point on the screen graph at the desired location when relative scale is selected.

This keyword is used to specify a reference point.

NOTE: When USER is selected, RefUserX (described in the next section) must also be specified.

(f) RefUserX: Belongs to the Reference group.

RefUserX=Waveform or frequency
' Sets an X coordinate reference point at the desired location. (This can be omitted.)

NOTE: Waveform data is expressed in nm and frequency data is expressed in THz.

(g) OffsetX: Belongs to the Reference group.

OffsetX=Waveform or frequency
' Specifies an offset. (The default is 0)

This keyword is used to specify an offset, which causes the limit line to move to the left or right on the screen.

NOTE: Waveform data is expressed in nm and frequency data is expressed in THz.

(h) DataModeY: Belongs to the Reference group.

RDataModeY=ABS ' Sets the Y-axis coordinate to relative scale. (default)

REF ' Sets the Y-axis coordinate to absolute scale.

This keyword is used to select relative or absolute scale for the Y-axis coordinate. When absolute scale is selected, the actual measurements are used. However, when relative scale is selected, the measurements are converted to values which are relative to the reference point.

NOTE: When REL is selected for the above setting, REL has to be specified for both RefModeY and RefUserY.

(i) RefModeY: Belongs to the Reference group.

RefModeY=TOP		' Sets an Y coordinate reference point on the top of the screen graph when relative scale is selected. (default)
	MIDDLE	' Sets an Y coordinate reference point on the middle level of the screen graph when relative scale is selected.
	BOTTOM	' Sets an Y coordinate reference point on the bottom of the screen graph when relative scale is selected.
	USER	' Sets an Y coordinate reference point at the desired location when relative scale is selected.

This keyword is used to specify a reference point.

NOTE: ***When USER is selected, RefUserY described in the next section also has to be specified.***

(j) RefUserY: Belongs to the Reference group.

RefUserY=Level	' Sets an Y coordinate reference point on the screen graph as desired. (This can be omitted.)

NOTE: ***The magnitude in logarithmic scale is expressed in dB but the magnitude in linear scale is expressed without a unit. Other measurements are expressed in psec.***

(k) OffsetY: Belongs to the Reference group.

OffsetY=Level	' Specifies an offset. (The default is 0)

This keyword is used to specify an offset, which causes the limit line to move up or down on the screen.

NOTE: ***The magnitude in logarithmic scale is expressed in dB but the magnitude in linear scale is expressed without a unit. Other types of measurement are expressed with psec.***

(l) PassRange: Belongs to the TableUp and TableLow groups.

PassRange=UNDER		' Set the upper limits. (default)
	OVER	' Sets the lower limits.

This keyword is used to specify the criteria for pass/fail judgement

(m) Value, value

Specify X and Y coordinates delimited by a coma according to the Meas and Domain settings. The X coordinate can be used to indicate waveform data in nm and also to indicate frequency data in THz.

The Y coordinate can be used to indicate optical magnitudes in dB in logarithmic scale and also to indicate optical magnitudes without a unit in linear scale. Other measurements are expressed in psec using the Y coordinate.

NOTE: ***Write only numeric values without a unit as shown below.***
Enter data in ascending order on the X-axis. Otherwise, the results of the PASS/FAIL judgments will be undefined.

Correct

1.549E+03	' 1549 nm
193.0	' 193 THz
-20.5	' -20.5 dB

Incorrect

1549 nm

193 THz

-20.5 dB

(3) Limit lines and measurement type

Limit lines can be loaded when the measurement type is changed. For example, suppose that limit line settings are written for the optical magnitude measurement and group delay measurement in lmtln1.txt and lmtln2.txt, respectively.

Once PATTERN 1 and PATTERN 2 are pressed to load LmtLn1.txt and LmtLn2.txt to the Q7760 internal memory, the limit lines are automatically displayed depending on the selected measurement type.

If the limit line data for the chromatic dispersion measurement has not been loaded to the internal memory, changing the measurement type to the chromatic dispersion measurement will not display the required limit lines even though a limit line is being displayed for the optical magnitude measurement.

Limit lines for necessary measurement type should be loaded in the internal memory beforehand.

NOTE: ***There is no need to change the limit lines when the measurement type is changed.***

---

(4) Maximum allowable number of limit line tables

Only one limit line table can be used for each measurement. Even for frequency-domain and waveform-domain measurements, one table is used.

To toggle the wavelength and frequency axes, load the limit line data from the floppy disk.

NOTE: ***Even when the domain is changed, the displayed limit line is not converted so that it can be used for a new domain.***

6.13 Tunable Light Source Calibration

To maintain high wavelength accuracy, calibration (light source CAL) should be performed for the tunable light source in this analyzer. Conditions for light source CAL are as follows:

(1) When more than two hours have elapsed since the power was turned on

(2) When more than 24 hours have elapsed since the last light source calibration

(3) If the room temperature rises or decreases over 5°C while executing the light source calibration

There are two methods used to perform light source calibration under conditions (1) and (2). One method is the auto mode for automatic calibration and the other is the manual mode for manual calibration. (For more information on the operation, refer to the ***tls*** menu in **CAL** (on page 4-15).) When the light source wavelength is within the allowable range after performing CAL, "TLS CAL" is displayed on the bottom left of the status window, which is on the upper part of the display. When the light source wavelength is outside the allowable range in the manual mode under conditions (1) and (2), "TLS UNCAL" is displayed. When it is displayed, perform the light source CAL immediately. It takes approximately six minutes to complete the light source CAL.

CAUTION:

1. ***Light source CAL can not be performed for two hours after the power is turned on in the manual mode, because the analyzer must warm up first.***
2. ***Light source CAL can not be performed under condition (3) in the auto mode. Also, the display in the status window can not be updated. If the room temperature rises or decreases over 5°C while executing the light source calibration, perform calibration in the manual mode even if "TLS CAL" is displayed.***
3. ***Always keep the light source unit in a horizontal position during use.***

"IN CALIBRATION**%" is displayed in the status window during the light source CAL. When it is displayed, the key operations and GPIB commands shown in Table 6-1 can not be executed.

Table 6-1 Prohibited Key operations and GPIB commands during light source CAL

Key operation	GPIB command
ADVANCE, ***FIBER LENGTH***	ELG
CAL, ***POL CAL***	POL
CAL, ***PMD NORM***	PDC
CAL, ***POL CAL+PMD NORM***	PPN
CENTER/SPAN, ***CENTER***	CEN
CENTER/SPAN, ***SPAN***	SPA
CENTER/SPAN, ***START***	STA
CENTER/SPAN, ***STOP***	STO
CENTER/SPAN, ***CUR TO CENTER***	CUC
CENTER/SPAN, ***FREQ DOMAIN***	FDO
DISPLAY, ***dual disp***, ***XCNG U/L***	XUL
DISPLAY, ***BOTH ON/OFF***	BOM
LOAD, ***load meas***, ***LOAD***	RCL, LDM
LOAD, ***load panel***, ***LOAD***	RCP, LPM
SWEEP	MEA1, E, *TRG
SWEEP(+PMD)	MEA3
SYSTEM, ***PRESET***	IPR
SYSTEM, ***SELF TEST***	*TST?
CAL, ***tls***, ***TLS CAL***, ***EXECUTE***	TLE

6.14 PMD Statistical Analysis Process

The analyzer enables the following statistical analysis for the PMD measurement values (τ_1, τ_2, ... τ_N):

Average: Avg = $\text{Avg} = \frac{1}{N}\sum_{i}^{N}\tau i$

Root-mean-square: $\text{Rms} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\tau i^2}$

Standard deviation: $\sigma = \sqrt{\frac{1}{N-1}\sum_{i}^{N}(\tau i - \bar{\tau})^2}$

τi: PMD measurement value

N: Number of measurement points

In addition, the following statistical analysis with the Maxwell distribution function for the histogram of the PMD measurement value can not be performed:

$$P(x) = k\sqrt{\frac{2}{\pi}}\frac{x^2}{\alpha^3}\exp\left(-\frac{x^2}{2\alpha^2}\right) = kf(x)$$

$$f(x) = \sqrt{\frac{2}{\pi}}\frac{x^2}{\alpha^3}\exp\left(-\frac{x^2}{2\alpha^2}\right)$$

$$k = \frac{N}{\sum_{i=1}^{n} f_i(x)}$$

x: PMD Measurement value

The relationship between the above Éø and the M.P. Value shown in the figure below is described using the following formula:

α parameter : $a = \frac{\text{Rms}}{\sqrt{3}}$

The most probable value : M. P. Value = $\sqrt{2}\alpha$

α : Maxwell distribution function α parameter

n: Number of classes. In the Figure 6-15, n must be 11.

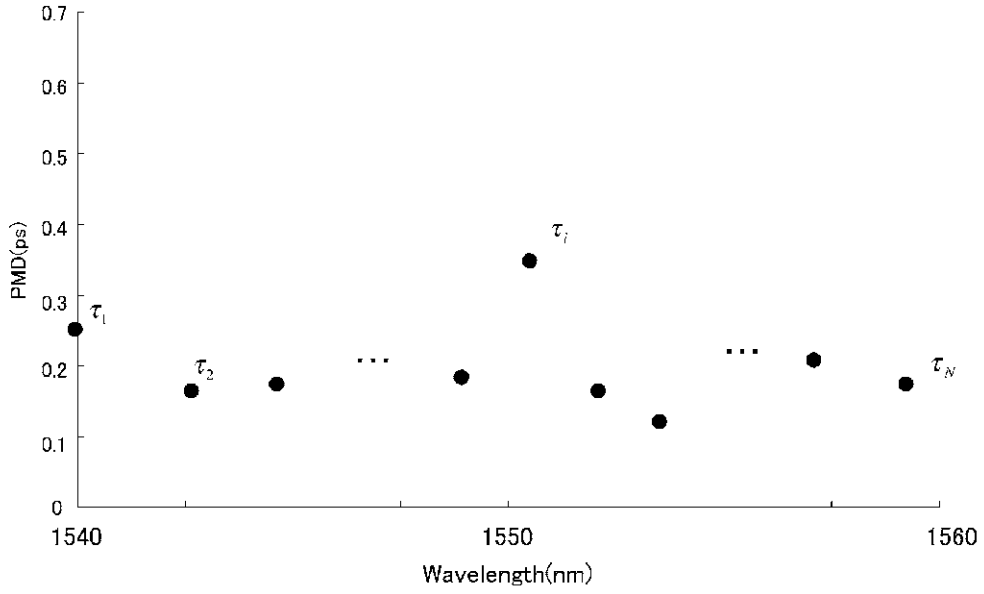


Figure 6-14 PMD Wavelength Characteristics

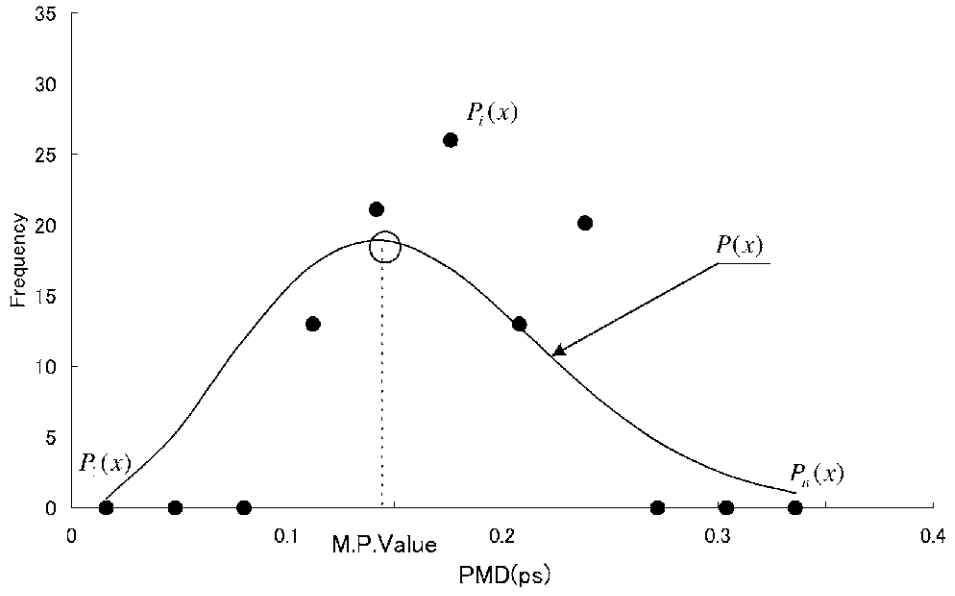


Figure 6-15 Histogram of PMD Measurement Value

7 SPECIFICATIONS

Shows the specifications of the Optical Network Analyzer.

Characteristics		Specification
Measurement function	Sweep channel	2 channels (Input reflection characteristics and forward direction transmission characteristics)
	Input reflection characteristics (S11)	Magnitude characteristics Group delay time characteristics Chromatic dispersion characteristics Chromatic dispersion slope characteristics
	Forward direction transmission characteristics (S21)	Magnitude characteristics Group delay time characteristics Chromatic dispersion characteristics Chromatic dispersion slope characteristics Polarization mode dispersion characteristics (+15 A and -15 A as an option)
Optical signal source characteristics *1	Measurable wavelength range	1525 nm to 1635 nm
	Absolute wavelength accuracy *2	±0.054 nm (Typ. ±0.025 nm) ±2 ppm ±1 pm (for the Q8326)
	Wavelength set resolution	0.001 nm
	Wavelength range (used to be set)	Arbitrary value between 0.1 nm and 110 nm. (Arbitrary value between 12.5 GHz and 13.2 THz.) However, the lower limit value (12.5 GHz) may change according to the center wavelength being used.
	Repeatability of wavelength *3	span × (±0.3%) ±30 MHz or less
	Sweep time (measurement time) *4	approx. 6.7 msec/point approx. 4 sec/span
	Optical output level *5	-15 dBm or more
	Optical monitor output level	-20 dBm or more

<table>
<tr><th colspan="2">Characteristics</th><th>Specification</th></tr>
<tr><td rowspan="5">Magnitude characteristics</td><td>Scale</td><td>Logarithmic (0.2, 0.5, 1.0, 2.0, 5.0 or 10.0 dB/div) and linear</td></tr>
<tr><td>Modulation frequency range</td><td>40 MHz to 3 GHz</td></tr>
<tr><td>Dynamic range *6</td><td>Forward direction transmission characteristics:
35 dB (Typically 40 dB)
Input reflection characteristics:
33 dB (Typically 38 dB.)</td></tr>
<tr><td>Linearity *7</td><td><table><tr><th rowspan="2">Linearity</th><th colspan="2">Relative level</th></tr><tr><th>S21</th><th>S11</th></tr><tr><td>±0.10 dB</td><td>0 to -25 dB</td><td>0 to -23 dB</td></tr><tr><td>±0.25 dB</td><td>-25 to -30 dB</td><td>-23 to -28 dB</td></tr></table></td></tr>
<tr><td>Polarization dependency</td><td>Forward direction transmission characteristics
(Test port 2): ±0.10 dB
Input reflection characteristics
(Test port 1): ±0.15 dB</td></tr>
<tr><td></td><td>Repeatability of connection/disconnection *8</td><td>±0.1 dB</td></tr>
<tr><td rowspan="4">Group delay time characteristics</td><td>Modulation frequency range (fm)</td><td>40 MHz to 3 GHz</td></tr>
<tr><td>Maximum measurement range</td><td>7.5 µsec</td></tr>
<tr><td>Group delay time resolution</td><td>1.0fsec</td></tr>
<tr><td>Accuracy of relative group delay time *7</td><td><table><tr><th rowspan="2">Accuracy</th><th colspan="2">Relative level</th></tr><tr><th>S21</th><th>S11</th></tr><tr><td>±0.015%/fm</td><td>0 to -5dB</td><td>0 to -3dB</td></tr><tr><td>±0.048%/fm</td><td>-5 to -10dB</td><td>-3 to -8dB</td></tr><tr><td>±0.15%/fm</td><td>-10 to -15dB</td><td>-8 to -13dB</td></tr><tr><td>±0.48%/fm</td><td>-15 to -20dB</td><td>-13 to -18dB</td></tr><tr><td>±1.5%/fm</td><td>-20 to -25dB</td><td>-18 to -23dB</td></tr></table></td></tr>
</table>

Characteristics		Specification
Chromatic dispersion	Measurement units	Wavelength domain (ps/nm), frequency domain (ps/GHz) Chromatic dispersion slope (ps/nm^2) ps/nm/km, ps/GHz/km, $ps/nm^2/km$, $ps/GHz^2/km$
	Measurable range	0.1 psec/nm to 1 μsec/nm
	Measurement resolution	0.01 psec/nm
Fiber's chromatic dispersion measurements *9	Repeatability of dispersion coefficient measurement	0.025psec/nm, 0.003psec/nm/km
	Repeatability of zero-dispersion wavelength	0.030nm
	Repeatability of dispersion slope measurement (at the zero-dispersion wavelength)	$0.025ps/nm^2$, $0.002ps/nm^2/km$
	Accuracy of zero-dispersion wavelength measurement	±0.084nm ±0.035 nm (for the Q8326)
	Waveform approximation function	linear approximation, second order polynomial, 3-term Sellmeier's polynomial and 5-term Sellmeier's polynomial
Fiber length measurement	Measurement range	0.2m to 10,000km
	Measurement resolution	0.02 mm or 0.01% of measured length, whichever is larger.
	Input range of refractive index	1.000000 to 2.000000

<table>
<tr><th colspan="2">Characteristics</th><th>Specification</th></tr>
<tr><td rowspan="4">Polarization mode dispersion (Only when OPT15 or OPT15A is installed.)</td><td>Measurement unit</td><td>psec, From the input data for the length of the optical fiber under measurement.
Psec/√ Km can be displayed.</td></tr>
<tr><td>Maximum measurement range</td><td>Continuous sweep mode: 333 psec
Step sweep mode: 25 psec</td></tr>
<tr><td>Measurement resolution</td><td>1.0fsec</td></tr>
<tr><td>Measurement accuracy</td><td>Continuous sweep mode *10
<table>
<tr><th rowspan="2">Accuracy</th><th colspan="2">Relative level</th></tr>
<tr><th>If m = 3 GHz</th><th>S11</th></tr>
<tr><td>±0.030%/fm</td><td>±0.1psec</td><td>0 to -5dB</td></tr>
<tr><td>±0.063%/fm</td><td>±0.2psec</td><td>-5 to -10dB</td></tr>
<tr><td>±0.17%/fm</td><td>±0.6psec</td><td>-10 to -15dB</td></tr>
<tr><td>±0.50%/fm</td><td>±1.7psec</td><td>-15 to -20dB</td></tr>
<tr><td>±1.6%/fm</td><td>±5.3psec</td><td>-20 to -25dB</td></tr>
</table>
Step sweep mode *10 *11
<table>
<tr><th colspan="3">Accuracy</th><th rowspan="2">Relative level</th></tr>
<tr><th>1ps range</th><th>10ps range</th><th>25ps range</th></tr>
<tr><td>±0.1ps</td><td>±0.2ps</td><td>±0.3ps</td><td>0 to -5dB</td></tr>
<tr><td>±0.2ps</td><td>±0.2ps</td><td>±0.4ps</td><td>-5 to -10dB</td></tr>
<tr><td>±0.2ps</td><td>±0.4ps</td><td>±0.8ps</td><td>-20 to -15dB</td></tr>
</table></td></tr>
<tr><td>Polarization control function (Only when OPT15 or OPT15A is installed.)</td><td>Polarization quenching ratio
Angular setting resolution</td><td>30 dB or more
0.1°</td></tr>
</table>

Characteristics		Specification
Processing function	Memory function	Measured data is saved into the backup memory or onto a floppy disk.
	Display	Optical frequency display, superposition display, up-and-down 2-screen display and the cursor functions.
	Operation/Analysis	Automatic measurement function, Automatic phase offset correction function, Half-height width calculation function, Averaging function, Normalize, Smoothing, Expanded display function, Limit line function, Partial waveform fitting function, Waveform fitting function (linear approximation, second-order polynomial, three-term Sellmeiyer polynomial and five-term Sellmeiyer polynomial), Ripple Extraction function, PMD statistical data analysis function
Optical input/output	Optical connector *12	FC-type optical connector SC-type optical connector (option) ST-type optical connector (option)
Input/Output interface	GPIB	IEEE-488-1978 compliant
	Floppy disk drive	3.5-inch MS-DOS format
	Printer	D-SUB 25-pin for ESC/P, ESC/P R and PCL
	Keyboard	IBM PC-AT compliant
	Display	15-pin D-SUB connector (VGA)

Characteristics		Specification
General specifications	Operating environment range	Temperature range: 15°C to 35°C, Relative humidity 85% or less (without condensation)
	Storage environment range	Temperature range: -10°C to 45°C, Relative humidity 90% or less (without condensation)
	AC input power source	Display unit: 100 to 120 V, 220 to 240 V, 50 Hz/60 Hz, 300 VA or less Optical network analyzer unit: 100 to 120 V, 220 to 240 V, 50 Hz/60 Hz, 310 VA or less
	Outer dimensions	Display unit: Approximately 424 (W) × 220 (H) × 400 (D) mm Optical network analyzer unit: Approximately 424 (W) × 220 (H) × 500 (D) mm
	Mass	Display unit: 17 kg or less Optical network analyzer unit:28 kg or less

*1 Warm-up time: 2 hours
*2 At the sweep start wavelength and a constant temperature.
*3 At a constant temperature
*4 For the specified span ≤60 GHz, except the internal setting time
*5 Using an average power
*6 Difference between the magnitude level and noise level (average value) when measuring the slew rate with SENSITIVITY set to HI.
*7 Relative value is with respect to the magnitude level with SENSITIVITY set to HI, assuming that the group delay time of the DUT is constant when measuring the slew rate.
*8 After a sequence of connecting and disconnecting an SMF fiber with a FC connector has been performed 10 times.
*9 After a 11-km dispersion shift fiber has been measured 20 times at a constant temperature under the following conditions: The zero dispersion wavelength is set to the center frequency, a measurement wavelength span of 10 nm, step sweep measurement, 11 points (1 point/nm), using the second order polynomial approximation and a dispersion slope of 0.074 ps/nm^2/km.
Unless otherwise specified, an external wavelength meter is not used.
*10 Relative value is with respect to the magnitude level with SENSITIVITY set to HI SENS, assuming that the group delay time of the DUT is constant when measuring the slew rate. When the wavelength correction function compatible with an external wavelength meter is used
*11 The accuracy is calculated according to the average of the measured waveform range.
*12 Can easily be replaced by the customer.

APPENDIX

A.1 TROUBLESHOOTING

If the suggestions in the Troubleshooting column fail to resolve the problem, contact an ADVANTEST sales representative for information on getting the analyzer repaired.

Problems	Suspected causes	Troubleshooting
Power is not turned on.	Any power cable may not be correctly connected.	Turn the power switch off, then connect the cable to the connector for AC power supply of this analyzer. Connect the cable to the outlet.
	A power fuse has blown.	Check for a blown fuse. If a fuse has blown, there is probably some kind of problem with the analyzer. Ask ADVANTEST Corp. or a sales representative to repair the analyzer.
The system does not start up (The self-test is not completed).	Optical network analyzer	Turn power off, then turn it on again.
	The PORT B is not connected.	Turn power off and after connecting PORT B, turn it on again.
An error message is displayed.	An operation error is suspected.	Correct the problem according to the displayed error message.
	A malfunction or defect in this analyzer is suspected.	
No sweeping.	PORT A is not connected.	Turn power off and after connecting PORT A, turn it on again.
Keys do not work.	This analyzer may have been placed in REMOTE control mode by a GPIB command.	Interrupt the program if it is running, then press LOCAL.
Can not read the data from the floppy disk. (Recalling is not possible.)	An abnormality may have occurred in the floppy disk.	An abnormality may have occurred in the disk drive.
	Check operation using another floppy disk.	Ask ADVANTEST Corp. or a sales representative to repair the analyzer.
Can not save the data in the floppy disk.	The write protect is set to on.	Set the write protect of the floppy disk to off.
	The floppy disk is not initialized.	Initialize the floppy disk.
	The floppy disk is short of capacity.	Use another floppy disk.

A.2 ERROR CODE LIST

If errors occur when the self-test is performed, the error codes are displayed on the screen. If an error occurs in the optical network analyzer, an error message is displayed. The error codes are explained in detail here. If any of these errors occur in the instrument, the status byte, b7 will be set to 1 (refer to "5.9 Status Byte").

The error details are explained below.

Error indication	Description
0000X	Normal
030XX	backup-RAM error
30XX	Error in the measurement system (Display unit, Optical network analyzer unit)
Optical Network Analyzer Unit Error(No.*).	There may be a problem with the optical network analyzer unit. Contact the nearest ADVANTEST customer service office or the representative. A number is displayed for *.

A.3 List of Simultaneous Executions and Settings for Each Function

The following table shows which functions are executable for each measurement:

Table A-1 Executable Functions for Each Measurement

Measurement item / Function	Measurement values using the **SWEEP** key	Measurement values using the **SWEEP** (+PMD) key	MAG	GROUP DELAY	CD	CD SLOPE	PMD
Continuous sweep (Number of points: 101 to 1101)	√	√	√	√	√	√	√
Continuous sweep (Number of points: 1102 to 12001)	√	√	√	√	√	√	√
Step sweep	√	√	√	√	√	√	√
0 span sweep	√		√	√	*	*	
Differential measurement	√	√	*	√	√	√	√
Wavelength meter -CAL measurement	√	√	√	√	√	√	√
Frequency measurement	√	√	√	√	√	√	√
Frequency display	√	√	√	√	√	√	√
Average measurement	√		√	√	√	√	
Modulated frequency AUTO measurement	√		√	√	√	√	
PMD range AUTO measurement		√	√	√	√	√	√
Dual-screen display	√	√	√	√	√	√	√
Multiple window display	√	√	√	√	√	√	√
Cursor normal	√	√	√	√	√	√	√
Cursor delta	√	√	√	√	√	√	√
Cursor 2nd peak	√	√	√	√	√	√	√
Cursor differ	√	√	√	√	√	√	√
Cursor band width	√	√	√				
Report display	√	√	*	√	√	√	*
Limit line display	√	√	√	√	√	√	√
/KM display	√	√		√	√	√	√
/√KM display	√	√		√	√	√	√
Expansion function	√	√	√	√	√	√	√
Fitting function	√	√	*	√	√	√	*
Partial fitting function	√	√	*	√	√	√	*
Smoothing function	√		√	√	√	√	
Save reference	√		√	√	√	√	
Normalization function	√		√	√	√	√	
Normalization fitting function	√		*	√	√	√	
Group delay Ripple Extraction function	√	√	*	√	√	√	*
Statistical analysis process		√					√

√ : This item can be set or executed.
(Blank) : This item can not be set or executed.
* : This item can be set, but it will not be valid.
- : N/A

Table A-2 List of Available Combinations for Simultaneous Executions Among Functions

	Continuous sweep	Continuous sweep (Number of points: 1102 to 12001)	Step sweep	Zero span sweep	Differential measurement	Wavelength meter -CAL measurement	Frequency measurement
Continuous sweep (Number of points: 101 to 1101)	-	-	-	-	-	-	-
Continuous sweep (Number of points: 1102 to 12001)	√	-	-	-	-	-	-
Step sweep			-	-	-	-	-
Zero span sweep				-	-	-	-
Differential measurement	*	*	√	*	-	-	-
Wavelength meter -CAL measurement	√	√	√	*	√	-	-
Frequency measurement	√	√	√	√	√		-
Frequency display	√	√	√	√	√	√	√
Average measurement	√	√	√	√	√		√
Modulated frequency AUTO measurement			√		√	√	
PMD range AUTO measurement			√			√	√
Dual-screen display	√	√	√	√	√	√	√
Multiple window display	√	√	√	√	√	√	√
Cursor normal	√	√	√	√	√	√	√
Cursor delta	√	√	√	√	√	√	√
Cursor 2nd peak	√	√	√	√	√	√	√
Cursor differ	√	√	√		√	√	√
Cursor band width	√	√	√	*	√	√	√
Report display	√		√		√	√	
Limit line display	√	√	√		√	√	√
/KM display	√	√	√	√	√	√	√
/√KM display	√	√	√	√	√	√	√
Expansion function	√	√	√		√	√	√
Fitting function	√		√		√	√	
Partial fitting function	√		√		√	√	
Smoothing function	√	√	√	√	√	√	√
Save reference	√	√	√		√	√	√
Normalization function	√	√	√	√	√	√	√
Normalization fitting function	√		√		√	√	√
Group delay Ripple Extraction function	√		√	√	√	√	√
Statistical analysis process	√	√	√		√	√	√

√ : This item can be set or executed.
(Blank) : This item can not be set or executed.
* : This item can be set, but it will not be valid.
- : N/A

	Frequency display	Average measurement	Modulated frequency AUTO measurement	PMD range AUTO measurement	Dual-screen display	Multiple window display	Cursor normal
Continuous sweep (Number of points: 101 to 1101)	-	-	-	-	-	-	-
Continuous sweep (Number of points: 1102 to 12001)	-	-	-	-	-	-	-
Step sweep	-	-	-	-	-	-	-
Zero span sweep	-	-	-	-	-	-	-
Differential measurement	-	-	-	-	-	-	-
Wavelength meter -CAL measurement	-	-	-	-	-	-	-
Frequency measurement	-	-	-	-	-	-	-
Frequency display	-	-	-	-	-	-	-
Average measurement	√	-	-	-	-	-	-
Modulated frequency AUTO measurement	√	√	-	-	-	-	-
PMD range AUTO measurement	√			-	-	-	-
Dual-screen display	√	√	√	√	-	-	-
Multiple window display	√	√	√	√		-	-
Cursor normal	√	√	√	√	√	√	-
Cursor delta	√	√	√	√	√	√	
Cursor 2nd peak	√	√	√	√	√	√	
Cursor differ	√	√	√	√	√	√	
Cursor band width	√	√	√	√	√	√	
Report display		√	√	√			
Limit line display	√	√	√	√			√
/KM display	√	√	√	√	√	√	√
/√KM display	√	√	√	√	√	√	√
Expansion function	√	√	√	√	√	√	√
Fitting function		√	√	√	√	√	√
Partial fitting function		√	√	√	√	√	√
Smoothing function	√	√	√	√	√	√	√
Save reference	√	√	√		√	√	√
Normalization function	√	√	√		√	√	√
Normalization fitting function	√	√	√		√	√	√
Group delay Ripple Extraction function	√	√			√	√	√
Statistical analysis process	√				√	√	√

√ : This item can be set or executed.
(Blank) : This item can not be set or executed.
* : This item can be set, but it will not be valid.
- : N/A

	Cursor delta	Cursor 2nd peak	Cursor differ	Cursor band width	Report display	Limit line display	/KM display
Continuous sweep (Number of points: 101 to 1101)	-	-	-	-	-	-	-
Continuous sweep (Number of points: 1102 to 12001)	-	-	-	-	-	-	-
Step sweep	-	-	-	-	-	-	-
Zero span sweep	-	-	-	-	-	-	-
Differential measurement	-	-	-	-	-	-	-
Wavelength meter -CAL measurement	-	-	-	-	-	-	-
Frequency measurement	-	-	-	-	-	-	-
Frequency display	-	-	-	-	-	-	-
Average measurement	-	-	-	-	-	-	-
Modulated frequency AUTO measurement	-	-	-	-	-	-	-
PMD range AUTO measurement	-	-	-	-	-	-	-
Dual-screen display	-	-	-	-	-	-	-
Multiple window display	-	-	-	-	-	-	-
Cursor normal	-	-	-	-	-	-	-
Cursor delta	-	-	-	-	-	-	-
Cursor 2nd peak		-	-	-	-	-	-
Cursor differ			-	-	-	-	-
Cursor band width				-	-	-	-
Report display					-	-	-
Limit line display	√	√	√	√		-	-
/KM display	√	√	√		√	√	-
/√KM display	√	√	√		√	√	
Expansion function	√	√	√	√		√	√
Fitting function	√	√	√		√		√
Partial fitting function	√	√	√			√	√
Smoothing function	√	√	√	√	√	√	√
Save reference	√	√	√	√		√	*
Normalization function	√	√	√	√	√	√	√
Normalization fitting function	√	√	√	√	√	√	√
Group delay Ripple Extraction function	√	√	√	√	√	√	√
Statistical analysis process	√	√	√	√	√	√	√

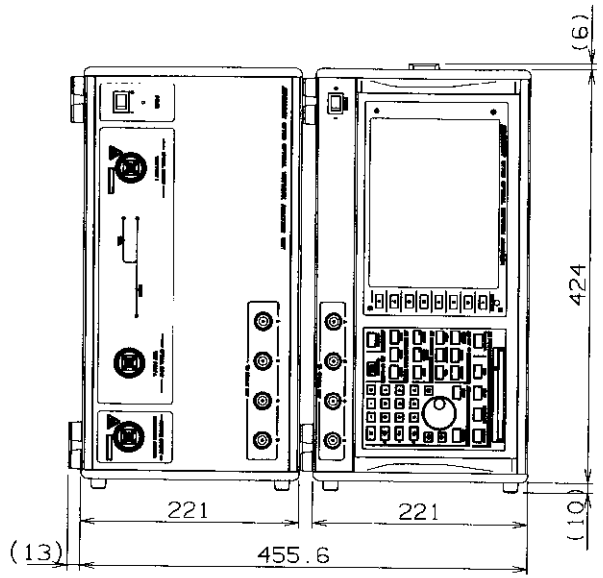
√ : This item can be set or executed.
(Blank) : This item can not be set or executed.
* : This item can be set, but it will not be valid.
- : N/A

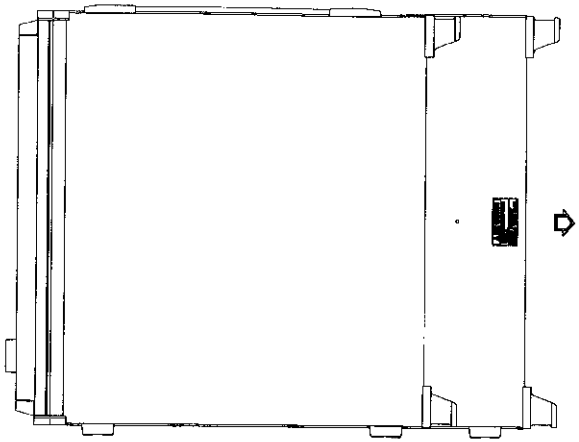
	/√KM display	Expansion function	Fitting function	Partial fitting function	Smoothing function	Save reference	Normalization function
Continuous sweep (Number of points: 101 to 1101)	-	-	-	-	-	-	-
Continuous sweep (Number of points: 1102 to 12001)	-	-	-	-	-	-	-
Step sweep	-	-	-	-	-	-	-
Zero span sweep	-	-	-	-	-	-	-
Differential measurement	-	-	-	-	-	-	-
Wavelength meter -CAL measurement	-	-	-	-	-	-	-
Frequency measurement	-	-	-	-	-	-	-
Frequency display	-	-	-	-	-	-	-
Average measurement	-	-	-	-	-	-	-
Modulated frequency AUTO measurement	-	-	-	-	-	-	-
PMD range AUTO measurement	-	-	-	-	-	-	-
Dual-screen display	-	-	-	-	-	-	-
Multiple window display	-	-	-	-	-	-	-
Cursor normal	-	-	-	-	-	-	-
Cursor delta	-	-	-	-	-	-	-
Cursor 2nd peak	-	-	-	-	-	-	-
Cursor differ	-	-	-	-	-	-	-
Cursor band width	-	-	-	-	-	-	-
Report display	-	-	-		-	-	-
Limit line display	-	-	-	-	-	-	-
/KM display	-	-	-	-	-	-	-
/√KM display	-	-	-	-	-	-	-
Expansion function	√	-	-	-	-	-	-
Fitting function	√	√	-	-	-	-	-
Partial fitting function	√	√		-	-	-	-
Smoothing function	√	√	*	*	-	-	-
Save reference	*	*	*	*	*	-	-
Normalization function	√	√	√	√	√	√	-
Normalization fitting function	√	√	√	√	√	*	√
Group delay Ripple Extraction function	√	√	√	√	√	√	√
Statistical analysis process	√	√					

√ : This item can be set or executed.
(Blank) : This item can not be set or executed.
* : This item can be set, but it will not be valid.
- : N/A

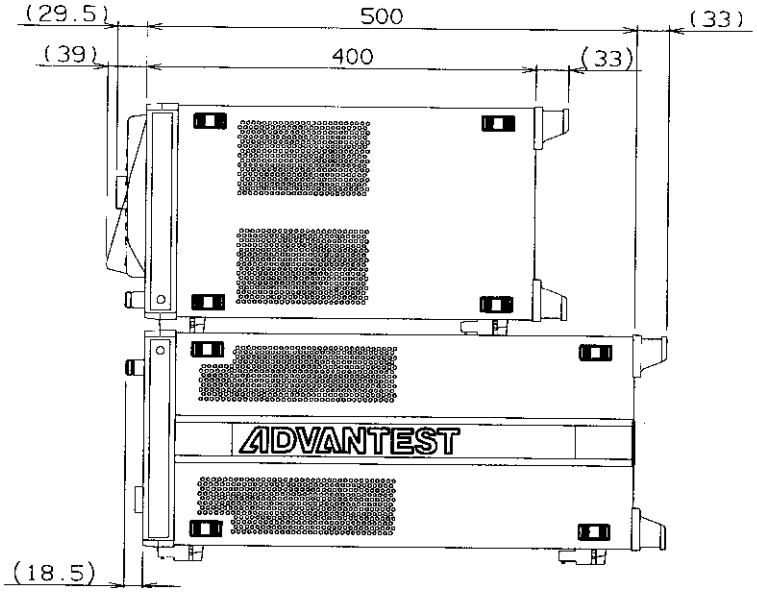
	Normalization fitting function	Normalization fitting function	Statistical analysis process
Continuous sweep (Number of points: 101 to 1101)	-	-	-
Continuous sweep (Number of points: 1102 to 12001)	-	-	-
Step sweep	-	-	-
Zero span sweep	-	-	-
Differential measurement	-	-	-
Wavelength meter -CAL measurement	-	-	-
Frequency measurement	-	-	-
Frequency display	-	-	-
Average measurement	-	-	-
Modulated frequency AUTO measurement	-	-	-
PMD range AUTO measurement	-	-	-
Dual-screen display	-	-	-
Multiple window display	-	-	-
Cursor normal	-	-	-
Cursor delta	-	-	-
Cursor 2nd peak	-	-	-
Cursor differ	-	-	-
Cursor band width	-	-	-
Report display	-	-	-
Limit line display	-	-	-
/KM display	-	-	-
/√KM display	-	-	-
Expansion function	-	-	-
Fitting function	-	-	-
Partial fitting function	-	-	-
Smoothing function	-	-	-
Save reference	-	-	-
Normalization function	-	-	-
Normalization fitting function	-	-	-
Group delay Ripple Extraction function	√	-	-
Statistical analysis process			-

√ : This item can be set or executed.
(Blank) : This item can not be set or executed.
* : This item can be set, but it will not be valid.
- : N/A





AIR FLOW



Unit : mm

CAUTION

This drawing shows external dimensions of this instrument.

The difference in products and options used can cause a change in the appearance of the instrument.

DIMENSIONAL OUTLINE DRAWING

ALPHABETICAL INDEX

[Symbol]

[Numerics]

[A]

[B]

[C]

[D]

[E]

[F]

[G]

[H]

[I]

[K]

[L]

[M]

[N]

[O]

[P]

[Q]

[R]

[S]

[T]

[U]

[V]

[W]

[X]

[Y]

[Z]

IMPORTANT INFORMATION FOR ADVANTEST SOFTWARE

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

SOFTWARE License

All rights in and to the SOFTWARE (including, but not limited to, copyright) shall be and remain vested in Advantest. Advantest hereby grants you a license to use the SOFTWARE only on or with Advantest PRODUCTS.

Restrictions

(1) You may not use the SOFTWARE for any purpose other than for the use of the PRODUCTS.
(2) You may not copy, modify, or change, all or any part of, the SOFTWARE without permission from Advantest.
(3) You may not reverse engineer, de-compile, or disassemble, all or any part of, the SOFTWARE.

Liability

Advantest shall have no liability (1) for any PRODUCT failures, which may arise out of any misuse (misuse is deemed to be use of the SOFTWARE for purposes other than it's intended use) of the SOFTWARE. (2) For any dispute between you and any third party for any reason whatsoever including, but not limited to, infringement of intellectual property rights.

LIMITED WARRANTY

1. Unless otherwise specifically agreed by Seller and Purchaser in writing, Advantest will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by Advantest or (ii) specifically recommended or authorized by Advantest and performed in accordance with Advantest 's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than Advantest or its agents);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;

   (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);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

5. **EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADVANTEST HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.**

6. **THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.**

7. **ADVANTEST WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADVANTEST HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE. TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

8. **OTHER THAN THE REMEDY FOR THE BREACH OF WARRANTY SET FORTH HEREIN, ADVANTEST SHALL NOT BE LIABLE FOR, AND HEREBY DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY LIABILITY FOR, DAMAGES FOR PRODUCT FAILURE OR DEFECT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLEGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

CUSTOMER SERVICE DESCRIPTION

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

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

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

SALES & SUPPORT OFFICES

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

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

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

Advantest (Singapore) Pte. Ltd.
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

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

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

ADVANTEST®

http://www.advantest.co.jp

ADVANTEST CORPORATION
Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Phone: +81-3-3214-7500