ADVANTEST

ADVANTEST CORPORATION

Q7761
Performance Test Guide

MANUAL NUMBER FOE-8440124A01

First printing March 15, 2004
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

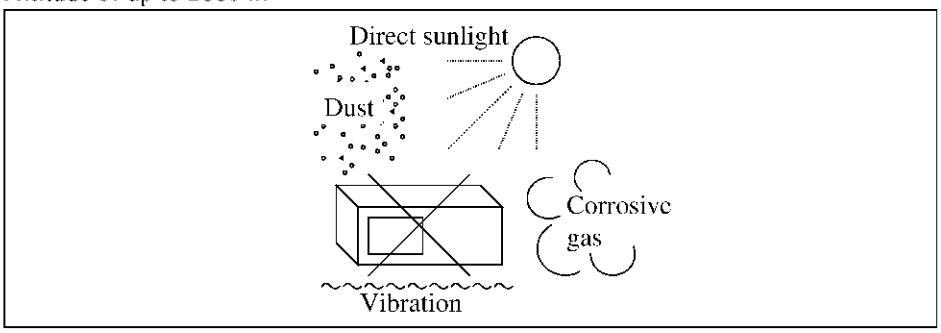


Figure-1 Environmental Conditions

- Operating position

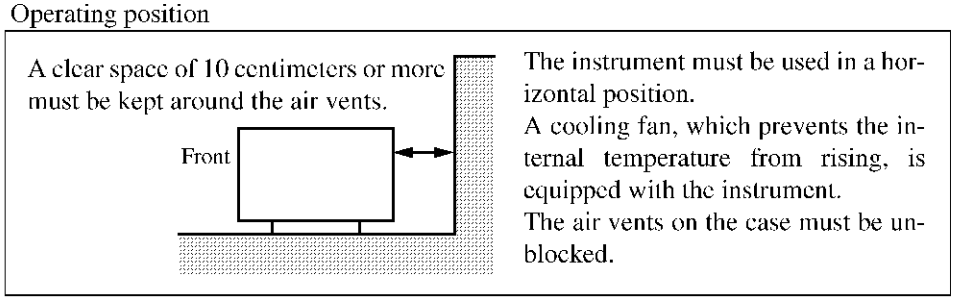


Figure-2 Operating Position

- Storage position

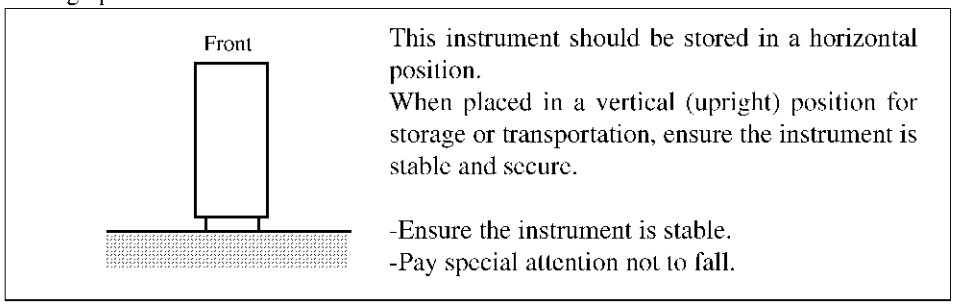


Figure-3 Storage Position

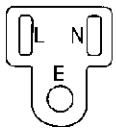
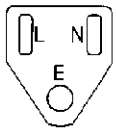
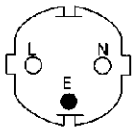
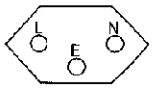
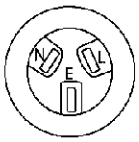
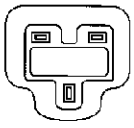
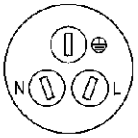
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  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

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1. INTRODUCTION

This chapter describes the contents of this manual to help the user get the most out of the manual.

1.1 About this Manual

This manual is a performance test guide for the Q7761 optical network analyzer.

The manual describes the procedure which is used to check whether the Q7761 Optical Network Analyzer performs according to its specifications.

This manual does not contain detailed descriptions of the operating methods and functions of the Q7761 optical network analyzer. For information on the operating methods and functions, refer to the user's guide.

Contents of each chapter are as follows:

Chapter 1, "INTRODUCTION"	Describes the manual, instruments and information required to calibrate the Q7761 to help the user get the most out of the manual.
Chapter 2, "PERFORMANCE VERIFICATION"	Describes the performance test items and performance test procedures of the Q7761. Performance test record sheets are provided in this chapter.
Chapter 3, "SPECIFICATIONS"	Describes the specifications of the Q7761.

1.2 Required Instruments

Table 2-2 shows the instruments, which are required for the performance verification of the Q7761.

The instruments, which are required in all tests, are listed. Instruments which are required for individual tests are also listed in each test. If the user's instruments meet the specifications described in Table 2-2, the instruments can be used instead of the recommended models.

1.3 Performance Verification Period

It is recommended that the performance is verified once a year to check whether the optical analyzer meets its specifications.

1.4 Performance Verification Record Sheets

The performance verification record sheets are provided at the end of Chapter 2 for users to record values, which are measured in each performance verification test.

The performance verification record sheets feature the test specifications and acceptable values.

Copy the sheets, enter all the test results, and keep the sheets as calibration test records.

These records can be used to trace gradual changes of the test results if using the instruments over a long period of time.

1.5 Conventions of Notation Used in This Document

In this document, panel keys, on-screen buttons and menus are represented by the following symbols:

On-panel hard keys

Sample	Represents an on-panel hard key labeled "Sample." Example: **START**, **STOP**

On-screen system menus

[Sample]	Represents an on-screen menu, tab, button or dialog box that is labeled "Sample" and that is selected or executed when touched. Example: **[File]** menu, **[Normal]** tab, **[Option]** button

On-screen function buttons

{Sample}	Represents an on-screen function button labeled "Sample." Example: **{FREQ}** button, **{SWEEP}** button

On-screen soft menu bar

Sample	Sample Represents an on-screen function button labeled "Sample." Example: **Center** key, **Span** key

On-screen system menu key operation

[File]→[Save As...]	Indicates a touch on the **[File]** menu followed by a choice of **[Save As...]**.

Sequential key operation

{FREQ}, **Center**	Indicates a touch on the **{FREQ}** button followed by a touch on the **Center** key.

Toggle key operation

ΔMarker On/Off (On)	Indicates a touch on the **ΔMarker On/Off** key to turn on the ΔMarker.

1.6 Trademarks and Registered Trademarks

- Microsoft® and Windows® are trademarks or registered trademarks of Microsoft Corporation in the United States and other countries.
- Other product and company names referenced herein are trademarks or registered trademarks of their respective owners.

1.7 Other Manuals Pertaining to This Instrument

Available manuals pertaining to this instrument include:

- User's Guide (Part Code: {EQ7761/U}, English)

  Contains information prerequisite to using the Q7761 Optical Network Analyzer, ranging from setup to basic operation, applied measurement, functionality, specifications, and maintenance.

- Programming Guide (Part Code: {EQ7761/P}, English)

  Covers programming information to use the Q7761 Optical Network Analyzer to automate measurement sequences, including a remote control overview, SCPI command references, and sample application programs.

- Performance Test Guide (Part Code: {EQ7761/T}, English, this manual)

  Covers information necessary to verify the performance of the Q7761 Optical Network Analyzer, including performance test procedures and specifications.

2. PERFORMANCE VERIFICATION

2.1 Overview

2.1.1 Before Starting

This chapter describes the performance verification procedure in order of the items listed in Table 2-1.

Table 2-1 Performance Verification List

Test No.	Test item
2.2.1	Absolute Wavelength Accuracy
2.2.2	Dynamic Range (POWER Measurement Mode)
2.2.3	Dynamic Range (Dispersion Measurement Mode)
2.2.4	Linearity (POWER Measurement Mode)
2.2.5	Linearity (Dispersion Measurement Mode)
2.2.6	Polarization Dependency (POWER Measurement Mode)
2.2.7	Polarization Dependency (Dispersion Measurement Mode)
2.2.8	OPTICAL SIGNAL OUTPUT Output Power Measurement
2.2.9	WAVELENGTH MONITOR OUTPUT Output Power Measurement
2.2.10	Internal Light Source Output Verification
2.2.11	Relative Group Delay Time (RGD) Accuracy
2.2.12	Wavelength Dispersion Measurement Accuracy
2.2.13	Polarization Mode Dispersion Measurement Accuracy
2.2.14	Fiber Length Measurement Repeatability

2.1.2 Required Instruments

Table 2-2 shows a list of required instruments.

Instruments, which are required in all tests, are listed.

Instruments, which are required for individual tests, are listed in each test.

If the user's instruments meet the specifications described in Table 2-2, these instruments can be used instead of the recommended models.

2.1.2 Required Instruments

1. Test environment and conditions

   Before the performance verification is conducted, the following conditions must be satisfied.

   - A warm-up of 2 hours or more at an ambient temperature of 15°C to 35°C is performed.
   - Automatic calibration is performed.

2. Required measurement instruments

   Table 2-2 shows the list of instruments, which are required in all tests.

   Instruments which are required for individual tests are listed in each test.

   If the user's instruments meet the specifications described in the table, these instruments can be used instead of the recommended models.

3. Performance verification period

   It is recommended that the performance is verified once a year to check whether the optical network analyzer meets its specifications.

4. Performance verification sheets

   Performance verification sheets are included at the end of this chapter for users to record the results of each performance verification test.

   When conducting performance verification, it is recommended that copies of the sheets are used to record the test results and kept as records.

Table 2-2 Required Instruments List

Instrument	Specification		Recommended Model	Qty.
Multi Wavelength Meter	Absolute Accuracy	≤ ±2 pm	Q8331 Advantest	1
Wavelength Meter	Absolute Accuracy	≤ ±0.3 pm	WA-1650 Burleigh	1
Optical Attenuator	Accuracy Repeatability	≤ ±0.1 dB ≤ ±0.01 dB	HA2 JDS Uniphase	1
Polarization Controller	PDL Option022	≤ ±0.05 dB FC Angled Connector	11896A Agilent	1
Optical Power Meter	Accuracy	≤ ±4.5%	Q8221, Q82208 Advantest	1
Optical Spectrum Analyzer	Absolute Wavelength Accuracy Level Accuracy	≤ 20 pm ≤ ±0.4 dB	Q8384 Advantest	1
PMD Emulator	Absolute Accuracy Relative Accuracy	≤ ±0.1 ps ≤ (0.02 ps+5% of PMD)	PE3 JDS Uniphase	1
PMD Standard Material	PMD Accuracy	≤ ±0.003 ps	OFCR-100-0.5 Okinawa Photonics	1

2.2 Performance Verification Procedure

This section describes the performance verification procedure in order of the items listed in Table 2-1.

2.2.1 Absolute Wavelength Accuracy

[Overview]

This section describes how to verify the absolute wavelength accuracy of this instrument.

After a 2-hour warm-up, the set wavelength of the OPTICAL SIGNAL OUTPUT output is checked by measuring with a calibrated wavelength meter.

[Specification]

Absolute wavelength accuracy: ≤ ±9 pm

|Required instruments|

Item	Quantity	Recommended model
Wavelength meter	1	WA-1650 EXFO Burleigh
PC	1	
Optical fiber cord	1	FC/SPC-FC/SPC
GP-IB cable	1	

|Connection|

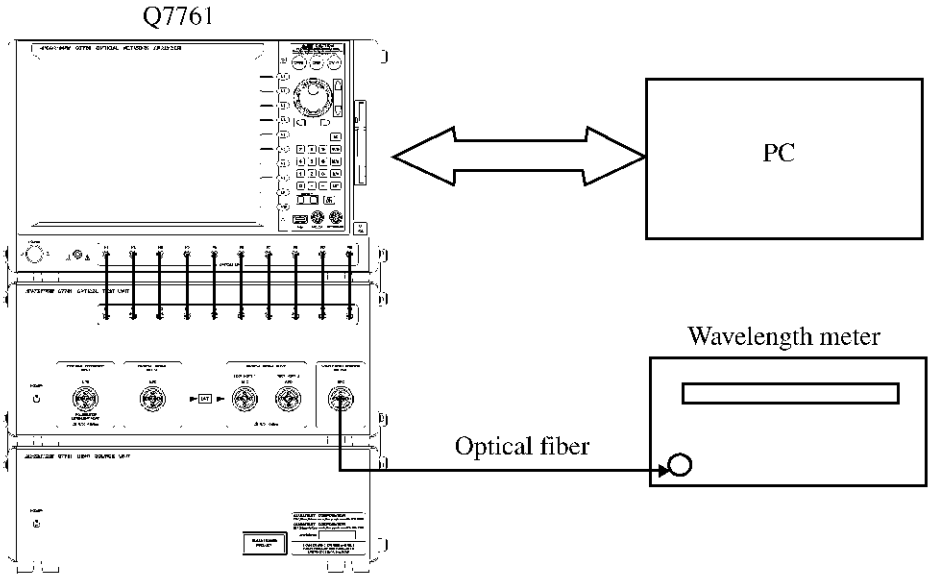


Figure 2-1 When Checking Absolute Wavelength Accuracy

2.2.1 Absolute Wavelength Accuracy

[Test procedure]

1. Connect "WAVELENGH MONITOR OUTPUT" on the front panel of this instrument to the optical input connector of the wavelength meter by using the optical fiber.
2. Connect the GP-IB connector of this instrument to the PC.
3. Preset this instrument.

   Operation: **[Special]→[Preset...]**, **OK**
4. Set the span to 0 nm.

   Operation: **{HOME}**, **Center/Span**, **Span**, **0**, **M/n**
5. Set the center wavelength to 1525 nm.

   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **2**, **5**, **M/n**
6. Carry out measurement with SINGLE.

   Operation: **SINGLE**
7. Calculate the difference between the wavelength of the optical output measured with the wavelength meter and the wavelength read by the personal computer with GPIB, and enter it into the corresponding column on the performance verification sheet. The GP-IB command that reads the wavelength inside this instrument by the personal computer is ":SOURce:WAVelength:VERification?".
8. Repeat procedures 3 to 7, setting the center wavelength of procedure 5 to 1535 nm, 1545 nm, 1555 nm, 1565 nm, 1575 nm, 1585 nm, 1595 nm, 1605 nm, 1615 nm and 1625 nm, respectively.

2.2.2 Dynamic Range (POWER Measurement Mode)

[Overview]

This section describes how to verify the dynamic range in the POWER measurement mode of this instrument.

[Specifications]

Item	Specification		Condition
Dynamic range (POWER measurement mode)	TEST PORT 1	≥ 58 dB	Sensitivity:High
	TEST PORT 2	≥ 58 dB	

[Required instruments]

Item	Quantity	Recommended model
FC/APC-FC/APC master fiber	1	A180001

[Connection figure]

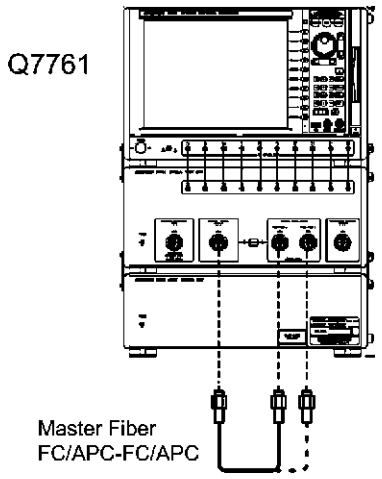


Figure 2-2 Connection for Dynamic Range (POWER Measurement Mode) Test

[Test procedure]

1. Connect equipment as shown in Figure 2-2. First, connect the "OPTICAL SIGNAL OUTPUT" with "TEST PORT 1", using the master fiber.
2. Preset this instrument.

   Operation: **[Special]→[Preset...]**, **OK**
3. Set the number of measurement points to 1001.

   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **1**, **0**, **0**, **1**, **ENT**

4. Set the start wavelength to 1525 nm.
   Operation: {HOME}, **Center/Span**, **Start**, [1], [5], [2], [5], [M/n]
5. Set the stop wavelength to 1625 nm.
   Operation: {HOME}, **Center/Span**, **Stop**, [1], [6], [2], [5], [M/n]
6. Set the waveform display port to Port 1.
   Operation: {HOME}, **Trace**, **Port 1/2** (1)
7. Set the waveform display mode to the magnitude (logarithm) mode.
   Operation: {HOME}, **Trace**, **Trace Mode**, **Mag**
8. Set the measurement mode to the Power mode.
   Operation: {HOME}, **Measure**, **Measure Mode**, **Power**
9. Set the sensitivity to "Middle".
   Operation: {HOME}, **Measure**, **Sensitivity**, **Middle**
10. Carry out measurement with SINGLE.
    Operation: [SINGLE]
11. After completing sweep, execute normalization.
    Operation: {HOME}, **Analysis**, **Normalize**, **Save Normalize Data (Port 1)**, **Normalize (Port 1) ON/OFF** (ON)
12. Disconnect the master fiber connected to TEST PORT 1 of this instrument.
13. Set the sensitivity to "High".
    Operation: {HOME}, **Measure**, **Sensitivity**, **High**
14. Carry out measurement with SINGLE.
    Operation: [SINGLE]
15. After the measurement is completed, read the maximum value of the vertical axis displayed on the upper left of the screen and enter the value into the corresponding column on the performance verification sheet.
16. Connect the "OPTICAL SIGNAL OUTPUT" with "TEST PORT 2", using the disconnected master fiber.
17. Repeat steps 2 to 15, reading **Port 1/2** (1) in step 6 as **Port 1/2** (2), **Port 1** in step 11 as **Port 2** and "TEST PORT 1" in step 12 as "TEST PORT 2".

2.2.3 Dynamic Range (Dispersion Measurement Mode)

[Overview]

This section describes how to verify the dynamic range in the dispersion measurement modes of this instrument.

[Specifications]

Item	Specification		Condition
Dynamic range (Dispersion measurement mode)	TEST PORT 1	≥ 43 dB	Sensitivity:High
			fm:100 MHz
			fm:500 MHz
			fm:1 GHz
			fm:1.5 GHz
			fm:2 GHz
			fm:2.5 GHz
	TEST PORT 2	≥ 43 dB	Sensitivity:High
			fm:100 MHz
			fm:500 MHz
			fm:1 GHz
			fm:1.5 GHz
			fm:2 GHz
			fm:2.5 GHz

|Required instruments|

Item	Quantity	Recommended model
FC/APC-FC/APC master fiber	1	A180001

|Connection figure|

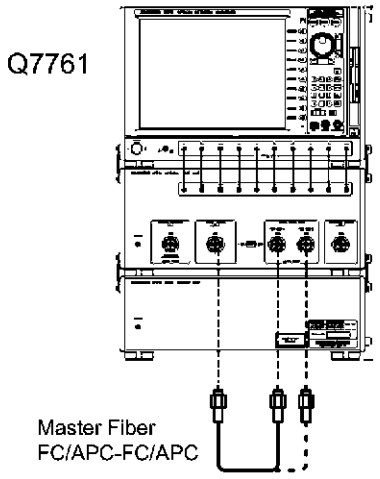


Figure 2-3 Connection for Dynamic Range (Dispersion Mode) Test

2.2.3 Dynamic Range (Dispersion Measurement Mode)

[Test procedure]

1. Connect equipment as shown in Figure 2-3. First, connect the "OPTICAL SIGNAL OUTPUT" with "TEST PORT 1", using the master fiber.
2. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
3. Set the number of measurement points to 1001.
   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **1**, **0**, **0**, **1**, **ENT**
4. Set the start wavelength to 1525 nm.
   Operation: **{HOME}**, **Center/Span**, **Start**, **1**, **5**, **2**, **5**, **M/n**
5. Set the stop wavelength to 1625 nm.
   Operation: **{HOME}**, **Center/Span**, **Stop**, **1**, **6**, **2**, **5**, **M/n**
6. Set the waveform display port to Port 1.
   Operation: **{HOME}**, **Trace**, **Port 1/2** (1)
7. Set the waveform display mode to the magnitude (logarithm) mode.
   Operation: **{HOME}**, **Trace**, **Trace Mode**, **Mag**
8. Set the measurement mode to the CD mode.
   Operation: **{HOME}**, **Measure**, **Measure Mode**, **CD**
9. Set the modulation frequency to 100 MHz.
   Operation: **{HOME}**, **Measure**, **Modulation Frequency**, **1**, **0**, **0**, **M/n**
10. Set the sensitivity to "Middle".
    Operation: **{HOME}**, **Measure**, **Sensitivity**, **Middle**
11. Carry out measurement with SINGLE.
    Operation: **SINGLE**
12. After completing sweep, execute normalization.
    Operation: **{HOME}**, **Analysis**, **Normalize**, **Save Normalize Data (Port 1)**, **Normalize (Port 1) ON/OFF** (ON)
13. Disconnect the master fiber from TEST PORT 1.
14. Set the sensitivity to "High".
    Operation: **{HOME}**, **Measure**, **Sensitivity**, **High**
15. Carry out measurement with SINGLE.
    Operation: **SINGLE**

16. Set the smoothing width to 1 nm.

    Operation: **{HOME}**, **Analysis**, **Smoothing**, **Smoothing Window**, **1**, **M/n**

17. Set the smoothing function to ON.

    Operation: **{HOME}**, **Analysis**, **Smoothing**, **Smoothing ON/OFF** (ON)

18. After the measurement is completed, read the maximum value of the vertical axis displayed on the upper left of the screen and enter the value into the corresponding column on the performance verification sheet.

19. Connect the master fiber disconnected in step 13 with "TEST PORT 1" again.

20. Repeat steps 2 to 19, reading the modulation frequency of step 9 as 500 MHz, 1 GHz, 1.5 GHz, 2 GHz and 2.5 GHz, respectively.

21. Connect the "OPTICAL SIGNAL OUTPUT" with "TEST PORT 2", using the disconnected master fiber.

22. Repeat steps 2 to 20, reading **Port 1/2** (1) in step 5 as **Port 1/2** (2), "TEST PORT 1" in step 13 and 19 as "TEST PORT 2" and **Port 1** in step 12 as **Port 2**.

2.2.4 Linearity (POWER Measurement Mode)

[Overview]

This section describes how to verify the linearity of the magnitude characteristic in the POWER measurement mode of this instrument.

[Specifications]

Item	Specification		Condition
Magnitude characteristic linearity (POWER measurement mode)	TEST PORT 1	≤ ±0.15 dB	Relative level 0 to -38 dB
		≤ ±0.45 dB	Relative level -38 to -48 dB
	TEST PORT 2	≤ ±0.15 dB	Relative level 0 to -38 dB
		≤ ±0.45 dB	Relative level -38 to -48 dB

[Required instruments]

Item	Quantity	Recommended model
Variable optical attenuator	1	HA2
FC/APC-FC/APC optical fiber	1	
FC/APC-FC/SPC optical fiber	2	

2.2.4 Linearity (POWER Measurement Mode)

[Connection figure]

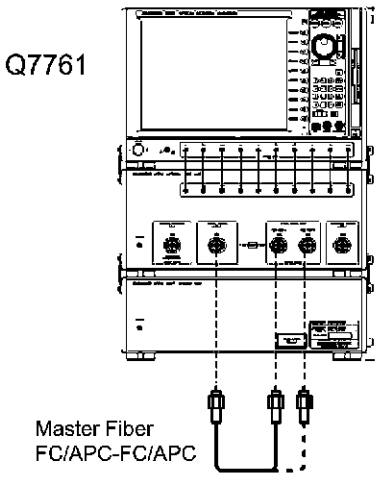


Figure 2-4 Connection-1 for Magnitude Characteristic Linearity (POWER Measurement Mode) Test

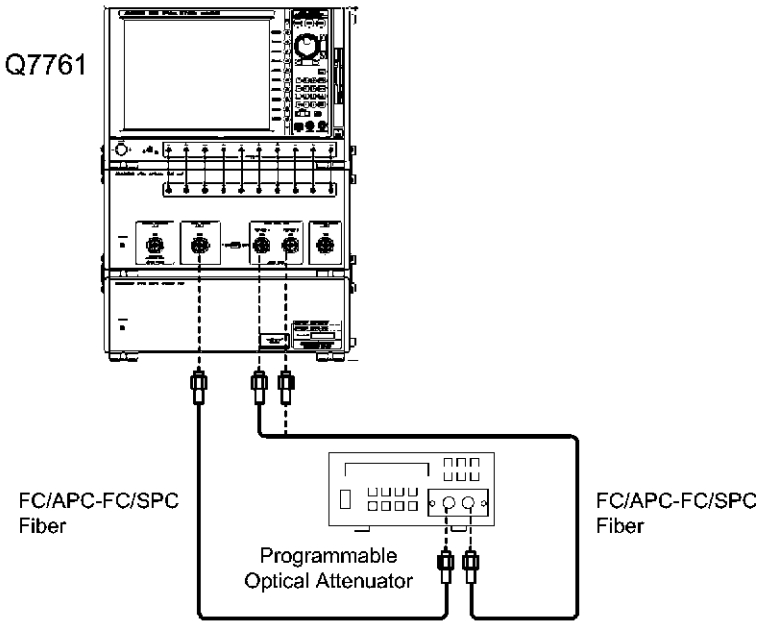


Figure 2-5 Connection-2 for Magnitude Characteristic Linearity (POWER Measurement Mode) Test

[Test procedure]

1. As shown in Figure 2-4, connect the "OPTICAL SIGNAL OUTPUT" of this instrument with "TEST PORT 1", using the FC/APC-FC/APC optical fiber.
2. Preset this instrument.

   Operation: **[Special]→[Preset...], OK**

3. Set the center wavelength to 1550 nm.

   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **5**, **0**, **M/n**

4. Set the span to 0 nm.

   Operation: **{HOME}**, **Center/Span**, **Span**, **0**, **M/n**

5. Set the waveform display port to Port 1.

   Operation: **{HOME}**, **Trace**, **Port 1/2** (1)

6. Set the waveform display mode to the magnitude (logarithm) mode.

   Operation: **{HOME}**, **Trace**, **Trace Mode**, **Mag**

7. Set the measurement mode to the Power mode.

   Operation: **{HOME}**, **Measure**, **Measure Mode**, **POWER**

8. Set the number of measurement points to 11.

   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **1**, **1**, **ENT**

9. Set the sensitivity to "High".

   Operation: **{HOME}**, **Measure**, **Sensitivity**, **High**

10. Carry out measurement with SINGLE.

    Operation: **SINGLE**

11. After the measurement is completed, read the maximum value of the vertical axis displayed on the upper left of the screen and set the value obtained with the following formula as the level offset value of the magnitude. After the setting, use the waveform traced on 0 dB as the reference.

    Formula: Level offset value = Measured maximum value × (-1) [dB]

    Operation: **{HOME}**, **Analysis**, **Mag Level Offset**, Input the level offset value in **dB**, **ENT**

12. As shown in Figure 2-5, connect the "OPTICAL SIGNAL OUTPUT" of this instrument with the INPUT port of the variable optical attenuator, using the FC/APC-FC/SPC optical fiber, and the OUTPUT port of the variable optical attenuator with "TEST PORT 1" of this instrument, using another FC/APC-FC/SPC optical fiber.

13. Preset the variable optical attenuator, and make settings as follows:

    Attenuation: 0 dB

    λ: 1550 nm

14. Carry out measurement with SINGLE.

    Operation: **SINGLE**

15. After the measurement is completed, read the maximum value (≤ 0 dB) of the vertical axis displayed on the upper left of the screen and set the value obtained with the following formula as the variable optical attenuator value.

    Formula: Variable optical attenuator set value = Measured maximum value (≤ 0) +5 [dB]

16. Carry out measurement with SINGLE.

    Operation: [SINGLE]

17. After the measurement is completed, execute Auto Scale and read the average value of the waveform using the cursor, referring to Figure 2-6. Enter the obtained value into the corresponding column on the performance verification sheet as the "deducting 5 dB from the reference value".

    Operation 1: {HOME}, **Scale**, **Reference Position**, [5], [0], [ENT], **Auto Scale Active Trace**

    Operation 2: {HOME}, **Cursor**, **Cursor ON/OFF** (ON), **Y1 ON/OFF** (ON), **Cursor Mode 1/2** (2), Turn the knob

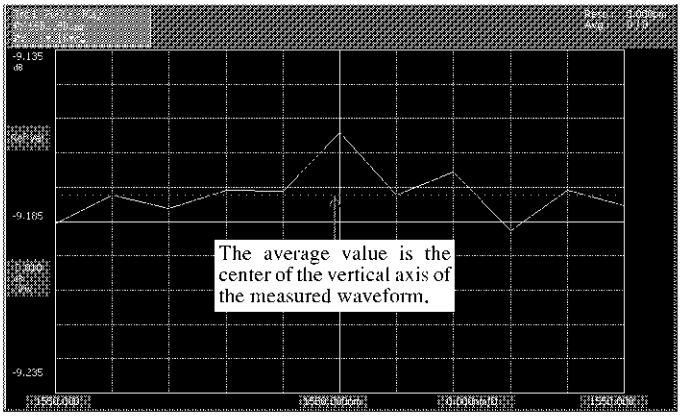


Figure 2-6 Reading Average Value of Magnitude Characteristic Linearity (POWER Measurement Mode)

18. Repeat steps 16 and 17, adding 5 dB to the value of step 15 to obtain the set value for the variable optical attenuator. In this case, the measured value is obtained as the "deducting 10 dB from the reference value". Repeat steps 16 and 17 until the value reaches the "deducting 48 dB from the reference value".

19. Repeat steps 1 to 18, reading "TEST PORT 1" of steps 1 to 18 as "TEST PORT 2", and **Port 1/2** (1) of step 5 as **Port 1/2** (2).

2.2.5 Linearity (Dispersion Measurement Mode)

[Overview]

This section describes how to verify the linearity of the magnitude characteristic in the dispersion measurement mode of this instrument.

[Specifications]

Item	Specification		Condition
Magnitude characteristic linearity (Dispersion measurement mode)	TEST PORT 1	≤ ±0.15 dB	Relative level 0 to -23 dB
		≤ ±0.25 dB	Relative level -23 to -28 dB
	TEST PORT 2	≤ ±0.15 dB	Relative level 0 to -23 dB
		≤ ±0.25 dB	Relative level -23 to -28 dB

[Required instruments]

Item	Quantity	Recommended model
Variable optical attenuator	1	HA2
FC/APC-FC/APC optical fiber	1	
FC/APC-FC/SPC optical fiber	2	

[Connection figure]

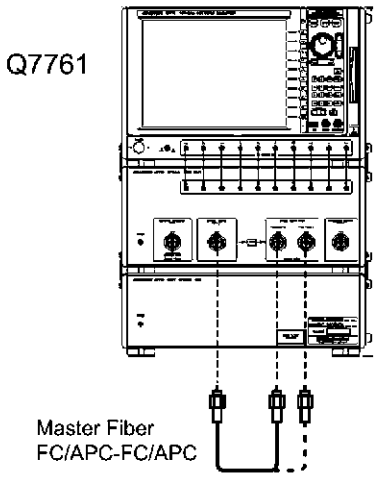


Figure 2-7 Connection-1 for Magnitude Characteristic Linearity (Dispersion Measurement Mode) Test

2.2.5 Linearity (Dispersion Measurement Mode)

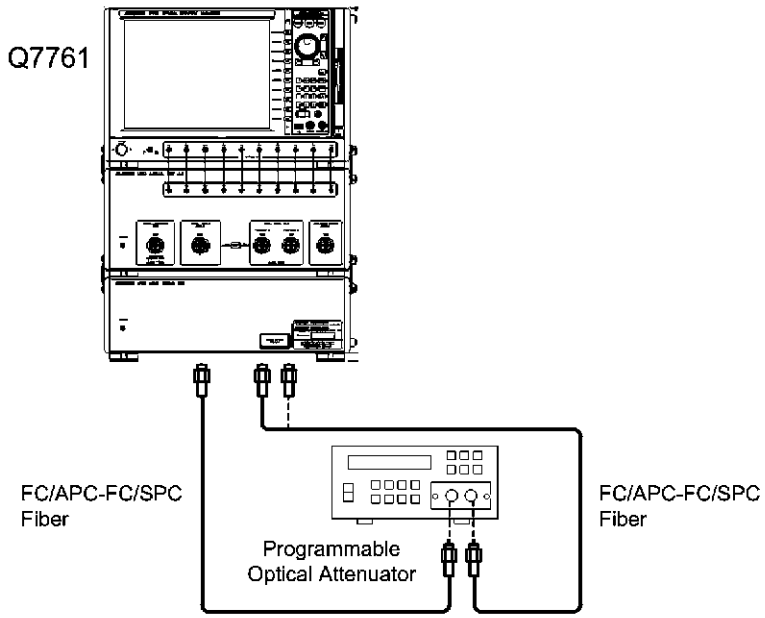


Figure 2-8 Connection-2 for Magnitude Characteristic Linearity (Dispersion Measurement Mode) Test

[Test procedure]

1. As shown in Figure 2-7, connect the "OPTICAL SIGNAL OUTPUT" of this instrument with "TEST PORT 1", using the FC/APC-FC/APC optical fiber.
2. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
3. Set the center wavelength to 1550 nm.
   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **5**, **0**, **M/n**
4. Set the span to 0 nm.
   Operation: **{HOME}**, **Center/Span**, **Span**, **0**, **M/n**
5. Set the waveform display port to Port 1.
   Operation: **{HOME}**, **Trace**, **Port 1/2** (1)
6. Set the waveform display mode to the magnitude (logarithm) mode.
   Operation: **{HOME}**, **Trace**, **Trace Mode**, **Mag**
7. Set the measurement mode to the CD mode.
   Operation: **{HOME}**, **Measure**, **Measure Mode**, **CD**
8. Set the number of measurement points to 11.
   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **1**, **1**, **ENT**

9. Set the modulation frequency to 100 MHz.

   Operation: **{HOME}**, **Measure**, **Modulation Frequency**, **1**, **0**, **0**, **M/n**

10. Set the sensitivity to "High".

    Operation: **{HOME}**, **Measure**, **Sensitivity**, **High**

11. Carry out measurement with SINGLE.

    Operation: **SINGLE**

12. After the measurement is completed, read the maximum value of the vertical axis displayed on the upper left of the screen and set the value obtained with the following formula as the level offset value of the magnitude. After the setting, use the waveform traced on 0 dB as the reference.

    Formula: Level offset value = Measured maximum value × (-1) [dB]

    Operation: **{HOME}**, **[Analysis]**, **Mag Level Offset**, Input the level offset value in **dB**, **ENT**

13. Then, as shown in Figure 2-8, connect the "OPTICAL SIGNAL OUTPUT" of this instrument with the INPUT port of the variable optical attenuator, using the FC/APC-FC/SPC optical fiber, and the OUTPUT port of the variable optical attenuator with "TEST PORT 1" of this instrument, using another FC/APC-FC/SPC optical fiber.

14. Preset the variable optical attenuator, and make settings as follows:

    Attenuation: 0 dB

    λ: 1550 nm

15. Carry out measurement with SINGLE.

    Operation: **SINGLE**

16. After the measurement is completed, read the maximum value (≤ 0 dB) of the vertical axis displayed on the upper left of the screen and set the value obtained with the following formula to the variable optical attenuator.

    Formula: Variable optical attenuator set value = Measured maximum value (≤ 0) +5 [dB]

17. Carry out measurement with SINGLE.

    Operation: **SINGLE**

18. After the measurement is completed, execute Auto Scale and read the average value of the waveform, using the cursor and referring to Figure 2-9. Enter the value into the corresponding column on the performance verification sheet as the measurement value for "deducting 5 dB from the reference value".

    Operation 1: **{HOME}**, **[Scale]**, **Reference Position**, **5**, **0**, **ENT**, **Auto Scale Active Trace**

    Operation 2: **{HOME}**, **[Cursor]**, **Cursor ON/OFF** (ON), **Y1 ON/OFF** (ON), **Cursor Mode 1/2** (2), Turn the knob

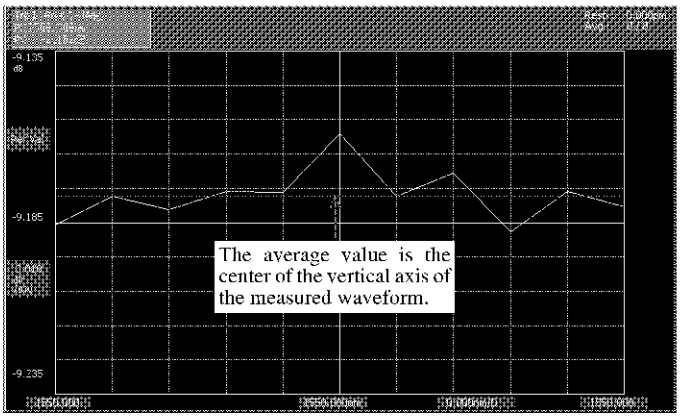


Figure 2-9 Reading Average Value of Magnitude Characteristic Linearity (Dispersion Measurement Mode)

19. Repeat steps 17 and 18, adding 5 dB to the value of step 16 as the set value for the variable optical attenuator. In this case, the measured value is obtained by "deducting 10 dB from the reference value". Repeat steps 17 and 18 until the value reaches the value obtained by "deducting 28 dB from the reference value".

20. Repeat steps 1 to 19, reading "TEST PORT 1" of steps 1 to 19 as "TEST PORT 2", and **Port 1/2** (1) of step 5 as **Port 1/2** (2).

2.2.6 Polarization Dependency (POWER Measurement Mode)

[Overview]

This section describes how to verify the polarization dependency in the POWER measurement mode of this instrument.

[Specifications]

Item	Specification		Condition
Polarization dependency (POWER measurement mode)	TEST PORT 1	≤ 0.1 dB	
	TEST PORT 2	≤ 0.1 dB	

[Required instruments]

Item	Quantity	Recommended model
Polarization controller	1	11896A
FC/APC-FC/SPC optical fiber	2	

[Connection figure]

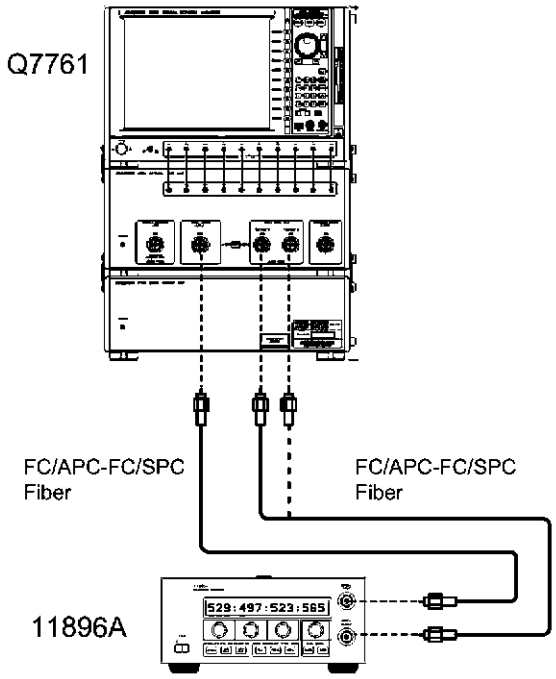


Figure 2-10 Connection for Polarization Dependency (POWER Measurement Mode) Test

[Test procedure]

1. As shown in Figure 2-10, connect the "OPTICAL OUTPUT" of the polarization controller with "TEST PORT 1" of this instrument, using the FC/APC-FC/SPC optical fiber.
2. Set the polarization controller.
   AUTO SCAN mode
   SCAN RATE: Turn the knob on the right end of 11896A to "8".

   MEMO ***Set the polarization controller to output sufficient random polarization during the SINGLE measurement. The SINGLE measurement takes approximately 10 seconds.***

3. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
4. Set the center wavelength to 1550 nm.
   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **5**, **0**, **M/n**
5. Set the span to 0 nm.
   Operation: **{HOME}**, **Center/Span**, **Span**, **0**, **M/n**

6. Set the waveform display port to Port 1.

   Operation: {HOME}, Trace, Port 1/2 (1)

7. Set the waveform display mode to the magnitude (logarithm) mode.

   Operation: {HOME}, Trace, Trace Mode, Mag

8. Set the measurement mode to the Power mode.

   Operation: {HOME}, Measure, Measure Mode, Power

9. Set the number of measurement points to 1001.

   Operation: {HOME}, Measure, Measure Points, Points, 1, 0, 0, 1, ENT

10. Set the sensitivity to "Middle".

    Operation: {HOME}, Measure, Sensitivity, Middle

11. Carry out measurement with SINGLE.

    Operation: SINGLE

12. After the measurement is completed, execute Auto Scale and read the maximum and minimum values of the waveform, using the cursor. Enter the values into the corresponding columns on the performance verification sheet.

    Operation 1: {HOME}, Scale, Reference Position, 5, 0, ENT, Auto Scale Active Trace

    Operation 2: {HOME}, Cursor, Cursor ON/OFF (ON), Cursor Mode 1/2 (2), Y1 ON/OFF (ON), Search for the maximum value of the waveform by turning the knob

    Operation 3: {HOME}, Cursor, Y2 ON/OFF (ON), Search for the minimum value of the waveform by turning the knob

13. Repeat steps 1 to 12, reading "TEST PORT 1" of step 1 as "TEST PORT 2", and Port 1/2 (1) of step 6 as Port 1/2 (2).

2.2.7 Polarization Dependency (Dispersion Measurement Mode)

[Overview]

This section describes how to verify the polarization dependency in the dispersion measurement mode of this instrument.

[Specifications]

Item	Specification		Condition
Polarization dependency (Dispersion measurement mode)	TEST PORT 1	≤ ±0.1 dB	
	TEST PORT 2	≤ ±0.1 dB	

[Required instruments]

Item	Quantity	Recommended model
Polarization controller	1	11896A
FC/APC-FC/SPC optical fiber	2	

[Connection figure]

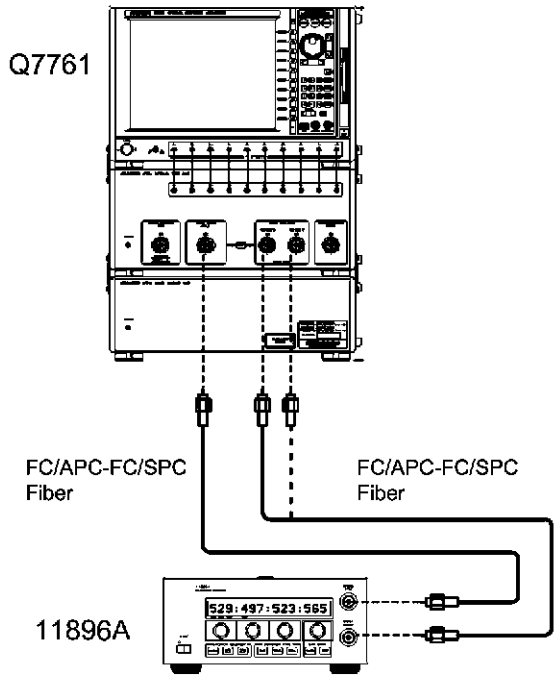


Figure 2-11 Connection for Polarization Dependency (Dispersion Measurement Mode) Test

[Test procedure]

1. As shown in Figure 2-11, connect the "OPTICAL OUTPUT" of the polarization controller with "TEST PORT 1" of this instrument, using the FC/APC-FC/SPC optical fiber.

2. Set the polarization controller.
   AUTO SCAN mode
   SCAN RATE: Turn the knob on the right end of 11896A to "8".
3. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
4. Set the center wavelength to 1550 nm.
   Operation: **{HOME}**, **Center/Span** , **Center** , **1**, **5**, **5**, **0**, **M/n**
5. Set the span to 0 nm.
   Operation: **{HOME}**, **Center/Span** , **Span** , **0**, **M/n**
6. Set the waveform display port to Port 1.
   Operation: **{HOME}**, **Trace** , **Port 1/2** (1)
7. Set the waveform display mode to the magnitude (logarithm) mode.
   Operation: **{HOME}**, **Trace** , **Trace Mode** , **Mag**
8. Set the measurement mode to the CD mode.
   Operation: **{HOME}**, **Measure** , **Measure Mode** , **CD**
9. Set the number of measurement points to 1001.
   Operation: **{HOME}**, **Measure** , **Measure Points** , **Points** , **1**, **0**, **0**, **1**, **ENT**
10. Set the modulation frequency to 1 GHz.
    Operation: **{HOME}**, **Measure** , **Modulation Frequency** , **1**, **G/p**
11. Set the sensitivity to "Middle".
    Operation: **{HOME}**, **Measure** , **Sensitivity** , **Middle**
12. Carry out measurement with SINGLE.
    Operation: **SINGLE**
13. After the measurement is completed, execute Auto Scale and read the maximum and minimum values of the waveform, using the cursor. Enter the values into the corresponding columns on the performance verification sheet.
    Operation 1: **{HOME}**, **Scale** , **Reference Position** , **5**, **0**, **ENT**, **Auto Scale Active Trace**
    Operation 2: **{HOME}**, **Cursor** , **Cursor ON/OFF** (ON), **Cursor Mode 1/2** (2), **Y1 ON/OFF** (ON), Search for the maximum value of the waveform by turning the knob
    Operation 3: **{HOME}**, **Cursor** , **Y2 ON/OFF** (ON), Search for the minimum value of the waveform by turning the knob
14. Repeat steps 1 to 13, reading "TEST PORT 1" of step 1 as "TEST PORT 2", and **Port 1/2** (1) of step 6 as **Port 1/2** (2).

2.2.8 OPTICAL SIGNAL OUTPUT Output Power Measurement

[Overview]

This section describes how to verify the output power of the "OPTICAL SIGNAL OUTPUT" port of this instrument.

[Specifications]

Item	Specification	Condition
Output power (OPTICAL SIGNAL OUTPUT)	≥ -18 dBm	

[Required instruments]

Item	Quantity	Recommended model
Optical power meter	1	Q8221
Optical sensor	1	Q82208
FC/APC-FC/SPC optical fiber	1	

[Connection figure]

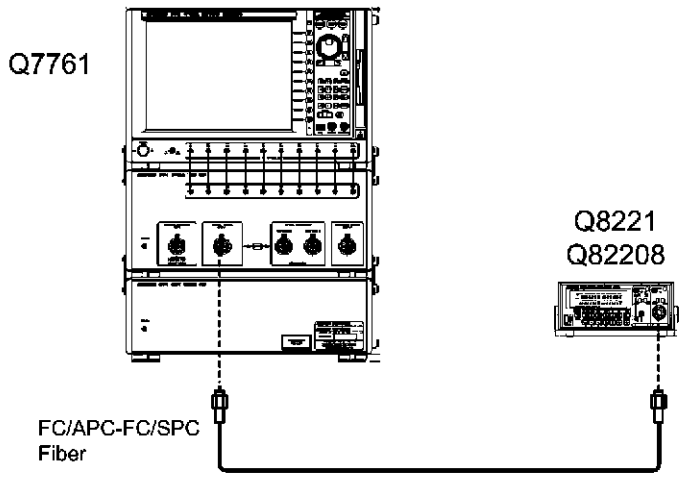


Figure 2-12 Connection for OPTICAL SIGNAL OUTPUT Output Power Measurement

[Test procedure]

1. Initialize the power meter.
2. Connect equipment as shown in Figure 2-12.
3. Set the power meter.
   Enter a measurement wavelength of 1550 nm.
4. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**

5. Set the center wavelength to 1550 nm.
   Operation: {HOME}, **Center/Span**, **Center**, **1**, **5**, **5**, **0**, **M/n**
6. Set the span to 0 nm.
   Operation: {HOME}, **Center/Span**, **Span**, **0**, **M/n**
7. Set the measurement mode to the CD mode.
   Operation: {HOME}, **Measure**, **Measure Mode**, **CD**
8. Set the number of measurement points to 11.
   Operation: {HOME}, **Measure**, **Measure Points**, **Points**, **1**, **1**, **ENT**
9. Set the modulation frequency to 1 GHz.
   Operation: {HOME}, **Measure**, **Modulation Frequency**, **1**, **G/p**
10. Set the sensitivity to "Middle".
    Operation: {HOME}, **Measure**, **Sensitivity**, **Middle**
11. Carry out measurement with SINGLE.
    Operation: **SINGLE**
12. After the measurement is completed, enter the measured value of the optical power meter into the corresponding column on the performance verification sheet.

2.2.9 WAVELENGTH MONITOR OUTPUT Output Power Measurement

[Overview]

This section describes how to verify the output power of the "WAVELENGTH MONITOR OUTPUT" of this instrument.

[Specifications]

Item	Specification	Condition
Output power (WAVELENGTH MONITOR OUTPUT)	≥ -25 dBm	

[Required instruments]

Item	Quantity	Recommended model
Optical power meter	1	Q8221
Optical sensor	1	Q82208
FC/APC-FC/SPC optical fiber	1	

[Connection figure]

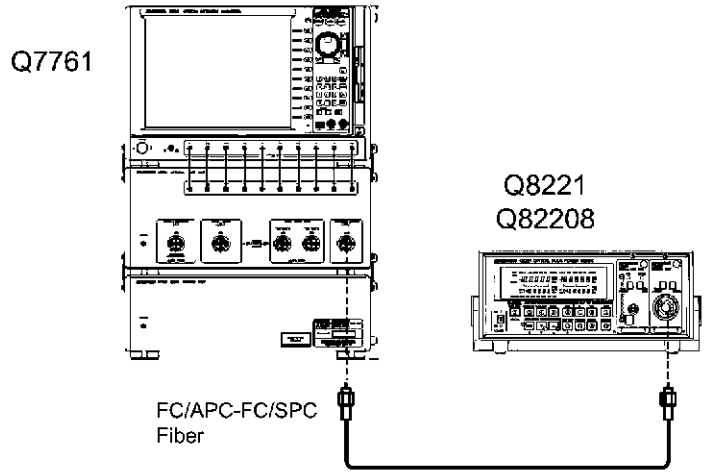


Figure 2-13 Connection for WAVELENGTH MONITOR OUTPUT Output Power Measurement

[Test procedure]

1. Initialize the power meter.
2. Connect equipment as shown in Figure 2-13.
3. Set the power meter.
   Enter the measured wavelength (center wavelength of step 5).
4. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
5. Set the center wavelength to 1550 nm.
   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **5**, **0**, **M/n**
6. Set the span to 0 nm.
   Operation: **{HOME}**, **Center/Span**, **Span**, **0**, **M/n**
7. Set the measurement mode to the CD mode.
   Operation: **{HOME}**, **Measure**, **Measure Mode**, **CD**
8. Set the number of measurement points to 11.
   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **1**, **1**, **ENT**
9. Set the modulation frequency to 1 GHz.
   Operation: **{HOME}**, **Measure**, **Modulation Frequency**, **1**, **G/p**
10. Set the sensitivity to "Middle".
    Operation: **{HOME}**, **Measure**, **Sensitivity**, **Middle**

11. Carry out measurement with SINGLE.

    Operation: SINGLE

12. After the measurement is completed, enter the measured value of the optical power meter into the corresponding column on the performance verification sheet.

2.2.10 Internal Light Source Output Verification

[Overview]

This section describes how to verify the output power of the built-in internal light source of this instrument.

[Specifications]

Optical power of -21 dBm or more must be output at 1540 nm ±2 nm.

[Required instruments]

Item	Quantity	Recommended model
Optical spectrum analyzer	1	Q8384
FC/APC-FC/SPC optical fiber	1	

[Connection figure]

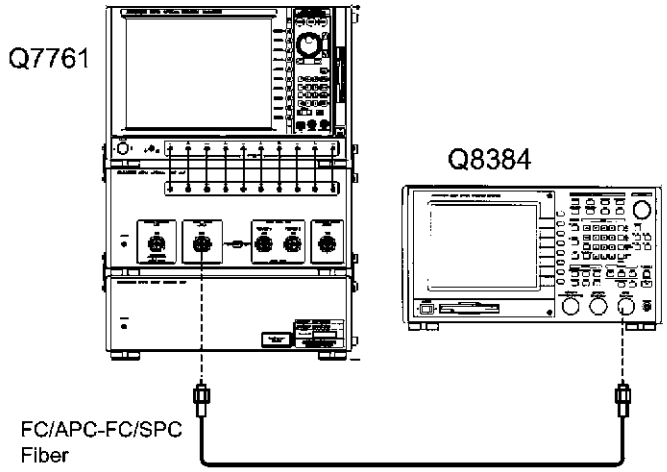


Figure 2-14 Connection for Internal Light Source Output Verification

[Test procedure]

1. Initialize the optical spectrum analyzer.
2. Set the optical spectrum analyzer.

Center:	1540 nm
Span:	20 nm
Wavelength resolution:	100 pm
Scale:	5 dB/div
Reference level:	0 dB

3. Connect equipment as shown in Figure 2-14.
4. Preset this instrument.

   Operation: **[Special]→[Preset...]**, **OK**
5. Set the center wavelength to 1575 nm.

   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **7**, **5**, **M/n**
6. Set the span to 0 nm.

   Operation: **{HOME}**, **Center/Span**, **Span**, **0**, **M/n**
7. Set the measurement mode to the CD mode.

   Operation: **{HOME}**, **Measure**, **Measure Mode**, **CD**
8. Set the number of measurement points to 11.

   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **1**, **1**, **ENT**
9. Set the modulation frequency to 1 GHz.

   Operation: **{HOME}**, **Measure**, **Modulation Frequency**, **1**, **G/p**
10. Set the sensitivity to "Middle".

    Operation: **{HOME}**, **Measure**, **Sensitivity**, **Middle**
11. Set the drift compensation function to ON.

    Operation: **{HOME}**, **Measure**, **Differential Measure**, **Differential Measure ON/OFF** (ON)
12. Carry out measurement with SINGLE.

    Operation: **SINGLE**
13. After the measurement is completed, execute a peak search with the optical spectrum analyzer.
14. Enter the measured values of the peak wavelength and optical power measured with the spectrum analyzer into the corresponding columns on the performance verification sheet.

2.2.11 Relative Group Delay Time (RGD) Accuracy

[Overview]

This section describes how to verify the relative group delay time (RGD) accuracy.

[Specifications]

Relative group delay time (RGD) accuracy:

≤ ±0.015%/fm (≤ ±0.06 ps, relative level 0 to -8 dB, 2.5 GHz)
≤ ±0.048%/fm (≤ ±0.192 ps, relative level -8 to -13 dB, 2.5 GHz)
≤ ±0.15%/fm (≤ ±0.6 ps, relative level -13 to -18 dB, 2.5 GHz)
≤ ±0.48%/fm (≤ ±1.92 ps, relative level -18 to -23 dB, 2.5 GHz)
≤ ±1.5%/fm (≤ ±6 ps, relative level -23 to -28 dB, 2.5 GHz)

[Required instruments]

Item	Quantity	Recommended model
PMD emulator	1	PE3 JDS Uniphase
Polarization controller	1	11896A Agilent
Variable optical attenuator	1	HA2 JDS Uniphase
Optical power meter	1	Q8221, Q82208 Advantest
FC/APC-FC/APC optical fiber	2	
FC/APC-FC/SPC optical fiber	2	

[Connection figure]

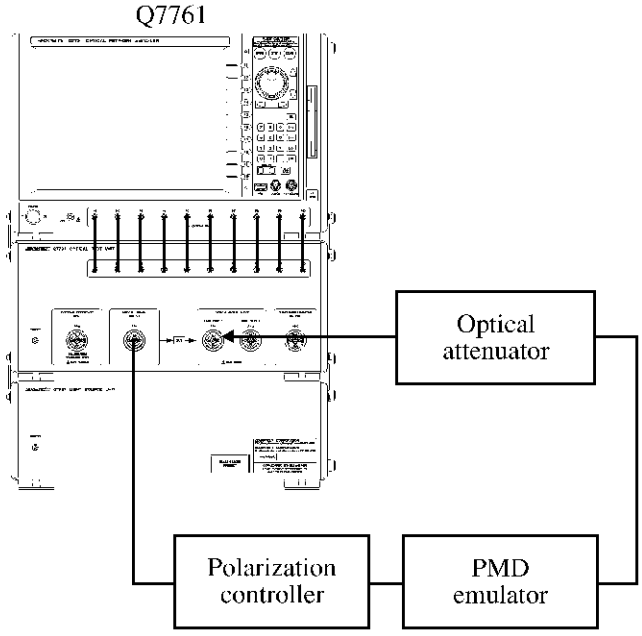


Figure 2-15 Connection for Relative Group Delay Time Accuracy Test

[Test procedure]

1. Connect equipment as shown in Figure 2-15.
2. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
3. Set the center wavelength to 1550 nm.
   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **5**, **0**, **M/n**
4. Set the span to 1 nm.
   Operation: **{HOME}**, **Center/Span**, **Span**, **1**, **M/n**
5. Set the number of measurement points to 101.
   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **1**, **0**, **1**, **ENT**
6. Set the measurement sensitivity to HIGH.
   Operation: **{HOME}**, **Measure**, **Sensitivity**, **High**
7. Set the measurement mode to the CD mode.
   Operation: **{HOME}**, **Measure**, **Measure Mode**, **CD**
8. Set the modulation frequency to 2.5 GHz.
   Operation: **{HOME}**, **Measure**, **Modulation Frequency**, **2**, **.**, **5**, **G/p**
9. Set the waveform display port to Port 1.
   Operation: **{HOME}**, **Trace**, **Port 1/2** (1)
10. Set the waveform display mode to the Mag display mode.
    Operation: **{HOME}**, **Trace**, **Trace Mode**, **Mag**
11. Press the PMD emulator "∞" button (the lamp turns on).
12. The output light power of the PMD emulator is measured by the optical power meter. Adjust the polarization controller so that the value of the optical power meter is at least -30 dB less than the value before the PMD emulator "∞" button was pressed.

    MEMO ***The optical path of the PMD emulator delay line side is intercepted by pressing the ∞ button. Adjust the polarization controller to maximize the optical input of the PMD emulator delay line side.***

    ---

13. Press the PMD emulator "∞" button (the lamp turns off).
14. Carry out measurement with SINGLE.
    Operation: **SINGLE**
15. Set the optical attenuator so that the measured Mag value (relative level) is equal to -8 dB.

16. Set the waveform display mode to the GD mode.

    Operation: {HOME}, **Trace**, **Trace Mode**, **GD**

17. Carry out measurement with SINGLE.

    Operation: **SINGLE**

18. Save the group delay measurement data in the reference memory.

    Operation: {HOME}, **Trace**, **Save to Reference**

19. Set the reference trace 1 to ON.

    Operation: {HOME}, **Trace**, **Trace ON/OFF**, **Reference Trace1 ON/OFF** (ON)

20. Set the defined PMD value to the PMD emulator.

21. Carry out measurement with SINGLE.

    Operation: **SINGLE**

22. Compare the measured Group Delay waveform with the reference trace waveform, and read the relative group delay time (the vertical axis difference between 2 measured value). Enter the values into the corresponding column on the performance verification sheet.

23. Repeat steps 17 to 22, adding 5 dB to the value in step 15 to obtain the set value for the optical attenuator. In this case, the measured value is obtained by "-13 dB of relative level". Repeat this procedure until the relative level reaches -28 dB.

24. Disconnect the fiber, which is connected to "TEST PORT 1" as shown in the connection figure, and connect it to "TEST PORT 2". Repeat steps 2 to 23, reading **Port 1/2** (1) in step 9 as **Port 1/2** (2).

2.2.12 Wavelength Dispersion Measurement Accuracy

[Overview]

This section describes how to verify the wavelength dispersion measurement accuracy.

|Specifications|

Wavelength dispersion: ≤ Relative group delay time accuracy/Wavelength resolution ±(1.5 pm/wavelength resolution)% of CD

|Required instruments|

Item	Quantity	Recommended model
Standard dispersion fiber	1	OFCR-100 Okinawa Photonics
FC/APC-FC/SPC optical fiber	2	

[Connection figure]

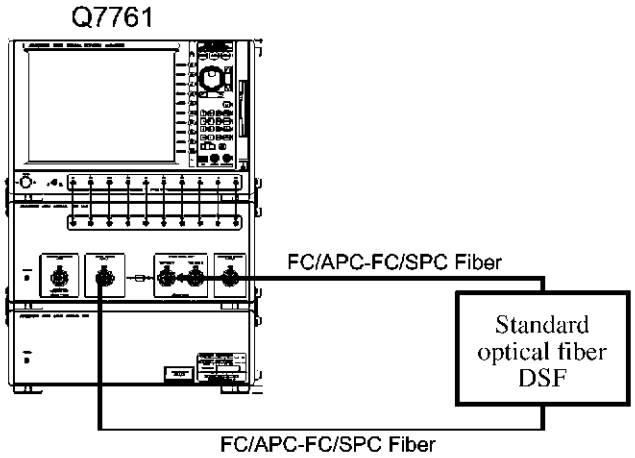


Figure 2-16 Connection for Wavelength Dispersion Measurement Accuracy Test

[Test procedure]

1. Connect equipment as shown in Figure 2-16.
2. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
3. Set the center wavelength to 1575 nm.
   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **7**, **5** (zero dispersion wavelength of the standard dispersion fiber), **M/n**
4. Set the wavelength span to 100 nm.
   Operation: **{HOME}**, **Center/Span**, **Span**, **1**, **0**, **0**, **M/n**

5. Set the number of measurement points to 101.

   Operation: {HOME}, **Measure**, **Measure Points**, **Points**, [1], [0], [1], [ENT]

6. Set the sensitivity to "HIGH".

   Operation: {HOME}, **Measure**, **Sensitivity**, **High**

7. Set the measurement mode to the CD.

   Operation: {HOME}, **Measure**, **Measure Mode**, **CD**

8. Set the modulation frequency to 2.5 GHz.

   Operation: {HOME}, **Measure**, **Modulation Frequency**, [2], [.], [5], [G/p]

9. Set the drift compensation function to ON.

   Operation: {HOME}, **Measure**, **Differential Measure**, **Differential Measure ON/OFF** (ON)

10. Set the waveform display port to Port 1.

    Operation: {HOME}, **Trace**, **Port 1/2 (1)**

11. Set the waveform display mode to CD.

    Operation: {HOME}, **Trace**, **Trace Mode**, **CD**

12. Carry out measurement with SINGLE.

    Operation: [SINGLE]

13. Set the fitting type to quadratic polynomial (Quadratic) and set the fitting function to ON.

    Operation: {HOME}, **Analysis**, **Fitting**, **Fitting Mode**, **Quadratic**, **Return**, **Fitting ON/OFF** (ON)

14. Read the dispersion value and enter it into the corresponding column on the performance verification sheet.

15. Disconnect the fiber connected to "TEST PORT 1" in the connection figure and connect the fiber to "TEST PORT 2". Repeat steps 1 to 14, reading "Port 1" of step 10 as "Port 2", and **Port 1/2 (1)** of the operation as **Port 1/2 (2)**.

2.2.13 Polarization Mode Dispersion Measurement Accuracy

[Overview]

This section describes how to verify the polarization mode dispersion measurement accuracy.

|Specifications|

Wavelength dispersion: ≤ ±0.1 ps ±3% of PMD

[Required instruments]

Item	Quantity	Recommended model
PMD standard	1	OFCR-100-0.5 Okinawa Photonics
FC/APC-FC/APC master fiber	1	A180001
FC/APC-FC/SPC optical fiber	2	

[Connection figure]

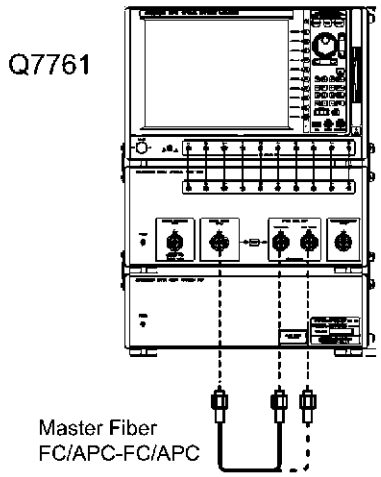


Figure 2-17 Connection-1 for Polarization Mode Dispersion Measurement Accuracy Test

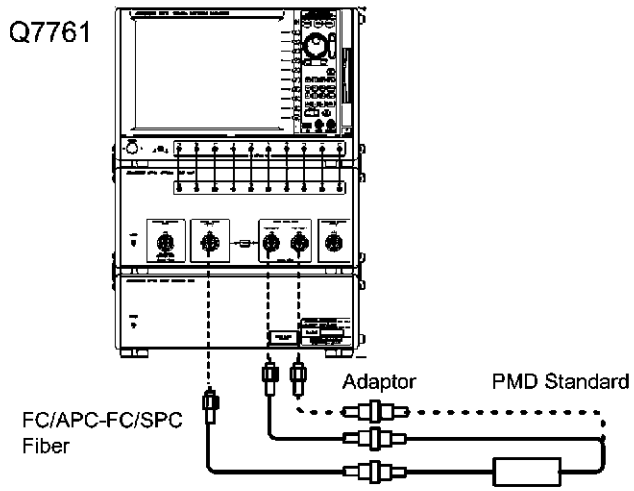


Figure 2-18 Connection-2 for Polarization Mode Dispersion Measurement Accuracy Test

[Test procedure]

1. Connect equipment as shown in Figure 2-17.
2. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
3. Set the center wavelength to 1550 nm.
   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **5**, **0**, **M/n**
4. Set the number of measurement points to 501.
   Operation: **{HOME}**, **Measure**, **Measure Points**, **Points**, **5**, **0**, **1**, **ENT**
5. Set the wavelength span to 50 nm.
   Operation: **{HOME}**, **Center/Span**, **Span**, **5**, **0**, **M/n**
6. Set the sensitivity to "MIDDLE".
   Operation: **{HOME}**, **Measure**, **Sensitivity**, **Middle**
7. Set the measurement mode to the PMD mode.
   Operation: **{HOME}**, **Measure**, **Measure Mode**, **PMD**
8. Set the modulation frequency to 2.5 GHz.
   Operation: **{HOME}**, **Measure**, **Modulation Frequency**, **2**, **.**, **5**, **G/p**
9. Set the waveform display port to Port 1.
   Operation: **{HOME}**, **Trace**, **Port 1/2** (1)

10. Set the waveform display mode to the PMD mode.

    Operation: **{HOME}**, **Trace** , **Trace Mode** , **PMD**

11. Carry out PMD normalization of Port 1.

    Operation: **{HOME}**, **Calibration** , **PMD Normalize Port1**

12. After PMD normalization is completed, connect the PMD standard as shown in Figure 2-18 and make this instrument carry out measurement with SINGLE.

    Operation: **SINGLE**

13. Display the average value of the measurement data.

    Operation: **{HOME}**, **Analysis** , **More 1/2** , **Statistics Analysis**

14. Write the values displayed in "AVERAGE" in the appropriate fields on the performance verification sheet.

15. Disconnect the fiber connected to "TEST PORT 1" in the connection figure and connect the fiber to "TEST PORT 2". Repeat steps 1 to 13, reading "Port 1" of step 9 as "Port 2", and **Port 1/2** (1) of the operation as **Port 1/2** (2), and "Port 1" of step 11 as "Port 2".

2.2.14 Fiber Length Measurement Repeatability

[Overview]

This section describes how to verify the fiber length measurement repeatability.

[Specifications]

Fiber length measurement repeatability: ≤ 0.02 m

[Required instruments]

Item	Quantity	Recommended model
Standard dispersion fiber	1	OFCR-100 Okinawa Photonics
FC/APC-FC/SPC optical fiber	2	

[Connection figure]

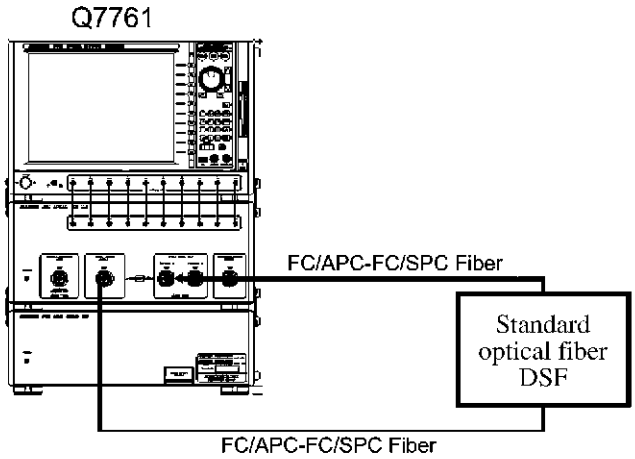


Figure 2-19 Connection for Fiber Length Measurement Repeatability Test

[Test procedure]

1. Connect equipment as shown in Figure 2-19.
2. Preset this instrument.
   Operation: **[Special]→[Preset...]**, **OK**
3. Set the center wavelength to 1565 nm.
   Operation: **{HOME}**, **Center/Span**, **Center**, **1**, **5**, **6**, **5**, **M/n**
4. Set the sensitivity to "MIDDLE".
   Operation: **{HOME}**, **Measure**, **Sensitivity**, **Middle**
5. Set the drift compensation function to OFF.
   Operation: **{HOME}**, **Measure**, **Differential Measure**, **Differential Measure ON/OFF** (OFF)

6. Set the waveform display port to Port 1.

   Operation: **{HOME}**, **Trace** , **Port 1/2** (1)

7. Carry out fiber measurement.

   Operation: **{HOME}**, **Advance** , **Fiber Length Meas Execute**

8. Repeat fiber measurement three times and enter the measured values into the corresponding columns on the performance verification sheet to check the measured fiber length repeatability.

2.3 Performance Verification Record Sheets

2.3.1 Absolute Wavelength Accuracy

Item	Set value	Specification	Measurement value	Pass/Fail
Absolute wavelength accuracy	1525 nm	≤ ±15 pm		
Absolute wavelength accuracy	1535 nm	≤ ±15 pm		
Absolute wavelength accuracy	1545 nm	≤ ±15 pm		
Absolute wavelength accuracy	1555 nm	≤ ±15 pm		
Absolute wavelength accuracy	1565 nm	≤ ±15 pm		
Absolute wavelength accuracy	1575 nm	≤ ±15 pm		
Absolute wavelength accuracy	1585 nm	≤ ±15 pm		
Absolute wavelength accuracy	1595 nm	≤ ±15 pm		
Absolute wavelength accuracy	1605 nm	≤ ±15 pm		
Absolute wavelength accuracy	1615 nm	≤ ±15 pm		
Absolute wavelength accuracy	1625 nm	≤ ±15 pm		

2.3.2 Dynamic Range (POWER Measurement Mode)

Item	Set value	Specification		Measurement value	Pass/Fail
Dynamic range (POWER measurement mode)		TEST PORT 1	≥ 58 dB		
		TEST PORT 2	≥ 58 dB		

2.3.3 Dynamic Range (Dispersion Measurement Mode)

Item	Set value	Specification		Measurement value	Pass/Fail
Dynamic range (Dispersion measurement mode)	Sensitivity:High, fm:100 MHz	TEST PORT 1	≥ 43 dB		
	Sensitivity:High, fm:500 MHz				
	Sensitivity:High, fm:1 GHz				
	Sensitivity:High, fm:1.5 GHz				
	Sensitivity:High, fm:2 GHz				
	Sensitivity:High, fm:2.5 GHz				
	Sensitivity:High, fm:100 MHz	TEST PORT 2	≥ 43 dB		
	Sensitivity:High, fm:500 MHz				
	Sensitivity:High, fm:1 GHz				
	Sensitivity:High, fm:1.5 GHz				
	Sensitivity:High, fm:2 GHz				
	Sensitivity:High, fm:2.5 GHz				

2.3.4 Linearity (POWER Measurement Mode)

Item	Set value	Specification		Measurement value	Pass/Fail
Linearity (POWER measurement mode)	Relative level -5 dB	TEST PORT 1	≤ ±0.15 dB		
	-10 dB				
	-15 dB				
	-20 dB				
	-25 dB				
	-30 dB				
	-35 dB				
	-38 dB				
	-43 dB		≤ ±0.45 dB		
	-48 dB				
	Relative level -5 dB	TEST PORT 2	≤ ±0.15 dB		
	-10 dB				
	-15 dB				
	-20 dB				
	-25 dB				
	-30 dB				
	-35 dB				
	-38 dB				
	-43 dB		≤ ±0.45 dB		
	-48 dB				

2.3.5 Linearity (Dispersion Measurement Mode)

Item	Set value	Specification		Measurement value	Pass/Fail
Linearity (POWER measurement mode)	Relative level -5 dB	TEST PORT 1	≤ ±0.15 dB		
	-10 dB				
	-15 dB				
	-20 dB				
	-23 dB				
	-28 dB		≤ ±0.25 dB		
	Relative level -5 dB	TEST PORT 2	≤ ±0.15 dB		
	-10 dB				
	-15 dB				
	-20 dB				
	-23 dB				
	-28 dB		≤ ±0.25 dB		

2.3.6 Polarization Dependency (POWER Measurement Mode)

Item	Set value	Specification		Measurement value	Pass/Fail
Polarization dependency (POWER measurement mode)		TEST PORT 1	≤ ±0.1 dB		
		TEST PORT 2	≤ ±0.1 dB		

2.3.7 Polarization Dependency (Dispersion Measurement Mode)

Item	Set value	Specification		Measurement value	Pass/Fail
Polarization dependency (Dispersion measurement mode)		TEST PORT 1	≤ ±0.1 dB		
		TEST PORT 2	≤ ±0.1 dB		

2.3.8 OPTICAL SIGNAL OUTPUT Output Power Measurement

Item	Set value	Specification	Measurement value	Pass/Fail
OPTICAL SIGNAL OUTPUT output power	1550 nm	≥ -18 dBm		

2.3.9 WAVELENGTH MONITOR OUTPUT Output Power Measurement

Item	Set value	Specification	Measurement value	Pass/Fail
WAVELENGTH MONITOR OUTPUT output power	1550 nm	≥ -25 dBm		

2.3.10 Internal Light Source Output Verification

Item	Set value	Specification	Measurement value	Pass/Fail
Wavelength		1540 nm ±2 nm		
Optical output power		≥ -21 dBm		

2.3.11 Relative Group Delay Time (RGD) Accuracy

Item	Set value	Specification		Measurement value	Pass/Fail
Relative group delay time (RGD) accuracy	Relative level -8 dB, 0.6 ps	TEST PORT 1	0.6 ps ±0.06 ps		
	Relative level -13 dB, 2 ps		2 ps ±0.192 ps		
	Relative level -18 dB, 6 ps		6 ps ±0.6 ps		
	Relative level -23 dB, 20 ps		20 ps ±1.92 ps		
	Relative level -28 dB, 60 ps		60 ps ±6 ps		
	Relative level -8 dB, 0.6 ps	TEST PORT 2	0.6 ps ±0.06 ps		
	Relative level -13 dB, 2 ps		2 ps ±0.192 ps		
	Relative level -18 dB, 6 ps		6 ps ±0.6 ps		
	Relative level -23 dB, 20 ps		20 ps ±1.92 ps		
	Relative level -28 dB, 60 ps		60 ps ±6 ps		

2.3.12 Wavelength Dispersion Measurement Accuracy

Item	Set value	Specification		Measurement value	Pass/Fail
Wavelength dispersion measurement accuracy	Wavelength resolution 100 pm	TEST PORT 1	≤ RGD accuracy/ 0.1 nm ±1.5% of CD		
	Wavelength resolution 100 pm	TEST PORT 2	≤ RGD accuracy/ 0.1 nm ±1.5% of CD		

2.3.13 Polarization Mode Dispersion Measurement Accuracy

Item	Set value	Specification		Measurement value	Pass/Fail
Polarization mode dispersion measurement accuracy	Wavelength resolution 100 pm	TEST PORT 1	≤ ±0.1 ps ±3% of PMD		
	Wavelength resolution 100 pm	TEST PORT 2	≤ ±0.1 ps ±3% of PMD		

2.3.14 Fiber Length Measurement Repeatability

Item	Set value	Specification	Measurement value	Pass/Fail
The first fiber length measurement		Repeatability ≤ 0.02 m		
The second fiber length measurement				
The third fiber length measurement				

3. SPECIFICATIONS

This chapter describes the specifications of this instrument.

The performance of this instrument is guaranteed when used under the following conditions unless noted specially.

- The instrument is calibrated at regular calibration periods.
- The instrument has been warmed up for 2 hours or more after power is turned on under the specified environmental conditions.
- Autocalibration has been performed.

The reference data is provided not to show you the guaranteed performance but to help you use this instrument efficiently. The data contains the following notations:

Specifications (spec.): Indicate the performance guaranteed by the product. The specifications are determined in consideration of possible irregularities of quality among individual products, uncertainty at the time of calibration, and performance changes due to environmental factors.

Typical value (typ.): Indicates the average performance of the product. Possible irregularities of quality among individual products, uncertainty at the time of calibration, and performance changes due to environmental factors are not considered.

Nominal value (nom.): Indicates the general performance data of the product. Performance levels of the product are not meant.

3.1 Q7761 Performance Specifications

Performances *1

Item	Specifications
Measurement functions	Magnitude characteristics: IL
	Group delay time characteristics: GD
	Chromatic dispersion characteristics: CD
	Chromatic dispersion slope characteristics: CDS
	Polarization mode dispersion characteristics: PMD
	2nd order PMD characteristics
	Polarization dependency loss characteristics: PDL
	Fiber length
Measurement ports	Two optical input ports The two ports can perform synchronous measurement of all characteristics.

<table>
<tr><th colspan="3">Item</th><th>Specifications</th></tr>
<tr><td rowspan="6">Dispersion characteristics</td><td colspan="2">Measurable wavelength range</td><td>1525 nm to 1625 nm</td></tr>
<tr><td colspan="2">Relative accuracy of the wavelength measurement *2</td><td>±1.5 pm</td></tr>
<tr><td colspan="2">Absolute accuracy of the wavelength measurement *3</td><td>±15 pm (When an external wavelength meter is not used)
±1.5 pm (When Q8331 is used as an external wavelength meter at the same time)</td></tr>
<tr><td colspan="2">Wavelength set resolution</td><td>1 pm</td></tr>
<tr><td colspan="2">Wavelength sweep range</td><td>Enable to set arbitrarily from 100 pm to 100 nm.</td></tr>
<tr><td colspan="2">Maximum wavelength sweep speed</td><td>20 nm/s</td></tr>
<tr><td rowspan="6">Magnitude characteristics</td><td rowspan="2">Dynamic range *4 *5</td><td>Power Mode</td><td>58 dB or more</td></tr>
<tr><td>CD Mode</td><td>43 dB or more</td></tr>
<tr><td rowspan="2">Linearity *5 *6</td><td>Power Mode</td><td>±0.15 dB (Relative level: 0 dB to -38 dB)
±0.45 dB (Relative level: -38 dB to -48 dB)</td></tr>
<tr><td>CD Mode</td><td>±0.15 dB (Relative level: 0 dB to -23 dB)
±0.25 dB (Relative level: -23 dB to -28 dB)</td></tr>
<tr><td colspan="2">Polarization dependency</td><td>±0.10 dB</td></tr>
<tr><td colspan="2">Repeatability of connection/disconnection *7</td><td>±0.10 dB</td></tr>
<tr><td colspan="2">Optical power at optical output port *8</td><td>-18 dBm or more</td></tr>
<tr><td colspan="2">Optical power of optical monitor for optical wavelength meter *8</td><td>-25 dBm or more</td></tr>
<tr><td rowspan="4">Group delay time characteristics</td><td colspan="2">Maximum measurement time *9</td><td>100 µs</td></tr>
<tr><td colspan="2">Group delay time resolution</td><td>1 fs</td></tr>
<tr><td colspan="2">Relative group delay (RGD) measurement accuracy *6 *10</td><td><table><tr><th>Relative level</th><th>Accuracy (s)</th><th>At 2.5 GHz</th></tr><tr><td>0 dB to -8 dB</td><td>±0.015%/fm</td><td>±0.06 ps</td></tr><tr><td>-8 dB to -13 dB</td><td>±0.048%/fm</td><td>±0.192 ps</td></tr><tr><td>-13 dB to -18 dB</td><td>±0.15%/fm</td><td>±0.6 ps</td></tr><tr><td>-18 dB to -23 dB</td><td>±0.48%/fm</td><td>±1.92 ps</td></tr><tr><td>-23 dB to -28 dB</td><td>±1.5%/fm</td><td>±6 ps</td></tr></table></td></tr>
<tr><td colspan="2">Modulation frequency setting range</td><td>10 MHz to 2.5 GHz</td></tr>
</table>

Item		Specifications
Chromatic dispersion (CD) characteristics	Maximum measurement range *9	10 µs/nm
	Measurement resolution	1 fs/nm
	Measurement accuracy *6 *10	±RGD accuracy/wavelength resolution ±(relative wavelength accuracy/wavelength resolution) % of CD
Polarization mode dispersion (PMD) characteristics	Maximum measurement range	100 ps
	Measurement resolution	1 fs
	Measurement accuracy *11	±0.10 ps ±3% of PMD
2nd order PMD characteristics	Maximum measurement range	1000 ps^2
	Measurement resolution	0.01 ps^2
Polarization dependency loss (PDL) characteristics	Maximum measurement range	3 dB
	Measurement resolution	0.001 dB
Fiber length measurement	Measurement range	0.2 m to 10,000 km
	Measurement resolution	0.01 m
	Input range of refractive index	1.0000 to 3.0000
	Repeatability of measurement *12	0.02 m
Fiber wavelength dispersion measurement *13	Repeatability of zero-dispersion wavelength measurement	0.015 nm
	Repeatability of dispersion slope measurement (at the zero-dispersion wavelength)	0.025 ps/nm^2, 0.002 $ps/nm^2/km$
	Waveform approximation function	Linear approximation, quadratic polynomial, 3-term Sellmeier expression, 5-term Sellmeier expression Drift compensation measurement function
Drift compensation measurement function *14	Real-time drift compensation function	
Polarization control function	Polarization extinction ratio	30 dB or more
	Angular setting resolution	0.1°
	Output function of linear polarization at the optical connector end of the outgoing port	When separately sold polarization reference accessory is used at the same time

Item		Specifications
Data processing function	Memory function	Data recording and reading
	Display function	Optical frequency display, superimpose display
	Operation/Analysis function	Averaging function, normalizing, smoothing, limit line function, parts fitting function, report output function, and ripple extraction
Optical input/output port and standard optical connector type *15	Optical output port	1 port: FC/Angled PC
	Optical input port	2 port: FC/Angled PC
	Optical monitor output for optical wavelength meter	1 port: FC/Super PC
	External reference optical input	1 port: FC/Angled PC
Input/Output interfaces	GP-IB	Compliant with IEEE-488.2, rear panel
	Floppy drive	2 modes compatibility (DD720 kB and HD1.4 MB)
	Printer port	Compliant with IEEE-1284-1994, rear panel
	Keyboard	PS/2 101/106 keyboard, front panel
	Display	12.1-inch SVGA TFT color liquid crystal touch panel display
	Mouse	PS/2 mouse, front panel
	LAN	10Base-T, protocol: TCP/IP, rear panel
	USB	Front panel
General specifications	Operating environment	Temperature range: 15°C to 35°C Relative humidity: 80% or less (no condensation)
	Storage environment	Temperature range: -20°C to +60°C Relative humidity: 80% or less (no condensation)
	Power source	Analysis unit: AC100 V-120 V, AC220 V-240 V, 50/60 Hz, 500 VA or less OPT unit: AC100 V-120 V, AC220 V-240 V, 50/60 Hz, 100 VA or less Light source unit: AC100 V-120 V, AC220 V-240 V, 50/60 Hz, 300 VA or less
	External dimensions	Analysis unit: Approx. 424 (W) × 266 (H) × 530 mm (D) OPT unit: Approx. 424 (W) × 177 (H) × 530 mm (D) Light source unit: Approx. 424 (W) × 132 (H) × 530 mm (D)
	Mass	Analysis unit: 33 kg or less OPT unit: 19 kg or less Light source unit: 26 kg or less

*1: At a constant temperature after the 2-hour warm-up
*2: 10 pm of the wavelength resolution at Sensitivity=Middle
*3: The external wavelength meter can be used only in the step measurement. No zero span measurement is included.

*4: The difference between the amplitude level and noise level (average value) in the through measurement. Sensitivity is set to High
*5: The POWER mode is used to measure the amplitude.
The DC mode is used to measure CD, GD, and the amplitude characteristics at the same time.
The values in the CD mode are specified at a fm of ≥100 MHz.
*6: The relative level is measured by using the amplitude level in the through measurement as the reference.
No group delay time fluctuation in the measured object is observed over time.
Sensitivity is set to High and the fm is ≥100 MHz.
*7: The FC/APC-FC/APC master optical fiber is connected and disconnected 10 times.
*8: Wavelength is 1550 nm, at the average power
*9: The modulation frequency is 10 MHz and the number of measurement points is 2401 or more.
*10: The real-time drift compensation function is not used.
*11: The average value measured when PMD is ≤5 ps, the modulation frequency is 2.5 GHz, the wavelength resolution is 100 pm, the insertion loss is ≤8 dB, PDL is 0 dB , and Sensitivity is set to Middle.
*12: The measurement is repeated three times by using a 12 km dispersion-shifted fiber.
Refractive index is 1.47
The real-time drift compensation function is set to ON.
*13: The measurement is repeated ten times by using a 12 km dispersion-shifted fiber and the modulation frequency is 2.5 GHz, the wavelength range is 1525 nm to 1625 nm, the number of measurement points is 501 (the wavelength resolution is 200 pm), Sensitivity is set to High, and the drift compensation function is used. By fitting to a quadratic polynomial
*14: When the internal reference light source is used, the device to be measured requires the pass band in the 1540 nm ±3.5 nm wavelength range.
*15: The optical connector can be replaced easily by using an accessory which is sold separately.

3.2 Accessories

Table 3-1 Accessories

Accessory Name	Part Code
FC/APC-FC/APC master optical fiber	A180001
SC/APC-SC/APC master optical fiber	A180002
FC/APC-FC/SPC master optical fiber	A180003
Adapter for SC connector output	A180004
FC/FC adapter (for APC)	A180005
SC/SC adapter (for APC)	A180006
FC/FC adapter	A180007
FC/SC adapter	A180008
Polarization reference module	A180009
FC/APC-SC/SPC plug	A180010

3.3 Rack-Mount Kits

Rack-Mount Kits:

A slide rail set A02615 is required when mounting onto TR16801 of our company's rack.

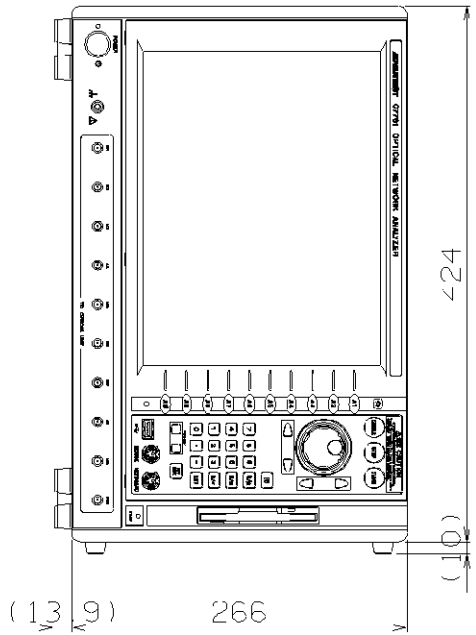
When mounting onto a rack of other company, the user needs to prepare an L angle set A02642 or a tray to support this instrument.

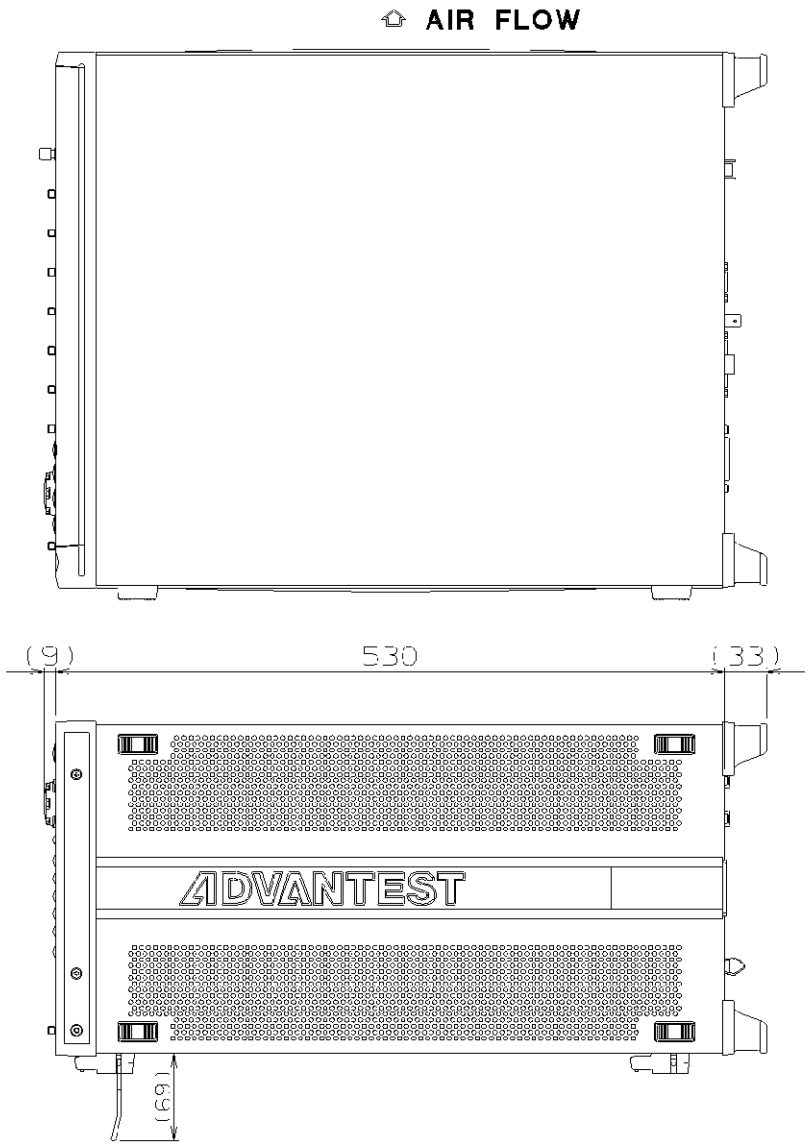
Each unit (analysis, OPT, and light source) requires a slide rail set or an L angle set.

- Analysis unit:
  EIA, with handle: A02714
  JIS, with handle: A02715
  EIA, without handle: A02724
  JIS, without handle: A02725
- OPT unit:
  EIA, with handle: A02710
  JIS, with handle: A02711
  EIA, without handle: A02720
  JIS, without handle: A02721
- Light source unit:
  EIA, with handle: A02708
  JIS, with handle: A02709
  EIA, without handle: A02718
  JIS, without handle: A02719

3.4 Information for the Safety of Laser Used in the Q7761

The laser source specified by this operation manual is classified according to IEC 60825-1 Am.2 2001. The laser source complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to laser notice No.50, July 26, 2001.

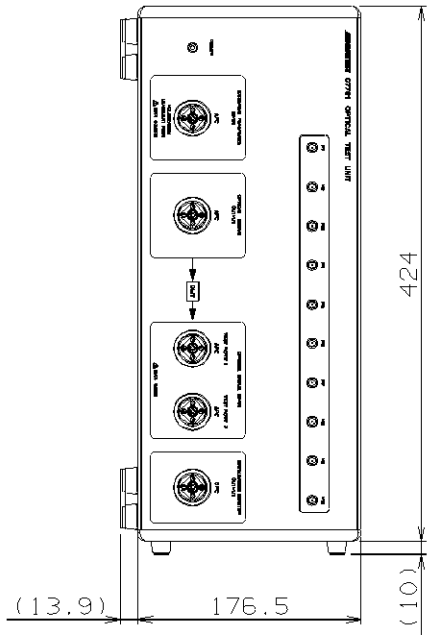


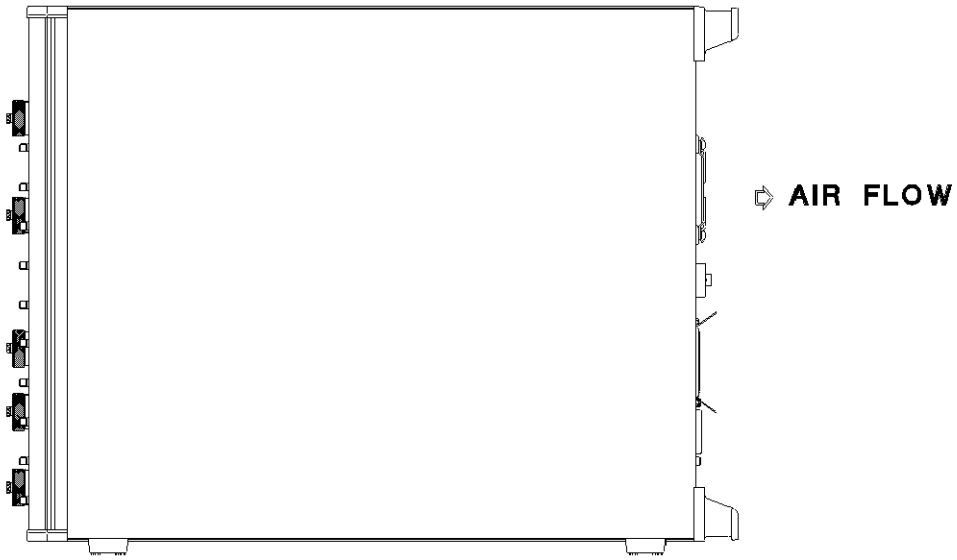


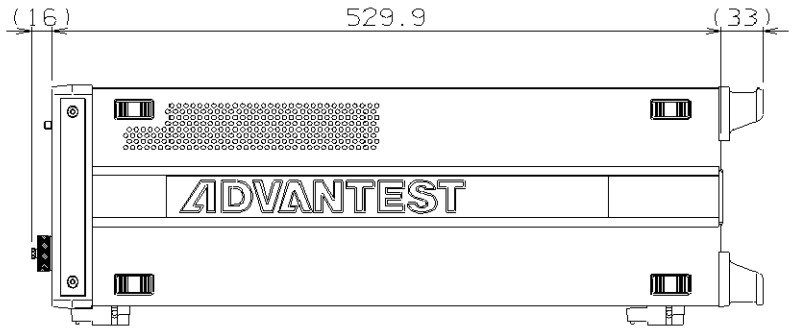
Unit : mm

NOTE
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.

ANALYSIS UNIT DIMENSIONAL OUTLINE DRAWING



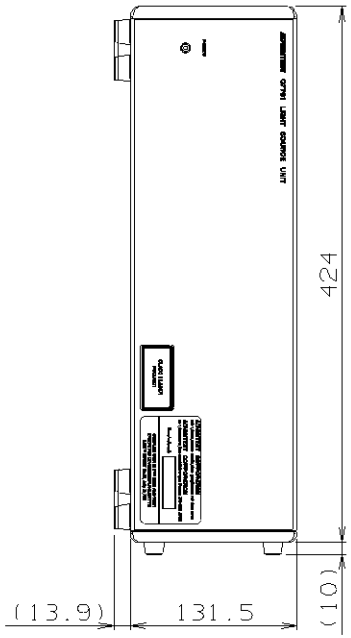


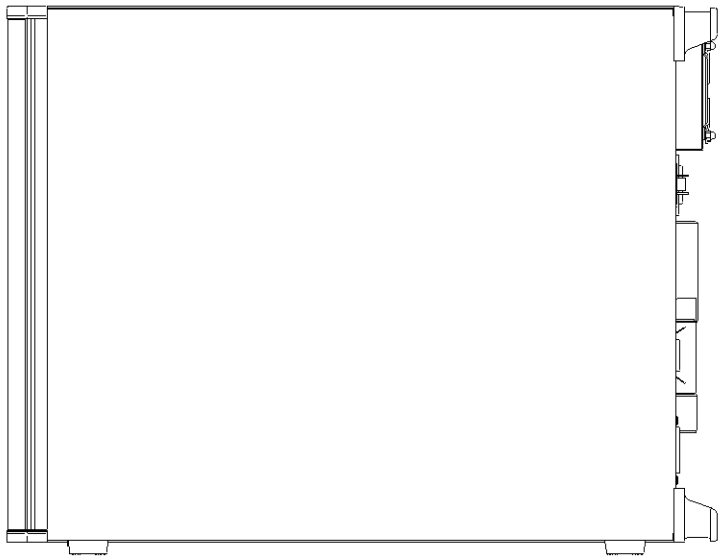


Unit : mm

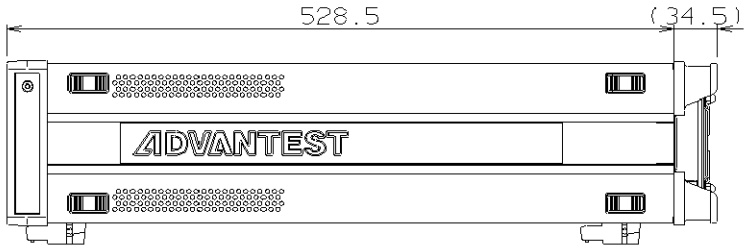
NOTE
This drawing shows external dimensions of this instrument.
The difference in products and options used can cause a change in the appearance of the instrument.

OPT UNIT DIMENSIONAL OUTLINE DRAWING





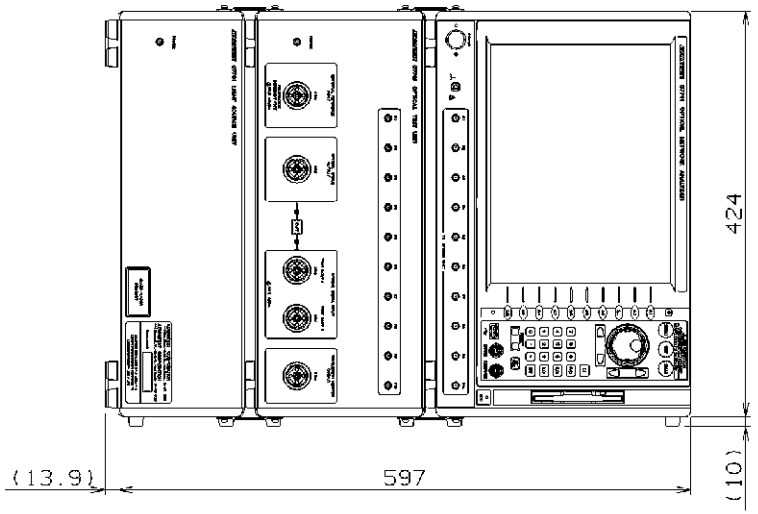
AIR FLOW

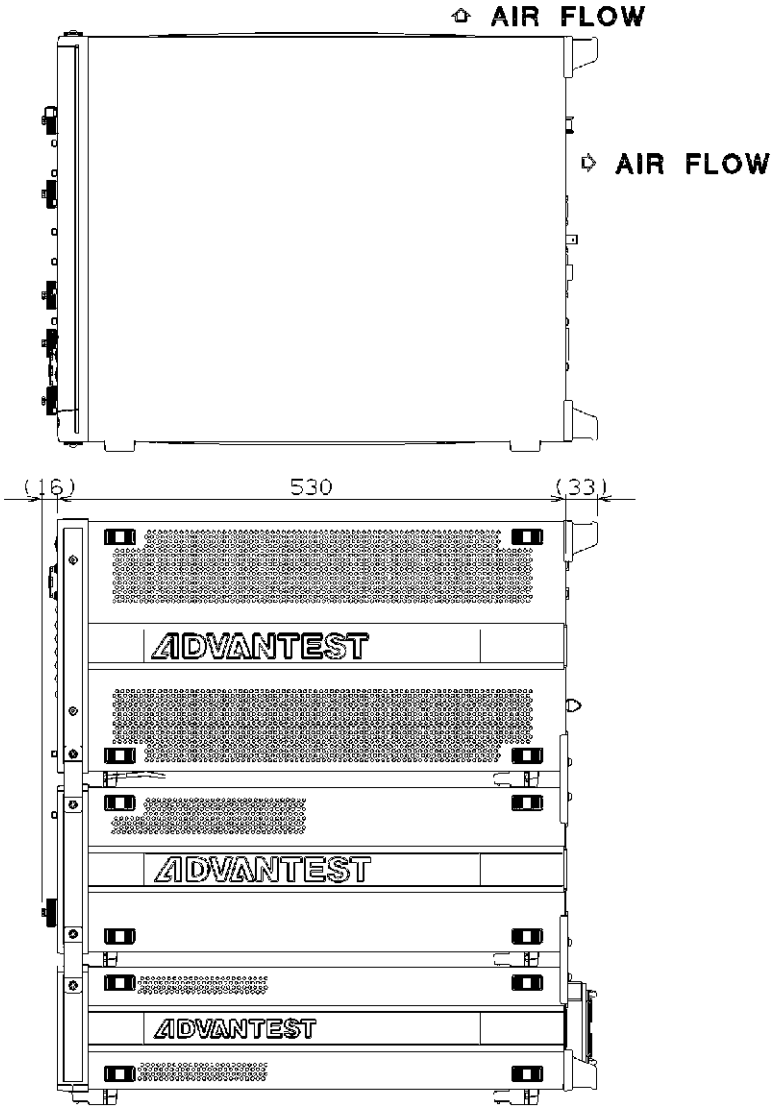


Unit : mm

NOTE
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.

LIGHT SOURCE UNIT DIMENSIONAL OUTLINE DRAWING





Unit : mm

NOTE
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.

Q7761 DIMENSIONAL OUTLINE DRAWING

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