MW9087 Series Card OTDR Operation Manual

11th Edition

For safety and warning information, please read this manual before attempting to use the equipment.

Keep this manual with the equipment.

ANRITSU CORPORATION

Document No.: M-W3543AE-11.0

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

Symbols used in manual



↑ DANGER

This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.



WARNING This indicates a hazardous procedure that could result in serious injury or death if not performed properly.

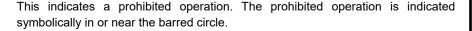


CAUTION This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.







This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.



This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.





This indicates a note. The contents are described in the box.





These indicate that the marked part should be recycled.

MW9087 Series Card OTDR **Operation Manual**

2 June 2011 (First Edition) October 2019 (11th Edition)

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The contents of this manual may be changed without prior notice.

Printed in Japan



WARNING



- ALWAYS refer to the operation manual when working near locations at which the alert mark shown on the left is attached. If the advice in the operation manual is not followed there is a risk of personal injury or reduced equipment performance. The alert mark shown on the left may also be used with other marks and descriptions to indicate other dangers.
- Overvoltage Category
 This equipment complies with overvoltage category II defined in IEC 61010. DO NOT connect this equipment to the power supply of overvoltage category III or IV.
- Laser radiation warning
 - NEVER look directly into the cable connector on the equipment nor into the end of a cable connected to the equipment. There is a risk of injury if laser radiation enters the eye.
 - The Laser Safety label is attached to the equipment for safety use as indicated in "Laser Safety" later in this section.

Electric Shock

 To ensure that the equipment is grounded, always use the supplied 3-pin power cord, and insert the plug into an outlet with a ground terminal. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock or causing damage to the internal components.

Repair



Only qualified service personnel with a knowledge of electrical fire and shock hazards should service this equipment. This equipment cannot be repaired by the operator. DO NOT attempt to remove the equipment covers or unit covers or to disassemble internal components. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.



WARNING

Calibration



• The performance-guarantee seal verifies the integrity of the equipment. To ensure the continued integrity of the equipment, only Anritsu service personnel, or service personnel of an Anritsu sales representative, should break this seal to repair or calibrate the equipment. Be careful not to break the seal by opening the equipment or unit covers.If the performance-guarantee seal is broken by you or a third party, the performance of the equipment cannot be guaranteed.

Falling Over

 This equipment should always be positioned in the correct manner. If the cabinet is turned on its side, etc., it will be unstable and may be damaged if it falls over as a result of receiving a slight mechanical shock.

Always set up the equipment in a position where the power switch can be reached without difficulty.

Laser Safety

Class 1, and 1M indicate the danger degree of the laser radiation specified below according to IEC 60825-1:2007.

Class 1: Lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

Class 1M: Lasers emitting in the wavelength range from 302.5 to 4000 nm that are safe under reasonably foreseeable conditions of operation, but may be hazardous if the user employs optics within the beam. Two conditions apply:

- a) for diverging beams, if the user views the laser output with certain optical instruments (for example, eye loupes, magnifiers and microscopes) within a distance of 100 mm;
- b) for collimated beams, if the user views the laser output with certain optical instruments (for example, telescopes and binoculars).



CAUTION

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

The use of optical instruments with this product will increase eye hazard.



WARNING

The laser in this equipment is classified as Class 1 or 1M according to the IEC 60825-1:2007 standard, and is safe under reasonably foreseeable operating conditions.

Never use optical instruments to directly view Class 1M laser products. Doing so may result in serious damage to the eyes.

Table 1 Laser Safety Classifications Based on IEC 60825-1:2007

Model Name	Class	Max. Optical Output Power (W) [*]	Pulse Width (s)/ Repetition Rate	Emitted Waveleng th (nm)	Beam Divergence (deg)	Incorporated Laser Specification (refer to Table 2)	Laser Aperture
MW9087B	1	0.15	20×10^{-6} / 0.019	1650	11.5	a)	Figure 1, [1]
MW9087D	1M	0.60	20 × 10 ⁻⁶ / 0.019	1550	11.5	b)	Figure 1, [1]

^{*:} Indicates the possible optical output power when each and every reasonably foreseeable single-fault condition is included.

Table 2 Incorporated Laser Specification

Incorporated Laser	Max. Optical Output Power (W)*	Pulse Width (s)/ Repetition Rate	Emitted Wavelength (nm)	Beam Divergence (deg)
a)	< 0.30	$20 \times 10^{-6} / 0.019$	1650	11.5
b)	< 1.20	$20 \times 10^{-6} / 0.019$	1550	11.5

^{*:} Maximum output power is the estimated value when something breaks down.

Table 3 Indication Labels on Product (Ex: Label list)

	Туре	Sample	Affixed to:	Model Name
1	Explanation	IEC 60825-1 2007 CLASS 1 LASER PRODUCT	Figure 1, A	MW9087B
2	Explanation	IEC 60825-1:2007 INVISIBLE LASER RADIATION DO NOT VIEW DIRECTRY WITH OPTICAL INSTRUMENTS (MAX OUTPUT POWER) (PULSE DURATION) (WAVELENGTH) 600mW ≤20 u s 1550mm CLASS 1M LASER PRODUCT	Figure 2, B	MW9087D
3	Certification	CERTIFICATION LABEL THIS PRODUCT COMPLIES WITH 21 CFR 1040.10 AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50, DATED JUNE 24, 2007	Figure 2, C	All Models
4	Identification	IDENTIFICATION LABEL ANRITSU CORP. 5-1-1,0NNA,ATSUGI-SHI KANAGAWA 243-8555,JAPAN MANUFACTURED ATTOHOKU ANRITSU CO., LTD KORIYAMA PLANT,	Figure 2, D	All Models

Laser Radiation Markings

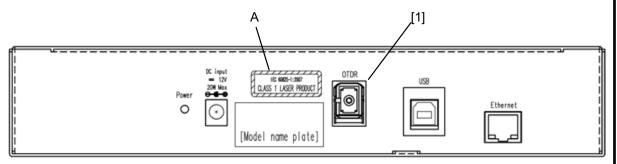


Figure 1 Locations of Laser Beam Apertures and Affixed Labels

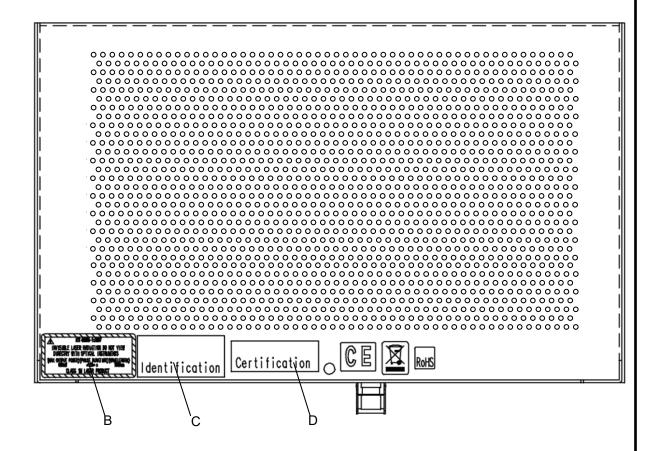


Figure 2 Label Locations



CAUTION

Disconnect from Communication

The OTDR Module outputs high-power optical pulses. Disconnect the communication equipments from the optical fibers before a measurement, or the optical sensor of the equipment may be broken.

Use in a Residential **Environment**

This equipment is designed for an industrial environment.

In a residential environment, this equipment may cause radio interference in which case the user may be required to take adequate measures.

Use in Corrosive Atmospheres

Exposure to corrosive gases such as hydrogen sulfide, sulfurous acid, and hydrogen chloride will cause faults and failures.

Note that some organic solvents release corrosive gases.

Equipment Certificate

Anritsu Corporation certifies that this equipment was tested before shipment using calibrated measuring instruments with direct traceability to public testing organizations recognized by national research laboratories, including the National Institute of Advanced Industrial Science and Technology, and the National Institute of Information and Communications Technology, and was found to meet the published specifications.

Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within one year after shipment due to a manufacturing fault. However, software fixes will be made in accordance with the separate Software End-User License Agreement. Moreover, Anritsu Corporation will deem this warranty void when:

- The fault is outside the scope of the warranty conditions separately described in the operation manual.
- The fault is due to mishandling, misuse, or unauthorized modification or repair of the equipment by the customer.
- The fault is due to severe usage clearly exceeding normal usage.
- The fault is due to improper or insufficient maintenance by the customer.
- The fault is due to natural disaster, including fire, wind, flooding, earthquake, lightning strike, or volcanic ash, etc.
- The fault is due to damage caused by acts of destruction, including civil disturbance, riot, or war, etc.
- The fault is due to explosion, accident, or breakdown of any other machinery, facility, or plant, etc.
- The fault is due to use of non-specified peripheral or applied equipment or parts, or consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.
- The fault is due to use in unusual environments (Note).
- The fault is due to activities or ingress of living organisms, such as insects, spiders, fungus, pollen, or seeds.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation shall assume no liability for injury or financial loss of the customer due to the use of or a failure to be able to use this equipment.

Note:

For the purpose of this Warranty, "unusual environments" means use:

- · In places of direct sunlight
- In dusty places
- In liquids, such as water, oil, or organic solvents, and medical fluids, or places where these liquids may adhere
- In salty air or in places where chemically active gases (sulfur dioxide, hydrogen sulfide, chlorine, ammonia, nitrogen dioxide, or hydrogen chloride etc.) are present
- In places where high-intensity static electric charges or electromagnetic fields are present
- In places where abnormal power voltages (high or low) or instantaneous power failures occur
- In places where condensation occurs
- In the presence of lubricating oil mists
- In places at an altitude of more than 2,000 m
- In the presence of frequent vibration or mechanical shock, such as in cars, ships, or airplanes

Anritsu Corporation Contact

In the event that this equipment malfunctions, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

Notes On Export Management

This product and its manuals may require an Export License/Approval by the Government of the product's country of origin for re-export from your country.

Before re-exporting the product or manuals, please contact us to confirm whether they are export-controlled items or not.

When you dispose of export-controlled items, the products/manuals need to be broken/shredded so as not to be unlawfully used for military purpose.

Reuse parts

Anritsu group promotes recycling activities in order to reuse available resources and save energy. This product may use recycled parts (mechanical components) that conform to Anritsu's quality standards.

Lifetime of Parts

The life span of certain parts used in this instrument is determined by the operating time or the power-on time. Due consideration should be given to the life spans of these parts when performing continuous operation over an extended period. These parts must be replaced at the customer's expense even if within the guaranteed period described in Warranty at the beginning of this manual. For details on life span, refer to the corresponding section in this manual.

Crossed-out Wheeled Bin Symbol

Equipment marked with the Crossed-out Wheeled Bin Symbol complies with council directive 2012/19/EU (the "WEEE Directive") in European Union.



For Products placed on the EU market after August 13, 2005, please contact your local Anritsu representative at the end of the product's useful life to arrange disposal in accordance with your initial contract and the local law.

Software End-User License Agreement (EULA)

Please read this Software End-User License Agreement (hereafter this EULA) carefully before using (includes executing, copying, registering, etc.) this software (includes programs, databases, scenarios, etc., used to operate, set, etc., Anritsu electronic equipment). By reading this EULA and using this software, you are agreeing to be bound by the terms of its contents and Anritsu Corporation (hereafter Anritsu) hereby grants you the right to use this Software with the Anritsu-specified equipment (hereafter Equipment) for the purposes set out in this EULA.

1. Grant of License and Limitations

- 1. Regardless of whether this Software was purchased from or provided free-of-charge by Anritsu, you agree not to rent, lease, lend, or otherwise distribute this Software to third parties and further agree not to disassemble, recompile, reverse engineer, modify, or create derivative works of this Software.
- 2. You may make one copy of this Software for backup purposes only.
- 3. You are not permitted to reverse engineer this software.
- 4. This EULA allows you to install one copy of this Software on one piece of Equipment.

2. Disclaimers

To the extent not prohibited by law, in no event shall Anritsu be liable for personal injury, or any incidental, special, indirect or consequential damages whatsoever, including, without limitation, damages for loss of profits, loss of data, business interruption or any other commercial damages or losses, arising out of or related to your use or inability to use this Software.

3. Limitation of Liability

- a. If a fault (bug) is discovered in this Software, preventing operation as described in the operation manual or specifications whether or not the customer uses this software as described in the manual, Anritsu shall at its own discretion, fix the bug, or exchange the software, or suggest a workaround, free-of-charge. However, notwithstanding the above, the following items shall be excluded from repair and warranty.
 - If this Software is deemed to be used for purposes not described in the operation manual or specifications.
 - ii) If this Software is used in conjunction with other non-Anritsu-approved software.
 - iii) Recovery of lost or damaged data.
 - iv) If this Software or the Equipment has been modified, repaired, or otherwise altered without Anritsu's prior approval.
 - v) For any other reasons out of Anritsu's direct control and responsibility, such as but not limited to, natural disasters, software virus infections, etc.
- b. Expenses incurred for transport, hotel, daily allowance, etc., for on-site repairs by Anritsu engineers necessitated by the above faults shall be borne by you.
- c. The warranty period for faults listed in article 3a above covered by this EULA shall be either 6 months from the date of purchase of this Software or 30 days after the date of repair, whichever is longer.

4. Export Restrictions

You may not use or otherwise export or re-export directly or indirectly this Software except as authorized by Japanese and United States law. In particular, this software may not be exported or re-exported (a) into any Japanese or US embargoed countries or (b) to anyone on the Japanese or US Treasury Department's list of Specially Designated Nationals or the US Department of Commerce Denied Persons List or Entity List. By using this Software, you warrant that you are not located in any such country or on any such list. You also agree that you will not use this Software for any purposes prohibited by Japanese and US law, including, without limitation, the development, design and manufacture or production of missiles or nuclear, chemical or biological weapons of mass destruction.

5. Termination

Anritsu shall deem this EULA terminated if you violate any conditions described herein. This EULA shall also be terminated if the conditions herein cannot be continued for any good reason, such as violation of copyrights, patents, or other laws and ordinances.

6. Reparations

If Anritsu suffers any loss, financial or otherwise, due to your violation of the terms of this EULA, Anritsu shall have the right to seek proportional damages from you.

7. Responsibility after Termination

Upon termination of this EULA in accordance with item 5, you shall cease all use of this Software immediately and shall as directed by Anritsu either destroy or return this Software and any backup copies, full or partial, to Anritsu.

8. Dispute Resolution

If matters of dispute or items not covered by this EULA arise, they shall be resolved by negotiations in good faith between you and Anritsu.

9. Court of Jurisdiction

This EULA shall be interpreted in accordance with Japanese law and any disputes that cannot be resolved by negotiation described in Article 8 shall be settled by the Japanese courts.

Cautions against computer virus infection

- Copying files and data
 - Only files that have been provided directly from Anritsu or generated using Anritsu equipment should be copied to the instrument.
 - All other required files should be transferred by means of USB or CompactFlash media after undergoing a thorough virus check.
- Adding software
 - Do not download or install software that has not been specifically recommended or licensed by Anritsu.
- Network connections
 Ensure that the network has sufficient anti-virus security protection in place.

CE Conformity Marking

Anritsu affixes the CE conformity marking on the following product(s) in accordance with the Directive 768/2008/EC to indicate that they conform to the EMC, LVD, and RoHS directive of the European Union (EU).

CE marking



1. Product Model

Model: MW9087 Series Card OTDR

2. Applied Directive

EMC: Directive 2014/30/EU LVD: Directive 2014/35/EU RoHS: Directive 2011/65/EU

3. Applied Standards

EMC: Emission: EN 61326-1: 2013 (Class A)
 Immunity: EN 61326-1: 2013 (Table 2)

	Performance Criteria [*]
IEC 61000-4-2 (ESD)	В
IEC 61000-4-3 (EMF)	Α
IEC 61000-4-4 (Burst)	В
IEC 61000-4-5 (Surge)	В
IEC 61000-4-6 (CRF)	Α
IEC 61000-4-8 (RPFMF)	Α
IEC 61000-4-11 (V dip/short)	B, C

^{*:} Performance Criteria

A: The equipment shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

- B: The equipment shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.
- C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

Harmonic current emissions:

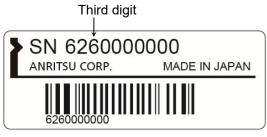
EN 61000-3-2: 2014

- : No limits apply for this equipment with an active input power under 75 W.
- LVD: EN 61010-1: 2010 (Pollution Degree 2)
- RoHS: EN 50581: 2012 (Category 3)

If the third digit of the serial number is "7", the product complies with Directive 2011/65/EU as amended by (EU) 2015/863.

(Pb,Cd,Cr6+,Hg,PBB,PBDE,DEHP,BBP,DBP,DIBP) If the third digit of the serial number is "6", the product complies with Directive 2011/65/EU.

(Pb,Cd,Cr6+,Hg,PBB,PBDE)



Serial number example

4. Contact

Name: Anritsu GmbH

Address, city: Nemetschek Haus, Konrad-Zuse-Platz 1

81829 München,

Country: Germany

Name: ANRITSU EMEA Ltd.

Address, city: 200 Capability Green, Luton

Bedfordshire, LU1 3LU

Country: United Kingdom

RCM Conformity Marking

Anritsu affixes the RCM mark on the following product(s) in accordance with the regulation to indicate that they conform to the EMC framework of Australia/New Zealand.

RCM marking



1. Product Model

Model: MW9087 Series Card OTDR

2. Applied Standards

EMC: Emission: EN 61326-1: 2013 (Class A equipment)

About This Manual

The configuration of the MW9087 Series Card OTDR operation manual is divided into the following three parts: Card OTDR Mainframe, LED Interface, and Password function.

This manual describes the operation/maintenance method for MW9087 Series Card OTDR.

Refer to Chapter 2 "Before Use" to understand the setting of this device and precautions.

Also, refer to Chapter 3 "Measurement Method" to understand the overview of operation flow.

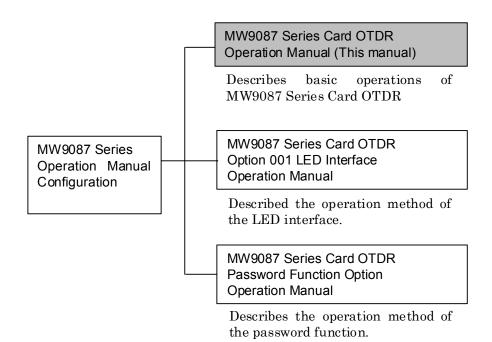


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Appendix

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Chapter 1 Outline

This chapter explains the features of the MW9087 Series Card OTDR $\,$

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1.1 Introduction to MW9087 Series Card OTDR

MW9087 Series Card OTDR is a module form for the optical fiber measurement device.



Figure 1.1-1 Card OTDR Appearance (MW9087B)

This device has multiple models depending on wavelengths and dynamic ranges.

Table 1.1-1 Model Name of Card OTDR

Model	Wavelength	Dynamic range (Typ.)
MW9087B	1650 nm	41 dB
MW9087D	1550 nm	50 dB

1550 nm wavelength is used for communications.

To monitor the fiber loss/deterioration or breaks without effects on communications, the model with wavelength of 1650 nm is used.

To measure the fiber loss of the wavelength used for communications, the model with wavelength of $1550~\mathrm{nm}$ is used.

If the fiber loss is large or the communication path has the fiber loss due to optical coupler, the model with a large dynamic range is used.

1.2 Features

The MW9087 Series Card OTDR has been developed in order to monitor faults in the optical fiber system.

You can control it via Ethernet; therefore, it can be used for automatic/remote measurement.

Partial sampling

Distance range to be measured can be set, and only the range set can be measured. This feature will shorten the measurement time.

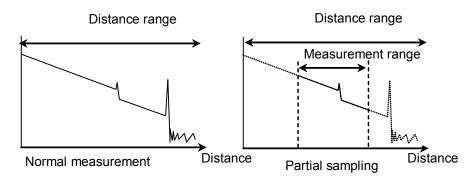


Figure 1.2-1 Normal Measurement and Partial Sampling

SR-4731 file format

The measurement results can be saved with Telcordia standard SR-4731 OTDR Data Format-compliant files. These files have the extension of SOR, and waveforms can be displayed with TraceView software. This software is available from the following URL.

 $\underline{\text{http://www.anritsu.com/en-US/Downloads/Software/Drivers/Software-Downloads/DWL2761.aspx}}$

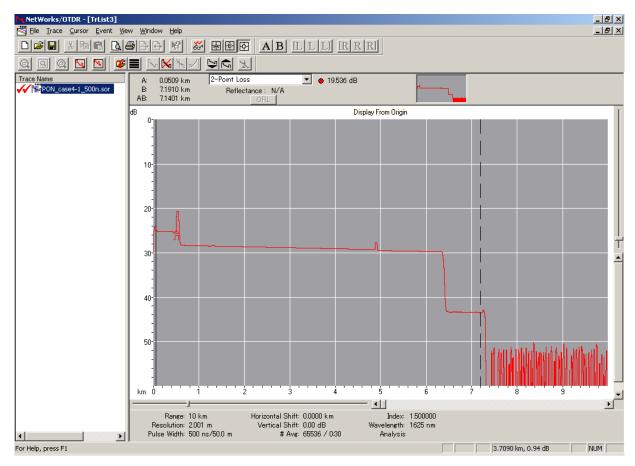


Figure 1.2-2 Waveform Display with TraceView software

Note:

The obtained waveform using the partial sampling cannot be displayed with the Trace View software properly.

1.3 Outline of OTDR

OTDR operating principle

OTDR (Optical Time Domain Reflectometer) transmits brief optical pulses to the fiber to measure the intensity and time difference of lights reflected from within the fiber.

The distance of the reflection point is calculated from the time difference, light speed, and index of refraction (IOR) of the fiber.

The light attenuation (fiber loss) is calculated from the light intensity reflected from within the fiber.

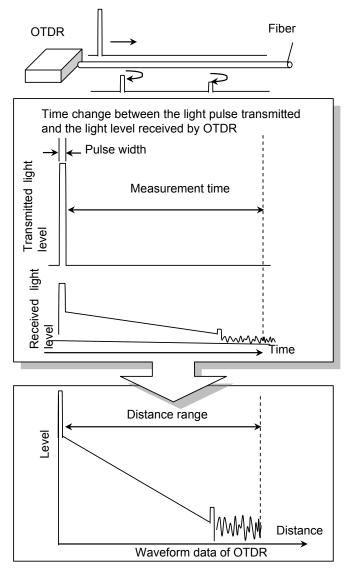


Figure 1.3-1 OTDR Transmitted/Received Waveform and Waveform Data

The maximum measurable distance (distance range) is determined by the time when OTDR measures the received light level after the optical pulse is transmitted.

Transmitted optical pulse is reflected little by little within the fiber. The more distant the reflected light is, the lower is the light level received by OTDR. Therefore, the waveform of measurement result becomes a downward-sloping rectilinear graph.

OTDR fiber measurement

In places where the fiber is connected or damaged, the fiber loss or the light reflection may become larger. These changes make the waveform of measurement result discontinuous.

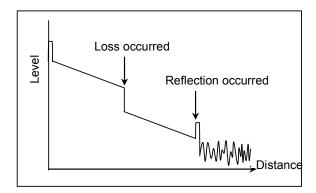
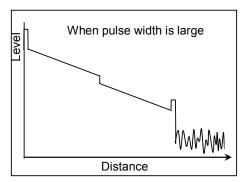


Figure 1.3-2 Detection of Fiber Loss and Reflection

Waveform change with pulse width

The larger is the transmitted optical pulse width, the higher is the received light level. Therefore, make the pulse width larger for the measurement system with large fiber loss such as the case of a long distance range.



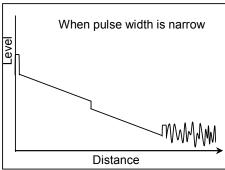
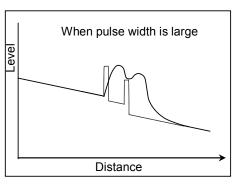


Figure 1.3-3 Level Change with Pulse Width

The narrower is the transmitted optical pulse width, the shorter is the optical pulse length within the fiber. Therefore, the loss change within the fiber can be measured to the direction of length finely (at high resolution).



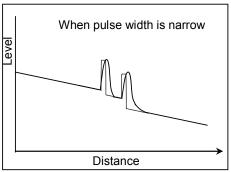


Figure 1.3-4 Resolution Change with Pulse Width

Chapter 2 Before Use

This chapter provides information that should be thoroughly understood before actually using the Card OTDR, such as the installation method, setting items, and precautions.

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2.1 Product Configuration

The standard composition of the MW9087 Series Card OTDR (hereafter, Card OTDR) is listed in the following table. After unpacking, check the packing list and make sure that all the components are included. If any part is missing or damaged, contact Anritsu or your Anritsu sales agent immediately.

Table 2.1-1 Standard Configuration

Item	Model	Product Name	Q'ty
Mainframe	MW9087B/D	Card OTDR	1
Accessories		CD-ROM	1

The MW9087 Series Card OTDR Operation Manual (W3543AE) and the USB serial driver are included in the CD-ROM.

2.2 Names of Parts

The following figure shows the names of parts.

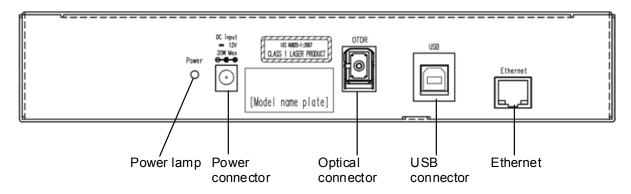


Figure 2.2-1 Front Panel (MW9087B)

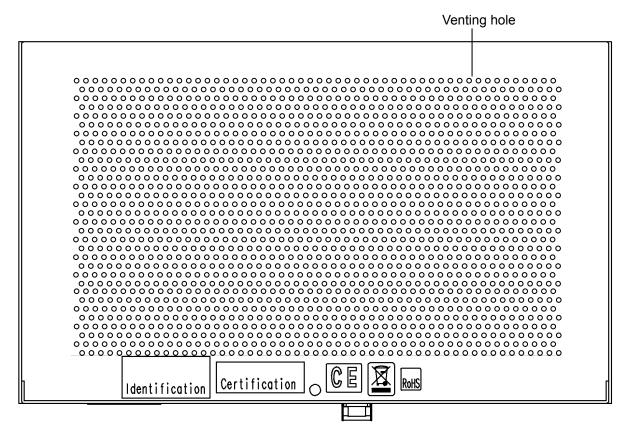


Figure 2.2-2 Upper Surface Panel

Table 2.2-1 Name and Function

Name	Function	
Power lamp	Lights when power is supplied.	
Power connector	Input terminal for DC power	
Optical connector	Input/Output connector for optical pulse measurement	
USB connector	Used for serial port communication	
Ethernet connector	Connects the Lan cable.	
Venting hole		



⚠ WARNING

NEVER look directly into the laser radiation emitted from the Card OTDR optical connector or the end of the cable connected to the Card OTDR. If you do so, the laser light may damage your eyes.

2.3 Installing the Card OTDR

2.3.1 Installation method

Install the Card OTDR top surface or side up as shown in Figure 2.3.1-1.

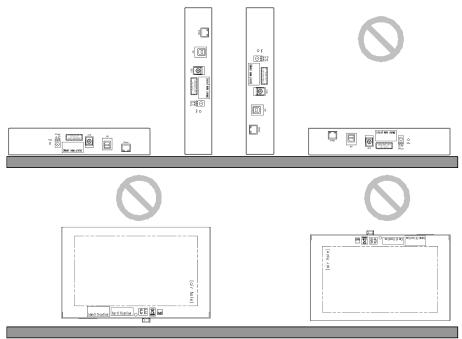


Figure 2.3.1-1 Installation Orientation

A venting hole is installed in the Card OTDR to prevent the internal temperature from rising. Install the Card OTDR in a location with the vents at least 10 cm away from walls, peripherals or other obstructions so as not to block the fan perimeter.

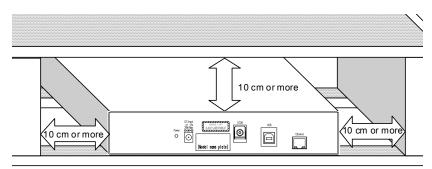


Figure 2.3.1-2 Vent Airflow System

The Card OTDR releases the air to the top surface. When two units of the Card OTDR are used, place them so that the air released from one unit is not received by the other unit.

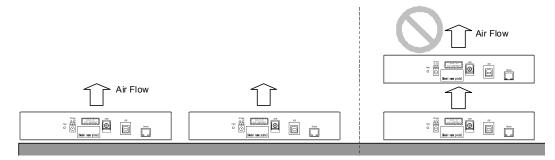


Figure 2.3.1-3 Arrangement for Multiple Units

Although the Card OTDR operates at an ambient temperature of 0° to 50°C, avoid using it in locations, such as the following, since it may cause failure.

- In places of direct sunlight
- In dusty places
- Outdoors
- In liquids, such as water, oil, or organic solvents, and medical fluids, or places where these liquids may adhere
- In salty air or in place chemically active gases (sulfur dioxide, hydrogen sulfide, chlorine, ammonia, nitrogen dioxide, or hydrogen chloride etc.) are present
- In places where high-intensity static electric charges or electromagnetic fields are present
- In places where abnormal power voltages (high or low) or instantaneous power failures occur
- In places where condensation occurs
- In the presence of lubricating oil mists
- In places at an altitude of more than 2,000 m
- In the presence of frequent vibration or mechanical shock, such as in cars, ships, or airplanes
- Locations where there is a risk of equipment toppling over, etc.

2.3.2 Dimension

The Card OTDR has holes on bottom panel to secure with screws. Install it using screws of M3 (8 mm or less).

The arrangement for screw holes is shown in the figure below. The unit is mm.

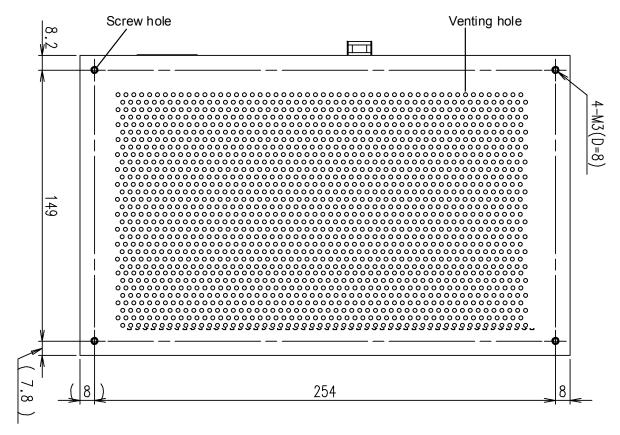


Figure 2.3.2-1 Dimensional Drawing (Bottom View)

2.4 Power Connection

The Card OTDR operates with the DC 12 V power supply and it starts when the power is supplied.

Connect the polarities correctly as shown in Figure 2.4-1.

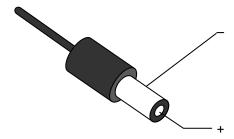


Figure 2.4-1 Power Connector Polarity

Hosiden DC Jack HEC-0470-01-630 is used as the power input pin. The recommended DC plug dimension is ϕ 2.1 × ϕ 5.5 × 9.5 mm (Refer to Figure 2.4-2).

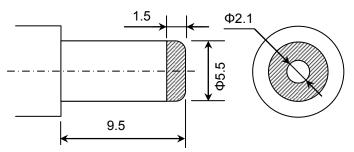


Figure 2.4-2 Dimension Figure for Power Connector

The specifications for the power source are as follows.

Table 2.4-1 Specifications for Power Source

Item	Specifications	
Power Voltage	12 V±10%	
Power Consumption	≤20 W	



WARNING

Be sure to check that the power source is set within the range specified. Supplying power exceeding the rated range may result in electrical shock, fire, failure, or malfunction.

2.5 Communication Settings

2.5.1 Interface

The enabled interfaces are as follows.

- PC side: RJ45 port, USB port type A
- The Card OTDR side: RJ45 port, USB port type B

When the Card OTDR is connected to a PC, use the Ethernet cable or USB cable of type A-B. Also Anritsu driver is required when the USB interface is used. Refer to Section 2.6 "Installation/Uninstallation for USB Serial Driver to install it in a PC.

When the Card OTDR is connected to a PC using the Ethernet cable directly, use the cross cable.

2.5.2 Network setting

When the Ethernet setting is not changed from the factory default, the PC should be set according to the following values.

Communication mode
IP address
Subnet mask
Default gateway
Port number

Autonegotiation
192.168.1.2
255.255.255.0
None
2288

Use NETNEG command to change the communication mode setting and NET command to change the Network setting. The Card OTDR is restarted using the RST command after setting the Network. The set values have been reflected since the Card OTDR is restarted.

2.5.3 Serial port setting

Set the serial port of the communication control software to be operated on the PC as follows.

Baud rate (bit/sec) 115200 bps
Data bit 8 bits
Parity None
Stop bit 1 bit
Flow control Hardware

Note:

The communication condition of the serial port cannot be changed.

2.6 Installation/Uninstallation for USB Serial Driver

2.6.1 Installation (Windows XP)

The installation method for USB serial driver is explained with the example of Windows XP.

- 1. Copy the UsbSerialDrivers folder of the CD-ROM to the PC.
- 2. Power on the Card OTDR and PC and connect the USB cable.
- When the cable is connected, the Welcome to the Found New Hardware Wizard is displayed.

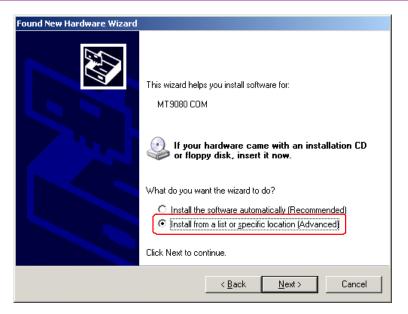


4. Select "No, not this time" and click **Next>**.

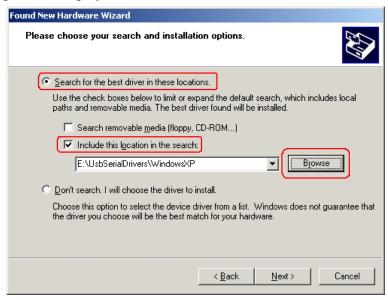
Note:

The above window is not displayed depending on the version of the Windows XP.

5. The installation selection window is displayed.



- Select "Install from a list of specific location (Advanced)" and click Next>.
- 7. The windows describing "Please choose your search and installation option" is displayed.



- 8. Select "Search for the best driver in these location" and put the check mark in the "Include this location in the search:". Then, specify the RemoteControl folder saved at the procedure 1. (When clicking **Browse**, the folder is enabled.)
- 9. Then, when clicking **Next>**, the driver is installed.
- When the installation confirmation window is displayed, click <u>C</u>ontinue Anyway.



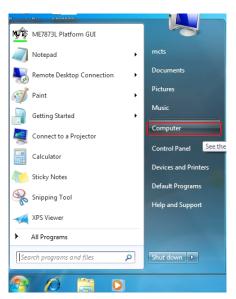
11. When the completion message is displayed, installing the driver is completed. Click **Finish**.



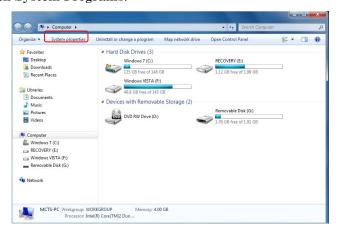
2.6.2 Installation (Windows 7)

The installation method for USB serial driver is explained with the example of Windows 7.

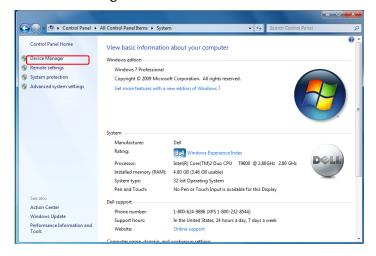
- 1. Copy the UsbSerialDrivers folder of the CD-ROM to the PC.
- 2. Power on the Card OTDR and PC and connect the USB cable.
- 3. Click Computer from Start Menu.



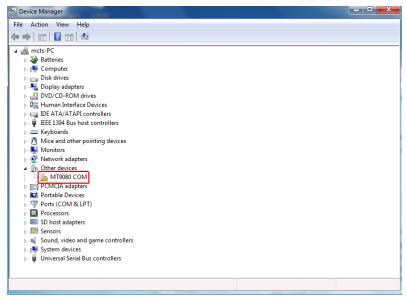
4. Click System Programs.



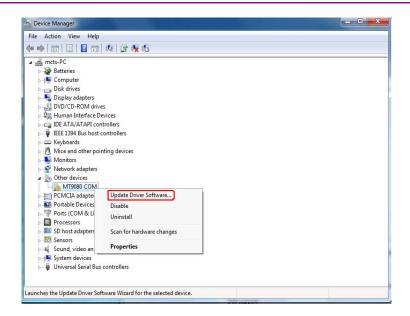
5. Click Device Manager.



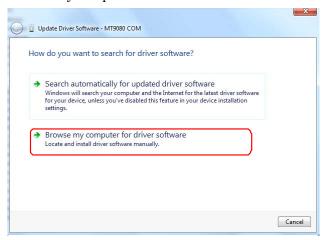
6. Check that MT9080 COM is displayed on the device manager.



7. Right-click MT9080 COM and select Updating Driver Software.

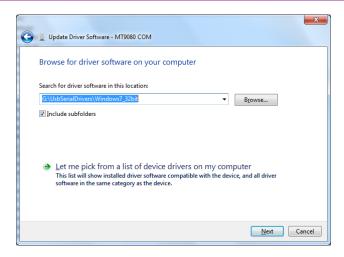


8. Click "Browse my computer for driver software".



9. Specify the Win7 folder in the UsbSerialDrivers saved at the step 1. When using the Windows 32-bit version, specify the Windows 32-bit folder. When using the Windows 64-bit version, specify the Windows 64-bit folder.

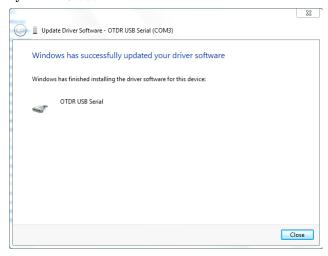
When clicking **Browse...**, the folder is enabled.



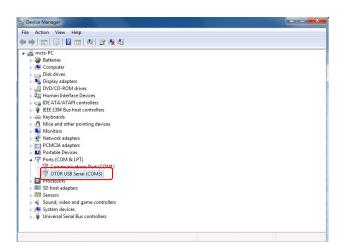
- 10. Then, when clicking **Next**, the driver installation is started.
- 11. When the installation confirmation screen is displayed, click "Install this driver software anyway".



12. When the completion message is displayed, the process is completed normally. Click **Close**.



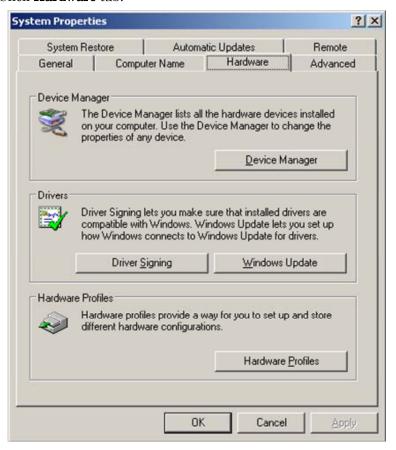
13. The current port number is displayed on the right side of the OTDR USB Serial.



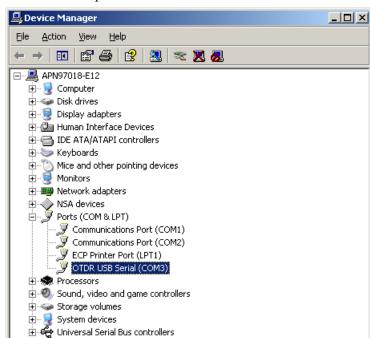
2.6.3 Uninstallation (Window XP)

Avoid turning off the power during uninstallation of the USB serial driver since the PC communicates with the Card OTDR.

- 1. Turn on the power of the mainframe and the PC, and connect them with a USB cable.
- 2. Click Control Panel from the Start menu of Windows.
- 3. Double-click **System**.
- 4. Click **Hardware** tab.



5. Click **Device Manager**.



6. Double-click the port (COM and LPT).

Right-click OTDR USB serial and click Uninstall.



8. When the Confirm Device Removal window is displayed, click **OK**.



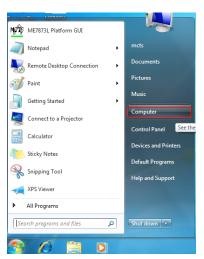
- 9. Confirm that the OTDR USB Serial is removed.
- 10. Close the opened windows such as the device manager and system properties.
- 11. Unplug the USB cable connected to the Card OTDR.

2.6.4 Uninstallation (Windows 7)

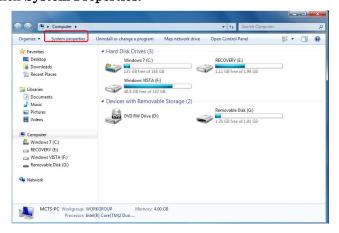
Uninstallation Procedures for the USB serial driver:

As the PC communicates with the Card OTDR during uninstalltion of the USB serial driver, set the Card OTDR to the remote control mode before uninstallation.

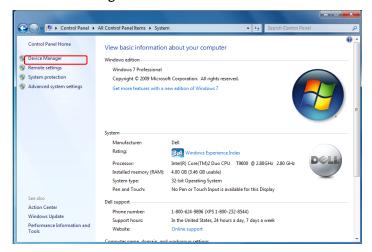
- 1. Power on the Card OTDR and PC and connect the USB cable.
- 2. Click **Computer** from the **Start Menu**.



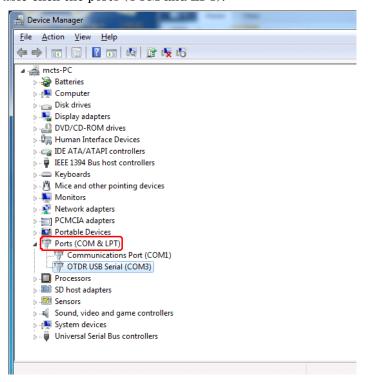
3. Click System Properties.



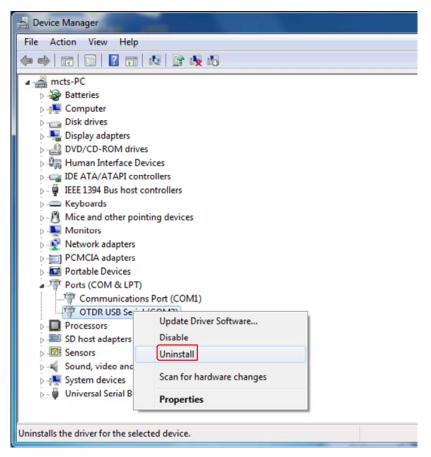
4. Click Device Manager.



5. Double-click the ports (COM and LPT).



6. Right-click OTDR USB Serial and click Uninstall.



7. The confirmation message for deleting the device, click **OK**.



- 8. Check that **OTDR USB Serial** is deleted.
- 9. Close the properties for the device manager, system, and etc.
- 10. Unplug the USB cable connected to the Card OTDR.

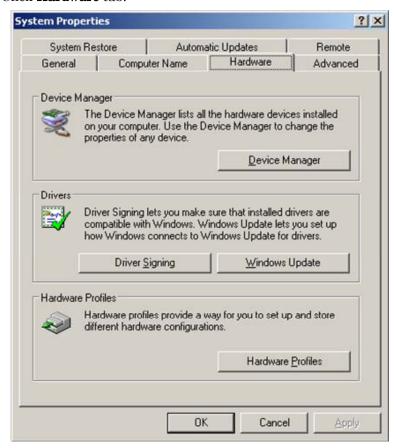
2.7 Confirmation of COM Ports

2.7.1 Confirmation of COM Ports (Windows XP)

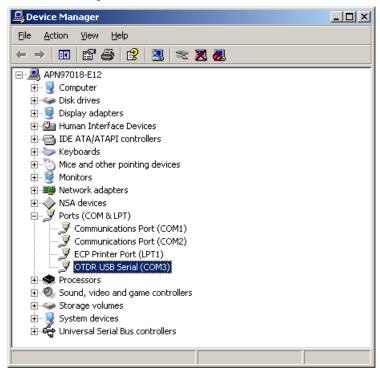
Confirmation Procedures for COM Ports

Avoid turning off the power during confirmation of COM port since the PC communicates with the Card OTDR.

- 1. Power on the Card OTDR and PC to connect the USB cable.
- 2. Click the control panel from the Windows start menu.
- 3. Double-click **System**.
- 4. Click **Hardware** tab.



5. Click Device Manager.



6. Double-click the port (COM and LPT).

7. Check the number displayed on the right side of the OTDR USB Serial.

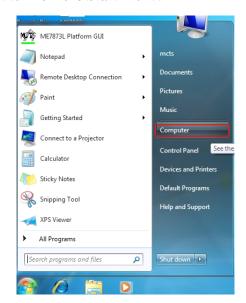
The COM port number is acquired automatically. The COM port number varies with the PC to be installed.

2.7.2 Confirmation of COM Ports (Windows 7)

Confirmation Procedures for COM Ports

Communicate with the Card OTDR while confirming the COM port.

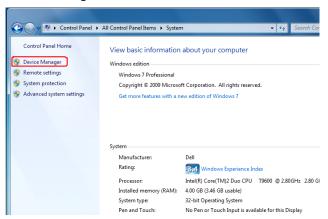
- 1. Power on the Card OTDR and PC and connect the USB cable.
- 2. Click Computer from the Start Menu.



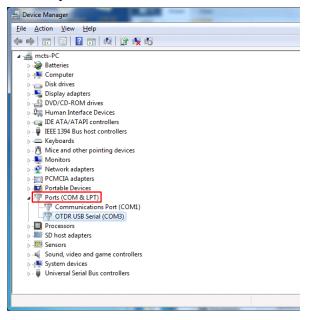
Click System Properties.



4. Click Device Manager.



5. Double-click the ports (COM and LPT).



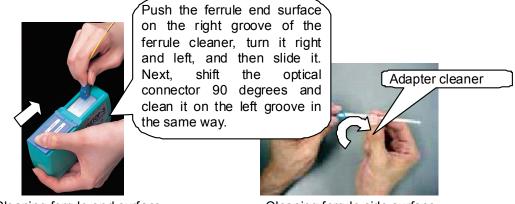
6. Check the displayed number on the right side of the **OTDR USB**Serial

The COM port number is acquired automatically. So, the COM port number varies with the PC.

2.8 Connecting the Optical Fiber Cable

Cleaning the Optical Fiber End Surface

Before connecting the optical fiber cable, clean the ferrule end surface with the dedicated cleaning device. In some cases, the cleaning of the ferrule side surface is effective.



Cleaning ferrule end surface

Cleaning ferrule side surface

Lights pass within the optical fiber of about 10 micron in diameter. The optical fiber may cause loss or reflection which prevents correct measurement even with very little dirt. Make sure to clean the optical connector before measurement.

Figure 2.8-1 Cleaning the Ferrule

Cleaning the Measurement Port (Optical Connector)

Remove the replaceable connector to clean the ferrule end surface. Also, clean the dirt on sleeve within the replaceable connector with the adapter cleaner.

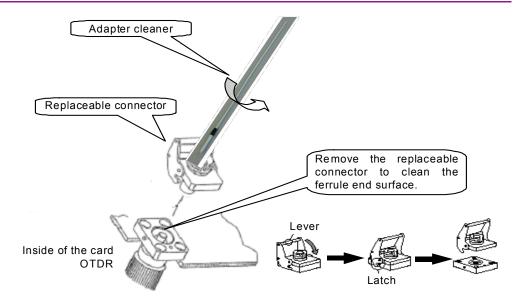


Figure 2.8-2 Cleaning the Optical Connector

Connect the optical fiber cable to the optical connector on the front panel.

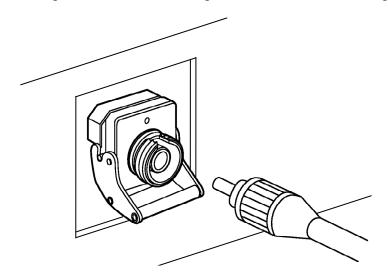


Figure 2.8-3 Connection of Optical Fiber Cable

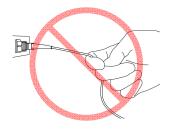


NEVER look into the cable connecting end of the optical connector of the OTDR or the end of the cable connected to the OTDR. If you do so, the laser light may damage your eyes.

2.9 Cautions on Handling Optical Fiber Cables

Optical fiber cables may degrade in performance or be damaged if handled improperly.

Note the following points when handling them.





Do not pull the cable when removing the connector.

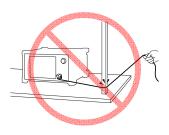
Doing so may break the optical fiber inside the cable, or remove the cable sheath from the optical connector.

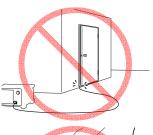


CAUTION

Do not excessively bend, fold, or pinch an optical fiber cable.

Doing so may break the optical fiber inside the cable. Keep the bend radius of an optical fiber cable at 30 mm or more. If the radius is less, optical fiber cable loss will increase.







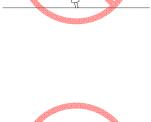


CAUTION

Do not excessively pull on or twist an optical fiber cable.

Also, do not hang anything by using a cable. Doing so may break the optical fiber inside the cable.







CAUTION

Be careful not to hit the end of an optical connector against anything hard such as the floor or a desk by dropping the optical fiber cable.

Doing so may damage the connector end and increase connection loss.



WARNING

Do not touch the end of a broken optical fiber cable.

The broken optical fiber may pierce the skin, causing injury.



CAUTION

Do not disassemble optical connectors.

Doing so may cause part to break or the performance to degrade.

2.10 Replacing the Optical Connector

The optical connector of the Card OTDR has SC as standard. This optical connector can be replaced with other connectors depending on the intended use.

To replace the optical connector

- 1. Pull the adapter lever towards you until the latch is released.
- 2. Remove the connector by lifting it.

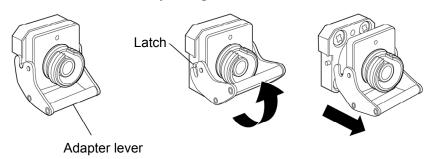


Figure 2.10-1 How to Remove the Optical Connector

For the types of optical connector, refer to Figure 2.10-2.

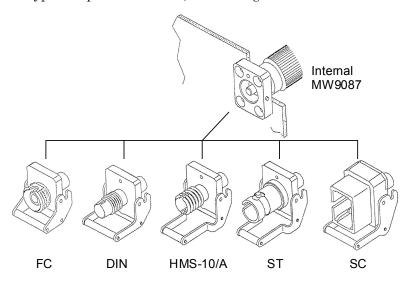


Figure 2.10-2 Types of Optical Connector

2.11 Precautions

Disconnect from communication equipments

If output pulses of the Card OTDR enter the communication device, the light receiving section of the device may be damaged. Before the measurement is started, remove the communication device from the optical fiber.

Limit to the interface

The Card OTDR has USB (serial port) and Ethernet. The serial port can be used only for the network setting of Ethernet. Also, the serial port and Ethernet cannot be used simultaneously.

Condensation

If the Card OTDR is carried from a low-temperature environment to a warm room, there is a danger of condensation in it. In this case, allow the Card OTDR to dry completely before turning on its power.

Results of auto search function

Auto measurement function is a supporting function to reduce the workload of an operator, while it may generate false detection. If false detection is presumed, check the measured waveform data.

Chapter 3 Measurement Method

This chapter explains the measurement procedures and calculation method.

3.1	Setting	gs before Measurement	3-2
	3.1.1	Network settings	3-2
	3.1.2	System settings	3-2
3.2	Measu	rement Procedures	3-3
3.3	Setting	g Measurement Conditions	3-4
3.4	Measu	ırement	3-5
3.5	Wavef	form Analysis	3-6
3.6	Calcul	ation Method	3-7
	3.6.1	Loss measurement	3-7
	3.6.2	Return loss measurement	3-9
	3.6.3	Event evaluation	3-10
	3.6.4	Approximate line method	3-12
3.7	Obtain	ning State	3-14

3.1 Settings before Measurement

The network and system are set before performing the measurement.

3.1.1 Network settings

To control the Card OTDR via the Ethernet, set the following items.

		Command
1.	Connect the Card OTDR and PC via the USB cable.	
2.	Set the Ethernet address and port number, etc. via RS-232C.	NET
3.	Set the Ethernet communication speed and flow control via RS-232C.	NETNEG
4.	Restart the Card OTDR.	RST
5.	Connect the Card OTDR and PC via the Ethernet cable.	
6.	Set the timeout time via the Ethernet.	CONNTM

Other than the network settings, communicate with the Card OTDR via the Ethernet

3.1.2 System settings

Check the self diagnosis and set time of the Card OTDR via the Ethernet.



The optical pulse is output when performing self diagnosis. When the fiber is connected to the communication device, remove the fiber before performing the self diagnosis. The receiving parts of the communication device may be damaged depending on the optical pulse output from the Card OTDR.

1.	Connect the Card OTDR and PC via the Ethernet cable.	Command
2.	Perform the self diagnosis.	SLFTST
3.	Check the date and time settings.	DATE2

3.2 Measurement Procedures

The following figure shows the fiber loss measurement procedures using the Card OTDR.

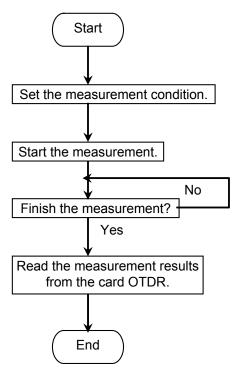


Figure 3.2-1 Procedures for Fiber Loss Measurement

3.3 Setting Measurement Conditions

The measurement conditions such as the distance range, correction values, and averaging process method are set.

	Command
Select the wavelength.	WLS
Set the pulse width.	PLA
	PLS
Set the distance range.	DSA
	DSR
Set the sampling mode.	RES
When the partial sampling is executed, set the	SSMP
range.	
Set IOR (fiber index of refraction).	IOR
Set the attenuation of the attenuator.	ATA
	ATT
	ATV
Set the backscatter coefficient level correction	CAL
Set the averaging processing method.	ALA
When the enhance mode is used, set the mode.	ENH
	Set the pulse width. Set the distance range. Set the sampling mode. When the partial sampling is executed, set the range. Set IOR (fiber index of refraction). Set the attenuation of the attenuator. Set the backscatter coefficient level correction value. Set the averaging processing method.

The INI command allows restoring measurement conditions to the factory default settings.

3.4 Measurement

The measurement is performed using the following procedures and the waveform data is obtained.

		Command
1.	Connect the optical fiber to be measured to the Card OTDR.	
2.	Set whether averaging process is executed or not.	AVG
3.	Set whether smoothing process is executed or not.	SMTH
4.	Set the distance offset for the optical connector of the Card OTDR.	OFS
5.	Change Marker mode or Event table mode.	MES^*
6.	Set the approximate line method.	APR
7.	Start the measurement.	LD
8.	Query whether the measurement is finished or not.	STS
9.	Query whether the waveform data is created or not.	WAV
10.	Obtain the waveform data.	
	SOR format	SRLV HDFG GETFILE
	Binary format	DAT
11.	When the averaging process is executed, query the number of times.	AVE

^{*:} When Marker mode is selected, an event is not detected automatically.

The settings for the optical connector distance offset and approximate line method can be changed even after the measurement is completed. The data obtained with SOR format can be displayed with Trace View software.

3.5 Waveform Analysis

Waveform data analysis allows the detection of fiber reflection/loss occurrence positions and the measurement of reflection/loss amount.

		Command
1.	Set the fiber far end threshold.	THF
2.	Set the reflection threshold.	THR2
3.	Set the splice loss threshold.	THS
4.	Query the number of detected events.	AUT
5.	Query the measurement result and event type of the event number.	EVN2
6.	Query the measurement result of the splice loss.	SPLICE
7.	Query the measurement result of the return loss.	REFLCT
8.	Query the measurement result of the loss.	LOS2
9.	Query the measurement result of all the losses.	TLOS MKDR

When thresholds are changed, events are redetected.

The INI command allows restoring thresholds to the factory default settings.

3.6 Calculation Method

The waveform analysis calculation method is as follows.

3.6.1 Loss measurement

Loss

LOS2 command displays the level difference of X1 marker and X2 marker in dB as the loss measurement result.

When the X1 marker level is higher than the X2 marker level, the loss will be a positive value.

$$Loss = L_1 - L_2$$

Loss:Loss (dB)

L₁: X1 marker level

L₂: X2 marker level

When connecting a fiber with a different Backscatter coefficient level correction value, sometimes the loss value may become negative. LOS2 command is used to measure the loss between two points on the

optical fiber.

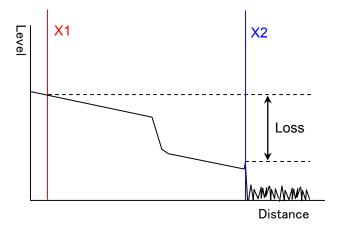


Figure 3.6.1-1 Measurement Method for Loss

Splice loss measurement

SPLICE command measures the loss of points where the optical fiber is connected with connectors, fusion splices, and couplers.

The measured waveform of splice points of the optical fiber looks like the solid line in the following figure. It is observed that the loss occurs over the distance of ΔL depending on the settings of pulse width and sampling count. In fact, loss only occurs at the splice points as shown by the dotted lines. LOS2 command cannot measure the loss shown with the dotted line.

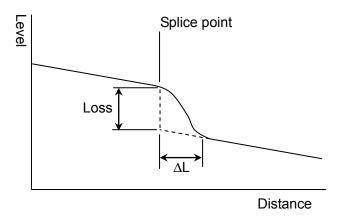


Figure 3.6.1-2 Example of Fiber Connection Measurement

Using SPLICE command, two approximate lines are generated from four markers range using the two-point method or the least square method. The level difference between the approximate lines at cursor B is the measured splice point loss.

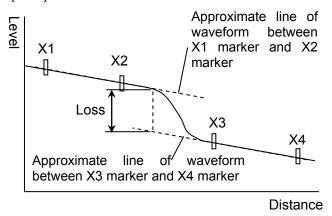


Figure 3.6.1-3 Splice loss Measurement Method

3.6.2 Return loss measurement

The return loss measurement method obtained with REFLCT command is as follows.

Detect the waveform local maximum level L₁.

Measure the Rayleigh scattering level L_2 just before the local maximum level.

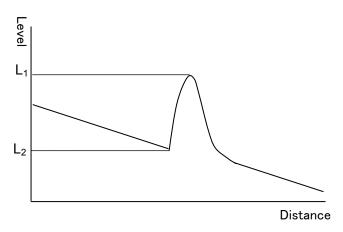


Figure 3.6.2-1 Return Loss Measurement Method

Obtain the return loss by the following formula.

$$ORL = -10\{\log_{10}(BSL) + \log_{10}(10^{\frac{|L_2 - L_1|}{5}} - 1)\}$$

$$BSL = \frac{BSC \times \alpha_R \times c \times PW}{2 \times IOR}$$

ORL: Return loss (dB)

αR: Rayleigh scattering loss

c: Light velocity 3×108 (m/s)

BSC: Backscatter light coefficient

IOR: Index of refraction

PW: Pulse width

L₁: Local maximum level

L₂: Previous Rayleigh scattering level

3.6.3 Event evaluation

The event type evaluation method obtained with EVN2 command is as follows.

Reflection

Fresnel reflection has been generated with a light connector or mechanical splice.

Either one of the points below is evaluated as the reflection event.

- Point where the reflection rate measurement result is equal to or greater than the reflection threshold set with THR2 command.
- Point where the loss measurement result is equal to or greater than the splice loss threshold set with THS command.

Saturation

Point where the reflection light level is high and the measurement level is saturated among the reflection events.

Non-reflective

The loss without Fresnel reflection has been generated with fusion splice or fiber bending loss.

The point where the loss measurement result is equal to or greater than the splice loss threshold set with THS command is evaluated as the non-reflective event.

Group

When there are multiple points where the loss measurement result is equal to or greater than the splice loss threshold set with THS command, the points where the loss of each event cannot be measured due to its short interval are evaluated as the group event.

The measured loss result is displayed as the total of the losses of the multiple points.

Sometimes, reducing the pulse width makes it possible to separate the events.

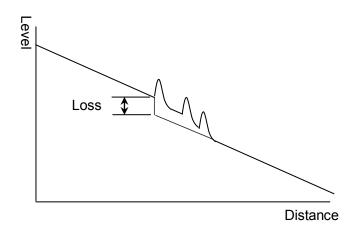


Figure 3.6.3-1 Group Event Loss

Far end

This is the far end of the fiber point or a break in point of the fiber. The point where the loss measurement result is equal to or greater than the far end threshold set with THF command is evaluated as the far end event.

3.6.4 Approximate line method

The approximate line method set with APR command is explained.

Suppose, the two lines of L1 and L2 from the measurement data in order to obtain the splice point loss as shown in the figure below.



Figure 3.6.4-1 Method to Obtain Splice Point Loss

There are two methods, the least square method and two-point method, to obtain these lines.

Two-point method (2PA)

The line which goes through the two markers is the approximate line.

Least square method (LSA)

The least square method obtains the line that is the minimum distance variation from all data which exist between markers to the line.

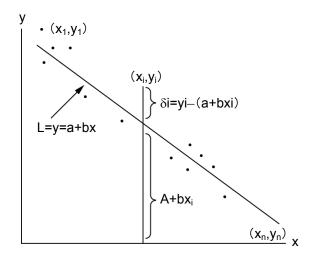


Figure 3.6.4-2 Approximate Line and Gap Amount

Line L is y = a + bx, when the variation of the distance from n points (x1, y1), (x2, y2), ..., (xn, yn) is the minimum as shown in the figure above. Obtain gaps $\delta 1$, $\delta 2$, $\delta 3$, ... from each point to line L including variables a and b, and obtain variables a and b so that E, the sum of the square of δi (gap of each point) becomes the minimum to determine line L.

$$\delta i = yi - (a + bxi)$$

The necessary and sufficient conditions for E to become the minimum with this formula are $\frac{\partial E}{\partial a}$ =0 , $\frac{\partial E}{\partial b}$ =0 .

When these formulas are solved, variables a and b can be obtained as follows.

$$a\!=\!\!\frac{\bar{y}\!\sum_{i=1}^{n}(xi)^2\!\!-\!\bar{x}\!\sum\!(xiyi)}{\sum\limits_{i=1}(xi)^2\!\!-\!\!n(\bar{x})^2},\ b\!=\!\frac{\sum\limits_{i=1}^{n}(xiyi)\!\!-\!\!n\bar{x}\;\bar{y}}{\sum\limits_{i=1}^{n}(xi)^2\!\!-\!\!n(\bar{x})^2}$$

Here,
$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} (xi)$$
, $\bar{y} = \frac{1}{n} \sum_{i=1}^{n} (yi)$.

3.7 Obtaining State

To obtain the information of the Card OTDR, use the following commands.

Error information query

Command ERR MINF

System information query MIN
Measurement state query STS

For the detail of error messages, refer to Section 4.5 "Error Code."

Chapter 4 Command Reference

This chapter explains the command format, transmission procedure, and details of commands.

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4.1 Command Format

The transmission format is classified as follows.

For text data:

Command	Data Part	TRM
Name		

- Command Name: The control command or query command is entered.
- Data Part: Setting parameters of commands and values obtained from the Card OTDR are entered.
- TRM: When transmitting commands, the terminator (CR + LF) is added.

When receiving responses, the terminator (CR + LF) is added.

For binary data (control command):

Command	Data size	Data part (binary)	
Name	(binary)		

- Command Name: The control command is entered.
- Data Size: The byte length (big endian format) of the data part is indicated with 4 bytes.
- Data Part: The terminator is not added.

For binary data (response):

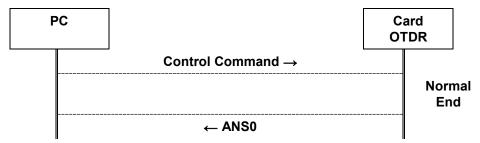
Data Size	Data Part (binary)
(binary)	

- Data Size: The byte length (big endian format) of the data part is indicated with 4 bytes.
- Data Part: The terminator is not added.

4.2 Transmission Procedures

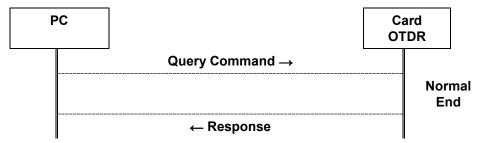
(1) When the command is processed normally

When the control command is transmitted to the Card OTDR, processing the command normally returns ANSO. After it is received, the PC program (called the control program) transmits the following command.



For the query command, a response is returned.

After the response is received, the control program transmits the next command.



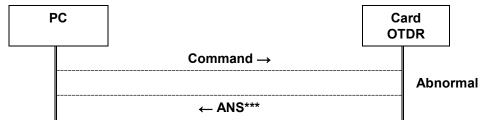
Note:

If the control program transmits the next command before the Card OTDR returns the response, the Card OTDR discards the command received by the time of response transmission (does not return the response for the command that has been received).

(2) When the command is not processed normally

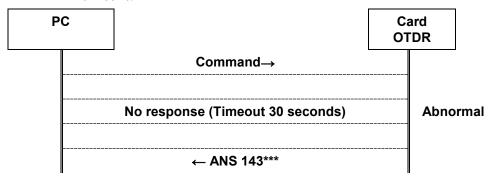
When the Card OTDR cannot execute the received command to

When the Card OTDR cannot execute the received command, the negative response (ANS***) is returned. Enter an error code to ***.



(3) When there is no response

When the command from the control program stops for 30 seconds during transmission, the Card OTDR returns the error (ANS 143) as timeout.



4.3 Command List

Outline of each command is described in the following tables. Refer to 4.4 for the details of each command.

4.3.1 Alphabetical order

Table 4.3.1-1 Command List

Control Command	Query Command	Function
A		
ALA	ALA?	Averaging Mode Setup
APR	APR?	Approximate Line Method Setup
ATA	ATA?	Attenuator Setup in Auto Mode
ATT	ATT?	Attenuator Setup
_	ATV?	Query for available Attenuator
_	AUT?	Query for the result of Auto Search
_	AVE?	Query for Average Mode
AVG	AVG?	Average Setup
В		
_	BSL?	Query for Backscatter Coefficient Level
С		
CAL	CAL?	Backscatter Level Calibration Setup
CONNTM	CONNTM?	Timeout Interval Setup
D		
_	DAT?	Query for Waveform Data
DATE2	DATE2?	Date & Time Setup
DSA	DSA?	Distance Range Mode Setup
DSR	DSR?	Distance Range Setup
DWNLD	DWNLD?	Software Download
E		
_	ERR?	Query for Error Status
ENH	ENH?	High Dynamic Range Mode Setup
_	EVN2?	Query for Event Analysis Result
G		
_	GETFILE?	Data File Acquisition of Waveform
H		
HDFG	HDFG?	Data Flag Setup

Table 4.3.1-1 Command List (Cont'd)

	14510 4.0.1 1	ommand List (Cont d)
Control Command	Query Command	Function
I		
INI	_	Initialization
IOR	IOR?	IOR Setup
L		
LD	LD?	OTDR Measurement Start/Stop
_	LOS2?	Query for Insertion Loss Measurement Results
M		
MES	MES?	Mode Setup
_	MINF?	Query for the Equipment Profile
_	MKDR?	Query for Total Insertion Loss Analysis Range
N		
NET	NET?	Network Configuration
NETNEG	NETNEG?	Ethernet Speed Setup
0		
OFS	OFS?	Relative Distance Setup
PLA	PLA?	Pulse Width Mode Setup
PLS	PLS?	
R	FLS:	Pulse Width Setup
_	REFLCT?	Query for Return Loss
RES	RES?	Sampling Auto Setup
RST	_	Reset Execution
S		Noset Execution
SETFILE	_	Waveform Data File Transfer
SLFTST	SLFTST?	Self-diagnosis
_	SMPINF?	Query for Sampling Conditions
SMTH	SMTH?	Smoothing Setup
=	SPLICE?	Query for Splice Loss Measurement
SRLV	SRLV?	File Data Format Setup
SSMP	SSMP?	Partial Sampling Mode Setup
_	SSMPINF?	Query for Partial Sampling Value
_	STS?	Query for the Equipment Status (OTDR)

Table 4.3.1-1 Command List (Cont'd)

Control Command	Query Command	Function
Т		
THF	THF?	Fiber-end Threshold Setup
THR2	THR2?	Reflection Threshold Setup
THS	THS?	Slice Loss Threshold Setup
_	TLOS?	Query for Total Loss
W		
_	WAV?	Query for Waveform Data Status
WLS	WLS?	Wavelengths Setup

4.3.2 Setup Measurement Condition

CNT: Control command QUR: Query command

RSP: Response for query command

Table 4.3.2-1 Commands for Measurement Conditions

No	Function		Message	Remarks
		CNT	WLS w	w: Wavelength: 1 = 1μm
	33 7 1 41	QUR	WLS? {[0] 1}	0: Current Wavelength [] can be
1	Wavelengths Setup	-	WLS w	omitted, 1: All
	Setup	RSP	WLS n, w1, w2,	n: Wavelength
			wn	w1,, wn: Wavelength
	Distance	CNT	DSA	O: Manual Satur
2	Range Mode	QUR	DSA?	- 0: Manual Setup - 1: Automatic Setup
	Setup	RSP	DSA {0 1}	1. Automatic Setup
		CNT	DSR d	d: Distance Range 1 = 1 m
3	Distance	QUR	DSR?	Available range depends on pulse width
3	range	RSP	DSR d	and sampling mode
		CNT	PLA	0.34
4	Pulse Width Mode Setup	QUR	PLA?	0: Manual Setup
		RSP	PLA {0 1}	1: Automatic Setup
	Pulse width Setup	CNT	PLS p	p: Pulse width 1 = 1 ns
5		QUR	PLS?	Available pulse width depends on
		RSP	PLS p	distance range.
	High	CNT	ENH {0 1}	
C	Dynamic	QUR	ENH?	m: Mode 0: Standard 2: High Dynamic Range
6	Range Mode Setup	RSP	ENH m	- Kange
		CNT	IOR i	: IOD 1 1
7	IOR Setup	QUR	IOR:	i: IOR 1=1
		RSP	IOR i	1.000000 to 1.999999
		CNT	ALA m, [v]	m: Mode 0: Manual by number 1:
		QUR	ALA?	Manual by time 2: Auto
8	Average Mode Setup	•		V= Set value 1=1 Number of time/ 1 second
	Wode Setup		ALA m, Vn, Vt	[] can be omitted.
				Vn: Number
		G1 ****	PDG (0.14.1-2)	Vt: Time
	Sampling	CNT	RES {0 1 3}	0: Coarse
9	Mode Setup	QUR	RES?	1: Medium
		RSP	RES {0 1 3}	3: Fine

Table 4.3.2-1 Commands for Measurement Conditions (Cont'd)

No	Function		Message	Remarks
		CNT	SSMP s,r,q	s: Sampling start 1.00=1.00 m r: Resolution 1.00=1.00 m
10	Partial Sampling Mode Setup	RSP	SSMP? SSMP s,r,q	p: Number of point 0: 5001pt 1: 20001 or 25001 pt 2:100001 or 125001 pt
11	Query for Sampling Point and Resolution	CNT QUR RSP	SMPINF? SMPINF p,r	p: Sampling point r: Resolution 1.00=1.00 m
12	Query for Partial Sampling Status	CNT QUR RSP	SSMPINF? SSMPINF s,r,p	s: Sampling start distance 1.00=1.00 m r: Resolution 1.00=1.00 m p: Number of points
13	Attenuation Auto Setup	CNT QUR RSP	ATA ATA? ATA {0 1}	— 0: Manual Setup — 1: Automatic Setup
14	Attenuator Setup	CNT QUR RSP	ATT a ATT? ATT a	a: Attenuation 1 = 1 dB
15	Query for available Attenuation	CNT QUR RSP	ATV? p ATV a1,a2,an	P: Pulse width a1, •••, an: Attenuation
16	Query for Backscatter Coefficient Level	CNT QUR RSP	BSL? BSL b	b: Backscatter coefficient level at current pulse width $1 = -1 \text{ dB}$
17	Backscatter Level Calibration Setup	CNT QUR RSP	CAL n CAL? CAL n	n: -9.99 to +9.99
18	Fiber-end Threshold Setup	CNT QUR RSP	THF s THF? THF s	s: Threshold, 1 = 1 dB 1 to 99 dB, (1 dB step)
19	Reflection Threshold Setup	CNT QUR RSP	THR2 THR2? THR2 s	s: Threshold,1=1 dB -60 to -20 dB (0.1 dB step)
20	Slice Loss Threshold Setup	CNT QUR RSP	THS s THS? THS s	s: Threshold, 1 = 1 dB 0.01 to 9.99 dB (0.01 dB step)

4.3.3 Setup for Measurement

Table 4.3.3-1 Setup for Measurement

No	Function		Message	Remarks
1	Average Setup	CNT QUR RSP	AVG {0 1} AVG? AVG {0 1}	0: Real time measurement 1: Average Measurement
2	Linear Approximation Method Setup	CNT QUR RSP	APR {0 1} APR? APR {0 1}	- 0: 2PA - 1: LSA
ą	OTDR 3 Measurement Start/Stop	CNT QUR	LD {0 1 2}	0: Measurement stopped 1: Start normal measurement (In progress)
o.		RSP	LD {0 1 2}	2: Start partial sampling measurement (In progress)
4	Mode Setup	CNT QUR RSP	MES {0 1} MES? MES {0 1}	0: Marker mode 1: Event table mode
5	Relative Distance Setup	CNT QUR RSP	OFS 1 OFS 1	l: Relative distance (zero point) 1 = 1 m
6	Smoothing ON/Off Setup	CNT QUR RSP	SMTH {0 1} SMTH? SMTH {0 1}	0: Smoothing OFF 1: Smoothing ON

4.3.4 Query for Measurement Results

Table 4.3.4-1 Commands for Querying Measurement Results

No	Function		Message	Remarks
		CNT QUR	SPLICE?	e: Event position x1: Position X1
1	Query for Insertion Loss		e,x1,x2,x3,x4	x2: Position X2 x3: Position X3
	Measurement	RSP	SPLICE? e,x1,x2,x3,x4,v	x4: Position X4 v: Event loss
	Query for Return	CNT		e: Event position
2	Loss Measurement	QUR	REFLCT? e,p	p: Peak position
	Result	RSP	REFLCT e,p,v	v: Return loss
	Query for Loss	CNT		x1: Marker position X1
3	Measurement	QUR	LOS2? x1,x2	x2: Marker position X2
	Result	RSP	LOS2 x1,x2,v	v: Loss
		CNT		e: Number of Event
4	Query for the	QUR	AUT?	d: Fiber length
4	result of Auto Search	Dan	ATTO 11	l: Total Loss
	Search	RSP	AUT e,d,l,r	r: Total Return loss
		CNT		e: Event number
		QUR	EVN2? e	d: Distance
5	Query for Event Measurement Result			s: Slice loss
5		RSP	EVN2 e,d,s,r,l,t	r: Return loss
	Ivosair	Itor	EVN2 e,a,s,r,1,t	l: Total Loss
				t: Events, types reported
	Overs for Total	CNT		x1: Marker Position X1
6	Query for Total Loss	QUR	TLOS? x1,x2	x2: Marker Position X2
	LOSS	RSP	TLOS x1,x2,t	t: Total Loss
		CNT		s: Data start distance [] can be
		QUR	DAT? [s,e,[k]]	omitted.
				e: Data end distance [] can be omitted.
7	Query for Waveform Data			k: Data decimation rate [] can be
	waveloriii Data	RSP	ds,d	omitted.
				ds: Data length
				d: Data
		CNT		m: Average mode 0: Manual,
	Query for Average	QUR	AVE?	1: Auto
8	Result	RSP	AVE m,k,b	k: number
			. , , ,	b: time
	Query for Total	CNT		a: Stant naint
9	Loss Analysis	QUR	MKDR?	s: Start point e: End point
	Range	RSP	MKDR s,e	e. Ena point

4.3.5 Query for Statuses

Table 4.3.5-1 Command for Querying Statuses

No	Function	Message		Remarks
		CNT		1: In pre-process of measurement
1	Query for the	QUR	STS?	2: Under measurement
1	OTDR Status	RSP	STS {1 2 3 4}	3: In post-process of measurement
		IGI	515 (1 2 5 4)	4: Stopped
	Query for Waveform Data Status	CNT		0: No waveform data
2		QUR	WAV?	1: Waveform data is available
		RSP	WAV {0 1}	1. Waveloriii data is available
	O C F	CNT		
3	Query for Error Information	QUR	ERR?	e: Error number (ANS0 to ANS255)
		RSP	ERR e	

4.3.6 File Data Access

Table 4.3.6-1 Command for File Data Access

No	Function	Message		Remarks
	On our for Data	CNT		s: Data size
1	Query for Data File	QUR	GETFILE?	d: File data
	THE	RSP	s,d	u. File data
		CNT	SETFILE s,d	
2	File Data Transmission	QUR		s: File size d: File data
		RSP		u. The data
		CNT	SRLV {1 2 3}	1: Key event data block only
3	File Data Format Setup	QUR	SRLV?	2: Data point block only
	Soup	RSP	SRLV {1 2 3}	3: Both key event and data point blocks
		CNT	HDFG {0 1 2}	0: BC
4	Data Flag Setup	QUR	HDFG?	1: RC
		RSP	HDFG {0 1 2}	2: OT

4.3.7 System Maintenance

Table 4.3.7-1 Command for System Maintenance

No	Function		Message	Remarks
1	Date & Time Setup	QUR RSP	DATE2 y,m,d,h,mm,s, diff DATE2? DATE2 y,m,d,h,mm,s, diff	y: year m: month d: day h: hour mm: minute s: second diff: Time difference from UTC
		CNT	SLFTST	l: optical level
		QUR	SLFTST?	w: warming up
2	Solf-Diagnostics	RSP	SLFTST	p: power voltage
4	Self-Diagnostics		l,w,p,t	t: internal temperature
				0: Normal
				1 or more: Failure
	Query for System Information	CNT		m: maker n: model name
3		QUR	MINF?	c: comment s: serial number
		RSP	MINF	mac: mac address v: software version
			m,n,c,s,mac,v	
		CNT	DWNLD s,d	s: File size
				d: File data
	Software Update	QUR	DWNLD?	
4		RSP	DWNLD	0: Software is not received.
			{0 1 2 3}	1: Software is being updated.
				2: Software update is completed.
				3: Software update is failed.

4.3.8 Network Configuration

Table 4.3.8-1 Command for Network Configuration

No	Function	Message		Remarks
	m	CNT	CONNTM t	
1	Timeout Interval Setup	QUR	CONNTM?	t: Timeout interval 1 = 1 s
	Setup	RSP	CONNTM t	
	NT / 1	CNT	NET i,p,m,g	: ID adduces n' nont number
2	Network Configuration	QUR	NET?	i: IP address p: port number
		RSP	NET i,p,m,g	m: Netmask g: Gateway
	Ethernet Speed Setup	CNT	NETNEG t,f	t: Communication speed
3		QUR	NETNEG?	(10 or 100 or AUTO)
		RSP	NETNEG t,f	f: Flow control F:Full H: Half
	m·	CNT	ATO t	
4	Timeout Interval for Alarm Setup	QUR	ATO?	t: Timeout interval 1 = 1 s
		RSP	ATO t	

4.3.9 Other Setup

Table 4.3.9-1 Command for Other Setup

No	Function	Message		Remarks
	Reset	CNT	RST	
1		QUR		Resets the Card OTDR.
		RSP		
	Initialization	CNT	INI	0 1 1 1 1
2		QUR		Sets measurement conditions to the factory default.
		RSP		lactory default.

4.4 Command Details

4.4.1 Description of Message Explanations

Command Syntax

"_" between the header and the arguments of the command means a space.

Effective argument range

Entered value in dB will be rounded off to four decimal places.

It will also be converted to a discrete value, for example in 0.1 dB steps, according to the definition of each command.

The distance argument entry in IOR calibration mode works as follows. The entered value is inversely converted to a law distance and rounded by current physical data resolution. After acceptable range verification (IOR=1.5), it will be used as an argument of the command.

4.4.2 Measurement Condition Setup

(1) Averaging Mode Setup

Command	ALA		
Description	Set the number of times for averaging or number of seconds used in measurement.		
	ALA_ <mode>,[<</mode>	argument>]	
Control	Mode	0: Times 1: Seconds 2: Auto For switching to Auto Times (Seconds), set to Times	
		(Seconds) first, and then set to Auto.	
	Set value	Times: 1 to 9999 times Seconds: 1 to 9999 seconds Auto: none	
Query	ALA?		
	ALA_ <mode>,<</mode>	Set times >,< Set seconds >	
Response	Mode	0: Times 1: seconds 2: Auto	
	Set number	1 to 9999 times	
	Set number	1 to 9999 seconds	
returned.		is Auto, the value set with the auto setting will be is Auto and in case of no waveform, the response will be d.	

(2) Attenuator Setup in Auto Mode

Command	ATA			
Description	Set Attenuator in Auto mode.			
Control	ATA	ATA		
Query	ATA?			
	ATA_{0 1}			
Response	0	Manual Setup		
	1	Automatic Setup		
Remarks When Pulse width is in Auto mode, Attenuator will be set to Auto Also, when Attenuator is changed to Auto mode, the waveform be erased.		•		

(3) Attenuator Setup

Command	ATT		
Description	Sets Attenuation.		
	ATT_ <attenuati< td=""><td>on></td></attenuati<>	on>	
		Number rounded down to three decimal places Unit: dB	
Control		Available attenuation range depends on Pulse width.	
	Attenuation	Available attenuation rang can be obtained using ATV?_ <pulse width=""> command.</pulse>	
		When Pulse width setting is in Auto mode, Attenuator will be set to Auto mode automatically.	
Query	ATT?		
	ATT_ <attenuation></attenuation>		
, n		Numeric value Unit : dB	
Response	Attenuation	When Attenuator is in Auto mode, the response will be "ATT ***".	
		When Pulse width is in Auto mode, the response will be "ANS103".	
	When Pulse wid	th is in Auto mode, Attenuator will be set to Auto mode.	
	When Attenuation is changed, Auto mode will be released.		
Remarks	When the setup value is changed with the command, the waveform data will be erased. However, when Attenuator is set to Auto mode, the		
	Also, if measure	will be erased even without setup value change. ment is being executed, the measurement will stop, and eer the command processing has been executed.	

(4) Query for Available Attenuator

Command	ATV			
Description	Queries availabl	e Attenuation values under the specific Pulse width.		
Control				
	ATV?_ <pulse td="" wi<=""><td>dth></td></pulse>	dth>		
Query	Pulse width	Numeric value Unit: ns		
	ATV_ <attenuati< td=""><td>on>,[<attenuation>]</attenuation></td></attenuati<>	on>,[<attenuation>]</attenuation>		
Response	Attenuation	Number of three decimal places Unit: dB		
Remarks				

(5) Query for Backscatter Coefficient Level

Command	BSL			
Description	Queries Backscatter coefficient level under the present Pulse width.			
Control				
Query	BSL?			
	BSL_ <backscatter coefficient="" level=""></backscatter>			
Response	Backscatter coefficient level	Numeric value Unit: dB 1=-1 dB When Pulse width is in Auto mode or in case of no waveform data, the response will be BSL ***.		
Remarks				

(6) Backscatter Level Calibration Setup

Command	CAL		
Description	Sets the coefficient	ent value to calibrate Backscatter level.	
	CAL_ <coefficien< td=""><td>t value></td></coefficien<>	t value>	
Control	Coefficient value	Number rounded down to three decimal places Unit: dB Acceptable coefficient range: -9.99 to +9.99 In case of waveform data, changing the setup value with CAL command will re-execute auto search. When the setup range is exceeded (including integer or negative numbers), the response will be ANS41. When the parameter data format is incorrect, the response will be ANS42.	
Query	CAL?		
Pagnanga	CAL_ <coefficien< td=""><td>t value></td></coefficien<>	t value>	
Response	Coefficient value	-9.99 to +9.99	
Remarks			

(7) Distance Range Mode Setup

Command	DSA	
Description	Sets the distanc	e range control in Automatic Setup mode.
Control	DSA	
Query	DSA?	
	DSA_{0 1}	
Response	0	Manual Setup
	1	Automatic Setup
Remarks	Waveform data will be erased as the result of DSA command execution.	

(8) Distance Range Setup

Command	DSR	
Description	Sets the distanc	e range used at the measurement.
	DSR_< Distance Range >	
Control	Distance Range	Value without IOR compensation. Unit: m Available distance range per present sampling mode: Medium: No less than 100 km Coarse or Fine: No less than 1 km
Query	DSR?	
	DSR_ <distance< td=""><td>Range ></td></distance<>	Range >
Response	Distance Range	Value without IOR compensation. Unit: m In case of no waveform data in Automatic distance range mode, the response will be "DSR ***".
Remarks	Automatic distance range Setup mode will be released as the result of DSR command execution. The waveform data will be erased when Distance range is changed.	

(9) High Dynamic Range Mode Setup

Command	ENH		
Description	Sets high dynamic range mode for measurements		
	ENH_{0 1}	ENH_{0 1}	
Control	0	Standard Mode	
Control	1	High dynamic range mode Available when the pulse width is between 50 ns to 2000 ns.	
Query	ENH?		
D	0 Standard Mode		
Response	1	High dynamic range mode	
Remarks	The wave form data will be erased when the high dynamic range mode is changed.		

(10) IOR Setup

Command	IOR	
Description	Sets IOR for measurements.	
C 1	IOR_ <ior value=""></ior>	
Control	IOR value	1.000000 to 1.999999
Query	IOR?	
T)	IOR?_ <ior value=""></ior>	
Response	IOR value	1.000000 to 1.999999
Remarks		

(11) Pulse Width Mode Setup

Command	PLA		
Description	Sets the pulse width to Automatic Setup mode.		
Control	PLA	PLA	
Query	PLA?		
	PLA_{0 1}		
Response	0	Manual Setup	
	1	Automatic Setup	
Remarks	Waveform data will be erased as the result of PLA command execution.		
Itemarks	Attenuator control is also set in Automatic Setup mode.		

(12) Pulse Width Setup

Command	PLS	
Description	Sets the pulse w	idth for measurements.
	PLS_ <pulse td="" wid<=""><td>th></td></pulse>	th>
Control	Pulse width	Numeric value Unit: ns The settable range varies with the distance range. Refer to Appendix B "Relationship between Pulse Width and Distance Range".
Query	PLS?	
	PLS_ <pulse width=""></pulse>	
Response	Pulse width	Numeric value Unit: ns
Remarks	Automatic pulse width Setup mode will be released as the result of PLS command execution. The wave form data will be erased when the pulse width is changed.	
	When the pulse width is Auto and in case of no waveform, the response will be PLS ***.	

(13) Sampling Mode Setup

Command	RES		
Description	Sets Sampling N	Sets Sampling Mode for measurements.	
	RES_{0 1 3}		
	0	Coarse: 5001 points	
Control	1	Medium: 25001 points Available when Distance range is 1 km or more.	
	3	Fine: 125001 points Available when Distance range is 100 km or more.	
Query	RES?		
	RES_{0 1 3}		
Damana	0	Coarse	
Response	1	Medium	
	3	Fine	
Remarks	The wave form data will be erased when the sampling mode is changed.		

(14) Query for Sampling Point and Resolution

Command	SMPINF		
Description	Queries sampling information.		
Control			
Query	SMPINF?		
	SMPINF_< number of points >, <modified resolution(m)=""></modified>		
Response	Number of points	Numeric value	
	Modified resolution	Value without IOR compensation. Unit: m	
Remarks	When distance range is in Auto mode and in case of no waveform data, the response will be SMPINF ***,***.		

(15) Partial Sampling Measurement Condition Setup

Command	SSMP		
Description	Sets the conditions for the partial sampling measurements.		
Control	SSMP_< start distance(m)>,< resolution(m)>,< number of points >		
	Start distance	Set the sampling start distance. Value rounded down to two decimal places with IOR compensation. Unit: m	
	Resolution	Value without IOR compensation. Unit: m	
	Number of points	0: 5001 points 1: 20001 points or 25001 points 2: 100001 points or 125001 points	
Query	SSMP?		
	SSMP_< start distance(m)>,< resolution(m)>,< number of points >		
	Start distance	Set the sampling start distance. Value rounded down to two decimal places with IOR compensation. Unit: m	
Response	Resolution	Value without IOR compensation. Unit: m	
	Number of points	0: 5001 points 1: 20001 points or 25001 points 2: 100001 points or 125001 points	
Remarks	distance from th Example: When distance offset a 1000 m.	offset is set with OFS command, the start distance is the distance offset. the position of start distance is set at 1000 m and to m, then absolute distance of the start distance is offset is 100 m, absolute distance of the start distance is Partial Sampling Range= Resolution×(Number of points-1) Sart distance 1000 m	

(16) Query for Partial Sampling Value

Command	SSMPINF		
Description	Queries set valu	Queries set value for the partial sampling measurements.	
Control			
Query	SSMPINF?	SSMPINF?	
	<modified p="" resolution<=""> Compensation</modified>	npensation start distance(m)>, ation(m)>,< Sampling point > A number rounded down to two decimal places in the resolution of measurement data with IOR	
Response	start distance	compensation. Unit: m	
	Resolution	Value with IOR compensation. Unit: m	
	Sampling point	Numeric value	
Remarks			

(17) Fiber-end Threshold Setup

Command	THF	
Description	Sets threshold.	
	THF_ <threshold< td=""><td>></td></threshold<>	>
Control	Threshold	Fiber -end threshold, integer in dB. Available threshold value: Integer from 1 to 99 dB In case of waveform data, changing the setup value with THF command will re-execute auto search. When the setup range is exceeded (including integer or negative numbers), the response will be ANS41. When the parameter data type is incorrect, the response will be ANS42.
Query	THF?	
Response	THF_ <threshold></threshold>	
	Threshold	1 to 99 dB
Remarks		

(18) Reflection Threshold Setup

Command	THR2	
Description	Sets Reflection threshold.	
	THR2_ <thresho< td=""><td>ld></td></thresho<>	ld>
Control	Threshold Value	Reflection threshold, value rounded down to one decimal place in dB. Available threshold value: -60.0 dB to -20.0 dB In case of waveform data, changing the setup value
		with THR2 command will re-execute auto search. When the setup range is exceeded (including integer or negative numbers), the response will be ANS41.
		When the parameter data type is incorrect, the response will be ANS42.
Query	THR2?	
	THR2_ <threshold></threshold>	
Response	Threshold Value	-60.0 dB to -20.0 dB
Remarks		

(19) Splice Loss Threshold Setup

Command	THS	
Description	Sets Slice loss threshold.	
	THS_ <threshold< td=""><td>></td></threshold<>	>
Control	Threshold	Splice loss threshold, value rounded down to two decimal places in dB. Available threshold value: 0.01 dB to 9.99 dB In case of waveform data, changing the setup value with THS command will re-execute auto search. When the setup range is exceeded (including integer or negative numbers), the response will be ANS41. When the parameter data type is incorrect, the response will be ANS42.
Query	THS?	
Response	THS_ <threshold></threshold>	
	Threshold	0.01 dB to 9.99 dB
Remarks		

(20) Wavelength Setup

Command	WLS	
Description	Sets the measurement wavelength.	
	WLS_ <waveleng< td=""><td>gth></td></waveleng<>	gth>
Control	Wavelength	Value rounded down to three decimal places Unit: µm The wavelength to be set varies with the optical units. The settable wavelength will be obtained by the query command, WLS? 1.
	WLS?_{[0] 1}	
Query	0	Queries currently set wavelength
	1	Queries all of the available wavelengths
	In case of the argument = "0": WLS_ <wavelength></wavelength>	
Response	In case of argument = "1": WLS_ <number n="" of="" wavelength="">,<wavelength 1="">,···,<wavelength n=""></wavelength></wavelength></number>	
Remarks	[] can be omitted. When WLS command is executed, the waveform data will be erased.	

4.4.3 Settings for Measurement

(1) Linear Approximation Method Setup

Command	APR		
Description	Sets the approximate line method to 2PA or LSA.		
Control	APR_{0 1}		
	0	2PA (Two-point method)	
	1	LSA (Least square method)	
Query	APR?		
Response	APR_{0 1}		
	0	2PA	
	1	LSA	
Remarks			

(2) Average Setup

Command	AVG		
Description	Sets the real time measurement or average measurement.		
Control	AVG_{0 1}		
	0	Real Time Measurement	
	1	Average Measurement	
Query	AVG?		
Response	AVG_{0 1}		
	0	Real Time Measurement	
	1	Average Measurement	
Remarks	If the average measurement is being executed, the measurement will stop, and it will restart after the command processing has been executed. However, if the setup value is not changed, nothing will be executed.		

(3) OTDR Measurement Start/Stop

Command	LD		
Description	Start or stop the OTDR measurements.		
	LD_{0 1 2}		
Control	0	Stop measurement.	
Control	1	Start measurement.	
	2	Start Partial sampling measurement.	
Query	LD?		
	LD_{0 1 2}		
D	0	Measurement stopped.	
Response	1	Measurement in progress	
	2	Partial sampling Measurement in progress.	
Remarks	If LD_1 is executed while the measurement is being executed, the measured waveform will be erased, and the measurement will be restarted from the beginning. When LD_2 is executed while the measurement is being executed, an error is returned. For the partial sampling measurement, if LD_2 is executed with improper setup of the start distance and end distance, an error is returned.		

(4) Mode Setup

Command	MES	
Description	Change Marker mode or Event table mode.	
	MES_{0 1} 0	
Control		
	1	Event table mode
Query	MES?	
	MES_{0 1} 0 Marker mode	
Response		
	1	Event table mode
Remarks	When Marker mode is selected, an event is not detected automatically.	

(5) Relative Distance Setup

Command	OFS		
Description	Set relative distance as the relative zero point.		
	OFS_< offset distance>		
Control	Offset distance	Value rounded down to three decimal places. Unit: m From 0.00 m to the current distance range When distance range is in Auto mode and in case of no waveform data, the response will be ANS60.	
Query	OFS?		
	OFS_< offset distance >		
Response	Offset distance	Value rounded down to three decimal places. Unit: m When distance range is in Auto mode and in case of no waveform data, the response will be OFS ***.	
Remarks	The distance set by OFS is the IOR compensation value when the IOR set value is exceeding 1.5, the higher value than the setting distance range can be set. When the distance range shorter than the relative distance value is set by the DSR command, the response will be OFS 0.00.		

(6) Smoothing On/Off Setup

Command	SMTH	
Description	Sets the smoothing processing ON/OFF.	
	SMTH_{0 1} 0 Smoothing OFF	
Control		
	1	Smoothing ON
Query	SMTH?	
	SMTH_{0 1}	
Response	0	Smoothing OFF
	1	Smoothing ON
Remarks		

4.4.4 Querying Measurement Results

(1) Query for Auto Search Result

Command	AUT			
Description	Queries the auto sear	Queries the auto search result.		
Control				
Query	AUT?	AUT?		
	AUT_ <number eve<br="" of=""><total loss="" return=""></total></number>	AUT_ <number events="" of="">,<fiber length="">,<end end="" loss="" to="">,</end></fiber></number>		
	Number of events	0 to 99		
	Fiber length	Value rounded down to three decimal places with IOR compensation. Unit: m When the measurement is unavailable, the response will be ***.		
Response	Total loss	Value rounded down to three decimal places. Unit: dB When the measurement is unavailable, the response will be ***.		
	Total return loss	Value rounded down to two decimal places. Unit: dB When the measurement is unavailable, the response will be ***. The saturation information is added as the first byte of the response data. <: Saturated : Not saturated		
Remarks				

(2) Query for Average Mode

Command	AVE			
Description	Queries the number of averages (seconds).			
Control				
Query	AVE?	AVE?		
	AVE_ <average mode="">,<number average="" of="">,<time average="" of=""></time></number></average>			
	Average mode	0: Manual Setup 1: Automatic Setup		
Response	Number of average	Numeric value Unit: number In case of no waveform or real time measurement, the response will be 0.		
	Time of average	Numeric value Unit: second In case of no waveform or real time measurement, the response will be 0.		
Remarks				

(3) Query for Waveform Data

Command	DAT		
Description	Queries waveform data.		
Control			
	DAT?_[<data distance="" start="">,<data distance="" end=""> [,<decimation rate="">]]</decimation></data></data>		
		Value rounded down to three decimal places with IOR compensation.	
	Data start	Unit: m	
	distance	Value from the sampling start distance to sampling end distance.	
		If omitted, the sampling start position is specified.	
Query		Value rounded down to three decimal places with IOR compensation.	
	Data end	Unit: m	
	distance	Value from the sampling start distance to sampling end distance.	
		If omitted, the sampling end position is specified.	
		The number of points	
	Decimation rate	The skip interval for output data is specified.	
		0 to 150000 (according to the current resolution) 0 when omitted.	
	<data length=""> <data></data></data>		
	Data length	Number of output data points in 32-bit binary format.	
		One item of the data is indicated with 16 bits.	
		The data is divided into upper 8 bits and lower 8 bits,	
		and first upper ones are output, and then lower ones are output.	
Response		1 = 0.001 dB	
	Data		
		If the data end distance is shorter than the start	
		distance, 1 point of data which corresponds to the	
		data start distance will be output.	
		Example: For DAT? 100,0, data of 100 m (1 point) will be output.	

(Cont'd)

	There are three typical usage are as follows;		
	– DAT? :When measured data is to be output as it is		
	– DAT? 100,2000 : When only a part of measured data is to be output		
	– DAT? 100,2000,5: When partially swept measured data is to be output		
	In case of no waveform data, the response will be ANS15.		
	Arguments in [] can be omitted.		
Remarks			
	Example of the response: When outputting the data of 5001 points, 37.580		
	dB on 1st data.		
	Data length: $5001 \text{ points } \rightarrow 5001 \text{ (Dec)} = 00001389 \text{ (Hex)}$		
	1st data: $37.580 \text{ dB} \rightarrow 37.580 \text{ x } 1000 = 37580 \text{ (Dec)} = 92\text{CC (Hex)}$		
	00h 00h 13h 89h,92h CCh (second and subsequent data)		
	Data length 1st data		

(4) Query for Event Analysis Result

Command	EVN2					
Description	Queries Event table.					
Control						
	EVN2?_ <event 1<="" td=""><td>number></td><td></td><td></td><td></td></event>	number>				
Query	Event number	Number to ide	=	ent on the even	t table.	
	EVN2_ <event number="">,<distance>,<event loss="">,</event></distance></event>					
	<return loss="">,<t< td=""><td>otal loss>,<event< td=""><td>type></td><td></td><td></td></event<></td></t<></return>	otal loss>, <event< td=""><td>type></td><td></td><td></td></event<>	type>			
	Event number	Number of the 1 to the number				
	Distance	Value rounded compensation. Unit: m	Value rounded down to three decimal places with IOR compensation.			
	Splice loss	Unit: dB When the mea will be ***.	surement is	ee decimal place	e response	
Response		For the far end, the response will be END. Value rounded down to three decimal places. Unit: dB When the measurement is unavailable, the response will be ***.				
	Return loss	The following threshold status is added as the first byte of the response data. "_" means a space character.				
		Event detection setup	Saturat ed	Exceeding the threshold	Under the threshold	
		Enable	<	_	(
	Total loss	Value rounded down to three decimal places. Unit: dB When the measurement is unavailable, the response				
		will be ***.			- I	
	Event type	N: Non reflective event, R: Reflective event, E: Fiber end, C:Grouped, S:Saturated reflective event For descriptions of event types, refer to Section 3.6.3.			ent	
Remarks		"Event evaluat	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			

(5) Query for Insertion Loss Measurement

Command	LOS2			
Description	Calculates the le	Calculates the loss from the marker positions.		
Control				
	LOS2? <position< td=""><td>X1>,<position x2=""></position></td></position<>	X1>, <position x2=""></position>		
Query	Position X1	Value rounded down to two decimal places with IOR compensation.		
	Position X2	Unit: m 0.00 m to the setup value of distance range		
	LOS2? <calibrated position="" x1="">,<calibrated position="" x2="">,<insertion loss=""></insertion></calibrated></calibrated>			
	Calibrated position X1	Value of two decimal places rounded down to multiple number of data resolution with IOR compensation. Unit: m		
Response	Calibrated position X2	When the relation of the positions of calibrated markers is not X1 < X2, the response will be ***.		
	Insertion Loss	Value rounded down to three decimal places. Unit: dB		
		When the loss exceeds +99.999 dB or falls below -99.999 dB, the response will be ***.		
		Also when the relation of the positions of calibrated markers is not X1 < X2, the response will be ***.		
Remarks				

(6) Query for Total Loss Analysis Range

Command	MKDR		
Description	Queries the calculation range of total loss.		
Control			
Query	MKDR?		
Response	MKDR_ <start point="">,<end point=""></end></start>		
	Start point	0 to number of data point When the measurement is unavailable, the response will be MKDR ***.	
	End point	0 to number of data point When the measurement is unavailable, the response will be MKDR ***.	
Remarks			

(7) Query for Return Loss

Command	REFLCT		
Description	Calculates the return loss from the marker positions.		
Control			
	REFLCT?_ <event< td=""><td>position>,<peak position=""></peak></td></event<>	position>, <peak position=""></peak>	
Query	Event position	Value rounded down to two decimal places with IOR compensation.	
	Peak position	Unit: m 0.00 m to the setup value of distance range	
	REFLCT_< calibrated event position >, < calibrated peak position >, < return loss>		
Response	Calibrated event position	Value of two decimal places rounded down to multiple number of data resolution with IOR compensation.	
	Calibrated peak position	Unit: m When the calibrated peak position is not higher than the calibrated event position, the response will be ***.	
	Return loss	Value rounded down to three decimal places. Unit: dB When the measurement is unavailable (when the event position level is higher than the peak position or the peak position is shorter than the event position), the response will be ***. The saturation information is added as the first byte of the response data.	
		<: Saturated _: Not saturated	
Remarks			

(8) Query for Splice Loss Measurement

Command	SPLICE		
Description	Calculates the splice loss from the marker positions.		
Control			
	SPLICE?_ <event position="">,<position x1="">,<position x2="">,<position x3="">,<position x4=""></position></position></position></position></event>		
	Event position		
Query	Position X1	Value rounded down to two decimal places with IOR	
query	Position X2	compensation. Unit: m	
	Position X3	0.00 m to the setup value of distance range	
	Position X4		
Response	position X2>, <calibrated calibrated="" event="" position="" td="" x1="" x2="" x3<=""><td>value of two decimal places rounded down to multiple number of data resolution with IOR compensation. Unit: m When the relationship of the positions of calibrated markers is not X1 < X2 ≤ event position < X3 < X4, the response will be ***.</td></calibrated>	value of two decimal places rounded down to multiple number of data resolution with IOR compensation. Unit: m When the relationship of the positions of calibrated markers is not X1 < X2 ≤ event position < X3 < X4, the response will be ***.	
	Calibrated position X4		
	Splice loss	Value rounded down to three decimal places. Unit:dB When the loss exceeds +99.999 dB or falls below −99.999 dB, the response will be ***. Also when the relation of the positions of calibrated markers is not X1 < X2 ≤ event position < X3 < X4, the response will be ***.	
Remarks			

(9) Request for Total Loss

Command	TLOS		
Description	Queries the total loss of marker section.		
Control			
	TLOS?_ <position< td=""><td>X1>,<position x2=""></position></td></position<>	X1>, <position x2=""></position>	
Query	Position X1	Value rounded down to two decimal places with IOR	
	Position X2	compensation. Unit: m 0.00 m to the setup value of distance range	
	TRL_ <calibrated position="" x1="">,<calibrated position="" x2="">,<total loss=""></total></calibrated></calibrated>		
	Calibrated position X1	Value of two decimal places rounded down to multiple number of data resolution with IOR compensation.	
Response	Calibrated position X2	Unit: m When the relation of the positions of calibrated markers is not X1 < X2, the response will be ***.	
		Value rounded down to three decimal places. Unit: dB	
	Total loss	When the measurement is unavailable, the response will be ***.	
Remarks			

4.4.5 Queries for statuses

(1) Query for Error Status

Command	ERR	
Description	Queries the error status of the command executed lastly.	
Control		
Query	ERR?	
D	ERR_ <error code<="" td=""><td>e></td></error>	e>
Response	Error code	ANS0 to 255
Remarks	For more information about the error code, refer to "4.5 Error Code".	

(2) Query for the Equipment (OTDR) Status

Command	STS	
Description	Queries the equipment status (OTDR).	
Control		
Query	STS?	
	STS_ <status></status>	
	Status	1: In pre-process of measurement
Response		2: Under measurement
		3: In post-process of measurement (such as smoothing and auto search)
		4: Stopped
Remarks		

(3) Query for Waveform Data Status

Command	WAV		
Description	Queries the waveform data status.		
Control			
Query	WAV?		
	WAV_{0 1}		
Response	0	No waveform data	
	1	Waveform data is available	
Remarks			

4.4.6 Settings for Data File

(1) Data File Acquisition of Waveform

Command	GETFILE		
Description	Acquires the wa	Acquires the waveform data file.	
Control			
Query	GETFILE?	GETFILE?	
	<data size=""> <file data=""></file></data>		
Response	Data size	File size (Binary data of 4 bytes) Upper bytes are output first, and then the lower bytes.	
	File data	Binary data in SR4731 format	
Remarks	Example) For the 1000 bites waveform file data(1000=000003E8h): 00h 00h 03h E8h (hereafter, file data) File size Write the received binary data to the file, except the first 4-bytes (data size). If saved with the .sor file extension, this can be loaded by Trace View software.		

(2) Data Flag Setup

Command	HDFG	
Description	Sets data flag.	
	HDFG_{0 1 2}	
Control	0	BC (Installation)
Control	1	RC (Repair)
	2	OT (Others)
Query	HDFG?	
	HDFG_{0 1 2}	
Dognongo	0	BC (Installation)
Response	1	RC (Repair)
	2	OT (Others)
Remarks		

(3) Waveform Data File Transfer

SETFILE	
Transfers a Waveform data file to the Card OTDR.	
SETFILE <file s<="" td=""><td>size> <file data=""></file></td></file>	size> <file data=""></file>
File size	File size (Binary data of 4 bytes) Upper bytes are set first, and then the lower bytes. 800 to 400 Kbytes (409600 bytes)
File data	Binary data of waveform file to be written
Remarks Example) When transferring the 1000 bytes waveform file(1000=000003E8h): 53h 45h 54h 46h 49h 4Ch 45h 00h 00h 03h E8h (hereafter, file S E T F I L E File size	
	Transfers a Wa SETFILE <file data="" example)="" file="" file(1000="00000</td" s="" size="" wher=""></file>

(4) File Data Format Setup

Command	SRLV	
Description	Sets the recording level of SR-4731 data file.	
	SRLV {1 2 3}	
	1	Event data only (Key event data block)
Control	2	Measurement condition and waveform data only (Data point block)
	3	Event data, measurement condition, and waveform data
Query	SRLV?	
	SRLV {1 2 3}	
	1	Event data only (Key event data block)
Response	2	Measurement condition and waveform data only (Data point block)
	3	Event data, measurement condition, and waveform data
Remarks		

4.4.7 System Maintenance

(1) Date & Time Setup

Command	DATE2	
Description	Sets the current Date & Time and the time difference from UTC.	
	DATE2_ <year difference=""></year>	>, <month>,<day>,<hour>,<minute>,<second>,<time< td=""></time<></second></minute></hour></day></month>
	Year	2000 to 2036
	Month	1 to 12
Control	Day	1 to 31
Control	Hour	0 to 23
	Minute	0 to 59
	Second	0 to 59
	Time difference	-12 to +12 (0.5 step)
Query	DATE2?	
	DATE2_ <year>,<month>,<day>,<hour>,<minute>,<second>,<time difference=""></time></second></minute></hour></day></month></year>	
	Year	2000 to 2036
	Month	1 to 12
D	Day	1 to 31
Response	Time	0 to 23
	Minute	0 to 59
	Second	0 to 59
	Time difference	-12 to +12 (0.5 step)
Remarks		

(2) Software Download

Command	DWNLD	
Description	Updates the software of the equipment by downloading operation	
	DWNLD <file siz<="" td=""><td>ze><file data=""></file></td></file>	ze> <file data=""></file>
Control	data	Data file in binary format. The size of the file is located in the first 4 bytes of the data.
Query	DWNLD?	
	DWNLD_{0 1 2 3}	
	0	Software is not received.
Response	1	Software is being updated.
	2	Software update is completed.
	3	Software update is failed.
Remarks	Example) When sending the byte file(256=00000100h): 44h 57h 4Eh 4Ch 44h 00h 00h 01h 00h (hereafter, file data) D W N L D File size	
		he LAN cable and turn off the power while updating the nay cause the software failures.

(3) Query for the Equipment Profile

Command	MINF	
Description	Queries for the profile of the equipment.	
Control		
Query	MINF?	
	MINF_ <maker>,<model name="">,<individual information="">, <serial number="">,<mac address="">,<software version=""></software></mac></serial></individual></model></maker>	
	Maker	Anritsu
	Model name	MW9087B
Response	Information	Product information: Example) "1650nm"
	Serial number	Serial number: Example) "SN6200000000"
	MAC Address	MAC address: Example) "00-00-91-12-34-56"
	Software Version	Software version: Example) "1.00"
Remarks		

(4) Self-diagnosis

Command	SLFTST	
Description	Executes Self-diagnosis.	
Control	SLFTST	
Query	SLFTST?	
Response	SLFTST_ <optical level="">, <warming up="">, <power voltage="">, <internal temperature=""> SLFTST*** returns when self-test is not being executed.</internal></power></warming></optical>	
	Diagnosis 0: Normal or measurement enabled report 1: Abnormal or warming up	
Remarks	ANS76 returns when other command is received during self-test.	



CAUTION

When performing the SLFTST command, the optical pulse is output.

When the fiber is connected to the communication device, remove the fiber before performing the SLFTST command. The receiving part of the communication device may be damaged depending on the optical pulse output from the Card OTDR.

4.4.8 Network Configuration

(1) Timeout Interval Setup

Command	CONNTM	
Description	Sets timeout int	erval for TCP/IP connection.
CONNTM_ <timeout interval=""></timeout>		eout interval>
Control	Timeout 1 to 7200 (1 second step)	
Query	CONNTM?	
CONNTM_ <timeout interval=""></timeout>		eout interval>
Response	Timeout interval	1 to 7200
	The set value will be reflected after restarting the equipment.	
Remarks If the timeout interval, which was set in the state of no reception command, passes, the connection will be forcibly terminated.		, <u> </u>

(2) Network Configuration

Command	NET			
Description	Configures the n	Configures the network for remote control.		
	NET_< IP address>, < Port number >, <netmask>,<gateway></gateway></netmask>			
	IP address	0.0.0.0 to 255.255.255.255		
Control	Port number	1024 to 65535		
	Netmask	0.0.0.0 to 255.255.255.255		
	Gateway	0.0.0.0 to 255.255.255.255		
Query	NET?			
	NET_< IP address>, < Port number >, <netmask>,<gateway></gateway></netmask>			
	IP address	0.0.0.0 to 255.255.255.255		
Response	Port number	1024 to 65535		
	Netmask	0.0.0.0 to 255.255.255.255		
	Gateway	0.0.0.0 to 255.255.255.255		
Remarks	The gateway assigned to 0.0.0.0 or 255.255.255.255 is not effective. The set value will be reflected after restarting the equipment.			

(3) Ethernet Speed Setup

Command	NETNEG		
Description	Sets the commu	nication speed of Ethernet link.	
	NETNEG _ <communication speed="">,<flow control=""></flow></communication>		
Control	Communicati on speed	10: 10 Mbps 100: 100 Mbps AUTO: Auto negotiation	
	Flow Control	F: Full Duplex H: Half Duplex	
Query	NETNEG?		
	NETNEG _ <com< td=""><td>nmunication speed>,<flow control=""></flow></td></com<>	nmunication speed>, <flow control=""></flow>	
Response	Communicati on speed	10: 10 Mbps 100: 100 Mbps AUTO: Auto negotiation	
	Flow Control	F: Full Duplex H: Half Duplex When the communication speed is set to AUTO, the flow control is set to ***.	
Remarks	The set value will be reflected after restarting the equipment.		

(4) Timeout Interval for Alarm Setup

Command	ATO	
Description	Sets timeout into	erval for Alarm.
ATO_ <timeout interval=""></timeout>		nterval>
Control	Timeout interval	0 to 360 (1 second step)
Query	ATO?	
	ATO_ <timeout is<="" td=""><td>nterval></td></timeout>	nterval>
Response	Timeout interval	0 to 360
Remarks	When setting 0, Alarm does not occur.	

4.4.9 Other Settings

(1) Initialization

Command	INI
Description	Sets measurement conditions to the factory defaults.
Control	INI
Query	
Response	
Remarks	Refer to Appendix C "Factory Shipment Defaults" for the values to be affected by this command.

(2) Reset Execution

Command	RST
Description	Restarts the Card OTDR.
Control	RST
Query	
Response	
Remarks	

4.5 Error Code

Table 4.5-1 Error Code

Item	Description	Error Code
On one one	The command which cannot be executed when a waveform does not exist was received.	ANS15
Query error	The command which cannot be executed when an event does not exist was received.	ANS16
Command error	The command which does not conform to the format was received.	ANS20
	The number of parameters is incorrect.	ANS40
Execution error	The setup range is exceeded (including integer or negative numbers).	ANS41
	The data type of the parameter is incorrect. (e.g. specified real value at command using integers)	ANS42
	The command which cannot be executed depending on the OTDR status was received.	ANS60
	The command which cannot be executed in the OTDR mode was received.	ANS61
	Hardware is warming up.	ANS71
Status error	Hardware is out of the temperature range.	ANS72
	The command which cannot be executed during self-diagnosis was received.	ANS76
	The condition which cannot be measured with the partial sampling was set.	ANS77
	Self-diagnosis was failed.	ANS78
	The device cannot be used because it is unsupported.	ANS81
Setting error	Unsettable distance range, pulse width, or wave length was specified.	ANS82

Table 4.5-1 Error Code (Cont'd)

Item	Description	Error Code
	The distance range which is unsettable in combination with the pulse width was specified.	ANS101
	The value which is unsettable in combination with the distance range was specified.	ANS102
	ATT which is unsettable in combination with the pulse width was specified.	ANS103
II	The distance range which is unsettable in combination with the sampling mode was specified.	ANS104
Unsettable error	The current pulse width cannot be set to the high dynamic range.	ANS105
	The pulse width which cannot be set in combination with the high dynamic range mode was specified.	ANS106
	The command which cannot be used when a waveform does not exist was received.	ANS115
	The command which cannot be used when an event does not exist was received.	ANS116
No response	The response has been terminated for 30 seconds while receiving the command.	ANS143
Media error	The file with unauthorized contents was specified with SETFILE.	ANS167
	The file by other companies or for other units was specified with SETFILE.	ANS168
Others	Other errors occurred.	ANS255

Chapter 5 Performance Test and Maintenance

This chapter describes the performance test, maintenance, storage and disposal procedures.

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5.1 Performance Test

The following 5 items should be tested to check the performance of the Card OTDR.

- Optical output and wavelength for optical pulse test
- · Pulse width
- Dynamic range (One-way back-scattered light dynamic range test)
- Distance measurement accuracy
- Loss measurement accuracy (Linearity)

Refer to Appendix E "Performance Test Result Form" for recording the performance test results.

Before the test, clean the optical connector. The test procedure explained here starts from the state where the power supply is ON and the Card OTDR is running.

5.1.1 Required Equipment for Performance Test

The following table lists the required equipment for the performance test.

Table 5.1.1-1 Required Equipment for Performance Test

Item	Required Performance	Recommended Model (Model Name)
Optical	Wavelength:600 nm to 1650 nm	MS9740A
spectrum	Level: -65 dBm to +20 dBm	(Anritsu)
analyzer	Wavelength stability: ±0.3 nm	
Optical	Wavelength: 1200 nm to 1650 nm	8163B+81570A
variable	Input loss: 3 dB or less	(Agilent Technologies)
attenuator	Attenuation: 0 dB to 30 dB	
	Resolution: 0.1 dB or less	
O/E converter	Wavelength: 1100 nm to 1650 nm	P6703B
	Uplink/Downlink:	(Tektronix)
	500 ps or less	
	Compatible fiber: Single-mode	
Oscilloscope	Band frequency:	TDS5104B
	DC GHz to 1 GHz	(Tektronix)
Single mode	Fiber length: 2 km per piece	
Optical fiber	20 km or more per piece	
	40 km to 50 km per piece	
	800 m per piece	
	300 m to 400 m per piece	
	2 m to 3 m in two pieces	
Optical	Shape: 1×2	
coupler	Branch ratio: 50%:50%	
	Excess loss: 1 dB or less	

Item	Required Performance	Recommended Model (Model Name)
Light source	Wavelength: 1550 nm	8163B+81940A
(DFB-LD)	Laser type: DFB-LD	(Agilent Technologies)
	Output: -5 dBm or more	
Optical power	Wavelength: 1550 nm	8163B+81634B
meter	Level: -50 to +10 dBm	(Agilent Technologies)
(Wavelength 1550 nm)	Level stability: ±0.2 dB	
Light source	Wavelength:1550±20 nm	CMA5 (Anritsu)
	Level: -10 to 0 dBm	
	Level stability: ±0.1 dB	
	Compatible fiber:	
	Single-mode	
Optical coupler	Shape: 1×2	
(10:1)	Branch ratio: 10%:90%	
	Excess loss: 1 dB or less	

Table 5.1.1-1 Required Equipment for Performance Test

5.1.2 Wavelength Accuracy

Confirm whether the wavelength of the measurement light is satisfied with the specifications.

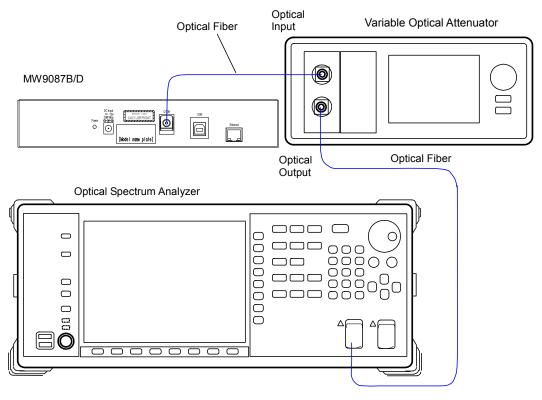


Figure 5.1.2-1 Connection Figure for Wavelength Measurement

<Test procedure >

1. Setup and connect as shown in Figure 5.1.2-1.

2. Set the optical spectrum analyzer as follows.

Span: 50 nm Res: 0.05 nm VBW: 1 kHz

Sampling Point: 2001

Analysis: RMS K = 1, S. Level: 20 dB

- 3. Set the wavelength of the main frame to the Center of the optical spectrum analyzer.
- 4. Set the distance range to 25 km using the DSA 0 or DSR 25000 command.
- 5. Set the pulse width to 1µs using the PLA 0 or PLS 1000 command.
- 6. Set to the real time measurement using the AVG 0 command.
- 7. Output the optical pulse when starting the measurement by LD 1 command.
- 8. Measure the spectrum of the optical pulse for the mainframe using the optical spectrum analyzer.
- 9. If the waveform level measured by the optical spectrum analyzer is saturated, adjust the attenuation of the variable optical attenuator.
- 10. Record the center wavelength measured with the optical spectrum analyzer.

5.1.3 Pulse width

Check whether the optical pulse width for the measurement is satisfied with the specifications.

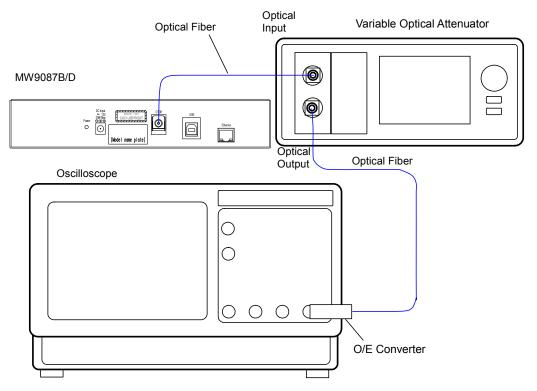


Figure 5.1.3-1 Pulse Width Measurement Setup

<Test procedure>

- 1. Connect the mainframe to the measurement equipment as shown in Figure 5.1.3-1.
- 2. Set the distance range to $100~\mathrm{km}$ using the DSA 0 or DSR $100000~\mathrm{command}$.
- 3. Set the pulse width to 10 ns using the PLA 0 or PLS 10 command.
- 4. Set to the real time measurement using the AVG 0 command.
- 5. Output the optical pulse when starting the measurement by the LD 1 command.
- 6. Adjust the oscilloscope trigger level, amplitude, and time base scale to display the waveform in the oscilloscope. Adjust the optical variable attenuator to prevent the waveform monitor from becoming saturated.

- 7. Monitor the waveform with the oscilloscope and measure the pulse width at half the amplitude of the peak level as shown in Figure 5.1.3-2 and record the results.
- 8. Change the pulse width at the step 2 and repeat the steps 4 thru 6.

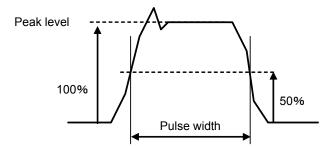


Figure 5.1.3-2 Waveform Measurement Points

9. Change the pulse width from 20 ns to 20 μs at the step 2 and repeat steps 4 to 6.

5.1.4 Dynamic range

Check whether the dynamic range (One-way back-scattered light dynamic range) is satisfied with the specifications.

The measurement method varies with the model.

<Test Procedures for MW9087B>

For the dynamic range measurement for MW9087B, the background light is entered with the use of the light source.

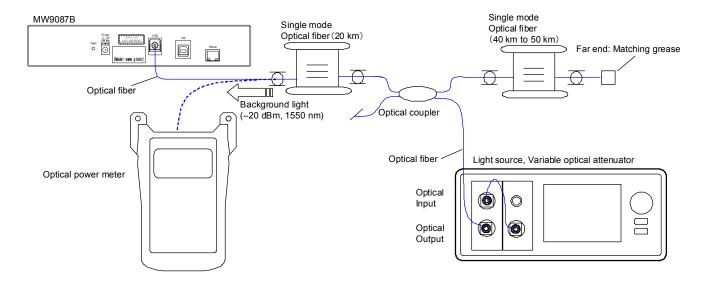


Figure 5.1.4-1 Dynamic Range Measurement Setup (MW9087B)

- 1. Connect the optical source, variable optical attenuator, Optical coupler, single mode optical fiber, and optical power as shown in Figure 5.1.4-1.
- 2. Set the wavelength of the optical power meter to 1550 nm.
- 3. Turn on the optical source.
- 4. Adjust the attenuation of the variable optical attenuator so that the optical power meter displays -19±0.1 dBm.
- 5. Disconnect the optical fiber connected to the optical power meter and connect to the Card OTDR.
- 6. Set to the average measurement using the AVG1 command.
- 7. Set the averaging time to 180 seconds using the ALA 1,180 command.
- 8. Set the sampling to Coarse using the RES 0 command.
- 9. Set the pulse width to 100 ns using the PLA 0 or PLS 100 command.

- 10. Output the optical pulse when starting the measurement using the LD 1 command.
- 11. After the measurement is finished, obtain the waveform data using the GETFILE? command.
- 12. Display the waveform data using the waveform analysis software.
- 13. Move the cursor A to the position of the optical output connector (Refer to Figure 5.1.4-2), move the cursor B to the noise peak position, and then record 2-pt Loss.
- 14. Add 2.6 dB to the value recorded at the step 13. Record the measurement results.
- 15. Set the pulse width to 10µs using the PLS 10000 command at the step 9 and repeat steps 10 to 14.

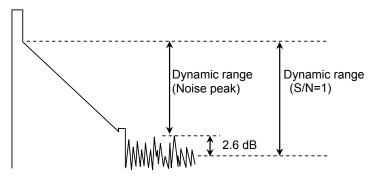
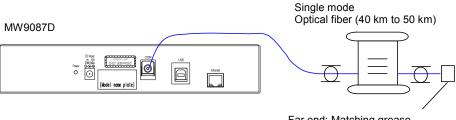


Figure 5.1.4-2 Waveform Measurement Position

<Test Procedures for MW9087D>



Far end: Matching grease

Figure 5.1.4-3 Dynamic Range Measurement Setup (MW9087D)

<Test Procedures>

- 1. Connect the measurement equipment to the mainframe as shown in Figure 5.1.4-3.
- 2. Set the average measurement using the AVG 1 command.
- 3. Set the averaging time to 180 seconds using the ALA 1,180 command.
- Set the sampling to Coarse using the RES 0 command. 4.
- 5. Set the pulse width to 100 ns using the PLA 0 or PLS 100 command.

- 6. Output the optical pulse when starting the measurement using the LD 1 command.
- 7. After the measurement is finished, obtain the waveform data using the GETFILE? command.
- 8. Display the waveform data using the waveform analysis software.
- 9. Move the cursor A to the position of the optical output connector (Refer to Figure 5.1.4-2), move the cursor B to the noise peak position, and then record 2-pt Loss.
- 10. Add 2.6 dB to the value recorded at the step 10. Record the measurement results.
- 11. Set the pulse width to $10\mu s$ using the PLS 10000 command at the step 5 and repeat steps 6 to 10.

5.1.5 Distance measurement accuracy

Measure the optical fiber whose length and index of refraction are known, then perform a horizontal axis (i.e., measurement distance) accuracy test. This is not required for other ranges when this test is performed at a certain distance range.

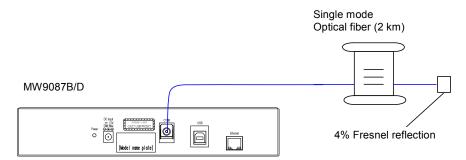


Figure 5.1.5-1 Accuracy Measurement for Distance Measurement

<Test Procedures>

- 1. Connect the measurement equipment to the mainframe as shown in Figure 5.1.5-1.
- 2. Set the average measurement using the AVG 1 command.
- 3. Set the distance range to 5 km using the DSA 0 or DSR 5000 command.
- 4. Set the pulse width to 10 ns using the PLA 0 or PLS 10 command.
- 5. Set the averaging time to 180 seconds using the ALA 1,180 command.
- 6. Set the optical fiber's index of refraction using the IOR command.
- 7. Output the optical pulse using the LD 1 command.
- 8. After the measurement is finished, obtain the waveform data using the GETFILE? command.
- 9. Display the waveform data using the waveform analysis software.
- 10. Move the cursor to the Fresnel reflection position (Refer to Figure 5.1.5-2).
- 11. Set the horizontal axis scale to 0.005 km/div centering around the cursor position.
- 12. Place the cursor on the rising point of the Fresnel reflection accurately, and read the absolute distance. Record the measurement results.

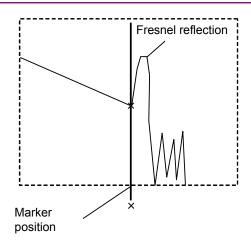


Figure 5.1.5-2 Waveform Measurement Position

5.1.6 Loss Measurement Accuracy (Linearity)

Check the accuracy of the vertical axis (level measurement).

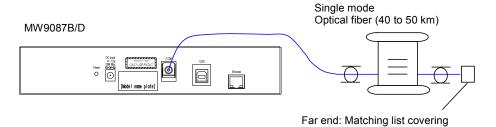


Figure 5.1.6-1 Linearity Measurement Setup

<Test Procedures for One Fiber Setup>

- 1. Connect the measurement equipment to the mainframe as shown in Figure 5.1.6-1.
- 2. Set the average measurement using the AVG 1 command.
- 3. Set the averaging time to 180 seconds using the ALA 1,180 command.
- 4. Set the sampling to Coarse using the RES 0 command.
- 5. Set the pulse width to 100 ns using the PLA 0 or PLS 100 command.
- 6. Output the optical pulse when starting the measurement using the LD 1 command.
- 7. After the measurement is finished, obtain the waveform data using the GETFILE? command.
- 8. Display the waveform data using the waveform analysis software.
- 9. Move the cursor A to the 0 km position.
- 10. Move the cursor B to the 4 km position, and record the dB/km LSA.
- 11. Move the cursor A to the 2 km position.
- 12. Move the cursor B to the 6 km position, and record the dB/km LSA.
- 13. Move the cursor A and B in 2 km increments until cursor B reaches the 30 km position, and record the dB/km LSA (Refer to Figure 5.1.6-2).
- 14. Calculate the averaging value recorded at the steps 10 thru 13.
- 15. Calculate the difference between the value calculated at the step 14 and the values recorded at the steps 10 thru 13, and multiply this value by four.

<Test Procedures for Multiple-Fiber Setup>

- 1. Execute the same operations as described for <Test Procedures for One Fiber Setup> up to step 9.
- 2. Move the cursor B to the 4 km position, and record the dB/km LSA.
- 3. With cursor B inside the splice point range, move cursor A and cursor B in 2 km increments and measure the dB/km LSA.
- 4. Calculate the averaging value recorded at the steps 2 thru 3.
- 5. Calculate the difference between the value calculated at the step 4 and the values recorded at the steps 2 thru 3, and multiply this value by four.
- 6. Move the cursor A to the position that is a multiple of 2 km further than the splice point.
- 7. Move the cursor B to a position 4 km distant from cursor A, and record the dB/km LSA.
- 8. With cursor B inside the splice point range, move cursor A and cursor B in 2 km increments and measure the dB/km LSA.
- 9. Calculate the average of the values recorded at the steps 7 thru 8.
- 10. Calculate the difference between the value calculated at the step 9 and the value recorded at the steps 7 thru 8, and multiply this value by four.
- 11. Move the cursor B to the position 4 km distant from cursor A, and record the dB/km LSA.
- 12. Repeat the steps 6 thru 10 until cursor B reaches the 30 km position.

[Example] When connecting fiber $(16 \text{ km} \times 2)$

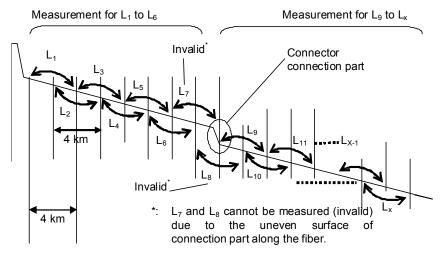


Figure 5.1.6-2 Loss Measurement Positions

Measurement for L_1 to L_6 Averaging value $L_{ave_{1}} = (L_{1} + L_{2} + L_{3} + L_{4} + L_{5} + L_{6})/6$ $L_{diff_{-}1} = (L_1 - L_{ave_{-}1}) \times 4$ $L_{diff_2} = (L_2 - L_{ave_1}) \times 4$ $L_{diff_6} = (L_6 - L_{ave_1}) \times 4$ Measurement for $L_{\rm 9}$ to $L_{\rm x}$

Averaging value $L_{ave_2} = (L_9 + L_{10} + L_{11} + \cdots + L_x)/(x-9+1)$

 $L_{diff_9} = (L_9 - L_{ave_2}) \times 4$ $L_{diff_10} = (L_{10} - L_{ave_2}) \times 4$

 $L_{diff_x} = (L_x\!\!-\!\!L_{ave_2}) \times 4$ $L_{diff_n}\{L_{diff_1},\,L_{diff_2},\,.....L_{diff_6},\,L_{diff_9},\,.....L_{diff_X}\}\colon Check\;it\;is\;\pm 0.1\;or\;less.$

5.2 Updating Software

When the software version is upgraded, update the software for the main frame using the following procedures.

		Command
1	Check the software version of the mainframe.	MINF
2	Send the software to the mainframe.	DWNLD
3	Check the updating progress.	DWNLD
4	Restart the mainframe after updating the software.	RST



Do not turn off the power while updating the software. Otherwise, the Card OTDR may cause failure.

5.3 Cautions on Storage

Avoid storing the Card OTDR in these places:

- (1) Wipe off dust, fingerprint marks, stains, spots, etc. from the surface of the Card OTDR before storing it.
- (2) Places with temperatures and relative humidity in the following ranges:

Temperature: lower than -20°C or higher than 60°C Humidity: 95% or more

- (3) Places that are exposed to direct sunlight and dusty places.
- (4) Damp places where condensation may occur on the MS9740A surface or places where the Card OTDR may be corroded by active gases
- (5) Places where the Card OTDR may be exposed to strong vibration and shock or be oxidized

Recommended storage conditions

The Card OTDR should be stored in a place that meets the ambient conditions above, plus the following conditions if it is not to be used for a long time:

(1) Temperature: 5° to 30°C

(2) Humidity: 40% to 75%

(3) Slight daily change in temperature and humidity.

5.4 Transporting and Disposal

The following describes precautions for transporting and disposing of the Card OTDR.

Repackaging

Repack the Card OTDR in the packing material (box) in which it was delivered. If the packing materials have not been kept, repack it as indicated in step (3) and (4) below.

The repackaging procedure is as follows.

- (1) Clean the module surface with a dry cloth.
- (2) Check that the screws are tight.
- (3) Cover the projections and portions which can be easily deformed, and wrap this module in a polyester sheet.
- (4) Place the wrapped module into a corrugated paper box and seal the box with an adhesive tape. Then, insert this into a wooden box suitable for long-distance transportation.

Transporting

Avoiding vibrations as much as possible and meet the recommended storage conditions during transport.

Disposal

Follow the instructions of your local waste disposal office when finally disposing of the Card OTDR.

To prevent leakage of information stored in the internal memory of the Card OTDR, destroy the Card OTDR before disposing.

Appendix A Specifications

Table A-1 Specifications of MW9087 Series

Item		Specifications	Remarks			
Model name	MW9087B/D	Card OTDR				
Configuration	Standard App	plication (Operation Manual)				
Wavelength *1	MW9087B	1645 to 1655 nm Wavelength range at peak value [Spectrum peak value] –20 dB)				
	MW9087D	1525 to 1575 nm				
Pulse peak power	MW9087B	≤+15 dBm				
3.4 (C1	MW9087D	(IIII III C 070)				
Measurement fiber	i i	M fiber (ITU-T G.652)				
Optical connector	•FC: Option0 •ST: Option0					
	·DIN: Option					
	·SC: Option0					
	•HMS-10/A:					
Distance range		/50/100/200/300 km	IOR=1.500000			
Pulse width		0/200/500 ns 1/2/4/10/20 μs				
Dynamic range *2		·	SNR=1, 25°C,			
	MW9087B	≥ 40 dB (Typical value: 41 dB)	Pulse width 20 μs			
	MW9087D	≥ 49 dB (Typical value: 50 dB)	-			
Dead zone	MW9087B	≤ 0.5 m	25°C,			
(Fresnel reflection)	MW9087D	≤ 1.0 m	IOR=1.500000, Pulse width 3 ns,			
Dead zone	MW9087B	≤ 6.5 m	25°C,			
(Backscatter light)	MW9087D	≤ 4.3 m	IOR=1.500000, Pulse width 10 ns			
Linearity	±0.05 dB/dB	or ±0.1 dB (Whichever greater)				
(Loss measurement accuracy)						
Sampling resolution	0.05 to 60 m		IOR=1.500000			
Sampling points	Coarse: 5001 Medium: 150 Fine: 100001	Either of the value is automatically selected depending on the distance range.				
IOR setting	1.000000 to 1	999999 (0.000001 step)				
Distance measurement accuracy		±1m±3×Measurement distance×10 ⁻⁵ ±Sampling resolution (Uncertainty with fiber's index of refraction is excluded.)				
Loss minimum unit	0.001 dB					

Table A-1 Specifications of MW9087 Series (Cont'd)

Item	Specifications	Remarks
Averaging time [Averaging count]	1 to 9999 times or 1 to 9999 seconds (settable range)	
Auto measurement *5	Measurement item: Total loss, Distance of each event, Splice loss, Return loss, or Reflectance Threshold: Splice loss 0.01 to 9.99 dB (0.01 dB step) Reflectance -60 to -20 dB (0.1 dB step), Far end 1 to 99 dB (1 dB step) Number of detected events: Up to 99 events Automatic setting: Distance range, pulse width, and averaging count (period)	
Manual measurement	Measurement item: 2-point loss, 2-point LSA, dB/km loss, splice loss, return loss, or level difference	
Other function	Partial sampling function Remote control function High dynamic range mode added (pulse width 50 ns to 2 µs) Distance unit setup: m fixed	
Interface	Ethernet: RJ45 Ethernet 10Base-T/100Base-TX Auto negotiation supported Ethernet Full Duplex/Half Duplex supported USB 1.1: Type B×1 *6	
Laser safety	MW9087B IEC 60825-1: 2007 Class 1 MW9087D IEC 60825-1: 2007 Class 1M	21CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50 (dated June 24, 2007)
Power	+12 Vdc±10%	
Power consumption	≤ 20 W	
Dimensions	165 (H)×50 (W)×270 (D) mm (not including projection portion)	
Mass	≤1.5 kg	
Temperature/Humi dity	Operating temperature and humidity: 0 to 50 °C, ≤95% (no condensation)	
	Storage temperature and humidity: −20 to +60 °C, ≤95%	

*1 Pulse width:1 µs at 25°C

 μs)

- *2 Distance range: 100 km, Average: 180 seconds, 25°C. With background light, 1310/1550 mm –19 dBm Continuous light (MW9087B)

 Standard/High dynamic range mode added (pulse width 50 ns to 2
- *3 I₁ in the right
 figure. Return
 loss: 40 dB

 *4 I₂ in the right
 figure. Return
 loss: 55 dB
- *5 So that the automatic measurement function is used for simplifying the measurement, any detected results are not guaranteed. The faulty values might be detected. Be sure to check the waveform data when the final judgement is made.
- *6 Interface for IP address setup. The specified driver installation is required for connection.

Appendix B Relationship between Pulse Width Distance Range

Table B-1 Settable Pulse Width

Distance	` <i>'</i>											
Range (km)	3	10	20	50	100	200	500	1000	2000	4000	10000	20000
1	✓	✓	✓	✓	✓	_	_	_	_	_	_	_
2.5	✓	✓	✓	√	✓	_	_	_	_	_	_	_
5	✓	✓	✓	✓	✓	✓	_	_	_	_	_	_
10	✓	✓	✓	✓	✓	✓	✓	_	_	_	_	_
25	✓	✓	✓	√	✓	✓	✓	✓	_	_	_	_
50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	_	_
100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
200	✓	✓	✓	√	✓	✓	✓	✓	✓	✓	✓	✓
300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

✓: Settable

Not settable

Appendix B	Relationship between Pulse Width and Dynamic Range

Appendix C Factory Shipment Defaults

The Card OTDR is set as follows at the factory default.

Items described in Table C-1 "Factory Shipment Defaults (Initialized Items)" are initialized when the remote command (INI command) is executed.

Table C-1 Factory Shipment Defaults (Initialized Items)

Item	Command	Setting Value
Averaging	ALA	Auto setting
Averaging unit	ALA	times
Wavelength	WLS	First wavelength (Shortest wavelength)
Distance range setting method	DSA	Auto setting
Distance range	DSR	Auto
Pulse width setting method	PLA	Auto setting
Pulse width	PLS	Auto
Attenuator	ATA	Auto setting
Index of refraction (IOR)	IOR	1550 nm:1.466100 1650 nm:1.466500
Enhance mode	ENH	Standard
Sampling mode	RES	Standard
Partial sampling setting	SSMP	Starting distance 0 m, Resolution 0.05 m, 5001 points
Backscatter coefficient level correction value	CAL	0.00 dB
Average setting	AVG	Average measurement
Approximate line method setting	APR	Least square method
Relative distance	OFS	0.00 m
Event automatic detection		
Splice loss threshold	THS	0.30 dB
Reflection threshold	THR2	−25.0 dB
Fiber far end threshold	THF	5 dB
File		
File format	SRLV	Event data, measurement condition, and waveform data
Data flag	HDFG	BC (When installed)

Items described in Table C-2 "Factory Shipment Defaults (No Initialized Items)" are not initialized, even if the INI command is sent.

Table C-2 Factory Shipment Defaults (No Initialized Items)

Item	Command	Setting Value
Network address	NET	
Speed		10M Full
IP address		192.168.1.2
Subnet mask		255.255.255.0
Default gateway		None
Port number		2288
Ethernet speed	NETNEG	
Communication speed		Auto
Flow control		Auto
Time out	CONNTM	7200 seconds
Serial port	_	
Baud rate (bit/second)		115200 bps
Data bit		8 bits
Parity		None
Stop bit		1 bit
Flow control		Hardware

Appendix D Command Compatibility

MW9087 series remote command compatibility with MW9077A/A1 OTDR module remote command is shown below.

- ✓: Compatible
- \triangle : Compatible, parameter to be changed
- -: Not compatible

Table D-1 Command Compatibility

	Table B-1 Command Compatibility							
Control Command	Query Command	Compatibility	Function/Change					
ALA	ALA?	✓	Average Mode Setup					
APR	APR?	✓	Approximate Line Method Setup					
ATA	ATA?	✓	Attenuator Setup					
ATT	ATT?	✓	Attenuator Setup					
_	ATV?	✓	Query for Available Attenuator					
_	AUT?	✓	Query for the Result of Auto Search					
_	AVE?	✓	Query for Average Mode					
AVG	AVG?	✓	Average Setup					
BSL2	BSL2?	-	Query for Backscatter Coefficient Level Change to BSL? for Backscatter Level, CAL? for Backscatter Coefficient Level.					
CONNTM	CONNTM?	✓	Timeout Interval Setup					
_	DAT?	Δ	Query for Waveform Data Format of number of data items of response is changed.					
DATE2	DATE2?	✓	Date & Time Setup					
DLMODE	DLMODE?	_	Start-up Mode Change MW9087 does not have the function.					
DWNLD	DWNLD?	✓	Software Download					
_	ERR?	✓	Query for Error Status					
_	EVN2?	✓	Query for Event Analysis Result					
_	GETFILE?	✓	Data File Acquisition of Waveform					
INI	_	✓	Initialization					
IOR	IOR?	Δ	Index of Refraction Setup Setup range is changed to 1.00000 to 1.999999.					
LD	LD?	Δ	OTDR Measurement Start/Stop Partial sampling measurement start added to the parameter.					
	LOS2?	✓	Query for Insertion Loss Measurement					
	MINF?	✓	Query for the Equipment Profile					
	MKDR?	✓	Query for Total Loss Analysis Range					

Table D-1 Command Compatibility (Cont'd)

Control Command	Query Command	Compatibility	Function/Change
NET	NET?	✓	Network Configuration
OFS	OFS?	✓	Relative Distance Setup
_	REFLCT?	✓	Query for Return Loss
RST	_	✓	Reset Execution
SETFILE		✓	File Data Write
_	SLFTST?	✓	Self-diagnosis
_	SMPINF?	✓	Query for Sampling Conditions
_	SPLICE?	✓	Query for Splice Loss Measurement
SRLV	SRLV?	✓	Assignment of File Data Format
_	STATUS?	_	Query for Status (OTDR) Changed to STS?
STP	STP?	_	Measurement Condition Setup Setup for DSR, ENH, PLS, and RES individually
THF	THF?	✓	Fiber Specific Setup
THR2	THR2?	Δ	Return Loss Threshold Setup Setup range is changed to -60 to -20.
THS	THS?	√	Splice Loss Threshold Setup
_	TLOS?	✓	Query for Total Loss
_	WAV?	✓	Query for Waveform Data Status
WLS	WLS?	✓	Wavelengths Setup

Table D-2 Command Added to MW9087 Series

Control Command	Query Command	Function	
CAL	CAL?	Backscatter Level Calibration Setup	
DSA	DSA?	Distance Range Mode Setup	
DSR	DSR?	Distance Range Setup	
ENH	ENH?	Enhanced Mode Setup	
HDFG	HDFG?	Assignment of the Data Flag of File Header	
NETNEG	NETNEG?	Ethernet Speed Setup	
PLA	PLA?	Pulse Width Mode Setup	
PLS	PLS?	Pulse Width Setup	
RES	RES?	Sampling Mode Setup	
SMTH	SMTH?	Smoothing Setup	
SSMP	SSMP?	Partial Sampling Mode Setup	
_	SSMPINF?	Query of Partial Sampling Mode	
_	STS?	Query for the Equipment (OTDR) Status	

Appendix

Appendix E Performance Test Result Form

Document number:	
Test Location:	
Date:	
Test person in charge:	
Product name: MW9087 Card OTDR	
Serial number:	
Software version:	
Option:	
Power voltage: V	
Ambient temperature	$^{\circ}$ C
Relative humidity %	
Instruments used: Model name	Serial number
Model name	Serial number
Model name	Serial number
Model name	Serial number
Remarks	

Table E-1 MW9087B Performance Test Recording Table

Test I	tem	Specifications	Result	Rema	rks
Wavelength	1650 nm	1645 to 1655 nm		Pulse wid µs, wavel range of the or lower the peak	ength 20 dB than
Pulse width	10 ns	10 ns		±35%	
	20 ns	20 ns		±35%	
	50 ns	50 ns		±25%	
	100 ns	100 ns		±0%	(Re
	200 ns	200 ns		±10%	(Reference value)
	500 ns	500 ns		±10%	enc
	1 μs	1 μs		±10%	e v:
	2 μs	2 μs		±10%	alu:
	4 μs	4 μs		±10%	9)
	10 μs	10 μs		±10%	
	20 μs	20 μs		±10%	
Dynamic range	MW9087B	40 dB *		S/N=1	
Distance measurement accuracy		±1 m ±3×Measurement distance ×10 ⁻⁵ ±Marker resolution			
Loss measurement accuracy (linearity)		±0.05 dB/dB or ±0.1 dB (Whichever greater)			

^{*:} Pulse width: 20 $\mu s,$ Distance range: 100 km, Averaging time: 180 seconds

Table E-2 MW9087D Test Recording Table

Test Item		Specifications	Specifications Result		Remarks	
Wavelength	1550 nm	1525 to 1575 nm				
Peak value		+15 dBm or less				
Pulse width	10 ns	10 ns		±35%	(Reference value)	
	20 ns	20 ns		±35%		
	50 ns	50 ns		±25%		
	100 ns	100 ns		±20%		
	200 ns	200 ns		±10%		
	500 ns	500 ns		±10%		
	1 μs	1 μs		±10%		
	2 μs	2 μs		±10%		
	4 μs	4 μs		±10%		
	10 μs	10 μs		±10%		
	20 μs	20 μs		±10%		
Dynamic range	MW9087D	49 dB *		S/N=1		
Distance measurement accuracy		±1 m ±3×Measurement distance ×10 ⁻⁵ ±Marker resolution				
Loss measurement accuracy (linearity)		±0.05 dB/dB or ±0.1 dB (Whichever greater)				

^{*:} Pulse width: 20 μ s, Distance range: 100 km, Averaging time: 180 seconds