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

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



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 a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

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 11 2019 (11th Edition)

Copyright © 2011-2019, ANRITSU CORPORATION.

All rights reserved. No part of this manual may be reproduced without the prior written permission of the publisher.

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.
- 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; or
	b) for collimated beams, if the user views the laser output with certain optical instruments (for example, telescopes and binoculars).

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.



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.

Incorporated Laser	Max. Optical Output Power (W) [*]	Pulse Width (s)/ Repetition Rate	Emitted Wavelength (nm)	Beam Divergence (deg)
a)	< 0.30	20×10 ⁻⁶ /0.019	1650	11.5
b)	< 1.20	20×10 ⁻⁶ /0.019	1550	11.5

Table 2 Incorporated Laser Specification

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

		— For Safety —		
		Table 3 Indication Labels on Product (I	Ex: Label list)	
	Туре	Sample	Affixed to:	Model Name
1	Explanation	LEC 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 POMER) (PLLSE DURATION) (MAVELENSTH) 600mW ≤20 µ s 1550nm 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 AT-TOHOKU ANRITSU CO., LTD KORIYAMA PLANT,	Figure 2, D	All Models



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.
 - i) 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

CE

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)	А
IEC 61000-4-4 (Burst)	В
IEC 61000-4-5 (Surge)	В
IEC 61000-4-6 (CRF)	А
IEC 61000-4-8 (RPFMF)	А
IEC 61000-4-11 (V dip/short)	В, С

*: 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.



Table of Contents

For Sa	fety	iii
About	This Manual	I
Chapte	er 1 Outline	1-1
1.1	Introduction to MW9087 Series Card OTDR	1-2
1.2	Features	1-3
1.3	Outline of OTDR	1-5
Chapte	er 2 Before Use	2-1
2.1	Product Configuration	2-2
2.2	Names of Parts	2-3
2.3	Installing the Card OTDR	2-5
2.4	Power Connection	2-8
2.5	Communication Settings	2-9
2.6	Installation/Uninstallation for USB Serial Driver	2-11
2.7	Confirmation of COM Ports	2-25
2.8	Connecting the Optical Fiber Cable	2-29
2.9	Cautions on Handling Optical Fiber Cables	2-31
2.1	0 Replacing the Optical Connector	2-33
2.1	1 Precautions	2-34

Chapter	3 Measurement Method	3-1
3.1	Setting before Measurement	3-2
3.2	Measurement Procedures	3-3
3.3	Setting Measurement Conditions	3-4
3.4	Measurement	3-5
3.5	Waveform Analysis	3-6
3.6	Calculation Method	3-7
3.7	Obtaining State	3-14

1
2
3
4
5
Appendix

.

Chapter 4 Command Reference...... 4-1

4.1	Command Format	4-2
4.2	Transmission Procedures	4-3
4.3	Command List	4-5
4.4	Command Details	4-15
4.5	Error Code	4-53

Chapter 5 Performance Test and

	Maintenance	5-	1
5.1	Performance Test	5-2	
5.2	Updating Software	5-16	
5.3	Cautions on Storage	5-17	
5.4	Transporting and Disposal	5-18	

Appendix A	Specifications	A-1
Appendix B	Relationship between Pulse Width Distance Range	B-1
Appendix C	Factory Shipment Defaults	C-1
Appendix D	Command Compatibility	D-1

Appendix E	Performance Test Result	
	Form	E-1

Chapter 1 Outline

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

1.1	Introduction to MW9087 Series Card OTDR1-	2
1.2	Features1-	3
1.3	Outline of OTDR 1-	5

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	$1550~\mathrm{nm}$	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 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.

http://www.anritsu.com/en-US/Downloads/Software/Drivers/Software-Downloads/DWL2761.aspx

1

Chapter 1 Outline



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

1

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

1

Outline

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 1 Outline

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.

2.1	Product Configuration		
2.2	Names of Parts2-3		
2.3	Installing the Card OTDR2-5		
	2.3.1	Installation method2-5	
	2.3.2	Dimension2-7	
2.4	Power	Connection2-8	
2.5	Comm	unication Settings2-9	
	2.5.1	Interface2-9	
	2.5.2	Network setting2-9	
	2.5.3	Serial port setting2-10	
2.6	Installa	ation/Uninstallation for USB Serial Driver 2-11	
	2.6.1	Installation (Windows XP)2-11	
	2.6.2	Installation (Windows 7)2-14	
	2.6.3	Uninstallation (Window XP)2-19	
	2.6.4	Uninstallation (Windows 7)2-22	
2.7	Confir	mation of COM Ports2-25	
	2.7.1	Confirmation of COM Ports (Windows XP) 2-25	
	2.7.2	Confirmation of COM Ports (Windows 7) 2-27	
2.8	Conne	cting the Optical Fiber Cable2-29	
2.9	Cautions on Handling Optical Fiber Cables2-31		
2.10	Replacing the Optical Connector		
2.11	Precautions		

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.

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

Table 2.1-1 Standard Configuration

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

Names of Parts 2.2

The following figure shows the names of parts.









Chapter 2 Before Use

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		



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

Before Use

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 $\phi 2.1 \times \phi 5.5 \times 9.5$ 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

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

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	Autonegotiation
• IP address	192.168.1.2
• Subnet mask	255.255.255.0
• Default gateway	None
• Port number	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

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)	$115200 \mathrm{~bps}$
٠	Data bit	8 bits
٠	Parity	None
٠	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.
- 3. When the cable is connected, the **Welcome to the Found New Hardware Wizard** is displayed.



4. Select "No, not this time" and click <u>Next></u>.

Note:

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

5. The installation selection window is displayed.

Chapter 2 Before Use



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

Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM)
✓ Include this location in the search:
E:\UsbSerialDrivers\WindowsXP Browse
O Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< <u>B</u> ack <u>N</u> ext > Cancel

- 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 <u>Next></u>, the driver is installed.
- 10. When the installation confirmation window is displayed, click <u>Continue Anyway</u>.

2.6 Installation/Uninstallation for USB Serial Driver



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

Found New Hardware Wizard	
	Completing the Found New Hardware Wizard
	The wizard has finished installing the software for:
	OTDR USB Serial
	Click Finish to close the wizard.
	K Back Finish Cancel

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.

2

Before Use

Chapter 2 Before Use



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

•	Search automatically for updated driver software Windows will search your computer and the Internet for the latest driver software for your device, unless you've disabled this feature in your device installation settings.
•	Browse my computer for driver software Locate and install driver software manually.

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.

2.6 Installation/Uninstallation for USB Serial Driver



- 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**.

		23
🕝 🛽 U	Update Driver Software - OTDR USB Serial (COM3)	
Win	ndows has successfully updated your driver software	
Wind	dows has finished installing the driver software for this device:	
Trend	OTDR USB Serial	
		Close

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

2

Chapter 2 Before Use



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.

em Prop	erties				1
System	Restore	Aut	omatic Up	dates	Remote
General	Comp	uter Name	[F	lardware	Advanced
Device M	anager				
Ż	The Device M on your compo properties of a	lanagerlists uter. Use th any device.	all the ha e Device	ardware device Manager to ch	es installed hange the
				<u>D</u> evice Ma	anager
Drivers					
e /	Driver Signing compatible wit how Windows	l lets you ma th Windows s connects t	ake sure ti . Window to Windov	hat installed dr s Update lets j vs Update for (ivers are you set up drivers.
	Driver	<u>S</u> igning		<u>W</u> indows L	lpdate
Hardware	Profiles				
æ	Hardware prof different hardv	files provide vare config	a way foi urations.	r you to set up	and store
				Hardware [Profiles

5. Click **Device Manager**.

2

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



7. Right-click OTDR USB serial and click Uninstall.



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

2.6 Installation/Uninstallation for USB Serial Driver



- 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.

Organize 👻 System properties	Uninstall or change a program Map network drive	Open Control Panel	
Favorites Desktop Desktop Downloads Maceent Places Downloads Unaries Documents Music Music Pictures	Hard Disk Drives (3) Windows 7 (C) SG Bfreed 1148 GB Windows VISTA (F) J35 GB freed 1147 GB Devices with Removable Storage (2) DDN BW Drive (P)	RECOVERY (E)	
Videos Computer Windows 7 (C:) Windows 7 (C:) Windows VISTA (F:) Removable Disk (G:) Network		7.76 GB free of 1.91 GB	

4. Click **Device Manager**.



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



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

Chapter 2 Before Use



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

Confirm Device Uninstall
OTDR USB Serial (COM3)
Warning: You are about to uninstall this device from your system.
Delete the driver software for this device.
OK Cancel

- 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.

System R	estore	Automa	atic Updates	Remote
General	Comp	uter Name	Hardware	Advanced
Device Mar	nager			
🤶 j	he Device M n your compo roperties of a	lanagerlists all uter. Use the D iny device.	the hardware device evice Manager to ch	es installed nange the
			Device Ma	anager
Drivers				
	river Signing ompatible wit	lets you make th Windows. W	sure that installed dr /indows Update lets ;	ivers are you set up
	ow windows	connects to V	/indows Update for	drivers.
	ow windows Driver	: connects to V <u>S</u> igning	/indows Update for	drivers. Jpdate
Hardware F	ow windows Driver	: connects to V <u>S</u> igning	/indows Update for 	drivers.
Hardware F	ow windows Driver Profiles lardware prof ifferent hardv	: connects to V <u>S</u> igning files provide a v vare configurat	√indows Update for <u></u> <u></u> <u> </u>	drivers.
Hardware F	Profiles	: connects to V <u>S</u> igning files provide a v vare configurat	/indows Update for <u>W</u> indows U way for you to set up ions. Hardware]	drivers. Jpdate and store Profiles

5. Click **Device Manager**.

2

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**.



3. 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.



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.

Chapter 2 Before Use



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.

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.



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.

Before Use

Chapter 2 Before Use





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.

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.



Adapter lever

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	Settings before Measurement				
	3.1.1	Network settings			
	3.1.2	System settings			
3.2	Measu	rement Procedures			
3.3	Setting Measurement Conditions				
3.4	Measurement				
3.5	Waveform Analysis3-				
3.6	Calculation Method				
	3.6.1	Loss measurement			
	3.6.2	Return loss measurement			
	3.6.3	Event evaluation			
	3.6.4	Approximate line method			
3.7	Obtain	ing State	3-14		

3.1 Settings before Measurement

1.

2.

3.

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.

Connect the Card OTDR and PC via the Ethernet cable.	Command
Perform the self diagnosis.	SLFTST
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
1.	Select the wavelength.	WLS
2.	Set the pulse width.	PLA
		PLS
3.	Set the distance range.	DSA
		DSR
4.	Set the sampling mode.	RES
5.	When the partial sampling is executed, set the	SSMP
	range.	
6.	Set IOR (fiber index of refraction).	IOR
7.	Set the attenuation of the attenuator.	ATA
		ATT
		ATV
8.	Set the backscatter coefficient level correction	CAL
0	Sot the averaging processing method	ΔΤ Δ
9. 10	When the adverse made is used as t the made	ALA
10.	when the enhance mode is used, set the mode.	ENH

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.	\mathbf{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 L_1 .

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

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.

$$\begin{split} &\delta i = yi - (a + bxi) \\ &E = \sum_{i=1}^{n} \delta i^2 = (y_1 - a - bx_1)^2 + (y_2 - a - bx_2)^2 + \cdots + (y_n - a - bx_n)^2 \\ & \text{The necessary and sufficient conditions for E to become the minimum} \end{split}$$

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.

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

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

3.7 Obtaining State

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

	Command
Error information query	ERR
System information query	MINF
Measurement state query	STS

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

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

4.1	Command Format4-2					
4.2	Transmission Procedures					
4.3	Comm					
	4.3.1	Alphabetical order				
	4.3.2	Setup Measurement Condition				
	4.3.3	Setup for Measurement				
	4.3.4	Query for Measurement Results				
	4.3.5	Query for Statuses				
	4.3.6	File Data Access				
	4.3.7	System Maintenance				
	4.3.8	Network Configuration				
	4.3.9	Other Setup				
4.4	Comm	and Details				
	4.4.1	Description of Message Explanations				
	4.4.2	Measurement Condition Setup				
	4.4.3	Settings for Measurement				
	4.4.4	Querying Measurement Results				
	4.4.5	Queries for statuses				
	4.4.6	Settings for Data File				
	4.4.7	System Maintenance				
	4.4.8	Network Configuration				
	4.4.9	Other Settings				
4.5	Error (Code				

4.1 Command Format

The transmission format is classified as follows.

For text data:

Command Name	Data Part	TRM	
 Command Na 	ame: The con	ntrol comr	nand or o

- 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 ANS0. 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, 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

Control Query Command Command		Function
Α		·
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	1	
_	GETFILE?	Data File Acquisition of Waveform
H	1	
HDFG	HDFG?	Data Flag Setup

Table 4.3.1-1 Command List

4

Ocartas	0	
Command Command		Function
Ι		
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	NIDTO	
NET	NET?	Network Configuration
NETNEG	NETNEG?	Ethernet Speed Setup
0 OFS	OFS?	Polotivo Distance Sotup
P	015:	Relative Distance Setup
PLA	PLA?	Pulse Width Mode Setup
PLS	PLS?	Pulse Width Setup
R		
_	REFLCT?	Query for Return Loss
RES	RES?	Sampling Auto Setup
RST	-	Reset Execution
S		
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)

4.3 Command List

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

Table 4.3.1-1 Command List (Cont'd)

4

4.3.2 Setup Measurement Condition

CNT: Control command QUR: Query command RSP: Response for query command

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

 Table 4.3.2-1
 Commands for Measurement Conditions

No	Function	Message		Remarks
		CNT	SSMP s,r,q	s: Sampling start 1.00=1.00 m
		QUR	SSMP?	r: Resolution 1.00=1.00 m
10	Partial Sampling Mode	RSP	SSMP s,r,q	p: Number of point
10	Sampring Mode Setup			0:5001 pt
	T. T.			1: 20001 or 25001 pt
				2:100001 or 125001 pt
	Query for	CNT		n: Sampling point
11	Sampling Point	QUR	SMPINF?	r: Besolution 1 00=1 00 m
	and Resolution	RSP	SMPINF p,r	
	Query for	CNT		s: Sampling start distance 1.00=1.00 m
12	Partial	QUR	SSMPINF?	r: Resolution 1.00=1.00 m
	Status	RSP	SSMPINF s,r,p	p: Number of points
	A	CNT	АТА	O: Marcard Catal
13	Attenuation	QUR	ATA?	0. Manual Setup
	Auto Setup	RSP	ATA {0 1}	1. Automatic Setup
	A	CNT	ATT a	
14	Attenuator Setup	QUR	ATT?	a Attenuation $I = I dB$
		RSP	ATT a	in Full trace mode
	Query for	CNT		
15	available	QUR	ATV? p	P. Pulse wiath
	Attenuation	RSP	ATV a1,a2,an	al, •••, an Attenuation
	Query for	CNT		h: Backscatter coefficient level
16	Backscatter	QUR	BSL?	at current pulse width
	Coefficient	RSP	BSL b	1 = -1 dB
	Backscatter	CNT	CAL n	
17	Level	QUR	CAL?	n: -9.99 to $+9.99$
11	Calibration Setup	RSP	CAL n	
	Fiber-end	CNT	THF s	$(T_{1}, \dots, t_{n}) = 1$
18	Threshold	QUR	THF?	s. Threshold, $I = I dB$
	Setup	RSP	THF s	1 to 99 dB, (1 dB step)
	Reflection	CNT	THR2	
19	Threshold	QUR	THR2?	s. Threshold, $I=I dB$
	Setup	RSP	THR2 s	-60 to -20 dB (0.1 dB step)
	Slice Loss	CNT	THS s	
20	Threshold Setup	QUR	THS?	s. Inreshold, $I = I dB$
		RSP	THS s	0.01 to 9.99 aB (0.01 dB step)

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

4

4.3.3 Setup for Measurement

Table 4.3.3-1 Setup for Measurement

No	Function	Message		Remarks
		CNT	AVG {0 1}	0: Paal time maagurament
1	Average Setup	QUR	AVG?	1: Average Measurement
		RSP	AVG {0 1}	1. Average measurement
	Linear	CNT	APR {0 1}	0. 9D4
2	Approximation	QUR	APR?	0. 2FA 1. L C A
	Method Setup	RSP	APR {0 1}	I. LSA
	CNT	LD {0 1 2}	0: Measurement stopped	
3	3 Measurement Start/Stop	QUR	LD?	(In progress)
		RSP	LD {0 1 2}	2: Start partial sampling measurement (In progress)
		CNT	MES {0 1}	
4	Mode Setup	QUR	MES?	0. Marker mode
		RSP	MES {0 1}	1. Event table mode
		CNT	OFS 1	
5 Relative Distance	Relative Distance	QUR	OFS?	l: Relative distance (zero point) $1 = 1 m$
	serup	RSP	OFS 1	
	6 Smoothing ON/Off	CNT	SMTH {0 1}	0: Smoothing OFF
6		QUR	SMTH?	0. Smoothing OF F
betup	RSP	SMTH {0 1}	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		e: Event position
		QUR	SPLICE?	x1: Position X1
1	Query for		e,x1,x2,x3,x4	x2: Position X2
1	Insertion Loss Measurement			x3: Position X3
	Measurement	RSP	SPLICE: a x 1 x 2 x 3 x 4 y	x4: Position X4
		C,A1,A2,A0,A4,V	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	Search	DCD		l: Total Loss
	bearen	nor	AUT e,d,1,r	r: Total Return loss
	Query for Event 5 Measurement Result	CNT		e: Event number
		QUR	EVN2? e	d: Distance
5			EVN2 e,d,s,r,l,t	s: Slice loss
0		RSP		r: Return loss
				l: Total Loss
				t: Events, types reported
	Query for Total	CNT		x1: Marker Position X1
6	Loss	QUR	TLOS? x1,x2	x2: Marker Position X2
		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
7	Query for Weyeform Data			b: Data designation rate [] can be
	waveloriii Data	RSP	ds,d	omitted
				ds: Data length
				d: Data
		CNT		m: Average mode 0: Manual.
-	Querv for Average	QUR	AVE?	1: Auto
8	Result	RSP	AVE m.k.b	k: number
		1001	11 + 12 111,11,~	b: time
	Query for Total	CNT		
9	Loss Analysis	QUR	MKDR?	s. Start point
	Range	RSP	MKDR s,e	e. End 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
T	OTDR Status	DCD	CTTC (1191914)	3: In post-process of measurement
		RSP S1S {1 2 3 4}	4: Stopped	
	Query for 2 Waveform Data Status	CNT		0: No monoforme data
2		QUR	WAV?	1: Waveform data is available
		RSP	WAV {0 1}	1. wavelorni data is available
	3 Query for Error	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
	0 0 D	CNT		a: Data sina
1	Query for Data	QUR	GETFILE?	s. Data size
	гпе	RSP	s,d	d. File data
		CNT	SETFILE s,d	
2	File Data Transmission	QUR		s: File size d: File data
		RSP		
	File Data Format Setup	CNT	SRLV {1 2 3}	1: Key event data block only
3		QUR	SRLV?	2: Data point block only
		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	CNT QUR	DATE2 y,m,d,h,mm,s, diff DATE2?	y: year m: month d: day h: hour mm: minute s: second
		KSP	y,m,d,h,mm,s, diff	and time anterence from 010
		CNT	SLFTST	l: optical level
		QUR	SLFTST?	w: warming up
9	Solf-Diagnostics	RSP	SLFTST	p: power voltage
2	Sen-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
0		RSP	MINF	mac: mac address v: software version
			m,n,c,s,mac,v	
		CNT	DWNLD s,d	s: File size
				d: File data
		QUR	DWNLD?	
4	Software Update	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
		CNT	CONNTM t	
1	Timeout Interval	QUR	CONNTM?	t: Timeout interval $1 = 1$ s
	Setup	RSP	CONNTM t	
		CNT	NET i,p,m,g	: ID address n' nort number
2	Network Configuration	QUR	NET?	m. Notmool a. Cotomou
		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
		CNT	ATO t	
4	for Alarm Sotup	QUR	ATO?	t: Timeout interval 1 = 1 s
	for Alarm Setup	RSP	ATO t	

4.3.9 Other Setup

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

Table 4.3.9-1 Command for Other Setup

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>,[<argument>]</argument></mode>			
Control	Mode	0: Times 1: Seconds 2: Auto For switching to Auto Times (Seconds), set to Times		
		(Seconds) first, and then set to Auto.		
	~ .	Times: 1 to 9999 times		
	Set value	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		
Remarks	When the mode returned. When the mode ALA 2,***,***. [] can be omitted	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 i	Set Attenuator in Auto mode.		
Control	АТА			
Query	ATA?			
	ATA_{0 1}			
Response	0	Manual Setup		
	1	Automatic Setup		
Remarks When Puls Also, when be erased.		th is in Auto mode, Attenuator will be set to Auto mode. nuator is changed to Auto mode, the waveform data will		

(3) Attenuator Setup

Command	ATT		
Description	Sets Attenuation.		
	ATT_ <attenuati< td=""><td>on></td></attenuati<>	on>	
Control	Attenuation	Number rounded down to three decimal places Unit: dB Available attenuation range depends on Pulse width. Available attenuation rang can be obtained using	
		When Pulse width setting is in Auto mode, Attenuator will be set to Auto mode automatically.	
Query	ATT?		
	ATT_ <attenuati< td=""><td>on></td></attenuati<>	on>	
		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 waveform data will be erased even without setup value change.		
	Also, if measure it will restart aft	ment is being executed, the measurement will stop, and ter the command processing has been executed.	

(4) Query for Available Attenuator

Command	ATV			
Description	Queries availabl	Queries available Attenuation values under the specific Pulse width.		
Control				
	ATV?_ <pulse width=""></pulse>			
Query	Pulse width	Numeric value Unit: ns		
	ATV_ <attenuation< td=""><td>on>,[<attenuation>]</attenuation></td></attenuation<>	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 coefficie	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?		
D	CAL_ <coefficien< td=""><td>t value></td></coefficien<>	t value>	
Kesponse	Coefficient value	-9.99 to +9.99	
Remarks			

(7) Distance Range Mode Setup

Command	DSA		
Description	Sets the distance 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	DSB		
Command			
Description	Sets the distance	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	ponse 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 dista DSR command e The waveform d	nce range Setup mode will be released as the result of execution. ata will be erased when Distance range is changed.	

(9) High Dynamic Range Mode Setup

Command	ENH	
Description	Sata high dynamic range mode for measurements	
Description	Sets high dynam	the range mode for measurements
Control	ENH_{0 1}	
	0	Standard Mode
	1	High dynamic range mode Available when the pulse width is between 50 ns to 2000 ns.
Query	ENH?	
Response	0	Standard Mode
	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.	
Control	IOR_ <ior value=""></ior>	
	IOR value	1.000000 to 1.999999
Query	IOR?	
Response	IOR?_ <ior td="" valu<=""><td>ie></td></ior>	ie>
	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. Attenuator control is also set in Automatic Setup mode.		

(12) Pulse Width Setup

Command	PLS		
Description	Sets the pulse w	Sets the pulse width for measurements.	
	PLS_ <pulse td="" wid<=""><td>th></td></pulse>	th>	
Control	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	
	Automatic pulse width Setup mode will be released as the result of PLS command execution.		
Kemarks	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 ***.		

4.4 Command Details

(13) Sampling Mode Setup

r		
Command	RES	
Description	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}	
Decrement	0	Coarse
Kesponse	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?	
Response	SMPINF_< number of points >, <modified resolution(m)=""></modified>	
	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 ***,***.	

Command	SSMP		
Description	Sets the conditions for the partial sampling measurements.		
	SSMP_< start d	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	
Control	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?	
	SSMP_< start d	istance(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	
	When distance of distance from the	offset is set with OFS command, the start distance is the ne distance offset.	
	Example: When distance offset a 1000 m.	the position of start distance is set at 1000 m and t 0 m, then absolute distance of the start distance is	
	When distance of 1100 m.	offset is 100 m, absolute distance of the start distance is	
Remarks	МW9087В	Partial Sampling Range= Resolution×(Number of 1100 m	
	Offset 100 m	Sart distance 1000 m	

(15) Partial Sampling Measurement Condition Setup

(16) Query for Partial Sampling Value

Command	SSMPINF	
Description	Queries set value for the partial sampling measurements.	
Control		
Query	SSMPINF?	
Response	SSMPINF_ <con <modified resolution<="" td=""><td>npensation start distance(m)>, ntion(m)>,< Sampling point > A number rounded down to two decimal places in the resolution of measurement data with IOR</td></modified></con 	npensation start distance(m)>, ntion(m)>,< Sampling point > A number rounded down to two decimal places in the resolution of measurement data with IOR
	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></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		

4

Command THR2 Description Sets Reflection threshold. THR2_<threshold> Reflection threshold, value rounded down to one decimal place in dB. Available threshold value: -60.0 dB to -20.0 dB Control In case of waveform data, changing the setup value Threshold with THR2 command will re-execute auto search. Value 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. THR2? Query THR2_<threshold> Response Threshold -60.0 dB to -20.0 dB Value ___ Remarks

(18) Reflection Threshold Setup

(19) Splice Loss Threshold Setup

Command	THS	
Description	Sets Slice loss threshold.	
	THS_ <threshold></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		

4.4 Command Details

(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 omi When WLS com	tted. mand 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.	
	APR_{0 1}	
Control	0	2PA (Two-point method)
	1	LSA (Least square method)
Query	APR?	
	APR_{0 1}	
Response	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.			
	•			
-------------	---	---	--	--
Command	LD			
Description	Start or stop th	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?		
	LD_{0 1 2}			
Л	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.			

(3) OTDR Measurement Start/Stop

4

(4) Mode Setup

Command	MES		
Description	Change Marker mode or Event table mode.		
	MES_{0 1}		
Control	0	Marker mode	
	1	Event table mode	
Query	MES?		
	MES_{0 1}		
Response	0	Marker mode	
	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 dist	ance as the relative zero point.	
	OFS_< offset dis	stance>	
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.		

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

(6) Smoothing On/Off Setup

4.4.4 Querying Measurement Results

(1) Query for Auto Search Result

Command	AUT			
Description	Queries the auto search result.			
Control				
Query	AUT?			
	AUT_ <number events="" of="">,<fiber length="">,<end end="" loss="" to="">,< <total loss="" return=""></total></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				

Query for Average Mode

Command	AVE		
Description	Queries the numbe	er of averages (seconds).	
Control			
Query	AVE?		
	AVE_ <average mode="">,<number average="" of="">,<time average="" of=""></time></number></average>		
	Average mode	0: Manual Setup	
		1: Automatic Setup	
	Number of average	Numeric value	
Deenenee		Unit: number	
Kesponse		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			

Command	DAT		
Description	Queries waveform data.		
Control			
	DAT?_[<data start<br="">[,<decimation rate<="" td=""><td>distance>,<data distance="" end=""> >]]</data></td></decimation></data>	distance>, <data distance="" end=""> >]]</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.	
	Decimation rate	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.	
Response		The data is divided into upper 8 bits and lower 8 bits, and first upper ones are output, and then lower ones	
		are output. 1 = 0.001 JP	
	Data	1 – 0.001 ab	
		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.	

(3) Query for Waveform Data

(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.			
Romarks				
Remarks	Example of the response: When outputting the data of 5001 points, 37.580			
	dB on 1st data.			
	Data length: 5001 points → 5001 (Dec) = 00001389 (Hex)			
	1st data: 37.580 dB \rightarrow 37.580 x 1000 = 37580 (Dec) = 92CC (Hex)			
	00h 00h 13h 89h,92h CCh (second and subsequent data)			
	Data length 1st data			

Command Reference

Command	EVN2				
Description	Queries Event table.				
Control					
	EVN2?_ <event r<="" td=""><td>number></td><td></td><td></td><td></td></event>	number>			
Query	Event number	Number to ide 1 to Number of	ntify each ev f events	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 event table. 1 to the number of events			
	Distance	Value rounded down to three decimal places with IOR compensation. Unit: m			
	Splice loss	Value rounded down to three decimal places. Unit: dB When the measurement is unavailable, the response will be ***.			
Response	Return loss	Value rounded down to three decimal places. Unit: dB When the measurement is unavailable, the reswill be ***. The following threshold status is added as the byte of the response data. "_" means a space character. Event Saturat detection Saturat ed the the the the the the the ed the threshold the		es. e response the first Under the threshold (
	Total loss	Value rounded down to three decimal places. Unit: dB When the measurement is unavailable, the response will be ***.			
	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. "Event evaluation "			t, E: Fiber ent ction 3.6.3.
Remarks					

(4) Query for Event Analysis Result

(5) Query for Insertion Loss Measurement

Command	LOS2		
Description	Calculates the lo	oss 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	
	Position X2	Unit: m 0.00 m to the setup value of distance range	
Response	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.	
	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			

4

Command	MKDR		
Description	Queries the calculation range of total loss.		
Control			
Query	MKDR?		
	MKDR_ <start point="">,<end point=""></end></start>		
Response	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		·	

(6) Query for Total Loss Analysis Range

(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_< calibra <return loss=""></return>	ted event position >, < calibrated peak position >,
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		

4

Command	SPLICE	
Description	Calculates the splice loss from the marker positions.	
Control		
	SPLICE?_ <event p<br=""><position x3="">,<pos< td=""><td>position>,<position x1="">,<position x2="">, sition X4></position></position></td></pos<></position></event>	position>, <position x1="">,<position x2="">, sition X4></position></position>
	Event position	
Query	Position X1	Value rounded down to two decimal places with IOR
quory	Position X2	compensation. Unit: m
	Position X3	0.00 m to the setup value of distance range
	Position X4	
	SPLICE_ <calibrated event="" position="">,<calibrated position="" x1="">,<calibrated position="" x2="">, <calibrated position="" x3="">,<calibrated position="" x4="">,<splice loss=""></splice></calibrated></calibrated></calibrated></calibrated></calibrated>	
	Calibrated event position	
	Calibrated position X1	Value of two decimal places rounded down to multip number of data resolution with IOR compensation.
	Calibrated position X2	Unit: m When the relationship of the positions of calibrated
Response	Calibrated position X3	markers is not $X1 < X2 \le$ 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 ***.
	F	Also when the relation of the positions of calibrated markers is not $X1 < X2 \le$ event position $< X3 < X4$, the response will be ***.
Remarks		

(8) Query for Splice Loss Measurement

4.4 Command Details

1	a	١
ſ	J	,

Request for Total Loss

Command	TLOS	
Description	Queries the total loss of marker section.	
Control		
	TLOS?_ <position 2<="" 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	0.00 m to the setup value of distance range
Response	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.
	Calibrated position X2	Unit: m When the relation of the positions of calibrated markers is not X1 < X2, the response will be ***.
	Total loss	Value rounded down to three decimal places. Unit: dB When the measurement is unavailable, the response will be ***.
Remarks		

4

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?	
Response	ERR_ <error code=""></error>	
	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		

4.4 Command Details

(3) Query for Waveform Data Status

	-		
Command	WAV		
Description	Queries the waveform data status.		
Control			
Query	WAV?		
Response	WAV_{0 1}		
	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 waveform data file.	
Control		
Query	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}	
Decrease	0	BC (Installation)
Response	1	RC (Repair)
	2	OT (Others)
Remarks		

(3) Waveform Data File Transfer

Command	SETFILE	
Description	Transfers a Waveform data file to the Card OTDR.	
Control	SETFILE <file size=""> <file data=""></file></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
Query		
Response		
Remarks	Example) When transferring the 1000 bytes waveform file(1000=000003E8h): 53h 45h 54h 46h 49h 4Ch 45h 00h 00h 03h E8h (hereafter, file data) S E T F I L E File size	

(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>,<month>,<day>,<hour>,<minute>,<second>,<time difference></time </second></minute></hour></day></month></year>	
	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
Dognongo	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 size=""><file data=""></file></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}	
Response	0	Software is not received.
	1	Software is being updated.
	2	Software update is completed.
	3	Software update is failed.
	Example) When sending the byte file(256=00000100h): 44h 57h 4Eh 4Ch 44h 00h 00h 01h 00h (hereafter, file data)	
Remarks	D W N L	D File size
	Do not unplug the LAN cable and turn off the power while updating the software. This may cause the software failures.	

4

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) "SN620000000"
	MAC Address	MAC address: Example) "00-00-91-12-34-56"
	Software Version	Software version: Example) "1.00"
Remarks		

(3) Query for the Equipment Profile

(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 report	0: Normal or measurement enabled 1: Abnormal or warming up
Remarks	ANS76 returns when other command is received during self-test.	

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 interval for TCP/IP connection.	
	CONNTM_ <timeout interval=""></timeout>	
Control	Timeout interval	1 to 7200 (1 second step)
Query	CONNTM?	
	CONNTM_ <timeout interval=""></timeout>	
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 of the command, passes, the connection will be forcibly terminated.	

(2) Network Configuration

Command	NET	
Description	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>	
Response	IP address	0.0.0.0 to 255.255.255.255
	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 communication 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 _ <communication speed="">,<flow control=""></flow></communication>		
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	АТО	
Description	Sets timeout interval for Alarm.	
	ATO_ <timeout interval=""></timeout>	
Control	Timeout interval	0 to 360 (1 second step)
Query	ATO?	
D	ATO_ <timeout interval=""></timeout>	
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

ltem	Description	Error Code
0	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

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
TT (11)	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

Table 4.5-1 Error Code (Cont d	Table 4.5-1	Error Code	(Cont'd)
--------------------------------	-------------	------------	----------

Required Equipment for Performance Test...... 5-3

Dynamic range5-8

Distance measurement accuracy 5-11

Loss Measurement Accuracy (Linearity) 5-13

5.1

5.2

5.3 5.4 5.1.1 5.1.2

5.1.3

5.1.4

5.1.5 5.1.6

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

5

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.

Item	Required Performance	Recommended Model (Model Name)
Optical spectrum analyzer	Wavelength:600 nm to 1650 nm	MS9740A
	Level: -65 dBm to $+20 \text{ dBm}$	(Anritsu)
	Wavelength stability: ±0.3 nm	
Optical variable attenuator	Wavelength: 1200 nm to 1650 nm	8163B+81570A
	Input loss: 3 dB or less	(Agilent Technologies)
	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 Optical fiber	Fiber length: 2 km per piece	
	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	

 Table 5.1.1-1
 Required Equipment for Performance Test

Chapter 5 Performance Test and Maintenance

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





<Test procedure >

- 1. Setup and connect as shown in Figure 5.1.2-1.
- 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 1μ s 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 km using the DSA 0 or DSR 100000 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.

- 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 μ s 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 $10\mu s$ 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>





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.
- 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 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.

5

Performance Test and Maintenance

Chapter 5 Performance Test and Maintenance



Figure 5.1.5-2 Waveform Measurement Position

5.1.6 Loss Measurement Accuracy (Linearity)

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



Far end: Matching list covering

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.
- 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.





Figure 5.1.6-2 Loss Measurement Positions

```
\begin{array}{l} \mbox{Measurement for $L_1$ to $L_6$} \\ \mbox{Averaging value $L_{ave_1} = (L_1 + L_2 + L_3 + L_4 + L_5 + L_6)/6$} \\ \mbox{L}_{diff_1} = (L_1 - L_{ave_1}) \times 4 \\ \mbox{L}_{diff_2} = (L_2 - L_{ave_1}) \times 4 \\ \mbox{....} \\ \mbox{L}_{diff_6} = (L_6 - L_{ave_1}) \times 4 \\ \mbox{Measurement for $L_9$ to $L_x$} \\ \mbox{Averaging value $L_{ave_2} = (L_9 + L_{10} + L_{11} + \dots + L_x)/(x - 9 + 1)$} \\ \mbox{L}_{diff_9} = (L_9 - L_{ave_2}) \times 4 \\ \mbox{L}_{diff_10} = (L_{10} - L_{ave_2}) \times 4 \\ \mbox{....} \\ \mbox{L}_{diff_1x} = (L_x - L_{ave_2}) \times 4 \\ \mbox{....} \\ \mbox{L}_{diff_n} \{L_{diff_1}, L_{diff_2}, \dots, L_{diff_6}, L_{diff_9}, \dots, L_{diff_x}\} : Check it is \pm 0.1 or less. \end{array}
```

5.2 Updating Software

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

- Command1Check the software version of the mainframe.MINF2Send the software to the mainframe.DWNLD3Check the updating progress.DWNLD
- 4 Restart the mainframe after updating the RST software.



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.

ltem		Specifications	Remarks	
Model name	MW9087B/D	Card OTDR		
Configuration	Standard Ap	Standard Application (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		
	MW9087D			
Measurement fiber	$10/125 \mu m SN$	A fiber (ITU-T G.652)		
Optical connector	•FC: Option0	37		
	•ST: Option0	38		
	•DIN: Option	1039		
	•SC: Option0	40		
	•HMS-10/A:	Option043		
Distance range	1/2.5/5/10/25/	50/100/200/300 km	IOR=1.500000	
Pulse width	3/10/20/50/10	0/200/500 ns 1/2/4/10/20 μs		
Dynamic range *2			SNR=1, 25°C,	
	MW9087B	$\geq 40 \text{ dB}$ (Typical value: 41 dB)	Pulse width 20 µs	
	MW9087D	\geq 49 dB (Typical value: 50 dB)		
Dead zone	MW9087B	$\leq 0.5 \text{ m}$	25°C,	
(Fresnel reflection) * ³	MW9087D	≤ 1.0 m	IOR=1.500000, Pulse width 3 ns,	
Dead zone	MW9087B	$\leq 6.5 \text{ m}$	25°C,	
(Backscatter light) *4	MW9087D	$\leq 4.3 \text{ m}$	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		Either of the value	
	Medium: 150	01, 20001 or 25001	is automatically	
	Fine: 100001.	, 125001 or 150001	selected depending	
			on the distance range.	
IOR setting	1.000000 to 1	.9999999 (0.000001 step)		
Distance	±1m±3×Meas	urement distance×10 -5±Sampling resolution		
measurement	(Uncertainty	with fiber's index of refraction is excluded.)		
accuracy				
Loss minimum unit	0.001 dB			

Table A-1 Specifications of MW9087 Series

Appendix A Specifications

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
Power	+12 Vdc+10%	June 24, 2007)
Power consumption	$\leq 20 \text{ W}$	
Dimensions	165(H)×50(W)×270(D) mm (not including projection portion)	
Mass	$\leq 1.5 \text{ kg}$	
Temperature/Humi dity	Operating temperature and humidity: 0 to 50 °C, ≤95% (no condensation)	
	Storage temperature and humidity: −20 to +60 °C, ≤95%	

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

- *1 Pulse width:1 µs at 25°C
- *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

Standard/High dynamic range mode added (pulse width 50 ns to 2 μ s)

- *3 *I*₁ in the right figure. Return loss: 40 dB
- *4 *l*₂ 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

Distance	Pulse Width (ns)											
Range (km)	3	10	20	50	100	200	500	1000	2000	4000	10000	20000
1	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	_	-	—	_	-	-	_
2.5	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	_	-	_	_	-	_	_
5	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	-	_	_	-	_	_
10	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	_	_	-	_	_
25	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	_	-	_	_
50	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	_	_
100	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
200	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
300	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark

Table B-1 Settable Pulse Width

 \checkmark : Settable

 \Rightarrow Not settable

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.

ltem	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	$-25.0~\mathrm{dB}$
Fiber far end threshold	THF	5 dB
File		
File format	SRLV	Event data, measurement condition, and waveform data
Data flag	HDFG	BC (When installed)

Table C-1 Factory Shipment Defaults (Initialized Items)

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

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

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

Appendix D Command Compatibility

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

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

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

MKDR?

_

 \checkmark

Query for Total Loss Analysis Range

Appendix D Command Compatibility

Control Command	Query Command	Compatibility	Function/Change
NET	NET?	\checkmark	Network Configuration
OFS	OFS?	\checkmark	Relative Distance Setup
—	REFLCT?	\checkmark	Query for Return Loss
RST	—	\checkmark	Reset Execution
SETFILE	_	\checkmark	File Data Write
_	SLFTST?	\checkmark	Self-diagnosis
_	SMPINF?	\checkmark	Query for Sampling Conditions
_	SPLICE?	\checkmark	Query for Splice Loss Measurement
SRLV	SRLV?	\checkmark	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?	\checkmark	Fiber Specific Setup
THR2	THR2?	\bigtriangleup	Return Loss Threshold Setup Setup range is changed to –60 to –20.
THS	THS?	\checkmark	Splice Loss Threshold Setup
_	TLOS?	\checkmark	Query for Total Loss
_	WAV?	\checkmark	Query for Waveform Data Status
WLS	WLS?	\checkmark	Wavelengths Setup

Table D-1 Command Compatibility (Cont'd)

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 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	<u>°C</u>
Relative humidity %	
Instruments used: Model name	Serial number
Model name	Serial number
Model name	Serial number
Model name	Serial number
Remarks	

Appendix E Performance Test Result Form

		1	1	1	
Test l	tem	Specifications	Result	Remar	rks
Wavelength	1650 nm	1645 to 1655 nm		Pulse wid µs, wavele range of 2 or lower th the peak w	th: 1 ength 0 dB han value
Pulse width	10 ns	10 ns		$\pm 35\%$	
	20 ns	20 ns		$\pm 35\%$	
	50 ns	50 ns		$\pm 25\%$	
	100 ns	100 ns		±0%	(Re
	200 ns	200 ns		±10%	fer
	500 ns	500 ns		±10%	enc
	$1 \ \mu s$	1 μs		±10%	e va
	$2~\mu m s$	$2~\mu s$		±10%	alu
	$4 \ \mu s$	4 μs		±10%	e)
	10 µs	10 µs		±10%	
	$20 \ \mu s$	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)			

 Table E-1
 MW9087B Performance Test Recording Table

*: Pulse width: 20 µs, Distance range: 100 km, Averaging time: 180 seconds

Test I	tem	Specifications	Result	Remarks	
Wavelength	1550 nm	1525 to 1575 nm			
Peak value		+15 dBm or less			
Pulse width	10 ns	10 ns		±35%	
	20 ns	20 ns		$\pm 35\%$	
	50 ns	50 ns		±25%	
	100 ns	100 ns		±20%	(Re
	200 ns	200 ns		±10%	fer
	500 ns	500 ns		±10%	enc
	1 μs	1 μs		±10%	e v
	2 μs	2 μs		±10%	alu
	4 μs	4 μs		±10%	e)
	10 μs	10 μs		±10%	
	20 μs	20 μs		±10%	
Dynamic	MW9087D	49 dB *		S/N=1	•
range					
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)			

Appendix E Performance Test Result Form

 Table E-2
 MW9087D Test Recording Table

*: Pulse width: 20 µs, Distance range: 100 km, Averaging time: 180 seconds

Appendix Appendix E