# <u>/Inritsu</u>

# MW9070B Optical Time Domain Reflectometer

**Operation Manual** 

• Read this manual before using the equipment. Keep this manual with the equipment.

# MW9070B Optical Time Domain Reflectometer Operation Manual

**Sixth Edition** 

Read this manual before using the equipment. Keep this manual with the equipment.

> Measuring Instruments Division Measurement Group ANRITSU CORPORATION

> > Document No.: M-W1046AE-6.0

# Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Insure that you clearly understand the meanings of the symbols BEFORE using the equipment.

### Symbols used in manual

DANGER	$\wedge$	This indicates a very dangerous procedure that could result in seri- ous injury or death if not performed properly.
WARNING	$\triangle$	This indicates a hazardous procedure that could result in serious in- jury or death if not performed properly.
CAUTION	$\triangle$	This indicates a hazardous procedure or danger that could result in light-to- severe injury, or loss related to equipment malfunction, if proper precau- tions are not taken.

## Safety Symbols Used on Equipment and in Manual

(Some or all of the following five symbols may not be used on all Anritsu equipment. In addition, there may be other labels attached to products which are not shown in the diagrams in this manual.)

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Insure 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.

 $\sum$ 

This indicates 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.

MW9070B Optical Time Domain Reflectometer Operation Manual

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

	WARNING 🖄
Ŵ	<ol> <li>ALWAYS refer to the operation manual when working near locations at which the alert mark shown on the left is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced. Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.</li> </ol>
	<ul> <li>2. Laser radiation warning <ul> <li>NEVER look directly into the cable connector on the equipment nor into the end of a cable connected to the equipment. If laser radiation enters the eye, there is a risk of injury.</li> <li>Laser Radiation Markings on a following page shows the Laser Safety label attached to the equipment near the cable connector.</li> </ul> </li> </ul>
Repair	3. This equipment cannot be repaired by the user. DO NOT at- tempt to open the cabinet or to disassemble internal parts. Only Anritsu-trained service personnel or staff from your sales representative with a knowledge of electrical fire and shock
WARNING 🥂	age 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 parts.

# WARNING A

4. This equipment should be used in the correct position. 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.

**Replacing Battery** 

**Falling Over** 



- 5. When replacing the battery, use the specified battery and insert it with the correct polarity. If the wrong battery is used, or if the battery is inserted with reversed polarity, there is a risk of explosion causing severe injury or death.
- 6. DO NOT short the battery terminals and never attempt to disassemble it or dispose of it in a fire. If the battery is damaged by any of these actions, the battery fluid may leak. This fluid is poisonous.

**Battery Fluid** 

LCD

DO NOT touch it, ingest it, or get in your eyes. If it is accidentally ingested, spit it out immediately, rinse your mouth with water and seek medical help. If it enters your eyes accidentally, do not rub your eyes, irrigate them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

 This instrument uses a Liquid Crystal Display (LCD); DO NOT subject the instrument to excessive force or drop it. If the LCD is subjected to strong mechanical shock, it may break and liquid may leak.

This liquid is very caustic and poisonous.

DO NOT touch it, ingest it, or get in your eyes. If it is ingested accidentally, spit it out immediately, rinse your mouth with water and seek medical help. If it enters your eyes accidentally, do not rub your eyes, irrigate them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

# 

1. Do not use any AC adapter other than the supplied accessory adapter. If another adapter is used, it may not meet the required specifications and the OTDR may be damaged.

### Grounding

When the AC adapter is used, connect the ground line to earth. The OTDR may be damaged if the AC adapter is not grounded or there may be a danger of an electric shock.

2. Insert the batteries with the correct polarity when the Dry-Cell Batteries are used, or the electrolyte may leak or the battery may explode.

Never mix new and old batteries, or different types of batteries.

Be sure not to short the battery pack contacts when it is detached.

Do not dispose of batteries by incineration.



3. Use the SWA1702W ac adapter within doors. It is not designed for outdoor use.

# — For Safety — Laser Radiation Markings

This equipment uses parts radiating Class 1 or Class 2 laser radiation. The warning labels shown below are attached near the laser-radiation locations.

The danger classification specified by JIS, IEC825 and 21CFR1040.10 are explained below.

	OTDR light source	Visible LD light source
IEC825	Class 1	Class 2
21 CFR 1040.10	Class 1	Class 2

Class 1 and Class 2 indicates the degree of danger of the laser radiation outlined below as defined by JIS, IEC825 and 21CFR1040.10.

- Class 1 Safe laser presenting no danger when used according to design specifications.
- Class 2 Laser radiating in 400 to 700 nm wavelength range. In principal, this class of laser is not safe, but the danger to the eyes is eliminated by the eye avoidance reaction including the blink response.

# Label Attachment Positions



# WARNING

# FOR US CUSTOMERS Please Recycle.



The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of it's useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal.

Before disposing of this product, discharge the battery, and then mail the battery to your local recycling center.

- 1. Disconnect the ac adapter, if used.
- 2. Turn the power switch to on.
- 3. Leave the product on until the power indicator goes off; the battery is now discharged.
- 4. Remove the Ni-Cd Battery Pack.
- 5. Insulate the battery terminals with adhesive tape.
- 6. Mail it to your local recycling center, or to the following address.

ANRITSU WILTRON COMPANY 685 Jarvis Drive, Morgan Hill, CA 95037, USA



# WARNING \land

# FOR EU•EFTA CUSTOMERS Please Recycle.



Read the following when using products to which the mark shown on the above is attached.

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste. Check with your local solid-waste disposal officials for details of recycling options or proper disposal in your area.

Before disposing of this product, discharge the battery, and then mail the battery to your local recycling centre.

- 1. Disconnect the ac adapter, if used.
- 2. Turn the power switch to on.
- 3. Leave the product on until the power indicator goes off; the battery is now discharged.
- 4. Remove the Ni-Cd Battery Pack.
- 5. Insulate the battery terminals with adhesive tape.
- Please recycle in accordance with your national or regional legislation.

Nach Gebrauch der Ver Kaufsstelle Zurückgeben.

Après usage à rapporter au point de vente.

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# 

Changing memory       This equipment uses a lithium battery to back-up the memory. This battery must be replaced by a service engineer when it has reached the end of its useful life; contact the Anritsu sales section or your nearest representative.         Storage media       This equipment uses plug-in memory cards (PMCs) as external media for storing data and programs.         If this media is mishandled, important data may be lost. To prevent this chance occurrence, all important data and programs should be backed-up.         Anritsu will not be held responsible for lost data.         Pay careful attention to the following points. In particular, never remove the PMC from the pulse tester, while it is being accessed.         (PMC)         • PMCs are easily damaged by static electric charges.         • The back-up battery in SRAM plug-in memory cards has a finite life. Replace the battery periodically.		
Storage media       This equipment uses plug-in memory cards (PMCs) as external media for storing data and programs.         If this media is mishandled, important data may be lost. To prevent this chance occurrence, all important data and programs should be backed-up.         Anritsu will not be held responsible for lost data.         Pay careful attention to the following points. In particular, never remove the PMC from the pulse tester, while it is being accessed.         (PMC)         • PMCs are easily damaged by static electric charges.         • The back-up battery in SRAM plug-in memory cards has a finite life. Replace the battery periodically.	Changing memory back-up battery	This equipment uses a lithium battery to back-up the memory. This battery must be replaced by a service engineer when it has reached the end of its useful life; contact the Anritsu sales section or your nearest representative.
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		<ul> <li>(PMC)</li> <li>PMCs are easily damaged by static electric charges.</li> <li>The back-up battery in SRAM plug-in memory cards has a finite life. Replace the battery periodically.</li> </ul>

# **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 Electrotechnical Laboratory, the National Research Laboratory and the Communication Research laboratory, and was found to meet the published specifications.

# Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within 1 year after shipment due to a manufacturing fault, provided that this warranty is rendered void under any or all of the following conditions.

- The fault is outside the scope of the warranty conditions described in the operation manual.
- The fault is due to misoperation, 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, flooding and earthquake, etc.
- The fault is due to use of non-specified peripheral equipment, peripheral parts, consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.

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

Anritsu Corporation will not accept liability for equipment faults due to unforeseen and unusual circumstances, nor for faults due to mishandling by the customer.

# **Anritsu Corporation Contact**

If this equipment develops a fault, contact Anritsu Corporation or its representatives at the address in this manual.

# **CE Marking**

Anritsu affix the CE Conformity Marking on the following product(s ) accordance with the Council Directive 93/68/EEC to indicate that they conform with the EMC directive of the European Union (EU).

**CE Conformity Marking** 

# CE

#### 1. Product Name/Model Name

Product Name:	MW9070 Series Optical Time Domain Reflectome-	
	ter and Plug in Units	
Model Name:	MW9070A/B, MW097 ~	,~ MZ5018A,
	MZ5020A, SWA1702W	

#### 2. Applied Directive

EMC: Council Directive 89/336/EEC

Safety: Council Directive 73/23/EEC

#### 3. Applied Standards

EMC:

Electromagnetic radiation: EN55011(ISM, Group 1, Class A equipment)

#### Immunity:

EN50082-1

	Performance Criteria*
IEC801-2 (ESD) 4 kVCD, 8 kV	AD B
IEC801-3 (Rad.) 3 V/m	А
IEC801-4 (EFT) 1 kV	В

#### \*: Performance Criteria

- A: No performance degradation or function loss
- B: Self-recovered temporary degradation of performance or temporary loss of function

#### Safety:

EN61010-1 (Installation Category II, Pollution Degree 2) This operation manual explains the operation, calibration and maintenance of the MW9070B Optical Time Domain Reflectometer (OTDR). In particular, make sure that you thoroughly understand the basic functions and operations described in Section 1. Further details are given in subsequent sections.

The symbol indicates related sections with more detailed descriptions.

See the operation map in section 4 for the operational sequence.

This equipment can be controlled by a computer which can also analyze the measurement results; refer to the following operation manual for details of the computer interface.

MW9070B Serial Interface Operation Manual (M-W1047AE)

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# Section 1 Outline

This section explains the functions of the MW9070B and the equipment composition. Refer to Appendix A for the performance and functions, options and related equipment.

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Outline

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The MW9070B Optical Time Domain Reflectometer (OTDR) has been developed for finding faults in optical fibers when installing and maintaining optical fiber systems. It can be used to measure total loss, interval loss, splice loss and cable length (distance).

The automatic measurement procedure and the small lightweight portable design make it very easy to use at field installation and maintenance of optical fibers. In addition, the internal memory can save measured waveforms for subsequent analysis and print-out. The MW9070B also has an interface for connecting a computer to process measurement results.

Faults are located and losses are measured automatically by just pressing the [Start] key after setting the measurement conditions at the Setup screens.

Automatic Fault Location	Full Auto Mode/Auto Mode
Loss and Splice Loss Measurement	Manual Mode

When the visible light option is used, leak of the light from the cable can be seen.



**Measuring Cable Loss** and Distance The laser light (wavelength  $\lambda$ ) launched into the optical fiber cable from the OTDR is scattered as it passes to the far end of the cable. Part of this scattered light returns to the OTDR as backscattered light. The strength of this backscattered light is measured and used to find the cable loss. In addition, the time taken from when the optical pulse is launched into the fiber until it returns to the OTDR from a fault is used to calculate the distance to the fault. The cable loss and distance data are stored in the OTDR memory and displayed as a waveform on the screen. For accurate measurement, the light launched into the fiber must pass to the far end of the cable and return to the OTDR as backscattered light before the next optical pulse is launched into the fiber. Therefore, the length of the measured cable is set as the Distance Range on the Setup screens. When the Distance range and Pulse width are set to Auto, the MW9070B sets the optimum values automatically.

Start Key

### 1.1 Searching for Faults Automatically •••Full Auto Mode/Auto Mode

In this mode, faults in the cable are detected and displayed after about 3 minutes just by pressing the [Start] key. Set the measurement mode at the Setup screen to Full Auto or Auto, then the following screen is displayed when measurement is finished. Faults are indicated by the  $\triangleleft$  (event) symbol and the fault data is displayed under the waveform. The faults are called events and this display is called an Event Table.

In the Full Auto mode, the optimum Distance range and Pulse width values are found by the MW9070B. In the Auto mode, measurment is performed using the values for these parameters set at the Setup screen.



For details, see section 4.1.

#### **Event Table**

#### Trace Waveform

The trace waveform is displayed with the attenuation on the yaxis and the distance on the x-axis. The left end of the trace display is the OTDR optical output and the right end is the far end of the fiber cable. The  $\nearrow$  symbol is displayed at faults in the cable.

#### Measurement Conditions

Light Wavelength ( $\lambda$ ), Distance Range (DR), Pulse Width (PW),

Index of Refraction (IOR), Number of Averagings (Average) • Search Results

Total number of Faults (Total), Total Fiber Length (Fiber Length), Total Loss of Entire Fiber (Total Loss)

• Event Table

Number of Fault counted from Left (No.), Distance from OTDR (Position), Splice Loss, Return Loss (R. Loss), Total Loss to the Fault (T. Loss)

Loss to the Fault (1. LOSS

#### 1.2 Detailed Measurement ••• Manual Mode

In this mode, any position on the fiber can be measured by moving the markers to it. Press the [Start] key after the measurement mode has been set to Manual on the Setup screen. In this mode, select Loss to find the cable total loss, and select Splice & Return Loss to find the connection loss. Two markers are displayed for Loss measurement and six markers are displayed for Splice & Return Loss measurement. The vertical cursor is displayed at the selected marker. The measured values are displayed at the bottom of the screen. Furthermore, in this mode, either the Averaging mode, which averages the measured value for each sweep, or the Real time mode, which re-writes the waveform at each sweep, can be selected.

The following diagram shows a Splice & Return Loss measurment example.



For further details, see section 4.3.

Outline

**Before Use** 

Setting Up

Operation

**Performance Test** 

Appendixes Maintenance

<b>1.3 Useful Functions</b>	See the operation map in Page 52 for the operation method.
See section 4.2.2.	When searching automatically for faults in the Auto mode, there is a possibility of misidentifying normal points as faults or of missing real faults as a result of noise. By changing to the Edit mode when the waveform is displayed, misidentified faults can be eliminated or moved and new events can be added.
See section 4.3 (1).	Averaging and Real Time functions The strength of the backscatter light changes with distance. The effect is particu- larly large when the fiber far end is close and is observed on the screen as noise. When the Averaging function is set to ON, the value measured each time the optical pulse is launched into the fiber is averaged so the noise is reduced and a smoother waveform is observed. The Averaging completion conditions can be set at the Setup menu either as the Averaging Time or the No. of Averagings. When the [F2] (Real Time) key is pressed, the screen data is re-written at each sweep and real-time measurement is performed.
See section 4.7.	<b>Saving and reading measured waveforms</b> The waveform displayed on the screen can be saved either in the MW9070B in- ternal memory or in a memory card. These waveforms can be read or printed at a printer connected to the OTDR. In the Analysis mode, searching for faults and measuring loss or distance with markers can be available on the read waveform. See Appendix A for the number of waveforms which can be saved.
See section 4.3.2.	<b>Changing from Manual mode to Auto mode</b> When searching for faults using data that has been collected in the Manual mode, the event marker is displayed at the fault and the Event Table is displayed. This method reduces the fault misdetection rate because it can use waveforms that have been averaged over sufficient time. It is also possible to edit event points in the same manner as the Auto mode.
See section 3.4	<b>Preview</b> In the Preview mode, the waveform trace is refreshed about every 0.9 seconds permitting checking of the waveform while adjusting connectors, etc.
See section 3.2.2	Auto Power-off and Automatic Waveform Save Functions When a key or button is not pressed for a specified time. the power is switched off automatically . At auto power-off, the waveform is saved automatically . The Setup screen is displayed at the next power-on and the stored waveform is re- displayed when the [F5] (Close) key is pressed. When the power is switched off manually, the waveform is not saved automati- cally.
See section 3.5	<b>Outputting Visible Light</b> An optical unit of light source with 635 nm wavelength is available as an option. Since the light of the unit is visible, the leak of the light from the cable can be seen to find faults in the dead zone of the OTDR, and to collate the core of fibers.
See section 4.1	Launch quality check This function is for checking that the fiber under test is connected correctly to the optical connector of the OTDR. It operates in the Preview Mode and at Auto/ Manual measurement, and is used to check the connection condition.

### Section 1 Outline

See section 4.6	<b>Event Registration Function</b> This function is convenient for measuring repeatedly regular splices or connections cable by cable like measurement in multicore fiber cable. Some points can be preset by operator and each measurement is performed at these preset points.
See section 4.10	Waveform Comparison Function This function either displays two waveforms simultaneously on the same screen, or displays the difference between the two waveforms as a waveform. It is very useful for measuring distance and level differences so it is convenient for moni- toring aging changes and comparing several fibers.
See section 4.11	Ghost Fresnel Reflection Detection Function Fresnel reflection occurs when there is a connector in the measured fiber. The light reflected by the connector returns to the OTDR and is in turn reflected back by the OTDR. In this case, the reflected light produces a secondary Fresnel re- flection (ghost) at a range of twice the true distance to the connector. This func- tion is useful for detecting this type of ghost Fresnel reflection.
See section 4.12	<b>Auto-increment Function</b> This function automatically increments the number specified for a title of file name each time the file is saved. This is very useful for solving the problem of changing the title contents or file name each time the file is saved.
See section 4.13	Moving Cursor and Shifting Waveforms (Coarse Adjustment) Fine fine-adjusts the cursor movement and shifting; Coarse coarse-adjusts the cursor movement and shifting. This is very useful for matching the movement and shifting according to the purpose.
See section 4.14	<b>Shortcut Keys</b> This miniOTDR has a full lineup of functions for every application. However, although its multifunctionality may give the impression that it is hard to use, it has been designed with a number of easy-to-use shortcut keys for executing common operations straight from the front panel.
See section 4.15	<b>Sampling Resolution Change Function</b> Since the number of measurement data points is limited, generally, as the distance range becomes longer, the data resolution becomes worse. Consequently, with a long fiber to be measured, it is difficult to measure the far-end distance accurately. However, this function permits accurate measurement of the fiber length by sampling the far end of the fiber at a high resolution.

#### 1.4 Loss, Splice & Return Loss, and TORL Measurements

In the Manual mode, Loss measurement or Splice & Return Loss measurement or Total Optical Return Loss Measurement can be selected.

#### (1) Loss Measurement

This measures the loss between any two points on the fiber.

The distance between the two points and the fiber loss (loss per unit length) are also displayed simultaneously. The  $\times$  and  $\frac{1}{2}$  markers are used for this measurement.



#### (2) Splice & Return Loss Measurement

This measures the loss at a connection or splice. The # marker is set at the connection point and then a pair of  $\times$  markers is set on each side of the # marker as shown in the diagram below. If Fresnel reflection is generated by the connection, a  $\bigtriangledown$  marker is set at the peak point.

The four  $\times$  markers are called  $\times 1$ ,  $\times 2$ ,  $\times 3$ , and  $\times 4$  from the left. The splice loss is found from the vertical difference at the # marker between straight lines drawn between the  $\times 1$  and  $\times 2$ , and  $\times 3$  and  $\times 4$  markers.



The distances between the  $\times 1$  and  $\times 2$  markers and between the  $\times 3$  and  $\times 4$  markers as well as the fiber loss (loss per unit length) is also displayed.

There is a section at the splice where the backscattered light cannot be measured precisely during the time corresponding to the pulse width. The distance L shown in the diagram on the left corresponds to this section. As a result of this L, when splice loss is measured using the same method as in Loss Measurement, the loss of the cable L section is included.

cable lengthAppendices C and D give more details about measuring splice loss and returnof Lloss, respectively.

(3) Total Optical Return Loss Measurement

See section 1.5 (b)



Outline

### 1.5 Total Optical Return Loss Measurement

This function calculates the Total Optical Return Loss and displays it on the screen.

#### (a) At Auto Measurement mode

TORL (From zero) or TORL (Each event) can be selected at [Event ORL Select] of the Setup screen 1. When TORL (From zero) is selected, the TORL from 0 km to each event is calculated and displayed. When TORL (Each event) is selected, the TORL between each event is calculated and displayed.

The reference level of TORL calculation is as follows. If sampling start position is not 0 km, the reference level of TORL calculation is sampling start position.

#### TORL (From zero)

Based on distance 0 km (position of the zero cursor when the horizontal offset is ON), calculate the TORL from 0 km to each event (X3 marker).



#### TORL (Each event)

Based on the preceding event marker, calculate the TORL from the event marker to the event (X3 marker) for each event.



#### 1.5 Total Optical Return Loss Measurement

#### (b) At Manual Measurement mode

When the F5 (TORL) key is pressed after sweeping is finished, two markers (x and \*) are displayed and the TORL between these markers is calculated and displayed. The markers can be moved to any position using the arrow keys (>, <).

Based on the X marker, calculate the TORL from the X marker to the marker.



Appendix E give more details about measuring total optical return loss.

Outline

**Before Use** 

### 1.6 Linear Approximation Methods ••• LSA/2PA

At Loss Measurement and Splice Return & Loss Measurement, the loss is found by drawing an imaginary line between two set markers. There are two methods for drawing the line.

#### LSA (Least Square Approximation) Method

In this method, the line is drawn by computing the least square of the distances from all the measured data between the two markers. It is very effective when there is a lot of noise in the measurement data. See Appendix B for further details.



#### 2PA (Two Point Approximation) Method

This method draws the line linking the two measured data points at the two markers.



#### Comparison on LSA and 2PA

These two methods are compared for Loss and Splice Loss & Return measurement when there is a lot of noise as follows:

#### When LSA is selected

When LSA is chosen at Loss measurement, there is a chance of a large error occurring when measuring a fiber with a splice loss along its length.



#### When 2PA is selected

There is a chance of a large error occurring when the noise is large. An example for Splice & Return Loss measurement is shown below.



### 1.7 Equipment Composition

The MW9070B is composed of the main frame, optical unit and battery pack.

See Appendix A for the list of options, peripheral equipment and related

parts.

### Main Frame

The optical unit is mounted in the main frame which is powered by the installed battery pack. The main frame can also be powered by 100/200 Vac system when the AC adapter is connected. If the main frame is powered by 100/200 Vac system while the battery pack is installed, the battery pack will be recharged too. The main frame can be operated on 100/200 Vac system without the battery pack installed.

When the optional floppy disk drive is installed in the main unit, waveforms in the internal memory can be saved to a 3.5-inch floppy disk. Also, data saved on a floppy disk can be copied to the internal memory. The disk file format is the same as that of internal memory and memory cards.

### **Optical Unit**

The following two optical units can be chosen according to the wavelength to be used for measurement. The wavelength should match the optical wavelength used by the system, and can be set to  $1.55\,\mu m$  for more detailed checks of faults at bends in the cable.



SM Fiber 1.31 μm Optical UnitMVSM Fiber 1.31/1.55 μm Optical UnitMVGI Fiber 0.85 μm Optical UnitMVGI Fiber 0.85/1.3 μm Optical UnitMV

MW0970A/B MW0972A/B MW0973J MW0975J

Additionally, when specifying the optical connector, append the 2 digits with a hyphen to the model as shown below. If these 2 digits are not appended, the unit will be supplied with an FC connector.

Optical unit with HMS-10/A connector	-43	(SM Unit)
Optical unit with FC connector	-37	(SM/GI Unit)
Optical unit with ST connector	-38	(SM/GI Unit)
Optical unit with DIN connector	-39	(SM/GI Unit)
Optical unit with SC connector	-40	(SM/GI Unit)
Optical unit with D4 connector	-21	(SM/GI Unit)
Optical unit with Biconic connector	-22	(SM/GI Unit)
Optical unit with HFS-13/A connector	-42	(GI Unit)
Optical unit with Amphenol 906 connector	-23	(GI Unit)

#### **Battery Pack**

Two types of battery packs are available:

Ni-Cd Battery Pack	MZ5018A
Dry-Cell Battery Pack	MZ5020A

The Ni-Cd Battery Pack is re-chargeable. The Dry-Cell Battery Pack accomodates 10 C size dry-cell batteries. Please prepare those dry-cell batteries before use.



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Operation

This section provides important information that should be understood before actually using the MW9070B. In particular, it explains how to charge the battery pack at first use after purchasing the OTDR.

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### 2.1 Unpacking

Remove the OTDR and accessories after undoing the packing case. Save the packing case and spacers, etc. if it might be reshipped again sometime. The standard OTDR consists of the following items. If any part is missing or if the OTDR has been damaged in transport, contact your sales representative immediately.

Item	Name	Qty.	Remarks
Main Unit	OTDR	1	MW9070B
	Opticcal Unit	1	MW0970A/B, MW0972A/B
			MW0973J or MW0975J
	Battery Pack	1	MZ5018A or MZ5020A
Accessories	AC Adapter	1	SWA1702W
	Power Cord(2.5 m)	1	J0017
	Operation Manual	1	W0683AE
	Service Manual	1	W0683BE
	Serial Interface		
	Operation Manual	1	W0751AE
	Shortcut Key Label	1	

#### Table 1 List of Parts and Accessories

Note : Refer to the factory packing lists for the parts and accessories when there are special specifications.

The soft case and the hard case are available for the OTDR. The following two figures show how the related equipment is packed in the hard case. See 2.15 for the soft case.

### Packing of the Hard Case Hard case is option.



### Packing of the Hard Case (Continued)



**Printer Cable** 

### 2.2 Names of Each Part

Check the names and functions of each part. The connector and switch protective covers are not shown in the following diagram.



#### **Status Display Lamp**

#### Power

This lamp lights when the Power switch is set to ON and power is supplied to the OTDR.

If the lamp flashes, it indicates that the battery pack is discharged or that the AC adapter is not correctly inserted.

#### Charge

This lamp is lit when the battery pack is being charged from the AC adapter. It is also lit when the Power switch is off but power is supplied from the AC adapter.

#### Backlight

When this lamp is lit, the Backlight switch is on and the LCD is backlit.

### Memory

This lamp is lit when the unit accesses to the memory card, or floppy disk. When the lamp is lit, it means that the memory card a floppy disk must not be removed from the main frame. The lamp is not lit when internal memory is being accessed.

### Start Key

When this key is pressed, the laser light is output and measurement (sweeping) starts. Laser output is stopped by pressing the F5 (Stop) function key.

### Select Key

This key switches the function of the Cursor key.



### Cursor Key

This circular key is divided into 4 parts: Up, Down, Left and Right. The function of each part is displayed on the bottom right of the screen. Refer to the next page for details about cards. The parts of the key are represented in this manual as follows:



### **Function Keys**

There are five function keys F1 to F5. The function of each key is displayed at the right side of the screen. These displays are called the function key labels. The operations that can be executed on the displayed screens can be found from the function key labels and from the cards explained on the next page.

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#### Keyboard

An IBM-compatible US English Keyboard (101 keys) can be used. The keyboard connector specifications are listed below.



5-pin DIN Connector

Pin No.	Signal
1	Keyboard Clock
2	Keyboard Data
3	
4	Signal Ground
5	+5 Vdc
Shield	Frame Ground

Check that the connector is properly aligned when connecting the keyboard. If the connector is inserted incorrectly, it may be damaged. Do not disconnect the keyboard during input from the keyboard, otherwise there is a possibility of damage to the OTDR.

When a keyboard is used, connect it before setting the OTDR power to ON. If the keyboard is connected while the OTDR power is ON, the OTDR may malfunction.

#### **Keyboard input**

Alphanumeric characters can be input from the keyboard during the following operations.

- · File name input
- Title / Header input
- Event Comment input

In addition, the F1 to F5, F9, F10,  $\leftarrow$ ,  $\rightarrow$ ,  $\uparrow$  and  $\downarrow$  key operations become equivalent to the normal OTDR key operations as follows:

Keyboard key	OTDR key
F1 to F5	F1 to F5
F9	Select
F10	Start
$\leftarrow$	$\leftarrow$
$\rightarrow$	$\rightarrow$
$\uparrow$	$\uparrow$
$\downarrow$	$\downarrow$
	٨

# CAUTION /!

Only disconnect the keyboard after closing the input screen. If the input screen is left open by mistake, there is a possibility that incorrect characters may be input.

#### Cards

Cards explaining the operations that are possible on a particular screen are displayed at the bottom right of the screen. The card at the front of the pile explains the function of the Cursor key on the card. The cards at the back of the pile just display an index tab. The function of the Cursor key changes according to which card is at the front of the pile.



For example, in the diagram above, the Event card is at the front of the pile so the explanation on the card explains that the Cursor key is used to select events and pages; the  $\land$  and  $\checkmark$  keys are used to select the event, and the > and < keys are used to turn over the pages of the Event Table.

To expand the waveform, press the [Select] key to bring the Zoom card to the front of the pile. The displays explains that the  $\land$  and  $\checkmark$  keys expand and contract the display in the vertical direction, respectively, and that the > and < keys expand and contract it, respectively, in the horizontal direction.

Press the [Select] key once. The front card changes as shown below each time the Select button is pressed.



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### 2.3 Charging Battery Pack

CAUTION A

The MZ5020A Dry-Cell Battery Pack is not rechargeable. NEVER attempt to recharge it.

When the MZ5018A Ni-Cd Battery Pack is purchased, first, charge the battery pack for at least 14 hours. However, take care NOT to charge it for more than 20 hours because this may shorten the overall battery life. In addition, charge the battery within an ambient temperature range of  $0^{\circ}$  to  $40^{\circ}$ C.

Connect the accessory AC adapter to the DC IN connector and then connect the adapter to an AC outlet. The Charge lamp is lit when power is supplied from the AC adapter to the OTDR whether or not the Power switch in on or off. (If the Dry Cell Battery is mounted, the battery is not charged.)



When the Ni-Cd battery pack is not mounted in the main frame, the battery pack can still be charged by connecting the AC adapter to it as shown in the following diagram.



### 2.4 Changing Optical Connector

Use the following procedure to change the optical connector.

To change the optical connector, pull the lever forward until the hook is released and then lift off the optical connector. Refer to Appendix A for the various optical connectors that are available.



### 2.5 Connecting Optical Fiber Cable

Open the cover of the OTDR output connector or the visible light output connector on the main frame, and connect the optical cable as shown in the following diagram.



**NEVER** look into the optical output connector on the main frame nor into the end of a cable connected to the optical output connector. If you do, the laser light may damage your eyes.

### 2.6 Connecting Power Supply

#### Connecting AC adapter

When using the AC adapter, connect it as shown in the following diagram.



#### 2.7 Power-on

Setup screen 1 is displayed as shown below when the Power switch is set to ON and the self diagnosties is completed successfully. When the error message is displayed, see section 6.3 to take an action. If the setup screen 1 is not displayed, check the power supply and adjust the contrast knob. If the screen still does not appear, call Anritsu Corporation.

-[Setup mode <1/3>]	19-Dec-96 10:10	-
Heasurement mode. Hanual Event Auto search	Full auto/Auto/Manual	Recall DFN
Macsurement parameters           A(Wavelength)		Print/ Memory More (2/3) Pre-view
Auto measure parameters		Close t:Item *:Parameter

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### 2.8 Adjusting Screen Contrast

See section 2.2.

### 2.9 Connecting Printer

- 1 At Setup screen 2, specify the printer to be connected, and printer interface to be used. At print screen, specify the print format. For details, see paragraph 3.2.2 Print.
- 2 Connect the printer using the printer cable as follows. There are two different cable: for the parallel interface and the serial interface. Prepare a proper cable for your printer. Check that the printer has paper loaded.



3 Set the printer internal DIP-SW1 for the parallel interface printer, and set both DIP-SW1 and DIP-SW2 for the serial interface printer.

#### DIP-SW1

SW No.	Function	Setting
1	Interface	ON: Parallel / OFF: Serial
2	CR Code	OFF: Carriage Return
3	Print Mode	OFF: Condensed Printing (80 columns)
4	Character Set	ON: Ordinary Set
5	Zero Font	OFF: Ø
6	Language Selection	OFF:
7	Language Selection	ON: US English
8	Language Selection	ON:

#### DIP-SW2

SW No.	Function	Setting
1	Data bit length	ON: 8 bits
2	Parity permission	OFF: With
3	Parity condition	OFF: Even
4	Boud rate	OFF:
5	Boud rate	OFF: 9600 bps
6	Boud rate	OFF: )

### 2.10 Using Memory Card

R

See Appendix A for the usable memory cards.

A new memory card must be formatted before a file can be saved on it. The card is formatted in the MS-DOS format.



To write a file to the memory card, check that the write-protect switch is not set and insert the memory card into the card slot in the main frame. (For the writeprotect setting, see the memory card manual.)

#### Inserting memory card

To prevent mis-insertion, the memory card has a cutout; insert it as shown in the diagram below.



### Removing memory card

The memory card can be removed as shown below when the eject button is pressed.



### Changing memory card battery

The memory card has a back-up battery. This must be changed when the voltage falls too low. The following alarm is displayed on the screen at this time and a buzzer sounds.

When this screen appears, change the battery in the memory card by referring to the memory card manual.



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### 2.11 Using Floppy Disk (Option)

A new floppy disk must be formatted before a file can be saved on it. The floppy disk format is MS-DOS.

Refer to section 4.8 (2) for details.

Both double-density (2DD) and high-density (2HD) disks can be used. The data capacity of each floppy disk is as follows:

2DD	2HD
720 KB	1.44 MB

To save a file to a floppy disk, check that the disk write-protect slot is closed and insert the disk into the disk drive in the main unit.

#### Inserting floppy disk

Insert the disk as shown in the diagram below.



#### **Ejecting floppy disk**

Eject the floppy disk as shown below by pressing the eject button.



#### CAUTION

- 1. Only operate the floppy disk drive with the screen of the main frame horizontal, or when the stand is set to incline the screen from the vertical position.
- 2. The floppy disk drive operating temperature is 5 to 40°C.
- 3. Eject a floppy disk from the disk drive before moving the equipment.

## 2.12 Inserting Dry-Cell Batteries

Use 10 dry-cell batteries (C or Baby size) in the Dry-Cell Battery Pack. Use Alkaline Dry Cell Battery (LR14) or Manganese Dry Cell Battery (R14). Never mix old and new batteries.



<sup>></sup> See Appendix A (3) for the operation time of alkaline dry-cell battery and manganese dry cell battery.

Remove the two screws to open the cover.



Insert the batteries correctly.



- **1.** Insert the batteries with the correct polarity, or the electrolyte may leak or the battery may explode.
- 2. Never mix new and old batteries, or different types of batteries.
- 3. Be sure not to short the battery pack contacts when it is detached.
- 4. Do not dispose of batteries by incineration.

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### 2.13 Fitting Battery Pack

Raise the stand as shown below by pressing on the inside of both arms. Fit the battery pack to the main unit and tighten the two screws with a coin or screw-driver.

Tighten the two mounting screws shown in the following diagram to install the battery pack in the main frame.



### 2.14 Installing Optical Unit

Install the optical unit in the main frame as shown in the following diagram and tighten the two screws with a screwdriver.



### 2.15 Fitting Soft Case

To put the OTDR in the optional soft case, remove the stand mounted on the rear panel of the OTDR as shown in the diagram below.



Put the unit in the soft case.



The removed stand fits in the soft case as shown below.



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## 2.16 Fitting Band

The OTDR band can be removed as shown in the following diagram.



The band can be fitted so that the OTDR can be operated while slung from the shoulder or from the neck.



The MW9070B has an RS-232C interface for connecting a computer to process the waveform data and for printing.

Refer to MW9070B Serial Interface Manual (M-W1047AE) for details of remote controlling command.

### 2.18 Precautions

#### **Connector Cover**

The interface connector has a protective cover. Only remove the protective cover to fit a cable to the connector.

#### Condensation

When carrying the OTDR from a low-temperature environment into a warm room, etc., there is a danger of condensation forming in the OTDR. In this case, allow the OTDR to dry out thoroughly before switching the power on.

#### **Extreme Temperatures in Vehicles**

There is a danger of a fault occurring if the OTDR is exposed to very extreme temperatures (-20°C or +60°C) when left in a vehicle. Do not expose the OTDR to extreme temperatures.

#### Safety

#### Grounding

When the AC adapter is used, connect the ground line to earth. The OTDR may be damaged if the AC adapter is not grounded or there may be a danger of an electric shock.

Do not use any AC adapter other than the supplied accessory adapter. If another adapter is used, it may not meet the required specifications and the OTDR may be damaged.

This section explains the items that can be set at the Setup screens and the setting methods. It also explains the preview function for checking the settings, how to save the settings as a file, how to recall the saved settings file, and how to print the settings.

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Setup Screen 1

Title Anritsu Mini OTDR MW9070 Newley	B (Recall DF)
Nemory	
Target INT Memory	(/Print/
Save format: Standard	(L Memor
File IU Number	
Directory format: No title	
Printer	((Nore <3/3)
Printer EPSON	
Printer Interface: Parallel	
	( provident
	Pre-view
	Close
	<u> </u>
	[
	\$:Item

Setup Screen 2

[Setup mode <3/3>]	19-Dec-96 10:14-	
System parameters       IX         Format	Display <b>IN</b> or OFF	Recall BFN (Print/Menory) (Back (1/3) (Pre-view) (Close
		t:Iten *:Parameter

Setup Screen 3

The Setup screens are used to change the OTDR measurement conditions. They are composed of Setup screen 1 (Setup mode <1/3>), Setup screen 2 (Setup mode <2/3>) and Setup screen 3 (Setup mode <3/3>). Setup screen 1 is always displayed when the OTDR is switched on. In addition, the measurement conditions can be changed by displaying the Setup screens by pressing the F1 (Setup) key in any measurement mode.

The measurement conditions are saved in the OTDR internal memory when the OTDR is turned off and the same conditions are read from memory when the power is next turned on. Furthermore, when the measurement conditions have been pre-saved as a DFN (DeFiNition file), the standard measurement conditions can be recalled simply by reading the DFN file even after various settings have been changed.

Note: The DFN file cannot be saved in other than the OTDR internal memory.

### 3.1 Settings

#### **Changing Settings (Items)**

The setting items are moved up and down by pressing the  $\land$  and  $\checkmark$  keys.



#### **Changing Measurement Conditions (Parameters)**

Some measurement parameters are selected from a displayed list, and others are input any value.

#### **Selecting Parameter**

The reverse-displayed parameter to the right of the : symbol is the currentlyset parameter; this can be changed by selecting another parameter using the

 $\langle$  and  $\rangle$  keys.



#### **Inputting Value**

Numeric values displayed to the right of the specified item can be changed as described below. The IOR, threshold value, date and time can be input in a similar manner.

- Move the cursor to the numeric value to be changed using the > key. To return, use the < key.</li>
- 2 Change the numeric value using the  $\wedge$  and  $\checkmark$  keys.
- 3 Repeat steps 1 and 2 to move to the other digits to be changed and then return the cursor to the : symbol using the  $\checkmark$  key.

keys.

Note:

- 1. The method for inputting a title at the Title line on the upper part of Setup screen 2 is different from the above method. It is the same as the method used for inputting a title when saving and printing a file.
- 2. When the setup contents are changed, sometimes, the waveform is cleared, or a new waveform is computed and overwritten.

### **3.2 Explanation of Setup Screens**

This section explains each parameter in the Setup screens shown below. The settings at factory shipment are explained in section 3.2.3.

### 3.2.1 Setup Screen 1

[Setup mode <1/3>] 19-Dec-96 10:10-	
Icessnvenent note. # (Anual Event Auto search	F1
r Measurement parameters	F2
IDR 1.465500 Attenuator 4.0dB Averaging limit Setting item: Number	F3
Linit value: 256 Sampling res: 2m (0.0.000 to 10.235 km) Backscatter leyel: +0.00	F4
Auto measure parameters Close	F5
Beturn Loss: 5:0 dB Fiber end: 5:0 dB Event order: Distance Event ORL Select.: B.Loss	
\$:Item *:Parameter	

#### Measurement mode

Measurement mode (Full Auto/Auto/Manual)

The measurement mode can be set to either Full Auto, Auto or Manual.

#### Full Auto mode

Measurement is performed in about 3 minutes and any fault point on the fiber that exceeds the values set at Auto measure parameters is displayed as an event. The optimum values for the Distance range and Pulse width are set automatically.

#### Auto mode

This is the same as the Full Auto mode except that the Distance range and Pulse width set at the Setup menu are used. (It is exactly the same when the Distance range and Pulse width are set to Auto.)

#### Manual mode

The loss and distance of any part of the fiber can be measured by using the markers. The number of averaging times is set at Manual measure parameters to obtain a waveform with less noise. The Distance range and Pulse width can also be set to the optimum values in this mode by setting the parameters to Auto.

#### Event

#### Event(Auto search/Fixed)

Auto search or Fixed mode can be selected.

#### Auto search

This function automatically detects points in the measured waveform and the displayed waveform that exceed the threshold value, sets an event marker at them and measures connection loss, etc. The threshold value is set at Auto measure parameters.

#### Fixed

With this function, automatic detection is not performed and the position of the currently-set event markers remains unchanged; the connection loss, etc., of the measured waveform is measured. 35 Outline

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#### Measurement parameters Measurement parameters

The measurement parameters are common to all of the Full Auto, Auto and Manual modes. The Distance range and Pulse width parameters are skipped when the Full Auto mode is set.

#### $\lambda$ Wavelength (1.31/1.55 $\mu$ m, 0.85/1.3 $\mu$ m)

SM Fiber Unit:	A wavelength of either 1.31 or 1.55 $\mu$ m can be selected.
	$(1.31 \ \mu m \text{ only for the MW0970A and MW0970B unit})$
GI Fiber Unit:	A wavelength of either 0.85 or $1.3 \mu m$ can be selected.
	(0.85 µm only for the MW0973J unit)

#### Distance range (AUTO/5/10/25/50/100/200 km)

The displayed Distance Range options depend on the mounted optical unit and Pulse Width set at the Setup screen.

When the Distance range is set to Auto and the [Start] key is pressed, the optimumDistance range is found automatically and displayed on the screen. If the length of the optical cable is known, input a value that is slightly larger than the known length. If the input length is too long, the measurement time will increase. If a shorter length is input, the measurement will not be correct.

#### Pulse width

#### (AUTO/20/50/100/500/1000/2000/4000/10000 ns)

The displayed Pulse Width options depend on the mounted optical unit and Distance Range set at the Setup screen.

When the Pulse width is set to Auto and the [Start] key is pressed, the optimum Pulse width is found automatically and displayed on the screen. Although the resolution is increased by setting a shorter Pulse width, since the power is decreased, in longer cables, the noise component increases progressively.

The maximum settable pulse width changes according to the distance range.

The cable loss (D) in dB can be calculated with the cable length (L) in km as follows (When SM fiber is used):

 $D = 0.35 \text{ x L} (at 1.31 \,\mu\text{m})$   $D = 0.25 \text{ x L} (at 1.55 \,\mu\text{m})$ 

Use the following figures as a guide to set the pulse width.

Wavelength: 1.31 µm						
Cable loss (dB)	10	13	15.5	19.5	21	22.5
Pulse width (ns)	20	50	100	500	1000	2000
Wavelength: 1.55 µm						
Cable loss (dB)	8	11	13.5	17.5	19	20.5
Pulse width (ns)	20	50	100	500	1000	2000

#### Index of Refraction (IOR) (1.400 000 to 1.699 999)

Set the IOR of the cable to be measured. If the IOR is not known, use the distance value displayed on the right, indicating the distance to the currently-selected marker or event. Adjust the IOR so the displayed distance to the marker or event is correct.

### Attenuator (only for the MW0970B, MW0972B)

To measure longer distances, the pulse width of the optical output should be wider. However, a wider pulse width can cause saturation of the near-end trace because of excessive reflection. The attenuator is inserted to prevent the saturation. The available attenuation values depend on the Pulse Width set at the Setup screen as listed below:

Pulse Width	Available attenuation Values
20 ns	AUTO/0.0/4.0/9.0/14.0 dB
50 ns	AUTO/0.0/4.0/9.0/14.0 dB
100 ns	AUTO/0.0/4.0/9.0/14.0 dB
500 ns	AUTO/0.0/4.0/8.0/13.0/18.0 dB
1000 ns	AUTO/0.0/4.0/8.0/13.0/18.0 dB
2000 ns	AUTO/0.0/4.0/8.0/13.0/18.0 dB
4000 ns	AUTO/0.0/3.0/6.5/10.5/15.5/20.5 dB
10000 ns	AUTO/0.0/3.0/6.5/10.5/15.5/20.5 dB

#### **Sampling Resolution**

Measurement must be performed at the highest resolution even for long-distance fibers. However, since the number of sampling points is limited, there are limits to the sampling resolution for long-distance fibers. But even long-distance fibers can be measured at high resolution by increasing the sampling resolution only for the part of the fiber to be monitored.

The following table shows the sampling range that can be selected for each distance range. The number of sampling points is 5001.

Distance Range	Selectable Sampling Range
5 km	1 m
10 km	1/2 m
25 km	1/2/5 m
50 km	1/2/5/10 m
100 km	1/2/5/10/20 m
200 km	1/2/5/10/20/40 m

When changing the distance range, the maximum selectable sampling resolution is set automatically.

### Sampling Range

The sampling range determined automatically according to the sampling resolution and is displayed. The sampling range cannot be changed at the setup screen. The sampling range is determined automatically as described below.

- When cursor displayed on measurement screen, equally to left and right sides of cursor
- When cursor not displayed on measurement screen, center of sampling range centered on center of distance range

The sampling range can be calculated as the selected sampling resolution x 5001 points.

Averaging limit	Averaging Value
	Setting Item (Auto/Number/Time)
	This sets how the obtained data is averaged.
	Auto
	The averaging time or number is set automatically. When Full Auto is set at
	the Measurement mode, only Auto can be selected.
	Time
	The data obtained in a set time period is averaged.
	Number
	The data obtained over a set number of sweeps is averaged.
	Limit value
	This sets the number of seconds for averaging, or the number of times. This
	cannot be set at the Full Auto of Measurement mode; * ***is displayed to indi-
	cate it.
Auto measurement	Full Auto mode and Auto mode parameters
parameters	These are the measurement parameters that are set when the Auto mode is set.
	Threshold
	This sets the thresholds for evaluating fault points.
	Splice loss (0.01 to 9.0 dB)
	Points with a loss greater than the set value are evaluated as faults (events).
	Return loss (20 to 60 dB)
	Points with a return loss less than the set value are evaluated as faults (events).
	Fiber end (1 to 10 dB)
	The point showing a loss greater than the value set here is evaluated as the
	fiber far end.
	Event order (Distance/Level)
	This sets the order in which events in the Event Table are displayed.
	Distance
	The events are displayed in order from the OTDR to the far end of the cable.
	Level
	The events are displayed in order from the event with the largest loss to the
	event with the smallest loss.

#### **Event ORL Select**

This selects the contents displayed in the Optical Return Loss item of the event table.

**R.Loss** 

Displays the Optical Return Loss of the ŧmarker.

#### TORL (From zero)

Based on distance 0 km, TORL (from zero) displays the Total Optical Return Loss from 0 km to each event.

#### **TORL** (Each event)

Based on the preceding event marker, TORL (each event) displays the Total Optical Return Loss from the event marker to each event.



See section 1.5 for Total Optical Return Loss Measurement

**Calibration factor** 

#### **Backscatter level**

This sets the calibration value for return loss. Usually, 0 is set, but set a calibration value when wanting to measure with very high precision.



See section 5.2 for the setting method.

### 3.2.2 Setup Screen 2

[Setup mode <2/3>]	19-Dec-96 11:10-	
Title Anritsu Mini OTDR MW9070B Header Bori@naniwa	(Recall DFN	F1
Nemory	Print/ Memory	F2
Printer Printer EPSON	(More <3/3>	F3
	Pre-view	F4
	Close	F5
	‡:Item ♥:Parameter	

Title

The title set here is displayed on the top of the screen displaying the waveform trace. Up to 32 characters can be displayed.

When this item is selected by pressing the > key, the character input window is displayed. Characters can be input from either the panel keys or the keyboard.

When using the panel keys, select the character from the character input window.

When using the keyboard, input the characters directly from the keyboard.

The following screens are displayed when both panel-key input and keyboard input are used.



Input Title Screen (From Front Panel)



Input Title Screen (From Keyboard)

#### **Front Panel**

Title : and the reverse display to its right are called the cursor; characters and spaces can be input and deleted at this position.

#### **Inputting Characters**

All the characters that can be input are displayed in the rectangular box in the center of the screen. One of these characters is reverse-displayed. Move the reverse display up, down, left and right using the  $\nearrow$ ,  $\checkmark$ ,  $\checkmark$ , and  $\flat$  keys respectively. When the reverse display is positioned at the character to be input, press the F4 (Cursor  $\Rightarrow$ ) key. The Title: field input cursor moves to the right each time a character is input. When the F3 (Cursor  $\Leftarrow$ ) key is pressed, the reverse-displayed character is input in the same manner as above, but the Title: field cursor moves to the left instead.

#### Inputting spaces

When the F1 (INS) key is pressed, one space is inserted in front of the character where the cursor is positioned.

#### **Deleting Characters**

When the F2 (DEL) key is pressed, the character where the cursor is positioned is deleted.

#### **Confirming title**

The title input is confirmed by pressing the F5 (Close) key, and the Setup screen is returned.

#### Keyboard

#### **Inputting Characters**

The characters input at the keyboard are inserted at the cursor position. The cursor is moved using the arrow keys and only moves to the position where characters can be input.

#### **Overwriting/Inserting Characters**

The overwrite/insert mode is toggled each time the INS key is pressed. A reverse-displayed cursor indicates the overwrite mode, and an underlined cursor indicates the insert mode.

#### **Deleting Characters**

The character at the cursor position is deleted when the Delete key is pressed. When the Backspace key is pressed, the character to the immediate left of the cursor is deleted.

#### **Confirming Title**

When the Return key or F5 key is pressed, Title input is completed and the Setup screen is fetched.

#### **Canceling Title**

When the Esc key is pressed, the characters input up to that point are canceled and the status returns to the condition before input to the Title screen.





Outline

**Before Use** 

Setting Up

Operation

#### Header

The header set here is printed and saved in a file. Up to 12 rows of 60 characters can be displayed. When this item is selected by pressing the > key, the character input window is displayed. Characters can be input from either the panel keys or the keyboard.

When using the panel keys, select the character from the character input window.

When using the keyboard, input the characters directly from the keyboard.

The following screens are displayed when both panel-key input and keyboard input are used.



Input Header Screen (fron Front Panel)



Input Header Screen (from Keyboard)



Header: and the reverse display to its under are called the cursor, characters and spaces can be input and deleted at this posistion.



**Inputting Characters** 

All the characters that can be input are displayed in the rectangle at the bottom of the screen. Any one of these characters is reverse displayed. When the F3 (Character  $\iff$ ) and F4 (Character  $\iff$ ) keys are used, the reverse display moves left and right, respectively. Move the reverse display to the character to be input and press the > key. The Header input field cursor moves to the right side of this input character. When the  $\lt$  key is pressed, the character is input in the same way and the cursor moves to the left side of this input character.

The  $\land$  and  $\checkmark$  keys move the cursor to the upper and lower sides, respectively.



#### **Inputting spaces**

When the F1 (INS) key is pressed, one space is inserted in front of the character where the cursor is positioned.

#### Deleting Characters

When the F2 (DEL) key is pressed, the character where the cursor is positioned is deleted.

#### **Confirming Header**

The Header input is confirmed by pressing the F5 (Close) key, and the Setup screen is returned.

#### Keyboard

#### **Inputting Characters**

The character for the key pressed on the keyboard is inserted at the cursor position. Characters are input in 1-line units. To move to the next line, use the Return or arrow keys. When the cursor is moved using the arrow keys, it only moves to the position at which a character can be input.

#### **Overwriting/Inserting Characters**

The overwrite/insert mode is toggled each time the INS key is pressed. A reverse-displayed cursor indicates the overwrite mode, and an underlined cursor indicates the insert mode.

#### **Deleting Characters**

The character at the cursor position is deleted when the Delete key is pressed. When the Backspace key is pressed, the character to the immediate left of the cursor is deleted.

#### **Confirming Header**

When F5 key is pressed, Header input is completed and the Setup screen is fetched.

#### **Canceling Header**

When the Esc key is pressed, the characters input up to that point are canceled and the status returns to the condition before input to the Header screen.

Index

#### Memory

#### File ID (Number/Name)

Number :	File name is input as number.
Name :	File name is input as alphabetic name.

#### Target (INT Memory/memory card)

This specifies where to save and read the waveform data to and from.INT Memory :Main frame internal memoryMemory card :Memory card inserted in slot

#### Save format (Print/Analysis/Standard)

Print :	The data is saved in a format that can only be printed. The data quantity is smaller so more waveforms can be saved. Waveforms saved in this mode cannot be searched for faults in newly set threshold conditions, or cannot be redrawn in newly set marker position.
Analysis :	Waveform saved in this mode can be analyzed or printed. They can be searched for faults in newly set threshold conditions, or can be analyzed with newly set marker position.
Standard :	The data is saved in a format that meets Bellcore GR-196-CORE (Issue 1, September 1995). Files saved in this data format cannot be read by this equipment. Use MX3607B Emulation Software to read them.

#### **Directory Format**

No. Title :	File titles not displayed and file list displayed quickly
Title :	File titles displayed in file list

Print

#### Printer (EPSON/HP/DPU-411/DPU-412)

This specifies the printer to be connected to the main frame.

EPSON :	EPSON printers (printers that use the ESC/P commands*)
HP :	HP printers (printers that use the ESC/P commands*)
DPU-411 :	Seiko printer (37.5 cps, 8 x 320 dot/line)
DPU-412 :	Seiko printer (80 cps, 16 x 640 dot/line)
Note : Som com	e models of EPSON and HP printers that support the ESC/P mands cannot be used.
Printer inte	rface (Parallel/Serial)
This specifie	es the printer interface. This setting becomes valid after turning back
the power of	n.

Parallel : The print data are output from the printer connector.

Serial : The print data are output from the RS-232C connector.

### 3.2.3 Setup Screen 3



#### System parameters

#### Date (ON/OFF)

- ON: The date is displayed at the top right of the screen. The date is printed at printing.
- OFF: The data is not displayed and is not printed.

#### Format (M-D-Y/D-M-Y/Y-M-D)

- M-D-Y: The date is displayed in the order month, day and year.
- D-M-Y: The date is displayed in the order day, month and year.
- Y-M-D: The date is displayed in the order year, month and day.

Move the cursor to the current date item on the line displayed under Format and press the  $\land$  or  $\checkmark$  keys to change the day, month or year.

#### Time (ON/OFF)

- ON: The time is displayed at the top right of the screen. The time is printed at printing.
- OFF: The time is not displayed, but is printed.

#### **Time and Date Display**

The time difference from the local time can be displayed on the screen. The time difference is the difference from Greenwich Mean Time. When the local time is ahead of GMT, set +, and when it is behind GMT, set –.

Example: Japan local time is +9:00. New York local time is -5:00.

The time can be changed with the cursor and arrow keys. When the file save format is standard, the time is saved as the local time. When saving, the time difference set here is used to calculate the local time.

#### Distance units (kf/f/km/m/mi)

kf : kilofeet f : feet km : kilometers m : meters mi : mile

#### Auto power off (3/5/15/30/None)

The power is switched off automatically if a key or switch is not pressed during a set time interval (minutes). This time does not include averaging time or autosearching time. The function does not operate when None is set.

#### Auto backlight off (3/5/15/30/None)

The backlight is switched off automatically if a key or switch is not pressed during a set time interval (minutes). The function does not operate when None is set.

#### Sound (ON/OFF)

ON: The buzzer sounds when key or button is pressed, error message is dis played, or the battery pack is discharged. The length of the buzz varies as follows:

Key or button:	Short
Error message:	Quite longer
Battery:	Very long

OFF : The buzzer only sounds when the battery pack is discharged.

#### Connection check (ON/OFF)

ON : This checks whether the condition of the connection between the OTDR and the fiber is good or bad. When the Start key is pressed, the connection check is performed during the waveform sweep. Measurement starts if the sweep condition is good; if it is bad, the following alarms are issued according to the measurement mode. The horizontal line displayed at the top part of the screen, indicates the reference level for the connection condition check.

#### (a) Auto / Manual Measurement mode

The waveform is swept in real time and if an error is detected, the following message is displayed.

Please check connector and press "Start" to continue.

When the connection condition is good, the following message is displayed.

Press "Start" key to continue.

(b) Pre-view mode

The following message is displayed when an error is detected. The message disappears when the connection is good.

Please check and Re-clean connector.

If the Start key is pressed when the connection is bad, measurement will start, but the error marker will be displayed at the top right of the screen.

## See section 3.5.

Visible LD

This is displayed when Option 05 is installed. Connect an optical fiber to the Visible Light Output Connector, and you can see leaked light or you can easily identify a cable when checking a multiple core cable. The output light flashes.

Index

## 3.2.4 Settings at Factory Shipment

– The DFN file is set as follows at	factory shipment.
Measurement mode	FULL AUTO
Event	AUTO SEARCH
Measurement parameters	
$\lambda$ (Wave Length)	1.31 μm
Distance range	AUTO
Pulse width	AUTO
IOR (Index of reflection)	1.465500 (at 1.31 µm)
	1.466100 (at 1.55 µm)
Attenuator	AUTO
Averaging limit	
Setting item	AUTO
Sampling res.	AUTO
Auto measure parameter	
Threshold	
Splice loss	0.30 dB
Returen loss	25.0 dB
Fiber end	5.0 dB
Event order	Distance
Event ORL select	R.Loss
Calibration factor	
Backscatter level	0.00 dB
When the Measurement mode is se	t to the Manual
Averaging limit	
Limit value	256 times, or 180 seconds
Mode	Splice mode
	LSA
– The unit is set as follows at fact	ory shipment.
System parameters	
Date	ON
Format	D-M-Y
Time	ON
Distance unit	kf
Auto power off	15 minutes
Auto backlight off	5 minutes
Sound	ON
Connection check	OFF
Memory	
Target	INT Memory
Save format	Print mode
File ID	Number
Directory Format	Title
Print	
Printer	DPU-411
Print format	Waveform & Data

48

### 3.2.5 Function Keys



### 3.3 Reading, Saving and Printing Setting Contents

When the power is turned off, the settings are saved in the main frame internal memory. At power-on, these saved settings are returned.

The settings can also be saved in a file. This file is called the DFN file. At factory shipment, each of the items in section 3.2.3 is written to this file. If this file is properly used, standard measurement parameters can be saved in it for recalling them after the various settings have been changed temporarily for any reason.

When an event is fixed and saved in a DFN file, the event data at that time (marker position, comment) are also saved. When that DFN file is recalled, the event data is also reset.

Note: <u>Items of Setup screen 2 and other than [connection check] of Setup</u> screen 3 cannot be saved in the DFN file.

#### (1) Reading DFN file

1

2

If the measurement parameters have been saved in the DFN file, they can be recalled and set just by pressing one key after various settings have been changed temporarily.

- Press F1 (Recall DFN) displayed at the Setup screens.
- When the F1 (Yes) key displayed at the screen for confirmation is pressed, the DFN file is read and the main frame settings are changed to the settings saved in the DFN file.

When F2 (No) is pressed, reading of the DFN file is canceled and the Setup screen is returned.





#### (2) Saving to DFN file



When the F1 (Yes) key displayed at the screen for confirmation is pressed, the settings are written to the DFN file in the internal memory and the Setup screen is returned.

When F2 (No) is pressed, the rewriting is stopped and the Setup screen is returned.



Outline

**Before Use** 

Setting Up



Note: When an error occurred in printing, turn off the power, clear the causes of error, and then turn on the power again.

Outline

**Before Use** 

Setting Up

Operation

### 3.4 Preview

After setting the Setup screens and connecting the fiber cable, check the settings and connection with the preview function. The preview function updates the trace waveform about every 0.9 seconds to check the waveform while adjusting cable connections. The markers can be used in the same way as in the Full Auto, Auto and Manual modes.



1

Press F4 (Preview) at the Setup screen. Preview is started and the following screen is displayed.



**Preview Screen** 

- 2 Press F4 (either Slice & Return Loss or Loss is displayed) to set the measurement purpose. The set measurement is displayed at the bottom left of the screen.
- 3 Press F3 (either LSA or 2PA is displayed) to set the linear approximation method.
- 4 Press F1 (Setup) to stop the preview function and return to the Setup screen.

To expand or move the waveform using the cursor keys, or to move the markers,



### 3.5 Visible LD Output (Option 05)

WARNING A

NEVER look directly into the optical output connector of this instrument nor into the end of an optical cable connected to it, because there is a risk of injury if the laser light enters the eyes.

Procedures other than those specified herein may result in hazardous radiation exposure.

The following subwindow is displayed when the Visible LD of the Setup screen 3 is set to ON and the visible red light is output from the Visible LD optional connector.



Visible LD ON Screen

When the cursor is moved to the Visible LD item, it is always OFF. After setting the Visible LD to ON if the cursor is moved to any other item or any function key is pressed, the Visible LD setting returns to OFF.

Since this red light is visible, you can find a fault part of the optical fiber with leaked light. Note that the loss measurement and event detection cannot be performed using this visible light.

# WARNING <u></u>

NEVER look directly into the optical output connector of this instrument nor into the end of an optical cable connected to it, because there is a risk of injury if the laser light enters the eyes.

This section explains the operation methods for the principal uses of the OTDR. See Section 2 for the names of each part of the OTDR, and Section 3 for the setup methods.

Make sure you properly understand the precautions in section 2.16 regarding operation and storage.

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## **Operation Map**



# CAUTION A

Don't connect this equipment to the circuit fiber line in operation. Light for the operation can cause an error in the measurement.

## 4.1 Launch quality check function

This function checks that the fiber is connected correctly to the OTDR and displays an error message when a poor connection is discovered. When [Connection Check] at the Setup screen (3/3) is set to ON, the connection is checked at the start of waveform sweeping. Measurement is started if the connection check result is good. If the connection check result is poor, an alarm is issued according to the measurement mode. Take the action corresponding to the error message. In addition, the horizontal dotted line at the top of the waveform screen indicates the reference level equivalent to a launch quality check.

Please note that sometimes it may be impossible to perform the connection check due to the small level difference between the optical input and the noise floor, depending on the pulse width and attenuator conditions, etc.

#### (a) Auto / Manual Measurement mode

The entire waveform is swept in real time. The error message is:

Please check connector and press "Start" to continue.



**Connection check** 

When the connection condition is OK, the error message changes to the following message.





**Bad connection** —> Good connection

#### (b) Pre-view mode

Sweeping continues. The error message is:

Please check and re-clean connector.



**Connection check** 

Index

When the connection condition is OK, the error message disappears. Measurement is started if the Start key is pressed while the launch quality check is generated, but an error marker is displayed at the top of the screen.



**Bad Connection Marler** 

In addition, the ON / OFF status of the launch quality check function is saved when DFN is saved.

## 4.2 Auto Measurement

This automatically displays the position of faults (events) on the screen. Simultaneously, numeric data for each fault is displayed in table form on the lower part of the screen. This table is called the Event Table.

## (1) Start

- 1 Set Measurement mode: at the Setup screen to Full Auto or Auto.
- 2 Set each of the Measurement parameters at the Setup screen to match the system to be measured.
- 3 Set the Auto measure parameters at the Setup screen to match the conditions for evaluating faults.
- 4 Press the [Start] key.

### Auto measurement steps

When the [Start] key is pressed, the following three steps occur in sequence, the Event Table is displayed, and the screen displaying information about the faults is displayed. Press the F5 (Stop) key to stop Auto measurement.

### 1) Autosetting

In the Full Auto mode, the optimum values for the Distance range and Pulse width are found. In addition, if Distance range and Pulse width are set to Auto at the Setup screen in the Auto mode, this step finds these values.

## 2) Averaging

The optimum number of averaging times is assessed and executed.

### 3) Processing waveform and searching for faults

- Phase 1: The waveform is smoothed.
- Phase 2: Faults are searched for.
- Phase 3 : TORL is calculated.

#### (2) Event Table screen

The following screen is displayed when searching for faults is completed.



**Event Table Screen** 

The following items are displayed on this screen.

### **Measurement parameters**

$\lambda$ : Wavelength of light	DR : Distance range PW : Pulse width
IOR : Index of Refraction	Average : Number of averagings executed

Note : When Distance range and Pulse width are set to Auto at the Setup screen, the values chosen by the OTDR are displayed at DR and PW, respectively.

#### Search results

- Total: Total number of faults
- Total Loss : Total loss of fiber
- Fiber length : Length of fiber
- Note : "OUT OF RANGE" is displayed at Fiber Length when the far end of the fiber cannot be detected.

#### **Trace waveform**

The trace waveform is displayed with the attenuation on the vertical scale and the distance on the horizontal scale. The scales of each axis are displayed at the bottom right of the screen. The  $\gtrsim$  symbol is displayed at fault points.

#### **Event Table**

The following values are displayed for each event.

No : The number of the fault counted from the left (near end) Position : The distance of the fault from the OTDR Splice Loss : The connection loss R. Loss : The return loss T. Loss : The total loss

Note : The splice loss and return loss are assessed for faults exceeding the threshold values set at Setup screen 1. Brackets are attached to faults where one of the two items is within the threshold limits. However, when the measured value is not found for some reason such as the close proximity of a fault, \* \*.\* is displayed. In addition, when the circuit is saturated by a large amount of reflected light, the measured value is prefixed by  $\boldsymbol{\zeta}$ .





#### **Calls Setup screen**

The measurement parameters can be changed at the setup screen.



See section 3.2.1.



### **Enlarges specific event**

For details, see section 4.2.1.

### **Edits event**

For details, see section 4.2.2.

## **Manual operation**

This is used at Manual measurement for data collected in the Auto mode, to display the Manual screen and to make the same types of measurements as the manual measurement using markers.

The Event Table can be returned by pressing it again.

For details, see section 4.3. (2)

Page 2

## Print



For details, see section 4.7.1.

Returns function key display to page 1

## Save / Recall

For details, see section 4.10, 4.7.2 and 4.7.3.

## **Relative Measurement**

For details, see section 4.4.

## **Inputting Event Comment**



## Section 4 Operation

Event	Selecting Event To zoom and display a specific event, first press the [Select] key to bring the Event card displayed at the bottom right of the Event Table screen to the front of the pile. Change the selected event by moving the cursor up and down with the $\checkmark$ and $\land$ keys.
	When the last line in the Event Table under Splice Loss is not END, the next page can be displayed by pressing the $>$ key. Moreover, when Event No. column does not start from 1, the previous page can be displayed by pressing the $<$ key.
Zoom	Zooming/Compressing to Any Magnification When the [Select] key is pressed to bring the Zoom card to the front of the card pile, the vertical scale can be changed by pressing the $\checkmark$ and $\land$ keys, and the horizontal scale can be changed by pressing the $>$ and $<$ keys to enlarge or com- press the displayed waveform.
Shift	<b>Shifting Waveform</b> When the [Select] key is pressed to bring the Shift card to the front of the card pile, the waveform can be shifted up, down, left and right by pressing the cursor keys. The waveform is shifted slightly each time the cursor key is pressed; it shifts continuously if the key is pressed and held.

## 4.2.1 Zooming to Specific Event



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## 4.2.2 Editing Events

The waveform is edited when wanting to save data about splices that are not faults in the Event Table, and when wanting to delete points mis-evaluated as faults because of noise. Also, a point which is not the physical for end, can be registered as a logical for end.



### Adding Events

**F2** 

F1

Edit

Add







When an event was selected at the previous screen before the Add screen, the # marker is positioned at that event; when an event was not selected at the previous screen, the # marker is positioned at the screen center.



Press [F5] (Exit) to stop addition.

When the # marker is moved to any position with the cursor keys and the F1 (Add Execute) key is pressed, the new event is added to the waveform and the Event Table Screen is returned.

**F1** A \* symbol is appended to the event added to the Event Table this time so that the changed event can be recognized.





When the F1 (Move Execute) key is pressed after moving the marker, the event point is moved. The Event Table screen is returned and the added event is displayed at the head of the table with the \* symbol appended so that the changed event can be recognized easily.

F1

F2

F3

F4

F5



Move

Execute

F1

#### **Deleting Event**

When the event to be deleted is selected with the cursor keys at the Event Edit screen and the F3 (Delete) key is pressed, the selected event is deleted. Confirm the event to be deleted with the zoom screen and then press [F1] (Delete) to delete the event.



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## 4.2.3 Event Comment



When the F5 key (Event Comment) at the Event Table screen is pressed, a comment can be input at each event and the input comments are listed. Select the event to which a comment is to be input and press the F5 (Event Comment) key; the following screen is displayed.



#### **Event Comments**

#### (1) Input Event Comments

When the F1 (Input Event Comments) key is pressed, a comment can be input to the currently-selected event. The comment can be input from either the panel keys or the keyboard. The respective screens are shown below.



Input Event Comments (from Front Panel)





Input Event Comments (from Keyboard)

### Front panel

Event No. \* and the reverse display to its under are called the cursor, characters and spaces can be input and deleted at this position.

### **Inputting Characters**



All the characters that can be input are displayed in the rectangular box in the center of the screen. One of the characters is reverse displayed. Move the reverse display up, down, left and right using the  $\land$ ,  $\checkmark$ ,  $\lt$  and  $\rbrace$  keys respectively. When the reverse display is positioned at the character to be input, press the F4 (Cursor  $\Rightarrow$ ) key. The character is input cursor moves to the right each

F3/F4 time a character is input. When the F3 (Cursor <⇒) key is pressed, the reversedisplayed character is input in the same manner as above, but the Event Comment field cursor moves to the left instead.

### **Inputting Spaces**





Close

F2

F5

### F1 Deleting Character

When the F2 (DEL) key is pressed, the character where the cursor is positioned is deleted.

## **Confirming Event Comment**

The Event Comment input is confirmed by pressing the F5 (Close) key, and the Setup screen is returned.

## Keyboard

#### **Character Input**

The characters input at the keyboard are inserted at the cursor position. The cursor is moved using the arrow keys and only moves to the position where characters can be input.

#### **Overwriting/Inserting Characters**

The overwrite/insert mode is toggled each time the INS key is pressed. A reverse-displayed cursor indicates the overwrite mode, and an underlined cursor indicates the insert mode.

#### **Deleting Characters**

The character at the cursor position is deleted when the Delete key is pressed. When the Backspace key is pressed, the character to the immediate left of the cursor is deleted.

#### **Confirming Event Comment**

When the Return key or F5 key is pressed, Event Comment input is completed and the Setup screen is fetched.

#### **Canceling Event Comment**

When the Esc key is pressed, the characters input up to that point are canceled and the status returns to the condition before input to the Event Comment screen.

#### (2) Event Information

When the F2 (Event Information) key is pressed, the comments input to all the events are listed as shown below. In addition, comments for individual events can be deleted.



#### **Event Information**



When the F2 key (Select Delete INF) is pressed, an asterisk symbol (\*) is attached to the left side of the event number where the cursor is positioned to indicate that the comment has been selected for deletion.





## 4.2.4 Moving to Manual Screen



When the F5 (Manual) key is pressed at the Event Table screen, the Manual screen is displayed for using data collected in the Auto mode to make various manual measurements with the same markers. When the F5 (Event Table) key is pressed in it, the Event Table screen is returned.

For further details, see section 4.3 (2).

## 4.3 Manual Measurements

```
(1) Start
```

- 1 Set Measurement mode: at the Setup screen to Manual.
- 2 Set Measurement parameters at the Setup screen to match them to the system to be measured.
- 3 Set the averaging method at the Setup screen with Manual measure parameters.
- 4 Press the [Start] key. Measurement (sweeping) starts. The waveform shown in the Averaging display below is displayed on the screen and the measurement is repeated so the noise component is gradually reduced. When the F2 (Real Time) key is pressed, averaging is stopped and the waveform trace changes to the real-time display at each sweep. The averaging display is returned when the F2 (Average ON) key is pressed.
- 5 At the Averaging display, when the set number of averagings has been completed or the averaging time has elapsed, the Manual screen shown on the next page is displayed. When the F5 (Stop) key is pressed when a sufficiently good waveform has been obtained during averaging, the Manual screen is displayed immediately. At the real-time display, the Manual screen is not displayed until the F5 (Stop) key is pressed.
- Note: During averaging, the current number of averagings or the elapsed time, as well as the set values are displayed at the top right of the screen.



**Averaging Display** 



Stop F5

## (2) Manual Screen

#### Splice & Return Loss Display

When the sweeping is finished, the following screen is displayed. This screen is also displayed when the F4 (Splice & Return Loss) key is pressed at the Loss Display screen.



Manual Screen (Splice & Return Loss Display)

Six markers as well as the splice loss measurement results are displayed on this screen. The following additional items are also displayed.

#### **Measurement Parameters**

 $\lambda$  : Wavelength of light \$DR\$ : Distance range \$PW\$ : Pulse width IOR : Index of Refraction

Note : When the Distance range and Pulse width are set to Auto at the Setup screen, the values chosen by the OTDR are displayed at DR and PW, respectively.

### **Trace Waveform**

The trace waveform is displayed with the attenuation on the vertical scale and the distance on the horizontal scale. The scales of each axis are displayed at the bottom right of the screen.

### **Measurement Results**

Splice Loss (*)	:	Splice loss at $*$ point
Return Loss ( $\triangle$ )	:	Return loss at $ riangle$ point
Fiber Loss ( $\times 1 - \times 2$ )	:	Loss per unit distance between $\times 1$ and $\times 2$ points
Fiber Loss ( $\times 3 - \times 4$ )	:	Loss per unit distance between $\times 3$ and $\times 4$ points

Note : \* \*.\* is displayed if measurement is impossible for any reason.When the circuit is saturated by a large amount of reflected light, the measured value is prefixed by ∠.

### **Marker Positions**

The distance from the main-frame optical connector to each marker is displayed.

### Linear Approximation Method

LSA or 2PA is displayed. LSA is displayed in the above diagram.

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#### Loss Display

When the F4 (Loss) key is pressed at the Splice & Return Loss Display screen, the following Loss Display screen is displayed.



Manual Screen (Loss Display)

Two markers are displayed on this screen along with the loss between them.

#### **Measurement Parameters**

 $\lambda$ : Wavelength of light DR : Distance range PW : Pulse width IOR : Index of Refraction

Note : When the Distance range and Pulse width are set to Auto at the Setup screen, the values chosen by the OTDR are displayed at DR and PW, respectively.

#### **Trace Waveform**

The trace waveform is displayed with the attenuation on the vertical scale and the distance on the horizontal scale. The scales of each axis are displayed at the bottom right of the screen.

### Measurement Results

Distance :	Distance between two markers
Loss :	Loss between two markers
Fiber Loss :	Loss per unit distance
Note : * *.*	is displayed if measurement is impossible for any reason.

#### **Marker Positions**

The distance from the main-frame optical connector to each marker is displayed.

#### **Linear Approximation Method**

LSA or 2PA is displayed. 2PA is displayed in the above diagram.

## TORL Display

When the F5 (TORL) key is pressed at the 2 page of function key, the following Loss Display screen is displayed.



Manual Screen (TORL Display)

Two markers are displayed on this screen along with the TORL between them.

### **Measurement Parameters**

Note : When the Distance range and Pulse width are set to Auto at the Setup screen, the values chosen by the OTDR are displayed at DR

## and PW, respectively.

## **Trace Waveform**

The trace waveform is displayed with the attenuation on the vertical scale and the distance on the horizontal scale. The scales of each axis are displayed at the bottom right of the screen.

## **Measurement Results**

TOTAL RETURN LOSS : TORL between two markers

Note : \*\*.\* is displayed if measurement is impossible for any reason.

## **Marker Positions**

The distance from the main-frame optical connector to each marker is displayed.

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F1



#### Setup Screen

The measurement parameters can be changed at the Setup screen.



ion key display to page 2.



The LSA and 2PA linear approximation methods are toggled each time this key is pressed. The selected method is displayed at the bottom left of the screen.

For details see section 1.6.



F5

**F1** 

F2

## Switching Splice & Return Loss and Loss Displays

The Splice & Return Loss and Loss displays are toggled each time this key is pressed. Six markers are displayed on the Splice & Return Loss display and two markers are displayed in the Loss display.

#### **Searching for Faults**

When the F5 (Event Table) key is pressed, the Event Table screen is displayed using the data collected in the Manual mode. The event markers can be displayed at the faults in the same way as at Auto measurement. When the F5 (Manual) key is pressed in it, the Manual screen is returned.

For details, see section 4.2 (2).

For details see Section 4.7.1.



Event

Table



Offset

TORL



Print

## Waveform Comparison and Save/Recall

Returns function key display to page 1.



## **Relative Measurement**

For details, see section 4.4.

## **TORL Measurement**

For details, see section 4.2 (2).

#### **Shifting Markers**





Shift

When the [Select] key is pressed to bring the Mark card to the front of the card pile, a marker can be selected with the  $\checkmark$  and  $\land$  keys. The selected marker is moved with the > and < keys. The marker shifts continuously when the key is pressed and held.

#### Zooming/Compressing to Any Magnification

When the [Select] key is pressed to bring the Zoom card to the front of the card pile, the vertical scale can be changed by pressing the  $\checkmark$  and  $\land$  keys, and the horizontal scale can be changed by pressing the > and < keys to magnify or compress the displayed waveform.

#### **Shifting Waveform**

When the [Select] key is pressed to bring the Shift card to the front of the card pile, the waveform can be shifted up, down, left and right by pressing the cursor keys. The waveform is shifted slightly each time the cursor key is pressed; it shifts continuously if the key is pressed and held.

Note: Measurement such as loss at set markers and the Splice & Return-Loss/ Loss display switching can still be performed during averaging.

## **4.3.1** How to Measure Accurately

#### (1) Setting marker

To measure the splice loss and distance correctly, it is necessary to set the # or  $\times$  marker at the beginning of the step on the trace waveform as shown below.



#### (2) Averaging

Read the measured values after obtaining a sufficiently smooth waveform trace using averaging. If you are not sure for how long or how many times to perform averaging, set a large value and press the F5 (Stop) key when a smooth waveform is displayed on the screen during averaging.

#### (3) Selecting LSA or 2PA linear approximation

Basically, use LSA to find splice losses, and 2PA for total loss.

## 4.3.2 Calling Event Table



When the F5 (Event Table) key is pressed, the Event Table screen is displayed using the data collected in the Manual mode. The event markers can be displayed at the faults in the same way as at Auto measurement.

For details, see section 4.2 (2).

## 4.4 Relative Measurement

This function measures the relative distance with reference to any position. When the F4 (Horizontal Offset) key is pressed after sweeping is finished, the reference position setting screen is displayed. The reference position cursor (zero cursor) and the distance relative to it are displayed at this screen.





Press the F4 (Horizontal Offset) key to fetch the zero cursor position setting screen.

The zero cursor (vertical dotted line) appears on the waveform; move it to the required position using the arrow keys (>, <). If the zero cursor is outside the displayed waveform, a solid vertical line (|) is displayed above h-bar over the waveform.

Press the F1 (Set) key to set the zero cursor and start measurement of the relative distance. When relative distance measurement is being performed, R-MEAS is displayed at the top right of the waveform screen. In addition, at relative distance measurement, fault points are detected and total return loss is measured from the zero cursor to the far end (right side of waveform).

When the F2 key (Clear Offset) is pressed, the zero cursor is deleted and the relative measurement mode is quit.

When the F5 key (Exit) is pressed, the measurement screen is returned.

## 4.5 Full Trace

When an optical unit with an attenuator is used and the attenuator is set to Auto at the Setup screen, the attenuator is automatically switched to the best value to sweep the optical cable. Each trace obtained under the best attenuation is concatenated to display a single screen display. However, this function is not supported in real-time measurement. When the concatenation is performed, Full Trace is displayed at the top part of the screen instead of the attenuation.

When any value is set at Attenuator of the Setup screen and measurement is performed, the used attenuation is displayed as shown below:



When Attenuation is set to Auto at the Setup screen, Full Trace is displayed instead of the attenuation value as shown in the two figures below:

[Manual m	easur	ement]-				2	4-Nar-	95 12:30-	-
λ:1.31μm( DR:25km PW:1μs	SM)	IOR:1 Avera Full	.465000 ges:25 Trace	l					Setup
									(More <2/2>
									LSA
									Splice & Return loss
   ×					WWW		hilling	ANN HAAN	Event
DISTAN LOSS FIBER [2PA	CE LOSS ]		9.96 7.19 9.77	9 kn d E d E	n } }∕km		X : * :	0.154km 9.522km	H-SCALE: 2.5km/div V-SCALE: 10.0dB/div <sup>2000</sup> Shitt/Tark +:V-zoom +:H-zoom

(At manual measurement)

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(At event measurement)

## 4.6 Event Fixed

This function is convenient for measuring repeatedly regular splices or connections cable by cable like measurement in multicore fiber cable. Some points can be preset by operator and each measurement is performed at these preset points.

When [Measurement mode] at the Setup screen (1/2) is Auto, and [Event] is set to Fixed, and Start is pressed, the position of each event marker and the event data, such as comments, immediately before measurement started, are saved. When the waveform sweeping is completed, the connection losses, etc., are measured in accordance with the position of each saved event marker.

The subsequent operation is the same as Auto Measurement.

When event points are edited in the Fixed condition and Start is pressed, the edited event data is measured.

The following key operations are restricted according to the [Event] condition.

- When [Event] is Fixed, the distance range cannot be changed.
- When [Measurement Mode] is Manual, [Event] cannot be changed.
- When [Measurement mode] is set to Full auto, [Event] changes to Auto search.
- When [Event] is set to Fixed, [Measurement mode] changes from Full auto to Auto.

The [Event] item, position of the marker for each event, and the comment data are saved in the DFN file.

The event data can be saved and recalled only when [Event] is in the Fixed condition.

In the Fixed condition, an \* symbol is not attached to an event edited on Edit screen. However, an exclamation symbol (!) is attached to events exceeding the threshold value set at Auto measure parameters. An example where the splice loss threshold value is set to 0.3 dB is shown below.



## 4.7 Printing, Saving, Recalling

## 4.7.1 Printing

Print

F1

Either the measurement results and waveform data, or just the measurement results can be printed. Specify this print item and the printer type at the Print field

on Setup screen 2. See section 2.9 for the printer connection.

The following sample shows a printed result when the "measurement resuls and waveform" is specified.





The following screen is displayed when the F1 (Print) key is pressed.



#### Print Screen

The title and the header to be set at the top left of the screen is displayed as a subwindow. These are the title and the header that was set at Setup screen 1. To change this title for print, input the changes as described below and press the F1 (Print Execute) key. If the displayed title does not need changing, just press the F1 (Print Execute) key.

Exit

F5

#### Exit

When the F5 (Exit) key is pressed, the Print screen is closed.

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### Inputting or Changing Title

When the F2 (Input Title) key is pressed, the area at the right side of the Title: display becomes reverse displayed. This reverse-displayed area is called the cursor; characters and spaces can be inserted or deleted at the cursor area. A maximum of 32 characters can be input.

Characters can be input from either the panel keys or the keyboard.

When using the panel keys, select the character from the character input window.

When using the keyboard, input the characters directly from the keyboard.

The following screens are displayed when both panel-key input and keyboard input are used.





Input Title (from Front Panel)

Input Title (from Keyboard)



F3

#### **Inputting Characters**

The characters that can be input are displayed in a rectangular box. One of the characters in the box is reverse displayed. The reverse-displayed character can be moved up, down, left and right using the  $\land$ ,  $\checkmark$ ,  $\checkmark$ ,  $\checkmark$  and  $\rangle$  keys.

When the cursor is positioned at the character to be input, press the F4 (Cursor  $\Rightarrow$ ) key; the character is input and the cursor moves one character to the right. If the F3 (Cursor  $\Rightarrow$ ) key is pressed, the character is input in the same way, but the cursor moves one character to the left.

## Inputting Spaces

When the F1 (INS) key is pressed, one space is inserted in front of the character where the cursor is positioned.

### **Deleting Character**

When the F2 (DEL) key is pressed, the character where the cursor is positioned is deleted.

### **Confirming Title**

When the F5 (Close) key is pressed, the input title is confirmed and the Input Title screen is closed.

**F5** Title input from the keyboard is the same as Title input for the Setup screen.

When Press the F3 (Input Header) key, the character input window is displayed. Up to 12 rows of 60 characters can be displayed. Characters can be input from either the panel keys or the keyboard.

When using the panel keys, select the character from the character input window.

When using the keyboard, input the characters directly from the keyboard.

The following screens are displayed when both panel-key input and keyboard input are used.



**Input Header (from Front Panel)** 



Input Header (from Keyboard)

Header input from the keyboard is the same as Header input for the Setup screen.



#### **Continuous Printout**

Measurement data saved to internal memory, memory card, and FD can be printed continuously and repeatedly in the specified sequence.

The print format is the format specified by the Print format item at the Setup Screen 2.

At continuous printing, the file is read and printed continuously and automatically. Consequently, the currently-displayed waveform is lost, so execute Save if it must be saved.

The following screen is displayed when the F4 (Continuous Printout) key at the Print screen is pressed.

F4: Continuous Printout

Displays file list as follows :



First you press F4 (Continuous Printout) key to display a file list and move the cursor with the  $\land$  or  $\checkmark$  keys. Press F2 (Select) key if you want to print the selected file; otherwise use the arrow key to move cursor to another file. A number is displayed at the left end on the line you selected and printing is performed in this order. Use F3 (Cancel) key to cancel your selection. After completing the select procedure, press F1 (Execute) key to proceed the Print Execute Screen.



## **4.7.2 Saving** The F3 key with the label

The F3 key with the label Compare/Memory can save the waveform screen as a file.

See section 3.3 for details of saving screen when the Setup screen is

displayed.

#### Applicable media

The screen can be saved either in internal memory, memory card a floppy disk. The media to be used is specified in the Target of Memory field of Setup screen 2.

Note : A memory card and floppy disk must be formatted before it can be used.

For details, see section 4.8 (2).

### Save format

Three types of save format can be selected for printing or analysis or standard. In the Print mode format, the data is saved in a format that can only be printed. In the Analysis mode format, saved data can be printed, markers can be set and manual measurement can be performed. Consequently, the data volume becomes larger. In the standard format, the data is saved in a format that meets Bellcore GR-196-CORE, but files saved in this format cannot be read by this equipment. Use MX3607B Emulation Software to read them. These three formats are specified in the save format of Memory field of Setup screen 2.

## 4.7.2.1 Print and Analysis Mode Formats



The following screen is displayed when the F1 (Save) key at the Memory screen is pressed.

### (1) When the "File ID" is set to "Number"

The following screen is displayed when the "File ID" is set to "Number" at the Setup screen 2. Use the  $\land$  or  $\checkmark$  keys to increment or decrement, respectively.



File Number Input (Save) Screen

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#### (2) When the "File ID" is set to "Name"

The following screen is displayed when the "File ID" is set to "Name" at the Setup screen 2.

File name input can be performed from either the panel keys or keyboard. The screen for panel-key input and keyboard input is shown below.

[ Save ]			24-1	lar-95	12:30-	_	
Anritsu NN9070A/ λ:1.55μm(SN) DR:200km <u>PW:10μs</u> (Auto)	8 IOR:1.465500 Averages:37s Full Trace	Total Fiber Total Total	15 events Length: 1 Loss : R.Loss:	04. 29. 37.	278 67 9	km dB dB	F
Input Fi	le name:	[CON	MENT		]	DEL	F
	ABCDEFGH NOPQRSTU 12345678	90.	LM YZ !#			Cursor	F
	<u>\$8%'()^@</u>	_ {}				Cursor	F4
Select Charact	ter with 🛞 key, Title:Anrits	and F: m MW90'	ix with < 70A/B	= ->I	(ey	Close	F:
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	66 Ø.: 41 1.:	22	**.* **.*		3.16 3.97	H~SCALE: 20km/div V-SCALE:	
5 31.6 16 34.7 Sinjuku	48 Ø.3 59 1.9	30 52	**.* 46.2		0.00 8.38 9.29	18.0d8/d1v	
						character	

File Name Input Screen (from Front Panel)



File Name Input Screen (from Keyboard)



File name input from the keyboard is the same as Title, Header and Event Comment.



# 4.7.2.2 Standard Format



Save format at the setup screen is set to Standard and is displayed at the next Save screen when the F1 (Save) key is pressed at the Memory screen.

When File ID is set to Number at Setup Screen2, the cursor is displayed at the File Name in the Save screen and the status changes to permit the operator, etc., to input the Standard file information.

However, input is only possible from an external keyboard and is not possible from the panel keys. An external keyboard should be connected when the power is turned on.



Standard Save screen

When the F5 (Exit) key is pressed, saving is quit and the Measurement screen is returned.

The following items can be input at the Save screen. Comments can be composed of six lines of up to 40 characters on each line. Other items can be composed of one line of up to 40 characters.

Operator :	Name of operator
Start :	Name of measurement start position
End :	Name of measurement end position (far end)
Cable ID :	Cable No.
Fiber ID :	Fiber No.
Cable code :	
Comment :	



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# 4.7.3 Recalling



Saved files can be recalled and printed at any time.

See section 3.4 for recalling a file while the Setup screen is displayed.

When the F2 (Recall) key at the Memory screen is pressed, the following screen is displayed.



#### Selecting file name

# Recall Screen (None title)

Move the cursor with the  $\langle, \rangle$ ,  $\wedge$  and  $\checkmark$  keys to select the name of the file to be recalled.

## Analyzing waveform

As shown in the above diagram, saved files are either about 1.5 KB or 21 KB in size. 21 KB files can be recalled for manual measurement.

See section 4.3.

In addition, faults on the waveform trace can be automatically searched for.

See section 4.3.2 for details.



**Recalled Waveform** 

## 4.8 File Operations



When the F4 (Utility) key at the Memory screen is pressed, the following screen

specified in the Target of Memory field of Setup screen 2 are listed. Press the F5



**Delete Screen** 

To delete files prefixed by \*, press the F1 (Delete Execute) key.

F3

F4

F1

Select All

Delete

Execute



The Format screen is returned when the F2 (No) key is pressed.

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#### (3) Copying Data

Measurement data saved to internal memory, memory card, or FD can be copied as the same file name to other media described above.

The copy origin media is the item specified by Memory target in the Setup Screen 2. The Copy destination media can be specified in the Copy Execute Screen.

The copy operation has no effect on the currently-displayed waveform screen.

The F1 (Copy) key has been added to the Utility Screen shown in item 4.8 "File Operations" of the Operation Manual. Two screens have been added under the F1 (Copy) key as shown below.

First you press F1 (Copy) key on the Utility Screen to display a file list and move the cursor (reverse-displayed line) with the  $\land$  or  $\checkmark$  keys. Press F2 (Select Copy File) key if you want to copy the selected file; otherwise use the arrow key to move cursor to another file. Or repeat this operation if you want to copy multiple files. An asterisk (\*) is displayed at the left end on the line you selected. Use F3 (Cancel Copy File) key to cancel your selection. After completing the select procedure, press F1 (Copy Execute) key to proceed the Copy Execute Screen. The Copy destination media can be specified in the screen. And then, press F1 (Copy Execute) key to proceed the copy.

Displays file list as shown below

viedi (Sele	ia:F ctNedi	U a at Setup)		Fil	e No.	Execute
3 file	s exist	, 16384 Bytes free		< 1	/ 33>	
File n	ame	Title	Size	Date	Time	Select
000	DAT	Manual (Analycic pp	21126	27-12-93	19,911	Lopy File
001	DAT	Nanual / Analysis no	21126	27-12-93	17:39	
001	DAT	Nanual / Analysis no	21126	27-12-93	17:39	(Cancel
002	DAT	Manual / Analysis no	21126	27-12-93	17:39	Copy file
884	HAT	Manual / Analysis mo	21126	27-12-93	17:39	
885	DAT	Manual / Analysis me	21126	27-12-93	17:39	
086	DAT	Manual / Analysis mo	21126	27-12-93	17:39	( Salast All
807	.DAT	Nanual / Analysis mo	21126	27-12-93	17:39	Select Mil
808	BAT	Manual / Analysis mo	21126	27-12-93	17:39	
889	. BAT	Manual / Analysis mo	21126	27-12-93	17:39	
018	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	/ Frit
011	. BAT	Manual / Analysis mo	21126	27-12-93	17:39	
612	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	
013	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	
014	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	
015	. DAT	Manual / Analysis no	21126	27-12-93	17:33	
016	.DAT	Manual / Analysis no	21126	27-12-93	17:35	
017	.DAT	Manual / Analysis no	21120	27-12-33	17.33	
818	. DAT	manual / Analysis no	21120	27-12-93	17.33	File
013	. DA1	nanual / Analysis wo	21120	27 16 33	17.35	\$:Select



#### F2: Select Copy File

Selects reverse-displayed file name as file to be copied. The reverse-displayed file name is prefixed with an asterisk (\*), and the reverse display moves to the next file name. Move the position of the reverse display to the name of the file to be copied by pressing the  $\wedge$  or  $\checkmark$  keys.

Med	ia:F	D				Copy				
(Seli	ect Medi	a at Setup)		Fil	e No.	Execute				
33 file	es exist	, 16384 Bytes free		< 17	7 332					
file p	ane	Title	Size	Bate	Time	Select	]			
888	DAT	Manual / Analysis mo	21126	27-12-93	19:41					
661	DAT	Manual / Analysis no	21126	27-12-93	17:39					
002	. DAT	Manual / Analysis me	21126	27-12-93	17:39	(Cancel				
003	. DAT	Banual / Analysis mo	21126	27-12-93	17:39	(Copy file				
084	. DAT	Manual / Analysis mo	21126	27-12-93	17:39					
605	. DAT	Manual / Analysis mo	21126	27-12-93	17:39					
006	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	Select All	· ·			
007	. DAT	Manual / Analysis no	21126	27-12-93	17:39	1				
008	. DAT	Manual / Analysis mo	21126	27-12-93	17:39					
609	. DAT	Manual / Analysis no	21126	27-12-93	17:39					
• 010	. DAT	Nanual / Analysis mo	21126	27-12-93	17:39	( Exit	1			
811	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		11			
012	. BAT	Manual / Analysis mo	21126	27-12-93	17:39					
013	, DAT	Manual / Analysis mo	21126	27-12-93	17:39					
014	. DAT	Manual / Analysis mo	21126	27-12-93	17:39					
015	, DAT	Manual / Amalysis mo	21126	27-12-93	17.35					
016	DAT	Manual / Analysis mo	21126	27-12-56	10.20					
617	. BAT	Manual / Analysis me	21126	27-12-93	17:39					
018	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	File				
019	. DAT	Manual / Analysis no	21126	27-12-93	14:38	1:Select				

#### **File Selection Screen**

## F3: Cancel Copy File

Cancels copying of reverse-displayed file name. The asterisk prefix is deleted and the reverse display moves to the next file name. Move the position of the reverse display to the name of the file to cancel copying by pressing the  $\land$  and  $\checkmark$  keys.



Select Copy

F2

File

## F4 : Select ALL/Cancel ALL Toggles selecting all files to be copied or deleting all asterisks

F5: Exit

Returns screen to Waveform screen or Setup Screen



#### **Copy Destination Selection Screen**

This screen is used to select the copy destination media. Select the media in the same way as described for the Setup Screen.

The copy origin can only be changed at the Setup Screen 2.

File 000 001 002 003 004 005 006 007 008 009 010 011 012 013	e name . DAT . DAT . DAT . DAT . DAT . DAT	J Title Manual / Analysis mo Manual / Analysis mo Manual / Analysis mo Manual / Analysis mo	Size 21126 21126 21126 21126	Date  27-12-93 27-12-93	Time 19:41	
000 001 002 003 004 005 006 007 008 009 009 010 011 012 013	. DAT . DAT . DAT . DAT . DAT . DAT	Manual / Analysis mo Manual / Analysis mo Manual / Analysis mo Manual / Analysis mo	21126 21126 21126	27-12-93 27-12-93	19:41	
<ul> <li>901</li> <li>902</li> <li>903</li> <li>904</li> <li>905</li> <li>906</li> <li>907</li> <li>908</li> <li>909</li> <li>910</li> <li>911</li> <li>912</li> <li>913</li> </ul>	. DAT . DAT . DAT . DAT	Manual / Analysis mo Manual / Analysis mo Manual / Analysis mo	21126 21126	27-12-93	17.90	
<ul> <li>002</li> <li>003</li> <li>004</li> <li>005</li> <li>006</li> <li>007</li> <li>008</li> <li>009</li> <li>010</li> <li>011</li> <li>012</li> <li>013</li> </ul>	. DAT . DAT . DAT	Manual / Analysis mo Manual / Analysis mo	21126		11.33	
+ 003 004 005 006 007 008 009 + 010 011 012 012	. BAT . BAT	Manual / Analysis ma		27-12-93	17:39	//
004 005 006 007 008 009 009 010 011 012 012	. BAT	(indiate ) three just no	21126	27-12-93	17:39	
005 006 007 008 009 010 011 012 012 013		Manual / Analysis mo	21126	27-12-93	17:39	
006 007 008 009 010 011 012 012 013	. BAT	Manual / Analysis mo	21126	27-12-93	17:39	
007 008 009 010 010 011 012 013	. DAT	Manual / Analysis no	21126	27-12-93	17:39	//
008 009 010 011 012 013	. DAT	Manual / Analysis no	21126	27-12-93	17:39	
009 • 010 011 012 013	. BAT	Manual / Analysis mo	21126	27-12-93	17:39	
• 010 011 012 013	. DAT	Manual / Analysis no	21126	27-12-93	17:39	
011 012 013	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	( Frit
012 013	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	( LXIL
Ø13	.DAT	Manual / Analysis mo	21126	27-12-93	17:39	
	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	
014	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	
• 015	.DAT	Manual / Analysis mo	21126	27-12-93	17:39	
016	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	
017	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	$\square$
018		Manual / Analysis no	21126	27-12-93	17:39	

**Copy Destination Selection Screen** 

F1: Copy Execute

When F1(Copy Execute) key is pressed, the following copy confirmation screen is displayed.

To execute the copying, first check the destination media for proper media mounting and for write enable setting, and then press F1 (Yes) key. After executing the copy, the original waveform screen or setup screen is returned.

				;	14-Apr-94 1	.6:14—		
	5 files	copy Memory	Copy OK?		Fil < 17	e No. / 33>	Yes	F1
	File na	une	] Title	Size	Bate	Time	No	F2
	000	. DAT	Manual / Analysis mo	21126	27-12-93	19:41		
1	* 001	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
1	* 002	.DAT	Manual / Analysis mo	21126	27-12-93	17:39	((	F3
	* 003	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
ł	004	. BAT	Manual / Analysis no	21126	27-12-93	17:39		
ł	005	. DAT	Manual / Analysis no	21126	27-12-93	17:39		
1	006	.DAT	Manual / Analysis mo	21126	27-12-93	17:39	(( )	F4
I	667	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
ł	608	. BAT	Manual / Analysis mo	21126	27-12-93	17:39		
ł	009	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
	* 010	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	( Faite	F5
l	011	. DAT	Manual / Analysis mo	21126	27-12-93	17:39	LXIC .	
ļ	012	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
	013	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
1	014	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
	* 015	. DAT	Manual / Analysis mo	21126	27-12-93	17:39		
1	016	DAT	Manual / Analysis mo	21126	27-12-93	-17:39		
	017	. DAT	Manual / Analysis no	21126	27-12-93	17:39		
1	018	.BAT	Manual / Analysis no	21126	27-12-93	17:39		
	019	. DAT	Manual / Analysis no	21126	27-12-93	17:39		
I								



F5

**Copy Confirmation Screen** 

To quite the copying, press F2 (No) key, and the file selection screen is returned.



Copying is not executed and the original Waveform screen or Setup Screen is returned.

# 4.9 Measurement Examples

The following six measurement examples are described here.

- (1) Absolute distance measurement
- (2) Relative distance measurement
- (3) Connection loss measurement (splice)
- (4) Connection loss measurement (connector)
- (5) Transmission loss measurement
- (6) Return loss measurement
- (7) Total optical return loss measurement

To perform these measurements, the OTDR must first be set as follows:

- 1 Set the Power switch to ON and check that the Setup screen is correct.
- 2 Set the measurement mode to manual.
- 3 If the wavelength  $(\lambda)$  of the optical unit can be selected, set the correct value.
- 4 Set the Distance range to 10 km.
- 5 Set the Pulse width to 100 ns.
- 6 Set the index of refraction (IOR) of the fiber.
- 7 To terminate the setup and display the loss display screen. (The F4 key label displays Splice & Return Loss.)

## (1) Measuring absolute distance

The distance from the OTDR to the marker is measured.

#### Setup

Connect the OTDR as shown below.



The cable length in this setup is 10 km max.

#### **Measurement Procedure**

- 1 Press the [Start] key.
- 2 Set the # marker to the connector point or to the end of the fiber <sup>Note</sup>.

#### Connector point

**Fresnel reflection point** 





- 3 Zoom both the horizontal and vertical scales to the maximum.
- 4 Press the F2 (Average ON) key if there is a lot of noise in the waveform.
- 5 Position the cursor exactly at the fault.
- 6 The value at DISTANCE on the lower part of the screen is the distance from the OTDR to the marker.
- Note : When measuring the distance to the marker, set the marker to the beginning of the step where the waveform changes that is near to the OTDR.



# (2) Measuring relative distance

The distance between markers is measured.

## Setup

5

Connect a dummy fiber in front of the fiber to be measured as shown below.



The cable length in this setup is 10 km max.

## **Measurement Procedure**

- 1 Press the [Start] key.
- Press the [Select] key so that the card with Mark on the tag, which is displayed at the bottom right of the screen, is at the front of the card pile.
   The cursor can be moved with the > and < keys.</li>
- 3 Select the  $\times$  marker with the  $\wedge$  and  $\checkmark$  keys.
- 4 Use the > and < keys to match the position of the × marker to the rising edge of the Fresnel reflection observed at the connection between the dummy fiber and the fiber to be measured. Press the [Select] key so that the Zoom card is at the front of the card pile, and use the cursor keys to expand the screen. Press the [Select] key once again so that the Mark card is at the front of the pile and match the marker exactly to the rising edge of the trace. Note the position of the × marker displayed at the bottom right of the screen.



Press the [Select] key so that the Zoom card is at the front of the card pile, and compress the screen with the cursor keys so that the Fresnel reflection at the cable end is displayed.

- 6 Press the [Select] key so that the Mark card is at the front of the card pile, and select the # marker with the  $\land$  and  $\checkmark$  keys.
- 7 Use the > and < keys to match the position of the \* marker to the rising edge of the Fresnel reflection observed at the end of the cable.



8 Press the [Select] key so that the Zoom card is at the front of the card pile, and use the cursor keys to expand the screen. Press the [Select] key once again so that the Mark card is at the front of the pile, and match the marker exactly to the rising edge of the trace.



- 9 If there is a lot of noise in the trace, press the F2 (Average ON) key to perform averaging.
- 10 When the \* marker is positioned exactly at the rising edge, note the position of the \* marker displayed at the bottom right of the screen.
- 11 The distance between the  $\times$  and  $\frac{1}{2}$  markers is found by subtracting the position of the  $\times$  marker from the position of the  $\frac{1}{2}$  marker.
- Note : Be careful about ghosts occurring at measurement. Ghosts occur when the reflected light from a connector is reflected again at the OTDR. These ghosts appear at integer multiple distances of the connector, and can be identified quite easily from this characteristic. To prevent ghosting, adjust connectors properly and use matching oil, etc. on the end faces of connectors to minimize the reflection.



# (3) Measuring connection loss (splice)

The connection loss of a splice in the fiber is measured.

### Setup

Connect the OTDR as shown below.



- 1 Press the [Start] key and set the # marker to the beginning of the splice step near to the OTDR.
- 2 Position the splice at the center of the screen so that only the straight sections ((L1) and (L2) in the figure below) of the fiber before and after the splice are displayed on the screen. In other words, other splices and faults should not be displayed on the screen.



Other splices and faults not displayed on screen

- 3 Set Averaging to ON and wait until a smooth trace is obtained.
- 4 Press the F4 (Splice & Return Loss) key to set the Splice & Return Loss mode.
- 5 Press the F3 (LSA) key to set the linear approximation method to LSA.
- 6 The splice loss is displayed at SPLICE LOSS field at the bottom left of the screen.
- Note : When a splice other than the target splice, or Fresnel reflection is displayed on the screen between two  $\times$  markers, move the outermost of the two  $\times$  markers to the inside point as shown below so that the other splice or Fresnel reflection is not included between the two  $\times$  markers. In this case, the two  $\times$  markers should be as far apart as possible.



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## (4) Measuring connection loss (connector)

The connection loss of a connector in the fiber is measured.

#### Setup

Connect the OTDR as shown below.



#### **Measurement Procedure**

- 1 Press the [Start] key and set the # marker to the rising edge of the Fresnel reflection.
- 2 Position the connector at the center of the screen so that only the straight sections ((L1) and (L2) in the figure below) of the fiber before and after the connector are displayed on the screen. In other words, other connectors and faults should not be displayed on the screen.



- 3 Set Averaging to ON and wait until a smooth trace is obtained.
- 4 Press the F4 (Splice & Return Loss) key to set the Splice & Return Loss mode.
- 5 Press the F3 (LSA) key to set the linear approximation method to LSA.
- 6 The connector loss is displayed at SPLICE LOSS field at the bottom left of the screen.
- Note : When a connector other than the target connector, or Fresnel reflection is displayed on the screen between two  $\times$  markers, move the outermost of the two  $\times$  markers to the inside point as shown below so that the other connector or Fresnel reflection is not included between the two  $\times$  markers. In this case, the two  $\times$  markers should be as far apart as possible.



# (5) Measuring transmission loss

The fiber transmission loss is measured.

#### Setup

Connect the OTDR as shown below.



## **Measurement Procedure**

- 1 Press the [Start] key.
- 2 Display the Zoom card at the front of the card pile, and use the cursor keys to magnify the screen so that the entire trace waveform is displayed on the screen.
- 3 Set Averaging to ON and wait until a smooth waveform is obtained.
- 4 Set 2PA display.
- 5 Set the  $\times$  marker to the near end of the fiber and the # marker to the rising edge of the Fresnel reflection at the far end of the cable as shown below.



6 Read the Loss value displayed on the screen.

Outline

## (6) Measuring return loss

The connector is measured.

#### Setup

Connect the OTDR as shown below.



#### **Measurement Procedure**

- 1 Press the [Start] key.
- 2 Set the Splice & Return Loss mode.



4 Display the Mark card at the front of the card pile, and select the ★ marker with the cursor keys. Position the ★ marker at the rising edge of the Fresnel reflection as shown below.



- 5 If there is a lot of noise in the trace, set Averaging to ON.
- 6 Read the Return Loss displayed at the bottom of the screen.

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# (7) Total Optical Return Loss Measurement

Measures the ratio of reflected light returning from the measured fiber to the incident light.

## Setup

Connect as shown in the figure. (It is recommended that lead-in fiber be connected to improve the measurement accuracy.)



Move the relative measuring cursor to this point.

## Measurement procedure

- 1 Press the Start button to measure.
- 2 Move the relative measuring cursor to the connection between the lead-in fiber and measured fiber.



Relative measuring cursor

Turn off the relative measuring cursor when the lead-in fiber is connected. The length of the lead-in fiber depends on the pulse width. As shown in the above figure, use a lead-in fiber with a length such that the back scattered light trace can be observed.

- 3 Set the measurement mode to "Full auto" on the setup screen (1/2).
- Press the Start button.
   When the measurement is completed, the measured value is displayed in the Total Optical Return Loss column at the upper right of the screen.
- 5 To manually measure the total optical return loss from × to \*, use the F5 key to move from the event table to the manual measurement mode. Then, press the F5 key (TORL) on the second page. In this state, the total optical return loss between two optional points can be measured.

Outline

**Before Use** 

Setting Up

## 4.10 Waveform Comparison Function

When monitoring aging changes in optical fibers, this function is used to compare the current waveform data with the data at fiber installation. Either both waveforms can be displayed simultaneously, or the difference between the waveforms can be displayed to monitor aging changes in events (faults) and levels. In addition, the waveforms can be saved to/read from a file.

The two displayed waveforms are called the reference waveform and current waveform. For the current waveform, measurement conditions can be changed in the same manner as the normal measurement and re-measurement can be performed under the new conditions. The markers are moved on the current waveform to display the results for the current waveform.

Conversely, the reference waveform is displayed on the same scale as the current waveform, but it cannot be re-measured even by changing the measurement conditions.

# 4.10.1 Waveform Compare ON/OFF

Page 2



There are two methods for switching the waveform comparison function on and off as follows :

Method 1

Press the F3 (Compare/Memory) key at page 2 and then press the F3 (Compare On) key to execute comparison. At this instant, the displayed measured waveform becomes the reference waveform and the current waveform disappears; measurement is started by pressing the Start key.

Consequently, the currently-displayed waveform becomes the reference waveform and it is possible to use it for comparison with another fiber being measured.

If no waveform is displayed on the screen, the F3 (Compare On) key is not displayed.





#### Method 2

Press the F3 (Compare/Memory) key at page 2, press the F2 (Recall) key and then press the F2 (Cmp Recall Execute) key.

The waveform read from the file at this time becomes the reference waveform and the displayed waveform becomes the current waveform.

Consequently, the currently-displayed waveform can be compared with the waveform read from file. In addition, when the F1 (Recall Execute) key is pressed, the waveform read from file is displayed as the current waveform.

The Cmp Recall Execute key can be used even if no waveform is displayed on the screen but there will be no current waveform displayed.

When the waveform comparison function is on, the following screen is displayed.

The markers can be moved on the current waveform but they are not displayed on the reference waveform. The measurement results display field at the bottom of the screen displays the current waveform measurement results. In addition, when the waveform comparison function is on, two vertical bars are displayed at the vertical axes. The left scale displays the current waveform and the right scale displays the reference waveform. If there is no current waveform (waveform disappears immediately after switching range or wavelength, etc.), the vertical bar on the left side for the current waveform disappears. It reappears when the waveform is displayed.





To switch off the waveform comparison function, press the F3 (Compare/ Memory) key of page 2, press the F3 (Compare On) key and then press the F1 (Compare Off) key.

When this procedure is completed, the vertical bar for the reference waveform displayed at the right scale disappears and the waveform comparison function is switched off.

# 4.10.2 Waveform Difference Display



To display the waveform difference, first, set the waveform comparison function to on and display the two waveforms for which the difference is to be displayed. The, press the F3 (Compare/Memory) key of page 2, press the F3 (Compare) key, and then the F2 (Difference Waveform) key.

When this procedure is executed, the following screen is displayed. In the waveform difference display status, only one marker is displayed. The difference in the level between the two waveforms at the point where the marker is displayed, is displayed in the measurement results display field. The waveform difference is calculated from (current waveform) - (reference waveform).

To display the difference waveform, the following three measurement parameters must be matched. If one parameter is mismatched, the difference waveform will not be displayed. Since the difference waveform cannot be displayed, the F2 (Difference Waveform) key is disabled and becomes Reference Parameters which can be used to check the measurement parameters.

- Distance Range
- · Sampling Resolution
- Sampling Range



Difference Waveform F2

Level difference between two waveforms at cursor position

To return to the dual waveform display from the waveform difference display, press the F2 (2Waveform) key.

The operation functions are restricted at the waveform difference display. The functions that cannot be used are as follows:

- Save/Recall DFN
- Pre-view
- Memory (Save, Recall, Utility)
- Measurement mode (2PA/LSA, Loss/Splice, Event Table/Manual)
- Event Edit, Auto Zoom, Event Comment

In addition, when the measurement conditions are changed so as to cause the displayed waveform to disappear, the display changes to the dual waveform display from the waveform difference display and the current waveform disappears.

# 4.10.3 Saving/Reading Reference Waveform



The current waveform can be saved and read using the normal Save and Recall functions, but the reference waveform is saved and read using the following keys.

#### Saves reference waveform

To save the reference waveform, press the F3 (Compare/Memory) key of page 2, press the F3 (Compare) key and then press the F3 (Reference Save) key. When this procedure is executed, the file name and file number input screen is displayed. After inputting the file name and number, the file is saved in the same manner as the normal Save procedure. However, it is not possible to input a title and header at the reference waveform save screen.



#### Reads reference waveform

To read the reference waveform, press the F3 (Compare/Memory) key of page 2, press the F2 (Recall) key and then press the F2 (Cmp Recall Execute) key. The subsequent procedures are the same as the normal Recall procedure.

# 4.10.4 Others

The waveform difference function also has a function for temporarily blanking the current waveform, as well as a function for vertically shifting only the reference waveform and for displaying the reference waveform measurement parameters. These functions are displayed below.



(1) Blanking

(2)

To blank the current waveform, press the F3 (Compare/Memory) key of page 2, press the F3 (Compare) key and then press the F4 (Blank) key.

Vertical Shift To shift the reference waveform vertically, press the Up and Down arrow keys while pressing the F4 (Blank) key. When using an external keyboard, press the [8] and [2] keys.

#### (3) Listing Measurement Parameters

To list the reference waveform measurement parameters, press the Left arrow key while pressing the F4 (Blank) key. The parameters are displayed at the bottom of the screen. When using an external keyboard, press the F7 key.P22

# 4.11 Ghost Fresnel Reflection Detection Function

Fresnel reflection occurs when there is a connector in the measured fiber. The light reflected by the connector is returned to the OTDR and is in turn reflected repeatedly back and forth between the connector and OTDR. In this case, the secondary reflection is called a ghost and appears on the waveform trace at the twice the distance of the connector as shown in the following diagram. The ghost Fresnel reflection detection function is useful for detecting this type of

ghost reflection.



In the manual mode, the \* marker jumps to twice the distance of the X marker, so it is easy to detect ghost Fresnel reflection.

In addition, in the auto mode, a Ghost marker is displayed at the event according to whether the event is a ghost Fresnel reflection or not.

# 4.11.1 Manual Mode

This mode only operates in the loss mode; it is executed by pressing the right arrow key while pressing the Splice&Return loss key.

When the X marker is set to the Fresnel reflection point and the ghost detection function is operated, the \* marker and the cursor move to twice the distance and a ghost marker is displayed.

When the Horizontal Offset function is on, the zero cursor position functions as 0 km.

When using an external keyboard, press the F8 key.

# 4.11.2 Auto Mode

When a ghost Fresnel reflection is detected, a ? mark is displayed at the right of the event table number as shown below.

When a ghost event is moved, the ? marker changes to a \* marker.

## 4.12 Auto-increment Function

As shown below, each time a waveform is saved, this function automatically increments the number by 1. This is very useful when repeatedly measuring and saving data for a multicore fiber, etc.



Proceed as follows to set character auto-incrementing.

Display the title or file name input screen and input the numeric characters.

At this screen, move the cursor to the numeric character to be auto-incremented. When the right arrow key is pressed while the Select key is pressed, the cursorselected numeral is set to the auto-increment range. The auto-increment range numeral is enclosed in a square.

To released the auto-increment range, press the left arrow key while pressing the Select key. The left or right character of the auto-increment range can only be released; the middle character of the range cannot be released.



Only numerals can be set and a maximum of four numerals can be set.P24

Set numerals are : For 1 : For 2 :  $8 \rightarrow 9 \rightarrow 0$ For 3 :  $98 \rightarrow 99 \rightarrow 00$ For 3 :  $998 \rightarrow 999 \rightarrow 000$ For 4 :  $998 \rightarrow 9999 \rightarrow 0000$ 

When using an external keyboard, Setting range : Press  $\rightarrow$  key while pressing Shift key Releasing setting range : Press  $\leftarrow$  key while pressing Shift keyP25

Setting Up

Operation

**Performance Test** 

Appendixes Maintenance

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# 4.13 Moving Cursor and Shifting Waveforms (Coarse Adjustment)

Use the Fine key to move the cursor and for fine shifting; use the Coarse key for coarse adjustments.

The cursor movement means the marker movement on the waveform and Horizontal Offset zero cursor movement.

The shift means the shift of the waveform vertical and horizontal axis.

Fine is executed in the same manner as previously. Coarse is executed by pressing an arrow key that is not being used while pressing the previous operation key. The operations are shown below. The item in parenthesis () indicates the external keyboard operation.

	Fine	Coarse
Moving cursor	Press < or > key.	Press $\land$ or $\lor$ while pressing $<$ or
		> key.
	$(\text{Press} \leftarrow \text{or} \rightarrow \text{key.})$	(Home or End)
Vertical shift	Press or key.	Press < or > key while pressing
		$\wedge$ or $\vee$ key.
	(Press $\uparrow$ or $\downarrow$ key.)	(PgUp or PgDn)
Horizontal	Press < or > key.	Press $\land$ or $\lor$ key while pressing
shift		< or $>$ key.
	$(\text{Press} \leftarrow \text{or} \rightarrow \text{key.})$	(Home or End)

The following diagram shows the cursor movement.



# 4.14 Shortcut Keys

This mini OTDR has a full lineup of functions for every application. However, although its multifunctionality make give an impression that it is hard to use, it has been designed with a number of easy-to-use shortcut keys for executing common operations straight from the front panel.

When the arrow keys are pressed while pressing the Select key, the wavelength can be switched and the Save, Recall and Print screens can be displayed immediately.

(1)  $\lambda$  (Wavelength)

When the  $\land$  key is pressed while the Select key is pressed, (for an external keyboard, press the  $\uparrow$  key while pressing the Shift key), the wavelength is switched. This is the same operation as selecting the wavelength at the Setup screen and pressing the Close key. Consequently, when this operation is executed, the displayed waveform is cleared. This function can only be used with a wavelength-switchable unit. If this key operation is used at the Setup screen, an error is returned.

(2) Print

When the  $\lor$  key is pressed while the Select key is pressed, (for an external keyboard, press the  $\downarrow$  key while pressing the Shift key), the Print screen is displayed in the same manner as when the Print key is pressed. If this key operation is performed at the Setup screen, the mode becomes the Setup screen Print mode.

(3) Save

When the < key is pressed while the Select key is pressed, (for an external keyboard, press the  $\leftarrow$  key while pressing the Shift key), the Save screen is displayed in the same manner as when the Save key is pressed. If this key operation is performed at the Setup screen, the mode becomes the Save DFN mode.

(4) Recall

When the > key is pressed while the Select key is pressed, (for an external keyboard, press the  $\rightarrow$  key while pressing the Shift key), the Recall screen is displayed in the same manner as when the Recall key is pressed. If this key operation is performed at the Setup screen, an error is returned.



# 4.15 Sampling Resolution Change Function

Since the number of measurement data points is limited, generally, as the distance range becomes longer, the data resolution becomes worse. Consequently, with a long fiber to be measured, it is difficult to measure the far-end distance accurately. However, this function permits accurate measurement of the fiber length by sampling the far end of the fiber at a high resolution.

The sampling resolution is set using the Sampling res. item in the Measurement parameters column of Setup Screen 1. For details, refer to 3. Setup.

When the sampling resolution is changed while the cursor is displayed, the sampling range is switched so that the cursor is at the center of the range. When a cursor is not displayed, the sampling range is switched so that the screen center is at the range center.

 The horizontal axis scale which can be selected is as follows.

 2.5 / 5 / 10 / 25 / 50 / 100 / 250 / 500 / 1 k / 2.5 k / 5 k / 10 k / 20 km / div

The sampling resolution is displayed above the screen title. The sampling range is displayed at the horizontal-axis bar. The following screen shows examples of the screen.



The relationship between the sampling resolution and other functions is shown below.

- 1) The sampling resolution cannot be selected at the following items.
  - a. When measurement mode is Full Auto
  - b. When distance range is Auto
  - c. When event is Fix
- 2) When event is Fix, \*\*\* is displayed at events outside the sampling range.
- 3) Total loss is indicated as the total loss from the sampling start point.
- 4) Total return loss is calculated based on the level at the sampling start point.
- 5) When the Save mode is Print, when recalling a waveform file saved with an earlier software version using this software version, the file is read and displayed at the horizontal scale when the file was saved. In the analysis mode, when recalling a waveform file saved with an earlier software version using this software version, the file is read and displayed at the closest horizontal scale that can be selected.

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When the sampling resolution is Coarse as shown below, accurate distance measurement is sometimes difficult. When measuring at 200 km full scale, since the sampling resolution is 40 m, the distance seems to be as shown below. However, if measurement of the far end section of the fiber is performed with a sampling resolution of 1 m, the far-end waveform can be measured accurately.



This section explains how to check the OTDR performance and how to calibrate the measurement results.

If the specifications described in this performance test are not met, call Anritsu Corporation or your nearest service representative.

To help with repair, provide details of the following items.

- (1) The model name and the instrument serial number on the back panel
- (2) The nature of the fault
- (3) The name and contact telephone number of the person in charge for Anritsu to notify the repair time details, etc.

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WARNING A

**NEVER** look directly into the optical output connector of this instrument nor into the end of an optical cable connected to it, because there is a risk of injury if the laser light enters the eyes.

Procedures other than those specified herein may result in hazardous radiation exposure.

# **5.1 Performance Test** The following six items are tested to check the performance of the OTDR; The optical output level and wavelength of visible LD is only tested when the option 05 Visible LD Light Source is installed.

- Wavelength
- Pulse Width
- Dynamic Range
- Horizontal Axis Accuracy
- Vertical Axis Accuracy
- Optical Output Level and Wavelength of Visible LD Light Source (Option 05)

Clean the optical connector before performing the test. The test procedure described here is performed with an optical unit installed in the main frame and the Power switch set to ON so that the Power lamp is lit. (However, item, 5.1.1 starts with the power off.)

The specifications for performance tests are listed below, and equipment and cables required for them are listed on the following page.

#### **Required Test Specification**

Visible LD

			MW09	72A						M	W0972E	3		
Optical Unit	М	W0970A	4				MW0970B							
	131	0±30 nr	n	1550±30 nm			131	0±30 nr	n	1550±30 nm				
Wave Length					Pu	ılse Wid	th: 1μs	5		-				
				-	_	At 2	25°C							
Pulse Width (ns)	20	50	100	500	1000	2000	20	50	100	500	1000	2000	4000	10000
Dynamic Range ( dB )		8.5 6.0	10.0 7.5	$\underbrace{\frac{13.5}{11.0}}$	$\underbrace{\frac{15.0}{12.5}}$	16.5 14.0	10.0	12.0	13.5 11.5	21.0 19.0	22.5 20.5	$\underbrace{\frac{24.0}{22.0}}$	28.0 26.0	30.0 28.0
Horizontal Axis Accuracy		±2 m±r	neasured	1 distan	ce X li	04	Horizontal/Vartecal are the same other unit							
Vertical Axis Accuracy (Linearity)	$\pm 0.05 \text{ dB/dB} \text{ or } \pm 0.1 \text{ dB}$							101120	india of the		o uno sui	ne outer	unit	
Optical Output Level														-

Optical Unit	М	W0973J	I		MW	)975J		(Option 05)	
	85	0±30 nn	n	850±	30 nm/1	300±30	nm	625+10 nm	
Wave Length			Pulse	Width	100 n	5		055±10 mm	
Pulse Width (ns)	20	50	100	20	50	100	500		
Dynamic Range (dB)	11.5	13.5	15.0	$\frac{11.5}{9.5}$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				
Horizontal Axis Accuracy		±2							
Vertical Axis Accuracy (Linearity)		:							
Optical Output Level		-						-3.0±1.5 dBm	

\*1: Value at 1310 nm / value at 1550 nm

\*2: Value at 850 nm / value at 1310 nm

# Equipment and Cables Required for Each Performance Test

Test Items	Wave	length	Pu	lse Wi	dth	Dyn Ra	amic inge	Hor.	Axis uracy	V.	Axis uracy	Opt. Out.	
Equipment and Cables	OTDR Output	Option 05	SM Unit	0.85 μm	ðI nit 1.3 μm	SM Unit	GI Unit	SM   Unit	GI   GI   Unit	SM Unit	GI Unit	Option 05	Outline
Optical Spectrum Analyzer MS9001B Wavelength: 0.8 to 1.6 µm Level: -70 to 0 dBm MS9030A + MS9702B	√	           		           	         	         		         	         	           	         	         	efore Use
Wavelength: 0.35 to 1.75 $\mu m$ Level: -90 to 0 dBm		   	 	   	,     	   	   	   	     	   	,   	1     	<b>A</b>
Optical Variable Attenuator MN924A Wavelength: 1.31/1.55 μm Attenuation: 60 dB min. MN95C (Wavelength: 0.85 μm) MN95D (Wavelength: 1.3 μm) Attenuation: 60 dB min.		             	$\checkmark$		             	             	-           	-             	         	             	             	             	1 Setting Up
Optical Variable Attenuator MN9002A, Wavelength: 1.31/1.55 μm Attenuation: 60 dB min.		-         		-           	         	         	       	         	       	√	         	           	Operation
MN938A Wavelength: 0.85/1.3 μm Attenuation: 60 dB min.		   	•     	,     	     	'     		   	     	     	N     	   	Test
Waveform Monitor MP96A Wavelength: 1.2 to 1.6 µm Rise/Fall Time: 500 ps max. MP95A Wavelength: 0.5 to 1.1 µm Rise/Fall Time: 500 ps max.		           	√			           		             	             	             	             	               	Performance
Oscilloscope DC to 200 MHz		     	√	√	   √ 	     		     	     	     	   	     	enance
SM Optical Fiber (25 km for MW0970A/72A) SM Optical Fiber (75 km for MW0970B/72B) GI Optical Fiber (2 to 4 km)		-           		- 	       	√	√	-           	·           	-         	-         		ixes Mainte
SM Optical Fiber (2 km) GI Optical Fiber (4 km)		     	     	     	<u> </u>     	     	     	   √ 	     √	     	     	     	pnend
Optical Power Meter ML9001A + MA9001B + MA9411A Wavelength: 0.38 to 1.15 μm Level: -70 to 7 dBm		         		         	         	         		         	         	         	         		Index A

- **5.1.1 Wavelength** This test checks the center wavelength of the laser optical output.
- (1) **Setup** Connect as shown in the diagram below.



**Optical Fiber** 

# (2) Test Procedure

- 1 (From power-off status) Turn on the power while pressing the F5 key. Keep pressing the F5 key until the Setup screen is displayed. This sets the service mode.
- 2 Confirm that the nominal value is displayed in the  $\lambda$  (Wavelength) field of Setup screen 1.
- 3 Press the [Select] key so that the following screen is displayed.



4 Press the F1 (Yes) key. If you want to stop the performance test at this step, press the F2 (No) key to return to the Setup screen<sup>(Note)</sup>. The following screen is displayed when the F1 (Yes) key is pressed.



- 5 Set Distance range to 50 km for SM Unit or 5 km for GI Unit at this screen.
- 6 \$ Set Pulse width to 1  $\mu s$  for SM Unit or 100 ns for GI Unit .
- 7 Press the F1 (Execute) key to output the laser continuously. The output can be stopped by pressing the F5 (Stop) key. Press the F1 (Execute) key to restart optical output.
- 8 Receive the light at the optical spectrum analyzer and adjust the optical spectrum analyzer measurement level and wavelength resolution.
- 9 Select the RMS method at the optical spectrum analyzer.
- 10 Confirm that the measurement results are within the specification.
- 11 When measurement is finished, turn off the power once.
- Note: Because the Service mode is held after returning to the Setup screen, pressing the [Select] key displays the screen of the previous page. The Service mode is released by power-off.
- **5.1.2 Pulse Width** This test checks the pulse width of the laser output.
- (1) **Setup** Connect as shown in the diagram below.



#### (2) Test Procedure

- 1 Check the wavelength at the  $\lambda$  (Wavelength) field of Setup screen 1. Select the pulse width to be measured at the Pulse width field.
- 2 Press the [Start] key.
- 3 Adjust the oscilloscope amplitude and time axes, and display the waveform on the oscilloscope. Adjust the variable optical attenuator so that the waveform monitor is not saturated at this time.
- 4 Observe the waveform on the oscilloscope and check that the pulse width is within ±10% for MW0970A/MW0972A/MW0970B/MW0972B and 20% for MW0973J of the nominal value at an amplitude of half the peak level as shown in the diagram below (within ±5 ns at pulse width of 20 ns).



## 5.1.3 Dynamic Range (one-way backscattered light dynamic range test)

This test checks the dynamic range. Perform this test at each wavelength and pulse width.

(1) Setup

Connect as shown in the diagram below.



Optical Fiber (75 km SM Fiber for MW0970B/WM0972B 25 km SM Fiber for MW0970B/WM0972B 2 to 4 km GI Fiber for GI Unit)



## (2) Test Procedure

1	Set Manual at the Measurement mode field of Setup screen 1.
2	Check the wavelength at the $\lambda$ (Wavelength) field.
3	Set 50 km for MW0970A/MW0972A, 100 km for MW0970B/ MW0972B or 5 km for GI Unit at the Distance range field. Set Attenuator to Auto when MW0970B or MW0972B is used.
4	Choose the pulse width for the dynamic range to be measured at the Pulse width field.
5	Set Setting item to Time and Limit value to 180 seconds.
6	Press the [Start] key.
7	Set Averaging to ON and the display mode to Loss.
8	Find the following values from the waveform displayed when averaging is completed.
	(a) The level at the OTDR optical connector: A
	(b) The noise level at the noise floor level: B
	Check that the level difference (A-B) (dynamic range) meets the specifications for each wavelength and pulse width.

## 5.1.4 Horizontal Axis Accuracy

Measure a fiber length of known length and IOR; this test checks the accuracy of the horizontal scale (distance). It is only necessary to perform this test at one distance range.

### (1) Setup

Connect as shown in the diagram below.



## (2) Test Procedure

1	Check the wavelength at the $\lambda$ (Wavelength) field of Setup screen 1.
2	Set Distance range to 5 km.
3	Set Pulse width to 1 $\mu s$ for SM Unit or 100 ns for GI Unit .
4	Set the IOR for the fiber to be measured at the IOR field.
Note:	The IOR varies with the wavelength. Check the wavelength at step 1 and then set the correct IOR.
5	Press the [Start] key.
6	Set a marker at the far-end Fresnel reflection and set the horizontal scale to 5 m/div.

- 7 Set Averaging to ON.
- 8 Precisely set the marker at the rising edge of the far-end Fresnel reflection and read the absolute distance. Check that this value meets the specifications for the distance measurement accuracy.



## 5.1.5 Vertical Axis Accuracy

This test checks the vertical axis accuracy or the accuracy of the measured level. Perform this test at every pulse width and every attenuation.

### (1) Setup

Connect as shown in the diagram below. When checking a multimode fiber unit, change the MN9002A Variable Optical Attenuator to the MN938A.



## (2) Test Procedure

- 1 Check the wavelength at the  $\lambda$  (Wavelength) field of Setup screen 1.
- 2 Set the Pulse width to 100 ns, attenuator to 0 dB when MW0970B or MW0972B is used.
- 3 Press the [Start] key.
- 4 Set the Loss display.
- 5 Set the  $\times$  marker to the zero level and the \* marker to the far-end Fresnel reflection.
- 6 Set ATT-B to 0 dB and adjust ATT-A so that the far-end Fresnel reflection peak is fractionally lower than the saturation level (within 0.2 dB).
- 7 Read the level of the Fresnel reflection from the OTDR screen and make this value PL0.
- 8 Set ATT-B to 2 dB and measure the Fresnel reflection level. Make this value PH0.
- 9 Return ATT-B to 0 dB and increase the attenuation of ATT-A by 1 dB and measure the Fresnel reflection level. Make this value PL<sub>1</sub>.
- 10 Set ATT-B to 2 dB and measure the Fresnel reflection level. Make this value PH<sub>1</sub>.
- 11 Increase the attenuation of ATT-A in 1 dB steps up to 15 dB to measure PL; and PH; at each step.
- 12 Find the vertical axis accuracy at each ATT-A setting using the following formula and check that they meet the specifications.

Vertical axis accuracy =  $[(PL_i - PH_i) - \Delta A]/\Delta A$ 

 $\Delta A$  is the previously-calibrated-attenuation difference between ATT-B settings at 0 dB and 2 dB.

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# 5.1.6 Optical Output Level and Wavelength of Visible LD Light Source (Option 05)



**NEVER** look directly into the optical output connector of this instrument nor into the end of an optical cable connected to it, because there is a risk of injury if the laser light enters the eyes.

Procedures other than those specified herein may result in hazardous radiation exposure.

This test checks the optical output level and wavelength of the Visible LD Light Source (Option 05).

#### (1) Setup

Connect as shown in the diagram below.



(2) **Test Procedure** Turn on the Visible LD Light Source using the remote command.

Measure the center wavelength and optical output level using a spectrum analyzer and optical power meter, respectively.

Note: The wavelength and optical output level must be tested with Visible LD Light Source lit, not with it flashing.

## 5.2 Calibration Setup

Only the backscattered level can be calibrated.

Prepare an optical connector with a known return loss (R<sub>0</sub> dB) and connect as shown in the diagram below.



## **Calibration Procedure**

1

- Set the Calibration factor displayed at Setup screen 1 to 0.
- 2 Press the [Start] key. Press the F4 (Splice & Return Loss) key to set the Splice & Return Loss mode. Press the F3 (LSA) key to set the LSA linear approximation method. Set the # and  $\bigtriangledown$  markers at the rising edge and the top of the Fresnel reflection, respectively.
- 3 Display the connector in the center of the screen, so that only the straight parts before and after the connector are displayed (no other splices or connections or fault points should be displayed on the screen).



- 4 Set Averaging to ON and wait until the noise disappears.
- 5 The connection loss is displayed at SPLICE LOSS on the bottom left of the screen. Make this value R<sub>1</sub> dB.
- 6 Find the difference between the known return loss, R<sub>0</sub> dB, and the measured return loss,  $R_1 dB$ , as  $R_1 - R_0$ . Set this value including the ±sign at Calibration factor of Setup screen 1.
- 7 Return to the measurement screen and check that the connection loss displayed at SPLICE LOSS is the same as R<sub>0</sub>.

## Section 6 Maintenance

This section explains how to clean the OTDR to maintain its performance, as well as the steps to take if an abnormality occurs.

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## 6.1 Cleaning Optical Connector

Clean the optical output connector with the supplied cleaning set

Appendix A) before making a measurement.

Clean optical connector as described below.

- 1 Set the Power switch to OFF.
- 2 Pull the lever forward and check that the latch is released so that the optical connector can be removed.



3 Wet the cotton bud with isopropyl alcohol and clean the face of the equipment-side connector.



- 4 Refit the removed optical connector.
- Note: When removing and fitting the connector, take care not to scratch the ferrule.

## 6.2 Recharging Battery



The OTDR can be used for about 5 to 15 minutes after the alarm is displayed. This length of time depends on initial charging condition of the batery and operating temperature. When the battery voltage drops too low, the following alarm display appears on the screen and a buzzer sounds. Complete the current measurement within about 5 minutes and set the Power switch to OFF.



To change the battery to a spare one, raise the stand as shown below, turn the two screws by hand and remove the battery.



The MZ5020A Dry-Cell Battery Pack is not rechargeable. NEVER attempt to recharge it.



Recharge the removed battery by connecting it to the AC adapter if the Ni-Cd Battery Pack is used.



- 1. It is necessary to charge the battery for about 14 hours or more to return to full charge. If the battery is charged for more than 20 hours, it may be damaged.
- 2. A partly-discharged battery cannot be fully recharged.



If the AC adapter is connected to the OTDR with the battery pack installed, the OTDR can be operated while the battery is charging.



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## 6.3 Self-Diagnostic Error Display

An error message screen is displayed automatically if an abnormality is found in the equipment at power-on.

#### **ROM Error**

If the following screen is displayed, check the optical unit mounting, and if this does not remedy the problem, call Anritsu Corporation.



#### **Optical Unit Not Installed**

If the following screen is displayed, check the optical unit mounting, and if this does not remedy the problem, call Anritsu Corporation.



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These appendixes contain the reference information.

## (1) Main Frame (MW9070B)

Item	Specification	Remarks		
Display	640 x 480 dots	Backlighting ON/OFF		
	110(H) x 147(W) mm	0 0		
	7-inch semi-translucent LCD			
Interface	Serial interface: RS-232C	1 port		
		D-sub 9-pin connector		
	Printer interface: 8-bit parallel interface	-		
		Centronics		
		D-sub 25-pin connector		
	Keyboard interface:			
	For IBM US English (101) keyboard	(5V: < 300m <b>∄</b>		
	Connector: DIN 5-pin			
Waveform storage	Internal memory	Internal memory with		
C C	Memory card slot x 1	battery backed-up		
	Floppy disk drive x 1 (Option)	Memory card		
		conforms to JEIDA <sup>*1</sup> Ver.4		
		and PCMCIA <sup>*2</sup>		
		FDD is optional		
		Saves GR-196-CORF		
		format files *3		
Calendar	Year Month Day Hour Minute display	Battery backed-up		
Calcindar	rear, Month, Day, Hour, Minute display	diamlars ON/OFF		
Auto measurement function				
Measurement items	Event distance loss reflection attenuation loss and	d total return loss from near end		
Threshold	Event distance, 1955, forfeetion attendation, 1955 and			
Splice loss	0.01 to 9 dB (0.01 dB steps)			
Return loss	20 to 60 dB (1 dB steps)			
Fiber end	1 to 10 dB (1 dB steps)			
Detected events	99 max.			
Automatic setting	Pulse width, Distance range, No. of averagings (a	automatic only)		
Event registration function	Creates event table recording event positions, measured	sured reflection attenuation, etc.		
Connection check	On/Off switchable			
Manual measurement functions	Loss and distance between any two points			
	Loss per unit length between two points			
	Splice loss and Return loss, Return loss and Tota	l optical return loss		
Distance units	m/km/ft/kft/mi selectable			
Relative distance measuremen	t Zero cursor settable			
Functions *3	Waveform comparison: Dual or difference waveform display			
	Variable sampling resolution: Switchable from 1 to 40 m			
	Shortcut keys: Save, recall, print, switch wave	eform		
	Ghost detection: Moves marker to ghost Fresnel reflection and indicates			
77 1 1 4	ghost events with ghost mark	ker		
Keyboard input	For inputting file name, titles, headers and even $1400,000$ to $1,600,000,(0,000,001,stops)$	Notes		
	1.400 000 to 1.699 999 (0.000 001 steps)	Notes		
Title input	32 characters max. (Title Auto-increment <sup>3</sup> )			
Power		<b>a</b> 1 <b>a</b>		
Battery	MZ5018A Ni-Cd Battery Pack, or	See item (3).		
	MZ5020A Dry Cell Battery Pack			
DC input	DC10 to 18 V			
AC input	100 to 240 V, 50/60 Hz	Using SWA 1702W		
		AC adapter (Item (4))		

Item	Specification	Remarks	
Power consumption			
DC input	9 W (not charging)	Not including option	
	14 W (charging)	(DC 10 to 18 V)	
AC input	50 VA max.	Using SWA 1702W	le
		AC adapter	l il
Size	194(H) x 290(W) x 75(D) mm, and	Including optical unit and	<b>I</b>
Mass	3.2 kg max.	battery pack (MW0972A,	
		MZ5018A)	
		Not including option	JS
Operating temperature,	-10° to +40°C, and 85%	• There are limitations on	el
and humidity		the memory card specifica-	0L
Storage temperature,	-20° to +60°C, and 85%	tions.	Bef
and humidity			-
Vibration	MIL-T-28800D (Class 3)	• Not using AC adapter	
Drop test	Height 76 cm, 6 surfaces, 8 corners		15
EMI	CISPR, Pub. 22 (Class A)		50
Dustproofing	MIL-T-28800E		tin
Waterproofing	MIL-T-28800E		jet
EMC *4	EN55011: 1991, Group 1, Class A		
	EN50082-1: 1992		
Safety	EN61010-1: 1993 (Installation Category II,	Pollution Degree II)	lon lon
*1: Japan Electronic Industr	y Development Association		ati
*2: Personal Computer Mer	nory Card International Association		er
*3: Only software version 3	.0 and later.		C
*4. FMC. Electromagnetic	Compatibility		

\*4: EMC: Electromagnetic Compatibility.

## Number of files saved in memory

Measuring conditions, waveform, and event data can be saved in the internal memory or a memory card.

Note: The number of files which can be saved in any medium may be varied a little depending on the number of fault points and on functions to be added in future.

Fi	le Measurement Mode	Full	Auto/Auto Mod	de *1		Manual Mode	
	Save Format	Analysis	Print	Standard	Analysis	Print	Standard
In	ternal Memory	23	132	44	24	176	48
	256 KB	10	67	21	11	08	22
	(256,096 byte)	10	02	21	11	90	23
ard	512 KB	21	125	12	22	100	47
5	(516,096 byte)	21	123	43	23	199	47
lou U	1 MB	44	252	91	16	401	02
Me	(1,039,360 byte)	44	232	04	40	401	92
	2 MB	04	505	176	04	804	102
	(2,082,816 byte)	94	505	170	94	804	195
bisk	2HD (1.44 MB)	61	353	123	66	562	135
D		01					100
Flopp	2DD (720 KB)	31	176	59	32	235	64

\*1: For ten fault positions

**Performance Test** 

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## (2) Optical Unit (MW0970A or MW0972A)

Spe	Remarks	
MW0970A	MW0972A	
1310±30 nm	1310±30/1550±30 nm	At 25°C and 1 µs pulse width
10/125 µm SM fiber	CCITT G.652	
FC, SC, ST, DIN or D	amond of PC type	Any one supplied
User exchangable and	cleanable	Biconic and D4 mounted at plant
5/10/25/50/100 km		
20/50/100/500/1000/20	000 ns	
23 dB min. (1.31 µm)	25.5 dB typ.	At 2000 ns Pulse width
20.5 min. (1.55 µm) 22	2.5 typ.	and Auto measurement
15.5 dB min. (1.31 μm	) 18 dB typ.	At 2000 ns Pulse width
13.0 min. (1.55 µm) 15	5 dB typ.	and Auto measurement
10 m		When return loss
50 m		25 dB min. with 20 ns Pulse width
1 m		5 km distance range
$\pm 2 \text{ m} \pm 10^{-4} \text{ x}$ measurem	nent range ±marker	Excluding uncertainty due
resolution		to fiber IOR
$\pm 0.05 \text{ dB/dB}$ or $\pm 0.1 \text{ d}$	B (whichever larger)	
±4 dB		
Sweep time of less that	n 0.9 seconds <sup>*2</sup>	
180 s min.*3		
Laser: 21CFR Class 1		
IEC Class 1		
120(H) x 290(W) x 35	(D) mm	
Same as main frame		
	Spectry   MW0970A   1310 $\pm$ 30 nm   10/125 µm SM fiber   FC, SC, ST, DIN or Di   User exchangable and   5/10/25/50/100 km   20/50/100/500/1000/20   23 dB min. (1.31 µm)   20.5 min. (1.55 µm) 12   15.5 dB min. (1.31 µm)   3.0 min. (1.55 µm) 15   10 m   50 m   1 m $\pm$ 2 m $\pm$ 10 <sup>4</sup> x measurem   resolution $\pm$ 0.05 dB/dB or $\pm$ 0.1 d $\pm$ 4 dB   Sweep time of less tha   180 s min.* <sup>3</sup> Laser: 21CFR Class 1   120(H) x 290(W) x 35   Same as main frame	SpecificationMW0970AMW0972A1310±30 nm1310±30/1550±30 nm10/125 $\mu$ m SM fiberCCITT G.652FC, SC, ST, DIN or Diamond of PC typeUser exchangable and cleanable5/10/25/50/100 km20/50/100/500/1000/2000 ns23 dB min. (1.31 $\mu$ m) 25.5 dB typ.20.5 min. (1.55 $\mu$ m) 22.5 typ.15.5 dB min. (1.31 $\mu$ m) 18 dB typ.13.0 min. (1.55 $\mu$ m) 15 dB typ.10 m50 m1 m±2 m ±10 <sup>4</sup> x measurement range ±markerresolution±0.05 dB/dB or ±0.1 dB (whichever larger)±4 dBSweep time of less than 0.9 seconds*2180 s min.*3Laser: 21CFR Class 1120(H) x 290(W) x 35(D) mmSame as main frame

Notes:

\*1 :0.5 dB splice detection range with ±0.1 dB accuracy by Bellcore TR-NWT-001138 test method

\*2 :Measured in the conditions that a 25-km fiber is measured at room temperature in the distance range of 50 km, the approximation method of 2PA, and the normal scale (not zoomed).

\*3 :The measurement time is the period from when the [Start] key is pressed until the measurement result is displayed in the table. This time changes according to the fiber loss, Pulse width, and level of Fresnel reflection, and to whether or not Distance range and Pulse width are set to Auto. The typical measurement time is 45 seconds when measuring a 5-km fiber (0.35 dB/km loss) at a wavelength of 1.31 μm with Distance range and Pulse width set to Auto.

## MW0973J Optical Unit Specifications

Item	Specifications	Remarks	
Wavelength	850±30 nm	At 25°C and 100 ns pulse width	
Measured fiber	62.5/125 µm Multimode fiber <sup>*1</sup>		
Optical connector	FC, SC, ST, DIN or Diamond of PC type User exchangeable and cleanable	Any one supplied	
Distance range	5/10/25/50/100 km		
Pulse width	20/50/100 ns		
Dynamic range $(S/N = 1)$	18 dB	At 100 ns Pulse width and Auto measurement	
Measurement range <sup>*2</sup>	10 dB	At 100 ns Pulse width and Auto measurement	
Dead zone			
Fresnel reflection*3	6 m	When return loss	
Backscattered light*3	15 m (D=±0.5 dB), 50 m (D=±0.1 dB)	20 dB min. with 20 ns Pulse width	
Marker resolution	1 m	5 km distance range	
Accuracy			
Distance measurement Loss measurement	$\pm 2 \text{ m} \pm 10^{-4} \text{ x}$ measurement range $\pm \text{marker}$ resolution $\pm 0.05 \text{ dB/dB}$ or $\pm 0.1 \text{ dB}$ (whichever larger)	Excluding uncertainty due to fiber IOR	
Return loss measurement	±4 dB		
Real-time sweep	Sweep time of less than 1.0 seconds <sup>*4</sup>		
Measurement time	180 s min.		
Optical safety	Laser: 21CFR Class 1 IEC Class 1		
Size	120(H) x 290(W) x 35(D) mm		
Usage environment	Same as main frame		

Notes:

\*1 :When a 50/125  $\mu$ m fiber is used, the dynamic range is about 14 dB and the dead zone in backscattered light is about 20 m (0.5 dB).

\*2 :0.5 dB splice detection range with  $\pm$ 0.1 dB accuracy

\*3 :See figure below.



\*4 :Measured in the conditions that a 2-km fiber is measured at room temperature in the distance range of 5 km, the approximation method of 2PA, and the normal scale (not zoomed).

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Item	Specifications			
Wavelength	850/1300 nm±30 nm (25 , Pulse width: 100 ns, Typical: ±20 mm)			
Measured fiber	62.5/125 μm Multimode fiber <sup>*1</sup>			
Optical connector *2	FC, SC, ST, DIN and HFS-13/A (All are PC type.)			
Distance range	5/10/25/50/100 km			
Pulse width	20/50/100 ns (Wavelength: 850 nm), 20/50/100/500 ns (Wavelength: 1300 nm)			
Dynamic range $(S/N = 1)$	18 dB (850 nm, Typical: 22 dB)*3, 22 dB (1300 nm)*4			
Measurement range <sup>*5</sup>	10 dB*3(Wavelength: 850 nm), 14 dB*4(Wavelength: 1300 nm)			
Dead zone				
Fresnel reflection <sup>*6</sup>	6 m (850 nm, Typical <sup>†</sup> : 5 m) <sup>*7</sup> , 8 m (1300 nm, Typical <sup>†</sup> : 6 m) <sup>*7</sup>			
Backscattered light*6	50 m (850/1300 nm, D=±0.1 dB), 15 m (850 nm, D=±0.5 dB, Typical <sup>†</sup> : 9 m)			
	20 m (1300 nm, D=±0.5 dB, Typical <sup>†</sup> : 13 m)			
Marker resolution	1 m 5 km distance range			
Accuracy				
Distance measurement	$\pm 2 \text{ m} \pm (10^{-4} \text{ x measurement range}) \pm \text{marker resolution}^{*8}$			
Loss measurement	$\pm 0.05 \text{ dB/dB}$ or $\pm 0.1 \text{ dB}$ (whichever larger)			
(Linearity)				
Return loss measurement	±4 dB			
Real-time sweep	Sweep time of less than 1.0 seconds <sup>*9</sup>			
Measurement time	180 s min.			
Optical safety	Laser: 21CFR Class 1			
	IEC Class 1			
Size	120(H) x 290(W) x 35(D) mm			
Usage environment	Same as main frame			

## **MW0975J Optical Unit Specifications**

Notes:

\*1 :When a 50/125 μm optical fiber is used, the dynamic range becomes narrower by about 4 dB and the dead zone defined by 0.5 dB backscatter level is increased to about 20 m at 850 nm and to about 30 m at 1300 nm.

\*2 :One of them is supplied as standard. They can be replaced by users.

\*3 : At pulse width of 100 ns, in Auto Measurement

\*4 : At pulse width of 500 ns, in Auto Measurement

\*5 :Range where a 0.5 dB splice can be measured with  $\pm 0.1$  dB accuracy.

\*6 :See figure below.



- \*7 :Pulse width: 20 ns, return loss:  $\geq$ 20 dB
- \*8 : An error caused by fiber refraction index is not included.
- \*9 :When a 2-km optical fiber is measured at 5 km of distance range, 500 m/div of full scale, and 2PA of Loss measurement.
- † :Typical value at ≥30 dB of return loss

## **Optical Unit (MW0970B or MW0972B)**

	are not guaranteed spec	cifications.		
Item	Spe	Specification		
	MW0970B	MW0972B		
Wave length	1310±30 nm	1310±30/1550±30 nm	At 25°C and 1 µs pulse width	
	(typical value: ±15 nm)	) (typical value: $\pm 15/20$ nm	1)	
Measuring fiber	10/125 µm SM fiber		CCITT G.652	
Optical connector	FC, SC, ST, DIN, DIA	MOND	Any one supplied.	
	(All PC type User exch	angeable & cleanable)	Biconic and D4 mounted at plant	
Distance range	5/10/25/50/100/200 km	1		
Pulse width	20/50/100/500/1000/20	000/4000/10000 ns		
Dynamic range (S/N=1)	36 dB	36 dB (at 1.31 µm) /	Pulse width of 10 µs,	
		34 dB (at 1.55 µm)	at 25°C	
Measurement range <sup>*1</sup>	22 dB	22 dB (at 1.31 µm,		
	(typical value: 25 dB)	typical value: 25 dB)	At 4 µs pulse width and	
		20 dB (at 1.55 µm	Auto measurement	
		typical value: 23 dB)		
Dead zone				
Reflective	5 m		Pulse width: 20 ns	
Backscatter	25 m (ORL=40 dB)			
Marker resolution	1 m		Distance range: 5 km	
Accuracy				
Distance measure	$\pm 2 \text{ m} \pm 10^{-4}$ ~measured di	$\pm 2~m \pm 10^4~$ <code>~measured distance±marker resolution</code>		
Linearity	$\pm 0.05 \text{ dB/dB} \text{ or } \pm 0.1 \text{ dI}$	$\pm 0.05 \text{ dB/dB}$ or $\pm 0.1 \text{ dB}$ (whichever larger)		
Return loss	±4 dB			
Real-time sweep	Sweep time of less than 0.4s <sup>*2</sup>			
Measurement time	180s min.*3			
Optical safety	Laser: 21CFR Class 1,	IEC Class 1		
Size	120 H x 290 W x 35 E	Omm		
Usage environment	Same as main frame			

The typical values are given for reference only to assist in the use of the unit, and

\*1 0.5 dB splice detection range with ±0.1 dB accuracy by Bellcore TR-NWT-001138 test method

\*2 Measured in the conditions that a 25 km fiber is measured at room temperature in the distance range of 50 km, the approximation method of 2PA, and the normal scale (not zoomed).

\*3 The measurement time is the period from when the [Start] key is pressed until the measurement result is displayed in the table. This time changes according to the fiber loss. Pulse width, and level of Fresnel reflection, and to whether or not Distance range and Pulse width are set to Auto. The typical measurement time is 45 seconds when measuring a 5 km fiber (0.35 dB/km loss) at a wavelength of 1.31 μm with Distance range and Pulse width set to Auto.

Note:

## Shapes of optical connectors



## (3) Battery Pack

Item	Specification	Remarks
Voltage	10.8 V nominal	
Capacity	2.8 AH nominal	
Cell type	Ni-Cd secondary cell	
Charging time	14 hours min. (20 hours max.)	At 25°C
Charging environment	$0^{\circ}$ to $+40^{\circ}$ C	
Continuous operation time	5 hours min.	At 25°C, backlight off
Size	74(H) x 290(W) x 35(D) mm	
Mass	1 kg max.	

#### (a) Ni-Cd Battery Pack (MZ5018A)

#### (b) Dry-Cell Battery Pack (MZ5020A)

10 batteries Batteries are not included
Batteries are not included
Batteries are not merudeu.
Without dry cell battery

\* Size: C or Baby

The operation time of alkaline dry cell battery and manganese dry cell battery is listed below. (Typical value)

Cell type	Main unit backlight	Environment		
		-10°C	25°C	40°C
Alkaline Dry Cell Battery	ON	40 minutes	4 hours	7 hours
(LR14)	OFF	2 hours	13 hours	15 hours
Manganese Dry Cell Battery	ON	20 minutes	1 hour	2 hours
(R14)	OFF	1 hour	4 hours	6 hours

## (4) AC Adapter (SWA1702W)

Item	Specification	Remarks
AC input	100 to 240 Vac, 50/60 Hz	
DC output	17.5 Vdc, 1.2 A	
Size	36(H) x 163(W) x 63(D) mm	
Safety standards	UL1950, CSA1402C, EN60-950	
Operating temperature,	0° to +40°C, and 90%	
and humidity		
Storage temperature,	-10° to +70°C, and 95%	
and humidity		

Outline

## (5) Built-in 3.5 inch FDD (MW9070B-01)

Item	Specification	Remarks
Storage medium	3.5"FD (2DD or 2HD)	
Format	MS-DOS	
Storage capacity	2DD (720KB), 2HD (1.2 MB or 1.44 MB)	
Power consumption	4W at DC input	
	Included in max. value at AC input	
Mass	3.5 kg max.	Including main frame, optical unit and battery pack (MW0972A, MZ5018A)
Operation temperature, and humidity	+5°~ 40°C, 85%	At FDD operation
Operation condition	The screen of the main frame is horizontal or the stand is set to incline the screen from the vertical position.	At FDD operation

## (6) Visible LD Light Source (MW0970A-05/MW0972A-05/MW0973J-05/ MW0975J-05/MW0970B-05/MW0972B-05)

Item	Specification	Remarks	
Center wavelength	635±10 nm	At 25°C, lit	
Optical output	-3.0±1.5 dBm	At lit (Flashing about	
		0.5 sec interval)	
Output fiber	10/125 µm SM fiber		
Optical connector	FC, SC, ST, DIN, or Diamond (User exchangeable)		
	D4 and Biconic (Mounted at plant)		
Optical safety	IEC Class 2		
	21CFR Class 2		

## (7) Hard Carrying Case (Z0243)

Item	Specification	Remarks
Size	500(H) x 380(W) x 235(D) mm	
Mass	4.5 kg max.	

## (8) Peripherals and Parts

Name	Specification	Model
AC adapter	Input voltage: 100 to 240 Vac, 50/60 Hz	SWA1702W
Power cord	2.5 m 1 pc.	J0017
MW9070B Operation manual		M-W1046AE
MW9070B Serial interface Op	eration manual	M-W1047AE
MW9070B Service manual		M-W1046BE
Thermal printer	120 V ±10%, 60 Hz	DPU-411-21BU
Thermal printer	220 V ±10%, 50 Hz	DPU-411-21BE
256 KB memory card	JEIDA Ver.4	JS256G3-C-13
512 KB memory card	JEIDA Ver.4	JS512G3-C-13
1024 KB memory card	JEIDA Ver.4	JS1024G3-C-13
2048 KB memory card	JEIDA Ver.4	JS2048G3-C-13
Printer connection cable	Centronics	J0614
FC type adapter		FC-AP
Optical fiber cable	with FC-PC at both ends for SM fiber	J0486 *1
FDDI-FC conversion cable		J0699 *1
FDDI-ST conversion cable		J0700 *1
FDDI-SC conversion cable		J0701 *1
Connector cleaning set		MZ8012A
Soft carrying case	Handbag type	Z0242
Hard carrying case	Main frame, unit, thermal printer	Z0243
	Optical loss test set can be contained	
Replaceable FC optical connection	ctor	J0617B
Replaceable ST optical connec	tor	J0618D
Replaceable DIN optical connector		J0618E
Replaceable HMS-10/A optical connector		J0618F
Replaceable SC optical connector		J0619B
Serial interface cable	For remote control with IBM-PC/AT or J-3100	J0654A
Serial interface cable	For peripheral equipment	J0661A
Printer paper	10 rolls/set	TP411-28CL
for DPU-411/DPU-412		

Notes: \*1

Specify A to C at the mark according to the length of the cable (A: 1 m, B: 2 m, C: 3 m).

Outline

**Before Use** 

When splice loss is measured, two lines, L1 and L2, are determined from the measurement data as shown below and the loss is found.



There are two methods for determining these lines: the LSA, and 2PA methods (section 1.6). The LSA (Least Square Approximation) method is explained here.

In the Least Square Approximation method, the straight line that best fits all the measurement data points between the markers is found.



As shown in the above diagram, the straight y = a + bx is the best fit for n data points  $(x_1, y_1), (x_2, y_1), ..., (x_n, y_n)$ . The value of the deviation of each point ( $\delta 1$ ,  $\delta 2$ ,  $\delta 3_{n}$ ) including the variables a and b from the line, L, is found, and the line, L, is determined from variables a and b so that the sum, E, of the square of the deviation,  $\delta i$ , of each point is the minimum value.

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

$$E = \sum_{i=1}^{n} \delta t^{2} = (y_{1}-a-bx_{1})^{2} + (y_{2}-a-bx_{2})^{2} + c + (y_{n}-a-bx_{n})^{2}$$

In this method, the condition required to minimize E is :

$$\frac{\delta E}{\delta a}=0, \quad \frac{\delta E}{\delta b}=0$$

When this equation is solved, the variables a and b can be found as shown below and the line, L can be determined as follows :

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

where,

The trace waveform at the splice point should be displayed as the dotted line in the figure below, but is actually displayed as the solid line. The waveform input to the OTDR shows a sharp falling edge at the splice point, so the circuit cannot respond correctly. The interval L gets longer as the pulse width becomes longer.



Therefore, the splice loss cannot be measured conectly in the Loss mode.

In the Splice & Return Loss mode, two markers are set on each side of the splice point and the lines L1 and L2 are drawn as shown below. The part of the straight line immediately after the splice point is the forward projection of the straight line, L2.

The splice loss is found by dropping a vertical line from the splice point to this projection of L2 and measuring the level difference between the splice point and the intersection.



The return loss, R, is found from the following calculation.

where, 
$$R = -(10\log_{10}bsl+10\log_{10}(10^{L/5}-1))$$

$$bsl = S \bullet \alpha_{R} \bullet V \bullet \frac{W}{Q}$$
$$S = K \bullet \frac{N1^{2} - N2^{2}}{N1^{2}}$$

$$V = \frac{C}{N_e}$$

W (sec):	Currently-set pulse width
L:	Difference of levels between $\#$ and $/$ markers
$BSL = 10log_{10}bsl:$	Backscattered light level
S :	Backscattered coefficient
$\alpha_{R}$ :	Rayleigh Scattering Loss (np/m)
	$= 0.23026 \text{ x } 10^{-3} \text{ x RSL}$
RSL:	Rayleigh Scattering Loss (dB/km)
V:	Group velocity in optical fiber
K:	Constant determined by optical fiber
N1:	Index of refraction of optical fiber core
N2:	Index of refraction of optical fiber cladding
N <sub>e</sub> :	Effective group index of refraction of optical fiber
C (m/s):	Speed of light (2.99792458 x 10 <sup>8</sup> )

Use the following to obtain the total return loss, or TRL, in db.

$$TRL = -10 \log_{10} \frac{E_R}{E_{in}}$$
$$= -10 \log_{10} \frac{\int_0^{\infty} P(t)dt}{P_0 W}$$
$$= -10 \log_{10} \frac{bsl \int_0^{\infty} P'(t)dt}{W} \quad \text{where, P'}(t) = \frac{P(t)}{P_0 bsl}$$

$$= -10 \log_{10} \text{bsl} + 10 \log_{10} \text{W} - 10 \log_{10} \int_{0}^{\infty} \text{P}'(t) dt$$

Er:	Reflected light energy
Ein:	Incident light energy
<b>P</b> (t):	OTDR measurement power
Po:	Incident light pulse peak power at t=0
W:	Incident light pulse width
$10 \log_{10} bsl:$	Backscattered light level
$\int_0^\infty P'(t)dt:$	Measured waveform normalized and integrated at the incident and for the backscattered light intensity

<Reference> bsl is determined according to the fiber, wavelength, and pulse width. Typical values for 1.3µm single mode optical fiber are shown below.

Dulco widoth	Backscatter level idB	
Puise widelli	λ=1.31µm	λ=1.55µm
100 ns	-60	-62.5
1 μs 10 μs	-50 -40	-52.5 -42.5

Outline

**Before Use** 

Setting Up

# /inritsu

ANRITSU CORPORATION 5-10-27, Minamiazabu, Minato-ku, Tokyo 106 Japan / Phone: 81-3-3446-1111