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MW9060A

OPTICAL TIME DOMAIN REFLECTOMETER

OPERATION MANUAL

FIRST EDITION

MEASURING INSTRUMENTS DIVISION
ANRITSU CORPORATION

JUL.
1993

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MW9060A

OPTICAL TIME DOMAIN
REFLECTOMETER

OPERATION MANUAL

JUNE 1993 (FIRST EDITION)

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WARNING

NO OPERATOR SERVICEABLE PARTS INSIDE.
REFER SERVICING TO QUALIFIED PERSONNEL.

CAUTION

FOR CONTINUED FIRE PROTECTION REPLACE
ONLY WITH SPECIFIED TYPE AND RATED FUSE.

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■ SAFETY CONSIDERATIONS:

Anritsu uses the following labels to identify safety precautions which should be followed to prevent personal injury or product damage. Please familiarize yourself with them before operating this product.

Labels used in this manual:

WARNING Indicates that the procedure could result in personal injury if not correctly performed. Do not proceed before you fully understand the explanation given with this symbol and meet the required conditions.

CAUTION Indicates that the operating procedure could result in damage to the product if not correctly performed. Do not proceed before you fully understand the explanation given with this symbol and meet the required conditions

Note: Indicates that information helpful in understanding the operation of the product is about to be presented.

Labels or symbols used on/in the product:



This international caution symbol indicates that the operator should refer to the operation manual before beginning a procedure.



This symbol indicates an earth (ground) terminal. The product should be grounded via the earth terminal if a three prong power cord is not used.

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CERTIFICATION

ANRITSU CORPORATION certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All parts of this product are warranted by Anritsu Corporation of Japan against defects in material or workmanship for a period of one year from the date of delivery.
In the event of a defect occurring during the warranty period, Anritsu Corporation will repair or replace this product within a reasonable period of time after notification, free-of-charge, provided that: it is returned to Anritsu; has not been misused; has not been damaged by an act of God; and that the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and is not transferable if it is resold.

ALL OTHER EXPRESSED WARRANTIES ARE DISCLAIMED AND ALL IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY. IN NO EVENT SHALL ANRITSU CORPORATION BE LIABLE TO THE CUSTOMER FOR ANY DAMAGES, INCLUDING LOST PROFITS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, ARISING OUT OF THE USE OR INABILITY TO USE THIS PRODUCT.

All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to Anritsu Corporation or its representative in your area.

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Note 1:

1. The instrument is operable on a nominal voltage of 100 to 127 Vac or 200 to 250 Vac by changing the voltage-rating selection switch under the top cover.

   The voltage and current ratings are indicated on the rear panel when the instrument is shipped from the factory.

   To operate on the other voltage, change the selection switch. The plate on the rear panel indicating the voltage and current ratings should be changed to the appropriate one. Order the plate from ANRITSU CORPORATION if needed.

2. In this manual, the power supply voltage and current ratings are represented by **Vac and ***A, respectively.

3. The relationship between power supply voltage and current ratings is shown below.

**Vac	***A
85 to 132 V	5 A
170 to 250 V	5 A

Note 2:

STORAGE MEDIUM

This equipment stores data and programs using IC card (PMC), backed-up memories.

Data and programs may be lost due to improper use or failure.

ANRITSU therefore recommends that you back-up the memory.

ANRITSU CANNOT COMPENSATION FOR ANY MEMORY LOSS.

Please pay careful attention to the following points. Do not remove the IC card (PMC) from equipment being accessed.

For details refer to the relevant operation manual.

(IC card: PMC)

- Isolate the card from static electricity.
- The back-up battery in the card has a limited life; renew the battery periodically. See paragraph 2.8 for the life.

(Backed-up memory)

- Isolate the memory from static electricity.

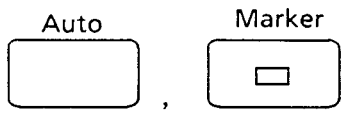
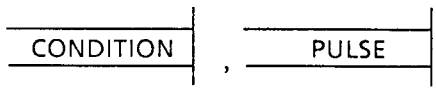
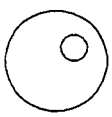
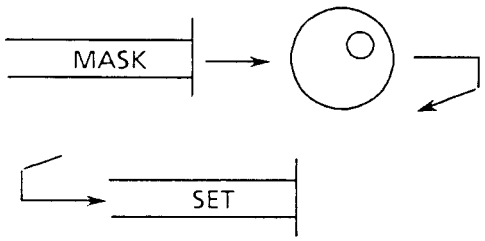
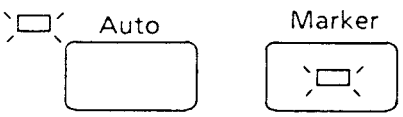
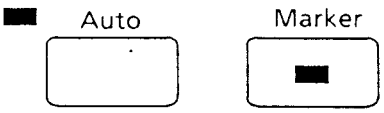
Note: The battery life is about 7 years. Early battery replacement is recommended.

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Note 3:

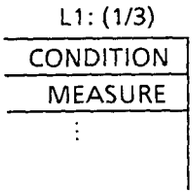
Notation of operation keys, etc.

In the description of this manual, the operation keys, knobs, etc. are represented as follows:

Notation example	Explanation
Panel key 	When only keys are indicated in the description of operation procedure, it means you simply press the key. For soft keys, it means you press the soft key (F1 to F6) that corresponds to the label.
Soft key 	
Rotary knob 	
Indication of operation procedure 	An arrow is used when it is necessary to clearly indicate the sequence of key and other operations. In the example shown on the left, you first press the soft key corresponding to MASK, then turn the rotary knob, and then press the soft key corresponding to SET.
Lamp on/off On  Off 	Whether the lamp goes on or off when the key is pressed is respectively indicated by  and .

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(Continued)

Notation example	Explanation
Soft key label 	This indicates an example of soft key labels displayed on screen when you operate the key. L1 indicates the first layer, and the second and third layers are respectively indicated by L2 and L3.

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SECTION 1
OVERVIEW

This section outlines the features of the MW9060A Optical Time Domain Reflectometer and the organization of this manual, as well as describes the equipment composition of the MW9060A when it is used with standard fittings, plug-in units, expansion options, optional accessories and peripheral devices, and specifications.

1.1 Product Outline

The MW9060A Optical Time Domain Reflectometer lets you automatically or manually detect fault locations in fiber-optic cables and measure cable splice loss, optical-connector connecting loss, etc. with high accuracy. With its wide dynamic range of 34 dB in wavelength 1.3 μm band or 32 dB in 1.55 μm band, it can made precise measurement with a 10 cm read-out resolution even for 250 km long-distance measurement. The MW9060A is equipped with a high-speed printer and floppy disk drive so that the waveform can be printed out and saved to microfloppy disk at the site and the data can be processed with a personal computer.

An event point registration function which measures preregistered measurement points and displays them in an event table, and a procedure function which registers a string of operations and re-executes them by one key operation, are advantageous in automating measurement.

The MW9060A comes with plug-in units that you can simply fit into it after selecting the appropriate type depending on the measurement wavelength band, kind of fiber, or measurement range (distance and resolution).

The MW9060A is designed and manufactured conforming to the FDA optical safety standard 21CFR1040.10, and is classed as Class-1 Laser Equipment under the standards.

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1.2 Manual Organization

This manual consists of nine sections and an appendix. The following outlines the contents of each section.

Sections	Contents
Section 1 Overview	Product outline, manual organization, standard equipment composition, plug-in units, options, optional accessories and peripheral devices, and MW9060A specifications
Section 2 Preparations Before Use	Various preparatory operations before using the MW9060A (before power-on) and precautions to be observed when using the equipment
Section 3 Description of Panel	Names and functions of keys, connectors, knobs, indicators, etc located on front and rear panels
Section 4 Basic Method of Operation	Basic operations for distance range, pulse width, and refractive index settings; and basic configuration of screen information and circuitry
Section 5 Detail Method of Operation	Details on how to use various functions using panel keys and soft keys
Section 6 Measurement	Methods of measuring distance, splice loss, and transmission loss, as well as auto fault location measurement method
Section 7 Performance Test	Measurement equipment, setup, and test procedure necessary for conducting performance tests
Section 8 Calibration	Calibration period and calibration items
Section 9 Storage and Transport	Daily maintenance, long-term storage, and repackaging and transport
Appendix	Front and rear panel layout diagrams and soft key hierarchy transition dagrams

Thus, reading sections 2, 3, 4, and 6 you will learn the basic procedure to make measurement with the MW9060A.

When using the MW9060A, also refer to the operation manual for GPIB. It will help you know details on GPIB based remote control.

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1.3 Equipment Composition

1.3.1 Standard composition

Table 1-1 shows the standard composition of theMW9060A.

Table 1-1 Standard Composition

Item	Model No./ Order No.	Name	Qty.	Remarks
Main frame	MW9060A	Optical Time Domain Reflectometer	1	
Accessories supplied	J0017	Power cord, 2.5 m	1	
	F0013	Fuse, 5 A	2	T5A250V
	Z0240	Printer paper	2	
	W0667AE	Operation manual	1	

The MW9060A comes with one of the plug-in units listed in Table 1-2 that you can simply fit into the main frame for making measurement.

1.3.2 Plug-in units

Table 1-2 lists the plug-in units used for the MW9060A.

Table 1-2 Plug-in Units

Model No.	Name	Remarks
MW0942A	Plug-in unit	Used for 1.31 μm SM fiber, short distance, high resolution
MW0944B	Plug-in unit	Used for 1.31/1.55 μm SM fiber, short distance, high resolution
MW0945B	Plug-in unit	Used for 1.31 μm SM fiber, long-distance, wide-dynamic range measurement
MW0946B	Plug-in unit	Used for 1.55 μm SM fiber, long-distance, wide-dynamic range measurement
MW0947B	Plug-in unit	Used for 1.31/1.55 μm SM fiber, long-distance, wide-dynamic range measurement
MW0967B	Plug-in unit	Used for 0.85/1.30 μm GI fiber, short distance, high resolution

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1.3.3 Options

Table 1-3 lists the options used for the MW9060A.

Table 1-3 Option

Model No./Order No.	Name	Remarks
MW9060A-01	GPIB interface	
MW9060A-02	1.2MB FDD	Format corresponding to NEC PC-9800 series
MW0942A/0944B/0945B/0946B/0947B/0967B-21	D4 connector	
MW0945B/0946B/0947B/0967B-22	AT&T Biconic connector	
MW0967B-23	Amphenol 906	
MW0945B/0946B/0947B-37	FC-PC connector	

Note: The PC 9800 series are products of the NEC Corporation.

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1.4 Optional Accessories and Peripheral Devices

Tables 1-4 and 1-5 list the optional accessories and peripheral devices.

Table 1-4 Optional Accessories

Model No./Order No.	Name	Remarks
B346	Unit adapter	Adapter to mount plug-in unit
B293	CRT hood	
BS32F1-C-172	Memory card	RAM, 32 k bytes
BS64F1-C-173	Memory card	RAM, 64 k bytes
BS128F1-C-174	Memory card	RAM, 128 k bytes
BS256F1-C-1175	Memory card	RAM, 256 k bytes
BS512F1-C-1176	Memory card	RAM, 512 k bytes
J0007	GPIB connection cable, 1 m	408JE-101
J0008	GPIB connection cable, 2 m	408JE-101
J0126A	Coaxial cable, 1 m	Used for connecting UA455A video plotter
J0126B	Coaxial cable, 2 m	Used for connecting UA455A video plotter
FC-AP	Adapter	
J0200*	Optical fiber cord	GI optical fiber cord with FC connectors at both ends
J0056*	Optical fiber cord	SM optical fiber cord with FC connectors at both ends
J0087*	FC/D4 conversion cord	GI optical fiber
J0210*	FC/D4 conversion cord	SM optical fiber
J0209*	FC/Biconic conversion cord	GI optical fiber
J0208*	FC/Biconic conversion cord	SM optical fiber
J0207*	FC/DIAMOND conversion cord	GI optical fiber
J0206*	FC/DIAMOND conversion cord	SM optical fiber
J0516*	FC/DIN conversion cord	GI optical fiber
J0517*	FC/DIN conversion cord	SM optical fiber
J0518*	FC/ST conversion cord	GI optical fiber
J0519*	FC/ST conversion cord	SM optical fiber
J0520*	FC/SC conversion cord	GI optical fiber
J0521*	FC/SC conversion cord	SM optical fiber
MZ8012A	Connector cleaning set	
B0177	UA455A carrying case	
B0329K	Protective cover	

* ● Specify the desired type with character A to C according to the length of fiber cord. (A: 1 m, B: 2 m, C: 3 m)

● Flat polished connectors are used for connectors of the optical fiber cord and conversion cord. Please contact us separately for PC type connectors.

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Table 1-5 Peripheral Devices

Model No./Order No.	Name	Remarks
MC2102A	Floppy Disk Drive Unit	Used for recording measured data.
MA9014A	Bare fiber connector	Shared for SM and GI
MA9013A	Fiber adapter	
MN9607A	SM/GI converter	
UA455A	Video plotter	
CTM-800	Printer	(Epson, Japan)
GD9411F-1-11	Plotter	(Graphtec, Japan)
Z0240	Thermal printer paper (2 volumes/pair)	
Z0168	Microfloppy disk	3.5 inches, 2HD, a group of 10
Z0054	Microfloppy disk	3.5 inches, 2DD, a group of 10

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1.5 Specifications

Table 1-6 Specifications of the MW9060A (1/2)

Model		MW9060A
Sweep Speed		Min. 0.3 s/sweep (Used in Fast Sweep Mode and 2PA Mode)
Automatic Search	No. of Search Points	Max. 5 points (At event mode off), Max. 100 points (At event mode on)
	Threshold	0.05/0.1/0.3/1.0/3.0/5.0 dB
Optical Return Loss Measurement		Provided
Waveform Comparison		Displays 2 waveforms simultaneously
Smoothing Function		Improves the S/N ratio of the waveform by 6 levels from level 1 through 6
Full-Trace Display Function		Displays the full measurement trace, measured by switching each attenuator in turn.
Relative Distance Measurement Function		Displays distance relative to cursor setting.
Event Function		Fiber length, total loss, transmission loss, return loss for fiber on either side of splice point.
Procedure Function		Key command sequence is recorded and assigned to a single key for automatic execution.
Built-in Memory		32 waveforms (Store the setting conditions at the same time.)
Memory Card		Plug-in Memory Card 32KB/64KB/128KB/256KB/512KB
Floppy Disk *1		Micro Floppy disk Storage Capacity (MS-DOS *2 formatted) 2M/1MB (1.44M/720KB) or 1.6M/1MB (1.2M/720KB)
Printer		Hard copy of screen display is available by line thermal printer.
Title Display		20 Characters × 2 Lines
IOR		1.400000 to 1.699999 (in 0.000001 steps)
Distance Display Unit		meters/feet/miles
CRT		6-inch, Green
Video Output		Composite Video Signal: 1 Vp-p (75 Ohm Load) Connector: BNC

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Table 1-6 Specifications of the MW9060A (2/2)

Interface	GPIB	Device	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
		Controller	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C4, C7, E2
			IEEE-488.1 and IEEE-488.2
	Direct Plot		Hard copy of the measurement screen to an external plotter/printer is available through the GPIB.
Power Supply			85 to 132 (170 to 250) Vac, 50/60 Hz ±5%, ≦160 VA
Temperature and Humidity *3			−10°C to +55°C (+5 to +35°C for FDD & printer), −20°C to +60°C (storage), ≦80%
Dimension/Weight			177 H×284 W×450 D mm, ≦12.5 kg (with no plug-in units)

*1 Option is available for 1.6M/1MB (1.2M/720KB)

1.44M/720KB: For IBM-PC series formatting('IBM-PC ' is a registered trademark of the International Business Machines Corporation.)

1.2M/720KB: For PC-9800 series formatting('PC-9800 series ' is a product of the NEC Corporation.)

*2 'MS-DOS ' is a registered trademark of the Microsoft Corporation.

*3 When plug-in memory cards (PMC) are used, the operating temperature is:

PMC left inserted: −10°C to +55°C

Inserting/removing PMC: 0°C to +55°C

Operating temperature when floppy disk drive & printer are used: +5°C to +35°C

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Table 1-7 Specifications of Plug-in Units

Model		MW0942A				
Center Wavelength		1310±15 nm				
Fiber under measurement		10/125 μm Single-mode fiber (CCITT G.652)				
Optical connector *1		FC-PC/DIAMOND-PC/ST-PC/DIN-PC/SC-PC				
Pulse width		10 ns	20 ns	100 ns	500 ns	2 μs
Dynamic range (one-way back-scattered light level)*2, *6	Effective	6.0 dB	7.5 dB	11.0 dB	14.5 dB	17.5 dB
	S.N.R=1	9.0 dB	10.5 dB	14.0 dB	17.5 dB	20.5 dB
4% Fresnel reflection dynamic range *6	Effective	34.0 dB				
	S.N.R=1	37.0 dB				
Near-end deadzone *3, *4	Back-scattered light	5 m	7.5 m	20 m	75 m	250 m
Spatial resolution *3, *5	Fresnel reflection	2 m	3 m	15 m	60 m	220 m
	Back-scattered light	2 m	3 m	15 m	60 m	220 m
Mask function	No. of masks	Max. 5 (Optical)				
Variable near-end mask-width function		Provided				
Attenuation		0.0 dB fixed				
Variable optical output power function		Not provided				
Distance range *3		10/25/50/100 km				
Horizontal axis *3	Scale (m/div)	2.5/5/10/25/50/100/250/500/1 k (10 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k (25 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k/5 k (50 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k (100 km range)				
	Resolution	Sampling resolution : 5 cm to 20 m Read-out resolution : 5 cm to 200 m				
	Accuracy	±1 m ±measured value (m) ×2×10−5 (does not include the uncertainty in the index of refraction for the fiber.)				

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0942A
Vertical axis	Scale (dB/div)	0.1/0.25/0.5/1/2.5/5
	Read-out resolution	0.001 dB
	Linearity	±0.3 dB (0 to 5 dB) ±0.5 dB (5 to 10 dB) ±0.7 dB (10 to 15 dB)
Ambient temperature	Spec.	5°C to +35°C
	Storage	−10°C to +60°C
Weight		≦ 2.5 kg

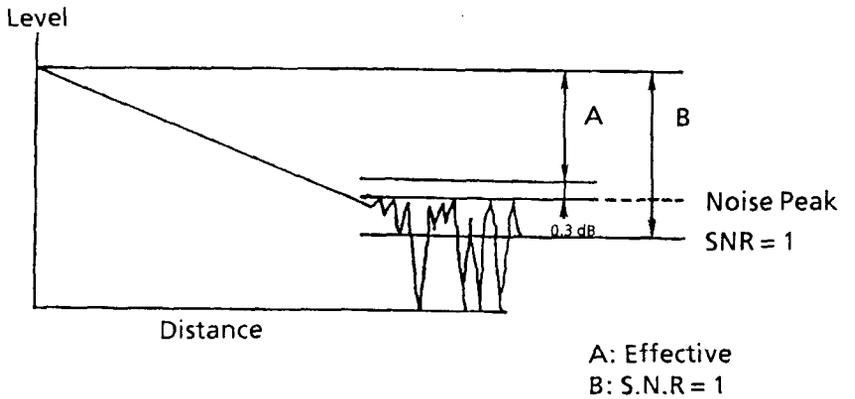
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*1: Specify one of the connectors in the table. For other optical connectors, please refer to Table 1-3.

*2: Dynamic range (one-way back-scattered light)

Effective: The difference between the level of the point which is 0.3 dB higher than the peak noise level and the level of the point at which near-end back-scattering occurs.

SNR=1: Level difference between the RMS noise level and the level at which near-end back-scattering occurs.

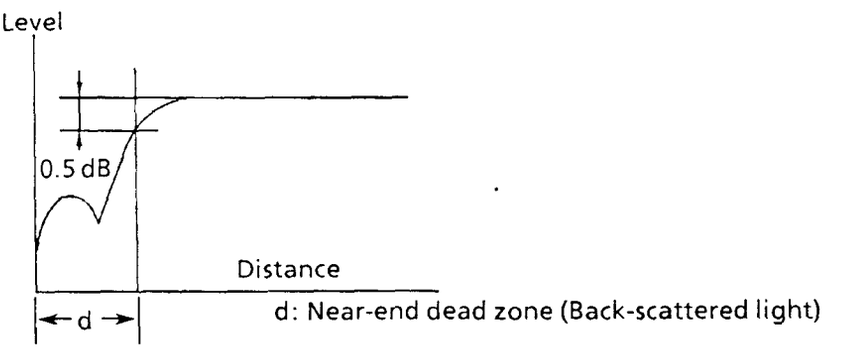


*3: When IOR is set to 1.500 000.

*4: Near-end Dead Zone

(For Back Scattered light): The near-end dead zone (for back-scattered light) is the distance at which the near-end back-scattered light level approaches to within ±0.5 dB of its final value.

This specification represents the values for the FC-PC connector (when return loss ≧ 25 dB). When fiber which includes a PC connector (flat polished) is measured, the dead zone may be larger than the specified value.

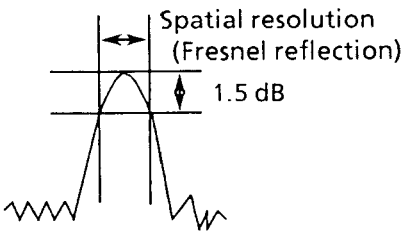


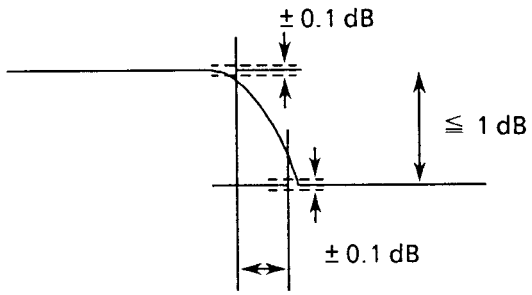
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*5: Spatial resolution

For Fresnel Reflection: The width of an unsaturated Fresnel reflection pulse at a point which is 1.5 dB less than the peak value.

For Back-Scattering: The distance between the points at which the beginning and ending levels at a splice etc. gap (≦1 dB) are within ±0.1 dB of their initial and final values respectively.





Spatial resolution
(Back-scattered light)

*6: These are values when using the SMOOTHING function (with level 6).
When the SMOOTHING not used, each value decreases by 2 dB.

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0945B					
Center Wavelength *7		1310±15 nm					
Fiber under measurement		10/125 μm Single-mode fiber (CCITT G.652)					
Optical connector *1		FC/DIAMOND/ST/DIN/SC					
Pulse width *9		20 ns	100 ns	500 ns	1 μs	4 μs	10 μs
Dynamic range (one-way back-scattered light level)*2, *10	Effective	15 dB	20 dB	23 dB	26 dB	31 dB	34 dB
	S. N. R=1	18 dB	23 dB	26 dB	29 dB	34 dB	37 dB
4% Fresnel reflection dynamic range *10	Effective	35 dB	39 dB	41 dB	42 dB	44 dB	45 dB
	S. N. R=1	38 dB	42 dB	44 dB	45 dB	47 dB	48 dB
Near-end deadzone *3, *4	Fresnel reflection	35 m	50 m	95 m	200 m	700 m	1500 m
	Back-scattered light	35 m	50 m	95 m	200 m	700 m	1500 m
Spatial resolution *3, *5	Fresnel reflection	15 m	30 m	75 m	150 m	500 m	1500 m
	Back-scattered light	30 m	50 m	90 m	200 m	700 m	1500 m
Mask function *3, *6	No. of masks	Max. 5 (Optical)					
	Mask width	75 m	75 m	150 m	200 m	700 m	1500 m
Variable near-end mask-width function		Not provided					
Attenuation *8		AUTO/0.0 to 23.75 dB in 1.25 dB steps					
Variable optical output power function *6		Provided					
Distance range *3		10/25/50/100/250 km					
Horizontal axis *3	Scale (m/div)	5/10/25/50/100/250/500/1 k (10 km range) 5/10/25/50/100/250/500/1 k/2.5 k (25 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k (50 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k (100 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k/25 k (250 km range)					
	Resolution	Sampling resolution : 10 cm to 50 m Read-out resolution : 10 cm to 500 m					
	Accuracy	±1 m ±measured value (m) ×2×10^{-5} (does not include the uncertainty in the index of refraction for the fiber.)					

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0945B
Vertical axis	Scale (dB/div)	0.1/0.25/0.5/1/2.5/5
	Read-out resolution	0.001 dB
	Linearity	±0.03 dB/dB
Ambient temperature	Spec.	−10°C to 55°C
	Storage	−40°C to 75°C
Weight		≦ 2.5 kg

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0946B					
Center Wavelength *7		1550 ± 15 nm					
Fiber under measurement		10/125 μm Single-mode fiber (CCITT G.652)					
Optical connector *1		FC/DIAMOND/ST/DIN/SC					
Pulse width *9		20 ns	100 ns	500 ns	1 μs	4 μs	10 μs
Dynamic range (one-way back-scattered light level)*2, *10	Effective	13 dB	18 dB	21 dB	24 dB	29 dB	32 dB
	S. N. R = 1	16 dB	21 dB	24 dB	27 dB	32 dB	35 dB
4% Fresnel reflection dynamic range *10	Effective	34 dB	38 dB	40 dB	41 dB	43 dB	44 dB
	S. N. R = 1	37 dB	41 dB	43 dB	44 dB	46 dB	47 dB
Near-end deadzone *3, *4	Fresnel reflection	35 m	50 m	95 m	200 m	700 m	1500 m
	Back-scattered light	35 m	50 m	95 m	200 m	700 m	1500 m
Spatial resolution *3, *5	Fresnel reflection	15 m	30 m	75 m	150 m	500 m	1500 m
	Back-scattered light	30 m	50 m	90 m	200 m	700 m	1500 m
Mask function *3, *6	No. of masks	Max. 5 (Optical)					
	Mask width	75 m	75 m	150 m	200 m	700 m	1500 m
Variable near-end mask-width function		Not provided					
Attenuation *8		AUTO/0.0 to 23.75 dB in 1.25 dB steps					
Variable optical output power function *6		Provided					
Distance range *3		10/25/50/100/250 km					
Horizontal axis *3	Scale (m/div)	5/10/25/50/100/250/500/1 k (10 km range) 5/10/25/50/100/250/500/1 k/2.5 k (25 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k (50 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k (100 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k/25 k (250 km range)					
	Resolution	Sampling resolution : 10 cm to 50 m Read-out resolution : 10 cm to 500 m					
	Accuracy	± 1 m ± measured value (m) × 2 × 10^{-5} (does not include the uncertainty in the index of refraction for the fiber.)					

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0946B
Vertical axis	Scale (dB/div)	0.1/0.25/0.5/1/2.5/5
	Read-out resolution	0.001 dB
	Linearity	±0.03 dB/dB
Ambient temperature	Spec.	−10°C to 55°C
	Storage	−40°C to 75°C
Weight		≦ 2.5 kg

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0947B					
Center Wavelength *7		1310/1550 ± 15 nm					
Fiber under measurement		10/125 μm Single-mode fiber (CCITT G.652)					
Optical connector *1		FC/DIAMOND/ST/DIN/SC					
Pulse width *9		20 ns	100 ns	500 ns	1 μs	4 μs	10 μs
Dynamic range (one-way back-scattered light level)*2, *10	Effective	15/13 dB	20/18 dB	23/21 dB	26/24 dB	31/29 dB	34/32 dB
	S. N. R=1	18/16 dB	23/21 dB	26/24 dB	29/27 dB	34/32 dB	37/35 dB
4% Fresnel reflection dynamic range *10	Effective	35/34 dB	39/38 dB	41/40 dB	42/41 dB	44/43 dB	45/44 dB
	S. N. R=1	38/37 dB	42/41 dB	44/43 dB	45/44 dB	47/46 dB	48/47 dB
Near-end deadzone *3, *4	Fresnel reflection	35 m	50 m	95 m	200 m	700 m	1500 m
	Back-scattered light	35 m	50 m	95 m	200 m	700 m	1500 m
Spatial resolution *3, *5	Fresnel reflection	15 m	30 m	75 m	150 m	500 m	1500 m
	Back-scattered light	30 m	50 m	90 m	200 m	700 m	1500 m
Mask function *3, *6	No. of masks	Max. 5 (Optical)					
	Mask width	75 m	75 m	150 m	200 m	700 m	1500 m
Variable near-end mask-width function		Not provided					
Attenuation *8		AUTO/0.0 to 23.75 dB in 1.25 dB steps					
Variable optical output power function *6		Provided					
Distance range *3		10/25/50/100/250 km					
Horizontal axis *3	Scale (m/div)	5/10/25/50/100/250/500/1 k (10 km range) 5/10/25/50/100/250/500/1 k/2.5 k (25 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k (50 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k (100 km range) 5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k/25 k (250 km range)					
	Resolution	Sampling resolution : 10 cm to 50 m Read-out resolution : 10 cm to 500 m					
	Accuracy	±1 m ± measured value (m) × 2 × 10^{-5} (does not include the uncertainty in the index of refraction for the fiber.)					

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0947B
Vertical axis	Scale (dB/div)	0.1/0.25/0.5/1/2.5/5
	Read-out resolution	0.001 dB
	Linearity	±0.03 dB/dB
Ambient temperature	Spec.	−10°C to 55°C
	Storage	−40°C to 75°C
Weight		≦ 2.5 kg

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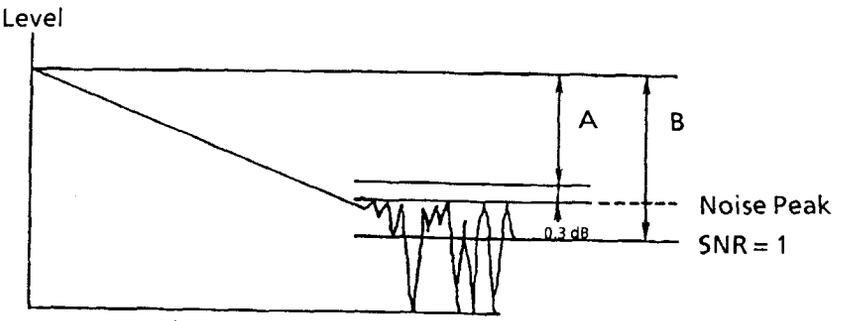
*1: Specify one of the connectors in the table. For other optical connectors, please refer to Table 1-3.

However, the dynamic range is degraded by 0.5 dB for the DIAMOND, D4, and AT & T Biconic connectors.

*2: Dynamic range (one-way back-scattered light)

Effective: The difference between the level of the point which is 0.3 dB higher than the peak noise level and the level of the point at which near-end back-scattering occurs.

SNR = 1: Level difference between the RMS noise level and the level at which near-end back-scattering occurs.



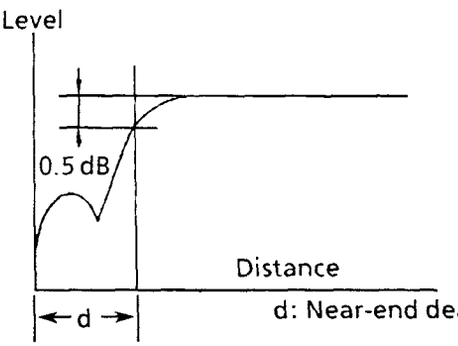
A: Effective
B: S.N.R = 1

*3: When IOR is set to 1.500 000.

*4: Near-end Dead Zone

(For Fresnel Reflection): The minimum distance at which the 4% Fresnel Reflection generated by the fault point can be detected.

(For Back Scattered light): The near-end dead zone (for back-scattered light) is the distance at which the near-end back-scattered light level approaches to within ±0.5 dB of its final value.



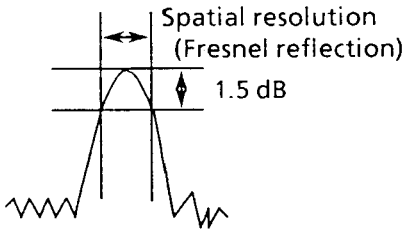
d: Near-end dead zone (Back-scattered light)

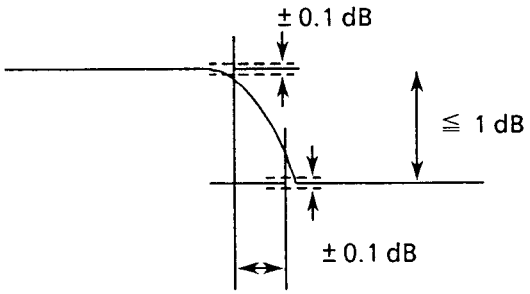
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*5: Spatial resolution

For Fresnel Reflection: The width of an unsaturated Fresnel reflection pulse at a point which is 1.5 dB less than the peak value.

For Back-Scattering: The distance between the points at which the beginning and ending levels at a splice etc. gap (≦ 1 dB) are within ±0.1 dB of their initial and final values respectively.





Spatial resolution
(Back-scattered light)

*6: All the masks except for the near-end mask are turned Off in the variable optical output power mode.

*7: Not applicable in the variable optical output power mode.

*8: The value selected for the attenuation depends on the pulse width.

*9: Pulse widths of 4 μs and 10 μs cannot be selected for the 10-km, 25-km, and 50-km distance ranges. Furthermore, 1-μs pulse width cannot be selected for the 10-km and 25-km distance range.

*10: These are values when using the SMOOTHING function (with level 6).
When the SMOOTHING not used, each value decreases by 2 dB.

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0944B				
Center Wavelength *7		1310/1550±15 nm				
Fiber under measurement		10/125 μm Single-mode fiber (CCITT G.652)				
Optical connector *1		FC-PC/DIAMOND-PC/ST-PC/DIN-PC/SC-PC				
Pulse width		10 ns	20 ns	100 ns	500 ns	2 μs
Dynamic range (one-way back-scattered light level)*2, *8	Effective	6.5/4.0 dB	8.0/5.5 dB	11.5/9.0 dB	15.0/12.5 dB	18.0/15.5 dB
	S. N. R=1	9.5/7.0 dB	11.0/8.5 dB	14.5/12.0 dB	18.0/15.5 dB	21.0/18.5 dB
4% Fresnel reflection dynamic range *8	Effective	34.5/33.0 dB				
	S. N. R=1	37.5/36.0 dB				
Near-end deadzone *3, *4	Fresnel reflection	3 m	5 m	13 m	55 m	220 m
	Back-scattered light	8 m	10 m	20 m	65 m	240 m
Spatial resolution *3, *5	Fresnel reflection	2 m	4 m	13 m	55 m	220 m
	Back-scattered light	2 m	4 m	15 m	60 m	220 m
Mask function *3, *6	No. of masks	Max. 5 (Optical)				
	Mask width	13 m	13 m	18 m	65 m	240 m
Variable near-end mask-width function		Provided				
Attenuation		0.0 dB fixed				
Variable optical output power function *6		Provided				
Distance range *3		10/25/50/100 km				
Horizontal axis *3	Scale (m/div)	2.5/5/10/25/50/100/250/500/1 k (10 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k (25 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k/5 k (50 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k (100 km range)				
	Resolution	Sampling resolution : 5 cm to 20 m Read-out resolution : 5 cm to 200 m				
	Accuracy	±1 m ±measured value (m) ×2×10−5 (does not include the uncertainty in the index of refraction for the fiber.)				

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0944B
Vertical axis	Scale (dB/div)	0.1/0.25/0.5/1/2.5/5
	Read-out resolution	0.001 dB
	Linearity	±0.05 dB/dB
Ambient temperature	Spec.	0°C to 35°C
	Storage	−10°C to 60°C
Weight		≦ 2.5 kg

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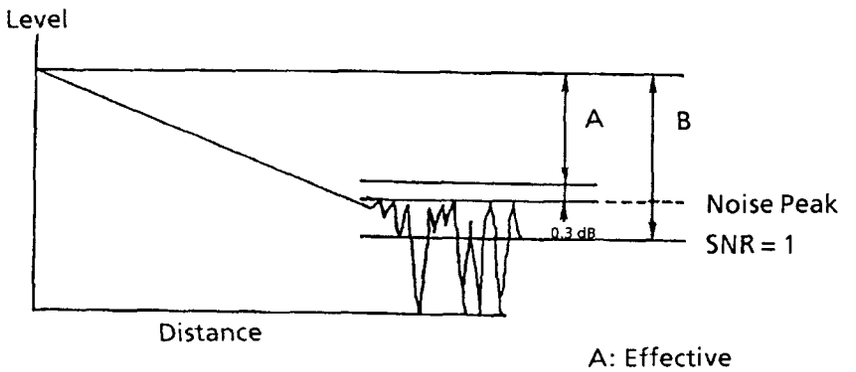
*1: Specify one of the connectors in the table. For other optical connectors, please refer to Table 1-3.

The dynamic range is degraded by 0.5 dB for the DIAMOND and D4 connectors.

*2: Dynamic range (one-way back-scattered light)

Effective: The difference between the level of the point which is 0.3 dB higher than the peak noise level and the level of the point at which near-end back-scattering occurs.

SNR = 1: Level difference between the RMS noise level and the level at which near-end back-scattering occurs.



*3: When IOR is set to 1.500 000.

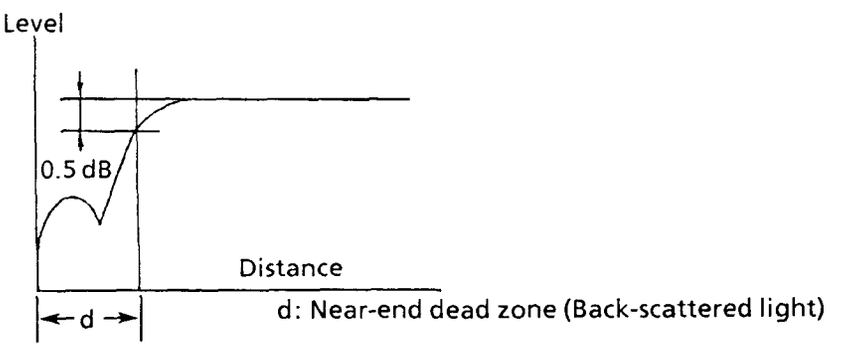
*4: Near-end Dead Zone

(For Fresnel Reflection): The minimum distance at which the 4% Fresnel Reflection generated by the fault point can be detected.

(For Back Scattered light): The near-end dead zone (for back-scattered light) is the distance at which the near-end back-scattered light level approaches to within ±0.5 dB of its final value.

This specification represents the values for the FC-PC connector (when return loss ≧ 25 dB). When fiber which includes a PC connector (flat polished) is measured, the dead zone may be larger than the specified value.

The variable near-end mask-width function can be used to suppress dead-zone widening to a value of 2~3 meters.

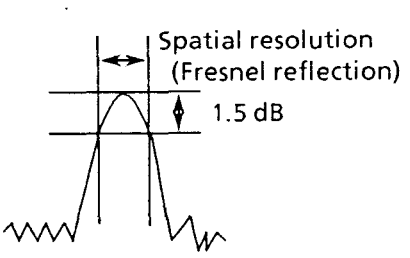


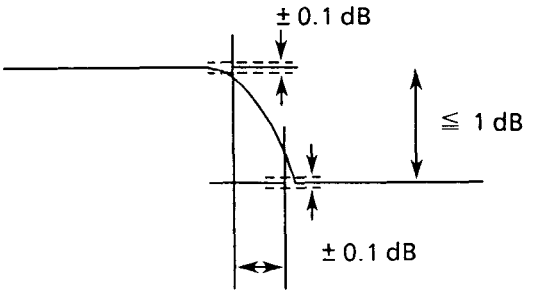
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*5: Spatial resolution

For Fresnel Reflection: The width of an unsaturated Fresnel reflection pulse at a point which is 1.5 dB less than the peak value.

For Back-Scattering: The distance between the points at which the beginning and ending levels at a splice etc. gap (≦1 dB) are within ±0.1 dB of their initial and final values respectively.





Spatial resolution
(Back-scattered light)

*6: All masks including the near-end mask are turned Off in the variable optical output power mode.

*7: Not applicable in the variable optical output power mode.

*8: These are values when using the SMOOTHING function (with level 6).
When the SMOOTHING not used, each value decreases by 2 dB.

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0967B				
Center Wavelength *7		850/1300±15 nm				
Fiber under measurement *6		50/125 μm GI multi-mode fiber (NA0. 2), (CCITT G.651)				
Optical connector *1		FC/DIAMOND/ST/DIN/SC				
Pulse width		5 ns	20 ns	100 ns	500 ns	2 μs
Dynamic range (one-way back-scattered light level)*2, *8	Effective	9.0/7.0 dB	12.0/10.0 dB	15.5/13.5 dB	19.0/17.0 dB	21.5/20.0 dB
	S. N. R=1	12.0/10.0 dB	15.0/13.0 dB	18.5/16.5 dB	22.0/20.0 dB	24.5/23.0 dB
4% Fresnel reflection dynamic range *8	Effective	27/29 dB	29/31 dB			
	S. N. R=1	30/32 dB	32/34 dB			
Near-end deadzone *3, *4	Fresnel reflection	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m
	Back-scattered light	3 m	4.5 m	15 m	60 m	220 m
Spatial resolution *3, *5	Fresnel reflection	2 m	4 m	15 m	60 m	220 m
	Back-scattered light	2 m	4 m	15 m	60 m	220 m
Mask function		Not provided				
Variable near-end mask-width function		Not provided				
Attenuation		0.0 dB fixed				
Variable optical output power function		Provided				
Distance range *3		10/25/50/100 km				
Horizontal axis *3	Scale (m/div)	2.5/5/10/25/50/100/250/500/1 k (10 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k (25 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k/5 k (50 km range) 2.5/5/10/25/50/100/250/500/1 k/2.5 k/5 k/10 k (100 km range)				
	Resolution	Sampling resolution : 5 cm to 20 m Read-out resolution : 5 cm to 200 m				
	Accuracy	±1 m ±measured value (m) ×2×10^{-5} (does not include the uncertainty in the index of refraction for the fiber.)				

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Table 1-7 Specifications of Plug-in Units (Continued)

Model		MW0967B
Vertical axis	Scale (dB/div)	0.1/0.25/0.5/1/2.5/5
	Read-out resolution	0.001 dB
	Linearity	±0.05 dB/dB
Ambient temperature	Spec.	−10°C to 55°C
	Storage	−40°C to 75°C
Weight		≦ 2.5 kg

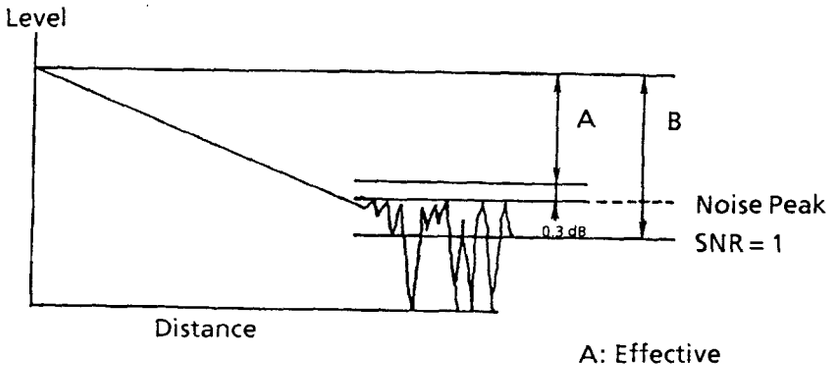
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*1: Specify one of the connectors in the table. For other optical connectors, please refer to Table 1-3.

*2: Dynamic range (one-way back-scattered light)

Effective: The difference between the level of the point which is 0.3 dB higher than the peak noise level and the level of the point at which near-end back-scattering occurs.

SNR = 1: Level difference between the RMS noise level and the level at which near-end back-scattering occurs.



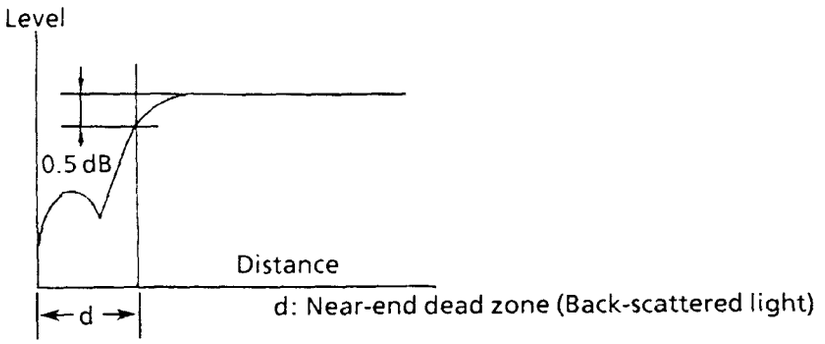
A: Effective
B: S.N.R = 1

*3: When IOR is set to 1.500 000.

*4: Near-end Dead Zone

(For Fresnel Reflection): The minimum distance at which the 4% Fresnel Reflection generated by the fault point can be detected.

(For Back Scattered light): The near-end dead zone (for back-scattered light) is the distance at which the near-end back-scattered light level approaches to within ±0.5 dB of its final value.

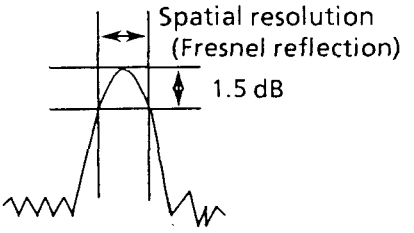


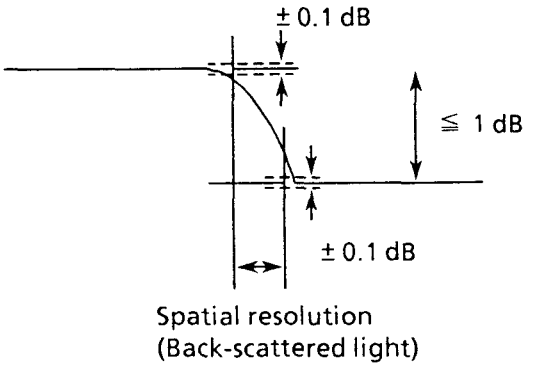
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*5: Spatial resolution

For Fresnel Reflection: The width of an unsaturated Fresnel reflection pulse at a point which is 1.5 dB less than the peak value.

For Back-Scattering: The distance between the points at which the beginning and ending levels at a splice etc. gap (≦1 dB) are within ±0.1 dB of their initial and final values respectively.





*6: The dynamic range is increased by about 1.5 dB when measuring 62.5/125 μm (NA 0.29) fibers. However, the transmission loss measurement result may differ from those obtained with NA 0.29 by as much as 0.1 dB/km.

*7: Not Applicable in the variable optical output power mode.

*8: These are values when using the SMOOTHING function (with level 6).
When the SMOOTHING not used, each value decreases by 2 dB.

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SECTION 2
PREPARATIONS BEFORE USE

This section describes various preparatory operations to be done before using the MW9060A and precautions to be observed when using the equipment.

2.1 Environmental Conditions at Place of Installation

The MW9060A is designed to operate normally at ambient temperatures of −10° to 55°C (+5° to 35°C for floppy disk and printer). For some unit, this value is different. See paragraph 1.5. However, to use the equipment under the best conditions, avoid using it in the following places:

- Vibration-prone places
- Humid or dusty places
- Places exposed to direct sunlight
- Places where the equipment may be attacked by active gas

In addition to the above recommended conditions, use the MW9060A under room temperature conditions in places where the supply voltage does not fluctuate, to maintain stable operation over a long time.

CAUTION

When using the MW9060A under room conditions after you used it at low temperatures below 0°C for a long time, note that the circuit may be shorted by water droplet attachment, causing trouble. In such a case, be sure to completely dry the equipment before turning the power switch on.

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2.2 Safety Protection

2.2.1 Laser Safety

The MW9060A is designed and manufactured conforming to the FDA optical safety standards 21 CFR1040.10, and is classed as Class-1 Laser Equipment under the standards.

WARNING

1. *The MW9060A uses semiconductor laser as the optical source. For safety reasons, never look into the laser output opening and the far end of the fiber (being measured) connected to it.*
2. *When using the MW9060A, be sure to follow the method of operation described in this manual. Otherwise, you may be exposed to invisible laser radiation.*
3. *If any modification is made to the MW9060A, it must be subjected to laser classification again before it can be used.*

2.2.2 Electrical safety

The MW9060A is the product of Safety Class 1 (with its protective ground terminal provided on the rear panel).

WARNING

1. *To avoid getting an accidental electric shock, make sure the GND terminal*  *on the rear penel is grounded to the earth.*
2. *Because the MW9060A uses CRT-use high voltage, do not disassemble the cabinet while the power is on.*
3. *Do not touch or insert metallic objects into the MW9060A connectors used for plug-in units.*

CAUTION

1. *Confirm that the utility power supply voltage matches the voltage (100 V or 200 V system) indicated on the rear panel supply voltage nameplate.*
2. *Do not connect the power cord to the utility power outlet while the power switch is on.*
3. *Besure to turn the power off before inserting or removing a plug-in unit.*

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2.3 Handling Plug-in Units and GPIB Interface Board

2.3.1 Plug-in unit change

CAUTION

Be sure to turn the power off before inserting or removing a plug-in unit.

Insert and remove a plug-in unit from the rear of the MW9060A as shown in Fig. 2-1. First, insert the unit adapter into the unit as shown in Fig. 2-2. Next, insert the unit from the rear panel. Push in the unit until the unit adapter shield spring contacts the rear panel fully.

Align the lock lever with the notch in the unit adapter and lock the unit adapter by turning the lock knob clockwise.

Remove the unit in the opposite order of insertion.

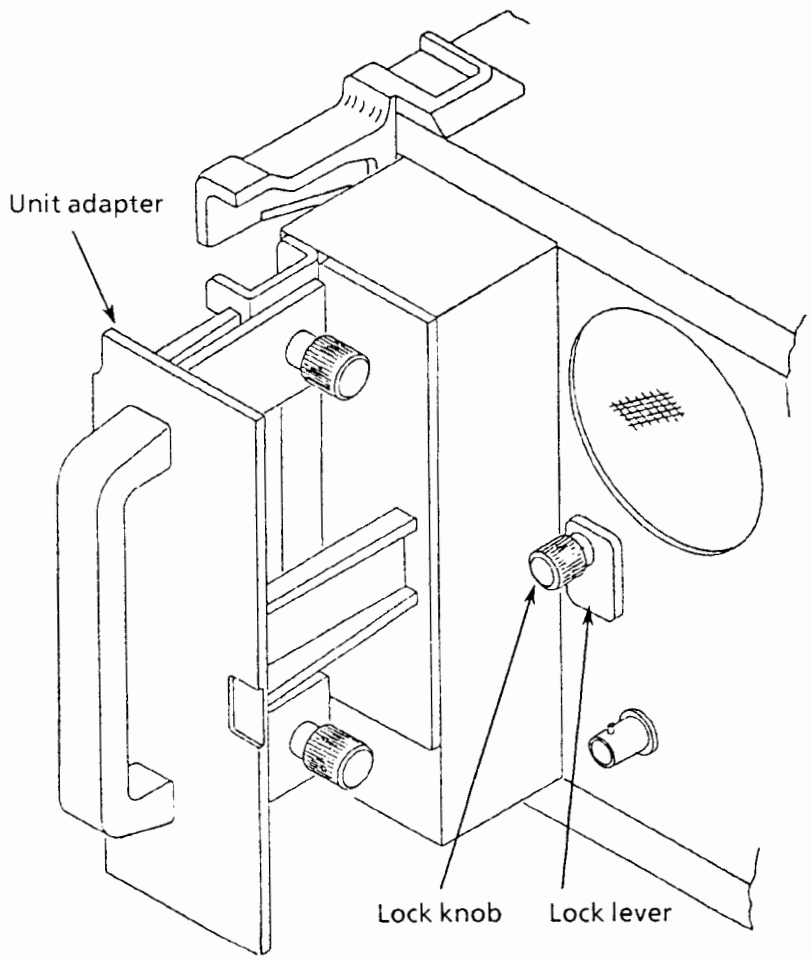


Fig. 2-1 Inserting and Removing Plug-In Unit

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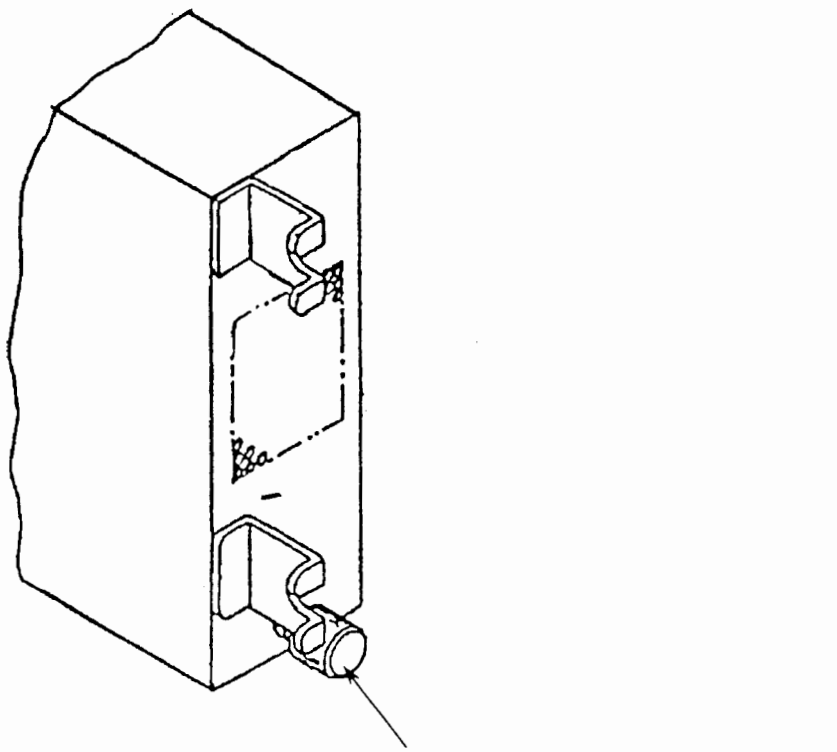
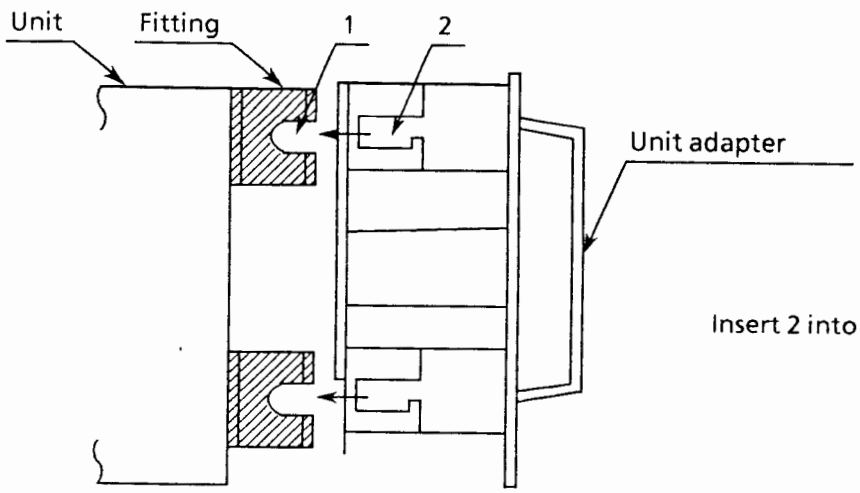
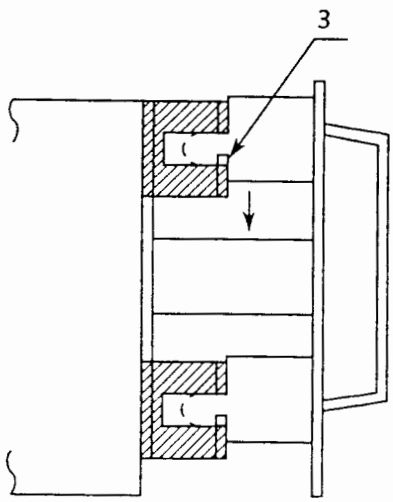


Fig. 2-2 Inserting Unit Adapter

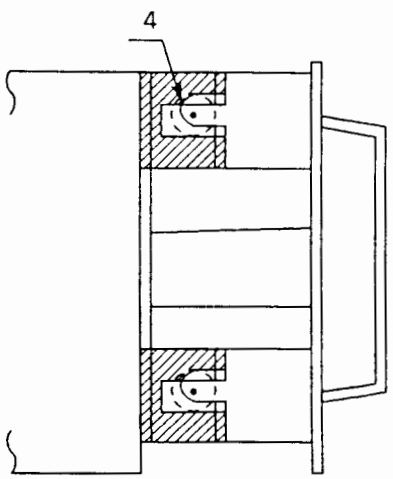
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Insert 2 into groove of fitting 1.



Insert groove of 3 into fitting.



Lock adapter by turning knob 4 clockwise.

Fig. 2-2 Inserting Unit Adapter (Continue)

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2.3.2 GPIB interface change

CAUTION

Be sure to turn the power of the MW9060A off before inserting or removing the GPIB interface board.

An optional GPIB board can be installed in the MW9060A, in addition to the standard GPIB board.

Insert and remove the GPIB board from the rear of the MW9060A as shown in Fig. 2-3.

Gently push the printed-circuit board into the slot with the connector fitted, then fasten the upper and lower screws to fix it into position.

Note: When the optional GPIB board is installed, the standard GPIB board becomes the device and the optional GPIB board becomes the controller. (See paragraph 5.15.)

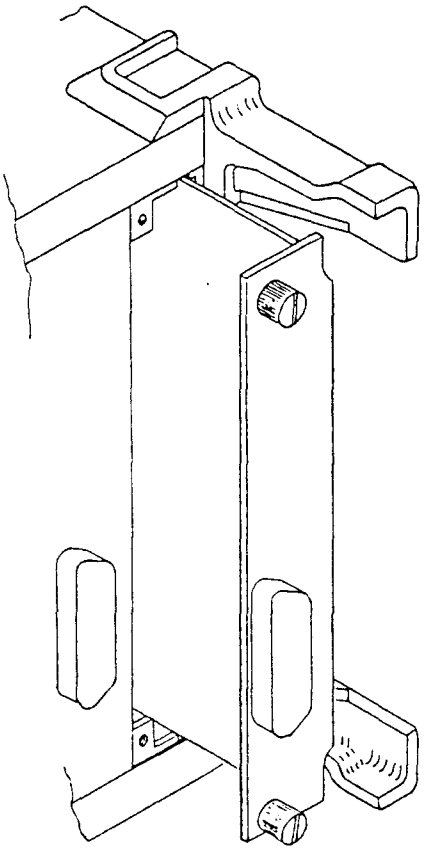


Fig. 2-3 Inserting and Removing GPIB Interface Board

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2.4 Preparations before Power-on

1. Confirming supply voltage

Confirm that the utility power supply voltage matches the voltage (100 V or 200 V system) indicated on the rear panel supply voltage nameplate.

Check whether the rear panel fuse holder contains a fuse of the appropriate capacity according to the table below.

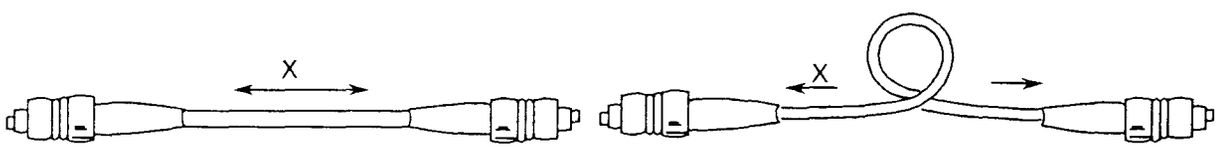
Indicated voltage	Fuse capacity	Fuse name
85 to 132 Vac 170 to 250 Vac	5 A 5 A	T5 A 250 V

2. Connect the AC cord to the inlet.
3. Ground the rear panel GND terminal ⏚ to the earth.
4. Correct the main-frame installation until its front panel becomes easy to see. Then, adjust the carrying handle angle as necessary.

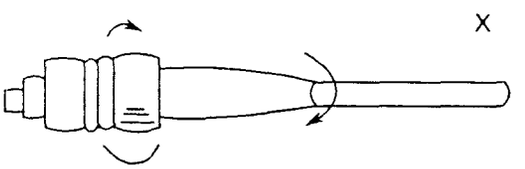
2.5 Precautions on Handling Fiber-optic Cables and Optical Connectors

Pay attention to the following when handling fiber-optic cables and optical connectors.

1. Do not forcibly pull or severely bend fiber-optic cables.



2. Do not twist the connection between fiber-optic cable and optical connector.



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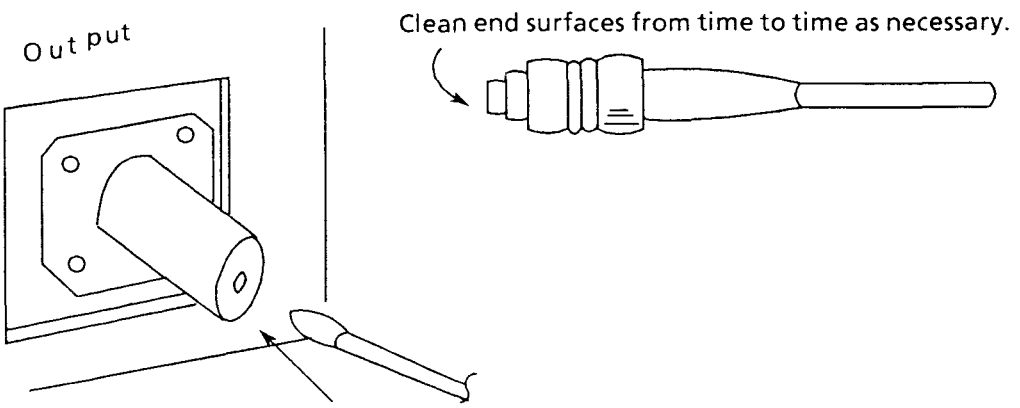
3. Check that the optical adapter and plug do not have dust or dewdrops.

   Especially, carefully check the end section of optical fiber.

   Keep them clear during storage also using caps, etc.

   To clean, use a alcohol-soaked cotton swab or other appropriate tools.

4. If the internal of the optical output connector is stained with dust or the optical fiber for test use is broken at its near end, trace waveform may not appear on the display even when the laser is on. In such a case, clean the end surface of the optical connector or use another fiber-optic cable.



CAUTION

Never apply a matching jell at the optical output connector.

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2.6 Cleaning Connector (MW0944B/MW0945B/MW0946B/MW0947B)

Follow the procedure below for cleaning the connectors on the MW0944B/0945B/0946B/0947B Plug-in Units.

Step	Procedure
1	With the light-detection section uppermost stand the unit up.
2	Gripping the cover at the top and the bottom, remove it from the unit. (Fig. 2-4)
3	Unscrew connector adapter as shown in Fig. 2-5.
4	Remove connector adapter to expose the fiber-end surface, then use the MZ8012A Connector Cleaning Set to clean it.

Note: The above cleaning procedure only applies to the connectors of the MW0944B/MW0945B/MW0946B/MW0947B plug-in units.

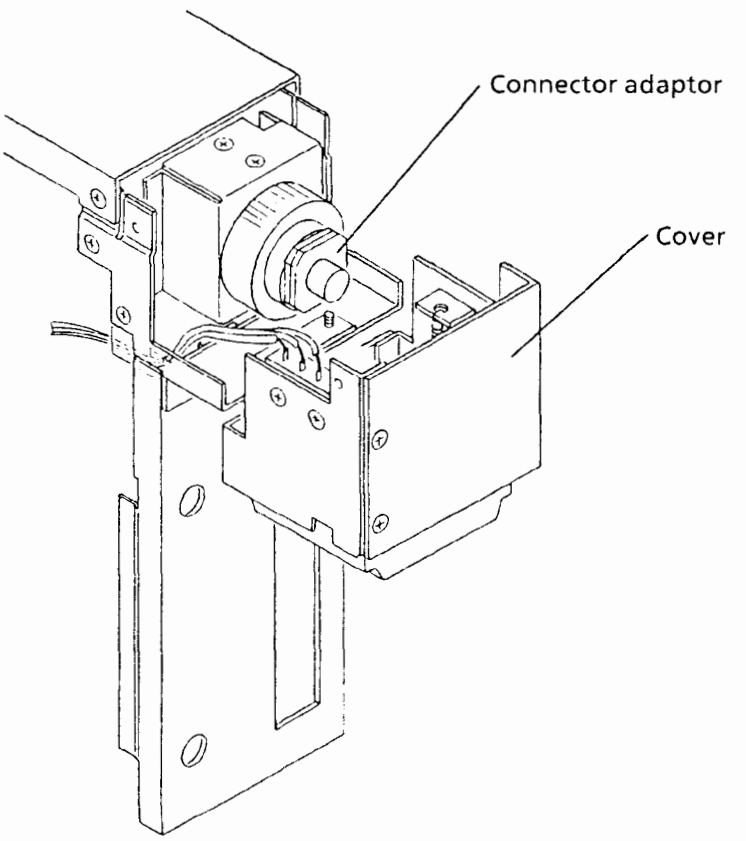


Fig. 2-4 Opening Cover

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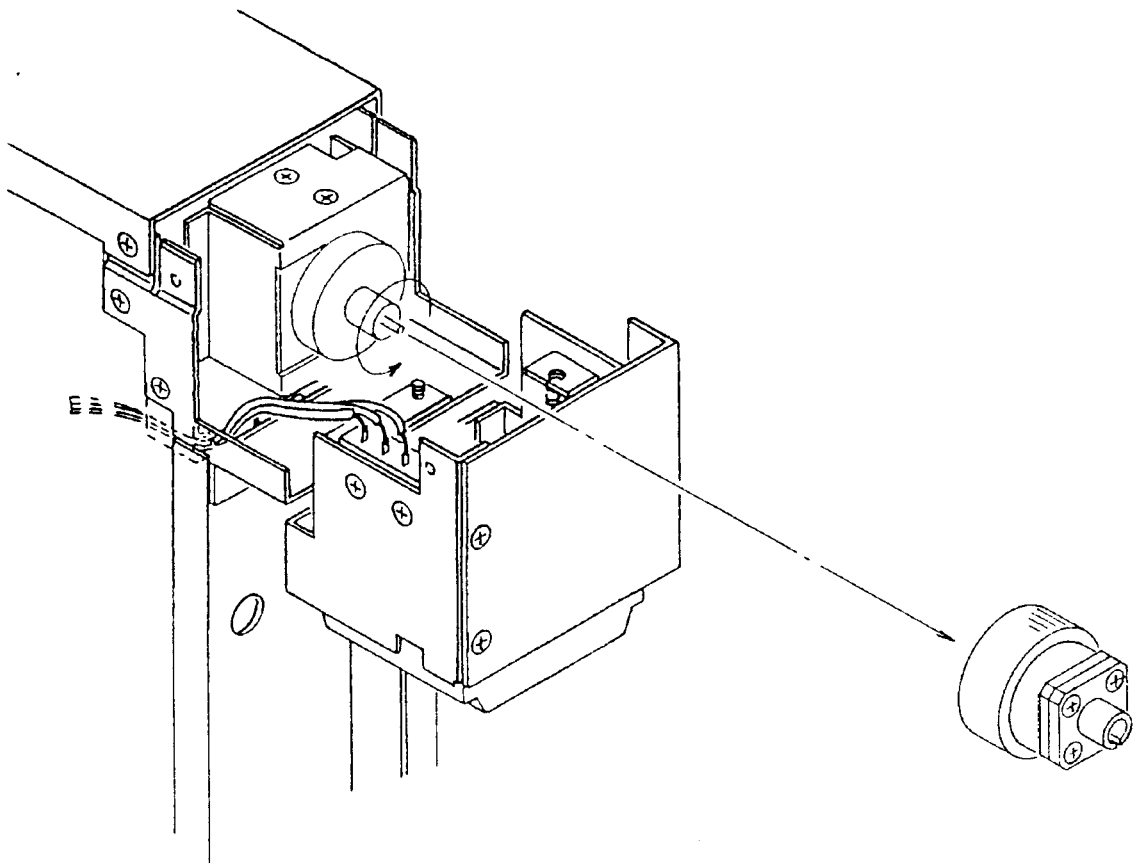


Fig. 2-5 Inserting and Removing Connector Adapter

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2.7 Changing Connector (MW0967B)

Follow the procedure below for changing the connector on the MW0967B Plug-in Unit.

Step	Procedure
1	With the light-detection section uppermost stand the unit up.
2	Gripping the cover at the top and the bottom, remove it from the unit.
3	Unscrew and remove the connector adapter to change as shown in Fig. 2-6.
4	Unscrew the connector-adapter fixing screw to free the optical module (Fig. 2-7).
5	To fix the module in position again, following the instructions on the unit side, replace the fixing screw in the respective hole on each connector adapter.

Note: The above procedure only applies to the connector on the MW0967B. All other plug-in units must be returned to the factory to have their connectors changed.

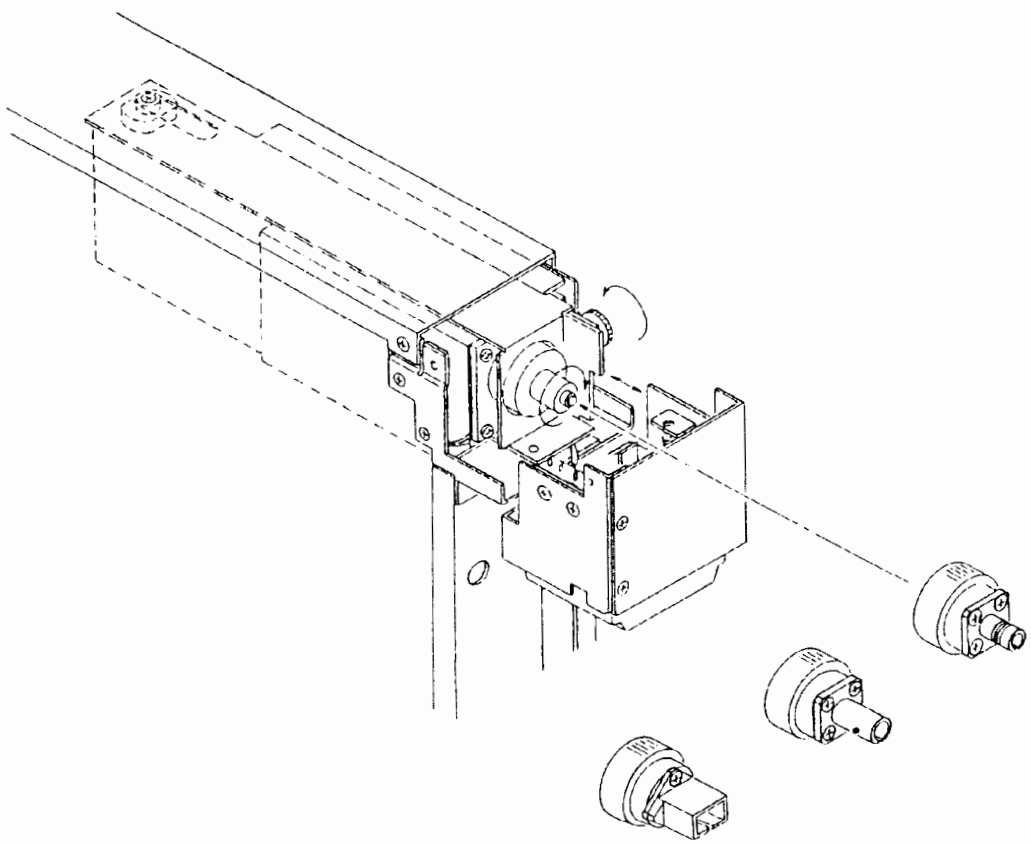


Fig. 2-6 Replacing connector Adapter

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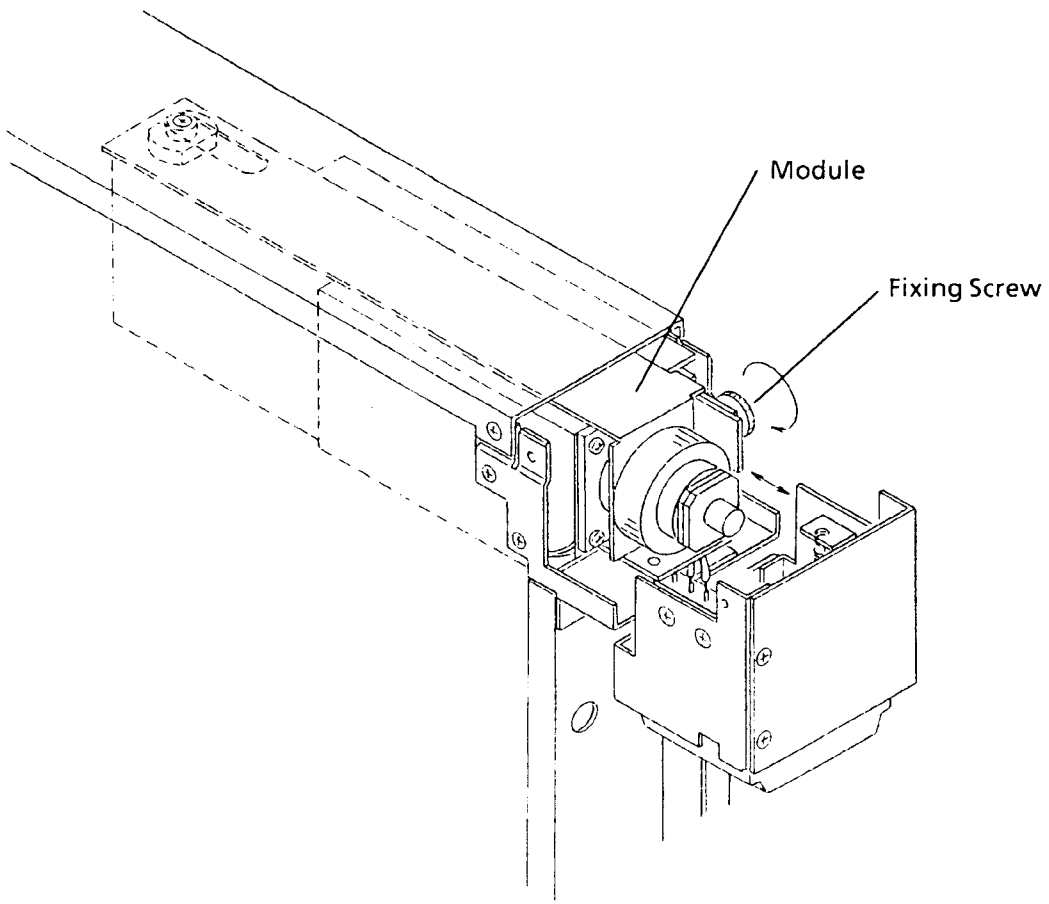


Fig. 2-7 Adjusting Module

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2.8 Precautions on Handling Storage Media

The MW9060A uses plug-in memory cards (PMC) and floppy disks (FD) to save data. If the storage media is incorrectly used or has defects, your valuable data may be damaged or lost. To prepare for the worst, copy the data and keep it for backup.

Anritsu does not assume responsibility for loss of storage contents.

Pay attention to the notes of each storage media when using storage media. Especially, it is important that you never remove the plug-in memory card and floppy disk during access.

2.8.1 Plug-in memory card

1. The plug-in memory card may be damaged when static electricity is applied to it.
2. Do not apply strong impact to the plug-in memory card by dropping or bending it.
3. Do not wet the plug-in memory card with water.
4. Do not expose the plug-in memory card to high-temperature, high-humidity environment or direct sunlight.
5. Do not insert tweezers or other foreign matter into the connector section of the plug-in memory card.
6. Be careful not to let dust or dirt enter the connector section of the plug-in memory card.
7. Do not insert any other plug-in memory cards than specified into the plug-in memory card slot.
8. The 128 K, 256 K, and 512 K-byte plug-in memory cards do not contain batteries when shipped from the factory, so fit the attached battery into the plug-in memory card before using it.
9. The table below shows battery life under normal temperature conditions. When the battery power runs out, the saved data may be lost. Replace the battery in advance.

Type of PMC	Memory capacity	Battery life	Type of battery used
BS32F1-C-172	32 K bytes	Approx. 5 years	BR2325
BS64F1-C-173	64 K bytes	Approx. 5 years	
BS128F1-C-174	128 K bytes	Approx. 4.3 years	
BS256F1-C-1175	256 K bytes	Approx. 2.2 years	
BS512F1-C-1176	512 K bytes	Approx. 1.1 years	

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10. Replacing the battery (only for SRAM PMCs)

When replacing the battery, first turn the instrument power ON, then mount the PMC in the instrument, before performing the following procedure:

(Attention: PMC data will be lost, if this procedure is not followed.)

(a) Prepare the lithium battery.

(b) Turn the instrument power ON.

(c) Take the cap off the PMC, and mount the PMC in the instrument. (When mounting, aligh the ▼ and ▲ marks.)

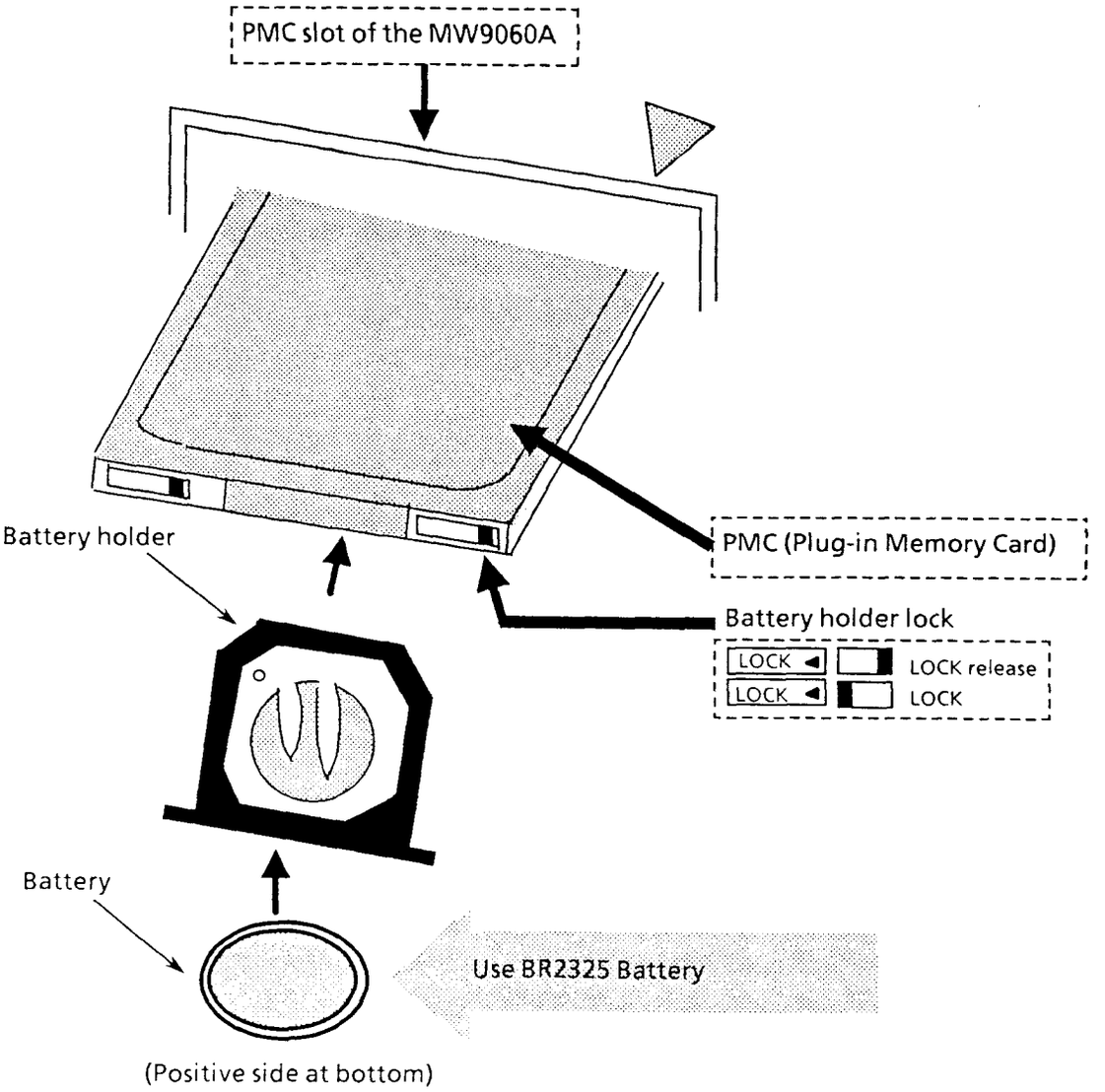
(d) Release the battery holder lock.

(e) Remove the battery holder, and replace the old battery with the new one.

(f) Reinsert the battery holder into the PMC, and engage the battery holder lock.

(g) Take the PMC out of the instrument, and mount the cap.

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Removing the cap:

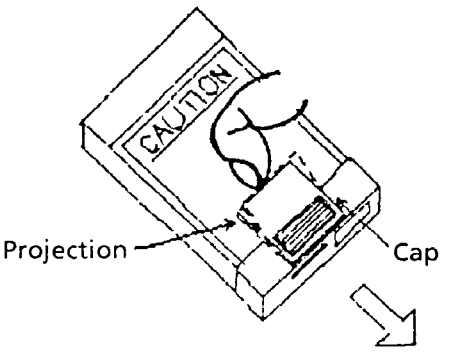
Position the PMC back-side up (such that the CAUTION faces upwards) so that the cap can be easily removed.

11. Using the write-protection switch (only for SRAM PMCs)

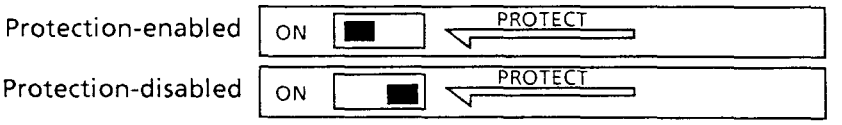
The write-protection switch has been preset at the factory to the "OFF" position. To enable write protection, move the switch to the On position with a ball point pen.

If the software for the instrument performs write protection, set the write-protection switch to the "OFF" position.

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While slightly lifting the cap projection (as indicated by the dotted line), push the cap in the direction of the arrow.



2.8.2 Floppy disk

(1) Do not open the write-protect shutter.

(2) Keep disks away from magnets and magnetic fields.

(3) Do not place heavy objects on disks, do not use clips, and never bend or subject the disks to excessive force.

(4) Do not throw or drop disks.

(5) Keep disks away from solvents, drinks, etc. .

(6) Do not use or store disks in a dirty or dusty place.

(7) Keep disks away from direct sunlight and high temperature.

(8) Write on the label before sticking it to the disk.

(9) Store disks in their envelope.

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SECTION 3
DESCRIPTION OF OPERATION KEY

3.1 Description of Panel

This section describes the layout and functions of front and rear panel keys, connectors, knobs, and indicators. Table 3-1 describes how to use operation keys. The numbers in this table correspond to those in front and rear panel layout drawings in Figures B-1 and B-2.

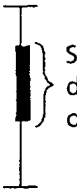
Table 3-1 Description of Operation Keys (1/6)

No.	Name	Description
1	Intensity	Adjusts the screen brightness. Turn it clockwise to make the screen bright.
2	(CRT)	Dislays the observation waveform, scale, measurement conditions, measurement results, and soft key labels.
3	Prior	Returns the current soft key layer to the previous layer.
4	(Soft keys)	Executes each function of the function menu displayed on the right side of the screen. The keypad consists of six keys from F1 to F6. The function defined in the menu is selected and executed by pressing the key corresponding to each function (this key being called the soft key). The menu is hierarchically structured from layer 1 to layer 3. When there are six menu items or more within the same layer, the menu is displayed on two or more screens. In this case, press [etc.] key to go to the next screen.
5	Coarse	Lights the key switch lamp to speed up the movement of markers and waveforms. When pressed again, the movement speed returns to the previous original one.
6	(Rotary knob)	Used along with [H-Shift], [V-Shift], and [Marker] keys and soft keys from [F1] to [F6], it moves the cursor, marker, or waveform and inputs various data (including conditions setting).
7	Marker	Selects or moves the marker. Each time this key is pressed while the lamp is on, the next marker on the right is selected and the cursor is moved. Also, the marker and cursor can be moved by turning the rotary knob. ***Note:*** When the auto function actuated by the [Auto] key is in operation, the marker and cursor cannot be moved with the rotary knob.

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Table 3-1 Description of Operation Keys (2/6)

(Continued)

No.	Name	Description
8	V-Shift	Moves the waveform displayed on the screen up and down. Turn the rotary knob for this movement. The range currently displayed on the screen relative to the measurable range on the vertical axis will be indicated by a thick line on the left edge of the screen.  When the key is pressed once during 2-waveform comparison mode, the lamp goes on and both waveforms are moved up and down. When the key is pressed a second time, the lamp blinks and only the measurement waveform moves up and down. When the key is pressed one more time, the previous state returns with the lamp on.
9	H-Shift	Moves the start position of the waveform displayed on the screen. Turn the rotary knob for this movement. The movable range is as follows: 0 to {distance range − (minimum distance scale × 10)} × 1.5/ refractive index The thick line in the upper part of the screen indicates which part of distance range the currently displayed distance range is.  Section displayed on screen
10	V-Zoom	Selects the level scale of the vertical axis on the screen. An expanded or reduced waveform can be obtained by the [In] or [Out] keys. The following scales can be selected: 0.1 / 0.25 / 0.5 / 1.0 / 2.5 / 5.0 dB/div
11	H-Zoom	Selects the distance scale of the horizontal axis on the screen. An expanded or reduced waveform can be obtained by the [In] or [Out] keys. The scale (km/div) varies with the plug-in unit used. The set scale is displayed on the upper right of the screen.

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Table 3-1 Description of Operation Keys (3/6)

(Continued)

No.	Name	Description
12	SPL & DZL Splice Loss	Switch the simultaneous measurement of the splice loss and the transmission loss, splice loss (Splice) measurement, and the transmission loss (Loss) measurement. The selection is consecutively changed each time, and the lamp which indicates the selected measurement item lights up. 1) SPL & DZL Making * marker as a center, each three × markers are located before and after it. The splice loss, transmission loss of whole section including the dead zone, and each distance between the * marker and the × markers at the both ends are calculated by either the Least Square Approximation (LSA method) or the 2-point Approximation (2PA method) and the calculation results is displayed on the screen. The measurement result is displayed inside the scale or in the table format at the bottom of the screen. 2) Splice Making * marker as a center, each two × markers are located before and after it. The measurement result of the splice loss is calculated by using the LSA method or the 2PA method, and the indication of the splice mode and the calculated value are displayed at the left bottom of the CRT surface. 3) Loss Each one * marker and × marker are displayed on the screen, and the indication of the LOSS mode and the loss and the distance between two points are displayed together with the loss per unit length at the left bottom of the CRT surface. ***Note:*** While in the event mode, this key can not be operated.
13	Auto	Automatically detects fault location. When the automatic fault location detect function is in operation, the lamp lights and markers are positioned at fault locations (up to 5) greater than the set level difference with the cursor positioned at the first marker point. The cursor moves to the next marker point each time the [Marker] key is pressed. When the cursor is positioned at a given fault location, fiber transmission loss before and behind that fault location, splice loss at the fault location, and the distance from the near end to the fault location are displayed.

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Table 3-1 Description of Operation Keys (4/6)

(Continued)

No.	Name	Description
14	Laser Output	A connector for fiber to be measured is fitted inside the protective cover. The protective cover has a safety device so that the laser is not emitted even when the cover is opened. The laser can only be emitted when a connector is connected.
15	Laser On/Off	The Ready lamp lights when the laser diode (LD) temperature becomes constant, indicating that the LD is ready. The laser to the fiber to be measured can be turned on or off with this key only when the Ready lamp is on and the fiber cable is connected to the Laser Output connector. ① On The key switch lamp lights and the laser is emitted to the fiber to be measured. ② Off The key switch lamp goes out and laser emission to the fiber to be measured is stopped. Also, the waveform on the screen is held in place.
16	Average	Turns average On and Off, alternatively. The key switch lamp comes on at average on. (1) Average On Averaging starts, and noise components of the waveform shown on the screen are reduced along with an elapse of time, making waveform observation easier. When the full trace is set to on, then the Average is On and the ATT is Auto, simultaneously; the full trace mode comes on. Averaging is reset when set conditions are changed as follows: a. When the distance range is changed b. When the pulse width is changed c. When the wavelength (λ-Select) is changed d. When the Average setting is changed from On to Off e. When the laser is turned on by a change of sampling conditions while the laser is off f. When the laser is turned on after being turned off by action of the safety device g. When MASK is newly set or the previously set mask position is changed or cleared h. When the set value of averaging count limit is changed in which case the changed value is smaller than the hitherto counted averaging count/time i. When the sweep mode is changed j. When the output power is changed k. When the [Initial] key is pressed

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Table 3-1 Description of Operation Keys (5/6)

(Continued)

No.	Name	Description
16	Average	(2) Average Off New waveforms are displayed on the screen for each sweep.
17	λ-Select	Changes wavelength. Only when the wavelength-switchable unit is installed, the λ-Select lamp lights to indicate this key is effective. When a wavelength is switched while sweeping, the receive system and amplifier are adjusted to the optimum levels, and it may take about 10 seconds until a trace waveform appears.
18	(Floppy Disk Drive)	A drive unit of the floppy diskette for the external memory. Inserting a floppy diskette in the slot enables reading/writing from/to the floppy diskette. During the read or write from/to the floppy diskette is processing, the lamp at the left side of the slot light up. The inserted floppy diskette can be ejected by pressing the button located at the right side of the slot.
19	(Plug-in memory card)	This slot is provided for the insertion of a plug-in memory card (PMC) as external storage media. The Busy lamp located at the right side of this slot lights when the PMC inserted in this slot is being accessed for a read or write.
20	(Power Switch)	Turns the power on or off. When the key is depressed, the lamp lights indicating that the power is turned on.
21	Recall	Used for reading a file from the memory device selected. The file is read from the currently selected memory device (INT MEMORY / INT PMC / INT FDD / EXT PMC 1 / EXT PMC 2 / EXT FDD). See paragraph 5.16 for reading a file, recall contents, and selecting the memory device.
22	Save	Used for writing the measurement waveform and so on to the memory device selected. Reading is performed to the currently selected memory device (INT MEMORY / INT PMC / INT FDD / EXT PMC 1 / EXT PMC 2 / EXT FDD). See paragraph 5.16 for execution of writing, saving contents, and selecting the memory device.
23	Feed	Feed the paper for the built-in printer. The paper is fed while this key is pressed. ***Note:*** As this key is dedicated to the built-in printer, an error occurs if this key is used when the output device other than the built-in printer is selected. See paragraph 5.16 for selecting the output device.

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Table 3-1 Description of Operation Keys (6/6)

(Continued)

No.	Name	Description
24	Copy	Output the waveform and so on to the output device selected. The information displayed on the CRT surface is output to the selected output device (Internl Printer / External Printer / External Plotter) when this key is pressed. See paragraph 5.17 for selecting the output device and output conditions.
25	Initialize	Initializes the measurement conditions and screen display. However, when the MW9060A is in REMOTE mode, pressing the key is ignored.
26	(Fan)	Used to discharge the internally generated heat to the outside. Be careful not to block the exhaust opening while the MW9060A is in operation.
27	GPIB	A GPIB interface board (standard equipment).
28	(Optional GPIB)	This slot is provided for fitting another GPIB interface board.
29	– –	AC power inlet and fuse holder.
30	– –	Frame gound terminal.
31	Video Output	This connector outputs the screen or record waveform signals to an external video plotter.
32	(Unit lock mechanism)	This mechanism prevents the plug-in unit from being accidentally removed. After fitting a plug-in unit, position the unit lock mechanism horizontally and fasten the screw.
33	(Handle)	Used to remove the plug-in unit installed.
34	(Carrying handle)	Used to carry the MW9060A. A round knob is provided in the handle fitting section. Push it inside from left and right sides, and the handle can be turned. Therefore, the handle can be used as a stand by fixing it at an appropriate angle.

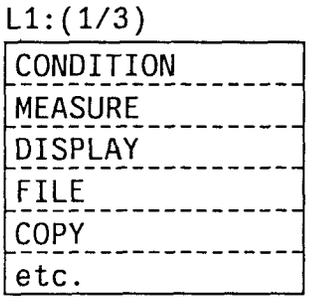
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3.2 Description of Soft-key

This chapter describes the soft-keys. The layer transition diagram of the soft-key is shown in the Appendix A at the end of this volume.

3.2.1 The First Layer

3.2.1.1 The First Layer Page 1



(1) CONDITION

The soft-key is switched to the layer for measurement condition setting by pressing this key. (See Paragraph 3.2.2.1 CONDITION.)

(2) MEASURE

The soft-key is switched to the layer mainly for measurement parameter setting by pressing this key. (See Paragraph 3.2.2.2 MEASURE.)

(3) DISPLAY

The soft-key is switched to the layer for screen display related setting by pressing this key. (See Paragraph 3.2.2.3 DISPLAY.)

(4) FILE

The soft-key is switched to the layer for file save/recall related setting by pressing this key. (See Paragraph 3.2.2.4 FILE.)

(5) COPY

The soft-key is switched to the layer for screen hard copy related setting by pressing this key. (See Paragraph 3.2.2.5 COPY.)

(6) etc.

The soft-key is switched to the second page of the first layer by pressing this key.

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3.2.1.2 The First layer Page 2

L1:(2/3)

COMPARE
SWEEP MODE
EVENTS
PROCEDURE MODE
PROCEDURE REGIST
etc.

(1) COMPARE

The soft-key is switched to the layer having the function to compare the waveforms by pressing this key. (See Paragraph 3.2.2.6 COMPARE.)

(2) SWEEP MODE

The sweep speed of the measurement waveform is switched by pressing this key. "FAST" is displayed at the left upper of the screen in the case where the high speed sweeping is performed. To be used when the real-time observation of the waveform is required such as the work to connect the connectors.

(3) EVENTS

Pressing this key allows to enter into the event mode, and the soft-key is switched to the layer for event related setting. (See Paragraph 3.2.2.7 EVENTS.)

(4) PROCEDURE MODE

The soft-key is switched to the layer for selecting the registered procedure function by pressing this key. (See Paragraph 3.2.2.8 PROCEDURE MODE.)

(5) PROCEDURE REGIST

The soft-key is switched to the layer for registering the procedure function by pressing this key. (See Paragraph 3.2.2.9 PROCEDURE REGIST.)

(6) etc.

The soft-key is switched to the third page of the first layer by pressing this key.

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3.2.1.3 The First Layer Page 3

L1:(3/3)

SYSTEM
etc.

(1) SYSTEM

The soft-key is switched to the layer mainly for system setting. (See Paragraph 3.2.2.10 SYSTEM.)

(2) etc.

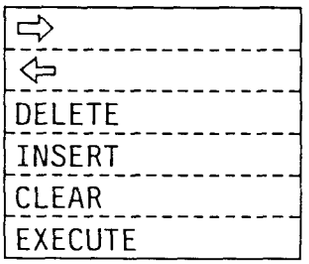
The soft-key is switched to the first page of the first layer by pressing this key.

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3.2.1.4 The First Layer SAVE

The soft-key is switched to the layer for saving the file by pressing the [Save] key on the front panel. The display on the screen is switched to the file name setting screen.

Up to 8 characters can be input as a file name. The extension consisting of 3 characters is automatically added by setting of the memory content (ITEM). When the memory media is set to the internal memory, specify the memory number. (Note that it is impossible to input the file name in such case.) If the same name or the same memory number is specified, it is overwritten to the new one. The rotary knob is used for selecting the character or the memory number. See Paragraph 3.2.2.4 FILE as for setting the memory content (ITEM).



(1) ⇨

The character cursor for input of the file name is moved one character right by pressing this key.

(2) ⇦

The character cursor for input of the file name is moved one character left by pressing this key.

(3) DELETE

The character placed on the cursor is deleted and all the characters right to the cursor are shifted one character left.

(4) INSERT

One character is inserted into the where the cursor is placed and all the characters right to the cursor are shifted one character right.

(5) CLEAR

Delete all the file name displayed. The character cursor is moved to the first character position, and "A" is reverse-displayed.

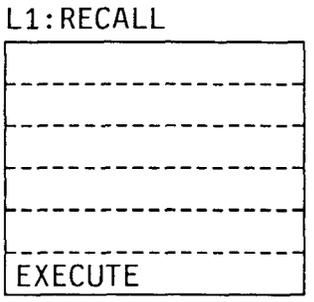
(6) EXECUTE

Save the set memory content (ITEM) by the set file name to the memory media (MEDIA). The soft-key is returned to the previous layer, which was the one before the [Save] key was pressed, by pressing this key.

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3.2.1.5 The First layer RECALL

The soft-key is switched to the layer for file recall by pressing the [Recall] key on the front panel. The display on the screen is switched to the screen for reading the file name. Only the file set in the memory content (ITEM) is displayed on the screen. The rotary knob is used for selecting the file name. See Paragraph 3.2.2.4 FILE as for setting the memory content (ITEM). In the case where this screen is displayed and the destination of copying is set in the internal printer, it is possible to print out the list of the files by pressing the [Copy] key.



(1) EXECUTE

The file selected is read by pressing this key. The soft-key is returned to the previous layer, which was the one before the [Recall] key was pressed.

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3.2.2 The Second Layer and The Third Layer

3.2.2.1 CONDITION

L2:CONDITION

DISTANCE
PULSE
ATT.
MASK
OUTPUT POWER

L3:DISTANCE

10km
25km
50km
100km
250km

(1) DISTANCE

The soft-key is switched to this layer for distance range setting by pressing this key. The distance range should be set longer than the length of the fiber under measurement.

It is impossible to select 250 km range when the plug-in units MW0942A, MW0944B, and MW0967B are used.

(a) 10 km to 250 km

The distance range is switched and the soft-key is returned to the CONDITION layer, by pressing this key. The distance range currently set is displayed at the right upper of the screen.

L3:PULSE

20ns
100ns
500ns
1μs
4μs
10μs

* Display Example of the MW0947B

(2) PULSE

The soft-key is switched to the layer for pulse width setting. When the long distance filber is measured, the wide pulse width is used, and when the fiber which is connected at the near end or in the short span is measured, the narrow pulse width is to be used.

The pulse width which can be selected depends on the plug-in unit to be used.

(a) 20ns to 10μs (Values in the display sample are in the case of the MW0947B.)

The pulse width is switched and the soft-key is returned to the CONDITION layer, by pressing this key. The pulse width currently set is displayed at the center bottom of the screen.

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L3:ATT

AUTO
SET

(3) ATT

The soft-key is switched to the layer for attenuator setting by pressing this key. The accurate measurement can not be realized if the waveform saturates or the level is too low and with much noise. In order to avoid such problems, adjust the attenuator. The attenuator value is reverse-displayed at the center bottom of the screen, and the rotary knob is used for changing it.

Note that it is impossible to use the attenuator when the plug-in units MW0942A, MW0944B, and MW0967B are used.

(a) AUTO

The maximum attenuator value within the range in which the waveform at the measurement start position (the distance displayed "SS" at the upper center of the screen) does not saturate is selected and set. The soft-key is returned to the CONDITION layer. In the case where the attenuator is set ot AUTO. "(A)" is displayed at the right of the set attenuator and the attenuator is re-set every time when the measurement condition such as pulse width is changed.

(b) SET

The set value is fixed and the soft-key is returned to the CONDITION layer, by pressing this key.

(4) MASK

L3:MASK

⇨
⇦
CLEAR
ALL CLEAR
NEAR END
SET

The soft-key is switched to the layer for optical mask setting by pressing this key. The rotary knob is used for moving the mask position. Up to five optical masks can be set.

The near-end mask-width varying (NEAR END) function is available only for the MW0942A and the MW0944B.

Note that it is impossible to use a mask when the MW0967B is used.

(a) ⇨

Select the mask marker to be moved. The mask to be selected is shifted right by pressing this key. The marker not selected is displayed by " ⌐¬ ", and the selected one is displayed by " ■ ". The rotary knob is used to move the mask.

(b) ⇦

The selected mask is shifted left by pressing this key.

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(c) CLEAR

The selected mask is deleted and the selected mask is shifted to the left end, by pressing this key.

(d) ALL CLEAR

All the masks set are deleted and the soft-key is returned to the CONDITION layer, by pressing this key.

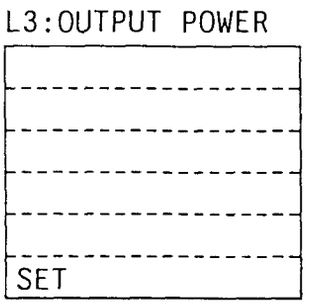
(e) NEAR END

"N__MASK" is reverse-displayed at the left upper of the screen by pressing this key. The mask width at the near end can be varied by turning the rotary knob. It is fixed by pressing the "SET" key and the soft-key is returned to the CONDITION layer. In the case where several points are connected between the main frame and the fiber under measurement by using the connectors, it is possible to set a mask to cover those connectors at a time. And if the connector with high return loss is connected, the near-end dead zone can be shortened by setting the near-end mask width narrow.

(f) SET

The settings of the mask and the near-end mask width are set and the soft-key is returned to the CONDITION layer, by pressing this key.

(5) OUTPUT POWER



The soft-key is switched to the layer for the optical output power varying function. In the case where the fiber under measurement is connected by connectors at adjacent two points, the Fresnel reflection occurs at the connection points to make it very difficult to distinguish them. In such cases, reducing the optical output power allows the observation. "PWR=0" (note that the value depends on the set value) is reverse-displayed at right upper of the screen by pressing this key. The rotary knob is used for varying the value.

The varying function is not available when the MW0942A is used.

(a) SET

The optical output power is set and the soft-key is returned to the CONDITION layer, by pressing this key.

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3.2.2.2 MEASURE

L2:MEASURE

LSA/2PA
AUTO CONDITION
AVG.LIMIT
IOR
RETURN LOSS
R.LOSS PARA

L3:LSA/2PA

LSA(ALL)
LSA(DISP)
2PA

(1) LSA/2PA

The soft-key is switched to the layer for waveform linear approximation setting by pressing this key. It is also possible to set the linear approximation method of the back-scattered light in order to perform the measurement with higher accuracy.

(a) LSA (ALL)

As the least square method based on all the data between markers is used for the linear approximation, the more accurate measurement can be realized.

The display of the linear approximation method at the left bottom of the screen is changed to "LSA(ALL)", and the soft-key is returned to the MEASURE layer, by pressing this key.

(b) LSA (DISP)

The least square method based on the display data between the markers is used for the linear approximation. Comparing with the above mentioned "LSA(ALL)", the amount of data to be used for the calculation is less. Therefore, the speed of displaying the calculation results and sweeping the waveform are faster.

The display of the linear approximation method at the left bottom of the screen is changed to "LSA(DISP)", and the soft-key is returned to the MEASURE layer, by pressing this key.

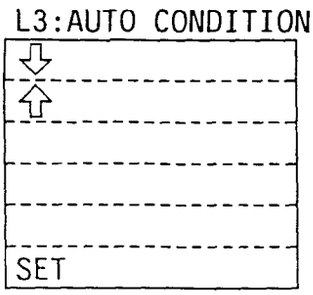
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(c) 2PA

The loss is calculated by using only the data at the point where the marker is placed. In the case where the loss between markers is measured by using "LSA", the error of the measurement results becomes large if the connection exists between those markers. In such cases, "2PA" is to be used. Also it is effective in such cases where the waveform is desired to be measured in real-time, for example of the connection procedure of the connector because the sweep speed of the waveform is higher than the time "LSA" is used.

The display of the linear approximation method at the left bottom of the screen is changed to "2PA", and the soft-key is returned to the MEASURE layer, by pressing this key.

(2) AUTO CONDITION



The soft-key is switched to the layer for auto faulty-point location measurement. One value is selected as threshold (THRESHOLD) is selected from 0.05/0.1/0.3/1.0/3.0/5.0 dB. By pressing the [Auto] key on the front panel, the loss over the set value is detected automatically. "ALL" and "DISP' can be set to select the data for detection (DATA SELECT). "ALL" indicates the detection of the fault-point by using all the data measured, and "DISP" is the case only the data displayed on the screen is used for the detection. Therefore, the accuracy of the detection is better in the case where "ALL" is used, and it takes more time for measurement. The rotary knob is used for selecting the threshold and the data.

(a) ⇩

The setting of the data selection for detection (DATA SELECT) is reverse displayed and can be changed by pressing this key when the set value of the threshold (THRESHOLD) is reverse-displayed.

(b) ⇧

The set value of the threshold (THRESHOLD) is reverse-displayed and can be changed by pressing this key when the setting of the data selection for detection (DATA SELECT) is reverse-displayed.

(c) SET

The displayed setting is set and the soft-key is returned to the MEASURE layer, by pressing this key.

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(3) AVG.LIMIT

L3:AVG.LIMIT

TIME
NUMBER
SET

The soft-key is switched to the layer for setting times or time of averaging process (AVERAGE) by pressing this key. The maximum times able to be set is 50,000. The longest time which can be set is 43,200 seconds. (14,400 seconds in the case where the sweep mode is set to "FAST".)

(a) TIME

The averaging process is performed by time, if this key is pressed. The set time for averaging process is reverse-displayed at the right bottom of the screen. The rotary knob is used for setting it.

(b) NUMBER

The averaging process is performed by times, if this key is pressed. The set times of averaging process is reversed displayed at the right bottom of the screen. The rotary knob is used for setting it.

(c) SET

The times or time for averaging process which is reverse-displayed is set and the soft-key is returned to the MEASURE layer, by pressing this key.

(4) IOR

L3:IOR

⇨
⇦
SET

The soft-key is switched to the layer for setting the index of refraction (IOR) by pressing this key. The first place of decimals of the index of refraction at the right bottom of the screen is reverse-displayed. The value of the digit reverse-displayed can be changed by using the rotary knob. The index of refraction is required to be correctly set as for the fiber under measurement. (Otherwise the distance can not be measured accurately.)

(a) ⇨

The digit which the set value is able to be changed (the digit which is reverse-displayed) is shifted one digit right.

(b) ⇦

The digit which the set value is able to be changed (the digit which is reverse-displayed) is shifted one digit left.

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(c) SET

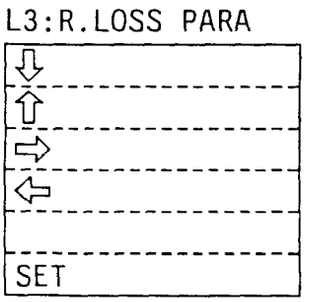
The displayed index of refraction is set and the soft-key is returned to the MEASURE layer, by pressing this key.

(5) RETURN LOSS

The mode for measurement of the return loss is set by pressing this key.

The return loss is measured by placing the * marker at the peak of the reflection point to be measured and the × marker at the back-scattered light level just before that reflection. The measurement result is displayed at the left bottom of the screen. The return loss measurement mode is removed by pressing the [Loss/Splice/SPL &DZL] key.

(6) R. LOSS PARA



The soft-key and the screen are switched to the layer and the screen parameter setting of the return loss measurement individually, by pressing this key. In order to calculate the return loss measurement, the index of refraction as for the core of the fiber to be measured, the index of refraction of the clad, the effective group IOR, and the transmission loss are necessary to be set. (The back-scattered level may be set instead of them.) The screen is switched to the parameter setting display and the digit in which the value can be changed is reverse-displayed, by pressing this key. The rotary knob is used for changing the value. If the [Copy] key is pressed in the state that this screen is displayed, it is possible to make a hard copy.

(a) ⇩

The digit in which the set value is able to be changed (the digit which is reverse-displayed) is shifted on one line lower.

(b) ⇧

The digit in which the set value is able to be changed (the digit which is reverse-displayed) is shifted on one line upper.

(c) ⇨

The digit in which the set value is able to be changed (the digit which is reverse-displayed) is shifted one digit right.

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(d) ⇦

The digit in which the set value is able to be changed (the digit which is reverse-displayed) is shifted one digit left.

(e) SET

The parameter displayed is set and the soft-key is returned to the MEASURE layer, by pressing this key.

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3.2.2.3 DISPLAY

L2:DISPLAY

TITLE
UNIT
SMOOTHING
SMOOTHING LEVEL
FULL TRACE
H-REF ADJ

L3:TITLE

⇨
⇦
DELETE
INSERT
CLEAR
SET

(1) TITLE

The soft-key and the screen are switched to the layer and the screen for title setting by pressing this key. The title of 20 characters × 2 lines displayed at the left upper of the measurement screen is set.

(a) ⇨

The character cursor for title input is moved one character right by pressing this key.

(b) ⇦

The character cursor for title input is moved one character left by pressing this key.

(c) DELETE

The character at the place where the character cursor is placed is deleted, and all the characters right to the cursor are shifted one character left.

(d) INSERT

One character is inserted in the place where the character cursor is placed. All the characters right to the cursor are shifted one character right.

(e) CLEAR

Delete all the titles displayed. The character cursor is moved to the first character position, and "A" is reverse-displayed.

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(f) SET

The set title is set and the soft-key is returned to the DISPLAY layer.

(2) UNIT

L3:UNIT

METERS
FEET
MILES

The soft-key is switched to the layer for distance display unit setting by pressing this key.

(a) METERS

The unit of the display distance is switched to the meter (m, km) and the soft-key is returned to the DISPLAY layer, by pressing this key.

(b) FEET

The unit of the display distance is switched to the feet (ft, kft) and the soft-key is returned to the DISPLAY layer, by pressing this key.

(c) MILES

The unit of the display distance is switched to the mile (mi) and the soft-key is returned to the DISPALY layer, by pressing this key.

(3) SMOOTHING

The smoothing process is performed to the measurement waveform by pressing this key, and the noise is reduced to make the observation of the waveform easier.

It becomes more effective by operating the averaging function together.

Pressing this key once again returns the waveform to the one before smoothing.

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(4) SMOOTHING LEVEL

L3:SMOOTHING LEVEL

LEVEL 1
LEVEL 2
LEVEL 3
LEVEL 4
LEVEL 5
LEVEL 6

The soft-key is switched to the layer for the smoothing level setting by pressing this key. The level can be set from 1 through 6. The larger the number is; the lower the noise of the measurement waveform is, but the longer time is required before displaying the waveform.

(a) LEVEL 1 to LEVEL 6

The level of smoothing is set and the soft-key is returned to the DISPLAY layer, by pressing this key.

(5) FULL TRACE

The full trace display function is turned on by pressing this key. If the attenuator is set to "AUTO" at that time and averaging is set to on, the attenuator is automatically switched, the averaging process is performed at each attenuator value, and then the measured waveform is to be displayed with each the measured waveforms (at each the attenuator value) connected. It is effective for measuring the whole waveform of the long distance fiber at one time.

When this function is set to on, "FT" is displayed at the right to the attenuator value displayed at the center bottom of the screen.

As for the plug-in unit which does not have the attenuator function, it is invalid.

(6) H-REF ADJ

L3:H-REF ADJ

CLEAR
SET

The soft-key is switched to the layer for relative distance measurement setting by pressing this key. Normally the fiber under measurement is connected to the optical output of the OTDR for display with regarding the optical output section as 0 m on the screen. However, the measurement becomes more convenient if the position where the fiber to be measured is connected is assumed 0 m, in the case where the dummy fiber is inserted between the OTDR and the fiber under measurement for the purpose of avoiding the dead zone. In such cases, the cursor on the screen disappears and "0.00 m" is reverse-displayed under the scale. The vertical cursor of dashed line appears and moves on the screen by turning the rotary knob in this state. Move this cursor to the place desired to be set to 0 m. Setting this 0 m reference cursor displays the distances of the × and the * markers, the data fetch start position (display of "SS" at the center upper of the screen), and the shift value of the horizontal axis at the left bottom of the screen, by using the relative distance to the reference cursor. When this cursor is set, "(R)" is displayed at the right of the marker distance display. And the marker of the left to the reference cursor is displayed with "−" (minus).

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(a) CLEAR

Pressing this key deletes the cursor of 0 m reference and returns the soft-key to the DISPLAY layer.

(b) SET

Pressing this key sets the 0 m reference cursor and returns the soft-key to the DISPLAY layer.

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3.2.2.4 FILE

L2:FILE

MEDIA
ITEM
SAVE RANGE
FILE DELETE
FORMAT

L3:MEDIA

INT MEMORY
INT PMC
INT FDD
EXT PMC1
EXT PMC2
EXT FDD

(1) MEDIA

The soft-key is switched to the layer for setting the media (MEDIA) to save the file, by pressing this key.

It is possible to set the media which saves and recalls the waveform data, the event table, and the measurement procedure.

(a) INT MEMORY

The memory media is set to the internal memory and the soft-key is returned to the FILE layer, by pressing this key. It is impossible to save/recall the event table and the measurement procedure in/from the internal memory. And the memory number (1 to 32) instead of the file name is to be used as for the internal memory.

(b) INT PMC

The memory media is set to the internal Plug-in Memory Card (PMC) and the soft-key is returned to the FILE layer, by pressing this key.

PMC with 32 KB to 512 KB capacity can be available.

(c) INT FDD

The memory media is set to the internal Floppy Disk Drive (FDD) and the soft-key is returned to the FILE layer, by pressing this key. Both 2HD, 2DD (formatted to 1.44 MB/720 KB, with automatic switched) can be supported. Also it is possible to support 2HD, 2DD (formatted to 1.2 MB/720 KB) by using an option.

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(d) EXT PMC1

The memory media is set to the external PMC1 and the soft-key is returned to the FILE layer, by pressing this key. The MC8104A (Data Storage Unit) is required to be connected to the GPIB interface.

(e) EXT PMC2

The memory media is set to the external PMC2 and the soft-key is returned to the FILE layer, by pressing this key. The MC8104A (Data Storage Unit) is required to be connected to the GPIB interface.

(f) EXT FDD

The memory media is set to the external FDD and the soft-key is returned to the FILE layer, by pressing this key. The MC8104A (Data Storage Unit) or the MC2102A (Floppy Disk Drive Unit) is required to be connected to the GPIB interface.

(2) ITEM

L3:ITEM

WAVEFORM
WAVEFORM & TABLE
TABLE
PROCEDURE

The soft-key is switched to the layer for setting the content (ITEM) to be saved to/recalled from the memory media, by pressing this key. One of the following four items is to be selected; the waveform data (WAVEFORM), the waveform data and the event table (WAVEFORM & TABLE), the event table (TABLE), and the measurement procedure (PROCEDURE). The extension of the file name is automatically determined by the set item. Therefore, this extension is attached to the file name in saving process, and only the name with this extension is displayed as for recall. Only the waveform data (WAVEFORM) can be set in the case where the memory media (MEDIA) is set to the internal memory.

(a) WAVEFORM

The content (ITEM) of the save/recall is set to the waveform data and the soft-key is returned to the FILE layer, by pressing this key. The extensions to be used are ".DAT".

(b) WAVEFORM & TABLE

The content (ITEM) of the save/recall is set to the waveform data and the event table, and the soft-key is returned to the FILE layer, by pressing this key. The extension is to be ".DAT" and ".TBL". The two files with the same names and the different extensions ".DAT" and ".TBL" are created at a time in saving.

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(c) TABLE

The content (ITEM) of the save/recall is set to the soft-key and the soft-key is returned to the FILE layer, by pressing this key. The extension is to be ".TBL".

(d) PROCEDURE

The content (ITEM) of the save/recall is set to the measurement procedure and the soft-key is returned to the FILE layer, by pressing this key. The extension is to be ".PRO".

(3) SAVE RANGE

L3:SAVE RANGE

ALL MEASURED
DISP.RANGE

The soft-key and the screen are respectively switched to the layer and the screen for setting the range in saving the measurement waveform data into the file, by pressing this key. Up to 25,000 points can be measured by the MW9060A as for the number of points for data measurement. In saving the waveform data, it is convenient to evaluate the measurement results if all the measurement data is stored. And in the case where the data on the displayed waveform is enough, it is possible to avoid wasting too much memory and save more waveform data required by saving the display data only.

(a) ALL MEASURED

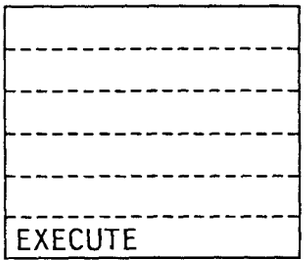
Pressing this key sets all the measurement data is to be stored in saving the waveform data and returns the soft-key to the FILE layer.

(b) DISP.RANGE

Pressing this key sets only the data displayed on the screen is to be stored in saving the waveform data and returns the soft-key to the FILE layer.

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L3:FILE DELETE



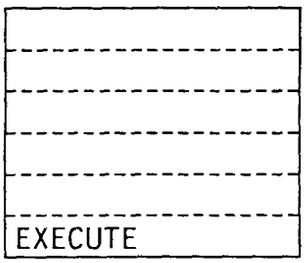
(4) FILE DELETE

The soft-key is switched to the layer for file deletion. The set save/recall item (ITEM) is read from the set memory media (MEDIA) and the file name is displayed on the screen. The rotary knob is used for selecting the name of the file to be deleted.

(a) EXECUTE

The file whose name is selected (reverse-displayed) is deleted and the soft-key is returned to the FILE layer.

L3:FORMAT



(5) FORMAT

The soft-key and the screen are respectively switched to the layer and the screen for memory media (MEDIA) formatting, by pressing this key. All the memory media are required to be formatted before they are used. If the media which the data is saved in is formatted, all the data in it is to be deleted. As for the internal and external FDDs, formatting is performed with automatically judging 2HD or 2DD. The floppy disk (FD) is formatted to the MS-DOS (1.44 MB/720 KB). The internal FDD can support the format of 1.2 MB/720 KB by option. The PMC is formatted in accordance with the MS-DOS.

(a) EXECUTE

The formatting process is executed and the soft-key is returned to the FILE layer.

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3.2.2.5 COPY

L2:COPY

TARGET
ALL/TRACE

L3:TARGET

INT PRINTER
DSU
PL 1
PL 2
PR 1
PR 2

(1) TARGET

The soft-key is switched to the layer for setting the target of the screen hard copy output (TARGET) by pressing this key. The screen which can be printed out, besides the measurement screen are; the return loss parameter setting screen, the waveform comparison function setting screen, and the external interface screen. In addition, the event table, the recall file name list, and the edit screen of the measurement procedure can be displayed by setting the TARGET to the internal printer.

(a) INT PRINTER

Pressing this key sets the TARGET of the hard copy to the internal printer and the soft-key is return to the COPY layer.

(b) DSU

Pressing this key sets the TARGET of the hard copy to the printer of the external MC8104A Data Storage Unit (DSU) and the soft-key is return to the COPY layer.

(c) PL 1

The TARGET of the hard copy is set to the HP-GL plotter and the soft-key is returned to the COPY layer, by pressing this key.

(d) PL 2

The TARGET of the hard copy is set to the GP-GL plotter and the soft-key is returned to the COPY layer, by pressing this key.

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(e) PR 1

The TARGET of the hard copy is set to the printer in accordance with the HP2225 and the soft-key is returned to the COPY layer, by pressing this key.

(f) PR 2

The TARGET of the hard copy is set to the printer in accordance with the VP-800 (Epson, Japan) and the soft-key is returned to the COPY layer, by pressing this key.

(2) ALL/TRACE

L3:ALL/TRACE

ALL
TRACE

The soft-key is switched to the layer to set whether all the content on the screen is output or only the waveform is output in outputting the hard copy y of the measurement screen, by pressing this key.

Printing of the measurement screen is only concerned.

(a) ALL

Pressing this key sets all the displayed content on the measurement screen to be output in hard copying and returns the soft-key to the COPY layer.

(b) TRACE

Pressing this key sets only the waveform on the measurement screen to be output in hard copying and returns the soft key to the COPY layer. When the plotter is set to the TARGET of copying, only the waveform is overwritten to enable the waveforms to be compared.

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3.2.2.6 COMPARE

L2:COMPARE

COMPARE RECALL
SETTING ON/OFF
COMPARE OFF

(1) COMPARE RECALL

L3:COMPARE RECALL

EXECUTE

The soft-key is switched to the layer for reading the data file for the waveform comparison, by pressing this key. Regardless of the setting for the content to be recalled (ITEM), only the waveform data is read. The list of the file names is displayed on the screen as in the same manner that of for the normal recall, and the file to be read is selected by using the rotary knob.

(a) EXECUTE

The selected (reverse displayed) file name is set and the waveform data is read, by pressing this key. The soft-key is returned to the COMPARE layer.

(2) SETTING ON/OFF

The measurement conditions of the two waveforms under waveform comparison are listed and displayed on the screen by pressing this key. Pressing this key again returns the measurement screen. It is possible to take hard copy by pressing the [Copy] key in the condition that this screen is displayed.

(3) COMPARE OFF

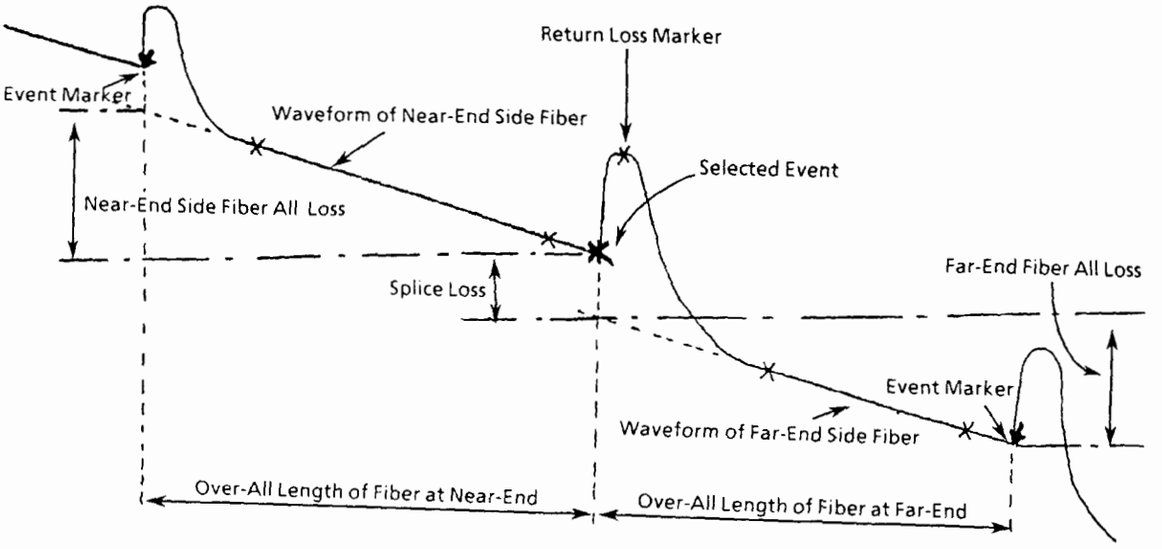
Quit the waveform comparison mode by pressing this key.

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3.2.2.7 EVENTS

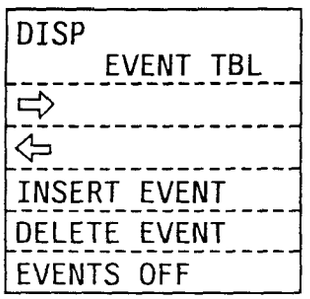
The event mode is set by pressing the soft-key "EVENTS". The splice loss of the event, all the loss, whole length, the transmission loss and the return loss before and the after the fiber concerned are measured and those measurement results are displayed on the screen in this mode. Up to 100 events can be registered, and the marker "↙" is displayed at the register location. In the case where the auto faulty-point location detecting function (AUTO) is set, the event with the loss exceeding to the set threshold (THRESHOLD, see Paragraph 3.2.2.2 (2) AUTO CONDITION), and "↙" marker is set. It is possible to list these event points in the table and display on the screen (event table, see Paragraph 3.2.2.7 (1) DISP EVENT TBL) and save in the file (to allow the same event point to be read later for measurement).

One * marker and five of × markers are on the screen. The × marker next to the * marker's right is used for measuring the return loss (hereafter this marker is referred as a "return loss marker"). The * marker is set to the start point of the event. Two of the × markers next to the * marker's left are set to the linear section of the back-scattered light waveform of the fiber at the near end side (left side of the screen) of the event. And two × markers among the three located at the right to the * marker, except for the return loss marker, are set to the linear section of the back-scattered light waveform of the fiber at far end of the event (the right side of the screen). (The same as marker setting for the splice loss measurement can be applied, other than the return loss marker.) The return loss marker is to be set to the peak of the reflection occurs with the event. In the case where the cursor is located on the * marker, all the markers are linked. The Auto mode is removed by operating the [Marker] key or the rotary knob when Auto mode is set in the event mode.

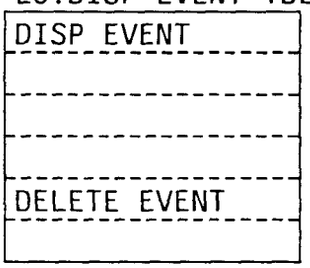


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L2:EVENTS



L3:DISP EVENT TBL



(1) DISP EVENT TBL

The soft-key is switched to the layer for the event table display by pressing this key. The distance of the event (DISTANCE), the interval of the event (LENGTH), the splice loss (SPLICE), all the loss of the fiber between the event (LOSS), the transmission loss (unit: dB/km), and the return loss (R. Loss) are listed and displayed on the screen. When the content set by the Paragraph 3.2.2.4 (2) ITEM is the waveform and the event (WAVEFORM & TABLE), it is possible to save/recall the registered event table together with the measurement waveform at one time. In the case where it is set to the event table (TABLE), only the location information on the registered event point is able to be saved/recalled. Therefore, this function is convenient for the later evaluation with the event point or the loss of the fiber batched. Also, it is possible to measure the same point again by the recall of the event table, without resetting the marker or the event point, as for the measurement of the same link. When the internal printer is set to the target of copying in the condition this screen is displayed, pre-window of the event table is available by pressing the [Copy] key.

(a) DISP EVENT

Selecting the event point to be observed by using the rotary knob (the selected point is reverse-displayed on the screen) and pressing this key automatically select the scale to contain the events as the selected one at the center and the before and the after it in one screen.

The soft-key is returned to the EVENTS layer.

(b) DELETE EVENT

The selected event is deleted and the soft-key is returned to the EVENTS layer, by pressing this key.

The screen returns to the measurement screen.

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(2) ⇨

The selected event marker is shifted one position right by pressing this key. The "↙" marker of the selected event is changed to the * marker and five of the markers are displayed at its left and right. The "↙" marker is placed at the event point which has been selected by that time (the position where * marker has been placed).

(3) ⇦

The selected event marker is shifted one position left by pressing this key. The "↙" marker of the selected event is changed to the * marker and five of the × markers are displayed at its left and right. The "↙" marker is placed at the event point which has been selected by that time (the position where * marker has been placed).

(4) INSERT EVENT

The event point is registered at the position where the * marker currently placed, by pressing this key. As the position is always regarded as the event point even * marker is moved, it is not necessary to press this key when the event point is only one or in setting the last event after two or more events have been set.

(5) DELETE EVENT

The selected event (the position where the * marker is placed) is deleted by pressing this key. When the deletion is performed, the event to be selected goes to the next event. In the case where the farthest event is deleted, the event one previous is to be selected. If the event is one, this key is invalid.

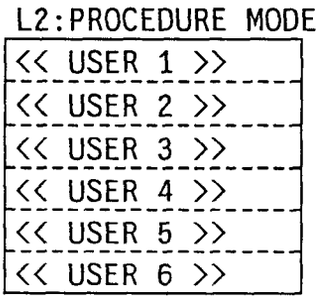
(6) EVENTS OFF

The event mode is removed by pressing this key.

Once the "EVENT" key is pressed, the event mode is kept until this key is pressed.

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3.2.2.8 PROCEDURE MODE



(1) < USER 1 > to <USER 6>

<USER 1> to <USER 6> indicate the labels attached to the series of measurement procedure registered.

When any of those keys is pressed, the measurement registered with that label is executed. The soft-key is switched to the display of "STOP" and "PAUSE". To abort the measurement of the procedure function midway, press "STOP". To pause the measurement temporarily, press "PAUSE". The display of the soft-key is changed to "CONTINUE". To restart the measurement, press "CONTINUE".

The completion of all the registered measurement processes are noted by the buzzer. When the measurement of the procedure function is performed, the keys other than "STOP" and "PAUSE" can not be accepted. In the case where the power supply is turned off while this layer is displayed, the displayed layer is the first to appear on the screen at the time the power supply will be on again.

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3.2.2.9 PROCEDURE REGIST

When this key is pressed, the memory number (REGIST MEM No.) currently set is displayed under the soft key.

L2:PROCEDURE REGIST

REGIST MEM No.
LABELING
REGIST START/STOP
DELETE
EDITING CONTENTS
WAIT

(1) REGIST MEM No.

L3:REGIST MEM No.

SET

The soft-key and the screen are respectively switched to the layer and the screen for setting the memory number of the procedure function, by pressing this key. In this step, input of the label; registration, deletion and edit of the measurement; and setting of the wait time can be performed. The memory can be selected by indicating one number out of 1 through 6 with using the rotary knob. The selected memory number is reverse-displayed on the screen. And if the measurement procedure has already registered, "REGISTERED" is displayed and if not yet registered, "NOT REGISTERED" appears on the screen.

(a) SET

The selected memory number is set and the soft-key is returned to the PROCEDURE REGIST layer, by pressing this key.

(2) LABELING

L3:LABELING

⇨
⇦
DELETE
INSERT
CLEAR
SET

The soft-key and the screen are respectively switched to the layer and the screen for labeling the set memory number (REGIST MEM No.), by pressing this key. This label can be used for the soft-key display in the measurement of the procedure function (PROCEDURE MODE). Up to 20 characters (10 characters × 2 lines) can be input. The character on the cursor position can be selected by using the rotary knob.

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(a) ⇨

The character cursor for label input is shifted one character right by pressing this key.

(b) ⇦

The character cursor for label input is shifted one character left by pressing this key.

(c) DELETE

The character at the place where the character cursor is placed is deleted and all the characters right to the cursor are to be shifted one character left.

(d) INSERT

One character is inserted in the place where the character cursor is placed. All the characters right to the cursor are shifted one character right.

(e) CLEAR

Delete all the labels displayed. The character cursor is moved to the first character position, and "A" is reverse-displayed on the screen.

(f) SET

The set label is determined and the soft-key is returned to the PROCEDURE REGIST layer.

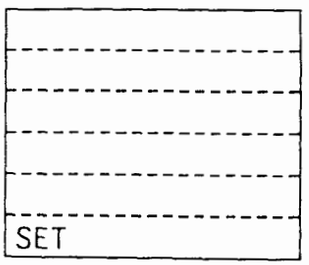
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(3) REGIST START/STOP

The set memory number (REGIST MEM No.) with"REGIST ☆" under the soft-key display are reverse-displayed and the soft-key is returned to the one previous layer (Paragraph 3.2.1.2 The First Layer 2 Page), by pressing this key. All the operations of the content to be desired to register (which are performed in the same manner as the normal operations) are to be registered in the set memory number from this step on. However, operations of the keys not directly related to the measurement, such as "Prior", "etc." are not to be registered. (Note that the "☆" display blinks when the operation is registered.) The keys which can not be operated are the following three; execution key of the procedure (Paragraph 3.2.2.8 PROCEDURE MODE), the deletion key of the procedure content (Paragraph 3.2.2.9 (4) DELETE), the edit key of the procedure content (Paragraph 3.2.2.9 (5) EDITING CONTENTS). Pressing this key again terminates the registration.

(4) DELETE

L3:DELETE



The soft-key and the screen are respectively switched to the layer and the screen for deleting the registered measurement procedure, by pressing this key. Only the registered memory number is displayed. Then the memory number to be deleted is selected by using the rotary knob. The selected memory number is reverse-displayed on the screen.

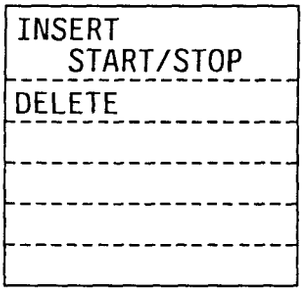
(a) SET

The registered content of the selected memory number is deleted and the soft-key is returned to the PROCEDURE REGIST layer, by pressing this key.

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(5) EDITING CONTENTS

L3:EDITING CONTENTS



The soft-key and the screen are respectively switched to the layer and the screen for editing the content of the set memory number, by pressing this key. It is invalid if the memory number which no measurement procedure has been registered is set to. The registered item is displayed by pressing this key. It is displayed by the same instruction as the command of the GPIB.

For further information on the command, refer to the operation manual of the GPIB. When the target of copying is set to the internal printer in the condition that this screen is displayed, pressing the [COPY] key prints out the list of the registered contents.

(a) INSERT START/STOP

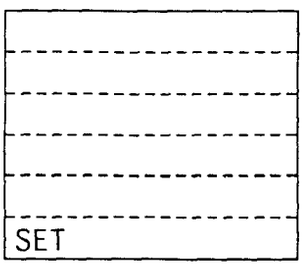
By pressing this key, the content operated after that is inserted, and pressing this key again terminates the insertion. The location where the insertion is to be performed is immediately before the item reverse-displayed on the list of the registered content. The soft-key is returned to the first layer Page 2 by pressing this key.

(b) DELETE

The item reverse-displayed on the list of the registered content is deleted, and the soft-key is returned to the PROCEDURE REGIST layer.

(6) WAIT

L3:WAIT



The soft-key and the screen are switched to the layer and the screen for setting the wait time during the procedure function operation. This key can be used only when the operation procedure of the PROCEDURE is under registration (Paragraph 3.2.2.9 (3) REGIST START/STOP) or insertion (Paragraph 3.2.2.9 (5) (a) INSERT START/ STOP). 1 to 999 seconds can be set by one second step with using the rotary knob. This wait time can be set to the temporarily stop (PAUSE). In that case, the procedure function is temporarily stopped by this command when it is executed, and the soft-key displays "CONTINUE". To continue the measurement, press "CONTINUE".

(a) SET

The set waiting time is determined and the soft-key is returned to the PROCEDURE REGIST layer, by pressing this key.

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3.2.2.10 SYSTEM

L2:SYSTEM

INTERFACE
CALENDAR
RESULT DISP AREA

L3:INTERFACE

⇩
⇧
⇨
⇦
SET

(1) INTERFACE

The soft-key and the screen are respectively switched to the layer and the screen for setting the items related to the GPIB interface, by pressing this key. It is possible to set the address of the GPIB interface, and the controller/device. The rotary knob is used for the setting. When only the standard GPIB is used, "device" is to be set if the MW9060A is controlled by the computer and "controller" is to be set in the case where the external printer or plotter is used. If one more GPIB is installed by option, the setting for the GPIB1 is fixed to "device" and the one for the GPIB2 is fixed to "controller". It is possible to take a hard copy by pressing the [Copy] key in the state this screen is displayed.

(a) ⇩

The character cursor is moved one line lower by pressing this key.

(b) ⇧

The character cursor is moved one line upper by pressing this key.

(c) ⇨

The character cursor is moved one character right by pressing this key.

(d) ⇦

The character cursor is moved one character left by pressing this key.

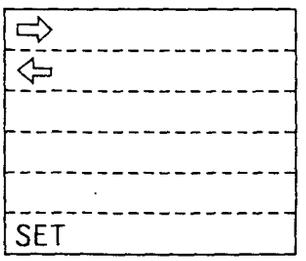
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(e) SET

The set content of the interface is determined and the soft-key is returned to the SYSTEM layer, by pressing this key.

(2) CALENDAR

L3:CALENDAR



The soft-key is switched to the layer for calendar setting, and the date and the time at the left upper of the screen are reverse-displayed, by pressing this key. The set value can be changed by the rotary knob.

(a) ⇨

The changeable place is moved right by pressing this key.

(b) ⇦

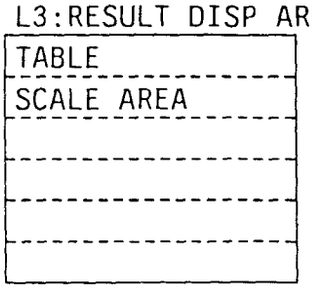
The changeable place is moved left by pressing this key.

(c) SET

The set value is determined and the soft-key is returned to the SYSTEM layer, by pressing this key.

(3) RESULT DISP AREA

L3:RESULT DISP AREA



The soft-key is switched to the layer for display position change of the measurement results of the fiber loss, length and transmission loss, by pressing this key.

(a) TABLE

Pressing this key sets the display position of the measurement results at the left bottom of the screen in table. The soft-key is returned to the SYSTEM layer.

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(b) SCALE AREA

Pressing this key sets the measurement results to be displayed in the scale.

The soft-key is returned to the SYSTEM layer.

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SECTION 4
BASIC METHOD OF OPERATION

This section describes the basic operations such as distance range and pulse width settings which are performed in common in each measurement. This section also outlines the screen display information necessary for measurement, and circuitry to facilitate your understanding of their basic operation.

4.1 Power-on

The power is turned on when you depress the power switch. When you press the switch a second time and the switch button protrudes, the power is turned off. All front-panel lamps light immediately after power-on; after the selftest completed, the equipment returns to the key state of the immediately preceding power-on time.

Notes: 1. When the result of the selftest is NG (no good), the MW9060A can not be used. It is necessary to repair.

2. When the power turned off, the measurement condition immediately before power-off is backed-up.
   However, when turned off during or immediately after changing of the measurement condition, sometimes the condition is not backed-up and initialized. (See paragraph 5.25 "[Initialize] key".)

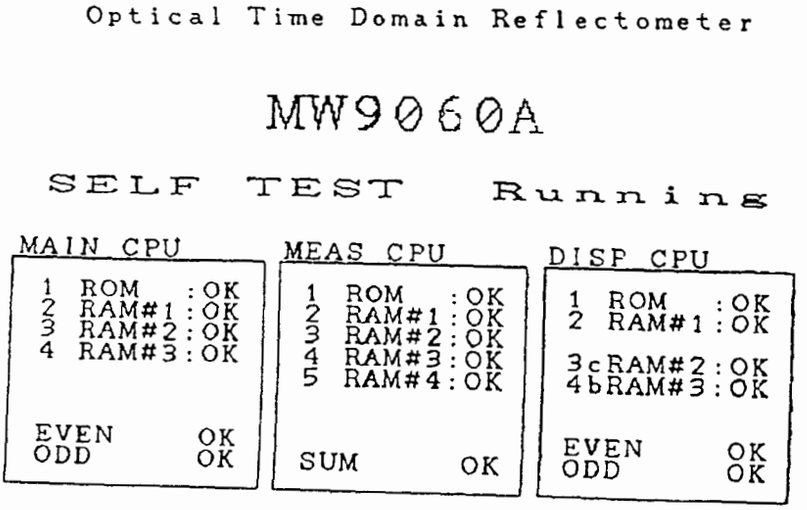


Fig. 4-1 Self-test Screen

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4.2 Screen Display

Figure 4-2 shows contents of screen display. The table below lists the names of the displayed items in relation to the numbers in the diagram.

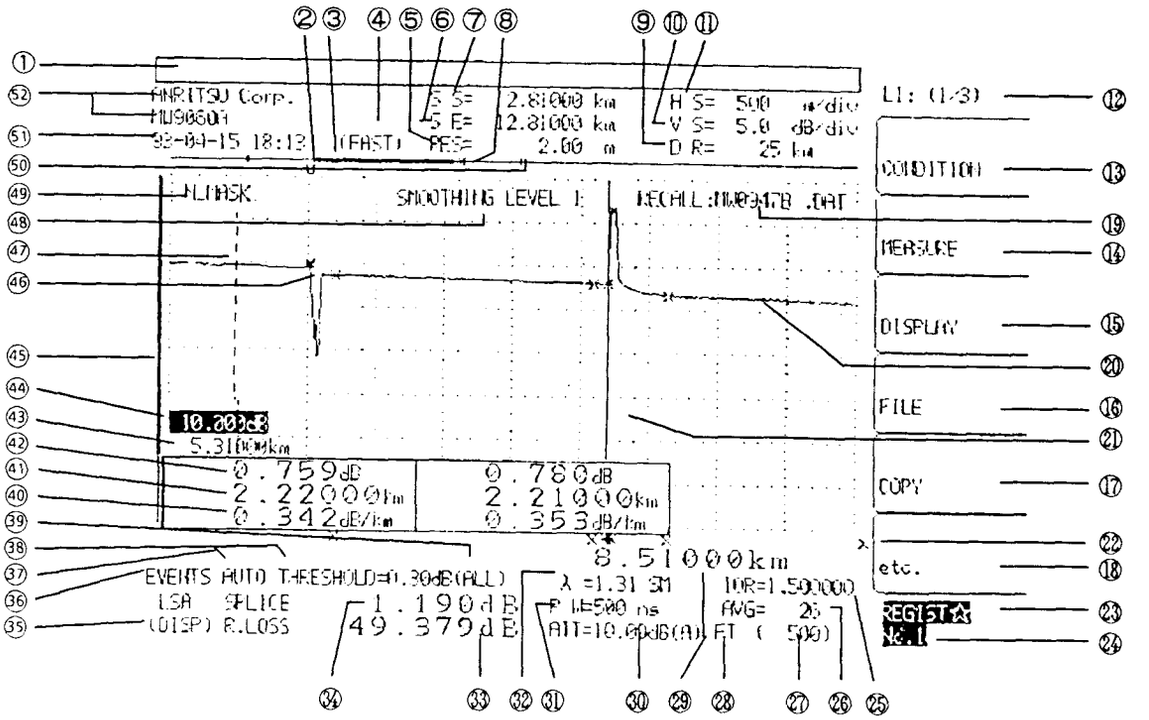


Fig. 4-2 Contents of Screen Display

① Message display area
② Mask marker
③ Thick line indicating the horizontal axis display range.
④ Indicates when the sweep mode is fast.
⑤ Distance resolution display
⑥ Sampling end position
⑦ Sampling start position
⑧ Marker set outside the screen
⑨ Distance range
⑩ Vertical axis scale
⑪ Horizontal axis scale
⑫ Soft-key label and layer
⑬ to ⑱ Soft-key display area
⑲ File name
⑳ Measurement waveform
㉑ Cursor
㉒ X marker or * marker position
㉓ Procedure function registration display
㉔ Procedure memory number
㉕ Refractive index set value
㉖ Averaging count/time in progress
㉗ Averaging count/time set value
㉘ Full trace mode display
㉙ Distance from output connector to cursor line
㉚ Attenuator set value
(A) is displayed in AUTO mode
㉛ Pulse width set value
㉜ Wavelength and type of optical fiber cable
㉝ Return loss
㉞ Splice loss
㉟ Linear approximation method (LSA/2POINTS)

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㊱ Event mode display
㊲ Automatic fault location display
㊳ Threshold value
㊴ Type of automatic fault location data
㊵ Loss per unit length
㊶ Distance between event points
㊷ Fiber loss between event points
㊸ Horizontal axis shift value
㊹ Vertical axis shift value
㊺ Thick line indicating vertical axis display range
㊻ Event marker
㊼ Horizontal axis reference cursor
㊽ Smoothing level
㊾ Near-end mask width adjustment function display
㊿ Marker indicating sampling range
(51) Date and time display
(52) Title display area

Figure 4-3 schematically shows a general measurement waveform that is displayed on the screen when measuring optical fiber with the Optical Time Domain Reflectometer.

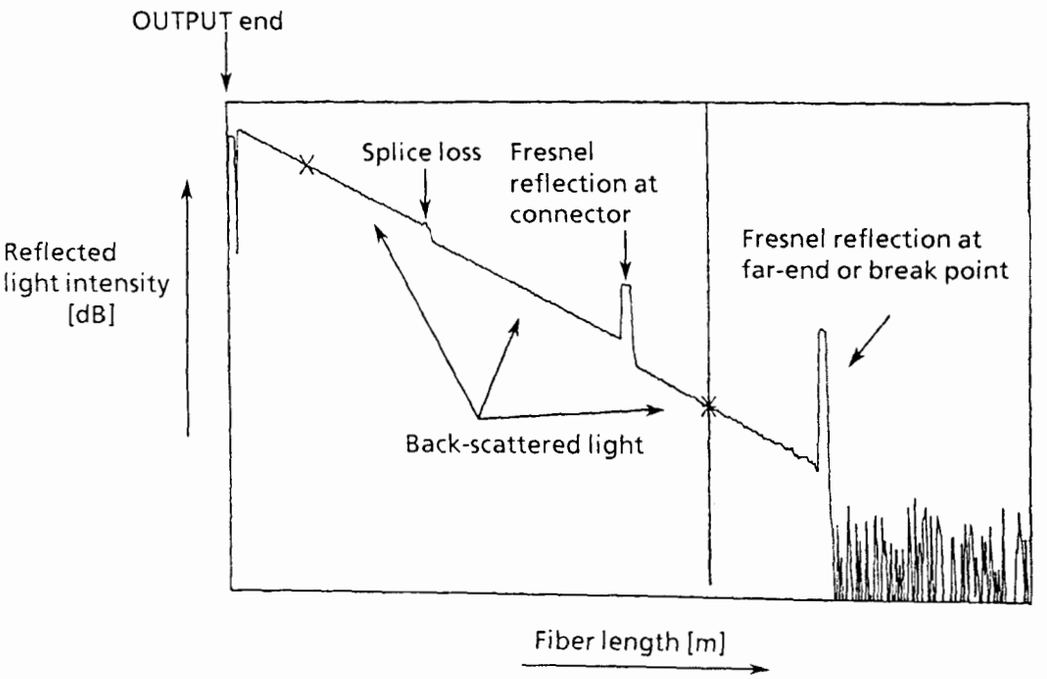


Fig. 4-3 General Measurement Waveform

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The horizontal axis indicates distance, that is, fiber length. The vertical axis indicates the stength of reflected light. The back scattered light represents the characteristics of the optical fiber, and the inclination matches with transmission loss. For example, if the optica fiber has low-loss, consistent characteristics, the waveform should show a smooth linear line with a moderate inclination relative to the horizontal axis.

If the optical fiber has a break or connector-fitted point, Fresnel reflection is generated. The Fresnel reflection at the far left is caused by connection between the Output connector and fiber to be measured. When a fusion-connected fiber is observed, a stepwise difference (splice loss) results in place of the fusion-connected point without Fresnel reflection of a break-point. The magnitude of this step difference indicates the magnitude of splice loss.

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4.3 Basic Operation

4.3.1 Items of basic operation

The operations necessary to set or select each item described below are the basic operations common in each measurement with the MW9060A. Set each item to the optimum value before starting measurement. Once set, the values are internally retained even when the power is turned off unless pressing the [Initialize] key.

(1) Setting distance range

Set the distance range after selecting mimimum range among those longer than the length of the fiber to be measured.

(2) Setting pulse width

Select a wide pulse width when measuring long distance; select a narrow pulse width when measuring short distance. The distance that can be measured with the Optical Time Domain Reflectometer is determined by the dynamic range and loss in the fiber to be measured. Therefore, select the optimum pulse width by considering loss in the fiber to be measured and the dynamic range of each pulse width.

Note that when the pulse width becomes wider, the effective distance resolution (with which two adjacent fault points can be identified) becomes longer.

(3) Setting attenuator

An attenuator (ATT) is used to optimize the level of the receive system. First, set it for AUTO; then, select an ATT value according to the need.
For some unit, ATT is fixed. (See paragraph 1.5.)

(4) Selecting wavelength

When using a wavelength switchable plug-in unit, select the LD wavelength according to the measurement wavelength of the fiber to be measured. When using a non-switchable unit, you need not select a wavelength because the wavelength is fixed.

(5) Setting refractive index

Set the refractive index (IOR) of the fiber to be measured. Because the refractive index varies with wavelength, set it for each wavelength when using a switchable plug-in unit.

(6) Selecting unit of distance

Select meter, foot, or mile. The unit of distance can be set (i.e., changed) for recalled waveforms (which are recalled onto the screen after being saved in memory), as well as for the currently measured waveform.

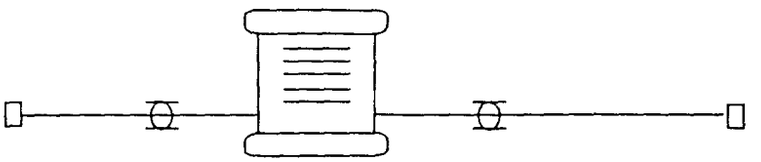
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(7) Laser on

Turn the laser on after confirming that the Ready lamp is on. Waveform sweep begins upon laser-on.

4.3.2 Example of basic operation

The following describes the basic operation before starting measurement after laser-on taking measurement of the optical fiber shown below as an example.



The fiber characteristics are as follows:

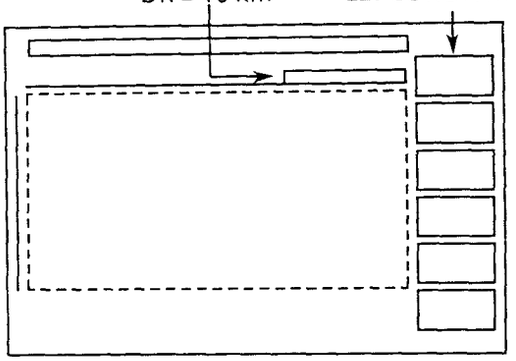
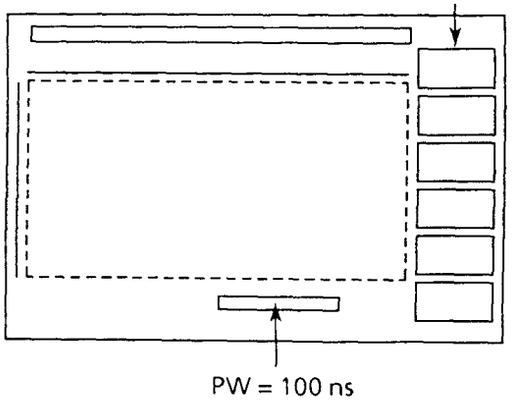
- Wavelength : 1.31 μm
- Refractive index : 1.482
- Type : Single mode (SM)

The plug-in unit used is the MW0947B (for 1.31/1.55 μm SM fiber). It is assumed here that this plug-in unit is fitted into the MW9060A main-frame and the equipment is in a power-on state.

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
CONDITION	L2: CONDITION DISTANCE ⋮	The soft key is brought to the CONDITION layer.

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(Continued)

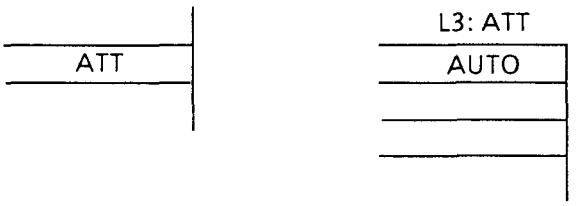
Key operation	Screen display	Description
Setting distance range DISTANCE	L3: DISTANCE 10 km 25 km ⋮	The soft key is brought to DISTANCE layer.
10 km	DR = 10 km L2: CONDITION 	The display on the scale becomes DR = 10 km. The soft key returns to the CONDITION layer.
Setting pulse width PULSE	L3: PULSE 20 ns 100 ns ⋮	The soft key is brought to the PULSE layer.
100 ns	L2: CONDITION  PW = 100 ns	The dispaly below the scale becomes PW = 100 ns. The soft key returns to the CONDITION layer.

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(Continued)

Key operation	Screen display	Description

Setting attenuator (AUTO)

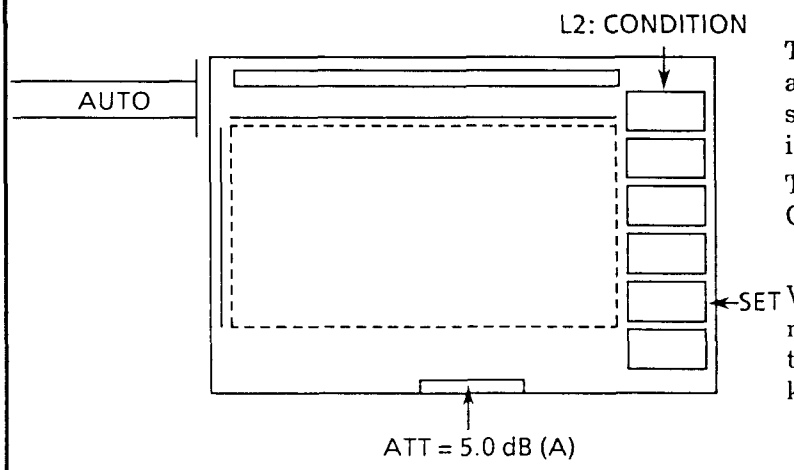


The soft key is brought to the ATT layer.

The ATT display below the scale becomes reversed.

Notes: • For some plug-in unit, the ATT is disabled fixed.

• Any value can be set using the rotary knob, but set the value so that the trace waveform (back scattered light trace) would not saturate. If the trace waveform saturates, a distortion such as trace waveform falling may be caused and accurate measurement may not be performed.



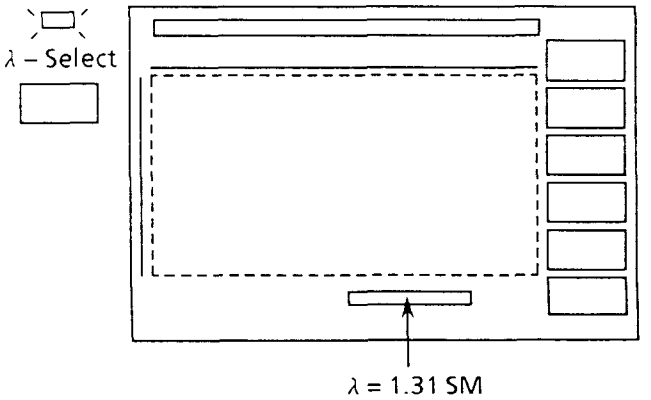
The (A) to the right of the attenuator set value under the scale, indicates that the attenuator is in AUTO mode.

The soft key returns to the CONDITION layer.

When the ATT is set by manual mode, the ATT level is adjusted by the rotary knob, then the SET soft key is pressed.

Note: When returned to the CONDITION layer by pressing [Prior], [Marker], [V-Shift], or [H-Shift] without [SET]. ATT set value returns to the previous value before entering the ATT layer.

Setting wavelength



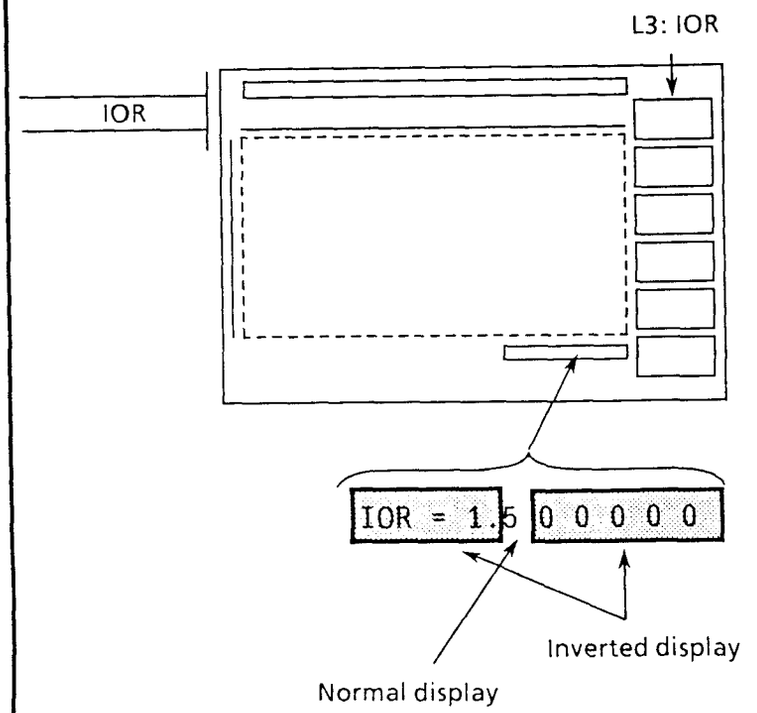
If the current wavelength setting is 1.55 μm, $\lambda = 1.31$ SM will be displayed below the scale.

If the wavelength setting is 1.31 μm, the display changes to $\lambda = 1.55$ SM.

The soft key returns to the first layer.

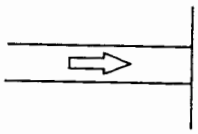
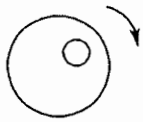
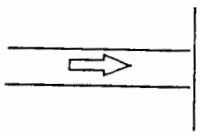
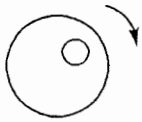
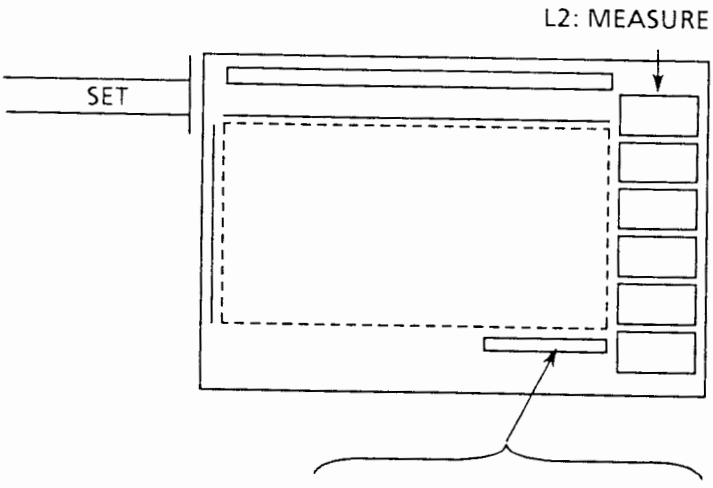
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(Continued)

Key operation	Screen display	Description
Setting refractive index		
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key returns to the first layer.
MEASURE	L2: MEASURE LSA / 2PA AUTO CONDITION AVG. LIMIT IOR ⋮	The soft key is brought to the MEASURE layer.
IOR		The soft key is brought to the IOR layer. The IOR display below the scale is inverted. The digit for which the set value can be changed is not inverted, however.

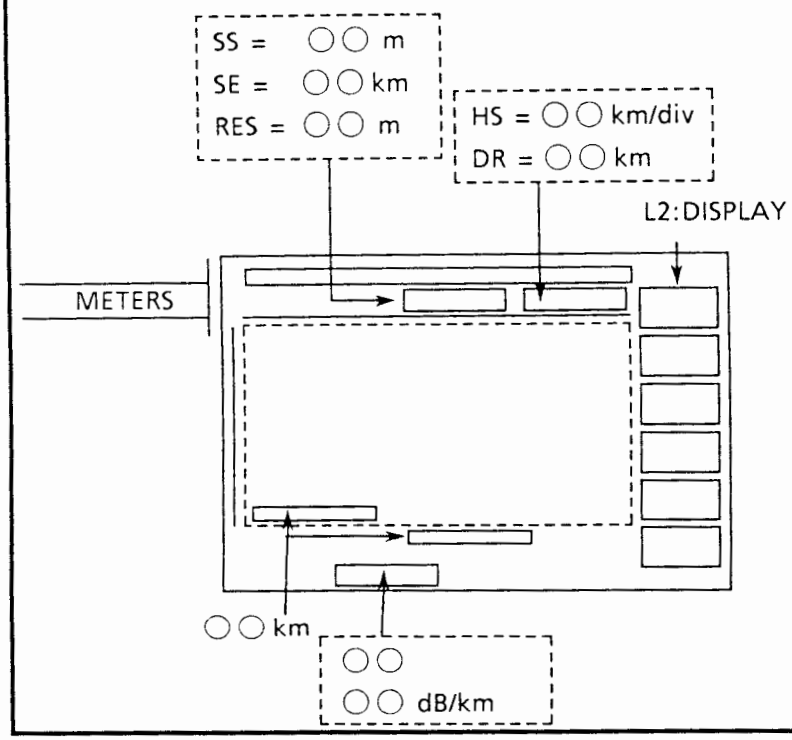
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(Continued)

Key operation	Screen display	Description
	IOR = 1.4 0 0 0 0 0	
	IOR = 1.4 0 0 0 0 0	The IOR value in the first decimal place becomes 4. The digit in the second decimal place is selected with its value normally displayed (not inverted).
	IOR = 1.4 8 0 0 0 0	
	IOR = 1.4 8 0 0 0 0	The IOR value in the second decimal place becomes 8. The digit in the third decimal place is selected with its value normally displayed (not inverted).
	IOR = 1.4 8 2 0 0 0	
		IOR = 1.482000 is set, and the soft key returns to the MEASURE layer. ***Note:*** When returned to the MEASURE layer by pressing [Prior], [Marker], [V-Shift], or [H-Shift] without [SET]; IOR set value returns to the previous value before entering the IOR layer.

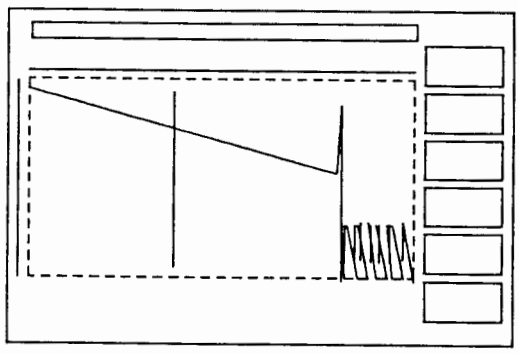
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(Continued)

Key operation	Screen display	Description
Setting unit of distance		
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key returns to the first layer.
DISPLAY	L2: DISPLAY TITLE UNIT ⋮	The soft key is brought to the DISPLAY layer.
UNIT	L3: UNIT METERS FEET MILES ⋮	The soft key is brought to the UNIT layer.
METERS		All displayed distances are changed to the metric unit. The soft key is brought to the DISPLAY layer.

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(Continued)

Key operation	Screen display	Description
Laser-on On Off		Measurement waveform is displayed in the scale window.

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4.4 Basic Circuit Configuration

Figure 4-4 shows the basic circuit configuration of the MW9060A.

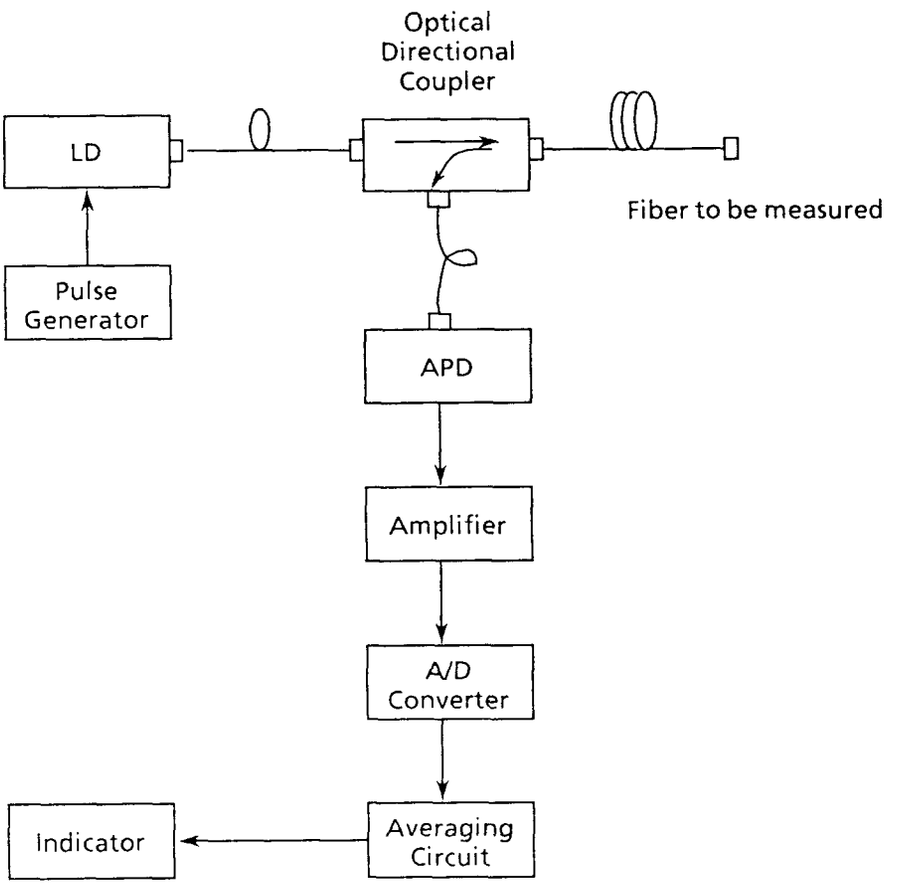


Figure 4-4 Basic Circuit Configuration

The optical pulse from the laser diode (LD) driven by the pulse generator is emitted into fiber to be measured through an optical directional coupler. The back scattered light generated in the measured fiber or Fresnel reflection light generated at a fault location returns to the emission end, and is fed via the optical directional coupler into the avalanche photodiode (APD) where it is converted into an electric signal. This electric signal is sufficiently amplified by an amplifier and then converted into a digital signal by an A/D converter. This signal is further processed by an averaging circuit to improve the S/N ratio before being displayed by an indicator.

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SECTION 5
DETAIL METHOD OF OPERATION

This section describes the method of operation in detail using appropriate examples to ensure that the equipment is used to the full extent of its performance capabilities.

5.1 Sampling Range and Resolution

The sampling range and resolution are determined by the horizontal axis scale when one of the following operations is done:

① When the horizontal axis scale is changed while averaging is off

② When averaging is turned off

③ When the sweep mode is changed

④ When the distance range is changed

⑤ When the pulse width is changed

⑥ When the attenuator value is changed

⑦ When the wavelength is switched to another

⑧ When the mask position is changed

⑨ When the output power is changed

⑩ When the average limit TIME or NUMBER is changed to NUMBER or TIME, respectively.

⑪ When AVE. LIMIT [SET] key is pressed while averaging is on and the hitherto averaged count or time exceeds the set value of the average limit

⑫ When the laser is turned on while averaging is off

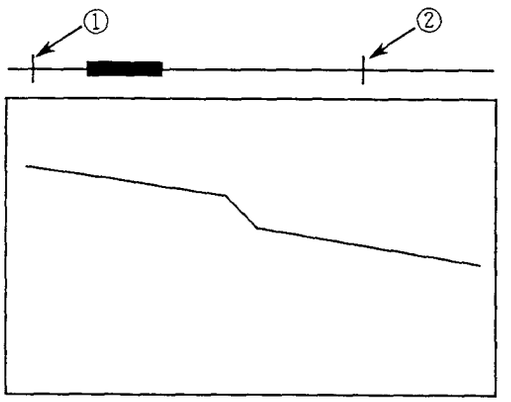
⑬ When the [Initialize] key is pressed (in which case, the horizontal axis becomes full scale)

⑭ When the full trace is turned on and off when the AUTO ATTENUATOR and laser are on

⑮ When an event selected by event table when the laser is on and averaging is off is displayed by [DISP EVENT] key

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The markers (indicating the sampling-range start and stop points) are displayed on the horizontal bar, as shown below (① and ②).



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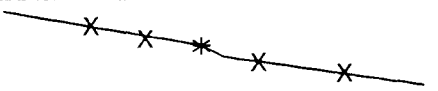
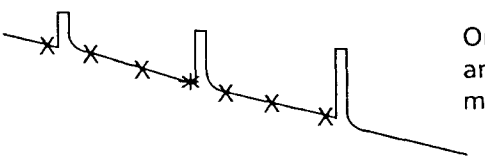
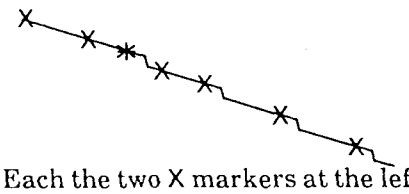
5.2 Selecting Marker and Moving Cursor

After pressing the [Marker] key and the key lamp coming on, the next marker on the right is selected and the cursor is moved each time this key is pressed while in this state.

However, if the last selected marker is at the rightmost position, the leftmost marker is selected next. The marker overlapped with the cursor can be moved by turning the rotay knob. However, if the AUTO function is in operation, the marker and cursor cannot be moved with the rotay knob.

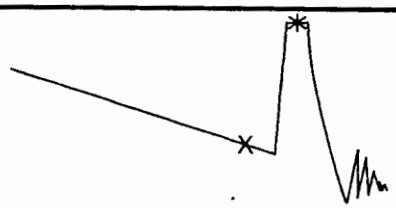
There are two kinds of markers: ✳ and X markers. The kind, number, movement and arrangement of markers displayed on the screen vary with each measurement mode as shown below.

Table 5-1 Kind, Arrangement, Movement and Number of Markers

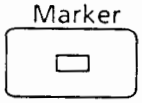
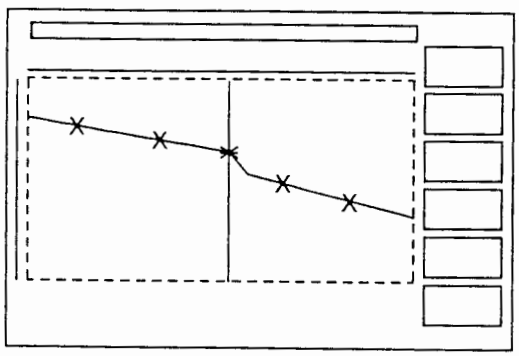
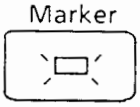
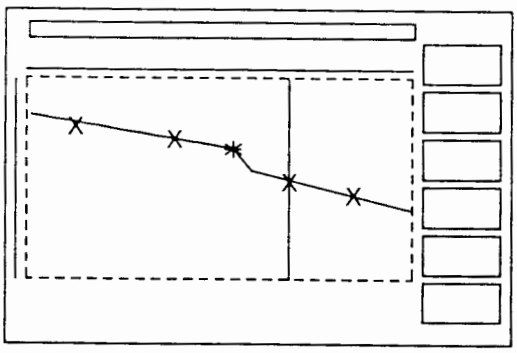
Measurement mode	Related keys	Kind, arrangement, movement and number of displayed markers
Loss	SPL&DZL Splice Loss	 One X marker and one ✳ marker ***Note:*** × and ✳ move independently.
Splice	SPL&DZL Splice Loss	 One ✳ marker Four X markers ***Note:*** When the cursor is on the ✳marker, these 5 markers move simultaneously. When the cursor is on the × marker, it moves independently.
Loss, Splice, Dead Zone Loss	SPL&DZL Splice Loss	 One ✳ marker and 6 X markers. When the cursor is on the✳ marker, these 7 markers move simultaneously. When the cursor is on the × marker, it moves independently.
AUTO	Auto	 One ✳ marker at selected fault location Each the two X markers at the left and right of other fault locations and selected fault location. ***Note:*** The rotary knob cannot move the marker.

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Table 5-1 Kind, Arrangement, Movement and Number of Markers (Continued)

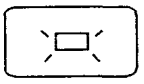
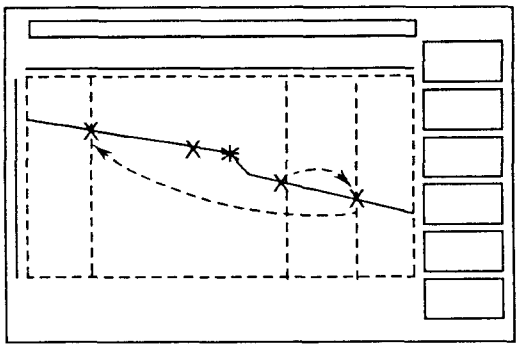
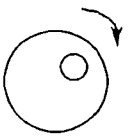
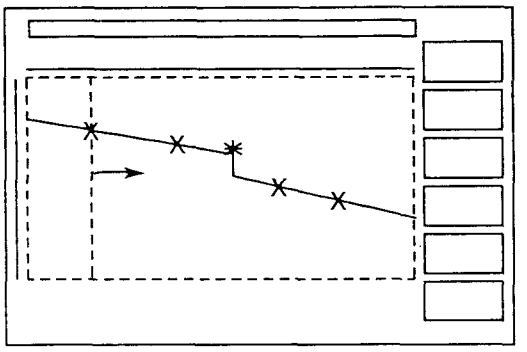
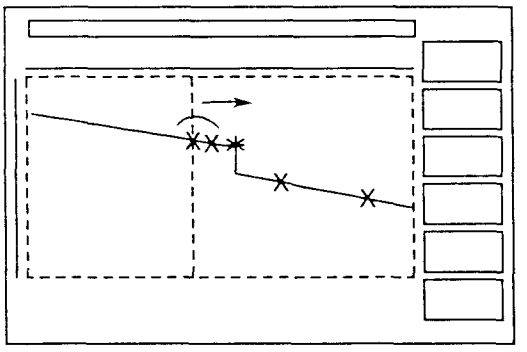
Measurement mode	Related keys	Kind, arrangement, movement and number of displayed markers
RETURN LOSS	RETURN LOSS R. LOSS PARA	 One × marker and one ✳ marker ***Note:*** When the cursor is on the ✳ marker, these 2 markers move simultaneously. When the cursor is on the × marker, it moves independently.

5.2.1 Examples of selecting and moving markers

Key operation	Screen display	Description
Marker 		The [Marker] key lamp lights.
Marker 		When the [Marker] key is pressed again, the cursor moves to another marker position (in the rightward direction).

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(Continued)

Key operation	Screen display	Description
Marker  (Pressed twice)		Each time the [Marker] key is pressed, the cursor cyclically moves along the markers.
Clockwise 		When the rotary knob is turned clockwise, the marker and cursor move in the rightward direction simultaneously. When turned counterclockwise, the marker and cursor move in the leftward direction.
– NOTE –		
		When a marker comes in contact with the righthand-side marker while moving in the rightward direction, these two markers move together. When the marker moves in the leftward direction next, the righthand-side marker is left in place.

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5.2.2 Markers outside scale area

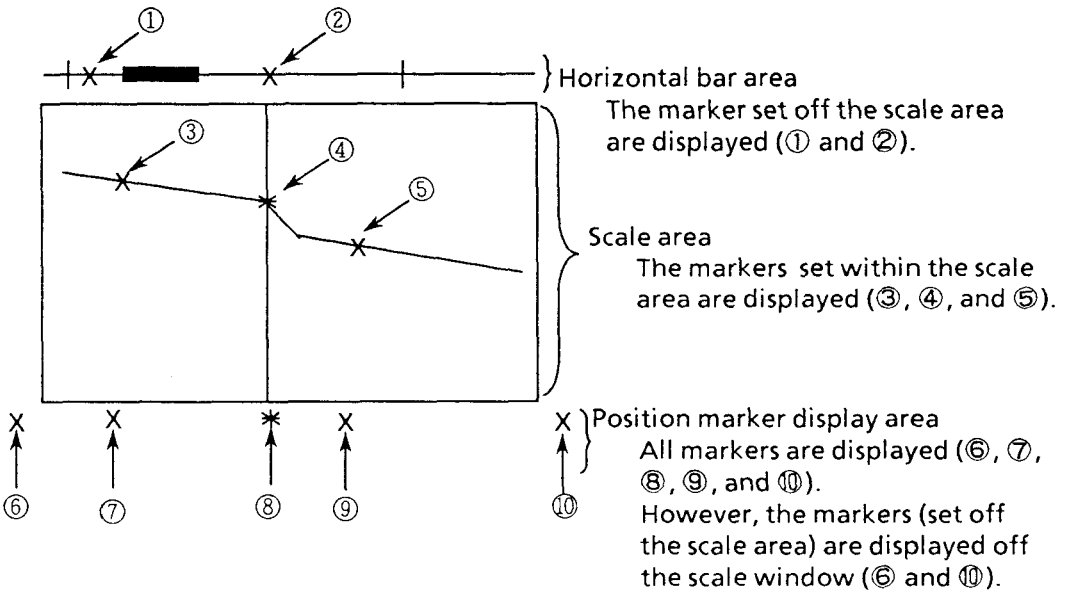
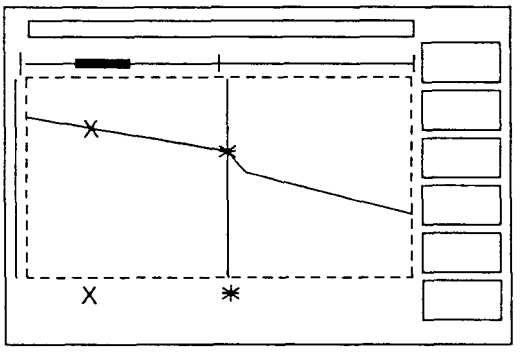
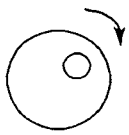
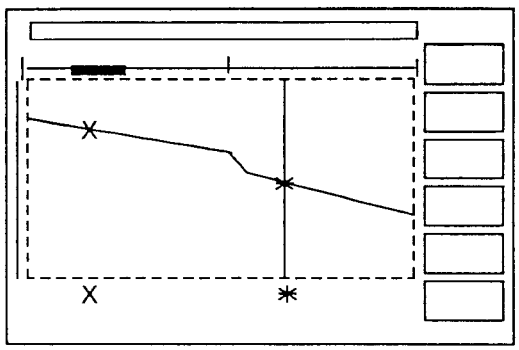
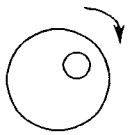
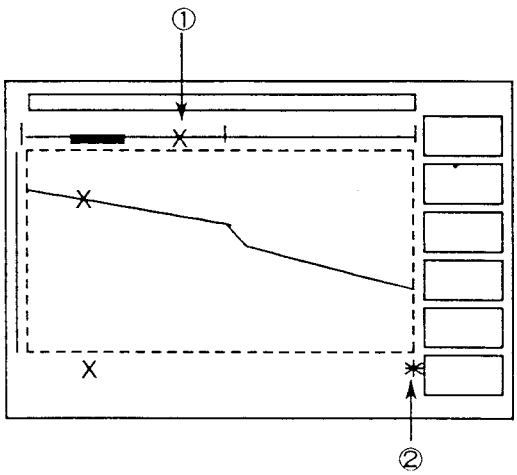


Fig. 5-1 Marker Display Area

Key operation	Screen display	Description
Marker 		Select the * marker.

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(Continued)

Key operation	Screen display	Description
		Move the * marker.
		Move the * marker off the scale area. The marker appears in the horizontal bar area (①). The * marker disappears from the scale area. The * marker stops at the edge of the position marker display area (②).

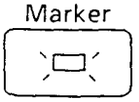
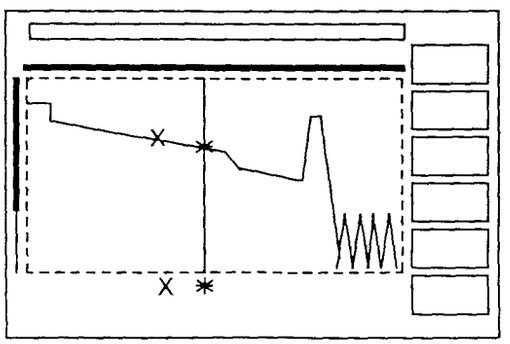
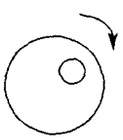
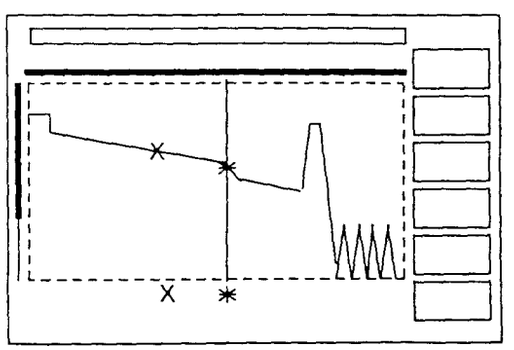
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5.3 Setting Vertical-Axis and Horizontal-Axis Shifts and Scale

To set the vertical-axis and horizontal-axis shifts, press the [V-Shift] and [H-Shift] keys and, after confirming that the key lamps are on, turn the rotary knob.

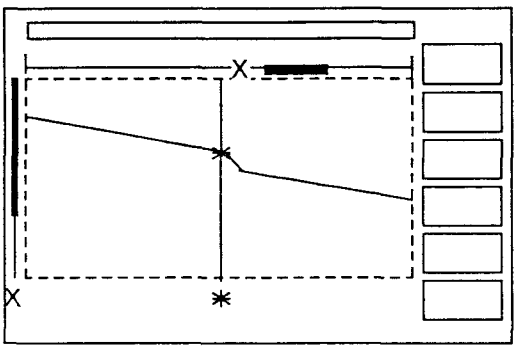
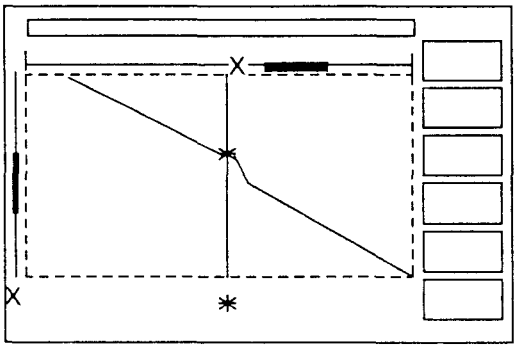
To zoom in or out the vertical and horizontal axes, use the [V-Zoom] and [H-Zoom] keys. Each time the keys are pressed, the axes are zoomed in or out with the discrete scale. The waveform (displayed on the screen when pressing the [V-Zoom] or [H-Zoom] key) is zoomed in or out around the selected marker (the one overlapped with the cursor) by setting it at the center of the scale area. At this time, if zoomed in while the cursor is positioned at any other marker than the one that not wanted to be zoomed in, the desired waveform may not be observed. (For more details, see paragraph 5.3.2.)

5.3.1 Examples of expanding fault location and shifting vertical/horizontal axes

Key operation	Screen display	Description
Marker 		Select the * marker.
		Position the marker at the fault location.

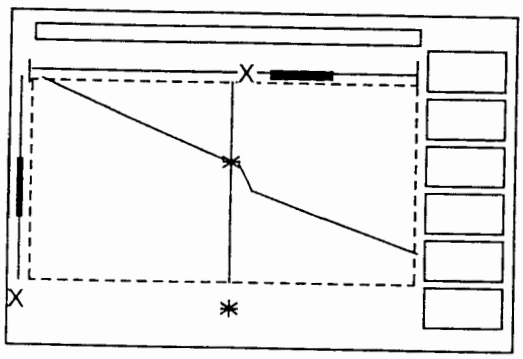
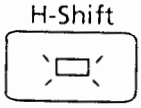
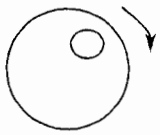
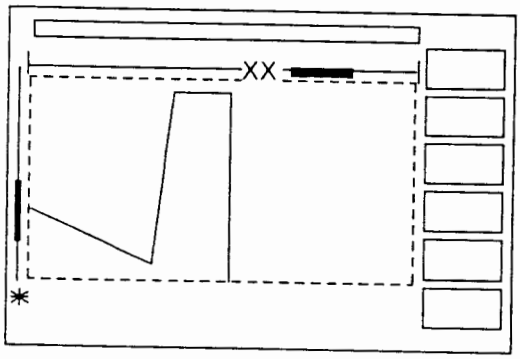
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(Continued)

Key operation	Screen display	Description
H-Zoom In		The horizontal axis is expanded.
V-Zoom In		The vertical axis is expanded.
V-Shift	Same as above	The [V-Shift] key lamp lights. The MW9060A enters the vertical-axis shift mode.

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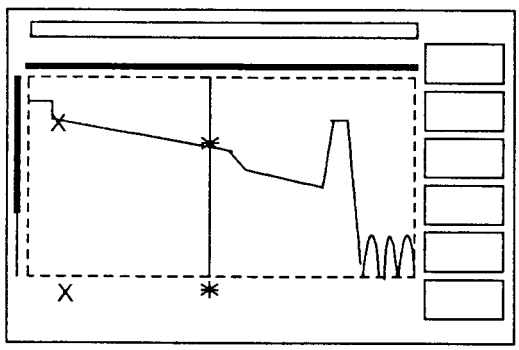
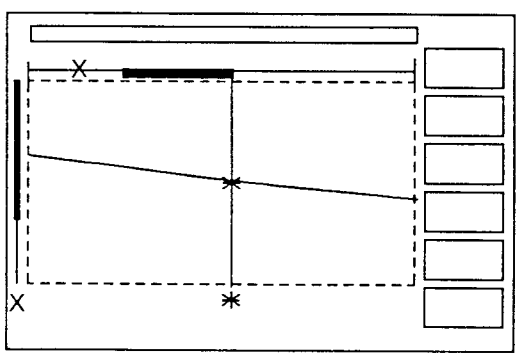
(Continued)

Key operation	Screen display	Description
		The waveform moves in the vertical-axis direction, an enlarged waveform at the fault location can be obserbed.
H-Shift 	Same as above.	The [H-Shift] key lamp lights. The MW9060A enters the horizontal- axis shift mode.
		The waveform moves in the horizontal-axis direction, an enlarged waveform of Fresnel reflection can be observed.

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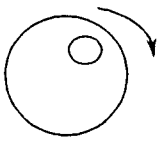
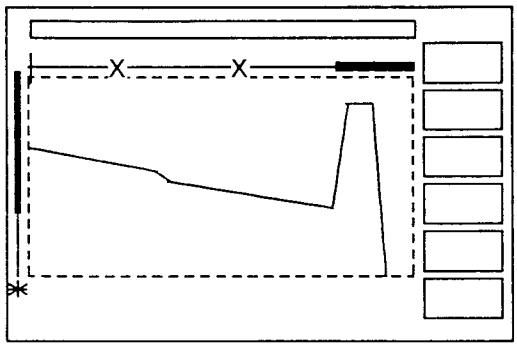
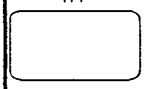
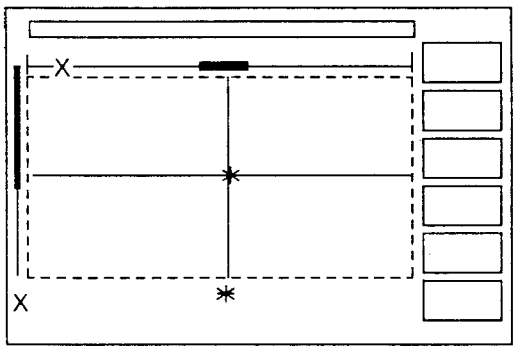
5.3.2 Examples of operation failure

Shown here is an example of operation failure that may be encountered when expanding waveforms. Be careful not to commit such error.

Key operation	Screen display	Description
		The * marker is selected.
H-Zoom In		The horizontal axis is expanded entering around the * marker.
H-Shift	Same as above.	The [H-Shift] key lamp lights. The MW9060A enters the horizontal-axis shift mode.

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(Continued)

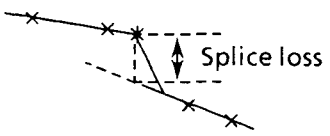
Key operation	Screen display	Description
		Shift the waveform in the horizontal-axis direction to have the waveform near the fault location displayed on the screen.
H-Zoom In 		Although attempted to expand a place near the fault location, an entirely different place is expanded. This is because the marker and cursor are not positioned at the place that wanted to be expanded.

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5.4 Selecting Measurement Mode (Splice/Loss) and Approximation Method (LSA/2PA)

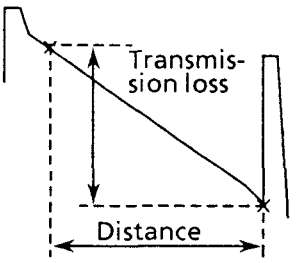
When measuring loss, use one of the three modes (Splice/Loss) available with the MW9060A according to the purpose.

(Splice mode)



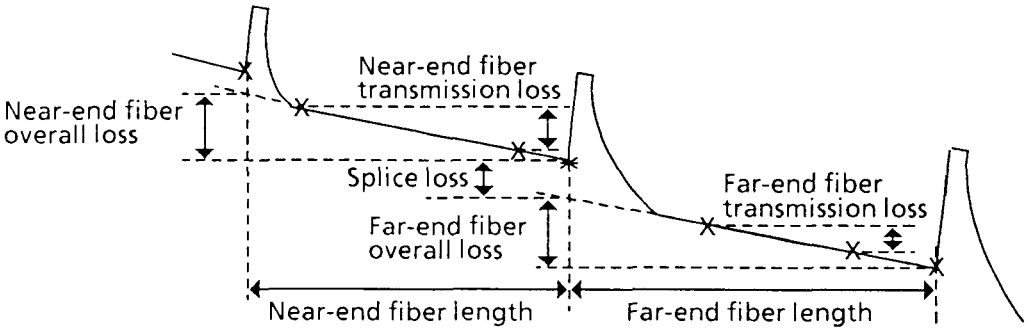
Measure splice loss at the connecting point (connector or fusion connection).

(Loss mode)



Measure transmission loss and distance between two arbitrary points.

(Splice loss and dead zone loss)



The splice loss at the connection point (connector or fusion connection), overall loss of the near-end and far-end fibers, including the dead zone loss before and after the splice, and the length and transmission loss of the near-end and far-end fibers are measured.

Fig. 5-2 Measurement Modes

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Also, two linear approximation methods are provided that can be used according to the purpose when measuring loss.

These include the Least Square Approximation (LSA) and Two Point Approximation (2PA).

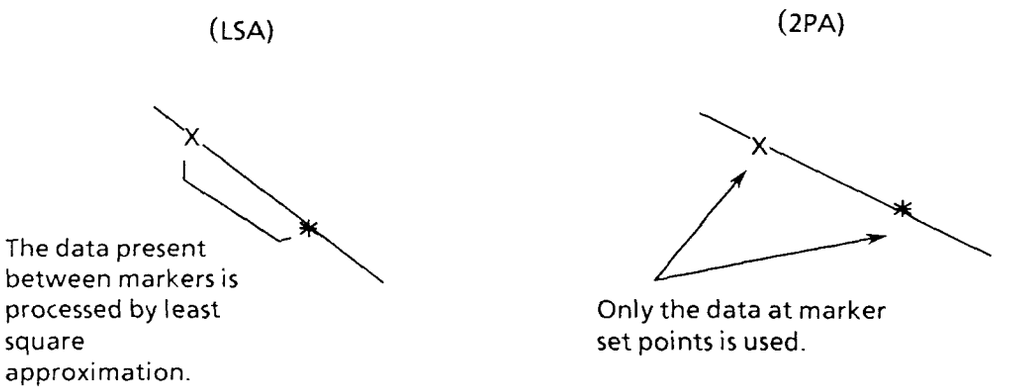


Fig. 5-3 Linear Approximation Methods

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Figure 5-4 shows the difference in measurement results between the two methods of linear approximation.

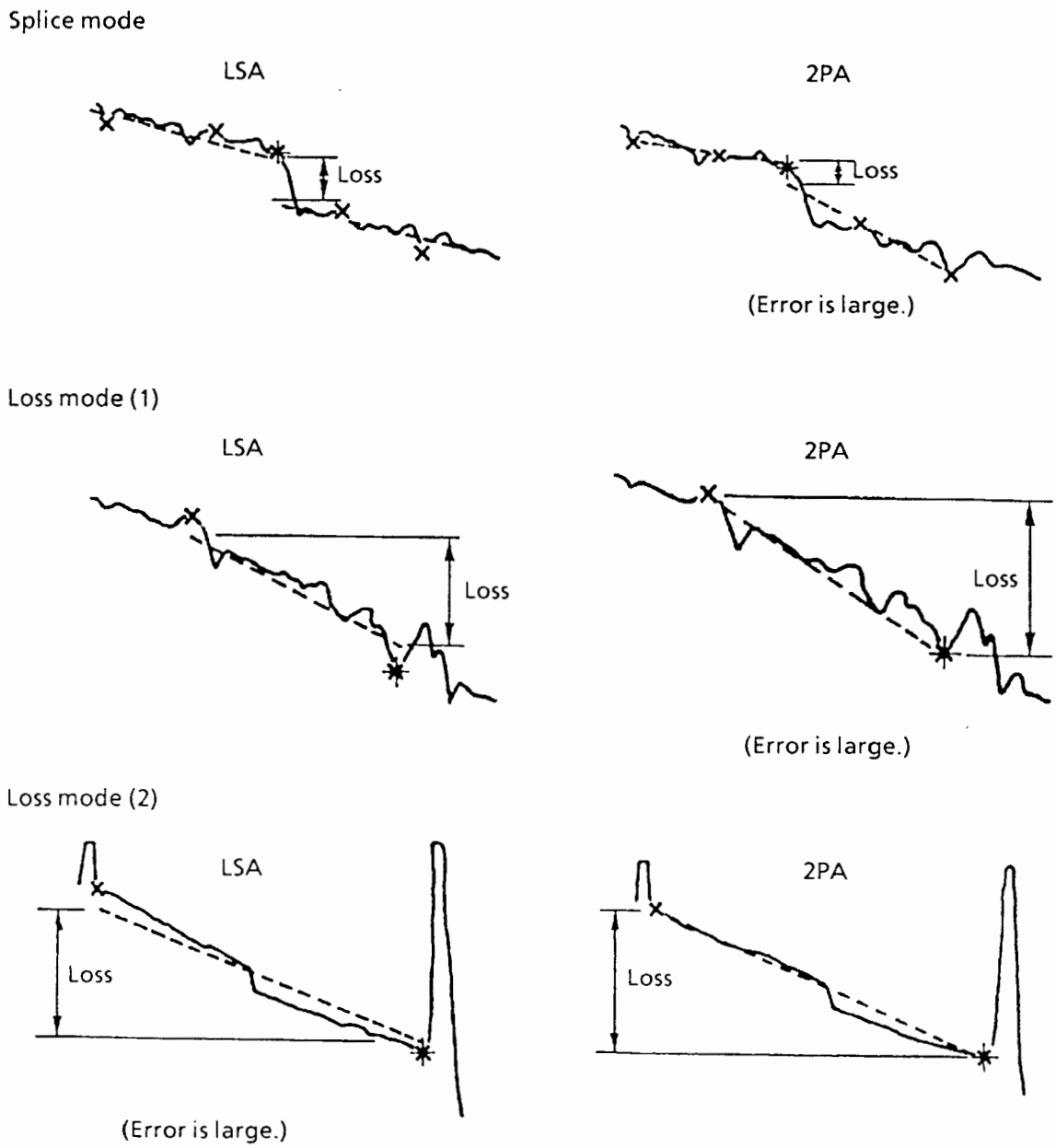


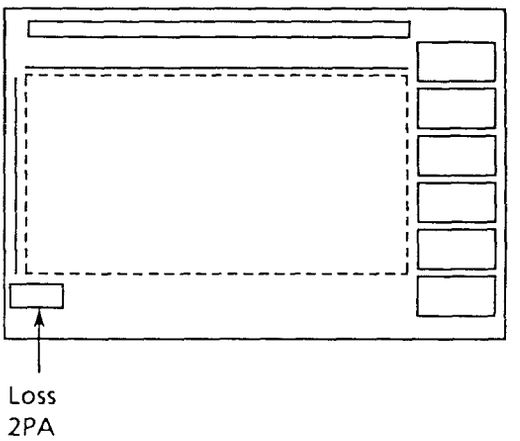
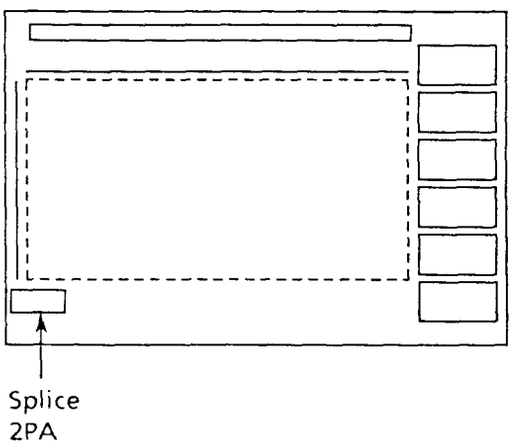
Fig. 5-4 Measurement Modes vs. Approximation Methods

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The LSA method comes in two types: ALL and DISP. The LSA (ALL) method executes the LSA processing using all measured data including those not displayed on the screen. The LSA (DISP) method executes the LSA processing using only the data displayed on the screen. The LSA (ALL) method takes a longer time to process data than LSA (DISP), but it does approximation with fewer errors.

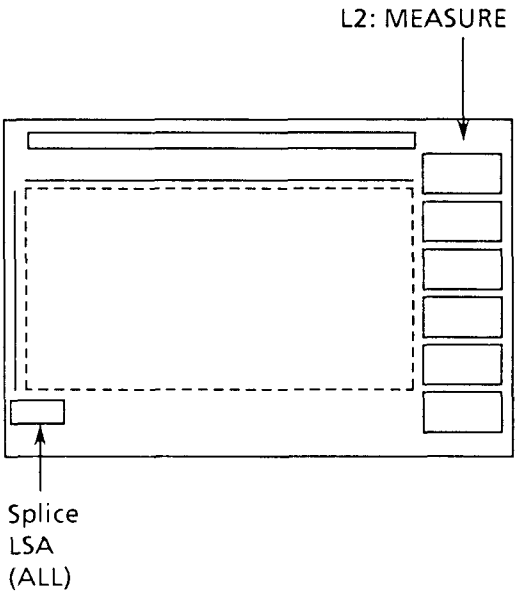
The smoothing processing (paragraph 5.19) reduces the noise to make more accurate measurement.

5.4.1 Example of setting when measuring splice loss with LSA

Key operation	Screen display	Description
		
SPL&DZL Splice Loss		The Splice lamp lights.
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.

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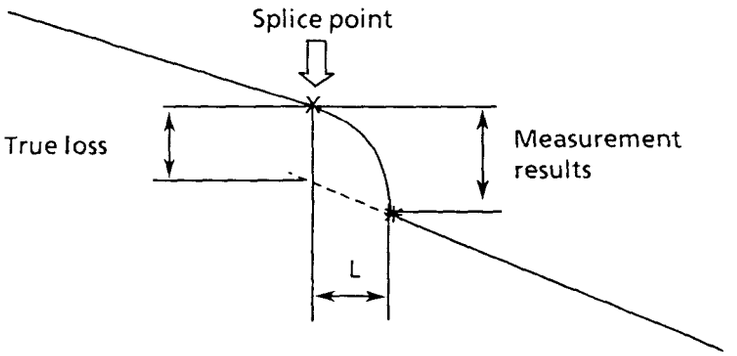
(Continued)

Key operation	Screen display	Description
MEASURE	L2: MEASURE LSA/2PA AUTO CONDITION ⋮	The soft key is brought to the MEASURE layer.
LSA/2PA	L3: LSA/2PA LSA(ALL) LSA (DISP) 2PA ⋮	The soft key is brought to the LSA/2PA layer.
LSA (ALL)		The screen display changes from 2PA to LSA (ALL). The soft key returns to the MEASURE layer.

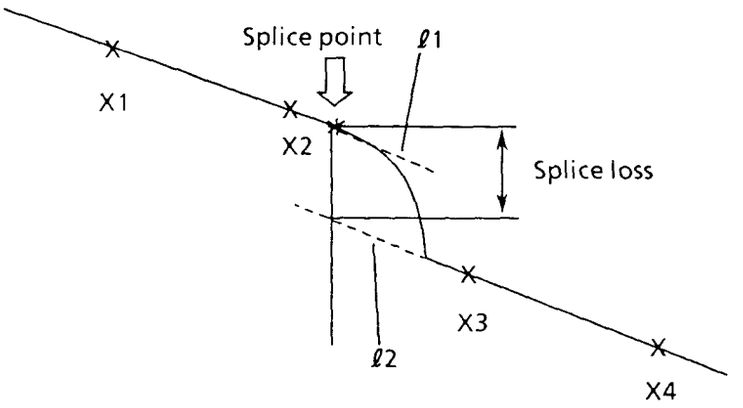
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5.4.2 Principle of splice measurement

At a splice point, there is a section (indicated by L in the diagram below) where back scattered light cannot be detected. (The distance varies with the pulse width). When measurement is made in Loss mode (measurement between two points), loss in section L is not taken into account and accuracy is reduced accordingly.



The following shows the method of calculation in Splice mode. Approximated line $\ell 1$ of the fiber before the splice point is obtained from X1 and X2 markers; approximated line $\ell 2$ of the fiber after the splice point (except section L where back scattered light cannot be detected) is obtained from X3 and X4 markers. Loss at the splice point (* marker) is calculated from $\ell 1$ and $\ell 2$.



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5.4.3 Approximated line by LSA

Least Square Approximation (LSA) is a method where all data (present between markers) have minimum dispersions relative to the approximated line. Therefore, this method is effective in cases when measurement results for an optical fiber (having consistent transmission loss) contain much noise.

As shown to the right, $\ell \equiv y = a + bx$ is assigned for n pieces of points (x1, y1), (x2, y2), ... , (xn, yn), and deviation δ_i from ℓ is calculated for each point. Then, parameters a and b are obtained that minimize the sum E of the square of these deviations.

$$E = \sum_{i=1}^{n} \delta_i^2 = (y1 - a - bx1)^2 + (y2 - a - bx2)^2 + \cdots\cdots\cdots + (yn - a - bxn)^2$$

From this equation,

$\frac{\partial E}{\partial a} = 0$ and $\frac{\partial E}{\partial b} = 0$ are the necessary and sufficient conditions for E to be minimum and smallest.

By solving this, the next equations are obtained.

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

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

Where,

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

From the above, the approximated line closest to n pieces of points, that is, y = a + bx can be obtained.

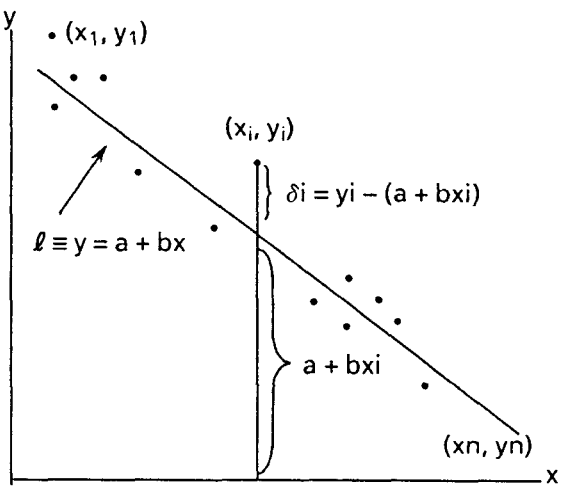
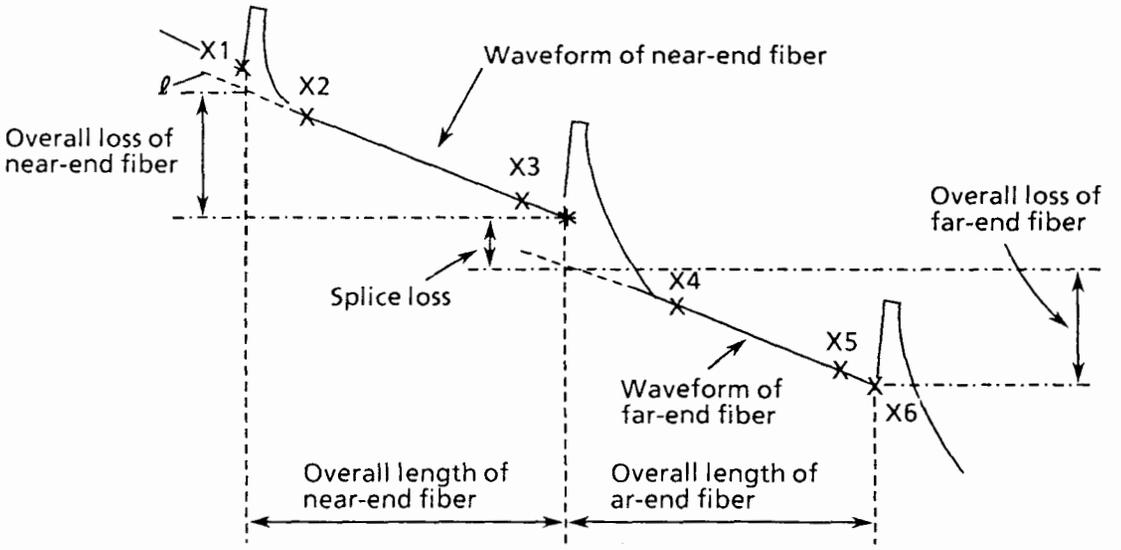


Fig. 5-5 Data and Approximated Line

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5.4.4 Principle of splice loss & dead zone loss (SPL&DZL) measurement

If measurement of the overall loss of the fiber before and after a splice is tried when multiple fibers are connected, accurate measurements cannot be made because there is a dead zone where the back scattered light cannot be detected as described in paragraph 5.4.2 "Principle of splice measurement".



In the SPL&DZL mode, the approximated straight line ℓ is found with the X2 and X3 markers. The loss of the part corresponding to the dead zone is calculated from this ℓ and the overall loss produced over the entire length of the fiber from the X1 marker to the ✳ marker is computed. Therefore, the X1 and ✳ markers must be set to the fiber splice point and the X2 and X3 markers must be set to the straight part of the waveform. Similarly, the overall length, overall loss, and transmission loss of the fiber before and after the ✳ marker are displayed simultaneously by setting the X4 and X5 markers to the straight part of the waveform and setting the X6 marker to the next splice point.

For an example of marker setting, see paragraph 6.6.

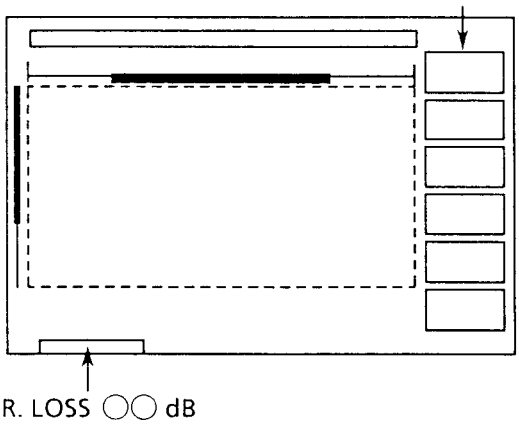
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5.5 Return Loss (Reflection Factor) Measurement Mode

The return loss (reflection factor) is computed from the Fresnel reflection at the connector and the amount of immediate back scattered light it produces, and the measured results are displayed. Press the [RETURN LOSS] key or the [R. LOSS PARA] key in the MEASURE layer to enter Return Loss Mode.

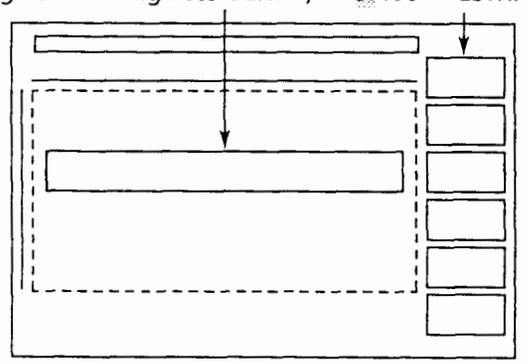
Note: If the Fresnel reflection is saturated, the return loss will not be measured correctly. In this case, use the internal or an external attenuator so that the Fresnel reflection is not saturated.

5.5.1 Setting return loss mode

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
MEASURE	L2: MEASURE LSA/2PA AUTO CONDITION ⋮	The soft key is brought to the MEASURE layer.
RETURN LOSS	L2: MEASURE  R. LOSS ○○ dB	Return Loss Measurement Mode is activated and the result is displayed on the lower left of the screen. ***Note:*** The parameters of the fiber should be set correctly in the R. LOSS-PARA layer.

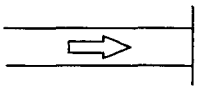
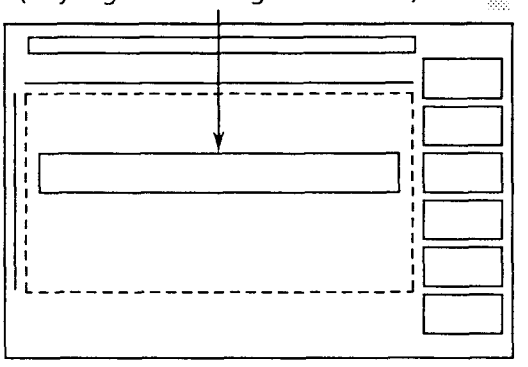
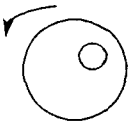
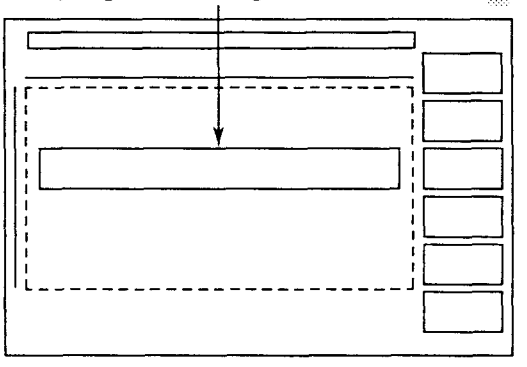
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5.5.2 Setting the fiber parameters for return loss measurements

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
MEASURE	L2: MEASURE LSA/2PA AUTO CONDITION ⋮	The soft key is brought to the MEASURE layer.
R. LOSS PARA	RSL (Rayleigh Scattering Loss:dB/km) = 0.400 L3:R. LOSS-PARA 	The screen display changes to the parameter setting screen for return loss measurements. (The first character position of the rayleigh scattering loss parameter (RSL) displayed on the screen is reversed.)

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(Continued)

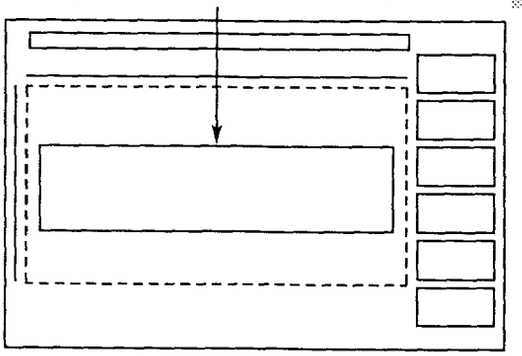
Key operation	Screen display	Description
	RSL (Rayleigh Scattering Loss:dB/km) = 0.400 	Use the arrow [→] key to select the digit to be changed.
	RSL (Rayleigh Scattering Loss:dB/km) = 0.300 	Change the setting with the rotary knob.
	(Use the arrow key and the rotary knob to change the settings. The display will be as shown below.)	

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(Continued)

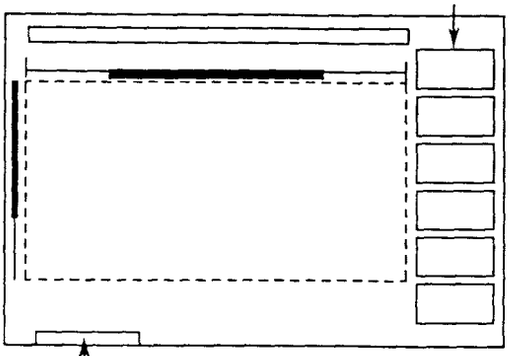
Key operation	Screen display	Description

RSL (Rayleigh Scattering Loss:dB/km) = 0.350
N1 (Refractive Index of Core) = 1.4666
N2 (Refractive Index of Clad) = 1.4616
Ne (Group Refractive Index of Fiber) = 1.4655



L2: MEASURE

SET



R. LOSS ○○ dB

Sets the fiber parameters.
The soft key returns to the MEASURE layer.

Note: When returned to MEASURE layer by pressing [Prior] without [SET], the parameter setting returns to the previous state before entering the R. Loss-PARA layer.

Parameter Ranges RSL :0.005 to 9.999
N1 :1.0000 to 1.9999
N2 :1.0000 to 1.9999
Ne :1.0000 to 1.9999
BSL : −00.000 to −99.999

1. When the values for RSL, N1, N2, and Ne are entered, the BSL will be displayed as ***. ***. The BSL is automatically computed and the result is displayed. If the BSL value cannot be computed correctly, error occurs.
2. When the BSL value is entered;RSL, N1, N2, and Ne will be displayed as *. ****.
3. When the pulse width setting is changed, the BSL value will be automatically recomputed.

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5.5.3 Computing return loss

Return loss is computed as follows:

$$\text{R. Loss (dB)} = -(10\log_{10}\text{bsl} + 10\log_{10}(10^{L/5} - 1))$$

$$\text{bsl} = S \cdot \alpha_R \cdot V \cdot \frac{W}{2}$$

$$S = K \cdot \frac{N1^2 - N2^2}{N1^2}$$

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

$$\alpha_R\,(\text{np/m}) = 0.23026 \times 10^{-3} \times \text{RSL}$$

$$K = 0.21\ (\text{SM fiber})$$

$$0.25\ (\text{GI fiber})$$

$$C\,(\text{m/s}) = 3 \times 10^8$$

$$W\,(\text{sec}) = \text{Current pulse-width setting}$$

R. Loss: Return loss
L: Level difference between X marker and * marker
BSL: $10\log_{10}$ (Back scattered light level)
S: Index of back scattering
α_R: Rayleigh scattering loss (np/m)
RSL: Rayleigh scattering loss (dB/km)
V: Group velocity in the optical fiber
K: Optical fiber constant
N1: Refractive index of the optical fiber's core
N2: Refractive index of the optical fiber's clad
Ne: Effective group refractive index of the optical fiber
C: Speed of Light

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5.6 Setting the Measurement Conditions for Auto Fault Location

By pressing the [Auto] key, it is possible to automatically detect fault locations in the measurement waveform shown on the screen and to set markers at points assumed to be fault locations. The cursor is positioned at the near-end marker point, but is sequentially moved toward the far-end marker points each time the [Marker] key is pressed.

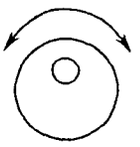
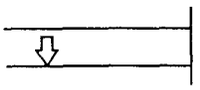
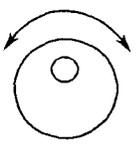
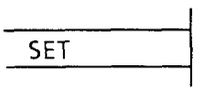
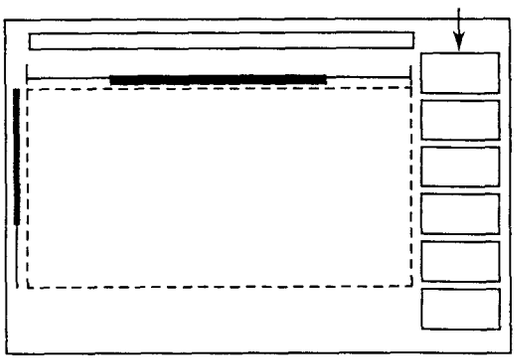
In auto fault location, the points where the loss is greater than the designated value are assumed to be fault locations. The designated value can be set to 0.05, 0.10, 0.30, 1.00, 3.00, or 5.00 dB as selected from the THRESHOLD value of the AUTO CONDITION layer of the soft key. Whether only the data (DISP) shown on the screen or all the measurement data (ALL) is used in fault location detection can also be selected. Using all the measurement data increases detection precision, but also increases the time needed for detection.

5.6.1 Example of measurement conditions (THRESHOLD, DATA SELECT) setting

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
MEASURE	L2: MEASURE LSA/2PA AUTO CONDITION ⋮	The soft key is brought to the MEASURE layer.
AUTO CONDITION	THRESHOLD = 0.05dB L3: AUTO CONDITION	The AUTO CONDITION layer is displayed on the screen and the current THRESHOLD value is reverse displayed.

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(Continued)

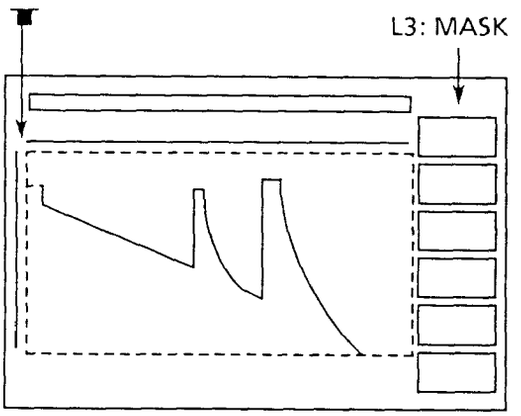
Key operation	Screen display	Description
	THRESHOLD = 0.10dB	The THRESHOLD value is changed.
	DATA SELECT : DISP	The current type of fault location detection data is reverse displayed.
	DATA SELECT : ALL	The type of fault location detection data becomes all measurement data.
	L2: MEASURE 	The THRESHOLD value and type of fault location detection data are set to 0.10dB and all measurement data, respectively. The soft key is returned to the MEASURE layer. ***Note:*** When the soft key is returned to the MEASURE layer with the following keys without pressing the [SET] key, the THRESHOLD/DATA SELECT settings are returned to their value before the AUTO CONDITION layer was entered. Prior, Marker, V-Shift, H-Shift When the [Auto] key was pressed, "AUTO" is displayed at the bottom left corner of the screen and the current THRESHOLD value and the type of fault location detection data are displayed to the right of it.

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5.7 Setting and Clearing Mask

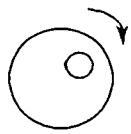
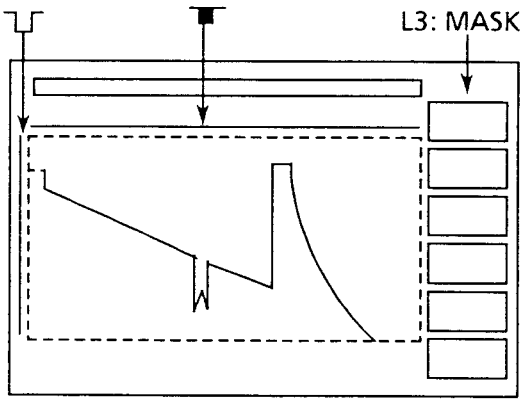
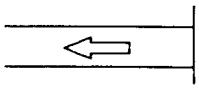
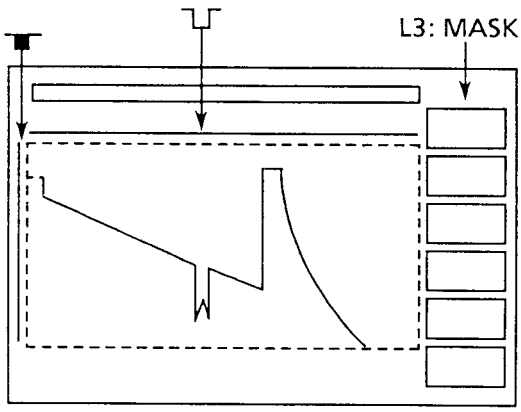
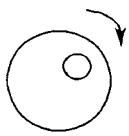
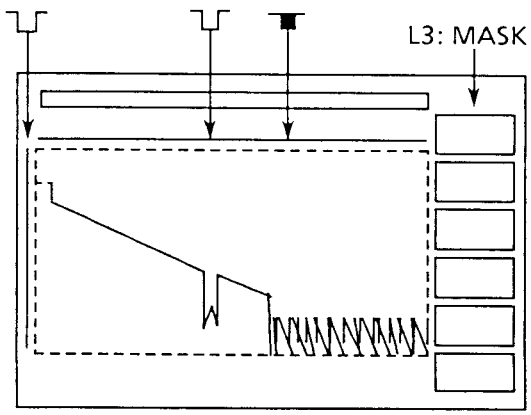
When the waveform is distorted by large Fresnel reflection, correct measurement cannot be taken. A mask is used to attenuate such Fresnel reflection to improve waveform linearity.

5.7.1 Example of setting mask

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
CONDITION	L2: CONDITION DISTANCE PULSE ATT MASK ⋮	The soft key is brought to the CONDITION layer.
MASK		The soft key is brought to the MASK layer. The cursor disappears and a mask marker (▛) is displayed on the upper left of the scale.

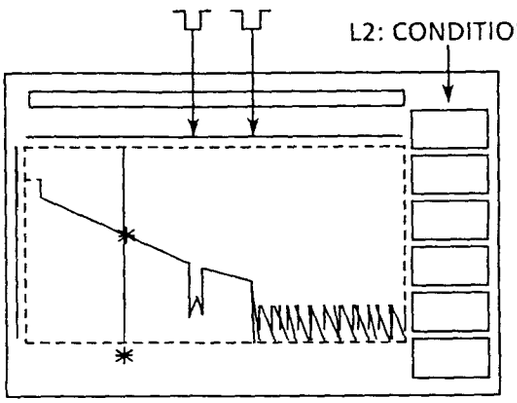
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(Continued)

Key operation	Screen display	Description
		Fresnel reflection is attenuated as the marker is moved to the first Fresnel reflection point.
		A mask is set and another mask marker is selected. ▮ : Selected (movable) mask marker ⊓ : Unselected (unmovable) mask marker
		Fresnel reflection is attenuated as the mask marker is moved to the second Fresnel reflection point.

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(Continued)

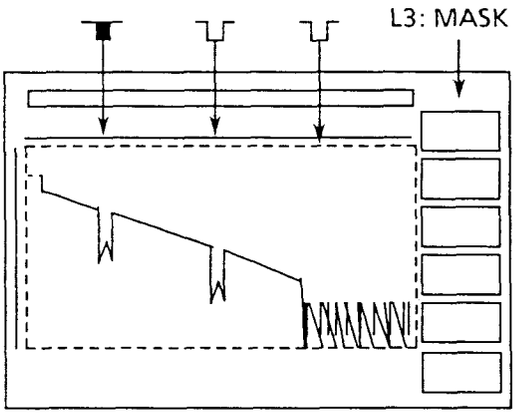
Key operation	Screen display	Description
SET		A mask is set and selected mask markers are none. The cursor is displayed. The soft key returns to the CONDITION layer.

Note: When returned to the CONDITION layer by pressing [Prior], [Marker], [V-Shift], or [H-Shift] without [SET]; the mask setting returns to the previous state before entering the MASK layer.

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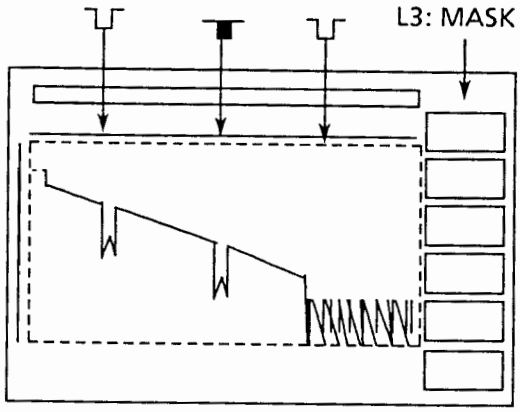
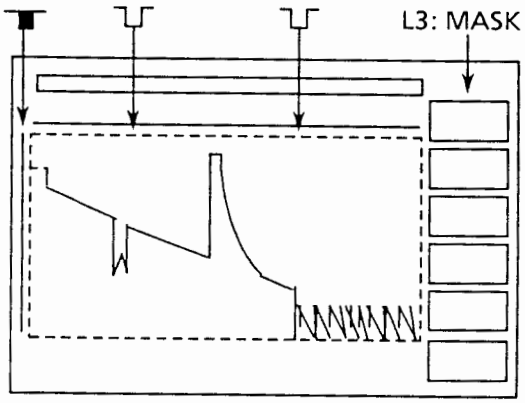
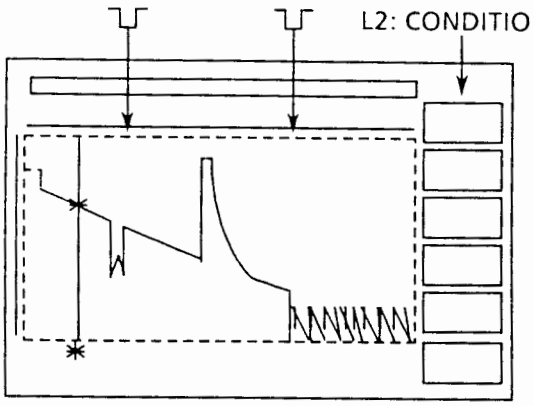
5.7.2 Example of clearing mask

Assume that three masks are set. In this example, clear one of the three masks first and then clear the other two masks by all mask clear operation.

Key operation	Screen display	Description
When clearing one mask		
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
CONDITION	L2: CONDITION DISTANCE PULSE ATT MASK ⋮	The soft key is brought to the CONDITION layer.
MASK	L3: MASK 	The soft key is brought to the MASK layer. The cursor disappears and mask markers are displayed. The mask marker that was last selected in the previous mask setting is indicated by ▼.

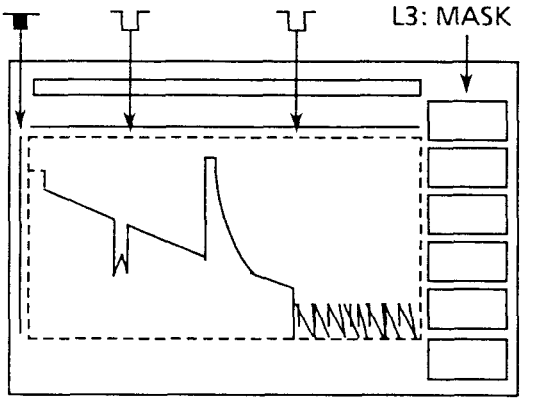
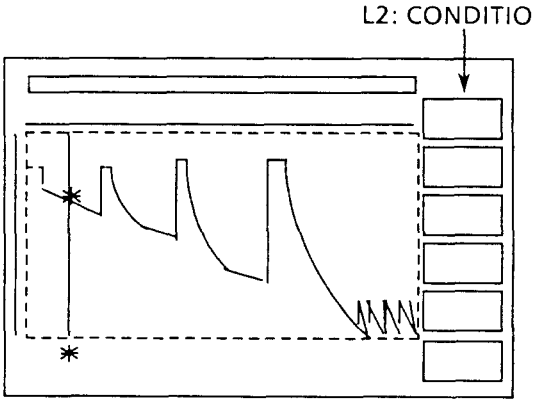
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(Continued)

Key operation	Screen display	Description
⇨		The mask marker to be cleared is selected by the soft keys [→] and [←].
CLEAR		The selected mask marker is moved to the left edge of the scale. Fresnel reflection waveform appears.
SET		One mask is cleared, and there is no selected mask marker. The cursor is displayed. The soft key returns to the CONDITION layer. ***Note:*** When returned to the CONDITION layer by pressing [Prior], [Marker], [V-Shift], or [H-Shift] without [SET]; the mask setting returns to the previous state before entering the MASK layer.

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(Continued)

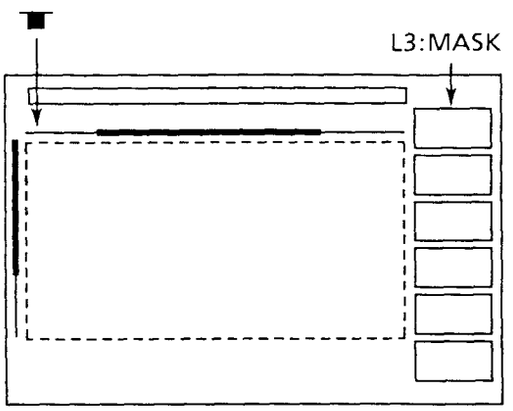
Key operation	Screen display	Description
When clearing all masks		
MASK		The soft key is brought to the MASK layer. The cursor disappears and mask markers are displayed. The mask marker that was last selected in the previous mask setting is indicated by ⌐⌐.
ALL CLEAR		All masks are cleared, and the soft key returns to the CONDITION layer. The cursor is displayed.

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5.8 Varying Near-End Mask Width

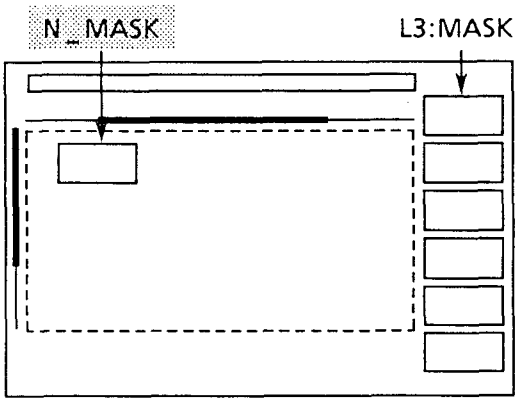
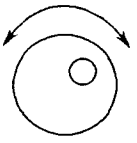
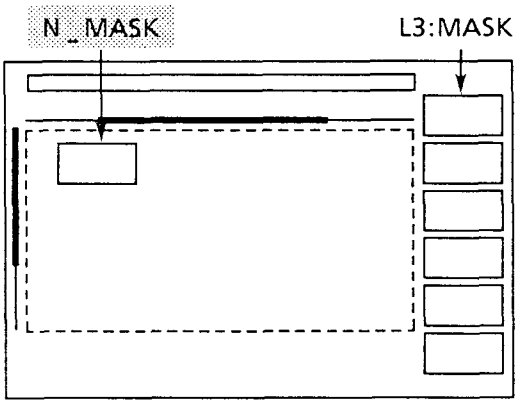
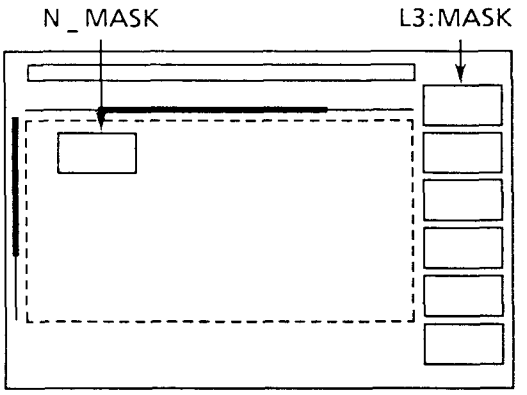
When there are plural connecting points between the MW9060A and the fiber to be measured, only one mask can cover from the near-end of the MW9060A to the fiber to be measured by using near-end mask-width variable mode (NEAR END mode). There are no needs to set corresponding plural masks at the points.
In contrast, when a connector with a large return-loss value is used, the near-end dead zone becomes short by narrowing the near-end mask width. Then the fiber can be measured at the nearer end.

Note: Some plug-in unit cannot use this function. (See paragraph 1.5.)

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
CONDITION	L2: CONDITION DISTANCE PULSE ⋮	The soft key is brought to the CONDITION layer.
MASK		The soft key is brought to the MASK layer. The cursor disappears and mask marker is displayed.

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(Continued)

Key operation	Screen display	Description
NEAR END		The near-end mask-width variable mode (NEAR END mode) is set to reverse-display "N _ MASK" on the upper left.
		Set the mask width with the rotary knob. Turn on [Coarse] key to increase the step-change amount of mask width. ***Note:*** When the mask width is changed during averaging On, the averaging turns Off. Press [SET] or [Prior] to restart the averaging.
SET		Sets the near-end mask width. "N _ MASK" label is reverse-displayed. The soft key returns to the CONDITION layer. ***Note:*** If returned to the CONDITION layer with the [Prior] key without the [SET] key, the near-end mask setting returns to the preveous setting before entering the MASK layer.

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- When the [←] key is pressed with the most-left mask marker selected in ordinary mask setting mode, the NEAR END mode is fetched.
- When the [→] key is pressed in the NEAR END mode, the ordinary mask setting mode is fetched.
- When the [CLEAR] key is pressed in the NEAR END mode, the set near-end mask width is returned to the specific value and the ordinary mask setting mode is fetched.
- When the [ALL CLEAR] key is pressed, both the ordinary masks and near-end mask are cleared.
- In NEAR END mode, "N _ MASK" is displayed at the upper left.
- The variable range of the mask width is the specific value −10 m to +500 m for IOR = 1.500000.

Note: The mask-width varying function is effective only to the near-end mask. Therefore, when the mask width is varied without a near-end waveform on the screen, the waveform on the screen does not change.

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5.9 Averaging

5.9.1 Averaging Start and Limit Value Setting

When the [Average] key is pressed on, processing is begun for data averaging. The result of noise improvement by averaging is displayed by sweep. The amount of averaging process can be set in terms of frequency (No. of operations) or time. When the preset frequency or time is over, the laser output is automatically switched off and sweep of waveforms is stopped.

Regarding frequency or time for the amount of averaging process to be set, the limit values and setting step are as specified below.

Table 5-2 Setting Items and Limit Values for Averaging

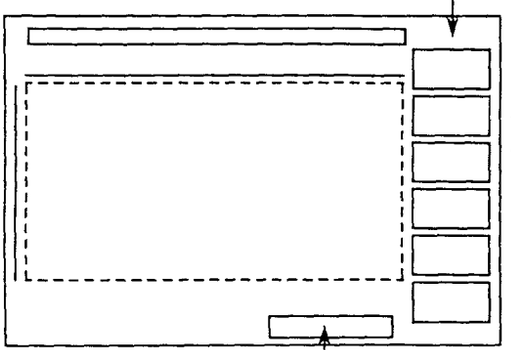
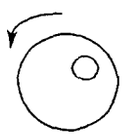
Setting item	Limit value	Setting step
Frequency	50,000 times	10-time step for 0 to 1000 100-time step for 1000 to 5000 500-time step for 5000 to 50000
Time	43,200 seconds	10-second step for 0 to 600 60-second step for 600 to 3600 600-second step for 3600 to 43200

When setting is made with time, "S" is indicated after the setting value on the CRT screen. When the sweep mode is FAST, the maximum time is 14,400 seconds.

When a measured-fiber plug is drawn out of the optical output terminal under the condition of averaging On, the laser output is turned off and averaging is stopped. If this plug is connected again and laser output is turned on, averaging is reset.

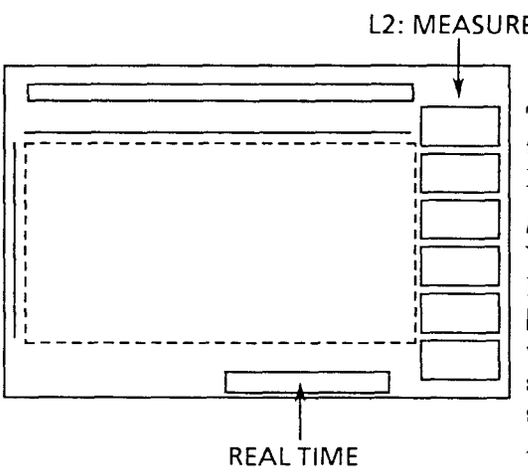
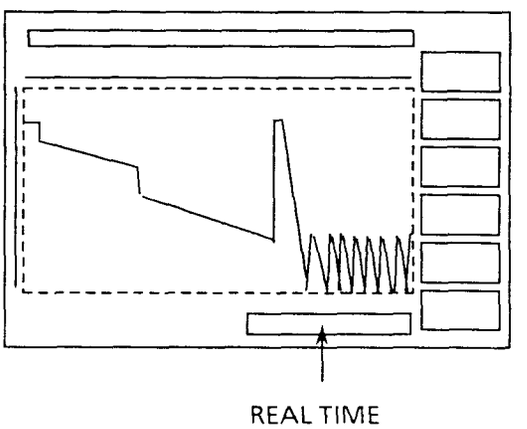
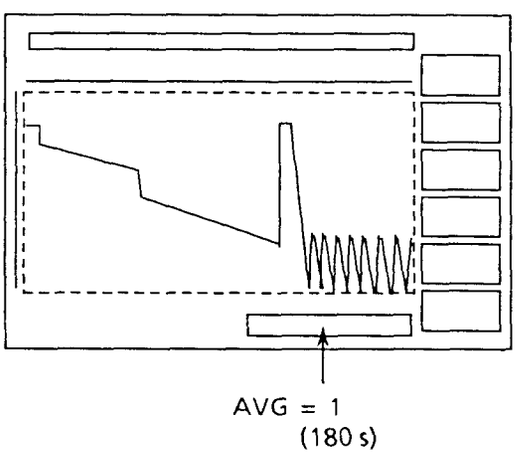
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5.9.2 Example of setting averaging limit and starting averaging

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
MEASURE	L2: MEASURE LSA/2PA AUTO CONDITION AVG. LIMIT ⋮	The soft key is brought to the MEASURE layer.
AVG. LIMIT	L3: AVG. LIMIT  AVG = 0 (5000)	The soft key is brought to the AVG. LIMIT layer. The set count displayed on the lower right of the scale is reversed.
TIME	AVG = 0 (43205)	The display changes for time indication.
	AVG = 0 (1805)	(Avraging is reset when display is changed from TIME to NUMBER or from NUMBER to TIME while averaging is on.) The displayed time changes.

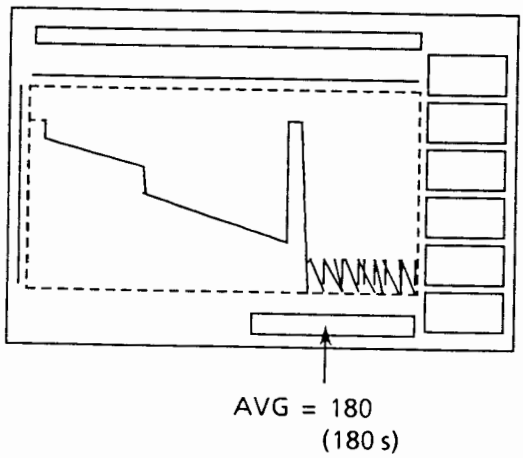
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(Continued)

Key operation	Screen display	Description
SET		The averaging time is set, and the soft key returns to the MEASURE layer. ***Note:*** When returned to the MEASURE layer by pressing [Prior], [Marker], [V-Shift], or [H-Shift] without [SET]; the Average setting returns to the previous state before entering the AVG.LIMIT layer.
Laser On Off		The waveform is swept in real time. (When above operation is executed at average Off.)
Average		Averaging is started, and noise begins to converge.

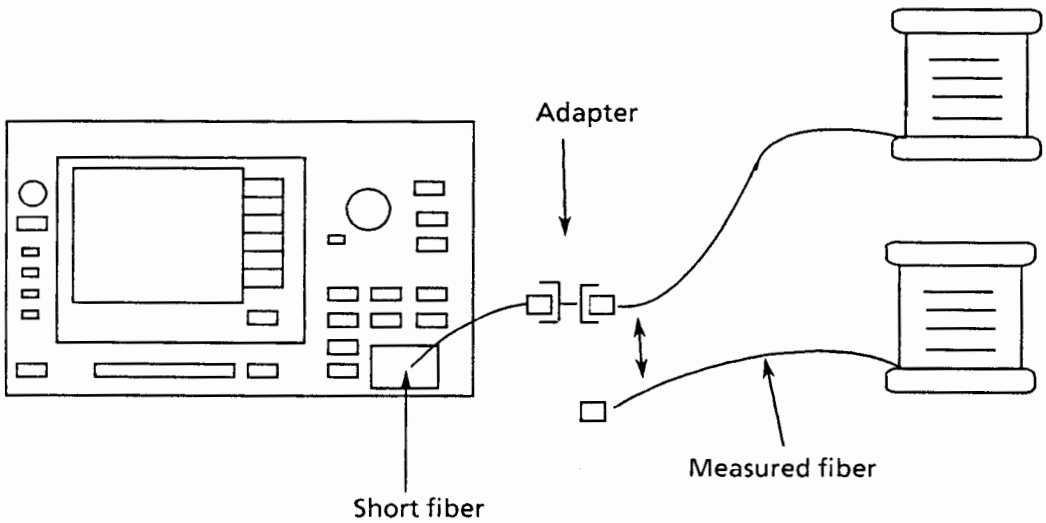
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(Continued)

Key operation	Screen display	Description
(After an elapse of 180 seconds)		The laser is automatically turned off, and the waveform sweeping stops.

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Note: When the measured fiber (connected to the Output connector via a short fiber as shown below) is replaced while averaging is on, correct waveform may not be displayed. In such a case, temporarily turn averaging off, then turn it on.



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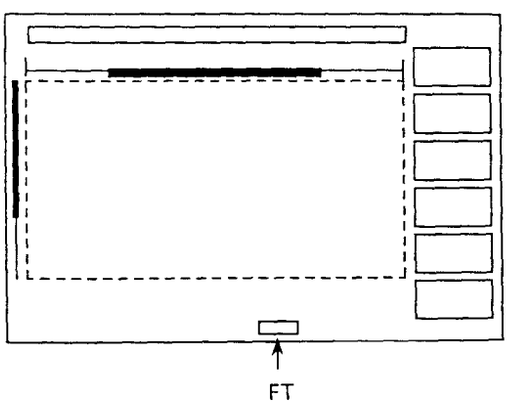
5.10 Full Trace Mode

When the FULL TRACE is set to On, then the ATT is set to AUTO mode, the AVERAGING is set to On, and the LD is set to On; the attenuator is selected automatically so that the waveform obtained at each attenuation is combined with each other to give a wide dynamic range that can be monitored in a single viewing.

This function is usefull to see the whole waveform of a long fiber cable.

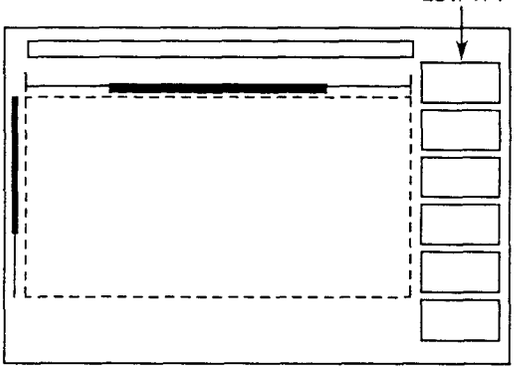
Notes:
- The FULL TRACE function cannot be used in the plug-in units with no auto-attenuator function.
- If the sweep mode is FAST, the number of averaging in switching ATT with AUTO ATT is about four times the number in the NORMAL mode.

5.10.1 Setting full trace mode

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
DISPLAY	L2: DISPLAY TITLE UNIT ⋮ FULL TRACE	The soft key is brought to the DISPLAY layer.
FULL TRACE		FT is displayed on the lower right to indicate the Full Trace mode.

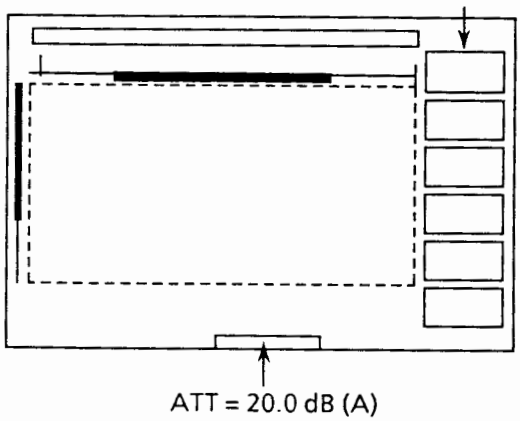
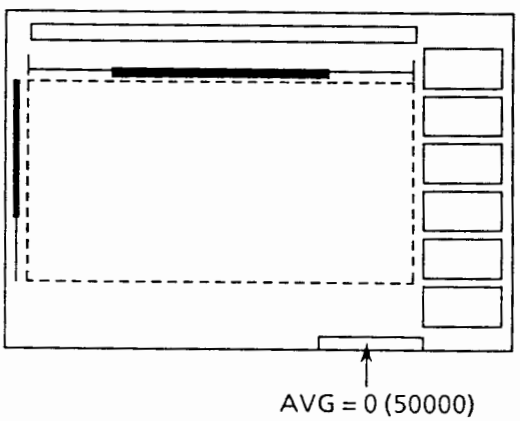
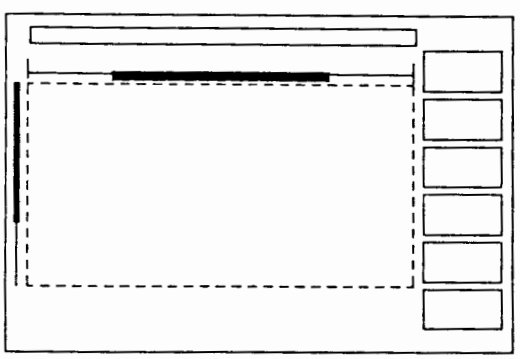
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(Continued)

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
CONDITION	L2: CONDITION DISTANCE PULSE ⋮	The soft key is brought to the CONDITION layer.
ATT	L3:ATT 	The soft key is brought to the ATT layer.

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(Continued)

Key operation	Screen display	Description
AUTO		The A (to the right of the attenuator set value under the scale) indicates that the attenuator is in AUTO mode. The soft key returns to the CONDITION layer.
Average		The number of averagings and the set value are displayed on the lower right of the screen.
On Off		Averaging is performed while the attenuator is selected automatically. The FULL TRACE waveform starts to be displayed. ***Note:*** If the Fresnel reflection is saturated, the height of the Fresnel reflection may become lower when the attenuator is changed. Since the measured waveform at each attenuation is combined together, some waveform steps may be appeared at the combined positions.

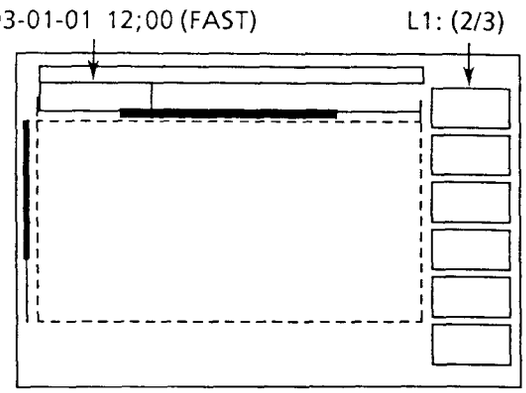
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5.11 Sweep Mode

The sweep mode can be switched to the FAST mode or NORMAL mode. The FAST mode, sweeps a waveform in approximately 0.3 seconds, is convenient to observe waveform in real-time at assembling cable connector.

Note: The sweep speed is lower when AVERAGING is set to On.
Note also that more noise is produced when sweep mode is set to FAST than when it is set to NORMAL.
When the sweep mode is FAST, the maximum averaging time that can be set is 14,400 seconds.

5.11.1 Setting sweep mode

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer (1/3).
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The soft key is brought to the first layer (2/3).
SWEEP MODE		FAST is displayed to the right of the date and sweep speed becomes fast. Everytime the [SWEEP MODE] soft key is pressed, the sweep speed changes from NORMAL to FAST and vice-versa. ***Note:*** Only FAST is displayed. NORMAL is not displayed.

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5.11.2 Sampling resolution, number of data, and range in FAST mode

The sampling resolution, number of data, and range for FAST sweep mode is shown below.

H-SCALE \ Distance range	10km	25km	50km	100km	250km
25km/div					50 → Sampling resolution [m]
					5001 → Number of sampling data
					250000 → Sampling range [m]
10km/div				20	20
				5001	5001
				100000	100000
5km/div			10	10	10
			5001	5001	5001
			50000	50000	50000
2.5km/div		5	5	5	5
		5001	5001	5001	5001
		25000	25000	25000	25000
1km/div	2	2	2	2	2
	5001	5001	5001	5001	5001
	10000	10000	10000	10000	10000
500m/div	2	2	2	2	2
	5001	5001	5001	5001	5001
	10000	10000	10000	10000	10000
250m/div	1	1	1	1	1
	5001	5001	5001	5001	5001
	5000	5000	5000	5000	5000
100m/div	1	1	1	1	1
	5001	5001	5001	5001	5001
	5000	5000	5000	5000	5000
50m/div	1	1	1	1	1
	5001	5001	5001	5001	5001
	5000	5000	5000	5000	5000
25m/div	0.1	0.1	0.1	0.1	0.1
	5001	5001	5001	5001	5001
	500	500	500	500	500
10m/div	0.1	0.1	0.1	0.1	0.1
	5001	5001	5001	5001	5001
	500	500	500	500	500
5m/div	0.1	0.1	0.1	0.1	0.1
	5001	5001	5001	5001	5001
	500	500	500	500	500
2.5m/div	0.05	0.05	0.05	0.05	0.05
	5001	5001	5001	5001	5001
	250	250	250	250	250

Notes:

1. The values are for IOR = 1,500000.
2. The selectable distance range is different depending on the plug-in unit used.
   (See paragraph 1.5.)

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5.11.3 Sampling resolution, number of data, and range in NORMAL mode

The sampling resolution, number of data, and range for NORMAL sweep mode is shown below.

H-SCALE \ Distance range	10km	25km	50km	100km	250km
25km/div					10
					25001
					250000
10km/div				5	5
				20001	25001
				100000	125000
5km/div			2	2	2
			25001	25001	25001
			50000	50000	50000
2.5km/div		2	2	2	2
		12501	25001	25001	25001
		25000	50000	50000	50000
1km/div	2	2	2	2	2
	5001	12501	25001	25001	25001
	10000	25000	50000	50000	50000
500m/div	2	2	2	2	2
	5001	12501	25001	25001	25001
	10000	25000	50000	50000	50000
250m/div	1	1	1	1	1
	10001	25001	25001	25001	25001
	10000	25000	25000	25000	25000
100m/div	1	1	1	1	1
	10001	25001	25001	25001	25001
	10000	25000	25000	25000	25000
50m/div	1	1	1	1	1
	10001	25001	25001	25001	25001
	10000	25000	25000	25000	25000
25m/div	0.1	0.1	0.1	0.1	0.1
	25001	25001	25001	25001	25001
	2500	2500	2500	2500	2500
10m/div	0.1	0.1	0.1	0.1	0.1
	25001	25001	25001	25001	25001
	2500	2500	2500	2500	2500
5m/div	0.1	0.1	0.1	0.1	0.1
	25001	25001	25001	25001	25001
	2500	2500	2500	2500	2500
2.5m/div	0.05	0.05	0.05	0.05	0.05
	25001	25001	25001	25001	25001
	1250	1250	1250	1250	1250

→ Sampling resolution [m]
→ Number of sampling data
→ Sampling range [m]

Notes:

1. The values are for IOR = 1,500000.
2. The selectable distance range is different depending on the plug-in unit used.
   (See paragraph 1.5.)

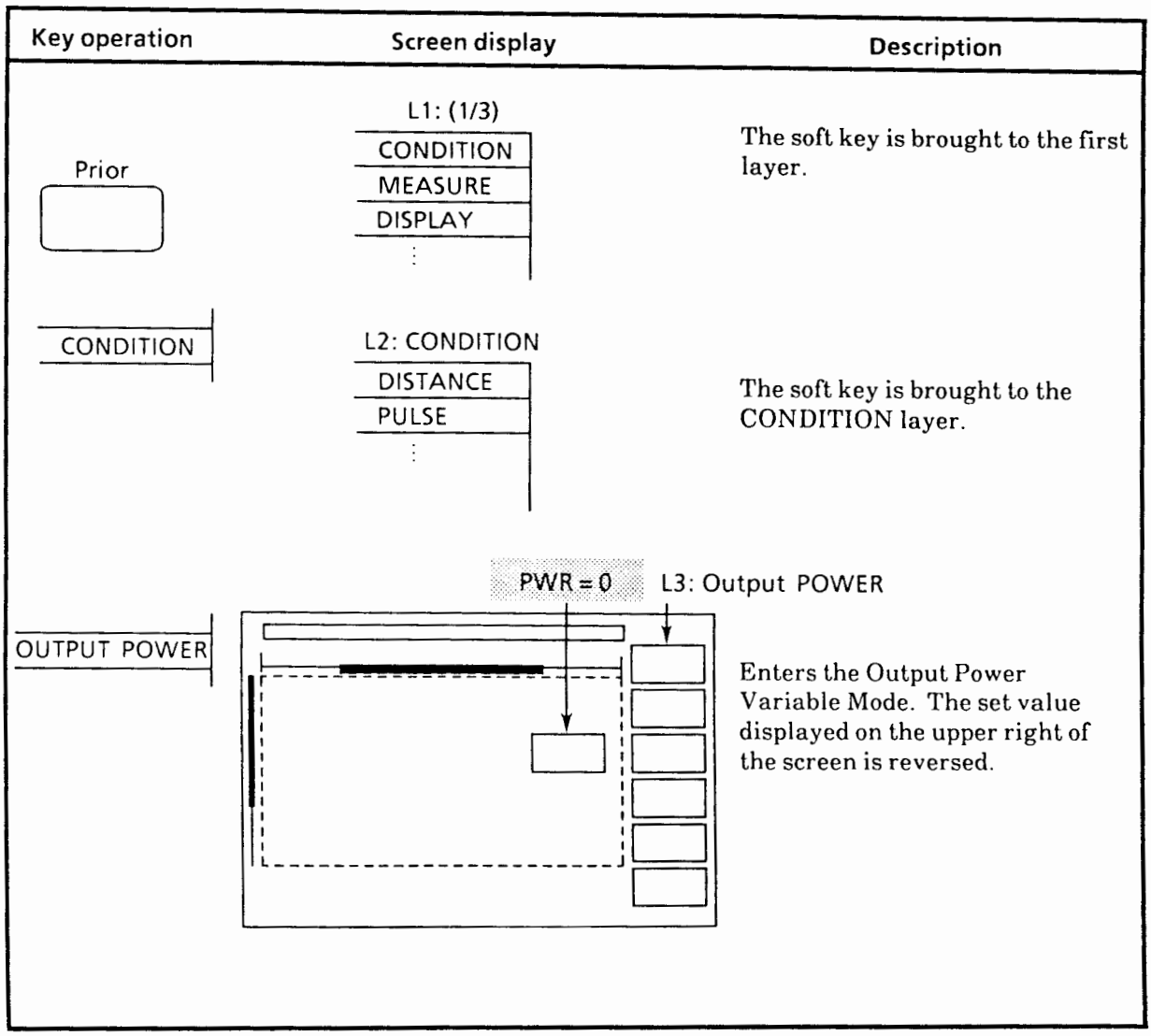
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5.12 Output-Power Variable Mode

When Fresnel reflection occurs between two points, there are cases where the two points become undistinguishable because of waveform distortion. In normal cases, masking can be used to distinguish them. However, if they are very close to each other, distinguishing them becomes difficult even with masking. In this case, by decreasing the LD output power, they can become distinguishable.
There are some plug-in units which cannot use this function (refer to paragraph 1.5).

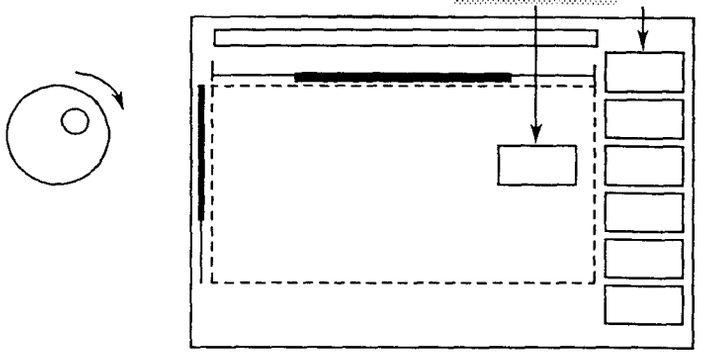
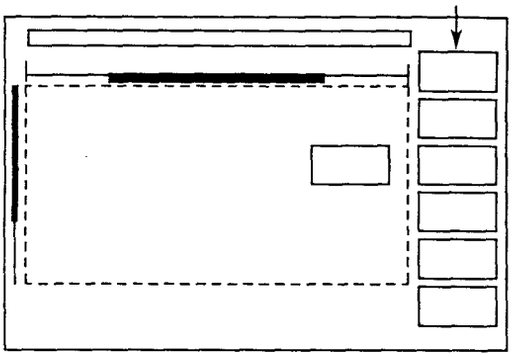
Note: When the output power is changed, the result of the fiber-loss measurement also varies because the spectrum of the laser varies.

5.12.1 Setting output power



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(Continued)

Key operation	Screen display	Description
	PWR = 90 L3: OUTPUT POWER 	Decrease the output power with the rotary knob. ***Note:*** When the output power is changed while averaging is On. Averaging is reset
SET	L2: CONDITION 	Sets the output power. The soft key returns to the CONDITION layer. ***Note:*** When returned to the CONDITION layer by pressing [Prior] without [SET], the output-power set value returns to the preveous value before entering the OUTPUT POWER layer.

- The output-power range can be set to any value from 0 to 127.
  The output-power set value is displayed on the upper right of the screen, except for the maximum setting (0).

Note: Normally set the output power to 0.

- The set mask is disabled during Output-Power Variable Mode. The mask will be enabled (recovered) again after the output power is returned to 0.

Note: Masks cannot be set while in Output-Power Variable Mode.

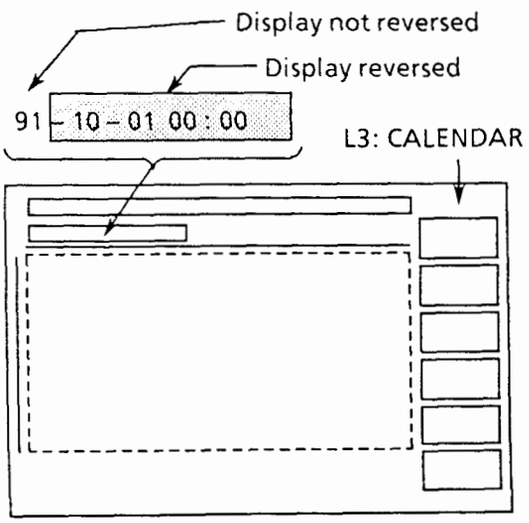
- If the Output-Power Variable Mode is enabled while in Auto-Attenuator Mode, the Auto Mode is disabled. Even if the output power is reset to 0, the Auto Mode will still remain disabled.

Note: Auto-Attenuator Mode cannot be set while in Output-Power Variable Mode.

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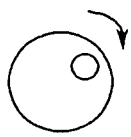
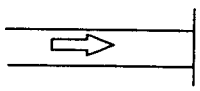
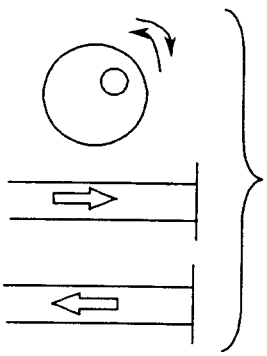
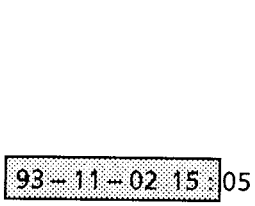
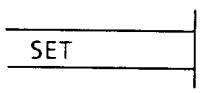
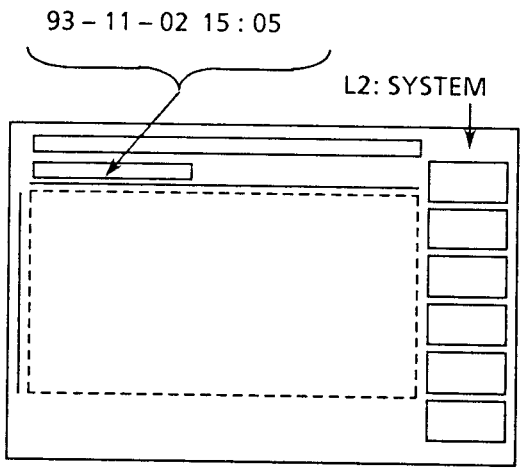
5.13 Setting the Calendar

Here, sets the date (year, month, day) and time (hour, minute) to the internal RTC (real-time clock) of the MW9060A. This RTC is protected against power-off by a built-in battery. The date and time are displayed on the screen in the format of "year-month-day hour:minute"

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key returns to the first layer.
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The second screen of the first layer is displayed.
etc.	L1: (3/3) SYSTEM ⋮	The third screen of the first layer is displayed.
SYSTEM	L2: SYSTEM INTERFACE CALENDAR ⋮	The soft key is brought to the SYSTEM layer.
CALENDAR		The soft key is brought to the CALENDAR layer. The calendar part displayed on the upper left of the screen is reversed. However, item for which setting can be changed (the "year" part in this example) are not reversed.

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(Continued)

Key operation	Screen display	Description
		
		The "year" item is changed to 93, and the "month" item is normally displayed (not reversed so that its setting can be changed).
		Each item has been changed by operating the rotary knob and arrow ([→] [←]) soft keys repetitively.
		The date and time have been set to the calendar, and the soft key returns to the SYSTEM layer. ***Note:*** When returned to SYSTEM layer by pressing [Prior], [Marker], [V-Shift], or [H-Shift] without [SET]; the calendar setting returns to the previous state before entering the CALENDAR layer.

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5.14 Setting Title

The MW9060A allows a title to be set on the upper left of the scale using 20 characters × 2 lines (total 40 characters). The characters that can be used for this title are as follows:

```
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m
n o p q r s t u v w x y z
1 2 3 4 5 6 7 8 9 0 ! # $
& % ' ( ) ^ @ _ { } .
Space
```

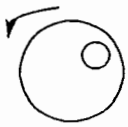
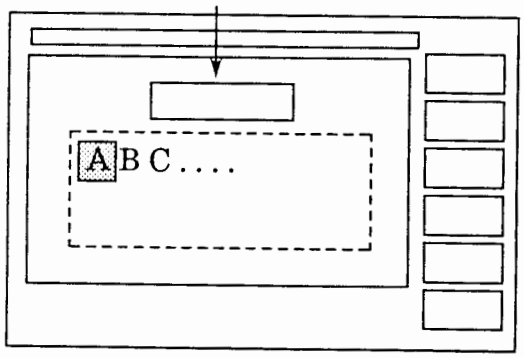
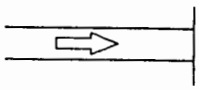
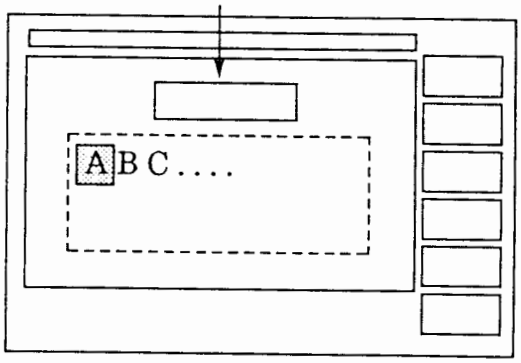
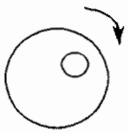
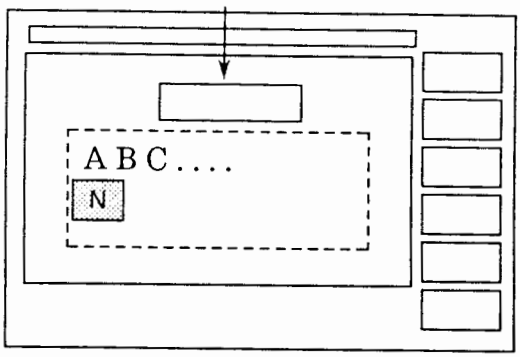
Example of title input is described below.

Title: ANRITSU

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE	The soft key is brought to the first layer.
DISPLAY	L2: DISPLAY TITLE UNIT	The soft key is brought to the DISPLAY layer.
TITLE	TITLE: [ ] L3: TITLE A B C . . . . Space	The screen display changes to a title setting screen. (The first character position of the title displayed on the screen is reversed.)

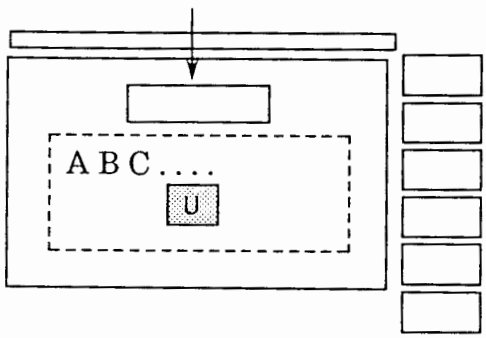
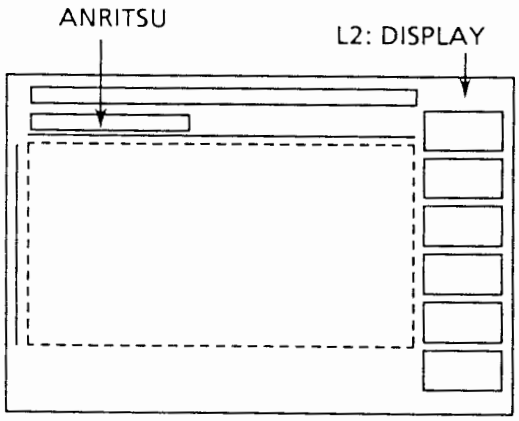
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(Continued)

Key operation	Screen display	Description
	TITLE: A 	Select the character (A) to be input with the rotary knob. (The reversed character cursor moves.)
	TITLE: A A 	"A" is set in the first character position. Select the next character position (i.e., second character position) with the arrow [→] key.
	TITLE: A N 	Select the second character (N) to be input. (The reversed character cursor moves.)

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(Continued)

Key operation	Screen display	Description
	(Repeat the above using the arrow key and rotary knob until all characters are set.)	
	TITLE: ANRITSU	
		
SET		The title has been set. the soft key returns to the DISPLAY layer ***Note:*** When returned to DISPLAY layer by pressing [Prior] without [SET]; the title setting returns to the previous state before entering the TITLE layer.

Use [DELETE] to delete one character at the character cursor position.

Use [INSERT] to insert one character immediately before the character where the character cursor is positioned.

Use [CLEAR] to delete all characters.

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5.15 Setting External Interface

An optional GPIB board can be fitted to the MW9060A, in addition to the standard GPIB board.

The standard GPIB board can control (device mode) the MW9060A from an external controller or control (controller mode) an external device (printer, plotter, etc.) via a GPIB.

When the optional GPIB board is installed, the standard GPIB board operates in the device mode only and the optional GPIB board operates in the controller mode only.

This lets you make a hard copy at an external printer, plotter, etc. while controlling the MW9060A from an external device.

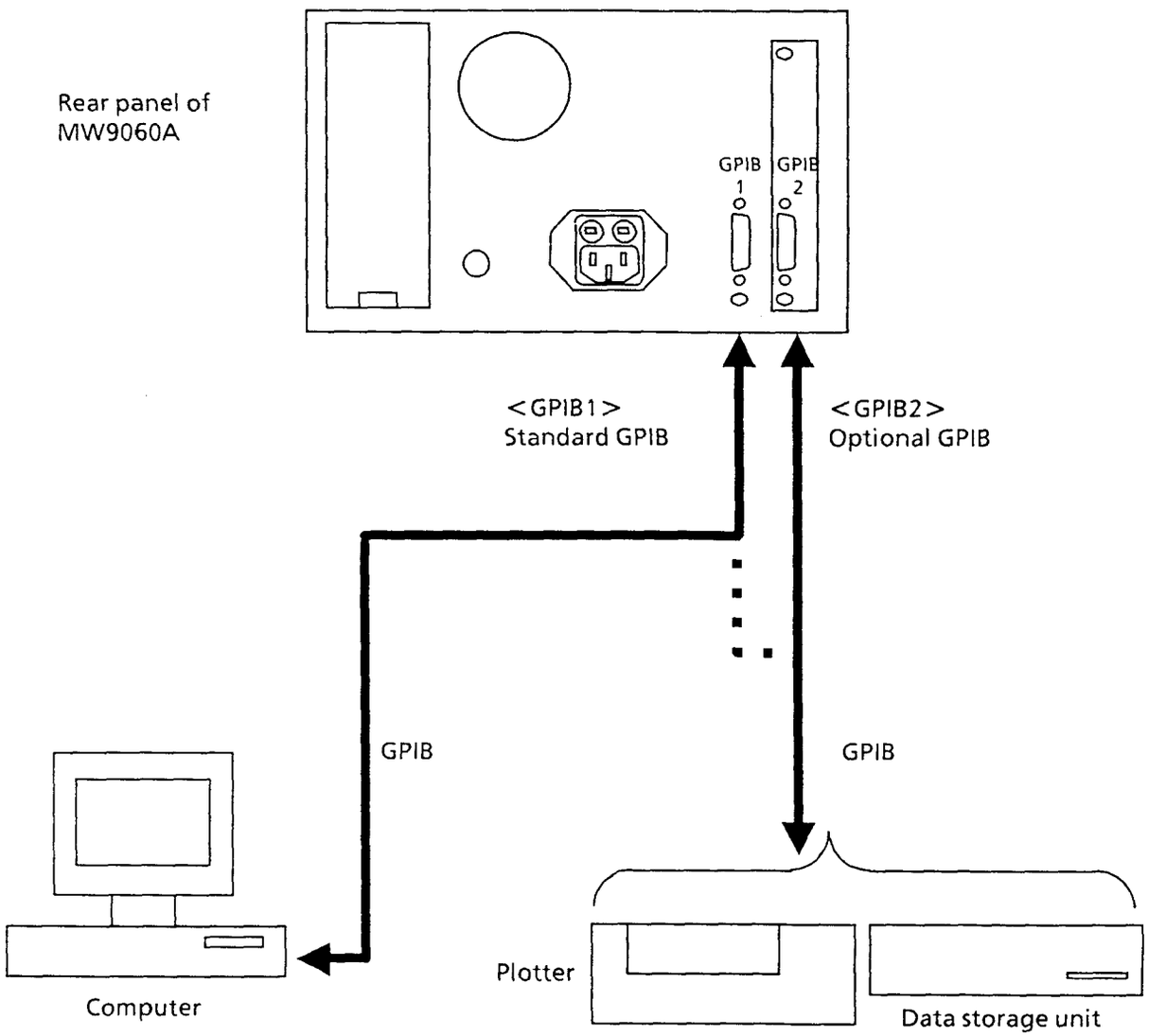


Fig. 5-6 External Interface

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Fig. 5-7 shows an interface setting screen.

GPIB1 represents the standard GPIB board and GPIB2 represents the optional GPIB board.

Addresses are set by a number from 0 to 30.

Controller/device can be set only when the optional GPIB board is not installed.

When the optional GPIB board is installed, GPIB1 functions as the device and GPIB2 functions as the controller.

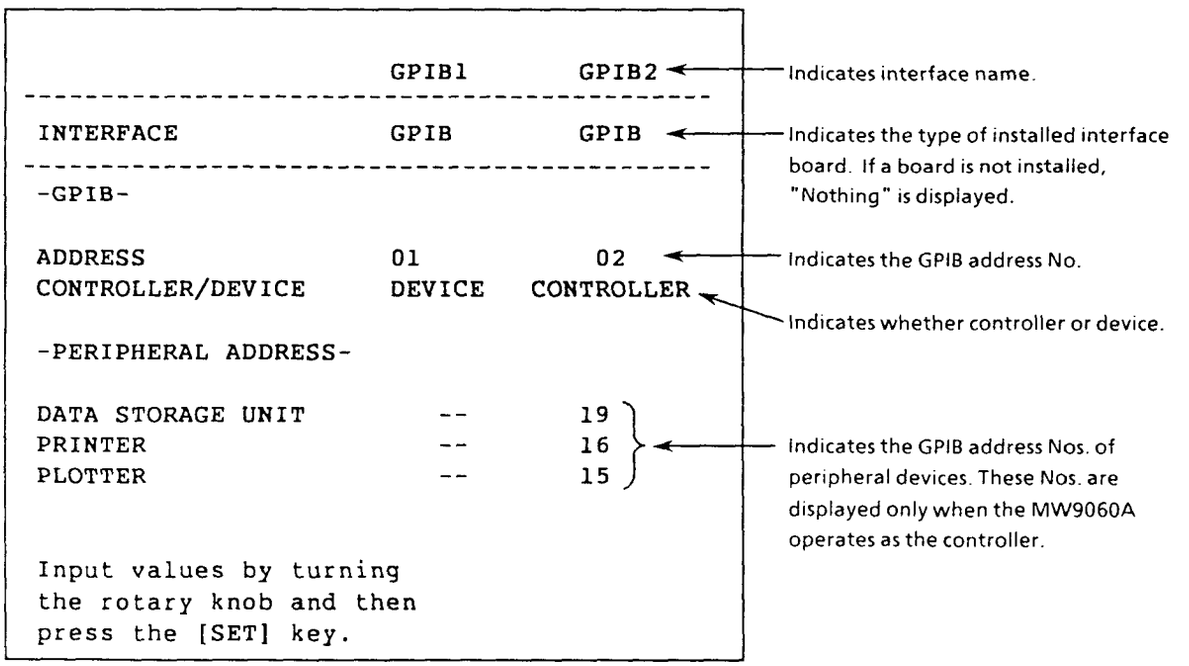
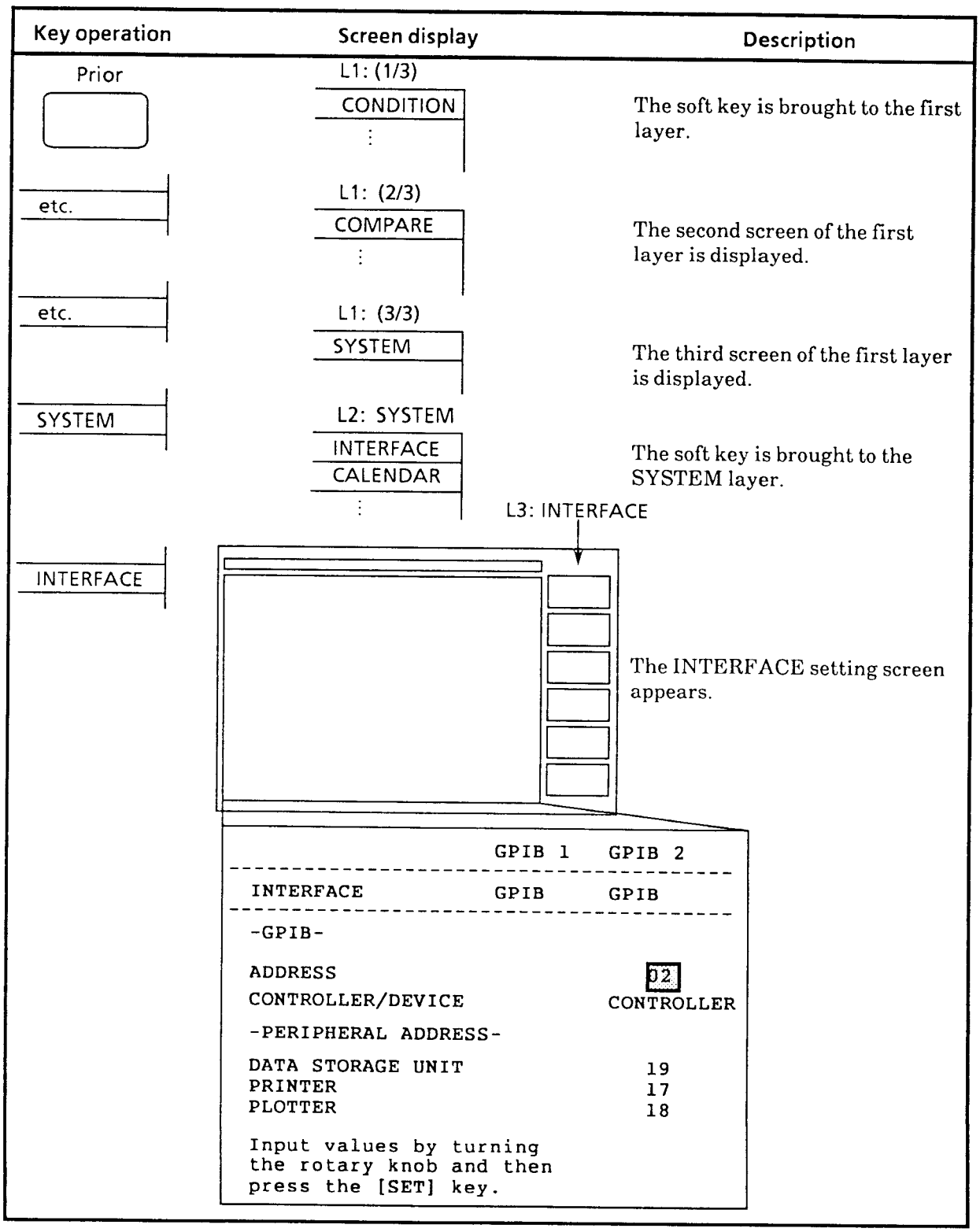


Fig. 5-7 Interface Setting Screen

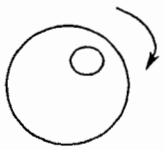
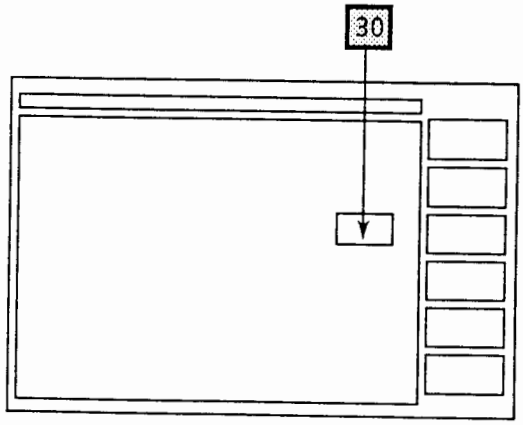
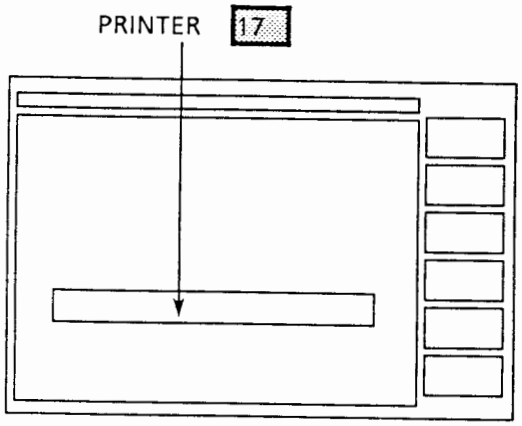
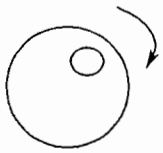
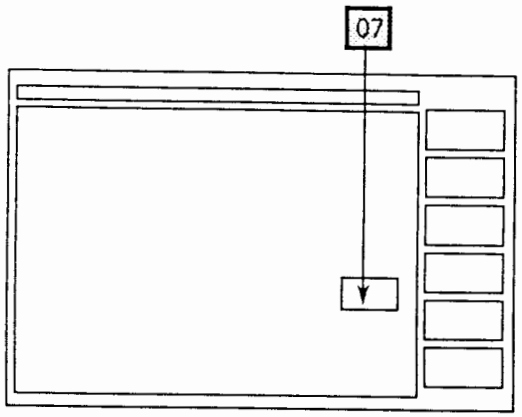
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Example of setting external interface



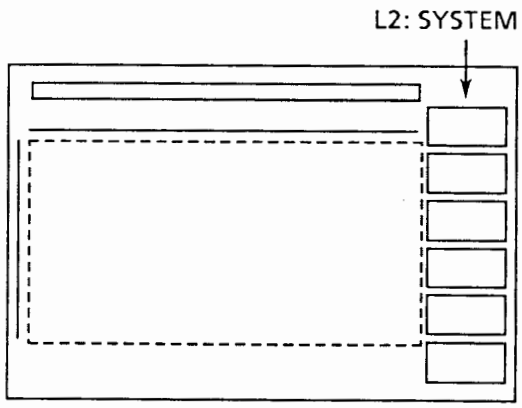
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(Continued)

Key operation	Screen display	Description
		Set the MW9060A's GPIB address to "30."
(Press 3 times)		Set the printer address.
		Set the printer address to "7." (The address on the printer must also be set to 7.)

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(Continued)

Key operation	Screen display	Description
SET		The interface setting is completed. The soft key returns to the SYSTEM layer. ***Note:*** When returned to the SYSTEM layer by pressing [Prior] without [SET], the interface setting returns to the previous state before entering the INTERFACE layer.

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5.16 Saving and Recalling

Measurement screens can be saved to and recalled from three types of storage media: MW9060A's internal memory, plug-in memory card, and floppy disk (FD). Three contents - measurement waveform (WAVEFORM), event table (TABLE), and measurement procedure (PROCEDURE) - can also be saved. The measurement waveform and event table can be saved simultaneously. However, only the measurement waveform can be saved to the MW9060A's internal memory. For a description of the event table and measurement procedure, see paragraphs 5.22 "Event Function" and 5.23 "Procedure Function".

For PMC, the data can be saved and recalled using the MC8104A Data Storage Unit also. For FD, the data can be saved and recalled using the MC2102A Floppy Disk Drive Unit or MC8104A Data Storage Unit.

When saving data, the file name can be defined in up to 8 characters using the characters and symbols shown below. When using internal memory (INT MEMORY), specify the location by a memory No. (01 to 32). A 3-character extension is automatically added at the end of the file name according to the contents to be saved.

Types of extensions

Measurement waveform (WAVEFORM) : ".DAT" or ".D**" (** represents 00 to 99.)
Event table (TABLE) : ".TBL" or "T**" (** represents 00 to 99.)
Measurement procedure (PROCEDURE) : ".PRO"

The extensions ".D**" and ".T**" are added only when saving files using the procedure function. For a description of saving and recalling these files, see paragraph 5.23 "Procedure Function".

```
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
1 2 3 4 5 6 7 8 9 0 ! # $
& % ' ( ) ^ @ _ { } .
```

File name . Extension

Up to 8 characters — Up to 3 characters (added automatically)

CAUTION

If a file is saved by specifying an existing file name or memory No., the contents of the that file or memory No. will be overwritten. Therefore, when creating a new file, always input an unused file name.

The table below shows the usable PMC and FD storage capacities.

PMC	32K, 64K, 128K, 256K, 512K bytes
FD	1.44M/720K bytes or 1.2M/720K bytes

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Note: 2HD (1.44M or 1.2MB formatted) or 2DD (720KB formatted) is judged automatically. 1.44M or 1.2M is fixed by factory option. The MC8104A and MC2102A cannot handle 1.2M.

This paragraph describes media formatting, saving to internal memory/plug-in memory card (INT MEMORY/INT PMC), recalling from internal FD/external FD (INT FDD/EXT FDD), and file deletion.

The following table shows the maximum number of waveforms that can be saved in the media.

Table 5-3 Maximum Number of Waveforms Saved in Media

Media	Memory capacity	Range to be saved (Number of measurement points)					
		ALL MEASURED					DISP. RANGE
		5001	10001	12501	20001	25001	501
Internal memory	——	——	——	——	——	——	32
PMC	32KB	2	1	1	0	0	16
	64KB	5	3	2	1	1	34
	128KB	11	6	4	3	2	69
	256KB	23	12	10	6	5	123
	512KB	47	24	20	12	10	248
3.5" FD	720MB	64	33	28	17	14	350
	1.2MB	107	56	47	29	23	584
	1.44MB	135	69	56	35	28	700

When PROCEDURE and TABLE except for WAVEFORM are saved to one media simultaneously, the number of waveforms saved becomes smaller than the number given in the table.

See the number of sampling data in paragraphs 5.11.2 and 5.11.3 for the number of measurement points at the save range.

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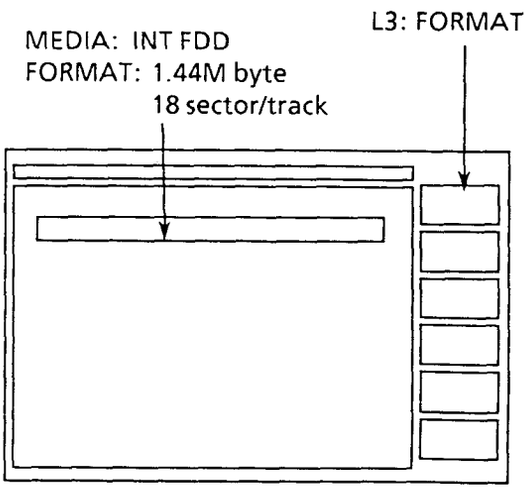
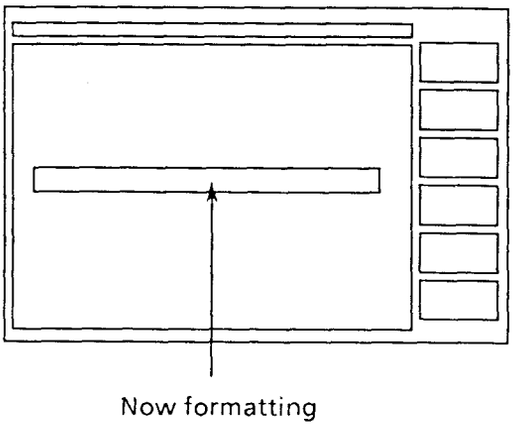
5.16.1 Example of formatting media

When using new PMC or FD, first format it. The following describes how to format storage media taking FD as an example. Insert 2HD type FD into the drive and then perform followings.

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
FILE	L2: FILE MEDIA ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA INT MEMORY INT PMC ⋮	The soft key is brought to the MEDIA layer.
INT FDD	L2: FILE MEDIA ⋮ FORMAT	INT FD is selected, and the soft key returns to the FILE layer.

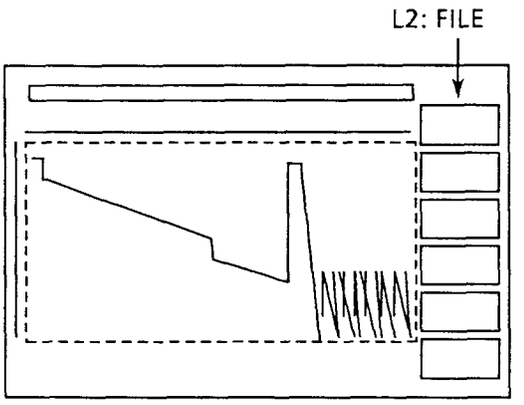
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(Continued)

Key operation	Screen display	Description
FORMAT		The MW9060A enters the FORMAT layer. FORMAT display automatically identifies the type of FD inserted. 2HD 1.44MB or 1.2MB is fixed by factory option. **Note:** If the [FORMAT] key is pressed when an FD or PMC is not inserted, or the FD or PMC write-protect switch is in the protect position, "Floppy error" or "PMC error" is displayed.
	CAUTION ***The lamp lights when FD or PMC is being accessed for a read or write. Never remove the FD or PMC during this time.***	
EXECUTE		The FD inserted in the MW9060A is formatted.

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(Continued)

Key operation	Screen display	Description
		When formatting is completed, the lamp goes out and the MW9060A returns to the FILE layer and measurement screen.

Note: If a PMC or FD (with data already written to) is formatted, all of the data is erased.

The media is formatted in MS-DOS format.

2DD 3.5-inch FDs are data compatible with the PC-9801 (NEC, Japan) and IBM PC.

2HD 3.5-inch FDs are data compatible with the personal computer set as a factory option of the IBM PC or PC-9801.

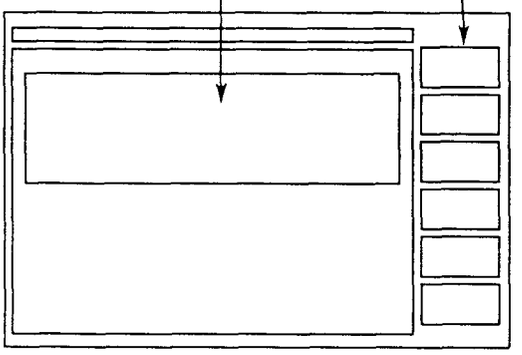
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5.16.2 Example of saving measurement screen in INT MEMORY

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA INT MEMORY INT PMC ⋮	The soft key is brought to the MEDIA layer.
INT MEMORY	L2: FILE MEDIA ITEM ⋮	INT MEMORY is selected as storage media. The soft key returns to the FILE layer. ***Note:*** When INT MEMORY is selected, the ITEM setting is automatically switched to WAVEFORM.

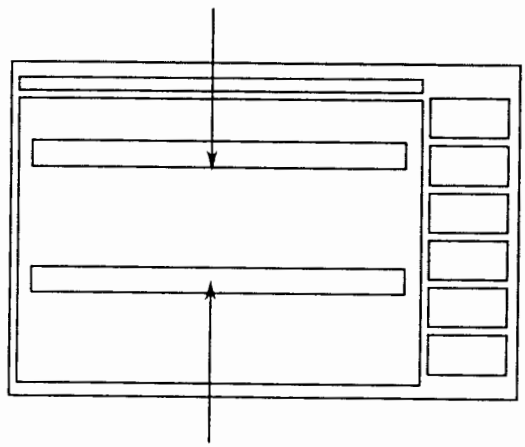
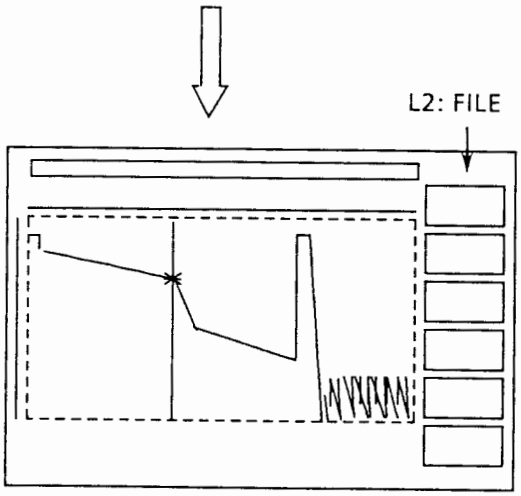
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(Continued)

Key operation	Screen display	Description
Save	MEDIA : INT MEMORY FILE No. : ○○ SAVE START = ○○○ m SAVE END = ○○○ km SAVE RES = ○○○ m	The soft key is brought to the SAVE layer, and the screen is changed. When media is INT MEMORY, all soft keys other than [EXECUTE] are invalid.
	L1: SAVE 	
	FILE No. : 07 (Unused)	To save data in internal memory No. 7, select memory No. 7 with the rotary knob.

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(Continued)

Key operation	Screen display	Description
EXECUTE	FILE No. : 07 (Unused)  Now saving  L2: FILE	Data is being saved into internal memory. ***Note:*** When data is saved into the memory number displaying " (Used) " at the back of the memory number, the data is overwritten. When save is completed, the MW9060A returns to the FILE layer and measurement screen.

Note: When data is saved to INT MEMORY, the save is made with the save start, save end, and save resolution currently displayed on the CRT screen.

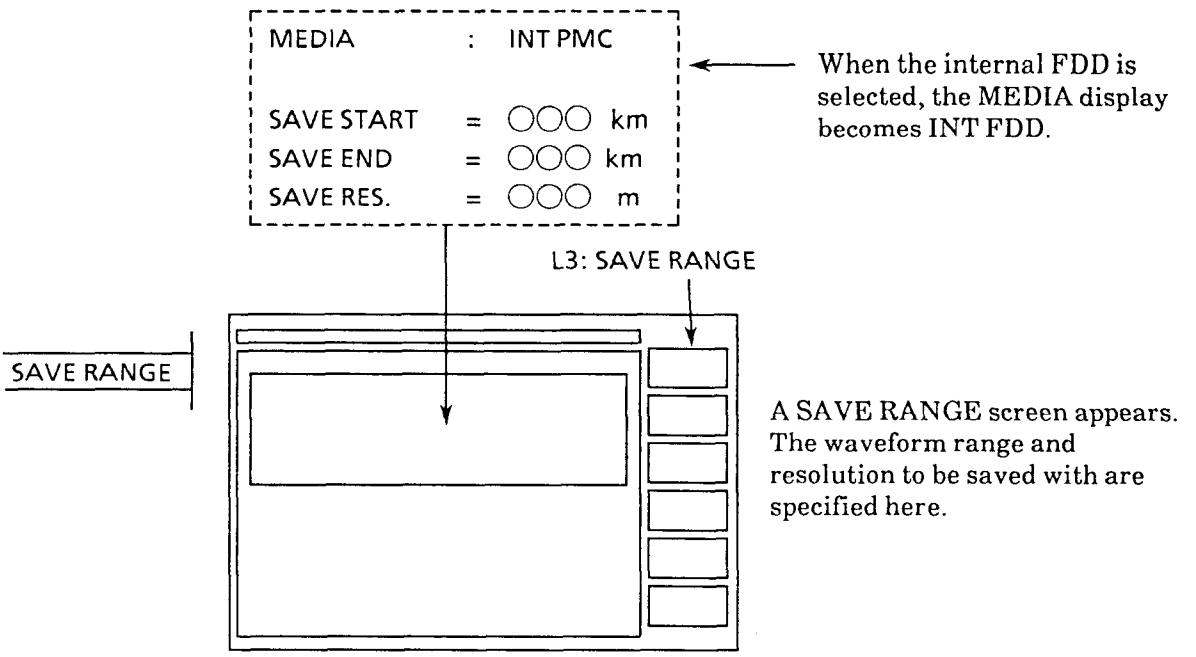
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5.16.3 Example of saving measurement screen in INT PMC or INT FDD

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA INT MEMORY INT PMC ⋮	The soft key is brought to the MEDIA layer.
INT PMC or INT FDD	L2: FILE MEDIA ITEM ⋮	INT PMC (FDD) is selected as storage media. The soft key returns to the FILE layer.
ITEM	L3: ITEM WAVEFORM WAVEFORM & TABLE ⋮	The soft key is brought to the ITEM layer.
WAVEFORM	L2: FILE MEDIA ITEM ⋮	WAVEFORM is selected as the save contents and the soft key is returned to the FILE layer.

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(Continued)

Key operation	Screen display	Description
		When the internal FDD is selected, the MEDIA display becomes INT FDD. A SAVE RANGE screen appears. The waveform range and resolution to be saved with are specified here.

Specifying save range

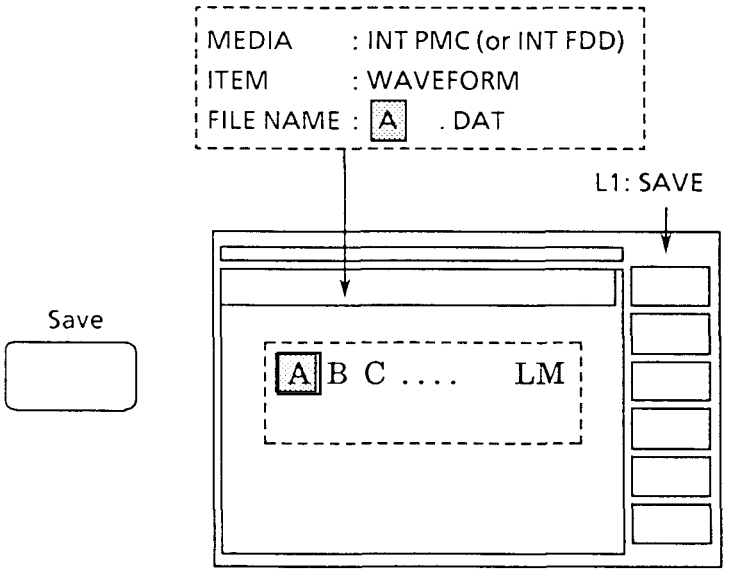
There are two methods to specify the save range as described below.

① When saving all measured data
Press the soft key [ALL MEASURED], and all data is specified.

② When saving waveform with the range and resolution displayed on the screen
Press the soft key [DISP. RANGE], and the data with the range and resolution displayed on the screen is specified.

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(Continued)

Key operation	Screen display	Description
The save range has been specified by the above operation.		
SET	L2: FILE MEDIA ITEM ⋮	The specified range and resolution are fixed up. ***Note:*** ● When returned to the FILE layer by pressing [Prior] without [SET], the save-range set value returns to the previous value before entering the SAVE RANGE layer. ● ALL MEASURED can not be set when MEDIA is set in the internal memory. When the media is set at the internal memory after ALL MEASURED was set, the save range is switched to DISP. RANGE screen.
Entering file name		
Save		The MW9060A enters the SAVE layer and SAVE screen. Input the file name using the soft key and rotary knob. The file name can be entered in up to 8 alphabetic characters. The extension (3 characters) after the file name is determined automatically by ITEM setting. The method of entering a file name is the same as entering a title described in paragraph 5.14.1. (Refer to steps from [TITLE] key operation to [SET] key operation.)
The file name has been entered by the above operation.		

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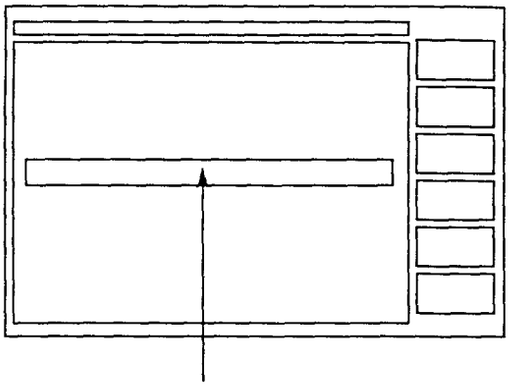
Key operation	Screen display	Description

Executing save

CAUTION

- ***The BUSY lamp lights when PMC is being accessed for a read or write. Never remove the PMC or FD during this time. If the same file name is specified, be careful that file will be overwritten without an alarm.***

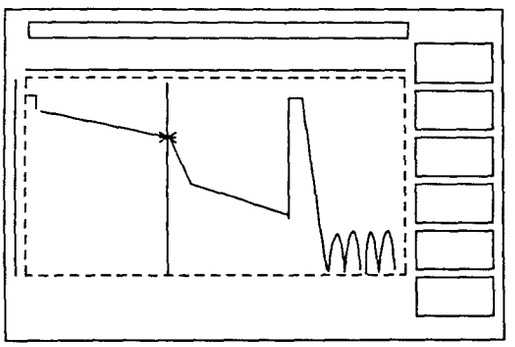
EXECUTE



Data is being saved in the PMC or FD inserted in the MW9060A.

Note: If the [EXECUTE] key is pressed when an FD or PMC is not inserted, or when the FD or PMC write-protect switch is in the protect position, "Floppy error" or "PMC error" is displayed.

Now saving



When save is completed, the MW9060A returns to the previous layer before pressing the [Save] key.

If the layer before the [Save] key is pressed is the third layer, the soft key is returned to the second layer.

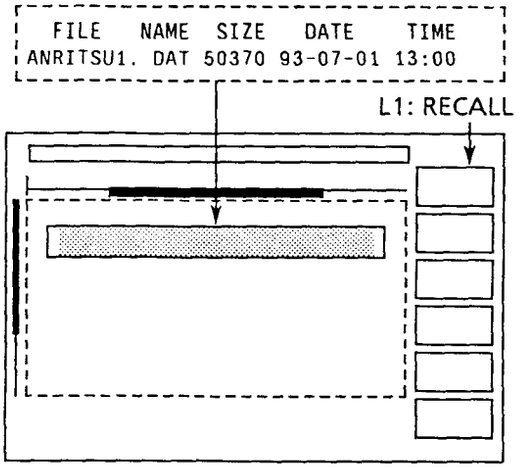
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5.16.4 Example of recalling waveform (read) from INT PMC and INT FDD

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA INT MEMORY INT PMC	The soft key is brought to the MEDIA layer.
INT FDD	L2: FILE MEDIA ITEM ⋮	The INT FDD is selected. The soft key returns to the FILE layer.
ITEM	L3: ITEM WAVEFORM WAVEFORM & TABLE ⋮	The soft key is brought to the ITEM layer.
WAVEFORM	L2: FILE MEDIA ITEM ⋮	WAVEFORM is selected as the save contents and the soft key is returned to the FILE layer.

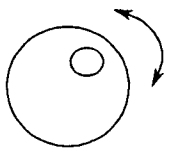
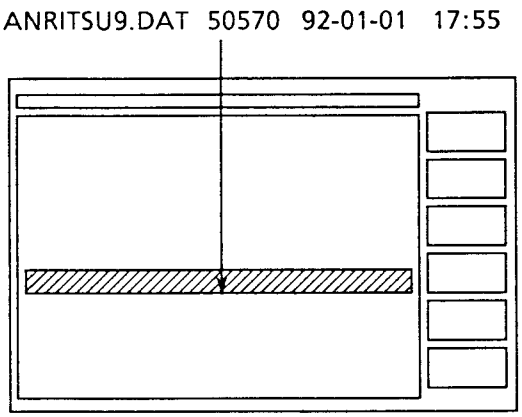
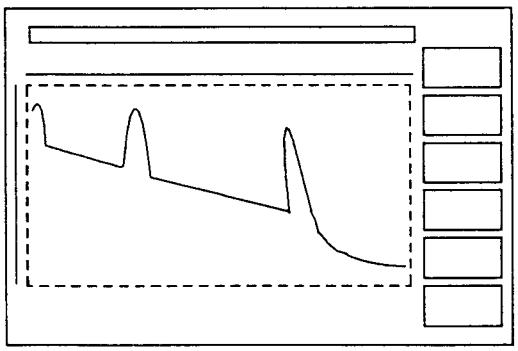
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(Continued)

Key operation	Screen display	Description
Recall 		The soft key is brought to the RECALL layer. The RECALL select screen appears. The selected file is reverse-displayed. Only the file corresponding to the ITEM setting is displayed. In the example, ITEM is set to WAVEFORM and only files with the file name extension "DAT" or "D**" (*: 0 to 9) are displayed. MW9040A/B data files can also be recalled regardless of their extension. However, ITEM must be set to WAVEFORM or WAVEFORM&TABLE. ***Note:*** Measurement waveform and other files are recalled by pressing the [Recall] key, except while the COMPARE and PROCEDURE functions are executing.

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(Continued)

Key operation	Screen display	Description
		Select the measurement result file to be recalled with the rotary knob. ***Note:*** When the [Coarse] key is On, the screen changes by the page (page scroll). So, search the file quickly by setting the [Coarse] key On when the desired file name is not displayed on the screen.
EXECUTE		The selected waveform is displayed on the screen, and the soft key returns to the previous layer before pressing the [Recall] key. If the layer before the [Recall] key was pressed was the third layer, the soft key is returned to the second layer. ***Note:*** If the current installed plug-in unit differs from the previous installed plug-in unit which is used to save the file to be recalled now, the recalling cannot be performed.

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- The MW9040A/B and MX3602B (emulation software) can read MW9060A waveform files. However, saved files cannot be read if an MW9060A function that the MW9040A/B does not have was executed. These functions are shown below.

MW9060A	MW9040B (Version4) MX3602B	MW9040A
MW09**B unit data file	○	×
Near-end mask width adjustment function	○	×
Optical output adjustment function	○	×
Automatic measurement threshold value	○	×
Return loss function	○	×
Smoothing function	○	×
Full trace function	○	×
Sweep mode	○	×
SPL & DZL	×	×
Automatic measurement data select "ALL"	○ (Functions as DISP)	×
Relative distance measurement function	×	×
Event function	×	×
Event table file	×	×
Procedure file	×	×
Measurement result display position switching function	○ (Displayed in scale)	×

○: Readable ×: Not readable

- If file is recalled when a plug-in unit is not installed, only the MW0947B measurement waveform data can be recalled. To recall the data of another unit, install the unit to the MW9060A.

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5.16.5 Example of deleting files

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA INT MEMORY INT PMC	The soft key is brought to the MEDIA layer.
INT MEMORY	L2: FILE MEDIA ITEM ⋮	The INT MEMORY is selected. The soft key returns to the FILE layer.
	No. TITLE MEMORY DATE TIME 01 Unused 02 ANRITSU0123456789012 9876543210 ...()MDSP Used 89-01-01 17:20 03 ANRITSU5ABCDEFGHIJKL ABCDEFGHIJKLMNOPQRST Used 89-01-01 17:20	
FILE DELETE	L3: FILE DELETE	The soft key is brought to the FILE DELETE layer. FILE DELETE select screen appears. The selected file is reverse-displayed.

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(Continued)

Key operation	Screen display	Description
	08 ANRITSU5ABCDEFGHIJKL Used 89-01-01 19:25 ABCDEFGHIJKLMNOPQRST L3: FILE DELETE	Select the file desired to be deleted with the rotary knob. ***Note:*** When the [Coarse] key is On, the screen changes by the page (page scroll). So, search the file quickly by setting the [Coarse] key On when the desired file name is not displayed on the screen.
EXECUTE	L2: FILE	The selected file is deleted, and the measurement screen appears. The soft key returns to the FILE layer.

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5.16.6 External memory

The MC8104A Data Storage Unit and MC2102A Floppy Disk Drive Unit are available as MW9060A external storage units.

When using these units, connect them to the MW9060A with a GPIB cable and set the GPIB address of the connected unit and the MW9060A peripheral device address to the same address. (The MC8104A GPIB address is set to 19 at the factory.)

If the optional GPIB board is not installed, set the GPIB1 to the controller mode. If the optional GPIB board is installed, connect the GPIB cable to the GPIB2 port.

Fig. 5-8 is an example of connection to the MC8104A.

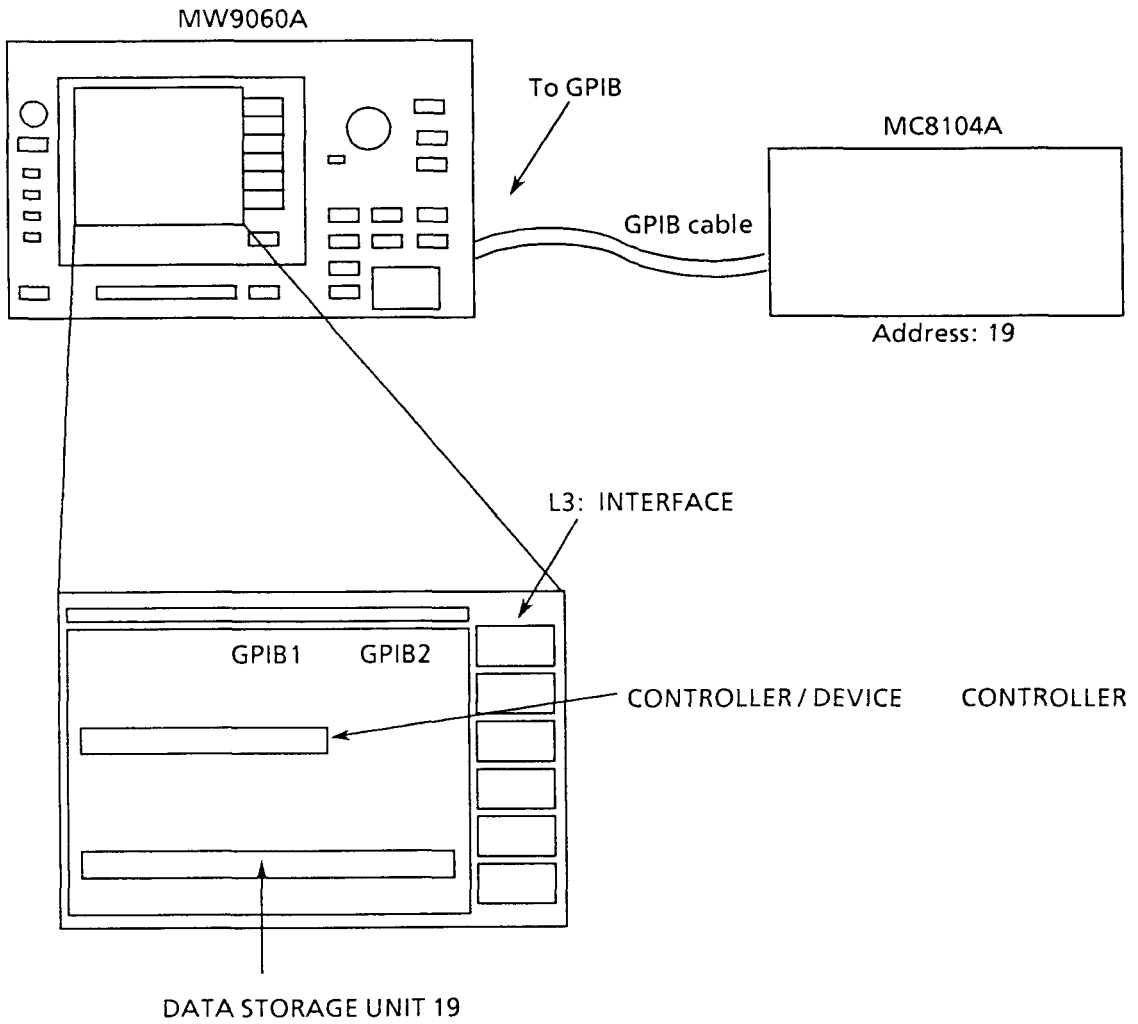


Fig. 5-8 Example of Connection to MC8104A

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Carry out operations to external memory device the same as to internal memory device by selecting the external storage device as shown in the example below.

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA INT MEMORY INT PMC	The soft key is brought to the MEDIA layer.
EXT FDD	L2: FILE MEDIA ITEM ⋮	EXT FDD is selected. The soft key is returned to the FILE layer.

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5.17 Producing Screen Hard Copy

The MW9060A allows information on the screen to be output to an internal priter and an external printer or plotter. A hard copy can be produced without interrupting measurement.

The measurement screen, return loss parameters setting screen (R. LOSS PARA), waveform compare function setting screen (SETTING ON/OFF), and external interface screen (INTERFACE) can be printed out.

The event table screen (DISP EVENT TBL), procedure function measurement procedure contents editing screen (EDITING CONTENTS), and recall file name table screen (Recall) can also be copied at the internal printer. When these screens are copied, the entire screen is copied at one time, even if some of it overflows one screen.

Notes:
- One roll of the accessory paper can print about 320 measurement screens. (When only measurement screens are printed.)
- If a printer is not used, the MW9060A can be used up to an ambient temperature of +55°C, but since the printer uses heat sensitive paper, using the MW9060A at a high temperature will degrade the printing paper.
- The screen printed on the printer paper will fade with time. Before storing a printed screen for a long time, make a copy of it.
- If a screen is copied at a temperature lower than the operating temperature range, "INT PRINTER error" will be displayed and the screen will not be printed.

CAUTION

When "INT PRINTER error" is displayed when the printer is used at a temperature within a range from + 5 to + 35°C range, the printer head is abnormally hot. Therefore, immediately turn off the power and contact our service department.

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5.17.1 Producing hard copy of measurement screen at internal printer

Key operation	Screen display	Description
Starting copy Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
COPY	L2: COPY ⋮	The soft key is brought to the COPY layer.
TARGET	L3: TARGET INT PRINTER DSU ⋮	The soft key is brought to the TARGET layer.
INT PRINTER	L2: COPY ⋮	The target is set to internal printer. The soft key is returned to the COPY layer.

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The following shows an example of how to set conditions for producing hard copy and operations to start and stop. In this example, the MC8104A Data Storage Unit is used and whole screen data is copied.

Key operation	Screen display	Description
Starting copy		
ALL/TRACE	L3: ALL/TRACE ALL TRACE ⋮	The soft key is brought to the ALL/TRACE layer.
ALL	L2: COPY ⋮	This setting makes the whole screen data copied. The soft key returns to the COPY layer. ***Note:*** Since the waveform trace only is copied in the TRACE mode, overwrite the trace on the plotter to compare the waveforms each other.
Copy	Copying L1: (1/3)	The system starts copying data to a printer. ***Notes:*** ● It takes about 7 seconds to copy one measurement screen. However, it may take longer when printing at a low temperature. ● When "NO paper or Head up" is displayed, there is no paper in the printer, or the printer head is raised. Load the paper, or lower the printer head lever.

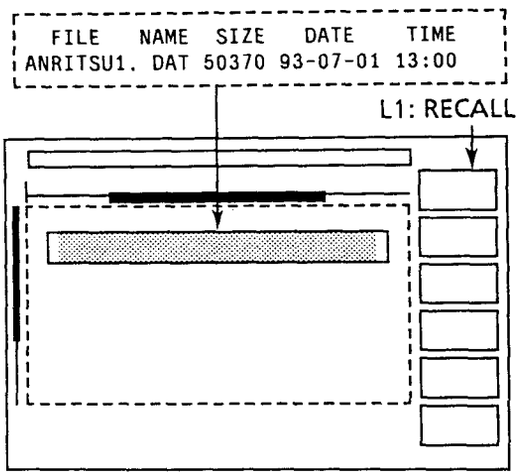
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(Continued)

Key operation	Screen display	Description
Stopping copy To stop copying, press the [Copy] key again. Copy 		Copying is stopped.
Paper feed To feed the internal printer paper, press the [Feed] key. Feed 		When the key is pressed and released once, the printer paper is fed about 3mm. When the key is held down, the paper is fed until the key is released. ***Note:*** This is effective only when the internal printer (INT) is set as the TARGET. If another device is set as the TARGET, "Select INT PRINTER" is displayed and an error is generated.

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5.17.2 Producing hard copy of file name table at internal printer

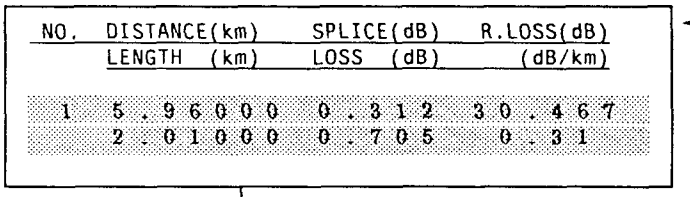
Key operation	Screen display	Description
Set TARGET to INT as described in paragraph 5.17.1 and set MEDIA and ITEM as described in paragraph 5.16.4. (Unnecessary if already set.)		
Recall		The soft key is returned to the RECALL layer. A RECALL selection screen appears. The selected file is reverse-displayed. The displayed file corresponds to the ITEM setting.
Copy		A file name table is printed at the internal printer. Even if the file names overflow one screen, they are printed continuously while switching the screen.

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5.17.3 Producing hard copy of event table and measurement procedure screens at internal printer

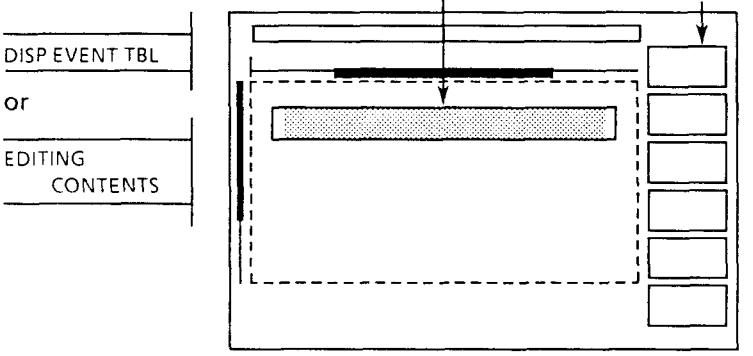
Key operation	Screen display	Description

Set TARGET to INT as described in paragraph 5.17.1. (Unnecessary if already set.)
The MW9060A enters the EVENT mode and displays the event table to be printed, or enters the PROCEDURE REGIST mode and displays the EDITING CONTENTS. (For more information, see paragraphs 5.22.1 "Event mode measurement" and 5.23.1 "Example of setting of measurement procedure by procedure function".)

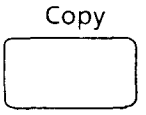


← (Event table)

L3: DISP EVENT TBL (or EDITING CONTENTS)



The soft key is brought to the DISP EVENT TBL or EDITING CONTENTS layer.



The DISP EVENT TBL or EDITING CONTENTS screen is printed at the internal printer. Even if the contents overflow one screen, they are printed continuously while switching the screen.

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5.17.4 Replacement of Internal Printer Paper

Use the following procedure to replace the printer paper.

(1) Open the MW9060A printer cover.

(2) Pull the lever upward. Then, remove the paper from the rubber roller and printer head.

(3) Pull the bar which immobilizes the roll of paper to remove it.

(4) Replace the paper and reconnect the bar.

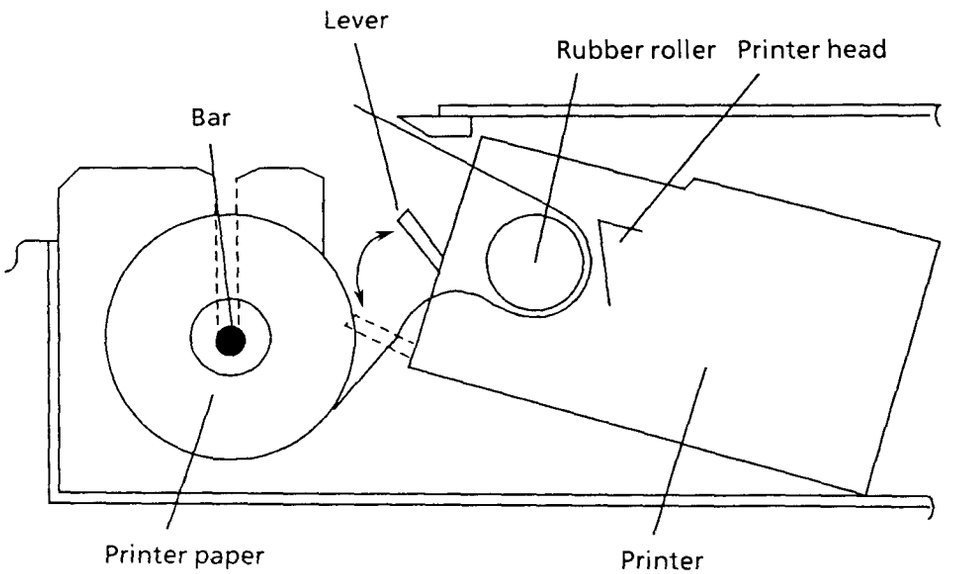
(5) Replace the bar and roll of paper assembly and insert the end of the paper between the rubber roller and printer head.

(6) Push the lever to its original position thereby locking the paper position relative to the printer head and rubber roller.

(7) Advance the paper by pressing the FEED button on the front panel.

(8) Close the cover. This completes the paper replacement procedure.

- Printer paper : TF50KS-E2C



CAUTION

When the printer will not be used for a long period of time, pull the lever upward to separate the printer head from the rubber roller.

If the printer head is left in contact with the rubber roller, the rubber roller may be deformed.

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5.17.5 Producing hard copy at external printer or plotter

When making a hard copy at an external printer or plotter, connect the printer or plotter to the MW9060A with a GPIB cable and set the GPIB address of the connected device and the MW9060A peripheral device address to the same address. (The external printer GPIB address is set to 17 and the external plotter GPIB address is set to 18 at the factory.)

If the optional GPIB board is not installed in the GPIB port, set GPIB1 to the controller mode. If the optional GPIB board is installed in the GPIB port, connect the GPIB cable to the GPIB2 port.

Fig. 5-9 is an example of connection to an external printer or plotter. Table 5-4 lists the printers and plotters that can be connected to the MW9060A and the names of the corresponding soft keys. Do not set the external printer or plotter to the LISTEN ONLY mode. If set to the LISTEN ONLY mode, erroneous operation may occur.

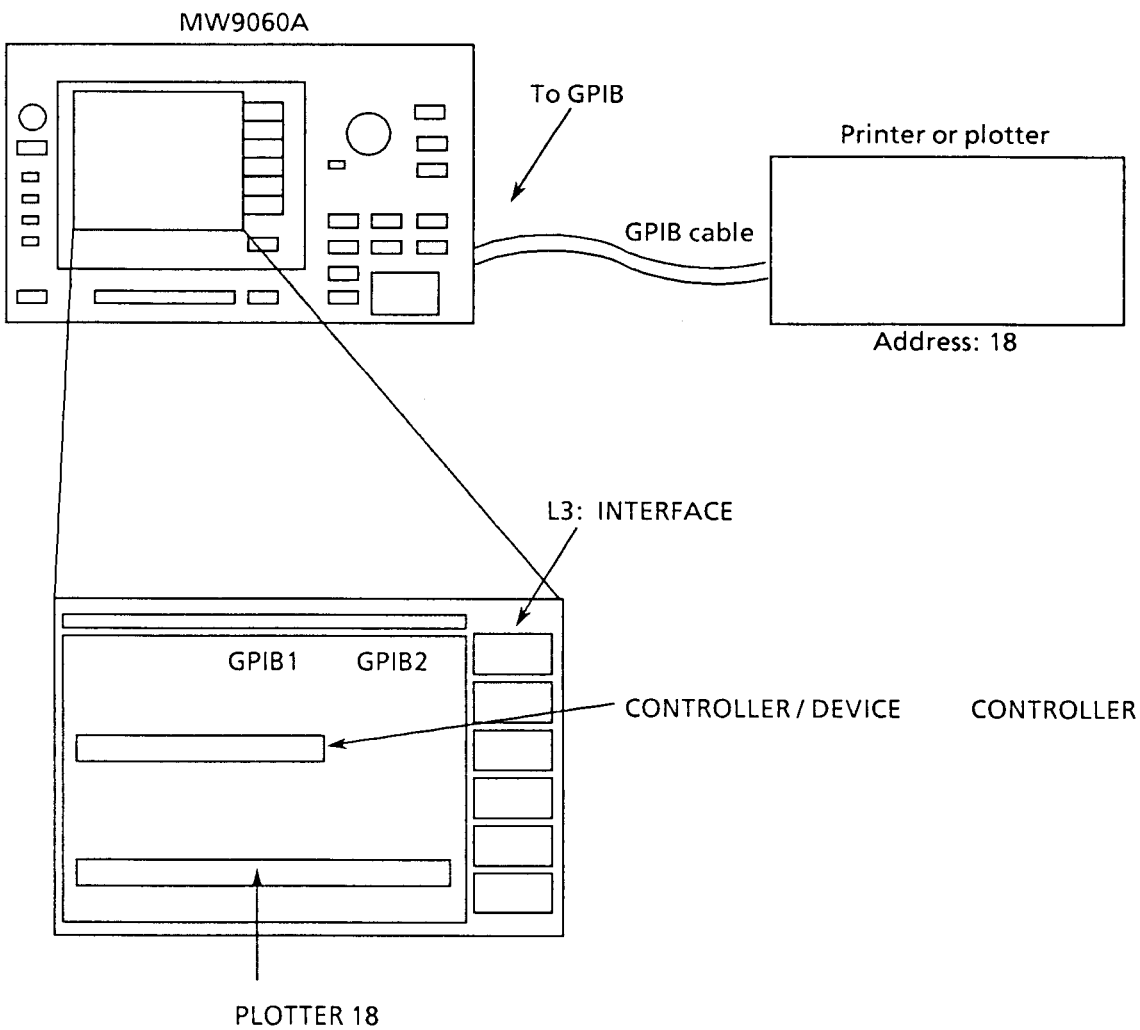


Fig. 5-9 Example of Connection to Printer or Plotter

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Table 5-4 Connectable Printers and Plotters

Soft key name (TARGET layer)	Output format	Equipment name
DSU	Based on MC8104A	MC8104A (Anritsu)
PL1	HP-GL plotter	7550A, 7475, 7470 (HP)
PL2	GP-GL plotter	GD9411F-1-11 (Graphtec, Japan)
PR1	2225 based printer	2225AJ (HP)
PR2	VP-800 based printer*	FP-850 (Epson, Japan) VP-800 (Epson, Japan) CTM-800 (Epson, Japan)

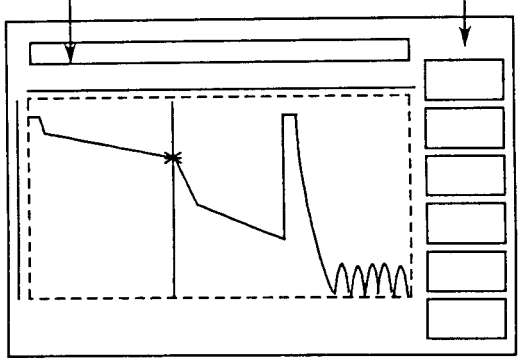
* When printing with a VP-800 based printer, use the automatic line-feed mode.

The following shows an example of how to set conditions for producing hard copy and operations to start and stop. In this example, the MC8104A Data Storage Unit is used and whole screen data is copied.

Key operation	Screen display	Description
Starting copy		
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
COPY	L2: COPY ⋮	The soft key is brought to the COPY layer.
TARGET	L3: TARGET INT PRINTER DSU	The soft key is brought to the TARGET layer.

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(Continued)

Key operation	Screen display	Description
DSU	L2: COPY ⋮	The output format based on the MC8104A is set. The soft key returns to the COPY layer.
ALL/TRACE	L3: ALL/TRACE ALL TRACE ⋮	The soft key is brought to the ALL/TRACE layer.
ALL	L2: COPY ⋮	This setting makes the whole screen data copied. The soft key returns to the COPY layer. ***Note:*** Since the waveform trace only is copied in the TRACE mode, overwrite the trace on the plotter to compare the waveforms each other.
Copy	Copying L1: (1/3) 	The system starts copying. ***Note:*** Care should be taken to the following connections and operations. If the [Copy] key is pressed and then key operations are performed while the connected printer or plotter is different from one which is set at TARGET, this instrument does not operate normally.

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(Continued)

Key operation	Screen display	Description
Stopping copy Press the [Copy] key when you want to stop copy in middle. Copy 		Copying is stopped.

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5.18 Setting Waveform Compare Mode

The MW9060A can recall a waveform stored in certain media and display it on the screen simultaneously with the waveform under measurement. For this operation to be done, the media that contains the waveform desired to be recalled must be selected with [MEDIA] in the FILE layer.

To make a comparison between two waveforms, turn the LD on or with the waveform displayed by RECALL and then move to the COMPARE hierarchy. Retrieve the waveform data at the COMPARE RECALL state. After that, make a comparison between a measured waveform and the stored waveform.

The H-Zoom and H-Shift are disabled in the waveform-compare mode.

Assume that the waveform to be recalled is stored on the plug-in memory card (PMC) inserted in the front-panel slot in the example below.

Key operation	Screen display	Description
Selecting media		
Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA INT MEMORY INT PMC ⋮	The soft key is brought to the MEDIA layer.

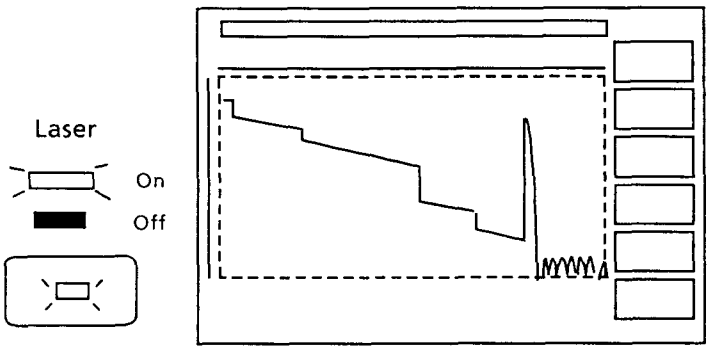
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(Continued)

Key operation	Screen display	Description
INT PMC	L2: FILE MEDIA ITEM ⋮	INT PMC is selected. The soft key returns to the FILE layer.

Thus, the media has been selected by the above operation.

Measured waveform display



The measured waveform is displayed on the screen.

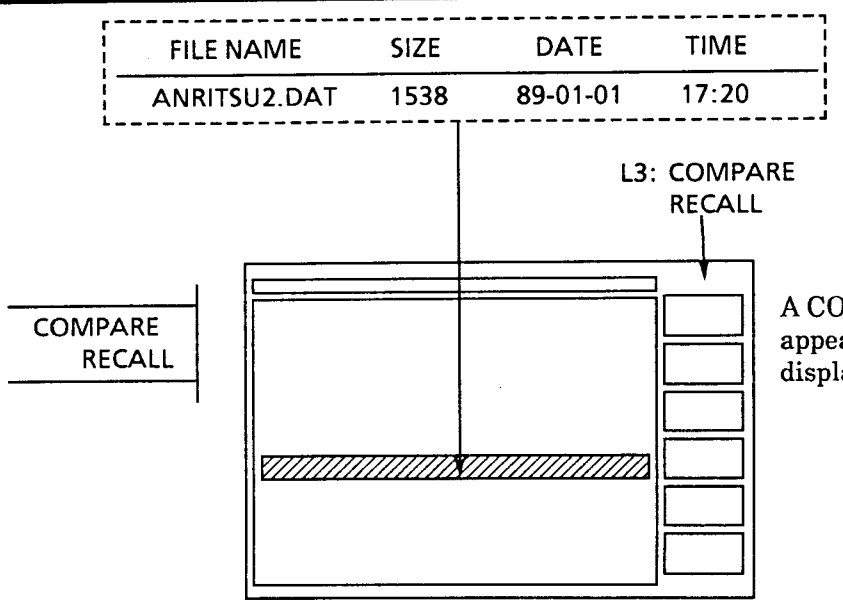
Waveform comparison

Prior	L1: (1/3) CONDITION MEASURE ⋮	The soft key is brought to the first layer.
etc.	L1: (2/3) COMPARE ⋮	The second screen of the first layer is displayed.
COMPARE	L2: COMPARE COMPARE RECALL ⋮	The soft key is brought to the COMPARE layer.

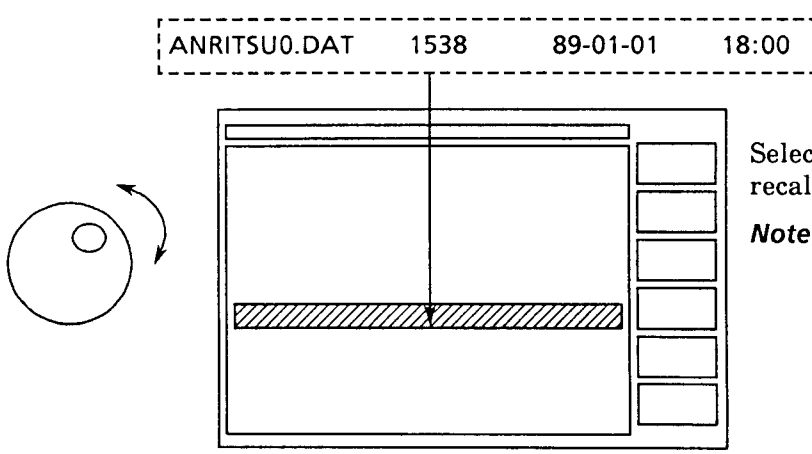
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(Continued)

Key operation	Screen display	Description



A COMPARE RECALL screen appears, and file names are displayed.

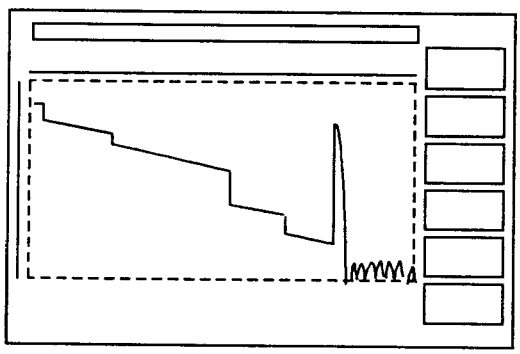
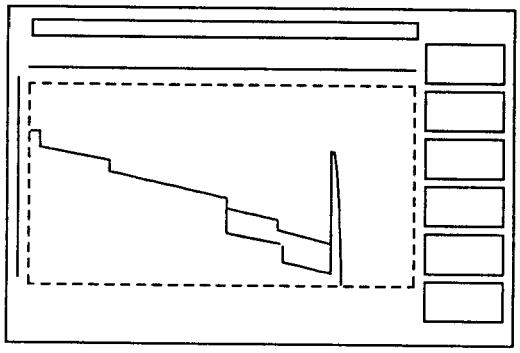
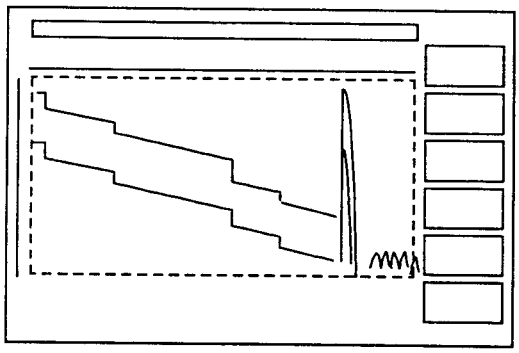


Select the file name desired to be recalled.

Note: When the [Coarse] key is On, the screen changes by the page (page scroll). So, search the file quickly by setting the [Coarse] key On when the desired file name is not displayed on the screen.

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(Continued)

Key operation	Screen display	Description
EXECUTE		The recalled waveform is displayed on the screen. The stored waveform cannot be recalled unless five points or more of its data are displayed. ***Note:*** The RECALL operation can be enabled in the COMPARE RECALL mode even if the plug-in unit (used to save the file) and the current plug-in unit (used to recall it) are different.
V-Shift		While the [V-Shift] lamp is on, the two waveforms can be simultaneously shifted in the vertical direction by turning the rotary knob.
V-Shift		When the [V-Shift] key is pressed again while the [V-Shift] lamp is on, the lamp blinks. In this state, only the currently measured waveform can be shifted in the vertical direction by turning the rotary knob.

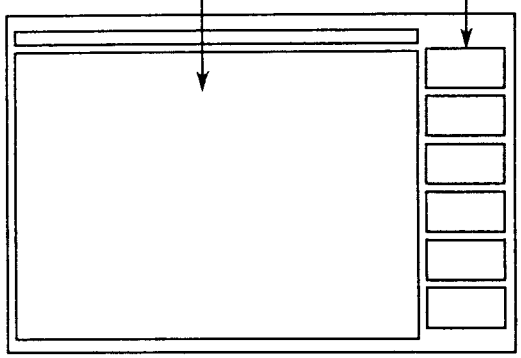
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Key operation	Screen display	Description

Displaying measurement conditions

ITEMS		Select WAVE	UNSelect WAVE
TITLE	:	ANRITSU CORP. MW9060A	ANRITSU CORP. MW9060A
CALENDAR	:	89-01-03 07:30	89-01-01 16:40
DISTANCE	:	250 km	820.2 kft
PULSE	:	100 ns	10 μs
ATT	:	10.0 dB	5.0 dB
MASK 1	:	165.50000 km	328.08399 kft
⋮		⋮	⋮

L2: COMPARE

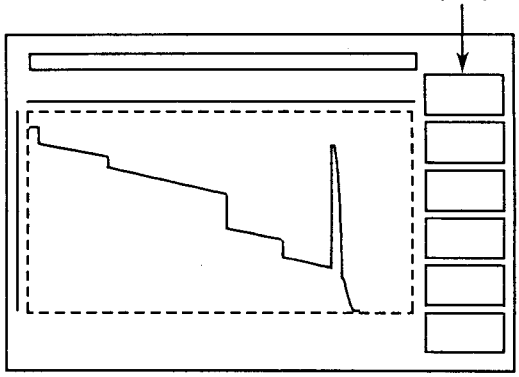


SETTING ON/OFF

The measurement conditions of each waveform stored in the media are displayed on the screen. When this key is pressed again, the display returns to the two waveform compare screen.

Note: If the waveforms measured by the different model units are compared, the measurement conditions may not be displayed correctly.

L1: (1/3)



COMPARE OFF

The system exits from the compare mode and returns to the measurement state. The soft key returns to the first layer.

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5.19 Smoothing

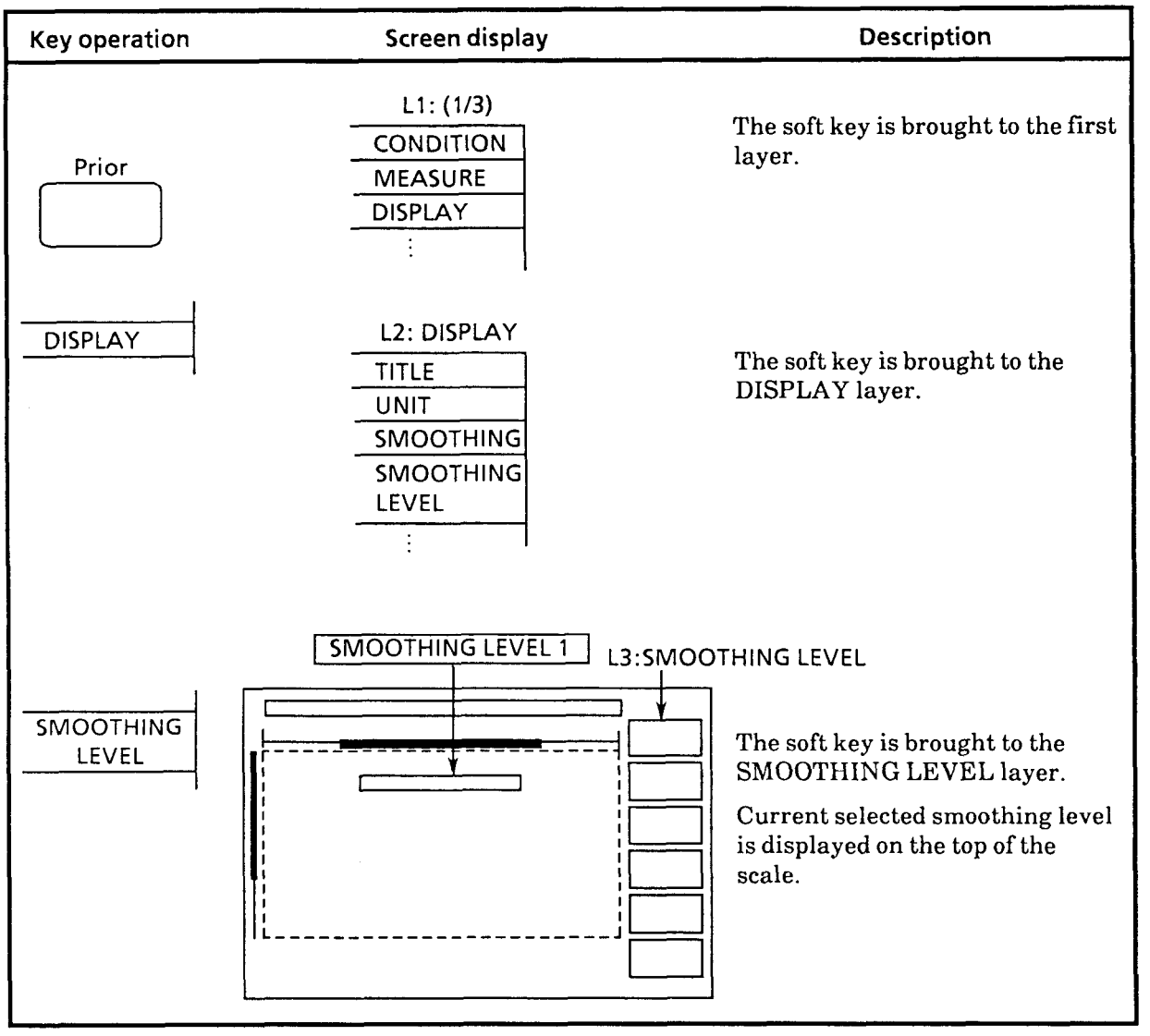
The smoothing function improves the S/N of the waveform.

Notes: **1.** When the smoothing is performed during Laser On, the Laser is turned Off.

2. The smoothed waveform can be saved to a media (paragraph 5.16). However, the recalled waveform from a media cannot be smoothed or off-smoothed.

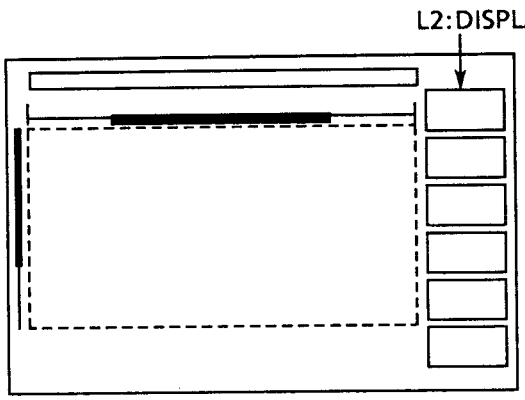
3. The smoothing level can be specified by a level number of 1 to 6. The larger level number, the greater S/N-improvement degree and the longer smoothing time.

5.19.1 Setting smoothing level



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(Continued)

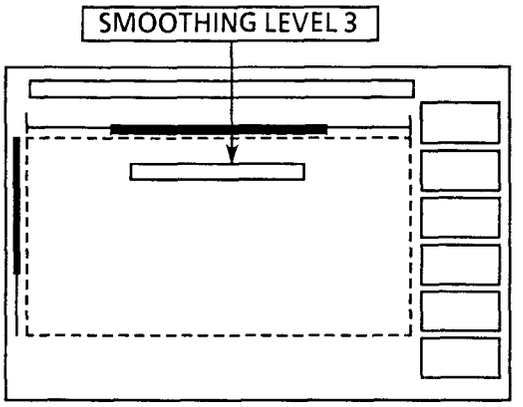
Key operation	Screen display	Description
LEVEL 3		Smoothing level is set, and the soft key is brought to the DISPLAY layer. When the smoothing is On, SMOOTHING LEVEL 3 remains to be reverse-displayed. When it is Off, nothing is displayed.

5.19.2 Performing smoothing function

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
DISPLAY	L2: DISPLAY TITLE UNIT SMOOTHING SMOOTHING LEVEL ⋮	The soft key is brought to the DISPLAY layer.

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(Continued)

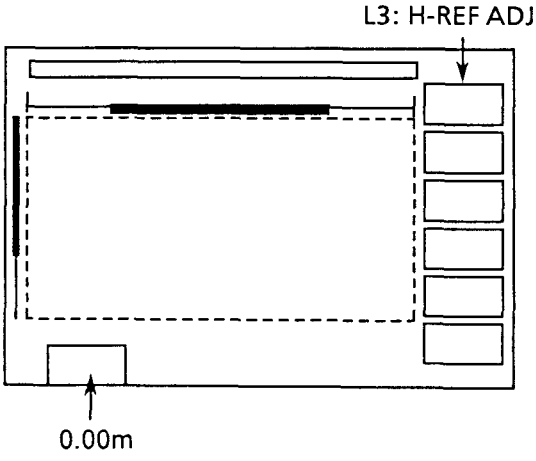
Key operation	Screen display	Description
SMOOTHING		Current selected Smoothing level is displayed on the top of the scale, and the smoothing processing is performed. During the processing, the Laser turns Off and the keys except [Smoothing] and [Initialize] do not work. When the processing completed, the S/N-improved waveform is sweeped once. ***Note:*** When the [SMOOTHING] key is pressed again when a smoothed waveform is displayed, the display returns to the unsmoothed waveform.

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5.20 Relative Distance Measurement (H-REF ADJ) Function

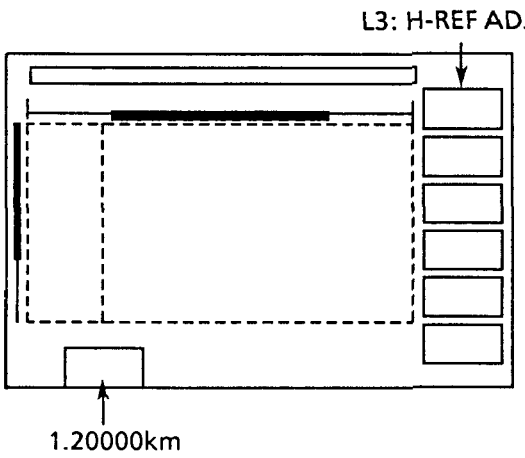
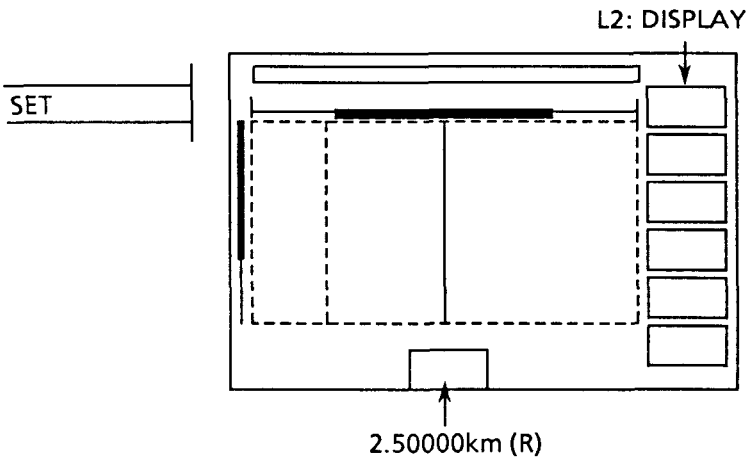
Ordinarily, the fiber to be tested is connected to the OTDR output and is displayed on the screen with the optical output as 0m. However, when making measurements by inserting a dummy fiber between the OTDR and the fiber to be tested to avoid the dead zone, it is convenient to make the position at which the fiber to be tested is connected 0m.

5.20.1 Setting relative distance measurement marker

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
DISPLAY	L2: DISPLAY TITLE UNIT ⋮	The soft key is brought to the DISPLAY layer.
H-REF ADJ		"0.00m" is reverse-displayed at the bottom left corner of the screen. The cursor on the × or ✱ marker is cleared.

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(Continued)

Key operation	Screen display	Description
		When the rotary knob is turned, a dashed line cursor (reference cursor) is displayed and its position is displayed under the cursor. Move the cursor to the position you want to set to 0m. ***Note:*** When the reference cursor is outside the display range of the screen, a cursor is not displayed on the screen.
SET		The reference cursor is set and the soft key is returned to the DISPLAY layer. The distance between the × and ✳ cursors distance, the horizontal axis shift value, the sampling start distance, and the event table distance are displayed by relative distance from this reference cursor. When the reference marker is set, "(R)" is displayed at the right side of the × and ✳ markers distance display. The distance display at the left side of the reference cursor becomes "–" (minus). ***Note:*** When the following keys are returned to the DISPLAY layer without pressing the [SET] key, reference marker setting is returned to its state before the H-REF ADJ layer was entered: Prior, Marker, V-Shift, H-Shift

- When the [CLEAR] key is pressed at the H-REF ADJ layer, the reference marker is erased from the screen .

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5.21 Measurement Result Display Position Setting Function (RESULT DISP AREA)

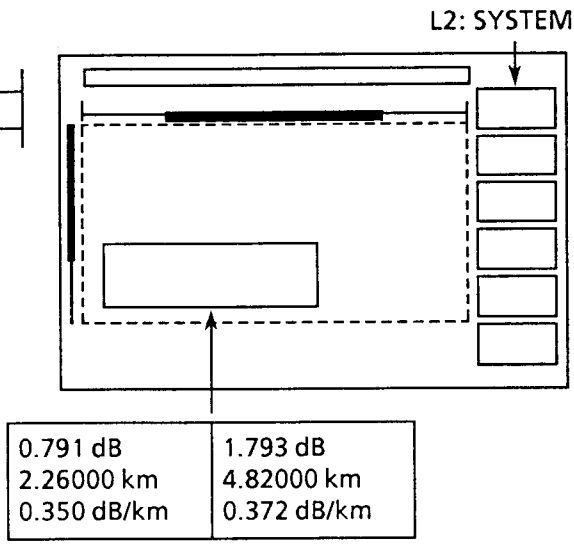
In splice loss & dead zone measurement, auto fault location (automatic fault location function), and event measurement, the fiber overall loss, overall length, and transmission loss measurement result display position can be selected from collective display at the bottom left corner of the screen or display near the waveform.

5.21.1 Example of measurement result display position setting

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer display.
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The soft key is brought to the first layer (2/3).
etc.	L1: (3/3) SYSTEM ⋮	The soft key is brought to the first layer (3/3).
SYSTEM	L2: SYSTEM INTERFACE CALENDAR ⋮	The soft key is brought to the system layer.
RESULT DISP AREA	L3: RESULT DISP AREA TABLE SCALE AREA ⋮	The soft key is brought to the RESULT DISP AREA layer.

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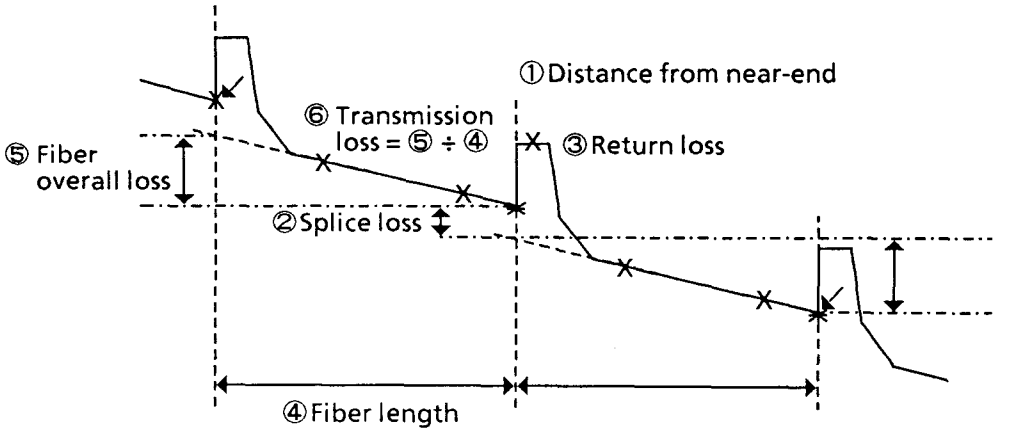
(Continued)

Key operation	Screen display	Description
TABLE		The measurement result is displayed at the bottom left corner of the screen and the soft key is returned to the system layer.

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5.22 Event (EVENTS) Measurement Function

When registration of a fiber splice point, break point, or other event point produces overall loss (⑤ in the figure below), overall length (④ in the figure below), transmission loss (⑥ in the figure below), and reflection of the fiber before and after that event, the return loss (③ in the figure below) is measured and displayed. Up to 100 events can be registered. A "◢" marker is displayed at the registered positions. When the AUTO function is on, events with a loss greater than the THRESHOLD value are detected and the "◢" marker is set automatically. These event points are displayed in a table (event table) that can be saved and recalled. The waveform data can also be saved together with the event table. Therefore, the waveform does not have to be saved for each event and all the event points can be recalled and evaluated at one time. When a fiber with multiple events is measured repeatedly, the marker does not have to be set at the event point at each measurement, but can be set by recalling this table.

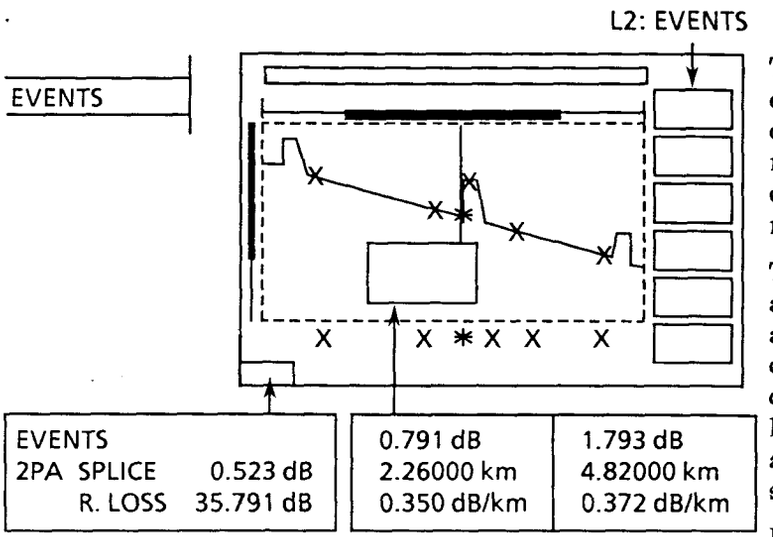


5.22.1 Event mode measurement

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer display.
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The soft key is brought to the first layer (2/3).

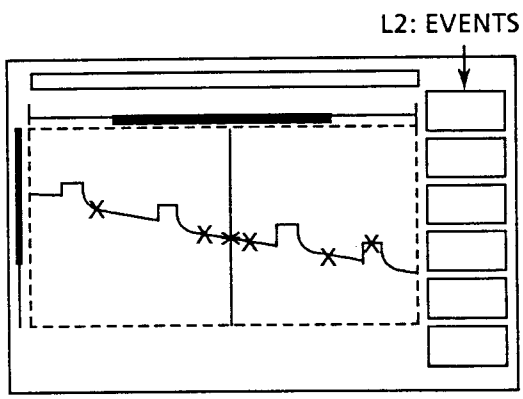
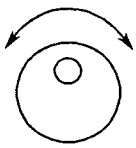
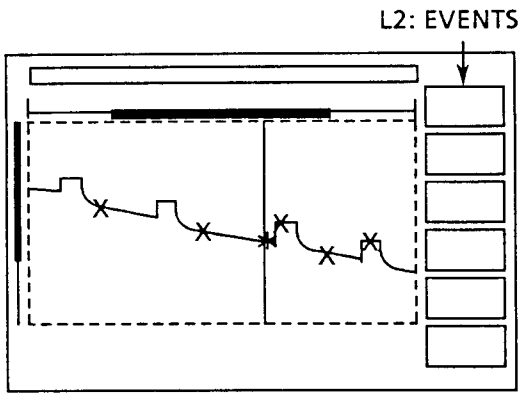
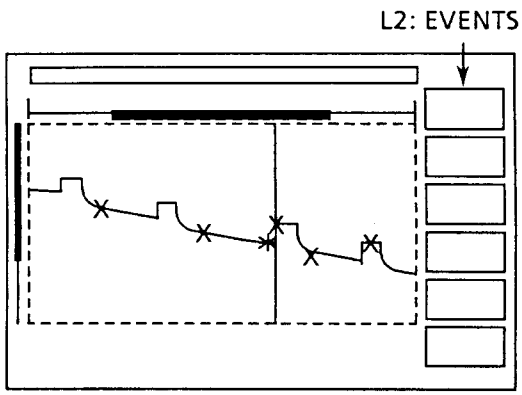
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(Continued)

Key operation	Screen display	Description
EVENTS		The soft key is brought to the event layer. Two × markers are displayed at the left of the ✱ marker and 3 × markers are displayed at the right of the ✱ marker. The overall loss, overall length, and transmission loss of the fiber are displayed at the bottom left corner of the scale (or near the center of the scale) and the splice loss and return loss are displayed at the bottom left corner of the screen. In the event mode, "EVENTS" is displayed at the bottom left corner of the screen. ***Note:*** In the event mode, the [SPL&DZL], [Splice], and [Loss] keys cannot be operated. To reset the event mode, press the [EVENTS OFF] key. When the [Prior] key is pressed, the system remains in the event mode and the soft key is brought to the first layer page 2. When the event marker at the farthest end is selected, ✱✱. ✱✱ is displayed at the overall loss, overall length, and transmission loss measurement result of that event.

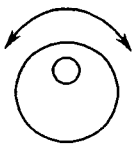
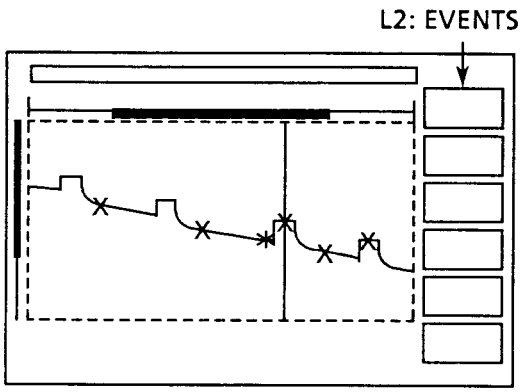
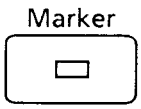
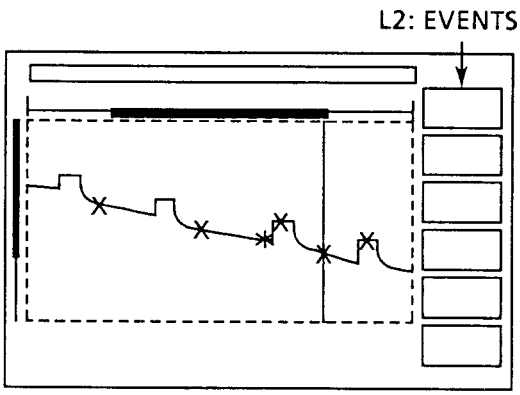
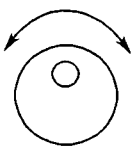
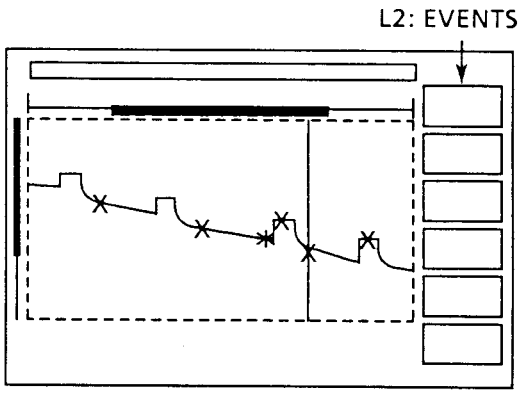
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(Continued)

Key operation	Screen display	Description
Registering an event		
Marker		The [Marker] key is pressed and the cursor is moved to the ✱ marker.
		The rotary knob is turned and the cursor is moved to the rising (or falling) edge of the event waveform. If the cursor is moved when it is on an ✱ marker, the other five × markers are moved simultaneously.
Marker		The [Marker] key is pressed and the cursor is moved one marker to the right (return loss measurement marker).

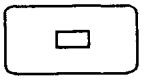
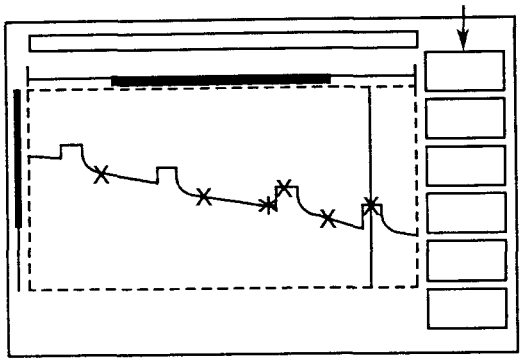
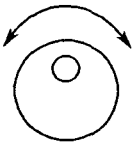
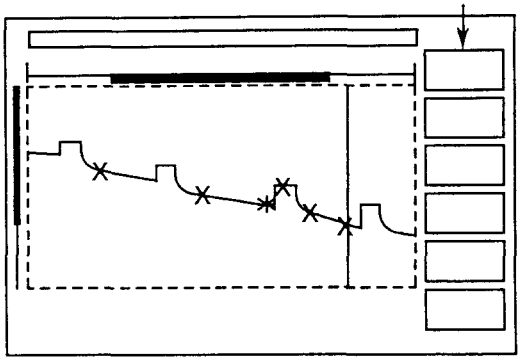
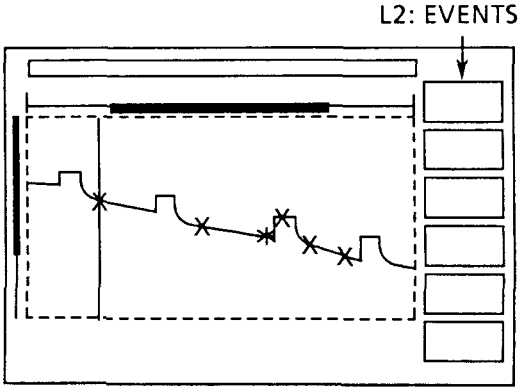
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(Continued)

Key operation	Screen display	Description
		The rotary knob is turned and the cursor is moved to the peak of the reflection from the event point.
		The [Marker] key is pressed and the cursor is moved one marker to the right.
		The rotary knob is turned and the cursor is moved to the straight part of the waveform behind the event point.

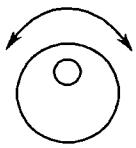
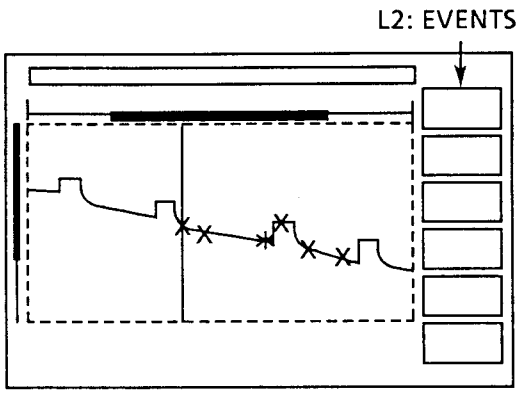
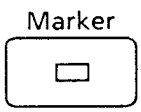
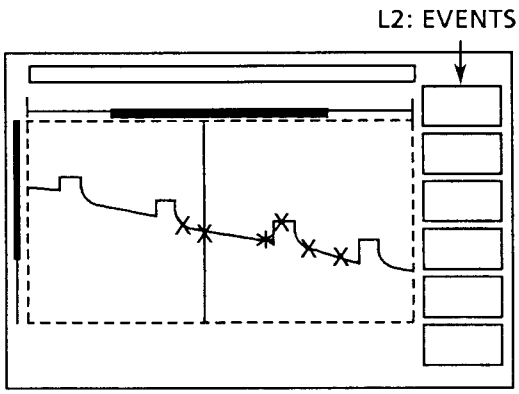
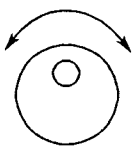
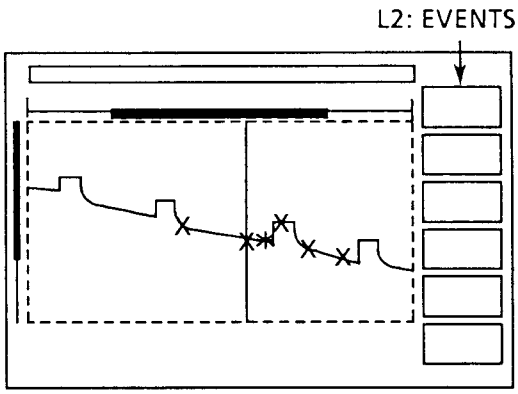
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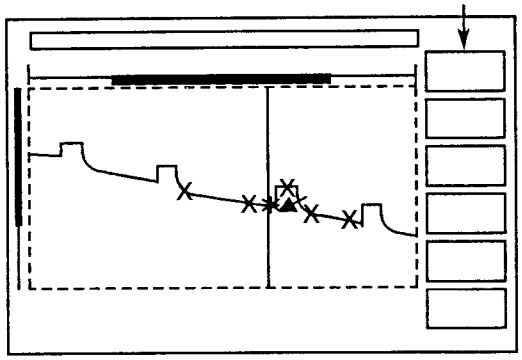
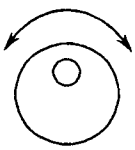
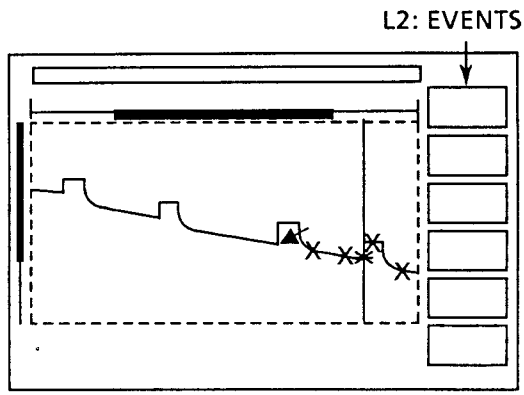
Key operation	Screen display	Description
Marker 	L2: EVENTS 	The [Marker] key is pressed and the cursor is moved to the rightmost marker.
	L2: EVENTS 	The rotary knob is turned and the cursor is moved so that the distance to the marker set earlier becomes as long as possible in front of the next event. This marker is set to the straight part of the waveform also.
Marker 	L2: EVENTS 	The [Marker] key is pressed and the cursor is moved to the leftmost marker.

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(Continued)

Key operation	Screen display	Description
		The rotary knob is turned and the cursor is moved to the straight part of the waveform to the rear of the previous event point.
		The [Marker] key is pressed and the cursor is moved one marker to the right.
		The rotary knob is turned and the cursor is moved so that the distance to the leftmost marker at the right of the * marker becomes as long as possible. This marker is set to the straight part of the waveform also. ***Note:*** The marker cannot be moved past its adjacent markers. In this case, the adjacent markers move also.

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Key operation	Screen display	Description
INSERT EVENT		The event point is registered and "▲" is displayed at the ✳ marker. The cursor is also moved to the * marker.
		The rotary knob is turned and the cursor is moved to the rising (or falling) edge of the next event waveform. Thereafter, the × and ✳ markers are set and the event is registered (INSERT EVENT) the same as before. "▲" is not displayed at the * marker position, but this position always becomes the event point. Thus the [INSERT EVENT] key does not have to be pressed if only one event is set or if the last event is set when multiple events are set. The operation above completes event registration. Up to 100 events can be registered. ***Note:*** The horizontal axis scale (H-Zoom In, Out) can be operated during event registration, but if the laser is on and averaging is off, the data fetch range (from SS to SE on the screen) is changed and event markers set outside this range are cleared.

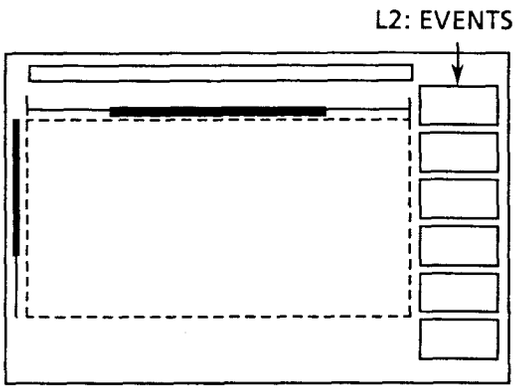
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(Continued)

Key operation	Screen display	Description

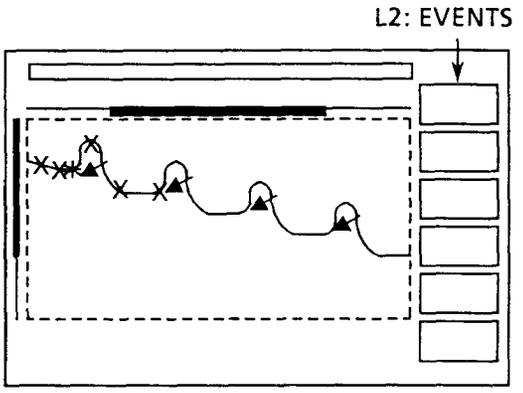
Event setting using auto (AUTO)

EVENTS



The event mode is set.

Auto



The fault location is detected automatically in accordance with the DATA SELECT and THRESHOLD settings and the event marker is set to that point.

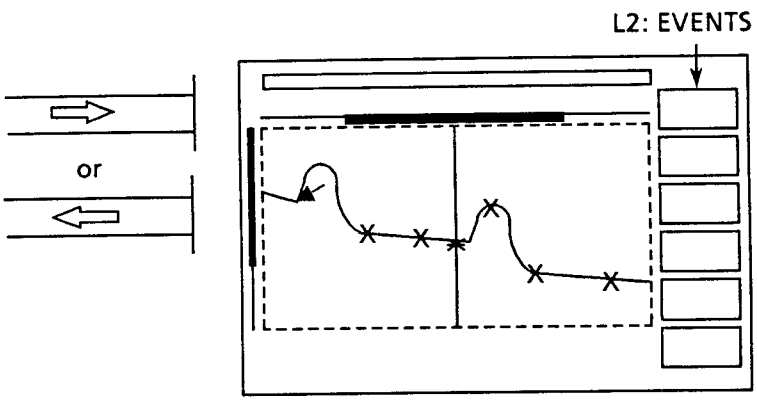
Note: When the range of the waveform displayed on the screen is changed by horizontal shift and scale switching when DATA SELECT is set to DISP, events outside the screen are cleared.
To avoid this, DATA SELECT must be set to ALL, or the AUTO mode must be reset.
The AUTO mode is reset by pressing the [Marker] key, or by turning the rotary knob. (However, the marker position changes.)

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(Continued)

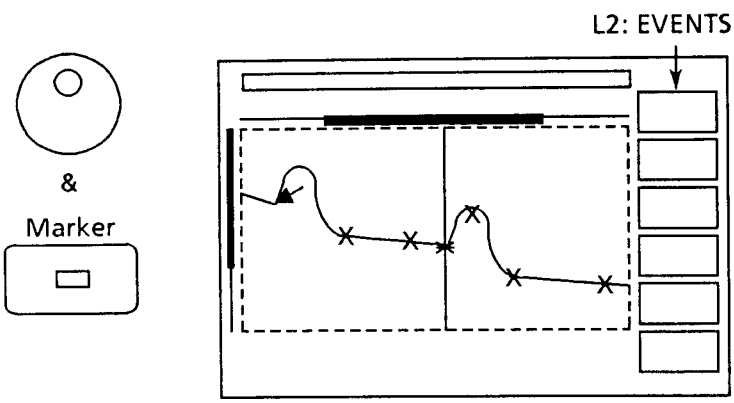
Key operation	Screen display	Description

Changing the event position



The event to be changed is selected with the " ⇨ " or " ⇦ " key.

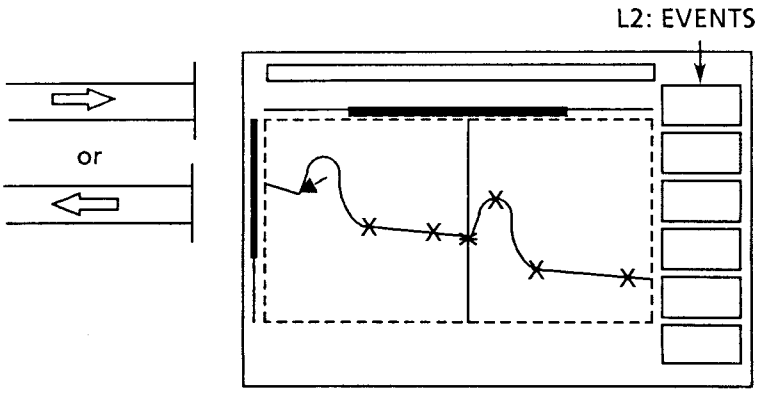
The next event marker " ◢ " to the right (left) is changed to an ✱ marker and × markers are displayed to the left and right of it. The event marker " ◢ " is displayed at the previous ✱ marker position.



The rotary knob and [Marker] key are used to move the markers to the position to be changed.

The event is selected with the " ⇨ " or " ⇦ " key and the position of the marker is changed with the rotary knob and [Marker] key.

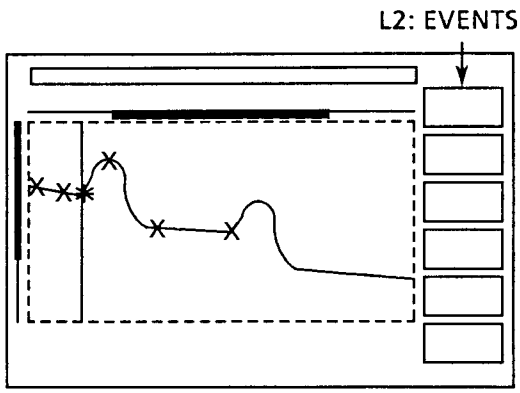
Deleting an event point



The event to be deleted is selected with the " ⇨ " or " ⇦ " key.

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(Continued)

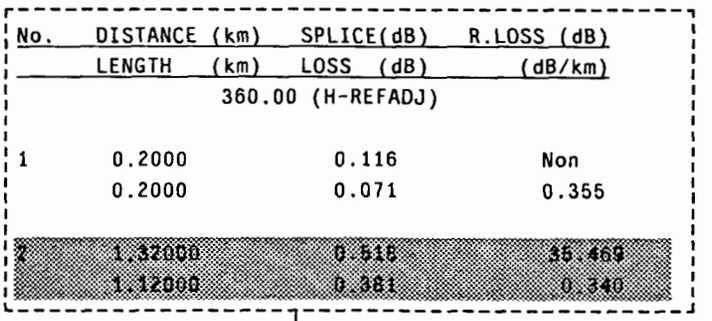
Key operation	Screen display	Description
DELETE EVENT		The selected event is deleted and the ✱ and × markers are moved one event to the right. When the rightmost event was deleted, the ✱ and × markers are moved one event to the left of the deleted event.

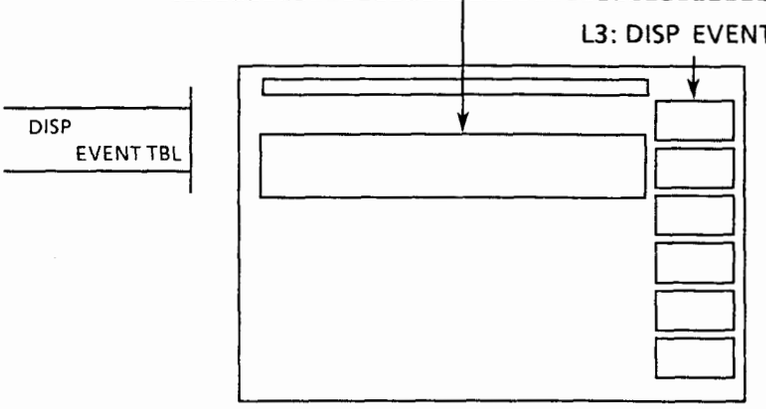
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Key operation	Screen display	Description

Displaying the event table

Set the event point as described earlier.





The selected event is reverse-displayed.

The event points are displayed sequentially, beginning from the event point near the MW9060A optical output connector.

The measurement result for each event point is displayed in two rows. From the left end of top row:

① Distance from OTDR optical output (When the relative distance marker is displayed, the distance from that position and the set value are displayed on the screen.)

② Event point splice loss

③ Return loss (When the reflection from the event is saturated, "?" is displayed at the left of the measurement value. When there is no reflection, "Non" is displayed.)

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(Continued)

Key operation	Screen display	Description
		From left end of bottom row ④ Distance between selected event and previous event (fiber length) ⑤ Loss at fiber length of ④ ⑥ Fiber transmission loss (loss ⑤ divided by fiber length ④) ***Note:*** If the copy key is pressed when this screen is displayed and the internal printer is set as the copy target, the event table can be printed out. (The part not displayed on the screen is also printed.)

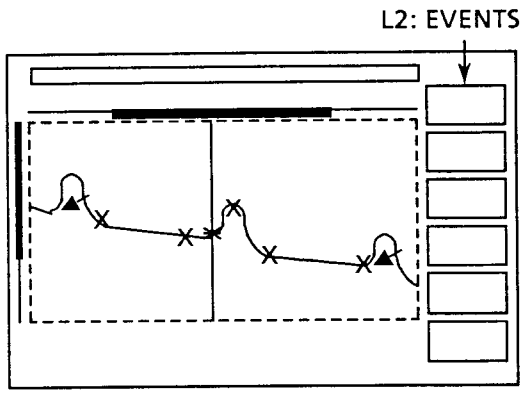
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Key operation	Screen display	Description

Displaying an event waveform selected by event table

Display the event table and select the event with the rotary knob and proceed as described below.

DISP EVENT



The selected event is brought to the center of the screen and the scale is automatically selected and displayed so that events before and after the selected event appear on one screen.

The measurement screen is displayed and the soft key is brought to the EVENTS layer.

Note: If this key is pressed when AUTO CONDITION layer DATA SELECT was set to DISP and the event was set by AUTO measurement, registration of events outside the screen display range is cleared. To avoid this, DATA SELECT must be set to ALL, or the AUTO mode must be reset.
The AUTO mode is reset by pressing the [Marker] key, or by turning the rotary knob. (However, the marker position changes.)
If DISP EVENT is performed when the laser is on and averaging is off, the sampling range may change. If event points set at this time are outside the sampling range, they are cleared.

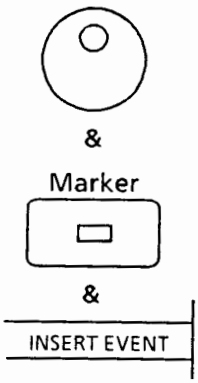
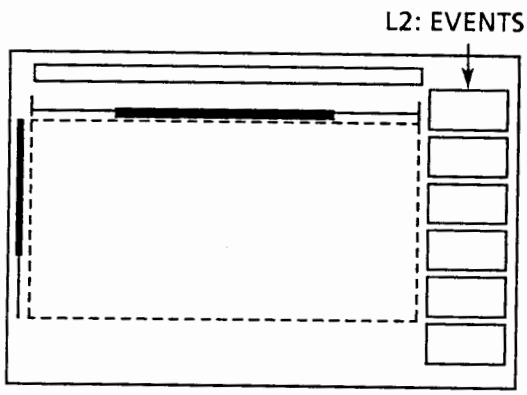
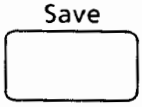
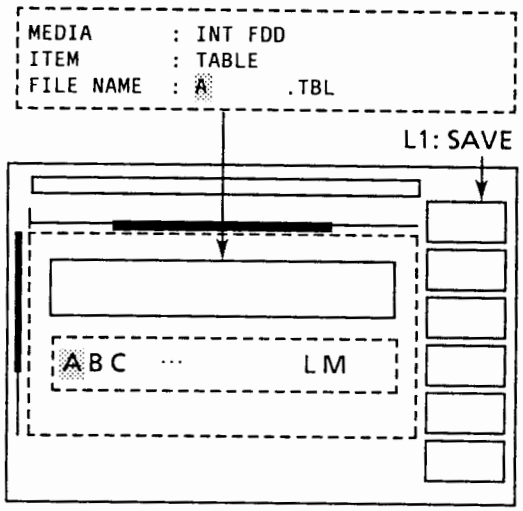
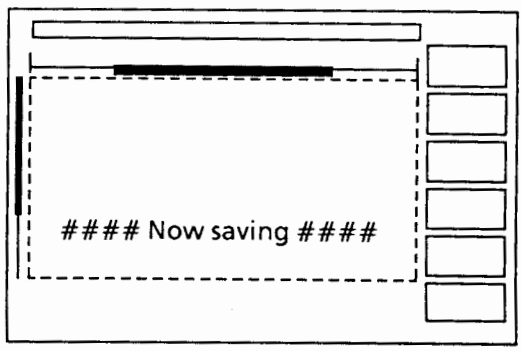
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5.22.2 Saving and recalling event table

Key operation	Screen display	Description
Saving event table Set MEDIA as described in paragraph 5.16 "Saving and Recalling". (Select a media other than internal memory.)		
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer display.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
ITEM	L3: ITEM WAVEFORM WAVEFORM & TABLE ⋮	The soft key is brought to the ITEM layer.
TABLE	L2: FILE MEDIA ITEM ⋮	The contents to be saved to or recalled from MEDIA are set to the event table. The soft key is returned to the FILE layer.

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(Continued)

Key operation	Screen display	Description
		The event point is set as described in paragraph 5.22.1 "Setting event mode".
		The soft key is brought to the SAVE layer and the SAVE screen is displayed. The file name is entered.
		The event table is saved. ***Note:*** If a file name which has already been saved is specified, be careful that file will be overwritten.

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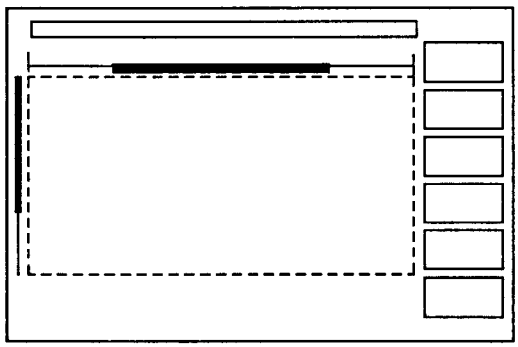
(Continued)

Key operation	Screen display	Description

Recalling an event table

Set MEDIA and ITEM the same as saving an event table.

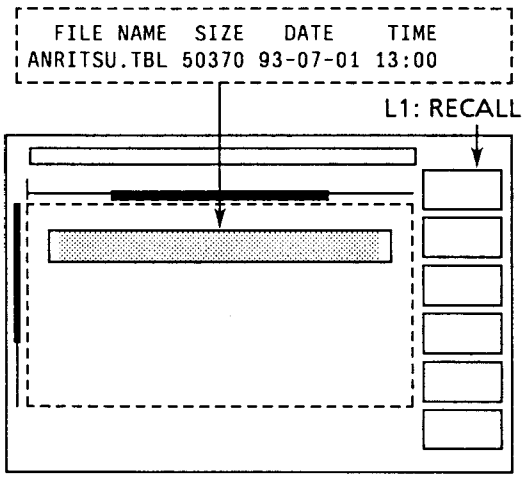
EVENTS



The event mode is set.

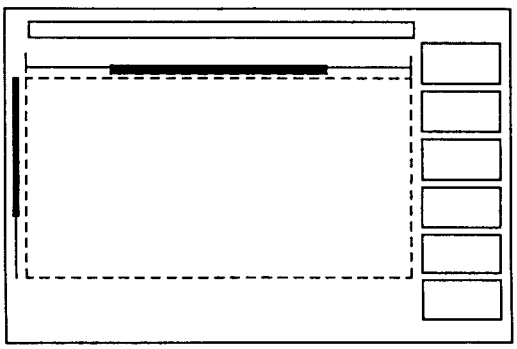
Note: When ITEM is set to TABLE, set the event mode before recalling the event table.

Recall



The soft key is brought to the RECALL layer and the RECALL selection screen is displayed and only files with a "TBL" or "T**" extension are displayed (when ITEM is set to TABLE). Therefore, the file name to be read is selected with the rotary knob.

EXECUTE

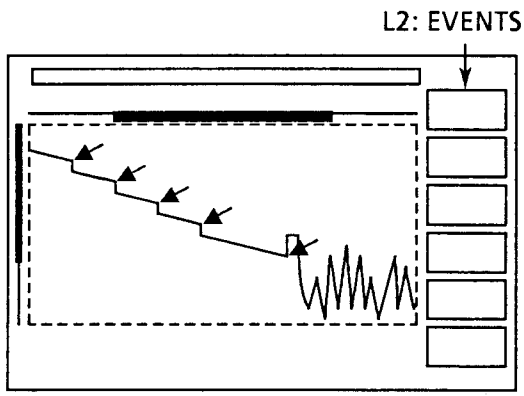


The event point is recalled.

Note: If an event table is recalled when a waveform is not displayed, the " ◢ " marker is not displayed.

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(Continued)

Key operation	Screen display	Description
On Off		A waveform is displayed and a "↙" marker is displayed at the registered event points.

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5.23 PROCEDURE Function

Consecutive key operations can be registered at one key. Registration is the same as ordinary measurement key operation so that special work such as GPIB program generation is unnecessary. Repetitive measurement and simple automatic measurement can be carried out easily using this function.

5.23.1 Example of setting measurement procedure by PROCEDURE function

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The soft key is brought to the first layer (2/3).
PROCEDURE REGIST	L2: PROCEDURE REGIST REGIST MEM No. LABELING ⋮	The soft key is brought to the PROCEDURE REGIST layer and the current memory number is displayed below the soft key display.

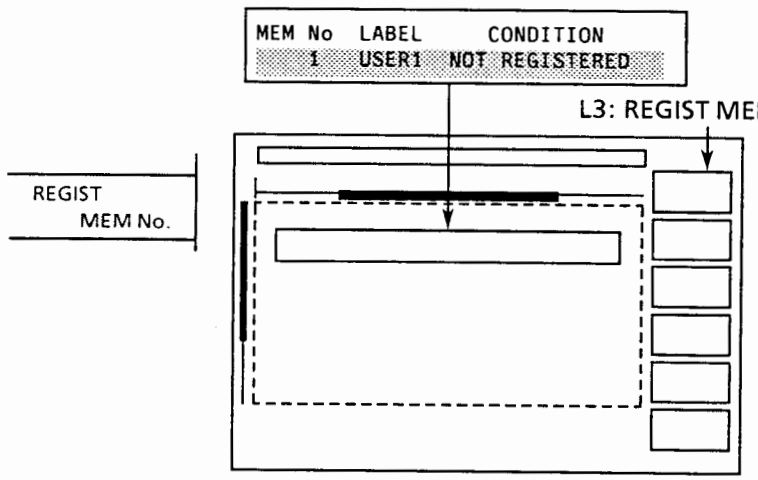
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(Continued)

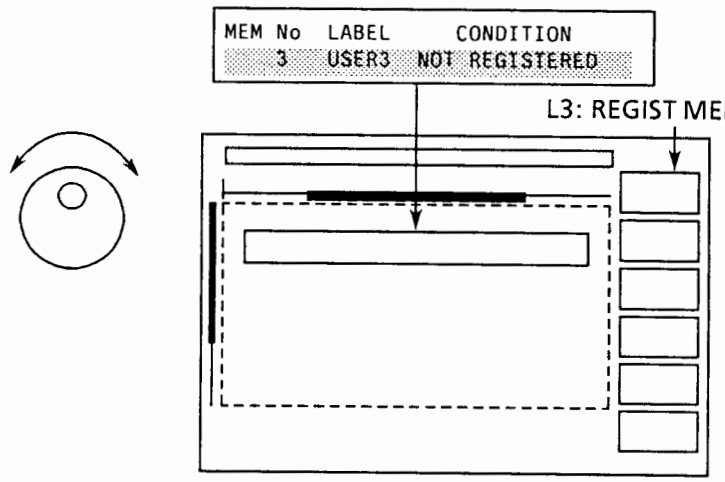
Key operation	Screen display	Description

Setting procedure memory No.

(When the memory No. is not changed, this operation is unnecessary.)



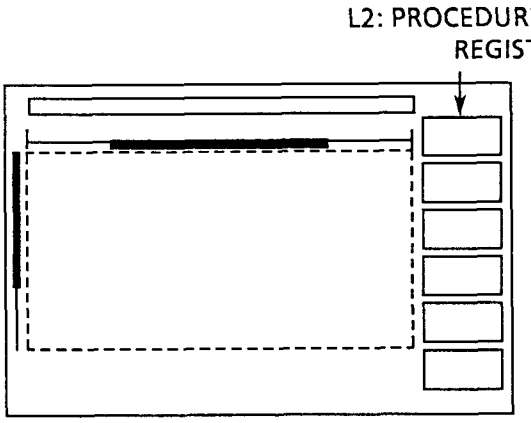
The soft key is brought to the REGIST MEM NO. layer. When numbers 1 to 6 and the label and measurement procedures for them are registered, "REGISTERED" is displayed on the screen. When they are not registered, "NOT REGISTERED" is displayed.



The memory No. is selected with the rotary knob.

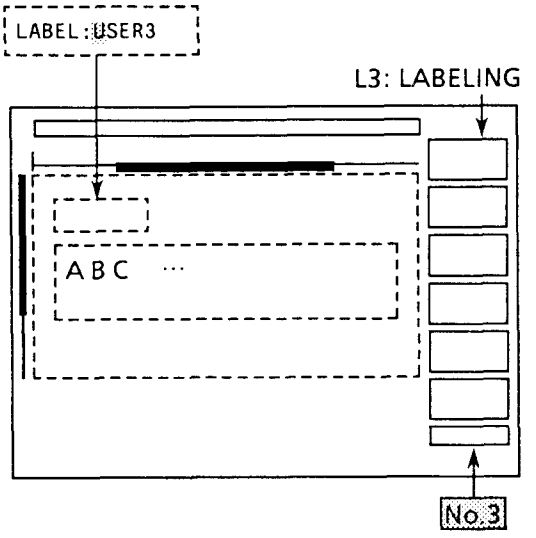
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(Continued)

Key operation	Screen display	Description
SET		The procedure memory number is set and the soft key is returned to the PROCEDURE REGIST layer.

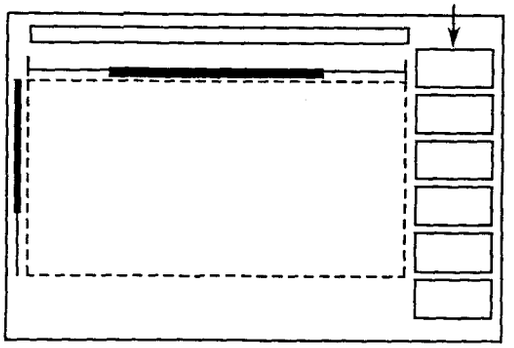
Labeling memory numbers

Memory numbers 1 to 6 can be labeled. When the [PROCEDURE MODE] soft key is pressed, this label is displayed on the screen. Up to 20 characters (10 characters × 2 lines) can be entered at the label. USER1 to USER6 are registered at the factory.

LABELING		The soft key is brought to the LABELING layer. The memory No. is reverse-displayed under the soft key. The entry method is the same as for title. See paragraph 5.14 "Setting Title".

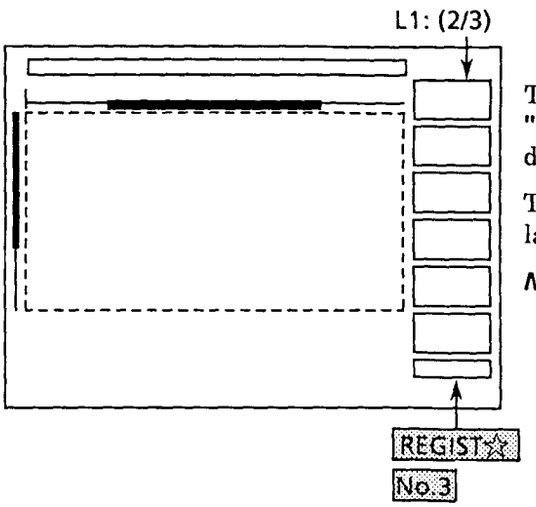
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(Continued)

Key operation	Screen display	Description
SET		The procedure memory number label is set and the soft key is returned to the PROCEDURE REGIST layer.

Registering measurement procedure

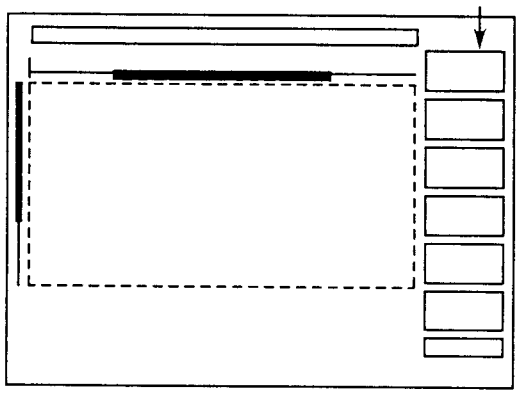
Consecutive key operations can be registered to the set memory No. by carrying out the following operations at the PROCEDURE REGIST layer.

REGIST START / STOP		The current memory No. and "REGIST☆" are reverse-displayed below the soft key. The soft key is brought to first layer page 2/3. ***Note***: If a registered memory No. is selected and this key is pressed, the registered contents will be cleared.

Thereafter, the keys to be operated are registered sequentially in all the memory Nos.. However, keys not directly related to measurement and setting, such as the [etc.] and [Prior] keys, are not registered. When operated key input was registered, ☆ of the REGIST☆ display at the bottom right corner of the screen flashes. An example of registering a procedure that uses the MW0947B to print out the waveform is shown as follows.

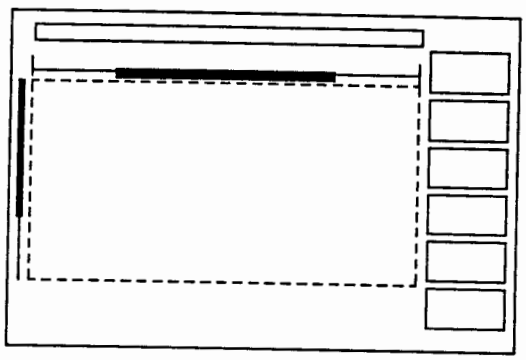
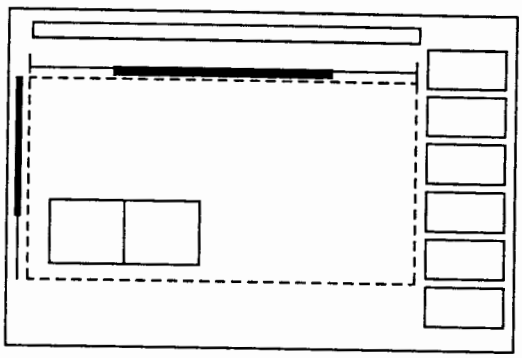
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(Continued)

Key operation	Screen display	Description
Initialize		The initial state is set.
CONDITION	L2: CONDITION DISTANCE PULSE ⋮	The soft key is brought to the CONDITION layer.
DISTANCE	L3: DISTANCE 10 km 25 km ⋮	The soft key is brought to the DISTANCE layer.
10 km	L2: CONDITION 	The distance range is set to 10km. (For the MW0947B, the pulse width is 500 ns.)

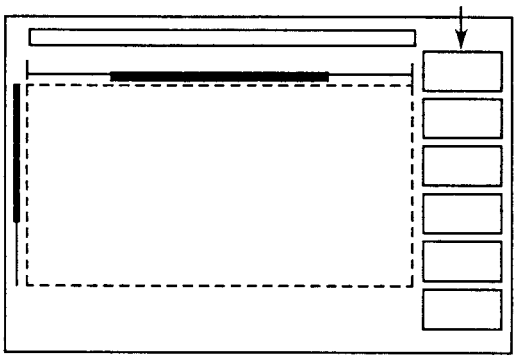
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(Continued)

Key operation	Screen display	Description
On / Off		The laser is turned on and a waveform is displayed.
Auto		The auto fault location function detects the fault location.
Copy		A hard copy of the screen is output at the internal printer. (At initialization, the copy target becomes the internal printer.)
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer.

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(Continued)

Key operation	Screen display	Description
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The soft key is brought to the first layer (2/3).
PROCEDURE REGIST	L2: PROCEDURE REGIST REGIST MEM No. LABELING ⋮	The soft key is brought to the PROCEDURE REGIST layer and the current memory No. is displayed below the soft key display.
REGIST START / STOP	L1: (2/3) 	The memory No. and REGIST☆ displayed below the soft key are cleared from the screen. The soft key is brought to first layer page 2/3 and key operation registration is ended. For a description of the registered measurement procedure execution method, see paragraph 5.23.2 "Procedure execution".

Note: The memory capacity for registering measurement procedures by PROCEDURE function is 5 K bytes/memory. The registered procedures can be checked by pressing the [EDITING CONTENTS] key as described later in the editing of registered procedure. These are described by GPIB command. For example, the operation that displays laser on by LD 1 is described by a 4-character, including spaces, command. Because one character corresponds to one byte, four bytes are necessary to register this operation in memory. As the capacity of one memory is 5 K bytes (=5120 bytes), for 4-byte commands, up to 1280 steps can be input. However, the memory capacity needed by one command is larger than this so that the number of steps that can be registered is smaller than 1280.
A wait time during measurement procedure registration by PROCEDURE function can be set. For more information, see paragraph of the setting wait time during procedure execution item described later.

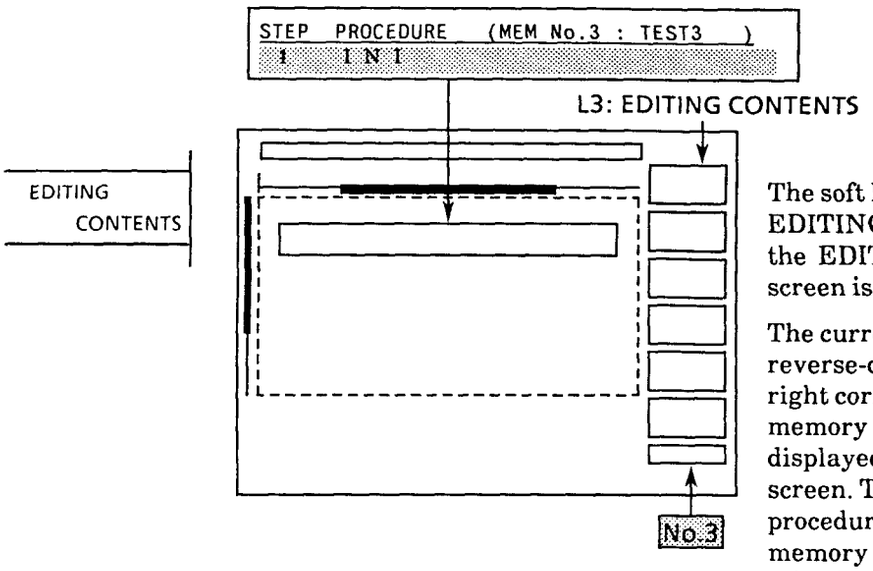
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(Continued)

Key operation	Screen display	Description

Editing of registered procedure

An example of insertion of a procedure that saves the measurement waveform data to the internal floppy disk before copying of the measurement procedure described earlier is given below. Perform the following operations at the PROCEDURE REGIST layer.



The soft key is brought to the EDITING CONTENTS layer and the EDITING CONTENTS screen is displayed.

The current memory No. is reverse-displayed at the bottom right corner of the screen. The memory No. and label are also displayed at the top center of the screen. The measurement procedure registered at that memory No. is displayed and the initial step is reverse-displayed.

Up to 10 steps are displayed on one screen. Steps after this can be viewed by turning the rotary knob. When the [Coarse] key is turned on, the page is scrolled.

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(Continued)

Key operation	Screen display	Description

Note: The measurement contents displayed on this screen use the same commands as GPIB commands. For detailes of each command, refer to the GPIB operation manual. Event point selection (⇦ , ⇨), wait time setting (WAIT), and pause (PAUSE) are described as follows:

EVTSB
Selects the event point before the currently selected point (corresponds to the [←] key).

EVTSF
Selects the event point after the currently selected point (corresponds to the [→] key).

WAIT ␣ {0|1}, <sweep count or wait time>
0: Sweep count
1: Time
<Sweep count or wait time> : Sweep count 1 = 1 sweep
: Time 1 = 1 second

PAUSE
This command procedure temporarily stops execution of the PROCEDURE function. To resume measurement by PROCEDURE function, press the [CONTINUE] soft key.

WAITs may be automatically inserted in a procedure, as required. Do not delete them.

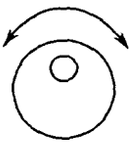
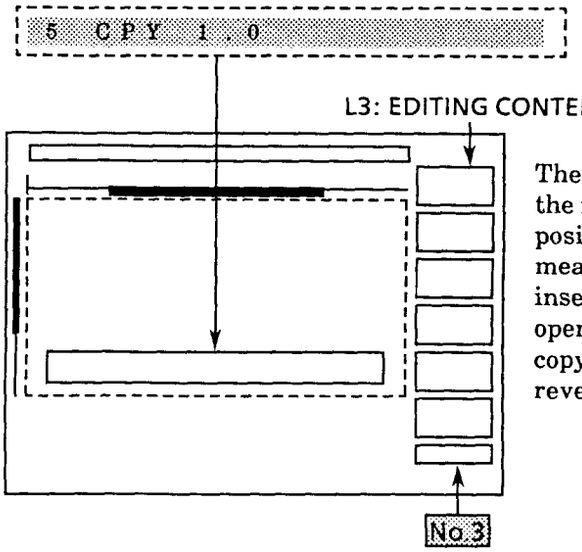
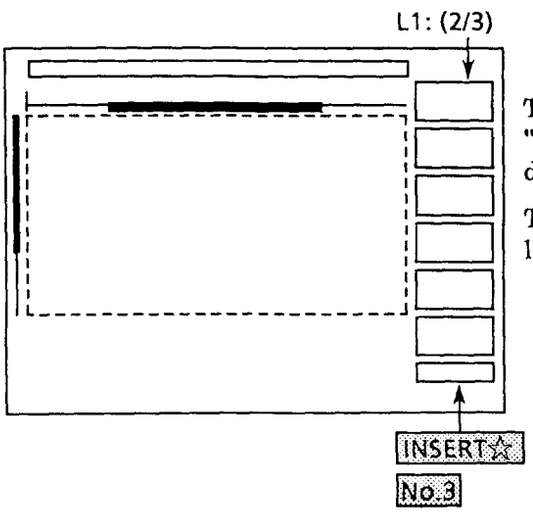
WAIT can be set during measurement procedure editing.

WAIT can be set by sweep count by setting AVG. LIMIT at measurement procedure registration.

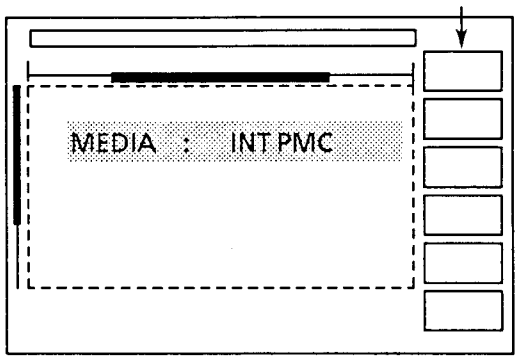
When this screen is displayed and the internal printer is set as the copy target, the procedure editing screen can be printed out by pressing the [Copy] key. (Parts not displayed on the screen are printed also.)

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(Continued)

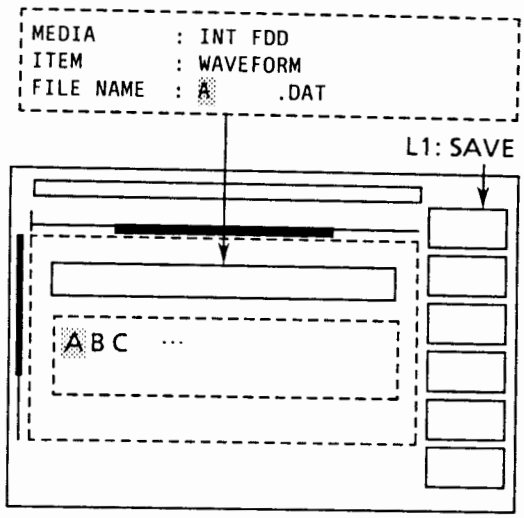
Key operation	Screen display	Description
		The rotary key is used to move the reverse-displayed line to the position (step) to which the measurement procedure is to be inserted. (In this example, an operation is to be inserted before copy. Therefore, CPY 1,0 is reverse-displayed.)
INSERT START / STOP		The current memory number and "INSERT☆" are reverse-displayed below the soft keys. The soft key is brought to first layer page 2/3.

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Key operation	Screen display	Description
All the keys to be operated thereafter are added. However, keys that are not directly related to measurement and setting, such as the [etc.] and [Prior] keys, are not registered. When operated key input is registered, the ☆ of the INSERT☆ display at the bottom right corner of the screen blinks.		
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer display.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
MEDIA	L3: MEDIA 	The soft key is brought to the MEDIA layer and the current media is reverse-displayed.
INT FDD	L2: FILE MEDIA ITEM ⋮	The media is set the internal floppy disk drive and the soft key is returned to the FILE layer.

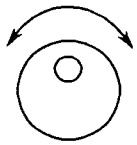
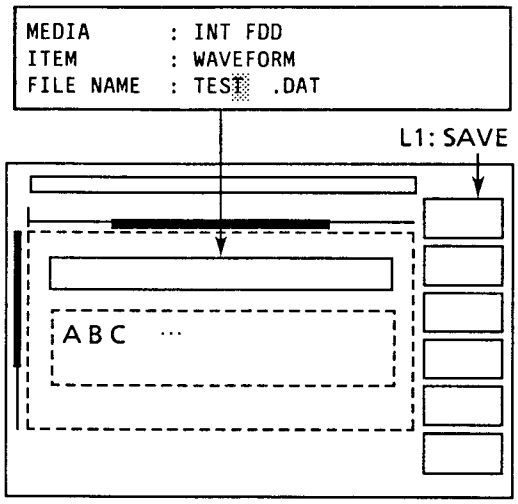
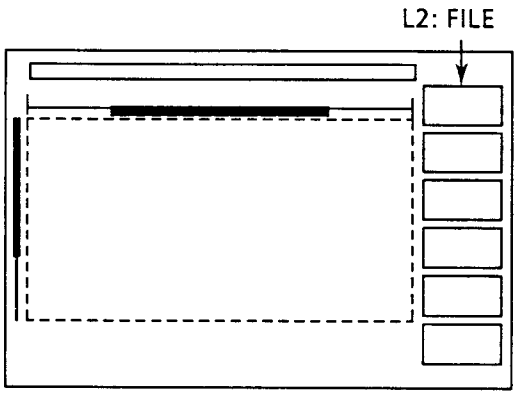
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(Continued)

Key operation	Screen display	Description
ITEM	L3: ITEM WAVEFORM WAVEFORM & TABLE ⋮	The soft key is brought to the ITEM layer.
WAVEFORM	L2: FILE MEDIA ITEM ⋮	The contents to be saved to, or recalled, from the media are set at the waveform data and the soft key is returned to the FILE layer.
Save		The soft key is brought to the SAVE layer and the SAVE screen is displayed. The file name is entered using the soft key and rotary knob.

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(Continued)

Key operation	Screen display	Description
		The file name is entered using the soft key and rotary knob. "TEST" is entered here.
EXECUTE		Save is executed, the screen is returned to the measurement screen, and the soft key is brought to the FILE layer.
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer display.
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The soft key is brought to the first layer (2/3).

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(Continued)

Key operation	Screen display	Description
PROCEDURE REGIST	L2: PROCEDURE REGIST REGIST MEM No. LABELING ⋮	The soft key is brought to the PROCEDURE RESIST layer.
EDITING CONTENTS	STEP PROCEDURE (MEM No.3 : TEST3) 1 INI L3: EDITING CONTENTS INSERT☆ No.3	The measurement procedure editing screen is displayed and the soft key is brought to the EDITING CONTENTS layer. ***Note:*** At this time, inserted procedures are not displayed.
INSERT START / STOP	L1: (2/3) No.3	Measurement procedure editing is ended and the screen is returned to the measurement screen. The soft key is brought to first layer page 2/3.

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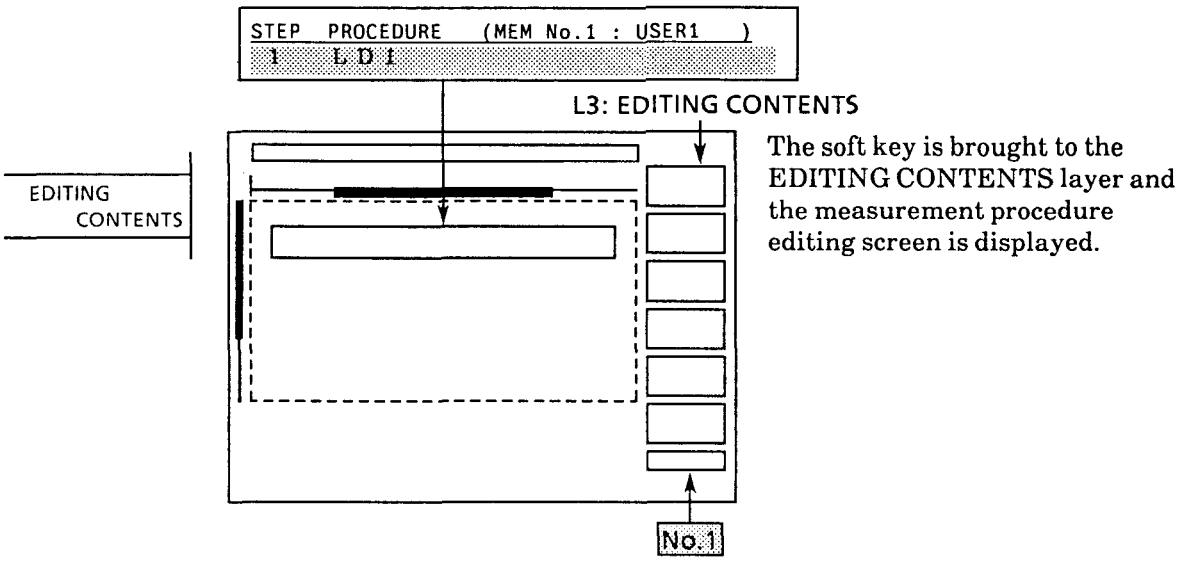
(Continued)

Key operation	Screen display	Description

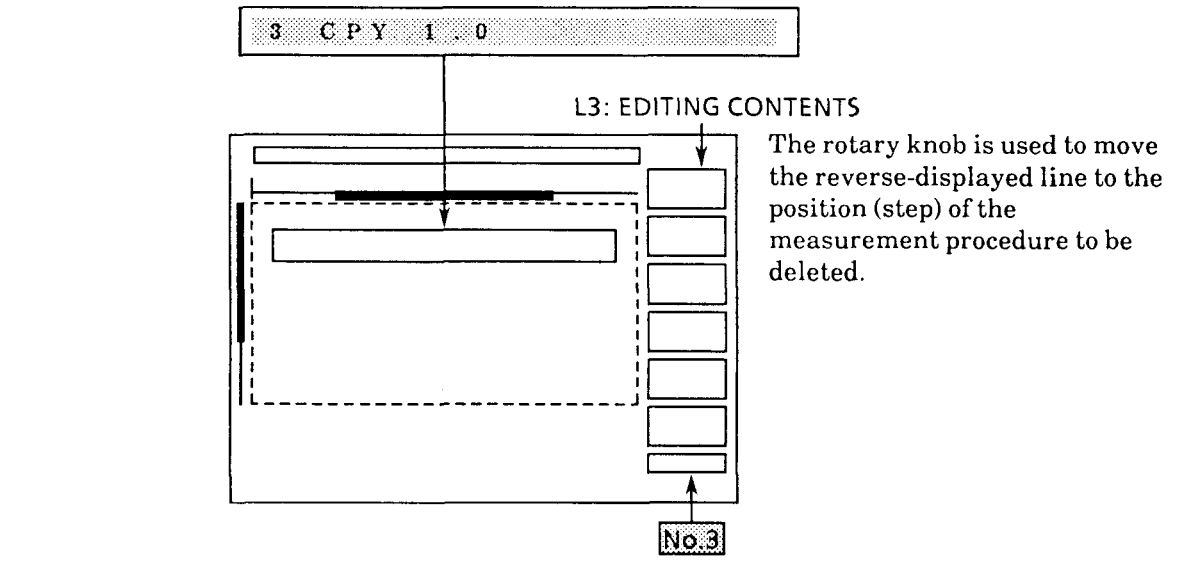
Deleting part of a registered procedure

Unnecessary steps, etc. can be deleted from a registered procedure.

Set the memory No. at the PROCEDURE REGIST layer, then carry out the operations shown below.



The soft key is brought to the EDITING CONTENTS layer and the measurement procedure editing screen is displayed.



The rotary knob is used to move the reverse-displayed line to the position (step) of the measurement procedure to be deleted.

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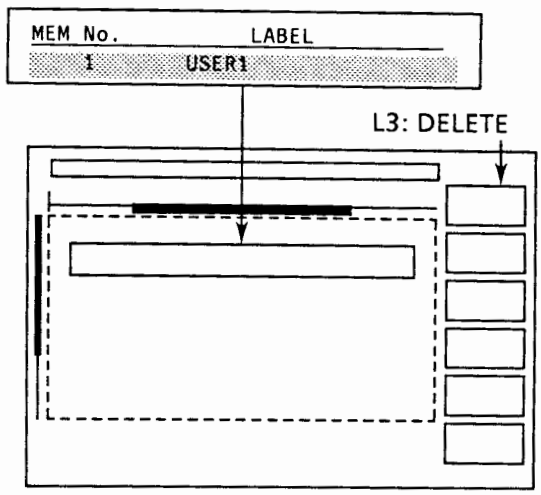
(Continued)

Key operation	Screen display	Description
DELETE	L2: PROCEDURE REGIST REGIST MEM No. LABELING ⋮	The reverse-displayed procedure is deleted. The soft key is brought to the PROCEDURE REGIST layer.

Deleting all the procedures registered at a memory No.

To delete an entire procedure instead of only some steps of the procedure as described earlier, carry out the following operations at the PROCEDURE REGIST layer.

DELETE

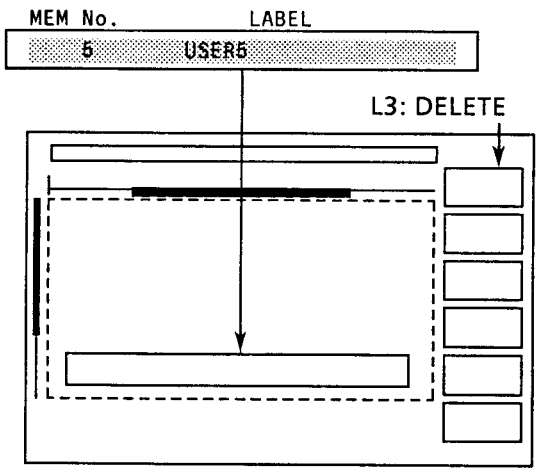
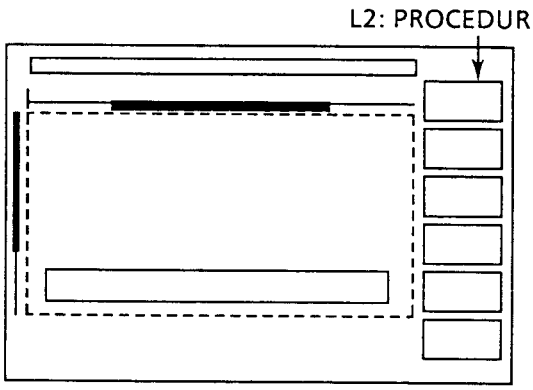


The soft key is brought to the DELETE layer.

Only the memory No. and label registering the measurement procedure are displayed.

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(Continued)

Key operation	Screen display	Description
		The memory No. to be deleted is selected by turning the rotary knob.
SET		The contents of the selected memory No. are deleted, the soft key is brought to the PROCEDURE REGIST layer, and the screen is returned to the measurement screen.

Note: If registration is started when registering a new procedure at a memory No. to which a measurement procedure has already been registered, the existing contents are cleared. Therefore, the contents do not have to be deleted before registration.

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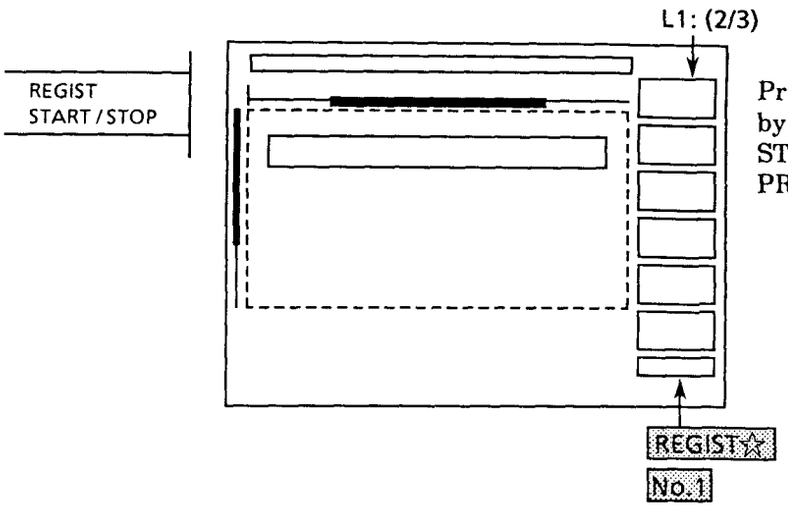
(Continued)

Key operation	Screen display	Description

Setting wait time during procedure execution (WAIT)

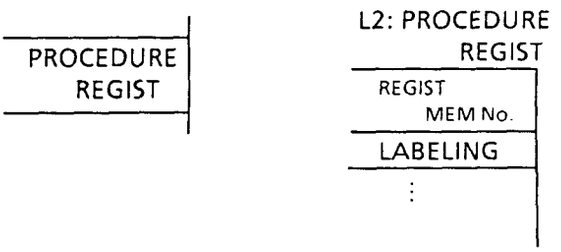
A wait time can be set during procedure function execution.

Note: Time is set only during procedure function measurement procedure registration or editing function insertion.



Procedure registration is started by pressing the [REGIST START/STOP] key at the PROCEDURE REGIST layer.

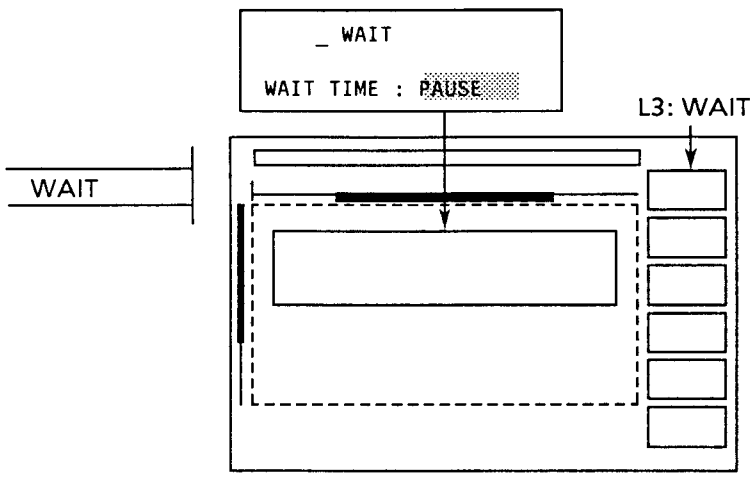
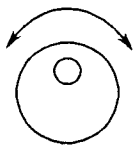
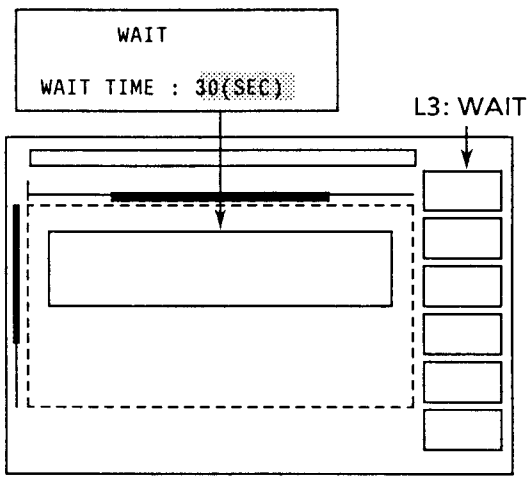
Perform the registered measurement and carry out the following operation where you want to insert a wait time.



The soft key is brought to the PROCEDURE REGIST layer.

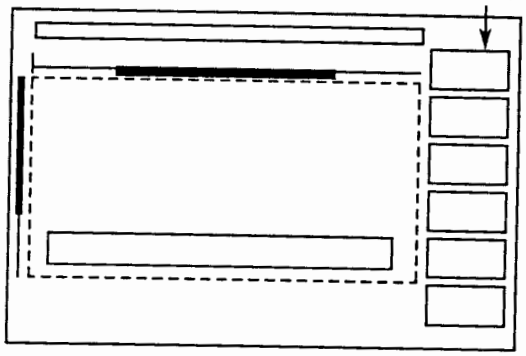
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(Continued)

Key operation	Screen display	Description
WAIT		The soft key is brought to the WAIT layer and the time setting screen is displayed.
		The wait time is set by turning the rotary knob. ***Note:*** When PAUSE is set, measurement pauses and "CONTINUE" is displayed at the soft key in the PAUSE position. To resume procedure measurement, press the [CONTINUE] key. The time can be set up to 999 seconds in 1 second steps. When the [Coarse] key is pressed, the set value is changed to 10 seconds steps.

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(Continued)

Key operation	Screen display	Description
SET	L2: PROCEDURE REGIST 	The wait time is set, the soft key is brought to the PROCEDURE REGIST layer, and the screen is returned to the measurement screen.

Saving measurement procedure

Set MEDIA as described in paragraph 5.16 "Saving and Recalling". (Select a medium other than internal memory.)

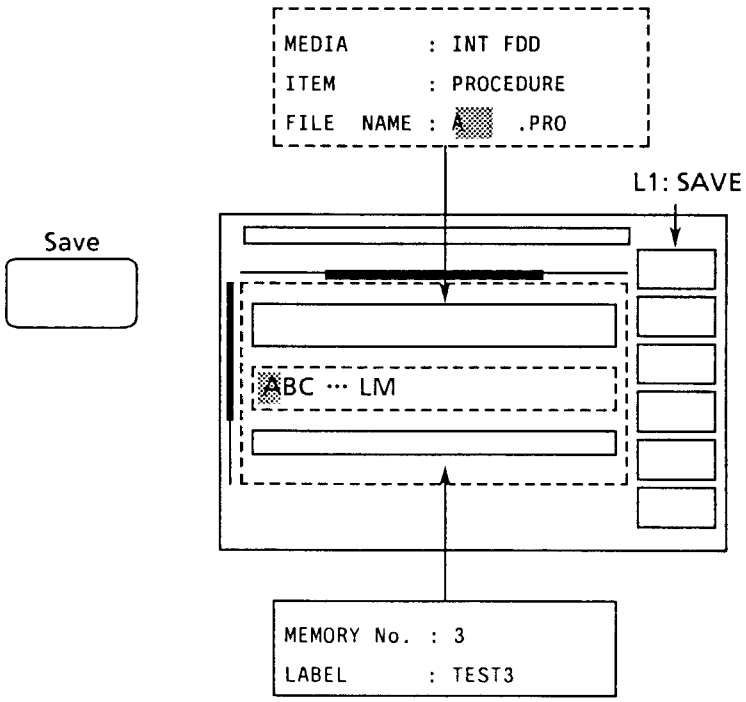
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer display.
FILE	L2: FILE MEDIA ITEM ⋮	The soft key is brought to the FILE layer.
ITEM	L3: ITEM WAVEFORM WAVEFORM & TABLE ⋮	The soft key is brought to the ITEM layer.

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(Continued)

Key operation	Screen display	Description
PROCEDURE	L2: FILE MEDIA ITEM ⋮	The contents to be saved to, or recalled from, MEDIA are set at PROCEDURE. The soft key is brought to the FILE layer.

Register the procedure as shown in the PROCEDURE setting example.



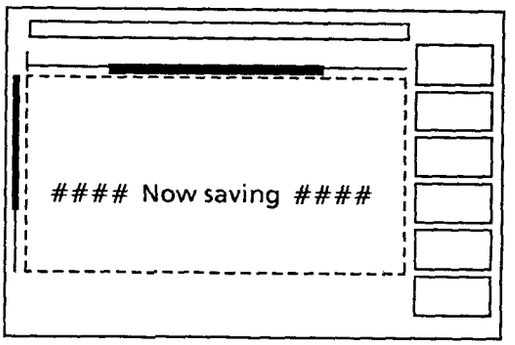
The soft key is brought to the SAVE layer, the SAVE screen is displayed, and the file name is entered.

The current memory No. and label are displayed at the bottom of the screen.

Note: Check if the memory No. registering the measurement procedure to be saved and the current memory No. are the same.

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(Continued)

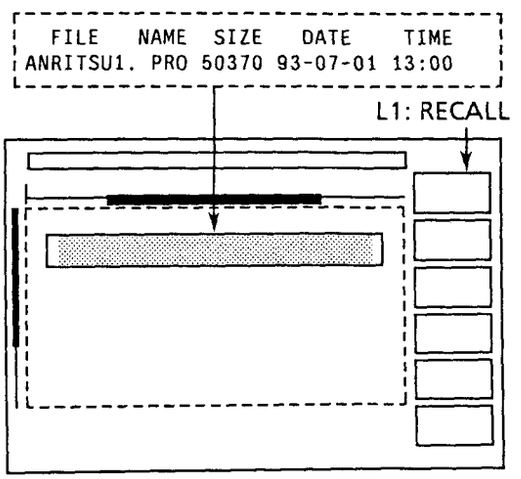
Key operation	Screen display	Description
EXECUTE		The measurement procedure is saved. ***Note:*** If the same file name as a file name already saved is specified, the old file will be overwritten.

Recalling measurement procedure

Set MEDIA and ITEM the same as when saving a measurement procedure. The memory No. registering the recalled measurement procedure can also be set in advance.

Note: If an existing memory No. is specified, be creful that the contents registered before recall will be destroyed.

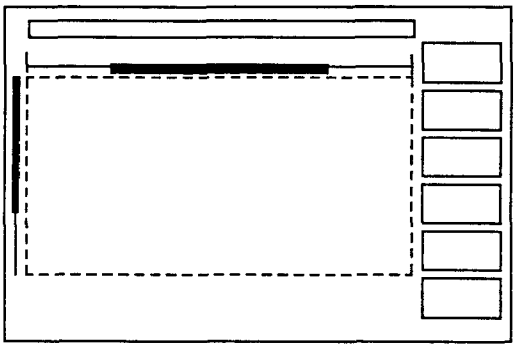
Recall



The soft key is brought to the RECALL layer, the RECALL selection screen is displayed, and only files with the extension "PRO" are displayed (when ITEM is set to PROCEDURE). The file name to be read is selected with the rotary knob.

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(Continued)

Key operation	Screen display	Description
EXECUTE		The measurement procedure is recalled.

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Notes: Saving and recalling waveforms (or event tables) registered as procedure function measurement procedures.

- When saving the measurement waveform is registered as a procedure, or when the registered contents are displayed at the EDITING CONTENTS layer, the file name extension becomes "○○.DAT". However, the extension of the file name that is saved when the procedure function was executed becomes "○○.D00".
- When multiple saves are registered in one procedure memory, the extension number is incremented at each save. For example, if the laser is turned on and save is executed three times as shown below, the three files "MW0947B.D00", "MW0947B.D01", and "MW0947B.D02 are saved.

```
LD 1
SAV MW0947B.DAT
SAV MW0947B.DAT
SAV MW0947B.DAT
END
```

- An example of registration of multiple saves and recalls in one procedure memory is shown below.

Consecutive save and recall

```
SAV MW0947B.DAT    ← Saves file MW0947B.D00.
SAV MW0947B.DAT    ← Saves file MW0947B.D01.
SAV MW0947B.DAT    ← Saves file MW0947B.D02.
RCL MW0947B.DAT    ← Recalls file MW0947B.D00.
RCL MW0947B.DAT    ← Recalls file MW0947B.D01.
RCL MW0947B.DAT    ← Recalls file MW0947B.D02.
```

Alternate save and recall

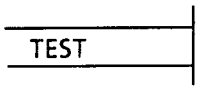
```
SAV MW0947B.DAT    ← Saves file MW0947B.D00.
RCL MW0947B.DAT    ← Recalls file MW0947B.D00
SAV MW0947B.DAT    ← Saves file MW0947B.D01.
RCL MW0947B.DAT    ← Recalls file MW0947B.D01.
SAV MW0947B.DAT    ← Saves file MW0947B.D02.
RCL MW0947B.DAT    ← Recalls file MW0947B.D02.
```

- If the [Initialize] key is pressed while the power is turned off, when the procedure registered contents are changed, or when a procedure function is not executing, the extension No. becomes 0.
- In the following cases, the extension No. is incremented by one each time the procedure function is executed. The following are assumed to be registered at the "TEST" procedure memory.

```
LD 1
SAV MW0947B.DAT
RCL MW0947B.DAT
END
```

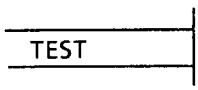

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The procedure function is executed.



← File MW0947B.D00 is saved, then recalled.

The procedure function is executed again.



← The file MW0947B.D01 is saved, then recalled.

However, when execution of the procedure function is interrupted by the [STOP] key, the extension No. may not change normally. When initialization by the [Initialize] key is registered, the extension No. always begins from 0.

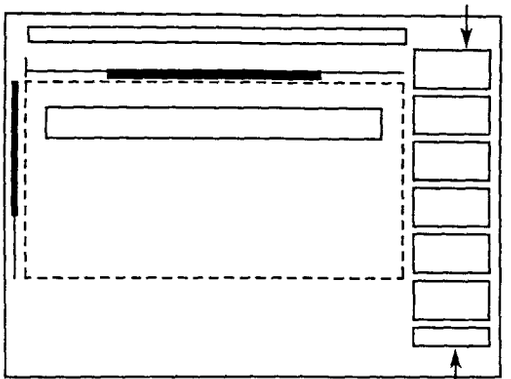
When recalling a file by PROCEDURE function, the file saving procedure must be registered before recalling procedure.

5.23.2 Example of execution of measurement procedure by procedure function

Key operation	Screen display	Description
Prior	L1: (1/3) CONDITION MEASURE DISPLAY ⋮	The soft key is brought to the first layer display.
etc.	L1: (2/3) COMPARE SWEEP MODE ⋮	The soft key is brought to the first layer (2/3).

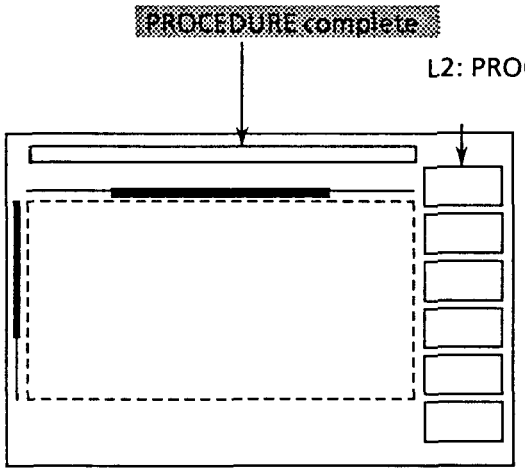
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(Continued)

Key operation	Screen display	Description
PROCEDURE MODE	L2: PROCEDURE MODE TEST1 TEST2 ⋮	The soft key is switched to the PROCEDURE MODE layer. The label set at the PROCEDURE REGIST layer is displayed at the soft key. The memory numbers are displayed at the soft key in ascending order, beginning from memory No. 1.
TEST1	L3: TEST1  PROCEDURE No. 1	The measurement procedures registered at the memory Nos. corresponding to the pressed soft key are executed sequentially. The display above the soft key is changed to the set label display and "PROCEDURE" and the executing memory No. are reversed-displayed below the soft keys. The soft key display is changed to STOP and PAUSE.

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(Continued)

Key operation	Screen display	Description
		When all the registered measurements are complete, "PROCEDURE complete" is displayed on the screen and a buzzer is sounded. The soft key is brought to the PROCEDURE MODE layer.

Note: To stop automatic measurement by procedure function, press the [STOP] soft key. When you want to pause during measurement, press the [PAUSE] soft key. When this key is pressed, the soft key display changes to "CONTINUE". To resume measurement by procedure function, press the [CONTINUE] key.

The measurement procedure registered by procedure function is preserved in the internal memory even when the power is turned off.

If the power is turned on after being turned off when the soft key is at the PROCEDURE MODE layer, the soft key is brought to the PROCEDURE MODE layer. Therefore, a certain registered measurement can be made by only turning on the power and pressing the soft key registering that measurement. Other key operations are unnecessary.

If an error occurs while the procedure function is executing, "PROCEDURE error (step*)" is displayed and measurement is stopped at that point and the soft key is returned to the PROCEDURE MODE layer. Here, * represents the step number that generated error in the registered measurement procedure. When the [EDITING CONTENTS] key is pressed at the PROCEDURE REGIST layer, that step is reverse-displayed.

If an averaging count was set, the count may be one higher than the set value.

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5.24 Soft Keys

The following describes the operation method, structure, and functions of soft keys.

5.24.1 Outline of operation

The MW9060A has six soft keys from F1 to F6. The menu of soft keys is displayed on the right edge of the screen. Any desired function in the menu can be selected and executed by pressing the key corresponding to that function (this key being called the soft key).

The menu is hierarchically structured from layer 1 to layer 3. Each time pressing any key in a given layer, it goes to the next layer. The third layer is used primarily for selecting function parameters, in which case use the rotary knob in combination with soft keys. The [Prior] key below the F1 to F6 keys is used to bring the selected function backward from the current layer to the immediately preceding layer.

Figure 5-11 schematically shows what is described above. Operating a key or the rotary knob moves the current layer to the layer indicated by the arrow.

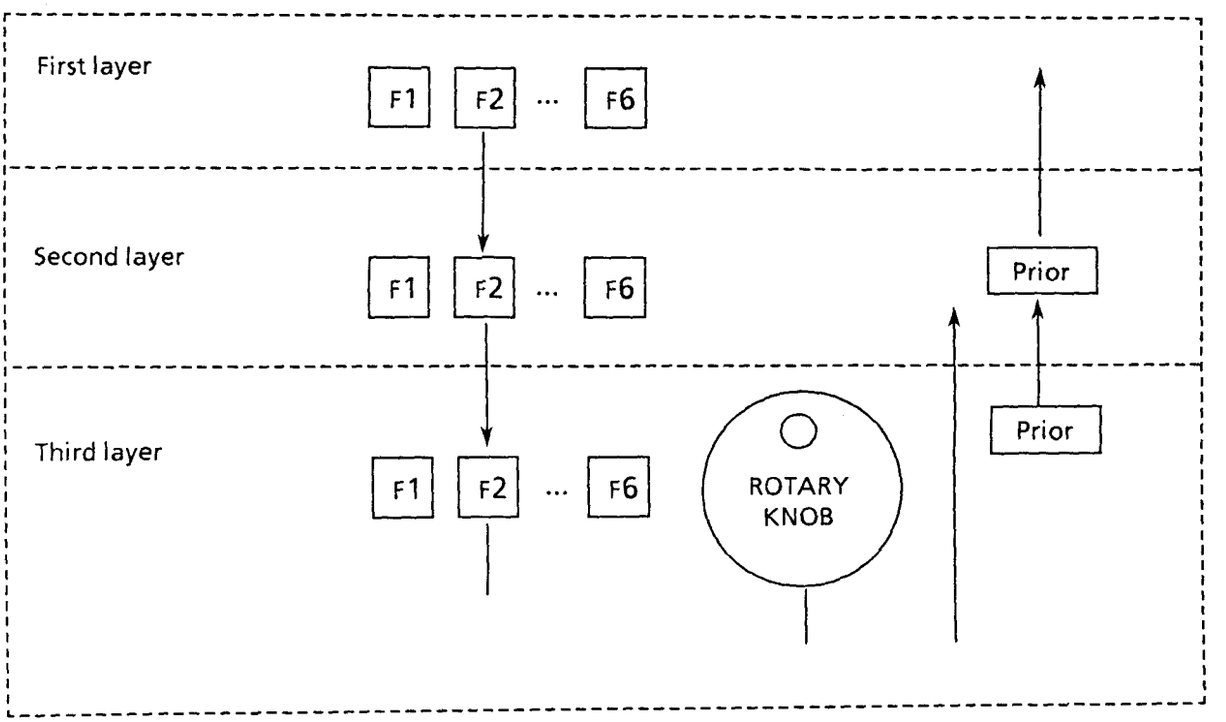


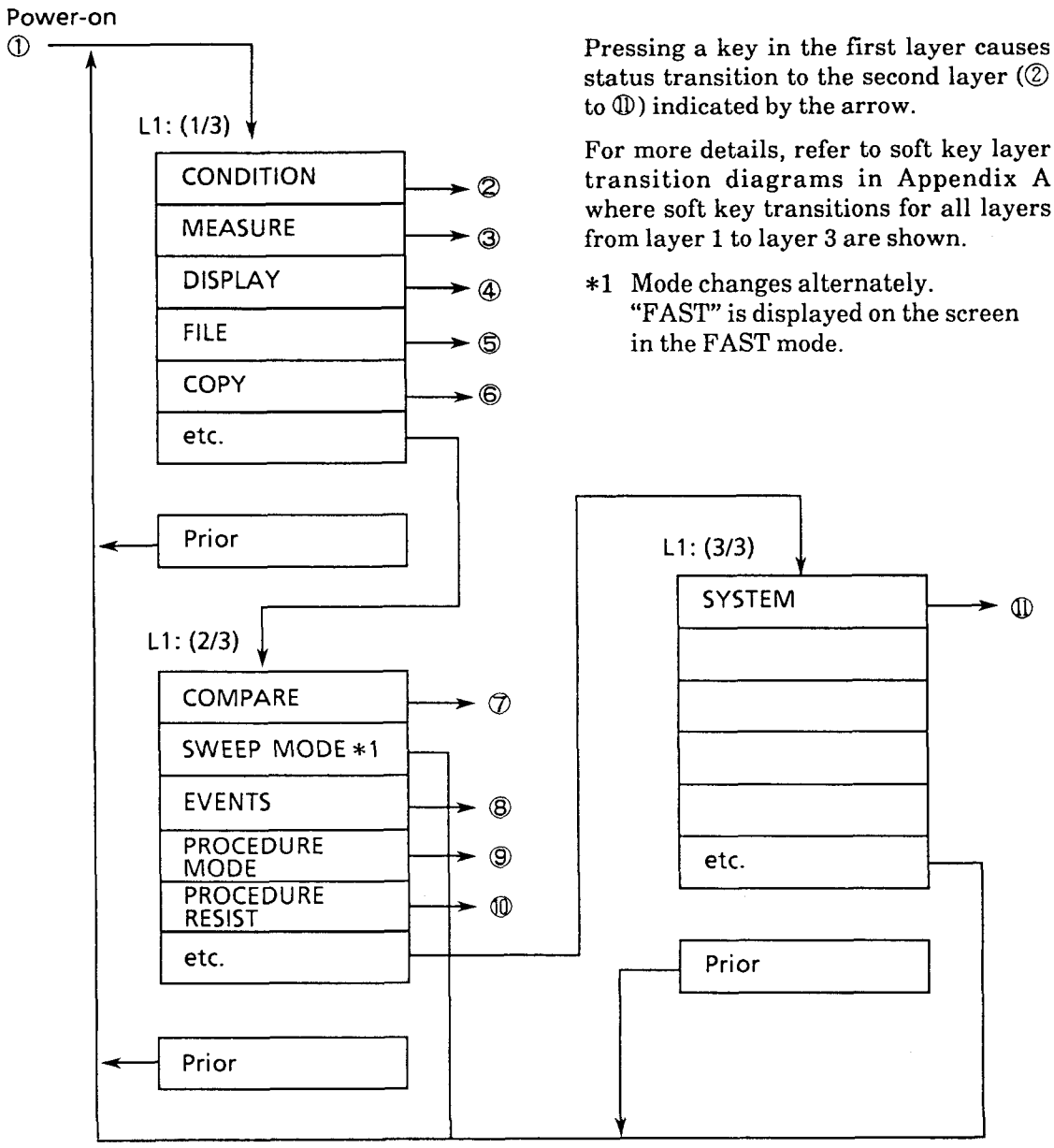
Fig. 5-11 Layer Transition of Soft Keys

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5.24.2 Hierarchical structure

In the first layer, mainly functions are devided into certain groups of functions. In the second layer, each function is selected. In the third layer, function parameters are selected.

Figure 5-12 shows the soft key menu in the first layer. The first layer is divided into 11 function groups. Because the whole menu cannot be displayed at a time, the menu is displayed on three separate screens (L1: (1/3), L2: (2/3) and L3: (3/3)). When the menu is displayed on multiple screens, change the displayed menu within the same layer by pressing the [etc.] key.



Pressing a key in the first layer causes status transition to the second layer (② to ⑪) indicated by the arrow.

For more details, refer to soft key layer transition diagrams in Appendix A where soft key transitions for all layers from layer 1 to layer 3 are shown.

*1 Mode changes alternately. "FAST" is displayed on the screen in the FAST mode.

Fig. 5-12 Menu in First Layer

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5.24.3 Description of functions of 1st/2nd layers

Table 5-4 shows the names of first and second layers and outline description of functions.

Table 5-5 Names of First/Second Layers and Description of the Functions

First layer	Second layer	Function
CONDITION	DISTANCE	Sets distance range.
	PULSE	Sets pulse width.
	ATT.	Sets attenuator. (For some unit, fixed value is set. See paragraph 1.5.)
	MASK.	Sets mask.
	OUTPUT POWER	Sets LD output power. (For some unit, this cannot be used. See paragraph 1.5.)
MEASURE	LSA/2PA	Selects the linear approximation method of loss measurement. (Least Square Approximation (LSA) or 2-point Approximation (2PA))
	AUTO CONDITION	Sets the method of auto fault location.
	AVG. LIMIT	Sets averaging count or time.
	IOR	Inputs the refractive index of fiber-optic cable.
	RETURN LOSS	Enters return-loss measurement mode.
	R. LOSS-PARA	Sets parameters for the return-loss measurement.
DISPLAY	TITLE	Inputs the title of measurement screen.
	UNIT	Sets the unit of distance.
	SMOOTHING	Turns the smoothing function On/Off.
	SMOOTHING LEVEL	Sets the smoothing level.
	FULL TRACE	Turns the Full Trace function On/Off.
	H-REF ADJ	Sets the relative distance 0 km.

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Table 5-5 Names of First/Second Layers and Description of the Functions (Cont'd)

First layer	Second layer	Function
FILE	MEDIA	Sets the media type when saving or recalling.
	ITEM	Selects the file type to be recorded/read.
	SAVE RANGE	Inputs the range and resolution of data to be saved.
	FILE DELETE	Deletes files in storage media.
	FORMAT	Formats storage media.
COPY	TARGET	Selects the device for data to be copied.
	ALL/TRACE	Sets the contents of copy (whose screen/waveform trace-only)
COMPARE	COMPARE RECALL	Recalls stored measurement result and compares it with other measurement data.
	SETTING ON/OFF	Turns the list of displayed waveform setting conditions on or off.
	COMPARE OFF	Terminates waveform comparison.
SWEEP MODE		Sets the sweep time. (Normal/Fast)
EVENTS	DISP EVENT TBL	Displays an event table.
	⇨	Selects the far- end fault location point.
	⇦	Selects the near-end fault location.
	INSERT EVENT	Inserts events.
	DELETE EVENT	Deletes events.
	EVENT OFF	Returns to the normal measurement screen.

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Table 5-5 Names of First/Second Layers and Description of the Functions (Cont'd)

First layer	Second layer	Function
PROCEDURE MODE	<label name>	Executes a registered procedure. <label name> is the name given to the procedure during registration.
PROCEDURE RESIST	RESIST MEM No.	Selects procedure registration.
	LABELING	Sets the label name.
	RESIST START/STOP	START starts registration and STOP stops registration. START and STOP are switched alternately.
	DELETE	Deletes a registered procedure.
	EDITING CONTENTS	Edits a registered procedure.
	WAIT	Sets the wait time.
SYSTEM	INTERFACE	Sets each parameter value of external interface.
	CALENDAR	Sets the date and time of built-in clock.
	RESULT DISP AREA	Sets the measured result display position.

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5.25 [Initialize] Key

Pressing the front-panel [Initialize] key initializes the measurement conditions and screen display. While in a remote state and executing procedure function, however, pressing this key is ignored.

Table 5-6 lists the items to be initialized and their initial states/initial values. In this table, PID means the initial values inherent in each plug-in unit. Table 5-7 lists the initial values of each plug-in unit.

Table 5-6 Items to be Initialized and Initial States/Values

Item	Initial states/values
Laser	Off
Average	Off
SPL & DZL/Splice/Loss	Loss
LSA/2PA	2PA
AUTO	Off
HORIZONTAL SCALE	PID
VERTICAL SCALE	5dB/div
Rotary knob	
Marker	
✳	5 div. from left of horizontal axis scale
X	3 div. from left of horizontal axis scale
H-Shift	0 km
V-Shift	10 dB
DISTANCE RANGE	PID
Sampling	
Start	0 km
End	PID
Resolution	PID
λ-Select (Valid only for switchable plug-in unit)	PID

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Table 5-6 Items to be Initialized and Initial States/Values (Cont'd)

Item	Initial states/values
PULSE WIDTH	PID
ATT (Only units with attenuator function)	AUTO
AVG. LIMIT	
TIME	12 hours (43,200 seconds)
NUMBER	50,000 times
MASK	Off
AUTO CONDITION	
THRESHOLD	1.00 dB
DATA SELECT	DISP
SETTING ON/OFF	Off
OUTPUT POWER	0
SWEEP MODE	NORMAL
SMOOTHING	Off
SMOOTHING LEVEL	1
FULL TRACE	Off
H-REF ADJ	Off
MEDIA	INT FDD
ITEM	WAVEFORM
SAVE RANGE	DISP
COPY	
TARGET	INT PRINTER
EVENTS	Off
PROCEDURE	Off
RESULT DISP AREA	TABLE

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Table 5-7 Initial Values of Plug-in Unit (PID)

Item	Plug-in unit					
	MW0945B	MW0946B	MW0947B	MW0942A	MW0944B	MW0967B
HORIZONTAL SCALE	25 km/div	25 km/div	25 km/div	1 km/div	1 km/div	1 km/div
DISTANCE RANGE	250 km	250 km	250 km	10 km	10 km	10 km
SAMPLING START	0 km	0 km	0 km	0 km	0 km	0 km
END	250 km	250 km	250 km	10 km	10 km	10 km
RESOLUTION	10 m	10 m	10 m	2 m	2 m	2 m
λ-Select	—	—	1.31 μm	—	1.31 μm	0.85 μm
PULSE WIDTH	10 μs	10 μs	10 μs	2 μs	2 μs	2 μs

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SECTION 6
MEASUREMENT

This section describes measurement procedure for the typical measurement items with the MW9060A Optical Time Domain Reflectometer. The methods of operation to set individual items such as distance range and pulse width are described in detail in Sections 4 and 5. In this section, these operation items are briefly explained as measurement procedure centering around the sequence of execution. Note that the distance range, pulse width, and other values set in this procedure are just examples, and not actually required values.

Before entering each measurement procedure, it is assumed that the plug-in unit to be used is fitted to the MW9060A mainframe and the MW9060A is in a power-on state.

WARNING

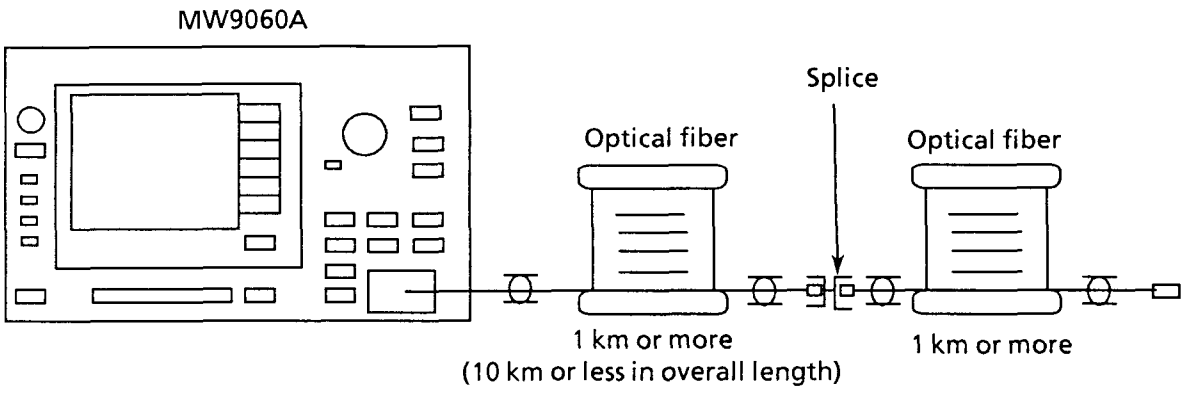
For safety reason, never look into the laser output opening and the far end of fiber to be measured connected to it.

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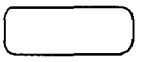
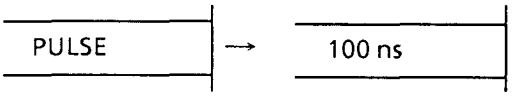
6.1 Measuring Absolute Distance

Here, measure the distance from the MW9060A Output connector to a fault location of fiber (splice point or break point) or its far end.

(1) Setup



(2) Measurement procedure

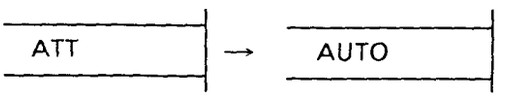
Step	Procedure
1	Initialize. Initialize 
2	Set the distance range to 10 km. 
3	Set the pulse width to 100 ns. 

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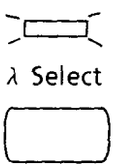
(Continued)

Step	Procedure

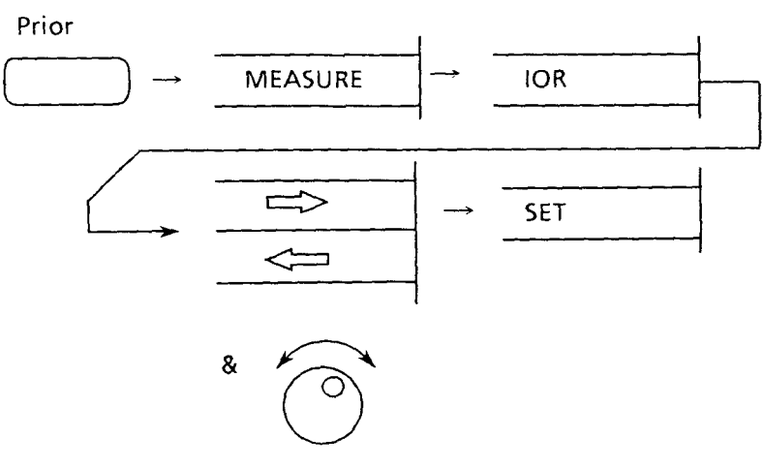
4 Set the attanuator to AUTO. (Some unit cannot be set. See paragraph 1.5.)



5 Select wavelength when using a switchable unit.



6 Input the reflective index of the fiber to be measured.

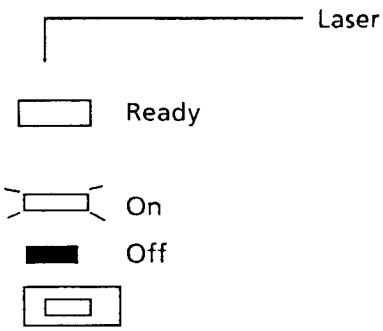


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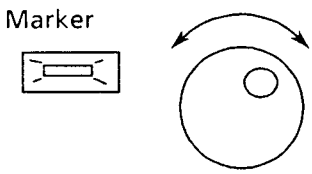
(Continued)

Step	Procedure

7 Press the [Laser] key after confirming that the Ready lamp is on.

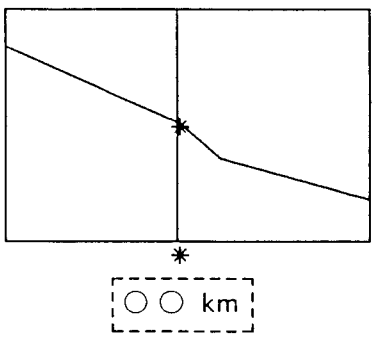


8 Press the [Marker] key. When this is done, the cursor can be moved in the horizontal axis direction with the rotary knob.



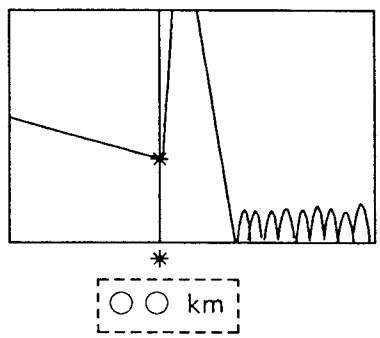
9 Position the cursor at the fault location.

For splice point



Position the cursor at the point where the step difference begins to rise or fall.

For Fresnel reflection point



Position the cursor at the rising point of Fresnel reflection.

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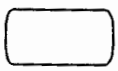
(Continued)

Step	Procedure

10 Get the optimum scale by zooming in the horizontal and vertical axes.

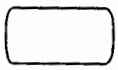
——— V-Zoom

IN



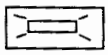
——— H-Zoom

IN

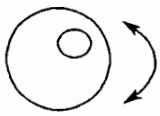


11 When there is much noise, press the [Average] key to turn averaging on.

Average



12 Then, precisely position the cursor at the fault location.



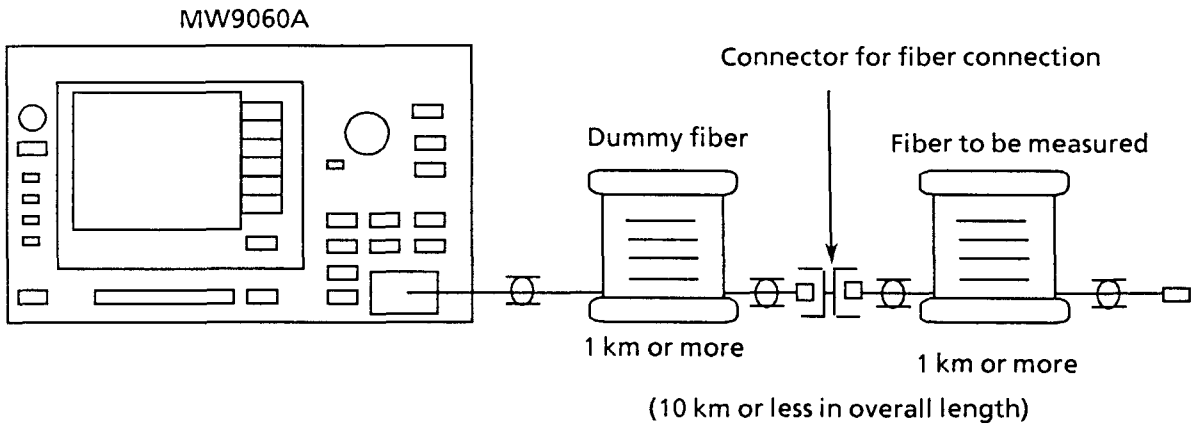
13 The value displayed below the cursor indicates the absolute distance from the Output connector to the fault location of fiber or end of fiber. ([- - - - - -] section displayed on the screen in step 9)

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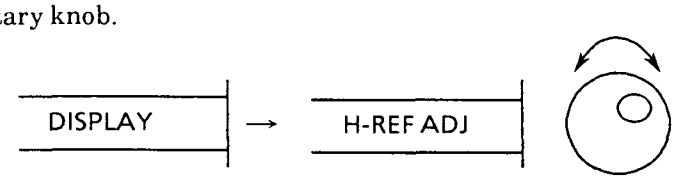
6.2 Measuring Relative Distance

Relative distance between two points is measured. Connect a dummy fiber between the MW9060A and a fiber to be measured as shown below, then measure the length of the fiber to be measured or distance from the connection point to the fault location by relative distance measurement. In this way, it is possible to obtain a value free of error (±1 m) at the measurement start point of the MW9060A and make measurement with much better accuracy than in absolute distance measurement. The length of the fiber to be measured is obtained using this method.

(1) Setup



(2) Measurement procedure

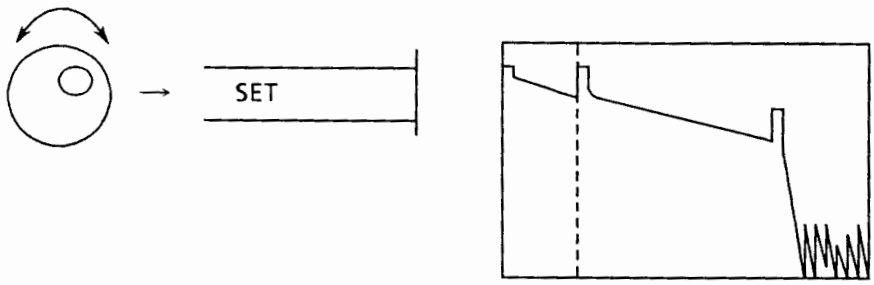
Step	Procedure
1	Execute steps 1 to 7 described in paragraph 6.1 (2).
2	Set the system to the relative distance measurement marker setting mode. The relative distance cursor can be moved in the horizontal axis direction with the rotary knob. 

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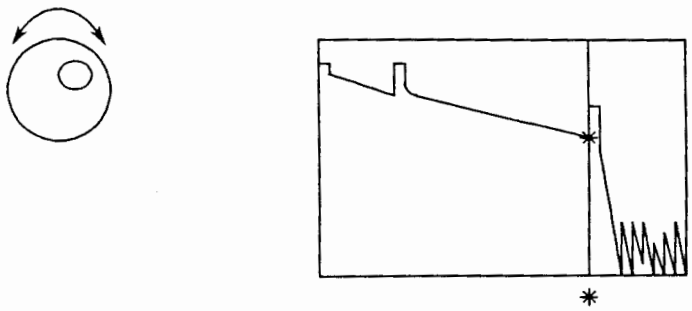
(Continued)

Step	Procedure

3 Set the relative distance cursor at the Fresnel-reflection rising point of the connector connection between the dummy fiber and fiber to be measured.



4 Position the cursor of the * marker to the Fresnel-reflection rising point at the far end of the fiber to be measured using the rotary knob.

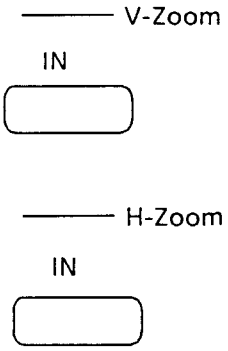


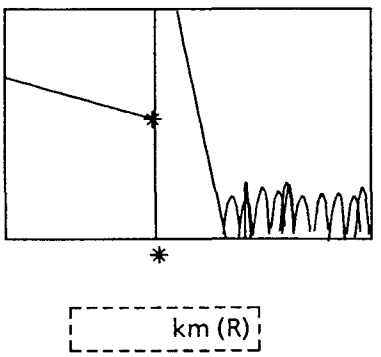
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(Continued)

Step	Procedure

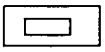
5 Zoom in the horizontal and vertical axes to get the optimum scale.



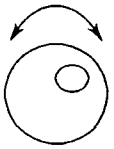


6 If there is much noise, press the [Average] key to turn averaging on.

Average



7 Then, position the cursor more accurately. Get the * marker distance at this time (assumed to be X2 km).



8 The relative distance between two points can be measured with high accuracy by the * marker distance obtained here.

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(Continued)

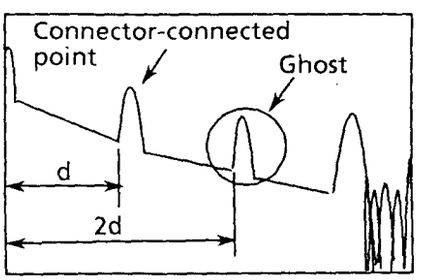
Step	Procedure

Note: Ghost caused by multiple refelection

If the reflected light at the connector-connected point returns to the Laser Output end and reflects again here, optical pulse may seem to be re-emitted from the LD.
This irregular reflection appears as a ghost at a point two times the distance from the Output connector to the connector-connected point as enclosed with a circle in the waveform shown below.

Be careful not to mistake the ghost for a fault location.

To eliminate the ghost, adjust the connector's connecting condition or apply matching grease at the connecting surface of the connector to suppress Fresnel reflection to a minimum.



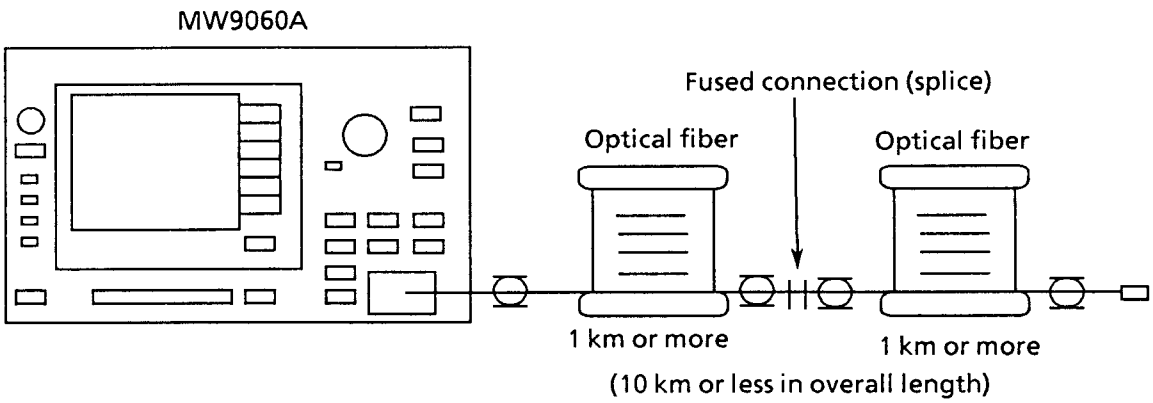
Ghost caused by multiple reflection

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6.3 Measuring Splice Loss (fused connection point)

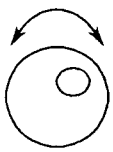
The splice loss at the fused connection point of fiber is measured.

(1) Setup



(2) Measurement procedure

Step	Procedure
1	Execute steps 1 to 8 described in paragraph 6.1 (2).
2	Position the * marker at the splice point (point where the step difference begins to rise or fall).

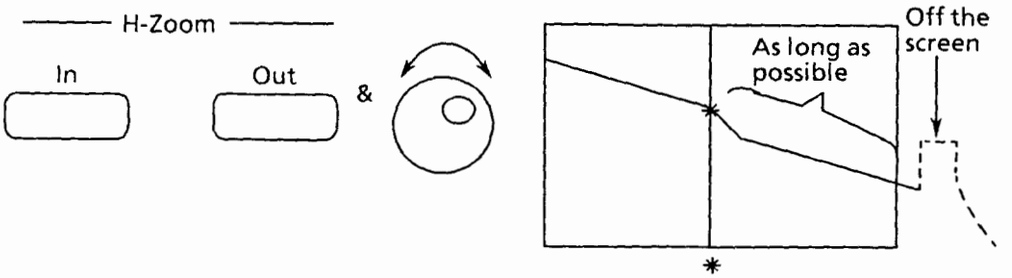


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(Continued)

Step	Procedure

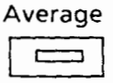
3 Set the horizontal axis scale so that the inclined portion of the waveform before and after the splice point is displayed to the full over the screen. (At this time, it is desirable that the inclined portion is as long as possible and that no fault locations other than the splice point to be measured are displayed on the screen.)



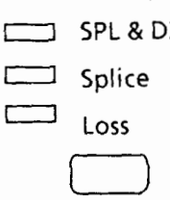
4 Press the [Average] key to turn averaging on.

Wait until noise is compressed.

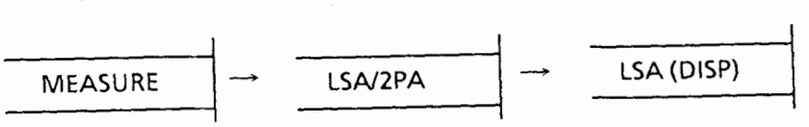
Average



5 Set the measurement mode to Splice.



6 Set the approximation method to LSA.



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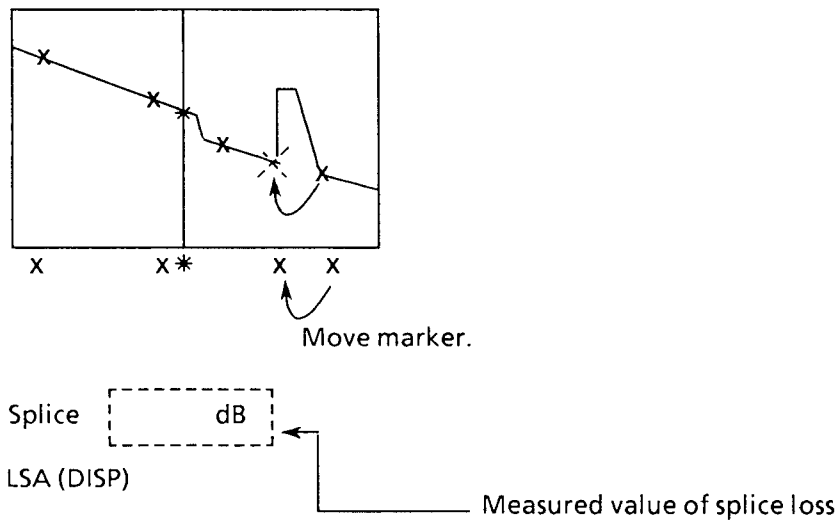
(Continued)

Step	Procedure

7 If there are no splice, etc. other than the object of measurement betrween the two X markers each before and after the * marker, read the measured value of Splice indicated in the lower left part of the screen.

Note: If there are splice or Fresnel reflection other than the object of measurement between the two X markers each before and after the * marker, change the X marker positions until there is no splice or Fresnel reflection between the X markers before step 6. At this time, the interval between the X markers should be as long as possible.

To move the X markers, press the [Marker] key (two or more times as necessary) to position the cursor at the X marker desired to be moved, then turn the rotary knob.

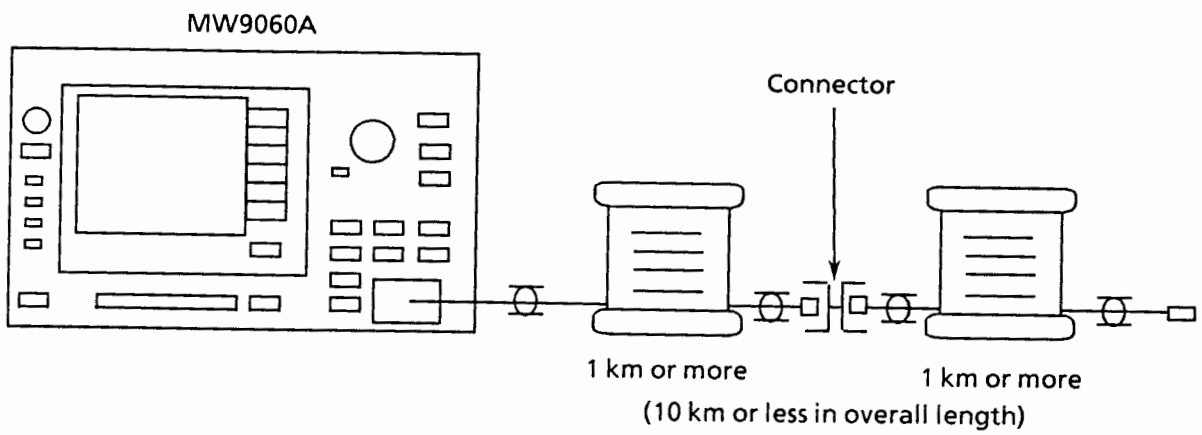


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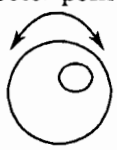
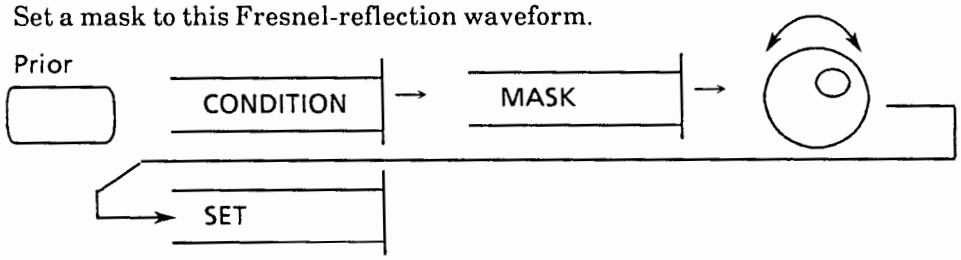
6.4 Measuring Splice Loss (connector point)

The splice loss at the connector point of fiber is measured.

(1) Setup



(2) Measurement procedure

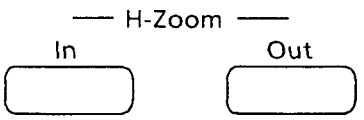
Step	Procedure
1	Execute steps 1 to 8 described in paragraph 6.1 (2).
2	Position the * marker at the splice point (Fresnel-reflection rising point at the connector point.) 
3	Set a mask to this Fresnel-reflection waveform. 

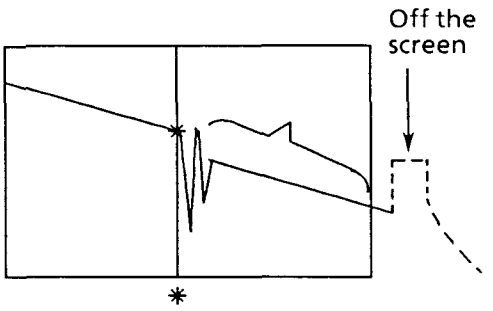
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(Continued)

Step	Procedure

4 Set the horizontal axis scale so that the inclined portion of the waveform before and after the splice point is displayed to the full over the screen. (At this time, it is desirable that the inclined portion is as long as possible and that no fault locations other than the splice point to be measured are displayed on the screen.)

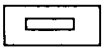




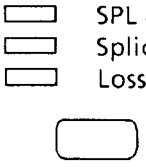
5 Press the [Average] key to turn averaging on.

Wait until noise is compressed.

Average

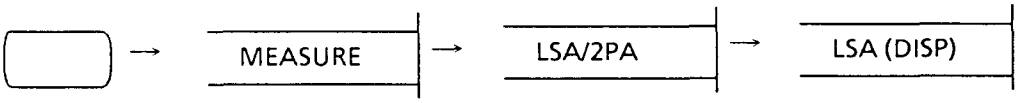


6 Set the measurement mode to Splice.



7 Set the approximation method to LSA.

Prior



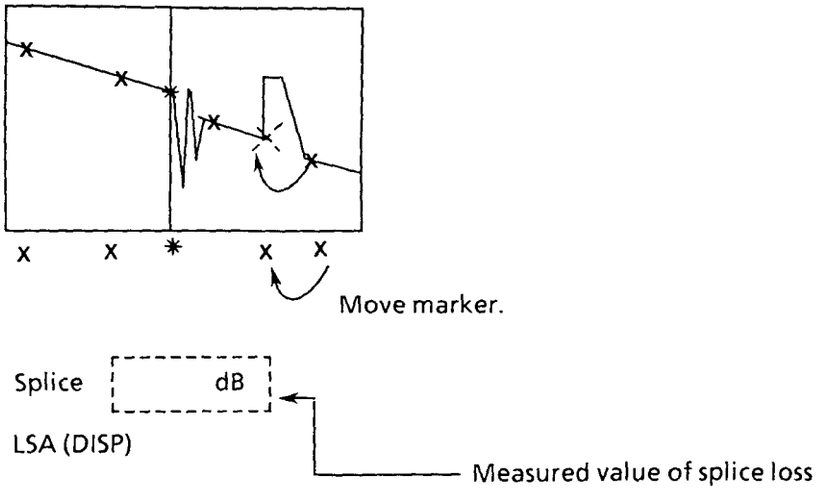
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(Continued)

Step	Procedure

8 If there are no splice, etc. other than the object of measurement between the two X markers each before and after the * marker, read the measured value of Splice indicated in the lower left part of the screen.

Notes: 1. If there are splice of Fresnel reflection other than the object of measurement between the two X markers each before and after the * marker, change the X marker positions until there is no splice of Fresnel reflection between the X markers. At this time, the interval between the X markers should be as long as possible.



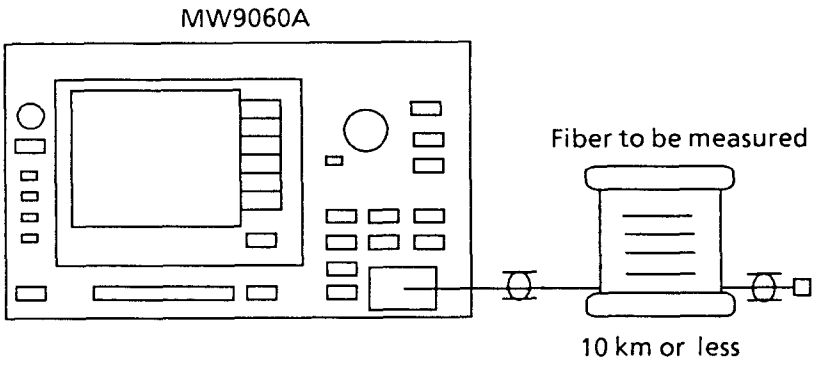
2. If secondary reflection (ghost) occurs, set the markers in front of the secondary reflection waveform or change the approximation method from LSA (DISP) to 2PA before making measurement. To set 2PA, use 2PA in place of LSA (DISP) in step 7.

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6.5 Measuring Transmission Loss

The transmission loss of fiber is measured.

(1) Setup



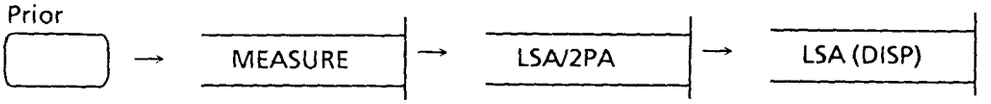
(2) Measurement procedure

Step	Procedure
1	Execute steps 1 to 7 described in paragraph 6.1 (2).
2	Set the horizontal axis scale so that the entire waveform is displayed over the screen. — H-Zoom — In Out
3	Press the [Average] key to turn averaging on. Wait until noise is compressed. Average

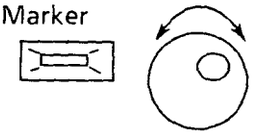
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Step	Procedure

4 Set the approximation method to LSA.

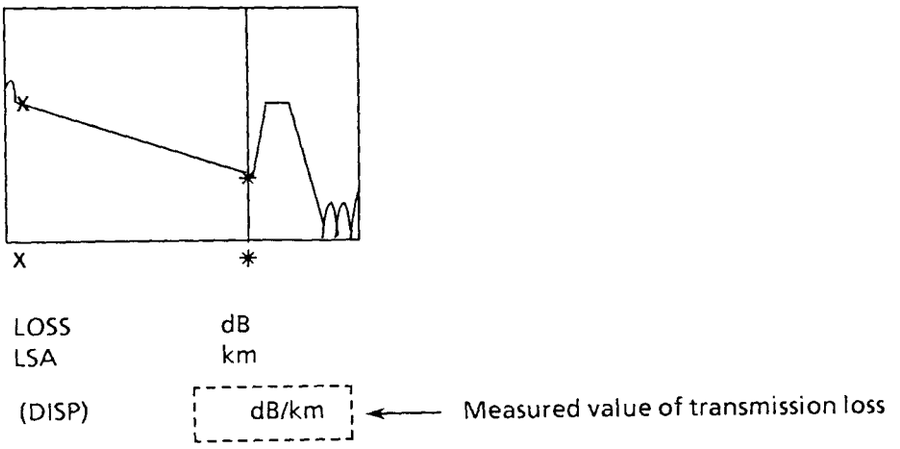


5 Press the [Marker] key, and the cursor can be moved in the horizontal axis direction with the rotary knob.



Note: Each time pressing the [Marker] key, the cursor line alternately move along the * marker and X marker.

6 Set a X marker at the near end of fiber and a * marker at the Fresnel-reflection rising point at the far end of fiber.



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(Continued)

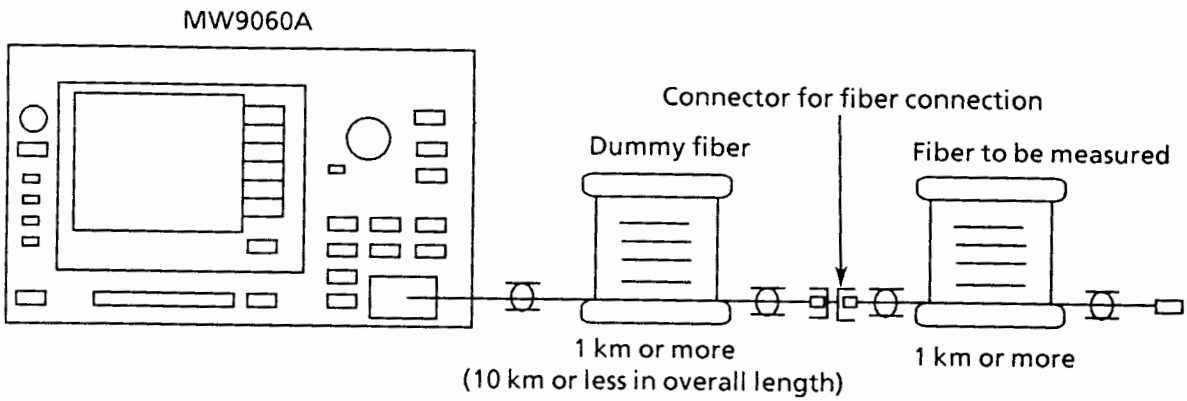
Step	Procedure
7	Read the measured value of transmission loss (indicated in the [------] section of the screen in step 6).

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6.6 Loss Measurement Including Dead Zone Loss

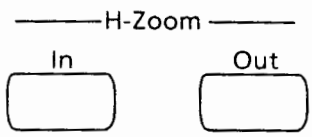
The overall loss of the fiber, including the dead zone loss at connectors and other event points, is measured.

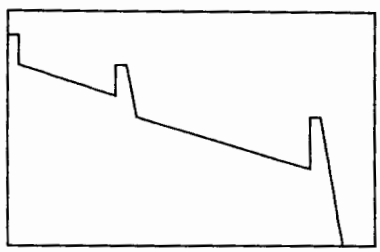
(1) Setup

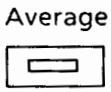


(2) Measurement procedure

Step	Procedure
1	Execute steps 1 to 7 as described in paragraph 6.1(2).
2	Set the horizontal axis scale so that the entire waveform fills the screen.
3	Press the [Average] key to turn averaging on. Wait until the noise is attenuated.





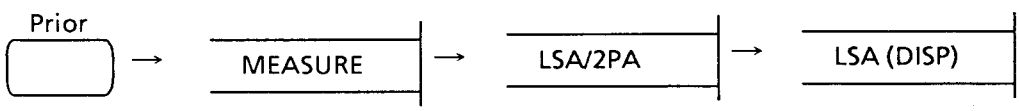


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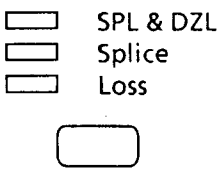
(Continued)

Step	Procedure

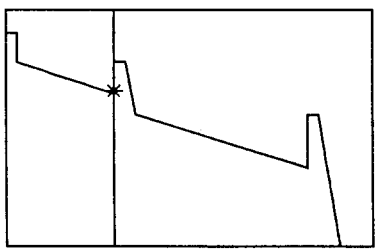
4 Set the LSA method.



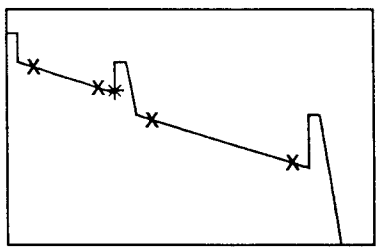
5 Set the SPL&DZL mode.



6 Set the ✳ marker to the event point (point at which the step of the waveform starts to fall or rise).



7 Set two × markers each to the left and right of the ✳ marker to the straight part of the back-scattered light waveform before and after the event point, the same as splice measurement.

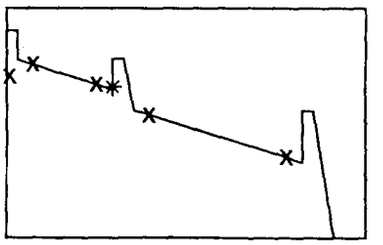


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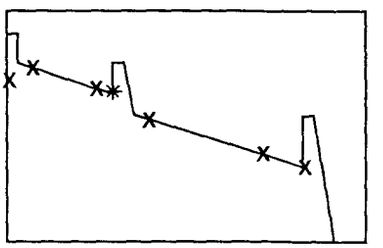
(Continued)

Step	Procedure

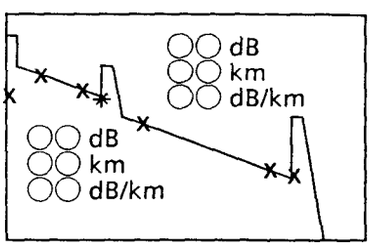
8 Set the leftmost × marker to one event point (point at which the step of the waveform starts to fall or rise) before the ✱ marker event point. (When measuring the OTDR near-end dead zone loss, set this marker to 0m.)



9 Set the rightmost × marker to one event point (point at which the step of the waveform starts to fall or rise) after the ✱ marker event point.



10 The measured ✱ marker splice loss and the overall loss, the distance between event points, and the transmission loss of the fiber, including the loss of the dead zone near the ✱ marker in the scale, are displayed at the bottom left corner of the screen. Read these values.



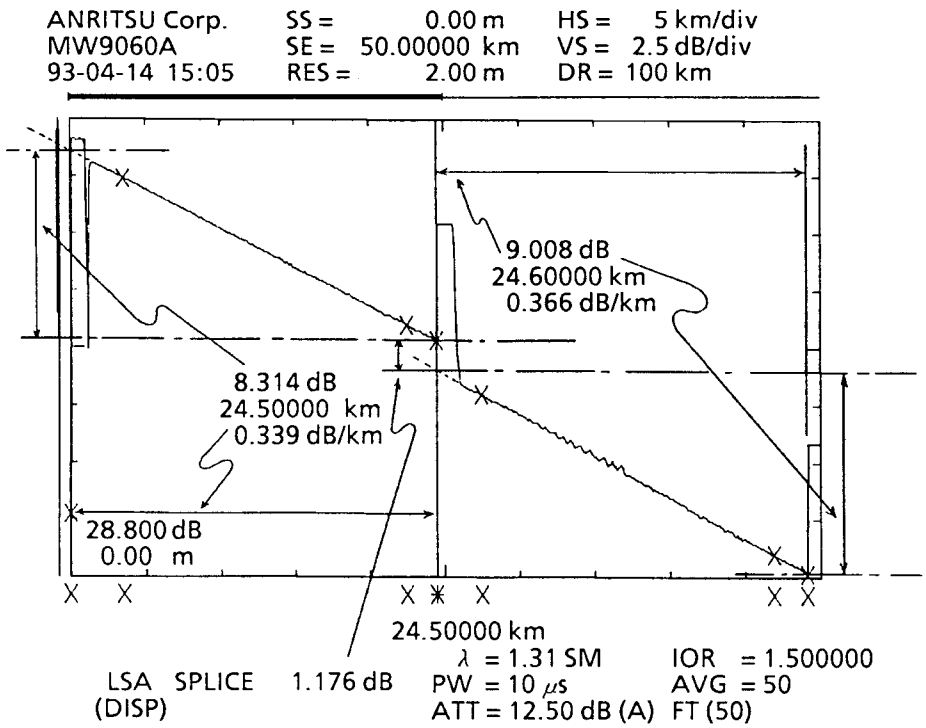
LSA SPLICE dB
(DISP)

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(Continued)

Step	Procedure

An example of measurement waveform is shown below.

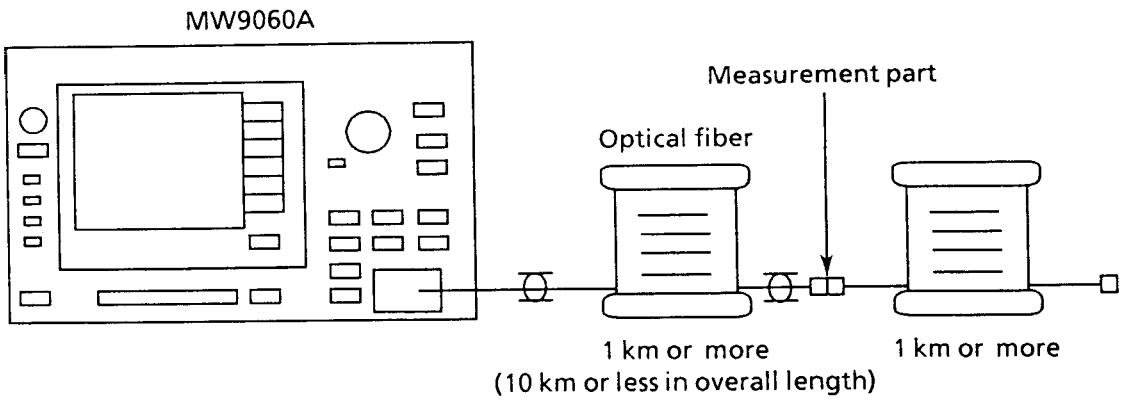


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6.7 Measuring Return Loss

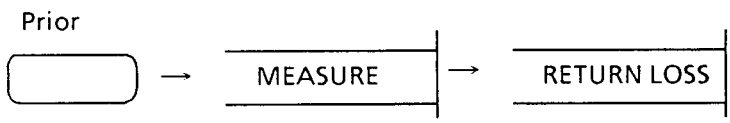
Measures the return loss of a connector.

(1) Set up

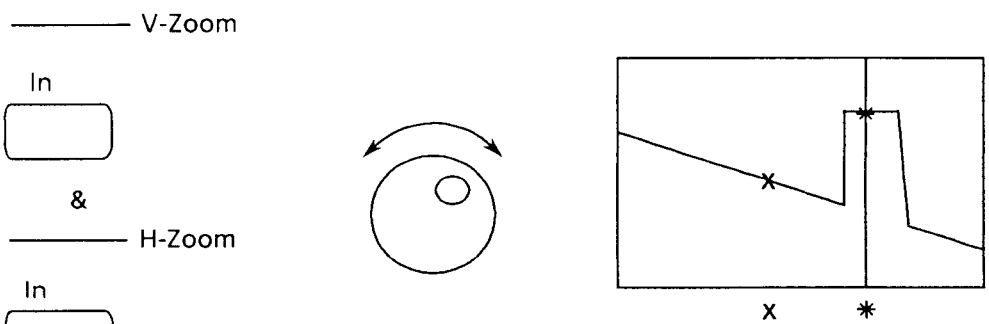


(2) Measurement procedure

Step	Procedure
1	Perform steps 1 to 7 in paragraph 6.1 (2).
2	Set to Return Loss Mode.



3	Using the rotary knob, position the cursor of the * marker at the peak of the Fresnel reflection of the connector to be measured. Zoom out the horizontal and vertical axes, and then adjust the position of the cursor more exactly.



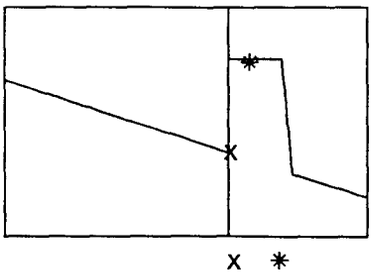
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(Continued)

Step	Procedure

4 Press the [Marker] key. Position the cursor of the × marker at the nearest back-scattered-light waveform immediately before the Fresnel reflection.

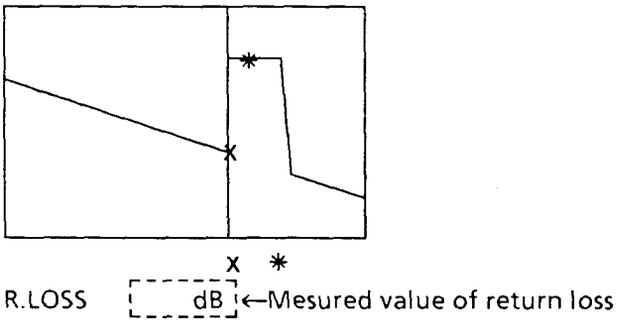
Marker



5 If there is a lot of noise, press the [Average] key to enable averaging.

Average

6 Read the return-loss (R.Loss) value shown on the lower left of the screen.

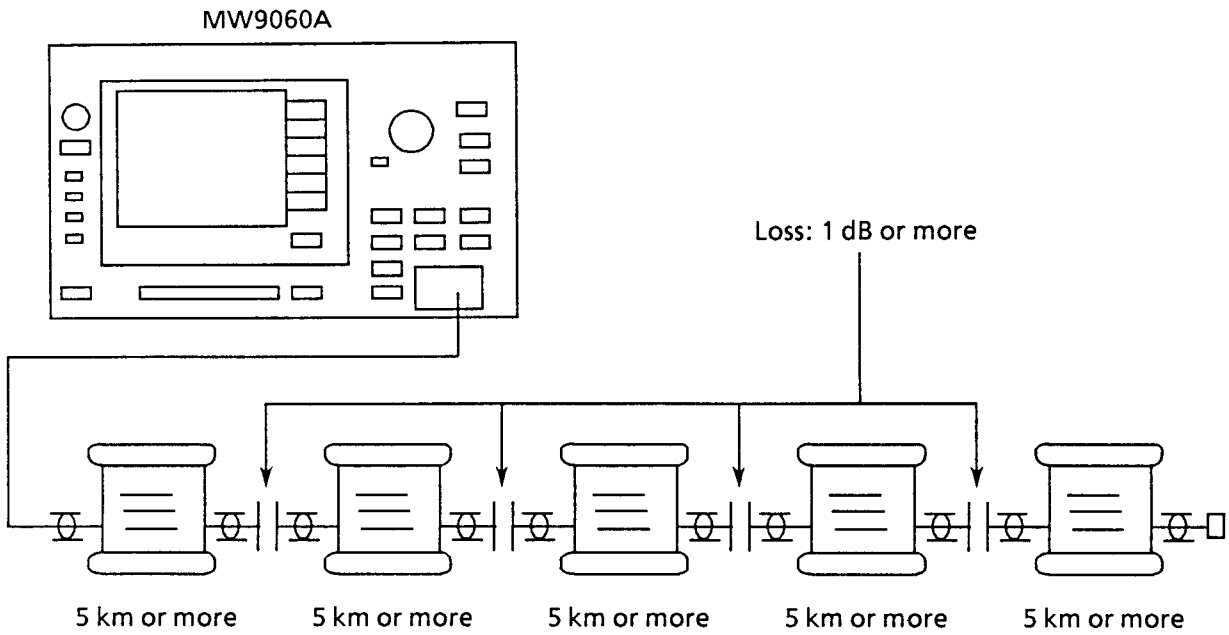


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6.8 Auto Fault Location

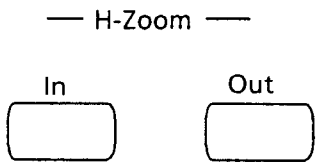
When splice loss is greater than the user's set value (threshold value), or when the difference between far-end back-scattered light level and noise floor level is greater than the threshold value within the waveform range displayed on the MW9060A screen, such points are regarded as fault points and automatically detected.

(1) Set up



(2) Measurement procedure

Step	Procedure
1	Make operation as per Steps 1 to 7 in Paragraph 6.1 (2).
2	Set the horizontal scale so that the whole waveform is fully displayed throughout the screen.

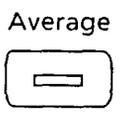


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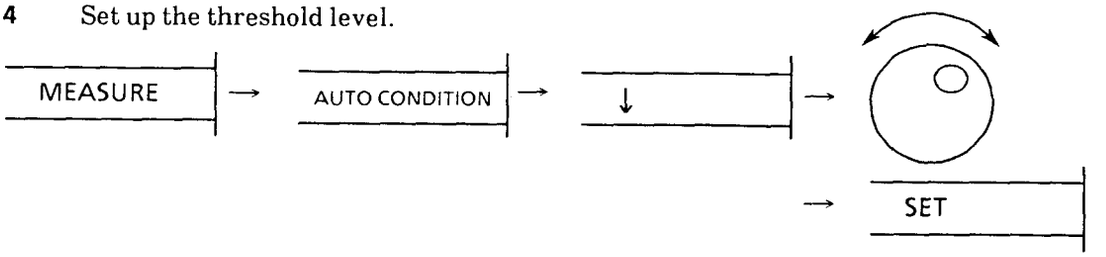
(Continued)

Step	Procedure

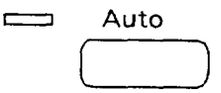
3 Press the [Average] key for average on.



4 Set up the threshold level.

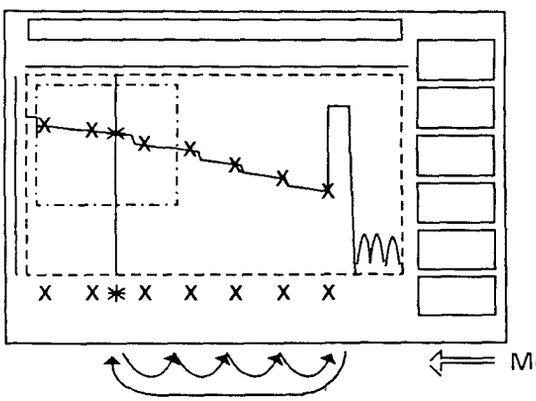


5 Make setting for the Auto mode.



6 The result of measurement is displayed, as illustrated below. "AUTO" is displayed at the bottom left corner of the screen and the current THRESHOLD value and type of fault location detection data are displayed to the right of it.

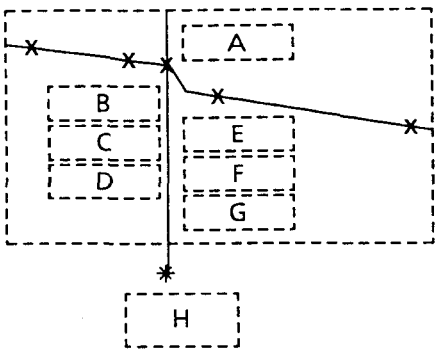
X marker is placed on a maximum of 5 fault points. In the first place, selection is made for the fault point closest to the laser output port. A cursor is given there. The selected fault point is indicated by * marker . Each time the [Marker] key is pressed, the cursor moves to the neighboring fault point on the right and the result of related measurement is displayed.



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Step	Procedure

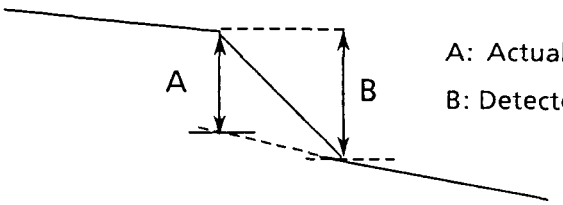
The following information is presented in the vicinity of the fault point box ( ) in the above illustration) where the cursor is placed.



A:	Loss at the fault point	dB
B and E:	Loss in fiber between X markers immediately before or after the fault point	dB
C and F:	Length of fiber between X markers immediately before or after the fault point	km
D and G:	Transmission loss in fiber between X marker immediately before or after the fault point	dB/km
H:	Distance from the fiber near-end to the fault point	km

When the measurement result display position is set to TABLE at the RESULT DISP AREA layer, A is displayed at the bottom of the screen and B to G are collectively displayed at the bottom left corner of the screen.

Notes: 1. Since the threshold value to be detected is a value as shown in the illustration below, even a fault point with splice loss smaller than the present threshold value may actually be detected.



A: Actual splice loss

B: Detected threshold value

2. In addition to the * and X markers to indicate fault points, × Marker used for loss measurement is also displayed on the waveform being measured.

   The X marker for loss measurement moves together with the* marker.

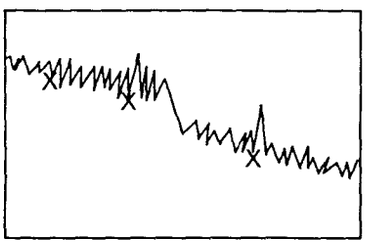
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(Continued)

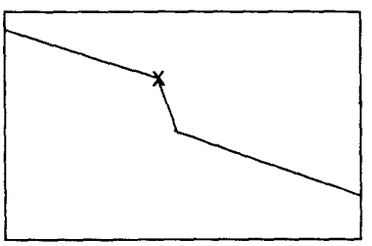
Step	Procedure

3. In case of measurement impossible, information about fiber loss, etc., is indicated by the character: "*".

4. Where a considerable amount of noise is contained in a waveform being measured, and if the threshold value is very small, a singular point of noise may be identified as a fault point, as illustrated below.



In such a case, reduce the noise by either sufficiently averaging all values being used, or by increasing the threshold value. Or use the smoothing function (paragraph 5.19).



When averaging has been sufficiently conducted

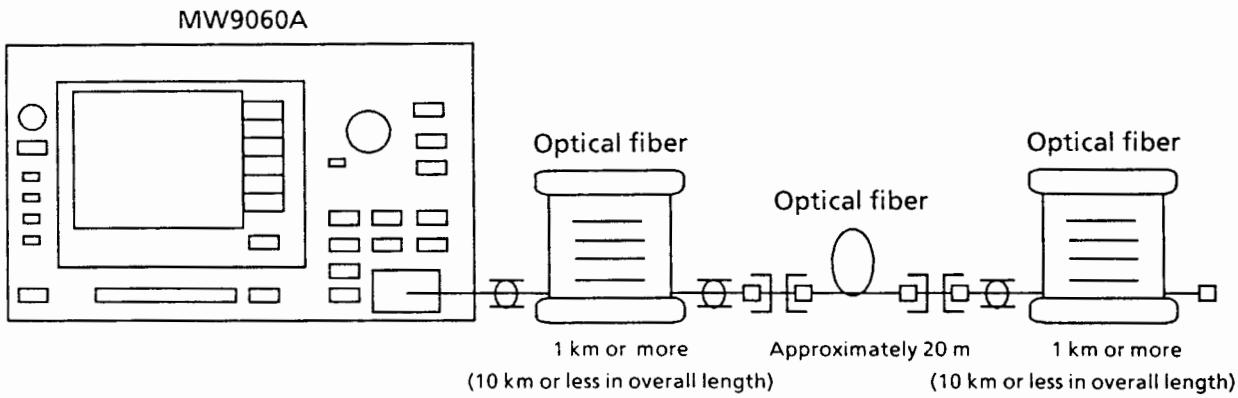
5. If the set mask position is overlapped on the screen, multiple detection may be performed on the position.

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6.9 Measuring Distance between Two Proximate Connecting Points

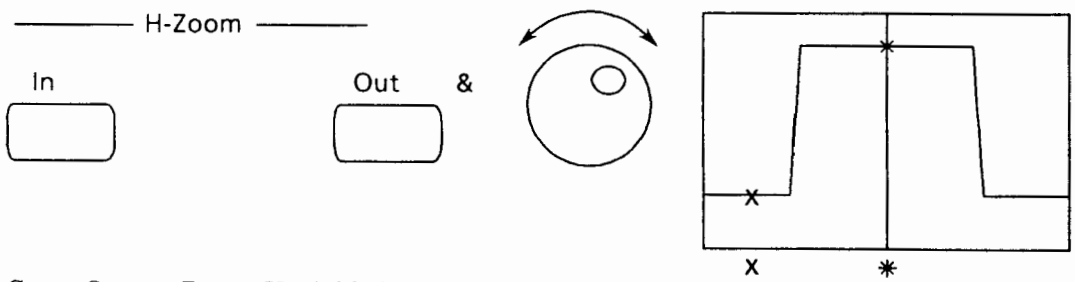
Measures the distance between two connecting points by connectors.
There are some plug-in units that cannot use this function. (refer to paragraph 1.5).

(1) Set up

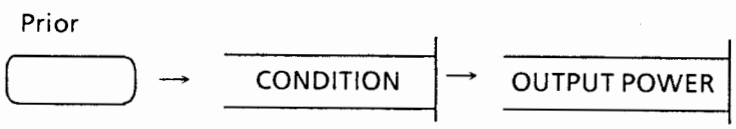


(2) Measurement procedure

Step	Procedure
1	Perform steps 1 to 7 in paragraph 6.1 (2).
2	Set the scale of the horizontal axis so that the Fresnel-reflection pattern (of the connecting points to be measured) appears on the screen.



3	Set to Output-Power Variable Mode.

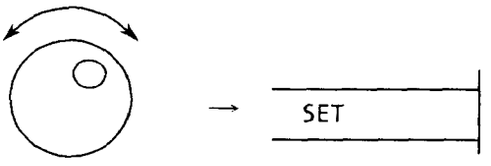


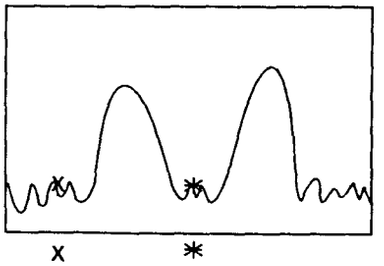
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(Continued)

Step	Procedure

4 Set the output power.

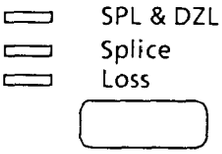




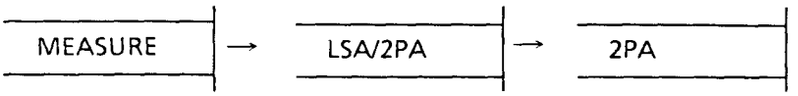
5 If there is a lot of noise, press the [Average] key to enable averaging.



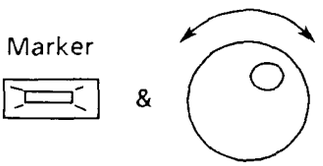
6 Set to Loss mode.

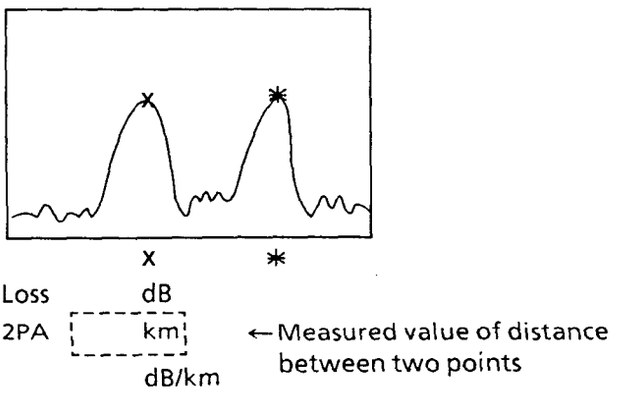


7 Set to 2PA approximation methed.



8 Position the × marker and the * marker at the two Fresnel-reflection peaks. The distance between the two connecting points will be displayed on the lower left of the screen.





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SECTION 7
PERFORMANCE TEST

This section describes the testing equipment used to test the performance of the MW9060A and the method to set it up and procedure to conduct the test.

7.1 Need for Performance Test

The performance test described here is required as part of maintenance to prevent a reduction in measurement reliability due to performance deterioration of the MW9060A over time.

The performance test is made for the following items:

- Wavelength
- Pulse width
- Dynamic range
- Accuracy of distance measurement
- Accuracy of vertical axis

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7.2 Testing Equipment

Table 7-1 lists the equipment used for the performance test.

Table 7-1 Testing Equipment

Equipment (recommended type)	Required performance	Measurement item
Optical spectrum analyzer (MS9001B)	Wavelength: 0.8 to 1.6 μm Level: −70 to 0 dBm	Wavelength
Stabilized light source (MG9001A, MG0930C)	Wavelength: 1.31/1.55 ±0.02 μm Spectrum width: ≦0.01 μm Level: −10 to 0 dBm	Dynamic range (for MW0945B, MW0946B, and MW0947B)
Optical power meter and sensor (ML9001A, MA9611A)	Wavelength: 1.2 to 1.6 μm Level: −70 to 0 dBm	Dynamic range (for MW0945B, MW0946B, and MW0947B)
Optical variable attenuator (MN924A)	Wavelength: 1.31/1.55 μm Attenuation: >60 dB max	Dynamic range, Pulse width (for SM units)
Optical variable attenuator (MN9002A, MN0901A, MN0902A)	Wavelength: 1.3/1.55 μm Attenuation: >60 dB max	Vertical-axis accuracy (for MW0944B, MW0945B, MW0946B, and MW0947B)
Optical variable attenuator (MN938A)	Wavelength: 0.85/1.3 μm Attenuation: >60 dB max	Pulse width Vertical-axis accuracy (for GI units)
Waveform monitor (MP95A)	Wavelength: 0.7 to 1.0 μm Rise time/fall time: ≦2 ns	Pulse width (for 0.85 μm)
Waveform monitor (MP96A)	Wavelength: 1.2 to 1.6 μm Rise time/fall time: ≦500 ps	Pulse width (for 1.3/1.55μm)
Oscilloscope	Frequency: DC to 200 MHz	Pulse width

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7.3 Test Method

The following describes the specification of each test item and the test procedure.

The equipment setup is indicated for each test item.

Carefully clean the optical connector part before connecting the connectors. (For details, see paragraph 9.1.)

The test procedure described here assumes that the necessary plug-in unit is fitted into the MW9060A and the MW9060A is in a power-on state before each test procedure is executed.

WARNING

For safety reason, never look into the MW9060A Optical Time Domain Reflectometer, its optical source laser output opening, or the far end or other parts of the fiber connected to it.

7.3.1 Specifications

Table 7-2 summarizes the specifications of each test item.

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Table 7-2 Performance Test Specifications

Mainframe	MW9040B																																	
Unit	MW0942A					MW0944B					MW0945B						MW0946B						MW0947B						MW0967B					
Measured fiber	SM																												GI					
Wavelength (nm)	1310±15					1310±15 /1550±15					1310±15						1550±15						1310±15 /1550±15						850±15 /1300±15					
Pulse width (μs)	0.01	0.02	0.1	0.5	2	0.01	0.02	0.1	0.5	2	0.02	0.1	0.5	1	4	10	0.02	0.1	0.5	1	4	10	0.02	0.1	0.5	1	4	10	0.05	0.02	0.1	0.5	2	
One-way back scattered light dynamic range (dB) *	6.0	7.5	11.0	14.5	17.5	6.5 / 4.0	8.0 / 5.5	11.5 / 9.0	15.0 / 12.5	18.0 / 15.5	15	20	23	26	31	34	13	18	21	24	29	32	15 / 13	20 / 18	23 / 21	26 / 24	31 / 29	34 / 32	9.0 / 7.0	12.0 / 10.0	15.5 / 13.5	19.0 / 17.0	21.5 / 20.0	
Accuracy of distance measurement	±1 m ± measured value × 2 × 10-5 (However, this does not include the uncertain factor of the measured fiber's refractive index.)																																	
Accuracy of vertical axis	±0.3 dB (0 to 5 dB) ±0.5 dB (5 to 10 dB) ±0.7 dB (10 to 15 dB)					±0.05 dB/dB					±0.03 dB/dB																		±0.05 dB/dB					

* Difference between the near-end back-scattered light level and the level 0.3 dB higher than the noise peak on noise floor

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7.3.2 Wavelength Test

Test the center wavelength of the laser output.

(1) Set up

Connect the equipment as shown in Fig. 7-1.

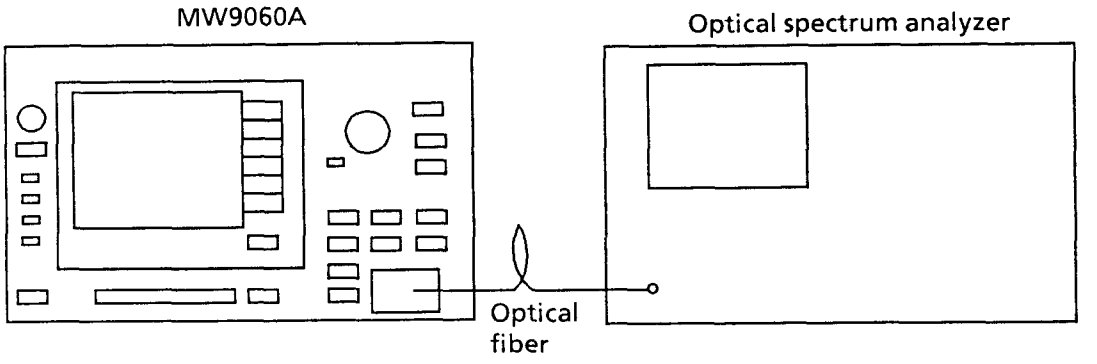
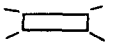
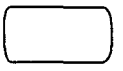


Fig. 7-1 Equipment Setup for Wavelength Test

(2) Test procedure

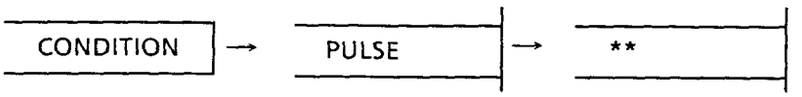
Step	Procedure
1	Press the [Initialize] key to initialize the settings. Initialize 
2	When using the wavelength switchable plug-in unit, select the wavelength to be used for testing.  λ-Select 

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(Continued)

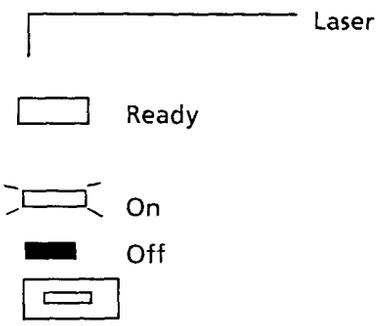
Step	Procedure

3 Select the maximum pulse width among the allowable ones.



** :
Selectable pulse width which differs depending on the distance range and plug-in unit (See para. 1.5.)

4 Press the [Laser] key after confirming that the [Ready] lamp is on.



5 Receive the laser light with an optical spectrum analyzer to adjust the measurement level and wavelength resolution.

6 Select the envelope method on the optical spectrum analyzer and set r = 0.25.

7 Confirm that the measured results are within the specifications.

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7.3.3 Pulse Width Test

Test the pulse width of the laser output.

(1) Set up

Connect the equipment as shown in Fig. 7-2.

For testing the MW0967B; change the MN924A and MP96A to the MN938A and MP95A, respectively.

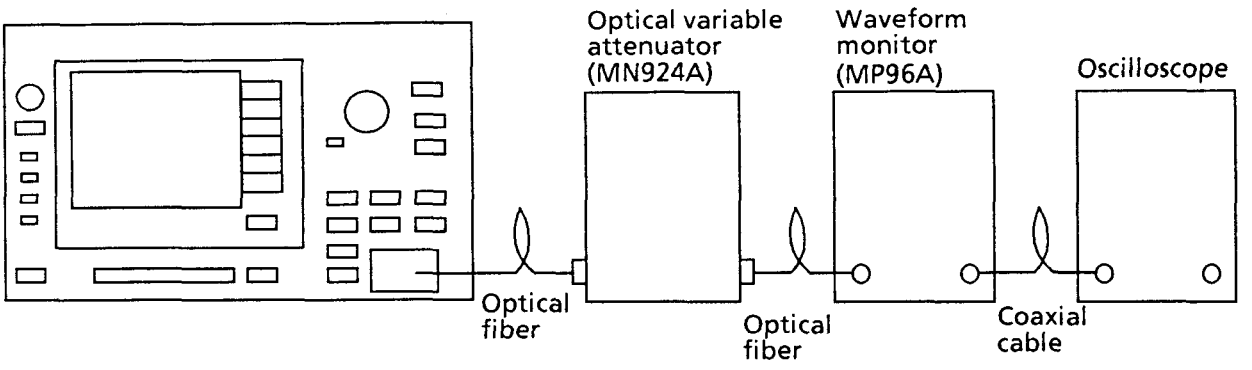
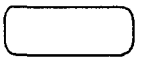
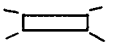
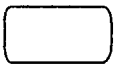


Fig. 7-2 Equipment Setup for Pulse Width Test

(2) Test procedure

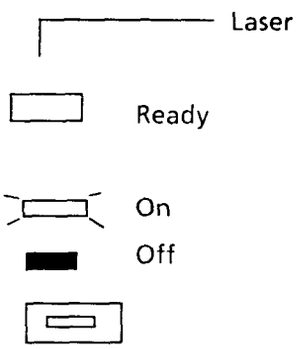
Step	Procedure
1	Press the [Initialize] key to initialize the settings. Initialize 
2	When using the wavelength switchable plug-in unit, select the wavelength to be used for testing.  λ-Select 

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(Continued)

Step	Procedure

3 Press the [Laser] key after confirming that the [Ready] lamp is on.



4 Adjust the oscilloscope amplitude- and time-base scale appropriately, then display the waveform as shown in Fig. 7-3 on the oscilloscope screen.

Adjust the Optical Variable Attenuator so that the Waveform Monitor does not saturate.

5 Find the pulse width PW of the MW9060A laser output according to the procedure described below.

Measure the pulse width at the half peak level of the waveform on the oscilloscope screen as shown in Fig. 7-3.

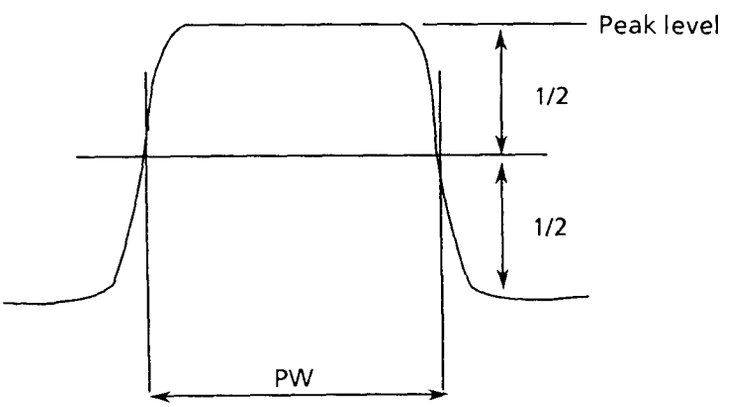
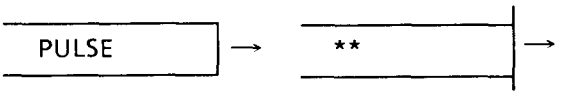


Fig. 7-3 Pulse Width

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(Continued)

Step	Procedure
6	Confirm that PW is within the displayed value ±10%.
7	Change the pulse width.  **: The selectable pulse width differes depending on the unit. See paragraph 1.5. Distance range Repeat the above steps 4 to 6 after changing the pulse width each time.

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7.3.4 Dynamic-range test for one-way back-scattered light

Test the dynamic range. This testing is required for each wavelength and each pulse width.

1. Testing the MW0945B, MW0946B, and MW0947B

(1) Setup

According to the test procedure, connections of (a) to (c) are made as shown in Fig. 7-4, bearing in mind the following conditions:

Conditions:

Fiber A and Fiber B shall be more than 40 km respectively, and minimum whole loss shall be 13 dB or less at 1.31 μm or 11 dB or less at 1.55 μm.

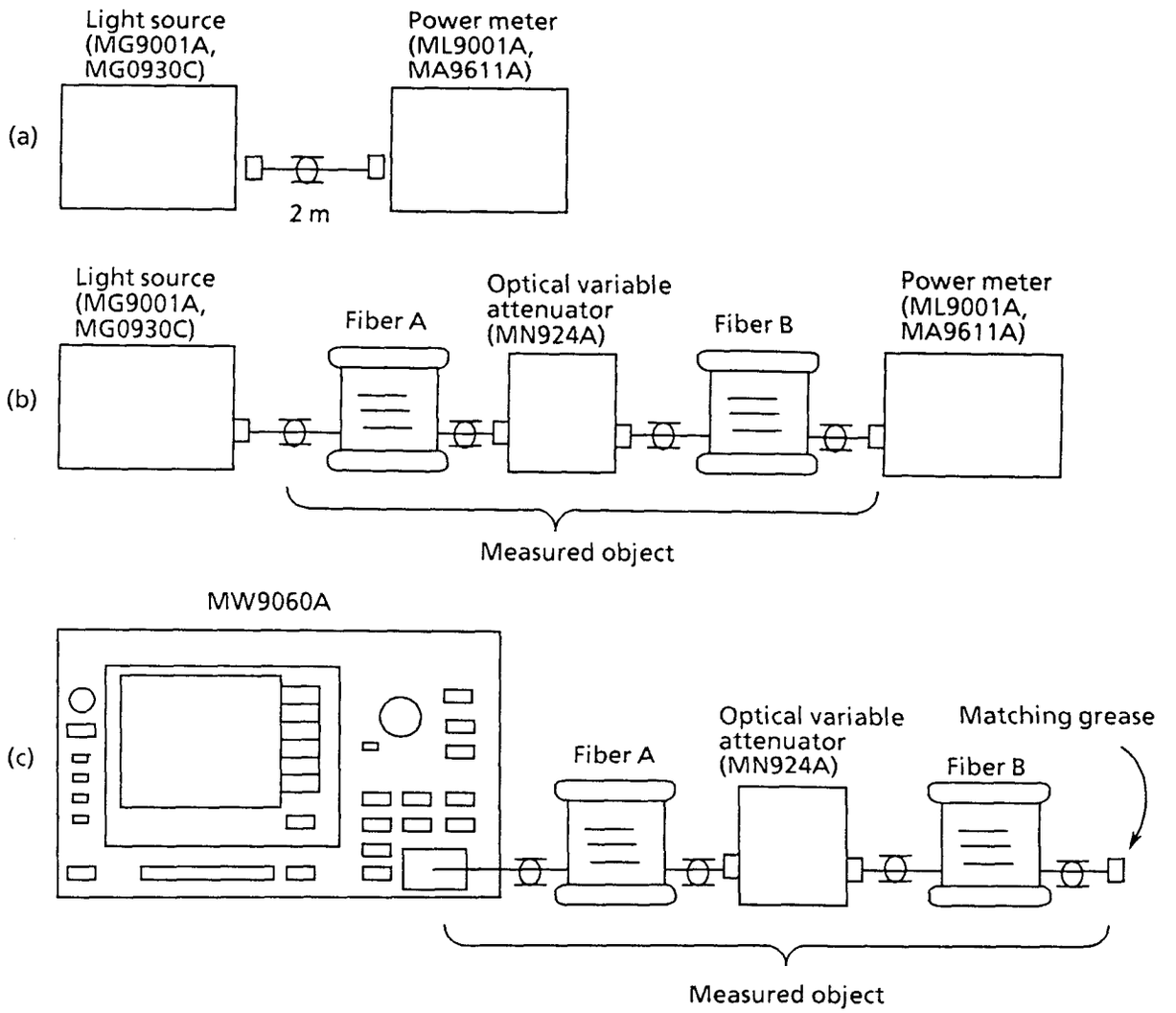
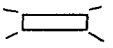
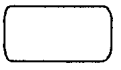
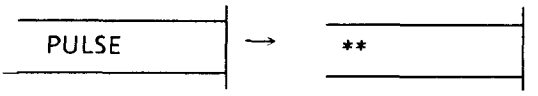


Fig. 7-4 Equipment Setup for Dynamic-Range Test (For MW0945B, MW0946B, and MW0947B)

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(2) Test procedure

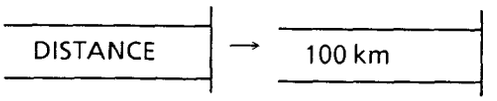
Step	Procedure
1	Connect equipment as shown in Fig. 7-4 (a).
2	Read out the output level P1 (dBm) of the light source with a power meter.
3	Make connections as shown in Fig. 7-4 (b).
4	Adjust the value for the optical variable attenuator so that the difference (P1 – P2, dB) between power meter read-out P2 (dBm) and P1 of Step 2 (dBm) becomes equal to the required dynamic range. ***Note:*** Connects of operation for this step are to set up a measured object with a loss equal to the dynamic range. The measure object is a set of optical variable attenuator connected between Fiber A and Fiber B. Until completion of a series of measurements, it is not recommended to move connections and change the setting conditions for the optical variable attenuator.
5	Disconnect the measured object from the light source and the power meter. Then connect it to the Laser Output connector as shown in Fig. 7-4 (c).
6	Apply a matching grease to the far end of the Fiber B. ***Note:*** If a connector applied with a matching grease is being reconnected to other equipment, remove this matching grease thoroughly. Refer to paragraph 2.5 herein.
7	When using the wavelength switchable plug-in unit, select the wavelength to be used for testing.  λ-Select 
8	Set up the pulse width that is being used. (The selectable pulse width differs depending on the unit. See paragraph 1.5.) 

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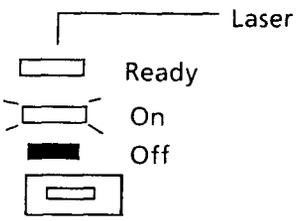
(Continued)

Step	Procedure

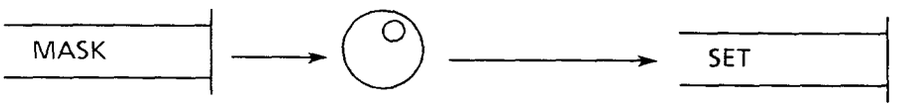
9 Set the distance range to 100 km.



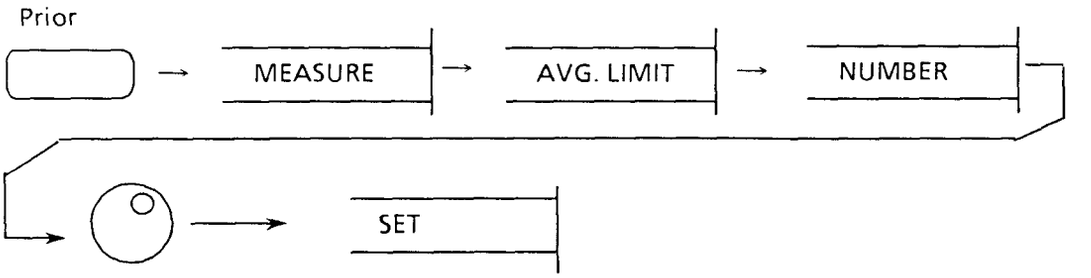
10 Press the [Laser] key after confirming that the Ready lamp is on.



11 To attenuate Fresnel reflection, set a mask at a point of Fresnel reflection, which is located at the connector joint of the optical variable attenuator.



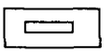
12 Set the averaging limit value to 1000.



(Adjust to 1000.)

13 Press the [Average] key to enable averaging.

Average

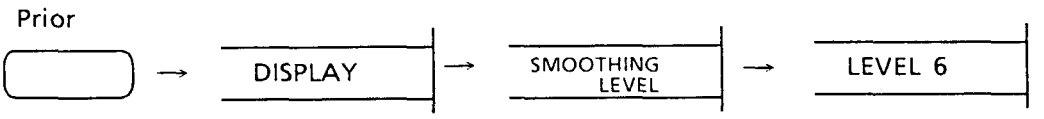


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(Continued)

Step	Procedure

14 After averaging has been completed and the laser has been turned off, set the SMOOTHING LEVEL to 6.



15 Perform the SMOOTHING.



16 After SMOOTHING has been completed, confirm that the difference between fiber's far-end level and peak noise level (excluding anomalous points) is 0.3 dB or more.

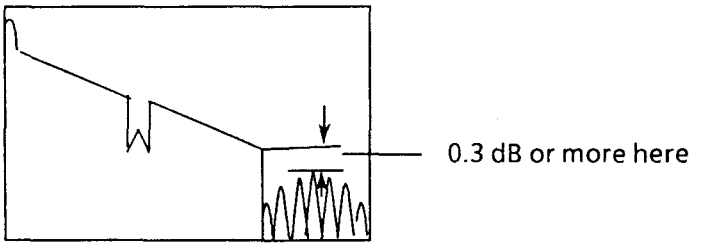


Fig. 7-5 Fiber Far-End Trace

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2. Testing the MW0944B and MW0967B

(1) Setup

Set up the system as shown in Fig.7-6.

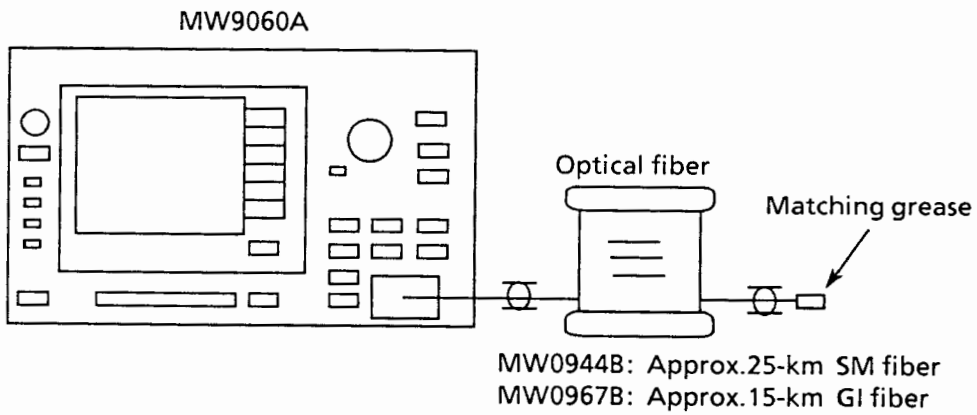
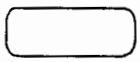
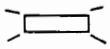
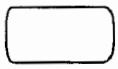
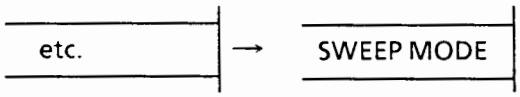


Fig. 7-6 Setup for Dynamic Range Test (For MW0944B and 0967B)

(2) Test procedure

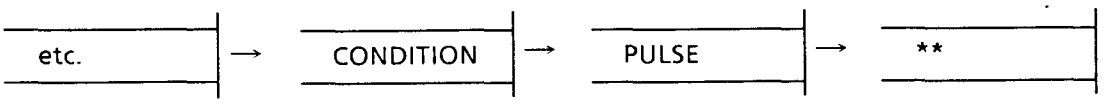
Step	Procedure
1	Press the [Initialize] key to initialize the settings. Initialize 
2	When using the wavelength switchable plug-in unit, select the wavelength to be used for testing.  λ-Select 
3	Set the sweep mode to FAST. 

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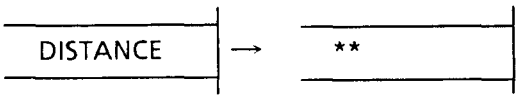
(Continued)

Step	Procedure

4 Set the pulse width to the appropriate value. (The range of the pulse width setting varies in accordance with the type of plug-in unit. See paragraph 1.5.)

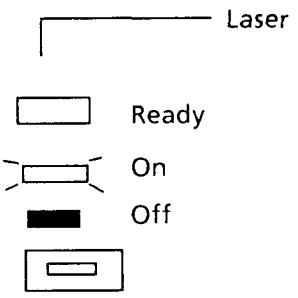


5 Set the distance range to 50 km or 25 km for the MW0944B or MW0967B, respectively.

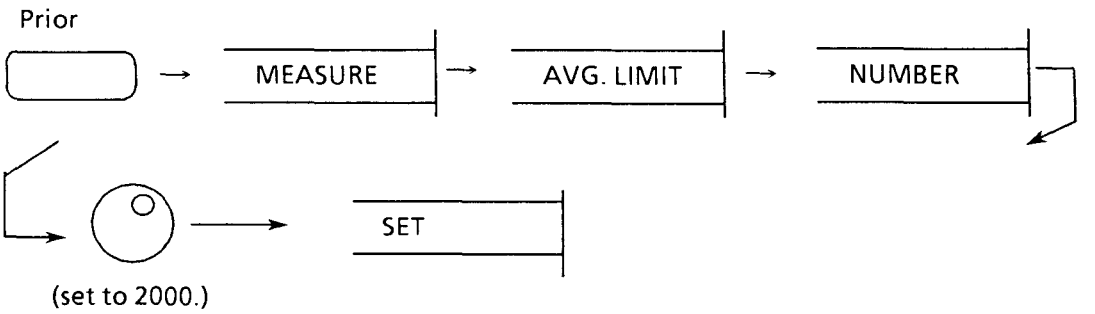


** : 50 km for MW0944B
: 25 km for MW0967B

6 Press the [Laser] key after confirming that the Ready lamp is on.



7 Set the averaging limit value to 2000.

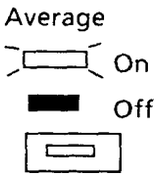


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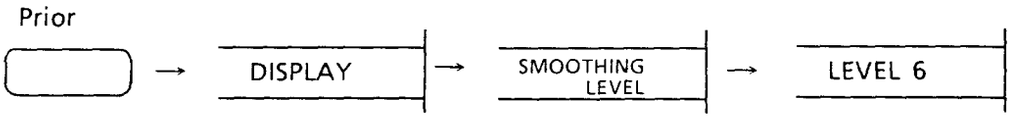
(Continued)

Step	Procedure

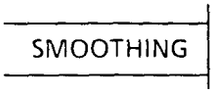
8 Press the [Average] key to enable averaging.



9 After averaging has been completed and the laser has been turned off, set the SMOOTHING LEVEL to 6.



10 Perform the SMOOTHING.



11 After SMOOTHING has been completed, confirm that the difference between the near-end back-scattered light level and the level of the point which is 0.3 dB higher than the noise-floor peak (excluding anomalous points) is greater than the specified value.

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7.3.5 Testing Accuracy of Distance Measurement

Test the horizontal axis, that is, the accuracy of distance measurement. This test may only be conducted with a certain distance range; there is no need to test with other ranges.

(1) Setup

Connect the equipment as shown in Fig. 7-7.

The length and refractive index of the fiber to be measured must be known values.

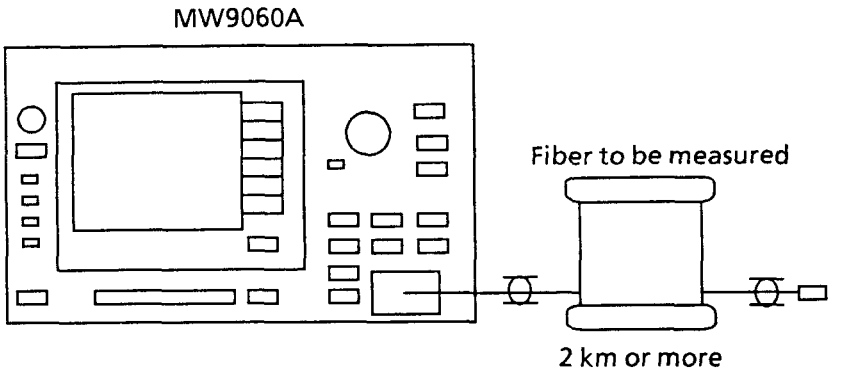
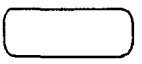
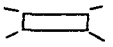


Fig. 7-7 Equipment Setup for Testing Accuracy of Distance Measurement

(2) Test procedure

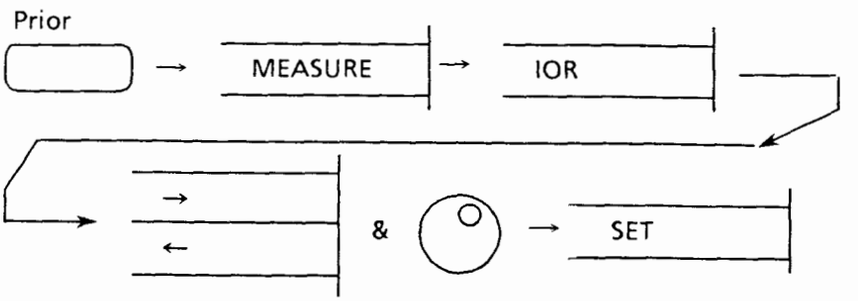
Step	Procedure
1	Press the [Initialize] key to initialize the settings. Initialize 
2	When using the wavelength switchable plug-in unit, select the wavelength to be used for testing.  λ-Select 

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(Continued)

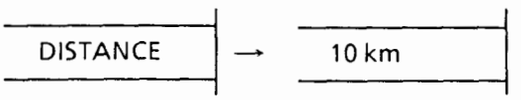
Step	Procedure

3 Set the refractive index of the fiber to be measured.

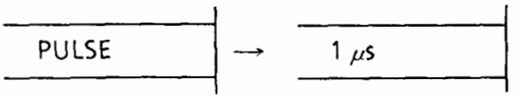


Note: The refractive index of fiber varies with wavelength. When using the wavelength switchable plug-in unit, set the refractive index for the wavelength selected in step 2.

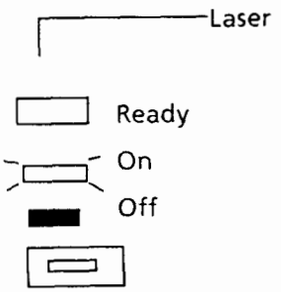
4 Set the distance range to 10 km.



5 Set the pulse width to 1 μs.



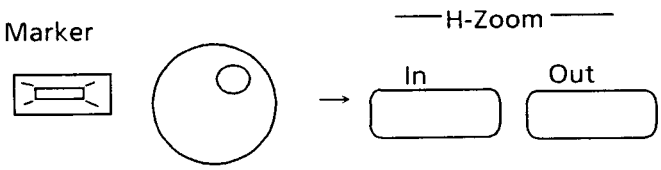
6 Press the [Laser] key after confirming that the [Ready] lamp is on.



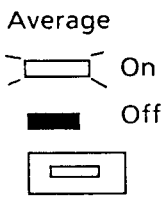
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Step	Procedure

7 Position the marker at the far-end Fresnel reflection and set the horizontal axis sensitivity for 25 m/div.

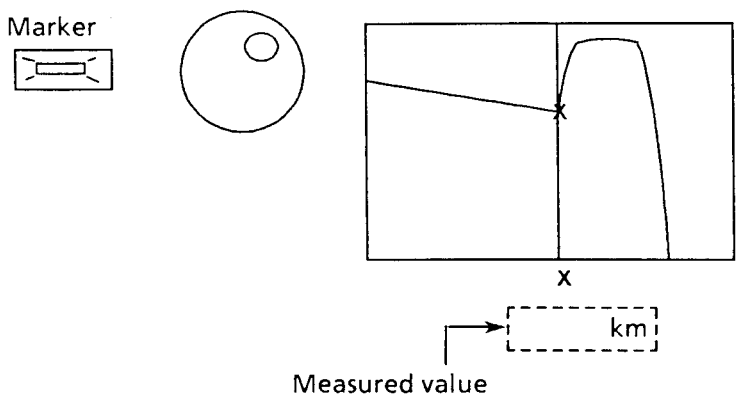


8 Press the [Average] key to enable averaging.



9 Precisely position the marker at the rising point of Fresnel reflection, then measure the absolute distance.

Confirm that this value is within the specifications for the accuracy of distance measurement.



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7.3.6 Vertical-axis accuracy test

Test the accuracy of the vertical axis, or that of level measurements.

(A) Testing the MW0944B and MW0967B

(1) Setup

Connect the equipment as shown in Fig.7-8.
To test the MW0967B, substitute the MN9002A for the MN938A.

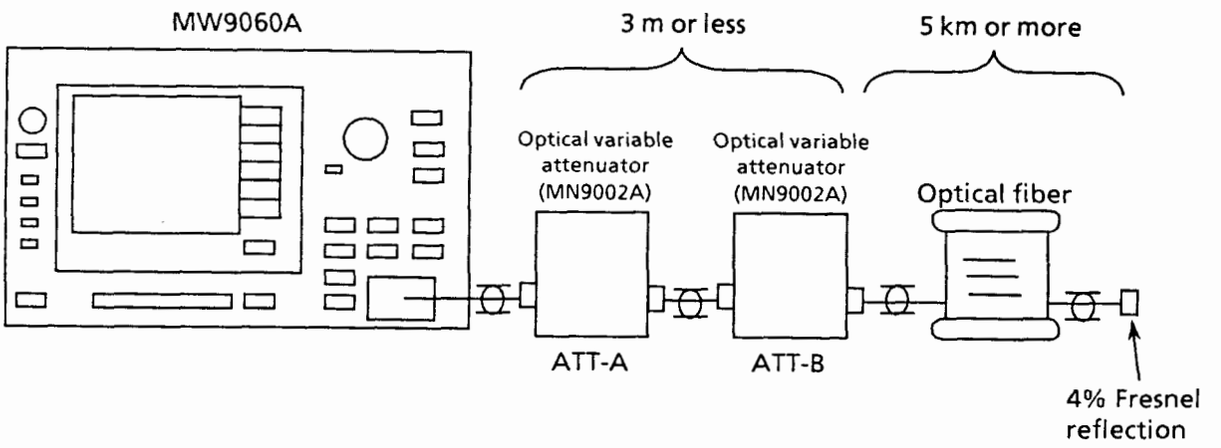
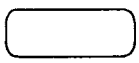
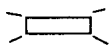
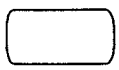
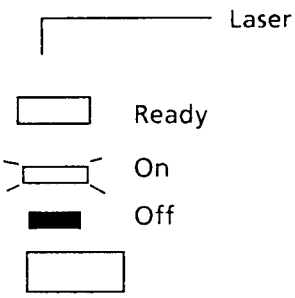
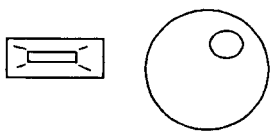


Fig. 7-8 Equipment Setup for Vertical-Axis Accuracy Test (FOR MW0944B and MW0967B)

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(2) Test procedure

Step	Procedure
1	Press the [Initialize] key to initialize the settings. Initialize 
2	When using the wavelength switchable plug-in unit, select the wavelength to be used for festing  λ-Select 
3	Set the pulse width to 100 ns. 
4	Press the [Laser] key after confirming that the Ready lamp is on. 
5	Set the × marker to zero level and the * marker to far-end Fresnel reflection. Marker 

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(Continued)

Step	Procedure
6	Set ATT-B to 0 dB, and adjust ATT-A so that the peak level of the far-end Fresnel reflection is about 0.2 dB or so less than the saturation level.
7	Read the Fresnel reflection level via the OTDR screen. (Assume that this level is PL0.)
8	Set ATT-B to 2 dB and measure the Fresnel reflection level. (Assume that this level is PH0.)
9	Reset ATT-B to 0 dB and increase the attenuation of ATT-A by 1 dB. Then measure the Fresnel reflection level. (Assume that this level is PL1.)
10	Set ATT-B to 2 dB and measure the Fresnel reflection level. (Assume that this level is PH1.)
11	Increase ATT-A to 15 dB in 1-dB increments, and measure the PLi and PHi at each i-dB increment.
12	Calculate the vertical-axis accuracy at each ATT-A setting value with the following formula, and confirm that the accuracy conforms to specifications. Vertical-axis accuracy (dB/dB) = $\frac{(PLi - PHi) - \Delta A}{\Delta A}$ where, ΔA is the actual attenuation difference between the 0 dB and 2 dB ATT-B settings. (Note: Calibrate before testing.)

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(B) Testing the MW0945B, MW0946B, and MW0947B

(1) Setup

Connect the equipment as shown in Fig.7-9.

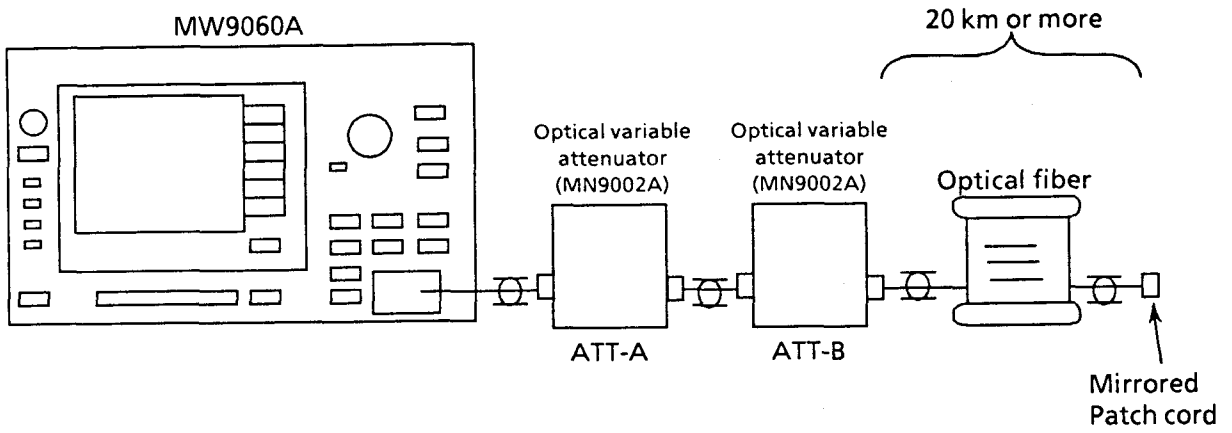


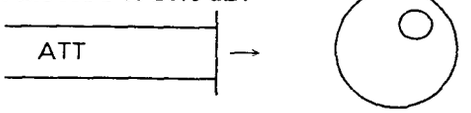
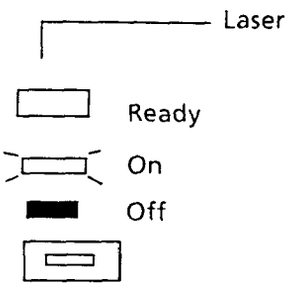
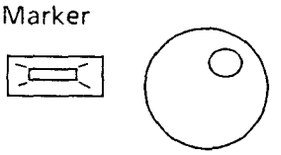
Fig. 7-9 Equipment Setup for Vertical-Axis Accuracy Test (For MW0945B, MW0946B, and MW0947B)

(2) Test procedure

Step	Procedure
1	Press the [Initialize] key to initialize the settings. Initialize
2	Set the wavelength to 1.55 μm. λ-Select
3	Set the pulse width to 1 μs. CONDITION → PULSE → 1 μs

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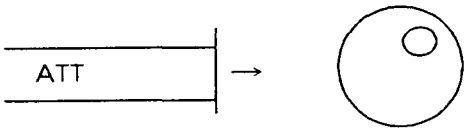
Step	Procedure
4	Set the ATT to 20.0 dB. 
5	Press the [Laser] key after confirming that the Ready lamp is on. 
6	Set the × marker to zero level and the * marker to far-end Fresnel reflection. 
7	Set ATT-B to 0 dB, and adjust ATT-A so that the peak level of the far-end Fresnel reflection is about 0.2 dB or so less than the saturation level.
8	Read the Fresnel reflection level via the OTDR screen. (Assume that this level is PL0.)
9	Set ATT-B to 2 dB and measure the Fresnel reflection level. (Assume that this level is PH0.)
10	Reset ATT-B to 0 dB and increase the attenuation of ATT-A by 1 dB. Then measure the Fresnel reflection level. (Assume that this level is PL1.)
11	Set ATT-B to 2 dB and measure the Fresnel reflection level. (Assume that this level is PH1.)
12	Increase the attenuation of ATT-A to 10 dB in 1-dB increments, and measure the PLi and PHi at each i-dB increment.

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(Continued)

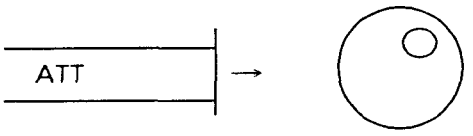
Step	Procedure

13 After measurements have been completed at ATT-A attenuations of up to 10 dB; set the ATT of the MW9060A to 10.0 dB, and, while once again increasing the attenuation of ATT-A by 1 dB, measure PLi and PHi.



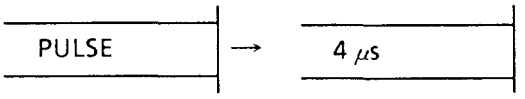
14 Increase the attenuation of ATT-A to 20 dB in 1-dB increments, and measure the PLi and PHi at each i-dB increment.

15 After measurements have been completed at ATT-A attenuations of up to 20 dB; set the ATT of the MW9060A to 0.0 dB, and, while once again increasing the attenuation of ATT-A by 1 dB, measure PLi and PHi.



16 Increase the attenuation of ATT-A to 30 dB in 1-dB increments, and measure the PLi and PHi at each i-dB increment.

17 Set the pulse width to 4 μs and the ATT of the MW9060A to 5 dB. Increase the attenuation of ATT-A by 19 dB from its initial value, and measure the PLi and PHi.



18 Increase the attenuation of ATT-A to 29 dB in 1-dB increments, and measure the PLi and PHi at each i-dB increment.

19 Increase the attenuation of ATT-A to 30 dB. Then, set the ATT of the MW9060A to 0.0 dB, and measure the PLi and PHi.

20 Increase the attenuation of ATT-A to 35 dB in 1-dB increments, and measure the PLi and PHi at each i-dB increment.

21 Calculate the vertical-axis accuracy at each ATT-A setting value with the following formula, and confirm that the accuracy conforms to specifications.

$$\text{Vertical-axis accuracy (dB/dB)} \simeq \frac{(\text{PLi} - \text{PHi}) - \Delta A}{\Delta A}$$

where, ΔA is the actual attenuation difference between the 0 dB and 2 dB ATT-B settings.
(Note: Calibrate before testing.)

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7.4 Service

When the MW9060A is found incapable of meeting the specifications as a result of performance test, send it for repair after contacting your dealer or nearest office of Anritsu.

When requesting repair, supply us with information on the following:

(1) Equipment name and the equipment No. indicated on the rear panel nameplate

(2) Fault conditions

(3) Name and address of the person in charge in your company to be contacted for confirmation of the contents of fault or when repair is completed

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SECTION 8
CALIBRATION

Calibration is done in order to guarantee the reliability of measurment made with the MW9060A. Therefore, calibration is required when, for example, the equipment is repaired.

In addition, it is recommended that the MW9060A be periodically calibrated every year.

The calibration items and calibration procedure are the same as the performance test items and test procedure described in Section 7. For details, refer to Section 7.

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SECTION 9
STORAGE AND TRANSPORT

This section describes how to maintain the MW9060A Optical Time Domain Reflectometer during daily use, as well as how to do when storing it for a long time or repackaging and transporting it.

9.1 Daily Maintenance

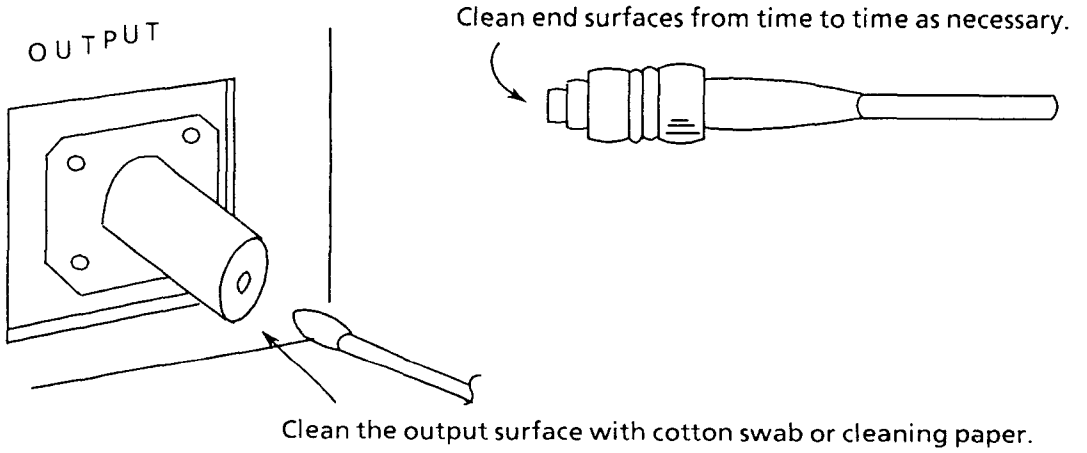
The table below shows the method of daily maintenance and the time when maintenance is required.

Daily Maintenance

Item	Time	Method of maintenance
External stain	• When the equipment is used indust-prone places • When foreign matter is entered the inside of the equipment • When there is noticeable accumulation of dust inside the equipment	Clean with soapy water or industrial gasoline, if proper ventilation is provided*.
Attachment of dust or dirt		Open the equipment frame and blow away the dust with compressed air, taking care to shield face from dust or dirt.
Slack in screw-fitted components	When loosely-fitted components are discovered	Refasten the screws with designated tools.

* Do not use thinner or benzene, or these chemicals may damage the coating.

Especially, for stain and dust in the optical output connector, carefully wipe them off with alcohol-soaked cotton swab or cleaning paper as shown below. For the optical fiber connectors connected to the optical output connector, clean their end surfaces as frequently as possible.



Note: The MZ8012A Connector Cleaning Set is sold separately.

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9.2 Storage

When storing the MW9060A for a long period, follow the procedure described below.

(1) Before storing the MW9060A; remove dust, finger marks, and other stains by thoroughly wiping it with a cloth, then cover the equipment with vinyl or other appropriate sheet.

(2) Avoid storing the equipment in the following places:

1) Places exposed to direct sunglight or dust-prone places
2) Humid places where water droplets may attach to the equipment or water droplets may be generated by dew condensation
3) Places where the equipment may be damaged by active gas or exposed to oxidizing atmosphere
4) Extreme places where the temperature is above 60°C or below −20°C (for some unit, this value is different. See paragraph 1.5.) and humidity is more than 90%

(3) Recommended storage conditions

In additon to avoding the above places, it is desirable that the equipment be stored within the range of the recommended environment conditions shown below.

- Temperature: 0 to 30°C
- Humidity: 40 to 80%
- Changes in temperature and humidity within a day are moderate.

(4) When using the equipment after storage

If the equipment is suddenly exposed to normal or high temperatures after being stored under low-temperature conditions, water droplets may attach to it. In this case, leave the equipment for a sufficient time until it is dry before use. If not sufficiently dried, the circuit or components may be short-circuited, causing trouble. Also, check whether or not the air blower is clogged or stained with dust.

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9.3 Repackaging and Transport

When transporting the MW9060A to a distance place, place the equipment in its dedicated carrying case. If the carrying case is not available, repackage the equipment by following the precaustions and procedure described below.

Use the packaging materials included with the MW9060A when it was first delivered. If these packaging materials discarded or damaged, package the equipment as follows:

(1) Fit protective covers to the MW9060A front and rear panels.

(2) Enclose the MW9060A with vinyl or other appropriate sheet.

(3) Prepare a carton, wooden, or aluminum box of an appropriate size so that there are 10 to 15 cm margins from each side of the MW9060A.

(4) Place the MW9060A at the center of the box, then fill the gaps on each side of the equipment with 10 to 15 cm thick cushioning material.

(5) Bind the box with packaging string, adhesive tape, or band.

Note: The equipment can be easily repackaged if the packaging materials (included with the MW9060A when it was first delivered) are available. So we recommend you to keep them in your place for transport at a later time.

When transporting the equipment, avoid vibration as much as possible. At the same time, it is desirable that the recommended storage conditions described in the preceding paragraph are applied when transporting the equipment, too.

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APPENDIX A
SOFT-KEY LAYER TRANSITION DIAGRAMS

A1 Format of Soft-Key Layer Transition Diagrams

The soft-key layer transition diagrams are described using the format shown in Fig. A-1. Layer transitions actuated by pressing such panel keys as [Marker] and [H-Shift] other than soft keys are also indicated. The upper section marked by Ⓐ is for soft keys; the lower section marked Ⓑis for other panel keys. Note that the following symbols are used in the layer transition diagrams, but these symbols are actually not displayed on the screen.

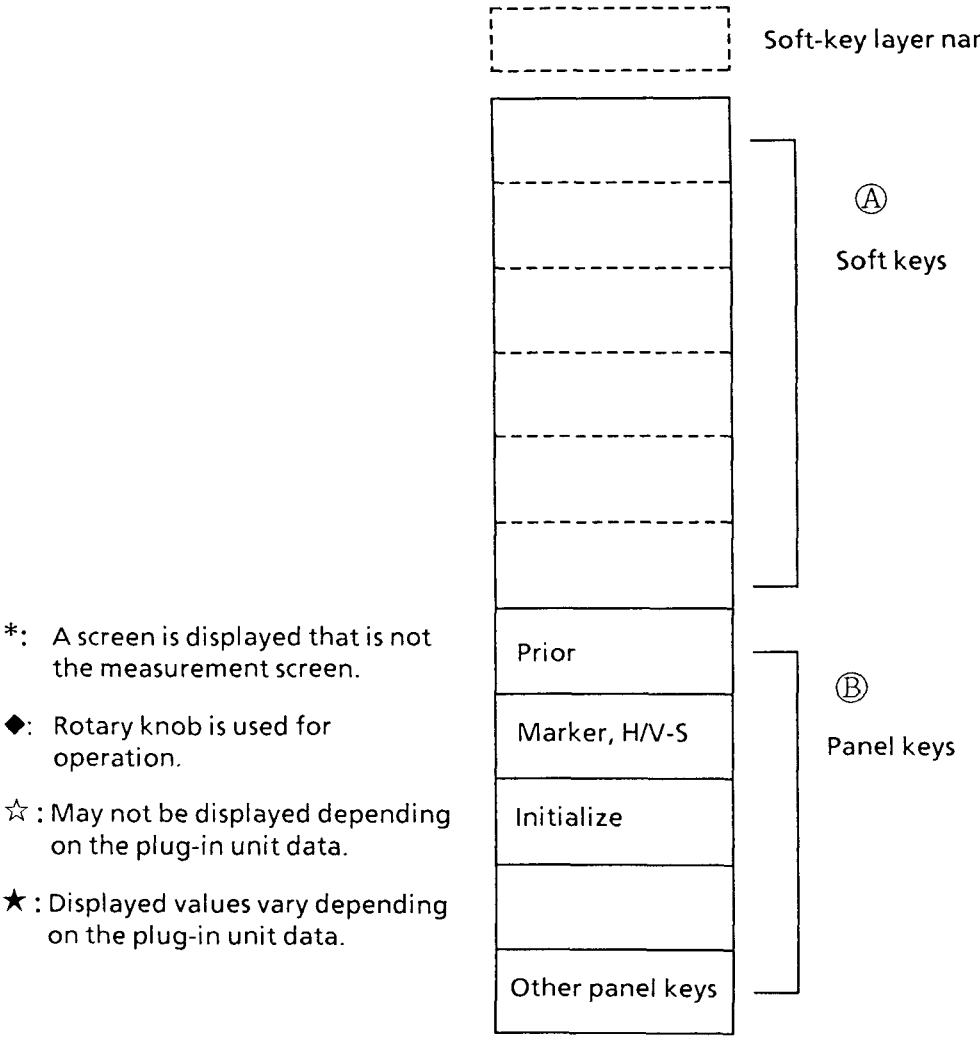


Fig. A-1 Format of Soft-Key Layer Transition Diagrams

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When a soft key is pressed, the layer changes to a state in the destination indicated by the arrow mark.

When no arrow marks are indicated, the soft-key state does not change.

A2 Layer Transition Diagrams

The next pages show the layer transition diagrams of the MW9040B soft keys.

The following passage briefly explains how to see the transition diagram.

When powered on, the L1: (1/3) menu in the first layer is displayed. To set measurement conditions from here, for example, you may press the [CONDITION] soft key. Take a look at desination ② of the arrow mark. You find that the layer name is L2: CONDITION in the second layer.

Assume that you set the pulse width next. Take a look at the destination of the arrow mark extended from PULSE.

You find that the layer name is L3: PULSE in the third layer. Selectable pulse widths are listed in the frame below this heading. (○○○○ in the third layer indicates the figure or value of each setting parameter.)

Select one from this list and look at the destination of the arrow mark extended from there. You see that it returns to L2: CONDITION in the second layer. So now you can set other measurement conditions. If measurement conditions need not be changed, press the [Prior] key and look at the destination of the arrow mark extended from there. You see you have returned to L1: (1/3) in the first layer. In this way, you can track the soft-key layer transition through its hierarchical structure.

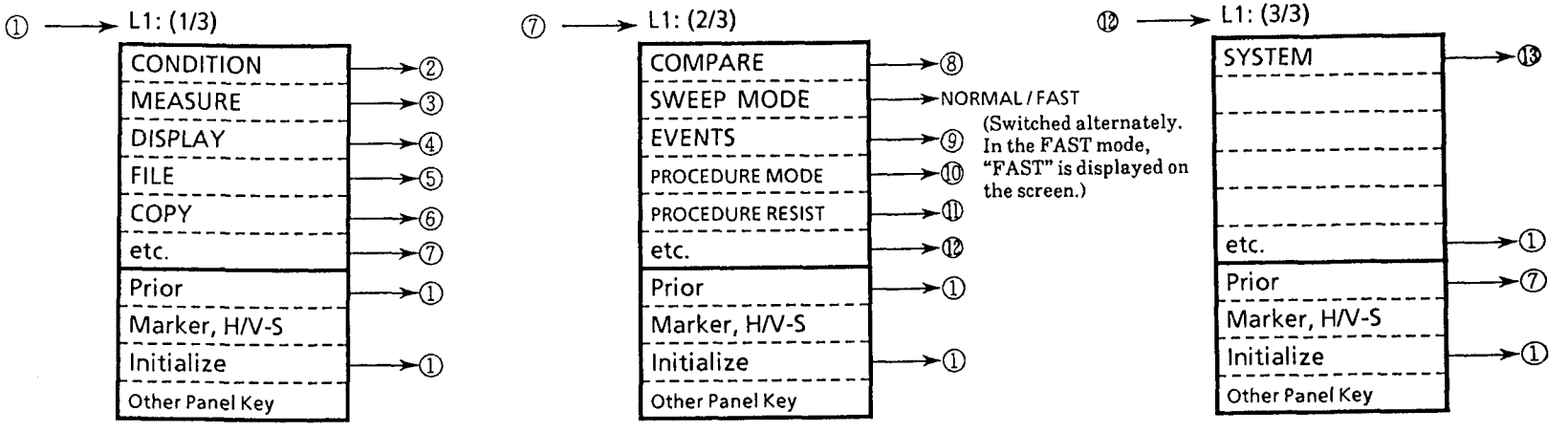
Notes: 1. For some unit, ATT is fixed (See paragraph 1.5.)

2. For some unit, OUTPUT POWER can not be used. (See paragraph 1.5)

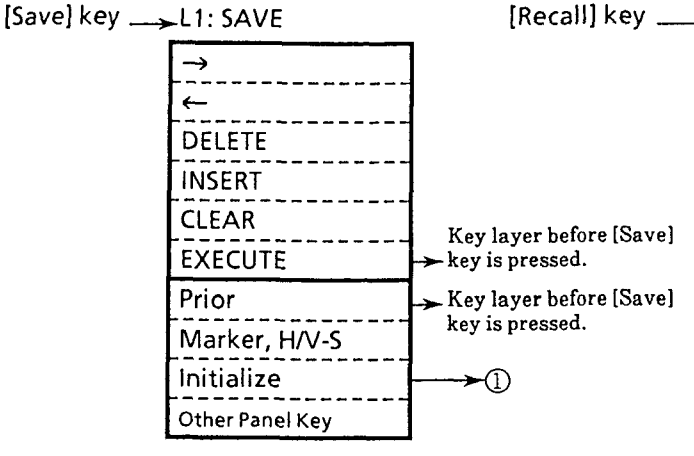
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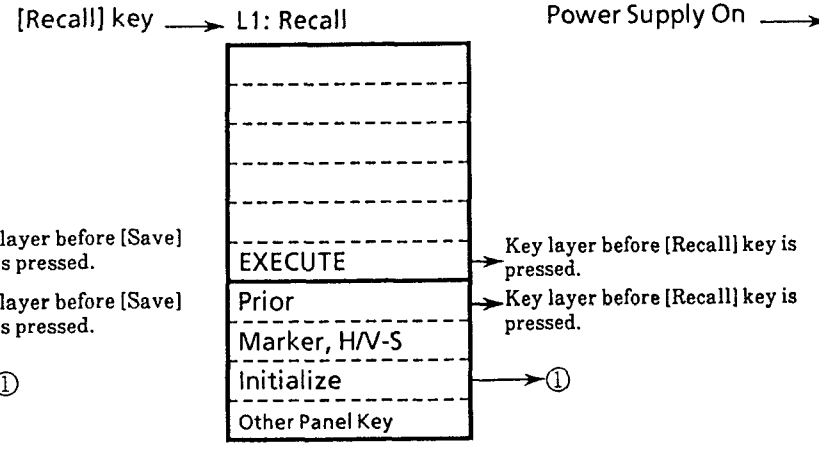
1. The First Layer

1.1 At power supply On (Other than Paragraph 1.3)

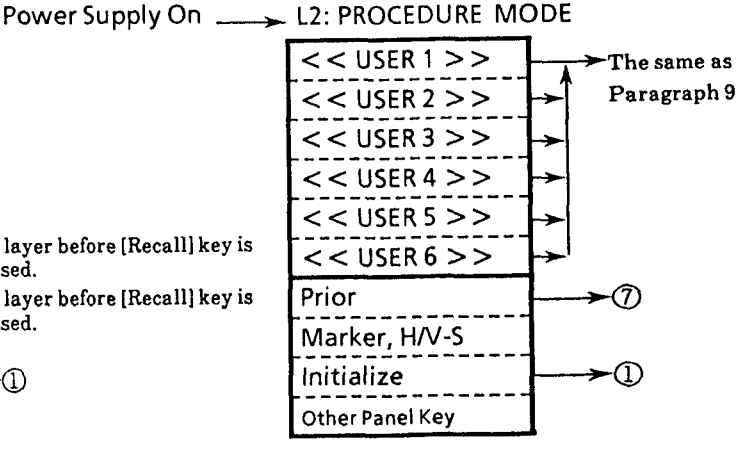


1.2 When [Save], [Recall] key is pressed



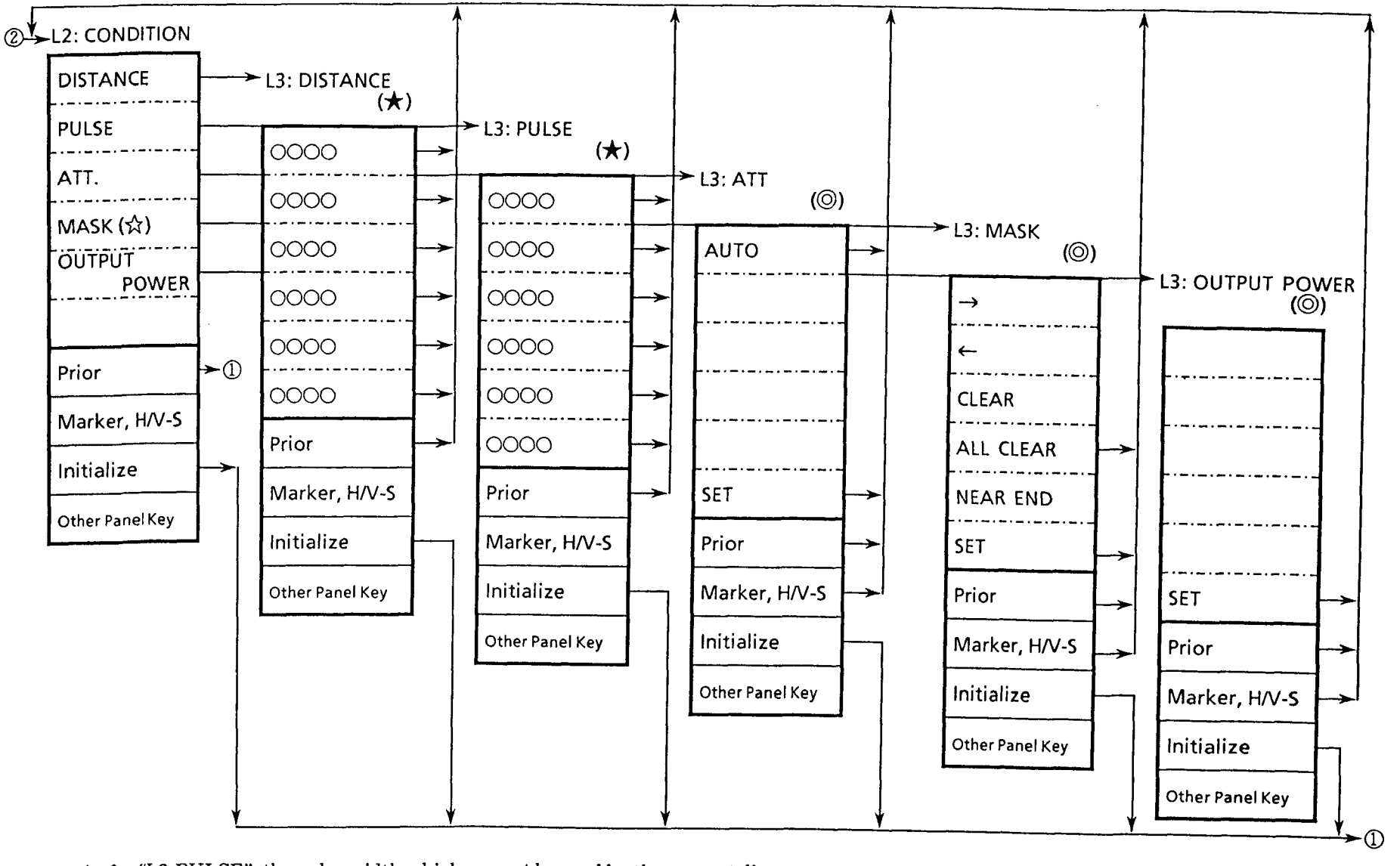


1.3 When the power supply is turned off in PROCEDURE MODE



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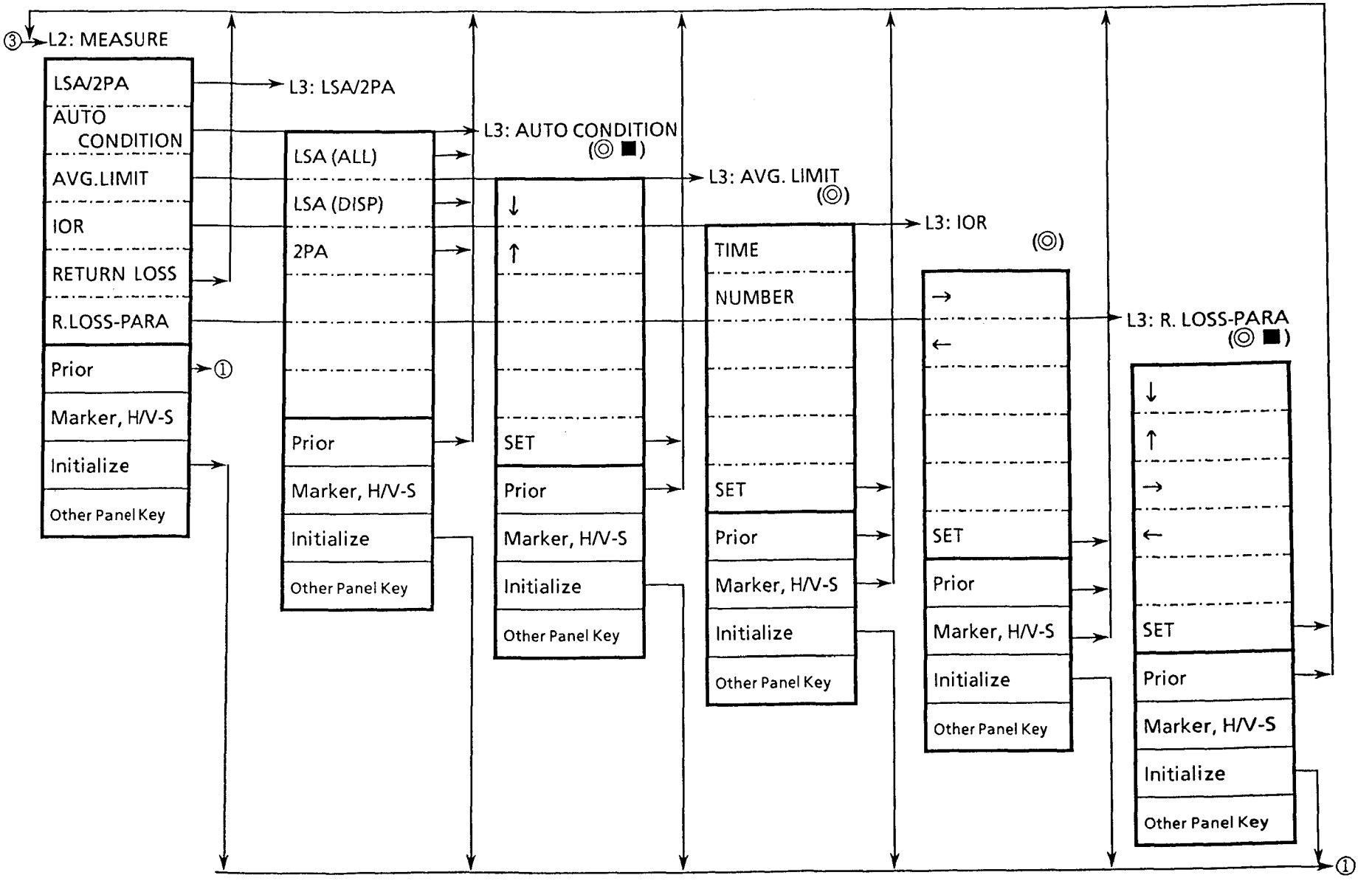
2. The Second Layer CONDITION



Note: As for "L3:PULSE", the pulse width which can not be used by the current distance range is not displayed. The currently available pulse width is displayed from the S1 position.

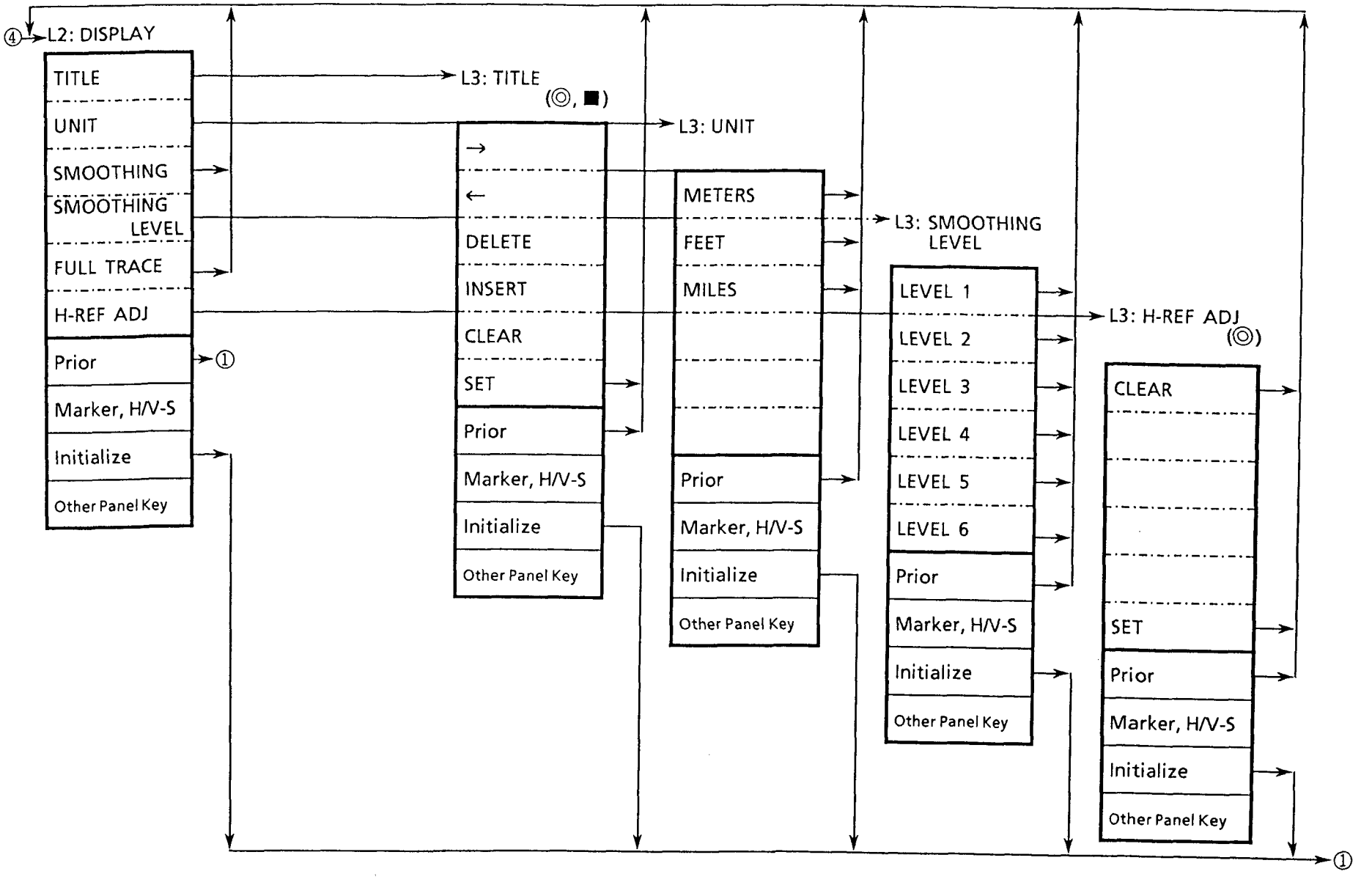
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3. The Second Layer MEASURE



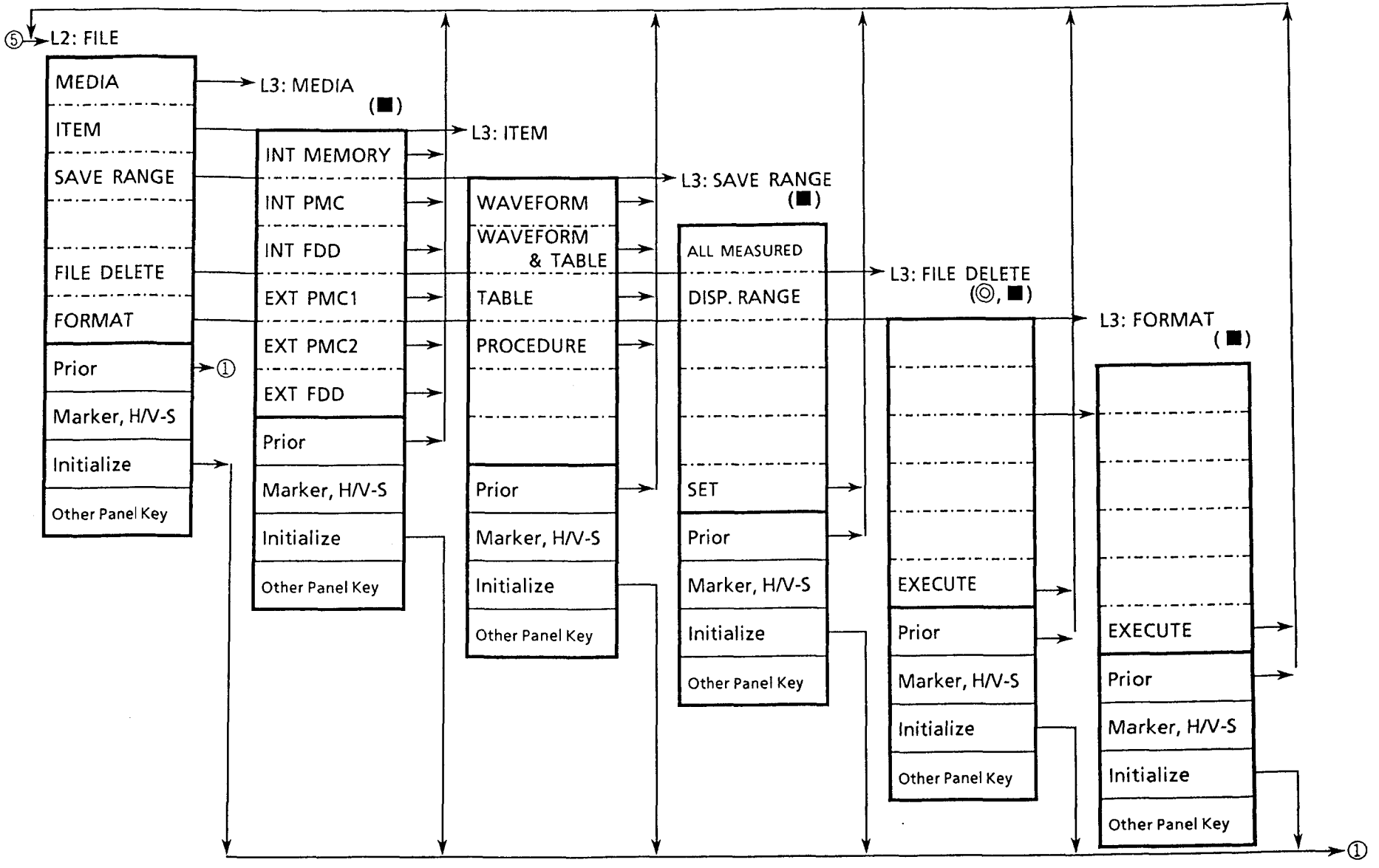
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4. The Second Layer DISPLAY



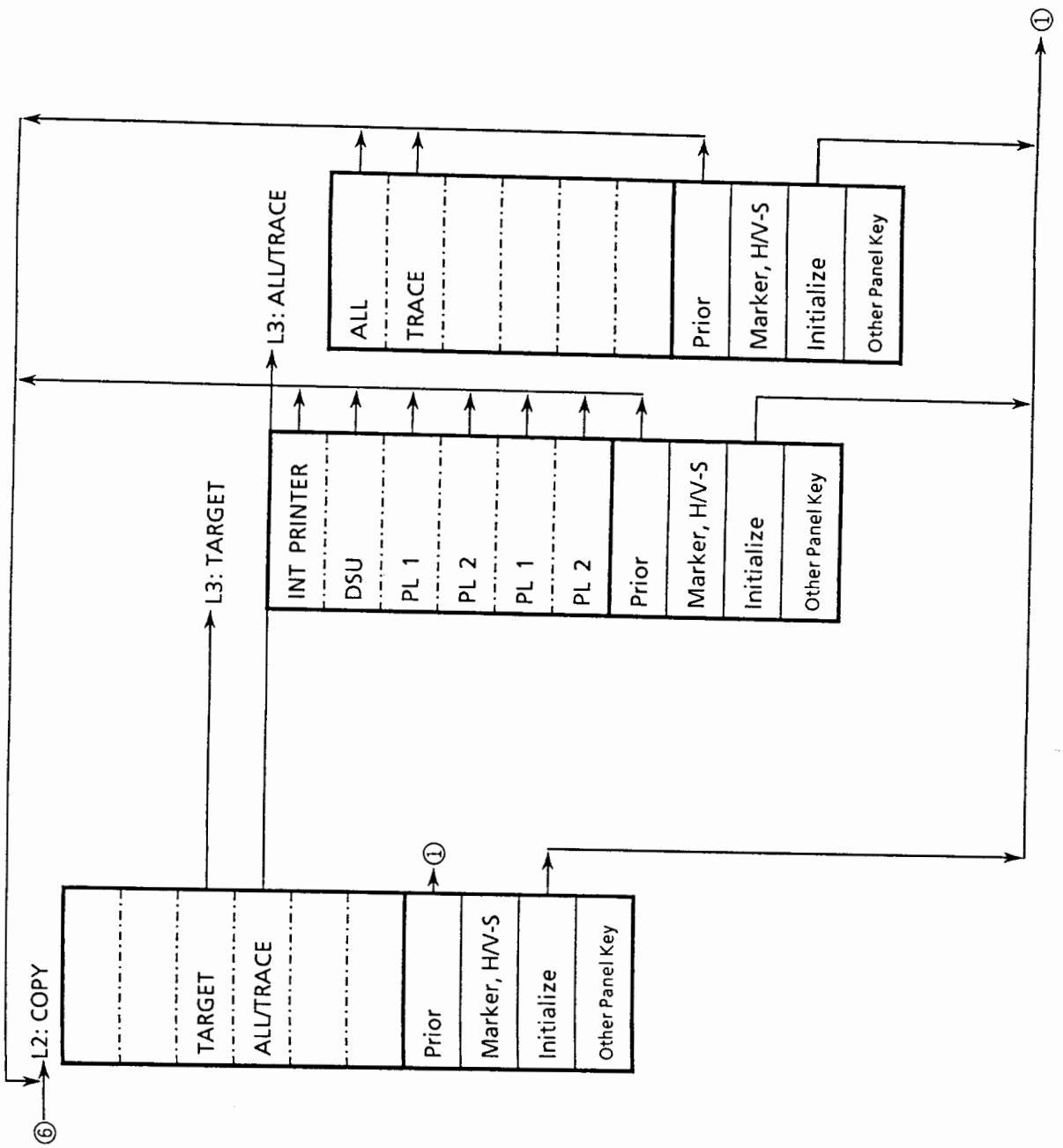
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5. The Second Layer FILE



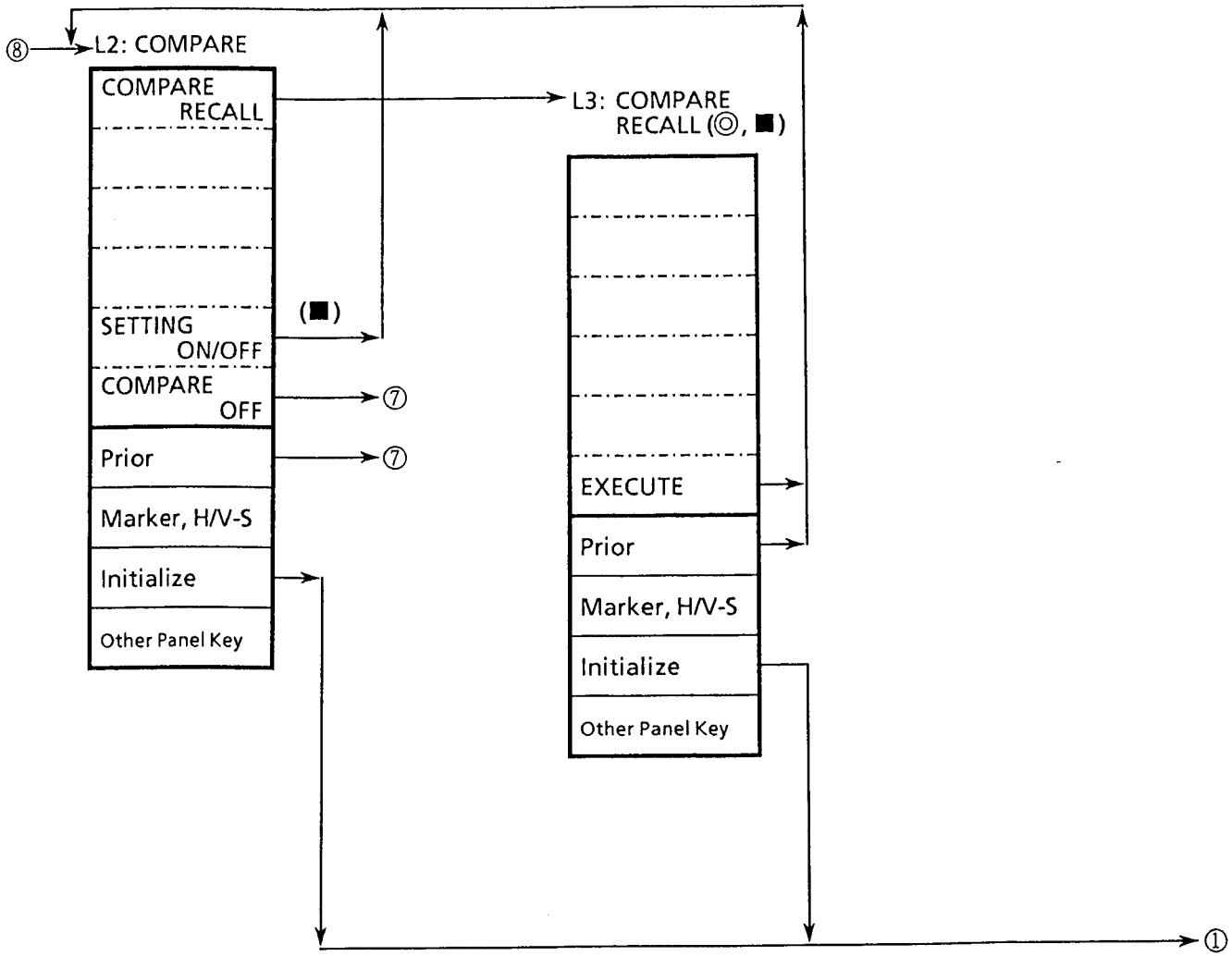
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6. The Second Layer COPY

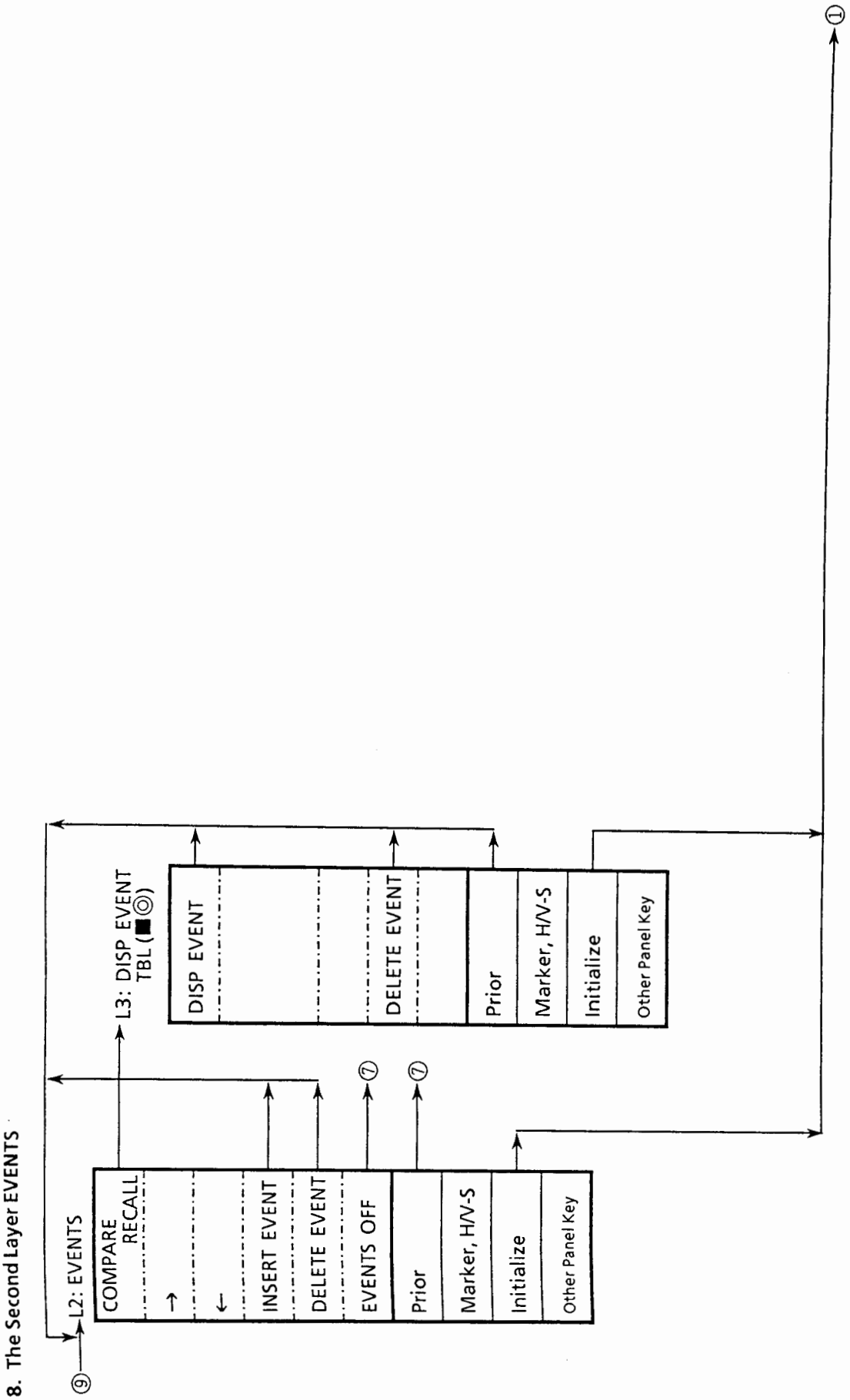


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7. The Second Layer COMPARE

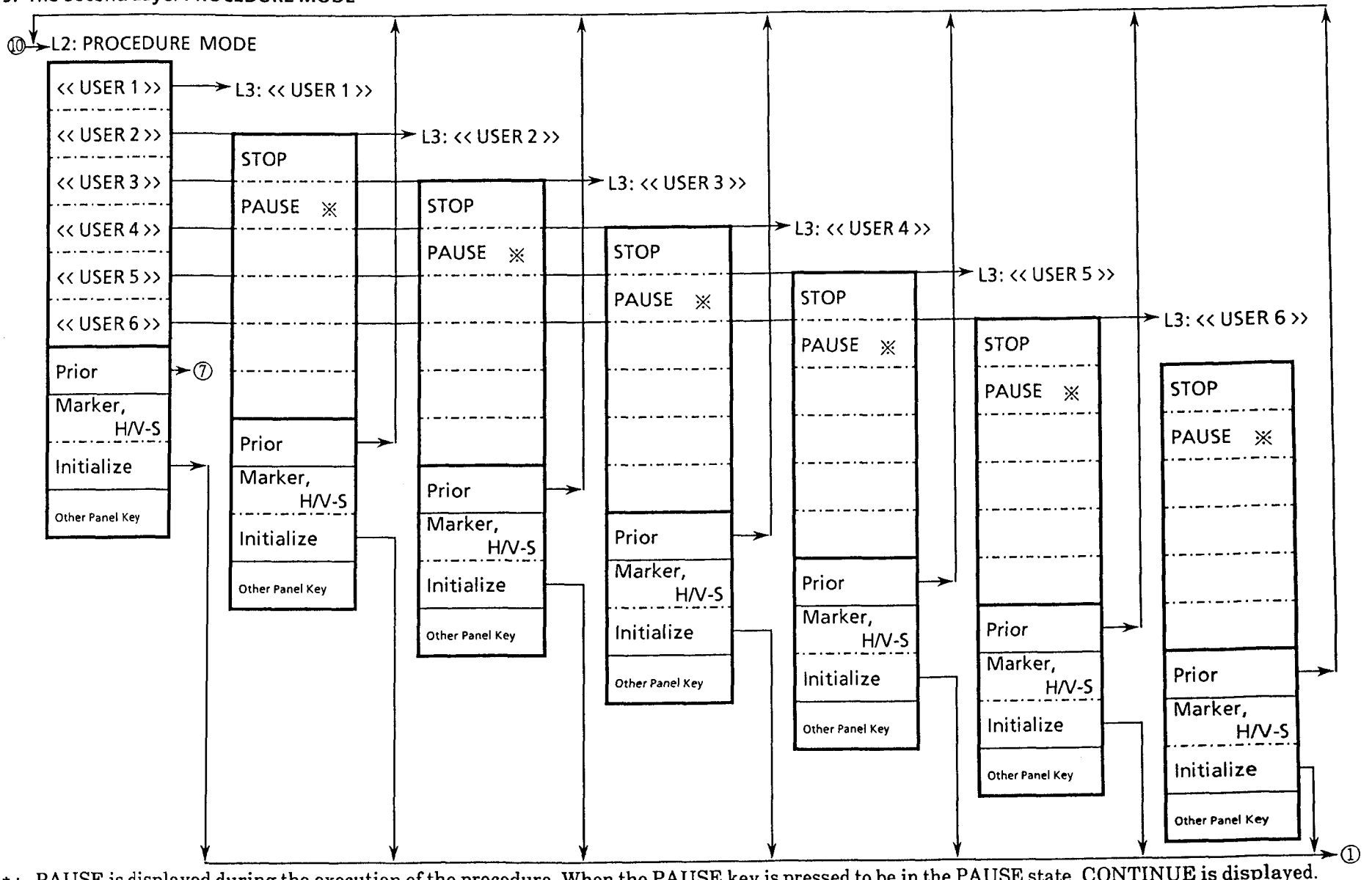


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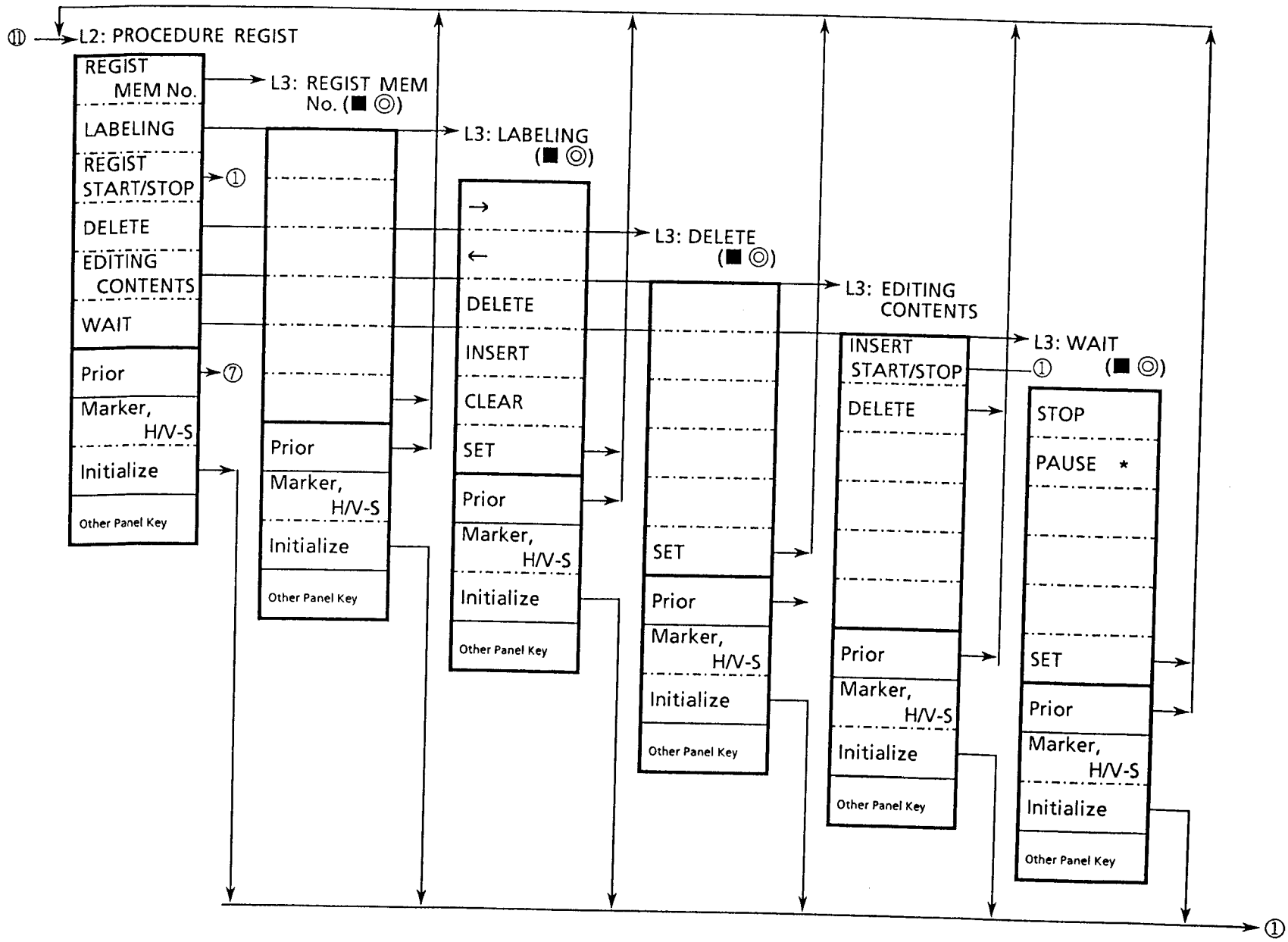
9. The Second Layer PROCEDURE MODE



*: PAUSE is displayed during the execution of the procedure. When the PAUSE key is pressed to be in the PAUSE state, CONTINUE is displayed. Pressing the CONTINUE key after that, displays PAUSE again.

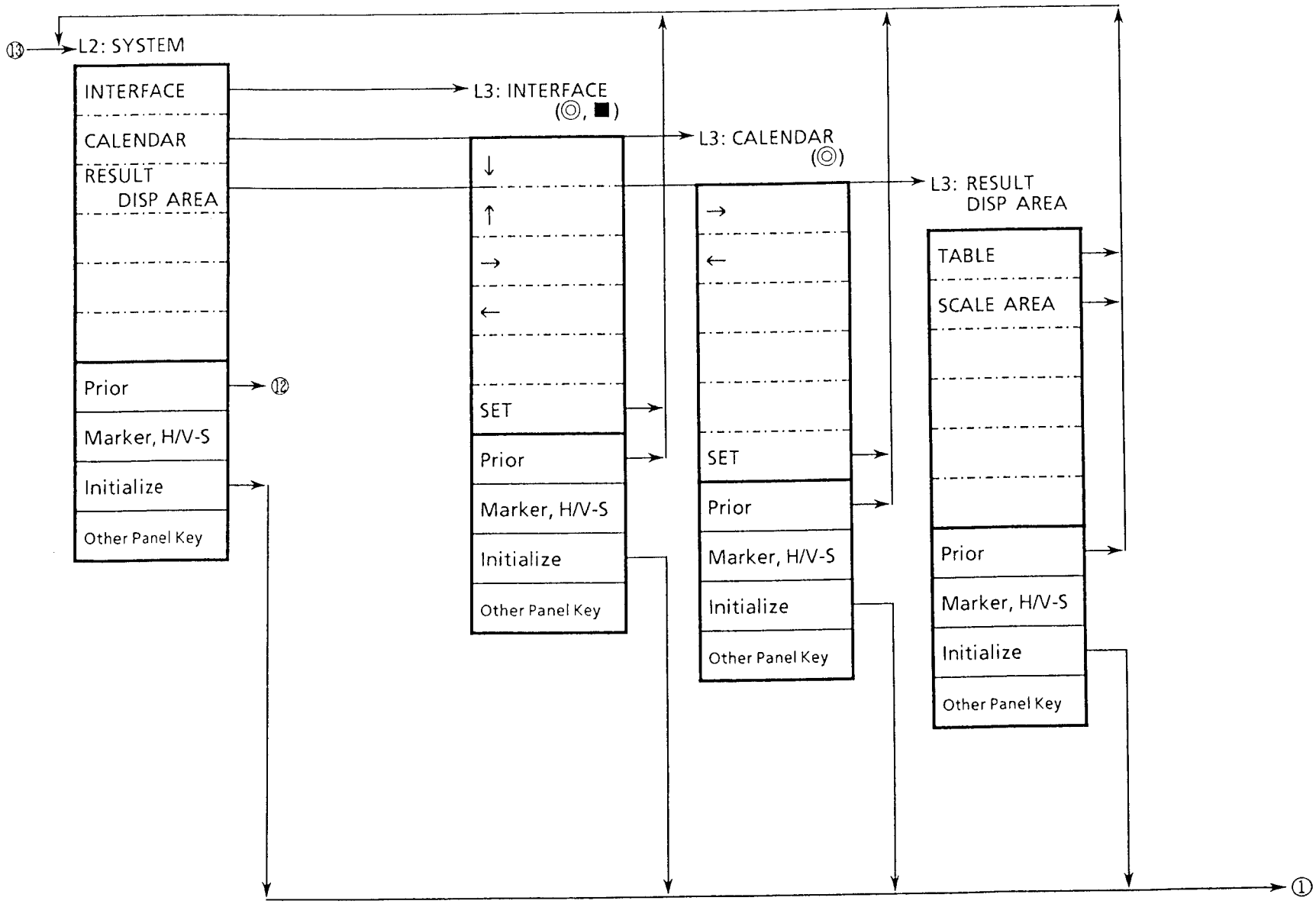
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10. The Second Layer PROCEDURE REGIST



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11. The Second Layer SYSTEM



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APPENDIX B
FRONT AND REAR PANEL LAYOUTS

Figures B-1 and B-2 respectively show the front-panel and the rear-panel layouts.

The names, functions, etc. corresponding to the numbers given to the keys, connectors, etc. on the operation panel are described in Section 3. When referring to Fig. B-1 or B-2 for description in Section 3, spread the diagram for easy reference.

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