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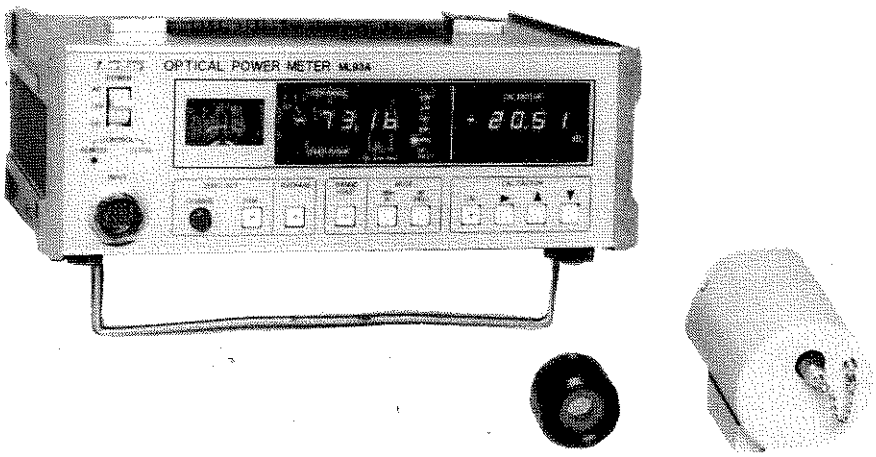
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OPERATION AND SERVICE MANUAL

OPTICAL POWER METER
ML93A



ANRITSU ELECTRIC CO., LTD.

TOKYO, JAPAN

1982.04×100 RII-2(Y)

N O T E

(1) The instrument is operable on a nominal voltage from 100 to 130 Vac or from 200 to 260 Vac by changing the connections of the power transformer taps.

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

In the case of other voltage operation, change the connections of the power supply transformer, and the plate of voltage and current designations on the rear panel should be changed to suitable one.
Order the plates to Anritsu Electric Co., Ltd. if necessary.

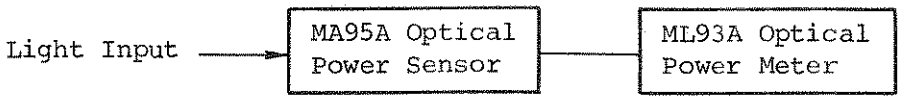
(2) In this manual, a power supply voltage and current rating are represented by [**] Vac and [*] A.

(3) The relation between power supply voltage and current rating is listed below.

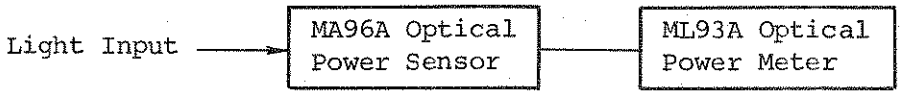
** Vac	* A
100 to 130 V	0.5 A
200 to 260 V	0.2 A

SECTION 1 GENERAL

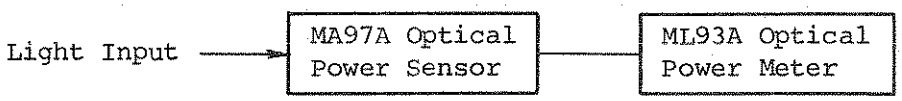
The ML93A Optical Power Meter is designed to measure optical power in conjunction with the MA95A/MA96A/MA97A/MA98A Optical Power Sensor. The combinations of the Meter and the Sensor are shown as follows.



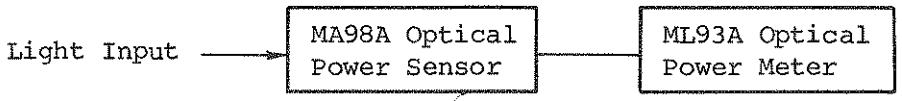
(a) Measures Low-Level Optical Power in the 0.85 μm Band



(b) Measures Low-Level Optical Power in the 1.3 μm Band



(c) Measures High-Level Optical Power in the 0.85 μm Band



(d) Measures High-Level Optical Power in the 1.3 μm Band

Fig. 1-1 Combinations of the Meter and the Sensor

Features

- Wide Wavelength Range

  Two optical power sensors cover a wavelength range from 0.38 to 1.8 μm.

- Wide Power Measuring Range

  Two optical power sensors cover a wide range of power from -90 to +10 dBm.

- Excellent Interchangeability

  The power meter can be connected to any optical power sensor without readjustment.

- Automatic Zero Adjustment

  Zero adjustment can be automatically done with a single flip of the switch.

- Battery Operation

  The ML93A can be operated on an external Battery Pack MZ95A.

- The ML93A with digital display permits direct reading of measurements with high accuracy.

SECTION 2 COMPOSITION AND SPECIFICATIONS

2.1 Standard Composition

Table 2-1 Standard Composition

Name	Quantity	Remarks
ML93A optical power meter	1	
Connecting cord for MA95A/96A	1	2 m, 16-pin connector
Connecting cord for MA97A/98A	1	2 m, 6-pin connector 16-pin connector
Instruction manual	1	
Fuses	1 set	1 set: 2 A ..... 1, * A 1

2.2 Option

GP-IB interface

2.3 Optional Accessories

Name	Remarks
MA95A optical power sensor	
MA96A optical power sensor	
MA97A optical power sensor	
MA98A optical power sensor	
Connecting cord for MA95A/96A	1.7 m, 16-pin connectors
Connecting cord for MA97A/98A	1.7 m, 6-pin connector, and 16-pin connector
Accessory Box	
Connector adapter	D3 connector
MP91A/91B optical fiber adapter	Connector adapter
MP92A Connector adapter	
MP93A Fiber adapter	
MP94A Adapter for MP93A	
GP-IB cord	1 m
Conversion Connector	GP-IB ⟶ IEC-IB conversion
MZ95A battery pack	
MZ96A battery charger	
DC POWER SUPPLY cord	

Table 2-2 Specifications

		Optical Power Meter ML93A			
Sensor	Model	MA95A	MA96A	MA97A	MA98A
	Wavelength range	0.38 to 1.15 μm	0.75 to 1.8 μm	0.38 to 1.15 μm	0.75 to 1.8 μm
	Element	Si photo diode	Ge photo diode	Si photo diode	Ge photo diode
	Active area diameter	—	—	D = 11.3 mm	D = 5 mm
	Input type	connector		Photo diode	
	Dimensions and weight	65 ø, 85 L mm ≦ 0.7kg		35 ø, 27L mm ≦ 0.1 kg	
Indicator	Model	ML93A			
	Display	Selection among Watts/dBm/dB (REL) Four digits and a small analog meter			
	Calibration coefficient	Front-panel adjustment			
	Recorder output	For each range, 1V corresponding to full-scale and 0.316V to -5dB			
	Relative value display	Digital 4 digits			
	Averaging	ON/OFF switchable			
	Dimensions and weight	282W, 99H, 200D mm ≦ 3.5 kg			
Overall	Power measuring range	-90 to 0 dBm (at 0.85 μm) 9 ranges	-80 to 0 dBm (at 1.3 μm) 8 ranges	-65 to +10 dBm (at 0.85 μm) 7 ranges	-40 to +10 dBm (at 1.3 μm) 5 ranges
	Accuracy	±5% (0.85 μm, -10 dBm)	±5% (1.3 μm, -10 dBm)	±5% (0.85 μm, -10 dBm)	±5% (1.3 μm, -10 dBm)
	Resolution	Watts display: 0.1 to 1% dBm display : 0.01 dB			
	Power	** V ±10%, 50/60 Hz, ≦20 VA or Battery Pack MZ95A			

SECTION 3 PRINCIPLES OF OPERATION

3.1 General

There are two types of circuits used in the ML93A optical power meter. One circuit uses an optical modulation method with an optical chopper. This circuit is used with the MA95A or 96A optical power sensor. The other circuit employs a direct detection method which does not require an optical chopper. This circuit is used with the MA97A or 98A optical power sensor. Light input power is converted into electric power and displayed digitally by the ML93A optical power meter.

3.2 Optical Power Sensor

3.2.1 MA95A and 96A Optical Power Sensors

The MA95A uses a silicion photodiode and the MA96A employes a germanium photodiode as the photoelectric conversion element. Fig.3-1 shows a block diagram of the optical power meter. The light input power from the light connector (1) is focused by the lens (2) on a shading plate on the tuning fork (3). The collimated light is interrupted by the tuning fork with a repetition frequency of approx. 270 Hz and then concentrated on the photodiode (5) by the lens (4). It is converted into photoelectric current and then converted further into voltage by the current-to-voltage conversion circuit (6), which is an operational amplifier. The conversion circuit (6) controls the gain according to the input optical power level over three ranges, 0 to -30 dBm, -30 to -60 dBm and -60 to -90 dBm to expand the dynamic range of the optical power sensor.

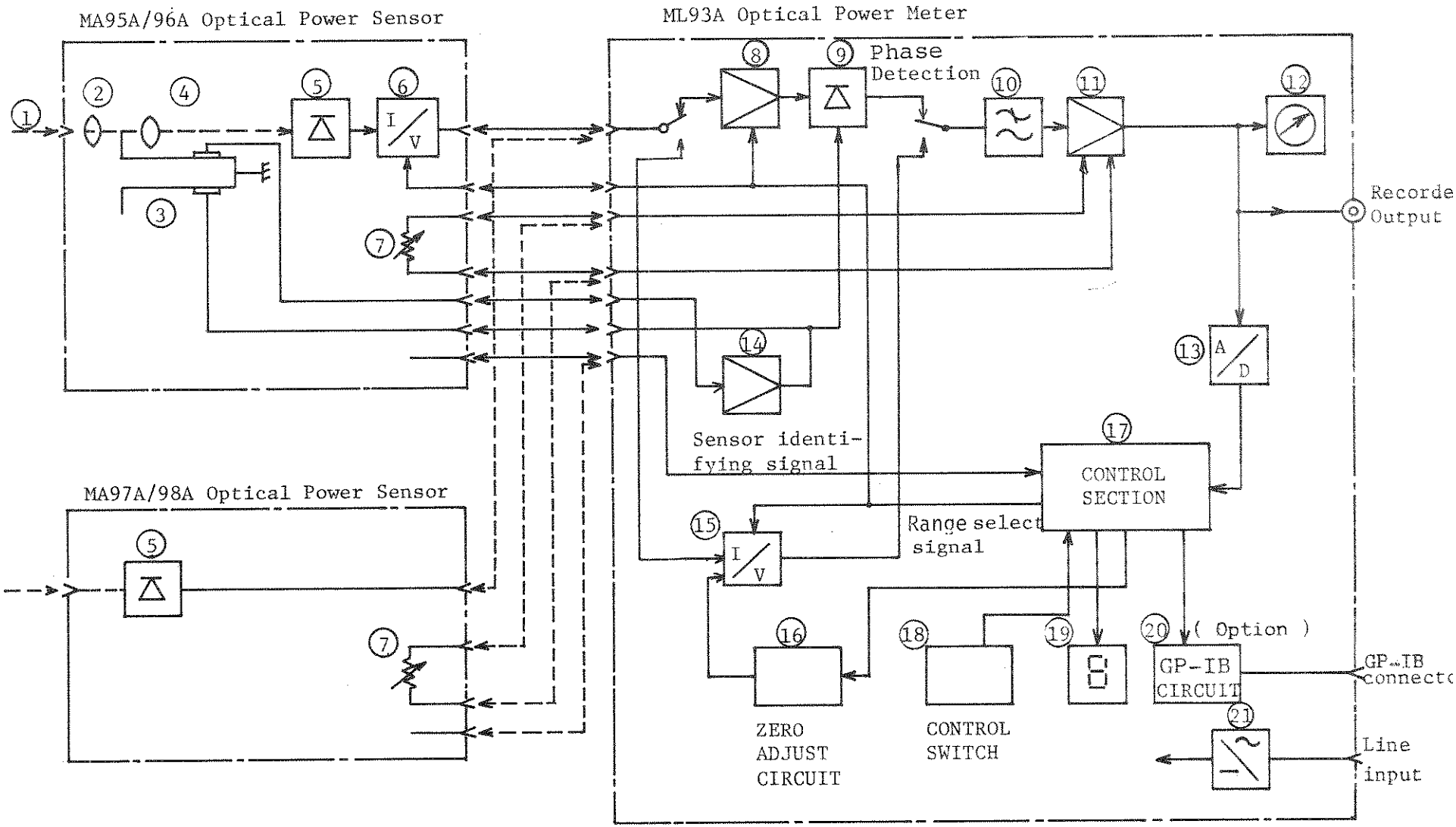


Fig. 3-1 Optical Power Meter Block Diagram

The overall gain in combination with the optical power meter and optical power sensor is made constant, irrespective of the sensor, by the sensitivity adjustment (7) which compensates for variance in photodiode sensitivity.

3.2.2 MA97A and 98A Optical Power Sensors

The MA97A uses a silicon photodiode and the MA98A uses a germanium photodiode as the photoelectric conversion element. These sensors only contain photodiode (5) and sensitivity adjustment (7) described in Section 3.2.1. The conversion circuit (6) is in the ML93A optical power meter.

3.3 ML93A OPTICAL POWER METER (Indicator)

Indicator displays optical power converted into photoelectric current by the optical power sensor in digital form. Each optical power sensor is given a unique identifier signal by which the control section automatically determines which sensor is currently connected. The control section selects the amplifier circuit (8), phase detection circuit (9) and the tuning fork oscillator circuit (14) when sensor MA95A or 96A is connected. The current-to-voltage conversion circuit (15) and the zero adjusting circuit (16) are selected when MA97A or 98A is connected.

The signal output from a MA95A or 96A sensor is switched to suitable range in the amplifier circuit (8).

It then passes through the phase detection circuit (9) and enters the low-pass filter (10). When the MA97A or 98A sensor is connected, the signal is switched to suitable range in the current-to-voltage conversion circuit (15) before entering the low-pass filter (10).

The variable resitor (7) in each sensor adjusts the gain in the amplifier circuit (11) to adjust sensitivity. The detected signal is digitized by the A/D converter (13), processed in the microprocessor control section (17) and then indicated on the numeric display (19). The detected signal is branched to the signal level meter (12) and to the recorder output (4).

The zero adjust circuit (16) is used to compensate for variations of offset voltage which occur when the MA97A or 98A sensor is connected.

When the GP-IB circuit (20) (option) is connected, the instrument can be controlled externally and measurement results can be output.

SECTION 4 OPERATION

4.1 Controls and Functions

4.1.1 MA95A/96A Optical Power Sensor

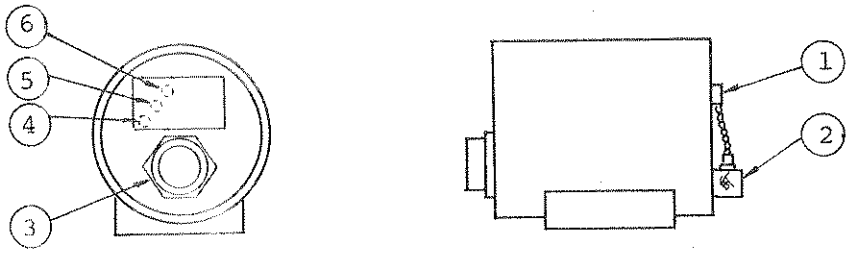


Fig. 4-1 MA95A/96A Optical Power Sensor

(1)	Light input connector :	Attaches the optical fiber connector for measurement.
(2)	Cover :	Cover for (1). Also used for zero adjustment.
(3)	Receptacle :	Connected to the optical power meter with the supplied cord.
(4)	Sensitivity adjustment :	Component No. R14 (located under the label).
(5)	Sensitivity adjustment :	Component No. R8 (located under the label).
(6)	Sensitivity adjustment :	Component No. R11 (located under the label).

4.1.2 MA97A/98A Optical Power Sensor

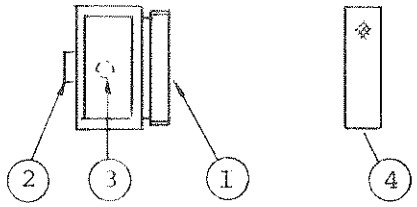


Fig. 4-2 MA97A/98A Optical Power Sensor

(1)	Light input area	:	Receives the light to be measured.
(2)	Receptacle	:	Connected to the optical power meter with the supplied cord.
(3)	Sensitivity adjustment	:	Adjusts the photodiode sensitivity.
(4)	Cover	:	Protects the light input area.

4.1.3 ML93A Optical Power Meter

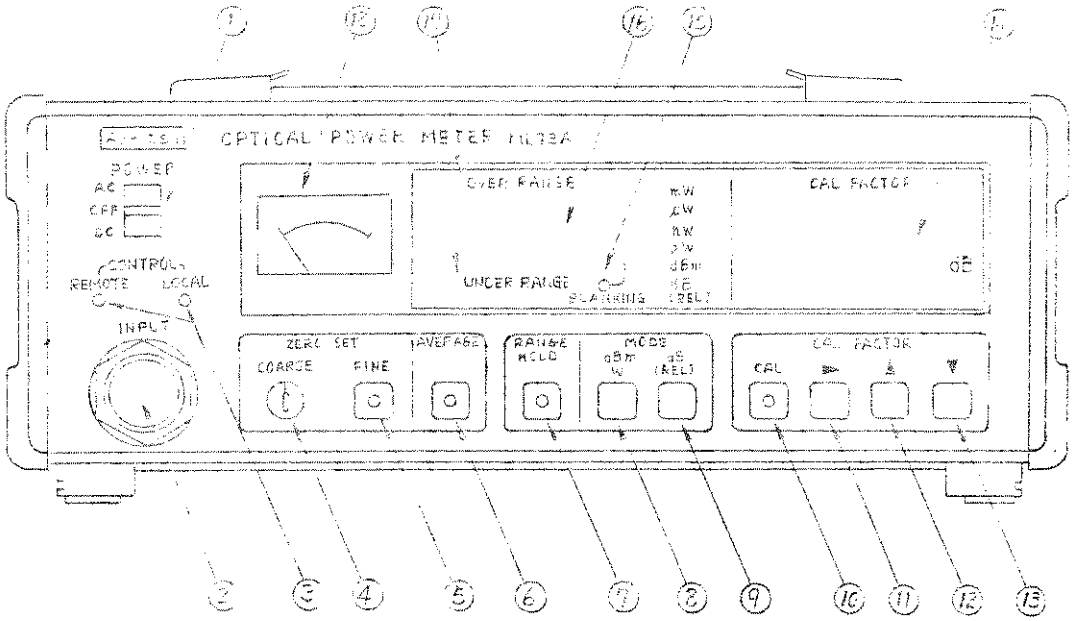


Fig. 4-3 Front Panel

Table 4-1 Front Panel Controls and Functions

No.	Indication	Function
(1)	Power	Power switch
	AC	AC power supply
	OFF	OFF
	DC	MZ95A battery pack or other external DC power supply
(2)	INPUT	INPUT receptacle. Socket for connection of optical power sensor cord.

No.	Indication	Function
(3)	CONTROL REMOTE LOCAL	CONTROL indicators. REMOTE is lit when the meter is operating in remote mode using an external controller through GP-IB. Otherwise, LOCAL is lit.
(4)	ZERO SET COARSE	Zero adjustment knob (4) and switch (5) (see below). Used only when the MA97A/98A optical power sensor is connected. Adjusts zero point when the optical power sensor is changed or if ambient temperature varies greatly. (Coarse adjustment.)
(5)	FINE	The zero point is adjusted automatically when this switch is pressed. • If the MA95A/96A optical power snesors is connected, the zero point is automatically adjusted when this switch is pressed. If the optical power sensor is to be used in the highest sensitivity range, press this swtich after setting the AVERAGING switch (6) to ON. • If the MA97A/98A optical power sensor is connected, the zero point is precisely adjusted when this switch is pressed after adjustment with the COARSE knob. The coarse adjustment must be within 10% of the value of the highest sensitivity range used.
(6)	AVERAGE	Averaging ON/OFF switch. When this switch is turned on, the display (16) is indicated an integrated value to reduce short-term noise. The The LED on the switch indicates whether the averaging function is on or off.
(7)	RANGE HOLD	Automatic Range/Range Hold Selection Switch. When this switch is pressed, the range is held and the LED on the switch comes on. When the switch is pressed again, the automatic range function is restored.

No.	Indication	Function
(8)	MODE dBm W	Watt/dBm selection switch. Measured values can be displayed in units of dBm or watts. The unit can be changed alternately by pressing selection switch. The selected unit of measurement is indicated by the LED on the display (16).
(9)	dB (REL)	When the dB(REL) switch is pressed the LED on the dB(REL) switch comes on, the current measurement value is stored in memory, and the difference between this value and a subsequent measurement value is indicated in dB. The dB (REL) function is released by pressing the dBm/W Switch (8).
(10)	CAL FACTOR CAL	Calibration value set switch The calibration factor can be changed with switches (11), (12), and (13) when the CAL switch (10) is ON. During the CAL switch is on, one of these LEDs on the CAL factor display (14) blinks to indicate a settable digit. After CAL factor setting on the display (14) is finished (refer to the No.(11), (12), (13)), then repress the CAL switch (10). At this time, the LED on the CAL switch goes off. Numeric display (16) indicates the value including this set CAL factor.
(11)	▶	The variable digit shifts to the right each time this button is pressed.
(12)	▲	The numeric value of the blinking digit increments each time this button is pressed.
(13)	▼	The numeric value on the blanking digit decrements each time this button is pressed. The sign is alternated from + to - each time either switch (12) or (13) is pressed.

No.	Indication	Function
(14)		CAL factor display: Indicates a 4-digit number and plus (+) or minus (-) sign for polarity of the measured value.
(15)	BLANKING	Suppression switch for the display of the least significant digit of the measured value display (16).
(16)		Numeric display: Indicates a 4-digit number and plus (+) or minus (-) sign for polarity of the measured value.
(17)	OVER RANGE UNDER RANGE	The applicable LED lights up to indicate whether the input to be measured is over- or under-range.
(18)		The meter indicates the approximate value of the measurement result.

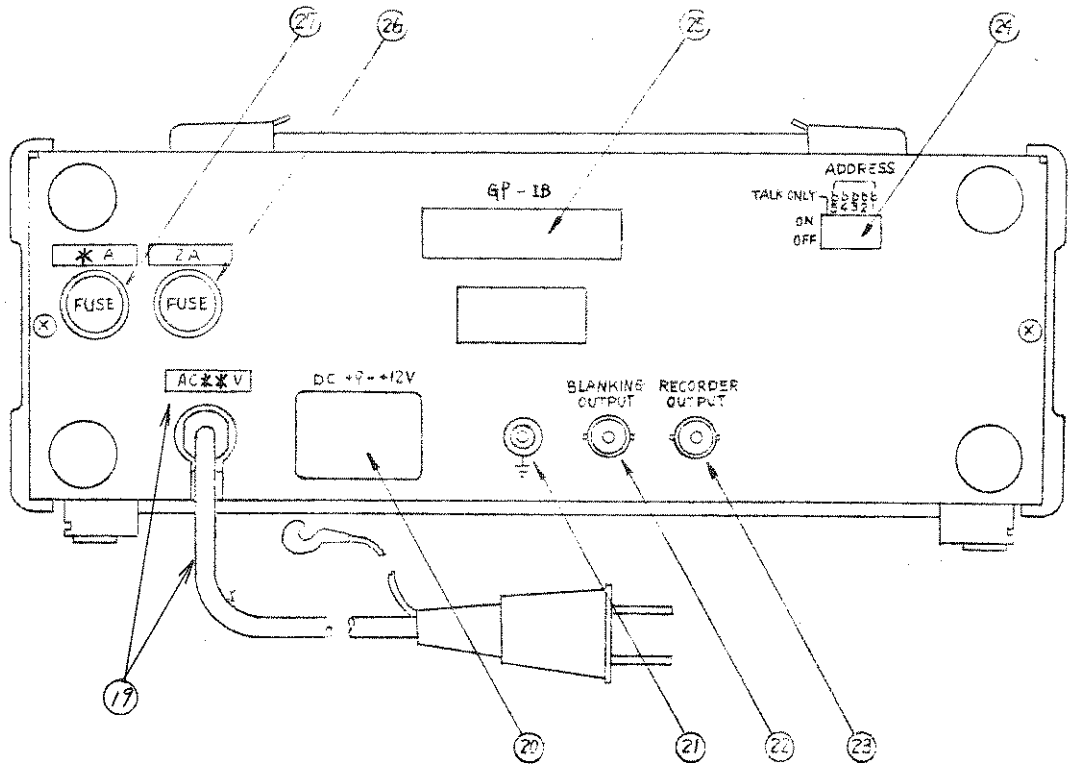


Fig. 4-4 Rear Panel

Table 4-2 Rear Panel Controls and Functions

No.	Indication	Function
(19)	AC ** V	ac power cord
(20)	DC +9 – +12 V	Input connector for MZ95A battery pack or external dc power supply. The instrument is connected to an external DC power supply with an optionally supplied cord. Supply voltage between +9 and +12 V is required. And then DC power is supplied when power switch (1) is set to the DC position.
(21)	⏚	Ground terminal. Should be well-grounded.

No.	Indication	Function
(22)	BALNKING OUTPUT	Grounded during zero adjustment with open collector output.
(23)	RECORDER OUTPUT	Recorder output connector. The voltage corresponding to the W (watt) scale is output: 1V corresponding to the full scale and 0.316V to -5dB.
(24)	ADDRESS (option)	Enables address setting when using the GP -IB interface.
(25)	GP -IB (option)	GP -IB connector
(26)	FUSE 2A	dc power supply fuse.
(27)	FUSE *A	ac power supply fuse.

4.2 Measurement

4.2.1 Notes on Measurement

1) Make sure the ground terminal (21) on the rear panel is well-connected to ground.

2) Excessive light input will damage the photodiode. Do not input light exceeding the specified value.

3) When using the instrument in a light place, be careful to avoid interference.

4) Sensitivity will change if the light source is exposed to a place other than the active area of the crystal element. Be careful to place other than the active area of the crystal element. Be careful to place the light source to be measured within the active area of the MA97A/98A optical power sensor when it is used without the connector adapter.

5) If a low impedance circuit or instrument is connected to the recorder output terminal, the recorded value will not be accurate. Use a recorder with an input impedance of at least 100 kΩ.

   The recorder output is not averaged. When measuring low-level light input, insert an appropriate smoothing circuit into the input of the recorder to procedure a record of averaged values.

6) Instrument functions are initialized (refer to 4.2.3 (1)) whenever the power is turned on again after ac power operation is interrupted.

7) If a high-amplitude spike enters through the power line, the instrument may fail to operate normally. Turn the power off and then on again to reinitialize the instrument in such a case.

4.2.2 Power Supply

1) AC Power Supply

Verify that the POWER switch (1) is set to OFF and that the line voltage is ** V ac ±10%. Connect the power cord to the ac line.

2) MZ95A Battery Pack

Verify the POWER switch (1) is set to OFF. Connect the MZ95A battery pack to the connector (20). Refer to the MZ95A Instruction Manual.

3) External DC Power Supply

Verify that POWER switch (1) is set to OFF. Connect the DC power supply to connector (20) with the optionally supplied cord.

4.2.3 Measurement

1) Connect the optical power sensor to the optical power meter and turn on the power.

When the power is turned on, the functions are initialized as follows:

i) Zero adjustment: OFF

ii) Average : OFF

iii) Range : Automatic range (the range with the maximum sensitivity as determined by the optical power sensor)

iv) Mode : dBm

v) CAL switch : OFF

vi) Calibration

Factor : 0.00 dB

2) Shut off any light input using the cover attached to the optical power sensor and press the automatic zero set switch.

After the MA95A/96A optical power sensor is connected, if an accurate zero adjustment is required, turn on the AVERAGE switch (6) and press the ZERO SET FINE button (5). The LED lights up and goes off when the zero adjustment is finished, in approximately 3 seconds.

When the MA97A/98A optical power sensor is connected, adjust the numeric display (16) with the ZERO SET COARSE knob (4) so that the displayed value is below 10% of the highest sensitivity range and press the ZERO SET FINE button (5). The LED goes off in approxiately 20 seconds after the completion of zero adjustment.

3) Set the CAL FACTOR, MODE, RANGE HOLD switches as required and input the light to be measured.

The measurement result is displayed on the numeric display (16) in 4 digits from 0.00 to 99.99 with a sign digit. The approximate value of the measurement is indicated by the meter (18).

Press the BLANKING switch (15) to suppress the least significant digit.

4) Refer to Section 5 below for information remote control using the GP-IB option.

5) The response of the optical power sensor varies at different wavelengths. The detection response of MA95A and MA97A is calibrated at the 0.85 μm wavelength and MA96A and MA98A are calibrated at 1.3 μm. Therefore, responsivity compensation is required when measuring optical power at wavelengths other than those given above. Sensor responsivity - wavelengths curves can be supplied on request (option).

Responsivity variations are compensated for in the manner described below. If the responsivity of MA95A at 1 μm is -1dB, set the CAL FACTOR to "-1.00" when measuring optical power at 1 μm, the measured value will be accurately compensated.

SECTION 5 GP-IB (OPTION)

5.1 General

The GP-IB interface option satisfies all standard specifications for GP interface bus. Programmable automatic measurements can be carried out with any controller conforming to specifications for an GP interface bus. When this option is connected to a data output device, such as a printer, which has a listener function, a record of measured power can be obtained.

5.2 Interface Functions

The GP-IB has the following functions:

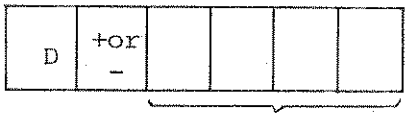
Function	Description
SH1	Complete source handshake functions
AH1	Complete acceptor handshake functions
L4	Basic listener function The listener function can be released by MTA.
T5	Basic talker function Serial pole function Talk-only mode The talk function can be released by MLA.
SR0	Not including the service request function
RL1	Including the remote operation/local operation selecting function
PP0	Not including the parallel pole function
DC0	Not including the device clear function
DT0	Not including the device trigger function
C0	Not including the control function

Note: The POWER switch and the COARSE ZERO knob on the front panel of the ML93A optical power meter are enabled during remote operation.

5.3 Programming Codes

All programming codes are ASCII codes.

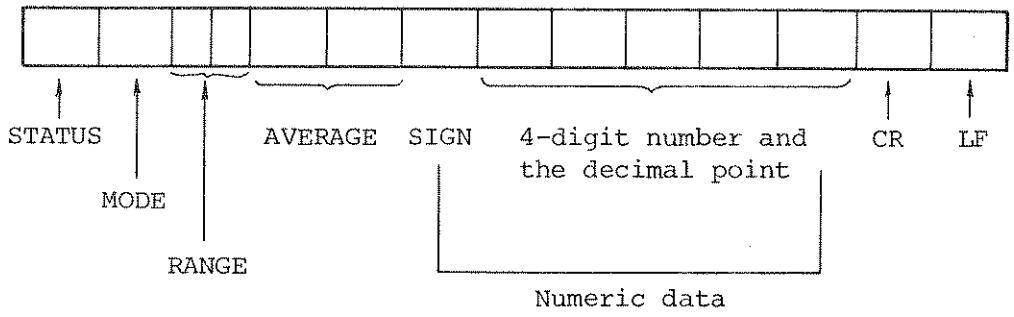
(a) Input Programming Codes

Function	Contents	Programming Code
RANGE specification	RANGE HOLD: +10 dBm (10 mW) range	A0
	RANGE HOLD: 0 dBm (1 mW) range	A1
	RANGE HOLD: -10 dBm (100 µW) range	A2
	RANGE HOLD: -20 dBm (10 µW) range	A3
	RANGE HOLD: -30 dBm (1 µW) range	A4
	RANGE HOLD: -40 dBm (100 nW) range	A5
	RANGE HOLD: -50 dBm (10 nW) range	A6
	RANGE HOLD: -60 dBm (100 pW) range	A7
	RANGE HOLD: -70 dBm (100 pW) range	A8
	RANGE HOLD: -80 dBm (10 pW) range	A9
	AUTO RANGE	B
Display mode	WATT display	C0
	dBm display	C1
	dB (REL) display	C2
CAL. FACTOR	CAL. FACTOR data format	 CAL. FACTOR 4 digits The decimal point is assumed to be in the third digit location. Example: 1234 = 12.34
AVERAGING	AVERAGING ON	E0
	AVERAGING OFF	E1
ZERO SET (FINE ZERO)	ZERO SET ON	Z

Function	Contents	Programming Code
Measurement rate	HOLD (No measurement)	F0
	FREE RUN (Continuous measurements at the same rate as operations of key switchs on the front panel.)	F1
	EXT TRIGGER (Switched to HOLD MODE after each measurement)	F2

(b) Output Data Format

This option outputs data in the format shown below:

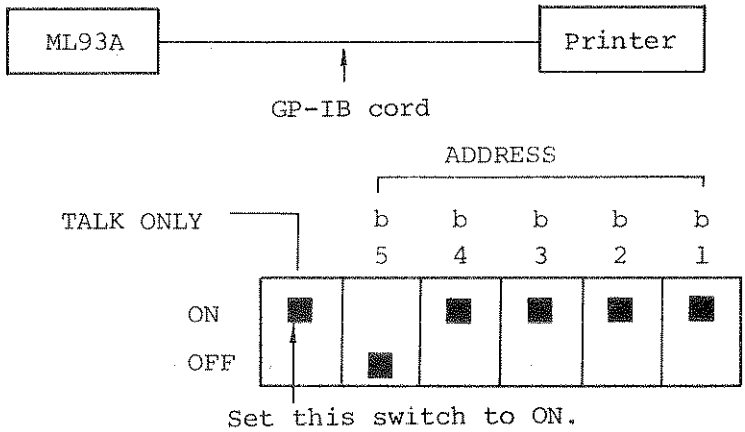


Function	Contents	Programming Code
STATUS	OVER RANGE	V
	UNDER RANGE	W
	IN RANGE	X
MODE	mW	P
	μW	Q
	nW	R
	pW	S
	dBm	T
	dB (REL)	U

Fuction	Contents	Programming Code
RANGE	RANGE HOLD: +10 dBm (10 mW) range	A0
	RANGE HOLD: 0 dBm (1 mW) range	A1
	RANGE HOLD: -10 dBm (100 µW) range	A2
	RANGE HOLD: -20 dBm (10 µW) range	A3
	RANGE HOLD: -30 dBm (1 µW) range	A4
	RANGE HOLD: -40 dBm (100 nW) range	A5
	RANGE HOLD: -50 dBm (10 nW) range	A6
	RANGE HOLD: -60 dBm (1 nW) range	A7
	RANGE HOLD: -70 dBm (100 pW) range	A8
	RANGE HOLD: -80 dBm (10 pW) range	A9
	AUTO RANGE	AB
AVERAGE	With AVERAGING	E0
	Without AVERAGING	E1
Sing for measured value	Positive	+
	Negative	-

5.4 Instructions for Operation

(a) When using the power meter with a data output device having a listener function, set the ADDRESS switch on the rear panel to TALK ONLY mode (refer to the diagram below).



(b) When Connected to a Controller for Programmable Automatic Measurement

Set the device address with the ADDRESS switches b1 to b5 on the rear panel. The address set shown in the example is 15. Set the TALK ONLY switch to OFF.

If the Anritsu DDC7705A personal computer or DPR7710A printer is being used, the following table is applicable.

Measurement Method	Program Example	Remark
FREE RUN (Continuous measurement)	0 FORMAT "C12" 1 READ #115: 0, A$ 2 PRINT A$ 3 GOTO 1 4 END	FREE RUN MODE when ML93A power is turned on.
EXT TRIGGER (Single measurement)	0 FORMAT "C12" 1 CMD #115, "?P/";"F2" 2 READ #115: 0, A$ 3 PRINT A$ 4 END	? → UNL P → TALK ADDRESS of controller. 1 → LSN. ADDRESS of ML93A
Others	REN #115	REMOTE operation. Switches on the front panel are disabled.
	LCL #115	LOCAL operation.

Notes:

1. ZERO SET operation requires the time indicated below.
   20 seconds for MA97A/98A
   3 seconds for MA95A/96A
2. Maximaly 5 seconds is required for the measured value to stabilize after RANGE is switched.

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