

## OPTICAL POWER METER ML9001A

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The ML9001A is a single-channel digital-display optical power meter. It insures accuracy and linearity over a wide wavelength range and greatly improves measurement reliability. It also has an improved basic performance. For example, measurement can be made over the wide level range from  $-100$  to  $+20$  dBm because internal reflection in the power sensors has been suppressed. The ML9001A also has many new functions which make it easier to use than other power meters. It can be used for all optical power measurements such as optical fiber loss measurement and optical device performance evaluation.

### Features

- **Enables high-accuracy measurement**

The ML9001A accurately and automatically calibrates all the power sensors within the specified wavelength range and ensures a  $\pm 5\%$  accuracy at  $-23$  dBm. It also has a  $\pm 0.15$  dB linearity ( $-23$  dBm reference value). The ML9001A extends the guaranteed accuracy range of the measured values and enables high-accuracy measurement.

- **One power sensor for repeater maintenance and long-distance fiber loss measurement**

The MA9612A Optical Power Sensor has ultra-high sensitivity. Its measurement level range is  $-100$  to  $\pm 3$  dBm in the  $1.3 \mu\text{m}$  band and it can sense either continuous light or modulated light. A single MA9612A can measure the near-end and far-end outputs of a repeater as well as measure long-distance fiber losses.

### Specifications

- **ML9001A Optical Power Meter**

#### Indicator

Display	4 digit, W, W(REL), dBm, dB(REL) selectable
Calibration coefficient	Adjustable
Recorder output	1 V/full-scale, linear output
Range select	Manual selection and automatic ranging
Measurement mode	Continuous and modulated light**1
Wavelength sensitivity correction	Automatic correction in 1 nm steps
Data memory	Max. 1000 data via GPIB
Dimensions and mass	213 (W) x 88 (H) x 250 (D) mm, $\leq 4$ kg

- **Multi-Core fiber cable losses easily measured**

For modulated light measurement, the ML9001A has 12 modulation frequencies including 270 Hz. This meter can easily be used to measure multi-core fiber cable losses by using it with the MG9002A Stabilized Light Source (mounts up to 12 light source units).

- **Interchangeable optical connectors**

The optical connectors of all the power sensors accept adaptors. This system allows the optical connectors to be interchanged so the ML9001A can be quickly used with various optical connectors. Since the internal coating of the optical power sensors suppresses reflected light, measurement errors are reduced in beam measurement (with or without an optical fiber).

- **Reduced measurement time**

The ML9001A has a much better response speed and stability than conventional optical power meters. With GPIB, it can measure at 30 ms/point so the measurement time can be reduced to less than 50% of conventional automatic measurement.

- **High-performance optical loss test set**

Stacking the ML9001A with the MG9001A Stabilized Light Source quickly configures a high-performance optical loss test set. It provides for selecting various light source units and enables the ML9001A to measure all optical losses.

## Sensor

Model	MA9411A/A1	MA9412A	MA9413A	MA9611A
Wavelength range	0.38 to 1.15 $\mu\text{m}$		0.45 to 1.05 $\mu\text{m}$	0.75 to 1.7 $\mu\text{m}$
Element	Si photodiode		Cooled-Si photodiode	InGaAs photodiode
Active area diameter	9.5 mm	–	5 mm	–
Input type	Direct to photodiode	Connector*2	Direct to photodiode	Connector*2
Dimensions and mass	40 (W) x 32 (H) x 62/73 (D) mm, $\leq$ 400 g	61 (W) x 42 (H) x 110 (D) mm, $\leq$ 800 g	42 (W) x 47 (H) x 160 (D) mm, $\leq$ 700 g	40 (W) x 32 (H) x 65 (D) mm, $\leq$ 400 g

Model	MA9612A	MA9711A/A1	MA9712A	MA9714B
Wavelength range	0.75 to 1.7 $\mu\text{m}$	0.75 to 1.8 $\mu\text{m}$		
Element	InGaAs photodiode	Ge photodiode	Cooled-Ge photodiode	
Active area diameter	–	5 mm		
Input type	Connector*2	Direct to photodiode		Connector*3
Dimensions and mass	61 (W) x 42 (H) x 110 (D) mm, $\leq$ 800 g	40 (W) x 32 (H) x 62/73 (D) mm, $\leq$ 400 g	42 (W) x 47 (H) x 110 (D) mm, $\leq$ 500 g	47 (W) x 61 (H) x 128 (D) mm, $\leq$ 800 g

## Overall

Model	MA9411A/A1	MA9412A	MA9413A	MA9611A	
Optical power measurement range	Continuous light	–70 to +10 dBm*4 (0.1 nW to 10 mW)	–90 to 0 dBm*4 (1 pW to 1 mW)	–80 to +10 dBm*4 (10 pW to 10 mW)	–70 to +3 dBm*5 (0.1 nW to 2 mW)
	Modulated light	–70 to +7 dBm*6 (0.1 nW to 5 mW)	–90 to –3 dBm*6 (1 pW to 0.5 mW)	–90 to +7 dBm*6 (1 pW to 5 mW)	–80 to 0 dBm*7 (10 pW to 1 mW)
Measurement accuracy	Absolute accuracy (–23 dBm)	$\pm$ 5%*8 (0.5 to 0.95 $\mu\text{m}$ )		$\pm$ 4.5%*8 (0.85 $\mu\text{m}$ ) $\pm$ 5% (0.5 to 0.95 $\mu\text{m}$ )	$\pm$ 5%*9 (1.0 to 1.6 $\mu\text{m}$ )
	Linearity continuous light: 23°C, –23 dBm as reference	$\pm$ 0.15 dB*10 ( $\pm$ 0.45 dB for –70 to –60 dBm)	$\pm$ 0.15 dB*10 ( $\pm$ 0.45 dB for –90 to –80 dBm)	$\pm$ 0.15 dB*10 ( $\pm$ 0.45 dB for –80 to –70 dBm)	$\pm$ 0.15 dB*10 ( $\pm$ 0.45 dB for –70 to –60 dBm)
Resolution	W, W (REL) display: 0.1 to 1%, dBm display: 0.01 dB, dB (REL) display: 0.001 dB				
Power	100/115/120/200/220 Vac $\pm$ 1% <sub>15</sub> %, 240 Vac $\pm$ 4% <sub>15</sub> %, 50/60/400 Hz, $\leq$ 40 VA				
Operating temperature	0° to 50°C				
EMC*11	EN55011: 1991, Group 1, Class A EN50082-1: 1992				
Safety	EN61010-1: 1993 (Installation Category II, Pollution Degree II)				

Model	MA9612A	MA9711A/A1	MA9712A	MA9714B	
Optical power measurement range	Continuous light	–100 to +3 dBm*5 (0.1 pW to 2 mW)	–40 to +10 dBm*5 (0.1 $\mu\text{W}$ to 10 mW)	–60 to +10 dBm*5 (1 nW to 10 mW)	–47 to +23 dBm*12 (20 nW to 200 mW)
	Modulated light	–90 to 0 dBm*7 (1 pW to 1 mW)	–60 to +7 dBm*7 (1 nW to 5 mW)	–70 to +7 dBm*7 (0.1 nW to 5 mW)	–57 to +20 dBm*13 (2 nW to 100 mW)
Measurement accuracy	Absolute accuracy (–23 dBm)	$\pm$ 5%*9 (1.0 to 1.6 $\mu\text{m}$ )	$\pm$ 5%*9 (0.95 to 1.5 $\mu\text{m}$ )	$\pm$ 4.5% (1.3 $\mu\text{m}$ ) $\pm$ 5% (0.95 to 1.6 $\mu\text{m}$ )	$\pm$ 4.5% (1.55 $\mu\text{m}$ )*14 $\pm$ 5% (0.95 to 1.6 $\mu\text{m}$ )*15
	Linearity continuous light: 23°C, –23 dBm as reference	$\pm$ 0.15 dB*10 ( $\pm$ 0.45 dB for –90 to –80 dBm)	$\pm$ 0.15 dB*10 ( $\pm$ 0.45 dB for –40 to –30 dBm)	$\pm$ 0.15 dB*10 ( $\pm$ 0.45 dB for –60 to –50 dBm)	$\pm$ 0.15 dB*16 (–37 to +20 dBm, $\pm$ 0.45 dBm for –47 to –37 dBm)
Resolution	W, W (REL) display: 0.1 to 1%, dBm display: 0.01 dB, dB (REL) display: 0.001 dB				
Power	100/115/120/200/220 Vac $\pm$ 1% <sub>15</sub> %, 240 Vac $\pm$ 4% <sub>15</sub> %, 50/60/400 Hz, $\leq$ 40 VA				
Operating temperature	0° to 50°C				
EMC*11	EN55011: 1991, Group 1, Class A EN50082-1: 1992				
Safety	EN61010-1: 1993 (Installation Category II, Pollution Degree II)				

\*1: Twelve modulation frequencies including 270 Hz and 1 kHz

\*2: FC-type connector standard

\*3: Only for PC type SM fiber (10/125  $\mu\text{m}$ , NA 0.1)

\*4: At 0.85  $\mu\text{m}$

\*5: At 1.3  $\mu\text{m}$

\*6: At 0.85  $\mu\text{m}$ , 270 Hz

\*7: At 1.3  $\mu\text{m}$ , 270 Hz

\*8: For wavelengths other than 0.85  $\mu\text{m}$ , specified at 23°  $\pm$ 5°C

\*9: For wavelengths other than 1.3  $\mu\text{m}$ , specified at 23°  $\pm$ 5°C

\*10: At 23°  $\pm$ 5°C

\*11: Electromagnetic compatibility

\*12: At 1.55  $\mu\text{m}$

\*13: At 1.55  $\mu\text{m}$ , 270 Hz

\*14: At 1.55  $\mu\text{m}$ , 0 dBm

\*15: At 0 dBm

\*16: Reference = 0 dBm

Note: When an optical fiber is used, performance is guaranteed for a fiber core diameter of up to 62.5  $\mu\text{m}$  and an NA of up to 0.29. When any other fiber is used, a measurement error may occur.

## • Optical connector options

Option No.	Optical connector
21	D4
22	RUNGE
23*1	Amphenol 906 type
34	DIAMOND (∅ 3.5)
35*1	HP-SMA, Amphenol 905 type
36	Amphenol 905 type
38	ST
39	DIN
40	SC
41*2	TOCP172
43	HMS-10/A
45	FC

\*1: If adaptor mounted on MA9412A/9612A, repeatability may be reduced.

\*2: For MA9411A

## Ordering information

Please specify model/order number, name and quantity when ordering.

Model/order No.	Name
ML9001A	<b>Main frame</b> Optical Power Meter
J0313	<b>Standard accessories (for ML9001A)</b> Sensor connecting cord A, 2 m (for MA9412A/9413A/9612A/9712A): 1 pc
J0314	Sensor connecting cord B, 2 m (for MA9411A/A1, MA9611A and MA9711A/A1): 1 pc
J0017	Power cord, 2.5 m: 1 pc
F0004	Fuse, 0.4 A (T400MA250V): 2 pcs
F0007	Fuse, 0.8 A (T400MA250V): 2 pcs
W0420AE	ML9001A operation manual: 1 copy
W0420BE	ML9001A service manual: 1 copy
MA9411A/A1*1	<b>Optical power sensors</b> Optical Power Sensor
MA9412A	Optical Power Sensor (with J0480A connector adaptor)
MA9413A	Optical Power Sensor
MA9611A	Optical Power Sensor (with MA9005A Connector Adaptor)
MA9612A	Optical Power Sensor (with J0480A connector adaptor)
MA9711A/A1*1	Optical Power Sensor
MA9712A	Optical Power Sensor
MA9714B*2	Optical Power Sensor
MA9001B*3	<b>Optional accessories</b> Connector Adaptor (FC type, for MA9411A/MA9711A)
J0480A*3	Connector adaptor (FC type, for MA9412A)
J0480B*3	Connector adaptor (FC type, for MA9612A)
MA9005A*3	Connector Adaptor (FC type, for MA9611A)
MP92B*3	Connector Adaptor (FC type, for MA9413A/MA9712A)
MA9013A*3	Fiber Adaptor (with FC type plug, for fibers with 125 µm clad dia., 0.25 to 1.0 mm jacket dia.)
MP916A	Fiber Adaptor (for MA9002A and MP94A, for plastic fiber with 1 mm dia.)
MP93A	Fiber Adaptor (≤150 µm clad dia., 0.8 to 1.0 mm jacket dia.)
MP94A	Adaptor (for MA9413A/MA9712A, used with MP93A)
MA9002A	Adaptor (for MA9411A/MA9711A, used with MP93A)
MA9805A	Optical Attenuator (for MA9411A, 10 dB)
MA9306A	Optical Attenuator (for MA9711A, 10 dB)
MZ8010A	Optical Sensor Holder (securely mounts MA9411A/A1 or MA9711A/A1 for measuring light traveling through free space)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0186	Front cover
J0592	Optical sensor connecting cord F (for MA97B)
J0617B*4	Replaceable optical connector (FC)
J0618D*4	Replaceable optical connector (ST)
J0618E*4	Replaceable optical connector (DIN)
J0618F*4	Replaceable optical connector (HMS-10/A)
J0619B*4	Replaceable optical connector (SC)

\*1: MA9411A1 and MA9711A1 are lateral input sensors.

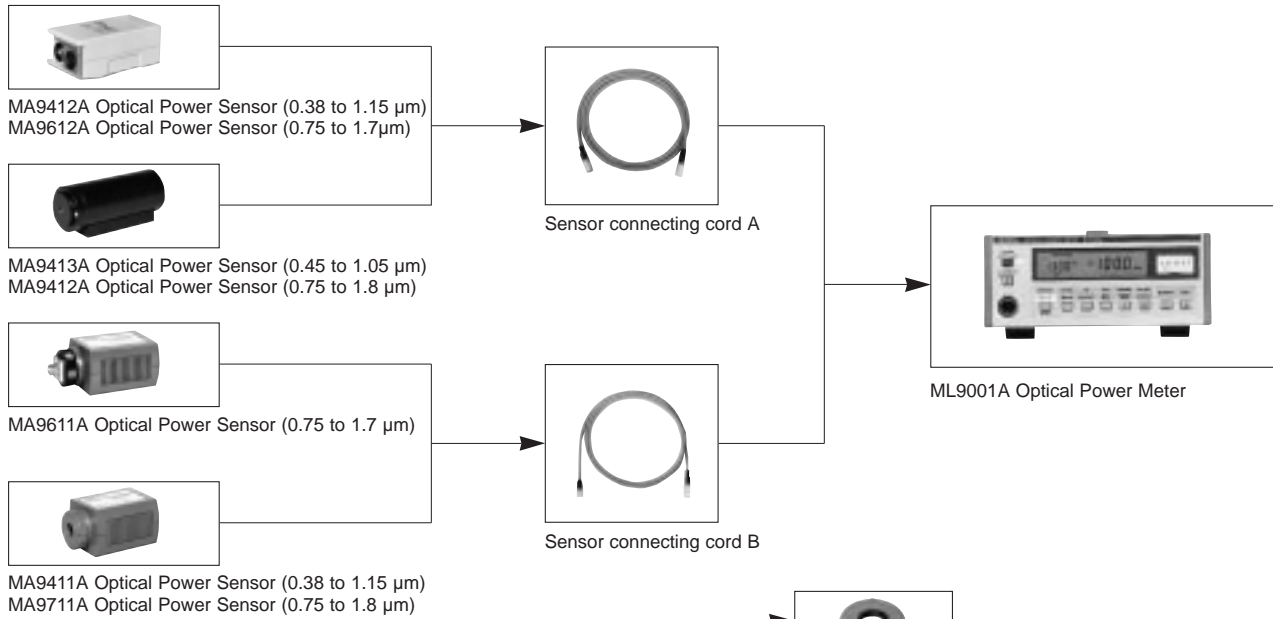
\*2: Specify one of FC, ST, DIN, SC or DIAMOND (HMS-10A).

When the connector type is not specified, FC is supplied.

\*3: The optical connector of the standard product is FC. Please specify the option numbers along with model names shown in the tables, if you need a different optical connector.

\*4: For MA9714B

## ML9001A with sensor



## Adaptors (option)

