

# Digital Laser Power Meter

## User's Guide



**Model Numbers:**  
**45-545A**

**INDUSTRIAL FIBER OPTICS**

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# ***INTRODUCTION***

*This manual provides information about the Digital Laser Power Meter (45-545A) that formerly was manufactured by Metrologic, Inc. It contains all the information needed to assemble and set up the Digital Laser Power Meter, even if you are a novice to optical technology. Please read the manual carefully before operating the Digital Laser Power Meter.*

*As soon as you receive this Digital Laser Power Meter inspect it and the shipping container for damage. If any damage is found, immediately refer to the section of this manual entitled Shipment Damage Claims.*

*Industrial Fiber Optics makes every effort to incorporate state-of-the-art technology, highest quality and dependability in its products. We constantly explore new ideas and products to best serve the rapidly expanding needs of industry and education. We encourage comments that you may have about our products, and we welcome the opportunity to discuss new ideas that may better serve your needs. For more information about our company and products refer to <http://www.i-fiberoptics.com> on the Worldwide Web.*

*Thank you for selecting this Industrial Fiber Optics product. We hope it meets your expectations and provides many hours of productive activity.*

*Sincerely,*

**The Industrial Fiber Optics Team**



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# GENERAL

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The Digital Laser Power Meter, Model 45-545A, provides accuracy required for research applications and for CDRH compliance measurements. It employs an LCD with large 12 mm (.47") - high numerals. This unit operates in three modes: standard, peak/hold and percentage ratiometer. In standard and peak/hold mode, the meter's four ranges have full scale readings for 19.99  $\mu$ W, 199.9  $\mu$ W, 1.999 mW and 19.99 mW.

Calibration is within 5 percent of full scale for 633 nm of He-Ne (helium neon) or 635 nm of red laser light. For monochromatic light or other wavelengths within the range of 500 to 950 nm, a built-in radiometric filter corrects to within 20 percent of standard. The chart shown in Figure 1 gives the nominal response at each wavelength.

An analog signal, available from a BNC output terminal, may be used to drive strip chart recorders, oscilloscopes, and other devices. Signals up to 100 kHz can be detected and amplified. The analog output ranges from 0 to +2 Volts.

The meter's detector cell may be exposed to bright light without damage because circuitry within the amplifier protects the instrument from an overload up to 20 mW.

The detector, a silicon photo sensor with 1 cm<sup>2</sup> active area, has a 7 mm diameter aperture and 30 degree acceptance angle. The detector is mounted in a 25.4 mm diameter cell on a 0.5 m retractable, shielded cable.

The meter may be powered by either 115 VAC or two 9V batteries. The meter will automatically disconnect the batteries when 115 VAC is in use. A small step-down (230 VAC to 115 VAC) transformer is required if the meter will be powered by 230 VAC.

# SAFETY & OPERATING PRECAUTIONS

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Before opening the unit, unplug the AC line cord from the receptacle. NEVER open the unit until you are certain the AC line cord is unplugged.

The following operating precautions should also be observed:

- Never measure the output of any light source until it is determined to be 20 mW or less. Extremely high intensity sources can damage the silicon photo detector.
- Always begin readings at the highest range.

Turn the meter off and unplug the line cord from the AC receptacle when not in use.

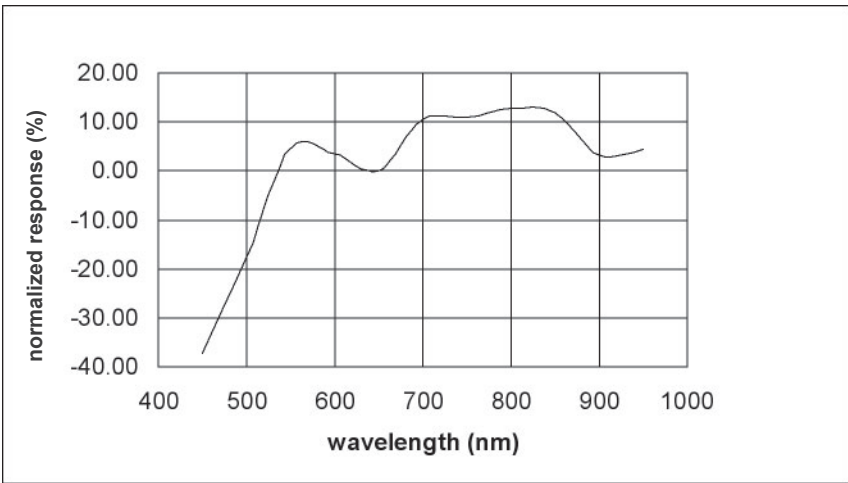


Figure 1.



# LASER CLASSIFICATIONS

All manufacturers of lasers used in the United States must conform to regulations administered by the Center for Devices and Radiological Health (CDRH), a branch of the U.S. Department of Health and Human Services. CDRH categorizes lasers as follows:

Class	Description
I	A laser or laser system, which does not present a hazard to skin or eyes for any wavelength or exposure time. Exposure varies with wavelength. For ultraviolet, 2 to 4 $\mu\text{m}$ exposures is less than from 8 nW to 8 $\mu\text{W}$ . Visible light exposure varies from 4 $\mu\text{W}$ to 200 $\mu\text{W}$ , and for near-IR, the exposure is < 200 $\mu\text{W}$ . Consult CDRH regulations for specific information.
II	Any visible laser with an output less than 1 mW of power. Warning label requirements – yellow caution label stating maximum output of 1 mW. Generally used as classroom lab lasers, supermarket scanners and laser pointers
IIIa	Any visible laser with an output over 1 mW of power with a maximum output of 5 mW of power. Warning label requirements – red danger label stating maximum output of 5 mW. Also used as classroom lab lasers, in holography, laser pointers, leveling instruments, measuring devices and alignment equipment.
IIIb	Any laser with an output over 5 mW of power with a maximum output of 500 mW of power and all invisible lasers with an output up to 400 mW. Warning label requirements – red danger label stating maximum output. These lasers also require a key switch for operation and a 3.5-second delay when the laser is turned on. Used in many of the same applications as the Class IIIa when more power is required.
IV	Any laser with an output over 500 mW of power. Warning label requirements – red danger label stating maximum output. These lasers are primarily used in industrial applications such as tooling, machining, cutting and welding. Most medical laser applications also require these high-powered lasers.

# THE DIGITAL LASER POWER METER

Becoming familiar with the features of the digital laser power meter will help when operating the unit. The following illustration and list explain the pertinent parts.



Figure 2. Front view of digital power meter.

<b>LCD Display</b>	Displays the measurement.
<b>Zero Offset</b>	Sets zero before every application.
<b>Range Selector</b>	Specifies the milliwatt (mW), microwatt ( $\mu$ W) scale or sets the power meter to percentage ratiometric mode.
<b>Cal.</b>	Calibrates the meter against the standard.
<b>Set 100%</b>	Sets the display to 100.00 reading of a transmitted beam before starting ratiometric measurements.
<b>Mode Switch</b>	Specifies if standard (CONT: Continuous) or peak/hold mode is in use.
<b>BNC Output Jack</b>	Provides a 0 to +2 volt analog signal.
<b>Detector Cell</b>	Detects measurable light.
<b>ON/OFF Switch</b>	Turns the unit on or off.
<b>Line Cord</b>	Plugs into a 115 VAC outlet.

# BATTERY INSTALLATION

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The meter may be powered by either 115 VAC or two 9V batteries. The meter will automatically disconnect the batteries when 115 VAC is in use. A small step-down (230 VAC to 115 VAC) transformer is required if the meter will be powered by 230 VAC.

To install the batteries:

1. Make sure the AC line cord is unplugged.
2. From the corners of the front panel remove the four screws, then lift the panel from the base.
3. Place two 9V batteries in the battery holders located on the back of the PC board.
4. Replace the front panel and screws. Once the panel is secured to the case, the AC line cord may be plugged into an AC outlet again.

The meter will operate for approximately 10 hours on a pair of zinc carbon batteries; on alkaline batteries it will operate 25 hours.

Voltage is continuously monitored by the meter's circuitry. In the upper left hand corner of the LCD display, the message "Lo Batt" or a left pointed arrow will appear when the batteries are below 7V, or when the meter is operating from an AC outlet supplying less than 85 VAC.

# MEASURING: STANDARD MODE

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In standard mode (CONT: Continuous), the meter will display the power of the measured laser light as long as the detector cell aperture is illuminated by the laser beam. In peak/hold mode, the meter will display the maximum power of the measured laser light until RESET is chosen.

Before performing the following procedures, make sure the meter is on, the mode switch is in the CONT (Continuous) position, and the range selector is in the 20 mW position. Also, before starting measurements, position the photocell and its cord.

During each session, avoid touching or moving the detector cell and its cord while taking measurements because any movement of the detector cell or cord may cause an inaccurate measurement. This becomes especially important as the range of the meter becomes lower (more sensitive).

1. Position the detector cell (or optically block the detector cell) so a minimal amount of ambient light is getting into the cell, then rotate the zero offset knob to obtain a zero reading. (Reduce the amount of ambient light getting into the cell to no more than .5% of the chosen range to obtain a zero reading.)
2. Illuminate the detector cell aperture with the laser beam. If the reading is less than 199 (ignore the decimal point), rotate the range selector counter-clockwise to a successively lower scale while obtaining a zero reading each time by repeating Step 1.
3. To measure the power of laser light, illuminate the detector cell aperture once again with the laser beam.

**Note:** If the input exceeds the capability of any range, the meter will indicate “1” and the numerals in decimal places will not appear.

# MEASURING: PEAK/HOLD MODE

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1. Repeat Step 1 of Standard Mode.
2. Flip the mode switch toward the middle position.
3. Flip and release the mode switch toward the RESET position one to three times with  $\frac{1}{2}$  - 1 sec intervals until a zero reading on the display is obtained ( $0 \pm 5$  of last digit).
4. To measure the power of laser light, illuminate the detector cell aperture with the laser beam for no less than 10 ms. If the reading is less than 199 (ignore the decimal point), flip the mode switch toward the CONT (Continuous) position. Rotate the range selector counter-clockwise to the next lower range and repeat Steps 1, 2, 3 and 4 until the reading is more than 199.
5. The display will show the peak power sampled for approximately 1.25 seconds after the reset switch is released or the laser illuminates the detector. The BNC output will hold the peak power detected at any time after the reset switch is released.

# MEASURING: RATIOMETRIC MODE

The meter will perform a percentage calculation of the transmitted beam once it has been reflected from a mirror or passed through an attenuator when the Set 100% feature has been implemented.

Before performing the following procedure, make sure the meter is on, the mode switch is in the CONT (Continuous) position, and the range selector is in the SET 100% position.

1. Turn the SET 100% knob clockwise as far as it will go.
2. Position the detector cell (or optically block the detector cell) so a minimal amount of ambient light is getting into the cell, then rotate the zero offset knob to obtain a zero reading. (To obtain a zero reading, reduce to no more than .5% of the chosen range the amount of ambient light getting into the cell.)
3. Illuminate the detector cell aperture with the beam power previously measured from .5 mW to 1.5 mW. Rotate the SET 100% knob again to obtain a 100.0 reading. Refer to Example A in Figure 3.
4. Aim the beam onto the measured object (mirror or attenuator) and measure the transmitted power of this beam. The LCD display will show the coefficient of the transmission in percentage. Refer to Examples B and C in Figure 3.

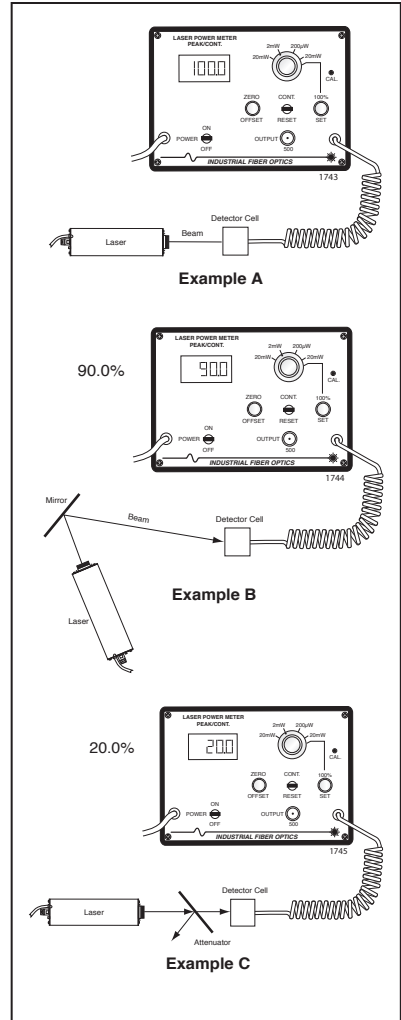


Figure 3.

# OUTPUT

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A BNC output jack on the front panel provides a 0 to +2 volt analog signal. The voltage of the output in millivolts is the same as the reading on the display except that decimal places are ignored. If the display reads 0.500 mW, the output will be 500 mV.

**NOTE:** If the input power exceeds the capability of the range, the voltage output will exceed +2 V.

The output has a 560 ohm impedance. The meter's frequency response is DC to 100 kHz. This is adequate to permit the meter to be used as a demodulator for an audio frequency modulated laser beam.

# RECALIBRATION

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When exacting precision and accuracy are required, annual recalibration is recommended. Where a deviation of a few percent is acceptable, the meter typically deviates very little over a several-year period.

Industrial Fiber Optics offers factory recalibration at a nominal cost. Contact Industrial Fiber Optics for current price and shipping instructions.

If field recalibration is desired, a suitable standard is available, and the meter is functioning normally, the display and output can be recalibrated as follows:

1. Position the detector cell (or optically block the detector cell) so a minimal amount of ambient light is getting into the cell, then rotate the zero offset knob to obtain a zero reading. (To obtain a zero reading, reduce to no more than .5% of the chosen range the amount of ambient light getting into the cell.)
2. Illuminate the detector cell aperture with a source of known brightness. With a small, flat blade screwdriver, adjust the CAL. potentiometer until the display equals the standard.

# SPECIFICATIONS

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Size	20 x 14 x 8 cm
Weight	1 kg
Operating temperature	10 to 30 °C
Storage temperature	-10 to 50 °C
Power requirement (85-125 VAC)	2 W
Battery life (two IEC 6F22 or 6LR61)	10-25 hrs
Maximum optical input power	20 mW
Display resolution	3 ½ digits
Minimum power resolution	0.01 uW
Calibration accuracy 635 nm	5%
Calibration accuracy 500 – 950 nm	20%
Minimum power for 100% ratiometric reading	0.5 mW
Peak/Hold sample time	1.25 seconds
Peak/Hold power threshold	6% of full scale

# TROUBLESHOOTING

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## LCD Remains Blank When Turned On

- On/Off switch is not fully “ON”.
- No batteries installed or no AC power.
- Batteries may be weak. Replace batteries. See section entitled Battery Installation.

## LCD Display Does Not Read “Zero”

- Too much ambient light.
- Zero adjustment needs to be made. See section entitled Measuring: Standard Mode for corrective procedure.
- Batteries may be weak. Replace batteries. See section entitled Battery Installation.



## **No Change in Display Reading**

- Light source or laser beam not striking the detector's sensitive area inside Detector Assembly. Reposition Detector Assembly or light source.
- Selector switch is set at too high a level. Turn Selector switch counter-clockwise one step.
- Selector switch is set at too low a level. Display stays on "1". Turn Selector switch clockwise one step.
- In Peak/Hold mode. Set Mode switch to CONT position.
- Batteries may be weak. Replace batteries. See section entitled Battery Installation.

## **No Output from BNC Jack**

- On/Off switch is not fully "ON".
- Light source or laser beam not striking the detector's sensitive area inside Detector Assembly. Reposition Detector Assembly or light source.
- Selector switch is set at too high a level. Turn Selector switch counter-clockwise one step.
- Batteries may be weak. Replace batteries. See section entitled Battery Installation.
- The device (load) attached to the jack output has too low an impedance. (This output was not designed to drive an audio speaker.)

Do not attempt to troubleshoot the Laser Power Meter beyond the steps listed above. If you believe that a problem exists within the Laser Power Meter, please either contact the factory or return it for appropriate servicing to Industrial Fiber Optics, as described in the section entitled Warranty.

# WARRANTY

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Industrial Fiber Optics products are warranted against defects in materials and workmanship for 90 days. The warranty will be voided if internal or external components have been damaged, mishandled, or altered by the buyer.

Warranty liability is limited to repair or replacement of any defective unit at the company's facilities, and does not include attendant or consequential damages. Repair or replacement can be made only after failure analysis at the factory. Authorized warranty repairs are made at no charge, and are guaranteed for the balance of the original warranty.

Industrial Fiber Optics will pay the return freight and insurance charges for warranty repair within the continental United States, by United Parcel Service or Parcel Post. Any other delivery means must be paid for by the customer.

The costs of return shipments for a Laser Power Meter no longer under warranty must be paid by the customer. If an item is not under warranty, repairs will not be undertaken until the cost of such repairs has been prepaid by the customer. Typical repair costs range from \$15 - \$75, and completion times from two to three weeks.

When returning items for analysis and possible repair, please do the following:

- In a letter, describe the problem, person whom we should contact, phone number and return address.
- Pack the unit and your letter carefully in a strong box with adequate packing material, to prevent damage in shipment.
- Ship the package to:

## **INDUSTRIAL FIBER OPTICS**

1725 WEST 1ST STREET  
TEMPE, AZ 85281-7622  
USA

# SHIPMENT DAMAGE CLAIMS

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If damage to an Industrial Fiber Optics product should occur during shipping, it is imperative that it be reported immediately, both to the carrier and the distributor or salesperson from whom the item was purchased. **DO NOT CONTACT INDUSTRIAL FIBER OPTICS.**

Time is of the essence because damage claims submitted more than five days after delivery may not be honored. If shipping damage has occurred during shipment, please do the following:

- Make a note of the carrier company, the name of the carrier employee, the date and the time of the delivery.
- Keep all packing material.
- In writing, describe the nature of damage to the product.
- In cases of severe damage, do not attempt to use the product (including attaching it to a power source).
- Notify the carrier immediately of any damaged product.
- Notify the distributor from whom the purchase was made.

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## *Rules for Laser Safety*

- Lasers produce a very intense beam of light. Treat them with respect. Most educational lasers have an output of less than 3 milliwatts, and will not harm the skin.
- Never look into the laser aperture while the laser is turned on! PERMANENT EYE DAMAGE COULD RESULT.
- Never stare into the oncoming beam. Never use magnifiers (such as binoculars or telescopes) to look at the beam as it travels – or when it strikes a surface.
- Never point a laser at anyone's eyes or face, no matter how far away they are.
- When using a laser in the classroom or laboratory, always use a beam stop, or project the beam to areas, which people won't enter or pass through.
- Never leave a laser unattended while it is turned on – and always unplug it when it's not actually being used.
- Remove all shiny objects from the area in which you will be working. This includes rings, watches, metal bands, tools, and glass. Reflections from the beam can be nearly as intense as the beam itself.
- Never disassemble or try to adjust the laser's internal components. Electric shock could result.