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EigenLight Series 300 Power Monitors and Series 400 Power Monitor-Attenuators

Operating Instructions

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Contents

Introduction 4
Main Features of Series 300/400 Monitors 6
Checking the Display 8
Measuring Power 10
Fast/Slow Mode Operation 14
Measuring Return Loss/Back Reflection 16
Using the Optional Analog Output 18
Replacing the Batteries 20
Using the Optional Magnetic Mount 22
Adjusting Attenuation (Series 400) 24
Applications 26
Product Specifications 28
Standards and Regulatory Compliance Statements 30

List of Tables

Table 1: Display Modes 9
Table 2: Series 300 and 400 Specifications 28

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List of Figures

Figure 1: Series 300 and Series 400 Monitors 5
Figure 2: Main features 7
Figure 3: Display check 8
Figure 4: Installation example 10
Figure 5: Wavelength selection 11
Figure 6: Absolute optical power measurement 12
Figure 7: Relative optical power measurement 13
Figure 8: Switching between fast and slow mode 15
Figure 9: Return loss/back reflection diagrams 17
Figure 10: Mini-coax jumper cable connections 19
Figure 11: Replacing the batteries 21
Figure 12: Mounting a monitor 23
Figure 13: Adjusting attenuation 25
Figure 14: Applications 26

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Introduction

Series 300 Power Monitors and Series 400 Power Monitor-Attenuators (PMAs) are in-line devices for measuring optical power flowing through a fiber optic cable. Unlike conventional power *meters*, Series 300 power *monitors* and Series 400 power *monitor-attenuators* allow the user to measure optical power or return loss in live fiber optic systems and test sets.

In addition, Series 400 power monitor-attenuators allow manual adjustment of the power level while at the same time providing a readout of optical power being delivered. By combining state-of-the-art electronic design with precision fiber optic engineering these devices provide functionality and ease-of-use previously unavailable in a portable fiber optic instrument.

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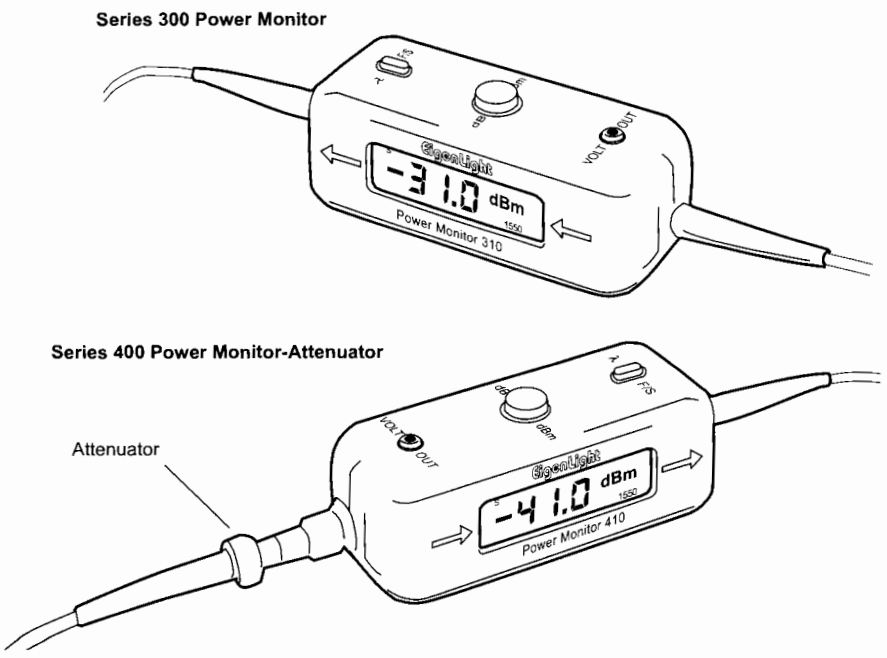


Figure 1: Series 300 and Series 400 Monitors

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Main Features of Series 300/400 Monitors

- **Auto-power on/off:** Series 300/400 monitors do not have an on/off switch. The monitors automatically turn on when the optical power level comes within measurement range of the device and turn off when optical power is out of range.
- **Directivity:** Series 300/400 monitors transmit light in both directions but only detect light propagating in the forward direction as indicated by the arrow legends.
- **Calibration:** Monitor readout always indicates optical power delivered to the output.
- **Dual displays:** Dual displays on front and back allow easy viewing of the readout in any configuration. The two displays always show the same reading.
- **Analog Output (optional):** Voltage provided at micro-phone jack can be used for data logging or auxiliary display using voltmeter.
- **Ultra-long battery life:** Battery drain in Series 300/400 monitors is comparable to the leakage current of the batteries. This results in typical battery life of 3 years even under continuous use.

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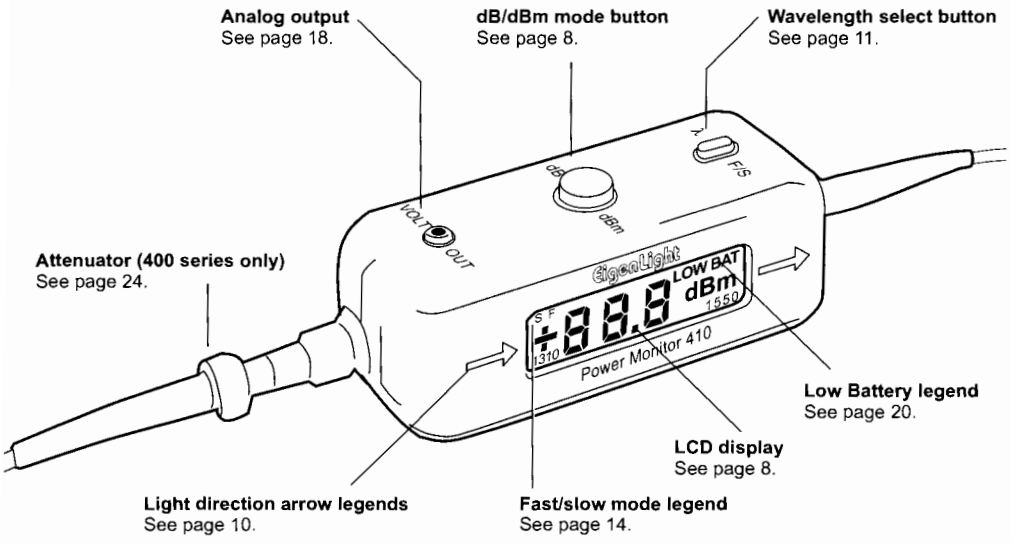


Figure 2: Main features

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Models:
Series 300 √
Series 400 √

Checking the Display

The monitor does not have an on/off switch. Instead, the display is automatically activated when light levels fall within the measurement range. You can check the display manually at any time by using the dB/dBm mode button.

To check the display:

1. Hold down dB/dBm button for longer than 0.5 seconds to activate display legends.
2. Release button to return to normal display operation.

During display check, all legends are illuminated including the LOW BAT legend.

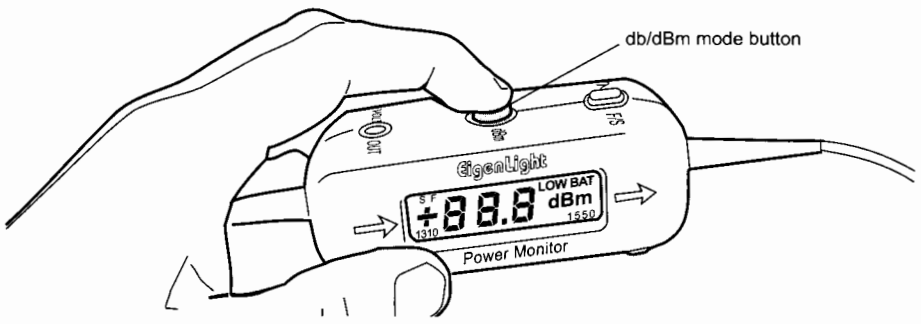


Figure 3: Display check

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When there is no optical power flowing through the monitor, it goes into a sleep mode in which the display is turned off. Optical power flowing through the monitor automatically determines the display of information based on the power level, as described in the following table.

Table 1: Display Modes

Model	Optical Power	Display Mode
Models 310, 322, 323, 410	< -54 dBm	Display OFF
	-54 to -50 dBm	Legends ON, numerical display OFF
	> -50 dBm	Legends ON, numerical display ON
Models 320, 420	< -44 dBm	Display OFF
	-44 to -40 dBm	Legends ON, numerical display OFF
	> -40 dBm	Legends ON, numerical display ON

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Models:
Series 300 √
Series 400 √

Measuring Power

To measure power:

1. Install Power Monitor in system or test-set with legend arrows pointing in direction of light propagation.

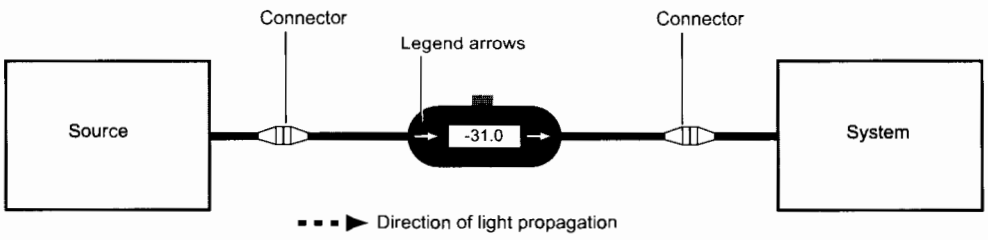


Figure 4: Installation example

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2. Turn on the optical source.
3. Set calibration wavelength by pressing and releasing the wavelength select button until the appropriate wavelength legend appears on the display.

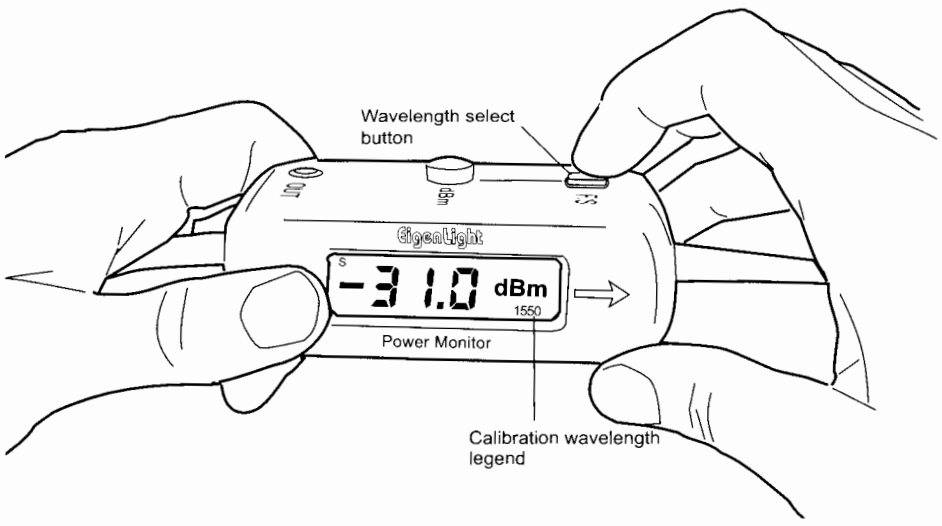


Figure 5: Wavelength selection

Note: Optical power reading corresponds to optical power at the monitor output.

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4. Measure either absolute optical power or relative optical power as follows:
   - To measure **absolute optical power** in dBm units, press and release the dB/dBm button until the dBm legend appears next to the number on the display. The displayed optical power corresponds to the optical power being delivered to the monitor output.

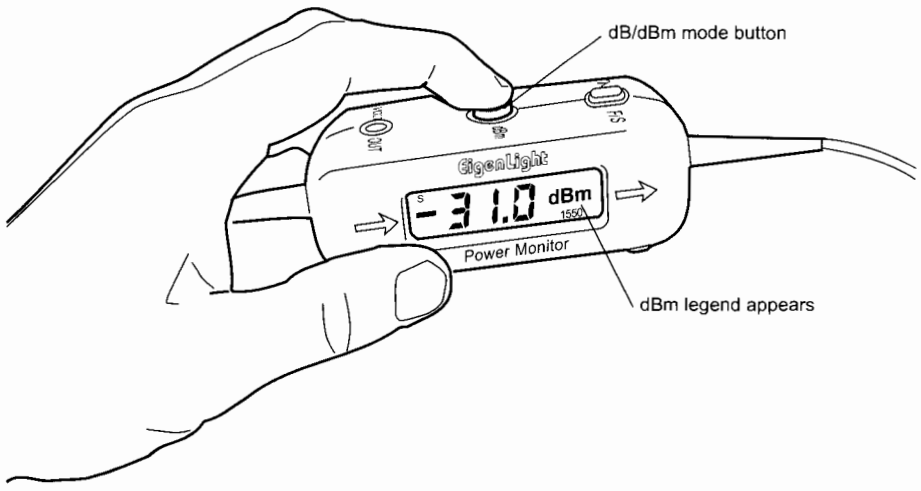


Figure 6: Absolute optical power measurement

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- To measure **relative optical power**, zero the display by pressing and releasing the dB/dBm button until the dB legend appears and the display reads 0.0 dB. From this point on, displayed power corresponds to the difference, in dB units, between the current absolute power and the reference optical power stored when the display was set to zero.

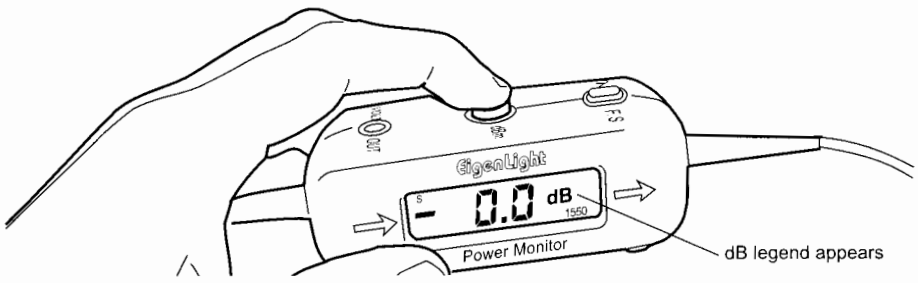


Figure 7: Relative optical power measurement

To return to the dBm measurement mode, press and release the dB/dBm mode button.

Note: the stored reference power is lost when the unit is returned to dBm mode.

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Models:
Series 300 √
Series 400 √

Fast/Slow Mode Operation

Series 300/400 monitors achieve ultra-long battery life by switching the detection circuit on for a short time during each measurement cycle. As a result, the response time of the monitors is determined by the time between measurements (i.e. the sampling rate).

You can switch the sampling rate between two modes using the wavelength select button:

- **Fast mode**: The display and analog voltage are updated approximately every 0.1 second.
- **Slow mode**: The display and analog voltage are updated approximately every 0.8 second.

To switch between fast or slow mode, hold down the wavelength select button for longer than one second. The sampling rate changes between fast or slow as indicated by the F or S legend on the LCD display.

When holding the wavelength select button down, the wavelength setting will change temporarily, returning to the original setting after the button is released.

Current drain, and thus battery life, depends on the sampling rate. In the slow mode, battery life is typically 3 years. In the fast mode it is reduced to 6-8 months. It is therefore recommended that the device be operated in slow mode unless faster response is required.

Note: Because of the sampling method that is used, the monitor will respond to low frequency (<5 kHz) modulation of optical power by indicating a fluctuating reading, much as a chopped optical power-head will do. This fluctuation disappears for CW signals or high-frequency modulation beyond 5 kHz. In the latter case, the monitor reading corresponds to the time-averaged optical power.

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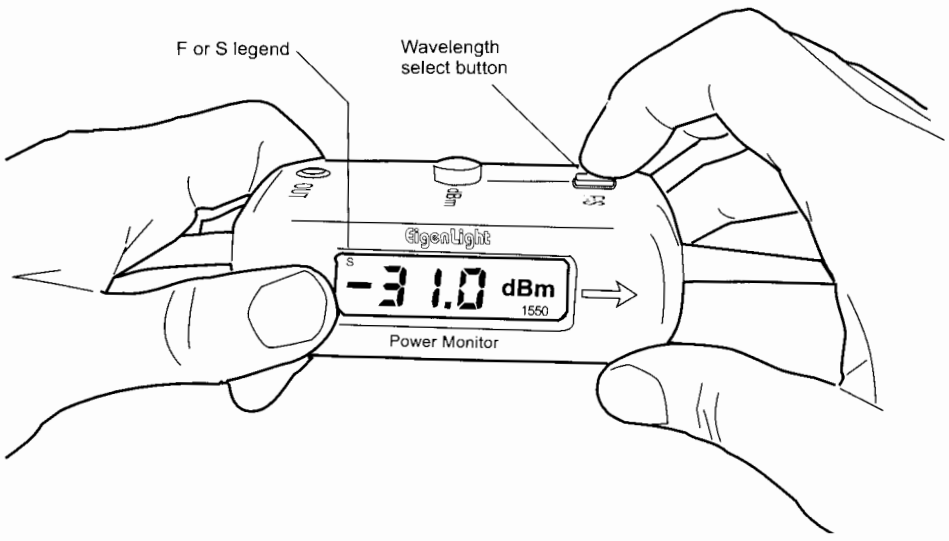


Figure 8: Switching between fast and slow mode

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Models:
Series 300 √
Series 400 √

accessories:
Reference reflector

Measuring Return Loss/Back Reflection

You can install a series 300 or 400 Power Monitor to measure return loss in a system or test set. The range of return loss that can be measured is approximately equal to the directivity of the monitor. Directivity is the sensitivity of the monitor to forward directed light relative to backward directed light in dB.

The directivity of Series 400 PMAs — and thus the range of return loss that can be measured — is affected by the attenuator setting. Maximum directivity is obtained at minimum attenuation.

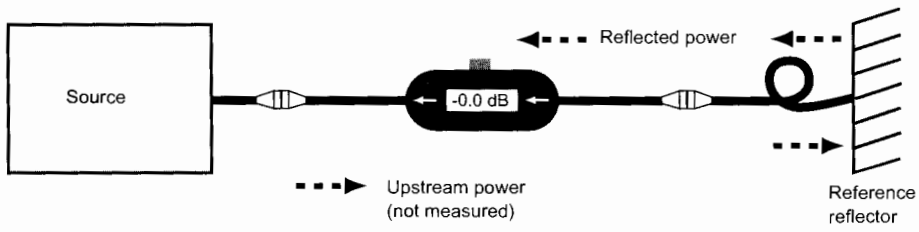
To measure return loss or back reflection:

1. Install the power monitor in the system or test set with legend arrows pointing back toward the source (see Figure 9).
2. Connect a 100% reference reflector (optional accessory) to monitor end farthest from source.
3. Turn on the optical source.
4. Zero the display and set measurement mode to dB relative by pressing and releasing the dB/dBm mode button until the dB legend appears and the display reads 0.0 dB.
5. Remove the reference reflector and reconnect monitor end to the device under test.

   Monitor reading now equals the return loss in dB of the device under test.

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Steps 1 through 3



Step 4

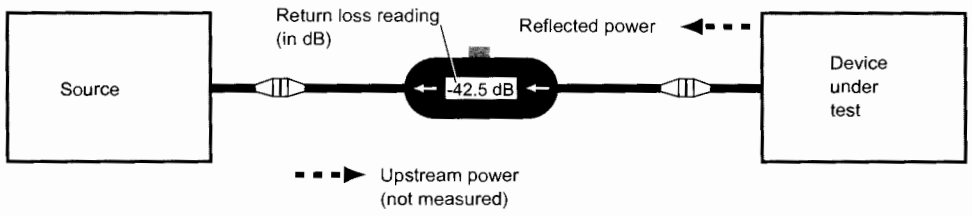


Figure 9: Return loss/back reflection diagrams

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Models:
Series 300 √
Series 400 √

Accessories:
- mini-coax jumper cable

Additional equipment:
- voltmeter or PC with A/D card

Using the Optional Analog Output

The analog output can be used to:

- Log data to a computer
- Provide an extra digit of resolution (0.01 dB)
- Provide a lighted display on a voltmeter under low ambient-light conditions
- Indicate *absolute* optical power on a voltmeter when the monitor is in dB relative mode

Note: The analog output voltage always indicates absolute optical power, even when the display is in dB relative mode.

To set up an analog output:

1. Connect the phone plug on mini-coax jumper cable (provided) to the phone jack on top of the monitor.
2. Connect BNC end of mini-coax cable to voltmeter or A/D card on a computer.

   Voltage output is 1 millivolt per 1 dBm of optical power (0 dBm = 0 millivolt).

   When the optical power level goes below the measurement range of the monitor, the analog output voltage automatically switches to 0 volts to indicate an out-of-range condition.

Note: A digital voltmeter can be used as an auxiliary display by setting the voltage range to 200 millivolts. With this range setting, the reading on the voltmeter is the absolute optical power in dBm.

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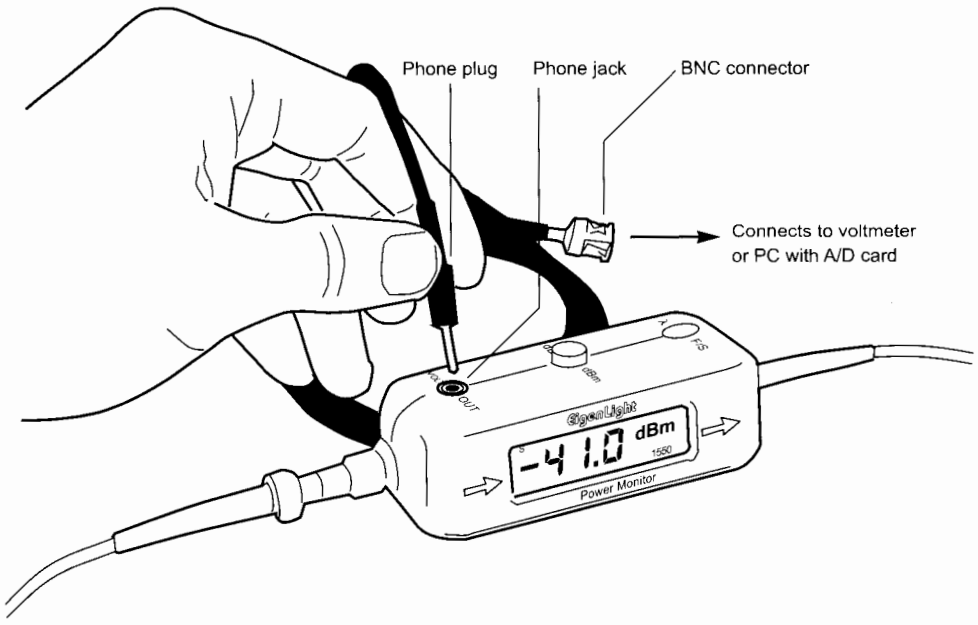


Figure 10: Mini-coax jumper cable connections

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Models:
Series 300 √
Series 400 √

Replacing the Batteries

When a low battery condition occurs, the **LOW BAT** legend in the upper right corner of the LCD display turns on and remains on until the batteries are replaced.

To replace the batteries:

1. Place the tip of a small screw driver into the semi-circular cutout in the corner of the bottom cover plate and pry it open.
2. Gently pull the four Lithium coin cell batteries from their compartments using tweezers.
3. Replace batteries with CR2032 Lithium coin cells, noting correct polarity of batteries as indicated by decal on outside of battery compartment and on battery face.
4. Replace the bottom cover plate by snapping into place.

Caution: Do not use metal tweezers to insert new batteries as this will short the batteries and reduce battery life.

Warning: Use only CR2032 lithium coin cell batteries. Use of a different type of battery might cause damage to the device.

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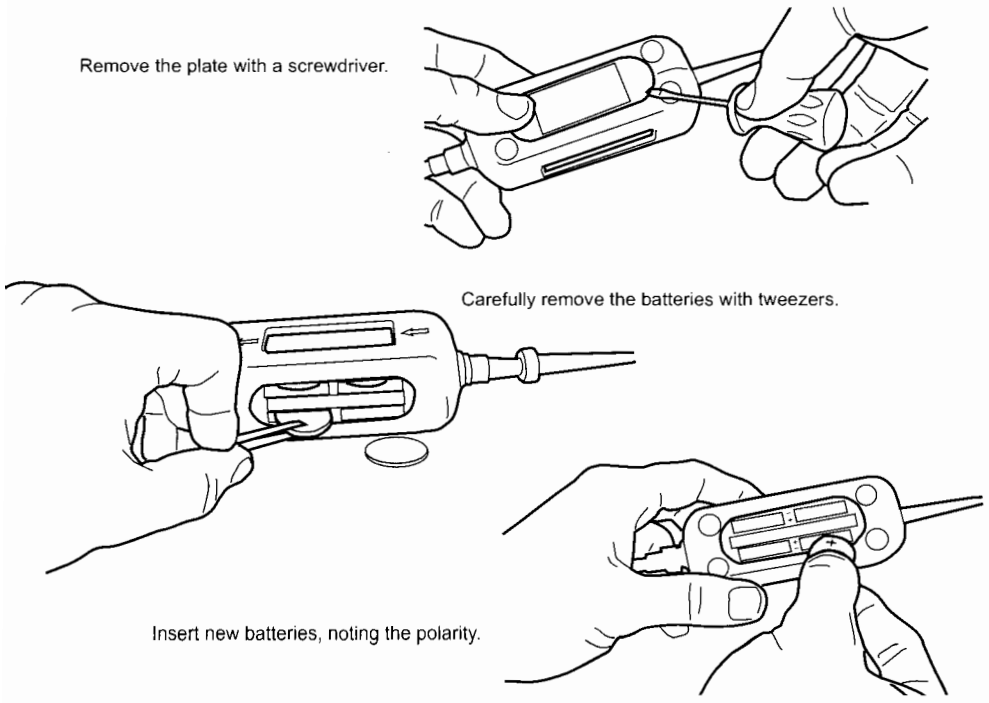


Figure 11: Replacing the Batteries

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Models:
Series 300 √
Series 400 √

accessories:
Magnetic Mount

Using the Optional Magnetic Mount

The optional magnetic mount can be used for securing the monitor on a table top or on the side of equipment racks made of magnetic steel.

To use the magnetic mount:

1. Place the monitor between mount posts.
2. Using finger tip, press monitor strain-relief boots into the clip holders on mount posts.
3. Rotate monitor for optimum viewing of display.

For Series 400 PMAs, place attenuator end into clip holder with wider opening.

Using the Optional Magnetic Mount

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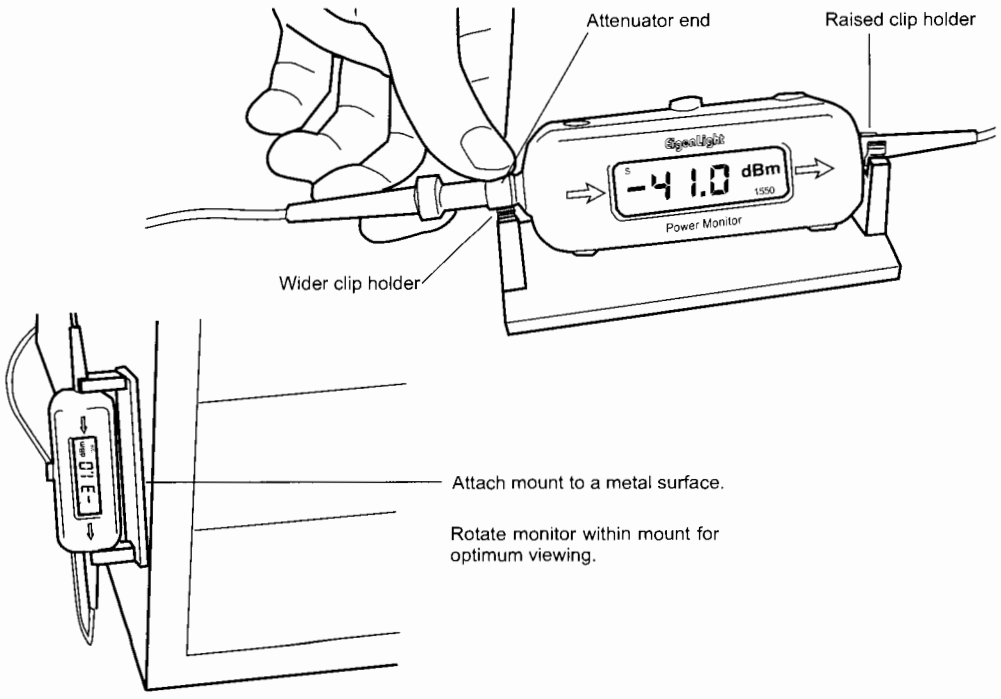


Figure 12: Mounting a monitor

Using the Optional Magnetic Mount

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Models:
Series 400 √

Adjusting Attenuation (Series 400)

Series 400 power monitor attenuators (PMAs) allow the optical power level to be varied using an integral variable attenuator.

To adjust the power level, turn the black knurled nut on the attenuator using fingertips:

- Turn the nut clockwise as viewed from the attenuator end to decrease the power level (increase attenuation).
- Turn the nut counter-clockwise as viewed from the attenuator end to increase the power level (decrease attenuation).

The display indicates the optical power delivered to the output.

To set the attenuator for minimum loss it is sometimes necessary to compensate for back-lash by first turning the nut counter-clockwise gently until it reaches the stop and then turning clockwise until the minimum loss is achieved.

Warning: do not use excessive force when turning against the attenuator stop as this might cause damage to the attenuator.

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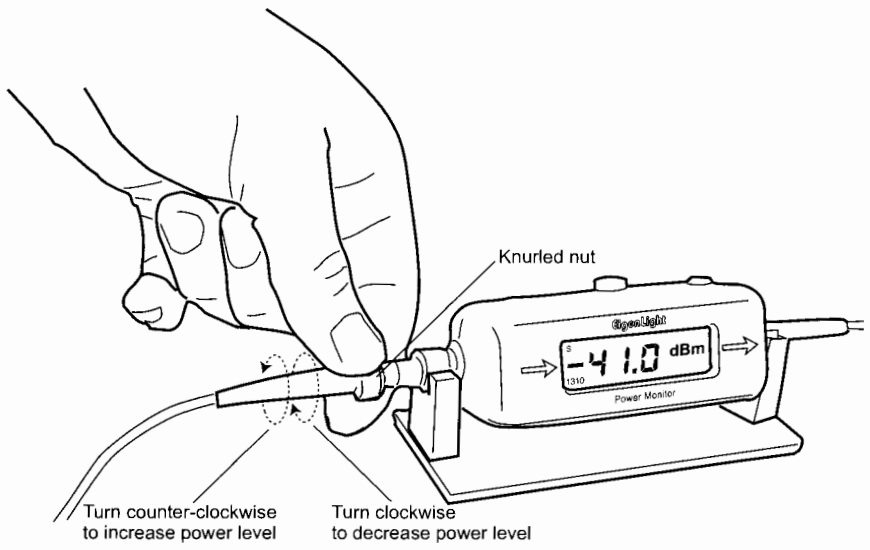


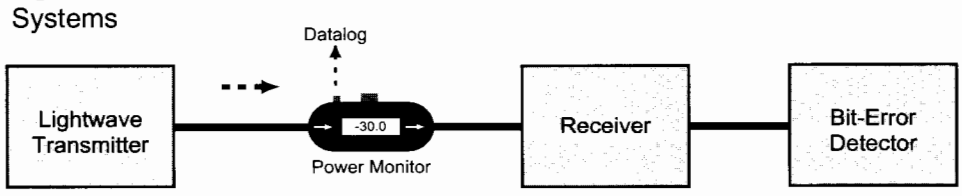
Figure 13: Adjusting attenuation

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Applications

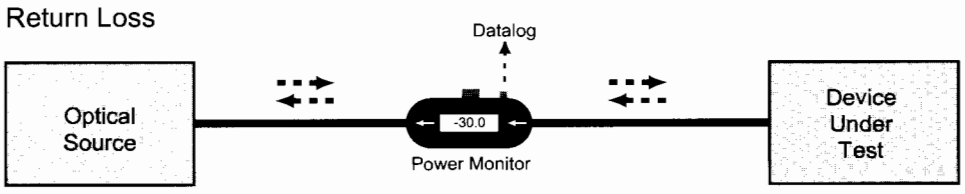
For a complete description of the application examples shown here, visit: www.eigenlight.com.

Lightwave Systems



Monitor Reading = Optical power delivered to receiver

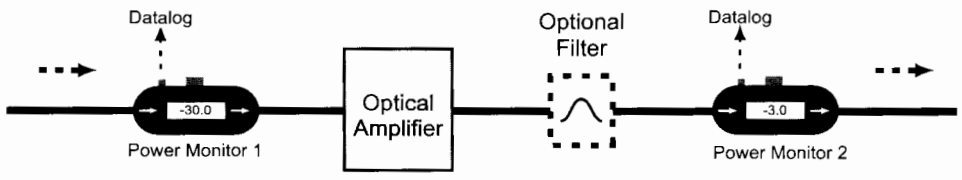
Real-Time Return Loss



Monitor Reading = Optical power returning to source

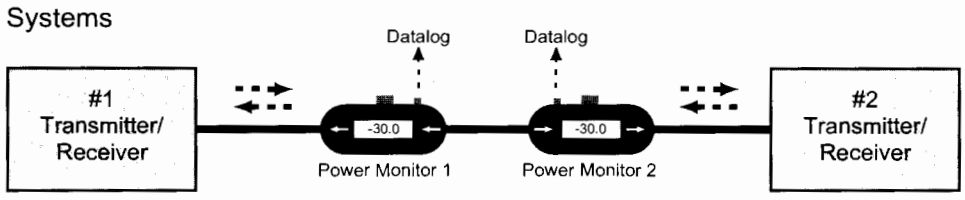
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Optical
Amplifiers



Monitor 2 Reading - Monitor 1 Reading = Amplifier Gain (dB)

Bi-directional
Transmission
Systems



Monitor 1 Reading = Optical power delivered to Receiver #1
Monitor 2 Reading = Optical power delivered to Receiver #2

Figure 14: Applications

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Product Specifications

Table 2: Series 300 and 400 Specifications (U.S. patents 5,591,964; 5,708,265)

OPTICAL SPECIFICATIONS	M310	M320	M322, M323[1]	M410	M420
Fiber Type	single-mode	single-mode	multimode	single-mode	single-mode
Power Range (dBm)	–50 to +18	–40 to +28	–50 to +18	–50 to +18	-40 to +20
Insertion Loss (dB)	< 1.0	< 0.25	< 1.5	< 2.0	< 1.3
Wavelength Range (nm)	1280 – 1580	1280 – 1580	800 – 1580	1280 – 1580	1280 – 1580
Cal. Wavelengths (nm)	1310, 1550	1310, 1550	850, 1310	1310, 1550	1310, 1550
Absolute Accuracy (dB)[2]	± 0.2	± 0.2	± 0.5	± 0.2	± 0.2
Return Loss (dB)	> 60	> 60	> 40	> 60	> 60
PDL (dB)	< 0.05	< 0.05	N/A	< 0.2	< 0.2
Polarization Stability (dB)[3]	≤ 0.2	≤ 0.2	N/A	≤ 0.2	≤ 0.2
Directivity (dB)[4]	> 50	> 50	> 30	> 50	> 50
Spectral Flatness (dB/nm)[5]	< 0.01	< 0.01	< 0.05	< 0.01	< 0.01
Attenuator Range (dB)	N/A	N/A	N/A	40	40
Attenuator Resolution (dB)	N/A	N/A	N/A	0.1	0.1

1. Model 322, 50/125 µm fiber. Model 323, 62.5/125 µm fiber
2. Measured at output and calibrated wavelengths
3. Maximum change in monitor reading with polarization
4. Sensitivity to forward directed light relative to backward directed light (at minimum attenuation for models 410 and 420)
5. Monitor sensitivity change with wavelength; optional spectral curve available

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Series 300 and 400 Specifications, continued

ELECTRICAL SPECIFICATIONS

Power	4 Lithium coin cells (CR2032)
Battery life	3 years typical (slow mode)
Displays	dual liquid crystal displays
Display resolution	0.1 dB
Display refresh rate	0.1 sec./0.8 sec. (Fast/slow mode)
Analog output voltage	1 millivolt/dBm (0 dBm = 0 millivolt)
Analog output impedance	40 kΩ
Analog connection	micro phone jack

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	0° C to +40° C
Storage Temperature	-10° C to +60° C
Relative Humidity	<95% non-condensing

MECHANICAL SPECIFICATIONS

Size (Housing only)	9.5 x 3.7 x 3.6 cm
Weight	140 gram (5 oz.) with batteries
Housing Material	flame retardant ABS plastic

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Standards and Regulatory Compliance Statements

NIST Traceability

This instrument has been tested for compliance with all product specifications published by Eigenlight Corporation. Calibration of this instrument is traceable to the National Institute of Standards and Technology (NIST), Boulder, Colorado, USA through equipment that is calibrated on a scheduled basis and in accordance with the Measurement Assurance Program (MAP) of NIST.

It is recommended that this instrument be returned to the factory for re-calibration on an annual basis as indicated by the "Recommended Re-Calibration Date" on the Calibration Certificate accompanying this manual, and on the bottom of the instrument itself. Calibration service is provided by EigenLight Corporation at a nominal fee.

For re-calibration or repair, send the instrument to:

EigenLight Corporation
30 Centre Road
Somersworth, NH 03878
Tel: (603) 692-9200
Fax: (603) 692-9205

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European Declaration of Conformity

CE

This fiberoptic equipment has been tested and found to comply with the following European directive:

Council Directive 89/336/EEC of 3 May 1989 on the Approximation of the Laws of the Member States Relating to Electromagnetic Compatibility, as amended by:

Council Directive 92/31/EEC (28 April 1992);

Council Directive 93/68/EEC (22 July 1993).

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Statement of Warranty

EigenLight Corporation warrants this product to be free from defects in material and workmanship for a period of one year from date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty contact EigenLight Corporation for return instructions. Send the instrument, transportation prepaid, to:

EigenLight Corporation
30 Centre Road
Somersworth, NH 03878
Tel: (603) 692-9200
Fax: (603) 692-9205

Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitations of Warranty

This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability of fitness for a particular use. EigenLight Corporation shall not be liable for any indirect, special or consequential damages.

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