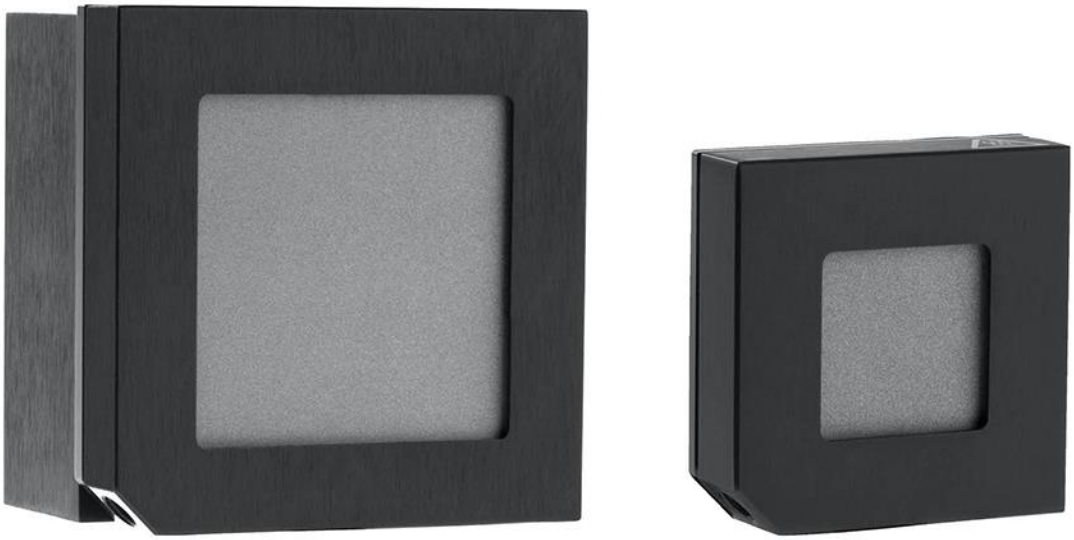
Edmund optics | worldwide



USER MANUAL

EO Series | Pyroelectric Energy Detectors

WARRANTY

First Year Warranty

The Edmund Optics thermal power detectors carry a one-year warranty (from date of shipment) against material and /or workmanship defects when used under normal operating conditions. The warranty does not cover recalibration or damages related to misuse.

Edmund Optics will repair or replace at its option any wattmeter or joulemeter which proves to be defective during the warranty period, except in the case of product misuse.

Any unauthorized alteration or repair of the product is also not covered by the warranty.

The manufacturer is not liable for consequential damages of any kind.

In case of malfunction, contact your local Edmund Optics distributor or nearest Edmund Optics office to obtain a return authorization number. The material should be returned to:

Edmund Optics, Inc
101 E. Gloucester Pike
Barrington, NJ 08007

P: 1-800-363-1992
F: 1-856-573-6295
E: techsup@edmundoptics.com
Web: www.edmundoptics.com

Lifetime Warranty

Edmund Optics will warranty any thermal power and energy detector head for its lifetime as long as it has been returned for recalibration annually from the date of shipment. This warranty includes parts and labor for all routine repairs including normal wear under normal operating conditions.

Edmund Optics will inspect and repair the detector during the annual recalibration. Exceptions to repair at other times will be at Edmund Optics' option.

Not included is the cost of annual recalibration or consequential damages from using the detector.

The only condition is that the detector head must not have been subject to unauthorized service or damaged by misuse. Misuse would include, but is not limited to, laser exposure outside Edmund Optics published specifications, physical damage due to improper handling, and exposure to hostile environments. Hostile environments would include, but are not limited to excessive temperature, vibration, humidity, or surface contaminants; exposure to flame, solvents or water; and connection to improper electrical voltage.

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1. GENERAL INFORMATION

1.1. Introduction

The Edmund Optics EO Series is a robust line of high performance and high accuracy pyroelectric joulemeters. Each modular unit is built for durability, compactness and ease of operation.

The EO optical absorber exhibits high damage thresholds and can operate at high rep-rates. The EO Series benefits from the use of a DB-15 male, “Smart Interface” connector, containing an EEPROM (Erasable Electrical Programmable Read-Only Memory) programmed with the calibration sensitivity, the spectral correction factors at different wavelengths and other data relating to the specific EO Series joulemeter head. This connector permits the monitor to automatically adjust to the characteristics of the joulemeter being connected.

Every EO Series joulemeter features high intrinsic responsivity and high insensitivity to electromagnetic interference.

The EO Series also offers an exceptionally wide dynamic range and permits energy measurement from UV to far IR.

EO Series joulemeters are designed for user-friendly energy measurement of pulsed lasers with monitor.

EO Series joulemeters require no power source. They can also be used with 1 MΩ[1] input impedance oscilloscopes[2] (or fast chart recorders). The calibrated V/J sensitivity is documented in the calibration certificate of each unit. The spectral correction of this sensitivity is also documented in the “Personal wavelength correction” certificate.

An appropriate damage test target is provided, as a safety precaution, for all EO models.

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[1] The capacitance of the cable linking the joulemeter to the electronic readout and the readout input impedance (capacitance and resistance) constitute the total impedance load seen by the detector. The total load capacitance, excluding the integral cable should be $\leq$ 30 pF.

[2] A DB-15 to BNC adaptor is required.

EO - series

The EO Series are modular low-profile heads, designed for ease of installation in tight optical setups. These detectors have square apertures, providing better compatibility with rectangular beam profiles, such as pulsed gas lasers.

A corner mounting thread permits diagonal mounting of the heads to accommodate longer rectangular beams.

1.2. EO Series "Smart Interface" CONNECTOR

The DB-15 male "Smart Interface" connector contains an EEPROM (Erasable Electrical Programmable Read-Only Memory) programmed with the calibration sensitivity and other data relating to the specific EO joulemeter in use. Faster set-ups are obtained because the monitor automatically adjusts to the characteristics of the joulemeter, when the "Smart Interface" is connected to the monitor. The cable length is 3 feet.

The DB-15 "Smart Interface" connector pin-out is:

1-	USED BY MONITORS			
2-	"	"	"	"
3-	"	"	"	"
4-	"	"	"	"
5-	"	"	"	"
6-	"+" SIGNAL OUTPUT			
7-	USED BY MONITORS			
8-	"	"	"	"
9-	"	"	"	"
10-	"	"	"	"
11-	"	"	"	"
12-	"	"	"	"
13-	"-" SIGNAL OUTPUT			
14-	USED BY MONITORS			
15-	"	"	"	"
SHELL-	COAX. SHIELD / BODY GRND			

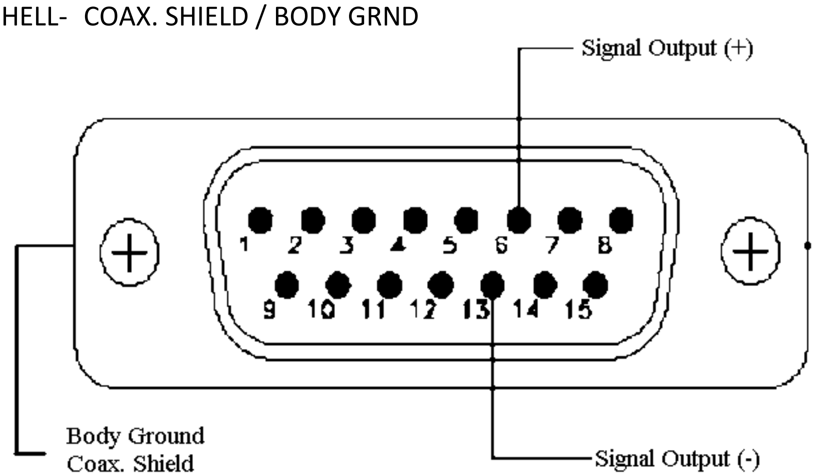

Fig. 1-1 DB-15 Connector Pin-Out

1.3. Specifications

The following specifications are based on a one-year calibration cycle, an operating temperature of 15°C to 28°C and a relative humidity not exceeding 80%. Storage 5°C to 45°C and relative humidity not exceeding 80%.

EO25LP-S-MB	
Effective Aperture	25 x 25 mm
Spectral Range [a, d] **Full** **Calibrated**	 0.19 – 20 µm 0.248 – 2.5 µm (10.6 µm in option)
Noise Equivalent Energy (Typical) [b, i]	4 µJ
Typical Rise Time (0-100%) [b, i]	550 µsec
Typical Sensitivity [b, c]	10 V/J
Calibration Uncertainty [b, c, d, k, i]	± 3%
Repeatability	< 0.5 %
Max. Pulse Energy [e, f] **1.064 µm** **0.266 µm**	 3.75 J 3.1 J
Max. Energy Density **1.064µm, 7ns, 10 Hz** **266nm, 7ns, 10 Hz**	 600 mJ/cm^2 500 mJ/cm^2
Max. Average Power [f, l]	5 W
Max. Average Power Density	10 W/cm^2 @ 5 W
Max. Repetition Rate [b, j, i]	300 Hz
Max. Pulse Width (Typical) [b, g, h, i]	400 µsec
Dimensions	50(H) x 50(W) x 14(D) mm
Weight	120 g

[a] See "Personal Wavelength Correction" certificate.
[b] Load capacitance must be ≤ 30 pF, excluding the supplied BNC to DB-15 "Smart Interface" coaxial cable.
[c] Outside the calibrated spectral range, only a typical value is available.
[d] Excludes non-linearities.
[e] Assuming 0.6 J/cm^2 @ 1.064 µm, 7 ns laser beam; with a uniform energy distribution; energy applied to full aperture.
[f] **Warning:** Detector body can reach 60°C at maximum powers.
[g] Calibrated at: 100 mJ, 10 Hz, @1.064 µm, 150 µsec pulse (FWHM), semi-Gaussian beam profile, energy applied to 80% of aperture, loaded into 1 MΩ/30 pF.
[h] Loaded into 1 MΩ/30 pF.
[i] Maximum measurable energy, maximum energy density and maximum average power can be increased by using an optional attenuator / diffuser.
[j] To maintain indicated calibration, sensitivity must be de-rated for longer pulses.
[k] Duration at base of pulse. Divide by 2 for FWHM (Full Width at Half Maximum) duration
[l] @1.064µm, CW

Specifications are subject to change without notice

EO50LP-H-MB	
Effective Aperture	50 x 50 mm
Spectral Range [a, d] **Full** **Calibrated**	 0.19 – 20 µm 0.248 – 2.5 µm (10.6 µm in option)
Noise Equivalent Energy (Typical) [b, i]	10 µJ
Typical Rise Time (0-100%) [b, i]	900 µsec
Typical Sensitivity [b, c]	3 V/J
Calibration Uncertainty [b, c, d, k, i]	± 3%
Repeatability	< 0.5 %
Max. Pulse Energy [e, f] **1.064 µm** **0.266 µm**	 15 J 12.5 J
Max. Energy Density **1.064µm, 7ns, 10 Hz** **266nm, 7ns, 10 Hz**	 600 mJ/cm^2 500 mJ/cm^2
Max. Average Power [f, l]	10 W
Max. Average Power Density	10 W/cm^2 @ 10 W
Max. Repetition Rate [b, j, i]	200 Hz
Max. Pulse Width (Typical) [b, g, h, i]	675 µsec
Dimensions	75(H) x 75(W) x 44(D) mm
Weight	338 g

[a] See "Personal Wavelength Correction" certificate.
[b] Load capacitance must be ≤ 30 pF, excluding the supplied BNC to DB-15 "Smart Interface" coaxial cable.
[c] Outside the calibrated spectral range, only a typical value is available.
[d] Excludes non-linearities.
[e] Assuming 0.6 J/cm^2 @ 1.064 µm, 7 ns laser beam; with a uniform energy distribution; energy applied to full aperture.
[f] **Warning:** Detector body can reach 60°C at maximum powers.
[g] Calibrated at: 100 mJ, 10 Hz, @1.064 µm, 150 µsec pulse (FWHM), semi-Gaussian beam profile, energy applied to 80% of aperture, loaded into 1 MΩ/30 pF.
[h] Loaded into 1 MΩ/30 pF.
[i] Maximum measurable energy, maximum energy density and maximum average power can be increased by using an optional attenuator / diffuser.
[j] To maintain indicated calibration, sensitivity must be de-rated for longer pulses.
[k] Duration at base of pulse. Divide by 2 for FWHM (Full Width at Half Maximum) duration
[l] @1.064µm, CW

Specifications are subject to change without notice

2. OPERATING INSTRUCTIONS

2.1. When using a Monitor

Refer to the respective monitor's instruction manual for further information.

2.1.1. General Instructions

1. Install the joulemeter on its optical stand.

2. Connect the joulemeter to the Edmund Optics laser energy monitor.

> *NOTE:*
> *The parameters programmed in the DB-15 "Smart Interface" are for a 1 MΩ/30 pF load impedance.*

3. Remove the detector's protective cover, when applicable.

4. Put the joulemeter head into the laser beam path (laser beam must be contained within the aperture).

> *CAUTION:*
> - *Be careful not to exceed the maximum levels and densities of, energy, peak power and average power, stated in the specifications pages. The use of a damage test target is strongly recommended.*
> - *At maximum average powers EO Series joulemeter bodies can reach 60°C and can represent a burn hazard if handled with bare hands.*
> - *A diffuse back reflection of ~30% is present from the joulemeter's optical absorber.*

> *NOTE:*
> *As with all large aperture pyroelectric devices, these detectors have some position and beam size sensitivity. For the most accurate measurements, the beam should normally be centered on the sensor surface and the beam diameter should ideally be close to that of the original calibration conditions, which is 100% encircled energy (of a semi-Gaussian beam stopped at $1/e^2$) applied to a diameter equal to 80% of the detector aperture. The use of a divergent lens, a Lambertian diffuser such as opal glass, or any other method of beam spreading, is recommended for this purpose. Please take note that all of the laser light must be directed within the detector aperture and that the transmission loss through the optical component must be known.*

2.1.2. Working at wavelengths other than 1064 nm

The monitor will automatically configure himself using the data stored in the EEPROM of the DB-15 “Smart Interface”. This includes the calibration sensitivity and wavelengths corrections for 20 current wavelengths [3, 4].

For more precise measurements with a EO Series joulemeter at wavelengths other than those already corrected by the “Personal Wavelength Correction ™” [3] data programmed into the “Smart Interface”, a correction factor[4] must be set in the monitor to compensate for the change in sensitivity of the joulemeter caused by the change in absorption of the optical absorber at different wavelengths.

To correct for the change in absorption refer to the spectral curve of the “ Personal Wavelength Correction ™ “ certificate supplied for the joulemeter and calculate K by taking the percentage difference between the absorption @1.064µm and that at the desired wavelength.

$$\mathbf{K} = \frac{\mathbf{A}(\lambda 1)}{\mathbf{A}(@1.064\mu m)}$$

Where: $\mathbf{A}(\lambda 1)$ = Absorption of the EO @ the desired wavelength.
$\mathbf{A}(@1.064\mu m)$ = Absorption of the EO @ 1.064µm

Example:

$\mathbf{A}(\lambda 1)$ = 92 %.
$\mathbf{A}(@1.064\mu m)$ = 94 %

$$K = \frac{\mathbf{A}(\lambda 1)}{\mathbf{A}(@1.064\mu m)} \times 100$$

$$K = \frac{92\%}{94\%} \times 100 = 0.9787 \times 100 = 97.87\ \%$$

and is the Correction Factor to be set in the monitor [4].

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[3] Refer to the spectral curve of the “ Personal Wavelength Correction ™ “ certificate supplied with the joulemeter
[4] Refer to the monitor manuals for instructions.

2.2. When using an Oscilloscope:

2.2.1. General Instructions

1. Install tall the joulemeter on its optical stand

2. Connect the joulemeter to the oscilloscope.

> *NOTE:*
> *The required load impedance is 1 MΩ/30 pF.*
> *An optional DB-15 to BNC adaptor may be required when used in conjunction with an oscilloscope.*

3. Remove the detector's protective cover, when applicable.

4. Put the joulemeter head into the laser beam path (laser beam must be contained within the aperture).

> *CAUTION:*
> - *Be careful not to exceed the maximum levels and densities of, energy, peak power and average power, stated in the specifications pages. The use of a damage test target is strongly recommended.*
> - *At maximum average powers EO Series joulemeter bodies can reach 60°C and can represent a burn hazard if handled with bare hands.*
> - *A diffuse back reflection of ~30% is present from the joulemeter's optical absorber.*

> *NOTE:*
> *As with all large aperture pyroelectric devices, these detectors have some position and beam size sensitivity. For the most accurate measurements, the beam should normally be centered on the sensor surface and the beam diameter should ideally be close to that of the original calibration conditions, which is 100% encircled energy (of a semi-Gaussian beam stopped at $1/e^2$) applied to a diameter equal to 80% of the detector aperture. The use of a divergent lens, a Lambertian diffuser such as opal glass, or any other method of beam spreading, is recommended for this purpose. Please take note that all of the laser light must be directed within the detector aperture and that the transmission loss through the optical component must be known.*

5. Adjust the oscilloscope to trigger on the joulemeter pulse or on the laser sync. signal.

6. Measure the foot to crest peak voltage generated by the joulemeter.

7. Determine the joulemeter Volt/Joule sensitivity from the detector identification label or calibration certificate. Choose the value stated for the wavelength being used.

8. Calculate the optical energy using the following equation:

Energy = V_{peak} / Calibration sensitivity

Ex:
- V_{peak} = 1 volt
Detector calibration sensitivity (10 Volts / Joule)
Energy = 1 Volt / 10 V/J = 100 mJ

> *NOTE:*
> *Exclude any DC offset from the pulse peak value measurement; this offset is a function of the repetition rate.*

2.2.2. Working at wavelengths other than 1064 nm

For measurements with a EO Series joulemeter at wavelengths other than 1.064µm, a correction factor must be set to compensate for the change in sensitivity of the joulemeter caused by the change in absorption of the optical absorber at different wavelengths.

To correct for the change in absorption refer to the spectral curve of the “ Personal Wavelength Correction ™ “ certificate supplied for the joulemeter and calculate K by taking the percentage difference between the absorption @1.064µm and that at the desired wavelength.

$$\mathbf{K} = \frac{\mathbf{A}(\lambda 1)}{\mathbf{A}(@1.064\mu m)}$$

Energy = V_{peak} / Calibration sensitivity / K

Where $\mathbf{A}(\lambda 1)$ = Absorption of the EO @ the desired wavelength.
$\mathbf{A}(@1.064\mu m)$ = Absorption of the EO @ 1.064µm

<u>Example:</u>

$\mathbf{A}(\lambda 1)$ = 92 %.
$\mathbf{A}(@1.064\mu m)$ = 94 %

$$K = \frac{\mathbf{A}(\lambda 1)}{\mathbf{A}(@1.064\mu m)} \times 100$$

$$K = \frac{92\%}{94\%} \times 100 = 0.9787 \times 100 = 97.87\ \%$$

Ex:
V_{peak} = 1 volt
Detector calibration sensitivity @1.064µm (10 Volts / Joule)

Energy = 1 Volt / 10 V/J / 97.87% = 102.18 mJ

3. DAMAGE TO THE OPTICAL ABSORBER MATERIALS

In any time, the beam's incident area should not be less than 10% of the detector's aperture. Please contact Edmund Optics to make measurements with such smaller beams.

Damage is usually caused by exceeding the manufacturer's specified maximum incident:

- Average Power Density
- Peak Pulse Power Density
- Single Pulse Energy Density

Refer to the EO Series joulemeter specifications pages. This damage can also be caused when using a detector with a contaminated absorber or attenuator surface.

The quoted damage thresholds in the specifications section refer to a visible alteration of the absorber surface[5]. In practice a slight alteration will not affect the joulemeter response. Consider the joulemeter to be damaged and/or out of calibration when large-scale damage is evident or you can see the metal electrode beneath the coating[6].

In the case of a TEMoo (Gaussian) beam, the maximum peak power and energy density can be calculated using the following equation:

$$\text{Density (power or energy)} \approx \frac{2Io}{\pi W^2}$$

Where Io is the total beam power or energy
W is the beam radius at $1/e^2$ and $\pi = 3.1416$

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[5] For EO Series detectors, the use of the appropriate "EO Series Test Target " is suggested in order to insure that the laser beam will not damage the detector's absorber coating; contact Edmund Optics for further instructions.

[6] Contact Edmund Optics for evaluation, repair, recalibration, or replacement (refer to the WARRANTY instructions).

> *NOTE:*
> *The beam waist for a TEMoo beam is the radius of a circle centered on the beam axis and containing 86 % of the beam energy. Ref.: SIEGMAN, A.E., An Introduction to Lasers and Masers, p. 313 (Mcgraw-Hill Series in the Fundamentals of Electronic Science).*

Example of energy density;

Io = 1 joule (total energy)
W = 1 cm

$$\text{Energy density} = \frac{2 \times 1 \text{ joule}}{\pi \times (1 \text{ cm})^2} = 0.64 \text{ joule/cm}^2$$

Example of power density calculation;

Io = 1 MegaWatt (total power)
W = 1 cm

$$\text{Power density} = \frac{2 \times 1 \text{ MegaWatt}}{\pi \times (1 \text{ cm})^2} = 0.64 \text{ MW/cm}^2$$

4. APPENDIX A: WEEE DIRECTIVE

4.1. Recycling and separation procedure for WEEE directive 2002/96/EC.

This section is used by the recycling center when the detector reaches its end of life. Breaking the calibration seal or opening the monitor will void the detector warranty.

The complete detector contains
- 1 Detector with wires or DB-15.
- 1 instruction manual
- 1 calibration certificate

4.2. Separation:

Paper: Manual and certificate
Wires: Cable Detector.
DB-15, no need to separate (less then 10 cm^2).
Aluminum: Detector casing.

5. DECLARATION OF CONFORMITY

Application of Council Directive(s): **2004/108/EC EMC Directive**

Manufacturer's Name: Gentec Electro Optics, Inc.
Manufacturer's Address: 445 St-Jean Baptiste, suite 160
(Québec), Canada G2E 5N7

Representative's Name: Laser Component S.A.S
Representative's Address: 45 bis Route des Gardes
92190 Meudon (France)

Type of Equipment: Laser Power/Energy Meter
Model No.: EO Series Pyroelectric Energy Detectors
Year of test & manufacture: 2011

Standard(s) to which Conformity is declared:
EN 61326-1: 2006 Emission generic standard

Standard	Description	Performance Criteria
CISPR11 :2009 +A1 :2010	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement	Class A
EN 61000-4-2 2009	Electromagnetic compatibility (EMC) – Part 4: Testing and measurements techniques- Section 4.2: Electrostatic discharge.	Class B
EN 61000-4-3 2006+A2:2010	Electromagnetic compatibility (EMC) – Part 4: Testing and measurements techniques- Section 3: Radiated, Radio Frequency immunity.	Class A
EN 61000-4-4 2004 +A1:2010	Electromagnetic compatibility (EMC) – Part 4: Testing and measurements techniques- Section 4: Electrical fast transient/burst immunity.	Class B
EN 61000-4-6 2009	Electromagnetic compatibility (EMC) – Part 4: Testing and measurements techniques- Section 6: Immunity to conducted Radio Frequency.	Class A

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s)

Place: Quebec (Quebec)
Date : June 18, 2012

(President)

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