For Models:

EO100-Si-HA-OD1
EO100-SiUV-OD.3

USER MANUAL

EO Series | Photo Detectors

WARRANTY

First Year Warranty

The Edmund Optics Photo 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 photo 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 Photo Detector family includes 2 models: EO100-Si-HA-OD1 and EO100-SiUV-OD.3. Both are Silicon photodiode. The EO100-SiUV-OD.3 has an enhanced sensitivity at shorter wavelengths.

All detector heads are 27.4mm thick by 38.1 mm in diameter.

The EO Series are supplied with a 180 cm long flexible cable terminated with a DB-15 "intelligent" male connector, for use with Edmund Optics Monitors.

NOTE: To avoid damaging the detector, do not carry it using the cable.

Call your nearest Edmund Optics office to replace the sensor/or to recalibrate the head. See p. ii, Contacting Gentec Electro-Optics Inc.

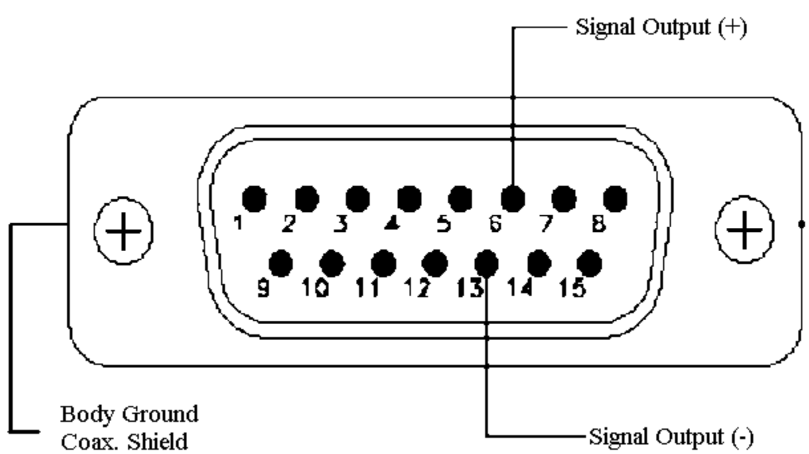
1.2. EO Series "Smart Interface" CONNECTOR

The DB-15 male "intelligent" connector contains an EEPROM (Erasable Electrical Programmable Read-Only Memory) that stores information such as the model of the detector, the calibration sensitivity of the available spectral range with or without attenuator and the applicable scales for that specific detector. Wavelengths are not available outside the physical capabilities of the sensor.

The Edmund Optics monitors and the PC-PREMIER software use the data in those connectors to adjust their characteristics automatically to the connected sensor. No calibration procedure is required when installing the photo detector heads, allowing for faster set-up.

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

1-	USED BY MONITORS
2-	" " " "
3-	" " " "
4-	" " " "
5-	" " " "
6-	"+" SIGNAL OUTPUT
7-	"-" SUPPLY VOLTAGE QE8 ONLY
8-	" " " "
9-	" " " "
10-	" " " "
11-	" " " "
12-	" " " "
13-	"-" SIGNAL OUTPUT
14-	USED BY MONITORS
15-	" " " "
SHELL-	COAX. SHIELD / BODY GRND



1.3. Specifications

EO100-Si-HA-OD1	With OD1	Without OD1
Effective Aperture	10 mm Ø	10 mm Ø
Spectral Range	420 – 1080 nm	350 – 1080 nm
Resolution	1.5 pW	1.5 pW
Noise (Peak-to-Peak)	5 pA	5 pA
Min. MeasurablePower	6 nW @ 980nm	0.3 nW @ 980nm
Max. Measurable Power	300 mW @ 1064 nm	36 mW @ 1064 nm
Max. Average Power Density	100 W/cm^2	100 W/cm^2
Typical Saturation Current	6.3 mA/cm^2	6.3 mA/cm^2
Bandwidth **(20 mA to 1 mA)** **(1 mA to 20 µA)** **(20 µA to 2 µA)** **(2 µA to 0.1 µA)** **(0.1 µA to 1 nA)**	 31 kHz 31 kHz 31 kHz 29 Hz 16 Hz	 31 kHz 31 kHz 31 kHz 29 Hz 16 Hz
Min. Repetition Rate (Pulsed Laser) **(20 mA to 1 mA)** **(1 mA to 20 µA)** **(20 µA to 2 µA)** **(2 µA to 0.1 µA)** **(0.1 µA to 1 nA)**	 155 kHz 155 kHz 155 kHz 145 kHz 80 Hz	 155 kHz 155 kHz 155 kHz 145 kHz 80 Hz
Response Time (10-90%)	0.2 sec	0.2 sec
Typical Sensitivity	0.5 A/W @ 980 nm	0.5 A/W @ 980 nm
Calibration Uncertainty	420-980 nm: ±4% 981-1049 nm: ±5% 1050-1080 nm: ±7%	350-399 nm: ±6.0% 400-449 nm: ±2.0% 450-940 nm: ±1.5% 941-980 nm: ±2.0% 981-1049 nm: ±5% 1050-1080 nm: ±7%
Temperature Offset (Typical)	20 pA/°C	20 pA/°C
Beam Position Dependence	±1% @ 780 nm ±3% @ 1064 nm	±1% @ 780 nm ±3% @ 1064 nm
Sensor Type	Silicon	Silicon
Dimensions	27.4 mm x 38.1 mm Ø	27.4 mm x 38.1 mm Ø
Weight	130 g	130 g

Specifications subject to change without notice.

EO100-SiUV-OD.3	With OD.3	Without OD.3
Effective Aperture	10 mm Ø	10 mm Ø
Spectral Range	210 – 1080 nm	210 – 1080 nm
Resolution	1.5 pW	1.5 pW
Noise (Peak-to-Peak)	5 pA	5 pA
Min. MeasurablePower	6 nW @ 850nm	0.3 nW @ 850nm
Max. Measurable Power	11 mW @ 300 nm	4 mW @ 532 nm
Max. Average Power Density	100 W/cm^2	100 W/cm^2
Typical Saturation Current	17.6 mA/cm^2	17.6 mA/cm^2
Bandwidth **(20 mA to 1 mA)** **(1 mA to 20 µA)** **(20 µA to 2 µA)** **(2 µA to 0.1 µA)** **(0.1 µA to 1 nA)**	 31 kHz 31 kHz 31 kHz 29 Hz 16 Hz	 31 kHz 31 kHz 31 kHz 29 Hz 16 Hz
Min. Repetition Rate (Pulsed Laser) **(20 mA to 1 mA)** **(1 mA to 20 µA)** **(20 µA to 2 µA)** **(2 µA to 0.1 µA)** **(0.1 µA to 1 nA)**	 155 kHz 155 kHz 155 kHz 145 kHz 80 Hz	 155 kHz 155 kHz 155 kHz 145 kHz 80 Hz
Response Time (10-90%)	0.2 sec	0.2 sec
Typical Sensitivity	0.45 A/W @ 850 nm	0.45 A/W @ 850 nm
Calibration Uncertainty	210-399nm : ±6.5 400-1049 nm: ±5 1050-1080 nm: ±7%	210-219 nm: ±8% 220-399 nm: ±6.5% 400-899 nm: ±2.5% 900-999 nm: ±3.5% 1000-1049 nm: ±5% 1050-1080 nm: ±7%
Temperature Offset (Typical)	20 pA/°C	20 pA/°C
Beam Position Dependence	±1% @ 652 nm ±3% @ 1064 nm	±1% @ 652 nm ±3% @ 1064 nm
Sensor Type	Silicon-UV	Silicon-UV
Dimensions	27.4 mm x 38.1 mm Ø	27.4 mm x 38.1 mm Ø
Weight	130 g	130 g

Specifications subject to change without notice.

2. OPERATING INSTRUCTIONS

2.1. When using a Monitor

Connect the detector to the monitor and turn it ON. (See monitor's instruction manual.)

Make a Zero on the monitor before making any measurements to ensure the best accuracy. See "Adjusting the Zero" in section 2.2 below.

If you want to subtract the room light from your readings, do the zero offset nulling without the black cover on the detector.

2.2. Quick Power Measurement Procedure

This section will show you the fastest way to make a laser power measurement with Edmund Optics monitors and photo detectors.

The monitor automatically recognizes all Edmund Optics photo detectors. The monitor automatically downloads all the technical data of the detector from the EEPROM in the DB-15 connector. This data includes sensitivity, model, serial number, version, wavelength correction factors, and time response.

Quick power measurement procedure:

1. Install the detector on its optical stand (if applicable).
2. Slide the connector latch to the right to unlock the connector.
3. Connect the detector using the PROBE INPUT JACK. We recommend turning the monitor OFF before connecting a new detector to avoid damaging the EEPROM.
4. Slide the latch to the left to lock the connector in place.
5. Switch the monitor ON or plug the it into a computer.
6. By default, the monitor will be on autoscale and at the lowest wavelength available without attenuator. You may want to obtain measurements in dBm rather than Watts. To do so, select Settings - Power Unit - dBm.
7. Select the correct wavelength for your application.
8. Remove the protective cover from the detector.
9. Put the detector in the laser beam path. The entire laser beam must be contained on the sensor. Do not exceed the specifications of your sensor. For the most accurate measurement, spread the beam across 90% of the sensor area.

Adjusting the zero:

1. Block off laser radiation to the detector.
2. Before resetting the zero, wait until the reading has stabilized. The power read by the monitor when no laser beam is incident on the detector may not be exactly zero if the detector or monitor is not thermally stabilized. Let the detector warm-up until the reading without laser power is stable for several minutes. Half an hour warm-up is recommended for measuring low powers.

<u>Set Diode Zero or Zero Offset or Offset</u> (refer to monitor user manual):

1. A message may appear requesting you to put the black cover on your photo detector. Put it on to block all light *if you do not want to compensate for background illumination*. Do not put it on *if you want to remove the signal from ambient light.*
2. Press the **ok** after taking the appropriate action with the protective cover.
3. The monitor passes through all the scales to determine the compensation needed to null each one.
4. The message “Diode Zero Done” appears when the monitor has completed the zeroing procedure. You are now ready to make an accurate measurement.
5. Apply the laser beam to the detector head.
6. The monitor displays the average power.

3. DAMAGE TO THE OPTICAL ABSORBER MATERIAL

Damage to the optical absorber material is usually caused by exceeding the manufacturer's specifications.

Refer to the specifications tables for details on the maximum powers and densities for your model.

Cleaning: Use Alcohol and a clean cotton cloth.

4. SOURCES OF ERROR

The photo detectors and monitors are NIST traceable. Several sources of error may affect your measurements.

4.1. Offset

You should always zero the offset before any measurement as described in Section 2.2 above, otherwise, all measurements will include a component not related to the laser power. This will add a systematic error to your power measurements. This error may disappear from relative power measurements. When you subtract two measurements made under identical conditions, the offset in the second measurement cancels the offset in the first if they are identical. We recommend zeroing the offset for all measurements to eliminate any drift that occurs between measurements.

4.2. Offset Drift Due to Temperature

The photo detector's Shunt Resistor is sensitive to temperature, this affects the offset value. When making measurements at very low powers, allow your system to warm up for 30 minutes or until the offset power is stable for several minutes. The sensitivity of the photo detector is also temperature dependent. See Fig 1 for the typical temperature sensitivity dependence over the spectral range for Si and SiUV detectors.

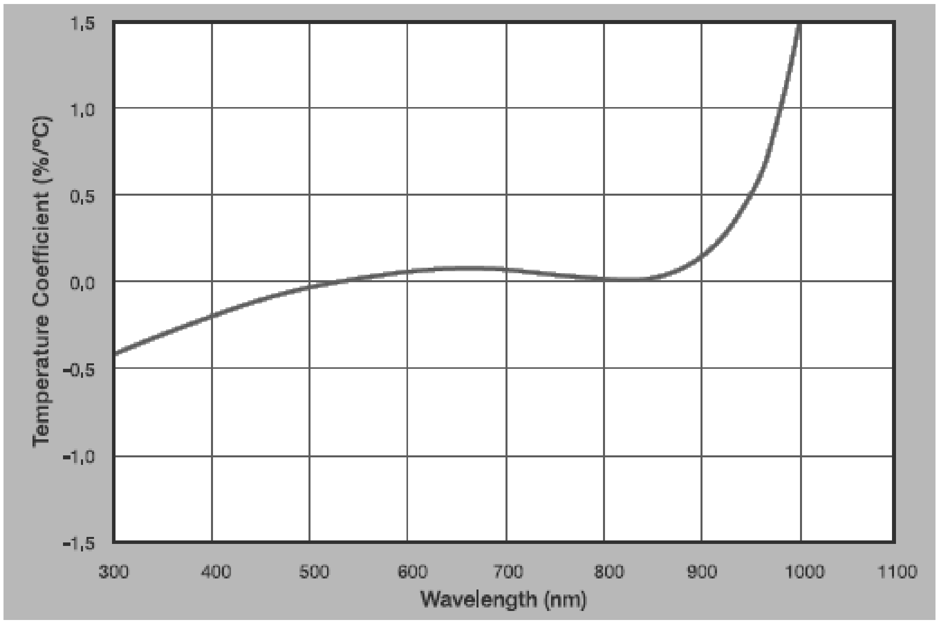


Fig 1. Typical Si and SiUV temperature dependence vs wavelength

4.3. Saturation

The maximum power varies with wavelength, power density and from one detector to another. When making measurements near the saturation power, you must verify the saturation effect with a calibrated filter.

4.3.1. Procedure with a known transmission value filter

Make the measurement with and without the filter.
Your power ratio should be equal to the transmission value of the filter.

4.3.2. Attenuator calibration procedure

Make sure your stable power source is far below the saturation point.
Make the measurement with and without the filter.
The transmission value is the ratio of the measurement with filter / without filter.

4.4. Measuring the Average Power of a Pulsed Laser

Conditions to be met:
The repetition rate must be at least 5 times the analog bandwidth (see the Specifications table). The peak power must not saturate the detector.

To know if the detector is saturated, use procedure 4.3.1. Be careful when calibrating an attenuator with a pulsed laser. The peak power must be in the linear region of the photo detector.

Peak power = Energy per pulse / pulse width.
Energy per pulse = Average power / repetition rate.

4.5. Wavelength

The photo detector's response varies with wavelength. You may select your wavelength with the *Settings/Wavelength* menu of the monitor or enter you wavelength manually in the *Settings/Custom* menu of the monitor.

If you decide to use the photo detector without an Edmund Optics monitor, you will have to use the sensitivity given in the photo detector's calibration certificate to calculate the power of you laser beam. If your wavelength is not in the calibration certificate, you will have to make a linear interpolation between two of the available calibration values. Fig. 2 and 3 show the typical spectral response.

4.5.1. Linear interpolation formula

$$Sensitivity_{desired\_\lambda} = Sens_{LOW\_\lambda} + \Delta\lambda * Slope$$

$$\Delta\lambda = \lambda_{DESIRED} - \lambda_{LOW}$$

$$Slope = \frac{(Sens_{HIGH\_\lambda} - Sens_{LOW\_\lambda})}{(\lambda_{HIGH} - \lambda_{LOW})}$$

Sensitivity $_{desired\_\lambda}$: The sensitivity at the desired wavelength.
Slope: The slope of the linear interpolation.
$Sens_{LOW\_\lambda}$: Sensitivity at λ_{LOW}.
$Sens_{HIGH\_\lambda}$: Sensitivity at λ_{HIGH}.
λ_{LOW}: The next lowest available wavelength near your desired wavelength.
λ_{HIGH}: The next highest available wavelength near your desired wavelength.
$\lambda_{DESIRED}$: Desired Wavelength.
$\Delta\lambda$: The difference between the desired wavelength and the inferior wavelength.

Example

You have an EO100-Si-HA-OD1 and your laser is at 632.8 nm.

See your CERTIFICATE OF CALIBRATION for the sensitivity of your detector as a function of the wavelength.

Wavelength (nm)	Sensitivity (A/W)
620	0.32
630	0.35
640	0.37
650	0.40
660	0.43

632.8 nm is between 630 nm and 640 nm therefore,

$Sens_{LOW\_\lambda}$ = 0.35 A/W
$Sens_{HIGH\_\lambda}$ = 0.37 A/W
λ_{LOW} = 630 nm
λ_{HIGH} = 640 nm
$\Delta\lambda$: 632.8 - 630 = 2.8 nm
Slope: (0.37-0.35)/(640-630) = 0.002
Sensitivity $_{desired\_}\lambda$: 0.35 + 2.8 * 0.002= 0.356 A/W

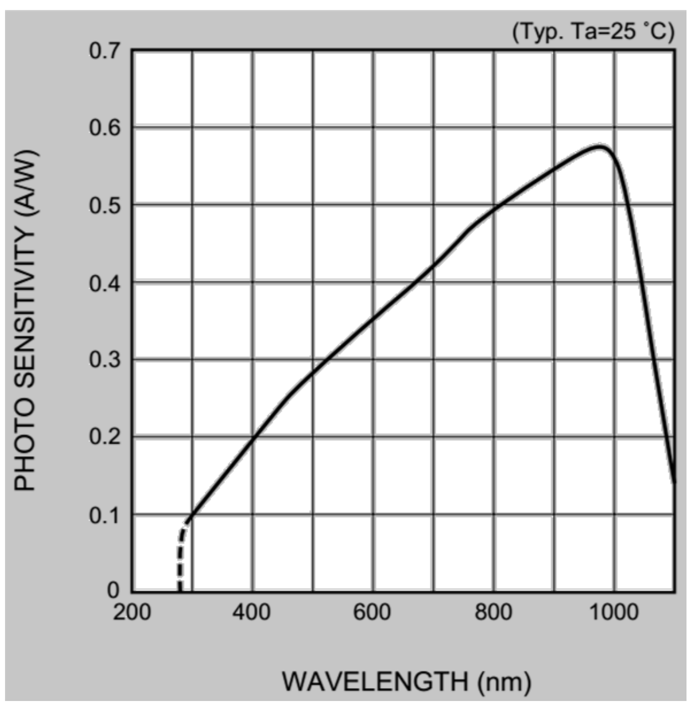


Fig 2. Typical Spectral Response for EO100-Si-HA-OD1

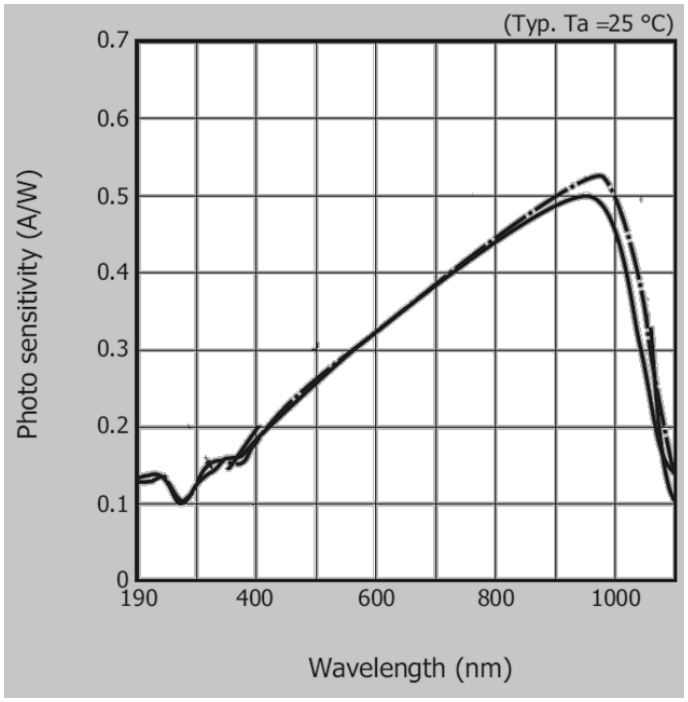


Fig 3. Typical Spectral Response for EO100-SiUV-OD.3

5. APPENDIX: WEEE DIRECTIVE

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

Separation:

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

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