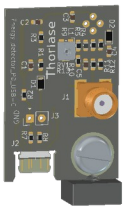
# Optical probe, PD with integrating diode, 1M ohm coaxial pulse energy output signal

## Features

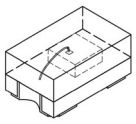
Fast pulse energy probe, - 1MHz
Compact
Prepared for post mount
USB-C power
Easy to customize with specialized PD

## Applications

Optical oscilloscope probe
Pulsed to pulse energy stability characterization
Optical alignment
Free space optics
Fiber optics





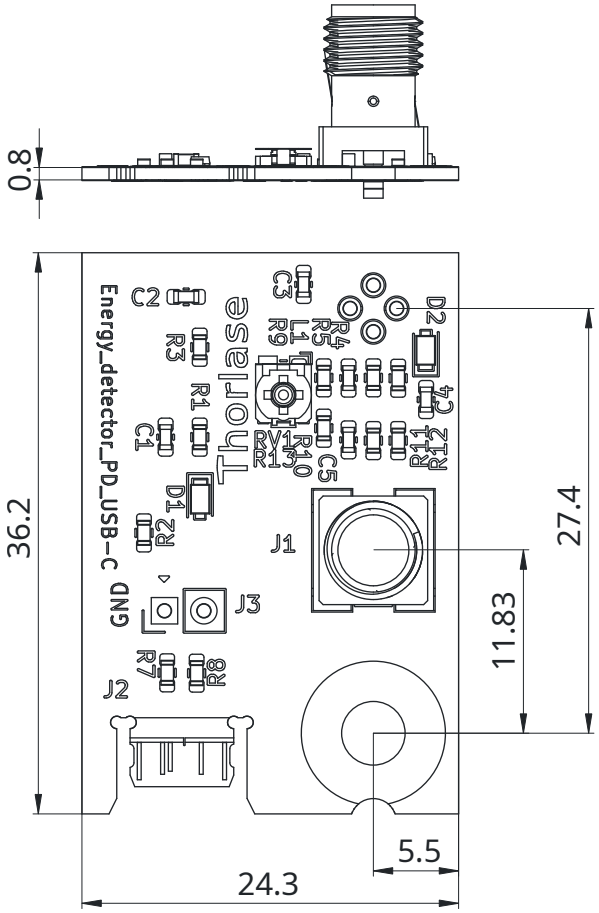


High speed and high sensitive Si PIN photodiode in 0805 SMD package.

## Description

The Energy detector PD USB-C is a photodiode based pulse energy probe. It uses a diode and capacitor integrator. The output has a peak voltage proportional to the pulse energy. It is used in conjunction with an oscilloscope (1M ohm input). It is particularly suited for characterization of pulse trains on digital oscilloscope. With a fast photodetector the finite Memory depth can lead to undersampling of the peak in pulse trains. The integration and filtering on the Energy_detector_PD_USB-C ensures that the pulse energy is correctly sampled even for long time scales. The board is standard fitted with a 0805 SMD Si PD. For particular wavelengths the PD can be replaced. The board has a through hole PD footprint to accommodate alternative TO can or plastic overmolded PD's.

## Drawing (mm)




## Absolute Maximum Ratings

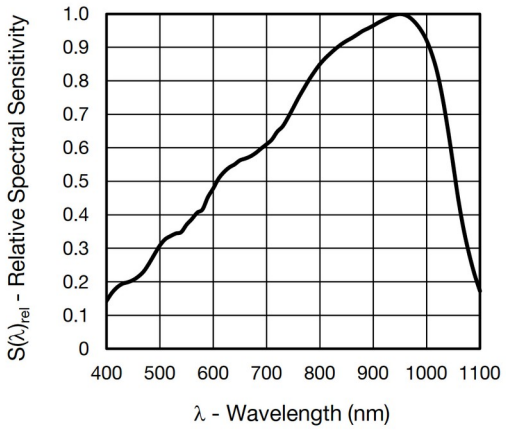
Bias voltage (J3 )……..…24V
Imax_PD…….5mA
Maximum Operating Temperature…….+50°C
Storage Temperature……..-5°C to +50°C

## Specifications

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|
| Active area | *Aact* | | 0.23 | | $mm^2$ | |
| Responsivity range | *BWo* | 350 | | 1120 | nm | |
| Peak Responsivity wavelength | *λp* | | 900 | | nm | |
| Peak Responsivity | *Rp* | | 0.55 | | A/W | |
| Output Conversion | *Ve* | | 0.6E9 | | V/J | Unit volt per joule |

Note: Parameters for factory fitted 0805 SMD Si PD.

## Relative responsivity




## Connector pinning

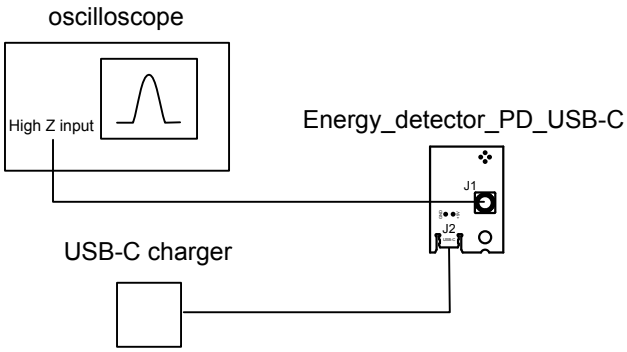
| J1 SMA Connector Receptacle, Female Socket 50 Ohms | |
|---|---|
| pin | Description |
| 1 | Vout |
| 2 | Earth |

| J3 HEADER VERT 2POS 2.54MM | |
|---|---|
| pin | Description |
| 1 | GND, Alternative / additional GND connection |
| 2 | Alternative bias supply input. Use when J2 is not connected |

| J2 USB-C power | |
|---|---|
| pin | Description |
| A1 | GND |
| A4 | VBUS +5V |
| A5 | CC1 5.1k ohm to GND |
| A9 | VBUS +5V |
| A12 | GND |
| B1 | GND |
| B4 | VBUS +5V |
| B5 | CC2 5.1k ohm to GND |
| B9 | VBUS +5V |
| B12 | GND |

## Application Information

The typical application of the Energy_detector_PD_USB-C is characterization pulse train transients. The setup is shown the connections to oscilloscope (high Z, 1M ohm) input. The PCB connector J2 is input for USB-C power.




The coaxial output J1 from the Energy_detector_PD_USB-C is connected to a 1M ohm oscilloscope input to visualize the signal. The signal maximum value is proportional to the pulse energy on the PD.

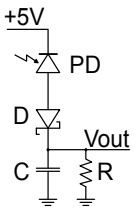
The mechanical arrangement for measuring free space optical beams is shown below.



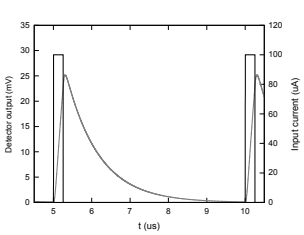
The board can be mounted on an ½ inch metric (M4) optical post with a mounting bracket.

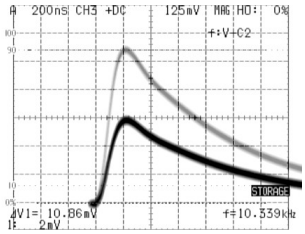
### *Working principle*

A simplified schematic of the Energy_detector_PD_USB-C show the reverse based PD, which acts as a current source. The current goes through the diode (D) so the charge accumulate on the capacitor (C). The resistor (R) gives a discharge path to reset in between pulses.




The graph show a simulated detector response to a 250ns square pulse

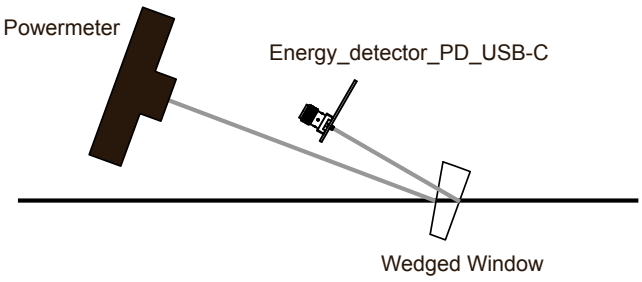



The detector integrates the pulse. The pulse energy is proportional to the max value of the signal. Signal filtering on the board produce a smooth signal, which is not demanding on the oscilloscope. The oscilloscope screenshot is for a 2ns pulse at two energy levels. The signal decays in between pulses. The Energy_detector_PD USB-C has a trimmer to optimize the decay time for the measured pulse train. The signal conditioning on the board is all passive for maximum stability. The EPDUSB can be calibrated in a fixed setup or used for measuring relative variations.

### *Beam tapping*

A good peak power on the PD is around 10 mW peak. To characterize lasers with higher peak power use a beam tap.




An uncoated wedged window makes a good beam tap, beam sampler. Any piece of glass gives ~4% reflection. For smaller tap ratio use an AR coated window. A wedged window prevents interference between front and back facet reflections. The divergence between the two beams gives two tap signals. Use one for the EPD and the other for power or energy meter. The small size of the Energy_detector_PD_USB-C allow a compact setup.

### *PD replacement*

One of the advantage of the Energy_detector_PD_USB-C is that the photodiode can be changed by the user. This allows selection of a PD with spectral response matching the laser under characterization. For energy detection select a large area PD, eg. 1 $mm^2$ or larger for better light collection and without excessive speed. Use Desoldering Tweezers to remove the fitted 0805 PD. Alternatively use a solder iron with a large drop of solder to desolder both terminals at the same time. Clean the PD through hole footprint with a desolder pump.

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|
| Output Conversion for EPD board, 1k ohm trimmer set | *Vc* | | 1.0E9 | | V/C | Unit volt per coulomb |

### *List of accessories*

This is a list of accessories that are not included in the kit but are often used together with the kit.

| **Description** | **Supplier** | **Part number** |
|---|---|---|
| SMA to BNC male cable | SparkFun Electronics | 27480 |
| | Amphenol | RF 095-850-249M100 |
| Ø12.7 mm Stainless Steel Optical Post | Ibtek | OP-75 |
| | Thorlabs | TR100/M |
| TUNING TOOL FLAT 5" | Bourns Inc. | H-91 |
| Specialty photodiode 400nm - 1100nm | ams OSRAM AG | SFH 203 P |
| Specialty photodiode 750nm - 1750nm | Marktech Optoelectronics | MTPD3001D3-030 |
| Wedged Window | Thorlabs | WW41050 |
| | Lambda | Wedge Windows (WW) |

## Document control

| Version | Apply to | Data |
|---|---|---|
| Datasheet_Energy_detector_PD_USB-C | Energy_detector_PD_USB-C_V1r3 | 20261030 |
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