DET10A Operating Manual – High Speed Silicon Detector

Description:
The Thorlabs DET10A is a ready-to-use high-speed photo detector. The unit comes complete with a photodiode and internal 12V bias battery enclosed in a rugged aluminum housing. The DET10A includes a removable 1” optical coupler (SM1T1), providing easy mounting of ND filters, spectral filters, fiber adapters (SMA, FC and ST style), and other Thorlabs 1” stackable lens mount accessories.

The DET10A includes two #8-32 tapped mounting holes with a 0.25” mounting depth, while the DET10A/M has two M4 tapped mounting holes. A 12V A23 battery is included.

Specifications:

<table>
<thead>
<tr>
<th>Electrical</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector:</td>
<td>Silicon PIN</td>
</tr>
<tr>
<td>Active Area:</td>
<td>0.8mm² (Ø1.0mm)</td>
</tr>
<tr>
<td>Wavelength Range:</td>
<td>$\lambda$ 200 to 1100 nm</td>
</tr>
<tr>
<td>Peak Wavelength:</td>
<td>$\lambda_p$ 750nm (typ)</td>
</tr>
<tr>
<td>Peak Response (typ):</td>
<td>$R(\lambda_p)$ 0.45 A/W (typ)</td>
</tr>
<tr>
<td>Shunt Resistance:</td>
<td>$R_{sh}$ &gt;10MΩ</td>
</tr>
<tr>
<td>Diode Capacitance:</td>
<td>$C_J$ 6pF</td>
</tr>
<tr>
<td>Rise/Fall Time:</td>
<td>$t_r$ 1ns (max.)</td>
</tr>
<tr>
<td>Linearity Limit (Current):</td>
<td>1mA</td>
</tr>
<tr>
<td>(Power):</td>
<td>2mW (min @ $\lambda_p$)</td>
</tr>
<tr>
<td>NEP (750nm):</td>
<td>1.9x10^{-14} W/Hz (max.)</td>
</tr>
<tr>
<td>Bias Voltage:</td>
<td>$V_{Bias}$ 10 V (9V min)</td>
</tr>
<tr>
<td>Dark Current**:</td>
<td>$I_D$ 0.3nA (2nA max.)</td>
</tr>
<tr>
<td>Output Voltage (50Ω):</td>
<td>$V_{OUT}$ 0 to 10V</td>
</tr>
<tr>
<td>Damage Threshold:</td>
<td>100mW/cm²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>On / Off Switch:</td>
<td>Slide</td>
</tr>
<tr>
<td>Battery Check Switch:</td>
<td>Momentary Pushbutton</td>
</tr>
<tr>
<td>Output:</td>
<td>BNC (DC Coupled)</td>
</tr>
<tr>
<td>Package Size:</td>
<td>2.8”x1.9” x 0.83”</td>
</tr>
<tr>
<td>PD Surface Depth:</td>
<td>0.11” (2.8mm)</td>
</tr>
<tr>
<td>Weight:</td>
<td>0.2 lbs</td>
</tr>
<tr>
<td>Accessories:</td>
<td>SM1T1 Coupler</td>
</tr>
<tr>
<td></td>
<td>SM1RR Retainer Ring</td>
</tr>
<tr>
<td>Storage Temp:</td>
<td>-25 to 70°C</td>
</tr>
<tr>
<td>Operating Temp:</td>
<td>10 to 50°C</td>
</tr>
<tr>
<td>Battery:</td>
<td>A23, 12VDC, 40mAh</td>
</tr>
<tr>
<td>Low Battery Voltage&lt;sup&gt;3&lt;/sup&gt;:</td>
<td>(See ‘Battery Check’)</td>
</tr>
<tr>
<td>$V_{OUT}$ (Hi-Z):</td>
<td>~9V</td>
</tr>
<tr>
<td>$V_{OUT}$ (50Ω):</td>
<td>~400mV</td>
</tr>
</tbody>
</table>

1. All measurements performed with a 50Ω load unless stated otherwise.
2. Measured with specified Bias Voltage.
3. Assumes the battery voltage drops below 9.6V. The reverse protection diode generates a 0.6V drop.

![Figure 1 - DET10A Spectral Responsivity Curve](image)

Page 1 of 5
**Operation**

Thorlabs DET series are ideal for measuring both pulsed and CW light sources. The DET10A includes a reversed-biased PIN photo diode, bias battery, and ON/OFF switch packaged in a rugged housing. The BNC output signal is the direct photocurrent out of the photo diode anode and is a function of the incident light power (P) and wavelength (\(\lambda\)). The Spectral Responsivity, \(\mathcal{R}(\lambda)\), can be obtained from Figure 1 to estimate the amount of photocurrent to expect. Most users will wish to convert this photocurrent to a voltage (\(V_{\text{OUT}}\)) for viewing on an oscilloscope or DVM. This is accomplished by adding an external load resistance, \(R_{\text{LOAD}}\). The output voltage is derived as:

\[
V_{\text{OUT}} = P \times \mathcal{R}(\lambda) \times R_{\text{LOAD}}
\]

It should be noted that the load resistor will react with the photodetector junction capacitance (\(C_J\)) to limit the bandwidth. For best frequency response, a 50Ω terminator should be used. The bandwidth (\(f_{\text{BW}}\)) and the rise-time response (\(t_r\)) can be approximated using the diode capacitance (\(C_J\)) and the load resistance (\(R_{\text{LOAD}}\)) as shown below:

\[
f_{\text{BW}} = \frac{1}{(2 \times \pi \times R_{\text{LOAD}} \times C_J)}
\]

\[
t_r = \frac{0.35}{f_{\text{BW}}}
\]

For maximum bandwidth, we recommend using a 50Ω coax cable with a 50Ω terminating resistor at the opposite end of the coax. This will also minimize ringing by matching the coax with its characteristic impedance. If bandwidth is not important, you may increase the amount of voltage for a given input light by increasing the \(R_{\text{LOAD}}\).

**Setup**

- Unpack the optical head, install a Thorlabs TR-series ½” diameter post into one of the #8-32 (M4 on /M version) tapped holes, located on the bottom and side of the sensor, and mount into a PH-series post holder.
- Attach a 50Ω coax cable (i.e. RG-58U) to the output of the DET. Select and install a terminating resistor to the remaining end of the cable and connect to a voltage measurement device. See the ‘Operation’ Section to determine resistor values. Thorlabs sells a 50Ω terminator (T4119) for best frequency performance and a variable terminator (VT1) for output voltage flexibility. Note the input impedance of your measurement device since this will act as a terminating resistor. A load resistor is not necessary when using current measurement devices.
- Power the DET on using the power switch. To check battery voltage, see ‘Battery Check’ below.
- Install any desired filters, optics, adapters, or fiber adapters to the input aperture. **Caution:** The DET10A was designed to allow maximum accessibility to the photodetector by having the front surface of the diode flush with the outside of the DET housing. When using fiber adapters, make sure that the fiber ferrule does not crash into the detector. Failure to do so may cause damage to the diode and / or the fiber. An easy way to accomplish this is to install a SM1RR retaining ring (included with the DET10A) inside the 1” threaded coupler before installing the fiber adapter.
- Apply a light source to the detector.

**Battery Check and Replacement**

**Battery Check**

Thorlabs new DET series includes a battery check feature that will allow the user to monitor the bias voltage on the output BNC. Simply hold down the “VBIAS OUT” bottom located on the bottom edge of the unit. The bias voltage will be output to the BNC. If a high impedance load is used (>10kΩ), the output will be equal to the bias voltage. This feature includes a 1.05kΩ current limiting resistor (\(R_{\text{CL}}\)) to prevent excessive loading of the battery if using small terminating resistors. For example, a 50Ω load resistor with a 10V bias will produce a 200mA current without this resistor. This will significantly decrease lifetime of the battery. The output bias voltage will be dependent on the load.
resistor as described below. The A23 battery voltage characteristics show that the charge level is almost depleted as the voltage drops below 10V. For this calculation we assume 9.6V since \( V_{\text{BAT}} \) = low battery voltage – one diode drop (0.6V) = ~9V. The detector will continue to operate until the battery charge is completely drained; however, these numbers provide a reference point at which the battery should be replaced.

\[
V_{\text{OUT}} = V_{\text{BAT}} \left[ \frac{R_{\text{LOAD}}}{R_{\text{LOAD}} + R_{\text{CL}}} \right]
\]

For \( V_{\text{BAT}} \) (min) = 9V, \( R_{\text{LOAD}} = 50\ \Omega \), and \( R_{\text{CL}} = 1050\ \Omega \)
\[
V_{\text{OUT}} = 410\text{mV}
\]

Figure 3 – Battery Check Schematic

**Battery Replacement**
Thorlabs delivers each DET with an A23 12V battery installed. This battery is readily available at most retail stores, as well as through Thorlabs. The battery supplied will deliver about 40 hours with a 1mA load, roughly equivalent to a continuous 1.5mW light source at peak wavelength. The supply current when the unit is on and no light is applied is very small and should not significantly degrade the battery.

Locate the battery cap directly above the output BNC. Unthread the cap and remove the battery. Install the new battery into the cap, negative side in, and thread back into the DET. Be careful not to cross thread the cap into the housing. The DET includes a protection diode to prevent damage if the battery is installed backwards. The battery direction is located on the housing.

**Troubleshooting**

There is no signal response.
- Verify that the power is switched on and all connections are secure.
- Verify the proper terminating resistor is installed if using a Voltage measurement device.
- Verify that the optical signal wavelength is within the specified wavelength range.
- Verify that the optical signal is hitting the detector active area.
- Connect the DET to an oscilloscope without a terminating resistor installed. Most general purpose oscilloscopes will have a 10M\(\Omega\) input impedance. Point the detector toward a fluorescent light and verify that a 60Hz (50Hz outside the US) signal appears on the scope. If so the device should be operating properly and the problem may be with the light source or alignment.

There is an AC signal present when the unit is turned off.
The detector has an AC path to ground even with the switch in the OFF position. It is normal to see an output response to an AC signal with the switch in this state. However, because the detector is unbiased, operation in this mode is not recommended.

The output appears AC coupled with long rise times and the power switch ON.
This is usually an indication that the battery level is low and needs to be changed. See the Battery Check and Replacement Section.

**Maintaining the DET10A**
There are no serviceable parts in the DET10A optical sensor. The housing may be cleaned by wiping with a soft damp cloth. The window of the detector should only be cleaned using isopropyl alcohol and optical grade wipes. If you suspect a problem with your DET10A please call Thorlabs and an engineer will be happy to assist you.

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www.thorlabs.jp
Email: sales@thorlabs.jp
WEEE
As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment
  - sold after August 13th 2005
  - marked correspondingly with the crossed out “wheelie bin” logo (see fig. 1)
  - sold to a company or institute within the EC
  - currently owned by a company or institute within the EC
  - still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as
  - pure OEM products, that means assemblies to be built into a unit by the user (e.g. OEM laser driver cards)
  - components
  - mechanics and optics
  - left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste treatment on your own responsibility
If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological background
It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future. The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of live products will thereby avoid negative impacts on the environment.
DET110 - HIGH-SPEED SILICON DETECTOR

DESCRIPTION:

Thorlabs’ DET110 is a ready-to-use high-speed photo detector. The unit comes complete with a photodiode and internal 12V bias battery enclosed in a ruggedized aluminum housing. The head includes a removable 1” optical coupler (SM1T1), providing easy mounting of ND filters; spectral filters and other Thorlabs 1” stackable lens mount accessories. Also available are fiber adapters (SMA, FC and ST style). An #8-32 tapped hole is provided on the base of the housing to mount the detector directly to a Thorlabs’ positioning device (1/2” post holder, mounting plates, etc.).

SPECIFICATIONS:

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector:</td>
<td>Silicon PIN</td>
</tr>
<tr>
<td>Spectral Response:</td>
<td>350-1100nm</td>
</tr>
<tr>
<td>Peak Wavelength:</td>
<td>960nm +/- 50nm</td>
</tr>
<tr>
<td>Rise/Fall Time:</td>
<td>20ns</td>
</tr>
<tr>
<td>Diode Capacitance:</td>
<td>20pF</td>
</tr>
<tr>
<td>NEP:</td>
<td>$1.2 \times 10^{-14} W/\sqrt{Hz}$</td>
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<tr>
<td>Dark Current:</td>
<td>10nA</td>
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<tr>
<td>Active Area:</td>
<td>13mm$^2$, 3.6mm x 3.6mm square</td>
</tr>
<tr>
<td>Linearity Limit:</td>
<td>1mW</td>
</tr>
<tr>
<td>Housing:</td>
<td>Black Anodized Aluminum</td>
</tr>
<tr>
<td>Size:</td>
<td>φ1.43” x 1.67”</td>
</tr>
<tr>
<td>Output:</td>
<td>BNC, DC-Coupled</td>
</tr>
<tr>
<td>Bias:</td>
<td>12V Battery (Type A23)</td>
</tr>
<tr>
<td>Mounting:</td>
<td>8-32 (M4) Tapped Hole</td>
</tr>
<tr>
<td>Diode:</td>
<td>TO-5, Anode Marked</td>
</tr>
<tr>
<td>Socket:</td>
<td>TO-5, Anode Marked</td>
</tr>
<tr>
<td>Damage Threshold:</td>
<td>100mW CW</td>
</tr>
<tr>
<td>Threshold:</td>
<td>0.5 J/cm$^2$ (10ns pulse)</td>
</tr>
</tbody>
</table>

Figure 1. - Mechanical Dimensions

OPERATION:

Thorlabs DET series are ideal for measuring both pulsed and CW light sources. The DET110 includes a reversed-biased PIN photo diode, bias battery, and ON/OFF switch packaged in a ruggedized housing. The BNC output signal is the direct photocurrent out of the photo diode anode and is a function of the incident light power and wavelength. The Spectral Responsivity, $\Re(\lambda)$, can be obtained from Figure 2 to estimate the amount of photocurrent to expect. Most users will wish to convert this photocurrent to a voltage for viewing on an oscilloscope or DVM. This is accomplished by adding an external load resistance, $R_{LOAD}$. The output voltage is derived as:

$$V_O = P \times \Re(\lambda) \times R_{LOAD}$$

The bandwidth, $f_{BW}$, and the rise-time response, $t_R$, are determined from the diode capacitance, $C_J$, and the load resistance, $R_{LOAD}$ as shown below:

$$f_{BW} = 1 / (2 \times \pi \times R_{LOAD} \times C_J)$$
$$t_R = 0.35 / f_{BW}$$

2199-S01 Rev D 8/15/2005
For maximum bandwidth, we recommend using a 50Ω coax cable with a 50Ω terminating resistor at the end of the coax. This will also minimize ringing by matching the coax with its characteristic impedance. If bandwidth is not important, you may increase the amount of voltage for a given input light by increasing the $R_{\text{LOAD}}$ up to a maximum of 10KΩ.

**Note:** The detector has an AC path to ground even with the switch in the OFF position. It is normal to see an output response to an AC signal with the switch in this state. However, because the detector is unbiased, operation in this mode is not recommended.

**Figure 2 - Typical DET110 Spectral Responsivity Curve**

![Graph showing typical DET110 spectral responsivity curve.](image)

**Figure 3 – Circuit Block Diagram**

![Circuit block diagram of the DET110.](image)

**FIBER ADAPTERS AND OTHER ACCESSORIES**

Thorlabs sells a number of accessories that are compatible with the 1" thread on the DET housing including FC, SMA, and ST fiber adapters, stackable lens tubes for mounting optics, and cage assemblies that allow the DET to be incorporated into elaborate 3-D optical assemblies.

**Caution:** The DET110 was designed to allow maximum accessibility to the photo detector by having the front surface of the diode extend outside of the DET housing. When using fiber adapters, make sure that the fiber ferrule does not crash into the detector. Failure to do so may cause damage to the diode and / or the fiber. An easy way to accomplish this is to install a SM1RR retaining ring (included with the DET110) inside the 1" threaded coupler *before* installing the fiber adapter.

Also available are 1ns Si detectors, InGaAs detectors, and a complete line of amplified detectors.

**MAINTAINING THE DET110**

There are no serviceable parts in the DET110 optical head or power supply. The housing may be cleaned by wiping with a soft, damp cloth. The window of the detector should only be cleaned using optical grade wipes. If you suspect a problem with your DET110 please call Thorlabs and technical support will be happy to assist you.
WEEE

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see fig. 1)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste treatment on your own responsibility
If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological background
It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future. The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of live products will thereby avoid negative impacts on the environment.
DET210 - HIGH-SPEED SILICON DETECTOR

DESCRIPTION:
Thorlabs' DET210 is a ready-to-use high-speed photo detector. The unit comes complete with a photodiode and internal 12V bias battery enclosed in a ruggedized aluminum housing. The head includes a removable 1” optical coupler (SM1T1), providing easy mounting of ND filters, spectral filters and other Thorlabs 1” stackable lens mount accessories. Also available are fiber adapters (SMA, FC and ST style). An #8-32 tapped hole is provided on the base of the housing to mount the detector directly to a Thorlabs' positioning device (1/2” post holder, mounting plates, etc.).

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<thead>
<tr>
<th>Feature</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Detector</td>
<td>Silicon PIN</td>
</tr>
<tr>
<td>Spectral Response</td>
<td>200-1100nm</td>
</tr>
<tr>
<td>Peak Wavelength</td>
<td>730nm +/- 50nm</td>
</tr>
<tr>
<td>Peak Response</td>
<td>0.45 A/W</td>
</tr>
<tr>
<td>Rise/Fall Time</td>
<td>1ns</td>
</tr>
<tr>
<td>Diode Capacitance</td>
<td>6pF</td>
</tr>
<tr>
<td>NEP</td>
<td>5 x 10^-14W/√HZ</td>
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<tr>
<td>Dark Current</td>
<td>0.80nA @ -12V</td>
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<tr>
<td>Active Area</td>
<td>ϕ1mm (0.8mm²)</td>
</tr>
<tr>
<td>Linearity Limit</td>
<td>1mW</td>
</tr>
<tr>
<td>Housing</td>
<td>Black Anodized Aluminum</td>
</tr>
<tr>
<td>Size</td>
<td>ϕ1.43” x 1.67”</td>
</tr>
<tr>
<td>Output</td>
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</tr>
<tr>
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<tr>
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<td>8-32 (M4) Tapped Hole</td>
</tr>
<tr>
<td>Diode Socket</td>
<td>TO-5, Anode Marked</td>
</tr>
<tr>
<td>Damage Threshold</td>
<td>100mW CW</td>
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<tr>
<td></td>
<td>0.5 J/cm² (10ns pulse)</td>
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</table>

OPERATION:
Thorlabs DET series are ideal for measuring both pulsed and CW light sources. The DET210 includes a reversed-biased PIN photo diode, bias battery, and ON/OFF switch packaged in a ruggedized housing. The BNC output signal is the direct photocurrent out of the photo diode anode and is a function of the incident light power and wavelength. The Spectral Responsivity, $\mathcal{R}$(λ), can be obtained from Figure 2 to estimate the amount of photocurrent to expect. Most users will wish to convert this photocurrent to a voltage for viewing on an oscilloscope or DVM. This is accomplished by adding an external load resistance, $R_{LOAD}$. The output voltage is derived as:

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The bandwidth, $f_{BW}$, and the rise-time response, $t_r$, are determined from the diode capacitance, $C_J$, and the load resistance, $R_{LOAD}$ as shown below:

$$f_{BW} = 1 / (2 \ast \pi \ast R_{LOAD} \ast C_J)$$
$$t_r = 0.35 / f_{BW}$$

Figure 1. - Mechanical Dimensions

2201-S01 Rev E 8/15/2005
For maximum bandwidth, we recommend using a $50\,\Omega$ coax cable with a $50\,\Omega$ terminating resistor at the end of the coax. This will also minimize ringing by matching the coax with its characteristic impedance. If bandwidth is not important, you may increase the amount of voltage for a given input light by increasing the $R_{\text{LOAD}}$ up to a maximum of $10\,K\,\Omega$.

**Note:** The detector has an AC path to ground even with the switch in the OFF position. It is normal to see an output response to an AC signal with the switch in this state. However, because the detector is unbiased, operation in this mode is not recommended.

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![Figure 2 - DET210 Spectral Responsivity Curve](image)

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**Figure 3 – Circuit Block Diagram**

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**FIBER ADAPTERS AND OTHER ACCESSORIES**

Thorlabs sells a number of accessories that are compatible with the 1" thread on the DET housing including FC, SMA, and ST fiber adapters, stackable lens tubes for mounting optics, and cage assemblies that allow the DET to be incorporated into elaborate 3-D optical assemblies.

**Caution:** The DET210 was designed to allow maximum accessibility to the photo detector by having the front surface of the diode extend outside of the DET housing. When using fiber adapters, make sure that the fiber ferrule does not crash into the detector. Failure to do so may cause damage to the diode and/or the fiber. An easy way to accomplish this is to install a SM1RR retaining ring (included with the DET210) inside the 1" threaded coupler before installing the fiber adapter.

Also available are InGaAs detectors, large area Si detectors, and a complete line of amplified detectors.

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**MAINTAINING THE DET210**

There are no serviceable parts in the DET210 optical head or power supply. The housing may be cleaned by wiping with a soft, damp cloth. The window of the detector should only be cleaned using optical grade wipes. If you suspect a problem with your DET210 please call Thorlabs and technical support will be happy to assist you.
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PDA55 Operating Manual - Switchable Gain, Amplified Silicon Detector

Description:
The PDA55 is an amplified, switchable-gain, silicon detector designed for detection of light signals from DC to 10 MHz. A five-position rotary switch allows the user to vary the gain in 10 dB steps. A buffered output drives a 50Ω load impedance up to 5 volt. The PDA55 housing includes a removable threaded coupler that is compatible with any number of Thorlabs 1” threaded accessories. This allows convenient mounting of external optics, light filters, apertures, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories.

The PDA55 has an 8-32 tapped mounting hole with a 0.25” mounting depth and includes a 120VAC power AC/DC supply. The PDA55-EC has an M4 tapped mounting hole and includes a 230VAC AC/DC power supply.

Specifications:

<table>
<thead>
<tr>
<th>Detector</th>
<th>Performance</th>
<th>min</th>
<th>typical</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector</td>
<td>Silicon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active Area</td>
<td>3.6 x 3.6 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response</td>
<td>320 to 1100 nm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Response</td>
<td>0.6 A/W @ 960 nm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bandwidth</td>
<td>DC to 10MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEP (960nm, 0dB)</td>
<td>1 x 10^-11 W/√Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEP (960nm, 10dB)</td>
<td>8 x 10^-12 W/√Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEP (960nm, 20dB)</td>
<td>5 x 10^-12 W/√Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEP (960nm, 30dB)</td>
<td>5 x 10^-12 W/√Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEP (960nm, 40dB)</td>
<td>4 x 10^-12 W/√Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Voltage (50Ω)</td>
<td>0 to 5V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>0 to 10V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>50 ohms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load Impedance</td>
<td>Hi-Z to 50 ohms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain Steps</td>
<td>0, 10, 20, 30, 40 dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain Switch</td>
<td>5-Pos Rotary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On / Off Switch</td>
<td>Toggle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>BNC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage Threshold</td>
<td>100mW CW 0.5J/cm^2 10ns PW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Head Size</td>
<td>6.425” x 1.45”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>60 grams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td>SM1T1 Coupler</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temp</td>
<td>-55 to 125°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temp</td>
<td>-20 to 70°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Power Supply</td>
<td>AC - DC Converter (AC-240VAC-EC version)</td>
<td>50-60Hz, 5W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Power</td>
<td>100-120VAC, (220-240VAC-EC version)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: The PDA55 has a 50Ω series terminator resistor (i.e. in series with amplifier output). This forms a voltage divider with any load impedance (e.g. 50Ω load divides signal in half).

Note 2: Newer PDA’s have a smaller package diameter to easily fit into Thorlabs cage plate assemblies. Also note that the length includes the SM1T1 mounting adapter and the BNC / power switch.

Setup

- Unpack the optical head, install a Thorlabs TR-series ½” diameter post into the 8-32 (M4 on -EC version) tapped hole on the bottom of the head, and mount into a PH-series post holder.
- Connect the power supply 5-pin DIN plug into the mating receptacle on the PDA55.
- Plug the power supply into a 50-60Hz, 100-120VAC outlet (220-240VAC for -EC version).
• Attach a 50Ω coax cable (i.e. RG-58U) to the output of the PDA. When running cable lengths longer than 12" we recommend terminating the opposite end of the coax with a 50Ω resistor (Thorlabs p/n T4119) for maximum performance.

**Operation**

• The PDA55 gain is adjusted using a small slotted screwdriver to turn the internal, gain-setting rotary switch. An access hole labeled **GAIN** is provided on the rear panel for this purpose. The gain is set to 0dB, when the slot is aligned counterclockwise as far as it will go. Each clockwise click of the switch increases the gain by 10 dB. *Do not use excessive force when adjusting the gain switch.*

• The PDA55 is switched on by the POWER toggle switch located on the rear of the optical sensor.

• The light to voltage conversion can be estimated by factoring the wavelength-dependent responsivity of the silicon detector with the transimpedance gain as shown below:

  \[
  \text{output in volts / watt} = \text{transimpedance gain (V/A)} \times \text{responsivity (A/W)}
  \]

• The maximum output of the PDA55 is 10 volts for high impedance loads (5V for 50Ω loads). Adjust the gain so that the measured signal level out of the PDA55 is below 10 volts (5 volts with a 50Ω load) to avoid saturation. If necessary, use external neutral density filters to reduce the input light level.

• For maximum linearity performance when measuring focused beams, fiber outputs, or small diameter beams, do not exceed a maximum intensity of 10mW/cm².

• Because of the finite gain-bandwidth performance common to all amplifier circuits, the bandwidth of the PDA55 goes down with increased gain settings.

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### Fiber Adapters and Other Accessories

Thorlabs sells a number of accessories that are compatible with the 1" thread on the PDA housing including FC, SMA, and ST fiber adapters, stackable lens tubes for mounting optics, and cage assemblies that allow the PDA to be incorporated into elaborate 3-D optical assemblies.

Caution: The PDA55 was designed to allow maximum accessibility to the photodetector by having the front surface of the diode extend outside of the PDA housing. When using fiber adapters, make sure that the fiber ferrule does not crash into the detector. Failure to do so may cause damage to the diode and / or the fiber. An easy way to accomplish this is to install a SM1RR retaining ring (included with the PDA55) inside the 1" threaded coupler *before* installing the fiber adapter.

Also available in the PDA series are InGaAs and higher bandwidth silicon models.

### Maintaining the PDA55

There are no serviceable parts in the PDA55 optical head or power supply. The housing may be cleaned by wiping with a soft damp cloth. The window of the detector should only be cleaned using optical grade wipes. If you suspect a problem with your PDA55 please call Thorlabs and technical support will be happy to assist you.

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![Figure 1. Detector Responsivity](image-url)

<table>
<thead>
<tr>
<th>Gain Switch</th>
<th>Gain (dB)</th>
<th>Transimpedance Gain (V/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1.5 \times 10^4</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>4.7 \times 10^4</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>1.5 \times 10^5</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>4.7 \times 10^5</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>1.5 \times 10^6</td>
</tr>
</tbody>
</table>

Table 1. Gain Settings
WEEE
As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see fig. 1)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste treatment on your own responsibility
If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological background
It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future. The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of live products will thereby avoid negative impacts on the environment.

Figure 2. Crossed out “wheelie bin” symbol
12" CABLE LENGTH (TYP)

1.035-40 THREAD

#8-32 TAPPED TO 1/4" DEPTH (M4 TAP FOR EC VERSION)

SM1T1 THEADED COUPLER (REMOVABLE)

CROSS SECTION VIEW X-X

INFORMATION ONLY, NOT FOR MANUFACTURING

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PDA55 OR PDA55-EC

THORLABS INC. NEWTON, NJ

2058-D02 Rev F 8/15/2005
Page 4 of 4
PDA400 Operating Manual - Switchable Gain, Amplified InGaAs Detector

Description:
The PDA400 is an amplified, switchable-gain, InGaAs detector designed for detection of light signals from DC to 10 MHz. A five-position rotary switch allows the user to vary the gain in 10 dB steps. A buffered output drives a 50Ω load impedance up to 5 volt. The PDA400 housing includes a removable threaded coupler that is compatible with any number of Thorlabs 1” threaded accessories. This allows convenient mounting of external optics, light filters, apertures, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories.

The PDA400 has an 8-32 tapped mounting hole with a 0.25” mounting depth and includes a 120VAC power AC/DC supply. The PDA400-EC has an M4 tapped mounting hole and includes a 230VAC AC/DC power supply.

Specifications:

<table>
<thead>
<tr>
<th>Detector</th>
<th>Performance</th>
<th>min</th>
<th>typical</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 dB Setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transimpedance Gain</td>
<td>1 \times 10^5 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trans. Gain (50Ω)</td>
<td>0.75 \times 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth</td>
<td>10 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise (RMS)</td>
<td>0.28 mV</td>
<td>0.33 mV</td>
<td>0.44 mV</td>
</tr>
<tr>
<td></td>
<td>Offset</td>
<td>-5 mV</td>
<td>6 mV</td>
<td>15 mV</td>
</tr>
<tr>
<td></td>
<td>10 dB Setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transimpedance Gain</td>
<td>4.7 \times 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trans. Gain (50Ω)</td>
<td>2.35 \times 10^4 V/A</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth</td>
<td>2.2 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise (RMS)</td>
<td>0.30 mV</td>
<td>0.35 mV</td>
<td>0.45 mV</td>
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<tr>
<td></td>
<td>Offset</td>
<td>-5 mV</td>
<td>8 mV</td>
<td>15 mV</td>
</tr>
<tr>
<td></td>
<td>20 dB Setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transimpedance Gain</td>
<td>1 \times 10^5 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trans. Gain (50Ω)</td>
<td>0.75 \times 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth</td>
<td>700 kHz</td>
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<tr>
<td></td>
<td>Noise (RMS)</td>
<td>0.36 mV</td>
<td>0.40 mV</td>
<td>0.46 mV</td>
</tr>
<tr>
<td></td>
<td>Offset</td>
<td>-10 mV</td>
<td>10 mV</td>
<td>20 mV</td>
</tr>
<tr>
<td></td>
<td>30 dB Setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transimpedance Gain</td>
<td>4.7 \times 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trans. Gain (50Ω)</td>
<td>2.35 \times 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth</td>
<td>160 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise (RMS)</td>
<td>0.48 mV</td>
<td>0.53 mV</td>
<td>0.60 mV</td>
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<tr>
<td></td>
<td>Offset</td>
<td>-20 mV</td>
<td>20 mV</td>
<td>50 mV</td>
</tr>
<tr>
<td></td>
<td>40 dB Setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transimpedance Gain</td>
<td>1 \times 10^5 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trans. Gain (50Ω)</td>
<td>0.75 \times 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth</td>
<td>50 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise (RMS)</td>
<td>0.74 mV</td>
<td>0.81 mV</td>
<td>1.0 mV</td>
</tr>
<tr>
<td></td>
<td>Offset</td>
<td>-100 mV</td>
<td>20 mV</td>
<td>100 mV</td>
</tr>
</tbody>
</table>

Note 1: The PDA400 has a 50Ω series termination resistance (i.e. in series with amplifier output). This forms a voltage divider with any load impedance (e.g. 50Ω load divides signal in half).

Note 2: Newer PDA’s have a smaller package diameter to easily fit into Thorlabs cage plate assemblies. Also note that the length includes the SM1T1 mounting adapter and the BNC / power switch.

Setup:
- Unpack the optical head, install a Thorlabs TR-series ½” diameter post into the 8-32 (M4 on -EC version) tapped hole on the bottom of the head, and mount into a PH-series post holder.
- Connect the power supply 5-pin DIN plug into the mating receptacle on the PDA400.
- Plug the power supply into a 50-60Hz, 100-120VAC outlet (220-240VAC for -EC version).
- Attach a 50Ω coax cable (i.e. RG-58U) to the output of the PDA. When running cable lengths longer than 12” we recommend terminating the opposite end of the coax with a 50Ω resistor (Thorlabs p/n T4119) for maximum performance.

**Operation**
- The PDA400 gain is adjusted using a small slotted screwdriver to turn the internal, gain-setting rotary switch. An access hole labeled **GAIN** is provided on the rear panel for this purpose. The gain is set to 0dB, when the slot is aligned counterclockwise as far as it will go. Each clockwise click of the switch increases the gain by 10 dB. **Do not use excessive force when adjusting the gain switch.**
- The PDA400 is switched on by the POWER toggle switch on the rear of the head.
- The light to voltage conversion can be estimated by factoring the wavelength-dependent responsivity of the InGaAs detector with the transimpedance gain
  
  \[
  \text{output in volts / watt} = \text{transimpedance gain (V/A)} \times \text{responsivity (A/W)}
  \]

- The maximum output of the PDA400 is 10 volts for high impedance loads (5V for 50Ω loads). Adjust the gain so that the measured signal level out of the PDA400 is below 10 volts (5 volts with a 50Ω load) to avoid saturation. If necessary, use external neutral density filters to reduce the input light level.
- For maximum linearity performance when measuring focused beams, fiber outputs, or small diameter beams, do not exceed a maximum intensity of 10mW/cm².
- Because of the finite gain-bandwidth performance common to all amplifier circuits, the bandwidth of the PDA400 goes down with increased gain settings.

<table>
<thead>
<tr>
<th>Gain Switch position</th>
<th>Gain (dB)</th>
<th>Transimpedance Gain (V/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1.5 × 10⁴</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>4.7 × 10⁴</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>1.5 × 10⁵</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>4.7 × 10⁵</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>1.5 × 10⁶</td>
</tr>
</tbody>
</table>

Table 1. Gain Settings

**Fiber Adapters and Other Accessories**
Thorlabs sells a number of accessories that are compatible with the 1” thread on the PDA housing including FC, SMA, and ST fiber adapters, stackable lens tubes for mounting optics, and cage assemblies that allow the PDA to be incorporated into elaborate 3-D optical assemblies.

**Caution:** The PDA400 was designed to allow maximum accessibility to the photodetector by having the front surface of the diode extend outside of the PDA housing. When using fiber adapters, make sure that the fiber ferrule does not crash into the detector. Failure to do so may cause damage to the diode and / or the fiber. An easy way to accomplish this is to install a SM1RR retaining ring (included with the PDA55) inside the 1” threaded coupler **before** installing the fiber adapter.

Also available in the PDA series are and higher bandwidth silicon and InGaAs models.

**Maintaining the PDA400**
There are no serviceable parts in the PDA400 optical head or power supply. The housing may be cleaned by wiping with a soft damp cloth. The window of the detector should only be cleaned using optical grade wipes. If you suspect a problem with your PDA400 please call Thorlabs and an engineer will be happy to assist you.
WEEE
As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

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Ecological background
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Detector Response Curve

PDA400 Responsivity

Responsivity (A/W)

Wavelength (nm)

800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
SWITCHABLE GAIN AMPLIFIED InGaAs SENSOR

12" CABLE LENGTH (TYP)

PDA400

GAIN

OFF

ON

12" CABLE LENGTH (TYP)

1.035-40 THREAD

#8-32 TAPPED TO 1/4" DEPTH
(M4 TAP FOR EC VERSION)

SM1T1 THEADED COUPLER (REMOVABLE)

Ø1mm InGaAs DETECTOR

0.05"

0.95"

0.67"

0.33"

DC POWER INPUT

EARTH GRID

COM

N/A

-12V

+12V

END VIEW OF 5-PIN DIN RECEPTACLE ON DETECTOR

CROSS SECTION VIEW X-X

INFORMATION ONLY, NOT FOR MANUFACTURING
# PDA520 Operating Manual

## High Precision Amplified Silicon Detector

### Description:
The PDA520 is a high precision, high accuracy, low noise, and switchable-gain silicon detector designed for detection of light in the wavelength range of 400 to 1100nm. A three-position rotary switch allows the user to vary the gain in 10 dB steps. A buffered output drives a 50Ω load impedance up to 5 volt. The PDA520 housing includes a removable threaded coupler that is compatible with any number of Thorlabs 1” threaded accessories. This allows convenient mounting of external optics, light filters, apertures, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories.

The PDA520 has an 8-32 tapped mounting hole with a 0.25” mounting depth and includes a 120VAC 50-60Hz power supply. The PDA520-EC has an M4 tapped mounting hole and includes a 230VAC 50-60Hz power supply.

### Specifications:

#### Detector

<table>
<thead>
<tr>
<th>Performance</th>
<th>min</th>
<th>typical</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0 dB Setting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transimpedance Gain</td>
<td>1.0 x 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trans. Gain (50Ω)</td>
<td>5.0 x 10^3 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain Error (3-Pos)</td>
<td>+/- 0.1%</td>
<td>+/- 0.15%</td>
<td></td>
</tr>
<tr>
<td>NEP (980nm, 0dB)</td>
<td>&lt;3 x 10^-11 W/√Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise (RMS)</td>
<td>&lt;0.1 mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offset</td>
<td>-1 mV</td>
<td>+/- 0.1 mV</td>
<td>1 mV</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>250kHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 10 dB Setting

<table>
<thead>
<tr>
<th>Performance</th>
<th>min</th>
<th>typical</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transimpedance Gain</td>
<td>1.0 x 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trans. Gain (50Ω)</td>
<td>5.0 x 10^3 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain Error (3-Pos)</td>
<td>+/- 0.12%</td>
<td>+/- 0.15%</td>
<td></td>
</tr>
<tr>
<td>NEP (980nm, 10dB)</td>
<td>5.4 x 10^-11 W/√Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise (RMS)</td>
<td>0.175 mV</td>
<td></td>
<td>0.2 mV</td>
</tr>
<tr>
<td>Offset</td>
<td>-5 mV</td>
<td>+/- 1 mV</td>
<td>5 mV</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>250kHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 20 dB Setting

<table>
<thead>
<tr>
<th>Performance</th>
<th>min</th>
<th>typical</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transimpedance Gain</td>
<td>1.0 x 10^4 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trans. Gain (50Ω)</td>
<td>5.0 x 10^3 V/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain Error (3-Pos)</td>
<td>+/- 0.14%</td>
<td>+/- 0.3%</td>
<td></td>
</tr>
<tr>
<td>NEP (980nm, 20dB)</td>
<td>4.6 x 10^-12 W/√Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise (RMS)</td>
<td>1.2 mV</td>
<td></td>
<td>1.5 mV</td>
</tr>
<tr>
<td>Offset</td>
<td>-20 mV</td>
<td></td>
<td>20 mV</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>160kHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** The PDA520 has a 50Ω terminating resistor in series with amplifier output. This forms a voltage divider with any load impedance (e.g. 50Ω load divides signal in half).

**Note 2:** Newer PDA’s have a smaller package diameter to easily fit into Thorlabs cage plate assemblies. Also note that the length includes the SM1T1 mounting adapter and the BNC / power switch.

**Note 3:** Test performed with a 50Ω terminator and 6’ coax cable.

**Note 4:** See ‘PDA520 Bandwidth’ curve for frequency response.

**Note 5:** Definition of Hi-Z: High Impedance. Refers to an oscilloscope or measurement device input. Actual Impedance values should be 1MΩ or higher. Lower values will create a voltage divider with the output 50Ω impedance and will cause larger gain errors than what is specified.

**Note 6:** The gain error does not apply to the 50Ω load since the user installed output terminating resistor will probably have a resistance tolerance greater than the gain errors above. Also note that the 50Ω output series resistance is 49.9Ω +/- 1%. This will also factor into gain error when using a 50Ω load.
WEEE

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see fig. 1)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste treatment on your own responsibility
If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological background
It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future. The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of live products will thereby avoid negative impacts on the environment.

Crossed out “wheelie bin” symbol
Setup

- Unpack the optical head, install a Thorlabs TR-series ½" diameter post into the 8-32 (M4 on -EC version) tapped hole on the bottom of the head, and mount into a PH-series post holder.
- Connect the power supply 5-pin DIN plug into the mating receptacle on the PDA520.
- Plug the power supply into a 100-120VAC, 50-60Hz outlet (220-240VAC for -EC version).
- Attach a 50Ω coax cable (i.e. RG-58U) to the output of the PDA. When running cable lengths longer than 12" we recommend terminating the opposite end of the coax with a 50Ω resistor (Thorlabs p/n T4119) for maximum performance.

Operation

- The PDA520 gain is adjusted using a small slotted screwdriver to turn the internal, gain-setting rotary switch. An access hole is provided on the rear panel for this purpose. The gain is set to 0dB, when the rotary switch is set fully counterclockwise. Each clockwise click of the switch increases the gain by 10 dB. **Note: Do not use excessive force when adjusting the gain switch.**
- The PDA520 is switched on by the POWER toggle switch located on the rear of the optical sensor.
- The light to voltage conversion can be estimated by factoring the wavelength-dependent responsivity of the silicon detector with the transimpedance gain as shown below:
  
  \[
  \text{Output (V/W)} = \text{Transimpedance gain (V/A)} \times \text{Responsivity (A/W)}
  \]

- The maximum output of the PDA520 is 10 volts for high impedance loads (5V for 50Ω loads). Adjust the gain so that the measured signal level out of the PDA520 is below 10 volts (5 volts with a 50Ω load) to avoid saturation. If necessary, use external neutral density filters to reduce the input light level.
- For maximum linearity performance when measuring focused beams, fiber outputs, or small diameter beams, do not exceed a maximum intensity of 10mW/cm².
- Because of the finite gain-bandwidth performance common to all amplifier circuits, the bandwidth of the PDA520 decreases at the highest gain settings.

Output Protection Circuitry

To enhance the product survivability the PDA520 offers output protection against short circuits, connection to output voltages, and current limiting. A 140mA resettable fuse was placed in line with the output drive supply to protect the drive circuitry from shorting or low load resistance values. Under these conditions, the fuse will ‘blow’ before damaging the unit. In order to reset the fuse the output load will need to be removed until the fuse cools down and resets. A high-speed diode protects the output from accidental application of negative voltages and limits the output from going more than -0.6V.

Maintaining the PDA520

There are no serviceable parts in the PDA520 optical head or power supply. The housing may be cleaned by wiping with a soft damp cloth. The window of the detector should only be cleaned using optical grade wipes. If you suspect a problem with your PDA520 please call Thorlabs and technical support will be happy to assist you.

Fiber Adapters and Other Accessories

Thorlabs sells a number of accessories that are compatible with the 1" thread on the PDA housing including FC, SMA, and ST fiber adapters, stackable lens tubes for mounting optics, and cage assemblies that allow the PDA to be incorporated into elaborate 3-D optical assemblies.

CAUTION: The PDA520 was designed to allow maximum accessibility to the photodetector by having the front surface of the diode exposed. Make sure that the nothing crashes into the detector. Failure to do so may cause damage to the diode.

Also available in the PDA and DET series are:

- PDA55: Switchable Gain Amplified Silicon Photo Detector
- PDA155: Wideband (50MHz) Amplified Silicon Photo Detector
- PDA255: Wideband (50MHz) Amplified InGaAs Photo Detector
- PDA400: Switchable Gain Amplified InGaAs Photo Detector
- DET110: High Speed Large Area Silicon Photo Detector
- DET210: High Speed Silicon Photo Detector
- DET410: High Speed InGaAs Photo Detector
Graphical Data:

- Photodetector Responsivity Curve
  - Responsivity (mA/mW)
  - Wavelength (nm)

- 0dB Response w/ 50 Ohm Terminator
  - Voltage Response (V/mW)
  - Wavelength (nm)

- 10dB Response w/ 50 Ohm Terminator
  - Voltage Response (V/µW)
  - Wavelength (nm)

- 20dB Response w/ 50 Ohm Terminator
  - Voltage Response (V/µW)
  - Wavelength (nm)

- PDA520 Bandwidth
  - Frequency (Hz)
  - Amplitude (dB)