PDA36AU
Si Switchable Gain USB DAQ Detector

User Guide



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Chapter 1 Introduction

1.1 Intended Use

This product is intended to be used to monitor light signals ranging from 350 nm to 1100 nm and create a digitized signal that gets transmitted to a host computer through USB. It is intended for a laboratory environment. The housed detector is intended to be used with Thorlabs 30 mm cage systems, Ø1" lens tube systems, and post mounting systems. The mounting holes can also be used for mounting into custom housings and devices. The sensor is flush with the front face of the detector.

The product may only be used in accordance with the instructions described in this manual. Any other use will invalidate the warranty.

1.2 Explanation of Safety Warnings

NOTICE Indicates information considered important, but not hazard-related, such as possible damage to the product.


ESD Component Caution


The CE/UKCA markings on the product are the manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety, and environmental protection legislation.


The wheelie bin symbol on the product, the accessories or packaging indicates that this device must not be treated as unsorted municipal waste but must be collected separately.

1.3 Description

The PDA36AU Si Switchable Gain USB DAQ Detector is an amplified, switchable-gain, Silicon (Si) detector designed to detect light signals ranging from 350 to 1100 nm. It is based on Thorlabs' popular PDA36A2, but includes a data acquisition system with USB communications for its output. Eight digitally controlled switches allow the user to vary the gain in 10 dB steps. The data acquisition has a 1 MS/s update rate and is directly sent to a controlling computer through USB communications. The PDA36AU detector housing includes a removable threaded coupler (SM1T1) and retainer ring (SM1RR) that is compatible with any number of Thorlabs SM1, Ø1" lens tube threaded accessories. This allows convenient mounting of external optics, light filters, apertures, and an easy mounting mechanism using Thorlabs' cage assembly accessories.

1.4 Technical Data

1.4.1 Performance Specifications

All performance specifications are typical and provided for 25 °C ambient temperature, unless stated otherwise.

Performance Specifications				
Gain Setting	**0 dB**	**10 dB**	**20 dB**	**30 dB**
Gain	1.51 x 10^3 V/A ±2%	4.75 x 10^3 V/A ±2%	1.5 x 10^4 V/A ±2%	4.75 x 10^4 V/A ±2%
Bandwidth[a,b]	12 MHz	1.6 MHz	1 MHz	260 kHz
Noise (RMS)	258 µV	192 µV	207 µV	211 µV
NEP (@ λ_p)[c]	7.57 x 10^{-11} W/√Hz	5.8 x 10^{-12} W/√Hz	3.4 x 10^{-12} W/√Hz	3.4 x 10^{-12} W/√Hz
Offset	±8 mV (Typical) ±12 mV (Maximum)			
Gain Setting	**40 dB**	**50 dB**	**60 dB**	**70 dB**
Gain	1.51 x 10^5 V/A ±2%	4.75 x 10^5 V/A ±2%	1.5 x 10^6 V/A ±5%	4.75 x 10^6 V/A ±5%
Bandwidth[a,b]	90 kHz	28 kHz	9 kHz	3 kHz
Noise (RMS)	214 µV	234 µV	277 µV	388 µV
NEP (@ λ_p)[c]	3.25 x 10^{-12} W/√Hz	3.69 x 10^{-12} W/√Hz	4 x 10^{-12} W/√Hz	4.29 x 10^{-12} W/√Hz
Offset	±8 mV (Typical) ±12 mV (Maximum)			

a. Tested at 650 nm wavelength. For NIR wavelengths, the rise time of the photodiode element will become slower, which may limit the effective bandwidth of the amplified detector.
b. The bandwidth of the signal displayed in the software is limited by the ADC sampling rate of the DAQ. See Section 1.4.2 for the ADC specifications.
c. The Noise Equivalent Power is specified at the wavelength of the peak responsivity.

1.4.2 Electrical Specifications

Electrical Specifications		
Specification	**Symbol**	**Value**
Detector	-	Si
Active Area	-	13 mm^2 (3.6 mm x 3.6 mm)
Wavelength Range	λ	350 to 1100 nm
Peak Responsivity	λ_p	970 nm (Typ.)
Peak Response	$\mathcal{R}(\lambda_p)$	0.65 A/W (Typ.)
Amplifier Gain Bandwidth Product (GPB)	-	600 MHz
Gain Adjustment Range	-	0 dB to 70 dB
Gain Steps	-	8 x 10 dB Steps
ADC Resolution	-	16 bit
ADC Sampling Rate	-	1 MS/s
ANALOG IN Range	-	0 - 5 V
ANALOG IN Impedance	-	50 Ω
TRIGGER IN Voltage		5 V TTL
Input High Threshold	VIH	2.3 V (Typical)
Input Low Threshold	VIL	1.0V (Typical)
TRIGGER IN Impedance	-	1000 Ω
USB Connection	-	USB 2.0

1.4.3 General Specifications

General Specifications	
Specification	**Value**
ANALOG IN Connector	SMA
TRIGGER IN Connector	SMA
USB Connector	Type Micro-B
Package Size	1.96" x 0.89" x 2.65" (49.8 mm x 22.5 mm x 67.4 mm)
PD Surface Depth[a]	0.09" (2.2 mm)
Weight, Detector Only	0.082 kg
Accessories	SM1T1 Coupler SM1RR Retainer Ring USB 2.0 Type-A to Micro-B Cable, Length 39" (1.0 m) One Snap-On Plastic Dust Cap for SM1 Lens Tubes (Item # SM1EC2B[b])
Operating Temp	10 to 40 °C
Storage Temp	-20 to 70 °C
Input Power	USB Powered

a. Measured from the active area to the start of the threads on the housing body. The detector active area surface is flush with the front of the housing body.

b. The detector contains one cap; replacements, which are sold in packages of five, are available by ordering the Item # listed.

1.4.4 Graphs

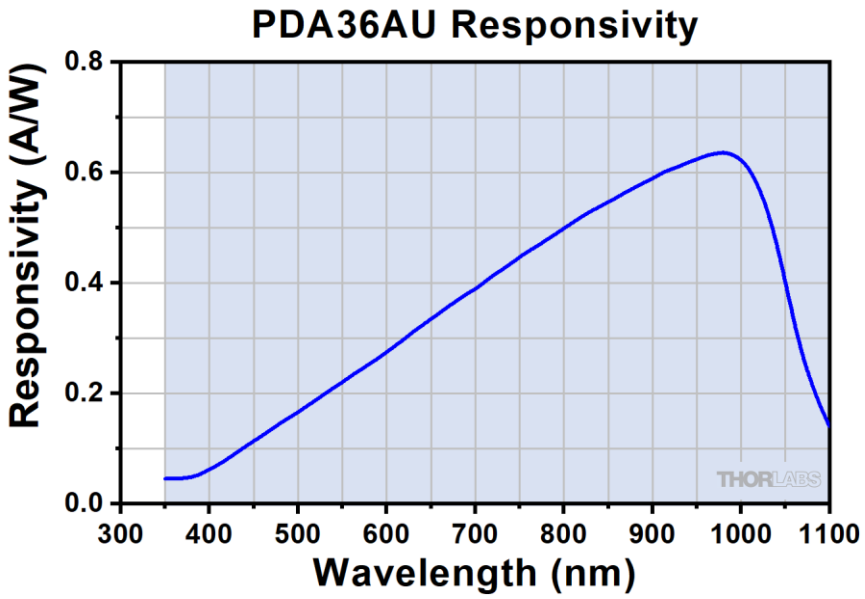


Figure 1 ***Typical Responsivity of the PDA36AU Detector with the Operating Wavelength Range in Blue***

1.4.5 Mechanical Drawings

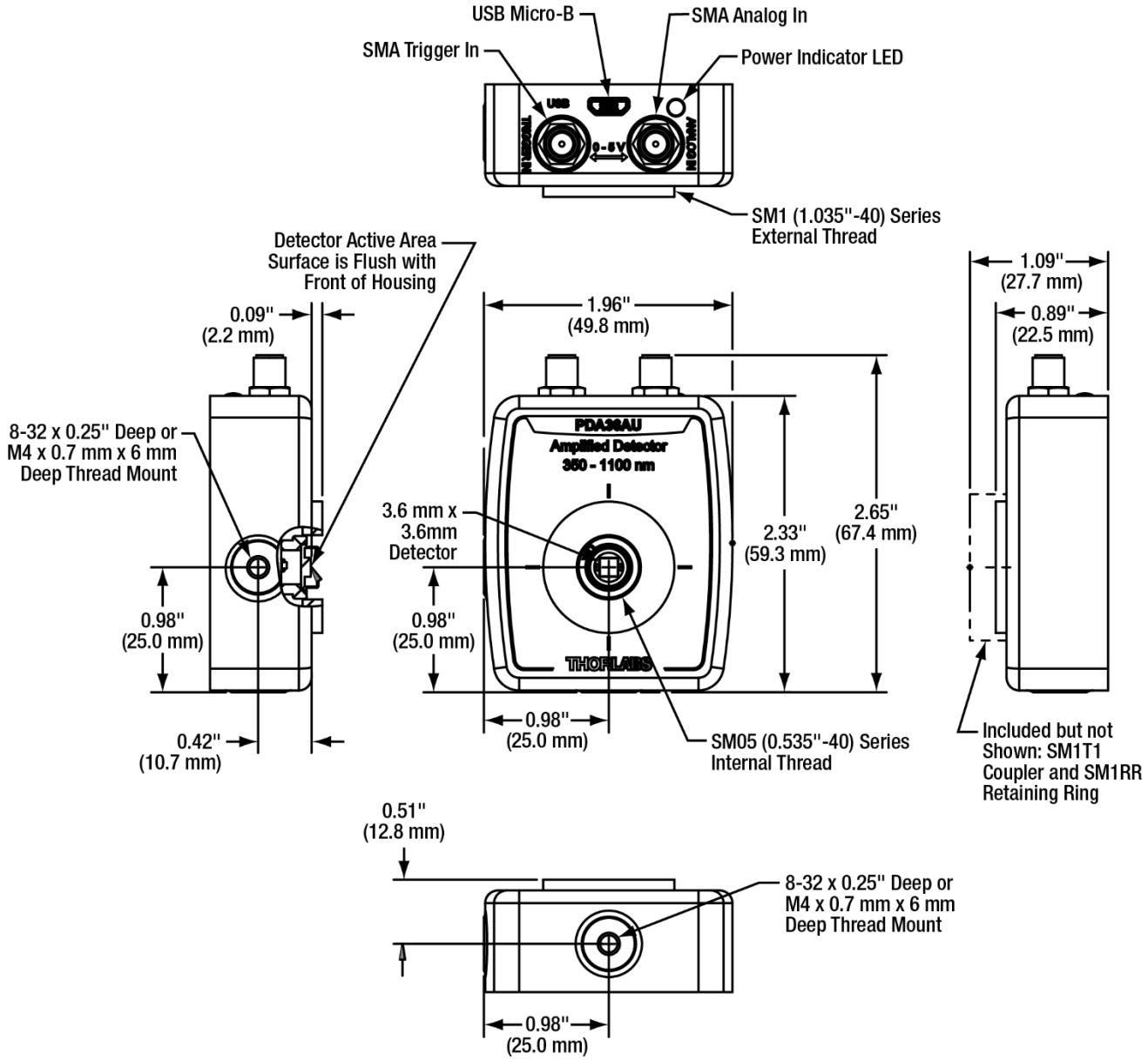


Figure 2 Mechanical Drawing

1.5 Components

1.5.1 Top Panel



Figure 3 PDA36AU Detector Top Panel

Front Panel	
Callout	**Description**
1	Power and Software Connection to PC, USB 2.0 Micro-B
2	Trigger Input, SMA Connector
3	Analog Input, SMA Connector
4	LED Indicator Green: Power On Amber: Power On and Connected to PDA Software Red: Error

1.6 Simplified Declaration of Conformity

The full text of the EU declaration of conformity is available at the following internet address: **https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=3257**.

1.7 FCC Designation

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Chapter 2 Safety

NOTICE

ESD Notice
The components inside this instrument are ESD sensitive. Take all appropriate precautions to discharge personnel and equipment before making any electrical connections to the unit.
Exposed Surface of Photodiode
The PDA36AU detector was designed to allow maximum accessibility to the photodetector by having the active area surface of the diode flush with the 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.

2.1 Laser Safety

While these devices do not produce laser or LED radiation, they are commonly used in setups where emissions are present. Take proper laser safety precautions when using this device in areas exposed to laser or LED radiation.

2.2 Warranty Information

Thorlabs warrants material and production of the PDA36AU Si switchable gain USB DAQ detector for a period of two years starting with the date of shipment in accordance with and subject to the terms and conditions set forth in Thorlabs' General Terms and Conditions of Sale which can be found at
https://www.thorlabs.com/Images/PDF/LG-PO-001_Thorlabs_terms_and_%20agreements.pdf.

This precision device is only serviceable if returned and properly packed into the complete original packaging including the complete shipment plus the cardboard insert that holds the enclosed devices. If necessary, ask for replacement packaging. Refer servicing to qualified personnel.

2.3 Packing List

Lists of items included:

- PDA36AU Detector
- SM1T1 Coupler
- SM1RR Retaining Ring
- USB 2.0 Type-A to Micro B Cable, Length 39" (1.0 m)
- Snap-On Plastic Dust Cap for SM1 Lens Tubes (Item # SM1EC2B, One Included, Replacements Sold in Packs of Five)

2.4 Installation Instructions

NOTICE

Exposed Surface of Photodiode
The PDA36AU detector was designed to allow maximum accessibility to the photodetector by having the active area surface of the diode flush with the 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.

The detector can be set up in many different ways using our extensive line of adapters. However, the detector should always be mounted and secured for best operation.

1. Unpack the optical head, install either an imperial or metric optical post into one of the mounting holes located on the bottom and side of the sensor, and mount using a post holder. Note that these detectors feature tapped holes that accept both 8-32 and M4 threads, so using either imperial or metric TR posts is possible.
2.  The components inside this instrument are ESD sensitive. Take all appropriate precautions to discharge personnel and equipment before making any electrical connections to the unit.
3. Connect the provided USB cable between the PDA36AU and a computer.
4. Install the application software provided and follow the onscreen prompts.
5. If you plan to use an external trigger source, connect an appropriate SMA coax cable between the connector marked TRIGGER IN and a trigger source. Note that an SMA cable must be purchased separately.

Chapter 3 Operation

3.1 Theory of Operation

Thorlabs' PDA series devices are ideal for measuring both pulsed and CW light sources. The PDA36AU detector includes a reverse-biased PIN photodiode, mated to a switchable gain transimpedance amplifier, and packaged in a rugged housing.

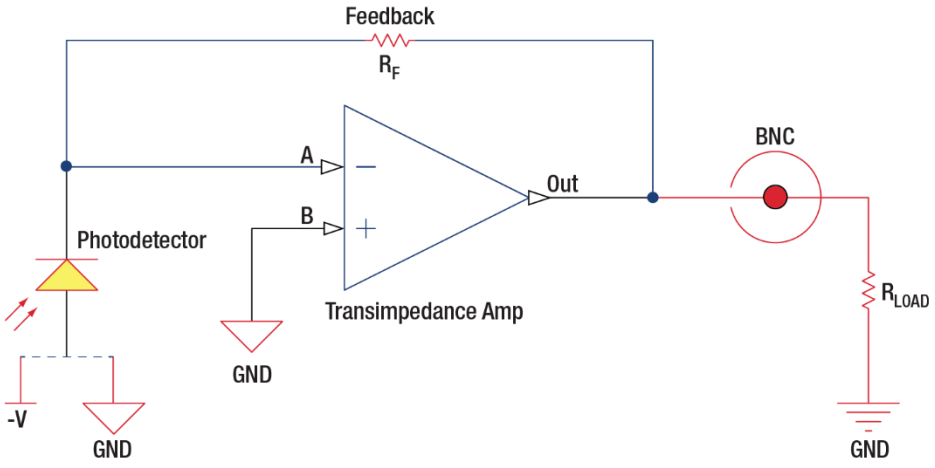


Figure 4 Schematic Diagram of PDA36AU Detector Operation

3.2 Responsivity

The responsivity of a photodiode can be defined as the ratio of generated photocurrent (I_{PD}) to the incident light power (P) at a given wavelength:

$$R(\lambda) = \frac{I_{PD}}{P}$$

3.3 Dark Current

Dark current is leakage current that flows when a bias voltage is applied to a photodiode. The PDA with Transimpedance Amplifier controls the dark current flowing out. Looking at Figure 4, it can be noted that Point B is held at ground and the amplifier will try to hold Point A to "Virtual Ground". This minimizes the effects of the dark current present in the system.

The dark current is also affected by the photodiode material and the size of the active area. Silicon devices generally produce low dark currents compared to germanium devices, which have high dark currents. The table below lists several photodiode materials and their relative dark currents, speeds, sensitivity, and costs. Please note that sensitivity values in the table are typical values; Thorlabs offers photodetectors with sensitivity ranges that vary from those shown below.

Material	Dark Current	Speed	Sensitivity[a]	Cost
Silicon (Si)	Low	High	400 - 1000 nm	Low
Germanium (Ge)	High	Low	900 - 1600 nm	Low
Gallium Phosphide (GaP)	Low	High	150 - 550 nm	Med
Indium Gallium Arsenide (InGaAs)	Low	High	800 - 1800 nm	Med
Extended Range: Indium Gallium Arsenide (InGaAs)	High	High	1200 - 2600 nm	High

a. Approximate values; actual wavelength values will vary.

3.4 Bandwidth and Response

For the PDA detectors, the gain of the detector depends on the feedback element (R_f). The bandwidth of the detector can be calculated using the following:

$$f(-3\ dB) = \sqrt{\frac{GBP}{4\pi R_f \times C_D}}$$

Where GBP is the amplifier gain bandwidth product and C_D is the sum of the photodiode junction capacitance and the amplifier capacitance.

The above equation explains the operation of the analog front end. The overall bandwidth response measured at the output USB connection is limited to the 1 MS/s data acquisition sampling rate and the USB 2.0 communications.

3.5 Data Acquisition

The PDA36AU detector uses a 2-channel data acquisition system to convert the transimpedance signal and the provided AUX IN into a digital signal that can be monitored and manipulated with the provided software program.

The AUX IN channel allows the user to connect other signal sources such as Thorlabs' PDA and DET series devices, or other monitoring sources that can be sampled alongside the primary photodiode signal. Examples might be other detector sources that can normalize a signal, or environmental sensors such as temperature.

The data acquisition system utilizes 16-bit resolution with a 1 MSample / second sampling rate.

3.6 Gain Adjustment

The PDA36AU detector includes a low-noise, low offset, high-gain transimpedance amplifier that allows gain adjustment over a 70 dB range. The gain is adjusted through the provided software application. There are eight gain positions incremented in 10 dB steps. Note that the analog bandwidth will decrease as the gain increases; however, all but the last gain step will be above the data acquisition sampling bandwidth. See the specifications in section 1.4.1 to choose the best gain versus bandwidth for a given input signal.

Chapter 4 Software Installation

The installation package is available from the **PDA36AU USB photodiode amplifier product page** on the Thorlabs, Inc. web site for users to download. The installation includes two components: PDA36AU Control Software and libusbK driver, as shown in Figure 5.



Figure 5 PDA36AU Control Software Installation

The first time the software is installed both components must be installed. The setup checks if another version of the selected component was previously installed. If another version exists, the new installation cannot be completed until the previous version is removed. The application executable and dependencies (DLLs) are installed in:

C:\Program Files (x86)\Thorlabs\TL_Devices\PDA36AU

Please see the user guide for the **PDA36AU Control Software User Guide** for more details.

Chapter 5 Maintenance and Cleaning

There are no user-serviceable parts in the PDA36AU detector. The device may be cleaned with a mild detergent such as dish soap or window cleaner. Do not apply liquid directly to the device or soak the device. Use a damp, clean cloth to wipe the unit down if needed. Avoid contacting the sensor area. To clean the sensor, use only canned air and gently blow across the surface.

Chapter 6 Troubleshooting and Repair

Problem	Suggested Solutions
There is no signal response.	Verify that the device software is installed on the target PC and that it is running. The device list on startup should point to any connected devices. Select and move forward. See the PDA36AU Software Manual for software operation.
	Check that the provided USB cable is properly connected between the device and the target PC. Try unplugging and reconnecting the device to reset the connection. You may also try replacing the USB cable. Any standard USB 2.0 Type-A to Micro-B cable can be used.
	Verify that the optical signal wavelength is within the specified wavelength range.
	Verify that the optical signal is illuminating the detector active area.
Output Voltage will not increase. **Detector Output is skewed.**	Install a 1" Lens Tube (SM1L10) to the thread coupler (SM1T1) to baffle any external light sources to see if this improves the response.

Chapter 7 Disposal



Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return “end of life” Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out “wheelie bin” logo (see right), were sold to and are currently owned by a company or institute within the EC and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. “End of life” units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site. It is the user’s responsibility to delete all private data stored on the device prior to disposal.

Chapter 8 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



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