

Operating Manual PDA400 - 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 50 ohm load impedance up to 5 volts. 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 a M4 tapped mounting hole and includes A 230VAC AC/DC power supply.

Specifications:

Detector		Performance			
Detector		min			
Active Diameter		typical			
Response		max			
Peak Response	0.95 A/W @ 1550 nm				
Bandwidth	DC to 10MHz				
NEP (1310nm, 0dB)	8.2×10^{-12} W/$\sqrt{\text{Hz}}$				
NEP (1310nm, 10dB)	6×10^{-12} W/$\sqrt{\text{Hz}}$				
NEP (1310nm, 20dB)	3.8×10^{-12} W/$\sqrt{\text{Hz}}$				
NEP (1310nm, 30dB)	3.4×10^{-12} W/$\sqrt{\text{Hz}}$				
NEP (1310nm, 40dB)	2.9×10^{-12} W/$\sqrt{\text{Hz}}$				
Output Voltage (50 Ω) ¹	0 to 5V				
Output Voltage ¹	0 to 10V				
Output Impedance ¹	50 ohms				
Load Impedance ¹	Hi -Z to 50 ohms				
Gain Steps	0, 10, 20, 30, 40 dB				
Gain Switch	5-Pos Rotary Switch				
On / Off Switch	Toggle				
Output	BNC				
Damage Threshold	100mW CW 0.5J/cm² 10ns PW				
Optical Head Size	$\phi 1.5'' \times 0.79''$				
Weight	60 grams				
Accessories	SM1T1 Coupler				
Storage Temp	-40 to 125°C				
Operating Temp	-40 to 85°C				
AC Power Supply	AC - DC Converter				
Input Power	100-120VAC, (220_240VAC -EC version) 50-60Hz, 5W				

Performance		min	typical	max
0 dB Setting				
Transimpedance Gain ¹			1.5×10^4 V/A	
Trans. Gain (50 Ω) ¹			0.75×10^4 V/A	
Bandwidth			10 MHz	
Noise (RMS)		0.28 mV	0.33 mV	0.44 mV
Offset		-5 mV	6 mV	15 mV
10 dB Setting				
Transimpedance Gain ¹			4.7×10^4 V/A	
Trans. Gain (50 Ω) ¹			2.35×10^4 V/A	
Bandwidth			2.2MHz	
Noise (RMS)		0.30 mV	0.35 mV	0.45 mV
Offset		-5 mV	8 mV	15 mV
20 dB Setting				
Transimpedance Gain ¹			1.5×10^5 V/A	
Trans. Gain (50 Ω) ¹			0.75×10^5 V/A	
Bandwidth			700kHz	
Noise (RMS)		0.36 mV	0.40 mV	0.46 mV
Offset		-10 mV	10 mV	20 mV
30 dB Setting				
Transimpedance Gain ¹			4.7×10^5 V/A	
Trans. Gain (50 Ω) ¹			2.35×10^5 V/A	
Bandwidth			160kHz	
Noise (RMS)		0.48 mV	0.53 mV	0.60 mV
Offset		-20 mV	20 mV	50 mV
40 dB Setting				
Transimpedance Gain ¹			1.5×10^6 V/A	
Trans. Gain (50 Ω) ¹			0.75×10^6 V/A	
Bandwidth			50kHz	
Noise (RMS)		0.74 mV	0.81 mV	1.0 mV
Offset		-100 mV	20 mV	100 mV

Note: 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).

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. **Note: Do not install a mounting post more than ¼" into the housing. This will damage the unit.**
- Plug the 5-pin DIN plug on the power supply provided with the PDA400 into the mating jack on the PDA400.
- Plug the power supply into an 50-60Hz, 100-120VAC outlet (220-240VAC for -EC version).
- Attach a 50 ohm 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 50 ohm resistor (Thorlabs p/n T4119) for maximum performance.

Operation

- The gain of the PDA400 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. When the slot is aligned vertical with the housing, the gain is at 0dB. Also, the switch has a physical stop at the 0dB setting. If in doubt, turn the switch counter-clockwise until it stops. At that point the gain is at 0dB. Each click of the switch clockwise 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

(e.g. output in volts / watt = transimpedance gain (V/A) x responsivity (A/W))

- The maximum output of the PDA400 is 10 volts (for high impedance loads). Adjust the gain so that the measured signal level out of the PDA400 is below 10 volts (5 volts for 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.

Gain Switch position	Gain (dB)	Transimpedance Gain (V/A)
1	0	1.5×10^4
2	10	4.7×10^4
3	20	1.5×10^5
4	30	4.7×10^5
5	40	1.5×10^6

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 to extend outside of the PDA housing. When using fiber adapters be sure that the fiber ferrule does not crash into the detector to avoid damage to the diode and or the fiber. An easy way to accomplish this is to install a SM1RR retaining ring (included with the PDA400) inside the 1" threaded coupler *before* installing the fiber adapter.

Also available are Germanium, silicon, and higher bandwidth silicon models of the PDA series.

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.

Detector Response Curve

