APD120A2/M - November 22, 2019

Item # APD120A2/M was discontinued on November 22, 2019. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

SI AVALANCHE PHOTODETECTORS

- High-Speed Response up to 1 GHz
- Conversion Gains up to 2.65 × 10^9 V/W
- Wavelength Range of 200 - 1000 nm or 400 - 1000 nm
- Temperature-Compensated and Variable-Gain Versions Available

APD210
Variable-Gain APD

APD120A
Avalanche Photodetector (APD)

APD130A2
Temperature-Compensated APD

APD430A
Variable-Gain,
Temperature-Compensated APD

Hide Overview

OVERVIEW

Features

- Noise Equivalent Powers (NEP) as Low as 2.5 fW/√Hz
- Max Bandwidth up to 1 GHz at 3 dB
- Temperature-Compensated Versions Provide M Factor Stability of ≤±3% Over 18 to 28 °C
- Variable Gain Detectors Available: M Factor from 5 to 50 or 10 to 100
- Internal SM05 and External SM1 Threading for Lens Tubes
- Power Supply Included

Thorlabs' Silicon Avalanche Photodetectors (APD) are designed to offer increased sensitivity and lower noise compared to standard PIN detectors, making them ideal for applications with low optical power levels. In addition to our standard APDs, versions featuring variable gain (i.e., M factor) and/or temperature compensation are offered.

In general, avalanche photodiodes use an internal gain mechanism to increase sensitivity. A high reverse bias voltage is applied to the diodes to create a strong electric field. When an incident photon generates an electron-hole pair, the electric field accelerates the electrons, leading to the production of secondary electrons by impact ionization. The resulting electron avalanche can produce a gain factor of several hundred times, described by a multiplication factor, M, that is a function of

Si APD Selection Guide

Item #	Wavelength Range	Bandwidth (3 dB)	Type (Quick Links)
APD120A2/M	200 - 1000 nm	DC - 50 MHz	Standard
APD120A(/M)	400 - 1000 nm		
APD130A2(/M)	200 - 1000 nm		Temperature Compensated
APD130A(/M)	400 - 1000 nm		
APD440A2	200 - 1000 nm	DC - 0.1 MHz	Variable Gain, Temperature Compensated
APD410A2(/M)		DC - 10 MHz	
APD430A2(/M)		DC - 400 MHz	
APD440A		DC - 0.1 MHz	

both the reverse bias voltage and temperature. In general, the M factor increases with lower temperatures and decreases with higher temperatures. Similarly, the M factor will increase when the reverse bias voltage is raised and decrease when the reverse bias voltage is lowered.

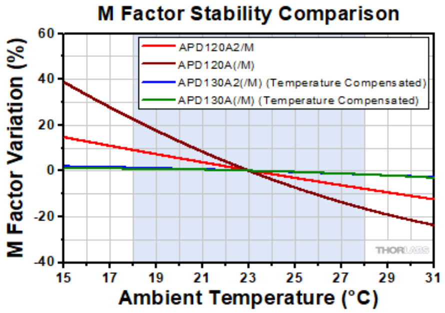
Our APD130A2(/M) and APD130A(/M) temperature-compensated APDs feature integrated thermistors that adjust the bias voltage to compensate for the effect of temperature changes on the M factor. A comparison with our non-temperature-compensated APDs is provided in the graph to the right.

In addition to being temperature compensated, our variable-gain APD400 series detectors allow the reverse bias voltage across the diodes to be adjusted via a rotary knob on the side of the housing, which varies the M factor from 5 to 50 or 10 to 100.

Thorlabs offers Menlo Systems' APD210 Variable-Gain Avalanche Photodetector, which offers high-speed response up to 1 GHz (at 3 dB). Additionally, we offer spectral-flattening filters that are designed to improve the response uniformity of our silicon photodiodes and detectors; click here to learn more.

A complete list of all of our APDs, including those that have an InGaAs photodiode for use at IR wavelengths, can be found on the *Selection Guide* tab. Please note that these packaged APDs are not suitable for use as single photon counters. Thorlabs has single photon counters available here.

APD410A(/M)	400 - 1000 nm	DC - 10 MHz	
APD430A(/M)		DC - 400 MHz	
APD210		5 - 1000 MHz	Variable Gain



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The above plot shows sample data comparing the M factor stability of our temperature-compensated avalanche photodetectors to our standard packages. The blue shaded region indicates the temperature range over which the M factor stability is guaranteed to within ±3%.

Hide APD1xx Specs

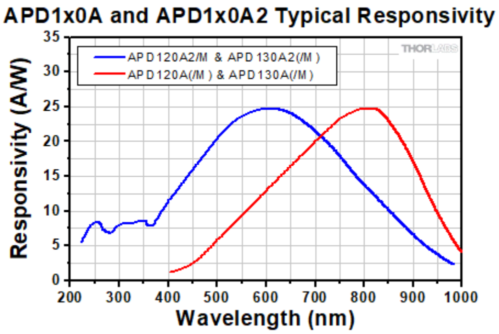
APD1XX SPECS

Item #	APD120A2/M	APD130A2(/M)	APD120A(/M)	APD130A(/M)
Detector Type	UV Enhanced Silicon APD		Silicon APD	
Wavelength Range	200 - 1000 nm		400 - 1000 nm	
Output Bandwidth (3 dB)	DC - 50 MHz			
Active Area Diameter	1 mm			
Typical Max Responsivity	25 A/W @ 600 nm (M = 50)		25 A/W @ 800 nm (M = 50)	
M Factor[a,b]	50			
M Factor Temperature Stability[c]	Not Specified	±2% (Typical); ±3% (Max)	Not Specified	±2% (Typical); ±3% (Max)
Transimpedance Gain	50 kV/A with 50 Ω Termination[d] 100 kV/A for High-Impedance Termination			
Max Conversion Gain[e,f]	2.5 x 10^6 V/W			
CW Saturation Power	1.5 µW			
Max Input Power[g]	1 mW			
Minimum NEP (DC - 50 MHz)[e,h]	0.21 pW/√Hz		0.20 pW/√Hz	
Integrated Noise (DC - 50 MHz)	1.4 nW (RMS)		1.5 nW (RMS)	
Electrical Outputs	50 Ω BNC			
Max Output Voltage	1.8 V with 50 Ω Termination 3.6 V with High-Impedance Termination			
DC Offset Electrical Output	<±15 mV			
Power Supply[i]	±12 V @ 250 mA (100/120/230 VAC, 50 - 60 Hz, Switchable)			
General				
Operating Temperature Range	0 to 40 °C (Non-Condensing)			

Storage Temperature Range	-40 to 70 °C
Device Dimensions (H x W x D)	75.5 mm x 50.8 mm x 27.4 mm (2.97" x 2.00" x 1.08")
Weight	<0.1 kg

- a. These detectors are factory set to M = 50, but other M factors are available on request. Please contact techsupport@thorlabs.com for more information.
- b. The responsivity scales with the M factor, which is dependent on the reverse bias voltage across the photodiode. For a given photodiode, a higher M factor corresponds to a higher reverse bias voltage, which increases the photodiode responsivity. By definition, M = 1 corresponds to a reverse bias voltage of 0 V.
- c. Temperature within 23 ± 5 °C.
- d. 50 Ω termination is recommended for the best performance.
- e. At the Peak Responsivity Wavelength
- f. The Conversion Gain is product of the Transimpedance Gain and the Responsivity for a given M factor and wavelength.
- g. This value is the damage threshold for the photodiode.
- h. For more information on how NEP is calculated, please see Thorlabs' Noise Equivalent Power White Paper.
- i. A replacement power supply is available below.

All technical data are valid at 23 ± 1 °C (APD120) or 23 ± 5 °C (APD130) and 45% ± 15% relative humidity (non-condensing).



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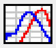
Hide APD4xx Specs

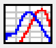
APD4XX SPECS

All technical data are valid at 23 ± 5 °C and 45% ± 15% relative humidity (non-condensing).

Item #	APD440A2	APD410A2(/M)	APD430A2(/M)
Detector Type	UV Enhanced Silicon APD		
Wavelength Range	200 - 1000 nm		
Output Bandwidth (3 dB)[a]	DC - 100 kHz	DC - 10 MHz	DC - 400 MHz
Active Area Diameter	1.0 mm	0.5 mm	0.2 mm
Typical Max Responsivity	25 A/W @ 600 nm (M = 50)	25 A/W @ 600 nm (M = 50)	50 A/W @ 600 nm (M = 100)
Responsivity Graph (Click to View)			
M Factor Adjustment Range[b,c]	5 - 50 (Continuous)		10 - 100 (Continuous)
M Factor Temperature Stability[d]	±2% (Typical); ±3% (Max)		
Transimpedance Gain	25 MV/A (50 Ω Termination) 50 MV/A (High-Z Termination)	250 kV/A (50 Ω Termination)[e] 500 kV/A (High-Z Termination)	5 kV/A (50 Ω Termination)[e] 10 kV/A (High-Z Termination)
Max Conversion Gain[f,g]	1.25×10^9 V/W	12.5×10^6 V/W	5.0×10^5 V/W

CW Saturation Power	3.28 nW @ 600 nm, M = 50 32.8 nW @ 600 nm, M = 5	0.32 µW @ 600 nm, M = 50 3.20 µW @ 600 nm, M = 5	8.0 µW @ 600 nm, M = 100 80 µW @ 600 nm, M = 10
Max Input Power[h]	1 mW		
Minimum NEP[i]	2.5 fW/√Hz (DC - 100 kHz)	0.09 pW/√Hz (DC - 10 MHz)	0.15 pW/√Hz (DC - 100 MHz)
Integrated Noise (RMS)[a]	0.8 pW (DC - 100 kHz)	0.28 nW (DC - 10 MHz)	6 nW (DC - 400 MHz)
Electrical Outputs	50 Ω BNC		
Max Output Voltage	2.0 V (50 Ω Termination); 4.1 V (High-Z Termination)		
DC Offset Electrical Output	<±3 mV		
Included Power Supply[j]	±12 V @ 250 mA (100/120/230 VAC, 50 - 60 Hz, Switchable)		
General			
Operating Temperature Range	0 to 40 °C (Non-Condensing)		
Storage Temperature Range	-40 to 70 °C		
Device Dimensions (H x W x D)	2.93" x 2.21" x 1.08" (74.5 mm x 56.1 mm x 27.4 mm)	2.97" x 2.20" x 1.09" (75.5 mm x 55.8 mm x 27.6 mm)	
Weight	0.12 kg	0.1 kg	

- a. At Maximum Gain Setting
- b. The responsivity scales with the M factor, which is dependent on the reverse bias voltage across the photodiode. For a given photodiode, a higher M factor corresponds to a higher reverse bias voltage, which increases the photodiode responsivity. By definition, M = 1 corresponds to a reverse bias voltage of 0 V.
- c. For Small Signals
- d. Ambient temperature within 23 ± 5 °C.
- e. 50 Ω termination is recommended for the best performance.
- f. At the Peak Responsivity Wavelength
- g. The conversion gain is the product of the transimpedance gain and the responsivity for a given M factor and wavelength.
- h. This value is the damage threshold for the photodiode.
- i. For more information on how NEP is calculated, please see Thorlabs' Noise Equivalent Power White Paper.
- j. A replacement power supply is available below.

Item #	APD440A	APD410A	APD430A
Detector Type	Silicon APD		
Wavelength Range	400 - 1000 nm		
Output Bandwidth (3 dB)[a]	DC - 100 kHz	DC - 10 MHz	DC - 400 MHz
Active Area Diameter	1.0 mm	1.0 mm	0.5 mm
Typical Max Responsivity	53 A/W @ 800 nm (M = 100)		
Responsivity Graph (Click to View)			
M Factor Adjustment Range[b]	10 - 100 (Continuous)		
M Factor Temperature Stability[c]	±2% (Typical); ±3% (Max)		
Transimpedance Gain	25 MV/A (50 Ω Termination) 50 MV/A (High-Z Termination)	250 kV/A (50 Ω Termination)[d] 500 kV/A (High-Z Termination)	5 kV/A (50 Ω Termination)[d] 10 kV/A (High-Z Termination)
Max Conversion Gain[e,f]	2.65×10^9 V/W	26.5×10^6 V/W	5.3×10^5 V/W
CW Saturation Power	1.54 nW @ 800 nm, M = 100 15.4 nW @ 800 nm, M = 10	0.15 µW @ 800 nm, M = 100 1.50 µW @ 800 nm, M = 10	8.0 µW @ 800 nm, M = 100 80 µW @ 800 nm, M = 10
Max Input Power[g]	1 mW		
Minimum NEP[f,g]	3.5 fW/√Hz (DC - 100 kHz)	0.04 pW/√Hz (DC - 10 MHz)	0.14 pW/√Hz (DC - 100 MHz)
Integrated Noise (RMS)[a]	1.1 pW (DC - 100 kHz)	0.13 nW (DC - 10 MHz)	5.5 nW (DC - 400 MHz)
Electrical Outputs	50 Ω BNC		
Max Output Voltage	2.0 V (50 Ω Termination); 4.1 V (High-Z Termination)		

DC Offset Electrical Output	<±3 mV	
Included Power Supply[i]	±12 V @ 250 mA (100/120/230 VAC, 50 - 60 Hz, Switchable)	
General		
Operating Temperature Range	0 to 40 °C (Non-Condensing)	
Storage Temperature Range	-40 to 70 °C	
Device Dimensions (H x W x D)	2.93" x 2.21" x 1.08" (74.5 mm x 56.1 mm x 27.4 mm)	2.97" x 2.20" x 1.09" (75.5 mm x 55.8 mm x 27.6 mm)
Weight	0.12 kg	0.1 kg

- a. At Maximum Gain Setting
- b. The responsivity scales with the M factor, which is dependent on the reverse bias voltage across the photodiode. For a given photodiode, a higher M factor corresponds to a higher reverse bias voltage, which increases the photodiode responsivity. By definition, M = 1 corresponds to a reverse bias voltage of 0 V.
- c. Ambient temperature within 23 ± 5 °C.
- d. 50 Ω termination is recommended for the best performance.
- e. At the Peak Responsivity Wavelength
- f. The conversion gain is the product of the transimpedance gain and the responsivity for a given M factor and wavelength.
- g. This value is the damage threshold for the photodiode.
- h. For more information on how NEP is calculated, please see Thorlabs' Noise Equivalent Power White Paper.
- i. A replacement power supply is available below.

Hide APD210 Specs

APD210 SPECS

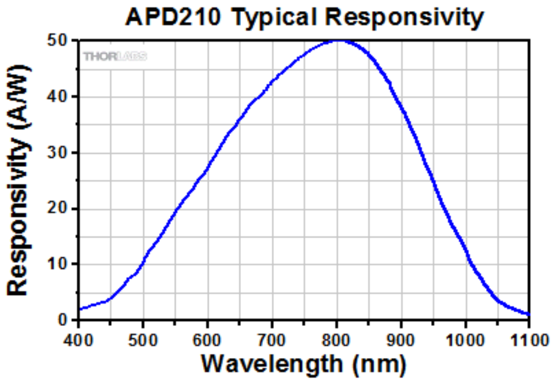
APD210 Specifications

Item #	APD210
Detector Type	Si APD
Wavelength Range	400 - 1000 nm
Bandwidth	5 MHz - 1000 MHz (3 dB) 1 MHz - 1600 MHz (Max)
Active Area Diameter	0.5 mm
Optical Input	Free Space[a]
Conversion Gain (Max)[b]	2.5 x 10^5 V/W @ 1 GHz, 800 nm
Max Input Power	10 mW
NEP (Calculated)[c]	0.4 pW/√Hz
Rise Time	500 ps
Dark State Noise Level[d]	-80 dBm
Operating Temperature	10 - 40 °C
Output Impedance	50 Ω
Output Connector	BNC
Output Coupling	AC
Current Consumption	200 mA
Supply Voltage	12 - 15 V[e]
Device Dimensions	2.4" x 2.2" x 1.9" (60 mm x 56 mm x 47.5 mm)

- a. With adapter for Thorlabs' SM05 Mount
- b. Gain Adjustable via Push Buttons
- c. The noise-equivalent power is a measure of the detector's minimum detectable power per square root of bandwidth. Since this value only depends on the detector itself, it can be used to compare two detectors

that do not have the same integration time. The smaller the NEP value, the better the detector.

- d. This is a measure of the noise when no light is incident on the detector's photosensitive area. Span: 5 MHz, Resolution Bandwidth: 3 kHz
- e. A power supply is included with a US or EU adapter, depending on your location. Please contact Tech Support if a different adapter is required.



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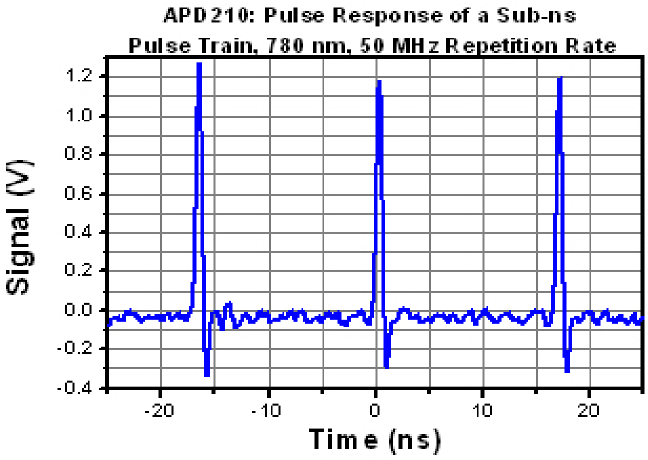
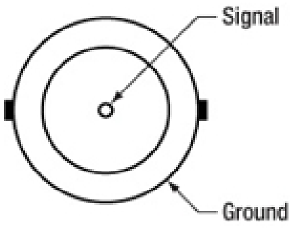
Pulse Response Data



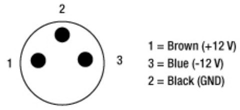
Hide Pin Diagrams

PIN DIAGRAMS

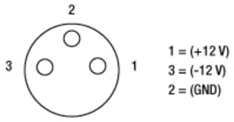
BNC Female Output (Photodetector)



APD Male (Power Cables)



APD Female (Photodetector)



Hide Fiber Coupling

FIBER COUPLING&NBSP;

Fiber Coupling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Output from a fiber is coupled into the photodetector using an aspheric lens to focus the signal onto the detector active area.

In fiber coupling applications, we recommend taking into account the divergence of light from the fiber tip to ensure that all of the signal is focused onto the detector active area. When using a standard fiber connector adapter with a detector with an active area smaller than Ø1 mm, high coupling losses and degradation of the frequency response may occur.

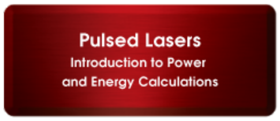
Components for Fiber Coupling	
Item #	**Description**
-	Avalanche Photodetector
LM1XY(/M)	Translating Lens Mount for Ø1" Optics
SM1L10	SM1 (1.035"-40) Lens Tube, 1" Long
-	Fiber Collimator (Dependent on Fiber)
AD11F or AD12F	SM1-Threaded Adapters for Ø11 or Ø12 mm Fiber Collimators (Dependent on Collimator)
-	Mounted Molded Aspheric Lens (Dependent on Collimator)
S1TM06, S1TM08, S1TM09, S1TM10, or S1TM12	SM1-Threaded Adapter for Molded Aspheric Lens Cell (Dependent on Lens)

To achieve high coupling efficiency, a fiber collimation package, focusing lens, and X-Y translator should be used, as shown in the photo to the right. The avalanche photodetector is shown with a fiber collimator, lens tube collimator adapter, lens tube, and X-Y translation mount. An adapter inside the lens tube holds an aspheric lens (not visible) to focus the collimated light onto the active area of the detector. The X-Y translation mount corrects for any centering issues.

Hide Pulse Calculations

PULSE CALCULATIONS

Pulsed Laser Emission: Power and Energy Calculations


Pulsed Lasers
Introduction to Power and Energy Calculations

Click above to download the full report.

Determining whether emission from a pulsed laser is compatible with a device or application can require referencing parameters that are not supplied by the laser's manufacturer. When this is the case, the necessary parameters can typically be calculated from the available information. Calculating peak pulse power, average power, pulse energy, and related parameters can be necessary to achieve desired outcomes including:

- Protecting biological samples from harm.
- Measuring the pulsed laser emission without damaging photodetectors and other sensors.
- Exciting fluorescence and non-linear effects in materials.

Pulsed laser radiation parameters are illustrated in Figure 1 and described in the table. For quick reference, a list of equations are provided below. The document available for download provides this information, as well as an introduction to pulsed laser emission, an overview of relationships among the different parameters, and guidance for applying the calculations.

Equations:

Period **and** ***repetition rate*** **are reciprocal:** $\Delta t = \frac{1}{f_{rep}}$ and $f_{rep} = \frac{1}{\Delta t}$

Pulse energy **calculated from** ***average power*****:** $E = \frac{P_{avg}}{f_{rep}} = P_{avg} \cdot \Delta t$

Average power **calculated from** ***pulse energy*****:** $P_{avg} = \frac{E}{\Delta t} = E \cdot f_{rep}$

Peak pulse power **estimated from** ***pulse energy*****:** $P_{peak} \approx \frac{E}{\tau}$

Peak power **and** ***average power*** **calculated from each other:**

and $P_{avg} = P_{peak} \cdot f_{rep} \cdot \tau = \frac{P_{peak} \cdot \tau}{\Delta t}$

$$P_{peak} = \frac{P_{avg}}{f_{rep} \cdot \tau} = \frac{P_{avg} \cdot \Delta t}{\tau}$$

Peak power **calculated from** ***average power*** **and** ***duty cycle****:**

$$P_{peak} = \frac{P_{avg}}{\tau/\Delta t} = \frac{P_{avg}}{duty\ cycle}$$

*Duty cycle ($\tau/\ \Delta t$) is the fraction of time during which there is laser pulse emission.

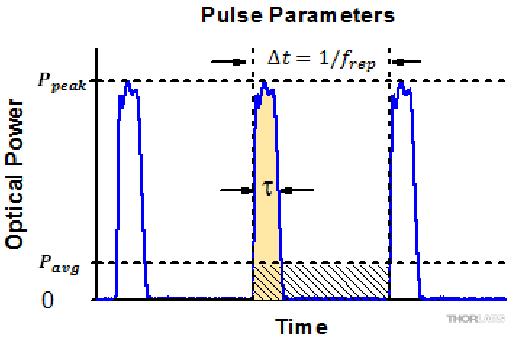


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Figure 1: Parameters used to describe pulsed laser emission are indicated in the plot (above) and described in the table (below). **Pulse energy** (**E**) is the shaded area under the pulse curve. Pulse energy is, equivalently, the area of the diagonally hashed region.

Parameter	Symbol	Units	Description
Pulse Energy	**E**	Joules [J]	A measure of one pulse's total emission, which is the only light emitted by the laser over the entire period. The pulse energy equals the shaded area, which is equivalent to the area covered by diagonal hash marks.
Period	**Δt**	Seconds [s]	The amount of time between the start of one pulse and the start of the next.
Average Power	$\mathbf{P_{avg}}$	Watts [W]	The height on the optical power axis, if the energy emitted by the pulse were uniformly spread over the entire period.
Instantaneous Power	**P**	Watts [W]	The optical power at a single, specific point in time.
Peak Power	$\mathbf{P_{peak}}$	Watts [W]	The maximum instantaneous optical power output by the laser.
Pulse Width	τ	Seconds [s]	A measure of the time between the beginning and end of the pulse, typically based on the full width half maximum (FWHM) of the pulse shape. Also called **pulse duration**.
Repetition Rate	$\mathbf{f_{rep}}$	Hertz [Hz]	The frequency with which pulses are emitted. Equal to the reciprocal of the period.

Example Calculation:

Is it safe to use a detector with a specified maximum peak optical input power of **75 mW** to measure the following pulsed laser emission?

- Average Power: 1 mW
- Repetition Rate: 85 MHz

- Pulse Width: 10 fs

The energy per pulse:

$$E = \frac{P_{avg}}{f_{rep}} = \frac{1\ mW}{85\ MHz} = \frac{1\ x\ 10^{-3} W}{85\ x\ 10^{6} Hz} = 1.18\ x\ 10^{-11} J = 11.8\ pJ$$

seems low, but the peak pulse power is:

$$P_{peak} = \frac{P_{avg}}{f_{rep} \cdot \tau} = \frac{1\ mW}{85\ MHz\ \cdot 10\ fs} = 1.18\ x\ 10^{3}\ W = \mathbf{1.18\ kW}$$

It is ***not safe*** to use the detector to measure this pulsed laser emission, since the peak power of the pulses is >5 orders of magnitude higher than the detector's maximum peak optical input power.

Hide Selection Guide

SELECTION GUIDE

Avalanche Photodetector Selection Guide

Item #	Detector Type	Wavelength Range	3 dB Bandwidth	Active Area Diameter	M Factor	Typical Max Responsivity	Max Conversion Gain[a]	Temperature Compensated	Variable Gain
APD440A2	UV Enhanced Silicon APD	200 - 1000 nm	DC - 0.1 MHz	1 mm	5 - 50	25 A/W @ 600 nm (M = 50)	1.25 x 10^9 V/W	✓	✓
APD410A2			DC - 10 MHz	0.5 mm	5 - 50	25 A/W @ 600 nm (M = 50)	12.5 x 10^6 V/W	✓	✓
APD120A2/M			DC - 50 MHz	1 mm	50	25 A/W @ 600 nm (M = 50)	2.5 x 10^6 V/W	-	-
APD130A2			DC - 50 MHz	1 mm	50	25 A/W @ 600 nm (M = 50)	2.5 x 10^6 V/W	✓	-
APD430A2			DC - 400 MHz	0.2 mm	10 - 100	50 A/W @ 600 nm (M = 100)	5.0 x 10^5 V/W	✓	✓
APD440A	Silicon APD	400 - 1000 nm	DC - 0.1 MHz	1 mm	10 - 100	53 A/W @ 800 nm (M = 100)	2.65 x 10^9 V/W	✓	✓
APD410A			DC - 10 MHz	1.0 mm	10 - 100	53 A/W @ 800 nm (M=100)	26.5 x 10^6 V/W	✓	✓
APD120A			DC - 50 MHz	1 mm	50	25 A/W @ 800 nm (M = 50)	2.5 x 10^6 V/W	-	-
APD130A			DC - 50 MHz	1 mm	50	25 A/W @ 800 nm (M = 50)	2.5 x 10^6 V/W	✓	-
APD430A			DC - 400 MHz	0.5 mm	10 - 100	53 A/W @ 800 nm (M = 100)	5.3 x 10^5 V/W	✓	✓
APD210			5 - 1000 MHz[b]	0.5 mm	N/A	N/A	2.5 x 10^5 V/W[c]	-	✓
APD110C	InGaAs APD	900 - 1700 nm	DC - 50 MHz	0.2 mm	10	9 A/W @ 1500 nm (M = 10)	0.9 x 10^6 V/W	-	-
APD130C			DC - 50 MHz	0.2 mm	10	9 A/W @ 1500 nm (M = 10)	0.9 x 10^6 V/W	✓	-
APD410C			DC - 10 MHz	0.2 mm	4 - 20	18 A/W @ 1550 nm (M = 20)	9.0 x 10^6 V/W	✓	✓
APD430C			DC - 400 MHz	0.2 mm	4 - 20	18 A/W @ 1550 nm (M = 20)	1.8 x 10^5 V/W	✓	✓
		1260 -				9 A/W @ 1550 nm (M =			

APD450C		1620 nm	0.3 - 1600 MHz	1.5 mm[d]	2 - 10	10)	45 × 10^3 V/W	✓	✓
APD310		850 - 1650 nm	5 - 1000 MHz[e]	0.03 mm	N/A	N/A	2.5 x 10^4 V/W[f]	-	✓

- a. At Peak Responsivity Wavelength Unless Otherwise Stated
- b. The max frequency range is 1 MHz - 1600 MHz.
- c. At 1 GHz and 800 nm
- d. 75 µm Detector with Ø1.5 mm Ball Lens
- e. The max frequency range is 1 MHz - 1800 MHz.
- f. At 1 GHz and 1500 nm

Hide Si Avalanche Photodetectors

Si Avalanche Photodetectors

- Internal SM05 and External SM1 Threads Accept Most Fiber Adapters, Lens Tubes, and Other Components
- Power Supply Included

Thorlabs' APD120A2/M and APD120A(/M) Avalanche Photodetectors are offered as a cost-effective solution for customers with applications that do not require temperature compensation or variable gain.

The orientation of the mechanical and electrical connections, combined with the compact design, ensures that these detectors can fit into tight spaces. Three 8-32 (M4) mounting holes, one on each edge of the housing, further ensure easy integration into complicated mechanical setups. The housing also provides compatibility with both our SM05- and SM1-Series Lens Tubes. An internally SM1-threaded cap is included.

Our SM1-threaded fiber adapters are compatible with these detectors. The internally SM1-threaded adapters can be mated directly to the housing, and are available below. To use our externally SM1-threaded fiber adapters, an internally SM1-threaded lens tube will be required to mate the fiber adapter to the detector's housing. The externally SM05-threaded fiber adapters are not compatible with these detectors.

Key Specifications[a]		
Item #	**APD120A2/M**	**APD120A(/M)**
Detector Type	UV-Enhanced Silicon APD	Silicon APD
Wavelength Range	200 - 1000 nm	400 - 1000 nm
Output Bandwidth (3 dB)	DC - 50 MHz	
Active Area Diameter	1 mm	
Typical Max Responsivity (M = 50)	25 A/W @ 600 nm	25 A/W @ 800 nm
Responsivity Graph (Click to View)		
Transimpedance Gain	50 kV/A (50 Ω Termination) 100 kV/A (High-Z Termination)	
Max Conversion Gain[b]	2.5 × 10^6 V/W	
M Factor	50	
M Factor Temperature Stability	Not Specified	
Saturation Power (CW)	1.5 µW	
Minimum NEP (DC - 50 MHz)[b]	0.21 pW/√Hz	0.20 pW/√Hz
Dimensions (H x W x D)	2.97" x 2.00" x 1.08"	

- a. For a complete list of specifications and responsivity graphs, please see the *APD1xx Specs* tab. Data are valid at 23 ± 1 °C and 45% ± 15% relative humidity (non-condensing).
- b. At the Peak Responsivity Wavelength. For more information on how NEP is calculated, please see Thorlabs' Noise Equivalent Power White Paper.

Part Number	Description	Price	Availability
APD120A2/M	**Si Avalanche Photodetector, UV Enhanced, 200 - 1000 nm, M4 Taps**	**$1,184.92**	**Lead Time**
APD120A/M	**Si Avalanche Photodetector, 400 - 1000 nm, M4 Taps**	**$1,184.92**	**Today**
APD120A	**Si Avalanche Photodetector, 400 - 1000 nm, 8-32 Taps**	**$1,184.92**	**Today**

Hide Temperature-Compensated Si Avalanche Photodetectors

Temperature-Compensated Si Avalanche Photodetectors

- Temperature Compensated to Provide M Factor Stability of ≤±3% Over 18 to 28 °C
- Internal SM05 and External SM1 Threads Accept Most Fiber Adapters, Lens Tubes,

Key Specifications[a]		
Item #	**APD130A2(/M)**	**APD130A(/M)**
Detector Type	UV-Enhanced	Silicon APD

and Other Components

- Power Supply Included

Thorlabs' APD130A2(/M) and APD130A(/M) Avalanche Photodetectors feature an integrated thermistor that maintains an M factor stability of ±3% or better over 23 ± 5 °C by adjusting the bias voltage across the avalanche photodiode, supplying improved output stability in environments with temperature variations.

The orientation of the mechanical and electrical connections, combined with the compact design, ensures that these detectors can fit into tight spaces. Three 8-32 (M4) mounting holes, one on each edge of the housing, further ensure easy integration into complicated mechanical setups. The housing also provides compatibility with both our SM05- and SM1-Series Lens Tubes. An internally SM1-threaded cap is included.

Our SM1-threaded fiber adapters are compatible with these detectors. The internally SM1-threaded adapters can be mated directly to the housing, and are available below. To use our externally SM1-threaded fiber adapters, an internally SM1-threaded lens tube will be required to mate the fiber adapter to the detector's housing. The externally SM05-threaded fiber adapters are not compatible with these detectors.

	Silicon APD	
Wavelength Range	200 - 1000 nm	400 - 1000 nm
Output Bandwidth (3 dB)	DC - 50 MHz	
Active Area Diameter	1 mm	
Typical Max Responsivity (M = 50)	25 A/W @ 600 nm	25 A/W @ 800 nm
Responsivity Graph (Click to View)		
Transimpedance Gain	50 kV/A (50 Ω Termination) 100 kV/A (High-Z Termination)	
Max Conversion Gain[b]	2.5 × 10^6 V/W	
M Factor	50	
M Factor Temperature Stability[a]	±2% (Typical); ±3% (Max)	
Saturation Power (CW)	1.5 µW	
Minimum NEP (DC - 50 MHz)[b]	0.21 pW/√Hz	0.20 pW/√Hz
Dimensions (H x W x D)	2.97" x 2.00" x 1.08"	

- a. For a complete list of specifications and responsivity graphs, please see the *APD1xx Specs* tab. Data are valid at 23 ± 5 °C and 45% ± 15% relative humidity (non-condensing).
- b. At the Peak Responsivity Wavelength. For more information on how NEP is calculated, please see Thorlabs' Noise Equivalent Power White Paper.

Part Number	Description	Price	Availability
APD130A2/M	**Si Avalanche Photodetector, Temperature Compensated, UV Enhanced, 200 - 1000 nm, M4 Taps**	**$1,272.58**	**Today**
APD130A/M	**Si Avalanche Photodetector, Temperature Compensated, 400 - 1000 nm, M4 Taps**	**$1,272.58**	**Today**
APD130A2	**Si Avalanche Photodetector, Temperature Compensated, UV Enhanced, 200 - 1000 nm, 8-32 Taps**	**$1,272.58**	**Today**
APD130A	**Si Avalanche Photodetector, Temperature Compensated, 400 - 1000 nm, 8-32 Taps**	**$1,272.58**	**Today**

Hide Variable-Gain, Temperature-Compensated Avalanche Photodetectors

Variable-Gain, Temperature-Compensated Avalanche Photodetectors

- Continuously Variable Gain
- Temperature Compensated to Provide M Factor Stability of ≤±3% Over 18 to 28 °C
- Internal SM05 and External SM1 Threads Accept Most Fiber Adapters, Lens Tubes, and Other Components
- Power Supply Included

Click to Enlarge
The M Factor is controlled by a knob on the side of the APD.

These Avalanche Photodetectors feature a variable gain that can be controlled by a knob on the right side of the housing. Like the APD130A detectors above, these devices feature an integrated thermistor that maintains an M factor stability of ±3% or better over 23 ± 5 °C by adjusting the bias voltage across the avalanche photodiode. Compared to the standard and temperature-controlled APDs above, the APD430A2 and APD430A detectors also offer a larger usable bandwidth of DC to 400 MHz. The APD410A2 and APD410A detectors offer a slightly smaller usable bandwidth (DC to 10 MHz), but with higher sensitivity. The APD440A2 and APD440A detectors offer high transimpedance gain with a lower max bandwidth of 100 kHz.

The orientation of the mechanical and electrical connections, combined with the compact design, ensures that these detectors can fit into tight spaces. Three 8-32 (M4) mounting holes, one on each edge of the housing, further ensure easy integration into complicated mechanical setups. The housing also provides compatibility with both our SM05- and SM1-Series Lens Tubes. An internally SM1-threaded cap is included.

Fiber Coupling Note:
For fiber-coupled applications, we do not recommend using fiber connector adapters such as Thorlabs' S120-FC with the APD410A2(/M), APD430A2(/M), and APD430A detectors due to the small size of the sensors. High coupling losses and degradation of the frequency response may occur. To achieve high coupling efficiency, a fiber collimation package, focusing lens, and X-Y translator should be used. See the *Fiber Coupling* tab for details.

Key Specifications[a]						
Item #	**APD440A2**	**APD410A2(/M)**	**APD430A2(/M)**	**APD440A**	**APD410A(/M)**	**APD430A(/M)**

Detector Type	UV-Enhanced Silicon APD			Silicon APD		
Wavelength Range	200 - 1000 nm			400 - 1000 nm		
Output Bandwidth (3 dB)[b]	DC - 100 kHz	DC - 10 MHz	DC - 400 MHz	DC - 100 kHz	DC - 10 MHz	DC - 400 MHz
Active Area Diameter	1.0 mm	0.5 mm	0.2 mm	1.0 mm	1.0 mm	0.5 mm
Typical Max Responsivity	25 A/W @ M = 50[c]	25 A/W @ M = 50[c]	50 A/W @ M = 100[c]	53 A/W @ M = 100[d]		
Responsivity Graph (Click to View)	📈					
Transimpedance Gain	25 MV/A (50 Ω) 50 MV/A (High-Z)	250 kV/A (50 Ω) 500 kV/A (High-Z)	5 kV/A (50 Ω) 10 kV/A (High-Z)	25 MV/A (50 Ω) 50 MV/A (High-Z)	250 kV/A (50 Ω) 500 kV/A (High-Z)	5 kV/A (50 Ω) 10 kV/A (High-Z)
Max Conversion Gain[e]	1.25×10^9 V/W	12.4×10^6 V/W	5.0×10^5 V/W	2.65×10^9 V/W	26.5×10^6 V/W	5.3×10^5 V/W
M Factor Adjustment Range	5 - 50 (Continuous)		10 - 100 (Continuous)			
M Factor Temperature Stability[f]	±2% (Typical); ±3% (Max)					
Saturation Power (CW)	3.28 nW @ M = 50[c] 32.8 nW @ M = 5	0.32 µW @ M = 50[c] 3.20 µW @ M = 5	8.0 µW @ M = 100[c] 80 µW @ M = 10	1.54 nW @ M = 100[d] 15.4 nW @ M = 10	0.15 µW @ M = 100[d] 1.50 µW @ M = 10	8.0 µW @ M = 100[d] 80 µW @ M = 10
Minimum NEP[g]	2.5 fW/√Hz	0.09 pW/√Hz	0.15 pW/√Hz	3.5 fW/√Hz	0.04 pW/√Hz	0.14 pW/√Hz
Dimensions (H x Wx D)	2.93" x 2.21" x 1.08"	2.97" x 2.20" x 1.09"		2.93" x 2.21" x 1.08"	2.97" x 2.20" x 1.09"	

- a. For a complete list of specifications and responsivity graphs, please see the *APD4xxx Specs* tab. Data are valid at 23 ± 5 °C and 45% ± 15% relative humidity (non-condensing).
- b. At Maximum Gain Setting
- c. At 600 nm
- d. At 800 nm
- e. At the Peak Responsivity Wavelength
- f. Within the 23 ± 5 °C temperature range.
- g. For more information on how NEP is calculated, please see Thorlabs' Noise Equivalent Power White Paper.

Part Number	Description	Price	Availability
APD410A2/M	**Si Variable-Gain Avalanche Detector, Temperature Compensated, UV Enhanced, 200 - 1000 nm, DC - 10 MHz, M4 Taps**	**$1,327.76**	**Today**
APD430A2/M	**Si Variable-Gain Avalanche Detector, Temperature Compensated, UV Enhanced, 200 - 1000 nm, DC - 400 MHz, M4 Taps**	**$1,327.76**	**Today**
APD410A/M	**Si Variable-Gain Avalanche Detector, Temperature Compensated, 400 - 1000 nm, DC - 10 MHz, M4 Taps**	**$1,327.76**	**Today**
APD430A/M	**Si Variable-Gain Avalanche Detector, Temperature Compensated, 400 - 1000 nm, DC - 400 MHz, M4 Taps**	**$1,327.76**	**Today**
APD440A	**Customer Inspired! Si Variable-Gain Avalanche Detector, Temperature Compensated, 400 - 1000 nm, DC - 100 kHz, Universal 8-32 / M4 Taps**	**$1,184.50**	**Today**
APD440A2	**Customer Inspired! Si Variable-Gain Avalanche Detector, Temperature Compensated, 200 - 1000 nm, DC - 100 kHz, Universal 8-32 / M4 Taps**	**$1,184.50**	**Today**
APD410A2	**Si Variable-Gain Avalanche Detector, Temperature Compensated, UV Enhanced, 200 - 1000 nm, DC - 10 MHz, 8-32 Taps**	**$1,327.76**	**Today**
APD430A2	**Si Variable-Gain Avalanche Detector, Temperature Compensated, UV Enhanced, 200 - 1000 nm, DC - 400 MHz, 8-32 Taps**	**$1,327.76**	**5-8 Days**
APD410A	**Si Variable-Gain Avalanche Detector, Temperature Compensated, 400 - 1000 nm, DC - 10 MHz, 8-32 Taps**	**$1,327.76**	**Today**
APD430A	**Si Variable-Gain Avalanche Detector, Temperature Compensated, 400 - 1000 nm, DC - 400 MHz, 8-32 Taps**	**$1,327.76**	**Today**

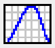
Hide Variable-Gain Si Avalanche Photodetector

Variable-Gain Si Avalanche Photodetector

- High-Speed, Variable-Gain Avalanche Photodetector (up to

Key Specifications[a]

1 GHz at 3 dB)
- Internal SM05 (0.535"-40) Threads for Lens Tube and Cage Assembly Integration
- 100 Step Adjustable Gain
- Location-Specific (EU or US) Power Supply Included

Item #	**APD210**
Detector Type	Silicon APD
Wavelength Range	400 - 1000 nm
Bandwidth	5 MHz - 1000 MHz (3 dB) 1 MHz - 1600 MHz (Max)
Active Area Diameter	0.5 mm
Responsivity Graph (Click to View)	
Transimpedance Gain	Variable
Max Conversion Gain	2.5×10^5 V/W
M Factor Temperature Stability	Not Specified
Minimum NEP[b]	0.40 pW/√Hz

- a. For a complete list of specifications and responsivity graphs, please see the *APD210 Specs* tab.
- b. For more information on how NEP is calculated, please see Thorlabs' Noise Equivalent Power White Paper.

Menlo Systems' APD210 Si Avalanche Photodetector is sensitive and fast enough for the characterization of pulsed lasers on the order of nanoseconds. The Si avalanche photodiode of the APD210 provides exceptional performance for low-light applications in the 400 - 1000 nm range. This APD maintains high-gain stability over the operating temperature range by utilizing a temperature-compensation circuit, which adjusts the ~150 VDC bias to ensure operation near the breakdown voltage.

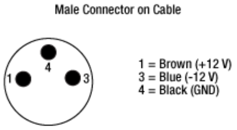
A 40 dB gain amplifier is integrated into the package and is AC-coupled to band the output BNC. The output is matched to 50 Ω impedance. The detector has an electronic bandwidth of 5 MHz to 1 GHz (at 3 dB) and offers user-accessible push buttons for 100 step gain adjustment. The APD210 has internal SM05 (0.535"-40) threading for easy integration into Thorlabs' family of lens tubes and cage assemblies. For direct fiber mounting, compatible fiber adapters are available. The bottom of the detector has a metric (M4) mounting hole and an M4 to 8-32 adapter for post mounting. The compact packaging allows the APD to be substituted directly into an existing setup while maintaining a small footprint on the benchtop. A power supply is included with this detector, and it ships with an EU or US adapter, depending on your location. Please contact Tech Support if a different adapter is required.

These photodetectors are not suitable for pulses longer than 30 ns or continuous light levels. Please see the FPD510 series for alternatives.

Part Number	Description	Price	Availability
APD210	**Variable-Gain, High-Speed Si Avalanche Photodetector, 400 - 1000 nm**	**$2,090.00**	**Today**

Hide ±12 VDC Regulated Linear Power Supply

±12 VDC Regulated Linear Power Supply



- Replacement Power Supply for Avalanche Photodetectors Sold Above (Except Item # APD210)
- ±12 VDC Power Output
- Current Limit Enabling Short Circuit and Overload Protection
- On/Off Switch with LED Indicator
- Switchable AC Input Voltage (100, 120, or 230 VAC)
- 2 m (6.6 ft) Cable with LUMBERG RSMV3 Male Connector
- UL and CE Compliant

The LDS12B ±12 VDC Regulated Linear Power Supply is intended as a replacement for the supply included with our APD series of avalanche photodetectors sold on this page, except for the APD210 photodetector. The cord has three pins: one for ground, one for +12 V, and one for -12 V (see diagram above). This power supply ships with a location-specific power cord. This power supply can also be used with the PDA series of amplified photodetectors, PDB series of balanced photodetectors, PMM series of photomultiplier modules, and the FSAC autocorrelator for femtosecond lasers.

Part Number	Description	Price	Availability
LDS12B	**±12 VDC Regulated Linear Power Supply, 6 W, 100/120/230 VAC**	**$85.22**	**Today**

Hide Internally SM1-Threaded Fiber Adapters

Internally SM1-Threaded Fiber Adapters

- Internally SM1-Threaded (1.035"-40) Disks with FC/PC, FC/APC, SMA, ST/PC, SC/PC, or LC/PC Receptacle
- Light-Tight Construction when used with SM1 Lens Tubes
- Compatible with Many of Our Photodiode Power Sensors

The APC adapter has two dimples in the front surface that allow it to be tightened with the SPW909 or SPW801 spanner wrench. The dimples do not go all the way through the disk so that the adapter can be used in light-tight applications when paired with SM1 lens tubes.

Item #	**S120-FC**	**S120-APC**[a]	**S120-SMA**	**S120-ST**	**S120-SC**	**S120-LC**
Adapter Image (Click the Image to Enlarge)						
Connector Type	FC/PC[b,c]	FC/APC[c]	SMA	ST/PC	SC/PC[d]	LC/PC
Threading	Internal SM1 (1.035"-40)					

- a. The S120-APC is designed with a 4° mechanical angle to compensate for the refraction angle of the output beam.
- b. In certain angle-independent applications, this adapter may also be used with FC/APC connectors.
- c. This connector uses a wide key (2.2 mm).
- d. In certain angle-independent applications, this adapter may also be used with SC/APC connectors.

Part Number	Description	Price	Availability
S120-FC	**FC/PC Fiber Adapter Cap with Internal SM1 (1.035"-40) Threads**	**$42.20**	**Today**
S120-APC	**Customer Inspired! FC/APC Fiber Adapter Cap with Internal SM1 (1.035"-40) Threads**	**$32.96**	**Today**
S120-LC	**LC/PC Fiber Adapter Cap with Internal SM1 (1.035"-40) Threads**	**$53.02**	**Today**
S120-SC	**SC/PC Fiber Adapter Cap with Internal SM1 (1.035"-40) Threads**	**$53.02**	**Today**
S120-SMA	**SMA Fiber Adapter Cap with Internal SM1 (1.035"-40) Threads**	**$42.20**	**Today**
S120-ST	**ST/PC Fiber Adapter Cap with Internal SM1 (1.035"-40) Threads**	**$42.20**	**Today**


OUTPUT
POWER IN
CE
THORLABS
www.thorlabs.com
APD120A2/M
Si Avalanche Photodetector
UV Enhanced
200 - 1000 nm
M4