Operation Manual

Thorlabs Instrumentation

APD110x Series

Avalanche Photodetectors

APD110A, APD110A2, APD110C

THORLABS

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We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to come up to your expectations and develop our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hear from you.

Thorlabs GmbH

This part of the instruction manual contains every specific information on how to handle and use the APD110x series Avalanche Photodetectors. A general description is followed by explanations of how to operate the unit.

☝Attention☝

This manual contains "WARNINGS" and "ATTENTION" label in this form, to indicate danger for persons or possible damage of equipment.

Please read these advises carefully!

NOTE

This manual also contains "NOTES" and "HINTS" written in this form.

1 Overview

The Thorlabs APD110x series Avalanche Photodetectors combines a high sensitivity Avalanche Photodiode (Silicon or InGaAs) with a specially designed ultra low noise transimpedance amplifier for detection of light signals from DC to 50 MHz. A buffered output drives a 50 Ω input impedance up to 1.8 volts. The ultra-low noise design includes an active low-pass filter to suppress out of band noise effectively. No external high voltage power supply is required for operation.

APD110x series Avalanche Photodetectors has an exceptional low NEP, making them ideal for fast low-light level detection applications, such as spectroscopy, fluorescence measurements, laser radar and optical rangefinders. Due to their very high sensitivity the APD110x series Avalanche Photodetectors can replace Photomultiplier Tubes (PMT´s) in many applications.

The new slim line housing includes a removable threaded coupler that is compatible with any number of Thorlabs 1” and ½” threaded accessories. This allows convenient mounting of external optics, filters, apertures or fiber adaptors, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories. The APD110x has three tapped mounting holes and includes an external power supply.

The “Getting Started Quickly” section below gives an overview of how to set up the APD110x series Avalanche Photodetectors. Subsequent sections contain detailed information about principle of operation, operating suggestions and technical specifications.

1.1 Ordering Codes and Customization

The following models of APD110x series are available:

APD110A Avalanche Photodetector, Silicon APD, 400 - 1000 nm, 8-32 mounting holes

APD110A/M Avalanche Photodetector, Silicon APD, 400 - 1000 nm, M4 mounting holes

APD110A2	Avalanche Photodetector, UV-enhanced Silicon APD, 200 - 1000 nm, 8-32 mounting holes
APD110A2/M	Avalanche Photodetector, UV-enhanced Silicon APD, 200 - 1000 nm, M4 mounting holes
APD110C	Avalanche Photodetector, InGaAs APD, 950 - 1650 nm, 8-32 mounting holes
APD110C/M	Avalanche Photodetector, InGaAs APD, 950 - 1650 nm, M4 mounting holes

AC-coupled versions as well as open detector versions (detector cover glass removed) of each model can be ordered on request.

Model APD110A and APD110A2 M-factor is factory set to 50. Different M-factor (10..100) can be ordered on request.

Model APD110C M-factor is factory set to 10. Lower M-factor (2..10) can be ordered on request

Please refer to www.thorlabs.com for new models.

1.2 Safety

☝ Attention ☝

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

Before connecting the power supply to the mains make sure that the line voltage range marked on the power supply agrees with your local supply.

The unit must not be operated in explosion endangered environments!

Only with written consent from Thorlabs GmbH may changes to single components be carried out or components not supplied by Thorlabs GmbH be used.

This precision device is only dispatchable if duly packed into the complete original packaging including the plastic form parts. If necessary, ask for a replacement package.

☝ Attention ☝

Mobile telephones, handy phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to EN 50 082-1.

2 Getting Started Quickly

This section is intended to provide information how to set up quickly the APD110x. More details and advanced features are described in further sections.

2.1 Unpacking

The APD110x series Avalanche Photodetectors consists of the following items:

- **APD110x** Avalanche Photodetector
- Metal cover cap
- Power supply (±12 V, 200 mA), 110 V or 230 V line voltage
- Operation manual

NOTE

Please check prior to operation, if the indicated line voltage range on the power supply matches with your local mains voltage!

NOTE

If you want to use your own power supply, you can ask Thorlabs for an appropriate power connector cable.

2.2 Setup

- Carefully unpack the unit and accessories. If any damage is noticed, do not use the unit. Call Thorlabs and have us replace the defective unit.
- If necessary, mount the unit on your optical table or application. The unit has three tapped mounting holes (see chapter 3.4 for details).
- Remove the metal cover cap on the optical input to detect your optical signal.
- If necessary, mount external optics, filters, apertures or fiber adapters.
- Switch the power supply to your local main voltage (100-120 VAC or 220 V-240 VAC), see Figure 1.

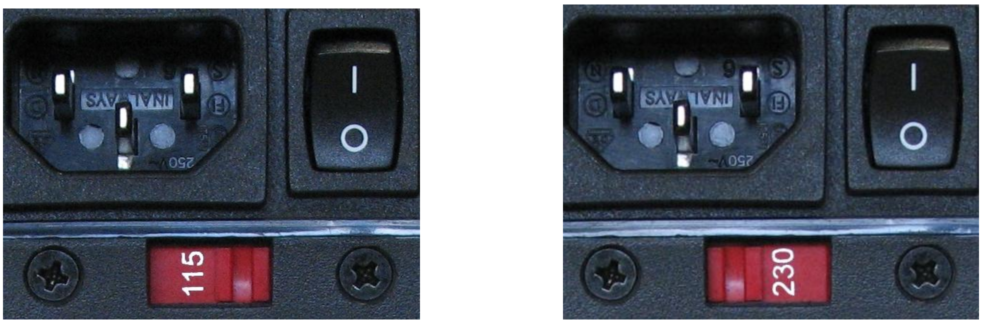


Figure 1: *Switchable power supply for 115 V and 230 V*

- Plug the power connector cable into the **POWER IN**.
- Plug the power supply into a 50-60 Hz, 100-120 VAC or 220V-240 VAC outlet, turn power supply on.
- Connect **OUTPUT** with coaxial cable to your data acquisition device. Please note, that a 50 Ω impedance device should be used for best RF performance.

2.3 First Operation

- Turn the power switch to **I**. The green LED on the APD110x indicates correct power supply.
- Adjust the optical source to the optical input. The maximum **OUTPUT** voltage swing of model APD110x is 3.6 V for high impedance loads (1.8 V into 50 Ω loads). The output signal must not exceed this maximum output voltage to avoid saturation. External neutral density filters or attenuators are recommended to reduce the input light level in critical cases.
- Do not exceed a maximum power density of 4 W/cm^2 for maximum linearity performance when measuring focused beams, fiber outputs, or small diameter beams.

- For fiber coupled applications fiber adapters like Thorlabs **S120-xx** series can easily mounted on the optical inputs. The fiber adapter will accommodate multi-mode as well as single-mode fiber.
- Turn the power switch to **O** when you are finished the measurements.

NOTE

To prevent saturation of the amplifier keep the optical input powers less than the saturation power listed in Specifications.

☝ Attention ☝

Refer to the Specifications and pay attention to the optical damage threshold!

Exceeding these values will permanently destroy the detectors!

3 Detailed Description

3.1 General Principle of Operation

The Thorlabs APD110x series Avalanche Photodetectors combines high sensitivity Avalanche Photodiode (Silicon or InGaAs) with a specially designed ultra low noise transimpedance amplifier for detection of light signals from DC to 50 MHz. A buffered output drives a 50 Ω input impedance up to 1.8 volts. The ultra-low noise design includes an active low-pass filter to suppress out of band noise effectively. No external high voltage power supply is required for operation.

APD110x series Avalanche Photodetectors has an exceptional low NEP, making them ideal for fast low-light level detection applications, such as spectroscopy, fluorescence measurements, laser radar and optical rangefinders. Due to their very high sensitivity the APD110x series Avalanche Photodetectors can replace Photomultiplier Tubes (PMT´s) in many applications. The Avalanche Photodetectors cannot be damaged by unwanted ambient light, which is critical for many Photomultiplier Tubes.

Avalanche Photodiodes uses an internal gain mechanism to increase sensitivity. The internal amplification process depends on the reverse bias voltage an is usually described by the M-factor (multiplication factor). Due to internal processes the M-factor is also temperature dependant. Model APD110A and APD110A2 M-factor is factory set to 50 at 23°C ambient temperature. Model APD110C M-factor is factory set to 10 at 23°C ambient temperature. While APD110x is operating on a fixed reverse bias voltage the actual APD M-factor will change with temperature. In general lower temperatures will increase M-factor while higher temperatures will decrease M-factor. Please call Thorlabs Tech-Support if further details are required.

The new slim line housing includes a removable threaded coupler that is compatible with any number of Thorlabs 1” and ½” threaded accessories. This allows convenient mounting of external optics, filters, apertures or fiber adaptors, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories. The APD110x has three tapped mounting holes.

The APD110x series is powered by the included external power supply (±12 V, 200 mA) via a PICO M8 power connector.

3.2 Optical Input and Detector Responsivity

Model APD110A uses a Silicon Avalanche Photodiode with a detector active area diameter of 1 mm, operating from 400 – 1000 nm. Figure 2 shows a typical responsivity curve for an M-factor of 1. Please note, that APD110A M-factor is factory set to M=50 at room temperature, which will increase responsivity by a factor of 50.

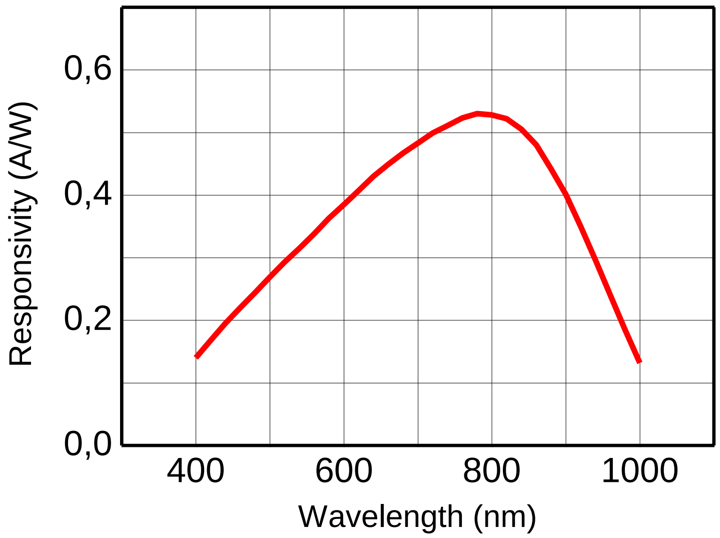


Figure 2: *APD110A detector responsivity (M=1)*

Model APD110A2 uses an UV-enhanced Silicon Avalanche Photodiode with a detector active area diameter of 1 mm, operating from 200 – 1000 nm. Figure *3* shows a typical responsivity curve for an M-factor of 1. Please note, that APD110A2 M-factor is factory set to M=50 at room temperature, which will increase responsivity by a factor of 50 and slightly shift peak responsivity to shorter wavelength .

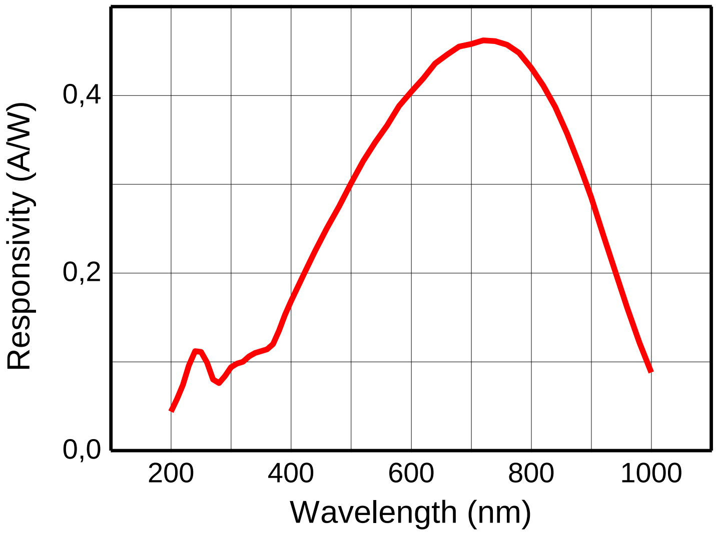


Figure 3: *APD110A2 detector responsivity (M=1)*

Model APD110C uses an InGaAs Avalanche Photodiode with a detector active area diameter of 0.2 mm, operating from 950 – 1650 nm. Figure *4* shows a typical responsivity curve for an M-factor of 1. Please note, that APD110C M-factor is factory set to M=10 at room temperature, which will increase responsivity by a factor of 10.

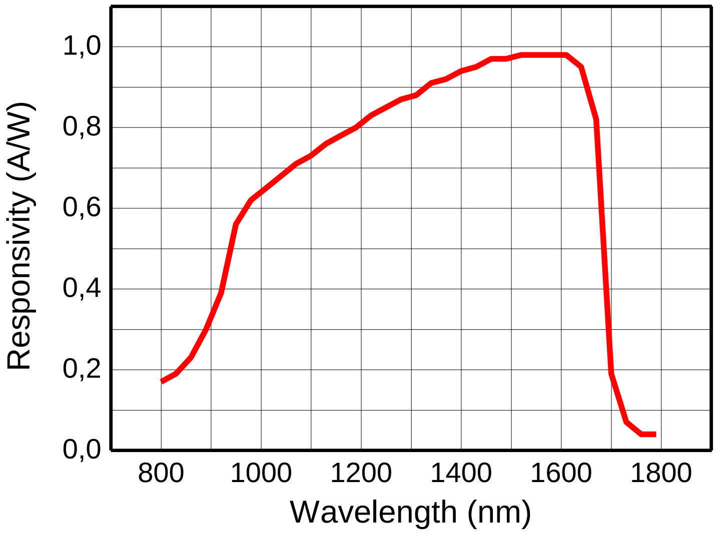


Figure 4: *APD110C detector responsivity (M=1)*

Open beams should be carefully aligned to the detectors. Additional focusing lenses can be easily attached to the Avalanche Photodetectors. The housing is compatible with any number of Thorlabs 1” and ½” threaded accessories. This allows convenient mounting of external optics, filters, apertures or fiber adapters, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories.

For fiber coupled application a fiber connector adapter like Thorlabs S120-FC or SM1*xx* can be easily used. The fiber adapter will accommodate multi-mode fiber as well as single-mode fiber. Please note, that coupling losses may occur due to small detector size, which will result in a reduced output signal. If angled connectors are used the fiber adapter can be rotated from its original position to check for an improved alignment. For this process use an optical input power below the saturation power while observing OUTPUT voltage on a digital voltmeter or other low-frequency measurement device.

For Model APD110C using fiber connector adapter like Thorlabs S120-FC or SM1xx is not recommended due to small detector size. Beside increased coupling losses degradation of the frequency response may occur. To achieve high coupling efficiency a fiber collimation package in combination with an additional focusing lens and a x-y translation stage should be used, which can be directly mounted to the external 1” thread. Please call Thorlabs Tech Support is you need assistance selecting the right parts.

The maximum OUTPUT voltage swing is 3.6 V. Saturation of the OUTPUT will occur at optical input power greater than CW Saturation Power listed in Specifications. If necessary, use external neutral density filters or attenuators to reduce the input light level. Please note, that the Avalanche Photodetectors are extremely sensitive to unwanted stray light. Carefully shielding of the Avalanche Photodetectors from any unwanted light sources is essential. Common techniques are baffling or other opaque barriers like black cloths, beam tubes or use appropriate band pass filters in front of the detector to minimize the influence of stray light.

The optical damage threshold is 1 mW. Exceeding this value will permanently destroy the Avalanche Photodetectors!

3.3 Electrical Output

The Thorlabs APD110x series Avalanche Photodetectors delivers an OUTPUT voltage, which is a function of incident light power P_{OPT}, detectors responsivity $\Re(\lambda)$, multiplication factor M and transimpedance gain G given by:

$$V_{OUT} = P_{OPT} \cdot \Re(\lambda) \cdot M \cdot G$$

The responsivity $\Re(\lambda)$ for a given wavelength can be read from the spectral responsivity curves (see chapter 3.2) to estimate the OUTPUT voltage. For Model APD110A and APD110A2 M-factor is factory set to 50 at 23°C ambient temperature. For Model APD110C M-factor is factory set to 10 at 23°C ambient temperature. Please note, that actual APD M-factor will change with temperature. In general lower temperatures will increase M-factor while higher temperatures will decrease M-factor. The amplifier's transimpedance gain G is 100.000 V/A for all Models APD110x. Please note, that OUTPUT voltage is reduced by a factor of 0.5 if connected to a 50 Ω load.

The maximum output voltage swing of OUTPUT is 3.6 V for high impedance loads (1.8 V into 50 Ω). Depending on wavelength responsivity $\Re(\lambda)$ of the detector and M-factor the amplifier will reach saturation at optical input power greater than CW Saturation Power listed in Specifications. The output signal should be below the maximum output voltage to avoid saturation.

The APD1100x series Avalanche Photodetectors has an OUTPUT BNC connector.

The amplifier offset voltage is factory set to zero at 23°C ambient temperature. Due to the very high transimpedance gain small temperature changes may affect offset voltage. Therefore it is recommended to use the Avalanche Photodetectors in a constant temperature environment after a short warm up period (~5 min) for exact DC light level measurements.

3.3.1 Model APD110A

The 3 dB bandwidth of the OUTPUT is DC – 50 MHz (typically in excess of 50 MHz). Figure 5 shows a typical frequency response curve of the OUTPUT for model APD110A. For this measurement a test signal generated by an optical transmitter was fiber coupled to the Avalanche Photodetector. The OUTPUT frequency response was measured with a optical network analyzer.

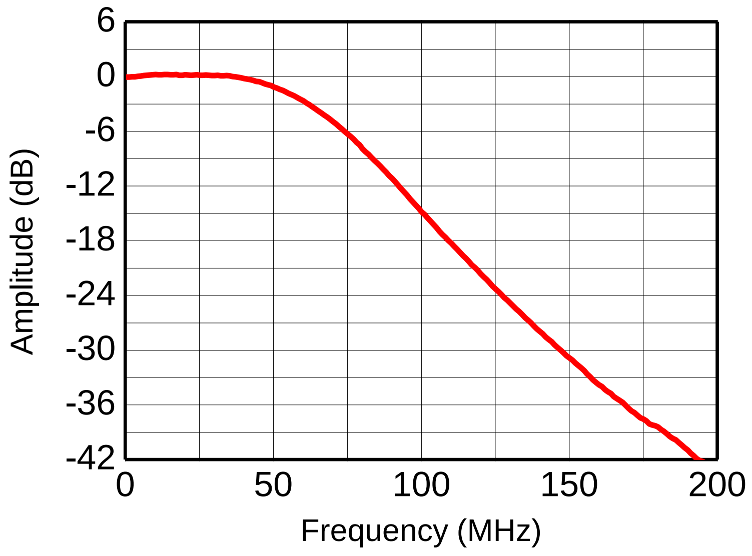


Figure 5: *APD110A OUTPUT frequency response*

Figure 6 shows a typical noise spectrum of model APD110A measured using an electrical spectrum analyzer (RBW 10 kHz, Video BW 10 kHz). The optical input of the APD110A was blocked. The lower curve is measured with the same setup and APD110A switched off , i.e., it represents the measurement system's noise floor.

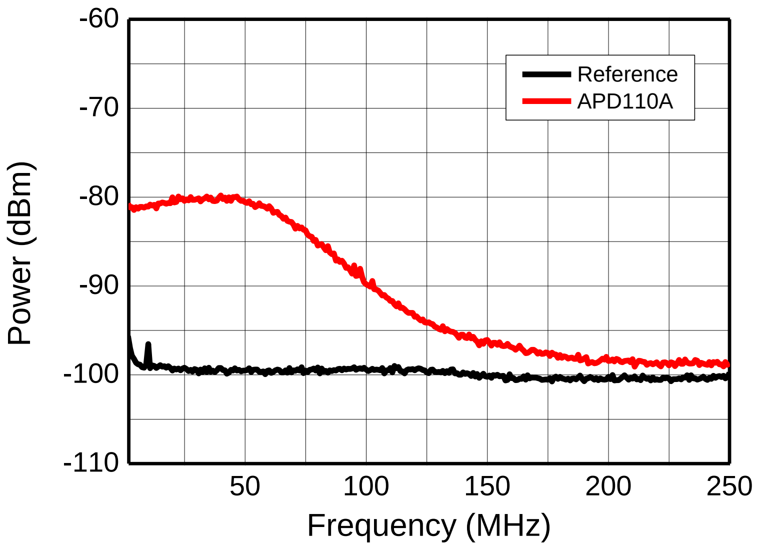


Figure 6: *APD110A spectral noise measurement*

Model APD110A has a minimum noise-equivalent power (NEP) of 0.16 pW/√Hz from DC – 50 MHz. The integrated noise from DC – 50 MHz is ~1.2 nW_{RMS}. This input optical noise level is the approximate minimum optical signal that can be detected. For APD110A, the overall output voltage noise (V_{RMS}) is ~1.5 mV_{RMS}.

3.3.2 Model APD110A2

The 3 dB bandwidth of the OUTPUT is DC – 50 MHz. Figure *7* shows a typical frequency response curve of the OUTPUT for model APD110A2. For this measurement a test signal generated by an optical transmitter was fiber coupled to the Avalanche Photodetector. The OUTPUT frequency response was measured with a optical network analyzer.

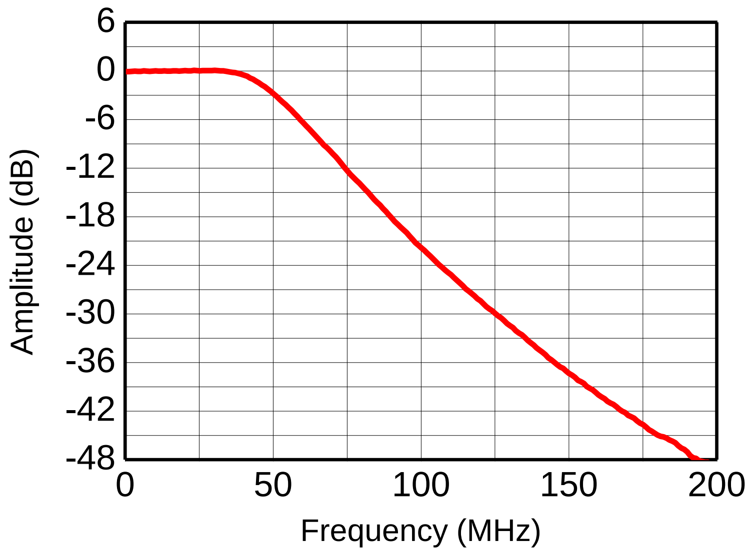


Figure 7: *APD110A2 OUTPUT frequency response*

Figure 8 shows a typical noise spectrum of model APD110A2 measured using an electrical spectrum analyzer (RBW 10 kHz, Video BW 10 kHz). The optical input of the APD110A was blocked. The lower curve is measured with the same setup and APD110A switched off , i.e., it represents the measurement system's noise floor.

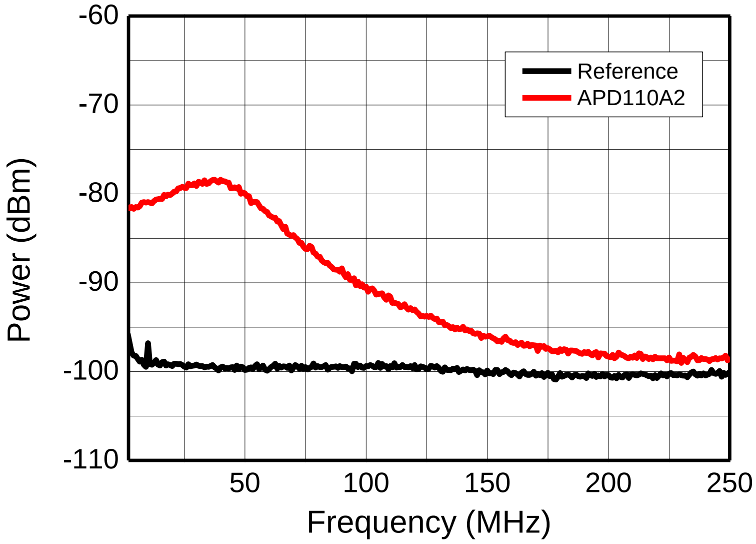


Figure 8: *APD110A2 spectral noise measurement*

Model APD110A2 has a minimum noise-equivalent power (NEP) of 0.18 pW/√Hz from DC – 50 MHz. The integrated noise from DC – 50 MHz is ~1.3 nW_{RMS}. This input optical noise level is the approximate minimum optical signal that can be detected. For APD110A2, the overall output voltage noise (V_{RMS}) is ~1.65 mV_{RMS}.

3.3.3 Model APD110C

The 3 dB bandwidth of the OUTPUT is DC – 50 MHz (typically in excess of 50 MHz). Figure 9 shows a typical frequency response curve of the OUTPUT for model APD110C. For this measurement a test signal generated by an optical transmitter was fiber coupled to the Avalanche Photodetector using a fiber collimation package in combination with an additional focusing lens and a x-y translation stage directly mounted to the external 1” thread. The OUTPUT frequency response was measured with a optical network analyzer.

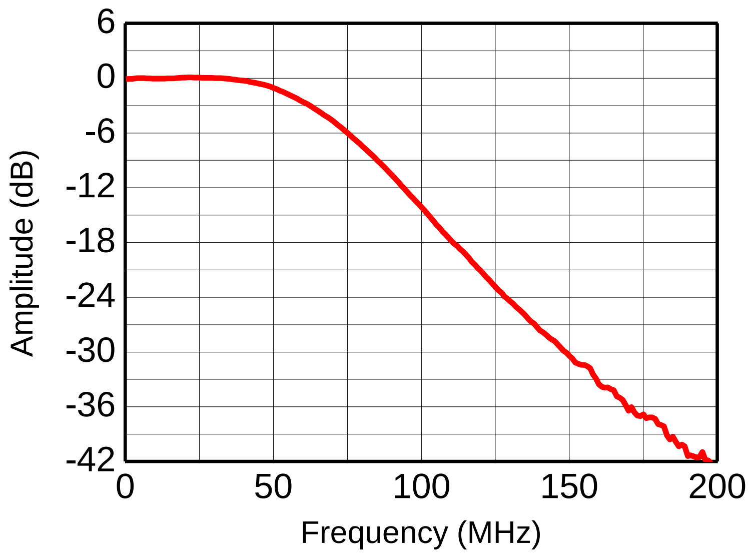


***Figure 9:** APD110C OUTPUT frequency response*

Figure 10 shows a typical noise spectrum of model APD110C measured using an electrical spectrum analyzer (RBW 10 kHz, Video BW 10 kHz). The optical input of the APD110C was blocked. The lower curve is measured with the same setup and APD110C switched off , i.e., it represents the measurement system's noise floor.

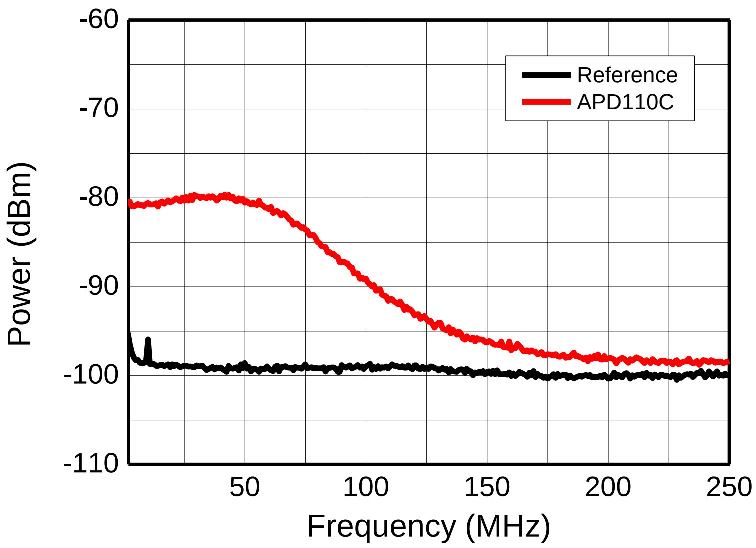


***Figure 10:** APD110C spectral noise measurement*

Model APD110C has a minimum noise-equivalent power (NEP) of 0.46 pW/√Hz from DC – 50 MHz. The integrated noise from DC – 50 MHz is ~3.3 nW_{RMS}. This input optical noise level is the approximate minimum optical signal that can be detected. For APD110C, the overall output voltage noise (V_{RMS}) is ~1.5 mV_{RMS}.

3.4 Mounting the APD110x series

The APD110x series is housed in a rugged 2x2.5x1 $inch^3$ shielded aluminum enclosure. The new slim line housing includes a removable threaded coupler that is compatible with any number of Thorlabs 1" and ½" threaded accessories. This allows convenient mounting of external optics, filters, apertures or fiber adaptors, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories. The electrical connectors and the ON/OFF switch are conveniently located on the side walls of the housing for easy access and to minimize the thickness of the Avalanche Photodetectors so it can fit into tight spaces. For maximum flexibility the APD110x has three 8-32 (M4 for metric version) tapped mounting holes to mount the unit to a post or pedestal, see Figure 11.

Figure 11: *Possible mounting options for APD110x*

3.5 Recommendations

Please always remember that the Avalanche Photodetectors are extremely sensitive devices. Carefully shielding of the Avalanche Photodetectors from any unwanted light sources is essential. Common techniques are baffling or other opaque barriers like black cloths or beam tubes.

It is highly recommended to use appropriate band pass filters in front of the detector to minimize the influence of stray light.

Since stray light has its strongest frequencies at DC and line frequency or harmonics, optical chopping and Lock-In detection can further improve measurement sensitivity.

It is not necessary to switch off the Avalanche Photodetectors when it is exposed to ambient light. The amplifier will saturate but unlike Photomultiplier Tubes it will not be damaged or saturated for a long period of time.

Another critical point can be electrostatic coupling of electrical noise associated with ground loops. In most cases an electrically isolated post (see Thorlabs parts TRE or TRE/M) will suppress electrical noise coupling. You should always try to identify the electrical noise sources and increase the distance to the Avalanche Photodetectors. If possible, you can also rotate the Avalanche Photodetectors input away from the noise source. Different common ground points can also be tested.

The amplifier offset voltage is factory set to zero at 23°C ambient temperature. Due to the very high transimpedance gain small temperature changes may affect offset voltage. Therefore it is recommended to use the Avalanche Photodetectors in a constant temperature environment after a short warm up period (~5min) for exact DC light level measurements.

Model APD110x M-factor is factory set at 23°C ambient temperature. While APD110x is operating on a fixed internal reverse bias voltage (no temperature compensation) the actual APD M-factor will change with ambient temperature. In general lower temperatures will increase M-factor while higher temperatures will decrease M-factor. Always try to operate the APD110x at 23°C ambient temperature for exact power measurements.

4 Maintenance and Repair

☝ Attention ☝

Do not try to open the power supply or the unit! Dangerous or even lethal voltages inside.

To avoid damage, do not expose it to spray, liquids or solvents!

4.1 General Care

Protect the APD110x series from adverse weather conditions. The APD110x series is not water resistant.

4.2 Cleaning

To clean the APD110x series housing, use a mild detergent and damp cloth. Do not soak the unit in water or use solvent based cleaners.

When cleaning the window of the photodetector, please remember that is a sensitive optical device. Gently blow off any debris using compressed air and wipe gently with an optic tissue wetted with propane.

4.3 Repair

There are no serviceable parts in the APD110x series or power supply. The APD110x series does not contain any components to be repaired by the user. If any malfunction should occur or you suspect a problem, please contact Thorlabs GmbH for repair return instructions.

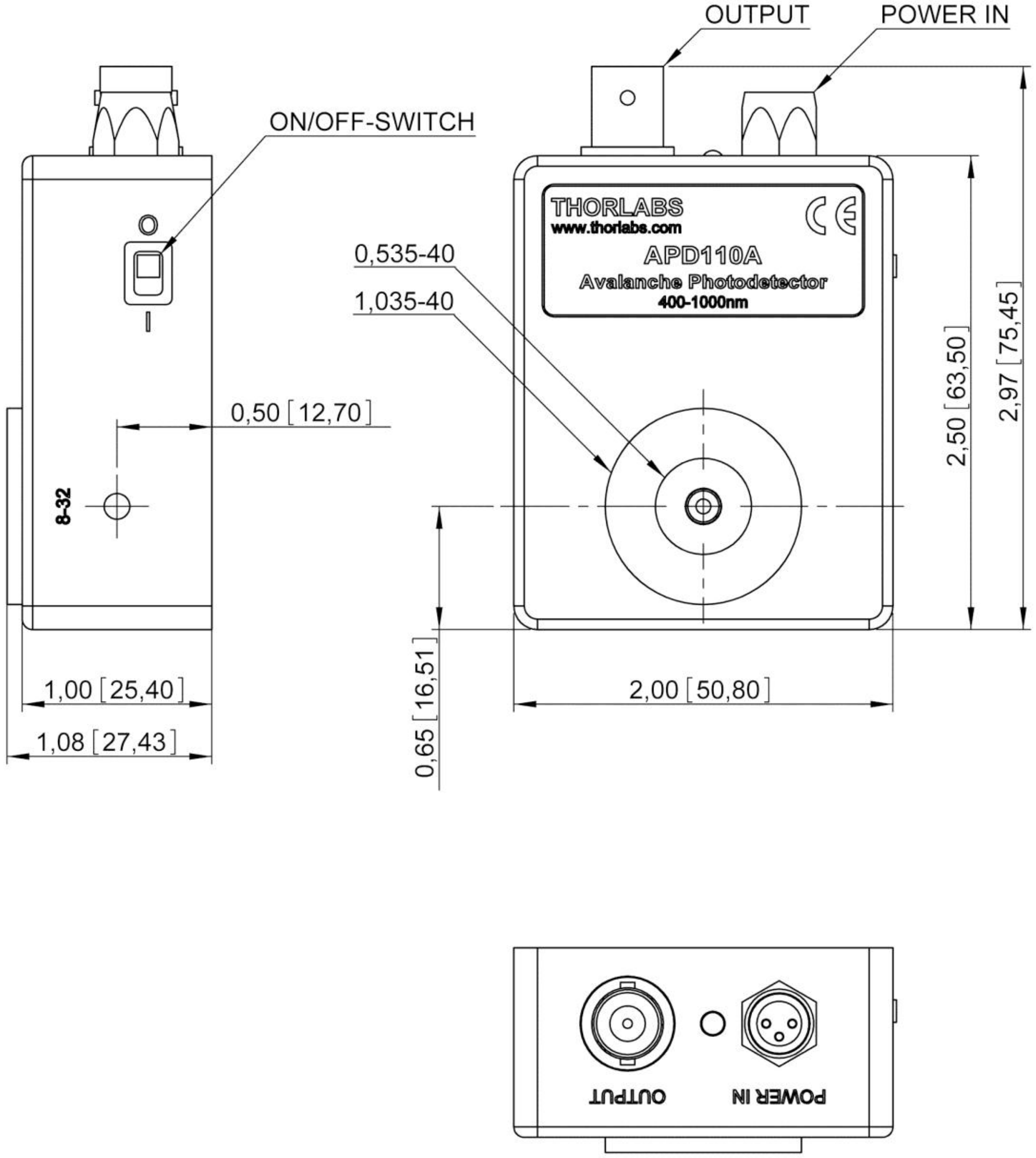
5 Appendix

5.1 Specifications

Specification	APD110A	APD110A2	APD110C
Detector Material/Type	Silicon APD	UV-enhanced Silicon APD	InGaAs APD
Wavelength Range	400 – 1000 nm	200 – 1000 nm	950 – 1650 nm
Maximum APD Responsivity	25 A/W @ 800 nm, M=50	25 A/W @ 600 nm, M=50	9 A/W @ 1500 nm, M=10
Detector Active Area Diameter	1 mm	1 mm	0.2 mm
Transimpedance Gain	100 kV/A 50 kV/A with 50 Ω termination		
Maximum Conversion Gain	$2.5x10^6$ V/W		$0.9x10^6$ V/W
OUTPUT Bandwidth (3dB)	DC – 50 MHz		
CW Saturation Power	1.5 µW		4.2 µW
Maximum Input Power (photodiode damage threshold))	1 mW		
Minimum NEP (DC-50MHz)	0.16 pW/√Hz	0.18 pW/√Hz	0.46 pW/√Hz
Electrical Output, Impedance	BNC, 50 Ω		
Maximum Output Voltage	3.6 V		
DC-Offset Electrical Output	< ±15 mV		
Size	2x2.5x1 inch³		
Power Supply	±12 V, 200 mA		

All accuracy data are valid at 23 ± 2°C and 45 ±15% humidity

5.2 Mechanical Drawing



Mechanical drawing
Unit inch [mm]
APD110A
© THORLABS

5.3 Warranty

Thorlabs GmbH warrants material and production of the APD110x series for a period of 24 months starting with the date of shipment. During this warranty period *Thorlabs GmbH* will see to defaults by repair or by exchange if these are entitled to warranty.
For warranty repairs or service the unit must be sent back to *Thorlabs GmbH (Germany)* or to a place determined by *Thorlabs GmbH* . The customer bears the shipping costs to *Thorlabs GmbH* , in case of warranty repairs *Thorlabs GmbH* will pay for return shipment back to the customer.
If no warranty repair is applicable the customer bears the costs for return shipment as well.
In case of shipment from outside EU applying customs fees, taxes etc. shall be paid by the customer.

Thorlabs GmbH warrants the hard- and software determined by *Thorlabs GmbH* for this unit to operate fault-free provided that they are handled according to our requirements. However, *Thorlabs GmbH* does not warrant a faulty free and uninterrupted operation of the unit, of the soft- or firmware for special applications nor this instruction manual to be error free. *Thorlabs GmbH* is not liable for consequential damages.

Restriction of warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient conditions stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. *Thorlabs GmbH* does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs GmbH reserves the right to change this instruction manual or the technical data of the described unit at any time.

5.4 Certifications and Compliances

Certifications and compliances

Category	**Standards or description**	
EC Declaration of Conformity - EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance is given to the following specifications as listed in the Official Journal of the European Communities:	
	EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A Radiated and Conducted Emissions[1] and Immunity.[2]
	IEC 61000-4-2	Electrostatic Discharge Immunity (Performance criterion C)
	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance criterion B) [2]
Australia / New Zealand Declaration of Conformity - EMC	Complies with the Radiocommunications Act and demonstrated per EMC Emission standard[1,2,3]:	
	AS/NZS 2064	Industrial, Scientific, and Medical Equipment: 1992
FCC EMC Compliance	Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B[1].	

[1] Using high-quality shielded interface cables.

[2] Minimum Immunity Test requirement.

5.5 Thorlabs “End of Life” Policy (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 (Figure 12)
- 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.

5.5.1 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.

5.5.2 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.

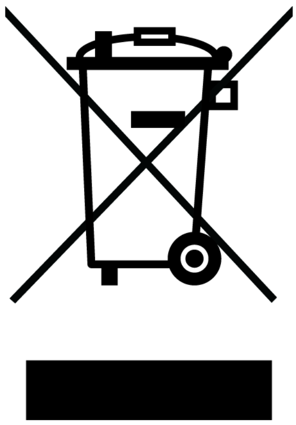


Figure 12: *Crossed out “wheelie bin” symbol*

5.6 List of Figures

5.7 List of Acronyms

The following acronyms are used in this manual:

APD	Avalanche Photodiode
InGaAs	Indium Gallium Arsenide
NEP	Noise-equivalent Power
PMT	Photo Multiplier Tube

5.8 Addresses

Our company is also represented by several distributors and sales offices throughout the world.

Europe
Thorlabs GmbH
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Germany

Sales and Support
Phone: +49 (0) 81 31 / 5956-0
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Email: europe@thorlabs.com
Web: www.thorlabs.com

USA
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435 Route 206 North
Newton, NJ 07860
USA

Sales and Support
Phone: 1-973-579-7227
Fax: 1-973-300-3600
Email: sales@thorlabs.com
Email: techsupport@thorlabs.com
Web: www.thorlabs.com

Japan

Thorlabs, Inc.
6th Floor, Fujimizaka Building
5-17-1, Ohtsuka
Bunkyo-ku, Tokyo 112-0012
Japan

Sales and Support

Phone:	+81-3-5977-8401
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Email:	sales@thorlabs.jp
Web:	www.thorlabs.jp

Please call our hotlines, send an Email to ask for your nearest distributor or just visit our homepage

http://www.thorlabs.com