

# APD-Series High Sensitivity Avalanche Photodetector

## USER MANUAL





Excitement Is Not Measureable. Light Is.

Menlo Systems, a leading developer and global supplier of instrumentation for high-precision metrology, was founded 2001 as spin-off of the Max-Planck-Institute of Quantum Optics. Known for the Nobel-Prize-winning Optical Frequency Comb technology, the Munich based company offers complete solutions based on ultrafast lasers, synchronization electronics and THz systems for applications in industry and research.

## I. IMPRINT

Title: User Manual

Model: APD210, APD310, APD410

Manufacturer: Menlo Systems GmbH, Munich, Germany

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Changes: Subject to technical changes without prior notice.

## II. TABLE OF CONTENTS

I.	IMPRINT .....	3
II.	TABLE OF CONTENTS .....	4
III.	SAFETY INSTRUCTIONS .....	5
III.1	Electrical Safety Precautions.....	5
1.	System Overview .....	6
1.1	Contents.....	6
1.2	Connectors and Controls .....	7
1.3	Specifications .....	8
1.3.1	Response Curve.....	9
1.3.2	Frequency Characteristics .....	9
1.3.3	Time Characteristics and Rise Time .....	10
1.4	Technical Drawings.....	13
2.	Installation / Operation .....	15
3.	Maintenance.....	16
4.	Troubleshooting.....	17
A.	Customer Service .....	19
A.1	Factory Service & Repair .....	19
A.2	Additional Service Plan.....	19
B.	Regulatory.....	20
B.1	Waste Treatment is Your Own Responsibility.....	20
B.2	Ecological Background.....	20
C.	Contacts .....	21

## III. SAFETY INSTRUCTIONS

### III.1 ELECTRICAL SAFETY PRECAUTIONS

You should make sure that electrical equipment used for work is safe. Here is a list of actions that should be taken:

- Do not use wet hands when turning on electrical equipment.
- Check that the electrical equipment is suitable for the work and way in which it is going to be used.
- Check that the electrical equipment is in good condition.
- Check that the equipment is suitable for the electrical supply with which it is going to be used, and the electrical supply is safe.
- Make sure that the user of the equipment is trained to use it safely and can keep others safe.
- Make sure the user knows which personal protective equipment to wear, how to use it, and make sure they do so.
- Power failures should be avoided.

## 1. SYSTEM OVERVIEW

### 1.1 CONTENTS

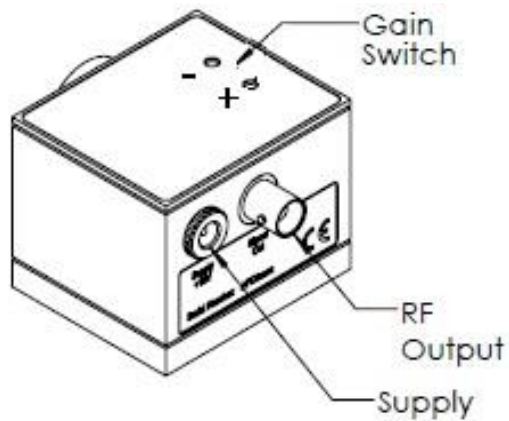
Your photo detector case contains the following items:



Item	Description
APD	Photodetector APD210, APD310 or APD410
Adapter	Adapter for imperial threads (Internal 8-32 threads and external M4 x 0.7 threaded stud)
Power Supply	Power supply (Voltage +15V, GND)
Power Clips	EU and US (UK on demand) clips suitable for your country
Manual	APD Manual
Testreport	Final Test Measurement

## 1.2 CONNECTORS AND CONTROLS

The detector itself has two connectors on the opposite side of the optical input:



*RF Output:* BNC connector

*Supply:* Metal DC jack 5.5x2.1 mm  
Center pin: +15V;  
Outer ring: Ground

Connect the *RF Output* to a 50  $\Omega$  coupled measurement tool (e.g. oscilloscope, RF spectrum analyzer,...) via BNC cable.

Connect the plug-in power supply to the *Supply* receptacle and plug the power cord into the 100-240 V, 50-60 Hz outlet.

Each unit's housing features an M4 x 0.7 mounting hole (an adapter for imperial mounting is enclosed) that enables the amplified photodetector to be vertically post mounted. For more information about the location of the mounting point, please see chapter 1.4 Technical Drawings.

### 1.3 SPECIFICATIONS

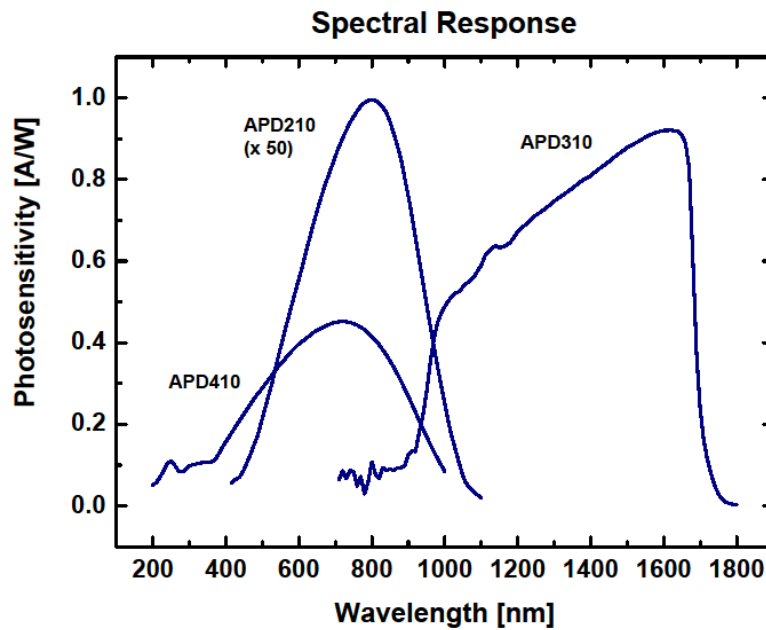
Specifications APD	APD210	APD310	APD410
Detector Type	Si	InGaAs	Si
Optical Input <sup>1)</sup>	Free space	Free space	Free space
Spectral Range [nm]	400-1000	850-1650	200-1000
Damage Threshold [mW]	10	10	10
Detector Diameter [mm]	0.5	0.04	0.2
Frequency Range [MHz]	1-1600	1-1800	1-1600
3dB Bandwidth [MHz]	5-1000	5-1000	5-900
Rise Time [ps]	500	500	500
Max. Gain <sup>2)</sup> [ $V_{Peak-} / W_{Input}$ ]	$2.5 \times 10^5$ (@800nm)	$2.5 \times 10^4$ (@1500nm)	$4.5 \times 10^4$ (@650nm)
Dark State Noise Level <sub>not integrated</sub> (up to 5MHz / 5-250MHz) [dBm]	-80	-80	-80
NEP (calculated) [pW/ $\sqrt{Hz}$ ]	0.24	13.3	87.6
Output Impedance [ $\Omega$ ]	50	50	50
Output Coupling	AC	AC	AC
Output Signal [V]	$V_{pp}=1$	$V_{pp}=1$	$V_{pp}=1$
Output Connector	BNC	BNC	BNC
Supply Voltage <sup>3)</sup> [V DC]	+12 to +15	+12 to +15	+12 to +15
Max. Current Consumption [mA]	200	200	200
Operating Temperature [ $^{\circ}C$ ]	10-40	10-40	10-40
Storage Temperature [ $^{\circ}C$ ]	-20 - +85	-20 - +85	-20 - +85
Storage Humidity [% RH]	10-90	10-90	10-90
Device Dimensions [mm <sup>3</sup> ]	60 x 50 x 47.5	60 x 50 x 47.5	60 x 50 x 47.5

1) With adaptor for Thorlabs SM05 series. 2) Gain adjustable via pushbuttons. 3) Power supply included, with adaptors for EU/USA, please ask for different types.



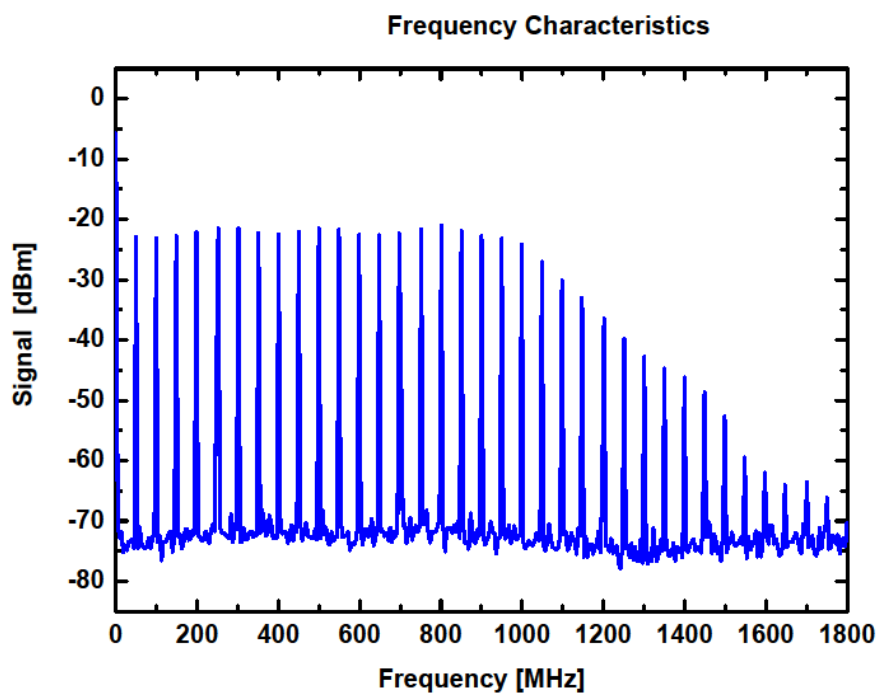
### 1.3.1 RESPONSE CURVE

The response curve for all models of the APD series is shown below.



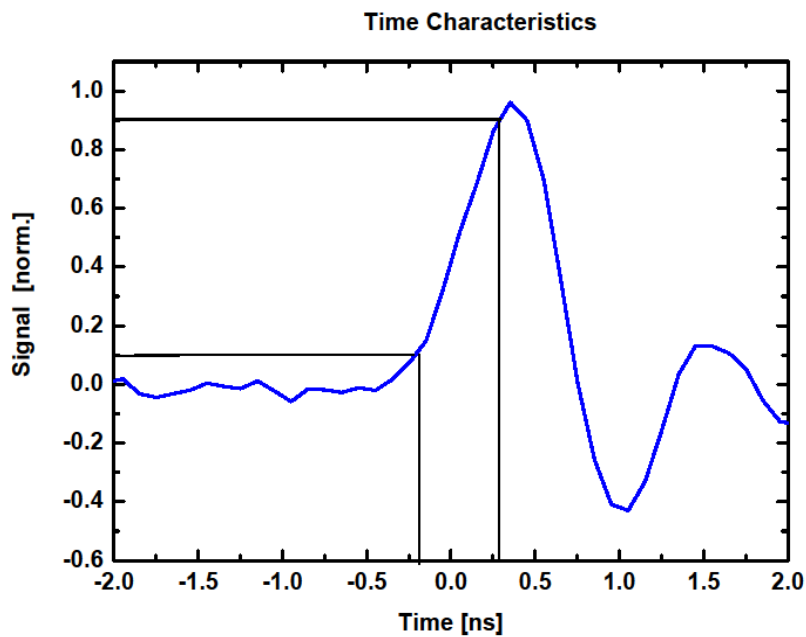
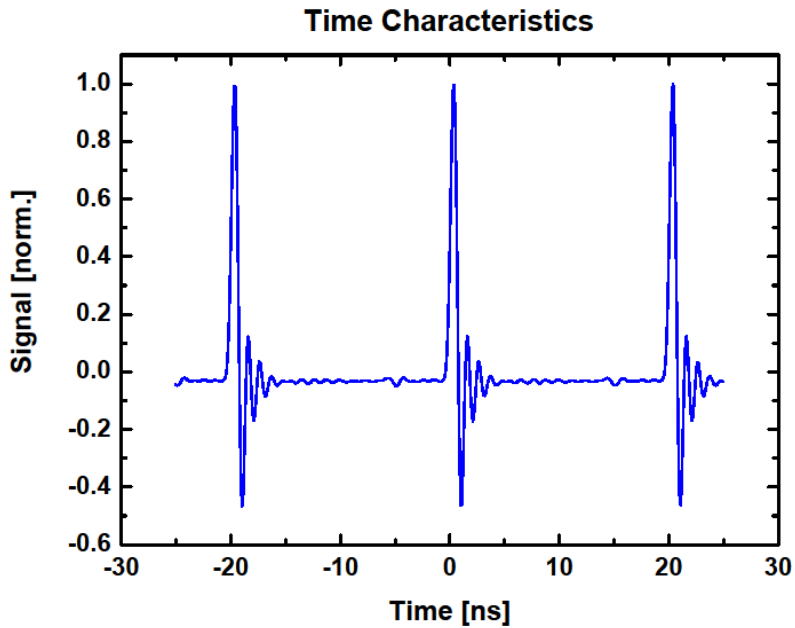
### 1.3.2 FREQUENCY CHARACTERISTICS

On the example of the APD210, the frequency characteristics for a sub 250 fs pulse with an optical power of 1.7 mW at 780 nm and a replate of 50 MHz is shown in the graph below.



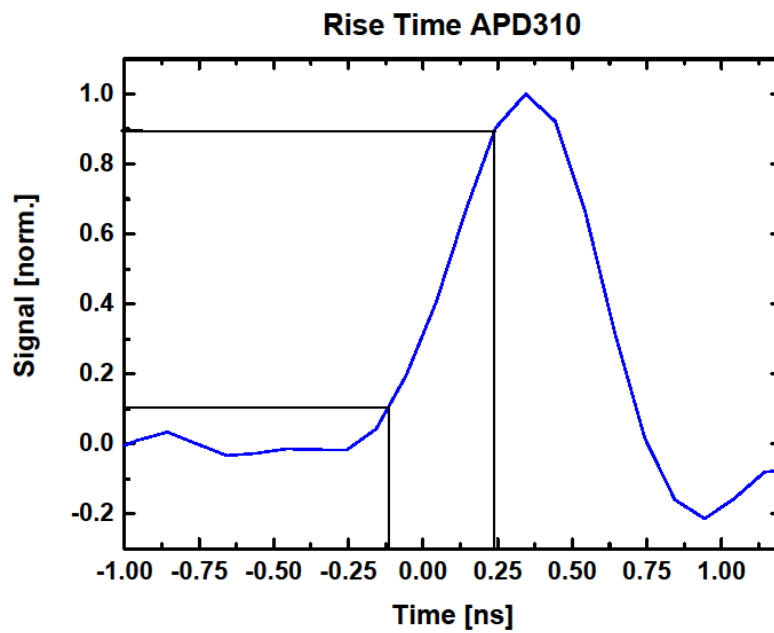
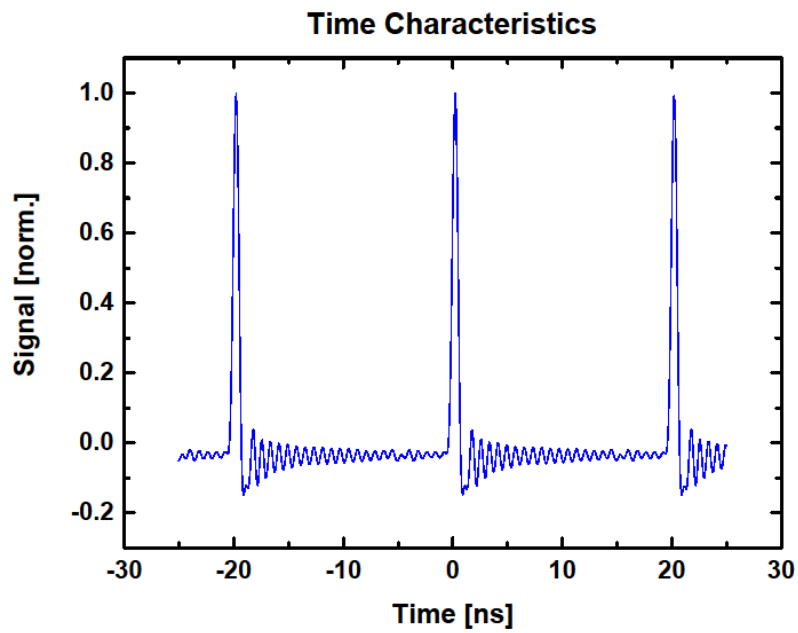
### 1.3.3 TIME CHARACTERISTICS AND RISE TIME

The time characteristics of the photodetectors APD210 is shown in the graph below.

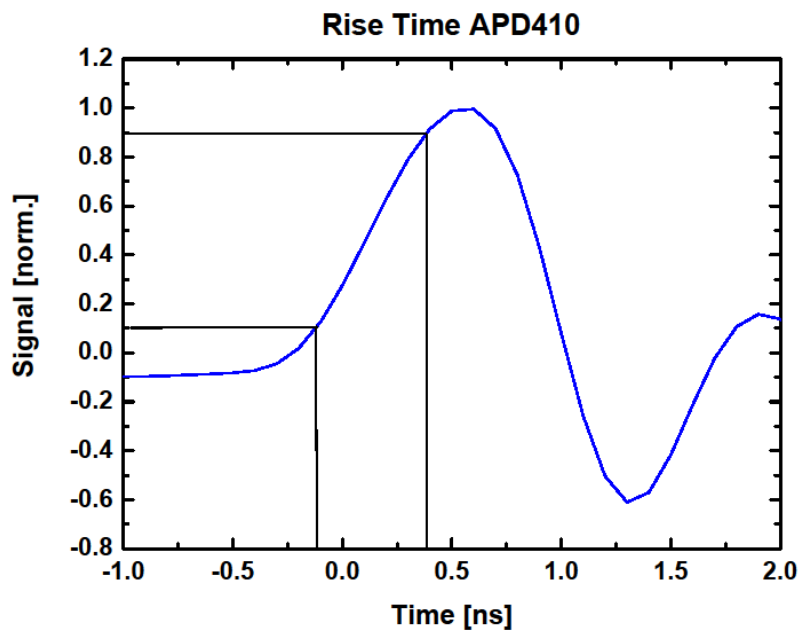
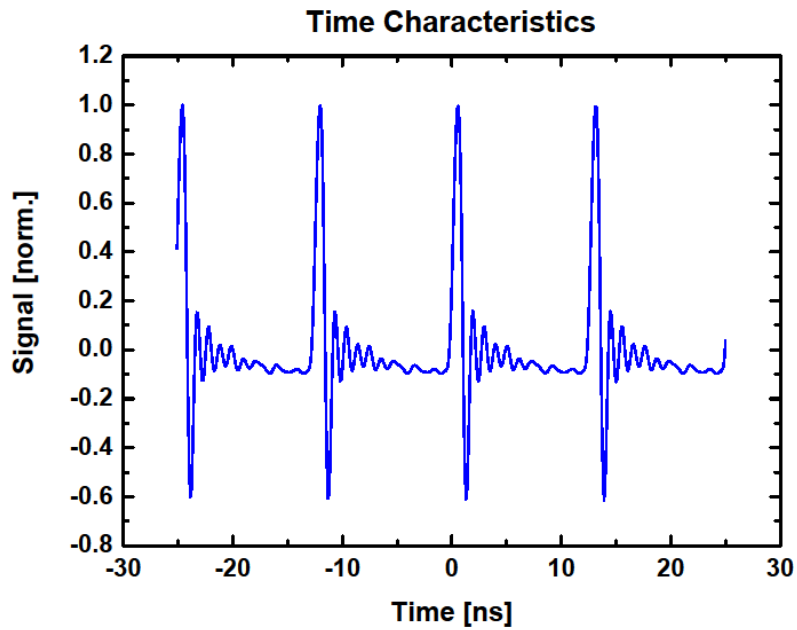


The rise time of the photodetectors APD210/APD310/APD410 is defined as the time for the signal to rise from 10% up to 90% of the maximum value.

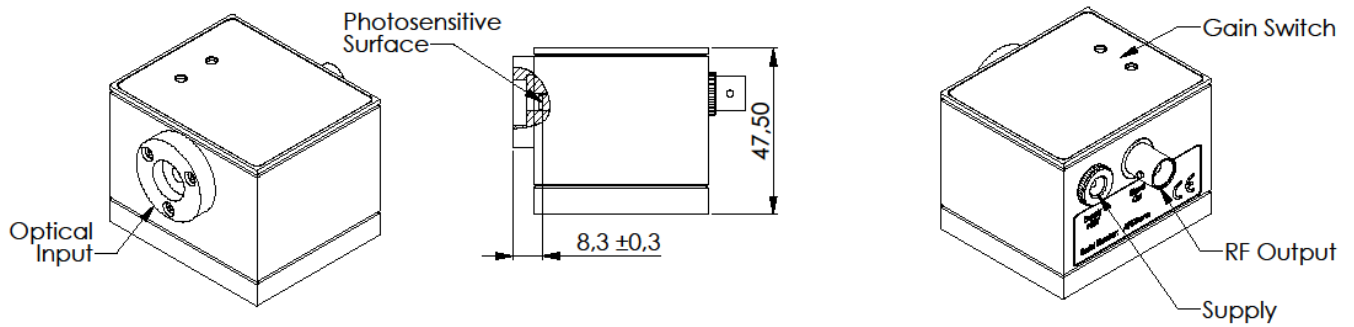
The time characteristics of the photodetectors APD310 is shown in the graph below.



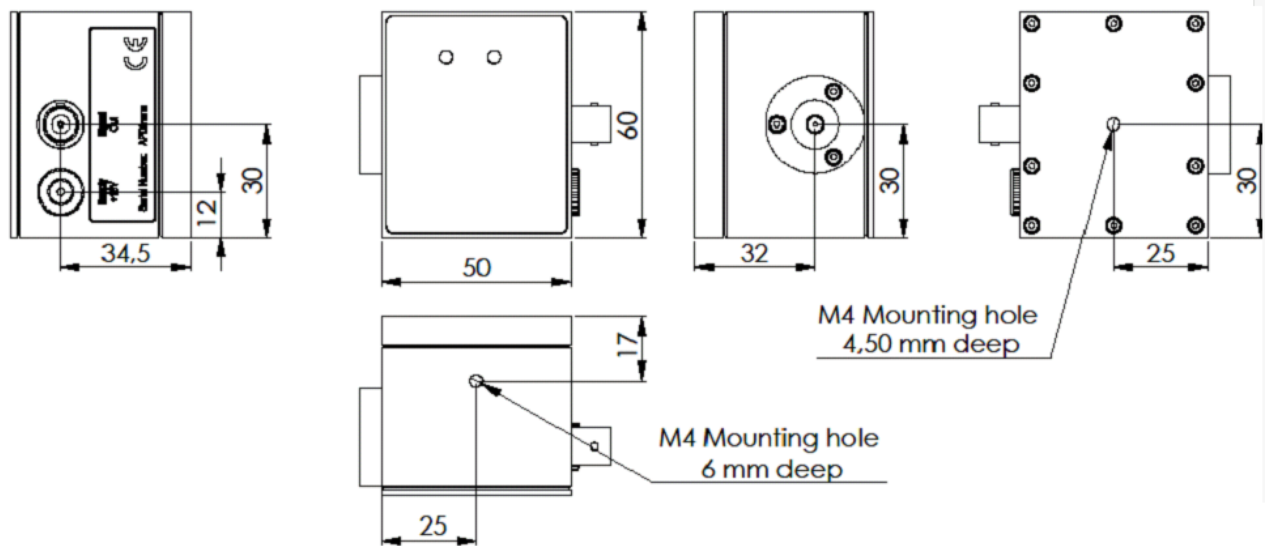
The time characteristics of the photodetectors APD410 is shown in the graph below.



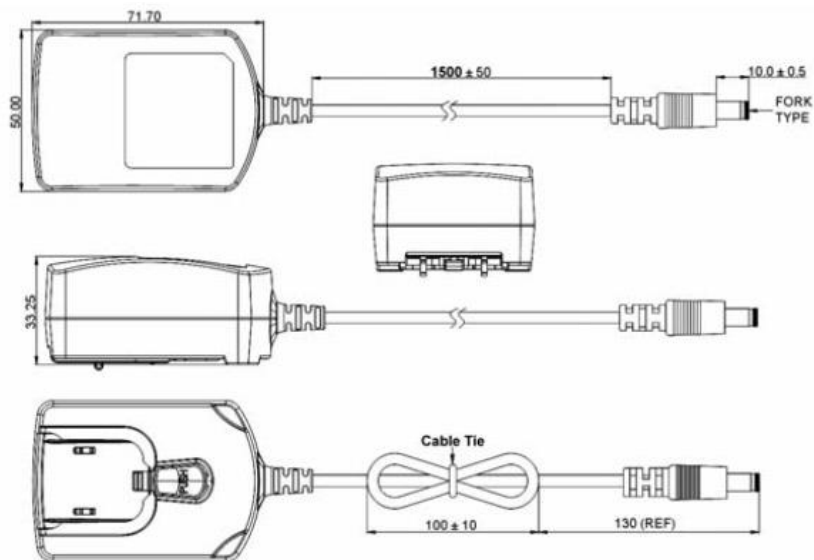
## 1.4 TECHNICAL DRAWINGS



Connection panel of the detector:



Dimensional unit is millimeter [mm].



Dimensional unit is millimeter [mm].

The output connector of the power supply is a barrel plug, 2.1mm I.D. x 5.5mm O.D. x 10.0mm.

The dimensions of the power supply are (71.7 x 50.0 x 33.3) mm with a 1.5 m cord length.

## 2. INSTALLATION / OPERATION

**Note: To prevent humidity condensation when the detector was stored or shipped at low temperatures, let the system packed for warm-up to room temperature.**

The detector should always be mounted and secured for best operation.

- Unpack the detector unit. The mounting thread is metric (M4 x 0.7). For your convenience an imperial adapter is included, if necessary. Mount it firmly.
- Connect the *RF Output* (BNC jack) to a suitable monitoring device, e.g. oscilloscope or RF-spectrum-analyzer (not a multimeter), with 50Ω impedance. Mount the device firmly in your setup. Please note that when the device is not mounted properly, involuntary displacements during operation might occur, leading to uncontrolled reflections from the device.
- After unpacking the power supply, attach the included wall plug matching your power line, to it. The power supply is now operable.
- Connect the power cord from the power supply to the power jack marked “Supply” at the rear of the detector.
- Plug the power supply into 100 to 240 VAC, 50 to 60 Hz outlet.
- Switch on the monitoring device, and apply a light source to the detector. We recommend centering the incident light on the active area of the photodetector and not overfilling the detector area. Failing to do so may result in undesirable capacitance and resistance effects, arising from inhomogeneities at the edges of the active area of the detector, that distort the frequency response.
- To adjust the gain setting, please use a small pen tip to operate the hidden push-buttons at the top of the device marked “Gain adj ±”. Pressing the corresponding button once will increase/decrease the gain. Change the gain continuously by keeping the respective button depressed. Rate of change will increase with time when the button is pressed continuously. To control the resulting gain, check the output signal with a suitable monitoring device.

### 3. MAINTENANCE

There are no serviceable parts in the photodetector. The housing may be cleaned by wiping with a soft damp cloth. Do not use any alcohol or organic solvent to clean the mechanical parts.

If necessary, for freespace version APD photodetectors, the window of the photo diode should only be cleaned using isopropyl alcohol and optical grade wipes.

If you suspect a problem with your photo detector, please contact Menlo Systems' technical support ([service@menlosystems.com](mailto:service@menlosystems.com)). They will be happy to assist you. For service requests, please make sure to provide the serial number of your device. For storage and shipping, please use the case your detector was shipped with.



## 4. TROUBLESHOOTING

This section lists error conditions the user might troubleshoot, depending on the error's root cause. If the information in this section cannot help, please contact Menlo Systems' support. The contact information is at the end of this section.

Problem	Suggested Solution
There is no signal response.	<ul style="list-style-type: none"> <li>▪ Verify that the power cord is connected and all connections are secure.</li> <li>▪ Verify the proper terminating resistor is installed if using a voltage measurement device.</li> <li>▪ Verify that the optical signal wavelength is within the specified spectral response curve of the detector (see 1.3.1).</li> <li>▪ Verify that the optical signal is aligned with the active area of the detector. Sweep the area in the vicinity of the center.</li> <li>▪ Adjust the oscilloscope to see if the signal is off the visible portion of the oscilloscope.</li> </ul>
Output Voltage will not increase.	<ul style="list-style-type: none"> <li>▪ The photodetector might be saturated. Reduce the incident power on the detector and check again.</li> </ul>
The gain changes during the first few minutes after powering on the detector	<ul style="list-style-type: none"> <li>▪ For a cold device, the gain stabilization may take a few minutes to kick in</li> <li>▪ After powering on the detector, wait a few minutes until the stabilization works; then adjust the gain to the desired level</li> </ul>

Even with no light on the detector the output signal shows periodic spikes; A multimeter directly connected to the detector shows an AC reading of around 0.5V

- If the gain setting is too high, reduce the gain setting until the spikes disappear
- The connecting signal cable might be flawed or the impedance might not be matched. Check if the cable used to connect the output signal to the monitoring device is flawless and fits for 50 Ohm technology; the input impedance of the monitoring device must be 50 Ohm

## A. CUSTOMER SERVICE

Your system is designed to be maintenance free.

Opening the chassis of the system voids the warranty and exposes the user to hazardous voltage.

### A.1 FACTORY SERVICE & REPAIR

For factory service or repair please call the Menlo Systems's customer service. Together with the product specialist they will determine if the equipment requires service, repair, calibration or replacement.

In case your system has to be returned to Menlo Systems for service or repair, we will provide an RMA number to you. For more information about the RMA procedure please read the online information at:

<http://www.menlosystems.com/legals/service-plans-returns-rma/>

### A.2 ADDITIONAL SERVICE PLAN

Menlo Systems offers a Service Plan for all its products. The Service Plan includes on-site service for installation, on-site training and on-site repair service when this is technically feasible. We also support our customers during measurement campaigns. For more information please look at:

<http://www.menlosystems.com/legals/service-plans-returns-rma/>

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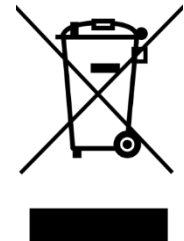
Email: [service@menlosystems.com](mailto:service@menlosystems.com)

## B. REGULATORY

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

This offer is valid for Menlo Systems electrical and electronic equipment:

- Sold after August 13, 2005
- Marked correspondingly with the crossed out "wheelie bin" logo (see right)
- 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 Menlo Systems products, such as:

- OEM products, assemblies to be built into a unit by the user
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Menlo Systems unit for waste recovery, please contact Menlo Systems for further information.

### **B.1 WASTE TREATMENT IS YOUR OWN RESPONSIBILITY**

If you do not return an "end of life" unit to Menlo Systems, 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.

### **B.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 life products will thereby avoid negative impacts on the environment.

**C. CONTACTS****Headquarters**

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