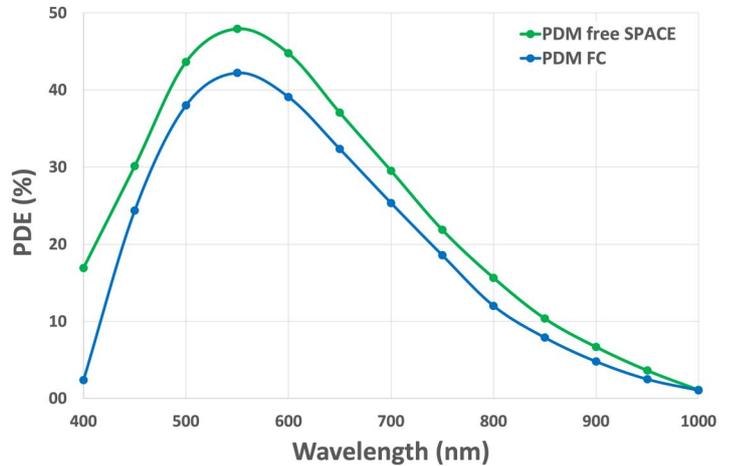


# PDM Series



The PDM series photon counting detector modules are all solid-state instruments. They have high photon detection efficiency and generate an output pulse per detected photon with better than 50ps FWHM photon timing resolution. A version with an optical FC connector, able to couple SingleMode or MultiMode fibers, is available.

- ▶ **High Photon Detection Efficiency**  
up to 49% @ 550nm
- ▶ **Best-in class Timing Accuracy**  
Typ. 35 ps FWHM
- ▶ **Low Dark Count Rate**  
as low as 1 cps, depending on detector diameter
- ▶ **High performance uniformity**  
across detector area

## MODULE FEATURES

- 20µm, 50µm, 100µm and 200µm active sensing area diameter
- Window and Fiber Receptacle versions available
- Available in different Grade depending on Dark Counts specifications
- Peltier-cooled
- FC connector with coupling efficiency ≥ 80%
- Low power consumption
- Robust and low cost

## BIOMEDICAL APPLICATION

- Confocal Microscopy
- Single Molecule Spectroscopy
- Ultra-Sensitive Fluorescence
- Time-correlated single photon counting
- DNA & Drug Discovery

## INDUSTRIAL APPLICATION

- Particle Sizing
- Optical testing of integrated circuits
- Metrology by Time of Flight measurements

## QUANTUM APPLICATION

- Quantum Cryptography
- Single-photon source characterisation

## ASTRONOMY APPLICATION

- Optical Range Finding, LIDAR & LADAR
- Astronomy Observations & Adaptive Optics

## Overview

The PDM photon counting detector series are all solid-state instruments that detect light from 375 nm to 1000 nm wavelength range. They have a peak photon detection efficiency of 49% at 550 nm and generate a TTL output pulse per detected photon. Standard TTL pulses provide better than 250 ps timing resolution. Anyway, they also generate an additional output pulse, according to the NIM standard, able to provide better than 50 ps FWHM photon timing resolution.

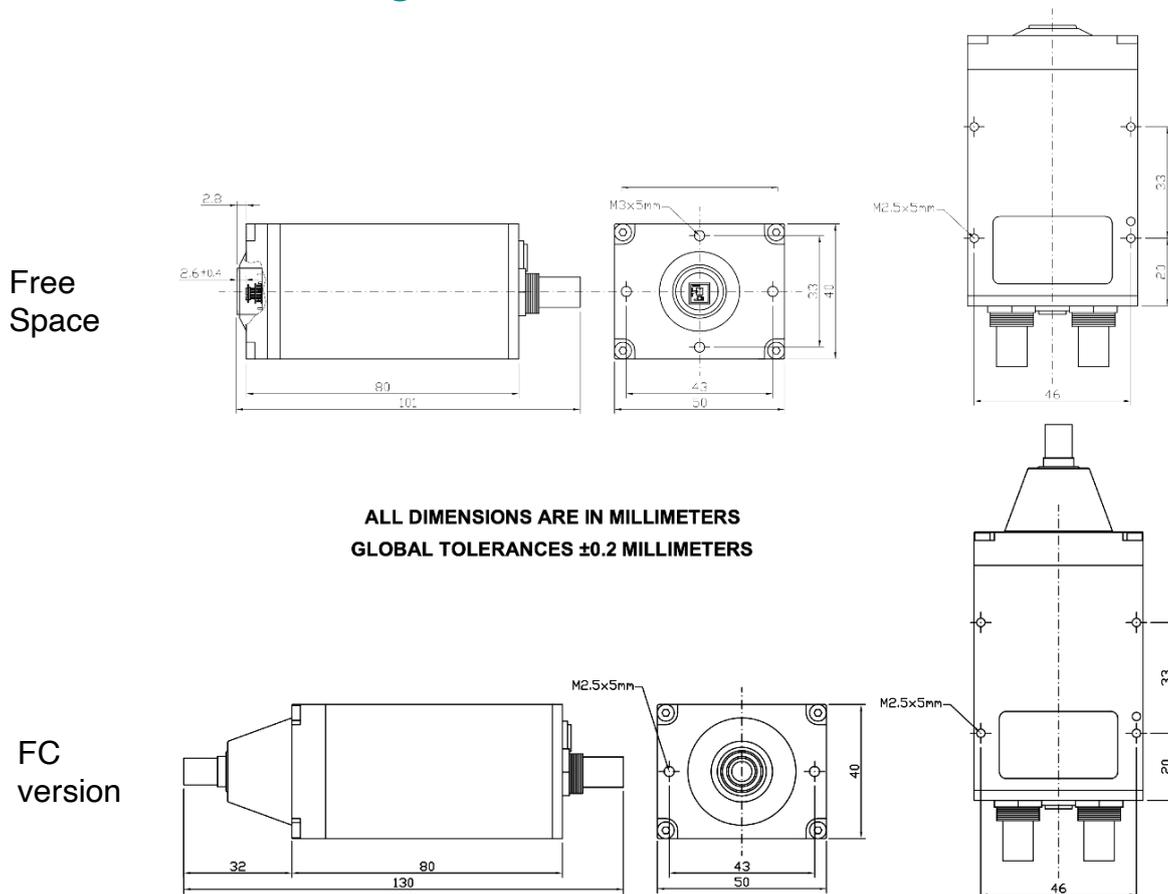
The excellent photon detection efficiency and superior timing resolution is obtained through the use of custom epitaxial silicon Single Photon Avalanche Diodes (SPAD), an Active Quenching Circuits (AQC), specifically designed and optimized for photon counting applications which generates the positive TTL pulses, and a fast timing circuit board, always installed in PDM modules, which generates the negative NIM pulses. The SPAD is thermoelectrically (TEC) cooled and its temperature controlled, ensuring stabilized performance despite ambient temperature changes.

Thanks to the use of an AQC, it is also possible to gate on or off the detector. The PDM GATE IN input is thus very useful for switching on the detector only during specific time windows for better noise rejection and increased signal-to-noise ratio. The GATE IN input is very useful also to be used as an interlock input whenever the user wants to switch off the detector if an event occurs. The PDM GATE IN input is also not designed to be used as a fast-gated module. In the scientific literature, a fast-gated detector is a detector that can be switched from the OFF state to the ON state very precisely and in very short periods of times, with falling or rising times in the order of few hundreds of ps. In this case the MPD FastGATED SPAD should be purchased. The PDM GATE IN input, indeed, is not designed to accept high repetition external trigger signals and should be used to gate ON or OFF the SPAD with minimum gate ON or GATE OFF times in the orders of few tens of microseconds or longer.

The PDM maximum saturated count rate is the reverse of the deadtime, and it is 12-13 Mc/s. Of course, in order to avoid non-linearity errors in counting applications, a maximum count rate of at least four or five times smaller than the saturation level is recommended. The module is fully protected against light overload.

The PDM series is available with two optical interfaces: a free space optical window and a fibre connectorized version that guarantees > 80% coupling efficiency with selected fibres (see below for technical details).

## Mechanical drawings



# Specifications

## Specifications @ 25°C

	Min	Typ	Max	Units
<b>Photon Detection Efficiency (free space)</b> @ 400nm @ 550nm @ 650nm	14 44 34	17 48 37		%
<b>Fiber Receptacle (FC/PC) coupling efficiency (CE)</b> 20 μm active area diam. - (wavelength > 470nm) 50 μm and 100 μm active area diam. - (wavelength > 470nm)	70 80	≥ 80		%
<b>Single Photon Timing Resolution (FWHM)</b> TTL Counting Output - (wavelength > 470nm) NIM Timing Output - (wavelength > 470nm)		35	250 50	ps
<b>After-pulsing probability</b>	0.1		3	%
<b>Dead Time</b>		77		ns
<b>Outputs</b> TTL OUT – amplitude TTL OUT – width TTL OUT – required load TTL OUT – pulse rising edge (10-90%) TTL OUT – propagation time from detection to rising edge  NIM OUT – amplitude NIM OUT – width NIM OUT – required load NIM OUT – pulse falling edge (10-90%) NIM OUT – propagation time from detection to falling edge		3.4 20 50 1 12  -700 17 50 450 2		V ns Ω ns ns  mV ns Ω ps ns
<b>Supply</b> DC voltage connector	5		12	V
	Standard 3.5mm supply socket			
<b>Gating input</b>	5V CMOS control (0V, detector off) 50Ω AC terminated, Internal 10kΩ pull-up			

## DCR Grades Specifications

Grade		Dark Counts (cps) – TEC cooled SPADs					
		<b>A</b> < 500	<b>B</b> < 250	<b>C</b> < 100	<b>D</b> < 50	<b>E</b> < 25	<b>F</b> < 5
Active Area Diameter	20 μm					√	√
	50 μm		√	√	√	√	
	100 μm	√	√	√	√	√	

**Not cooled SPADs with higher dark counts can be supplied to meet special OEM requirements**

## FC table guideline

Fiber types for getting specified CE	<b>SM</b>	<b>MM</b>	<b>MM</b>
	MFD: < 10 μm Numerical Aperture: ≤ 0.20	Core ≤ 62.5 μm Numerical Aperture: ≤ 0.275	Core: ≤ 105 μm Numerical Aperture: ≤ 0.22
Active Area Diameter			
20 μm	√		
50 μm	√	√	
100 μm	√	√	√

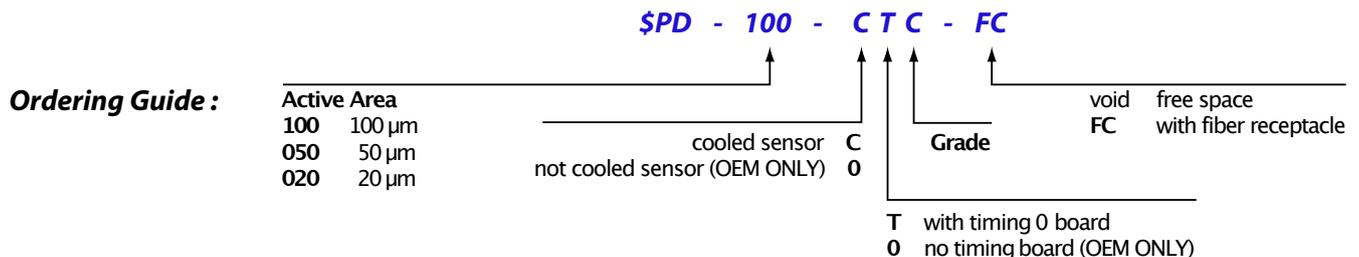
Using other types of fibers **is surely possible** but coupling efficiency **may vary** depending on chosen one.

## Accessories list

MPD provides also many different and very useful accessories. Please contact us or your local reseller for more information. The main ones are here below described.

Part Number	Description	Picture
\$MAC001	Cable Lemo 00 - SMA 3m - SMA male connector - cable type RG316 - optional to \$MAC008	
\$MAC003	12V-18W universal wall mount power supply (cable length 1.8m)	
\$MAC004 \$MAC005 \$MAC006	Mains plug Europe type Mains plug US/JP type Mains plug UK/Ireland type	
\$MAC008	Lemo 00 - SMA adaptor - length =10cm - SMA female connector - cable type RG316 - optional to \$MAC001	
\$MAC009  \$MAC024	Optical Table Universal Adaptor (left) for mounting on metric or imperial threaded optical tables  Adapter plate to Cage 30 mm adaptor (right)	 <small>order code : \$MAC009</small>

## Ordering Information



Products can be ordered directly from Micro Photon Devices or its representatives. For a complete list of representatives, visit our website at [www.micro-photon-devices.com](http://www.micro-photon-devices.com). Custom designed products are also available upon request.

Designed and built compliant with the European Union Directive 2011/65/CE (also known as RoHS 2)

## Warranty

A standard legal warranty according to local legislation applies following shipment. Any warranty is null and void if the module case has been opened or if the absolute maximum ratings are exceeded. Specifications are subject to change without any notice. Document version 4.6 – March 2022.