PDM Series

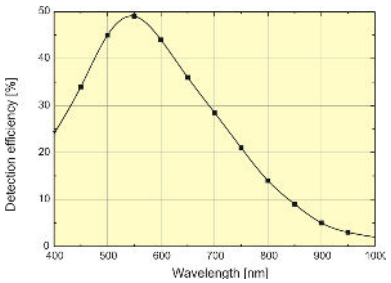
Single Photon Avalanche Diodes

- Timing resolution down to
  < 50 ps (FWHM)
- Quantum efficiency 49 % at 550 nm
- Different active areas:
  20, 50 and 100 µm
- Ultra stable at high count rates

Applications

- Time-resolved fluorescence
- Fluorescence liftetime imaging (FLIM)
- Fluorescence correlation spectroscopy (FCS, FLCS, 2fFCS)
- Förster resonance energy transfer (FRET)
- Stimulated emission depletion microscopy (STED)
- Time-resolved photoluminescence (TRPL)
- LIDAR, ranging, SLR
- Quantum optics

The photon counting detector modules of the PDM Series are all solid-state instruments designed and manufactured by Micro Photon Devices (MPD). They feature an excellent photon detection efficiency and superior timing resolution, which is obtained through the use of epitaxial silicon Single Photon Avalanche Diodes (SPAD) and patented integrated Active Quenching Circuits (iAQC). The SPADs are specifically designed and optimized for time-resolved photon counting applications.



Timing resolution down to 50 ps

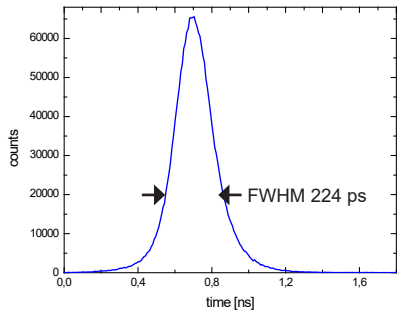
The SPADs of the PDM Series generate two output signals - a counting output (TTL signal) and a timing output (NIM signal), which provides better than 50 ps (FWHM) photon timing resolution for a wide range of detection wavelengths. Especially above 470 nm the temporal response is even comparable to MCP-PMTs and an Instrument Response Function (IRF) around 50 ps can be reached with fast TCSPC electronics along with a suited short pulsed laser.

Different active sensor areas

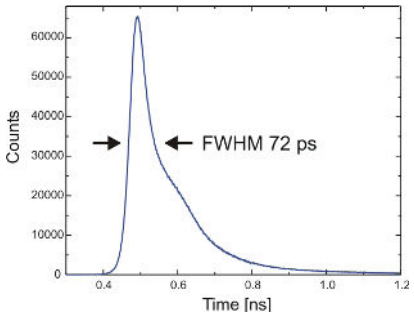
The SPADs are available with a diameter of the active area of 20, 50 or 100 µm, different dark count grades and can be supplied with an easy to use FC/PC connection for optical fibers or as a free-beam module. The PDM SPADs cover a spectral range from about 400 nm to 1000 nm with the highest quantum efficieny in the VIS range around 550 nm. They are extremely robust and can withstand continuous exposition to daylight. The high quantum efficiency make them an ideal detector for single molecule applications, like Fluorescence Correlation Spectroscopy (FCS) or Fluorescence Lifetime Imaging (FLIM), especially as the SPAD output has a stable timing even at count rates exceeding 1 million counts/sec.

Measurement Examples

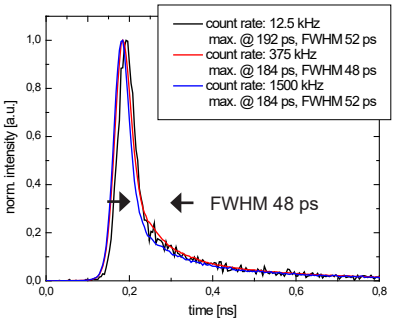
Instrument Response Function (IRF) of a PDM module with an active area of 50 µm. The measurements were taken with the TCSPC module PicoHarp 300 and different laser heads of the LDH Series driven by the PDL 800-B.



Excitation with LDH-P-C-405, laser pulse width: 60 ps



Excitation with LDH-P-C-470, laser pulse width: 56 ps



Excitation with LDH-P-670, showing the independence of the IRF on the count rates, laser pulse width: 32 ps

Specifications (at 25 °C)

Photon detection efficiency (typical, without FC connector)			
at 400 nm		24 %	
at 550 nm		49 %	
at 650 nm		37 %	
Losses due to fiber connector: < 20 % absolute			
Dark counts (typical)			
SPAD diameter	20 µm (on request)	50 µm	100 µm
Available selections (cps)	< 25, < 5	< 250, < 100, < 50, < 25	< 500, < 250, < 100, < 50, < 25
Single photon timing resolution			
Counting output, TTL signal (FWHM)		250 ps	
Timing output, NIM signal (FWHM)		down to 50 ps, increases in blue/UV spectral range	
Afterpulsing probability			
3 % (maximum)			
Input/output			
Dead time		77 ns (typical)	
Output signal		TTL for counting output, NIM for timing output	
Output pulse rise and fall times		< 2 ns on 10 pF load	
Output pulse duration		20 ns (typical)	
Gating input		TTL control (low level gates detector off)	
Supply input connector		standard 3.5 mm supply socket	
Supply voltage			
unregulated DC, any value 5 V - 12 V			

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