

SINGLE PHOTON COUNTING

Fast-Timing MCP-PMT

State of the Art Multi-Channel Plate (MCP) based PMT for Fast Photon Counting Applications

For scientists who need the **most accurate single photon counting solution** available. Exosens fast-timing MCP-PMT's offer **unmatched temporal characteristics** combined with **extreme low dark rates**. Using optimized MCP-PMT technology, Exosens fast-timing MCP-PMT's provide **market-leading detection speeds** showing rise time down to 100 ps, FWHM of about 300 ps and a Transit Time Spread (TTS) of 10 ps. Available with the **full-range Hi-QE Photocathodes** which are gateable down to 3ns.

All made by Exosens, the global leader in MCP Technology.



Key Features

- ◆ Excellent Temporal Characteristics
- ◆ Hi-QE Photocathode Technology
- ◆ Great PHD Characteristics
- ◆ High-CE MCP Technology
- ◆ High Linearity MCP
- ◆ Fast Gating Option Available
- ◆ Low Dark Rate

Applications

- ◆ High-End LiDAR
- ◆ Plasma Research
- ◆ Time Correlated Single Photon Counting (TCSPC)
- ◆ Fluorescence Lifetime Imaging (FLIM)
- ◆ Particle Physics
- ◆ Quantum Optics

Contact us for expert advice on your application

Fast Timing MCP-PMT General Specifications

Optical Specifications

Useful Input Diameter	8, 16 or 18mm
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Detector Specifications

Number of MCPs	2 (Chevron)
Anode Pixels	1, 61 or 163
Gain	$10^5 - 10^6$
Waveform	FWHM < 300 ps, Rise time < 200 ps
Time Resolution	20 ps, σ -Gaussian
Maximum Rate	Few 100 MHz
Magnetic Resistance	3 T

Mechanical Specifications

Housing Material	Anodized Aluminium
Housing Dimensions (HxWxL)	45 mm diameter, 60 mm length
Weight	112 grams

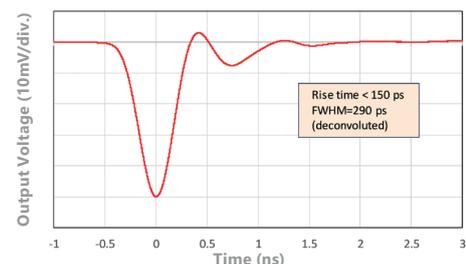
Supply Voltages

HV Supply (Vs)	3000 -Vdc
Supply Current (MCP-PMT)	200 μ A

Electrical Connections

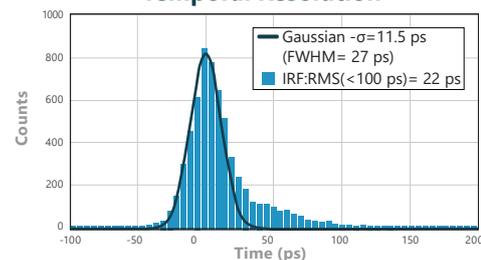
MCP-PMT	HV BNC Connector
Output	Single Anode, SMA Connector

Single Photon Pulse-Response Waveform



Pulse-response waveform from fast MCP-PMT measured with 2.2 GHz 20 dB amplifier and 2.5 GHz oscilloscope. FWHM and rise time are found to be about 370 ps and 240 ps, respectively; with deconvolution value for rise time to be below 150 ps.

Temporal Resolution



The IRF (instrument response function) measurement with fast Hi-CE MCP-PMT using 100 fs laser (in SPD mode) and 2.5 GHz oscilloscope. The IRF was found to be 25 ps (s) with time-transfer-spread (TTS) of MCP-PMT contribution to be below 20 ps.

Fast-Timing MCP-PMT Key Properties

Model	Active Area Diameter (mm)	TTS Single Photon (ps)								Rise Time		FWHM (ps)	
		σ - Gaussian				RMS ($\tau < 100$ ps)							
		Standard MCP		Hi-CE MCP		Hi-CE MCP		Standard MCP		Max	Typ	Max	Typ
FT-8	8	15	10	25	15	30	20	35	25	150	100	350	300
FT-16	16	25	15	25	15	30	25	35	25	240	180	460	400
FT-18	18	-	-	30	20	-	-	40	30	250	190	480	420

Fast-Timing MCP-PMT Configurable Options

Model ¹	MCP Type ³				Collection Efficiency (Typical)		Gating Functionality ⁴	
	Dynamic Range (MCP Linearity, Detected Pulse Rate in MHz)				Standard MCP	Hi-CE MCP	Gatespeed (ns)	
	Standard		High				Normal	Fast
FT-8	Min	Typ	Min	Typ	0,7	0,95	200	3
FT-16	2	3	20	35				
FT-18	5	10	90	130				
FT-18	10	15	110	160				

Configuring the Right Fast-Timing MCP-PMT for your Application

Model (FT-8 | FT-16 | FT-18), Photocathode (Wavelength response), MCP Type (Dynamic range: Standard or High Linearity | Collection efficiency: Standard or Hi-CE) and the optional Gating functionality (Normal Gating or Fast Gating) can be selected in order to configure the optimal Fast-Timing MCP-PMT for your application.

¹Model FT-8

With a photocathode diameter of 8 mm, this model, FT-8 MCP-PMT, shows the best temporal characteristics. The rise slope (the leading edge) is about 100 ps, FWHM approximately 300 ps, and TTS (for single photon illumination) 10 ps. For multiphoton excitation the time resolution improves further.

¹Model FT-16

With a photocathode diameter of 16 mm, the FT-16 MCP-PMT is the best choice when temporal characteristics and high dynamic range are equally important. FT-16 shows a 4 times higher dynamic range (ref. FT-8) and still good temporal resolution.

¹Model FT-18

The FT-18/LIDAR makes use of the full 18 mm diameter useful area, which demonstrates the highest dynamic range of this series. This property is required in particular for LIDAR applications, with high load of background illumination and high flux from the ground-echo. This configuration is optimal for applications where ns laser illumination is typically used.

²Photocathode (Wavelength Response)

A broad range of photocathodes can be selected The Hi-QE UV, Blue and Green are very attractive with a high QE above 30% and a very low dark rate (down to 50 Hz/cm²). For applications requiring longer wavelength response, the Hi-QE Red, S25 or Hot S20 photocathodes are recommended.

⁴Gating Functionality (200 ns or 3 ns)

A broad range of photocathodes can be selected The Hi-QE Gating will improve the signal to noise ratio significantly, especially when a high dark rate photocathode is selected or when a high background signal is present. Gating unit down to 3 ns is available as an option.

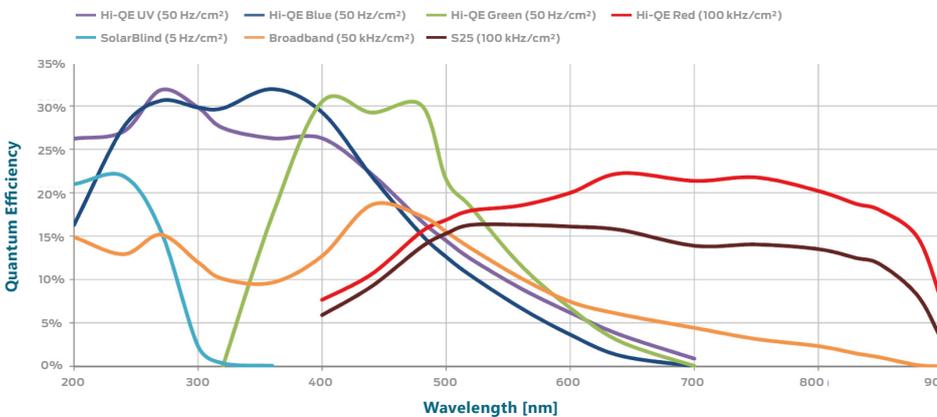
³MCP Type (Dynamic Range & Collection Efficiency)

The fast-timing MCP-PMTs make use of Exosens' optimized MCP technology resulting in excellent shape of pulse height distribution (PHD) and a collection efficiency almost equal to 100% to provide DQE close to the QE value. The dynamic range can be extended with the high linearity MCPs for GHz counting rate.

Power Supply

A resistive bleeder chain is integrated in the MCP-PMT housing. Only a single high voltage needs to be applied. An optional miniature USB power supply will help you get your experiment under way quickly.

Photocathode Overview

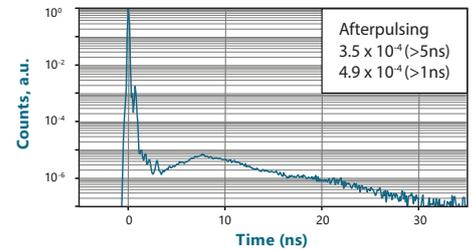


Exosens Fast-Timing MCP-PMTs demonstrate excellent temporal characteristics with the top-of-the-line FT-8 model showing rise time down to 100 ps, FWHM of about 300 ps and Transit Time Spread (TTS) of 10 ps. The Quantum Efficiency exceeds 30% in a broad spectral range, combining extreme low dark rates for the Hi-QE UV, Blue and Green photocathode series.

The Fast-Timing MCP-PMTs use optimized MCP technology resulting in excellent shapes of Pulse Height Distribution (PHD) and a Collection Efficiency (CE) close to 100% resulting in Detection Quantum Efficiency (DQE) being almost the same as QE. The dynamic range can be extended with the High Linearity MCPs for a photon count rate approaching 500 MHz.

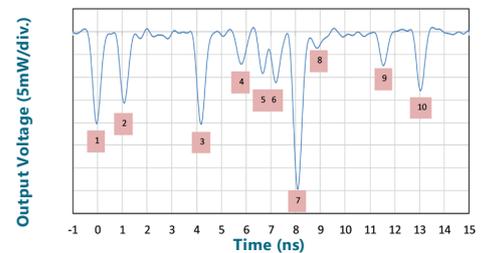
This new series of MCP-PMT is as well gateable down to 3 ns.

Afterpulse Spectrum

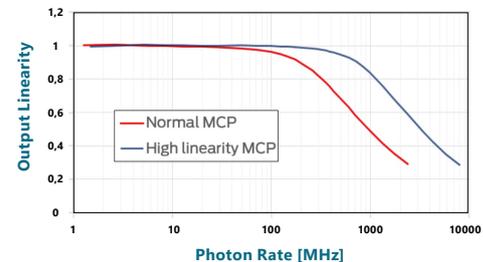


After-pulse time-of-flight spectra measured with 100 ps laser in SPD mode. The small after-pulse intensity (<0.5%) is important for the counting properties of the detectors, but it also a good indicator for the long lifetime of these detectors [3].

Waveform Response to Burst Pulse Excitation



High-Rate Capability in Continuous Mode



Linearity output of high-linearity MCP-PMT vs photon rate (for 18 mm photocathode with QE of 30%) for different gains. The possibility to detect average photon rates up to about 1 GHz is demonstrated.

