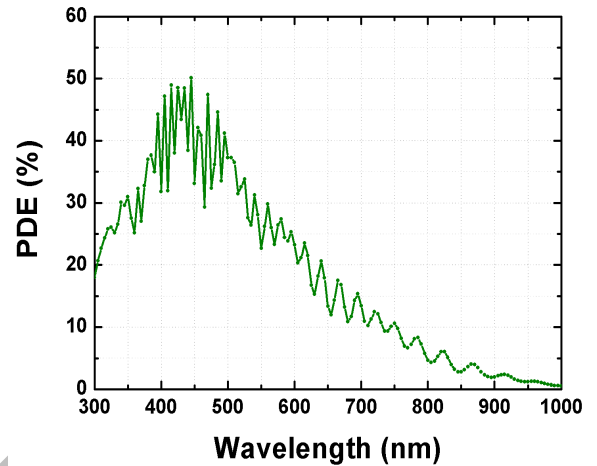




FluoSPAD60



FluoSPAD60 is based on a 60 x 1 linear array of smart pixels, each comprising a single-photon avalanche diode, an analogue front-end and digital processing electronics including a precise time to digital converter. The **FluoSPAD60** provides single-photon sensitivity, high electronic noise immunity, and fast readout speed up to 2M frames per second with negligible inter-frame dead time. A common gate input enables counting only during specific time-windows.

- ▶ **Full digital acquisition of light**
PDE up to 50% @ 400 nm, NUV response
- ▶ **Large Active area and fill factor**
100 μm SPAD, 150 μm pitch
- ▶ **High frame rate**
up to 2 Mframes/s
- ▶ **Low noise**
Typical noise of 2.5 kc/s per pixel, no readout noise.
- ▶ **LABVIEW™ Block-set**

MODULE FEATURES

- 60 detectors with full parallel operation
- TDC incorporated in each pixel
- Counting and Timing in the same chip
- USB 3.0 interface with DLLs provided
(compatible with C, C++, C#, Matlab etc.)
- Optical port with inter-changeable adapter
C-mount adapter available
- Low power consumption
- Robust and compact

BIOMEDICAL APPLICATION

- Confocal Microscopy
- Single Molecule Spectroscopy
- Ultra-Sensitive Fluorescence
- Time-correlated single photon counting
- Single Molecule Detection

INDUSTRIAL APPLICATION

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

ASTRONOMY APPLICATION

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

Overview

FluoSPAD60 is based on a 60 x 1 linear array of smart pixels. Each pixel comprises a single-photon avalanche diode detector, an analogue front-end for fast quenching and resetting the diode and a digital processing electronics able to count and precise time events thanks to an in-pixel-integrated Time to Digital Converter (TDC). The imager can be operated at a maximum frame rate of about 2M frames per second (120 Mcount/s) with only 100 ns inter-frame dead time. The linear array differs from conventional Charge-Coupled Devices or CMOS sensors because it performs a “fully digital” acquisition of the light signal. Each pixel effectively counts or measure the exact arrival time of photons which are detected by the sensor.

At the maximum frame-rate photon-counting dynamics is 6-bit when counting, but camera processing electronics allows noiseless frame-binning, thus providing higher dynamics at lower frame-rates. In case of timing applications, i.e. when enabling the TDC, the array is able to perform one conversion per frame and per pixel with a user selectable full scale ranges of 500 ns or 250 ns. **FluoSPAD60**'s TDC work in reverse START – STOP mode, i.e. the SPADs will trigger the START of the associated TDC while the laser will act as the common STOP. **FluoSPAD60** can be thus used effectively used for measuring lifetimes or for direct time of flight measurements. **FluoSPAD60** can also work in time tagging mode and connects seamlessly to scanning mirror systems thus allowing the acquisition of for Fluorescence Lifetime Images (FLIM). The high-speed **FLIM acquisition** is straightforward and can be enabled and configured by user via a simple interface.

Each pixel includes one independent gate-able counter. Such gating capability enables the counting during specific time-windows only independent on the actual frame duration; gate width can be user defined in position and width in steps of 10 ns. The gate signal can also be provided by the user externally. In case of timing applications, the gate acts as a way to define temporally which photons should be timed.

FluoSPAD60 is easily integrated into common optical setups thanks to the C-mount optical port and a high-speed USB 3.0 computer interface. Cross-platform DLLs/shared libraries for easy integration in most application (C, C++, C#, Objective-C, Matlab, Labview, etc.) are provided.

Hardware connections

- **USB High-speed USB 3.0 connector:** for data download and camera configuration.
- **Multi-coax connector (adapter to SMAs provided)**
 - **SYNC OUT:** Electric 3.3V CMOS (LVCMOS) pulses are generated at this output to synchronize the device with any external device. Drives 50Ω terminated transmission lines.
 - **SYNC IN:** Requires > 1ns positive/negative pulse (-2.5 V – +2.5 V) and is used as the common stop of all the TDCs (Laser sync input). 50Ω DC input impedance.
 - **AUX IN:** LVCMOS input compatible. User defined. The minimum pulse duration is xx ns. 3.3 V CMOS inputs but 5V tolerant.
 - **AUX OUT:** Electric 3.3V CMOS (LVCMOS), user defined pulses are generated at this output. Drives 50Ω terminated transmission lines.
 - **LINE IN:** LVCMOS input compatible. Input for interfacing FluoSPAD60 to systems with scanning mirrors. The minimum pulse duration is xx ns. 3.3 V CMOS inputs but 5V tolerant.
 - **FRAME IN:** LVCMOS input compatible. Input for interfacing FluoSPAD60 to systems with scanning mirrors. The minimum pulse duration is xx ns. 3.3 V CMOS inputs but 5V tolerant.
- **+12Vdc:** Jack for connecting the provided +12 V power supply.

System requirements

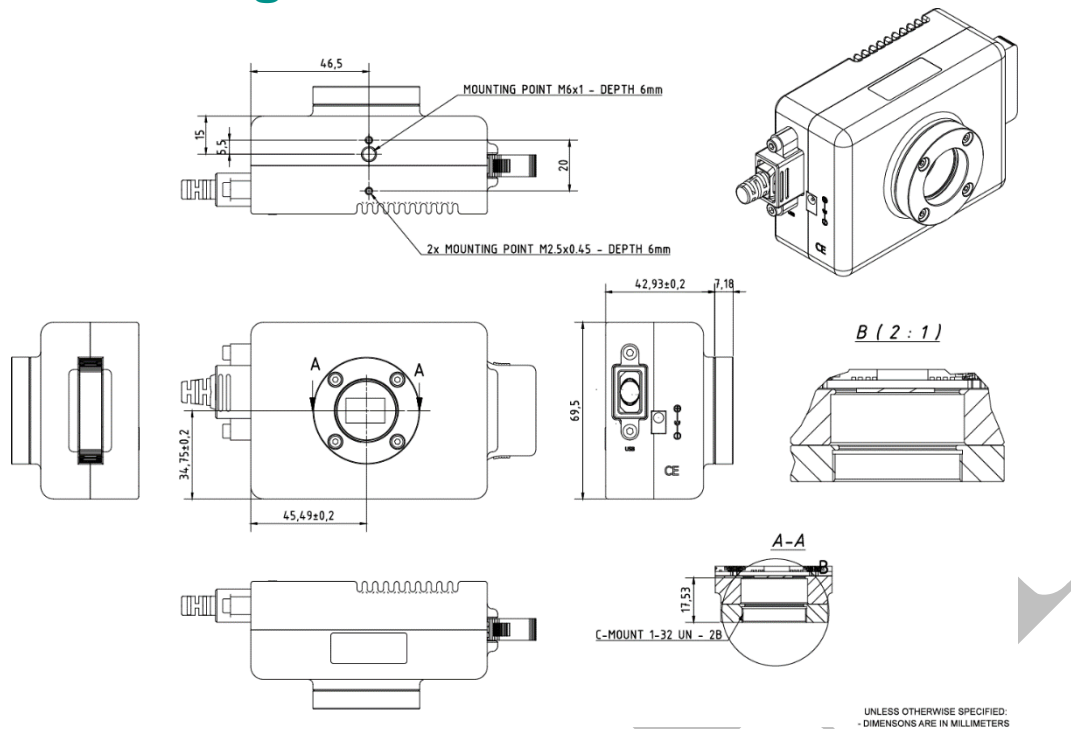
- High-speed USB 3.0 interface.
- Host computer (minimum requirements) : 2 GHz processor and 4 GB of RAM, SSD required
- Supported operating systems
 - Software interface
 - Microsoft Windows 7, 8, 10, 32 or 64 bit versions
 - SDK
 - Microsoft Windows 7, 8, 10, 32 or 64 bit versions
 - Linux Ubuntu 12.04 LTS, CentOS 6.5, 6.6, 6.7 or compatible distributions, 32 or 64 bit versions. Different distributions should work, but were not tested.
 - Mac OS X 10.8 and above

Specifications

Specifications @ 25°C and 5V overvoltage	Min	Typ	Max	Units
Photon Detection Efficiency (PDE) Average on entire array				
@ 320 nm		25		%
@ 400 nm		50		
@ 650 nm		14		
@ 800 nm		4		
Dark-counting rate (DCR) 60 th percentile ¹ of entire array 80 th percentile ² of entire array		2.5 10.0		kcps
Optical crosstalk adjacent pixels non- adjacent pixels		0.1 10 ⁻⁷		%
After-pulsing probability (at xx ns SPAD dead-time)		1		%
SPAD dead-time (user adjustable) ³	50		200	ns
Active area diameter of each SPAD		100		µm
SPAD pitch		150		µm
Defective pixels per array (i.e. with DCR>100kps)			2	
Frame-rate			2000	kframe/s
Inter-frame dead-time		100		ns
Counter		6		bit
Gate ⁴				
Gate Width	10		TBD	ns
Step Size		10		ns
TDC ⁴				
Bin Width	250	or	500	ps
Full Scale Range	250	or	500	ns
INL		5		% LSB
DNL		30		% LSB
IRF				
Average pixel IRF (FWHM)		600		ps
Pixel to pixel centroid shift std. deviation (rms)		24		ps
Supply Voltage	+12 Vdc			
USB connector FRAME IN, LINE IN, AUX IN SYNC IN SYNC OUT, AUX OUT	USB 3.0 compliant 3.3 V CMOS ; 5 V-tolerant any -2.5 V - +2.5 V pulse larger than 1ns 3.3 V CMOS			
Objective mounting	Flange for interchangeable adapter (Standard C-mount adapter available)			
Dimensions	40 mm (H) x 70 mm (W) x 93 mm (L) M6 threading for fixing			
Weight	360 g (camera only) + 140 g (USB and Coax)			

1. 60th percentile means 60% of devices satisfying the specified value
2. 80th percentile means 80% of devices satisfying the specified value
3. actual maximum dead-time is calibrated for each camera and may differ from the written value
4. see user manual

Mechanical drawing



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. Custom designed products are available upon request.

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 1.0.0.1 – Draft March 2016

Contacts

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Packing list

Accessories included in the box with the purchased camera.

Power Supply with socket adaptors	Custom USB 3.0 cable	I/O Multicoax connector and camera thread adapter
