pi imaging

ENABLING THE SPAD REVOLUTION

SPAD 93

A high-performance single-photon detector array

DESCRIPTION

SPAD 93 is a detector array with 93 hexagonally packed single-photon avalanche diodes (SPADs) with best-in-class performance. It features both the capability of direct photon-counting and photon-time tagging to enable a wide range of single-photon detection applications.

KEY BENEFITS

Ideal point detector

SPAD 93 is the ideal solution for a confocal scanning setup. Each pixel can act as a virtual pinhole, increasing resolution and contrast.

Wide detection spectra and low noise

Our single-photon detectors are fabricated in a state-of-the-art CMOS process and offer an ultra-low dark count rate of less than 100 cps. Microlenses enhance the detection with a peak detection efficiency of over 45%.

High timing resolution

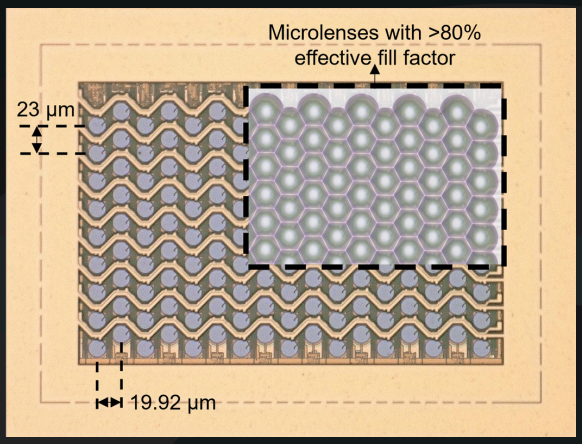
Real-time processing of photon events occurs in a field-programmable gate array. The detector can process up to 2.3 Gcps over the whole array. Time-to-digital converters per pixel enable a fine timing resolution down to 20 ps with at a maximum photon flux of 70 Mcps.

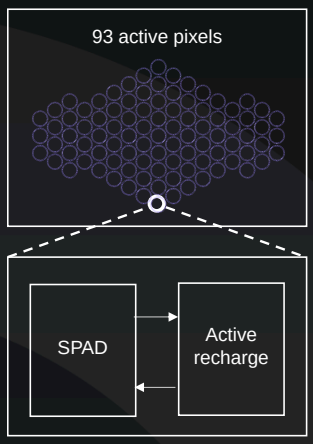
Plug and play

The system requires just a 5V power adapter and USB3 cable to run. For full flexibility, 4 additional control lines can be connected to the SMA connectors. The SM1 optical port, the M2.5 and the M4 screw mounting positions offer a flexible integration into an existing optical setup.

pi imaging

ENABLING THE SPAD REVOLUTION





APPLICATIONS

Confocal microscopy

SPAD arrays increase light collection and enable innovation in the field of confocal scanning microscopy. This innovation finally leads to a sharper and brighter image with functional information about the underlying molecular function, interactions and environment.

Quantum information

Temporal photon correlations and photon number resolving (PNR) enable probing of quantum properties of light. Our detector has an extremely low crosstalk and thus enables reliable measurements of second and third order photon correlations, as well as quantum random number generation for unbreakable encryption.

Applications:

Image scanning microscopy (ISM), quantum ISM (Q-ISM), fluorescence lifetime imaging (FLIM), fluorescence correlation spectroscopy (FCS), stimulated emission depletion microscopy (STED)

Applications:

Antibunching and coincidence correlation, quantum random number generation.

Why SPAD arrays?

- Achieve super-resolution with a standard confocal microscope
- Increase light collection
- Increase imaging speed
- Reduce background noise

Why SPAD arrays?

- Simplify setup with single-chip multi-channel detector
- Increase data rate with detector parallelization
- Photon number resolving (PNR) detection

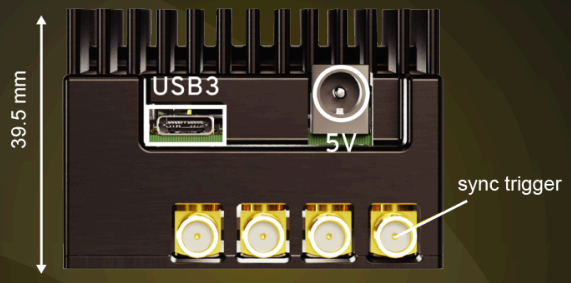
pi imaging

ENABLING THE SPAD REVOLUTION

OPERATING CONDITIONS & TECHNICAL SPECIFICATIONS

RECOMMENDED OPERATING CONDITIONS

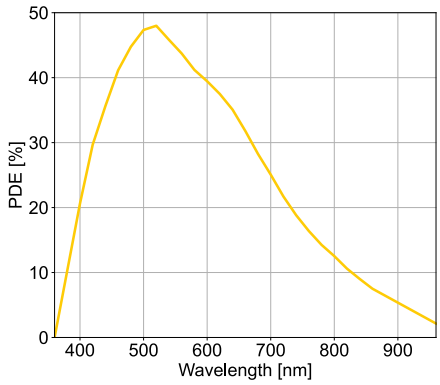
SYMBOL	PARAMETER	MIN	MAX	UNIT
Operating voltages				
V_{ex}	SPAD excess bias	4	7	V
Environment				
T	Temperature	-55	35	°C

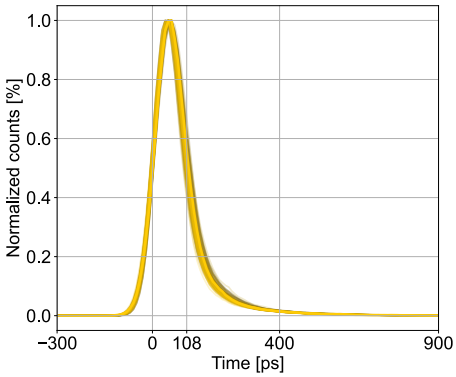


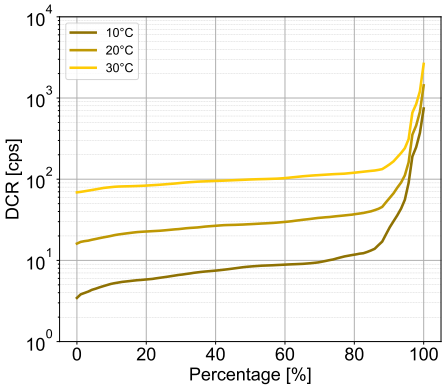
TYPICAL TECHNICAL SPECIFICATIONS

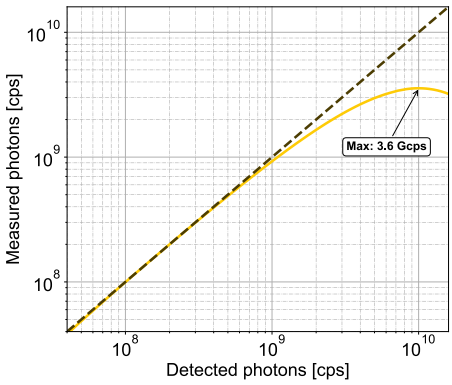
PARAMETER	CONDITIONS	TYP
Peak detection probability	V_{ex} = 7 V	55% @ 520 nm
Wavelength window with PDP > 35%	V_{ex} = 7 V	440-660 nm
Fill factor		>80%
Median dark count rate	V_{ex} = 7 V T = 20 °C	<100 cps
Dead time	V_{ex} = 7 V	10 ns
Timing jitter	V_{ex} = 7 V	<120 ps
Afterpulsing	V_{ex} = 7 V	0.1%
Crosstalk	V_{ex} = 7 V	0.14%
Maximum count rate per pixel		25 Mcps
Time-tagging resolution		20 ps

PERFORMANCE CHARACTERISTICS









SYSTEM INTEGRATION

A system overview is shown on the right. For operation, only two plugs are required, a 5 V power supply and a USB3 connection.

The detector enables three modes: both 8-bit photon counting and time tagging data with 20 ps resolution are available through a USB stream while a combined photon-pulse output is available through an SMA connection.

The software provides functionalities for photon-counting and time-tagging modes. It can be accessed through TCP/IP for easy integration into LabVIEW, MATLAB or Python.

Pi Imaging Technology SA
EPFL Innovation Park
1015 Lausanne, Switzerland

info@piimaging.com
www.piimaging.com
+41 76 5733 314