SPCM Product Series

High-Performance Single Photon Counting Modules

EXCELITAS TECHNOLOGIES®

Excelitas –
Single Photon Counting Modules

Excelitas Technologies® high performance Single Photon Counting Modules (SPCMs) combine more than 30 years of photon counting design and engineering expertise to deliver superior technology for the most demanding low-light-level detection applications. With the broadest range of SPCM modules, combined with the technical expertise and global resources to support our customers, Excelitas has the solution to best meet your photon counting needs.

As the first to introduce single photon counting modules using silicon avalanche photodiodes (Si-APDs), Excelitas remains committed to delivering innovative and market-leading photon counting technology to provide high Photon Detection Efficiency (PDE), low afterpulsing, unmatched uniformity over a large active area, high linear dynamic range and low dark counts.

Typical photodiodes that generate an electrical current output when illuminated by light offer a one-to-one ratio of electrons to photons. With avalanche photodiodes (APDs), however, these photon-generated electrons then liberate a greater number of electrons to produce more than a one-to-one ratio of electrons to photons. Excelitas SPCM modules are designed with a unique built-in silicon avalanche photodiode (SLiK APD) that operates in Geiger mode, which means operated above breakdown voltage, to create an avalanche effect resulting in an internal gain that can be as high as 106 electrons per photon detected. This innovative capability has enabled a wide range of applications requiring extreme low-light-level detection.

Excelitas' self-contained modules have all the APD control and output pulse generation circuitry built-in for easy and user-friendly adaptation in both research and OEM environments. Due to rapid and recent advances in the technology, SPCMs are now being integrated into sophisticated OEM devices used for detecting and measuring materials such as environmental toxins, proteins, particles in emulsions and solutions, as well as for drug development, cancer and genetic research and in clinical lab diagnostics. In addition, SPCM modules are useful in super-resolution microscopy, fluorescence, particle sizing, single photon 3D LiDAR imaging and nanotechnology.

Excelitas' SPCM-AQRH is designed and built to be fully compliant with the European Union's RoHS Directive 2011/65/EU and Directive 2015/863 (amendment to Annex II).

SPCM –
Advantages & Applications

Utilizing a unique silicon avalanche photodiode (SLiK), Excelitas SPCMs can achieve maximum peak photon detection over a 180µm diameter circular active area. The photodiode is temperature-controlled by a double-stage thermoelectric cooler, ensuring stabilized performance and optimal signal to noise ratio despite ambient temperature changes.

Excelitas SPCMs provide as standard a dark count as low as < 25 counts per second, which when combined with the large active area, makes for easy optical alignment, wavelength responsiveness from UV to NIR and after-pulsing probability considerably less than 1%, as well as very short dead times. Thus, our SPCMs offer the most comprehensive combination of capabilities for any single photon application without comprising on performance or affordability.

Excelitas offers a comprehensive series of SPCMs suitable for a variety of cutting-edge applications including:

- Particle Sizing (DLS)
- STED & Multi-Photon Microscopy
- Ultra-Sensitive Fluorescence
- Luminescence
- Time-Correlated Single Photon Counting (TCSPC)
- Single Molecule Detection
- Diffused Correlation Spectroscopy (DCS)
- Single Photon LiDAR
- Optical Range Finding
- Quantum Cryptography (QKD)
- Photon Entanglement Experiments

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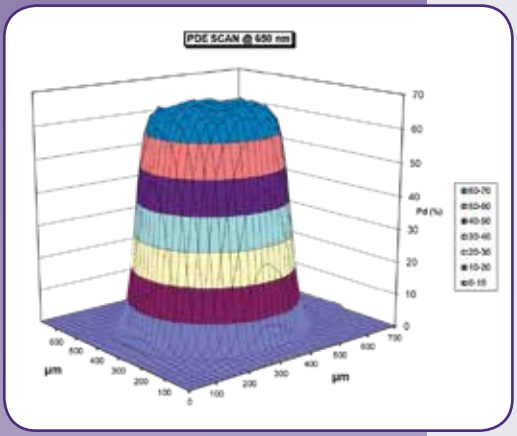
SPCM-AQRH

Standard product range with option details



Excelitas SPCM-AQRH

The Excelitas SPCM-AQRH Single Photon Counting Module detects single photons over the wavelength range of 400nm to 1060nm with performance parameters superior to other solid state or vacuum-tube based photon counters.

The SPCM-AQRH achieves typical peak photon detection efficiency greater than 70% at 700nm over a 180µm diameter, with unmatched uniformity over the full active area. Featuring a simple 5V power input, a TTL voltage pulse is generated for each photon detected with the signal available at the BNC connector at the rear of the module.

With a wide operating temperature range, the SPCM-AQRH will function between 5˚C and 70˚C.

This SPCM Series offers several optical interface options that include free space window, FC fiber adaptor, and C-mount or tube cage mount bracket/ adaptors. The SPCM-AQRH also comes with 6 standard output pulse options to match any photon count read-out instrument requirements.

With an enhanced electronic circuit, the SPCM-AQRH provides reduced minimum dead-time to less than 25ns, thereby enabling increased linearity and improved dynamic range. The SPCM-AQRH has internal protection circuitry that protects the avalanche photodiode and the module electronics from any damage due to accidental overload from exposure to ambient lighting.

Single Photon Counting Modules – SPCM-AQRH-WX

Part Number	Active Area Diameter	Maximum Dark Count Rate	Photon Detection Efficiency @ 650 nm	Typ. Count Rate before Saturation	Dead Time[1]	Pulse Width[2]
Unit	mm	c/s	%	c/s	ns	ns
SPCM-AQRH-10	180	1500	65	37M	22	10
SPCM-AQRH-11	180	1000	65	37M	22	10
SPCM-AQRH-12	180	500	65	37M	22	10
SPCM-AQRH-13	180	250	65	37M	22	10
SPCM-AQRH-14	180	100	65	37M	22	10
SPCM-AQRH-15	180	50	65	37M	22	10
SPCM-AQRH-16	180	25	65	37M	22	10

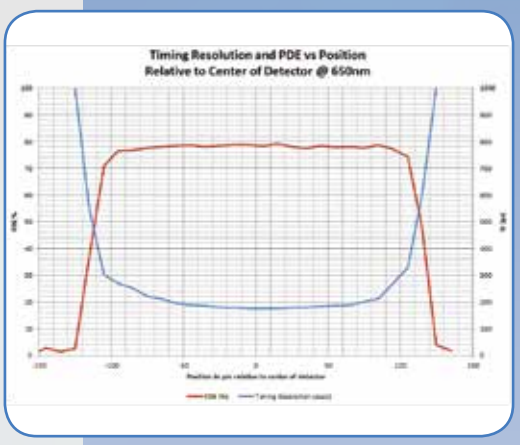
1. Option for 28ns and 35ns Dead Time available.
2. Option for 18ns and 28ns Pulse Width available.

SPCM-AQRH-TR

Performance-optimized for timing resolution

Excelitas SPCM-AQRH-TR

The Excelitas SPCM-AQRH-XX-TR is the newest generation of the Excelitas Single Photon Counting Modules specifically selected and performance-optimized for timing resolution.



The SPCM-AQRH-XX-TR uses a specially selected SLiK silicon avalanche photodiode with timing resolution better than 250ps while maintaining peak photon detection efficiency (PDE) of more than 75% at 650nm over a 180µm diameter active area. This new timing-optimized module offers multiple optical interfaces and output pulse options of the standard SPCM-AQRH, as well as performance parameters such as outstanding uniformity, over-load protection, temperature stability, and linearity.

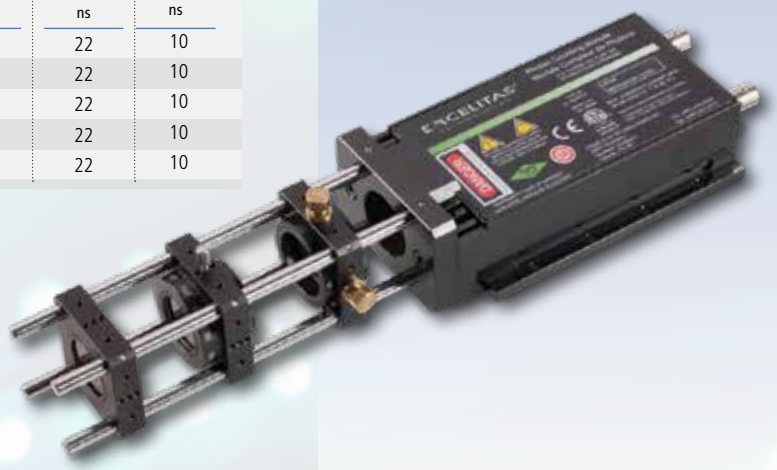
The SPCM-AQRH-XX-TR is suitable for applications in time correlated single photon counting (TCSPC), fluorescence lifetime measurements and fluorescence lifetime imaging microscopy (FLIM).

As with the standard SPCM family of parts, the "-TR" series of photon counting modules is designed and built to be fully RoHS compliant.

Single Photon Counting Modules – SPCM-AQRH-WX-TR

Part Number	Active Area Diameter	Maximum Dark Count Rate	Photon Detection Efficiency @ 650 nm	Max. Count Rate before Saturation	Dead Time[1]	Pulse Width[2]
Unit	mm	c/s	%	c/s	ns	ns
SPCM-AQRH-10-TR	180	1500	75	37M	22	10
SPCM-AQRH-11-TR	180	1000	75	37M	22	10
SPCM-AQRH-12-TR	180	500	75	37M	22	10
SPCM-AQRH-13-TR	180	250	75	37M	22	10
SPCM-AQRH-14-TR	180	100	75	37M	22	10

1. Option for 28ns and 35ns Dead Time available.
2. Option for 18ns and 28ns Pulse Width available.



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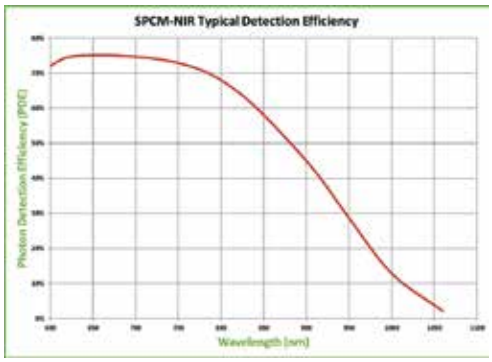
SPCM-NIR

Models with enhanced NIR PDE



Excelitas SPCM-NIR

The Excelitas SPCM-NIR is a Single Photon Counting Module specifically selected and performance-optimized for the near-infrared wavelength spectrum between 780-950nm.

The SPCM-NIR uses a specially selected silicon avalanche photodiode (SLiK) with peak single photon detection efficiency (PDE), typically 70% at 780nm and 45% at 900nm, while maintaining uniformity over a 180 µm diameter active area. This module achieves enhanced red and NIR sensitivity while maintaining other performance parameters of our standard SPCM-AQRH, such as outstanding uniformity, overload protection, temperature stability and linearity.

This NIR-spectrum enhanced device is designed to support microscopy, long-range single photon LiDAR, quantum key distribution, photon entanglement experiments as well as many other NIR single photon applications.

Users will benefit from the choice of output pulse options as well as optical interfaces available to this RoHS-compliant NIR series of photon counting modules.

Single Photon Counting Modules – SPCM-NIR[1]-WX

Part Number	Active Area Diameter	Maximum Dark Count Rate	Photon Detection Efficiency @ 780 nm	Max. Count Rate before Saturation	Dead Time[2]	Pulse Width[3]
Unit	µm	c/s	%	c/s	ns	ns
SPCM-NIR-10	180	1500	70	37M	22	10
SPCM-NIR-11	180	1000	70	37M	22	10
SPCM-NIR-12	180	500	70	37M	22	10
SPCM-NIR-13	180	250	70	37M	22	10
SPCM-NIR-14	180	100	70	37M	22	10

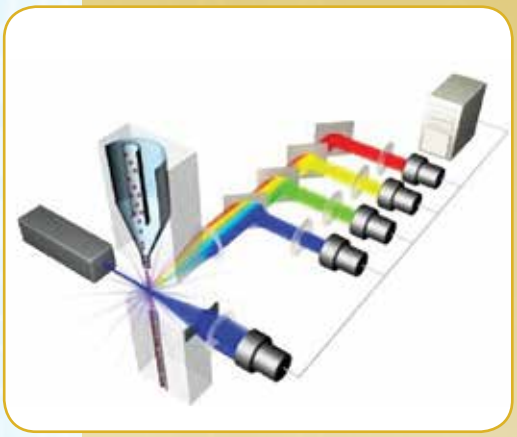
1. Options available with PDE measured at 780, 800, 850 or 900nm. When ordered, the -NIR- is replaced by the wavelength chosen
2. Option for 28ns and 35ns Dead Time available
3. Option for 18ns and 28ns Pulse Width available

SPCM-AQ4C

Four-channel SPCM

Excelitas SPCM-AQ4C

The Excelitas SPCM-AQ4C is a four-channel photon counting card capable of detecting single photons of light over the wavelength range of 400nm to 1075nm. Each of the four photon counting channels is independent from the others.



The SPCM-AQ4C uses a unique silicon avalanche photodiode (SLiK) that has a circular active area of 180µm with a peak photon detection efficiency exceeding 60% at 650nm. Each photodiode is both thermoelectrically cooled and temperature controlled, ensuring stabilized performance despite changes in the ambient temperature. This module is built in the FC adaptor configuration, suitable to be used with Multi-Mode fiber up to 100µm in core diameter, to allow remote collection of photons for delivery to the detectors.

The SPCM-AQ4C card uses an improved circuit with a peak count rate >4 M c/s for short bursts of time on all four channels and a count rate of 1.5 M c/s for continuous operation. The module requires +2 Volt, +5 Volt, and +30 Volt power supplies, for separate controls of the TE coolers, the quenching circuit and the HV power supply. Each of the 4 channels offer the standard features of the single SPCM-AQRH series, such as high single-photon detection efficiency, low afterpulse, internal over-illumination protection circuit, and individual-channel gating function.

The output of each channel – a TTL pulse that is 4.5 Volts high (into a 50 Ω load) and 25 ns wide – is available at the card edge behind the circuit board. All input and output signals are available at the card connector. An interface board, to simplify input and output connectivity, is also available for this array module.

Single Photon Counting Modules – SPCM-AQ4C

Part Number	Active Area Diameter	Maximum Dark Count Rate	Photon Detection Efficiency @ 650 nm	Max. Count Rate before Saturation	Dead Time	Pulse Width
Unit	µm	c/s	%	c/s	ns	ns
SPCM-AQ4C	Fibered	500	60	4M	50	25

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About Excelitas Technologies

Excelitas Technologies high performance Single Photon Counting Modules (SPCMs) are self-contained modules that meet the low-light-level detection demands of confocal microscopy, fluorescence, luminescence, and TCSPC, particle sizing and Quantum Communications. With over 30 years of photon counting design and engineering expertise, Excelitas SPCMs offer market-leading Photon Detection Efficiency (PDE), low after-pulsing, highest uniformity over the active area, high linear dynamic range, and low dark counts. With the broadest range of SPCM modules, combined with technical expertise and global resources, Excelitas has the solution to best meet your photon counting needs.

Excelitas is a global technology leader focused on delivering innovative, high-performance, market-driven photonic solutions to meet the lighting, optronics, detection and optical technology needs of global customers. Serving a vast array of applications across biomedical, scientific, safety, security, consumer products, semiconductor, industrial manufacturing, defense and aerospace sectors, Excelitas stands committed to enabling our customers' success in their end markets. Excelitas has approximately 6,700 employees in North America, Europe and Asia, serving customers across the world.

www.excelitas.com

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Excelitas Technologies
22001 Dumberry Road
Vaudreuil-Dorion QC J7V 8P7 CANADA
Telephone (+1) 450-424-3000

Excelitas Technologies GmbH & Co. KG
Wenzel-Jaksch-Str. 31
D-65199 Wiesbaden
Germany
Telephone: (+49) 611 492 430

Excelitas Technologies
8 Tractor Road
Singapore 627969
Telephone: (+65) 6775 2022 Main number)
Telephone: (+65) 6770 4366 (Customer Service)

For written support, please visit www.excelitas.com/contact

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