excelitas®

SPCM-1064



1064 nm enhanced Single Photon Counting Module

Excelitas' SPCM-1064 is a Single Photon Counting Module engineered for high performance across the 905 nm to 1064 nm wavelength range, delivering superior sensitivity where many analytical and quantum optical systems operate.

It incorporates a high-efficiency silicon avalanche photodiode with typical single-photon detection efficiency of 10% at 1064 nm, and above 50% from 750 nm to 950 nm, with excellent uniformity across a large 500 µm active area providing more consistent signal capture and reducing calibration effort for precise measurements.

The module offers enhanced NIR and 1064 nm response while preserving the strengths of standard SPCM-AQRH models, including stable temperature behavior, robust overload protection, and highly linear output, ensuring reliable results in demanding measurement environments. Optimized for this spectral band, the module improves detection of weak photon signals in applications such as Raman spectroscopy, time-resolved photoluminescence, nonlinear optics experiments, single-molecule measurements, and quantum communication, enabling clearer spectra, higher measurement precision, and greater experimental sensitivity.

YOUR BENEFITS

- Cutting-edge detection capability at the challenging 1064 nm wavelength, supporting **Raman spectroscopy, IR photoluminescence** and **quantum optics** experiments
- Strong sensitivity for **Raman setups, fluorescence-suppressed spectroscopy, and TRPL** using 830 nm excitation
- High efficiency in NIR **analytical systems, nonlinear optics experiments** and 905 nm-based excitation schemes
- Captures more photons from divergent beams, reducing alignment sensitivity and ensuring stable coupling efficiency in microscopy and spectroscopy
- Maintains accurate quantitative measurements even in high-flux conditions, critical for fast scans and dynamic experiments
- Enables precise timing discrimination and background suppression, improving signal-to-noise ratios

SPECIFICATIONS

- Typ. PDE:
  54% @800 nm, 58% @905 nm, **10 % @1064 nm**
- 500 µm active area
- Single +5 V supply
- High linearity at high count rates
- Gated output option

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All specifications refer to an ambient temperature of T_A = 22 °C, unless otherwise specified.

Table 1: Electro-Optical Specifications

Parameter	Symbol/Description	Min	Typ.	Max	Unit
Active area diameter	$Ø_{PD}$		500		µm
Photon Detection Efficiency[1,2]	800 nm	50	54		%
	905 nm	52	58		
	1064 nm	8	10		
Dark Count Rate	SPCM-1064-30			1500	s^{-1}
	SPCM-1064-31			1000	
	SPCM-1064-32			500	
Average Dark Count Variation[3]	d(DCR)/dt			±20	%
Dark Count Variation with Case Temperature	Δ(DCR)/ΔT			±10	%
Single Photon Timing Resolution[4]	TR		600		ps
Dead Time[5]	t_D		44		ns
Output count rate before saturation	CR_{sat}		21		Mcs^{-1}
Linearity correction factor	200 kcs^{-1}		1		
	1 Mcs^{-1}		1.1		
	5 Mcs^{-1}		1.6		
	10 Mcs^{-1}		2.9		
	15 Mcs^{-1}		7.0		
Afterpulsing Probability[6]	APR		1.0	3.0	%
Output Pulse Width[7]	t_P		28		ns
Settling time following power-up[8]	t_{stab}		15	20	s
Gating turn on/off	Disable		40	45	ns
	Enable		60	65	

Note 1: Without FC adaptor

Note 2: Minimum PDE measured and recorded at specific wavelength.

Note 3: At constant case temperature. 6 hours at 25 °C.

Note 4: Timing resolution is measured using a 10 µm diameter light spot, at 1064 nm, and with case temperature at 22 °C. For timing resolution requirements of larger spot size measurement, or at different wavelengths, please contact Excelitas.

Note 5: Count Rate < 5 Mcs^{-1}

Note 6: After pulse is measured for the first 500 ns (excluding the first 75 ns) on the timeline of the after-pulse curve, at an average count rate of 100 kcs^{-1} ± 20 kcs^{-1}.

Note 7: ±3 ns

Note 8: 1% stability at 1 Mcs^{-1} and 25 °C

Table 2: Electrical Specifications

Parameter	Symbol/Description	Min	Typ.	Max	Unit
Supply Voltage[1]	V_{Bias}	4.75	5.00	5.25	V
Supply Current	I_{Bias}		0.4	1.2	A
Power cable total resistance	R_P		0.1	0.2	Ω
Output Pulse Amplitude	TTL HIGH	1.5	2.2		V
	TTL LOW	-0.1		0.8	
Threshold setting required on counter for digital output pulse[2]	V_{Th}		1.0		V
Gating Threshold voltage[3]	Low Level[4]	0		0.4	V
	High Level[5]	2.0		5.25	
	Enable		60	65	

Note 1: Connecting to incorrect voltage or reverse voltage may damage or destroy the module. The warranty is invalid should such damage occur. The center contact of the barrel type power connector is +5 V.
Note 2: Terminate into 50 Ω
Note 3: 50 Ω Output
Note 4: Sink current > 90 mA
Note 5: Sink current > 30 mA

Table 3: Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Supply Voltage	V_{Bias}	5.5	V
Peak Light Intensity[3]	P_{Opt}	10^4	photons/pulse
Storage Temperature	T_S	-20 ... 70	°C
Operating Temperature	T_{op}	+5 ... 40	°C

Note 1: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.
Note 2: Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
Note 3: Pulse Width < 1 ns.

Table 4: Ordering Information

SPCM-1064-3X-YY	Description
SPCM-1064-3X	Free space window, no adaptor / bracket
SPCM-1064-3X-FC	FC/PC adaptor
SPCM-1064-3X-BR1	Bracket for 1" tube mount (1.035" x 40 TI) and 30 mm cage mount system
SPCM-1064-3X-BR2	Bracket for C-mount system (1.0" x 32 TPI) and 30 mm cage mount system

Note 1: X in the part number denotes the upper limit for dark count: 0 ≤ 1500cps, 1 ≤ 1000cps, 2≤ 500 cps

Linearity

The actual photon count rate can be calculated as follows:

$$CR_{act} = \frac{CR_{mod} * CF(CR_{mod}) - DCR}{PDE(\lambda)}$$

with CR_{act} the actual photon count rate, CR_{mod} the output count rate of the SPCM module, $CF(CR_{mod})$ the correction factor at the output count rate of the SPCM module, DCR the dark count rate of the module and PDE the Photon Detection Efficiency at a given wavelength λ.

The theoretical value, at low count rate, of the Correction Factor follows this equation:

$$CF = \frac{1}{1 - t_d * CR_{mod}}$$

with t_d the dead time of the module.

The deviation from an ideal linear system is another way of looking at the saturation effect. The following equation shows how to calculate this departure from linearity:

$$Linearity = \left[\frac{CR_{mod}}{CR_{act} * PDE(\lambda) + DRC}\right] - 1 = \left[\frac{1}{CF(CR_{mod})}\right] - 1$$

General Notes

1. These modules are not qualified for shock or vibration other than normal instrument environments.
2. The module dissipates a mean power of 2 W and a maximum power of 6 W at high count rate and 40 °C. Adequate heat sinking must be provided by clamping the module to a suitable heat sink via the holes in the module base. To meet specified performance, the module case temperature must not exceed 40 °C.
3. On a small percentage of delivered modules, bi-stability of dark counts has been observed. Research indicates this bi-stability is probably due to transitions at a single impurity site between a low energy and a high energy state.
   The phenomenon is seen as an abrupt change in the dark count rate, e.g., 350 cs^{-1} to 390 cs^{-1}, and the dark count switches between the two states at a rate dependent upon the detector temperature. Multilevel switching has also been observed, where more than one impurity site is switching.
   Long-term bi-stability is related to fundamental semiconductor physics and is beyond Excelitas' control. Warranty claims will not be considered against bi-stability alone.
   Warranty claims will only be considered if the high level of the dark count exceeds the maximum level of the specification.
4. In the dark, the module generates random counts that follow Poisson distribution. In a Poissonian process, the standard deviation is equal to the square root of the average count. In this specification the "dark count variation" refers to the stability of the average count of the module.
5. If needed, an FC fiber adaptor can be factory installed on the SPCM allowing optical fibers to be used. The FC adaptor is optimized for use at 1064 nm and with a 100 µm core multimode fiber.
   If other wavelengths or fiber sizes are needed, please contact the factory for availability. The addition of an FC adapter will cause a small drop in the effective PDE of the module. The amount of the loss will depend on the wavelength and the diameter of the fiber used to provide optical input to the module. Typically, one can expect around a 5% loss with a 100 µm core fiber at 1064 nm.

FIG. 1: TYPICAL PDE VS. WAVELENGTH

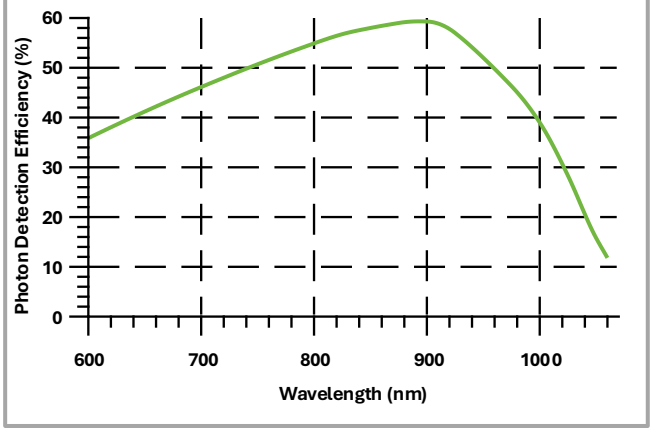


FIG. 2: TYPICAL CORRECTION FACTOR

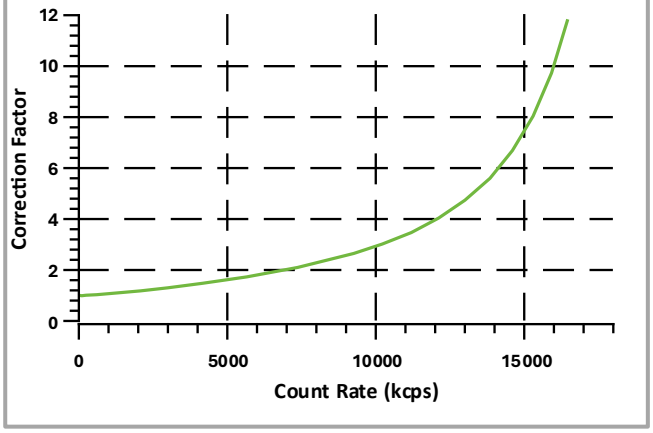


FIG. 3: TYPICAL PDE SCAN AT 900 NM

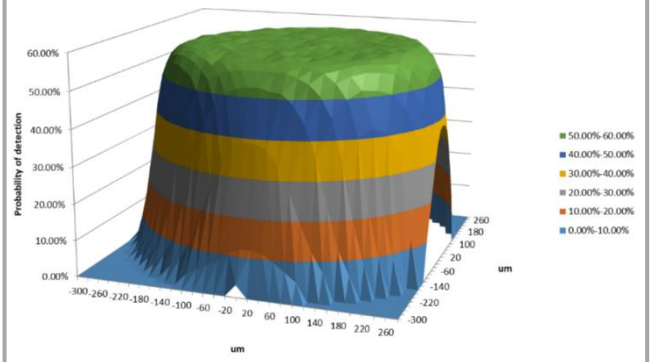


FIG. 4: TYPICAL PDE SCAN AT 1064 NM

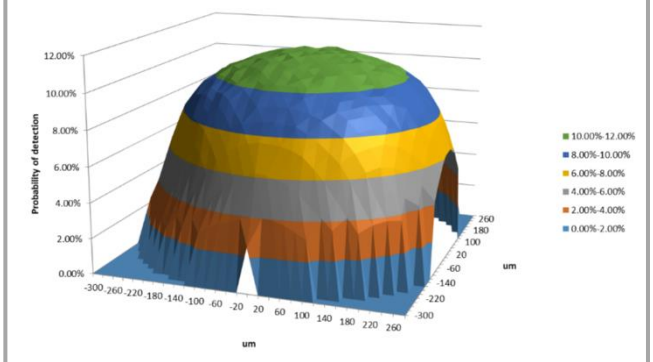
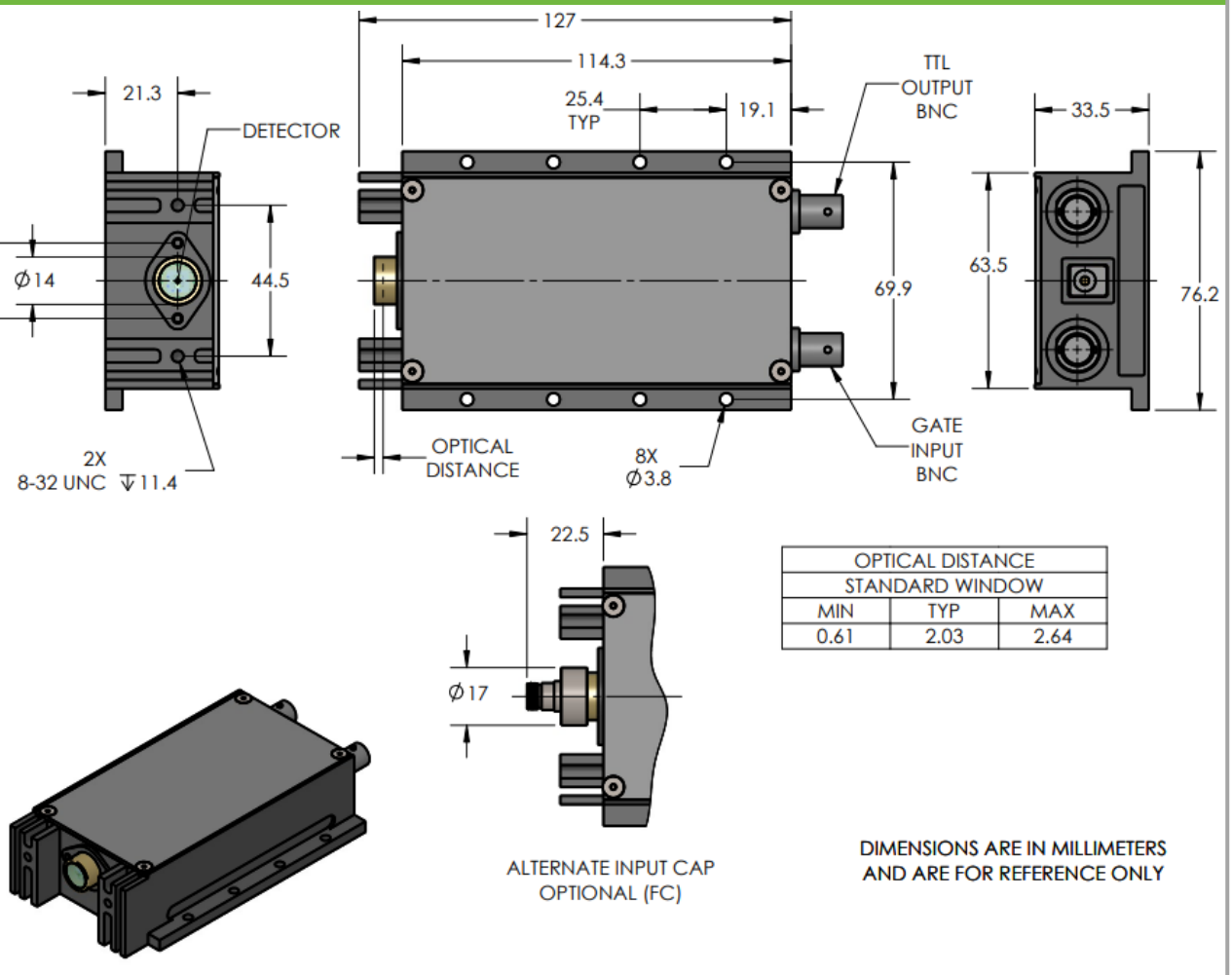
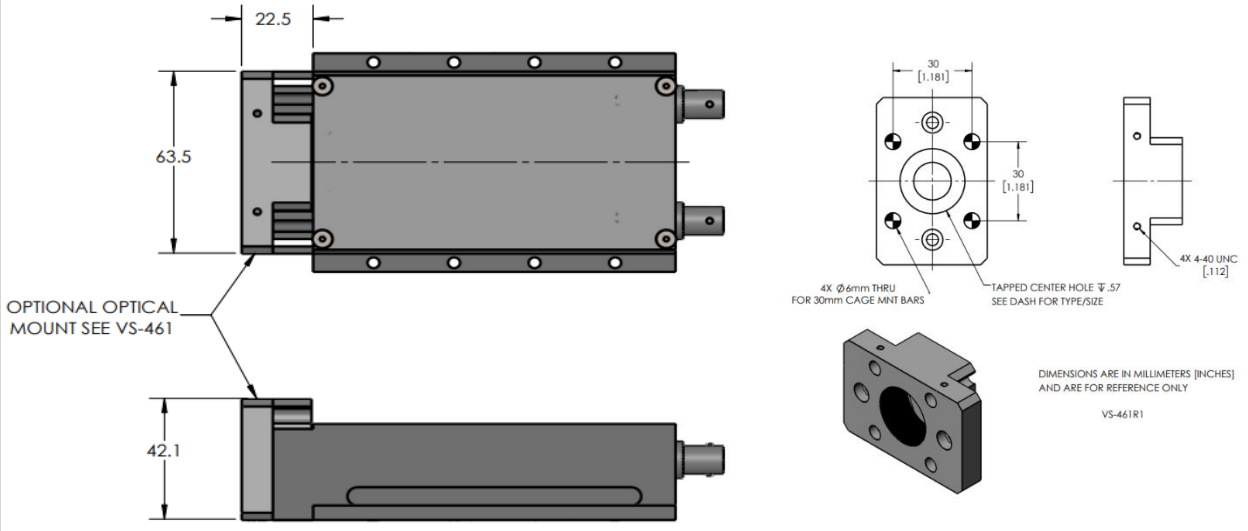


FIG. 5: MECHANICAL DIMENSIONS



OPTICAL DISTANCE		
STANDARD WINDOW		
MIN	TYP	MAX
0.61	2.03	2.64

FIG. 6: MECHANICAL DIMENSIONS BRACKET OPTIONS



Electrical Connections

OUTPUT CONNECTOR

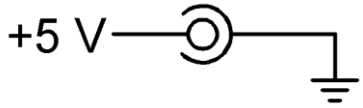
The digital OUTPUT pulse (BNC connector, TTL levels, >1.5V) should be terminated into a 50Ω load to avoid distortion and ringing. A 1.0V triggering level is recommended on counters and oscilloscopes to avoid triggering on noise. Note that TTL stands for Transistor-Transistor Logic.

GATE CONNECTOR

The GATE input (BNC connector) impedance is 50Ω and is internally connected to the +5 volts supply through a 50Ω pull-up resistor (standard module versions). It can be driven by standard TTL level signals. The gate drive must be capable of sinking 100 mA to gate the module "off" (5V/50Ω). Operation: TTL high – module counts, TTL low – counting disabled.

POWER CONNECTOR

The +5V power connector is a standard barrel connector (2.5mm I.D., 5.5mm O.D.) with an 18 AWG cable. The center stripe corresponds to the center of the barrel and connects to the positive terminal of the 5Vsupply. Reversal of the wires may damage the module.



Optical Mount Bracket Options

There are two optical mounting bracket options available to the module. The mounting brackets are factory installed and cannot be removed by end users without risk of damaging the detector, thus voiding the warranty to the module.
These mounting brackets are for industry standard C-mount and Cage Mount systems, such as those offered by Excelitas' LINOS, called Microbench, that can be attached to the mounting brackets. These systems provide high flexibility in building customized setups tailored to any specific need. In addition, a vast portfolio of optical components that can be integrated into these systems is offered by Excelitas.

Saturation

The photon count decreases at higher incoming light levels. The count at which the output rate starts to decrease is called the saturation point. As an extreme example, if the module is exposed to intense light the count rate will fall to zero. While the module is protected against light overload, precautions should be taken to avoid any excessive light level that will damage the SPCM module. After an over exposure, the dark count of the module could increase temporarily for up to an hour. For faster recovery, it is recommended to power off the module and leave it in the dark for one to two minutes prior to restarting.

Fiber Connection Option

The SPCM-1064-WX-FC has an "FC" fiber-optic receptacle pre-aligned to the optical detector. Optical fibers with an FC connector on one end are available separately. The photon detection efficiency of connectorized modules is about 95% of that quoted for standard modules at 1064 nm.

Fiber Shielding

When used with optical fibers, both the fiber jacket and the connector shrouds must be completely opaque. Otherwise, external light will increase the count rate. The SPCM-QCX pigtails conform to this requirement

Gating Function

A gating function is provided with each module – useful for viewing a signal that occurs only in a small timeframe window. Also, in some applications the background light flux is higher than the signal. In this case, the gating option could be used to improve the S/N ratio by opening a window only when the light signal is present. The output of the module and the active quench function are disabled when a TTL low level is applied to the module gate input. When a TTL high level is applied to the module gate input, the output of the module and the active quench circuit are enabled again. Any photon detection that occurs less than 2µs before the module gate input changes can result in an output pulse. However, this output pulse has lost timing accuracy.

Light Emission during Photon Detection

One peculiarity of silicon avalanche photodiodes operating in Geiger mode is that as an incoming photon is detected a small amount of light is emitted from the avalanche region. The emitted light has a broad spectral distribution. In most cases, this is not a problem. However, it can cause some confusion if another detector is monitoring light, or if the optical system is such that light emitted from the SPCM-1064 is reflected on itself. If these photons return more than 20 ns after the initial event, they will be detected.

Power Supply

The SPCM is relatively insensitive to power supply noise. It can handle +/- 100mV of ripples without much difficulty. A low impedance path for the ground line to the module is desirable. Generally, any reasonable quality power supply is acceptable. The power supply must be able to support between 4.8 – 5.25V, and up to 1.2A current. Whether it's a linear or switch type of supply is not critical if the ripples and noise are kept below 50mV.

Testing Methods

Each module is supplied with test data indicating the modules actual dark count, dead time, pulse width, photon detection efficiency @ 1060 nm, correction factor and linearity.
Excelitas Technologies meets the certification requirements of ISO-9001 and design criteria to meet MIL-STD-883 and/or MIL-STD-750 specifications.

Storage and handling

Excelitas highly recommends following the below notes:

- Modules should only be handled at an ESD-safe work station
- Do not make contact to the window surface.

Safety Warning



The SPCM contains a **high voltage power supply.** Users may be injured if the case is opened. All internal settings are pre-set; there are no user adjustments.



Units that appear defective or have suffered mechanical damage should not be used because of possible electrical shorting of the high voltage power supply. Opening the case may damage sensitive components and expose the user to the risk of electrical shock. Please contact factory for repairs.

Declaration of Conformity

This product is eligible to bear the ETL mark with adjacent indicator ‘C’ and ‘US’. The Intertek control number is 4010815.

Products:

CLASS 8721 85 ELECTRICAL EQUIPMENT FOR LABORATORY USE – Certified to US standards
CLASS 8721 84 ELECTRICAL EQUIPMENT FOR LABORATORY USE – Certified to US standards
CLASS 8721 04 LABORATORY EQUIPMENT – Electrical
CLASS 8721 04 LABORATORY EQUIPMENT – Electrical

All Single photon counting module SPCM-1064, incl. (SPCM-1064-3X-FC, SPCM-1064-3X-BR1, SPCM-1064-3X-BR2 and SPCM CDXXXX), rated 5Vdc, 1.2A.

Altitude of Operation: 0 – 5000 Meters.
Humidity of Operation: 15% - 95% relative humidity, non-condensing Equipment class III, measurement category l, pollution degree 2.

APPLICABLE REQUIREMENTS: CAN/CSA C22.2# 61010-1 Issue: 2012/05/11 Ed:3 SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE -PART 1: GENERAL REQUIREMENTS.

UL 61010-1 Issued: 2012/05/11 Ed:3 SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE - PART 1: GENERAL REQUIREMENTS.

This product is eligible to bear the CE and UK CA marks in accordance with:

EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use
EN 61010-1:2012 Safety requirements for electrical equipment for measurement, control and laboratory use

This product has been tested as per the following standards:

- Emission CISPR 11
- IEC 61000-4-2 ESD
- IEC 61000-4-3 Radiated susceptibility
- IEC 61000-4-4 Burst
- IEC 61000-4-5 Surge
- IEC 61000-4-6 Conducted susceptibility
- IEC 61000-4-11 Voltage dips and interruptions

The object of the declaration described herein is in conformity with the relevant EU legislation: EMC Directive 2004/108/EC (through April 19, 2016) and EMC Directive 2014/30/EU (from April 20, 2016).

This equipment is intended for Indoor Use Only. There is no applicable maintenance manual. The data sheet is used also as an instruction manual.

EU and UK RoHS Compliance

This series of avalanche photodiode modules are designed and built to be fully compliant with the European Union Directive 2011/65/EU as amended by Directive (EU) 2015/863 and the UKCA legislation for the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS). Exemption 7(a) is claimed on certain models.

China RoHS

This document certifies that all components and all homogeneous sub-components which are manufactured by Excelitas Technologies Canada comply with the current China RoHS 2 standard.

The green "e" symbol signifies that the product does not contain restricted substances and is a green, environmentally friendly product which can be recycled

The orange “number” symbol signifies that the product contains certain hazardous substances, can be used safely during its environmental protection use period (EPUP), as indicated by the number of years in the center, and should enter the recycling system after its EPUP. Manufacturers and importers shall also provide a declaration table of the hazardous substances present in the product, in accordance with standard GB/T 26572-2011.

For modules that contain the orange symbol, our products contain the substances as shown in the table (exemption claimed in Annex III, Exemption 7(a)).

Part Name	Toxic and hazardous substances and elements					
	Pb	Hg	Cd	Cr(VI)	PBB	PBDE
PCB	X	0	0	0	0	0
Enclosure	0	0	0	0	0	0
Cable	0	0	0	0	0	0

REACH

We declare that the part numbers listed in this document conform to the requirements of Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) Regulation (EC 1907/2006). This directive requires the identification of Substances of Very High Concern (SVHC) contained in articles above the threshold 0.1% w/w.

Warranty

A standard 12-month warranty following shipment applies. Any warranty is null and void if the module case has been opened. Warranty is null and void if the module input exceeds 5.5 V or the polarity of the +5 V supply is reversed.

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