

## HOLITA SPCM-S-APD

### 单光子计数模块

#### 介绍

北京和力达科技最新推出的 SPCM-S-APD 系列单光子计数模块使用的是工作在 Geiger 模式下的 APD 检测器，用于检测波长范围在 350nm—1060nm 的极弱的单光子信号。SPCM-S-APD 系列单光子探测器具有非常高的量子效率，具有超过 24Mcps 的检测动态范围。

SPCM-S-APD 单光子计数模块通过端接 SMB 公口的 RF 电缆输出脉冲信号，输出信号需要使用 50Ω 终端匹配电阻进行信号匹配。模块提供门控制功能，用于方便用户在程序控制下进行单光子计数模块的使能和禁止。

SPCM-S-APD 具有温度采集和制冷控制功能，为了适应环境温度的变化，内部控制电路会采用不同的控温策略，以便检测器一直处于最佳的工作状态。虽然检测器能够在 -20°C to 70°C 范围内工作，但为了使检测器具有最佳的性能，最好使模块的温度不超过 25°C；模块的外壳提供可以插入 PT100 的孔用来监测外壳的温度，在某些特殊应用中，用户可以自行在模块底部使用半导体制冷片来进一步对模块进行降温。

SPCM-S-APD 单光子计数模块的死区时间为 33ns，因此极大的增加了线性度和检测动态范围，时间分辨率也因此得以大幅提升。

SPCM-S-APD 单光子计数模块从蓝光到近红外区域具有非常高的光子探测效率，且由于使用的是工作在 Geiger 模式下的 APD，因此具有高达  $10^6$ -- $10^8$  的高增益。

SPCM-S-APD 单光子计数模块具有比 SPCM-APD 单光子计数模块更小的体积。



#### 关键特性

- 低暗计数
- 光子探测效率:
  - >50% @410nm
  - >60% @532nm
  - >65% @830nm<sup>(12)</sup>
- 检测动态范围大于 24Mcps
- 具有门控输入
- 单 12V 直流供电
- 可选 FC 光纤接口
- 非常小的体积

#### 典型应用

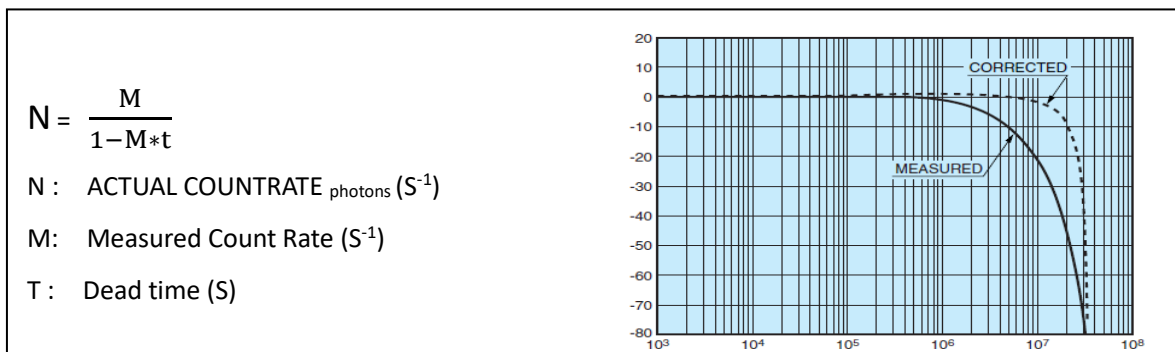
- LIDAR 雷达
- 颗粒物分析
- 远距离检测
- 荧光分析
- 天文观测
- 量子密钥
- 超高灵敏度荧光分析
- 光子相关光谱学

**Table 1 Specifications of SPCM-S-APD-ACE, @25°C, all models, unless otherwise indicated.**

Parameter	Min	Typ	Max	Unit
Supply voltage <sup>(1)</sup>	11.5	12	12.5	V
Supply current		0.1	0.2	A
Case operating temperature <sup>(1,2)</sup>	-20		70	°C
Active area diameter		500		μm
Active area		0.2		mm <sup>2</sup>
Photon detection efficiency (PDE)				
405nm <sup>(11)</sup>	50	55		%
532nm <sup>(11)</sup>	60	70		%
670nm <sup>(11)</sup>	50	55		%
830nm <sup>(12)</sup>	45	55		%
Dark Count <sup>(3,4)</sup>				
SPCM-S-APD-A0E			1500	Counts / second (CPS)
SPCM-S-APD-A1E			1000	
SPCM-S-APD-A2E			500	
SPCM-S-APD-A3E			250	
SPCM-S-APD-A4E			100	
SPCM-S-APD-A5E			50	
SPCM-S-APD-A6E			25	
Output pulse width <sup>(5)</sup>	8	10	12	ns
Dead time <sup>(6)</sup>				
SPCM-L-APD-Axx		33		ns
SPCM-L-APD-Bxx		47		
Output pulse amplitude <sup>(7)</sup> @1K Ohm(50 Ohm)				
TTL HIGH	4(2)	4.4(2.2)		V
TTL LOW			0.8	V
Single photon timing resolution <sup>(8)</sup>		500	800	ps
Afterpulsing probability <sup>(9)</sup>		2		%
Setting time following power up(1% stability) at 1Mc/s and 25°C		15	20	S
Output count rate before saturation <sup>(10)</sup>		24		Mc/s
Gating threshold voltage				
Low level	0		0.4	V
High level	2.4		5.25	V
Gating turn on/off input				
Disable = TTL low(<0.4V)		40	45	ns
Enable = TTL high(>2.4V)		50	65	ns

1. Connection to incorrect voltage or reverse voltage may damage or destroy the module. The warranty is invalid should such damage occur. The yellow wire is +12V and the black wire is GND.
2. The module dissipates a mean power of 2.0W and a maximum power of 6W at high count rate and over 70°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 70°C. To get best performance, the module case temperature must not exceed 25°C.
3. On a small percentage of delivered modules, bi-stability of the dark count 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.
4. In the dark, the module generates random counts that follow a Poisson distribution. In a poisonings 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. Output pulse width is set at the standard of 10ns ± 2ns at 2.2V with 50ohm load.
6. The default dead time of SPCM-L-APD-Axx is 33ns and the default dead time of SPCM-L-APD-Bxx is 47ns; The actual photon rate could be calculated using the following equation, as indicated in Note #6 in the box below:

Note #6: [Actual photon rate calculation formula](#)

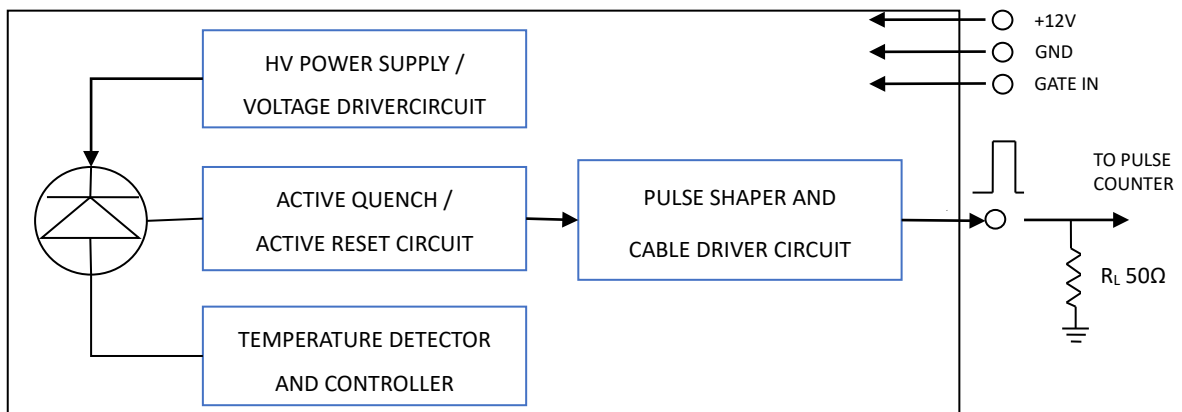


7. Output pulse height standard is set to 4.4V ± 0.4V when un-terminated.
8. Timing resolution depends on count rate and wavelength. Timing resolution is measured using a less than 10µm diameter light spot.
9. Defined at 5% photon detection probability (830nm), After-pulse occurring 1us to 60 seconds after main pulse.
10. For the typical dead time setting of 33ns, typical maximum count rate is 24Mc/s before saturation. If the maximum dead time setting is used, about 62ns, typical maximum count rate would be about 12Mc/s. Note that using a longer dead time will degrade linearity.
11. With the module SPCM-S-APD-ACE.
12. With the module SPCM-S-APD-BCE.

**Table 2 Absolute Maximum Rating**

Supply Voltage <sup>(1)</sup>	13V
Maximum count rate	Maximum count rate can be sustained if case temperature is maintained within limit specified limits
Peak light intensity	maximum $10^4$ photons / pulse, light pulse width < 1ns
Case temperature <sup>(2)</sup>	-20°C/+85°C storage, -5°C /+28°C operating

**Figure 1 SPCM-S-APD Module Block Diagram**



**Figure 2 SPCM-S-APD Modules Electrical Connections**

**OUTPUT CONNECTOR**

The digital OUTPUT pulse (blue wire, 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 (green wire) impedance is internally connected to the +5 volt supply through a 10KΩ pull-up resistor (standard module versions). It can be driven by standard TTL level signals. Operation: TTL high – module counts, TTL low – counting disabled.

**POWER CONNECTOR**

The yellow wire is +12V and the black wire is GND. Reversal of the wires may damage the module.

Figure 3 Typical Photon Detection Efficiency (PDE) vs. Wavelength (SPCM-S-APD-ACE)

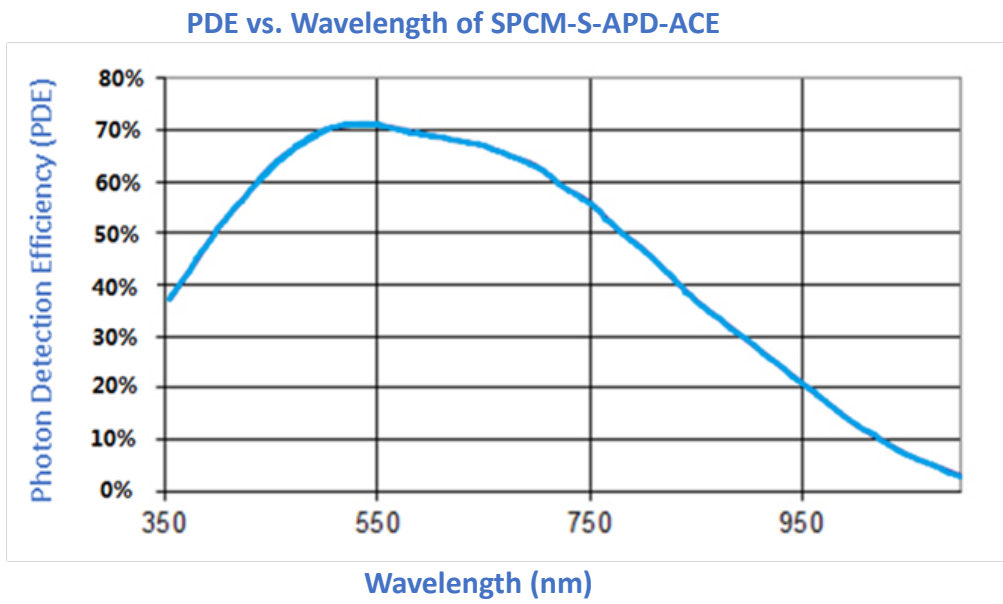


Figure 4 Typical Photon Detection Efficiency (PDE) vs. Wavelength (SPCM-S-APD-BCE)

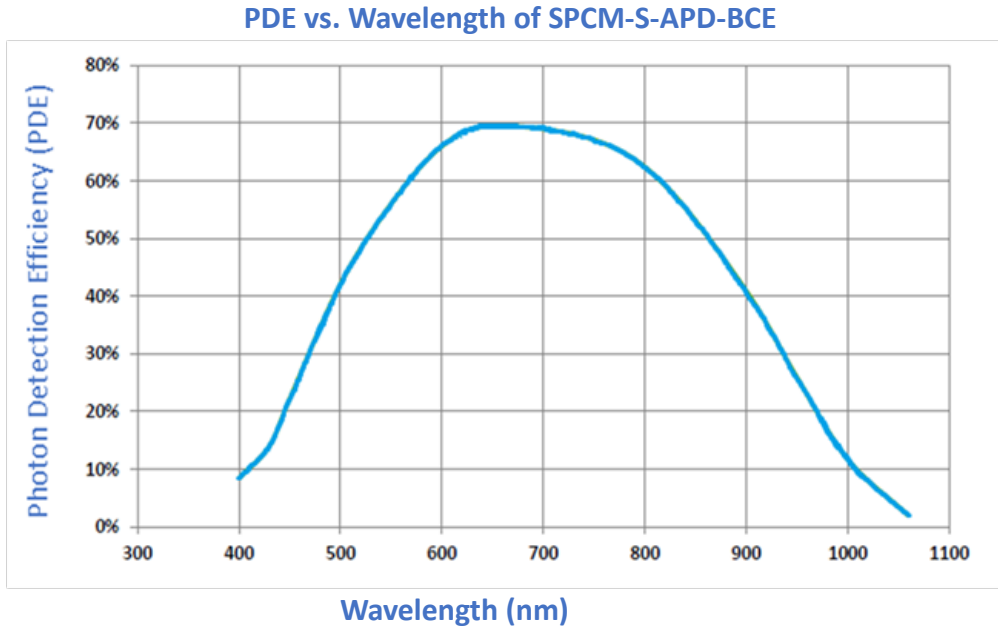


Figure 5 Beam diameter on detector surface vs. relative intensity of PDE referring to maximum value

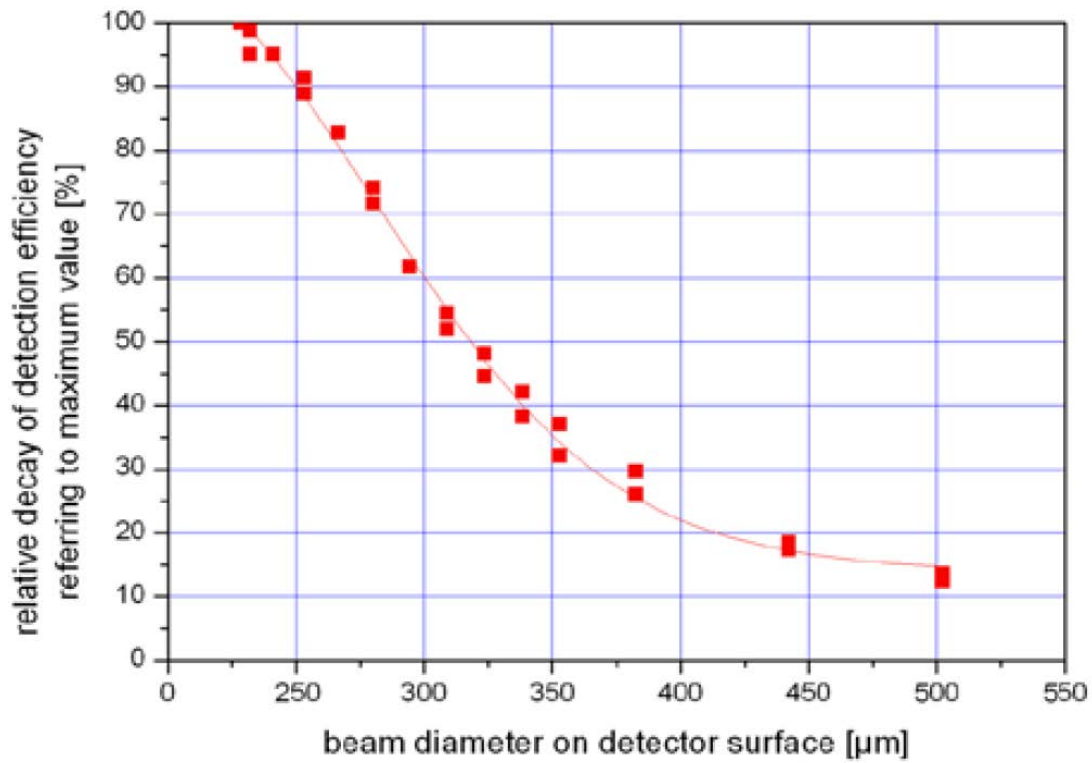


Figure 6 Optical Power vs. Number of Photons

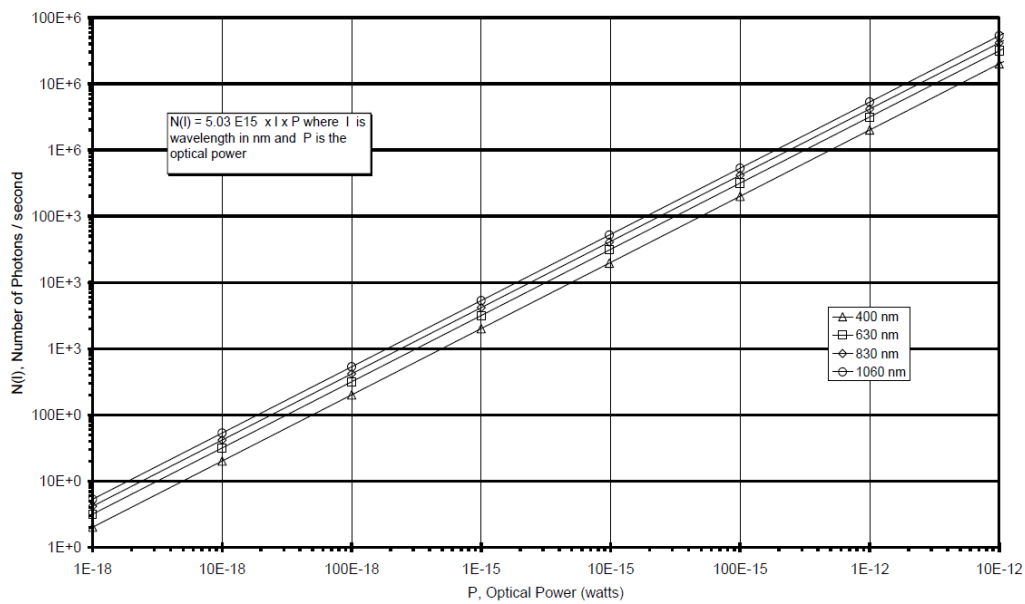


Figure 7 Dimensional Outline (unit: mm)

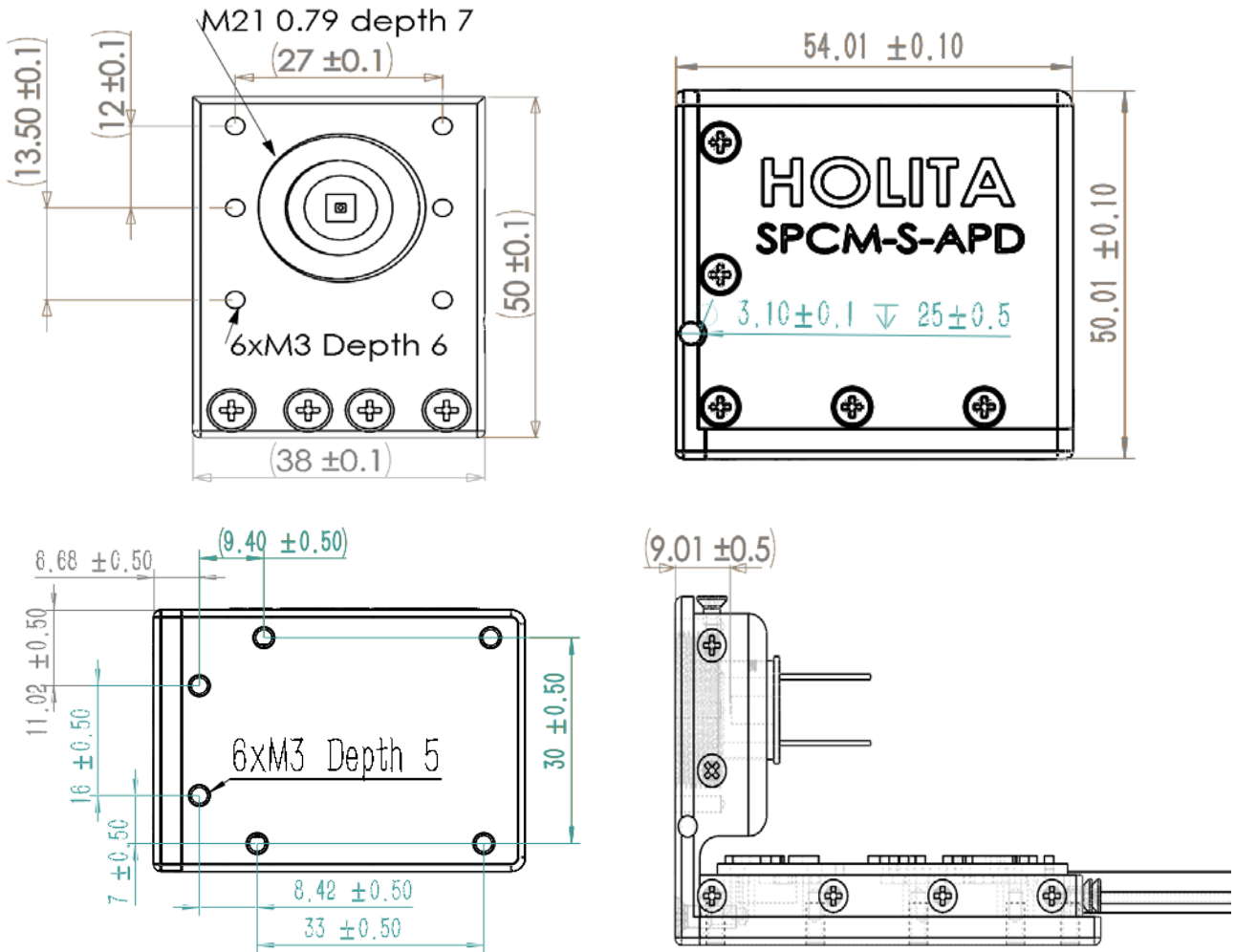
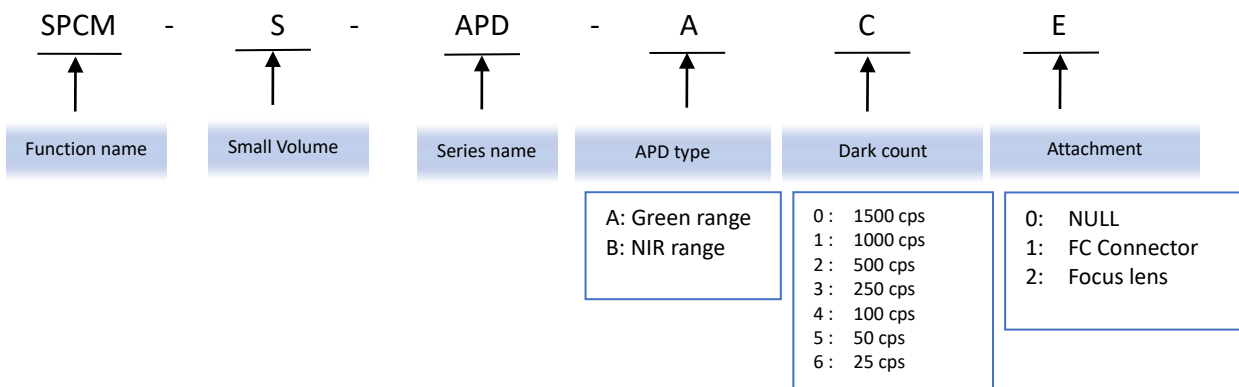


Figure 8 SPCM-S-APD Ordering Guide



## 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 is enabled again. Any photon detection that occurs less than 2 $\mu$ s before the module gate input changes can result in an output pulse. If the gating input is left unconnected, the module is enabled by default.

## Saturation

The photon count rate decreases at high 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 leaves it in the dark for one to two minutes prior to restarting.

## Safety Warning



The SPCM-S-APD 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.

## 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 13 V or the polarity of the +12V supply is reversed.

## ESD Warning

Modules should only be handled at an ESD-safe work station.

## Ordering information

Products can be ordered directly from HOLITA or its representatives. For a complete listing of representatives, visit our website at [www.holita.cn](http://www.holita.cn). Custom designed products are available on request.