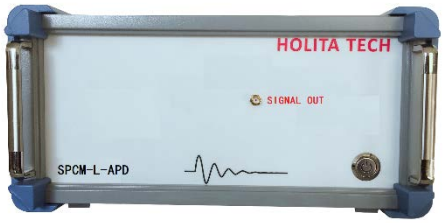
HOLITA SPCM-L-APD

单光子计数模块

介绍



北京和力达科技推出的低暗计数 SPCM-L-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-L-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-L-APD单光子计数模块通过端接SMA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-L-APD模块内部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。模块内部采用三级帕尔贴制冷器，可以将APD固定在-30°C进行恒温工作，使得探测器获得更小的暗计数。

SPCM-L-APD单光子计数模块的典型死区时间为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-L-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。

关键特性

- 低暗计数
- 光子探测效率:
  - >50% @410nm
  - >60% @532nm
  - >65% @830nm(12)
- 检测动态范围大于 24Mcps
- 可选门控使能
- 220V 供电
- FC 光纤接口

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 SPCM-L-APD 参数说明（在环境 25℃条件下）

参数	最小	典型	最大	单位
电源电压(1)	200	220	250	VAC
供电电流		0.2	1	A
工作环境温度(1,2)	-20		50	℃
探测器有效直径		500		μm
探测器有效面积		0.2		mm^2
光子探测效率 (PDE)				
405nm(11)	50	55		%
532nm(11)	60	70		%
670nm(11)	50	55		%
830nm(12)	45	55		%
暗计数(3,4)				
SPCM-L-APD-x0x			1500	
SPCM-L-APD-x1x			1000	(CPS)
SPCM-L-APD-x2x			500	个/每秒
SPCM-L-APD-x3x			250	
SPCM-L-APD-x4x			100	
SPCM-L-APD-x5x			50	
SPCM-L-APD-x6x			25	
输出脉冲宽度(5)	8	10	12	ns
死区时间(6)				
SPCM-L-APD-Axx		33		ns
SPCM-L-APD-Bxx		47		ns
输出脉冲幅度(7) @1K Ohm(50 Ohm)				
TTL HIGH	4(2)	4.4(2.2)		V
TTL LOW			0.8	V
单光子时间分辨率(8)		500	800	ps
后脉冲概率(9)		2		%
上电后稳定时间		600	800	S
最大技术率(10)	12	24		Mc/s
门控电压要求				
Low level	0		0.4	V
High level	2.4		5.25	V
门控输入延时				
Disable = TTL low(<0.4V)		40	45	ns
Enable = TTL high(>2.4V)		50	65	ns
尺寸	340x310x160(长 x 宽 x 高)			mm

1. Connection to incorrect voltage or reverse voltage may damage or destroy the module. The warranty is invalid should such damage occur.
2. The module dissipates a mean power of 30W and a maximum power of 60W at high count rate and over 50°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 50°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:

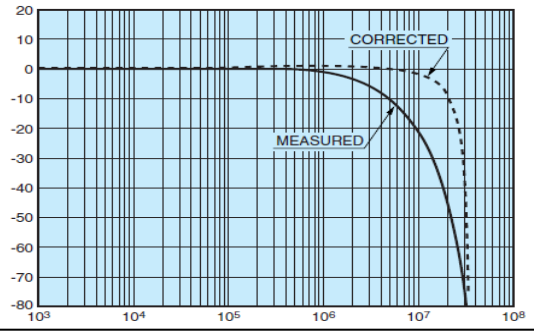
   Note #6: Actual photon rate calculation formula

$$N = \frac{M}{1 - M * t}$$

N : ACTUAL COUNTRATE $_{photons}$ (S^{-1})

M: Measured Count Rate (S^{-1})

T : Dead time (S)



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 is 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-L-APD-Axx.
12. With the module SPCM-L-APD-Bxx.

Table 2 Absolute Maximum Rating

Supply Voltage(1)	220VAC
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(2)	-20°C/+85°C storage, -5°C /+28°C operating

Figure 1 SPCM-APD Module Block Diagram

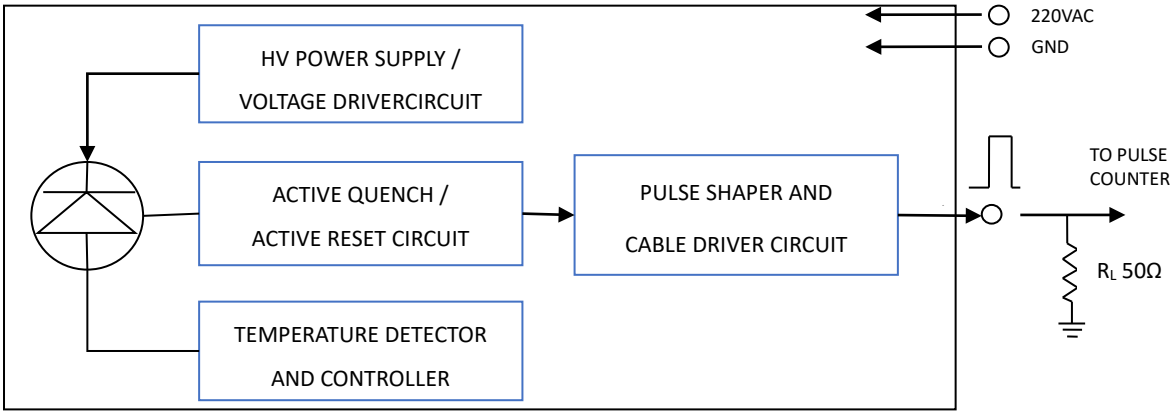


Figure 2 SPCM-L-APD Modules Electrical Connections

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 （optional）

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

Connection to incorrect voltage or reverse voltage may damage or destroy the module.

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

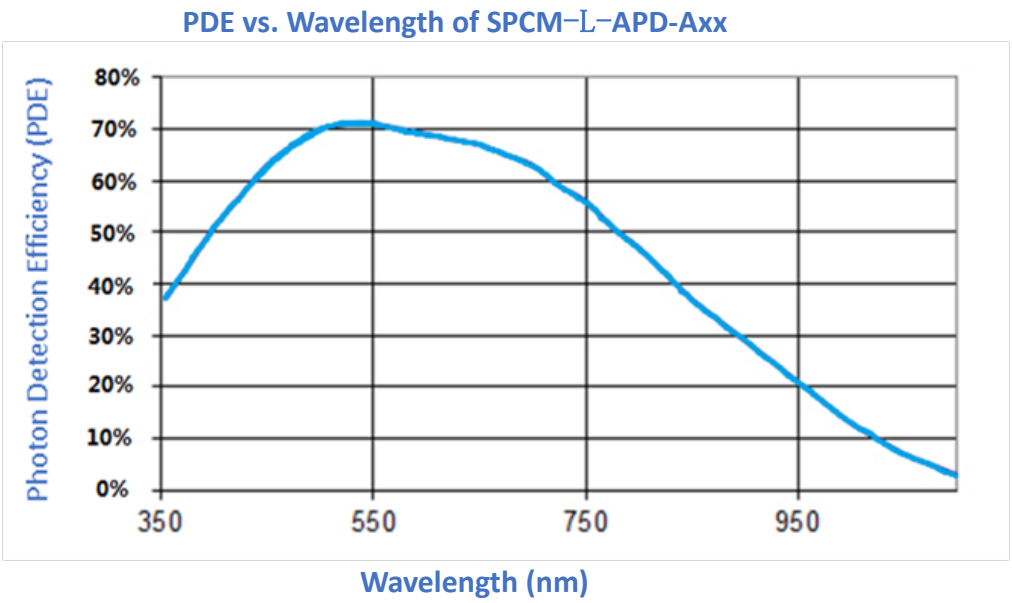


Figure 4 Typical Photon Detection Efficiency (PDE) vs. Wavelength (SPCM-L-APD-Bxx)

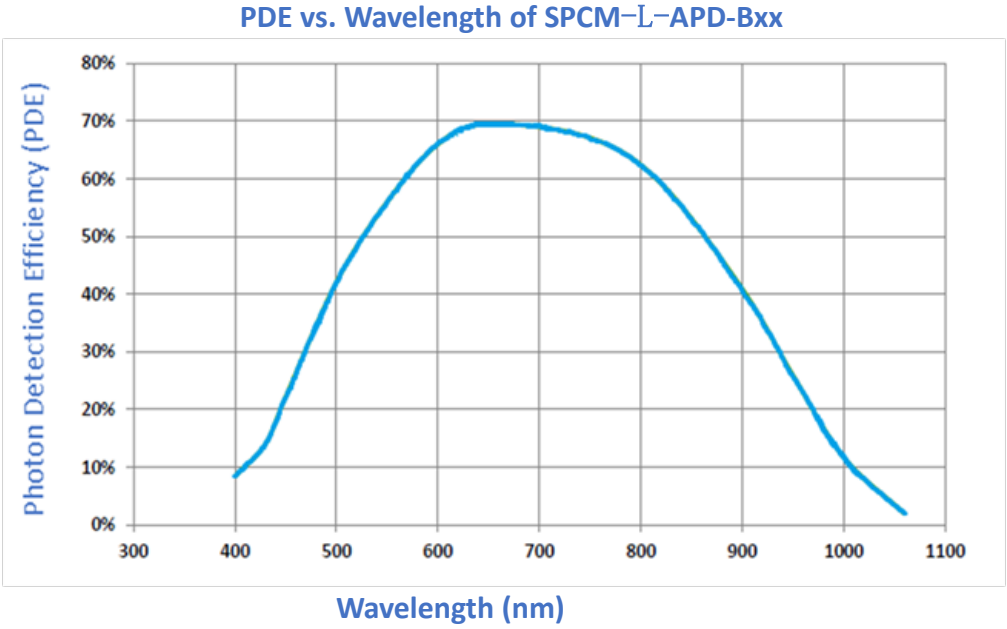


Figure 5 Beam diameter on detector surface vs. relative intensity of PDE referring to maximum value

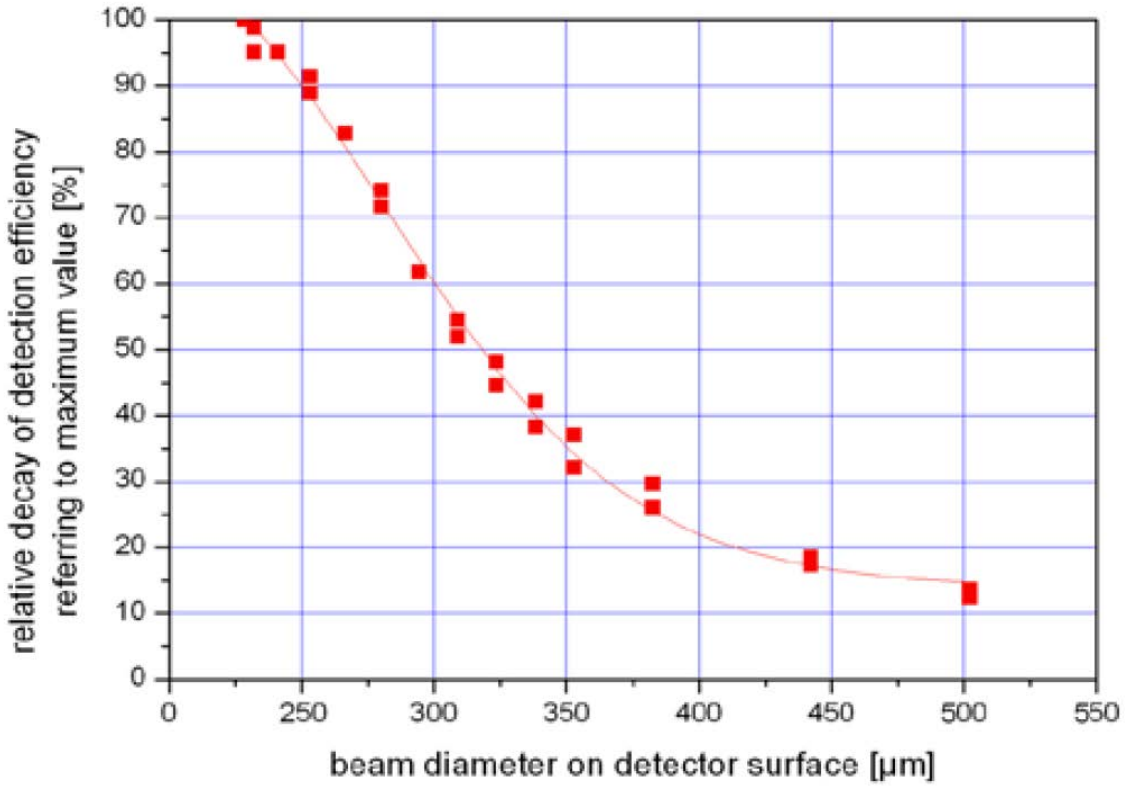


Figure 6 Optical Power vs. Number of Photons

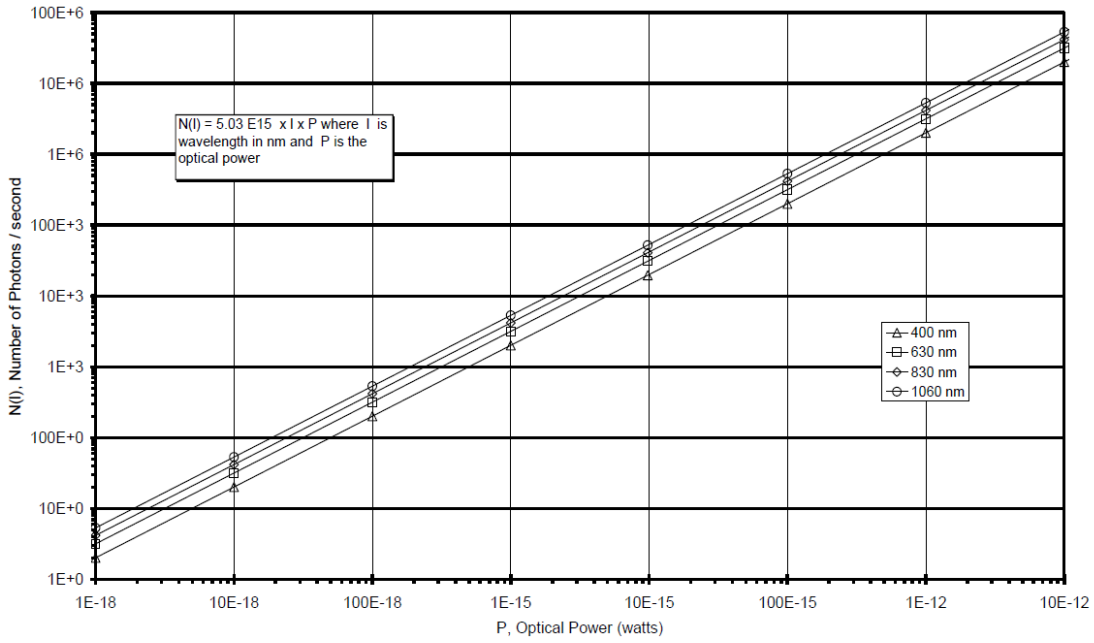


Figure 7 Dimensional Outline (unit: mm)

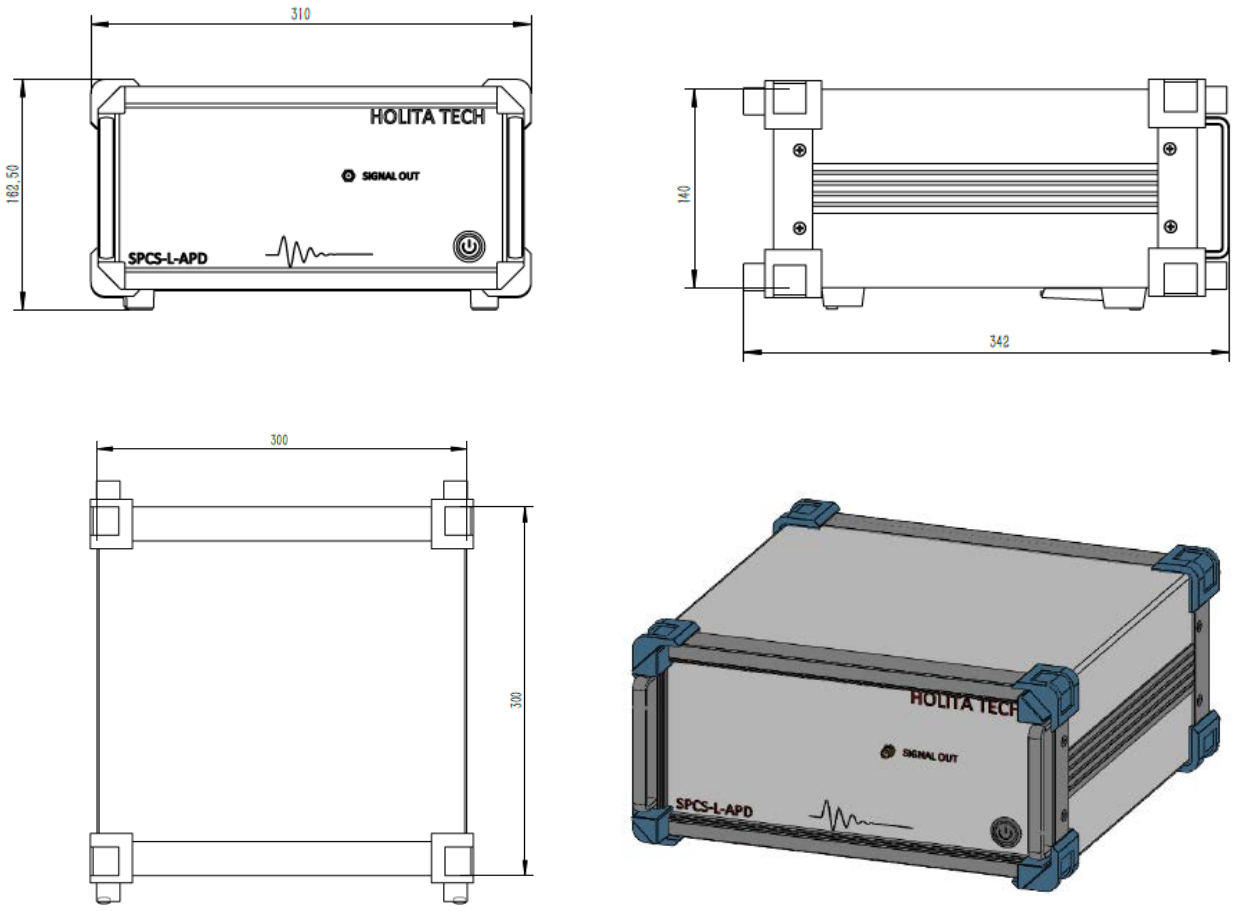


Figure 8 SPCM-L-APD Ordering Guide

SPCM - L - APD - X X X

Function name	Series name	APD type	Dark count	Attachment
		A: Green range B: NIR range	0 : 1500 cps 1 : 1000 cps 2 : 500 cps 3 : 250 cps 4 : 100 cps 5 : 50 cps 6 : 25 cps	0: NULL 1: FC Connector

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 2μs 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 counts 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-L-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 250 VAC or the polarity of the 220VAC 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. Custom designed products are available on request.