

Biophoton and EAV medical device BOM

Single photon detector

Option 1:

https://www.lasercomponents.com/fileadmin/user_upload/home/Datasheets/lc-photon-counter/count-blue-series.pdf



Dimensions: 102x76mm

Laser Components COUNT® series offers the best value for broad-range biophoton detection (~350 - 800 nm). It provides **exceptionally high QE across the visible spectrum (peaking >70% in the red)** along with **record-low dark counts** without requiring complex cooling.

Option 2:

[SPCM-AQRH Single Photon Counting Module](#)

Excelitas Technologies' recently-improved 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.



Enclosure:

1. <https://www.bopla.de/en/enclosure-technology/alu-topline>
2. ATPH-IP 2385-0300



Dimensions:

Power supply (medical grade, external):

Medical grade, low noise linear power supply that prevents pulsations and noise in the system, as well as interference that can pollute the biophoton signal.

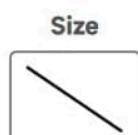
1. <https://www.osaelectronics.com/product/ulps3010a/>



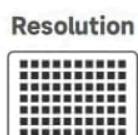
Dimensions:

Touchscreen options:

1. <https://www.amazon.de/GeeekPi-kapazitiver-Lautsprecher-Montage%C3%B6chern-Installieren/dp/B0DHV6DZC1>
2. <https://www.amazon.de/Waveshare-10-1inch-Capacitive-LCD-DSI/dp/B0BLZ5CSJQ>
3. <https://www.amazon.de/Waveshare-HDMI-LCD-kapazitiver-Videoeingang-schwarz/dp/B01CU7VX5Q>



10.1"



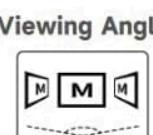
1280×800



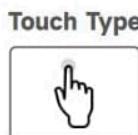
DSI
MIPI



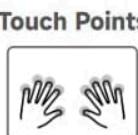
IPS



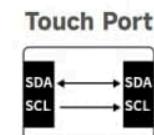
178°



Capacitive



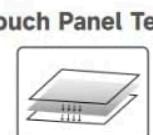
10-Point



I2C



Toughened Glass



Optical Bonding

Dimensions:

Central computer:

- Raspberry Pi 4 8GB
- Raspberry Pi - M.2 HAT+ for Raspberry Pi 5
- Raspberry Pi - M.2 NVMe SSD, 256GB

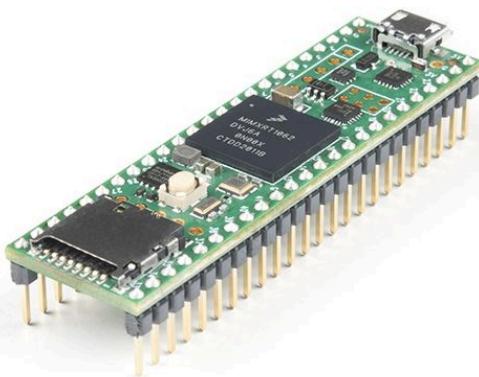
- Raspberry Pi 5 - Heat sink 40 x 30 x 5 mm, black



Dimensions: 86x57x17mm

Microcontroller Teensy 4.1

Teensy 4.1



Dimensions: 102x18x8mm

EAV (GSR) Sensor (op-Amp+ADC):

1. <https://de.aliexpress.com/i/1005005467354271.html> (10 euro)



Dimensions: 33x18x7mm

Pigtailed NIR laser

Custom 850 nm near-infrared (NIR) fiber-pigtailed laser diode with FC/PC connector and output power around 1 mW, suitable for applications requiring low power and fiber compatibility:

- **Wavelength:** 850 nm
- **Output Power:** 1 mW
- **Fiber Type:** Single-mode
- **Connector:** FC/PC, SMA
- **Fiber Length:** 2 m
- **Operating Voltage:** 5 V
- **Price:** €300.00
- <https://frlaserco.com/>

Dimensions: Ø16mm x 70mm

This laser diode is fiber-coupled and requires a 5V power supply. It's suitable for applications needing stable, low-power NIR sources.

Other components:

Rod coated with TiN (titanium nitride)

The “indestructible”, easy care, and established standard coating. Synonym of PVD. Not only wear protection, but also decorative with “high value” appearance.

 [TiN-en.pdf](#)



Fiber optics and connectors:

More detailed information about connectors layout -

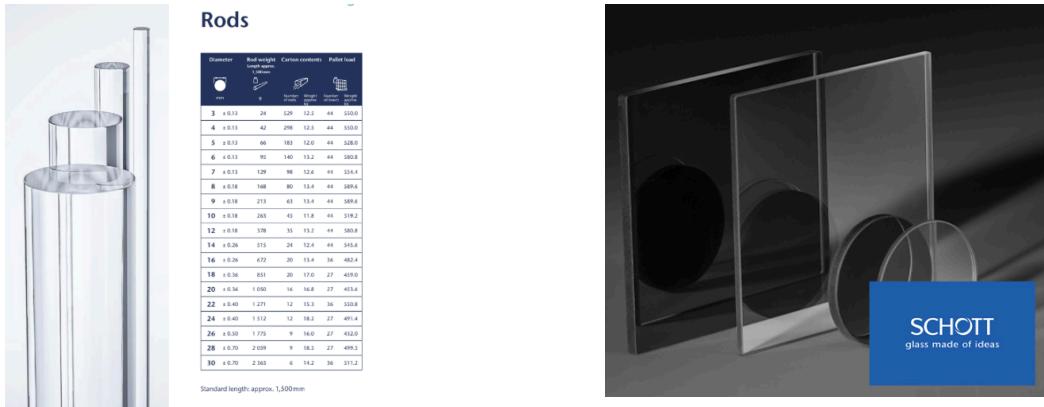
 [Optical connectors and routing strategy](#)

Glass rod and plate:

https://www.mt-berlin.com/frames_home/homefr_set_company.htm

<https://www.schott.com/de-de/kontakt>

<https://www.layertec.de/en/components/>



Justification for the components selected

Comparison of SPAD modules for Biophoton detection

Laser Components COUNT vs. Hamamatsu C13001-01 vs. Excelitas SPCM-AQRH

To evaluate suitability for **biophoton detection** in the ~200 - 800 nm range (UV to visible), we compare three single-photon avalanche diode (SPAD) modules on key factors: affordability, dark count rate, fiber (FC) connector availability, spectral range, quantum efficiency (QE), and output type.

The table below summarizes the comparison, followed by a brief discussion of which module offers the **best value** for sensitive photon detection in this wavelength range.

Comparison summary table

Feature	Laser Components COUNT® Series	Hamamatsu C13001-01	Excelitas SPCM-AQRH (FC)
Spectral Range	400–1000 nm lasercomponents.com (visible to NIR) Note: “BLUE” version extends down to ~350 nm	370–900 nm hamamatsu.com (covers some UV to NIR)	400–1064 nm farnell.com (visible to NIR)
Peak Quantum Efficiency	~70–75% at red (~650–670 nm); notably high QE in blue vs. other modules	~45% at 450 nm (peak sensitivity in blue).	>70% at 650 nm (peak) excelitas.com (≈65% typ. at 650 nm; lower at blue end).

Dark Count Rate (typical)	Ultra-low: Standard models < 20–250 cps, with special versions <10 cps (no TE cooling required).	Ultra-low: ~7 cps typ. (TE-cooled APD); max ~25 cps.	Low (selected): Available in graded versions from <25 cps up to ~1500 cps; a typical mid-range unit has ~100–250 cps dark count.
Fiber Connector	Yes – available with FC fiber adapter (optional) for coupling into ≤105 μm core fibers.	Yes – integrated FC fiber-coupling (built-in) to minimize coupling losses.	Yes – “-FC” versions include an FC/PC receptacle pre-aligned to the APD.
Output Type	TTL pulse output (digital pulses ~3 V into 50 Ω, ~15–17 ns width per photon)	TTL-compatible pulse output (integrated comparator yields digital count pulses)	TTL pulse output (≥2.5 V high into 50 Ω, ~10–15 ns width per photon detected)
Affordability	High-cost, specialized module (several \$k). <i>Price is comparable to Excelitas</i> for similar dark count specs.	High cost (advanced TE-cooled design likely at a premium price point).	High cost (industry-standard SPAD; a typical unit is on the order of \$5–7 k digikey.com).

All three are high-end photon counting modules; none is truly “low cost.” Lower dark-count bin selections (for Laser Components and Excelitas) command higher prices.

Note that **none of these Si-based SPADs is sensitive down to 200 nm** – the Hamamatsu module extends furthest into the UV (~370 nm minimum), whereas others cut off ~400 nm.

Best value for 200–800 nm Biophoton detection

Assuming each device is used in a configuration with average dark count performance and fiber-coupling, the **Laser Components COUNT® series** offers the best value for broad-range biophoton detection (~350 - 800 nm). It provides **exceptionally high QE across the visible spectrum (peaking >70% in the red)** along with **record-low dark counts** without requiring complex cooling. In practice, this means strong signal detection efficiency and low noise, which is ideal for ultra-weak biophoton signals, at a price comparable to other modules.

The **Hamamatsu C13001-01** excels in **UV/blue sensitivity and ultralow dark noise** (only ~7 cps thanks to TE cooling), making it very attractive for detection toward the lower end of the range. However, its peak QE is lower (~45%) and the added cooling complexity likely raises its cost. It is a superb performer for short-wavelength photon counting, but when balancing performance vs. price for the full 400–800 nm span, it may not outshine the COUNT module’s overall efficiency advantage in the visible region.

The **Excelitas SPCM-AQRH** is a proven, industry-standard SPAD module with **high peak efficiency** in the red and robust operation. It offers reliability and a similar feature set (FC coupling, TTL output, etc.), but its **sensitivity in the near-UV/blue region is lower** than the COUNT or Hamamatsu devices, and its cost remains high. Thus, for applications covering the broad 400–800 nm range, it delivers slightly less value if UV/blue photon detection is critical.

Conclusion: For general biophoton detection in the ~200–800 nm range, the **Laser Components COUNT series likely provides the best value**, given its combination of very high quantum efficiency across visible wavelengths, very low dark counts, and fiber-ready configuration. It achieves excellent sensitivity for weak signals without the need for expensive cooling. The Hamamatsu module is a strong contender for UV-enhanced applications requiring the absolute lowest dark noise, albeit at higher cost, while the Excelitas module remains a solid high-performance choice but doesn't surpass the COUNT series in cost-to-performance for this spectral range.

Chinese PMT and SPAD Suppliers

A curated selection of photomultiplier tube (PMT) and single-photon detector (SPAD) modules from trusted Chinese vendors on Alibaba:

Supplier Link	Product Description
 M2031 Photon Counting Metal Detector Module	Compact PMT module for photon counting applications.
 M1011 Photon Counting Detector Module	Integrated PMT-based single-photon counter with analog and TTL output.
 P25Pc High-Quality Photon Counting Photomultiplier Tube	High-sensitivity PMT designed for precise photon detection and low background noise.
 GOHI – PMT Module Product Group	Broad collection of PMT modules for OEM and scientific applications.
 M2011 Photon Counting PMT Module	Photon counting PMT with integrated power and signal output stages.

BOM list

Name	Quantity	Description	Price	Note
Raspberry Pi 4	1		64 Euro	
Raspberry Pi - M.2 HAT+ for Raspberry Pi 5	1		12 Euro	
Raspberry Pi - M.2 NVMe SSD, 256GB	1		32 Euro	
Raspberry Pi 5 - Heat sink 40 x 30 x 5 mm, black	1		3 Euro	
RPi 4 40pin cable M-F, F-F	1		3 Euro	
Teensy 4.1			38 Euro	https://www.pjrc.com/store/teensy41.html
Laser Components Count Blue	1	Option 1		COUNT-250C-FC: PSU 12V, Lemo-BNC adapter TTL output: LEMO/BNC adapter ABF.00.250.CTA.
SPCM-AQRH Single Photon Counting Module	1	Option 2		
CJMCU-6701 GSR Skin Sensor Module Sensor Module Analog SPI Measurement EDA GSR	1		7 Euro	
Mini embedded power Supply AMS1117 3.3 V	2		2x2.5=5Euros	
TXS0108E 8 Channel Logic Level Converter 3.3V 5V	1		5 Euro	
ATPH-IP 2385-0300 enclosure	1			
External power supply ULPS2250B 5x3.5x2	1			

<u>Laser module</u>	1		400Euro	
<u>SMA Female</u>	1		5 Euro	
<u>Banana EAV Male</u>	2		10Euro	
<u>Banana EAV Female</u>			5 Euro	short
<u>XT30 Power connector</u>	2		5 Euro	Optionally (TBD)

Theory:

[Photomultiplier HandBook](#)

References for the EAV:

<https://forum.arduino.cc/t/cjmcu-6701-gsr-sensor/565538> GSR SPI code

<https://github.com/biotronika/miniVOLL/blob/master/miniVOLL.ino> GSR measurements code

<https://projecthub.arduino.cc/biotronika/qiwellness-8dd7a6> mini Voll

<https://www.lioncircuits.com/parts/101020052> GSR (without ADC)

Other options:

Biophoton detectors:

1. Photosensor module with [PMT H10722-20](#)
2. [APD module C12702-12](#) this one is in range
3. [MPPC module C13852-3050GA](#)
4. [sCMOS cameras](#)
5. [Koheron High gain Light detector](#) not in wavelength range
6. Excelitas' optimized [SPCM-AQRH](#) detects single photons in the wavelength range from 400 nm to 1064 nm and offers performance that is far superior to other solid-state or vacuum tube-based photon counters.
7. [Single Photon Detector](#) (Ray-quant)
8. [Silicon Photomultiplier \(SiPM\) Amplified Detectors](#)

Temp

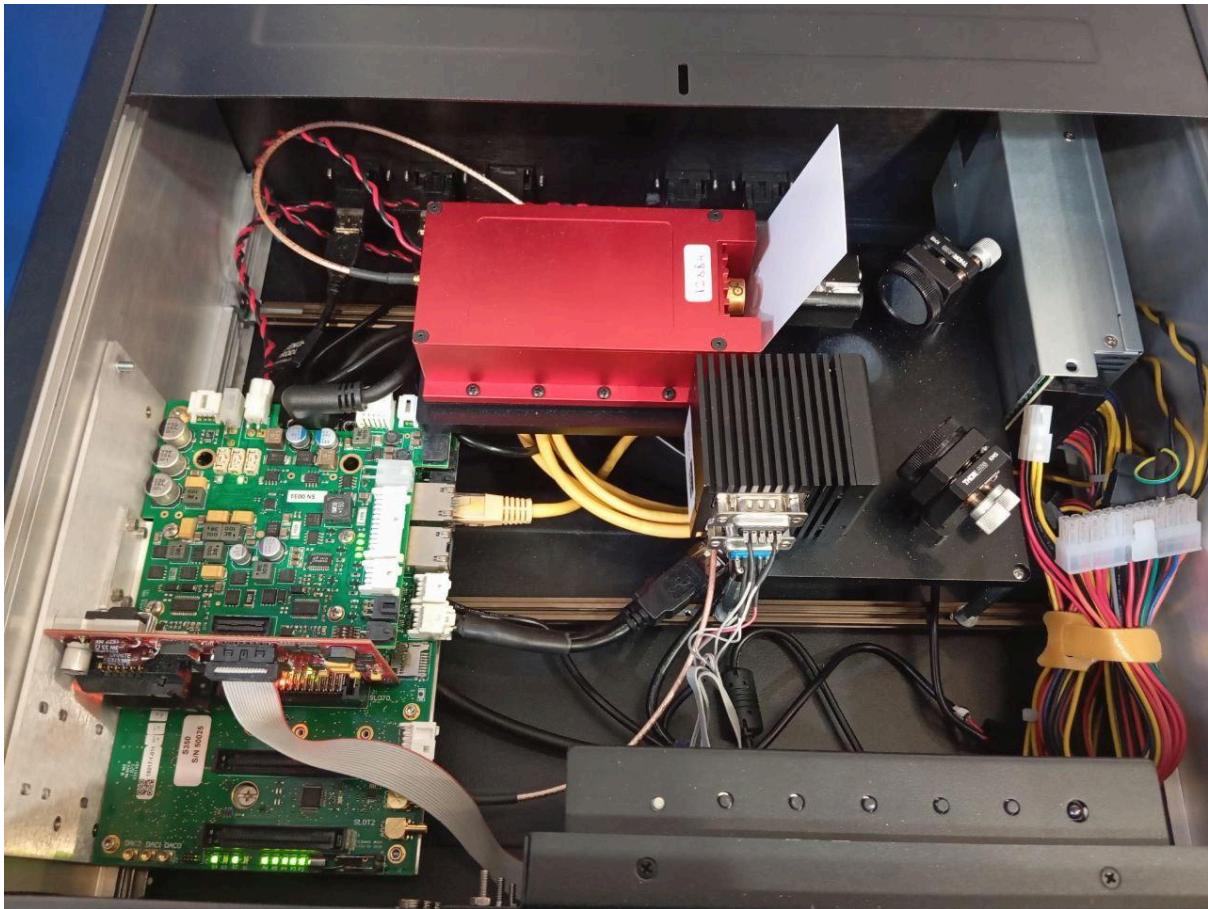
https://www.electromaker.io/shop/product/gsr-click?srsltid=AfmBOorHs5nuu_cMD4zy1GZ-ue_oLvyXbyPUvL4ES7kml0qBNCUbOpOk

<https://www.berrybase.de/seeed-grove-gsr-sensor?srsltid=AfmBOopB4bw8JYCvqZUJNlpdiyOXnWiBFvDbu8WIxEB-H5p0w2OENTht>

<https://www.posterus.sk/?p=11852>

Reference pictures:

1. Similar device



2. Power supply

