Detectors

Single Photon Counting Module COUNT® S Series User Manual

Table of Contents

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Introduction

Laser Components' COUNT® S series of single photon counting modules has been developed to offer a unique combination of high quantum efficiency, large active area and ease of use for photon counting applications. Combining Laser Components' SAP500 silicon avalanche photodiode with specially developed quenching and signal processing electronics, the module offers everything needed for single photon detection from 400 – 1000 nm. Incoming photons generate corresponding electrical pulses which may be conveniently read out at the TTL output. These TTL pulses can then be further processed by connecting the module to the quTAU which provides the possibility to count, time-tag and store the data via USB on a PC.

Operation

Handling single photon counting modules

The avalanche photon diode inside the COUNT® S is an extremely sensitive device. It can be permanently damaged by over-exposure to intense light.

The COUNT® S contains a high voltage supply. Users may be injured if the case is opened. All internal settings are pre-set; there are no user adjustments necessary. Opening the case will invalidate the warranty.

Excessive light level (e.g. daylight) might damage a powered COUNT® S. Precautions should be taken to avoid such situations or, alternatively, to monitor the count rate and eventually shut down the power to the COUNT® S.

When the COUNT® S detector is mounted on another instrument, ensure that the optical connection is light-tight.

Handle the COUNT® S detector with care. Do not drop it or expose it to excessive mechanical shocks or vibrations.

Heat Dissipation

In order to avoid damage to the module adequate heat sinking must be provided by placing or mounting the module onto a suitable heat sink, e.g. an optical table.

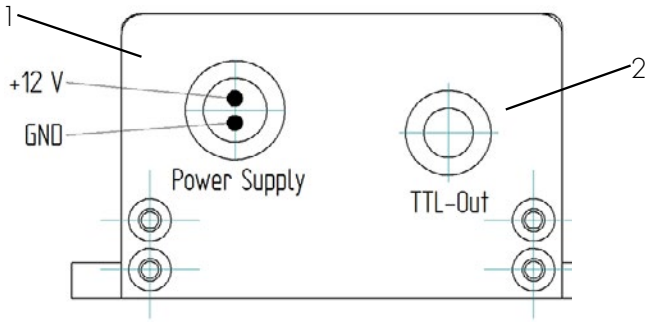
TTL output and power supply

Always switch off the module before connecting or disconnecting TTL output.

In order to not damage the APD it is recommended to put ferrite beads or ferrite clamp-ons on all cables leading to the APD. This includes TTL output and power supply input.

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Electrical connections (rear side)



1 - Power Supply (2-pin LEMO connector, type EXG.0B.302). This is for the optional +12V DC power adapter COUNT®-PSU (sold separately). Alternatively, the appropriate cable from the dual-SPAD power supply DSN 102 (PicoQuant) or from the COUNT®-PSU is connected here. The appropriate mating connector is the LEMO FGG.0B.302.CLAD42.

2 - TTL signal output (LEMO connector, type EPS-00.250). Use a double shielded RG223/U coaxial cable to connect his signal to e. g. the dual-SPAD power supply DSN 102 (PicoQuant). Suited Lemo connector types are e. g. FFS.00.250 or the Lemo/BNC adapter type ABF.00.250.CTA (supplied).

Note: the output should be terminated into a 50 Ohms load.

Powering up the module

Before powering up the module it is strongly advised to make sure that no light reaches the sensor.

In order to power up the module, simply plug-in the AC adapter in the power supply connector or, in case you are using the DSN 102 dual-SPAD power supply, turn on the DSN and power up the corresponding SPAD channel. After power on, allow 30 seconds settling time in which the sensor will be cooled down to its operating temperature.

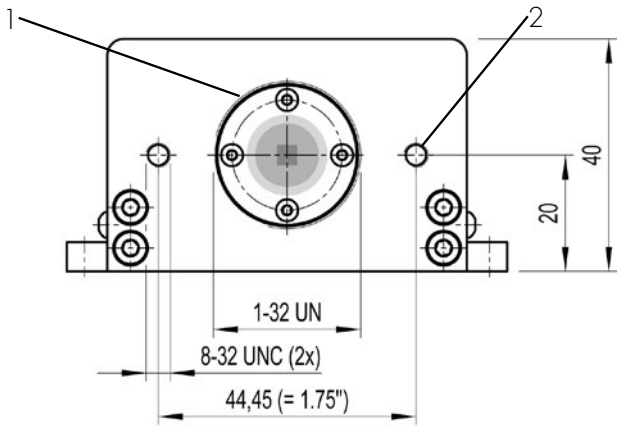
NOTE: the COUNT® S will not generate any output signal until the operating temperature has been reached.

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Mounting the Count-Module

The COUNT® S can be either mounted from the front-side or by using the dedicated mounting holes on the base plate.

Front-side



The front side of the COUNT® S provides two mounting options:

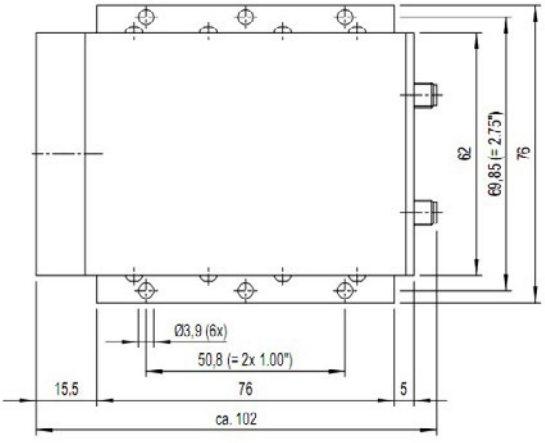
1 - a C-mount thread (1-32 UN), compatible with, for example, the LINOS tube system

2 - two mounting holes with 8-32 UNC thread, depth 8 mm.

Please note that you still have to support the weight of the detector when this mounting style is used!

Base plate

The base plate of the COUNT® S provides 6 mounting holes (3 holes each side) with a diameter of 3.9 mm.



Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Performance

Timing resolution

The single photon timing resolution of the COUNT® S depends on three factors and is generally different for every single module (please see the test report of your COUNT® S for details):

1. Detection wavelength - the best photon timing resolution (i. e. smallest FWHM) is generally achieved around 680 nm. The FWHM increases slightly towards blue and NIR detection wavelengths.
2. Focusing quality - for optimum timing resolution the light should be focused to a small spot (<50 µm) in the center of the sensor. Off-center focusing or overfilling the sensor area might lead to an increased FWHM of the photon timing resolution.
3. Counting rate - the FWHM of the photon timing resolution increases at high counting rates.

Correction factor

Every COUNT® S has an inherent dead time of approx. 700 ns after detecting a photon. During this dead time, the COUNT® S is "blind" and can not detect further photons. As a consequence, the measured counting rate is lower than the true actual counting rate. The true actual counting rate can be calculated from the measured counting rate as follows:

$$R_{actual} = \frac{R_{measured}}{1 - R_{measured} \cdot T_D}$$

where Ractual = actual counting rate

Rmeasured = measured counting rate

TD = SPAD dead time

The dead time effect can also be seen as a deviation from the unity of the ratio between the actual counting rate and the measured counting rate. Given a dead time and equation 1, it is possible to calculate a correction factor as a function of the measured count rate as shown in figure 2.

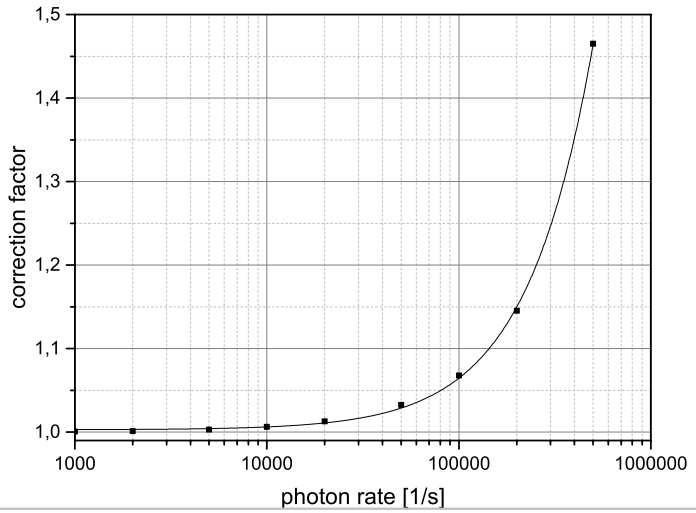


Fig. 2: Correction factor calculated for a dead time of 700 ns

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Technical Specifications for COUNT® S Module

Parameter	Min.	Typ.	Max.	Unit
Spectral range	400		1000	nm
Dark count rate COUNT-1000S COUNT-2000S COUNT-5000S			 1000 2000 5000	 Counts/s Counts/s Counts/s
Photon detection efficiency Pd[1] at: 405 nm 670 nm 810 nm	 - - -	 60 65 45		 % % %
Pd variation at constant temperature		TBC		%
Active area diameter (nominal) [2]		500		µm
Timing resolution		600		ps
Dead time	300	700	1500	ns
TTL output pulse length		22		ns
TTL output pulse amplitude (into 50 Ohm)		2		V
Delay between photon impact and TTL pulse		20		ns
Supply voltage	11.5	12.0	12.5	V
Supply current (switch on)		0.5		A
Supply current (operation at 100 Kcps)		0.15		A

[1] Specifications valid for modules without FC-connector

[2] Timing resolution depends on count rate and wavelength.

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Absolute Maximum Ratings

	Min.	Typ.	Max.	Unit
Supply voltage	11.5	12.0	12.5	V
Operating temperature	10		40	°C
Storage temperature	-20		70	°C
Count rate		500		Kcps

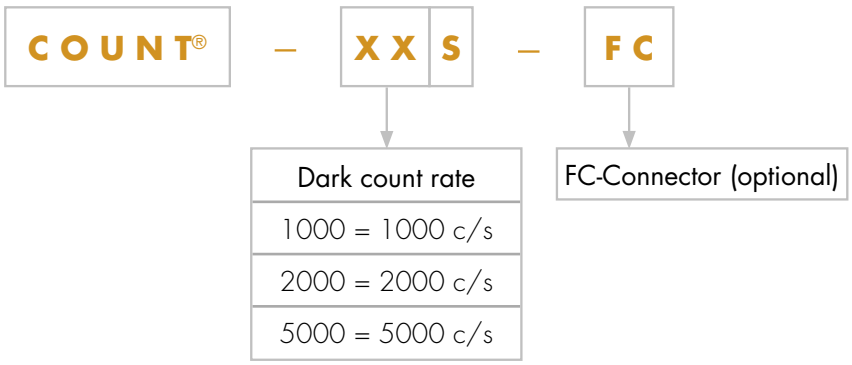
Fiber Connection Option

The COUNT®-XX-FC has a FC-style fiber-optic receptacle pre-aligned to the optical detector surface. The GRIN lens used in this assembly is optimized and AR-coated for the range 440 – 1000 nm.

Optical Fiber Shielding

To avoid stray light impinging on the detector and affecting the count rate, any optical fiber assembly attached to the FC connector must be completely opaque. LASER COMPONENTS offers suitably shielded optical fiber assemblies, please contact us for details.

Product Number Designations



Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Warranty

A standard 12-month warranty following shipment applies. Any warranty is null and void if the module case has been opened. Warranty is void if the module input exceeds 12.5 V.

ESD Information

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

Individual Module Test Data

Each module is supplied with test data indicating the module's actual dark count, dead time, photon detection efficiency @ 405 nm, 670 nm and 810 nm and afterpulsing probability.

Safety

The COUNT® S Series 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.

RoHS Compliance

The COUNT® S Series is designed and built to be fully compliant with the European Union Directive 2002/95/EC.

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

Support

Your COUNT® S module has undergone thorough testing at Laser Components. It is stable and reliable. Nevertheless, we continually make improvements that will be incorporated into future versions.

In any case, we would like to offer you our complete support. Please do not hesitate to contact Laser Components iif you would like assistance with your system. If you observe any errors, please e-mail a detailed description of the problem and relevant circumstances, to info@lasercomponents.com. Your feedback will help us to improve the product and documentation.

Of course we also appreciate good news. If you have obtained exciting results with one of our systems, please let us know, and where appropriate, mention us in your publications.

Retraction of old devices

Waste electrical products must not be disposed of with household waste. This equipment should be taken to your local recycling center for safe treatment.

WEEE-Reg.-No. De96457402

Product Changes

LASER COMPONENTS reserves the right to make changes to the product(s) or information contained herein without notice. No liability is assumed as a result to their use or application.

Ordering Information

Products can be ordered directly from LASER COMPONENTS or its representatives. For a complete listing of representatives, visit our website at www.lasercomponents.com

Custom designed products are available on request.

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com