Single Photon Counting Module
COUNT® NIR Series

Description

Laser Components' COUNT® NIR series of Single Photon Counting Modules low dark count rate, has been developed to offer a unique combination of high photon detection efficiency specially adapted to NIR region, wide dynamic range, low dark count rate and ease of use for photon counting applications. Combining LASER COMPONENTS' ultra-low-noise VLoK 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. The gating function allows the module to be disabled between measurements to provide protection against accidental overload. The optional FC connector provides a convenient method for connecting the module to the sample using a multimode optical fiber.

Features

- Extremely low dark count rates below 50 Hz
- Detection efficiency typ. 60 % at 810 nm
- Optional FC fiber connector
- Single 12 V DC supply operation
- Stable count rate (no bi-stability)

Applications

- Quantum technologies & cryptography
- Particle sizing fluorescence analysis
- LIDAR
- Spectroscopy
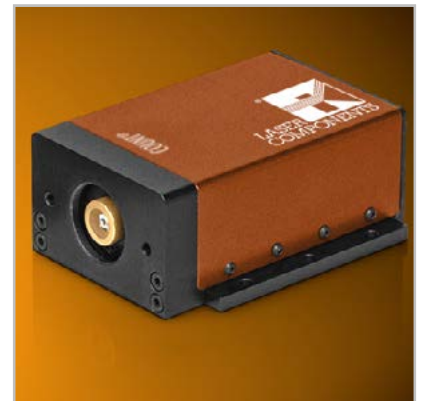
Technical Specifications for COUNT® NIR Module

Parameter	Min.	Typ.	Max.	Unit
Spectral range	400		1000	nm
Dark count rate COUNT-50N COUNT-100N COUNT-250N COUNT-500N			50 100 250 500	Counts/s Counts/s Counts/s Counts/s
Photon detection efficiency Pd[1] at: 405 nm 520 nm 670 nm 810 nm	 40 55 50	 10 50 70 60		% % % %
Pd variation with FC-connection		5		%
Pd variation at constant temperature		1		%
Dark count raate variation at constant temperature		5		%
Active area diameter (nominal) [2]		100		µm
Timing resolution [3]		1000		ps
Afterpulsing probability [4]		0.2	1	%
Dead time	42	45	48	ns
Gating input voltage Gating on (= disable module) Gating off (= enable module)		TTL low (<0.5) TTL high (>2.4)		V V
Gating input response time Gating on (= disable module) Gating off (= enable module)		15 60	20 65	ns ns
TTL output pulse length		15	17	ns
TTL output pulse amplitude (into 50 Ohm)		3		V
Delay between photon impact and TTL pulse		30		ns
Supply voltage	11.5	12.0	12.5	V
Supply current (switch on)		0.8		A
Supply current (operation at 1 Mcps)		0.2		A

[1] Specifications valid for modules without FC-connector

[2] The active area of the integrated Si-APD is larger than 100 µm.
The FC-version is optimised for optical fibers with core diameter <105 µm. The pre-aligned GRIN lens focuses the light onto a spot of <70 µm diameter in the centre of the detector. Please also see Fig. 2. The NA of the fiber used with the module is recommended to be ≤ 0.29.

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

[4] Defined for a time interval from 0 to 500 ns

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Absolute Maximum Ratings

	Min.	Typ.	Max.	Unit
Supply voltage	11.5	12.0	12.5	V
Operating temperature	10		40	°C
Humidity at 40 °C			85	%
Storage temperature	-20		70	°C
Count rate			20	MCounts/s

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.

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.

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.

Gating Function

The COUNT® module features a gating input provided as standard. This can be used for viewing a signal that occurs only in a small timeframe window, or in applications with very weak signals and higher background. The output of the module is disabled when a TTL low level is applied to the gate input. Applying a TTL high level will enable the module and permit photon detection. If the gate input is left unconnected, the module is enabled by default.

⚠️ Always switch off the module before connecting or disconnecting the gating input.

Warranty

A standard 12-month warranty following shipment applies. Any warranty expires if the module case has been opened. The 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, 520 nm, 670 nm and 810 nm, timing jitter and afterpulsing probability.

Safety

The COUNT®-Series contains a high voltage power supply. Users may be injured if the case has been 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®-Series is designed and built to be fully compliant with the European Union Directive 2011 / 65 /EU.

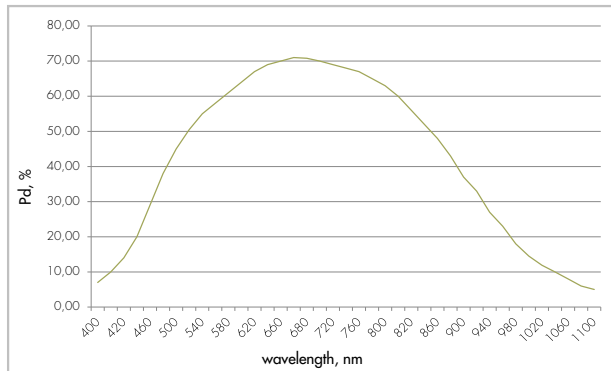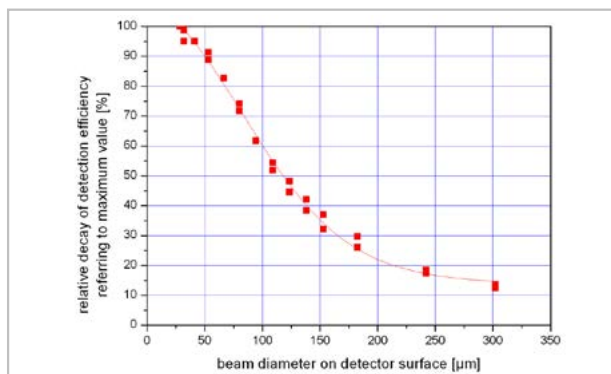Fig. 1: Typical photon detection efficiency (P$_d$) vs. wavelength

Fig. 2: Beam diameter on detector surface vs. relative
intensity of P$_d$ referring to maximum value at 670 nm

Saturation

The dead time limits the measurable count rate at high incoming light levels. The count rate at which the signal does not change significant by increasing incident photon number is called saturation level. Precautions should be taken to avoid prolonged excessive light levels that may damage the COUNT® module.

Correction Factor Non-Linearity

Every COUNT® has an inherent dead time of approximately 43 ns after detecting a photon. During this dead time, the COUNT® is „blind" and can not detect further photons. As a consequence, the measured counting rate is lower than the true incident photon rate. The photon rate can be calculated from the measured counting rate as follows:

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

where R_{photon} = actual incident photon rate

          $R_{measured}$ = measured count rate

          T_D = dead time of the module

The dead time effect can also be seen as a deviation from the unity of the ratio between the incident photon rate and the measured count rate (fig. 3).

The correction factor can be used to correct the non-linearity especially at high light levels.

$$Correction\ Factor = \frac{R_{photon}}{R_{measured}} = \frac{1}{(1 - R_{measured} * T_D)}$$

The following two figures demonstrate the effect of the dead time on the measured count rate and its correction factor.

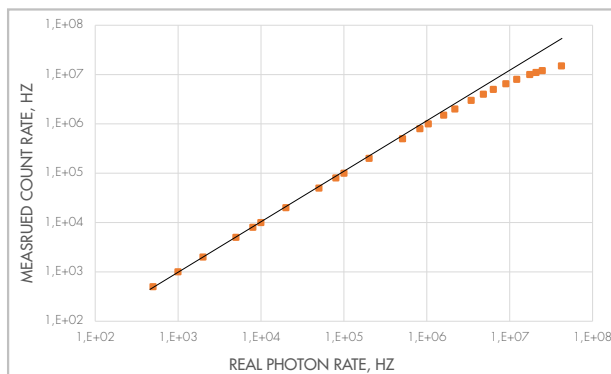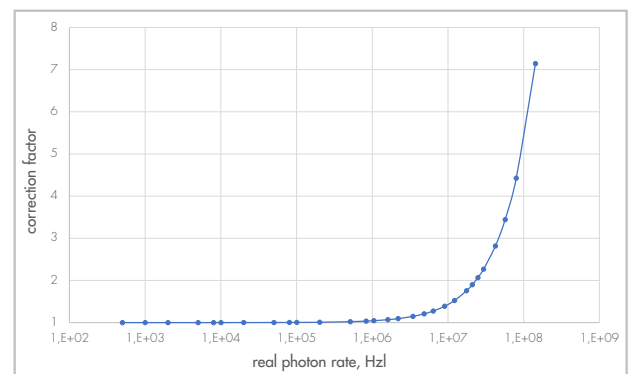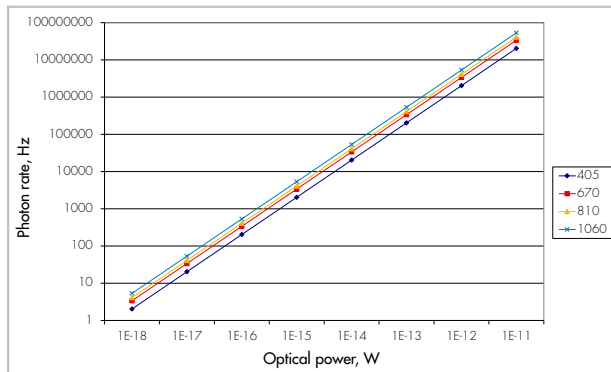Fig. 3: Measured count rate vs. actual photon rate for a dead time of 43 ns.

Fig. 4: Correction factor vs. photon rate for a dead time of 43 ns
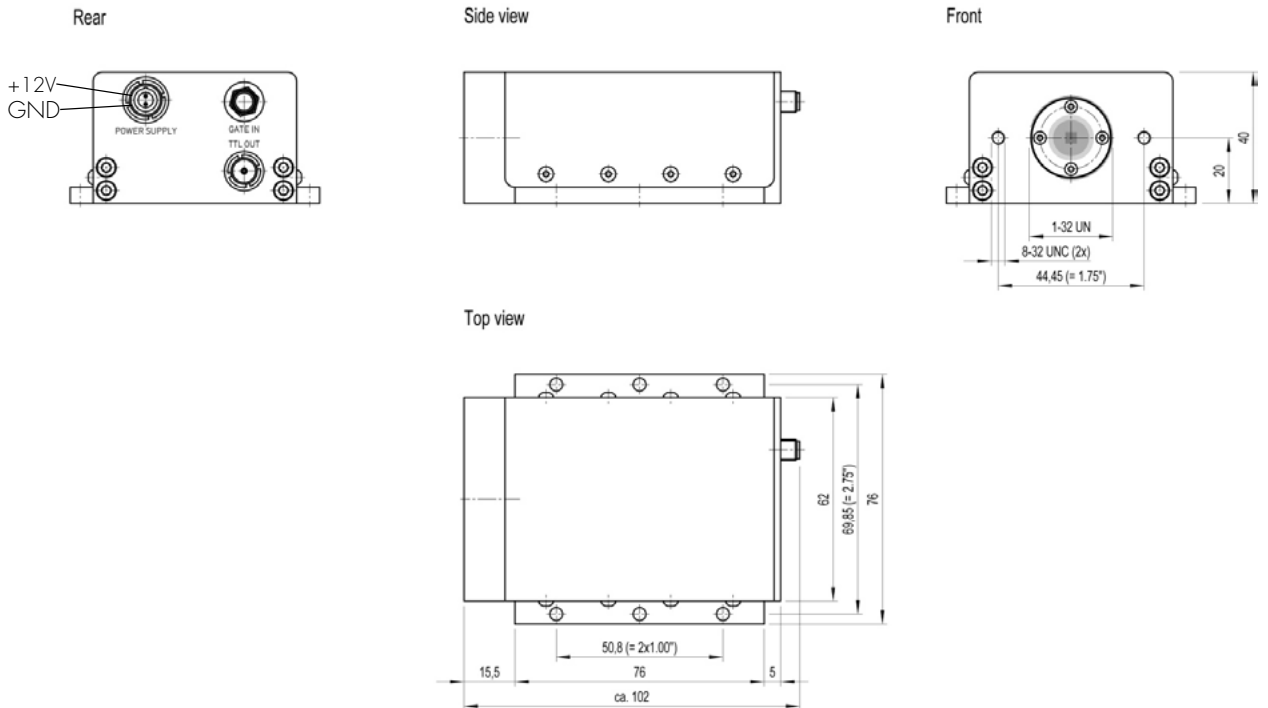
Photon Number vs. Optical Power

Single photon detection is applicable to the VERY Low Light Level (Very LLL). The following graph helps to understand the optical power level for which the actual single photon counting method is relevant.

Fig. 5: Photon number vs. optical power at different wavelengths (nm)

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Package Drawings

Free-Space Version

Rear

+12V
GND

POWER SUPPLY
GATE IN
TTL OUT

Side view

Front

40
20
1-32 UN
8-32 UNC (2x)
44,45 (= 1.75")

Top view

62
69,85 (= 2.75")
76
50,8 (= 2x1.00")
15,5
76
5
ca. 102

Distance from top of window to active area plane: typ. 1.35 mm
Dimensions in mm

Fiber Connector Version

Top view

62
69,85 (= 2.75")
76
15
FC Connector
50,8 (= 2x1.00")
15,5
76
5
ca. 102
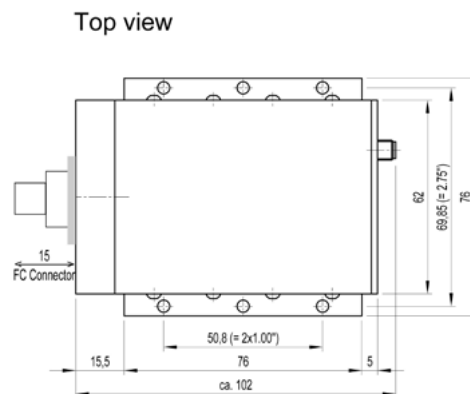
Interface Information

- Power Supply: LEMO connector, item number FGG.OB.302.CLAD42
  (optional COUNT® power supply is available upon request).
- Gate input: SMA connector
- TTL output: LEMO connector, compatible with LEMO/BNC adapter ABF.00.250.CTA. An optional LEMO-to-BNC adapter is available upon request
- Optical input (FC connector version): compatible with standard FC/PC-connector, suitable for fiber core diameters up to 105 µm.

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Product Number Designations

| COUNT® | — | X X N | — | F C |

Dark count rate

50 = 50 c/s

100 = 100 c/s

250 = 250 c/s

500 = 500 c/s

FC-Connector (optional)
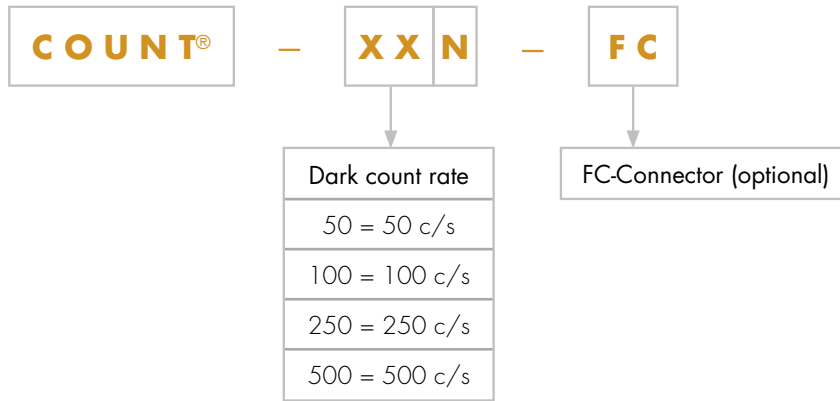
По вопросам продаж и продукции обращайтесь: