NV07SLN-DEV Small line sensor

Features

- **2×12 or 1×24 SPAD array**
- **Compatible with fiber bundles**
- **On-chip coincidence**
- **Up to 300 Mevents/s per SPAD**
- **External gate signal**
- **All digital outputs**
- **USB-C for power and data**

Applications

- **Quantum imaging**
- **Intensity interferometry**
- **Fast QKD**
- **Metrology**

Description

The NV07SLN-DEV small line sensor was developed for applications requiring single photon line detectors with low timing jitter. The device does not require any external threshold circuitry and provides an asynchronous digital output for every pixel. It is built around the NovoViz NV07SLN small line single-photon avalanche diode (SPAD) sensor. Accumulated counts are read over the single USB connection that also provides power.

The sensor combines the benefits of a SPAD pixel, namely the single-photon resolution and fast operating speeds, with the benefits of on chip recharge and threshold circuitry – high event rates and reduced noise.

The array can be reshaped instantaneously from one to two lines with a digital signal. In addition, the two lines can be combined through AND gates to provide coincidence detection capabilities. The two line pixel pitch was designed to match with off the shelf optical fiber bundles. The sensor is well suited for interferometry, quantum imaging and metrology, among others.

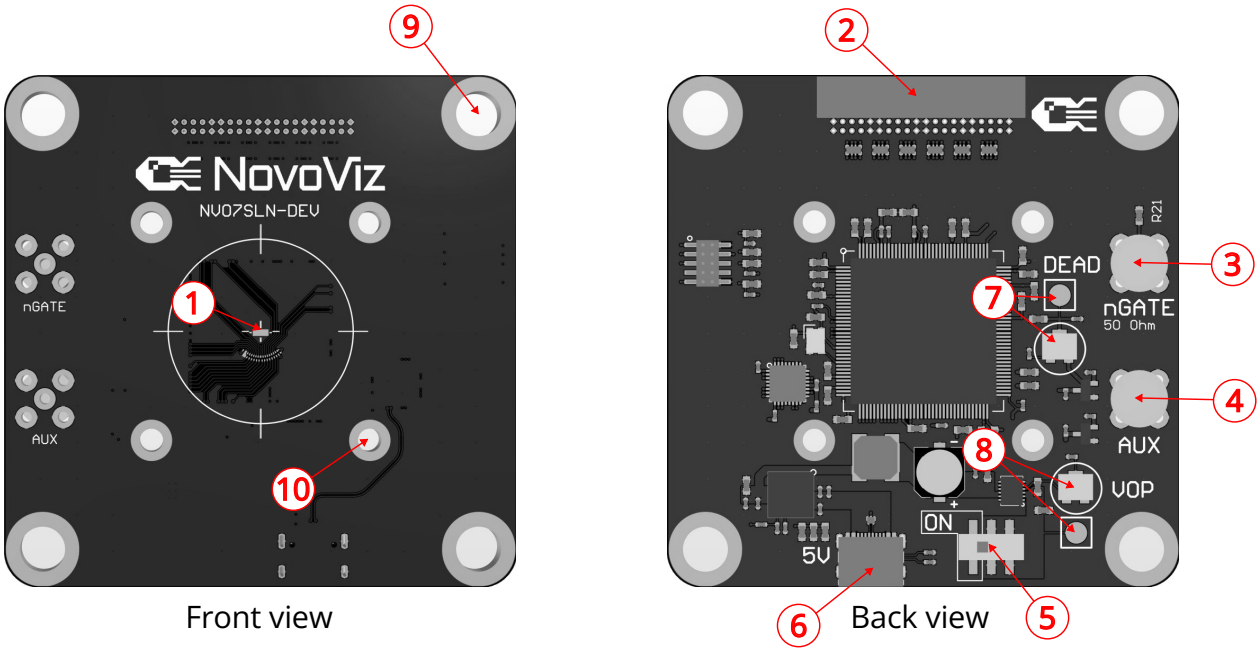
Contents

1 Absolute maximum ratings

		MIN	MAX	UNIT
V_{DD}	Supply voltage	4.5	5.5	V
V_{EX}	Excess bias voltage		3	V
P_{peak}	Peak power consumption		550	mW
T_A	Operating temperature	10	85	°C
E_{SPAD}	Single SPAD photon event rate		300	Mcps

2 Specifications

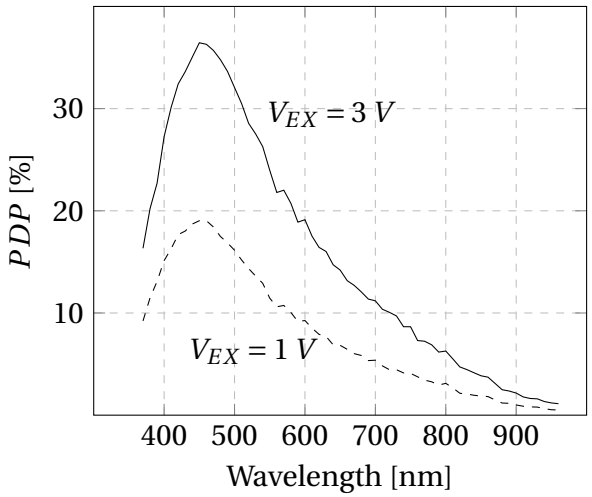
		COMMENT	MIN	TYP	MAX	UNIT
	Array format			2×12 1×24		pixels pixels
P_P	Pixel pitch	2×12 format 1×24 format		125 25		µm µm
P_Φ	Pixel sensitive area diameter			10		µm
V_{BRK}	SPAD breakdown voltage			20.2		V
PDP	Photon detection probability	λ=450 nm, V_{EX}=3 V			35	%
λ_W	Wavelength window	PDP>10%, V_{EX}=3 V	350		720	nm
DCR	SPAD dark count rate	T_A=27 °C, V_{EX}=3 V	20	75		cps
T_{DEAD}	SPAD deadtime		2.5		9.6	ns
T_W	Output pulse width			T_{DEAD}		ns
APP	Afterpulsing probability	T_A=27 °C, V_{EX}=3 V		1.9		%

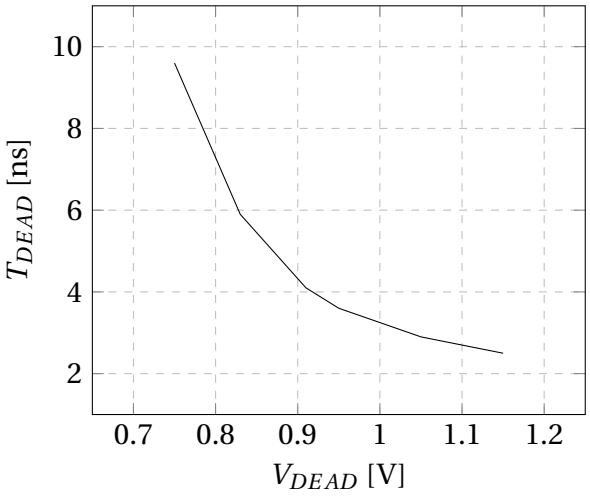


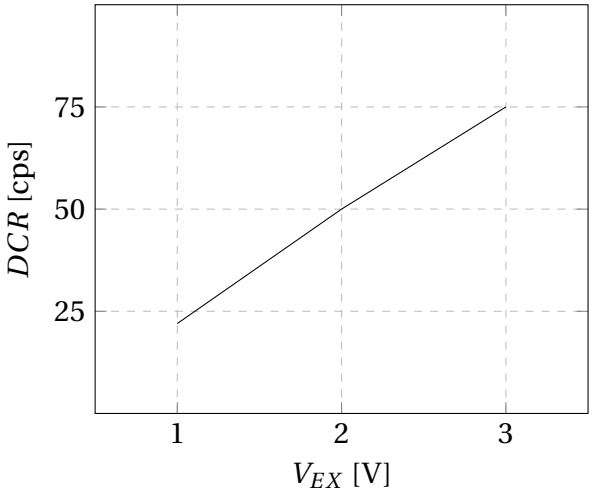
Front view Back view

ITEM	NAME	DESCRIPTION
1		NV07SLN
2	*BRK*	Breakout connector
3	*nGATE*	Gate signal input port. Active low. 50 Ω termination.
4	*AUX*	User-defined input/output port
5		SPAD power switch
6	*USB – C*	Data and 5 V input power port
7	*DEAD*	Dead time adjustment trimmer potentiometer and test point
8	*VOP*	SPAD bias adjustment trimmer potentiometer and test point
9		6 mm mounting holes for 60 mm cage systems
10		M3 mounting holes for 30 mm cage systems

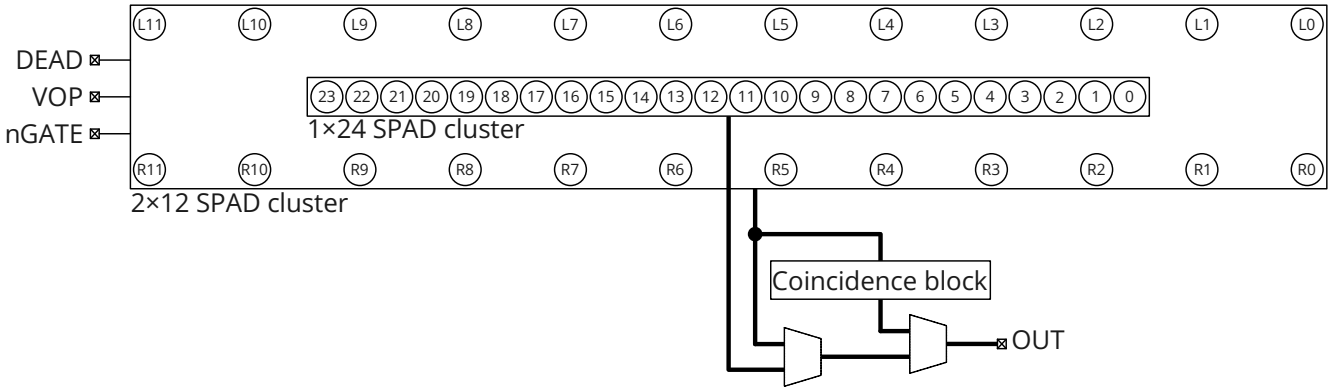
3 Typical characteristics







4 Detailed description



The NV07SLN-DEV system is a small line array of independent single photon counters based on the NovoViz NV07SLN SPAD sensor. It produces photon count histograms accumulated during a variable exposure period which can also be combined with an electronic gate signal. Additionally, the raw SPAD outputs are available at the breakout connector BRK.

The $nGATE$ input has a 50 Ω pulldown, keeping the pixels fully on when the port is left unconnected.

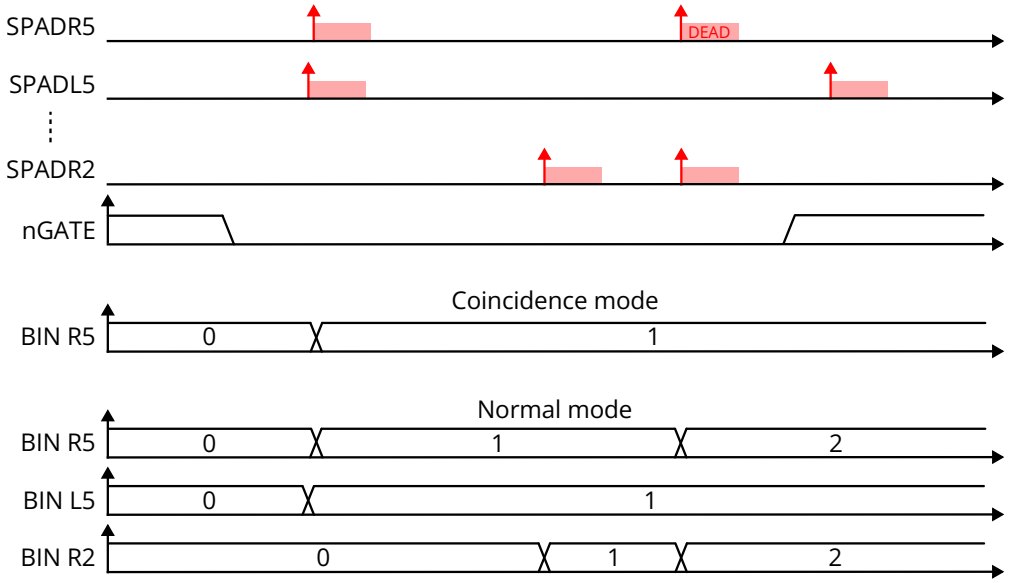
The sensor has two separate SPAD arrays, a 2×12 large pitch format designed to be coupled with optical fiber bundles, and a 1×24 small pitch format. The two-line array can be combined into a 1×12 format using AND gates to implement on-chip coincidence detection. In this mode, half of the SPAD outputs are kept at logic zero. The user can instantly switch between the two array formats and enable/disable the coincidence circuit by changing two electrical control signals.

The output pulse width for all pixels is equal to the SPAD dead time selected by the user. Each SPAD has an independent active recharge circuit with an adjustable dead time, controlled through an external voltage. The user can change this value by adjusting the $DEAD$ trimmer potentiometer on the board.

The board requires a single 5 V supply provided through the same USB-C connector used for data transfer. The SPAD bias voltage can be adjusted via the VOP trimmer potentiometer.

The BRK output is disabled by default to reduce power consumption. If used, the load should be buffered or the total output current kept under 10 mA.

5 Operation



The system requires a PC in order to configure the operation modes and recover the data. If requested, the firmware can be customized to enable the BRK port at start-up or set up default operating modes, allowing the system to function coupled with only external circuitry, without a PC connection.

The figure above shows normal operation of the NV07SLN-DEV system, assuming that the SPADs which are not shown do not generate any events and that the 2×12 array is selected. Two cases are shown, with the coincidence mode enabled and disabled. In the former, the corresponding bin increments only when simultaneous detections take place in the two corresponding SPADs. Two events are considered in coincidence if the time interval between them is less than $T_{DEAD} - 3$ ns. With the coincidence mode disabled, every bin increments if the corresponding SPAD has a photon event. In either case, the photons arriving when the $nGATE$ is disabled are ignored.

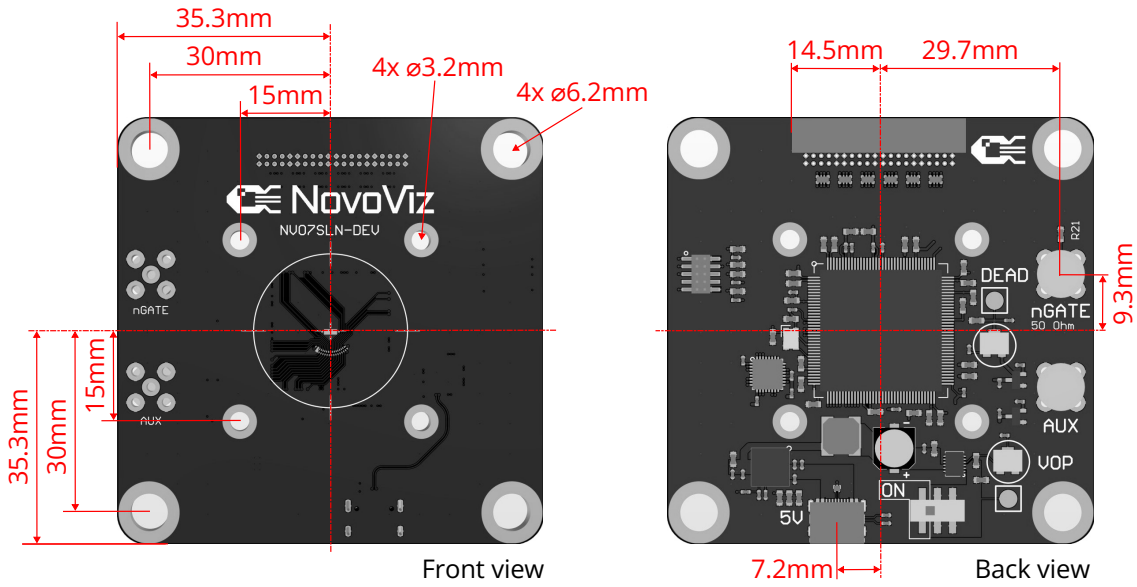
The switch on the back of the board should be in the OFF position when the power supply is turned on or off. This prevents damage to the SPAD pixels. It must be noted that the SPADs do not turn off instantaneously when the switch is moved to the OFF position after normal operation. A few seconds is needed for the decoupling capacitors to fully discharge below the SPAD breakdown voltage.

Adjusting the SPAD bias voltage with the VOP trimmer potentiometer should be done with the switch in the OFF position. The current bias voltage can be measured at the VOP test point.

Adjusting the SPAD dead time is done via the $DEAD$ trimmer potentiometer, with the control voltage available at the $DEAD$ test point.

The SMA auxiliary port AUX functions as a user-defined input/output. The default state is HiZ input.

6 Mechanical details



7 Resources

7.1 Documentation updates

The latest documentation can be found on the specific product page on www.novoviz.com. Please take note of the current document version and review the revision history included in the updated documentation.

7.2 Support

For inquiries please use the contact form on www.novoviz.com.

8 Ordering

Part number	Description
NV07SLN-DEV	Standalone board

The NV07SLN-DEV comes as a standalone board with the latest firmware. Visit www.novoviz.com to download the necessary software. There are no cables included.

9 Notice and disclaimer

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ESD caution

This device is vulnerable to damage from electrostatic discharge (ESD). NovoViz recommends that all devices be handled using proper ESD precautions. Failure to follow correct handling and installation procedures may result in damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits are often more susceptible, which may cause the device to fail to meet published specifications.

