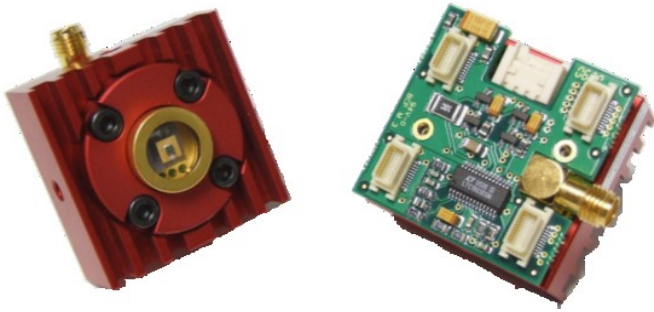


sensL



SPMMini High Gain APD Module

Overview



The SPMMini is a solid state alternative to the Photomultiplier Tube (PMT). It combines the high gain (10^6) and high quantum efficiency of the PMT with the well appreciated benefits of silicon including size, low operating voltage, robustness, reliability, magnetic field insensitivity, tolerance of excess/ambient light, and suitability for miniaturization. In addition, the detector has high signal to noise and fast timing properties.

The SensL SPMMini detector consists of a microcell array of Geiger mode Avalanche Photodiodes (APD), each individually coupled to integrated quench electronics, is known this is known as a Silicon Photomultiplier (SPM). The uniform high gain of the SPM allows the single photoelectron peaks to be clearly resolved permitting both single photon detection and measurement of the photon number.

The SensL SPMMini includes a transimpedance pre-amplifier, a Peltier cooler driver circuit to enable cooling to -20°C and integrated power supply as standard. A variety of add-on options to enhance functionality are provided, including C-mount (male) adapter and a fiber coupler (adapter and fiber cable included).

The detector is mounted on a two-state Peltier cooler and housed in a hermetically sealed TO8 can. During normal operation the SPMMini is cooled to -20°C . This allows greater performance over room temperature operation as the dark rate is reduced by over an order of magnitude. It is available with an active area of 1mm circular diameter or 3mm x 3mm (square) and with two different microcell sizes: $20\mu\text{m}$ and $35\mu\text{m}$.

The features and applications for the SPMMini detectors are summarized below. Whether you are an OEM or a researcher, and your application is a portable instrument or a high tier laboratory analysis instrument, the SPMMini will provide significant benefit over existing detector platforms.

Full Featured Silicon Photomultiplier Module for OEM and Research Applications

Features

- High gain (10^6)
- Operates from a single +5 Volt power supply (supplied)
- Low dark count rate (typically 10-100 KHz/mm²)
- High signal to noise ratio
- Not damaged by excess/ambient light
- Insensitive to magnetic fields
- Detector active area available from 1mm diameter to 9mm²
- Pre-amplifier simplifies system integration
- Compact, rugged, and stable module
- C-mount adapter (option)
- Fiber Coupler including connector adapter and lensed fibercable (option)
- 3-Year Extended Warranty (option)

Applications

- Fluorescence Lifetime Measurement
- Biological Sensors
- Scanning Microarrays
- DNA Biochips and Sequencing
- Proteomics and Protein Biochips
- Point-of-Use Biological Detection
- Confocal Microscopy
- Environmental Monitoring
- Homeland Security
- High Energy Physics
- Flow Cytometry
- Capillary Electrophoresis
- Range Finding

SPMMini Key Specifications

Parameter	Value	Units	Notes
Spectral Range (λ)	400-1100	nm	
Peak Spectral Response (λ)	490	nm	
Breakdown Voltage at -20°C	Typ. 27	V	Calibration sheet supplied with unit purchased
Microcell Gain	$\sim 1 \times 10^6$	-	
Operating Temperature	-20	$^{\circ}\text{C}$	Set at factory
Cooling Time	10	s	From room temperature
Temperature Setpoint Stability	-20 ± 0.1	$^{\circ}\text{C}$	
Max Storage Temperature	40	$^{\circ}\text{C}$	
Magnetic Sensitivity	2	T	Demonstrated insensitive on signal output up to 2T.
Supply Voltage	5 ± 0.1	V	200mA at normal operation, 700mA at startup for cooling. Wall mounted power supply included
Maximum Output Voltage	2	V	2V output swing across the dynamic range of the detector with integrated transimpedance preamplifier.

Typical Values	Part Number				Notes
	SPMMini 1020X08	SPMMini 1035X08	SPMMini 3020X08	SPMMini 3035X08	
SPM Pixel Active Area (mm)	$\varnothing 1$ (diameter)		3 x 3		1mm detector has circular active area 3mm detector has square active area
Number of Microcells per SPM Pixel	848	400	8640	3640	
PDE (%)	5-20				+1V to +4V above V_{br} . Module set to +2V at factory.
Dark Rate @ +2V (kHz)	15	18	400	510	Measured at -20°C and measured at 0.5 p.e. threshold
Temp. Dependence of V_{br} (mV/ $^{\circ}\text{C}$)	23				
Single Photon Pulse (ns)	5-10	5-10	10-15	10-15	Leading Edge (typ.) using TIA pre-
Single Photon Pulse (ns)	40-150	40-150	40-150	40-150	Falling Edge (typ.) using TIA pre-amp.

NOTE: SENSL RESERVES THE RIGHT TO CHANGE ALL PRODUCT SPECIFICATION AND FUNCTIONALITY WITHOUT NOTIFICATION. INFORMATION ON THIS DATASHEET IS BELIEVED TO BE ACCURATE, HOWEVER, NO RESPONSIBILITY IS ASSUMED FOR ANY INACCURACIES OR OMISSIONS.

Ordering Information

PRODUCT CODE	DESCRIPTION
SPMMini1020X08A1	SPMMini1000 series, 20 μ m (848) microcells, 1mm (circular) sensor, TO8 Package, Peltier TEC with Peltier Cooling, Heat Sink, Transimpedance Amplifier and Power Supply Board
SPMMini1035X08A1	SPMMini1000 series, 35 μ m (400) microcells, 1mm (circular) sensor, TO8 Package, Peltier TEC with Peltier Cooling, Heat Sink, Transimpedance Amplifier and Power Supply Board
SPMMini3020X08A1	SPMMini3000 series, 20 μ m (8640) microcells, 3mmx3mm sensor, TO8 Package, Peltier TEC with Peltier Cooling, Heat Sink, Transimpedance Amplifier and Power Supply Board
SPMMini3035X08A1	SPMMini3000 series, 35 μ m (3640) microcells, 3mmx3mm sensor, TO8 Package, Peltier TEC with Peltier Cooling, Heat Sink, Transimpedance Amplifier and Power Supply Board
Options	
CMNT1	Option: C Mount Adapter (Male)
SPMF1	Option: SPM Fiber Coupler (FC, 400 μ m core)
SPMF3	Option: SPM Fiber Coupler (SMA, 400 μ m core)
SPMMini-W	Option: SPMMini 3-Year Extended Warranty

SPMMini Electronics

Transimpedance (TIA) Preamplifier Board

The transimpedance preamplifier converts the raw current from the SPM into a voltage and is primarily recommended for signal detection where, in addition to the high frequency components, the signal contains DC and low frequency components. The typical gain for a SensL transimpedance amplifier is matched to provide a 2V output swing across the dynamic range of the detector. This board is ideal for applications that require detection of continuous signals where integration of the signal is done over time.

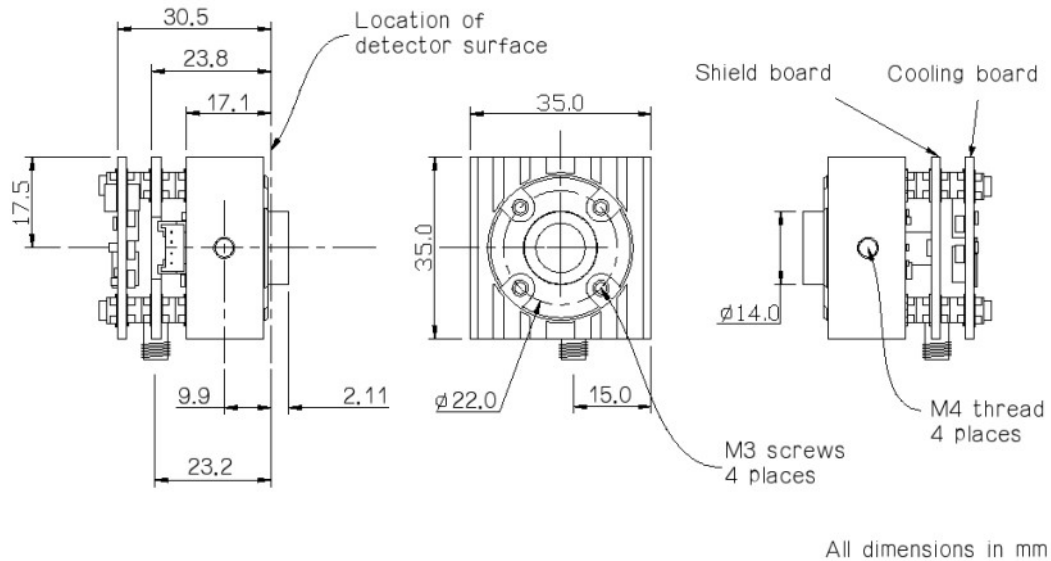
Cooling Board

The SPMMini as standard has cooling electronics for reducing the temperature of the sensor to -20°C . Cooling is achieved with a two-stage TEC Peltier cooler controlled by the add-on board which connects directly onto the SPMMini or main module. A pulse width modulator is used to maintain a stabilized temperature to within 0.1°C based upon feedback from a thermistor situated beside the SPMMini in the hermetically sealed TO8 can. The module features current soft-start for controlled start-up to prevent high current in-rush and an output slew rate limiter to reduce system noise. The cooling board snaps onto the main module quench board. The drawing shows the dimensions of the module combined with the cooling board.

Power Board

The power supply board simplifies the input power requirements of the SPMMini. Instead of the requirement for the user to supply separate voltages +5V, -5V and bias voltage the power board included as standard with SPMMini only requires a single +5V input and generates the other two voltages. The power module plugs onto the bottom of the SPMMini module to neatly distribute power. An input jack socket enables power to be input from the supplied by a 5VDC mains adapter or a bench supply. The bias voltage is optimally set during production however details of how to adjust the bias voltage via a potentiometer are available upon request.

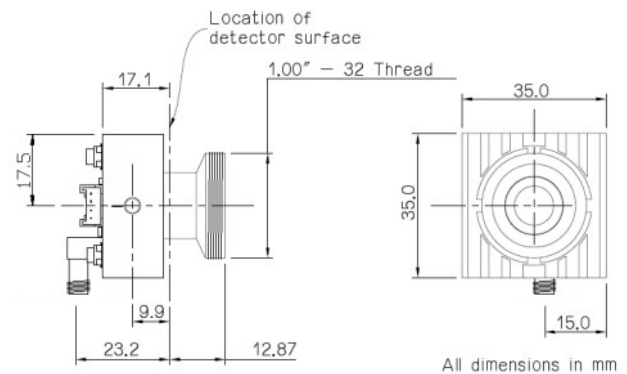
Mechanical Information



SPMMini Product Options

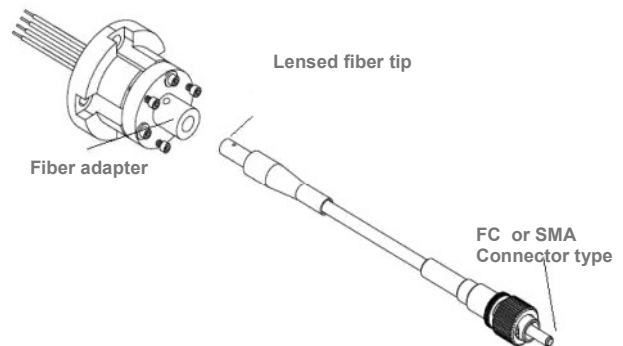
C Mount Adapter

A C Mount Adapter option is available that attaches to the collar around the TO8 can and facilitates the attachment of various standard C Mount fittings, including filters and lenses. This is an ideal solution for attaching light collection lenses.



Fiber Coupler

SensL offers the following pigtail lens style photodiode to multimode (MM) fiber coupler to couple light signals from a source via MM glass fiber to SPMMini1020X08A1 and SPMMini1035X08A1 modules. A universal receptacle is mounted onto the collar of the SPM module which allows different fiber types and specifications depending on the application requirements. The standard option at present uses a 400mm glass core with SMA or FC connector. The fiber output facet to the detector is tipped with a focusing lens for optimal coupling onto detector. This approach offers a "plug and play" solution for any fiber type, which can be specified when placing your order. Details of current fiber specifications are available on the SensL website under Product Options.



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