

sensL



SPMMicro

Low Cost High Gain APD

Overview



Silicon Photomultiplier (SPM) Technology

SensL's SPMMicro series is a High Gain APD provided in a variety of miniature, easy to use, and low cost packages. The SPMMicro detector series is suitable for applications requiring high sensitivity, low noise detection in the visible to near IR range. The SPMMicro series is a solid-state detector sensitive to single photons. The detector consists of an array of Geiger Mode. Avalanche Photodiodes (APDs) or microcells, each individually coupled to integrated quench electronics. It is a type of detector referred to as a Silicon Photomultiplier (SPM). The SPMMicro combines high gain and quantum efficiency characteristics comparable to Photomultiplier Tube (PMT) detectors with the additional benefits of silicon technology such as compact size, magnetic field insensitivity, low operating voltage, robustness, and tolerance to overexposure.

Geiger Mode APDs have extremely high internal amplification that allows single photon sensitivity at room temperature. The output of a Geiger Mode APD is an identical, fixed charge or current pulse for each single photon detected. By connecting an array of Geiger Mode APDs (microcell) in parallel, the summed output becomes proportional to the number of Geiger Mode pulses and hence proportional to the incident photon flux. SensL offers three detector sizes for the SPMMicro series: a circular 1mm diameter, square 3mm x 3mm active area, and a square 6mm x 6mm active area.

Each detector size is offered with a variety of microcell design sizes, 20µm, 35µm, 50µm and 100µm.

Applications

The SensL SPMMicro detectors have been designed to meet a variety of applications and environmental conditions

- Biological Sensors
- DNA Biochips and Sequencing
- Scanning Microarrays
- Proteomics and Protein Biochips
- Point-of-Use Biological Agent Detection
- Environmental Monitoring
- Nuclear Radiation Detection
- Homeland Security
- Flow Cytometry
- Range Finding/Targeting/LIDAR
- Food Monitoring and Inspection
- High Energy Physics

Features

- Spectral Range – 400nm to 1100nm
- Detection Area – 1mm diameter, 9mm² and 36mm²
- Photon Detection Efficiency (PDE) – 5-20%
- Signal to Noise: Superior S/N to standard APDs
- Sensitivity – High Gain Responsivity device (10⁶).
- Photon Sensitivity – Single photon level sensitivity.
- Bandwidth – High Bandwidth up to 20MHz.
- Timing – <100ns pulse widths.
- Noise – Typical 1MHz/mm² at RT, <50kHz at -20°C.
- Bias Operation – Low Voltage operation, <30V.
- Packaging – Hermetically Sealed TO-can Package or ceramic submount with epoxy encapsulation.
- Readout Electronics – SPMA4 low noise transimpedance amplifier & integrated power supply.
- Form Factor – Small size, with minimal working distance on all package designs.

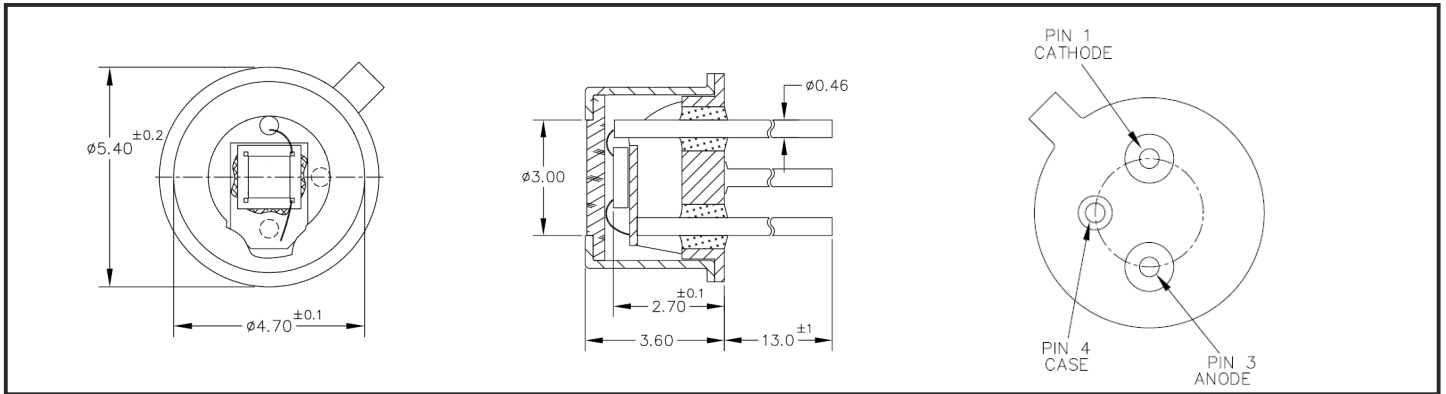
SPMMicro Key Specifications

Detector Parameter	1mm SPMMicro				3mm SPMMicro			6mm SPMicro	
	1020	1035	1050	1100	3020	3035	3050	6035	6050
SPM PIXEL ACTIVE AREA	Ø1MM				2.85MM X 2.85MM			ARRAY OF 2X2 3020 OR 3050 DIE	
NUMBER OF MICROCELLS PER SPM	848	400	216	74	8640	3640	2112	14560	8448
PDE (%) MEASURED @+2V ABOVE V _{br} @ λ _{PEAK}	9	13.5	15.5	19	Note: PDE CAN BE VARIED DEPENDING ON APPLICATION BETWEEN +1V TO +5V ABOVE V _{br}				
DARK RATE (MHz) MEASURED @+2V ABOVE V _{br}	0.8	1-1.5	1.3	-	Note: TYPICAL MEASURED RT AND TAKEN AT 0.5 P.E. THRESHOLD.				
DARK RATE (kHz) MEASURED @+2V ABOVE V _{br}	30	50	60	-	Note: TYPICAL MEASURED -20C AND TAKEN AT 0.5 P.E. THRESHOLD.				
SPECTRAL RANGE (λ)	400-1100nm								
RESPONSIVITY (ka/W)	25-100 Note: VARIES WITH DETECTOR MICROCELL SIZE AND BIAS								
PEAK SPECTRAL RESPONSE (λ)	490nm								
GAIN	>1X10 ⁶ [Note: GAIN INCREASES LINEARLY WITH OVERBIAS]								
SINGLE PHOTON PULSE (ns)	5-15 DEPENDING ON DEVICE [Note: LEADING EDGE (TYP.) USING TIA PREAMP]								
SINGLE PHOTON PULSE (ns)	40-150ns DEPENDING ON DEVICE [Note: FALLING EDGE (TYP.) USING TIA PREAMP]								
BREAKDOWN VOLTAGE (V _{br})	TYPICALLY V _{br} = 28V [Note: TEST SHEET PROVIDED WITH EACH DETECTOR]								
OPERATING VOLTAGE	TYPICALLY @ +2V ABOVE V _{br} [Note: SEE TEST SHEETS FOR DETECTOR DETAILS]								
OPERATING TEMPERATURE	TYPICAL ROOM TEMPERATURE OPERATION [Note: COOLING CAPABILITY WITH TO8 PACKAGE—SEE SPMMINI DATASHEET.]								
MAX STORAGE TEMPERATURE (C)	40								
EPOXY: REFRACTIVE INDEX	1.5318 AT 589nm (APPLIES ONLY TO CERAMIC PACKAGES)								
EPOXY: SPECTRAL TRANSMISSION	>98% AT 550-900 (APPLIES ONLY TO CERAMIC PACKAGES)								

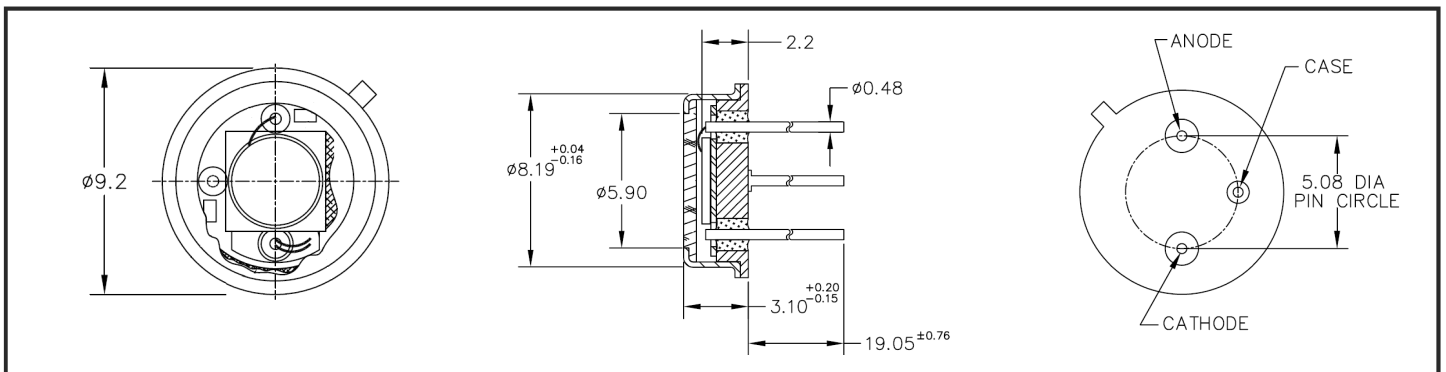
Note: SensL reserves the right to change all product specification and functionality without notification. Information on this datasheet is believed to be accurate, however, no responsibility is assumed for any inaccuracies or omissions.

Mechanical Information (TO Package Formats)

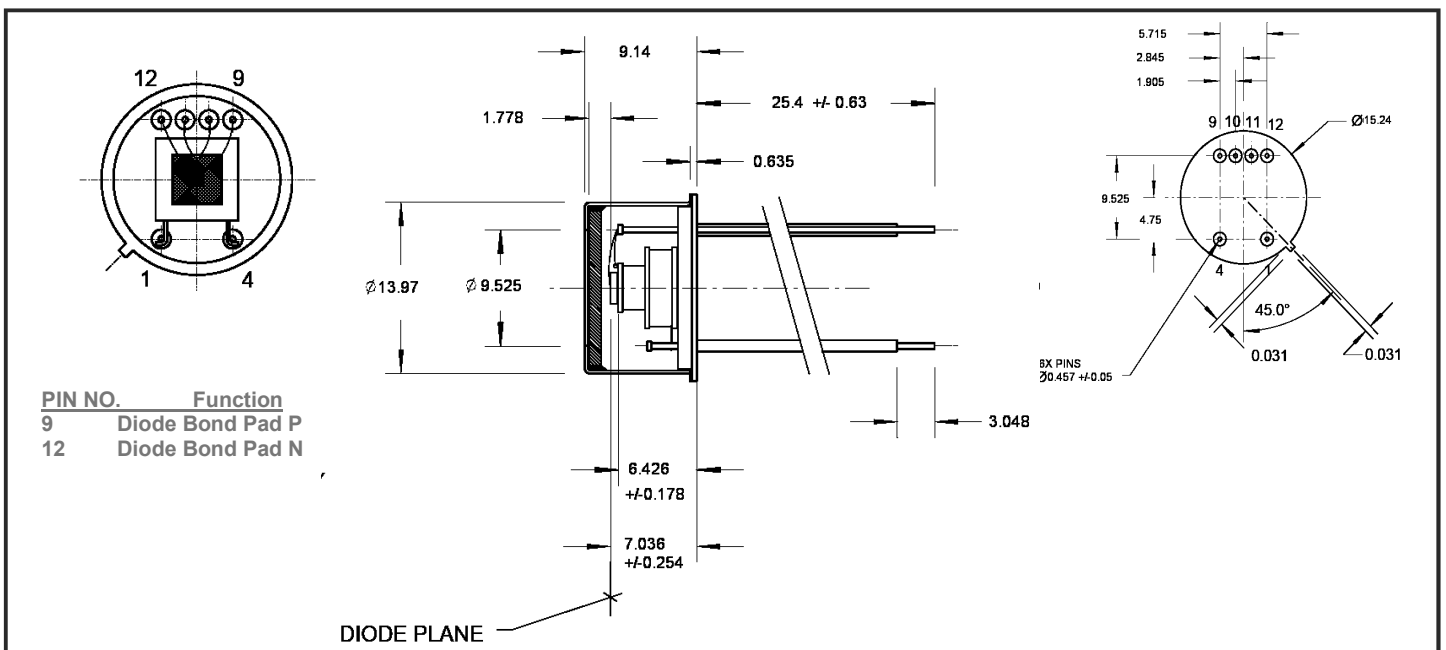
SPMMicro 1000 series TO46 Header (TO18/TO52 cap) Package



SPMMicro 3000 series TO5 Package



SPMMicro 1000 and 3000 series TO8 Package



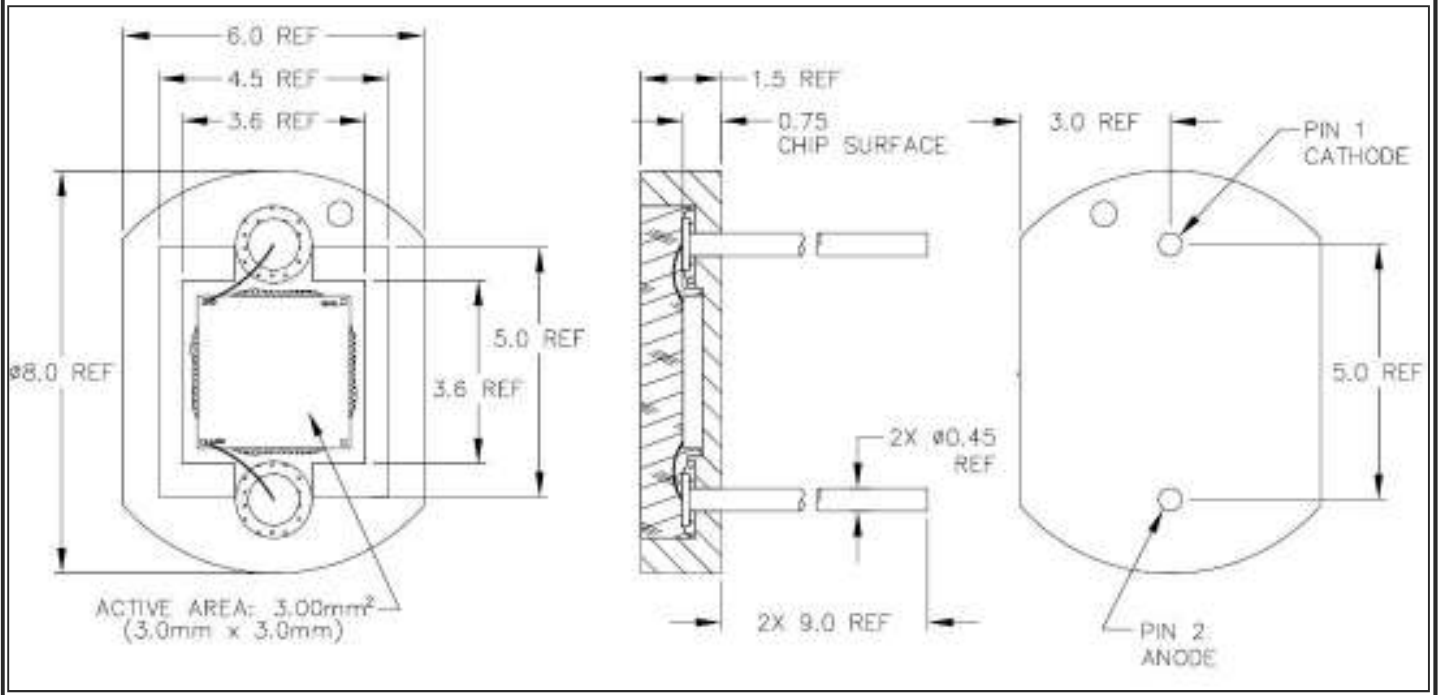
All dimensions shown in mm

Mechanical Information (Ceramic Package)

SPMMicro1000 and 3000 series x13 Ceramic Package

(2 pin TO5 pin compatible package, available with 1mm and 3mm detector.)

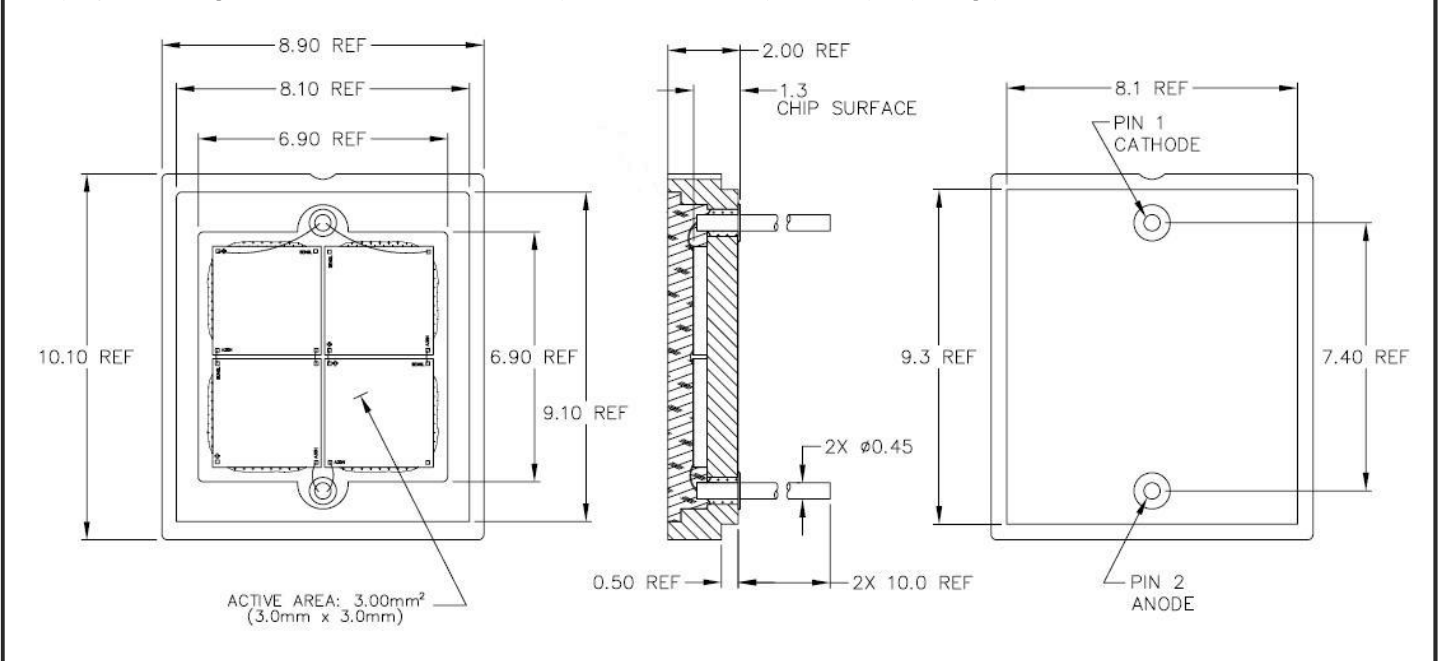
The epoxy die coverage is <math><250\mu\text{m}</math> from top of detector surface plane to top of package).



SPMMicro 6000 series x13 Ceramic Package

(2 pin TO5 pin compatible package, available with 3mm detectors mounted in 2x2 configuration. The die butted into the package together into a ceramic package and orientated for parallel connections between pixels.)

The epoxy die coverage thickness is 600 ±50mm from top of detector surface plane to top of package).



Product Number	Description
SPM1000 Series	Ordering Information
SPMMicro1020X08	SPMMicro1000: Silicon Photomultiplier, 20 μ m (848 microcells), 1mm diameter circular, TO8 Can, Peltier TEC
SPMMicro1020X18	SPMMicro1000: Silicon Photomultiplier, 20 μ m (848 microcells), 1mm diameter circular, TO46 Package
SPMMicro1020X13	SPMMicro1000: Silicon Photomultiplier, 20 μ m (848 microcells), 1mm diameter circular, Ceramic Package, Epoxy Fill
SPMMicro1035X08	SPMMicro1000: Silicon Photomultiplier, 35 μ m (400 microcells), 1mm diameter circular, TO8 Package, Peltier TEC
SPMMicro1035X18	SPMMicro1000: Silicon Photomultiplier, 35 μ m (400 microcells), 1mm diameter circular, TO46 Package
SPMMicro1035X13	SPMMicro1000: Silicon Photomultiplier, 35 μ m (400 microcells), 1mm diameter circular, Ceramic Package, Epoxy Fill
SPMMicro1050X08	SPMMicro1000: Silicon Photomultiplier, 50 μ m (216 microcells), 1mm diameter circular, TO8 Can, Peltier TEC
SPMMicro1050X18	SPMMicro1000: Silicon Photomultiplier, 50 μ m (216 microcells), 1mm diameter circular, TO46 Package
SPMMicro1050X13	SPMMicro1000: Silicon Photomultiplier, 50 μ m (216 microcells), 1mm diameter circular, Ceramic Package, Epoxy Fill
SPMMicro1100X18	SPMMicro1000: Silicon Photomultiplier, 100 μ m (74 microcells), 1mm diameter circular, TO46 Package
SPMMicro1100X13	SPMMicro1000: Silicon Photomultiplier, 100 μ m (74 microcells), 1mm diameter circular, Ceramic Package, Epoxy Fill
SPM3000 Series	Ordering Information
SPMMicro3020X08	SPMMicro3000: Silicon Photomultiplier, 20 μ m (8640 microcells), 3mm x 3mm sensor, TO8 Package, Peltier TEC
SPMMicro3020X05	SPMMicro3000: Silicon Photomultiplier, 20 μ m (8640 microcells), 3mm x 3mm sensor, TO5 Package
SPMMicro3020X13	SPMMicro3000: Silicon Photomultiplier, 20 μ m (8640 microcells), 3mm x 3mm sensor, Ceramic Package, Epoxy Fill
SPMMicro3035X08	SPMMicro3000: Silicon Photomultiplier, 35 μ m (3640 microcells), 3mm x 3mm sensor, TO8 Package, Peltier TEC
SPMMicro3035X05	SPMMicro3000: Silicon Photomultiplier, 35 μ m (3640 microcells), 3mm x 3mm sensor, TO5 Package
SPMMicro3035X13	SPMMicro3000: Silicon Photomultiplier, 35 μ m (3640 microcells), 3mm x 3mm sensor, Ceramic Package, Epoxy Fill
SPMMicro3050X08	SPMMicro3000: Silicon Photomultiplier, 50 μ m (2112 microcells), 3mm x 3mm sensor, TO8 Package, Peltier TEC
SPMMicro3050X05	SPMMicro3000: Silicon Photomultiplier, 50 μ m (2112 microcells), 3mm x 3mm sensor, TO5 Package
SPMMicro3050X13	SPMMicro3000: Silicon Photomultiplier, 50 μ m (2112 microcells), 3mm x 3mm sensor, Ceramic Package, Epoxy Fill
SPM6000 series	Ordering Information
SPMMicro6035X13	SPMMicro6000: Silicon Photomultiplier, 35 μ m (14560 microcells), four 3mm x 3mm sensors arranged in 2x2 configuration, Summed Output, Ceramic Package, Epoxy Fill
SPMMicro6050X13	SPMMicro6000: Silicon Photomultiplier, 50 μ m (8448 microcells), four 3mm x 3mm sensors arranged in 2x2 configuration, Summed Output, Ceramic Package, Epoxy Fill
Options	
SPMA4	Option: SPM Transimpedance Preamplifier and Power Supply Board

Option: Transimpedance Preamplifier and Power Supply Board

Transimpedance Preamplifier Board

The transimpedance preamplifier can convert 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 also. 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., or situations where the signal is a pulse input or where the DC component is undesirable (such as ranging applications or scintillation experiments). The preamplifier circuitry allows the fast rise time of the detector to be exploited and provides the simplest way to accurately bring pulse information to the user. The signal from the preamp is then output to the user via a DC blocking capacitor to convey pulse information originating in the SPM.

Power Board

The power supply board option simplifies the input power requirements of the SPMMicro. The user does not need to supply separate voltages of +5V, -5V and bias voltage (~30V) as the power option only requires a single +5V input and generates the other two voltages. The power module plugs onto the bottom of the SPMMicro 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 on adjustment via a potentiometer can be made available upon request.