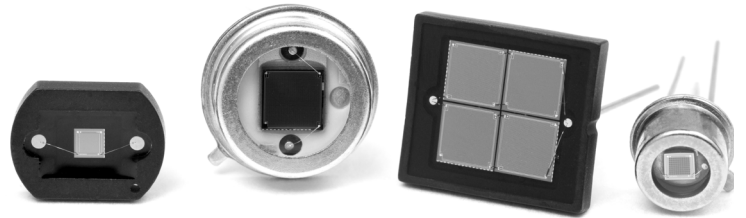


Silicon Photomultiplier Detectors

SensL MicroSL detectors are based on the silicon photomultiplier concept and form a range of high gain, single-photon sensitive, visible light sensors. They have performance characteristics similar to a conventional PMT, whilst benefiting from the practical advantages of solid-state technology: low operating voltage, robustness, compactness, insensitivity to magnetic fields and light over-exposure, and low cost.

The MicroSL is a family of detectors that are available in a variety of miniature packages, to suit a wide range of applications, and three detector sizes (1mm, 3mm and 6mm). The 1mm detectors are available in a range of variants that represent different performance trade-offs, as determined by the 'microcell size'. The tables below summarize the information for each detector variant. More information is available at www.sensl.com.



PERFORMANCE PARAMETERS (All values are typical)

	10000 series				30000 series	60000 series
	10020*	10035*	10050*	10100*	30035*	60035*
Breakdown Voltage (V_{br})	27.5V				27.5V	27.5V
Recommended Operating Voltage (V_{op})	29.5V				29.5V	29.5V
Spectral Range	400 – 1000nm				400 – 1000nm	400 – 1000nm
Peak wavelength (λ_p)	500nm	500nm	500nm	500nm	500nm	500nm
PDE at λ_p § 1	8%	14%	22%	28%	14%	14% [†]
Gain [§]	1.2x10 ⁶	2.4x10 ⁶	4x10 ⁶	1x10 ⁷	2.4x10 ⁶	2.4x10 ⁶
Dark Count Rate [§]	600kHz	740kHz	-	-	-	-
Dark Current [§]	0.1µA	0.4µA	0.7µA	2.6µA	3.0µA	12.0µA
Microcell Recovery Time [§]	30ns	130ns	320ns	1800ns	130ns	-
Temperature dependence of V_{br}	21mV/°C				21mV/°C	21mV/°C
Cross-talk (charge duplication probability ^{**})	17%	21%	38%	49%	21%	21%
Excess Noise Factor ^{***}	1.2	1.2	1.4	1.5	1.2	1.2

§ Measured at V_{op} and room temperature

1 Includes the effects of crosstalk and afterpulsing

† Does not include the effect of dead space between pixel active areas

* SensL naming convention: 10000 represents a 1mm detector, 020 a 20µm microcell. Therefore, the 10020 is a 1mm detector with 20µm microcells.

** Vinogradov et al., IEEE Trans. Nucl. Sci., Vol: 58, (2011)

*** Hakim et al., IEEE Trans. Electron Devices, Vol. 37, No.3 (1990)

GENERAL PARAMETERS

	10000 series				30000 series	60000 series
	10020	10035	10050	10100	30035	60035
Active area (Approx.)	1 x 1 mm ²				3 x 3 mm ²	6 x 6 mm ²
No. of microcells	1296	576	324	90	4774	19096
Pixel fill factor	48%	64%	72%	85%	65%	65% ⁰
Recommended operating temperature range	0°C - +40°C					
Recommended storage temperature range	-40°C - +80°C					
Max. device temperature during soldering	350°C for 3 seconds					
Recommended max. reverse bias	35V					
Encapsulant material transmission ^{*1}	>98%					
Encapsulant material refractive index ^{*2}	1.569					

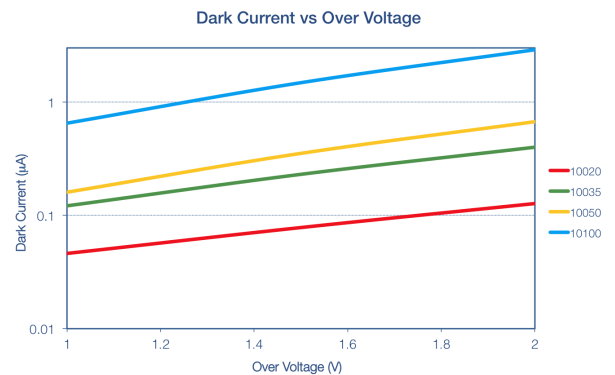
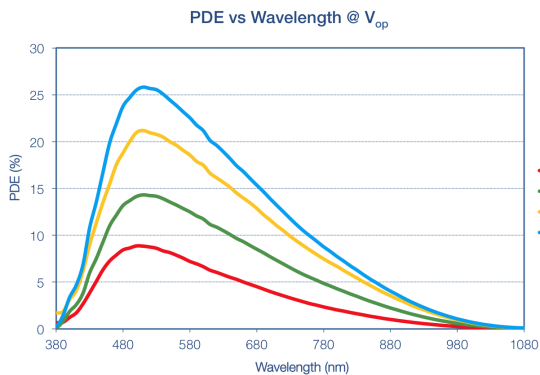
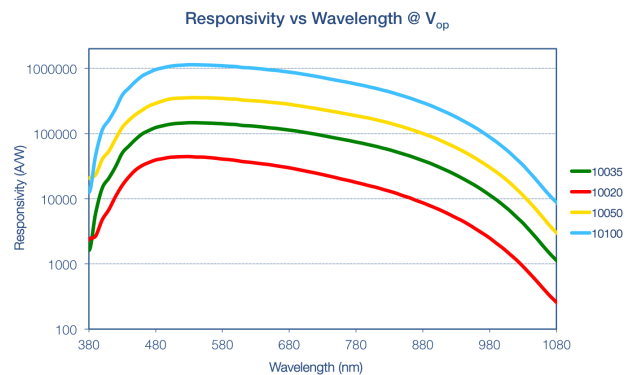
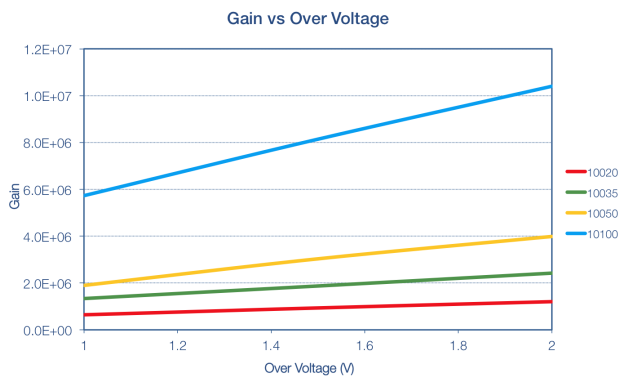
^{*} Only applicable to X13 package where there is an Epotek 301-2FL epoxy fill

¹ At 550 - 900nm, from Epotek datasheet

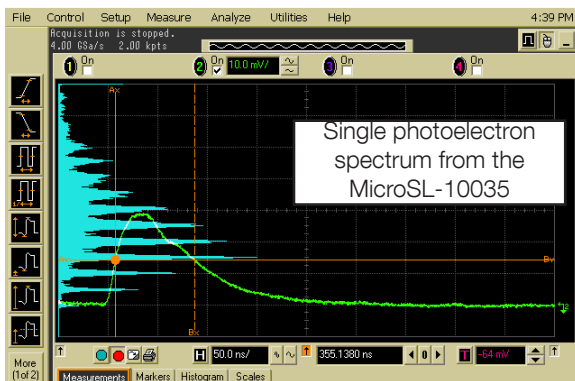
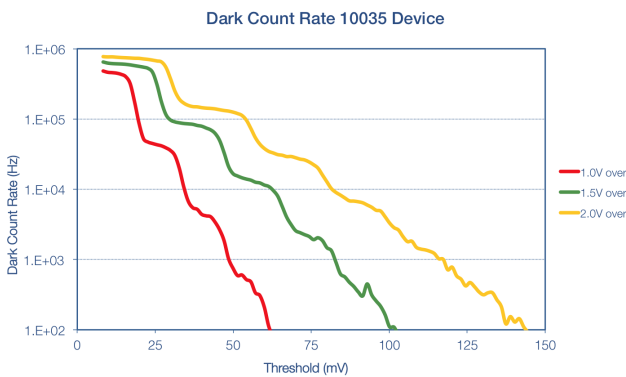
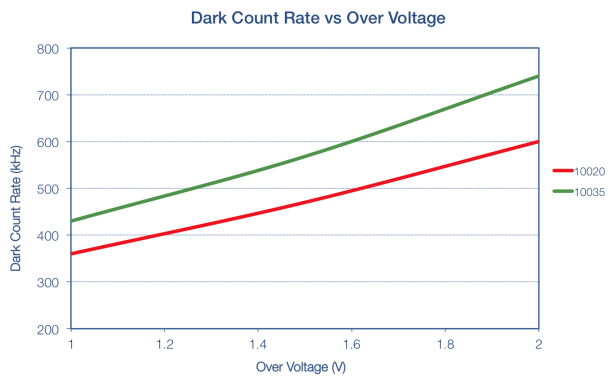
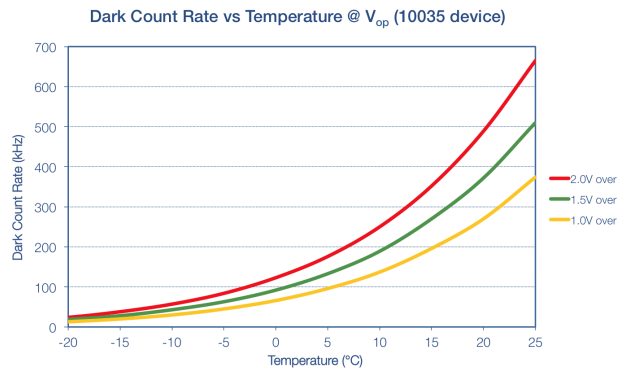
² At 543nm, cured epoxy as measured by J. Va'vra, DIRC Note #140

⁰ Does not include the effect of dead space between pixel active areas

PERFORMANCE GRAPHS

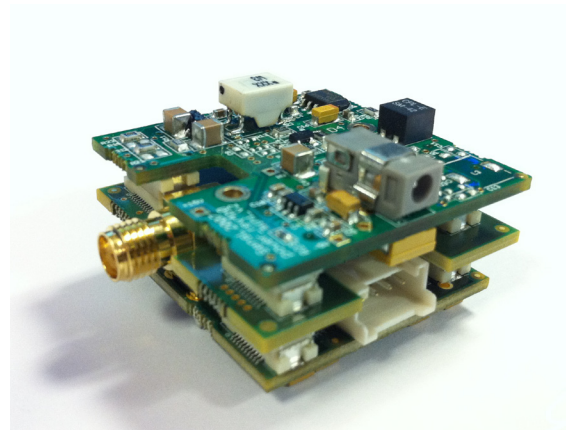


PERFORMANCE GRAPHS



PREAMPLIFIER AND POWER SUPPLY MODULE

The Micro-EVB preamplifier and power supply module provides a simple 'plug and play' solution for use with SensL's MicroSL detectors, eliminating the need for separate bench-top supplies and other electronics. It is comprised of three boards: a preamplifier board that interfaces with the detector and provides signal amplification, a power supply board that, via a mains adapter, provides the detector bias and power for the preamp, and a shield board between the two to prevent interference. Together these three boards allow the user to work with the MicroSL SPMs with minimal additional support equipment.



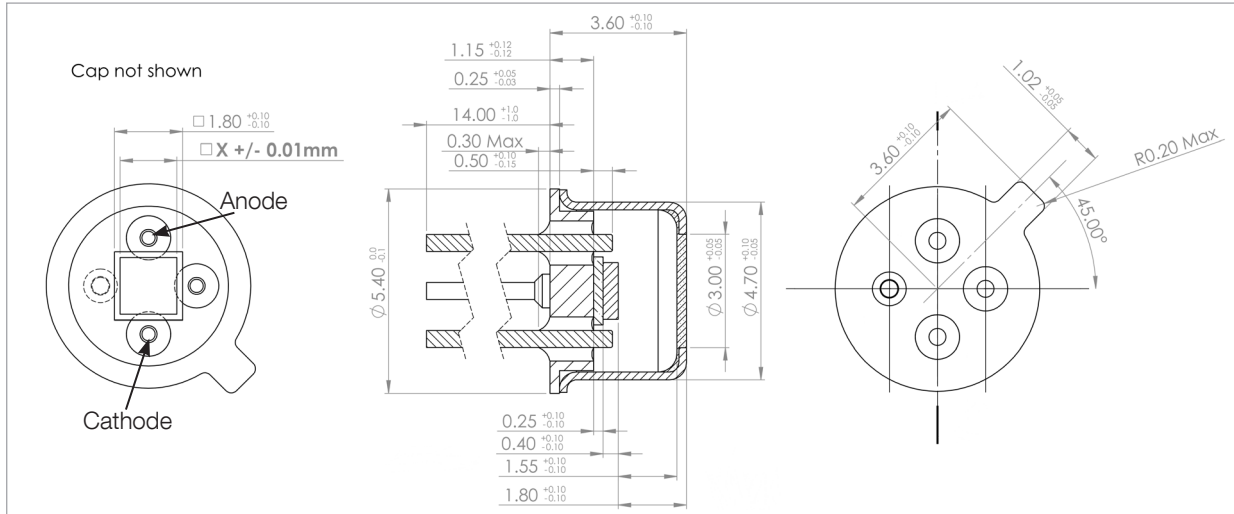
The Micro-EVB preamplifier and power supply module

General		
Dimensions: Boards only (w x l x h)	35 x 35 x 23 mm ³	
Including SMA conn.	35 x 41 x 23 mm ³	
Weight	25g	
Operating temperature range	-20°C to +40°C	
Compatible detector packages*	TO18, TO5, X13	
Preamplifier Board		
Gain (by detector size)	1mm	3mm, 6mm
	2200 V/A	470 V/A
Low frequency cut-off	DC	
Output voltage maximum	2V	
Output impedance	50Ω	
+ Supply min/max	4.75V / 5.5V	
- Supply min/max	-5.5V / -4.75V	
Power consumption	+5V <25mA; -5V <25mA	
Bandwidth	20MHz	
Output connector	SMA	
Power Supply Board		
Bias output range	25.6V - 37.2V	
Ripple (@30V)	4%	
Input jack	Lumburg, 0.65mm LV socket	

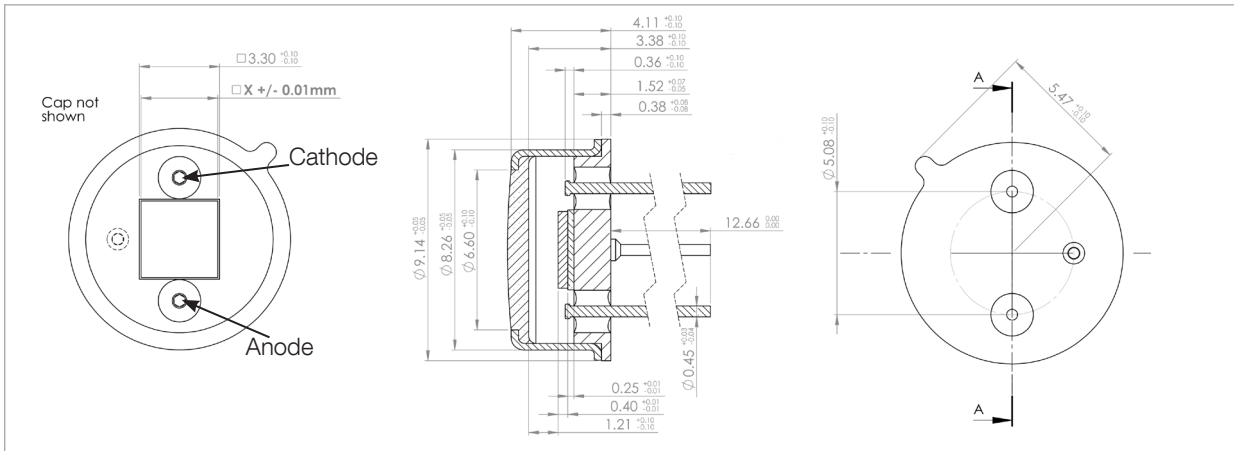
* Please note that the Micro-EVB is NOT compatible with the TO39 package containing Peltier cooler

SCHEMATICS (All Dimensions in mm)

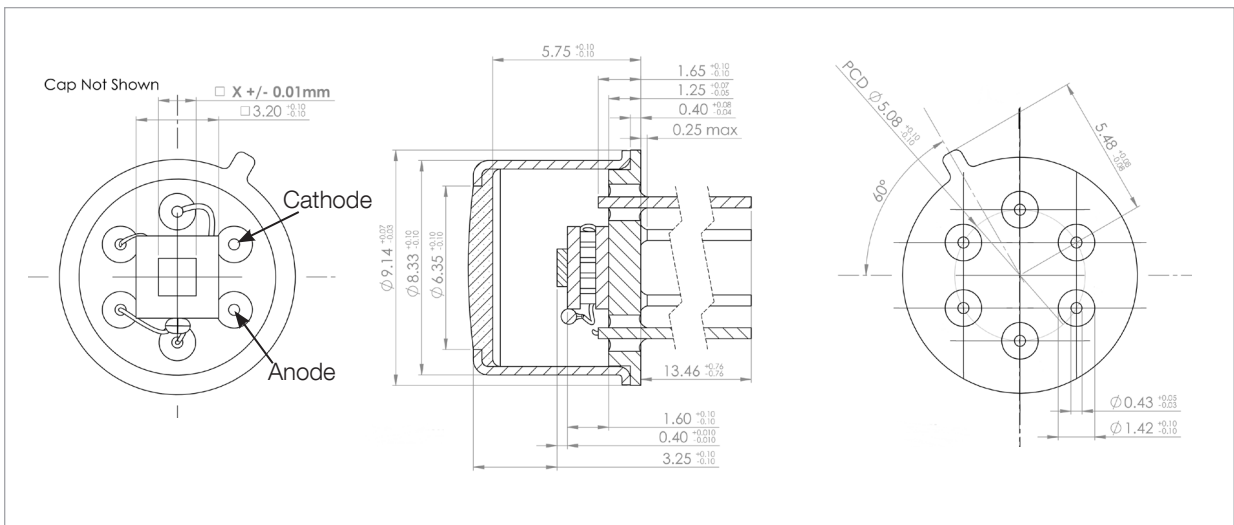
MicroSL 10000 Series TO18 Package



MicroSL 30000 Series TO5 Package

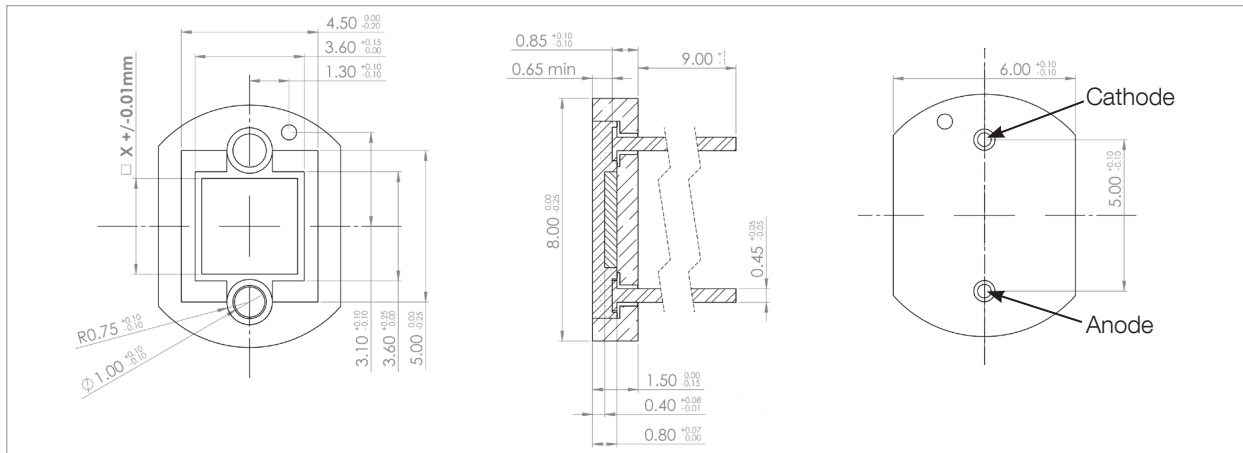


MicroSL 10000 and 30000 Series TO39 Package

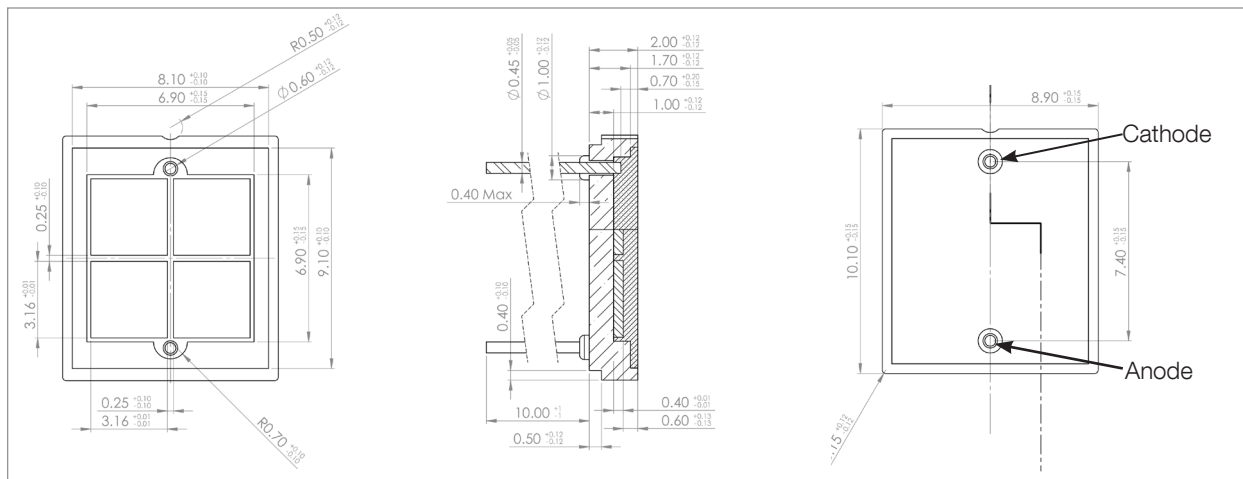


SCHEMATICS (Cont'd)

MicroSL 10000 and 30000 Series X13 Ceramic Package



MicroSL 60000 Series X13 Ceramic Package



ORDERING INFORMATION

Product Code	Microcell size (Total number)	Sensor active area	Package type
10000 Series			
MicroSL-10020-X18	20µm (1296 microcells)	1mm x 1mm	TO18
MicroSL-10020-X13			Ceramic Package, Epoxy Fill
MicroSL-10035-X39	35µm (576 microcells)		T039 Package, Peltier TEC
MicroSL-10035-X18			TO18
MicroSL-10035-X13			Ceramic Package, Epoxy Fill
MicroSL-10050-X18	50µm (324 microcells)		TO18
MicroSL-10050-X13			Ceramic Package, Epoxy Fill
MicroSL-10100-X18	100µm (90 microcells)		TO18
MicroSL-10100-X13			Ceramic Package, Epoxy Fill
30000 Series			
MicroSL-30035-X39	35µm (4774 microcells)	3.05mm x 3.05mm	T039 Package, Peltier TEC
MicroSL-30035-X05			T05
MicroSL-30035-X13			Ceramic Package, Epoxy Fill
60000 Series			
MicroSL-60035-X13	35µm (19096 microcells)	four 3.05mm x 3.05mm sensors arranged in 2x2 configuration, Summed Output	Ceramic Package, Epoxy Fill
Options			
Micro-EVB-1mm	SPM Transimpedance Preamplifier and Power Supply Module for use with 1mm MicroSL devices		
Micro-EVB-3mm	SPM Transimpedance Preamplifier and Power Supply Module for use with 3mm MicroSL devices		