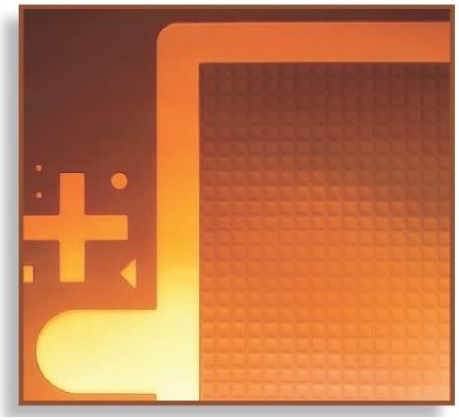
INGAAS AVALANCHE PHOTODIODE (APD) ARRAYS

INGAAS APD LINEAR ARRAYS

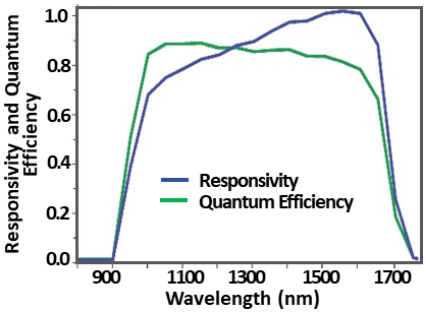


Voxtel's portfolio of linear-format avalanche-photodiode (APD) arrays are sensitive in the eyesafe spectral range beyond 1300 nm, making them ideal for scanned automotive, hyperspectral, and other lidar applications.

These custom-engineered InGaAs APD arrays provide higher avalanche gain and less excess noise than competing InGaAs arrays, allowing for superior sensitivity and signal-to-noise-ratio (SNR) performance. The backside-illuminated architecture achieves lower-capacitance pixels with higher bandwidth than is possible with frontside-illuminated APDs. These pixels of the arrays can be operated as individual elements or grouped into larger-format elements as needed to meet resolution requirements.

These performance advantages allow for scanned lidar systems to be implemented with lower laser pulse energy and average power. This contributes to lower overall system size, weight, power, and cost.

The APD pixels can be integrated individually or binned for larger effective pixel area. The arrays are available as bare dies or with a temperature sensor on a ceramic submount.



Spectral responsivity and quantum efficiency @ 298K

FEATURES

- **Low Capacitance:** backside-illuminated InGaAs pixel elements
- **Wide Spectral Response:** 950–1700-nm wavelength response
- **High Gain:** Operation up to a multiplication gain of $M = 75$
- **Low Excess Noise:** Models available with McIntyre parameterization of $k_{eff} = 0.03$
- **Customization:** Custom devices available upon request. Custom readout integrated circuits (ROICs) available upon request
- **Options:** Microlenses optionally available

MODELS

- High-gain low-excess-noise or ultra-low-dark-current APD pixels
- Stand-alone back-illuminated APD arrays for flip-chip bumping to silicon readout circuits or multi-chip modules
- Ceramic submount options for easy test and integration to circuit boards

CONTACT INFO

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VOXTEL OPTO

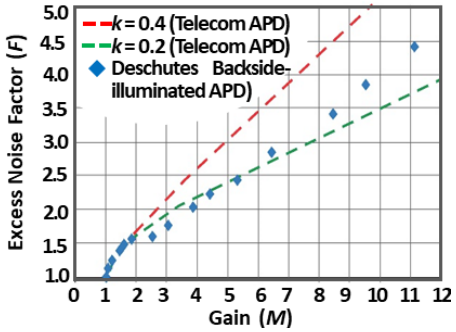
SPECIFICATIONS

Part Number—Bare Die	VXCY-5AXC	VXPS-WAXC	VXPT-WAXC	VXPU-WAXC
Part Number—Die Mounted to Ceramic Fanout Submount with integrated temp sensor	**VXCY-5BXC**	**VXPS-WBXC**	**VXPT-WBXC**	**VXPU-WBXC**
Format	1 x 4	1 x 32	1 x 64	1 x 128
Pixel Pitch	50 µm	24 µm	24 µm	24 µm
Pixel Element Dimensions, μm^2	38 x 288 μm^2	12 x 112 μm^2	12 x 112 μm^2	12 x 112 μm^2
Spectral Range, λ	950–1720 nm	950–1720 nm	950–1720 nm	950–1720 nm
Quantum Efficiency (1550 nm)	80-85%	80-85%	80-85%	80-85%
APD Operating Gain, *M*	1-25	1-75	1-75	1-75
Typical Responsivity at *M* = 10 (top: 1064 nm; bottom: 1550 nm)	7.3 A/W 10.1 A/W	7.3 A/W 10.1 A/W	7.3 A/W 10.1 A/W	7.3 A/W 10.1 A/W
Fill Factor	76%	55%	55%	55%
Pixel Bandwidth	1.5 GHz	2.5 GHz	2.5 GHz	2.5 GHz
Pixel Capacitance[i]	$8.42*10^{-13}$	$7.21*10^{-14}$	$7.21*10^{-14}$	$7.21*10^{-14}$
McIntyre Parameterization of Excess Noise, k_{eff}	0.2	0.03	0.03	0.03
Excess Noise Factor, *F(M,k), at M = 10*	3.5	1.7	1.7	1.7
Dark Current @ *M*=1[ii]	$5.52*10^{-10}$	$8*10^{-10}$	$8*10^{-10}$	$8*10^{-10}$
V_{BR}	44 – 50 V	65 – 80 V	65 – 80 V	65 – 80 V
$\Delta V_{BR}/\Delta T$	34 mV/k	29 mV/k	29 mV/k	29 mV/k
Maximum Instantaneous Input Power[iii] (per pixel) at *M* = 10	$1*10^{-1}$ W	$1.28*10^{-3}$ W	$1.28*10^{-3}$ W	$1.28*10^{-3}$ W

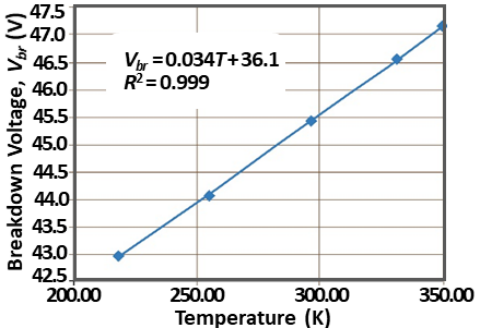
[i] M > 3
[ii] Unity referenced from measurements at M = 10, T = 298 K
[iii] 10 ns, 1064 nm signal at a 20 Hz PRF with an APD multiplication gain of M = 10

PERFORMANCE (TYPICAL)

Models VXCY-5(A,B)XC and VXCU-6(A,B)XC

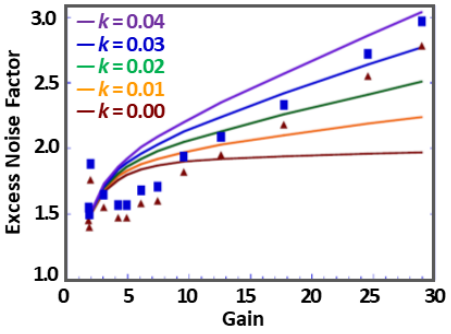


Excess noise of the APD, k~0.2

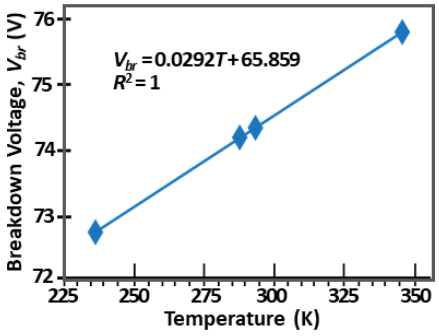


Effects of temperature on breakdown voltage of an APD at M = 10

Models VXPS-W(A,B)XC, VXPT-W(A,B)XC, VXPU-W(A,B)XC

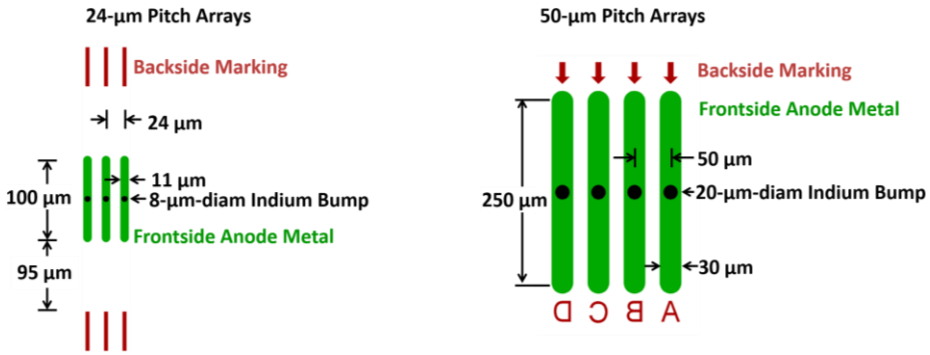


Excess noise of the APD, k~0.03



Effects of temperature on breakdown voltage of an APD at M = 10

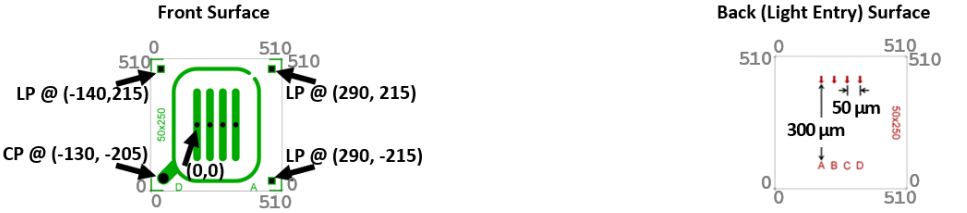
PIXEL DIMENSIONS



MECHANICAL MODELS—BARE DIES

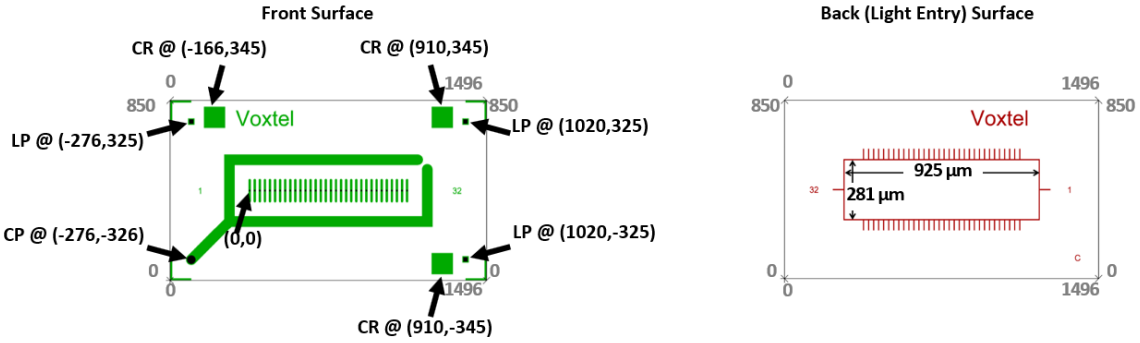
1 x 4 Linear Array (50-µm Pitch)

Contact Metal/UBM | Solder Bumps | Back Markings | Major tick = 1000 µm | Minor tick = 50 µm
CR—Corner Reflector (100-µm Pad) | LP—Leveling Pad (20-µm Indium Bump) | CP—Cathode Pad (40-µm Indium Bump)



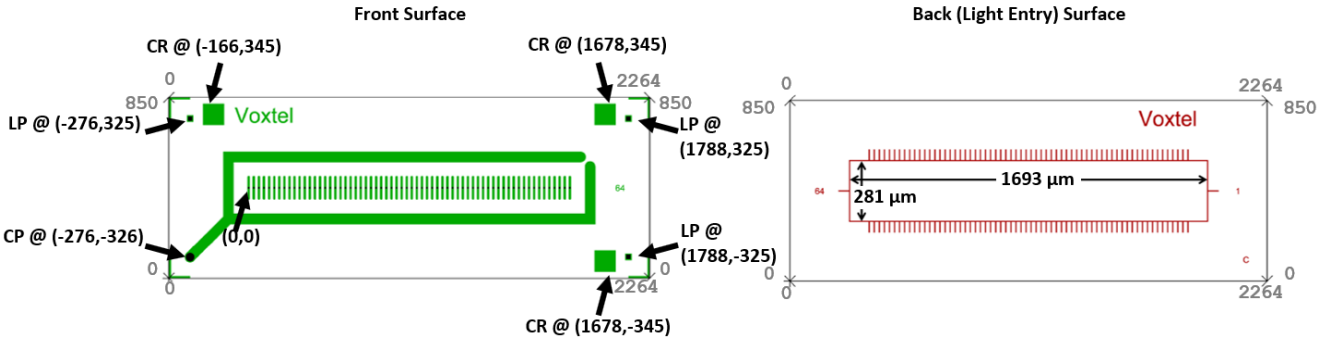
1 x 32 Linear Array (24-µm Pitch)

Contact Metal/UBM | Solder Bumps | Back Markings | Major tick = 1000 µm | Minor tick = 50 µm
CR—Corner Reflector (100-µm Pad) | LP—Leveling Pad (20-µm Indium Bump) | CP—Cathode Pad (40-µm Indium Bump)

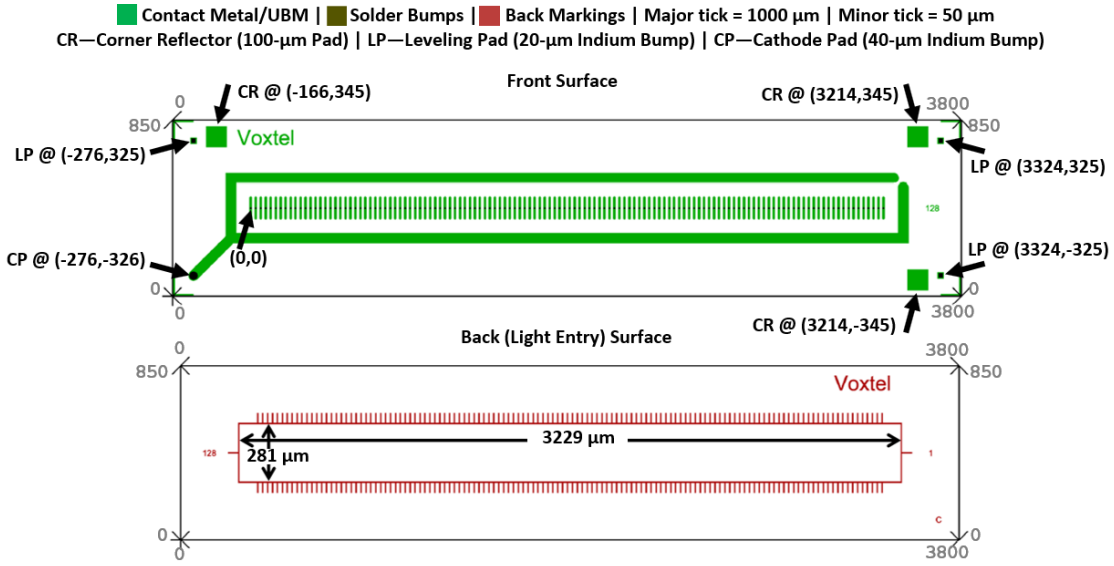


1 x 64 Linear Array (24-µm Pitch)

Contact Metal/UBM | Solder Bumps | Back Markings | Major tick = 1000 µm | Minor tick = 50 µm
CR—Corner Reflector (100-µm Pad) | LP—Leveling Pad (20-µm Indium Bump) | CP—Cathode Pad (40-µm Indium Bump)

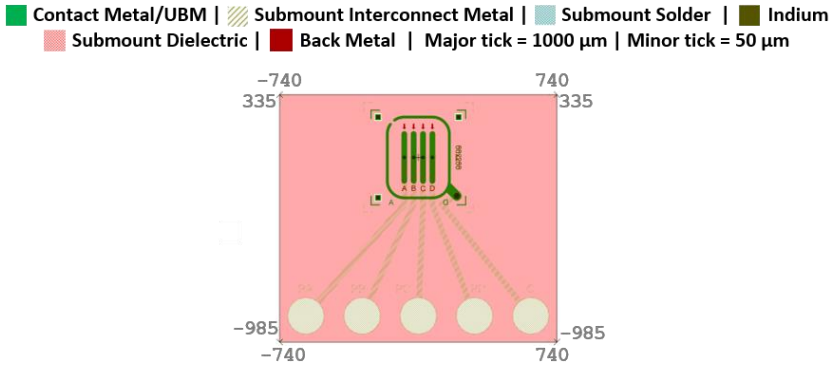


1 x 128 Linear Array (24-µm Pitch)

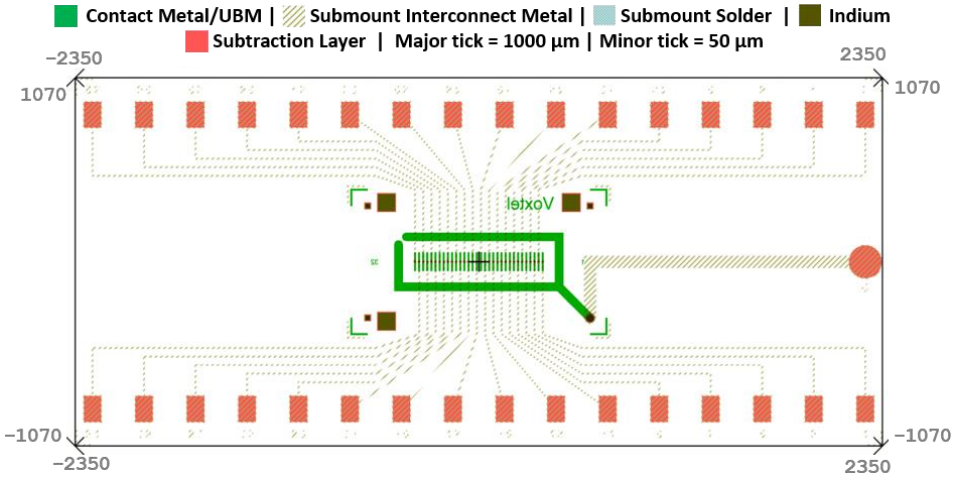


MECHANICAL MODELS—CERAMIC SUBMOUNTED DIES

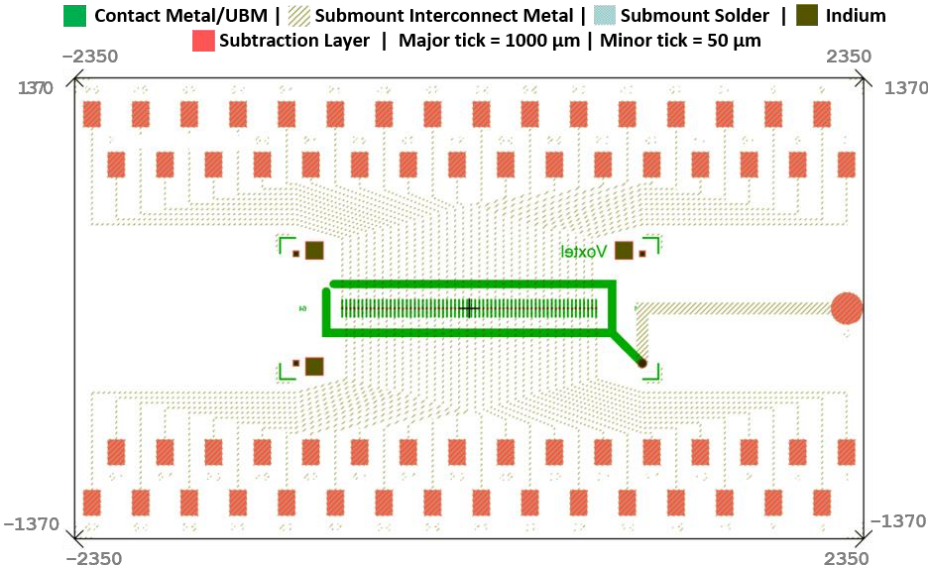
1 x 4 Linear Array (50-µm Pitch)



1 x 32 Linear Array (24-µm Pitch)



1 x 64 Linear Array (24-µm Pitch)



1 x 128 Linear Array (24-µm Pitch)