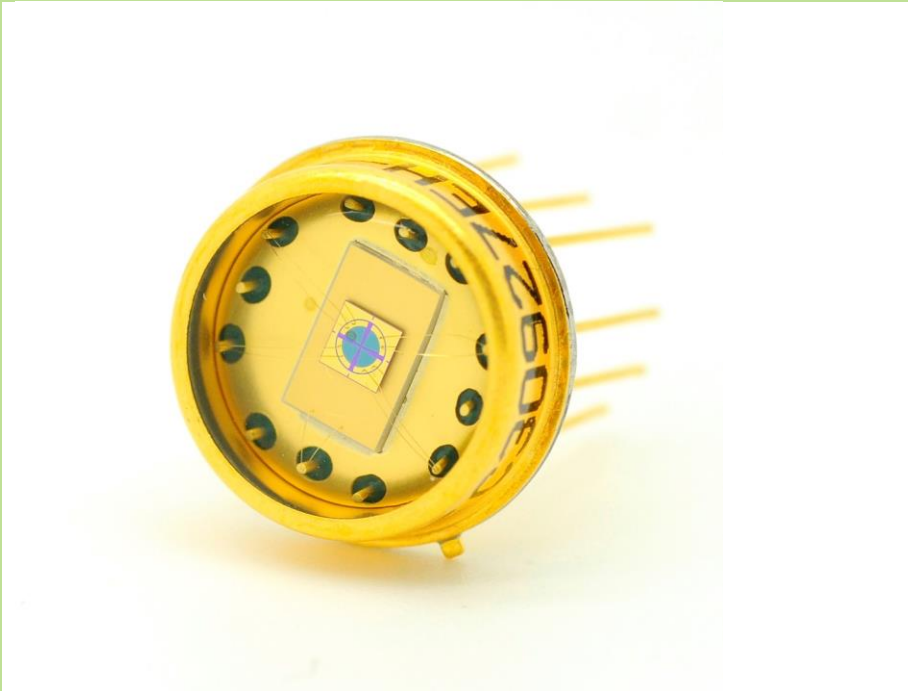
C30927EH-01, -02 and -03

Quadrant Silicon Avalanche Photodiode for Tracking Applications



Key Features

- Full Angle for Totally illuminated Photosensitive Surface greater than 90 degrees
- High Quantum Efficiency -
  C30927EH-03 85% typically at 800 nm
  C30927EH-02 85% typically at 900 nm
  C30927EH-01 18% typically at 1060nm
- Fast Time Response -
  Rise Time typically 3 ns
  Fall Time Typically 3 ns
- Large Area : 1.77mm^2
- Hermetically Sealed Low Profile TO-8 Packages

Applications

- Tracking
- Alignment
- "Friend or Foe" identification

The C30927EH-01, C30927EH-02 and C30927EH-03 types are quadrant silicon photodiodes made using a double diffused "reach-through" structure. The quadrant structure has a common avalanche junction, with separation of the quadrants achieved by segmentation of the light-entry p+ surface opposite the junction. With this design, there is no dead space between the elements and therefore no loss of response at boresight.

They are optimized for use at wavelengths of 1060, 900 and 800 nm respectively. Each device type will provide high responsivity and excellent performance when operated within about 50 nm of the specified wavelength.

The quadrant avalanche photodiodes are useful in a variety of tracking and alignment applications.

Table 1 – Mechanical and Optical Characteristics

Parameter	Symbol		Unit
Shape		Circular	
Configuration		Quadrant	
Photosensitive Surface: Useful area Useful diameter	 A d	 1.77 1.55	 mm^2 mm

Table 2 – Electro-Optical Characteristics

Case Temperature T_A = 22 °C; at the DC reverse operating voltage, V_{op}, and light spot diameter of 1.0 mm (0.04 inches) centered at boresight, unless otherwise specified[1].

Parameter	Symbol	Minimum	Typical	Maximum	Units
Breakdown Voltage	V_{br}	350	425	485	V
Temperature Coefficient of V_{op} for Constant M	V_{op}		2.4		V/°C
Gain	M		100		
Responsivity at 800 nm at 900 nm at 1060 nm	R	 45 50 12	 55 62 15		A/W
Quantum Efficiency at 800 nm at 900 nm at 1060 nm	Q.E.		 85 85 18		%
Total Dark Current	I_d		100	200	nA
Noise Current (f=10kHz, Δf=1.0Hz, See Figure 5)	i_n		1.0	1.5	pA/√Hz
Capacitance total all quadrants between quadrants	C_d		3	 5 0.5	pF
Resistance Between Paralleled Quadrant Pairs (See Figure 6)		8		50	kΩ
Crossover at Boresight (25µm spot, 10% to 90%, See Figure 8)			75		µm
Series Resistance	R_s			15	Ω
Rise/Fall Time, R_L = 50Ω, λ=900nm: 10% to 90% points 90% to 10% points	 t_r t_f		 3 3	 4 4	ns

[1] A specific value of V_{op} is supplied with each device when the photodiode is operated at this voltage, the device will meet the electrical characteristics limits shown above, the voltage value will be within the range of 275 to 425 volts.

Table 3 – Absolute – Maximum Ratings, Limiting Values

Parameter	Symbol	Minimum	Maximum	Unit	Remarks/Conditions
Reverse Bias Current			200	µA	
Photocurrent Density : average value peak value	J_p		 5 20	mA/mm^2	Continuous operation
Forward Current: average value peak value	I_F		 5 50	mA	Continuous operation (For 1 second duration, non-repetitive)
Maximum total power Dissipation			0.1	W	At 22 °C
Storage Temperature	T_{stg}	-60	100	°C	
Operating Temperature	T_o	-40	60	°C	
Soldering			200	°C	5 seconds, leads only

Figure 1 – Typical Variation of Responsivity at 800 nm for type C30927E-03 as a function of Temperature and Voltage Difference from the Designated Voltage, V_{op} (See Footnote 1)

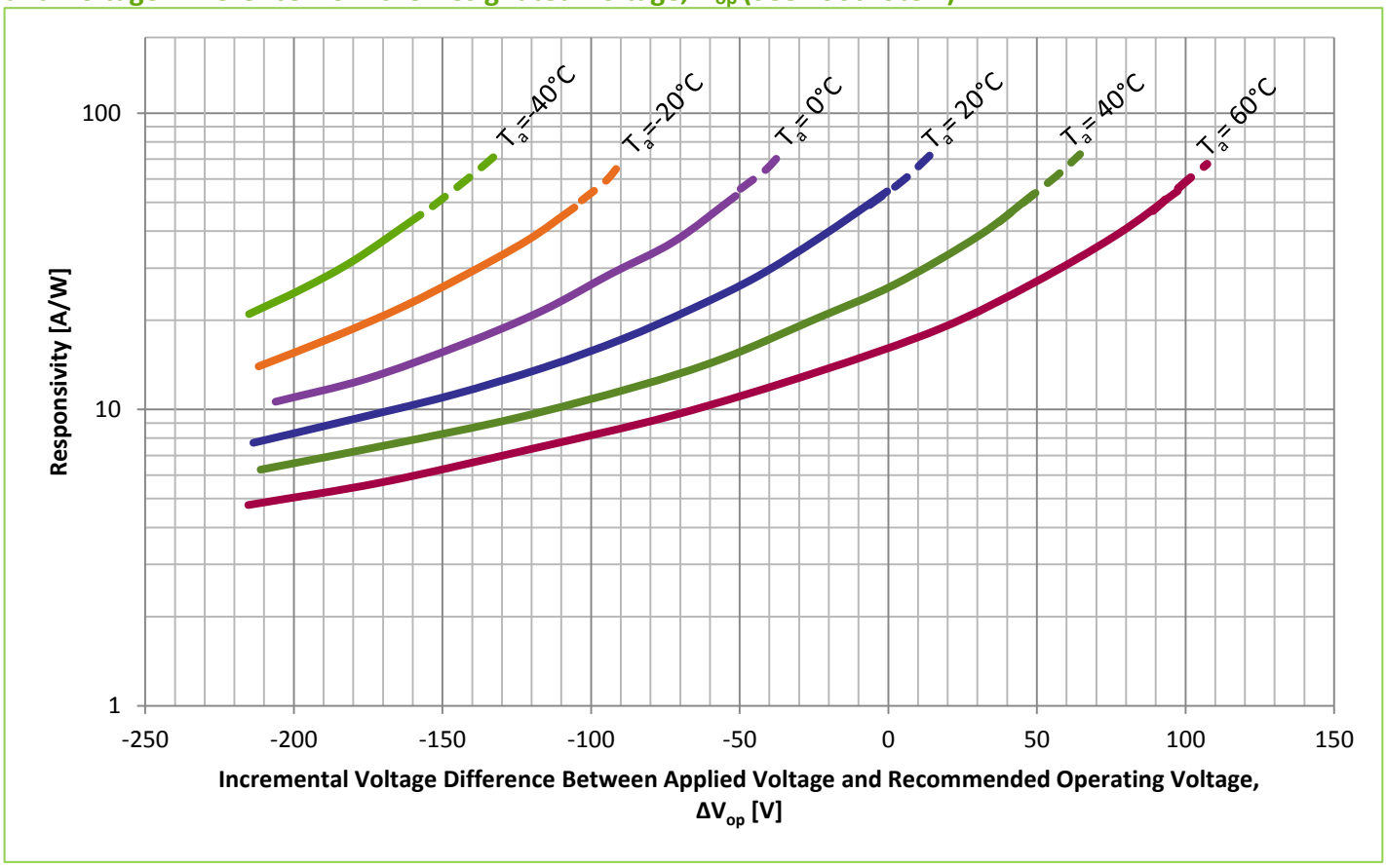


Figure 2 – Typical Variation of Responsivity at 900 nm for type C30927E-02 as a function of Temperature and Voltage Difference from the Designated Voltage, V_{op} (See Footnote 1)

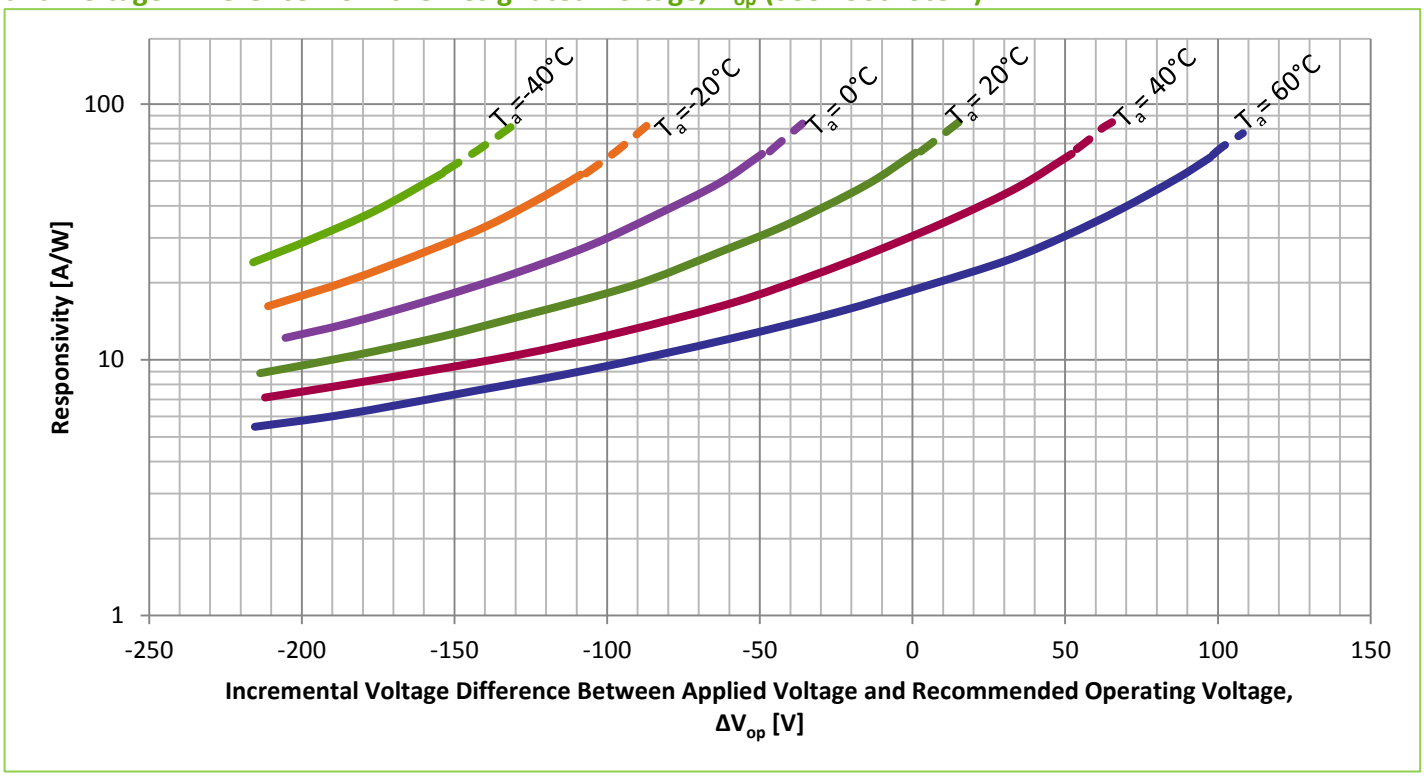


Figure 3 – Typical Variation of Responsivity at 1060 nm for type C30927E-01 as a function of Temperature and Voltage Difference from the Designated Voltage, V_{op} (See Footnote 1)

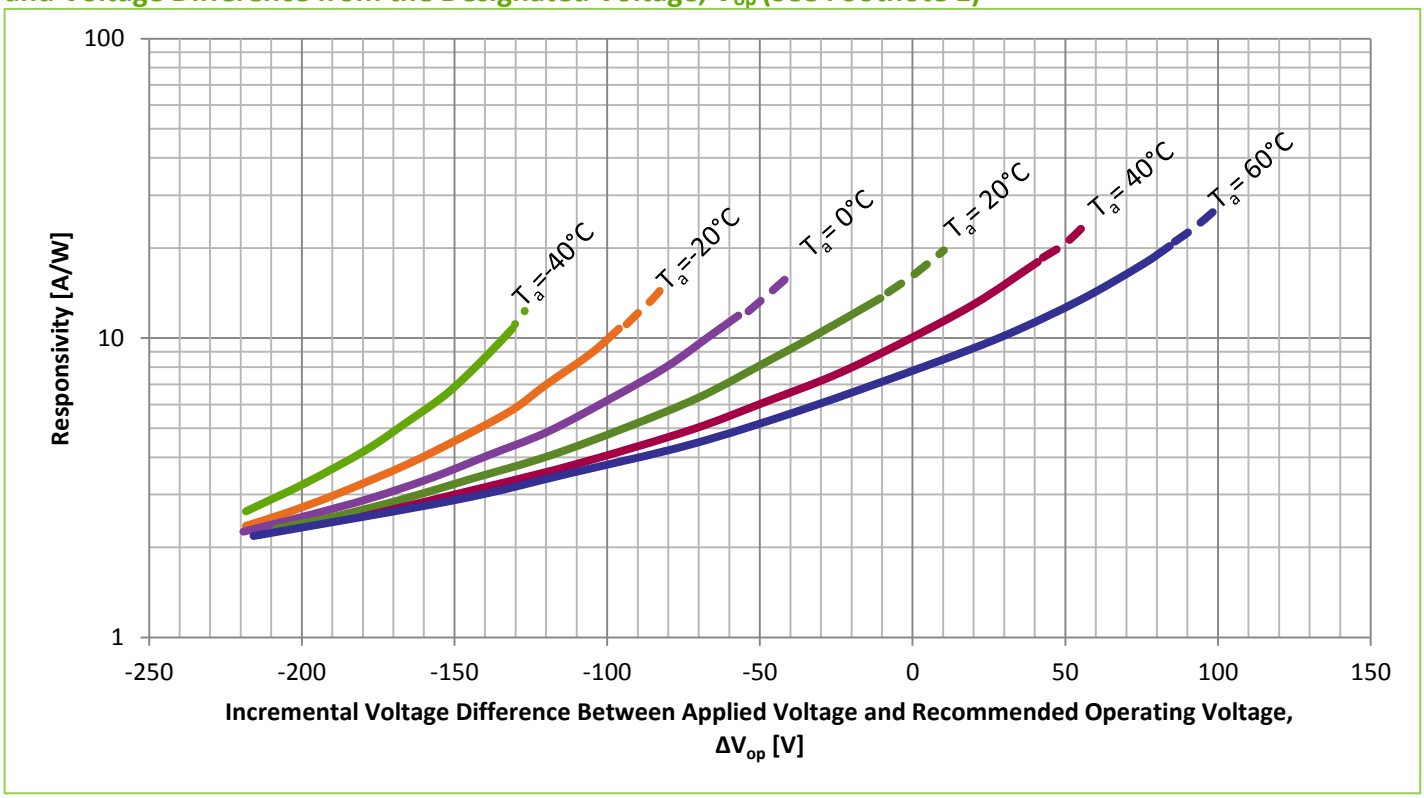


Figure 4 – Typical Total Dark Current as a function of Operating Voltage, V_{op}

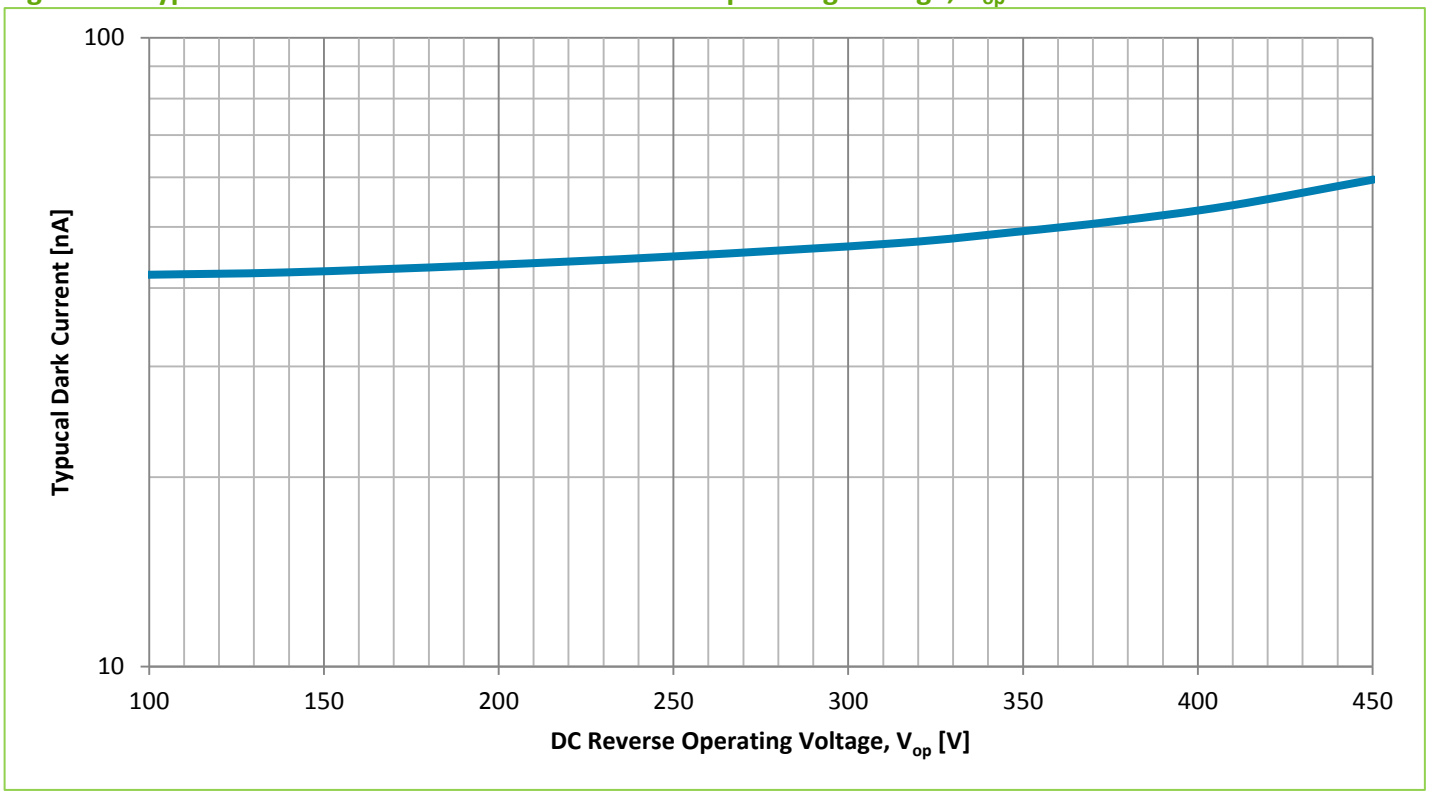


Figure 5 – Typical Noise Current as a function of Gain, M (All quadrants paralleled)

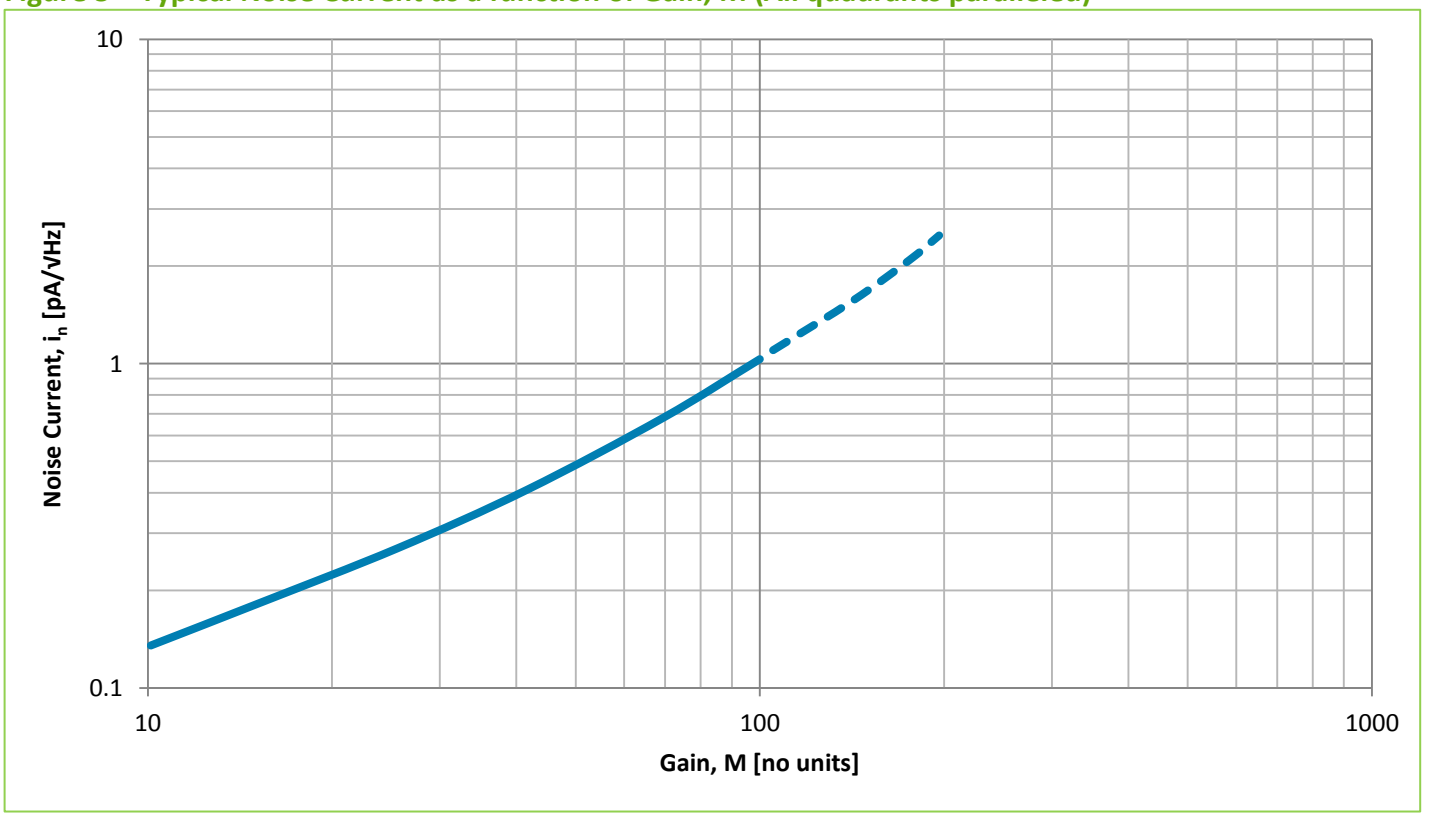


Figure 6 – Typical Inter-electrode Resistance as a function of Voltage Difference from the Designated Voltage, V_{op} [2]

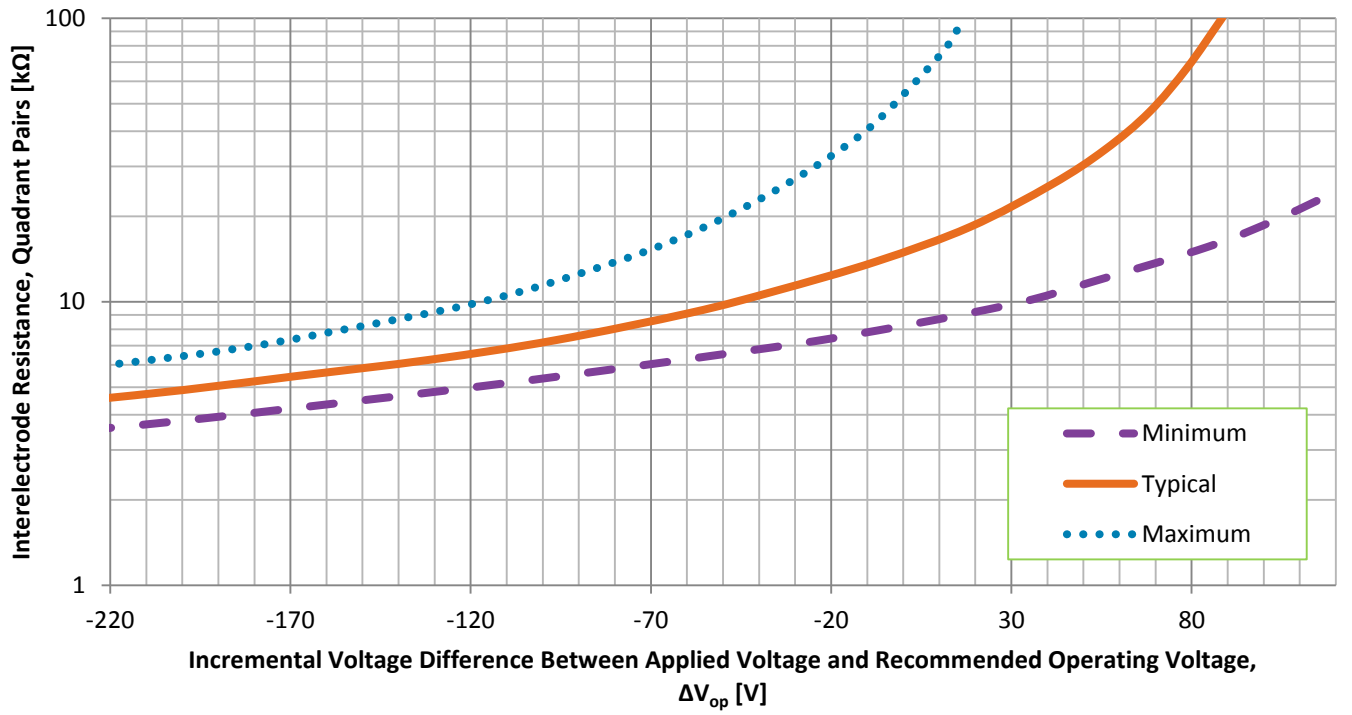
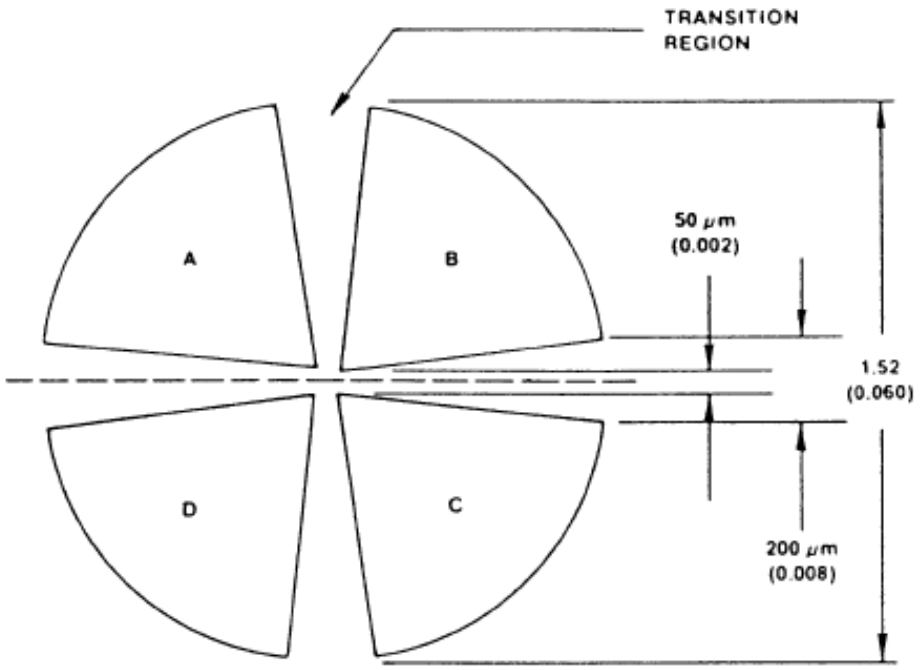


Figure 7 – Quadrant Geometry



[2] There is a resistance between the quadrant elements which varies as a function of the applied voltage In Figure 6, the typical measured resistance between paralleled quadrant pairs is shown. For equivalent circuit considerations, the resistive element between any two adjacent quadrants is twice this value.

Figure 8 – Scan Showing Typical Crossover Characteristic at Boresight, Quadrant B & C Grounded

Dotted line from Figure 7 represents scan line, Spot size = 25 µm

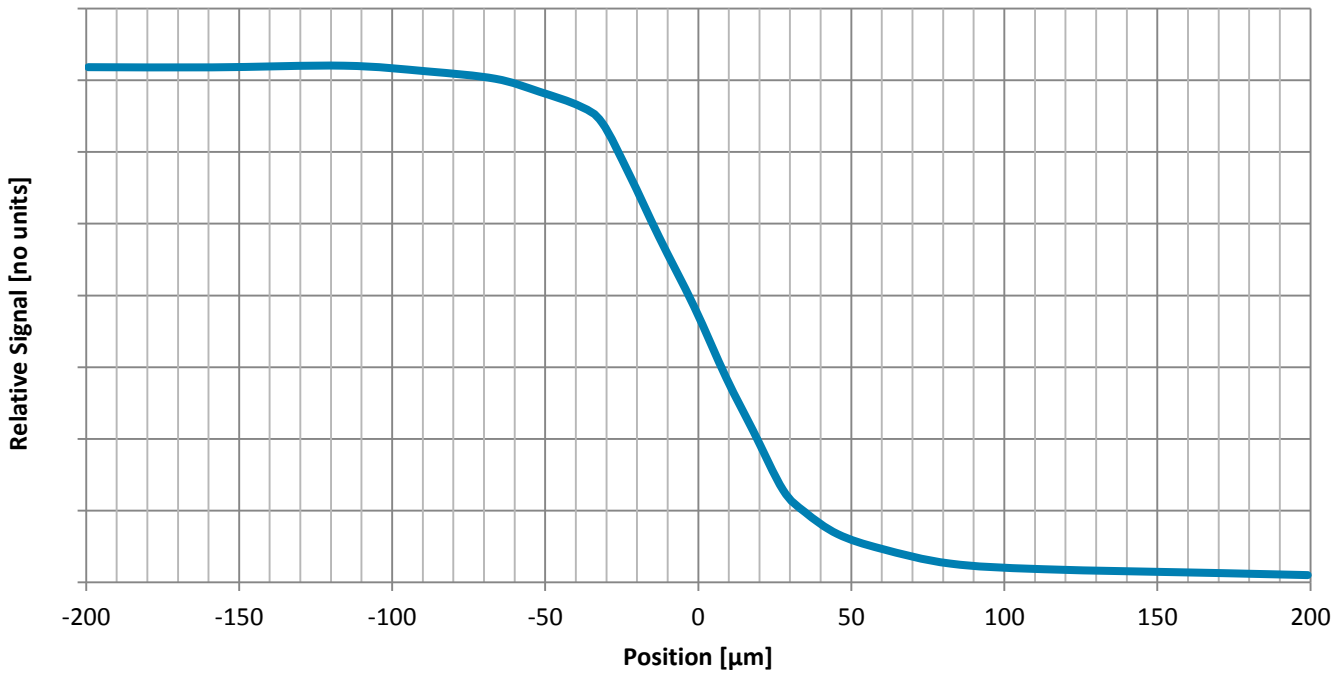
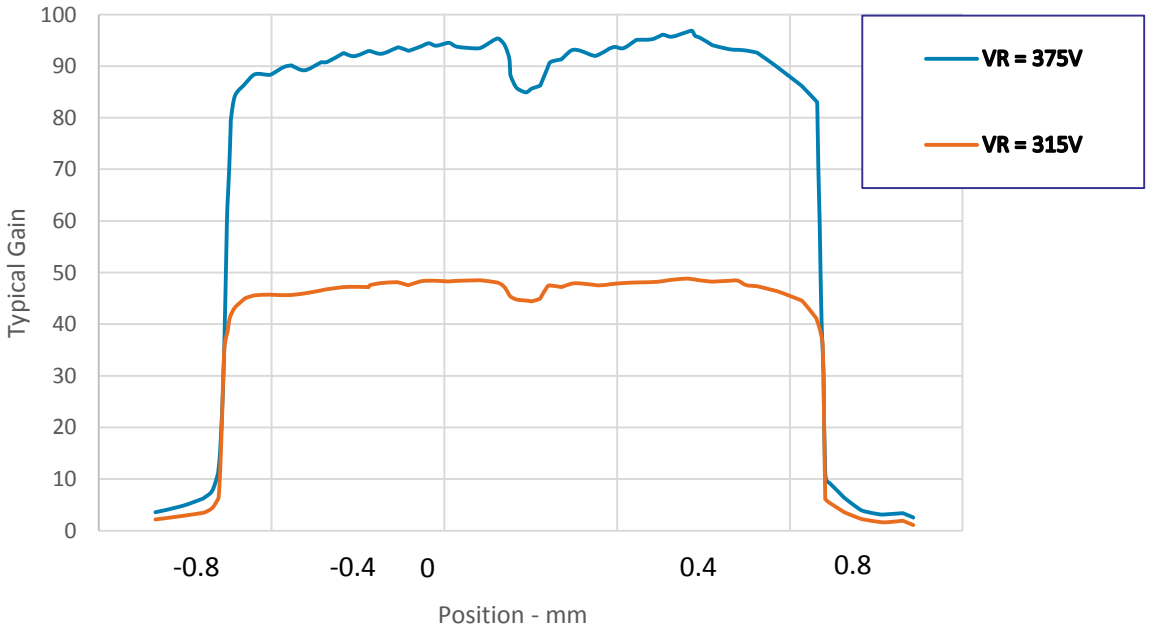
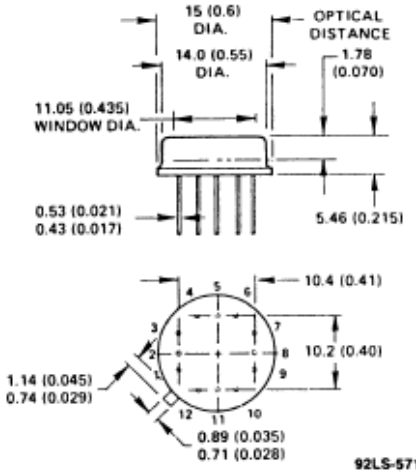


Figure 9 – Typical Response as a function of Light Spot Position Scanned Diagonally Through Boresight – All Quadrants Connected[3].



[3] The response dips at boresight (approx.. 10%) observed in the scans of Figure 9 are caused by a slight difference in antireflection coating in the crosshair region as compared to the rest of the active area.

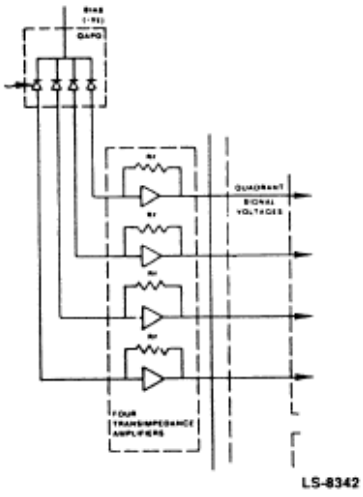
Figure 10 – Dimensional Outline and Pin Connections



Optical distance from outside surface of window to quadrant avalanche photodiode surface = 1.78 mm (0.070 inch).

Pin Connections

1. Quadrant C, Anode
2. No Connection, Do Not Use
3. Quadrant B, Anode
4. No Connection, Do Not Use
5. Case (Ground)
6. No Connection, Do Not Use
7. Quadrant A, Anode
8. No Connection, Do Not Use
9. Quadrant D, Anode
10. No Connection, Do Not Use
11. Positive Lead (Cathode)
12. No Connection, Do Not Use



RoHS Compliance

The C30927EH Quadrant Silicon Avalanche photodiode series is designed and built to be fully compliant with the European Union Directive 2011/65/EU – Restriction of the use of certain Hazardous Substances (RoHS) in Electrical and Electronic equipment.

Warranty

A standard 12-month warranty following shipment applies. Any warranty is null and void if the photodiode window has been opened.

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