

## Large Area Silicon Avalanche Photodiode for General-Purpose Applications

- High Quantum Efficiency —  
85% typical at 900 nm  
18% typical at 1060 nm
- Spectral Response Range  
(10% Points) —  
400 to 1100 nm
- Large Area — 1.77 mm<sup>2</sup>
- Fast Time Response —  
Rise time typically 3 ns  
Fall time typically 3 ns
- Wide Operating Temperature Range —  
-40° C to +70° C
- Hermetically-Sealed Low-Profile  
TO-5 Package

RCA Developmental Type C30916E is a general-purpose silicon avalanche photodiode made using a double-diffused "reach through" structure. This structure provides high responsivity between 400 and 1100 nanometers as well as fast rise and fall times at all wavelengths. Because the fall time characteristic has no "tail", the responsivity of the device is independent of modulation frequency up to about 200 MHz.

The C30916E is hermetically sealed behind a flat glass window in a modified low-profile TO-5 package.

This device is useful in a wide variety of applications including laser detection, ranging, optical communications, high-speed switching, and transit-time measurements.

### Maximum Ratings, Absolute-Maximum Values

Reverse Bias Current .....	200 max. $\mu$ A
Photocurrent Density, $i_p$ , at 22° C:	
Average value, continuous operation .....	5 mA/mm <sup>2</sup>
Peak value .....	20 mA/mm <sup>2</sup>
Forward Current, $I_F$ , at 22° C:	
Average value, continuous operation .....	5 max. mA
Peak value (for 1 second duration, non-repetitive) .....	50 max. mA
Maximum Total Power Dissipation at 22° C ....	0.1 max. W
Ambient Temperature:	
Storage, $T_{stg}$ .....	-60 to +100 °C
Operating, $T_A$ .....	-40 to +70 °C
Soldering:	
For 5 seconds .....	200 °C

### Mechanical Characteristics

Photosensitive Surface:	
Shape .....	Circular
Useful area .....	1.77 mm <sup>2</sup>
Useful diameter .....	1.5 mm

### Optical Characteristics

Field of View:<sup>a</sup>

See Figure 9 —

Full angle ( $\alpha$ ) for totally illuminated photosensitive surface .....	104 deg
Full angle ( $\alpha$ ) for partially illuminated photosensitive surface .....	130 deg

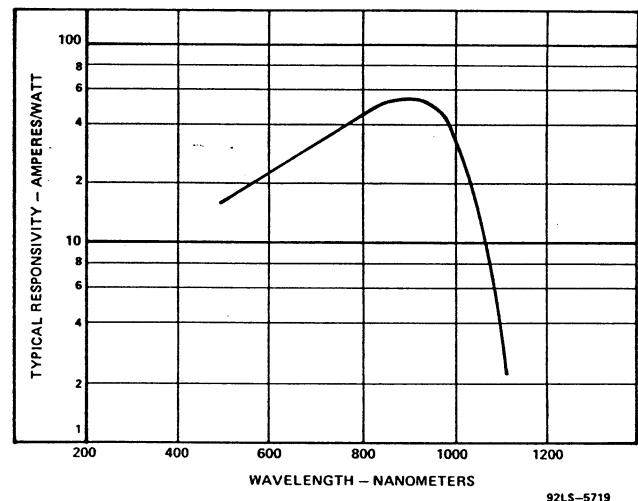


Figure 1 — Typical Spectral Responsivity  
Characteristics at a Gain of 80

For further information or application assistance on these devices, contact your RCA Sales Representative or Photodetector Marketing, RCA, Ste. Anne de Bellevue, Quebec, Canada H9X 3L3 (514) 457-9000.

### Electrical Characteristics at $T_A = 22^\circ\text{C}$

At the DC reverse operating voltage  $V_R$  supplied with the device and a light spot diameter of 1.0 mm (0.04"), unless otherwise specified. See footnote b.

	Min.	Typ.	Max.	Units
Breakdown Voltage, $V_{BR}$ .....	315	390	490	V
For $V_{BR}$ at other temperatures, see Figures 2 and 3.				
Temperature Coefficient of $V_R$ for Constant Gain .....	—	2.2	—	V/ $^\circ\text{C}$
Gain .....	—	80	—	
Responsivity:				
At 900 nm .....	43	50	—	A/W
At 1060 nm .....	10	12	—	A/W
Quantum Efficiency:				
At 900 nm .....	—	85	—	%
At 1060 nm .....	—	18	—	%
Total Dark Current, $I_d$ .....	—	0.1	0.2	$\mu\text{A}$
Noise Current, $i_n$ :				
$f = 10\text{ kHz}$ , $\Delta f = 1.0\text{ Hz}$ .....	—	1	2	pA/Hz <sup>1/2</sup>
See Figure 5				
Capacitance, $C_d$ .....	—	3	5	pF
Series Resistance .....	—	—	15	$\Omega$
Rise Time, $t_r$ :				
$R_L = 50\ \Omega$ , $\lambda = 900\text{ nm}$ , 10% to 90% points .....	—	3	4	ns
Fall Time:				
$R_L = 50\ \Omega$ , $\lambda = 900\text{ nm}$ , 90% to 10% points .....	—	3	4	ns

a The values specified for field of view are approximate and are critically dependent on the dimensional tolerances of the package component parts.

b A specific value of  $V_R$  is supplied with each device. When the photodiode is operated at this voltage, the device will meet the electrical characteristic limits shown above. The voltage value will be within the range of 275 to 425 volts.

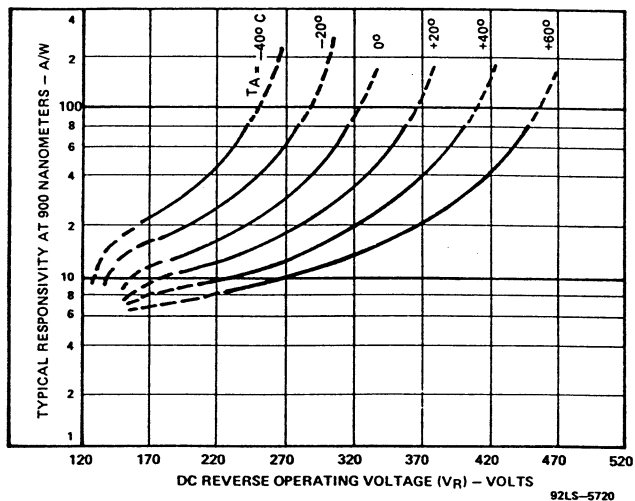


Figure 2 — Typical Responsivity at 900 nm vs Operating Voltage

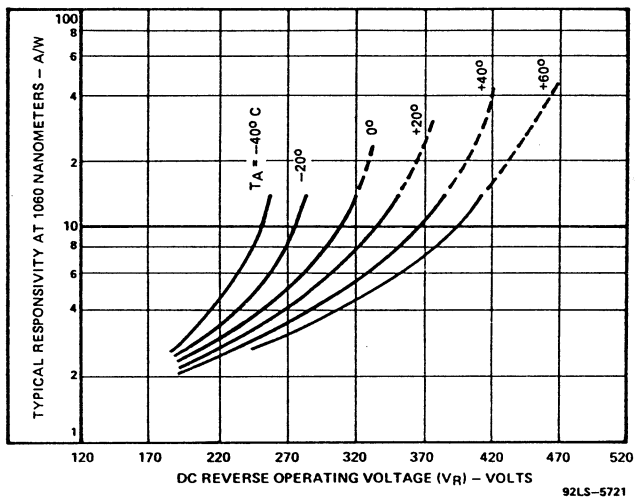


Figure 3 — Typical Responsivity at 1060 nm vs Operating Voltage

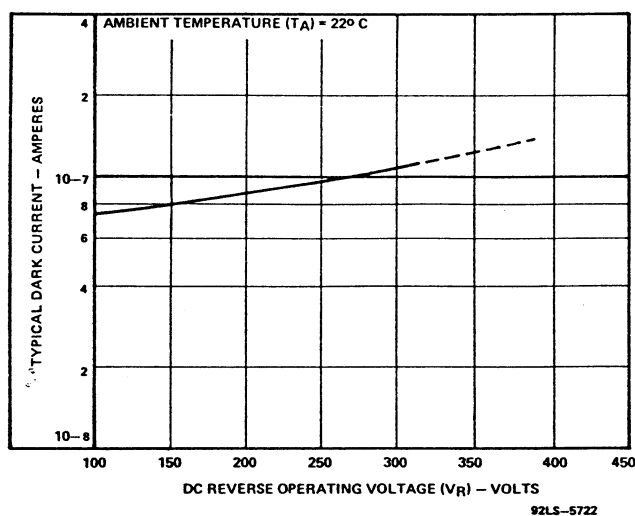


Figure 4 — Typical Dark Current vs Operating Voltage

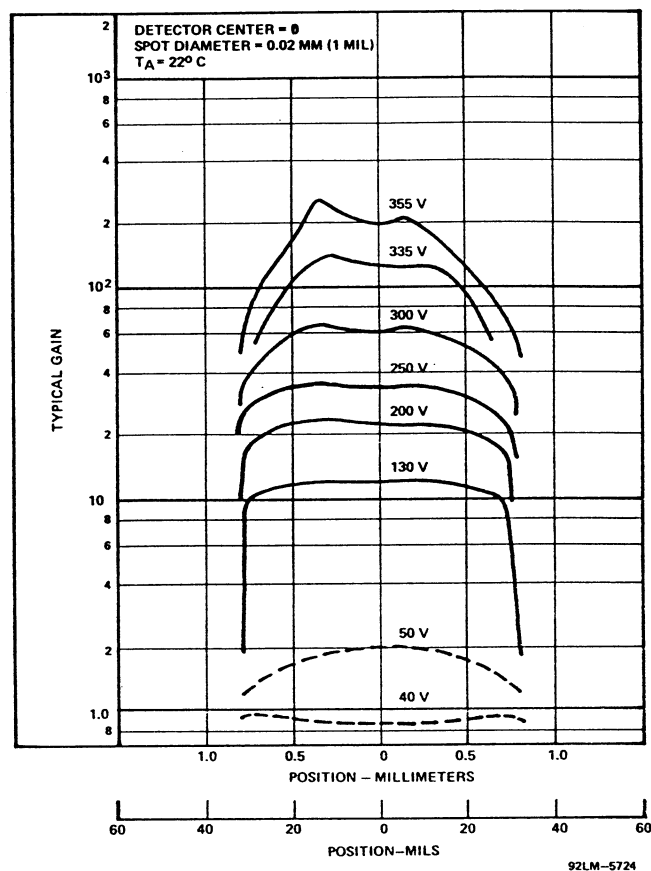


Figure 6 — Typical Gain vs Light Spot Position

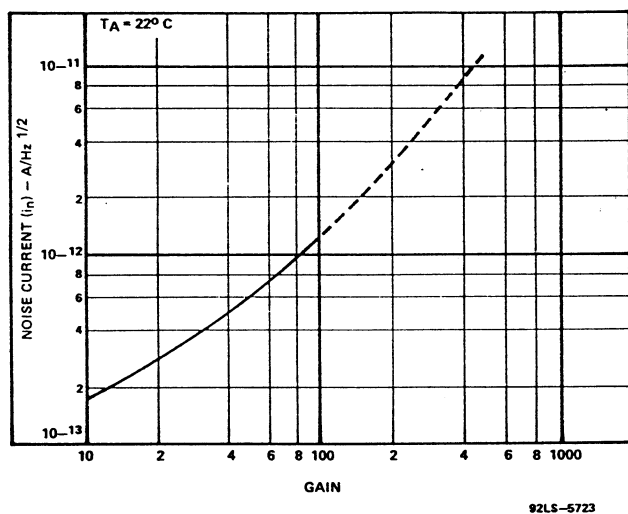


Figure 5 — Typical Noise Current vs Gain

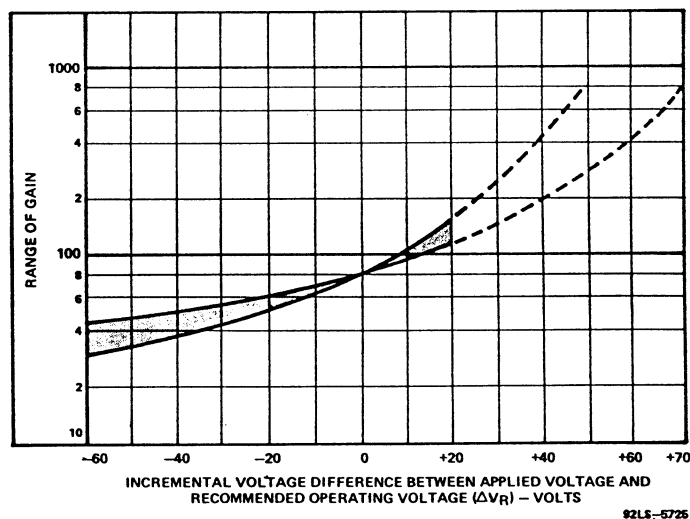
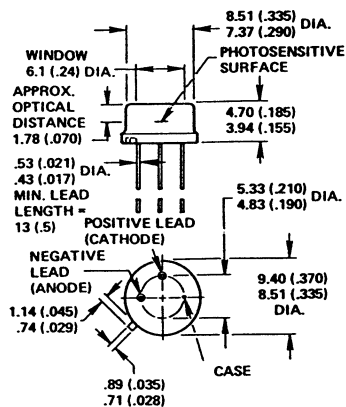


Figure 7 — Variation of Gain as a Function of Difference Between Actual Applied Operating Voltage and Recommended Operating Voltage



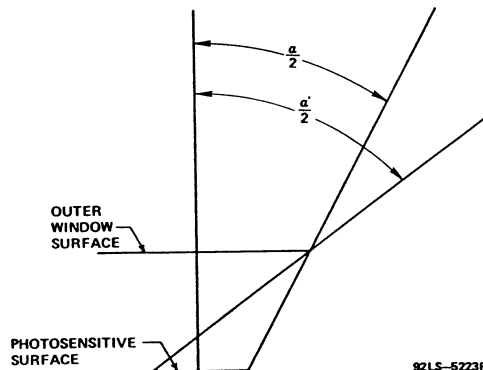
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### Low-Profile TO-5 Package

Dimensions in millimeters. Dimensions in parentheses are in inches.

**Note:** Optical distance is defined as the distance from the surface of the silicon chip to the front surface of the window.

Figure 8 — Dimensional Outline



92LS-5223R1

For incident radiation at angles  $\leq \frac{\alpha}{2}$ , the photosensitive surface is totally illuminated.

For incident radiation at angles  $> \frac{\alpha}{2}$  but  $\leq \frac{\alpha'}{2}$ , the photosensitive surface is partially illuminated.

Figure 9 — Definition of Half-Angle Approx. Field-of-View (Scale is exaggerated for clarity)

