

C30902 Family of Reach-Through APDs for Linear and Geiger Mode Operation

APDs for low light level detection and photon counting



Excelitas' C30902 Family of Avalanche Photodiodes are high speed, large area Silicon Reach-Through APDs that provide high responsivity at low noise. They are especially designed for low light applications such as Photon Counting and can be used either in Geiger Mode ($V_{OP} > V_{BD}$) or Linear Mode ($V_{OP} < V_{BD}$) with Gains up to 250.

Key Features

- Spectral response 400 nm – 1100 nm
- Low Dark Current / Dark Count Rate
- Low Noise at Room Temperature
- SPAD for photon counting applications
- High quantum efficiency of 84% at 800 nm
- Large active area of 500 μm
- RoHS compliant

Applications

- LiDAR / ToF measurements
- Quantum Communication
- Small-signal fluorescence
- Optical time-domain reflectometer (OTDR)
- Laser scanning

All specifications are referring to an ambient temperature of $T_A = 22^\circ\text{C}$ and $\lambda = 800\text{ nm}$.

Table 1: Key parameters

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Breakdown Voltage	V_{BD}	185	225	260	V
Spectral Range	$\Delta\lambda$	400		1100	nm
Peak Responsivity	λ_{peak}		800		nm
Quantum Efficiency ¹	QE		84		%

Note 1: Quantum Efficiency is not a directly measureable quantity. The above specified typical parameter is linked to the typical responsivity by $QE = \frac{1240R}{\lambda M}$

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Table 2: Ordering Information

Parameter	C30902							C30921EH
	EH	EH-2	BH	SH	SH-2	SH-TC	SH-DTC	
Reach-Through APD					X			
Geiger Mode SPAD				X	X	X	X	
Ball Lens			X					
Flat Glass Window	X	X		X	X	X	X	
Active Area Shape						Circular		
Useful Area						0.2 mm ²		
Useful Diameter						0.5 mm ²		
905 nm Filter		X			X			
TO-18 package	X	X	X	X	X			X
TO-66 flange outline						X	X	
Light Pipe								X

Table 3: Absolute Maximum Ratings

Parameter	Symbol	Condition	Value	Units
Forward Current	I _F	RMS	5	mA
		Single Peak, 1 s	50	
Total Power dissipation	P _{tot}		60	mW
Reverse Current	I _R	RMS	0.2	mA
		Single Peak, 1s	1	
Storage Temperature	T _S		-60 ... 100	°C
Operating Temperature	T _{Op}		-40 ... 85	

Note 1: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device.

Note 2: Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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Technical drawing of the 3000 Series Photodiode showing three views: top, side, and bottom.

Top View Dimensions:

- Outer diameter: $\varnothing 5.41$ [.213]
- Inner diameter: $\varnothing 3.94$ [.155]

Side View Dimensions:

- Top flange diameter: $\varnothing 4.70$ [.185]
- Reference plane diameter: 2.52 [.099]
- Reference plane to top flange: 3.89 [.153]
- Reference plane to bottom flange: 12.7 MIN [.50]
- Bottom flange diameter: 2X $\varnothing 0.44$ [.018]

Bottom View Dimensions:

- Inner diameter: $\varnothing 2.54$ [.100]
- Labels: ANODE (-) and CATHODE (+)

3D Isometric View:

Shows the photodiode with its top flange and two leads.

Dimensions are in millimeters [inches] and are for reference only.

Technical drawing of a photodiode showing three views: top, side, and perspective.

Top View Dimensions:

- Overall diameter: $\phi 5.41 [.213]$

Side View Dimensions:

- Overall length: $5.23 [.206]$
- Internal diameter: $\phi 4.70 [.185]$
- Photodiector reference plane offset: $2.32 [.091]$
- Minimum distance from end to anode: $12.7 [.50] \text{ MIN}$
- Anode (-) and Cathode (+) labels
- Distance from anode to cathode: $1.27 [.050]$
- Distance from cathode to end: $2X \phi 0.44 [.018]$

Perspective View:

- Shows the cylindrical body and the two leads.

Legend:

DIMENSIONS ARE IN MILLIMETERS [INCHES]
AND ARE FOR REFERENCE ONLY

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Figure 3: TO-18 Dimensions C30902BH

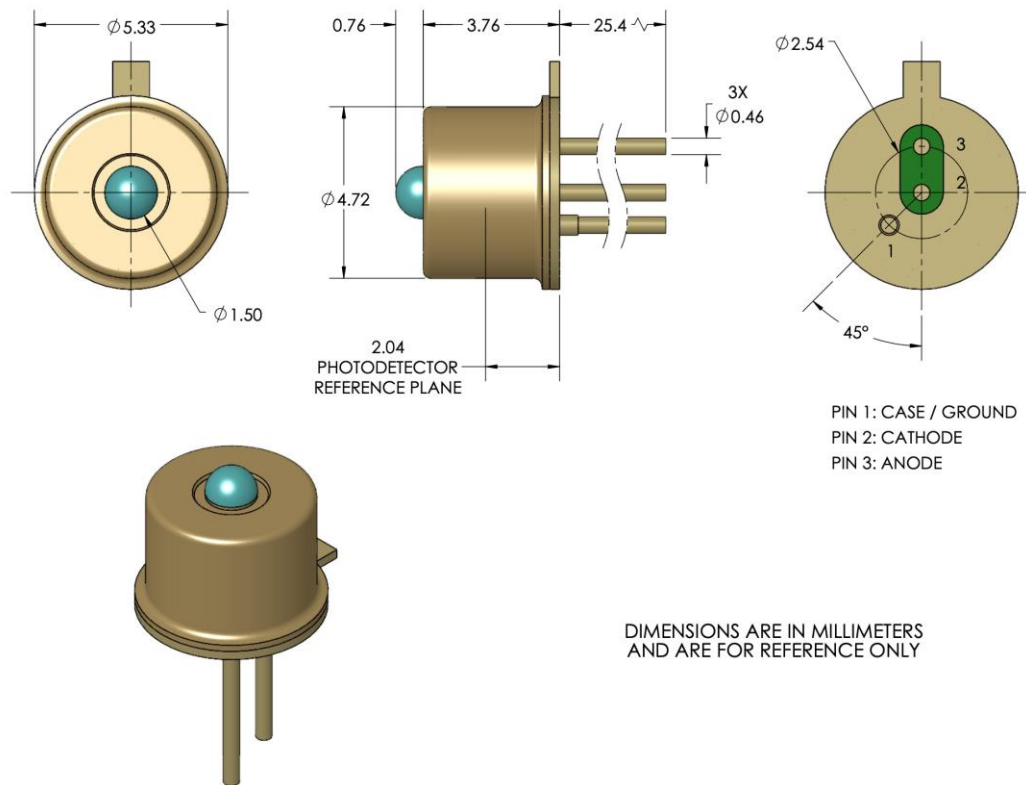
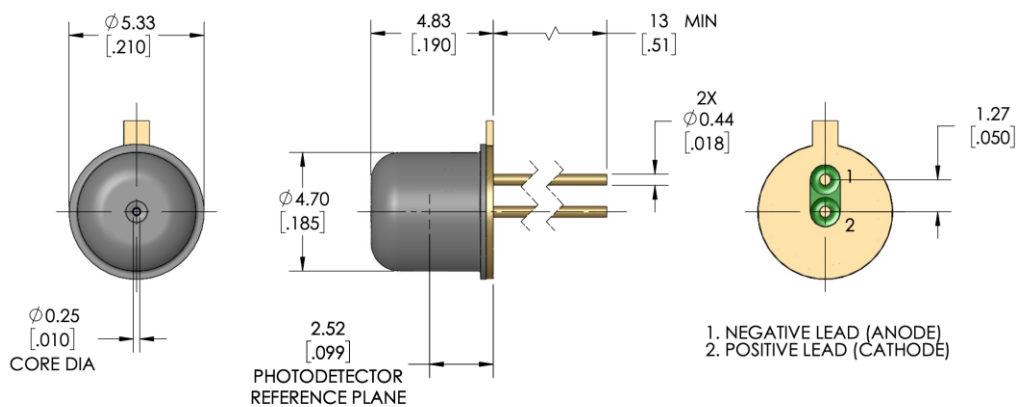


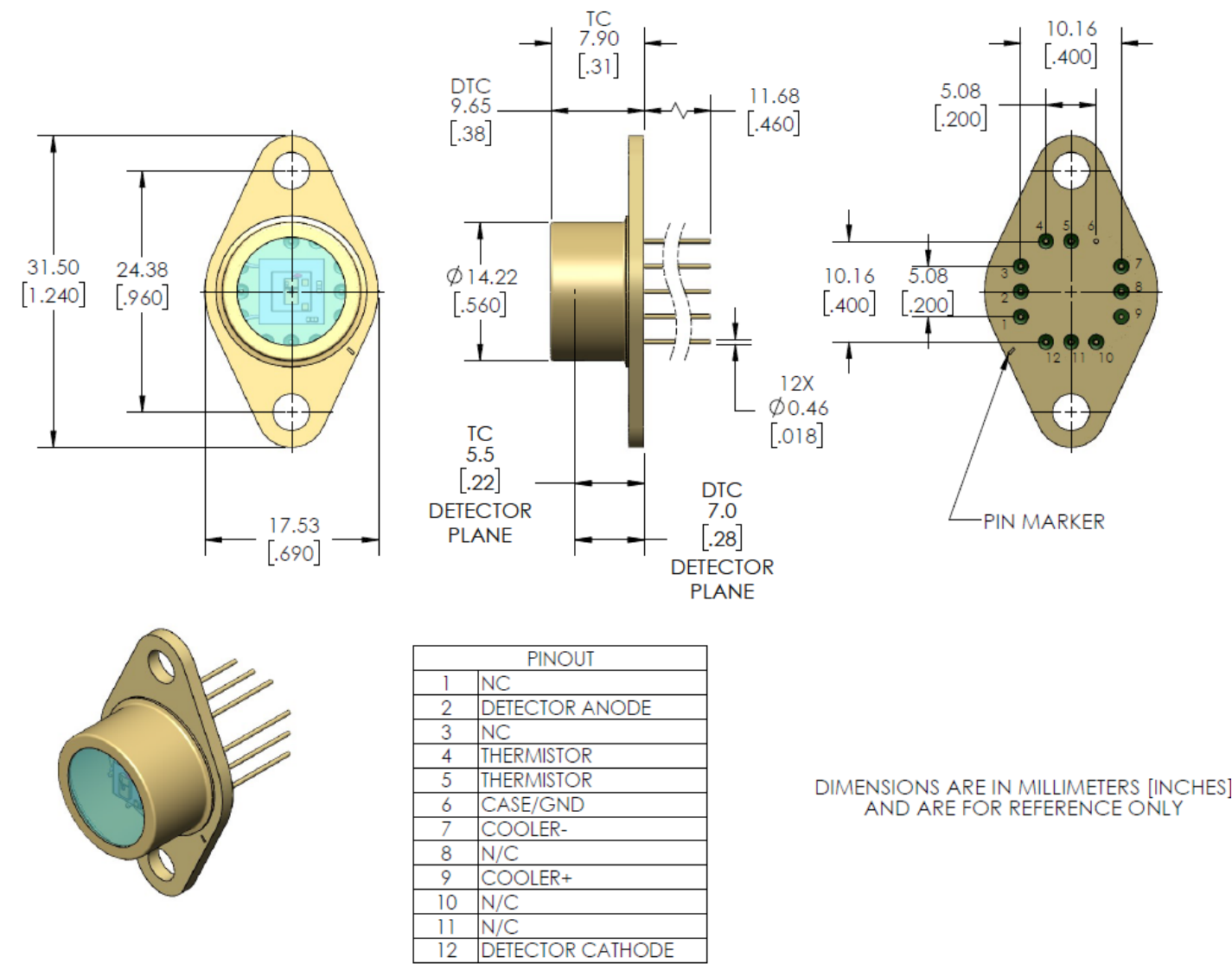
Figure 4: TO-18 Dimensions C30921EH



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Figure 5: TO-66 Dimensions C30902SH-TC / C30902SH-DTC



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Information

Excelitas Technologies' C30902EH series of avalanche photodiodes is fabricated with a double-diffused "reach-through" structure. This structure provides high responsivity between 400 nm and 1000 nm as well as extremely fast rise and fall times at all wavelengths. The responsivity of the device is independent of a modulation frequency up to about 800 MHz. The C30902SH series of silicon SPADs provide extremely low noise and bulk dark-current enabling very high performance data and distance measurements. They are especially well suited for ultra-low light level detection applications (e.g. single photon counting and quantum communication) and intended for use with optical powers less than 1 pW. The C30902SH can be used in either the linear mode ($V_{OP} < V_{BD}$) at typical gains of 250 or greater, or in "Geiger" mode ($V_{OP} > V_{BD}$) with extremely low and stable dark count rates and after pulsing ratios. In this mode, no amplifiers are necessary and single-photon detection probabilities of up to approximately 50% are possible. For even greater performance, these high performance SPADs are available with single or dual-stage thermoelectric coolers.

The detector chip is hermetically-sealed behind a flat glass window in a modified TO-18 package. The useful diameter of the photosensitive surface is 0.5 mm.

The C30921EH is packaged in a lightpipe TO-18 which allows efficient coupling of light to the detector from either a focused spot or an optical fiber up to 0.25 mm in diameter. The hermetically-sealed TO-18 package allows fibers to be mated to the end of the lightpipe to minimize signal losses without fear of endangering detector stability. The C30902EH-2, with hermetic TO-18 package with inline 905nm passband filter and the C30902BH, with hermetic ball lens, complete the C30902EH series.

Testing methods

Excelitas verifies the electro optical specifications on every device. Hence, a specific voltage, V_{OP} , is supplied with each device. When the photodiode is operated at this voltage (at 22 °C), it will meet the electrical specifications shown above. The voltage will be lower as the breakdown voltage V_{BD} .

Visual inspection during fabrication is performed as per our quality standard and failed diodes are removed. Excelitas Technologies is certified to meet ISO-9001 and our products are designed to meet MIL-STR-883 and/or MIL-STD-750 specifications.

Packaging and shipping

The C3902EH series APDs are shipped in ESD safe plastic trays.

Storage and handling

Excelitas highly recommends to follow the below notes:

- Keep APDs in a ESD controlled environment until final assembly.
- Keep the trays closed until final assembly.
- Remove APDs from tray by using a non-metallic, ESD safe tweezer.

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RoHS Compliance

This series of APD diodes are designed and built to be fully compliant with the European Union Directive on restrictions of the use of certain hazardous substances in electrical and electronic equipment.



Warranty

A standard 12-month warranty following shipment applies.

About Excelitas Technologies

Excelitas Technologies is a global technology leader focused on delivering innovative, customized solutions to meet the lighting, detection and other high-performance technology needs of OEM customers.

Excelitas has a long and rich history of serving our OEM customer base with optoelectronic sensors and modules for more than 45 years beginning with PerkinElmer, EG&G, and RCA. The constant throughout has been our innovation and commitment to delivering the highest quality solutions to our customers worldwide.

From aerospace and defense to analytical instrumentation, clinical diagnostics, medical, industrial, and safety and security applications, Excelitas Technologies is committed to enabling our customers' success in their specialty end-markets. Excelitas Technologies has approximately 7,000 employees in North America, Europe and Asia, serving customers across the world.

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