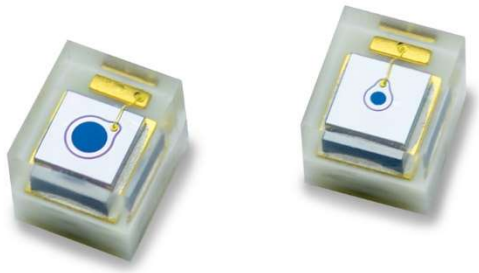
C30737MH Series – Silicon Avalanche Photodiodes (APD) in LLC SMD package

APD for High Volume LiDAR, Range Finding and Laser Meters



Excelitas' C30737MH-230 and C30737MH-500 series Avalanche Photodiodes are high speed, low breakdown voltage APDs that provide low noise and high responsivity, optimized for wavelengths of 800 nm or 900 nm. These Photodiodes are mounted inside an ultra-compact 1.75mm x 2 mm SMD package.

Key Features

- Spectral response 500 nm – 1100 nm
- High Responsivity at 800 nm and 900 nm
- Low Noise 0.1 pA/√Hz
- Large active area diameter of 230 µm and 500 µm
- Ultra Compact SMD Package (1.75 mm x 2 mm)
- Tape and Reel packaging
- RoHS compliant

Applications

- LiDAR / ToF measurements
- Laser range finding
- Speed measurements
- Optical communication systems
- 3D Laser scanning
- Gesture Recognition

All specifications are referring to an ambient temperature of T_A = 22 °C and a voltage V_{OP} that operates the APD at a Gain of M = 100, unless otherwise specified.

Table 1: Key parameters

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Breakdown Voltage[1]	V_{BD}	120		260	V
Spectral Range	Δλ	500		1100	nm
Recommended Operating Gain[2]	M		100		

Note 1: Breakdown Voltage binning available. Refer to Table 2.
Note 2: For further information on the usage at different gains, please contact our experts at Excelitas Technologies.

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Table 2: Ordering Information

Parameter	C30737MH	-	###	-	##	X
EPI APD	**X**					
Ultra Compact LLC SMD package	**X**					
Circular Active Area	**X**					
230 µm useful diameter			**230**			
500 µm useful diameter			**500**			
Optimized for 800 nm					**80**	
Optimized for 900 nm					**90**	
V_{BD} = 120 – 160 V[1,3,4]						**A**
V_{BD} = 160 – 200 V[1]						**B**
V_{BD} = 180 – 220 V[2,3,5]						**C**
V_{BD} = 220 – 260 V[2]						**D**
No V_{BD} binning						**N**

Note 1: Binning A and B are available for 800 nm optimized APDs (C30737MH-230-80X, C30737MH-500-80X).
Note 2: Binning C and D are available for 900 nm optimized APDs (C30737MH-230-90X, C30737MH-500-90X).
Note 3: Bandwidth tends to be lower for lower breakdown voltage bins. Please contact our experts at Excelitas Technologies for further information.
Note 4: Bins A and B may overlap by 2 V.
Note 5: Bins C and D may overlap by 5 V.

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}		2	mW
Reverse Current	I_R	RMS	5	µA
		Single Peak, 10 ns	400	
Reverse Current Density	J_R	RMS	0.1	mA/mm^2
		Single Peak, 10 ns	10	
Storage Temperature	T_S		-50 … 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.

Table 4: Optical Specifications C30737MH-230-80 / C30737MH-500-80

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Peak Responsivity	λ_{peak}		800		nm
Responsivity @λ = 800 nm	R		50		A/W
Quantum Efficiency @λ = 800 nm[1]	QE		78		%
Rise Time / Fall Time[2]	t_r / t_f		0.3		ns
Bandwidth	f_{3dB}		1.3		GHz

Table 5: Optical Specifications C30737MH-230-90 / C30737MH-500-90

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Peak Responsivity	λ_{peak}		900		nm
Responsivity @λ = 900 nm	R		60		A/W
Quantum Efficiency @λ = 900 nm[1]	QE		83		%
Rise Time / Fall Time[2]	t_r / t_f		0.9		ns
Bandwidth	f_{3dB}		400		MHz

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

Note 2: As estimated by $t_{r/f} = \frac{0.35}{f_{3dB}}$.

Table 6: Electrical Specifications C30737MH-230-80 / C30737MH-500-80

Parameter	Symbol	Minimum	Typical	Maximum	Units
Breakdown Voltage	V_{BD}	120		210	V
Temperature Coefficient of V_{BD}	$\Delta V/\Delta T$		0.5		V/°C
Capacitance	C_{230}		1		pF
	C_{500}		2		
Dark Current[1]	$i_{D,230}$		0.05	0.5	nA
	$i_{D,500}$		0.1	1	
Dark Noise[2]	i_N		0.1		pA/√Hz
Noise Equivalent Power[3]	NEP		2.0		fW/√Hz

Table 7: Electrical Specifications C30737MH-230-90 / C30737MH-500-90

Parameter	Symbol	Minimum	Typical	Maximum	Units
Breakdown Voltage	V_{BD}	180		260	V
Temperature Coefficient of V_{BD}	$\Delta V/\Delta T$		1.3		V/°C
Capacitance	C_{230}		0.6		pF
	C_{500}		1		
Dark Current[1]	$i_{D,230}$		0.05	0.5	nA
	$i_{D,500}$		0.1	1	
Dark Noise[2]	i_N		0.1		pA/√Hz
Noise Equivalent Power[3]	NEP		1.7		fW/√Hz

Note 1: Surface (i_{DS}) and bulk (i_{DB}) dark current are contributing to the total dark current by $\boldsymbol{i_D = i_{DS} + i_{DB}M}$.
Note 2: Due to the natural fluctuations of amplified charge carriers the APD will also generate noise when not illuminated. Since the noise characteristics and hence the signal-to-noise ratio (SNR) are dependant on the bandwidth (B) and operating wavelength (λ) inside the final system the illuminated noise

$$\boldsymbol{i_{ill} = \sqrt{2qB[i_{DS} + (i_{DB}M^2 + R_0(\lambda)M^2P)F]}}$$

needs to be considered. Hence the SNR is defined as:

$$\boldsymbol{SNR = \frac{i_P^2}{i_{ill}^2} = \frac{(PR_0(\lambda)M)^2}{i_{ill}^2}}$$

with P the incident optical power in W, $R_0(\lambda)$ the intrinsic (M = 1) responsivity in A/W, q the charge carrier and an excess noise factor of typical 6.9 for silicon materials.

Note 3: The NEP is specified in dark conditions and gain of M = 100 as $\boldsymbol{NEP = \frac{i_N}{R(\lambda)}}$

Figure 1: APD Package Dimensions C30737MH Series

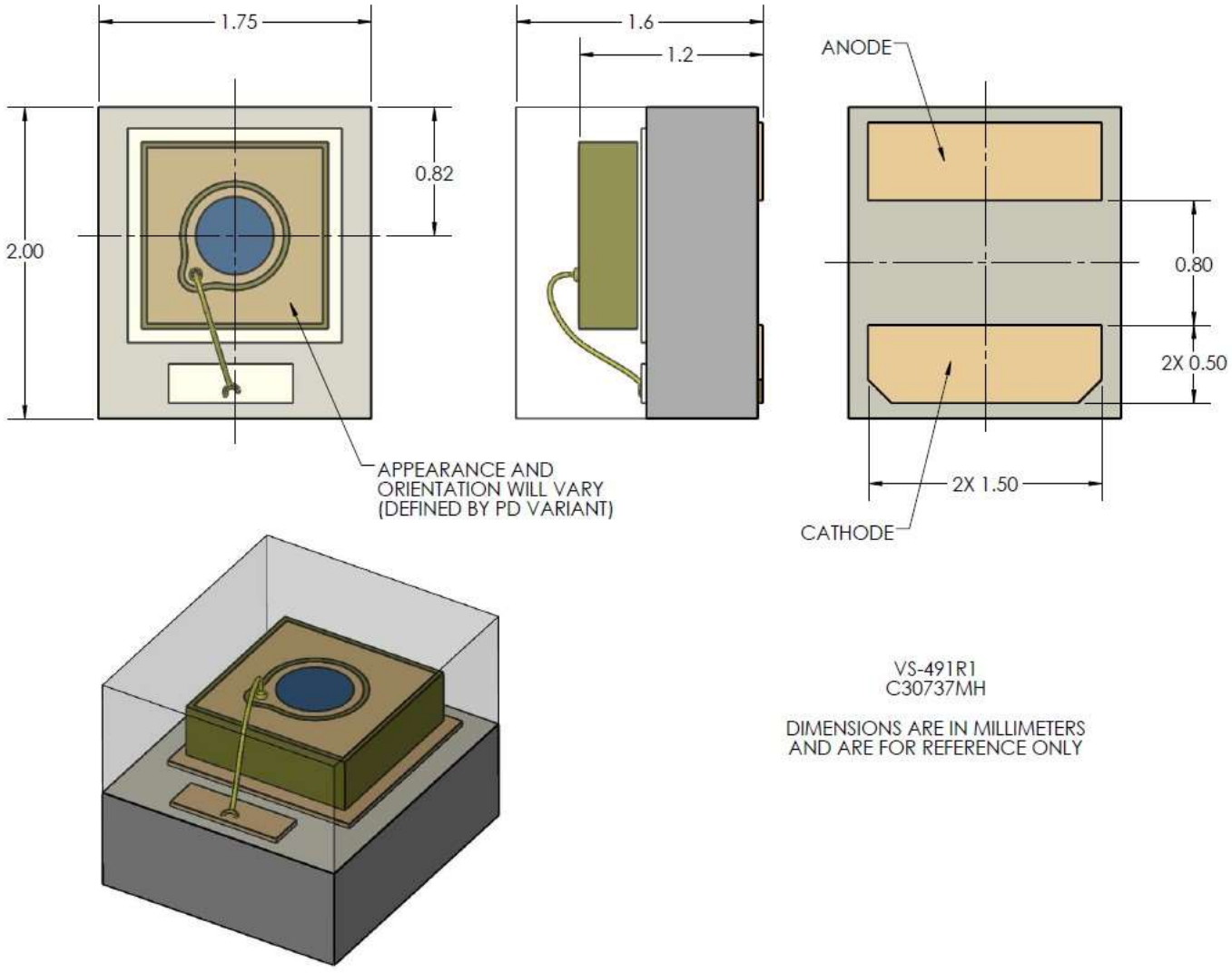


Figure 2: Typical Responsivity

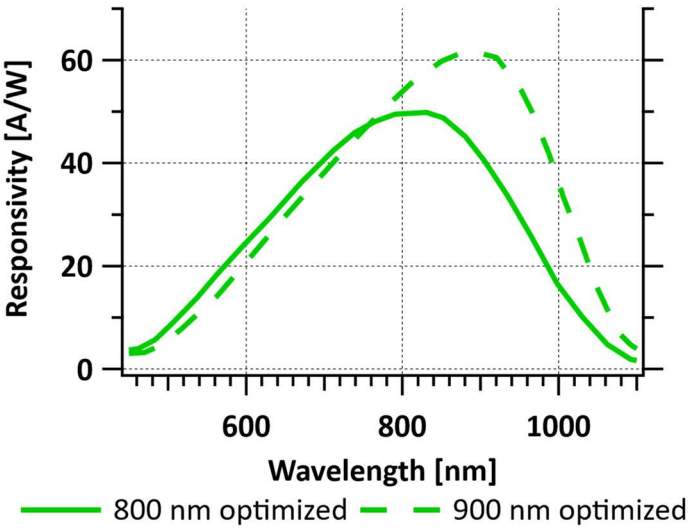


Figure 3: Typical Gain vs. Operating Voltage

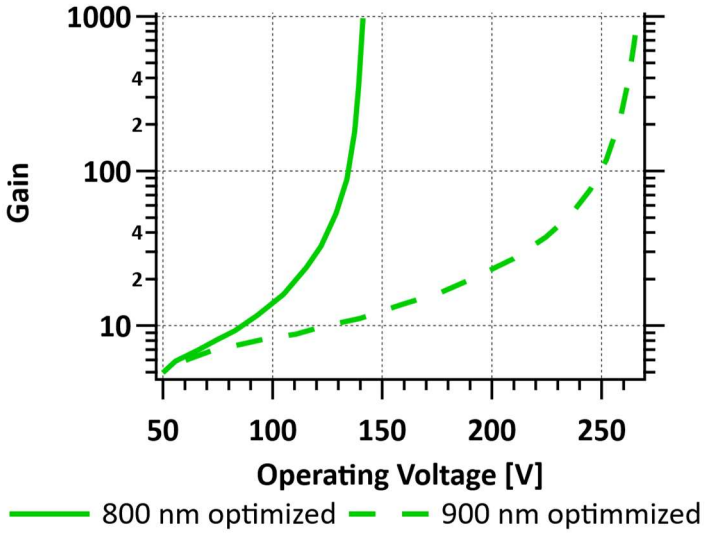


Figure 4: Typical Capacitance vs. Operating Voltage

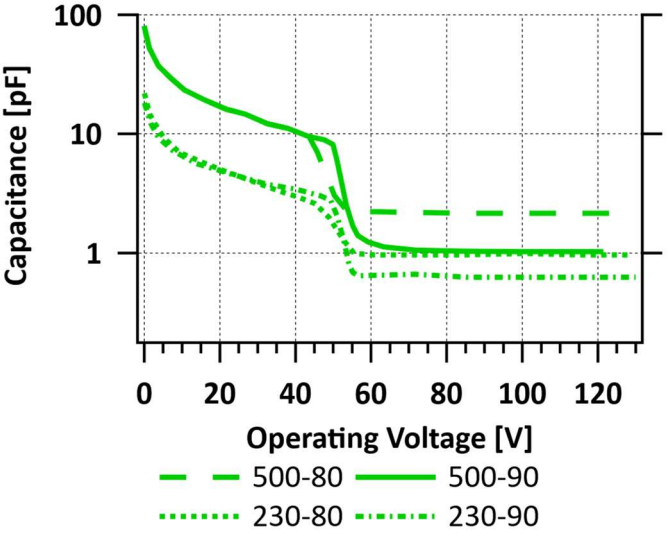


Figure 5: Typical Dark current vs. Ambient Temperature

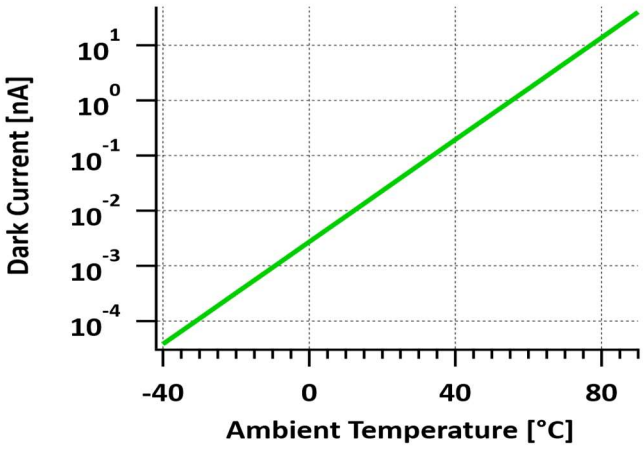
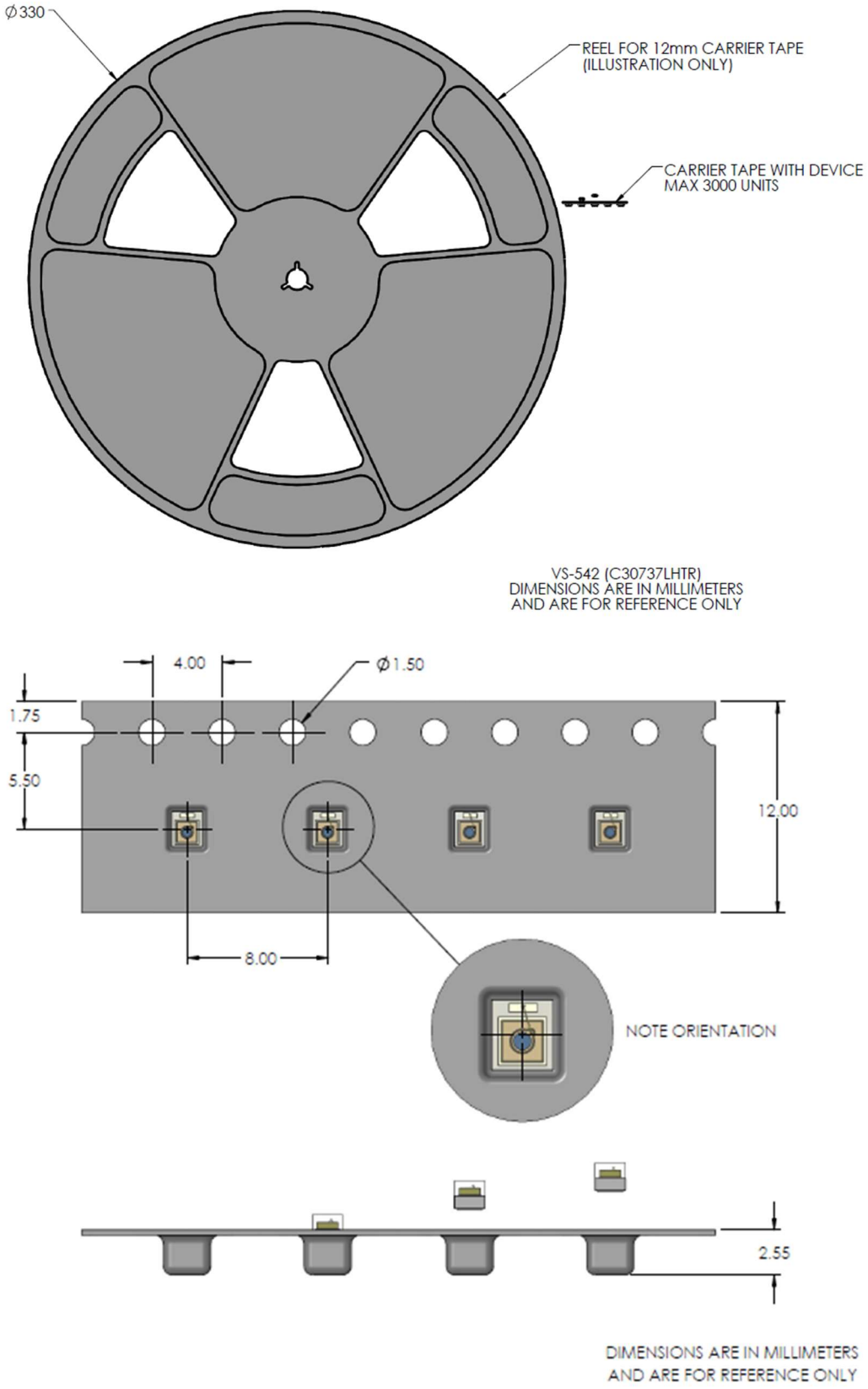


Figure 6: Tape and Reel Packing Specification



APD for High Volume LiDAR, Range Finding and Laser Meters

Information

Excelitas Technologies' C30737MH series silicon avalanche photodiodes (APD) provide high responsivity between 500 nm and 1100 nm, as well as extremely fast rise times at all wavelengths with a cut-off frequency > 1 GHz for some versions.

The APDs are available in standard sizes of 230 µm and 500 µm diameter. The diodes are mounted on a FR4 substrate leadless laminate carrier (LLC) for surface mount assembly. The encapsulation material is an epoxy resin for cost efficient and high-volume manufacturing.

The package design and assembly processing techniques are such that the die positioning is well controlled to the reference surfaces. This aids in the alignment of optical elements to the package and is superior to many of the commercially available plastic lead frame TO packages.

Testing methods

Excelitas verifies the electro optical specifications on every device. Visual inspection during fabrication is performed as per our quality standards.

Excelitas Technologies is certified to meet ISO-9001.

Packaging and shipping

All C30737MH APDs are supplied in tape and reel for quantities of 3000 units per reel; as shown in Figure 6.

For sampling quantities the APDs are shipped in Gel Pack packages.

Storage and handling

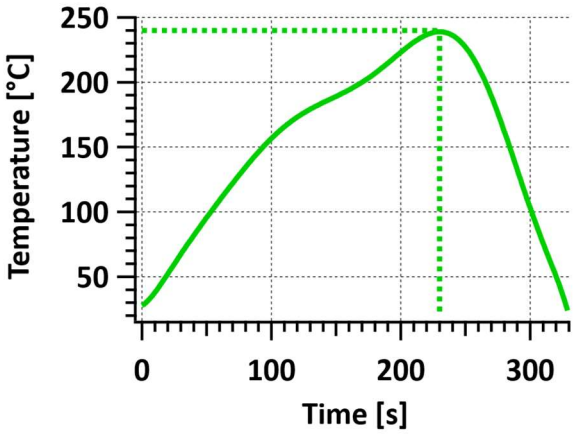
Excelitas highly recommends to follow the below guidelines:

- Keep devices in an ESD controlled environment until final assembly.
- Keep Tape & Reel package closed until final assembly.
- Remove Devices from Tape & Reel by using a vacuum pick-up tool.
- If a manual picking method is necessary, use a vacuum pick or non-metallic tweezer.

Table 8: Reflow Solder Profile

The following reflow solder profile is a typical used profile for SAC305 solder alloys. Specific solder parameters depend on the solder alloy used.

Profile Feature	Symbol	Typical	Units
Minimum Sparkling Temperature	T_{Smin}	150	°C
Maximum Sparkling Temperature	T_{Smax}	200	°C
Sparkling Time	t_S	75	s
Minimum Reflow Temperature	T_L	217	°C
Peak Temperature	T_P	244	°C
Reflow Time	t_L	65	s
Time within T_P - 5°C	t_P	25	s
Ramp Down Rate	ΔT_c	2	°C/s



MSL rating

The series of PIN diodes comply with a moisture sensitivity level (MSL) rating of 2A as defined in IPC/JEDEC-J-STD-033C. This allows for up to 4 weeks floor life at ≤ 30 °C / 60% RH once removed from the sealed reel packaging. For complete details refer to the IPC/JEDEC-J-STD-033C specification.

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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. Any warranty is null and void if the photodiode window has been opened.

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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