

C30733EH-1 High Gain InGaAs APD series

Low Noise Avalanche Photodiodes for OTDR applications



Excelitas' C30733EH-1 series Avalanche Photodiodes in metal TO-can are high speed, high gain, and low noise InGaAs APDs especially designed for OTDR applications.

Key Features

- Spectral response 1000 nm – 1700 nm
- Typical Operation Gain of 40
- Small Active Area of 30 μm
- High responsivity
- Low dark current and noise
- Robust and hermetic metal TO-can
- RoHS compliant

Applications

- Optical time-domain reflectometer (OTDR)
- Optical communication systems
- LiDAR / ToF measurements
- Eye-safe Laser range finding
- Low Light Level Detection

All specifications are referring to an ambient temperature of $T_A = 22^\circ\text{C}$, $\lambda = 1550\text{ nm}$ and $M = 40$, unless otherwise specified.

Table 1: Key parameters

Parameter	Symbol	Min	Typ	Max	Unit
Breakdown Voltage	V_{BD}	45	50	70	V
Spectral Range	$\Delta\lambda$	1000		1700	nm
Peak Responsivity	λ_{peak}		1550		nm
Responsivity @ M_{min} and M_{typ}	R	9.4	37.6		A/W
Recommended Operating Gain ¹	M	10	40		

Note 1: 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	C30733EH-1	Units
Active Area Shape	Circular	
Useful Area	707	μm^2
Useful Diameter	30	μm

Table 3: Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Forward Current	I_F	5	mA
Reverse Current	I_R	0.4	mA
Total Power Dissipation	P_{tot}	20	mW
Storage Temperature	T_S	-60 ... 125	$^{\circ}\text{C}$
Operating Temperature	T_{Op}	-20 ... 70	$^{\circ}\text{C}$

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 C30733EH-1

Parameter	Symbol	Minimum	Typical	Maximum	Units
Rise Time / Fall Time ¹	t_r / t_f		0.12		ns
Bandwidth	$f_{3\text{dB}}$			3	GHz
Quantum Efficiency ²	QE		75		%

Note 1: As estimated by $t_{r/f} = \frac{0.35}{f_{3\text{dB}}}$

Note 2: Quantum Efficiency is a not directly measurable quantity. The above specified typical parameter is linked to the typical responsivity by $QE = \frac{1240 R}{\lambda M}$.

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Table 5: Electrical Specifications C30733EH-1

Parameter	Symbol	Minimum	Typical	Maximum	Units
Temperature Coefficient of V_{BD}	$\Delta V/\Delta T$		0.14		V/°C
Capacitance	C			0.5	pF
Dark Current ^{1,4}	i_D		0.5	10.0	nA
Dark Noise ^{2,4}	i_N		0.3	0.5	pA/V(Hz)
Noise Equivalent Power ^{3,4}	NEP		8	13	fW/V(Hz)

Note 1: Surface (i_{DS}) and bulk (i_{DB}) dark current are contributing to the total dark current by $i_D = i_{DS} + i_{DB}M$.

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 dependent on the bandwidth (f_{3dB}) and operating wavelength (λ) inside the final system the illuminated noise

$$i_{ill} = \sqrt{2qf_{3dB}[i_{DS} + (i_{DB}M^2 + R_0(\lambda)M^2P)F]}$$

needs to be considered. Hence the SNR defines as

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

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 5.5 for InGaAs materials.

Note 3: The NEP is specified in dark conditions as $NEP = \frac{i_N}{R(\lambda)}$

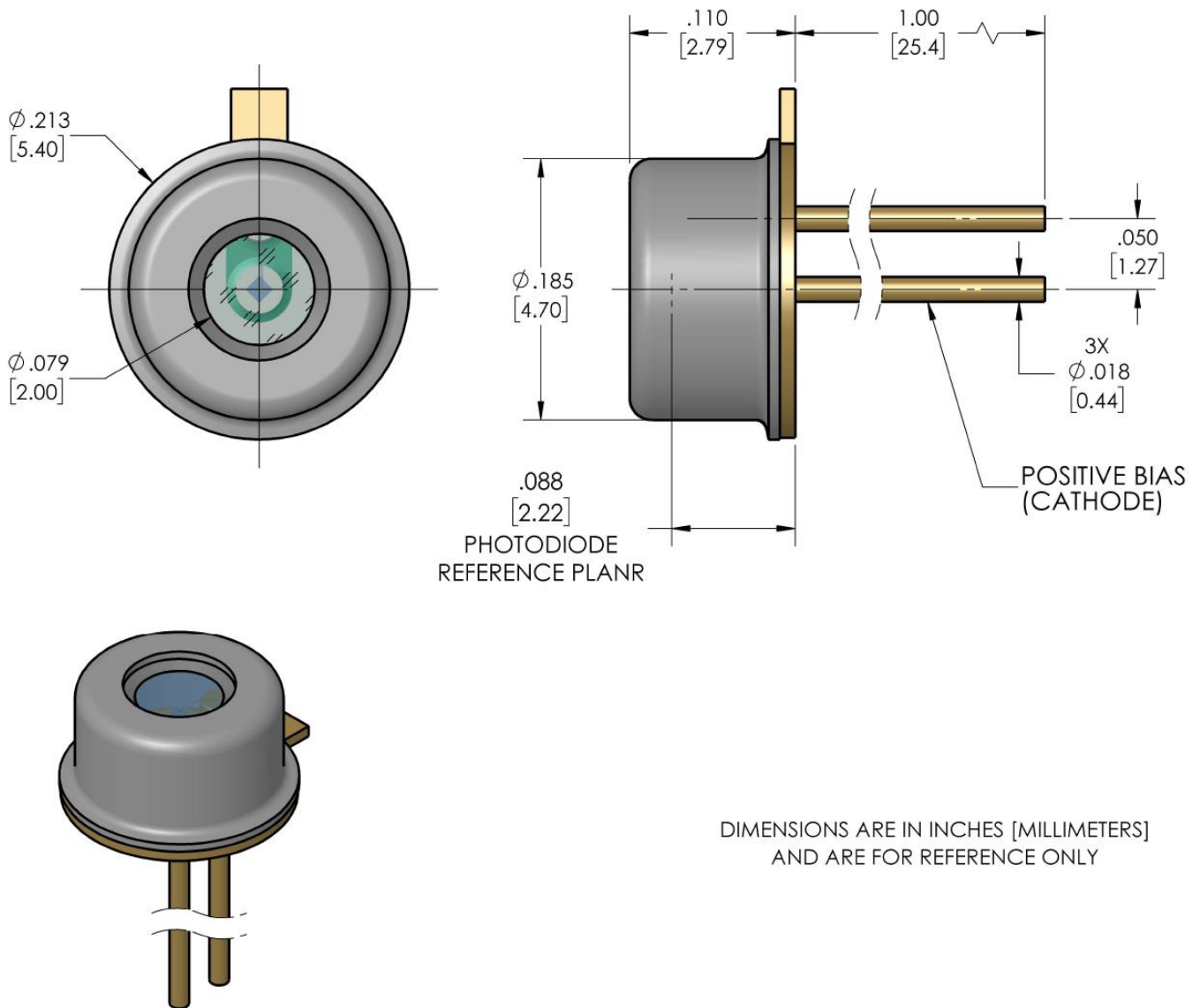
Note 4: Specified for Gain $M = 40$.

The optimum Operation Point for M can be identified by a Signal-to-Noise-Ratio analysis as described in Note 2.

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Figure 1: Mechanical Characteristics



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Figure 2: Typical Responsivity

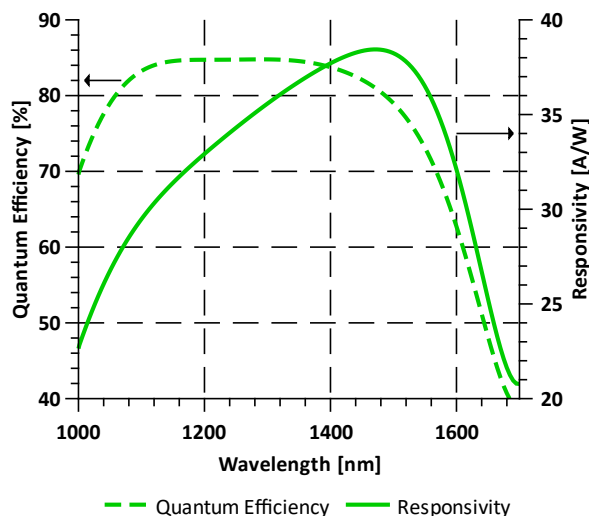


Figure 3: Typical Dark Noise

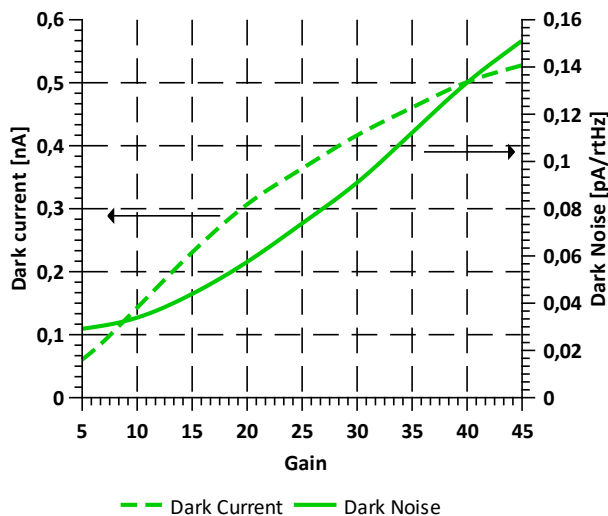


Figure 4: Typical Gain

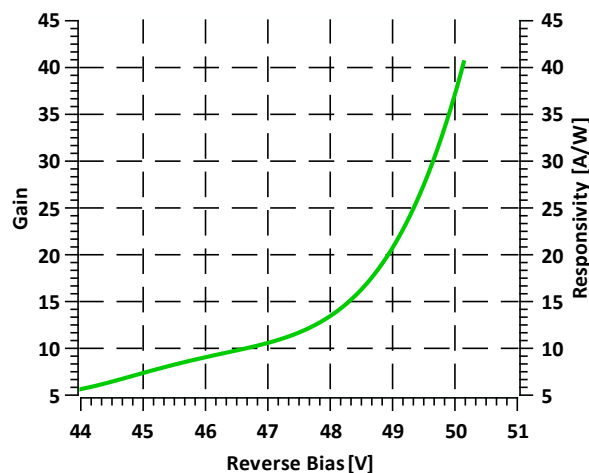
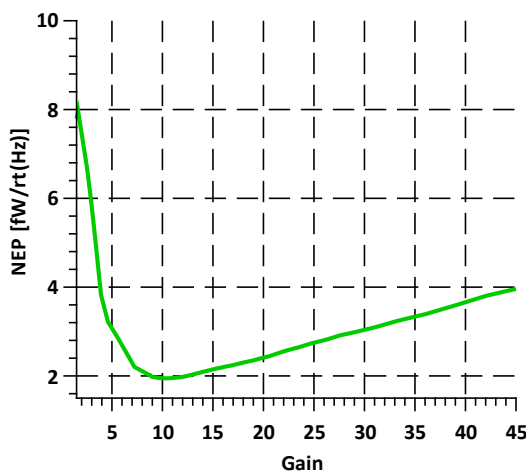


Figure 5: Typical Noise Equivalent Power



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Information

Excelitas Technologies' C30733EH-1 High Gain APDs are small size, high speed InGaAs/InP avalanche photodiodes. Due to the small active area of only 30 μm these photodiodes provide highest gains at high quantum efficiency. Their low noise levels provide high signal to noise ratios and low NEP values, perfectly suited for small signal applications as OTDR.

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.

Visual inspection during fabrication is performed as per our quality standard and failed dies are removed.

The following parameters are part of Excelitas testing procedures:

- Measurement at 1300 nm or 1550 nm
- Breakdown Voltage ($I_R = 1 \mu\text{A}$)
- Reach-Through Voltage
- Operating Voltage ($M = 40$)
- Dark Current ($M = 40$)

Excelitas Technologies is certified to meet ISO-9001 and are designed to meet MIL-STD-883 and/or MIL-STD-750 specifications.

Packaging and shipping

The modules are shipped in individually sealed plastic packages.

Storage and handling

Excelitas highly recommends following the below notes:

- Keep devices in an ESD controlled environment until final assembly.
- Do not open any housings.

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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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