C30645 and C30662 Series

Large Area InGaAs Avalanche Photodiodes

Key Features

- Spectral response 1100 - 1700 nm
- High responsivity
- Resistant to unexpected high optical inputs
- Large area
- RoHS-compliant
- Available with lead-solder
- Low-noise products available

Applications

- Eye-safe Laser Range Finding
- Optical time-domain reflectometer (OTDR)
- Optical communication systems

The C30645 and C30662 Series Avalanche Photodiodes are high speed, large area lnGaAs/lnP APDs that provide large QE, high responsivity, and low noise.

Excelitas Technologies' C30645 and C30662 Series APDs are high speed, large area lnGaAs/lnP avalanche photodiodes. These devices provide large quantum efficiency, (QE), high responsivity and low noise in the spectral range between 1100 nm and 1700 nm. They are optimized for use at a wavelength of 1550 nm, suitable for use in eye-safe laser range-finding and LiDAR systems.

Our -7, low-noise, products take advantage of recent major investments in our iii-v wafer growth and processing facility to offer significantly lower noise specifications, providing the user with better SNR and therefore increased range from the same laser output power

These APDs are supplied in a hermetically sealed TO-18 package or on a ceramic carrier. Custom packaging is also available. Please contact Excelitas to discuss the packaging in further detail. Excelitas is committed to supplying the highest quality product to our customers.

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

All devices undergo extended burn-in and periodic process qualification programs to assure high reliability.

Table 1: Electrical Characteristics at T_A = 22°C

	C30645			C30662			
Parameter	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Units**
Active Diameter		80			200		µm
Breakdown voltage (V_{br})	45	50	70	45	50	70	V
Operation Point from Breakdown (V_{br}-V_{op}) (C30662EH-1@ M=10) (Note 6)				4.0			V
Temperature Coefficient of V_{br} for Constant Gain		0.14	0.20		0.14	0.20	V / deg C
Responsivity (@ 1550 nm)	9.3			9.3			A/W
Dark Current (@ M=10) (i_d)		2.5	15		13	35	nA
Noise Equivalent Power		25	64		60	106	fW/√Hz
Spectral Noise Current (@ M=10) (i_n)		0.2	0.6		0.7	1.5	pA/rt(Hz)
Capacitance		1.25			2.5		pF
Bandwidth (@ M=10)	1000			600	850		MHz
Quantum Efficiency (1300-1550 nm)	75			75			%
Maximum Useable Gain (M)	10	20		10	20		

Table 2: Electrical Characteristics at T_A = 22°C for low-noise C30642-7 & C30662-7

	C30645-7			C30662-7			
Parameter	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Units**
Active Diameter		80			200		µm
Breakdown voltage (V_{br})	45	50	70	45	50	70	V
Temperature Coefficient of V_{br} for Constant Gain		0.14	0.20		0.14	0.20	V / deg C
Responsivity (@ 1550 nm)	9.3			9.3			A/W
Dark Current (@ M=10) (i_d)		1	5		7.5	15	nA
Noise Equivalent Power		11	26		37	53	fW/√Hz
Spectral Noise Current (@ M=10) (i_n)		0.1	0.25		0.35	0.5	pA/rt(Hz)
Capacitance		1.25			2.5		pF
Bandwidth (@ M=10)	1000			600	850		MHz
Quantum Efficiency (1300-1550 nm)	75			75			%
Maximum Useable Gain (M)	10	20		10	20		

Notes for Tables 1 & 2

1. A specific voltage, V_{op} , is supplied with each device. When the photodiode is operated at this voltage (at 22 °C), the device will meet the electrical characteristic limits shown above. The voltage value will be within the range of 45 to 70 volts.

2. The voltage dependence of the gain, M, for gains above 4, is given approximately by the following empirical formula yielding a rough approximation of the sensitivity:
$$M \sim \frac{K}{V_{br} - V_{op}}$$
where: K will vary from APD to APD, but should be within 40-50 for most InGaAs APDs

3. Gain, M, and quantum efficiency, η, are not directly measurable quantities. The numbers quoted are estimated typical values. Gain, quantum efficiency and responsivity are related by the following: $R = \frac{\eta \lambda M}{1.24}$ expressed in A/W, where:
η is the quantum efficiency, expressed in %
λ is the wavelength in units of mm, and
M is the APD gain

4. The detector noise current expressed in $1/\sqrt{Hz}$, is given by the following expression:

$$i_n = \sqrt{2q(i_s + i_b M^2 F)}$$

where:

q is the electron charge,

$F = k_{eff} M + \left(1 - k_{eff}\right)\left(2 - \frac{1}{M}\right)$, is the excess noise factor, around 5.5 for InGaAs,

k_{eff} is ionization coefficient, typically around 0.45 for InGaAs, and

i_s and i_b are the un-multiplied and multiplied portions of the dark current, respectively.

The total dark current is given by: $i_t = i_s + i_b M$

However, since both i_s and i_b are somewhat voltage dependent, and M is not directly measurable (see Note 3), it is not usually possible to determine both i_s and i_b unambiguously. Since system performance depends on noise current and responsivity, these measurable quantities are the ones that have been specified.

5. Most devices can be operated at gains up to about 30 or more, but with values of noise current correspondingly higher, as indicated by the discussion in Note 4 above.

6. The product C30662EH can be ordered with a guaranteed minimal delta of the operation voltage bias from the voltage breakdown (V_{br}-V_{op}), also known as *deltaV* or *dV*. Using the "-1" suffix specifies a *dV* larger than 4.0 V. Please contact us for more information.

Table 3: Absolute Maximum Rating, Limiting Values

Parameter	Limits	Units
Forward Current	5	mA
Reverse Current	1	mA
Total Power dissipation	20	mW
Storage Temperature	-60 to +152	°C
Operating Temperature	-40 to +85	°C
Optical input (5ns, 10kHz)	20	MW/cm^2
Soldering Temperature (10 seconds)	250	°C

Figure 1: Spectral Responsivity Curve as a function of wavelength (M = 10)

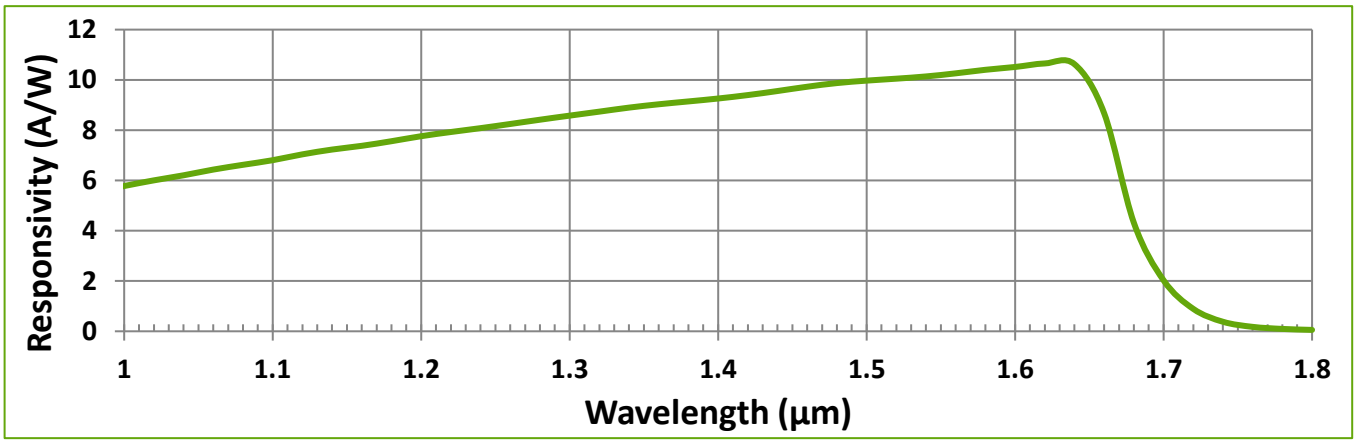


Figure 2: Typical Gain, M, as a function of voltage bias

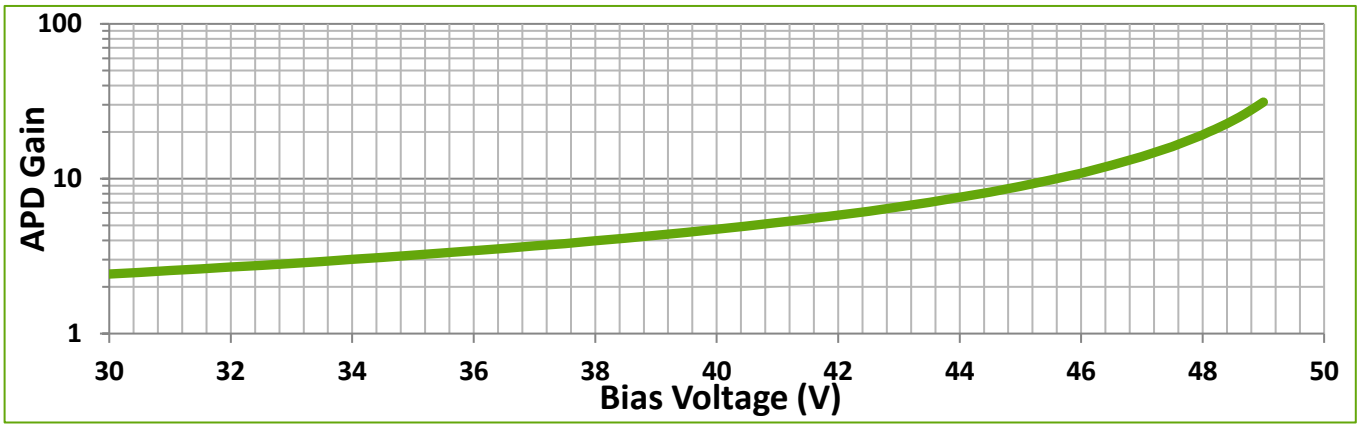


Figure 3: Typical Gain as a function of deltaV, Vbr-Vop

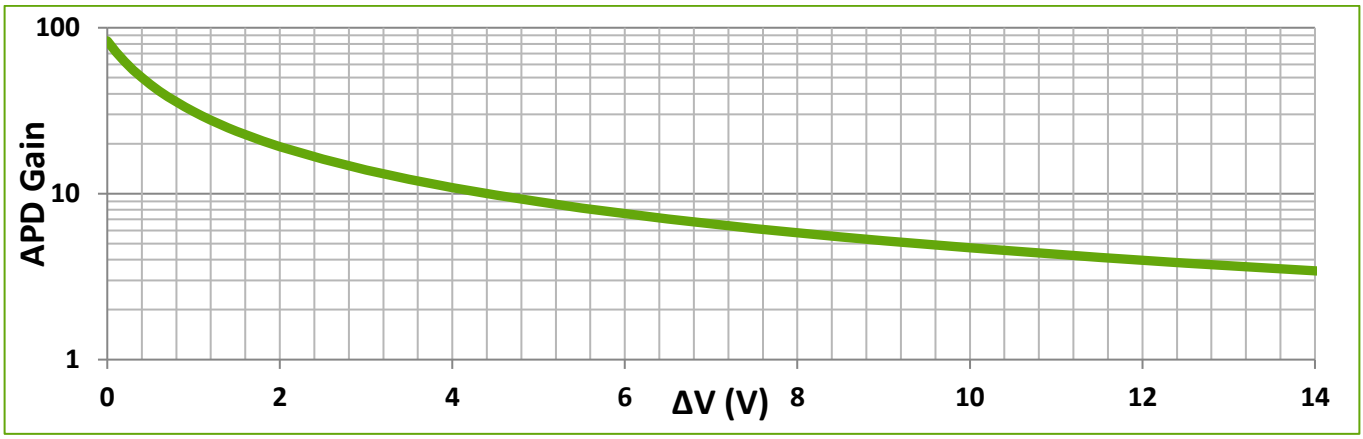


Table 4: Ordering Guide and Packaging information

Model	Active area	Package Type	Package reference	Window		RoHS compliance	Additional screening
				Material[1]	Aperture		
C30645ECERH	80µm diameter	Ceramic Carrier	See **Figure 4**	N/A	N/A	Yes	
C30645E		Standard TO-18	See **Figure 5**	Silicon	Small	No	
C30645EH		Standard TO-18	See **Figure 5**	Silicon	Small	Yes	
C30645EH-1		Standard TO-18	See **Figure 6**	Glass	Large	Yes	
C30645EH-7		Standard TO-18	See **Figure 6**	Glass	Large	Yes	
C30662ECERH	200µm diameter	Ceramic Carrier	See **Figure 4**	N/A	N/A	Yes	
C30662ECERH-1		Ceramic Carrier	See **Figure 4**	N/A	N/A	Yes	*dV* > 4.0V
C30662E		Standard TO-18	See **Figure 5**	Glass	Small	No	
C30662EH		Standard TO-18	See **Figure 6**	Glass	Large	Yes	
C30662EH-1		Standard TO-18	See **Figure 6**	Glass	Large	Yes	*dV* > 4.0V
C30662EH-3		Standard TO-18	See **Figure 5**	Glass	Small	Yes	
C30662EH-7		Standard TO-18	See **Figure 6**	Glass	Large	Yes	

Notes: *1. Glass material is transparent for visible and IR wavelengths, while Silicon blocks visible light up to about 1.1µm.*

Figure 4: Ceramic package (reference dimensions, in mm)

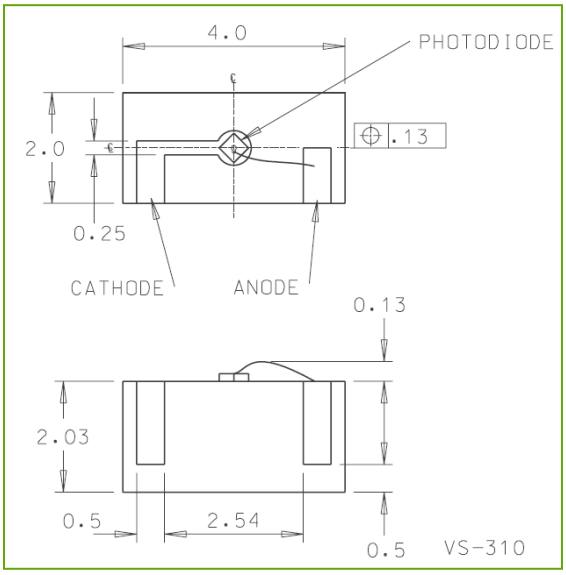


Figure 5: Standard TO-18, small aperture (reference dimensions, in mm)

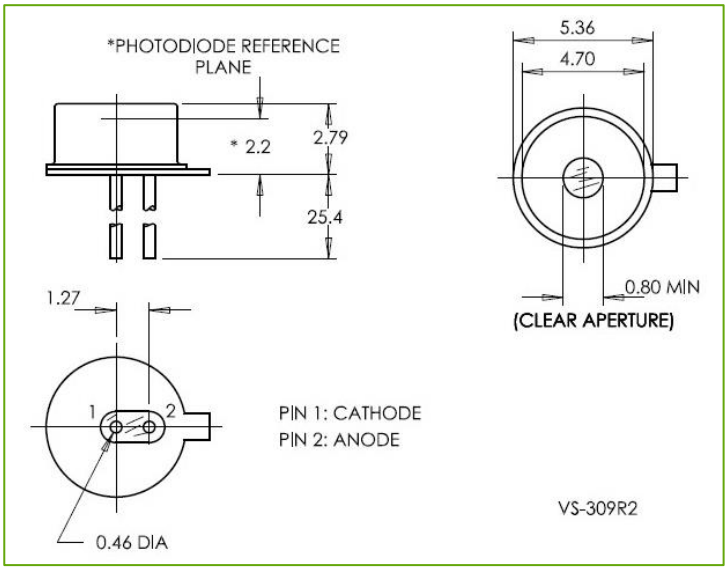
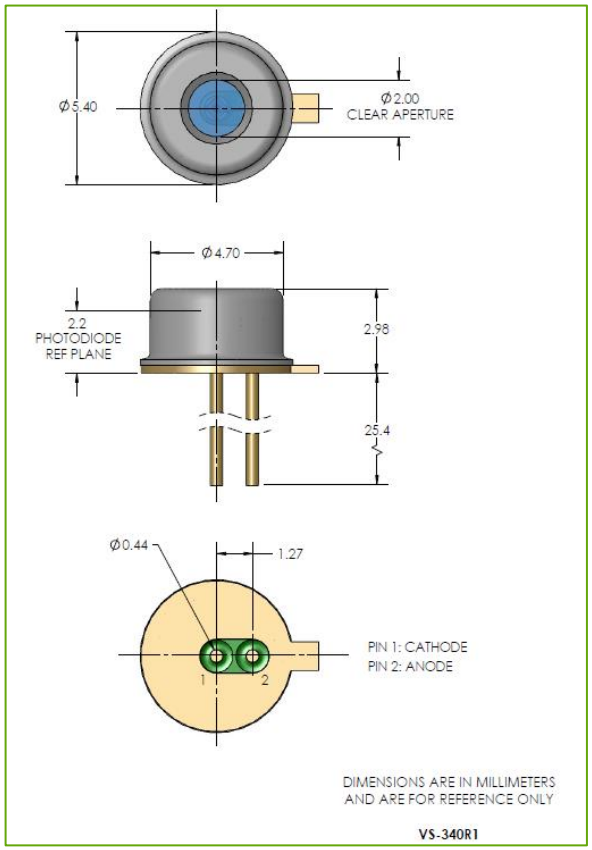


Figure 6: Standard TO-18, large aperture



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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