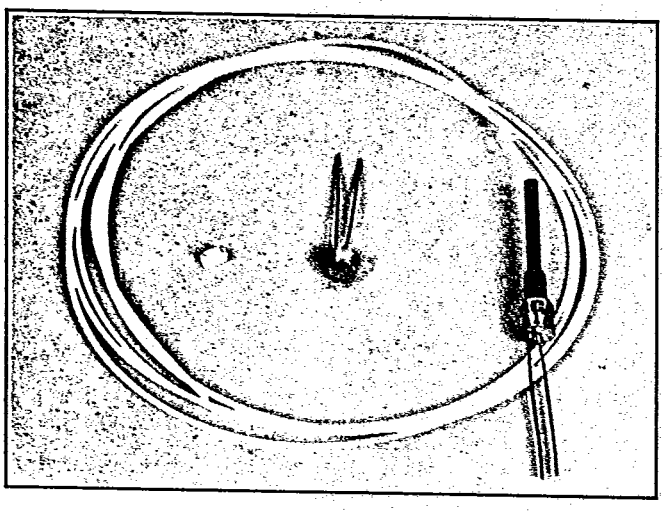
T-41-41

RCA Electro Optics

Planar InGaAs APD C30644, C30645

DATA SHEET



- Spectral response range - 1100 to 1700 nm
- High responsivity
- Low capacitance
- Fast response time
- Low dark current and noise
- Available in a variety of convenient packages

RCA C30644 and C30645 series are high speed InGaAs/InP Avalanche Photodiodes. Their structure provides fast response and good quantum efficiency in the spectral range between about 1000 nm and 1600 nm. The APD's are optimized for use in fiber optic communication systems at 1300 and 1550 wavelengths.

The planar structure with passivation layer assures stable leakage currents and high reliability over the specified temperature range of operation.

The C30644E and C30645E devices are supplied in TO-18 packages, and are hermetically sealed behind a silicon window. The -ECER versions of the APD's are mounted on ceramic blocks for use in hybrid applications. The C30645ECER is suitable for use in coupling to multimode fibers, while the C30644ECER is best suited for monomode applications.

The type C30645EQC is supplied in an hermetically sealed package, which incorporates a 50 μm core optical fiber as an integral part of the assembly. The positioning of the fiber is such that high coupling efficiency is achieved between the fiber and the avalanche photodiode.

Absolute Maximum Ratings [1]

		C30644/C30645E		C30644/C30645CER		C30645EQC		UNITS
		Min.	Max.	Min.	Max.	Min.	Max.	
Forward Current	I_F		5		5		5	mA
Total Power Dissipation	P_T		20		20		20	mW
Ambient Temper.:								
Storage	T_{STG}	-60	+125	-60	+125	-40	+80	°C
Operating	T_A	-40	+80	-40	+80	-40	+70	°C
Soldering (10s)	T_{sd}		250		250		250	°C

[1] These are limiting values of operating and environmental conditions. Exceeding these values can cause damage to the device.

Electrical Characteristics [1]

PARAMETER	C30644/C30645D C30644/C30645E			C30644/C30645DCER C30644/C30645ECER			C30645DQC C30645ECQ			UNITS
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Breakdown Voltage	50	75	95	50	75	95	50	75	95	V
Gain [3]	—	10	—	—	10	—	—	10	—	
Temperature Coefficient of V_r for constant gain		.18			.18			.18		V/°C
Quantum Efficiency [3]										
1300 nm	—	80	—	—	80	—	—	65	—	%
1550 nm	—	75	—	—	75	—	—	60	—	%
Responsivity										
1300 nm	—	8.4	—	—	8.4	—	—	6.8	—	A/W
1550 nm	—	9.4	—	—	9.4	—	—	7.5	—	A/W
Total Dark Current (C30644)	—	100	200	—	100	200	—	100	200	nA
(C30645)	—	150	250	—	150	250	—	150	250	nA
k_{eff}	—	.5	—	—	.5	—	—	.5	—	—
Noise Current [4] (C30644)	—	1.0	1.5	—	1.0	1.5	—	—	—	$pA/\sqrt{Hz}$
Noise Current [4] (C30645)	—	1.4	2.0	—	1.4	2.0	—	1.4	2.0	$pA/\sqrt{Hz}$
Capacitance (C30644)	—	0.7	1.0	—	0.3	0.5	—	0.7	1.0	pF
(C30645)	—	1.0	1.25	—	0.5	0.8	—	1.0	1.25	pF
Frequency Response (3 dB)										
M = 10 (D)[7]	700	—	—	700	—	-	700	—	-	MHz
M = 10 (E)	700	—	—	700	—	—	700	—	—	MHz
M = 2 (E)	400	—	—	400	—	—	400	—	—	MHz
Active Diameter (C30644)	—	50	—	—	50	—	—	—	—	μm
Active Diameter [6] (C30645)	—	75	—	—	75	—	—	50	—	μm

NOTES:

1. A specific voltage, V_{op}, is supplied with each device. When the photodiode is operated at this voltage (at 23°C), the device will meet the electrical characteristic limits shown above. The voltage value will be within the range 50 to 90 volts.

2. The voltage dependence of the gain, for gains above about 2, is given approximately by the following empirical formula:

$$M = \frac{50}{V_b - V}$$

3. Gain and quantum efficiency are not directly measurable quantities. The numbers quoted are estimated typical values. Gain, quantum efficiency and responsivity are related by the following:

$$R = \frac{\eta \lambda M}{1.24}$$

where: λ is the wavelength in units of μm $\quad$ η is the quantum efficiency

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

$$i_n^2 = 2q\,(I_s + I_b M^2 F)$$

where: $F = k_{eff}M + (1 - k_{eff})(2 - 1/M)$ and I_s and I_b are the unmultiplied 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 which 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. Core diameter of the pigtail in the DQC & EQC versions of this device is 50 μm.

7. The "D" versions of these APD's meet all the specifications of the "E" devices except that the minimum bandwidth of 400 MHz is not met for M = 2.

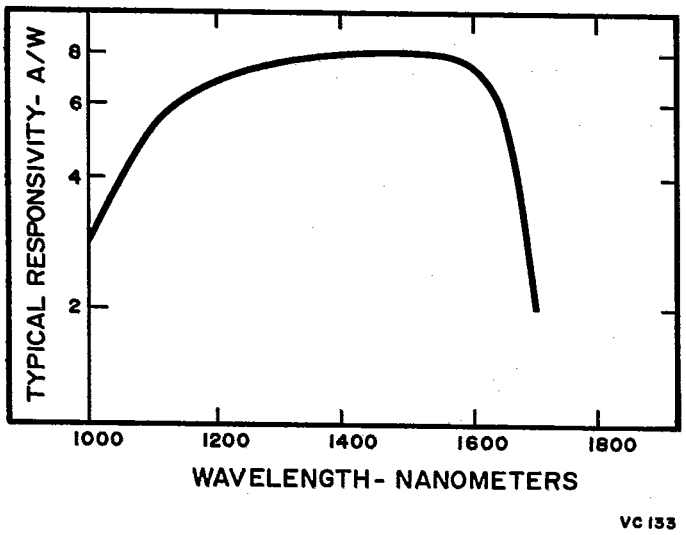


Figure 1 - Typical Spectral Responsivity

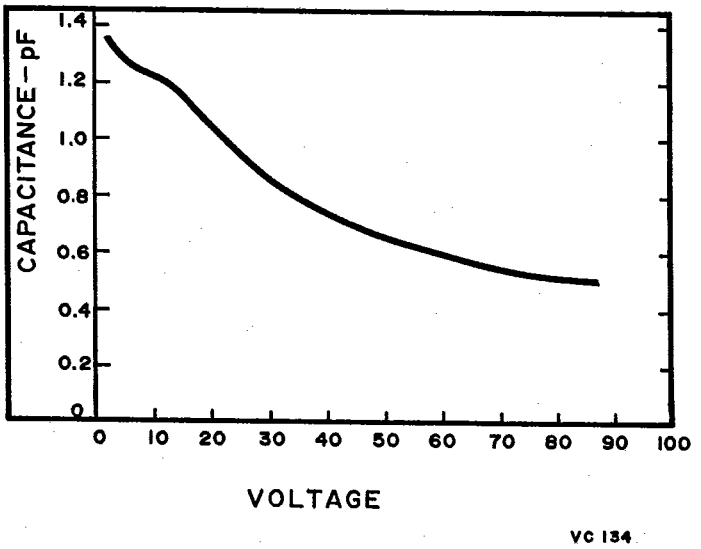


Figure 2 - Typical Capacitance vs Operating Voltage (for C30645E)

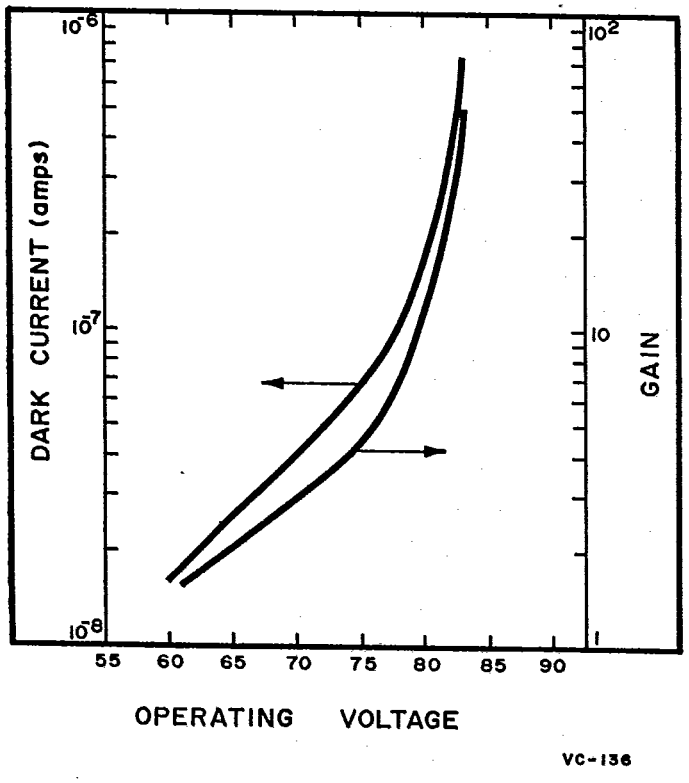


Figure 3 - Typical Dark Current and Gain vs Operating Voltage

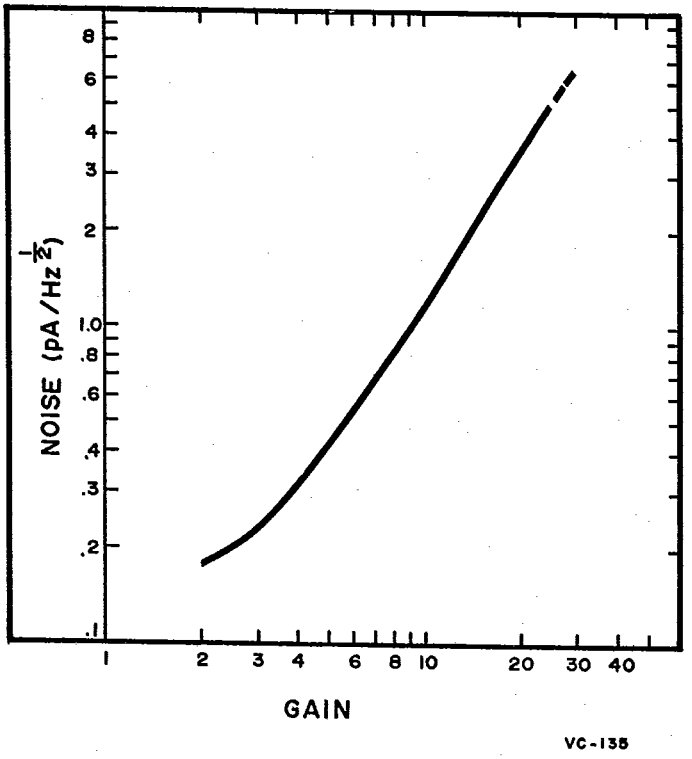


Figure 4 - Typical Noise Current vs Gain

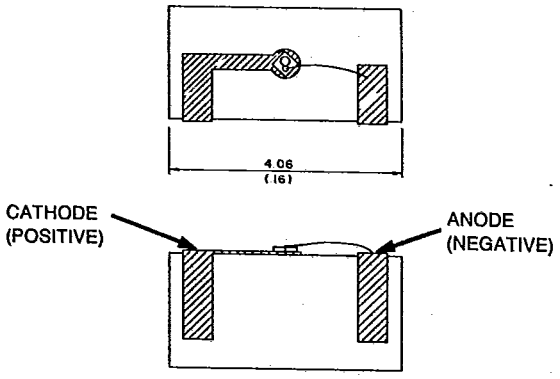


Figure 5 - CER Package: a low capacitance ceramic block for hybrid assemblies

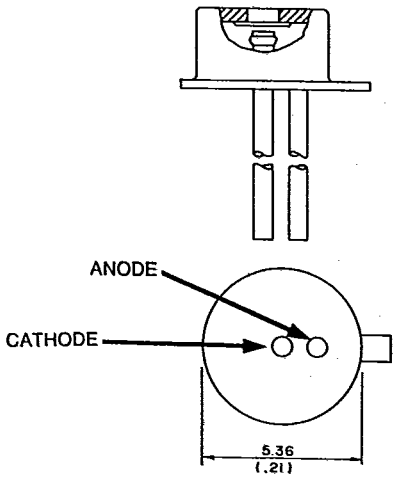


Figure 6 - E Package: TO-18 package, with a low profile silicon window to reduce the optical distance from the window surface to the chip

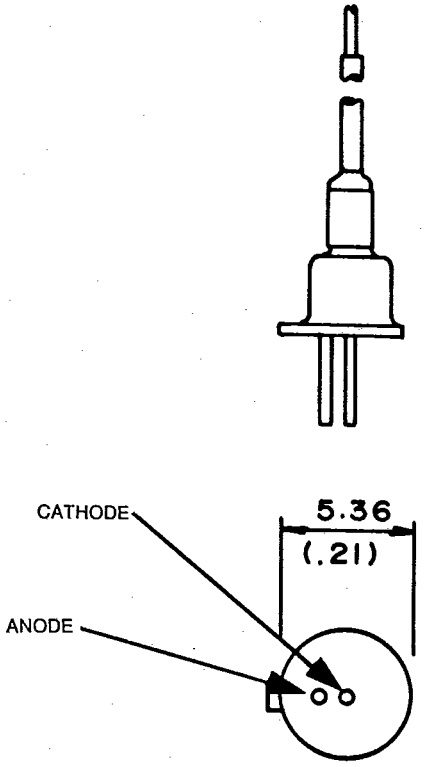


Figure 7 - EQC Package: E package with an integral fiber optic pigtail (available with C30645 only)

Dimensions in millimeters. Dimensions in parentheses are in inches.

For further information, please contact your local RCA Electro Optics representative or RCA Inc., Electro Optics, P.O. Box 900, Vaudreuil, Canada J7V 7X3
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