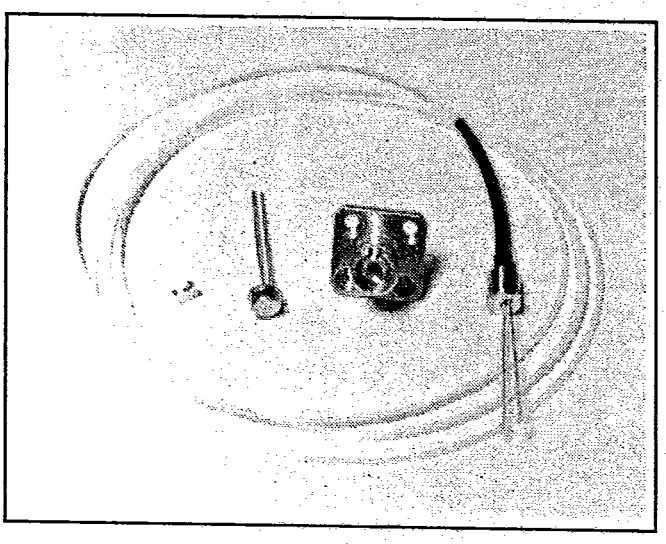
RCA Electro Optics

# Planar PIN InGaAs Photodiodes C30616, C30637, C30617

## 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's new low capacitance, high speed InGaAs photodetectors offer improved passivation and contact technologies to provide lower dark current and noise with negligible series resistance. 200°C purging, extended lifetest and periodic qualification programs assure high quality, reliable devices ideally suited for today's demanding electro-optics and communications industries.

## Absolute Maximum Ratings [1]

| | | | C30616 | | | C30637 | | | C30617 | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Forward Current | $I_F$ | | | | 5 | | | 5 | | | 5 | mA |
| Total Power Dissipation | $P_T$ | | | | 25 | | | 50 | | | 100 | mW |
| Ambient Temper.: Storage | $T_{STG}$ | CER | -60 | | +125 | -60 | | +125 | -60 | | +125 | °C |
| | | E | | | | | | | -60 | | +125 | °C |
| | | EQC | | | | | | | -40 | | +80 | °C |
| | | EFC | | | | | | | -40 | | +80 | °C |
| Operating | $T_A$ | CER | -40 | | +80 | -40 | | +80 | -40 | | +80 | °C |
| | | E | | | | | | | -40 | | +80 | °C |
| | | EQC | | | | | | | -40 | | +70 | °C |
| | | EFC | | | | | | | -40 | | +70 | °C |
| Soldering (10s) | $T_{sd}$ | (All) | | | 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
($T_A$ = 25°C, $V_r$ = -5V)

| | Sym. | Pkg. | C30616 Min. | C30616 Typ. | C30616 Max. | C30637 Min. | C30637 Typ. | C30637 Max. | C30617 Min. | C30617 Typ. | C30617 Max. | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Operating Voltage | Vr | (all) | 1 | 5 | 10 | 1 | 5 | 10 | 1 | 5 | 10 | V |
| Breakdown Voltage | Vb | (all) | 20 | 50 | | 20 | 50 | | 20 | 50 | | V |
| Responsivity at 1300 nm | $R_{1.3}$ | CER | .80 | .86 | | .80 | .86 | | .80 | .86 | | A/W |
| | | E | | | | | | | .78 | .84 | | A/W |
| | | EQC | | | | | | | .73 | .79 | | A/W |
| | | EFC (mono mode fiber) | | | | | | | .73 | .79 | | A/W |
| | | EFC (graded index fiber) | | | | | | | .62 | .68 | | A/W |
| Responsivity at 1550 nm | $R_{1.55}$ | CER | .85 | .90 | | .85 | .90 | | .85 | .90 | | A/W |
| | | E | | | | | | | .83 | .88 | | A/W |
| | | EQC | | | | | | | .80 | .85 | | A/W |
| | | EFC (mono mode fiber) | | | | | | | .80 | .85 | | A/W |
| | | EFC (graded index fiber) | | | | | | | .68 | .75 | | A/W |
| Reverse Dark Current | $I_d$ | (all) | | <1 | 2 | | <1 | 3 | | 1 | 4 | nA |
| Noise Current ( f = 10 kHz, $\Delta$f = 1.0 Hz) | $I_n$ | (all) | | <.05 | .15 | | <.05 | .15 | | <.05 | .15 | pA/Hz$^{1/2}$ |
| Capacitance | C | CER | | .35 | .55 | | .4 | .6 | | .5 | .7 | pF |
| | | E | | | | | | | | .8 | 1.0 | pF |
| | | EQC | | | | | | | | .8 | 1.0 | pF |
| | | EFC | | | | | | | | .8 | 1.0 | pF |
| Rise Time (10%-90%) | $t_r$ | (all) | | .1 | .5 | | .1 | .5 | | .1 | .5 | ns |
| Fall Time (90%-10%) | $t_f$ | (all) | | .1 | .5 | | .1 | .5 | | .1 | .5 | ns |
| Chip Photosensitive Surface Shape | | | | Circular | | | Circular | | | Circular | | |
| Useful Area | | (all) | | .002 | | | .004 | | | .008 | | mm$^2$ |
| Useful Diameter | | (all) | | 50 | | | 75 | | | 100 | | $\mu$m |

## Reliability and Quality Assurance:

RCA has implemented several programs to assure the highest quality and reliability.

These include:

1. 200°C Burn-In: All RCA InGaAs PIN photodiodes are subjected to 200°C at -10V bias for 16 hours to eliminate any weak units.

2. Lifetest: Before a wafer is sourced for production, a sample lot is first tested at 200°C for 500 hours, ensuring a MTTF of at least $10^7$ hours at 50°C (Ea = .7eV). Extended lifetesting of random samples show that the typical MTTF at 50°C is greater than $10^9$ hours.

3. Periodic Qualification: Process control is maintained by annual requalification testing of production samples. These tests include extensive electrical, thermal and mechanical stress as well as extended lifetest.

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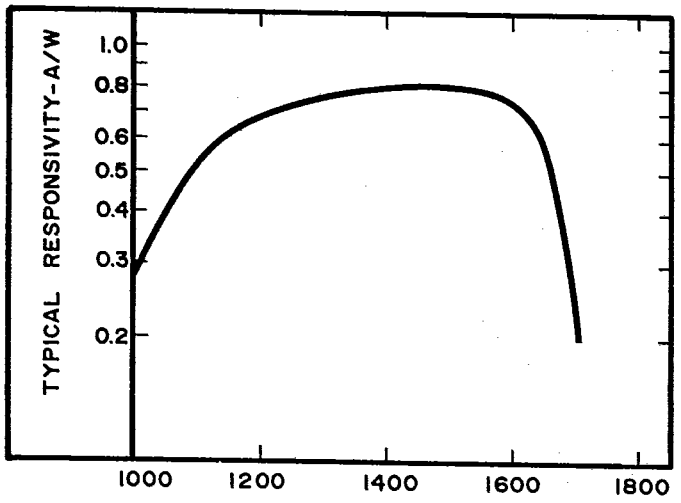


**Figure 1 - Typical Spectral Responsivity**

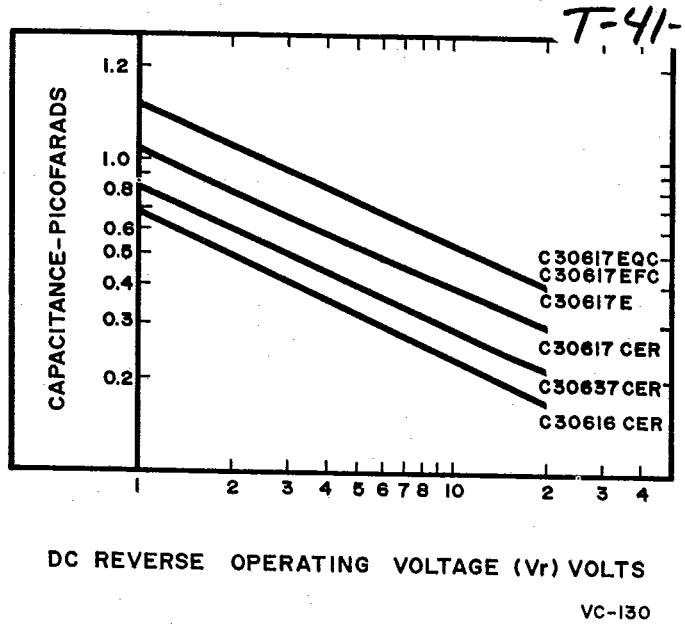


**Figure 2 - Typical Photodetector Capacitance**

The useful spectral range of the InGaAs photodiode is determined by the bandgaps of the semiconductors used in the heterostructure. This InP / InGaAs structure provides a high quantum efficiency of near 80% in the wavelength range of 1150 nm to 1650 nm.

The total device capacitance is a sum of the diode capacitance and that of the package. RCA's high purity semiconductor material produces diodes with a capacitance of about 5nF / cm² at -5 volts. The CER package adds .07 pF, while the E package adds about .3 pF.

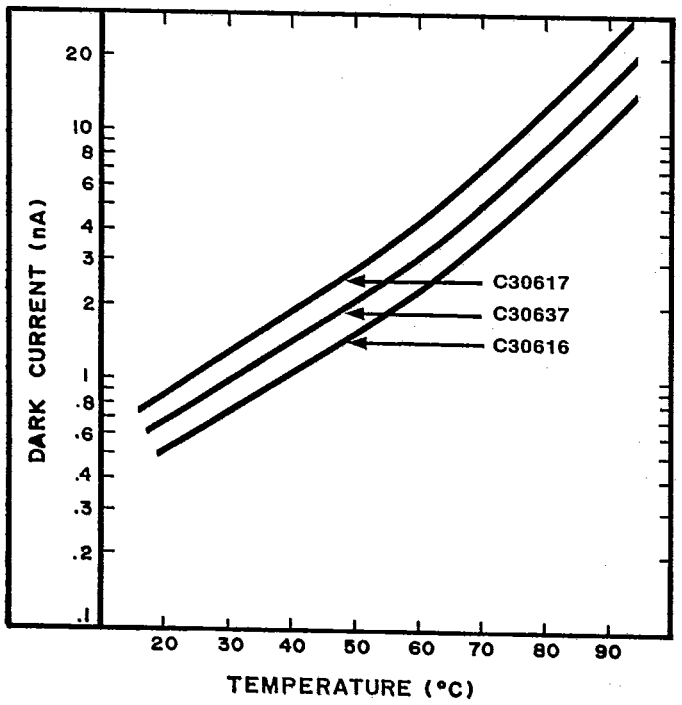


**Figure 3 - Typical Photodiode Dark Current**

In the temperature range of interest, the reverse bias dark current has two contributions. The surface current, dominant at low temperature, is kept to a minimum by RCA's advanced passivation process. The bulk current, dominant at higher temperatures, is also exceptionally low due to the high quality of RCA's VPE grown heterostructure.

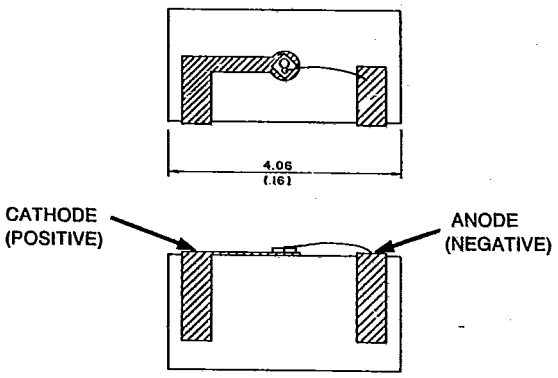


**Figure 4 - CER PACKAGE**

A low capacitance ceramic block for hybrid assemblies.

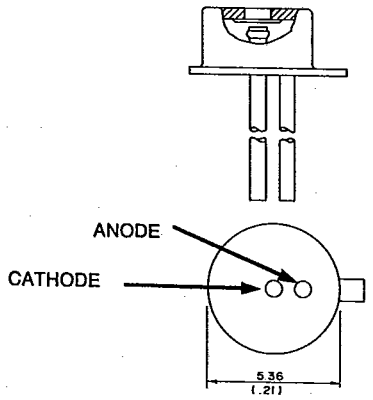


**Figure 5 - E PACKAGE**

TO-18 package, with a low profile silicon window to reduce the optical distance from the window surface to the chip.

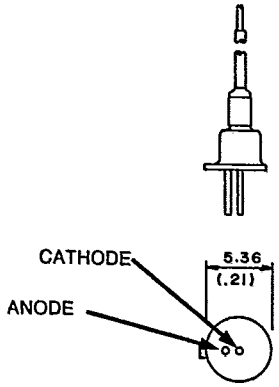


**Figure 6 - EQC PACKAGE**

E package with an integral fiber optic pigtail (available with C30617 only).

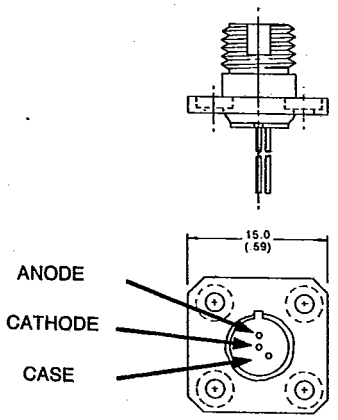


**Figure 7 - EFC PACKAGE**

E package aligned and epoxied in an "FC" compatible receptacle (available with C30617 only).

PART NUMBER: C30617EQC

Chip Type — Package

Dimensions in millimeters. Dimensions in parentheses are in inches.

For further information, please contact your local RCA Electro Optics representative or
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