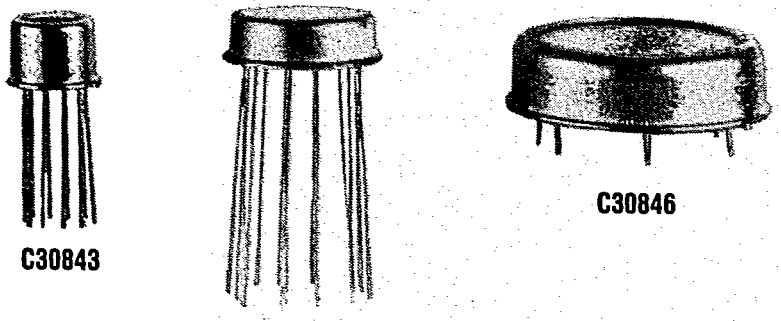
RCA Electro Optics

Photodiode C30843 C30844, C30845, C30846

DATA SHEET

Quadrant N-Type Silicon p-i-n Photodetectors



- Broad Range of Photosensitive Suface Areas — 5 mm² to 100 mm²
- Low Operating Voltage — V_R = 45 V
- Anti-Reflection Coated to Enhance Responsivity at 900 nm
- Hermetically-Sealed Packages
- Spectral Response Range (10% Points) — 400 to 1100 nm
- Very Low Quadrant-Quadrant Separation — 0.25 mm
- Very Low Cross Talk — 1%

This family of quadrant N-type silicon p-i-n photodiodes is designed for use in a wide variety of broad band low light level applications covering the spectral range from below 400 to over 1100 nanometers.

Because of the very small quadrant separation, and the large surface areas, the devices are useful in obtaining positioned information on the active surface from both focused small spots and defocused large spots. This positioned information can be obtained from either high speed pulsed or cw sources.

These devices can be connected externally to form bicells for use in comparator circuits. These characteristics make the devices highly useful in Nd:YAG, HeNe and GaAs laser detection systems.

Maximum Ratings, Absolute-Maximum Values (All Types)

DC Reverse Operating Voltage, V_R . . . . 100 max. V

Photocurrent Density, j_p, at 22° C:
- Average value, continuous operation 5 mA/mm²
- Peak value . . . . . 20 mA/mm²

Forward Current, I_F:
- Average value, continuous operation 10 max. mA
- Peak value . . . . . 100 max. mA

Ambient Temperature:
- Storage, T_{stg} . . . . . −60 to +100 °C
- Operating, T_A . . . . . −40 to +80 °C

Soldering:
- For 5 seconds . . . . . 200 °C

Mechanical Characteristics

Photosensitive Surface (Total):
- Shape —
  - All types . . . . . Circular
- Area —
  - Type C30843 . . . . . 5 mm²
  - Type C30844 . . . . . 20 mm²
  - Type C30845 . . . . . 50 mm²
  - Type C30846 . . . . . 100 mm²

Optical Characteristics

Field of View:[a]
See Figure 1

Approx. Full Angle For —	Totally Illuminated Photosensitive Surface	Partially Illuminated Photosensitive Surface	
Type C30843	84	131	deg
Type C30844	104	144	deg
Type C30845	74	150	deg
Type C30846	73	141	deg

[a] The values specified for field of view are approximate and are critically dependent on the dimensional tolerances of the package component parts.

Electrical Characteristics	At a DC Reverse Operating Voltage (V_R) = 45 Volts[b] and T_A = 22° C Unless Otherwise Specified												Units
	C30843			C30844			C30845			C30846			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Breakdown Voltage, V_{BR}[b]	100	—	—	100	—	—	100	—	—	100	—	—	V
Responsivity:													
At 900 nm	0.50	0.60	—	0.50	0.60	—	0.50	0.60	—	0.50	0.60	—	A/W
At 1060 nm	0.13	0.17	—	0.13	0.17	—	0.13	0.17	—	0.13	0.17	—	A/W
See Figure 2													
Luminous Responsivity (2856 K)	—	0.85	—	—	0.85	—	—	0.85	—	—	0.85	—	mA/lm
Quantum Efficiency:[c]													
At 900 nm	70	90	—	70	90	—	70	90	—	70	90	—	%
At 1060 nm	15	20	—	15	20	—	15	20	—	15	20	—	%
Dark Current, I_d:													
At V_R = 10 V	—	15	50	—	30	100	—	70	200	—	200	1000	nA/quad
At V_R = 45 V	—	25	100	—	75	300	—	200	700	—	500	2500	nA/quad
See Figure 3													
Noise Current, i_n:[d] f = 10 kHz, Δf = 1.0 Hz	—	0.10	0.70	—	0.16	0.80	—	0.26	1.10	—	0.40	2.00	$pA/Hz^{1/2}$ per quad
See Figure 4													
Noise Equivalent Power (NEP):[e] f = 10 kHz, Δf = 1.10 Hz													
At 900 nm	—	0.17	1.20	—	0.27	1.30	—	0.43	1.80	—	0.67	3.30	$pW/Hz^{1/2}$
At 1060 nm	—	0.59	4.10	—	1.00	4.70	—	1.50	6.50	—	2.30	11.80	$pW/Hz^{1/2}$
Capacitance, C_d	—	3	4	—	6	10	—	8	11	—	18	22	pF/quad
See Figure 5													
Rise Time, t_r:[f] R_L = 50 Ω, λ = 900 nm, 10% to 90% points	—	3	5	—	5	8	—	6	9	—	8	12	ns
Fall Time:[f] R_L = 50 Ω, λ = 900 nm, 90% to 10% points	—	6	10	—	8	13	—	10	14	—	13	20	ns
Uniformity[g]	—	±1	±5	—	±1	±5	—	±2	±7	—	±2	±7	%
See Figure 6													
Transition Width[h]	—	0.25	0.51	—	0.25	0.51	—	0.25	0.51	—	0.25	0.51	mm
See Figure 6		0.010	0.020		0.010	0.020		0.010	0.020		0.010	0.020	inch
Cross Talk[j]	—	1	5	—	1	5	—	1	5	—	1	5	%
See Figure 6													
Balance[k]	—	1	5	—	1	5	—	1	5	—	1	5	%
See Figure 6													
Signal Loss[m]	—	10	25	—	10	25	—	10	25	—	10	25	%
See Figure 7													

b The breakdown voltage is arbitrarily defined as that voltage at which the dark current is 1000 x the dark current at 45 V, or 25 μA whichever is greater.

c The relationship between quantum efficiency, η (λ), and responsivity, resp (λ), at any wavelength λ is resp (λ) = 0.806 $\lambda \eta$ (where λ is in μm).

d Specially selected detectors with very low noise and dark currents are available on special order. Devices with closely matched dark currents in each quadrant of the detector are also available on special order.

e The NEP at wavelength λ is:

$$\text{NEP}(\lambda) = \frac{\text{Noise Current}}{\text{Resp}(\lambda)} \text{ Watt Hz}^{-1/2}$$

f Faster rise and fall times are available (at the expense of noise current) if the device is operated at higher bias but below the breakdown voltage.

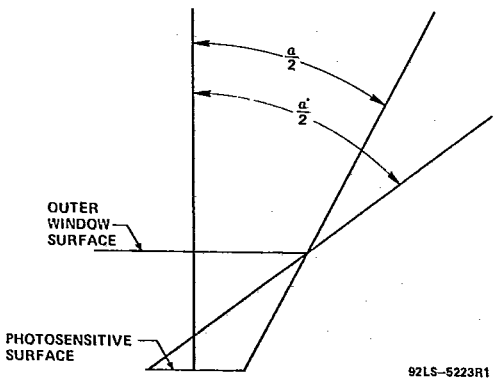
g The uniformity of the device is measured within one quadrant at 900 nm and with a 0.10 mm (0.004 inch) diameter spot. On special order a complete scan of the detector surface can be made with the 0.10 mm (0.004 inch) diameter spot, giving a picture of the surface of the detector with spots where the signal has fallen any set percentage below the average signal value for that quadrant.

h The transition width is the distance a 0.10 mm (0.004 inch) spot of light has to move to go from 90% signal in one quadrant to 90% signal in the adjacent quadrant.

j Crosstalk is measured using a 10 KΩ load and signal frequency of about 100 Hz.

k Balance is a measure of the worst responsivity variation from quadrant to quadrant.

m Signal loss is defined as the loss in signal in going from one quadrant to the adjacent quadrant when both quadrant outputs are tied together.



Full incident radiation at angles $\leqslant \frac{\alpha}{2}$, the photosensitive surface is totally illuminated.

For incident radiation at angles $> \frac{\alpha}{2}$ but $\leqslant \frac{\alpha'}{2}$, the photosensitive surface is partially illuminated.

Figure 1 — Definition of Half-Angle Approx. Field-of-View. (Scale is exaggerated for clarity)

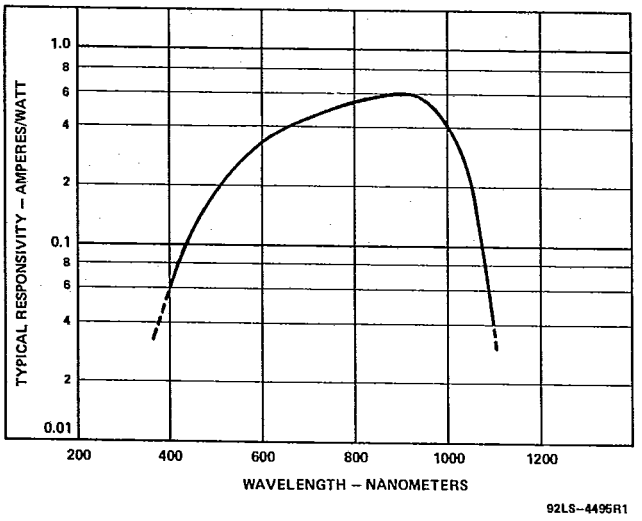


Figure 2 — Typical Spectral Responsivity Characteristic

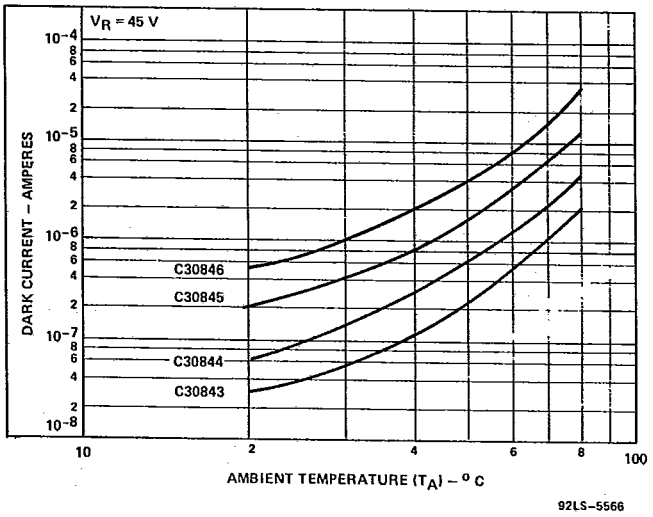


Figure 3 — Typical Dark Current vs Ambient Temperature

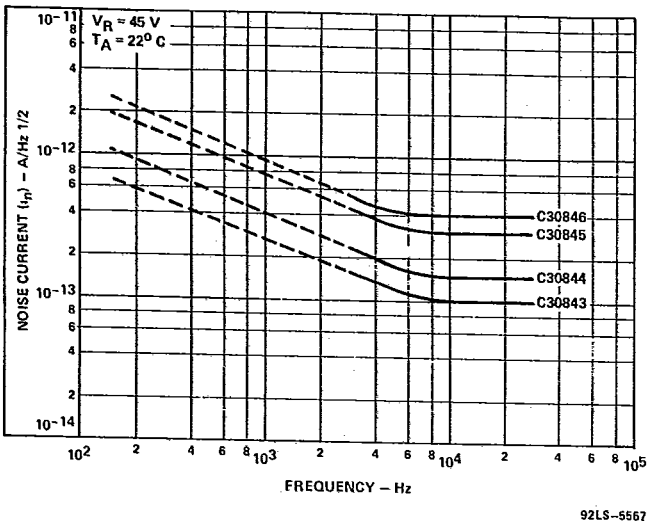


Figure 4 — Typical Noise Current vs Frequency

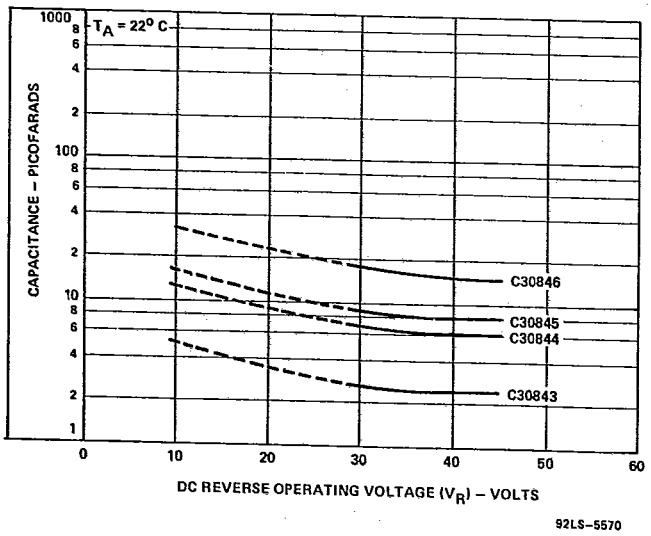
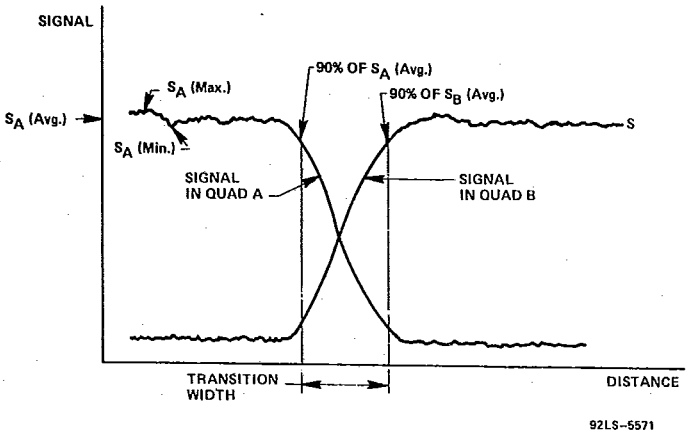


Figure 5 — Typical Photodiode Capacitance vs Operating Voltage

Warning — Personal Safety Hazards

Electric Shock — Operating voltages applied to this device present a shock hazard.



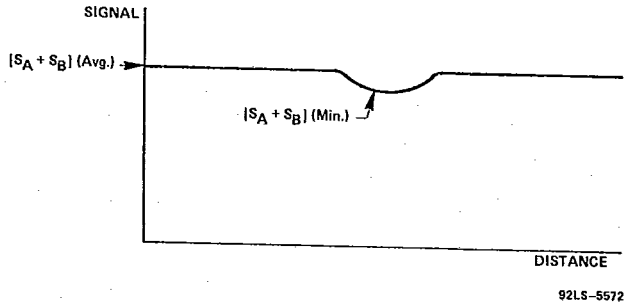
Transition Width = distance moved in going from 90% signal in one quadrant to 90% signal in adjacent quadrant.

$$\text{Cross Talk } [A \rightarrow B] = \frac{\text{Average Signal in Quad B}}{\text{Average Signal in Quad A}} \times 100\%, \text{ when the light spot is in quad A.}$$

$$\text{Uniformity} = \pm 1/2 \times \frac{S_A\,(\text{Max.}) - S_A\,(\text{Min.})}{S_A\,(\text{Avg.})} \times 100\%$$

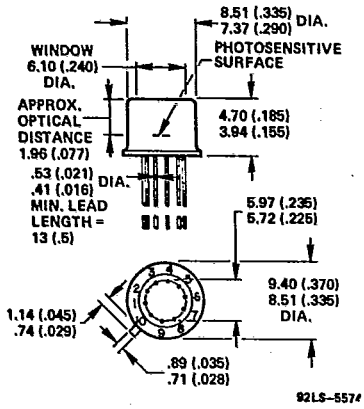
$$\text{Balance} = \frac{S_A\,(\text{Avg.}) - S_B(\text{Avg.})}{1/2\,[S_A\,(\text{Avg.}) + S_B\,(\text{Avg.})]} \times 100\%$$

Figure 6 — Typical Quadrant Transition Characteristics

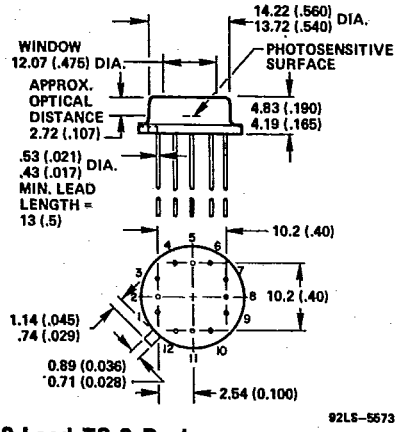


$$\text{Signal Loss} = \frac{[S_A + S_B]\,(\text{Avg.}) - [S_A + S_B]\,(\text{Min.})}{[S_A + S_B]\,(\text{Avg.})} \times 100\%$$

Figure 7 — Typical Signal Loss Characteristics



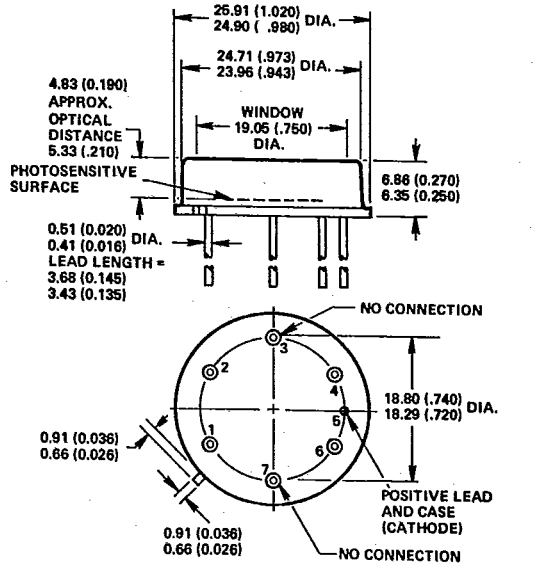
Modified 10-Lead TO-5 Package
Figure 8 — Dimensional Outline for C30843



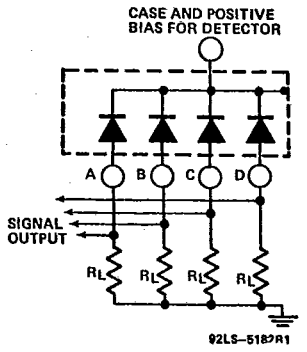
Modified 12-Lead TO-8 Package
Figure 9 — Dimensional Outline for C30844 and C30845

Lead Connections

Lead Number	C30843	C30844 C30845	C30846
1	—	Quadrant "A"	Quadrant "A"
2	Quadrant "A"	—	Quadrant "B"
3	Quadrant "B"	Quadrant "B"	—
4	—	—	Quadrant "C"
5	—	—	Case and positive bias voltage for detector
6	—	—	Quadrant "D"
7	Quadrant "C"	Quadrant "C"	—
8	Quadrant "D"	—	—
9	—	Quadrant "D"	—
10	Case and positive bias voltage for detector	—	—
11	—	—	—
12	—	Case and positive bias voltage for detector	—



RCA 25-mm Package
Figure 10 — Dimensional Outline for C30846



R_L = 50 Ω to 50 kΩ

Schematic Arrangement of RCA Quadrant Photodiode Types C30843, C30844, C30845 and C30846