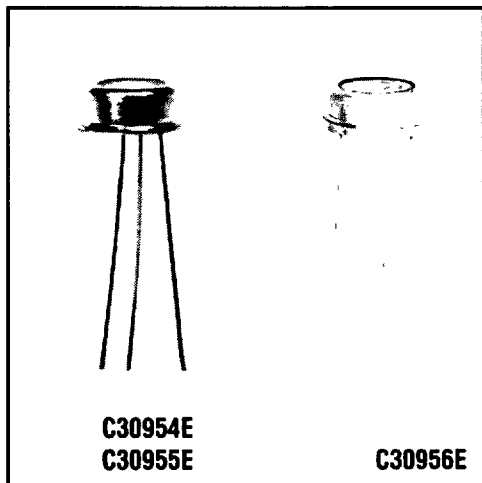




# Photodiode C30954E, C30955E, C30956E

## DATA SHEET



### Large Area Long Wavelength Enhanced Silicon Avalanche Photodiodes for General-Purpose Applications

- High Quantum Efficiency —  
85% typical at 900 nm — 36% - 40% typical at 1060 nm  
5% typical at 1150 nm
- Spectral Response Range — (10% Points) 400 to 1150 nm
- Fast Time Response —  
Rise time typically 2 ns — Fall time typically 2 ns
- Wide Operating Temperature Range — -40°C to +70°C
- Hermetically-Sealed Packages

RCA Type C30954E, C30955E, and C30956E are general purpose silicon avalanche photodiodes made using a double-diffused "reach through" structure. These photodiodes are designed such that their long wave response (i.e.  $\lambda > 900$  nm) has been enhanced without introducing any undesirable properties. At the same time, the desirable properties of the double diffused "reach through" structure (such as low noise, low capacitance, and fast rise and fall times) have been retained.

The C30954E, C30955E, and C30956E are improved performance versions of the RCA types C30817, C30916E, and C30872; they are hermetically sealed behind a flat glass window.

The devices are useful in a wide variety of applications including detection, ranging, optical communications, high-speed switching, and transit-time measurements.

#### Maximum Ratings, Absolute Maximum Values

Reverse Bias Current . . . . .	200	max.	$\mu$ A
Photocurrent Density, $J_p$ , at 22°C:			
Average value,			
continuous operation . . . . .	5		mA/mm <sup>2</sup>
Peak value . . . . .	20		mA/mm <sup>2</sup>
Forward Current, $I_F$ , at 22°C:			
Average value,			
continuous operation . . . . .	5	max.	mA
Peak value (For 1 second			
duration, non-repetitive) . . . . .	50	max.	mA
Maximum Total Power Dissipation			
at 22°C: (With heat sink cooling			
provided to case) . . . . .	0.1	max.	W
Ambient Temperature:			
Storage, $T_{stg}$ . . . . .	-60 to +100		°C
Operating, $T_A$ . . . . .	-40 to +70		°C
Soldering:			
For 5 seconds . . . . .	200		°C
	(leads only)		

#### Mechanical Characteristics

	C30954E	C30955E	C30956E
Photosensitive Surface:			
Shape . . . . .	Circular	Circular	Circular
Useful area (mm <sup>2</sup> ) . . . . .	0.5	1.77	7
Useful diameter (mm) . . . . .	0.8	1.5	3
Package . . . . .	TO-5	TO-5	TO-8

#### Optical Characteristics

Field of View<sup>1</sup>:

See Figure 18 —

Full angle ( $\alpha$ ) for totally illuminated photosensitive surface (deg) . . . . .	110	104	132
Full angle ( $\alpha'$ ) for partially illuminated photosensitive surface (deg) . . . . .	125	130	150

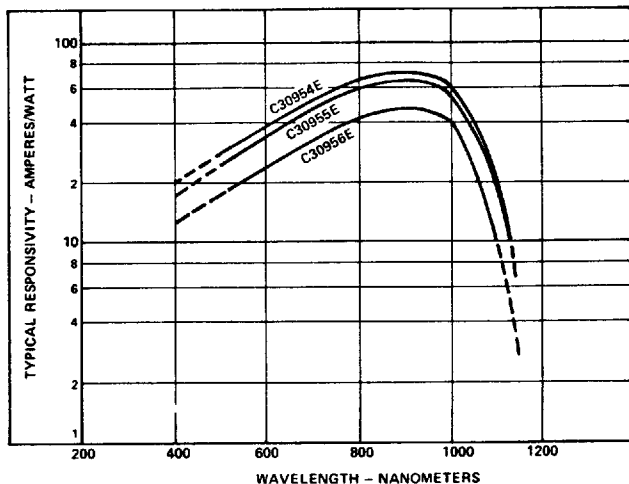


Figure 1 — Typical Spectral Responsivity Characteristics

T-41-51

Electrical Characteristics at $T_A = 22^\circ\text{C}$  At the DC reverse operating voltage $V_R$ supplied with the device <sup>2</sup>	C30954E			C30955E			C30956E			Units
	Light spot diameter 0.25 mm (0.01")			Light spot diameter 1.0 mm (0.04")			Light spot diameter 2.5 mm (0.10")			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Breakdown Voltage, $V_{BR}$ . . . . . For $V_{BR}$ at other temperat., see Figures 2 thru 7	300	375	475	315	390	490	325	400	500	V
Temperature Coefficient of $V_R$ for Constant Gain . . . . .	—	2.2	—	—	2.2	—	—	2.2	—	V/°C
Gain . . . . .	—	120	—	—	100	—	—	75	—	
Responsivity:										
At 900 nm . . . . .	65	75	—	55	70	—	36	45	—	A/W
At 1060 nm . . . . .	30	36	—	26	34	—	20	25	—	A/W
At 1150 nm . . . . .	4	5	—	4	5	—	2.8	3.5	—	A/W
Quantum Efficiency:										
At 900 nm . . . . .	—	85	—	—	85	—	—	85	—	%
At 1060 nm . . . . .	—	36	—	—	40	—	—	40	—	%
At 1150 nm . . . . .	—	5	—	—	5	—	—	5	—	%
Total Dark Current, $I_d$ . . . . .	—	$5 \times 10^{-8}$	$1 \times 10^{-7}$	—	$1 \times 10^{-7}$	$2 \times 10^{-7}$	—	$1 \times 10^{-7}$	$2 \times 10^{-7}$	A
Noise Current, $i_n$ : f = 10 kHz, $\Delta f = 1.0$ Hz . . . . . See Figure 9	—	$1 \times 10^{-12}$	$2 \times 10^{-12}$	—	$1 \times 10^{-12}$	$2 \times 10^{-12}$	—	$1.1 \times 10^{-12}$	$2.2 \times 10^{-12}$	A/Hz <sup>1/2</sup>
Capacitance, $C_d$ . . . . .	—	2	4	—	3	5	—	10	12	pF
Series Resistance . . . . .	—	—	15	—	—	15	—	—	15	$\Omega$
Rise Time, $t_r$ : $R_L = 50 \Omega$ , $\lambda = 900$ nm, 10% to 90% points . . . . .	—	2	3	—	2	3.5	—	2	3.5	ns
Fall Time: $R_L = 50 \Omega$ , $\lambda = 900$ nm, 90% to 10% points . . . . .	—	2	3	—	2	3.5	—	2	3.5	ns

<sup>1</sup> The values specified for field of view are approximate and are critically dependent on the dimensional tolerances of the packages component parts.

<sup>2</sup> A specific value of  $V_R$  is supplied with each device. When the photodiode is operated at this voltage, the device will meet the electrical characteristic limits shown above. The voltage value will be within the range of 275 to 425 volts.

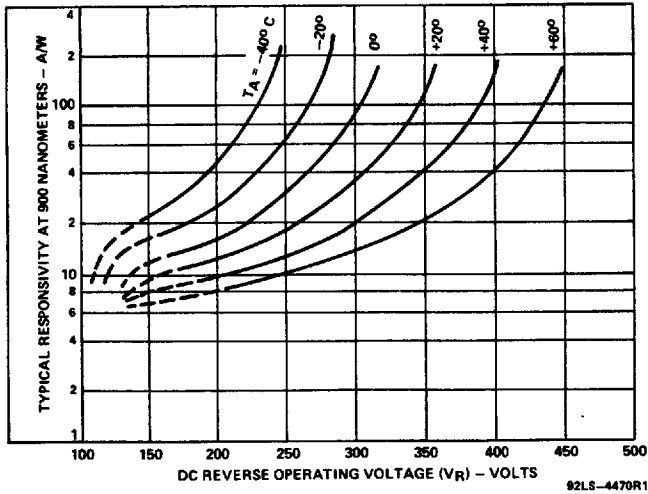


Figure 2 - Typical Responsivity at 900 nm vs Operating Voltage - C30954E

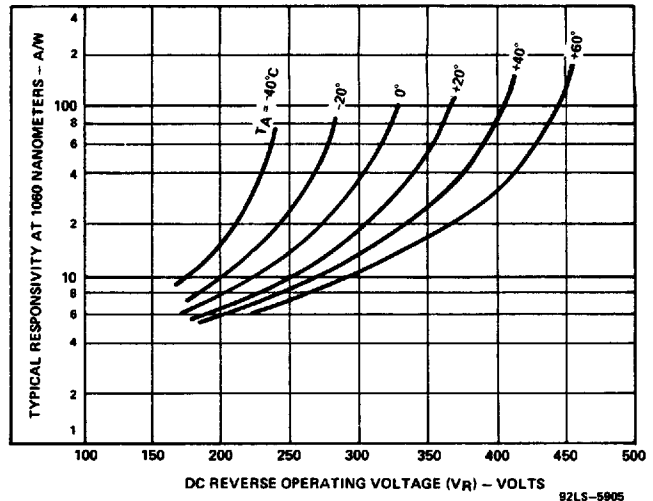


Figure 3 - Typical Responsivity at 1060 nm vs Operating Voltage - C30954E

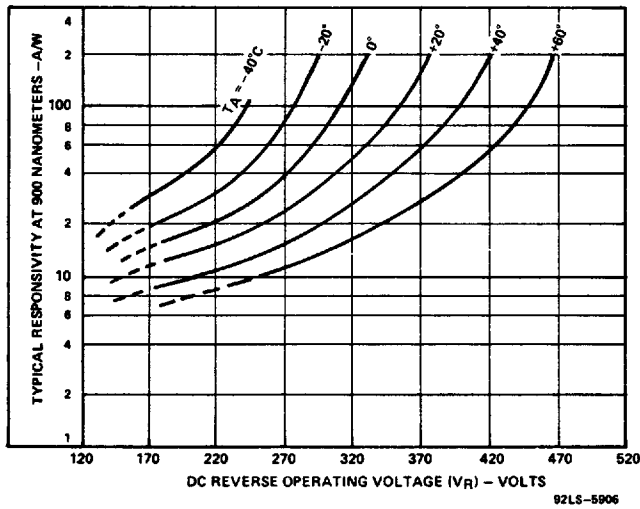


Figure 4 - Typical Responsivity at 900 nm vs Operating Voltage - C30955E

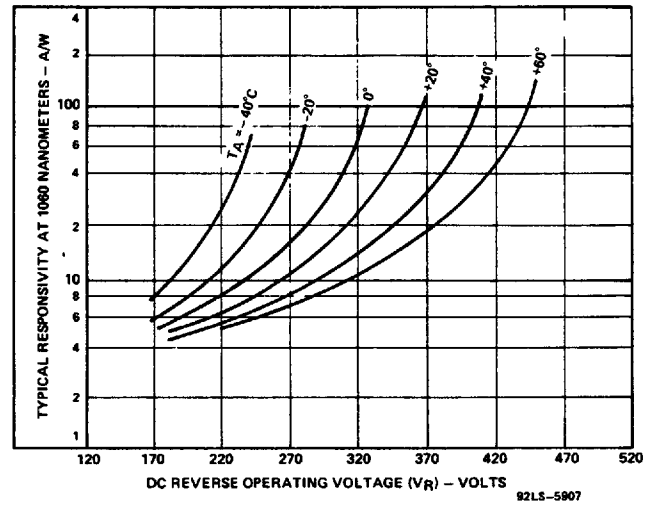


Figure 5 - Typical Responsivity at 1060 nm vs Operating Voltage - C30955E

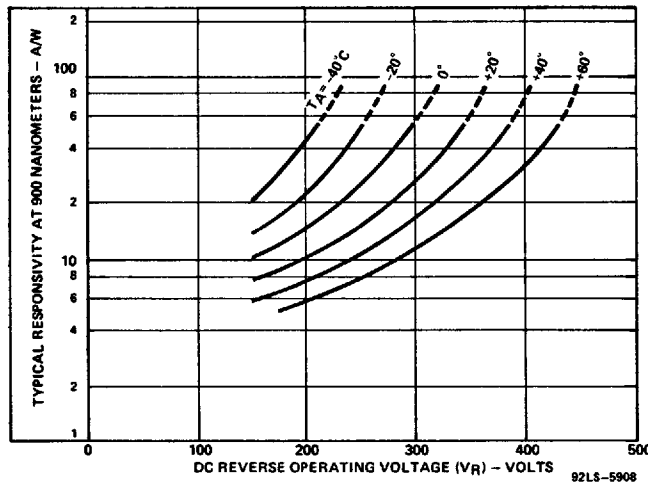


Figure 6 - Typical Responsivity at 900 nm vs Operating Voltage - C30956E

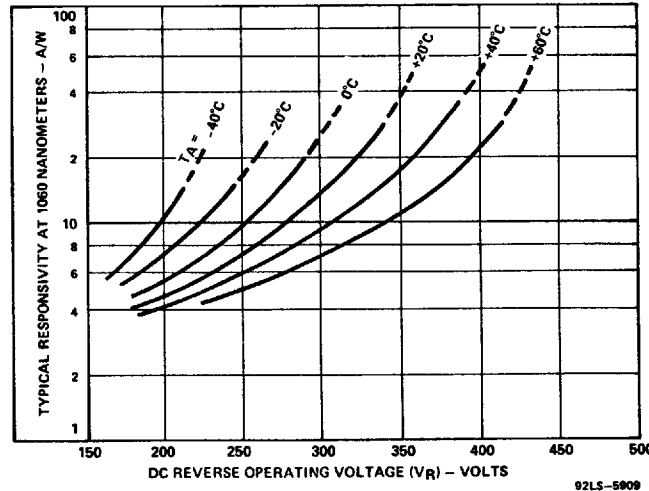


Figure 7 - Typical Responsivity at 1060 nm vs Operating Voltage - C30956E

T-41-51

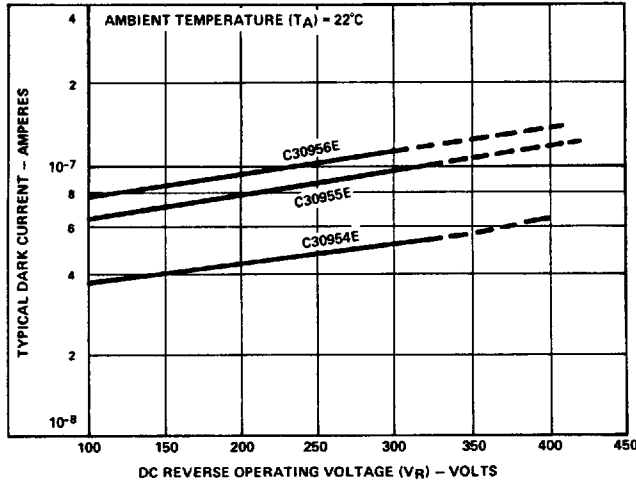


Figure 8 - Typical Dark Current vs Operating Voltage

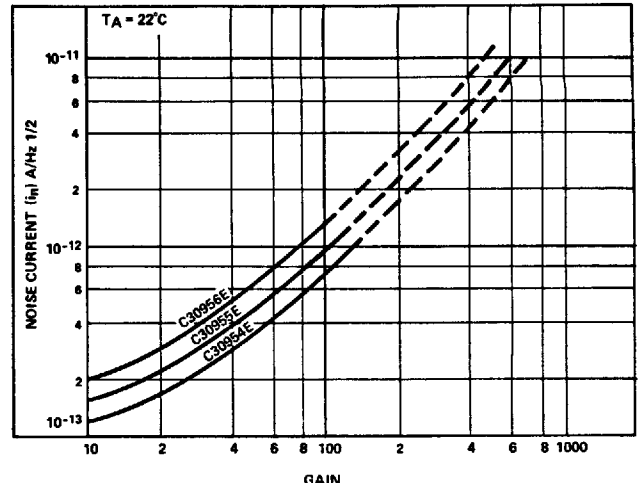


Figure 9 - Typical Noise Current vs Gain

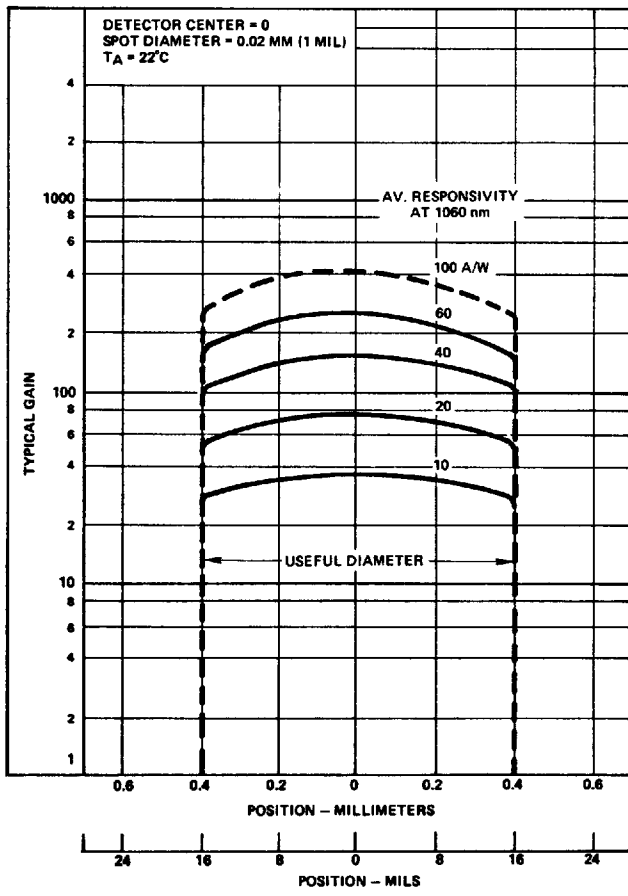


Figure 10 - Typical Gain vs Light Spot Position - C30954E

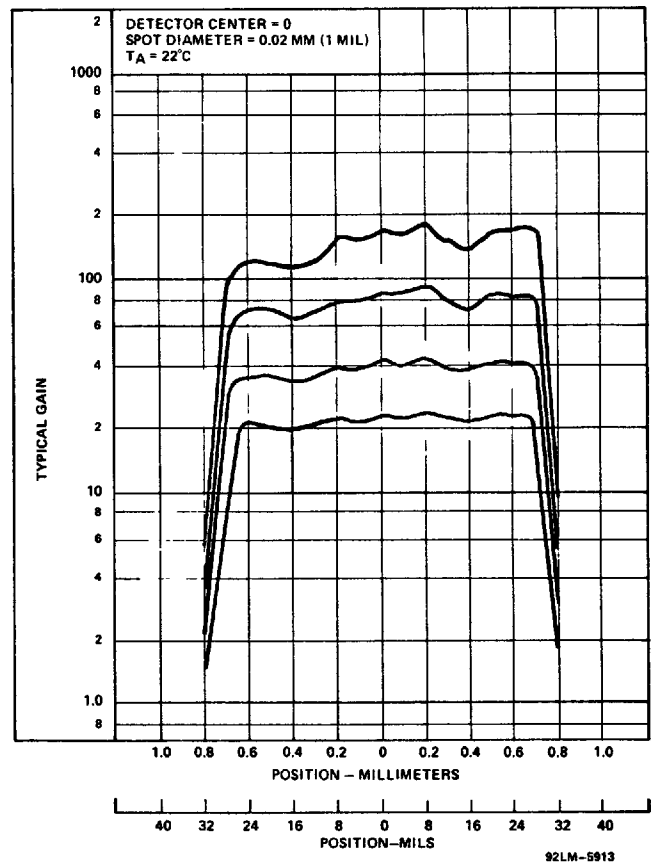


Figure 11 - Typical Gain vs Light Spot Position - C30955E

T-41-51

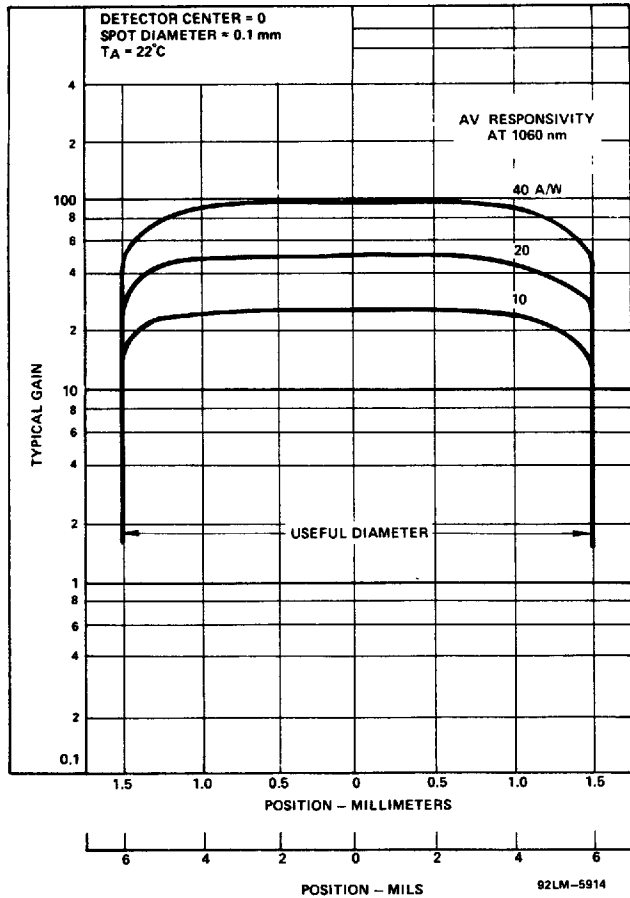


Figure 12 - Typical Gain vs Light Spot Position - C30956E

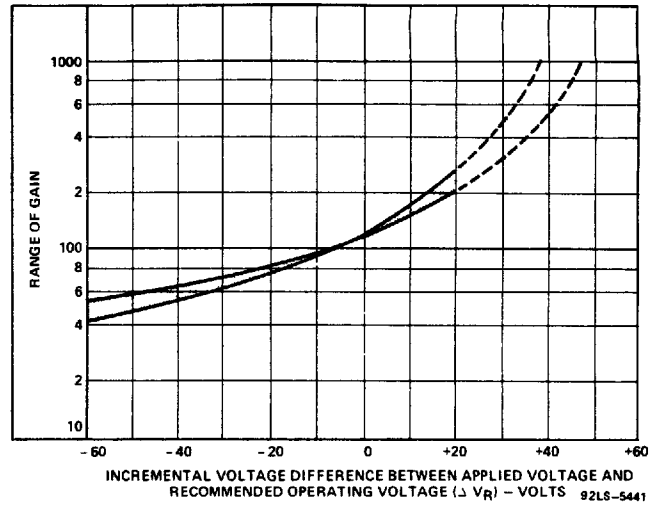


Figure 13 - Variation of Gain as a Function of Difference Between Actual Applied Operating Voltage and Recommended Operating Voltage - C30954E

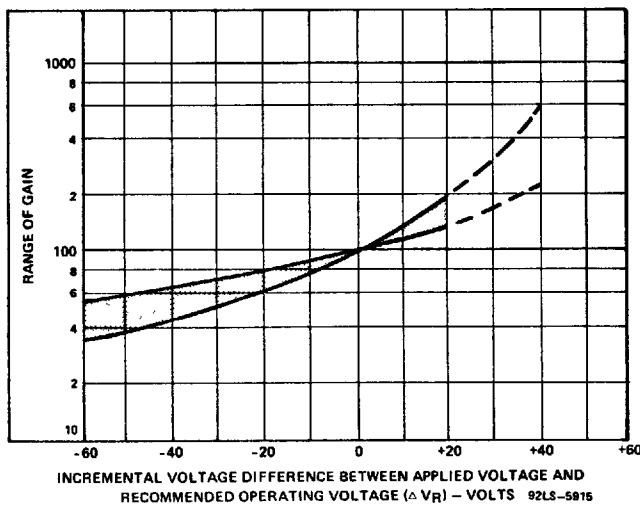


Figure 14 - Variation of Gain as a Function of Difference Between Actual Applied Operating Voltage and Recommended Operating Voltage - C30955E

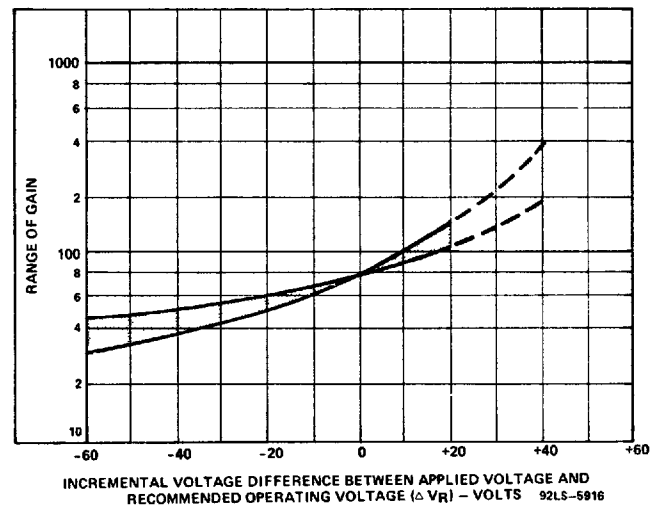
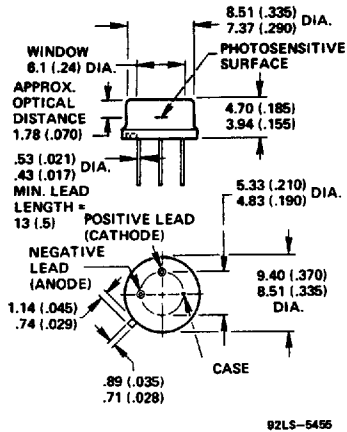


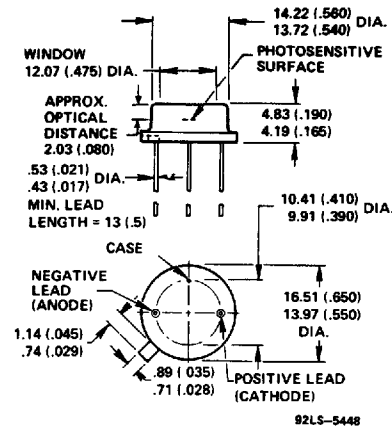
Figure 15 - Variation of Gain as a Function of Difference Between Actual Applied Operating Voltage and Recommended Operating Voltage - C30956E

C30954E, C30955E, C30956E

T-41-51



92LS-5455



92LS-5448

Low-Profile TO-5 Package

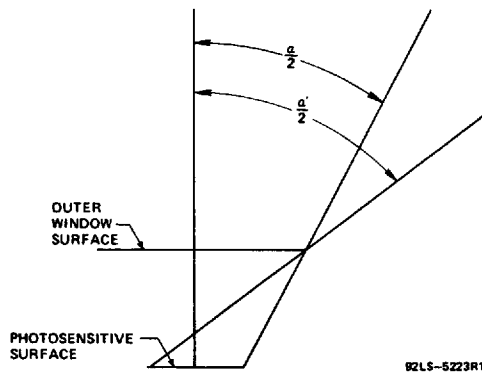
Low-Profile TO-8 Package

**Note:** Optical distance is defined as the distance from the surface of the silicon chip to the front surface of the window.

**Note:** Optical distance is defined as the distance from the surface of the silicon chip to the front surface of the window.

Figure 16 - Dimensional Outline - C30954E, C30955E

Figure 17 - Dimensional Outline - C30956E



92LS-5223R1

For incident radiation at angles  $\leq \alpha/2$ , the photosensitive surface is totally illuminated.

For incident radiation at angles  $> \alpha/2$  but  $\leq \alpha'/2$ , the photosensitive surface is partially illuminated.

Figure 18 - Definition of Half-Angle Approx. Field-of-View (Scale is exaggerated for clarity)

**Warning — Personal Safety Hazards**  
**Electric Shock** — Operating voltages applied to this device present a shock hazard.

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  
 Tel.: (514) 455-6191

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