AVTECH

AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

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INSTRUCTIONS

MODEL AV-149-BW3-1K-APD-SP2-A-FC-PD2 TRANSIMPEDANCE AMPLIFIER

S.N.: 7910

WARRANTY

Avtech Electrosystems Ltd. warrants products of its manufacture to be free from defects in material and workmanship under conditions of normal use. If, within one year after delivery to the original owner, and after prepaid return by the original owner, this Avtech product is found to be defective, Avtech shall at its option repair or replace said defective item. This warranty does not apply to units which have been dissembled, modified or subjected to conditions exceeding the applicable specifications or ratings. This warranty is the extent of the obligation or liability assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

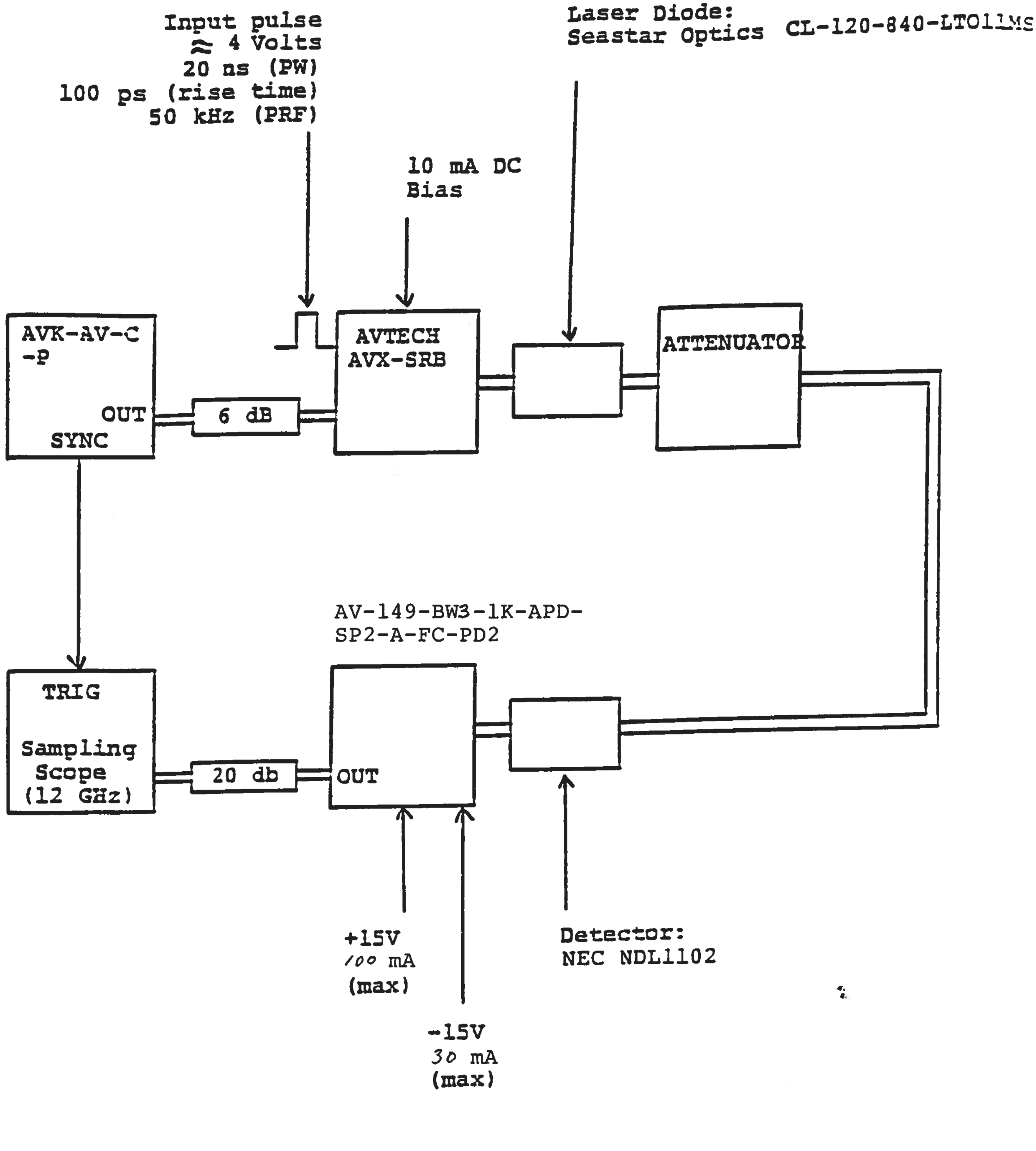


Fig. 1 BASIC TEST SET-UP (PULSE MODE)

<u>GENERAL OPERATING INSTRUCTIONS</u>

1) The basic operation of the amplifier was confirmed using the pulse mode test arrangement shown in Fig. 1.

2) The AV-149 amplifier requires a prime power of ±15 VDC (100 mA max).

3) The bias voltage for the APD may be varied from about +20 Volts to +228 using the 10 turn "BIAS ADJ" screw. Note clockwise rotation of the screw reduces the bias voltage while counterclockwise rotation increases the bias voltage. At the time of shipping this voltage was set to +180 Volts (as measured at the red "BIAS" banana terminal adjacent to the "BIAS ADJ" screw). <u>CAUTION</u>: The diode supplied with the unit has a breakdown voltage of 190 Volts.

4) The connecterized detector diode may be removed by removing the 2 Phillips 2-56 screws which affix the diode assembly to the 2 x 5 cm aluminum mounting plate in the side of the amplifier. The diode may then be removed from the socket by gently pulling the diode package away from the amplifier chassis. The aluminum mounting plate may be removed by loosening the 8-32 nuts (4) then removing the 8-32 machine screws (2). Other APD detector diodes may be inserted into the socket. The pin connections are shown in Fig. 2.

5) The DC offset on the output may be varied from -1.0 to +1.0 Volt using the ten turn OS control. Clockwise rotation of the pot shifts the offset more negative. At the time of shipping the offset was set to zero.

6) To test the AV-149 in a sweep frequency mode (DC to 600 MHz) the AVK-AV-C and the sampling scope should be replaced by a network analyzer.

7) <u>CAUTION</u>: The amplifier will be damaged if the anode and cathode connections are reversed. Also, the photodiode must not be installed or removed once the ±15V prime power is on and the bias voltage on the diode must not exceed the breakdown voltage (of 190 Volts). The warranty does not apply to failures resulting from abuses related to the above.

8) The leads of the photo diode should not be inserted more than 1.0 cm into the socket.

9) The ±15 VDC supply should be turned off when installing or removing the photo diode.

10) The MITSUBISHI PD1002 diode with the FC connector has been discontinued and so was replaced by an EG&G C30902E diode (Case "Q"). A copy of the diode data sheet is enclosed.

11) For additional information:

Tel: (613) 226-5772
Fax: (613) 226-2802

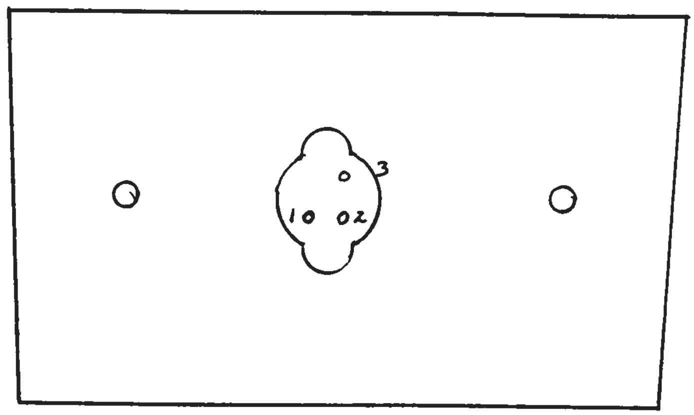


Fig. 2 DIODE SOCKET PIN CONNECTIONS

1) ANODE
3) CASE
2) CATHODE

Y7

EG&G CANADA LTD. ctro
Optoelectronics Division tics

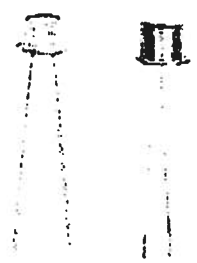
Formerly RCA
Effective January 1, 1991

Silicon Avalanche Photodiodes
C30902E, C30902S, C30921E, C30921S

DATA SHEET

High Speed Solid State Detectors for Fiber Optic and Very Low Light-Level Applications

ISO-9001-87 Cert #001975



C30902E C30921E
C30902S C30921S

RCA Type C30902E avalanche photodiode utilizes a silicon detector chip fabricated with a double-diffused "reach-through" structure. This structure provides high responsivity between 400 and 1000 nanometers as well as extremely fast rise-and falltimes at all wavelengths. Because the fall-time characteristics have no "tail", the responsivity of the device is independent of modulation frequency up to about 800 MHz. The detector chip is hermetically-sealed behind a flat glass window in a modified TO-18 package. The useful diameter of the photosensitive surface is 0.5 mm.

RCA Type C30921E utilizes the same silicon detector chip as the C30902E, but in a package containing a lightpipe which allows efficient coupling of light to the detector from either a focussed spot or an optical fiber up to 0.25 mm in diameter. The internal end of the lightpipe is close enough to the detector surface to allow all of the illumination exiting the lightpipe to fall within the active-area of the detector. The hermetically-sealed TO-18 package allows fibers to be epoxied to the end of the lightpipe to minimize signal losses without fear of endangering detector stability.

The C30902E and C30921E are designed for a wide variety of uses including optical communications at data rates to 1 GBit/second, laser range-finding, and any other applications requiring high speed and/or high responsivity.

The C30902S and C30921S are selected C30902E and C30921E photodiodes having extremely low noise and low bulk dark-current. They are intended for ultra-low light level applications (optical power less than 1 pW) and can be used in either their normal linear mode ($V_R<V_{BR}$) at gains up to 250 or greater, or as photon counters in the "Geiger" mode ($V_R>V_{BR}$) where a single photoelectron may trigger an avalanche pulse of about 10^8 carriers. In this mode, no amplifiers are necessary and single-photon detection probabilities of up to approximately 50% are possible.

Photon-counting is also advantageous where gating and coincidence techniques are employed for signal retrieval.

- **High Quantum Efficiency**
  77% Typical at 830 nm
- **C30902S and C30921S in Geiger Mode:**
  - **Single-Photon Detection Probability to 50%**
  - **Low Dark-Count Rate at 5% Detection Probability – Typically**
    15,000/second at +22° C
    350/second at -25° C
  - **Count Rates to 2 x 10^6/second**
- **Hermetically Sealed Package**
- **Low Noise at Room Temperature**
  - **C30902E, C30921E –**
    2.3 x 10^{-13} A/Hz$^{1/2}$
  - **C30902S, C30921S –**
    1.1 x 10^{-13} A/Hz$^{1/2}$
- **High Responsivity –**
  Internal Avalanche Gains in Excess of 150
- **Spectral Response Range – (10% Points)**
  400 to 1000 nm
- **Time Response – Typically 0.5 ns**
- **Wide Operating Temperature Range –**
  -40° C to +70° C

Optical Characteristics

C30902E, C30902S (Figure 13)

Photosensitive Surface:

Shape	Circular	
Useful area	0.2	mm^2
Useful diameter	0.5	mm

Field of View:

Approximate full angle for totally illuminated photosensitive surface	100	deg

C30921E, C30921S (Figure 14)

Numerical Aperture of Light Pipe	0.55	
Refractive Index (n) of Core	1.61	
Light Pipe Core Diameter	0.25	mm

Maximum Ratings, Absolute-Maximum Values

Reverse Current at 22° C:

Average value, continuous operation	200	µA
Peak value (For 1 second duration, non-repetitive	1	mA

Forward Current, I_F at 22°C:

Average value, continuous operation	5	mA
Peak value (For 1 second duration, non-repetitive)	50	mA

Maximum Total Power Dissipation at 22° C	60	mW

Ambient Temperature —

Storage, T_{stg}	-60 to + 100	°C
Operating, T_A	-40 to +70	°C

Soldering:

For 5 seconds	200	°C

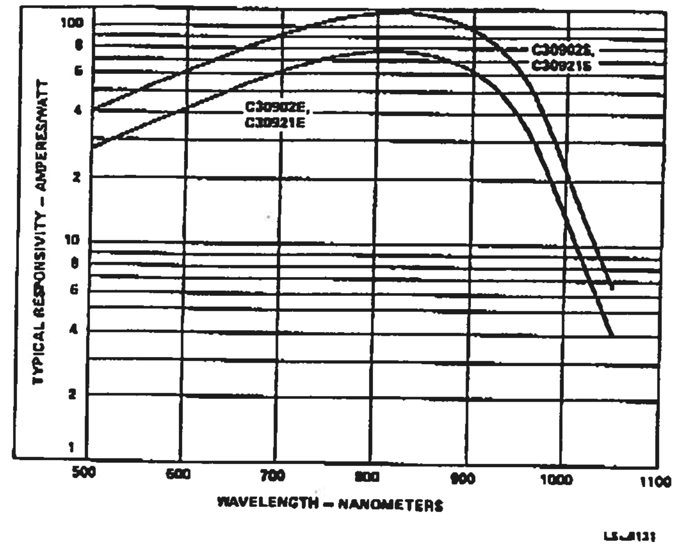


Fig. 1 Typical Spectral Responsivity at 22° C

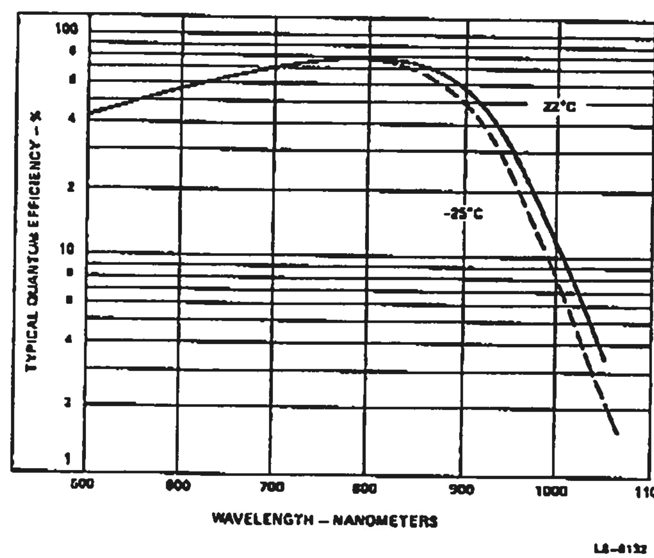


Fig. 2 Typical Quantum Efficiency vs Wavelength

Electrical Characteristics[1] at $T_A = 22°$ C

	C30902E, C30921E			C30902S, C30921S			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Units
Breakdown voltage, V_{BR}	–	225	–	–	225	–	V
Temperature Coefficient of V_R for Constant Gain	0.5	0.7	0.8	0.5	0.7	0.8	V/° C
Gain	–	150	–	–	250	–	
Responsivity:							
At 900 nm	55	65	–	92	108	–	A/W
At 830 nm	70	77	–	117	128	–	A/W
Quantum Efficiency:							
At 900 nm	–	60	–	–	60	–	%
At 830 nm	–	77	–	–	77	–	%
Dark Current, I_d	–	1.5×10^{-8} (Figure 6)	3×10^{-8}	–	1×10^{-8} (Figure 6)	3×10^{-8}	A
Noise Current, i_n:[2] f = 10 kHz, Δ f = 1.0 Hz	–	2.3×10^{-13} (Figure 3)	5×10^{-13}	–	1.1×10^{-13} (Figure 3)	2×10^{-13}	$A/Hz^{1/2}$
Capacitance, C_d	–	1.6	2	–	1.6	2	pF
Rise Time, t_r: $R_L = 50\ \Omega$, $\lambda = 830$ nm, 10% to 90% points	–	0.5	0.75	–	0.5	0.75	ns
Fall Time: $R_L = 50\ \Omega$, $\lambda = 830$ nm, 90% to 10% points	–	0.5	0.75	–	0.5	0.75	ns
Geiger Mode (See Appendix)							
Dark Count Rate at 5% Photon Detection Probability[3] (830 nm):							
22° C	–	–	–	–	15,000	30,000	cps
-25° C	–	–	–	–	350	700	cps
Voltage Above V_{BR} for 5% Photon Detection Probability[3] (830 nm) (see Figure 8)	–	–	–	–	2	–	V
Dead-Time Per Event (See Appendix)	–	–	–	–	300	–	ns
After-Pulse Ratio at 5% Photon Detection Probability (830 nm) 22° C[4]	–	–	–	–	2	15	%

1 At the DC reverse operating voltage V_R supplied with the device and a light spot diameter of 0.25 mm (C30902E, S) or 0.10 mm (C30921E, S). Note that 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 180 to 250 volts.

2 The theoretical expression for shot noise current in an avalanche photodiode is $i_n = (2q\ (I_{ds} + (I_{db}M^2 + P_oRM)\ F)\ B_w)^{1/2}$ where q is the electronic charge, I_{ds} is the dark surface current, I_{db} is the dark bulk current, F is the excess noise factor, M is the gain, P_o is the optical power on the device, and B_w is the noise bandwidth. For these devices F = 0.98 (2-1/M) + 0.02 M. (Reference: PP Webb, RJ McIntyre, JJ Conradi, "RCA Review", Vol. 35, p. 234, (1974).

3 The C30902S and C30921S can be operated at a substantially higher Dectection Probabilities. See Appendix.

4 After-Pulse occurring 1 microsecond to 60 seconds after main pulse.

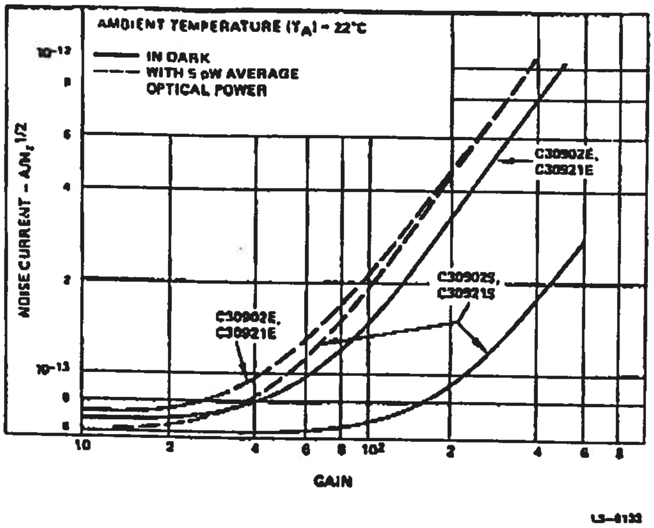


Fig. 3 Typical Noise Current vs Gain

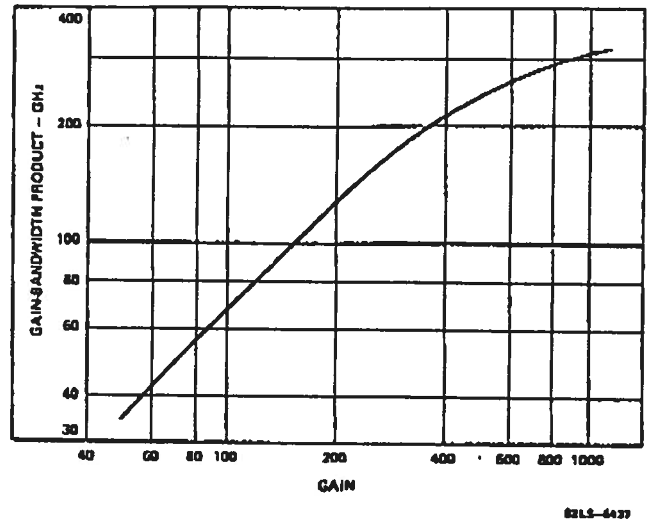


Fig. 5 Typical Gain-Bandwidth Product vs Gain

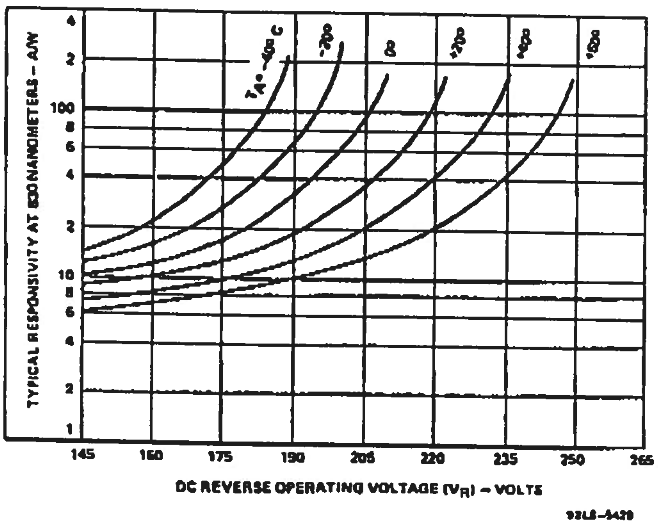


Fig. 4 Typical Responsivity at 830 nm vs Operating Voltage

Note: Operation below 145 volts is not recommended, since the device is not fully depleted below this value.

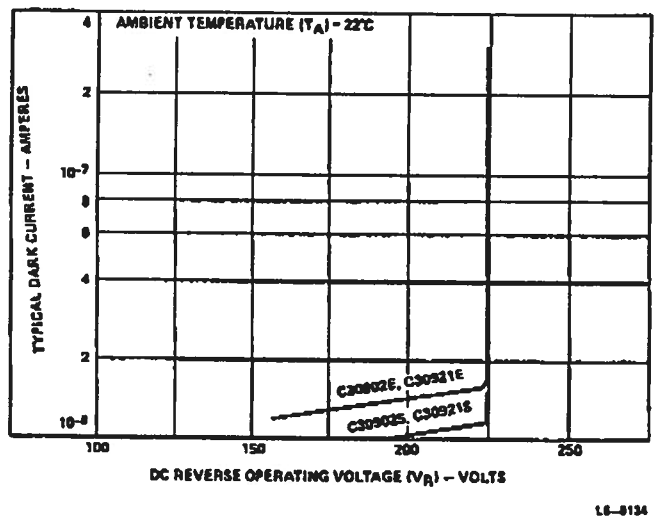


Fig. 6 Typical Dark Current vs Operating Voltage ($V<V_{BR}$)

5/1

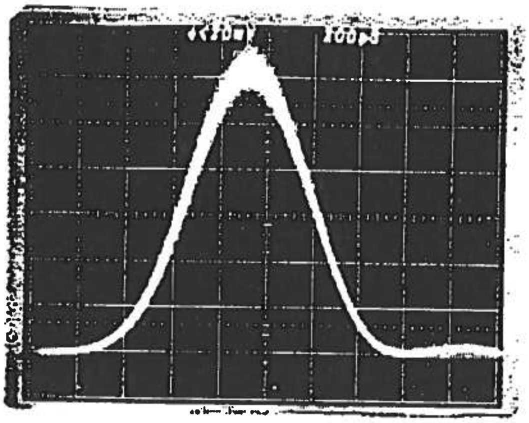


Fig. 7 Avalanche Photodiode Response to a 100 ps Laser Pulse as Measured With a 350 ps Sampling Head. (Horizontal Axis: 200 ps /Division)
Normal Linear Mode $V_R < V_{BR}$

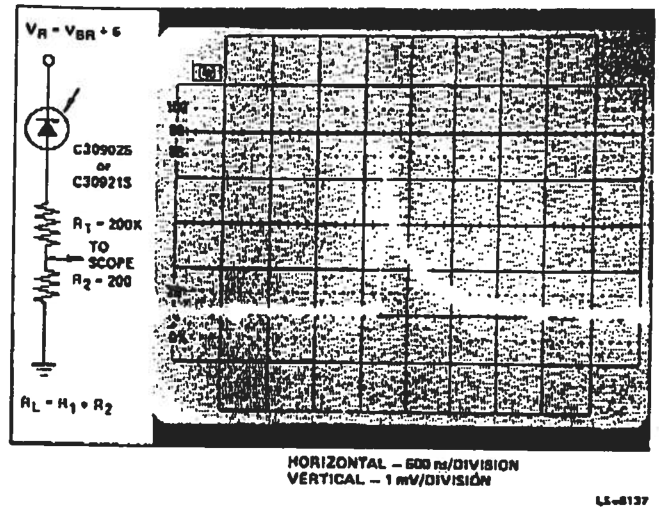


Fig. 9 Passively Quenched Circuit and Resulting Pulse Shape

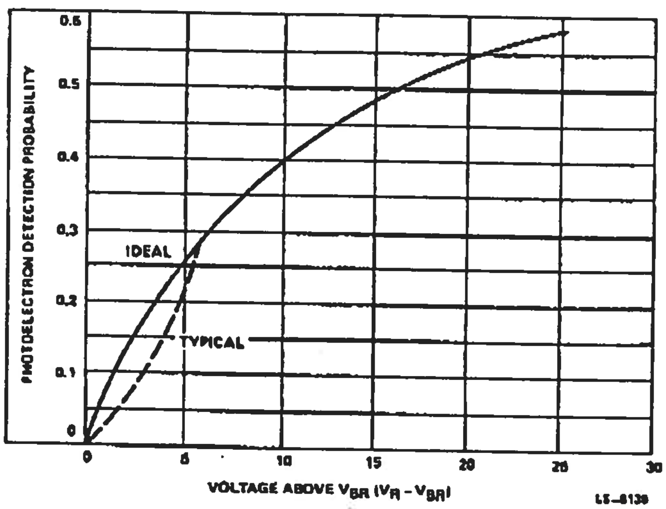


Fig. 8 Geiger Mode, Photoelectron Detection Probability vs Voltage Above V_{BR} ($V_R > V_{BR}$)

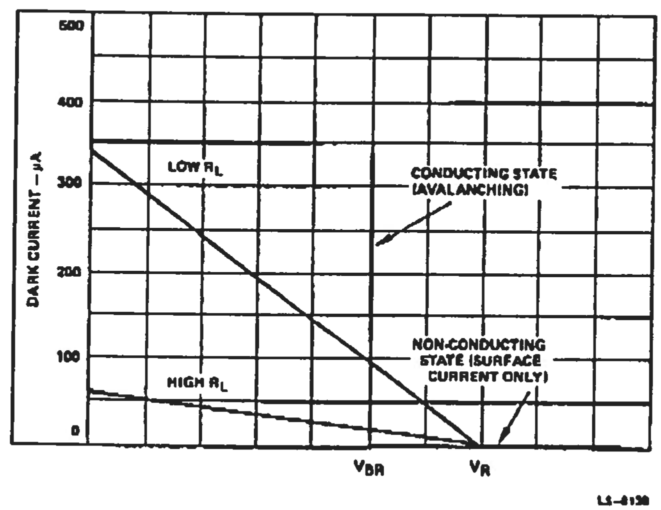


Fig. 10 Load Line for C30921S in the Geiger Mode

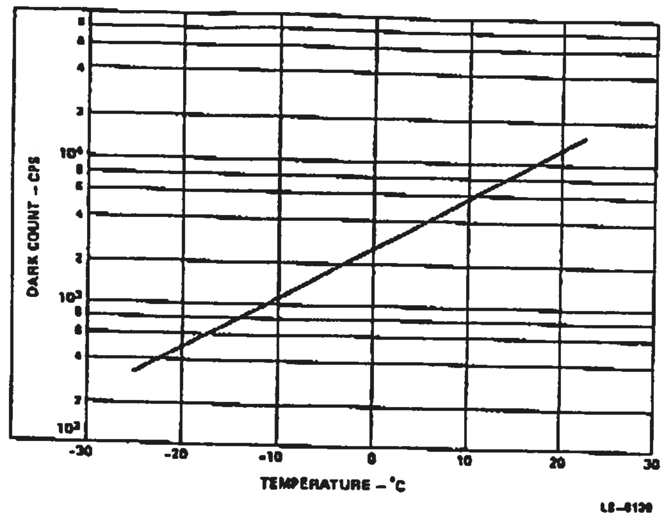


Fig. 11 Typical Dark Count vs Temperature at 5% Photon (830 nm) Detection Efficiency

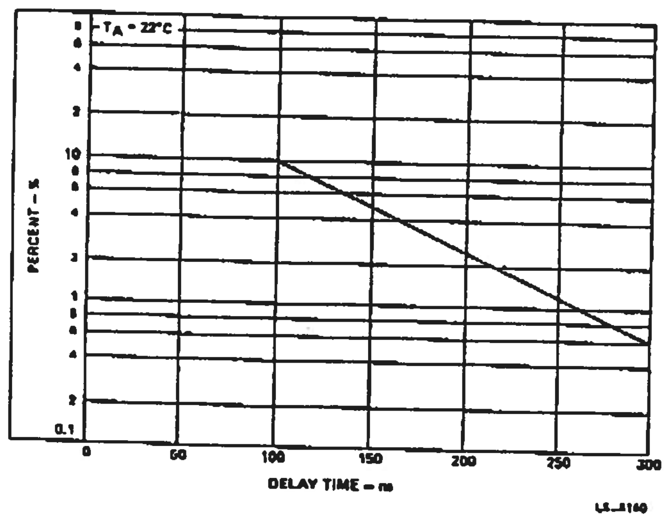
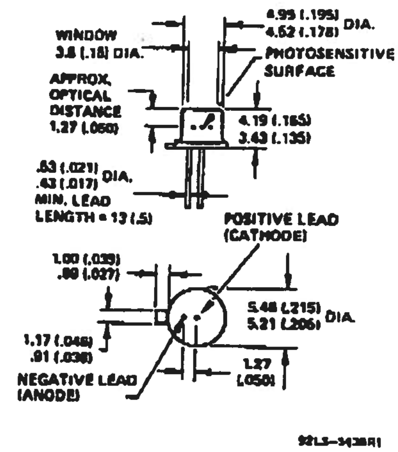


Fig. 12 Chance of an After-Pulse Within the Next 100 ns vs Delay-Time in an Actively Quenched Circuit.
(Typical for C30902S, C30921S at V_{BR} + 25)

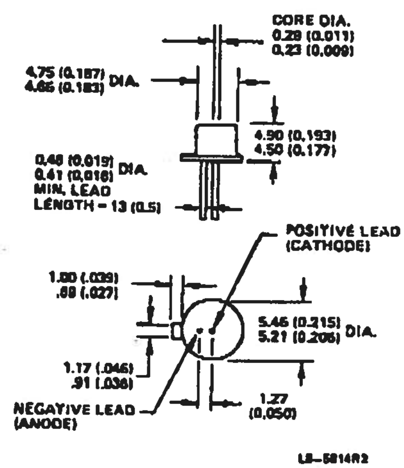


Modified TO-18 Package

Dimensions in millimeters. Dimensions in parentheses are in inches.

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

Fig. 13 Dimensional Outline - C30902E, C30902S



TO-18 Package

Dimensions in millimeters. Dimensions in parentheses are in inches.

Fig. 14 Dimensional Outline - C30921E, C30921S

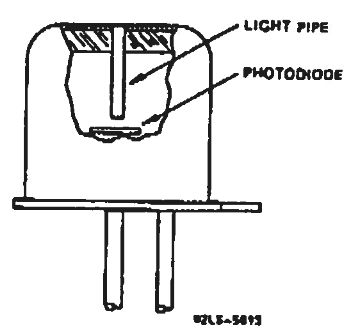


Fig. 15 Cutaway of the RCA C30921E, C30921S

Appendix

Operation of the C30902S & C30921S in the Geiger Mode

Introduction

When biased above the breakdown voltage, an avalanche photodiode will normally conduct a large current. However, if the current is such that the current is limited to less than a particular value (about 50 µA for these diodes), the current is unstable and can switch off by itself. The explanation of this behaviour is that the number of carriers in the avalanche region at any one time is small and fluctuating wildly. If the number happens to fluctuate to zero, the current must stop. It subsequently remains off until the avalanche pulse is retriggered by a bulk-or photo-generated carrier.

The C30902S and C30921S are selected to have small bulk-generated dark-current. This makes them suitable for low-noise operation below V_{BR} or of photon-counting above V_{BR} in the Geiger mode. In this so-called Geiger mode, a single photoelectron (or thermally-generated electron) may trigger an avalanche pulse which discharges the photodiode from its reverse voltage V_R to a voltage slightly below V_{BR}. The probability of this avalanche occuring is shown in **Figure 8** as the "Photoelectron Detection Probability" and as can be seen, it increases with reverse voltage V_R. For a given value of V_R-V_{BR}, the Photoelectron Detection Probability is independent of temperature. To determine the Photon Detection Probability, it is necessary to multiply the Photoelectron Detection Probability by the Quantum Efficiency, which is shown in **Figure 2**. the Quantum Efficiency also is relatively independent of temperature, except near the 1000 nm cut-off.

The C30902S and C30921S can be used in the Geiger mode using either "passive" or "active" pulse quenching circuits. The advantages and disadvantages of each are discussed below.

Passive-Quenching Circuit

The simplest, and in many cases a perfectly adequate method of quenching a breakdown pulse, is through the use of a current-limiting load resistor. An example of such a "passive" quenching circuit is shown in **Figure 9**. The load-line of the circuit is shown in **Figure 10**. To be in the conducting state at V_{BR} two conditions must be met:

1. The avalanche must have been triggered by either a photoelectron or a bulk-generated electron entering the avalanche region of the diode. (Note: holes are inefficient at starting avalanches in silicon.) The probability of an avalanche being initiated is discussed above.
2. To continue to be in the conducting state, a sufficiently large current, called the latching current I_{LATCH}, must be passing through the device so that there is always an electron or hole in the avalanche region. Typically in the C30902S and C30921S, I_{LATCH} = 50 µA. for currents $(V_R$-$V_{BR})/R_L$ much greater thant I_{LATCH}, the diode remains conducting. If the current $(V_R$-$V_{BR})/R_L$ is much less than I_{LATCH}, the diode switches almost immediately to the non-conducting state. If $(V_R$-$V_{BR})/R_L$ is approximately equal to I_{LATCH}, then the diode will switch at an arbitrary time from the conducting to the non-conducting state depending on when the number of electrons and holes in the avalanche region statistically fluctuates to zero.

When R_L is large, the photodiode is normally nonconducting, and the operating point is at V_R - $I_{ds}R_L$ in the non-conducting state. Following an avalanche breakdown, the device recharges to the voltage V_R - $I_{ds}R_L$ with the time constant CR_L where C is the total device capacitance including stray capacitance. Using C = 1.6 pF and R_L = 200.2 KΩ a recharge time constant of .32 microseconds is calculated, in reasonable agreement with observation as shown in **Figure 9**. As is also evident from Figure 9, the rise-time is fast, 5 to 50 nanoseconds, decreases as V_R-V_{BR} increases, and is very dependent on the capacitances of the load resistors, leads, etc. The jitter at the half-voltage point is typically the same order of magnitude as the rise-time. For timing purposes where it is important to have minimum jitter, the lowest possible threshold of the rising pulse should be used.

Active-Quenching Circuit

Until the C30902S or C30921S is recharged, the probability of detecting another incoming photoelectron is relatively low. To avoid an excessive dead-time when operating at a large voltage above V_{BR}, an "actively quenched" circuit can be used. The circuit temporarily drops the bias voltage for a fraction of a microsecond following the detection of an avalanche discharge. This delay time allows all electrons and holes to be collected, including most of those temporarily "trapped" at various impurity sites in the silicon. When the higher voltage is reapplied, there are no electrons in the depletion region to trigger another avalanche or latch the diode. Recharging can now be very rapid through a small load resistor. Alternatively, the bias voltage can be maintained but the load resistor is replaced by a transistor which is kept off for a short time after an avalanche, and then turned on for a period sufficient to recharge the photodiode.

After-Pulsing

An after-pulse is an avalanche breakdown pulse which follows a photon-generated pulse and is induced by it. An after-pulse is usually caused by one of the approximately 10^8 carriers which pass through the diode because of the first avalanche. This electron or hole is captured and trapped at some impurity site in the silicon, as previously described. When this charge-carrier is liberated, usually in less than 100 nanoseconds but sometimes several milliseconds later, it may start another avalanche. The probability of an after-pulse occurring more than one microsecond later is typically less than 2% at 2 volts above V_{BR}, using the circuit shown in **Figure 9**. After-pulsing increases with bias voltage. If it is necessary to reduce after-pulses, it is recommended that one keep V_R-V_{BR} low, use an actively-quenched circuit with a long delay-time (see **Figure 12**), or a passively-quenched circuit with a long R_LC constant. Stray capacitances must also be minimized. Electronic gating of the signal can be performed in certain situations. Should after-pulses be a serious complication in a particular application, operation below V_{BR} with a good amplifier might be considered.

Dark Current

Both the C30902S and C30921S have been selected to have a low dark-count rate. Cooling to -25° C can reduce this by a factor of 50, since the dependence of dark-count rate on temperature is exponential.

The Dark-Count increases with voltage following the same curve as the Photoelectron Detection Probability until a voltage where after-pulsing is responsible for a feedback mechanism which dramatically increases the dark-count rate. This maximum voltage is circuit dependent, and is not warranted other than the values listed on page 3. In most cases, with a delay time of 300 ns, the diode can be used effectively at V_R up to V_{BR} + 25 V.

The C30902S and C30921S should not be forward biased or, when unbiased, exposed to strong illumination. These conditions result in a greatly enchanced dark-count which requires up to 24 hours to return to its nominal value.

Silicon Avalanche Photodiodes – 400 to 1150 nm

Type Number	Std. Pkg. See Photo and Diag. Ref.	Photo. Sens. Surface$_2$ Dia. mm	Resp. at 830 nm A/W	Dark Curr. I_d nA	Spectral Noise Curr. Dens. pA/Hz$^{1/2}$	Cap C_d (100 kHz) pF	Resp. Time t_r ns	N.E.P. at 830 nm fW/Hz$^{1/2}$
		Typical Characteristics$_3$, T = 22°C						
Sealed Case With Window (400 to 1100 nm)								
C30817E	(B)	0.8	75_7	50	1	2	2	13_7
C30872E	(C)	3	37_7	100	1.1	10	2	30_7
C30626E	(C)	5×5mm	22_7	250	0.5	30	5	23_7
C30902E	(Q)	0.5	77	15	0.23	1.6	0.5	3.0
C30902S	(Q)	0.5	128	10	0.11	1.6	0.5	0.86
C30916E	(B)	1.5	50_7	100	1.0	3	2	20_7
C30607E	(Q)	0.5	77	15	0.23	1.6	0.5	3.0
C30703E	(G)	10×10mm	Available late '92					
Sealed Case With Window (400 to 1150 nm)								
C30627E	(C)	5×5mm	14_4	250	0.5	30	5	36
C30954E	(B)	0.8	36_4	50	1.0	2	2	28
C30955E	(B)	1.5	34_4	100	1.0	3	2	29
C30956E	(C)	3	25_4	100	1.1	10	2	44
Sealed Case With Integral Light Pipe$_1$ (400 to 1100 nm)								
C30904E	(K)	0.5	75_7	50	1	2	2	13_7
C30905E	(K)	1.25	50_7	100	1	3.5	3	20_7
C30908E	(K)	0.25	77	15	0.23	1.6	0.5	3.0
C30921E	(H)	0.25	77	15	0.23	1.6	0.5	3.0
C30921S	(H)	0.25	128	10	0.11	1.6	0.5	0.86
C30607EL	(H)	0.25	77	15	0.23	1.6	0.5	3.0
Sealed Case With Fiber Optic Pigtail$_1$ (400 to 1100 nm)								
C30902EQC	(J)	0.05	77	15	0.23	1.6	0.5	3.0
C30902SQC	(J)	0.05	128	10	0.11	1.6	0.5	0.86
Sealed Case With Thermoelectric Cooler								
C30902STC$_8$	(L)	0.5	128	1	0.02	1.6	0.5	0.16
QUADRANT TYPES – 400 to 1100 nm$_1$ (Electrical characteristics per element)								
C30927E	(L)	1.5	62_7	25	0.5	3	3	8_7

Special Purpose Avalanche Photodiode Products

APD Arrays			
C30927E	(L)	Quadrant APD — see listing	
C30985E	(O)	25-element linear array	0.3 mm pitch
C30635E	(O)	32-element linear array, lensed for minimum dead space	150 μm pitch

Photon Counting APD Products

(These detectors are processed and selected for low dark count)			Typ. Dark Count @ 22°C
C30902S	(Q)	0.5 mm diameter, windowed	15,000 c/s (<5,000 c/s available)
C30921S	(H)	0.25 mm diameter light pipe	15,000 c/s
C30902SQC	(J)	50 μm core, fibered package	15,000 c/s
C30902STC	(L)	C30902S on TE cooler with thermistor	350 c/s @ -25° (<70 c/s available)
SPCM-100-PQ	(Z)	0.15 mm detector, integral cooler, driver & HV bias. TTL output, low voltage inputs. P_d > 40% @ 600 nm	250 c/s
SPCM-200-PQ	(Z)	As -100 but lower dark count	25 c/s
SPCM-100/200-PQ-FXXX	(Z)	FC fiber optic connectorized versions of -100, -200	250/25 c/s
SPCM-QCX		3 μm to 100 μm core, FC connectorized, opaque fiber optic pigtails	

OTHER: Most of our sales represent custom products and product developments. Call us with your special requirements.

Silicon Avalanche Photodiode Preamplifier Modules$_6$ – 400 to 1100 nm

Type Number	Std. Pkg. See Photo and Diag. Ref.	Photo. Sens. Surface$_2$ Dia. mm	Resp. at 830 nm V/W	Spectral Noise Volt. Dens. nV/Hz$^{1/2}$	Lin. Volt. Out. Swing V	Sys. BW$_5$ (3 dB) MHz	Resp. Time t_r ns	Sensitivity at 10^{-9} B.E.R. 830 nm dBm	N.E.P. at 830 nm pW/Hz$^{1/2}$
		Typical Characteristics$_3$, T = 22°C							
BI-POLAR AMPLIFIER$_1$									
Sealed Case With Window$_1$									
C30950E	(L)	0.8	$5.6\times10^5{}_7$	20	0.7	50	7	–	0.035_7
C30950F	(L)	0.5	1.9×10^5	12	0.7	100	4	–	0.052
C30950G	(L)	0.5	5.8×10^4	7	0.7	200	2	–	0.12
C30974E	(L)	0.8×7	$1.8\times10^5{}_4$	25	0.7	20	18	–	0.14_4
Sealed Case With Integral Light Pipe$_1$									
C30950EL	(M)	0.50	$5.6\times10^5{}_7$	20	0.7	50	7	–	0.035_7
C30950FL	(M)	0.25	1.9×10^5	12	0.7	100	4	–	0.052
C30950GL	(M)	0.25	5.8×10^4	7	0.7	200	2	–	0.12
Sealed Case With Temperature Compensation Circuit$_1$									
C30919E	(N)	0.8	$1.0\times10^6{}_7$	25	0.7	40	10	–	0.025_7
TRANS-IMPEDANCE AMPLIFIER$_1$									
Sealed Case With Window$_1$									
C30998-010	(R)	0.5	1.9×10^7	100	2	10	35	-60	0.005
C30998-050	(R)	0.5	4.4×10^6	50	2	50	7	-53	0.011
C30998-090	(R)	0.5	2.3×10^6	40	2	90	4	-50	0.017
C30998-250	(R)	0.5	4.0×10^5	30	2	250	1.5	-46	0.075
C30998-350	(R)	0.5	3.0×10^5	25	2	350	1.0	-44	0.09
Sealed Case With Soldered Pigtail$_1$									
C30657-010QC	(S)	.05	1.9×10^7	100	2	10	35	-60	0.005
C30657-050QC	(S)	.05	4.4×10^6	50	2	50	7	-53	0.011
C30657-090QC	(S)	.05	2.3×10^6	40	2	90	4	-50	0.017
C30657-250QC	(S)	.05	4.0×10^5	30	2	250	1.5	-46	0.075
C30657-350QC	(S)	.05	3.0×10^5	25	2	350	1.0	-44	0.09

Notes

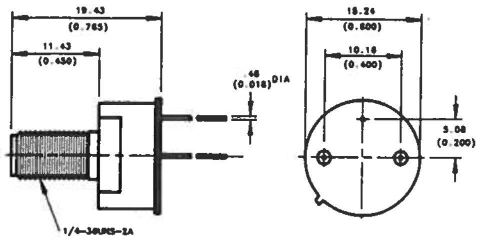
~~[illegible]~~ C30902E

from Metrotek

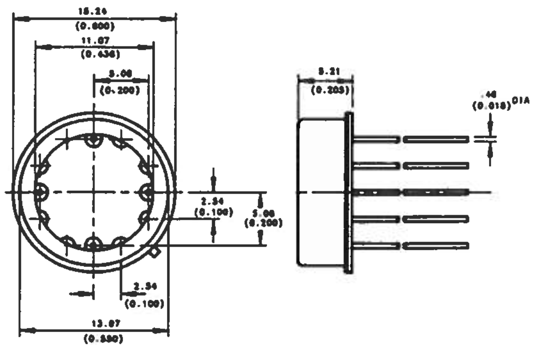
- case "Q"

NOT REPRODUCED TO ACTUAL SIZE – MEASURES IN mm/(inches)

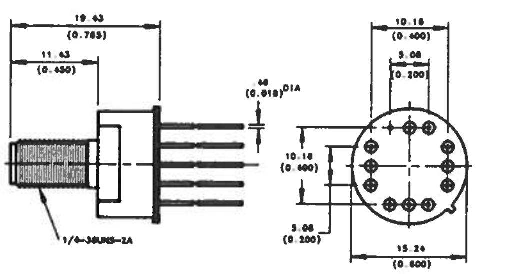
(K)



(L)



(M)



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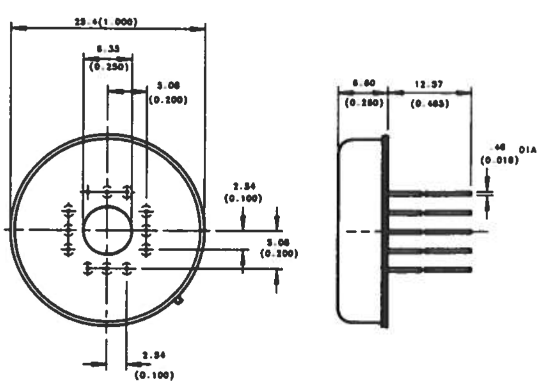
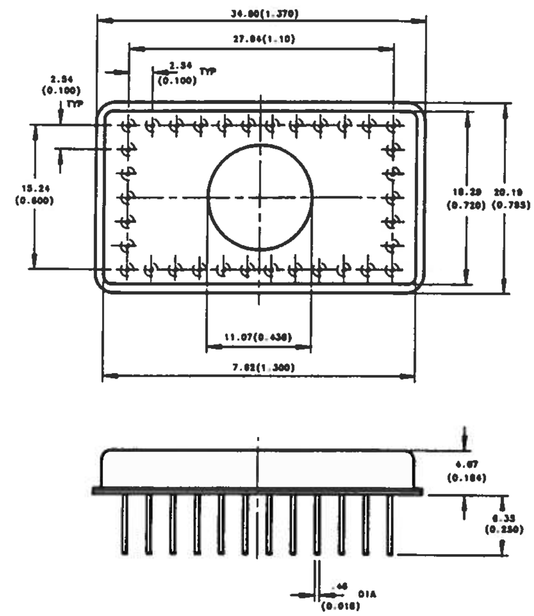


(O)



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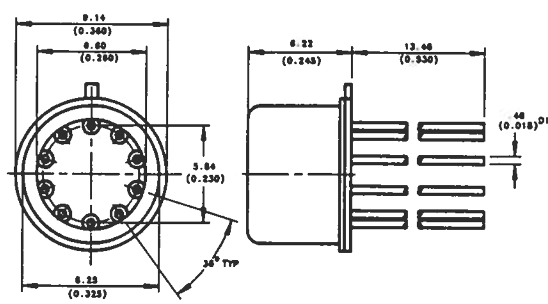
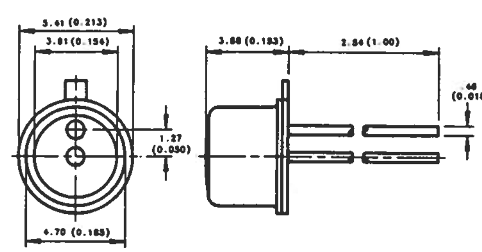


(Q)



missing case pin?

July 7/97

Disk: AV -

Name: 149 #7910.INS