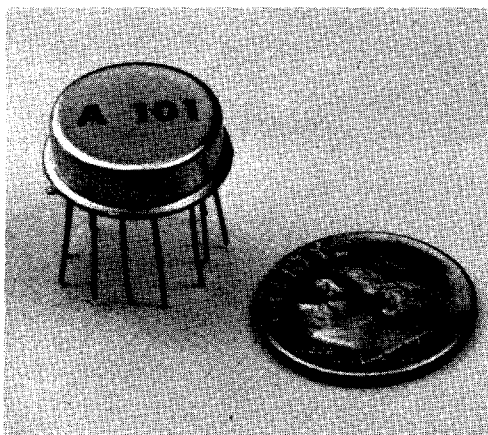


## CHARGE SENSITIVE PREAMPLIFIER-DISCRIMINATOR

# A-101

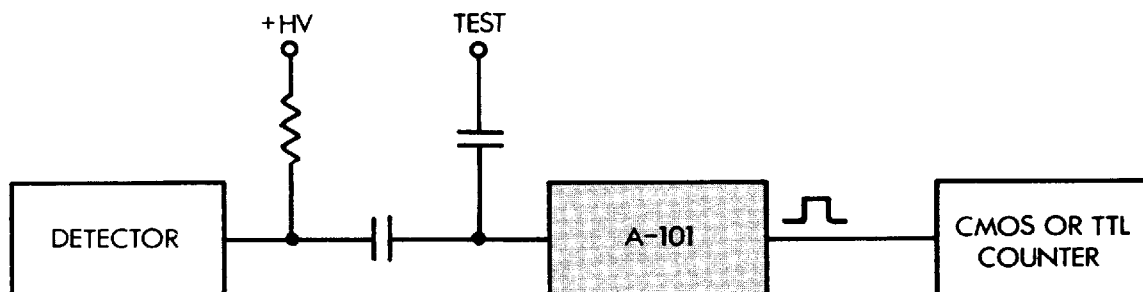


Designed for direct applications in the field of aerospace instrumentation, mass spectrometers, laboratory and research experiments, medical electronics, and electro-optical systems.

Model A-101 is a hybrid charge sensitive preamplifier, discriminator, and pulse shaper developed especially for instrumentation employing photomultiplier tubes, channel electron multipliers and other low capacitance charge producing detectors in the pulse counting mode. While this unit was specifically designed for satellite instrumentation, the following unique characteristics make it equally useful for space, laboratory and commercial applications:

- Small size (TO-8 package) allows mounting close to collector of multiplier.
- Power required is typically 15 milliwatts.
- Single power supply voltage.
- Outputs interface directly with C-MOS and TTL logic.
- Input threshold is externally adjustable.
- Output pulse width is variable with external trim capacitor.
- High reliability process.
- One year warranty.

### TYPICAL PARTICLE COUNTING SYSTEM



### AMPTEK HIGH RELIABILITY SCREENING

- |                        |   |
|------------------------|---|
| 1. PRECAP VISUAL:      | MIL-STD-883, method 2017. Low Magnification, High Magnification.  |
| 2. SEALING:            | Welded, hermetic seal.  |
| 3. STAMPING:           | Date code and serial number.  |
| 4. STABILIZATION BAKE: | MIL-STD-883, method 1008, Condition C. + 150°C, 24 hours minimum.   |
| 5. TEMPERATURE CYCLE:  | MIL-STD-883, method 1010, Condition C min. T = - 65°C to + 150°C. 10 minutes each extreme, 5 minutes maximum transfer time. |
| 6. CENTRIFUGE:         | MIL-STD-883, method 2001, Condition B. YI Axis; 10,000 G's.   |
| 7. ELECTRICAL TEST:    | As per specifications.  |
| 8. BURN-IN TEST:       | MIL-STD-883, method 1015, 160 hours at + 125°C.   |
| 9. FINE LEAK TEST:     | MIL-STD-883, method 1014, Condition A. Rejection if leak rate in excess of $5 \times 10^{-7}$ cc/sec.                       |
| 10. GROSS LEAK TEST:   | MIL-STD-883, method 1014, Condition C. Fluoro Carbon; Rejection if stream of bubbles is present.                            |
| 11. ELECTRICAL TEST:   | As per specifications.  |
| 12. EXTERNAL VISUAL:   | MIL-STD-883, method 2009.   |

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## SPECIFICATIONS

( $V_s = 5V$ ,  $T = 25^\circ C$ )

**THRESHOLD:** Model A-101 has a nominal threshold referred to the input of  $1.6 \times 10^{-13}$  coulomb. This is equivalent to  $10^6$  electrons. The threshold can be increased by the addition of a resistor between Pins 9 and 12. See Figure 1.

**STABILITY:**  $< 1.5\%$  of threshold,  $0^\circ$  to  $50^\circ C$ . See Figure 3.

**NOISE:** RMS noise level  $< 0.4\%$  of threshold.

**PROTECTION:** Back-to-back diodes to ground.

### DETECTOR

**CAPACITANCE:** 0-60 pF

### OUTPUT CHARACTERISTICS

1) Pin 5 provides a positive 5 volt output pulse capable of interfacing directly with CMOS.

Pulse characteristics are:

**RISETIME:** 6 ns

**FALLTIME:** 20 ns

**WIDTH:** 220 ns nominal. May be increased to greater than  $1 \mu s$  by the addition of a capacitor between Pins 3 and 4. See Fig. 2.

**AMPLITUDE:** 5 volts

2) Pin 6 is an open collector output and with an external pullup resistor provides a negative going pulse (the complement of Pin 5). This output can drive TTL and can be wire-or'd with other units. Pullup resistor may be connected to  $V_s$  or to other positive supply up to +15V.

### GENERAL

**COUNT RATE:**  $4 \times 10^6$  CPS, Periodic

**PULSE PAIR RESOLUTION:** 250 ns

**OPERATING VOLTAGE:** +4 to +10 VDC

**OPERATING CURRENT:** 3ma Quiescent  
4ma @  $10^6$  CPS

**TEMPERATURE:**  $-55^\circ$  to  $+70^\circ C$  operational

**WARRANTY:** One year

**RADIATION RESISTANCE:**  $> 10^6$  Rads

**PACKAGE:** 12-Pin, TO-8 case.

**SCREENING:** AMPTEK HIGH RELIABIL

**TEST BOARD:** PC-11

### OPERATING NOTES:

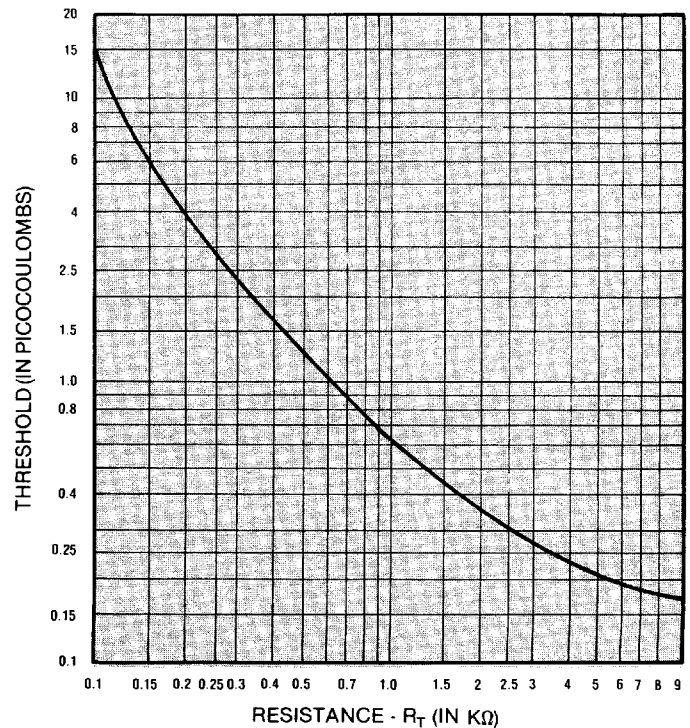
#### POWER REQUIREMENTS:

All device specifications apply to operation at +5V. The unit can be operated up to +10V with increased power dissipation and threshold. Supply is internally bypassed. Care should be taken in circuit layout and in some applications power supply decoupling may be helpful.

The case is internally connected to Pin 1, ground.

### INPUT

The detector is normally capacitively coupled to Pin 12 with a capacitor of adequate voltage rating. Alternately, the detector anode can be direct coupled to the input if the cathode is at negative potential. The A-101 is sensitive to a negative charge pulse of at least 0.16 picocoulomb. This threshold may be increased by the connection of a resistor between Pins 9 and 12. Approximate values are given in Figure 1.

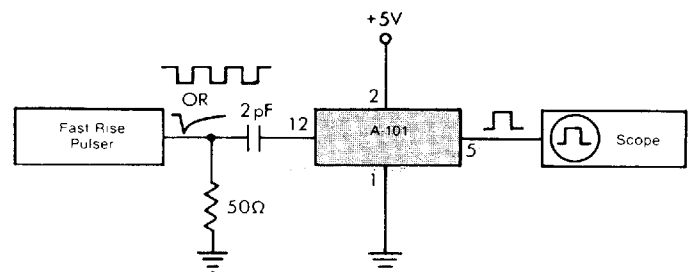


Input threshold as a function of external resistance

Figure 1

The A-101 can be tested with a pulser by using a small capacitor to inject a test charge into the input. The unit will trigger on the negative-going edge of the pulse which should have a transition time of less than 20 ns. Either a tail pulse with a much longer fall time ( $> 1 \mu s$ ) or a square wave may be used. (If a square wave is used, triggering on the positive-going edge will occur for large pulses.)

Charge transfer in the test circuit is according to  $Q = CV$  where  $Q$  = Total amount of charge,  $C$  = Capacitor, and  $V$  = Voltage. Use only a small capacitor in this circuit (1-10pF). DO NOT connect a low impedance pulser through 500 pF when testing as this will produce a large pulse through the input transistor and may cause irreversible damage.



$T_r < 20ns$ ,  $T_f > 1\mu s$   
Negative going  
Amplitude: 0.25 V = 0.5 picocoulomb

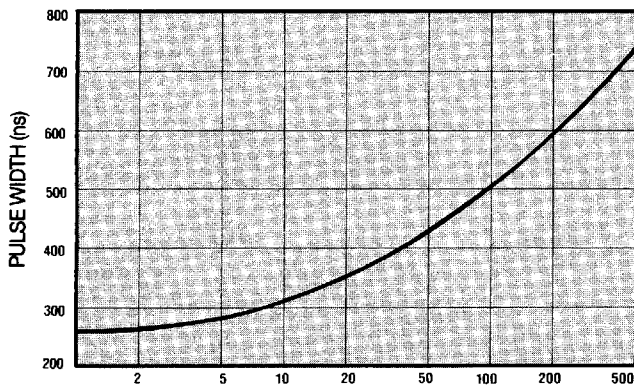
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## OUTPUTS

The output at Pin 5 is a positive, 220ns wide pulse.

Pin 6 is an open collector output and should be left unconnected if not used. A negative going output can be obtained by connecting a pullup resistor (Typically 1k $\Omega$ ) between  $V_S$  and Pin 6. The pullup resistor may be tied to any positive voltage up to 15V (as required for example, in interfacing with particular logic families.) In multi-detector systems, where more than one preamp drives the same counter, the open collector outputs of several A-101s can be connected together to the counter input with a single pullup resistor. **DO NOT CONNECT THIS PIN DIRECTLY TO  $V_S$  (PIN 2) AS THIS MAY DAMAGE OUTPUT STAGE AND VOID WARRANTY.**

The output pulse width can be increased by the connection of a capacitor between Pins 3 and 4. See Figure 2 for typical values.

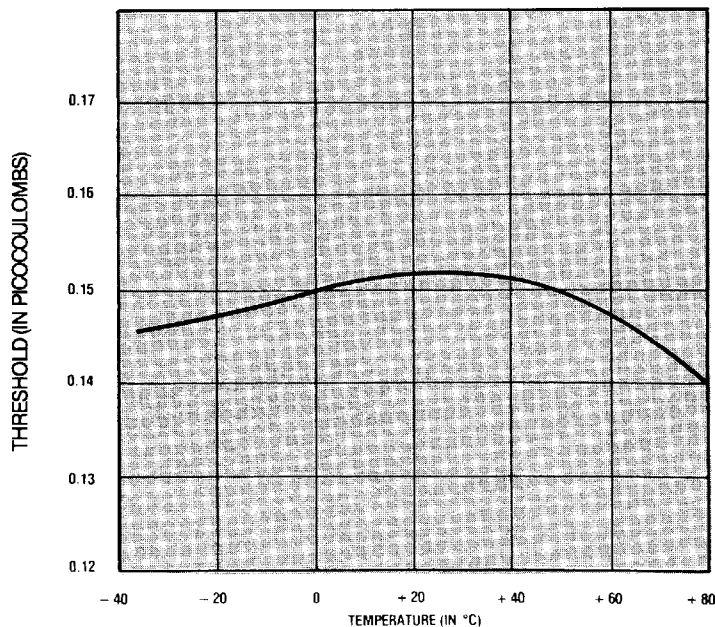


$C_W$ (pF)

Pulse width as a function of external capacitance

Figure 2

If the standard pulse width is adequate Pins 3 and 4 must be left unconnected.



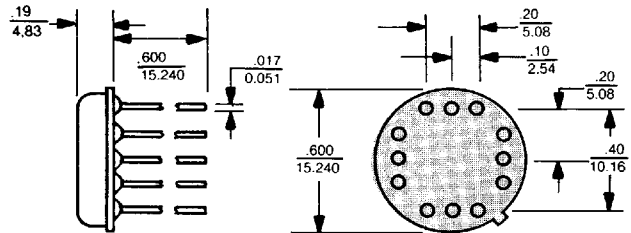
Threshold vs. Temperature (Typical)

Figure 3

## GENERAL

Due to its hermetic seal and small size, the A-101 is well suited to use within a vacuum chamber. In such applications the mounting should provide adequate heat dissipation and care should be taken to avoid electrical discharge near the input which can damage unit and void warranty.

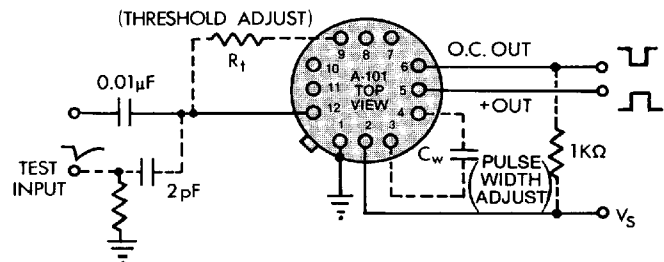
**Use care in soldering leads - avoid overheating.**



TO-8 TYPICAL DIMENSIONS:  $\frac{\text{inches}}{\text{mm}}$

## PIN ASSIGNMENTS

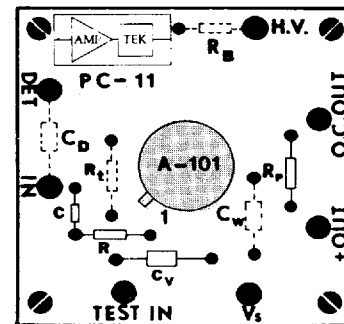
- |                          |                     |
|--------------------------|---------------------|
| 1. GROUND                | 7. No Connection    |
| 2. $V_S$ (+4 to +10 VDC) | 8. No Connection    |
| 3. Pulse Width Adjust    | 9. Threshold Adjust |
| 4. Pulse Width Adjust    | 10. No Connection   |
| 5. Positive Output       | 11. No Connection   |
| 6. Open Collector Output | 12. Input           |



Connection Diagram

## TEST BOARD

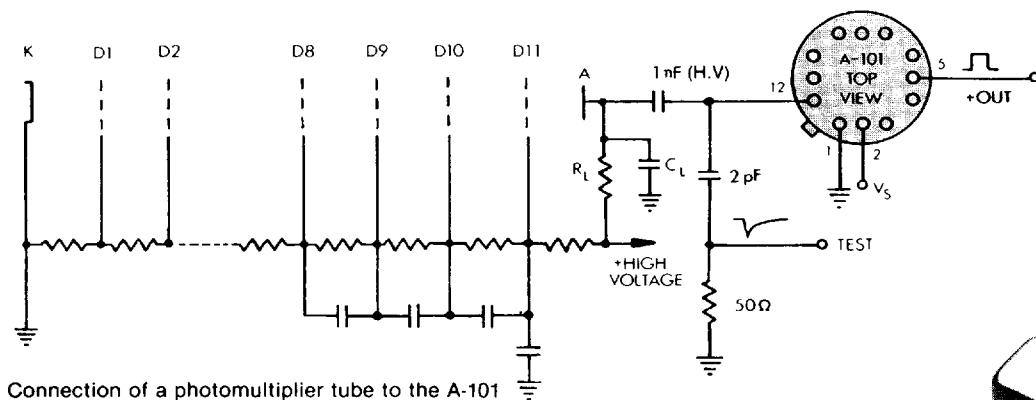
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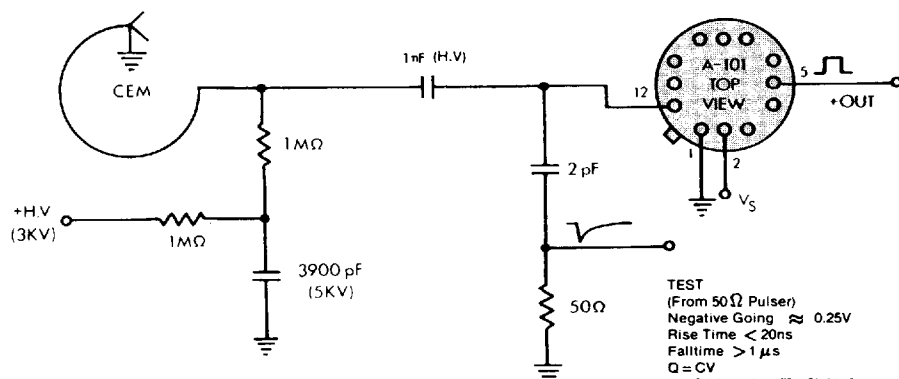
PC-11 Test Board for the A-101

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## TYPICAL APPLICATIONS

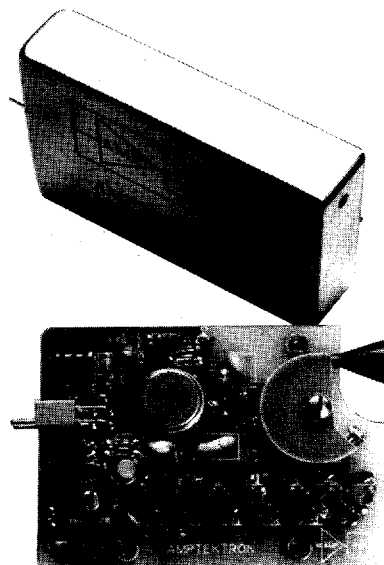


Connection of a photomultiplier tube to the A-101  
Using + High Voltage

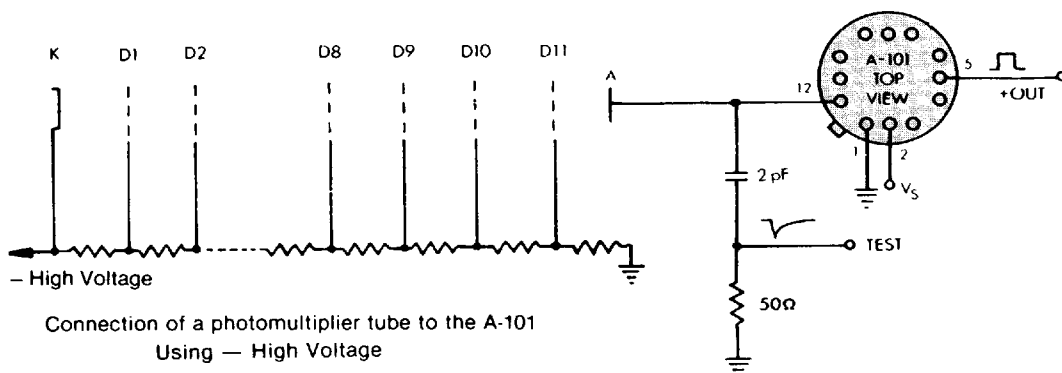


Connection of a Channel Electron Multiplier to the A-101.

TEST  
(From 50Ω Pulser)  
Negative Going  $\approx 0.25V$   
Rise Time  $< 20ns$   
Falltime  $> 1\mu s$   
 $Q = CV$   
 $= [(2.2 \times 10^{-11}F) \times [0.25V]]$   
 $= 0.55 \times 10^{-11} COULOMB$



Model A-101 mounted on the MD-501 Amp-tektron®, complete with CEM, high voltage power supply and line driver.



Connection of a photomultiplier tube to the A-101  
Using - High Voltage

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