

# Model 404

## Pyroelectric IR Detector with Both Voltage and Current Mode Electronics



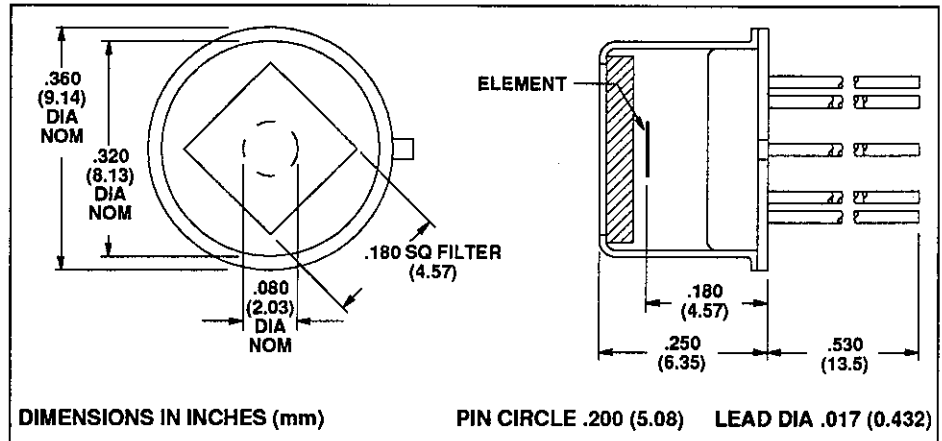
Manufactured under one or more of the following U.S. patents: 3,839,640 - 4,218,620 - 4,326,663 - 4,384,207 - 4,437,003 - 4,441,023 - 4,523,095

**Model 404** consists of a single lithium tantalate sensing element and electronics configured for 3 modes of operation sealed into a modified TO-99 transistor housing with optical filter.

**(1) The voltage mode circuit:** Configured as a JFET source follower with source resistor, provides a voltage output with the best possible signal-to-noise (S/N) ratio throughout a frequency range of .1 to 1000 Hz.

**(2) The current mode circuit:** Functions as a current-to-voltage converter and provides substantially higher voltage responsivity with slightly lower S/N performance.

**(3) Model 404** may also be operated as a detector without internal electronics (see "Pin Connections" table on reverse).

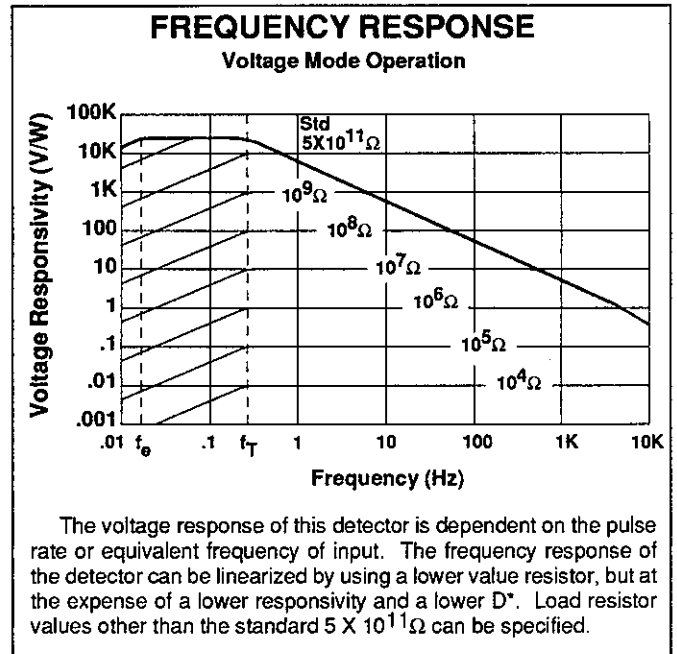
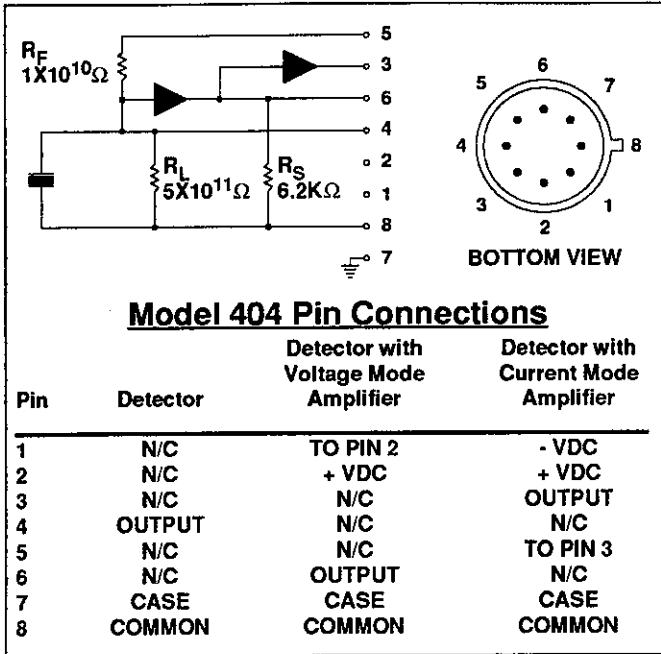


Characteristics	Voltage Mode	Current Mode	Unit	Test Conditions	ELTECdata Reference
Detector Type	Single	Single	—		
Element Size	2.0	2.0	mm, Dia	Nominal	
Optical Bandwidth	0.0001 to 1000	0.0001 to 1000	$\mu\text{m}$	Without filter	101
Responsivity (Typ)	1,840	12,100	V/W	7.6-14.6 $\mu\text{m}$ , 1Hz	
Responsivity (Typ)	236	7,430	V/W	7.6-14.6 $\mu\text{m}$ , 10Hz	
NEP (Typ)	$3.78 \times 10^{-10}$	$5.21 \times 10^{-10}$	W/ $\sqrt{\text{Hz}}$	7.6-14.6 $\mu\text{m}$ 1Hz, BW 1Hz	100
NEP (Typ)	$1.02 \times 10^{-9}$	$1.75 \times 10^{-9}$	W/ $\sqrt{\text{Hz}}$	7.6-14.6 $\mu\text{m}$ 10 Hz, BW 1Hz	100
D* (Typ)	$4.69 \times 10^8$	$3.4 \times 10^8$	cm $\sqrt{\text{Hz}}$ /W	7.6-14.6 $\mu\text{m}$ 1Hz, BW 1Hz	100
D* (Typ)	$1.74 \times 10^8$	$1.01 \times 10^8$	cm $\sqrt{\text{Hz}}$ /W	7.6-14.6 $\mu\text{m}$ 10 Hz, BW 1Hz	100
Operating Voltage (Min)	+5	$\pm 5$	VDC		104
Operating Voltage (Max)	+15	$\pm 15$	VDC		(4.1.c)
Operating Current (Max)	0.2	5.0	mA		104 (4.1.c)
Offset Voltage (Min)	0.2	—	V	$R_S = 6.2 \text{K}\Omega$	104
Offset Voltage (Max)	1.2	0.1	V		Fig. 4
Output Impedance	<6.2K	<100	$\Omega$		
Thermal Breakpoint $f_T$ (Typ)	0.25	0.25	Hz		102
Electrical Breakpoint $f_e$ (Typ)	0.01	20	Hz	$R_L = 5 \times 10^{11} \Omega$ $R_F = 1 \times 10^{10} \Omega$	102
Recommended Operating Temp.	-10 +40	-10 +40	$^{\circ}\text{C}$		
Storage Temperature	-55 +125	-55 +125	$^{\circ}\text{C}$	$\Delta T < 50^{\circ}\text{C}/\text{minute}$	

Characteristics at 25 $^{\circ}\text{C}$ , with -3 filter,  $V_S = 10$  VDC for VM;  $\pm 10$  VDC for CM. Data is established on a sample basis and is believed to be representative.

## Applications

- Pyrometry
- FT Spectroscopy
- Gas Analysis
- Materials' Transmission / Reflectance Studies
- UV Curing Instrumentation
- Total Energy Plasma Studies



**Field of View:** Approximately  $110^\circ$  (50% power points).

**Mounting:** Avoid mechanical stresses on case and leads.

**Soldering:** Use minimum heat and a heat sink between case and leads. Leave minimum lead length of .25 inch (6.0mm). DO NOT MACHINE SOLDER.

**Static Discharge:** Protect detectors from electrostatic charges.

**Thermal Shock:** Temperature changes and rate of change must be kept to a minimum ( $<50^\circ\text{C}/\text{min.}$ ) to prevent damage.

**Power Polarity:** Carefully note power supply polarity connections to avoid damage to internal op amp.

**Output Protection:** Output is short circuit protected in both current and voltage modes.

**Current Mode Output:** Output in the current mode is inverting (negative output for positive temperature change).

**Voltage Mode Output:** No external resistor is needed in the voltage mode because the Model 404 contains an internal source resistor of 6.2 K $\Omega$ .

**Optical Filter:** This Model can be used with any standard ELTEC detector filter or used without a filter. For more information, please refer to ELTECdata #101.

**Noise:** As a resolution or low level information limit, noise is established not only by the detector. Other noise sources are:

- Radiated and conducted RF signals
- Subsequent amplification or signal conditioning stages
- Power supply noise
- Components, such as high value resistors and capacitors (tantalum and aluminum electrolytic)
- Mechanical contacts and weak solder joints
- Vibration excited microphonics
- Outside thermal influences on the detector other than the desired infrared input, i.e. drafts.

All of these noise sources should be considered carefully when the information signal is  $<1\text{mV}$  for voltage mode operation and  $<20\text{mV}$  for current mode operation.

**Light Leakage:** Slight sensitivity to visible light leaking through the glass-to-metal seal on the base may be observed.

**Calculations** (for operation with only crystal and load resistor): When calculating response from basic formulae, (see ELTECdata #100) use crystal thickness as 0.005 cm and use 30 pF capacitance for crystal.

**Optical Design:** Use of a detector with a filter in an optical system may require consideration of the image displacement toward the filter. This displacement (s) caused by the insertion of a planoparallel plate (filter thickness = t; refractive index = N) is given by  $s = (t/N)(N-1)$ .