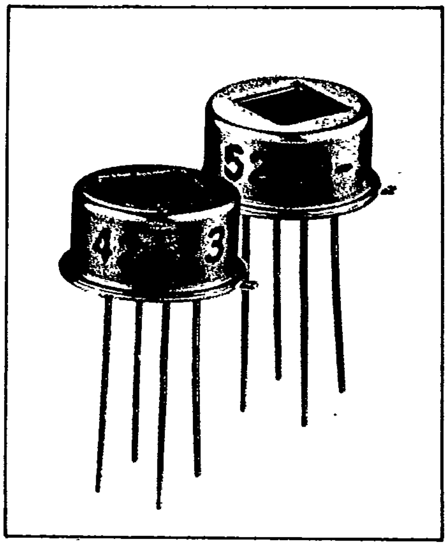
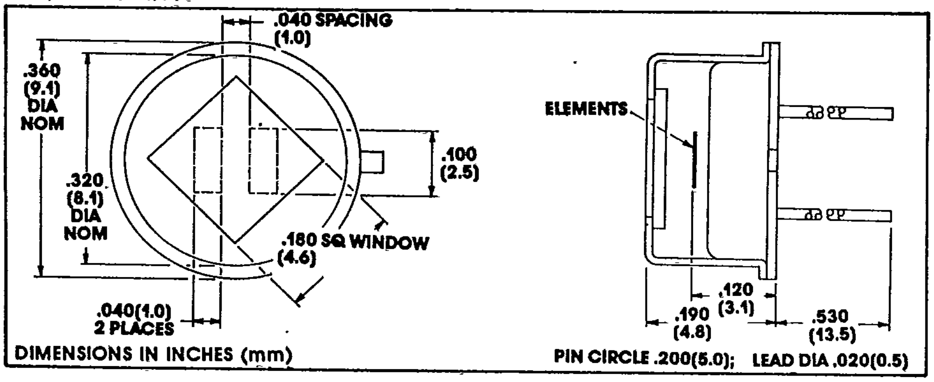
421/5210

Parallel Opposed Dual Pyroelectric IR Detector with Internal Amplifier



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 421 consists of two separate lithium tantalate sensing elements connected parallel opposed to a source follower (JFET and high megohm load resistor) plus gain stage comprised of a transistor and resistor sealed within a TO-5 housing with optical filter.

This Parallel Opposed Detector (POD) provides common mode signal cancellation when identical incident radiation falls upon both elements. Electrically, the Model 421 provides a very low output impedance. The internal gain is set with external resistors. See sample circuit on reverse.

This model offers improved stability throughout a broad temperature range because the feedback circuit eliminates FET drift and gives high immunity against RF fields.

Model 421 offers the advantage of lower output impedance and higher signal levels than detectors with only a source follower.

Model 5210 is a lower cost alternative selected to a higher noise tolerance.

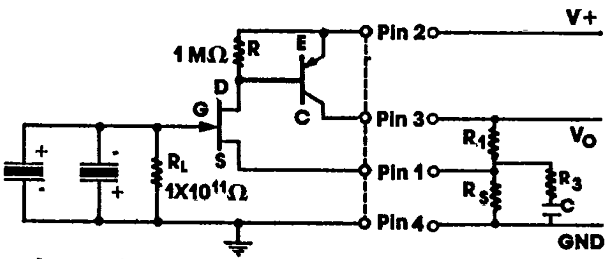
Applications

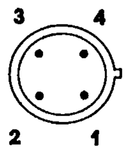
- **Intrusion Detection**
- **Industrial Control**
- **Motion Sensing**
- **Safety Warning**

Characteristics		421	5210	Unit	Test Conditions	ELTECdata Reference
Detector Type		POD	POD	—		
Element Size		1.0 x 2.5	1.0 x 2.5	mm	nominal, each	
Element Spacing		1.0	1.0	mm	nominal	
Responsivity (Each Element)	min typ max	2000 2700 3500	2000 2700 3500	V/W	8-14μm@1Hz	
Common Mode Rejection Ratio	min typ	5:1 15:1	5:1 15:1	—	8-14μm@1Hz	
Noise	typ max	13.5 27.0	20.0 54.0	$\mu V/\sqrt{Hz}$	1.0Hz p-p (1 minute)	
NEP	typ max	1.3×10^{-9} 3.4×10^{-9}	1.9×10^{-9} 6.8×10^{-9}	$W/\sqrt{Hz}$	8-4μm @1Hz, BW 1Hz	100
D*	min typ	0.4×10^{8} 1.1×10^{8}	0.2×10^{8} 0.7×10^{8}	$cm\sqrt{Hz}/W$	8-14μm @1Hz, BW 1Hz	100
Operating Voltage	min max	3 15	3 15	V	V_D to Gnd	104 (4.1.c)
Operating Current	min max	5 200	5 200	μA	Including Gain Stage	104 (4.1.c)
Offset Voltage	min max	0.3 1.2	0.3 1.2	V	$R_S = 100K\Omega$	104 Fig. 4
Offset Voltage	min max	0.35 1.8	0.35 1.8	V	Gain Stage in Operation	104 Fig. 4
Open Loop Gain	min max	200 600	200 600			
Output Impedance		20	20	KΩ		
Thermal Breakpoint f_T	typ	0.2	0.2	Hz		102
Electrical Breakpoint f_e	typ	0.05	0.05	Hz	$R_L = 1 \times 10^{11}\Omega$	102
Recommended Operating Temp.		-10 +50	-10 +50	°C		
Responsivity vs. Temperature	max	+0.2	+0.2	%/°C	Unity Gain Circuit	104 (3.5)
Pressure Sensitivity	max	200	200	μV/mbar	Step Response	
Microphony	max	50	50	μV/g	10-1000Hz	104 (3.9)
Package Sealing	max	10^{-8}	10^{-8}	cm^3/sec	Helium	
Storage Temperature		-55 +125	-55 +125	°C	ΔT<5°C/minute	

Characteristics at 25°C, with -3 Window, V_S = 5 VDC on Pin 2, R_S = 100KΩ output on Pin 1, gain stage not in operation (Pin 3 open) unless otherwise stated.
Data is established on a sample basis and is believed to be representative.

Recommended Operation and Pin Connection





BOTTOM VIEW

1. SOURCE
2. V+
3. COLLECTOR
4. GND

$R_s = 10\ K\Omega$ to $1\ M\Omega$
$R_1 = 0\Omega$ to $1\ M\Omega$

The **DC Gain** of Model 421 is determined by the choice of resistor values for R_1 and R_s.

$$\text{DC Gain} = \frac{R_1 + R_s}{R_s}$$

For stability over temperature range:

$$\text{DC Gain} \ \frac{+V_s}{2V} \ \text{max}$$

If unity gain is desired, then make $R_1 = 0\Omega$.

AC Gain: An additional RC loop may be used to increase AC gain as shown in the sample circuit.

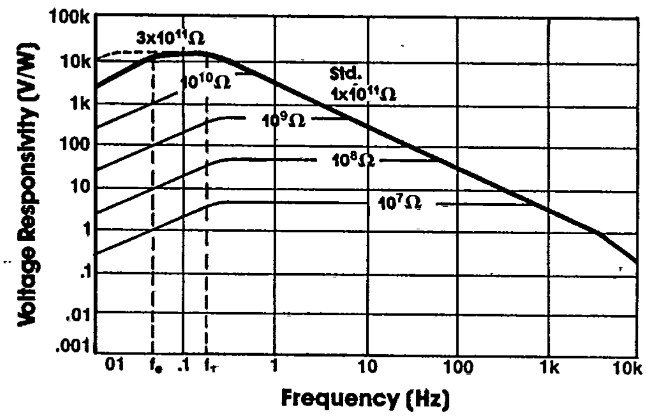
An example of low current, high gain circuit for the Model 421 utilized the sample circuit with a supply voltage of 7 VDC, $R_1 = 470\ K\Omega$, $R_s = 220\ K\Omega$, $R_3 = 10\ K\Omega$, and $C_1 = 47\mu F$.

With values given, gain is approximately 50 and the current draw is typically $5\mu A$.

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

Optical Bandwidth: The detector is sensitive in a range from 1.5 to 1000 μm depending on window used. For more information, see ELTECdata #101.

FREQUENCY RESPONSE



The voltage response of this detector is dependent on the pulse rate or equivalent frequency of input. The frequency response of the detector can be linearized by using a lower value resistor, but at the expense of a lower responsivity and a lower D*. Load resistor values other than the standard $1x10^{11}\Omega$ can be specified.

Mounting: Avoid mechanical stresses on case and leads.

Soldering: Use minimum heat and heat sink between case and leads. Leave minimum lead length of .250 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 (<5°C/min.) to prevent damage.

Noise: As a resolution or lower information limit, noise is not established 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 tantalum or electrolytic capacitors
- Mechanical contacts and weak solder joints
- Microphonics or vibration
- Outside thermal influences on the detector other than the desired infrared input, i.e. drafts.

All these noise sources should be considered carefully when the information signal is <1mV.

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