

Lead Tin Telluride Infrared Detector

The Lead Tin Telluride Infrared Detector utilizes intrinsic photodetection in single-crystal, lead tin telluride (PbSnTe) material. Barnes now offers two types of PbSnTe detectors. The first type is liquid nitrogen-cooled and provides optimum sensitivity throughout the 5-13 micron region with peak wavelength selectable. The second type performs optimally in the 6.5-18 micron region with peak wavelength selectable and is liquid helium-cooled.

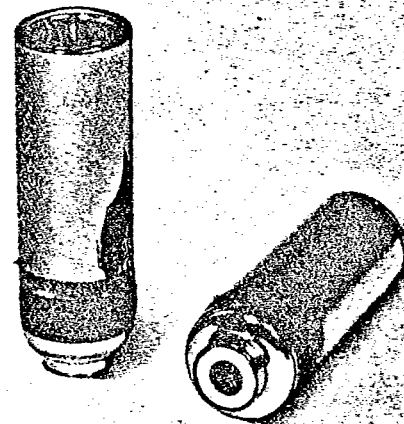
Barnes PbSnTe detectors are photovoltaic in operation, resulting in a number of significant advantages. When used with a current mode amplifier, the speed of response is not compromised for detector sensitivity and response times as fast as 20 nanoseconds can be achieved. In addition, bias currents are not required, resulting in very low $1/f$ noise. This is of particular importance in those applications where relatively low chopping frequencies, e.g., 100 Hz, are employed, or where scanning systems require video bandwidths extending to low frequencies. Barnes PbSnTe detectors feature long term stability with no material migration, such as can be experienced with mercury cadmium telluride (HgCdTe).

Standard liquid nitrogen-cooled PbSnTe detectors are available in a Dewar Model D05E of all-glass construction with an evaporated barium getter. The package is an end-looking configuration with a liquid nitrogen holding time of four hours. A side-looking configuration in Model D10S is also available. PbSnTe material permits high temperature bakeout which ensures extended vacuum integrity of the dewar. Available on special order are other dewar styles and package configurations, including conformal metal jackets. Optimized current mode preamplifiers are available on a custom basis.

The liquid helium-cooled dewar is of all-metal construction employing super insulation. It is available in an end-looking configuration and features a 12 hour hold time.

Standard detector element sizes are 0.6 mm dia. and 1.0 mm dia.; other sizes from 0.1 mm to 2.0 mm dia. are available. Custom detectors, including multi-element arrays, are available on special order. Each Barnes PbSnTe detector is supplied with an individual spectral response curve together with complete detector performance data.

Barnes provides a wide range of specifications to meet your specific application requirements in wavelength region of interest, sensitivity, electrical and optical characteristics and cooling technique. Each PbSnTe detector type, liquid nitrogen-cooled and liquid helium-cooled, is offered in three standard wavelength range models.



Barnes Engineering Company's new high-performance infrared detectors have a lead-tin-telluride sensitive element and responds to long wavelength radiation in the 5-18 micron region with a speed of response as fast as 20 nanoseconds.

Special Features

- Fast Response
- Photovoltaic Operation
- No Bias Current Required
- Low $1/f$ Noise
- Long Wavelength Sensitivity

Typical Applications

- Thermal Imaging
- Military Surveillance
- Remote Sensing
- Laser Diagnostics
- Evaluation of Focal Plane Arrays
- Laser Ranging
- CO₂ Laser Communications Systems

Below are typical specifications for a 1.0 mm dia. detector

Note that many characteristics are a function of detector area and resistance. It is important that the detector be operated under zero volts bias conditions. This can be accomplished with a transformer or with an optimized current mode preamplifier.

Test Conditions

Blackbody Temperature	500°K
Chopping Frequency	900 Hz
Electrical Bandwidth	1 Hz
Background Temperature	300°K
Bias Conditions	0 volts, transformer coupled
Window	Irtran 2

Liquid Nitrogen-Cooled

Liquid Helium-Cooled

	Model 501	Model 502	Model 503	Model 601	Model 602	Model 603
Wavelength Range (50% pts)	5-10.2 μ m	6-11.5 μ m	6.5-13 μ m	6.5-13 μ m	7.5-15 μ m	9-18 μ m
Typical D* (λ_p , 900, 1)	2×10^{10}	1.5×10^{10}	0.5×10^{10}	1.5×10^{11}	1×10^{11}	0.5×10^{11}
High D* (λ_p , 900, 1)	3×10^{10}	2×10^{10}	1×10^{10}	2×10^{11}	1.5×10^{11}	1×10^{11}
Zero Bias Resistance (R_0)	150 Ω	50-100 Ω	15-20 Ω	15k Ω	5-10k Ω	1.5-2k Ω
Capacitance	12,000 pF	12,000 pF	12,000 pF	12,000 pF	12,000 pF	12,000 pF
Response Time (10 μ m) (50 Ω load)	<0.5 μ s	<0.5 μ s	<0.25 μ s	Amplifier Limited		
1/f Noise (knee)	<100 Hz	<100 Hz	<100 Hz	<200 Hz	<200 Hz	<200 Hz
Nominal Field of View	60°	60°	60°	10°	10°	10°
Operating Temperature	77°K	77°K	77°K	4°K	4°K	4°K
Dewar Holding Time	4 hrs.	4 hrs.	4 hrs.	12 hrs.	12 hrs.	12 hrs.

Note: For other PbSnTe detector sizes the capacitance and zero bias resistance can be calculated. The (area) (resistance) product and the $\left(\frac{\text{capacitance}}{\text{area}}\right)$ quotient are constants.

$$(AR_0) = K_1$$

$$\frac{C}{A} = K_2$$

2

Optional Detector Sizes

Available in liquid nitrogen and liquid helium cooled.

The D^* values are as specified for the standard detectors.

0.1 mm sq.	0.35 mm dia.
0.15 mm sq.	0.50 mm dia.
0.25 mm sq.	0.70 mm dia.
0.35 mm sq.	
0.40 mm sq.	
0.50 mm sq.	
0.75 mm sq.	
1.00 mm sq.	

Available in liquid nitrogen cooled only, Models 501, 502, and 503.

1.5 mm dia.
2.0 mm dia.

The D^* values available are shown below:

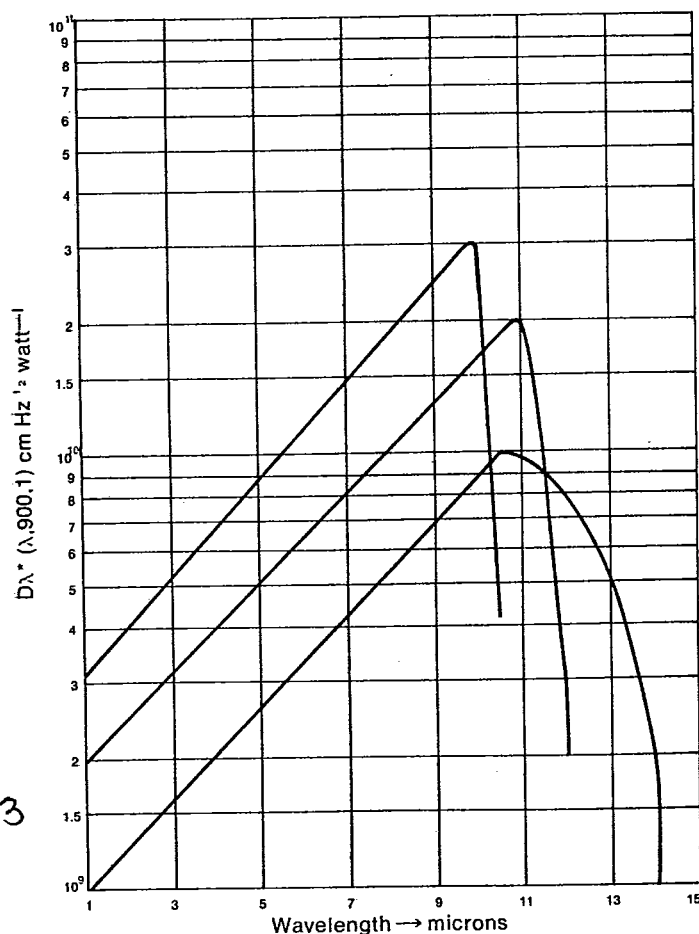
Model	Typical D^*	High D^*
501	1×10^{10}	1.5×10^{10}
502	7.5×10^9	1×10^{10}
503	5×10^9	N/A

Special detector sizes will be quoted on an individual basis.

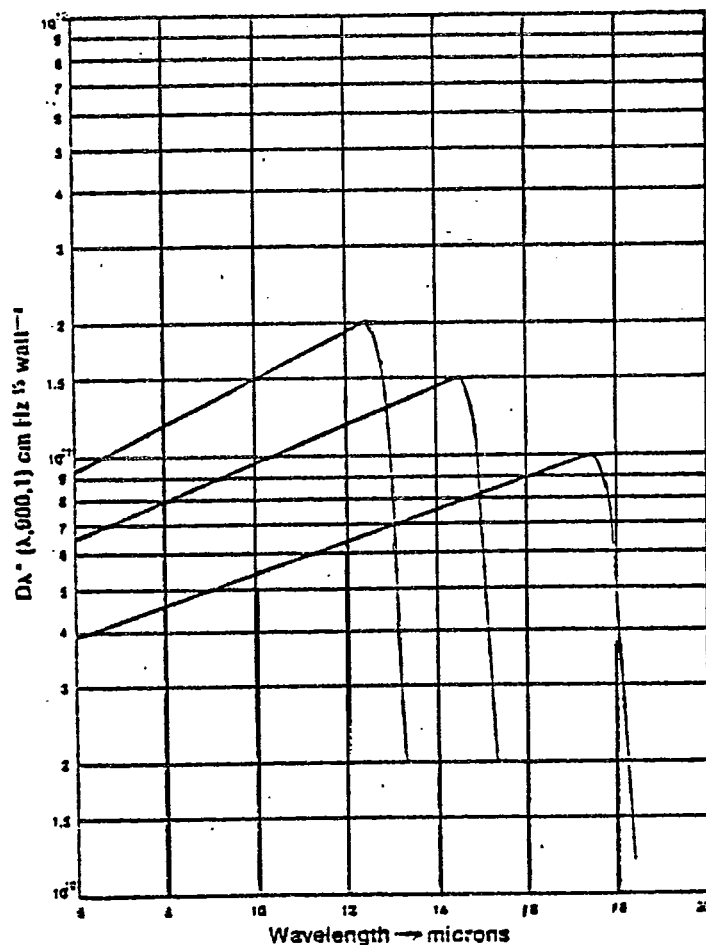
Additional Options

- Special dewar modifications.
- Cooled field of view masks of 60° (liquid nitrogen) and 10° (liquid helium) are included as standard. Other field of view masks are available.

Spectral Response of Liquid Nitrogen-Cooled PbSnTe Detectors at 77°K

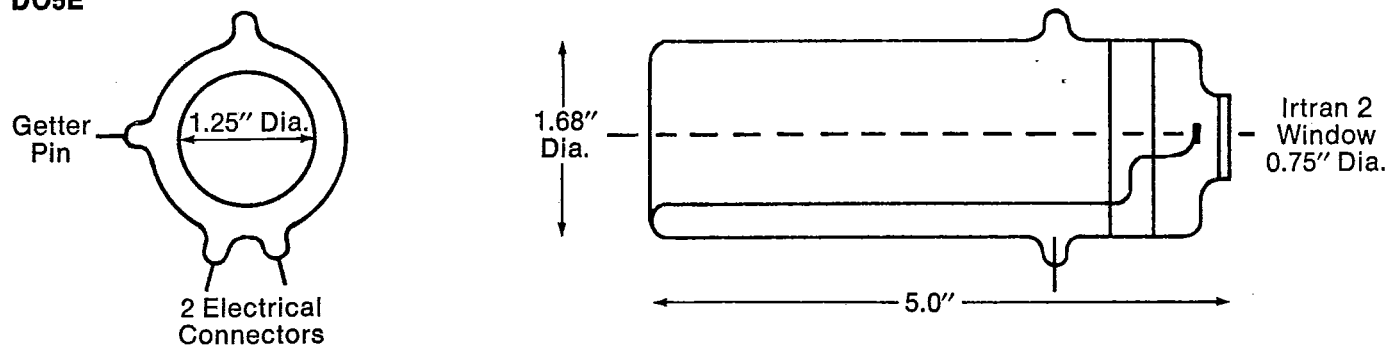


Spectral Response of Liquid Helium-Cooled PbSnTe Detectors at 4°K

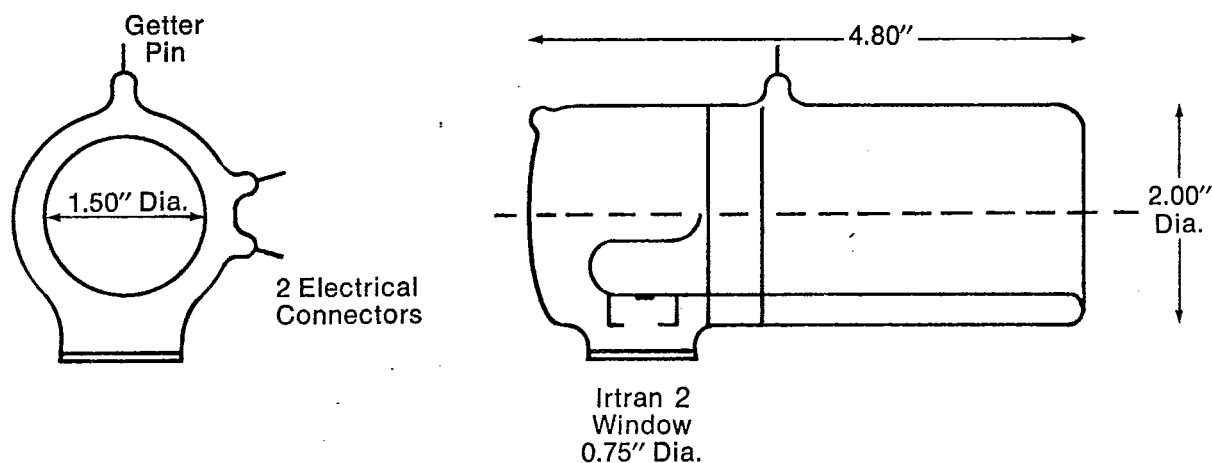


Outline drawings of Dewar Models D05E, D10S and H11E

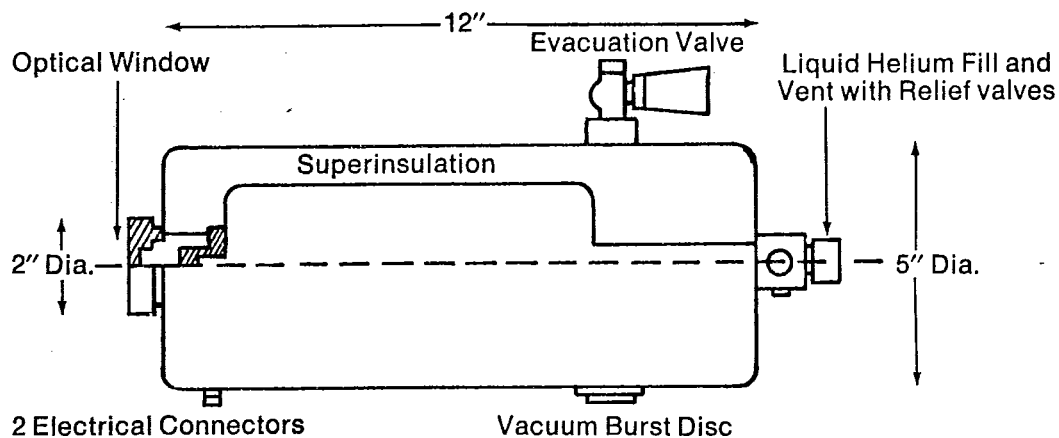
D05E



D10S



H11E.



Barnes Engineering Company
44 Commerce Road
P.O. Box 53
Stamford, Connecticut 06904

Cable Address/BEC Stamford, Conn.
TWX/710-474-3367
Telex/965921