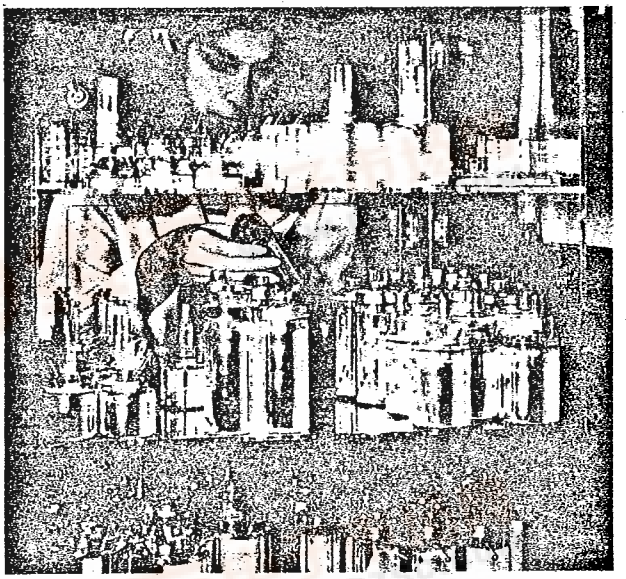
Bulletin 2-312

BARNES

Barnes Engineering Company
30 Commerce Road
Stamford, Connecticut 06904
Telephone 203 348-5381

Indium Antimonide Detector



The most sensitive detectors in the near infrared region are the photovoltaic devices typified by indium antimonide. Barnes InSb units approach the maximum theoretical limit of sensitivity for background limited (BLIP) applications. With a short time constant, less than 1 μs, the InSb detector is well suited to scanning instruments and transient measurements.

These detectors are offered in a wide range of active areas, including arrays and mosaics, and can be customized to your exact needs at very competitive prices.

Optical Characteristics

InSb detectors at liquid nitrogen temperature (77 K) have a spectral response (Fig. 1) that shows the characteristic sharp cutoff at longer wavelengths. Within the usable range from 1 to 5.5 μm, signal output from a Barnes InSb diode is linear with irradiance from the lower limit of detectability to power densities over 10 mW/cm²: a range of over nine orders of magnitude.

The active element is a mesa construction that is surface passivated. Barnes offers sizes from 0.05 to 7 mm (Table 1).

The field of view is likewise variable to fit the application. Depending on the dewar, the maximum angle can be as large as 120 degrees. Restricting the field of view with cooled masks will cut down the background noise and raise the sensitivity. Narrow band-pass filters will also increase sensitivity, particularly when mounted inside the dewar and cooled.

Sapphire windows are standard on InSb dewars. Anti-reflection coated silicon is optional.

Electrical Characteristics

InSb detectors perform optimally at zero voltage. When background radiation shifts the operating curve by generating a constant output in the active element, Fig. 2, the detector diode should be reverse-biased to bring it back to the optimum operating point: zero voltage. A dc bias on the detector will affect its dynamic impedance, as shown in Fig. 3. Its equivalent circuit is shown in Fig. 4.

Responsivity (Table 2) is specified at 77 K, and is less at higher operating temperatures as shown in Fig. 5. Sensitivity, as measured by D*, varies with the frequency of modulation of the measured radia-

)0 Hz the frequency

Construction and Dewar Mounts

Barnes supplies InSb detectors in a choice of end- and side-looking dewars, both evacuated glass and repumpable metal (Table 4). Holding times on a single filling of LN_2 vary from 30 minutes to 12 hours. Figures 7 through 15 are dimensioned outlines of styles available for prompt delivery in combination with any of the active areas listed in Table 1. All can be fitted with cooled masks and filters.

Because they are fully passivated, any Barnes InSb detector can be supplied unpackaged, on a ceramic substrate, for integration into your system.

To Select Your Detector

The wide variety of configurations available in Barnes InSb infrared detectors means you can select exactly what you need, from stock or custom made. To be sure the specification is complete, please include:

1. Size of the active area, from Table 1, round or square.
2. Minimum D* (500, 900, 1); the higher the D* value, the more expensive the detector. See Table 3 for active areas available with each D* value.
3. Dewar style, from Table 4, including any dimensional changes.
4. Field of view, including acceptance angle.
5. Any special spectral characteristics and/or filters.

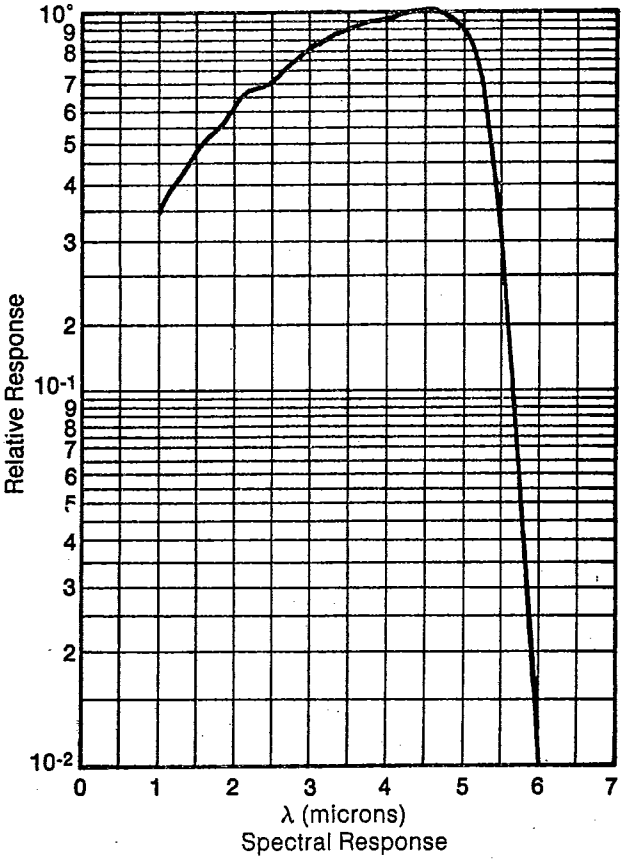


Fig. 1 — Spectral response of InSb detector peaks at 4.5 μm in usable range from 1 to 5.5 μm in the near infrared.

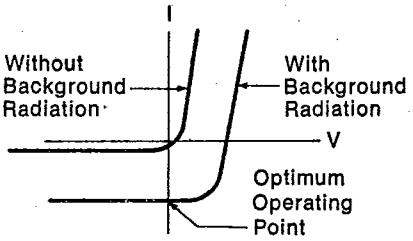


Fig. 2 — Optimum performance of InSb detector occurs when voltage is zero; biasing corrects for background radiation.

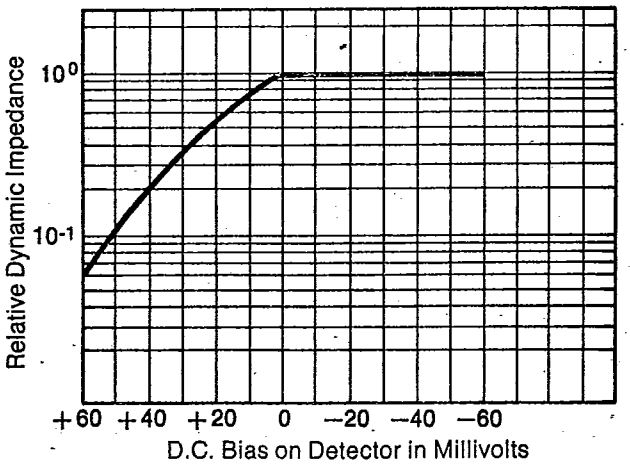


Fig. 3 — Dynamic impedance of the InSb detector is reduced by a positive bias that can be generated by

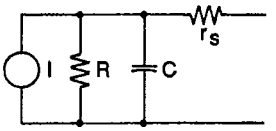


Fig. 4 — Equivalent circuit of the InSb detector.

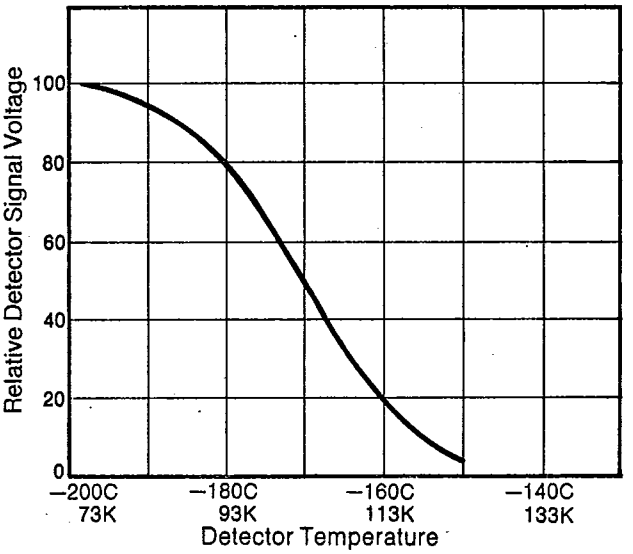


Fig. 5 — Relative signal voltage vs. operating temperature.

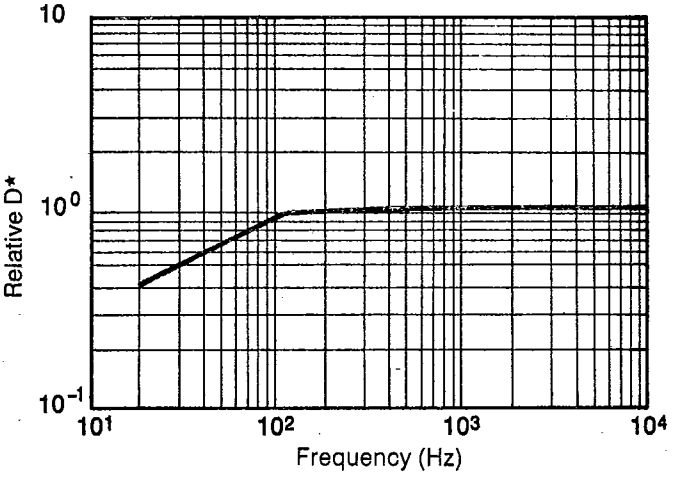


Fig. 6 — Frequency response to modulated signal is almost flat above 100 Hz.

Table 1 — InSb Detector Active Areas
(See Table 3 for applicable D* values)

Square Sizes, mm		Round Sizes, mm	
0.05	3.8	0.35	2.5
0.15	4.0	0.5	3.0
0.25	7.0	0.6	3.5
0.35		0.7	4.0
0.40		1.5	5.0
0.75		2.0	7.0
1.0		2.25	

Other areas available with a non-recurring tooling charge.

Table 2 — Typical Characteristics

D* (500, 900, 1)	2 x 10^{10} cm $Hz^{1/2}$/W
D* (5 μm, 900, 1)	1 x 10^{11} cm $Hz^{1/2}$/W
Responsivity (zero bias)	6000 V/W, 0.35 A/W
Time constant	< 1 μs maximum
Field of view	to 120 degrees
Spectral response	1 to 5.5 μm

Table 3 — Active Areas for D* Values

D* (500, 900, 1)	Available with Active Areas:
1.2 or 1.5 x 10^{10}	As large as 7 mm
2.0 x 10^{10}	As large as 2.25 mm
3.0 x 10^{10}	As large as 0.5 mm

Table 4 — Dewar Styles for Barnes InSb Detectors

Catalog Number	Fig.	Viewing Port	Field of View, max.	Metal Jacket	Holding Time	Notes
D03E	7	end	100°	optional	30 min.	Dewar D03E can be modified for cryostat operation.
D04EJ	8	end	100°	standard	1.5 hr.	
D05E	9	end	120°	optional	4-5 hr.	
D05ERJ	—	side	120°	standard	4-5 hr.	
D06EJ	10	end	120°	standard	3 hr.	
D07EJ	11	end	60°	standard	3-4 hr.	
D08S	12	side	60°	optional	1 hr.	
D10S	13	side	60°	optional	4 hr.	
D13E	14	end	90°	—	12 hr.	Metal construction
D155S	15	side	100°	—	8 hr.	Metal construction

Sapphire windows standard; anti-reflection coated silicon optional. Custom glass and metal dewars upon request.

E = End looking
S = Side looking
J = Metal jacket
R = Right angle mirror

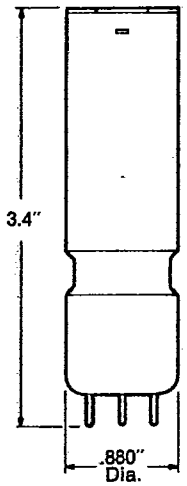


Fig. 7
Dewar type D03E.

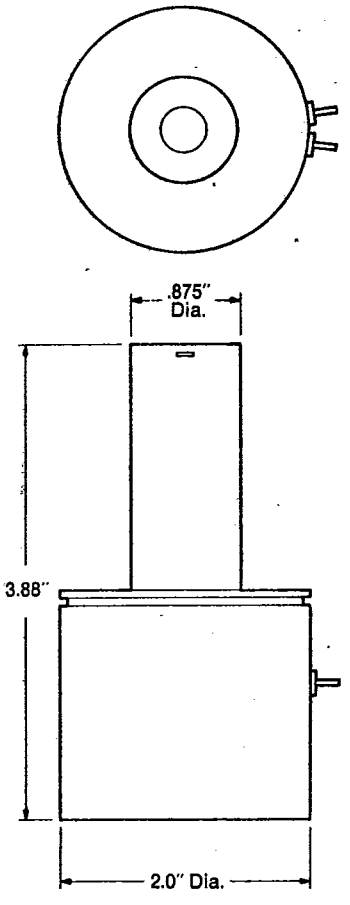


Fig. 8 — Dewar type D04EJ.

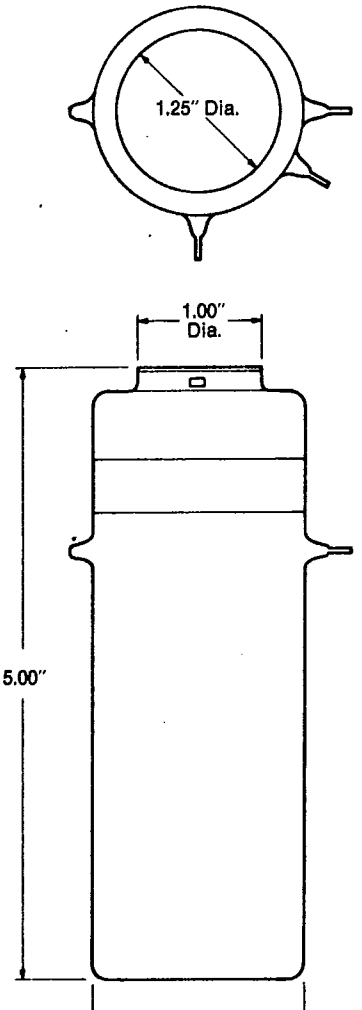


Fig. 9 — Dewar type D05E.

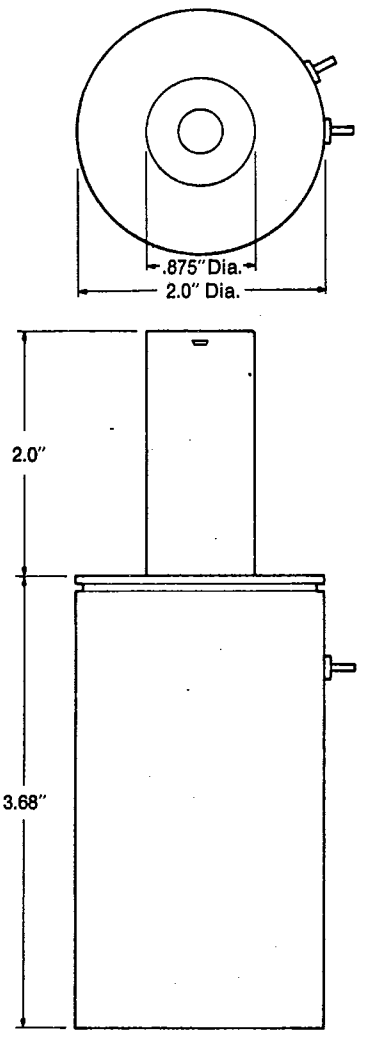


Fig. 10 — Dewar type D06EJ.

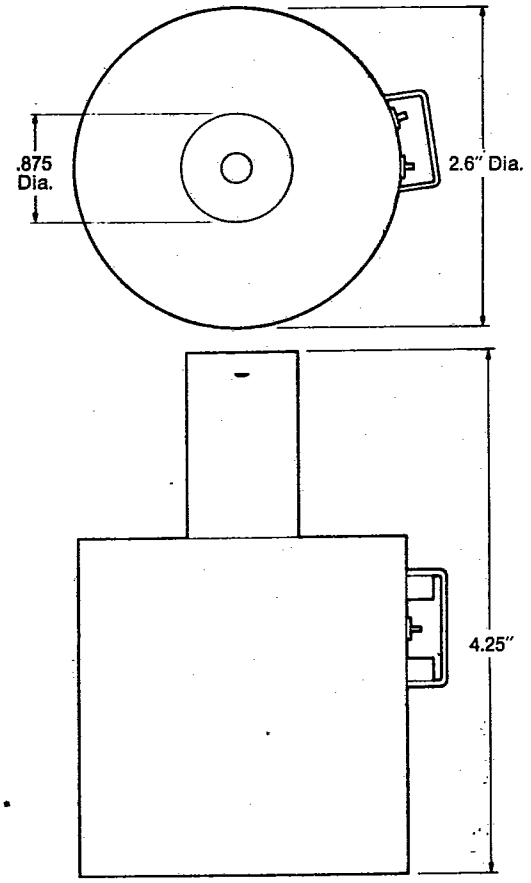


Fig. 11 — Dewar type D07EJ.

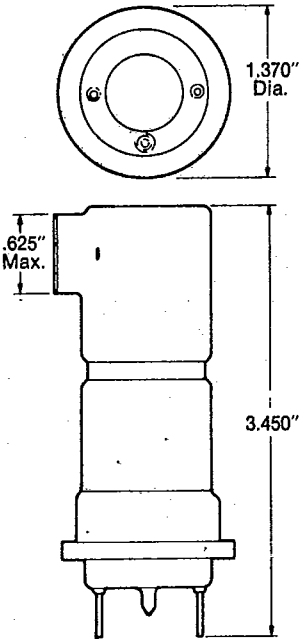


Fig. 12 — Dewar type D08S.

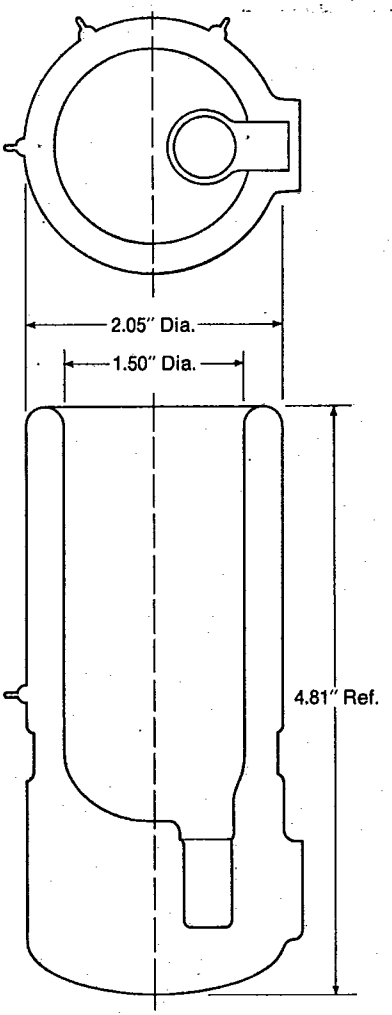


Fig. 13 — Dewar type D10S.

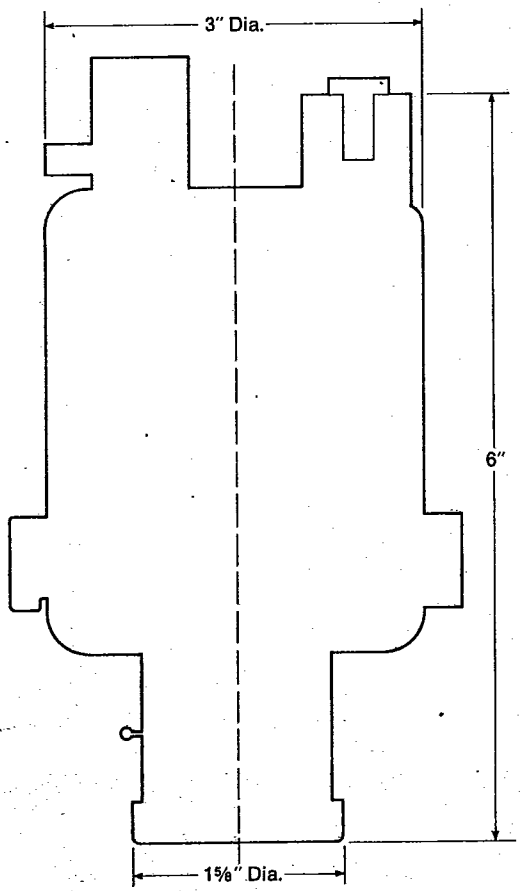


Fig. 14 — Dewar type D13E.

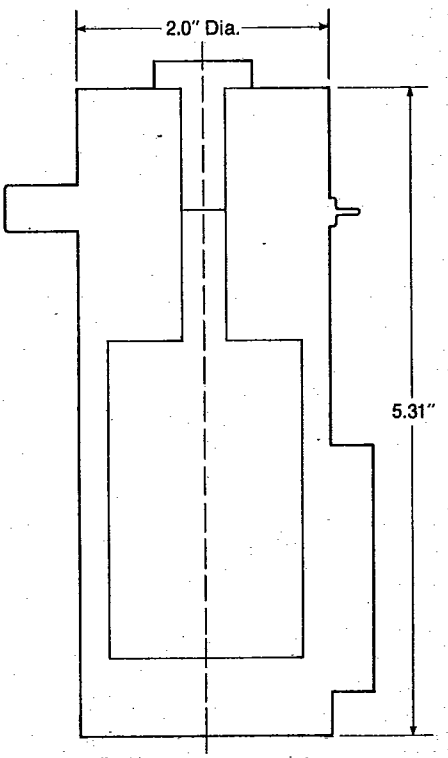


Fig. 15 — Dewar type D155S.

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

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