

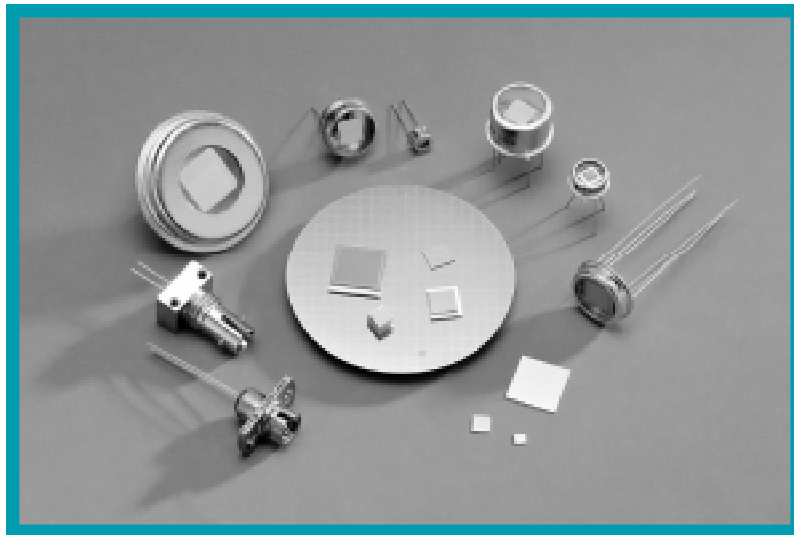
Small & Large Area pn, pin detectors  
Two-color detectors

# GPD

*OPTOELECTRONICS CORP.*

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## Germanium Photodetectors



- **Large and Small Area**
- **Wide Performance Range**
- **TE Coolers and Dewars Available**
- **Filtered Windows for High Power Available**
- **Standard and Custom Packages/Submounts**

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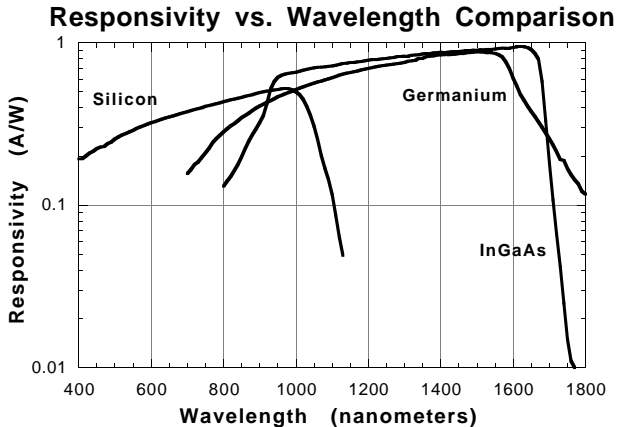
GPD Optoelectronics Corp.



## Introduction

GPD manufactures a broad range of Ge and InGaAs photodetectors, as well as Si/Ge dual detectors to meet the most demanding military and commercial applications. This brochure contains technical specifications for Ge pn, pin and dual (Si/Ge) detectors; other brochures describe InGaAs detectors (including extended-wavelength) and APDs.

Custom devices and packages are also available.



Both Germanium and InGaAs are sensitive to light in the near-infrared region of the spectrum. While InGaAs detectors offer better noise performance, Ge detectors offer significant cost advantages, particularly where a large detection area is required. In addition, Ge detectors have linear response at higher optical input power levels.

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## Glossary of Terms

### DARK CURRENT ( $I_D$ )

The current through a photodetector when a specified reverse bias is applied under conditions of no incident radiation.

### SHUNT RESISTANCE ( $R_{SH}$ )

The resistance of a photodetector at or near zero bias; shunt resistance values in this catalog are calculated at 10mV reverse bias.

### MAXIMUM REVERSE VOLTAGE ( $V_{RM}$ )

The maximum reverse voltage that may be applied without damaging the detector.

### RESPONSIVITY (R)

The photocurrent output per unit incident radiant power, usually at a specified wavelength.

### NOISE EQUIVALENT POWER (NEP)

The incident radiant power that creates a signal-to-noise ratio of one at the photodetector output.

### JUNCTION CAPACITANCE ( $C_J$ )

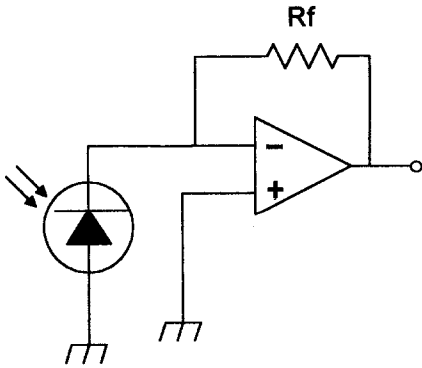
The total device capacitance, usually measured at a specified reverse bias and frequency.

### CUTOFF FREQUENCY ( $f_c$ )

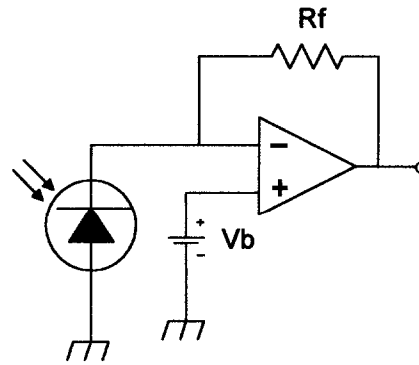
The frequency at which the responsivity decreases by 3 dB from the DC responsivity value. It can be calculated from the load resistance and the junction capacitance.  $f_c = 1/(2\pi R_L C_J)$



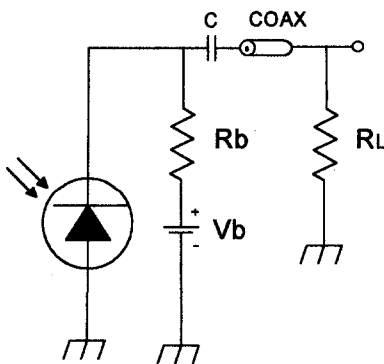
### BASIC OPERATING CIRCUIT (ZERO BIAS)



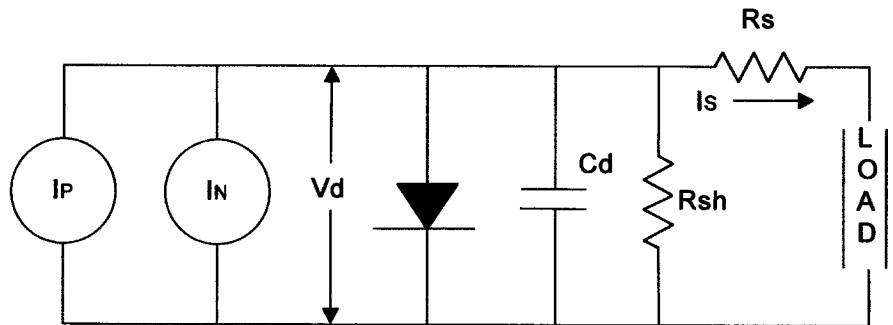
### BASIC OPERATING CIRCUIT (WITH BIAS)



### HIGH SPEED CIRCUIT



### EQUIVALENT CIRCUIT



$I_p$ : Photocurrent

$I_N$ : Noise Current

$V_D$ : Voltage across diode

$V_b$ : Bias Voltage

$I_s$ : Output Current

$C_d$ : Photodiode Capacitance

$R_{sh}$ : Shunt Resistance

$R_s$ : Series Resistance

$R_f$ : Feedback Resistance



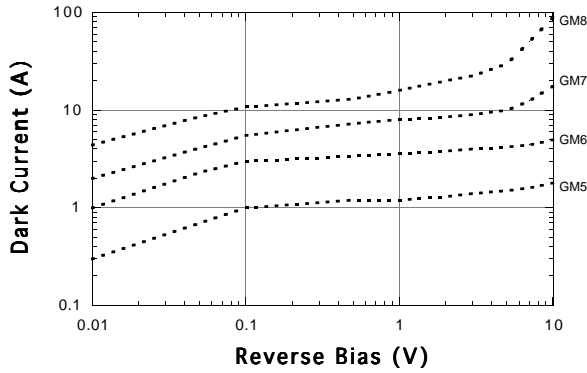
TYPE	ACTIVE DIA. (mm.)	SHUNT RES. @ $V_r=10\text{mV}$ (K $\Omega$ )		DARK CURRENT @ $V_r=V_{\text{test}}$ ( $\mu\text{A}$ MAX)	TEST REVERSE BIAS (Volts)	MAX REVERSE VOLTS	CAPACITANCE @ $V_r$ MAX (pF)	NEP (pW/ $\sqrt{\text{Hz}}$ )	CUT-OFF FREQ. @ $V_r$ , $50\Omega R_L$ (MHz)
		MIN.	TYP.						
GM2 GM2HS GM2VHS GM2VHR	0.5 SQ	30	60	2.0	10	15	27	1.0	120
		100	150	1.0	3.0	5.0	55	0.3	60
		250	350	0.7	0.3	0.5	200	0.2	35
		550	900	0.5	0.3	0.5	250	0.1	30
GM3 GM3HS GM3VHS GM3VHR	0.1	120	180	1.0	10	15	2.0	0.3	1500
		350	500	0.3	3.0	5.0	6.0	0.1	500
		1500	2500	0.1	0.3	0.5	8.0	0.1	350
		2000	3000	0.1	0.3	0.5	12	0.1	250
GM4 GM4HS GM4VHS GM4VHR	0.3	60	80	1.5	10	15	10	0.6	300
		250	400	0.4	3.0	5.0	25	0.3	120
		400	650	0.2	0.3	0.5	60	0.2	80
		900	1600	0.2	0.3	0.5	60	0.15	80
GM5 GM5HS GM5VHS GM5VHR	1.0	20	40	3.0	10	15	65	1.5	55
		60	100	1.5	2.0	3.0	300	0.5	10
		200	280	0.5	0.3	0.5	1800	0.3	2.0
		330	450	0.5	0.3	0.5	1800	0.3	2.0
GM6 GM6HS GM6VHS GM6VHR	2.0	6	12	10	10	15	300	2.0	17
		30	60	3.0	2.0	3.0	1200	0.8	1.0
		80	120	1.0	0.3	0.5	9000	0.4	0.6
		120	200	1.0	0.3	0.5	9000	0.4	0.6
GM7 GM7HS GM7VHS GM7VHR	3.0	4	8	30	5.0	10	800	3.0	4.0
		25	35	4.0	1.0	3.0	4000	1.0	0.7
		40	65	3.0	0.25	0.5	13000	0.6	0.2
		65	90	2.0	0.25	0.5	13000	0.6	0.2
GM8 GM8HS GM8VHS GM8VHR	5.0	2	4	40	3.0	5.0	3000	4.0	1.6
		10	15	15	1.0	3.0	6000	2.0	0.5
		15	20	5	0.1	0.3	35000	1.0	0.1
		20	30	5	0.1	0.3	35000	1.0	0.1
GM10HS	10 SQ.	2.0	3.5	50	0.5	1.0	30000	4.0	0.1
GM13HS	13	1.0	2.0	100	0.5	1.0	50000	8.0	0.05
GM5TEC1	1.0		300	0.2	5.0	7.0	65	0.4	55
GM8TEC2	5.0		60	1.0	1.0	2.0	3000	1.0	1.6

VHR series: Designed for zero reverse bias applications requiring high shunt resistance.  
 VHS series: Designed for zero reverse bias applications.  
 HS series: Designed for < 5V reverse bias applications.  
 GM series: Designed for high speed applications with reverse bias > 10V.  
 TEC series: Mounted on a one- or two-stage thermoelectric cooler for low-noise applications.

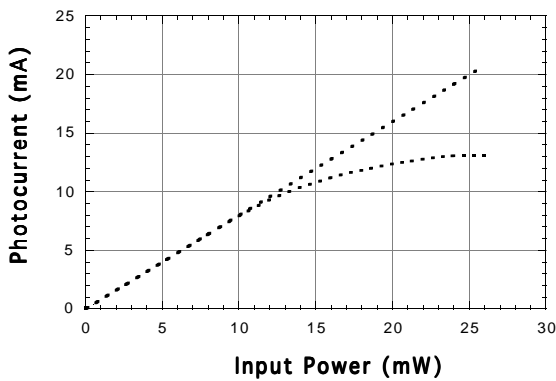


## Electrical Specifications

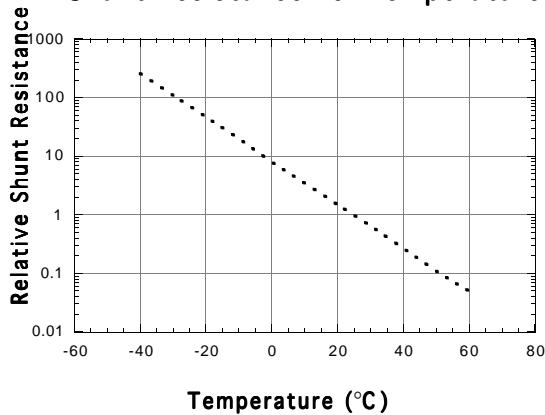
### Dark Current vs. Reverse Bias



### Linearity of Response



### Shunt Resistance vs. Temperature

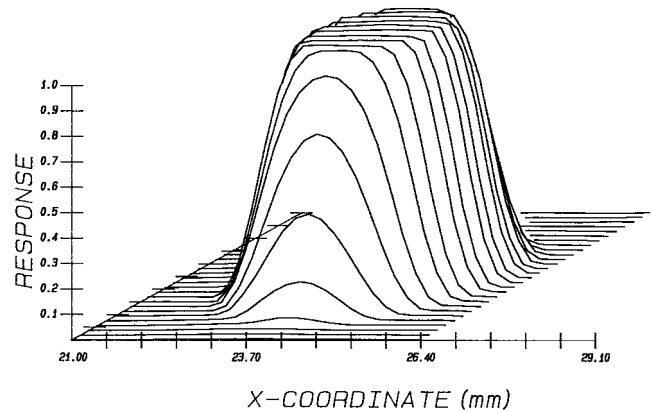


## Optical Specifications

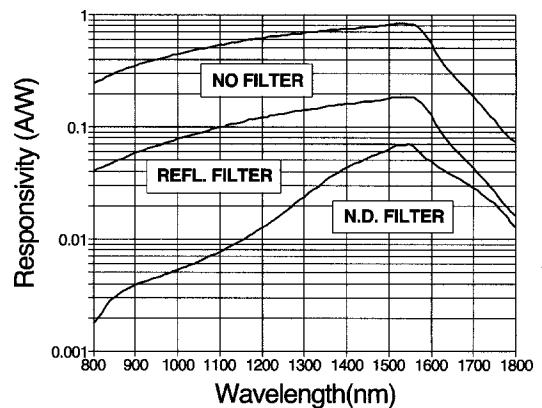
### Responsivity vs. Wavelength

Series	WAVELENGTH					
	850		1300		1550	
	min.	typ.	min.	typ.	min.	typ.
GM	.20	.26	.60	.65	.75	.85
GMHS	.20	.26	.60	.70	.75	.85
GMVHS	.20	.26	.60	.70	.80	.85
GMVHR	.26	.32	.70	.80	.82	.87
GEP	.20	.26	.60	.65	.75	.85

### Uniformity of Response



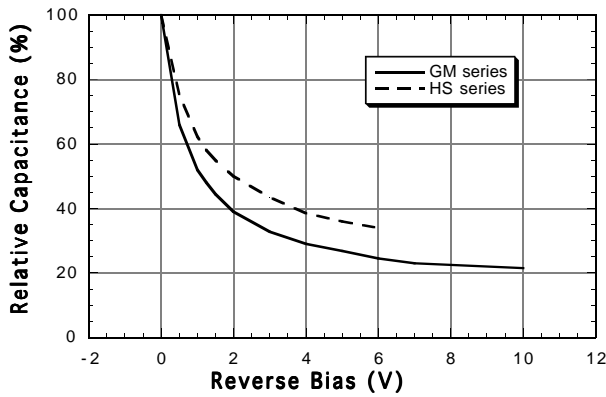
### Responsivity of Filtered Units





# PIN, Two-Color Detectors

Capacitance vs. Reverse Bias



## Special Options

- High response at short wavelength available
- BNC connectors
- Thermoelectric coolers (1- and 2-stage)
- Dewars
- Neutral density filters
- Reflective filters
- AR-coated lenses/windows
- Custom devices including arrays
- Calibrated spectral response

## Ge PIN DETECTOR: ELECTRICAL SPECIFICATIONS

### Electrical Parameters:

	GEP600	GEP700	GEP800
Shunt Resistance	2K	1K	0.7K
Reverse Voltage (max.)	10V	10V	10V
Dark Current (max.)	30 $\mu$ A	55 $\mu$ A	70 $\mu$ A
Capacitance (typ.)	50 pF	110 pF	450 pF
Bandwidth -3 dB, $R_L=50\Omega$	60 MHz	25 MHz	10 MHz
Risetime, $R_L=50\Omega$	3 ns.	6 ns.	15 ns.
Case Style (standard)	TO-5	TO-5	TO-8
Active Diameter	2 mm.	3 mm.	5 mm.

### Applications:

- Pulsed Laser Measurements
- FTIR
- High-speed Spectroscopy
- LIDAR Instrumentation

## Si/Ge TWO-COLOR DETECTOR: ELECTRICAL SPECIFICATIONS

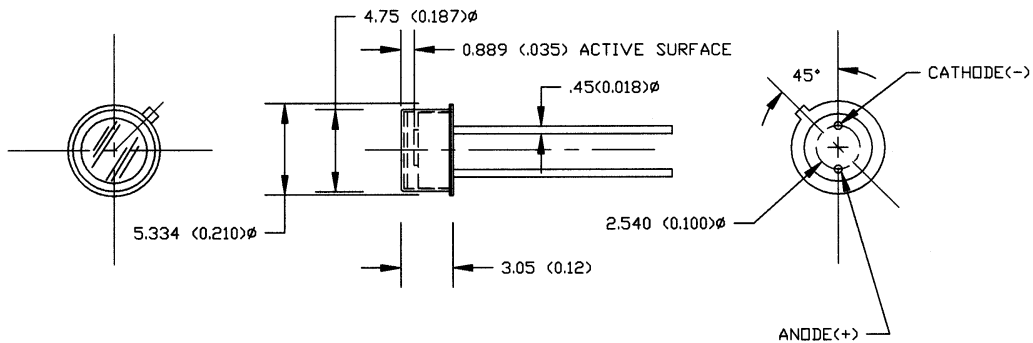
Type	Active Diam. (mm)	Wavelength Range (nm)	Peak Resp. (A/W)	NEP (pW/ $\sqrt{\text{Hz}}$ )	$R_{\text{SHUNT}}$ (K $\Omega$ )	Max Reverse Volts (V)	Leakage Current	Forward Voltage (V) $I_{\text{PH}}=10\text{mA}$
(Si) GM6Si5	5	400-1000	0.5	1.0x10 <sup>-14</sup>	> 1000	30	2 nA	1.1
(Ge)	2	1000-1800	0.6	1.0x10 <sup>-12</sup>	60	3	2 $\mu$ A	0.45
(Si) GM7Si5	5	400-1000	0.5	1.0x10 <sup>-14</sup>	> 1000	30	2 nA	1.1
(Ge)	3	1000-1800	0.6	1.5x10 <sup>-12</sup>	25	3	3 $\mu$ A	0.45
(Si) GM8Si5	5	400-1000	0.5	1.0x10 <sup>-14</sup>	> 1000	30	2 nA	1.1
(Ge)	5	1000-1800	0.6	2.0x10 <sup>-12</sup>	10	1.5	10 $\mu$ A	0.45

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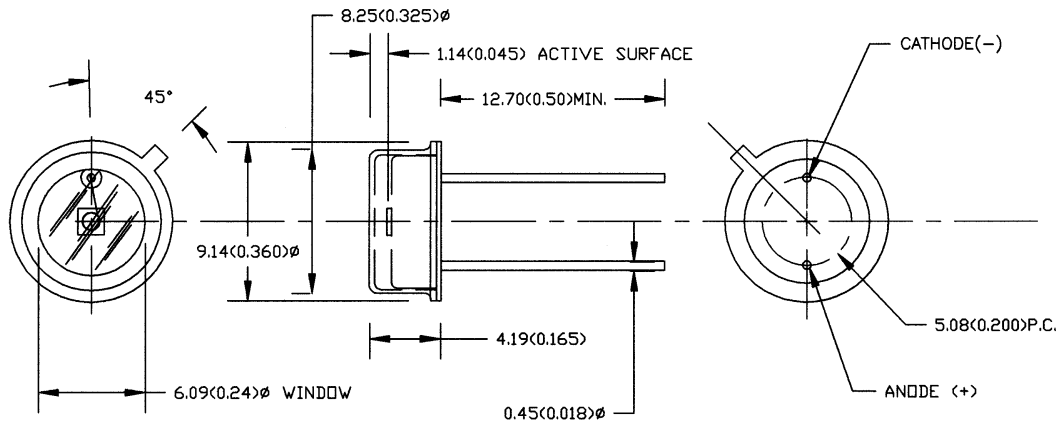


# Package Drawings

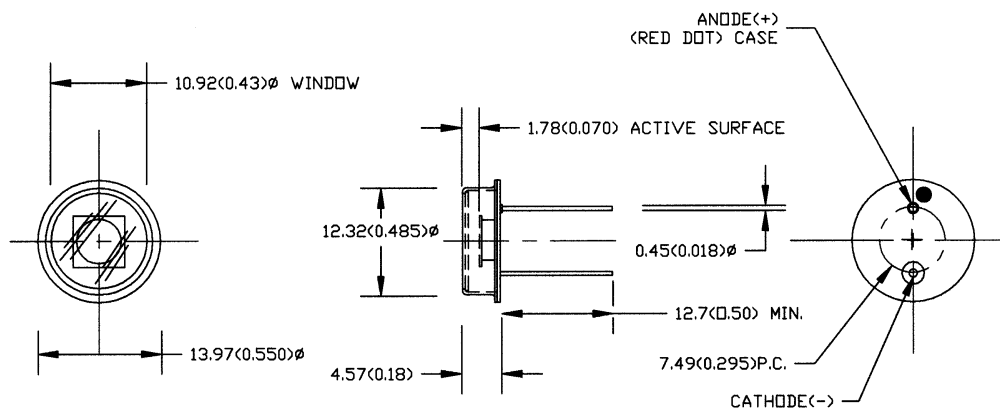
Dimensions in mm (in.) Many other packages (including lensed packages) available.



**TO-18**  
(Chip Diameter to 2 mm)



**TO-5**  
(Chip Diameter to 3 mm)



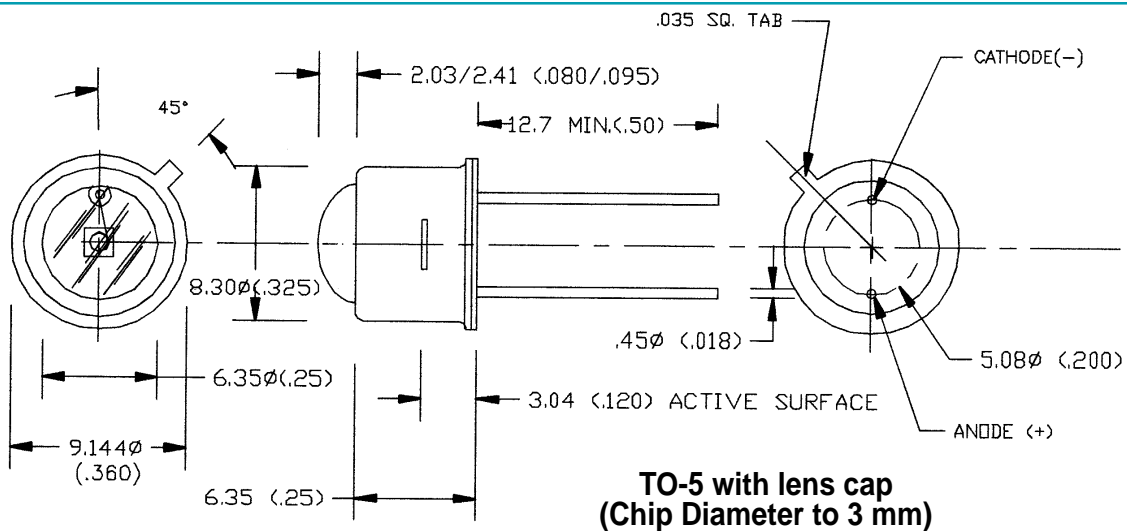
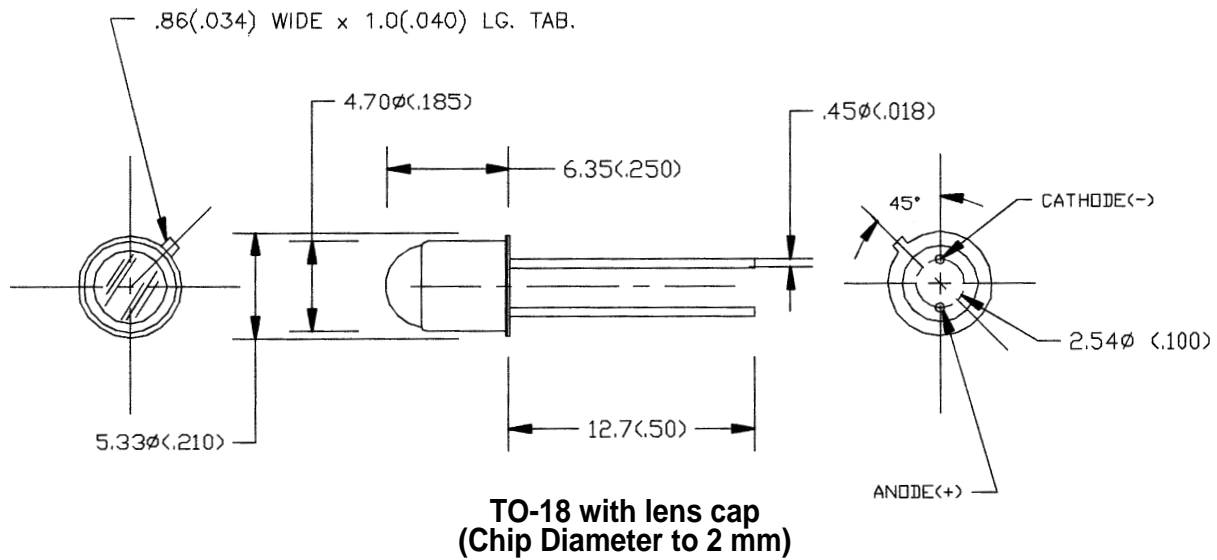
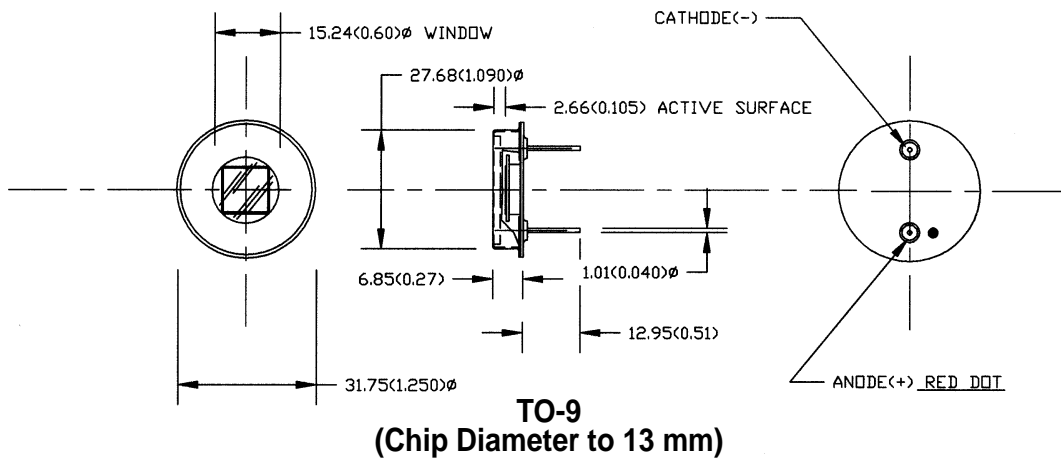
**TO-8 (5 mm chip)**

**GPD Optoelectronics Corp.**



# Package Drawings

Dimensions in mm (in.) Many other packages (including lensed packages) available.



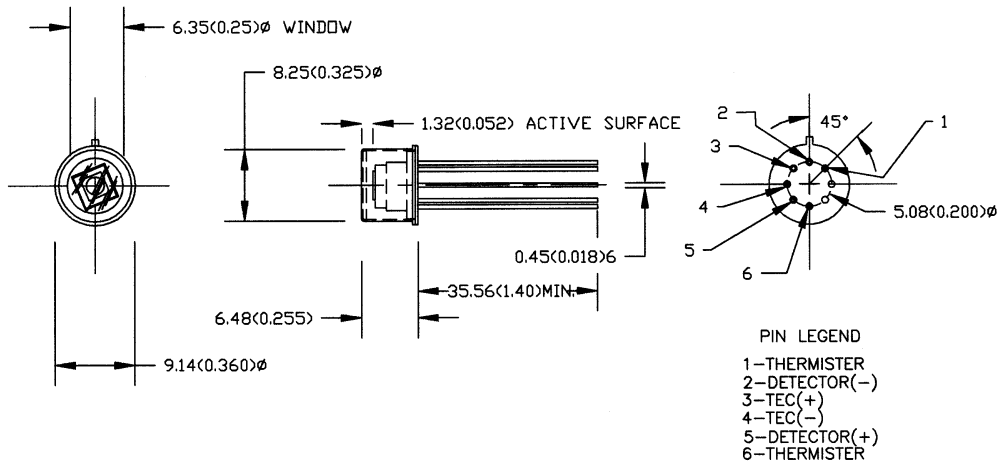
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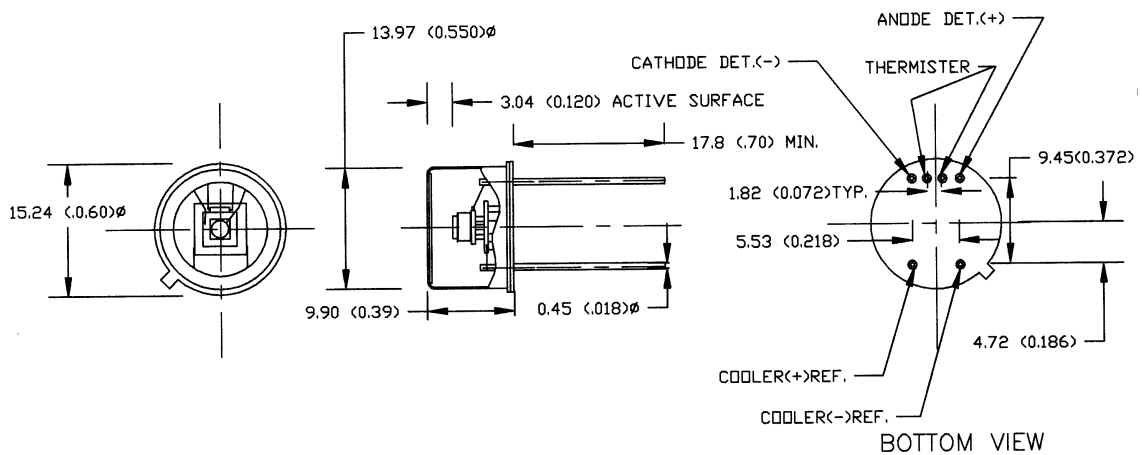


# Package Drawings

Dimensions in mm (in.) Many other packages (including lensed packages) available.



**TO-5 with TEC  
(Chip Diameter to 3 mm)**

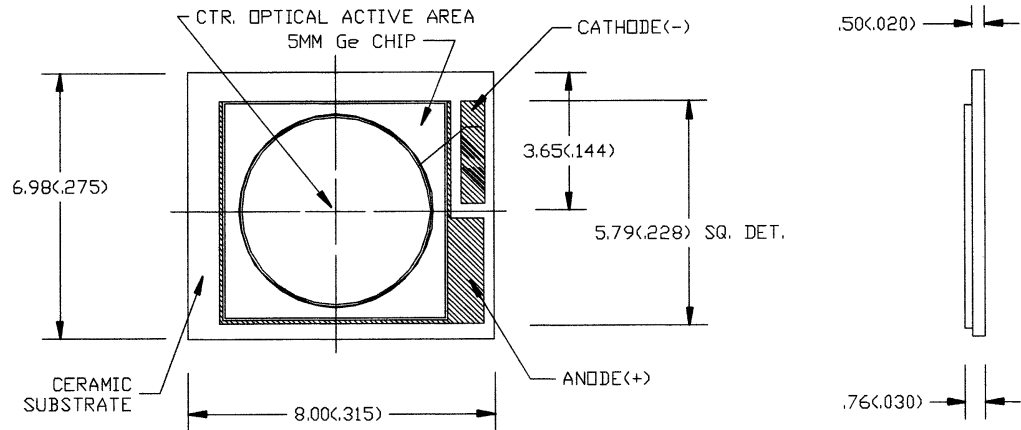


**TO-8 with TEC  
(Chip Diameter to 5 mm)**

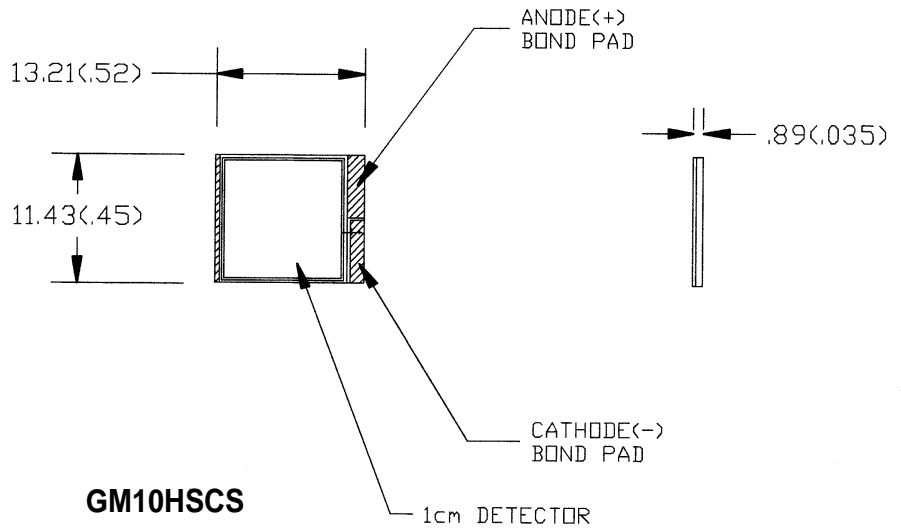
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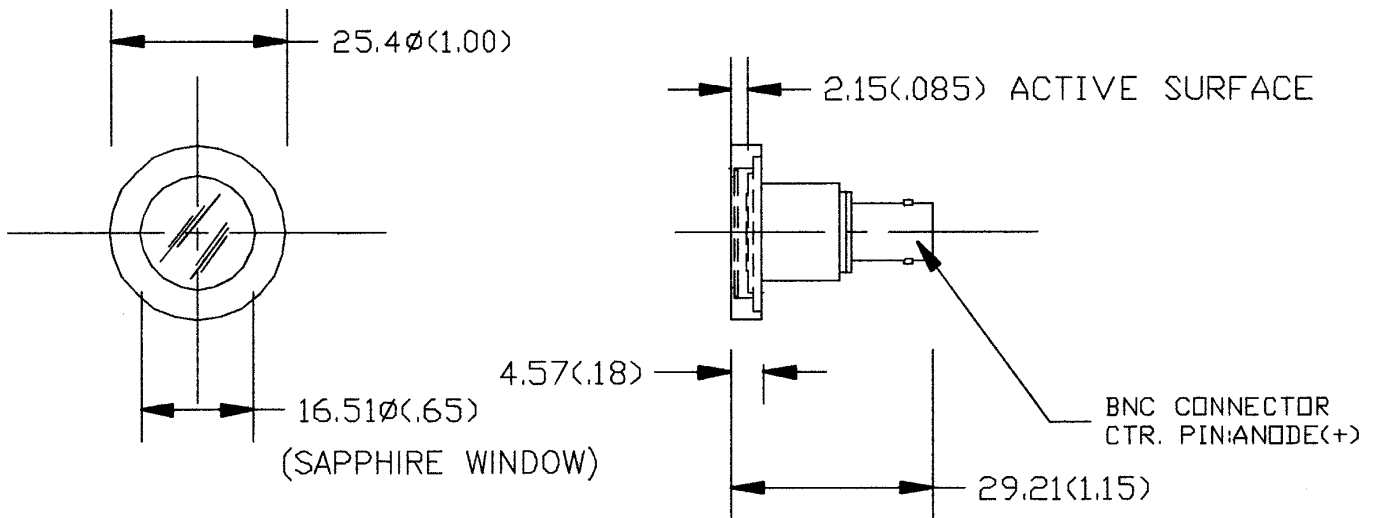
# Package Drawings



**GM8HSCS**



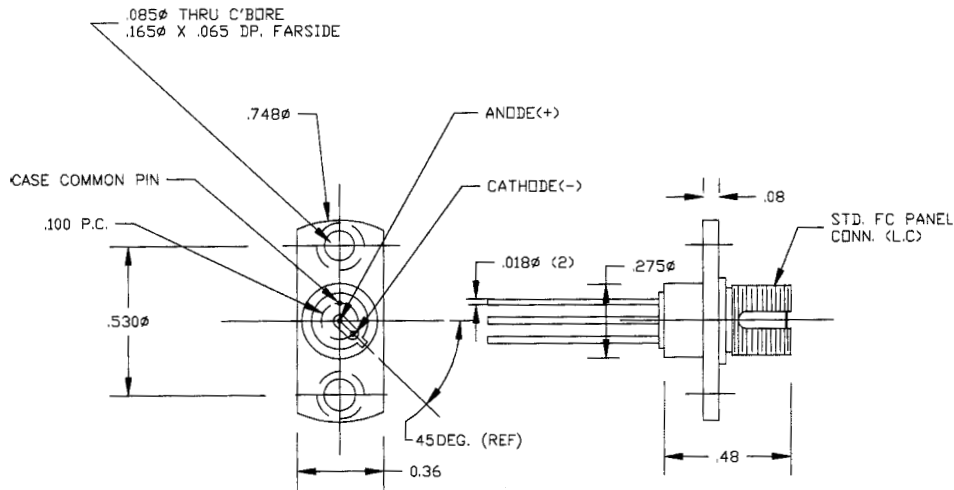
**GM10HSCS**



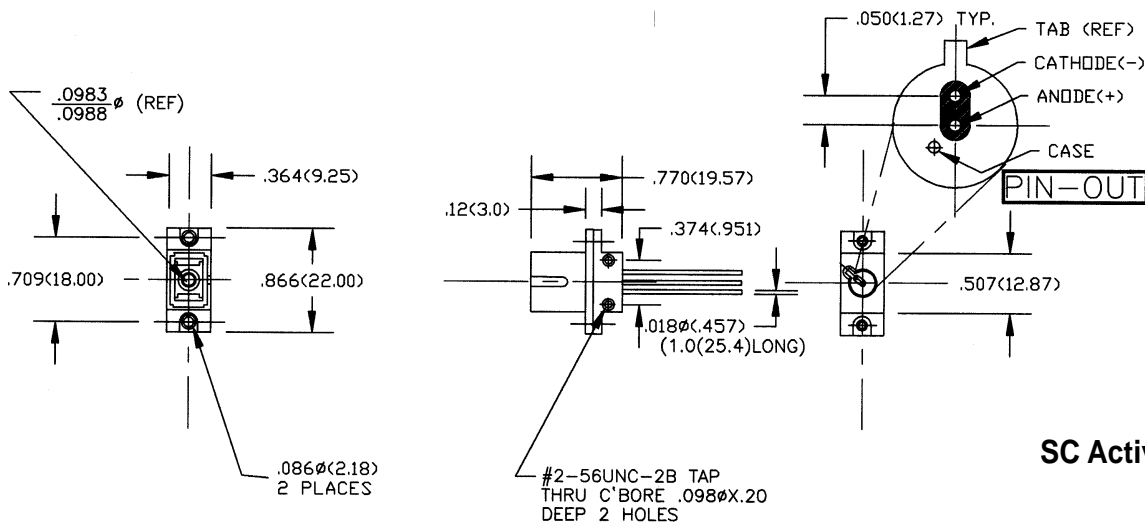
**GM10BNC**



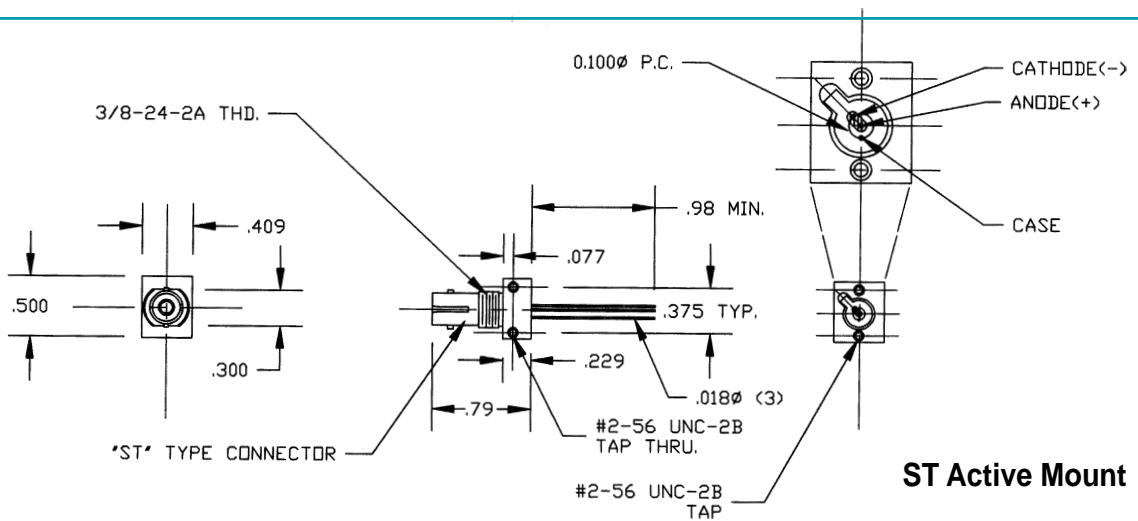
# Package Drawings



**FC Active Mount**



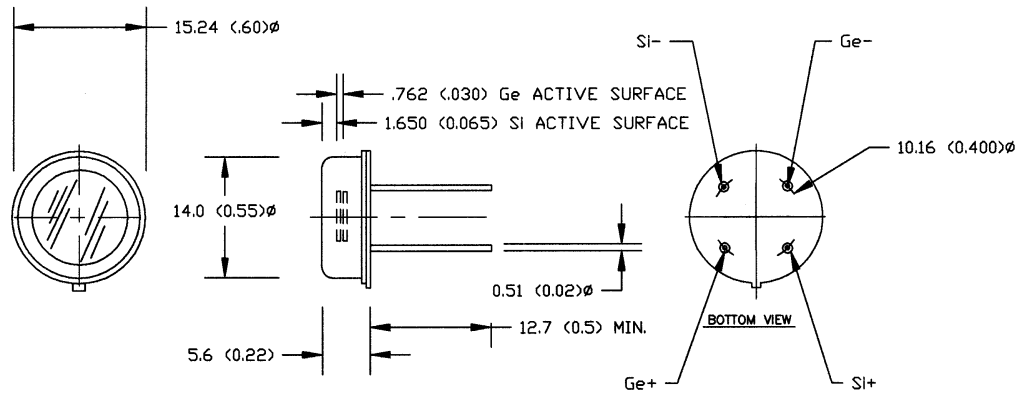
**SC Active Mount**



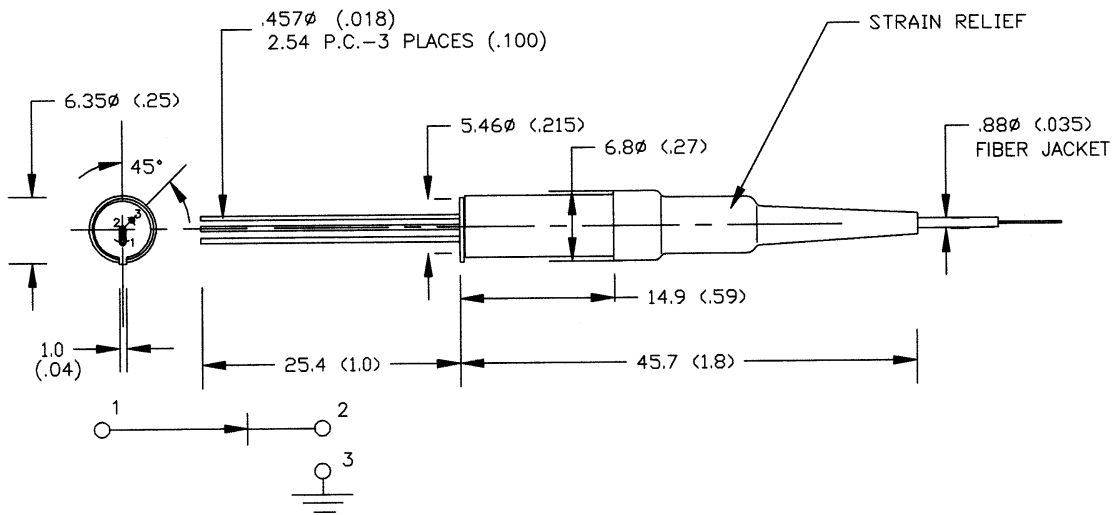
**ST Active Mount**



Dimensions in mm (in.) Many other packages (including lensed packages) available.



**Si/Ge Two-color Detector**



**Fiber-pigtailed Detector**

GPD Optoelectronics Corp. (formerly Germanium Power Devices) has been a manufacturer of power transistors and diodes since 1973 and a manufacturer of infrared photodetectors since 1980. GPD offers Germanium p-n, p-i-n, APD and InGaAs p-i-n high-speed and large area photodetectors for infrared radiation detection and telecommunications applications. GPD can offer you a photodetector that meets your technical and cost requirements.

GPD maintains an inspection system in accordance with MIL-I-45208. Photodiodes are subjected to Telcordia testing requirements (GR-468-CORE), MIL-STD-883 test methods and/or customer specifications.

**GPD Optoelectronics Corp.**  
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