

# GPD

OPTOELECTRONICS CORP.

**Small & Large Area Photodiodes  
Two-Color Photodiodes  
TE Cooled Photodiodes**

## Ge Photodiodes



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

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**GPD Optoelectronics Corp**



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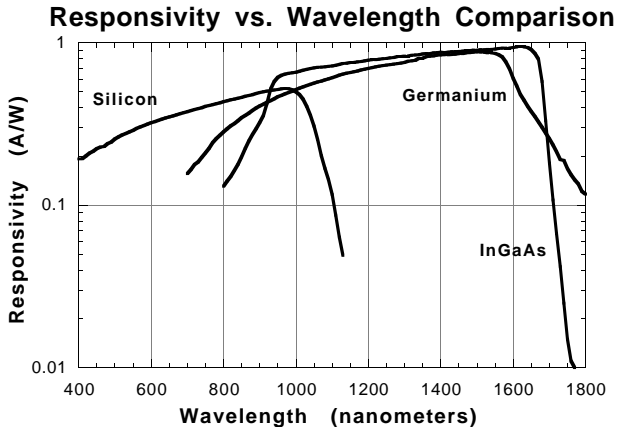
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## Introduction

GPD Optoelectronics manufactures a broad range of Ge and InGaAs photodetectors to meet the most demanding military and commercial applications. This brochure contains technical specifications for Ge, dual (Si/Ge) detectors, and TE cooled Ge photodiodes.

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 better linearity and cost advantages, particularly where a large detection area is required.

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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.  $f_c = 1/(2\pi R_L C_J)$

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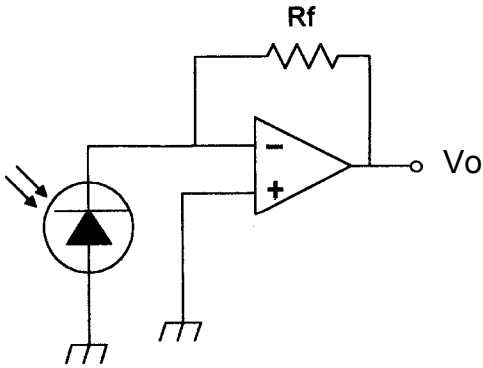
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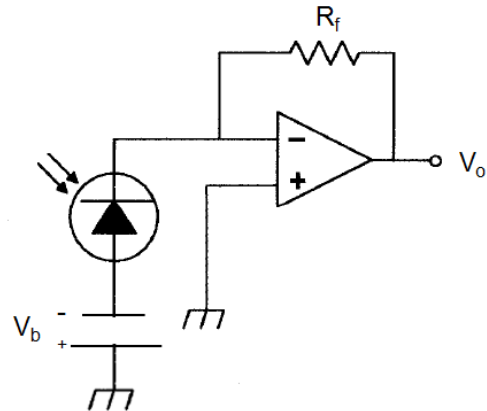
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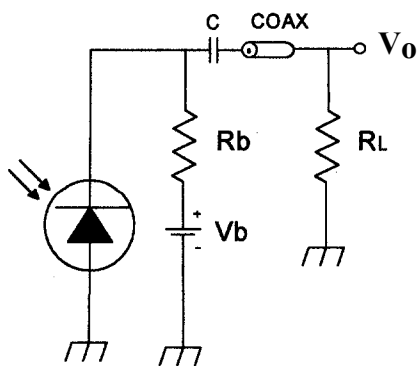
**BASIC OPERATING CIRCUIT  
(ZERO BIAS)**



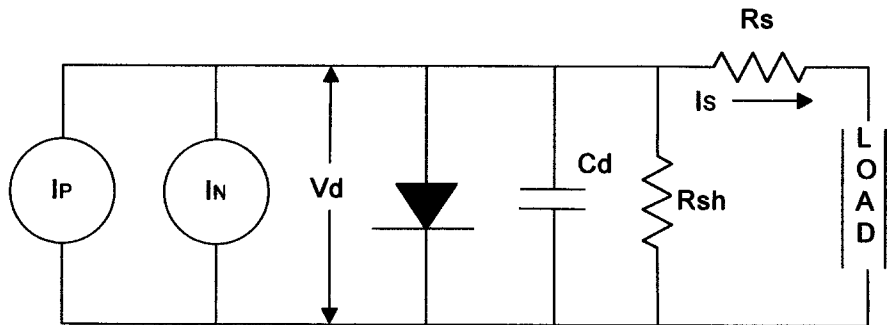
**BASIC OPERATING CIRCUIT  
(WITH BIAS)**



**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

$V_o$ : Output Voltage ( $I_s \times R_f$ )

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# Ge Photodiodes TE Cooled Photodiodes

TYPE	ACTIVE DIA. (mm.)	SHUNT RES. @ $V_r=10mV$ (K $\Omega$ )		DARK CURRENT @ $V_r=V_{test}$ ( $\mu A$ MAX)	TEST REVERSE BIAS (Volts)	MAX REVERSE VOLTS	CAPACITANCE @ $V_r$ MAX (pF)	NEP (pW/ $\sqrt{Hz}$ )	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	110	0.3	30
		250	350	0.7	0.3	0.5	300	0.2	10
		550	900	0.5	0.3	0.5	300	0.1	10
GM3 GM3HS GM3VHS GM3VHR	0.1	120	180	1.0	10	15	1	0.3	3000
		350	500	0.3	3.0	5.0	6	0.1	500
		1500	2500	0.1	0.3	0.5	21	0.1	150
		2000	3000	0.1	0.3	0.5	21	0.1	150
GM4 GM4HS GM4VHS GM4VHR	0.3	60	80	1.5	10	15	10	0.6	300
		250	400	0.4	3.0	5.0	50	0.3	60
		400	650	0.2	0.3	0.5	200	0.2	16
		900	1600	0.2	0.3	0.5	200	0.15	16
GM5 GM5HS GM5VHS GM5VHR	1.0	20	40	3.0	10	15	85	1.5	35
		60	100	1.5	2.0	3.0	300	0.5	10
		200	280	0.5	0.3	0.5	1450	0.3	2.0
		330	450	0.5	0.3	0.5	1450	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	85	0.4	55
GM8TEC2	5.0		60	1.0	1.0	2.0	3000	1.0	1.6

VHS series: Designed for zero reverse bias applications requiring high shunt resistance.  
VHR 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.

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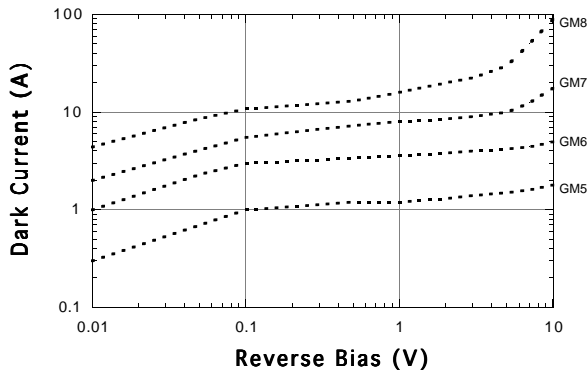
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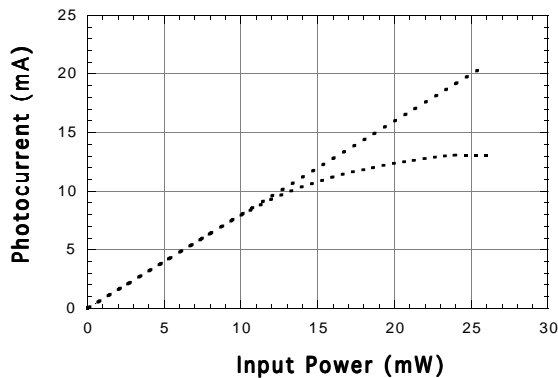


## Electrical Specifications

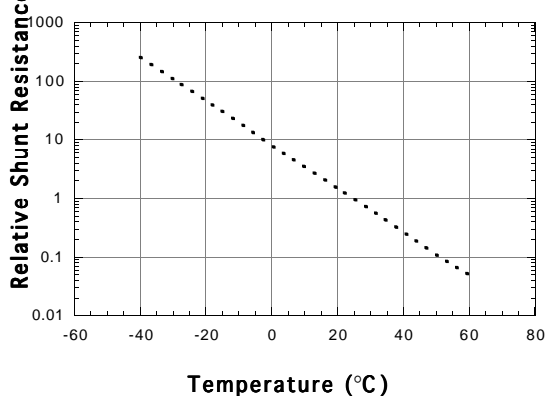
### Dark Current vs. Reverse Bias



### Linearity of Response



### Shunt Resistance vs. Temperature

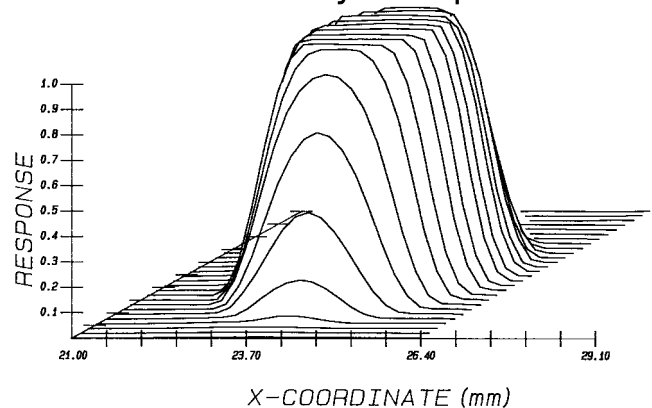


## Optical Specifications

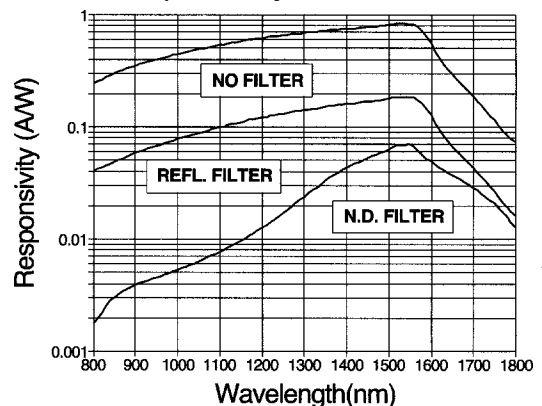
### Responsivity vs. Wavelength

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

### Uniformity of Response



### Responsivity of Filtered Units

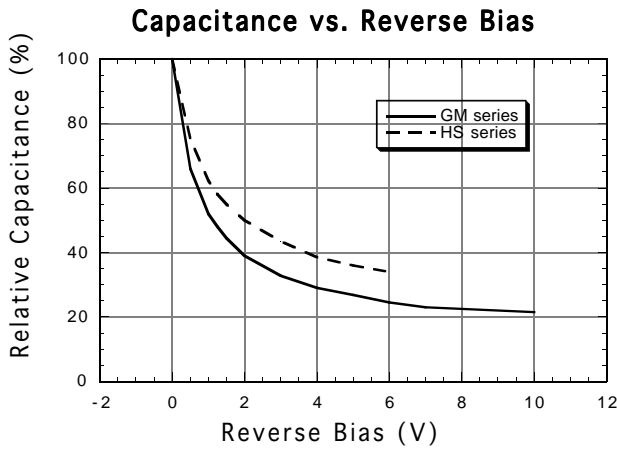


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# Two-Color Photodiodes



### Special Options

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

## 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	$1.0 \times 10^{-14}$	> 1000	30	2 nA	1.1
(Ge)	2	1000-1800	0.6	$1.0 \times 10^{-12}$	60	3	2 $\mu\text{A}$	0.45
(Si) GM7Si5	5	400-1000	0.5	$1.0 \times 10^{-14}$	> 1000	30	2 nA	1.1
(Ge)	3	1000-1800	0.6	$1.5 \times 10^{-12}$	25	3	3 $\mu\text{A}$	0.45
(Si) GM8Si5	5	400-1000	0.5	$1.0 \times 10^{-14}$	> 1000	30	2 nA	1.1
(Ge)	5	1000-1800	0.6	$2.0 \times 10^{-12}$	10	1.5	10 $\mu\text{A}$	0.45

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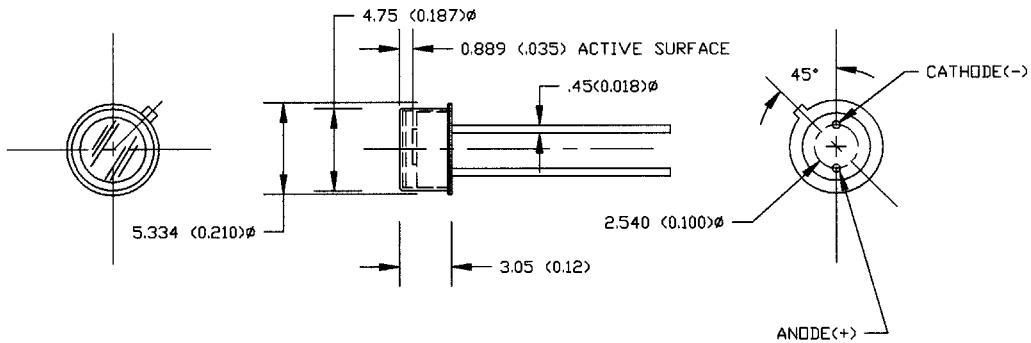
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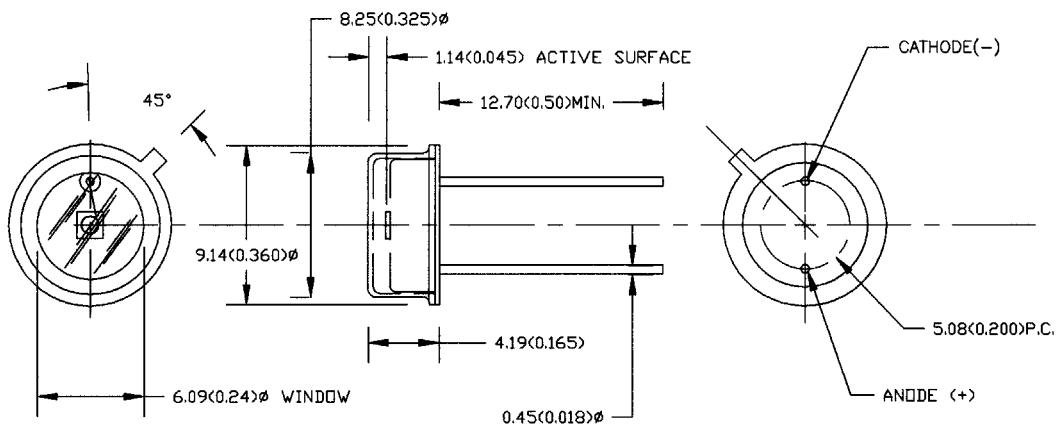


# Package Drawings

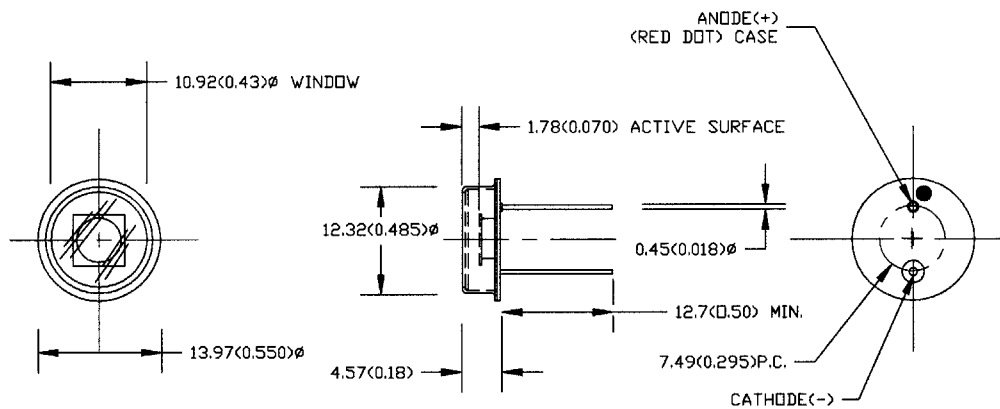
Dimensions in mm (in.) Many other packages (including lensed packages) available.



**TO-18**  
(Chip Diameter to 1 mm)



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



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

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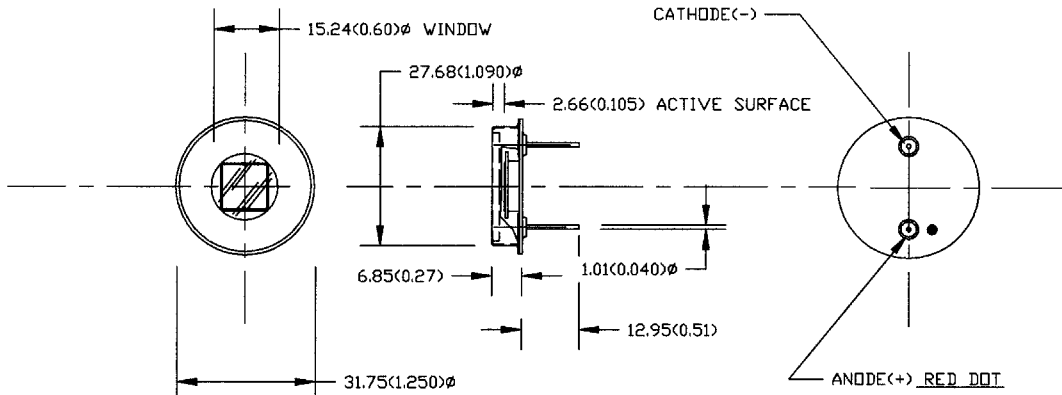
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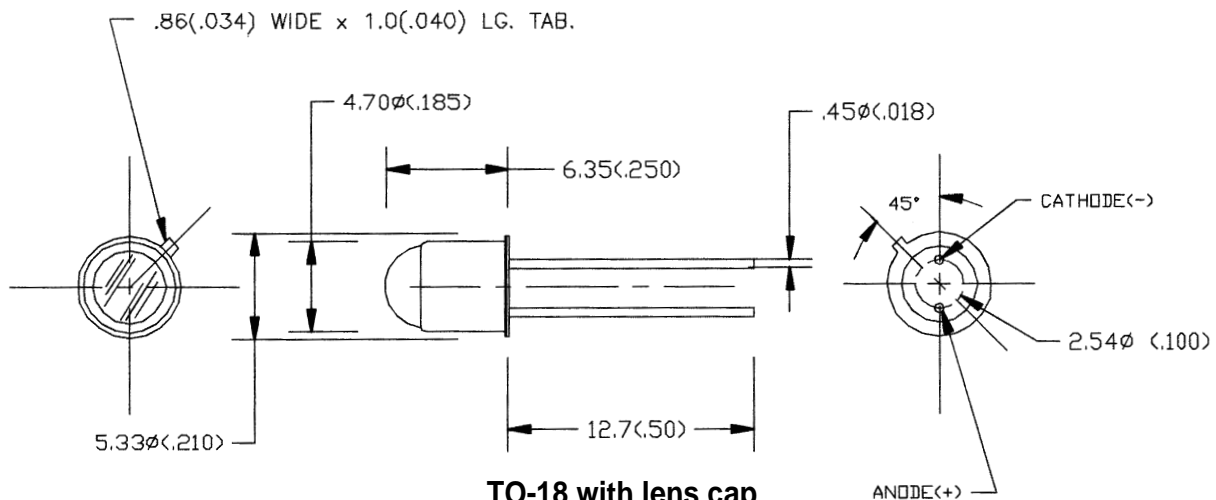


# Package Drawings

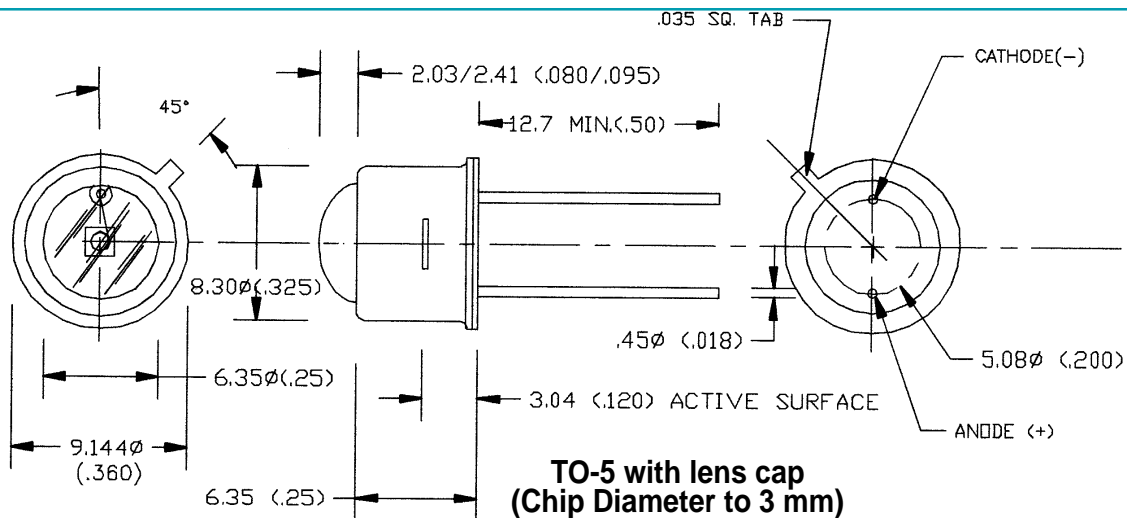
Dimensions in mm (in.) Many other packages (including lensed packages) available.



**TO-9**  
(Chip Diameter to 13 mm)



**TO-18 with lens cap**  
(Chip Diameter to 1 mm)



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

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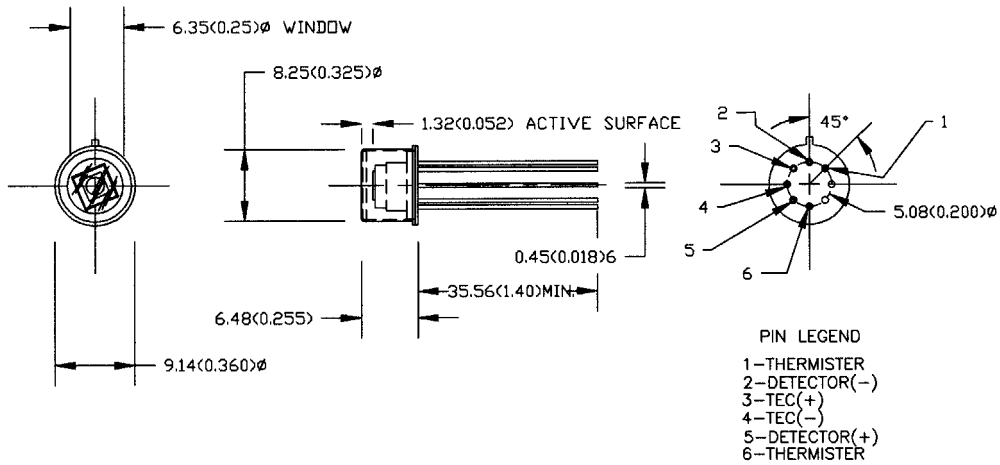
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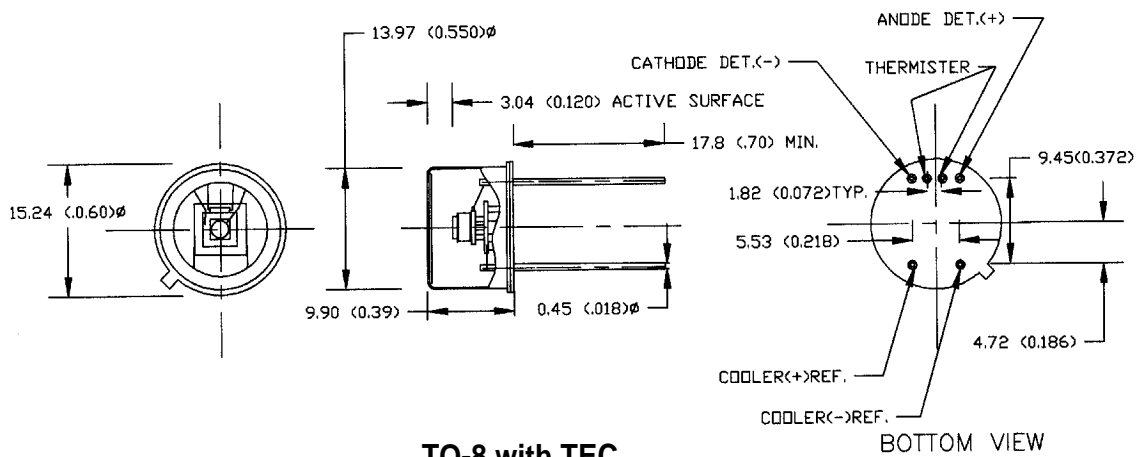


# Package Drawings

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



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



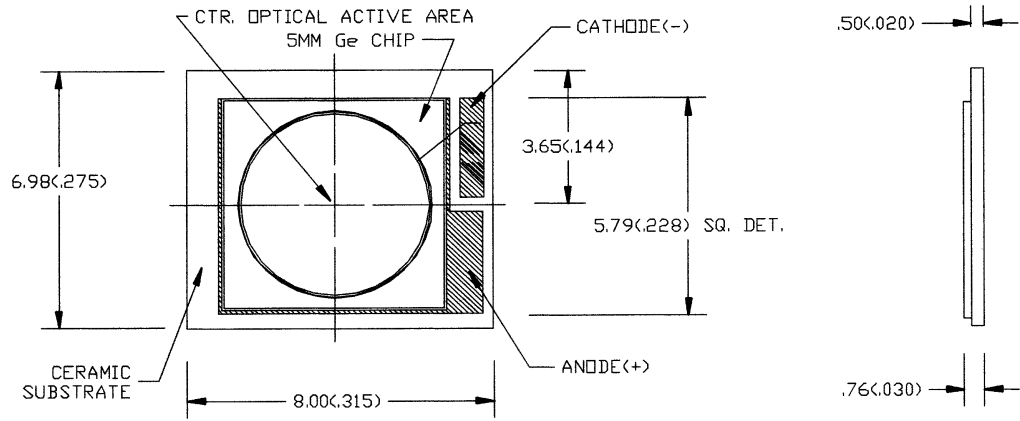
**TO-8 with TEC  
(Chip Diameter to 5 mm)**

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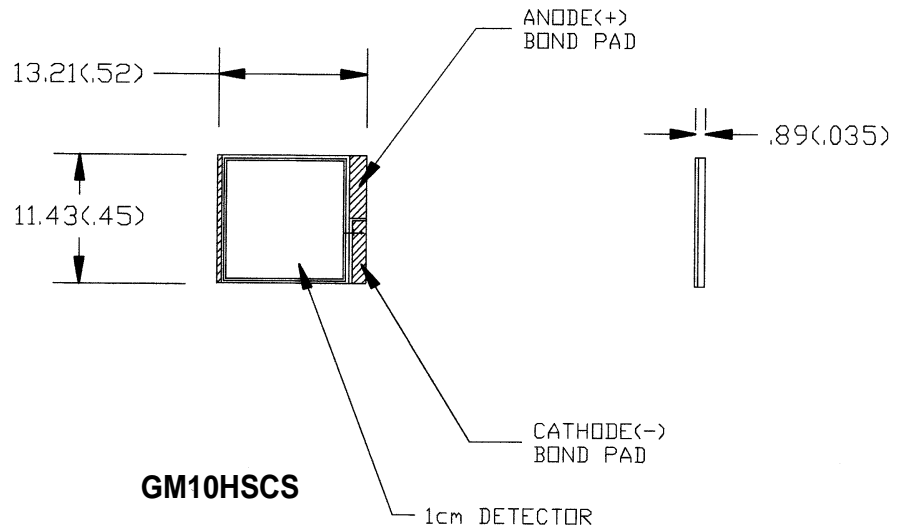
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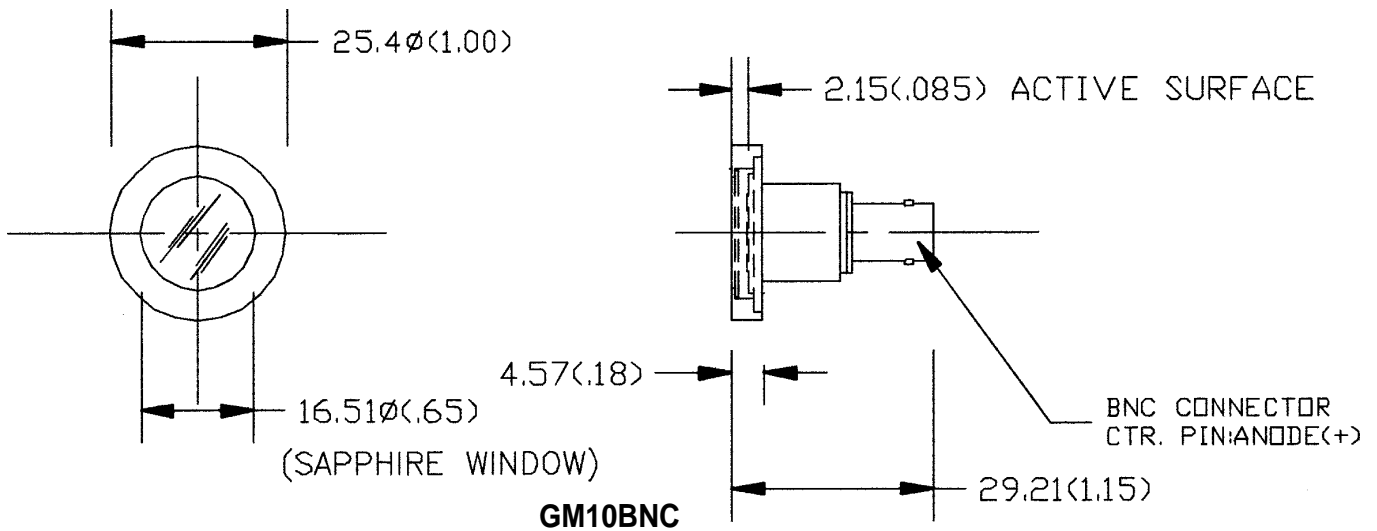
# Package Drawings



**GM8HSCS**



**GM10HSCS**



**GM10BNC**

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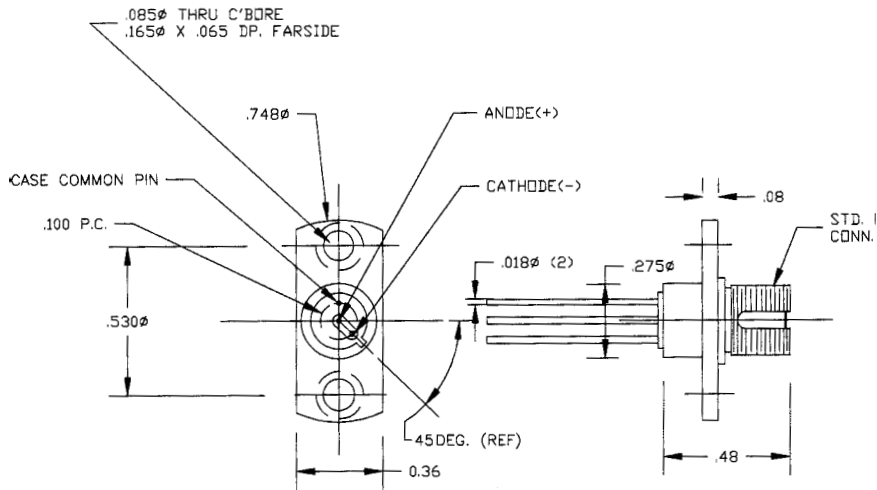
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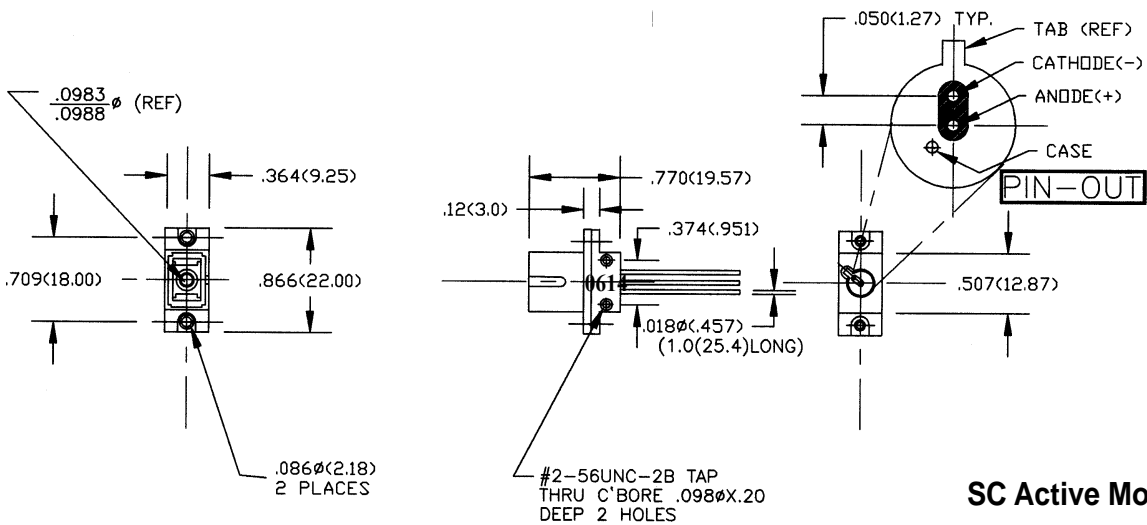
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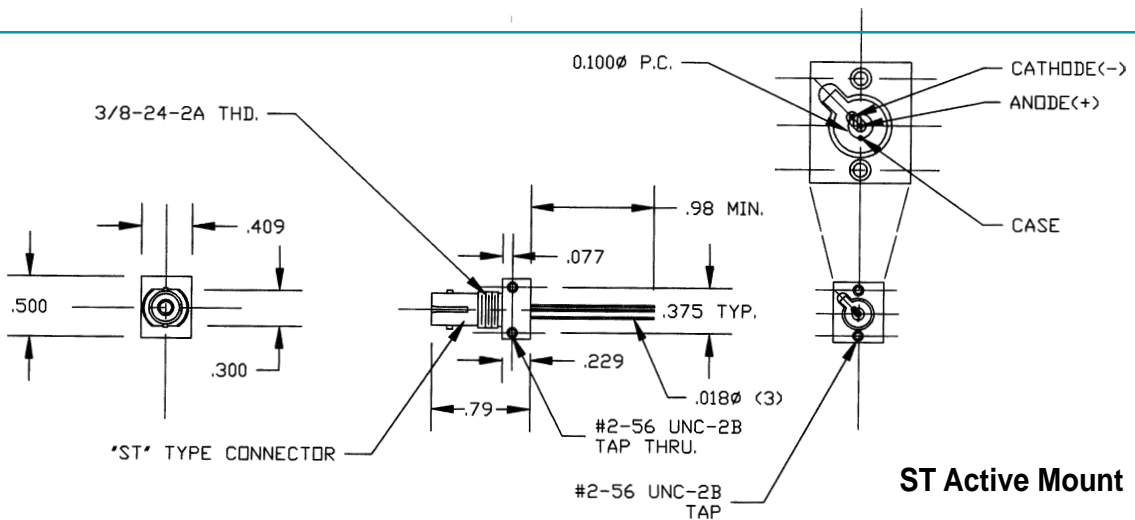
# Package Drawings



**FC Active Mount**



**SC Active Mount**



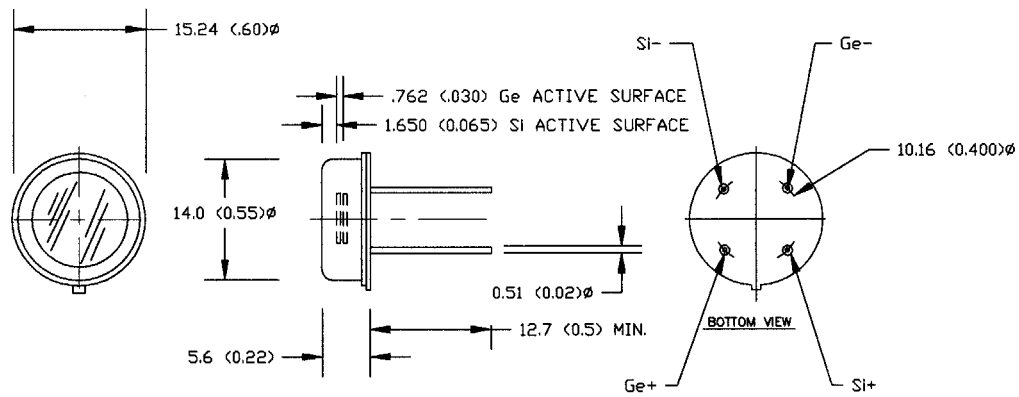
**ST Active Mount**

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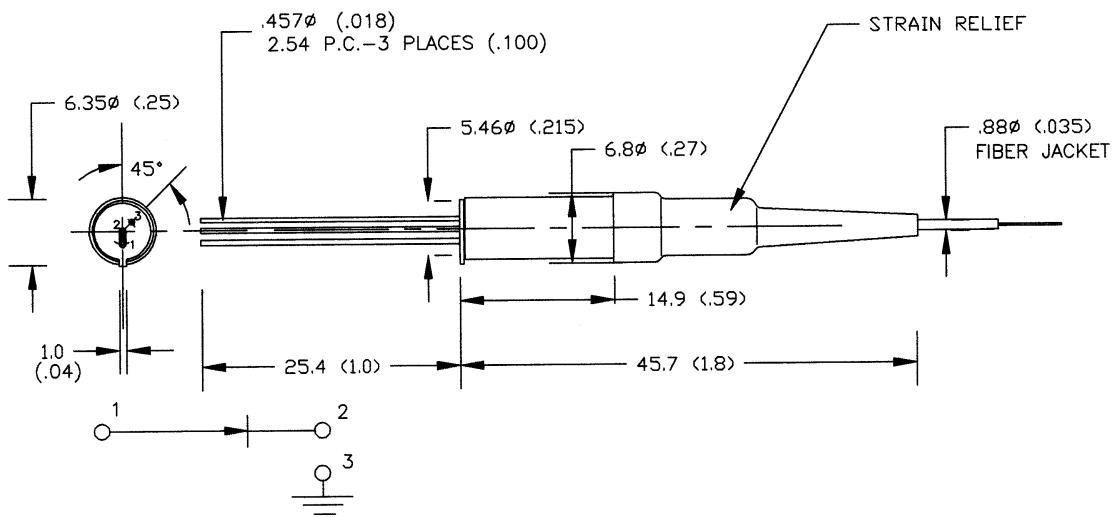
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Dimensions in mm (in.) Many other packages (including lensed packages) available.



**Si/Ge Two-color Detector**



**Fiber-pigtailed Detector**

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