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

GPD Optoelectronics Corp.

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
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.

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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Operating Circuits

**Basic Operating Circuit (Zero Bias)**

```
\[ R_f \quad \rightarrow \quad - \quad + \quad \rightarrow \quad \rightarrow \]
```

**Basic Operating Circuit (With Bias)**

```
\[ R_f \quad \rightarrow \quad - \quad + \quad \rightarrow \quad \rightarrow \quad + \quad V_b \]
```

**High Speed Circuit**

```
\[ C \quad COAX \quad R_b \quad R_L \quad \rightarrow \quad + \quad V_b \]
```

**Equivalent Circuit**

```
\[ IP \quad IN \quad V_d \quad \rightarrow \quad \rightarrow \quad Cd \quad R_{sh} \quad \rightarrow \quad LOAD \]
```

- \( I_p \): 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

GPD Optoelectronics Corp.
### Ge pn detectors

<table>
<thead>
<tr>
<th>TYPE</th>
<th>ACTIVE DIA. (mm.)</th>
<th>SHUNT RES. @ V_r=10mV (KΩ)</th>
<th>DARK CURRENT @ V_r=V_{bias} (μA MAX)</th>
<th>TEST REVERSE BIAS (Volts)</th>
<th>MAX REVERSE VOLTS</th>
<th>CAPACITANCE @V_r MAX (pF)</th>
<th>NEP (pW/√Hz)</th>
<th>CUT-OFF FREQ. @V_r, 50ΩR_L (MHz)</th>
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<td>60</td>
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<td>1.0</td>
<td>2.0</td>
<td>3000</td>
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</table>

*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.
Ge pn detectors

### Electrical Specifications

- **Dark Current vs. Reverse Bias**
  - Graph showing dark current in Amperes as a function of reverse bias voltage.

- **Linearity of Response**
  - Graph showing photocurrent in MilliAmpères as a function of input power in MilliWattères.

- **Shunt Resistance vs. Temperature**
  - Graph showing relative shunt resistance as a function of temperature in Celsius.

### Optical Specifications

- **Responsivity vs. Wavelength**
  - Table showing responsivity for different wavelengths.

- **Uniformity of Response**
  - Graph showing uniformity of response as a function of x-coordinate in millimeters.

- **Responsivity of Filtered Units**
  - Graph showing responsivity for different filters.
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

<table>
<thead>
<tr>
<th>Electrical Parameters</th>
<th>GEP600</th>
<th>GEP700</th>
<th>GEP800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shunt Resistance</td>
<td>2K</td>
<td>1K</td>
<td>0.7K</td>
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<tr>
<td>Reverse Voltage (max.)</td>
<td>10V</td>
<td>10V</td>
<td>10V</td>
</tr>
<tr>
<td>Dark Current (max.)</td>
<td>30μA</td>
<td>55μA</td>
<td>70μA</td>
</tr>
<tr>
<td>Capacitance (typ.)</td>
<td>50 pF</td>
<td>110 pF</td>
<td>450 pF</td>
</tr>
<tr>
<td>Bandwidth -3 dB, $R_L=50\Omega$</td>
<td>60 MHz</td>
<td>25 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Risetime, $R_L=50\Omega$</td>
<td>3 ns.</td>
<td>6 ns.</td>
<td>15 ns.</td>
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<tr>
<td>Case Style (standard)</td>
<td>TO-5</td>
<td>TO-5</td>
<td>TO-8</td>
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<td>3 mm.</td>
<td>5 mm.</td>
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### Si/Ge TWO-COLOR DETECTOR: ELECTRICAL SPECIFICATIONS

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<tr>
<th>Type</th>
<th>Active Diam. (mm)</th>
<th>Wavelength Range (nm)</th>
<th>Peak Resp. (A/W)</th>
<th>NEP (pW/√Hz)</th>
<th>$R_{SHUNT}$ (KΩ)</th>
<th>Max Reverse Volts (V)</th>
<th>Leakage Current</th>
<th>Forward Voltage (V) $I_{F}=10mA$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Si) GM6Si5 (Ge)</td>
<td>5</td>
<td>400-1000</td>
<td>0.5</td>
<td>1.0x10^{-14}</td>
<td>&gt; 1000</td>
<td>30</td>
<td>2 nA</td>
<td>1.1</td>
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<tr>
<td>(Si) GM7Si5 (Ge)</td>
<td>2</td>
<td>1000-1800</td>
<td>0.6</td>
<td>1.0x10^{-12}</td>
<td>60</td>
<td>3</td>
<td>2 μA</td>
<td>0.45</td>
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<tr>
<td>(Si) GM8Si5 (Ge)</td>
<td>3</td>
<td>1000-1800</td>
<td>0.6</td>
<td>1.5x10^{-12}</td>
<td>25</td>
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<td>3μA</td>
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<td>(Si) GM6Si5 (Ge)</td>
<td>5</td>
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<td>1.0x10^{-14}</td>
<td>&gt; 1000</td>
<td>30</td>
<td>2 nA</td>
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GPD Optoelectronics Corp.
TO-18
(Chip Diameter to 2 mm)

TO-5
(Chip Diameter to 3 mm)

TO-8 (5 mm chip)

GPD Optoelectronics Corp.
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 2 mm)

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

GPD Optoelectronics Corp.
Package Drawings

FC Active Mount

SC Active Mount

ST Active Mount

GPD Optoelectronics Corp.
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.