

DATA SHEET

Silicon Schottky Barrier Diodes in Hermetic and Epoxy Ceramic Packages

Applications

- Detectors
- Mixers

Features

- Available in both P-type and N-type low barrier designs
- Low 1/f noise
- Packages rated MSL1, 260 °C per JEDEC J-STD-020

Description

Our packaged Schottky barrier detector diodes are designed for applications through 20 GHz in the Ka band. They are made by the deposition of a suitable barrier metal on an epitaxial silicon substrate to form the junction. The process and choice of materials result in low series resistance along with a narrow spread of capacitance values for close impedance control. P-type silicon is used to obtain superior 1/f noise characteristics. N-type silicon is also available.

Packaged diodes are suitable for use in waveguide, coaxial, and stripline applications.

The choice of N- and P-type silicon allows the designer to optimize the silicon material for the intended application:

- Doppler mixers and high-sensitivity detectors benefit from using the low noise characteristics of the P-type silicon.
- Low conversion loss mixers and biased detectors can be designed using standard N-type material.

Applications

These diodes are categorized by Tangential Signal Sensitivity (TSS) for detector applications in four frequency ranges: S, X, Ku, and Ka bands. However, they can also be used as modulators, high-speed switches, and low-power limiters.

TSS is a parameter that describes a diode's detector sensitivity. It is defined as the amount of signal power, below a one-milliwatt reference level, required to produce an output pulse with an amplitude sufficient to raise the noise fluctuations by an amount equal to the average noise level. TSS is approximately 4 dB above the minimum detectable signal.



The P-type Schottky diodes in this data sheet are optimized for low noise in the 1/f region. They require a small forward bias (to reduce video resistance) if efficient operation is required. The bias not only increases sensitivity but also reduces parameter variation due to temperature change. Video impedance is a direct function of bias and follows the $26/I$ (mA) relationship. This is important to pulse fidelity, since the video impedance together with the detector output capacitance affects the effective amplifier bandwidth.

Bias does, however, increase typical noise, particularly in the 1/f region. Therefore, it should be kept as low as possible (typically 5 to 50 μ A).

Electrical and physical specifications for the silicon Schottky barrier diodes are provided in Tables 1 through 3. SPICE model parameters are defined in Table 4. Typical I-V characteristics are shown in Figures 1 and 2. Typical performance characteristics are shown in Figures 3 and 4. Typical video detector circuits are shown in Figure 5.

SILICON SCHOTTKY BARRIER DIODES

Table 1. Electrical Specifications: Beam-Lead P-Type Detector Schottky Diodes (Note 1)

| Frequency Band | Part Number | TSS (dBm) (Note 2) | R _v (Ω) | | Total Capacitance (CT) @ 0 V (pF) | V _F @ 1.0 mA (mV) | | V _B @ 10 μA (V) |
|----------------|-------------|--------------------|--------------------|---------------|-----------------------------------|------------------------------|---------|----------------------------|
| | | Typical | Minimum | Maximum | Maximum | Minimum | Maximum | Minimum |
| X | DDB2503-220 | 50 | 500 | 700 | 0.3 | 200 | 350 | 2 |
| X | DDB2503-230 | 50 | 500 | 700 | 0.3 | 200 | 350 | 2 |
| X | DDB2503-250 | 50 | 500 | 700 | 0.3 | 200 | 350 | 2 |
| Ku | DDB2504-220 | 48 | 500 | 700 | 0.2 | 200 | 350 | 2 |
| Ku | DDB2504-230 | 48 | 500 | 700 | 0.2 | 200 | 350 | 2 |
| Ku | DDB2504-250 | 48 | 500 | 700 | 0.2 | 200 | 350 | 2 |
| K | DDB2265-220 | 50 (Note3) | 800 (Note 3) | 1200 (Note 3) | 0.2 | 300 | 450 | 3 |
| K | DDB2265-230 | 50 (Note3) | 800 (Note 3) | 1200 (Note 3) | 0.2 | 300 | 450 | 3 |
| K | DDB2265-250 | 50 (Note3) | 800 (Note 3) | 1200 (Note 3) | 0.2 | 300 | 450 | 3 |

Note 1: Performance is guaranteed only under the conditions listed in this table.

Note 2: Bias = 50 μA
Video bandwidth = 10 MHz.

Note 3: Bias = 30 μA

Table 2. Electrical Specifications: P-Type Detector Schottky Diodes (Note 1)

| Frequency Band | Part Number | Barrier | R _v (Ω) | TSS (dBm) (Note 2) | Total Capacitance (CT) @ 0 V (pF) | V _F @ 1 mA (mV) | | Total Resistance (R _T) @ 10 mA (Ω) (Note 3) | V _B @ 10 μA (V) |
|----------------|-------------|---------|--------------------|--------------------|-----------------------------------|----------------------------|---------|---------------------------------------------------------|----------------------------|
| | | | Typical | Typical | Maximum | Minimum | Maximum | Maximum | Minimum |
| Ku | CDB7620-203 | Low | 537 | +40 | 0.4 | 250 | 350 | 30 | 2 |
| Ku | CDB7620-207 | Low | 537 | +40 | 0.4 | 250 | 350 | 30 | 2 |
| K | CDB7619-203 | Low | 735 | +50 (Note 4) | 0.35 | 275 | 375 | 40 | 3 |
| K | CDB7619-207 | Low | 735 | +50 (Note 4) | 0.35 | 275 | 375 | 40 | 3 |

Note 1: Performance is guaranteed only under the conditions listed in this table.

Note 2: Bias = 50 μA
Video bandwidth = 10 MHz
R_V = 2800 Ω

Note 3: R_t is the slope resistance @ 10 mA. The maximum series resistance (R_S) is calculated as : R_S = R_t – 2.8

Note 4: Bias = 30 μA

Table 3. Electrical Specifications: N-Type Detector Schottky Diodes (Note 1)

| Frequency Band | Part Number | Barrier | $V_F @ 1.0 \text{ mA}$ (mV) | | R_V (Ω) | Total Capacitance (CT) @ 0 V (pF) | Total Resistance (RT) @ 10 mA (Ω) (Note 2) | $V_B @ 10 \text{ }\mu\text{A}$ (V) |
|----------------|-------------|-------------|-----------------------------|---------|--------------------|-----------------------------------|-----------------------------------------------------|------------------------------------|
| | | | Minimum | Maximum | Typical | Maximum | Maximum | Minimum |
| X | CDF7623-203 | Low | 240 | 300 | 245 | 0.50 | 10 | 2 |
| X | CDF7623-207 | Low | 240 | 300 | 245 | 0.50 | 10 | 2 |
| K | CDF7621-203 | Low | 270 | 350 | 680 | 0.30 | 20 | 2 |
| K | CDF7621-207 | Low | 270 | 350 | 680 | 0.30 | 20 | 2 |
| Ku | CME7660-203 | Medium | 350 | 450 | - | 0.40 | 10 | 3 |
| Ku | CME7660-207 | Medium | 350 | 450 | - | 0.40 | 10 | 3 |
| K | CDE7618-203 | Medium | 375 | 500 | - | 0.30 | 20 | 3 |
| K | CDE7618-207 | Medium | 375 | 500 | - | 0.30 | 20 | 3 |
| Ku | CDP7624-203 | Medium/High | 450 | 575 | - | 0.40 | 15 | 3 |
| Ku | CDP7624-207 | Medium/High | 450 | 575 | - | 0.40 | 15 | 3 |

Note 1: Performance is guaranteed only under the conditions listed in this table.

Note 2: R_t is the slope resistance @ 10 mA. The maximum series resistance (R_S) is calculated as : $R_S = R_t - 2.8$

Table 4. SPICE Model Parameters

| Parameter | Units | Part Number | | | |
|-----------|----------|-------------|---------|---------|---------|
| | | CDB7620 | CDF7621 | CDC7623 | CDB7619 |
| I_S | A | 4E-08 | 9E-08 | 1.1E-07 | 3E-08 |
| R_S | Ω | 4 | 6 | 5 | 30 |
| N | - | 1.20 | 1.10 | 1.10 | 1.04 |
| TT | sec | 1E-11 | 1E-11 | 1E-11 | 1E-11 |
| CJO | pF | 0.15 | 0.11 | 0.20 | 0.11 |
| M | - | 0.35 | 0.30 | 0.30 | 0.32 |
| E_G | eV | 0.69 | 0.69 | 0.69 | 0.69 |
| XTI | - | 2 | 2 | 2 | 2 |
| Fc | - | 0.5 | 0.5 | 0.5 | 0.5 |
| Bv | V | 10 | 2.5 | 2.5 | 3.0 |
| I_{BV} | A | 1E-05 | 1E-05 | 1E-05 | 1E-05 |
| VJ | V | 0.495 | 0.510 | 0.510 | 0.540 |

Typical I-V Characteristics

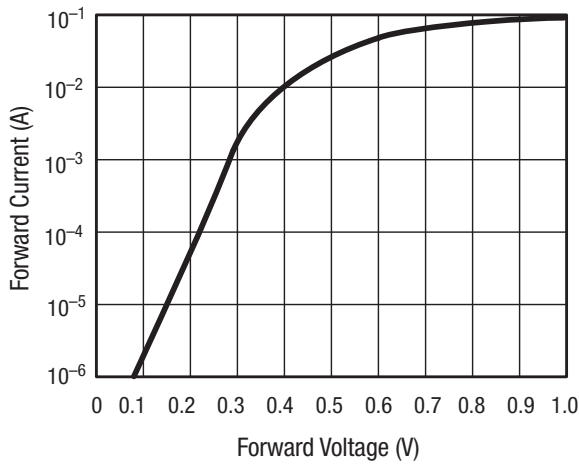


Figure 1. CDF7621

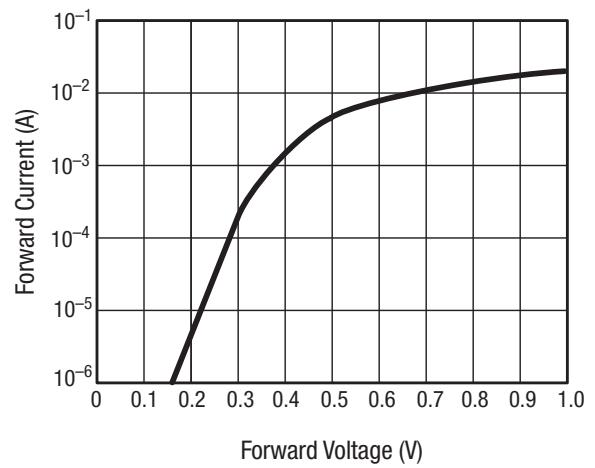


Figure 2. CDB7619

Typical Performance Characteristics

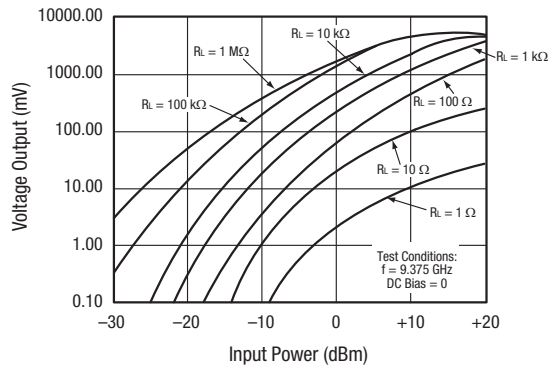


Figure 3. Voltage Output vs Input Power as a Function of Load Resistance

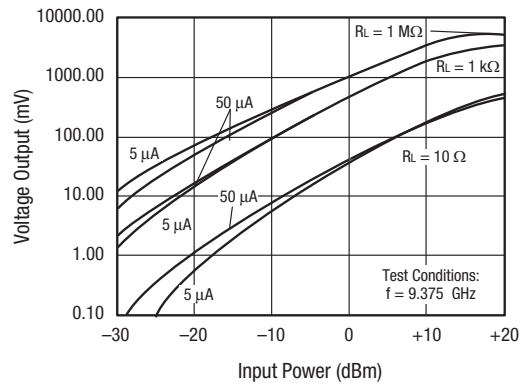


Figure 4. Voltage Output vs Input Power as a Function of Load Resistance and Bias

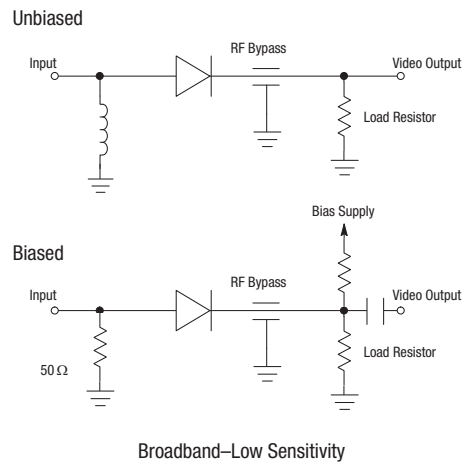
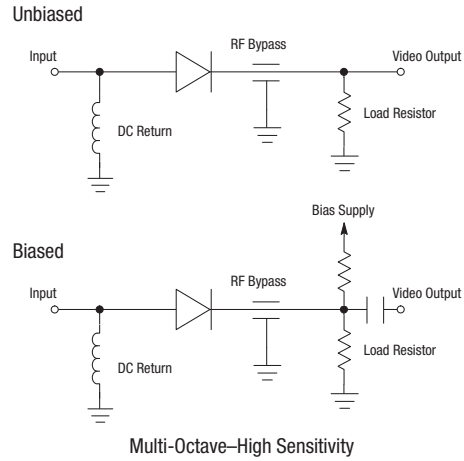


Figure 5. Typical Video Detector Circuits

Package Dimensions

Package dimensions are provided in Figures 6 through 10.

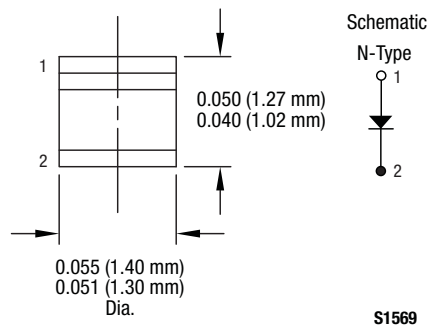


Figure 6. -203 Package Dimensions

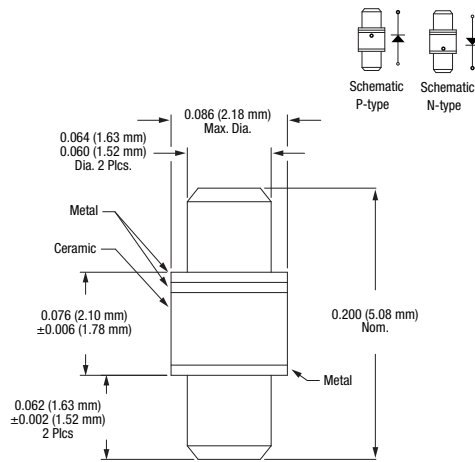


Figure 7. -207 Package Dimensions

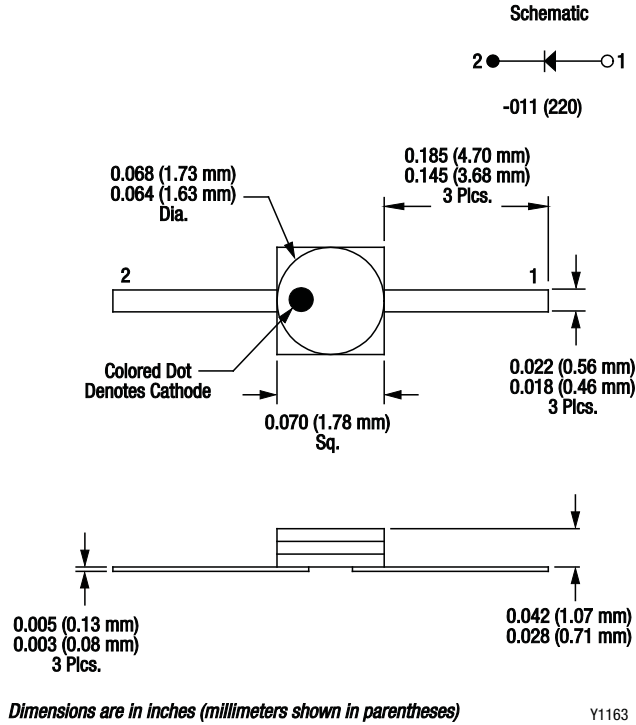
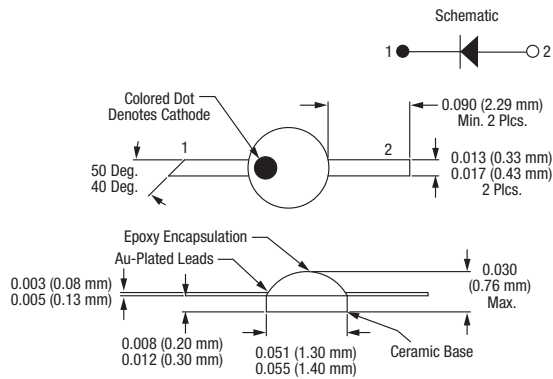


Figure 8. -220 Package Dimensions



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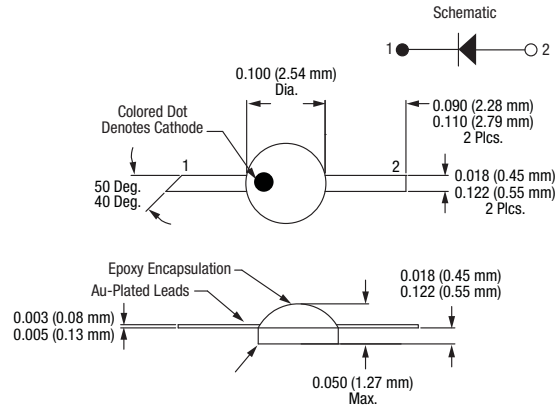


Figure 10. -250 Package Dimensions

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