SKYWORKS®

DATA SHEET

Silicon Schottky Barrier Diodes: Packaged, Bondable Chips and Beam Leads

Applications

- Detectors
- Mixers

Features

- Available in both P-type and N-type low barrier designs
- Low 1/f noise
- Large bond pad chip design
- Planar passivated beam-lead and chip construction
- Packages rated MSL1, 260 °C per JEDEC J-STD-020)

Skyworks Pb-free products are compliant with all applicable legislation. For additional information, refer to *Skyworks Definition of Lead (Pb)-Free*, document number SQ04-0073.

Description

Skyworks packaged, beam-lead and chip Schottky barrier detector diodes are designed for applications through 40 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. Beam-lead and chip diodes can also be mounted in a variety of packages or on special customer substrates.

Unmounted beam-lead diodes are especially well suited for use in Microwave Integrated Circuit (MIC) applications. Mounted beam-lead diodes can be easily used in MIC, stripline, or other such circuitry.

These “universal chips” are designed for a high degree of device reliability in both commercial and industrial uses. The offset bond pad assures that no mechanical damage occurs at the junction during the wire bonding. Additionally, the 4 mil bond pad eliminates performance variation due to bonding, improves

efficiency during manual operations, and is ideal for automated assembly.

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 μA).

Assembly and Handling Procedure

Die Attach Methods

Universal chips are compatible with both eutectic and conductive epoxy die attach methods.

Eutectic composition preforms of Au/Sn or Au/Ge are useful when soldering devices in circuit. Gold/silicon eutectic die attachments can be accomplished by scrubbing the chip directly to the gold plated bonding area.

Epoxy die attachments with silver or gold filled conductive epoxies can also be used when thermal heat sinking is not a requirement.

Wire Bonding

Two methods can be used to connect wire, ribbon, and wire mesh to the chips:

- Thermocompression
- Ballbonding

Skyworks recommends use of pure gold wire (0.7 to 1.25 mil diameter).

Electrical and physical specifications for the silicon Schottky barrier diodes are provided in Tables 1 through 6. SPICE model parameters are defined in Table 7. Typical performance characteristics are shown in Figures 1 through 4. Typical video detector circuits are shown in Figure 5.

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

Frequency Band	Part Number	Electrical Characteristics						Test Frequency (GHz)	Outline Drawing
		TSS (dBm) (Note 2)	Rv (Ω)		C_J @ 0 V (pF)	V_F @ 1 mA (mV)	V_B @ 10 mA (V)		
		Typ.	Min.	Max.	Max.				
X	DDB2503-000	50	500	700	0.15	200-350	2	10.00	491-006
Ku	DDB2504-000	48	500	700	0.10	200-350	2	16.00	491-006
K	DDB2265-000	50 (Note 3)	800 (Note 3)	1200 (Note 3)	0.10	300-450	3	24.15	491-006

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. Epoxy and Hermetic Packaged Beam-Lead P-Type Detector Schottky Diodes

Part Numbers/Outline Drawings		
Epoxy Stripline 250	Epoxy Stripline 230	Hermetic Stripline 220
DDB2503-250	DDB2503-230	DDB2503-220
DDB2504-250	DDB2504-230	DDB2504-220
DDB2265-250	DDB2265-230	DDB2265-220

Table 3. Electrical Specifications: P-Type Detector Schottky Diode Universal Chips

Frequency Band	Part Number	Barrier	Electrical Characteristics						Outline Drawing
			Rv (Ω)	TSS (dBm) (Note 1)	CJ @ 0 V (pF)	VF @ 1 mA (mV)	RT @ 10 mA (Ω) (Note 2)	VB @ 10 μA (V)	
			Typ.	Min.	Max.		Max.	Min.	
Ku	CDB7620-000	Low	537	40	0.15	250-350	30	2	571-006
K	CDB7619-000	Low	735	50 (Note 3)	0.10	275-375	40	3	571-006

Note 1: Bias = 50 μA
Video bandwidth = 10 MHz
Rv = 2800 Ω

Note 2: Rt is the slope resistance @ 10 mA. The maximum series resistance (Rs) is calculated as: Rs = Rt – 2.8.

Note 3: Bias = 30 μA

Table 4. Hermetic Packaged P-Type Detector Schottky Diode Chips

Part Numbers/Outline Drawings	
Hermetic Pill 207	Hermetic Pill 203
CDB7620-207	CDB7620-203
CDB7619-207	CDB7619-203

Table 5. Electrical Specifications: N-Type Detector Schottky Diode Chips

Frequency Band	Part Number	Electrical Characteristics					Rv (Ω)	Outline Drawing
		Barrier	VF @ 1 mA (mV)	CJ @ 0 V (pF)	RT @ 10 mA (Ω)	VB @ 10 μA (V)		
				Max.	Max.	Min.	Typ.	
X	CDF7623-000	Low	240-300	0.30	10	2	245	571-011
K	CDF7621-000	Low	270-350	0.10	20	2	680	571-011
Ku	CME7660-000	Medium	350-450	0.15	10	3	–	571-011
K	CDE7618-000	Medium	375-500	0.10	20	3	–	571-011
Ku	CDP7624-000	Medium/High	450-575	0.15	15	3	–	571-011

Table 6. Hermetic Packaged Beam-Lead N-Type Detector Schottky Diode Chips

Part Numbers/Outline Drawings	
Hermetic Ceramic Pill 207	Hermetic Ceramic Pill 203
CDF7623-207	CDF7623-203
CDF7621-207	CDF7621-203
CME7660-207	CME7660-203
CDE7618-207	CDE7618-203
CDP7624-207	CDP7624-203

Table 7. SPICE Model Parameters

Parameter	Units	Part Number			
		CDB7620-000	CDF7621-000	CDC7623-000	CDB7619-000
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
C_{JO}	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
F_C	–	0.5	0.5	0.5	0.5
B_V	V	10	2.5	2.5	3.0
I_{BV}	A	1E-05	1E-05	1E-05	1E-05
V_J	V	0.495	0.510	0.510	0.540

Typical I-V Characteristics

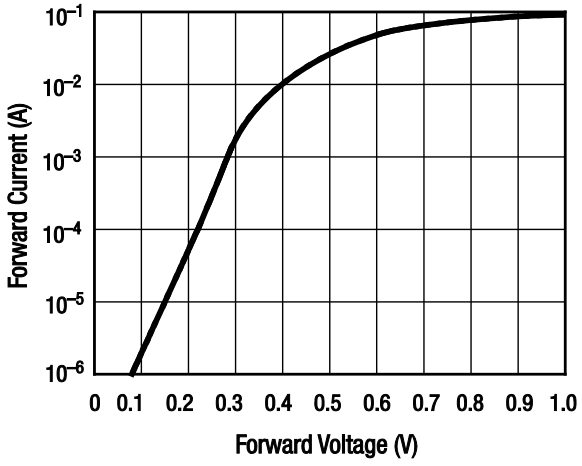

Figure 1. CDF7621-000

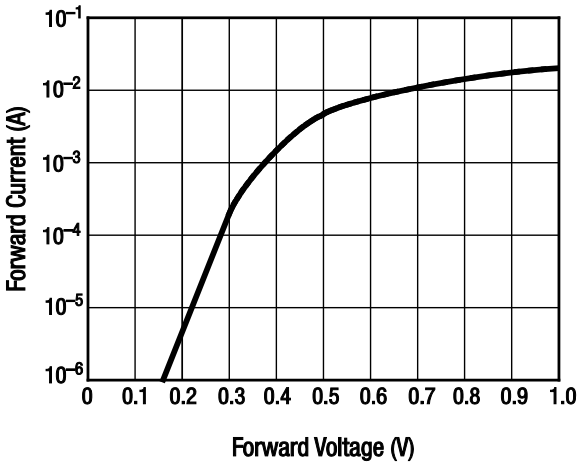

Figure 2. CDB7619-000

Typical Performance Data

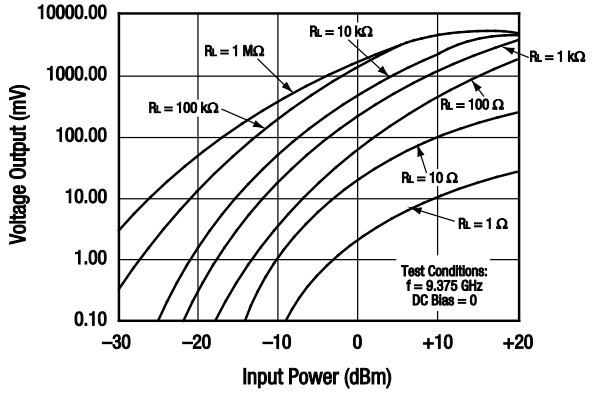

Figure 3. Voltage Output vs Input Power As a Function of Load Resistance

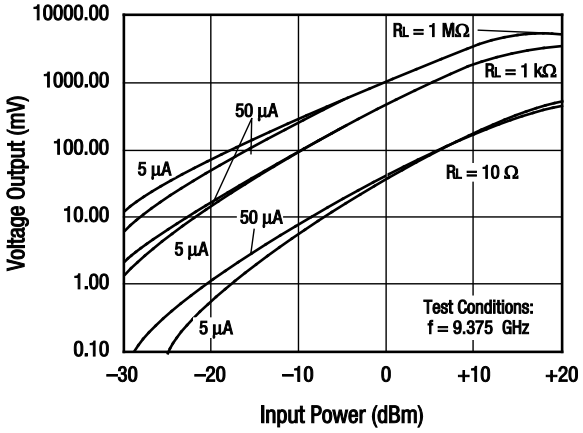

Figure 4. Voltage Output vs Input Power As a Function of Load Resistance and Bias

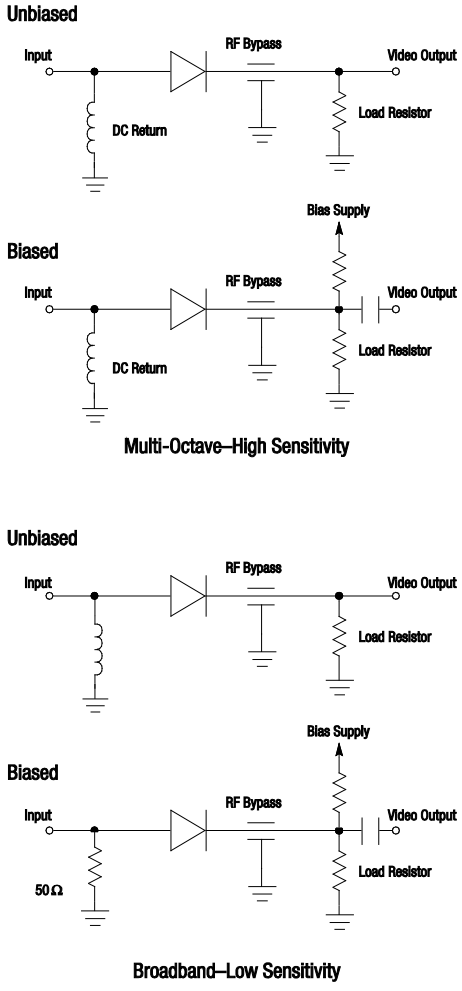

Figure 5. Typical Video Detector Circuits

Shipping Information

Individual Chips

Skyworks silicon Schottky barrier diodes are provided in waffle packs for bare die and in gel-pack carriers for beamlead devices.

Package dimensions are provided in Figures 6 through 13.

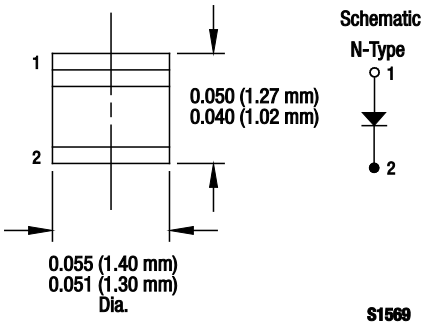

Figure 6. -203 Package Dimensions

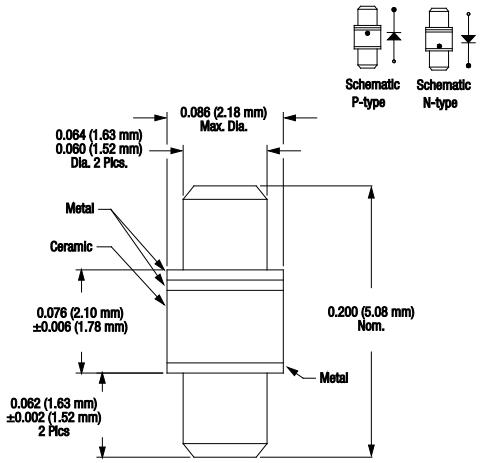

Figure 7. -207 Package Dimensions

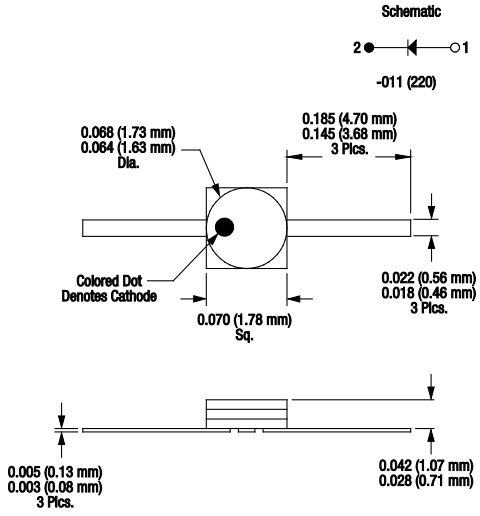

Figure 8. -220 Package Dimensions

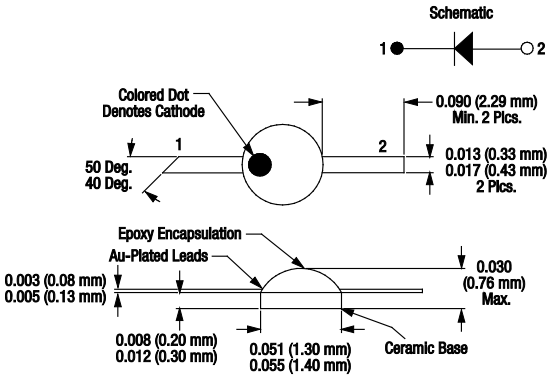

Figure 9. -230 Package Dimensions

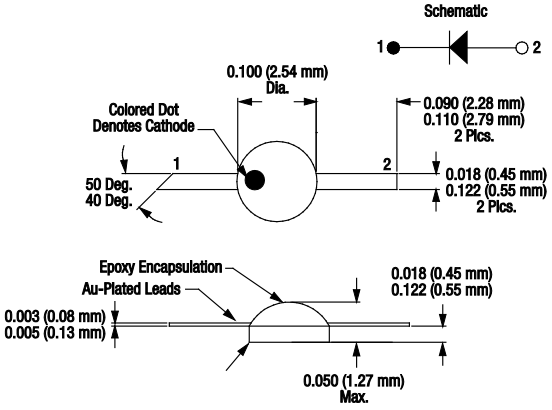

Figure 10. -250 Package Dimensions

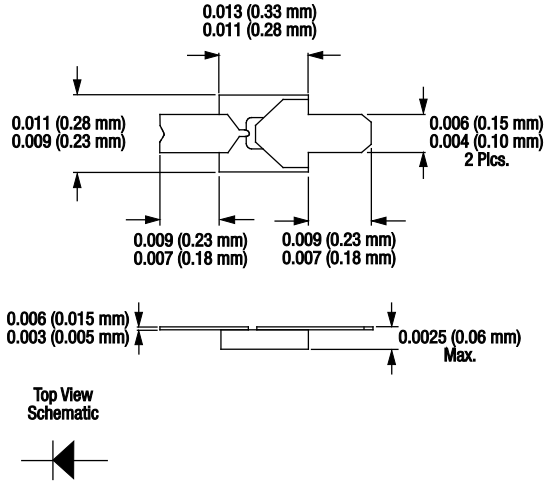

Figure 11. 491-006 Package Dimensions

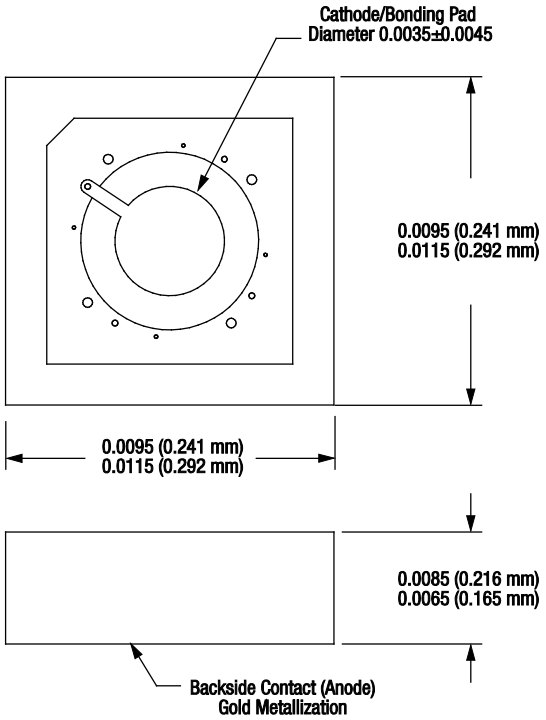

Figure 12. 571-006 Package Dimensions

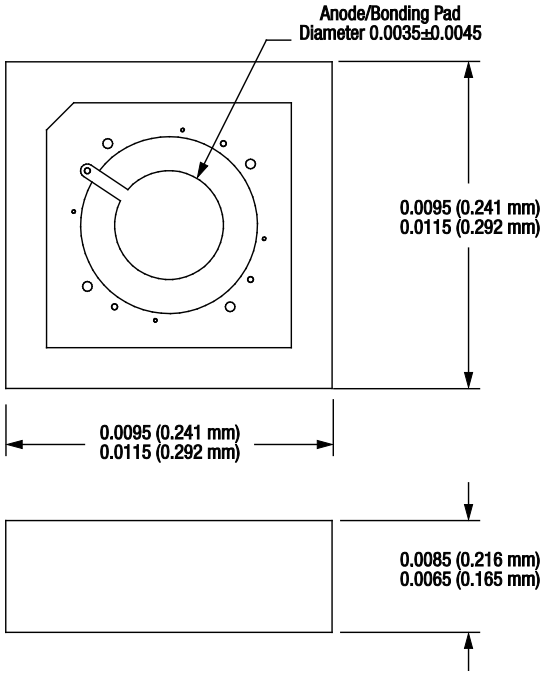

Figure 13. 571-011 Package Dimensions