

## DATA SHEET

# Silicon Schottky Barrier Diode 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



Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.

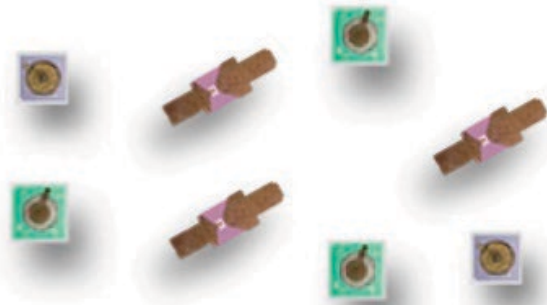
## Description

Skyworks 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.

Beam-lead and chip diodes can be mounted 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  $\mu$ A).

Additional bonding and handling methods are contained in the Skyworks Application Notes, *Waffle Pack Chip Carrier Handling/Opening Procedure* (document #200146) and *Diode Chips, Beam-Lead Diodes, Capacitors: Bonding Methods and Packaging* (document #200532).

## Electrical and Mechanical Specifications

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 performance characteristics are shown in Figures 1 through 4. Typical video detector circuits are shown in Figure 5.

**Table 1. DDB2503/04, DDB2265, CDB7619/20, CDF7621/23, CME7660, CDE7618 and CDP7624 Diode Series Absolute Maximum Ratings<sup>1</sup>**

| Parameter                                                   | Symbol           | Minimum | Maximum | Units |
|-------------------------------------------------------------|------------------|---------|---------|-------|
| Reverse voltage                                             | V <sub>R</sub>   |         | 2       | V     |
| Forward current                                             | I <sub>F</sub>   |         | 100     | mA    |
| RF input power @ T <sub>A</sub> = 25 °C                     | P <sub>D</sub>   |         | 75      | mW    |
| Storage temperature                                         | T <sub>STG</sub> | -60     | +200    | °C    |
| Operating temperature                                       | T <sub>A</sub>   | -55     | +150    | °C    |
| Electrostatic discharge:<br>Human Body Model (HBM), Class ) | ESD              |         | <250    | V     |

<sup>1</sup> Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

**ESD HANDLING:** Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.

**Table 2. Electrical Specifications: Beam-Lead P-Type Detector Schottky Diodes<sup>1</sup>**

| Frequency Band | Part Number | Electrical Characteristics |                    |                   |                           |                            |                            | Test Frequency (GHz) | Outline Drawing |
|----------------|-------------|----------------------------|--------------------|-------------------|---------------------------|----------------------------|----------------------------|----------------------|-----------------|
|                |             | TSS (dBm) <sup>2</sup>     | R <sub>v</sub> (Ω) |                   | C <sub>J</sub> @ 0 V (pF) | V <sub>F</sub> @ 1 mA (mV) | V <sub>B</sub> @ 10 μA (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 <sup>3</sup>           | 800 <sup>3</sup>   | 1200 <sup>3</sup> | 0.10                      | 300-450                    | 3                          | 24.15                | 491-006         |

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

<sup>2</sup> Bias = 50 μA

Video bandwidth = 10 MHz.

<sup>3</sup> Bias = 30 μA

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

| Frequency Band | Part Number | Barrier | Electrical Characteristics |                        |                           |                            |                                         |                            | Outline Drawing |
|----------------|-------------|---------|----------------------------|------------------------|---------------------------|----------------------------|-----------------------------------------|----------------------------|-----------------|
|                |             |         | R <sub>v</sub> (Ω)         | TSS (dBm) <sup>1</sup> | C <sub>J</sub> @ 0 V (pF) | V <sub>F</sub> @ 1 mA (mV) | R <sub>t</sub> @ 10 mA (Ω) <sup>2</sup> | V <sub>B</sub> @ 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 <sup>3</sup>       | 0.10                      | 275-375                    | 40                                      | 3                          | 571-006         |

<sup>1</sup> Bias = 50 μA

Video bandwidth = 10 MHz

R<sub>v</sub> = 2800 Ω

<sup>2</sup> R<sub>t</sub> is the slope resistance @ 10 mA. The maximum series resistance (R<sub>s</sub>) is calculated as: R<sub>s</sub> = R<sub>t</sub> – 2.8.

<sup>3</sup> Bias = 30 μA

**Table 4. Electrical Specifications: N-Type Detector Schottky Diode Chips**

| Frequency Band | Part Number | Electrical Characteristics |                            |                           |                            |                            | Rv (Ω) | Outline Drawing |
|----------------|-------------|----------------------------|----------------------------|---------------------------|----------------------------|----------------------------|--------|-----------------|
|                |             | Barrier                    | V <sub>F</sub> @ 1 mA (mV) | C <sub>J</sub> @ 0 V (pF) | R <sub>T</sub> @ 10 mA (Ω) | V <sub>B</sub> @ 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 5. SPICE Model Parameters**

| Parameter | Units    | Part Number |             |             |             |
|-----------|----------|-------------|-------------|-------------|-------------|
|           |          | CDB7620-000 | CDF7621-000 | CDF7623-000 | CDB7619-000 |
| Is        | A        | 4E-08       | 9E-08       | 1.1E-07     | 3E-08       |
| Rs        | $\Omega$ | 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        |
| Eg        | 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        | 2.0         | 2.5         | 2.5         | 3.0         |
| Ibv       | A        | 1E-05       | 1E-05       | 1E-05       | 1E-05       |
| VJ        | V        | 0.495       | 0.510       | 0.510       | 0.540       |

## Typical I-V Characteristics

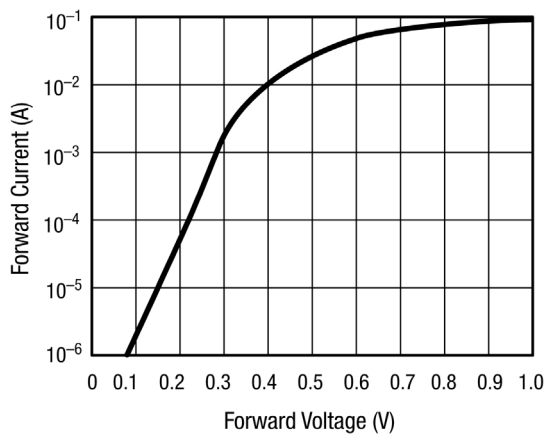


Figure 1. CDF7621-000

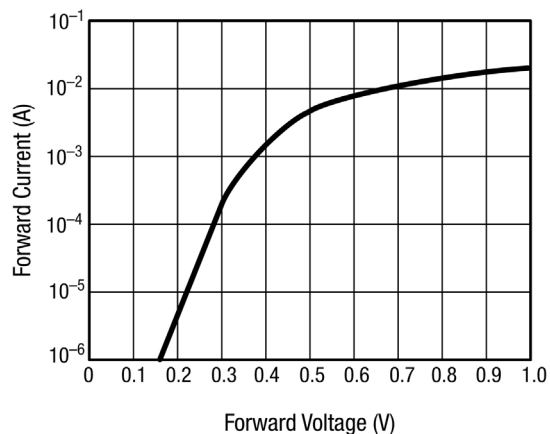


Figure 2. CDB7619-000

## Typical Performance Data

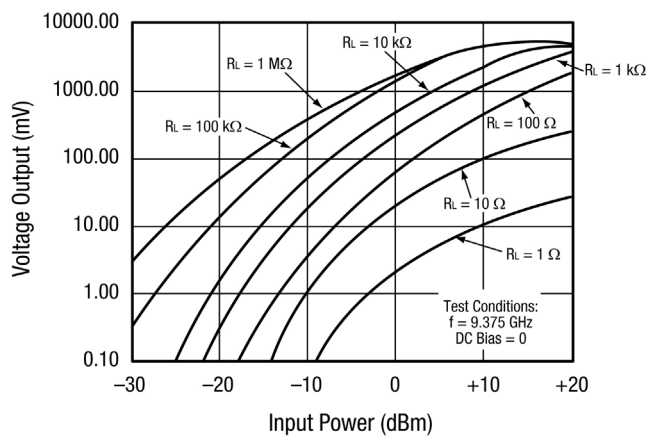


Figure 3. Voltage Output vs Input Power as a Function of Load Resistance

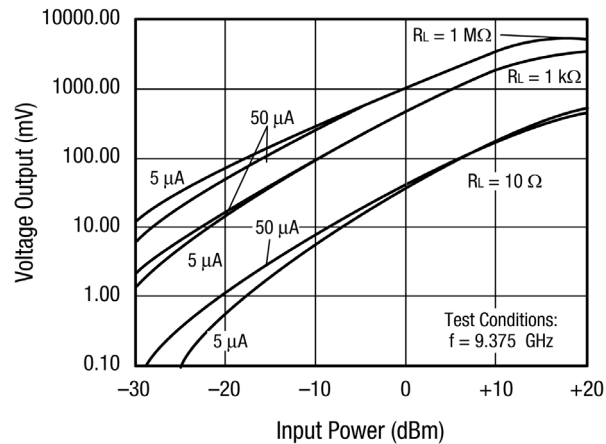
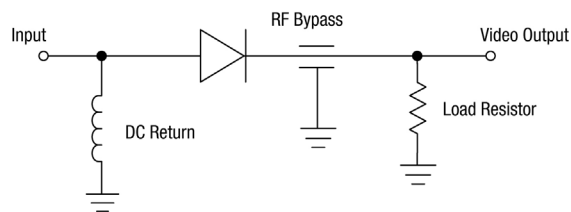
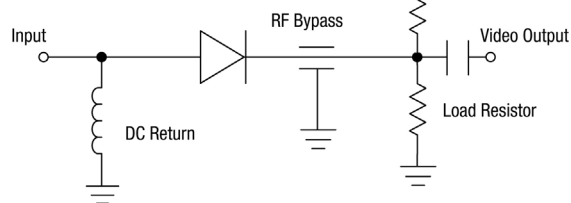


Figure 4. Voltage Output vs Input Power as a Function of Load Resistance and Bias

Unbiased

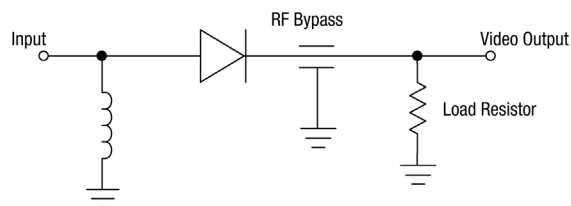


Biased

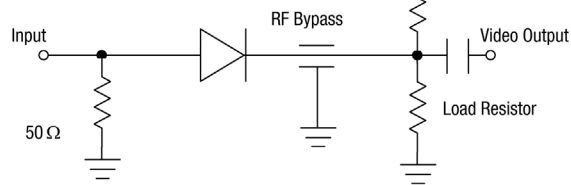


Multi-Octave-High Sensitivity

Unbiased



Biased



Broadband-Low Sensitivity

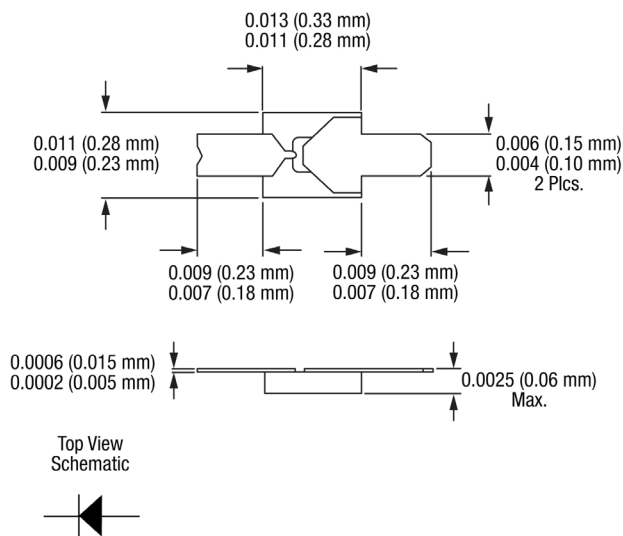
**Figure 5. Typical Video Detector Circuits**

## 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.

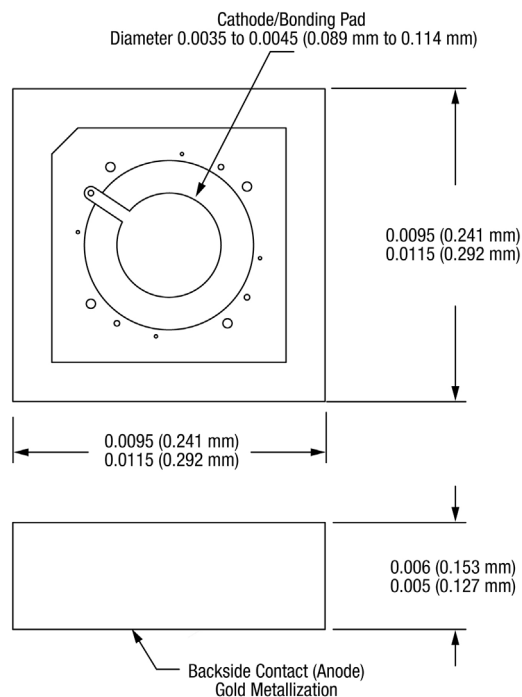
Dimensions are provided in Figures 6, 7, and 8.



Dimensions are in inches (millimeters shown in parentheses)

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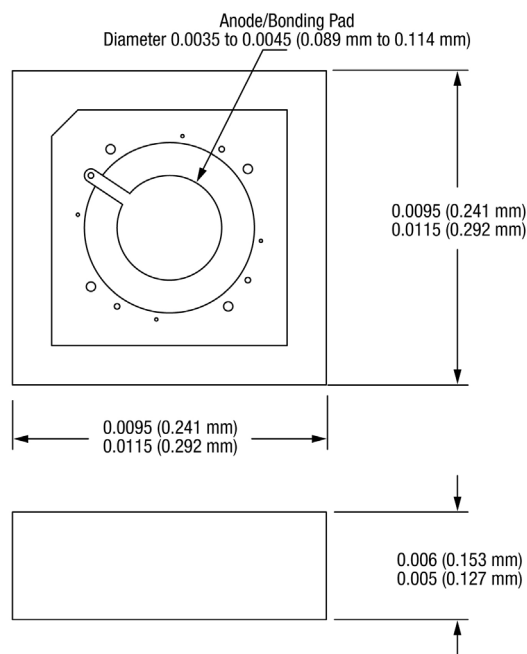
**Figure 6. 491-006 Package Dimensions**



Dimensions are in inches (millimeters shown in parentheses)

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**Figure 7. 571-006 Package Dimensions**



Dimensions are in inches (millimeters shown in parentheses)

200847-008

**Figure 8. 571-011 Package Dimensions**

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