DATA SHEET

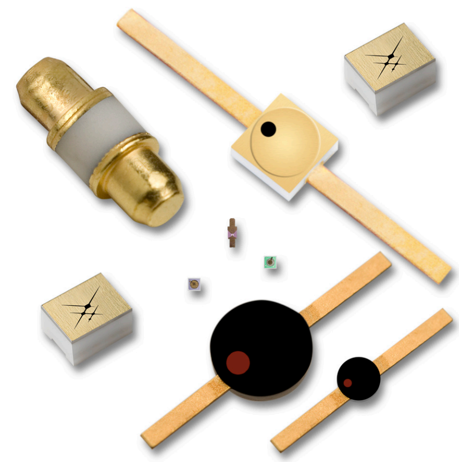
# Silicon Schottky Barrier Diodes: Packaged, Bondable Chips and Beam-Leads

## Applications

- Detectors

## Features

- Both P-type and N-type low barrier silicon available
- Low 1/f noise
- Bonded junctions for reliability
- Planar passivated beam-lead and chip construction
- See also zero bias silicon schottky barrier detector diodes



## Description

Skyworks packaged, beam-lead and chip Schottky barrier detector diodes are designed for applications through 40 GHz in 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 MIC applications. Mounted beam-lead diodes can be easily used in MIC, stripline or other such circuitry.

The "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 will occur at the junction during the wire bonding. Additionally the 4 mil bond pad eliminates performance variation due to bonding and is ideal for automated assembly, and improves efficiency during manual operations as well.

The choice on n- and p-type silicon allows for the designer to optimize the silicon material for the intended application.

- Doppler mixers, high-sensitivity detectors will 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 TSS (Tangential Signal Sensitivity) for detector applications in four frequency ranges: S, X, Ku, and Ka band. 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, to produce an output pulse whose amplitude is 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. 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 in conjunction 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 at as low a level as possible (typically 5–50 microamps). Typical voltage output versus power input as a function of load resistance and bias is shown in Figures 1a and 1b.

## Assembly and Handling Procedure

### Die Attach Methods

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

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

Epoxy die attach with silver or gold filled conductive epoxies can also be used where 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 (0.7–1.25 mil diameter).

## Beam-Lead P-Type Detector Schottky Diodes

| Frequency Band | Part Number | Electrical Characteristics: TSS – dBm[1,2] | Electrical Characteristics: $R_V$ (Ω) | | Electrical Characteristics: $C_J$ @ 0V (pF) | Electrical Characteristics: $V_F$ @ 1 mA (mv) | Electrical Characteristics: $V_B$ @ 10 mA (V) | Test Conditions: Frequency (GHz) | Outline Drawing |
|---|---|---|---|---|---|---|---|---|---|
| | | Typ. | Min. | Max. | Max. | | | | |
| X | DDB2503–000 | 50 | 500 | 700 | 0.15 | 200–350 | 2 | 10 | 491–006 |
| Ku | DDB2504–000 | 48 | 500 | 700 | 0.10 | 200–350 | 2 | 16 | 491–006 |
| K | DDB2265–000 | 50[3] | 800[3] | 1200[3] | 0.10 | 300–450 | 3 | 24.15 | 491–006 |

1. Bias = 50 μA.
2. Video bandwidth = 10 MHz.
3. Bias = 30 μA.

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

| 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 |

## P-Type Detector Schottky Diode Universal Chips

| Frequency Band | Part Number | Electrical Characteristics: TSS – dBm[1,2,4] | Electrical Characteristics: $C_J$ @ 0V (pF) | Electrical Characteristics: $V_F$ @ 1 mA (mv) | Electrical Characteristics: $R_T$ @ 10 mA (Ω) | Electrical Characteristics: $V_B$ @ 10 mA (V) | Outline Drawing |
|---|---|---|---|---|---|---|---|
| | | Min. | Max. | | Max. | Min. | |
| Ku | CDB7620–000 | 40 | 0.15 | 250–350 | 30 | 2 | 571–006 |
| K | CDB7619–000 | 50[3] | 0.10 | 300–450 | 40 | 3 | 571–006 |

1. Bias = 50 μA.
2. Video bandwidth = 10 MHz.
3. Bias = 30 μA.
4. $R_V$ = 2800 Ω.

## Hermetic Packaged P-Type Detector Schottky Diode Chips

| Hermetic Pill 207 | Hermetic Pill 203 | Hermetic 109 |
|---|---|---|
| CDB7620-207 | CDB7620-203 | SMS7620-109 |
| CDB7619-207 | CDB7619-203 | SMS7619-109 |

## N-Type Detector Schottky Diode Chips

| Frequency Band | Part Number | Electrical Characteristics | | | | | |
|---|---|---|---|---|---|---|---|
| | | Barrier | $V_F$ @ 1 mA (mv) | Max. $C_J$ @ 0V (pF) | Max. $R_T$ @ 10 mA (Ω) | Min. $V_B$ @ 10 µA (V) | Outline Drawing Number |
| X | CDF7623–000 | Low | 240–300 | 0.30 | 10 | 2 | 571-011 |
| K | CDF7621–000 | Low | 270–350 | 0.10 | 20 | 2 | 571-011 |
| Ku | CME7660–000 | Med | 350–450 | 0.15 | 10 | 3 | 571-011 |
| K | CDE7618–000 | Med | 375–500 | 0.10 | 20 | 3 | 571-011 |
| Ku | CDP7624–000 | Med/High | 450–575 | 0.15 | 15 | 3 | 571-011 |

## Hermetic Packaged Beam-Lead N-Type Detector Schottky Diode Chips

| Hermetic Ceramic Pill 207 | Hermetic Ceramic Pill 203 | Hermetic Surface Mount 108 |
|---|---|---|
| CDF7623-207 | CDF7623-203 | SMS7623-108 |
| CDF7621-207 | CDF7621-203 | SMS7621-108 |
| CME7660-207 | CME7660-203 | SMS7660-108 |
| CDE7618-207 | CDE7618-203 | SMS7618-108 |
| CDP7624-207 | CDP7624-203 | SMS7624-108 |

## SPICE Model Parameters

| Parameter | Unit | Part Number | | | |
|---|---|---|---|---|---|
| | | CDF7620-000 | CDF7621-000 | CDC7623-000 | CDB7619-000 |
| $I_S$ | A | 4e–08 | 9e–08 | 1.1e–7 | 3e–08 |
| $R_S$ | Ω | 4 | 6 | 5 | 30 |
| n | – | 1.2 | 1.1 | 1.1 | 1.04 |
| $T_D$ | s | 1e–11 | 1e–11 | 1e–11 | 1e–11 |
| $C_{J0}$ | pF | 0.15 | 0.11 | 0.2 | 0.11 |
| m | – | 0.35 | 0.3 | 0.3 | 0.32 |
| $E_G$ | eV | 0.69 | 0.69 | 0.69 | 0.69 |
| $V_J$ | V | 0.495 | 0.51 | 0.51 | 0.54 |
| $X_{TI}$ | – | 2 | 2 | 2 | 2 |
| FC | – | 0.5 | 0.5 | 0.5 | 0.5 |
| $B_V$ | V | 10 | 2.5 | 2.5 | 3 |
| $I_{BV}$ | A | 1e–05 | 1e–05 | 1e–05 | 1e–05 |

## Shipping Information

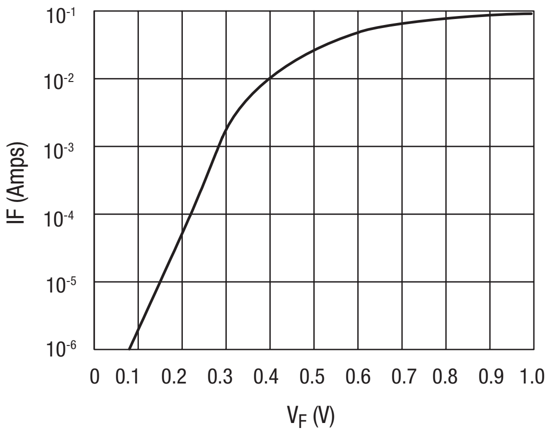
### Individual Chips

Standard packaging procedures at Skyworks are for “waffle pack” delivery. Devices can also be packaged on “Gel Pack” carriers.

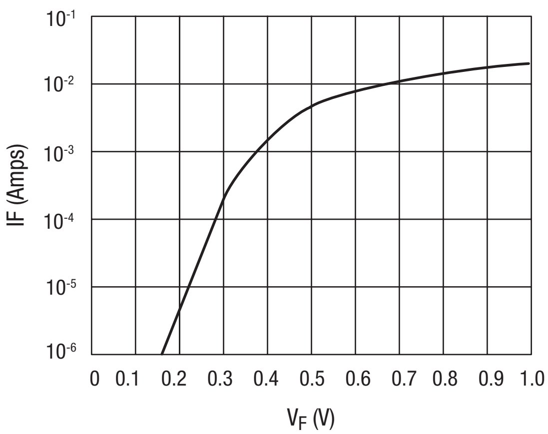
### Wafer Shipment for Whole Wafer

Packaging options include delivery for devices on film frame where wafer is sawn on wafer gel pack for uncut, unsawn wafer.

## Typical I-V Characteristics




**CDF7621-000**




**CDB7619-000**

## Typical Performance Data

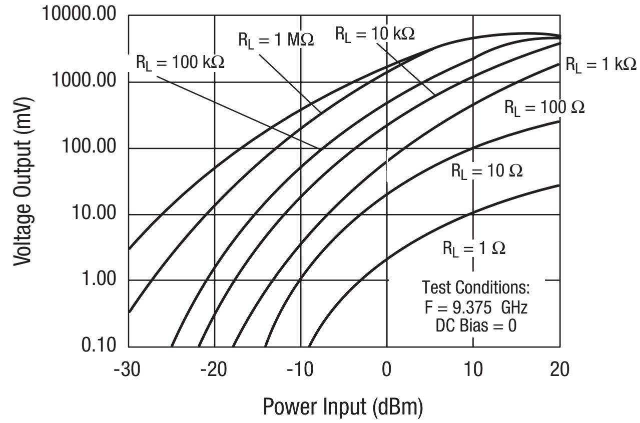



**Figure 1a. Voltage Output vs. Power Input As a Function of Load Resistance**

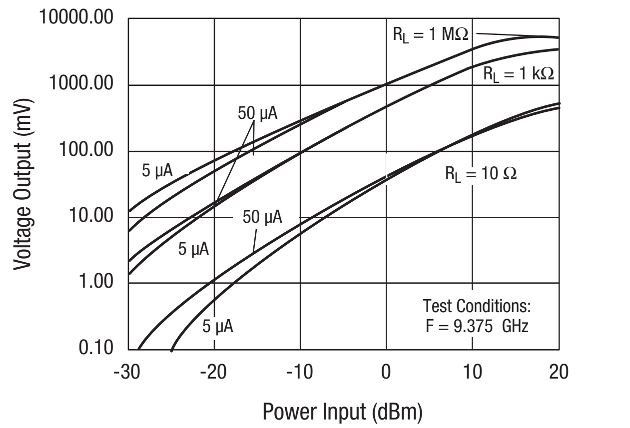
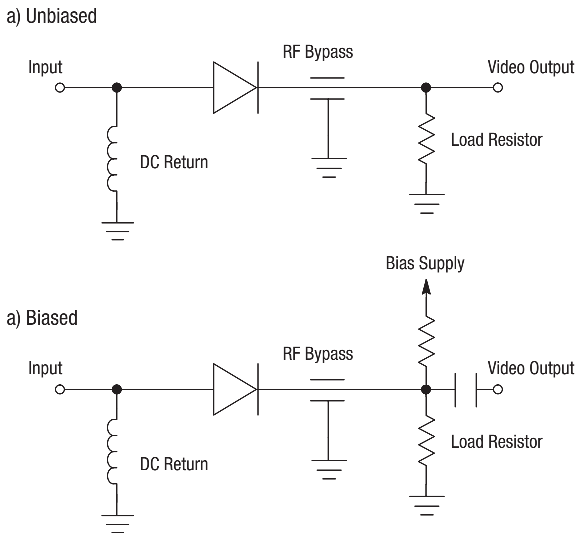
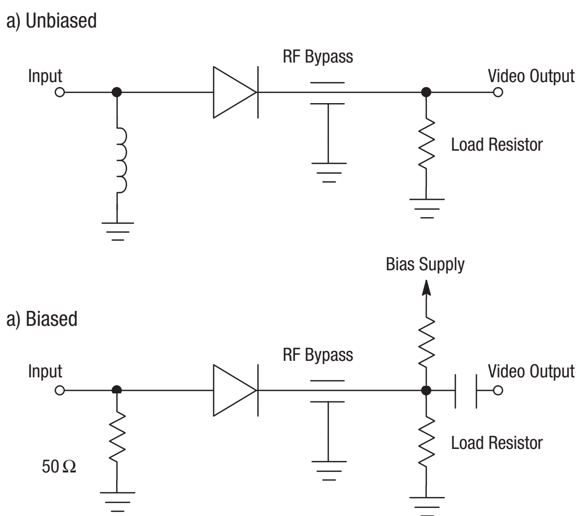



**Figure 1b. Voltage Output vs. Power Input As a Function of Load Resistance and Bias**



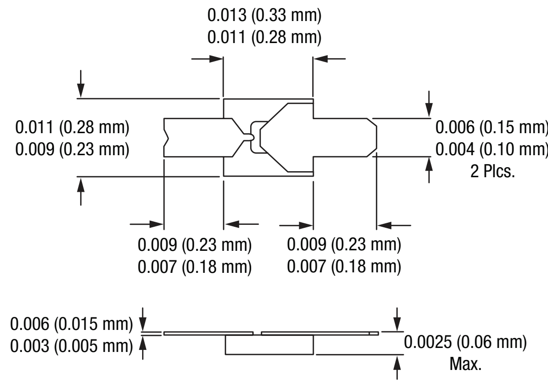

Multi-Octave–High Sensitivity




Broadband–Low Sensitivity

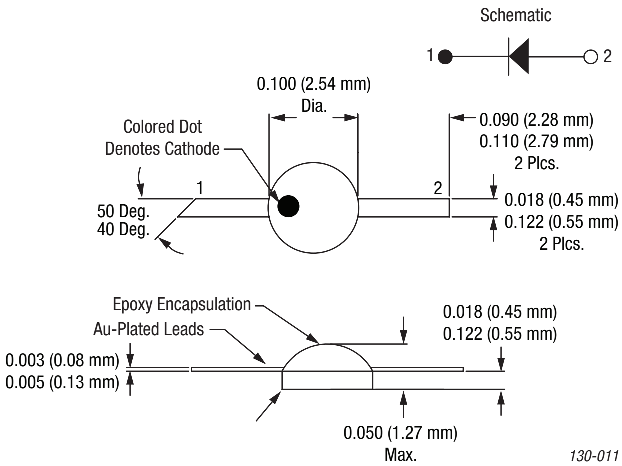
**Figure 2. Typical Video Detector Circuits**

## 491–006




Top View
Schematic

## -250

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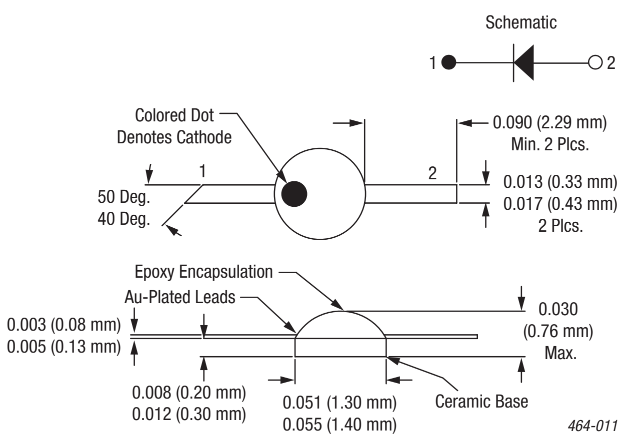


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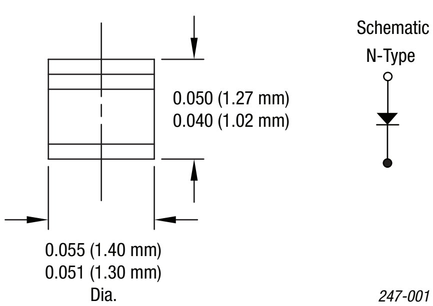


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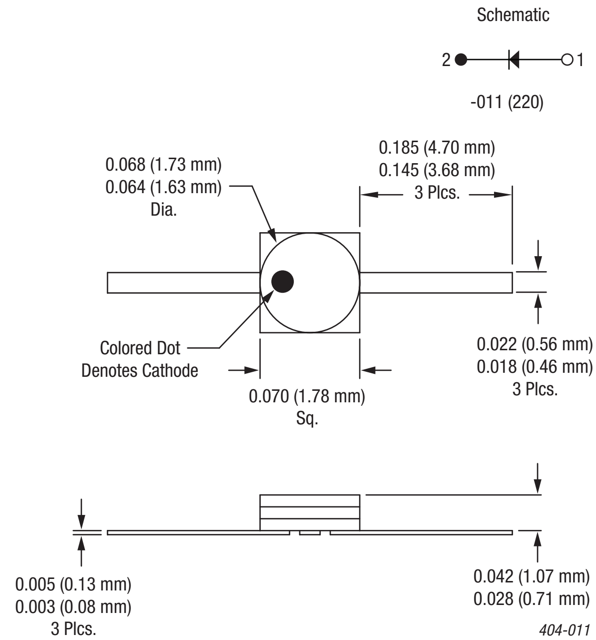


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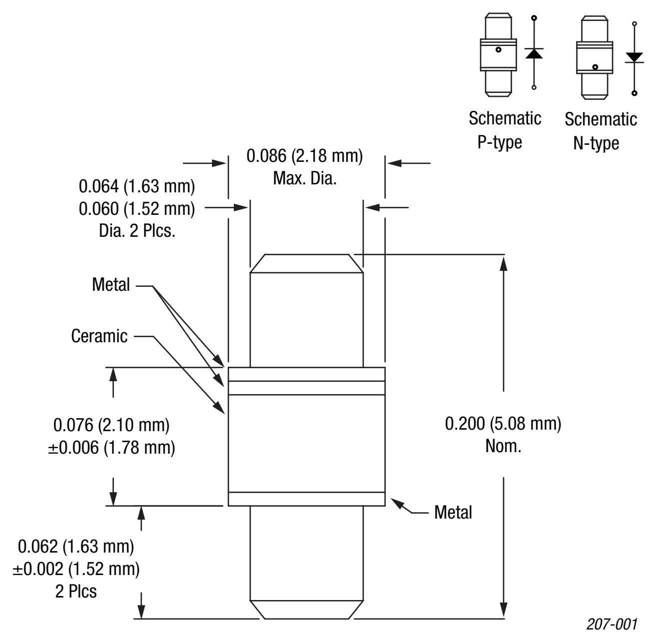

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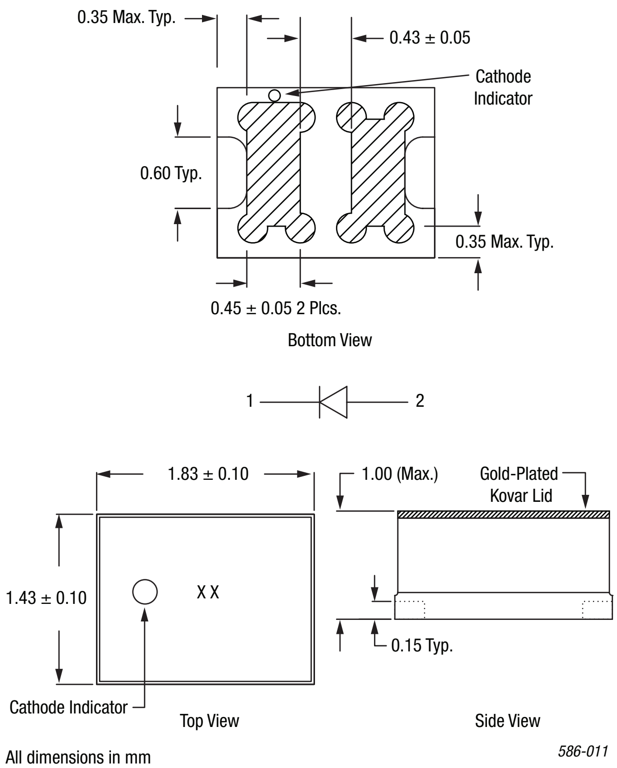


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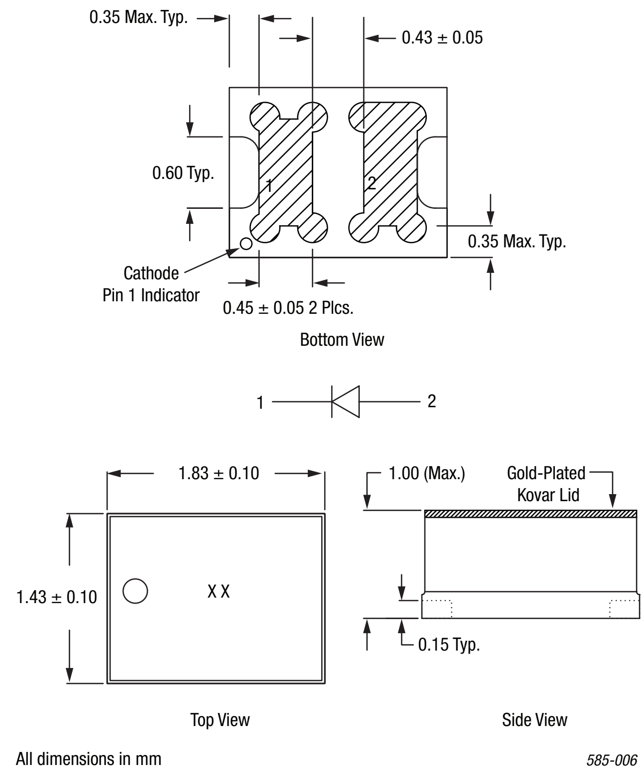
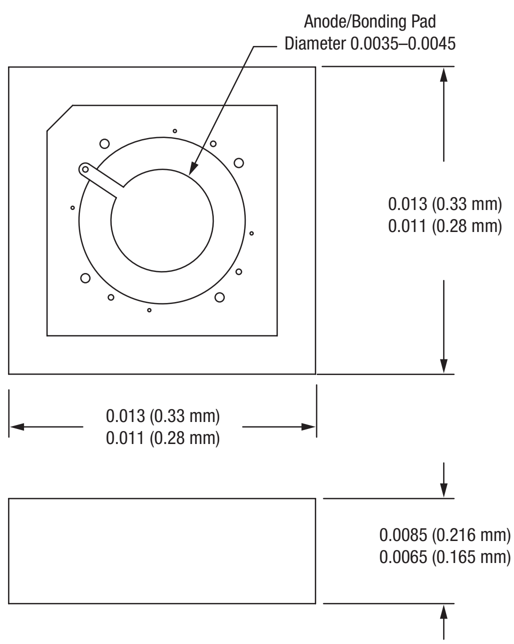



## 571-011




## 571–006