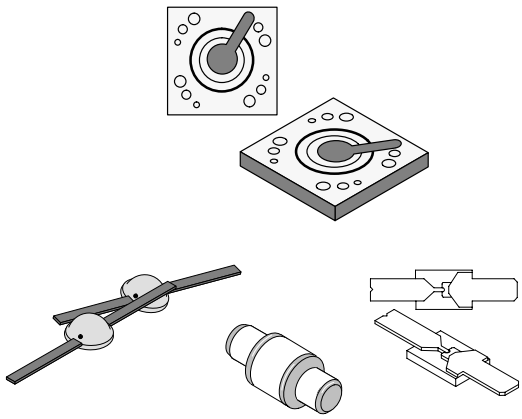
Silicon Schottky Barrier Detector Diodes

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

Alpha 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.

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

The 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. RF parameters on chips and beam–lead diodes are tested on a sample basis, while breakdown voltage and capacitance measurements are 100% tested. Packaged diodes are 100% RF tested.

TSS is the one parameter that best describes a diode's use as a video detector. It is defined as the amount of signal power, below a one milliwatt reference level, required 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 Schottky barrier diodes in this data sheet are of P–type construction and are optimized for low noise, particularly in the 1/f region. They require a small forward bias (to overcome the barrier potential) if efficient operation is required, especially at power levels below –20 dBm. Bias not only increases sensitivity but also greatly reduces parameter variation due to temperature change. Video impedance is a direct function of bias and closely follows the 28/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 noise, particularly in the 1/f region. Therefore, it should be kept at as low a level as possible (typically 5–50 microamps).

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

All 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 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.

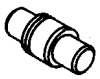
Wire Bonding

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

- Thermocompression
- Ballbonding

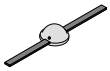
Alpha recommends use of pure gold wire (0.7 – 1.25 mil diameter).

Electrical Specifications at 25°C
"P" Type Detectors



207

220



250

Beam–Lead

Frequency Band	Part Number	Electrical Characteristics								Test Conditions	Outline Drawing Number
		TSS – dBm[1,2]	Z_{IF} (Ohms)		Gamma (λ)	C_J @ 0V (pF)	V_F @ 1 mA (mv)	R_T @ 10 mA (Ohms)	V_B @ 10 μA (V)	Frequency GHz	
		Min.	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

Chip

Ku	CDB7620–000	40	500	700	8000	0.15	250–350	30	2	16	526–006
K	CDB7619–000	50[3]	500	700	5000	0.10	300–450	40	3	24.15	526–006

Packaged Diodes

Ku	CDB7620–207	40	500	700	8000	0.15	300–350	30	2	16	207
K	CDB7619–207	50	500	700	5000	0.10	300–450	40	3	24.15	207
X	DDB2503–250	50	500	700		0.15	200–350		2	10	250
Ku	DDB2504–250	48	500	700		0.10	200–350		2	16	250
K	DDB2265–250	50[3]	800[3]	1200[3]		0.10	300–450	40	3	24.15	250
K	DDB2265–220	50[3]	800[3]	1200[3]		0.10	300–450	40	3	24.15	220

"N" Type Detectors

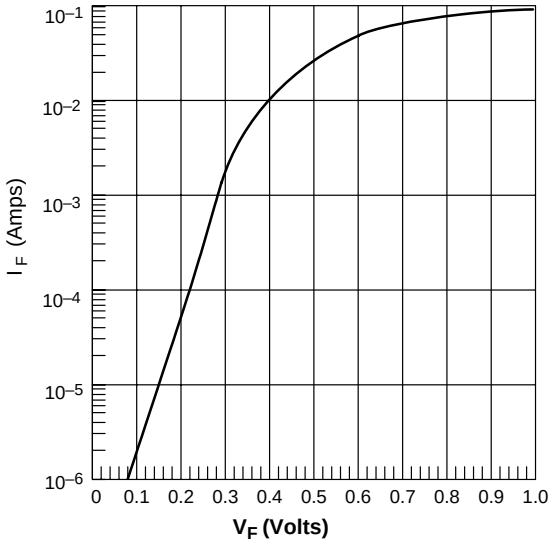
Frequency Band	Part Number	Electrical Characteristics				
		Drive Level	V_F @ 1 mA (mv)	C_J @ 0V (pF)	R_T @ 10 mA (Ohms)	V_B @ 10 uA (V)
				Max.		
X	CDF7623–000	Low	240–300	0.30	10	2
K	CDF7621–000	Low	270–350	0.10	20	2
Ku	CME7660–000	Med	350–450	0.15	10	3
K	CDE7618–000	Med	375–500	0.10	20	3
Ku	CDP7624–000	Med/High	450–575	0.15	15	3

1. Bias = 50 μA.
2. Video Bandwidth = 10 MHz.
3. Bias = 30 μA.
4. R_V = 2800 Ohms.

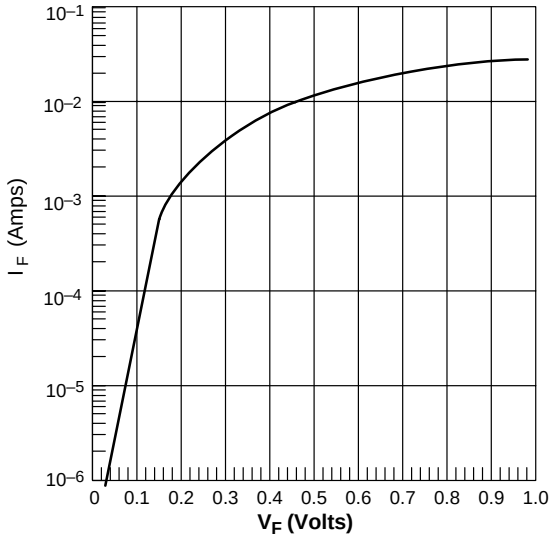
Spice Model Parameters

Parameter	Unit	Part Number		
		CDF7621–000	CDC7630–000	CDB7619–000
I_S	A	8E–08	3E–06	3E–09
R_S	Ohm	6	26	26
n	–	1.04	1.04	1.04
T_D	s	1E–11	1E–11	1E–11
C_J0	pF	0.11	0.1	0.11
m	–	0.3	0.25	0.32
E_G	eV	0.69	0.69	0.69
V_J	–	0.51	0.34	0.54
X_{TI}	–	2	2	2
FC	–	0.5	0.5	0.5
B_V	V	2.5	2	3
IBV	A	1E–05	0.001	1E–05

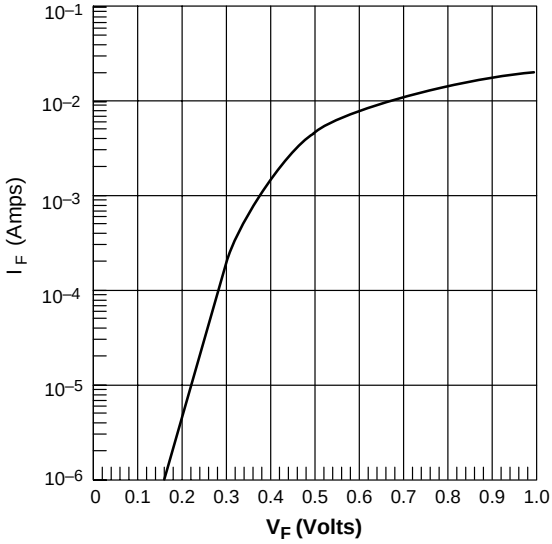
Typical I–V Characteristics



CDF7621–000



CDC7630–000



CDB7619–000

Shipping Information

Individual Chips

Standard packaging procedures at Alpha are for “wafflepack” delivery. Devices can also be packaged on “GelPack” 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 Performance Data

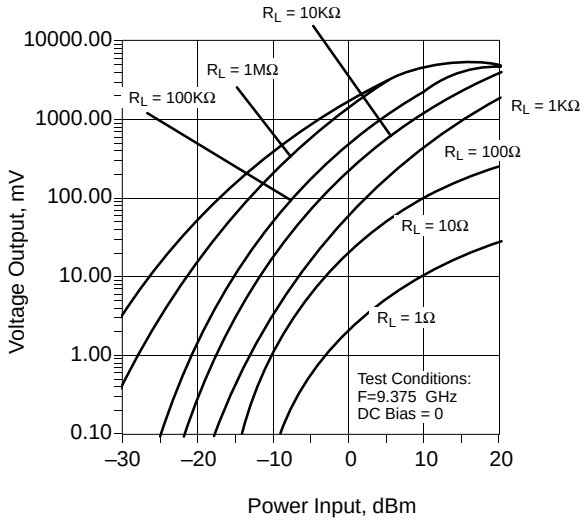


Figure 1a. Voltage Output vs. Power Input as a Function of Load Resistance

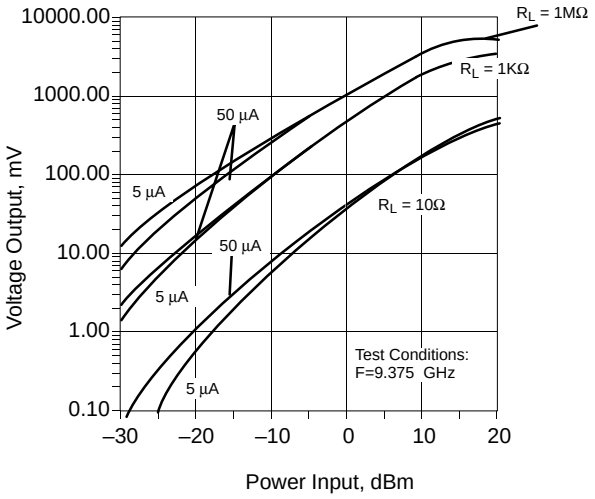
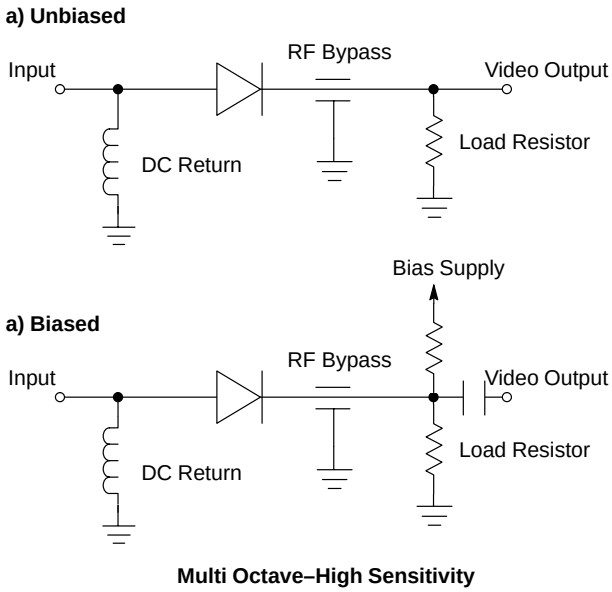
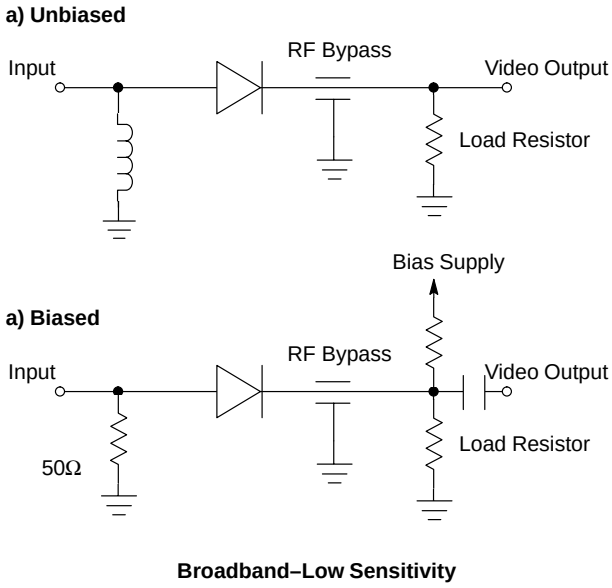


Figure 1b. Voltage Output vs. Power Input as a Function of Load Resistance and Bias



Multi Octave–High Sensitivity



Broadband–Low Sensitivity

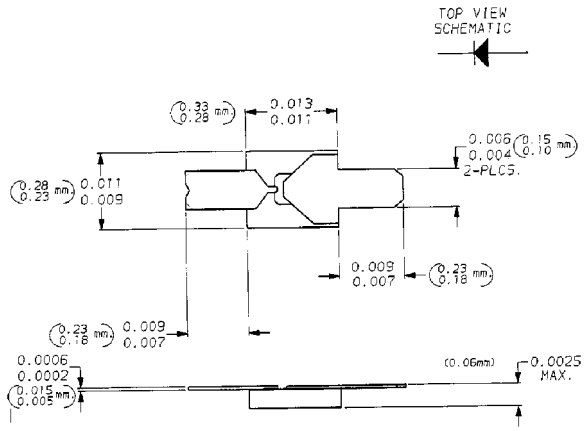
Figure 2. Typical Video Detector Circuits

Frequency Table

Band	Frequencies (GHz)
UHF	Up to 1
L	1 – 2
S	2 – 4
C	4 – 8
X	8.2 – 12.4
Ku	12.4 – 18
K	18.0 – 26.5
Ka	26.5 – 40
mm	40 – 100

Outline Drawings

491–006



526–006, 526–011

526–006 = Cathode Bond Pad
526–011 = Anode Bond Pad