HEWLETT® PACKARD

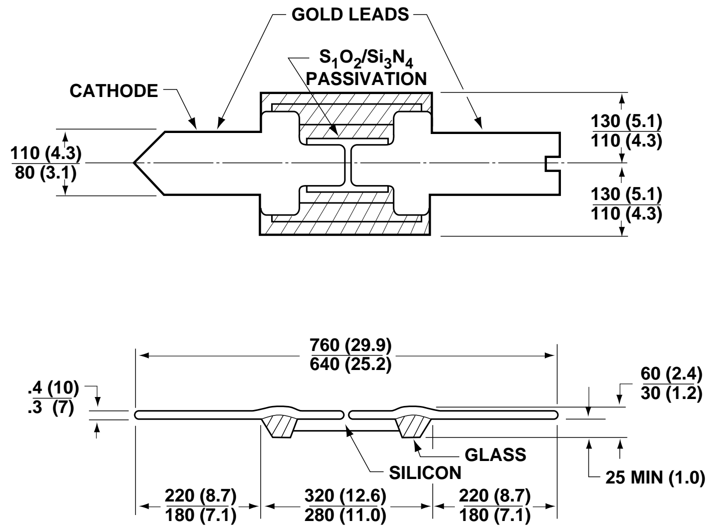
Beam Lead PIN Diode

Technical Data

HPND-4005

Features

- **High Breakdown Voltage 120 V Typical**
- **Low Capacitance 0.017 pF Typical**
- **Low Resistance 4.7 Ω Typical**
- **Rugged Construction 4 Grams Minimum Lead Pull**
- **Nitride Passivated**



Outline 21

Description

The HPND-4005 planar beam lead PIN diode is constructed to offer exceptional lead strength while achieving excellent electrical performance at high frequencies. High beam strength offers users superior assembly yield, while extremely low capacitance allows high isolation to be realized.

Nitride passivation and polyimide coating provide reliable device protection.

Applications

The HPND-4005 beam lead PIN diode is designed for use in stripline or microstrip circuits. Applications include switching, attenuating, phase shifting, limiting, and modulating at microwave frequencies. The extremely low capacitance of the HPND-4005 makes it ideal for circuits requiring high isolation in a series diode configuration.

Maximum Ratings

Operating Temperature .... -65°C to +175°C
Storage Temperature .... -65°C to +200°C
Power Dissipation at T_{CASE} = 25°C .... 250 mW
(Derate linearly to zero at 175°C.)
Minimum Lead Strength .... 4 grams pull on either lead
Diode Mounting Temperature .... 220°C for 10 sec. max.

5965-8877E

Electrical Specifications at T_A = 25°C

Part Number HPND-	Breakdown Voltage V_{BR} (V)		Series Resistance R_S (Ω)[2]		Capacitance C_T (pF)[1,2]		Forward Voltage V_F (V)	Reverse Current I_R (nA)	Minority Carrier Lifetime τ (ns)[2]	
	Min.	**Typ.**	**Typ.**	**Max.**	**Typ.**	**Max.**	**Max.**	**Max.**	**Min.**	**Typ.**
4005	100	120	4.7	6.5	0.017	0.02	1.0	100	50	100
Test Conditions	I_R = 10 mA		I_F = 20 mA I_F = 100 MHz		V_R = 10 V f = 10 GHz		I_F = 20 mA	V_R = 30 V	I_F = 10 mA I_R = 6 mA	

Notes:
1. Total capacitance calculated from measured isolation value in a series configuration.
2. Test performed on packaged samples.

Typical Parameters

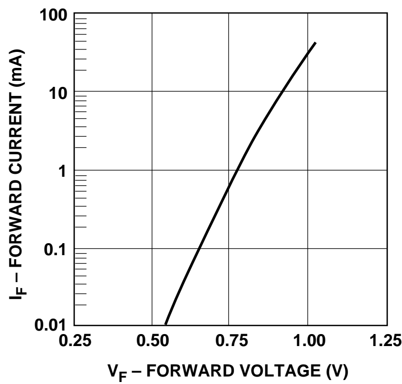


Figure 1. Typical Forward Conduction Characteristics.

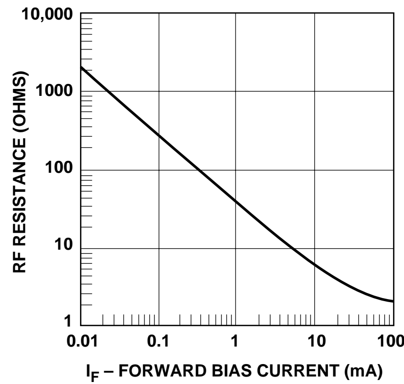


Figure 2. Typical RF Resistance vs. Forward Bias Current.

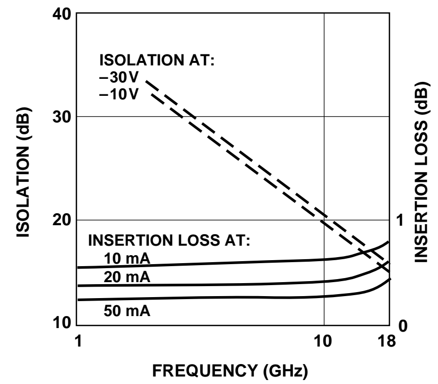


Figure 3. Typical Isolation and Insertion Loss in the Series Configuration (Z_O = 50 Ω).

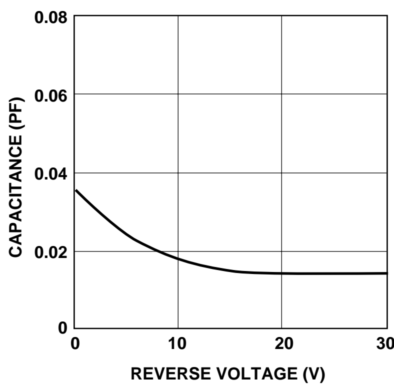


Figure 4. Typical Capacitance at 10GHz vs. Reverse Bias.

Bonding and Handling Procedures for Beam Lead Diodes

1. Storage
Under normal circumstances, storage of beam lead diodes in HP supplied waffle/gel packs is sufficient. In particularly dusty or chemically hazardous environments, storage in an inert atmosphere desiccator is advised.

2. Handling
In order to avoid damage to beam lead devices, particular care must be exercised during inspection, testing, and assembly. Although the beam lead diode is designed to have exceptional lead strength, its small size and delicate nature requires that special handling techniques be observed so that the devices will not be mechanically or electrically damaged. A vacuum pickup is recommended for picking up beam lead devices, particularly larger ones, e.g., quads. Care must be exercised to assure that the vacuum opening of the needle is sufficiently small to avoid passage of the device through the opening. A #27 tip is recommended for picking up single beam lead devices. A 20X magnification is needed for precise positioning of the tip on the device. Where a vacuum pickup is not used, a sharpened wooden Q-tip dipped in isopropyl alcohol is very commonly used to handle beam lead devices.

3. Cleaning
For organic contamination use a warm rinse of trichloroethane, or its locally approved equivalent, followed by a cold rinse in acetone and methanol. Dry under infrared heat lamp for 5–10 minutes on clean filter paper. Freon degreaser, or its locally approved equivalent, may replace trichloroethane for light organic contamination.

- Ultrasonic cleaning is not recommended.
- Acid solvents should not be used.

4. Bonding
Thermocompression: See Application Note 979 "The Handling and Bonding of Beam Lead Devices Made Easy". This method is good for hard substrates only.

Wobble: This method picks up the device, places it on the substrate and forms a thermocompression bond all in one operation. This is described in the latest version of MIL-STD-883, Method 2017, and is intended for hard substrates only.

Resistance Welding or Parallel-GAP Welding: To make welding on soft substrates easier, a low pressure welding head is recommended. Suitable equipment is available from HUGHES, Industrial Products Division in Carlsbad, CA.

Epoxy: With solvent free, low resistivity epoxies (available from ABLESTIK and improvements in dispensing equipment, the quality of epoxy bonds is sufficient for many applications.

5. Lead Stress
In the process of bonding a beam lead diode, a certain amount of "bugging" occurs. The term *bugging* refers to the chip lifting away from the substrate during the bonding process due to the deformation of the beam by the bonding tool. This effect is beneficial as it provides stress relief for the diode during thermal cycling of the substrate. The coefficient of expansion of some substrate materials, specifically soft substrates, is such that some bugging is essential if the circuit is to be operated over wide temperature extremes.

Thick metal clad ground planes restrict the thermal expansion of the dielectric substrates in the X-Y axis. The expansion of the dielectric will then be mainly in the Z axis, which does not affect the beam lead device. An alternate solution to the problem of dielectric ground plane expansion is to heat the substrate to the maximum required operating temperature during the beam lead attachment. Thus, the substrate is at maximum expansion when the device is bonded. Subsequent cooling of the substrate will cause bugging, similar to bugging in thermocompression bonding or epoxy bonding. Other methods of bugging are preforming the leads during assembly or prestressing the substrate.