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Innovating the HP Way

GaAs Beam Lead Schottky Barrier Ring and Bridge Diodes

Technical Data

HSCH-9301
HSCH-9351

Features

- **Gold Tri-Metal System** For Improved Reliability
- **Low Capacitance**
- **Low Series Resistance**
- **High Cutoff Frequency**
- **Polyimide Passivation**

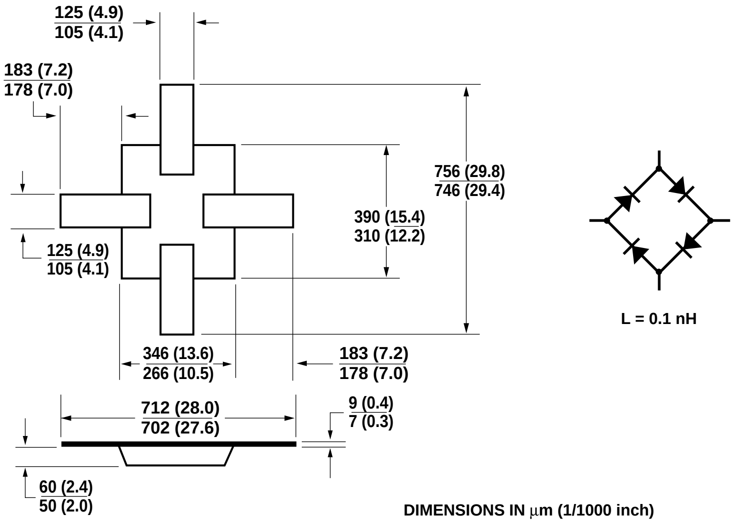
Description

The HSCH-9301 ring quad and the HSCH-9351 bridge quad are advanced gallium arsenide Schottky barrier diodes. These devices are fabricated utilizing molecular beam epitaxy (MBE) manufacturing techniques and feature rugged construction and consistent electrical performance. A polyimide coating provides scratch protection and resistance to contamination.

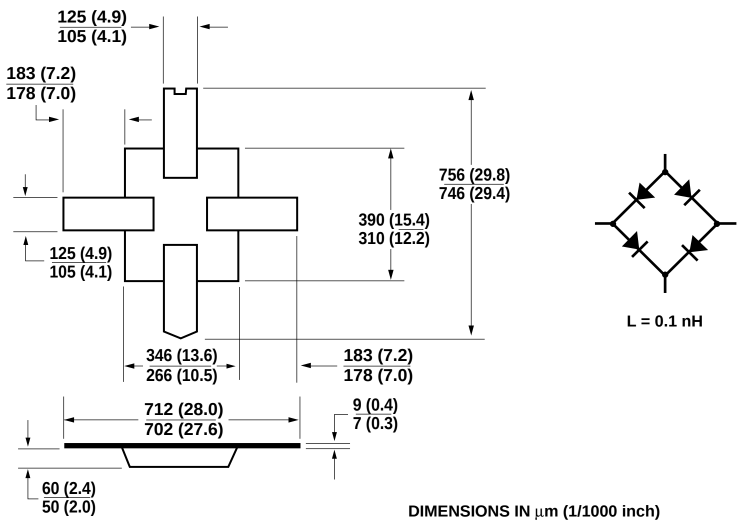
Applications

This line of Schottky diodes is optimized for use in mixer applications at millimeter wave frequencies. Some suggested mixer types are double balanced for the ring quad and biased double balanced for the bridge quad. The bridge quad can also be used in sampling circuits.

HSCH-9301 (Junction Side Up)



HSCH-9351 (Junction Side Up)



Assembly Techniques

Thermocompression bonding is recommended. Welding or conductive epoxy may also be used. For additional information see Application Note 979, “The Handling and Bonding of Beam Lead Devices Made Easy,” or Application Note 992, ”Beam Lead Attachment Methods,” or Application Note 993, “Beam Lead Device Bonding to Soft Substrates.”

GaAs diodes are ESD sensitive. Proper precautions should be used when handling these devices.

Maximum Ratings

Power Dissipation at T_{LEAD} = 25°C .... 75 mW per junction
Measured in an infinite heat sink derated linearly to zero at maximum rated temperature
Operating Temperature ....-65°C to +150°C
Storage Temperature ....-65°C to +150°C
Mounting Temperature ....235°C for 10 seconds
Minimum Lead Strength .... 6 grams

Electrical Specifications at T_A = 25°C

Part Number			HSCH-9301			HSCH-9351		
Symbol	**Parameters and Test Conditions**	**Units**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
C_M	Measured Capacitance V_R = 0 V, f = 1 MHz	pF		0.075	0.100		0.075	0.100
C_{TA}	Total Adjacent Capacitance V_R = 0 V, f = 1 MHz	pF		0.110			0.110	
C_{TD}	Total Diagonal Capacitance V_R = 0 V, f = 1 MHz	pF		0.075			0.075	
ΔC_M	Measured Capacitance Difference V_R = 0 V, f = 1 MHz	pF		0.015	0.025		0.015	0.025
R_S	Series Resistance	Ω			6			6
V_F	Forward Voltage I_F = 1 mA	mV		700	800		700	800
ΔV_F	Forward Voltage Difference I_F = 1 mA	mV			20			20
V_{BR}	Reverse Breakdown Voltage $V_R = V_{BR}$ measure $I_R \leq 10\ \mu A$ (per junction)	V				4.5		

Typical Parameters

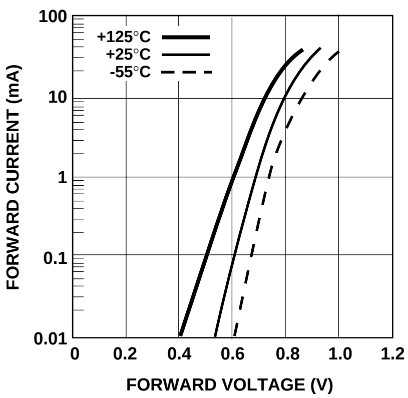


Figure 1. Typical Forward Characteristics for HSCH-9301, HSCH-9351.

SPICE Parameters

Parameter	Units	HSCH-9XXX
B_V	V	5
C_{J0}	pF	0.04
E_G	eV	1.43
I_{BV}	A	10E-5
I_S	A	1.6 x 10E-13
N		1.20
R_S	Ω	5
P_B	V	0.7
P_T		2
M		0.5

Dynamic and Series Resistance

Schottky diode resistance may be expressed as series resistance, R_S, or as dynamic resistance, R_D. These two terms are related by the equation

$$R_D = R_S + R_j$$

where R_j is the resistance of the junction. Junction resistance of a diode with DC bias is quite accurately calculated by

$$R_j = 26/I_B$$

where I_B is the bias current in milliamperes. The series resistance is independent of current.

The dynamic resistance is more easily measured. If series resistance is specified it is usually obtained by subtracting the calculated junction resistance from the measured dynamic resistance.

Quad Capacitance

Capacitance of Schottky diode quads is measured using an HP4271 LCR meter. This instrument effectively isolates individual diode branches from the others, allowing accurate capacitance measurement of each branch or each diode. The conditions are: 20 mV R.M.S. voltage at 1 MHz. Agilent defines this measurement as “C_M,” and it is equivalent to the capacitance of the diode by itself. The equivalent diagonal and adjacent capacitances can then be calculated by the formulas given below.

In a quad, the diagonal capacitance is the capacitance between points A and B as shown in Figure 2. The diagonal capacitance is calculated using the following formula

$$C_{DIAGONAL} = \frac{C_1 \times C_2}{C_1 + C_2} + \frac{C_3 \times C_4}{C_3 + C_4}$$

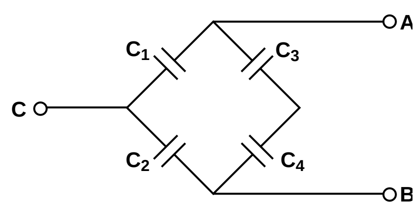


Figure 2.

The equivalent capacitance is the capacitance between points A and C in Figure 2. This capacitance is calculated using the following formula

$$C_{ADJACENT} = C_1 + \frac{1}{\frac{1}{C_2} + \frac{1}{C_3} + \frac{1}{C_4}}$$

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Bonding and Handling Procedures for Beam Lead Diodes

1. Storage

Under normal circumstances, storage of beam lead diodes in Agilent-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 followed by a cold rinse in acetone and methanol. Dry under infrared heat lamp for 5-10 minutes on clean filter paper. Freon degreaser may replace trichloroethane for light organic contamination.

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

4. Bonding

See Application Note 992, “Beam Lead Attachment Methods”, for a general description of the various methods for attaching beam lead diodes to both hard and soft substrates.

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 MIL-STD-883, Method 2017 and is intended for hard substrates only. Equipment specifically designed for beam lead wobble bonding is available from KULICKE and SOFFA in Horsham, PA.

Ultrasonic: Not recommended.

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.

For more information, see Application Note 993, “Beam Lead Diode Bonding to Soft Substrates”.

Epoxy: With solvent free, low resistivity epoxies (available from ABLESTIK in Gardena, CA, MICON in Lexington, MA, and many others) and improvements in dispensing equipment, the quality of epoxy bonds is sufficient for many applications. Equipment is available from ADVANCED SEMICONDUCTOR MATERIALS AMERICA, INC., Assembly Products Group in Chandler, AZ (Automatic), and WEST BOND in Orange, CA (Manual).

Reflow: Not recommended.

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