Hermetic PIN Diodes for Stripline/Microstrip Switches/ Attenuators

Technical Data

5082-3140
5082-3141

Features

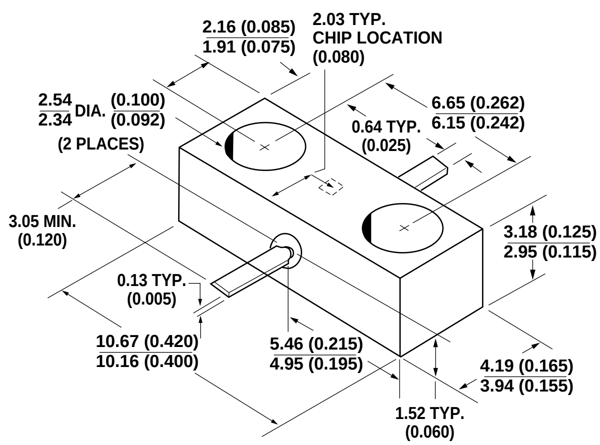
- **Broadband Operation**
  HF through X-Band
- **Low Insertion Loss**
  Less than 0.5 dB to 10 GHz (5082-3140)
- **High Isolation**
  Greater than 20 dB to 10 GHz (5082-3140)
- **Fast Switching/Modulation**
  5 ns Typical (5082-3141)
- **Low Drive Current Required**
  Less than 20 mA for 20 dB Isolation (5082-3141)

Description/Applications

The HP 5082-3140 is a passivated planar device and the 5082-3141 is a passivated mesa device. Both are in a shunt configuration in hermetic stripline packages. These diodes are optimized for good continuity of characteristic impedance which allows a continuous transition when used in 50 Ω microstrip or stripline circuits.

These diodes are designed for applications in microwave and HF-UHF systems using stripline or microstrip transmission line techniques.

Outline 60



DIMENSIONS IN MILLIMETERS AND (INCHES)

Maximum Ratings

Part No. 5082-	-3140	-3141
Junction Operating and Storage Temperature Range	-65°C to +150°C	-65°C to +150°C
Power Dissipation [1]	1.75 W	0.75 W
Peak Incident Pulse Power [2]	225 W	50 W
Peak Inverse Voltage	150 V	70 V
Soldering Temperature	230°C for 5 sec.	

Notes:
1. Device properly mounted in sufficient heat sink at 25°C, derate linearly to zero at maximum operating temperature.
2. $t_p = 1\ \mu s$, f = 10 GHz, Du = 0.001, $Z_O = 50\ \Omega$, $T_A = 25°C$.

5965-8882E

Typical circuit functions performed consist of switching, duplexing, multiplexing, leveling, modulating, limiting, or gain control functions as required in TR switches, pulse modulators, phase shifters, and amplitude modulators operating in the frequency range from HF through Ku-Band. These diodes provide nearly ideal transmission characteristics from HF through Ku-Band.

The 5082-3141 is recommended for applications requiring fast switching or high frequency modulation of microwave signals, or where the lowest bias current for maximum attenuation is required.

More information is available in HP Application Note 922 (Applications of PIN Diodes) and 929 (Fast Switching PIN Diodes).

Mechanical Specifications

Package Outline 60 is hermetically sealed and capable of meeting the stringent requirements of space level high reliability testing. Both the package and lead materials are gold plated Kovar.

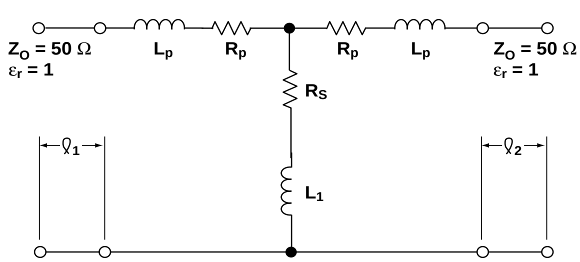
Electrical Specifications at $T_A = 25°C$

Part Number 5082-	Package Outline	Heat Sink	Min. Isolation (dB)	Max. Insertion Loss (dB)	Max. SWR	Max. Reverse Recovery Time t_{rr} (ns)	Typical Carrier Lifetime τ (ns)	Typical CW Power Switching Capability P_A (W)
3140	60	Anode	20	0.5	1.5	–	400	30
3141	60	Cathode	20	1.0	1.5	10	35*	13
Test[1] Conditions	–	–	$I_F = 100$ mA (Except 3141; $I_F = 20$ mA)	$I_F = 0$ $P_{in} = 1$ mW	$I_F = 0$ $P_{in} = 1$ mW	$I_F = 20$ mA $V_R = 10$ V Recovery to 90%	$I_F = 50$ mA $I_R = 250$ mA *$I_F = 10$ mA *$I_R = 6$ mA	–

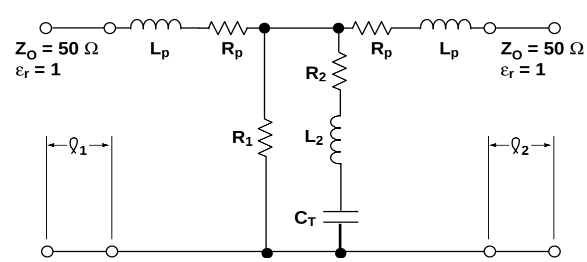
Note:
1. Test Frequencies: 8 GHz 5082-3141; 10 GHz 5082-3140.

Equivalent Circuits

Forward Bias (Isolation State)



Zero Bias (Insertion Loss State)



Typical Parameters

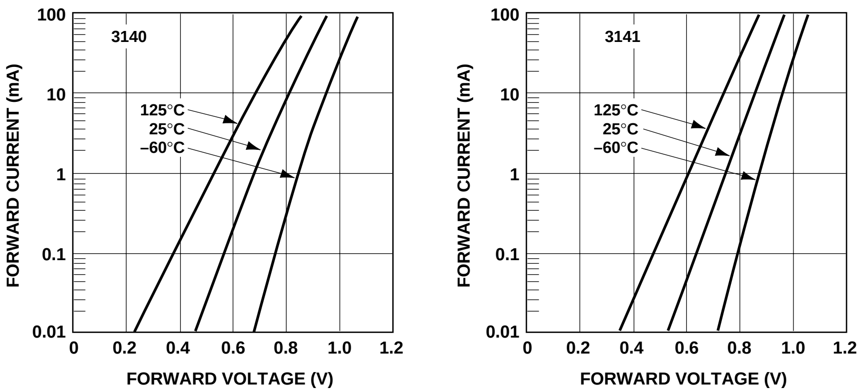


Figure 1. Typical Forward Characteristics.

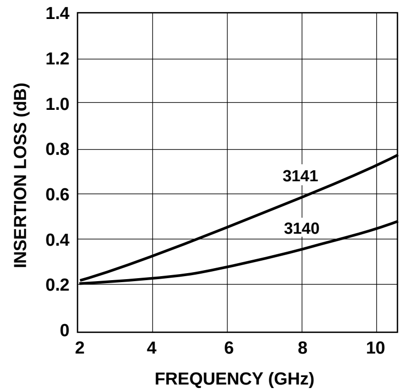


Figure 2. Typical Insertion Loss vs. Frequency.

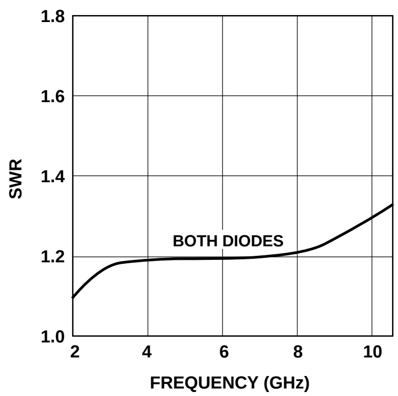


Figure 3. Typical SWR vs. Frequency.

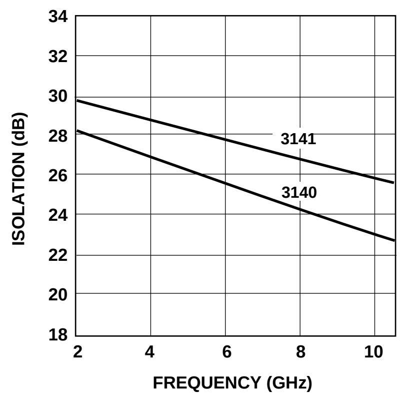


Figure 4. Typical Isolation vs. Frequency.

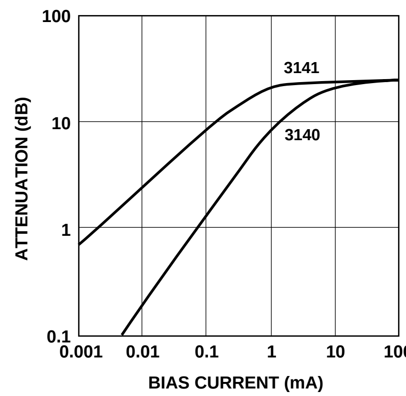


Figure 5. Typical Attenuation Above Zero Bias Insertion Loss vs. Bias Current at f = 8 GHz.

Typical Equivalent Circuit Parameters–Forward Bias

Part Number 5082-	Lp (pH)	Rp (Ω)	Rs (Ω)	L_1 (pH)	ℓ_1 (mm)	ℓ_2 (mm)
3140	150	0.0	0.95	30	3.8	3.8
3141	150	0.0	0.8	20	3.8	3.8

Typical Equivalent Circuit Parameters–Zero Bias

Part Number 5082-	Lp (pH)	Rp (Ω)	R_1 (KΩ)	L_2 (pH)	R_2 (KΩ)	C_T (pF)	ℓ_1 (mm)	ℓ_2 (mm)
3140	30	0.0	1.2	16	0.0	0.20	5.3	5.3
3141	200	0.0	∞	0	0.4	0.14	4.4	4.4

Typical Switching Parameters

RF Switching Speed HP 5082-3141

The RF switching speed of the HP 5082-3141 may be considered in terms of the change in RF isolation at 2 GHz. This switching speed is dependent upon the forward bias current, reverse bias drive pulse, and characteristics of the pulse source. The RF switching speed for the shunt-mounted stripline diode in a 50 Ω system is considered for two cases, one driving the diode from the forward bias state to the reverse bias state (isolation to insertion loss), second driving the diode from the reverse bias state to the forward bias state (insertion loss to isolation).

The total time it takes to switch the shunt diode from the isolation state (forward bias) to the insertion loss state (reverse bias) is shown in Figure 6. These curves are for three forward bias conditions with the diode driven in each case with three different reverse voltage pulses (V_{PR}). The total switching time for each case includes the delay time (pulse initiation to 20 dB isolation) and transition time (20 dB isolation to 0.9 dB isolation). Slightly faster switching times may be realized by spiking the leading edge of the pulse or using a lower impedance pulse driver.

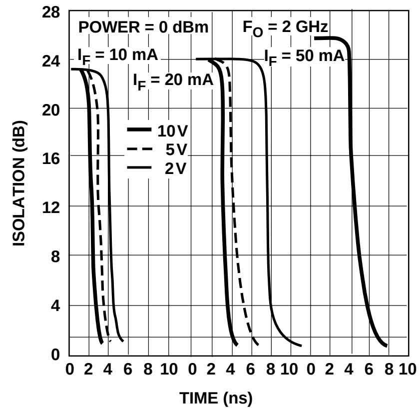


Figure 6. Isolation vs. Time (Turn-on) for HP 5082-3141. Frequency, 2 GHz.

The time it takes to switch the diode from zero or reverse bias to a given isolation is less than the time from isolation to the insertion loss case. For all cases of forward bias generated by the pulse generator (positive pulse), the RF switching time from the insertion loss state to the isolation state was less than 2 nanoseconds. A more detailed treatise on switching speed is published in AN929: “Fast Switching PIN Diodes”.

Reverse Recovery Time

Figures 8 and 9 show reverse recovery time, (t_{rr}) vs. forward current, (I_F) for various reverse pulse voltages V_R. The circuit used to measure t_{rr} is shown in Figure 7.

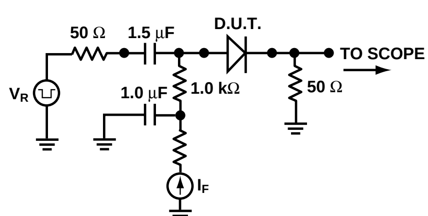


Figure 7. Basic t_{rr} Test Setup.

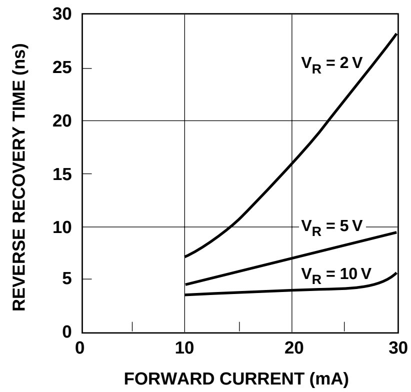


Figure 8. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3141.

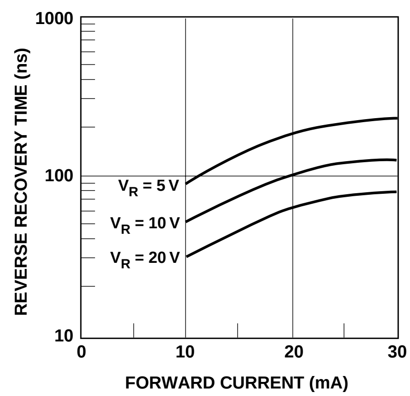


Figure 9. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3140.