HMIC™ PIN Diode SP2T 10 W Switch for 0.05 - 6.0 GHz High Power Applications

MASW-000822

Rev. V7

Features

- Exceptional Broadband Performance
- Lower Loss:
  Tx = 0.40 dB @ 3.8 GHz, 22 mA
  Rx = 0.60 dB @ 3.8 GHz, 22 mA
- Higher Isolation:
  Rx-Tx = 21 dB @ 3.8 GHz
  Tx-Rx = 26 dB @ 3.8 GHz
- Higher RF Input Power = 10 W CW
  (Tx-Ant Port)
- Higher IIP3 = 65 dBm (Tx-Ant Port).
- Lower EVM (OFDM):
  <1% @ 8 W P_{IN}, (Tx-Ant Port)
- Lead-Free 3 mm 16-Lead PQFN Package
- RoHS* Compliant

Applications

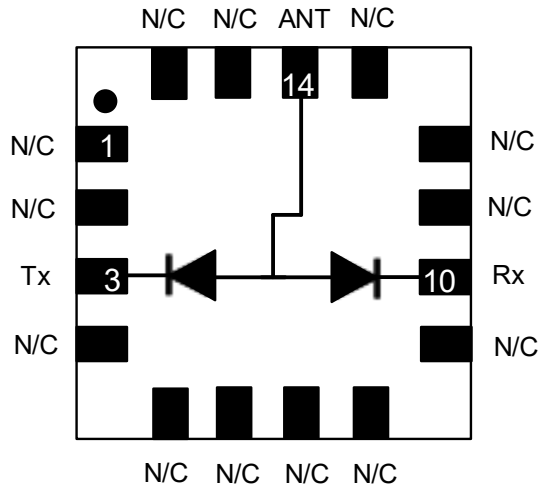
- Suitable for Higher Power WiMax & WLAN

Description

The MASW-000822 is a broadband, high linearity, common anode PIN diode SPDT switch in a lead-free 3 mm 16-lead PQFN package. This SP2T switch offers excellent isolation to loss ratio for both Tx and Rx states. The PIN diode provides exceptional 10 W CW power handling coupled with 65 dBm IIP3 for maximum switch performance @ 3.8 GHz.

This PIN diode switch incorporates a PIN diode die fabricated with MACOM's patented silicon-glass HMIC™ process. This chip features two silicon pedestals embedded in a low loss, low dispersion glass. The diodes are formed on the top of each pedestal. The topside is fully encapsulated with silicon nitride and has an additional polymer passivation layer. These polymer protective coatings prevent damage and contamination during handling and assembly.

Functional Schematic



Pin Configuration[1]

Pin #	Function
1, 2, 4 - 9, 11 - 13, 15, 16	N/C
3	Tx
10	Rx
14	Ant

1. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information[2]

Part Number	Package
MASW-000822-12770T	1000 piece reel
MASW-000822-001SMB	Sample Board

2. Reference Application Note M513 for reel size information.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications: T_A = 25°C, P_{IN} = 0 dBm, Z_0 = 50 Ω

Parameter	Conditions	Units	Min.	Typ.	Max.
Insertion Loss, Rx	Rx = 5 V @ 22 mA, Tx = 12 V @ 0 mA 2.3 - 2.7 GHz 3.3 - 3.8 GHz 4.9 - 5.9 GHz	dB	—	0.55 0.60 0.80	0.70 0.75 0.90
Insertion Loss, Tx	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA 2.3 - 2.7 GHz 3.3 - 3.8 GHz 4.9 - 5.9 GHz	dB	—	0.35 0.40 0.50	0.45 0.55 0.60
Isolation, Tx to R_X	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA 2.3 - 2.7 GHz 3.3 - 3.8 GHz 4.9 - 5.9 GHz	dB	27.0 24.5 21.0	29.5 26.5 21.5	—
Isolation, Rx to T_X	Rx = 5 V @ 22 mA, Tx = 12 V @ 0 mA 2.3 - 2.7 GHz 3.3 - 3.8 GHz 4.9 - 5.9 GHz	dB	22.5 19.5 17.5	24.5 21.5 17.5	—
Input Return Loss Tx	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA 2.3 - 2.7 GHz 3.3 - 3.8 GHz 4.9 - 5.9 GHz	dB	—	17 18 18	—
Input Return Loss Rx	Rx = 5 V @ 22 mA, Tx = 12 V @ 0 mA 2.3 - 2.7 GHz 3.3 - 3.8 GHz 4.9 - 5.9 GHz	dB	—	17 18 18	—

Electrical Specifications: F = 3.5 GHz, T_A = 25°C, Z_0 = 50 Ω[3,4,5]

Parameter	Conditions	Units	Min.	Typ.	Max.
Tx Input P0.1dB	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, Tx To Antenna	dBm	—	40	
Tx Input P1dB	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, Tx To Antenna	dBm	—	45	—
Tx 2nd Harmonic	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, P_{IN} = 30 dBm	dBc	—	-68	—
Tx 3rd Harmonic	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, P_{IN} = 30 dBm	dBc	—	-84	—
Tx Input 3rd Order Intercept Point	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, P_{IN} = 10 dBm F1 = 3.500 GHz, F2 = 3.510 GHz	dBm	—	65	—
Tx CW Input Power	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, F= 4 GHz	dBm	—	—	40
Rx CW Input Power	Rx = 5 V @ 22 mA, Tx = 12 V @ 0 mA, F= 4 GHz	dBm	—	—	33
Tx EVM (OFDM)	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, P_{IN} = 39 dBm	%	—	0.8	—
Tx EVM (OFDM)	Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA, P_{IN} = 40 dBm	%	—	1.2	—
Tx RF Switching Speed	(10% - 90% RF Voltage) Tx = 5 V @ 22 mA, Rx = 12 V @ 0 mA 1 MHz Rep Rate in Modulating Mode	ns	—	<500	—

3. Data taken at device RF leads.
4. Typical PIN diode forward voltage = 0.8 V @ 10 mA, 0.85 V @ 22 mA.
5. Typical PIN diode reverse voltage = 12 V.

Absolute Maximum Ratings[6,7]
@ T_A = +25°C (unless otherwise specified)

Parameter	Absolute Maximum
Forward Current	100 mA
DC Reverse Voltage	100 V
Tx Incident CW Power	10 W CW
Tx Peak Incident Power	20 W, 3 µs Pulse Width, 1% Duty Cycle
Rx Incident CW Power	2 W CW
Junction Temperature	+175°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +150°C

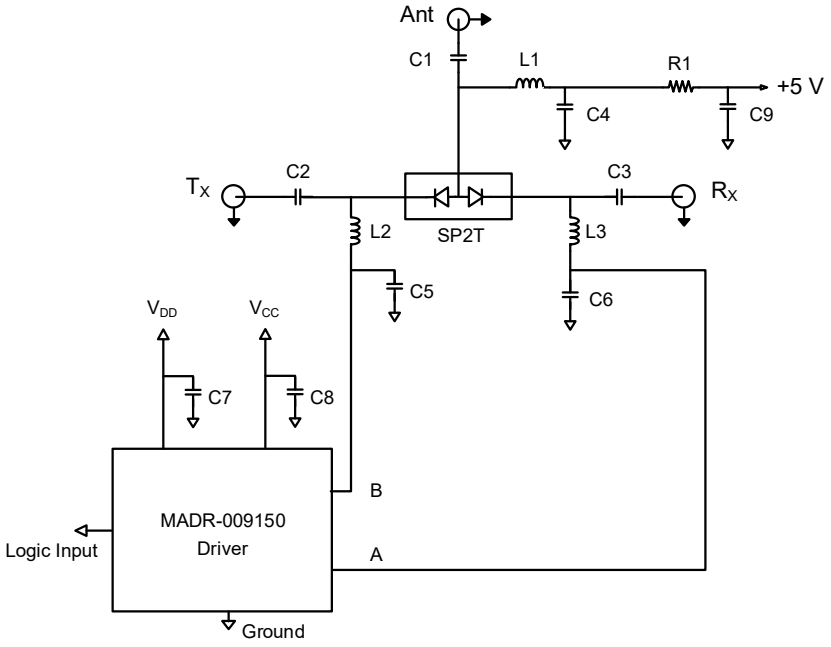
6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.

Minimum Reverse Bias Voltage[8]

Frequency (MHz)	DC Voltage (V)
50	54
500	50
1000	43
2000	29
4000	17
6000	12

8. Minimum DC bias voltage to maintain low loss under 20 W of Tx power with 1.5:1 VSWR.

Driver and SP2T Schematic with Positive Voltage[9,10,11,12,13]



9. Center ground area of MLP 3 mm package must be attached to thermal ground for optimum RF power performance.
10. MACOM recommends the usage of the **MADR-009150** driver with this switch.
11. Forward bias diode voltage, ΔVf @ 22 mA = + 0.9 V.
12. Reverse bias diode = | - (12 V - 0.9 V) | = | - 11.1 | V.
13. Assembly Note: A typical soldering process profile and handling instructions are provided in Application Notes, S2083 “Surface Mount Instructions for QFN / DFN Packages” on the MACOM website at www.macom.com.

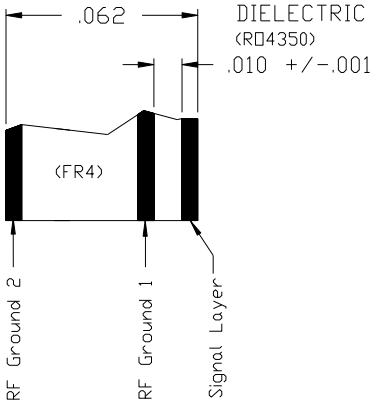
Parts List

Port	Value
C1 - C3	27 pF, 100 V
C4	1000 pF
C5, C6	50 pF
C7 - C9	0.1 µF
L1, L3	47 nH
R1	180 Ω

DC Bias to RF Truth Table

RF State	TTL & DC Bias Conditions	Voltage at Common Anode
Low Loss Tx-Ant & Isolation Tx-Rx	TTL = 1 5 V @ 22 mA (Tx), 12 V @ 0 mA (Rx)	0.9 V
Low Loss Ant-Rx & Isolation Rx-Tx	TTL = 0 5 V @ 22 mA (Rx), 12 V @ 0 mA (Tx)	0.9 V

Cross Section View of MACOM PCB



Handling Procedures

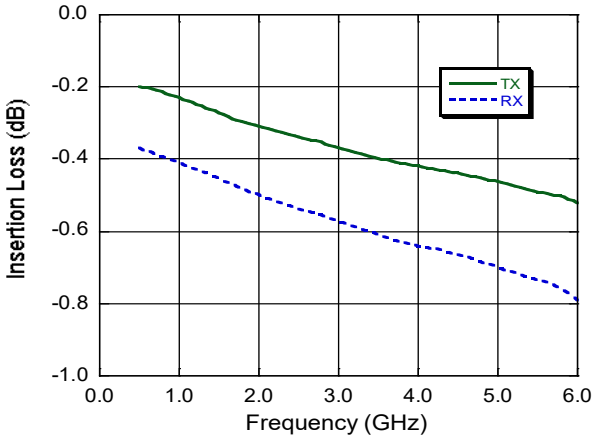
Please observe the following precautions to avoid damage:

Static Sensitivity

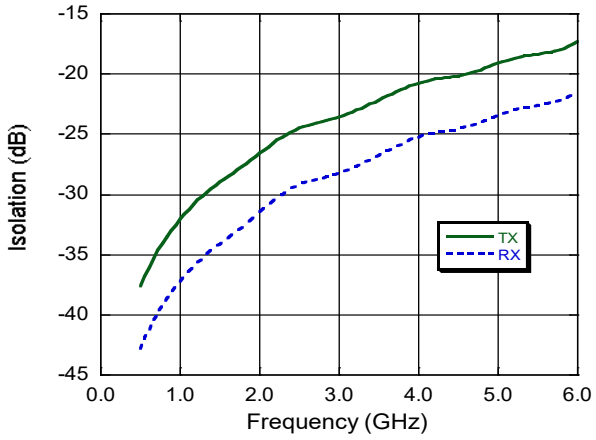
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 1B Human Body devices.

Typical Performance Curves: T_A = 25°C, Z_0 = 50 Ω

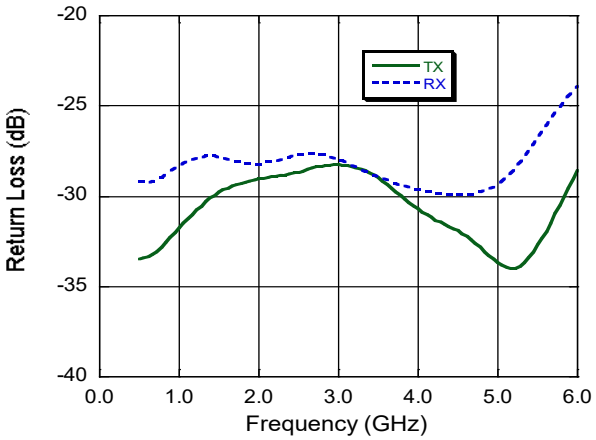
Insertion Loss



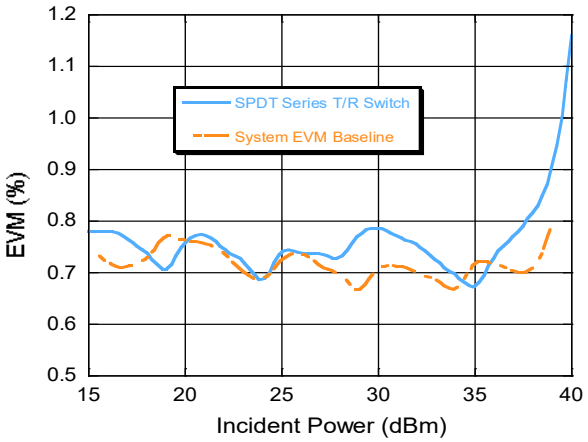
Isolation



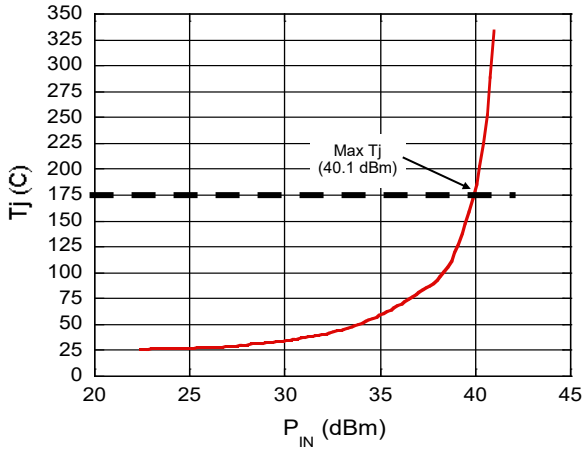
Tx and RX Return Loss



EVM

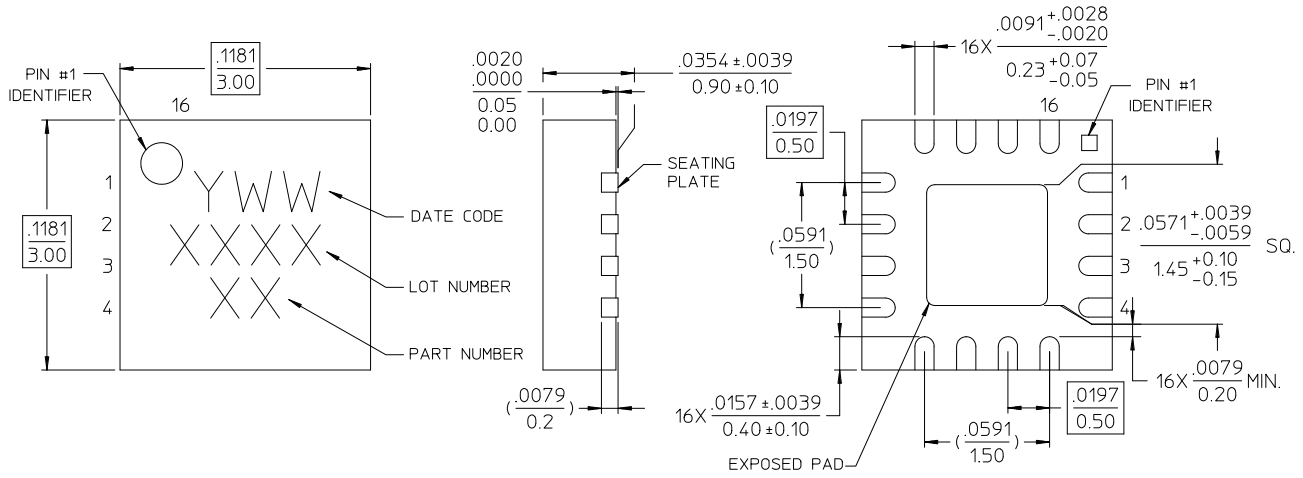


Tx Diode Junction Temperature vs. CW Input Power @ 4 GHz, T_J = 175°C



⚠ This device is not for saturation power application. Exceeding power dissipation maximum rating might result in device failure.

Lead-Free 3 mm 16-Lead PQFN†



† Reference Application Note S2803 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 1 requirements.