PIN Diode SPDT 120 W Switch for 0.05 - 6 GHz High Power Applications

MASW-000936
Rev. V8

Features

- Exceptional Broadband Performance
- Low Insertion Loss: T_X = 0.20 dB @ 2.7 GHz
- High Isolation: R_X = 50 dB @ 2.7 GHz
- High T_X RF Input Power = 120 W CW @ 2.0 GHz, +85°C
- High T_X RF Input Peak Power: 1000 W
- Positive DC Bias Only Required
- Surface Mount 4 mm PQFN Package
- RoHS* Compliant and 260°C Reflow Compatible

Applications

- Suitable for High Power LTE, TD-SCDMA, WiMAX, and Military Radio Applications

Description

The MASW-000936 is a SPDT high power, broadband, high linearity, PIN diode T/R switch for 0.05 - 6.0 GHz applications, including WiMAX & WiFi. The device is provided in an industry standard lead free 4 mm PQFN plastic package.

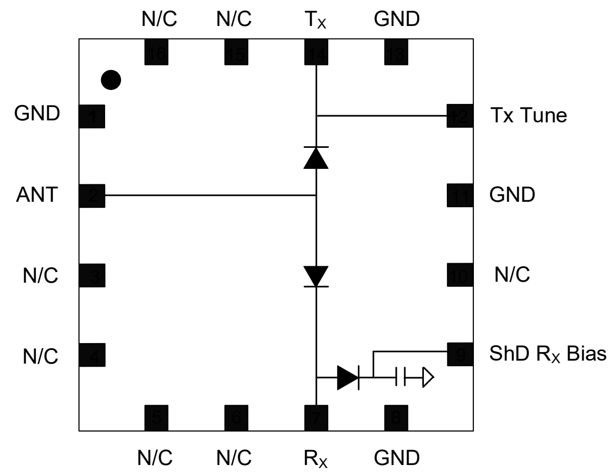
This device incorporates PIN diode die fabricated with a low loss, high isolation switching diode

Ordering Information[1]

Part Number	Package
MASW-000936-14000T	1000 piece reel
MASW-000936-001SMB	Sample Board
MASW-000936-DRVSMB	Sample Board (with MADR-009150 driver)

1. Reference Application Note M513 for reel size information.

Functional Diagram (Top View)



Pin Configuration[2]

Pin #	Pin Name	Description
1,8,11,13	GND	Ground
2	ANT	Antenna
3,6,15	N/C	Connect to Ground
4,5,10,16	N/C	No Connection
7	R_X	Receive
9	ShD R_X Bias	ShD R_X Bias
12	Tx Tune	Tx Tune[3]
14	T_X	Transmit

2. The exposed pad centered on the package bottom must be connected to RF, DC and Thermal ground.
3. Optional tuning pin. See note 6 for details.

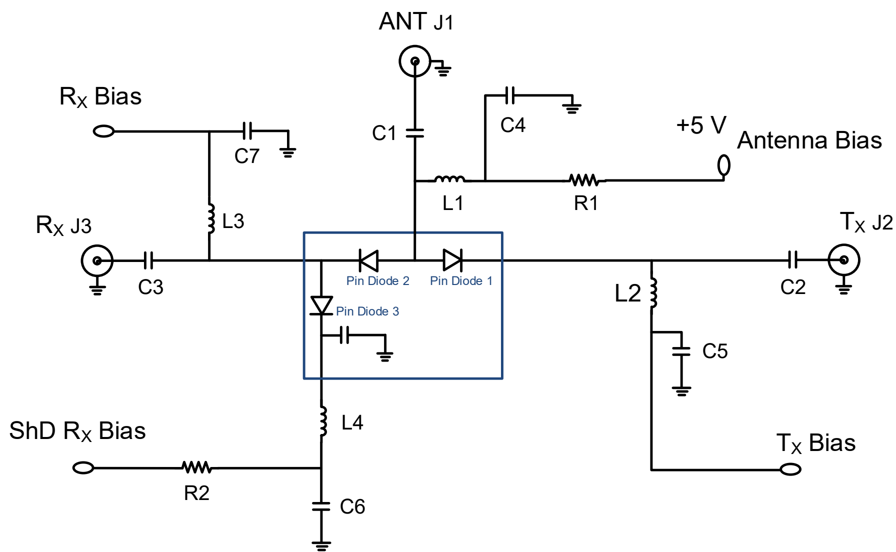
* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications[4]: Freq. = 2.0, 2.7, 3.5 GHz, T_A = 25°C, Bias = 100 mA / 28 V

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss[4] P_{IN} = 0 dBm	R_X, 0.8 GHz T_X, 0.8 GHz R_X, 2.0 GHz T_X, 2.0 GHz R_X, 2.7 GHz T_X, 2.7 GHz R_X, 3.5 GHz T_X, 3.5 GHz	dB	—	0.20 0.07 0.35 0.15 0.50 0.20 0.70 0.25	— — 0.55 — 0.75 — 0.90 —
Isolation[4] P_{IN} = 0 dBm	R_X to Antenna, 2.0 GHz T_X to Antenna, 2.0 GHz R_X to Antenna, 2.7 GHz T_X to Antenna, 2.7 GHz R_X to Antenna, 3.5 GHz T_X to Antenna, 3.5 GHz	dB	41 — 40 — 33 —	45 16 50 13 40 11	—
Input Return Loss[4] P_{IN} = 0 dBm	R_X T_X	dB	—	23 34	—
T_X Input P0.1 dB	T_X to Antenna	dBm	—	>50	—
T_X IIP3 P_{IN} = 30 dBm	F1 = 2010 MHz, F2 = 2020 MHz	dBm	—	72	—
T_X CW Input Power	85°C Base plate 2.0 GHz 2.7 GHz 3.5 GHz	dBm / W	—	50.8 / 120 50 / 100 49 / 80	—
R_X CW Input Power	85°C Base plate 2.0 GHz	dBm W	—	41.5 14	—
T_X RF Switching Speed	(10 - 90% RF Voltage) 1 MHz Rep Rate in Modulating Mode	ns	—	200	—

4. See Bias Table

Bias Schematic



Parts List[6]

Component	Value	Package
C1 - C3	22 pF	0603
C4 - C7	27 pF	0603
L1 - L4	68 nH	0603
R1[5]	39 Ω	0603
R2[5]	480 Ω	See note 5

5. R1 and R2 values equal to ((Applied Bias Voltage) - (Forward Voltage of Diode)) / (Ibias) where the Forward Voltage of Diode (Vf) can be approximated as 1 V. The size of the package will depend on the power rating needed.
6. Not shown, adding an LC network to pin 12 can improve R_X performance between 2.0 and 2.7 GHz but may limit performance above 3.0 GHz. For broadband applications MACOM recommends not using pin 12 and not connecting it to any metal trace.

Suggested Switch Driver

MADR-009150 or MADR-010574

Bias Table

Switch State	T_X Bias	R_X Bias	ShD R_X Bias	ANT Bias
T_X-ANT Isolation	(+28 V), 0 mA	(GND), -100 mA	(+28 V), 0 mA	+5 V
T_X-ANT Insertion Loss	(GND), -100 mA	(+28 V), +56 mA	(GND), -56 mA	+5 V
R_X-ANT Isolation	(GND), -100 mA	(+28 V), +56 mA	(GND), -56 mA	+5 V
R_X-ANT Insertion Loss	(+28 V), 0 mA	(GND), -100 mA	(+28 V), 0 mA	+5 V

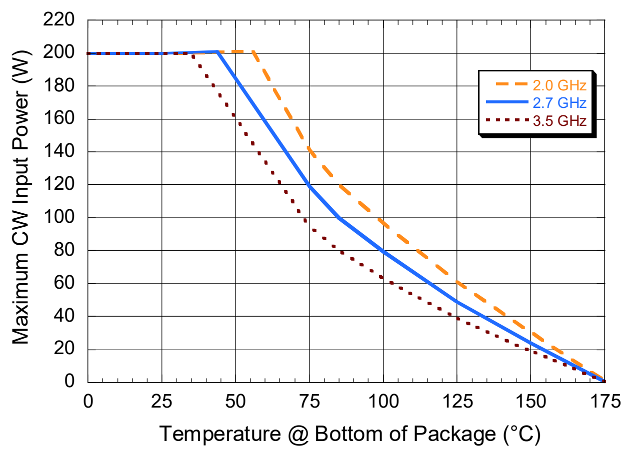
Absolute Maximum Ratings[7,8,9]

@ T_A = +25°C (unless otherwise specified)

Parameter	Absolute Maximum
Forward Current	150 mA
DC Reverse Voltage	130 V
T_X Incident CW Power	See Power De-rating Curve
T_X Incident Peak Power (10 µs Pulse Width[10])	1000 W
R_X Incident CW Power	41.5 dBm (14 W) @ 2 GHz, +85°C
Junction Temperature	+175°C
Operating Temperature	-40°C to +100°C
Storage Temperature	-55°C to +150°C

7. Exceeding these limits may cause permanent damage.
8. MACOM does not recommend sustained operation near these survivability limits.
9. Operating at nominal conditions with $T_J \leq$ +175°C will ensure MTTF > 1 x 10^6 hours.
10. Measured with 4 ms pulse period, up to +100°C case temperature.

T_X Input Power De-rating @ 20 dB I/O Return Loss



Minimum Reverse Bias Voltage[11]

Frequency (MHz)	DC Voltage (V)
50	130[12]
500	91[12]
1000	57[12]
2000	31
4000	16
6000	11

11. Minimum DC bias voltage to maintain low loss under 120 W of Tx power with 1.5:1 VSWR
12. The MADR-009150 switch driver has a maximum output voltage of 55 V. If a higher output voltage is desired, then one may want to consider using the MADR-010574 switch driver.

Handling Procedures

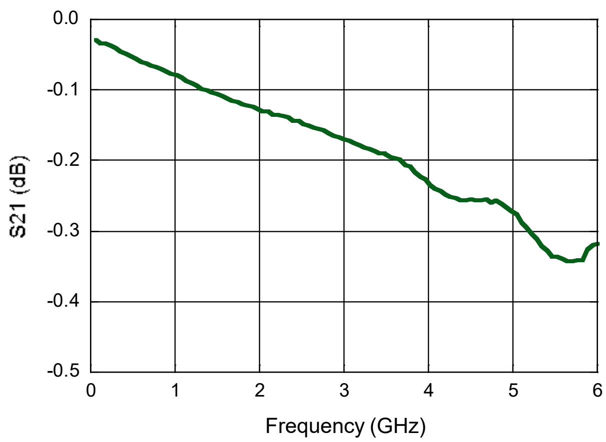
Please observe the following precautions to avoid damage:

Static Sensitivity

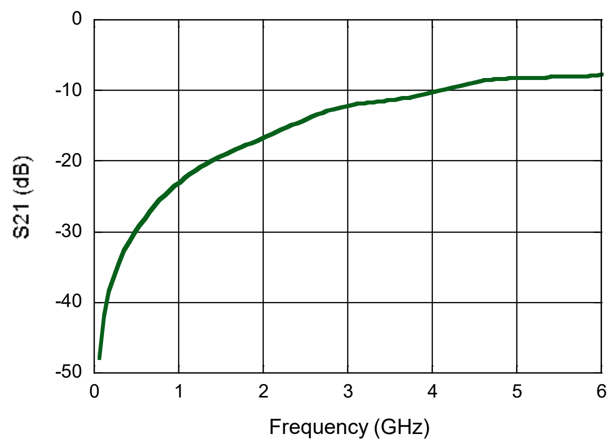
Silicon Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 1C Human Body devices.

Typical Performance Curves (RF-probed parts), T_X (100 mA Bias Current)

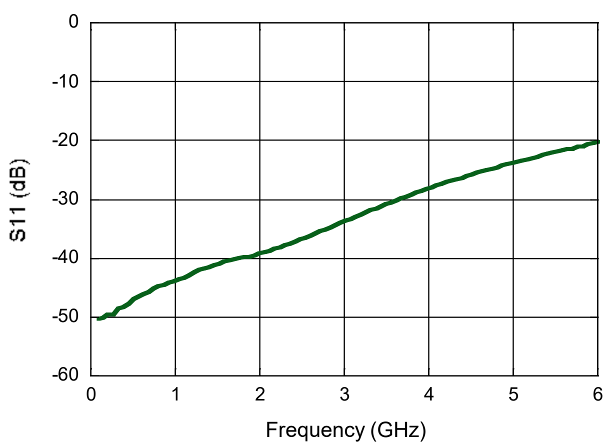
Insertion Loss, T_X



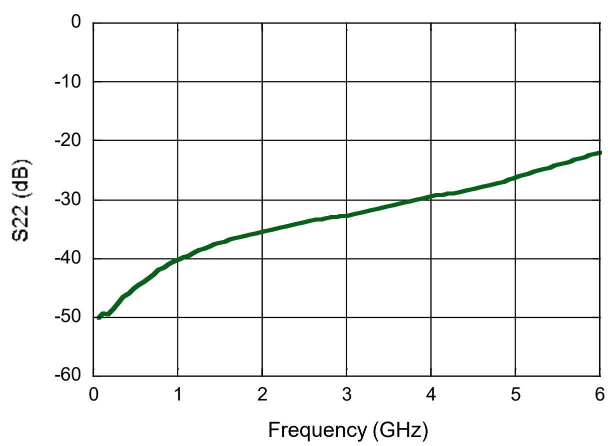
Isolation, T_X



Input Return Loss, T_X

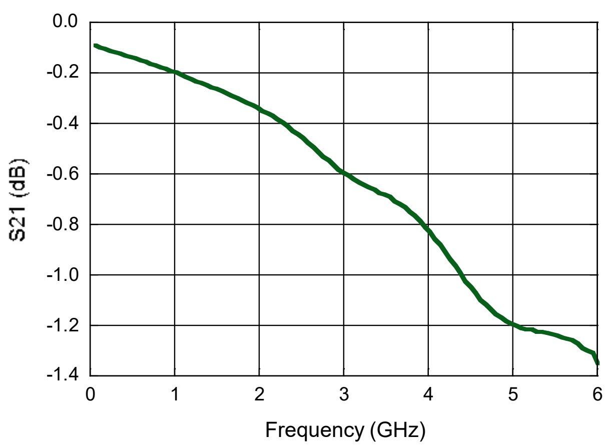


Output Return Loss, T_X

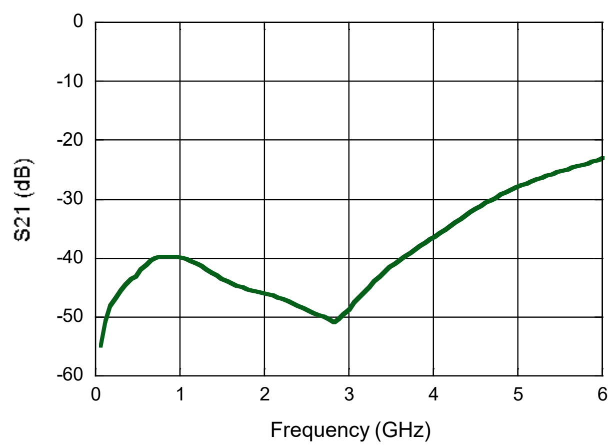


Typical Performance Curves (RF-probed parts), R_X (100 mA Bias Current)

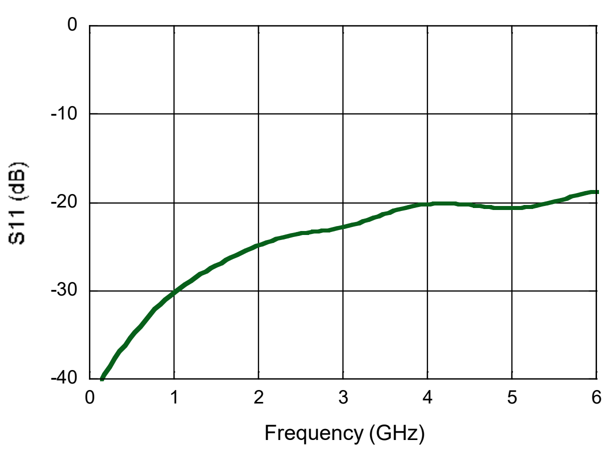
Insertion Loss, R_X



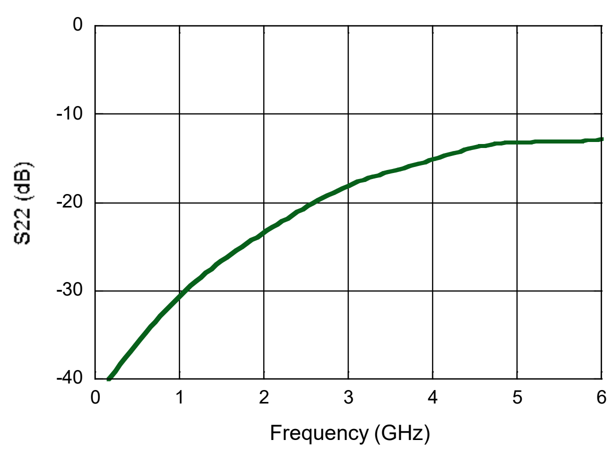
Isolation, R_X



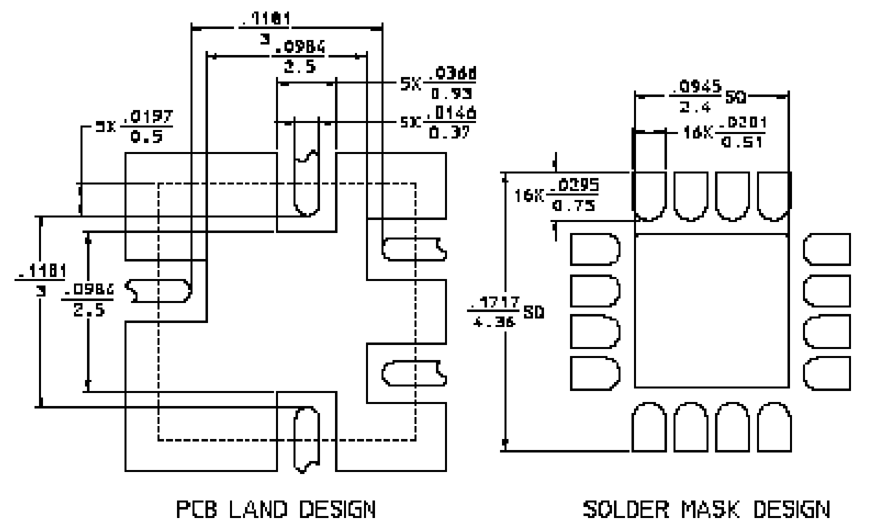
Input Return Loss, R_X



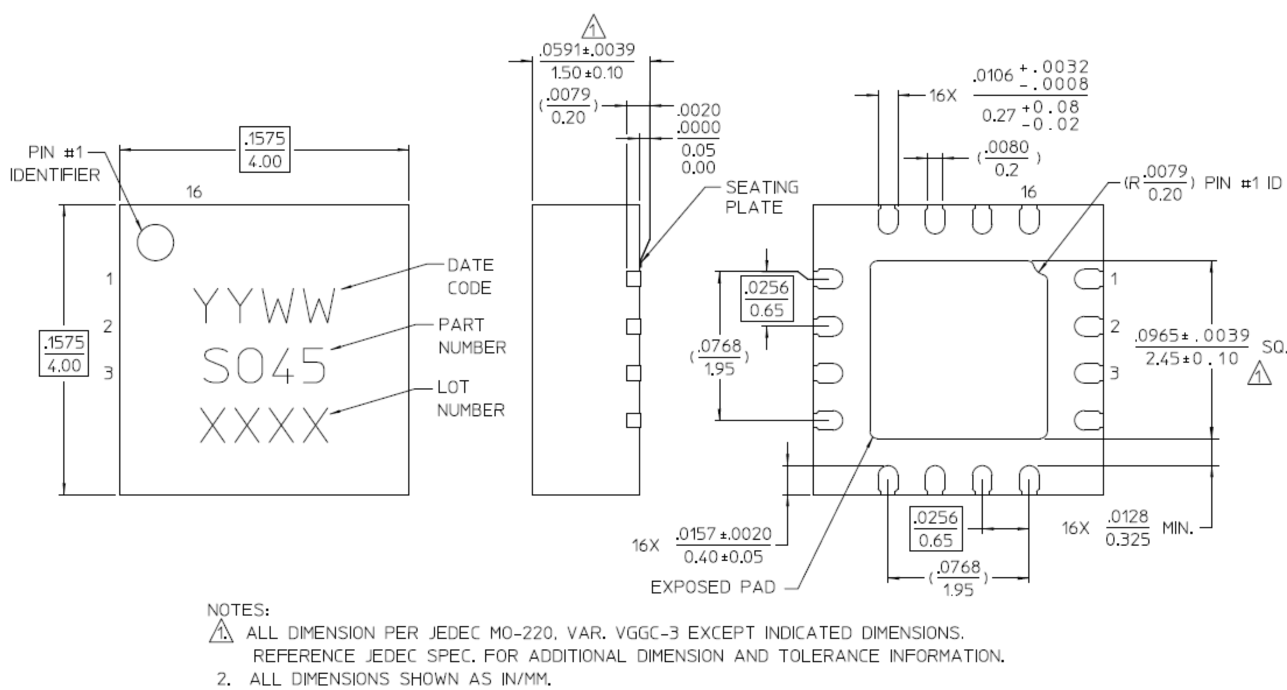
Output Return Loss, R_X



PCB Footprint



Lead Free 4 mm 16-Lead PQFN†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 1 requirements.
Plating is NiPdAuAg.