Features
- Broadband Performance
- Low Loss @ 4.2 GHz:
  TX = 0.31 dB
  RX = 0.40 dB
- High Isolation @ 4.2 GHz:
  RX = 48 dB
- Power Handling @ 1.8 GHz:
  240 W CW @ +85 ºC
  190 W CW @ +120 ºC
- Lead-Free 5 mm 20-Lead HQFN Package
- RoHS* Compliant

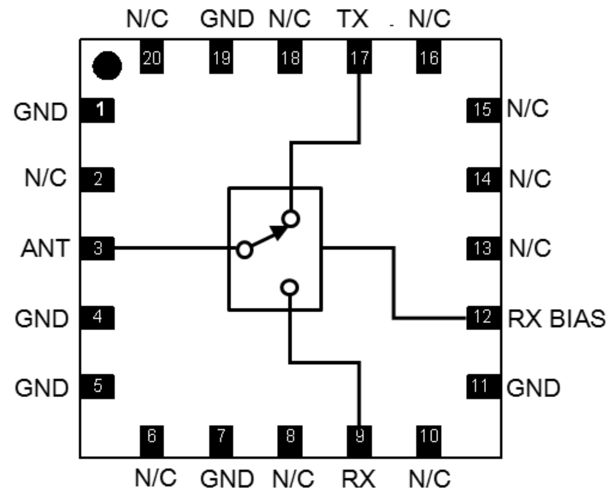
Features
- Designed for High Power TDD-LTE Applications

Description
The MASW-011249 is a SPDT high power, broadband, high linearity, PIN diode T/R switch for 0.01 - 7.0 GHz high power applications. The device is provided in an industry standard lead free 5 mm HQFN plastic package.

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

MASW-011249 can be used in any application requiring a low-loss, high-isolation, and high-power-handing SPDT.

Functional Schematic



Pin Configuration[3]

Pin #	Pin Name	Function
1,4,5,7,11,19	GND	Ground
2,6,8,10,13,14, 15,16,18,20	N/C	No Connection
3	ANT	RF Port
9	RX	RF Port
12	RX BIAS	RX Bias Input
17	TX	RF Port
21	Paddle	Ground[4]

3. MACOM recommends connecting all No Connection (N/C) pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information[1,2]

Part Number	Package
MASW-011249	Bulk
MASW-011249-TR1000	1000 Piece Tape and Reel
MASW-011249-SMB	Sample Board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 3 loose parts.

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

Electrical Specifications:
Freq. = 1.8 & 4.2 GHz, T_A = +25 °C, Z_0 = 50 Ω, Bias = 60 V / 0 V, See Bias Table.

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	ANT to TX ON @ 1.8 GHz ANT to TX ON @ 2.8 GHz ANT to TX ON @ 3.5 GHz ANT to TX ON @ 4.2 GHz ANT to TX ON @ 6.0 GHz ANT to RX ON @ 1.8 GHz ANT to RX ON @ 2.8 GHz ANT to RX ON @ 3.5 GHz ANT to RX ON @ 4.2 GHz ANT to RX ON @ 6.0 GHz	dB	—	0.20 0.23 0.26 0.31 0.49 0.20 0.26 0.32 0.40 0.67	— 0.8 1.0 — — — 1.1 1.2 — —
Isolation	ANT to RX (TX ON) @ 2.8 GHz ANT to RX (TX ON) @ 3.5 GHz ANT to RX (TX ON) @ 4.2 GHz ANT to TX (RX ON) @ 2.8 GHz ANT to TX (RX ON) @ 3.5 GHz ANT to TX (RX ON) @ 4.2 GHz	dB	38 32 — 14 11 —	40 38 36 17 16 14.5	—
ANT Return Loss	ANT to RX ON @ 4.2 GHz ANT to TX ON @ 4.2 GHz	dB	—	>38 >23	—
TX Return Loss	ANT to TX ON @ 4.2 GHz	dB	—	>22	—
RX Return Loss	ANT to RX ON @ 4.2 GHz	dB	—	>27	—
Input P0.1 dB[5]	ANT to TX ON	dBm	—	53	—
IIP3 TX	ANT to TX, P_{IN} = 30 dBm	dBm	—	74	—
IIP3 RX	ANT to RX, P_{IN} = 30 dBm	dBm	—	70	—
RF Input Power CW[5] ANT to TX ON	85°C @ 1.8 GHz; 100 mA TX) 85°C @ 1.8 GHz; 200 mA (TX) 120°C @ 1.8 GHz; 100 mA (TX) 120°C @ 1.8 GHz; 200 mA (TX)	W	—	200 240 130 150	—
Switching Speed TX T_{ON} TX T_{OFF} RX T_{ON} RX T_{OFF}	T_{ON} - 50% control to 90% RF T_{OFF} - 50% control to 10% RF 100kHz, Duty Cycle 50% RF CW 4.2 GHz	µs	—	0.86 3.10 3.40 2.34	—

5. Maximum source and load VSWR < 1.2:1.

Bias Table

Bias Table	TX	RX	RX BIAS	ANT
Pin	17	9	12	3
ANT to TX ON (Insertion Loss)	(GND), -100 mA[6]	(+60 V), 100 mA[6]	(GND), -100 mA[6]	+5 V, 100 mA[6]
ANT to RX (Isolation)	(GND), -100 mA[6]	(+60 V), 100 mA[6]	(GND), -100 mA[6]	+5 V, 100 mA[6]
ANT to RX ON (Insertion Loss)	(+60 V), 0 mA	(GND), -100 mA[6]	(+60 V), 0 mA	+5 V, 100 mA[6]
ANT to TX (Isolation)	(+60 V), 0 mA	(GND), -100 mA[6]	(+60 V), 0 mA	+5 V, 100 mA[6]

6. Currents level comply with the schematic on page 8. TX and RX bias current can be change as needed.

Maximum Operating Conditions[7]

Parameter	Operating Maximum
TX Forward Current	250 mA
RX Forward Current	250 mA
Reverse Voltage (RF & DC)	270 V
ANT to TX Power CW	See Power Derating Curve
ANT to TX Peak Power (LTE Signal)	1000 W
Junction Temperature[8, 9]	+175 °C
Case (Paddle) Temperature	-40 °C to +120 °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 $T_J \le +175$ °C will ensure MTTF > 1 x 10^6 hours.

Handling Procedures

Please observe the following precautions to avoid damage:

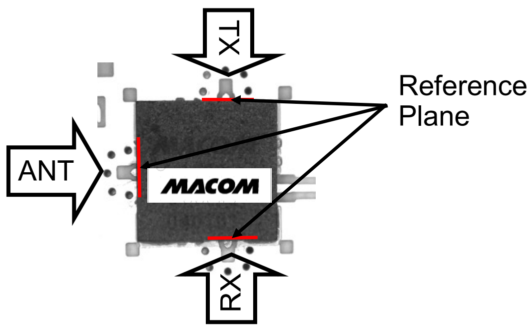
Static Sensitivity

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 HBM Class 1B and CDM Class C7 devices.

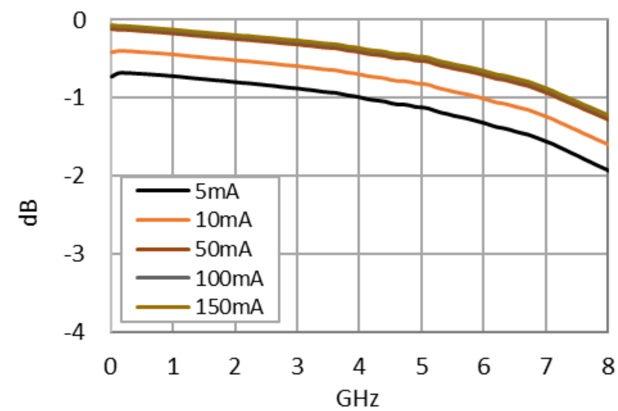
Typical Performance Curves

All plots herein are taken with bias per the Bias Table on Page 2 unless otherwise specified.

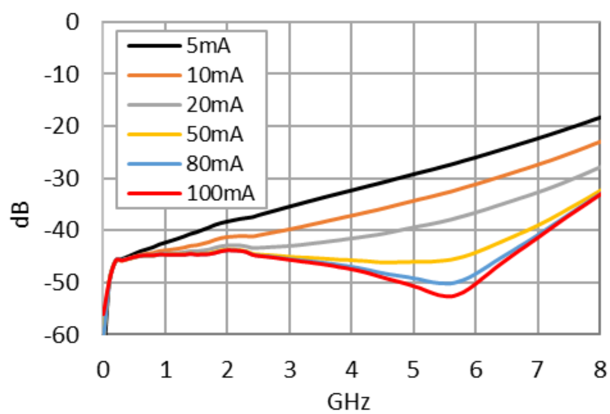
S-parameters were measured using G-S-G probes on a sample board; reference planes are at the part's RF ports. The sample board and its layer stack-up are on page 7



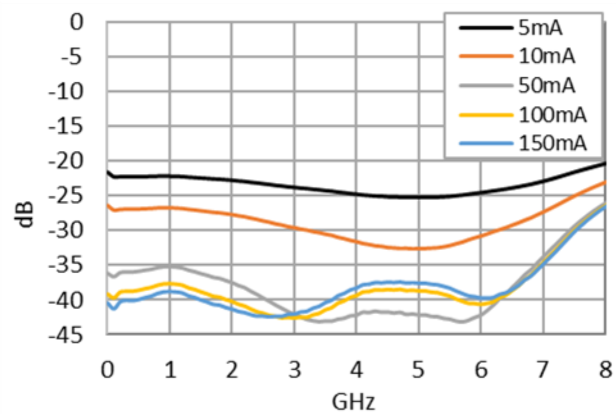
ANT to RX Insertion Loss (RX ON State) over Bias I



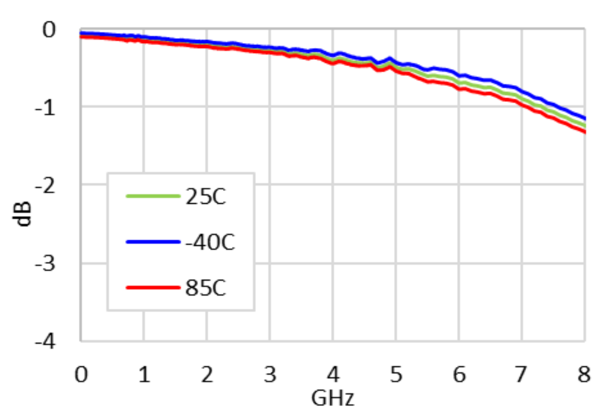
ANT to RX Isolation in TX ON state, over RX ShD Bias Current @ Room Temp



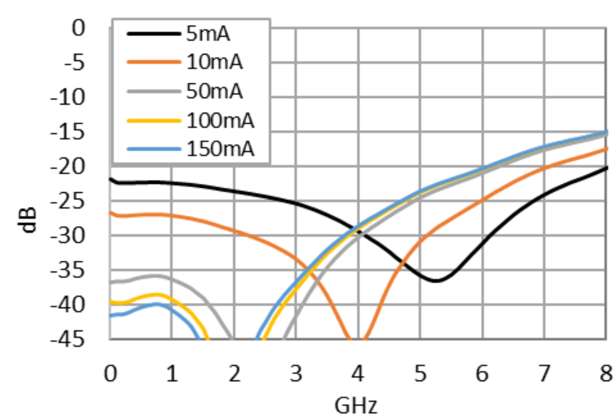
ANT Return Loss in RX ON state over Bias I



ANT to RX Insertion Loss over Temp @ 100mA

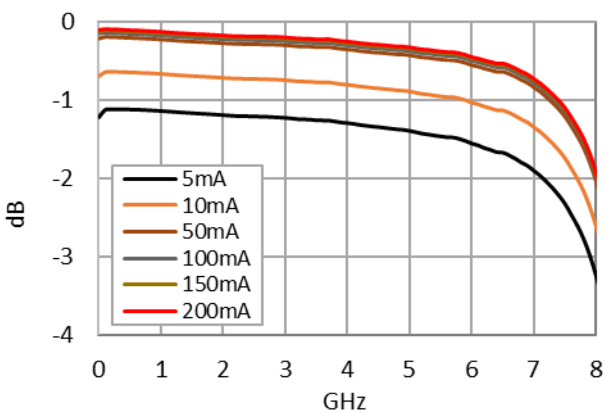


RX Return Loss in RX ON state over Bias I

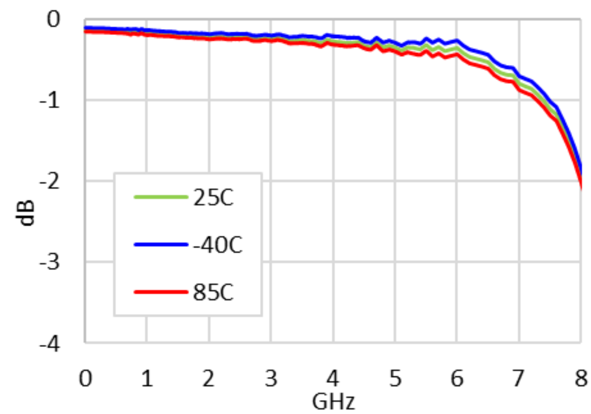


Typical Performance Curves over Temperature

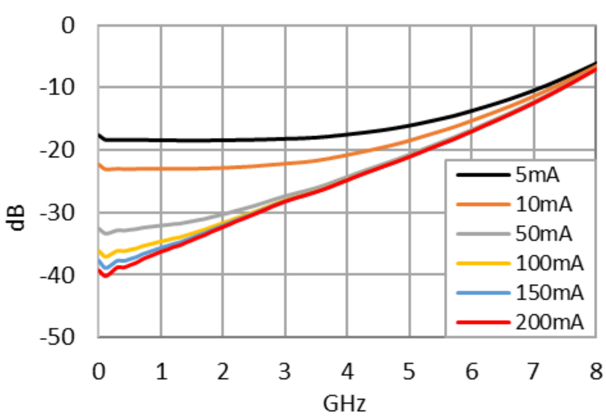
ANT to TX Insertion Loss over TX bias I



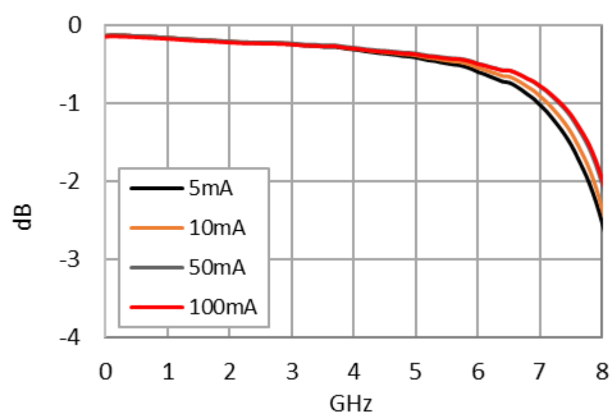
ANT to TX Isolation in RX ON state @ 100 mA



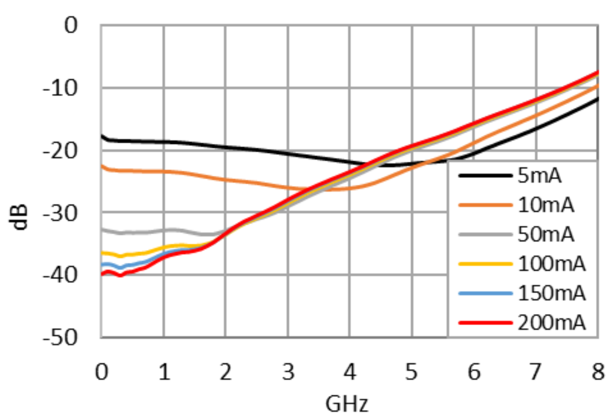
ANT Return Loss in TX ON state over TX bias I



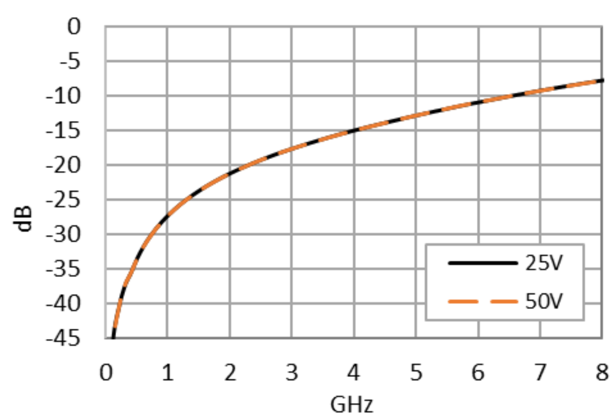
ANT to TX Insertion Loss over RX bias I



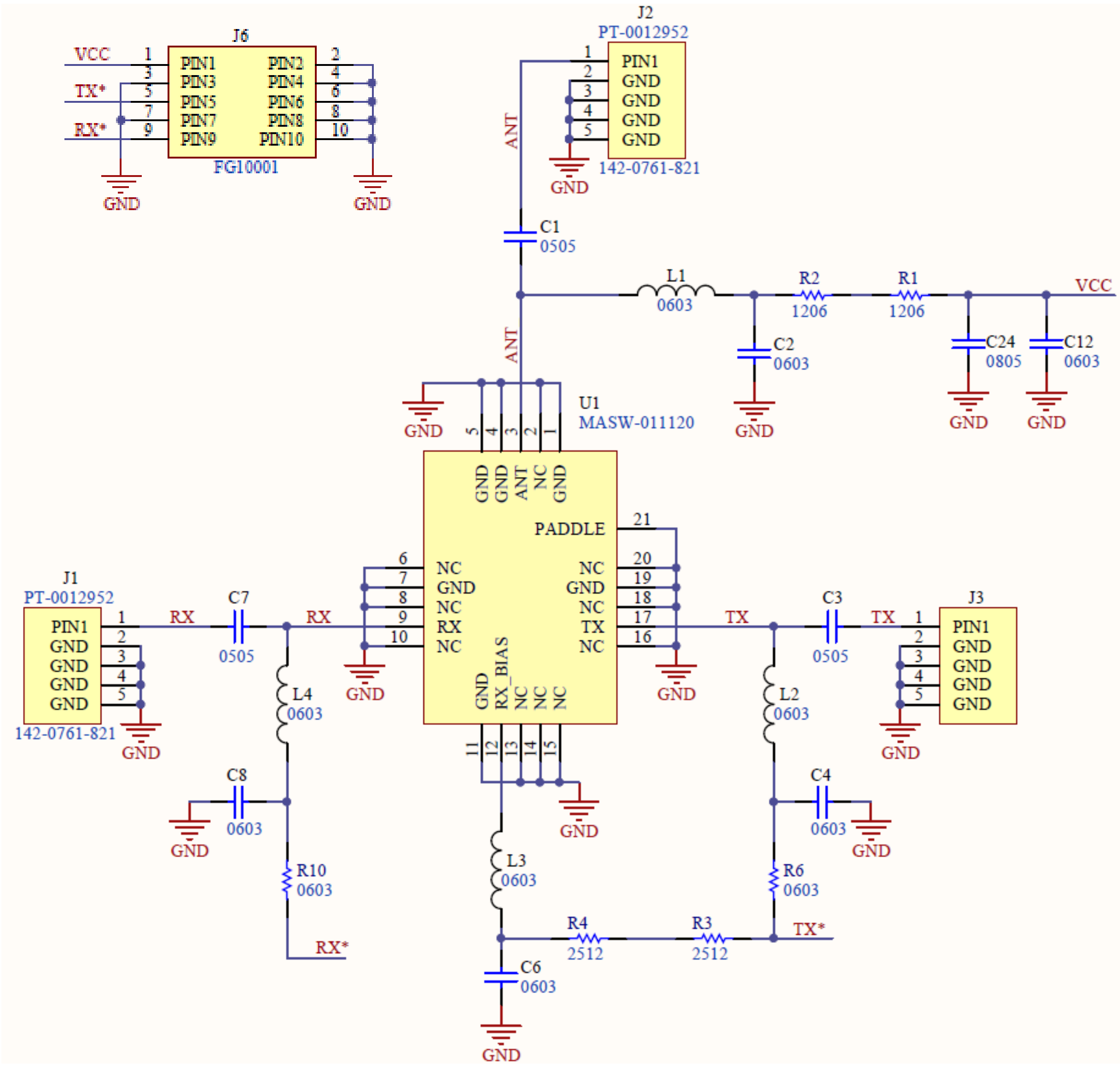
TX Return Loss in TX ON state over TX bias I



ANT to TX Isolation over TX Revers Bias Voltage



Application Schematic (parts list on page 9)



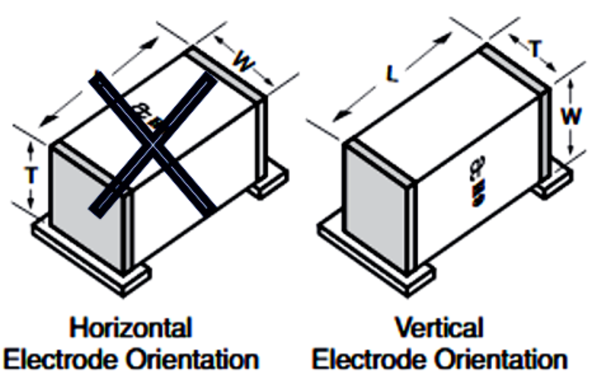
Control Table

Configuration	VCC	RX	TX/RX_Bias
TX ON RX OFF	5 V (100 mA)	60 V (10 mA)	GND
TX OFF RX ON	5 V (100 mA)	GND	60 V

Parts List

Component ID	Value	Package	Mfg. Part#	Spec
U1	—	HQFN-20LD 5 mm	MASW-011120	—
L1, L2, L3, L4	33 nH	0603	LQW18AN33NJ8ZD	>200 mA
C1, C3, C7[10]	10 pF	0505	800A100JT250X	High Freq
C2, C4, C6,C8, C12	22 pF	0603	600S220FT250XT	High Freq
C24	1 µF	0805	C2012X7S2A105K125AB	High Freq
R1, R2	20 Ω	1206	CRCW120620R0FKEA	0.25 Ω
R3, R4	2.37 kΩ	2512	CRCW25122K37FKEA	1 Ω
R10	7 Ω	0603		0.1 Ω
R6	0 Ω	0603	—	—
J1-J5	RF CONN	SMA	—	—
J6	DC CONN	10-pin	—	—

10. Required vertical mounting orientation of C1, C3, & C7. Noted on PCB Layout on page 7.



Determination of Minimum Reverse Bias Voltage

The minimum reverse bias voltage required to maintain a PIN diode out of conduction in the presence of a large RF signal is given by:

$$|V_{DC}| = \frac{|V_{RF}|}{\sqrt{1 + \left[\left(\frac{0.0142 \times f_{MHz} \times W_{mils}^2}{V_{RF} \times \sqrt{D}}\right) \times \left(1 + \sqrt{1 + \left(\frac{0.056 \times V_{RF} \times \sqrt{D}}{W_{mils}}\right)^2}\right)\right]^2}}$$

Where:

$|V_{DC}|$ = magnitude of the minimum DC reverse bias voltage
$|V_{RF}|$ = magnitude of the peak RF voltage (including the effects of the voltage standing wave ratio, VSWR)
f_{MHz} = lowest RF signal frequency expressed in MHz
D = duty factor (DF) of the RF signal
W_{mils} = thickness of the diode I layer, expressed in mils (thousands of an inch)

(R. Caverly and G. Hiller, “Establishing the Minimum Reverse Bias for a PIN Diode in a High Power Switch”, IEEE Transactions on Microwave Theory and Techniques, Vol. 38, No. 12, December 1990)

In the transmit state, the large transmit signal voltage appears across a series PIN diode in the receive side of the switch. This diode must be held in its nonconducting state in order to isolate the receiver output port from the large transmit signal applied to the transmit input port.

The minimum magnitude of the reverse DC bias which is necessary to maintain the receive diode in its nonconducting state can be seen from the equation above to be a function of the RF signal voltage, the VSWR in the signal path, the characteristic impedance (Z_0) of the signal path, the frequency of the RF signal, the DF of the RF signal and the I layer thickness of the diode in the receive side of the switch.

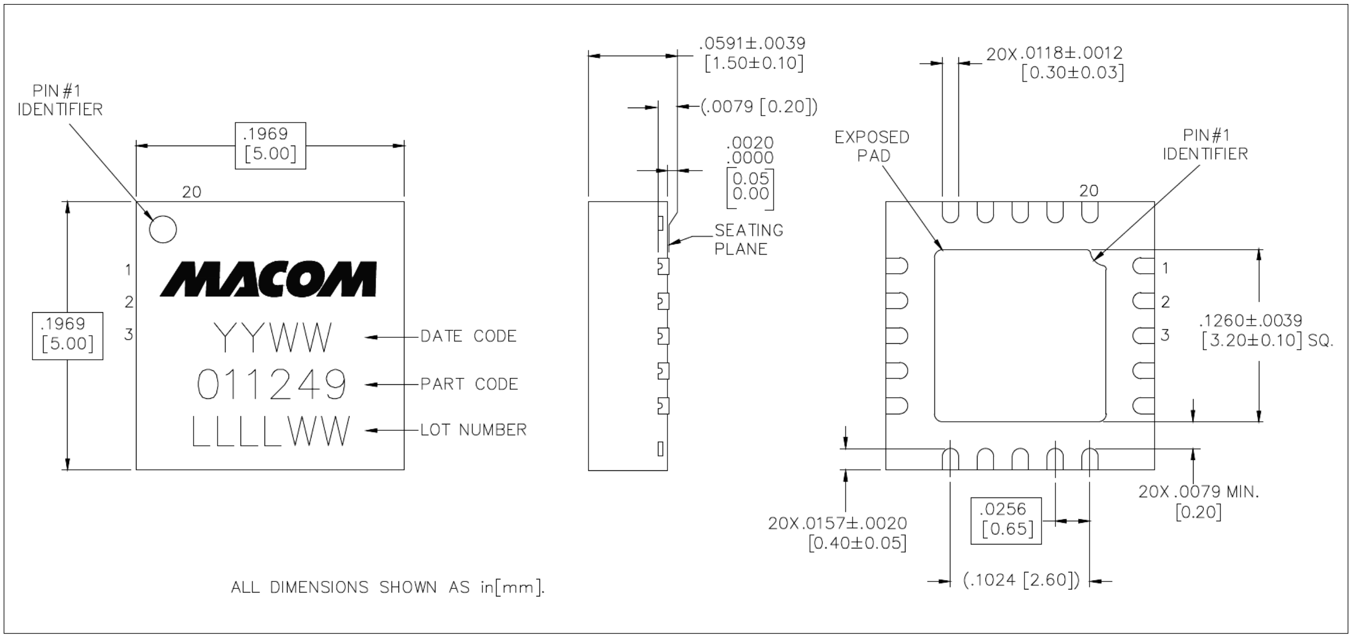
For a continuous wave signal (i.e., DF = 1) in a Z_0 = 50 Ω signal path with VSWR = 1.5:1, the minimum reverse bias voltage required for the MASW-011249 switch to operate properly as a function of input signal frequency and signal power applied to the transmit input is shown in the table below.

Minimum Reverse Bias Voltage vs. Signal Frequency & Transmit Input Signal Power VSWR = 1.5:1, Z_0 = 50 W, Duty Cycle = 1

Frequency (MHz)	Transmit Input Signal Power (W)							
	1	2	5	10	25	50	100	200
30	13	18	29	40	63	90	125	175
100	12	17	27	38	61	85	122	170
500	5	8	16	26	45	68	98	145
1000	3	5	9.5	16	30	45	70	105
2000	2	3	6	9	17	27	40	60
4000	1	2	4	5	9	15	23	35
6000	1	1.5	2	3	7.5	12	15	25

For other conditions, contact the factory for recommended minimum reverse bias voltage.

Lead-Free 5 mm 20-Lead HQFN†



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