MASW-011120

PIN Diode SPDT 200 W Switch for High Power Applications
0.03 - 6.0 GHz

Rev. V1

Features

- Broadband Performance
- Low Loss @ 2.7 GHz:
  TX = 0.25 dB
  RX = 0.35 dB
- High Isolation @ 2.7 GHz:
  RX = 44 dB
- Power Handling @ 2.7 GHz:
  200 W CW @ +85ºC
  122 W CW @ +120ºC
- Lead-Free 5 mm 20-Lead HQFN Package
- RoHS* Compliant
- Designed for High Power TDD-LTE Applications

Description

The MASW-011120 is a SPDT high power, broadband, high linearity, PIN diode T/R switch for 0.03 - 6.0 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.

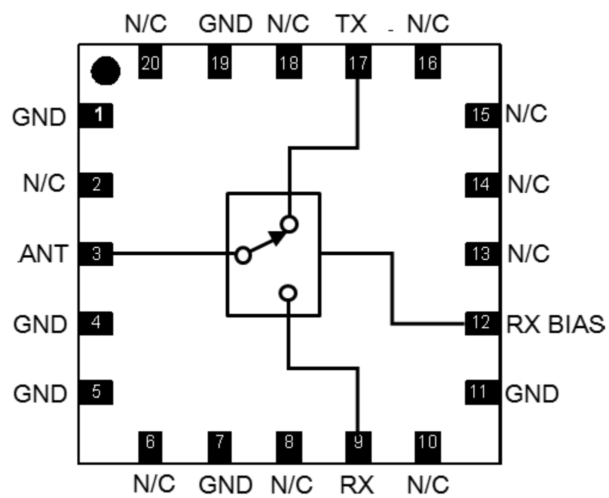
MASW-011120 can be used in any application requiring a low-loss, high-isolation, and high-power-handing SPDT.

Ordering Information[1,2]

Part Number	Package
MASW-011120-TR1000	1000 Piece Tape and Reel
MASW-011120-TR3000	3000 Piece Tape and Reel
MASW-011120-SMB	Sample Board

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

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.

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

Electrical Specifications:
Freq. = 2.7 GHz, 3.5 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 @ 2.7 GHz ANT to TX ON @ 3.5 GHz ANT to RX ON @ 2.7 GHz ANT to RX ON @ 3.5 GHz	dB	—	0.25 0.30 0.35 0.50	0.45 0.50 0.60 0.70
Isolation	ANT to RX (TX ON) @ 2.7 GHz ANT to RX (TX ON) @ 3.5 GHz ANT to TX (RX ON) @ 2.7 GHz ANT to TX (RX ON) @ 3.5 GHz	dB	35 35 12 10	44 44 15 13	—
ANT Return Loss	ANT to RX ON ANT to TX ON	dB	—	23 25	—
TX Return Loss	ANT to TX ON	dB	—	22	—
RX Return Loss	ANT to RX ON	dB	—	26	—
Input P0.1 dB[5]	ANT to TX ON	dBm	—	51	—
IIP3 TX	ANT to TX, P_{IN} = 30 dBm	dBm	—	68	—
IIP3 RX	ANT to RX, P_{IN} = 30 dBm	dBm	—	68.5	—
RF Input Power CW[5] ANT to TX ON	85°C @ 2.7 GHz; 100 mA 85°C @ 2.7 GHz; 200 mA 120°C @ 2.7 GHz; 100 mA 120°C @ 2.7 GHz; 200 mA	W	—	145 200 97 122	—
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	µs	—	0.5 1.6 0.3 0.3	—
Group Delay	—	ns	—	50	—
In-band Ripple	20 MHz 200 MHz	dB	—	0.05 0.1	—

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), 10 mA[6]	(GND), -10 mA[6]	+5 V, 100 mA[6]
ANT to RX (Isolation)	(GND), -100 mA[6]	(+60 V), 10 mA[6]	(GND), -10 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.

Maximum Operating Conditions[7]

Parameter	Operating Maximum
TX Forward Current	250 mA
RX Forward Current	250 mA
Reverse Voltage (RF & DC)	200 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 $T_J \leq +175°C$ will ensure MTTF > 1 x 10^6 hours.

Handling Procedures

Please observe the following precautions to avoid damage:

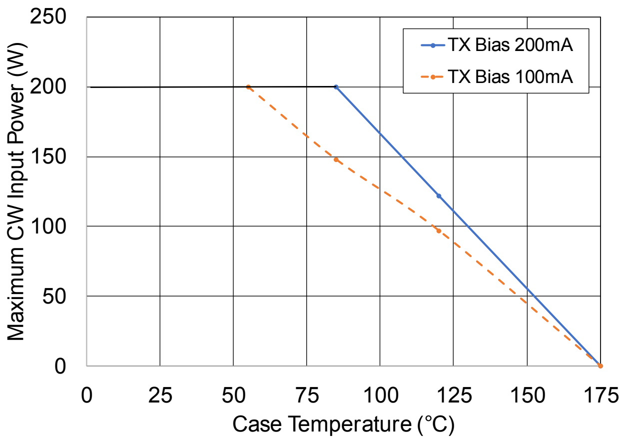
Static Sensitivity

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 devices.

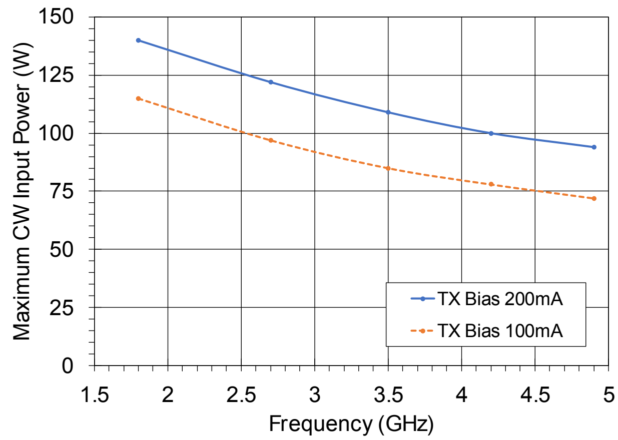
Parameter	Rating	Standard
Human Body Model (HBM)	500 V (Class 1B)	ESDA / JEDEC JS-001
Charged Device Model (CDM)	2000 V (Class C7)	JEDEC JESD22-C101

Typical Performance Curves

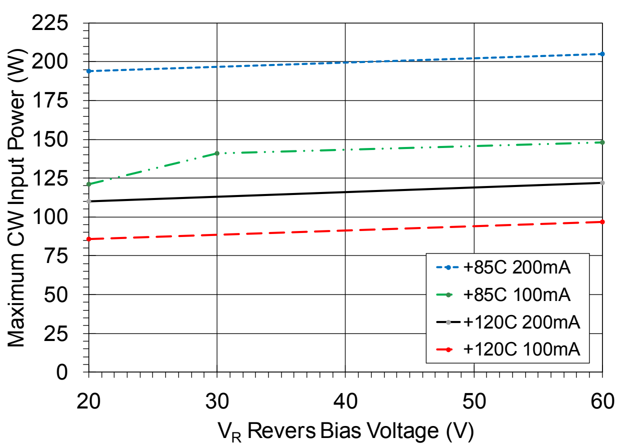
ANT to TX Input Power Derating Curve @ 2.7 GHz



ANT to TX Input Power Derating Curve over Frequency @ 120°C Case Temp



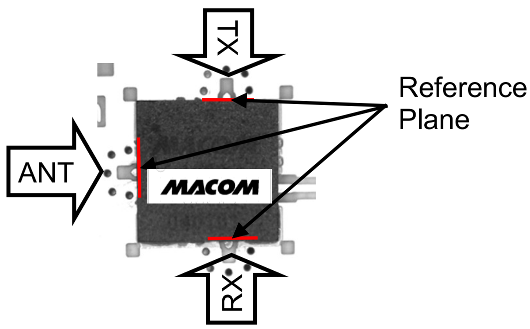
ANT to TX Input Power Derating Curve over Reverse Bias Voltage @ 2.7 GHz



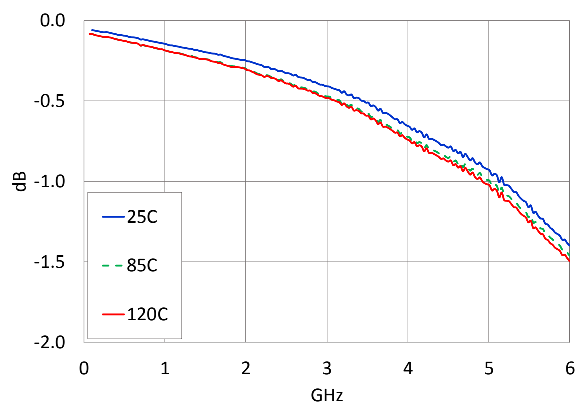
Typical Performance Curves over Temperature

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

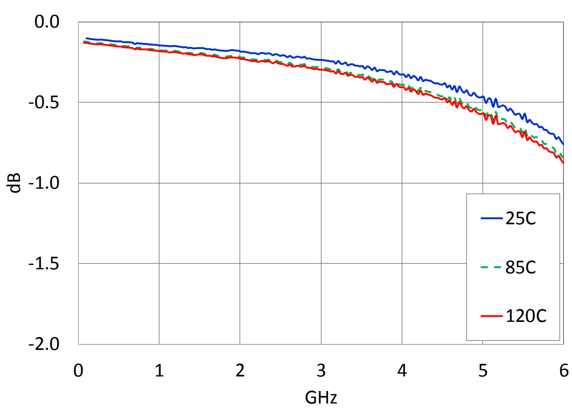
S-parameters were measured using G-S-G probes on a sample board; reference planes are at the part's RF ports. The sample board and its layer stack-up are on page 7



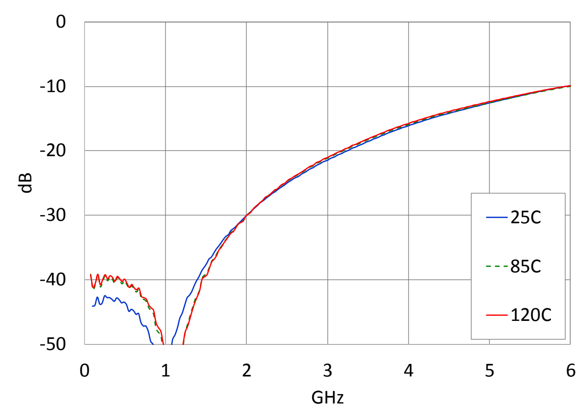
ANT to RX Insertion Loss



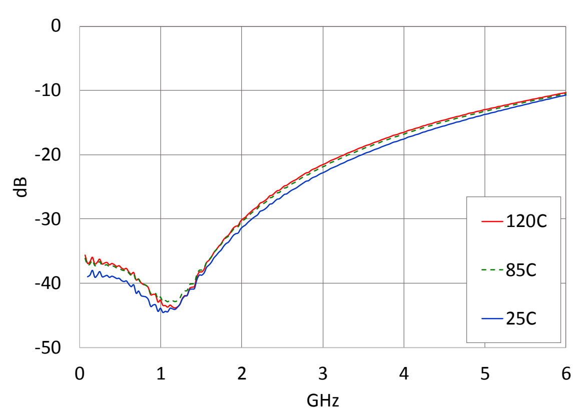
ANT to TX Insertion Loss



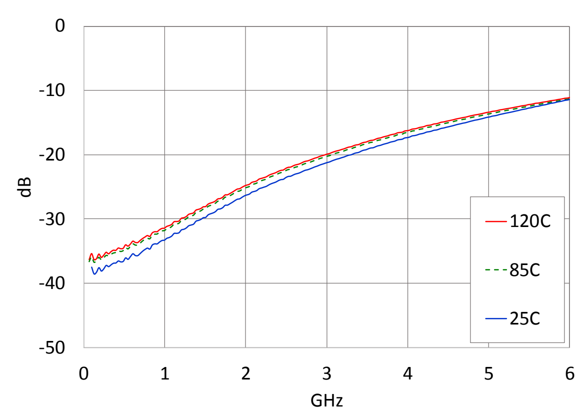
ANT Return Loss in RX ON state



ANT Return Loss in TX ON state

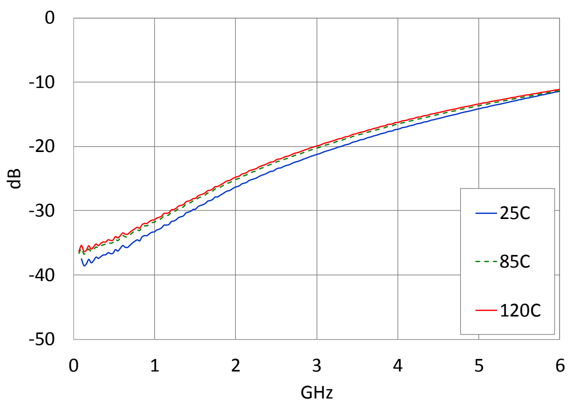


RX Return Loss in RX ON state

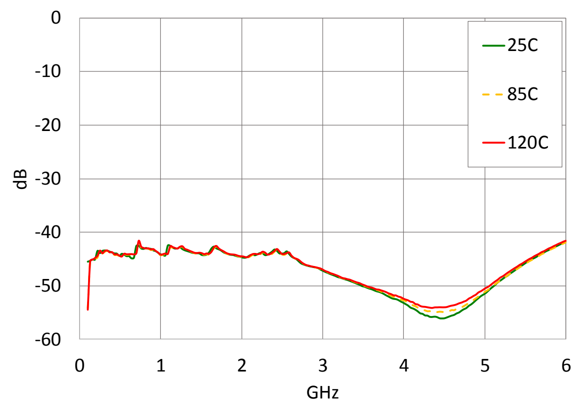


Typical Performance Curves over Temperature

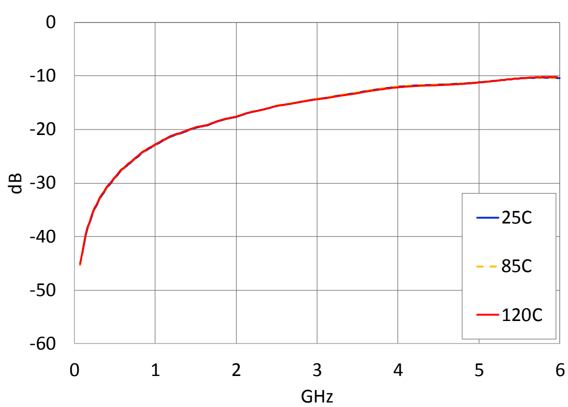
TX Return Loss in TX ON state



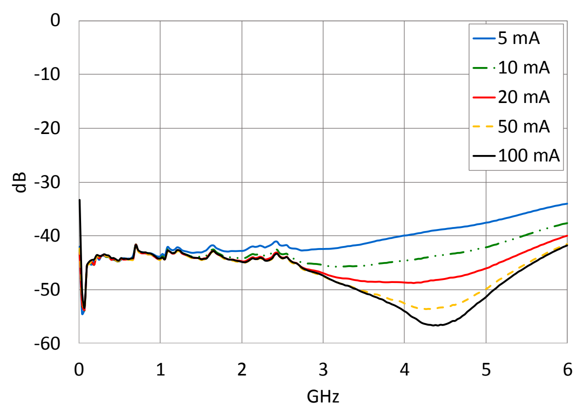
ANT to RX Isolation in TX ON state @ 100 mA



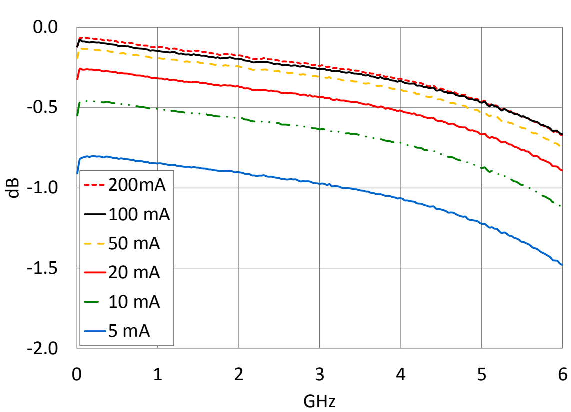
ANT to TX Isolation in RX ON state



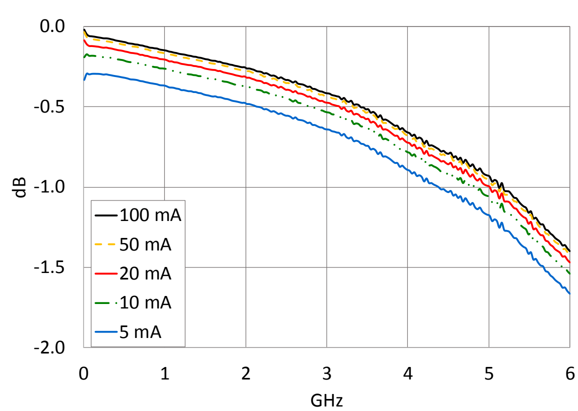
ANT to RX Isolation in TX ON state, over RX Bias Current @ 25°C



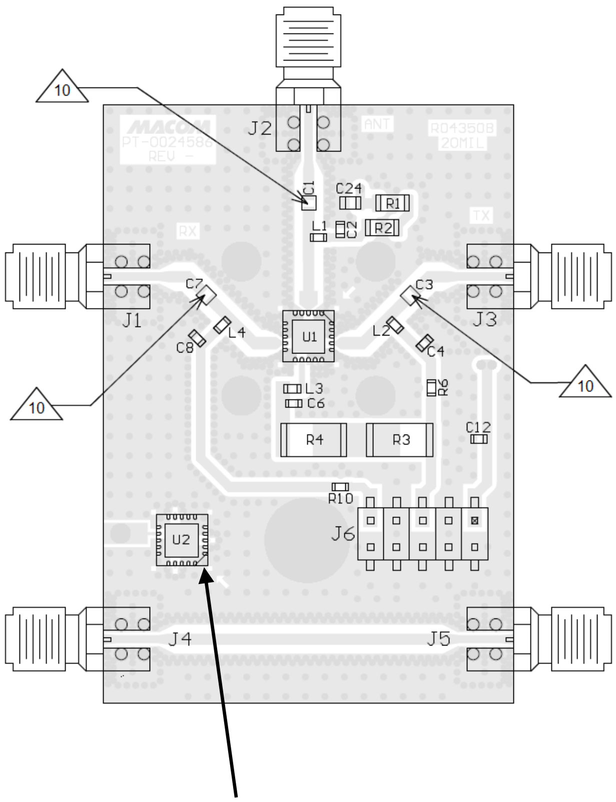
ANT to TX Insertion Loss over Current @ 25°C



ANT to RX Insertion Loss over Current @ 25°C

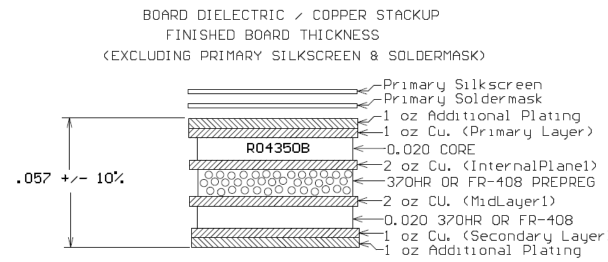


Sample Board



Optional part for probing, provided per request

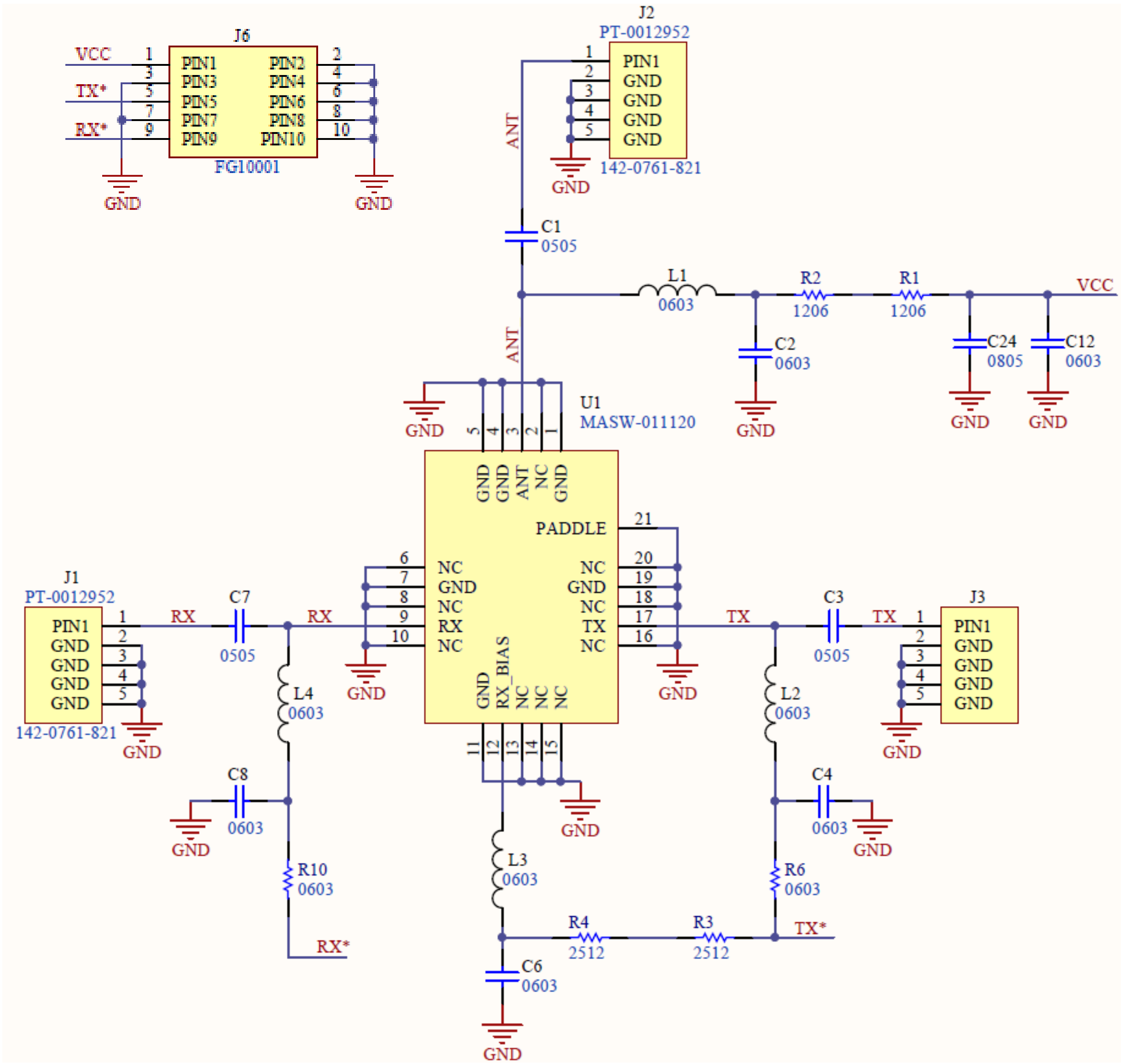
PCB Layout Stack-Up



Dimensions are in inches.

To use the sample board: bias VCC at 5 V (current will be limited to 100 mA by on-board resistors R1, R2) and bias RX and TX according to the control table on page 8.

Sample Board Schematic (parts list on page 9)



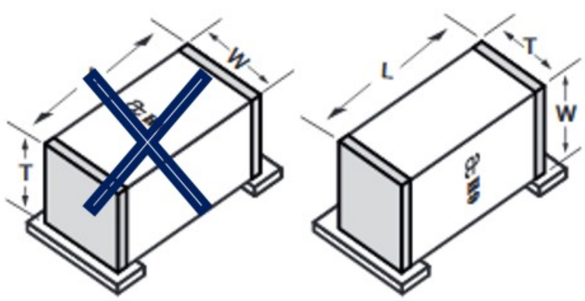
Control Table

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 W
R3, R4	2.37 kΩ	1210	ERJ-14NF2371U	—
R6, R10	0 Ω	0603	—	—
J1-J5	RF CONN	SMA	142-0761-821	—
J6	DC CONN	10-pin	—	Surmount

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

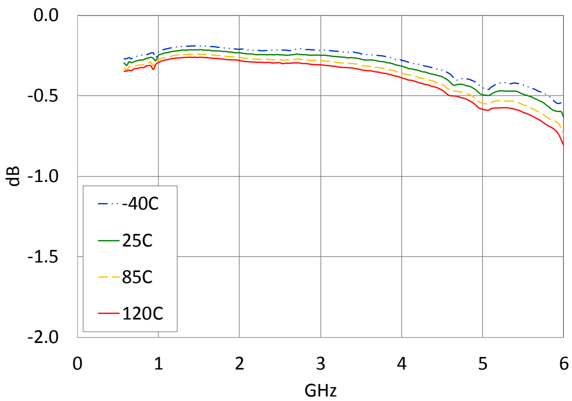


Horizontal
Electrode Orientation

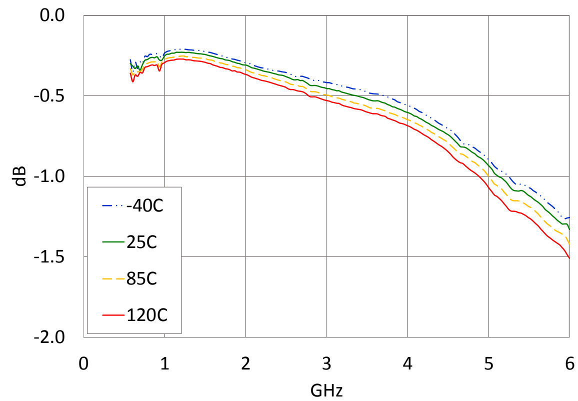
Vertical
Electrode Orientation

Typical Performance Curves on the Sample Board over Temperature

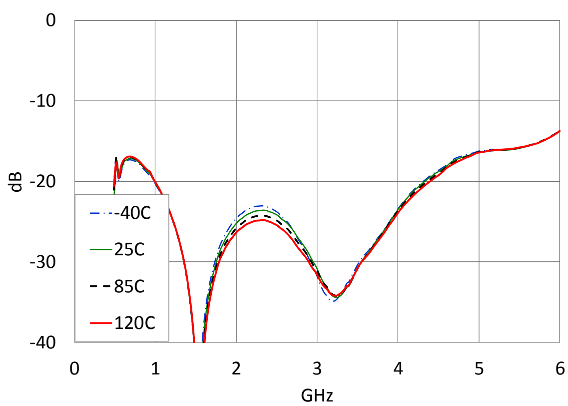
ANT to TX Insertion Loss (PCB loss de-embedded)



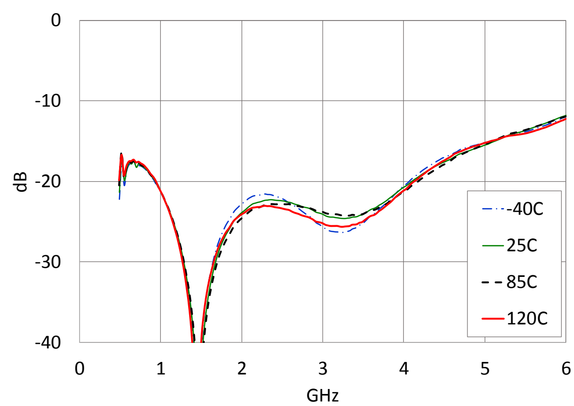
ANT to RX Insertion (PCB loss de-embedded)



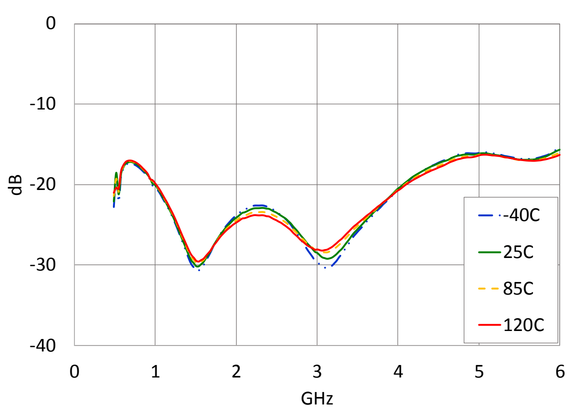
ANT Return Loss in TX ON state



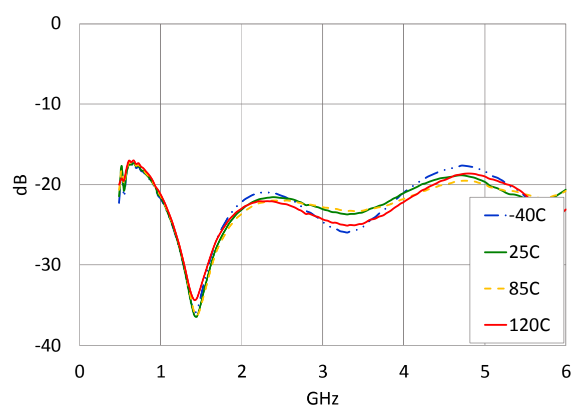
ANT Return Loss in RX ON state



TX Return Loss in TX ON state

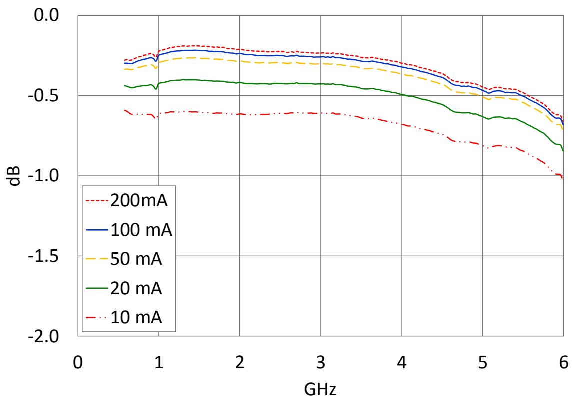


RX Return Loss in RX ON state

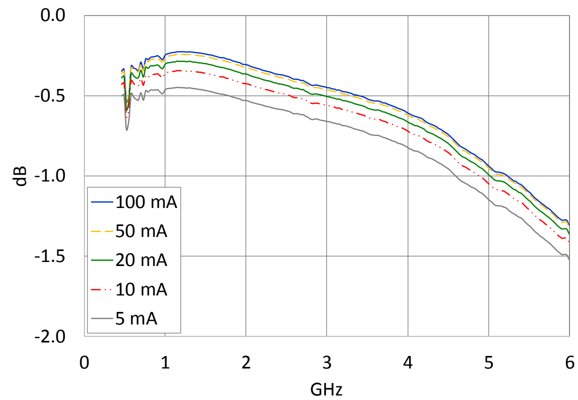


Typical Performance Curves on the Sample Board over Temperature

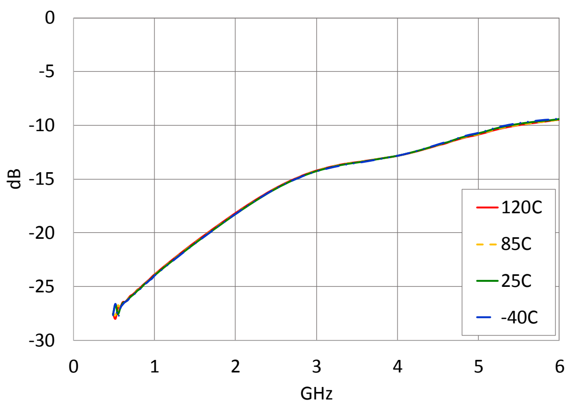
ANT to TX Insertion Loss over Current @ 25°C, PCB Loss De-embedded



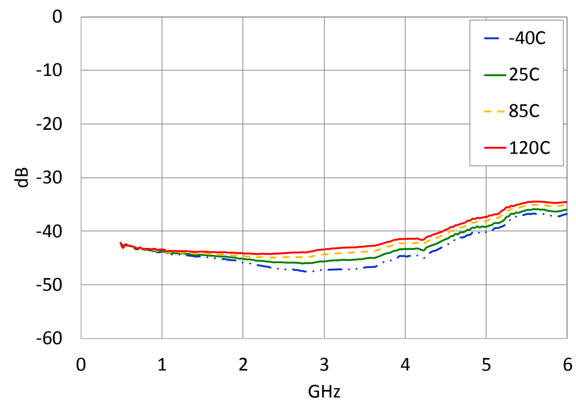
ANT to RX Insertion Loss over Current @ 25°C, PCB Loss De-embedded



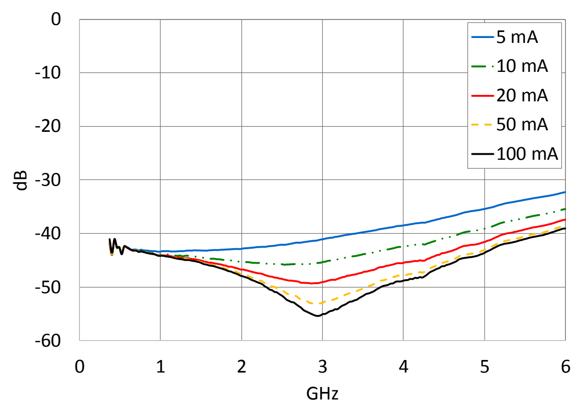
ANT to TX Isolation



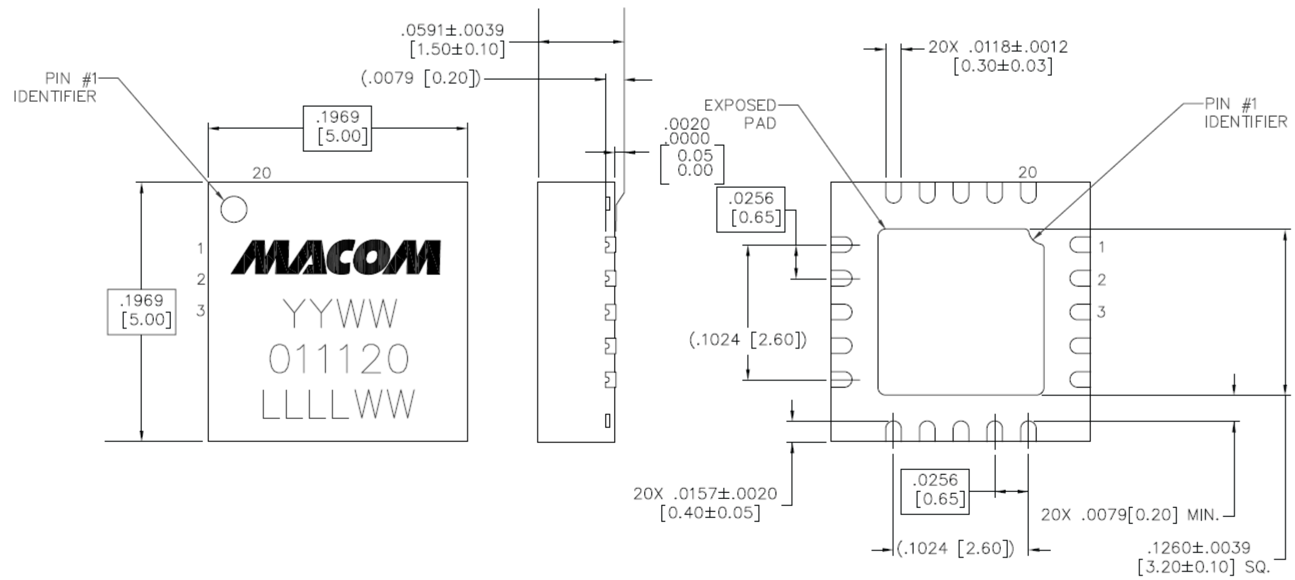
ANT to RX Isolation



ANT to RX Isolation over Current @ 25°C



Lead-Free 5 mm 20-Lead HQFN†



NOTES:
1. ALL DIMENSIONS AND TOLERANCES ARE BASED ON JEDEC MO–220, VAR WITH SAW SINGULATION. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN mm AND CONVERTED in DIMENSIONS ARE NOT NECESSARILY EXACT.

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