

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 @ +85°C
122 W CW @ +120°C
- 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.

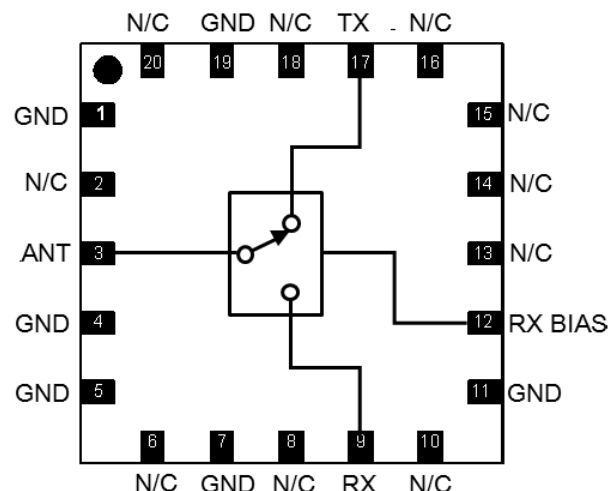
MASW-011120 can be used in any application requiring a low-loss, high-isolation, and high-power-handling SPDT.

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 Configuration³

| 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.

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Electrical Specifications:

Freq. = 2.7 GHz, 3.5 GHz, $T_A = +25^\circ\text{C}$, $Z_0 = 50\ \Omega$, 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, $P_{IN} = 30\ \text{dBm}$ | dBm | — | 68 | — |
| IIP3 RX | ANT to RX, $P_{IN} = 30\ \text{dBm}$ | 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.

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DC-0020391

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Maximum Operating Conditions⁷

| 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 $T_J \leq +175^\circ\text{C}$ will ensure MTTF > 1×10^6 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.

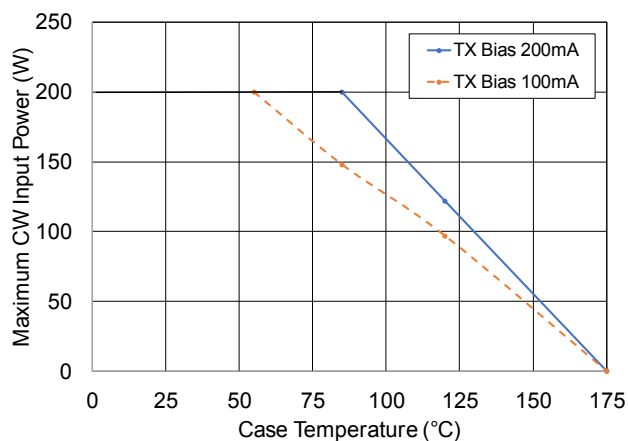
| Parameter | Rating | Standard |
|----------------------------|-------------------|---------------------|
| Human Body Model (HBM) | 500 V (Class 1B) | ESDA / JEDEC JS-001 |
| Charged Device Model (CDM) | 2000 V (Class C7) | JEDEC JESD22-C101 |

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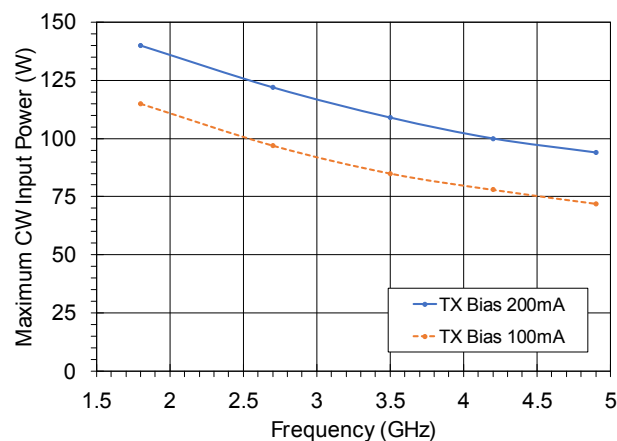
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Typical Performance Curves

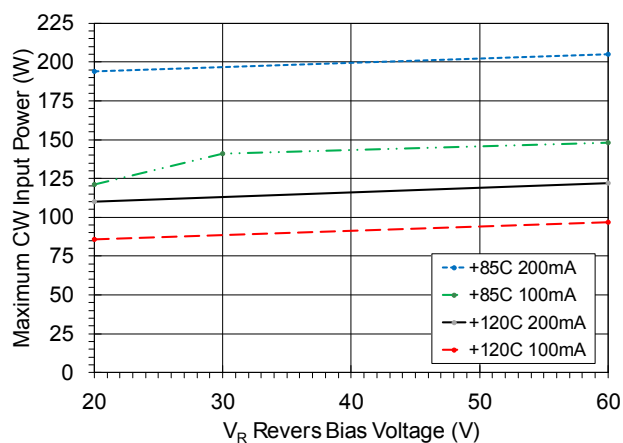
ANT to TX Input Power Derating Curve @ 2.7 GHz



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



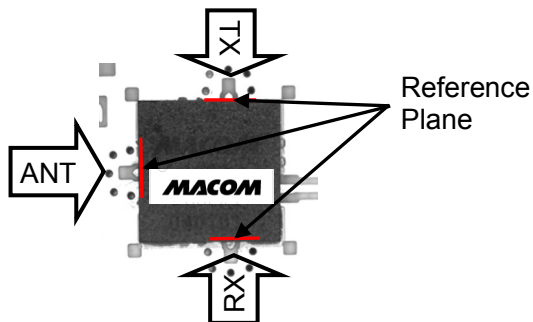
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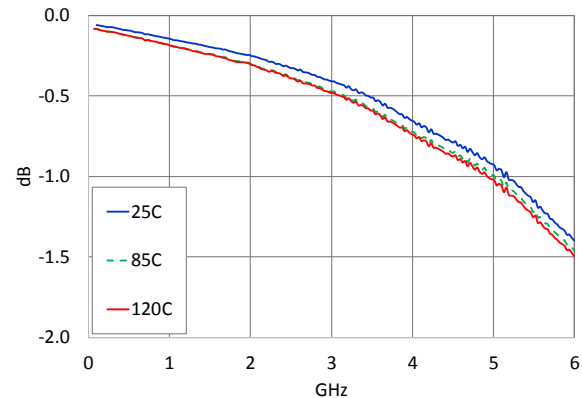
Typical Performance Curves over Temperature

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

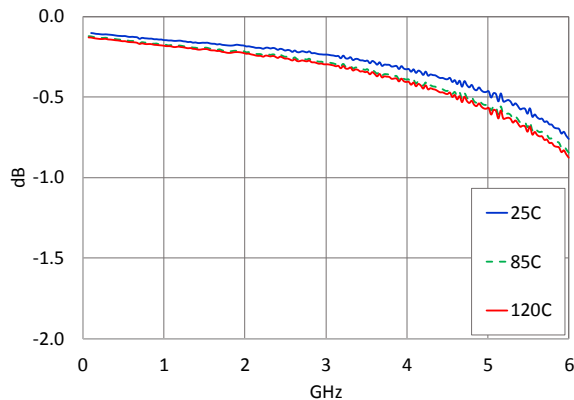
S-parameters were measured using G-S-G probes on a sample board; reference planes are at the part's RF ports. The sample board and its layer stack-up are on page 7



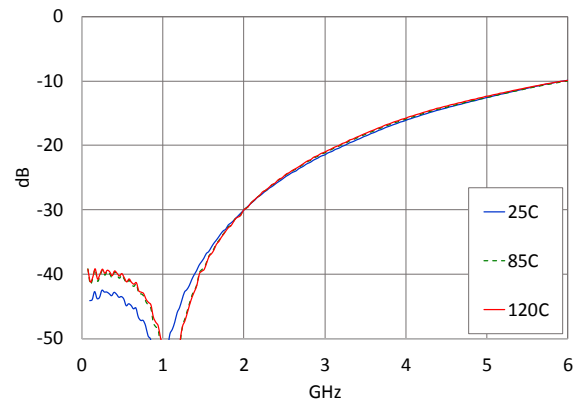
ANT to RX Insertion Loss



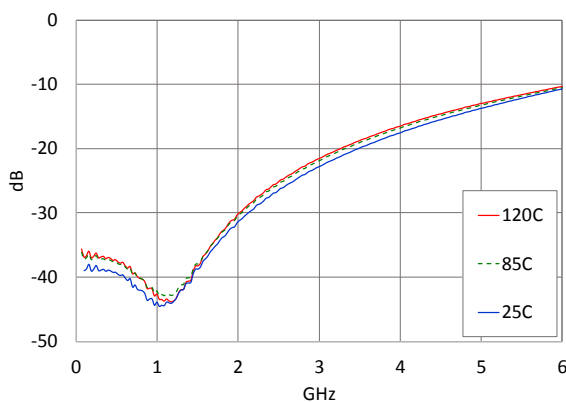
ANT to TX Insertion Loss



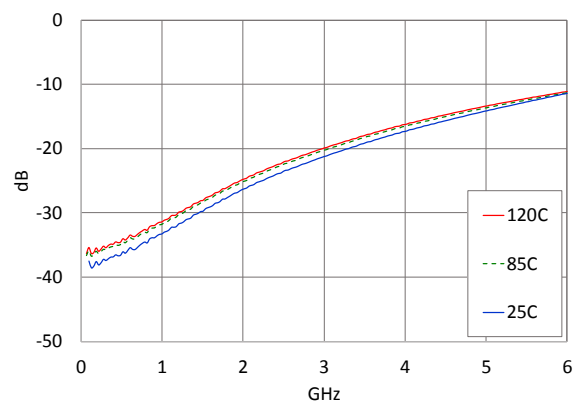
ANT Return Loss in RX ON state



ANT Return Loss in TX ON state



RX Return Loss in RX ON state

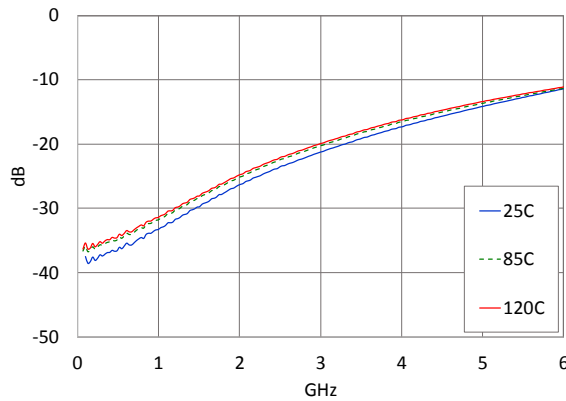


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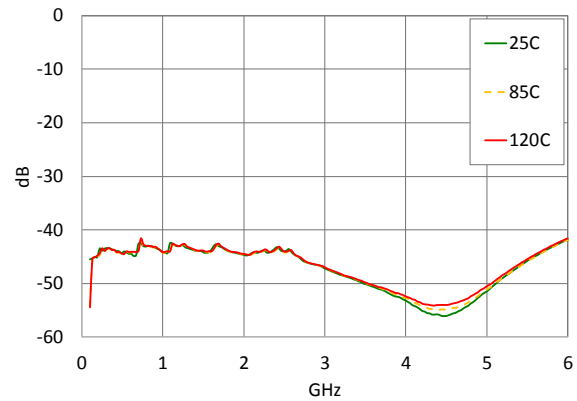
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Typical Performance Curves over Temperature

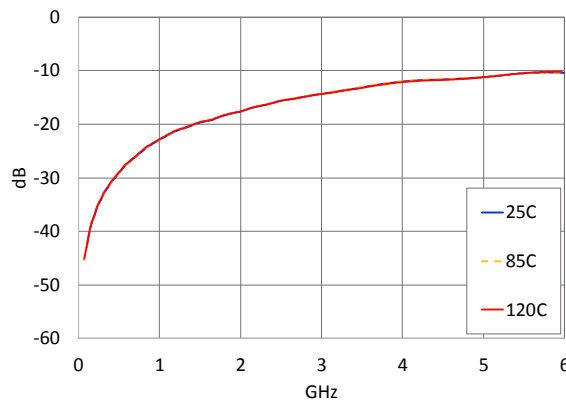
TX Return Loss in TX ON state



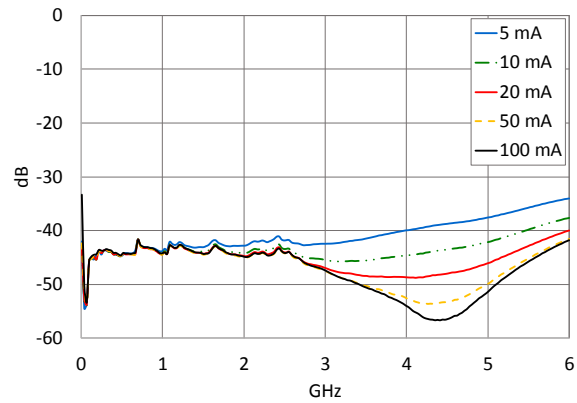
ANT to RX Isolation in TX ON state @ 100 mA



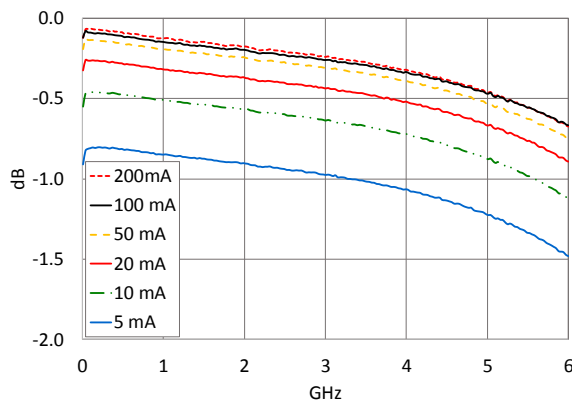
ANT to TX Isolation in RX ON state



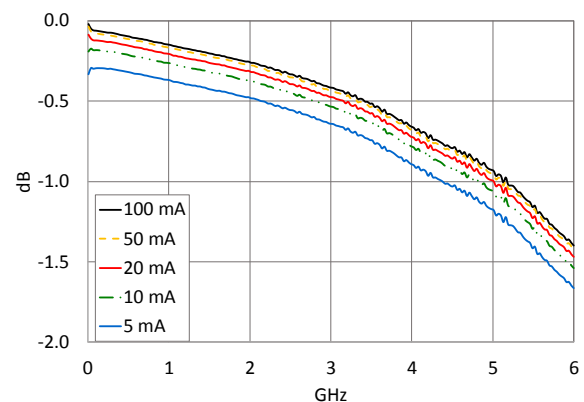
ANT to RX Isolation in TX ON state, over RX Bias Current @ 25°C



ANT to TX Insertion Loss over Current @ 25°C



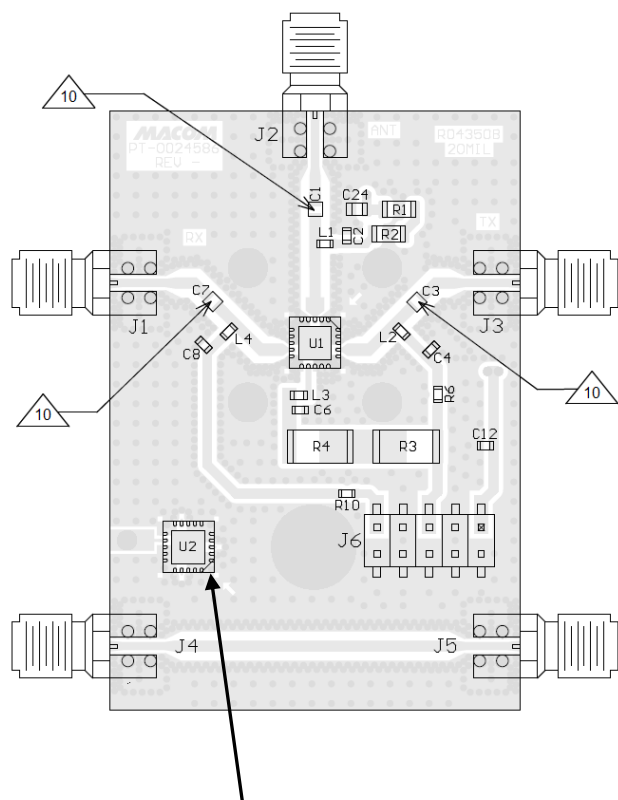
ANT to RX Insertion Loss over Current @ 25°C



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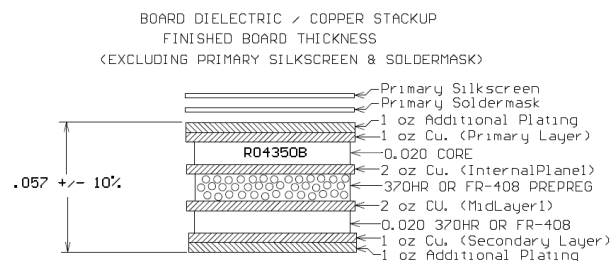
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Sample Board



Optional part for probing, provided per request

PCB Layout Stack-Up



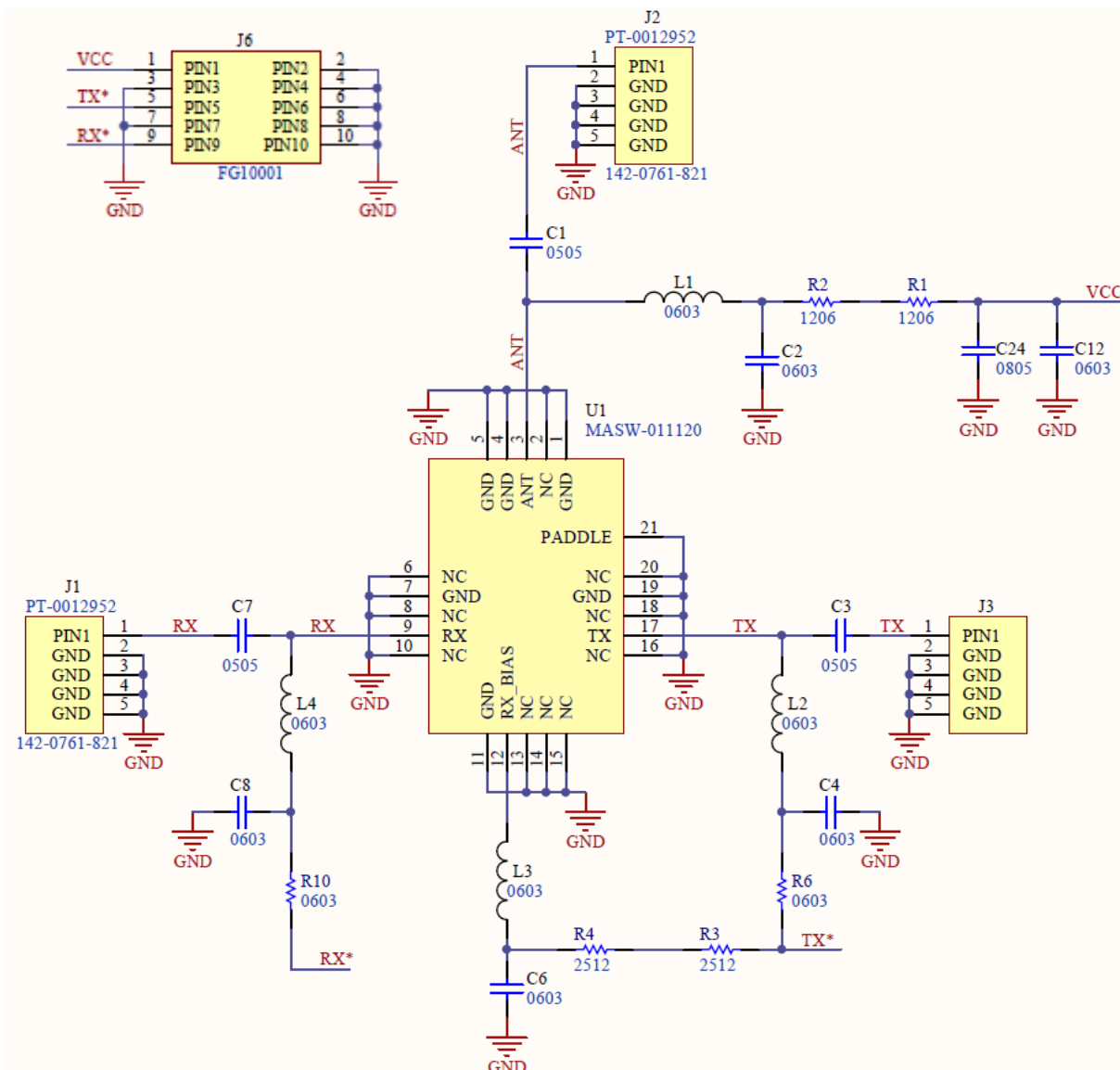
Dimensions are in inches.

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.

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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 |

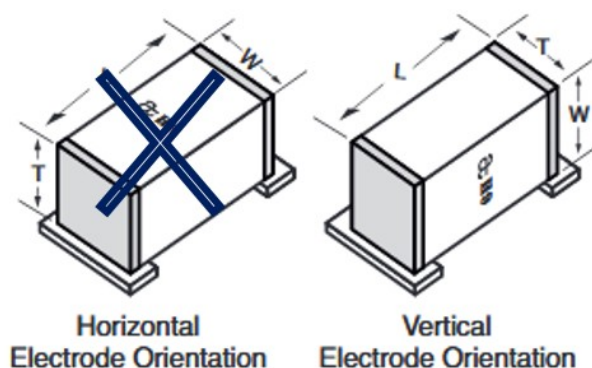
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Parts List

| 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 μ F | 0805 | C2012X7S2A105K125AB | High Freq |
| R1, R2 | 20 Ω | 1206 | CRCW120620R0FKEA | 0.25 W |
| R3, R4 | 2.37 k Ω | 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.

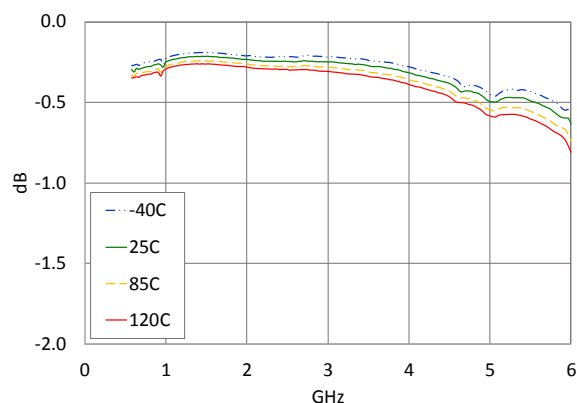


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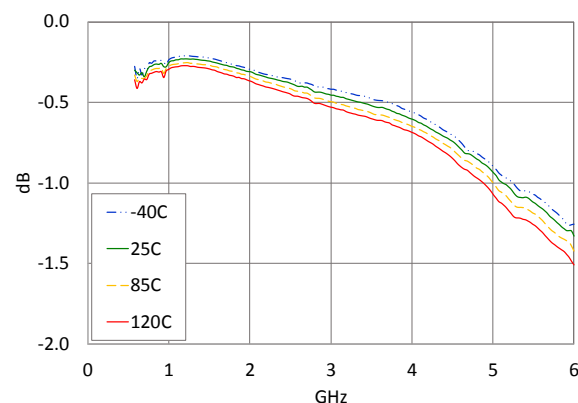
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Typical Performance Curves on the Sample Board over Temperature

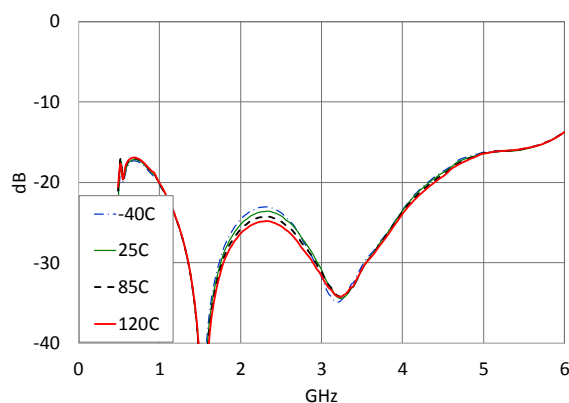
ANT to TX Insertion Loss (PCB loss de-embedded)



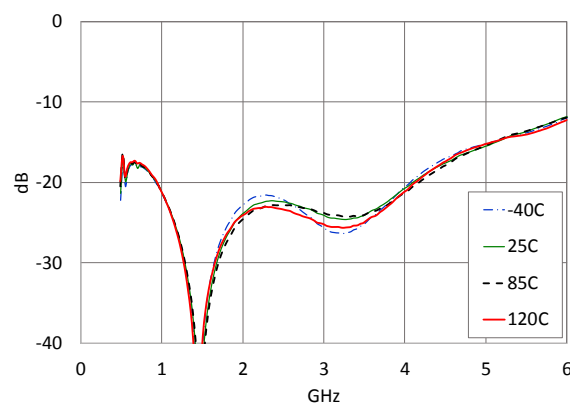
ANT to RX Insertion Loss (PCB loss de-embedded)



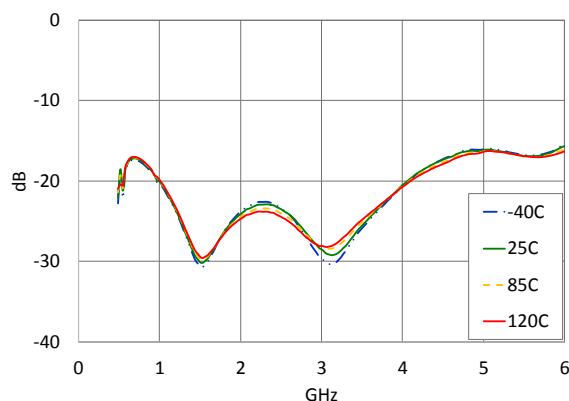
ANT Return Loss in TX ON state



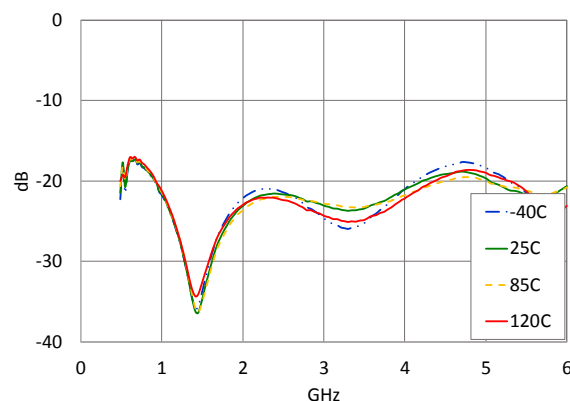
ANT Return Loss in RX ON state



TX Return Loss in TX ON state



RX Return Loss in RX ON state

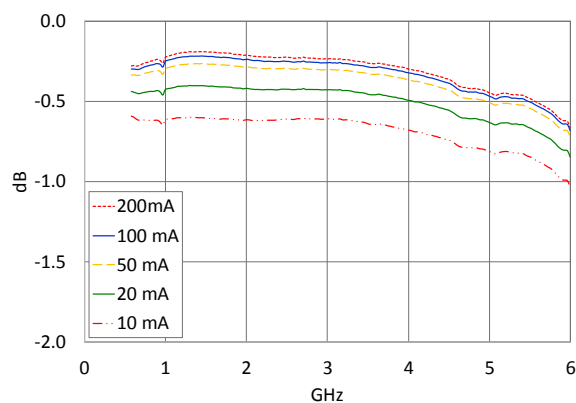


PIN Diode SPDT 200 W Switch for High Power Applications 0.03 - 6.0 GHz

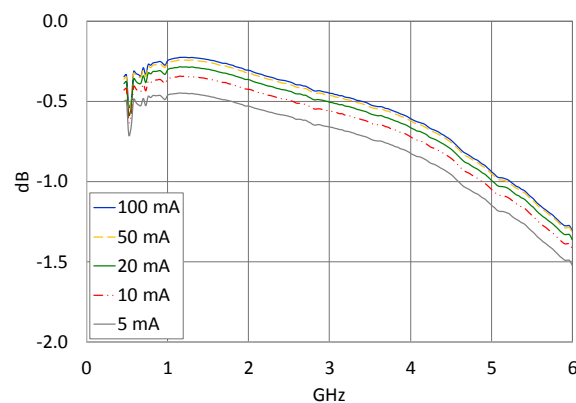
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Typical Performance Curves on the Sample Board over Temperature

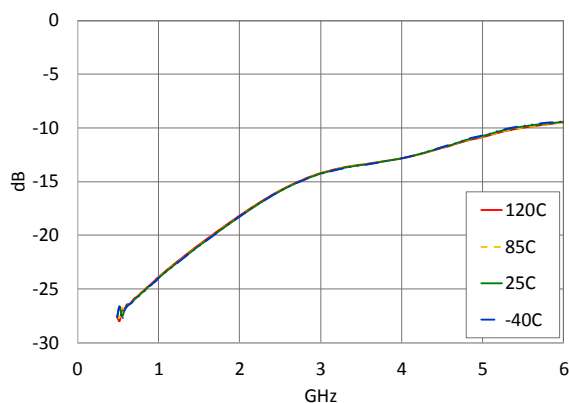
**ANT to TX Insertion Loss over Current @ 25°C,
PCB Loss De-embedded**



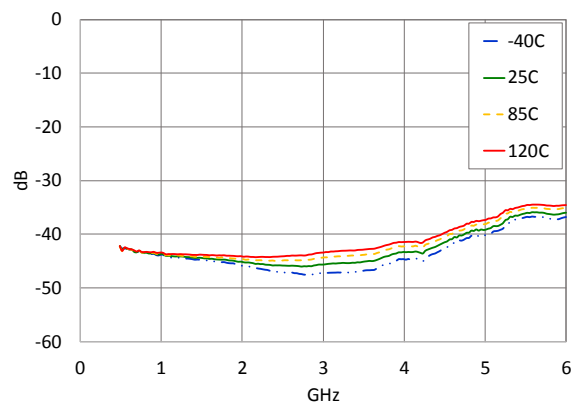
**ANT to RX Insertion Loss over Current @ 25°C,
PCB Loss De-embedded**



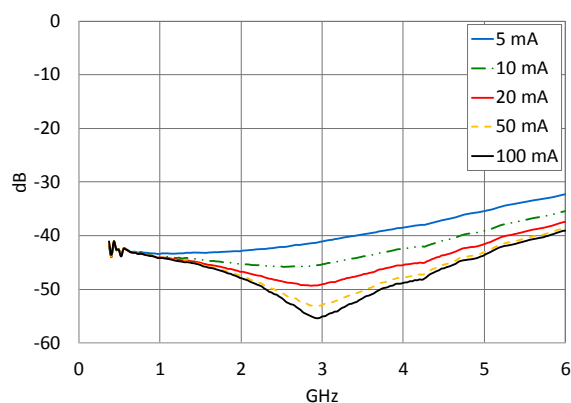
ANT to TX Isolation



ANT to RX Isolation



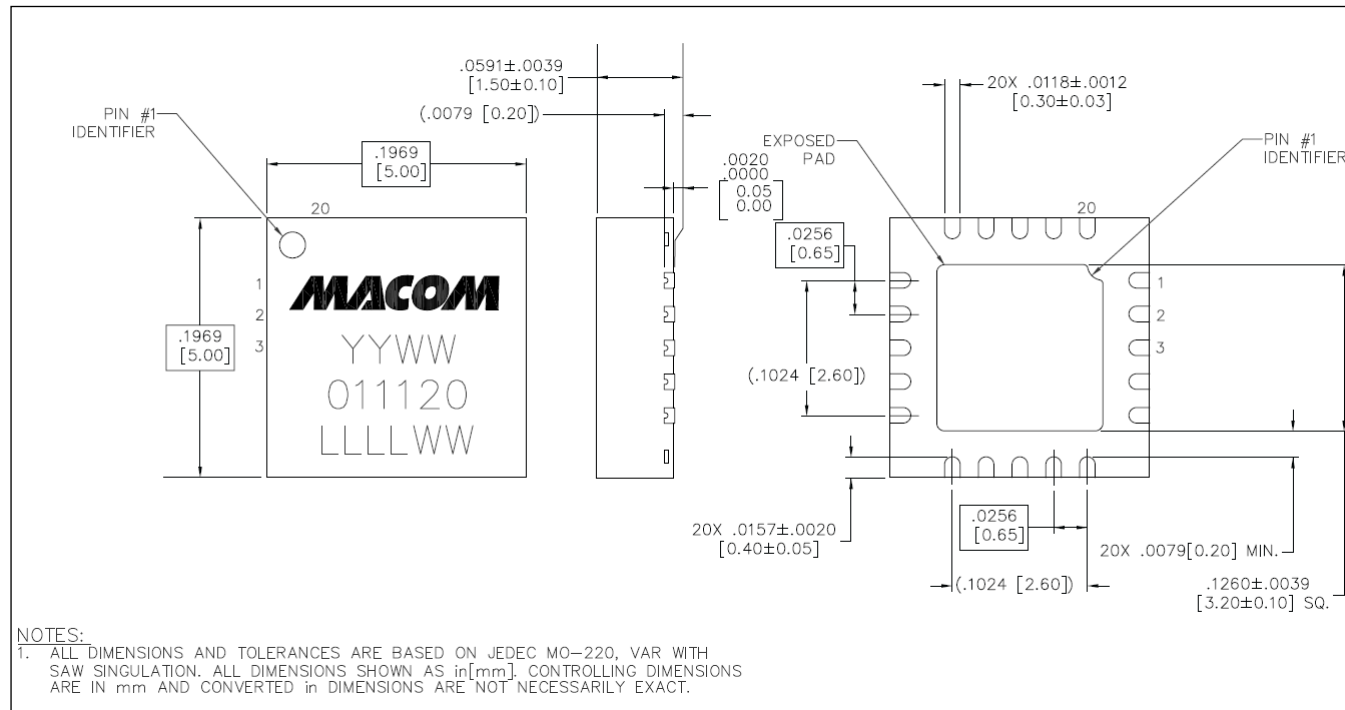
ANT to RX Isolation over Current @ 25°C



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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.

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