

## Integrated Dual Switch - LNA Module 1.8 - 3.9 GHz

Rev. V1

### Features

- Dual Channel Architecture
- Two Low Noise Amplifiers
- Two High Power Switches
- 20 W CW PIN Switch Power Handling
- Gain (Rx Mode):
  - 33 dB @ 2.6 GHz
  - 34 dB @ 3.5 GHz
- Noise Figure (Rx Mode):
  - 1.2 dB @ 2.6 GHz
  - 1.5 dB @ 3.5 GHz
- 0.5 dB Insertion Loss (Tx Mode)
- Lead-Free 5 mm 32-Lead QFN Package
- Integrated ESD Protection
- Halogen-Free "Green" Mold Compound
- RoHS\* Compliant

### Description

The MAMF-011069 is a dual channel module containing two 2-stage low noise amplifiers and two high power switches assembled in a 5 mm 32-lead QFN package.

This module operates from 1.8 GHz - 3.9 GHz. It features high gain and very low noise figure in the receive mode and low insertion loss in the transmission mode. The PIN switches provide high power handling over 20 W CW signal. External SMT components optimize the matching and enable flexible frequency of operation.

The MAMF-011069 is ideally suited for 4G or next generation 5G Massive MIMO or Small Cell BTS.

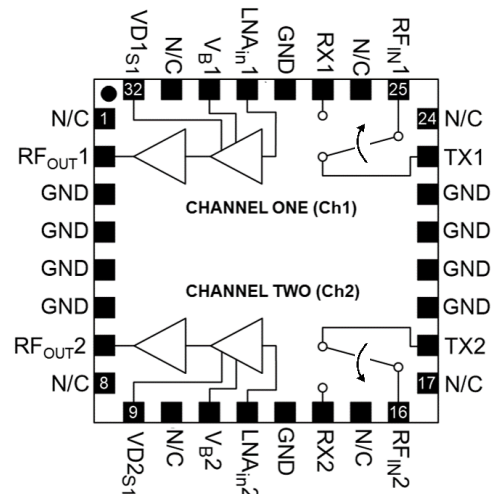
### Ordering Information<sup>1,2</sup>

| Part Number        | Package              |
|--------------------|----------------------|
| MAMF-011069-TR1000 | 1000 Piece Reel      |
| MAMF-011069-1SMB   | 2.6 GHz Sample Board |
| MAMF-011069-2SMB   | 3.5 GHz 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.

### Functional Schematic



### Pin Configuration<sup>3,4</sup>

| Pin #                        | Pin Name | Function                   |
|------------------------------|----------|----------------------------|
| 1, 8, 10, 15, 17, 24, 26, 31 | N/C      | No Connection              |
| 2                            | RF_OUT1  | Ch1 RF Output / VD1_STAGE2 |
| 3-6, 13, 19-22, 28           | GND      | Ground                     |
| 7                            | RF_OUT2  | Ch2 RF Output / VD2_STAGE2 |
| 9                            | VD2_S1   | Ch2 LNA Stage1 VD          |
| 11                           | V_B2     | Ch2 LNA Vbias              |
| 12                           | LNA_IN2  | Ch2 LNA Input              |
| 14                           | RX2      | Ch2 RX / V_RX2             |
| 16                           | RF_IN2   | Ch2 Antenna / V_ANT2       |
| 18                           | TX2      | Ch2 TX / V_TX2             |
| 23                           | TX1      | Ch1 TX / V_TX1             |
| 25                           | RF_IN1   | Ch1 Antenna / V_ANT1       |
| 27                           | RX1      | Ch1 RX / V_RX1             |
| 29                           | LNA_IN1  | Ch1 LNA Input              |
| 30                           | V_B1     | Ch1 LNA Vbias              |
| 32                           | VD1_S1   | Ch1 LNA Stage1 VD          |
| 33                           | Paddle   | Ground                     |

3. MACOM recommends connecting unused package pins (N/C) to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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**1.8 - 3.9 GHz**

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**Electrical Specifications<sup>5</sup>:**
**Frequency = 2.6 GHz,  $T_A = 25^\circ\text{C}$ ,  $V_D = 5\text{ V}$ , Switch Bias = (see Bias Table),  $Z_0 = 50\ \Omega$** 

| Parameter  | Test Conditions  | Units | Min. | Typ. | Max. |
|--|--|-------|------|------|------|
| Gain<br>$\text{RF}_{\text{IN}} - \text{RF}_{\text{OUT}}$         | Rx Mode  | dB    | 31   | 33   | —    |
| Noise Figure<br>$\text{RF}_{\text{IN}} - \text{RF}_{\text{OUT}}$ | Rx Mode  | dB    | —    | 1.2  | —    |
| Return Loss<br>$\text{RF}_{\text{IN}} - \text{RF}_{\text{OUT}}$  | Rx Mode  | dB    | —    | 13   | —    |
| Output IP3<br>$\text{RF}_{\text{IN}} - \text{RF}_{\text{OUT}}$   | Rx Mode<br>$P_{\text{IN}} = -32\text{ dBm/ tone, tone spacing } 10\text{ MHz}$ | dBm   | —    | 33   | —    |
| P1dB<br>$\text{RF}_{\text{IN}} - \text{RF}_{\text{OUT}}$         | Rx Mode  | dBm   | —    | 19   | —    |
| Isolation<br>$\text{RF}_{\text{OUT}1} - \text{RF}_{\text{OUT}2}$ | Switch State = $\text{RF}_{\text{IN}} - \text{RF}_{\text{OUT}}$                | dB    | —    | 37   | —    |
| Insertion Loss<br>$\text{RF}_{\text{IN}} - \text{TX}$            | Tx Mode  | dB    | —    | 0.5  | 0.8  |
| Return Loss<br>$\text{RF}_{\text{IN}} - \text{TX}$               | Tx Mode  | dB    | —    | 23   | —    |
| LNA Bias Current   | LNA1 Current + LNA2 Current  | mA    | —    | 210  | —    |
| Switch Current   | $V_{\text{ANT}} = 5\text{ V}$ , Ch1 + Ch2 ANT Current                          | mA    | —    | 45   | —    |
| RF Switching Time  | —  | ns    | —    | 200  | —    |

5. Specifications with the use of external matching components per recommended schematic for 2.6 GHz operation. Refer to schematic on page 4.

**Bias Table (See Recommended Schematic on Page 4)**

| $\text{RF}_{\text{IN}} - \text{RF}_{\text{OUT}}$<br>(Rx Mode) | $\text{RF}_{\text{IN}} - \text{TX}$<br>(Tx Mode) | $V_D$ | $V_{\text{ANT}}$ | $V_{\text{RX}}$ | $V_{\text{TX}}$ |
|---|--|-------|------------------|-----------------|-----------------|
| ON  | OFF  | 5 V   | 5 V              | 0 V             | 28 V (0 mA)     |
| OFF   | ON   | 0 V   | 5 V              | 28 V (0 mA)     | 0 V             |

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### Absolute Maximum Ratings<sup>6,7,8,9</sup>

| Parameter   | Absolute Maximum  |
|---|-------------------|
| RF Input Power<br>$RF_{IN} - RF_{OUT}$<br>$RF_{IN} - Tx$              | 19 dBm<br>20 W CW |
| LNA Bias Voltage<br>$V_{B1}$ & $V_{B2}$<br>$RF_{OUT}$ & $VD_{STAGE1}$ | 5.0 V<br>5.5 V    |
| Junction Temperature<br>Switch<br>LNA                                 | +175°C<br>+150°C  |
| Operating Temperature   | -40°C to +105°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.
8. Operating at nominal conditions with  $T_J \leq 150^\circ\text{C}$  will ensure  $MTTF > 1 \times 10^6$  hours. Channel temperature should be kept as low as possible to maximize lifetime.
9. LNA Junction Temperature ( $T_J$ ) =  $T_C + \Theta_{JC} \cdot (V \cdot I)$   
Typical thermal resistance ( $\Theta_{JC}$ ) = 55°C/W.
  - a) For  $T_C = 25^\circ\text{C}$ ,  
 $T_J = 54^\circ\text{C}$  @ 5 V, 105 mA
  - b) For  $T_C = 85^\circ\text{C}$ ,  
 $T_J = 113^\circ\text{C}$  @ 5 V, 98 mA

### Handling Procedures

Please observe the following precautions to avoid damage:

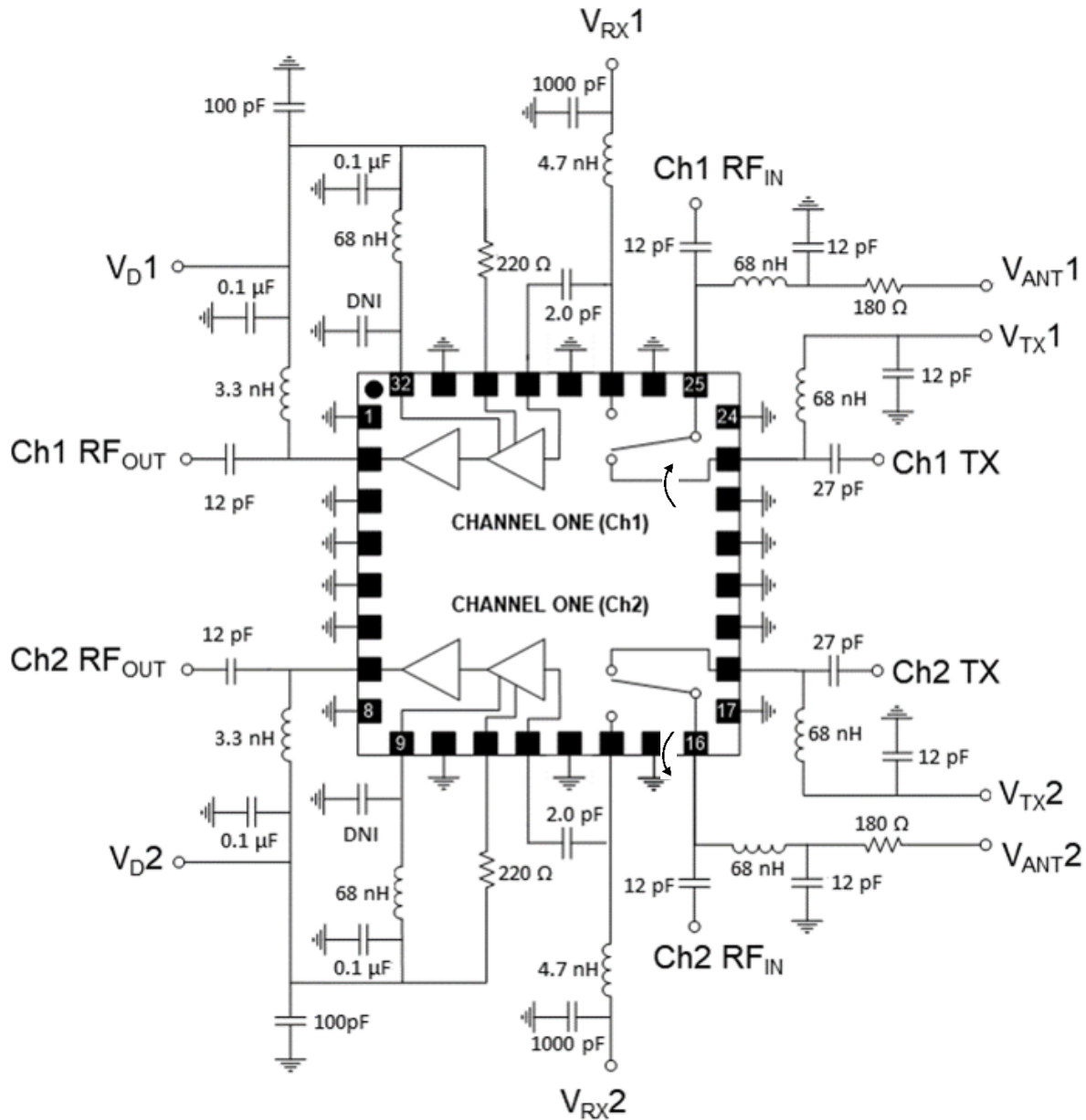
### Static Sensitivity

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 1B devices.

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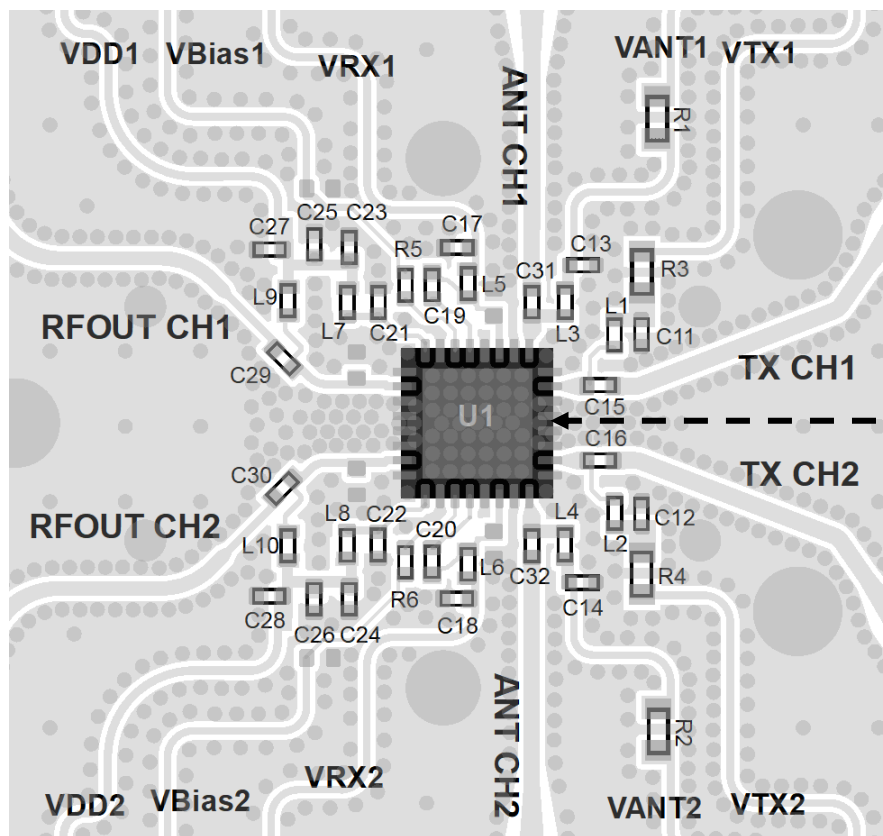
### Recommended Schematic (2.6 GHz Operation)



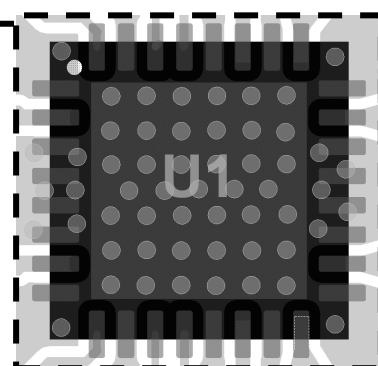
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### PCB Layout - Sample Board, 2.6 GHz Operation



PCB Land Pattern<sup>10</sup>



10. For best performance, ensure proper grounding at the device.

### Part List<sup>11</sup>

| Component            | Value           | Description              |
|----------------------|-----------------|--------------------------|
| C1 - C10             | 100 pF          | 0603 SMT Capacitor       |
| C11 - C14, C29 - C32 | 12 pF           | 0402 SMT Capacitor       |
| C15, C16             | 27 pF           | 0402 SMT Capacitor       |
| C17, C18             | 1000 pF         | 0402 SMT Capacitor       |
| C19, C20             | 2 pF            | 0402 SMT Capacitor       |
| C21, C22             | Do Not Populate | —                        |
| C23, C24, C27, C28   | 0.1 $\mu$ F     | 0402 SMT Capacitor       |
| C25, C26             | 100 pF          | 0402 SMT Capacitor       |
| L1 - L4, L7, L8      | 68 nH           | 0402 Wire Wound Inductor |
| L5, L6               | 4.7 nH          | 0402 Wire Wound Inductor |
| L9, L10              | 3.3 nH          | 0402 Inductor            |
| R1, R2               | 180 $\Omega$    | 0402 SMT Resistor        |
| R3, R4               | 0 $\Omega$      | 0603 SMT Resistor        |
| R5, R6               | 220 $\Omega$    | 0402 SMT Resistor        |

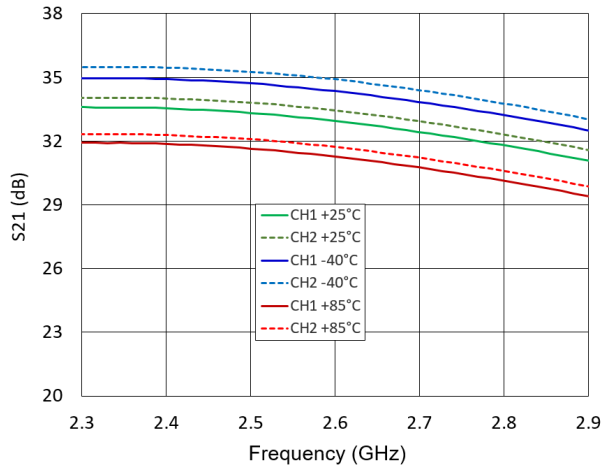
11. Bypass capacitors C1 - C10 are not shown on PCB layout.

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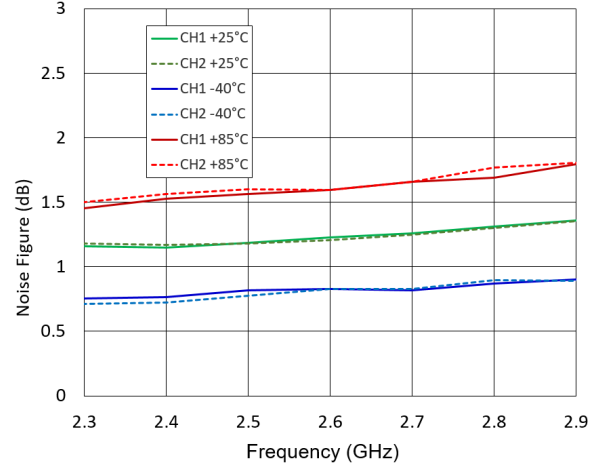
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### Typical Performance Curves: 2.6 GHz Operation

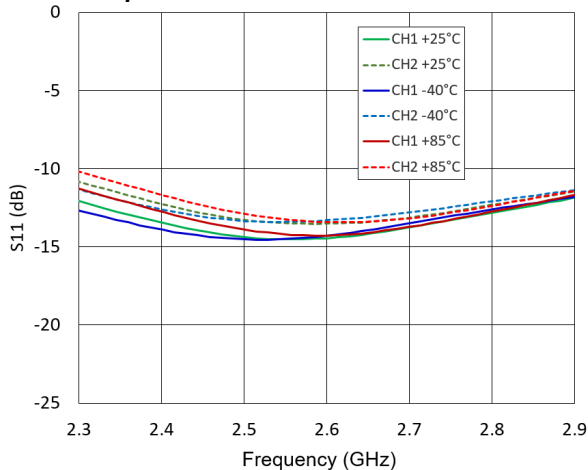
**Rx Mode: Gain**



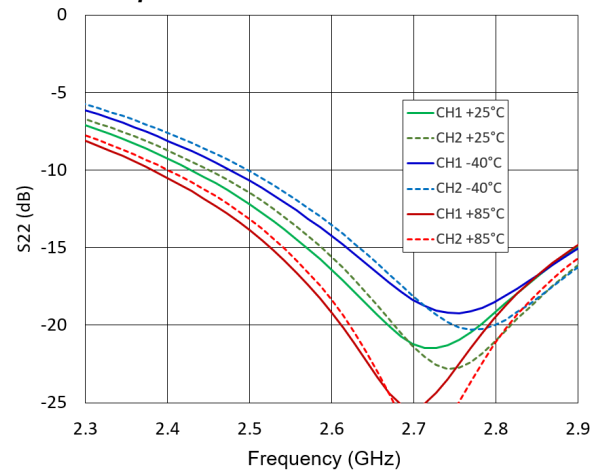
**Rx Mode: Noise Figure**



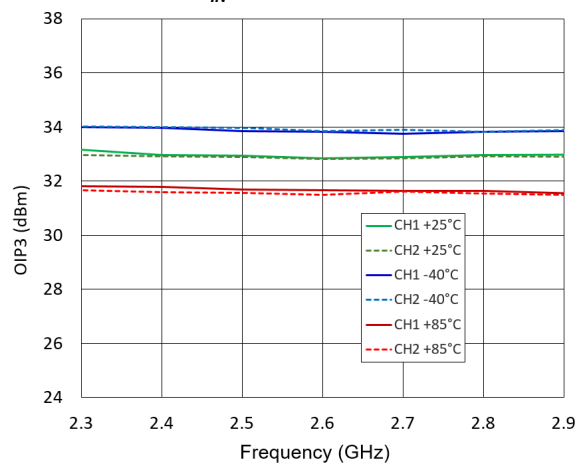
**Rx Mode: Input Return Loss**



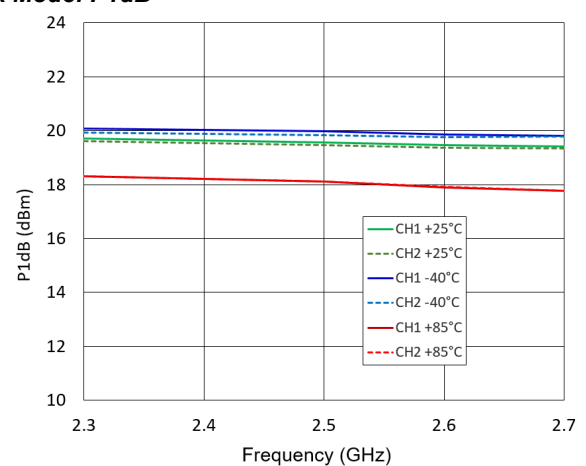
**Rx Mode: Output Return Loss**



**Rx Mode: OIP3 at P<sub>IN</sub> = -32 dBm/tone**



**Rx Mode: P1dB**

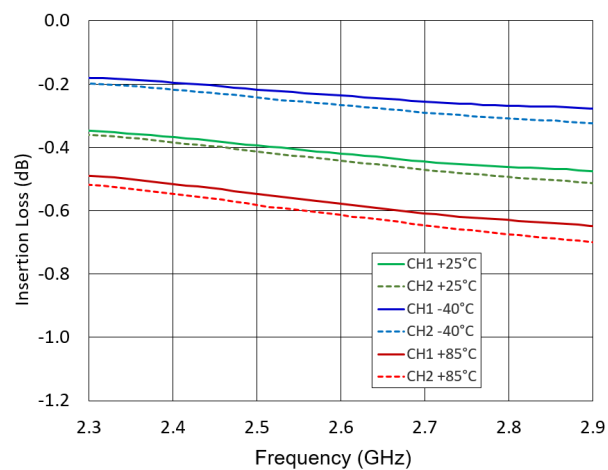


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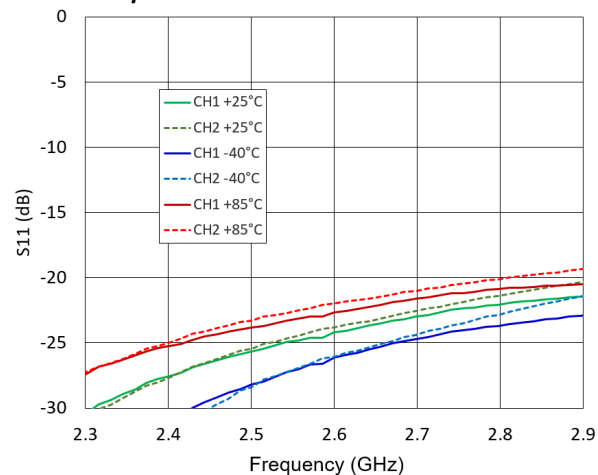
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### Typical Performance Curves: 2.6 GHz Operation

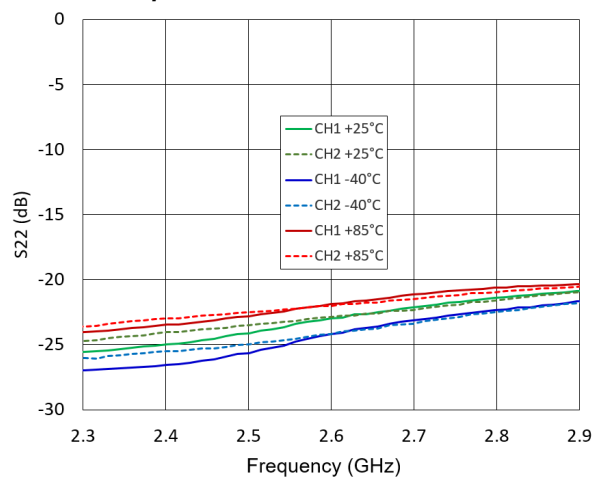
**Tx Mode: Insertion Loss**



**Tx Mode: Input Return Loss**



**Tx Mode: Output Return Loss**

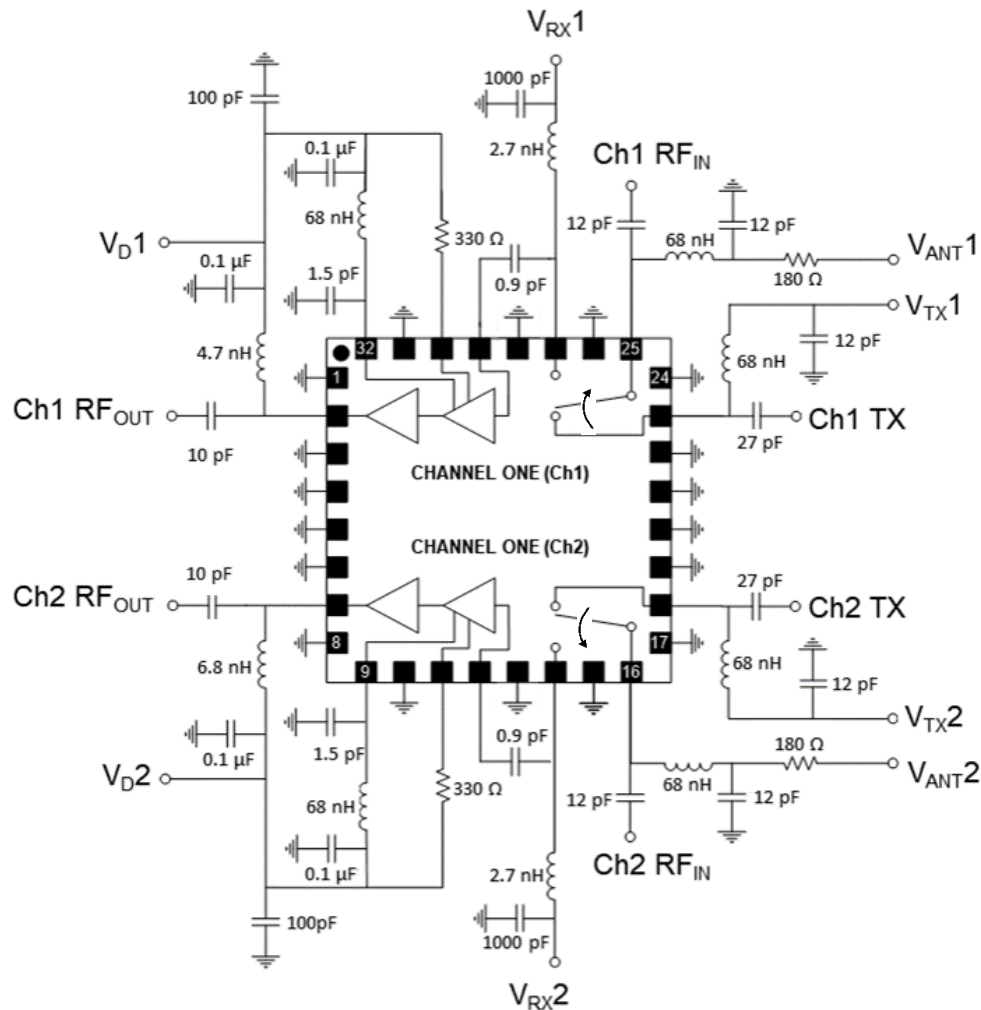


## Integrated Dual Switch - LNA Module 1.8 - 3.9 GHz

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### Application Section - 3.4 - 3.6 GHz Operation

The MAMF-011069 may be tuned for operation in 3.4 - 3.6 GHz band with alternate external tuning components. Updated parts are indicated in the table below. Non - listed components are the same as in the 2.6 GHz tune on page 5.



### Part List: 3.4 - 3.6 GHz Operation

| Component | Value  | Package                  |
|-----------|--------|--------------------------|
| C19 , C20 | 0.9 pF | 0402 SMT Capacitor       |
| C21, C22  | 1.5 pF | 0402 SMT Capacitor       |
| L5, L6    | 2.7 nH | 0402 Wire Wound Inductor |
| L9        | 4.7 nH | 0402 Inductor            |
| L10       | 6.8 nH | 0402 Inductor            |
| R5, 46    | 330 Ω  | 0402 SMT Resistor        |

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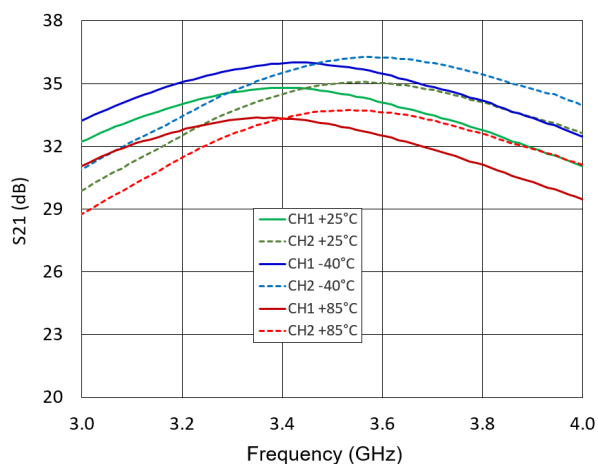
**Typical Performance<sup>12</sup>:**  $T_A = 25^\circ\text{C}$ ,  
 $V_D = 5\text{ V}$ , Switch Bias = (see Bias Table on Page 2),  $Z_0 = 50\ \Omega$ , 3.4 - 3.6 GHz Tune

| Parameter                            | Test Conditions   | Units | Min. | Typ.    | Max. |
|--------------------------------------|---|-------|------|---------|------|
| Gain<br>$RF_{IN} - RF_{OUT}$         | Rx Mode   | dB    | —    | 34      | —    |
| Noise Figure<br>$RF_{IN} - RF_{OUT}$ | Rx Mode   | dB    | —    | 1.5     | —    |
| Return Loss<br>$RF_{IN} - RF_{OUT}$  | Rx Mode: Input<br>Output  | dB    | —    | 8<br>13 | —    |
| Output IP3<br>$RF_{IN} - RF_{OUT}$   | Rx Mode<br>$P_{IN} = -32\text{ dBm/ tone, tone spacing } 10\text{ MHz}$ | dBm   | —    | 32      | —    |
| P1dB<br>$RF_{IN} - RF_{OUT}$         | Rx Mode   | dBm   | —    | 19      | —    |
| Insertion Loss<br>$RF_{IN} - TX$     | Tx Mode   | dB    | —    | 0.5     | —    |
| Return Loss<br>$RF_{IN} - TX$        | Tx Mode   | dB    | —    | 19      | —    |

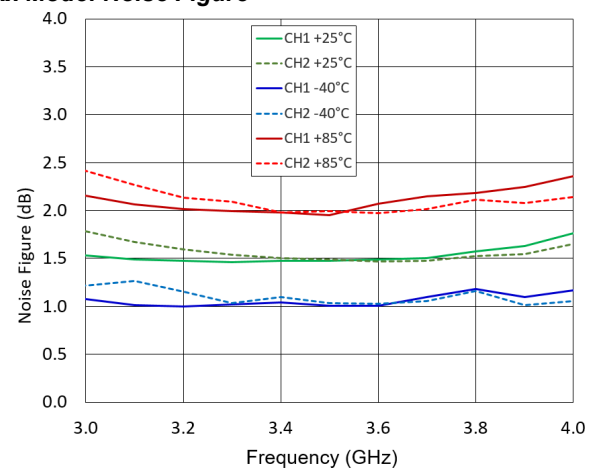
12. Performance with the use of the external matching components per recommended schematic for 3.4 - 3.6 GHz operation. See schematic on page 8.

## Typical Performance Curves: 3.4 - 3.6 GHz Operation

**Rx Mode: Gain**



**Rx Mode: Noise Figure**

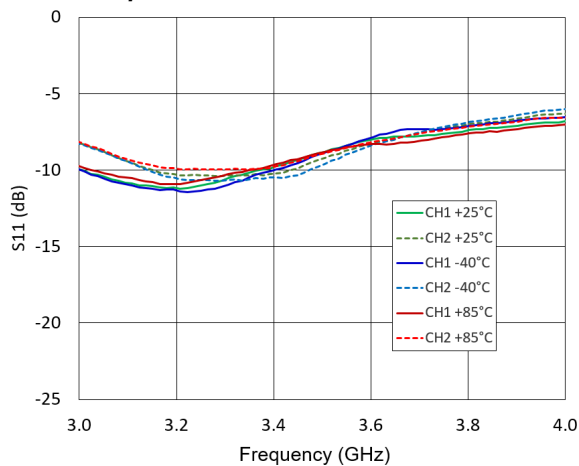


## Integrated Dual Switch - LNA Module 1.8 - 3.9 GHz

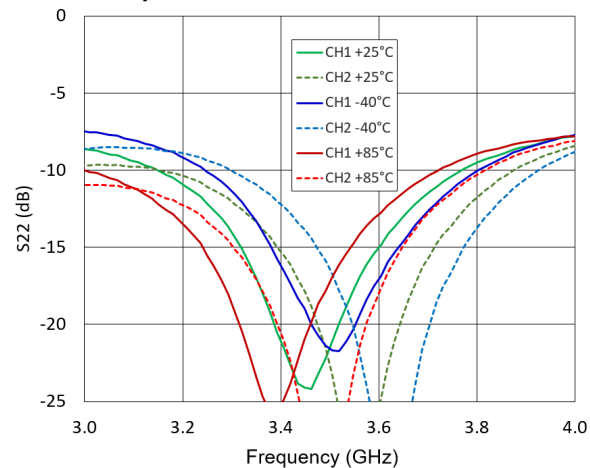
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### Typical Performance Curves: 3.4 - 3.6 GHz Operation

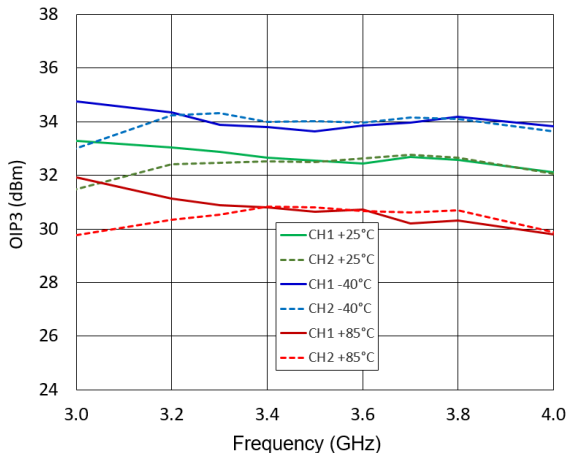
**Rx Mode: Input Return Loss**



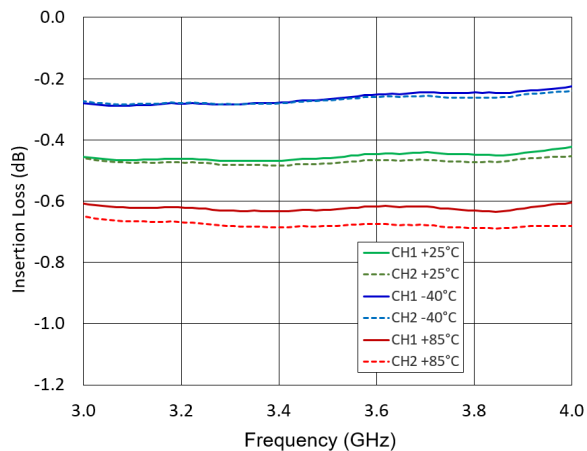
**Rx Mode: Output Return Loss**



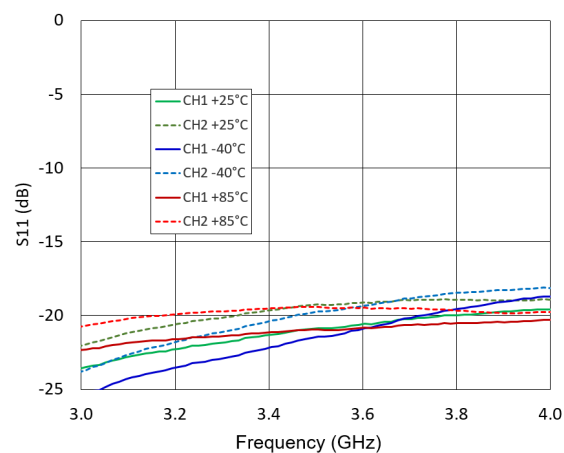
**Rx Mode: OIP3 at  $P_{IN} = -32$  dBm/tone**



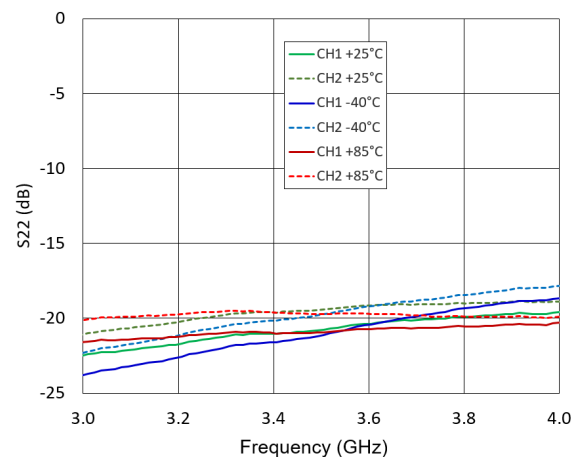
**Tx Mode: Insertion Loss**



**Tx Mode: Input Return Loss**

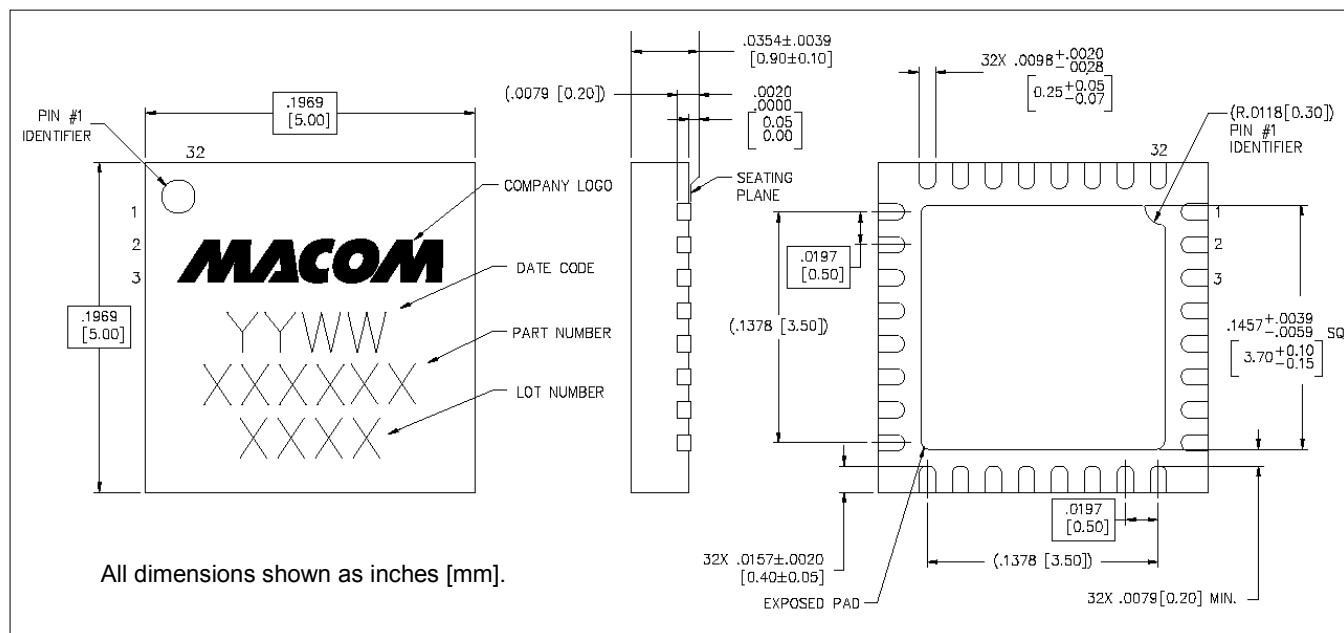


**Tx Mode: Output Return Loss**



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**Lead-Free 5 mm 32-Lead PQFN<sup>†</sup>**

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

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