

## MAAM-011275

Rev. V1

### Features

- Wide Frequency Range: 30 kHz 50 GHz
- 14.5 dB Gain
- 3 8 V DC, 200 mA
- 20.5 dBm P1dB @ 21 GHz
- Integrated Power Detector with a Detector Reference Voltage Generator
- 50 Ω Input and Output Match
- Lead-Free 5 mm 12-Lead AQFN Package
- RoHS\* Compliant

### Applications

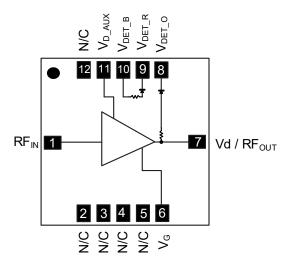
• Instrumentation and Communication Systems

### Description

MAAM-011275 is an easy-to-use, wideband amplifier that operates from 30 kHz to 50 GHz. The amplifier provides 14.5 dB gain, 20.5 dBm output power and 4 dB noise figure. It is matched to 50  $\Omega$  with typical return loss better than 10 dB.

MAAM-011275 is suitable for a wide range of applications in instrumentation and communication systems.

## Functional Schematic



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

| Pin #      | Pin Name                           | Description             |  |
|------------|------------------------------------|-------------------------|--|
| 1          | RF <sub>IN</sub>                   | RF Input                |  |
| 2,3,4,5,12 | N/C                                | Not Connected           |  |
| 6          | V <sub>G1</sub>                    | Gate Voltage 1          |  |
| 7          | RF <sub>OUT</sub> /V <sub>DD</sub> | RF Output               |  |
| 8          | DET <sub>OUT</sub>                 | Output Detector         |  |
| 9          |                                    | Reference Detector      |  |
| 10         |                                    | Detector Bias           |  |
| 11         | V <sub>DAUX</sub>                  | Auxiliary Drain Voltage |  |

3. MACOM recommends connecting unused package pins to ground.

 The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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

| Part Number        | Package        |
|--------------------|----------------|
| MAAM-011275-TR0500 | 500 Piece Reel |
| MAAM-011275-SB1    | Sample Board   |

1. Reference Application Note M513 for reel size information.

2. All sample boards include 5 loose parts.

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

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| -                          |   |       |                |                    |      |
|----------------------------|---|-------|----------------|--------------------|------|
| Parameter                  | Test Conditions   | Units | Min.           | Тур.               | Max. |
| Gain                       | 5 GHz<br>20 GHz<br>45 GHz                                       | dB    | 13<br>13<br>11 | 15<br>15<br>14     | —    |
| Gain Flatness              | 1 - 50 GHz  | dB    | —              | ±1                 | —    |
| Input Return Loss          | 1 - 50 GHz  | dB    | _              | 10                 | _    |
| Output Return Loss         | 1 - 50 GHz  | dB    | _              | 10                 | _    |
| P1dB                       | 21 GHz  | dBm   | _              | 20.5               | _    |
| P3dB                       | 5 GHz<br>20 GHz<br>45 GHz                                       | dB    | 23<br>22<br>17 | 24.5<br>23.5<br>19 | _    |
| Output IP3                 | P <sub>IN</sub> = -4 dBm / tone, 21 GHz<br>tone spacing = 2 MHz | dBm   |                | 29                 | _    |
| Noise Figure               | 26 GHz<br>40 GHz  | dB    |                | 3.2<br>6.5         | _    |
| Drain Current <sup>5</sup> | Quiescent bias  | mA    | —              | 200                | —    |

### Electrical Specifications: $T_c = 25 \text{ °C}$ , $V_{DD} = 7 \text{ V}$ , $Z_0 = 50 \Omega$

5. Set by adjusting VG1 as outlined in operating conditions on page 3.

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

| Parameter                           | Absolute Maximum                |
|-------------------------------------|---------------------------------|
| Farameter                           |                                 |
| Input Power                         | 17 dBm                          |
| Drain Supply Voltage                | 10 V                            |
| V <sub>G1</sub>                     | $-4 V < V_{G1} < 0 V$           |
| V <sub>G2</sub>                     | -3.5 V < V <sub>G2</sub> < +4 V |
| Drain Supply Current                | 340 mA                          |
| Junction Temperature <sup>8,9</sup> | +150°C                          |
| Operating Temperature               | -40°C to +85°C                  |
| Storage Temperature                 | -65°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.

 Operating at nominal conditions with T<sub>J</sub> ≤ +150°C will ensure MTTF > 1 x 10<sup>6</sup> hours.

9. Junction Temperature  $(T_J) = T_A + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$ Typical thermal resistance  $(\Theta_{JC}) = 15.6 \text{ °C/W}.$ 

### 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 1A devices.

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### **Operating Conditions**

The recommended biasing conditions are  $V_{DD} = 7 V$ and  $I_{DSQ} = 200 \text{ mA}$ , with  $I_{DSQ}$  set by adjusting  $V_{G1}$ after correctly setting  $V_{DD}$  (refer to turn on sequence). To maintain the best performance MACOM recommends using an active bias circuit for constant  $I_{DD}$ .

It is noted that any biasing arrangement used, including active biasing, must be able to source at least 10 mA into the V<sub>G1</sub> port. This is because the V<sub>G1</sub> port contains a resistive divider with a total resistance to ground of 244  $\Omega$ . For the recommended I<sub>DSQ</sub> of 200 mA obtained at a V<sub>G1</sub> voltage of around 2.5 V, 10 mA of V<sub>G1</sub> current (I<sub>G1</sub>) is expected. These values of V<sub>G1</sub> and I<sub>G1</sub> will vary slightly between devices.

For biasing  $V_{DD}$ , apply  $V_{DD}$  through a bias tee connected to the  $RF_{OUT}/V_{DD}$  port and connect an external DC block to the  $RF_{IN}$  port. This provides wide band performance of 40 MHz to 50 GHz (depending on the bandwidth of the bias tee).

### Operating the MAAM-011275 Turn-on

- 1. Apply V<sub>G1</sub> (-4 V).
  - 2. Increase  $V_{DD}$  to +7 V.
  - Set I<sub>DSQ</sub> by adjusting V<sub>G1</sub> more positive. (typically -2.5 V for I<sub>DSQ</sub> = 200 mA).
  - 4. Apply RF<sub>IN</sub> signal.

### Turn-off

- 1. Remove RF<sub>IN</sub> signal.
- 2. Decrease  $V_{G1}$  to -4 V.
- 3. Decrease  $V_{DD}$  to 0 V.

2 bypass capacitors of 100 pF and 1  $\mu$ F should be connected to V<sub>DAUX</sub>. This provides for improved gain flatness below 2 GHz down to 30 kHz when required.

The 100 pF capacitor can be a single layer capacitor or an SMT device on the PCB. Although it should be positioned as closely to the device as practically possible, the frequency response is not particularly sensitive to this. The 1  $\mu$ F capacitor can be placed further away on the PCB.

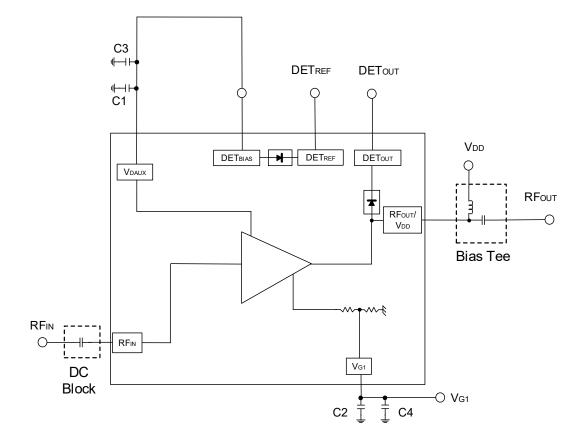
Data in this datasheet was measured using 100 pF (C1) and 1  $\mu$ F (C3) capacitors on V<sub>DAUX</sub>.

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### **Application Schematic**



### **Component List**

| Part   | Value   | Size |
|--------|---------|------|
| C1, C2 | 0.01 µF | 0402 |
| C3, C4 | 1 µF    | 0603 |

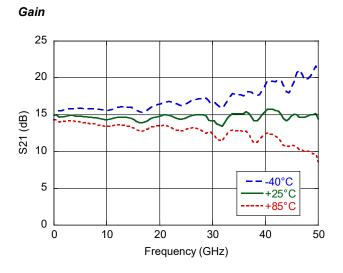
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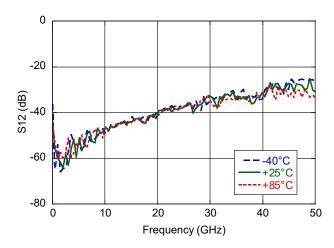
# MAAM-011275

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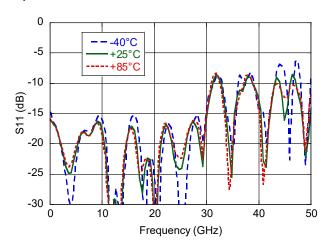
# Typical Performance Curves: $V_{DD}$ = 7 V, $I_{DSQ}$ = 200 mA



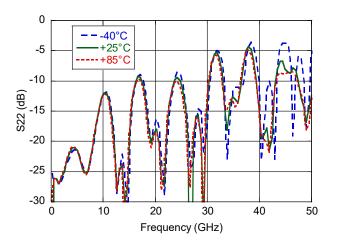
**Reverse Isolation** 



### Input Return Loss



### **Output Return Loss**

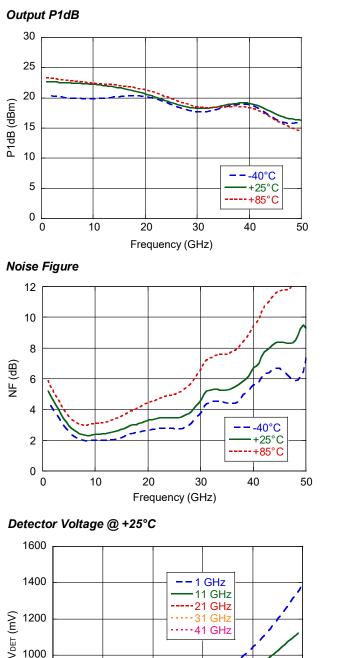


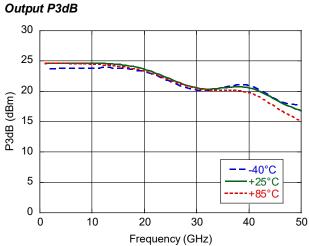
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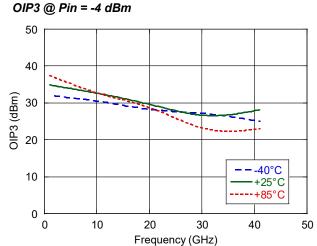
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25

6

800

600 L 0

5

10

Pout (dBm)

15

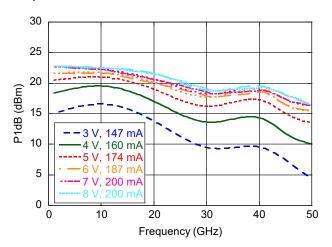
20

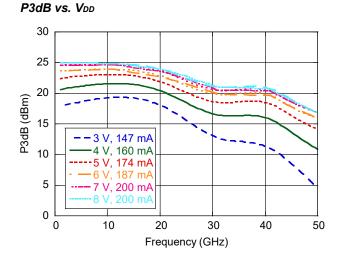


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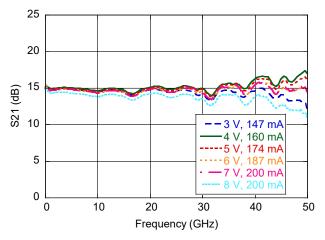
### Typical Performance Curves: T<sub>A</sub> = +25°C

### Output P1dB vs. VDD





### Gain vs. VDD



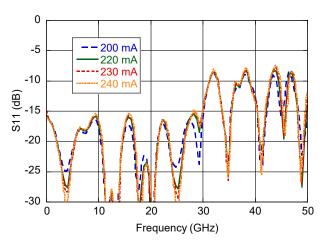
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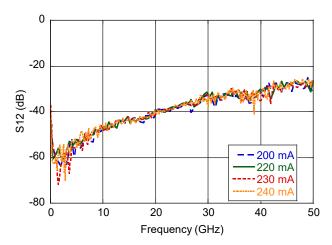
## Typical Performance Curves: $V_{DD}$ = 7 V, $T_A$ = +25°C

Gain vs. IDD 25 20 15 (dB) 10 - 200 mA 5 220 mA ---230 mA 240 mA 0 0 10 20 30 40 50 Frequency (GHz)

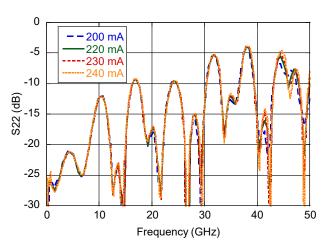
Input Return Loss vs. IDD



Reverse Isolation vs. IDD



### Output Return Loss vs. I<sub>DD</sub>



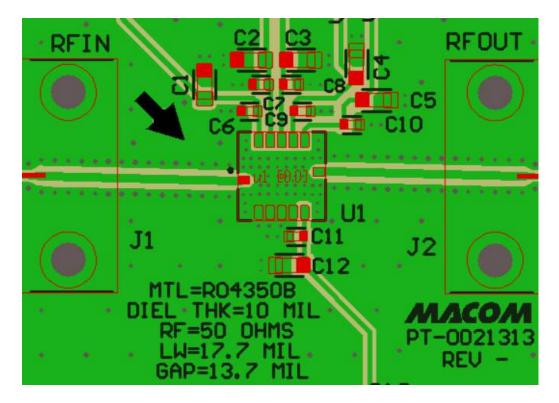
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## **Recommended PCB Layout**



### **Evaluation Board Parts List**

| Part    | Value   | Case Style |
|---------|---------|------------|
| C2, C12 | 1 µF    | 0603       |
| C7, C11 | 0.01 µF | 0402       |

## **Evaluation PCB Specifications**<sup>10,11</sup>

Top Layer: 1 oz Copper Cladding Dielectric Layer: Rogers RO4350B 10 mil Bottom Layer: 1 oz Copper Cladding Finished overall thickness: 12.8 mil

- PCB finish is ENEPIG. The vias located under the device are 8 mil in diameter and filled with thermally conductive material, capped over and planarized
- 11. Evaluation board should be mounted on a heat sink.

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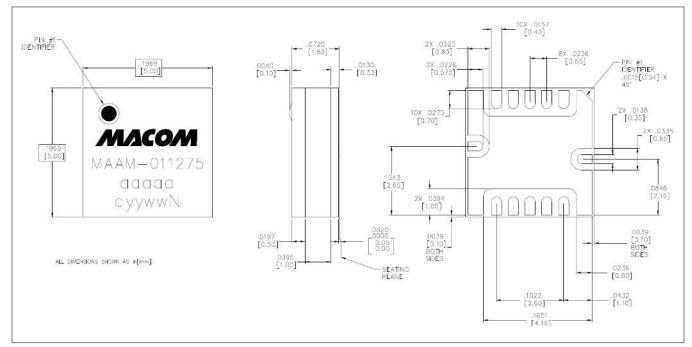
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# Lead-Free 5 mm 12-Lead AQFN <sup>12-16</sup>



12. All units in in(mm), unless otherwise noted, with a tolerance of .xxxx = ±.0005 in and .xxx = ±.005 in.

13. Lead finish: NiPdAu plating

14. Marking: line 2 part number; line 3 wafer lot number; line 4 c = country of origin (T = Thailand), yyww = date code, N = Nickel/Palladium/ Gold plating

15. Reference Application Note S2083 for lead-free solder reflow recommendations.

16. Meets JEDEC moisture sensitivity level 3 requirements.

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