

## Push Pull CATV Amplifier 50 - 1000 MHz

Rev. V1

### Features

- 20 dB Gain
- 8 V DC Bias
- Differential Inputs and Outputs
- Low Distortion
- Lead-Free 4 mm 20-Lead PQFN package
- Halogen-Free “Green” Mold Compound
- RoHS\* Compliant and 260°C Reflow Compatible

### Description

The MAAM-009455 is a GaAs MMIC amplifier in a lead-free 4 mm 20-lead PQFN package. The MMIC design is configured as a pair of cascode MESFET amplifiers for broadband performance. It is designed for integration in a 75  $\Omega$  push-pull, low distortion, amplifier circuit.

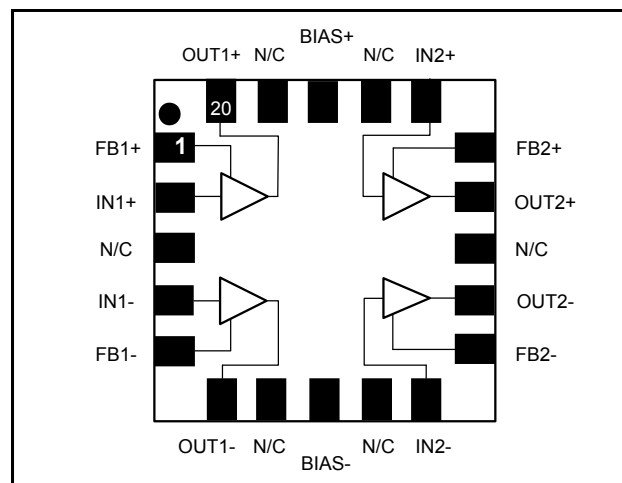
This device is ideally suited for use in CATV, FTTX, DBS, and HDTV applications where low noise figure and low distortion are required.

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

| Part Number        | Package           |
|--------------------|-------------------|
| MAAM-009455-000000 | Bulk Packaging    |
| MAAM-009455-TR1000 | 1000 Piece Reel   |
| MAAM-009455-TR3000 | 3000 Piece Reel   |
| MAAM-009455-001SMB | Sample Test Board |

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

### Functional Schematic



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

| Pin No.             | Pin Name         | Description   |
|---------------------|------------------|---------------|
| 1                   | FB1+             | Feedback 1+   |
| 2                   | IN1+             | Input 1+      |
| 3                   | N/C              | No Connection |
| 4                   | IN1-             | Input 1-      |
| 5                   | FB1-             | Feedback 1-   |
| 6                   | OUT1-            | Output 1-     |
| 7                   | N/C              | No Connection |
| 8                   | BIAS-            | DC Bias       |
| 9                   | N/C              | No Connection |
| 10                  | IN2-             | Input 2-      |
| 11                  | FB2-             | Feedback 2-   |
| 12                  | OUT2-            | Output 2-     |
| 13                  | N/C              | No Connection |
| 14                  | OUT2+            | Output 2+     |
| 15                  | FB2+             | Feedback 2+   |
| 16                  | IN2+             | Input 2+      |
| 17                  | N/C              | No Connection |
| 18                  | BIAS+            | DC Bias       |
| 19                  | N/C              | No Connection |
| 20                  | OUT1+            | Output 1+     |
| Paddle <sup>4</sup> | RF and DC Ground |               |

3. It is recommended, but not absolutely compulsory, that all No Connections (N/C) within the IC are connected to ground on the printed circuit board.
4. The exposed pad centered on the package bottom must be connected to RF and DC ground.

\* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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**Electrical Specifications:**  $T_A = 25^\circ\text{C}$ , Freq: 1000 MHz,  $V_{DD} = +8$  Volts,  $Z_0 = 75 \Omega$ ,  
**Test Circuit with M/A-COM Technology Balun MABA-009210-CT1760**

| Parameter                   | Test Conditions                                | Units | Min. | Typ. | Max. |
|-----------------------------|------------------------------------------------|-------|------|------|------|
| Gain                        | —                                              | dB    | 19.5 | 20.5 | 23   |
| Gain Flatness               | —                                              | dB    | —    | 0.5  | —    |
| Noise Figure                | —                                              | dB    | —    | 5.5  | —    |
| Reverse Isolation           | —                                              | dB    | —    | 36   | —    |
| Input Return Loss           | —                                              | dB    | —    | 22   | —    |
| Output Return Loss          | —                                              | dB    | —    | 15   | —    |
| Output IP2                  | Two tones at 500 & 506 MHz, +8 dBm output/tone | dBm   | —    | 80   | —    |
| Output IP3                  | Two tones at 500 & 506 MHz, +8 dBm output/tone | dBm   | 41   | 43   | —    |
| Composite Triple Beat, CTB  | 77 Channels, +39 dBm V / Channel at the output | dBc   | —    | -70  | —    |
| Composite Second Order, CSO | 77 Channels, +39 dBm V / Channel at the output | dBc   | —    | -70  | —    |
| Cross modulation            | 77 Channels, +39 dBm V / Channel at the output | dBc   | —    | -70  | —    |
| P1dB                        | 500 MHz                                        | dBm   | —    | 26   | —    |
| $I_{DD}$                    | +8 Volts                                       | mA    | —    | 325  | 385  |

**Electrical Specifications: Frequency: 500 MHz, 256 QAM**

| Parameter                                                                                                                                                                      | Test Conditions                                                                     | Units | Ref Spec <sup>5</sup> | Typical data      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------|-----------------------|-------------------|
| Adjacent channel up to 750 KHz from channel block edge                                                                                                                         | $P_{OUT} = +60$ dBmV, N=1<br>$P_{OUT} = +56$ dBmV, N=2<br>$P_{OUT} = +52$ dBmV, N=4 | dBc   | <-58<br><-58<br><-58  | -65<br>-65<br>-66 |
| Adjacent channel<br>(750 kHz from channel block edge to 6 MHz from channel block edge)                                                                                         | $P_{OUT} = +60$ dBmV, N=1<br>$P_{OUT} = +56$ dBmV, N=2<br>$P_{OUT} = +52$ dBmV, N=4 | dBc   | <-62<br><-60<br><-60  | -67<br>-64<br>-63 |
| Next-adjacent channel<br>(6 MHz from channel block edge to 18 MHz from channel block edge)                                                                                     | $P_{OUT} = +60$ dBmV, N=1<br>$P_{OUT} = +56$ dBmV, N=2<br>$P_{OUT} = +52$ dBmV, N=4 | dBc   | <-65<br><-64<br><-63  | -75<br>-70<br>-65 |
| Third-adjacent channel<br>(12 MHz from channel block edge to 18 MHz from channel block edge)                                                                                   | $P_{OUT} = +60$ dBmV, N=1<br>$P_{OUT} = +56$ dBmV, N=2<br>$P_{OUT} = +52$ dBmV, N=4 | dBc   | <-73<br><-70<br><-65  | -76<br>-73<br>-68 |
| In each of 2N contiguous 6 MHz channels or in each of 3N contiguous 6 MHz channels coinciding with 2nd harmonic and with 3rd harmonic components respectively (up to 1000 MHz) | $P_{OUT} = +60$ dBmV, N=1, 2nd Harmonic<br>$P_{OUT} = +60$ dBmV, N=1, 3rd Harmonic  | dBc   | -63<br>-63            | -70<br>-65        |

5. Reference Specification Data-Over-Cable Service Interface Specifications, DOCSIS. Downstream RF Interface Specification, DRFI.

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Rev. V1

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

| Parameter                         | Absolute Maximum |
|-----------------------------------|------------------|
| RF Input Power                    | 6 dBm            |
| Voltage                           | 15.0 volts       |
| Operating Temperature             | -40°C to +85°C   |
| Junction Temperature <sup>9</sup> | +150°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. M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.
8. These operating conditions will ensure MTTF > 1 x 10<sup>6</sup> hours.
9. Junction Temperature ( $T_J$ ) =  $T_C + \Theta_{jc} * (V * I)$   
Typical thermal resistance ( $\Theta_{jc}$ ) = 15° C/W.  
a) For  $T_C = 25^\circ\text{C}$ ,  
 $T_J = 71^\circ\text{C}$  @ 8 V, 385 mA  
b) For  $T_C = 85^\circ\text{C}$ ,  
 $T_J = 130^\circ\text{C}$  @ 8 V, 375 mA

### Handling Procedures

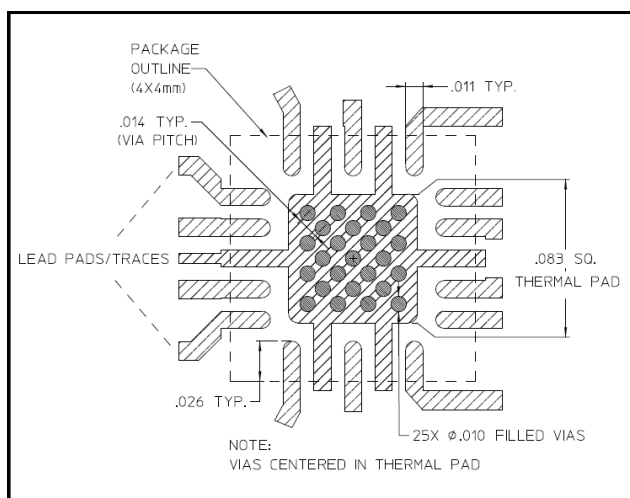
Please observe the following precautions to avoid damage:

### Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

An external protection circuit using an inexpensive anti-parallel diode pair can be used to protect the IC. Please reference application note AN3028 on <http://www.macomtech.com> for further detail.

### Land Pattern<sup>10</sup>

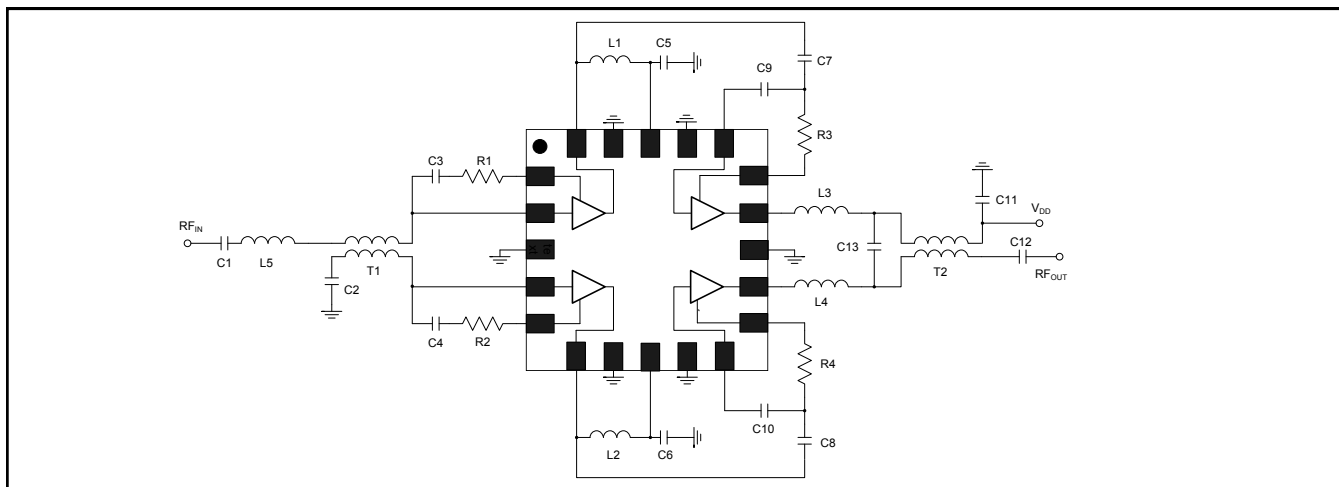


10. Vias to be plated solid copper.

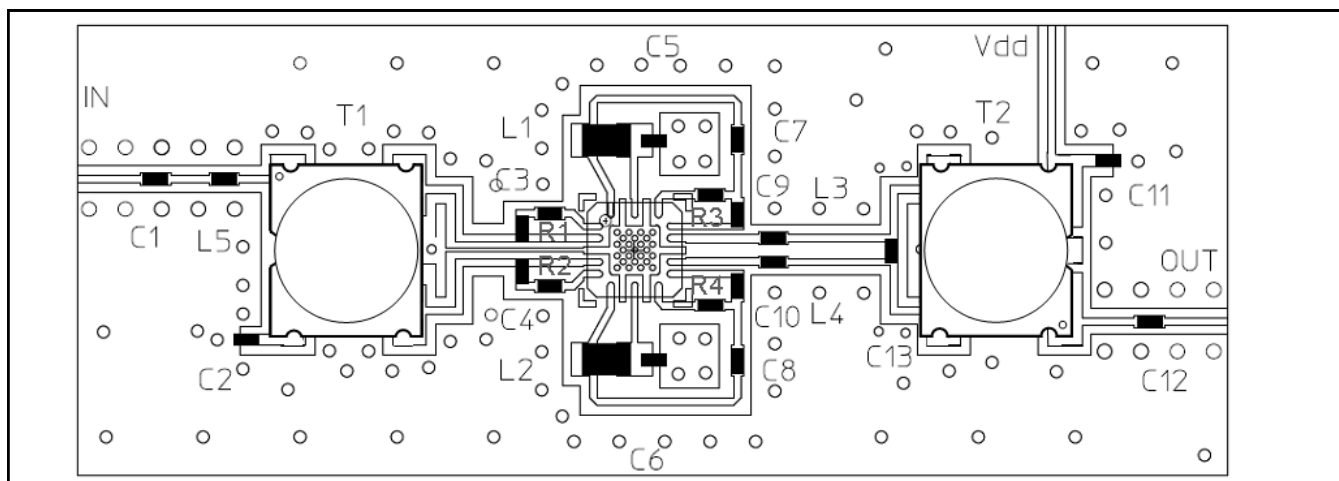
## Push Pull CATV Amplifier 50 - 1000 MHz

Rev. V1

### Application Schematic



### Recommended PCB



### Parts List<sup>11</sup>

| Component | Value        | Package |
|-----------|--------------|---------|
| C1 - C12  | 0.01 $\mu$ F | 0402    |
| C13       | 2.7 pF       | 0402    |
| L1, L2    | 390 nH       | 0805    |
| L3, L4    | 2 nH         | 0402    |
| L5        | 5.6 nH       | 0402    |
| R1 - R4   | 0 $\Omega$   | 0402    |
| T1, T2    | 1:1 Baluns   |         |

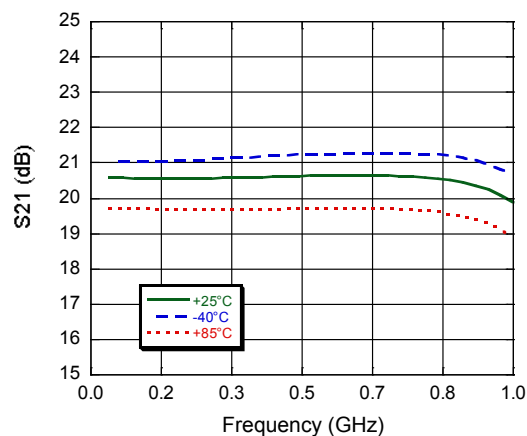
11. The 1:1 baluns, T1 & T2 are M/A-COM Technology Solutions part number MABA-009210-CT1760

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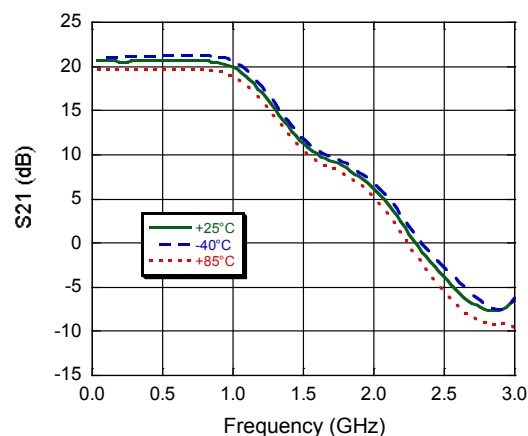
Rev. V1

### Typical Performance Curves Over Temperature

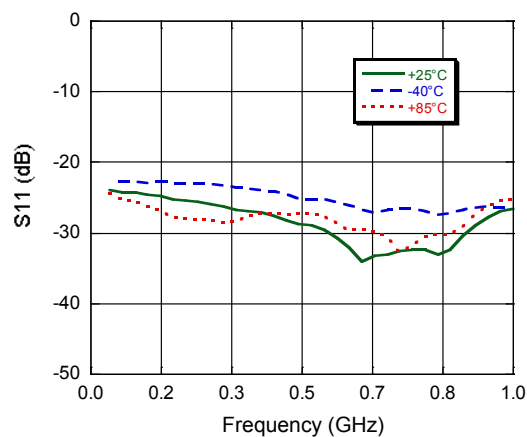
Gain to 1 GHz



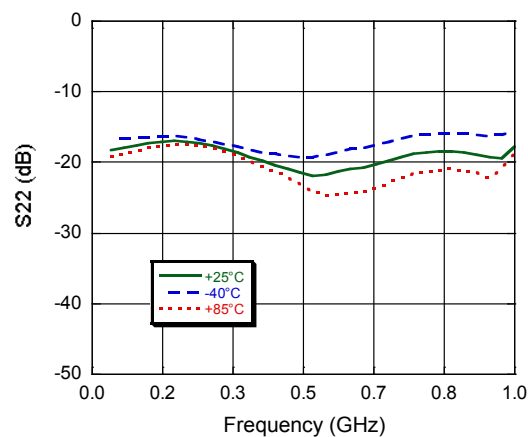
Gain to 3 GHz



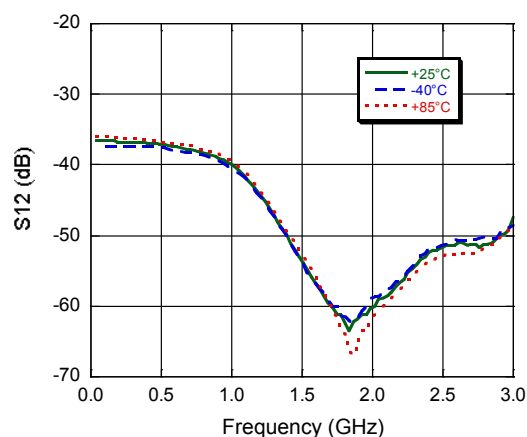
Input Return Loss



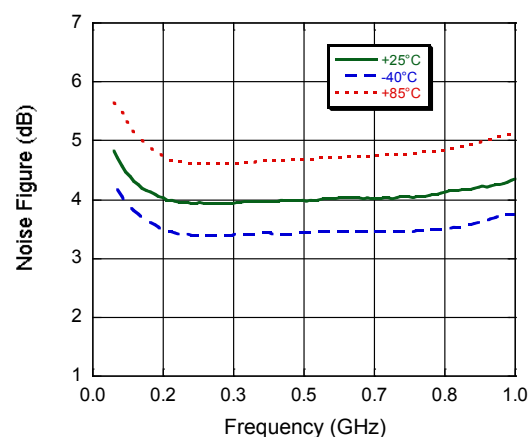
Output Return Loss



Reverse Isolation to 3 GHz



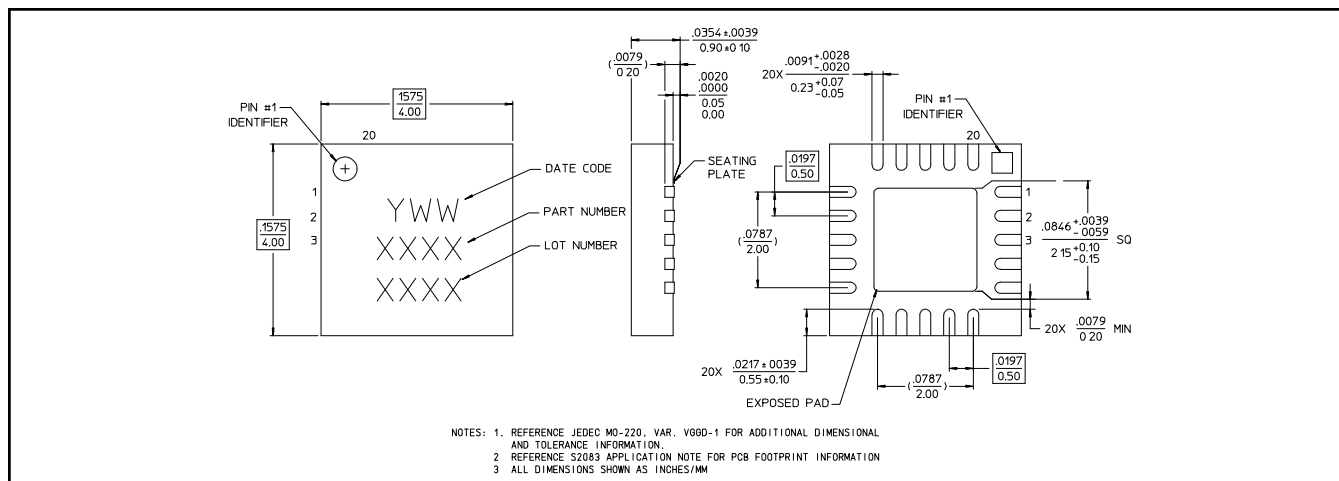
Noise Figure



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Rev. V1

### Lead Free 4 mm 20-lead PQFN<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations.  
Meets JEDEC moisture sensitivity level 1 requirements.  
Plating is 100% matte tin over copper.

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