MAAM-010513

Amplifier, Driver
40.5 - 43.5 GHz

Features
- Gain: 23 dB
- P1dB: 23 dBm
- OIP3: 32 dBm
- Variable Gain with Adjustable Bias
- Lead-Free 5 mm Laminate Package
- RoHS* Compliant and 260°C Reflow Compatible

Description
The MAAM-010513 is a 3-stage driver amplifier with excellent return losses, in a 5 mm laminate package allowing easy assembly. This amplifier product is fully matched to 50 ohms on both the input and output. It can be used as a driver amplifier stage in transmit chains or as an LO buffer amplifier. It is ideally suited for 42 GHz band point-to-point radios.

Each device is 100% RF tested to ensure performance compliance. The part is fabricated using an efficient pHEMT process.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAM-010513-000000</td>
<td>Bulk Quantity</td>
</tr>
<tr>
<td>MAAM-010513-TR0200</td>
<td>200 Piece Reel</td>
</tr>
<tr>
<td>MAAM-010513-TR0500</td>
<td>500 Piece Reel</td>
</tr>
<tr>
<td>MAAM-010513-001SMB</td>
<td>Sample Evaluation Board</td>
</tr>
</tbody>
</table>

Functional Schematic

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RF&lt;sub&gt;IN&lt;/sub&gt;</td>
<td>7</td>
<td>RF&lt;sub&gt;OUT&lt;/sub&gt;</td>
</tr>
<tr>
<td>2</td>
<td>V&lt;sub&gt;1&lt;/sub&gt;</td>
<td>8</td>
<td>V&lt;sub&gt;3&lt;/sub&gt;</td>
</tr>
<tr>
<td>3</td>
<td>V&lt;sub&gt;2&lt;/sub&gt;</td>
<td>9</td>
<td>V&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td>4</td>
<td>V&lt;sub&gt;3&lt;/sub&gt;</td>
<td>10</td>
<td>V&lt;sub&gt;1&lt;/sub&gt;</td>
</tr>
<tr>
<td>5</td>
<td>No Connection</td>
<td>11</td>
<td>No Connection</td>
</tr>
<tr>
<td>6</td>
<td>No Connection</td>
<td>12</td>
<td>No Connection</td>
</tr>
</tbody>
</table>

1. MACOM recommends connecting unused package pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF and DC ground.

## Electrical Specifications:
Freq: 40.5 - 43.5 GHz, $T_A = 25^\circ C$, $V_D = 4$ V, $ID_1 = ID_2 = 100$ mA, $ID_3 = 200$ mA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Signal Gain</td>
<td>dB</td>
<td>19</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>dB</td>
<td>-</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>dB</td>
<td>-</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Reverse isolation</td>
<td>dB</td>
<td>-</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>Output P1dB</td>
<td>dBm</td>
<td>-</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>Output IP3</td>
<td>dBm</td>
<td>27</td>
<td>32</td>
<td>-</td>
</tr>
<tr>
<td>Saturated Output Power</td>
<td>dBm</td>
<td>21</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>mA</td>
<td>400</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

3. Adjust $V_g$ between $-1.0$ and $-0.1$ V to achieve specified current. Typical 400 mA = 100 (ID1) + 100 (ID2) + 200 (ID3)

### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain Voltage</td>
<td>$+4.3$ V</td>
</tr>
<tr>
<td>Gate Bias Voltage</td>
<td>$-1.5$ V $&lt; V_g &lt; 0V$</td>
</tr>
<tr>
<td>Input Power</td>
<td>$+10$ dBm</td>
</tr>
<tr>
<td>Junction Temperature 7</td>
<td>$150^\circ$C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$-40^\circ$C to $+85^\circ$C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$-55^\circ$C to $+150^\circ$C</td>
</tr>
</tbody>
</table>

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.
6. Operating at nominal conditions with $T_J \leq 150^\circ$C will ensure $MTTF > 1 \times 10^9$ hours.
7. Junction Temperature ($T_J = T_C + \Theta_{JC} * (V * I)$
   Typical thermal resistance ($\Theta_{JC}$) = $26^\circ$ C/W.
   a) For $T_C = 25^\circ$C, $T_J = 67^\circ$C @ 4 V, 400 mA
   b) For $T_C = 85^\circ$C, $T_J = 127^\circ$C @ 4 V, 400 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 Human Body Model Class 1B and Machine Model Class A devices.
Amplifier, Driver
40.5 - 43.5 GHz

Typical Performance Curves: \( V_D = 4 \, V \), \( I_{D1} = I_{D2} = 100 \, mA \), \( I_{D3} = 200 \, mA \), \( T_A = 25^\circ C \)

**Small Signal Gain**

- Frequency (GHz)
- \( S_{21} \) (dB)

**Input Return Loss**

- Frequency (GHz)
- \( S_{11} \) (dB)

**Output Return Loss**

- Frequency (GHz)
- \( S_{22} \) (dB)

**Reverse Isolation**

- Frequency (GHz)
- \( S_{12} \) (dB)

**Output IP3 (Pout = 6 dBm SCL)**

- Frequency (GHz)
- \( Q_{IP3} \) (dBm)

**C/I3 (Pout = 6 dBm SCL)**

- Frequency (GHz)
- \( C_{I3} \) (dBc)
Typical Performance Curves: \( V_D = 4 \, \text{V}, \, ID_1 = ID_2 = 100 \, \text{mA}, \, ID_3 = 200 \, \text{mA}, \, T_A = 25^\circ \text{C} \)

**Output P1dB**

-25°C
-40°C
+85°C

**Psat**

-25°C
-40°C
+85°C
**App Note [1] Biasing** - It is recommended to bias the amplifier with $V_d=4.0\,\text{V}$ and $I_{\text{TOTAL}}=400\,\text{mA}$. It is also recommended to use active biasing to keep the currents constant as the RF power and temperature vary; this gives the most reproducible results. Depending on the supply voltage available and the power dissipation constraints, the bias circuit may be a single transistor or a low power operational amplifier, with a low value resistor in series with the drain supply used to sense the current. The gate of the pHEMT is controlled to maintain correct drain current and thus drain voltage. The typical gate voltage needed to do this is $-0.3\,\text{V}$. Typically the gate is protected with Silicon diodes to limit the applied voltage. Also, make sure to sequence the applied voltage to ensure negative gate bias is available before applying the positive drain supply.

**App Note [2] Bias Arrangement** - Each DC pin ($V_d$ and $V_g$) needs to have DC bypass capacitance (100pF/10nF/1µF) as close to the package as possible.

**Recommended Board Layout**
Lead-Free 5 x 5 mm Laminate Package†

Recommended Substrate Footprint

All dimensions are in mm.

Markings:
Line 1: MACOM Part Number
Line 2: Lot Wafer Number
Line 3:
P = Philippines (Country of Origin)
yyyw: Date Stamp (year-year-week-week)
N = Nickel/Gold plating

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
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