Amplifier, Buffer
37 - 40 GHz

Features
- High Gain: 21 dB
- Output P1dB: 20 dBm
- Variable Gain with Adjustable Bias
- Lead-Free 3 mm QFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description
The MAAM-010651 is a 3-stage, buffer amplifier with a 20 dBm output P1dB. The surface mount 3 mm QFN package allows easy assembly. This amplifier is fully matched to 50 ohms on both the input and output. It is designed for use as an LO buffer amplifier stage or as a driver amplifier in transmit chains and is ideally suited for 38 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.

The MTTF is >1,000,000 hours at a 150°C junction temperature.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAM-010651-00000</td>
<td>Bulk Packaging</td>
</tr>
<tr>
<td>MAAM-010651-TR0500</td>
<td>500 Piece Reel</td>
</tr>
<tr>
<td>MAAM-010651-TR1000</td>
<td>1000 Piece Reel</td>
</tr>
<tr>
<td>MAAM-010651-000SMB</td>
<td>Sample Evaluation Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.

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

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU
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Electrical Specifications:
Freq. 37 - 40 GHz, \( T_B = 30^\circ\text{C} \), \( V_{DD} = 4 \text{ V} \), \( I_{DQ} = 250 \text{ mA} \), \( P_{in} = -14 \text{ dBm} \), \( Z_0 = 50 \text{ \Omega} \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Return Loss</td>
<td>dB</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>dB</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Small Signal Gain</td>
<td>dB</td>
<td>17</td>
<td>21</td>
<td>24.5</td>
</tr>
<tr>
<td>Reverse Isolation (S12)</td>
<td>dB</td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Output P1dB</td>
<td>dBm</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Output IP3 (@ +4 dBm SCL)</td>
<td>dBm</td>
<td>27</td>
<td>30.5</td>
<td></td>
</tr>
<tr>
<td>( P_{SAT} )</td>
<td>dBm</td>
<td>19.5</td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

4. \( T_B \) = MMIC Base Temperature
5. Adjust \( V_{GG} \) between -1.0 and -0.1 V to achieve specified \( I_{DQ} \).

Maximum Operating Ratings\(^6,7\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>+20 dBm</td>
</tr>
<tr>
<td>Drain Supply Voltage</td>
<td>+4.3 V</td>
</tr>
<tr>
<td>Gate Supply Voltage</td>
<td>-1.5 to 0 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+150 °C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55°C to +150°C</td>
</tr>
<tr>
<td>ESD Machine Model</td>
<td>Class A</td>
</tr>
<tr>
<td>ESD Human Body Model</td>
<td>Class 1A</td>
</tr>
<tr>
<td>MSL</td>
<td>MSL3</td>
</tr>
</tbody>
</table>

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.

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.
Typical Performance Curves

**Small signal Gain (S21)**

MAAM-010651-000000 : Vd = 4V, Id1 = Id2 = 62.5mA, Id3 = 125mA

**Input Return loss (S11)**

MAAM-010651-000000 : Vd = 4V, Id1 = Id2 = 62.5mA, Id3 = 125mA

**Output Return loss (S22)**

MAAM-010651-000000 : Vd = 4V, Id1 = Id2 = 62.5mA, Id3 = 125mA

**Reverse Isolation (S12)**

MAAM-010651-000000 : Vd = 4V, Id1 = Id2 = 62.5mA, Id3 = 125mA

**OIP3 vs Freq**

MAAM-010651-000000 : Pscl=+5dBm; Vd1,2,3=4.0V, Id1 = Id2 = 62.5mA, Id3 = 125mA

**C/I3 vs Freq**

MAAM-010651-000000 : Pscl=+5dBm; Vd1,2,3=4.0V, Id1 = Id2 = 62.5mA, Id3 = 125mA

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Typical Performance Curves (cont.)

![P1dB vs Freq](image1)

![Psat vs Freq](image2)

MTTF

![MTTF vs Package Base Temp](image3)

![Tch(max) vs Package Base Temp](image4)

Operating Power De-rating Curve

![Operating Power De-rating Curve](image5)
App Note [1] Biasing - It is recommended to bias the amplifier with $V_D = 4 \text{ V}$ and $I_D_{\text{TOTAL}} = 250 \text{ mA}$. 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 (100 pF/10 nF/1 µF) as close to the package as possible.

Lead-Free 3 mm QFN Package

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**For further information and support please visit:**
https://www.macom.com/support
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