Wideband Distributed Amplifier
30 kHz - 40 GHz

Features
- Wide Frequency Range: 30 kHz - 40 GHz
- 15 dB Gain
- 3 - 8 V DC, 200 mA
- 22 dBm P1dB @ 22 GHz
- Integrated Power Detector with a Detector Reference Voltage Generator
- 50 Ω Input and Output Match
- RoHS* Compliant
- Die Size: 2.3 x 1.0 x 0.05 mm

Applications
- Instrumentation and Communication Systems

Description
MAAM-011275-DIE is an easy-to-use, wideband amplifier that operates from 30 kHz to 40 GHz. The amplifier provides 15 dB gain, 22 dBm output power and 5.3 dB noise figure. It is matched to 50 Ω with typical return loss better than 13 dB.

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

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAM-011275-DIE</td>
<td>Die in Gel Pack</td>
</tr>
</tbody>
</table>

Functional Schematic

1. Image not to scale.

Pad Configuration

<table>
<thead>
<tr>
<th>Pad #</th>
<th>Pad Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,3,5,7, 14,15,16</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>RF_IN</td>
<td>RF Input</td>
</tr>
<tr>
<td>4</td>
<td>V_G1</td>
<td>Gate Voltage 1</td>
</tr>
<tr>
<td>6</td>
<td>RF_OUT/V_DD</td>
<td>RF Output</td>
</tr>
<tr>
<td>8</td>
<td>DET_OUT</td>
<td>Output Detector</td>
</tr>
<tr>
<td>9</td>
<td>DET_REF</td>
<td>Reference Detector</td>
</tr>
<tr>
<td>10</td>
<td>DET_BIAS</td>
<td>Detector Bias</td>
</tr>
<tr>
<td>11</td>
<td>V_DD</td>
<td>Drain Voltage</td>
</tr>
<tr>
<td>12</td>
<td>V_DAUX</td>
<td>Auxiliary Drain Voltage</td>
</tr>
<tr>
<td>13</td>
<td>V_G2</td>
<td>Gate Voltage 2</td>
</tr>
</tbody>
</table>

2. Backside of die must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.
Wideband Distributed Amplifier
30 kHz - 40 GHz

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit www.macom.com for additional data sheets and product information.

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

MACOM-011275-DIE
Rev. V3

Electrical Specifications: $T_C = 25 \, ^\circ\text{C}$, $V_{DD} = 7 \, \text{V}$, $Z_0 = 50 \, \Omega$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>1 - 40 GHz</td>
<td>dB</td>
<td>13.5</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>1 - 40 GHz</td>
<td>dB</td>
<td>—</td>
<td>±0.75</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>1 - 40 GHz</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>1 - 40 GHz</td>
<td>dB</td>
<td>—</td>
<td>13</td>
<td>—</td>
</tr>
<tr>
<td>P1dB</td>
<td>22 GHz</td>
<td>dBm</td>
<td>—</td>
<td>21</td>
<td>—</td>
</tr>
<tr>
<td>P3dB</td>
<td>22 GHz</td>
<td>dBm</td>
<td>22.5</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>$P_{IN} = +2 , \text{dBm} / \text{tone}, 22 , \text{GHz}$ tone spacing = 2 MHz</td>
<td>dBm</td>
<td>—</td>
<td>33</td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>26 GHz/40 GHz</td>
<td>dB</td>
<td>—</td>
<td>5.3</td>
<td>6.8</td>
</tr>
<tr>
<td>Drain Current$^3$</td>
<td>Quiescent bias</td>
<td>mA</td>
<td>—</td>
<td>200</td>
<td>—</td>
</tr>
</tbody>
</table>

3. Set by adjusting $V_G$ as outlined in operating conditions on page 3.

Absolute Maximum Ratings$^{4,5}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>17 dBm</td>
</tr>
<tr>
<td>Drain Supply Voltage</td>
<td>10 V</td>
</tr>
<tr>
<td>$V_{G1}$</td>
<td>$-4 , \text{V} &lt; V_{G1} &lt; 0 , \text{V}$</td>
</tr>
<tr>
<td>$V_{G2}$</td>
<td>$-3.5 , \text{V} &lt; V_{G2} &lt; +4 , \text{V}$</td>
</tr>
<tr>
<td>Drain Supply Current</td>
<td>340 mA</td>
</tr>
<tr>
<td>Junction Temperature$^6,7$</td>
<td>+150°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

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.

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 $T_J \leq +150°C$ will ensure MTTF > $1 \times 10^6$ hours.
7. Junction Temperature ($T_J$) = $T_A + \Theta_{JC} \times ((V \times I) - (P_{OUT} - P_{IN}))$
   Typical thermal resistance ($\Theta_{JC}$) = 11.9 °C/W.

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

DC-0018857
Operating Conditions
The recommended biasing conditions are \( V_{DD} = 7 \) V and \( I_{DSQ} = 200 \) 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 \( V_{G1} \) port. This is because the \( V_{G1} \) port contains a resistive divider with a total resistance to ground of 244 \( \Omega \). For the recommended \( I_{DSQ} \) of 200 mA obtained at a \( V_{G1} \) voltage of around 2.5 V, 10 mA of \( V_{G1} \) current (\( I_{G1} \)) is expected. These values of \( V_{G1} \) and \( I_{G1} \) will vary slightly between devices.

There are two possible methods for biasing \( V_{DD} \):

1. 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).

2. Apply \( V_{DD} \) through a wideband conical inductor connected to the \( V_{DD} \) port. No external bias tee is required at the \( RF_{OUT}/V_{DD} \) port; however, external DC blocks are required at both the \( RF_{IN} \) and \( RF_{OUT} \) ports. Using this method provides for an operational frequency of 40 MHz to 50 GHz.

Operating the MAAM-011275-DIE
Turn-on
1. Apply \( V_{G1} \) (-4 V).
2. Increase \( V_{DD} \) to +7 V.
3. Set \( I_{DSQ} \) by adjusting \( V_{G1} \) more positive. (typically -2.5 V for \( I_{DSQ} = 200 \) mA).
4. Apply \( RF_{IN} \) signal.

Turn-off
1. Remove \( RF_{IN} \) signal.
2. Decrease \( V_{G1} \) to -4 V.
3. Decrease \( V_{DD} \) to 0 V.

\( V_{G2} \) can be used for gain control in all bias configurations. If gain control is not required, \( V_{G2} \) should be left open-circuited.

Regardless of bias method used, 2 bypass capacitors of 100 pF and 1 \( \mu \)F should be connected to \( V_{DAUX} \). 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 bias option 1 and 100 pF (C1) and 1 \( \mu \)F (C3) capacitors on \( V_{DAUX} \).
Application Schematic

All bond pads labelled GND have vias to the backside metal. Bond wires on these pads are optional.

Component List

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>100 pF</td>
<td>Single Layer</td>
</tr>
<tr>
<td>C2</td>
<td>1000 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C3, C4</td>
<td>1 µF</td>
<td>0402</td>
</tr>
</tbody>
</table>
Wideband Distributed Amplifier
30 kHz - 40 GHz

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

**Gain**

![Gain Graph](image)

**Reverse Isolation**

![Reverse Isolation Graph](image)

**Input Return Loss**

![Input Return Loss Graph](image)

**Output Return Loss**

![Output Return Loss Graph](image)
Typical Performance Curves: $V_{DD} = 7\, \text{V}$, $I_{DSQ} = 200\, \text{mA}$

**Output $P_{1dB}$**

![Graph showing $P_{1dB}$ vs. Frequency](image1)

**Output $P_{3dB}$**

![Graph showing $P_{3dB}$ vs. Frequency](image2)

**Noise Figure @ $+25^\circ\text{C}$**

![Graph showing Noise Figure vs. Frequency](image3)

**OIP3**

![Graph showing OIP3 vs. Frequency](image4)
Wideband Distributed Amplifier
30 kHz - 40 GHz

Typical Performance Curves: \( T_A = +25^\circ \text{C}, \ \text{Id}_{\text{SQ}} = 200 \text{ mA} \)

**Output P1dB vs. \( V_{DD} \)**

**P3dB vs. \( V_{DD} \)**

**Noise Figure vs. \( V_{DD} \)**

**Gain vs. \( V_{DD} \)**
Wideband Distributed Amplifier
30 kHz - 40 GHz

Typical Performance Curves: \( V_{DD} = 7 \text{ V}, \ T_A = +25^\circ \text{C} \)

**Gain vs. \( I_{DD} \)**

**Reverse Isolation vs. \( I_{DD} \)**

**Input Return Loss vs. \( I_{DD} \)**

**Output Return Loss vs. \( I_{DD} \)**
**Wideband Distributed Amplifier**

30 kHz - 40 GHz

---

**Die Dimensions**

9. All units in µm, unless otherwise noted, with a tolerance of ±5 µm.

10. Die thickness is 50 ±5 µm.

11. Die size reflects un-cut dimensions. Laser kerf reduces die size by ~ 25 µm each dimension.

---

**Bond Pad Detail**

<table>
<thead>
<tr>
<th>Pad</th>
<th>X (µm)</th>
<th>Y (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 5, 7</td>
<td>74</td>
<td>89</td>
</tr>
<tr>
<td>2, 6,</td>
<td>74</td>
<td>140</td>
</tr>
<tr>
<td>3, 13, 14, 16</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>8, 9, 10, 11</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>12</td>
<td>76</td>
<td>71</td>
</tr>
<tr>
<td>15</td>
<td>71</td>
<td>76</td>
</tr>
</tbody>
</table>
MACOM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with MACOM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM's Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppels or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.

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

Visit www.macom.com for additional data sheets and product information.