Low Noise Amplifier
18 - 31.5 GHz

Features
- Noise Figure: 2.5 dB @ 24 GHz
- High Gain: 23 dB @ 24 GHz
- 50 Ω match on input and output
- Single Voltage Bias: 3 V to 5 V range
- Integrated Active Bias Circuit
- Current adjustable from 1 mA - 80 mA
- Lead-Free 2 mm 8-lead PDFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description
The MAAL-011129 is an easy-to-use three stage low noise amplifier with high gain and broadband 50 Ω match. It is designed for operation from 18 to 31.5 GHz and housed in a lead-free 2 mm 8-lead PDFN plastic package.

The MAAL-011129 has an integrated active bias circuit and bias tee to allow direct connection to VDD without external chokes or DC blocks. The bias current is set by a simple external resistor, RB, so the user can customize the power consumption. When VBIAS = 0 V, the device is placed in power down mode.

The MAAL-011129 offers a surface-mount, easy-to-use, low noise amplifier solution that is well suited to diverse receiver applications such as VSAT, Point-to-Point and 24 GHz ISM.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAL-011129-TR3000</td>
<td>3000 piece reel</td>
</tr>
<tr>
<td>MAAL-011129-SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

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

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.
Electrical Specifications:  Freq. = 24 GHz, T_A = 25°C, V_DD = 5 V, R_B = 1 kΩ, Z_0 = 50 Ω

<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>Noise Figure</td>
<td></td>
<td>dB</td>
<td>2.5</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>P_IN = -20 dBm</td>
<td>dB</td>
<td>20</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>P_IN = -20 dBm</td>
<td>dB</td>
<td></td>
<td>-13</td>
<td></td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>P_IN = -20 dBm</td>
<td>dB</td>
<td></td>
<td>-13</td>
<td></td>
</tr>
<tr>
<td>Output IP3</td>
<td>P_IN = -22 dBm/tone</td>
<td>dBm</td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Output P1dB</td>
<td></td>
<td>dBm</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation</td>
<td>P_IN = -20 dBm</td>
<td>dB</td>
<td></td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Bias Current</td>
<td></td>
<td>mA</td>
<td>50</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings\textsuperscript{4,5}

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>10 dBm</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>6 V</td>
</tr>
<tr>
<td>Junction Temperature\textsuperscript{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 devices.
Application Information

The MAAL-011129 is designed to be easy to use yet provide high performance. The ultra small size, with no matching, and simple bias application allows easy placement on system boards.

Single Bias Operation

Connecting $V_{DD}$ to $V_{BIAS}$ using an external resistor $R_B$ enables single bias operation of the amplifier, and the value of external resistor $R_B$ sets the desired current $I_{DD}$. The following table shows drain current ($I_{DD}$) versus external resistor ($R_B$) values for $V_{DD}$ voltages of 5 V and 3.3 V:

<table>
<thead>
<tr>
<th>$V_{DD}$ (V)</th>
<th>$V_{BIAS}$ (V)</th>
<th>$R_B$ (Ω)</th>
<th>$I_{DD}$ (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>Open</td>
<td>Open</td>
<td>15</td>
</tr>
<tr>
<td>3.3</td>
<td>200</td>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>3.3</td>
<td>400</td>
<td>400</td>
<td>40</td>
</tr>
<tr>
<td>3.3</td>
<td>1k</td>
<td>1k</td>
<td>30</td>
</tr>
<tr>
<td>3.3</td>
<td>2k</td>
<td>2k</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>Open</td>
<td>Open</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>400</td>
<td>400</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>1k</td>
<td>1k</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>2k</td>
<td>2k</td>
<td>40</td>
</tr>
</tbody>
</table>

With pin 4 ($V_{BIAS}$) left open the amplifier will default to low power mode. When pin 4 ($V_{BIAS}$) is set to 0 V through RB, the device enters power down mode. In order to use power down mode a second supply is required that directly drives the RB resistor.

Grounding

It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200-μm) diameter vias under the device, assuming an 8-mil (200-μm) thick RF layer to ground.
Low Noise Amplifier
18 - 31.5 GHz

Typical Performance Curves $V_{DD} = 5$ V, $R_B = 1$ kΩ

Gain

Noise Figure

Input Return Loss

Output Return Loss

$P_{1dB}$

$OIP3$
Typical Performance Curves \( V_{DD} = 3.3 \text{ V} & 5 \text{ V} \)

**Gain**

- \( S_{21} \) (dB) vs. Frequency (GHz)
  - 5 V, \( R_B = 1 \text{ k} \)
  - 3.3 V, \( R_B = 200 \)

**Noise Figure**

- Noise Figure (dB) vs. Frequency (GHz)
  - 5 V, \( R_B = 1 \text{ k} \)
  - 3.3 V, \( R_B = 200 \)

**Input Return Loss**

- \( S_{11} \) (dB) vs. Frequency (GHz)
  - 5 V, \( R_B = 1 \text{ k} \)
  - 3.3 V, \( R_B = 200 \)

**Output Return Loss**

- \( S_{22} \) (dB) vs. Frequency (GHz)
  - 5 V, \( R_B = 400 \)
  - 3.3 V, \( R_B = 200 \)

**\( P_{1dB} \)**

- \( P_{1dB} \) (dBm) vs. Frequency (GHz)
  - 5 V, \( R_B = 400 \)
  - 3.3 V, \( R_B = 200 \)

**OIP3**

- OIP3 (dBm) vs. Frequency (GHz)
  - 5 V, \( R_B = 400 \)
  - 3.3 V, \( R_B = 200 \)

---

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](http://www.macom.com) for additional data sheets and product information.
Typical Performance Curves VDD = 5 V, $I_{DD}$ varied by $R_B$
Low Noise Amplifier
18 - 31.5 GHz

Lead Free 2 mm 8 Lead PDFN Package†

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% Matte Tin over Copper.
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.