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 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.

1. MACOM recommends connecting all No Connection (N/C) pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

---

**Features**

- 19 dB flat Broadband Gain to 3.25 GHz
- Low Noise Figure:
  - 1.3 dB @ 1.2 GHz
  - 1.6 dB @ 3.25 GHz
- High Linearity OIP3:
  - 38 dBm @ 1.2 GHz
  - 35 dBm @ 3.25 GHz
- Internal Matching to 50 Ω
- Single Voltage Bias: 3 - 5 V
- Integrated Active Bias Circuit
- Current Adjustable 20 - 120 mA
- Lead-Free 3 mm 12-Lead Ceramic QFN Package
- RoHS* Compliant
- Power Down Option

**Description**

The MAAM-011229-CQ3 is a broadband high dynamic range, single stage MMIC LNA assembled in a lead-free 3 mm 12 lead ceramic QFN package. The amplifier is internally matched to provide flat gain and excellent return losses to 3.25 GHz without any external matching components. Use of external matching could extend usable frequency range beyond 4 GHz.

This low noise amplifier has an integrated active bias circuit allowing direct connection to 3 V or 5 V bias and minimizing variations over temperature and process. The bias current can be adjusted with an optional external resistor, so the user can customize the power consumption to fit the application. \( I_{\text{ADJ}} \) pin can be utilized as an enable pin to power the device up and down during operation.

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAM-011229-CQ3</td>
<td>bulk</td>
</tr>
</tbody>
</table>

---

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.
Electrical Specifications: \( V_{DD} = 5 \text{ V}, +25^\circ\text{C}, Z_0 = 50 \ \Omega \), Typical Application Circuit

<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>0.05 - 3.25 GHz</td>
<td>dB</td>
<td>17.0</td>
<td>19.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>4 GHz</td>
<td></td>
<td>18.5</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>0.05 - 1.2 GHz</td>
<td>dB</td>
<td>—</td>
<td>1.3</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td>1.6</td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>4 GHz</td>
<td></td>
<td>2.0</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>0.05 - 3.25 GHz</td>
<td>dB</td>
<td>—</td>
<td>16.0</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>0.05 - 3.25 GHz</td>
<td>dB</td>
<td>—</td>
<td>14.0</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>( P_{IN} = -15 \text{ dBm per tone, 6 MHz spacing} )</td>
<td>dBm</td>
<td>—</td>
<td>38.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.05 - 1.2 GHz</td>
<td></td>
<td>35.0</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td></td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Output IP2</td>
<td>( P_{IN} = -15 \text{ dBm per tone, 6 MHz spacing} )</td>
<td>dBm</td>
<td>—</td>
<td>40.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.05 - 1.2 GHz</td>
<td></td>
<td>36.0</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td></td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Output P1dB</td>
<td>( P_{IN} = -15 \text{ dBm per tone, 6 MHz spacing} )</td>
<td>dBm</td>
<td>—</td>
<td>20.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.05 - 1.2 GHz</td>
<td></td>
<td>19.0</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td></td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>( I_{DD} )</td>
<td>mA</td>
<td>—</td>
<td>80.0</td>
<td>115</td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input Power CW</td>
<td>4 dBm</td>
</tr>
<tr>
<td>( V_{DD} )</td>
<td>7 V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55^\circ\text{C} to +150^\circ\text{C}</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40^\circ\text{C} to +85^\circ\text{C}</td>
</tr>
<tr>
<td>Junction Temperature(^6)</td>
<td>+150^\circ\text{C}</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 HBM class 1B, CDM class C3 devices.

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. Operating at nominal conditions with \( T_J \leq 150^\circ\text{C} \) will ensure MTTF > 1 x 10\(^6\) hours.
Broadband Low Noise Amplifier
0.05 - 4 GHz

Typical Performance Curves @ 5 V, 80 mA, Z₀ = 50 Ω

**Gain**

Gain vs Frequency (GHz)

**Isolation**

Isolation vs Frequency (GHz)

**Input Return Loss**

Input Return Loss vs Frequency (GHz)

**Output Return Loss**

Output Return Loss vs Frequency (GHz)

**Noise Figure**

Noise Figure vs Frequency (GHz)
Broadband Low Noise Amplifier
0.05 - 4 GHz

Typical Performance Curves @ 5 V, 80 mA, $Z_0 = 50 \, \Omega$

**IP3**

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>OP3 (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
</tr>
</tbody>
</table>

**P1dB**

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>P1dB (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
</tr>
</tbody>
</table>

For further information and support please visit: [www.macom.com/support](https://www.macom.com/support)
## Electrical Specifications: \( V_{DD} = 3 \text{ V} \), +25°C, \( Z_0 = 50 \Omega \), Typical Application Circuit

<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>0.05 - 3.25 GHz</td>
<td>dB</td>
<td>18.5</td>
<td>17.5</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>4 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Figure</td>
<td>0.05 - 1.2 GHz</td>
<td>dB</td>
<td>1.3</td>
<td>1.6</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>0.05 - 3.25 GHz</td>
<td>dB</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>0.05 - 3.25 GHz</td>
<td>dB</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output IP3</td>
<td>( P_{IN} = -15 \text{ dBm per tone, 6 MHz spacing} )</td>
<td>dBm</td>
<td>32</td>
<td>30</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>0.05 - 1.2 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output IP2</td>
<td>( P_{IN} = -15 \text{ dBm per tone, 6 MHz spacing} )</td>
<td>dBm</td>
<td>42</td>
<td>33</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>0.05 - 1.2 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output P1dB</td>
<td>0.05 - 1.2 GHz</td>
<td>dBm</td>
<td>17.0</td>
<td>15.5</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>1.2 - 3.25 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>( I_{DD} )</td>
<td>mA</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Broadband Low Noise Amplifier
0.05 - 4 GHz

Typical Performance Curves @ 3 V, 45 mA, Z₀ = 50 Ω

Gain

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>S21 (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
</tr>
</tbody>
</table>

Isolation

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>S12 (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>-10</td>
</tr>
<tr>
<td>2</td>
<td>-20</td>
</tr>
<tr>
<td>3</td>
<td>-30</td>
</tr>
<tr>
<td>4</td>
<td>-40</td>
</tr>
</tbody>
</table>

Input Return Loss

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>S11 (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-50</td>
</tr>
<tr>
<td>1</td>
<td>-40</td>
</tr>
<tr>
<td>2</td>
<td>-30</td>
</tr>
<tr>
<td>3</td>
<td>-20</td>
</tr>
<tr>
<td>4</td>
<td>-10</td>
</tr>
</tbody>
</table>

Output Return Loss

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>S22 (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>-10</td>
</tr>
<tr>
<td>2</td>
<td>-20</td>
</tr>
<tr>
<td>3</td>
<td>-30</td>
</tr>
<tr>
<td>4</td>
<td>-40</td>
</tr>
</tbody>
</table>

Noise Figure

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Noise Figure (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

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

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.
Typical Performance Curves @ 3 V, 45 mA, $Z_0 = 50 \Omega$
Current Adjust Options

The I_{ADJ} (pin 5) of MAAM-011229 may be used to adjust the DC operating current by placing either R1 or R2 as shown the sample board schematic. Placing resistor R2 to ground will reduce the current from typical application level. When using R2 to reduce current do not place (DNP) R1. To increase current from typical application circuit install resistor R1 and connect to V_{DD}.

Sample Board Parts List

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2, C5, C6, C11</td>
<td>DNP</td>
<td>—</td>
</tr>
<tr>
<td>C3, C4, C7, C9</td>
<td>1000 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C8</td>
<td>47 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C10</td>
<td>0.1 µF</td>
<td>0402</td>
</tr>
<tr>
<td>JP1, JP2</td>
<td>0 Ω</td>
<td>0402</td>
</tr>
<tr>
<td>R1, R2</td>
<td>DNP</td>
<td>0402</td>
</tr>
<tr>
<td>L1</td>
<td>Ferrite Bead(^7)</td>
<td>0402</td>
</tr>
</tbody>
</table>

Bias Table

<table>
<thead>
<tr>
<th>I (mA)</th>
<th>V_{DD} = 5 V</th>
<th>V_{DD} = 3 V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R1</td>
<td>R2 &gt; GND</td>
</tr>
<tr>
<td>20</td>
<td>—</td>
<td>820 Ω</td>
</tr>
<tr>
<td>45</td>
<td>—</td>
<td>2.1 kΩ</td>
</tr>
<tr>
<td>60</td>
<td>—</td>
<td>2.7 kΩ</td>
</tr>
<tr>
<td>80</td>
<td>Typical application without R1 or R2</td>
<td>5.0 kΩ</td>
</tr>
<tr>
<td>100</td>
<td>12 kΩ</td>
<td>—</td>
</tr>
<tr>
<td>120</td>
<td>5 kΩ</td>
<td>—</td>
</tr>
</tbody>
</table>

6. Typical application.
7. Murata, part number BLM15HD182SN.
8. J3 on sample board may be used to facilitate a ground or V_{ADJ} connection.
Power Down Option
The I\textsubscript{ADJ} (pin 5) of MAAM-011229-CQ3 may be used to power down and turn on the amplifier. The critical characteristics of the power down circuit are that it presents a low impedance to DC ground in the off mode and that it presents a high impedance (much greater than 5 k\( \Omega \)) in the on mode. The single very low cost MMBT3904 NPN switching transistor (available from many suppliers) may be added externally along with a 1 k\( \Omega \) resistor to provide this function. The time from when voltage on the I\textsubscript{ADJ} pin (V\textsubscript{ADJ}) goes HIGH to the time RF reaches 90% of final amplitude is 444 ns. The total turn-on time, however, from change of power down signal is 1.18 \( \mu \)s (736 ns of this time is consumed in time for MMBT3904 to transition). Alternate choice for switching transistor could reduce total turn-on time. Total turn off time is 392 ns.

Lead-Free 3 mm 12-Lead QFN Ceramic Package\textsuperscript{†}

\textsuperscript{†} Plating is ENEPIG
Reference Application Note S2083 for surface mount instructions for QFN packages
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.