Low Noise Amplifier
700 MHz - 6 GHz

Features
- 700 MHz - 6 GHz Low Noise Amplifier
- Low Noise Figure: 0.9 dB @ 5.8 GHz
- High Gain: 17.7 dB @ 5.8 GHz
- High Linearity OIP3: 34 dBm @ 5.5 GHz
- Single Voltage Bias: 3 - 5 V
- Integrated Active Bias Circuit
- Current Adjustable 30 - 80 mA
- Fast Switching Speed: <200 ns
- Lead-Free 2 mm 8-LD PDFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description
The MAAL-011134 is a high dynamic range, single stage MMIC LNA designed to operate from 700 MHz - 6 GHz assembled in a lead-free 2 mm 8-LD PDFN plastic package. This amplifier has ultra low noise figure, high gain and excellent linearity. In the 50 Ω environment and at 3 V, this device offers less than 0.5 dB noise figure at 2.4 GHz, with 24 dB of gain and over 33 dBm OIP3.

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 is set by an external resistor, so the user can customize the power consumption to fit the application. V_{BIAS} can be utilized as an enable pin to power the device up and down during operation.

This MAAL-011134 is ideally suited for 802.11 multimode applications at 2.4 GHz and 5.8 GHz. The high gain, low noise figure and fast switching speed make it ideal for 4 x 4 MIMO 802.11ac applications.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAL-011134-TR3000</td>
<td>3000 piece reel</td>
</tr>
<tr>
<td>MAAL-011134-1SMB</td>
<td>Sample Board 5 - 6 GHz</td>
</tr>
<tr>
<td>MAAL-011134-2SMB</td>
<td>Sample Board 2.4 GHz</td>
</tr>
</tbody>
</table>


1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.
3. MACOM recommends connecting all No Connection (N/C) pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.
Low Noise Amplifier
700 MHz - 6 GHz

Electrical Specifications: Freq = 5.8 GHz, V_{DD} = 3 V, +25ºC, Z_0 = 50 Ω, V_{BIAS} = 2.3 V

<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>0.85</td>
<td>1.30</td>
<td>—</td>
</tr>
<tr>
<td>Gain^6</td>
<td>—</td>
<td>dB</td>
<td>13</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss^6</td>
<td>—</td>
<td>dB</td>
<td>7</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss^6</td>
<td>—</td>
<td>dB</td>
<td>5.5</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Output IP3^6</td>
<td>P_{IN} = -22 dBm per tone, 11 MHz spacing</td>
<td>dBm</td>
<td>—</td>
<td>28</td>
<td>—</td>
</tr>
<tr>
<td>Output P1dB</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>I_{DD} I_{BIAS}</td>
<td>mA</td>
<td>60</td>
<td>1.5</td>
<td>80</td>
</tr>
</tbody>
</table>

5. Refer to biasing options.
6. Performance can be optimized using the 5 - 6 GHz circuit provided in the applications section.

Absolute Maximum Ratings^7,8,9

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input Power CW</td>
<td>18 dBm</td>
</tr>
<tr>
<td>V_{DD}</td>
<td>6 V</td>
</tr>
<tr>
<td>V_{BIAS}</td>
<td>5 V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55ºC to +150ºC</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40ºC to +105ºC</td>
</tr>
<tr>
<td>Junction Temperature^10</td>
<td>+150ºC</td>
</tr>
</tbody>
</table>

7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation near these survivability limits.
9. Operating at nominal conditions with T_J ≤ 150ºC will ensure MTTF > 1 x 10^6 hours.
10. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
    Typical thermal resistance (Θ_{JC}) = 83°C/W
    a) For T_C = +25ºC,
       T_J = 37ºC @ 3 V, 0.06 A, P_{OUT} = 15 dBm, P_{IN} = 1 dBm
    b) For T_C = +85ºC,
       T_J = 97ºC @ 3 V, 0.06 A, P_{OUT} = 15 dBm, P_{IN} = 1 dBm

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.
Biasing Options
The MAAL-011134 bias can be set in 2 different ways: using only \( V_{DD} \) or using separate \( V_{DD} \) and \( V_{BIAS} \) voltages. A separate \( V_{BIAS} \) voltage allows pin 5 (\( V_{BIAS} \)) to be used as an enable pin to power the device up and down during operation.

For both bias methods select the value of \( R_{BIAS} \) to achieve the desired current based on the tables on page 4, and use DC blocks at pin 2 (\( RF_{IN} \)) and pin 7 (\( RF_{OUT} / V_{DD} \)).

Biasing Option - \( V_{DD} \) only
To use only \( V_{DD} \), connect pin 7 (\( RF_{OUT} / V_{DD} \)) to \( V_{DD} \) through an RF choke inductor and connect pin 5 (\( V_{BIAS} \)) to \( V_{DD} \) through bias resistor \( R_{BIAS} \) as shown in Figure 1.

Biasing Option - Separate \( V_{DD} \) and \( V_{BIAS} \) Voltages (\( V_{BIAS} \leq V_{DD} \))
To use separate \( V_{DD} \) and \( V_{BIAS} \) voltages, connect pin 7 (\( RF_{OUT} / V_{DD} \)) to \( V_{DD} \) through an RF choke inductor and connect pin 5 (\( V_{BIAS} \)) to \( V_{BIAS} \) through bias resistor \( R_{BIAS} \) as shown in Figure 2. Typical current (\( I_{BIAS} \)) draw for pin 5 (\( V_{BIAS} \)) is 1.4 mA @ \( V_{BIAS} = 3 \) V and 1 µA @ \( V_{BIAS} = 0 \) V. Typical current (\( I_{DD} \)) draw for pin 7 (\( RF_{OUT} / V_{DD} \)) is < 1 µA @ \( V_{BIAS} = 0 \) V.
Typical Performance Curves of the Active Bias Circuit

Current, $V_{DD} = 3$ V

Current, $V_{DD} = 4$ V

Current, $V_{DD} = 5$ V

Bias Table

<table>
<thead>
<tr>
<th>Bias Resistance (Ω)</th>
<th>Total Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$V_{DD} = 3$ V</td>
</tr>
<tr>
<td></td>
<td>+25°C</td>
</tr>
<tr>
<td>2000</td>
<td>29</td>
</tr>
<tr>
<td>1200</td>
<td>38</td>
</tr>
<tr>
<td>1000</td>
<td>41</td>
</tr>
<tr>
<td>800</td>
<td>45</td>
</tr>
<tr>
<td>600</td>
<td>50</td>
</tr>
<tr>
<td>400</td>
<td>56</td>
</tr>
<tr>
<td>200</td>
<td>64</td>
</tr>
<tr>
<td>0</td>
<td>75</td>
</tr>
</tbody>
</table>

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Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.
Typical Performance Curves @ 3 V / 60 mA, \( Z_0 = 50 \, \Omega \)

### Gain

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

### Noise Figure

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.5</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>1</td>
<td>1.0</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>2</td>
<td>1.5</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>5</td>
<td>3.0</td>
<td>3.5</td>
<td>4.0</td>
</tr>
<tr>
<td>6</td>
<td>3.5</td>
<td>4.0</td>
<td>4.5</td>
</tr>
</tbody>
</table>

### Input Return Loss

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>-2</td>
<td>-4</td>
</tr>
<tr>
<td>1</td>
<td>-2</td>
<td>-4</td>
<td>-6</td>
</tr>
<tr>
<td>2</td>
<td>-4</td>
<td>-6</td>
<td>-8</td>
</tr>
<tr>
<td>3</td>
<td>-6</td>
<td>-8</td>
<td>-10</td>
</tr>
<tr>
<td>4</td>
<td>-8</td>
<td>-10</td>
<td>-12</td>
</tr>
<tr>
<td>5</td>
<td>-10</td>
<td>-12</td>
<td>-14</td>
</tr>
<tr>
<td>6</td>
<td>-12</td>
<td>-14</td>
<td>-16</td>
</tr>
</tbody>
</table>

### Output Return Loss

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>-2</td>
<td>-4</td>
</tr>
<tr>
<td>1</td>
<td>-2</td>
<td>-4</td>
<td>-6</td>
</tr>
<tr>
<td>2</td>
<td>-4</td>
<td>-6</td>
<td>-8</td>
</tr>
<tr>
<td>3</td>
<td>-6</td>
<td>-8</td>
<td>-10</td>
</tr>
<tr>
<td>4</td>
<td>-8</td>
<td>-10</td>
<td>-12</td>
</tr>
<tr>
<td>5</td>
<td>-10</td>
<td>-12</td>
<td>-14</td>
</tr>
<tr>
<td>6</td>
<td>-12</td>
<td>-14</td>
<td>-16</td>
</tr>
</tbody>
</table>

### OIP3

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>40</td>
<td>45</td>
</tr>
</tbody>
</table>

### P1dB

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>35</td>
<td>35</td>
<td>40</td>
</tr>
</tbody>
</table>
Low Noise Amplifier
700 MHz - 6 GHz

Typical Performance Curves @ 5 V / 70 mA, $Z_0 = 50 \Omega$

**Gain**

**Noise Figure**

**Input Return Loss**

**Output Return Loss**

**OIP3**

**P1dB**
Typical Performance Curves @ 3 V / 30 mA, 3 V / 60 mA, 5 V / 70 mA, $Z_0 = 50 \Omega$

Gain

Noise Figure

Input Return Loss

Output Return Loss

OIP3

P1dB
Lead-Free 2 mm 8-Lead PDFN†

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.
Applications Section 1: 5 - 6 GHz

The MAAL-011134 is designed to work as a low noise gain block over a wide range of frequencies in a 50 Ω environment.

Input and output can be tuned to improve performance over a specific frequency band.

The evaluation board shown has been designed for tuning flexibility. The parts list on page 10 details the components needed to tune the MAAL-011134 for operation from 5 - 6 GHz. R1 or R2 may be used as $R_{\text{BIAS}}$ according to the biasing option chosen.

Evaluation Board, 5 - 6 GHz

MACOM recommends placing components exactly as shown in the Evaluation Board, 5 - 6 GHz drawing.

Schematic, 5 - 6 GHz
Applications Section 1: 5 - 6 GHz

Parts List, 5 - 6 GHz

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Size</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.3 pF</td>
<td>0201</td>
<td>Johansson Technology 250R05L0R3BV4S</td>
</tr>
<tr>
<td>C2</td>
<td>1.8 pF</td>
<td>0201</td>
<td>Johansson Technology 250R05L1R8BV4S</td>
</tr>
<tr>
<td>C3</td>
<td>15 pF</td>
<td>0201</td>
<td>Johansson Technology 250R05L150JV4S</td>
</tr>
<tr>
<td>C6</td>
<td>47 pF</td>
<td>0201</td>
<td>GRM0335C1E470JA01</td>
</tr>
<tr>
<td>C5</td>
<td>1000 pF</td>
<td>0201</td>
<td>GRM033R71E102KA01D</td>
</tr>
<tr>
<td>C7, C8</td>
<td>0.1 µF</td>
<td>0402</td>
<td>GRM155R71C104K</td>
</tr>
<tr>
<td>L1</td>
<td>1.2 nH</td>
<td>0201</td>
<td>L-05C1N2SV4S</td>
</tr>
<tr>
<td>L2</td>
<td>2.7 nH</td>
<td>0201</td>
<td>L-05C2N7SV4S</td>
</tr>
<tr>
<td>R1, R2</td>
<td>470Ω</td>
<td>0402</td>
<td>RC0402FR-07470RL</td>
</tr>
<tr>
<td>R3, R4</td>
<td>0 Ω</td>
<td>0201</td>
<td>CR0201-J/-000GLF</td>
</tr>
</tbody>
</table>

12. Use R1 or R2 as $R_{\text{BIAS}}$ according to the biasing option chosen (see biasing options on page 3).

Electrical Specifications\(^{13}\): Freq. = 5.5 GHz, $T_A = +25°C$

<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>—</td>
<td>1.1</td>
<td>—</td>
</tr>
<tr>
<td>Gain</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>17.4</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>13</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>$P_{\text{IN}} = -22$ dBm per tone, 11 MHz spacing</td>
<td>dBm</td>
<td>—</td>
<td>34</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>$I_{\text{DD}} + I_{\text{BIAS}}$</td>
<td>mA</td>
<td>—</td>
<td>50</td>
<td>—</td>
</tr>
<tr>
<td>Voltage</td>
<td>—</td>
<td>V</td>
<td>—</td>
<td>3 to 5</td>
<td>—</td>
</tr>
</tbody>
</table>

13. Typical performance, including board and connector losses, of the evaluation board with components shown in the 5 - 6 GHz parts list.
Applications Section 1: 5 - 6 GHz

Typical Performance Curves @ 3 V, 5 - 6 GHz Applications Circuit

**Gain**

- **S21 (dB)**
  - Frequency (GHz): 5.0, 5.2, 5.4, 5.6, 5.8, 6.0
  - Temperature: +25°C, -40°C, +85°C

**Reverse Isolation**

- **S12 (dB)**
  - Frequency (GHz): 5.0, 5.2, 5.4, 5.6, 5.8, 6.0
  - Temperature: +25°C, -40°C, +85°C

**Input Return Loss**

- **S11 (dB)**
  - Frequency (GHz): 5.0, 5.2, 5.4, 5.6, 5.8, 6.0
  - Temperature: +25°C, -40°C, +85°C

**Output Return Loss**

- **S22 (dB)**
  - Frequency (GHz): 5.0, 5.2, 5.4, 5.6, 5.8, 6.0
  - Temperature: +25°C, -40°C, +85°C

**Noise Figure @ +25°C**

- **Noise Figure (dB)**
  - Frequency (GHz): 5.0, 5.2, 5.4, 5.6, 5.8, 6.0

**Output IP3 @ 5.5 GHz over bias**

- **OIP3 (dBm)**
  - Frequency (GHz): 5.0, 5.2, 5.4, 5.6, 5.8, 6.0
  - Current (mA): 3.0 V, +25°C
2.3 - 2.7 GHz Application Section

The MAAL-011134 is designed to work as a low noise gain block over a wide range of frequencies in a 50 Ω environment.

Input and output can be tuned to improve return loss over a specific frequency band.

The evaluation board shown has been designed for tuning flexibility. The parts list on page 16 details the components needed to tune the MAAL-011134 for operation from 2.3 - 2.7 GHz. R1 or R2 may be used as \( R_{\text{BIAS}} \) according to the biasing option chosen.

Evaluation Board, 2.3 - 2.7 GHz

Schematic, 2.3 - 2.7 GHz
2.3 - 2.7 GHz Application Section

### Parts List, 2.3 - 2.7 GHz

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Size</th>
<th>Manufacturer</th>
<th>Manufacturer Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>—</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C2</td>
<td>10 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0336C1E100JB01</td>
</tr>
<tr>
<td>C3</td>
<td>0.7 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0335C1ER70WB0</td>
</tr>
<tr>
<td>C4</td>
<td>1.8 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0335C1E1R8BB01</td>
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<td>C5</td>
<td>0.4 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0335C1ER40WB01</td>
</tr>
<tr>
<td>C6</td>
<td>—</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C7</td>
<td>—</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C8</td>
<td>0.1 µF</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C9, C10</td>
<td>49 pF</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>L1</td>
<td>2.5 nH</td>
<td>0201</td>
<td>Coilcraft</td>
<td>0201DS-2N5XJL</td>
</tr>
<tr>
<td>L2</td>
<td>2.7 nH</td>
<td>0201</td>
<td>Murata</td>
<td>LQP03TN2N7C02</td>
</tr>
<tr>
<td>R1</td>
<td>470 Ω</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>R2</td>
<td>—</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>R3</td>
<td>0 Ω</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
Low Noise Amplifier
700 MHz - 6 GHz

Electrical Specifications: Freq = 2.6 GHz\textsuperscript{14,15}, \(V_{DD} = 3\) V, +25°C, \(Z_0 = 50\) 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>—</td>
<td>0.7</td>
<td>—</td>
</tr>
<tr>
<td>Gain</td>
<td></td>
<td>dB</td>
<td>—</td>
<td>23</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td></td>
<td>dB</td>
<td>—</td>
<td>16</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td></td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>(P_{IN} = -22) dBm, tones 11 MHz apart</td>
<td>dBm</td>
<td>—</td>
<td>33.4</td>
<td>—</td>
</tr>
<tr>
<td>Total Current</td>
<td>(I_{DQ} = I_{DD} + I_{BIAS})</td>
<td>mA</td>
<td>—</td>
<td>50</td>
<td>—</td>
</tr>
</tbody>
</table>

\textsuperscript{14} Typical performance of the evaluation module with exact components shown on the 2.3 - 2.7 GHz parts list.

\textsuperscript{15} Typical measured data includes evaluation board and connector losses.

Typical Performance Curves: Broadband performance (2.3 - 2.7 GHz evaluation board)
Low Noise Amplifier
700 MHz - 6 GHz

Typical Performance Curves: Freq = 2.3 - 2.7 GHz, \( Z_0 = 50 \, \Omega \)

**Gain**

![Gain Graph](image)

**Noise Figure**

![Noise Figure Graph](image)

**Input Return Loss**

![Input Return Loss Graph](image)

**Output Return Loss**

![Output Return Loss Graph](image)

**Reverse Isolation**

![Reverse Isolation Graph](image)

**OIP3**

![OIP3 Graph](image)
1.88 - 2.025 GHz Application Section

The MAAL-011134 is designed to work as a low noise gain block over a wide range of frequencies in a 50 Ω environment.

Input and output can be tuned to improve return loss over a specific frequency band.

The evaluation board shown has been designed for tuning flexibility. The parts list on page 16 details the components needed to tune the MAAL-011134 for operation from 1.88 - 2.025 GHz. R1 or R2 may be used as $R_{\text{BIAS}}$ according to the biasing option chosen.

Evaluation Board, 1.88 - 2.025 GHz

Schematic, 1.88 - 2.025 GHz
Low Noise Amplifier
700 MHz - 6 GHz

1.88 - 2.025 GHz Application Section

Parts List: 1.88 - 2.025 GHz

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Size</th>
<th>Manufacturer</th>
<th>Manufacturer Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>—</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C2</td>
<td>10 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0336C1E100JB01</td>
</tr>
<tr>
<td>C3</td>
<td>1.8 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0335C1E1R8BB01</td>
</tr>
<tr>
<td>C4</td>
<td>2.2 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0335C1E2R2BB01</td>
</tr>
<tr>
<td>C5</td>
<td>1.2 pF</td>
<td>0201</td>
<td>Murata</td>
<td>GJM0335C1E1R2BB01</td>
</tr>
<tr>
<td>C6</td>
<td>—</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C7</td>
<td>—</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C8</td>
<td>0.1 µF</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C9, C10</td>
<td>49 pF</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>L1</td>
<td>4.7 nH</td>
<td>0201</td>
<td>Coilcraft</td>
<td>0201DS-4N7XJL</td>
</tr>
<tr>
<td>L2</td>
<td>2.7 nH</td>
<td>0201</td>
<td>Murata</td>
<td>LQP03TN2N7C02</td>
</tr>
<tr>
<td>R1</td>
<td>470 Ω</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>R2</td>
<td>—</td>
<td>0402</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>R3</td>
<td>0 Ω</td>
<td>0201</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
MAAL-011134

Low Noise Amplifier
700 MHz - 6 GHz

Electrical Specifications: Freq = 2.6 GHz\textsuperscript{16,17}, V\textsubscript{DD} = 3 V, +25ºC, Z\textsubscript{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>—</td>
<td>0.7</td>
<td>—</td>
</tr>
<tr>
<td>Gain</td>
<td>-</td>
<td>dB</td>
<td>—</td>
<td>25.5</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>-</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>-</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Total Current</td>
<td>(I_{DD} = I_{DD} + I_{BIAS})</td>
<td>mA</td>
<td>—</td>
<td>50</td>
<td>—</td>
</tr>
</tbody>
</table>

\textsuperscript{16} Typical performance of the evaluation module with exact components shown on the 1.88 - 2.025 GHz parts list.

\textsuperscript{17} Typical measured data includes evaluation board and connector losses.

Typical Performance Curves @ 3 V: 1.88 - 2.025 GHz evaluation board

Gain

Reverse Isolation

Input Return Loss

Output Return Loss
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