Features

- Non-Magnetic Laminate Module
- Noise Figure: 0.5 dB
- Gain: 28 dB
- Input Impedance (Real): 3 Ω
- Output Impedance: 50 Ω
- Single Voltage Bias: 3 V
- Integrated Active Bias Circuit
- RoHS* Compliant

Applications

- MRI Applications

Description

The MAAL-011227 is a high dynamic range, single stage MMIC LNA. The module includes external matching networks to provide excellent low noise performance and high gain characteristics suitable for 1.5T MRI applications.

This low noise amplifier has an integrated active bias circuit allowing direct connection to a 3 V bias and minimizing variations over temperature and process.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAL-011227-TR0100</td>
<td>100 piece reel</td>
</tr>
<tr>
<td>MAAL-011227-TR0500</td>
<td>500 piece reel</td>
</tr>
<tr>
<td>MAAL-011227-SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.

Functional Block Diagram

Pin Configuration

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RFIN</td>
<td>RF Input, DC Blocked</td>
</tr>
<tr>
<td>2</td>
<td>VDD</td>
<td>Bias Voltage</td>
</tr>
<tr>
<td>3</td>
<td>RFOUT</td>
<td>RF Output, DC Blocked</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>

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.

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### Electrical Specifications: Freq. = 63.87 MHz, $T_A = 25^\circ$C, $V_{DD} = +3$ V, $Z_0 = 50$ 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>Bandwidth</td>
<td>Centered @ 63.87 MHz</td>
<td>MHz</td>
<td>—</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>0.5</td>
<td>—</td>
</tr>
<tr>
<td>Gain</td>
<td>—</td>
<td>dB</td>
<td>24.0</td>
<td>28.0</td>
<td>—</td>
</tr>
<tr>
<td>Input Reflection Coefficient</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.900</td>
<td>—</td>
</tr>
<tr>
<td>Real Input Impedance</td>
<td>—</td>
<td>Ω</td>
<td>—</td>
<td>3.0</td>
<td>—</td>
</tr>
<tr>
<td>Imaginary Input Impedance$^4$</td>
<td>—</td>
<td>Ω</td>
<td>-2.0</td>
<td>0.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>28</td>
<td>—</td>
</tr>
<tr>
<td>Reverse Isolation</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>67</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>$P_{in} = -32$ dBm per tone, 100 kHz spacing</td>
<td>dBm</td>
<td>—</td>
<td>23</td>
<td>—</td>
</tr>
<tr>
<td>Output P1dB</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>6.8</td>
<td>—</td>
</tr>
<tr>
<td>Total Current</td>
<td>$I_{DD}$</td>
<td>mA</td>
<td>—</td>
<td>29</td>
<td>42</td>
</tr>
</tbody>
</table>

---

4. With test fixture at 17.6 mm “Delay Dist.” of RF input port and 1 Velocity Factor Port Extensions added.

### Maximum Operating Limits$^5,6$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input Power CW</td>
<td>-14 dBm</td>
</tr>
<tr>
<td>$V_{DD}$</td>
<td>5.5 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-10°C to +60°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+150°C</td>
</tr>
</tbody>
</table>

5. Operating at nominal conditions with $T_J \leq 150^\circ$C will ensure MTTF $> 1 \times 10^6$ hours.

6. Junction Temperature ($T_J) = T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$

Typical thermal resistance ($\Theta_{JC}$) = 83°C/W

a) For $T_C = +25^\circ$C,
   $T_J = 32^\circ$C @ 3V, 29 mA, $P_{OUT} = 3$ dBm

b) For $T_C = +60^\circ$C,
   $T_J = 67^\circ$C @ 3V, 29 mA, $P_{OUT} = 3$ dBm

### Absolute Maximum Ratings$^7,8$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input Power CW</td>
<td>-15 dBm</td>
</tr>
<tr>
<td>$V_{DD}$</td>
<td>6.0 V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55°C to +150°C</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.
Typical Performance Curves

Gain

\[ S_{21} \text{ (dB)} \]

\[
\begin{array}{c|c|c|c}
\text{Frequency (GHz)} & 50 & 55 & 60 \\
\hline
\text{+25°C} & 0 & 5 & 10 \\
\text{-10°C} & 5 & 10 & 15 \\
\text{+60°C} & 10 & 15 & 20 \\
\end{array}
\]

Reverse Isolation

\[ S_{12} \text{ (dB)} \]

\[
\begin{array}{c|c|c|c}
\text{Frequency (GHz)} & 50 & 55 & 60 \\
\hline
\text{+25°C} & -40 & -35 & -30 \\
\text{-10°C} & -35 & -30 & -25 \\
\text{+60°C} & -30 & -25 & -20 \\
\end{array}
\]

Output Return Loss

\[ S_{22} \text{ (dB)} \]

\[
\begin{array}{c|c|c|c}
\text{Frequency (GHz)} & 50 & 55 & 60 \\
\hline
\text{+25°C} & -50 & -45 & -40 \\
\text{-10°C} & -45 & -40 & -35 \\
\text{+60°C} & -40 & -35 & -30 \\
\end{array}
\]

Noise Figure

\[ \text{Noise Figure (dB)} \]

\[
\begin{array}{c|c|c|c}
\text{Frequency (GHz)} & 50 & 55 & 60 \\
\hline
\text{+25°C} & -0.0 & -0.2 & -0.4 \\
\text{-10°C} & -0.2 & -0.4 & -0.6 \\
\text{+60°C} & -0.4 & -0.6 & -0.8 \\
\end{array}
\]

Real Z

\[ \text{Real } Z_{\text{IN}} (\Omega) \]

\[
\begin{array}{c|c|c|c|c}
\text{Frequency (GHz)} & 60 & 61 & 62 & 63 \\
\hline
\text{+25°C} & 2.5 & 3.0 & 3.5 & 4.0 \\
\text{-10°C} & 3.0 & 3.5 & 4.0 & 4.5 \\
\text{+60°C} & 3.5 & 4.0 & 4.5 & 5.0 \\
\end{array}
\]

Imaginary Z

\[ \text{Imaginary } Z_{\text{IN}} (\Omega) \]

\[
\begin{array}{c|c|c|c|c}
\text{Frequency (GHz)} & 60 & 61 & 62 & 63 \\
\hline
\text{+25°C} & 0 & -5 & -10 & -15 \\
\text{-10°C} & -5 & -10 & -15 & -20 \\
\text{+60°C} & -10 & -15 & -20 & -25 \\
\end{array}
\]
1.5T Low Noise Low Input Impedance Pre-Amplifier
63.87 MHz

Parts List

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Case Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1 µF</td>
<td>0805</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 Class 2 HBM and Class C2A CDM devices.

Lead-Free Laminate Package
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